Operating instructions Compax3 IxxT40: Cam

Programmable motion control according to IEC61131-3

192-120108N11 C3IxxT40

December 2010

Release R09-10

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nonwarranty clause

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Worldwide sales
http://divapps.parker.com/divapps/eme/EME/Contact_sites/Sales%20Channel_Parker-EME.pdf

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ISO 9001:2008
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1. Introduction

In this chapter you can read about:

1.1 Device assignment

This manual is valid for the following devices:

- Compax3S025V2 + supplement
- Compax3S063V2 + supplement
- Compax3S100V2 + supplement
- Compax3S150V2 + supplement
- Compax3S015V4 + supplement
- Compax3S038V4 + supplement
- Compax3S075V4 + supplement
- Compax3S150V4 + supplement
- Compax3S300V4 + supplement
- Compax3H050V4 + supplement
- Compax3H090V4 + supplement
- Compax3H125V4 + supplement
- Compax3H155V4 + supplement
- Compax3M050D6 + supplement
- Compax3M100D6 + supplement
- Compax3M150D6 + supplement
- Compax3M300D6 + supplement
- PSUP10D6
- PSUP20D6

With the supplement:

- F10 (Resolver)
- F11 (SinCos©)
- F12 (linear and rotary direct drives)
- I11 T40: Cam via I/Os / RS232 / RS485
- I20 T40: Cam via Profibus
- I21 T40: Cam via CANopen
- I22 T40: Cam via DeviceNet
- I30 T40: Cam via Ethernet Powerlink
- I31 T40: Cam via EtherCAT
- I32 T40: Cam via Profinet

1.2 Scope of delivery

The following items are furnished with the device:

- Manuals*
  - Installation manual (German, English, French)
  - Compax3 DVD
  - Startup Guide (German / English)

*Comprehensiveness of documentation depends on device type

- Device accessories
  Device accessories for Compax3S
  - Cable clamps in different sizes for large area shielding of the motor cable, the screw for the cable clamp as well as
  - the mating plug connectors for the Compax3S plug connectors X1, X2, X3, and X4
  - a toroidal core ferrite for one cable of the motor holding brake
  - Lacing cord

- Device accessories for Compax3M
  - Cable clamps in different sizes for large area shielding of the motor cable, the screw for the cable clamp as well as
  - the matching plug for the Compax3M connectors X14, X15, X43
  - a toroidal core ferrite for one cable of the motor holding brake
  - an interface cable (SSK28/23) for communication within the axis combination

- Device accessories for PSUP
  - Matching plug for the PSUP connectors X9, X40, X41
  - 2 bus terminal connectors (BUS07/01) for mains module and the last axis controller in the combination

- Device accessories for Compax3H
  - Mating connector for X3 and X4
  - SSK32/20: RS232 adapter cable (programming port C3HxxxV4 - SSK1 - PC)
  - VBK17/01: SubD jumper mounted

1.3 Type specification plate

Compax3 - Type specification plate (example):

The present device type is defined by the type specification plate (on the housing):

Parker Hannifin GmbH
Robert-Bosch-Straße 22 77656 Offenburg
Tel. +49 (0) 781/509-0 www.parker-eme.com

PN: C3S025V2F10 I10 T10 M00

Tested: 14.06.2010

SN: 2826130002

Power Input: 1AC 230V/6A

Made in Germany

Explanation:

1	Type designation The complete order designation of the device (2, 5, 6, 9, 8).
2	**C3:**Abbreviation for Compax3 **S025:**Single axis device, nominal device current in 100mA (025=2.5A) **M050:**Multi-axis device, nominal device current in 100mA (050=5A) **H050:**High power device, nominal device current in 1A (050=50A)
	D6: Designation nominal supply **V2:**Mains supply voltage (2=230VAC/240VAC, 4=400VAC/480VAC)
3	Unique number of the particular device
4	Nominal supply voltage Power Input: Input supply data Power Output: Output data
5	Designation of the feedback system **F10:**Resolver **F11:**SinCos© / Single- or Multiturn **F12:** Feedback module for direct drives
6	Device interface **I10:**Analog, step/direction and encoder input **I11 / I12:**Digital Inputs / Outputs and RS232 / RS485 **I20:**Profibus DP / **I21:**CANopen / **I22:**DeviceNet / **I30:**Ethernet Powerlink / **I31:** EtherCAT / **I32:** Profinet **C20:** integrated controller C3 *power*PL*m*C, Linux & Web server
7	Date of factory test
8	Options **Mxx:** I/O extension, HEDA **Sx:** optional safety technology on C3M
9	Technology function **T10:**Servo drive **T11:**Positioning **T30:**Motion control programmable according to IEC61131-3 **T40:**Electronic cam
10	CE compliance
11	Certified safety technology (corresponding to the logo displayed)
12	UL certified (corresponding to the logo displayed)

1.4 Packaging, transport, storage

Packaging material and transport

Caution!

The packaging material is inflammable, if it is disposed of improperly by burning, lethal fumes may develop.

The packaging material must be kept and reused in the case of a return shipment. Improper or faulty packaging may lead to transport damages.

Make sure to transport the drive always in a safe manner and with the aid of suitable lifting equipment (**Weight** (see on page 615, see on page 625)). Do never use the electric connections for lifting. Before the transport, a clean, level surface should be prepared to place the device on. The electric connections may not be damaged when placing the device.

First device checkup

- Check the device for signs of transport damages.
- Please verify, if the indications on the **Type identification plate** (see on page 17) correspond to your requirements.
- Check if the consignment is complete.

Disposal

This product contains materials that fall under the special disposal regulation from 1996, which corresponds to the EC directory 91/689/EEC for dangerous disposal material. We recommend to dispose of the respective materials in accordance with the respectively valid environmental laws. The following table states the materials suitable for recycling and the materials which have to be disposed of separately.

Material Option	**suitable for recycling**	**Disposal**
Metal	yes	no
Plastic materials	yes	no
Circuit boards	no	yes

Please dispose of the circuit boards according to one of the following methods:

- Burning at high temperatures (at least 1200°C) in an incineration plant licensed in accordance with part A or B of the environmental protection act.
- Disposal via a technical waste dump which is allowed to take on electrolytic aluminum condensers. Do under no circumstances dump the circuit boards at a place near a normal waste dump.

Storage

If you do not wish to mount and install the device immediately, make sure to store it in a dry and clean **environment** (see on page 627). Make sure that the device is not stored near strong heat sources and that no metal chippings can get into the device.

Please note in the event of storage >1 year:

Forming the capacitors

Forming the capacitors only required with 400VAC axis controllers and PSUP mains module

If the device was stored longer than one year, the intermediate capacitors must be re-formed!

Forming sequence:

- Remove all electric connections
- Supply the device with 230VAC single phase for 30 minutes
  - via the L1 and L2 terminals on the device or
  - multi axis devices via L1 and L2 on the PSUP mains module

1.5 Safety instructions

In this chapter you can read about:

1.5.1. General hazards

General Hazards on Non-Compliance with the Safety Instructions

The device described in this manual is designed in accordance with the latest technology and is safe in operation. Nevertheless, the device can entail certain hazards if used improperly or for purposes other than those explicitly intended.

Electronic, moving and rotating components can

- constitute a hazard for body and life of the user, and
- cause material damage

Usage in accordance with intended purpose

The device is designed for operation in electric power drive systems (VDE0160). Motion sequences can be automated with this device. Several motion sequences can be combined by interconnecting several of these devices. Mutual interlocking functions must be incorporated for this purpose.

1.5.2. Safety-conscious working

This device may be operated only by qualified personnel.

Qualified personnel in the sense of these operating instructions consists of:

- Persons who, by virtue to their training, experience and instruction, and their knowledge of pertinent norms, specifications, accident prevention regulations and operational relationships, have been authorized by the officer responsible for the safety of the system to perform the required task and in the process are capable of recognizing potential hazards and avoiding them (definition of technical personnel according to VDE105 or IEC364),
- Persons who have a knowledge of first-aid techniques and the local emergency rescue services.
- persons who have read and will observe the safety instructions.
- Those who have read and observe the manual or help (or the sections pertinent to the work to be carried out).

This applies to all work relating to setting up, commissioning, configuring, programming, modifying the conditions of utilization and operating modes, and to maintenance work.

This manual and the help information must be available close to the device during the performance of all tasks.

1.5.3. Special safety instructions

- Check the correct association of the device and its documentation.
- Never detach electrical connections while voltage is applied to them.
- Safety devices must be provided to prevent human contact with moving or rotating parts.
- Make sure that the device is operated only when it is in perfect condition.
- Implement and activate the stipulated safety functions and devices.
- Operate the device only with the housing closed.
- Make sure that all devices are sufficiently fixed.
- Check that all live terminals are secured against contact. Perilous voltage levels of up to 850V occur.
- Do not bypass power direct current

Be cautious when performing configuration downloads with master - slave couplings (electronic gear, cam) Deactivate the drive before starting the configuration download: Master and Slave axis.

Caution!

Due to movable machine parts and high voltages, the device can pose a lethal danger. Danger of electric shock in the case of non-respect of the following instructions. The device corresponds to DIN EN 61800-3, i.e. it is subject to limited sale. The device can emit disturbances in certain local environments. In this case, the user is liable to take suitable measures.

- The device must be permanently grounded due to high earth leakage currents.
- The drive motor must be grounded with a suitable protective lead.
- The devices are equipped with high voltage DC condensers. Before removing the protective cover, the discharging time must be awaited. After switching off the supply voltage, it may take up to 10 minutes to discharge the capacitors. Danger of electric shock in case of non respect.
- Before you can work on the device, the supply voltage must be switched off at the L1, L2 and L3 clamps. Wait at least 10 minutes so that the power direct current may sink to a secure value (<50V). Check with the aid of a voltmeter, if the voltage at the DC+ and DC- clamps has fallen to a value below 50V. Danger of electric shock in case of non respect.
- Do never perform resistance tests with elevated voltages (over 690V) on the wiring without separating the circuit to be tested from the drive.
- Please exchange devices only in currentless state and, in an axis system, only in a defined original state.
- In the event of a axis controller device exchange it is absolutely necessary to transfer the configuration determining the correct operation of the drive to the device, before the device is put into operation. Depending on the operation mode, a machine zero run will be necessary.
- The device contains electrostatically sensitive components. Please heed the electrostatic protection measures while working at/with the device as well as during installation and maintenance.
- Operation of the PSUP30 only with mains filter.

Attention - hot surface!

The heat dissipator can reach very high temperatures (>70°C)

Protective seals

Caution!

The user is responsible for protective covers and/or additional safety measures in order to prevent damages to persons and electric accidents.

Please note in the event of storage >1 year:

Forming the capacitors

Forming the capacitors only required with 400VAC axis controllers and PSUP mains module

If the device was stored longer than one year, the intermediate capacitors must be re-formed!

Forming sequence:

- Remove all electric connections
- Supply the device with 230VAC single phase for 30 minutes
  - via the L1 and L2 terminals on the device or
  - multi axis devices via L1 and L2 on the PSUP mains module

1.6 Warranty conditions

- The device must not be opened.
- Do not make any modifications to the device, except for those described in the manual.
- Make connections to the inputs, outputs and interfaces only in the manner described in the manual.
- Fix the devices according to the **mounting instructions** (see on page 83, see on page 89).
  We cannot provide any guarantee for other mounting methods.

Note on exchange of options

Device options must be exchanged in the factory to ensure hardware and software compatibility.

- When installing the device, make sure the heat dissipators of the device receive sufficient air and respect the recommended mounting distances of the devices with integrated ventilator fans in order to ensure free circulation of the cooling air.
- Make sure that the mounting plate is not exposed to external temperature influences.

1.7 Conditions of utilization

In this chapter you can read about:

1.7.1. Conditions of utilization for CE-conform operation

- Industry and trade -

The EC guidelines for electromagnetic compatibility 2004/108/EC and for electrical operating devices for utilization within certain voltage limits 2006/95/EC are fulfilled when the following boundary conditions are observed:

Operation of the devices only in the condition in which they were delivered, i.e. with all housing panels.

In order to ensure contact protection, all mating plugs must be present on the device connections even if they are not wired.

Please respect the specifications of the manual, especially the technical characteristics (mains connection, circuit breakers, output data, ambient conditions,...).

1.7.1.1 Conditions of utilization mains filter

Mains filter: A mains filter is required in the mains input line if the motor cable exceeds a certain length. Filtering can be provided centrally at the system mains input or separately for each device or with C3M for each axis system.

Use of the devices in a commercial and residential area (limit value class in accordance with EN 61800-3)

The following mains filters are available for independent utilization:

Device: Compax3S	Limit value class	Motor cable length	Mains filter Order No.:
S0xxV2	C2	< 10 m	without
	C2	> 10 m, < 100 m	NFI01/01
S1xxV2, S0xxV4, S150V4	C2	< 10 m	without
	C2	> 10 m, < 100 m	NFI01/02
S300V4	C3	< 10 m	without
	C2, C3	> 10 m, < 100 m	NFI01/03

Device: Compax3H	Limit value class	Motor cable length	Mains filter Order No.:
H050V4	C2	< 10 m	without
	C2	> 10 m, < 50 m	NFI02/01
H090V4	C2	< 10 m	without
	C2	> 10 m, < 50 m	NFI02/02
H1xxV4	C2	< 10 m	without
	C2	> 10 m, < 50 m	NFI02/03

Use of the devices in the industrial area (limit values class C3 in accordance with EN 61800-3)

The following mains filters are available for independent utilization:

Device: PSU	Limit value class	Reference: Axis system with motor cable	Mains filter Order No.:
P10	C3	< 6 x 10 m	NFI03/01
P10	C3	< 6 x 50 m	NFI03/02
P20	C3	< 6 x 50 m	NFI03/03
P30	C3	< 6 x 50 m	NFI03/03

Connection length: Connection between mains filter and device:

unshielded:	< 0.5 m
shielded	< 5 (fully shielded on ground - e.g. ground of control cabinet)

1.7.1.2 Conditions of utilization for cables / motor filter

Motor and Feedback cable:

Operation of the devices only with motor and feedback cables whose plugs contain a special full surface area screening.

Compax3S motor cable

< 100 m (the cable should not be rolled up!)

A **motor output filter** (see on page 577) is required for motor cables >20 m:

- MDR01/04 (max. 6.3 A rated motor current)
- MDR01/01 (max. 16 A rated motor current)
- MDR01/02 (max. 30 A rated motor current)

Compax3H motor cable

A motor output filter is required for motor cables >50m. Please contact us.

Compax3M motor cable

<80m per axis (the cable must not be rolled up!)

The entire length of the motor cable per axis combination may not exceed 300m.

A **motor output filter** (see on page 577) is required for motor cables >20 m:

- MDR01/04 (max. 6.3 A rated motor current)
- MDR01/01 (max. 16 A rated motor current)
- MDR01/02 (max. 30 A rated motor current)

Shielding connection of the motor cable

The cable must be fully-screened and connected to the Compax3 housing. Use the cable clamps/shield connecting terminals furnished with the device.

The shield of the cable must also be connected with the motor housing. The fixing (via plug or screw in the terminal box) depends on the motor type.

Compax3 encoder cable:

< 100 m

Compax3M encoder cable:

< 80m

Cable for Compax3S, Compax3M

Corresponding to the specifications of the terminal clamp with a temperature range of up to 60°C.

Cable for Compax3H

Corresponding to the specifications of the terminal clamp with a temperature range of up to 75°C.

Cable installation:

- Signal lines and power lines should be installed as far apart as possible.
- Signal lines should never pass close to excessive sources of interference (motors, transformers, contactors etc.).
- Do not place mains filter output cable parallel to the load cable.

1.7.1.3 Additional conditions of utilization

Motors: Operation with standard motors.

Control: Use only with aligned controller (to avoid control loop oscillation).

Grounding: Connect the filter housing and the device to the cabinet frame, making sure that the contact area is adequate and that the connection has low resistance and low inductance.

Never mount the filter housing and the device on paint-coated surfaces!

Compax3S300V4 For CE and UL conform operation of the Compax3S300V4, a mains filter is compulsory:

- 400 VAC / 0.740 mH certified in accordance with EN 61558-1 bzw. 61558-2-2
- We offer the mains filter as an accessory: LIR01/01

Accessories: Make sure to use only the accessories recommended by Parker

Connect all cable shields at both ends, ensuring large contact areas!

Warning:

This is a product in the restricted sales distribution class according to EN 61800-3. In a domestic area this product can cause radio frequency disturbance, in which case the user may be required to implement appropriate remedial measures.

1.7.2. Conditions of utilization for UL certification Compax3S

UL certification for Compax3S

conform to UL:	◆according to UL508C
Certified	◆E-File_No.: E235342

The UL certification is documented by a "UL" logo on the device (type specification plate).

“UL” logo:

Conditions of utilization

- The devices are only to be installed in a degree of contamination 2 environment (maximum).
- The devices must be appropriately protected (e.g. by a switching cabinet).
- The X2 terminals are not suitable for field wiring.
- Tightening torque of the field wiring terminals (green Phoenix plugs)

◆C3S0xxV2	0.57 - 0.79Nm	5 - 7Lb.in
◆C3S1xxV2, C3S0xxV4, C3S150V4	0.57 - 0.79Nm	5 - 7Lb.in
◆C3S300V4	1.25 - 1.7Nm	11 - 15Lb.in

- Temperature rating of field installed conductors shall be at least 60°C Use copper lines only
  Please use the cables described in the **accessories chapter** (see on page 564, see on page 565), they feature a temperature rating of at least 60°C.
- Maximum Surrounding Air Temperature: 45°C.
- Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes and 480 volts maximum.

ATTENTION
Danger of electric shock.
Discharge time of the bus condenser is 10 minutes.

- The drive provides internal motor overload protection.
  This must be set so that 200% of the motor nominal current are not exceeded.
- Cable cross-sections
  - Mains input: corresponding to the recommended fuses.
  - Motor cable: corresponding to the **Nominal output currents** (see on page 617, see on page 618)
  - Maximum cross-section limited by the terminals mm^2 / AWG

◆C3S0xxV2	2.5mm^2	AWG 12
◆C3S1xxV2, C3S0xxV4, C3S150V4	4.0mm^2	AWG 10
◆C3S300V4	6.0mm^2	AWG 7

- Circuit breaker
  In addition to the main circuit breaker, the devices must be equipped with a S271 K or S273 K circuit breaker with K characteristic made by ABB.
  - C3S025V2: ABB, nom 480V 10A, 6kA
  - C3S063V2: ABB, nom 480V, 16A, 6kA
  - C3S100V2: ABB, nom 480V, 16A, 6kA
  - C3S150V2: ABB, nom 480V, 20A, 6kA
  - C3S015V4: ABB, nom 480V, 6A, 6kA
  - C3S038V4: ABB, nom 480V, 10A, 6kA
  - C3S075V4: ABB, nom 480V, 16A, 6kA
  - C3S150V4: ABB, nom 480V, 20A, 6kA
  - C3S300V4: ABB, nom 480V, 25A, 6kA

1.7.3. Conditions of utilization for UL certification Compax3M

UL-approval for PSUP/Compax3M

conform to UL:	◆ according to UL508C
Certified	◆ E-File_No.: E235342

The UL certification is documented by a "UL" logo on the device (type specification plate).

Conditions of utilization

- The devices are only to be installed in a degree of contamination 2 environment (maximum).
- The devices must be appropriately protected (e.g. by a switching cabinet).
- Tightening torque of the field wiring terminals (green Phoenix plugs)

Device	**X40: Ballast resistor**	**X41: Mains connector**	**X9: 24VDC**
PSUP10	0.5 Nm (4.43Lb.in)	1.2 Nm (10.62Lb.in)	1.2 Nm (10.62Lb.in)
PSUP20	0.5 Nm (4.43Lb.in)	1.7 Nm (15Lb.in)	1.2 Nm (10.62Lb.in)
PSUP30	UL approval in preparation		
Device	**X43: Motor connector**	**X15: Temperature monitoring**	
C3M050-150	0.5Nm (4.43Lb.in)	0.22Nm (1.95Lb.in)	
C3M300	1.2Nm (10.62Lb.in)	0.22Nm (1.95Lb.in)	

- Temperature rating of field installed conductors shall be at least 60°C Use copper lines only
  Please use the cables described in the **accessories chapter** (see on page 564, see on page 565), they feature a temperature rating of at least 60°C.
- Maximum Surrounding Air Temperature: 40°C.
- Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes and 480 volts maximum.

Caution!

Danger of electric shock.
Discharge time of the bus capacitor is 10 minutes.

- The drive provides internal motor overload protection.
  This must be set so that 200% of the motor nominal current are not exceeded.
- Cable cross-sections
  - Mains input: corresponding to the recommended fuses.
  - Motor cable: corresponding to the **Nominal output currents** (see on page 617, see on page 618)
- Maximum cross-section limited by the terminals mm^2 / AWG

Line cross-sections of the power connections (on the device bottoms)

Compax3 device:	**Cross-section: Minimum... Maximum [with conductor sleeve]**
M050, M100, M150	0.25 ... 4 mm^2 (AWG: 23 ... 11)
M300	0.5 ... 6 mm^2 (AWG: 20 ... 10)
PSUP10	Mains supply: 0.5 ... 6 mm^2 (AWG: 20 ... 10) Braking resistor: 0.25 ... 4 mm^2 (AWG: 23 ... 11)
PSUP20 & PSUP30	Mains supply: 0.5 ... 16 mm^2 (AWG: 20 ... 6) Braking resistor: 0.25 ... 4 mm^2 (AWG: 23 ... 11)

1.7.4. Conditions of utilization for UL certification Compax3H

UL certification for Compax3H

Conform to UL:	◆according to UL508C
Certified	◆E-File_No.: E235342

The UL certification is documented by a "UL" logo on the device (type specification plate).

"UL" logo:

Conditions of utilization

- ◆The devices are only to be installed in a degree of contamination 2 environment (maximum).
- ◆The devices must be appropriately protected (e.g. by a switching cabinet).
- ◆Tightening Torque of the Field Wiring Terminals.

Terminal clamps - max. line cross sections

The line cross sections must correspond to the locally valid safety regulations. The local regulations have always priority.

	Power clamps (minimum/maximum section)	
C3H050V4	2.5 / 16mm^2	
	Massive	Multiwire
C3H090V4	16 / 50mm^2	25 / 50mm^2
C3H1xxV4	25 / 95mm^2	35 / 95mm^2

The standard connection clamps of Compax3H090V4 and Compax3H1xxV4 are not suitable for flat line bars.

Temperature rating of field installed conductors shall be at least 75°C. Do only use copper lines.

- ◆Maximum Surrounding Air Temperature: 45°C.
- ◆Short Circuit Rating - Suitable for use on a circuit capable of delivering not more than 10000 RMS symmetrical amperes and 480 volts maximum.

CAUTION Danger of electric shock.

Upon removing power to the equipment, wait minimum 10 minutes before accessing the drive to ensure internal voltage levels are less than 50VDC.

- ◆The drive provides internal motor overload protection.
  This must be set so that 200% of the motor nominal current are not exceeded.
- ◆Cable cross-sections
  - ◆Mains input: corresponding to the recommended fuses.
  - ◆Motor cable: corresponding to the **Nominal output currents** (see on page 617, see on page 618)
  - ◆This device is provided with Solid State Short Circuit (output) Protection.

1.7.5. Current on the mains PE (leakage current)

Caution!

This product can cause a direct current in the protective lead. If a residual current device (RCD) is used for protection in the event of direct or indirect contact, only a type B (all current sensitive) RCD is permitted on the current supply side of this product . Otherwise, a different protective measure must be taken, such as separation from the environment by doubled or enforced insulation or separation from the mains power supply by means of a transformer.

Please heed the connection instructions of the RCD supplier.

Mains filters do have high leakage currents due to their internal capacity. An internal mains filter is usually integrated into the servo controllers. Additional leakage currents are caused by the capacities of the motor cable and of the motor windings. Due to the high clock frequency of the power output stage, the leakage currents do have high-frequency components. Please check if the FI protection switch is suitable for the individual application.

If an external mains filter is used, an additional leakage current will be produced.

The figure of the leakage current depends on the following factors:

- Length and properties of the motor cable
- Switching frequency
- Operation with or without external mains filter
- Motor cable with or without shield network
- Motor housing grounding (how and where)

Remark:

- The leakage current is important with respect to the handling and usage safety of the device.
- A pulsing leakage current occurs if the supply voltage is switched on.

Please note:

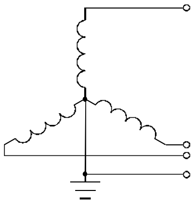
The device must be operated with effective grounding connection, which must comply with the local regulations for high leakage currents (>3.5mA).

Due to the high leakage currents it is not advisable to operate the servo drive with an earth leakage circuit breaker.

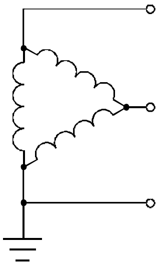
1.7.6. Supply networks

This product is designed for fixed connection to TN networks (TN-C, TN-C-S or TN-S). Please note that the line-earth voltage may not exceed 300VAC.

- When grounding the neutral conductor, mains voltages of up to 480VAC are permitted.



- When grounding an external conductor (delta mains, two-phase mains), mains voltages (external conductor voltages) of up to 240VAC are permitted.



Devices which are to be connected to an IT network must be provided with a separating transformer. Then the devices are operated locally as in a TN network. The secondary sided center of the separating transformer must be grounded and connected to the PE connector of the device.

2. Positioning with IEC61131-3

IEC 61131-3 Programming

Due to its high functionality, Compax3 in the version “IEC 61131-3 - Positioning with function modules based on PLCopen” forms an ideal basis for many applications in high-performance motion automation.

A standard with general applicability was created with Standard IEC 61131-3. The programming system is equipped with a series of functions in addition to the compliant editor. The Motion Control functions specified in PLCopen are also provided by Parker as a library with the device and control software.

The graphical program editor supports the following functions:

- Ladder diagram
- Function block diagram (structurally-guided)
- Function block diagram (free graphical editor)

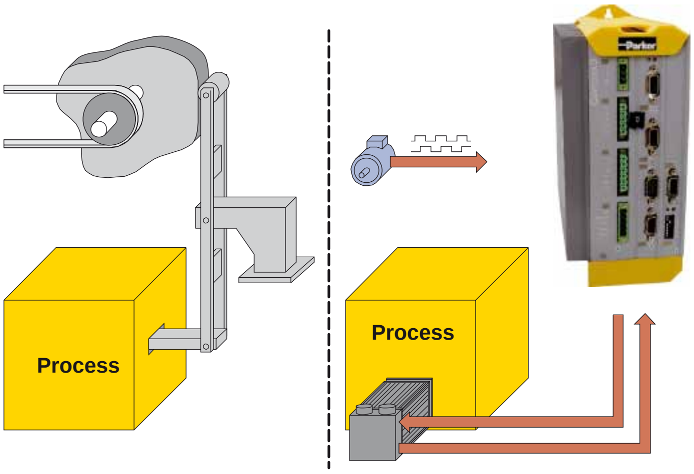
The text-oriented editor supports programming in

- Instruction list
- Structured text

Programming of Compax3 based on IEC 61131-3 is also made considerably easier by a series of additional functions. This includes in particular Syntax Coloring, multi-level undo/redo and context-sensitive input help.

Cam control T40

Rising rationalization pressure and an increasing degree of automation in process engineering demand modern and flexible drive concepts. The introduction of digital and communicating control devices was an important step towards the decentralization of control and regulation tasks. An increasing number of mechanical construction components can be replaced by programmable servo drives.



In particular mechanical cam switching mechanisms and discontinuous shafts maintained until today their fields of application in many areas of machine construction. Mechanical cam switching mechanisms offer, besides complex motion profiles, a high positioning accuracy and rigid coupling between master and slave drive. Their drawbacks are, however, the long changeover times and the limitation to a defined profile.

In this respect the Compax3 T40 electronic cam offers considerable time advantages, above all when changing between small batch sizes or with a wide range of products. The decentralization of the drive performance can reduce size, costs and maintenance effort considerably.

The switching command between different motion profiles takes only seconds - no fitter or wrench is required.

Large, mechanically coupled drive systems can be divided into small, independent drives. The dynamic and stationary behavior of every drive can be individually set and optimized.

Compax3 is able to simulate mechanical cams and cam switching mechanisms electronically.

This helps to realize discontinuous material supply, flying knife and similar drive applications with distributed drive performance.

The compact servo controller processes the signals of a master axis and controls a servo drive via the desired motion profile, which is defined in the form of an interpolation point memory.

The cam function modules and the CamDesigner make it easy to launch cam applications in the IEC program.

Interfaces with superordinate controllers

Independent of your motion automation you can access Compax3 externally via different interfaces (e.g. with the superordinate control):

- via RS232 / RS485
- via digital Inputs/Outputs (Interface I11)
- via Profibus (Interface I20)
- via Profinet (Interface I32)
- via CANopen (Interface I21)
- via Ethernet Powerlink (interface I30)
- via EtherCAT (interface I31)

Profibus (I20) &Profinet (I32) functions

The higher-level control system communicates with Compax3 via Profibus or Profinet.

A number of different cyclic transfer telegrams (which can be conveniently adjusted with the Compax3 ServoManager) can be used to adjust bus communication to the requirements of specific applications.

In addition to the cyclic data channel, parameter access is also possible via a DPV1 master or using the parameter channel with a DPV0 master.

CANopen (I21 - functions)

The higher level control system communicates with Compax3 via CANopen.

Via various cyclic process data objects (which can be comfortably set with the Compax3 ServoManager) the bus communication can be adapted to the application requirements.

Apart from the cyclic process data objects, acyclic parameter access is possible via service data objects.

DeviceNet (I22 functions)

The higher level control system communicates with Compax3 via DeviceNet.

Cyclic I/O messages (which can be conveniently adjusted with the Compax3 ServoManager) can be used to adjust bus communication to the requirements of specific applications.

Besides the cyclic data, acyclic access to objects is possible via Explicit Messages.

Compax3 control technology

High-performance control technology and openness for various sender systems are fundamental requirements for a fast and high-quality automation of movement.

Model / standards / auxiliary material

The structure and size of the device are of considerable importance. High-quality electronics are a fundamental requirement for the particularly small and compact form of the Compax3 devices. All connectors are located on the front of the Compax3S.

Partly integrated mains filters permit connection of motor cables up to a certain length without requiring additional measures. EMC compatibility is within the limits set by EN 61800-3, Class A. The Compax3 is CE-conform.

The intuitive user interface familiar from many applications, together with the oscilloscope function, wizards and online help, simplifies making and modifying settings via the PC.

The optional **Operator control module (BDM01/01)** (see on page 600) for Compax3S/F makes it possible to exchange devices quickly without requiring a PC.

Configuration

Configuration is made with a PC with the help of the Compax3 ServoManager.

General proceeding (see on page 117)

3. Compax3 device description

In this chapter you can read about:

3.1 Meaning of the status LEDs - Compax3 axis controller

Device status LEDs	Right LED (red)	Left LED (green)
Voltages missing	off	off
During the booting sequence	alternately flashing	
◆ No configuration present. ◆ SinCos© feedback not detected. ◆ Compax3 IEC61131-3 program not compatible with Compax3 Firmware. ◆ no Compax3 IEC61131-3 program ◆ For F12: Hall signals invalid.	flashes slowly	off
Axis without current excitation	off	flashes slowly
Power supplied to axis; commutation calibration running	off	flashes quickly
Axis with current excitation	off	on
Axis in fault status / fault present / axis energized (error reaction 1)	flashes quickly	on
Axis in fault status / fault present / axis currentless (error reaction 2)	on	off
Compax3 faulty: please contact us	on	on

Note on Compax3H: The **internal** device status LEDs are only connected to the **external** housing LEDs, if the RS232 jumper at X10 is fitted to the control and the upper dummy cover is fitted.

3.2 Meaning of the status LEDs - PSUP (mains module)

PSUP Status LEDs	**Left LED (green)**	**Right LED (red)**
Control voltage 24 VDC is missing	off	off
Error of mains module*	off	on
DC power voltage is built up	-	flashes quickly
Phase failure / mains power supply undervoltage	on	flashes slowly
Address assignment CPU active	flashes quickly	-
Address assignment CPU completed	flashes slowly	-
PSUPxx Ready - State	on	off
Incorrect wiring of internal communication X30/31	flashes slowly	flashes quickly
Device in bootloader state	flashes slowly	flashes slowly

*can be read out in each axis controller

Caution!

When the control voltage is missing there is no indication whether or not high voltage supply is available.

3.3 Connections of Compax3S

In this chapter you can read about:

3.3.1. Compax3S connectors

X1	AC Supply	**X20**	HEDA in (Option)	
X2	Ballast / DC power voltage	**X21**	HEDA out (Option)	
X3	Motor / Brake	**X22**	Inputs Outputs (Option M10/12)	
X4	24VDC / Enable	**X23/ X24**	Bus (Option)	Connector type depends on the bus system!
X10	RS232/RS485	**S24**	bus settings	
X11	Analog/Encoder	**LED1**	Device status LEDs	
X12	Inputs/Outputs	**LED2**	HEDA LEDs	
X13	Motor position feedback	**LED3**	Bus LEDs	

Caution - Risk of Electric Shock!

Always switch devices off before wiring them!

Dangerous voltages are still present until 10 min. after switching off the power supply.

Caution!

When the control voltage is missing there is no indication whether or not high voltage supply is available.

Attention - PE connection!

PE connection with 10mm^2 via a grounding screw at the bottom of the device.

Attention - hot surface!

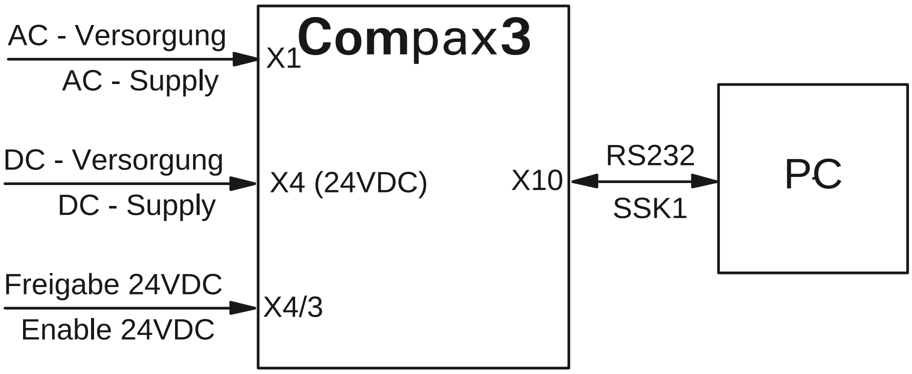
The heat dissipator can reach very high temperatures (>70°C)

Line cross sections of the line connections X1, X2, X3

Compax3 device:	Cross-section: Minimum... Maximum[mm^2]
S025V2, S063V2	0.25 ... 2.5 (AWG: 24 ... 12)
S100V2, S150V2 **S015V4, S038V4, S075V4, S150V4**	0.25 ... 4 (AWG: 24 ... 10)
S300V4	0.5 ... 6 (AWG: 20 ... 7)

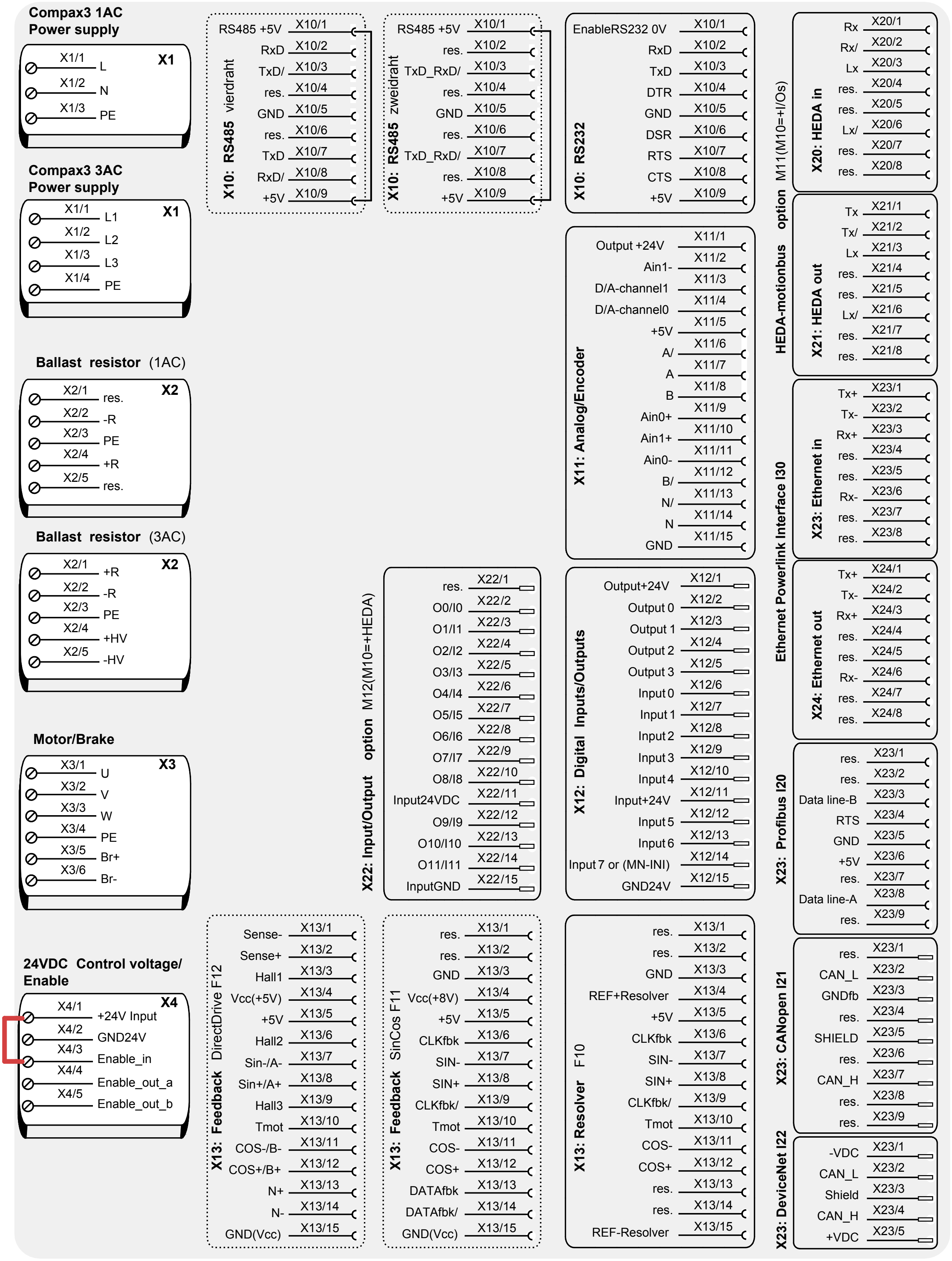
3.3.2. Connector and pin assignment C3S

Overview:



Further information on the assignment of the plug mounted at the particular device can be found below!

In detail: The fitting of the different plugs depends on the extension level of Compax3. In part, the assignment depends on the Compax3 option implemented.



The jumper drawn in at X4 (at the left side in red) is used to enable the device for testing purposes. During operation, the enable input is in most cases switched externally.

3.3.3. Control voltage 24VDC / enable connector X4 C3S

PIN	Description
1	+24V (supply)
2	Gnd24V
3	Enable_in
4	Enable_out_a
5	Enable_out_b

Line cross sections:

minimum: 0.25mm^2

maximum: 2.5mm^2

(AWG: 24 ... 12)

Control voltage 24VDC Compax3S and Compax3H

Controller type	**Compax3**
Voltage range	21 - 27VDC
Current drain of the device	0.8 A
Total current drain	0.8 A + Total load of the digital outputs + current for the motor holding brake
Ripple	0.5Vpp
Requirement according to safe extra low voltage (SELV)	yes
Short-circuit proof	conditional (internally protected with 3.15AT)

Hardware - enable (input X4/3 = 24VDC)

This input is used as safety interrupt for the power output stage.

Tolerance range: 18.0V - 33.6V / 720Ω

"Safe torque off (X4/3=0V)

For implementation of the "safety torque off" safety feature in accordance with the “protection against unexpected start-up” described in EN1037. Observe instructions in the corresponding **chapter** (see on page 92) with the circuitry examples!

The energy supply to the drive is reliably shut off, the motor has no torque.

A relay contact is located between X4/4 and X4/5 (normally closed contact)

Enable_out_a - Enable_out_b	**Power output stage is**
Contact opened	activated
Contact closed	disabled

Series connection of these contacts permits certain determination of whether all drives are de-energized.

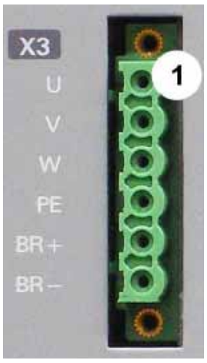
Relay contact data:

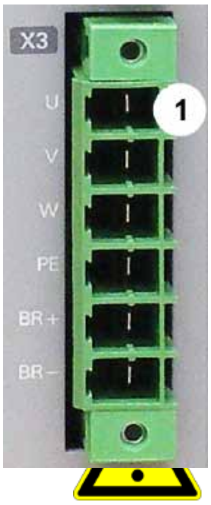
Switching voltage (AC/DC): 100mV - 60V

Switching current: 10mA - 0.3A

Switching power: 1mW...7W

3.3.4. Motor / Motor brake (C3S connector X3)





PIN	Designation		Motor cable lead designation*		
1	U (motor)		U / L1 / C / L+	1	U1
2	V (motor)		V / L2	2	V2
3	W (motor)		W / L3 / D / L-	3	W3
4	PE (motor)		YE / GN	YE / GN	YE / GN
5	BR+	Motor holding brake	WH	4	Br1
6	BR-	Motor holding brake	BK	5	Br2

* depending on the cable type

Requirements for motor cable

< 100m (the cable should not be rolled up!)

A **motor output filter** (see on page 577) is required for motor cables >20 m:

Shielding connection of the motor cable

The cable must be fully-screened and connected to the Compax3 housing. Use the cable clamps/shield connecting terminals furnished with the device.

The shield of the cable must also be connected with the motor housing. The fixing (via plug or screw in the terminal box) depends on the motor type.

Attention - Please wire the motor holding brake!

Connect the brake only on motors which have a holding brake! Otherwise make no brake connections at all.

Requirements cables for motor holding brake

If a motor holding brake is present, **one cable** of the motor holding brake must be fed on the device side through the toroidal core ferrite provided as accessory ZBH0x/xx (63Ω @1MHz, di=5.1mm), in order to ensure error-free switching on and off of the motor holding brake.

Motor holding brake output

Motor holding brake output	Compax3
Voltage range	21 – 27VDC
Maximum output current (short circuit proof)	1.6A

Motor cable

3.3.5. Compax3Sxxx V2

In this chapter you can read about:

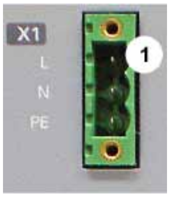
3.3.5.1 Main voltage supply C3S connector X1

Device protection

By cyclically switching on and off the power voltage, the input current limitation can be overloaded, which will cause a device error.

Therefore please wait at least 2 minutes after switching off before you switch the device on again!

Power supply plug X1 for 1 AC 230VAC/240VAC devices



PIN	Designation
1	L
2	N
3	PE

Mains connection Compax3S0xxV2 1AC

Controller type	S025V2	S063V2
Supply voltage	Single phase 230VAC/240VAC 80-253VAC / 50-60Hz	
Input current	6Arms	13Arms
Maximum fuse rating per device (=short circuit rating)	10 A (MCB miniature circuit breaker, K characteristic)	16A (automatic circuit breaker K)

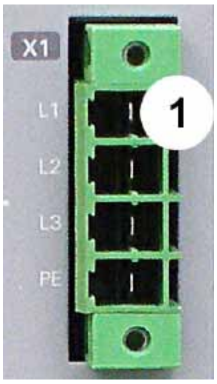
* for **UL conform operation** (see on page 26), a miniature circuit breaker, K characteristic, Type S203 is to be used.

Caution - Risk of Electric Shock!

Always switch devices off before wiring them!

Dangerous voltages are still present until 10 min. after switching off the power supply.

Power supply plug X1 for 3AC 230VAC/240VAC devices



PIN	Designation
1	L1
2	L2
3	L3
4	PE

Mains connection Compax3S1xxV2 3AC

Controller type	**S100V2**	**S150V2**
Supply voltage	Three phase 3* 230VAC/240VAC 80-253VAC / 50-60Hz	
Input current	10Arms	13Arms
Maximum fuse rating per device (=short circuit rating)	16A	20A
	MCB miniature circuit breaker, K characteristic	

* for **UL conform operation** (see on page 26), a miniature circuit breaker, K characteristic, Type S203 is to be used.

Caution!

<u>The 3AC V2 devices must only be operated with three phases!</u>

Caution - Risk of Electric Shock!

Always switch devices off before wiring them!

Dangerous voltages are still present until 10 min. after switching off the power supply.

3.3.5.2 Braking resistor / high voltage DC C3S connector X2

The energy generated during braking operation is absorbed by the Compax3 storage capacity.

If this capacity is too small, the braking energy must be drained via a braking resistor.

Braking resistor / high voltage supply plug X2 for 1AC 230VAC/240VAC devices

PIN	Designation
1	factory use
2	- braking resistor (not short-circuit protected!)
3	PE
4	+ braking resistor (not short-circuit protected!)
5	factory use

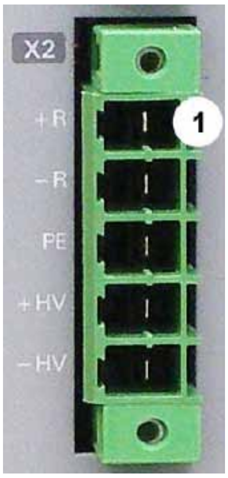
Braking operation Compax3S0xxV2 1AC

Controller type	**S025V2**	**S063V2**
Capacitance / storable energy	560µF / 15Ws	1120µF / 30Ws
Minimum braking- resistance	100Ω	56Ω
Recommended nominal power rating	20 ... 60W	60 ... 180W
Maximum continuous current	8A	15A

Caution!

<u>The power voltage DC of two Compax3 1AC V2 devices (230VAC/240VAC devices) must not be connected.</u>

Braking resistor / high voltage supply plug X2 for 3AC 230VAC/240VAC devices



PIN	Description	
1	+ Braking resistor	no short-circuit protection!
2	- Braking resistor	
3	PE	
4	+ DC high voltage supply	
5	- DC high voltage supply	

Braking operation Compax3S1xxV2 3AC

Controller type	S100V2	S150V2
Capacitance / storable energy	780µF / 21Ws	1170µF / 31Ws
Minimum braking- resistance	22Ω	15Ω
Recommended nominal power rating	60 ... 450W	60 ... 600W
Maximum continuous current	20A	20A

Connection of a braking resistor

Minimum line cross section:	1.5mm^2
Maximum line length:	2m
Maximum output voltage:	400VDC

3.3.6. Compax3Sxxx V4

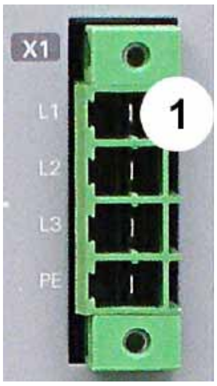
In this chapter you can read about:

3.3.6.1 Power supply connector X1 for 3AC 400VAC/480VAC-C3S devices

Device protection

By cyclically switching on and off the power voltage, the input current limitation can be overloaded, which will cause a device error.

Therefore please wait at least 2 minutes after switching off before you switch the device on again!



PIN	Designation
1	L1
2	L2
3	L3
4	PE

Mains connection Compax3SxxxV4 3AC

Controller type	**S015V4**	**S038V4**	**S075V4**	**S150V4**	**S300V4**
Supply voltage	Three phase 3*400VAC/480VAC 80-528VAC / 50-60Hz				
Input current	3Aeff	6Arms	10Arms	16Arms	22Arms
Maximum fuse rating per device(=short circuit rating)	6A	10A	16A	20A	25A
	MCB miniature circuit breaker, K characteristic				D*

* for **UL conform operation** (see on page 26), a miniature circuit breaker, K characteristic, Type S203 is to be used.

Caution!

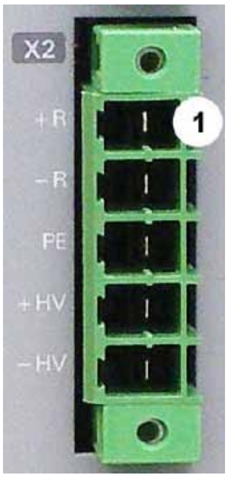
The 3AC V4 devices must only be operated with three phases!

Caution - Risk of Electric Shock!

Always switch devices off before wiring them!

Dangerous voltages are still present until 10 min. after switching off the power supply.

3.3.6.2 Braking resistor / high voltage supply connector X2 for 3AC 400VAC/480VAC_C3S devices



PIN	Description	
1	+ Braking resistor	no short-circuit protection!
2	- Braking resistor	
3	PE	
4	+ DC high voltage supply	
5	- DC high voltage supply	

Braking operation Compax3SxxxV4 3AC

Controller type	S015V4	S038V4	S075V4	S150V4	S300V4
Capacitance / storable energy 400V / 480V	235µF 37 / 21 Ws	235µF 37 / 21 Ws	470µF 75 / 42 Ws	690µF 110 / 61 Ws	1230µF 176 / 98 Ws
Minimum braking- resistance	100Ω	100Ω	56Ω	33Ω	15Ω
Recommended nominal power rating	60 ... 100W	60 ... 250W	60 ... 500 W	60 ... 1000 W	60 ... 1000 W
Maximum continuous current	10A	10A	15A	20A	30A

Connection of a braking resistor

Minimum line cross section: 1.5mm^2
Maximum line length: 2m
Maximum output voltage: 800VDC

3.3.6.3 Connection of the power voltage of 2 C3S 3AC devices

Caution!

The power voltage DC of the single phase Compax3 servo axes must not be connected!

In order to improve the conditions during brake operation, the DC power voltage of 2 servo axes may be connected.

The capacity as well as the storable energy are increased; furthermore the braking energy of one servo axis may be utilized by a second servo axis, depending on the application.

It is not permitted to connect the power voltage in order to use one brake circuit for two servo axes, as this function cannot be ensured reliably.

Note the following:

Caution! In case of non-compliance with the following instructions, the device may be destroyed!

- You can only connect two similar servo axes (same power supply; same rated currents)
- Connected servo axes must always be fed separately via the AC power supply.

If the external pre-fuse of one of the servo axes takes action, the second servo axis must also be disconnected automatically.

Please connect as follows:

Servo axis 1 X2/4 to servo axis 2 X2/4

Servo axis 1 X2/5 to servo axis 2 X2/5

3.4 Installation instructions Compax3M

General introductory notes

- Operation of the Compax3M multi-axis combination is only possible in connection with a PSUP (mains module).
- Axis controllers are aligned at the right of the mains module.
- Arrangement within the multi-axis combination sorted by power (with the same device types according to device utilization), the axis controller with the highest power is placed directly at the right of the mains module.
  e.g. first the device type with high utilization, at the right of this, the same device type with a lower utilization.
- Max. 15 Compax3M (axis controllers) per PSUP (mains module) are permitted (please respect the total capacity of max. 2400µF for PSUP10, max. 5000µF for PSUP20).
- The continuation of the current rail connection outside the axis combination is not permitted and will lead to a loss of the CE and UL approbation.
- External components **may not** be connected to the rail system.

Required tools:

- Allen key M5 for fixing the devices in the control cabinet.
- Crosstip screwdriver M4 for connection rails of the DC rail modules.
- Crosstip screwdriver M5 for grounding screw of the device.
- Flat-bladed screwdriver 0.4x2.5 / 0.6x3.5 / 1.0x4.0 for wiring and mounting of the phoenix clamps.

Order of installation

- Fixing the devices in the control cabinet.
  - Predrilling the mounting plate in the control cabinet according to the specifications. Dimensions. Fit M5 screws loosely in the bores.
  - Fit device on the upper screws and place on lower screw. Tighten screws of all devices. The tightening torque depends on the screw type (e.g. 5.9Nm for M5 screw DIN 912 8.8).
- Connection of the internal supply voltage.
  The Compax3M axis controllers are connected to the supply voltages via the rail modules. **Details** (see on page 49).
  - Deblocking the yellow protective cover with a flat-bladed screwdriver on the upper surface (click mechanism). Remove the closing devices (contact protection) that are not required from between the devices.
  - Connecting the rail modules, beginning with the mains module.
    For this, loosen crosshead screws (5 screws at the right in the mains module, all 10 screws in the next axis controller), push the rails one after the other against to the left and tighten screws. Proceed accordingly for all adjacent axis controllers in the combination.
    Max. tightening torque: 1.5Nm.
  - Close all protective covers. The protective covers must latch audibly.

Please note:

Insufficiently fixed screw connections of the DC power voltage rails may lead to the destruction of the devices.

Protective seals

Caution - Risk of Electric Shock!

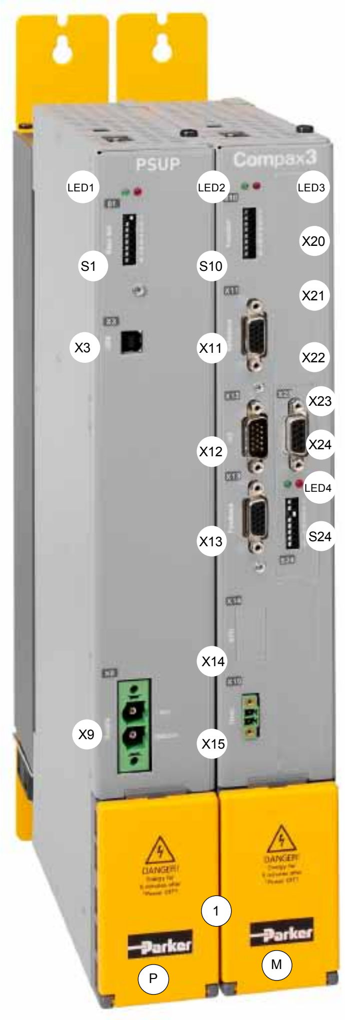
In order to secure the contact protection against the alive rails, it is absolutely necessary to respect the following:

- Insert the yellow plastic comb at the left or right of the rails.
  Make sure that the yellow plastic combs are placed at the left of the first device and at the right of the last device in the system and have not been removed.
- Setup of the devices only with closed protective covers.
- Connect protective earth to mains module (M5 crosshead screw on front of device bottom).
- Connecting the internal communication. **Details** (see on page 68).
- Connecting the signal and fieldbus connectors. **Details** (see on page 79).
- Connection of mains power supply **Details** (see on page 51) ballast resistor **details** (see on page 54) and motor **details** (see on page 56).
- Connecting the configuration interface to the PC. **Details** (see on page 68).

3.5 PSUP/Compax3M Connections

In this chapter you can read about:

3.5.1. Front connector



P	**Mains module PSUP**
LED1	Status LEDs Mains module
S1	Basic address
X3	Configuration interface (USB)
X9	Supply voltage 24VDC
M	**Axis controller**
LED2	Status LEDs of the axis
S10	Function
X11	Analog/Encoder
X12	Inputs/Outputs
X13	Motor position feedback
X14	Safety technology (option)
X15	Motor temperature monitoring
LED3	HEDA LEDs
X20	HEDA in (Option)
X21	HEDA out (Option)
X22	Inputs Outputs (Option M10/12)
X23	Bus (option) connector type depends on the bus system!
X24	Bus (option) depends on the bus system!
LED4	Bus LEDs
S24	bus settings
1	Behind the yellow protective covers you can find the rails for the supply voltage connection. ◆ Supply voltage 24VDC ◆ DC power voltage supply

3.5.2. Connections on the device bottom

Caution - Risk of Electric Shock!

Always switch devices off before wiring them!

Dangerous voltages are still present until 10 min. after switching off the power supply.

Caution!

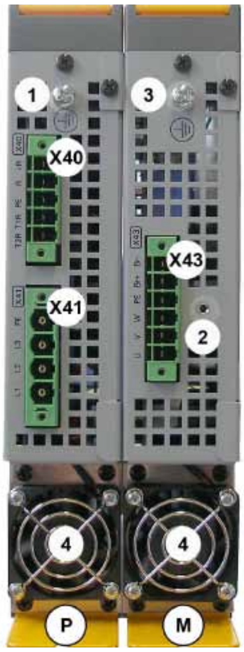
When the control voltage is missing there is no indication whether or not high voltage supply is available.

Attention - PE connection!

PE connection with 10mm^2 via a grounding screw at the bottom of the device.

Attention - hot surface!

The heat dissipator can reach very high temperatures (>70°C)



P	**Mains module PSUP**
X40	Ballast resistor
X41	Mains supply VAC/PE
1	Central ground connection for the axis system, with 10mm^2 to the ground screw on the housing.
4	Fan*
M	**Axis controller**
X43	Motor / Brake
2	Fixing for motor shield clamp
4	Fan*
3	optionally, the axis controller features a ground screw on the housing, if the grounding is not possible via the back plate.

* is internally supplied.

Line cross-sections of the power connections (on the device bottoms)

Compax3 device:	**Cross-section: Minimum... Maximum [with conductor sleeve]**
M050, M100, M150	0.25 ... 4 mm^2 (AWG: 23 ... 11)
M300	0.5 ... 6 mm^2 (AWG: 20 ... 10)
PSUP10	Mains supply: 0.5 ... 6 mm^2 (AWG: 20 ... 10) Braking resistor: 0.25 ... 4 mm^2 (AWG: 23 ... 11)
PSUP20 & PSUP30	Mains supply: 0.5 ... 16 mm^2 (AWG: 20 ... 6) Braking resistor: 0.25 ... 4 mm^2 (AWG: 23 ... 11)

3.5.3. Connections of the axis combination

The axis controllers are connected to the supply voltages via rails.

- Supply voltage 24VDC
- DC power voltage supply

The rails can be found behind the yellow protective covers. In order to connect the rails of the devices, you may have to remove the yellow plastic device inserted at the side.

CAUTION: Risk of Electric Shock

Caution - Risk of Electric Shock!

Please note before opening:

- **Warning** - Possible risk of electric shock; disconnect power before removing cover.
- **Caution!** - Dangerous electric voltage! Respect discharge time.

Caution - Risk of Electric Shock!

Always switch devices off before wiring them!

Dangerous voltages are still present until 10 min. after switching off the power supply.

Caution!

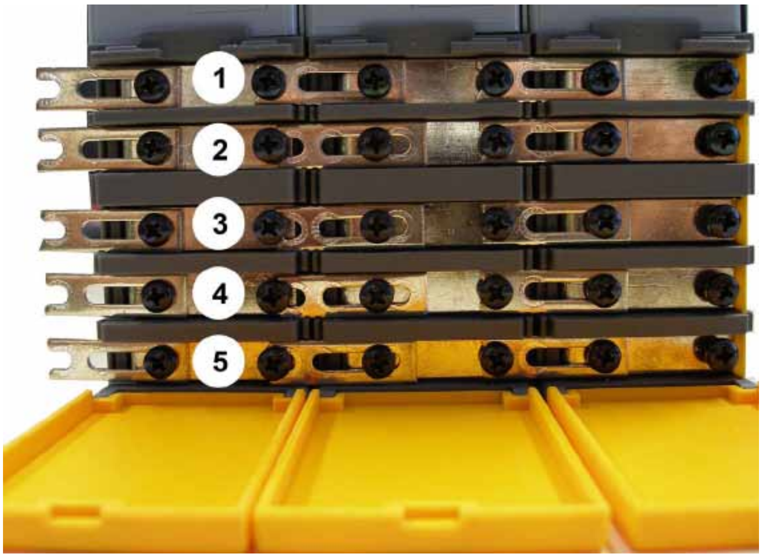
When the control voltage is missing there is no indication whether or not high voltage supply is available.

Protective seals

Caution - Risk of Electric Shock!

In order to secure the contact protection against the alive rails, it is absolutely necessary to respect the following:

- Insert the yellow plastic comb at the left or right of the rails.
  Make sure that the yellow plastic combs are placed at the left of the first device and at the right of the last device in the system and have not been removed.
- Setup of the devices only with closed protective covers.



1	24VDC
2	GND24V
3	-HV DC
4	PE
5	+HV DC

Note: External components **may not** be connected to the rail system.

Maximum capacity in the axis system:

- PSUP10: 2400 µF
- PSUP20 & PSUP30: 5000 µF

Reference value for the required capacity in an axis system

100 µF per kW of the temporal medium value of the total power (transmissions + power dissipation) in the axis system

Example: PSUP20 (1175 µF) with one axis controller (440 µF)

Total power 15 kW, 100 µF/kW => 1500 µF required in the axis system.

Axis system: 1615 µF are sufficient.

Protective seals

Caution!

The user is responsible for protective covers and/or additional safety measures in order to prevent damages to persons and electric accidents.

3.5.4. Control voltage 24VDC PSUP (mains module)

Connector X9

Pin	Designation
1	+24 V
2	GND24V

Line cross sections:

minimum: 0.5mm^2 with conductor sleeve

maximum: 6mm^2 with conductor sleeve

(AWG: 20 ... 10)

Control voltage 24 VDC PSUP

Device type	PSUP
Voltage range	21 - 27VDC
Ripple	0.5Vpp
Requirement according to safe extra low voltage (SELV)	yes (class 2 mains module)
Current drain PSUP	PSUP10: 0.2A PSUP20 / PSUP30: 0.3A
Electric current drain Compax3M	C3M050D6: 0.85 3M100D6: 0.85A C3M150D6: 0.85A C3M300D6: 1.0 A + Total load of the digital outputs + current for the motor holding brake

3.5.5. Mains supply PSUP (mains module) X41

Device protection

By cyclically switching on and off the power voltage, the input current limitation can be overloaded, which may cause damage to the device.

Wait at least one minute between two switching on processes!

Operation of the PSUP30 only with mains filter!

Connector X41

Pin	Designation
PE	Earth conductor
L3	Phase 3
L2	Phase 2
L1	Phase 1

Mains connection PSUP10D6

Device type PSUP10	**230V**	**400V**	**480V**
Supply voltage	230VAC ±10% 50-60Hz	400VAC ±10% 50-60Hz	480VAC ±10% 50-60Hz
Rated voltage	3AC 230V	3AC 400V	3AC 480V
Input current	22Arms	22Arms	18Arms
Output voltage	325VDC ±10%	565VDC ±10%	680VDC ±10%
Output power	6kW	10 kW	10 kW
Pulse power (<5s)	12kW	20kW	20kW
Power dissipation	60W	60W	60W
Maximum fuse rating per device (=short circuit rating)	Measure for line and device protection: MCB miniature circuit breaker (K characteristic) 25A in accordance with UL category DIVQ Recommendation: (ABB) S203UP-K 25(480VAC)		

Mains connection PSUP20D6

Device type PSUP20	**230V**	**400V**	**480V**
Supply voltage	230VAC ±10% 50-60Hz	400VAC ±10% 50-60Hz	480VAC ±10% 50-60Hz
Rated voltage	3AC 230V	3AC 400V	3AC 480V
Input current	44Arms	44Arms	35Arms
Output voltage	325VDC ±10%	565VDC ±10%	680VDC ±10%
Output power	12kW	20kW	20kW
Pulse power (<5s)	24kW	40kW	40kW
Power dissipation	120W	120W	120W
Maximum fuse rating per device (=short circuit rating) 2 circuit breakers in line are required	**Cable protection measure:** MCB (K characteristic) with a rating of 50A / 4xxVAC (depending on the input voltage) Recommendation: (ABB) S203U-K50 (440VAC) **Device protection measure:** Circuit breakers 80A / 700VAC per supply leg in accordance with UL category JFHR2 Requirement: Bussmann 170M1366 or 170M1566D		

PSUP30D6 Mains connection

Device type PSUP30	**230V**	**400V**	**480V**
Supply voltage	230VAC ±10% 50-60Hz	400VAC ±10% 50-60Hz	480VAC ±10% 50-60Hz
Rated voltage	3AC 230V	3AC 400V	3AC 480V
Input current	50Arms	50Arms	42Arms
Output voltage	325VDC ±10%	565VDC ±10%	680VDC ±10%
Output power	17kW	30kW	30kW
Pulse power (<5s)	34kW	60kW	60kW
Power dissipation	140W	140W	140W
Maximum fuse rating per device (=short circuit rating) 2 circuit breakers in line are required	**Cable protection measure:** MCB (K characteristic) with a rating of 63A / 4xxVAC (depending on the input voltage) Recommendation: (ABB) S203U-K63 (440VAC) **Device protection measure:** Circuit breakers 125A / 700VAC per supply leg in accordance with UL category JFHR2 Requirement: Bussmann 170M1368 or 170M1568D		

Caution!

Only three-phase operation of the PSUP devices is permitted!

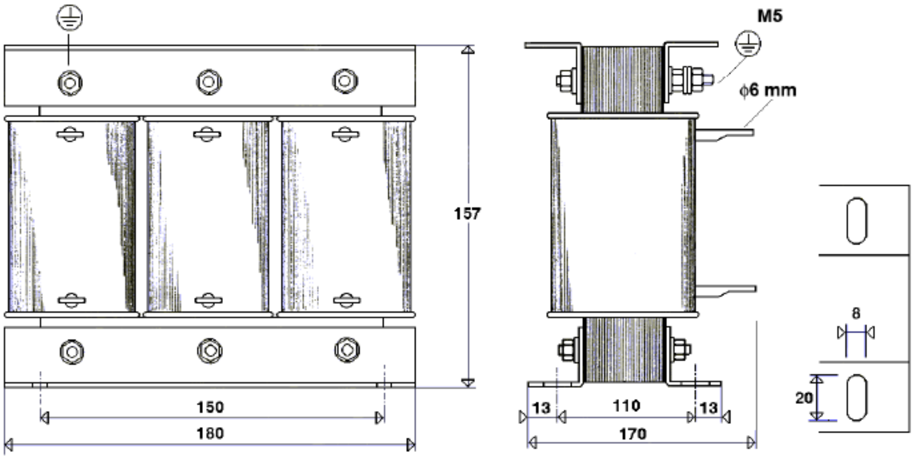
The PSUP30 mains module may only be operated with *mains filter* ***(see on page 579)***

Required mains filter for the PSUP30: 0.45 mH / 55 A

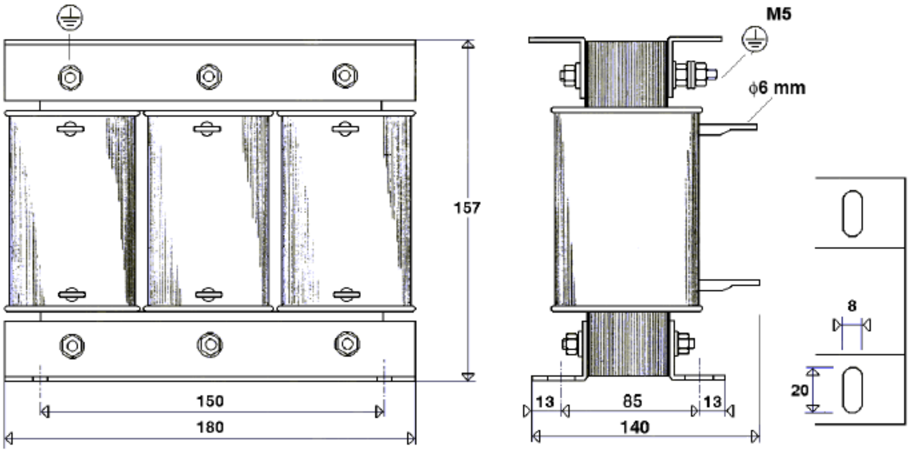
We offer the following mains filters:

- LCG-0055-0.45 mH (WxDxH: 180 mm x 140 mm x 157 mm; 10 kg)
- LCG-0055-0.45 mH-UL (with UL approval) (WxDxH: 180 mm x 170 mm x 157 mm; 15 kg)

Dimensional drawing: LCG-0055-0.45 mH



Dimensional drawing: LCG-0055-0.45 mH-UL



Caution - Risk of Electric Shock!

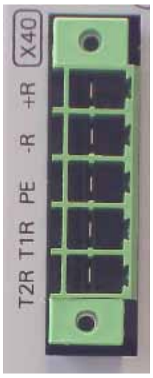
Always switch devices off before wiring them!

Dangerous voltages are still present until 10 min. after switching off the power supply.

3.5.6. Braking resistor / temperature switch PSUP (mains module)

The energy generated during braking operation must be dissipated via a braking resistor.

Connector X40



Pin	Description	
+R	+ Braking resistor	short-circuit proof!
-R	- Braking resistor	
PE	PE	
T1R	Temperature Switch	
T2R	Temperature Switch	

Braking operation PSUPxxD6 (mains module)

Device type	PSUP10	PSUP20	PSUP30
Capacitance / storable energy	550 µF/ 92 Ws at 400 V 53 Ws at 480 V	1175 µF/ 197 Ws at 400 V 114 Ws at 480 V	1175 µF/ 197 Ws at 400 V 114 Ws at 480 V
Minimum braking-resistance	27 Ω	15 Ω	10 Ω
Recommended nominal power rating	500 ... 1500 W	500 ... 3500 W	500 ... 5000 W
Pulse power rating for 1s	22 kW	40 kW	60 kW
Maximum permissible continuous current	13 A	15 A	15 A

Maximum capacity in the axis system:

- PSUP10: 2400 µF
- PSUP20 & PSUP30: 5000 µF

Reference value for the required capacity in an axis system

100 µF per kW of the temporal medium value of the total power (transmissions + power dissipation) in the axis system

Example: PSUP20 (1175 µF) with one axis controller (440 µF)

Total power 15 kW, 100 µF/kW => 1500 µF required in the axis system.

Axis system: 1615 µF are sufficient.

Connection of a braking resistor on PSUP (mains module)

Minimum line cross section:	1.5 mm²
Maximum line length:	2 m
Maximum intermediate circuit voltage:	810 VDC
Switch-on threshold:	780 VDC
Hysteresis	20 VDC

Braking operation Compax3MxxxD6 (axis controller)

Device type Compax3	M050	M100	M150	M300
Capacity/ storable energy	110µF/ 18Ws at 400V 10Ws at 480V	220µF/ 37Ws at 400V 21Ws at 480V	220µF/ 37Ws at 400V 21Ws at 480V	440µF/ 74Ws at 400V 42Ws at 480V

3.5.6.1 Temperature switch PSUP (mains module)

Connector X40 Pin T1R, T2R

Temperature monitoring:

The temperature switch (normally closed contact) must be connected, unless an error message will be issued.

Temperature switch/relay

No galvanic separation, the temperature sensor (normally closed contact) must comply with the safe separation according to EN 60664.

If there is no temperature monitoring due to the connected braking resistor, the T1R and T2R connections must be connected by a jumper.

Caution!

Without temperature monitoring, the braking resistor might be destroyed.

3.5.7. Motor / motor brake Compax3M (axis controller)

Connector X43

PIN	Designation	Motor cable lead designation*		
BR-	Motor holding brake *	BK	5	Br2
BR+	Motor holding brake *	WH	4	Br1
PE	PE (motor)	YE / GN	YE / GN	YE / GN
W	W (motor)	W / L3 / D / L-	3	U3
V	V (motor)	V / L2	2	U2
U	U (motor)	U / L1 / C / L+	1	U1

* depending on the cable type

Compax3M motor cable

<80m per axis (the cable must not be rolled up!)

The entire length of the motor cable per axis combination may not exceed 300m.

A **motor output filter** (see on page 577) is required for motor cables >20 m:

- MDR01/04 (max. 6.3 A rated motor current)
- MDR01/01 (max. 16 A rated motor current)
- MDR01/02 (max. 30 A rated motor current)

Shielding connection of the motor cable

The cable must be fully-screened and connected to the Compax3 housing. Use the cable clamps/shield connecting terminals furnished with the device.

The shield of the cable must also be connected with the motor housing. The fixing (via plug or screw in the terminal box) depends on the motor type.

Motor cables can be found in the accessories chapter of the device description.

Motor holding brake output

Motor holding brake output	Compax3
Voltage range	21 – 27VDC
Maximum output current (short circuit proof)	1.6A

Attention - Please wire the motor holding brake!

Connect the brake only on motors which have a holding brake! Otherwise make no brake connections at all.

Requirements cables for motor holding brake

If a motor holding brake is present, **one cable** of the motor holding brake must be fed on the device side through the toroidal core ferrite provided as accessory ZBH0x/xx (63Ω @1MHz, di=5.1mm), in order to ensure error-free switching on and off of the motor holding brake.

3.5.7.1 Measurement of the motor temperature of Compax3M (axis controller)

Connector X15

The acquisition of the motor temperature by the axis controller can either take place via the connection of X15 (Tmot) or via the feedback cable and the corresponding connection on X13 PIN10.

Pin	Description
1	+5V
2	Sensor

The temperature acquisition on X15 Tmot can not be connected at the same time as X13 Pin 10.

3.5.8. Safety technology option for Compax3M (axis controller)

Connector X14

Pin	Description	
1	STO1/	+24VDC
2	STO-GND	GND
3	STO2/	+24VDC
4	STO-GND	GND

Note!

If the Compax3M axis controller features a safety option, these connections must also be wired, otherwise it is not possible to set up the axis.

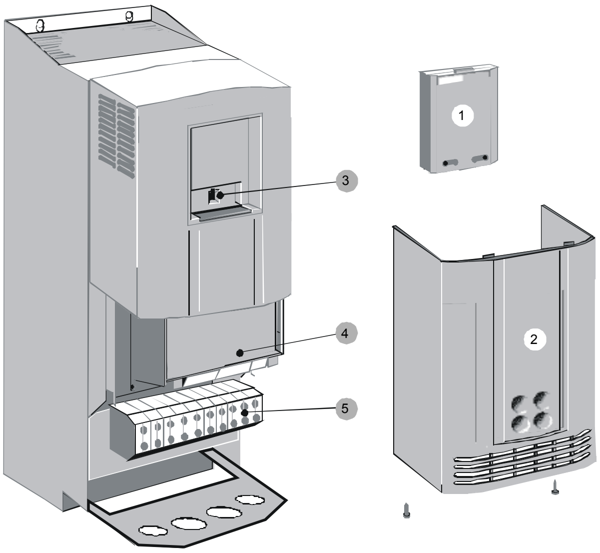
3.6 Connections of Compax3H

In this chapter you can read about:

3.6.1. Compax3H plugs/connections

The following figure is an example for all sizes.

The fitting of the different controller plugs depends on the extension level of Compax3.



(1): Dummy cover with display of the **external** device status LEDs.

(2): lower clamp cover, fixed by 2 screws at the device bottom.

(3): RS232 programming interface
Connection to the PC via adapter cable SSK32/20 (furnished with the device) and standard RS232 cable SSK1.

(4): Control

(5): Power connections

Always switch devices off before wiring them!

Dangerous voltages are still present until 5 minutes after switching off the power supply!

Caution!

If the control voltage is missing and if the X10-X10 jumper is not fitted (VBK17/01) on the control part, the availability of power voltage is not displayed.

PE connection

PE connection with 10mm^2 via a grounding screw at the bottom of the device.

Attention hot surface!

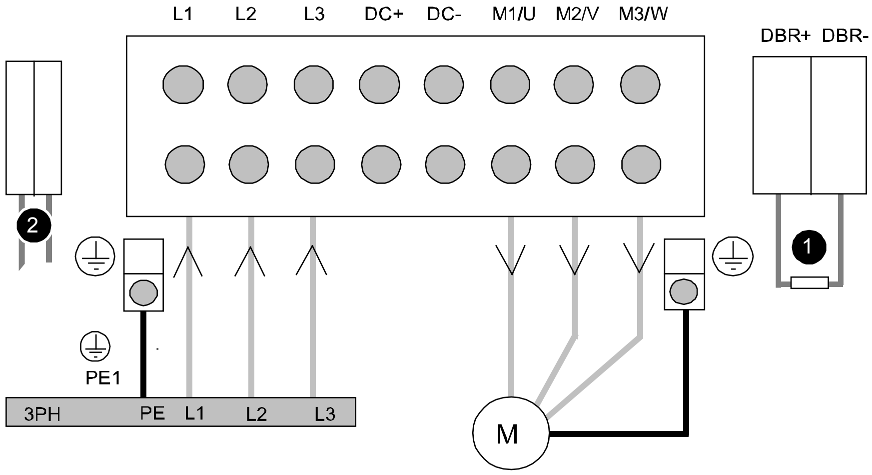
Metal parts can heat up to a temperature of 90°C during operation.

3.6.2. Connection of the power voltage

The terminal block of the drive can be found under the front cover. It is secured with 2 screws at the bottom of the device. Remove the bottom cover in order to access the connection clamps.

Make sure that all live parts are covered by the housing after installation.

Illustration of the connection clamps exemplarily for all sizes:



L1, L2, L3: 3 phase mains connection

M1, M2, M3: Motor connections

DC+, DC-: DC link voltage

(1) DBR+ und DBR-: Connection of external braking resistor

(2) AUX1, AUX2: only with C3H1xxV4 external supply (AC) for device ventilator L, N

- **All** shields must be connected via a cable joint to the cable feed through plate.
- Braking resistor and cable must be shielded if they are not installed in a control cabinet.
- The standard connection clamps of C3H090V4 and C3H1xxV4 are **not** suitable for flat line bars.

Attention: The MOT/TEMP connection is not supported by the Compax3H050; do therefore not wire this connection!

Terminal clamps - max. line cross sections

The line cross sections must correspond to the locally valid safety regulations. The local regulations have always priority.

	Power clamps (minimum/maximum section)	
C3H050V4	2.5 / 16mm^2	
	Massive	Multiwire
C3H090V4	16 / 50mm^2	25 / 50mm^2
C3H1xxV4	25 / 95mm^2	35 / 95mm^2

The standard connection clamps of Compax3H090V4 and Compax3H1xxV4 are not suitable for flat line bars.

Cover plate for cable feed through

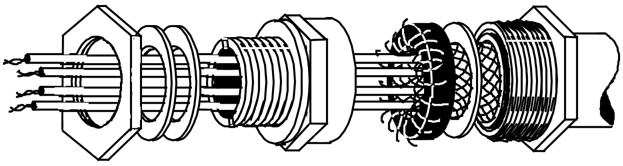
The cable feed through holes have the following dimensions:	
C3H050V4	28.6mm for M20, PG16 and ½” NPT (America). 37.3mm for M32, PG29 and 1” NPT (America).
C3H090V4	22.8mm for M20, PG16 und ½” NPT (America). 28.6mm for M25, PG21 and ¾” NPT (America). 47.3mm for M40, PG36 and 1¼” NPT (America). 54.3mm for M50, PG42and 1½” NPT (America).
C3H1xxV4	22.8mm for M20, PG16 and ½” NPT (America) 28.6mm for M25, PG21 and ¾” NPT (America)

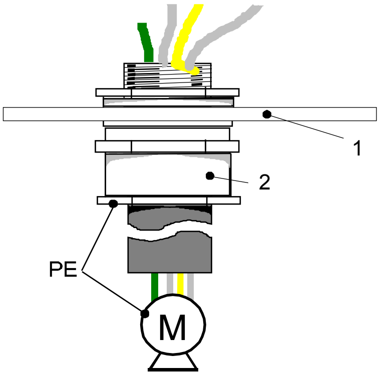
Recommended tightening torques

	High voltage supply	**Ballast resistor**	**Grounding**
C3H050V4	4Nm / 35lb-in	4Nm / 35lb-in	4.5Nm / 40lb-in
C3H090V4	6-8Nm / 53-70lb-in	6-8Nm / 53-70lb-in	6-8Nm / 53-70lb-in
C3H1xxV4	15-20Nm / 132-177lb-in	0.7Nm / 6.1lb-in	42Nm / 375lb-in

Cable joints

Use metallic cable joints permitting a 360° shielding in order to comply with the EMC directive.





1: Cable feed through plate

2: metallic joint with 360° shielding for EMC compliant design

The device must be grounded without interruption according to EN 61800-5-1. The mains supply lines must be protected with a suitable fuse or a circuit breaker (FI switches or earth fault fuses are not recommended).

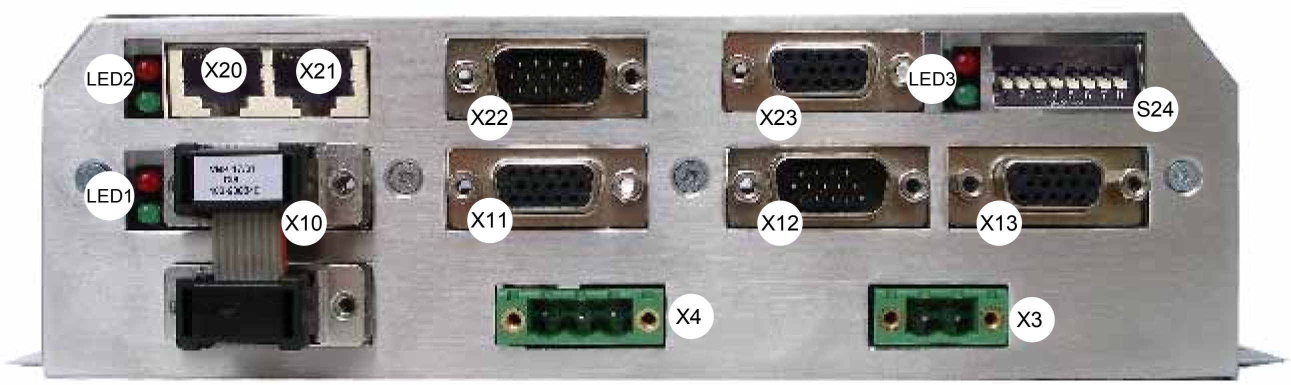
For installation in accordance with EN 61800-5-1 mm Europe:

- For grounding without interruption, two separate protective leads (^{2} cross-section) or one lead (>10mm^2 cross-section) are required. Each protective lead must meet the requirements according to EN 60204.

3.6.3. Compax3H connections front plate

Communication and signal interfaces

Showcase front plate of the control (number of connectors depends on the extension level of the Compax3)



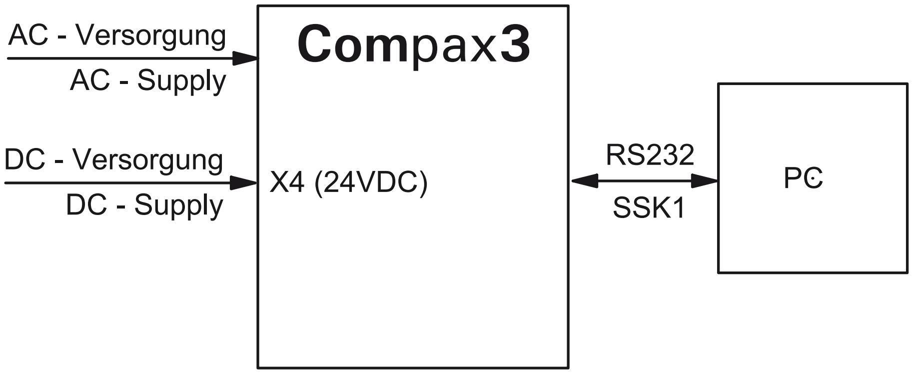
X3	Motor brake	**X20**	HEDA in (Option)	
X4	24VDC	**X21**	HEDA out (Option)	
X10	RS232/RS485 with jumper to the programming interface	**X22**	Inputs Outputs (Option M10/12)	
X11	Analog/Encoder	**X23**	Bus (Option)	Connector type depends on the bus system!
X12	Inputs/Outputs	**S24**	Bus settings	
X13	Motor position feedback	**LED1**	Device status LEDs	
		LED2	HEDA LEDs	
		LED3	Bus LEDs	

Note on Compax3H: The **internal** device status LEDs are only connected to the **external** housing LEDs, if the RS232 jumper at X10 is fitted to the control and the upper dummy cover is fitted.

The RS232 programming interface under the upper dummy cover is only available if the X10 jumper at the controller is fitted.

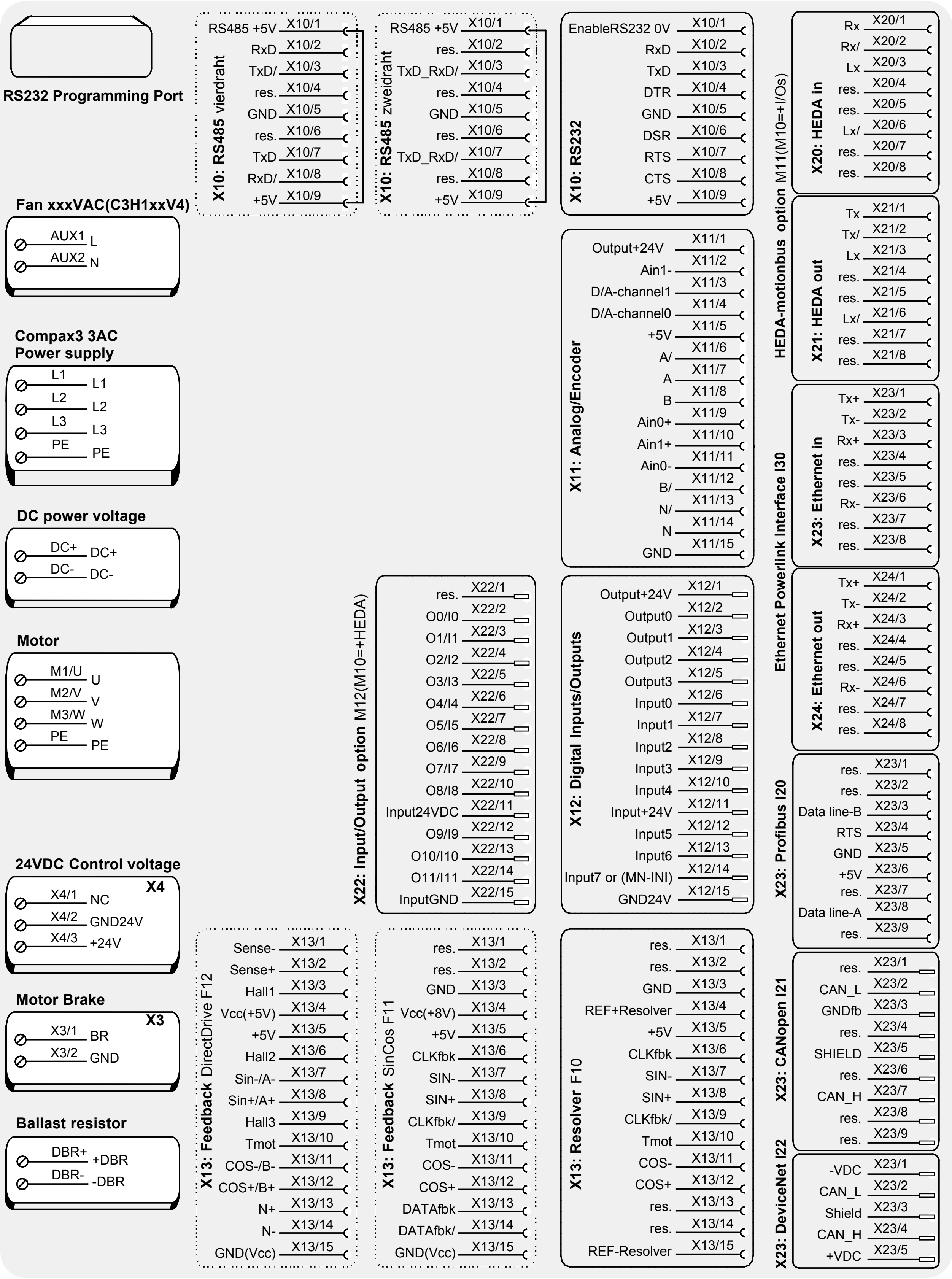
3.6.4. Plug and pin assignment C3H

Overview



Further information on the assignment of the plug mounted at the particular device can be found below!

In detail: The fitting of the different plugs depends on the extension level of Compax3. In part, the assignment depends on the Compax3 option implemented.



The RS232 programming interface under the upper dummy cover is only available if the X10 jumper at the controller is fitted.

Please note C3H1xxV4 uses a ventilator fan which must be externally supplied via separate connections. The ventilator fan is available in two versions for single phase feed: 220/240VAC; 110/120VAC

3.6.5. Motor / Motor brake C3H

Motor connection clamps - figure **(see on page 59)**

PIN	Designation	Motor cable lead designation*		
M1/U	U (motor)	U / L1 / C / L+	1	U1
M2/V	V (motor)	V / L2	2	U2
M3/W	W (motor)	W / L3 / D / L-	3	U3
PE	PE (motor)	YE / GN	YE / GN	YE / GN

* depending on the cable type

Compax3H motor cable

A motor output filter is required for motor cables >50m. Please contact us.

Shielding connection of the motor cable

The motor cable should be fully shielded and connected to the Compax3 housing. The shield of the motor cable must also be connected with the motor housing. The fixing (via plug or screw in the terminal box) depends on the motor type.

Attention - Please wire the motor holding brake!

Connect the brake only on motors which have a holding brake! Otherwise make no brake connections at all.

Requirements cables for motor holding brake

If a motor holding brake is present, **one cable** of the motor holding brake must be fed on the device side through the toroidal core ferrite provided as accessory ZBH0x/xx (63Ω @1MHz, di=5.1mm), in order to ensure error-free switching on and off of the motor holding brake.

Connection of motor brake X3 - figure **(see on page 61)**

PIN	Designation	Motor cable lead designation*		
1	BR	WH	4	Br1
2	GND	BK	5	Br2

Motor holding brake output

Motor holding brake output	Compax3
Voltage range	21 – 27VDC
Maximum output current (short circuit proof)	1.6A

3.6.6. Control voltage 24 VDC C3H

Connection of control voltage 24VDC figure **(see on page 61)**

Connector X4 Pin	Description	
1	NC	NC
2	GND24V	GND
3	+24 V	24 VDC (power supply)

Control voltage 24VDC Compax3S and Compax3H

Controller type	**Compax3**
Voltage range	21 - 27VDC
Current drain of the device	0.8 A
Total current drain	0.8 A + Total load of the digital outputs + current for the motor holding brake
Ripple	0.5Vpp
Requirement according to safe extra low voltage (SELV)	yes
Short-circuit proof	conditional (internally protected with 3.15AT)

3.6.7. Mains connection Compax3H

Device protection

Avoid permanent switching on and off so that the charging connection is not overloaded. Therefore wait at least 1 minute before switching on the device again.

Connection of mains voltage figure **(see on page 59)**

Mains connection Compax3HxxxV4 3*400VAC

Device type Compax3	H050V4	H090V4	H125V4	H155V4
Supply voltage	Three-phase 3*400VAC 350-528VAC / 50-60Hz			
Input current	66Arms	95Arms	143Arms	164Arms
Output current	50Arms	90Arms	125Arms	155Arms
Maximum fuse rating per device(=short circuit rating)	80A	100A	160A	200A
Branch circuit protection according to UL	JDDZ Class K5 or H JDRX Class H			

Mains connection Compax3HxxxV4 3*480VAC

Device type Compax3	H050V4	H090V4	H125V4	H155V4
Supply voltage	Three-phase 3*480VAC 350-528VAC / 50-60Hz			
Input current	54Arms	82Arms	118Arms	140Arms
Output current	43Arms	85Arms	110Arms	132Arms
Maximum fuse rating per device(=short circuit rating)	80A	100A	160A	200A
Branch circuit protection according to UL	JDDZ Class K5 or H JDRX Class H			

3.6.8. Braking resistor / supply voltage C3H

The energy generated during braking operation is absorbed by the Compax3 storage capacity.

If this capacity is too small, the braking energy must be drained via a braking resistor.

3.6.8.1 Connect braking resistor C3H

Connection of braking resistor - figure **(see on page 59)**

PIN	Designation
DBR+	+ Braking resistor
DBR-	- Braking resistor

Braking operation of Compax3HxxxV4

Controller type	H050V4	H090V4	H125V4	H155V4
Capacitance / storable energy 400V / 480V	2600 µF 602 / 419 Ws	3150 µF 729 / 507 Ws	5000 µF 1158 / 806 Ws	5000 µF 1158 / 806 Ws
Minimum braking- resistance	24 Ω	15 Ω	8 Ω	8 Ω
Maximum continuous current	11 A	17 A	31 A	31 A

Minimum line cross section:	2.5mm^2
Maximum line length:	2m
Maximum output voltage:	830VDC

3.6.8.2 Power supply voltage DC C3H

Connection of power voltage DC -figure **(see on page 59)**

PIN	Description
DC+	+ DC high voltage supply
DC-	- DC high voltage supply

Warning!

Do *not* ***connect any braking resistor on DC+/DC- .***

3.6.8.3 Connection of the power voltage of 2 C3H 3AC devices

In order to improve the conditions during brake operation, the DC power voltage of 2 servo axes may be connected.

The capacity as well as the storable energy are increased; furthermore the braking energy of one servo axis may be utilized by a second servo axis, depending on the application.

It is not permitted to connect the power voltage in order to use one brake circuit for two servo axes, as this function cannot be ensured reliably.

Note the following:

Caution! In case of non-compliance with the following instructions, the device may be destroyed!

- You can only connect two similar servo axes (same power supply; same rated currents)
- Connected servo axes must always be fed separately via the AC power supply.
- If the external pre-fuse of one of the servo axes takes action, the second servo axis must also be disconnected automatically.

Please connect as follows:

Servo axis 1 DC+ with servo axis 2 DC+

Servo axis 1 DC- with servo axis 2 DC-

- figure (see on page 59)

3.7 Communication interfaces

In this chapter you can read about:

3.7.1. RS232/RS485 interface (plug X10)

Interface selectable by contact functions assignment of X10/1:

X10/1=0V RS232

X10/1=5V RS485

PIN X10	RS232 (Sub D)
1	(Enable RS232) 0V
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	+5V

RS485 2-wire

PIN X10	RS485 2-wire Sub D Pin 1 and 9 externally jumpered
1	Enable RS485 (+5V)
2	res.
3	TxD_RxD/
4	res.
5	GND
6	res.
7	TxD_RxD
8	res.
9	+5V

RS485 4-wire

PIN X10	RS485 4-wire Sub D Pin 1 and 9 externally jumpered
1	Enable RS485 (+5V)
2	RxD
3	TxD/
4	res.
5	GND
6	res.
7	TxD
8	RxD/
9	+5V

USB - RS232/RS485 converter

The following USB - RS232 converters were tested:

- ATEN UC 232A
- USB GMUS-03 (available under several company names)
- USB / RS485: **Moxa Uport 1130 http://www.moxa.com/product/UPort_1130.htm**
- Ethernet/RS232/RS485: **NetCom 113 http://www.vscom.de/666.htm**

3.7.2. Communication Compax3M

In this chapter you can read about:

3.7.2.1 PC - PSUP (Mains module)

Connector X3

USB2.0

Connect your PC to the USB sleeve X3 of the mains module via an USB cable (SSK33/03).

3.7.2.2 Communication in the axis combination (connector X30, X31)

The communication in the axis combination is implemented via a SSK28 cable and double RJ45 sleeves on the device top.

Beginning with the PSUP (mains module) the connection is always made from X30 to X31 of the next device. On the first device (X31) and the last device (X30) in the multi-axis combination, a bus termination plug (BUS07/01) is required.

Orientation to the back side

Orientation to the front plate

	PSUP (Mains module)
X30	out
X31	in
res.	factory use
	Compax3M (axis)
X30	out
X31	in
res.	factory use

3.7.2.3 Adjusting the basic address

On the mains module, the basic address of the device combination is set in steps of 16 with the aid of the first three dip switches.

The mains module contains the set basic address while the axes placed at the right in the combination contain the following addresses.

Switch S1

Address setting

Basic addresses

Switch	Value upon ON
1	16
2	32
3	64

Settings:

left: OFF

right: ON

Settable value range: 0, 16, 32, 48, 64, 80, 96, 112

Address of the 1st axis = basic address+1

The addresses of the axis controllers are newly assigned after PowerOn.

Example:

Basic address = 48; mains module with 6 axis controllers in the combination

1. Axis right: Address = 49

2. Axis right: Address = 50

...

6. Axis right: Address = 54

3.7.2.4 Setting the axis function

Switch S10

Function settings for T30 and T40

The value of switch S10 on the axis controller is stored in object O110.1 C3plus.Switch_DeviceFunction and can be evaluated with the aid of a program.

This helps realize a more simple function selection.

3.7.3. Profibus connector X23 on Interface I20

Pin X23	Profibus (Sub D)
1	factory use
2	factory use
3	Data line B
4	RTS
5	GND
6	+5V
7	factory use
8	Data line A
9	factory use

The assignment corresponds to Profibus standard EN 50170.

Wiring (see on page 612).

3.7.3.1 Adjusting the bus address (Profibus I20)

Address setting

Values:

1: 2^0; **2:** 2^1; **3:** 2^2; ... **7:** 2^6; **8:** reserved

Settings:

left: OFF

right: ON

(The address is set to 0 in the illustration to the left)

Range of values: 1 ...127

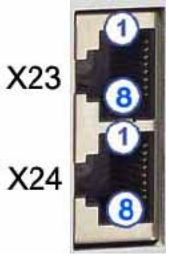
Address 0 is set internally to address 126.

3.7.3.2 Function of the Bus LEDs (Profibus I20)

Function of the LEDs (under X23)

Green LED (left)	Red LED (right)	Description
alternately flashing		Field bus program missing
off	flashing	Device is not initialized
on	flashing	Bus operation mode (no DATA exchange)
on	off	Bus operation mode (DATA exchange)
on	on	Bus error

3.7.4. Profinet connector X23, X24 on Interface I32



	RJ45 (X23)	RJ45 (X24)
Pin	**in**	**out**
1	Tx +	Tx +
2	Tx -	Tx -
3	Rx +	Rx +
4	-	factory use
5	-	factory use
6	Rx -	Rx -
7	-	factory use
8	-	factory use

Wiring with Ethernet Crossover cable Cat5e (from X24 to X23 of the next device without termination); for this, we offer our **SSK28** (see on page 567, see on page 606) interface cable.

3.7.4.1 Adjusting the bus address (Profinet I32)

With Profinet, the bus nodes are identified by name. This name is assigned during setup with the aid of a configuration tool (Engineering Tool).

In order to identify each device during this phase, a blinking check can be used. The Profinet node currently worked on in the configuration tool is made to identify itself optically (see LED description // C3 xxx LED flashes green).

With the aid of the address switch, it is possible to allocate a non-ambiguous name to each Compax3 in a network, without using a configuration tool.

Address setting

Settings:

left: OFF

right: ON

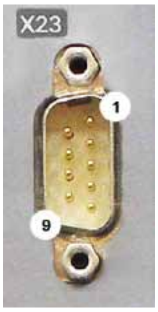
Address switch	Device name used
0	The device name used is the name assigned with the aid of the configuration tool. (standard settings)
1	Device name - "compax3-001"
...	
255	Device name - “compax3-255”

3.7.4.2 Function of the Bus LEDs (Profinet I32)

Function of the LEDs

LED2 (left)	LED1 (right)	Description
flashing green		Bus operation mode (no DATA exchange)
illuminated green		Bus operation mode (DATA exchange)
	flashing green	The blinking check in the PROFINET-IO-Controller projecting was activated in order to locate the node optically.
	illuminated red	Communication Error (Data exchange terminated).
Alternately flashing red		Fieldbus Interface in bootloader mode (no valid firmware available).
Alternately flashing red/green		Firmware is written into the FLASH during the firmware update (caution, do not switch off device).

3.7.5. CANopen connector X23 Interface I21



Pin X23	CANopen (Sub D)	
1	factory use	
2	CAN_L	CAN Low
3	GNDfb	Opto-isolated GND-supply
4	factory use	
5	SHIELD	Shield optional
6	factory use	
7	CAN_H	CAN High
8	factory use	
9	factory use	

The assignment corresponds to CANopen DS301.

At the beginning and end of the device chain a terminating resistor of 120Ω is required between CAN_L and CAN_H

Wiring (see on page 613).

3.7.5.1 Setting baud rate and Node-ID

Proceeding:

- Switch off 24VDC
- Switch 8 must be set to ON
- Set **Baud rate** with switches 1...7:
  0:= 20kbits/s
  1:= 50kbit/s
  2:= 100kbit/s
  3:= 125kbit/s
  4:= 250kbit/s
  5:= 500kbit/s
  6:= 800kbit/s
  7...127:= 1Mbit/s
- switch on 24VDC and wait until both LEDs above the DIP switch are blinking simultaneously
- With switch 1...7 **set Node ID**:
  Values: **1:** 2^0; **2:** 2^1; **3:** 2^2; ... **7:** 2^6;
  value range: 1 ...127
- **Switch 8:** = OFF
- Compax3 is now ready to operate

Position of the switch

left: OFF

right: ON

Note:

The baud rate can also be set in the C3 ServoManager. After switching on, the last setting made is valid!

3.7.5.2 Function of the Bus LEDs

LED red

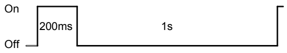
No.	Signal	Status	Description
1	**off**	No Error	The bus is operating
2	**Single flash**	Warning	At least one of the error counters of the CAN controller has reached the warning level. Cannot send Bootup Message.
3	**Double flash**	Error	Node Guarding Error
4	**Triple flash**	Error	Sync Error Buffer overflow (0x8110)
5	**on**	Bus not active	

If several errors occur at once, the error with the most significant number is reported.

LED green

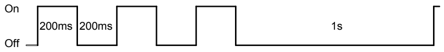
Signal	Status	Description
Single flash	Stop	The bus is in STOPPED state
blinks (permanently)	pre-operational	The bus is ready to operate (Pre-Operational)
on	operational	The bus is operating (operational)

Single flash

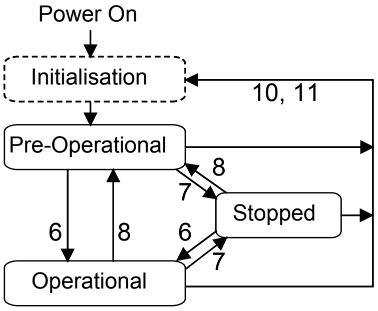


Double flash

Triple flash



CANopen states



6: Start Remote Node

7: Stop Remote Node

8: Enter Pre-Operational State

10: Reset Node

11: Reset Communication

The "Initialization" state is no fixed state but only a transition state.

3.7.6. DeviceNet connector X23

Pin X23	DeviceNet (Open Plug Phoenix MSTB 2.5/5-GF5.08 ABGY AU)	
1	V-	Mass
2	CAN-	CAN Low
3	Shield	Shield
4	CAN+	CAN High
5	V+	not required, internal supply

A mating plug is included in the delivery.

If Compax3 is used as first or last device in the fieldbus network, a terminal resistance of 121 Ω is required. This is integrated between Pin 2 and Pin 4.

Additional information on the DeviceNet wiring can be found under **www.odva.org http://www.odva.org**.

Please do also heed the instructions in the DeviceNet master manual.

3.7.6.1 Adjusting the bus address

Address setting (NA: Node Address)

Values:

1: 2^0; **2:** 2^1; **3:** 2^2; ... **6:** 2^5reserved

Settings:

left: OFF

right: ON

(The address is set to 2 in the illustration)

Range of values: 1 ... 63

Address 0 is set internally to address 63.

Data Rate setting (DR):

Data Rate [kBit/s]	S24_7	S24_8
125	left: OFF	left: OFF
250	right: ON	left: OFF
500	left: OFF	right: ON
factory use	right: ON	right: ON

Bear in mind that the maximum cable length depends on the Data rate:

Data Rate	Maximum length
500kbit/s	100m
250kbit/s	250m
125kbit/s	500m

3.7.6.2 Function of the Bus LEDs

LED (red)

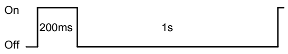
No.	**Signal**	**Status**	**Description**
1	**off**	No Error	The bus is operating
2	**Single flash**	Warning	at least one of the error counters of the CAN controller has reached the warning level.
3	**Double flash**	Error	Communication Fault
4	**Triple flash**	Error	Double Mac ID
5	**on**	Error	Bus Off

If several errors occur at once, the error with the most significant number is reported.

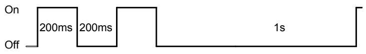
LED green

Signal	**Status**	**Description**
Single flash	On-line Not Connected	Online, not at the master (not allocated)
blinks (permanently)	On-line Connected	Online, at the master (allocated)
on	On-line I/O Connected	I/O Messages allocated

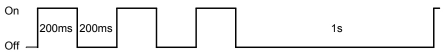
Single flash



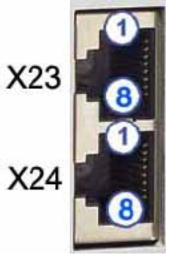
Double flash



Triple flash



3.7.7. Ethernet Powerlink (Option I30) / EtherCAT (option I31) X23, X24



	RJ45 (X23)	**RJ45 (X24)**
Pin	**in**	**out**
1	Tx +	Tx +
2	Tx -	Tx -
3	Rx +	Rx +
4	-	factory use
5	-	factory use
6	Rx -	Rx -
7	-	factory use
8	-	factory use

Wiring with Ethernet Crossover cable Cat5e (from X24 to X23 of the next device without termination); for this, we offer our **SSK28** (see on page 567, see on page 606) interface cable.

Meaning of the RJ45 LEDs (only for Ethernet Powerlink, I30)

Green LED (top): connection established (RPT_LINK/RX)

Yellow LED (bottom): Traffic (exchange of data) (Transmit / Receive Data) (RPT_ERR)

3.7.7.1 Set Ethernet Powerlink (option I30) bus address

Address setting

Values:

1: 2^0; **2:** 2^1; **3:** 2^2; ... **7:** 2^6; **8:** 2^7

Settings:

left: OFF

right: ON

(The address is set to 0 in the illustration)

Range of values: 1 ... 239

3.7.7.2 Set Ethernet Powerlink (option I30) bus address

Automatic address assignment with EtherCAT

3.7.7.3 Meaning of the Bus LEDs (Ethernet Powerlink)

Red LED (right): Ethernet Powerlink error

LED is influenced by the transitions of the NMT - status diagram (for further details, please refer to the **Ethernet Powerlink Specification http://divapps.parker.com/divapps/eme/EME/downloads/compax3/EPL/epl2.0-ds-v-1-0-0.pdf**)

Error LED	**Transition**
off => on	NMT_CT11,NMT_GT6,NMT_MT6
on => off	NMT_CT6, NMT_GT2, NMT_CT3, NMT_MT5

Green LED (left): Ethernet Powerlink Status

LED indicates the states of the NMT - status diagram (for further details, please refer to the **Ethernet Powerlink Specification**

http://divapps.parker.com/divapps/eme/EME/downloads/compax3/EPL/epl2.0-ds-v-1-0-0.pdf)

Status LED		**Status**
off	off	NMT_GS_OFF, NMT_GS_INITIALISATION, NMT_CS_NOT_ACTIVE / NMT_MS_NOT_ACTIVE
flickering	flickering	NMT_CS_BASIC_ETHERNET
single flash	Single flash	NMT_CS_PRE_OPERATIONAL_1 / NMT_MS_PRE_OPERATIONAL_1
double flash	Double flash	NMT_CS_PRE_OPERATIONAL_2 / NMT_MS_PRE_OPERATIONAL_2
triple flash	Triple flash	NMT_CS_READY_TO_OPERATE / NMT_MS_READY_TO_OPERATE
on	on	NMT_CS_OPERATIONAL / NMT_MS_OPERATIONAL
blinking	flashing	NMT_CS_STOPPED

3.7.7.4 Meaning of the Bus LEDs (EtherCAT)

Red LED (right): EtherCAT error

LED is influenced by the transitions of the status diagram

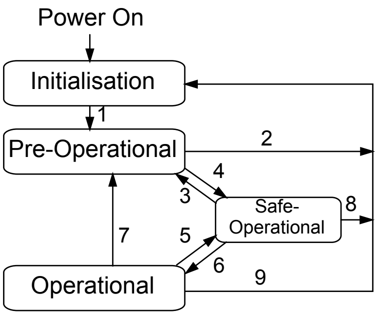
Error LED	**Error**	**Description**
Off	No Error	
Flickering	Boot error	Error during initialization
Blinking	Invalid configuration	
Single Flash	Unsolicited change of status	Slave changed the status independently
Double Flash	Application Watchdog Timeout	Watchdog
On	PDI Watchdog Timeout	

Green LED (left): EtherCAT Status

LED shows the states of the status diagram

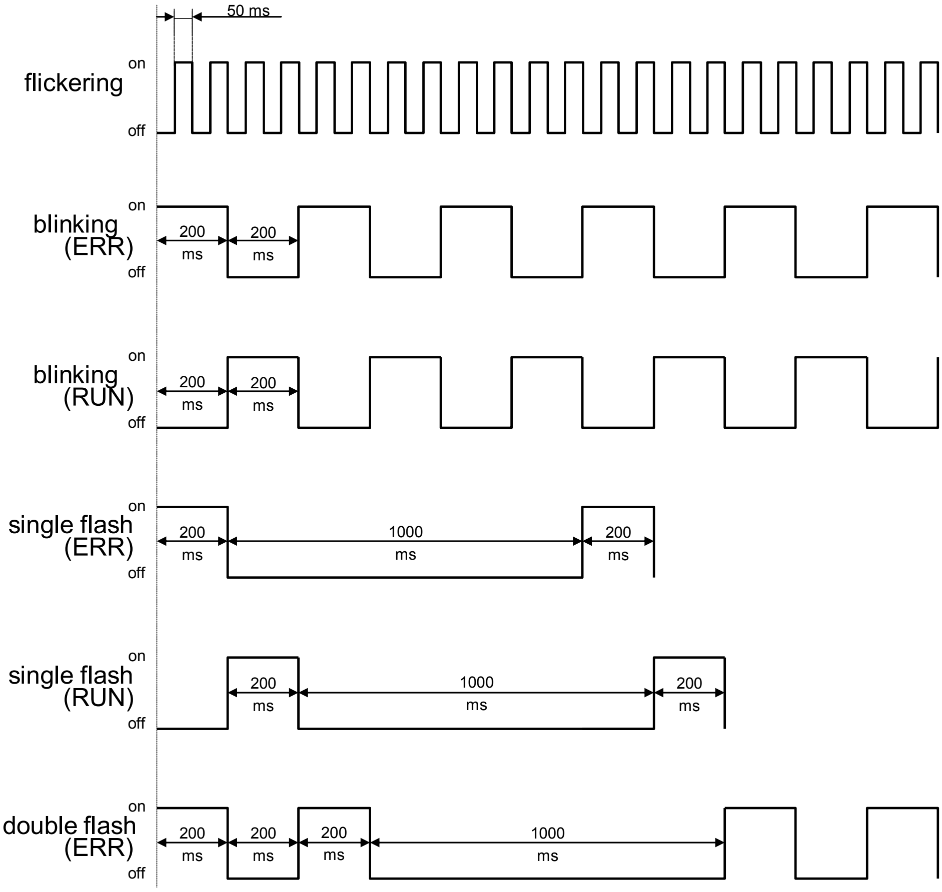
Status LED	**Status**	**Description**
Off	INITIALIZATION	Initialization
Blinking	PRE-OPERATIONAL	Ready
Single Flash	SAFE-OPERATIONAL	Master reads values
On	OPERATIONAL	Operation

Status diagram



Transition	Action
1	Start mailbox communication
2	Stop mailbox communication
3	Start input update
4	Stop input update
5	Start output update
6	Stop output update
7	Stop output update, stop input update
8	Stop input update, stop mailbox communication
9	Stop output update, stop input update, stop mailbox communication

Meaning of the LED states



3.8 Signal interfaces

In this chapter you can read about:

3.8.1. Resolver / feedback (plug X13)

PIN X13	Feedback /X13 High Density /Sub D (depending on the Feedback module)		
	Resolver (F10)	**SinCos (F11)**	**EnDat 2.1 (F12)**
1	factory use	factory use	Sense -*
2	factory use	factory use	Sense +*
3	GND	GND	factory use
4	REF-Resolver+	Vcc (+8V)	Vcc (+5V) * max. 350mA load
5	+5V (for temperature sensor)		
6	factory use	factory use	CLKfbk
7	SIN-	SIN-	SIN- / A- (Encoder)
8	SIN+	SIN+	SIN+ / A+ (Encoder)
9	factory use	factory use	CLKfbk/
10	Tmot*	Tmot*	Tmot*
11	COS-	COS-	COS- / B- (Encoder)
12	COS+	COS+	COS+ / B+ (Encoder)
13	factory use	DATAfbk	DATAfbk
14	factory use	DATAfbk/	DATAfbk/
15	REF-Resolver-	GND (Vcc)	GND (Vcc)

*X13 Pin10 Tmot may not be connected at the same time as X15 (on Compaxx3M).

Resolver cables (see on page 581) can be found in the accessories chapter of the device description.

SinCos© **cables** (see on page 582) can be found in the accessories chapter of the device description.

The **EnDat cable GBK38** (see on page 583) can be found in the accessories chapter of the device description.

PIN X13	Feedback /X13 High Density /Sub D
	Direct drives (F12)
1	Sense -*
2	Sense +*
3	Hall1 (digital)
4	Vcc (+5V)* max. 350 mA load
5	+5 V (for temperature sensors und Hallsensoren)
6	Hall2 (digital)
7	SIN-, A- (Encoder) or analog Hall sensor
8	SIN+, A+, (Encoder) or analog Hall sensor
9	Hall3 (digital)
10	Tmot*
11	COS-, B- (Encoder) or analog Hall sensor
12	COS+, B+ (Encoder) or analog Hall sensor
13	N+
14	N-
15	GND (Vcc)

*X13 Pin10 Tmot may not be connected at the same time as X15 (on Compaxx3M).

Note on F12:

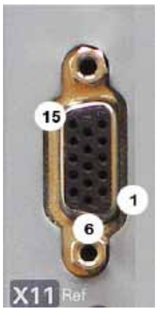
*+5V (Pin 4) is measured and controlled directly at the end of the line via Sense+ and Sense-.

Maximum cable length: 100m

Caution!

- Pin 4 and Pin 5 must under no circumstances be connected!
- Plug in or pull out feedback connector only in switched off state (24VDC switched off).

3.8.2. Analogue / encoder (plug X11)

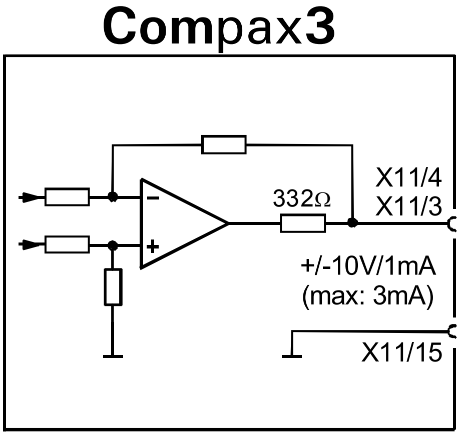


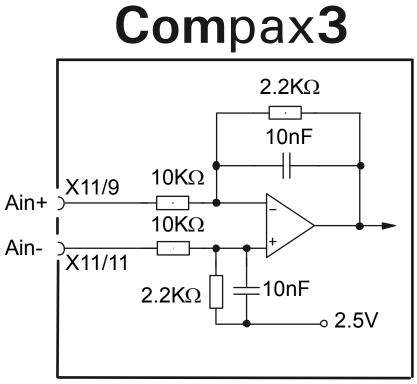
PIN X11	Reference High Density Sub D		
		Encoders	SSI **(see on page 155)**
1	+24V (output) max. 70mA		
2	Ain1 -; analog input - (14Bits; max. +/-10V)		
3	D/A monitor channel 1 (±10V, 8-bit resolution)		
4	D/A monitor channel 0 (±10V, 8-bit resolution)		
5	+5 V (output for encoder) max. 150 mA		
6	- Input: steps RS422 (5V - level)	**A/** (Input / -simulation)	Clock-
7	+ Input: steps RS422 (5V - level)	**A/** (Input / -simulation)	Clock+
8	+ Input: direction RS422 (5V - level)	**B** Input / -simulation)	
9	Ain0 +: analog input + (14Bits; max. +/-10V)		
10	Ain1 +: analog input + (14Bits; max. +/-10V)		
11	Ain0 -: analog input- (14Bits; max. +/-10V)		
12	- Input: direction RS422 (5V - level)	**B/** input / -simulation)	
13	factory use	**N/** input / -simulation)	DATA-
14	factory use	**N** input / -simulation)	DATA+
15	GND		

Technical Data X11 (see on page 623)

3.8.2.1 Wiring of analog interfaces

Output **Input**

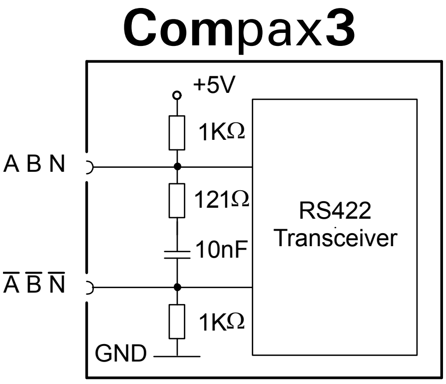




Perform an **offset adjustment** (see on page 248)!

Structure image of the **internal signal processing of the analog inputs**, Ain1 (X11/10 and X11/2) has the same wiring!

3.8.2.2 Connections of the encoder interface



The input connection is available in triple (for A & /A, B & /B, N & /N)

3.8.3. Digital inputs/outputs (plug X12)

Pin X12/	Input/output	I/O /X12 High density/Sub D
1	Output	+24 V DC output (max. 400mA)
2	O0	Output 0 (max. 100 mA)
3	O1	Output 1 (max. 100 mA)
4	O2	Output 2 (max. 100 mA)
5	O3	Output 3 (max. 100 mA)
6	I0	Input 0
7	I1	Input 1
8	I2	Input 2
9	I3	Input 3
10	I4	Input 4
11	I	24V input for the digital outputs Pins 2 to 5
12	I5	Input 5 or limit or direction reversal switch
13	I6	Input 6 or limit or direction reversal switch
14	I7	Input 7 or home switch
15	Output	GND24V

All inputs and outputs have 24V level.

Maximum capacitive loading of the outputs: 30nF (max. 2 Compax3 inputs)

Note:

The inputs and outputs are freely programmable using an IEC61131-3 program.

Input 7 is planned as home switch, the inputs 5 and 6 as limit switches or direction reversal switches.

If no limit switches are used and these are switched off (in the C3 ServoManager under configuration), the inputs 5 and 6 can be freely assigned.

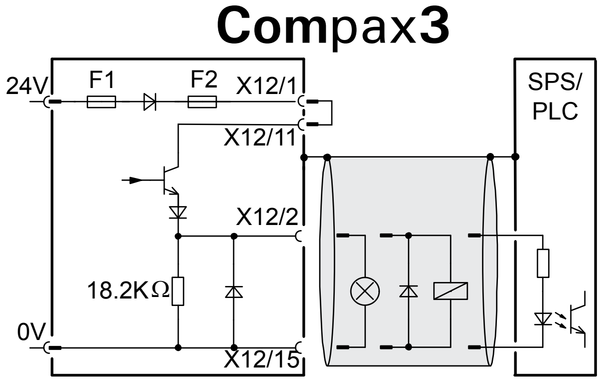
The same applies for input 7: A machine zero mode without home switch allows to freely assign input 7.

Optimization window display

The display of the digital inputs in the optimization window of the C3 ServoManager does not correspond to the physical status (24Volt=on, 0Volt=off) but to the logic status: if the function of an input or output is inverted (e.g. limit switch, negatively switching), the corresponding display (LED symbol in the optimization window) is OFF with 24Volts at the input and ON with 0 Volts at the input.

3.8.3.1 Connection of the digital Outputs/Inputs

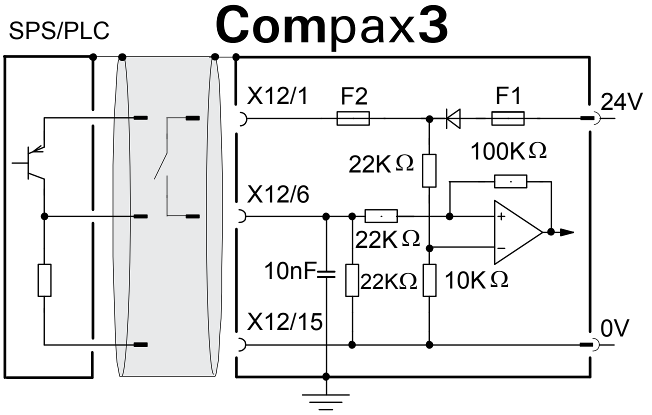
Wiring of digital outputs



The circuit example is valid for all digital outputs!

The outputs are short circuit proof; a short circuit generates an error.

Status of digital inputs



The circuit example is valid for all digital inputs!

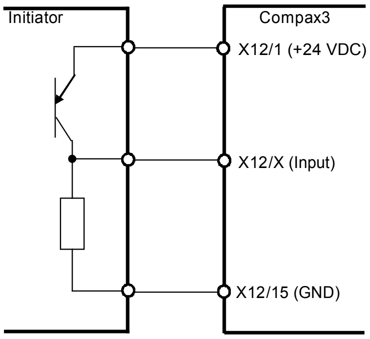
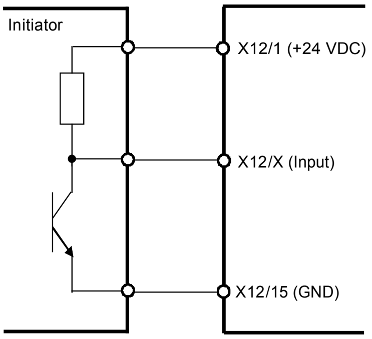
Signal level:

- > 9.15V = "1" (38.2% of the control voltage applied)
- < 8.05V = "0" (33.5% of the control voltage applied)

F1: Delayed action fuse

F2: Quick action electronic fuse; can be reset by switching the 24 VDC supply off and on again.

3.8.3.2 Logic proximity switch types

Type	1	2	3	4
Transistor switch	PNP	PNP	NPN	NPN
Logic	(N.O.) “active high"	(N.C) “active low"	(N.O.) “active low"	(N.C) “active high"
Description of logic	Compax3 sees a logical “1” upon activation	Compax3 sees a logical “0” upon activation"	Compax3 sees a logical “0” upon activation"	Compax3 sees a logical “1” upon activation
Fail safe logic	no	yes	Only conditional [1]	no
Instruction for pull up resistor in the initiator	-	-	Rmin=3k3 Rmax=10k [2]	Rmin=3k3 Rmax=10k [2]
Connections				

[1] When the connection between transistor emitter of the initiator and X12/15 (GND24V of the Compax3)is lost, it can not be guaranteed, that the Compax3 detects a logical „0".

[2] The INSOR NPN types INHE5212 and INHE5213 manufactured by Schönbuch Electronic do correspond to this specification.

3.9 Installation and dimensions Compax3

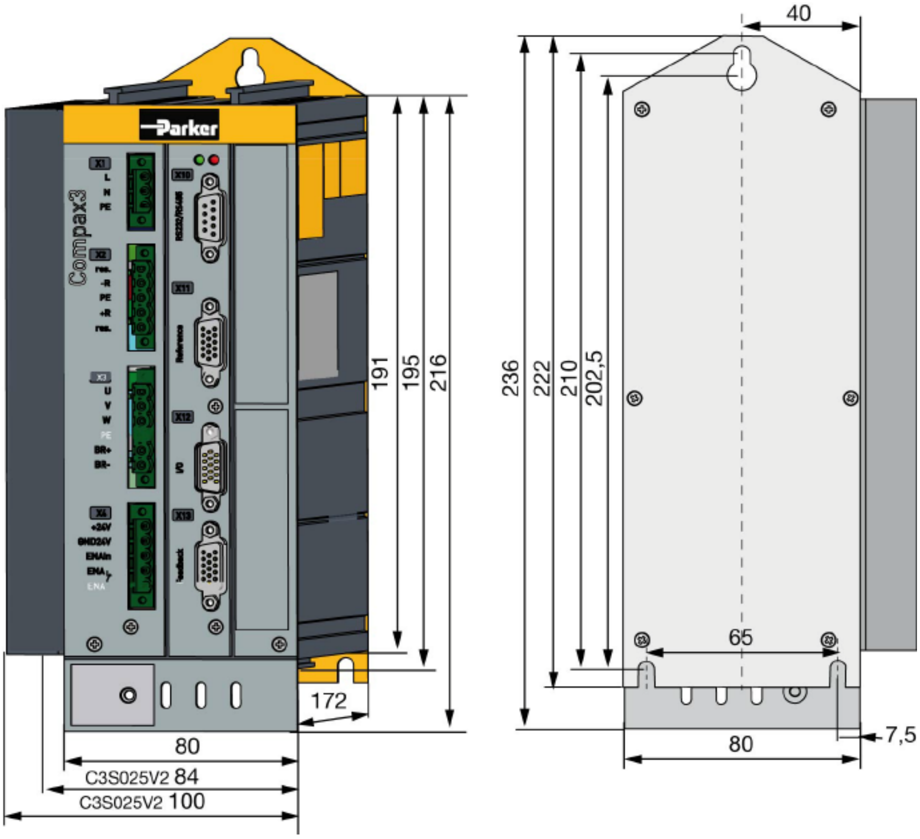
In this chapter you can read about:

3.9.1. Mounting and dimensions Compax3S

3.9.1.1 Mounting and dimensions Compax3S0xxV2

Mounting:

3 socket head screws M5



Stated in mm

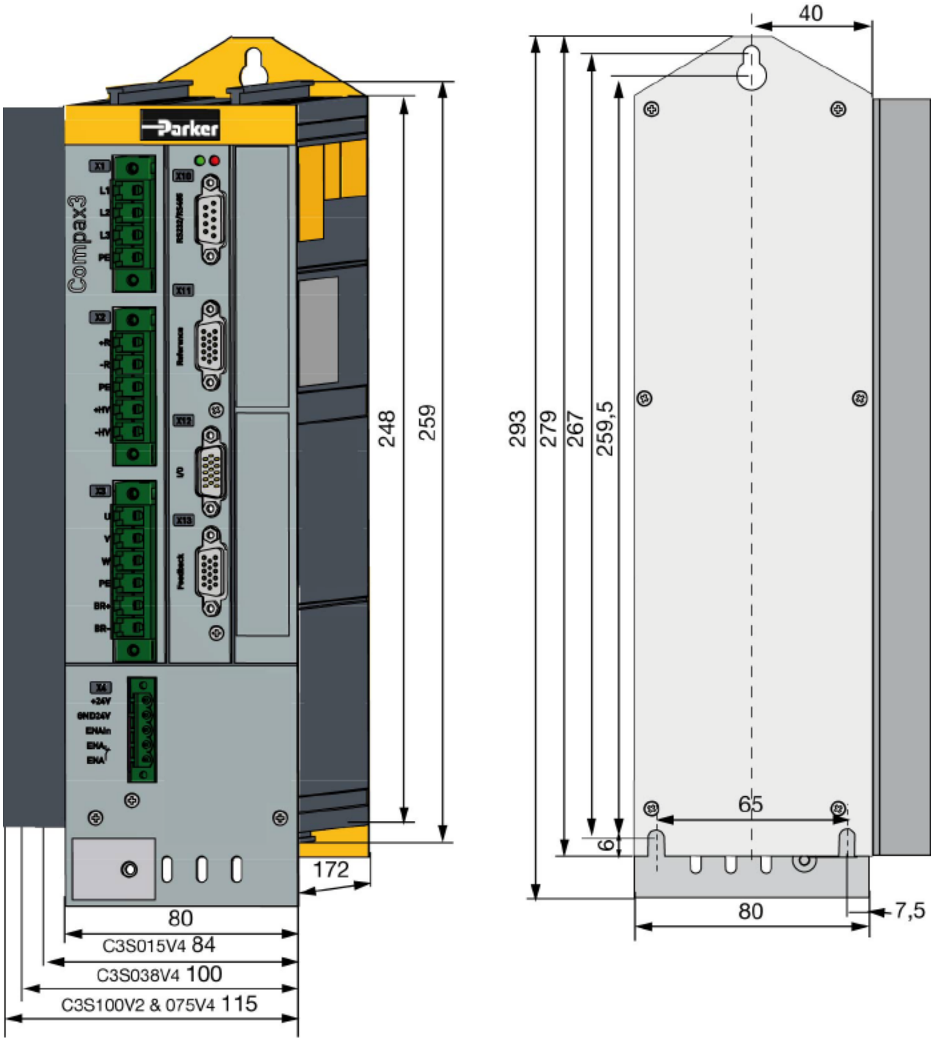
Please respect an appropriate mounting gap in order to ensure sufficient convection:

- At the side: 15mm
- At the top and below: at least 100mm

3.9.1.2 Mounting and dimensions Compax3S100V2 and S0xxV4

Mounting:

3 socket head screws M5



Stated in mm

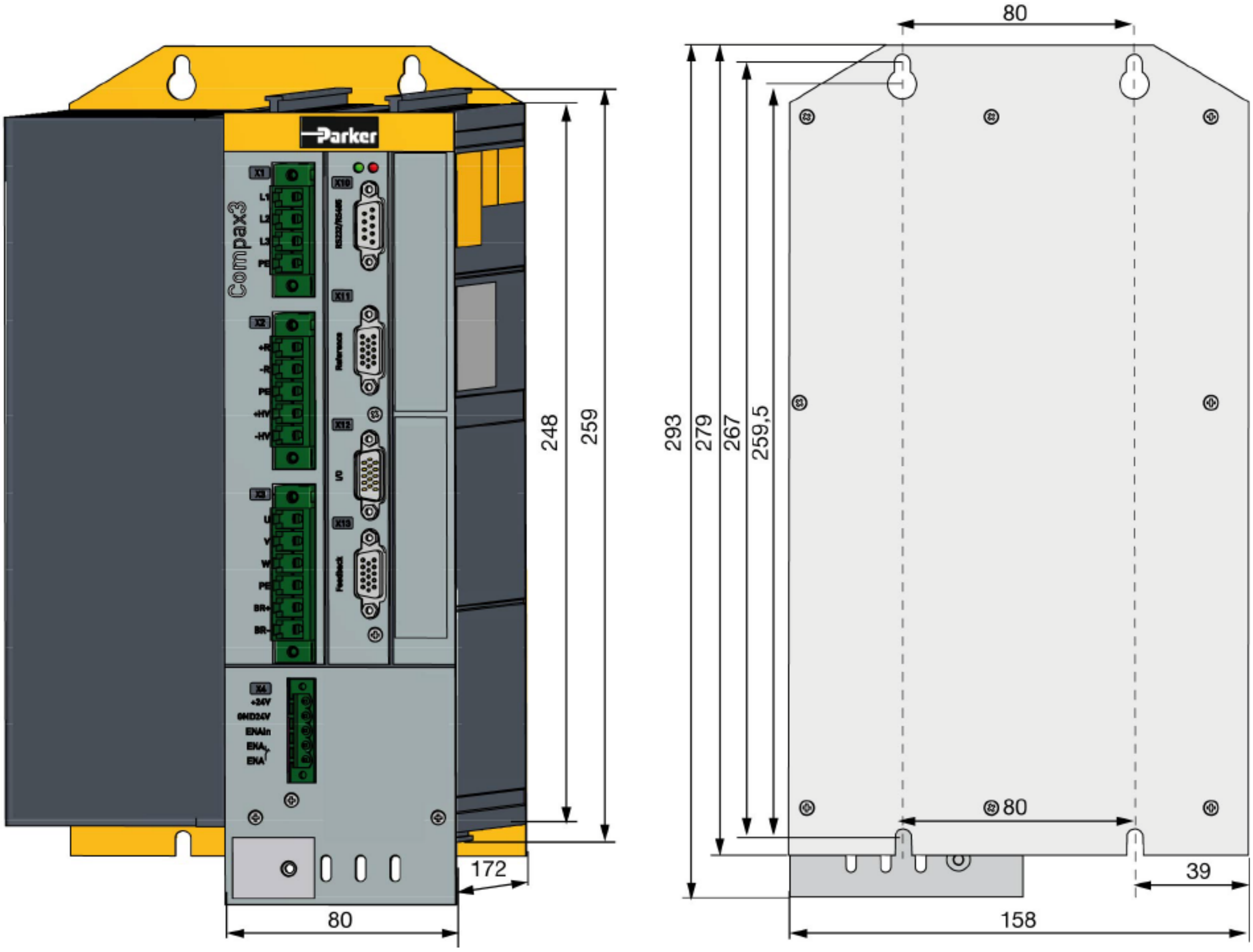
Please respect an appropriate mounting gap in order to ensure sufficient convection:

- ◆ At the side: 15mm
- ◆ At the top and below: at least 100mm

3.9.1.3 Mounting and dimensions Compax3S150V2 and S150V4

Mounting:

4 socket head screws M5



Stated in mm

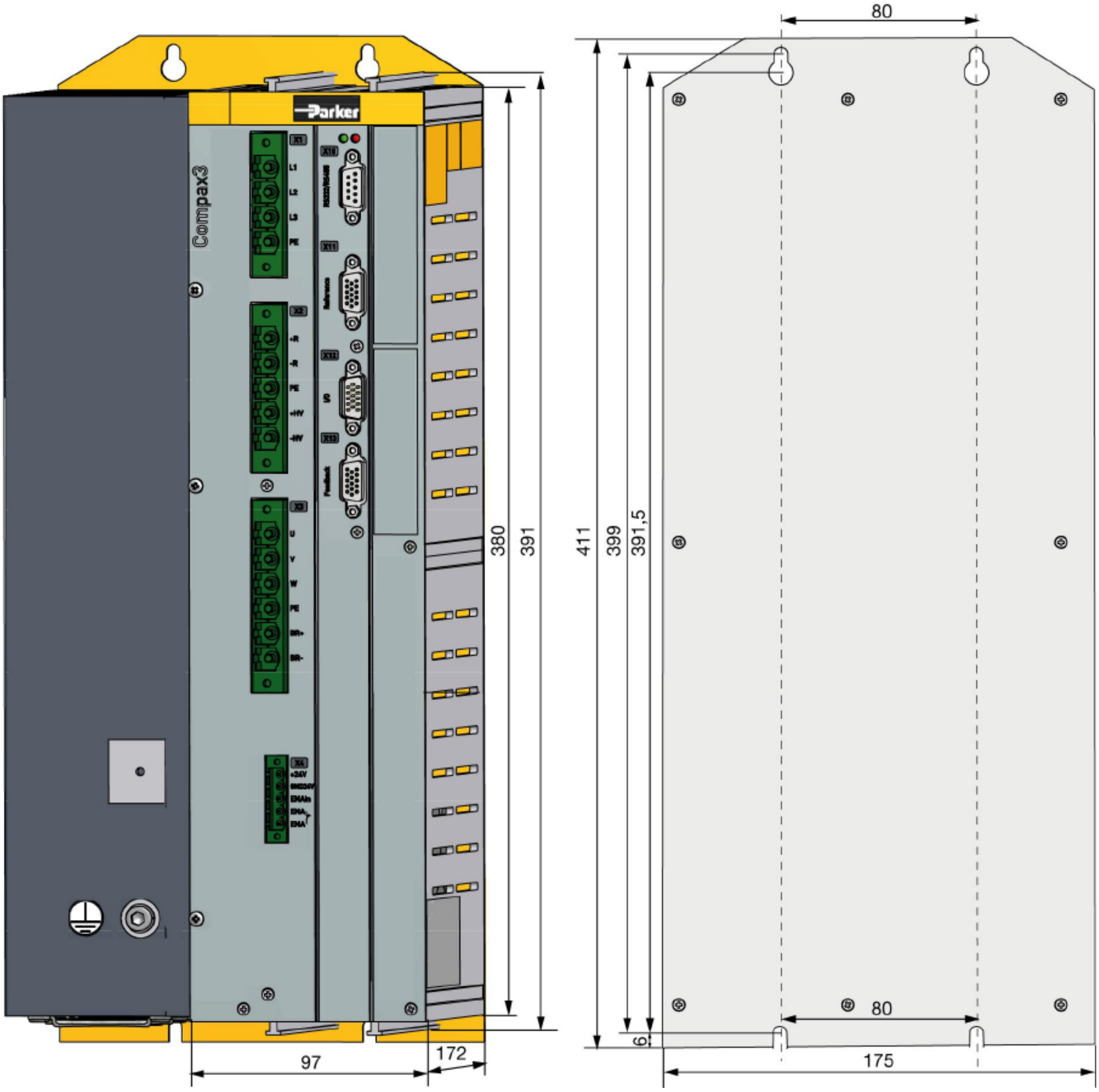
Please respect an appropriate mounting gap in order to ensure sufficient convection:

- At the side: 15mm
- At the top and below: at least 100mm

3.9.1.4 Mounting and dimensions Compax3S300V4

Mounting:

4 socket head screws M5



Stated in mm

Please respect an appropriate mounting gap in order to ensure sufficient convection:

- At the side: 15mm
- At the top and below: at least 100mm

Compax3S300V4 is force-ventilated via a fan integrated into the heat dissipator!

3.9.2. Mounting and dimensions PSUP/C3M

Ventilation: During operation, the device radiates heat (power loss). Please provide for a sufficient mounting distance below and above the device in order to ensure free circulation of the cooling air. Please do also respect the recommended distances of other devices. Make sure that the mounting plate is not exhibited to other temperature influences than that of the devices mounted on this very plate. The devices must be mounted vertically on a level surface. Make sure that all devices are sufficiently fixed.

3.9.2.1 Mounting and dimensions PSUP10/C3M050D6, C3M100D6, C3M150D6

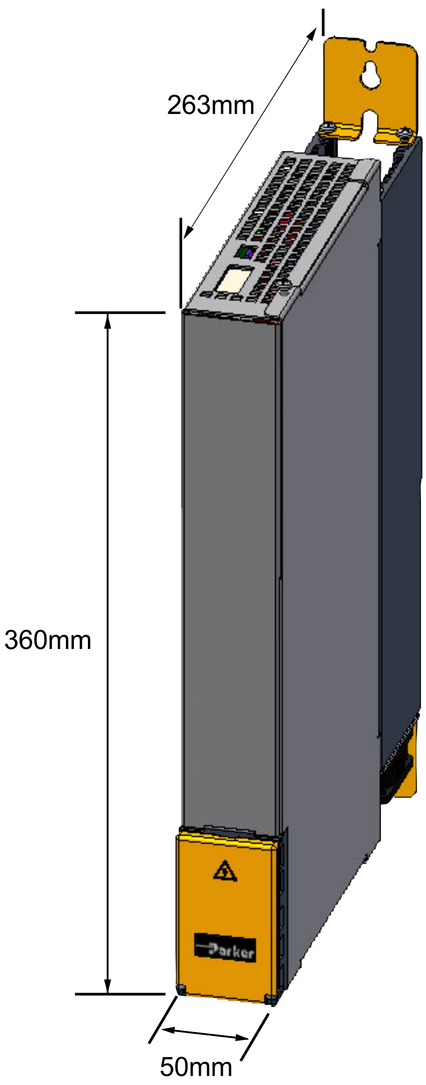
The devices are force-ventilated via a ventilator fan fixed to the lower part of the heat dissipator!

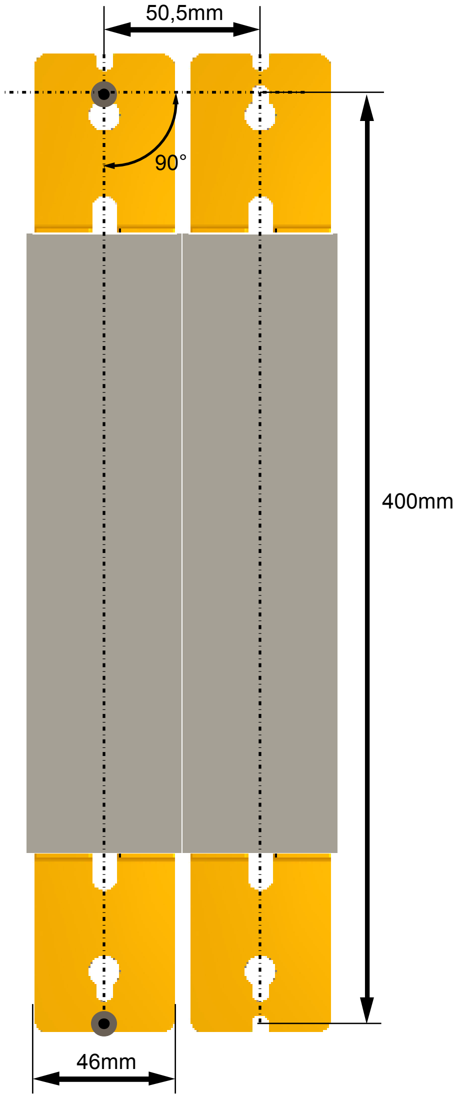
Mounting spacing: At the top and below: at least 100mm

Information on PSUP10D6/C3M050D6, C3M100D6, C3M150D6

Mounting:

2 socket head screws M5





Tolerances: DIN ISO 2768-f

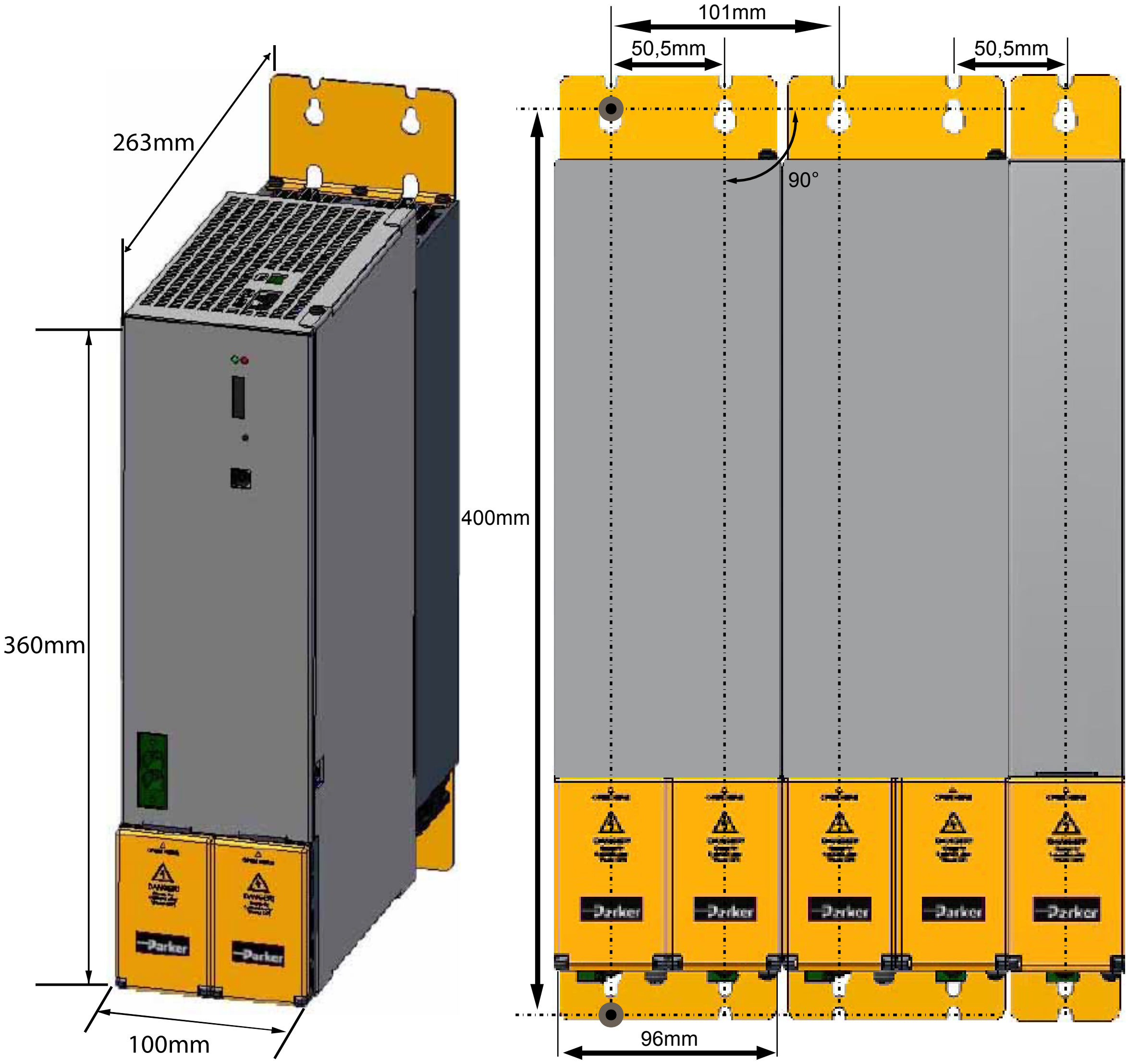
3.9.2.2 Mounting and dimensions PSUP20/PSUP30/C3M300D6

Information on

PSUP20/PSUP30/C3M300D6

Mounting:

4 socket head screws M5

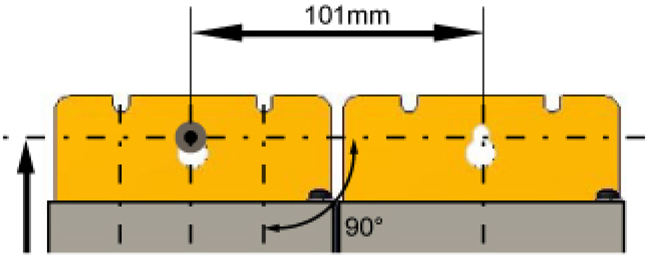


Tolerances: DIN ISO 2768-f

3.9.2.3 With upper mounting, the housing design may be different

Mounting:

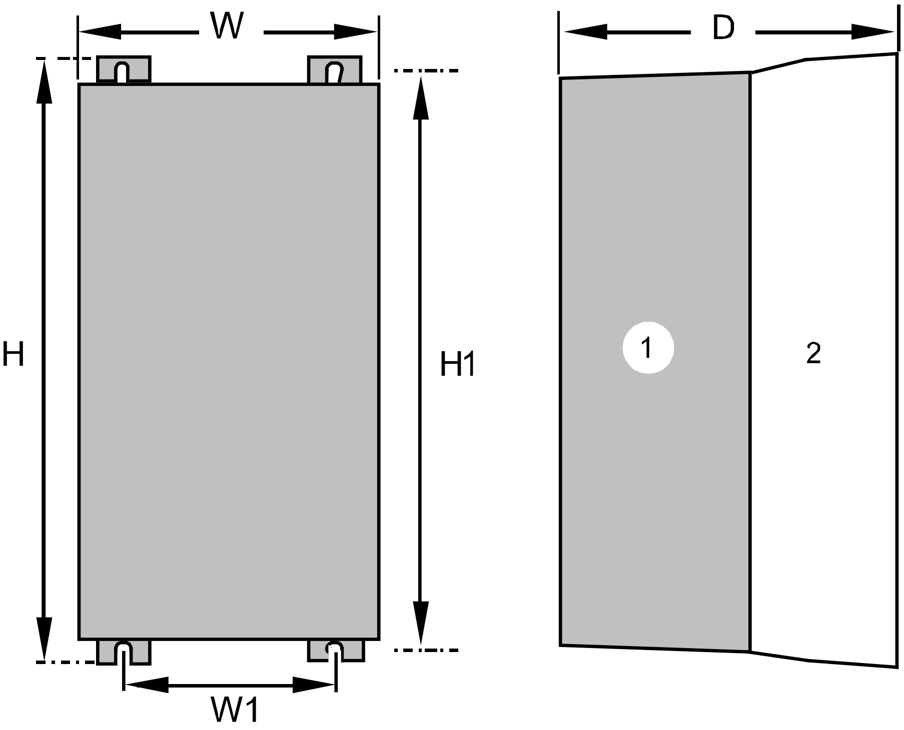
3 socket head screws M5



3.9.3. Mounting and dimensions C3H

The devices must be mounted vertically on a level surface in the control cabinet.

Dimensions:



(1): Electronics
(2): Head dissipator

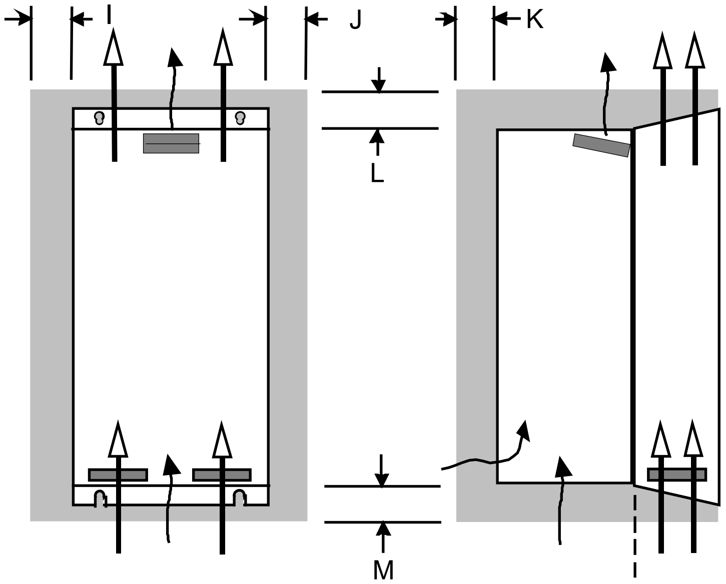
	H	H1	D	W	W1
C3H050V4	453mm	440mm	245mm	252mm	150mm
C3H090V4	668.6mm	630mm	312mm	257mm	150mm
C3H1xxV4	720mm	700mm	355mm	257mm	150mm

Mounting:4 screws M6

Ventilation: During operation, the device radiates heat (power loss). Please provide for a sufficient mounting distance below and above the device in order to ensure free circulation of the cooling air. Please do also respect the recommended distances of other devices. Make sure that the mounting plate is not exhibited to other temperature influences than that of the devices mounted on this very plate.

If two or more devices are combined, the mounting distances are added.

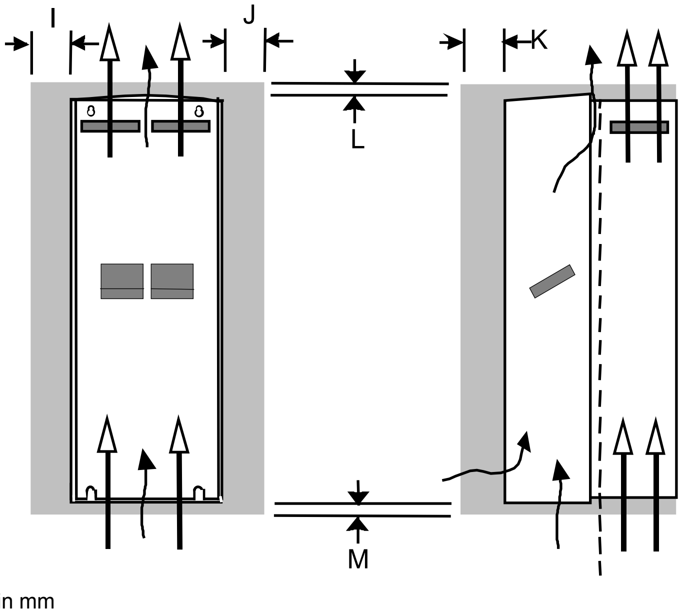
3.9.3.1 Mounting distances, air currents Compax3H050V4



in mm

	I	J	K	L	M
C3H050V4	15	5	25	70	70

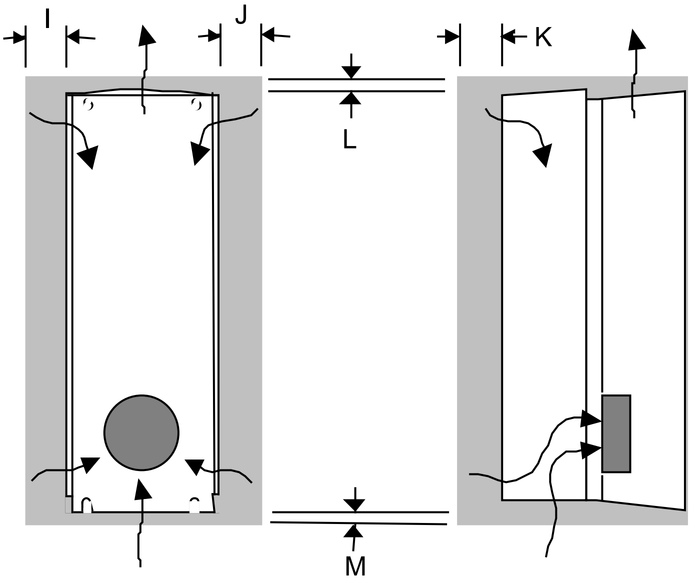
3.9.3.2 Mounting distances, air currents Compax3H090V4



in mm

	I	J	K	L	M
C3H090V4	0	0	25	70	70

3.9.3.3 Mounting distances, air currents Compax3H1xxV4



in mm

	I	J	K	L	M
C3H1xxV4	0	0	25	70	70

3.10 Safety function - STO (=safe torque off)

In this chapter you can read about:

3.10.1. General Description

In this chapter you can read about:

The present documentation assumes a basic knowledge of our drive controllers as well as an understanding of safety-oriented machine design. References to standards and other regulations are only rudimentarily expressed.

For complementary information, we recommend the respective technical literature.

3.10.1.1 Important terms and explanations

Term	Explanation
Safety category 3 in accordance with EN ISO 13849-1	Definition according to standard: Circuit with safety function against individual errors. Some, but not all errors are detected. An accumulation of errors may lead to a loss of the safety function. The remaining risk is accepted. The determination of the safety category required for an application (risk analysis) lies within the responsibility of the machine manufacturer. It can take place according to the method described in EN ISO 13849-1, appendix A.
"Safe torque off" **or abbreviated:** **STO=Safe torque off**	With the "safe torque off", the energy supply of the drive is safely interrupted according to EN 1037, paragraph 4.1. The drive is not to be able to produce a torque and thus dangerous movements (see EN 1037, paragraph 5.3.1.3). The standstill position must not be monitored. If an external force effect, e.g. a drop of hanging loads, is possible with the "safe torque off", additional measures to safely prevent those must be provided (e.g. additional mechanical brakes). The following measures are appropriate for a "safe torque off": Contactor between mains and drive system (mains contactor) Contactor between power section and motor (motor contactor) Safe blocking of the power semiconductor control (start inhibitor)
Start inhibitor	Safe blocking of the power semiconductor control. With the aid of this function, you can obtain a "safe torque off".

Stop categories according to EN60204-1 (9.2.2)

Stop category	Safety function	Requirement	System behavior	Remark
0	Safe torque off (STO)	Stopping by immediately switching off the energy supply of the machine drive elements	Uncontrolled stop	Uncontrolled stop is the stopping of a machine movement by switching off the energy of the machine drive elements. Available brakes and/or other mechanical stopping components are applied.
1	Safe stop 1 (SS1)	Stop where the energy of the machine drive elements is maintained in order to reach a stop. The energy supply is only interrupted, if the standstill is attained.	Controlled stop	Controlled stop is the stopping of a machine movement by for instance resetting the electrical command signal to zero, as soon as the stop signal has been detected by the controller, the electrical energy for the machine drive elements remains however during the stopping procedure.
2	Safe stop 2 (SS2)	Stop where the energy to the machine drive elements is maintained.	Controlled stop	This category is not covered.

3.10.1.2 Intended use

The Compax3 drive controller supports the "safe torque off" (STO) safety function, with protection against unexpected startup according to the requirements of EN ISO 13849-1, category 3 to PLe and EN 1037.

Together with the external safety control device, the "safe stop 1" (SS1) safety function according to the requirements of EN ISO 13849-1 category 3 can be used. As the function is however realized with the aid of an individually settable time delay on the safety switching device, you must take into account that, due to an error in the drive system during the active braking phase, the axis trundles to a stop unguided or may even accelerate actively in the worst case until the expiry of the preset switch-off time.

According to a risk evaluation which must be carried out according to the machine standard 98/37/EG and 2006/42/EG or EN ISO 12100, EN ISO 13849-1 and EN ISO 14121-1, the machine manufacturer must project the safety system for the entire machine including all integrated components. This does also include the electrical drives.

Qualified personnel

Projecting, installation and setup require a detailed understanding of this description.

Standards and accident prevention regulation associated with the application must be known and respected as well as risks, protective and emergency measures.

3.10.1.3 Advantages of using the "safe torque off" safety function.

Safety category 3 in accordance with EN ISO 13849-1

Requirements performance feature	Use of the safe torque off function	Conventional solution: Use of external switching elements
Reduced switching overhead	Simple wiring, certified application examples Grouping of drive controllers on a mains contactor is possible.	Two safety-oriented power contactors in series connection are required.
Use in the production process High operating cycles, high reliability, low wear	Extremely high operating cycles thanks to almost wear-free technology (low-voltage relay and electronic switch). The "safe torque off" status is attained due to the use of wear-free electronic switches (IGBTs).	This performance feature cannot be reached with conventional technology.
Use in the production process High reaction speed, fast restart	Drive controller remains performance- and control-oriented in connected state. No significant waiting times due to restart.	When using power contactors in the supply, a long waiting time for the energy discharge of the DC link circuit is required. When using two power contactors on the motor side, the reaction times may increase, you must however take into consideration other disadvantages: a) Securing that switching takes only place in powerless state (Direct current! Constant electric arcs must be prevented). b) Increased overhead for EMC conform wiring.
Emergency-stop function	According to the German version of the standard: Permitted without control of mechanical power switching elements 1)	Switch-off via mechanical switching elements is required

1) According to the preface of the German version of the EN 60204-1/11.98, electronic equipment for emergency-stop devices are also permitted, if they comply with the safety categories as described in EN ISO 13849-1.

3.10.1.4 Devices with the STO (=safe torque off) safety function

Safety function - STO (=safe torque off:

Compax3 technology function

- I10T10, I11T11, I12T11
- I11T30, I20T30, I21T30, I22T30, I30T30, I31T30, I32T30,
  I11T40, I20T40, I21T40, I22T40, I30T40, I31T40, I32T40
- I20T11, I21T11, I22T11, I30T11, I31T11, I32T11
- C10T11, C10T30, C10T40,
  C13T11, C13T30, C13T40,
  C20T11, C20T30, C20T40

with the device power / series

S025V2, S063V2, S100V2, S150V2, S015V4, S038V4, S075V4, S150V4, S300V4

M050D6, M100D6, M150D6, M300D6,

and is only valid with the stated conditions of utilization.

3.10.2. STO (= safe torque off) with Compax3S

In this chapter you can read about:

3.10.2.1 STO Principle (= Safe Torque Off) with Compax3S

To ensure safe protection against a motor starting up unexpectedly, the flow of current to the motor and thus to the power output stage must be prevented.

This is accomplished for Compax3S with two measures independent of each other (Channel 1 and 2), without disconnecting the drive from the power supply:

Channel 1:

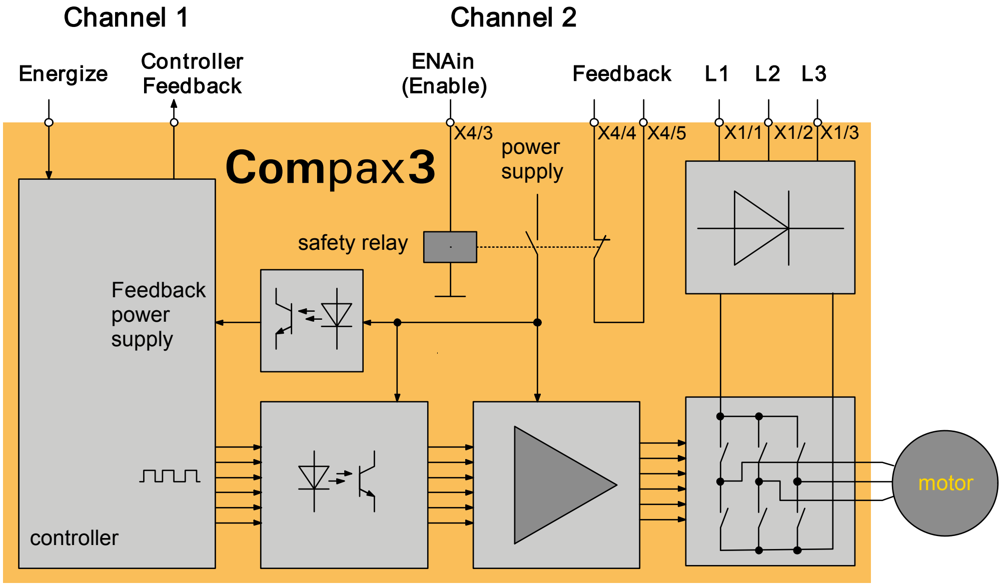
Activation of the power output stage can be disabled in the Compax3 controller by means of a digital input or with a fieldbus interface (depending on the Compax3 device type) (deactivation of the energize input).

Channel 2:

The power supply for optocouplers and drivers of power output stage signals is disconnected by a safety relay activated by the enable input "ENAin"(X4/3) and equipped with force-directed contacts. This prevents control signals from being transferred to the power output stage.

The STO (= Safe Torque Off) safety function in accordance with EN ISO 13849-1: 2008 PLd or PLe, Kat.3 is only possible when using both channels via an external safety switching device
Please note the application examples!

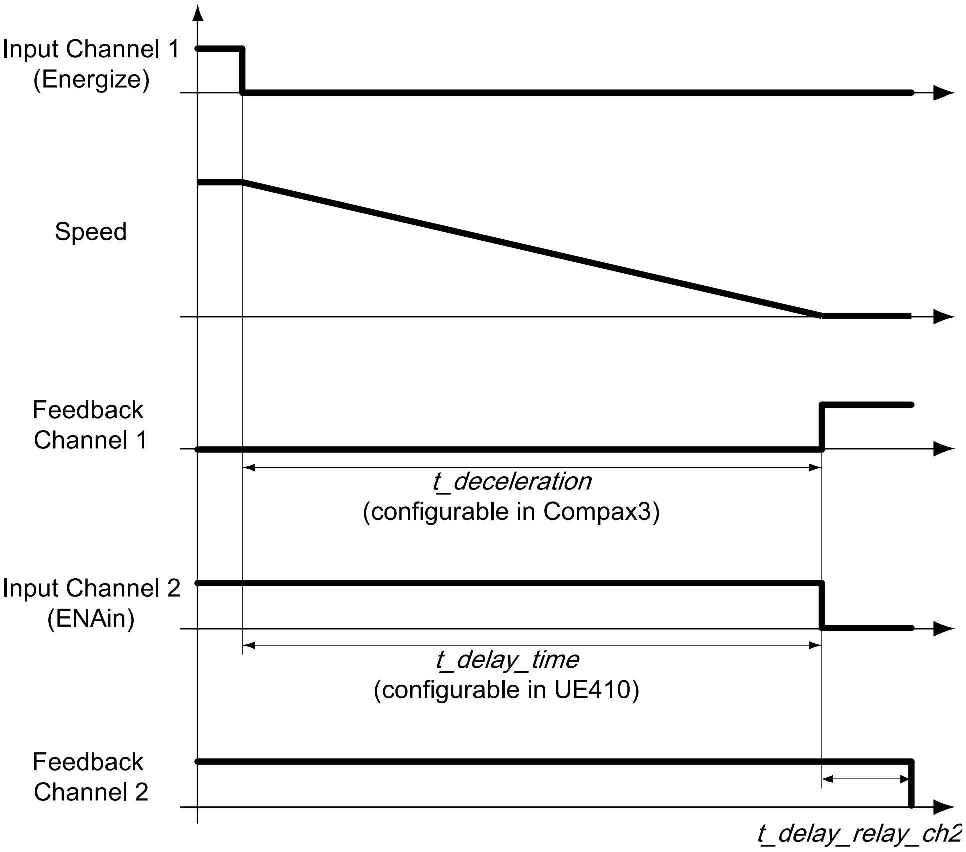
Circuit diagram illustrating working principle:



Notes

- In normal operation of Compax3, 24VDC of power is supplied to the "Enable" input (X4/3). The control of the drive takes then place via the digital inputs/outputs or via the fieldbus.

STO delay times



The deceleration time *t_deceleration* depends on the configuration of the Compax3. It must be configured so that oscillation free bringing to standstill is possible, depending on the mechanical load. The delay time *t_delay_time* must be set in the safety control device UE410 so that *t_delay_time* > *t_deceleration*.

Only after the elapsing of the relay delay *t_delay_relay_ch2*, the STO function is completely activated. The relay delay time *t_deay_relay_ch2* is 15 ms.

3.10.2.2 Conditions of utilization STO (=safe torque off) Safety function

- STO can only be implemented in Compax3 with a corresponding safety switching device considering the application examples.
- Safety functions must be tested 100%.
- The Compax3S and the safety switching device used must be mounted in a protected way (IP54 mounting cabinet).
- Only qualified staff members are permitted to install the STO (=safe torque off) function and place it in service.
- For all applications in which the first channel of the “Safe torque off” is implemented by means of a PLC, care must be taken that the part of the program that is responsible for current flowing to or not flowing to the drive is programmed with the greatest possible care. The Safe Torque off application example of Compax3 with fieldbus should be considered.
  The designer and operator responsible for the system and machine must refer programmers who are involved to these safety-related points.
- Terminal X4/2 (GND 24 V and at the same time the reference point for the safety relay bobbin) must be connected with the PE protective lead. This is the only way to ensure protection against incorrect operation through earth faults (EN60204-1 Section 9.4.3)!
- All conditions necessary for CE-conform operation must be observed.
- When using an external safety switching device with adjustable delay time, (as illustrated in the STO application example), it must be ensured that the delay time cannot be adjusted by persons not authorized to do so (for example by applying a lead seal). With the UE410-MU3T5 safety switching device, this is not necessary, if the anti manipulation measures are respected.
- The adjustable delay time on the safety switching device must be set to a value greater than the duration of the braking ramp controlled by the Compax3 with maximum load and maximum speed.
  If the setting range for the specified Emergency power-off module is not sufficient, the Emergency power-off module must be replaced by another equivalent module.
- All safety-related external leads (for example the control lead for the safety relay and feedback contact) must absolutely be laid so they are protected, for example in a cable duct. Short circuits and crossed wires must be reliably excluded!
- If there are external forces operating on the drive axes, additional measures are required (for example additional brakes). Please note in particular the effects of gravity on suspended loads!

3.10.2.3 Notes on the STO function

- It should be noted in connection with the STO (= safe torque off) application example illustrated here that after the Emergency stop switch has been activated, no galvanic isolation in accordance with EN 60204-1 Section 5.5 is guaranteed. This means that the entire system must be disconnected from the mains power supply with an additional main switch or mains power contactor for repair jobs. Please note in this regard that even after the power is disconnected, dangerous electrical voltages may still be present in the Compax3 drive for about 10 minutes.
- During the active braking phase of Stop category 1 (controlled bringing to a stop with safely monitored delay time according to EN60204-1) or safe stop 1, faulty function must be expected. If an error in the drive system or mains failure occurs during the active braking phase, the axis may trundle to a stop unguided or might even actively accelerate until the expiry of the defined switch-off time.
- Please note that the control of the drive via Energize (Energize input or fieldbus interface) is not executed in all operating conditions. The following restrictions apply when the set-up window of the C3 ServoManager is used:
  - If the setup mode is switched on, the fieldbus interface and the energize input are blocked.
  - the energize input can be ignored if the input simulator is activated (depending on the settings).

Note on error switch-off

If the "safe torque off" function of Compax3 is required or used for a machine or system, the two errors:

- “Motor_Stalled” (Motor stalled) and
- “Tracking” (following error)

are not to be switched off **(see on page 149, see on page 442, see on page 441, see on page 151).**

3.10.2.4 STO application example (= safe torque off)

In this chapter you can read about:

The application example described here corresponds to Stop Category 1 as defined by EN60204-1.

Together with the external safety switching device, the "Safe Stop 1”(SS1) safety function can also be implemented.

A Stop Category 0 in accordance with EN 60204-1 can be implemented, for example by setting the delay time on the Emergency power-off module as well as on the Compax3 (delay time for “switch to currentless”) to 0. The Compax3M will then be turned off immediately in 2 channels and will therefore not be able to generate any more torque. Please take into consideration that the motor will not brake and a coasting down of the motor may result in hazards. If this is the case, the STO function in stop category 0 is not permitted.

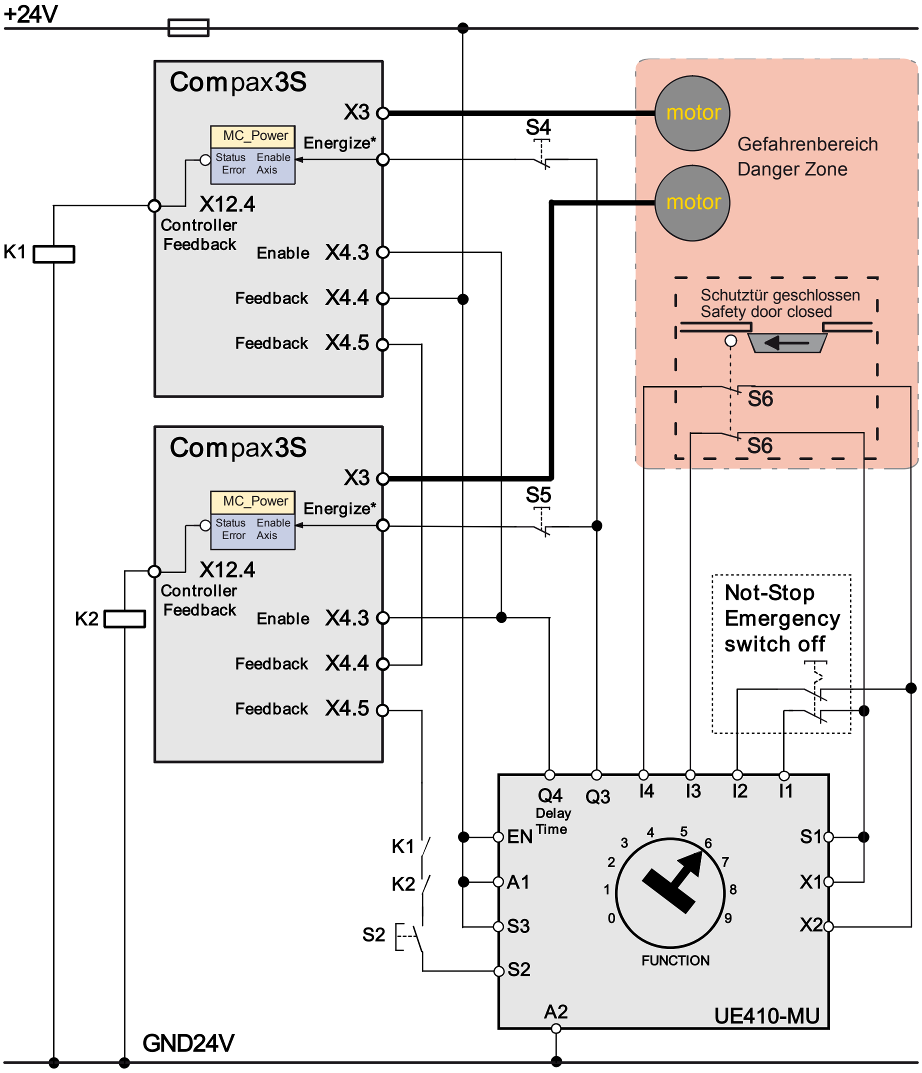
Safe torque off without bus option

In this chapter you can read about:

Circuit layout overview

- 2 Compax3 devices (the circuit example is also valid for one or multiple devices, if it is adapted accordingly)
- 1 Emergency Power-off module (UE410-MU3T5 manufactured by Sick)
  With adjustable delayed deactivation of the Compax3 enable input ENAin.
  The time must be set so that all axes are at a standstill before the Compax3 controllers are deactivated.
- The operating instructions of the UE410-MU3T5 safety switching device must be observed.
- 1 emergency power-off switch
- Hazardous area accessible via a safety door with safety door switch S6.
- 1 pushbutton per Compax3
- For the Energize input on Compax3, a debouncing time > 3 ms must be configured
- 1 relay per Compax3
  The relay must be dimensioned so that it has a lifetime of at least 20 years, taking the cycle time into consideration. If this is not the case, the relays must be exchanged for new relays after expiration of the lifetime.

Circuit:



*Energize = I0 (X12/6) (debounced digital input)

Instead of the safety switching device manufactured by Sick mentioned above, you may use other safety switching devices.

The safety switching device must however provide the following features:

- 1 normally open contact is required for switching off channel 1 (as an alternative, a safe semiconductor output is possible)
- 1 off-delayed normally open safety contact is required for switching off channel 2 (as an alternative, a safe semiconductor output with adjustable delay time for the high_to_low_edge is possible).
- 1 one-channel monitoring circuit where the feedback contacts of channels 1 and 2 can be integrated for simultaneous monitoring, is required.
  At the same time it must be possible to integrate a one-channel start button for activation of the safety switching device into the circuit.
  A new start may only be successful, if it is ensured, that channels 1 and 2 are switched off.
- 1 two-channel connection for emergency power off and/or safety door contacts with cross fault monitoring is required.
- The safety switching device must feature performance PL e. The I/Os must at least correspond to category 3.

Switches and buttons:

1 N/C (S4, S5) per device:	Guide Device to a currentless state
S6:	closed when the safety door is closed
S2:	Activate safety switching device

Caution!

Module UET410-MU3T5 modulates regularly test switching signals (OSSD) on outputs Q3 and Q4.
We recommend to use a filter > 3 ms for signal Q3 in the PLC.

Safe torque off description

In this chapter you can read about:

In this chapter you can read about:

Safe torque off basic function

Compax3 devices disabled by:

Channel 1: Energize input to “0” by safety switching device output Q3

Channel 2: Enable input ENAin to “0” by safety switching device output Q4

Activate safety switching device

Before the Compax3 can be placed into operation, the safety switching device must be activated by a pulse to Input S2.

Prerequisite:

- S2 closed
- Safety door closed
- K1 and K2 energized
  - K1: receives current if Compax3 Device 1 is currentless (output = "1" in currentless state) = Channel 1 feedback
  - K2: receives current if Compax3 device 2 is currentless (output = “1” in the currentless state) = channel 1 feedback
- The feedback contact of all Compax3 devices must be closed (channel 2).

Energize Compax3 (Motor and power output stage)

- With the safety switching device, the Compax3 devices are enabled via the energize input and the Enable input ENAin. (If an error is still present in the Compax3, it must be acknowledged - the ackn function depends on the Compax3 device type)
- The motors are energized with current.

Summary: Compax3 is only energized if the feedback functions are capable of functioning via two channels.

Access to the hazardous area

Actuate emergency power-off switch

Due to the interruption on two channels at the emergency power-off switch, the safety switching device is deactivated - output Q3 is immediately “0”.

Channel 1: Via the Energize input, the Compax3 devices receive the command to guide the drive to a currentless state (using the ramp configured in the C3 ServoManager for "drive disable").

Channel 1 feedback 1: The "Controller Feedback" Compax3 outputs supply current to Relays K1 and K2.

Channel 2: After the delay time set in the safety switching device, (this time must be set so that all drives are stopped after it has elapsed) the output Q4 = “0”, which in turn deactivates the Enable inputs ENAin of the Compax3 devices.

Channel 2 feedback: Via the series circuit of all feedback contacts, the “Safe Torque-off” status (all Compax3 devices without current) is reported.

Only if the drives are all at a standstill, the safety door may be opened and the hazardous area may be accessed.

If the safety door is opened during operation and the emergency-power-off switch was not triggered before, the Compax3 drives will also trigger the stop ramp.

Caution! The drives may still move.

If danger to life and limb of a person entering cannot be excluded, the machine must be protected by additional measures (e.g. a safety door locking).

Safe torque off with bus option

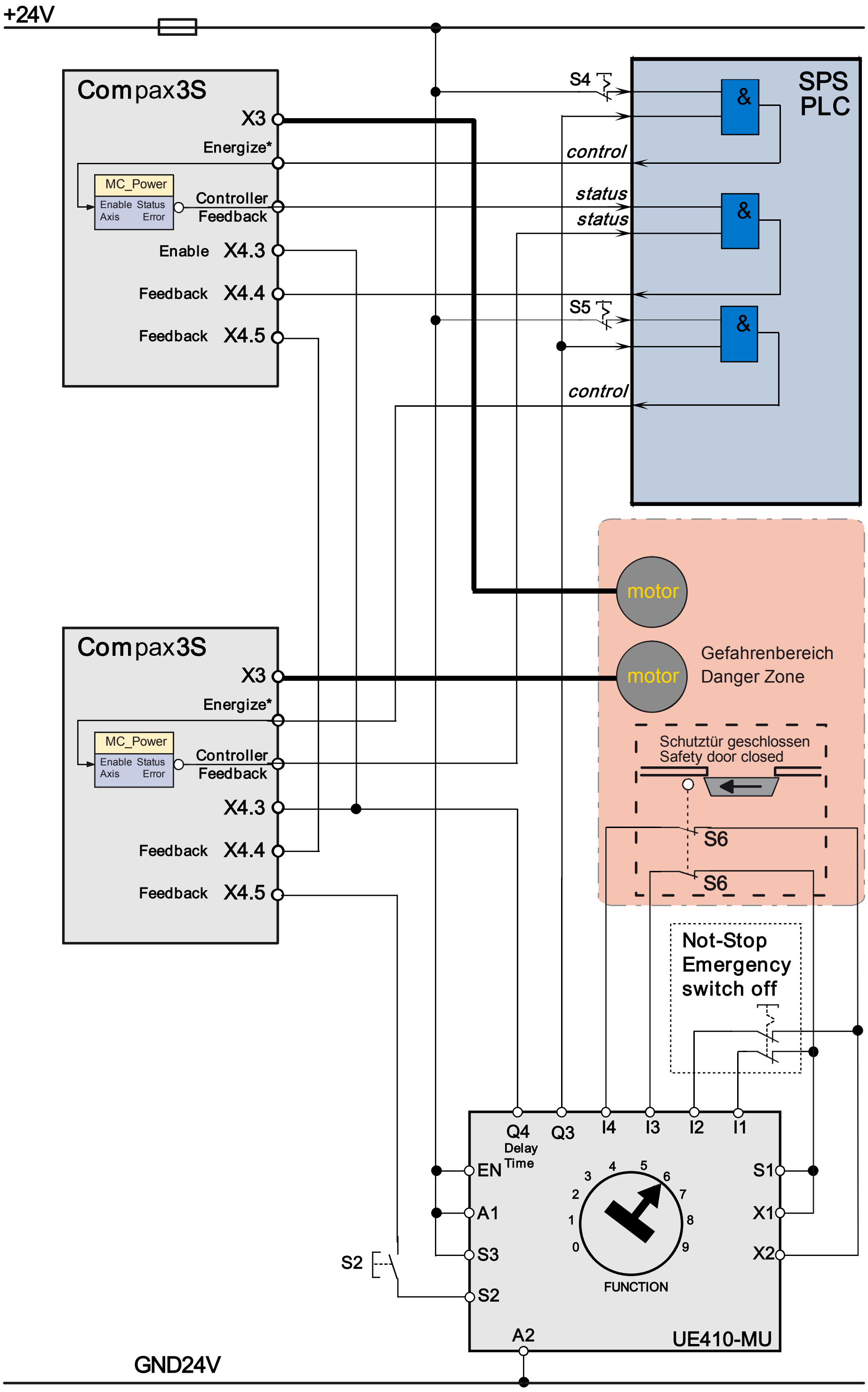
In this chapter you can read about:

Safe torque off layout with bus

- 2 Compax3 devices (the circuit example is also valid for one or multiple devices, if it is adapted accordingly)
- 1 Emergency Power-off module (UE410-MU3T5 manufactured by Sick)
  With adjustable delayed deactivation of the Compax3 enable input ENAin.
  The time must be set so that all axes are at a standstill before the Compax3 controllers are deactivated.
- The operating instructions of the UE410-MU3T5 safety switching device must be observed.
- 1 emergency power-off switch
- Hazardous area accessible via a safety door with safety door switch S6.
- 1 pushbutton per Compax3

Circuit:

Designation	Bus device I20	additional bus devices
control:	Control word CW	Controlword
status:	Status word SW	Status word



* Energize: free selection in the “control”

Controller Feedback Option: free choice in “status”

Instead of the safety switching device manufactured by Sick mentioned above, you may use other safety switching devices.

The safety switching device must however provide the following features:

- 1 normally open contact is required for switching off channel 1 (as an alternative, a safe semiconductor output is possible)
- 1 off-delayed normally open safety contact is required for switching off channel 2 (as an alternative, a safe semiconductor output with adjustable delay time for the high_to_low_edge is possible).
- 1 one-channel monitoring circuit where the feedback contacts of channels 1 and 2 can be integrated for simultaneous monitoring, is required.
  At the same time it must be possible to integrate a one-channel start button for activation of the safety switching device into the circuit.
  A new start may only be successful, if it is ensured, that channels 1 and 2 are switched off.
- 1 two-channel connection for emergency power off and/or safety door contacts with cross fault monitoring is required.
- The safety switching device must feature performance PL e. The I/Os must at least correspond to category 3.

Switches and buttons:

1 N/C (S4, S5) per device:	Guide Device to a currentless state
S6:	closed when the safety door is closed
S2:	Activate safety switching device

Caution! Module UET410-MU3T5 modulates regularly test switching signals (OSSD) on outputs Q3 and Q4.
We recommend to use a filter > 3 ms for signal Q3 in the PLC.

Safe torque off description

Basic functions:

Compax3 devices disabled by:

Channel 1: Energize deactivated by PLC and safety switching device output Q3.

Channel 2: Enable input to “0” by safety switching device output Q4.

Activate safety switching device

Before the Compax3 can be placed into operation, the safety switching device must be activated by a pulse to Input S2.

Prerequisite:

- S2 closed
- Safety door closed: only then the safety door monitor will enable the safety switching device on two channels
- Feedback activated via PLC (Controller feedback channel 1: motor not energized)
- The feedback contact of all Compax3 devices must be closed (channel 2).

Energize Compax3 (Motor and power output stage)

- The PLC enables the Compax3 devices by means of the control word and the safety switching device enables the Compax3 devices by means of the Enable input. (If an error is still present on the Compax3, it must be acknowledged before)
- The motors are energized with current.

Summary: Compax3 is only energized if the feedback functions are capable of functioning via two channels.

Access to the hazardous area

Actuate emergency power-off switch

Due to the interruption on two channels at the emergency stop switch, the safety switching device is deactivated - output Q is immediately “0”.

The PLC evaluates this and responds as follows:

Channel 1: The Compax3 devices receive via the control word the command to guide the drive to currentless state (vi the ramp for "deenergizing" configured in the C3 ServoManager).

Channel 1 feedback: The Compax3 feedback via the status word is evaluated by the PLC and passed on to the safety switching device via the Compax3 Feedback (X4.4 and X4.5).

Channel 2: After the delay time set in the safety switching device, (this time must be set so that all drives are stopped after it has elapsed) the output Q4 = “0”, which in turn deactivates the Enable inputs ENAin of the Compax3 devices.

Channel 2 feedback: Via the series circuit of all feedback contacts, the “Safe Torque-off” status (all Compax3 devices without current) is reported.

Only if the drives are all at a standstill, the safety door may be opened and the hazardous area may be accessed.

If the safety door is opened during operation and the emergency-power-off switch was not triggered before, the Compax3 drives will also trigger the stop ramp.

Caution! The drives may still move.

If danger to life and limb of a person entering cannot be excluded, the machine must be protected by additional measures (e.g. a safety door locking).

3.10.2.5 Technical Characteristics STO Compax3S

Safety technology Compax3S

Safe torque-off in accordance with EN ISO 13849: 2008, Category 3, PL d/e Certified. **Test mark IFA 1003004**	◆ For implementation of the “protection against unexpected start-up” function described in EN1037. ◆ Please note the **circuitry examples** (see on page 92).

Compax3S STO (=safe torque off)

Nominal voltage of the inputs	24 V
Required isolation of the 24V control voltage	Grounded protective extra low voltage, PELV
Protection of the STO control voltage	1 A
Grouping of safety level	**STO switch-off via internal safety relay & digital input:** PL e, PFHd=2.98E-8 **STO switch-off via internal safety relay & fieldbus:** PL d, PFHd=1.51E-7 A MTTFd=15 of the external PLC and STO cycles/year < 500 000 are assumed.

3.10.3. STO (= safe torque off) with Compax3m (Option S1)

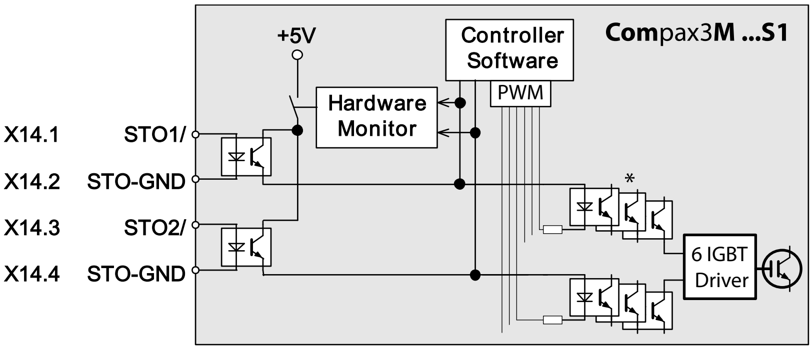
In this chapter you can read about:

3.10.3.1 Safety switching circuits

The current flow in the motor windings is controlled by a power semiconductor bridge (6-fold IGBT). A processor circuit and PWM circuit will switch the IGBT with rotary field orientation. Between control logic and power module, optocouplers are used for potential separation.

On the Compax3M drive controller with S1 option, the X14 (STO) connector can be found on the front plate. 2 optocouplers are controlled on two channels via the STO1/ and STO2/ terminals of this connector. When requesting the STO via an external safety switching device, the two auxiliary voltage supply channels of the power stage control circuits are switched off on two channels. Therefore the power transistors (IGBTs) for the motor current can not longer be switched on.

The hardware monitor detects the failure of the optocoupler circuit of a channel by always checking both channels for similarity. If the hardware monitor detects a discrepancy for a defined time (ax. 20s), the error will be stored in the hardware memory. The processor signals this error externally via the 0x5493 error code. An activation of the coupler supply can then only take place via a hardware reset (switching off and on again) of the device.



* Potential separation with optocoupler.

3.10.3.2 Safety notes for the STO function in the Compax3M

- It should be noted in connection with the STO application examples illustrated here that after the Emergency stop switch has been activated, no galvanic isolation in accordance with EN 60204-1 Section 5.5 is guaranteed. This means that the entire system must be disconnected from the mains power supply with an additional main switch or mains power contactor for repair jobs. Please note in this regard that even after the power is disconnected, dangerous electrical voltages may still be present in the Compax3 drive for about 10 minutes.
- During the active braking phase of Stop category 1 (controlled bringing to a stop with safely monitored delay time according to EN60204-1) or safe stop 1, faulty function must be expected. If an error in the drive system occurs during the active braking phase, the axis may trundle to an unguided stop or might even actively accelerate until the expiry of the defined switch-off time.
- For synchronous motors operated in the field weakening range, the operation of the STO function may lead to over speed and destructive, life-threatening over voltages as well as explosions in the servo drive. Therefore, NEVER use the STO function with synchronous drives in the field-weakening range.
- It is important to note that if the drive is being activated (Energize) by the USB / RS485 interface, it may not be possible to execute switch-off by a controlled braking ramp. For example, this is true when the set-up window of the C3 ServoManager is used. If set-up mode is turned on or with the input simulator, the digital I/O interface and fieldbus interface are automatically disabled.

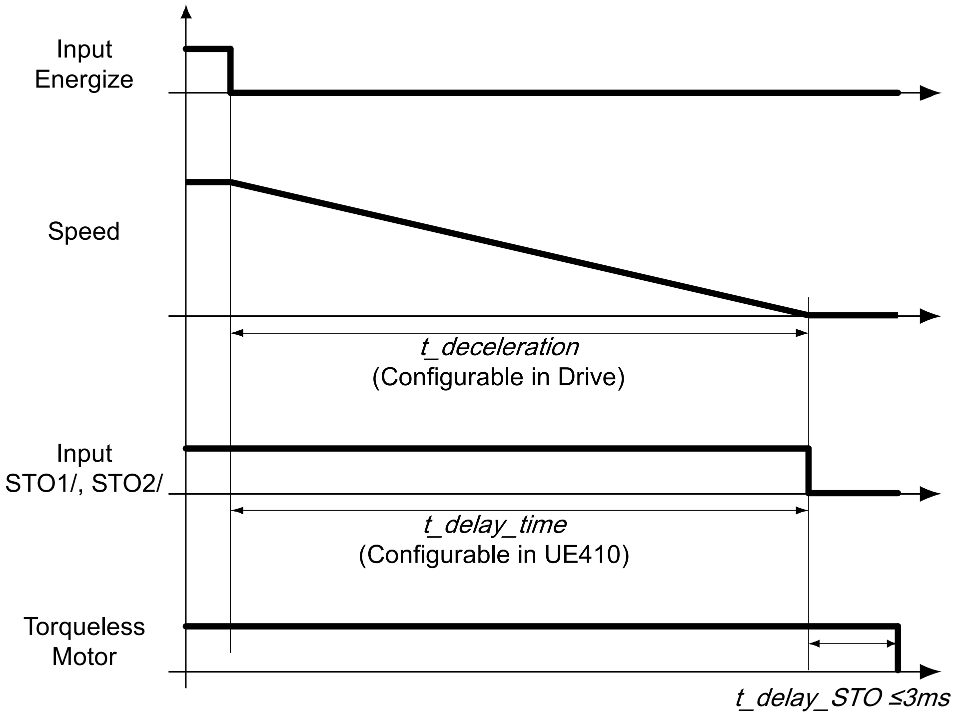
Maintenance

When using the S1 option, a protocol describing the orderly working of the safety function must be made upon the setup and in defined maintenance intervals (see protocol proposal).

3.10.3.3 Conditions of utilization for the STO function with Compax3M

- The STO safety function must be tested and protocoled **as described** (see on page 112). The safety function must be requested at least once a week. In safety door applications, the weekly testing interval must not be observed, as you can assume that the safety doors will be opened several times during the operation of the machine.
- The Compax3M with integrated STO safety function as well as the utilized safety switching devices must be mounted protected (IP54 control cabinet).
- Only qualified staff members are permitted to install the STO function and place it in service.
- The X9/2 (GND24V) terminal on the PSUPxx mains module must be connected to the PE protective lead. This is the only way to ensure protection against incorrect operation through earth faults (EN60204-1 Section 9.4.3)!
- When using an external safety switching device with adjustable delay time, (as illustrated in the STO application example), it must be ensured that the delay time cannot be adjusted by persons not authorized to do so (for example by applying a lead seal). With the UE410-MU3T5 safety switching device, this is not necessary, if the anti manipulation measures are respected.
- The adjustable delay time on the safety switching device must be set to a value greater than the duration of the braking ramp controlled by the Compax3 with maximum load and maximum speed.
- All conditions necessary for CE-conform operation must be observed.
- If there are external forces operating on the drive axes, additional measures are required (for example additional brakes). Please note in particular the effects of gravity on suspended loads! This must be respected above all for vertical axes without self-locking mechanical devices or weight balance.
- When using synchronous motors, a short movement over a small angle is possible, if two errors occur simultaneously in the power section. This depends on the number of pole pairs of the motor (rotary types: 2 poles = 180°, 4 poles = 90°, 6 poles = 60°, 8 poles = 45 °, Linear motors: 180° electrically).

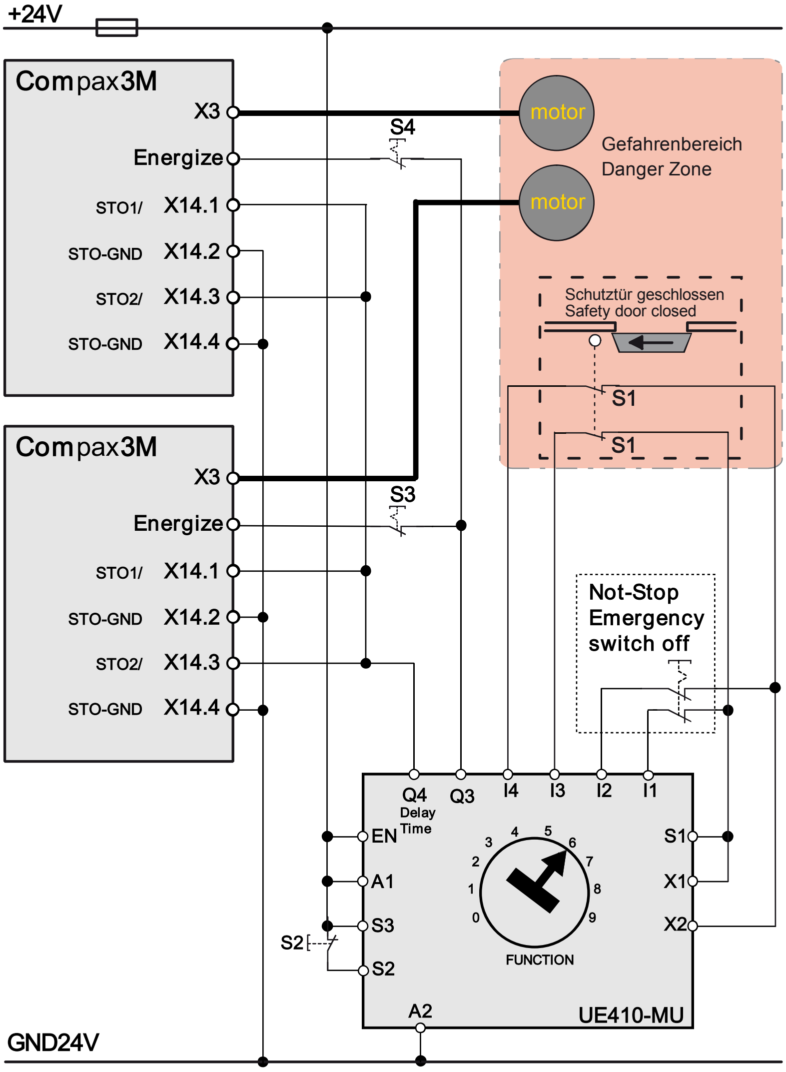
3.10.3.4 STO delay times



3.10.3.5 Compax3M STO application description

In this chapter you can read about:

STO function with safety switching device via Compax3M inputs



Recommendation Energize = I0 (X12/6) (debounceable digital input)

The acknowledgement S2 via the safety control UE410-MU3T5 is only necessary, if after the disabling of the STO function, a danger to any person or to the machine could arise by automatic starting. During the **Configuration des Compax3M** (see on page 146)you must see to a debouncing time >3ms being configured for the Energize input.

The operating instructions of the UE410-MU3T5 safety control must be observed.

The Compax3M devices and the UE410-MU3T5 safety control must be mounted in the same control cabinet.

1 N.C. (S3, S4) per device	Guide Device to a currentless state
S1	closed when the safety door is closed
S2	Activate safety switching device

STO function description

When opening the protective door or after actuating the emergency stop switch, the signal of the "energize" input of the Compax3M drive modules is interrupted via the Q3 output on the UE410-MU3T5 safety control. This triggers an immediate braking ramp on the drives. Then after the delay time set on the UE410-MU4T5 safety control, the STO function in the drives is triggered via the Q4 output. The servo drives are then in safe torqueless state. The delay time must be set on the safety control so that the braking ramp in the drives has run off and the drives are at standstill when the delay time has elapsed.

The described application example corresponds to the stop category 1 according to EN 60204-1. Together with the external safety switching device, the "Safe Stop 1" safety function can also be implemented.

A Stop Category 0 in accordance with EN 60204-1 can be implemented, for example by setting the delay time on the safety switching device to 0. The Compax3M will then be turned off immediately in 2 channels and will not be able to generate any more torque. Please take into consideration that the motor will not brake and a coasting down of the motor may result in hazards. If this is the case, the STO function in stop category 0 is not permitted.

Depending on the interface Ixx or technology function Txx of the Compax3M, the "energize" input can be a digital input or for instance a defined bit of a fieldbus control word (see the overview table below).

In the I10T10, I11T11, I12T11, I2xT11 and I3xT11 devices, the ackn input is assigned fixed.

Interface/Technology	**"Energize"**	**Ackn**
I10T10	Digital input I0 (X12/6)	I2 (X12/8)
I11T11	Digital input I2 (X12/8) (Energize & Ackn identical)	
I12T11	Digital input I0 (X12/6) (Energize & Ackn identical)	
I2xT11, I3xT11		
I2xT11, I3xT11	Applications with fieldbusses	
I11T30 and I11T40	Debounced digital input defined in the IEC program, which leads to the enable input of the MCpower function module	
I2xT30, I2xT40, I3xT30 and I3xT40	Bit defined in the IEC program (debounced digital input or via fieldbus) which is linked to the enable input of the MCpower function module	
C1xT30 and C1xT40 C20T30 and C20T40	Debounced digital input defined in the IEC program, which leads to the enable inputs of several MCpower function modules for different axes. The information is passed on to the individual axes via the CANbus.	

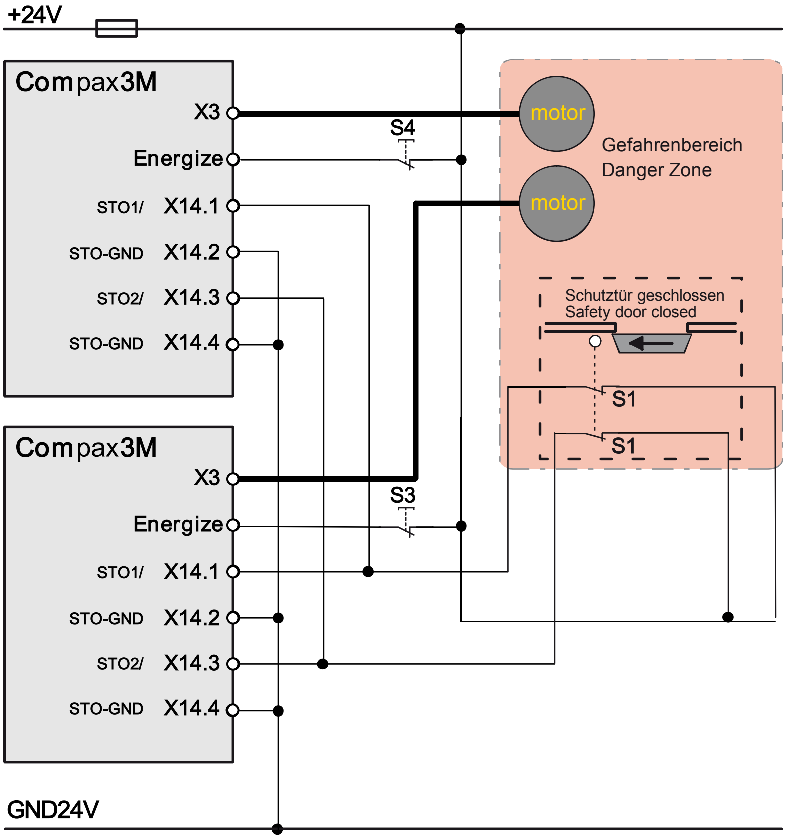
The acknowledement via the safety control UE410-MU3T5 is only necessary, if after the disabling of the STO function, a danger to any person or to the machine could arise due to automatic startup..

Emergency stop and protective door monitoring without external safety switching device.

With Compax3M, a 2-channel protective door monitoring switch or a 2 channel emergency power-off switch can be directly connected. The figure below visualizes an application with 2 channel protective door monitoring switch.

The Compax3M drive modules with PSUPxx mains rectifier must be located in a protected area (IP54 control cabinet). Outside this protected area, the line guiding to the external switches must be separated channelwise or must be especially protected (blinded).

It is also permitted to use one acknowledgement switch for both servo drives at a time. In both cases the acknowledgement does only correspond to category B, therefore this acknowledgement should not be used if there is any possibility of stepping in the dangerous area. In this case, an external acknowledgement device must be used.



3.10.3.6 STO function test

The STO function must be checked in the event of:

- Commissioning
- After each exchange of any equipment within the system
- After each intervention into the system wiring
- In defined maintenance intervals (at least once per week) and after a longer standstill of the machine
  If the STO function was triggered by opening a protective door and if this door is opened several times a week, the weekly testing interval is not required.

The check must be made by qualified personnel adhering to all necessary safety precautions.

The following testing steps must be performed:

STO Test	Action, activity	Expected reaction and effect
1	24V DC voltage on terminal X14.1 and X14.3	
2	Switch on power and 24V supply voltage	No error must be present
3	Configuring the device	No error must be present
4	Testing active STO on terminal X14.1 and X14.3: Remove 24V DC on terminal X14.1 and X14.3 at the same time	Error message 0x5492 must be present 1)
5	Re-apply 24V DC voltage on terminals X14.1 and X14.3 and then acknowledge error	No error must be present
6	Then switch off and on again 24V voltage supply	No error must be present

1) In order to automate the test, it is sufficient here to monitor the general error output with an external logic.

A manual check of the torqueless drive is here also sufficient.

The triggering of the STO can also be made by actuating the emergency stop switch. During the automated test, the STO can also be triggered via the contacts of an external relay

Following the test steps

The performance of the individual test steps of the STO function must be logged. A protocol specimen can be found in the following section.

Depending on the machine version, additional or other test steps may be required.

STO test protocol specimen

General information:

Project/machine: ______________________

Servo axis: ______________________

Name of the tester: ______________________

STO function test:

Test specification according to the Compax3 release: ______________________

STO function test steps 1-6: o successfully tested

Acknowledgement safety switching device: o successfully tested
o is not used

Safe stop 1: o successfully tested
o is not used

Initial acceptance on: ______________________

Repeat check on: ______________________

____
Signature of the tester

____
Signature of the tester

3.10.3.7 Technical details of the Compax3M S1 option

Safety technology Compax3M

Safe torque-off in accordance with EN ISO 13849-1: 2007, Category 3, PL=e Certified. Test mark MFS 09029	◆ Please respect the stated safety technology on the **type designation plate** (see on page 17) and the **circuitry examples** (see on page 106)

Compax3M S1 Option: Signal inputs for connector X14

Nominal voltage of the inputs	24V
Required isolation of the 24V control voltage	Grounded protective extra low voltage, PELV
Protection of the STO control voltage	1A
Number of inputs Signal inputs via optocoupler	2 Low = 0...7V DC or open High = 15...30V DC I_{in} at 24V DC: 8mA
STO1/	Low = STO activated High = STO deactivated Reaction time max. 3ms
STO2/	Low = STO activated High = STO deactivated Reaction time max. 3ms
Switch-off time with unequal input statuses (max. reaction time)	20 seconds
Grouping of safety level	Category 3 PL=e (according to table 4 in EN ISO 13849-1 this corresponds to SIL 3) PFHd=4.29E-8

4. Setting up Compax3

In this chapter you can read about:

4.1 Configuration

In this chapter you can read about:

The general proceeding in order to operate an empty-running motor is described **here** (see on page 117).

Configurations sequence:

Installation of the C3 ServoManager

The Compax3 ServoManager can be installed directly from the Compax3 DVD. Click on the corresponding hyperlink resp. start the installation program "C3Mgr_Setup_V.....exe" and follow the instructions.

PC requirements

Recommendation:

Operating system:	MS Windows XP SP2 / MS Windows 2000 as from SP4 / (MS Vista)
Browser:	MS Internet Explorer 6.x
Processor:	Intel Pentium 4 / Intel Core 2 Duo / AMD Athlon class as from >=2GHz
RAM memory:	>= 1024MB
Hard disk:	>= 20GB available memory
Drive:	DVD drive
Monitor:	Resolution 1024x768 or higher
Graphics card:	on onboard graphics (for performance reasons)
Interface:	USB

Minimum requirements:

Operating system:	MS Windows XP SP2 / MS Windows 2000 as from SP4
Browser:	MS Internet Explorer 6.x
Processor:	>=1.5GHz
RAM memory:	512MB
Hard disk:	10GB available memory
Drive:	DVD drive
Monitor:	Resolution 1024x768 or higher
Graphics card:	on onboard graphics (for performance reasons)
Interface:	USB

Note:

- For the installation of the software you need administrator authorization on the target computer.
- Several applications running in parallel, reduce the performance and operability.
- Especially customer applications, exchanging standard system components (drivers) in order to improve their own performance, may have a strong influence on the communication performance or even render normal use impossible.
- Operation under virtual machines such as Vware Workstation 6/ MS Virtual PC is not possible.
- Onboard graphics card solutions reduce the system performance by up to 20% and cannot be recommended.
- Operation with notebooks in current-saving mode may lead, in individual cases, to communication problems.

Connection between PC and Compax3

Your PC is connected with Compax3 via a RS232 cable (**SSK1** (see on page 603)).

Cable **SSK1** (see on page 603) (COM 1/2-interface on the PC to X10 on the Compax3 or via adapter SSK32/20 on programming interface of Compax3H).

Start the Compax3 ServoManager and make the setting for the selected interface in the "**Options Communication settings RS232/RS485...**" menu.

Device Selection

In the menu tree under device selection you can read the device type of the connected device (Online Device Identification) or select a device type (Device Selection Wizard).

Configuration

Then you can double click on "Configuration" to start the configuration wizard. The wizard will lead you through all input windows of the configuration.

Input quantities will be described in the following chapters, in the same order in which you are queried about them by the configuration wizard.

4.1.1. Test commissioning of a Compax3 axis

In the device online help, we show you at this place an animation of a test setup with the aim to move an unloaded motor.

- Simple and independent of the Compax3 device variant*
- Without overhead for configuration
- Without special knowledge in programming

* for device specific functions, please refer to the corresponding device description.

Due to continuous optimization, individual monitor displays may have changed.

This does however hardly influence the general proceeding.

4.1.2. Selection of the supply voltage used

Please select the mains voltage for the operation of Compax3.

This influences the choice of motors available.

4.1.3. Motor selection

The selection of motors can be broken down into:

- Motors that were purchased in Europe and
- Motors that were purchased in the USA.
- You will find non-standard motors under "Additional motors" and
- under "User-defined motors" you can select motors set up with the C3 MotorManager.

For motors with holding brake SMH**A** or MH**A** brake delay times can be entered. For this see **Brake delay times** (see on page 289).

Pleas note the following equivalence that applies regarding terms concerning linear motors**:**

- **Rotary motors / linear motors**
- **Revolutions ≡ Pitch**
- **Rotation speed (velocity)≡ Speed**
- **Torque ≡ Power**
- **Moment of inertia ≡ Load**

Notes on direct drives **(see on page 570) (Linear and Torque - Motors)**

4.1.4. Optimize motor reference point and switching frequency of the motor current

Optimization of the motor reference point

The motor reference point is defined by the reference current and the reference (rotational) speed.

Standard settings are:

- Reference current = nominal current
- Reference (rotational) speed = nominal (rotational) speed

These settings are suitable for most cases.

The motors can, however, be operated with different reference points for special applications.

- By reducing the reference (rotational) speed, the reference current can be increased. This results in more torque with a reduced speed.
- For applications where the reference current is only required cyclically with long enough breaks in between, you may use a reference current higher than I_0. The limit value is however reference current = max. 1.33*I_0. The reference (rotational) speed must also be reduced.

The possible settings or limits result from the respective motor characteristics.

Caution!

Wrong reference values (too high) can cause the motor to switch off during operation (because of too high temperature) or even cause damage to the motor.

Optimization of the switching frequency

The switching frequency of the power output stage is preset to optimize the operation of most motors.

It may, however, be useful to increase the switching frequency especially with direct drives in order to reduce the noise of the motors. Please note that the power output stage must be operated with reduced nominal currents in the case of increased switching frequencies.
The switching frequency may only be increased.

Caution!

By increasing the motor current switching frequency, the nominal current and the peak current are reduced.
This must already be observed in the planning stage of the plant!

The preset motor current switching frequency depends on the performance variant of the Compax3 device.

The respective Compax3 devices can be set as follows:

Resulting nominal and peak currents depending on the switching frequency

Compax3S0xxV2 at 1*230VAC/240VAC

Switching frequency*		**S025V2**	**S063V2**
16kHz	I_{nom}	**$2.5A_{rms}$**	**$6,3A_{rms}$**
	I_{peak} (<5s)	**$5.5A_{rms}$**	**$12,6A_{rms}$**
32kHz	I_{nom}	$2.5A_{rms}$	$5.5A_{rms}$
	I_{peak} (<5s)	$5.5A_{rms}$	$12,6A_{rms}$

Compax3S1xxV2 at 3*230VAC/240VAC

Switching frequency*		**S100V2**	**S150V2**
8kHz	I_{nom}	**-**	**$15A_{rms}$**
	I_{peak} (<5s)	**-**	**$30A_{rms}$**
16kHz	I_{nom}	**$10A_{rms}$**	$12.5A_{rms}$
	I_{peak} (<5s)	**$20A_{rms}$**	$25A_{rms}$
32kHz	I_{nom}	$8A_{rms}$	$10A_{rms}$
	I_{peak} (<5s)	$16A_{rms}$	$20A_{rms}$

Compax3S0xxV4 at 3*400VAC

Switching frequency*		**S015V4**	**S038V4**	**S075V4**	**S150V4**	**S300V4**
8kHz	I_{nom}	-	-	-	**$15A_{rms}$**	**$30A_{rms}$**
	I_{peak} (<5s)	-	-	-	**$30A_{rms}$**	**$60A_{rms}$**
16kHz	I_{nom}	**$1.5A_{rms}$**	**$3.8A_{rms}$**	**$7.5A_{rms}$**	$10.0A_{rms}$	$26A_{rms}$
	I_{peak} (<5s)	**$4.5A_{rms}$**	**$9.0A_{rms}$**	**$15.0A_{rms}$**	$20.0A_{rms}$	$52A_{rms}$
32kHz	I_{nom}	$1.5A_{rms}$	$2.5A_{rms}$	$3.7A_{rms}$	$5.0A_{rms}$	$14A_{rms}$
	I_{peak} (<5s)	$3.0A_{rms}$	$5.0A_{rms}$	$10.0A_{rms}$	$10.0A_{rms}$	$28A_{rms}$

Compax3S0xxV4 at 3*480VAC

Switching frequency*		**S015V4**	**S038V4**	**S075V4**	**S150V4**	**S300V4**
8kHz	I_{nom}	-	-	-	**$13.9A_{rms}$**	**$30A_{rms}$**
	I_{peak} (<5s)	-	-	-	**$30A_{rms}$**	**$60A_{rms}$**
16kHz	I_{nom}	**$1.5A_{rms}$**	**$3.8A_{rms}$**	**$6.5A_{rms}$**	$8.0A_{rms}$	$21.5A_{rms}$
	I_{peak} (<5s)	**$4.5A_{rms}$**	**$7.5A_{rms}$**	**$15.0A_{rms}$**	$16.0A_{rms}$	$43A_{rms}$
32kHz	I_{nom}	$1.0A_{rms}$	$2.0A_{rms}$	$2.7A_{rms}$	$3.5A_{rms}$	$10A_{rms}$
	I_{peak} (<5s)	$2.0A_{rms}$	$4.0A_{rms}$	$8.0A_{rms}$	$7.0A_{rms}$	$20A_{rms}$

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

Resulting nominal and peak currents depending on the switching frequency

Compax3HxxxV4 at 3*400VAC

Switching frequency*		H050V4	H090V4	H125V4	H155V4
8kHz	I_{nom}	50A_{rms}	90A_{rms}	125A_{rms}	155A_{rms}
	I_{peak} (<5s)	75A_{rms}	135A_{rms}	187.5A_{rms}	232.5A_{rms}
16kHz	I_{nom}	33A_{rms}	75A_{rms}	82A_{rms}	100A_{rms}
	I_{peak} (<5s)	49.5A_{rms}	112.5A_{rms}	123A_{rms}	150A_{rms}
32kHz	I_{nom}	19A_{rms}	45A_{rms}	49A_{rms}	59A_{rms}
	I_{peak} (<5s)	28.5A_{rms}	67.5A_{rms}	73.5A_{rms}	88.5A_{rms}

Compax3HxxxV4 at 3*480VAC

Switching frequency*		H050V4	H090V4	H125V4	H155V4
8kHz	I_{nom}	43A_{rms}	85A_{rms}	110A_{rms}	132A_{rms}
	I_{peak} (<5s)	64.5A_{rms}	127.5A_{rms}	165A_{rms}	198A_{rms}
16kHz	I_{nom}	27A_{rms}	70A_{rms}	70A_{rms}	84A_{rms}
	I_{peak} (<5s)	40.5A_{rms}	105A_{rms}	105A_{rms}	126A_{rms}
32kHz	I_{nom}	16A_{rms}	40A_{rms}	40A_{rms}	48A_{rms}
	I_{peak} (<5s)	24A_{rms}	60A_{rms}	60A_{rms}	72A_{rms}

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

Resulting nominal and peak currents depending on the switching frequency

Compax3MxxxD6 at 3*400VAC

Switching frequency*		M050D6	M100D6	M150D6	M300D6
8kHz	I_{nom}	5A_{rms}	10A_{rms}	15A_{rms}	30A_{rms}
	I_{peak} (<5s)	10A_{rms}	20A_{rms}	30A_{rms}	60A_{rms}
16kHz	I_{nom}	3.8A_{rms}	7.5A_{rms}	10A_{rms}	20A_{rms}
	I_{peak} (<5s)	7.5A_{rms}	15A_{rms}	20A_{rms}	40A_{rms}
32kHz	I_{nom}	2.5A_{rms}	3.8A_{rms}	5A_{rms}	11A_{rms}
	I_{peak} (<5s)	5A_{rms}	7.5A_{rms}	10A_{rms}	22A_{rms}

Compax3MxxxD6 at 3*480VAC

Switching frequency*		M050D6	M100D6	M150D6	M300D6
8kHz	I_{nom}	4A_{rms}	8A_{rms}	12.5A_{rms}	25A_{rms}
	I_{peak} (<5s)	8A_{rms}	16A_{rms}	25A_{rms}	50A_{rms}
16kHz	I_{nom}	3A_{rms}	5.5A_{rms}	8A_{rms}	15A_{rms}
	I_{peak} (<5s)	6A_{rms}	11A_{rms}	16A_{rms}	30A_{rms}
32kHz	I_{nom}	2A_{rms}	2.5A_{rms}	4A_{rms}	8.5A_{rms}
	I_{peak} (<5s)	4A_{rms}	5A_{rms}	8A_{rms}	17A_{rms}

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

4.1.5. Ballast resistor

If the regenerative brake output exceeds the **amount of energy that can be stored by the servo controller** (see on page 623), then an error will be generated. To ensure safe operation, it is then necessary to either

- reduce the accelerations resp. the decelerations,
- or to use an **external ballast resistor** (see on page 586).

Please select the connected ballast resistor or enter the characteristic values of your ballast resistor directly.

Please note that with resistance values greater than specified, the power output from the servo drive can no longer be dissipated in the braking resistor.

4.1.6. General drive

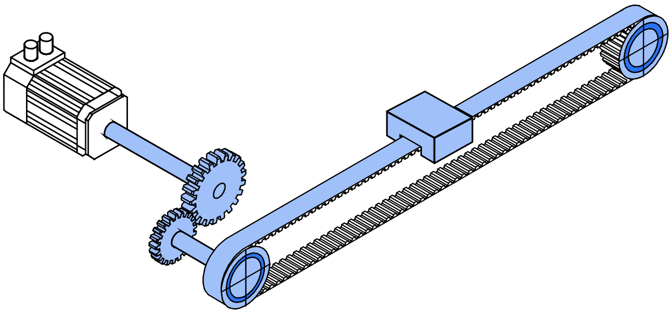
External moment of inertia / load

The external moment of inertia is required for adjusting the servo controller. The more accurately the moment of inertia of the system is known, the better is the stability and the shorter is the settle-down time of the control loop.

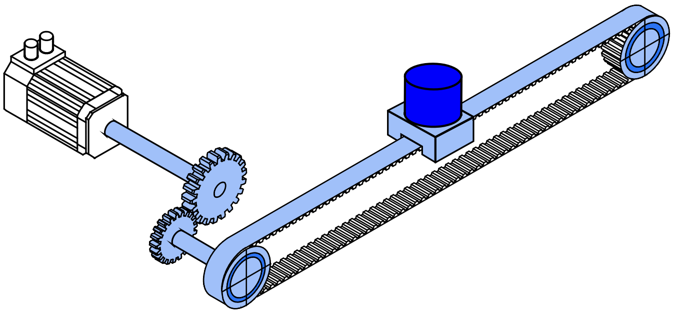
It is important to specify the minimum and maximum moment of inertia for best possible behavior under varying load.

If you do not know the moment of inertia, click on "Unknown: using default values". You have then the possibility to determine the moment of inertia by means of automatic **load identification** (see on page 245).

Minimum moment of inertia / minimum load



Maximum moment of inertia / maximum load



Enter minimum = maximum moment of inertia when the load does not vary.

4.1.7. Defining the reference system

The reference system for positioning is defined by:
- a unit,
- the travel distance per motor revolution,
- a machine zero point with true zero,
- positive and negative end limits.

4.1.7.1 Measure reference

You can select from among the following for the unit:

Unit

- mm,
- increments *
- angle degrees or
- Inch.

The unit of measure is always [mm] for linear motors.

*

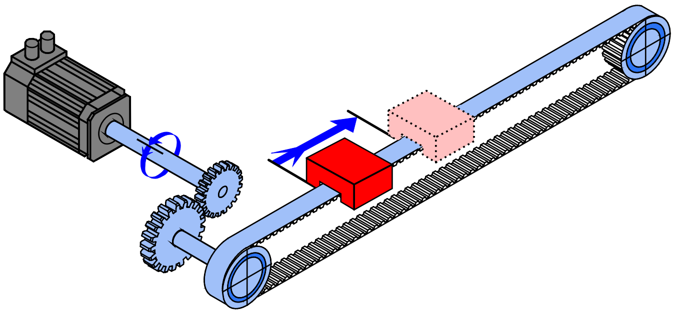
The unit "increments" is valid only for position values!

Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s^2 and revolutions/s^3 (resp. pitch/s, pitch/s^2, pitch/s^3 for linear motors).

Travel distance per motor revolution / pitch

The measure reference to the motor is created with the value:

"travel distance per motor revolution / pitch" in the selected unit.

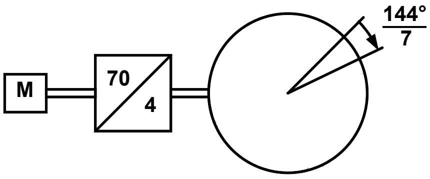


Input as numerator and denominator

You can enter the "travel distance per motor revolution" as a fraction (numerator divided by denominator). This is useful in the case of continuous operation mode or in reset mode if the value cannot be specified as a rational number. This makes it possible to avoid long-term drifts.

Example 1:

Rotary table control



Unit: Grade

Gear transmission ratio 70:4 => 4 load revolutions = 70 motor revolutions

Travel distance per motor revolution = 4/70 * 360° = 20.571 428 5 ...° (number cannot be represented exactly)

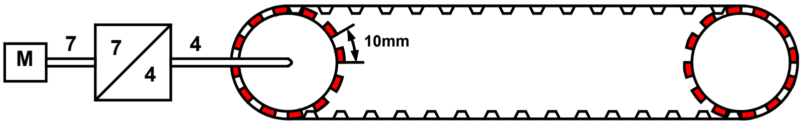
Instead of this number, you have the option of entering it exactly as a numerator and denominator:

Travel distance per motor revolution = 144/7

This will not result in any drift in continuous operation mode or in reset mode, even with relatively long motion in one direction.

Example 2:

Conveyor belt



Unit: mm

Gear transmission ratio 7:4 => 4 load revolutions = 7 motor revolutions

Number of pinions: 12

Tooth separation: 10mm

Travel path per motor revolution = 4/7 * 12 * 10mm = 68.571 428 5 ... mm (this number cannot be expressed exactly)

Instead of this number, you have the option of entering it exactly as a numerator and denominator:

Travel distance per motor revolution = 480/7 mm

For "travel distance per motor revolution" that can be represented exactly, enter 1 as the denominator.

Travel distance per motor revolution /-pitch

Numerator

Unit: Unit	Range: depends on the unit selected	Standard value: depends on the unit selected
Resolution: 0.000 000 1 (7 decimal places)		
Unit	**Division**	**Standard value**
Increments*	10 ... 1 000 000	1024
mm	0.010 000 0 ... 2000.000 000 0	1.000 000 0
Grade	0.010 000 0 ... 720.000 000 0	360.000 000 0
Inch	0.010 000 .. 2000.000 000	1.000 000

Denominator

Unit: -	Range: 1 ... 1 000 000	Standard value: 1
Integer value		

*

The unit "increments" is valid only for position values!

Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s^2 and revolutions/s^3 (resp. pitch/s, pitch/s^2, pitch/s^3 for linear motors).

Invert Motor Rotation/Direction Polarity

Unit: -	Range: no / yes	Standard value: no
Reverse direction inverts the sense of rotation, i.e. the direction of movement of the motor is reversed in the case of equal setpoint.		

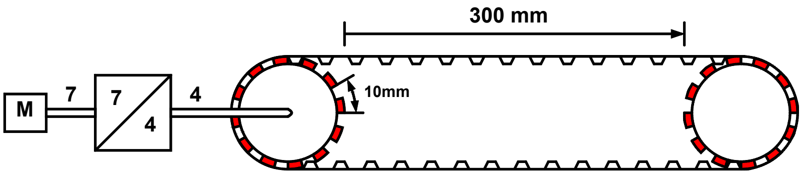
Reset mode

Reset mode is available for applications in which the positioning range repeats; some examples are: Rotary table applications, belt conveyor. ...

After the reset travel distance (exactly specifiable as **numerator and denominator** (see on page 122)) the position values in Compax3 are reset to 0.

Example:

Conveyor belt (from the "Conveyor belt" example) with reset path



A reset path of 300 mm can be entered directly with numerator = 300 mm and denominator = 1.

Reset mode is not possible for linear motors.

Reset distance

Numerator

Unit: Unit	Range: depends on the unit selected	Standard value: depends on the unit selected
Unit	**Division**	**Standard value**
Increments	10 ... 1 000 000	0
mm	1 ... 2000	0
Grade	1 ... 720	0

Denominator

Unit: -	Range: 1 ... 1 000 000	Standard value: 0
Integer value		

Turn off reset mode

Reset mode is turned off for numerator = 0 and denominator = 0.

4.1.7.2 Machine Zero

In this chapter you can read about:

The Compax3 machine zero modes are adapted to the CANopen profile for Motion Control CiADS402.

Position reference point

Essentially, you can select between operation with or without machine reference.

The reference point for positioning is determined by using the machine reference and the machine reference offset.

Machine reference run

In a homing run the drive **normally** (see on page 126) moves to the position value 0 immediately after finding the home switch. The position value 0 is defined via the **homing offset** (see on page 326).

A machine reference run is required each time after turning on the system for operation with machine reference.

Please note:

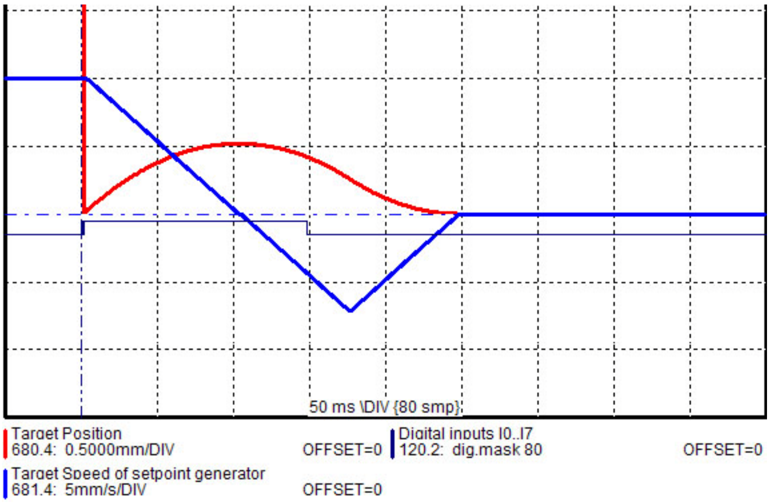
During homing run the software end limits are not monitored.

Positioning after homing run

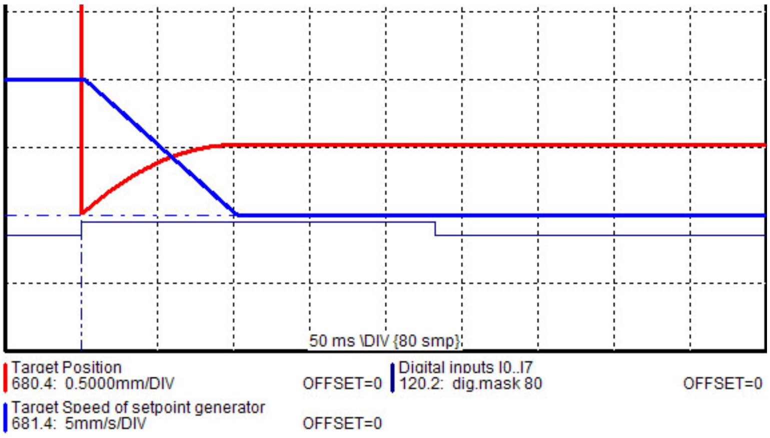
The positioning made after the home switch has been found can be switched off. For this enter in the "machine zero" window in the configuration wizard "no" under "approach MN point after MN run".

Example Homing (MN) mode 20 (Home on homing (MN) switch) with T40 by homing offset 0

With positioning after homing run The motor stands then on 0:



Without positioning after homing run The position reached is not exactly on 0, as the drive brakes when detecting the home and stops:



Absolute encoder

Using a SinCos© or EnDat Multiturn absolute value sensor as feedback system, the absolute position can be read in over the entire travel range when switching on the Compax3. This means that a machine zero run is not necessary after the switching on (feedback may not be shifted by the absolute range while switched off).

In this case the reference only needs to be established once

- at initial commissioning time
- after an exchange of motor / feedback system
- after a mechanical modification and
- after an exchange of device (Compax3); does not apply for the "Store absolute position in feedback" function.
- after a configuration download

by carrying out a machine zero run.

The homing mode 35 "**MN at the current position** (see on page 136)" is appropriate for this, because it is therewith possible to operate without proximity switch, but any other homing mode is possible too - if the hardware prerequisites are fulfilled.

When you have once re-established the reference, reset the machine zero run mode to "without machine zero run".

Operation with MultiTurn emulation

You can simulate the function of a Multiturn over the entire travel distance by the aid of a Multiturn emulation. A resolver or a SinCos© / EnDat Singleturn feedback is sufficient as a feedback signal from the motor.

It differs from the physical Multiturn in the way that the motor may not be moved by more than half a turn if Compax3 (24VDC) is switched off - unless the absolute position is lost.

Besides that, the Multiturn emulation offers the same function as the physical Multiturn feedback.

You can switch on the Multiturn emulation directly in the wizard.

You can assign the maximum permissible motor angle via the Multiturn validity window

If Compax3 states after switching on that this value is not exceeded, then this displayed via a status. The status can be read in the IEC61131-3 program in object 3310.1 "C3.Multiturnemulation_Status" ("0": angle in the window; "-1": angle was outside the window) is applied.

Compax3 restores nevertheless the absolute position, the motor angle is correct, the absolute position may however not be correct, if the motor was moved by more than the validity window while currentless.

Attention: In this case, the drive is considered “not referenced” and the software end limit monitoring is inactive!

Machine reference run For a unique machine zero run the same conditions apply as for the use of an absolute encoder (Multiturn).

Store absolute position in the feedback

With SinCos© or EnDat feedback systems, the absolute position can be memorized in the feedback; therefore the Compax3 device can be exchanged without loss of position.

The function is possible with Multiturn absolute value feedback systems and in combination with the "Multiturn emulation" function and is activated by selecting "Store absolute position: in the position feedback” (Configuration wizard: Reference system).

The standard setting valid up to now is "Store absolute position: in the device".

Read / write position value

The writing process into the position feedback takes place upon a successful machine zero run.

After PowerOn of Compax3, the position value of the position feedback is read out.

Please note:

- Other data stored in the feedback are overwritten!
- The motor may not move away from the homing position by more than +/-2048 revolutions (motor position upon completed homing mode), otherwise, the motor position will be lost after PowerOff/On
(->endless instructions are not permitted in this operating mode)!

Machine zero modes overview

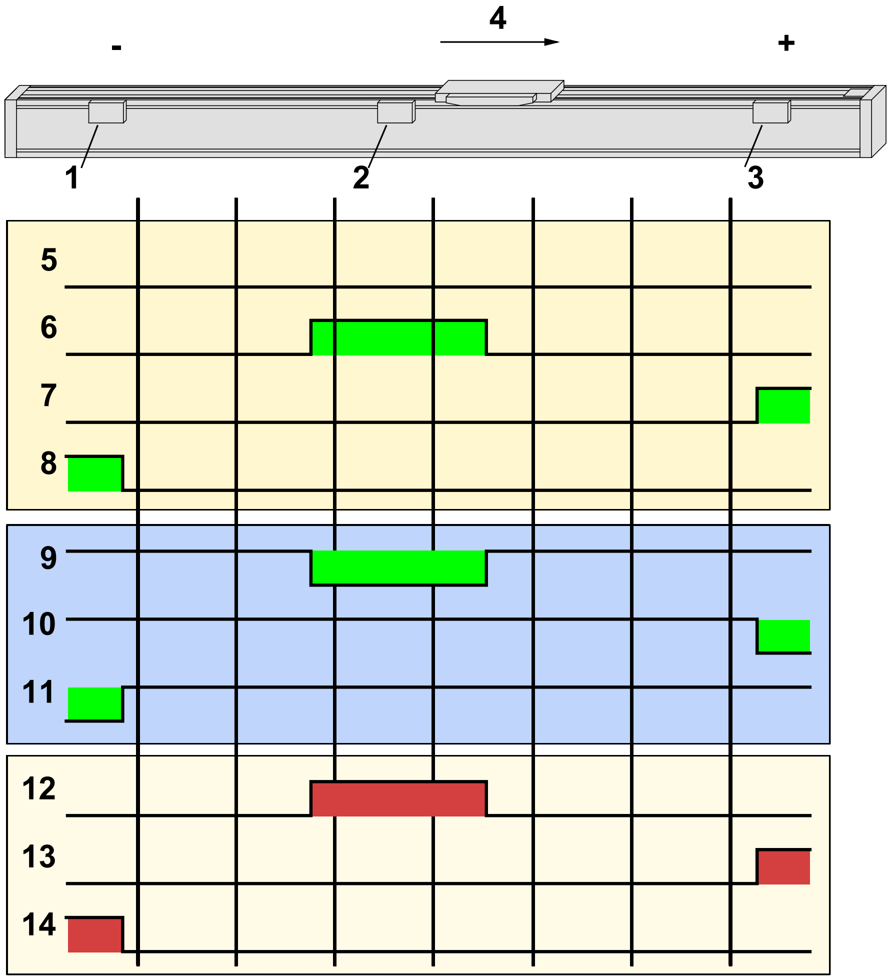
Selection of the machine zero modes (MN-M)

Machine home switch on X12/14: **MN-M 3 ... 14, 19 ... 30**	Without motor reference point MN-M 19 ...30	without direction reversal switches: **MN-M 19, 20** (see on page 130), **MN-M 21, 22** (see on page 131)
		with reversal switches: **MN-M 23, 24, 25, 26** (see on page 132), **MN-M 27, 28, 29, 30** (see on page 132)
	With motor reference point MN-M 3 ... 14 (possibly an **initiator adjustment** (see on page 140) is required)	without direction reversal switches: **MN-M 3, 4** (see on page 133), **MN-M 5, 6** (see on page 133)
		with reversal switches: **MN-M 7, 8, 9, 10** (see on page 135), **MN-M 11,12,13, 14** (see on page 135)
Without machine zero initiator on X12/14: **MN-M 1, 2, 17, 18, 33 .. 35, 128, 129, 130 ... 133**	Without motor reference point MN-M 17, 18, 35, 128, 129	**MN-M 35: on the actual position** (see on page 136) **MN-M 128, 129: by moving to block** (see on page 136)
		With limit switch as machine zero: **MN-M 17, 18** (see on page 137)
		Only motor reference: **MN-M 33, 34** (see on page 138), **MN-M 130, 131** (see on page 138)
		With limit switch as machine zero: **MN-M 1, 2** (see on page 139), **MN-M 132, 133** (see on page 140)

Definition of terms / explanations:

Motor zero point	Zero pulse of the feedback Motor feedback systems such as resolvers or SinCos© / EnDat give one pulse per revolution. Some motor feedback systems of direct drives do also have a zero pulse, which is generated once or in defined intervals. By interpreting the motor zero point (generally in connection with the machine zero initiator) the machine zero can be defined more exactly.
Machine zero initiator:	For creating the mechanical reference Has a defined position within or on the edge of the travel range.
Direction reversal switches:	Initiators on the edge of the travel range, which are used only with a machine zero run in order to detect the end of the travel range. In some cases, the function “direction reversal via Stromschwelle” is also possible, then you will need no initiator, Compax3 detects the end of the travel range via the threshold. Please observe the respective notes. During operation, the direction reversal switches are often used as limit switches.

Example axis with the initiator signals



1: Direction reversal / end switch on the negative end of the travel range (the **assignment of the reversal / end switch inputs** (see on page 146) to travel range side can be changed).
2: Machine zero initiator (can, in this example, be released to 2 sides)
3: Direction reversal / end switch on the positive end of the travel range (the **assignment of the reversal / end switch inputs** (see on page 146) to travel range side can be changed).
4: Positive direction of movement
5: Signals of the motor zero point (zero pulse of the motor feedback)
6: Signal of the machine zero initiator (**without inversion of the initiator logic** (see on page 146)).
7: Signal of the direction reversal resp. end switch on the positive end of the travel range (without inversion of the initiator logic).
8: Signal of the direction reversal / resp. end switch on the negative end of the travel range (without inversion of the initiator logic).
9: Signal of the machine zero initiator (**with inversion of the initiator logic** (see on page 146)).
10: Signal of the direction reversal resp. end switch on the positive end of the travel range (with inversion of the initiator logic).
11: Signal of the direction reversal / end switch on the negative end of the travel range (with inversion of the initiator logic).
12: Logic state of the home switch (independent of the inversion)
13: Logic state of the direction reversal resp. end switch on the positive end of the travel range (independent of the inversion)
14: Logic state of the direction reversal resp. end switch on the negative end of the travel range (independent of the inversion)

The following principle images of the individual machine zero modes always refer to the logic state (12, 13, 14) of the switches.

Homing modes with home switch (on X12/14)

In this chapter you can read about:

Without motor reference point

In this chapter you can read about:

Without direction reversal switches

MN-M 19,20: MN-Initiator = 1 on the positive side

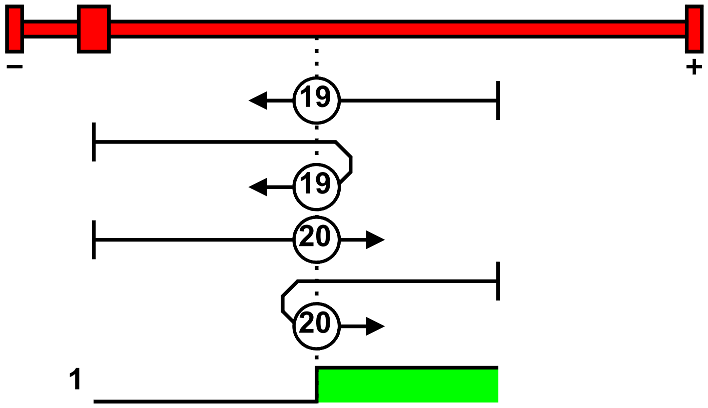
The MN initiator can be positioned at any location within the travel range. The travel range is then divided into 2 contiguous ranges: one range with deactivated MN initiator (left of the MN initiator) and one range with activated MN initiator (right of the MN initiator).

When the MN initiator is inactive (signal = 0) the search for the machine reference is in the positive travel direction.

Without motor zero point, without direction reversal switches

MN-M 19: The negative edge of the MN proximity switch is taken directly as MN (the motor zero point remains without consideration).

MN-M 20: The positive edge of the MN proximity switch is used directly as MN (the motor zero point remains without consideration).



1: logic state

MN-M 21,22: MN Initiator = 1 on the negative side

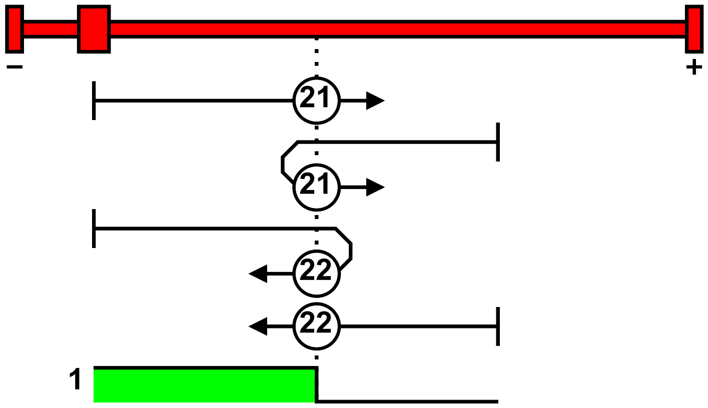
The MN initiator can be positioned at any location within the travel range. The travel range is then divided into 2 contiguous ranges: one range with deactivated MN initiator (positive part of the travel range) and one range with activated MN initiator (negative part of the travel range).

When the MN initiator is inactive (signal = 0) the search for the machine reference is in the negative travel direction.

Without motor zero point, without direction reversal switches

MN-M 21: The negative edge of the MN proximity switch is taken directly as MN (the motor zero point remains without consideration).

MN-M 22: The positive edge of the MN proximity switch is used directly as MN (the motor zero point remains without consideration).



1: logic state

With direction reversal switches

Machine zero modes with a home switch which is activated in the middle of the travel range and can be deactivated to both sides.

The **assignment of the direction reversal switches** (see on page 146) can be changed.

Function Reversal via Stromschwelle

If no direction reversal switches are available, the reversal of direction can also be performed during the machine zero run via the function “direction reversal via Stromschwelle”.

The drive drives against the mechanical end stop.

When the adjustable Stromschwelle is reached, the drive is decelerated and changes the direction of movement.

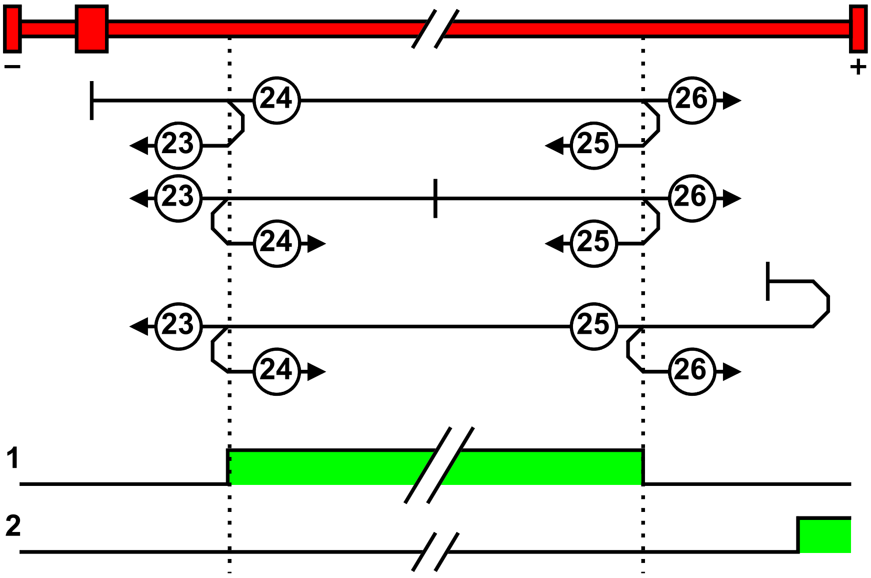
⚠	**Caution!** Wrong settings can cause hazard for man and machine.

It is therefore essential to respect the following:

- Choose a low machine zero speed.
- Set the machine zero acceleration to a high value, so that the drive changes direction quickly, the value must, however, not be so high that the limit threshold is already reached by accelerating or decelerating (without mechanical limitation).
- The mechanical limitation as well as the load drain must be set so that they can absorb the resulting kinetic energy.
- With a bad feedback signal or high controller gain (fast controller or high inertia or mass) the machine zero might not be detected.
  In this case it is necessary to use the control signal filter (O2100.20) or the velocity filter (O2100.10).

MN-M 23...26: Direction reversal switches on the positive side

Without motor zero point, with direction reversal switches

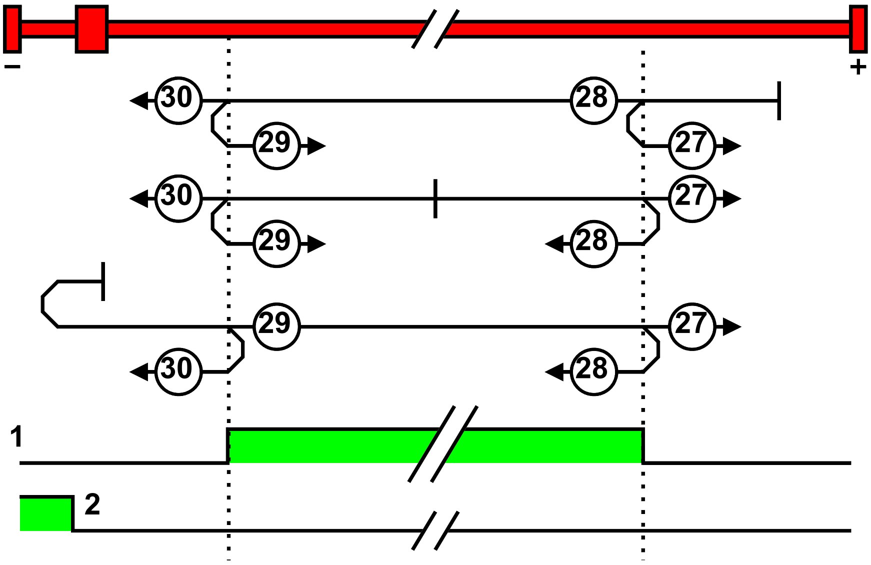


1: Logic state of the home switch

2: Logic state of the direction reversal switch

MN-M 27...30: Direction reversal switches on the negative side

Without motor zero point, with direction reversal switches



1: Logic state of the home switch

2: Logic state of the direction reversal switch

With motor reference point

In this chapter you can read about:

Without direction reversal switches

MN-M 3,4: MN-Initiator = 1 on the positive side

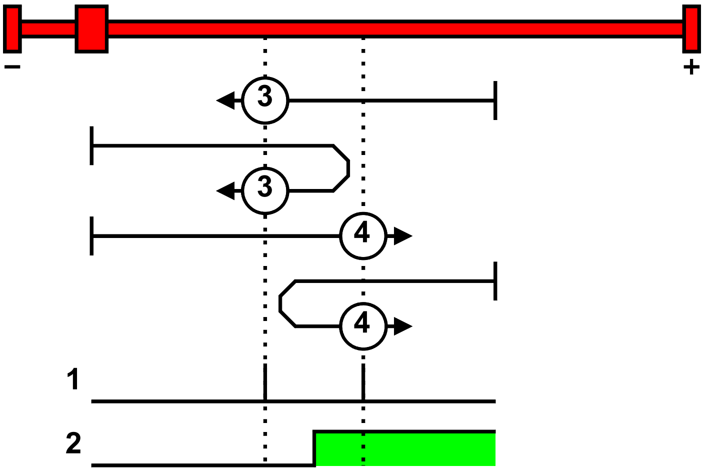
The MN initiator can be positioned at any location within the travel range. The travel range is then divided into 2 contiguous ranges: one range with deactivated MN initiator (left of the MN initiator) and one range with activated MN initiator (right of the MN initiator).

When the MN initiator is inactive (signal = 0) the search for the machine reference is in the positive travel direction.

With motor zero point, without direction reversal switches

MN-M 3: The 1st motor zero point at MN initiator = "0" is used as MN.

MN-M 4: The 1st motor reference point with MN initiator = "1" is used as the MN.



1: Motor zero point

2: Logic state of the home switch

MN-M 5,6: MN-Initiator = 1 on the negative side

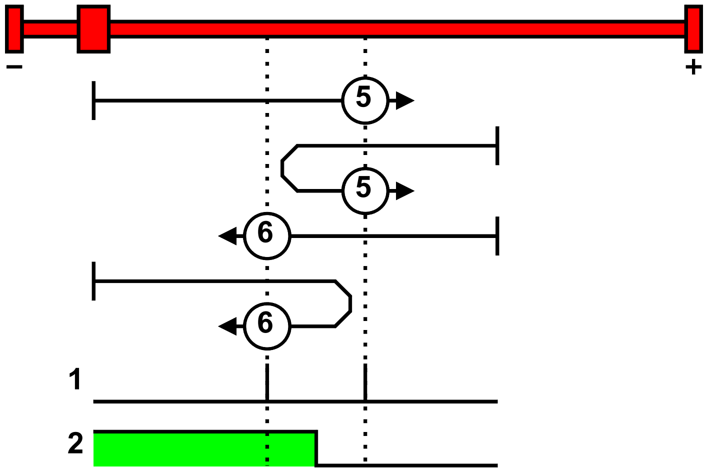
The MN initiator can be positioned at any location within the travel range. The travel range is then divided into 2 contiguous ranges: one range with deactivated MN initiator (positive part of the travel range) and one range with activated MN initiator (negative part of the travel range).

When the MN initiator is inactive (signal = 0) the search for the machine reference is in the negative travel direction.

With motor zero point, without direction reversal switches

MN-M 5: The 1st. motor zero point with MN proximity switch = "0" is used as MN.

MN-M 6: The 1st motor reference point with MN initiator = "1" is used as the MN.



1: Motor zero point

2: Logic state of the home switch

With direction reversal switches

Machine zero modes with a home switch which is activated in the middle of the travel range and can be deactivated to both sides.

The **assignment of the direction reversal switches** (see on page 146) can be changed.

Function Reversal via Stromschwelle

If no direction reversal switches are available, the reversal of direction can also be performed during the machine zero run via the function “direction reversal via Stromschwelle”.

The drive drives against the mechanical end stop.

When the adjustable Stromschwelle is reached, the drive is decelerated and changes the direction of movement.

⚠	**Caution!** Wrong settings can cause hazard for man and machine.

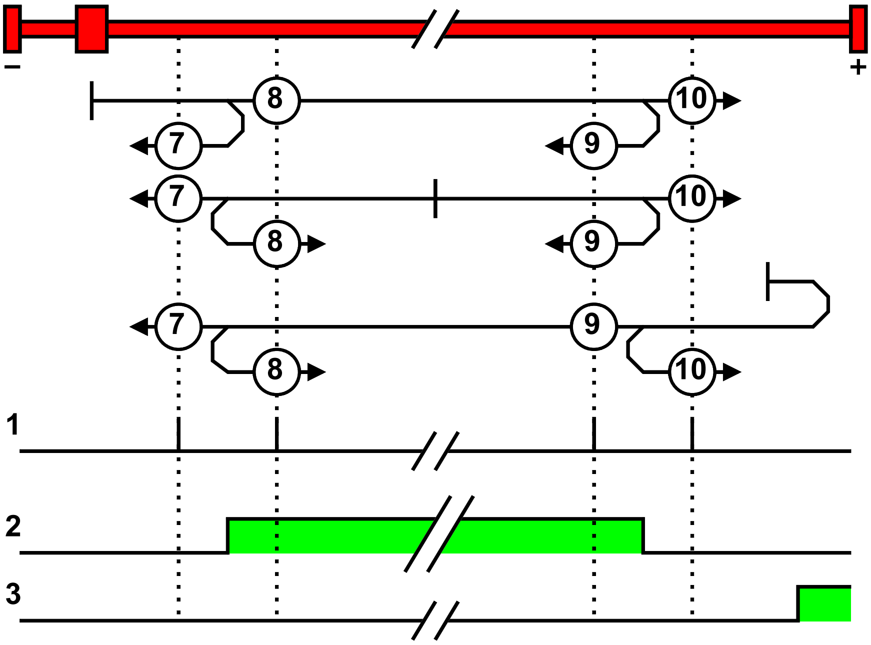
It is therefore essential to respect the following:

- Choose a low machine zero speed.
- Set the machine zero acceleration to a high value, so that the drive changes direction quickly, the value must, however, not be so high that the limit threshold is already reached by accelerating or decelerating (without mechanical limitation).
- The mechanical limitation as well as the load drain must be set so that they can absorb the resulting kinetic energy.
- With a bad feedback signal or high controller gain (fast controller or high inertia or mass) the machine zero might not be detected.
  In this case it is necessary to use the control signal filter (O2100.20) or the velocity filter (O2100.10).

MN-M 7...10: Direction reversal switches on the positive side

With motor zero point, with direction reversal switches

Machine zero modes with a home switch which is activated in the middle of the travel range and can be deactivated to both sides.



1: Motor zero point

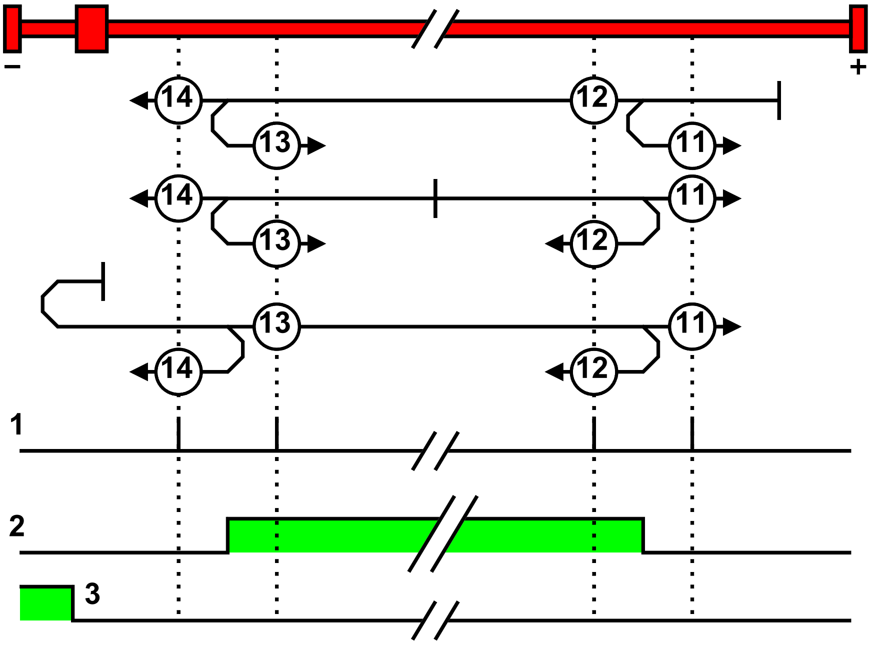
2: Logic state of the home switch

3: Logic state of the direction reversal switch

MN-M 11...14: With direction reversal switches on the negative side

With motor zero point, with direction reversal switches

Machine zero modes with a home switch which is activated in the middle of the travel range and can be deactivated to both sides.



1: Motor zero point

2: Logic state of the home switch

3: Logic state of the direction reversal switch

Machine zero modes without home switch

In this chapter you can read about:

Without motor reference point

MN-M 35: MN (machine zero) at the current position

The current position when the MN run is activated is used as an MN.

Please note:

Due to encoder noise it is possible that a value <> 0 is set when teaching to 0.

If end limits = 0, an end limit error may occur during homing run.

MN-M 128/129: Stromschwelle while moving to block

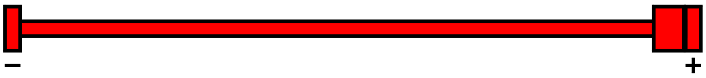
Without a MN (machine zero) initiator, an end of travel region (block) is used as MN (machine zero).

For this the Stromschwelle is evaluated if the drive pushes against the end of the travel region. When the adjusted current is exceeded, the Homing is set. During the homing run (MN), the error reaction "following error" is deactivated.

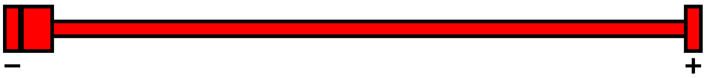
Please observe:

The machine zero offset must be set so that the zero point (reference point) for positioning lies within the travel range.

MN-M 128: Travel in the positive direction to the end of the travel region



MN-M 129: Travel in the negative direction to the end of the travel region

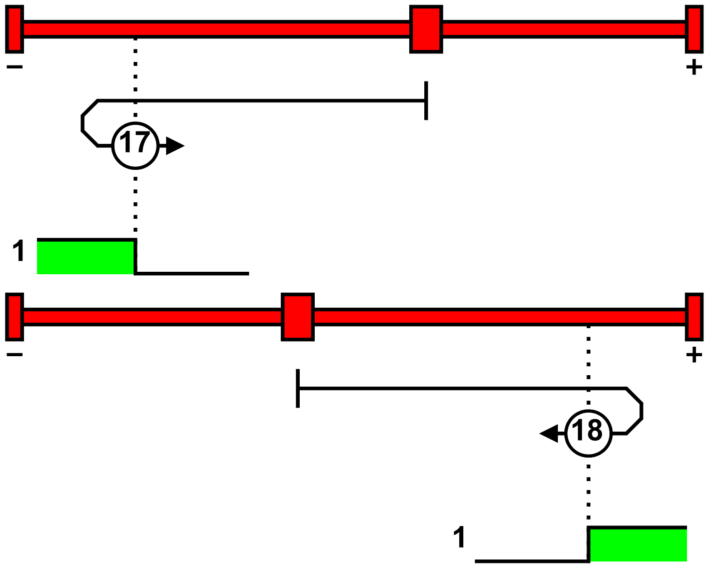


⚠	**Caution!** Wrong settings can cause hazard for man and machine.

It is therefore essential to respect the following:

- Choose a low machine zero speed.
- Set the machine zero acceleration to a high value, so that the drive changes direction quickly, the value must, however, not be so high that the limit threshold is already reached by accelerating or decelerating (without mechanical limitation).
- The mechanical limitation as well as the load drain must be set so that they can absorb the resulting kinetic energy.
- With a bad feedback signal or high controller gain (fast controller or high inertia or mass) the machine zero might not be detected.
  In this case it is necessary to use the control signal filter (O2100.20) or the velocity filter (O2100.10).

MN-M 17,18: Limit switch as machine zero



1: Logic state of the direction reversal switch

Function Reversal via Stromschwelle

If no direction reversal switches are available, the reversal of direction can also be performed during the machine zero run via the function “direction reversal via Stromschwelle”.

The drive drives against the mechanical end stop.

When the adjustable Stromschwelle is reached, the drive is decelerated and changes the direction of movement.

⚠	**Caution!** Wrong settings can cause hazard for man and machine.

It is therefore essential to respect the following:

- Choose a low machine zero speed.
- Set the machine zero acceleration to a high value, so that the drive changes direction quickly, the value must, however, not be so high that the limit threshold is already reached by accelerating or decelerating (without mechanical limitation).
- The mechanical limitation as well as the load drain must be set so that they can absorb the resulting kinetic energy.
- With a bad feedback signal or high controller gain (fast controller or high inertia or mass) the machine zero might not be detected.
  In this case it is necessary to use the control signal filter (O2100.20) or the velocity filter (O2100.10).

With motor reference point

In this chapter you can read about:

Machine zero only from motor reference

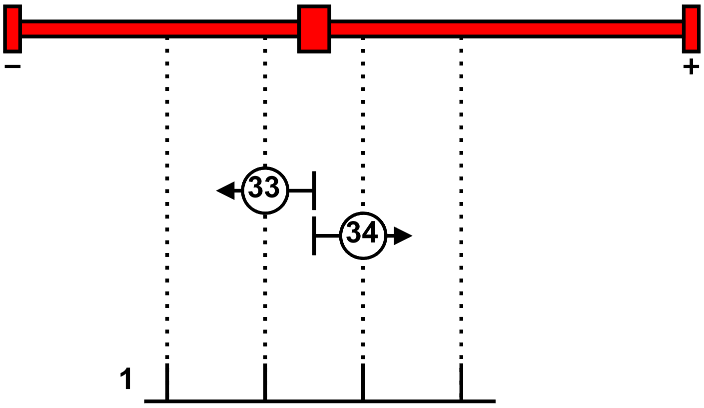
MN-M 33,34: MN at motor zero point

The motor reference point is now evaluated (no MN initiator):

Without home switch

MN-M 33: For a MN run, starting from the current position, the next motor zero point in the negative travel direction is taken as the MN.

MN-M 34: For a MN run, starting from the current position, the next motor zero point in the positive travel direction is taken as the MN.

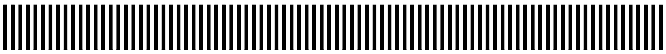


1: Motor zero point

MN-M 130, 131: Acquire absolute position via distance coding

Only for motor feedback with distance coding (the absolute position can be determined via the distance value).

Compax3 determines the absolute position from the distance of two signals and then stops the movement (does not automatically move to position 0).



1: Signals of the distance coding

With direction reversal switches

Machine zero modes with a home switch which is activated in the middle of the travel range and can be deactivated to both sides.

The **assignment of the direction reversal switches** (see on page 146) can be changed.

Function Reversal via Stromschwelle

If no direction reversal switches are available, the reversal of direction can also be performed during the machine zero run via the function “direction reversal via Stromschwelle”.

The drive drives against the mechanical end stop.

When the adjustable Stromschwelle is reached, the drive is decelerated and changes the direction of movement.

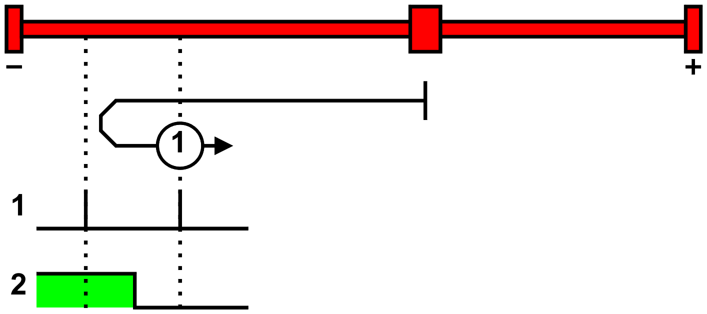
⚠	**Caution!** Wrong settings can cause hazard for man and machine.

It is therefore essential to respect the following:

- Choose a low machine zero speed.
- Set the machine zero acceleration to a high value, so that the drive changes direction quickly, the value must, however, not be so high that the limit threshold is already reached by accelerating or decelerating (without mechanical limitation).
- The mechanical limitation as well as the load drain must be set so that they can absorb the resulting kinetic energy.
- With a bad feedback signal or high controller gain (fast controller or high inertia or mass) the machine zero might not be detected.
  In this case it is necessary to use the control signal filter (O2100.20) or the velocity filter (O2100.10).

MN-M 1,2: Limit switch as machine zero

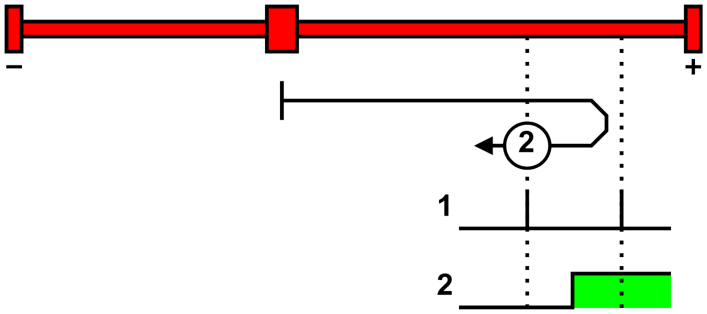
End switch on the negative side



1: Motor zero point

2: Logic state of the direction reversal switch

End switch on the positive side:



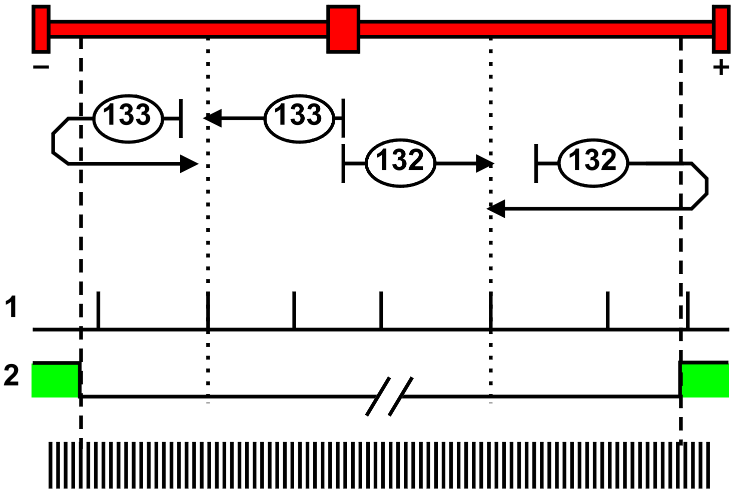
1: Motor zero point

2: Logic state of the direction reversal switch

MN-M 132, 133: Determine absolute position via distance coding with direction reversal switches

Only for motor feedback with distance coding (the absolute position can be determined via the distance value).

Compax3 determines the absolute position from the distance of two signals and then stops the movement (does not automatically move to position 0).



1: Signals of the distance coding

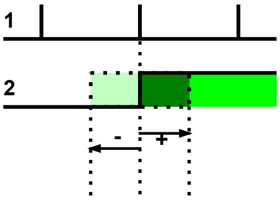
2: Logic state of the direction reversal switches

Adjusting the machine zero proximity switch

This is helpful in some cases with homing modes that work with the home switch and motor reference point.

If the motor reference point happens to coincide with the position of the MN initiator, there is a possibility that small movements in the motor position will cause the machine reference point to shift by one motor revolution (to the next motor reference point).

Via status value “Distance MN sensor - motor zero”, (O1130.13) you can check if the distance between machine home sensor and motor zero point is too short.



1: Motor zero point

2: Logic state of the home switch

A solution to this problem is to move the MN initiator by means of software. This is done using the value initiator adjustment.

Initiator adjustment

Unit: Motor angle in degrees	Range: -180 ... 180	Standard value: 0
Move the machine reference initiator using software As an aid you can use the status value “distance MN sensor - motor zero” in the “Positions” chapter under “status values“		

Machine zero speed and acceleration

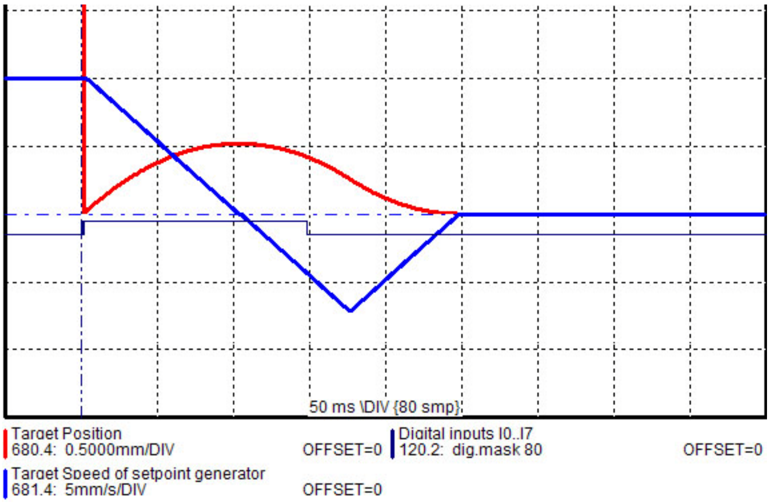
With these values you can define the motion profile of the machine zero run.

4.1.7.3 Positioning after homing run

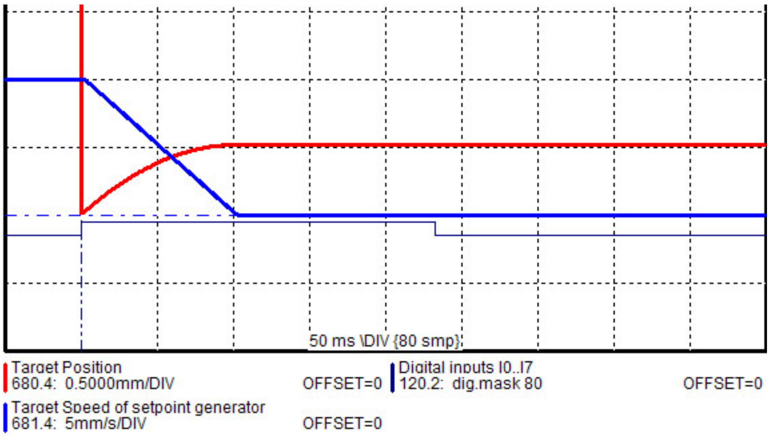
The positioning made after the home switch has been found can be switched off. For this enter in the “machine zero” window in the configuration wizard “no” under “approach MN point after MN run”.

Example Homing (MN) mode 20 (Home on homing (MN) switch) with T40 by homing offset 0

With positioning after homing run The motor stands then on 0:



Without positioning after homing run The position reached is not exactly on 0, as the drive brakes when detecting the home and stops:



4.1.7.4 Travel Limit Settings

Software end limits

The error reaction when reaching the software end limits can be set:

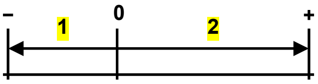
Possible settings for the error reaction are:

- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

If "no reaction" was set, no software limits must be entered.

Software end limits:

The travel range is defined via the negative and positive end limits.



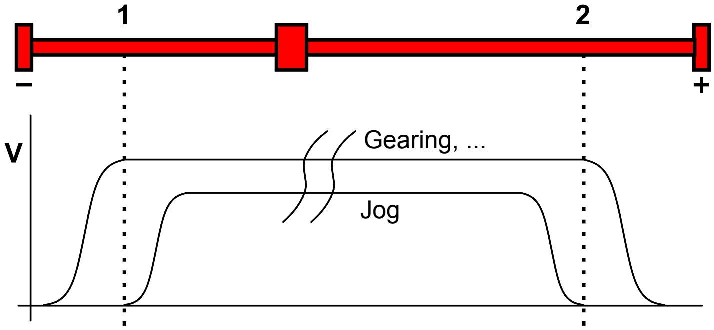
1: negative end limit

2: positive end limit

Software end limit in absolute operating mode

The positioning is restricted to the range between the travel limits.

A positioning order aiming at a target outside the travel range is not executed.



1: negative end limit

2: positive end limit

The reference is the position reference point that was defined with the machine reference and the machine reference offset.

Software end limits in reset mode

The reset mode does not support software end limits

Software end limit in continuous mode

Each individual positioning is confined within the travel limits.

A positioning order aiming at a target outside the software end limits is not executed.

The reference is the respective current position.

Error when disregarding the software end limits

A software end limit error is triggered, if the position value exceeds an end limit. For this, the position setpoint value is evaluated in energized state; in currentless state, the actual position value is evaluated.

Hysteresis in disabled state:

If the axis stands currentless at an end limit, another error may be reported due to position jitter after acknowledging the end limit error. To avoid this, a hysteresis surrounding the end limits was integrated (size corresponds to the size of the positioning window).
Only if the distance between axis and the end limits was larger than the positioning window, another end limit error will be detected

Error codes (see on page 563) of the end limit errors:

0x7323	Error when disregarding the positive software end limit.
0x7324	Error when disregarding the negative software end limit.

Activating / deactivating the end limit error:

In the C3 ServoManager under configuration: End limits, the error can be (de)activated.

For IEC-programmable devices with the "C3_ErrorMask" module.

Behavior after the system is turned on

The end limits are not active after switching on. The end limits do not refer to the position reference point until after a machine reference run.

During homing run the end limits are not monitored.

With a Multiturn encoder or with active Multiturn emulation, the limit is valid immediately after switching on.

Behavior outside the travel range

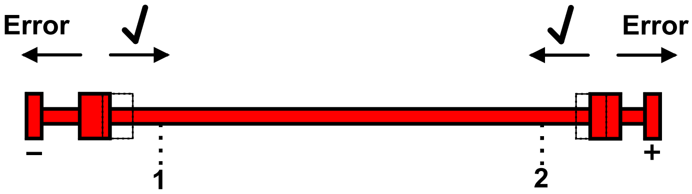
1. If the software end limit errors are deactivated, all movements are possible.

2. If the software end limit errors are activated:

After disregarding the software end limits, an error is triggered. First of all, this error must be acknowledged.

Then a direction block is activated: only motion commands in the direction of the travel range are executed. These will not trigger another error.

Motion commands inciting a movement in the opposite direction of the travel range are blocked and will trigger another error.



1: negative end limit

2: positive end limit

Notes on special feedback systems (Feedback F12)

During automatic commutation, the end limit monitoring is deactivated!

Behavior with software end limits of a referenced axis

	Position within target outside	**Position outside target outside and aiming in the opposite direction of the travel range**	**Position outside target within and aiming in the direction of the travel range**
JOG +/-	◆ Positioning up to the end limits ◆ No Error	◆ No positioning ◆ No Error	◆ Positioning
MC_MoveAbsolute, MC_MoveRelative, MC_MoveAdditive, C3_MoveSuperImposed	◆ No positioning ◆ Error	◆ No positioning ◆ Error	◆ Positioning
MC_GearIn, MC_Cam... C3_Cam...	◆ Positioning up to the end limits, from these on braking with the error ramp. The end limit is exceeded ◆ Error	◆ No positioning ◆ Error	◆ No positioning ◆ Error
MC_MoveVelocity	◆ Positioning up to the end limits ◆ Error	◆ No positioning ◆ Error	◆ Positioning
MC_Home	◆ No monitoring of the software end limits		

The software end limit error can be deactivated in general via the configuration or separately for each end limit via the **C3_Error_Mask** (see on page 442)module.

Hardware end limits

The error reaction when reaching the hardware end limits can be set:

Possible settings for the error reaction are:

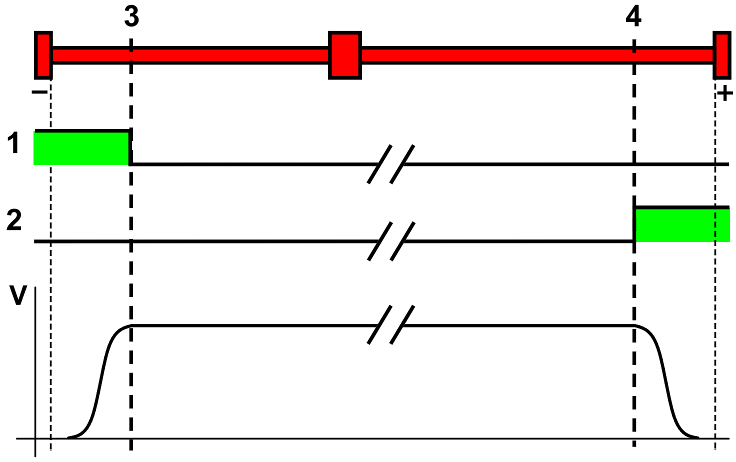
- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

Hardware end limits are realized with the aid of end switches.

These are connected to X12/12 (input 5) and X12/13 (input 6) and can be (de)activated separately in the C3 ServoManager under Configuration: End limits.

After a limit switch has been detected, the drive decelerates with the ramp values set for errors (error code 0x54A0 at X12/12 active, 0x54A1 at X12/13 active) and the motor is switched to currentless.

Please make sure that after the detection of the end switch there is enough travel path left up to the limit stop.



1: Limit switch E5 (X12/12)

2: Limit switch E6 (X12/13)

3: Limit switch position E5 (X12/12)

4: Limit switch position E6 (X12/13)

The **assignment of the end switches** (see on page 146) can be changed!

Please note:

The limit switches must be positioned so that they cannot be released towards the side to be limited.

Limit switch / direction reversal switch

Limit switches functioning as direction reversal switches during homing run, will not trigger a limit switch error.

Behavior in the case of an active limit switch

The error can be acknowledged with activated limit switch.

The drive can then be moved out of the end switch range with a normal positioning.

Both directions of movement are possible.

A direction block can be programmed in the IEC program with the aid of the limit switch bits or the error message.

(De)activate limit switch errors

The limit switch error can be deactivated in general via the configuration or separately for each limit switch via the **C3_Error_Mask module** (see on page 442).

Debouncing: Limit switch, machine zero and input 0

A majority gate is used for debouncing.

The signal is sampled every 0.5ms
The debounce time determines the number of scans the majority gate will perform. If the level of more than half of the signals was changed, the internal status will change.

The debounce time can be set in the configuration wizard within the range of 0 ... 20ms.

The value 0 deactivates the debouncing.

If the debouncing time is stated, the input I0 can be debounced as well (checkbox below).

4.1.7.5 Change assignment direction reversal / limit switches

If this function is not activated, the direction reversal / end switches are assigned as follows:

Direction reversal / limit switch on I5 (X12/12): negative side of the travel range

Direction reversal /limit switch on I6 (X12/13): positive side of the travel range

Change assignment of direction reversal / limit switch is activated

If this function is activated, the direction reversal / limit switches are assigned as follows:

Direction reversal / limit switch on **I5** (X12/12): **positive side** of the travel range

Direction reversal / limit switch on **I6** (X12/13): **negative side** of the travel range

4.1.7.6 Change initiator logic

The initiator logic of the limit switches (this does also apply for the direction reversal switches) and the machine zero initiator can be changed separately.

- Limit switch E5 low active
- Limit switch E6 low active
- Home switch E7 low active

In the basic settings the inversion is deactivated, so that the signals are “high active”.

With this setting the inputs I5 to I7 can even be switched within their logic, if they are not used as direction reversal/limit switches or machine zero.

Possible settings for the error reaction are:

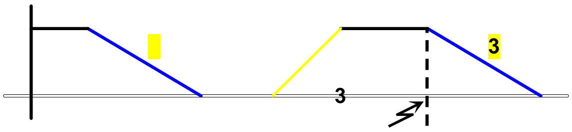
- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

4.1.8. Defining jerk / ramps

In this chapter you can read about:

4.1.8.1 Ramp upon error and stromlos schalten

Ramp (delay) upon error and "stromlos schalten"



3: Deceleration upon error and upon deactivation of **MC_Power** (see on page 301)

Please observe:

The configured error ramp is limited. The error ramp will not be smaller than the deceleration set in the last motion set.

4.1.9. Limit and monitoring settings

In this chapter you can read about:

4.1.9.1 Current (Torque) Limit

The current required by the speed controller is limited to the current limit.

4.1.9.2 Positioning window - Position reached

Position reached indicates that the target position is located within the position window.

In addition to the position window, a position window time is supported. If the actual position goes inside the position window, the position window time is started. If the actual position is still inside the position window after the position window time, "Position reached" is set.

If the actual position leaves the position window within the position window time, the position window time is started again.

When the actual position leaves the position window with Position reached = "1", Position reached is immediately reset to "0".

Position monitoring is active even if the position leaves the position window because of measures taken externally.

4.1.9.3 Following error limit

The error reaction upon a following error can be set:

Possible settings for the error reaction are:

- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

The following error is a dynamic error.

The dynamic difference between the setpoint position and the actual position during a positioning is called the following error. Do not confuse this with the static difference which is always 0; the target position is always reached exactly.

The change of position over time can be specified exactly using the parameters jerk, acceleration and speed. The integrated Setpoint value generator calculates the course of the target position. Because of the delay in the feedback loop, the actual position does not follow the target position exactly. This difference is referred to as the following error.

Disadvantages caused by a following error

When working with a number of servo drives (for example Master controller and slave controller), following errors lead to problems due to the dynamic position differences, and a large following error can lead to positioning overshoot.

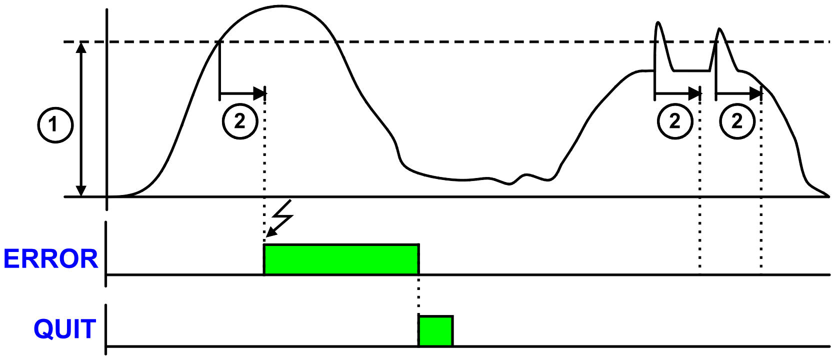
Error message

If the following error exceeds the specified following error limit, the “following error time” then expires. If the following error is even greater than the following error limit at the end of the following error time, an error is reported.

If the following error falls short of the following error limit, a new following error time is then started.

Minimizing the following error

The following error can be minimized with the help of the extended (advanced) control parameters, in particular with the feed forward parameters.



1: Following error limit [parameterized unit]

2: Following Error Time

ERROR: Error output of positioning modules

ACKN: Ackn with MC_Reset module

4.1.9.4 Maximum operating speed

The speed limitation is deduced from the maximum operating speed. In order to ensure control margins, the speed is limited to a higher value.

The speed setpoint value is actively limited to 1.1 times the given value.

If the speed actual value exceeds the preset maximum speed by 21% (=”switching off limit speed”), error 0x7310 is triggered.

4.1.10. Encoder simulation

You can make use of a permanently integrated encoder simulation feature to make the actual position value available to additional servo drives or other automation components.

Caution!

- The encoder simulation is not possible at the same time as the encoder input<ohne_SSI_t> resp. the step/direction input.
  The same interface is used here.
- A direction reversal configured in the C3 ServoManager does not affect the encoder simulation.
  The direction of rotation of the encoder simulation can, however, be changed via the feedback direction in the MotorManager.

Simulated Encoder Output Resolution

<table>
<tr><td>Unit: Increments per revolution / pitch</td><td>Range: 4 - 16384</td><td>Standard value: 1024</td></tr>
<tr><td colspan="3">Any resolution can be set
Limit frequency: 620kHz (track A or B) i.e. , with:</td></tr>
<tr><td>Increments per revolution</td><td colspan="2">max. Velocity</td></tr>
<tr><td>1024</td><td colspan="2">36000 rpm</td></tr>
<tr><td>4096</td><td colspan="2">9000 rpm</td></tr>
<tr><td>16384</td><td colspan="2">2250 rpm</td></tr>
</table>

4.1.10.1 Encoder bypass with Feedback module F12 (for direct drives)

If the feedback module F12 is used, the encoder signals can be placed directly (Bypass) to the encoder interface (X11: same assignment as encoder simulation) for further use. Sine/Cosine signals are directly converted into encoder signals, however no additional zero pulse is generated; an available zero pulse will be transmitted.

The advantage is, that the limit frequency is 5MHz instead of 620kHz (track A or B).

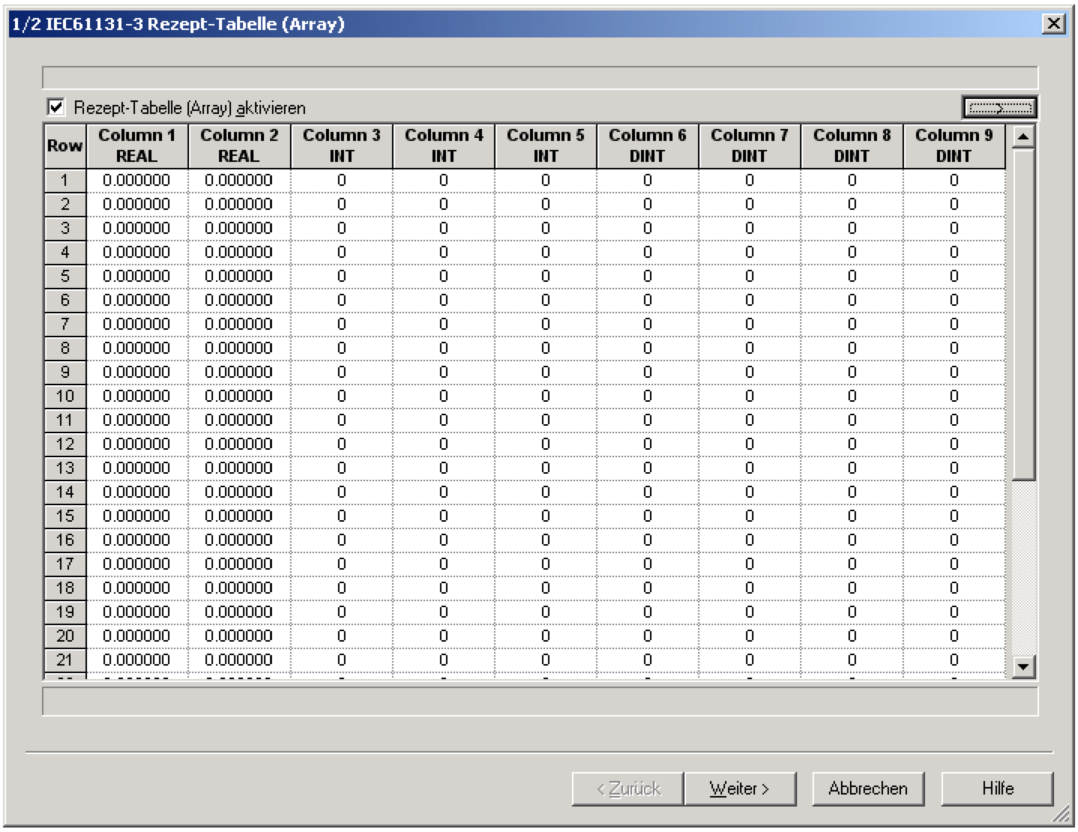
The direction of rotation is only defined via the encoder wiring; a direction inversion configured in the C3 ServoManager does not have any consequence.

4.1.11. Recipe table

If you would like to work with the **Recipe table** (see on page 294),(e.g. for memorizing variable machine data) you can make preassignments in it with Compax3 ServoManager.

Note:

The recipe array can also be loaded separately into the device (>button on the right side).



☑ Rezept-Tabelle (Array) aktivieren

Row	Column 1 REAL	Column 2 REAL	Column 3 INT	Column 4 INT	Column 5 INT	Column 6 DINT	Column 7 DINT	Column 8 DINT	Column 9 DINT
1	0.000000	0.000000	0	0	0	0	0	0	0
2	0.000000	0.000000	0	0	0	0	0	0	0
3	0.000000	0.000000	0	0	0	0	0	0	0
4	0.000000	0.000000	0	0	0	0	0	0	0
5	0.000000	0.000000	0	0	0	0	0	0	0
6	0.000000	0.000000	0	0	0	0	0	0	0
7	0.000000	0.000000	0	0	0	0	0	0	0
8	0.000000	0.000000	0	0	0	0	0	0	0
9	0.000000	0.000000	0	0	0	0	0	0	0
10	0.000000	0.000000	0	0	0	0	0	0	0
11	0.000000	0.000000	0	0	0	0	0	0	0
12	0.000000	0.000000	0	0	0	0	0	0	0
13	0.000000	0.000000	0	0	0	0	0	0	0
14	0.000000	0.000000	0	0	0	0	0	0	0
15	0.000000	0.000000	0	0	0	0	0	0	0
16	0.000000	0.000000	0	0	0	0	0	0	0
17	0.000000	0.000000	0	0	0	0	0	0	0
18	0.000000	0.000000	0	0	0	0	0	0	0
19	0.000000	0.000000	0	0	0	0	0	0	0
20	0.000000	0.000000	0	0	0	0	0	0	0
21	0.000000	0.000000	0	0	0	0	0	0	0

4.1.12. Error response

Under "configuring: Error reaction" you can change the error reaction for individual **errors** (see on page 563) (the error no. which can be influenced is displayed).

Possible settings for the error reaction are:

- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

Note on Compax3H:

The error reaction upon the "low voltage DC" error (0x3222) is fixed to "downramp/deenergize" for Compax3H.

4.1.13. Configuration name / comments

Here you can name the current configuration as well as write a comment.

Then you can download the configuration settings or, in T30 or T40 devices, perform a complete Download (with IEC program and curve).

⚠	**Caution!** Deactivate the drive before downloading the configuration software! **Please note!** Incorrect configuration settings entail danger when activating the drive. Therefore take special safety precautions to protect the travel range of the system.

⚠	**Mechanical limit values!** Observe the limit values of the mechanical components! Ignoring the limit values can lead to destruction of the mechanical components.

4.2 Configuring the signal source

In this chapter you can read about:

Possible master signal sources

Under the tree entry “Configuring the signal source” of the C3 ServoManager you can configure the signal sources for Master - Slave applications.

The master signal source can then be selected in the IEC program with the aid of the **C3_MasterControl** (see on page 372) module via the input “Master”.

The following signal sources are available:

- Physical source
  - analog value above +/-10V
  - Encoder signal A/B (5V)
  - Step/Direction signal (5V)
  - SSI - Geber
- Internal **virtual master** (see on page 300) (IEC program) (only T40)
- HEDA

Note on Compax3 firmware versions < 2.05

The "use as current signal source" CheckBox can be found in the signal source configuration wizards.

This CheckBox is only relevant for the Compax3 firmware versions <V2.05; it is used to define the signal source for the CoDeSys program.

Otherwise, the signal source is directly selected at the IEC module.

4.2.1. Signal source of the load feedback system

Configuration of the **load control** (see on page 158) (Dual Loop Option)

4.2.2. Physical Source

In this chapter you can read about:

4.2.2.1 Encoder A/B 5V, step/direction or SSI feedback as signal source

Caution!

- The encoder simulation is not possible at the same time as the encoder input<ohne_SSI_t> resp. the step/direction input.
  The same interface is used here.
- A direction reversal configured in the C3 ServoManager does not affect the encoder simulation.
  The direction of rotation of the encoder simulation can, however, be changed via the feedback direction in the MotorManager.

The dimensional reference to the master is established via the following settings:

- Travel distance per motor revolution (or pitch for linear motors) master axis numerator
  With denominator = 1 the value can be entered directly.
  Long-term drift can be avoided by entering non-integral values integrally as a fraction with numerator and denominator.
- Travel per motor revolution (or pitch of linear motors) master axis denominator
- Increments per revolution of the master axis

If required the direction of rotation of the master axis read in can be changed.

Example: Electronic gearbox with position detection via encoder

Reference to master axis

The reference to the master axis is established via the increments per revolution and the travel path per revolution of the master axis (corresponds to the circumference of the measuring wheel).

That is:

$$\text{MasterPos} = \frac{\text{Master\_I}}{\text{I\_M}} * \frac{\text{Travel Distance per Master Axis revolution (M\_Units/rev)}}{\text{Travel Distance per Master Axis revolution - Denominator}} \quad (1)$$

MasterPos: Master Position

Master_I: master increments read in

I_M: Increments per revolution of the master axis

External signal source

Encoder with 1024 increments per master revolution and a circumference of the measuring wheel of 40mm.

Settings:

Travel path per revolution of the master axis numerator = 40

Travel path per revolution of the master axis denominator = 1

Increments per revolution of the master axis = 1024

Configuration wizard:

Reference system of Slave axis: Unit of measure [mm]

Travel path per revolution numerator = 1

Travel path per revolution denominator = 1

Gearing:

Gearing numerator = 2

Gearing denominator = 1

This results in the following interrelations:

If the measuring wheel moves by 40mm (1 master revolution), the slave axis will move by 80mm.

$$\text{Slave unit} = \text{MasterPos} * \frac{\text{Gearing numerator}}{\text{Gearing denominator}} \quad (2)$$

(1) set into (2) and with numerical values results with 1024 increments read in (=1 Master revolution):

$$\text{Slave unit} = 1024 * \frac{1}{1024} * \frac{40\text{mm}}{1} * \frac{2}{1} = 80\text{mm}$$

Master - Position = +40mm => Slave - Position = +80mm

Structure:

Master	Z1	MasterPos	Gearing numerator	Slave -	N2	Slave_U	Gearbox	Load
	N1		Gearing denominator	Units	Z2	to motor		

Detailed structure image (see on page 328)

with:

$$MD = \frac{Z1}{N1} * \frac{\text{Travel Distance per Master Axis revolution (M\_Units/rev)}}{\text{Travel Distance per Master Axis revolution - Denominator}}$$

Entry in the “configuration of the signal source” wizard

$$SD = \frac{Z2}{N2} * \frac{\text{Travel path per revolution slave axis numerator}}{\text{Travel path per revolution slave axis denominator}}$$

Entry in the “configuration of the signal source” wizard

MD: Feed of the master axis

SD: Feed of the slave axis

SSI configuration

Notes on the SSI sensor **(see on page 155)**

- With Multiturn: Number of sensor rotations with absolute reference
- Word length: Gives the telegram length of the sensor.
- Baud rate/step: Max. transmission rate of the path measurement system.
- Gray code: Sensor gray code coded yes/no (if no binary coded).

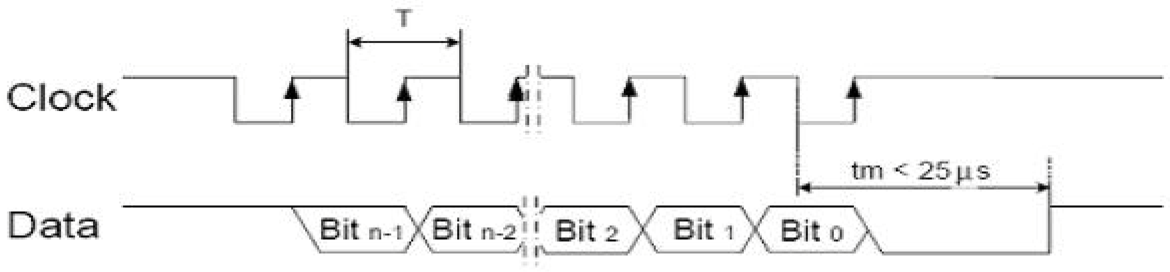
Note:

The absolute position is not evaluated!

It is available in the objects 680.24 (load position) and 680.25 (master position) (C3T30, C3T40).

General requirements for supported SSI feedbacks

- Baud rate: 350k ... 5MBaud
- Word length: 8 ... 32 Bit
- Binary or gray code (start value = 0)
- Initialization time after PowerOn: < 1.1s
- Signal layout:



The most significant bit must be transmitted the first!

Caution!Feedback systems, transmitting data containing error or status bits are not supported!

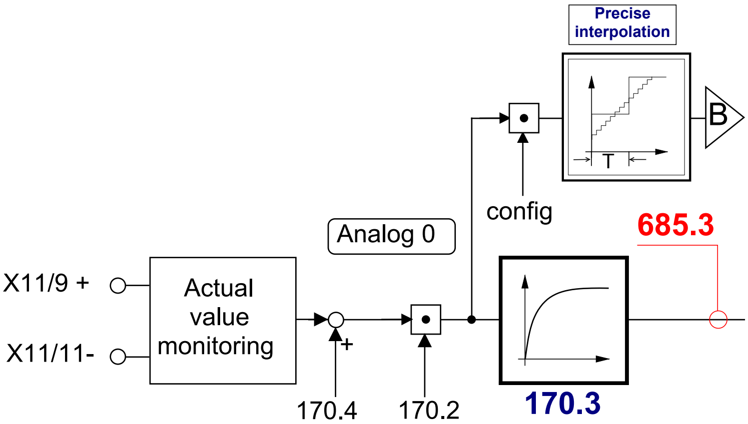
- Examples of supported SSI feedback systems:
  - IVO / GA241 SSI;
  - Thalheim / ATD 6S A 4 Y1;
  - Hübner Berlin / AMG75;
  - Stegmann / ATM60 & ATM90;
  - Inducoder / SingleTurn: EAS57 & Multiturn: EAMS57

4.2.2.2 +/-10V Master speed

Via Analogkanal 0 (X11/9 und X11/11) the speed of the master is read in.

From this value a position is internally derived.

Signal processing of the analog input 0



B: **Continuative structure image** (see on page 237)

The reference to the master is established with the velocity at 10V.

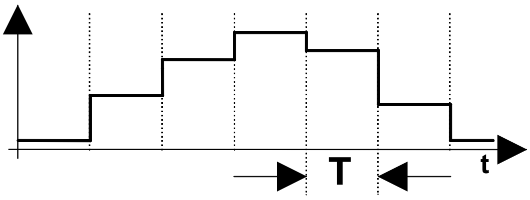
If required the direction of rotation of the master axis read in can be changed.

Zeitraster Signalquelle Master

Averaging and a following filter (interpolation) can help to avoid steps caused by discrete signals.

If the external signal is analog, there is no need to enter a value here (Value = 0).

For discrete signals e.g. from a PLC, the scanning time (or cycle time) of the signal source is entered.



This function is only available if the analog interface +/-10V is used!

4.2.3. Internal virtual master

Only Compax3 T40!

The reset distance of the virtual master is only used for resetting the displayed value (Object680.2).

The travel per motor revolution of the master axis (numerator/denominator) is set to 1 for a virtual master.

If required the direction of rotation of the master axis read in can be changed.

4.2.4. Fieldbus master

Only for Compax3 with the following fieldbusses:

- CanOpen
- Ethernet Powerlink
- EtherCAT

If required the direction of rotation of the master axis read in can be changed.

4.2.5. HEDA Master signal source

Please choose if the virtual master of the HEDA master is transmitted via the HEDA.

If yes, the input “travel per revolution” is not necessary, as a positioning signal is already present.

The dimensional reference to the master is established via the following settings:

- Travel distance per motor revolution (or pitch for linear motors) master axis numerator
  With denominator = 1 the value can be entered directly.
  Long-term drift can be avoided by entering non-integral values integrally as a fraction with numerator and denominator.
- Travel per motor revolution (or pitch of linear motors) master axis denominator

If required the direction of rotation of the master axis read in can be changed.

4.3 Load control

In this chapter you can read about:

The load control can be activated via an additional feedback system for the acquisition of the actual position of the load.

This helps for example compensate the slip between material and roller or non-linearities of the mechanic parts.

The load position is set to the demand position.

Please note:

- This function is not available in the C3I10T10 and C3I11T11 devices.
- As a sensor signal, **Encoder** (see on page 629) with A/B track, Step/Direction signal or SSI - sensor is supported.
- This controller structure improves the stationary precision at the load after the decay of all control movements.
  An increase of the dynamic precision (faster transient response) can in general not be reached with the "load control" structure variant.

Notes on the SSI sensor **(see on page 155)**

- With Multiturn: Number of sensor rotations with absolute reference
- Word length: Gives the telegram length of the sensor.
- Baud rate/step: Max. transmission rate of the path measurement system.
- Gray code: Sensor gray code coded yes/no (if no binary coded).

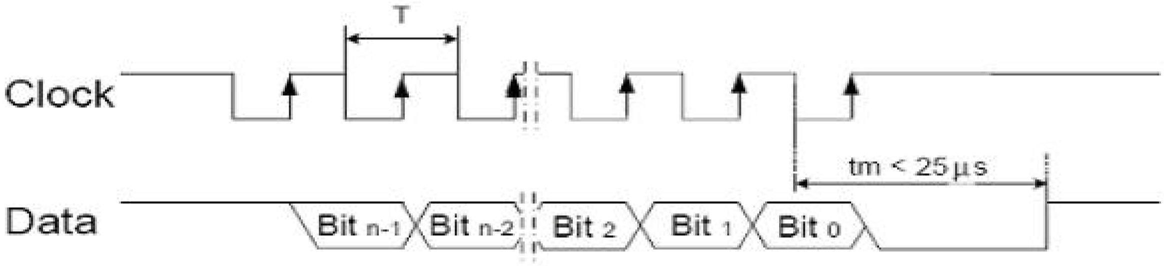
Note:

The absolute position is not evaluated!

It is available in the objects 680.24 (load position) and 680.25 (master position) (C3T30, C3T40).

General requirements for supported SSI feedbacks

- Baud rate: 350k ... 5MBaud
- Word length: 8 ... 32 Bit
- Binary or gray code (start value = 0)
- Initialization time after PowerOn: < 1.1s
- Signal layout:



The most significant bit must be transmitted the first!

Caution!Feedback systems, transmitting data containing error or status bits are not supported!

- Examples of supported SSI feedback systems:
  - IVO / GA241 SSI;
  - Thalheim / ATD 6S A 4 Y1;
  - Hübner Berlin / AMG75;
  - Stegmann / ATM60 & ATM90;
  - Inducoder / SingleTurn: EAS57 & Multiturn: EAMS57

4.3.1. Configuration of load control

Configuration in the "configure signal source" wizard under "load feedback system":

- The selection of the feedback signal activates the acquisition and the signals are available as **status values** (see on page 161).
- Rotatory or linear feedback systems are supported.
- Input values for rotatory feedback systems:
  - Increments per feedback revolution (physical, without quadruplication)
  - Direction reversal
    Attention!With wrong sense of direction and active load control, you will get a positive feedback; the motor will accelerate in an uncontrolled way
    Solution: Before the load control is activated, the signals must be checked with the aid of the **status values** (see on page 161) and secured against wrong sense of direction by configuring a "maximum difference to motor position" (O410.6).
  - Load travel per feedback revolution: Is used for establishing the measure reference between load- and motor position.
    The value can be configured very precisely by entering numerator and denominator.
- Input values for linear feedback system
  - Feedback resolution (physical, without quadruplication)
    Position difference, which corresponds to a cycle duration of the feedback signal.
  - Direction reversal
    Attention!With wrong sense of direction and active load control, you will get a positive feedback; the motor will accelerate in an uncontrolled way
    Solution: Before the load control is activated, the signals must be checked with the aid of the **status values** (see on page 161) and secured against wrong sense of direction by configuring a "maximum difference to motor position" (O410.6).
  - Scaling factor for an additional adaptation of the feedback signal (is normally not required = 1)
- Maximum difference tot he motor position
  Upon exceeding this value, Compax3 will report **error 7385hex** (see on page 161) (29573dec)
- Intervention limitation (=2201.13 in % of the reference velocity or reference speed);
  only active with position controller I component switched off (O2200.25=0)
  You can use this specification in order to limit position correction intervention, i.e. to limit the velocity correction factor resulting from the position difference. This can be especially sensible during the acceleration phase, if the material slips because of too high corrective velocities.
- Activate / Deactivate load control

Attention!

The load control is immediately active after the configuration download! Please do only activate after checking the load position signal (scaling, direction, value).

Alignment of the load control:

There is an **Alignment of the position values** of motor and load under the following operating conditions (Load position = Motor position):

- During a **Machine zero run** the load control is deactivated until the position value 0 (defined via the machine zero offset) was approached.
  Then an alignment of the position values is performed and the load control is activated.
- After switching on Compax3.
- When writing "1" into object 2201.2
- When activating the load control.

Continuous mode

In continuous operation (object 1111.8 <> 0) an alignment of the position values of motor and load (load position = motor position) takes place upon each new positioning command.

Application: e.g. roller feed

4.3.2. Error: Position difference between load mounted and motor feedback too high

The (unfiltered) position difference between motor feedback and load feedback has exceeded the "maximum difference to motor position" value (O410.6)

The load position in the position controller is deactivated.

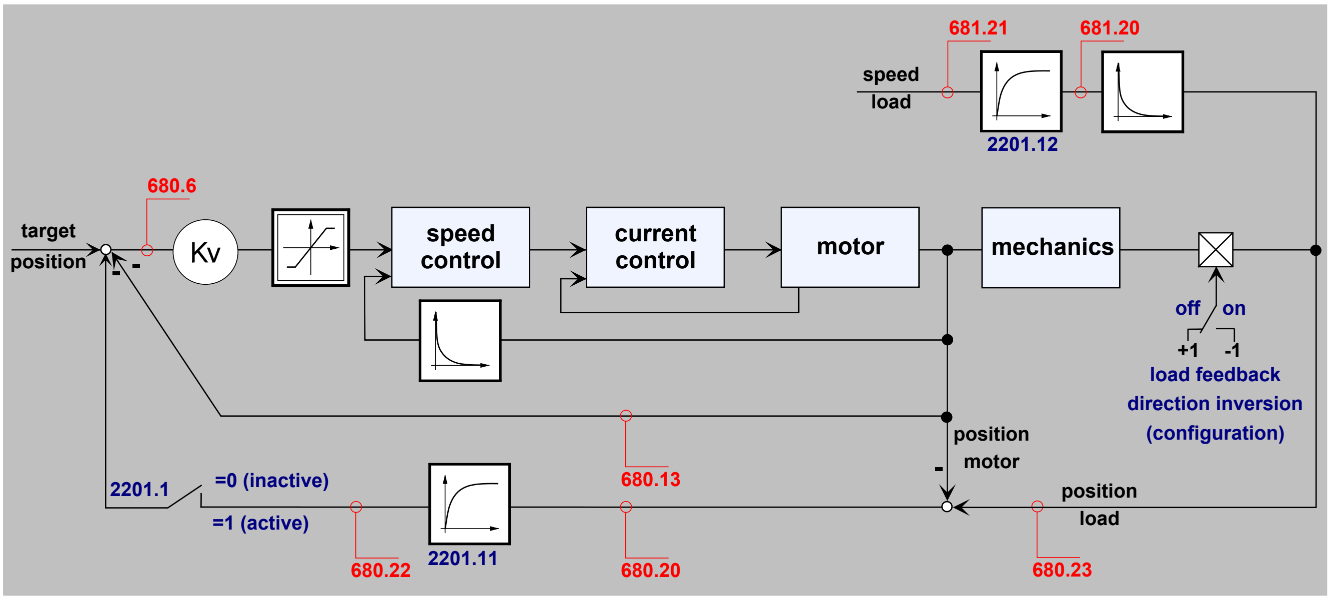
In order to re-activate the function (after eliminating the cause of the error), you have the following possibilities:

- Activate function in configuration and perform configuration download or enter True (-1) into O2201.1
- Perform Ackn and/or Homing (function becomes effective after homing run).

Caution!

The position difference is aligned to zero when switched on again, i.e. the original position reference is lost. Therefore it is advisable to approach the reference point again in this case (Machine zero run or Homing).

4.3.3. Load control signal image



4.3.3.1 Object for the load control (overview)

No.	Object name	Object	Format	PD	Valid beginning
410.6	C3.LimitPosition_LoadControlMaxPosDiff	Position difference load-motor (error threshold)	C4_3	no	VP
680.23	C3.StatusPosition_LoadControlActual	Actual position of the load	C4_3	no	-
680.20	C3.StatusPosition_LoadControlDeviation	Position difference load-motor (unfiltered)	C4_3	no	-
680.22	C3.StatusPosition_LoadControlDeviationFiltered	Position difference load-motor (filtered)	C4_3	no	-
680.21	C3.StatusPosition_LoadControlDeviationMax	Maximum position difference load-motor	C4_3	no	-
681.20	C3.StatusSpeed_LoadControl	Speed of the load feedback (unfiltered)	C4_3	no	-
681.21	C3.StatusSpeed_LoadControlFiltered	Speed of the load feedback (filtered)	C4_3	no	-
2201.2	C3Plus.LoadControl_Command	Load control command mode	I16	no	immediately
2201.1	C3Plus.LoadControl_Enable	Activate Load control	I16	no	immediately
2201.11	C3Plus.LoadControl_FilterDenominator	Time constant of position difference filter	U32	no	VP
2201.3	C3Plus.LoadControl_Status	Load control status bits	I16	no	-
2201.12	C3Plus.LoadControl_VelocityFilter	Time constant of the load-speed filter for the load feedback	I16	no	VP

4.3.3.2 Objects for load control

Detailed information on the topic of "objects for load control" can be found in the online help of the device.

4.4 Optimization

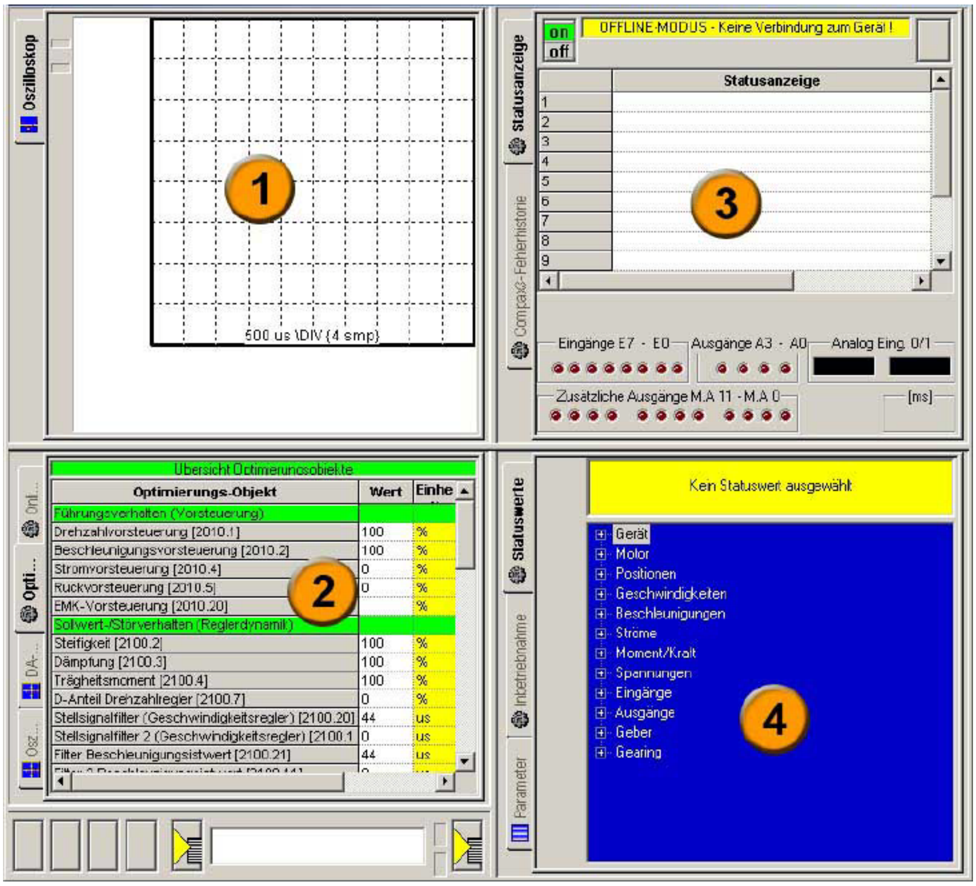
In this chapter you can read about:

- Select the entry **"Optimization"** in the tree.
- Open the optimization window by clicking on the **"Optimization Tool"** button.

4.4.1. Optimization window

Layout and functions of the optimization window

Segmentation	**Functions (TABs)**
Window1:	◆ **Oscilloscope** (see on page 165)
Window 2:	◆ Optimization: Controller optimization ◆ **D/A Monitor** (see on page 562): Output of status values via 2 analog outputs ◆ Scope Settings
Window 3:	◆ Status Display ◆ Compax3 Error History
Window 4:	◆ Status values ◆ Commissioning: **Setup mode** (see on page 242) with **load identification** (see on page 245) ◆ Parameters for commissioning, test movements (relative & absolute) and for load identification.



OFFLINE-MODUS - Keine Verbindung zum Gerät !

Übersicht Optimierungsobjekte

Optimierungs-Objekt	Wert	Einhe
Führungsverhalten (Vorsteuerung)		
Drehzahlvorsteuerung [2010.1]	100	%
Beschleunigungsvorsteuerung [2010.2]	100	%
Stromvorsteuerung [2010.4]	0	%
Ruckvorsteuerung [2010.5]	0	%
EMK-Vorsteuerung [2010.20]		%
Sollwert-/Störverhalten (Reglerdynamik)		
Steifigkeit [2100.2]	100	%
Dämpfung [2100.3]	100	%
Trägheitsmoment [2100.4]	100	%
D-Anteil Drehzahlregler [2100.7]	0	%
Stellsignalfilter (Geschwindigkeitsregler) [2100.20]	44	us
Stellsignalfilter 2 (Geschwindigkeitsregler) [2100.1	0	us
Filter Beschleunigungsistwert [2100.21]	44	us

Kein Statuswert ausgewählt

4.4.2. Scope

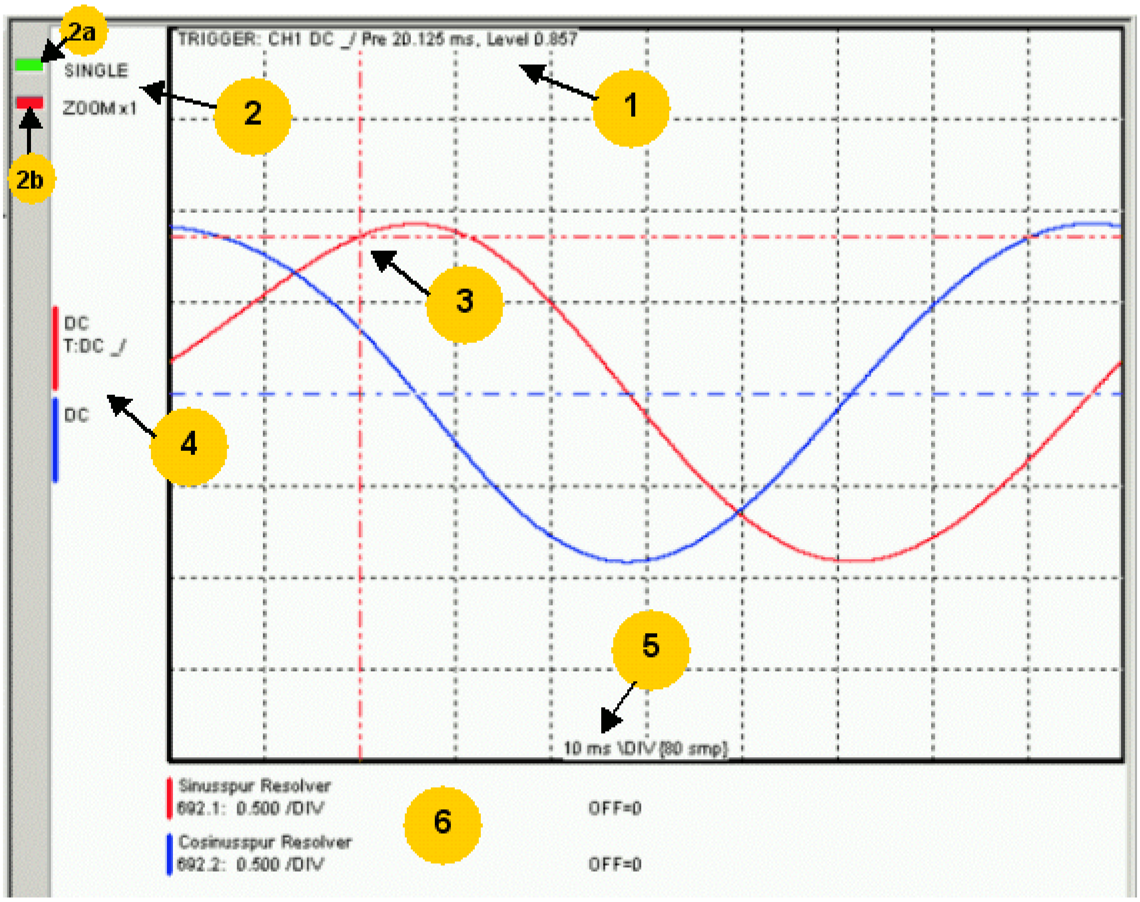
In this chapter you can read about:

The integrated oscilloscope function features a 4-channel oscilloscope for the display and measurement of signal images (digital and analog) consisting of a graphic display and a user interface.

Special feature:

In the single mode you can close the ServoManager after the activation of the measurement and disconnect the PC from Compax3 and upload the measurement into the ServoManager later.

4.4.2.1 Monitor information



1: Display of the trigger information

2: Display of the operating mode and the zoom setting

- **2a:** Green indicates, that a measurement is active (a measurement can be started or stopped by clicking here).
- **2b:** Active channel: The active channel can be changed sequentially by clicking here (only with valid signal source).

3: Trigger point for Single and Normal operating mode

4: Channel information: Type of display and trigger setting

5: X-DIV: X deviation set

6: Single channel sources

Cursor modes -functions

Depending on the operating mode, different cursor functions are available within the osci monitor.

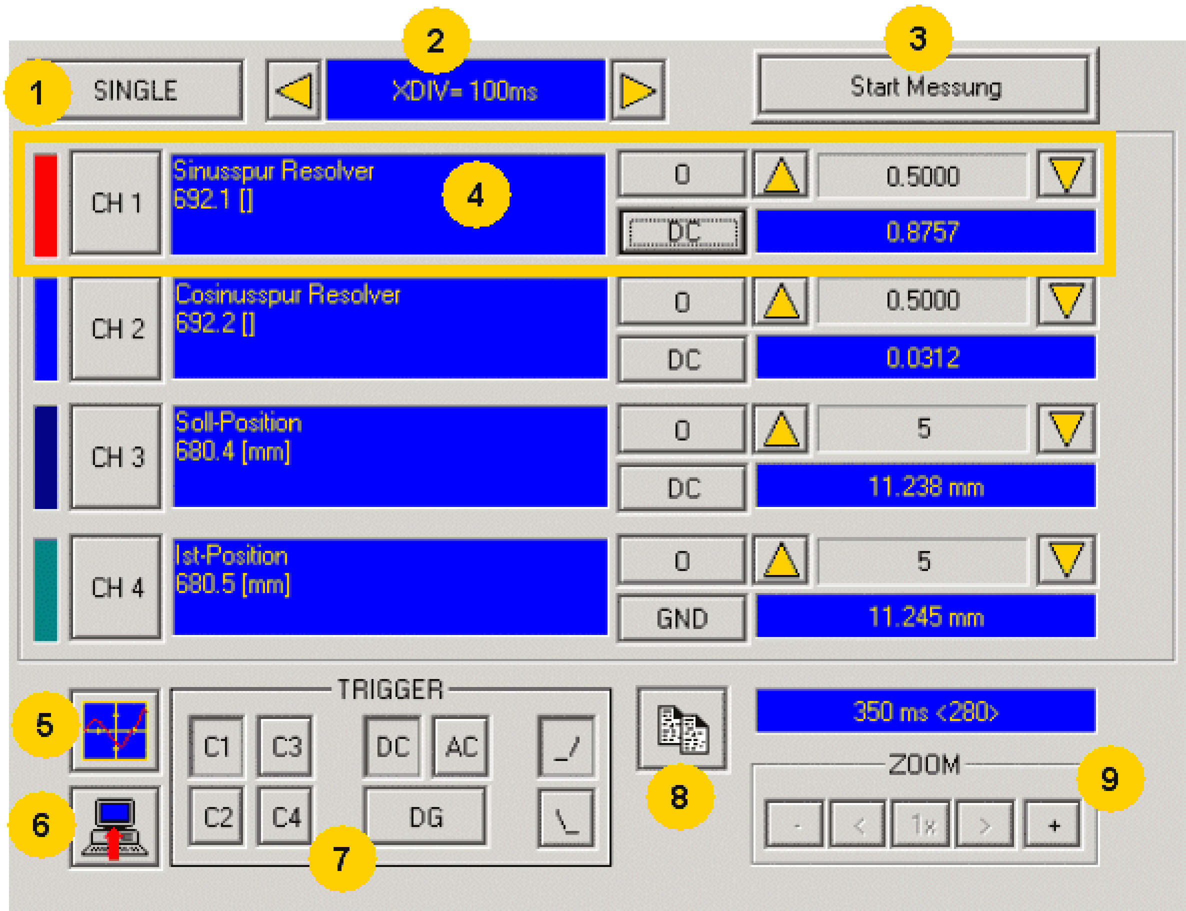
The functions can be changed sequentially by pressing on the right mouse button.

Cursor Symbol	**Function**
M 1	Set Marker 1 the measurement values of the active channel as well as the Y difference to marker 2 are displayed
M 2	Set Marker 2
Moff	Delete and hide marker
↕0 ↕0	Move offset of the active channel. The yellow symbol indicates that the scrolling is active.
T	Set trigger level and pretrigger

In the ROLL operating mode, marker functions and set trigger level positions are not available.

4.4.2.2 User interface

In this chapter you can read about:



1: **Operating mode switch** (see on page 167) (Single / Normal / Auto / Roll)

2: **Setting the time basis** (see on page 167)

3: Starting / Stopping the measurement (prerequisites are valid channel sources and if necessary valid trigger settings.)

4: **Setting channel** (see on page 168) (Channels 1 ...4)

5: **Special functions** (see on page 169) (Color settings; memorizing settings and measurement values)

6: Loading a measurement from Compax3: in the single mode you can close the ServoManager after the activation of the measurement and disconnect the PC from Compax3 and upload the measurement later.

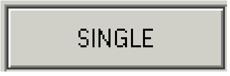
7: **Setting triggering** (see on page 169)

8: Copy osci display to clipboard

9: Zoom of the osci display (1, 2, 4, 8, 16 fold) with the possibility to shift the zoom window (<,>)

Oscilloscope operating mode switch:

Oscilloscope operating mode switch:



Selection of the desired operating mode: SINGLE, NORMAL; AUTO and ROLL by clicking on this button.

Changing the operating mode is also permitted during a measurement. The current measurement is interrupted and started again with the changed settings.

The following operating modes are possible:

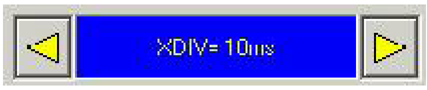
Operating mode	**Short description**
SINGLE	Single measurements of 1-4 channels with trigger on a freely selectable channel
NORMAL	Like Single, but after each trigger event, the measurement is started again.
AUTO	No Trigger. Continuous measuring value recording with the selected scanning time or XDIV setting
ROLL	Continuous measuring value recording of 1 .. 4 channels with selectable scanning time and a memory depth of 2000 measuring values per channel.

With SINGLE / NORMAL / AUTO, the measurement is made in Compax3 and is then loaded into the PC and displayed.

With ROLL, the measuring values are loaded into the PC and displayed continuously.

Setting the time basis XDIV

Setting the time basis XDIV



Depending on the selected operating mode, the time basis can be changed via the arrow keys.

For the operating modes SINGLE, NORMAL and AUTO, the following XDIV time settings are possible:

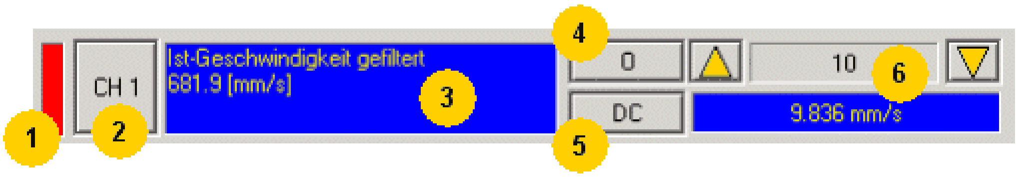
XDIV	Mode	Scanning time	Samples DIV/TOTAL	Measuring time
0.5ms	1	125us	4/40	5ms
1.0ms	2	125µs	8/80	10ms
2.0ms	3	125µs	16/160	20ms
5.0ms	4	125µs	40/400	50ms
10.0ms	5	125µs	80/800	100ms
20.0ms	6	250µs	80/800	200ms
50.0ms	7	625µs	80/800	500ms
100.0ms	8	1.25ms	80/800	1s
200.0ms	9	2.50ms	80/800	2s
500.0ms	10	6.25ms	80/800	5s
1s	11	12.50s	80/800	10s
2s	12	25.00ms	80/800	20s
5s	13	62.50ms	80/800	50s
10s	14	125.00ms	80/800	100s

For the operating ROLL, the following XDIV time settings are possible:

XDIV	Mode	Scanning time	Samples DIV/TOTAL
2 ms	54	125us	200/2000
2ms	54	125µs	200/2000
4ms	55	125µs	200/2000
10ms	56	125µs	200/2000
20ms	57	125µs	200/2000
40ms	58	125µs	200/2000
100ms	59	250µs	200/2000
200ms	60	625µs	200/2000

Changing the time basis is also permitted during an OSCI measuring sequence. This means, however, that the current measurement is interrupted and started again with the changed settings.

Settings for channels 1..4



1: Select channel color

2: Open menu for channel-specific settings

- **Resetting channel CH 1..4:** All channel settings are deleted.
  Please note: Channels can only be filled with sources one after the other. It is, for example, not possible to start a measurement which has only a signal source for channel 2!
- **Select channel color:**Here you can change the color of the channel.
- **Show/hide channel:**Hide/show display of the channel.
- **Change logic display mask:**Mask bits in logic display.
- **Autoscale:**Calculating YDIV and offset: The program calculates the best settings for YDIV and channel offset in order to display the complete signal values optimally.

3: Set signal source with object name, number and if necessary unit

- Define source: Draw the desired status object with the mouse (drag & drop) from the "Status value" window (right at the bottom) into this area.
  Multiple oscilloscope in Compax3M: select device in addition to the object.

4: Set Channel offset to 0

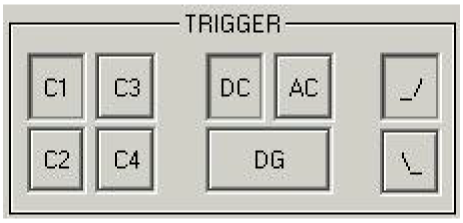
5: Select channel display (GND, DC, AC, DIG)

- **DC:**Display of the measurement values with constant component
- **AC:**Display of the measurement values without constant component
- **DIG:**Display of the individual bits of an INT signal source.
  The displayed bits can be defined via the logic display mask.
- **GND:**A straight line is drawn on the zero line.

6: Set Y-amplification (YDIV)

Change of the Y amplification YDIV in the stages 1, 2, 5 over all decades.
Arrow upwards increases YDIV, arrow downwards diminishes YDIV.
The standard value is 1 per DIV.
The measurement value of the channel at the cursor cross is displayed.

Trigger settings



Select trigger channel: Buttons C1, C2, C3, C4

Select trigger mode: DC, AC, DG

Selecting the trigger edge: Rising_/ or falling _.

The pretrigger as well as the trigger level are set by clicking on the trigger cursor (

) directly in the OSCI display.

Special functions

Menu with special oscilloscope functions such as memorizing or loading settings.

Functions:

- **Select background color:**Adapt background color to personal requirements.
- **Select grid color:**Adapt grid color to personal requirements.
- **Memorize OSCI settings in file:** The settings can be memorized in a file on any drive. The file ending is *.OSC.
- The format corresponds to an INI file and is presented in the appendix.
- **Open OSCI settings from file:**Loading a memorized set of settings. The file ending is *.OSC.
- **Memorizing OSCI settings in the project:**Up to four sets of OSCI settings can be memorized in the current C3 ServoManager project. .
- **Open OSCI settings from project:**If settings were memorized in the project, they can be read in again.
- **Memorize OSCI measurement in file:**Corresponds to memorizing the setting; the measurement values of the measurement are stored in addition. Thus it is possible to memorize and read measurements completely with settings. The file ending is *.OSM.
- **Export measure samples to csv file:**e.g. for reading into Excel.

4.4.2.3 Example: Setting the Oscilloscope

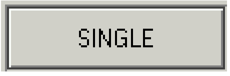
SINGLE measurement with 2 channels and logic trigger on digital inputs

The order of the steps is not mandatory, but provides a help for better understanding.

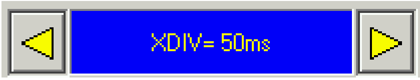
As a rule, all settings can be changed during a measurement. This will lead to an automatic interruption of the current measurement and to a re-start of the measurement with the new settings:

Assumption: A test movement in the commissioning mode is active.

1.) Select OSCI operating mode



2.) Select Time basis XDIV



3.) Select channel 1 signal source digital inputs 120.2 from status tree with the aid of Drag & Drop

4.) Select channel 2 (filtered actual speed) via "Drag and drop" from the status tree

5.) Set trigger to channel 1 and DG.

Input of the mask in HEX

Triggering a rising edge to input I1.

BIT 0 (value 1) = I0

BIT 1 (value 2) = I1

BIT 2 (value 4) = I2 etc.

Trigger to input	I0	I1	I2	I3	I4	I5	I6	I7
Trigger mask in hex	1	2	4	8	10	20	40	80

The masks can also be combined so that the trigger is only active, if several inputs are active. Example: Triggering to I2 and I5 and I6 -> 4h + 20h + 40h = 64h

The mask for input I1 is in this case 2.

Select rising edge.

NOTE: If the trigger mask DG (digital) is selected for a channel, the display mode of the trigger channel is automatically set to DIG display.

6.) Start measurement

7.) Set pretrigger in the OSCI window

Note: There is no level for the DIG trigger. The the event limit determines the mask

If a trigger event occurs, the measurement values are captured until the measurement is completed.

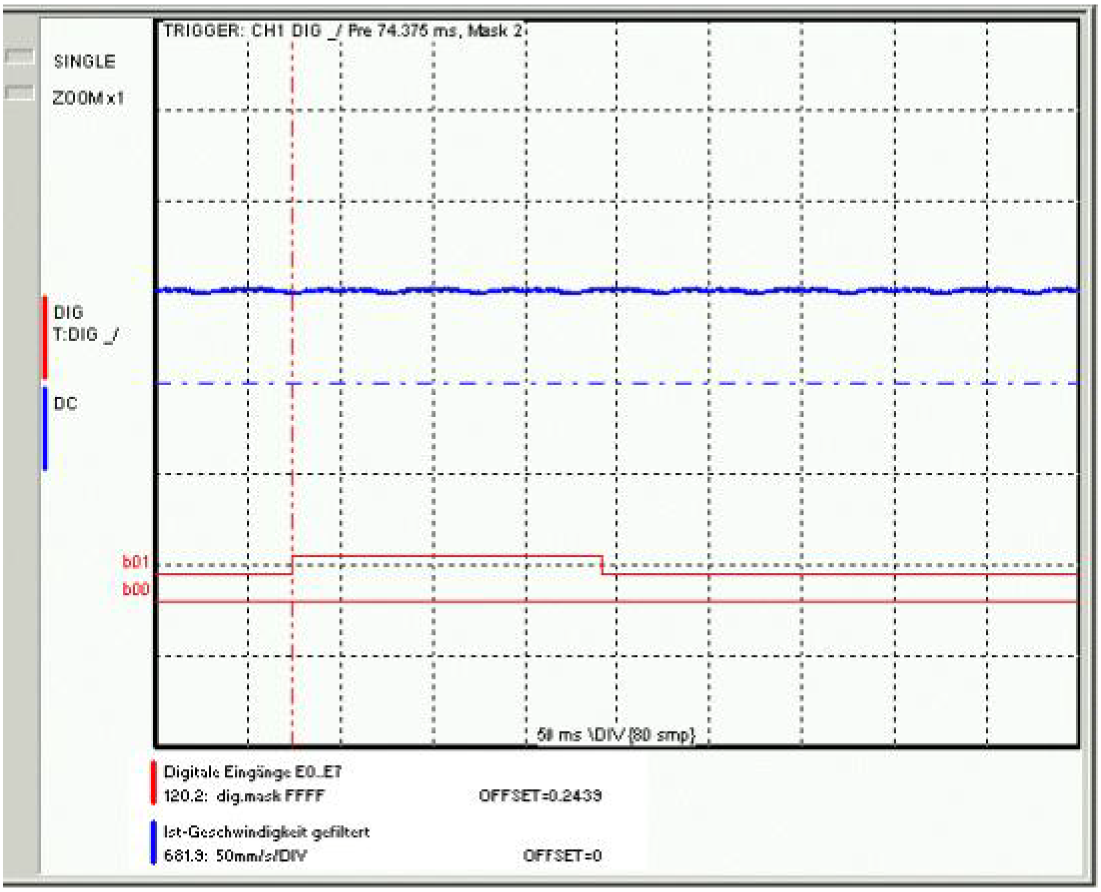
Afterwards, the measurement values are read from the Compax3 and displayed.

The display mask of trigger channel 1 was not yet limited, therefore it shows all 16 bit tracks (b0...b15). In order to limit it to 8 bit tracks, you must call up the menu for channel 1 via [CH1] and select "change logic of display mask [H].

Limit the display mask to 8 bit tracks with Mask FFh.

In the display the bit tracks b0 to b7 are now shown:

Example: Only b0 and b1 are to be displayed: Set display mask to 03



TRIGGER: CH1 DIG _/ Pre 74.375 ms, Mask 2

Digitale Eingänge E0..E7
120.2: dig.mask FFFF OFFSET=0.2439

Ist-Geschwindigkeit gefiltert
681.9: 50mm/s/DIV OFFSET=0

4.4.3. Controller optimization

In this chapter you can read about:

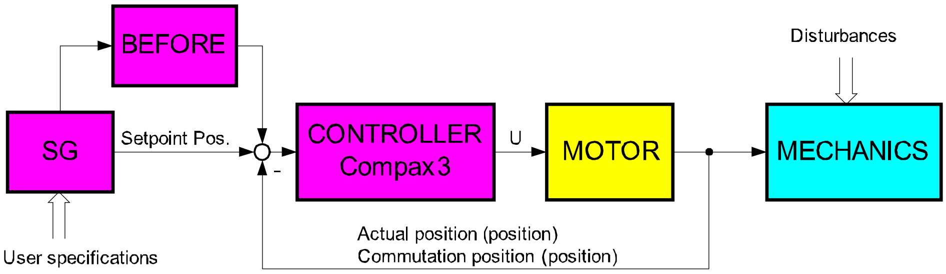
4.4.3.1 Introduction

In this chapter you can read about:

Basic structure of the control with Compax3

Compax3 is an intelligent servo drive for different applications and dynamic motion sequences.

Basic structure of a control with the Compax3e servo drive

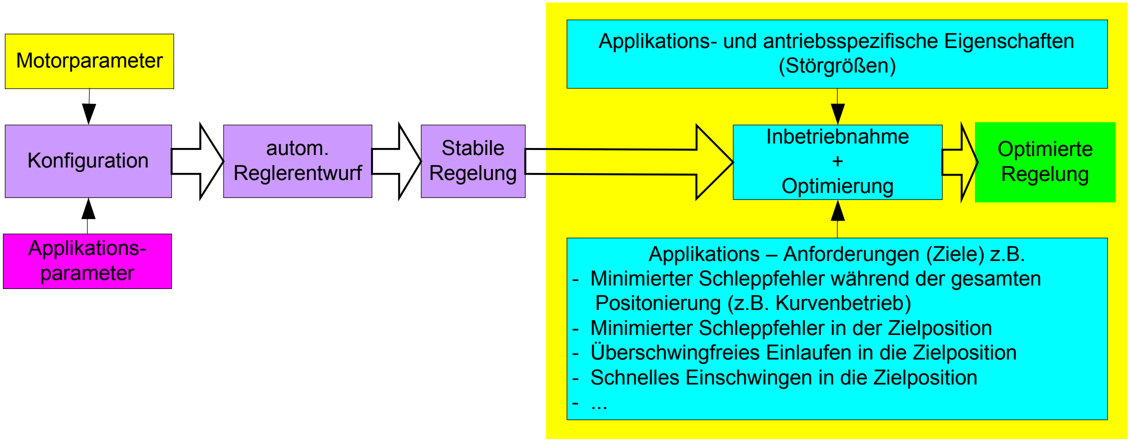


SG: **Command value generator**
BEFORE: **Feed Forward**

As shown in the above figure, the programmed motion sequences are generated by the internal Compax3 setpoint generator. The setpoint position as well as the other status values of the feedforward control are made available to the position controller in order to keep the following error as small as possible.

For the control, Compax3 requires on the one hand the actual position and on the other hand the commutation position, which represents the reference between the mechanic feedback position and the motor magnet.

Proceeding during configuration, setup and optimization



Overview of the processes during configuration and setup of the Compax3 drive system

The controller default settings are calculated from the configured motor and application parameters with the aid of the automatic controller design which runs in the background.

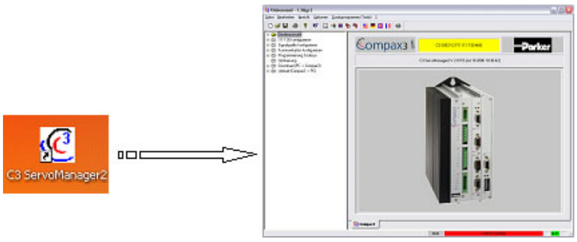
These controller presettings provide normally for a stable and robust control. Due to continually rising application requirements, this presetting is often not sufficient, so that further optimization of the control behavior is necessary.

This manual describes the setup and optimization procedure for Compax3.

In order to better understand the correlations and interactions, we will describe in the first step the individual correlations and physical values, that are required for the configuration and the prespecification of the control loops. In the following, the manual will then describe the function blocks for the optimization implemented in the servo drive as well as the setup tool.

Software for supporting the configuration, setup and optimization

In this chapter you can read about:



The entry of the motor and application parameters is made with the C3 ServoManager2 (C3Mgr2.exe):

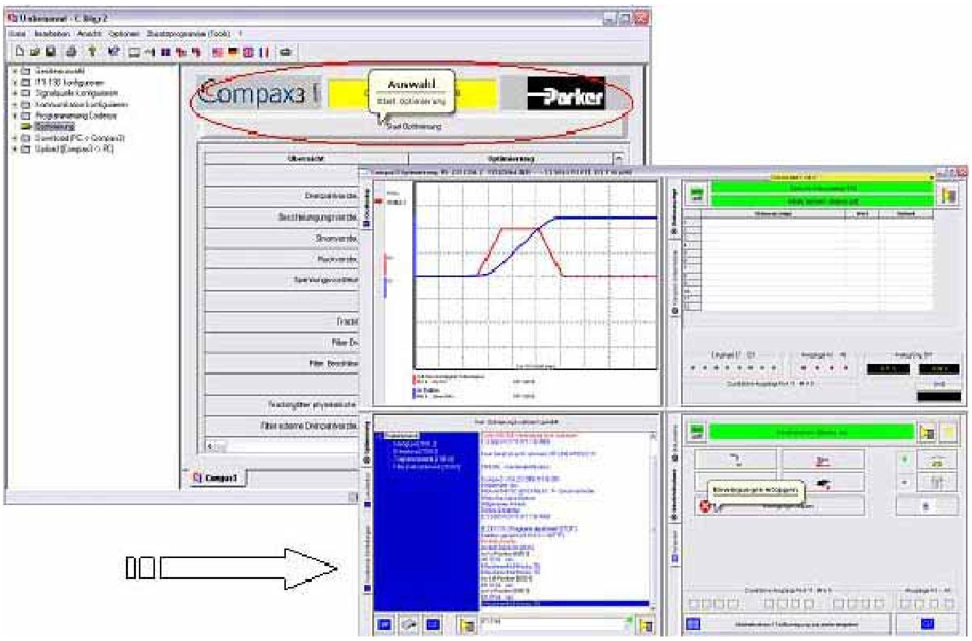
The configuration requires:

Application parameters

The wizard guided entry of the application parameters takes place directly in the ServoManager.

Carefully verify the entries and default values in order to detect entry errors in the run-up.

After the configuration download, the drive can be set up and be optimized if needs be. For this, please open the optimization window of the ServoManager:



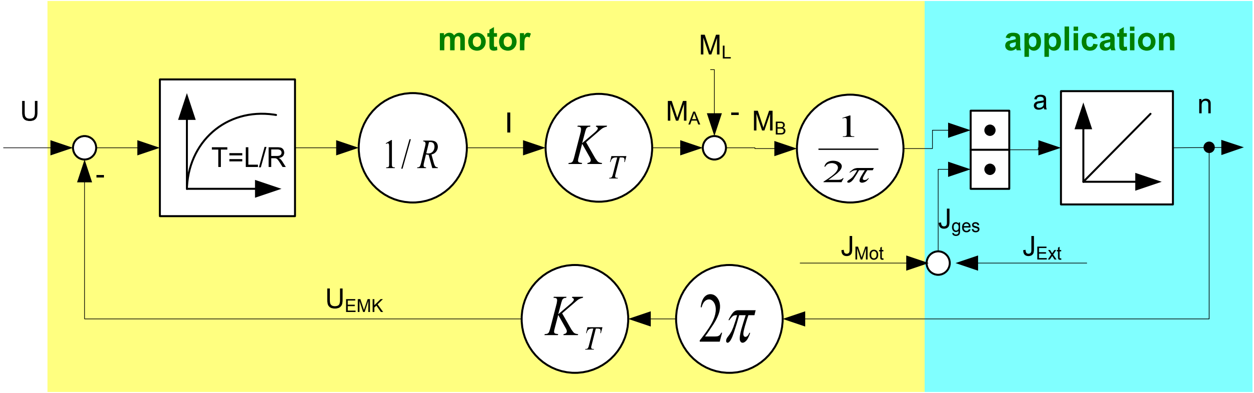
4.4.3.2 Configuration

In this chapter you can read about:

Control path

For the motors, the knowledge of the mathematical model is a prerequisite.

Mathematically idealized model of the control path:



U:	Control voltage
U_{EMK}:	electromagnetically generated voltage in the motor
T:	electric time constant of the motor winding
L:	Winding Inductance
R:	Winding Resistance
M_A:	Drive torque of the motor
M_L:	Load torque
M_B:	Acceleration torque
I:	Actual current r.m.s. (torque-producing)
K_T:	Torque constant
J_{mot}:	Motor mass moment of inertia
J_{ext}:	external mass moment of inertia
J_{total}:	Total mass moment of inertia
a:	Acceleration
n:	Velocity

Explanation:

The motor is controlled by the servo drive with control voltage U. During motion of the motor, an internal back e.m.f. U_{EMC} is induced. This antagonizes the control voltage and is therefore deduced in the motor model. The difference is available for the acceleration of the motor.

The first order delay component represents the delaying property of the motor winding with the time constant T=L/R. According to Ohm's Law, a current I=U/R results.

The drive torque of the motor is calculated by multiplying the current with the motor torque constant K_T. This is antagonized by the load torque of the machine.

The remaining acceleration torque accelerates the motor.

The resulting acceleration depends on the total mass moment of inertia (= motor + load moment of inertia).

The integration of the acceleration (sum of the acceleration over time) results in the velocity of the motor, which influences the amplitude of the induced EMC voltage.

Motor parameters relevant for the control

All motor parameters relevant for the control quality will be explained below.

Wizard guided entry of the motor parameters in the MotorManager.

Electromotoric countercheck EMC

A non-energized synchronous motor induces an induction voltage, the so-called EMC voltage during an armature movement.

The EMC constant (motor EMC) states the value of the induced voltage subject to velocity.

The EMC constant corresponds to the motor torque constant K_T, which represents the correlation between the torque-producing current and the drive torque, however in a different unit.

The EMC voltage antagonizes the control voltage of the servo drive.

As the control voltage of the drive is not unlimited, it must be taken into consideration that the drive may approach the voltage limit at high velocities and therefore high EMC voltages.

The EMC constant is important with respect to the velocity control design.

The motor EMC is entered in the "motor characteristics" wizard window of the MotorManager. You may choose between different units. Please note the information on the motor type specification plate.

Mass inertia

The mass moment of inertia (moment of inertia) is also an important motor parameter for the design of the velocity control loop. For the velocity control design, this parameter is effective in correlation with the external mass moment of inertia of the load. The external load is entered in the C3 ServoManager. With the "load identification" function of the C3 ServoManager, the mass inertia can be determined, if it is not yet known.

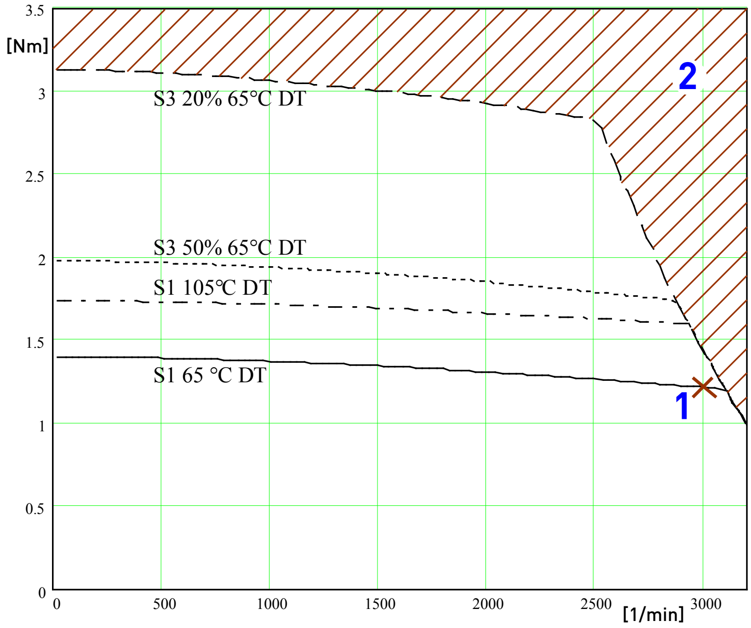
Nominal point data

In this chapter you can read about:

The nominal point data can be found in the velocity characteristic line of the motor. The prespecified nominal point can be changed in the 2nd wizard page of the C3 ServoManager configuration with the aid of "activate change of reference point" via the reference velocity and the reference current.

Motor characteristic line of a synchronous servo motor (torque via velocity)

SMH 60 30 1.4 ...2ID...4: 3000rpm at 400VAC



[Motorkennlinie.emf /.jpg]

1: Nominal point

2: Forbidden range

Calculation of the reference current from the characteristic line.

$$I = \frac{M[Nm]}{EMK} \bullet 85{,}5 = \frac{M[Nm]}{K_T}$$

or for linear motors

$$I = \frac{M[Nm]}{EMK\upsilon} \bullet \frac{\sqrt{2}}{\sqrt{3}} = \frac{M[Nm]}{Kf}$$

In the MotorManager, a motor can be defined for different operating modes (230V, 400V and 480V) without having to create several entities.

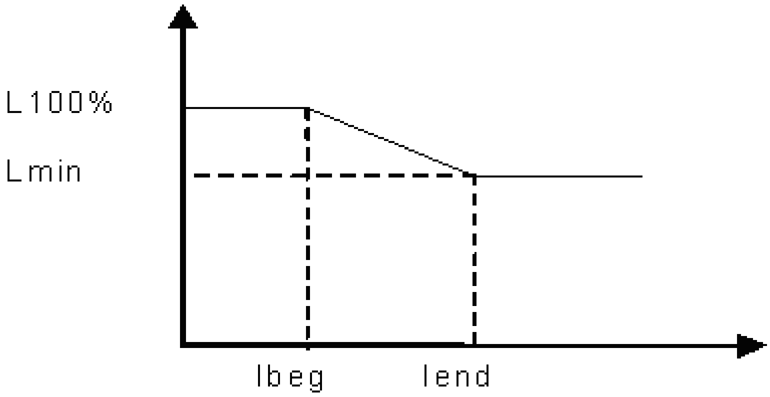
Additional parameters of a motor are:

- Standstill current [mA_{rms}]
- Pulse current [in % of the nominal current]
  The pulse current can be provided by the Compax3 for the duration of the pulse current time (as far as the device current permits). The thermal pulse load of the motor rises due to the pulse current. This pulse load is monitored by the i²t monitoring in the Compax3.

Saturation values

A motor may show a saturation behavior at higher currents due to iron saturation. This results in the reduction of the winding inductance at higher currents. As the inductance value of the winding enters directly into the P term of the current controller, the saturation at higher currents will result in too fast current control. This behavior can be counter steered with saturation values (entered in the "motor characteristics" wizard window of the MotorManager).

Consideration of the saturation values with the aid of a linear characteristic line



L 100%	Entered value of the nominal inductance
Lmin	Minimum winding inductance [% of the nominal inductance]. Value to which the inductance of the winding sinks at Ifinal.
Ibeg	End of the saturation [% of the nominal inductance].
Ifinal	Beginning of the saturation [% of the nominal inductance].

For the determination of the saturation values please see chapter **0** (see on page 237, see on page 237, see on page 238).

Quality of different feedback systems

In this chapter you can read about:

The controller quality depends to a great extent on the signal quality of the position feedback and its signal acquisition. It is therefore important to select a suitable measurement system for the individual application.

In the rotary range, a resolver is mostly used for reasons of economics. The single pole resolver provides one sine/cosine period per revolution. In very demanding applications, the performance of the resolver is often not satisfactory, so that a SinCos feedback with a higher resolution must be used. The typical resolution of a SinCos feedback is 1024 periods/revolution.

Other position feedbacks which are often used in the linear range, differ with respect to the reading principle. High-quality optical position measuring systems offer the highest resolution and accuracy.

Interface

An additional distinctive feature is the electric interface between servo drive and feedback. Analog sine/cosine signals or digital encoder signals (RS422 standard) are used to transmit the incremental position information. Due to the high interpolation rate (approx. 14 bits) of the Compax3 servo controller, an analog sine/cosine signal is in most cases preferable to digital encoder signals.

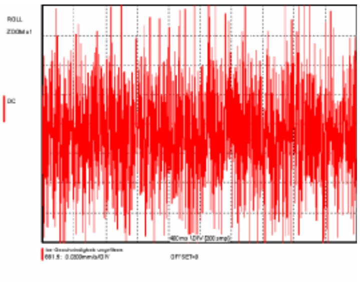
Resolution

The less precise the resolution, the higher the quantization noise on the velocity signal.

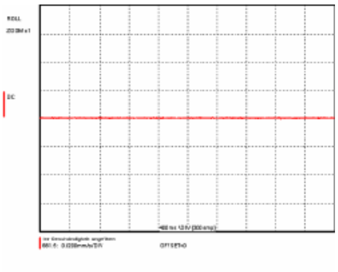
Noise

The feedbacks have different levels of analog noise, which have a negative effect on the control. The noise can be dampened with the aid of filters in the actual value acquisition, however at the cost of the controller bandwidth.

For comparison, the noise of the actual velocity value at standstill of two different feedbacks is displayed.



Resolver: 1 period/revolution



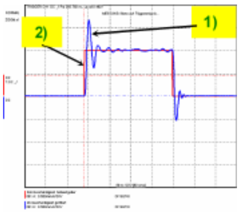
SinCos: 1024periods/revolution

Typical problems of a non optimized control

In this chapter you can read about:

Upon first setup of a control, the controller is normally not able to meet all application requirements at once. Typical problems may be:

Too high overshoot on velocity

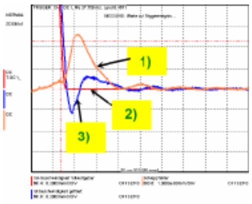


1) Actual velocity

2) Setpoint velocity

Increased following error

Increased following error when approaching the target position or the reduction of the following error takes too long

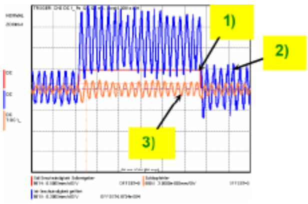


1) Following error

2) Setpoint velocity

3) Actual velocity

Instable behavior



1) Setpoint velocity
2) Actual velocity
3) Following error

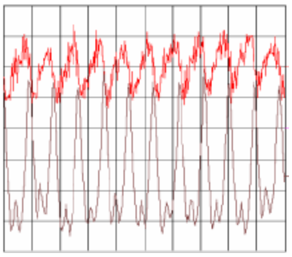
Feedback error compensation

Feedbacks with sine/cosine tracks may have different errors. The feedback error compensation supported by Compax3 eliminates offset and gain errors on both tracks online.

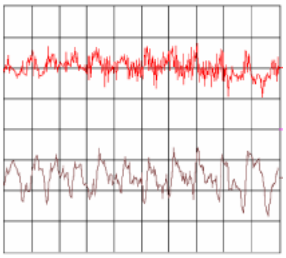
The feedback error compensation is activated in the MotorManager:

"Feedback system" wizard under "feedback error compensation".

Without compensation



With compensation



top: Actual current value

bottom: Actual speed value

Scale:

Current = 50mA/Div

Speed = 0.2mm/s/Div

Time = 3.8ms/Div

Type of motor:	Parker LMDT 1200-1 ironless linear motor
Linear encoder:	Renishaw RGH 24B with 20µm resolution
Servo drive:	Compax3

In order to accept the changes in the MotorManager in the project, the individual configuration pages must be clicked through. In order to make the changes made in the MotorManager effective in the device, the configuration download in the C3Manager must be executed.

In the event of formal errors, the feedback error compensation may however be disadvantageous; therefore it is switched off as a default.

Commutation settings

Another prerequisite for a good control quality is the correct motor commutation. This comprises several settings.

- The commutation angle describes the relation of the feedback position with respect to the motor pole pair position.
- Commutation direction reversal describes the correlation between the position of the feedback and the commutation position.
- Feedback direction reversal describes the direction correlation between the defined positive direction of the drive and the feedback position.
- If the commutation direction does not match the defined direction of rotation, this will result in a subsequent error with the error message "following error" or "motor stalled".
- A faulty commutation angle value results in increased current and following error. Therefore the voltage limit is reached faster. If the value of the commutation error exceeds 90°, the motor will spin due to the positive feedback effect.

These 3 settings can be automatically acquired with the MotorManager.

With the aid of the automatic commutation acquisition, the commutation settings can be determined and plausibility checks can be made. You will be guided through the individual wizard pages and the MotorManager will issue a prompt to define the positive direction of the drive. The wizard pages supporting the user depend on the feedback system as well as from the motor type (linear or rotary).

This function is activated in the MotorManager:

"Feedback system" wizard under "automatic commutation settings".

Hint The motor should be operated without load (=> no load torque e.g. weight force of a z-axis).

Additional setting of the commutation for incremental feedback:

This function is activated in the MotorManager:

"Feedback system" wizard under "feedback resolution".

In the event of an incremental feedback (Sine/cosine or RS424 encoder) the commutation must be defined in addition, in order to find the position reference to the winding.

- Automatic commutation with movement
- Commutation with digital hall sensors

I²t - monitoring of the motor

In this chapter you can read about:

With the I²t - monitoring, the motor is protected against overload or thermal destruction. For this, knowledge on the load bearing capacity of the motor is required. This information van be taken from the manufacturer documentation (motor parameters). Compax3 monitored:

- Continuous usage of the motor (motor usage)
- Pulse usage of the motor (motor pulse usage)

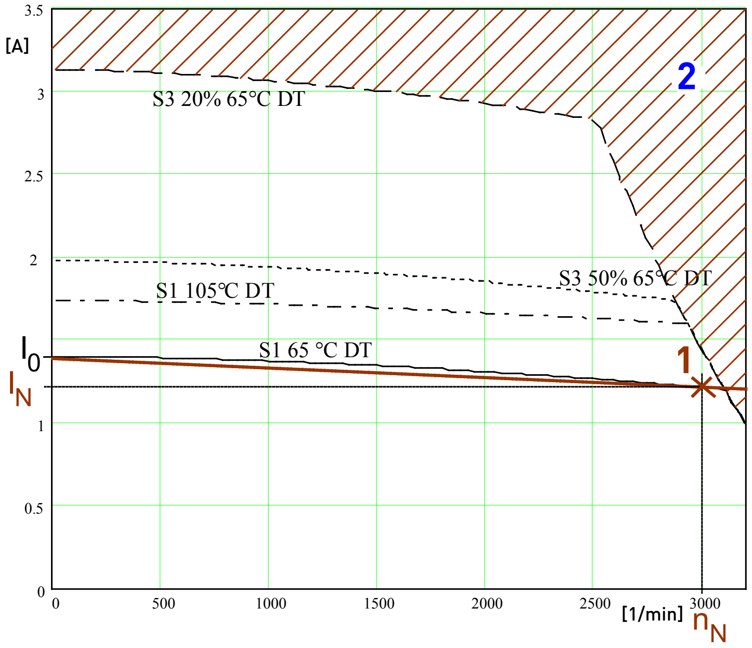
Motor continuous usage

In this chapter you can read about:

This kind of monitoring watches over the continually deliverable torque (continuous current). This continuous current depends on the velocity and is acquired online from the linearization of the motor characteristic line.

Linearized motor characteristic lien for different operating points

Nominal point



I_0: Standstill current

1: Nominal point

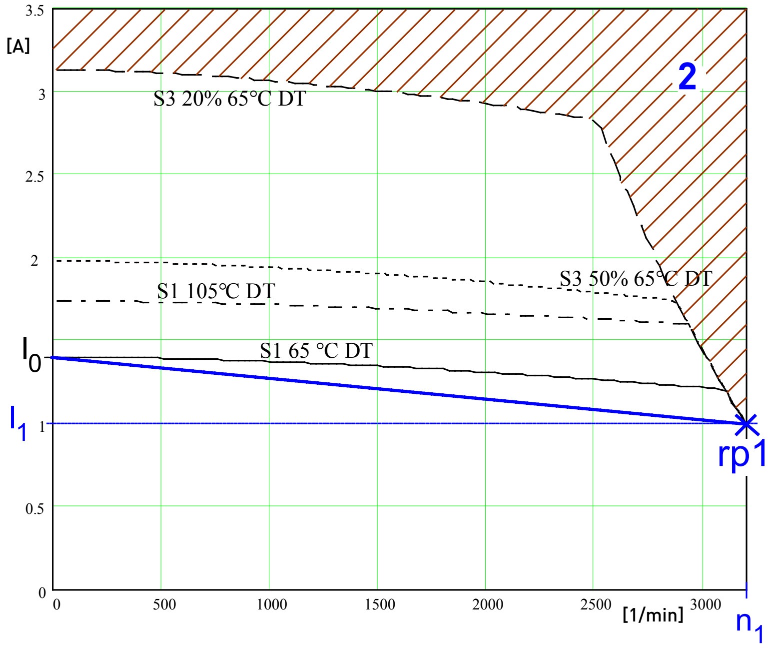
I_N: Nominal current (defined in the MotorManager)

n_N: Nominal Speed

2: Forbidden range

For monitoring the continuous utilization, the linearized characteristic line between I_0 und I_N / n_N is used as a threshold.

Reference point 1: higher velocity at reduced torque



I_0: Standstill current

rp1: Reference point 1 (defined in the C3 ServoManager)

I_1: Reference current to reference point 1

n_1: Reference velocity to reference point 1

2: Forbidden range

For monitoring the continuous usage, the linearized characteristic line between I_0 and I_1 / n_1 is used as a threshold.

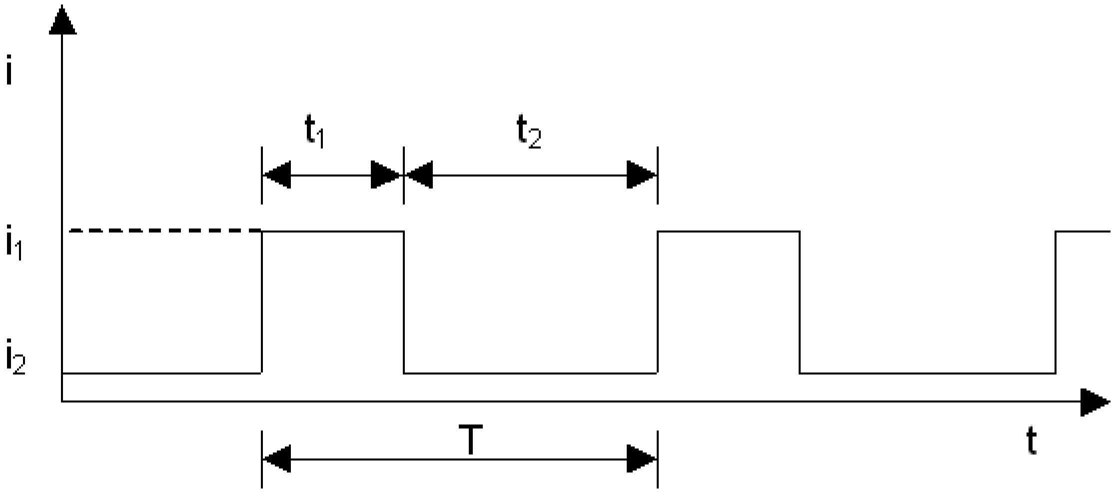
Motor pulse usage

This monitoring watches over the duration of the defined pulse current. The permitted duration for the pulse current is defined by the pulse current time constant.

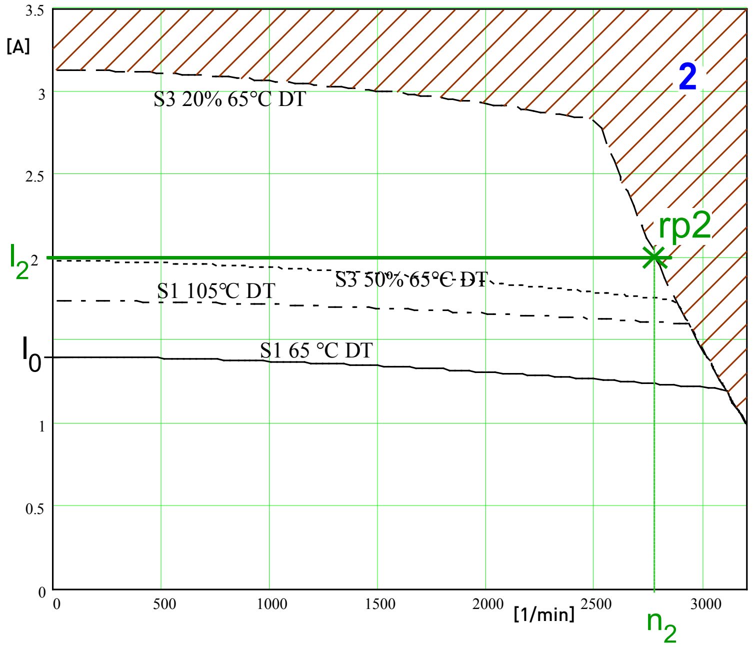
If the acceleration current exceeds the nominal current for a defined time t1, a sufficient break time t2 is required. If the current remains in average above the nominal current, the "monitoring motor pulse usage" [0x7180] error is triggered.

Upon a high pulse usage, the error will occur almost without delay.

Current cycle:



Reference point 2: Increased torque thanks to additional cooling



I_0:	Standstill current
1:	Nominal point
rp2:	Reference point 2 (defined in the C3 ServoManager)
I_2:	Reference current to reference point 2
n_2:	Reference velocity to reference point 2
2:	Forbidden range

In order to monitor the continuous usage, the velocity-idenpendent current limit I_2 is used.

If a r.m.s. current over the valid straight flows continually in the motor, the I²t monitoring will issue the "effective motor current monitoring" error message [0x5F48]. The period of time until the error occurs depends on the thermal time constant of the motor defined in the motor parameters. The electronic temperature monitoring simulates approximately the temperature behavior of the motor. By defining a reference point different from the motor nominal data, the I²t monitoring of the motor can be adapted to changed thermal ambient conditions (e.g. air stream caused by a ventilator fan).

Relevant application parameters

In this chapter you can read about:

Application parameters relevant for the control (C3 ServoManager)

Compax3 is configured with the aid of the C3 ServoManager. Here you can make application dependant settings. Among these are also parameters, that are relevant for the control. They will be explained below.

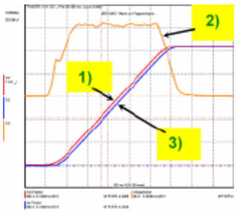
Switching frequency of the motor current / motor reference point

In this chapter you can read about:

The higher the switching frequency, the better the quality of the current control. The higher switching frequency reduces the dead time of the current control path as well as the current control noise. Furthermore, thermal losses caused by current ripple are reduced at higher switching frequencies.

Following Error (Position Error)

Too high following error (position error) during a movement



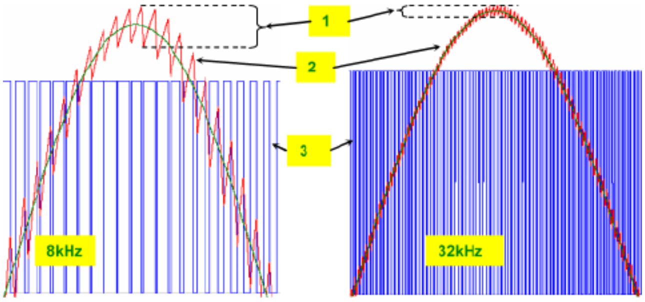
1) Setpoint Position

2) Position deviation = following error

3) Effective position

Reduction of the current ripple

Reduction of the current ripple of the phase current due to the higher switching frequency



1: Current ripple

2: Phase current

3: PWM control

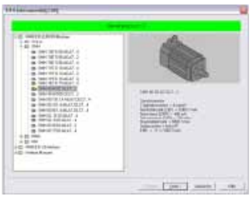
Hint Please note that a high switching frequency means also high switching losses in the power output stage of the controller. For this reason, you must consider derated data of the servo controller for the drive design with higher switching frequencies.

Motor parameters

In this chapter you can read about:

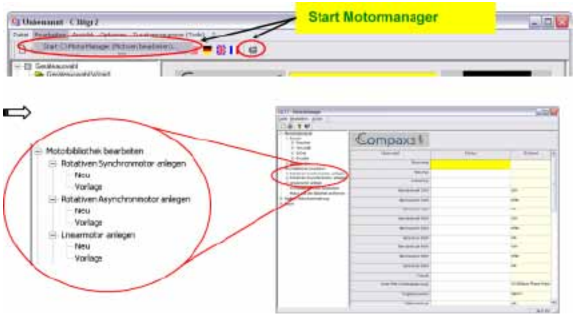
Parker Motor

If a Parker motor is used for the application, the parameters are already contained in the installed software. You can just select one of the available motors from the first configuration page.



Other motor

When using a motor from a different manufacturer, you will have to enter the relevant data. This process is supported by the MotorManager software tool, which can be called up from the ServoManager:



After double clicking on "new", the individual motor parameters are queried by the MotorManager.

Be careful to respect the units of the individual parameters when making your entries!

Furthermore you can use the MotorManager to edit motors already available. In addition, the import and export of motor data entities in XML format is supported.

Motor types supported

Compax3 supports the following motor types:

- Permanently excited synchronous rotary motors
- Permanently excited synchronous linear motors
- Asynchronous rotary motors

In general, rotary and linear motors do have the same signal flow chart. The difference consists solely in the basic physical values, which refer to circular movement resp. the linear motion laws of physics. For this, the following analogies can be established:

Rotary drive [unit]		**Linear drive [unit]**	
Travel x	[rev]	Path x	[m]
Mass moment of inertia J	[kgm²]	Mass m	[kg]
Velocity n Angular velocity ω	[rps] [1/s]	Velocity v	[m/s]
Torque constant Kt	[Nm/Arms]	Force constant KF	[N/Arms]
Torque M	[Nm]	Force F	[N]

For reasons of clarity, we will in the following refer to the rotary motor, which will represent both drive types.

An asynchronous motor is set up in the same way as a synchronous motor. The only differences are varying motor parameters.

Changing the switching frequency and the reference point

The switching frequency and the reference point are activated in the ServoManager: "Motor reference point" wizard

A reference point differing from the nominal data may also be entered on the wizard page displayed above.

Please activate "activate changing the reference point", then you may enter the new reference velocity as well as the new reference current.

Motor reference point

A reference point differing from the nominal data may also be entered on the wizard page displayed above.

Please activate "activate changing the reference point", then you may enter the new reference velocity as well as the new reference current.

External Moment of Inertia

The external mass moment of inertia is set against the moment of inertia of the rotor to form the total moment of inertia. The total moment of inertia is used for the controller design.

If you do not know or have only a vague knowledge of the external mass moment of inertia, the mass inertia can be determined via the load identification.

Configuration of an unknown external mass inertia:

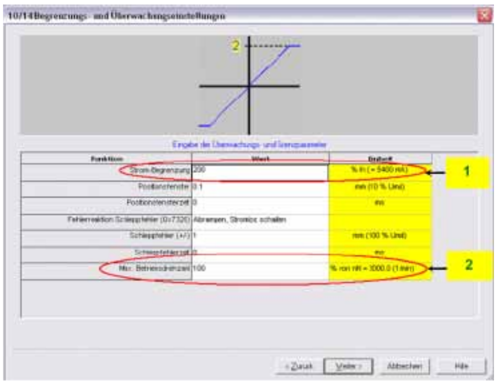
The load identification is activated in the ServoManager:
Wizard "External moment of inertia" “unknown: Using default values”.

The correct values can be determined later via the load identification!

Limit and monitoring settings

On the "limit and monitoring settings" wizard page, you can set among others the current and velocity limits in % of the nominal values. The nominal values are motor parameters resulting from the motor library or from shifting the reference point on the "motor reference point" wizard page.

Limit and Monitoring Settings wizard page:



10/14 Begrenzungs- und Überwachungseinstellungen

Eingabe der Überwachungs- und Grenzparameter

Funktion	Wert	Einheit
Strom-Begrenzung	200	% In (= 5400 mA)
Positionsfenster	0.1	mm (10 % Unit)
Positionsfensterzeit	0	ms
Fehlerreaktion Schleppfehler (0x7320)	Abrampen, Stromlos schalten	
Schleppfehler (+/-)	1	mm (100 % Unit)
Schleppfehlerzeit	0	ms
Max. Betriebsdrehzahl	100	% von nN = 3000.0 (1/min)

1: Current (Torque) Limit

2: Velocity limit

Asynchronous motors

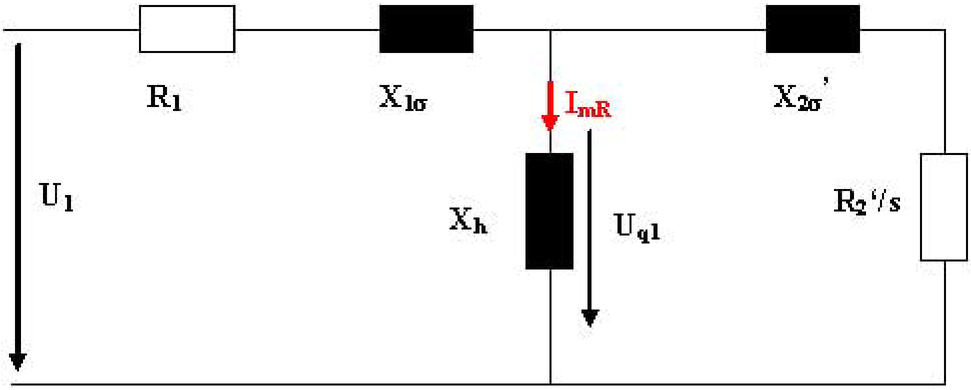
In this chapter you can read about:

Type specification plate data

On the 2nd. wizard page of the Compax3 MotorManager, the type specification plate data must be entered.

Replacement switching diagram - data for a phase

This data can be obtained from the manufacturer or be determined by measurement.



U1:	Nominal phase voltage
R1:	Stator leg resistance
$X1\sigma=2\pi fL1\sigma$:	Leak reactance (for f=50Hz mains frequency)
$L1\sigma$:	Stator leakage inductance
$X_h=2\pi fL_H$:	Main reactance (for f=50Hz mains frequency)
LH:	Main field inductance
$X2\sigma'=2\pi fL2\sigma$:	Referenced leak reactance (for f=50Hz mains frequency)
$L2\sigma$:	Rotor leak inductance
R_2':	Referenced carriage resistance
I_{mR}:	Magnetization Current

Slip Frequency

The slip frequency is stated in [Hz electrical] or in [‰] and can be determined as follows

f2[mHz (electrical)]= (fs*60-Nnominal*P/2)/N

$$f_2[mHz(el.)]=\frac{f_S\cdot 60-N_{Nenn}\cdot\frac{P}{2}}{f_S\cdot 60}\cdot f_S\cdot 1000=\left(f_S-N_{Nenn}\cdot\frac{P}{120}\right)\cdot 1000$$

$$f_2[\Pr omille]=\frac{f_S\cdot 60-N_{Nenn}\cdot\frac{P}{2}}{f_S\cdot 60}\cdot 1000$$

$$\frac{f_s\cdot 60\cdot 2}{N_{Nenn}}$$

Whereas P = value before the point of the term è

f_s: Synchronous nominal frequency (dimensioning base)

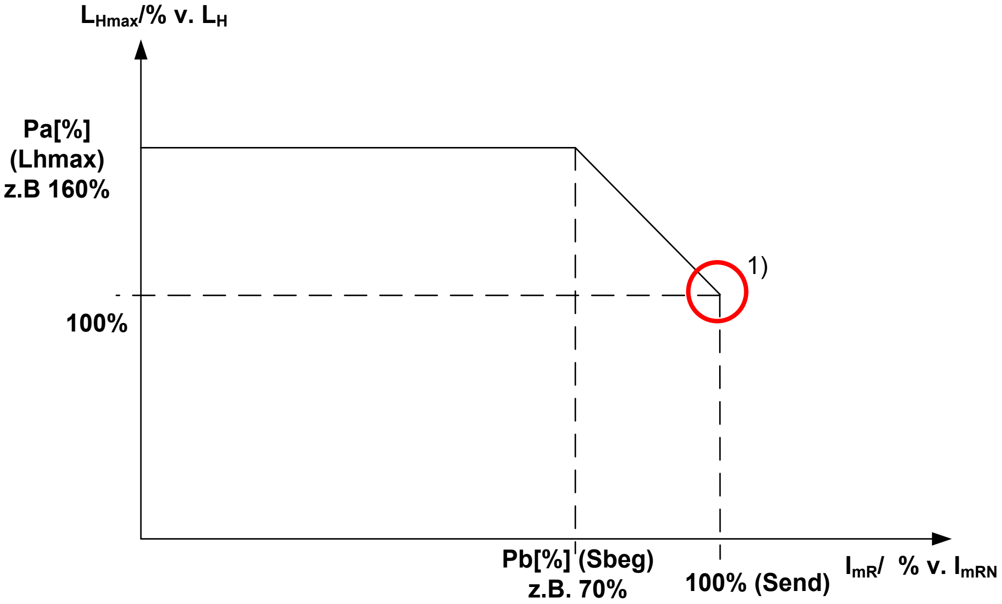
N_{Nom}: Nominal speed in rpm

f_2: Slip frequency in mHz (electrical)

Saturation behavior

The saturation of the main field inductance can be considered with the help of the following characteristic.

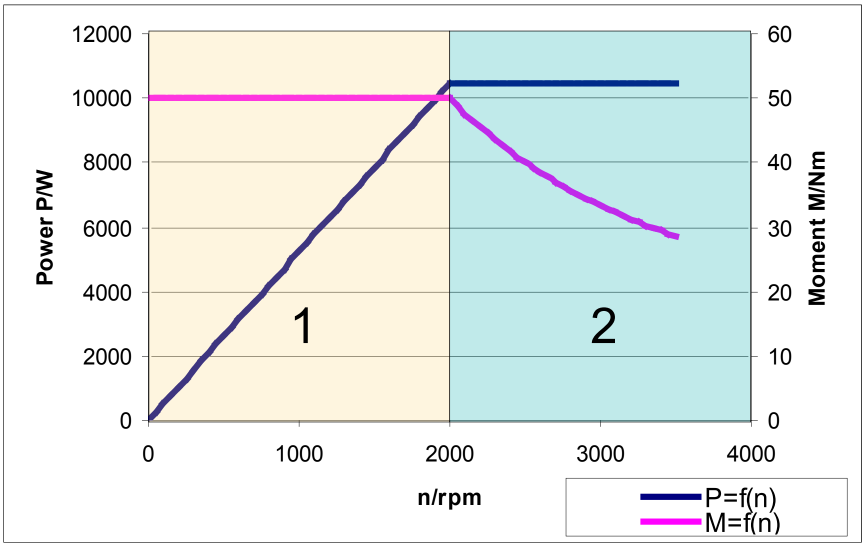
Activate the "consider saturation values" checkbox.



1)	Nominal point in the basic speed range
Lhmax:	max. main field inductance
Sbeg:	Beginning of Saturation
Send:	End of Saturation

Cut-off frequency for the field weakening range

The statement of the cut-off speed defines the beginning of the field weakening operation. From the cut-off speed on, the magnetization current and thus the force constant of the motor are reduced inversely proportional to the speed; the motor is operated in the field weakening range. In the field weakening range, the shaft power produced remains constant.



1: Basic speed range

2: Field weakening range

Rotor time constant

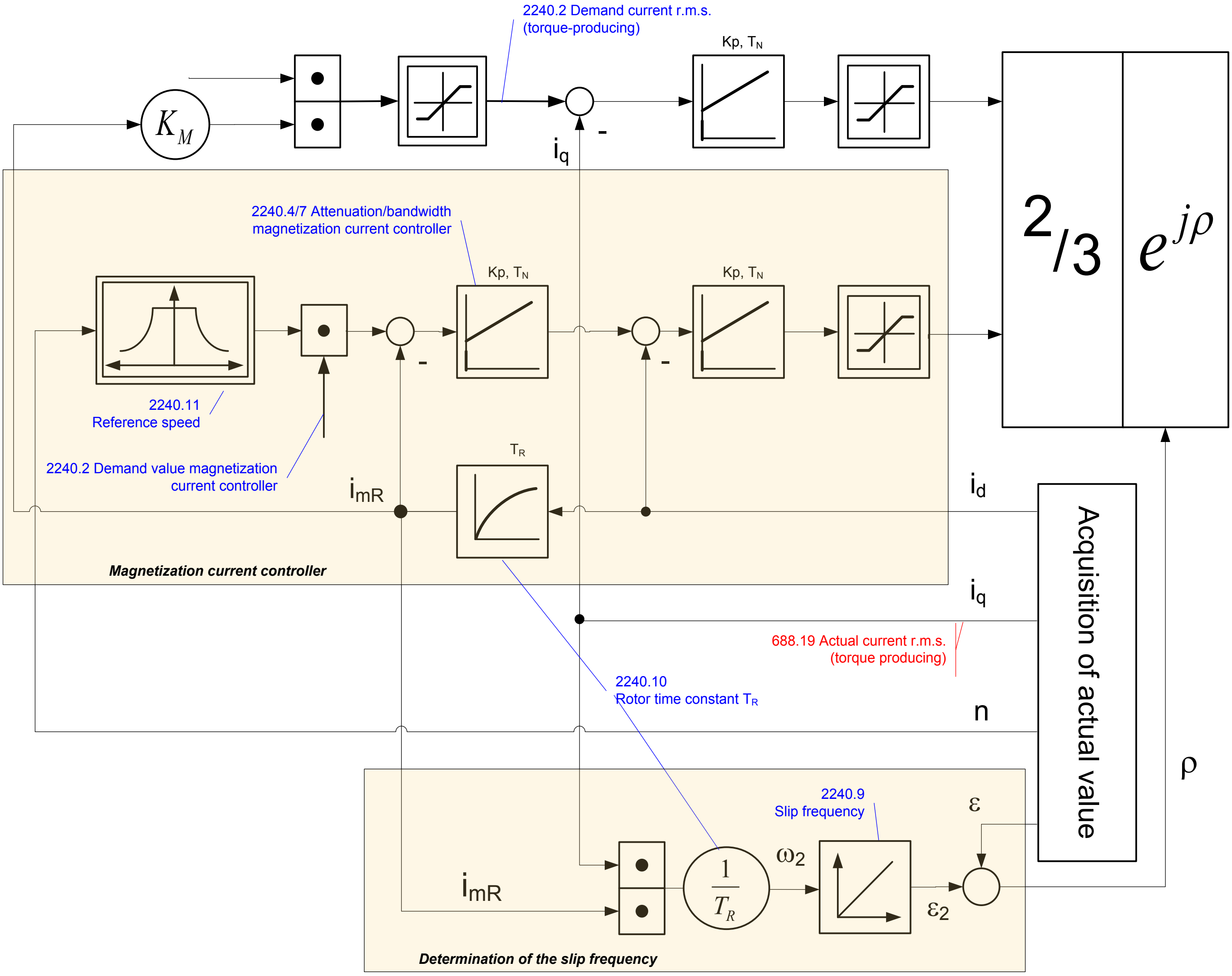
If the value of the rotor time constant is not known, it can be approximated automatically.

Determination of the commutation settings

On the last wizard page of the Compax3 MotorManager, the commutation settings (feedback direction reversal and commutation direction reversal) can be determined automatically.

Asynchronous motors: Extension of the controller structure

Structure of the magnetization current controller and determination of the slip frequency:



4.4.3.3 Automatic controller design

In this chapter you can read about:

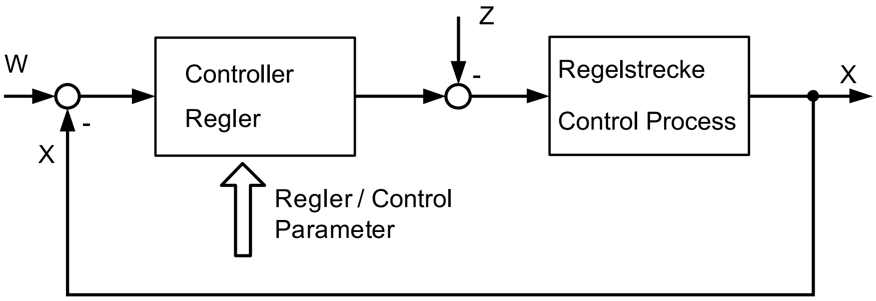
Dynamics of a control

In this chapter you can read about:

A change in the input value of a dynamic transmission element causes a change of its output value. The change of the output value is however not immediately effective, but takes a certain time, the transient response. The course of the transient response is characteristic for certain kinds of transmission behavior.

For this reason, a complete description of the transmission properties of a control comprises the stationary behavior (all setpoint, actual and disturbance values in settled state), as well as the dynamic behavior.

Structure of a control



The basic task of a control is the generation and maintaining of a desired state or sequence in spite of interfering disturbances. It is essential that the effects of the disturbances are balanced with the correct force and at the correct time. In the above figure, the setpoint value W represents the desired state and the disturbance value Z represents the interfering disturbance. The actual value X represents the generated and maintained state.

Oscillating plant

Oscillating control paths are control paths that respond with attenuated or unattenuated oscillation to an abrupt change in the setpoint value. Part of this class are for instance:

- Linear actuators with toothed belts, as a toothed belt represents an elasticity.
- A mechanic shaft with an external mass moment of inertia, as the shaft represents an elasticity due to its torsional properties.
  In general this kind of elasticity is due to a high ratio between J_{Load}/J_{Motor}, as the shaft is normally not designed for this high external load and which may lead to a considerable distortion.

Stability, attenuation

In this chapter you can read about:

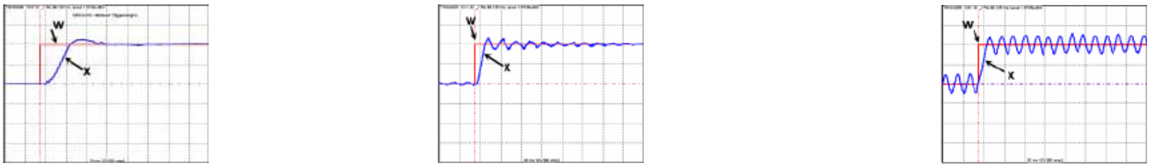
In general, two stability problems may occur in a servo drive control:

Stability problem in the high-frequency range:

The "control structure" figure shows that the reverse effect in the control loop (negative feedback) is a prerequisite for the functioning of a control system. Due to the delay in signal transmission, the effect of the negative feedback is diminished or even compensated. The reason is that the corrective measures of the controller are also delayed in the event of delayed signal transmission. This results in a typical oscillating course of the control variable. In the worst case, the deviation of the control variable and the effect of the corrective measures get in phase, if the delays reach a defined value. The negative feedback passes into positive feedback. If the product of the gain factors of all control loop components is higher than 1, the oscillation amplitude will continually rise.

In this case the control loop is unstable. In the total gain of 1 the oscillation keeps its amplitude and the control loop is within the limits of stability. The transient response can be characterized by the attenuation and the transient time (velocity).

Step response of a stable controller and of a controller approaching the stability limit



Rugged
Well attenuated

Rugged
Poorly attenuated

Stability limit
not attenuated

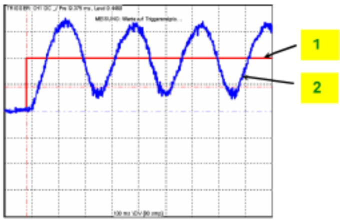
W: Setpoint value

x: Actual value

Stability problem in the low-frequency range:

In this case the controller was set for a very inert control path, while the actual control path is much more dynamic. The controller reacts to a disturbance variable with a much too strong corrective measure so that the disturbance variable is overcompensated and even an increasing oscillation may be the result. In this case the mechanic system of the control path may be destroyed.

Velocity jerk response (low-frequency stability limit)



1: Setpoint speed value

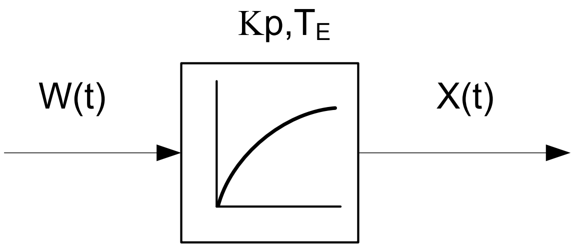
2: Actual speed value

Velocity, bandwidth

In this chapter you can read about:

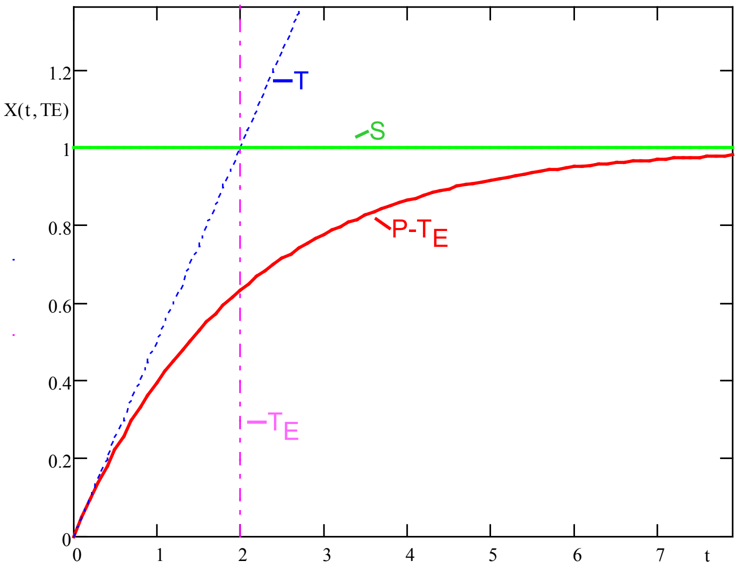
A well attenuated control loop can, under certain conditions, be approximated in order to simplify the controller design with a first order delay component (P-TE component) with the replacement time constant TE and the total gain Kp. A P-TE component represents a first order delay component and is a simple dynamic basic component.

P-TE - Symbol



Step response of a delay component

Step response of a first order delay component with Kp=1 and TE=2.0s



T: Tangent

S: Input jerk

P-TE: Output value of the P-TE component

TE: Time constant of the P-TE component

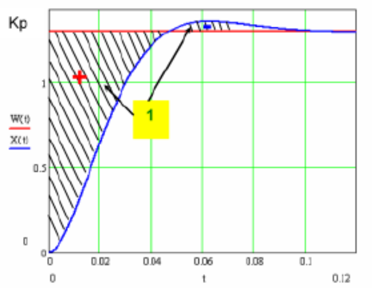
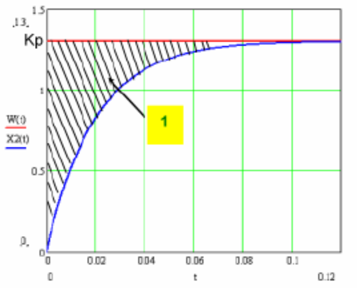
The definition of the delay time constant is displayed in the above figure. The time of intersection of the tangent and the jerk function itself is by definition the delay time constant (called filter time constant for filters) of a P-TE component. At this point in time the value of the step response is approx. 63% of the final value. In practice the step response corresponds, for instance, to the voltage charge curve of a capacitor.

Approximation of a well-attenuated control loop

The approximation of a well-attenuated control loop is based on the sameness of the control surface of the ideal first order delay component (P-T1 component) and the approximated system (P-TE component).

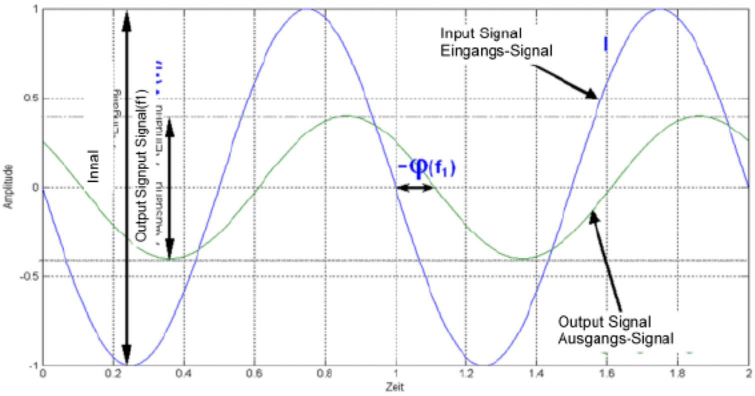
The control surface is a measure for the velocity of a system and is defined in the following figure. If the surface of the approximated system corresponds to the surface of the ideal system, the approximated system can be described, up to a certain frequency, with the transmission function of the P-T1 component.

Determination of the control surface from the transmission behavior of a P-TE component.

	
1: Control surface of the approximated system	2: Control surface of the ideal P-T1 component

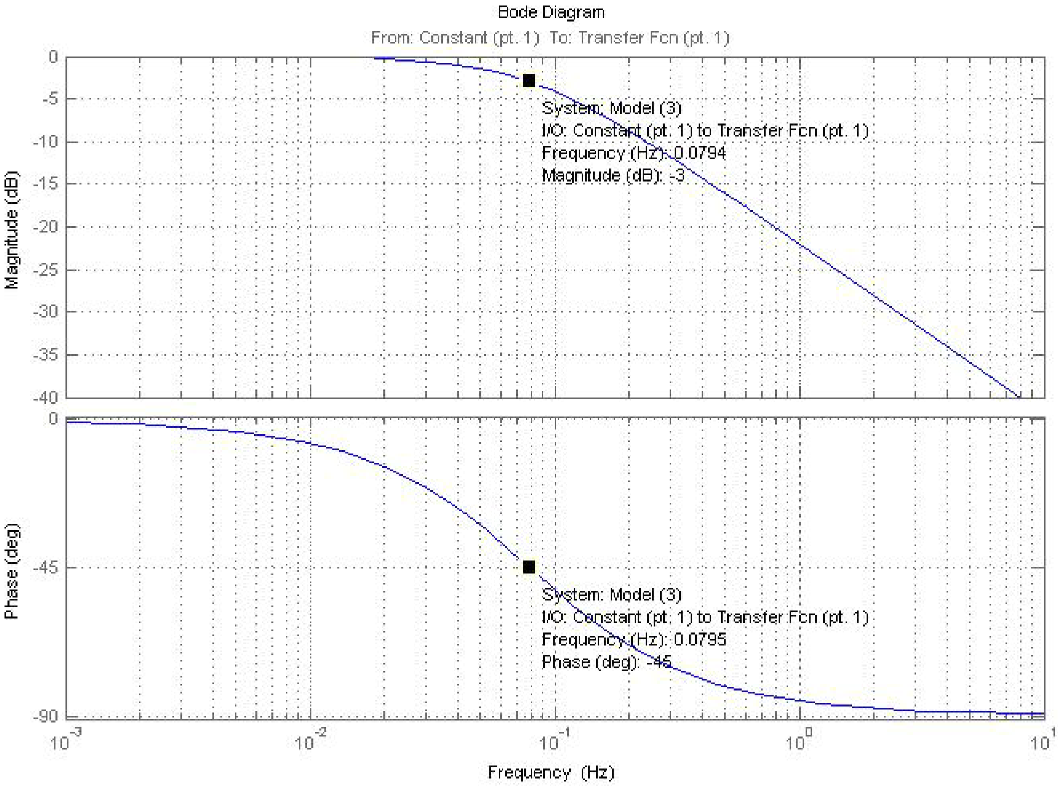
The velocity of a dynamic system can also be described in the frequency range. In the frequency range, the system behavior is analyzed to sinusoidal inputs signals of different frequencies (frequency response).

Input and output signals of a dynamic transmission component at a defined frequency f=f1



The bode diagram represents the behavior of a dynamic system (in our case of the P-TE component) against the input signal frequency with respect to amplitude and phase.

Frequency response of the P-TE component (value and phase)



$$f_0 = \frac{1}{2\pi \cdot T_E} = 0{,}0795Hz$$

The cut-off frequency is the frequency where the input signal is attenuated by 3dB (-3dB attenuation). The phase shift between the output and the input is -45° at this frequency.

Precisely this cut-off frequency is called the bandwidth of a control loop.

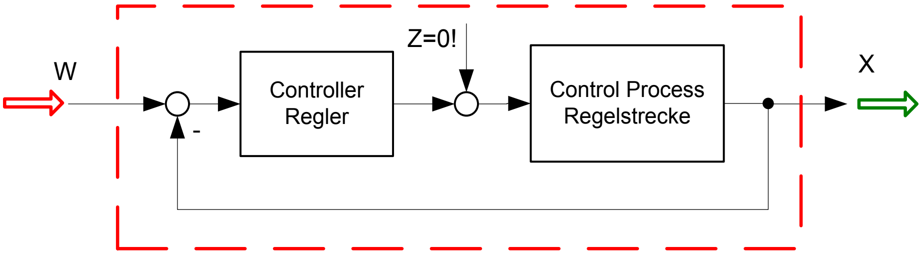
Setpoint and disturbance behavior of a control loop

In this chapter you can read about:

The setpoint behavior is the behavior of the control loop for the setpoint variable W. We assume that the disturbance variable Z=0.

The disturbance behavior describes the behavior of the control loop for disturbance variable Z. In this case, we assume, in analogy to the setpoint behavior, that the setpoint variable W=0.

Demand behavior

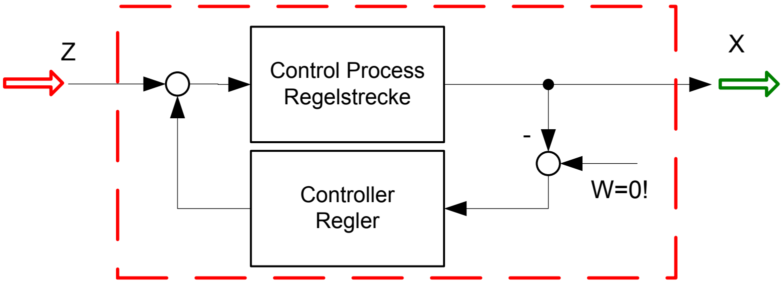


W: Setpoint value

X: Actual value

Z: Disturbance variable

Disturbance behavior



W: Setpoint value

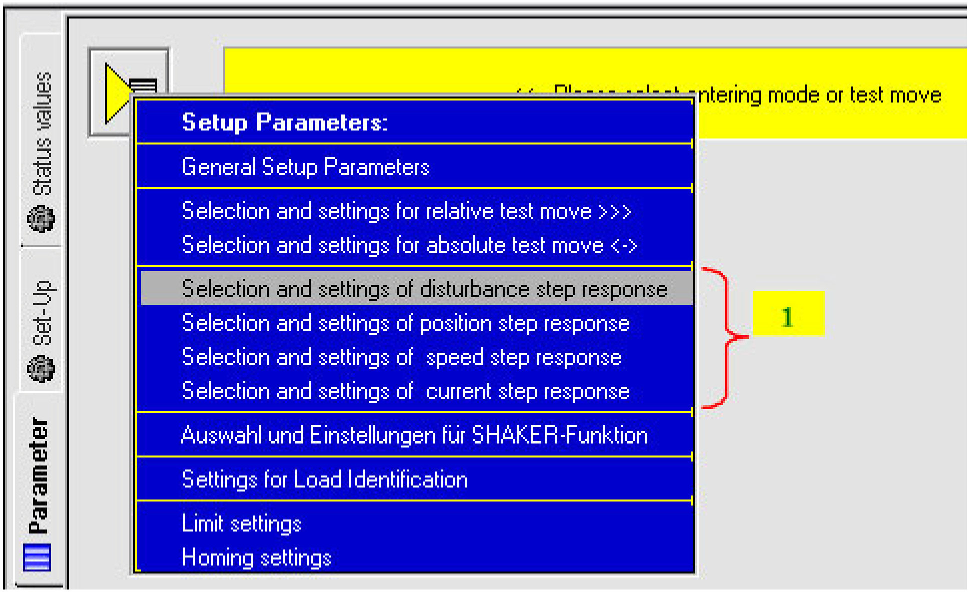
X: Actual value

Z: Disturbance variable

In order to examine the disturbance and setpoint behavior, the Compax3 setup software offers 4 jerk functions.

Test functions

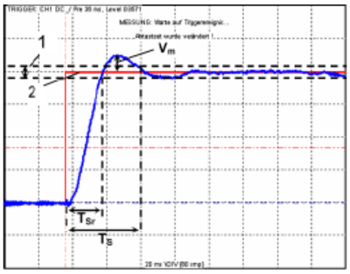
Test functions for the analysis of disturbance and setpoint behavior of the control loops



1: 4 jerk functions

The properties of the setpoint behavior of the velocity controller can be acquired from the velocity jerk response.

Characteristics of a control loop setpoint response

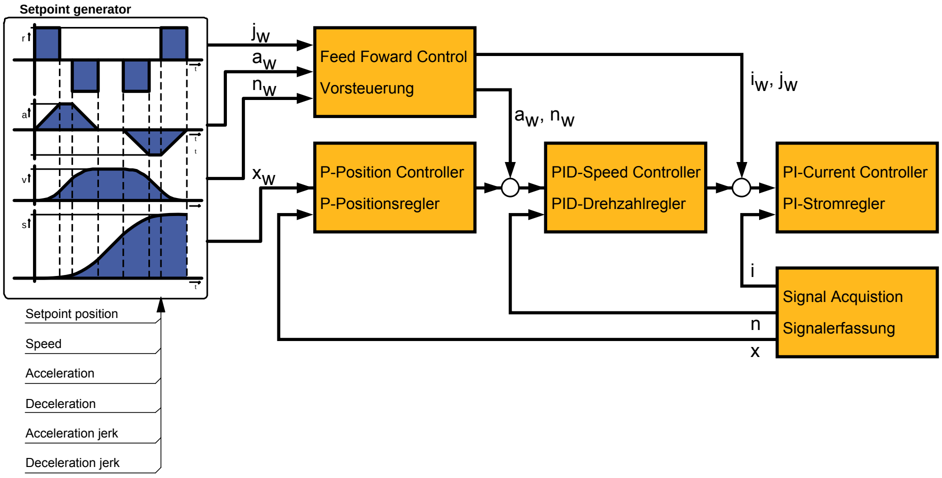


T_{Sr}:	Response time. (Time elapsing until the control variable reaches one of the +-5% tolerance limits for the first time)
T_S:	Settling time. (Time elapsing until the control variable ultimately enters the +-5% range)
V_m:	maximum overshoot width
1	Tolerance range +-5%
2	Setpoint value

Response

The response of the controller is the behavior of the actual value with respect to the calculated profile of the setpoint generator. The kinematic status variables, speed, acceleration and jerk are fed into the cascade as feedforward signals. The feedforward signals work with calculated factors and contribute to an improved contour constancy due to the minimization of the following error.

Compax3 servo controller structure



x: Position actual value

n: Actual (rotational) speed

i: Actual current value

x_w: Setpoint position value

n_w: Velocity setpoint value

j_w: Jerk setpoint value

a_w: Acceleration setpoint value

Limitation behavior

Each control variable is limited by the control (actuating) element. If the control variable demanded by the controller is within the linear range (without limitation), the control loop shows the behavior defined by the design. If the controller demands however a higher control variable than permitted by the limitation, the control variable is limited and the controller slows down.

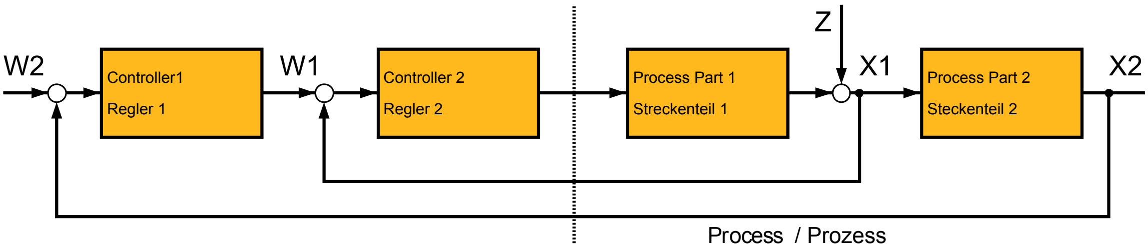
Hint You should therefore make sure that the control variable (output) of the controller does not remain within the limitation or only for a very short time.

Cascade control

In this chapter you can read about:

In drive technology, a cascading structure with several controllers (normally 3) is often used. This improves the control behavior. For this, additional sensors must be fixed within the control path. You will get the structure of a cascade control.

Structure of a cascade control



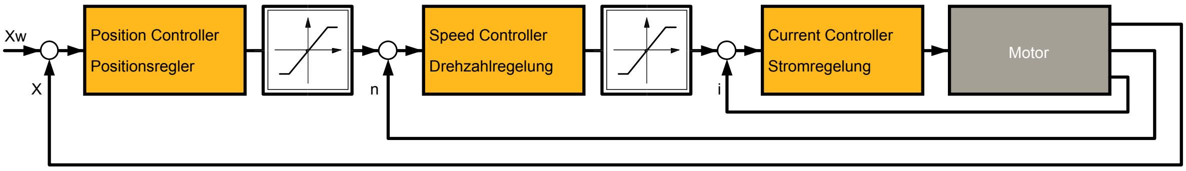
W1	Setpoint value (setpoint) for the superposed controller 2
W2	Setpoint value (setpoint) for the subordinate controller 1
X2:	Actual variable (actual value) for controller 2
X1:	Actual variable (actual value) for controller 1

The cascade control offers the following advantages:

- Disturbances occurring within the control path, can be compensated in the subordinate control loop. Therefore they must not pass through the entire control path and are thus compensated earlier.
- The delay times within the path can be reduced for the superposed controller.
- The limitation of the intermediate variables can be made by the control variable limitation of the superposed controller rather easily .
- The effects of the non-linearity for the superposed controllers can be reduced by the subordinate control loops.

In the Compax3 servo drive, a triple cascade control is implemented with the following controllers - position controller, velocity controller and current controller.

Cascade structure of Compax3



Rigidity

In this chapter you can read about:

The stiffness of a drive represents an important characteristic. The faster the disturbance variable can be compensated in the velocity control path and the smaller the oscillation caused, the higher the stiffness of the drive. With regard to stiffness, we distinguish static and dynamic stiffness.

Static stiffness

The static stiffness of a direct drive is comparable with the spring rate D of a mechanical spring, and indicates the excursion of the spring in the event of a constant interference force. It is the ratio between the constant force FDmax of the motor and a position difference. Due to the I term in the velocity controller, the static stiffness is therefore infinitely high in theory, as the I term is integrated until the control difference vanishes. In a digital control the static stiffness is above all limited by the finite resolution of the position signal (the error must be at least one quantization step, so that it can be detected by the reading system) and by numerical resolution. Additional effects are for instance mechanical stiffness of the mechanic components in the control path (e.g. load connection, guiding system) as well as measurement errors of the measurement system.

Dynamic stiffness

In this chapter you can read about:

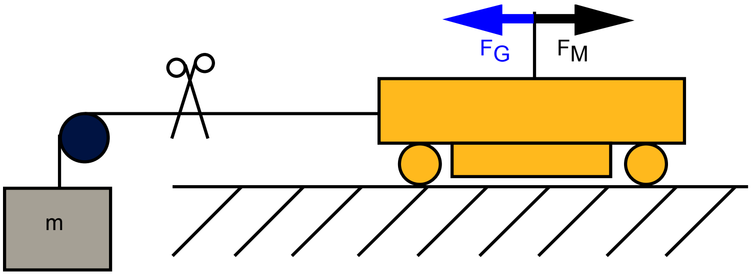
The dynamic stiffness is described by the ratio between the change in load torque or in load force and the resulting position deviation (following error):

$$\frac{-\Delta M_L}{\Delta x}$$

The higher this ratio (=dynamic stiffness), the higher the necessary change is load torque in order to generate a defined following error.

The dynamic stiffness can be acquired from the disturbance jerk response.

Traditional generation of a disturbance torque/force jerk

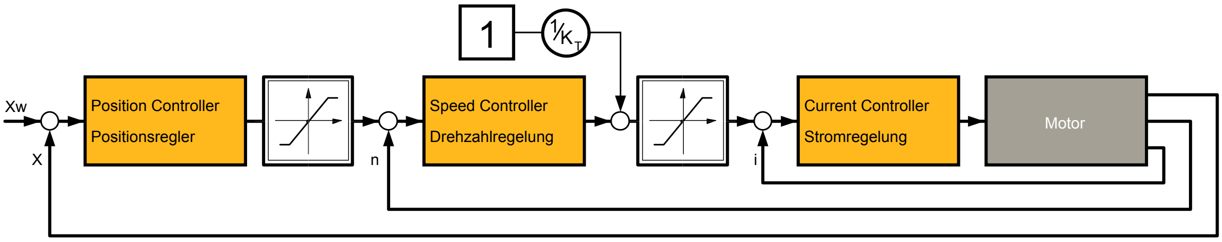


In settled state of the control, the motor force FM corresponds exactly to the load force FG=m×g.

If the cord is cut through, the load force is eliminated abruptly and the controller must first of all settle to the new situation.

In order to simulate this load jerk electronically, a disturbance current jerk is fed to the Compax3 as a variable proportional to the disturbance torque at the velocity controller output.

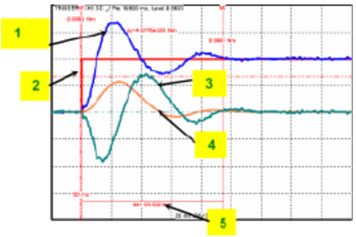
Electronic simulation of a disturbance torque jerk with the disturbance current jerk



1: Feeding in of a disturbance current jerk, which corresponds to a disturbance torque jerk.

The maximum amplitude an the settling time of the following error decline with rising dynamic stiffness. The settling behavior of the following error is furthermore a measure for the attenuation and the bandwidth of the control.

Disturbance jerk response



1: Compensation torque of the controller

2: Simulated disturbance torque

3: Actual speed

4: Following error

5: Settling Time

Correlation between the terms introduced

The introduced terms:

- Stability
- Damping
- Velocity
- Bandwidth
- Setpoint and disturbance behavior
- Control variable limitation
- Replacement time constant
- Rigidity

are related as follows:

- A well-attenuated control features a stable control behavior.
- The velocity of a control loop is a measure for the reaction rate of the controller to the disturbance variable (disturbance behavior) as well as to the setpoint variable (setpoint behavior).
- The faster the control, the higher its bandwidth.
- The term replacement time constant is an approximation and is only valid in a defined scope1. In this scope, the control is always stable and well-attenuated.
- If the controller does not work in the linear range, but the control variable of the controller is within the limitation, the control slows down and the control difference rises.
- The stiffness represents the bandwidth of the velocity control. The higher the stiffness value of the velocity control, the higher the bandwidth of the velocity controller and the stiffer the drive.

Automated controller design

In this chapter you can read about:

The controller design takes place after the configuration immediately before the configuration download into the device. The controller coefficients are preassigned according to the design method of cross-ratios so that a stable control is achieved.

The automatic, robust controller design calculates the P and I terms of the individual controllers (current, velocity, position) on the basis of the configured motor and application parameters.

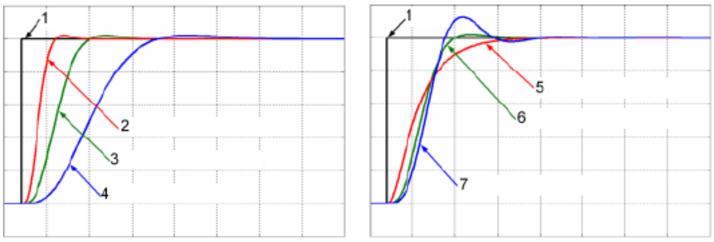
Please observe: Faulty motor and application parameters may lead under certain circumstances to instable controllers.

The controller parameters are not directly available for the optimization. Instead, they can be changed with the aid of the following optimization parameters:

Optimization of the current controller dynamics:	◆ Current loop bandwidth in % ◆ "Attenuation of current loop" in %
Optimization of the velocity loop dynamics:	◆ "Stiffness" in % ◆ "Attenuation" in % ◆ Velocity loop - "D" term in %

The bandwidth parameter states the actually effective % of the calculated default velocity. The default bandwidth of the current controller is fixed to approx. fGR=531Hz. In reverse this signifies that each motor delivers the same step response. The prerequisite is, of course, that you keep out of the control signal limitation (voltage limitation). The attenuation characterizes the controller's tendency to oscillate with respect to an excitation signal (see below). The stiffness (of the velocity loop, corresponds to the bandwidth of the current loop) describes the velocity of the velocity loop (see below).

Step response of the velocity loop depending on the optimization parameter "attenuation" and "stiffness"


Attenuation = 100%

Stiffness = 100%

1: Setpoint value

2: Actual value (stiffness = 200%)

3: Actual value (stiffness = 100%)

4: Actual value (stiffness = 50%)

5: Actual value (attenuation = 500%)

6: Actual value (attenuation = 100%)

7: Actual value (attenuation = 50%)

D-term

The D-term parameter (of the velocity loop) activates existing control oscillations of drives with elastic coupling (e.g. toothed belt drives). The D-term is not automatically designed and must therefore be set manually.

Position loop

The position controller is automatically adapted depending on the stiffness of the velocity loop.

Controller coefficients

In this chapter you can read about:

Dependence of the controller coefficients from the optimization objects

The controller coefficients are influenced by the optimization objects such as "stiffness" and/or "attenuation". The dependency is displayed below.

I-term KI in the velocity loop

$$K_I = \frac{St[\%]}{100 \cdot T_{EGD}}$$

$$\Rightarrow K_I \sim St$$

T_{EGD}:	The replacement time constant of the closed velocity loop.
St	Rigidity

Velocity Loop P Term

$$K_{PV} = \frac{St[\%]}{100 \cdot T_{EGD}} \cdot \frac{Tm[\%]}{100} \cdot T_N \cdot \frac{100}{EMK[\%]} \cdot \frac{30 + 0{,}14 \cdot Dp[\%]}{20}$$

$$\Rightarrow K_{PV} \sim St \;\wedge\; K_{PV} \sim Tm / EMK \;\wedge\; K_{PV} = f_{LIN}(Dp)$$

T_{EGD}:	The replacement time constant of the closed velocity loop.
T_N:	The mechanical integration time constant of the motor.
f_{LIN}():	Linear function (straight) between attenuation and KPV
Tm	Moment of Inertia
St	Rigidity
Dp	Damping

D-term of the KD velocity controller

$$K_D = \frac{Dterm[\%]}{100} \cdot K_{D\_100\%}$$

$$\Rightarrow K_D \sim Dterm$$

KD_100%:	The defined 100% coefficient
Dterm	D term

P-term KV position loop

$$K_V = \frac{St[\%]}{100 \cdot T_{EGD}} \cdot \frac{20}{30 + 0{,}14 \cdot Dp[\%]} \cdot T_X$$

$$\Rightarrow K_V \sim St[\%] \;\wedge\; K_V = f_{LIN}(1/Dp[\%])$$

T_{EGD}:	The replacement time constant of the closed velocity loop.
T_X:	The position integration time constant of the motor.
St	Rigidity
Dp	Damping
f_{LIN}():	Linear function (straight) between 1/attenuation and KV

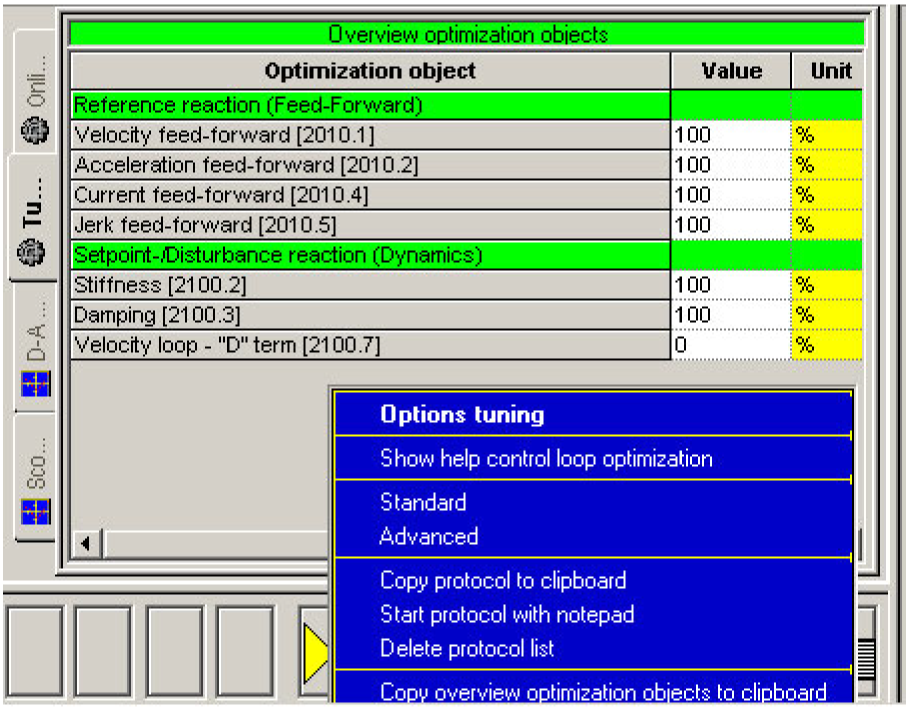
4.4.3.4 Setup and optimization of the control

In this chapter you can read about:

For the setup and optimization of the control loops, the optimization window is available.

The Compax3 control functionality is divided into 2 sections, standard and advanced; the advanced functionality does however incorporate the entire standard functionality. The switching can be made in the optimization window.

Switching between standard and advanced



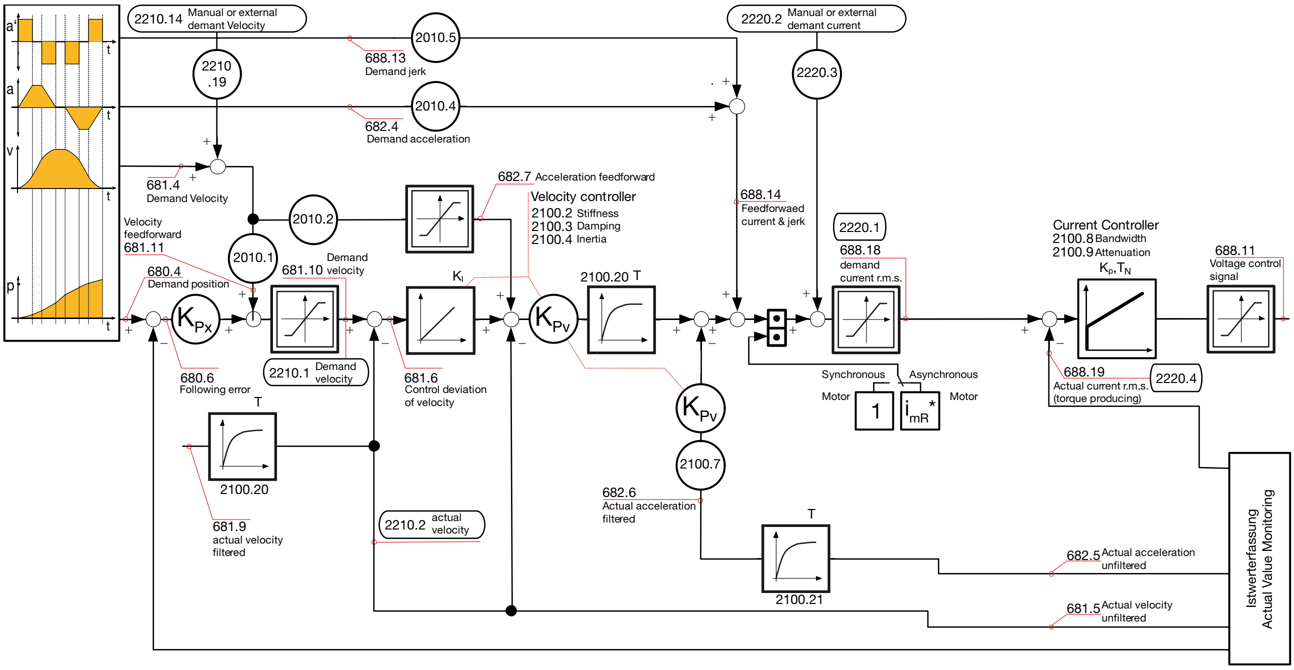
Overview optimization objects

Optimization object	Value	Unit
Reference reaction (Feed-Forward)		
Velocity feed-forward [2010.1]	100	%
Acceleration feed-forward [2010.2]	100	%
Current feed-forward [2010.4]	100	%
Jerk feed-forward [2010.5]	100	%
Setpoint-/Disturbance reaction (Dynamics)		
Stiffness [2100.2]	100	%
Damping [2100.3]	100	%
Velocity loop - "D" term [2100.7]	0	%

Standard

In this chapter you can read about:

Standard cascade structure



The framed objects are coupling objects for Compax3 - Compax3 coupling via HEDA.

Please note that the corresponding controller components must be deactivated for the coupling:

When coupling the velocity (O2219.14): O100.1 or O100.2=1063 (see object description)

When coupling via current (O2220.2): O100.1 or O100.2=1031 (see object description)

O100.1 is only copied into O100.2 upon activation of the controller, the controller can be influenced in active state with the aid of O100.2

Caution! Changing objects O100.1 and O100.2 may cause the control to be deactivated!

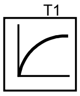
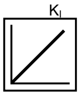
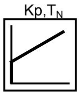
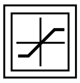
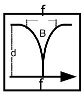
Protect dangerous areas!

External command value

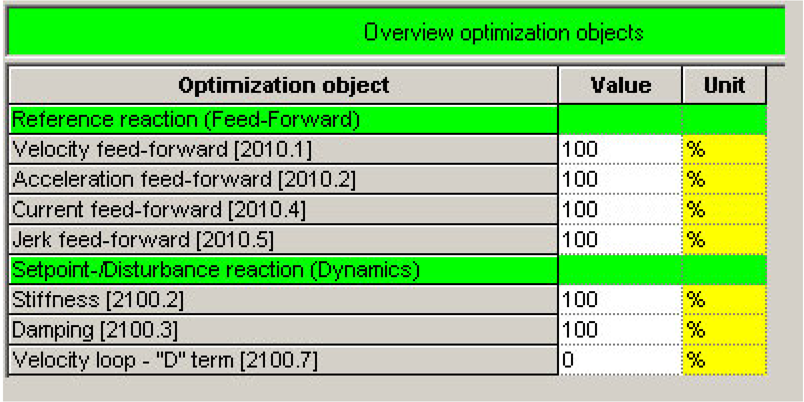
During external setpoint specification, please respect the structure images for electronic cams or gearboxes for **signal filtering with external setpoint specification** (see on page 237) !

Complementary structure for **load control** (see on page 161).

Compax3 **controller structures** (see on page 206, see on page 212, see on page 213).

Symbol	Description
K_p	Proportional term signal is multiplied with K_p
	First order delay component (P-T1 term)
	Integration block (I-block)
	PI-block
	Limitation block (signal limitation)
	Notch filter (band elimination filter)
○	Addition block
blue description	Optimization objects (simple pointer line)
red description	Status objects (pointer line with vertical stroke)

Standard optimization parameters



Overview optimization objects

Optimization object	Value	Unit
Reference reaction (Feed-Forward)		
Velocity feed-forward [2010.1]	100	%
Acceleration feed-forward [2010.2]	100	%
Current feed-forward [2010.4]	100	%
Jerk feed-forward [2010.5]	100	%
Setpoint-/Disturbance reaction (Dynamics)		
Stiffness [2100.2]	100	%
Damping [2100.3]	100	%
Velocity loop - "D" term [2100.7]	0	%

The above figure shows the parameters for the standard group. With the aid of these parameters, you can optimize the standard cascade structure.

Control signal limitations

In this chapter you can read about:

The cascade structure shows that a limitation block is available in the control signal sector of each controller. The limitations of the position and velocity loops are calculated from the set limitations in the configuration and the motor parameters of the selected motor.

Limitation of the setpoint velocity

Limitation of the setpoint velocity in the control signal sector of the position loop:

This limitation value is calculated from the maximum mechanical velocity of the motor and the set value in the configuration in % of the nominal velocity. The smaller of the two values is used for the limitation.

Example

MotorManager

maximum mechanical velocity of the motor:	n_{max}=3100rpm
Rated speed of the motor:	n_N=2500rpm

C3 ServoManager

Max. Operating velocity:	n_{bmax}=200% of n_N => 5000rpm

Velocity limitation value = MIN(n_{max}, n_{bmax}*n_N/100)=	***3100rpm***

Limitation of the setpoint current

Limitation of the setpoint current in the control signal sector of the velocity loop:

This limitation value is calculated from the device peak current, the pulse current of the motor and the set value in the configuration in % of the nominal current. The smaller of the three values is used for the current limitation.

Example

Device

C3 S063 V2 F10 T30 M00 device peak current:	I_{Gmax}=12.6A_{rms}

MotorManager

Rated current of the motor:	I_N=5.5Arms
Peak Current:	I_{imp}=300 %I_N => 16.5A_{rms}

C3 ServoManager

Current (Torque) Limit:	I_{bmax}=200% of I_N => 11A_{rms}

Current limitation value = MIN(I_{Gmax}, I_{imp}*I_N/100, Ibmax*I_N/100)=	***11A_{rms}***

Limitation of the control voltage

Limitation of the control voltage in the control signal sector of the current loop:

This limitation is fixed and cannot be influenced by the user. The limitation value depends on the DC voltage of the device.

Please note!

In the event of highly dynamic motion cycles it is necessary to make sure not to enter the control signal limitation (or, if so only for a very short time) as the drive is then not in the position to follow the set dynamics due to the slow drive physics and the limited control signal range.

Feedforward channels

In this chapter you can read about:

The feedforward channels are used for the specific influence of the guiding behavior of a control. The calculated and evaluated status variables are coupled into the corresponding places within the controller cascade. In practice, the feedforward control offers the following advantages:

- Minimal following error
- Improves the transient response
- Gives greater dynamic range with lower maximum current

The Compax3 servo drive disposes of four feedforward measures (see in the standard cascade structure):

- Velocity Feed Forward
- Acceleration feed-forward
- Current feed-forward
- Jerk feed-forward

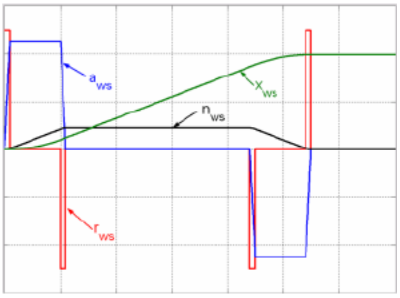
The above order represents at the same time the effectiveness of the individual feedforward measures. The influence of the jerk feedforward may be, depending on the profile and the motor, negligibly small.

Please note!

But the principle of feedforward control fails in limiting the motor current or the motor speed during the acceleration phase!

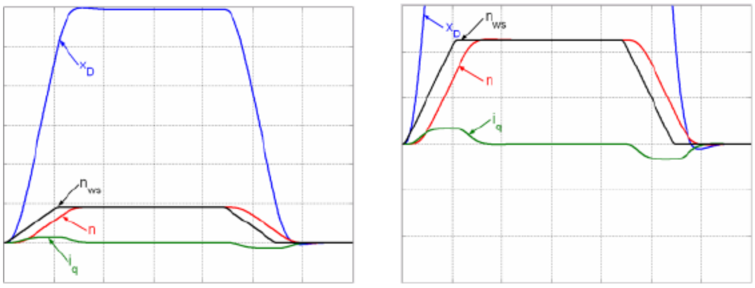
Influence of the feedforward measures

Following error minimization by feedforward control / course of the setpoint generator signals



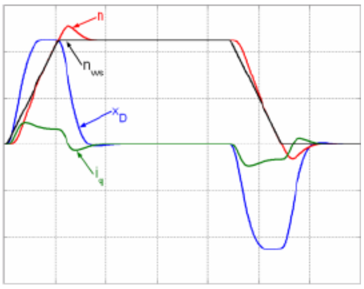
xws:	Position setpoint value of the setpoint generator
nws:	Velocity setpoint - setpoint generator
aws:	Acceleration setpoint value setpoint generator
rws:	Jerk setpoint value setpoint generator

Motion cycle without feedforward control

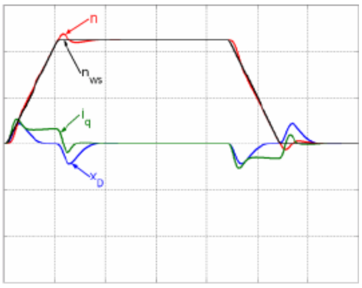


Motion cycle with feedforward measures

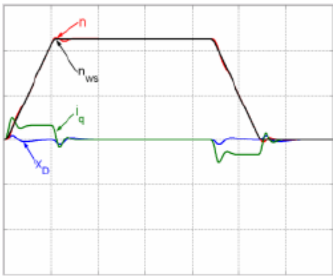
Velocity feedforward



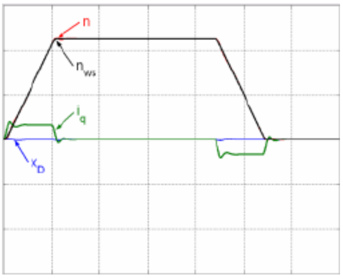
Velocity and acceleration feedforward



Velocity, acceleration and current feedforward



Velocity, acceleration , current and jerk feedforward



Control signal filter / filter of actual acceleration value

The filters in the Compax3 firmware are implemented as P-T1 filters (first order deceleration component see chapter **0** (see on page 237, see on page 237, see on page 238).)

The two "control signal filter (velocity loop)" (Object 2100.20) and "acceleration value filter" (Object 2100.21) are set in µs. The value range for these filters is 63... 8 300 000µs. Depending on the replacement time constant of the closed velocity loop, we can make recommendations for the setting.

Setting recommendation for "control signal filter (velocity loop)":

O2100.20 ≤ O2210.17[µs] / 5	for O2210.17 ≥ 10 000µs
O2100.20 ≤ O2210.17[µs] / 3 - 1333µs	for 4000µs ≤ O2210.17 < 10 000µs
O2210.20 = 0	for O2210.17 < 4000µs

O2210.17: Object replacement time constant of the velocity loop in µs.

O2100.20: Object control signal filter (velocity loop) in µs.

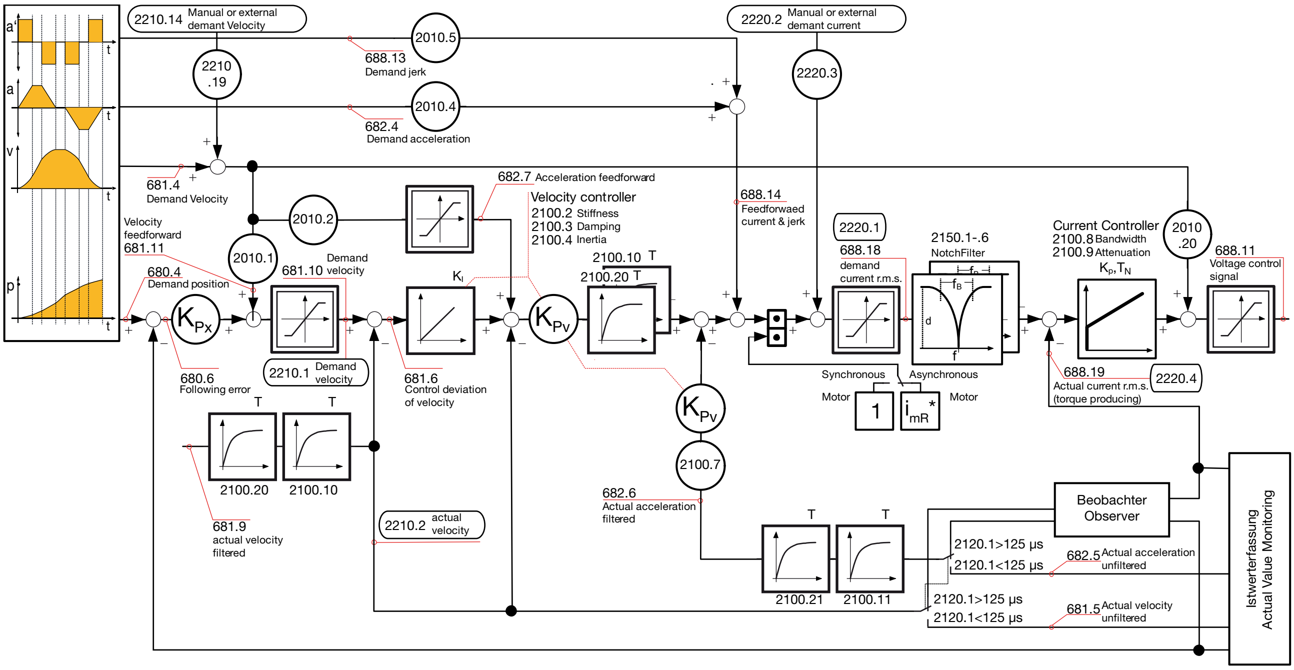
Please note!

It cannot be excluded that the filter may have a destabilizing effect even though set according to the above recommendation. In this case the filter time constant must be reduced.

Advanced

In this chapter you can read about:

Extended cascade (structure variant 1)



The framed objects are coupling objects for Compax3 - Compax3 coupling via HEDA.

Please note that the corresponding controller components must be deactivated for the coupling:

When coupling the velocity (O2219.14): O100.1 or O100.2=1063 (see object description)

When coupling via current (O2220.2): O100.1 or O100.2=1031 (see object description)

O100.1 is only copied into O100.2 upon activation of the controller, the controller can be influenced in active state with the aid of O100.2

Caution! Changing objects O100.1 and O100.2 may cause the control to be deactivated!

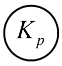
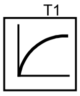
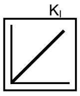
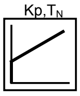
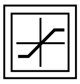
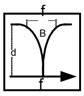
Protect dangerous areas!

External command value

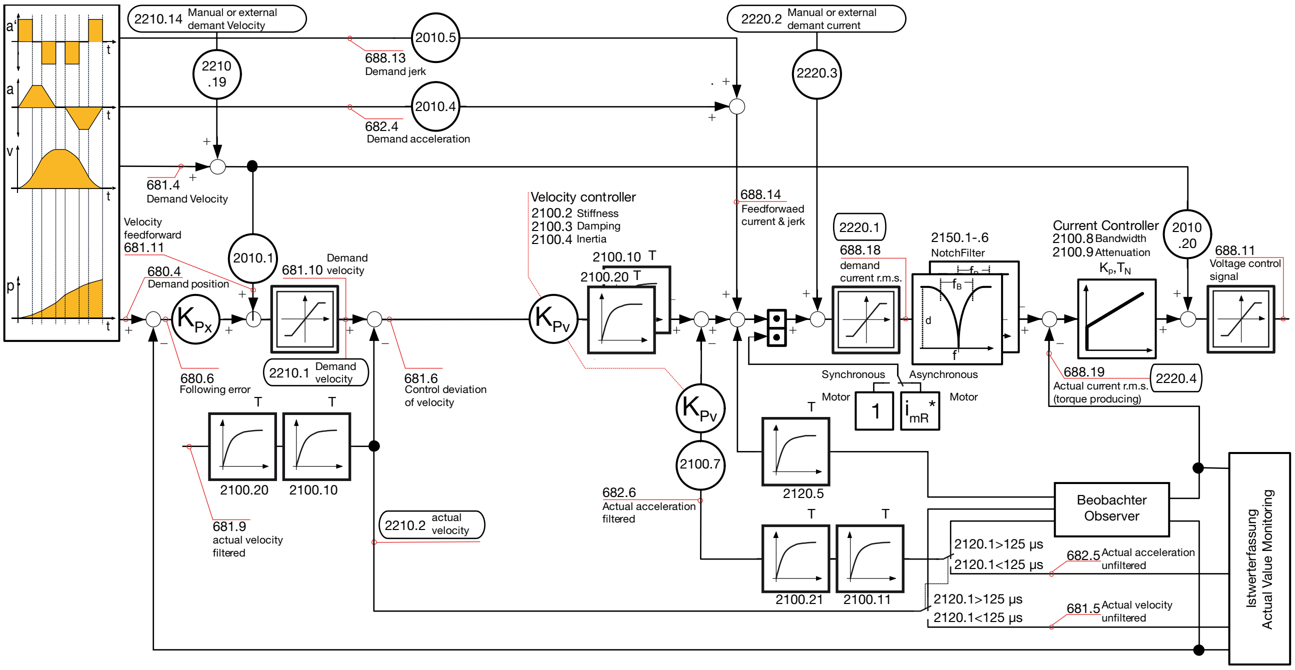
During external setpoint specification, please respect the structure images for electronic cams or gearboxes for **signal filtering with external setpoint specification** (see on page 237) !

Complementary structure for **load control** (see on page 161).

Compax3 **controller structures** (see on page 206, see on page 212, see on page 213).

Symbol	Description
	Proportional term signal is multiplied with K_p
	First order delay component (P-T1 term)
	Integration block (I-block)
	PI-block
	Limitation block (signal limitation)
	Notch filter (band elimination filter)
○	Addition block
blue description	Optimization objects (simple pointer line)
red description	Status objects (pointer line with vertical stroke)

Extended cascade structure (structure variant 2 with disturbance variable observer)



The framed objects are coupling objects for Compax3 - Compax3 coupling via HEDA.

Please note that the corresponding controller components must be deactivated for the coupling:

When coupling the velocity (O2219.14): O100.1 or O100.2=1063 (see object description)

When coupling via current (O2220.2): O100.1 or O100.2=1031 (see object description)

O100.1 is only copied into O100.2 upon activation of the controller, the controller can be influenced in active state with the aid of O100.2

Caution! Changing objects O100.1 and O100.2 may cause the control to be deactivated!

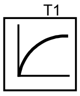
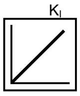
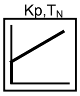
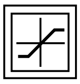
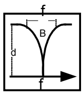
Protect dangerous areas!

External command value

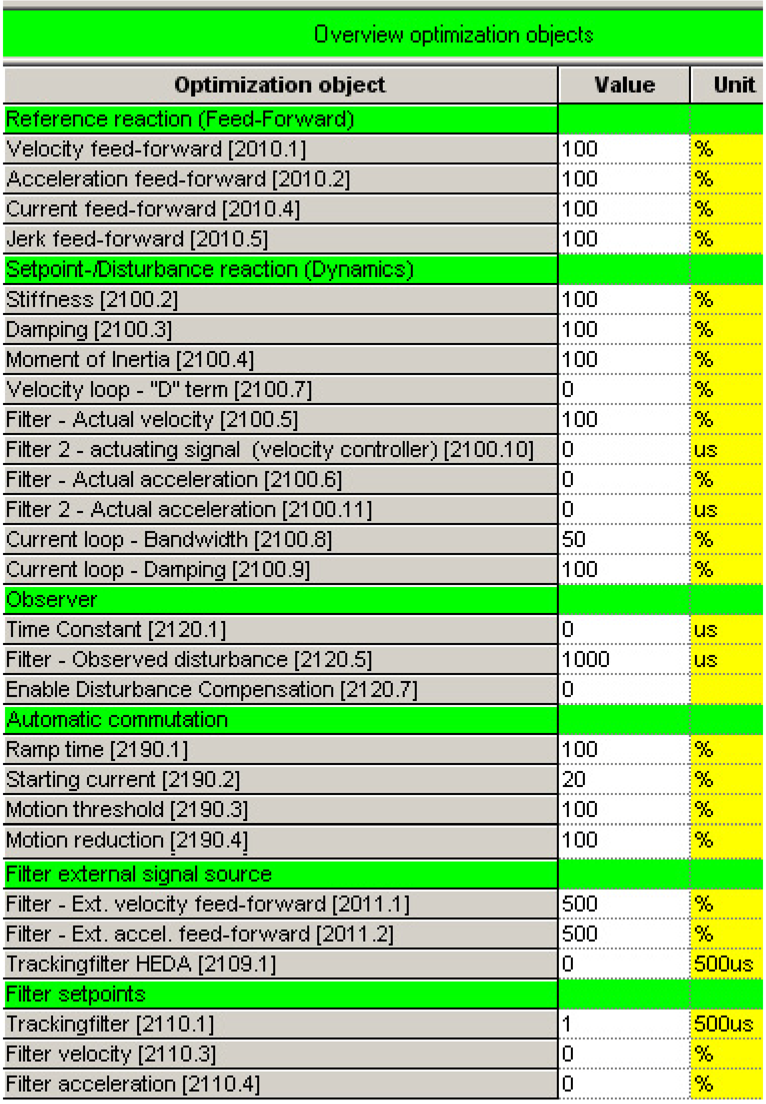
During external setpoint specification, please respect the structure images for electronic cams or gearboxes for **signal filtering with external setpoint specification** (see on page 237) !

Complementary structure for **load control** (see on page 161).

Compax3 **controller structures** (see on page 206, see on page 212, see on page 213).

Symbol	Description
K_p	Proportional term signal is multiplied with K_p
	First order delay component (P-T1 term)
	Integration block (I-block)
	PI-block
	Limitation block (signal limitation)
	Notch filter (band elimination filter)
○	Addition block
blue description	Optimization objects (simple pointer line)
red description	Status objects (pointer line with vertical stroke)

Optimization parameter Advanced



Overview optimization objects

Optimization object	Value	Unit
Reference reaction (Feed-Forward)		
Velocity feed-forward [2010.1]	100	%
Acceleration feed-forward [2010.2]	100	%
Current feed-forward [2010.4]	100	%
Jerk feed-forward [2010.5]	100	%
Setpoint-/Disturbance reaction (Dynamics)		
Stiffness [2100.2]	100	%
Damping [2100.3]	100	%
Moment of Inertia [2100.4]	100	%
Velocity loop - "D" term [2100.7]	0	%
Filter - Actual velocity [2100.5]	100	%
Filter 2 - actuating signal (velocity controller) [2100.10]	0	us
Filter - Actual acceleration [2100.6]	0	%
Filter 2 - Actual acceleration [2100.11]	0	us
Current loop - Bandwidth [2100.8]	50	%
Current loop - Damping [2100.9]	100	%
Observer		
Time Constant [2120.1]	0	us
Filter - Observed disturbance [2120.5]	1000	us
Enable Disturbance Compensation [2120.7]	0	
Automatic commutation		
Ramp time [2190.1]	100	%
Starting current [2190.2]	20	%
Motion threshold [2190.3]	100	%
Motion reduction [2190.4]	100	%
Filter external signal source		
Filter - Ext. velocity feed-forward [2011.1]	500	%
Filter - Ext. accel. feed-forward [2011.2]	500	%
Trackingfilter HEDA [2109.1]	0	500us
Filter setpoints		
Trackingfilter [2110.1]	1	500us
Filter velocity [2110.3]	0	%
Filter acceleration [2110.4]	0	%

Current controller

The current controller works with a P component in the feedback; this results in very low overshoot.

With the aid of object 2220.27 (Bit = “0”), it is possible to switch to P component in the forward path.

EMC feedforward

The EMC feedforward compensates the electromagnetically generated back e.m.f. of the motor U_{EMC}. This signal is proportional to velocity and is deduced from the setpoint velocity of the setpoint generator.

Motor parameters

Furthermore you can re-optimize the motor parameters inductance, resistance and EMC (or Kt) in the advanced mode. The LdLqRatio parameter is the ratio of the smallest and the highest inductance value of the winding, measured during one motor revolution.

Filter "External Command Interface"

Signal filtering with external command value (see on page 237, see on page 237, see on page 238)

Voltage decoupling

In the current control path there is a velocity and current proportional voltage disturbance variable, which must be compensated by the current loop. Due to limited controller dynamics, this disturbance variable can not always be entirely compensated by the current loop. The influence of this disturbance variable may however be minimized by activating the voltage decoupling.

Load control

If a second position feedback is available for the acquisition of the load position, the load control can be activated.

For more detailed information on the load control see device help for T30/T40 devices in the setup chapter Compax3\\load control.

Luenberg observer

In this chapter you can read about:

Introduction observer

A high signal quality of the actual signal value is of high significance in the control of the motor velocity n or the motor speed v. By means of oversampling and transmitter error compensation, a high-quality position signal can be produced for speed determination. As a rule the motor speed is determined by numeric differentiation of the motor position. In this case the quantization noise QvD of the digital speed signal depends on the quantisation Qx of the position signal and the sampling time TAR of the digital control loop:

Quantization speed signal QvD

$$Q_{vD} = \frac{Q_x}{T_{AR}}$$

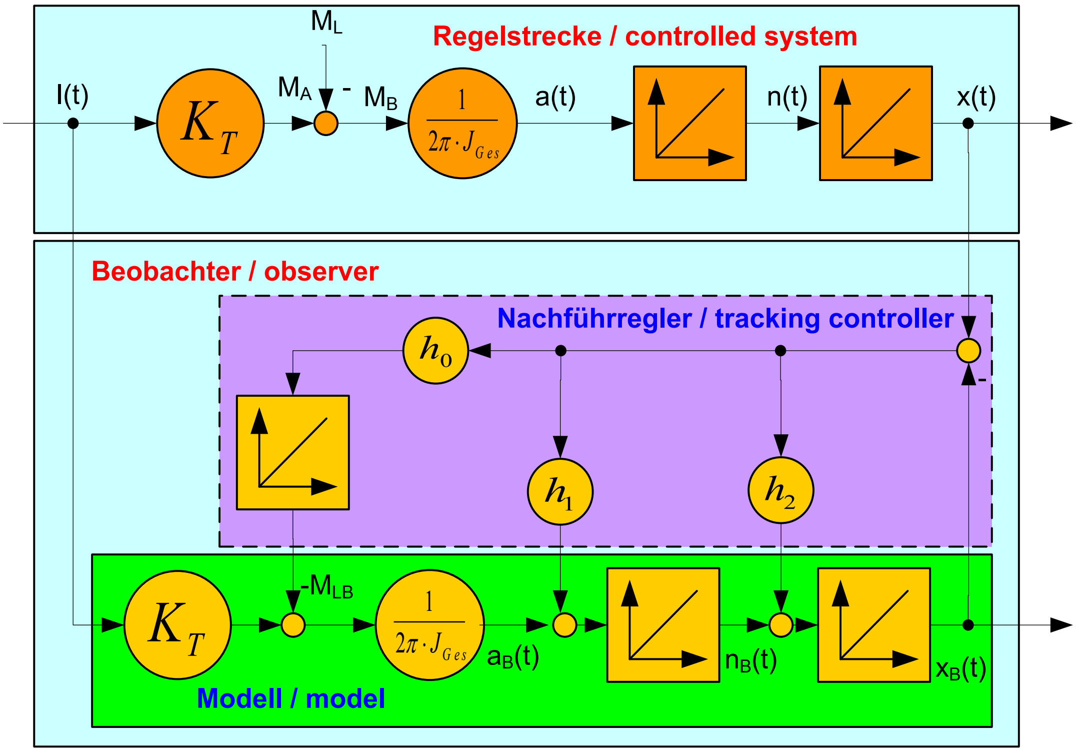
The quantisation of the speed signal is inversely proportional to the sampling time TAR. Hence the demands for the lowest possible sampling time and the minimum quantization noise oppose each other in the determination of speed by numeric differentiation. The noise superimposed by the digital speed signal may be reduced by the low-pass filter, however this is always at the cost of the stability margin of the digital control loop. An alternative method is to determine the speed by integration of the acceleration. The dependence of the quantisation noise QvD of the digital speed signal on the quantisation Qx of the position signal and the sampling time TAR of the digital control loop is shown by the following correlation.

Quantization speed signal QvI

$$Q_{vI} = Q_a \cdot T_{AR}$$

The observer technology offers the advantage that the velocity can be calculated with the aid of integration. The idea of the observer principle is to connect a mathematical model of the control path parallel to the section observed and with the same transfer behavior. In this case, the controller also has the intermediate variables (state variables) of the control path available. However in the presence of model deviations (in structure or parameters), different signal values occur between the model and the control path. For this reason, the technique cannot be employed in this way in practice. However, the model contains the measurable output signal of the control section as a redundant quantity. By comparing the two variables, a tracking control can be used to adapt the model state variables to the state variables of the control path. As the model deviations have become minor in this case due to the simple mechanical drive train, the observer now has an efficient aid available to increase the signal quality. Increase in signal quality in the observer means that the noise components decrease, and the dynamics improve as the observed speed is feedforward-controlled undelayed by the current and is not just calculated delayed from the position signal using simple differentiation.

Signal flow chart Luenberg observer



I(t):	Torque-forming motor current
Kt:	Torque constant
ML(t):	External disturbance torque
Jtotal:	Total mass moment of inertia (motor + load)
a(t):	Acceleration
n(t):	Velocity
x(t):	Position
Index b:	Observed signal quantities
h0…h2:	Controller coefficients of the tracking controller

The figure shows that an additional I element is connected for interference compensation to correct external disturbance forces in the observer. Therefore the speed and the acceleration observed are statically precise. The same applies to the output of the integrator in the tracking controller which is a statically precise determination of an external interference torque ML. For this reason, the I component is not required in the speed controller for some applications, and the entire control can be set up as a state cascade control. This increases the bandwidth of the speed and position controlled member by factor 2. As a consequence, the interference stiffness of the drive and the following error behavior improve.

Here the quantization of the speed signal is proportional to the sampling time TAR, hence there is no longer any conflict between the requirements for minimum sampling time and minimum quantization noise. For the integral velocity acquisition, the motor current variable, which is proportional to the acceleration, can be used. This approach is particularly advantageous in direct drive engineering; due to the absence of a mechanical drive train, there is a very good match between the mathematical model of the observer and the real physical control section in the fundamental frequency range of the control. This applies in particular to direct drive systems with fixed moving masses, as otherwise the mismatch between model and the physical drive system has a destabilizing influence on the transfer behavior of the speed control. A remedy is to increase the observer dynamics, however this increases the noise of the observed signals. Therefore in the case of variable moving masses a compromise has to be found between the dynamics of the observer and the maximum stiffness of the drive.

Commutation settings of the automatic commutation

In this chapter you can read about:

Permanently excited synchronous motors can only be operated with an absolute feedback system (at least for electric motor rotation). The reason is the necessary commutation information (position assignment of the magnet field generated by the motor to the motor magnets). Without the commutation information, there is inevitably the possibility of a positive feedback between position and velocity loop ("running away" of the motor) or of bad motor efficiency (reduced force constant).

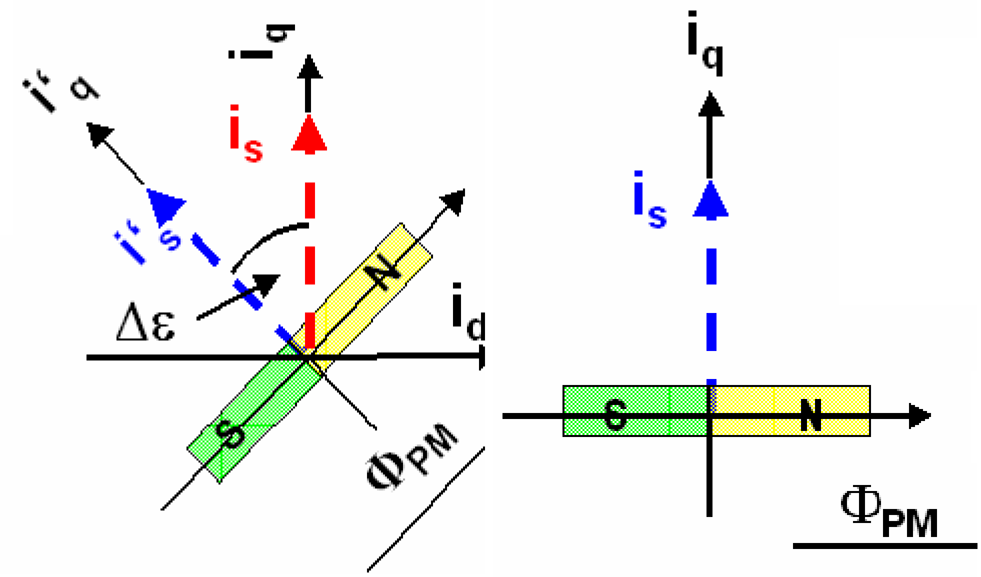
Digital hall sensors are the most common aid to prevent this. Due to the mechanical design it is however impossible or very hard to integrate these sensors in some motors. The Compax3 automatic commutation function (in the F12 direct drive device) described below allows however to use incremental feedback systems without hall sensors.

The functionality implemented in the servo drive establishes the necessary reference between motor stator field and permanent magnetic field without additional aids.

The incremental feedback devices are, in contrast to absolute feedback devices, able to acquire relative distances. It is true that any position can be approached from a starting point, there would be however no consistency between these position values and a fixed virtual absolute system. Other than with an absolute feedback, the correlation between rotor and stator is lost if the position acquisition is switched off ("the position acquisition zero is lost"). When switching on, the actual position is randomly taken as zero. A commutation angle error can therefore absolutely not be excluded. Even a system adjusted before, would show an angular error, for example after a current failure. Therefore the angular error occurring randomly upon each new switching on must always be compensated in an incremental system.

Display of the commutation error in incremental feedback systems

Δε = 0 (adjusted) **Δε ≠ 0 (not adjusted)**



Rotor was turned in switched-off state.

blue: ideal position

red: unfavorable position

PM: magnetic flux of the permanent magnets

i_S: Current pointer

Δε Commutation error

I': ideal position

i_q: Quadrature current (torque forming)

The automatic commutation function (AK) in Compax3 uses the position dependent sinusoidal torque course of permanently excited AC synchronous motors. If the motor windings are energized with DC voltage for instance, the motor develops a sinusoidal torque depending on the rotor position, which can be used for example by evaluating the resulting movement in order to determine the correct motor commutation.

The automatic commutation with movement in the Compax3 has the following properties:

- The motor movement occurring during the commutation is, with correctly parameterized function, very small. It is typically in the range smaller than 10° electrical revolution (=10°/motor poles physically or 10°/360°*motor pitch for a linear motor).
- The precision of the acquired commutation angle depends on the external conditions, however lies normally in the range better than 5° electrical revolution.
- The time until the termination of the commutation acquisition is typically below 10s.

Prerequisites for the automatic commutation

- A movement of the motor must be permitted. The movement actually occurring depends greatly on the motor (friction conditions) itself, as well as on the load moved (inertia).
- Applications requiring a motor brake, i.e. applications where active load torques are applied at the motor (e.g. vertical actuator, slope) are not permitted.
- Due to the function principle, high static friction or load torques will deteriorate the result of automatic commutation.
- When performing automatic commutation, a motion of at least ±180° must be electrically possible (no mechanic limitation)! The implemented automatic commutation function with motion cannot be used for applications with limit or reversal switches.
- With the exception of missing commutation information, the controller/motor combination is configured and ready for operation (parameters correctly assigned for the drive/linear motor). Feedback direction and effective direction of the field of rotation must be identical (automatic commutation performed in the MotorManager).

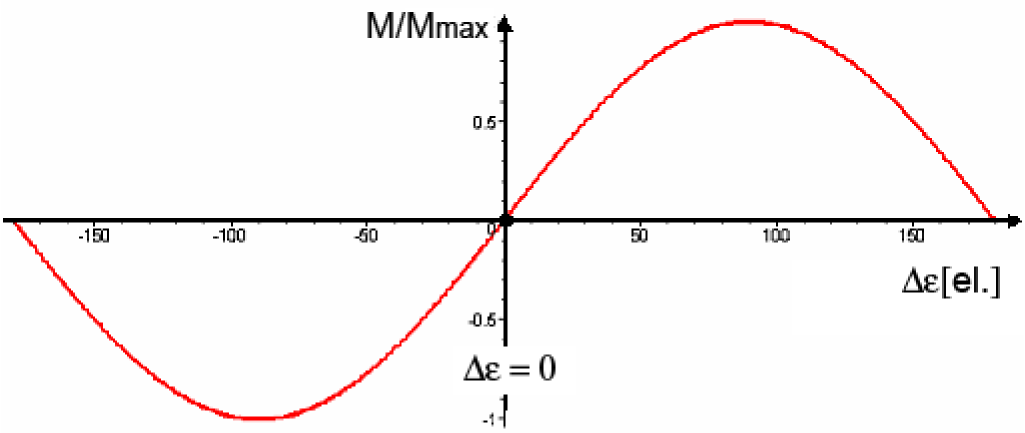
Course of the automatic commutation function

If "automatic commutation with movement" is selected as source of commutation, the automatic commutation sequence runs once if the power stage is enabled. If the power stage is enabled or disabled afterwards, the automatic commutation will be left out. If an error occurs during the execution, the automatic commutation is aborted. A new "attempt to enable" the power stage will trigger a new automatic commutation.

Function principle of the automatic commutation with movement

The implemented method with movement is based on the sinusoidal dependence of the provided motor currents and the resulting movement on the effective commutation error. The acceleration performed by the motor (-> movement) in the event of constantly maintained current is a measure for the actual change in the commutation angle in the way that it disappears upon a change of exactly 0° and is, for other angles, the acceleration and its direction in dependence of the sign and value of the angular error (-180° .. 180°).

Acceleration torque depending on the commutation error.

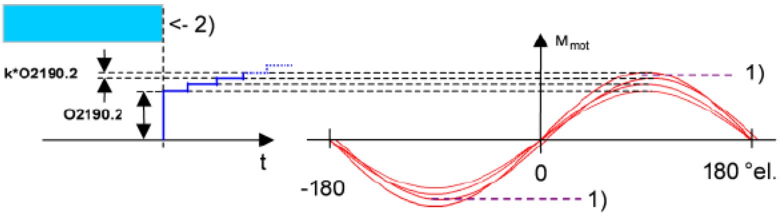


Δε:	Commutation error
M/Mμαξ	normalized acceleration torque

Searching for the torque maxima (phase 1)

If the sum of the actual and the estimated error angle is ±90° electrically, the motor torque is maximal for the provided current. If you gradually increase the provided motor current, the motor will, from a defined value on, surpass its friction torque and exceed a motion threshold defined by O2190.3:

Illustration of the first phase

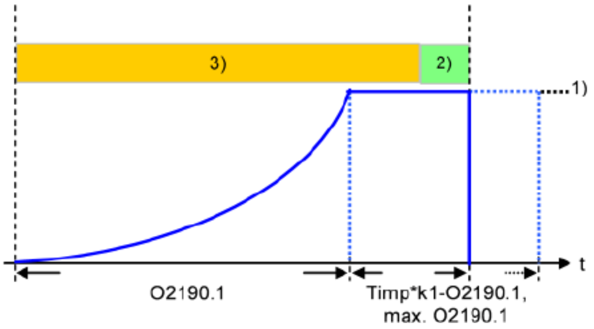


1):	Motion threshold O2190.3
2):	Waiting for standstill
O2190.2:	Starting current

Latching of the motor (phase 2)

Here, the drive is brought to the position with the provided motor torque=0, where the angular error is either +-180° or 0°.

Current rise in the second phase.



O2190.1:	Rising time of latching current
1)	Maximum current from controller or motor
2)	Monitoring on 5° electrical movement
3)	Monitoring on 60° electrical movement

Motion reduction:

It is possible, to considerably reduce the motor movement occurring during the fine angle search with the aid of the "motion reduction" parameter (O2190.4).

Please respect also that the acquired commutation result may be slightly worse than without this measure.

Hint

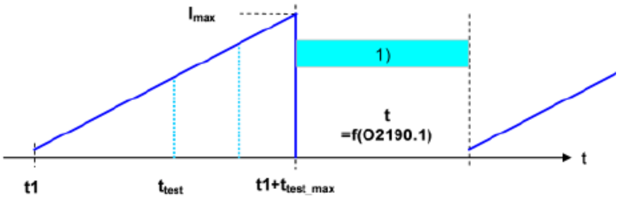
As a current well above the nominal motor current is provided here, there may be saturation effects on iron core motors, which might lead to an instable current loop (-> highly frequent "creaking noises" during the automatic commutation). This can be avoided by activating the saturation characteristic line in the motor data.

Test for positive feedback (phase 3)

Here it is verified, if the motor performs a motion in the expected positive direction in the event of positive current in the torque maximum. The same motion threshold (defined via O2190.3) as in phase 1 is valid. The test is repeated several times.

A current course in ramp form is specified (target: minimum motion). The break between the tests varies with he current rise time O2191.1.

Illustration of the third phase



1):	Waiting for standstill
tp	Waiting for standstill

Other

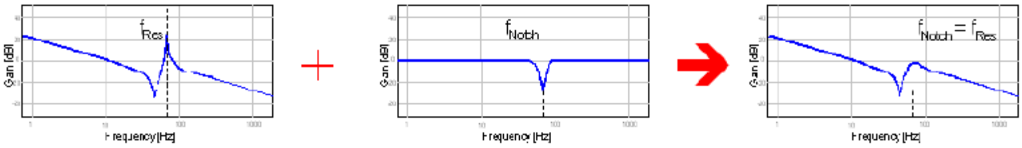
- During the sequence (time according to parameterization>>1s) the automatic commutation is externally visualized by a LED blinking code (green permanent and red blinking).
- Device errors will lead to an abort of the automatic commutation.
- During automatic commutation, no motion commands are accepted.
- The controller cascade entirely deactivated during automatic commutation, with the exception of the current loop.
- In multi-axis applications, the axes to be automatically commutated must be awaited (output of the MC_Power block must deliver "True")!
- The automatic commutation is only started if the drive is at standstill.
- After the occurring and acknowledgement of a feedback error or a configuration change of the feedback system, the automatic commutation must be performed again, as it might be that the position entrainment in the servo controller is interrupted (commutation information is lost).

Notch filter

In this chapter you can read about:

Notch filters are small-band band elimination filters which slope in a wedge form towards the center frequency. The attenuation of this center frequency is extremely high in most cases. With the aid of the notch filters it is possible to purposefully eliminate the effects of mechanical resonance frequencies. With this, the mechanical resonance point is not activated itself, but the excitation of this point of resonance is avoided by the control.

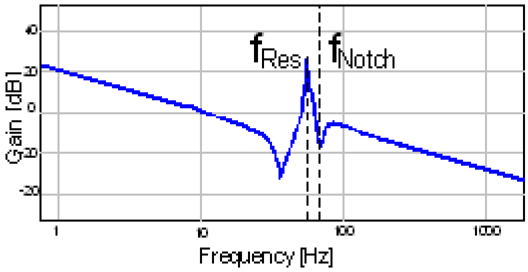
Effect of the notch filter



Resonance Notch filter Result

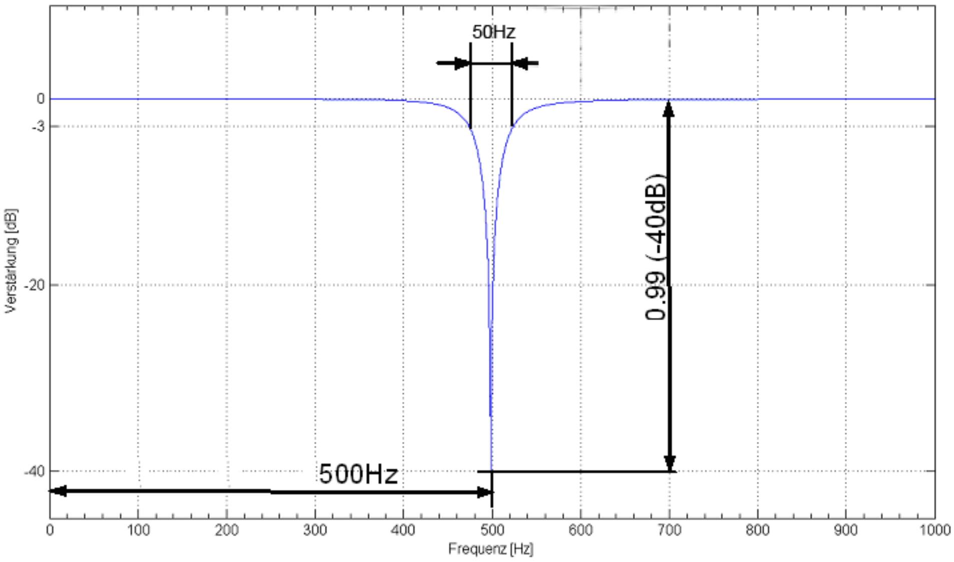
As can be seen in the figure, the notch filter is only useful in cases where the set frequency of the notch filter is exactly the same as the disturbing frequency. The notch filter as well as the resonance point are very narrowband. If the resonance point does only minimally change (e.g. by changing the masses involved), it is not sufficiently activated by the notch filter.

Wrongly set notch filter



In the Compax3, two notch filters which are independent of each other are implemented.

Frequency response of the notch filter.



Center frequency = 500Hz

Bandwidth = 50Hz

Depth = 0.99 (-40dB)

Parameterization by 3 objects.

In this chapter you can read about:

Frequency filter 1 (O2150.1) / frequency filter 2 (O2150.4)

This defines the frequency at which the notch filter attenuation is highest. In practice it shows that notch filters can only sensibly be used if the distance between the controller bandwidth (velocity loop) and the center frequency is long enough (at least factor 5). This permits to deduce the following recommendation:

$$O2150.x \geq \frac{5000000}{2\pi \cdot O2210.17[\mu s]}$$

$$x = 1 \text{or } x = 4$$

Obj2210.17: Replacement time constant of the velocity loop in µs.

Note: If this distance is too small, the stability of the control can be very negatively influenced!

Bandwidth filter 1 (O2150.2) / bandwidth filter 2 (O2150.5)

This defines the width of the notch filter.
The value refers to the entire frequency band, where the attenuation of the filter is higher than (-)3dB.

In practice it shows that even if there is enough distance towards the control, it can be negatively influenced by too high bandwidths (higher than 1/4 of the center frequency).

$$O2150.x \le \frac{O2150.1/4}{4}$$

$$x = 2 \text{ or } x = 5$$

Depth filter 1 (O2150.3) / depth filter 2 (O2150.6)

With this the size of the attenuation of the filter must be at the position of the center frequency. One stands here for complete attenuation (-∞ dB) and zero for no attenuation.

$$O2150.x = 1 - 10^{-\left(\frac{D[dB]}{20}\right)}$$

$$x = 3 \text{ or } x = 6$$

D [dB]: The desired attenuation at the center frequency in dB

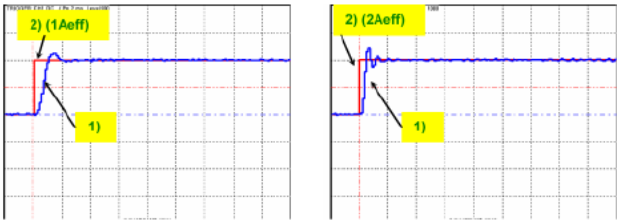
Saturation behavior

In this chapter you can read about:

Saturation can be stated with the aid of current jerk responses at different current height.

Current jerk response

Current jerk response of a motor to 2 different currents (1Arms / 2Arms)



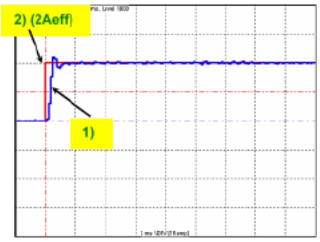
1) Actual current

2) Setpoint current

In the above figure we can see from the settling response that the drive shows a distinctive tendency to oscillate at doubled current. The saturation characteristic line, which is used to linearly reduce the P-term of the current loop depending on the current, helps against such a saturation behavior.

If you respect the saturation for the above example with the aid of the saturation characteristic line, the tendency to oscillate of the current loop can again be activated.

Current jerk response with the activated saturation characteristic line



The parameterization of the characteristic line is made in the MotorManager.

Note:

- In order to accept the changes in the MotorManager in the project, the entire configuration must be confirmed.
- In order to make the changes from the MotorManager effective in the device, the configuration download must be executed.

Control measures for drives involving friction

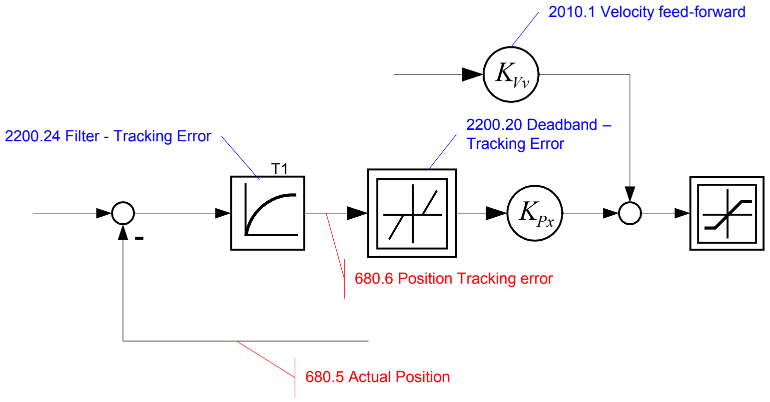
In this chapter you can read about:

Some drives, which involve much friction due to their guiding system, may show permanent oscillation at standstill. The transition between static friction (standstill) and kinetic friction (very low speed) is very steep. The controller can not longer follow the friction characteristic line at this position. The I-term integrates until the control variable pulls free the drive and the drive moves too far. This procedure is repeated in the opposite direction and a control oscillation occurs (so-called limit cycle). In order to eliminate this control oscillation, the following control functions were implemented:

- Deadband following error (Obj. 2200.20)
- Filter following error (Obj. 2200.24)
- Friction compensation (Obj. 2200.20)

Deadband following error

Deadband/filter following error in the position loop

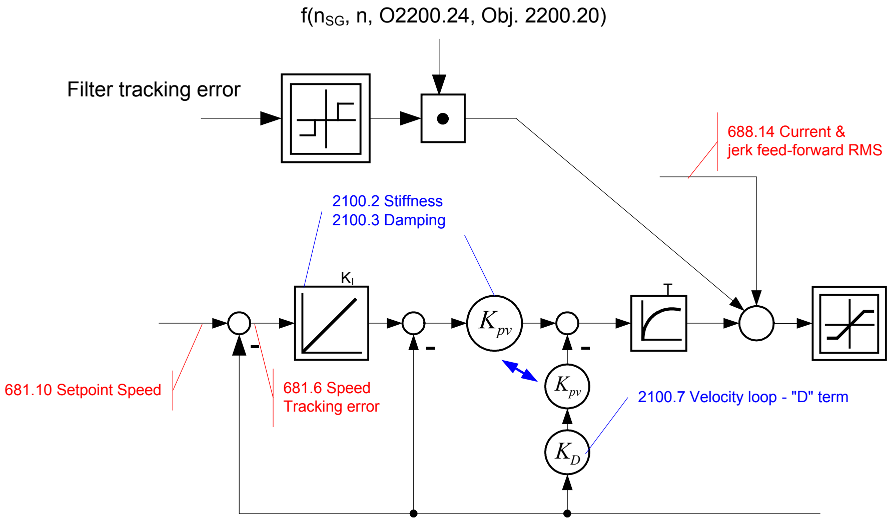


The deadband does no longer supply a velocity setpoint value (zero) for the subordinate velocity loop at small following error. The integrator of the velocity loop stops integrating and the system comes to a standstill.

In order to prevent that the velocity loop is excited by the noise on the following error, the following error should be filtered before the deadband, which will lead, however, to delays in the position loop. The deadband to be set depends on the friction behavior (amplitude of the limit cycle) and on the noise on the following error (the noise must remain within the deadband).

Friction compensation

The activation of the friction compensation (end of the velocity loop)



The friction compensation helps the control to surmount static friction at low setpoint speeds. The non linear characteristic line is partly compensated by this and a smaller deadband can be chosen, which will increase the position accuracy. The amplitude of the friction compensation depends on the application and must be calculated if needed. If the value is set too high, corrective movements may result and the tendency to oscillate is increased.

Commissioning window

In this chapter you can read about:

Commissioning window

With the aid of the setup window, the drive can be set up in a simple way.

Load identification

If you do not know the mass moment of inertia, it can be determined. For this, you click on the corresponding button (see setup window no. 13). After the following parameter entry, the identification can be started via the same button.

- For more detailed information on the load identification, see the device help, chapter "load identification".
- This measurement requires the correct EMC or torque constant value Kt.

Setpoint generation

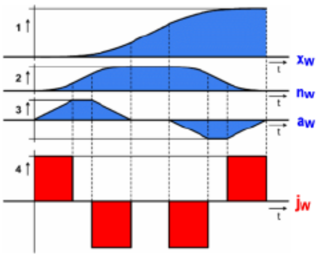
In this chapter you can read about:

The setpoints for the control loops are provided in two different ways - internally or externally. The setpoint generation depends on the technology option of the device.

Internal setpoint generation

The internal setpoint generation can be used for the technology options >T10. In this case, the internal setpoint generator generates the entire motion profile with position, velocity, acceleration and jerk.

Motion profile at jerk-controlled setpoint generation



x_W	Position
n_W	Velocity
a_W	Acceleration
j_W	Jerk

The drive cannot move randomly through hard profiles, as certain physical limits exist for the acceleration ability due to the motor physics and the limitation of the control variable. You must therefore make sure that the set movement corresponds to the real physics of the motor and of the servo drive.

As a support you can take the following physical correlation.

The calculation of the physically possible acceleration

rotary drives

$$a[rps^2] = \frac{M_A[Nm] - M_L[Nm]}{2\pi \cdot J_{ges}[kgm^2]}$$

M_A: Drive torque of the motor
M_L: Load torque of the motor
J_{total}: entire mass moment of inertia
a: possible acceleration

Linear drives

$$a\left[{}^{m}\!/_{s^2}\right] = \frac{F_A[N] - F_L[N]}{m_{ges}[kg]}$$

F_A: Drive force of a linear motor
F_L: Load force of a linear motor
m_{total}: Total mass of a linear motor

The generation of the setpoint profile is jerk-controlled and jerk-limited by the specification of the jerk.

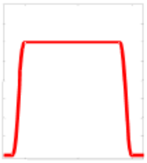
In practice, jerk-limited setpoint generation is important if the items to be moved must be handled gently. In addition, the service life of the mechanical guiding system will be extended. A separate setting of jerk and slope of the deceleration phase also permits overshoot-free positioning in the target position. For this reason, it is common practice to use higher values for acceleration and jerk in the acceleration phase than in the deceleration phase. In consequence a higher cycle rate can be achieved.

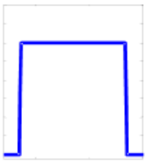
An additional important reason for the jerk limitation is the excitation of higher frequencies due to the too high jerk in the power density spectrum of the velocity function.

Jerk=1000°/s^3

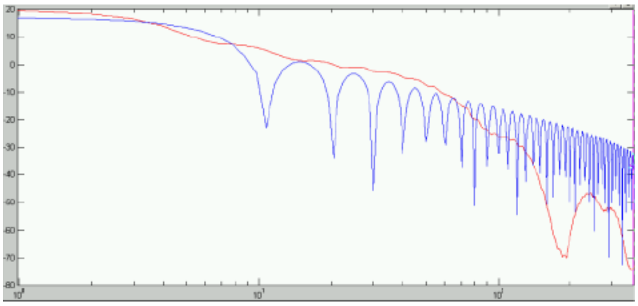
Jerk=1000000°/s^3

Time function:





Time function and power density spectrum of Compax3 setpoint generator with different jerk settings



Power density over the frequency

The profile can be simply calculated and displayed for control purposes.

External setpoint generation

During external setpoint generation, the necessary feedforward signals are calculated from the external setpoint with the aid of numerical differentiation and final filtering.

Hint For more detailed information on the external setpoint generation see device help for T11/T30/T40 devices in the "setup" chapter Compax3\\optimization\\controller dynamics\\signal filtering at external setpoint specification"

Test Move

In order to evaluate the behavior of the drive, test movements can be defined. For this you jump into the parameter entry either with the aid of the “enter setup/test movement parameters” or by selecting the parameter tab. Via the “setup settings” menu you access the settings for the desired test movement.

The desired motion profile can be set via the parameters in the following window.

Proceeding during controller optimization

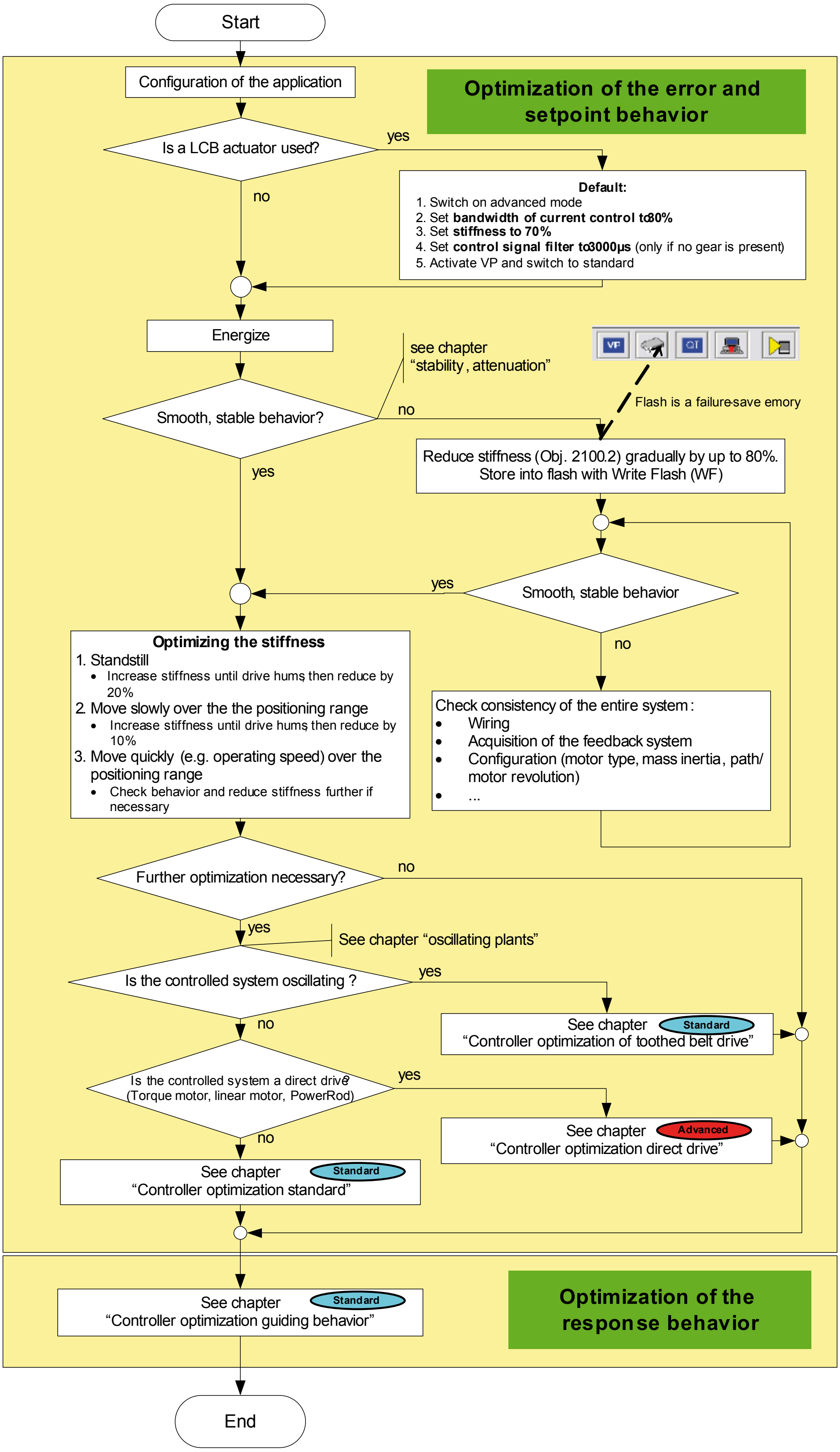
In this chapter you can read about:

If the control behavior is not sufficient for the present application, an optimization is required. We recommend the following approach:

Overview on the approach to setup + optimization

- At first, the disturbance and setpoint behavior of the velocity loop at standstill and at different displacement velocities is optimized (stiffness, attenuation, filter).
- After that, the necessary motion profiles are set via the setup tool and the desired guiding behavior in the entire velocity range is set via the feedforward control (motion profiles, feedforward).

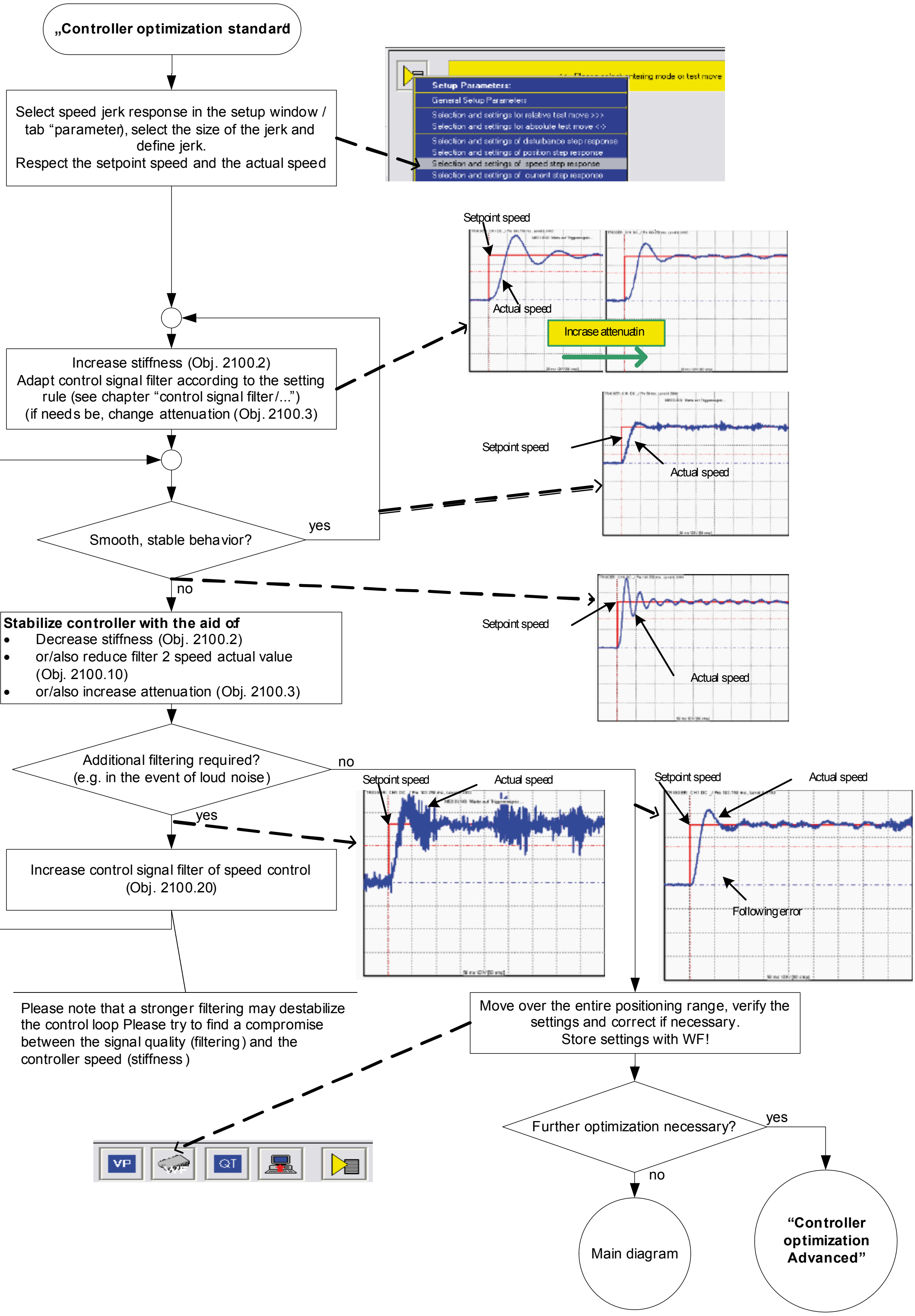
Main flow chart of the controller optimization



Controller optimization disturbance and setpoint behavior (standard)

In this chapter you can read about:

Controller optimization standard



„Controller optimization standard"

Select speed jerk response in the setup window / tab "parameter), select the size of the jerk and define jerk.
Respect the setpoint speed and the actual speed

Setup Parameters:
- General Setup Parameters
- Selection and settings for relative test move >>>
- Selection and settings for absolute test move <->
- Selection and settings of disturbance step response
- Selection and settings of position step response
- Selection and settings of speed step response
- Selection and settings of current step response

Increase stiffness (Obj. 2100.2)
Adapt control signal filter according to the setting rule (see chapter "control signal filter/...")
(if needs be, change attenuation (Obj. 2100.3)

Smooth, stable behavior?

Stabilize controller with the aid of
- Decrease stiffness (Obj. 2100.2)
- or/also reduce filter 2 speed actual value (Obj. 2100.10)
- or/also increase attenuation (Obj. 2100.3)

Additional filtering required?
(e.g. in the event of loud noise)

Increase control signal filter of speed control
(Obj. 2100.20)

Please note that a stronger filtering may destabilize the control loop Please try to find a compromise between the signal quality (filtering) and the controller speed (stiffness)

Move over the entire positioning range, verify the settings and correct if necessary.
Store settings with WF!

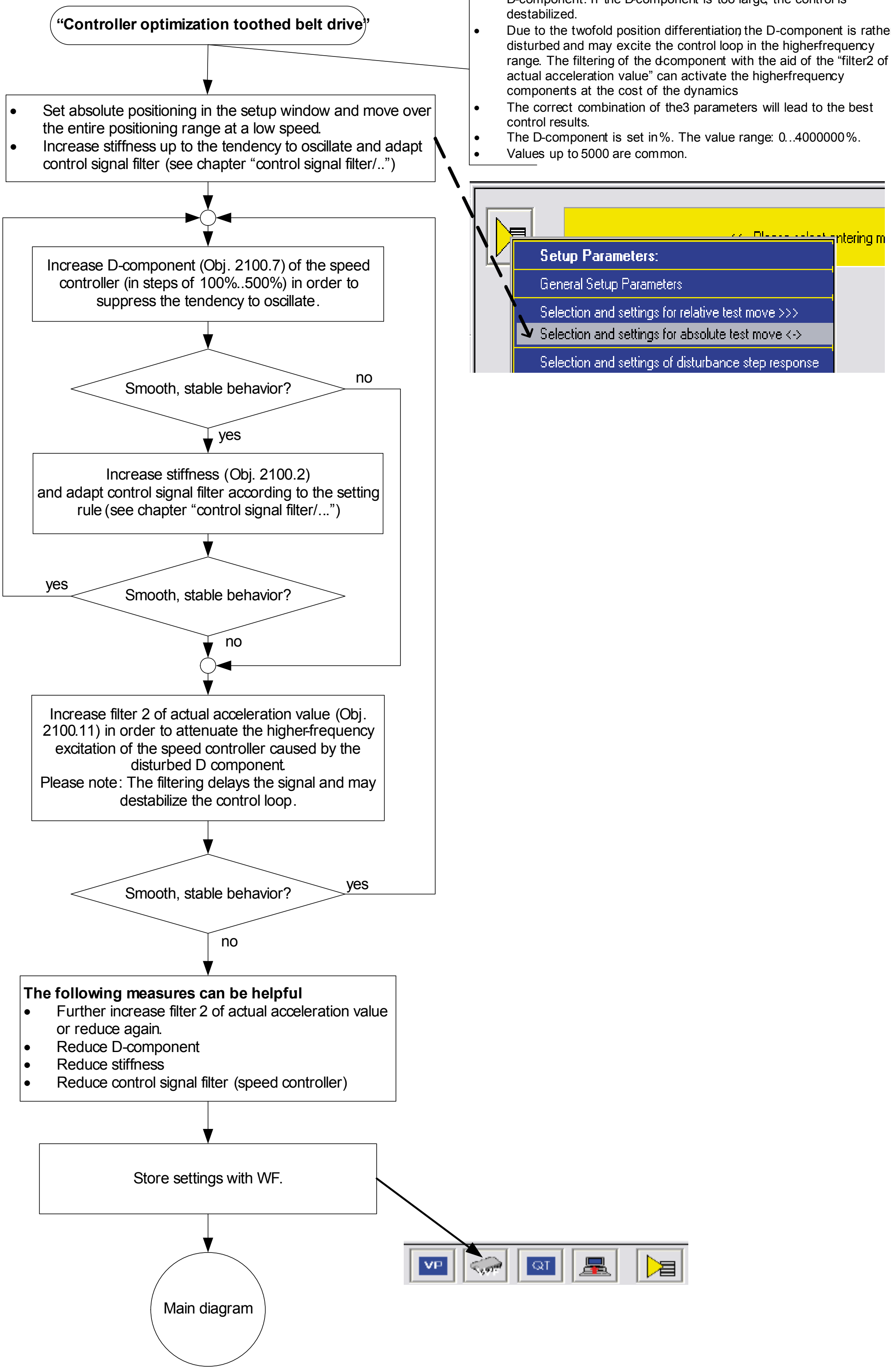
Further optimization necessary?

Main diagram

"Controller optimization Advanced"

Controller optimization of toothed belt drive

- The stiffness of a drive able to oscillate can be increased by using the D-component. If the D-component is too large, the control is destabilized.
- Due to the twofold position differentiation, the D-component is rather disturbed and may excite the control loop in the higher-frequency range. The filtering of the d-component with the aid of the "filter2 of actual acceleration value" can activate the higher-frequency components at the cost of the dynamics
- The correct combination of the3 parameters will lead to the best control results.
- The D-component is set in %. The value range: 0...4000000 %.
- Values up to 5000 are common.



"Controller optimization toothed belt drive"

- Set absolute positioning in the setup window and move over the entire positioning range at a low speed.
- Increase stiffness up to the tendency to oscillate and adapt control signal filter (see chapter "control signal filter/..")

Increase D-component (Obj. 2100.7) of the speed controller (in steps of 100%..500%) in order to suppress the tendency to oscillate.

Smooth, stable behavior?

Increase stiffness (Obj. 2100.2) and adapt control signal filter according to the setting rule (see chapter "control signal filter/...")

Smooth, stable behavior?

Increase filter 2 of actual acceleration value (Obj. 2100.11) in order to attenuate the higher-frequency excitation of the speed controller caused by the disturbed D component.
Please note: The filtering delays the signal and may destabilize the control loop.

Smooth, stable behavior?

The following measures can be helpful
- Further increase filter 2 of actual acceleration value or reduce again.
- Reduce D-component
- Reduce stiffness
- Reduce control signal filter (speed controller)

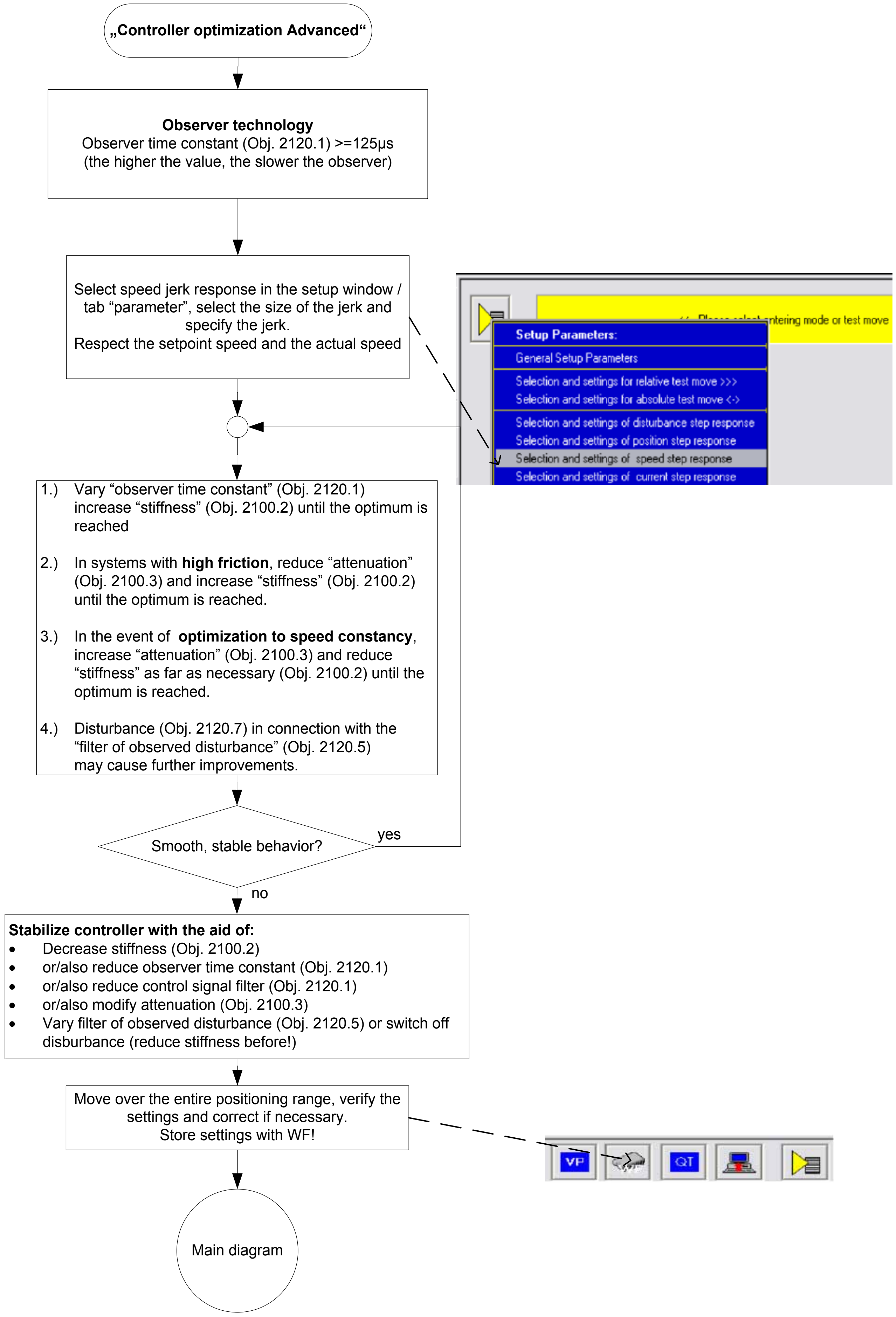
Store settings with WF.

Main diagram

Controller optimization disturbance and setpoint behavior (advanced)

In this chapter you can read about:

Controller optimization Advanced



„Controller optimization Advanced“

Observer technology
Observer time constant (Obj. 2120.1) >=125µs
(the higher the value, the slower the observer)

Select speed jerk response in the setup window / tab “parameter”, select the size of the jerk and specify the jerk.
Respect the setpoint speed and the actual speed

1.) Vary “observer time constant” (Obj. 2120.1) increase “stiffness” (Obj. 2100.2) until the optimum is reached

2.) In systems with **high friction**, reduce “attenuation” (Obj. 2100.3) and increase “stiffness” (Obj. 2100.2) until the optimum is reached.

3.) In the event of **optimization to speed constancy**, increase “attenuation” (Obj. 2100.3) and reduce “stiffness” as far as necessary (Obj. 2100.2) until the optimum is reached.

4.) Disturbance (Obj. 2120.7) in connection with the “filter of observed disturbance” (Obj. 2120.5) may cause further improvements.

Smooth, stable behavior?

yes

no

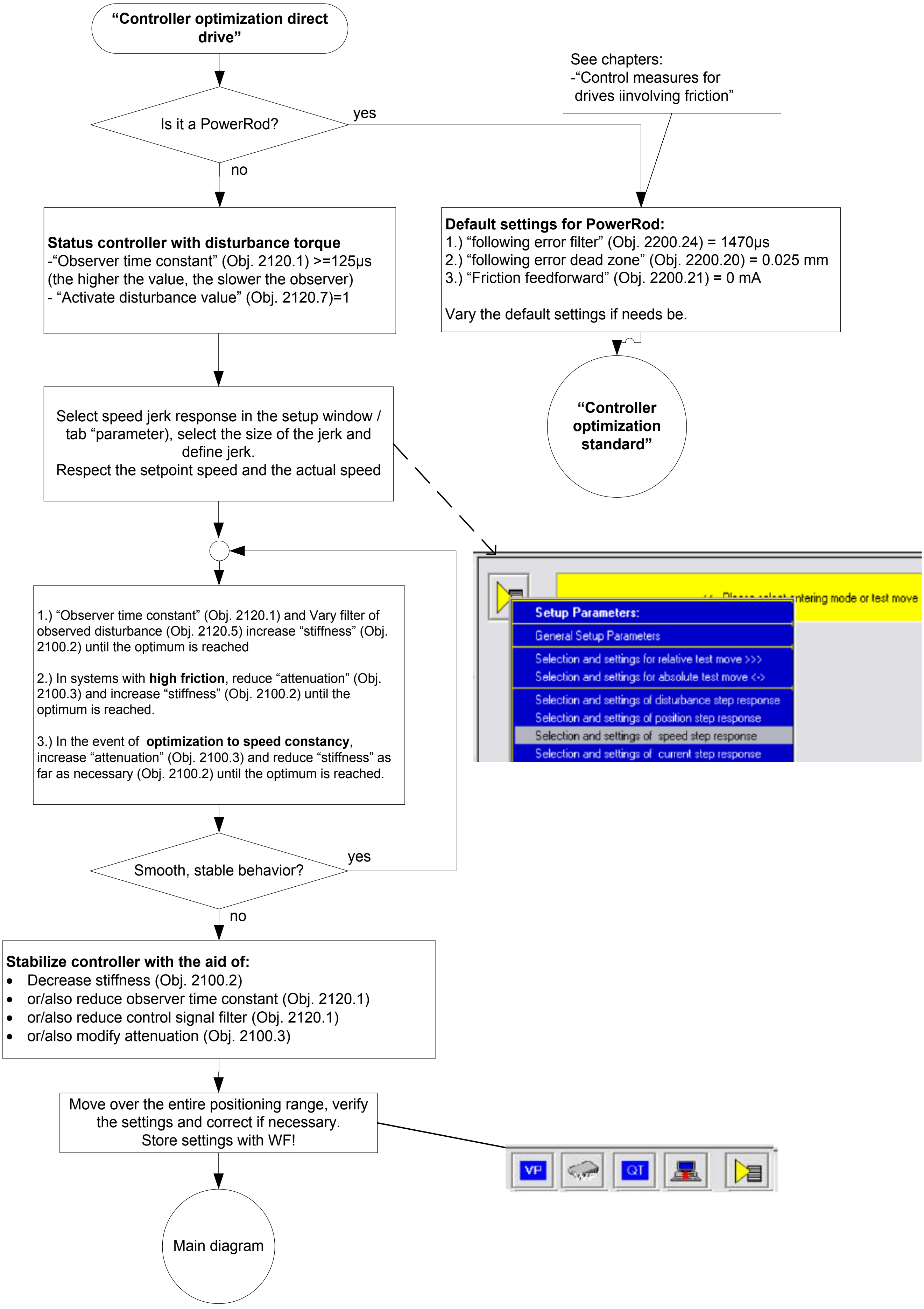
Stabilize controller with the aid of:

- Decrease stiffness (Obj. 2100.2)
- or/also reduce observer time constant (Obj. 2120.1)
- or/also reduce control signal filter (Obj. 2120.1)
- or/also modify attenuation (Obj. 2100.3)
- Vary filter of observed disturbance (Obj. 2120.5) or switch off disburbance (reduce stiffness before!)

Move over the entire positioning range, verify the settings and correct if necessary.
Store settings with WF!

Main diagram

Flow chart controller optimization of a direct drive



“Controller optimization direct drive”

Is it a PowerRod?

yes

See chapters:
-“Control measures for drives iinvolving friction”

Default settings for PowerRod:
1.) “following error filter” (Obj. 2200.24) = 1470µs
2.) “following error dead zone” (Obj. 2200.20) = 0.025 mm
3.) “Friction feedforward” (Obj. 2200.21) = 0 mA

Vary the default settings if needs be.

“Controller optimization standard”

no

Status controller with disturbance torque
-“Observer time constant” (Obj. 2120.1) >=125µs (the higher the value, the slower the observer)
- “Activate disturbance value” (Obj. 2120.7)=1

Select speed jerk response in the setup window / tab “parameter), select the size of the jerk and define jerk.
Respect the setpoint speed and the actual speed

1.) “Observer time constant” (Obj. 2120.1) and Vary filter of observed disturbance (Obj. 2120.5) increase “stiffness” (Obj. 2100.2) until the optimum is reached

2.) In systems with **high friction**, reduce “attenuation” (Obj. 2100.3) and increase “stiffness” (Obj. 2100.2) until the optimum is reached.

3.) In the event of **optimization to speed constancy**, increase “attenuation” (Obj. 2100.3) and reduce “stiffness” as far as necessary (Obj. 2100.2) until the optimum is reached.

Smooth, stable behavior?

yes

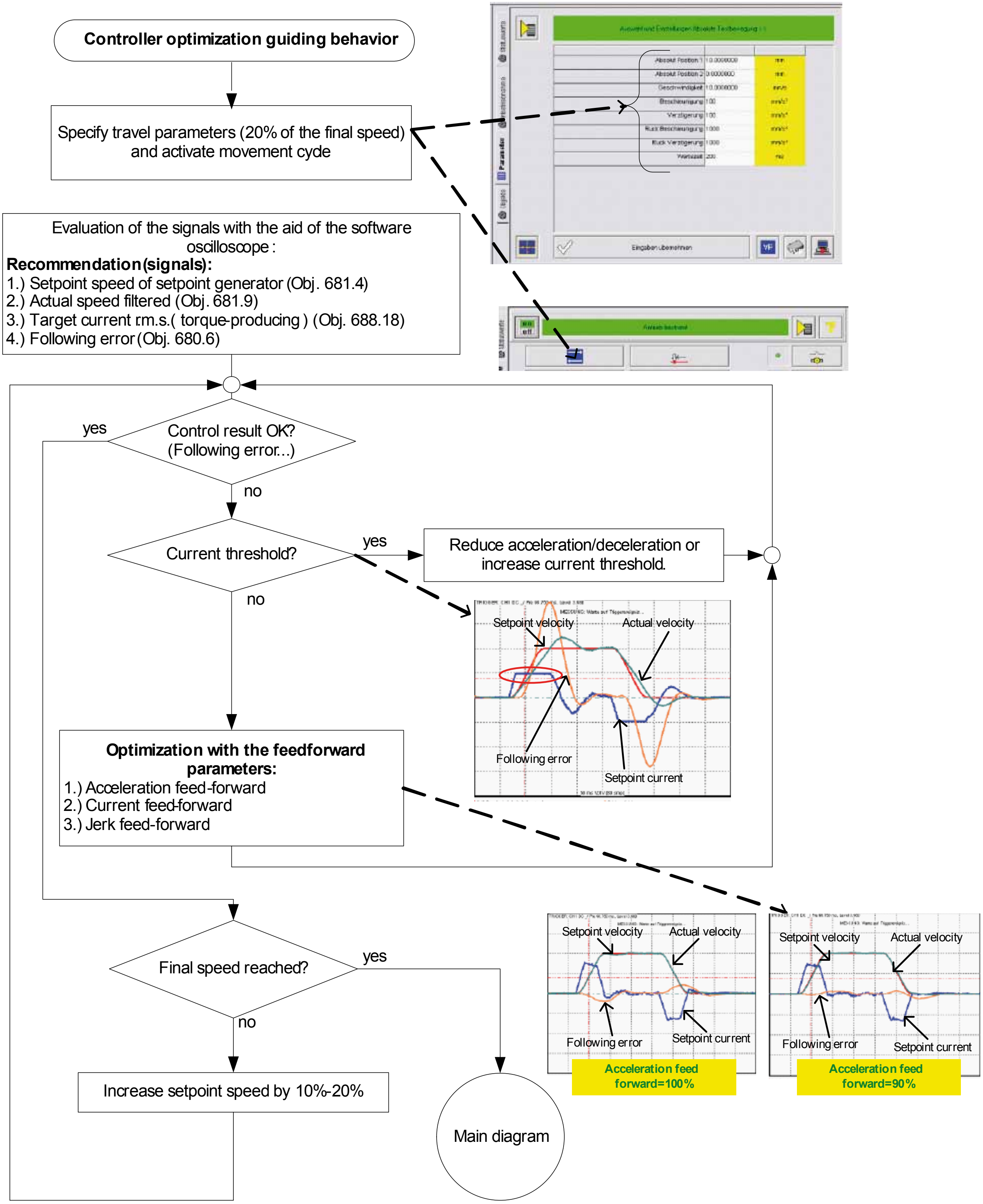
no

Stabilize controller with the aid of:
- Decrease stiffness (Obj. 2100.2)
- or/also reduce observer time constant (Obj. 2120.1)
- or/also reduce control signal filter (Obj. 2120.1)
- or/also modify attenuation (Obj. 2100.3)

Move over the entire positioning range, verify the settings and correct if necessary.
Store settings with WF!

Main diagram

Controller optimization guiding transmission behavior



4.4.4. Signal filtering with external command value

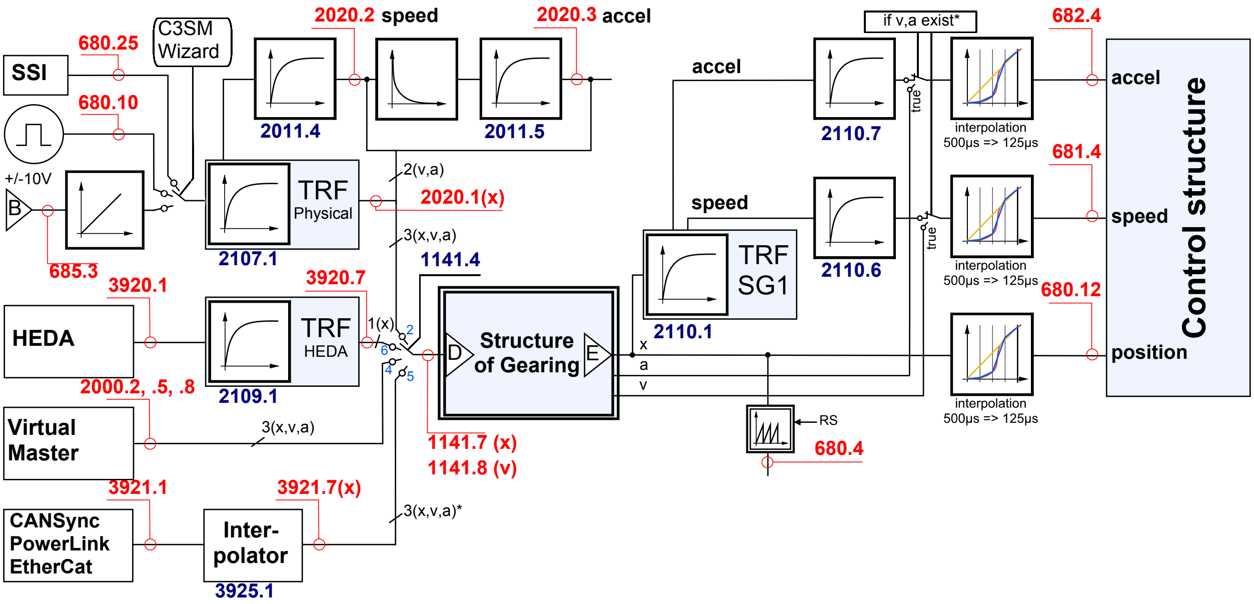
In this chapter you can read about:

The command signal read in from an external source (via HEDA or physical input) can be optimized via different filters.

For this the following filter structure is available:

4.4.4.1 Signal filtering for external setpoint specification and electronic gearbox

Does not apply for Compax3I11T11!



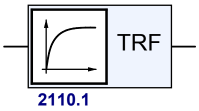
* Speed v and acceleration a are only present in the event of linear interpolation (bus interpolator: O3925.1) if they are provided by an external source.
In quadratic or cubic interpolation, v and a are emulated.

B: **Structure image of the signal processing**,

D/E: **Structure of Gearing** (see on page 329)

Control structure (see on page 206, see on page 212, see on page 213)

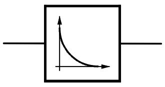
Symbols



Tracking filter

The displayed filter influences all outputs of the tracking filter.

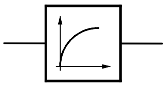
Number: Object number of the filter characteristic



Differentiator

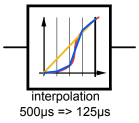
Output signal = d(input signal)/dt

The output signal is the derivation (gradient) of the input signal



Filter

Number: Object number of the filter characteristic



Interpolation

Linear Interpolation.

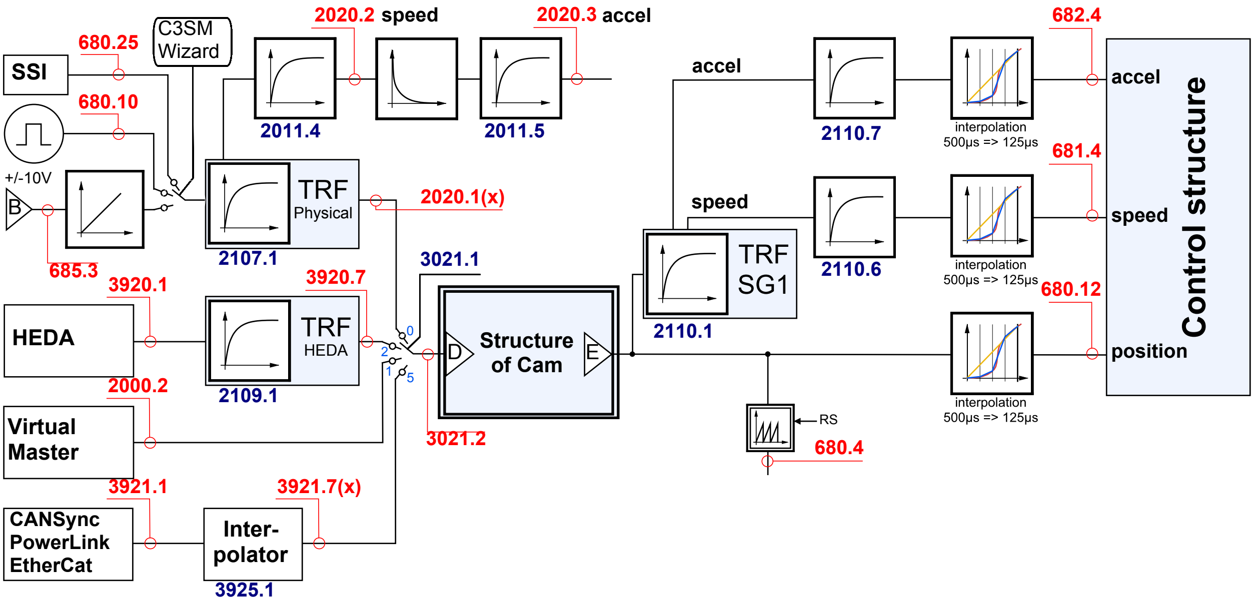
Values in the 500µs grid are converted into the more exact time grid of 125µs.

Note:

- A setpoint jerk setpoint feedback is not required for external setpoint specification.
- The description of the objects can be found in the **object list** (see on page 544).

4.4.4.2 Signal filtering for external setpoint specification and electronic cam

Only Compax3 T40!

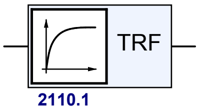


B: **Structure image of the signal processing**,

D/E: **Structure of Cam** (see on page 360)

Control structure (see on page 206, see on page 212, see on page 213)

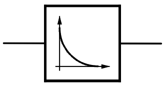
Symbols



Tracking filter

The displayed filter influences all outputs of the tracking filter.

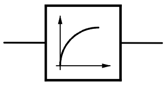
Number: Object number of the filter characteristic



Differentiator

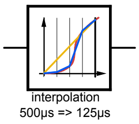
Output signal = d(input signal)/dt

The output signal is the derivation (gradient) of the input signal



Filter

Number: Object number of the filter characteristic



Interpolation

Linear Interpolation.

Values in the 500µs grid are converted into the more exact time grid of 125µs.

Note:

- A setpoint jerk setpoint feedback is not required for external setpoint specification.
- The description of the objects can be found in the **object list** (see on page 544).

4.4.5. Input simulation

In this chapter you can read about:

Function

The input simulation is used for the performance of tests without the complete input/output hardware being necessary.

The digital inputs (standard and inputs of M10/M12 option) as well as the analog inputs are supported.

The following operating modes are available for digital inputs:

- The physical inputs are deactivated, the digital inputs are only influenced via the input simulation.
- The digital inputs and the physical inputs are logically or-linked.
  This necessitates very careful action, as the required function is, above all with low-active signals, no longer available.

The pre-setting of an analog input value is always made in addition to the physical analog input.

The function of the inputs depends on the Compax3 device type; please refer to the respective online help or the manual.

The input simulation is only possible if the connection with Compax3 is active and if the commissioning mode is deactivated!

4.4.5.1 Calling up the input simulation

Open the optimization window (double click in the C3 ServoManager tree entry: Optimization).

Activate the Tab “Setup” in the right lower window.

Clicking on the following button will open a menu; please select the input simulation.

4.4.5.2 Operating Principle

Window Compax3 InputSimulator:

1. Row: Standard Inputs E7 ... E0 = “0” button not pressed; = “1” switch pressed

2. Row: Optional digital inputs (M10 / M12)

Green field: port 4 is defined as input

Red field: port 4 is defined as output

the least significant input is always on the right side

3. Row: If the button “deactivating physical inputs” is pressed, all physical, digital inputs are deactivated; only the input simulation is active.

If both sources (physical and simulated inputs) are active, they are or-linked!

Caution!

Please consider the effects of the or-linking; above all on low-active functions.

4. Row: Simulation of the analog inputs 0 and 1 in steps of 100mV.

The set value is added to the value on the physical input.

After the input simulation has been called up, all simulated inputs are on “0”.

When the input simulation is left, the physical inputs become valid.

4.4.6. Setup mode

The setup mode is used for moving an axis independent of the system control

The following functions are possible:

- Homing run
- Manual+ / Manual-
- Activation / deactivation of the motor holding brake.
- Acknowledging errors
- Defining and activating a test movement
- Activating the digital outputs.
- **Automatic determination of the load characteristic value** (see on page 245)
- **Setup** (see on page 244) of the **load control** (see on page 158)

Activating the commissioning mode

By activating the setup mode, das Steuerungsprogramm (IEC-Programm) is deactivated; the system function of the device is no longer available.

Access via an interface (RS232/RS485, Profibus, CANopen,...) and via digital inputs is deactivated. (if necessary, acyclic communication ways are nevertheless possible (e.g. Profibus PKW channel)

Caution!
The safety functions are not always guaranteed during the setup mode! This will for instance lead to the fact that the axis may trundle to a stop if the Emergency stop button is pressed (interruption of the 24 V on C3S X4.3), which requires special caution with z axes!

- In the Commissioning window (left at the bottom) the commissioning mode is activated.
- Then parameterize the desired test movement in the Parameter window.
  You can accept changed configuration settings into the current project.
- Now energize drive in the commissioning window and start the test movement.

Caution! Safeguard the travel range before energizing!

Deactivating the commissioning mode

If the setup mode is left, the drive is deactivated and the das Steuerungsprogramm (IEC-Programm) is re-activated.

Note:

- The parameters of the commissioning window are saved with the project and are loaded into Compax3 if the commissioning mode is activated (see explanation below).

4.4.6.1 Motion objects in Compax3

The motion objects in Compax3 describe the active motion set.

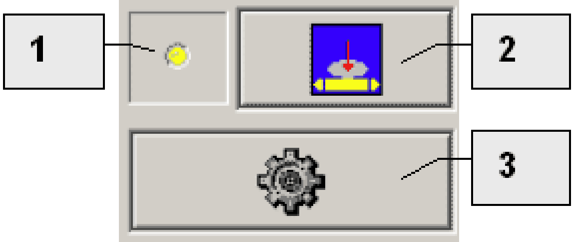
The motion objects can be influenced via different interfaces.

The following table describes the correlations:

Source	**active motion objects**		**Compax3 device**
	==>	**describe**	
	<==	**read**	
Set-up (working with the commissioning window)	**==>**	◆ With the "accept entry" button. ◆ The current project gets a motion set. Download by activating the motion	**Active motion objects:** ◆ Position [O1111.1] ◆ Speed [O1111.2] ◆ Acceleration [O1111.3] ◆ Deceleration [O1111.4] ◆ jerk* [O1111.5] (Acceleration) ◆ Jerk* [O1111.6] (Deceleration) * for IxxT11 - devices, both jerk values are identical
	<==	◆ When opening the commissioning window of a new project for the first time. ◆ Activated via the "Upload settings from device" button (bottom at the left side).	
Compax3 ServoManager project	**==>**	◆ C3IxxT11: via an activated motion set ◆ C3I2xT11: via a configuration download	
	<==	For Compax3 I2xT11: ◆ via a configuration upload ◆ in the commissioning window via "accept configuration"	
Fieldbus (Compax3 I2xTxx)	**==>**	◆ Changing the motion objects directly	
	<==	◆ Reading the motion objects	
IEC61131-3 program (Compax3 IxxT30, IxxT40)	**==>**	◆ via positioning modules	

4.4.6.2 Commissioning the load control

If a load control was configured, the following buttons are displayed in the Commissioning window :



1 Status of the load control - yellow => off; green => on

2 Activate / Deactivate load control

3 **Alignment of the position values** of motor and load
(Load position = Motor position)
Only if the load control is deactivated!

Please note the explanations for the Load control **(see on page 158)!**

4.4.7. Load identification

In this chapter you can read about:

Automatic determination of the load characteristic value:

- of the mass moment of inertia with rotary systems
- of the mass with linear systems

4.4.7.1 Principle

The load characteristic value is automatically determined.

For this it is necessary to excite the system additionally with a signal (excitation signal = noise).

The excitation signal is fed into the control loop. The control loop dampens the excitation signal. Therefore, the superimposed control loop is set so slowly by reducing the stiffness, that the measurement is not influenced.

A superimposed test movement is additionally possible. This helps to eliminate possible mechanical effects such as rubbing caused by friction.

4.4.7.2 Boundary conditions

If the control is instable before the beginning of the measurement, please reduce the stiffness (in the optimization window at the left bottom)

The following factors can disturb a measurement:

- Systems with high friction (e.g. linear actuators with sliding guide)
  Here, the systems where the static friction is considerably higher than the kinetic friction (slip-stick effect) are especially problematic.
- Systems with significant slack points (play)
- Systems with "too light" or susceptible to oscillation bearing of the total drive (rack).
  Formation of rack resonances. (e.g. with gantries,...)
- Non constant disturbance forces which influence the speed development. (e.g. extremely strong slot moments)

The effects of the factors one to three on the measurement can be reduced by using a test movement.

Caveat emptor (exclusion of warranty)

Due to multiple possibilities for disturbing influences of a real control path, we cannot accept any liability for secondary damages caused by faultily determined values. Therefore it is essential to verify all values automatically determined before loading them into the control loop.

4.4.7.3 Process of the automatic determination of the load characteristic value (load identification)

- Please click on "unknown: default values are used" in the configuration wizard in the "External moment of inertia" window.
- After the configuration download, you can enter directly, that the optimization window is to be opened.
- In the Commissioning window (left at the bottom) change to commissioning mode.
- Finally enter the values of the excitation signal and of the test movement in the parameter window.
  Parameters of the excitation signal:
  - Amplitude of the excitation signal in % of the motor reference current
    Only an amplitude value causing a distinct disturbance can give a usable result.
  - permissible following error
    In order to avoid a following error caused by the excitation signal, the permissible following error must be increased for the measurement if necessary.
  - Selection of the test movement: inactive, reverse, continuous
  - Parameterizing of the test movement if necessary
- Now energize drive and open load identification window in the commissioning window.

Caution! Safeguard the travel range before energizing!

- Starting the load identification.

Caution! The drive will perform a jerky movement during load identification!

- After the measurement, the values can be accepted. Depending on the application, 2 measurements for minimum external load and maximum external load are recommended.

4.4.7.4 Tips

Tip	Problem	Measures
1	Speed too low (with reverse operation)	Increase maximum speed and adapt travel range*
2	Speed too low (with continuous operation)	Increase maximum speed
3	Test movement missing	A test movement is important for drives with high friction or with mechanical slack points (play).
4	No error detected	Please note the **boundary conditions** (see on page 245).
5	Speed too low and amplitude of the excitation signal too small (with reverse operation)	Increase amplitude of the excitation signal; increase maximum speed and adapt travel range*
6	◆ Speed too low and ◆ amplitude of the excitation signal too small (with continuous operation)	Increase amplitude of the excitation signal; increase maximum speed.
7	◆ Test movement missing ◆ amplitude of the excitation signal too small	◆ Increase amplitude of the excitation signal or / and ◆ activate an appropriate test movement
8	amplitude of the excitation signal too small	Increase the amplitude of the excitation signal.
9	Following error occurred	Increase the parameter "permissible following error" or decrease the amplitude of the excitation signal.

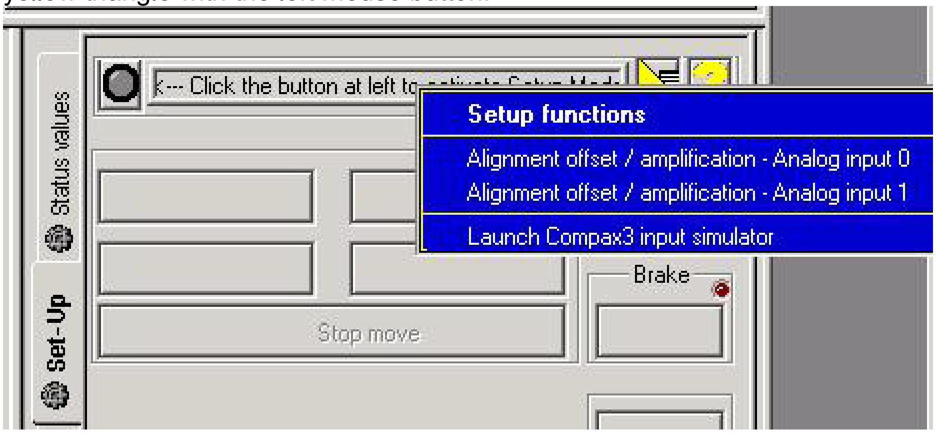
*if the travel range is too short, the speed is not increased, as the drive does not reach the maximum speed.

4.4.8. Alignment of the analog inputs

In this chapter you can read about:

There are two possibilities to align the analog inputs in the optimization window:

- Wizard-guided under commissioning: Commissioning functions (click on the yellow triangle with the left mouse button:



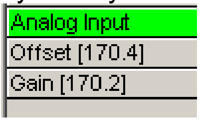
Caution!

This wizard guided automatic alignment does not work if you bridge Ain+ with Ground for the alignment!

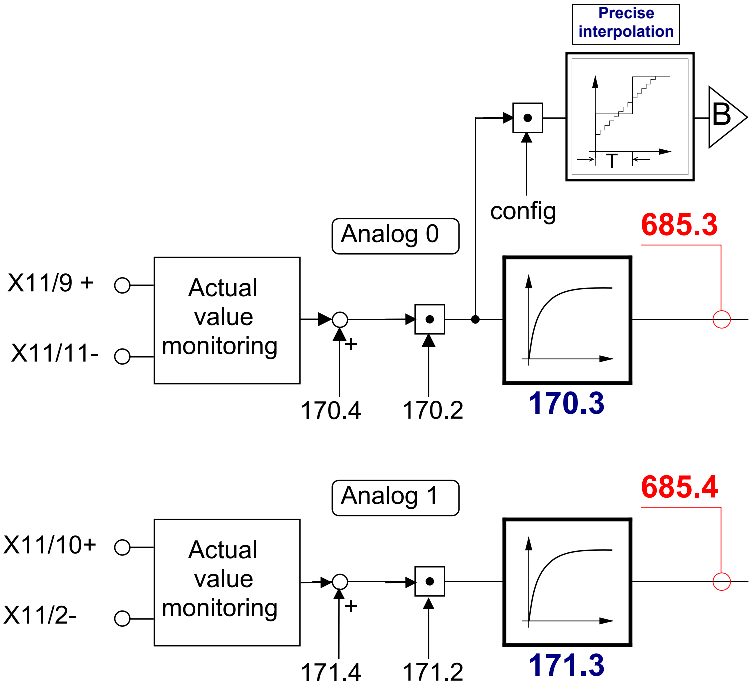
In this case, please make a manual alignment as described below.

or

- by directly entering under optimization: Analog input



4.4.8.1 Signal processing of the analog inputs



B: **Continuative structure image** (see on page 237)

4.4.8.2 Offset alignment

Performing an offset alignment when working with the ±10V analog interface in the optimization window under optimization: Analog input Offset [170.4].

Enter the offset value for 0V input voltage.

The currently entered value is shown in the status value "analog input" (optimizing window at the top right) (unit: 1 ≡ 10V). Enter this value directly with the same sign as offset value.

The status value "analogue input" shows the corrected value.

4.4.8.3 Gain alignment

Performing an offset alignment when working with the ±10V analog interface in the optimization window under optimization: Analog input: Gain [170.2].

A gain factor of 1 has been entered as default value.

The currently entered value is shown in the status value “analog input” (optimizing window at the top right).

The status value "analogue input" shows the corrected value.

4.4.9. C3 ServoSignalAnalyzer

In this chapter you can read about:

4.4.9.1 ServoSignalAnalyzer - function range

The function range of the ServoSignalAnalyzer is divided into 2 units:

Analysis in the time range

This part of the function is freely available within the Compax3 ServoManager.

The Compax3 ServoManager is part of the Compax3 servo drive delivery range.

Analysis in the frequency range

This part of the function requires a license key which you **can buy** (see on page 252).

The license is a company license and must only be bought once per company.

For each PC you need however an individual key, which you can request individually.

4.4.9.2 Signal analysis overview

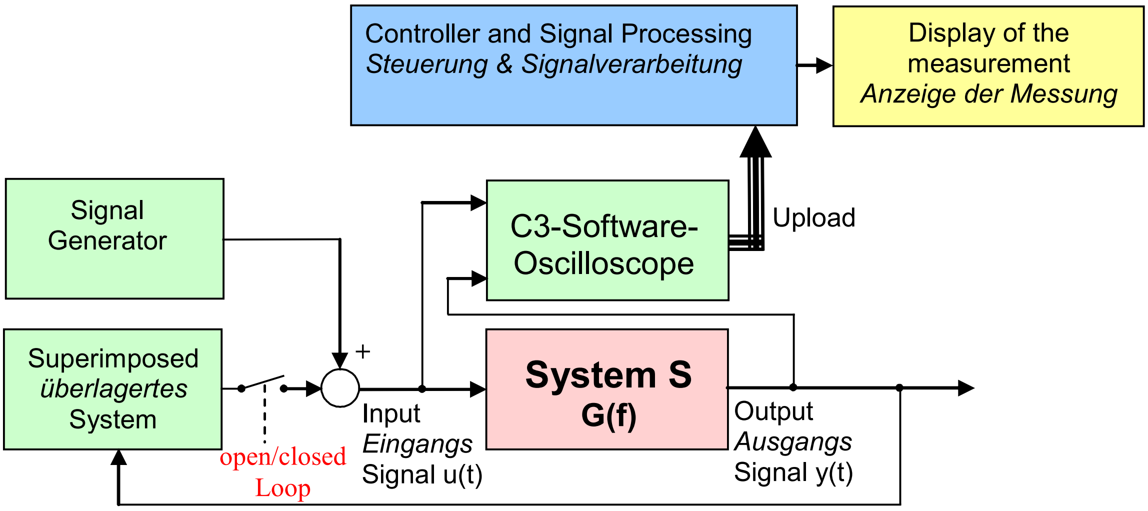
The ServoSignalAnalyzer offers three basic methods of analyzing systems:

- Analysis in the time range by measuring the step response
- Spectral analysis of individual signals
- Measurement of frequency response (Bode diagram) of the position control or of individual parts of the control as well as of the control path

These functions are available in the Compax3 ServoManager after the **activation** (see on page 252) with the aid of a system-dependent key.

You do not require expensive and complex measurement equipment -> a Compax3 device and a PC will do!

Basic structure of the signal analysis



Systems / signals

Depending on the kind of measurement, the SignalAnalyzer can help analyze the most different signals and systems.

Signal generator

This allows to inject different excitation signals (step, sine and noise signals) into the control loop.

Superposed system

For different analyses, superposed systems must be manipulated in order to allow a measurement. After the measurement, the changes made for this purpose are reset

C3 software oscilloscope

With the aid of the software oscilloscope, the contents of different objects can be registered and be loaded into the PC for further analysis.

Control and signal processing

The control of the entire measurement as well as the processing of the uploaded sample data are made in the PC.

4.4.9.3 Installation enable of the ServoSignalAnalyzer

In this chapter you can read about:

Prerequisites

- Compax3 with up-to-date controller board (CTP 17)
- Firmware version R06-0 installed

Installation

- Execution of the C3 ServoManager Setup (on CD)
- If the firmware is too old => update with the aid of the firmware from the CD

Activation

In order to being able to use the analysis functions in the frequency range (for example frequency response measurement), a software activation is required.

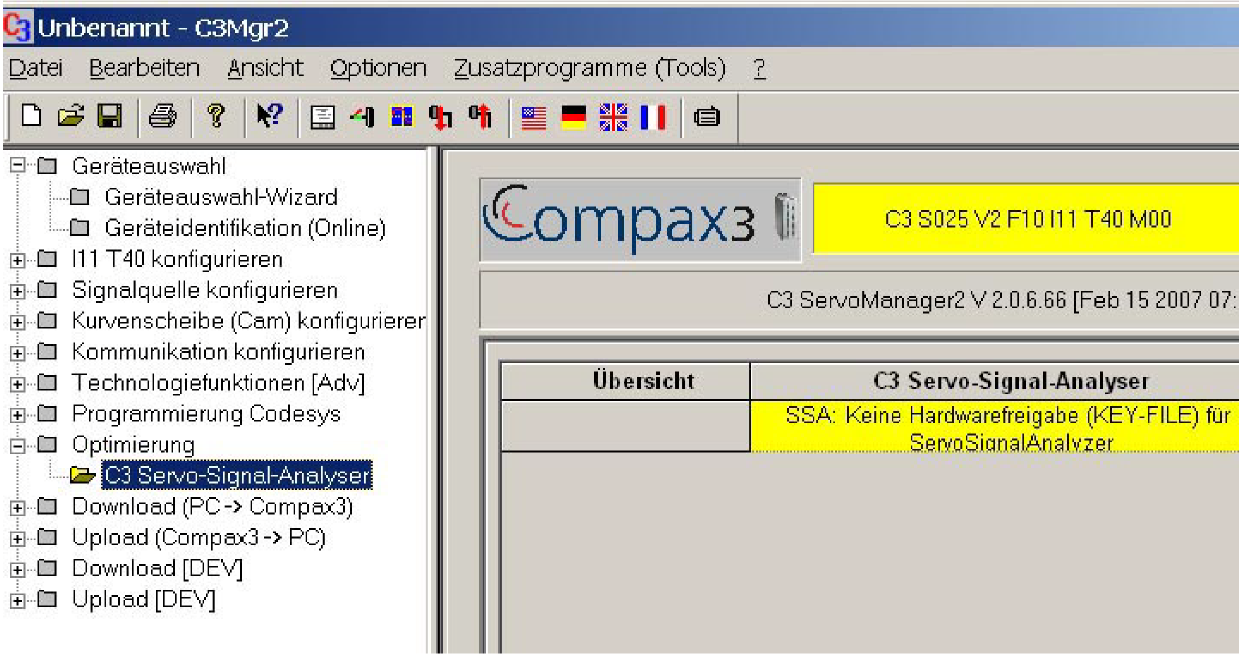
Please observe:

The activation is only valid for the PC on which it was performed!

Caution!: If the PC disposes of network adapters which are removed at times (e.g. PCMIA cards or notebook docking stations), these adapters should be removed before generating the key!

In order to activate the ServoSignalAnalyzer, please follow these steps:

- Start the Compax3 ServoManager.

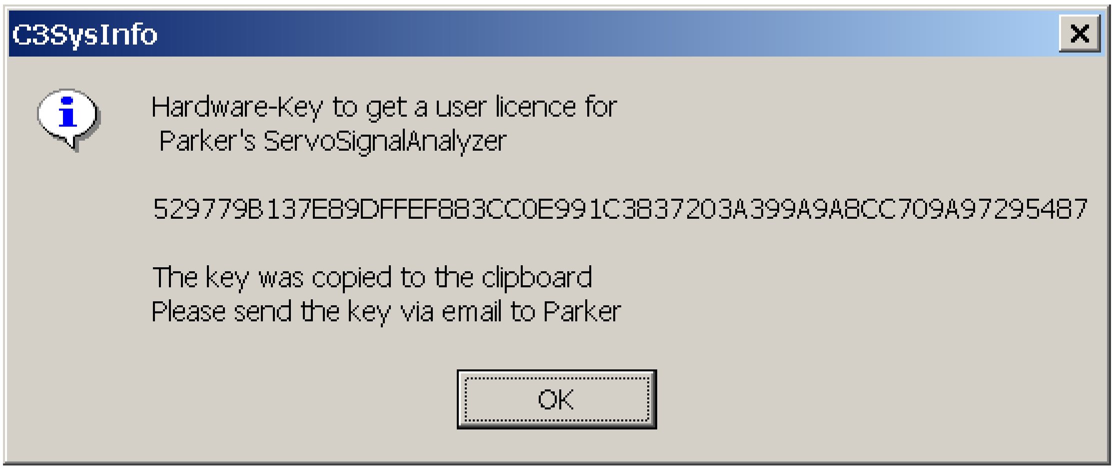


C3 S025 V2 F10 I11 T40 M00

C3 ServoManager2 V 2.0.6.66 [Feb 15 2007 07:

SSA: Keine Hardwarefreigabe (KEY-FILE) für ServoSignalAnalyzer

- Select the Select the C3 ServoSignalAnalyzer in the function tree under optimization.
  In the right part of the window you can see the note that no key file was found.
- A double click on the preselected C3 ServoSignalAnalyzer will generate a system-dependent key.



Hardware-Key to get a user licence for
Parker's ServoSignalAnalyzer

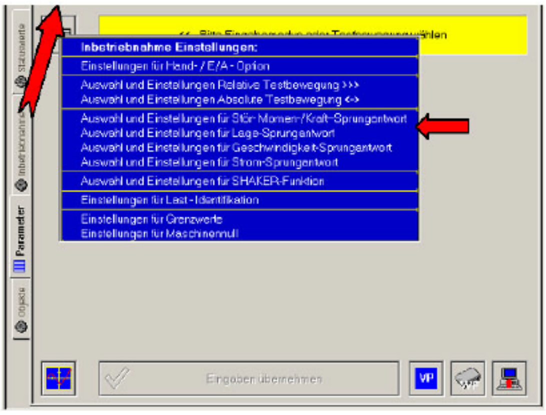
529779B137E89DFFEF883CC0E991C3837203A399A9A8CC709A97295487

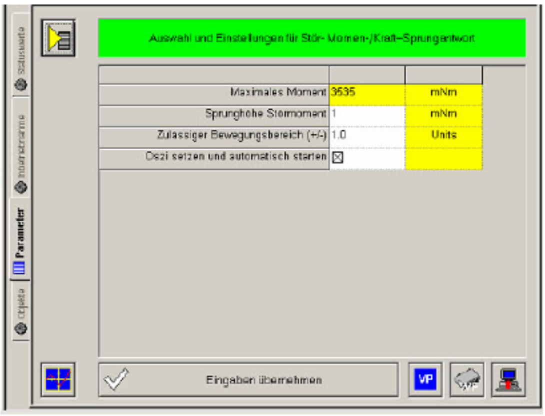
The key was copied to the clipboard
Please send the key via email to Parker

- Acknowledge with OK and enter the key, which is on your clipboard, into an e-mail, which you please send to **eme.ssalicence@parker.com** (**mailto:eme.ssalicence@parker.com**).
- After receipt of the reply, copy the attached file "C3_SSA.KEY" into the C3 ServoManager directory (C:\\Programs\\Parker Hannifin\\C3Mgr2\\).
- => the software is activated.

4.4.9.4 Analyses in the time range

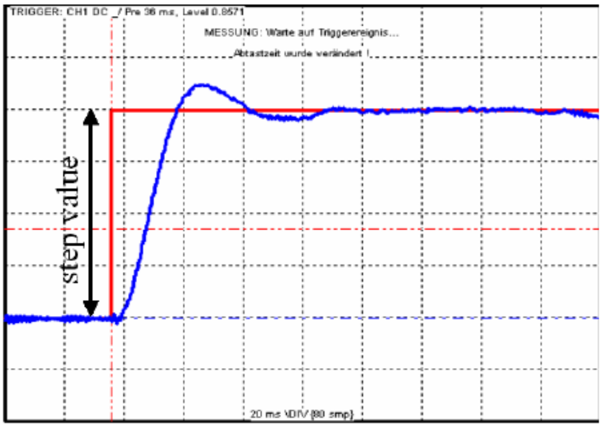
Selection and parameterization of the desired analysis function





Maximales Moment	3535	mNm
Sprunghöhe Störmoment	1	mNm
Zulassiger Bewegungsbereich (+/-)	1.0	Units
Oszi setzen und automatisch starten	☒	

Exemplary step function



step Value = Step Size

The following functions are available:

Position demand value step: For analysis of the demand value behavior of the position control

Step value < (admissible motion range / 2)

=> even a 100% overshoot does not incite an error message

Speed demand value step: For analysis of the demand value behavior of the speed control

The position control is switched off during the measurement, this might lead in exceptional cases to a slow drift of the position.

Furthermore you should make sure that the selected speed step value corresponds to the parameterized admissible motion range.

Step value < (admissible motion range / time of measurement)

with time of measurement > 2s

Current demand value step: For analysis of the demand value behavior of the current control

The current setpoint jerk is set at the end of the oscilloscope recording time, but is reset to 0 after max. 50mS.

Caution!

- Many systems are not stable without control!
- Position as well as speed control are switched off during measurement => **no measurement on z-axes!**

Disturbance torque / force step response: For analysis of the disturbance value behavior of the control

The step of an external disturbance force is simulated and the reaction of the controller is registered.

Shaker function

For this, a sine signal is injected to the current which is used to excite the mechanic system. This allows to analyze the oscillation behavior - what oscillates at which frequency.

Basic settings of the analysis functions:

Maximum torque / maximum current / maximum speed (display):

This is used as a lead for the selection of a suitable step value and indicates which maximum step value is possible.

Step value:

Gives the value of a step.

Permissible motion range (+/-):

- Indication, in which position window the axis may move during the analysis.
- This range is not left even in the event of an error.
- If the drive approaches the limits of the motion range, the controller will decelerate so that the drive will come to a standstill within the permitted motion range. The maximum permitted velocity is used to calculate the deceleration ramp, therefore the drive stops even before reaching the range limits and reports an error.
- Please make sure that a sufficiently large movement is set for the measurement and that it will be reduced by a high maximum permitted velocity.

◆ The motion range monitoring is especially important during current step responses, as position as well as speed control are deactivated during the measurement.

Max permitted speed

When exceeding this value, an error is triggered, the controller decelerates and reports an error.

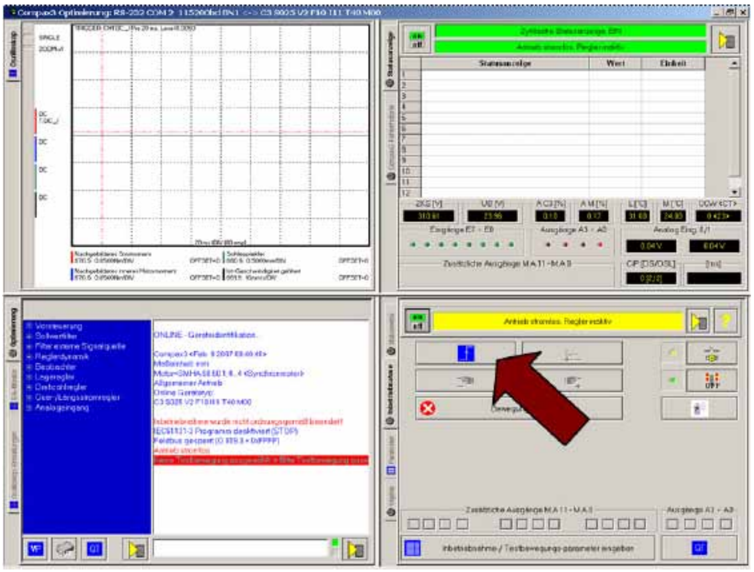
When measuring the velocity setpoint jerk, the maximum permitted velocity is set to twice the step height.

Setting and automatic start of the oscilloscope:

After pressing "accept entries", the parameters of the oscilloscope (such as scanning time and the assignment of the individual channels) are automatically set to default values according to the respective step value.

When starting the step function, the oscilloscope is automatically started.

Start of the measurement



The start of the step function is made with the aid of the highlighted button.

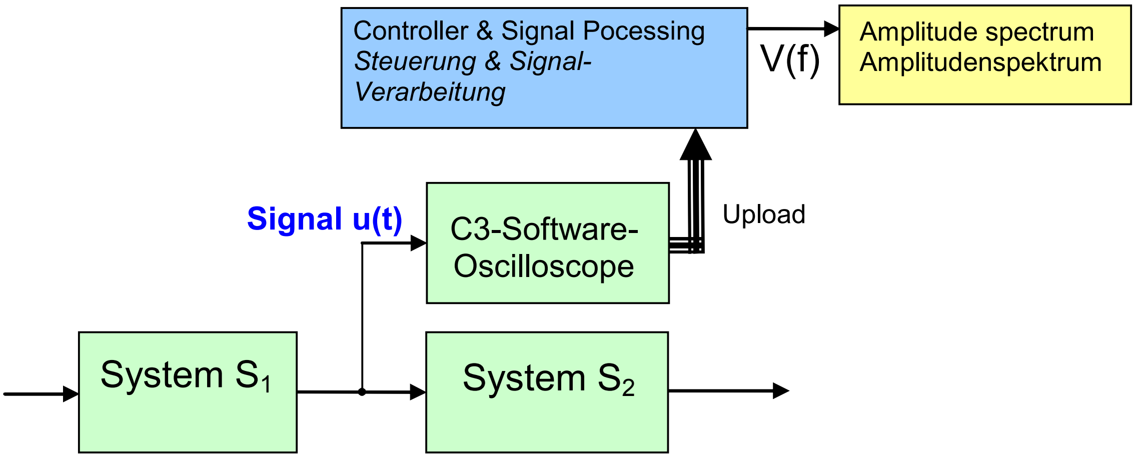
4.4.9.5 Measurement of frequency spectra

In this chapter you can read about:

Please note that you require a license key **(see on page 252, see on page 250) for this application!**

Functionality of the measurement

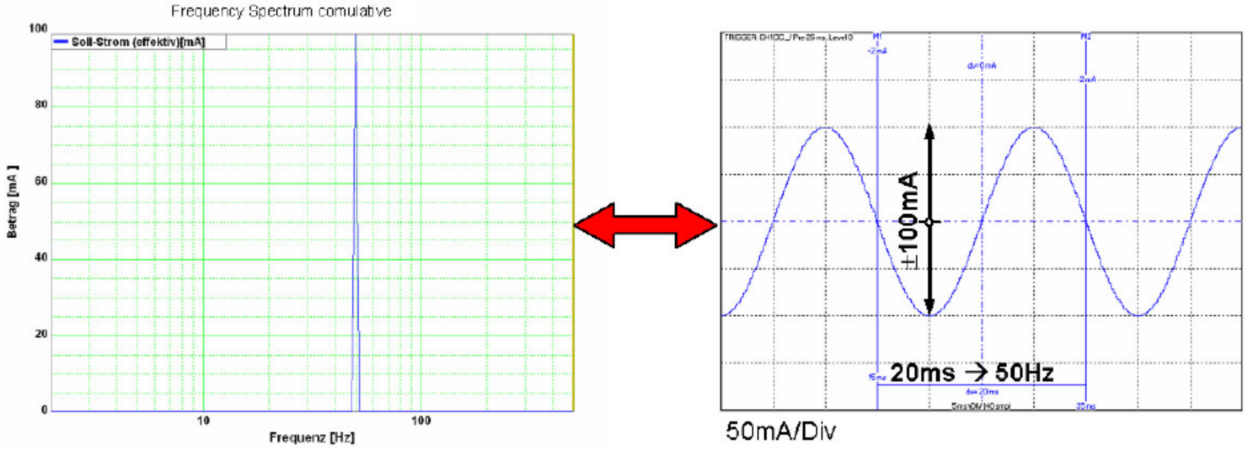
Measurement of the spectral analysis



During the spectral analysis of scanned signals with the aid of the discrete Fourier transformation, a so-called frequency resolution (Df) results, Df being =fA/N, independently of the scanning frequency (fA) and of the number of measurement values used (N).

The spectra of scanned signals are only defined for frequencies, which are an integer multiple of this frequency resolution.

Interpretation of the frequency spectrum

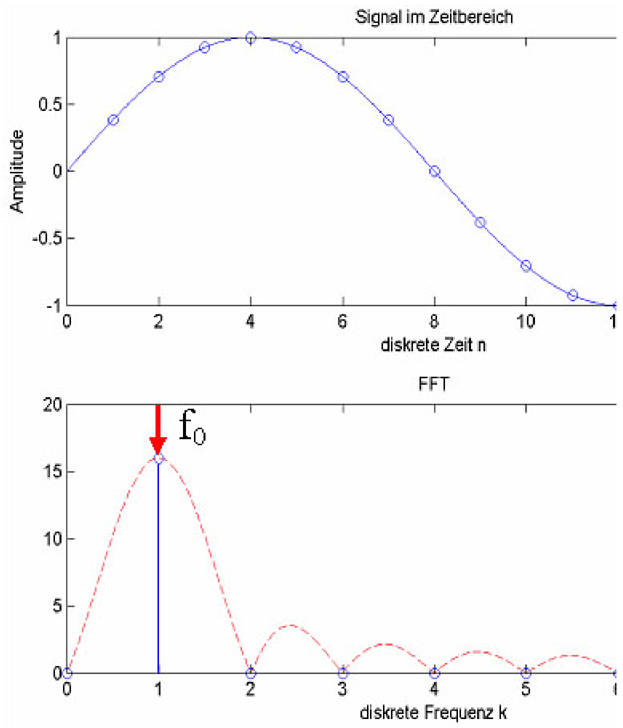


Leak effect and windowing

If frequencies not corresponding to the frequency resolution are present in the analyzed spectrum, the so-called leak effect can be caused.

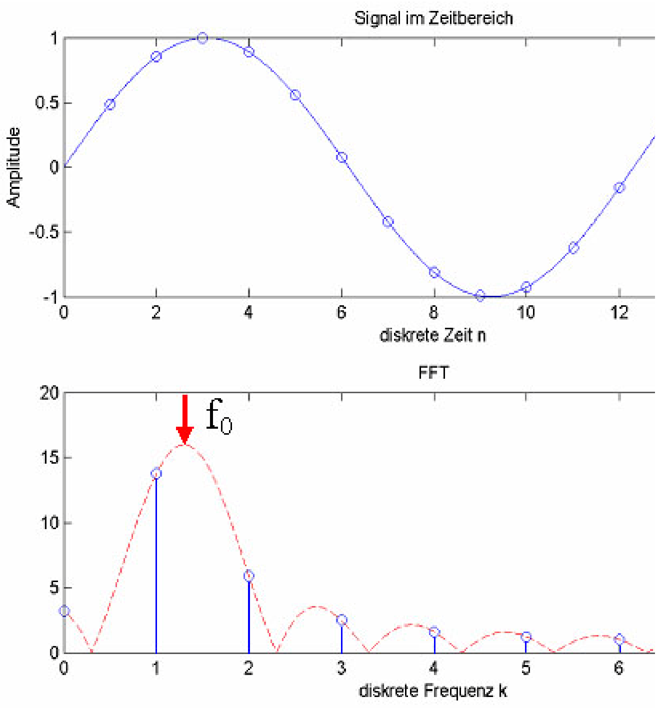
Display of the leak effect with the aid of a 16 point discrete Fourier transformation

Complete oscillation period in the scanning period



Envelope without leak effect

Non complete oscillation period in the scanning period



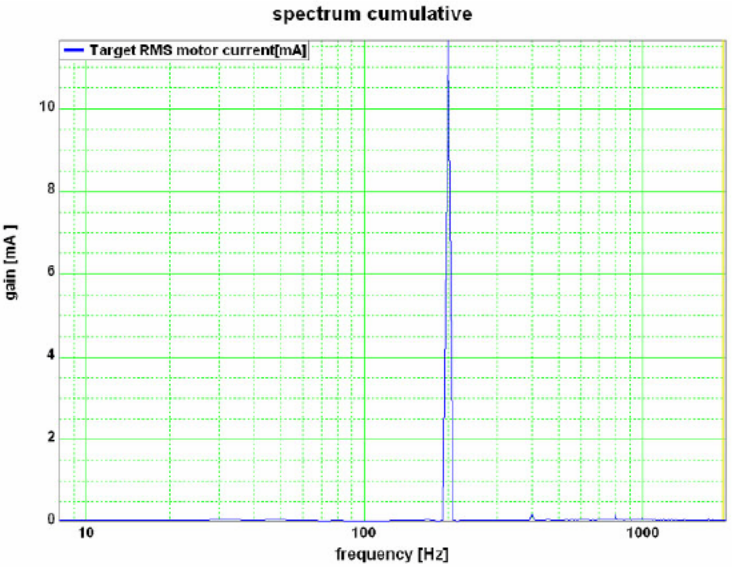
Envelope with leak effect

Sine at 200Hz without windowing

Consequence of the leak effect shown at the example of a sine signal.

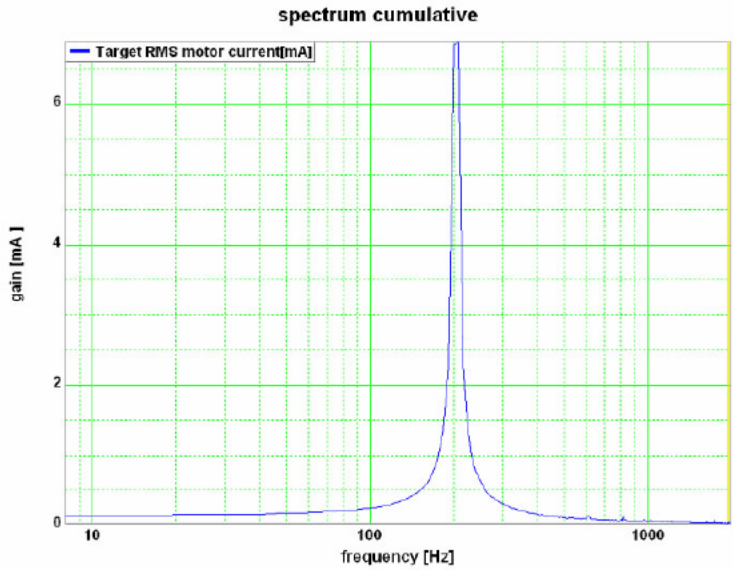
(fA=4000Hz; N=500; => Δf=8Hz

f0=200Hz = 25*Δf frequency corresponds to the frequency-resolution



The sine frequency is exactly on a multiple of the frequency resolution (200Hz / 8Hz=25). The spectrum is clearly separated and there are no leak effects visible.

Sine at 204Hz



∆f=8Hz / f0=204Hz = 25.5·∆f / frequency does not correspond to the frequency resolution!

The sine frequency has only minimally changed, due to which it does, however, no longer match the frequency resolution (204Hz/8Hz=25.5) => leak effect

Two consequences are visible:

The spectrum is faded in the ranges at the right and at the left of the sine frequency. In this range, an amplitude is displayed, even though these frequencies are not contained in the real signal.

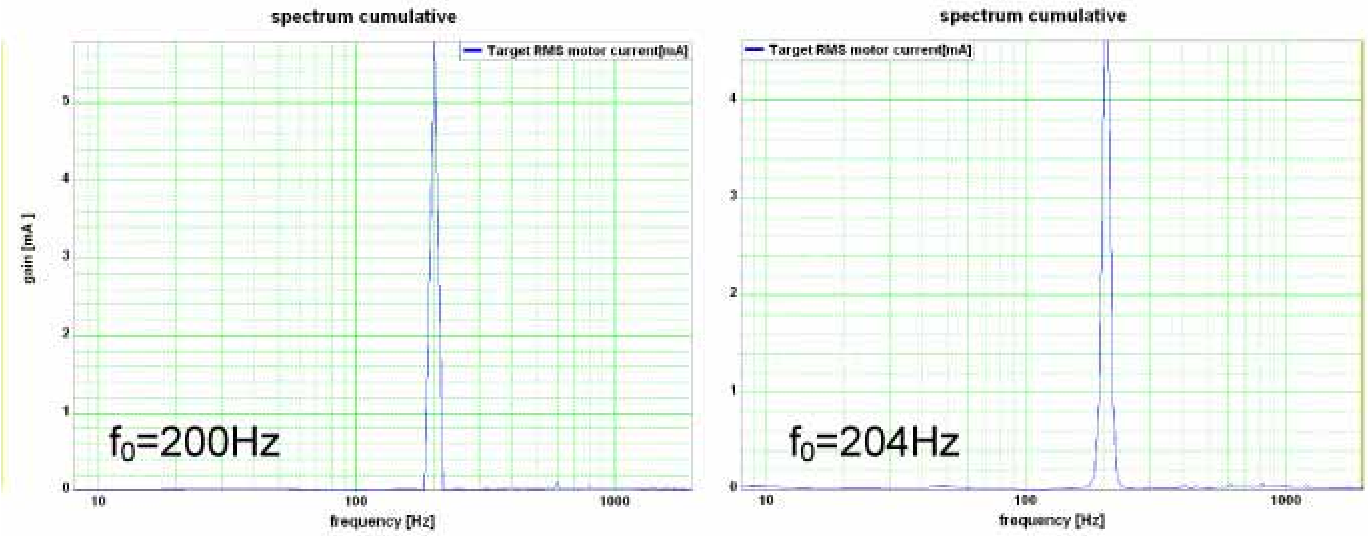
- The height of the peak of the sine frequency is reduced, => it seems as if the signal energy is leaking out and distributing over the spectrum. This explains the term leak effect.

Windowing

With the aid of the windowing, leak effects can be avoided. There are many different kinds of windowing, who do all have the same restrictions.

- windowing reduces the total energy of the analyzed signal, which results in a reduced amplitude of all measured frequencies.
- Individual frequency peaks do not appear so sharp and narrow as with measurements without windowing.

Sine at 200Hz and 204Hz with Hanning windowing



4.4.9.6 Measurement of frequency responses

In this chapter you can read about:

Please note that you require a license key **(see on page 252, see on page 250) for this application!**

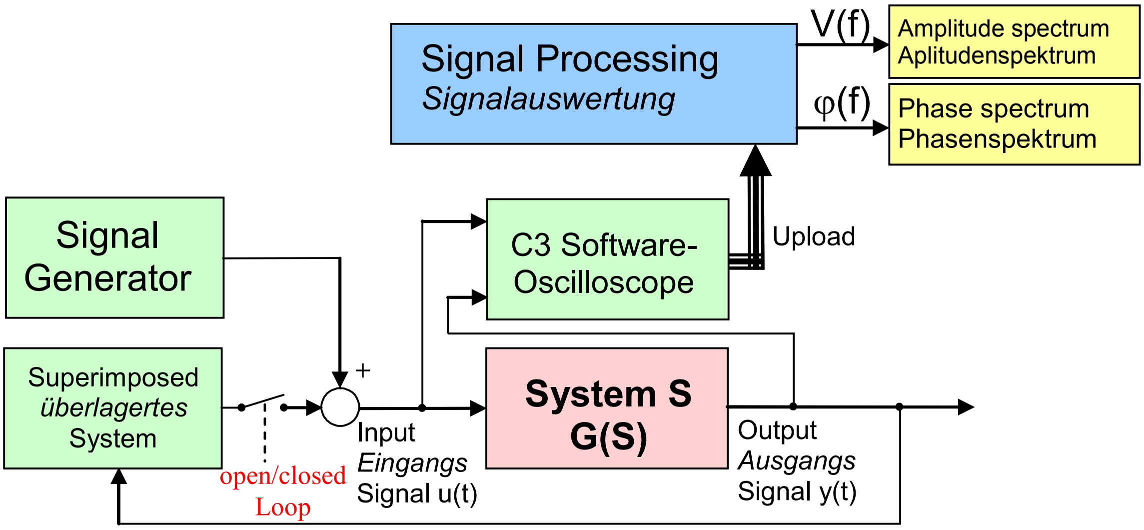
Safety instructions concerning the frequency response measurement

During the measurement of the frequency response, the control is changed and influenced in multiple ways. You should therefore respect the following notes:

- During the measurement, the entire system is excited via a broad frequency spectrum. This might damage especially sensitive components (such as lenses) The risk increases with the extent of the excitation. In addition, natural mechanical frequencies may cause an increased excitation of individual components.
- The measurement of the frequency response can only be made in the setup mode with energized controller.
- During the current measurement (between start and stop of the measurement), no write flash may be executed.
- In the event of a break in communication during the measurement, the controller must be switched off and then on again in order to reestablish the original status.
- Changes of the controller parameters during the measurement are not permitted. Those may be overwritten by standard values when the measurement is terminated.

Functionality of the measurement

Basic structure of a frequency response measurement



In general, the analysis of the dynamic behavior of a system is made by analyzing the input and output signals.

If you transform the input signal as well as the output signal of a system into the range (Fourier transformation) and then divide the output signal by the input signal, you get the complex frequency response of the system.

$$G(s) = \frac{Y(s)}{U(s)}$$

$$y(t) \xrightarrow{F} Y(s)$$

with $$u(t) \xrightarrow{F} U(s)$$

A problem are, however, superimposed systems (the control)

Course of the measurement

- Superimposed controls are switched of (open Loop) or attenuated
- The excitation signal is injected in front of the system to be measured with the aid of the signal generator. Wait, until the system settled.
- Execution of the measurement: Registration of input and output signal with the aid of the oscilloscope.
- Upload of the measurement values from the controller into the PC.
- Processing of the measurement values into a frequency response
- If a cumulated measurement is configured: Averaging over several frequency responses.

During cumulated measurement, an average is taken over all measurements in the result memory and the result is then put out.

Open/Closed Loop frequency response measurement

In order to be able to analyze the transmission behavior of subordinate systems (such as for example speed control, current control or mechanical system), the influence of the superposed controls on the measurement must be avoided.

Influence of a superposed system on the frequency response measured

In the simplest case, the superposed controls are switched off completely (Open Loop) This provides the best measurement results due to the elimination of any influence caused by the superposed controls.

This is, however, rarely possible for reasons of safety or feasibility.

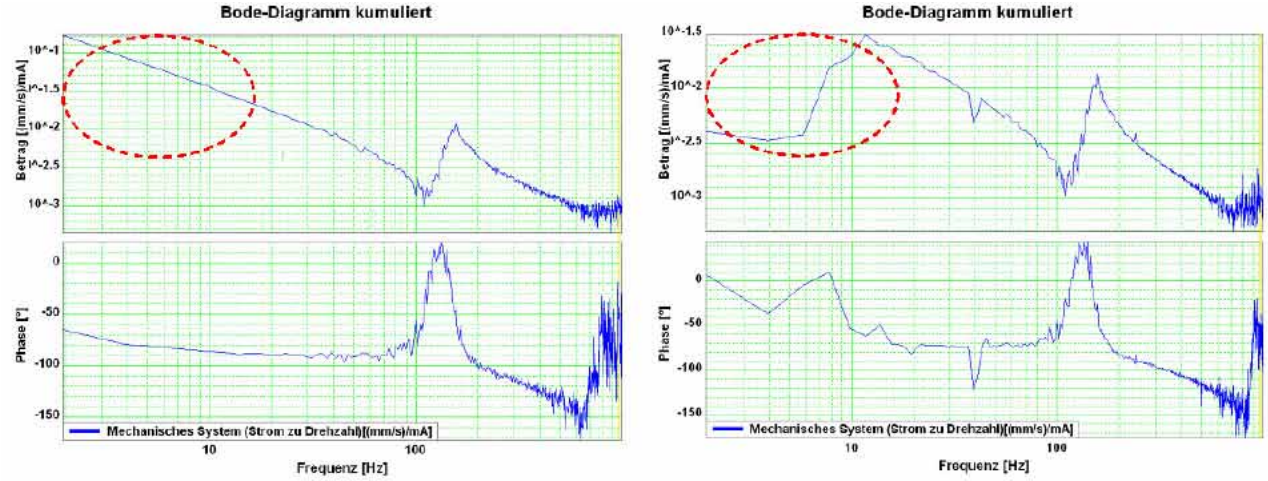
Caution!

- Many systems are not stable without control!
- Position as well as speed control are switched off during measurement =>
  no measurement on z-axes!

If you want to analyze for example the mechanic system of a z-axis, the position control as well as the speed control must remain active.

In systems subject to friction it may be necessary in order to improve the quality of the measurement, to **move the system with a superimposed speed** (see on page 265), which is however only possible with a closed loop measurement.

Influence of an active superposed control on the result of the measurement



At the left without, at the right with the influence of the superposed control

In order to attenuate the influence of the superposed controls, the controller bandwidth is reduced to such an extent, that their influence on the measurement is negligible.

Excitation Signal

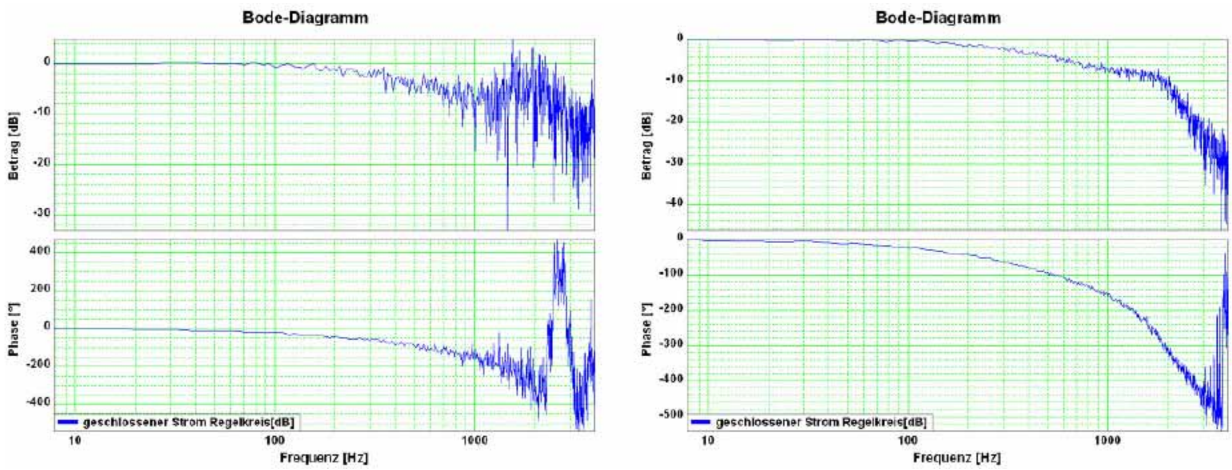
In order to be able to analyze the behavior of the system at individual frequencies, it is necessary that these frequencies can be measured in the input signal as well as in the output signal. For this, a signal generator excites all frequencies to be measured. For this applies, that the signal noise distance of the measurement is the larger, the larger the excitation of the system.

High noise distance => low influence of disturbances on the measurement.

For this, an excitation signal is injected in front of the system to be measured.

The power (amplitude) of the excitation signal can be set.
Start with a small amplitude and increase the amplitude slowly during the current measurement until the result of the measurement shows the desired quality.

Influence of the excitation amplitude on the quality of the measurement results



Left: Too small amplitude of the excitation signal (7.3mA)
Right: Suitable amplitude of the excitation signal (73mA)

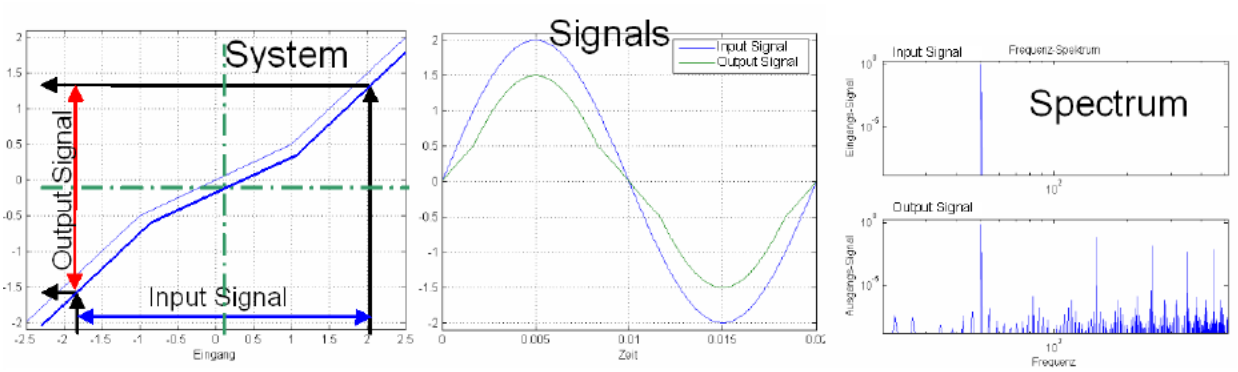
In the case of non-linearities in the system, an increase in the excitation may however lead to a **decline of the quality of the measurement** (see on page 264).

Non-linearities and their effects

In this chapter you can read about:

Non-linearities in mechanical systems are for example due to friction, backlash or position-dependent transmissions (cams and crankshaft drives). In general, the frequency response is only defined for linear systems (see **7.2** (see on page 282)). What happens in the frequency range in the event of a non-linear system, is shown below.

Signal amplitude too high => non-linearity in the signal range



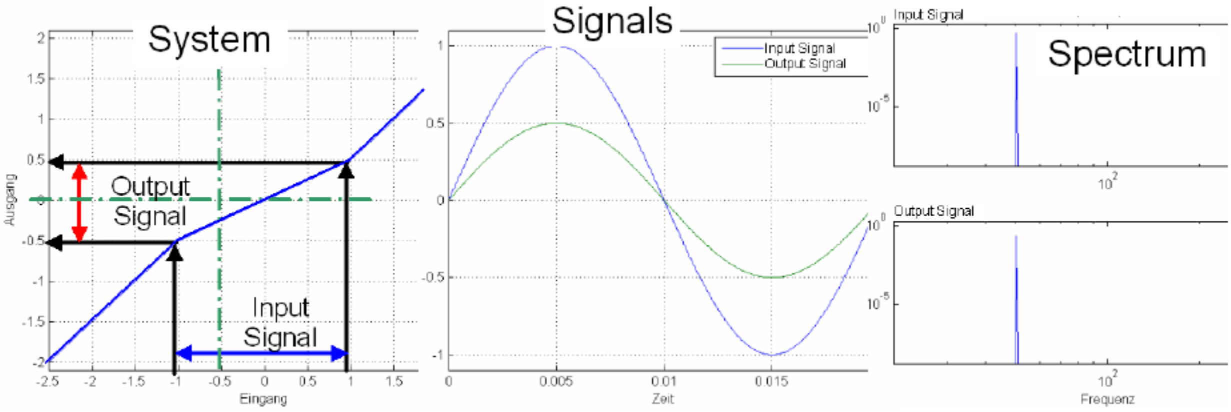
Due to the non-linear transmission behavior of the system, many "new" frequencies were generated in the output signal. In the frequency response, only one change of the frequency present in the input signal can be displayed meaningfully.

=> The frequencies generated in the spectrum of the output signal lead to a deterioration of the measured frequency response.

There are however two possibilities to make successful measurements of frequency responses in spite of non-linearities present:

Attenuation of the excitation amplitude

Signal amplitude too small => no non-linearity in the signal range



The signal range is reduced so that approximately linear conditions are valid. The results of the measurement will then display the dynamic behavior at the working point.

Example cam drive:

If the drive moves considerably (e.g. 180°) during the measurement, the behavior of the system will change greatly over this range => caused by non-linearities in the signal range.

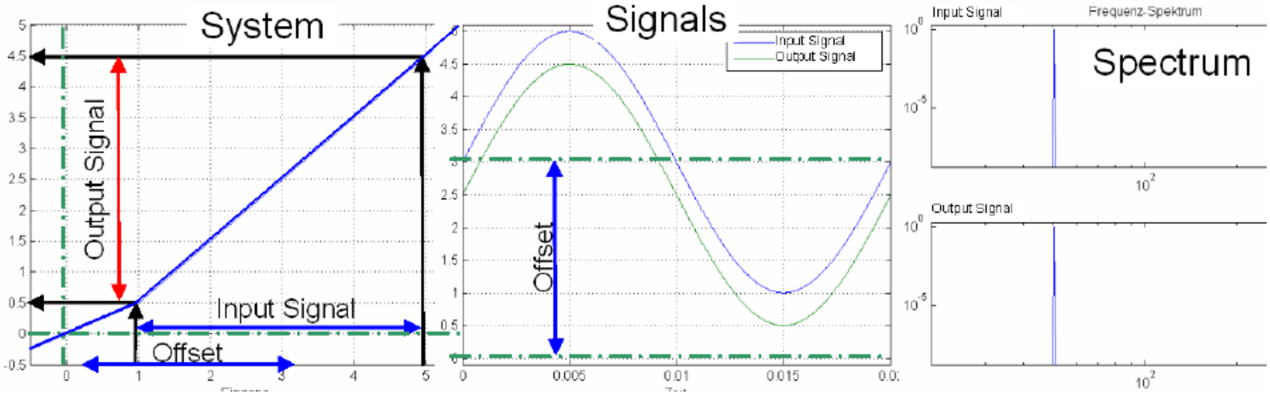
An inexact measurement is the result.

If the excitation is reduced so that the drive will move only by a few degrees, the behavior of the system at this working point will be approximately constant.

An exact measurement is the result.

Shifting the working point into a linear range

Signal amplitude large with offset => no non-linearity in the signal range



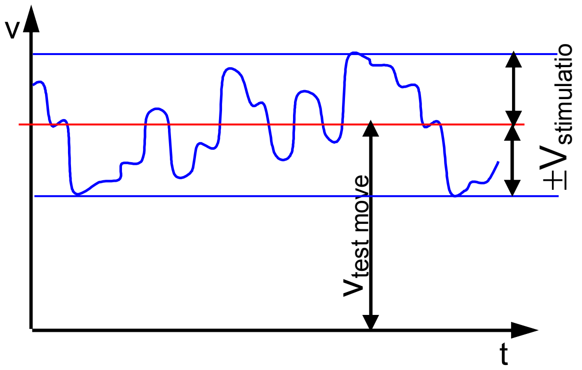
For this, the signal range is shifted so that approximately linear conditions are valid => the results of the measurement show the dynamic behavior at the working point.

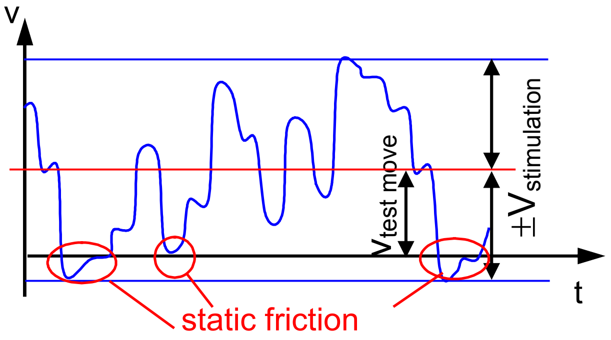
Example rubbing caused by friction:

In systems subject to a distinct transition between rubbing caused by friction and sliding friction, the rubbing force will reduce abruptly as soon as the drive is moved (v>0). With a motor at standstill, the excitation signal will cause a multiple passing through the range of rubbing friction during measurement. Due to the non-linearity in the signal range, the resulting measurement will be inexact.

If the drive moves, however, fast enough during the measurement, so that the speed will not become zero during the measurement, the system remains in sliding friction and a precise measurement can be obtained.

Optimal measurement with rubbing friction





$V_{test\ move}$: Speed of the test movement

$V_{stimulation}$: Speed of the excitation signal

static friction: Static friction

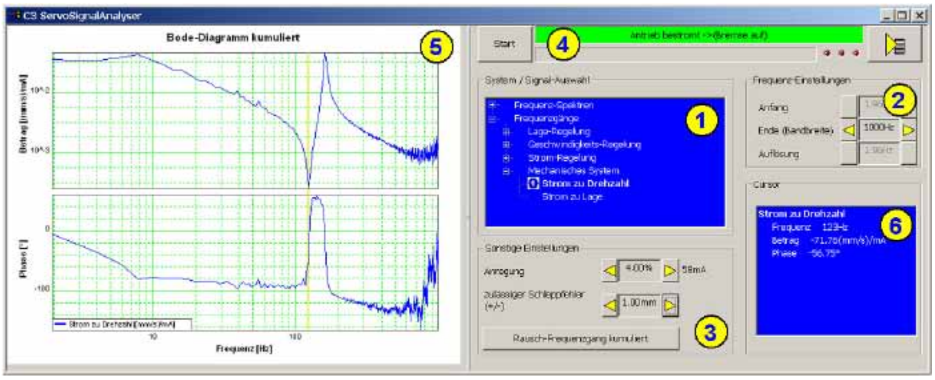
Example backlash: (for example in gearboxes)

Here, non-linearities are caused, if the tooth edges will turn from one side to the other during measurement. The reason for this is a change of the sign of the force transmitted by the gearbox.

In order to avoid this, you can try to transmit a constant torque by keeping a constant speed and to avoid a change of the sign during the measurement by choosing a relatively small excitation amplitude.

4.4.9.7 Overview of the user interface

In this chapter you can read about:



Antrieb bestromt ->(Bremse auf)

Anfang
Ende (Bandbreite) 1000Hz
Auflösung

Anregung 4.00% 58mA
zulässiger Schleppfehler (+/-) 1.00mm

Strom zu Drehzahl
Frequenz 123Hz
Betrag -71.75(mm/s)/mA
Phase -56.75°

(1) **Selection of the signal or system to be measured** (see on page 267)

(2) **Frequency settings** (see on page 271)

(3) **Other settings** (see on page 274)

(4) **Operating and status field** (see on page 277)

(5) **Display of the measurement result** (see on page 278)

(6) **Display of the measurement point at the cursor position** (see on page 280)

Selection of the signal or system to be measured.

In this chapter you can read about:

With the aid of the tree structure, you may select what you want to measure. Here, the selection is made, if a frequency spectrum or a frequency response is to be measured.

The shown structures are simplified in such as all feedbacks are displayed without special transmission behavior. This is surely not the case in reality, serves however a better overview.

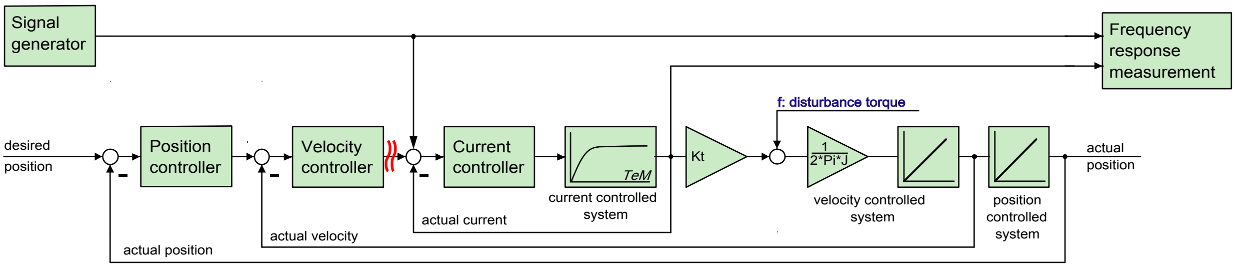
Current control

Closed current control

Shows the dynamic behavior of the closed current control.

=> How a signal on the current demand value is transmitted to the current actual value.

(response)



Signal generator	Signal Generator
Position controller	Lageregler
actual position	Lageistwert
desired position	Lagesollwert
Velocity controller	Geschwindigkeitsregler
actual velocity	Geschwindigkeitsistwert
Current controller	Stromregler
actual current	Stromistwert
current controlled system	Stromregelstrecke
f: disturbance torque	Störmoment
velocity controlled system	Geschwindigkeitsregelstrecke
position controlled system	Lageregelstrecke
Frequency response measurement	Frequenzgangmessung

Application:

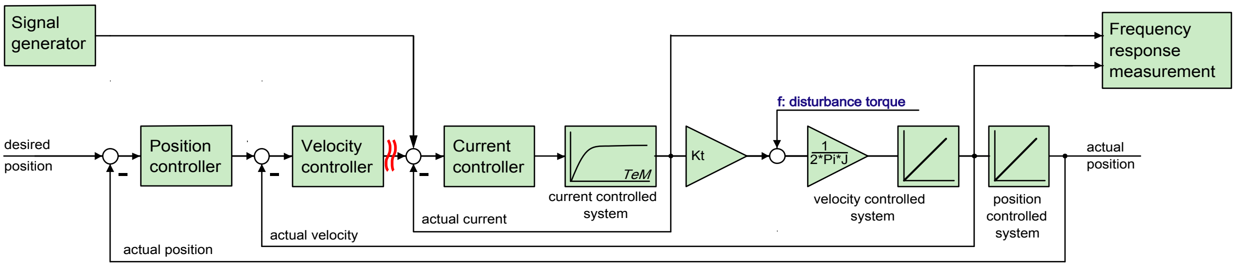
During the optimization of the current control for verification

- for the design of superposed controllers.

Mechanical system

Current to velocity

Shows the dynamic behavior between the measured current actual value and the velocity actual value



Signal generator	Signal Generator
Position controller	Lageregler
actual position	Lageistwert
desired position	Lagesollwert
Velocity controller	Geschwindigkeitsregler
actual velocity	Geschwindigkeitsistwert
Current controller	Stromregler
actual current	Stromistwert
current controlled system	Stromregelstrecke
f: disturbance torque	Störmoment
velocity controlled system	Geschwindigkeitsregelstrecke
position controlled system	Lageregelstrecke
Frequency response measurement	Frequenzgangmessung

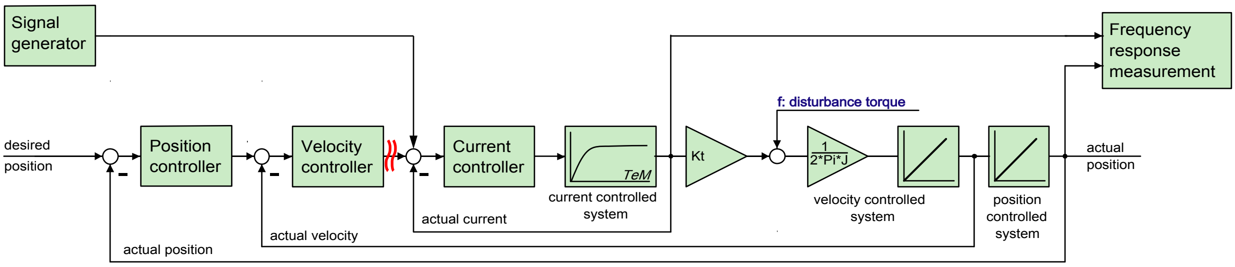
Reflects the transmission behavior between the acceleration at the motor and the acceleration at the load to be moved.

Application:

◆ for the analysis of the dynamic behavior of the mechanic system

Current to position

Shows the dynamic behavior between current actual value and position actual value.



Signal generator	Signal Generator
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current controlled system	Stromregelstrecke
f: disturbance torque	Störmoment
velocity controlled system	Geschwindigkeitsregelstrecke
position controlled system	Lageregelstrecke
Frequency response measurement	Frequenzgangmessung

Application:

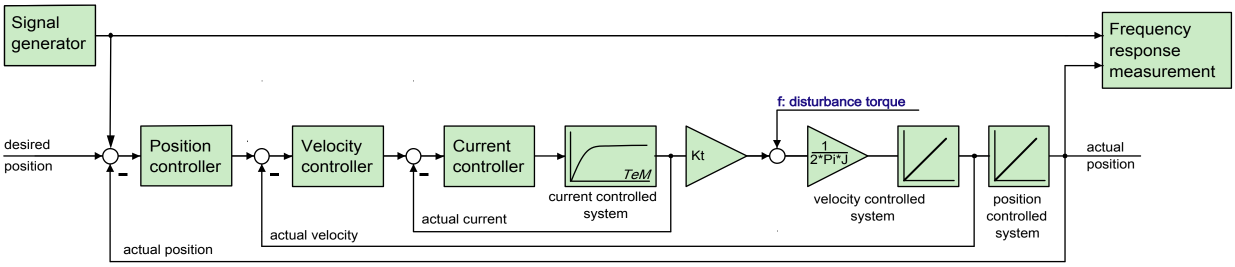
◆ for the analysis of the dynamic behavior of the mechanic system

Position control

Closed position control

Shows the dynamic behavior of the closed position control.

=> How a signal on the position demand value is transmitted to the position actual value.



Signal generator	Signal Generator
Position controller	Lageregler
actual position	Lageistwert
desired position	Lagesollwert
Velocity controller	Geschwindigkeitsregler
actual velocity	Geschwindigkeitsistwert
Current controller	Stromregler
actual current	Stromistwert
current controlled system	Stromregelstrecke
f: disturbance torque	Störmoment
velocity controlled system	Geschwindigkeitsregelstrecke
position controlled system	Lageregelstrecke
Frequency response measurement	Frequenzgangmessung

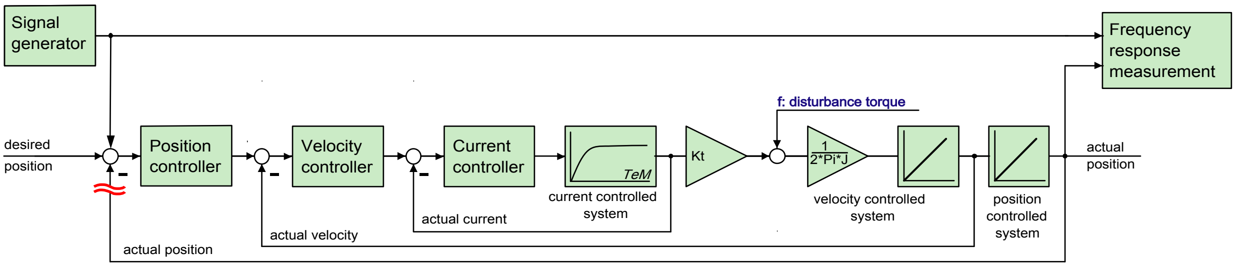
Application:

For the design of superposed controllers or systems.

- For the verification of the obtained controller speed during optimization
- for the revision of the controller design of the position control

open position control

Shows the dynamic behavior of all components in the position control loop, but without closing it.



Signal generator	Signal Generator
Position controller	Lageregler
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desired position	Lagesollwert
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actual velocity	Geschwindigkeitsistwert
Current controller	Stromregler
actual current	Stromistwert
current controlled system	Stromregelstrecke
f: disturbance torque	Störmoment
velocity controlled system	Geschwindigkeitsregelstrecke
position controlled system	Lageregelstrecke
Frequency response measurement	Frequenzgangmessung

Application:

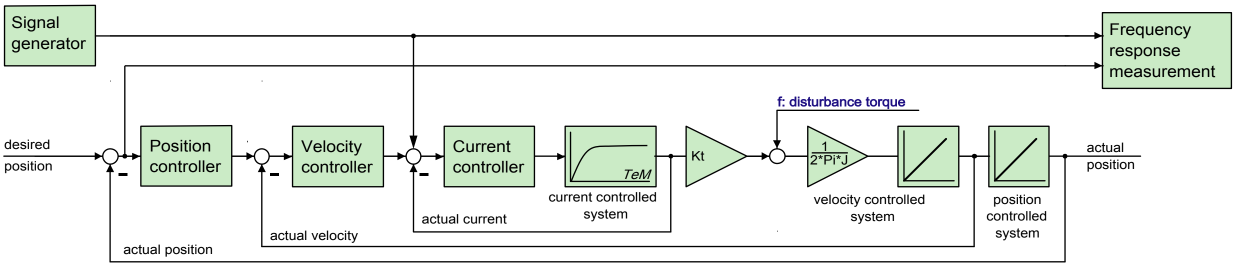
- For the graphic design of the position control.

Compliance of Position control

Shows the dynamic disturbance value behavior of the position control.

=> which dynamic influence does a disturbance torque have on the following error.

The disturbance toque is injected as disturbance current => this corresponds to the effect of a disturbance torque f



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f: disturbance torque	Störmoment
velocity controlled system	Geschwindigkeitsregelstrecke
position controlled system	Lageregelstrecke
Frequency response measurement	Frequenzgangmessung

Application:

- Verification of the dynamic disturbance value behavior of the position control.
- Which following error generates a sinusoidal disturbance torque / disturbance current with the frequency fZ ?
- The frequency response of the compliance corresponds to the disturbance step response in the time range

Frequency settings

◆

Frequenz-Einstellungen

Anfang 1.96Hz ①

Ende (Bandbreite) 1000Hz ②

Auflösung 1.96Hz ③

◆

(1) start frequency

- This is the smallest frequency at which is still measured. During the measurement of frequency spectrum and noise frequency response this results automatically from the bandwidth and is only displayed as an information.

(2) End (bandwidth)

- This corresponds to the highest frequency which is measured. Start frequency as well as the frequency resolution can be varied with the aid of the bandwidth for frequency spectrum and noise frequency response.

(3) Frequency resolution **(see on page 257)**

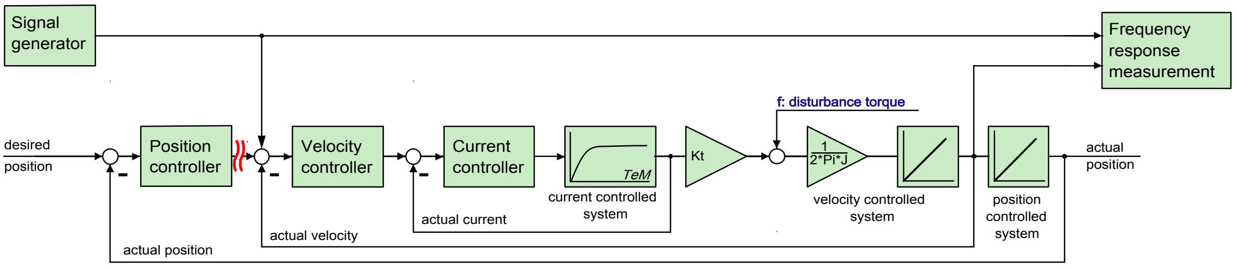
- During the measurement of frequency spectrum and noise frequency response this results automatically from the bandwidth and is only displayed as an information.

Speed control

Closed velocity control

Shows the dynamic behavior of the closed velocity control.

=> How a signal on the velocity demand value is transmitted to the velocity actual value.



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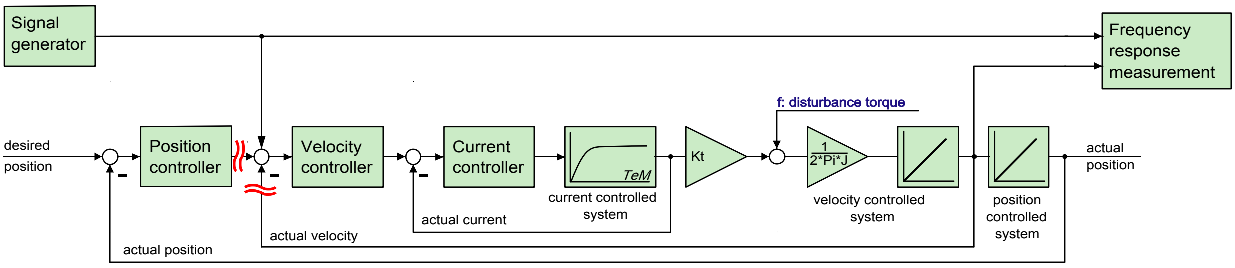
actual current	Stromistwert
current controlled system	Stromregelstrecke
f: disturbance torque	Störmoment
velocity controlled system	Geschwindigkeitsregelstrecke
position controlled system	Lageregelstrecke
Frequency response measurement	Frequenzgangmessung

Application:

- During the optimization of the velocity control for verification
- For the design of superposed controllers.

Open velocity control

Shows the dynamic behavior of all components in the velocity control loop, but without closing it.



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velocity controlled system	Geschwindigkeitsregelstrecke
position controlled system	Lageregelstrecke
Frequency response measurement	Frequenzgangmessung

Application:

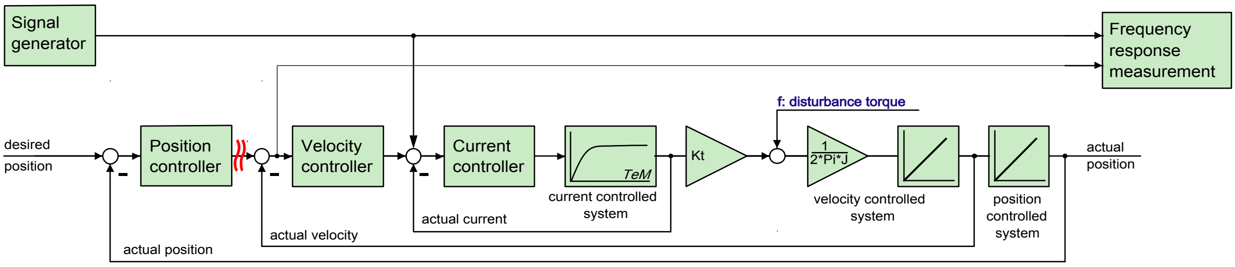
For the graphic design of the velocity control.

Compliance of velocity control

Shows the dynamic disturbance value behavior of the velocity control.

=> which dynamic influence does a disturbance torque have on the control deviation of the velocity control.

The disturbance toque is injected as disturbance current => this corresponds to the effect of a disturbance torque f



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f: disturbance torque	Störmoment
velocity controlled system	Geschwindigkeitsregelstrecke
position controlled system	Lageregelstrecke
Frequency response measurement	Frequenzgangmessung

Application:

- Verification of the disturbance value behavior of the velocity control
- Which velocity deviation generates a sinusoidal disturbance torque / disturbance current with the frequency fZ ?
- The frequency response of the compliance corresponds to the disturbance step response in the time range

Other settings

Sonstige Einstellungen

Anregung 4.00% 58mA

zulässiger Schleppfehler (+/-) 1.00mm

(1) Excitation

Serves to set the excitation signal of the frequency response measurement.

(2) Permissible following error (only for frequency response measurement)

The resulting following error is increased by the injection of the excitation signal during the frequency response measurement. In order to allow for this, the permissible following error window can be enlarged so that the measurement can be made. After the end of the measurement, this is reset to the original value.

(3) Selection of the kind of analysis of the measurement results

Depending on the fact whether frequency spectra or frequency responses are measured, the following types of analyses are available:

For frequency spectra:

- (a) Spectrum
- (b) Spectrum cumulated
- (c) cascade diagram

For frequency responses:

- (d) noise frequency response
- (d) noise frequency response cumulated

Non cumulated measurement (a & d)

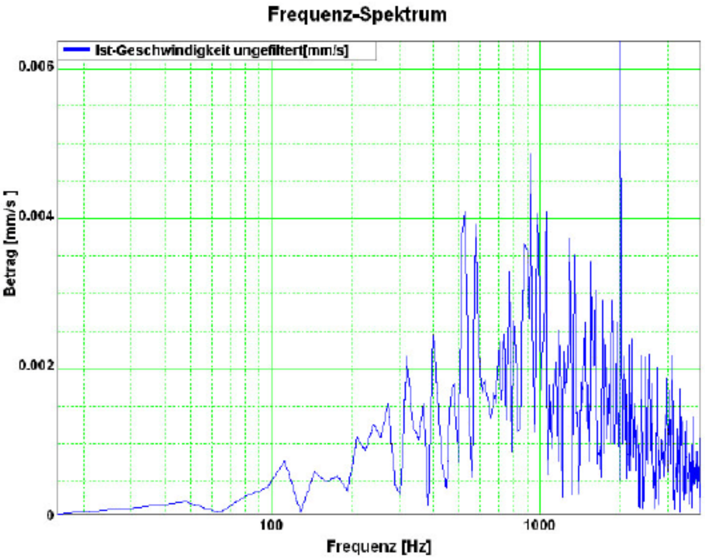
The measured data are displayed directly. This is especially suitable if you wish to analyze the effects of changes on the measurement results directly and promptly.

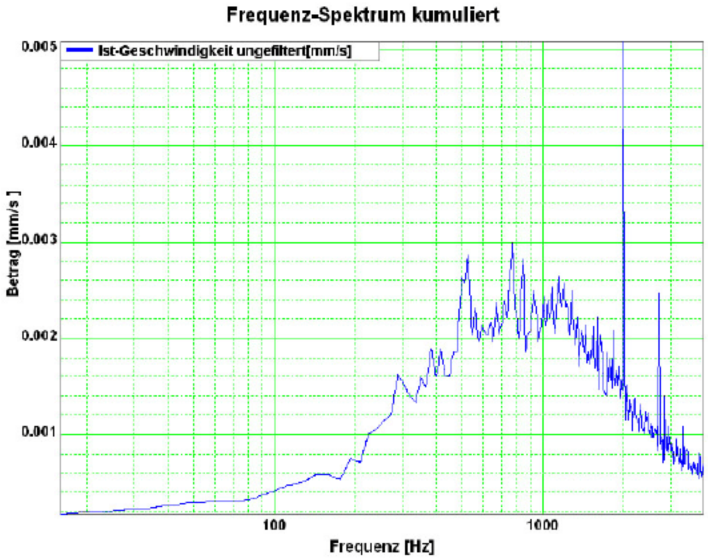
The disadvantage is however a smaller noise distance (quality) and an increased sensitiveness of the measurement towards unique disturbances.

Cumulated measurement (b & e)

An average is taken from all measurements in the result memory. This reduces the influence of random signals and disturbances extremely (improvement of the quality). The number of measurements from which the average is taken, is set with the **Size of the result memory** (see on page 277).

Comparison of two frequency spectra without and with cumulation

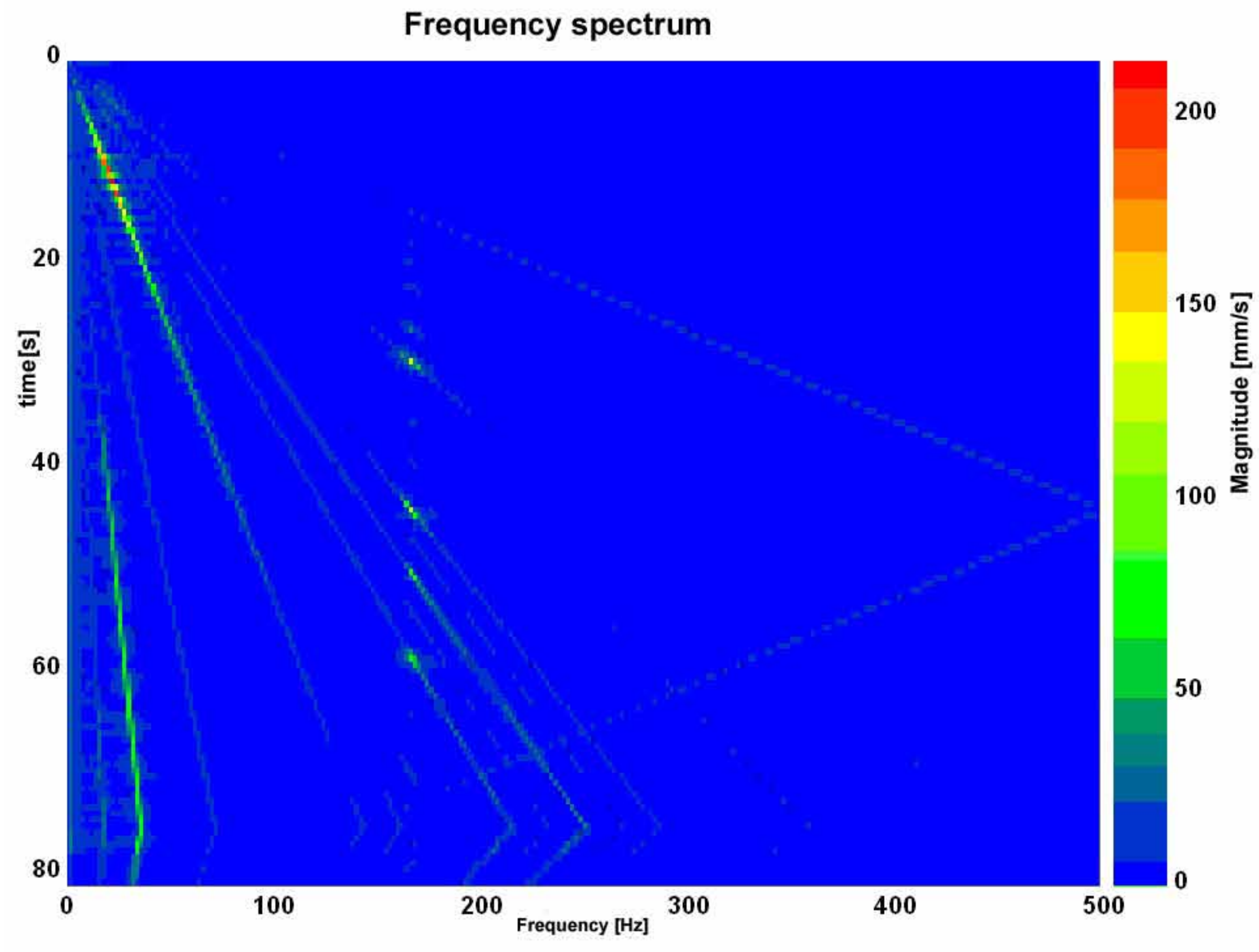




Cascade diagram (c)

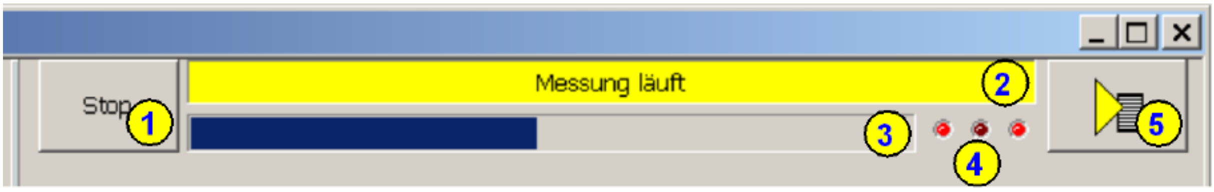
Frequency spectra are displayed subject to time. The information on the value of the signal is color-coded.

Cascade diagrams of the velocity signal during an acceleration process



This kind of display is suitable for the analysis of temporal changes in the measured spectrum.

Operating and status field



(1) Start and Stop of the measurement

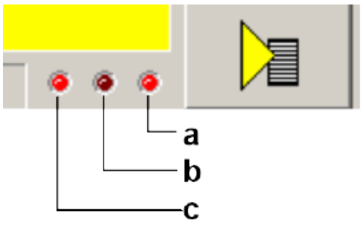
(2) Status display

Current status of the measurement or of the controller (if no measurement is taking place).

(3) Progress of the registration of the signals in the controller

The time of registration of the signals in the controller itself can, depending on the bandwidth and the kind of measurement, take up to one minute.

(4) status of the activity of the different partitions of the measurement



a: Registration of the measurement in the controller

b: Upload of the measurement from the controller to the PC

c: Processing the measurement in the PC

(5) Different settings and options

Functions available in a pull-down menu:

Open superimposed control loops (see on page 262)

accept load force

This serves, when opening the velocity controller, to accept the load which the controller has provided at the time of switching off => a z-axis does not drop down abruptly.

Measurement synchronous to the test movement

If this option is selected, it is ensured during the measurement, that the sampling does not take place in the turning point during a movement.

Unless frequencies are generated due to the deceleration/acceleration of the drive, which influence the measurement.

Result memory

In the result memory, the results of the N last measurements are kept.

This is important for the display of the cumulated measurement and for the cascade diagram. The larger the memory, the "older" the results still used. When the contents is deleted, all old measurements are discarded and do no longer influence the new results.

Windowing **(see on page 258)**

Here you can select different windowing modes for the measurement of frequency spectra. As default, no window is used.

Save measure to file

The currently displayed measurement result is stored and can be uploaded later into the ServoSignalAnalyzer. This does, however, not apply to the cascade diagram display.

Open measure from file

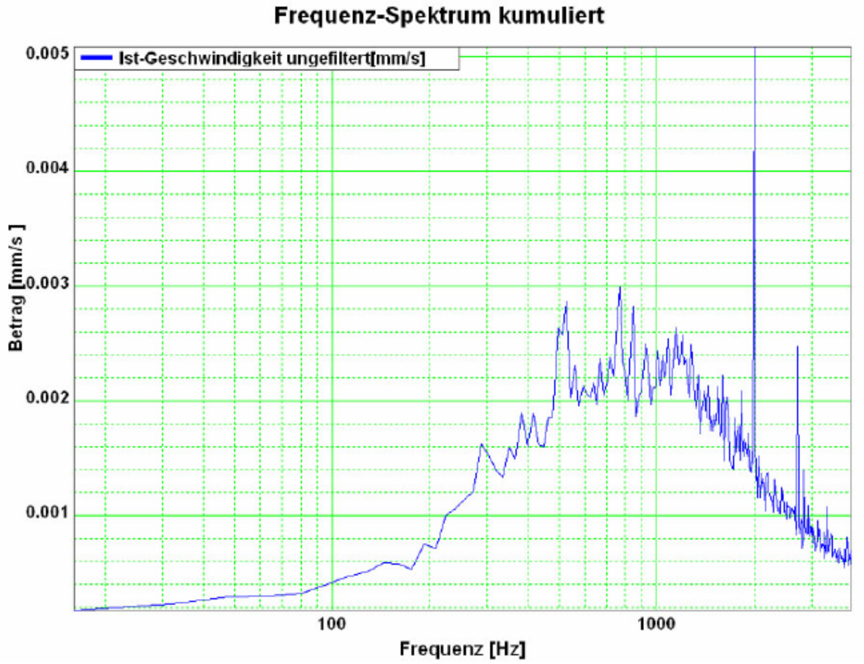
Here you can reload the measurements memorized before. You have the possibility to load up to four measurements subsequently and display them together in a graphic display.

Copy measurement to clipboard as graphic display.

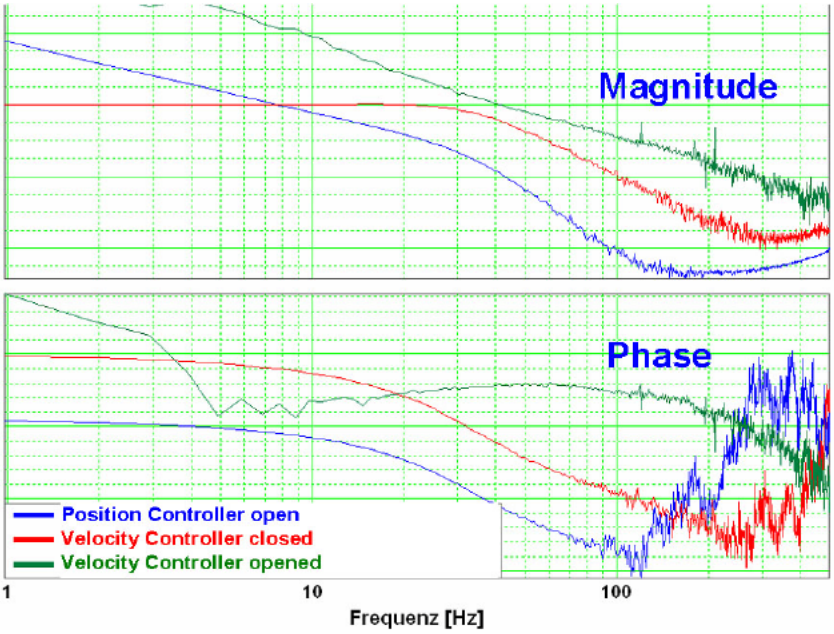
The currently displayed measurement result is copied as pixel graphic (e.g. BMP) to the clipboard.

Display of the measurement result

Frequency spectra



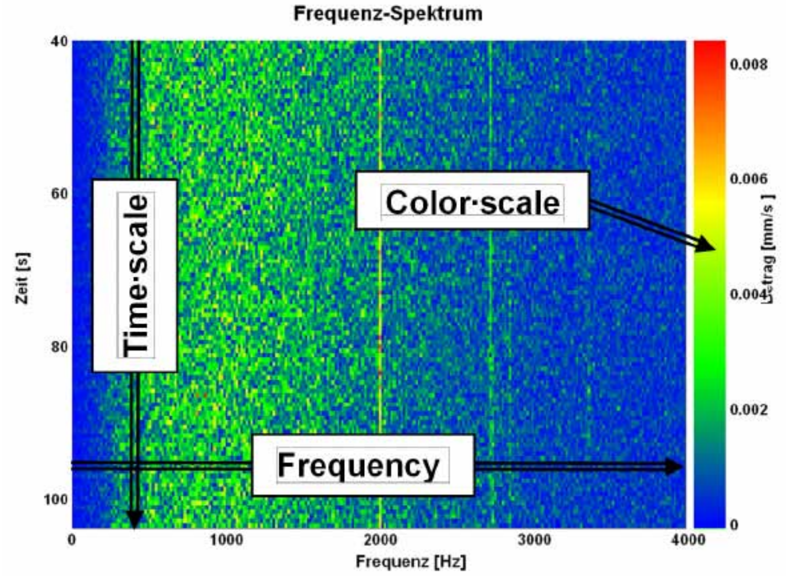
Bode diagrams: Value and phase



By clicking with the left mouse button on the legend, this can be shifted by 90°.

By clicking on the color bar, the color of the respective graph can be modified.

Cascade diagrams



By clicking with the left mouse button on the color scale, you can change between autoscale mode and fixscale mode.

AutoScaleMode:

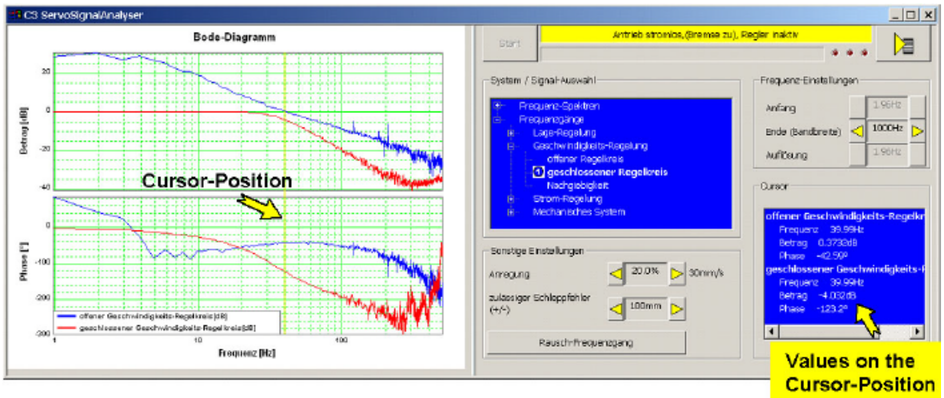
In this mode, the scaling of the color scale is adapted automatically so that all values can be displayed.

FixScaleMode:

Here, the scaling is fixed.

=> If, for instance, a considerably higher value than before is to be displayed, it is simply displayed like the former maximum (red).

Display of the measurement point at the cursor position



Antrieb stromlos,(Bremse zu), Regler inaktiv

Anfang 1.96Hz
Ende (Bandbreite) 1000Hz
Auflösung 1.96Hz

Anregung 20.0% 30mm/s
zulässiger Schleppfehler (+/-) 100mm

offener Geschwindigkeits-Regelkr
Frequenz 39.99Hz
Betrag 0.3732dB
Phase -42.59°
geschlossener Geschwindigkeits-R
Frequenz 39.99Hz
Betrag -4.032dB
Phase -123.2°

The cursor is set by clicking on the left mouse button. All measurement data of the selected cursor position (frequency) are displayed in the "cursor" operating field.

4.4.9.8 Basics of frequency response measurement

In this chapter you can read about:

In the drive and control technology, the display of signals and systems in the frequency range is often the best possibility to solve different tasks.

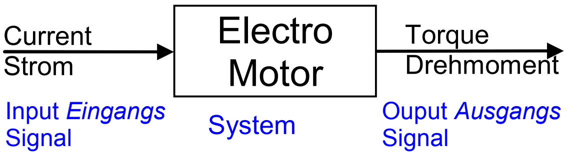
Distinction between signals and systems

Defined objects and their interactions that can be combined to a whole by a plausible distinction from their environment (i.e. the complex reality) are called a system.

Example electric motor

This consists of a multitude of different components, but the function and the behavior of a motor can be described as a whole without describing each individual component and their interactions separately.

If the motor is energized, it will generate a torque at the motor shaft.



Current is therefore a signal, which causes at the input of the system motor a change of its torque output signal.

In order to register and process such signals in the controller, they are digitized and read in with the so-called scanning frequency (fA). Thus the physical signal was converted into a finite sequence of numbers, which can be processed in the controller.

Linear Systems (LTI System)

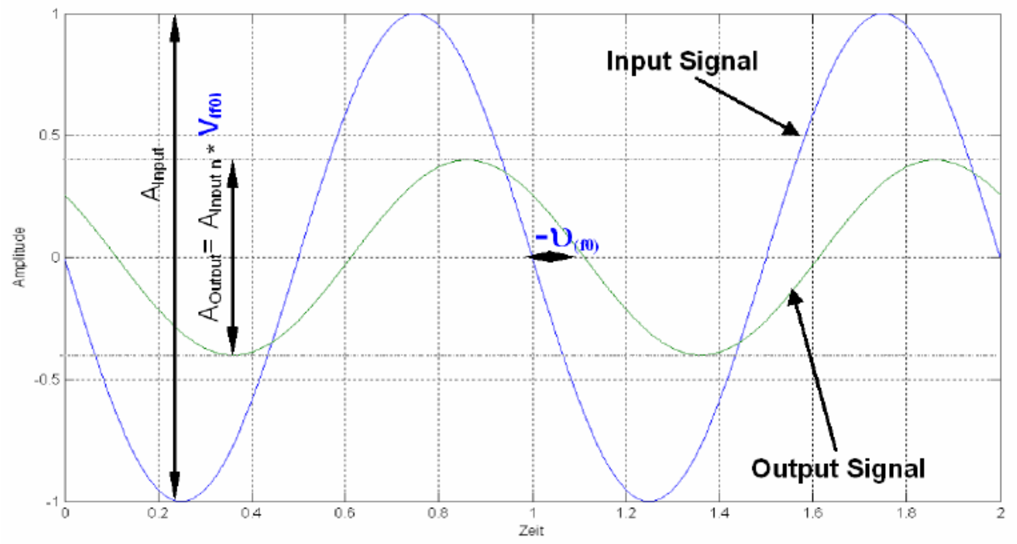
Further explanations are based on the concept of so-called linear systems. This means that doubling the input value means that the portion of the output value influenced by it is also doubled. This, for instance, is not the case in the event of influence due to limitations, friction and backlash.

=> those are called non-linear systems, which can not be analyzed with the methods described here (or only with difficulties).

One of the most important properties of linear systems is that a sine signal, which is put through a linear system, is still a sine signal at the output, which differs from the input signal only in value and phase.

When a signal passes a LTI system, no new frequencies are generated.

Input and output signals of a linear system

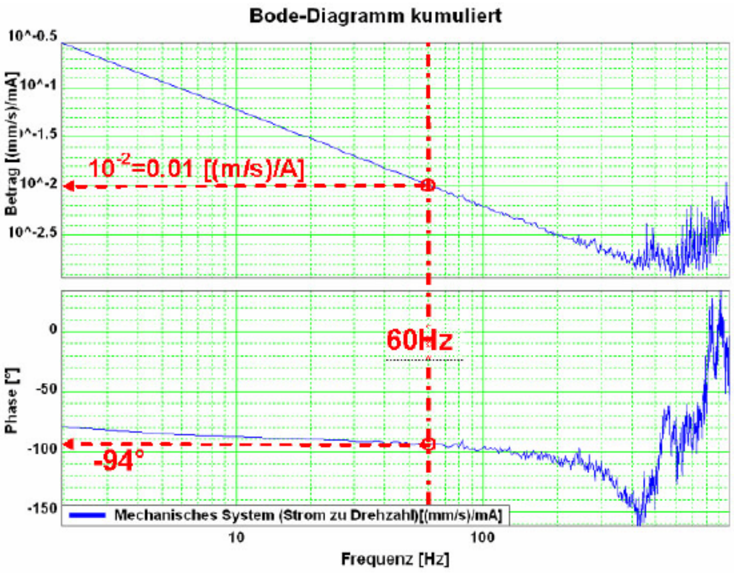


If you know the value (V(f0)) as well as the phase position (u(f0)) for all frequencies, the LTI system is completely defined.

Such a graph of value and phase position in dependence of the frequency, is called frequency response or bode diagram.

=> only LTI systems can be analyzed with the aid of frequency responses.

Frequency response / bode diagram



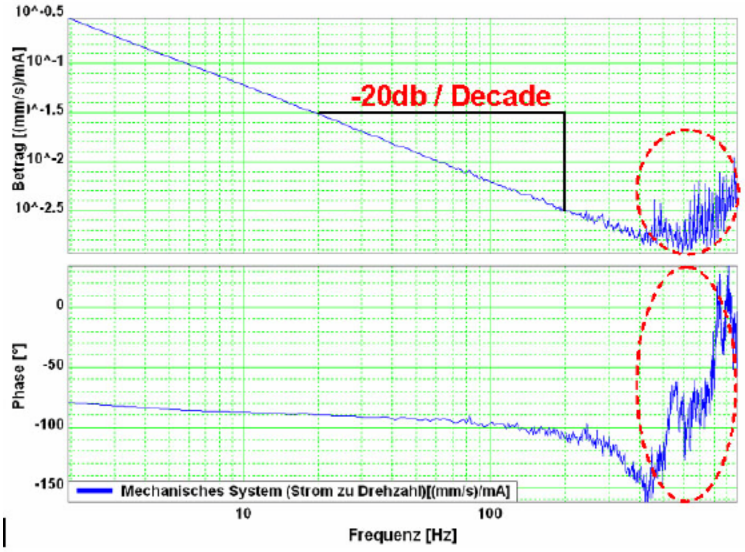
The frequency response shows the amplification (value) and the phase shift (phase), which a signal is submitted to when passing through a system.

The displayed bode diagram allows the following conclusions:

If a sine with 60Hz and an amplitude of 1A is present at the input, a sine delayed by 94° and an amplitude of 0.01m/s will result at the output.

Mechanical system

Frequency response of a mechanic system: Current - velocity of a motor



The outlined course at the end of the measurement range does not permit statements on the system measured due to disturbances. Due to the attenuation of the signals increasing with the frequency, the sensitiveness of the measurement to disturbances (signal to noise ratio) increases with a rising frequency. The value as well as the phase response of the displayed frequency response are "disturbed" at the same intensity, this shows, that disturbances are the reason.

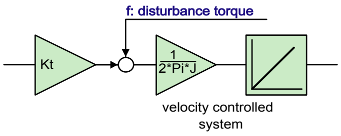
The value response consists basically of a straight, which declines with a slope of -20dB/decade (-20dB/decade => per tenfold increase of the frequency, the value decreases also by factor ten.

The phase response remains however almost constantly at -90° over a relatively large range.

In control technology, this is called integrating behavior (I-behavior).

the I-behavior can be explained as follows.

The measured current is proportional to the motor force and thus also to the acceleration of the driven mass. As the velocity is calculated from the integrated acceleration, the measured system looks as follows:

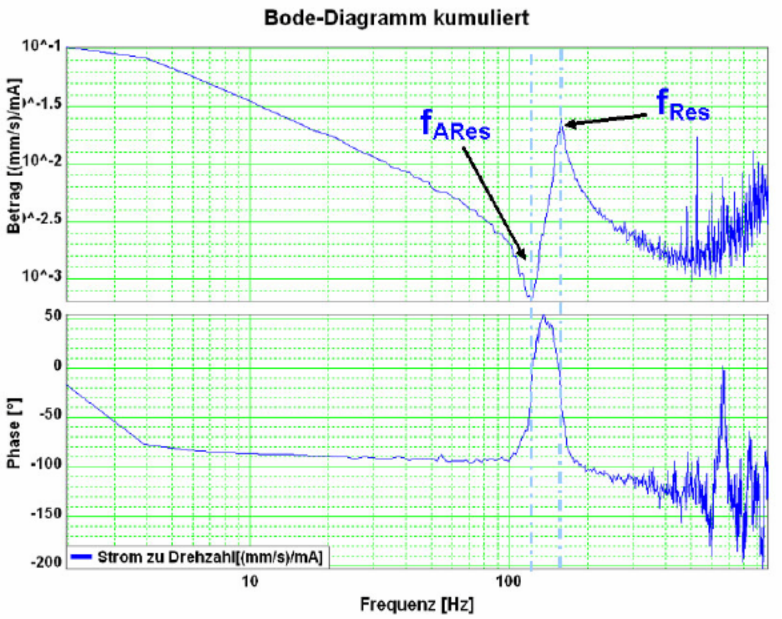


Input value is the current actual value, output value is the velocity actual value

Resonance points and their causes

In this chapter you can read about:

Mechanical system with a resonance point



fARes: Anti resonance frequency

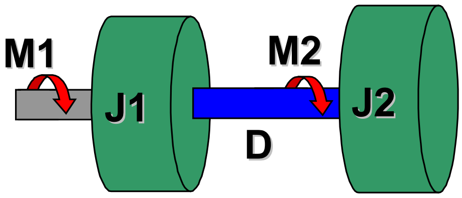
fRes: Resonance frequency

The displayed change of the frequency response (resonance point), has its cause in a so-called two mass system (caused by the elastic coupling of two masses).

Hint

As, upon closer examination, each mechanic coupling shows a certain elasticity, it is no the question if there is a resonance point, but at which frequency it is and how well it is attenuated.

Rotary two mass system



The shown system corresponds for instance to a motor with a flywheel coupled via a shaft. Hereby J1 corresponds to the motor moment of inertia and J2 to the moment of inertia of the flywheel.

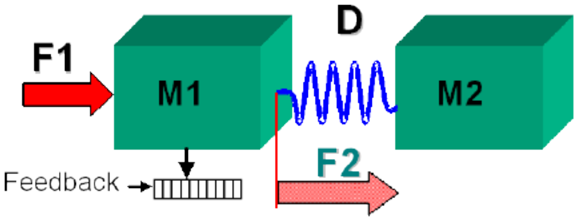
Calculation of the resonance frequencies in the rotary system with a hollow shaft as elastic coupling element

$$D = \int_{r_I}^{r_A} \frac{2 \cdot \pi \cdot G}{l} \cdot r^3 \cdot dr = \frac{G \cdot \pi \cdot \left(r_A^4 - r_I^4\right)}{2 \cdot l}$$

$$f_{A\mathrm{Res}} = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{D}{J_2}} \qquad f_{\mathrm{Res}} = \frac{1}{2 \cdot \pi} \cdot \sqrt{D \cdot \left(\frac{1}{J_1} + \frac{1}{J_2}\right)}$$

G	Shear modulus of the material used [N/m²] (e.g. approx. 80750N/mm² for steel)
D	Torsional rigidity in [m/rad]
rA	Outer radius of the hollow shaft
rI	Inner radius of the hollow shaft
l	Length of the hollow shaft

Linear two mass system

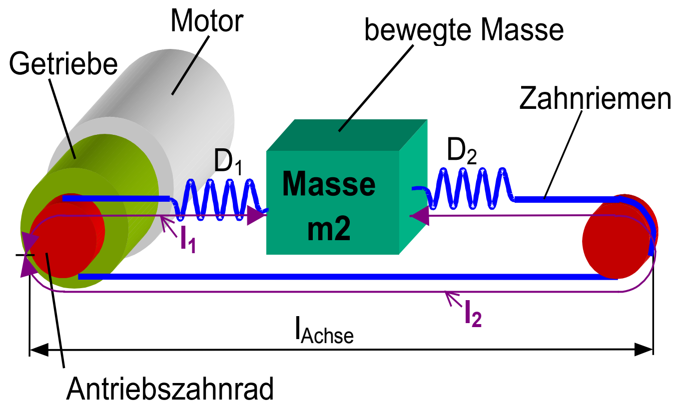


Resonance frequencies in the linear system

$$f_{A\mathrm{Res}} = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{D}{m_2}} \qquad f_{\mathrm{Res}} = \frac{1}{2 \cdot \pi} \cdot \sqrt{D \cdot \left(\frac{1}{m_1} + \frac{1}{m_2}\right)}$$

D	Rigidity in [N/m]
m1	e.g. motor mass
m2	e.g. load mass

Toothed belt drive as two mass system



In toothed belt drives, the toothed belt is the elastic coupling element. Its rigidity depends directly on the lengths l1 and l2 and changes in dependence of the position of the moved mass.

$$D_{spez} = \frac{F_{\max}}{0{,}004}; \qquad l_2 = 2 \cdot l_{Achse} - l_1$$

$$D_1 = \frac{D_{spez}}{l1}; \qquad D_2 = \frac{D_{spez}}{l2}; \qquad D = D_1 + D_2 = \frac{2 \cdot D_{spez}}{l_1 \cdot \left(2 - \frac{l_1}{l_{Achse}}\right)}$$

$$f_{ARes} = \frac{1}{2\pi} \cdot \sqrt{\frac{D}{m2}} \qquad f_{Res} = \frac{1}{2\pi} \cdot \sqrt{D \cdot \left(\frac{1}{m_2} + \frac{(r_{Zahnrad})^2}{J_1 \cdot (i_{Getriebe})^2}\right)}$$

D	Total spring constant of the toothed belt drive
Dspez	Specific spring constant of the toothed belt used
D1	Spring rate of the belt length l1
D2	Spring rate of the belt length l2
iGearbox	Transmission ratio of the gearbox
lAxis	Length of the axis
J1	Moment of inertia of motor and gearbox
m2	translatory moved mass
rToothed wheel	Radius of the drive pinion

4.4.9.9 Examples are available as a movie in the help file

Here you can find examples as a movie in the help file.

4.4.10. ProfileViewer for the optimization of the motion profile

In this chapter you can read about:

You will find the ProfilViewer in the Compax3 ServoManager under the "Tools" Menu:

4.4.10.1 Mode 1: Time and maximum values are deduced from Compax3 input values

- The motion profile is calculated from Position, Speed, Acceleration, Deceleration, Acceleration Jerk and Deceleration Jerk
- As a result you will get, besides a graphical display, the following characteristic values of the profile:
  - Times for the acceleration, deceleration and constant phase
  - Maximum values for acceleration, deceleration and speed

4.4.10.2 Mode 2: Compax3 input values are deduced from times and maximum values

- A jerk-limited motion profile is calculated from the positioning time and the maximum speed / acceleration
- As a result you will get, besides a graphical display, the following characteristic values of the profile:
  - the parameters Position, Speed, Acceleration, Deceleration, Acceleration Jerk and Deceleration Jerk
  - Times for the acceleration, deceleration and constant phase
  - Maximum values for acceleration, deceleration and speed

Set deceleration and acceleration phase

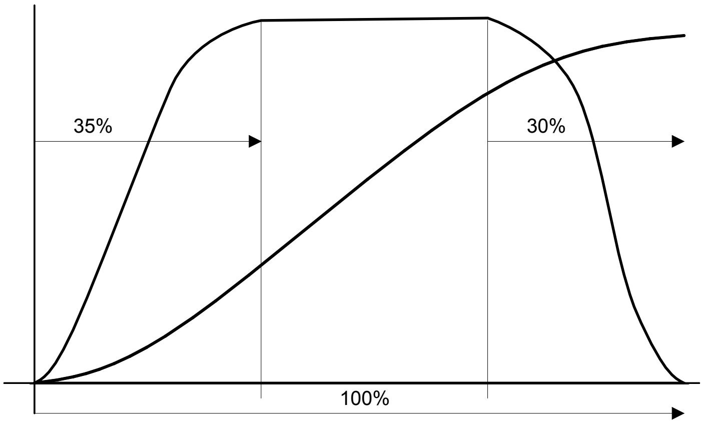
The profile can be defined more exactly by entering the segmentation into deceleration and acceleration phase.

When setting 50% and 50%, a symmetrical design will result, the values for triangular operation are calculated, which is limited by the maximum speed.

The total of the percentage values may not exceed 100.

The percentage entries refer to the total positioning time.

Example:



4.4.11. Turning the motor holding brake on and off

Compax3 controls the holding brake of the motor and the power output stage. The time behavior can be set.

Application:

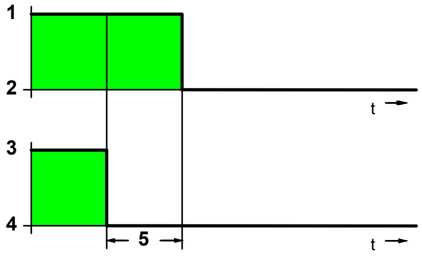
With an axis that is subject to momentum when it is halted (e. g. for a z-axis) the drive can be switched on and off such that no movement of the load takes place. The drive thereby remains energized during the holding brake response time. This is adjustable.

The power output stage current is de-energized by:

- Error or
- by deactivating the MC_Power module
- the ServoManager

Thereafter the motor is braked to zero rotation speed on the set ramp.

When zero speed is reached, the motor is de-energized with the delay "brake closing delay time".



1: Motor powered

2: Motor de-energized

3: Open brake

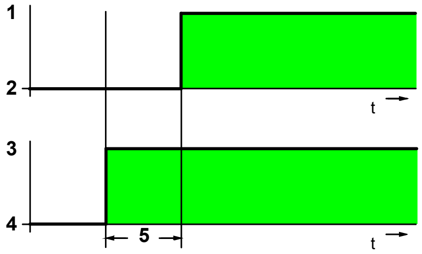
4: Engage the brake

5: Brake closing delay time

The power output stage is enabled by:

- Quit (acknowledge) (after error) with the MC_Reset module
- by activating the MC_Power module
- the ServoManager

The motor is energized with the delay "delay time for brake release".



1: Motor powered

2: Motor de-energized

3: Open brake

4: Engage the brake

5: Delay time for brake release

5. Motion control

In this chapter you can read about:

5.1 Programming based on IEC61131-3

In this chapter you can read about:

5.1.1. Compax3 ServoManager: IEC61131-3 programming

In the function directory of the Compa3 ServoManager, you can find the “IEC61131-3 programming category with IEC61131-3 functions:

- IEC61131-3 settings
  Input of the setpoint cycle time and specification of the error reaction upon cycle timeout
- IEC61131-3 CoDeSys development environment
  Starting CoDeSys
- IEC61131-3 Debugger
  Starting the Debugger
- Link IEC61131-3 Project.
  Link external IEC project to the active Compax3 project. When editing the IEC project, the external project is also edited. This makes it possible to use the same IEC project with several Compax3 projects.
- Import IEC61131-3 Project.
  Integrate external IEC project into the active Compax3 project.
- Export IEC61131-3 Project.
  Export IEC project from the active Compax3 project.

5.1.2. Prerequisites

- Installation of the CoDeSys programming tool.
- Installation of necessary Target Packages (target systems):
  - Bring up the "InstallTarget" program (program group "3S Software": "CoDeSys V2.3")
  - Select the target file; file name from “Open”; file name: "Compax3.tnf".
  - The selected target can be installed with "Install".

5.1.3. CoDeSys / Compax3 target system (Target Package)

Targets for Compax3 servo axes

Beginning with Compax3 software version V2.0, two Compax3 targets are included with delivery (containing module and object descriptions).

- **CoDeSys for C3 T30**: for Compax3 T30 (as per Compax3 Software version V2.0)
- **CoDeSys for C3 T40**: for Compax3 T40 (as per Compax3 Software version V2.0)

The old target is still available for programs that were created earlier (created with Compax3 software version < V2.0).

- **CoDeSys for Compax3**: for Compax3 T30

This programs are thus still capable of running.

When migrating to a new target, you must be certain that the module and object names have been changed.

Edit the appropriate parts of the IEC program accordingly.

Targets for Compax3F hydraulic axes

- **CoDeSys for C3F T30**: for Compax3 T30
- **CoDeSys for C3F T40**: for Compax3 T40

5.1.3.1 Program development and test

Program development

CoDeSys is the development environment for control systems which will help you develop Compax3 IEC61131 programs. CoDeSys is called up from the Compax3 ServoManager (under “programming: IEC61131-3 CoDeSys development environment")

The IEC program can be integrated into the C3 ServoManager project or exported again from the project as required.

When CoDeSys is brought up, the IEC program stored in the project is opened. If the project does not contains an IEC program, a selection dialog appears.

Download to Compax3

After the IEC61131 program has been developed and compiled with CoDeSys, it is downloaded to Compax3 by means of the ServoManager (in “Download: PC -> Compax3").

Program test

For testing your program directly with Compax3, you may use the Compax3 IEC61131-3 debugger (the debug functions of CoDeSys are not supported in conjunction with Compax3). The debugger is called up from the ServoManager (under Programming: IEC61131-3 debugger). It automatically accesses the last IEC61131-3 program in the ServoManager to be loaded into Compax3 with "Download: IEC61131-3" and makes its modules and variables available in the project tree.

The data from Compax3 are read via the instruction “log in”. Please note in this regard that the interface to Compax3 can only be assigned once: Online functions in the ServoManager such as Upload, Download, Status display in the Optimization window or oscilloscope functions are not possible simultaneously. These functions interrupt the connection between debugger and Compax3 automatically.

5.1.3.2 Recipe management

The recipe management function in CoDeSys is not supported in conjunction with Compax3. Please use the recipe table available in Compax3 (also see in the configuration wizard).

5.1.4. Languages supported

- IL (Instruction List)
- ST (Structured Text)
- FBD (Function block diagram)
- CFC (continuous function chart editor)
- LD (Ladder diagram)

5.1.5. Function range supported

In this chapter you can read about:

5.1.5.1 Operators supported

IL	FBP / CFC / SFC	ST
LD(N)		
ST(N)		
R		
S		
AND(N)	AND	AND(N)
OR(N)	OR	OR(N)
XOR(N)	XOR	XOR(N)
NOT	NOT	NOT
ADD	ADD	+
SUB	SUB	-
MUL	MUL	*
DIV	DIV	/
GT	GT	>
GE	GE	>=
EQ	EQ	=
NE	NE	<>
LE	LE	<=
LT	LT	<
RET	RET	RETURN
	MOVE	
		:=
CAL(C/N)		
JMP(C/N)		
		CASE
		DO
		ELSE
		ELSIF
		END_CASE
		END_FOR
		END_IF
		END_REPEAT
		END_WHILE
		EXIT
		FOR
		IF
		REPEAT
		THEN
		TO
		UNTIL
		WHILE

5.1.5.2 Standard functions supported

Bit manipulation functions

SHL, SHR, ROL, ROR

Numeric functions

ABS, SQRT, SIN, COS

Functions for type conversion

Type conversions x_TO_y	X=Source data type, Y=Target data type
TRUNC	

Functions for selection

MIN	Not for BOOL /WORD / DWORD
MAX	Not for BOOL /WORD / DWORD
LIMIT	Not for BOOL /WORD / DWORD
SEL	Not for BOOL /WORD / DWORD

5.1.5.3 Standard function modules supported

FlipFlops

RS, SR,

Trigger

R_TRIG, F_TRIG,

Numerator

CTU, CTD, CTUD,

Timer

TON, TOF, TP,

maximum 8 pieces, time resolution 0.5ms
(the number of timers required is displayed in the CoDeSys output window during compilation)

PID Controller function block

5.1.6. Data types supported

The following data types are available for IEC61131-3 programming:

Name	**Division**	**Format**
BOOL	Status values: TRUE or FALSE	Logical variable.
INT	-32768...32767	16-bit integer: Fixed point number without places after the decimal
DINT	-2147483648...2147483647	32 bit integer: Fixed point number without places after the decimal
REAL		32-bit floating point: 16 bits before the decimal and 16 bits after the decimal
WORD	0...65535	16-bit bit sequence (no range of values)
DWORD	0...4294967295	32-bit bit sequence (no range of values)
TIME	0...4194.3035s	32 Bit - Format (resolution: 0.5 ms)
ENUM	User-defined type of enumeration (local enumerations are not supported)	

Altogether 500 16-bit variables are available. These include BOOL, INT, and WORD.

Altogether 150 32-bit variables are available. These include DINT,DWORD,TIME,REAL.

The number of the required variables is displayed in the CoDeSys output window during compilation.

5.1.7. Retain Variables

6 retain variables (variables that are safe from power failure) are available

- 3x16-bit retain-variables
- 3x32-bit retain-variables

5.1.8. Recipe table with 9 columns and 32 (120) lines

An array, i.e. a table with 9 columns and 32 rows for direct access and additional 88 rows for indirect access, is available to store values.
This table is freely assignable and can be used for example to store position sets or for recipe management.
In addition, this table can be used to exchange data with an external control system or a POP, for example.

The layout of the table is as follows:

Column 1 Type: REAL objects O1901	**Column 2 Type: REAL objects O1902**	**Column 3 Type: INT objects O1903**	**Column 4 Type: INT objects O1904**	**Column 5 Type: INT objects O1905**	**Column 6 Type: DINT objects O1906**	**Column 7 Type: DINT objects O1907**	**Column 8 Type: DINT objects O1908**	**Column 9 Type: DINT objects O1909**
Row 1 "C3Array.Col01_Row01" (1901.1)	Row 1 "C3Array.Col02_Row01" (1902.1)	Row 1 "C3Array.Col03_Row01" (1903.1)	Row 1 "C3Array.Col04_Row01" (1904.1)	Row 1 "C3Array.Col05_Row01" (1905.1)	Row 1 "C3Array.Col06_Row01" (1906.1)	Row 1 "C3Array.Col07_Row01" (1907.1)	Row 1 "C3Array.Col08_Row01" (1908.1)	Row 1 "C3Array.Col09_Row01" (1909.1)
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
Row 32 "C3Array.Col01_Row32" (1901.32)	Row 32 "C3Array.Col02_Row32" (1902.32)	Row 32 "C3Array.Col03_Row32" (1903.32)	Row 32 "C3Array.Col04_Row32" (1904.32)	Row 32 "C3Array.Col05_Row32" (1905.32)	Row 32 "C3Array.Col06_Row32" (1906.32)	Row 32 "C3Array.Col07_Row32" (1907.32)	Row 32 "C3Array.Col08_Row32" (1908.32)	Row 32 "C3Array.Col09_Row32" (1909.32)

In addition to direct access to the first 32 table rows, indirect access to the 120 rows of the complete table is possible via pointer addressing.

To do this, the table pointer "C3ArrayPointer_Row" (Object 1900.1) must be set to the desired row.
This offers access to Columns 1 through 9 of the referenced rows through "C3Array_Indirect_Col1" to "C3Array_Indirect_Col9" (objects 1910.1 to 1910.9).

5.1.9. Maximum program size

Up to 6000 (IL) instructions are possible

Note! Please note, that integrated function modules do also require program memory. The required program memory can therefore increase due to a Targets update, even without any program changes.

The number of instructions generated is displayed in the CoDeSys output window by the Compax3 compiler during interpretation.

5.1.10. Cycle time

Minimal cycle time: 1ms.

The cycle time can be adjusted with the Compax3 ServoManager when downloading IEC61131-3 programs.

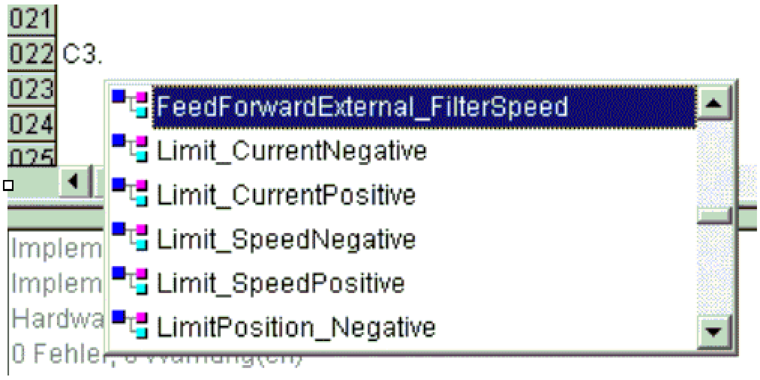
It is possible to optimize later in the optimization display of the Compax3 ServoManager. The cycle time is displayed there in increments of 500 µs (2 = 1 ms; 3 = 1.5 ms; etc.).

The IEC61131-3 program is stopped cycle time of 0.

5.1.11. Access to the Compax3 object directory

All Compax3 objects are encapsulated in the "C3" program module.

Access to **Compax3 objects** (see on page 544) in CoDeSys:



Compax3 objects are divided into groups:

C3.	Compax3 - Objects
C3Array.	Variable (Recipe) List
C3Pop.	Objects for the Parker Operator Panel Pop.
C3Cam.	Objects for the T40 cam control. **Do only use the objects described in this help; the additional objects are for internal use only!**
C3Plus.	Additional objects that are generally not required.
C3Scope.	Objects for programming the oscilloscope function. **For internal use only!**

The object name reveals the group assignment.

In general, it applies:

Objects that are not described here are reserved objects!

5.1.12. Compilation, debugging and down/upload of IEC61131 programs

- Compiling IEC61131-3 programs in CoDeSys
- Downloading or uploading of IEC61131-3 programs with the Compax3 ServoManager.
- The debugger is called up from the C3 ServoManager under “Programming: IEC61131-3 debugger” called up.

Note:

Before compiling you have to enter for which Compax3 versions the compilation is to be executed.
Please note that when selecting “all versions” not all functions are available, only the minimal range of functions is supported.

Only if the latest firmware version was selected (and the corresponding firmware is loaded in the target Compax3) all functions described here are supported.

5.1.13. General rules / timing

General rules

Positioning

Within an IEC cycle, only one positioning module may be activated!

If 2 positioning modules are activated within one IEC cycle, it is not defined which one is executed.

Status of the outputs

- The outputs "Done", "InVelocity", "Error", "ErrorID" and "CommandAborted" reset with the falling edge of the "Execute" input.
- If the "Execute" input goes back to FALSE again before the module action (for example positioning) has been completed ("pulse to Execute"), the corresponding outputs (for example “Done”)is set upon termination for precisely ONE cycle.
- The outputs "Done" and "Error" are never simultaneously TRUE.
- If the instance of a function module receives a new "Execute" signal before the function ends, the module will not show any response (no "Done" and no "Command Aborted") in reference to the previous action.

Input parameters

- Parameters are accepted with the rising edge of the "Execute" signal.
- To be able to accept modified parameters, the module must be triggered again with an "Execute" signal.

Missing input parameters

- If an input parameter is missing, the previous value of this instance will be used in accordance with IEC61131-3.
- On the 1st. callup, the standard value is used.

Position and distance

- "Position" is a value that is defined for a reference system, i.e. a specific position value is a fixed location in the reference system.
- "Distance" is the difference between 2 positions.

Sign

- "Velocity", "Acceleration", "Deceleration" and "Jerk" are always positive variables.
- "Position" and "Distance" may be positive or negative.

Error handling

- All function modules have an "Error" output that can be activated by a module during a module sequence.
- The ErrorID (error number) can be read by an axis error with the "MC_ReadAxisError" module.

Behavior of the "Done" - output

The "Done" output is set if the function module has been successfully executed.

If one positioning process is interrupted by a second If one positioning process is interrupted by a second before it is complete, the first function block no “Done”

Behavior of the "CommandAborted" output

"CommandAborted" is set if a positioning process is interrupted by a second positioning process is interrupted by "MC_Stop" or MC_Power.

The reset behavior of "CommandAborted" is the same as "Done".

If "CommandAborted" occurs, the other outputs will be reset.

Value range of the movement parameters

Please note that the limits are specified in revolutions.

To convert to the configured unit, multiply the min/max values by the "travel distance per motor revolution".

Linear motors

With a configured linear motor, all revolution data must be replaced by pitch.

To convert to the configured unit, the min/max values must be multiplied by the pitch length (see the technical data for the motor).

5.1.14. Library constants

The following global constants are declared in the PLCopen function module library:

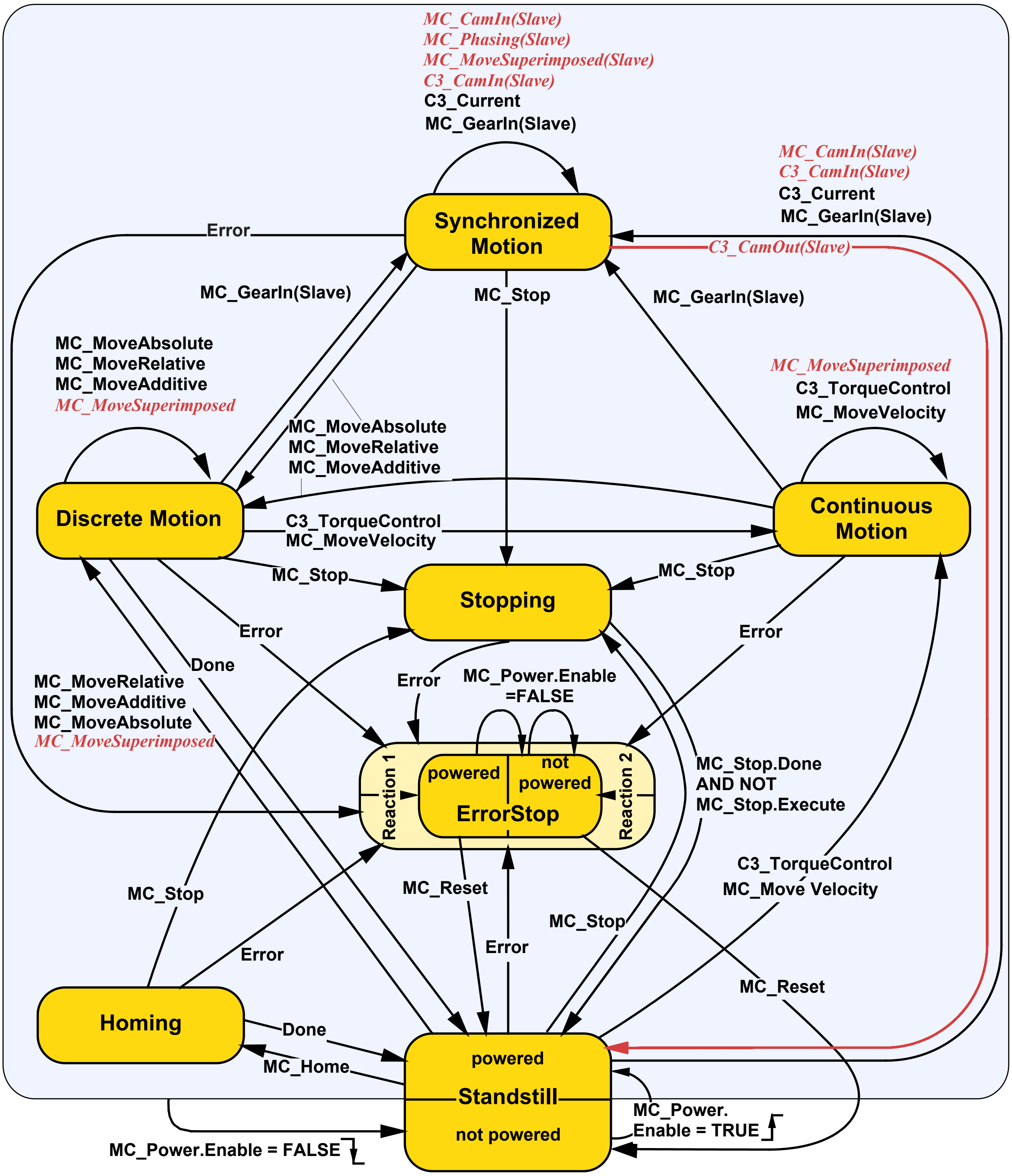
Name	Type	Description
For power supply of the axis inputs/outputs of modules:		
Axis_Ref_LocalAxis	INT	Local axis for Compax3F: Main axis
Axis_Ref_LocalAxisAux	INT	Only for Compax3F: Local auxiliary axis
Axis_Ref_Virtual	INT	virtual Master (only with T40)
AXIS_REF_LocalCam	INT	Local Cam axis (physically present axis)

For the selection of the master signal source:		
AXIS_REF_Physical	INT	for +/-10V analog input, step / direction input 5V or Encoder A/B input 5V (depending on the configuration of the physical source under signal source)
Axis_Ref_Virtual	INT	virtual Master
Axis_Ref_HEDA	INT	HEDA
Axis_Ref_Additional	INT	reserved (additional sources)
Axis_Ref_CAN	INT	reserved (CAN)
Axis_Ref_FieldBus	INT	reserved (CAN)
General constants		
MC_Direction_Positive	INT	For supply of the Direction input of the MC_MoveVelocity module (for positive rotational direction)
MC_Direction_Negative	INT	For supply of the Direction input of the MC_MoveVelocity module (for negative rotational direction)
MC_Direction_Current	INT	For supply of the Direction input of the MC_MoveVelocity module (retaining the last rotational direction to be selected)
Direction_Memory	INT (Variable)	The MC_MoveVelocity modules instances store the last direction parameter in this variable. This variable can only be used by Motion Control modules and must not be overwritten!
OutputSelect_C3Output	INT	for the C3_OutputSelect module: Assignment of the source for the respective output to module "C3_Output".
OutputSelect_FastCam	INT	for the C3_OutputSelect module: Assignment of the source for the respective output to the respective fast cam.
Reset positioning mode		
All directions	INT	C3_all_direction
Positive direction	INT	MC_positive_direction
Shortest path	INT	MC_shortest_way
Negative direction	INT	MC_negative_direction
Actual direction	INT	MC_current_direction

5.2 Status diagrams

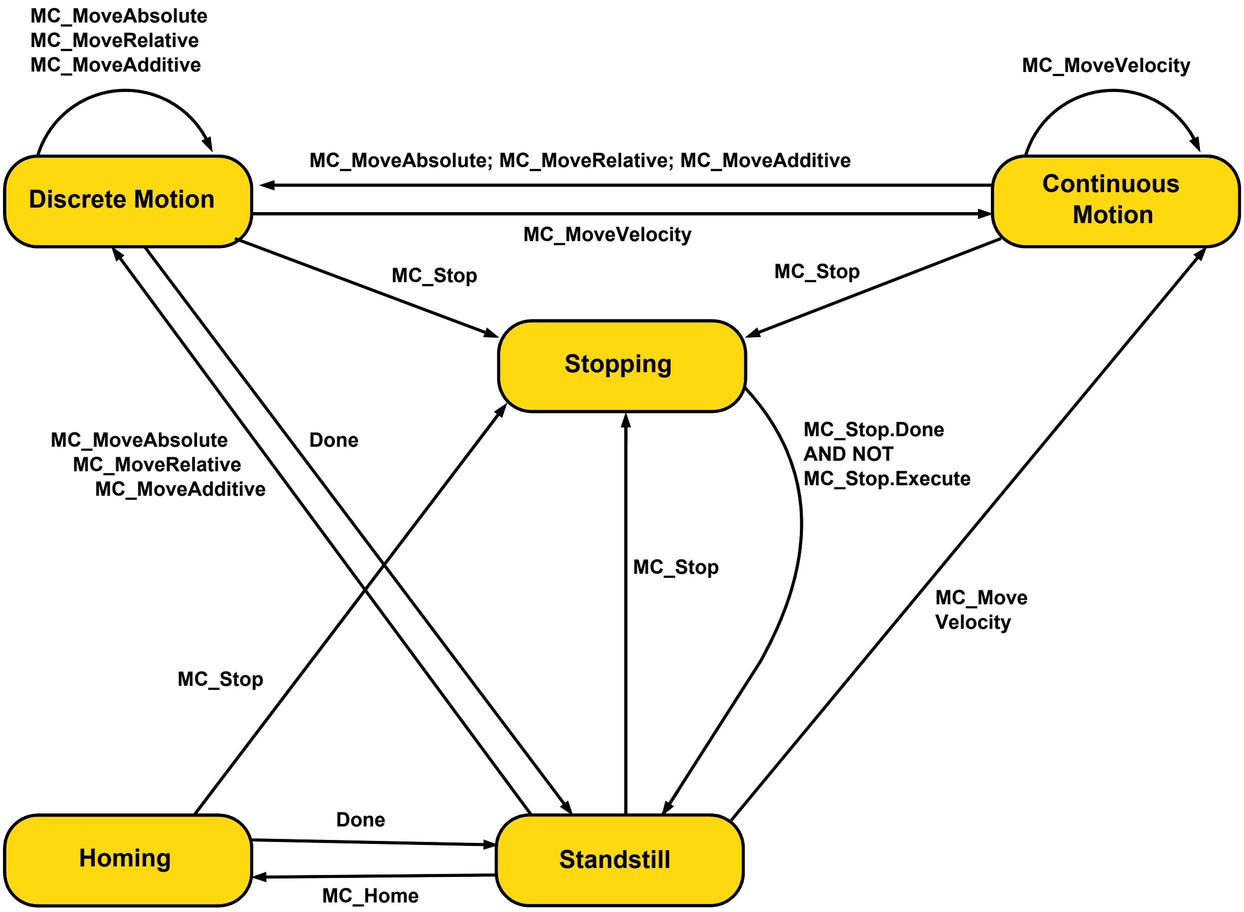
In this chapter you can read about:

5.2.1. Compax3 status diagram



5.2.2. Virtual Master

5.2.2.1 Status diagram of the virtual master



Create a program for the virtual axis.

The virtual axis supports the function modules listed in the status diagram.

To do so, the input/output variable "Axis" is assigned to the constant "AXIS_REF_Virtual".

The position value of the virtual axis can be used as master signal source.

Note: Please note that the virtual axis is only available for function modules listed in the status diagram.

5.3 Control functions

In this chapter you can read about:

5.3.1. Activation of the drive (MC_Power)

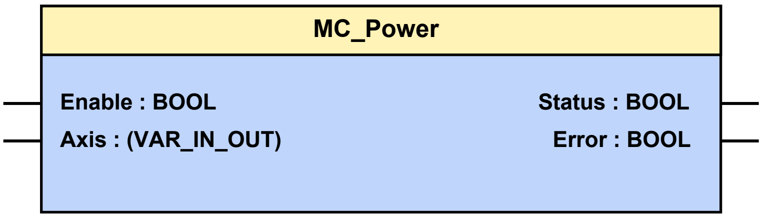
FB name	**MC_Power**	
Transition into the "Standstill: disable" or "Standstill: powered"		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Enable	BOOL	Activates the module; A rising edge on the input activates the drive, a falling edge deactivates the drive with the **ramp defined for errors** (see on page 147). **Please observe:** The configured error ramp is limited. The error ramp will not be smaller than the deceleration set in the last motion set. set deceleration.
VAR_OUTPUT		
Status	BOOL	State of the power output stage (TRUE=drive activated, FALSE=drive deactivated)
Error	BOOL	Error when activating or deactivating the drive

Notes:

- If the input parameter “Enable” is set to “TRUE”, all enables of the drive are set. The command is only accepted if the axis is not yet or still active (Output “State” = FALSE). Furthermore, the device may not be in error state.
- All enables will be reset if the input parameter "Enable" = FALSE, the axis decelerates with the configured error ramp to speed = 0 - the “state” output remains on “TRUE” during downramping.
- Compax3 Servo: During automatic commutation, the output “State" is not set to TRUE for activation, but rather not until after automatic commutation has been successfully completed.
- Compax3 Servo: During automatic commutation, the output “State" is not set to TRUE for activation, but rather not until after the magnetization current has been successfully built up.
- An enable is denied until the intermediate circuit is loaded, this may take up to 2s when switching on Compax3H for the first time.
- In the Compax3M, an enable is denied if the mains module is in the initialization phase (e.g. the intermediate circuit is not yet completely loaded) or the communication between axis and axis combination is not active).
- If the drive is in error state (error reaction 1: controller active) and the enable of the MC_Power is deactivated, the drive is deactivated (error reaction 2).
- C3 powerPLmC Note: This module is also available as group function block. You can then trigger this function for the entire Compax3 group.
- trigger for the entire Compax3 group.
- The “Error” output is generated, if activation is not possible. Possible cause: Device in error state, activation of a different IEC module after execution of the MC_Power.
- The “Error” output is generated, if deactivation is not possible. Possible cause: Activation of a different IEC module after execution of MC_Power.
- Compax3 Servo: On motors with brake, the configured braking delay for opening the brake to a temporal delay of the “state” output with reference to control of the “enable” input.

Note on sequencer programming **(see on page 303)**

- Input False on the enable input interrupts a stop sequence triggered by a rising edge on the Execute input of the MC_Stop.
- The axis is also in “Standstill” state after PowerOff (however deactivated), but the Done output of MC_Stop is not set.
- In sequencers, a sole query of the MC_Stop.Done output is not sufficient for standstill acquisition, in addition, the MC-ReadStatus.Standstill or MC_Power.Status signals must be linked. See also description of module MC_Stop.



5.3.2. Stop (MC_Stop)

In this chapter you can read about:

FB name	**MC_Stop**	
Stops the current movement **Please note:** Only one instance of MC_Stop is permitted per axis!		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Stops the movement
Deceleration	DINT	Value of deceleration (always positive) [units/s²] Range of values: 0.24 rev/s² ... 1000000 rev/s² **Please observe:** The configured STOP ramp is limited. The STOP ramp will not be smaller than the deceleration set in the last motion set.
Jerk	DINT	Value of the deceleration jerk [Units/s³] (always positive) value range: 30 rev/s³ ... 125000000 rev/s³
VAR_OUTPUT		
Done	BOOL	Stop move
Error	BOOL	Error while stopping positioning

Note:

- As long as the "Execute" input is set, the axis remains in the "Stopping" status (as long the axis is activated) and is unable to execute any additional movement commands!
- If the axis is deactivated by setting the Enable signal of the "MC_Power" module to FALSE, the Stopping state will then be exited.
- If the enable signal of the "MC_Power" module is set to TRUE again, the axis goes back to the "Stopping" state again if the Execute input of the "MC_Stop" module is still TRUE.
- Compax3 T40 note: Curve operation upon STOP: The master position and the curve are not influenced by a STOP of the axis.
  The acquisition and cam generation continue; this means that the curve output is available in the event of an average.
  If the curve is to restarted after the STOP without consideration of the previous history, the “**C3_CamReset** (see on page 379)“ module must be executed after stop.
- C3 powerPLmC Note: This module is also available as group function block. You can then trigger this function for the entire Compax3 group.

Note on sequencer programming

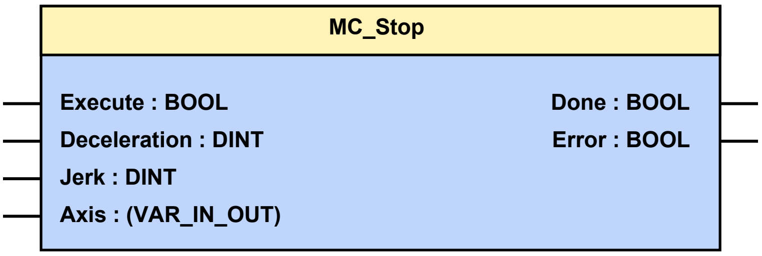
- In sequencers, a sole query of the done output is not sufficient for standstill acquisition, as it can be reported with a considerable delay. In addition, the MC-ReadStatus.Standstill or MC_Power.Status signals must be linked.

Example 1: PowerOff during a stop sequence:

- Input False on the enable input of MC_Power interrupts a stop sequence triggered by a rising edge on the Execute input.
- The Stop module goes on in the background “without function” in the “Standstill (not powered)” states and is only continued by reactivating the axis with the MC_Power module when the “Standstill (powered)” state is reached.
- The Done output message is delayed until the “Standstill (powered) state is reached.

Example 2: Device error during a stop sequence:

- A device error interrupts a stop sequence triggered by a rising edge on the Execute input.
- The axis is temporarily in “Errorstop” state und will only pass into “Standstill” state after acknowledging the error with MC_Reset (upon error reaction 2 not powered at first).
- The Stop module goes on in the background “without function” in the “Errorstop” and “Standstill (not powered)” states and is only continued by acknowledging the error (error reaction 1) (upon error reaction 2 followed by reactivation of the axis with MC_Power) when the “Standstill (powered)” state is reached.
- The Done output message is delayed until the “Standstill (powered) state is reached.



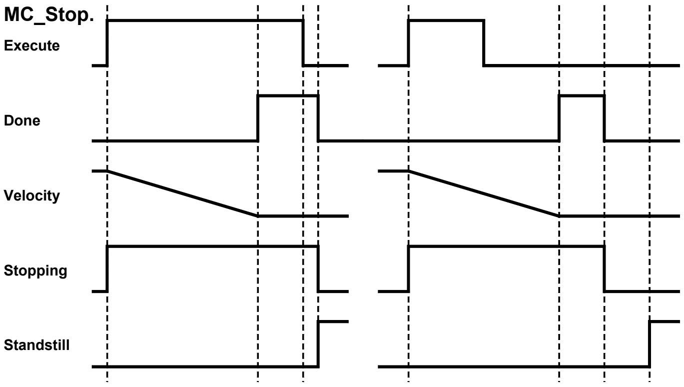
5.3.2.1 MC_Stop: Example 1

The following illustration shows an example of how the MC_Stop module interrupts and stops a movement that is in progress.

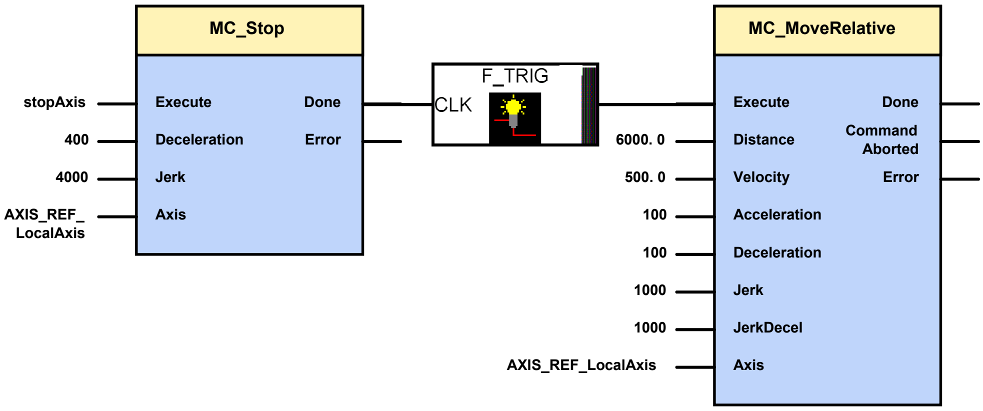
If a positioning module is interrupted by the MC_Stop module, it reports "Command Aborted" and can no longer be executed as long as the MC_Stop module is active.

If the MC_Stop module is inactive (no "Execute" signal), the function module can be executed again.

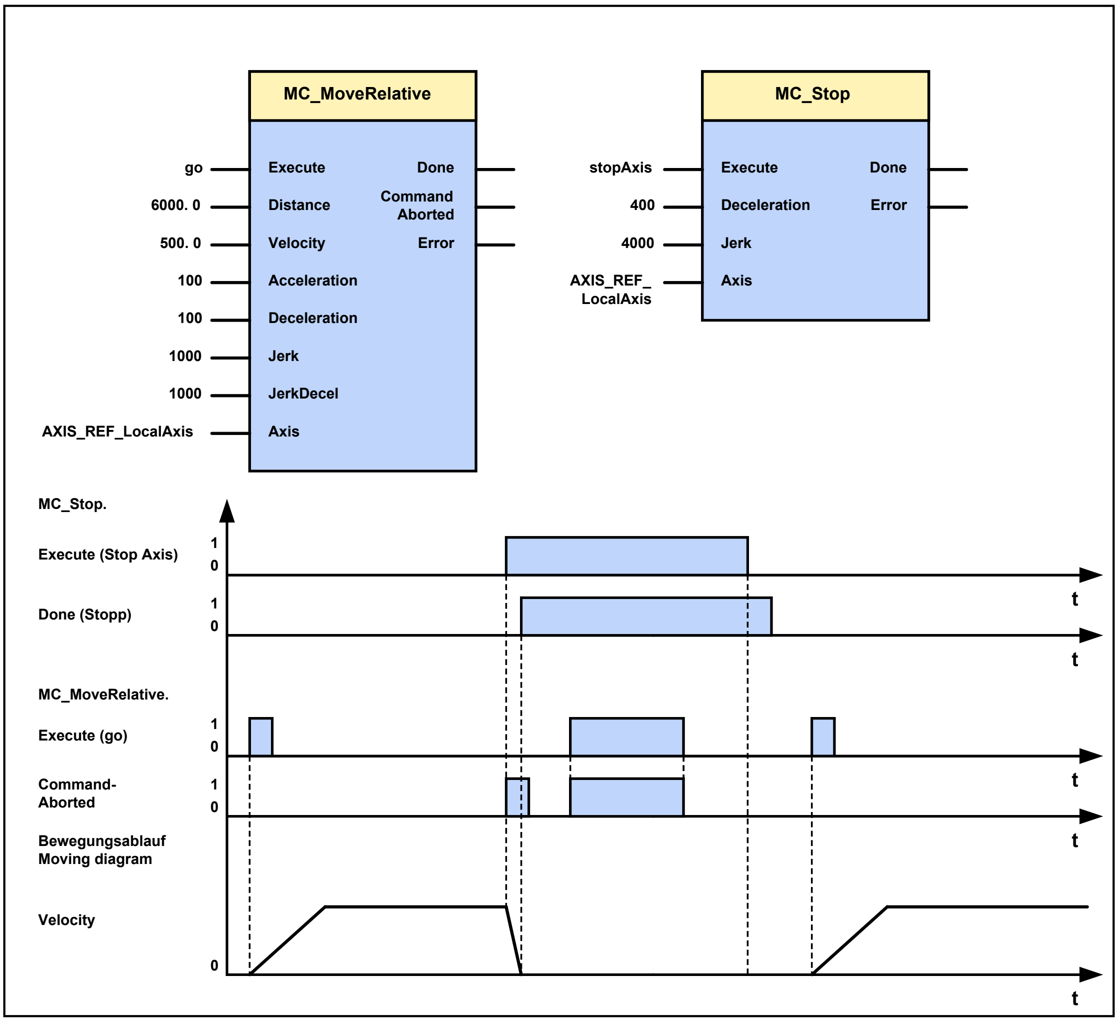
Timing Diagram:



Note: If a positioning is to follow immediately after the stop, this can take place with the falling edge of the done output at the earliest:

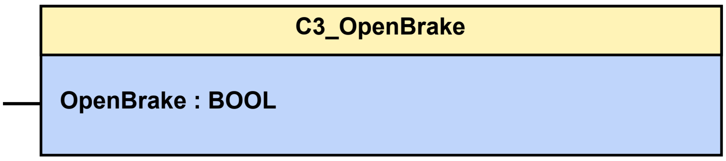


5.3.2.2 MC_Stop: Example 2



5.3.3. Opening the brake (C3_OpenBrake)

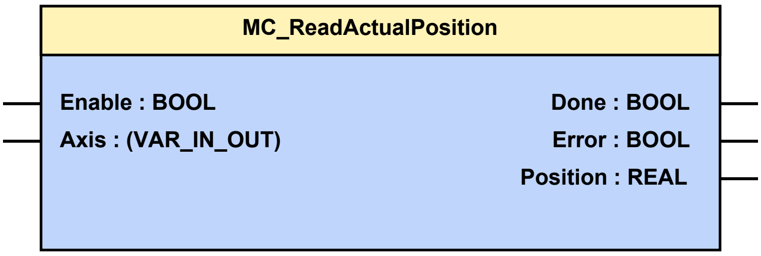
FB name	**C3_OpenBrake**	
Opening the motor holding brake - works only with no current (standstill - not powered)		
VAR_INPUT		
OpenBrake	BOOL	"TRUE" opens the motor holding brake
When current is being supplied to the drive, the input has no function.		



5.4 Reading values

5.4.1. Reading the current position (MC_ReadActualPosition)

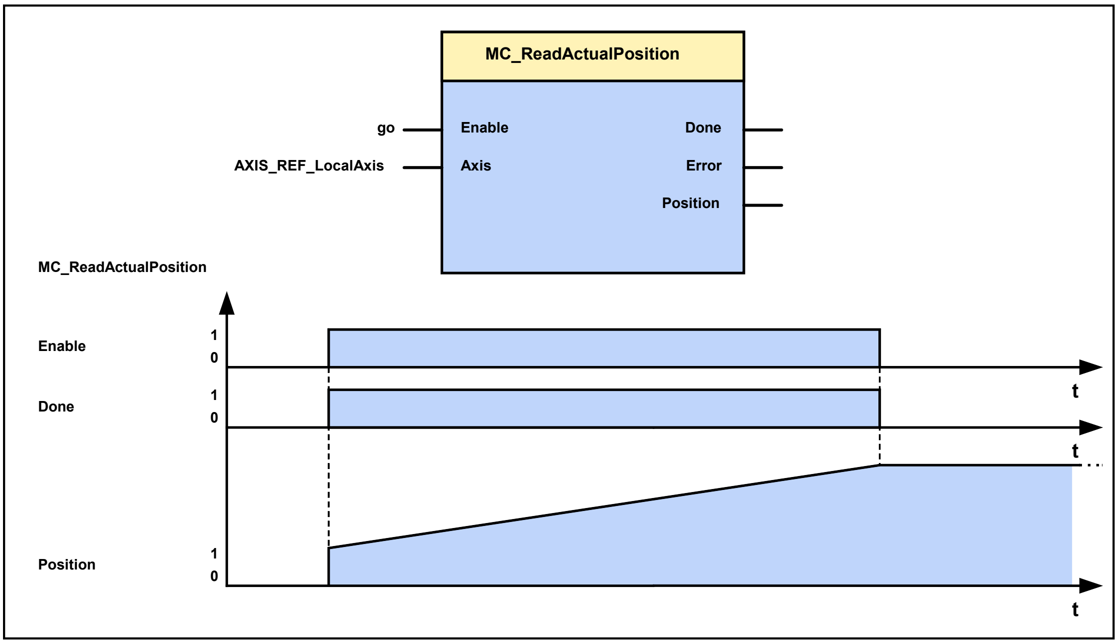
FB name	**MC_ReadActualPosition**	
Reading the current axis position		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Enable	BOOL	Activates the module, continuous reading of the axis position as long as Enable=TRUE
VAR_OUTPUT		
Done	BOOL	Position value available
Error	BOOL	Error while reading the position
Position	REAL	Axis position
Note: -		



You can read the current position of the axis with this module.
As long as the input parameter "Enable" = TRUE, the current parameter value will be supplied **cyclically** (see on page 456) to the output parameter "Position".

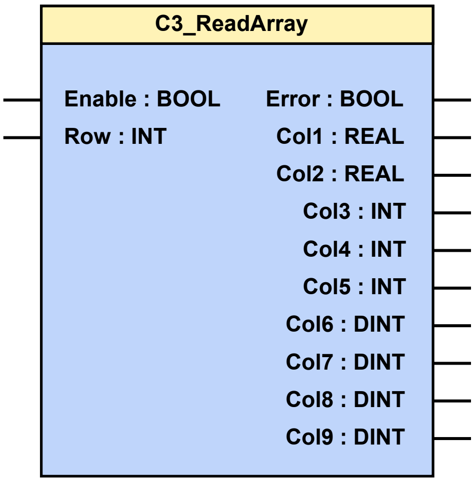
The status of the input parameter must be present for at least one module call.

The following illustration shows the behavior of parameters in the MC_ReadActualPosition function module.



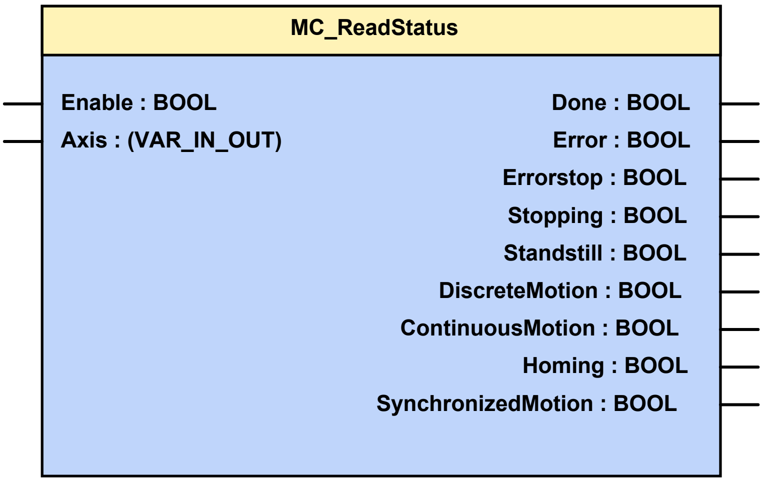
5.4.2. Read access to the (C3_ReadArray) array

FB name	**C3_ReadArray**	
This module is used for simplified read access to the array (recipe table).		
VAR_INPUT		
Enable	BOOL	The desired rows can be read with the Enable input (after selecting "Row").
Row	INT	Desired table row (1 ...120). This input works with object 1900.1, please respect this, if you access object 1900.1 directly in addition.
VAR_OUTPUT		
Error	BOOL	The output Error signalizes that there was an error during reading out the array (non existing row selected on the Row Input).
Col1 – Col9	REAL INT DINT	The individual columns of the array can be accessed through outputs Col1 through Col9.
Notes: - Rows will be read cyclically as long as Enable = TRUE.		



5.4.3. Reading the device status (MC_ReadStatus)

FB name	**MC_ReadStatus**	
Specifies the current status according to the PLCopen status machine		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Enable	BOOL	Activates the module; continuous outputs of output parameters as long as Enable=TRUE
VAR_OUTPUT		
Done	BOOL	Status values available
Error	BOOL	Error while executing module
Errorstop	BOOL	Error stop function. The motor brakes as specified by the stop ramp and is de-energized;
Stopping	BOOL	The motor is stopped;
Standstill	BOOL	The motor is stopped;
DiscreteMotion	BOOL	Individual movement;
ContinuousMotion	BOOL	Continuous positioning;
Homing	BOOL	Machine reference is approached;
SynchronizedMotion	BOOL	Synchronous motion
Note: See also in the status diagram.		



5.5 Positioning functions (standard)

In this chapter you can read about:

5.5.1. Value range for positioning parameters

The unit "increments" is valid only for position values!

Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s^2 and revolutions/s^3 (resp. pitch/s, pitch/s^2, pitch/s^3 for linear motors).

5.5.2. Absolute positioning (MC_MoveAbsolute)

FB name	**MC_MoveAbsolute**	
Absolute positioning to a specified position.		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Position	REAL	Absolute target position of the movement to be executed (configured unit [units]) (positive and negative direction) **<Wertebereich>**[1]
Velocity	REAL	Value of maximum speed (always positive) (not necessarily reached) **<Wertebereich>**[2] [**Units/s**[3]]
Acceleration	DINT	Value of acceleration (always positive)[**Units/s^2**[4]] **<Wertebereich>**[5]
Deceleration	DINT	Value of deceleration (always positive) [**Units/s^2**[6]] **<Wertebereich>**[7]
Jerk	DINT	Value of the acceleration **jerk** (see on page 316) [**Units/s^3**[8]] (always positive) **<Wertebereich>**[9]
JerkDecel	DINT	Value of the deceleration jerk [**Units/s^3**[10]] (always positive) **<Wertebereich>**[11]
VAR_OUTPUT		
Done	BOOL	Specified setpoint position on the setpoint generator output is reached
CommandAborted	BOOL	Positioning aborted
Error	BOOL	Error while executing module

---

[1] Target position: -4000000 rev...4000000 rev

[2] Speed for positioning: 0.00001157 rev/s...2000 rev/s

[3] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[4] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[5] Acceleration for positioning 0.24 rev/s^2 ...100000 rev/s^2

[6] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[7] Deceleration for positioning:0.24 rev/s^2 ...1000000 rev/s^2

[8] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[9] Acceleration jerk for positioning:30 rev/s^3 ...125000000 rev/s^3

[10] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

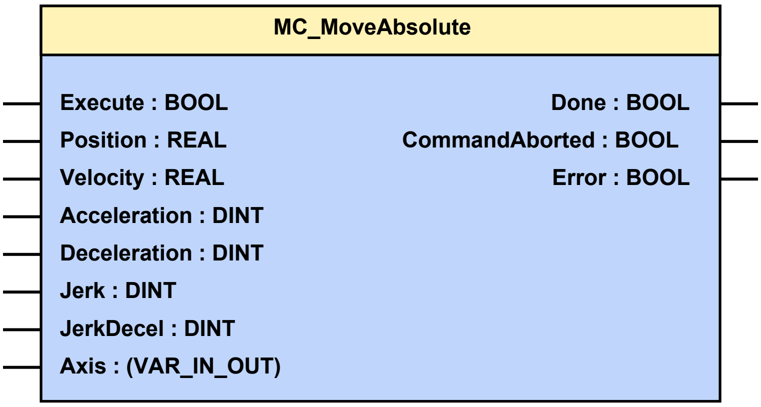
[11] Deceleration jerk for positioning:30 rev/s^3...125000000 rev/s^3

Notes:

- Continuous operation can be selected via object 1111.8 "C3Plus.Position_restposition_mode" <> 0; setpoint value and actual value are then set to 0 before each positioning.
- You can optimize the motion profile data with the **"ProfilViewer"** (see on page 287) software tool!

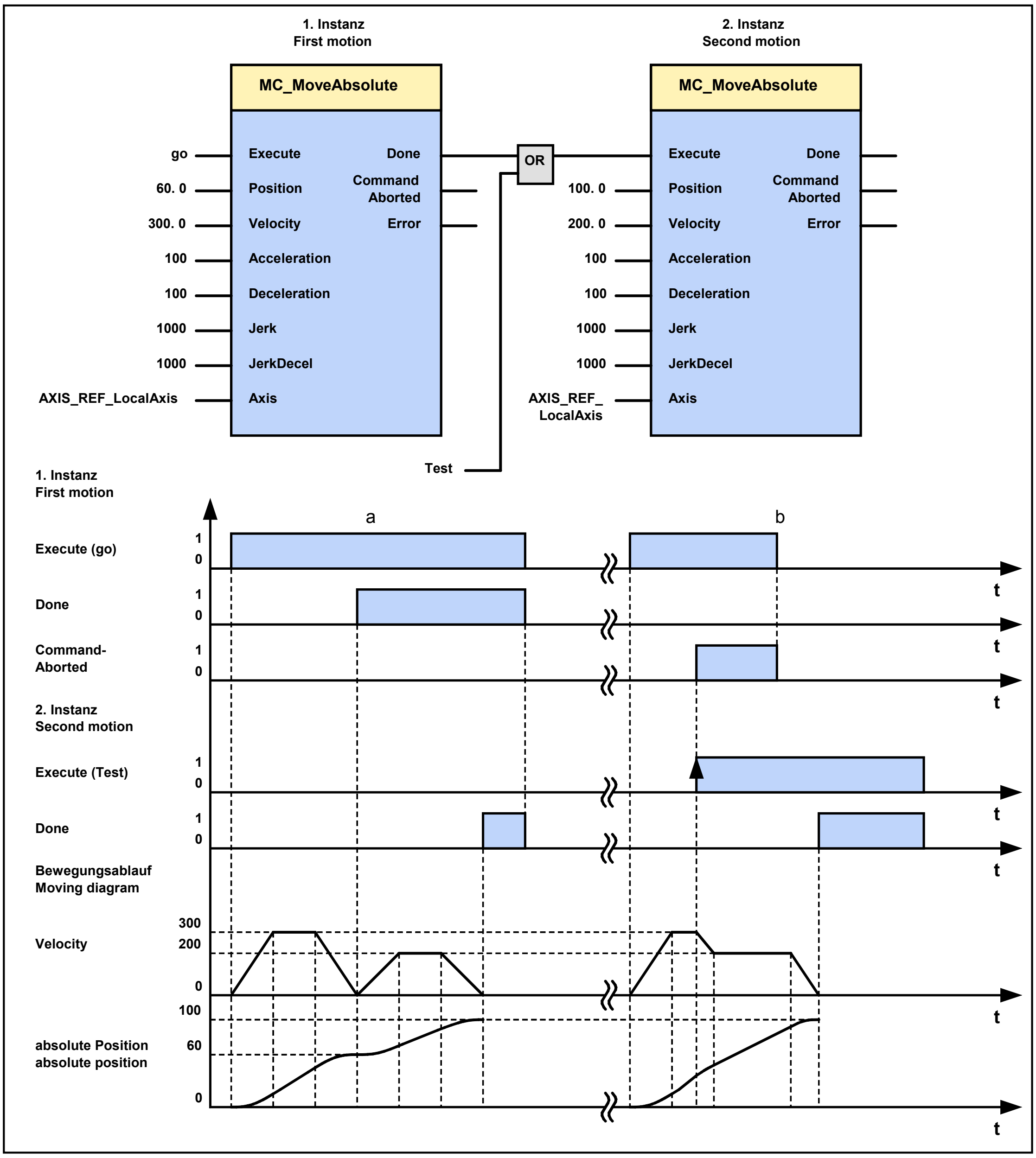
Notes on T40 (Cam):

- If a SuperImposed movement is started during an absolute movement, the absolute position is not accessed, but the absolute position plus the position entered in the SuperImposed.
- The same applies if a SuperImposed movement is already being executed and an absolute movement is started, then the absolute position is not accessed but the sum of both values.
- After the SuperImposed movement has been finished, the absolute position is accessed with the next absolute movement.



The following illustration shows two examples for the combination of two MC_MoveAbsolute modules.

- The left part (a) of the time diagram shows a case in which the second Function block after the first function block is executed.
  If the 1st. function block has reached position 60, the “Done” output will issue the execution command to the second function module, which then moves to Position 100.
- The right part (b) of the diagram shows a case in which the second function block is executed during execution of the 1st. function block. The 1st The first function module is automatically interrupted.
  The 2nd. function module moves directly to position 100 whether or not position 60 of the first Function block was already reached.



5.5.2.1 Position mode in reset operation

In this chapter you can read about:

In reset operation (activated by the configured reset distance), additional positioning functions are possible for absolute positionings (can be set under configuration in the “Positioning options / positioning profiles” window only in bus mode “Positioning” or “Profile selection”):

All directions	Standard positioning mode
Positive direction	Positioning only in positive direction
Shortest path	Positioning on the shortest path
Negative direction	Positioning only in negative direction
Actual direction	Positioning by keeping the actual direction of travel

Dynamic positioning

In dynamic positioning, a decision concerning the positioning travel is not taken on the basis of the actual position, but on the basis of the braking position resulting from the motion parameters.

Please observe:

- **In the event of positioning specifications below zero and higher than or equal to the reset distance, this function is deactivated.**
  The positioning target must for instance be in the range between 0..359.999999° for a reset distance of 360°.
- The positioning functions are neither effective in test movements nor in an automatic positioning after homing travel (if this was not deactivated in the configuration).
- In the event of “shortest path”, the motion is not defined for a positioning by a travel of half the reset distance.

Setting the positioning mode in reset mode

The positioning modes in reset operation are configured via object 1111.13 (C3Plus.POSITION_direction):

Mode	Value	IEC constant
All directions	0	C3_all_direction
Positive direction	1	MC_positive_direction
Shortest path	2	MC_shortest_way
Negative direction	3	MC_negative_direction
Actual direction	4	MC_current_direction

Setting the desired value must take place in the IEC initialization routine, as a configuration download by the C3 ServoManager would reset the value to 0 (due to downwards compatibility).

Example:

C3Plus.POSITION_direction:=MC_Direction_Positive;

Examples in the help file

In the help file you can find examples for the functioning of the individual positioning modes.

5.5.2.2 Description of jerk

Jerk

The jerk (marked with “4” in the drawing below) describes the change in acceleration (derivation of the acceleration)

The maximum change in acceleration is limited via the jerk limitation.

A motion process generally starts from a standstill, accelerates constantly at the specified acceleration to then move at the selected speed to the target position. The drive is brought to a stop before the target position with the delay that has been set in such a manner as to come to a complete stop at the target position. To reach the set acceleration and deceleration, the drive must change the acceleration (from 0 to the set value or from the set value to 0).

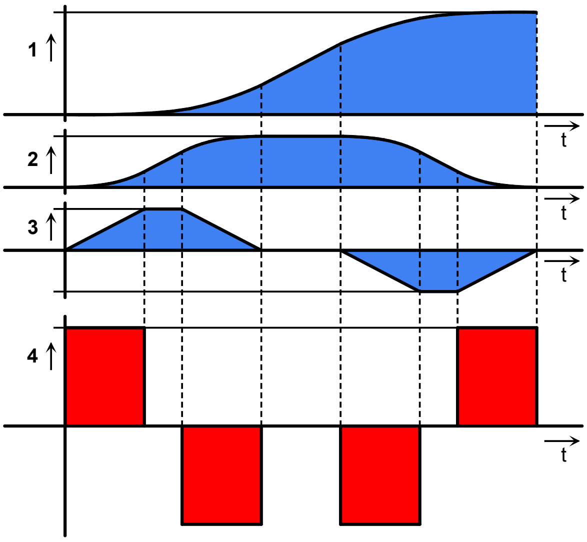
This change in speed is limited by the maximum jerk.

Without jerk according to VDI2143

According to VDI2143 the jerk is defined (other than here) as the jump in acceleration (infinite value of the jerk function).

This means that positionings with Compax3 are without jerk according to VDI2143, as the value of the jerk function is limited.

Motion sequence



1: Position

2: Speed

3: Acceleration

4: Jerk

High changes in acceleration (high jerks) often have negative effects on the mechanical systems involved. There is a danger that mechanical resonance points will be excited or that impacts will be caused by existing mechanical slack points.

You can reduce these problems to a minimum by specifying the maximum jerk.

5.5.3. Relative positioning (MC_MoveRelative)

FB name	**MC_MoveRelative**	
Relative positioning by a specified distance.		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Distance	REAL	Relative distance of the movement to be executed (configured unit [units]) **<Wertebereich>**[12]
Velocity	REAL	Value of the maximum speed (always positive) (not necessarily reached) **[units/s**[13]] **<Wertebereich>**[14]
Acceleration	DINT	Value of acceleration (always positive)[**Units/s²**[15]] **<Wertebereich>**[16]
Deceleration	DINT	Value of deceleration (always positive) [**Units/s²**[17]] **<Wertebereich>**[18]
Jerk	DINT	Value of the acceleration **jerk** (see on page 316) [**Units/s³**[19]] (always positive) **<Wertebereich>**[20]
JerkDecel	DINT	Value of the deceleration jerk [**Units/s³**[21]] (always positive) **<Wertebereich>**[22]
VAR_OUTPUT		
Done	BOOL	Specified setpoint distance on the setpoint generator output is reached
CommandAborted	BOOL	Positioning aborted
Error	BOOL	Error while executing module
Note: ◆ In the case of dynamic positioning (module is called during a positioning process) the specified position is added to the current actual position. ◆ Continuous operation can be selected via object 1111.8 "C3Plus.Position_restposition_mode" <> 0; setpoint value and actual value are then set to 0 before each positioning. ◆ You can optimize the motion profile data with the **"ProfilViewer"** (see on page 287) software tool!		

---

[12] Target position: -4000000 rev...4000000 rev

[13] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[14] Speed for positioning: 0.00001157 rev/s...2000 rev/s

[15] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[16] Acceleration for positioning 0.24 rev/s² ...100000 rev/s²

[17] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

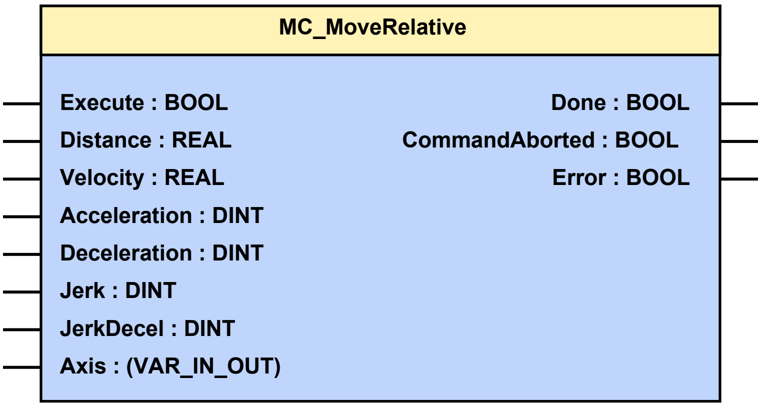
[18] Deceleration for positioning:0.24 rev/s² ...1000000 rev/s²

[19] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[20] Acceleration jerk for positioning:30 rev/s³ ...125000000 rev/s³

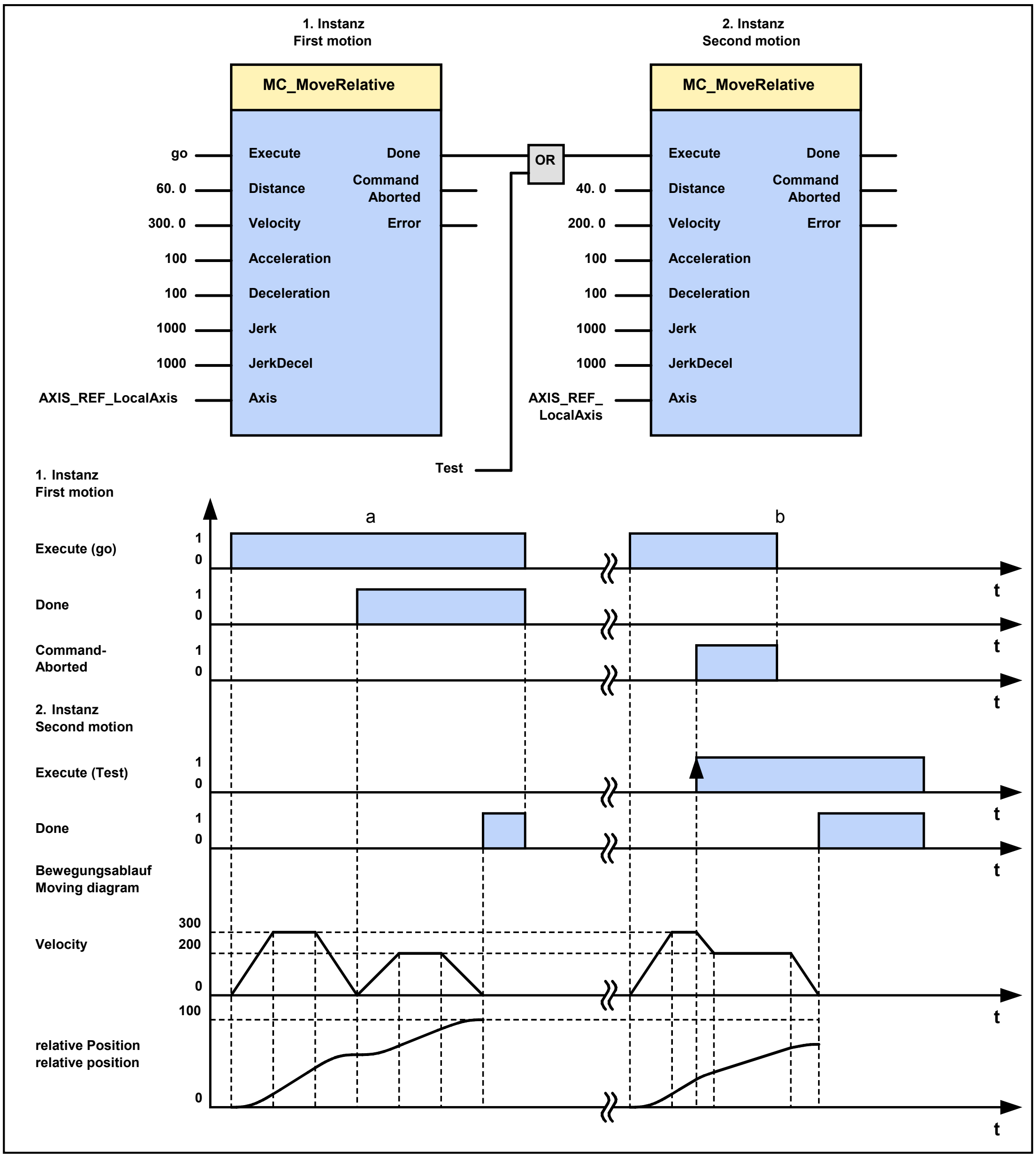
[21] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[22] Deceleration jerk for positioning:30 rev/s³...125000000 rev/s³


MC_MoveRelative
Execute : BOOL
Distance : REAL
Velocity : REAL
Acceleration : DINT
Deceleration : DINT
Jerk : DINT
JerkDecel : DINT
Axis : (VAR_IN_OUT)
Done : BOOL
CommandAborted : BOOL
Error : BOOL

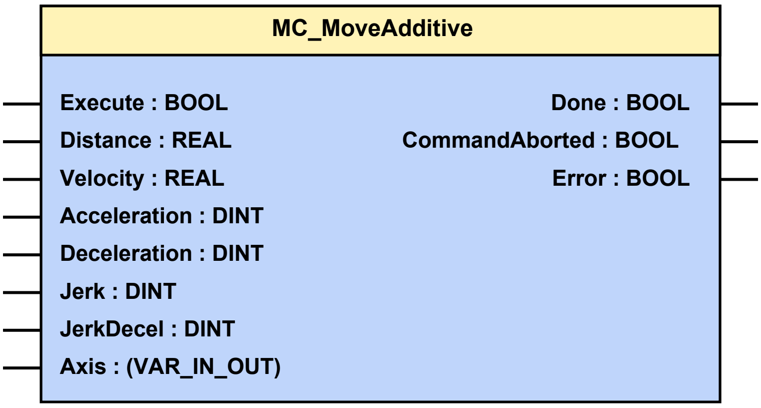
The following illustration shows two examples of the combination of two MC_MoveRelative modules.

- The left part (a) of the time diagram shows a case in which the second function module is executed after the first function module.
  If the first function module has reached 60 units, the "Done" output gives the execution command to the second function module, which then moves an addition 40 units.
- The right part (b) of the diagram shows a case in which the second function module is activated while the first function module is being executed. Because the second module is started during the execution of the first function module, the first function module is automatically interrupted.
  The second function module immediately moves an additional 40 units whether or not the 60 units of the first function were already reached.



5.5.4. Additive positioning (MC_MoveAdditive)

FB name	**MC_MoveAdditive**	
Adds a relative distance to the target position of a positioning process in progress.		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Distance	REAL	Relative distance **<Wertebereich>**[23]
Velocity	REAL	Value of the maximum speed (always positive) (not necessarily reached) **[units/s**[24]] **<Wertebereich>**[25]
Acceleration	DINT	Value of acceleration (always positive)[**Units/s**^{2}[26]] **<Wertebereich>**[27]
Deceleration	DINT	Value of deceleration (always positive) [**Units/s**^{2}[28]] **<Wertebereich>**[29]
Jerk	DINT	Value of the acceleration **jerk** (see on page 316) [**Units/s**^{3}[30]] (always positive) **<Wertebereich>**[31]
JerkDecel	DINT	Value of the deceleration jerk [**Units/s**^{3}[32]] (always positive) **<Wertebereich>**[33]
VAR_OUTPUT		
Done	BOOL	Specified distance has been reached
CommandAborted	BOOL	Positioning aborted
Error	BOOL	Error during positioning
Note: In the case of dynamic positioning (module is called during a positioning process) the specified position is added to the current target position.		



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[23] Target position: -4000000 rev...4000000 rev

[24] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[25] Speed for positioning: 0.00001157 rev/s...2000 rev/s

[26] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[27] Acceleration for positioning 0.24 rev/s² ...100000 rev/s²

[28] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[29] Deceleration for positioning:0.24 rev/s² ...1000000 rev/s²

[30] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

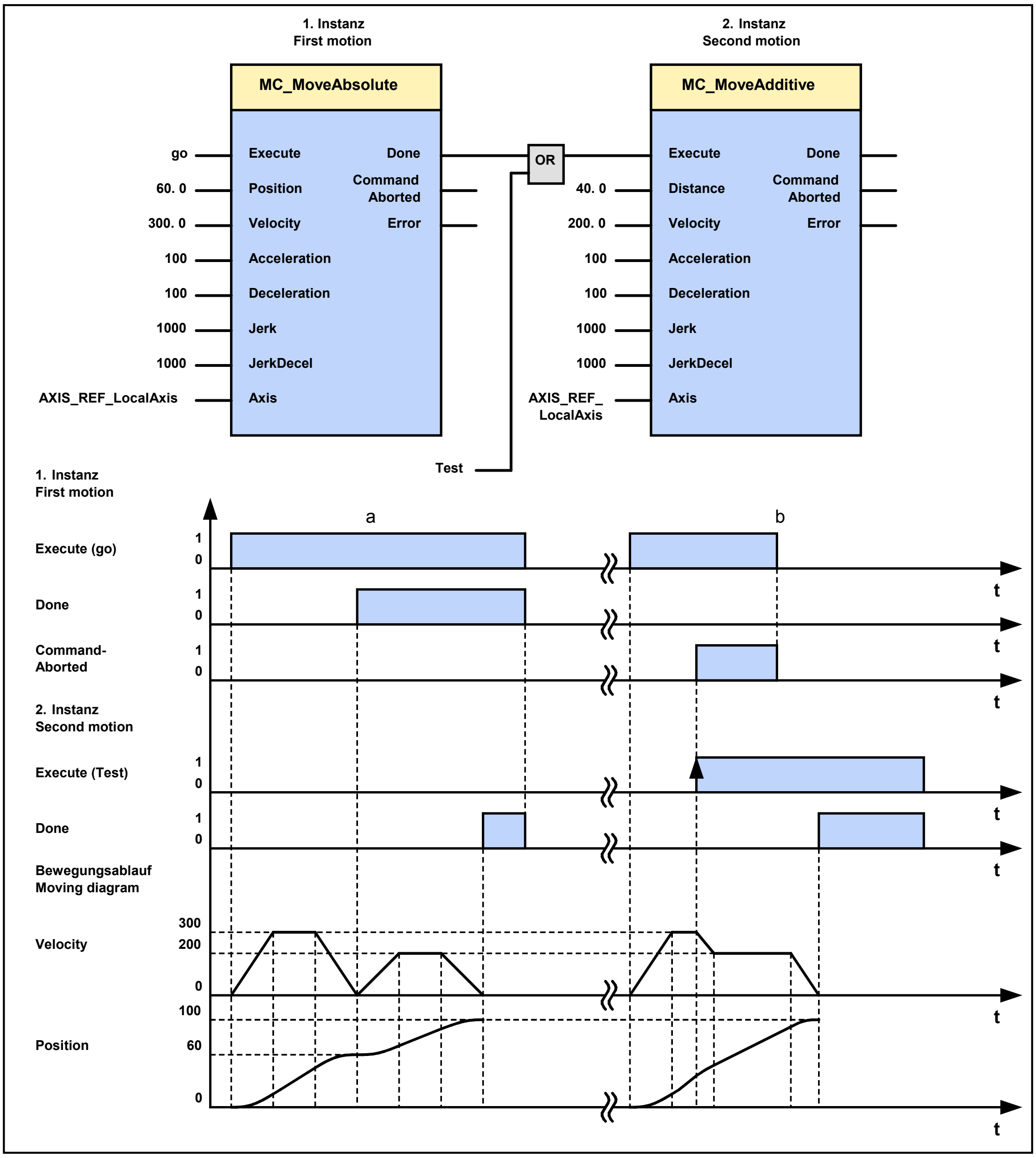
[31] Acceleration jerk for positioning:30 rev/s³ ...125000000 rev/s³

[32] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[33] Deceleration jerk for positioning:30 rev/s³...125000000 rev/s³

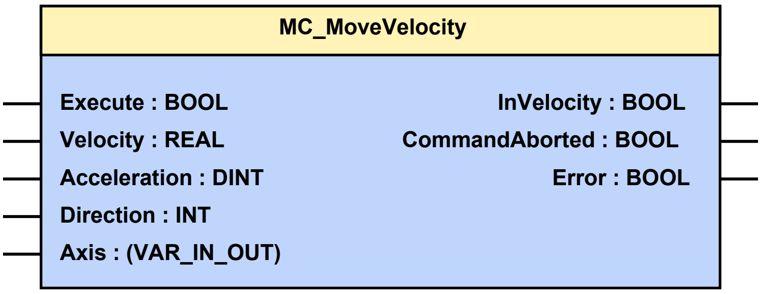
The following illustration shows two examples of the combination of a MC_MoveAbsolute and an MC_MoveAdditive module.

- The left part (a) of the time diagram shows a case in which the second function module is executed after the first function module.
  After the first function module has traveled to Position 60, the "Done" output gives the execution command to the second FB, which then moves on another 40 units.
- The right part (b) of the diagram shows a case in which the second function module is activated while the first FB is being executed. Because the second module is started during the execution of the first FB, the first FB is automatically interrupted.
  The second function module adds the missing units that are still lacking for the first module and the moves an additional 40 units with the new predefined settings.



5.5.5. Endless positioning (MC_MoveVelocity)

FB name	**MC_MoveVelocity**	
Endless controlled positioning with adjustable speed		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Velocity	REAL	Value of the maximum speed (always positive) [**Units/s**[34]] Range of values: 0 rev/s ... 2000 rev/s
Acceleration	DINT	Value of the acceleration and deceleration (always positive) [**Units/s²**[35]] Range of values: 0.24 rev/s² ... 1000000 rev/s²
Direction	INT	Selection: positive direction, negative direction, current direction; **library constants** (see on page 298)
VAR_OUTPUT		
InVelocity	BOOL	Specified target speed on the setpoint output is reached
CommandAborted	BOOL	Execution interrupted
Error	BOOL	Error during positioning
Note: ◆ To be able to stop the drive, the function module must be interrupted by another positioning function module or positioning must be stopped by calling the MC_Stop function module. ◆ A positioning to the end limit follows.		



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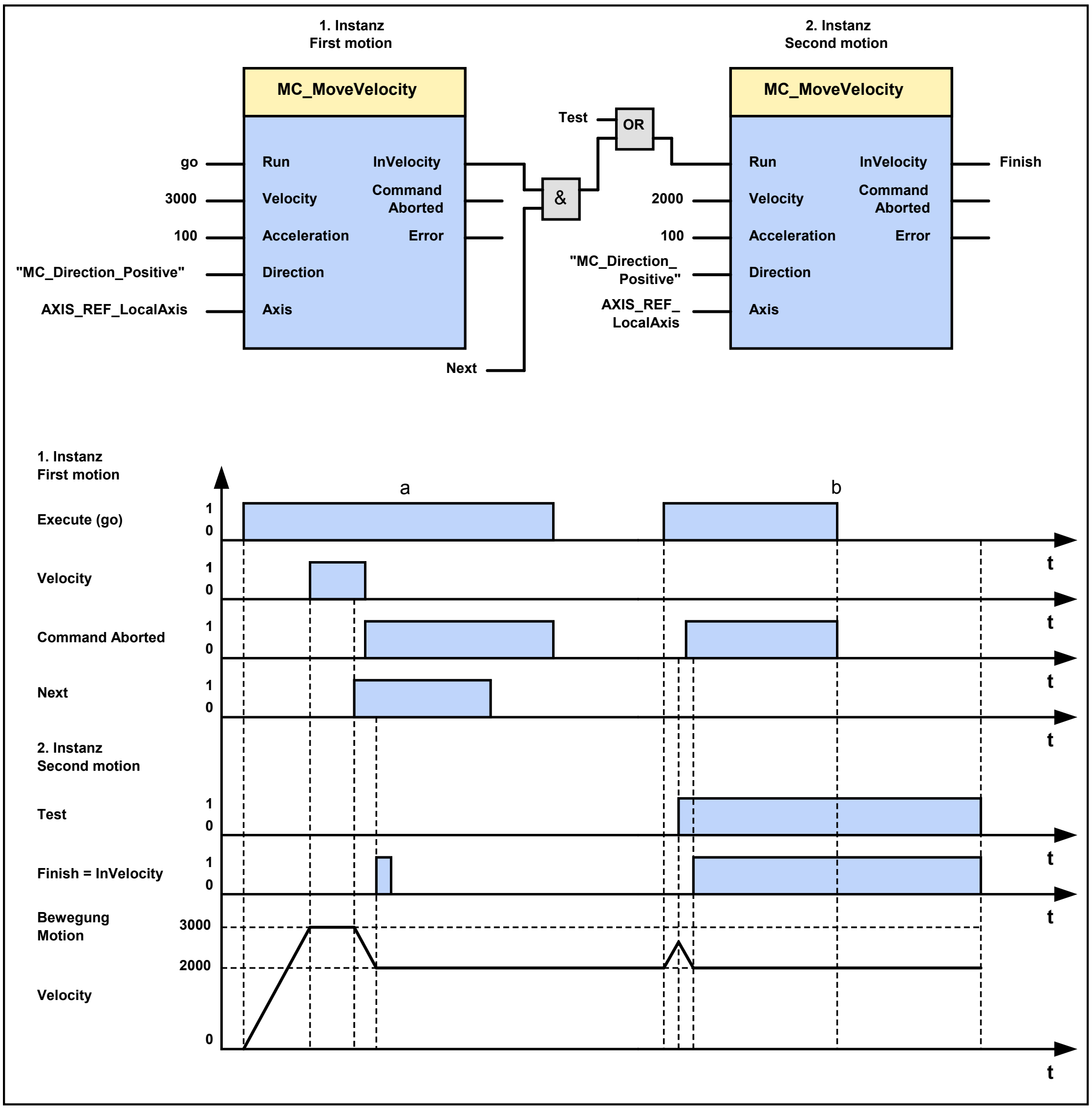
[34] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[35] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

Example

The following illustration shows two examples of the combination of two MC_MoveVelocity modules.

- The left part (a) of the time diagram shows a case in which the second function module (block) is executed after the first function module.
After the first function module has accelerated to a speed of 3000, the "InVelocity" output, AND-linked with the "Next" signal issues the execution command to the second FB, which then slows to a speed of 2000.
- The right part (b) of the diagram shows a case in which the second FB is activated while the first function module is being executed. Because the second module (block) is started during the execution of the first FB, the first FB is automatically interrupted.
During the acceleration of the first module (block), the second module slows again similarly to a speed of 2000 without the speed of the first module having been reached.

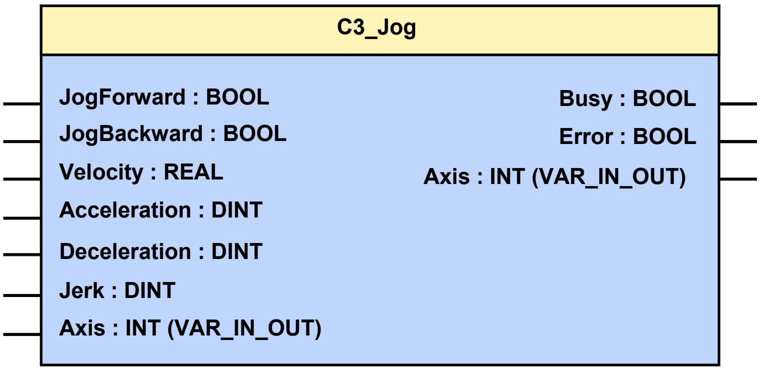


5.5.6. Manual operation (C3_Jog)

FB name	**C3_Jog**	
Traveling along the axis in manual mode (in the "standstill" state)		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
JogForward	BOOL	JogForward = TRUE makes the axis move in positive direction.
JogBackward	BOOL	JogBackward = TRUE makes the axis move in negative direction.**<Wertebereich>**[36]
Velocity	REAL	Speed value [**Units/s**[37]]**<Wertebereich>**[38]
Acceleration	DINT	Value of the acceleration [**Units/s^2**[39]]**<Wertebereich>**[40]
Deceleration	DINT	Value of deceleration with stop [**Units/s^2**[41]]**<Wertebereich>**[42]
Jerk	DINT	Value of the acceleration and deceleration **jerk** (see on page 316) [**Units/s^3**[43]] **<Wertebereich>**[44]
VAR_OUTPUT		
Busy	BOOL	Module is active (manual operation in progress)
Error	BOOL	Error during manual operation or faulty parameter when starting manual operation

Note:

- The axis must be in the "standstill" state in order to start manual operation (Jogging Mode).
- Start: When starting manual operation, the output Busy is set to TRUE.
- Stop: The axis is brought to a standstill if the respective input (JogForward or JogBackward) is set to FALSE again
- As soon as manual operation is stopped, the output Busy is set to FALSE. Further commands can only be executed after this feedback.



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[36] Target position: -4000000 rev...4000000 rev

[37] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[38] Speed for positioning: 0.00001157 rev/s...2000 rev/s

[39] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[40] Acceleration for positioning 0.24 rev/s^2 ...100000 rev/s^2

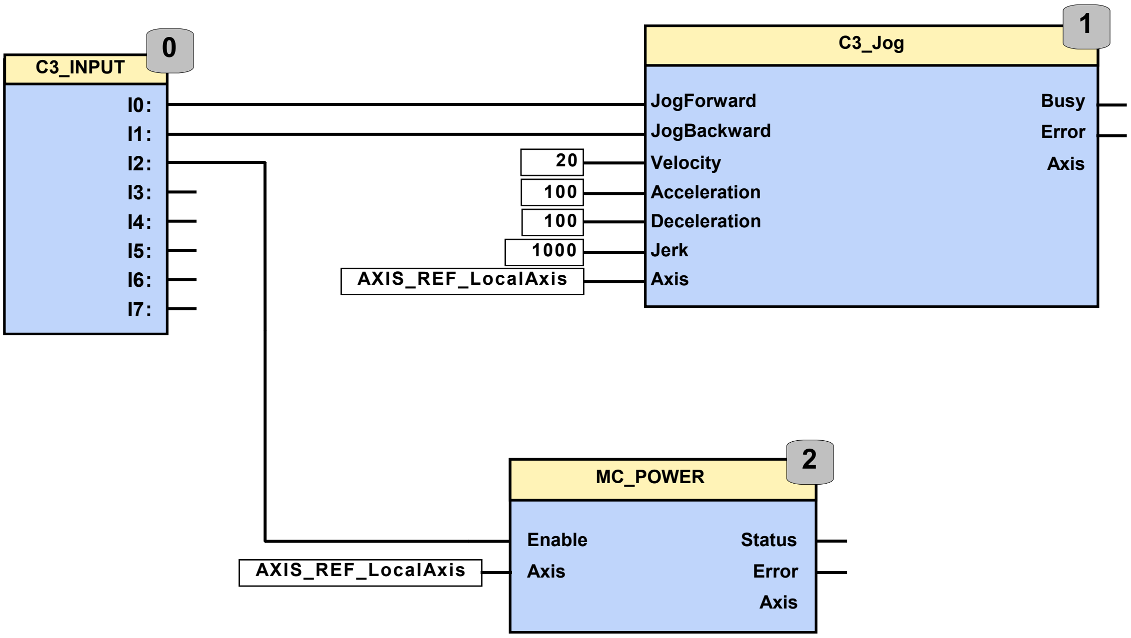
[41] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[42] Deceleration for positioning:0.24 rev/s^2 ...1000000 rev/s^2

[43] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[44] Acceleration jerk for positioning:30 rev/s^3 ...125000000 rev/s^3

Example: Manual movement via digital inputs.



5.5.7. Machine zero (MC_Home)

FB name	**MC_Home**	
Predefined search for the machine reference point		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Position	REAL	Position on the machine zero point (configured unit [units]) = **Machine zero Offset**
VAR_OUTPUT		
Done	BOOL	Referencing process completed
CommandAborted	BOOL	Referencing process aborted
Error	BOOL	Error while searching for machine reference point

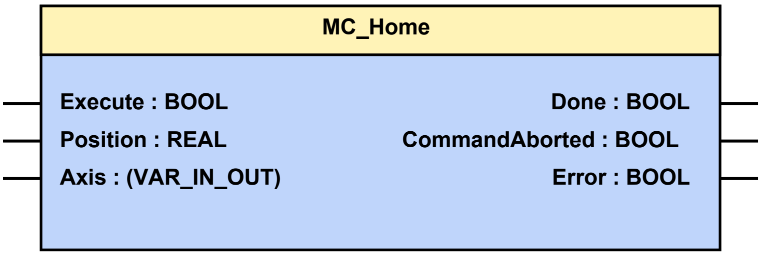
Note:

This module gives the command to search for the machine reference point; not for "zero" position. The type of search function (machine reference mode) can be adjusted with the configuration or with the object "HOMING_mode" (Object 1130.4).

.

Objects that are connected with the machine reference point:

◆ C3Plus.HOMING_speed (Object 1130.3)
◆ C3Plus.HOMING_accel (Object 1130.1)
C3Plus.HOMING_mode (Object 1130.4)
◆ C3Plus.HOMING_edge_sensor_distance (Object 1130.7)



The Compax3 machine zero modes are adapted to the CANopen profile for Motion Control CiADS402.

Position reference point

Essentially, you can select between operation with or without machine reference.

The reference point for positioning is determined by using the machine reference and the machine reference offset.

Machine reference run

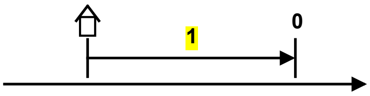
In a homing run the drive normally moves to the position value 0 immediately after finding the home switch. The position value 0 is defined via the homing offset.

A machine reference run is required each time after turning on the system for operation with machine reference.

Please note:

During homing run the software end limits are not monitored.

Machine reference offset



1: Machine Zero point

The machine reference offset is used to determine the actual reference point for positioning.

That is: Machine zero point = - Machine zero Offset

A change in the machine reference offset does not take effect until the next machine reference run.

5.5.8. Electronic gearbox (MC_GearIn)

FB name	**MC_GearIn**	
Controlled speed and position synchronicity with adjustable transmission ratio		
VAR_IN_OUT		
Master	INT	Constant for the **master signal source** (see on page 298) **Configuration** (see on page 153) of the signal sources
Sub	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
RatioNumerator	REAL	Transmission ratio of numerator
RatioDenominator	INT	Transmission ratio of denominator
Acceleration	DINT	Value of acceleration / deceleration (always positive) until the synchronism is reached [Units/s^2] **<Wertebereich>**[45]
VAR_OUTPUT		
InGear	BOOL	Synchronicity achieved

CommandAborted	BOOL	Command aborted
		◆ The device is not ready to operate when the Execute is issued
		◆ Another module of the MC_GearIn has interrupted (in gear operation or quasi in parallel in the same IEC cycle)
		◆ The gear command was not accepted by the setpoint generator because
		  ◆ The selected master source was not configured (signal source)
		  ◆ The command cannot be accepted in the current device status (not "standstill powered", "Discrete Motion", "Continuous Motion" or "Synchronized Motion"
		  ◆ The nominator of the gear factor (O1141.1) equals zero

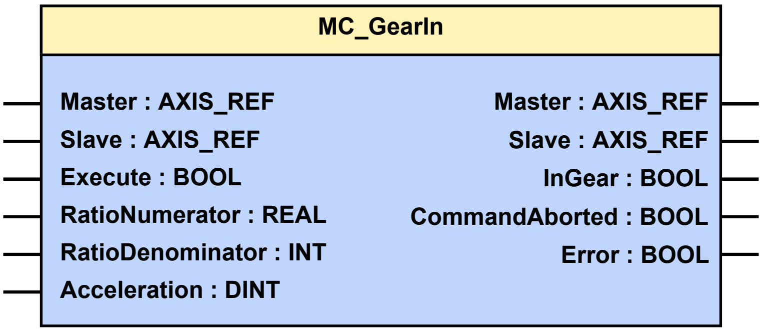
Error	BOOL	Error while executing module: ◆ Input Slave unequal AXIS_REF_LocalAxis ◆ Input Acceleration smaller than or equal to zero ◆ Input RatioDenumerator equals zero ◆ Input Master unequal to AXIS_REF_Physical, AXIS_REF_HEDA or AXIS_REF_Virtual (only T40) ◆ The device changes to "Error Stop" error status while gearing is running

---

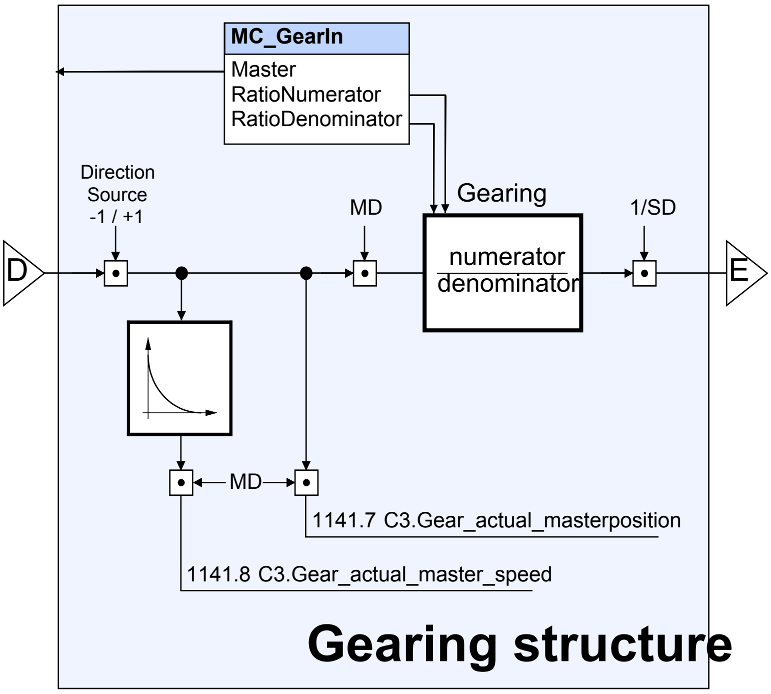
[45] Acceleration for positioning 0.24 rev/s^2 ...100000 rev/s^2

Note:

- Behavior: The drive accelerates (with Acceleration) until the master speed is reached - the module will report synchronicity with "InGear". Position losses during acceleration to master speed are not made up.
- The transmission ratio can be changed at any time with a positive edge on Execute. InGear is reset until synchronicity is achieved again.
- For example, if speed synchronicity is not achieved because of limiting effects, the position difference that arises will be made up (by the active position controller).
- Acceleration / deceleration to the set transmission ratio takes place without a jerk limit.
- If the master and slave units do not correspond, this fact must be considered for the transmission ratio.
- **Example** (see on page 154)



Structure of the "electronic cam" function

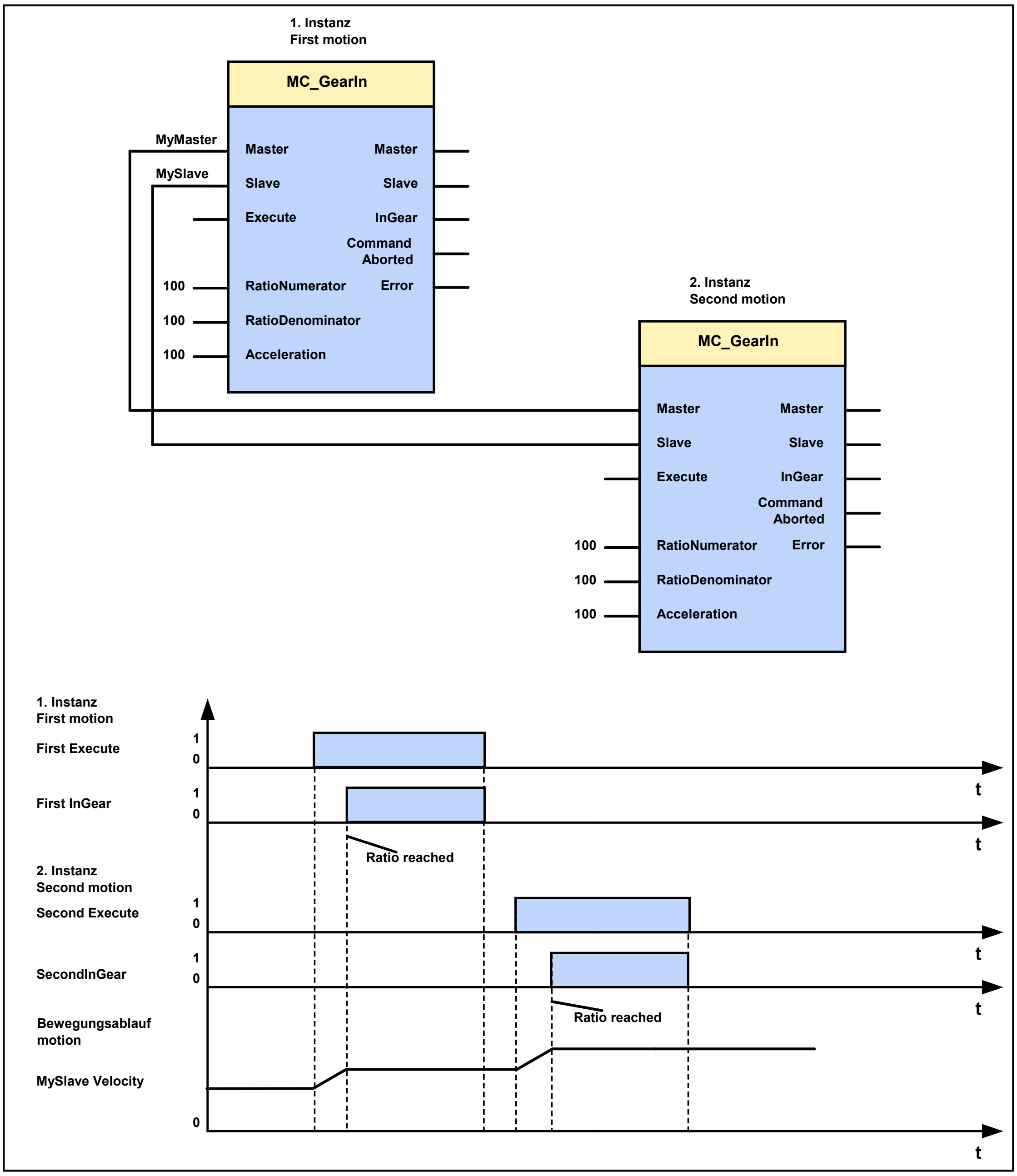


D: / E: **additional structure** (see on page 237)

Note:

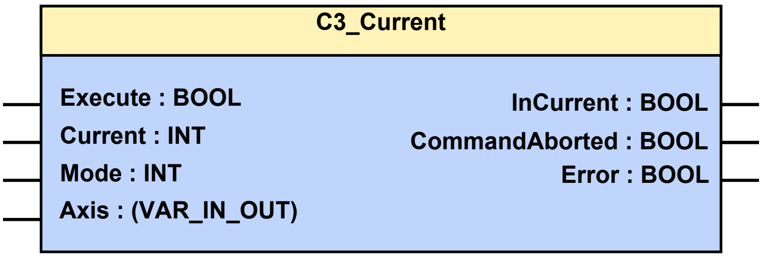
- Direction -1 / +1 with direction reversal (under signal source configuration) factor -1 is applied.
- The "virtual master" source is not available with Compax3 T30.

Example:


1. Instanz
First motion
MC_GearIn
MyMaster
MySlave
Master
Slave
Execute
100
100
100
RatioNumerator
RatioDenominator
Acceleration
Master
Slave
InGear
Command Aborted
Error
2. Instanz
Second motion
MC_GearIn
Master
Slave
Execute
100
100
100
RatioNumerator
RatioDenominator
Acceleration
Master
Slave
InGear
Command Aborted
Error
1. Instanz
First motion
First Execute
First InGear
Ratio reached
2. Instanz
Second motion
Second Execute
SecondInGear
Ratio reached
Bewegungsablauf motion
MySlave Velocity
1
0
t

5.5.9. Current setting operation (C3_Current)

FB name	**C3_Current**	
Current control. Speed and position controllers are switched off. The system controls to the specified current. The current setting can be made with the module input or with an analog input.		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Current	INT	Current to be set in [mA]
Mode	INT	0 = The current read during Execute on the Current input is set. 3 = After Execute, the Current input is read again in each cycle and the corresponding current is set (Execute must be permanently present for this mode).
VAR_OUTPUT		
InCurrent	BOOL	Specified current set
CommandAborted	BOOL	Command aborted
Error	BOOL	Error
Note: ◆ The current feedforward (optimization parameter) is set to 100% to operate C3_Current. ◆ The status “current control” must be aborted with MC_Stop before new positionings are possible.		



5.5.10. Torque / force control (C3_TorqueControl)

FB name	**C3_TorqueControl**	
Torque / force control with speed limitation The module can be started from the "Discrete Motion" and "Continuous Motion" states. The position control is deactivated during this operating mode.		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge
Torque	DINT	Command torque [mNm] or command force [mN] (limit value, not necessarily reached) If the configured velocity setpoint value is reached, the drive will move at this speed. The torque or force setpoint value is not reached.
TorqueRamp	DINT	Value of the torque-force ramp (always positive) [mNm/s] [mN/s]
Velocity	REAL	Value of the maximum speed (always positive) (not necessarily reached) **[units/s**[46]] **<Wertebereich>**[47] If the command torque or the command force is not reached, the drive will move with this speed.
Acceleration	DINT	Value of maximum acceleration (always positive) [**Units/s^2**[48]] **<Wertebereich>**[49]
Deceleration	DINT	Value of maximum deceleration (always positive) [**Units/s^2**[50]] **<Wertebereich>**[51]
Direction	INT	Selection of the permitted direction (positive direction "MC_Direction_Positive" or negative direction "MC_Direction_Negative") (library constant) The movement into the other direction is blocked, a speed of 0 is commanded!
VAR_OUTPUT		
InTorque	BOOL	Specified torque or specified force (setpoint or limitation value) reached
CommandAborted	BOOL	Module sequence is interrupted
Error	BOOL	Error while executing module

---

[46] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[47] Speed for positioning: 0.00001157 rev/s...2000 rev/s

[48] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

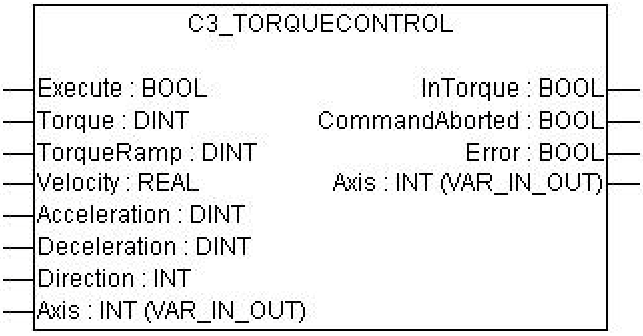
[49] Acceleration for positioning 0.24 rev/s^2 ...100000 rev/s^2

[50] The unit "increments" is valid only for position values!Speed, acceleration and jerk are specified in this case in revolutions/s, revolutions/s2 and revolutions/s3 (resp. pitch/s, pitch/s2, pitch/s3 for linear motors).

[51] Deceleration for positioning:0.24 rev/s^2 ...1000000 rev/s^2

Note:

- The movement is limited by the set maximum speed or by the command torque/command force.
- The setpoint values for velocity, acceleration and deceleration are always positive.
  The direction of movement depends on the Direction Input.
- The torque ramp “TorqueRamp” must always be entered as a positive value. The force direction results from the sign of the “Torque” torque/force setpoint value.
- There is no torque/force acquisition. Actual torque or actual force is acquired from the quadrature current and the motor parameters.
- Behavior on
  - Stop: (MC_Stop) => immediate switching to position control; this means entire torque (or entire force)!
  - C3 Fehler => depending on the error reaction (1) switching to position control, this means entire torque (or entire force)!
  - Change from positioning to velocity control (MC_MoveVelocity) in torque/force control => Torque/force limitation value is equal to the torque/force setpoint value, output “InTorque” is immediately set.
- The module can also be used for defined braking, e.g. for unwinders.
  - The command torque or the command force has then the opposite sign than the direction
  - If there is no counter torque or no counter force, so that braking is not possible, the drive will decelerate to 0 in a torque/force controlled manner.



5.6 Superimposed motion

In this chapter you can read about:

5.6.1. Dynamic positioning

Dynamic positioning processes can be performed with the modules MC_MoveAbsolute, MC_MoveRelative and MC_MoveAdditive. The speed can be altered dynamically with MC_MoveVelocity.

In the state: "Discrete Motion"

If another, second positioning process is activated in the "**Discrete Motion** (see on page 299)" state, Positioning activated, then the 1st. Positioning is aborted. The transition to the new destination occurs dynamically, i.e. without any intervening stop.

In "Continuous Motion" state

If a positioning process (MC_MoveAbsolute, MC_MoveRelative or MC_MoveAdditive) or a MC_MoveVelocity is activated in the "**Continuous Motion** (see on page 299)" state, the active function module will then be interrupted. All input variables of the new positioning process will then be taken over.

Superimposed positioning

Please note also the difference to **superimposed positioning** (see on page 335) with C3_MoveSuperImposed.

Here, the movement of the active function module is executed until the end.

5.6.2. Superimposed positioning (C3_MoveSuperImposed)

FB name	**C3_MoveSuperImposed**	
Temporal superimposing of an active positioning with an additional relative distance. Depending on the operating mode, the motion parameters can be changed during a movement. The positioning process that is currently underway is not interrupted by C3_MoveSuperImposed; it is superimposed instead.		
VAR_IN_OUT		
Axis	INT	Axis ID; constant: AXIS_REF_LocalAxis
VAR_INPUT		
Execute	BOOL	Starts the sequences of the module with positive edge. In the "SUPERIMPOSED_ABSOLUTE_CONT" mode, the module inputs are read, as long as "Execute" remains "TRUE".
Distance	REAL	Distance for the superimposed Positionierung (positive and negative direction). During a superimposed Positionierung in ◆ "SUPERIMPOSED_ABSOLUTE" ◆ "SUPERIMPOSED_ABSOLUTE_CONT" the "distance" is considered to be an absolute Lageziel with reference to the start position of the superimposed Positionierung (point in time of the first rising "Execute" edge where no superimposed positioning is active). For details please refer to input "Mode". In configured unit [Units] **<Wertebereich>**[52]
Velocity	REAL	Value of the max. speed difference to the speed of the actual Positionierung (always positive) (is not necessarily attained) [Units/s] **<Wertebereich>**[53] In the "SUPERIMPOSED_RELATIVE" operating mode, the specification of a speed <=zero is not permitted. In the other operating modes, a negative value will be set to 0.
Acceleration	DINT	Value of acceleration (always positive)[Units/s²] **<Wertebereich>**[54]
Deceleration	DINT	Value of deceleration (always positive) [Units/s²] **<Wertebereich>**[55]
Jerk	DINT	Value of the acceleration **jerk** (see on page 316) [Units/s³] (always positive) **<Wertebereich>**[56]
JerkDecel	DINT	Value of the deceleration jerk [Units/s³] (always positive) **<Wertebereich>**[57]

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[52] Target position: -4000000 rev...4000000 rev

[53] Geschwindigkeit für Positionierung: 0; 0,00001157 Umd/s...2000 Umd/s

[54] Acceleration for positioning 0.24 rev/s² ...100000 rev/s²

[55] Deceleration for positioning:0.24 rev/s² ...1000000 rev/s²

[56] Acceleration jerk for positioning:30 rev/s³ ...125000000 rev/s³

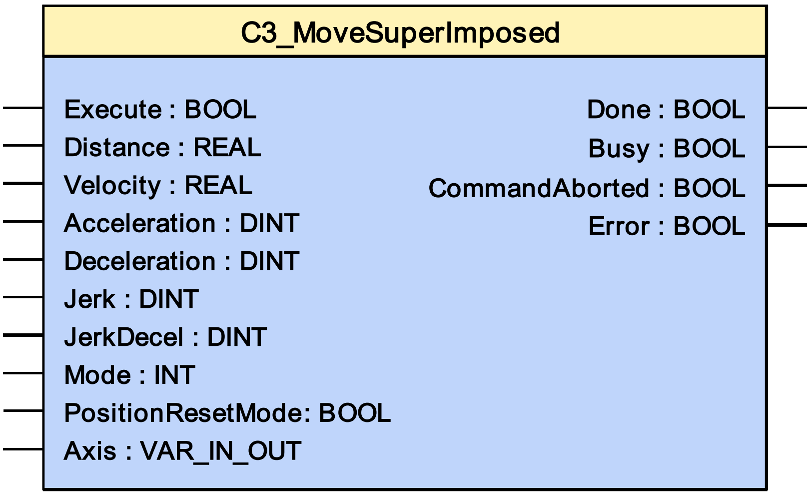
[57] Deceleration jerk for positioning:30 rev/s³...125000000 rev/s³

Mode	INT	**Open or "SUPERIMPOSED_RELATIVE":** With a rising edge on the Execute, a relative superimposed Positionierung, based on the value on input "Distance" is executed at that point in time (this does also apply if a superimposed Positionierung is already active. **"SUPERIMPOSED_ABSOLUTE":** Upon a **not active superimposed Positionierung**, a relative Positionierung starts on the "Execute" with a rising edge. With a rising edge on the "Execute" **during an active superimposed Positionierung** (output "Busy" is set), the Positionierungdistance based on the start points of the superimposed Positionierung is interpreted to be absolute. **"SUPERIMPOSED_ABSOLUTE_CONT":** corresponds to the "SUPERIMPOSED_ABSOLUTE" mode, the module inputs in each IEC cycle for the effective superimposed Positionierung are however accepted. **ATTENTION!** PositionResetMode = "TRUE" may only be used as from Compax3-Firmware R09-0! **Hint** The "SUPERIMPOSED_RELATIVE" operating mode corresponds to the function of the formerly used MC_MoveSuperImposed module
PositionResetMode	BOOL	**Open or "FALSE":** The demand position O680.3 (DemandValue3) is not reset. **"TRUE"**: With each new Positionierung (rising edge on "Execute"), the Lageziel O680.3 (DemandValue3) is reset to zero. **ATTENTION!** PositionResetMode = "TRUE" may only be used as from Compax3-Firmware R09-0!
VAR_OUTPUT		
Done	BOOL	Additional distance was added to the current positioning
Busy	BOOL	Superimposed motion is performed
CommandAborted	BOOL	Positioning aborted
Error	BOOL	Error while executing module

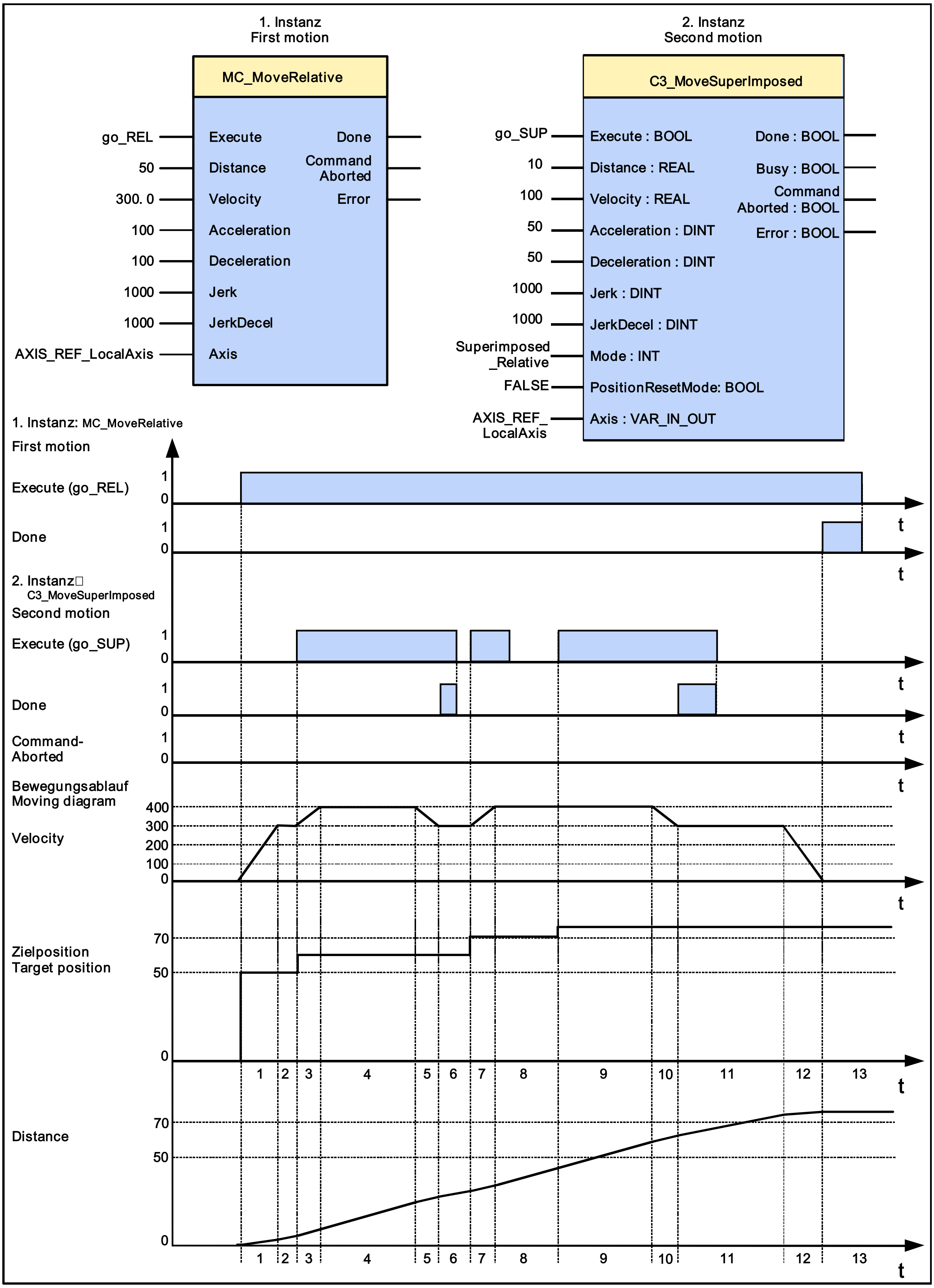
Notes:

- The values Velocity, Acceleration, Deceleration, Jerk, JerkDecel are only valid for the superimposed movement. The values resulting from the superimposition will set on the axis, which is not taken into consideration for the status values .
- Upon a MC_Stop of the local axis (AXIS_REF_LocalAxis), the movement in progress as well as the superimposed movement are interrupted.
  The module C3_StopSuperImposed does only interrupt the superimposed movement.
- The module can also be operated in the PLCopen "Standstill" state .
- The module does not interrupt any active command.
- "Position reached" (Object 420.6) is not influenced by the additional movement caused by C3_MoveSuperImposed.

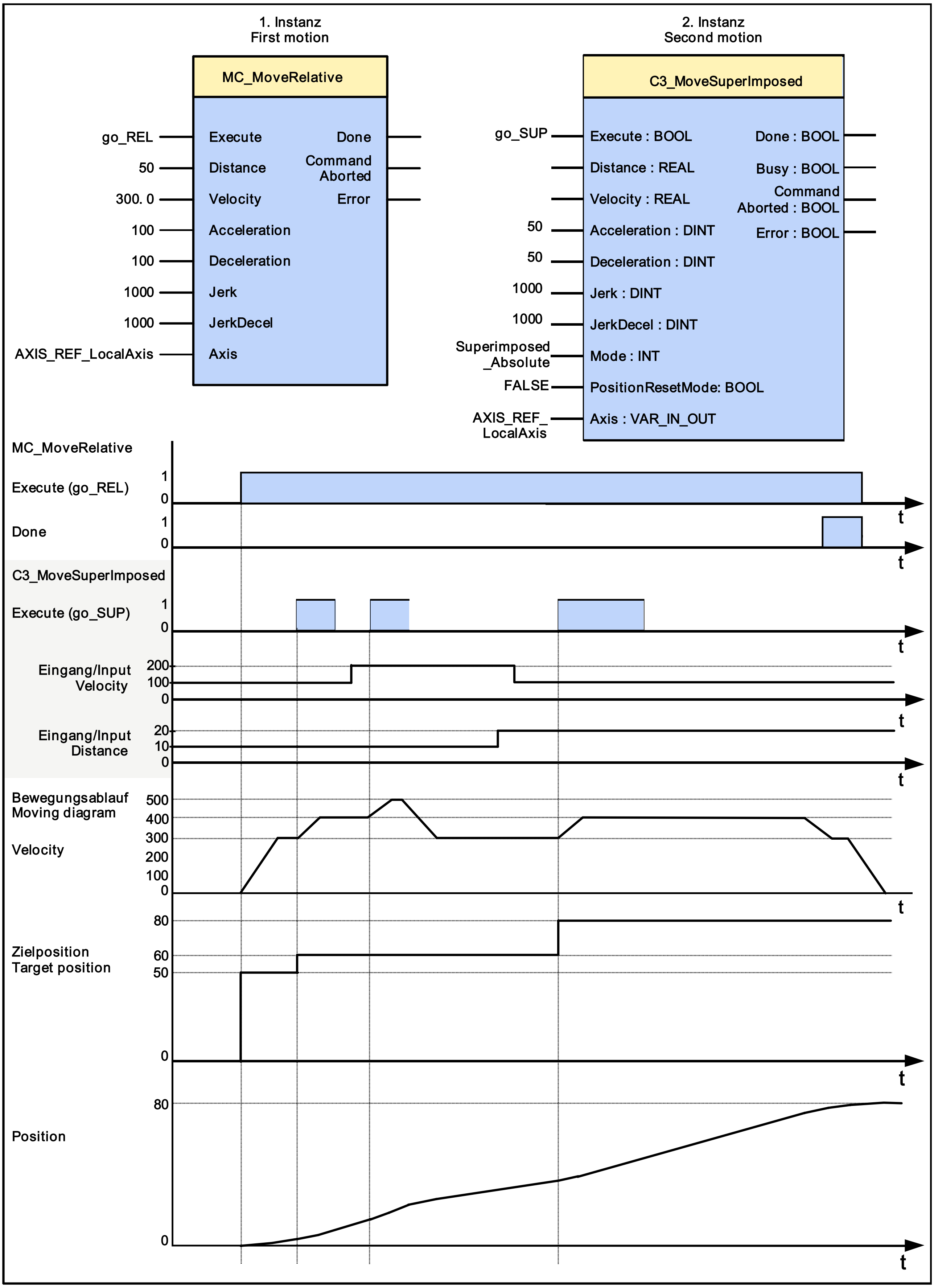
- This module cannot be operated with C3_ShiftPosition and MC_/C3_Phasing at a time.
- It is possible to change modes (“Mode”) during a superimposed Positionierung in progress.
- If a second instance is activated in an active module with “Execute”, the instance in progress is aborted (“CommandAborted” output is set) and the second second instance acts as upon a new start of a superimposed Positionierung).
- With a falling edge on the “Execute” in the SUPERIMPOSED_ABSOLUTE_CONT” mode, the positioning is aborted upon a zero “Velocity” specification (if the überlagterte_Geschwindigkeit has reached zero) , as it can never reach its target.
- Frequent changes of the Lageziel within a superimposed Positionierung may lead to imprecisions in the Positionierung in the “PositionResetMode” input is not set to “TRUE”!
- In the "SUPERIMPOSED_ABSOLUTE_CONT” mode, the sum of the specified motion parameters is internally calculated; positive value monitoring takes only place once with each rising “Execute” edge.
- If the speed is reduced to zero at the end of a Positionierung during setpoint generation, no new values for speed, deceleration and jerk are accepted in the absolute operating modes “SUPERIMPOSED_ABSOLUTE” or "SUPERIMPOSED_ABSOLUTE_CONT" with unchanged Lageziel (input "Distance".
- The position of the module in the **structure image** (see on page 542).
- The output "error" is reported if
  - the axis is in an impermissible state with a rising edge at the “Execute” input (not active, in error state, during reference run, stops or is in stop state (MC_Stop))
  - The superimposed movement stops or was stopped (by C3_StopSuperImposed) with a rising edge on the “Execute” input
  - The module was issued with invalid parameters (“Velocity” <= 0 in "Mode" SUPERIMPOSED_RELATIVE), acceleration values or jerks <= 0, input “Axis” unequal to “AXIS_REF_LOCALAXIS”, invalid operating mode (“Mode”)) upon a rising edge on the “Execute” input
  - An attempt to start the module (rising edge on the “Execute” input) is made during another superimposed movement (C3_ShiftPosition, MC_/C3_Phasing).
  - The axis changes into error state during a superimposed movement in progress
- The “CommandAborted” output is reported if an interruption of the superimposed Positionierung occurred caused by
  - another module instance
  - Stops the superimposed movement by stop on the axis (MC_Stop)
  - Stops the superimposed movement (C3_StopSuperImposed)
- superimposed speed zero with falling edge on the “Execute” of the superimposed positioning is not yet completed in the "SUPERIMPOSED_ABSOLUTE_CONT” mode or if the superimposed travel command was rejected by the firmware.



Example 1 Mode Superimposed_Relative



Example 2 Mode Superimposed_Absolute



5.6.3. Zero point shift caused by superimposed positioning (C3_ShiftPosition)

FB name	**C3_ShiftPosition**	
Time-related shifting of the reference point by an additional relative distance. Depending on the operating mode, the motion parameters can be changed during a movement. The system zero point shifts by the stated distance. The drive performs a physical movement, this is however not displayed. The positioning being executed at that time is not interrupted by C3_ShiftPosition, but superimposed. Application: Reg synchronization on the slave side.		
VAR_IN_OUT		
Axis	INT	Axis ID; constant: AXIS_REF_LocalAxis
VAR_INPUT		
Execute	BOOL	Starts sequence of the module upon a positive edge; in the “SUPERIMPOSED_ABSOLUTE_CONT” operating mode cyclic update of the positioning parameters as long as the “Execute” remains “TRUE”.
Distance	REAL	Distance for the superimposed Positionierung (positive and negative direction). During a superimposed Positionierung in ◆ "SUPERIMPOSED_ABSOLUTE" ◆ "SUPERIMPOSED_ABSOLUTE_CONT" the “distance” is considered to be an absolute Lageziel with reference to the start position of the superimposed Positionierung (point in time of the first rising “Execute” edge where no superimposed positioning is active). For details please refer to input “Mode”. In configured unit [Units] **<Wertebereich>**[58]
Velocity	REAL	Value of the max. speed difference to the speed of the actual Positionierung (always positive) (is not necessarily attained) [Units/s] **<Wertebereich>**[59] In the "SUPERIMPOSED_RELATIVE” operating mode, the specification of a speed <=zero is not permitted. In the other operating modes, a negative value will be set to 0.
Acceleration	DINT	Value of acceleration (always positive)[Units/s²] **<Wertebereich>**[60]
Deceleration	DINT	Value of deceleration (always positive) [Units/s²] **<Wertebereich>**[61]
Jerk	DINT	Value of the acceleration **jerk** (see on page 316) [Units/s³] (always positive) **<Wertebereich>**[62]
JerkDecel	DINT	Value of the deceleration jerk [Units/s³] (always positive) **<Wertebereich>**[63]

---

[58] Target position: -4000000 rev...4000000 rev

[59] Geschwindigkeit für Positionierung: 0; 0,00001157 Umd/s...2000 Umd/s

[60] Acceleration for positioning 0.24 rev/s² ...100000 rev/s²

[61] Deceleration for positioning:0.24 rev/s² ...1000000 rev/s²

[62] Acceleration jerk for positioning:30 rev/s³ ...125000000 rev/s³

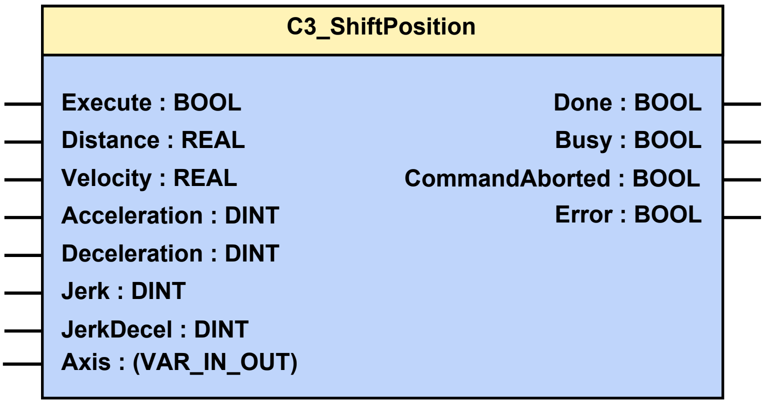
[63] Deceleration jerk for positioning:30 rev/s³...125000000 rev/s³

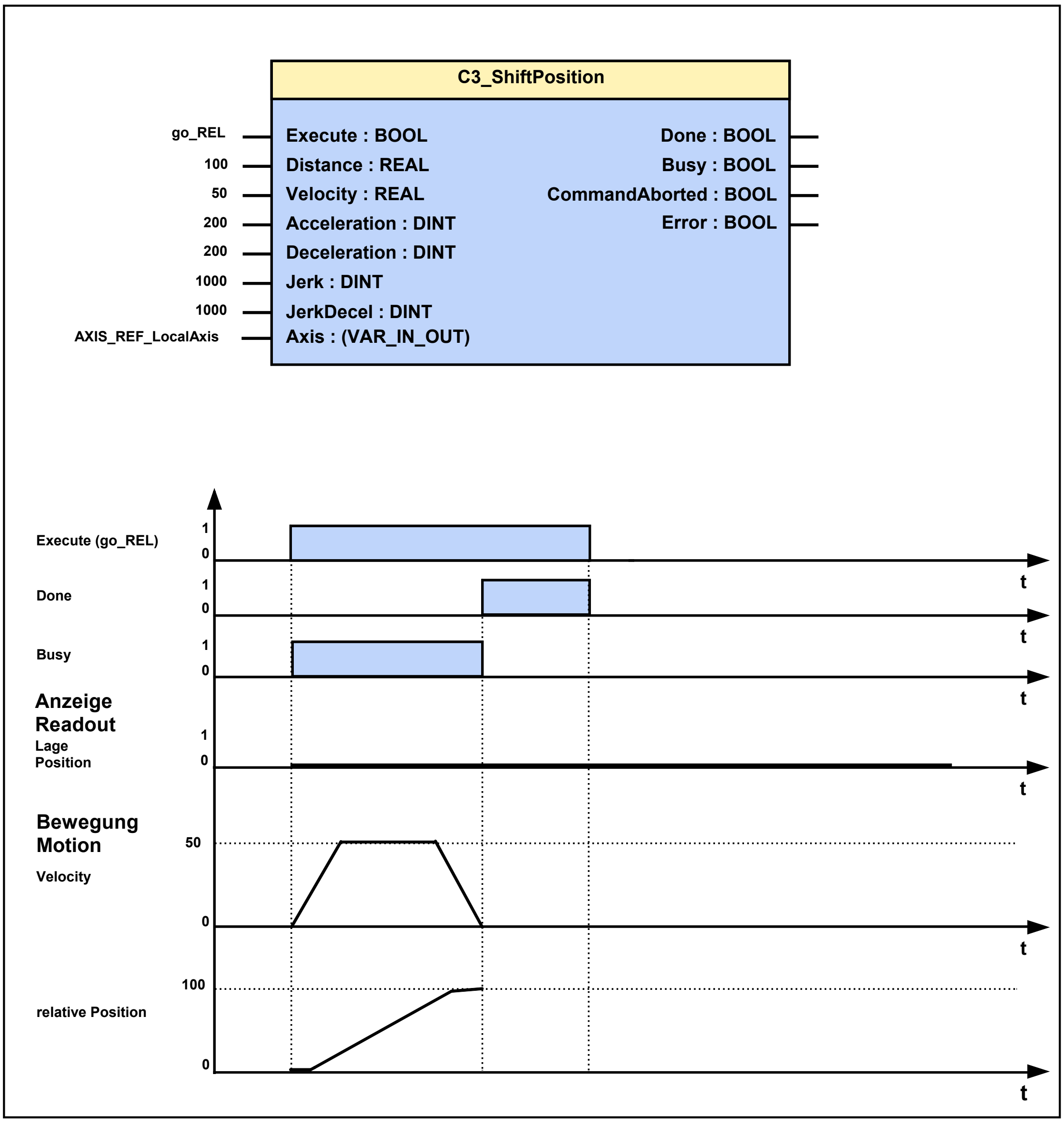
Mode	INT	**Open or "SUPERIMPOSED_RELATIVE":** With a rising edge on the Execute, a relative superimposed Positionierung, based on the value on input "Distance” is executed at that point in time (this does also apply if a superimposed Positionierung is already active. **"SUPERIMPOSED_ABSOLUTE":** Upon a **not active superimposed Positionierung**, a relative Positionierung starts on the “Execute” with a rising edge. With a rising edge on the “Execute” **during an active superimposed Positionierung** (output “Busy” is set), the Positionierungdistance based on the start points of the superimposed Positionierung is interpreted to be absolute. **"SUPERIMPOSED_ABSOLUTE_CONT":** corresponds to the "SUPERIMPOSED_ABSOLUTE” mode, the module inputs in each IEC cycle for the effective superimposed Positionierung are however accepted. **ATTENTION!** PositionResetMode = "TRUE" may only be used as from Compax3-Firmware R09-0!
PositionResetMode	BOOL	**Open or "FALSE":** The demand position O680.3 (DemandValue3) is not reset. **"TRUE"**: With each new Positionierung (rising edge on “Execute”), the Lageziel O680.3 (DemandValue3) is reset to zero. **ATTENTION!** PositionResetMode = "TRUE" may only be used as from Compax3-Firmware R09-0!
VAR_OUTPUT		
Done	BOOL	Additional distance was added to the current positioning
Busy	BOOL	Superimposed motion is performed
CommandAborted	BOOL	Positioning aborted
Error	BOOL	Error while executing module

Notes:

- The values Velocity, Acceleration, Deceleration, Jerk, JerkDecel are only valid for the superimposed movement. The values resulting from the superimposition will set on the axis, which is not taken into consideration for the status values .
- Upon a MC_Stop of the local axis (AXIS_REF_LocalAxis), the movement in progress as well as the superimposed movement are interrupted.
  The module C3_StopSuperImposed does only interrupt the superimposed movement.
- The module can also be operated in the PLCopen “Standstill” state (no change in the position display).
- The module does not interrupt any active command.
- “Position reached” (Object 420.6) is not influenced by the additional movement caused by C3_MoveSuperImposed.

- This module cannot be operated with MC_/C3_MoveSuperImposed and MC_/C3_Phasing at a time.
- It is possible to change modes (“Mode”) during a superimposed Positionierung in progress.
- If a second instance is activated in an active module with “Execute”, the instance in progress is aborted (“CommandAborted” output is set) and the second second instance acts as upon a new start of a superimposed Positionierung).
- With a falling edge on the “Execute” in the SUPERIMPOSED_ABSOLUTE_CONT” mode, the positioning is aborted upon a zero “Velocity” specification (if the überlagterte_Geschwindigkeit has reached zero) , as it can never reach its target.
- Frequent changes of the Lageziel within a superimposed Positionierung may lead to imprecisions in the Positionierung in the “PositionResetMode” input is not set to “TRUE”!
- In the "SUPERIMPOSED_ABSOLUTE_CONT” mode, the sum of the specified motion parameters is internally calculated; positive value monitoring takes only place once with each rising “Execute” edge.
- If the speed is reduced to zero at the end of a Positionierung during setpoint generation, no new values for speed, deceleration and jerk are accepted in the absolute operating modes “SUPERIMPOSED_ABSOLUTE” or "SUPERIMPOSED_ABSOLUTE_CONT" with unchanged Lageziel (input "Distance".
- The position of the module in the **structure image** (see on page 542).
- The output "error" is reported if
  - the axis is in an impermissible state with a rising edge at the “Execute” input (not active, in error state, during reference run, stops or is in stop state (MC_Stop))
  - The superimposed movement stops or was stopped (by C3_StopSuperImposed) with a rising edge on the “Execute” input
  - The module was issued with invalid parameters (“Velocity” <= 0 in "Mode" SUPERIMPOSED_RELATIVE), acceleration values or jerks <= 0, input “Axis” unequal to “AXIS_REF_LOCALAXIS”, invalid operating mode (“Mode”)) upon a rising edge on the “Execute” input
  - An attempt to start the module (rising edge on the “Execute” input) is made during another superimposed movement (MC_/C3_MoveSuperImposed, MC_/C3_Phasing).
  - The axis changes into error state during a superimposed movement in progress
- The “CommandAborted” output is reported if an interruption of the superimposed Positionierung occurred caused by
  - another module instance
  - Stops the superimposed movement by stop on the axis (MC_Stop)
  - Stops the superimposed movement (C3_StopSuperImposed)
- superimposed speed zero with falling edge on the “Execute” of the superimposed positioning is not yet completed in the "SUPERIMPOSED_ABSOLUTE_CONT” mode or if the superimposed travel command was rejected by the firmware.




C3_ShiftPosition
go_REL
100
50
200
200
1000
1000
AXIS_REF_LocalAxis
Execute : BOOL
Distance : REAL
Velocity : REAL
Acceleration : DINT
Deceleration : DINT
Jerk : DINT
JerkDecel : DINT
Axis : (VAR_IN_OUT)
Done : BOOL
Busy : BOOL
CommandAborted : BOOL
Error : BOOL
Execute (go_REL)
Done
Busy
Anzeige
Readout
Lage
Position
Bewegung
Motion
Velocity
relative Position
1
0
50
100
t

5.6.4. Stop module for superimposed movement (C3_StopSuperImposed)

FB name	**C3_StopSuperImposed**	
Stop current superimposed position (C3_MoveSuperImposed, C3_ShiftPosition) or C3_Phasing. **Please note:**Only one instance of C3_StopSuperImposed is permitted!		
VAR_INPUT		
Execute	BOOL	Stops the movement
Deceleration	DINT	Value of deceleration (always positive) [Units/s²] **<Wertebereich>**[64] Please observe: The configured STOP ramp is limited. The STOP ramp will not be smaller than the deceleration set in the last motion set.
Jerk	DINT	Value of the acceleration **jerk** (see on page 316) [Units/s³] (always positive) **<Wertebereich>**[65]
VAR_OUTPUT		
Done	BOOL	Stop move
Error	BOOL	Error while stopping positioning
Note: As long as the "Execute" input is set, the profile generator executing the superimposed movements or the phase shift in "Stopping" status and is unable to execute any additional movement commands! (The modules C3_MoveSuperImposed, C3_ShiftPosition or C3_Phasing set the “CommandAborted” output upon detection of the “Stop command” and acknowledge the trial to start in Stop state by setting the “error” output). The module may only be used as from Compax3-Firmware R09-0!		

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[64] Deceleration for positioning:0.24 rev/s² ...1000000 rev/s²

[65] Acceleration jerk for positioning:30 rev/s³ ...125000000 rev/s³

5.7 Cam Control

In this chapter you can read about:

5.7.1. Introduction: Electronic cam control

In this chapter you can read about:

Rising rationalization pressure and an increasing degree of automation in process engineering demand modern and flexible drive concepts.

The introduction of digital and communicating control devices was an important step towards the decentralization of control and regulation tasks. An increasing number of mechanical construction components can be replaced by programmable servo drives.

In particular mechanical cam switching mechanisms and discontinuous shafts maintained until today their fields of application in many areas of machine construction.

Mechanical cam switching mechanisms offer, besides complex motion profiles, a high positioning accuracy and rigid coupling between master and slave drive.

Their drawbacks are, however, the long changeover times and the limitation to a defined profile.

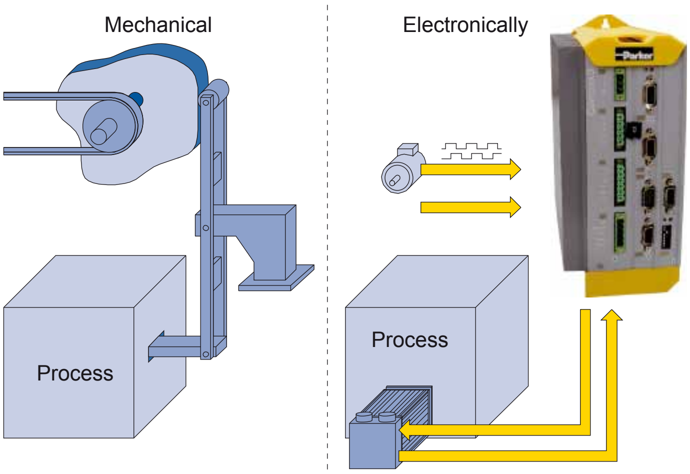
In this respect the Compax3 T40 electronic cam offers considerable time advantages, above all when changing between small batch sizes or with a wide range of products.

The decentralization of the drive performance can reduce size, costs and maintenance effort considerably.

Compax3 allows to implement in an axis module all control and drive functions for a flexible and cost-effective solution of complex motion sequences and synchronization tasks with the aid of powerful IEC61131-3 modules.

The switching command between different motion profiles takes only seconds - no fitter or wrench is required.

Large, mechanically coupled drive systems can be divided into small, independent drives. The dynamic and stationary behavior of every drive can be individually set and optimized.



Compax3 is able to simulate mechanical cams as well as cam switching mechanisms electronically.

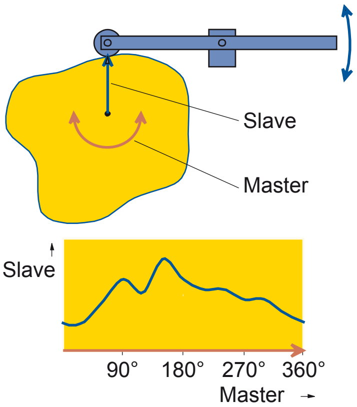
This helps to realize discontinuous material supply, flying knife and similar drive applications with distributed drive performance.

The compact servo controller processes the position signals of a master axis and controls a servo motor, torque motor or a direct-drive linear actuator via the desired motion profile, which is defined in the form of an interpolation point memory. The combination of drive, control and power unit in one device offers many advantages:

- Fast and easy commissioning.
- fast and stable control.
- feedforward control measures result in reduced need for peak torque and improved response behavior - therefore following errors are avoided.
- central digital control from the setpoint generator to the power output stage.
- lower wiring overhead and thus substantially reduced fault liability.

5.7.1.1 Function principle

In this chapter you can read about:



Depending on the angle setting of a leading axis (master), the following axis (slave) is moved according to a user-defined motion profile. The master position moves within a defined value range; the master clock distance, and moves through it cyclically. Each cycle corresponds to a revolution of the cam or a repetition cycle of any complex movement. Via the master position, a sequence of interpolation points with up to 10000 non-equidistant interpolation points is addressed. Compax3 interpolates linarly between the interpolation points. Those position setpoint values are used to form the feedforward signals for the subordinate controller cascades of the following axis. This feedforward of speed and acceleration is used to reduce the following error of the following axis as fas as possible.

Coupling and decoupling

An important function for complex plants is the coupling and decoupling of individual drives, triggered by an external control signal. During the coupling, the following axis (slave) is synchronized via a defined motion profile to the position of the leading axis (master). This can take place from any start position with a continuous, jump free speed course. Upon decoupling, the slave leaves the synchronous operation and is brought definedly to a standstill. The coupling or decoupling can take place with a running or stationary master axis.

Reg synchronization

In the packaging and print industry, a synchronization of following slave axes to print marks is required, for example in order to balance material slip or for an alignment according to existing prints. The error is compensated up to the next mark by correcting the master position acquired in the slave or by correcting the slave position by the determined slip between the product and the print mark button.

5.7.2. Overview

T40 Functions: Cam

General	◆ Cam control function ◆ Programming based on IEC61131-3 ◆ Position of selected master signal source via: ◆ Encoder, Step / direction or +/-10V analog ◆ HEDA ◆ Virtual Master
Cam memory	◆ 10 000 interpolation points (master/slave in 24 bit format) saved failure save. ◆ Distance of interpolation points can be adapted to curve (non equidistant interpolation points) ◆ Linear interpolation between points
Linking curve segments	◆ Up to 20 cam segments can be produced. ◆ Virtually random cam links (forwards) ◆ Freely programmable, event-triggered curve branching. ◆ Scalable cam segments and complete cam profiles
Coupling and decoupling functions	◆ With the aid of a quadratic function. ◆ By means of a change-over function ◆ Without overspeeding by coupling over several master cycles. ◆ Virtually free set-up of the coupling and decoupling movement ◆ Master-guided coupling movement. ◆ Random standstill position
Reg synchronization	◆ Master or slave oriented (simultaneous, cam-independent). ◆ Highly precise mark recognition (accuracy < 1 µs)
Cam generation with renowned Nolte tool.	◆ Standard or extended range of functions ◆ Evaluation of the motion profiles.

5.7.3. Basics

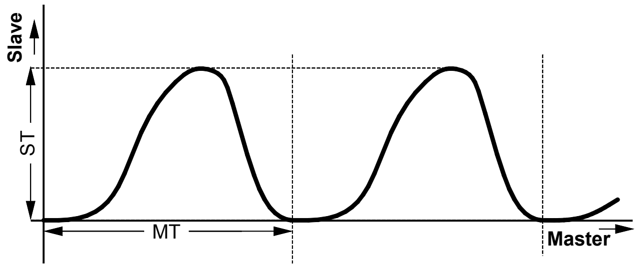
In this chapter you can read about:

5.7.3.1 Cam types

There are two principal curve types:

Closed curve

The start and end positions of the Slave are identical. I.e. the Slave moves always within the same position range.

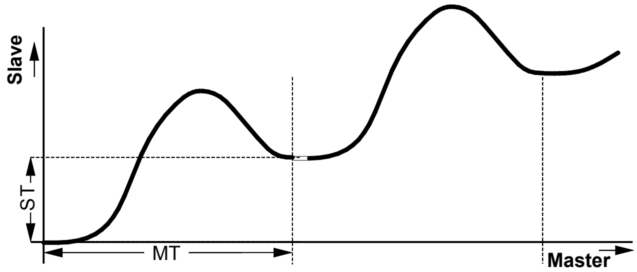


ST: Slave clock distance

MT: Master clock distance

Open curve

The start and end positions of the Slave are not identical. I.e. the Slave moves in one direction, as at the end of the curve the actual position of the Slave is compared to the start position of the curve.



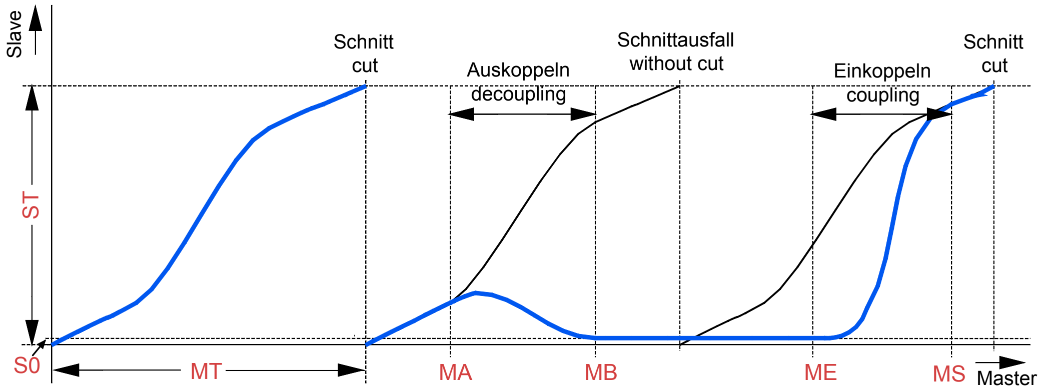
ST: Slave clock distance

MT: Master clock distance

In applications with open curves (“infinite applications”), reset operation should be activated on the slave side (reset distance to be specified under “reference system” in the configuration wizard).

5.7.3.2 Cam parameters / terms

Example:



ST:	Slave clock distance
MT:	Master clock distance
ME:	Coupling position
MS:	Synchronous position
MA:	Decoupling position
MB:	Braking position
S0:	Standstill position of the Slave

Master clock distance (MT)

The Master clock distance is the distance which the master runs, i.e. after which the cycle is repeated. This distance is stated in the physical unit of the Master.

After this distance, the curve is repeated.

Slave clock distance (ST)

The Slave clock distance is the distance which the Slave runs, stated in the physical unit of the Slave.

Coupling position (ME)

Master position, where the coupling sequence starts.

Synchronous position (MS)

The coupling sequence is finished, if the master has reached the synchronous position MS, i.e. at the master position MS the slave is synchronous to the curve (MS > MT possible).

Decoupling position (MA)

Via the decoupling position MA the decoupling sequence can be started in a defined fashion from a certain master position (MA) on (dependent on the decoupling operating mode selected).

Braking position (MB)

At this master position, the slave comes to a standstill after decoupling (MB > MT possible).

Standstill position Slave (S0)

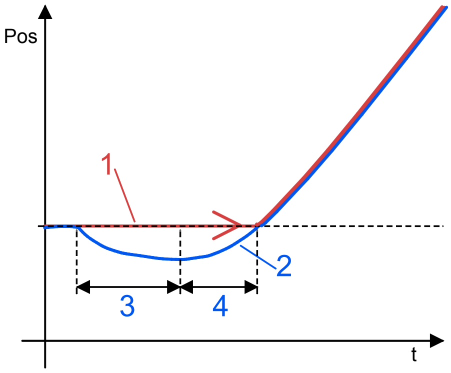
Target position of the slave axis after decoupling.

Back stop

The back stop can be enabled if required (IEC module **C3_MasterControl** (see on page 372)).

It ensures that a backwards movement of the master will not incite an axis movement of the slave.

Example:



1: Master signal after back stop

2: Master signal before back stop

3: Backwards movement of the master

4: Forwards movement of the master corresponding to the backwards movement.

Note: The negative distance difference caused by the backwards movement of the master (3) must be traveled in positive direction (4), before it can be effective as a movement.

5.7.3.3 Basic procedure

When implementing a standard cam application, the following steps are necessary:

- Create curve and load into Compax3.
- Setting the master position detection
- Establish relationship between master position read in and curve.
- Select curve.
- Start curve operation in a defined fashion.
- Establish relationship with slave position (coupling).
- Finish curve operation in a defined fashion (decoupling).

5.7.4. Generating cams

In this chapter you can read about:

The curve creation software "C3 CamDesigner" is a separate program and must therefore be installed separately.

You will find the program on the Compax3 CD.

Please note:

The CamDesigner must be installed in a folder, whose name does not contain any blanks.

This problem occurs above all when working with english Windows versions (...\Program Files\...).

5.7.4.1 Introduction to the CamDesigner (example)

Prerequisite:

Compax3 is configured

Compax3 ServoManager is installed (can be found on the Compax3 CD).

C3 CamDesigner is installed (can be found on the Compax3 CD).

Settings:

- Travel distance per motor revolution = 360°
- Reset distance = 360°

In the "Configuration" wizard in the "reference system" window

- Travel path per revolution of the physical source: Numerator = 360, Denominator = 1

in the "signal sources" wizard windows: "Physical source"

- Signal source: Encoder A/B 5V

Procedure:

Starting the CamDesigner: Nagivation tree of the Compax3 ServoManager under "cam": "Modify cam with CamDesigner"

The transfer window from Compax3 ServoManager to CamDesigner will open:

CamDesigner

Parameter axis 1

Axis name: Axis

Master axis

Reset distance: Numerator 360, Denominator 1

☐ Alternative master reset distance [M_Units]: 360

Signal source: Encoder A/B 5V

Max. speed [M_Units/s]: 1200.000

Cam Parameter

☐ ADVANCED Level

☐ Point reduction

Interpolation tolerance: 0.0001

Number of points per curve: 180

Dwell-to-dwell motion law: Modified Sine Line according to Neklutin

☐ Always calculate motion diagrams

Modular grid for graphic cam input

Step angle: 10

Travel coordinate: 1

Here you can enter:

- Axis name
- Number of interpolation points to be calculated per curve,
- Signal source "Encoder A/B 5V" and
- "Dwell-to-dwell motion law".

Do not change the default settings:

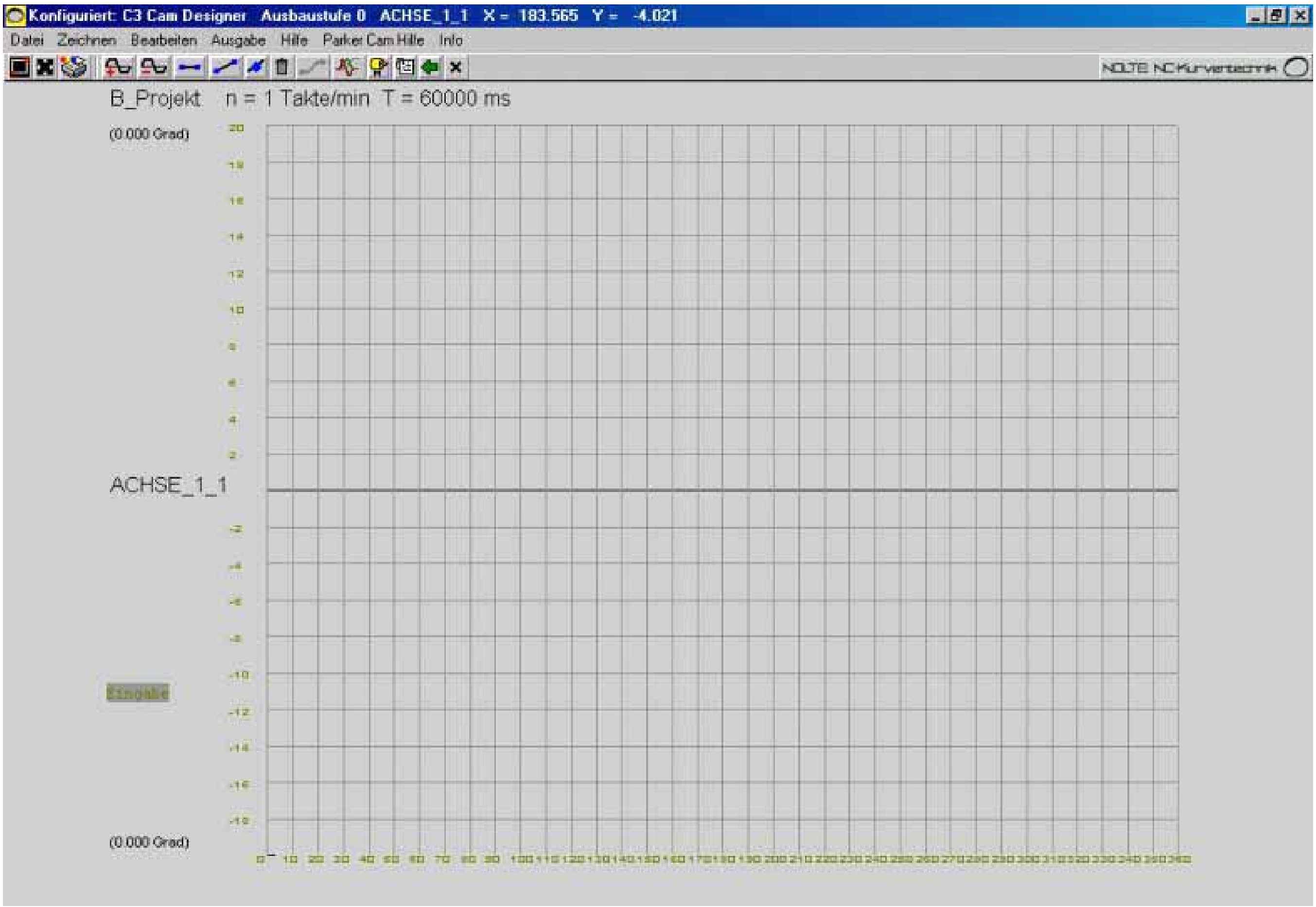
- 180 points and
- the “modified sine line according to Neklutin” (russian mathematician)

At first the display is empty; the motion sequence can be entered.

This is made via the menu: File: New sequence.

In the dialog box you can select the the axis name of your choice, here “axis”

The display looks as follows:



Now the curve can be created:

The BASIC version of the CamDesigner offers three tools:

- Drawing -> Dwell
- Drawing -> straight line
- Drawing -> point

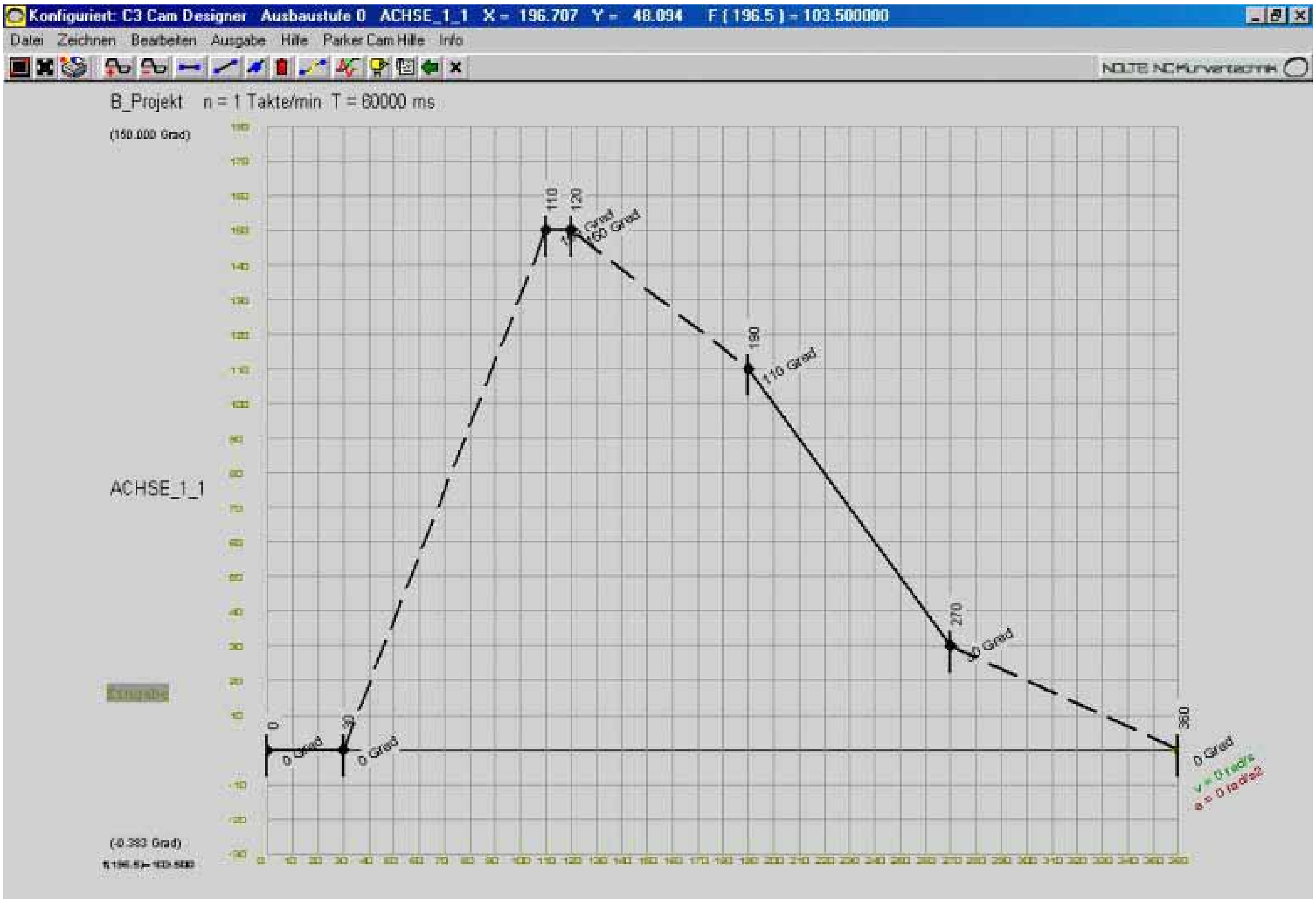
With the aid of these tools the known sections of a motion sequence, in general dwells or sections with constant speed, are entered. Please select a tool.

Now you can position the respective section per mouse click or enter it with the keyboard. Click into the “enter” field. In the dialog box you can make the following entries depending on the tool selected:

- Tool dwell:
  - a. Path coordinate 0 Degrees
  - b. Clock angle beginning 0 Degrees
  - c. Clock angle end 30 Degrees
- Tool dwell:
  - a. Path coordinate 150 Degrees
  - b. Clock angle beginning 110 Degrees
  - c. Clock angle end 120 Degrees
- Tool straight line:
  - a. Path coordinate beginning 110 Degrees
  - b. Clock angle beginning 190 Degrees
  - c. Path coordinate end 30 Degrees
  - d. Clock angle end 270 Degrees

- Tool interpolation point:
  - a. Path coordinate 0 Degrees
  - b. Clock angle 3600 Degrees
- and as an option
  - c. Speed 0 rad/s
  - d. Acceleration 0 rad/s²

The display looks as follows



```
Konfiguriert: C3 Cam Designer   Ausbaustufe 0   ACHSE_1_1   X = 196.707   Y = 48.094   F ( 196.5 ) = 103.500000
```

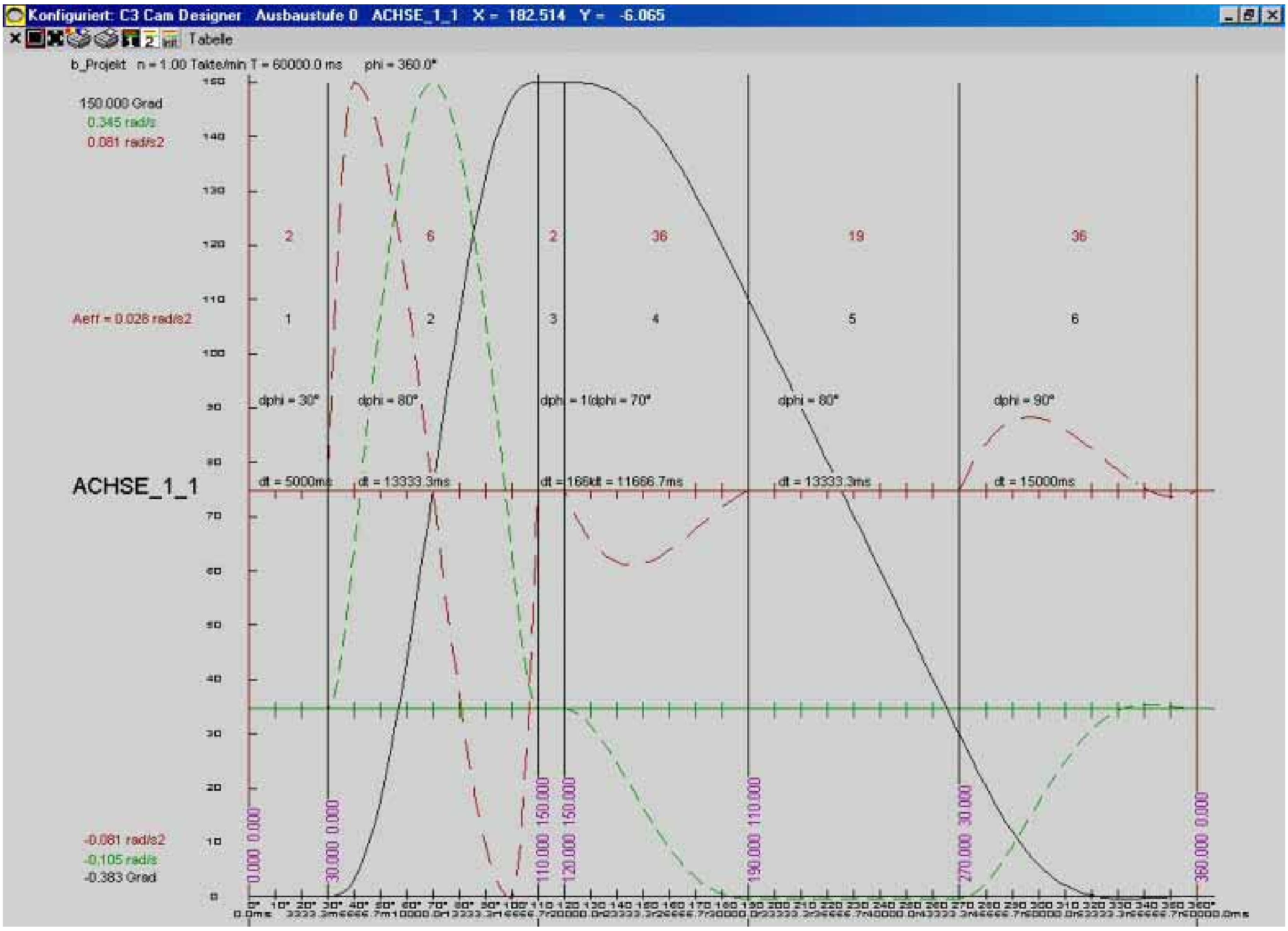
```
B_Projekt    n = 1 Takte/min  T = 60000 ms
```

The dashed sections are now calculated by the CamDesigner.

The transitions from dwell to motion are always calculated via a 5th order polynomial (in the BASIC version)

For the transitions dwell-to-dwell, the preselected motion law is used. This can also be changed retrospectively in the header data (menu: edit: Header data). The header data mask also states the cycle time (cycles per minute).

Via the “show motion diagram” icon the result is displayed:



Displayed are the sequences for position, speed and acceleration, in physical units and with respect to the cycle time entered.

This window can be left via the X Icon.

If necessary, you can make modifications (motion laws, cycle time, etc.)

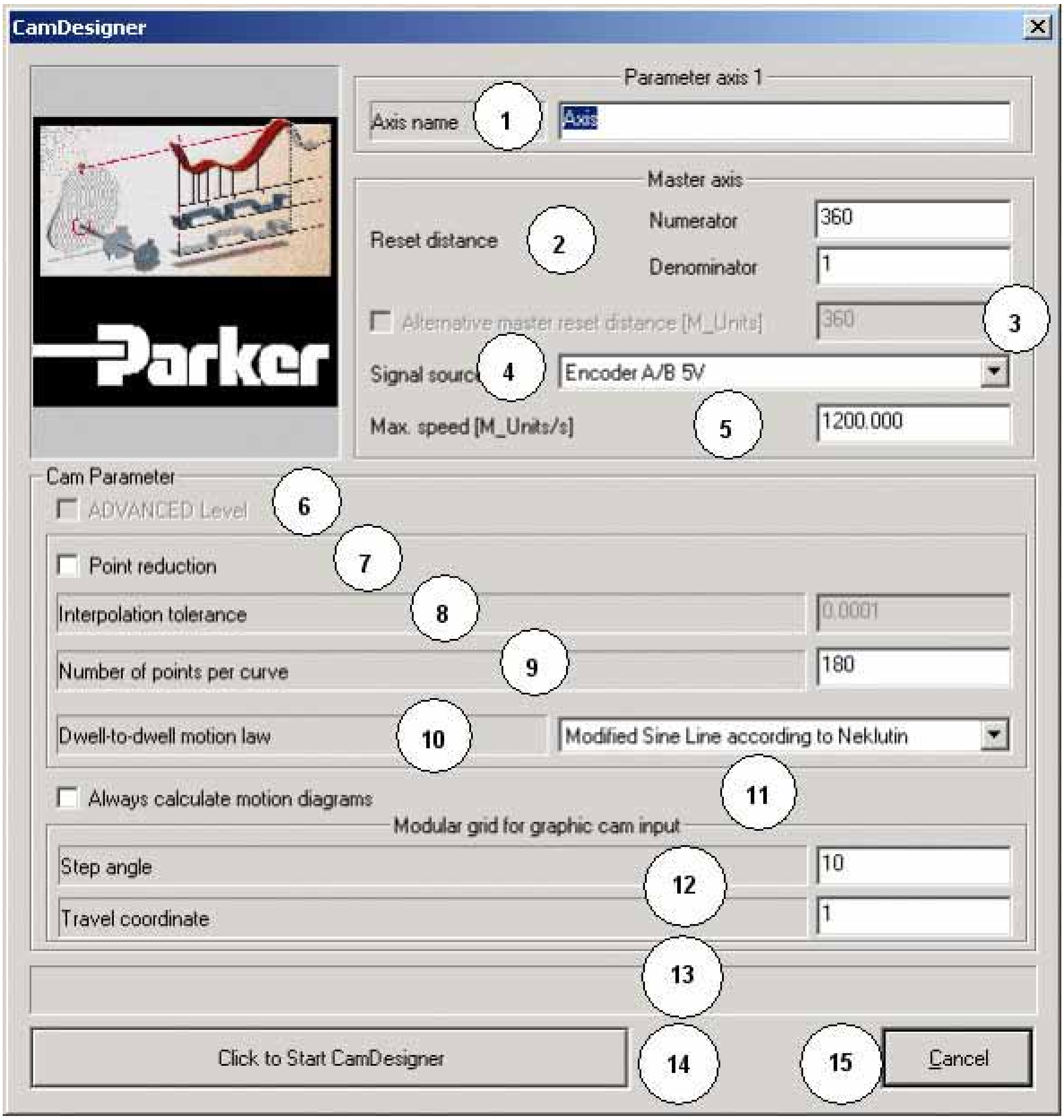
After the optimization the curve progression you can leave the CamDesigner via "file": "Exit"

The following dialog queries if the Cam Download is to take place immediately. The download can also be executed later via "Download": "Cam - curve data".

5.7.4.2 Cam functions of the Compax3 ServoManager / motion laws

In this chapter you can read about:

Description of the cam wizard



CamDesigner

Parameter axis 1

Axis name: Axis

Master axis

Reset distance

Numerator: 360

Denominator: 1

☐ Alternative master reset distance [M_Units]: 360

Signal source: Encoder A/B 5V

Max. speed [M_Units/s]: 1200.000

Cam Parameter

☐ ADVANCED Level

☐ Point reduction

Interpolation tolerance: 0.0001

Number of points per curve: 180

Dwell-to-dwell motion law: Modified Sine Line according to Neklutin

☐ Always calculate motion diagrams

Modular grid for graphic cam input

Step angle: 10

Travel coordinate: 1

1 Name of the cam project being used in the CamDesigner.

2 Reset distance (=clock distance) of the master = length of the X axis in the CamDesigner.
The entry fields are inactive, if motion profiles were already created in the CamDesigner.
The values can, however, be modified in the header data of the CamDesigner.
Attention:
Cam interpolation points may need to be adapted or deleted, if they are redundant due to a smaller clock distance!.
Decimal numbers must be converted into integers as numerator and denominator values. Please note, that max. 3 decimal places are considered for numerator/denominator.

3 If the master clock distance has more than 3 decimal places, a drift is created.
If the Compax3 ServoManager states this, you can avoid this drift by using an alternative master clock distance.
Use another unit for the alternative master clock distance, instead of [mm] or [degrees] rather use [product cycles] or [%], so that you have an integer.
This unit is then valid for all master-related values (ME, MS, status values, ...) as well as for the curve.
Create the curve for this alternative master clock distance and you will get ad

drift free curve operation.
The input field will become inactive, if motion sequences were already created in the CamDesigner. The alternative clock distance can also be manipulated in the header data mask of the CamDesigner.
Example:
Master: Direct-driven indexing table with 7 work stations;
Path/revolution = 360°
Reset distance = 360°
Slave: One of the work stations
Path/revolution = 360/7° master degree; cannot be displayed as clock resp. master reset distance (drift)!
Better: alternative clock distance for example 360 slave degrees.

4 Selection of the signal source which is used as default value for the master source (Input AXIS_REF_Local_Cam on the IEC block C3_MasterControl). An entry is required.
You can choose between configured signal sources.
The source can be changed afterwards with the input master of the IEC block C3_MasterControl.

5 The maximum speed is used as axis dimensioning for the display of the motion profile as well as a limit value for the motion sequence..
At +/-10V as signal source, the value 10V is used (the entry field is deactivated).
This value can also be manipulated in the header data mask of the CamDesigner.
Please note: The value is converted into steps/min by the CamDesigner; therefore a slight difference in this value caused by rounding is possible after the return from the CamDesigner.

6 If the license file is installed: Switching between Advanced and Basic version of the CamDesigner.

7 Interpolation point reduction
deactivated: The curve is stored in equidistant interpolation points (corresponding to the stated number of interpolation points)
Activation: The equidistant interpolation points are reduced (resulting in the creation of not equidistant interpolation points).
The interpolation points are removed so that the resulting error is smaller than the interpolation tolerance stated (linear interpolation is respected).

8 Interpolation tolerance (see 7).

9 Maximum number of interpolation points per curve. Value range 18..3600.
Without activated interpolation point reduction, a curve has this number of interpolation points.
If the reduction is activated, the actual number of interpolation points may (depending on the tolerance selected) be smaller. Please respect that this value also constitutes the "basic grid" for the interpolation point reduction.
The number of interpolation points can also be manipulated in the header data mask of the CamDesigner.

10 Here the dwell-to-dwell interpolation method is selected. The following motion laws are possible in the BasicVersion of the CamDesigner:

- 3 Sloping Sine Line according to Helling-Bestehorn
- 4 5th order polynomial
- 5 Modified acceleration trapezoid
- 6 Modified Sine Line according to Neklutin
- 7 Simple sine (disadvantageous jerk)
- 11 11th. order polynomial
- 12 Squared parabola (disadvantageous jerk)
- 28 8th. order polynomial (disadvantageous jerk)
- 30 low-noise cosine combination
- 31 3th order polynomial (disadvantageous jerk)
- 32 4th order polynomial
- 33 6th order polynomial (disadvantageous jerk)
- 34 7th. order polynomial
- 38 mirrored sine

- 47 harmonic combination

For all other interpolations, the 5th order polynomial is used in the basic version. In the "Advanced Version", all methods of interpolation (also in combination) are possible in general. A detailed description of the methods not mentioned here, can be found in the CamDesinger help.
The dwell-to-dwell motion law can also be specified in the header data mask of the CamDesigner.

11 If the option "always calculate motion diagrams" is activated, the CamDesigner will calculate the interpolated motion sequence and the acceleration sequence after each change.
This option can also be de-/activated in the header data mask of the CamDesigner.

12 Modular grid for graphic cam input.
These values determine to which master/slave grid the curve elements placed with the aid of the mouse are brought ("caught"). The grid of the master (x)-axis must be smaller than the configured clock distance.
These values can also be de-/activated in the input mask of the CamDesigner for curve points.

13 Here are displayed status resp. error messages and notes.

14 Starting the CamDesigner.
This must be installed from the Compax3 CD beforehand.
After the return from the CamDesigner it is necessary to perform a curve data download in order to load the changes into Compax3 (even if the curves themselves were not modified).

15 Cancel. Closing the window, the changes are discarded.

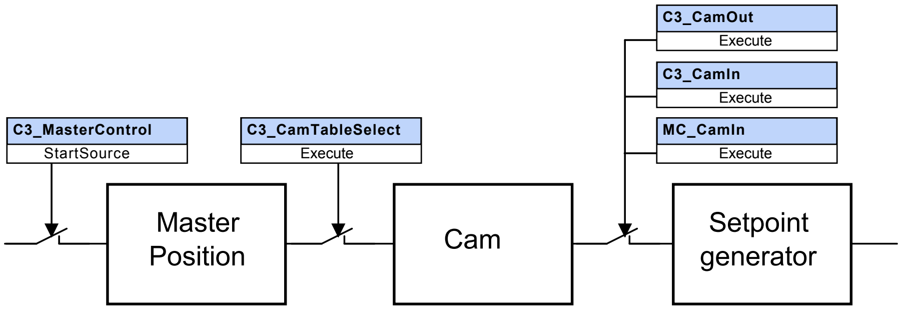
Motion laws:

Detailed information on the topic of "motion laws" can be found in the online help of the device.

5.7.5. Cam function structure

In this chapter you can read about:

5.7.5.1 Function modules of the cam



Functions of the individual modules:

Master Position:

- Detection of the master position
- Alignment / adjustment of the master position signal

For this the following IEC modules are available

- C3_MasterControl:
  - Select source
  - activate detection
  - activate master back stop (only rising master signals are accepted)
- C3_SetMaster: Define start position for the master signal.
- C3_MasterConfig: Define master reset distance (independent of the curve reseet distance).
- MC_Phasing: Additional master distance which is added to the master signal and which causes a slave movement.

Cam: Curve generation and control

- Selection of the curve
- Setting: run through curve once or cyclically
- Enable the master signal to the curve
- Definition of the master reference: relative or absolute.
- Specification of the master and slave segment distance.
- Specification of another MasterOffset with absolute reference or a starting delay with relative reference.

This is made via the "C3_CamTableSelect2 IEC module".

Setpoint generator: Coupling and decoupling curves

- Enable the curve slave position.
- Alignment / adjustment of the curve slave position to the actual slave position.

For this the following IEC modules are available

- MC_CamIn: Coupling with relative slave reference.
- C3_CamIn: Coupling with absolute slave reference with coupling function, master coupling position and master synchronous position
- C3_CamOut: Decoupling with absolute slave reference with coupling function, master decoupling position, master braking position and slave standstill position.

5.7.5.2 Signal image

Displayed are 2 different signal plans, which differ in their master reference:

- absolute master reference
- relative master reference

Displayed are:

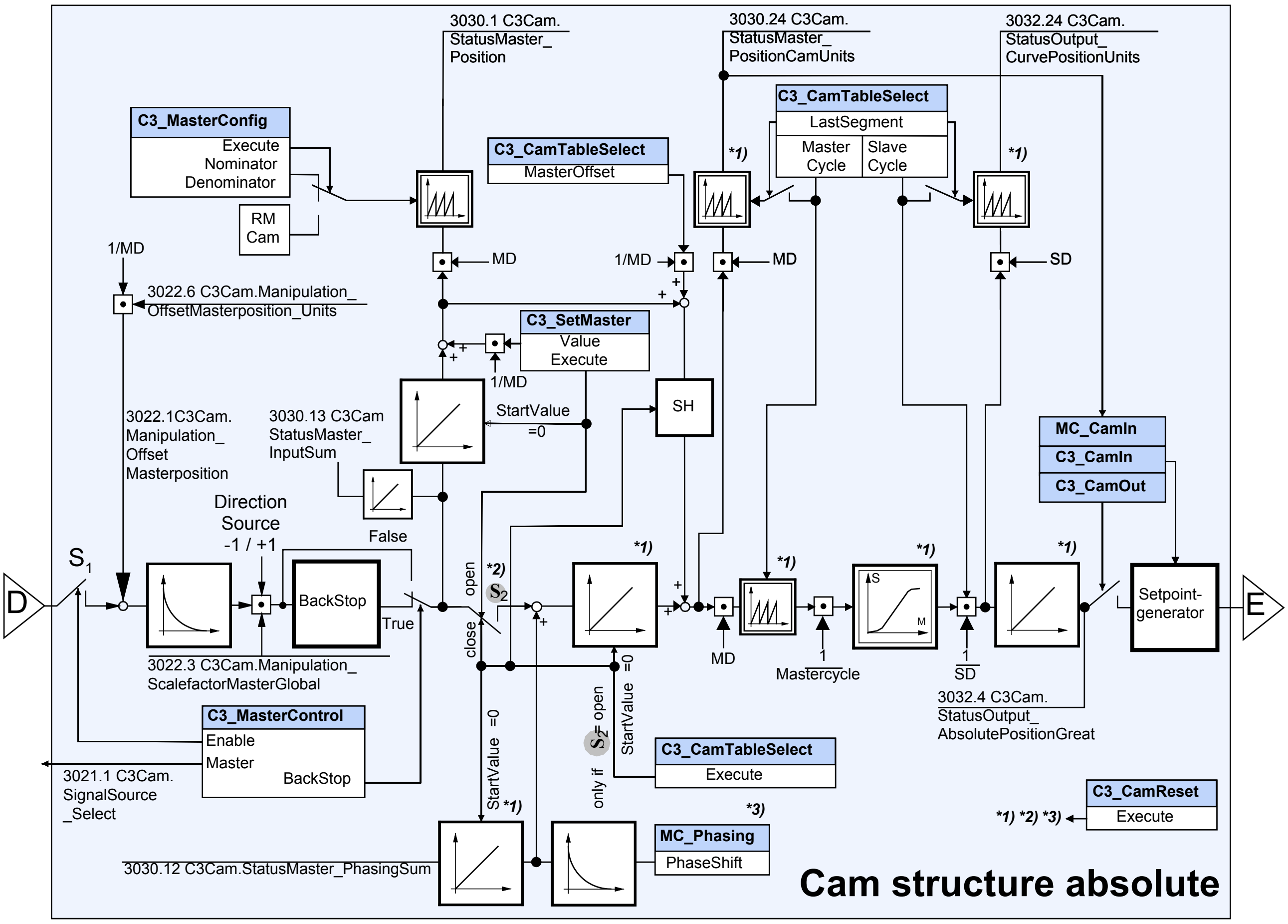
- the master signal processing,
- the function of the individual IEC function modules as well as
- the status objects made available for the commissioning or processing.

Symbols Please make yourself familiar with the **Symbols of the signal image** (see on page 363).

Abbreviations:

RV:	Reset distance of the virtual master (from C3 ServoManager wizard "signal source")
RM Cam:	Reset distance of the master from curve
RS:	Reset distance of the slave (from C3 ServoManger Wizard "configuration: Reference system)
MD:	Feed of the master axis
SD:	Feed of the slave axis

Signal image with absolute master reference



D: / E: **additional structure** (see on page 237)

Note: Direction -1 / +1 with direction reversal (under signal source configuration) factor -1 is applied.

Switches S1 & S2:

S1: Enable master acquisition; status switch in object 3030.7

O3030.7 = 0: switch open

O3030.7 = -2: switch closed, stop at the end of the cycle

O3030.7 = 2: switch closed, stop at the end of the cycle - single operation (run through curve once)

O3030.7 = 4: switch closed, periodic operation (run through curve cyclically)

S2: Enable cam input; status switch in object 3030.17

O3030.17 = 0: switch open

O3030.17 = 3: switch closed, single operation (run through curve once)

O3030.17 = 4: switch closed, periodic operation (run through curve cyclically)

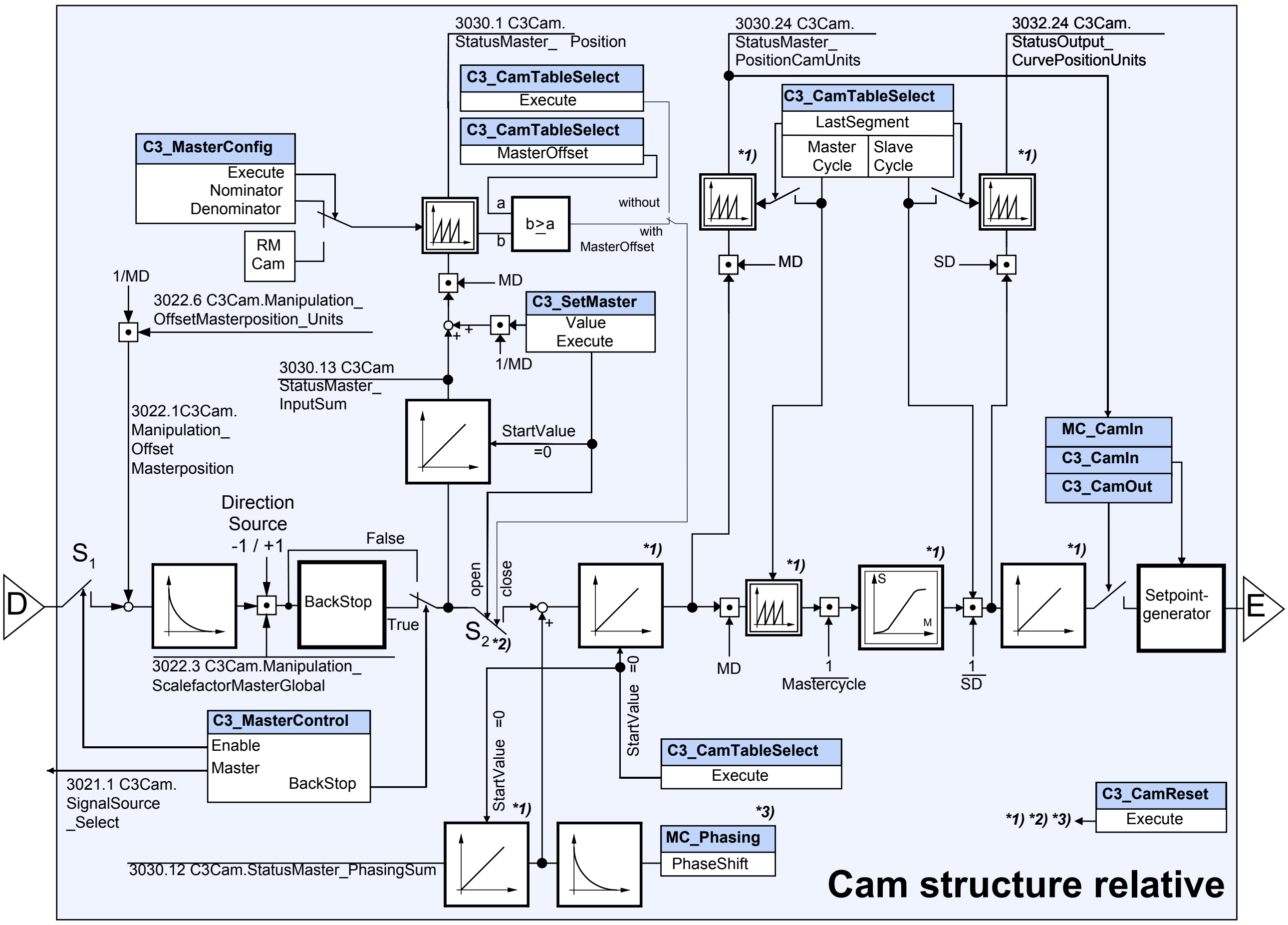
C3_CamReset function

**1)* Set output to zero

**2)* Open switch

**3)* Quick stop MC_Phasing

Signal image with relative master reference



D: / E: **additional structure** (see on page 237)

Note: Direction -1 / +1 with direction reversal (under signal source configuration) factor -1 is applied.

Switches S1 & S2:

S1: Enable master acquisition; status switch in object 3030.7

O3030.7 = 0: switch open

O3030.7 = -2: switch closed, stop at the end of the cycle

O3030.7 = 2: switch closed, stop at the end of the cycle - single operation (run through curve once)

O3030.7 = 4: switch closed, periodic operation (run through curve cyclically)

S2: Enable cam input; status switch in object 3030.17

O3030.17 = 0: switch open

O3030.17 = 3: switch closed, single operation (run through curve once)

O3030.17 = 4: switch closed, periodic operation (run through curve cyclically)

C3 CamReset function

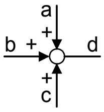
**1)* Set output to zero

**2)* Open switch

**3)* Quick stop MC_Phasing

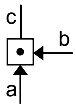
Symbols of the signal image

Symbol **Description**



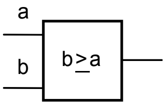
Point of addition:

d = a + b + c



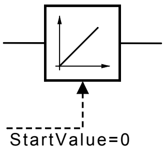
Point of multiplication:

c = a * b



Comparison:

If b >= a, then output active

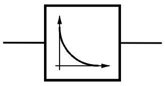


Integrator

Output signal = ∫(Input signal)*dt

The output signal is the integral (sum over time) of the input signal

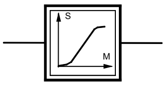
"Start value=0" will set the output to 0; this is triggered by activating “Execute” of an IEC module.



Differentiator

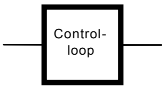
Output signal = d(input signal)/dt

The output signal is the derivation (gradient) of the input signal



Non-linear curve function Slave / Master

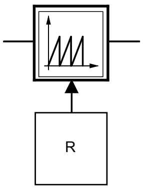
Slave-Position = f (Master-Position)



Closed control loop

Input: Setpoint Position

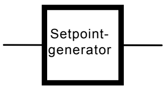
Output: Effective position



Reset function

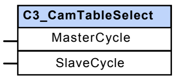
Output signal is reset to 0 after value "R".

Value R can be taken in the signal image.



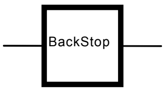
Setpoint generator

Generates the desired setpoint process (e. g. when coupling into a curve)



IEC function module

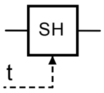
with module name and input values



Back stop

Prevents a declining master signal

(Function of **C3_MasterControl** (see on page 372))



Sampling-holding-function (SH: Sample & Hold)

The input value of the SH member is written to the output with trigger signal t.

5.7.5.3 Cam reference systems

In this chapter you can read about:

For a cam application it is necessary to adapt the curve values (positions) to the master and slave positions.

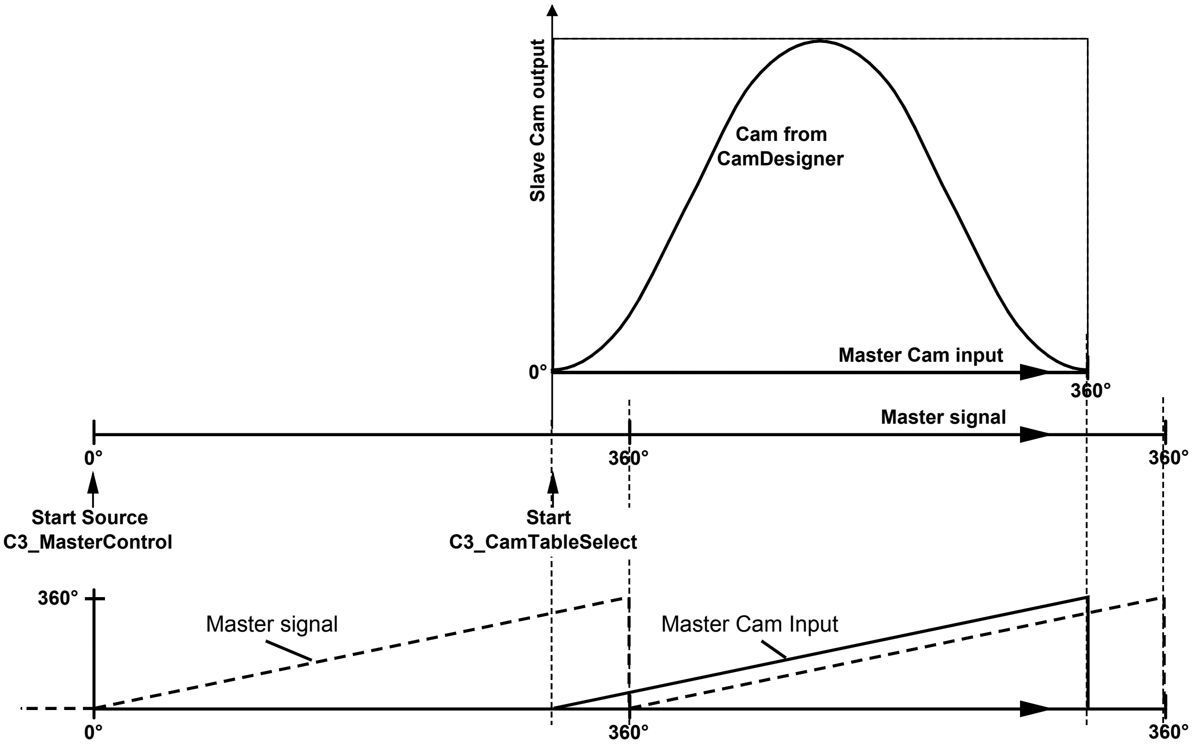
There are different possibilites to do this:

- relative master reference
  - without offset
  - with offset
- absolute master reference
  - without offset
  - with offset

The "Slave Cam output" setpoint signal from the curve is only related to the current physical slave position by the selected coupling function. A distinction is made between:

- relative slave reference and
- absolute slave reference

Relative master reference without offset



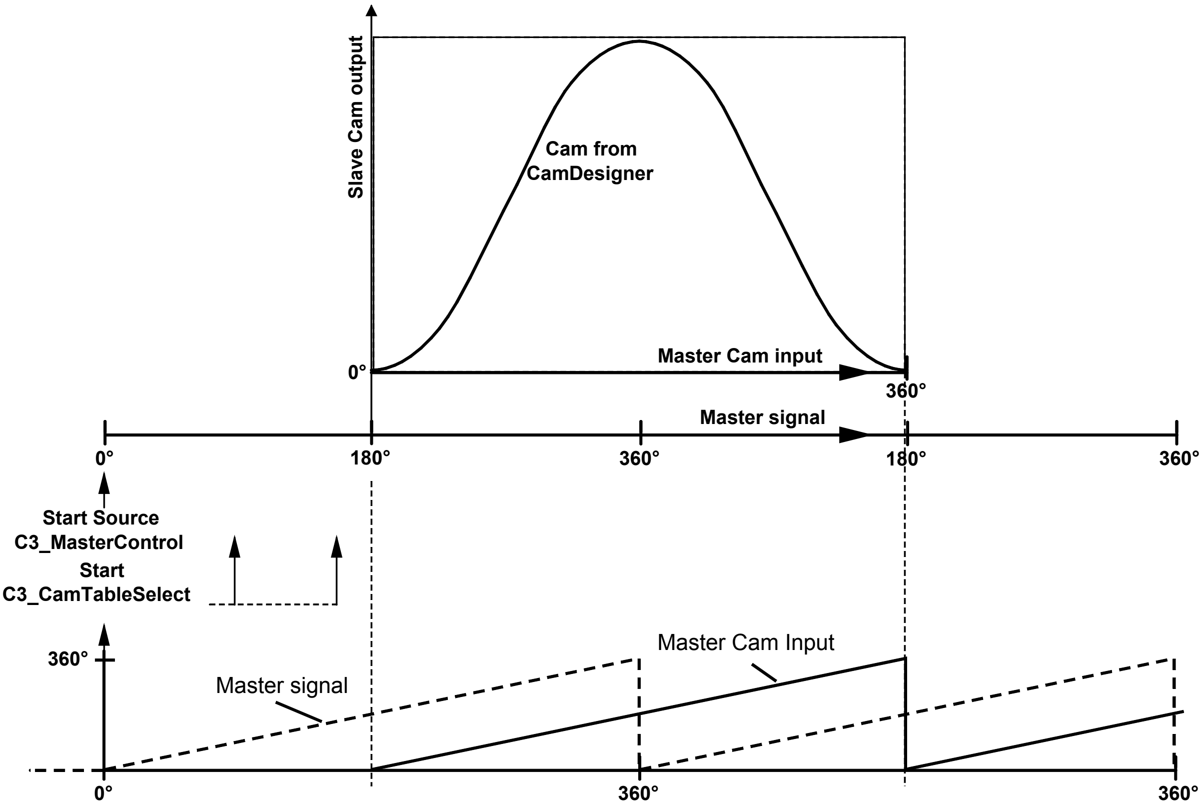
Master Cam input: Master signal at the curve input (C3Cam.StatusMaster_PositionCamUnits o3030.24)

Master signal: Master signal of the acquisition (C3Cam.StatusMaster_Position o3030.1)

Slave: Signal at the curve output (C3Cam.StatusOutput_CurvePositionUnits o3032.24)

Note:
- ◆With a relative master reference, a given curve is processed generally from the beginning, independent of the start delay (=offset).
- ◆The C3_CamTableSelect.Offset input is not to be wired!

Relative master reference with 180° offset



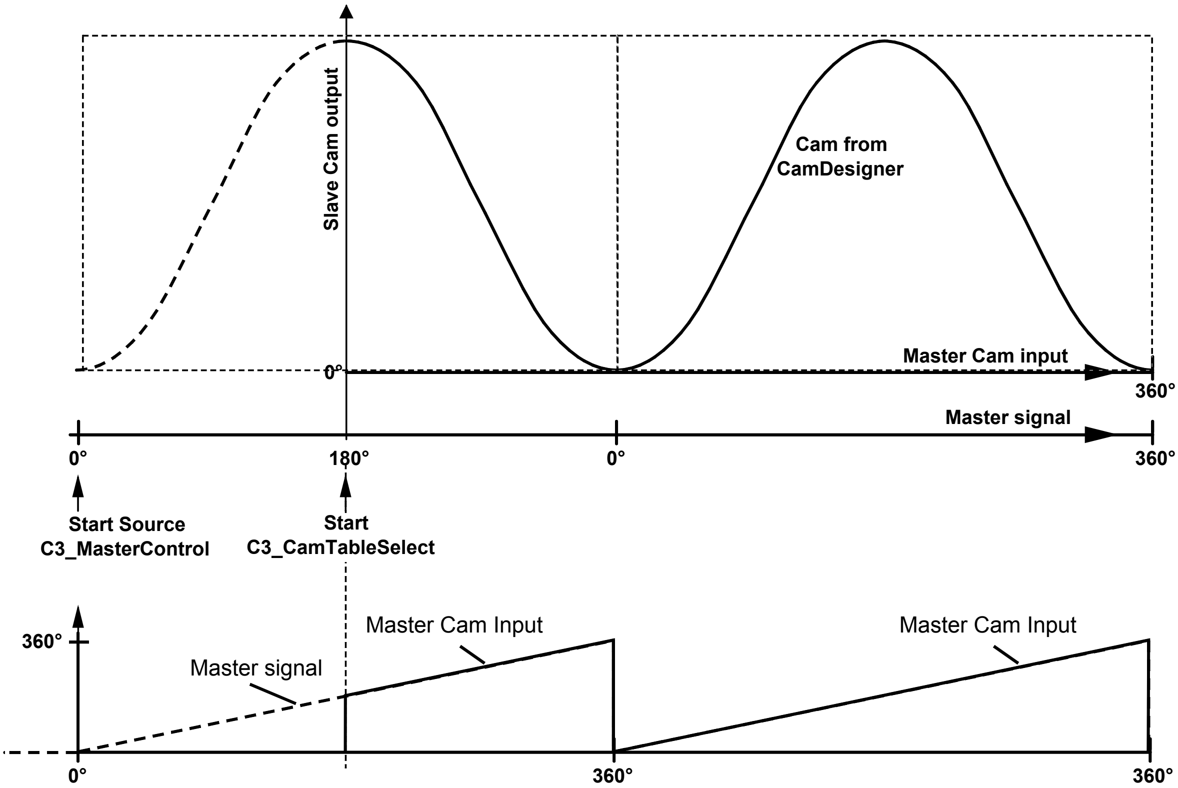
Master Cam input: Master signal at the curve input (C3Cam.StatusMaster_PositionCamUnits o3030.24)

Master signal: Master signal of the acquisition (C3Cam.StatusMaster_Position o3030.1)

Slave: Signal at the curve output (C3Cam.StatusOutput_CurvePositionUnits o3032.24)

Note:
- ◆With a relative master reference, a given curve is processed generally from the beginning, independent of the start delay (=offset).
- ◆The offset is here used as start delay.
- ◆The start of the C3_CamTableSelect can be at any position; it must however be before the start offset is reached.

Absolute master reference without offset



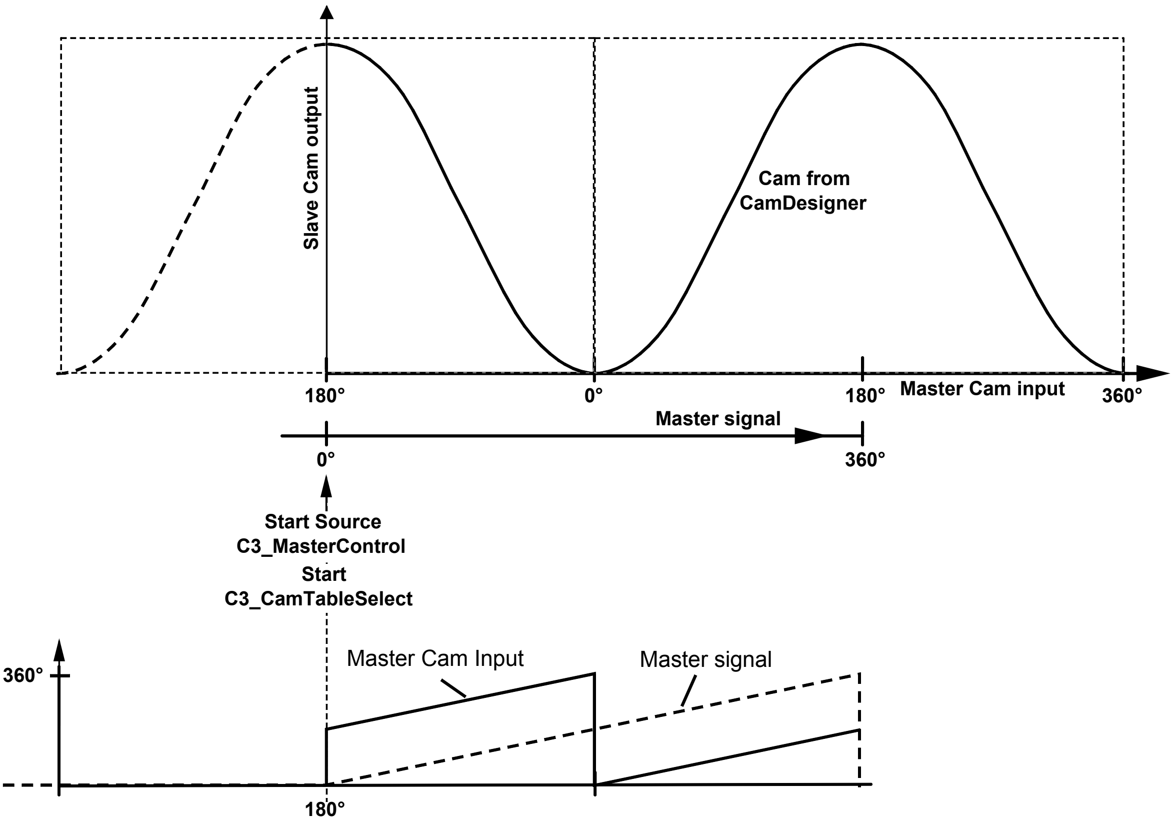
Master Cam input: Master signal at the curve input (C3Cam.StatusMaster_PositionCamUnits o3030.24)

Master signal: Master signal of the acquisition (C3Cam.StatusMaster_Position o3030.1)

Slave: Signal at the curve output (C3Cam.StatusOutput_CurvePositionUnits o3032.24)

Hint ◆ Only with absolute master reference, a given curve can be started at any position. This position corresponds to the offset value if the events "Start Source C3_MasterControl" and "Start C3_CamTableSelect" take place at the same point in time. Alternatively, you can preset the start value of the master position acquisition with the C3_SetMaster.
Typical application: Shifting an open, s-shaped curve in the master reference system.

Absolute master reference with 180° offset



Master Cam input: Master signal at the curve input (C3Cam.StatusMaster_PositionCamUnits o3030.24)

Master signal: Master signal of the acquisition (C3Cam.StatusMaster_Position o3030.1)

Slave: Signal at the curve output (C3Cam.StatusOutput_CurvePositionUnits o3032.24)

Hint

- Only with absolute master reference, a given curve can be started at any position. This position corresponds to the offset value if the events "Start Source C3_MasterControl" and "Start C3_CamTableSelect" take place at the same point in time. Alternatively, you can preset the start value of the master position acquisition with the C3_SetMaster.
  Typical application: Shifting an open, s-shaped curve in the master reference system.
- The offset is added to the current value of the master signal at the start time of CamTableSelect.

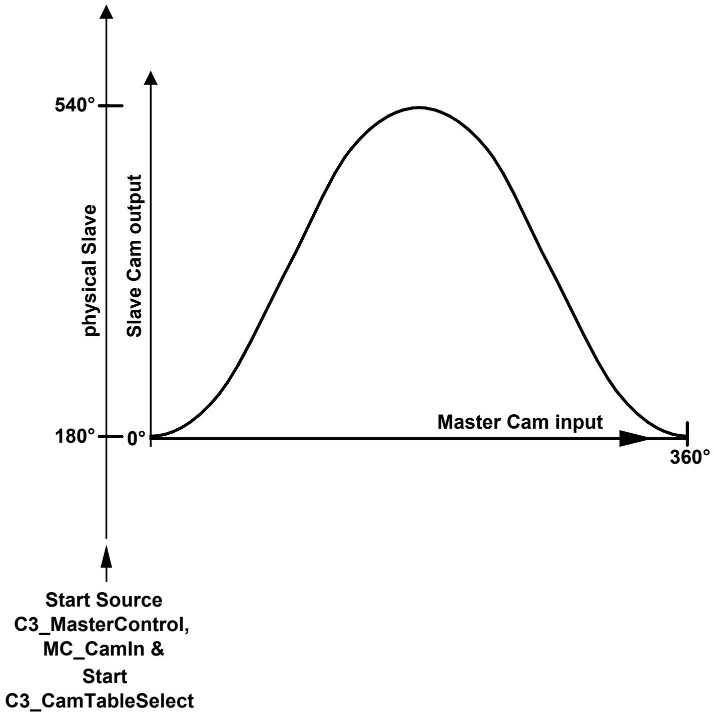
Relative slave reference

Relative slave reference can be established with MC_CamIn.

See also **application example 1** (see on page 405)

Relative slave reference example 1

Example 1: MC_CamIn is started before or upon the curve start and the master position acquisition:



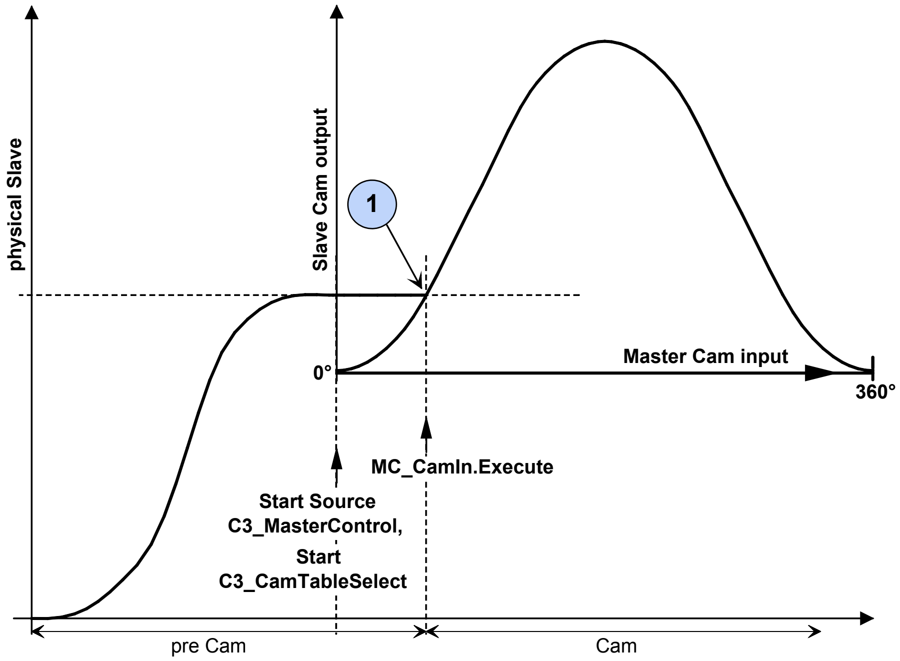
Master Cam input: Master signal at the curve input (C3Cam.StatusMaster_PositionCamUnits o3030.24)

Master signal: Master signal of the acquisition (C3Cam.StatusMaster_Position o3030.1)

Slave: Signal at the curve output (C3Cam.StatusOutput_CurvePositionUnits o3032.24)

Relative slave reference example 2

Example 1: MC_CamIn is started after the curve start and the master position acquisition:



1: Alignment of the current slave setpoint position from the curve with the current setpoint position from the history of the Execute of the MC_CamIn

Master Cam input: Master signal at the curve input (C3Cam.StatusMaster_PositionCamUnits o3030.24)

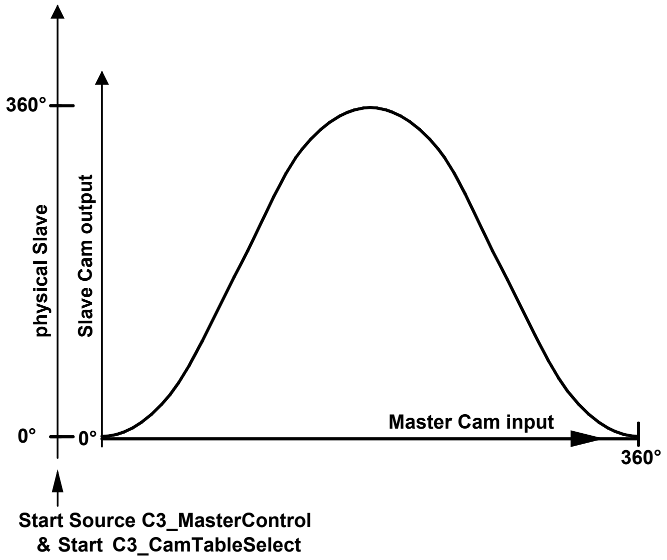
Master signal: Master signal of the acquisition (C3Cam.StatusMaster_Position o3030.1)

Slave: Signal at the curve output (C3Cam.StatusOutput_CurvePositionUnits o3032.24)

Note: If a closed curve is combined with absolute master reference, an entry with MC_CamIn at a master position > 0 will lead to a backwards movement of the axis with reference to the start point.

Absolute slave reference

Absolute reference can be established by coupling in with a coupling movement (Mode 1 or 2)



Master Cam input: Master signal at the curve input (C3Cam.StatusMaster_PositionCamUnits o3030.24)

Master signal: Master signal of the acquisition (C3Cam.StatusMaster_Position o3030.1)

Slave: Signal at the curve output (C3Cam.StatusOutput_CurvePositionUnits o3032.24)

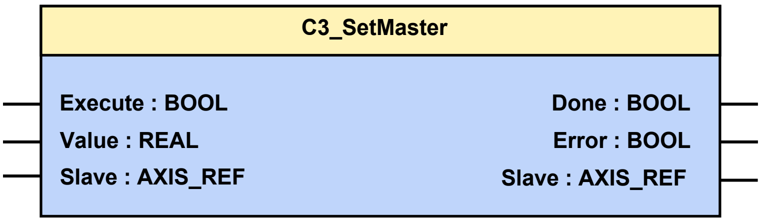
Note: The reference point and the curve zero point are always identical for absolute slave reference with C3_CamIn.

5.7.6. Master signal source

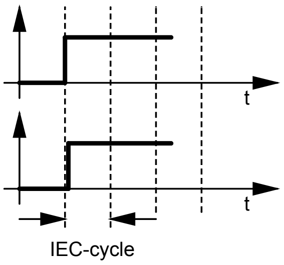
In this chapter you can read about:

5.7.6.1 Setting the position of the selected master source (C3_SetMaster)

FB name	**C3_SetMaster**	
Setting the master position		
VAR_IN_OUT		
Sub	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Start setting sequence
Value	REAL	Start value
VAR_OUTPUT		
Done	BOOL	Setting sequence finished successfully
Error	BOOL	Setting the master failed
Note: ◆ Setting the value is possible: ◆ without having selected a curve. ◆ during master position acquisition. ◆ The SetMaster function can only be executed, if the axis is not synchronized (not in "Synchronized Motion") ◆ SetMaster intrrupts the connection with the curve generator (see in the **signal image** (see on page 360)). ◆ If the "Value" is greater than the current reset distance, the value is allowed for in the reset distance.		



Timing for Execute / Done:



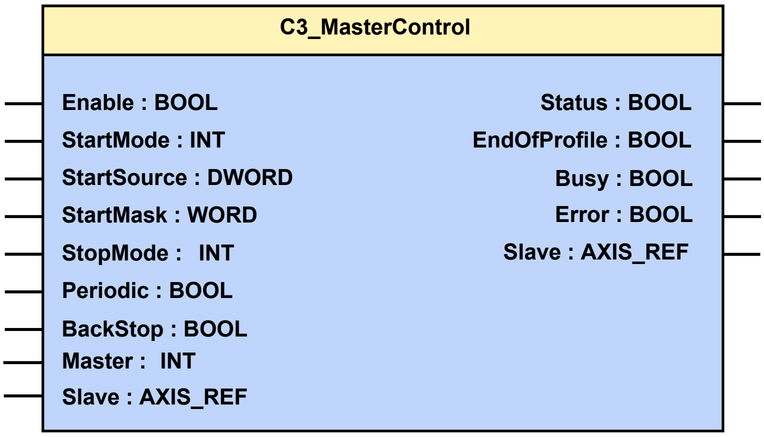
"Done" comes immediately after the execution of the module.

5.7.6.2 Recording the position of the selected master source (C3_MasterControl)

FB name	**C3_MasterControl**	
Start and Stop of the master detection		
VAR_IN_OUT		
Sub	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Enable	BOOL	Starting the module Acquisition is started or stopped depending on the Mode
StartMode	INT	Selecting the Start Mode 1: Start of the detection with rising edge of the enable 2: Fast start after external event (Impulse). Defined by “StartSource” and “StartMask”, , does start within 0.5ms. 3: Start of the acquisition with the next encoder zero pulse, after the start of the modules (Enable = TRUE)
StartSource	DWORD	Specification of an object (see example) for starting the acquisition. Only relevant with StartMode 2. The address operator ADR () must be used to select an object.
StartMask	WORD	Binary mask for and-linking the source in order to select a bit from the source object. Only relevant with StartMode 2.
StopMode	INT	Selection of the Stop mode 1: Stops the acquisition with falling edge of the Enable 2: Stops the detection at the end of the master clock distance. Defined via the curve or via **C3_MasterConfig** (see on page 380).
Periodic	BOOL	False: run through curve once Stops the acquisition at the end of the master clock distance (defined via the curve or via C3_MasterConfig) True: Cyclic run
BackStop	BOOL	False: Backstop not active True: Back stop active
Master	INT	**Axis- ID of the Master signal source** (see on page 298) AXIS_REF_HEDA: HEDA AXIS_REF_Physical: +/-10V, Step/Direction / Encoder AXIS_REF_Virtual: virtual master
VAR_OUTPUT		
Status	BOOL	Shows that the master position acquisition is running
EndOfProfile	BOOL	Impulse at the end of the configured master cycle
Busy	BOOL	Waiting for an external event
Error	BOOL	Command was aborted; error when starting the detection

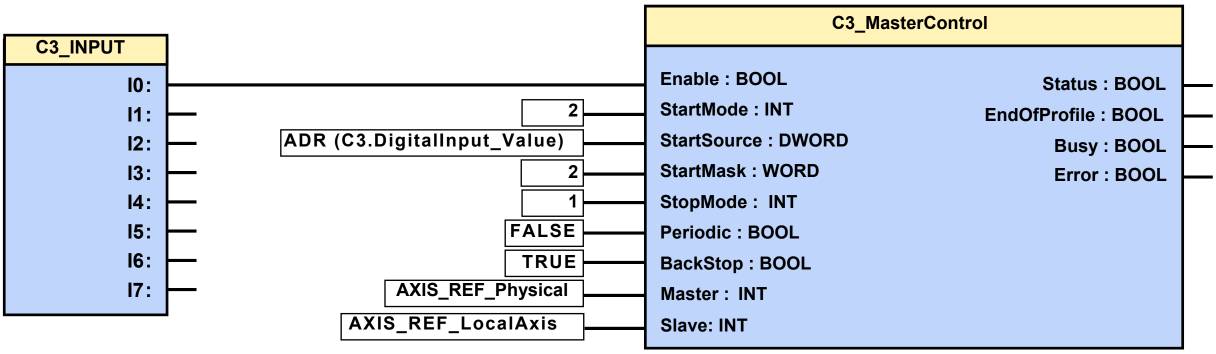
Note:

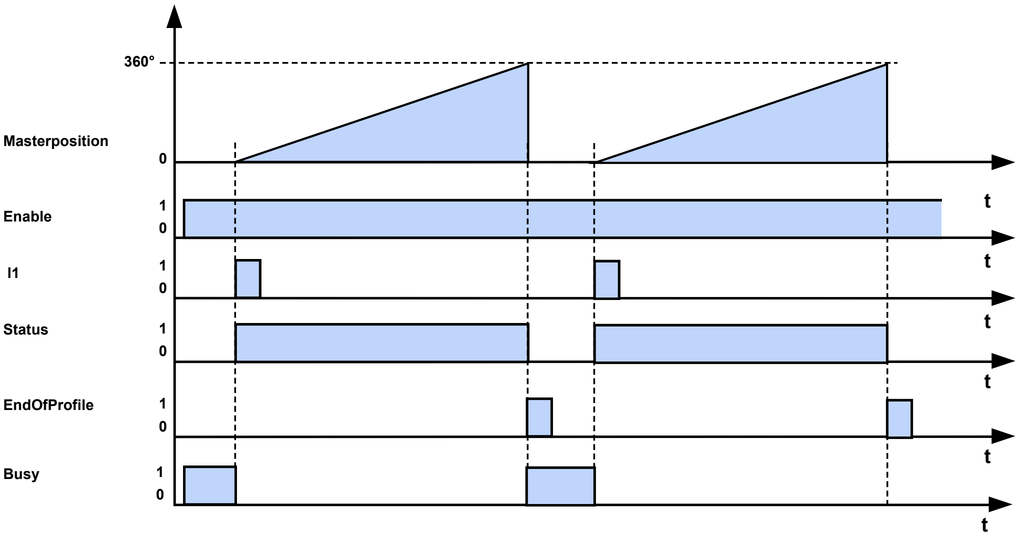
- With the active enable, the "Periodic" and "Master" inputs are always accepted.
- With the transition Enable low to high the StartMode is evaluated.
- With the transition Enable high to low the StopMode is evaluated.
- Only one module controlling the detection is allowed in the project.
- Enable and StartSource must have different sources.
- For drift free operation in single operation on the master acquisition side (input "Periodic" = FALSE) or upon multiple stops of the the master acquisition at the end of the cycle (StopMode=2), the “LastSegment” input must be = TRUE in the (last) curve (C3_CamTableSelect module). Furthermore, the sum of the individual master segment lengths must be equal to the master clock distance or its integer multiple for several linked curves (sum master cycle until LastSegment = n * master clock distance (n=1,2,...)). In the event of a single curve, the Mastercycle input must be open or the “Mastercycle” input must correspond the the master clock distance. See example 1: Single start of a closed cam



Example 1:

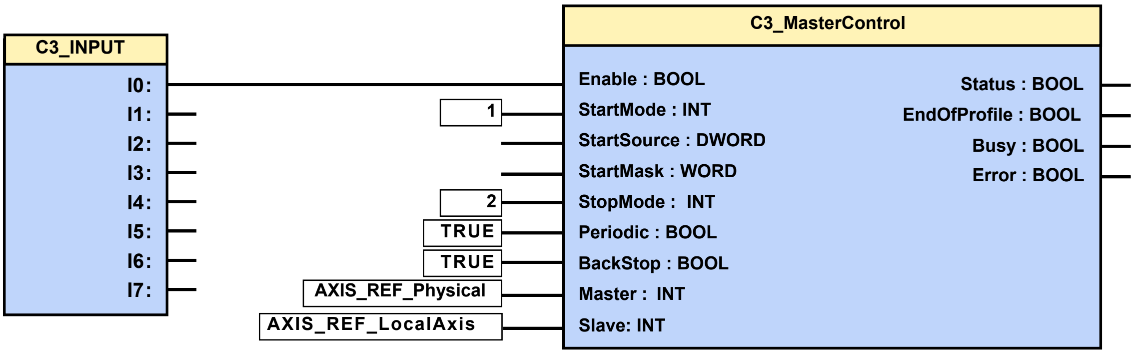
- ◆Enable of the master position acquisition with input I0.
- ◆Start of the detection with an external event = rising edge at the I1 input. Input I1 is selected via the object "C3.DigitalInput_Value”. The input I1 is placed on Bit 1 (counting from 0), as a result the input "StartMask” receives the value 2.
- ◆Detection runs in single mode.

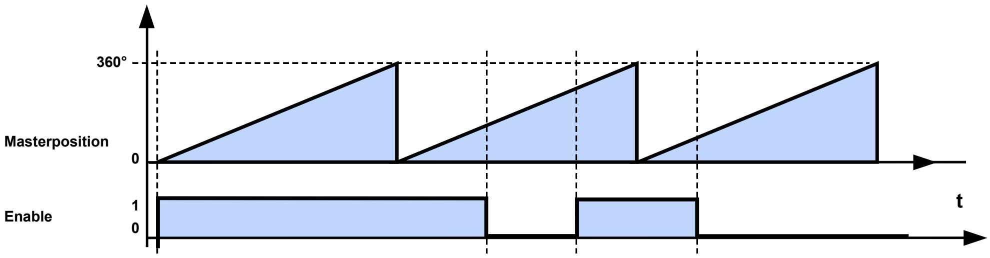




Example 2:

- StopMode=2: Acquisition stops at the end of the master clock distance
- If "Enable" is deactivated within the master clock distance and is re-activated before the end of the master clock distance, the acquisition will continue undisturbed.





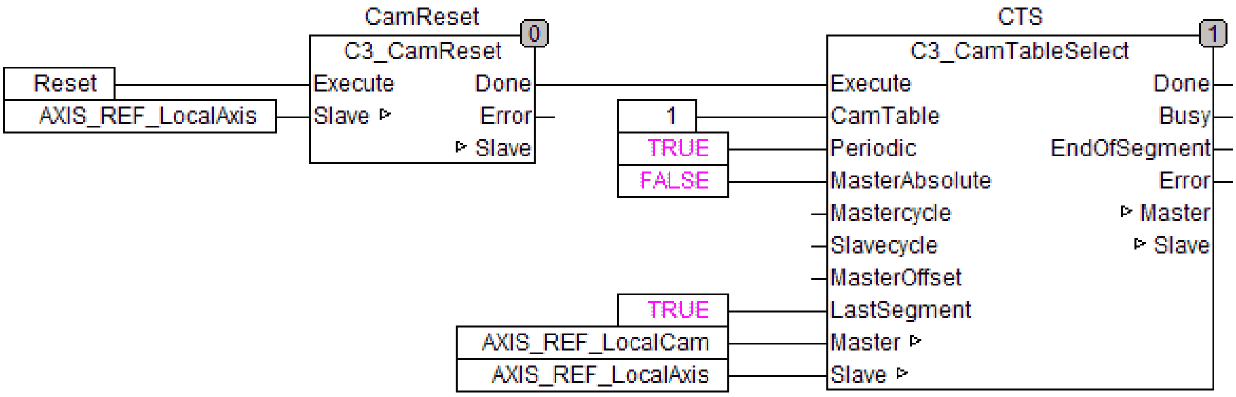
Cam operation with STOP or Error

The master position and the curve are not influenced by a STOP or an error of the axis.

The detection and the curve generation continue; this means that the curve output is also available in the case of an error.

If the curve is to be restarted after a STOP or an error without consideration of the previous history, the “**C3_CamReset** (see on page 379)“ module must be executed after stop or error before the first calling up of a “C3_CamTableSelect“.

Example:



5.7.6.3 Control of the cam generator (C3_CamTableSelect)

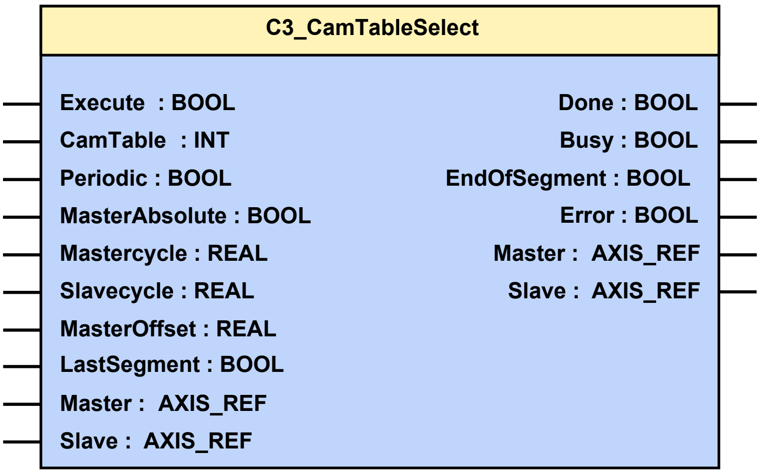
FB name	**C3_CamTableSelect**	
Control of the curve generator		
VAR_IN_OUT		
Master	INT	Axis ID; constant: AXIS_REF_LocalCam
Sub	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Curve selection with positive edge
CamTable	INT	Curve number (beginning with 1)
Periodic	BOOL	=FALSE: run through curve once (Single operation) is only evaluated in the last curve segment (it is therefore also possible to link several curves without gaps with “Periodic” = FALSE - cam operation is only left after the last curve). =TRUE: cyclic curve passage (Periodic operation)
MasterAbsolute	BOOL	Select master reference of the curve FASLE = relative TRUE = absolute
Mastercycle	REAL	Value of the master segment distance [physical units] 3 decimal places are considered.
Slavecycle	REAL	Value of the slave segment distance [physical units] 3 decimal places are considered.
MasterOffset	REAL	**Absolute operation:** Offset at the start of the master position acquisition **relative mode:** Start delay, the master position acquisition starts if the master signal exceeds this value positively, see in the **signal image** (see on page 360). **If the input is open or upon input value -999, the curve starts with Execute (without delay)**
LastSegment	BOOL	Resets the display, see in the **signal image** (see on page 360) and is used as reference signal for coupling. Must be set on the last segment within the master clock distance for driftless operation in single operation on the master side (see module C3_MasterControl and example 1: Single start of a closed cam)
VAR_OUTPUT		
Done	BOOL	Change of curves finished
Busy	BOOL	Waiting for change of cams
EndOfSegment	BOOL	Impulse at the end of a curve even if no Execute is present
Error	BOOL	Command aborted Error when selecting a curve or during master connection

Note:

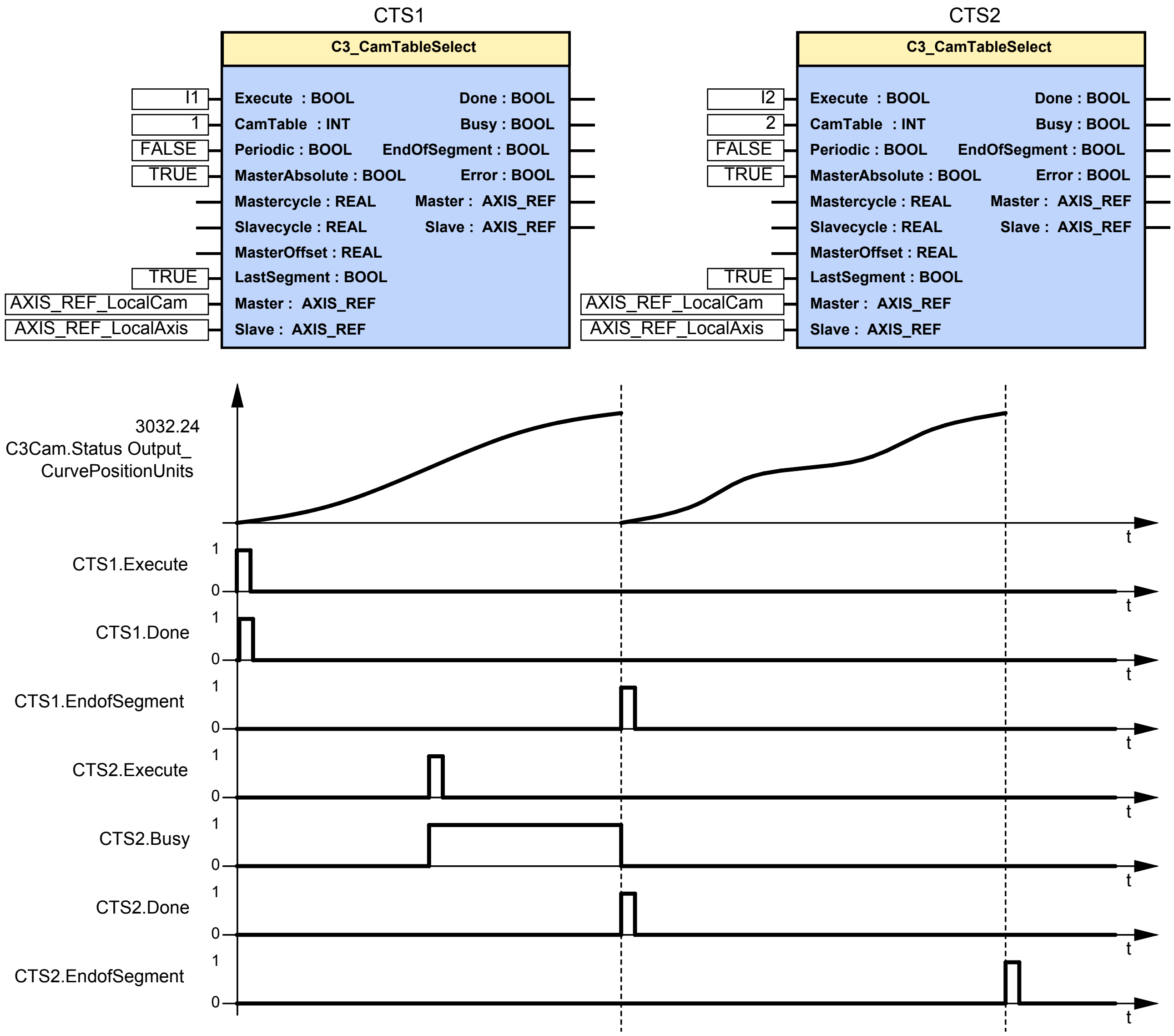
- If the inputs “Mastercycle” and “Slavecycle” are not assigned, the master cycle is accepted by the configuration and the highest feed of the selected curve is taken as slave cycle (see **curve types** (see on page 348)).
- If the MasterAbsolute input stands on TRUE (absolute), the switch to the curve generator is closed with the CamTableSelect and the curve aligns to the master position detection.
  The MasterOffset functions as Offset for the master position acquisition;
  Input not assigned means MasterOffset = 0.
- If the MasterAbsolute input stands on FALSE (relative), the switch to the curve generator is closed with the CamTableSelect and the curve does not align but begins on the master side at 0.
  The MasterOffset works as start delay; the curve starts only when the master (O3030.1) has traveled further than this value in the positive direction. If the master offset is larger than the effective master position, the curve start will only take place in the next master cycle (after its reset).
- If the curve runs in single mode, only direct coupling with MC_CamIn is sensible.
- If the curve runs in single mode and the master runs periodically, it is only sensible to have the curve run relative to the master.
- After running through the curve in single mode, the drive changes from the “Synchronized Motion” state back to the “Standstill” state, i.e. after a SingleStart a positioning is possible.
- An Execute during a curve cycle leads to a curve change at the end of the curve cycle. The “MasterAbsolute” and "MasterOffset" inputs are not evaluated. If the status of the “Periodic” input of the segment currently in progress was FALSE (single operation), a curve change will nevertheless be executed.
  Please note: If, (for instance by bouncing an input), an execute signal is followed by another excute signal, a new change of curve is already triggered.
- With relative master reference (MasterAbsoute=FALSE) with start delay, the change of curve is already executed (Done=TRUE), if the master signal has not yet reached the Masteroffset (start delay).
- In the event of error message 0xFFE2: Error in the IEC61131-3 program sequence. Function module was called with incorrect parameters: CamTable<1 or CamTable>C3Cam.StatusData_SegmentsInFlash
- If the curve is to restarted after a STOP or an error without consideration of the previous history, the “**C3_CamReset** (see on page 379)“ module must be executed after stop. The execution of the C3_CamReset turns all outputs of the C3_CamTAbleSelect to FALSE.

Limitations when linking curves

- When using several C3_CamTableSelects in order to link curves, the same curve may not be used twice after the first curve segment.



Example / Timing diagram



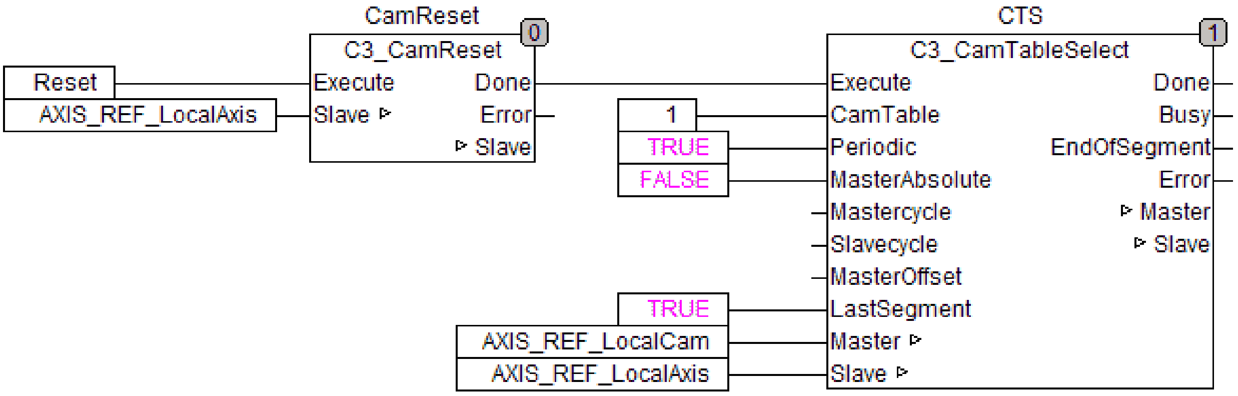
Cam operation with STOP or Error

The master position and the curve are not influenced by a STOP or an error of the axis.

The detection and the curve generation continue; this means that the curve output is also available in the case of an error.

If the curve is to be restarted after a STOP or an error without consideration of the previous history, the "**C3_CamReset** (see on page 379)" module must be executed after stop or error before the first calling up of a "C3_CamTableSelect".

Example:



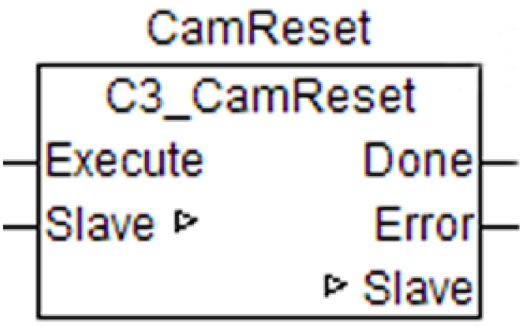
5.7.6.4 Reset curve generator (C3_CamReset)

FB name	**C3_CamReset**	
Resetting the curve generator into its original status after PowerOn and after abortion of the curve operation (e.g. by STOP or Error) **Please note:** Only one instance of C3_CamReset is required per axis!		
VAR_IN_OUT		
Axis	INT	Axis ID (Library constants)
VAR_INPUT		
Execute	BOOL	Resetting the curve with a rising edge on this input
VAR_OUTPUT		
Done	BOOL	Cam generator reset is executed
Error	BOOL	Error while resetting the cam generator

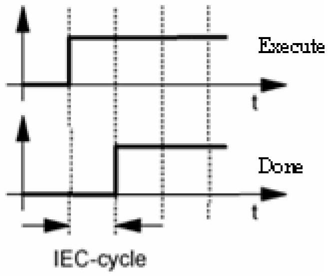
Note:

- C3_CamReset does not cut the connection to the cam generator (S2 is opened), stops a MC_Phasing in progress and resets the status objects O3030.x (not O3030.1, O3030.5, O3030.6, O3030.7, O3030.8), O3031.x, O3032.x (**signal image** (see on page 360)).
  The master position acquisition (controlled via C3_MasterControl) is NOT influenced.
- C3_CamReset must be executed before the first use of a “C3_CamTableSelect” module upon a new start of the curve (output “Done” must be waited for).
- Using C3_CamReset in a device featuring a firmware older than R08-3 will lead to device error “8190 CamCommand: Unknown command or no T40. After acknowledging the error, a correct restart of the curve is also possible, the curve status objects are however not reset!
- Output “Error” is set if the module is triggered while camming (State “Synchronized Motion”) is still active or if an invalid “Axis” input value is present.

The execution of the C3_CamReset turns all outputs of the C3_CamTAbleSelect to FALSE.



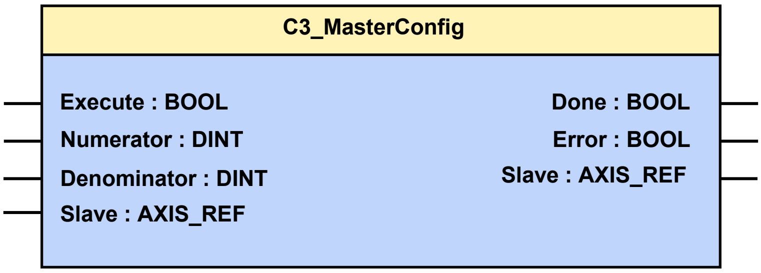
Timing for Execute / Done:



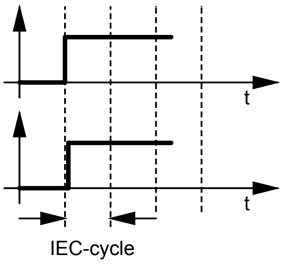
“Done” will come up one cycle after execution of the module.

5.7.6.5 Configure reset distance of the position of the selected master source (C3_MasterConfig)

FB name	**C3_MasterConfig**	
Configure reset distance of the position of selected master (does not influence the curve, only in the display object)		
VAR_IN_OUT		
Sub	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Start configuration
Numerator	DINT	Numerator of the reset distance to master position acquisition
Denominator	DINT	Numerator of the reset distance for the position of selected master source (automatically 1 with alternative master clock distance)
The reset distance is disabled with: Numerator = 0 and Denominator = 1 thus the display is no longer reset		
VAR_OUTPUT		
Done	BOOL	Configuration finished successfully.
Error	BOOL	Configuration of the master failed
Note: ◆ Module can be executed with running master. ◆ Write Flash is not executed, the changed values of the reset distance are lost when switching off. ◆ The reset distance defined via the module deactivates the previously valid reset distance of the curve, see in the **signal image** (see on page 360). ◆ For linked **curves** (see on page 411) the sum of all master segments (Numerator / Denominator) is entered as reset distance.		



Timing for Execute / Done:



"Done" comes immediately after the execution of the module.

5.7.6.6 Master signal phase shift (C3_Phasing)

FB name	**C3_Phasing**	
Time-related superimposition of the master position with an additional relative distance (PhaseShift). Depending on the operating mode, the motion parameters can be changed during a movement. With this, only the master signal affecting the slave via the cam is influenced, the master acquisition itself remains unchanged. PhaseShift influences the master signal before the curve; the slave moves by the resulting distance after the curve. Application: Reg synchronization on the master side.		
VAR_IN_OUT		
Master	INT	Axis ID; constant: AXIS_REF_LocalCam
Sub	INT	Axis ID; constant: AXIS_REF_LocalAxis
VAR_INPUT		
Execute	BOOL	Starts sequence of the module upon a positive edge; in the “SUPERIMPOSED_ABSOLUTE_CONT” operating mode cyclic update of the positioning parameters as long as the “Execute” remains “TRUE”.
PhaseShift	REAL	Distance for the superimposed Shift (positive and negative direction). During a superimposed Shift in ◆ "SUPERIMPOSED_ABSOLUTE" ◆ "SUPERIMPOSED_ABSOLUTE_CONT" the “distance” is considered to be an absolute Shift target with reference to the start position of the superimposed Shift (point in time of the first rising “Execute” edge where no superimposed positioning is active). For details please refer to input “Mode”. In configured unit [Units] **<Wertebereich>**[66]
Velocity	REAL	Value of the max. speed difference to the speed of the actual Shift (always positive) (is not necessarily attained) [Units/s] **<Wertebereich>**[67] In the "SUPERIMPOSED_RELATIVE” operating mode, the specification of a speed <=zero is not permitted. In the other operating modes, a negative value will be set to 0.
Acceleration	DINT	Value of acceleration (always positive)[Units/s²] **<Wertebereich>**[68]
Deceleration	DINT	Value of deceleration (always positive) [Units/s²] **<Wertebereich>**[69]
Jerk	DINT	Value of the acceleration **jerk** (see on page 316) [Units/s³] (always positive) **<Wertebereich>**[70]
JerkDecel	DINT	Value of the deceleration jerk [Units/s³] (always positive) **<Wertebereich>**[71]

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[66] Target position: -4000000 rev...4000000 rev

[67] Geschwindigkeit für Positionierung: 0; 0,00001157 Umd/s...2000 Umd/s

[68] Acceleration for positioning 0.24 rev/s² ...100000 rev/s²

[69] Deceleration for positioning:0.24 rev/s² ...1000000 rev/s²

[70] Acceleration jerk for positioning:30 rev/s³ ...125000000 rev/s³

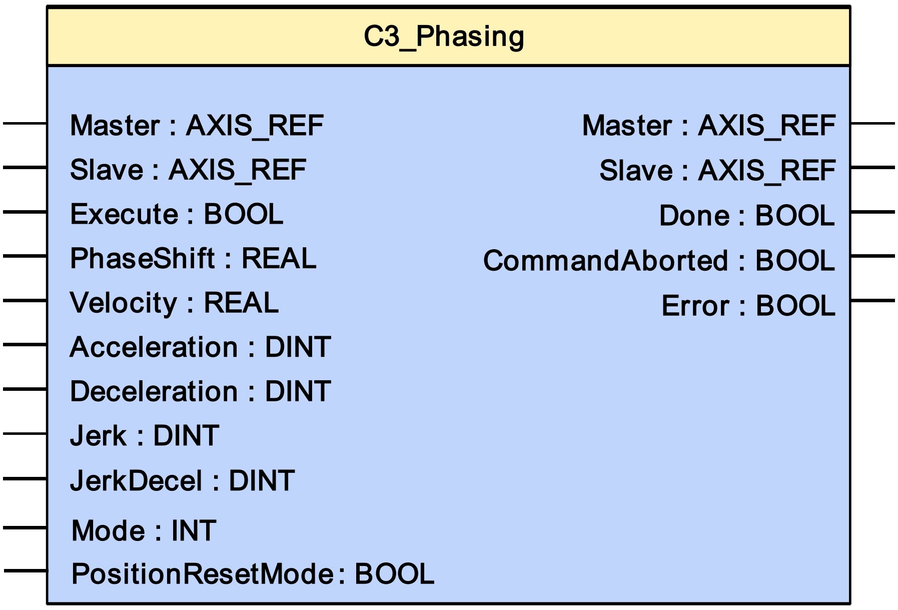
[71] Deceleration jerk for positioning:30 rev/s³...125000000 rev/s³

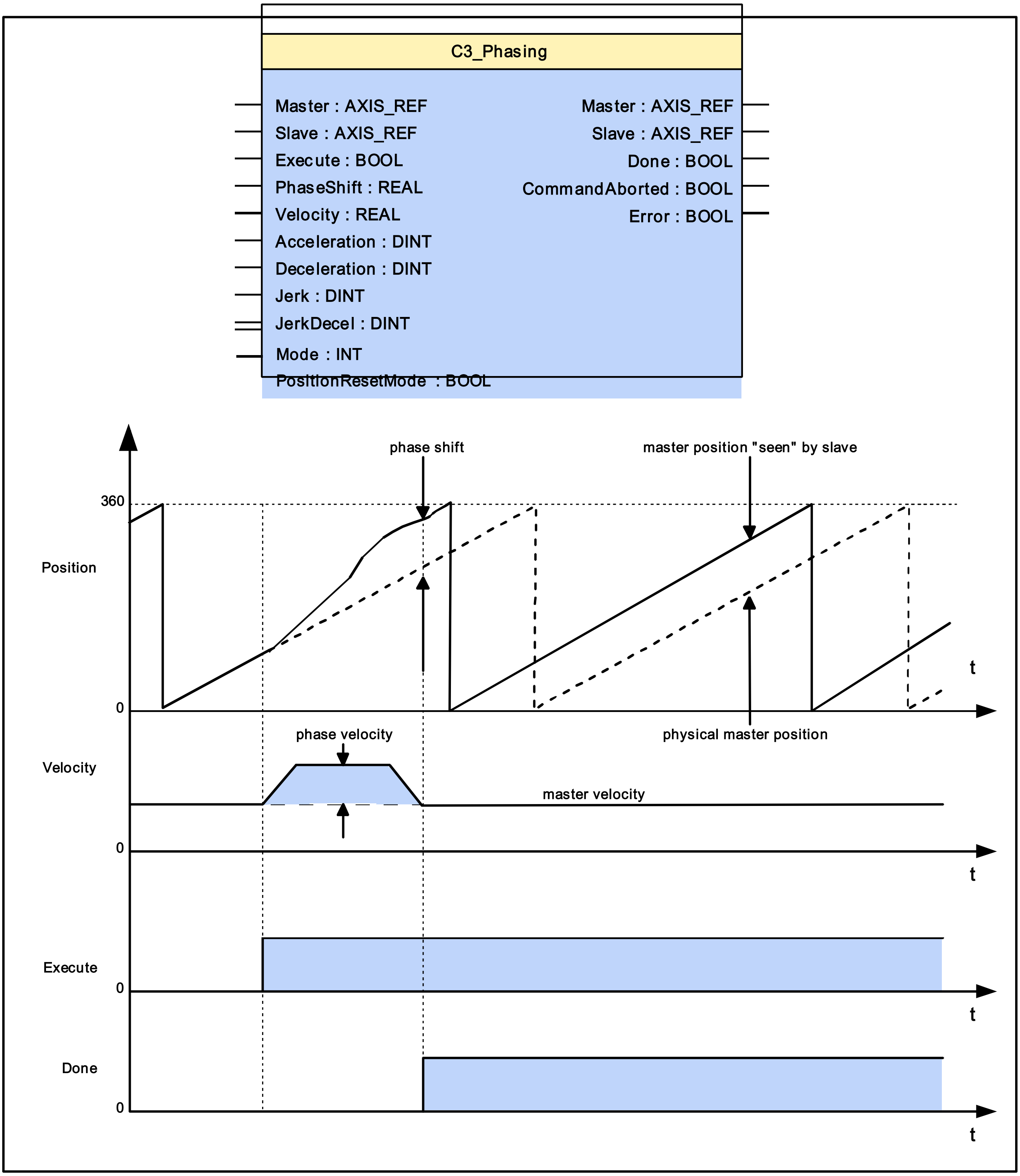
Mode	INT	**Open or "SUPERIMPOSED_RELATIVE":** With a rising edge on the Execute, a relative superimposed Shift, based on the value on input "PhaseShift” is executed at that point in time (this does also apply if a superimposed Shift is already active. **"SUPERIMPOSED_ABSOLUTE":** Upon a **not active superimposed Shift**, a relative Shift starts on the “Execute” with a rising edge. With a rising edge on the “Execute” **during an active superimposed Shift** (output “Busy” is set), the Shiftdistance based on the start points of the superimposed Shift is interpreted to be absolute. **"SUPERIMPOSED_ABSOLUTE_CONT":** corresponds to the "SUPERIMPOSED_ABSOLUTE” mode, the module inputs in each IEC cycle for the effective superimposed Shift are however accepted. **ATTENTION!** PositionResetMode = "TRUE" may only be used as from Compax3-Firmware R09-0! **Hint** The "SUPERIMPOSED_RELATIVE” operating mode corresponds to the function of the former MC_Phasing module
PositionResetMode	BOOL	**Open or "FALSE":** The demand position O680.3 (DemandValue3) is not reset. **"TRUE"**: With each new Shift (rising edge on “Execute”), the Shift target O680.3 (DemandValue3) is reset to zero. **ATTENTION!** PositionResetMode = "TRUE" may only be used as from Compax3-Firmware R09-0!
VAR_OUTPUT		
Done	BOOL	Phase shift executed
Busy	BOOL	Phase shift is being executed
CommandAborted	BOOL	Phase shift aborted
Error	BOOL	Error while executing module

Notes:

- The values PhaseShift, Velocity, Acceleration, Deceleration, Jerk, JerkDecel are only valid for the superimposed phase shift; on the axis, the values resulting from the superimposition in the master path corresponding to the effective CAM sequence are set, which will be taken into consideration in the status values.
- Upon a MC_Stop of the local axis (AXIS_REF_LocalAxis), the phase shift is not interrupted. If the shift is to be stopped, the C3_StopSuperImposed must be used.
- The module can only be used in cam operation.
- C3_Phasing does not interrupt an active command.
- This module cannot be operated with MC_/C3_MoveSuperImposed and C3_ShiftPosition at a time.
- It is possible to change modes (“Mode”) during a superimposed Shift in progress.
- If a second instance is activated in an active module with “Execute”, the instance in progress is aborted (“CommandAborted” output is set) and the second second instance acts as upon a new start of a superimposed Shift).
- With a falling edge on the “Execute” in the SUPERIMPOSED_ABSOLUTE_CONT” mode, the positioning is aborted upon a zero “Velocity” specification (if the Shift speed has reached zero) , as it can never reach its target.
- Frequent changes of the Shift target within a superimposed Shift may lead to imprecisions in the Shift in the “PositionResetMode” input is not set to “TRUE”!
- In the "SUPERIMPOSED_ABSOLUTE_CONT” mode, the sum of the specified motion parameters is internally calculated; positive value monitoring takes only place once with each rising “Execute” edge.
- If the speed is reduced to zero at the end of a Shift during setpoint generation, no new values for speed, deceleration and jerk are accepted in the absolute operating modes “SUPERIMPOSED_ABSOLUTE” or "SUPERIMPOSED_ABSOLUTE_CONT" with unchanged Shift target (input "PhaseShift".
- The position of the module in the **structure image** (see on page 542).
- The output "error" is reported if
  - the axis is in an impermissible state with a rising edge at the “Execute” input (not active, in error state, during reference run, stops or is in stop state (MC_Stop))
  - The superimposed movement stops or was stopped (by C3_StopSuperImposed) with a rising edge on the “Execute” input
  - The module was issued with invalid parameters (“Velocity” <= 0 in "Mode" SUPERIMPOSED_RELATIVE), acceleration values or jerks <= 0, input “Axis” unequal to “AXIS_REF_LOCALAXIS”, invalid operating mode (“Mode”)) upon a rising edge on the “Execute” input
  - An attempt to start the module (rising edge on the “Execute” input) is made during another superimposed movement (MC_/C3_MoveSuperImposed, C3_ShiftPosition).
  - The axis changes into error state during a superimposed movement in progress

- The “CommandAborted” output is reported if an interruption of the superimposed Shift occurred caused by
  - another module instance
  - Stops the superimposed movement by stop on the axis (MC_Stop)
  - Stops the superimposed movement (C3_StopSuperImposed)
- superimposed speed zero with falling edge on the “Execute” of the superimposed positioning is not yet completed in the "SUPERIMPOSED_ABSOLUTE_CONT” mode or if the superimposed travel command was rejected by the firmware.




C3_Phasing
Master : AXIS_REF
Slave : AXIS_REF
Execute : BOOL
PhaseShift : REAL
Velocity : REAL
Acceleration : DINT
Deceleration : DINT
Jerk : DINT
JerkDecel : DINT
Mode : INT
PositionResetMode : BOOL
Master : AXIS_REF
Slave : AXIS_REF
Done : BOOL
CommandAborted : BOOL
Error : BOOL
phase shift
master position "seen" by slave
360
Position
0
t
physical master position
phase velocity
Velocity
master velocity
0
t
Execute
0
t
Done
0
t

5.7.7. Alignment of the slave axis

In this chapter you can read about:

5.7.7.1 Start cam / coupling

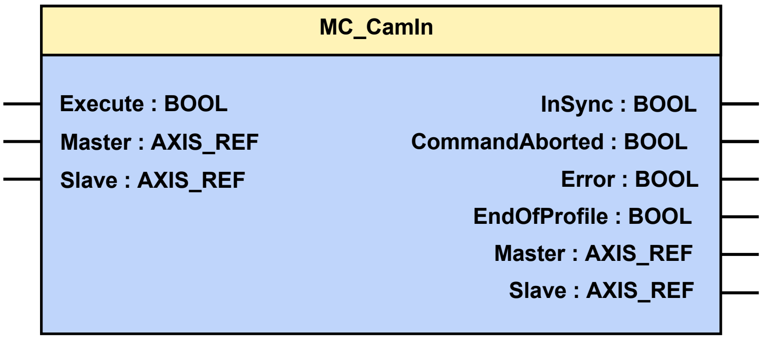
In this chapter you can read about:

Starting a selected curve (MC_CamIn)

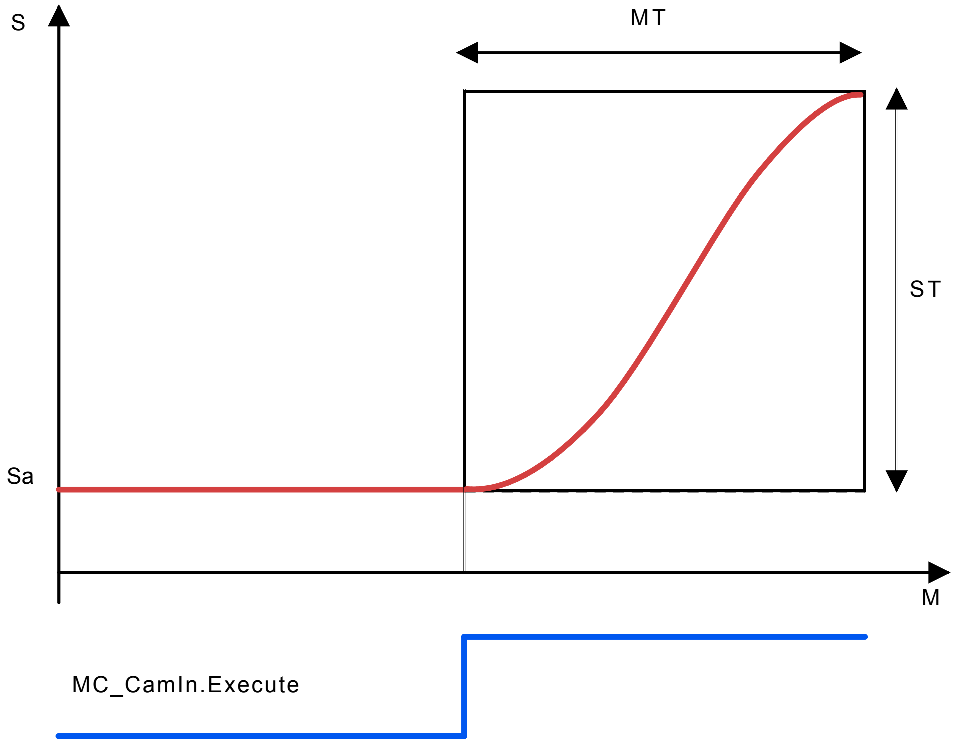
FB name	**MC_CamIn**	
Synchronization of the axis with the output of the curve generator without coupling movement		
VAR_IN_OUT		
Master	INT	Axis ID; constant: AXIS_REF_LocalCam
Sub	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Curve start with positive edge
VAR_OUTPUT		
InSync	BOOL	Synchronous operation active
CommandAborted	BOOL	Command aborted
Error	BOOL	Command aborted Error in the cam operation
EndOfProfile	BOOL	End of a cam cycle. A pulse with the length of an IEC cycle indicates the end of each cam cycle. Suitable for setting up a loop counter.

Note:

- Curve alignment:
  - Execute is followed by immediate coupling; the current curve setpoint value is adapted to the current slave setpoint value. This adapts the curve to the current position.
  - In order to avoid velocity jumps, the master should be at a standstill or the curve should have an initial gradient (slope) of 0.
- MC_CamIn can also be started by a C3_CamTableSelect, if the curve setpoint value does not jump after the start of the C3_CamTableSelect **example 6: Operation with curve segments and standstill area** (see on page 415).



Direct coupling with MC_CamIn



Sa: current slave position

MT: Master clock distance

ST: Slave clock distance

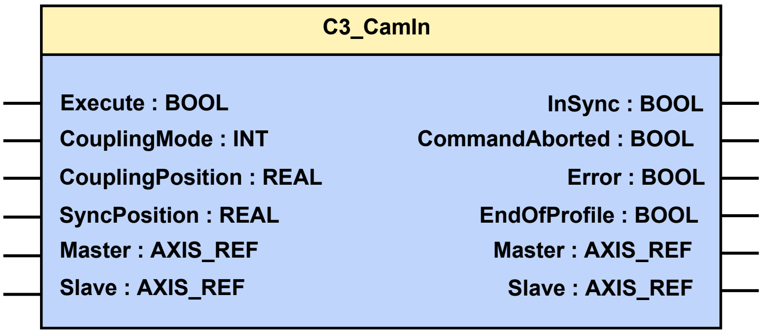
Starting a selected curve with coupling movement (C3_CamIn)

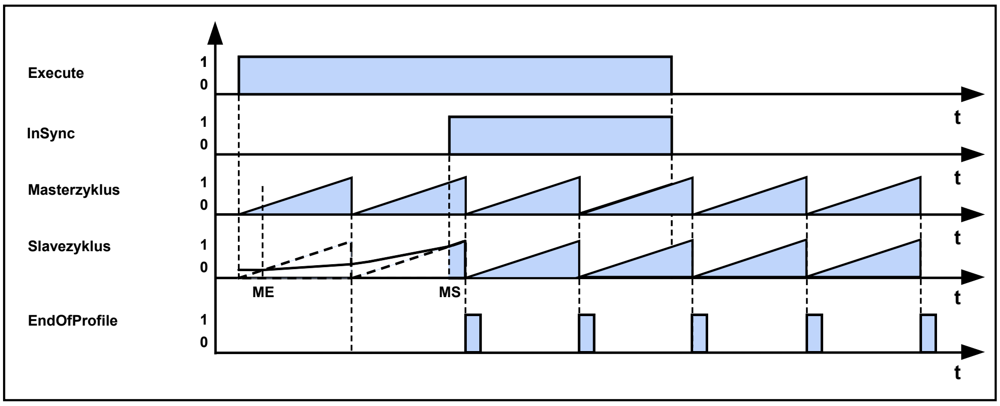
In this chapter you can read about:

FB name	**C3_CamIn**	
Synchronization of the axis to the output of the curve generator with adjustable coupling movement		
VAR_IN_OUT		
Master	INT	Axis ID; constant: AXIS_REF_LocalCam
Sub	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Curve start with positive edge
CouplingMode	INT	0 = coupling without coupling movement, after the master having traveled over the coupling position (ME) in positive direction. 1 = coupling via quadratic function; the master coupling position (ME) is calculated. 2 = coupling via changeover function.
CouplingPosition	REAL	Master coupling position (ME) in master units (is taken into consideration with CouplingMode = 0 and 2 with CouplingMode = 1, the coupling position is calculated) Value range: 0 ... n*MT
SyncPosition	REAL	Master synchronous position (MS) in master units (not relevant with CouplingMode = 0) Value range: CouplingMode 1: 0 ... MT or 0 ... Master reset distance CouplingMode 2: 0 ... n*MT
VAR_OUTPUT		
InSync	BOOL	Synchronous operation active
CommandAborted	BOOL	Command aborted
Error	BOOL	Command aborted Error in the cam operation
EndOfProfile	BOOL	End of a slave cam cycle., A pulse with the length of a IEC cycle indicates the end of each master cam cycle . Suitable for setting up a loop counter.

Note:

- Master coupling position (ME) and master synchronized position (MS):
  - With CouplingMode = 0: ME is taken into consideration, MS not relevant.
  - With CouplingMode = 1: ME is calculated internally, MS is taken into consideration.
  - With CouplingMode = 2: ME is taken into consideration, MS is taken into consideration.
- With CouplingMode =1 the curve must be constantly rising at the Master synchronous position (MS).
- Position MS must be inferior to the configured or equal to the configured master reset distance for quadratic coupling, otherwise an incorrect gradient will be calculated (MS is corrected when calculating the gradient in the value range of the master reset distance).
- If the master synchronous position MS is superior to the master clock distance MT, the coupling process will be distributed over several master cycles.
- The curve point in the synchronized position MS is not reached during coupling while C3_MoveSuperImposed is active. Coupling in is executed as if no superimposed movement were present.
- If the master runs backwards after the beginning of the coupling movement, the slave will again be at its original position after reaching the coupling position.
- Coupling from concatenated curves is possible in the “change-over” mode, if the backstop is activated or if the master does not run backwards; it is however not possible with quadratic coupling. It is assumed that the curve active at the point in time when the coupling command is given, is continuously repeated.
- With changeover, the coupling function depends on the current curve.
- The relevant master position for coupling position ME and synchronized position MS is object 3030.24 (=sum of the master distances up to LastSegment=True; value range 0..MT). Without LastSegment set on the C3_CamTableSelect module, coupling in is only possible with the first starting of the curve (after master position enable)!
- Before C3_CamIn is executed, a curve must be selected with C3_CamTableSelect.





Example with CouplingMode = 1 and C3_CamTableSelect: Periodic = TRUE.

Quadratic coupling (CouplingMode = 1)

The quadratic coupling results in a quadratic position course of the slave axis without velocity superelevation:

The synchronous position with master reference (MS) is ideally stated within the hind range of the master clock distance, so that the coupling movement takes place within one single cycle.

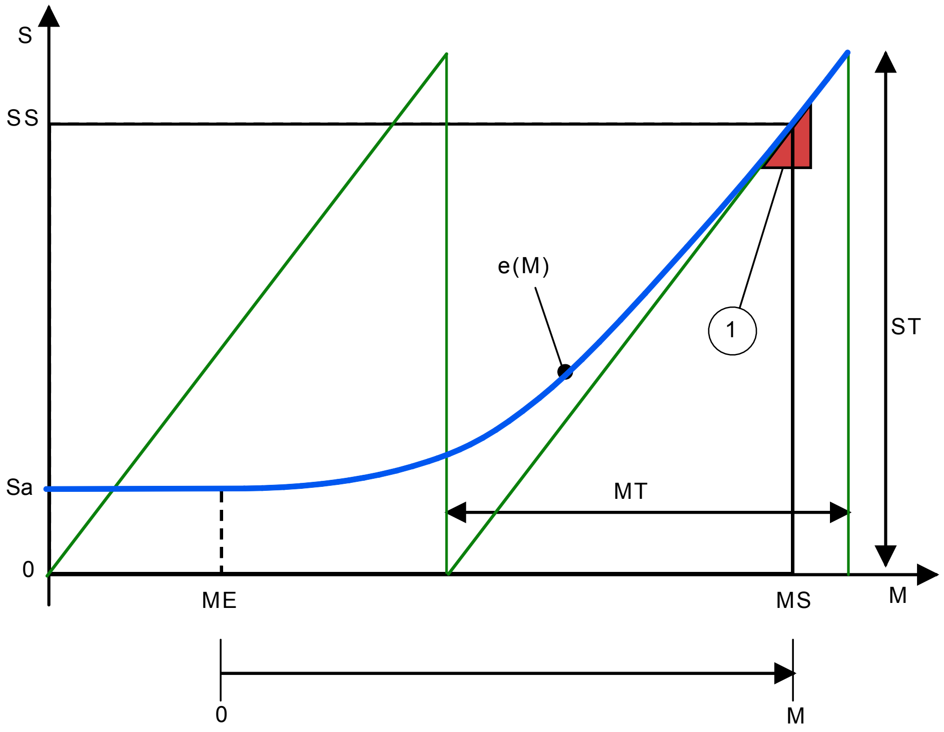
For this, the start position (activating the coupling sequence with C3_CamIn: Execute) must also be near the curve zero point.

The master-related coupling position (ME) is calculated from the slope of the curve in the synchronization point and the actual slave position (Sa) so that it results in a quadratic position course.

For this, there must be a positive slope (gradient) at the synchronization position.

The master speed must be positive, i.e. the master position must be rising.

Coupling via a slave clock distance



SS: Slave synchronization position

Sa: Current slave position before start of curve

Me: Master coupling position calculated from MS, slope in MS/SS and Sa

MS: Master synchronous position

MT: Master clock distance

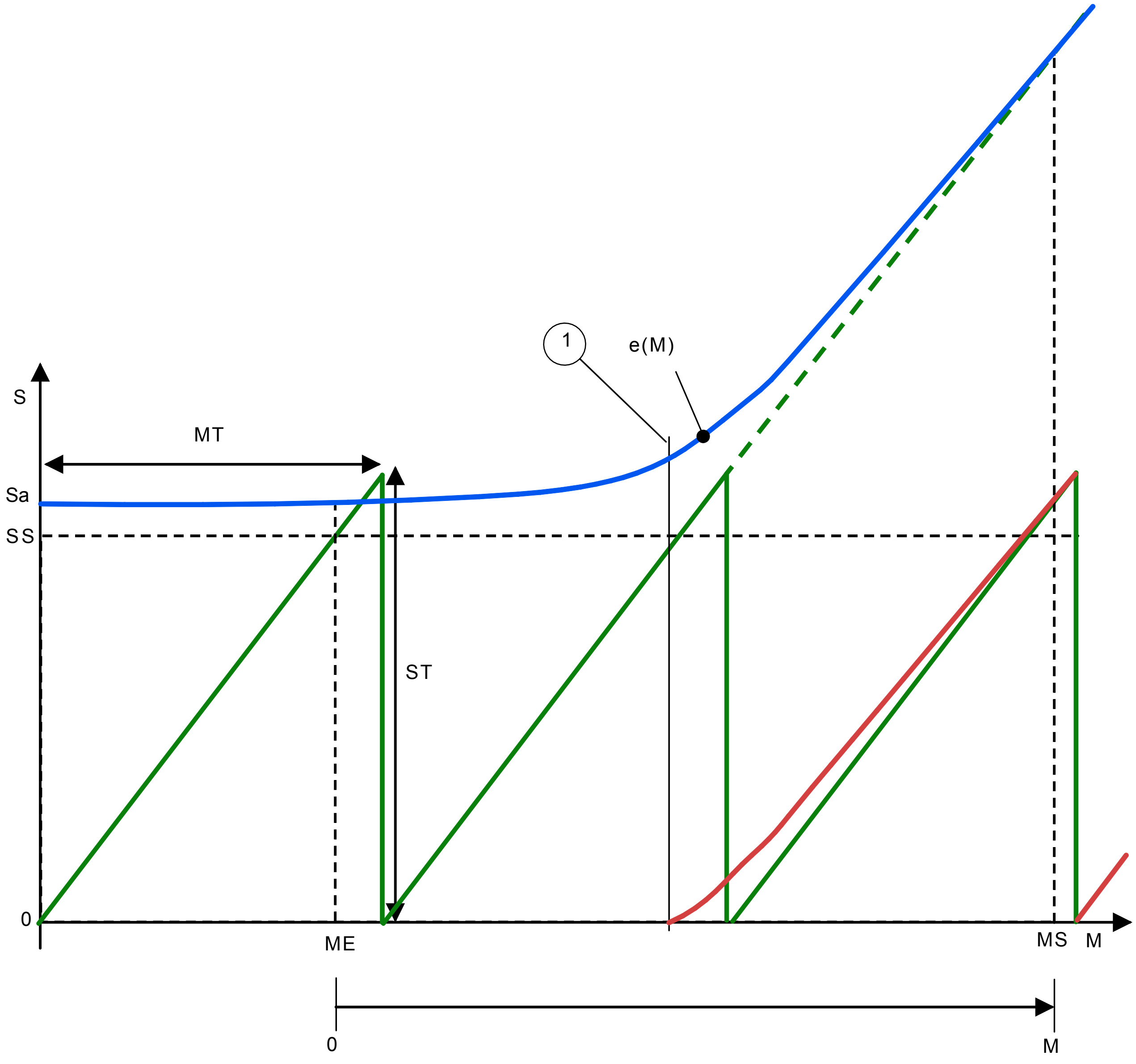
ST: Slave clock distance

e(M): quadratic coupling function

1: Gradient triangle: determines the duration of the coupling sequence (the steeper, the faster the coupling process)

Coupling over several slave clock distances

If the curve has a very flat slope in the synchronization point (MS/SS), or if the current Slave position Sa is behind the Slave synchronization position, or with a master synchronization position MS larger than the master clock distance MT, the coupling sequence takes place over several master cycles.



SS: Slave synchronization position

Sa: Current slave position before start of curve

Me: Master coupling position calculated from MS, slope in MS/SS and Sa

MS: Master synchronous position

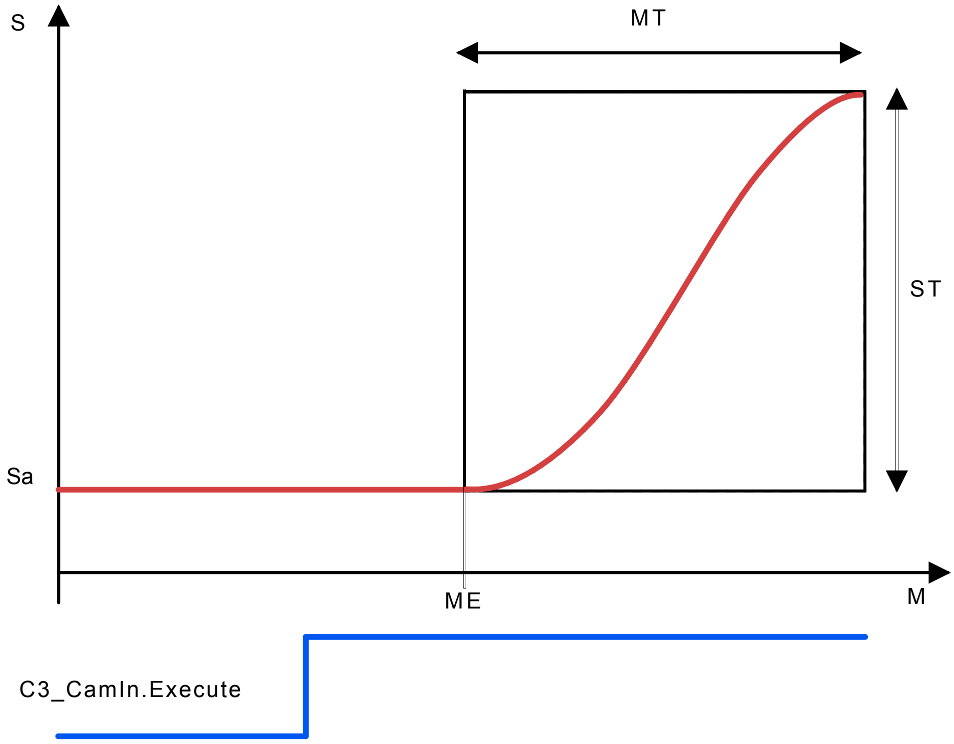
MT: Master clock distance

ST: Slave clock distance

e(M): quadratic coupling function

1: The slave setpoint value is reset at this position in the display.

Direct coupling (CouplingMode = 0)



Sa: current slave position

MT: Master clock distance

ST: Slave clock distance

After Execute of C3_CamIn the slave will only couple in from the master coupling position ME.

In order to avoid velocity jumps, the curve should have an initial gradient (slope) of 0.

Change-over (CouplingMode = 2)

When using the change-over-function, the curve setpoint value is permanently displayed during coupling, while the current slave position is permanently hidden. Overspeeding and pull-out movement are possible.

By specifying the master-related coupling and synchronization position in master units, the coupling curve is mapped to a range of any length of the curve. This means that it is no longer fixedly coupled to the curve cycle.

Algorithm of the change-over function

The normalized coupling function begins at the value 0 and end at the value 1 and rises continually in between. It is a 5th. order function.

The coupling curve does not produce a direct slave setpoint value but produces a factor KE for the weighting of the current curve setpoint value resp. the current slave position Sa (position at the start of the coupling sequence).

The course of the coupling curve depends on the slave position Sa and the course of the curve in synchronized operation.

The master speed must be positive, i.e. the master position must be rising.

The weighting is made according to the following function:

Coupling curve = SK * KE + S0 * (1 - KE)

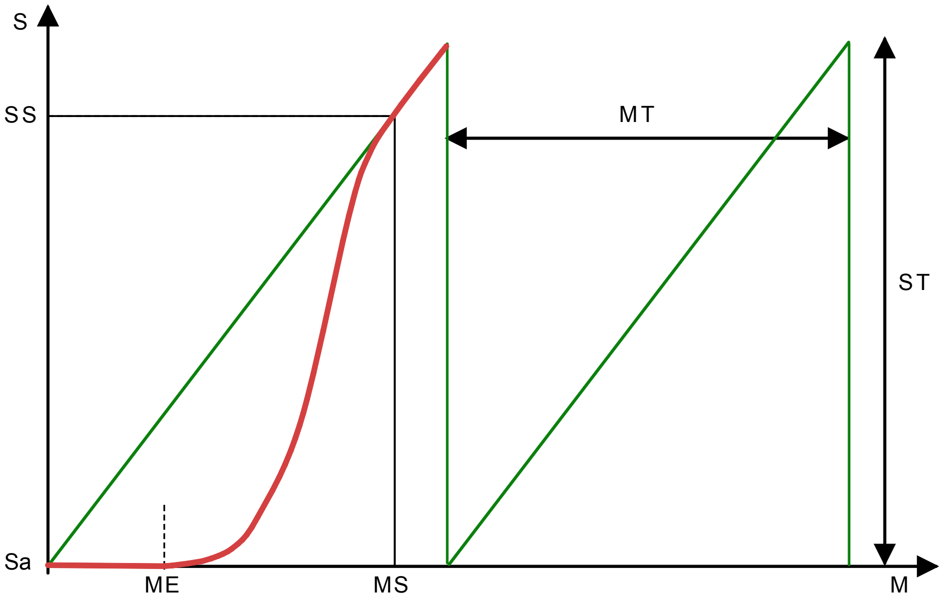
with:

S0 = standstill position

SK = current curve setpoint value

KA = control variable between 0 ... 1.0 (between ME and MS)

Example: Change-over function over a curve cycle



SS: Slave synchronization position

Sa: Current slave position before start of curve

ME: Master coupling position = 30°

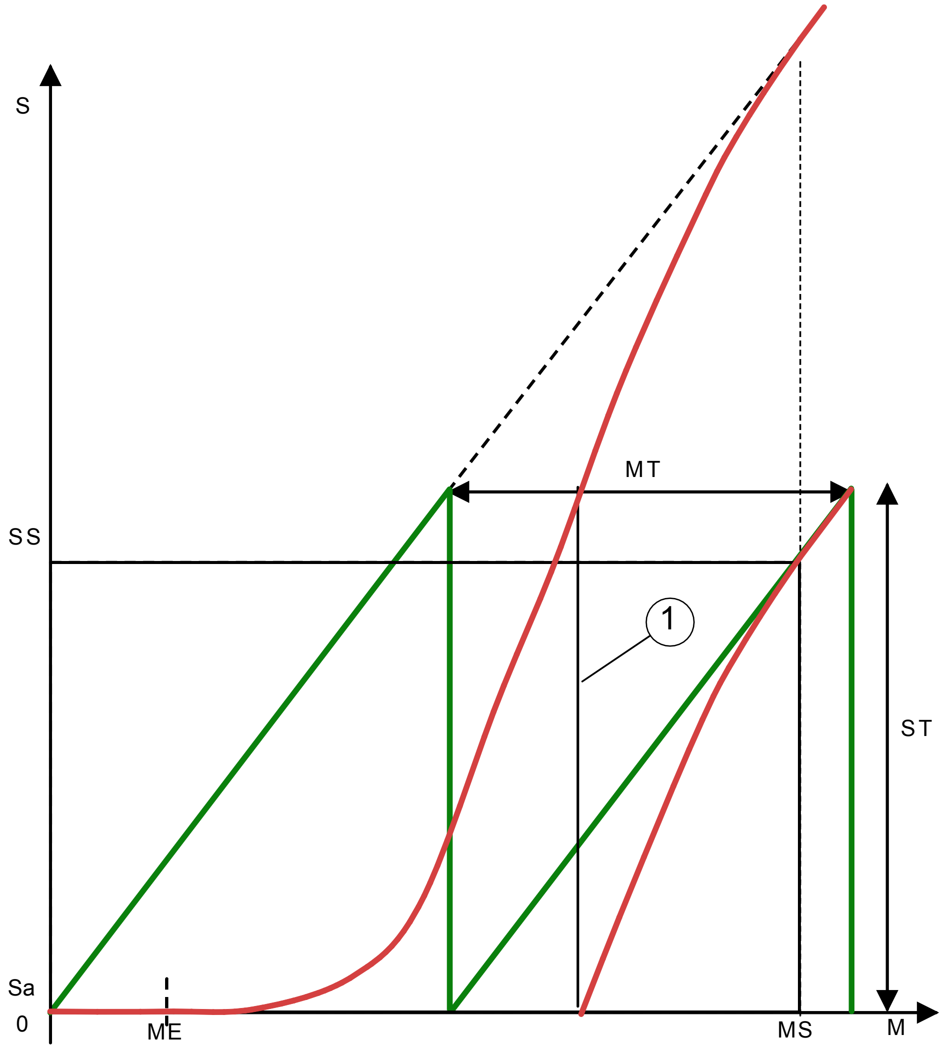
MS: Master synchronized position = 340°

MT: Master clock distance = 360°

ST: Slave clock distance

The slope (speed) of the coupling sequence shows a clear overspeeding in comparison with the synchronized run.

Example: Change-over function over several curve cycles



SS: Slave synchronization position

Sa: Current slave position before start of curve

ME: Master coupling position = 60°

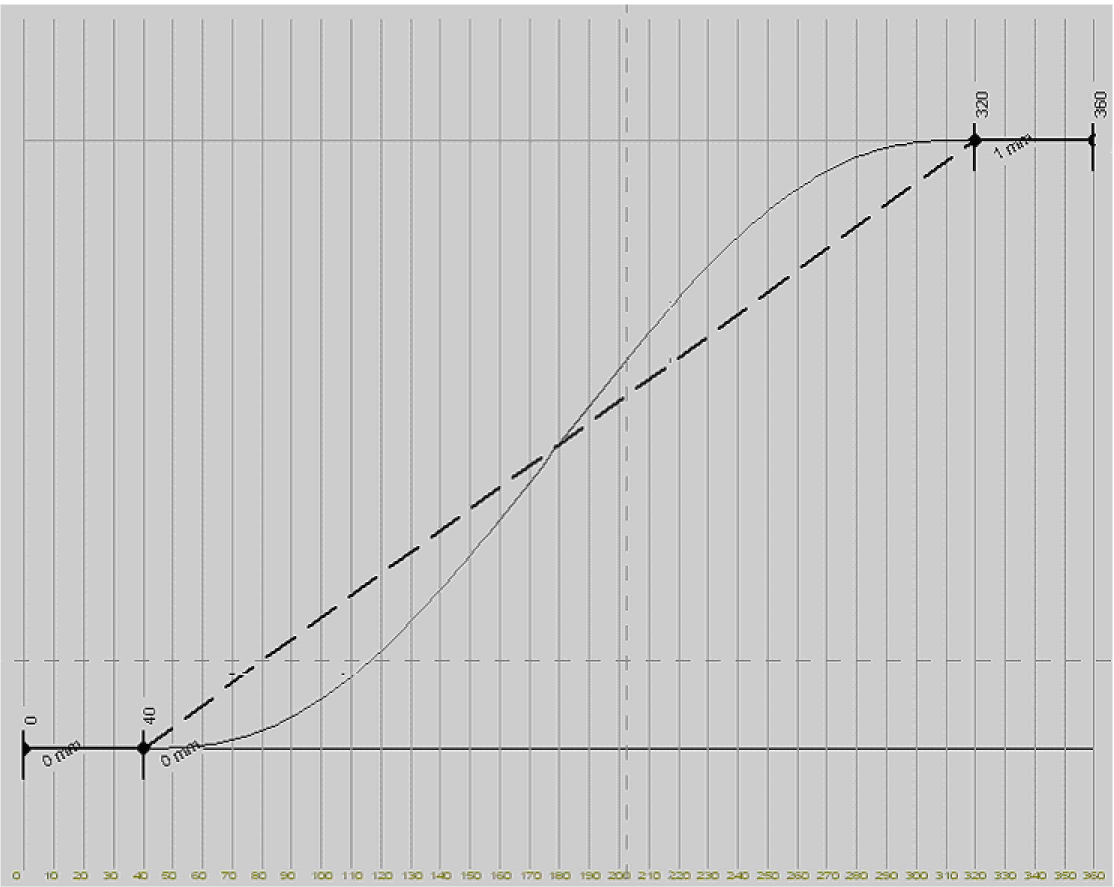
MS: Master synchronized position = 700°

MT: Master clock distance = 360°

ST: Slave clock distance

1: The slave setpoint value is reset at this position in the display.

Change-over function KE:



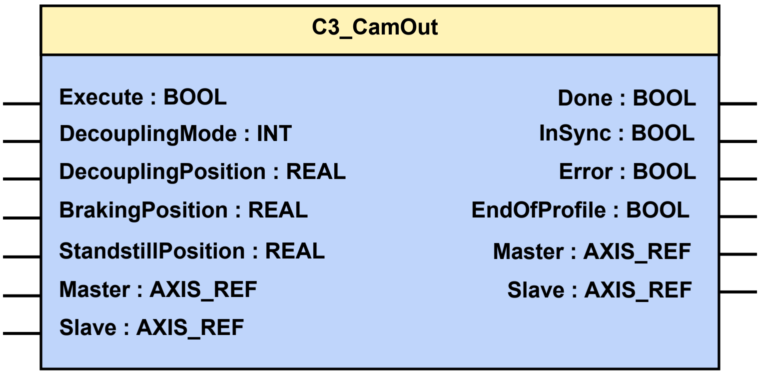
5.7.7.2 Exiting the active curve with coupling movement (C3_CamOut)

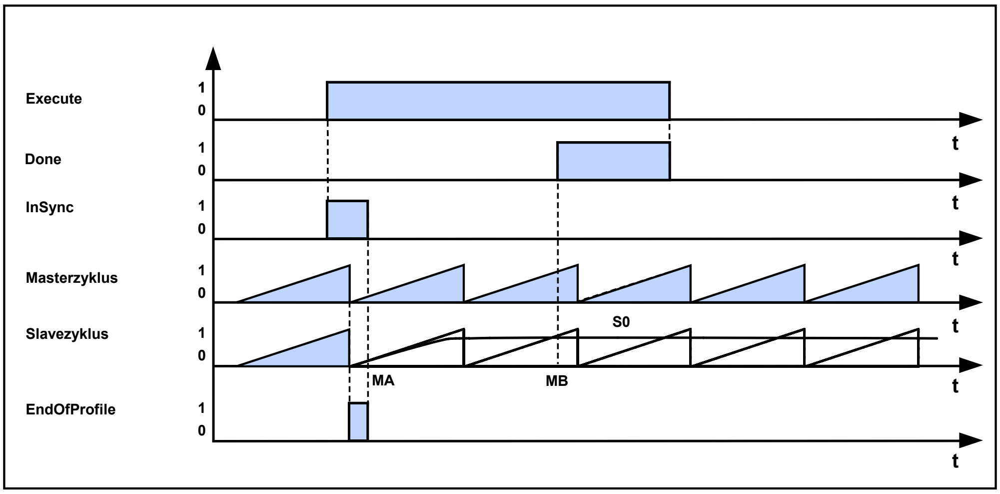
In this chapter you can read about:

FB name	**C3_CamOut**	
Decouple the active curve with adjustable coupling movement		
VAR_IN_OUT		
Master	INT	Axis ID; constant: AXIS_REF_LocalCam
Sub	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Activate the decoupling process with a positive edge
DecouplingMode	INT	0 = decoupling without coupling movement, after the master having traveled over the decoupling position MA in positive direction. (MB and S0 not relevant) 1 = decoupling via quadratic function; the master braking position (MB) is calculated 2 = decoupling via changeover function
DecouplingPosition	REAL	Master decoupling position in Master units (MA) **Range of values:** DecouplingMode 1: 0 ... MT or 0 ... Master reset distance DecouplingMode 2: 0 ... MT
BrakingPosition	REAL	Master braking position in master units (MB) (is taken into consideration with CouplingMode = 2 with CouplingMode = 1, the braking position is calculated). MB must be > than MA. Value range: 0 ... n*MT
StandstillPosition	REAL	Slave standstill position in Slave units (S0) During DecouplingMode 1 S0 should be > SA (=curve point at the "Master position MA).
VAR_OUTPUT		
Done	BOOL	Decoupling complete
InSync	BOOL	Wait for decoupling position
Error	BOOL	Command aborted Error in the cam operation
EndOfProfile	BOOL	End of the cam cycle.

Note:

- Decoupling is not possible during coupling.
- Master decoupling position (MA) and Master braking position (MB)
  - With DecouplingMode 0: MA is taken into consideration, MB not relevant.
  - With DecouplingMode 1: MA is taken into consideration; MB is calculated.
  - With DecouplingMode 2: MA is taken into consideration; MB is taken into consideration.
- The Slave standstill position is not taken into consideration with DecouplingMode = 0.
- With DecouplingMode =1 the curve must be constantly rising at the Master decoupling position (MA).
- The relevant master position for decoupling position MA and braking position MB is object 3030.24 (value range 0..MT (=sum of the master distances up to LastSegment=True)). Without LastSegment set on the C3_CamTableSelect module, decoupling in is not possible!
- Position MA must be within the limits of MT, otherwise decoupling will not be executed.
- Position MA must be inferior to the configured or equal to the configured master reset distance for quadratic coupling, otherwise an incorrect gradient will be calculated (MA is corrected when calculating the gradient in the value range of the master reset distance).
- if the master runs backwards after the beginning of the decoupling movement, the curve is accessed again after reaching the decoupling position.
- With changeover, the decoupling function depends on the current curve.
- The is no upper limit for synchronous position S0, even with active reset function. Decoupling via a slave distance > ST is therefore possible.
- Upon C3_MoveSuperimposed active during decoupling, the position S0 is not reached at the end of the decoupling process. Decoupling in is executed as if no superimposed movement were present.
- A superimposed movement executed via the C3_MoveSuperImposed from coupling in until the point in time of decoupling, is entirely or partly reversed upon quadratic decoupling or decoupling with change-over if no reset function was configured for the axis reference system.
- The StandstillPosition S0 is corrected internally during quadratic decoupling by multiple addition of the reset distance or the curve stroke with reference to the curve amplitude, so that a positive distance results for the decoupling sequence.
- Decoupling from concatenated curves is in general possible if the backstop is activated or if the master will not run backwards, with quadratic decoupling however only with the following restrictions:
  - The decoupling command must be triggered for several consecutive curves without Last Segment=True in the first curve (after a curve with LastSegment=True) and position MA must be within this curve.
  - The decoupling command must be triggered for several consecutive curves with LastSegment=True in the curve to be decoupled; position MA must also be within this curve.
- The relevant master position for decoupling position and braking position is object 3030.24.
- In the event of error message 0xFFE2: Error in the IEC61131-3 program sequence. Function module was called with incorrect parameters: DecouplingMode=2 and BrakingPosition <= DecouplingPosition





Example with DecouplingMode = 1 and C3_CamTableSelect: Periodic = TRUE.

Direct decoupling (CouplingMode = 0)

With direct decoupling, the curve operation is immediately terminated with the Execute.

In order to avoid speed jumps, the master should be at a standstill during direct decoupling or should be decoupled at a point, where the slope is 0 (constant slave position).

Quadratic decoupling (CouplingMode = 1)

The quadratic decoupling results in a quadratic position course of the slave axis without velocity superelevation or direction change.

The braking position (MB) is calculated from the slope of the curve at the decoupling point and the standstill position (S0) so that a quadratic position course is the result.

Standstill position < slave position

If the standstill position is inferior to the slave position at the beginning of the decoupling, it is corrected so that a positive travel results for the decoupling process. In this case, the decoupling process will only be completed in the following cycle.

The executed correction for S0 will be as follows:

- In slave axis reset operation, the reset distance will be added to S0 until the above condition is no longer fulfilled.
- Without a configured slave axis reset distance, the cam feed (open curve) or the maximum curve value (closed curve) of the curve active during execution of the CamOut module will be added to S0 until the above condition is no longer fulfilled. Therefore quadratic decoupling is only of limited use in such a “correction case” without reset operation. Decoupling is executed, the desired decoupling position does however no longer correspond to S0 (or its multiple).

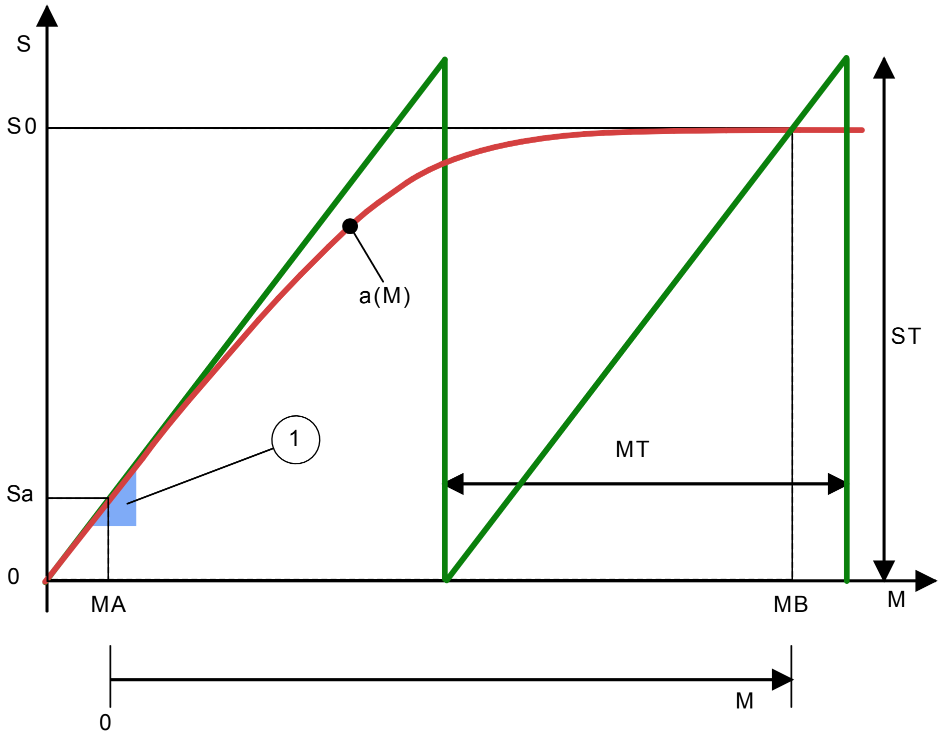
If a superimposed movement is executed by a C3_MoveSuperImposed in active curve mode (after coupling), its distance in negative curve direction will be completely reversed upon decoupling, if no slave axis reset operation is active. If no slave axis reset operation is active, only a relative correction takes place in superimposed movement in positive curve direction, as reverse movements during decoupling must be prevented (for this, S0 is internally modified corresponding to the above correction instructions). In active reset function, the decoupling distance is only influenced in the range between 0..reset distance and the reset demand position of the axis corresponds, as desired, to the (reset) specification for the decoupling position S0 if decoupling is completed.

There **must** be a positive slope (gradient) at the decoupling position.

The master speed must be positive, i.e. the master position must be rising.

Decoupling over several master clock distances

If the slope (gradient) of the curve in the decoupling point is very flat, the decoupling sequence will take several master clock distances.



S0: Slave standstill position

Sa: Effective slave position at the master decoupling position

MA: Master decoupling position

MB: Master braking position

MT: Master clock distance

ST: Slave clock distance

a(M): quadratic decoupling function

1: Gradient triangle: determines the duration of the decoupling sequence (the steeper, the faster the decoupling process)

Decoupling with change-over function (CouplingMode = 2)

The standstill position is continually displayed during decoupling, while the curve is continually hidden.

Overspeeding and pull-out movement are possible.

By the specification of the master-related decoupling and braking position in master units, the decoupling curve is mapped on any length of the curve.

If a superimposed movement is executed by a C3_MoveSuperImposed in active curve mode (after coupling), its distance will be completely reversed upon decoupling, if no slave axis reset operation is active. With activated reset function, the decoupling distance is only influenced in the range 0 .. reset distance and the reset demand position of the axis correspond to the (reset) specification for the decoupling position S0 if decoupling is completed.

Algorithm of the change-over function

The normalized coupling function corresponds to the coupling function, but it is run trough in inverse direction during decoupling. It provides factor KA, which is used for the weighting.

The course of the decoupling curve depends on the standstill position and the course of the curve in synchronized operation.

The weighting is made according to the following function:

Decoupling curve = SK * KA + S0 * (1 - KA)

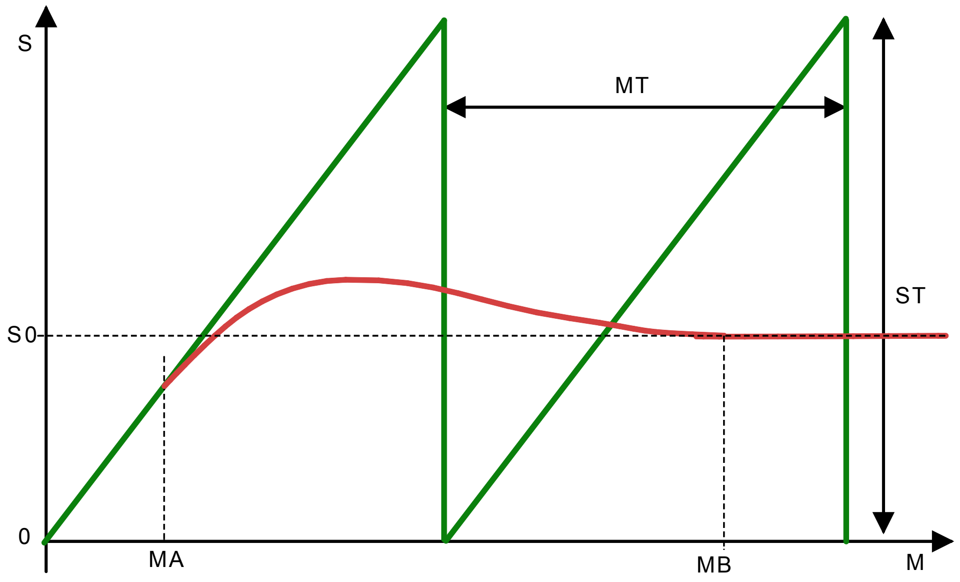
with:

S0 = standstill position

SK = current curve setpoint value

KA = control variable between 1.0 ... 0 (between MA and MB)

Example: Decoupling with the changeover-function



S0: Slave standstill position

MA: Master decoupling position = 60°

MB: Master braking position 680°

MT: Master clock distance = 360°

ST: Slave clock distance

5.7.8. 10 Steps for cam generation

In this chapter you can read about:

Example:

- Electronic Cam with 2 standstill areas,
- Master signal is the internal virtual master.

5.7.8.1 Step 1: C3 ServoManager

- Install Compax3 ServoManager (Compax3-CD 840-100005) on your PC (it is recommended to un-install all previous versions beforehand).
- Install CamDesigner (Compax3-CD 840-100005).
- You need a RS232 cable (SSK1/xx) for the connection PC - Compax3 X10.

5.7.8.2 Step 2: Connect motor.

- Motor cable to Compax3 X3
- Feedback cable to Compax3 X13.

5.7.8.3 Step 3: Supply & I/O wiring

- AC supply (1 or 3 phase) to X1
- DC supply to X4
- Device enable by 24VDC on X4/Pin3
- The following digital inputs must be assigned:

Input 0 - Pin X12/6	24V = Enable of the power output stage
Input 1 - Pin X12/7	24V = Start machine zero
Input 2 - Pin X12/8	24V = Start virtual master 0V = Stop virtual master
Input 4 - Pin X12/10	24V = select and start curve
Input 5 - Pin X12/12	24V = curve coupling
Input 6 - Pin X12/13	24V = curve decoupling
Input 7 - Pin X12/14	24V = Reset (ackn.)

5.7.8.4 Step 4: RS232 connection & C3 ServoManager

- Establish RS232 connection (cable SSk1/xx) between PC and C3 X10.
- Start C3 ServoManager

5.7.8.5 Step 5: Set Compax3 device type

- Compax3 device selection wizard, select type

or

- Type online identification

5.7.8.6 Step 6: Configuration

Start configuration in the C3 ServoManager and configure Compax3.

- Set motor
- Ballast resistor
- External moment of inertia
- Reference System
  - Unit: Grade
  - Travel distance per motor revolution numerator = 360°
  - Travel distance per revolution Denominator = 1
  - Reset distance numerator = 360°
  - Reset distance denominator = 1
- Machine zero = mode 34
- Limit sensor
- Jerk/Ramps
- Monitoring / Limits: Following error to 5°
- Encoder simulation
- Variable (Recipe) List

5.7.8.7 Step 7: Selecting Master signal source

- Open entry of signal source (left side of the tree)
- Select master signal source: virtual master
- Enter units and reset distance (360°)
- Rs485 settings

load configuration into Compax3.

5.7.8.8 Step 8: Generating the cam

Call up/process curve with the aid of the CamEditor

- Enter axis name
- Select signal source of virtual master
- Enter number of interpolation points: 360
- Enter motion law: dwell-to-dwell: "Modified Sine Line according to Neklutin"
- Start CamDesigner
- Under Menu File: New sequence. Select axis name
- Add 2 standstill areas: 0/360; 0/310; 50/360 (Path coordinate/clock angle)
- View path-time-diagram and optimize curve if needs be
- End CamDesigner via Menu:File:End
- Download of the curve into Compax3

5.7.8.9 Step 9: Create IEC program

- Start IEC development environment (in the tree on the left side under Programming: IEC61131-3 development environment
- File, enter new project name
- Set target system: CoDeSys for C3 T40
- Open program example "cd\exambles\\10StepsToCam" in CFC.
- Save project
- Project translate everything
- Download of the IEC program into Compax3 (in the C3 ServoManager in the tree on the left side under Download: IEC61131-3)

5.7.8.10 Step 10: Starting and monitoring cam

Input 0 - Pin X12/6	24V = energize Compax3
Input 1 - Pin X12/7	24V = Starting the homing run
Input 2 - Pin X12/8	24V = Start virtual master 0V = Stop virtual master
Input 4 - Pin X12/10	24V = select and start curve
Input 5 - Pin X12/12	24V = curve coupling
Input 6 - Pin X12/13	24V = curve decoupling
Input 7 - Pin X12/14	24V = Reset (ackn.)

Control status values in the IEC61131-3 - Debugger or in the oscilloscope (optimization window) (e. g. C3Cam.STATUSMASTER_Position, ...)

5.7.9. Cam applications

In this chapter you can read about:

You will find the applications described below as CoDeSys project on the Compax3 CD in the \Examples file.

Th following application descriptions can also be found on the CD in the "\Examples" file:

C3T40_A1003	Cutting on the fly with Start/Stop operating mode, registration mark reference, separation function, phase correction
C3T40_A1004	Flying knife with fixed blade circumference and variable product length
C3T40_A1005	Sync gate, registration mark reference, synchronous motion, automatic or manual travel back to start position.
C3T40_A1007	PID controller for IEC61131-3; operating P, PD, PI, PID are possible
C3T40_A1015	Gearing with Stop/Start and Phase correction

The ZIP files contain the German and English description as well as the related projects.

5.7.9.1 Example 1: Single start of a closed cam

Task:

- Closed cam (forwards and backwards) with standstill area at the beginning and at the end.
- Digital input starts run through curve once.
- Connection to virtual master.

Corresponding files:

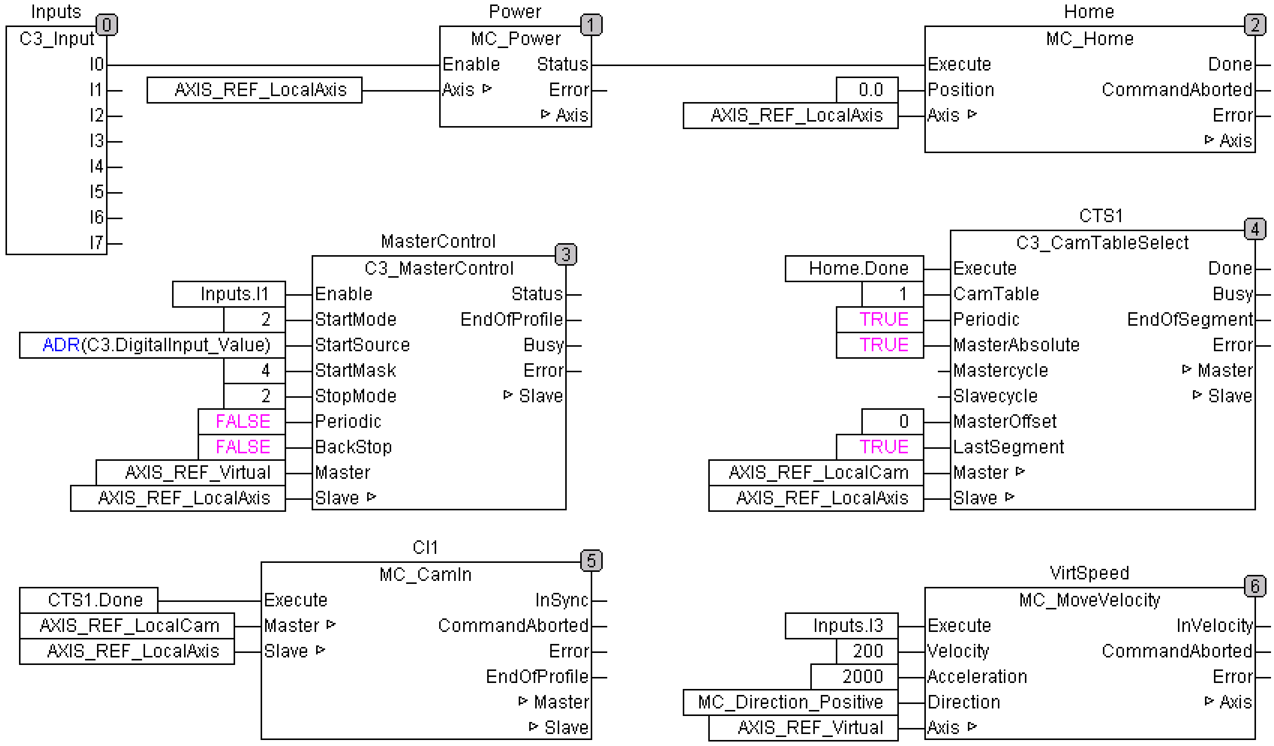
CamExample01.C3P (Compax3 project on the Compax3 CD:\Examples\Example1)

CamExample01.pro (CoDeSys project on the Compax3 CD:\Examples\Example1)

Control interface:

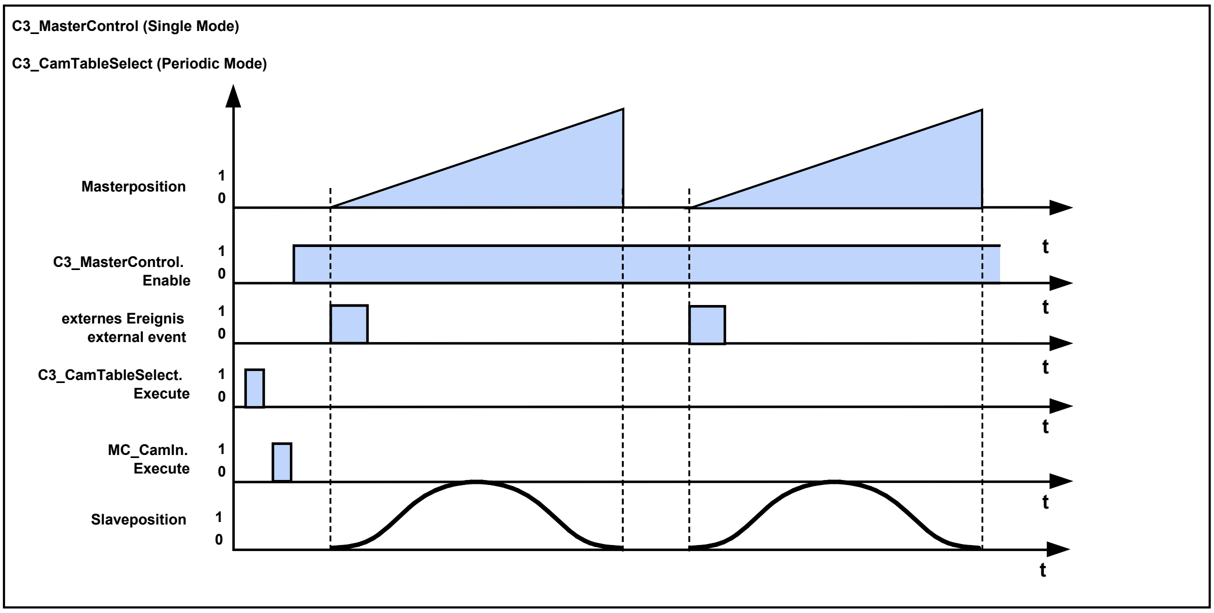
Input	**Function**
I0	Energize axis, homing, curve generator, starting and coupling axis
I1	Enable master detection
I2	Starting detection in single mode
I3	Start of the virtual master
I4	Free
I5	Free
I6	Free
I7	Free

Solution:


Inputs
0
C3_Input
I0
I1
I2
I3
I4
I5
I6
I7
Power
1
MC_Power
Enable
Status
Axis ⊳
Error
⊳ Axis
AXIS_REF_LocalAxis
Home
2
MC_Home
Execute
Done
Position
CommandAborted
Axis ⊳
Error
⊳ Axis
0.0
AXIS_REF_LocalAxis
MasterControl
3
C3_MasterControl
Inputs.I1
Enable
Status
2
StartMode
EndOfProfile
ADR(C3.DigitalInput_Value)
StartSource
Busy
4
StartMask
Error
2
StopMode
⊳ Slave
FALSE
Periodic
FALSE
BackStop
AXIS_REF_Virtual
Master
AXIS_REF_LocalAxis
Slave ⊳
CTS1
4
C3_CamTableSelect
Home.Done
Execute
Done
1
CamTable
Busy
TRUE
Periodic
EndOfSegment
TRUE
MasterAbsolute
Error
Mastercycle
⊳ Master
Slavecycle
⊳ Slave
0
MasterOffset
TRUE
LastSegment
AXIS_REF_LocalCam
Master ⊳
AXIS_REF_LocalAxis
Slave ⊳
CI1
5
MC_CamIn
CTS1.Done
Execute
InSync
AXIS_REF_LocalCam
Master ⊳
CommandAborted
AXIS_REF_LocalAxis
Slave ⊳
Error
EndOfProfile
⊳ Master
⊳ Slave
VirtSpeed
6
MC_MoveVelocity
Inputs.I3
Execute
InVelocity
200
Velocity
CommandAborted
2000
Acceleration
Error
MC_Direction_Positive
Direction
⊳ Axis
AXIS_REF_Virtual
Axis ⊳

- The curve is activated after the homing run (Home.Done to CTS1).
- After that the axis is synchronized via CS1.Done at CI1. Now the master detection can be started.
- Input I1 enables the master acquisition, which will wait for the external event (Input I2)
  In order to do this, the C3_MasterControl module: is assigned to following value: ADR(C3.DigitalInput_Value).
  In order to select the 3rd. bit from this value the input StartMask receives the value 4.
- The master acquisition runs in Single Mode and the curve generator (C3_CamTableSelect) in the Periodic, this means that the switch between the curve generator and detection is always closed, see in the **signal image** (see on page 360). With the external event (input I2) a curve cycle is run through.

Signal image:



5.7.9.2 Example 2: Change between single start of an open cam and POSA

Task:

- Open curve with standstill range at the beginning and at the end
- Digital input starts run through curve once
- Digital input starts positioning movement on slave cycle
- Connection to encoder

Corresponding files:

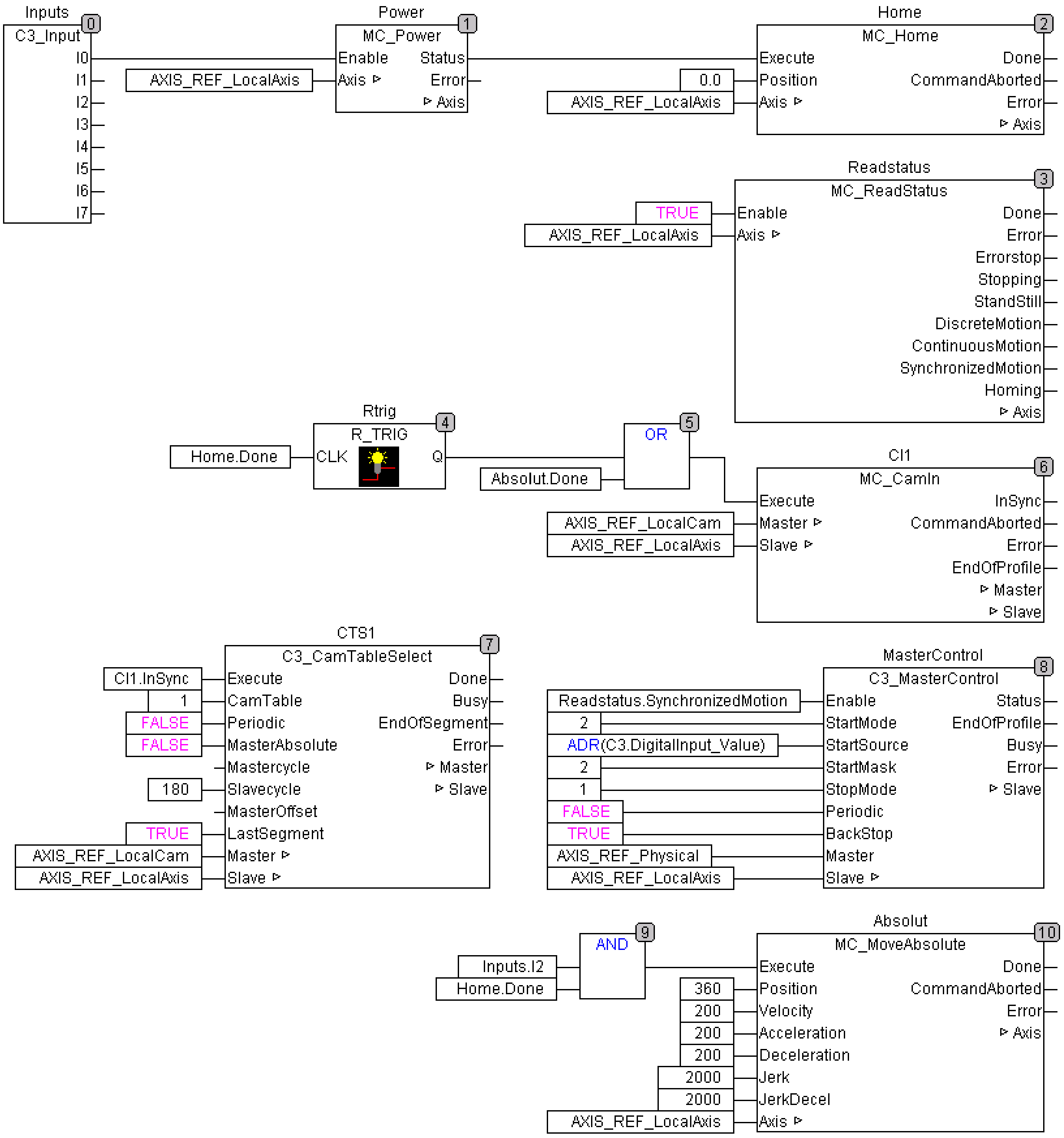
CamExample02.C3P (Compax3 project on the Compax3 CD:\\xamples\Example2)

CamExample02.pro (CoDeSys project on the Compax3 CD:\Examples\Example2)

Control interface:

Input	Function
I0	Energize axis, homing, curve generator, starting and coupling axis
I1	Starting detection in single mode
I2	Start of the absolute movement
I3	Free
I4	Free
I5	Free
I6	Free
I7	Free

Solution:



Explanation:

- The repeated turning up of the single start during the run through curve must not disturb the operation.
- Single start during positioning must not disturb, curve must not start: This is prevented by the fact that the enable of the master position acquisition is only started, if the drive is in the "Synchronized Motion" state.
- If a positioning is executed, the axis is in the "discrete Motion" state. When MC-CamIn is executed, the axis will switch into the "Synchronized Motion" state; the axis is now synchronous with the curve generator.
- Master detection is started with an external event (input I1). In order to do this the C3_MasterControl module: is assigned to following value: ADR(C3.DigitalInput_Value = object for the digital inputs). In order to select the 2nd. Bit from this value the input StartMask receives the value 2.
- The axis is coupled after Homing (MC_CamIn), then the curve generator (C3_CamTableSelect) starts, after that the master position acquisition is started via the external input (C3_MasterControl). As the output Home.Done is permanently present, this output must be put to CI1 with an edge module. This ensures that CI1 (MC_CamIn) can be activated again.
- The absolute movement is not executed in the "Synchronized Motion " status (MC_MoveAbsolut reports an error), so this is automatically blocked.

5.7.9.3 Example 3: Single Start for run through curve 5 times

Task:

- Open curve without standstill area
- Coupling / decoupling with change-over function
- Digital input for the start of 5 curve cycles (incl. coupling and decoupling cycle)

Corresponding files:

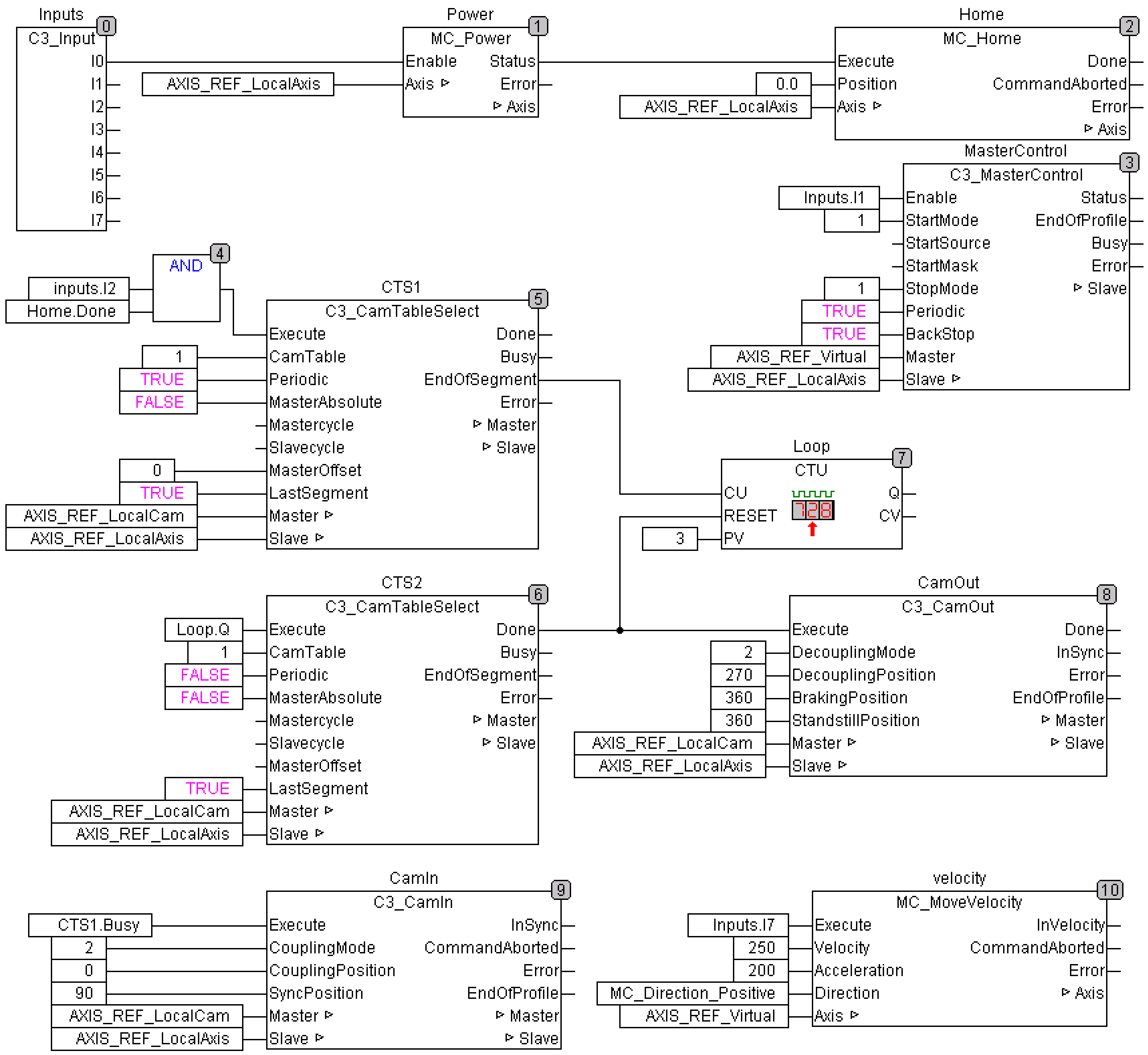
CamExample03.C3P (Compax3 project on the Compax3 CD:\Examples\Example3)

CamExample03.pro (CoDeSys project on the Compax3 CD:\Examples\Example3)

Control interface:

Input	**Function**
I0	Energize axis, Homing
I1	Enable and start of the master position detection
I2	Start of the curve cycle
I3	Free
I4	Free
I5	Free
I6	Free
I7	Start of the virtual master

Solution:



Explanation:

- Coupling from 0 on (CamIn.CouplingPosition = 0), decoupling on 360° (CamOut.StandstillPosition = 360°).
- The curve generator (C3_CamTableSelect) is started in relative Mode with the Input I2.
- with MasterOffset = 0, the next zero crossing is waited for if the master is already running.
- The busy output of CTS1 starts the coupling sequence before the selected curve is active. Only if the master position has exceeded the value 0 (CTS1.MasterOffset = 0, CTS1.MasterAbsolute = TRUE), the curve starts to run and CTS1.Done will become TRUE.
- After the 3rd. “EndOfSegment” pulse of the C3_CamTableSelect module runs through the 4th. curve. The change of cam to the single mode is then triggered with the counter module. This will become active at the end of the 4th curve, so that the curve is run through 4 times.
- If the change into the 5th. curve cycle was effected, the Done output will come up at this module (CTS2), which triggers the decoupling sequence.

5.7.9.4 Example 4: Composing curves

- 3 curves (ramp-up curve, straight line, ramp-down curve) with the same master clock distance
- digital input for single start of a curve sequence, after that standstill until the repeated start of the 3-curve sequence.

Corresponding files:

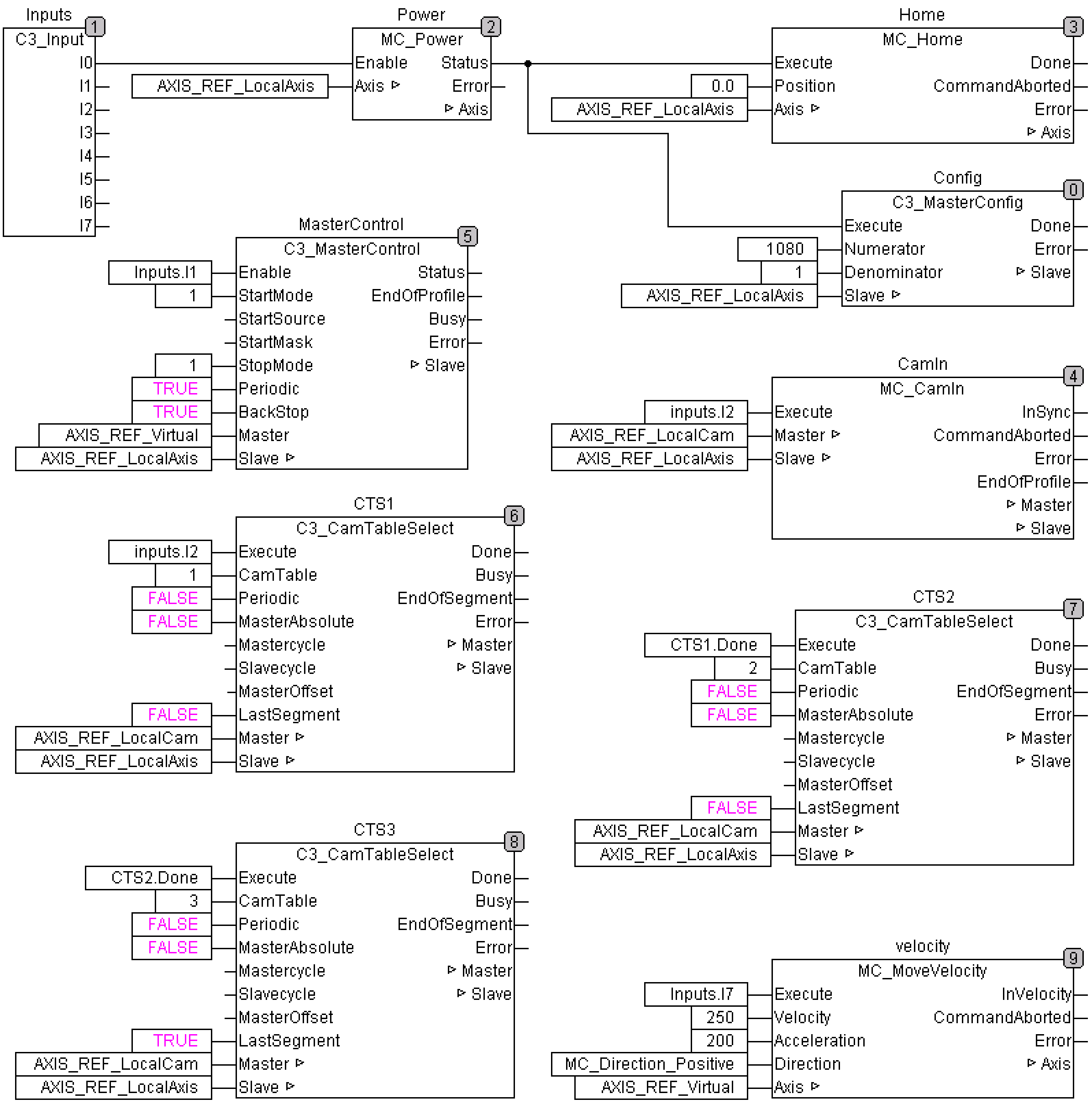
CamExample04.C3P (Compax3 project on the Compax3 CD:\Examples\Example4)

CamExample04.pro (CoDeSys project on the Compax3 CD:\Examples\Example4)

Control interface:

Input	Function
I0	Energize axis, Homing
I1	Enable and start of the master position detection
I2	Coupling and curve start
I3	Free
I4	Free
I5	Free
I6	Free
I7	Start of the virtual master

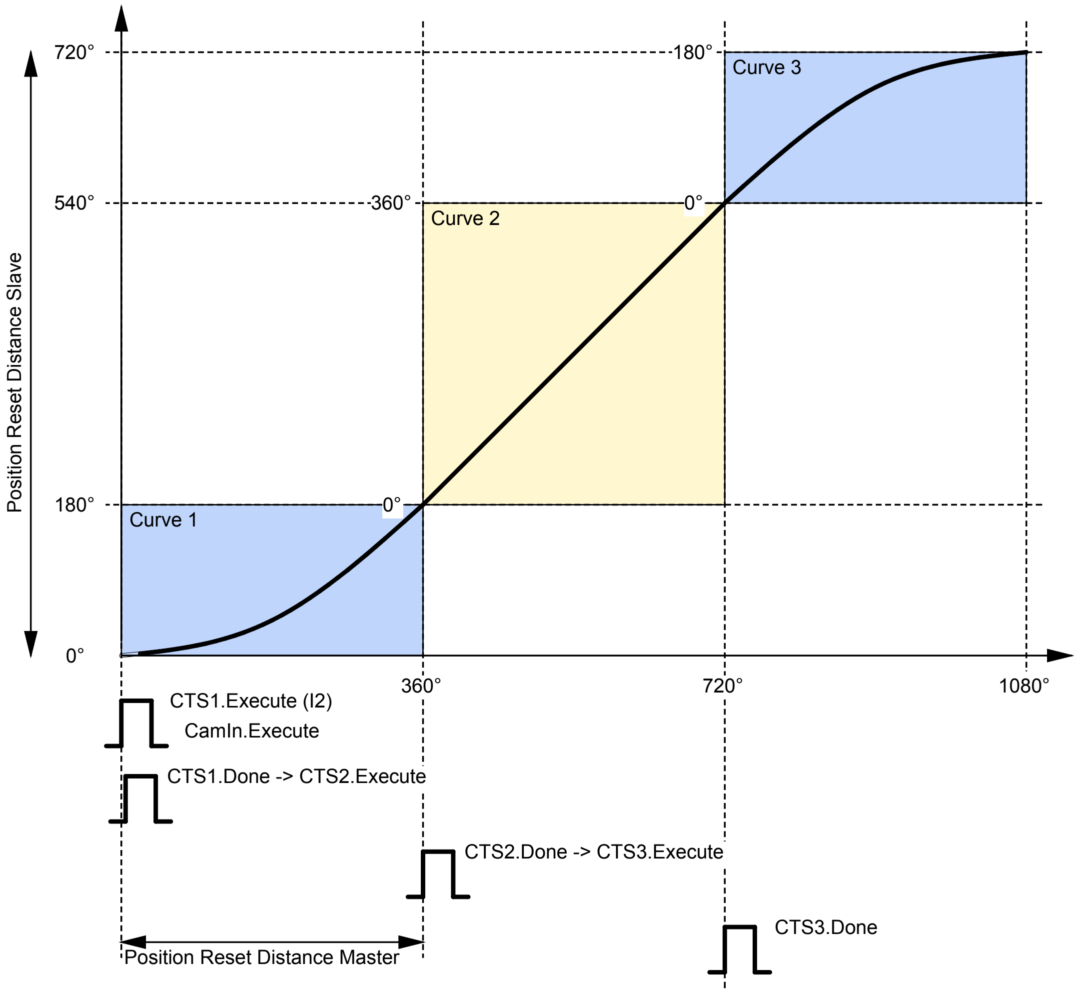
Solution:


Inputs
C3_Input
I0
I1
I2
I3
I4
I5
I6
I7
1
Power
MC_Power
Enable
Axis ⊳
Status
Error
⊳ Axis
AXIS_REF_LocalAxis
2
Home
MC_Home
Execute
Position
Axis ⊳
Done
CommandAborted
Error
⊳ Axis
0.0
AXIS_REF_LocalAxis
3
Config
C3_MasterConfig
Execute
Numerator
Denominator
Slave ⊳
Done
Error
⊳ Slave
1080
1
AXIS_REF_LocalAxis
0
MasterControl
C3_MasterControl
Enable
StartMode
StartSource
StartMask
StopMode
Periodic
BackStop
Master
Slave ⊳
Status
EndOfProfile
Busy
Error
⊳ Slave
Inputs.I1
1
1
TRUE
TRUE
AXIS_REF_Virtual
AXIS_REF_LocalAxis
5
CamIn
MC_CamIn
Execute
Master ⊳
Slave ⊳
InSync
CommandAborted
Error
EndOfProfile
⊳ Master
⊳ Slave
inputs.I2
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
4
CTS1
C3_CamTableSelect
Execute
CamTable
Periodic
MasterAbsolute
Mastercycle
Slavecycle
MasterOffset
LastSegment
Master ⊳
Slave ⊳
Done
Busy
EndOfSegment
Error
⊳ Master
⊳ Slave
inputs.I2
1
FALSE
FALSE
FALSE
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
6
CTS2
C3_CamTableSelect
Execute
CamTable
Periodic
MasterAbsolute
Mastercycle
Slavecycle
MasterOffset
LastSegment
Master ⊳
Slave ⊳
Done
Busy
EndOfSegment
Error
⊳ Master
⊳ Slave
CTS1.Done
2
FALSE
FALSE
FALSE
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
7
CTS3
C3_CamTableSelect
Execute
CamTable
Periodic
MasterAbsolute
Mastercycle
Slavecycle
MasterOffset
LastSegment
Master ⊳
Slave ⊳
Done
Busy
EndOfSegment
Error
⊳ Master
⊳ Slave
CTS2.Done
3
FALSE
FALSE
TRUE
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
8
velocity
MC_MoveVelocity
Execute
Velocity
Acceleration
Direction
Axis ⊳
InVelocity
CommandAborted
Error
⊳ Axis
Inputs.I7
250
200
MC_Direction_Positive
AXIS_REF_Virtual
9

Explanation:

- ◆ The entire curve line is 720° long, the reset distance in the slave axis configuration stands on 720° (Configuration: Reference system).
- ◆ The change of cams is triggered with the Done of the curve activated before (CTS1 ... CTS3). The Done output follows, if the change into the respective curve has been executed.
- ◆ The axis is synchronized with input I2 (CamIn) and at the same time the 1st. curve generator (CTS1) is started.
  This ensures that no increments are lost with running master.

Design of a curve:



Position Reset Distance Slave: Reset distance slave

Position Reset Distance Master: Reset distance Master = time axis in the Cam Designer

5.7.9.5 Example 5: Cyclic operation with event-triggered change of curve

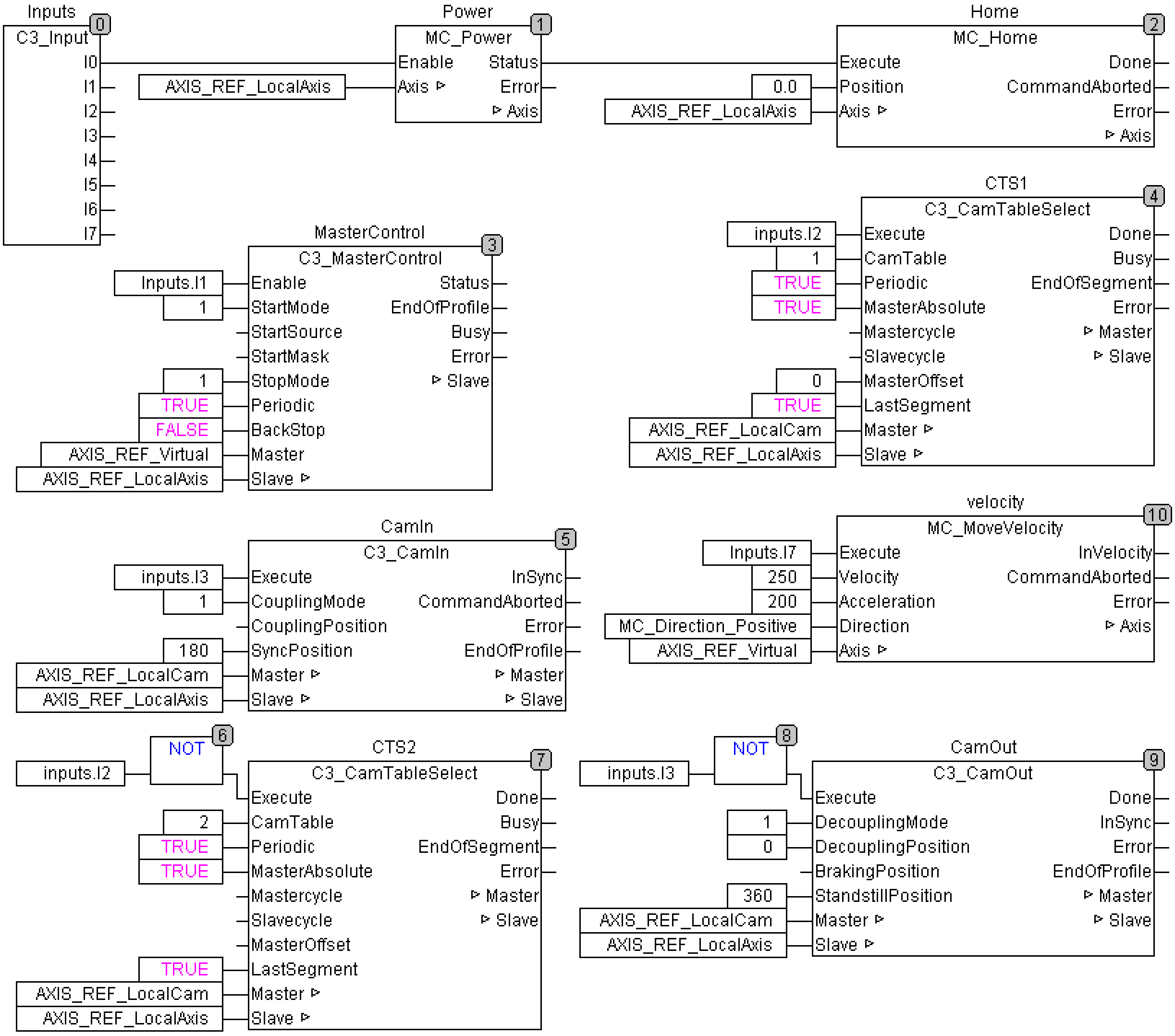
- ◆ 2 curves with the same clock distances: S-curve without standstill area and straight line
- ◆ digital input for quadratic coupling and decoupling
- ◆ digital input for switching of curve
- ◆ Master reference must be kept with exactly the same increments during the change
- ◆ The master position acquisition must continue in decoupled state

Corresponding files: CamExample05.C3P (Compax3 project on the Compax3 CD:\Examples\Example5)
CamExample05.pro (CoDeSys project on the Compax3 CD:\Examples\Example5)

Control interface:

Input	Function
I0	Energize axis, Homing
I1	Enable and start of the master position detection
I2	Selection of cam
I3	Coupling / Decoupling
I4	Free
I5	Free
I6	Free
I7	Start of the virtual master

Solution:



Explanations:

- ◆ Via Input I2 either curve 1 (CTS1) or curve 2 (CTS2) is activated, both in the absolute mode (MasterAbsolute=TRUE).
- ◆ The detection starts with I1 (MasterControl).
- ◆ Coupling in takes place with rising edge of I3, decoupling takes place with falling edge of I3.

5.7.9.6 Example 6: Operation with curve segments and standstill area

- Via a master cycle, a slave feed with following standstill is to take place from a master position of 30° on; from a master position of 230° on, the slave is to return. This sequence is to be repeated cyclically.

Corresponding files:

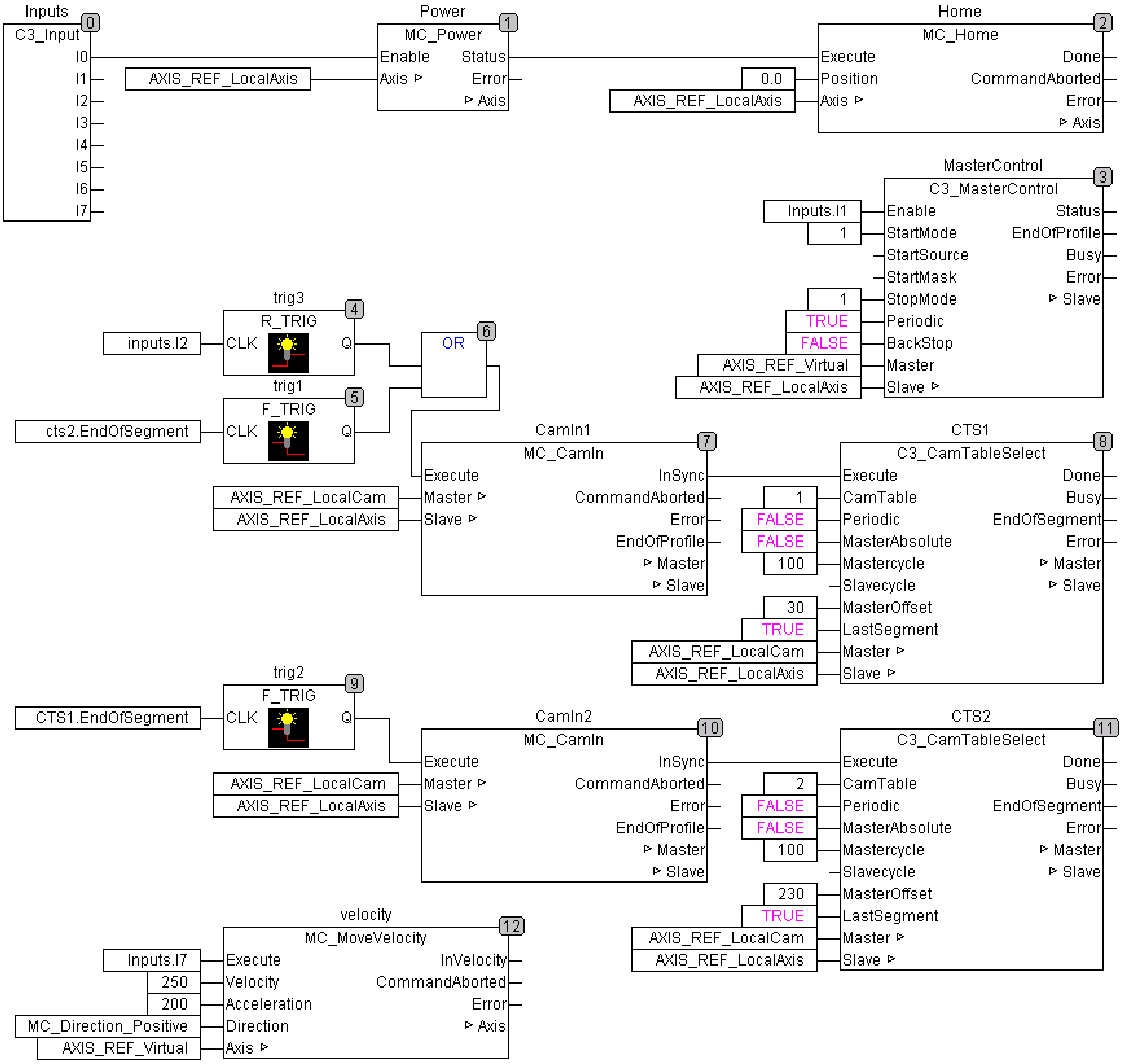
CamExample06.C3P (Compax3 project on the Compax3 CD:\Examples\Example6)

CamExample06.pro (CoDeSys project on the Compax3 CD:\Examples\Example6)

Control interface:

Input	Function
I0	Energize axis, Homing
I1	Enable and start of the master position detection
I2	Start of the curve cycle
I3	Free
I4	Free
I5	Free
I6	Free
I7	Start of the virtual master

Solution:


Inputs
C3_Input
0
I0
I1
I2
I3
I4
I5
I6
I7
Power
MC_Power
1
Enable
Status
Axis ⊳
Error
⊳ Axis
AXIS_REF_LocalAxis
Home
MC_Home
2
Execute
Done
Position
CommandAborted
Axis ⊳
Error
⊳ Axis
0.0
AXIS_REF_LocalAxis
MasterControl
C3_MasterControl
3
Inputs.I1
1
1
TRUE
FALSE
AXIS_REF_Virtual
AXIS_REF_LocalAxis
Enable
StartMode
StartSource
StartMask
StopMode
Periodic
BackStop
Master
Slave ⊳
Status
EndOfProfile
Busy
Error
⊳ Slave
trig3
R_TRIG
4
inputs.I2
CLK
Q
OR
6
trig1
F_TRIG
5
cts2.EndOfSegment
CLK
Q
CamIn1
MC_CamIn
7
Execute
Master ⊳
Slave ⊳
InSync
CommandAborted
Error
EndOfProfile
⊳ Master
⊳ Slave
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
CTS1
C3_CamTableSelect
8
1
FALSE
FALSE
100
30
TRUE
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
Execute
CamTable
Periodic
MasterAbsolute
Mastercycle
Slavecycle
MasterOffset
LastSegment
Master ⊳
Slave ⊳
Done
Busy
EndOfSegment
Error
⊳ Master
⊳ Slave
trig2
F_TRIG
9
CTS1.EndOfSegment
CLK
Q
CamIn2
MC_CamIn
10
Execute
Master ⊳
Slave ⊳
InSync
CommandAborted
Error
EndOfProfile
⊳ Master
⊳ Slave
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
CTS2
C3_CamTableSelect
11
2
FALSE
FALSE
100
230
TRUE
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
Execute
CamTable
Periodic
MasterAbsolute
Mastercycle
Slavecycle
MasterOffset
LastSegment
Master ⊳
Slave ⊳
Done
Busy
EndOfSegment
Error
⊳ Master
⊳ Slave
velocity
MC_MoveVelocity
12
Inputs.I7
250
200
MC_Direction_Positive
AXIS_REF_Virtual
Execute
Velocity
Acceleration
Direction
Axis ⊳
InVelocity
CommandAborted
Error
⊳ Axis

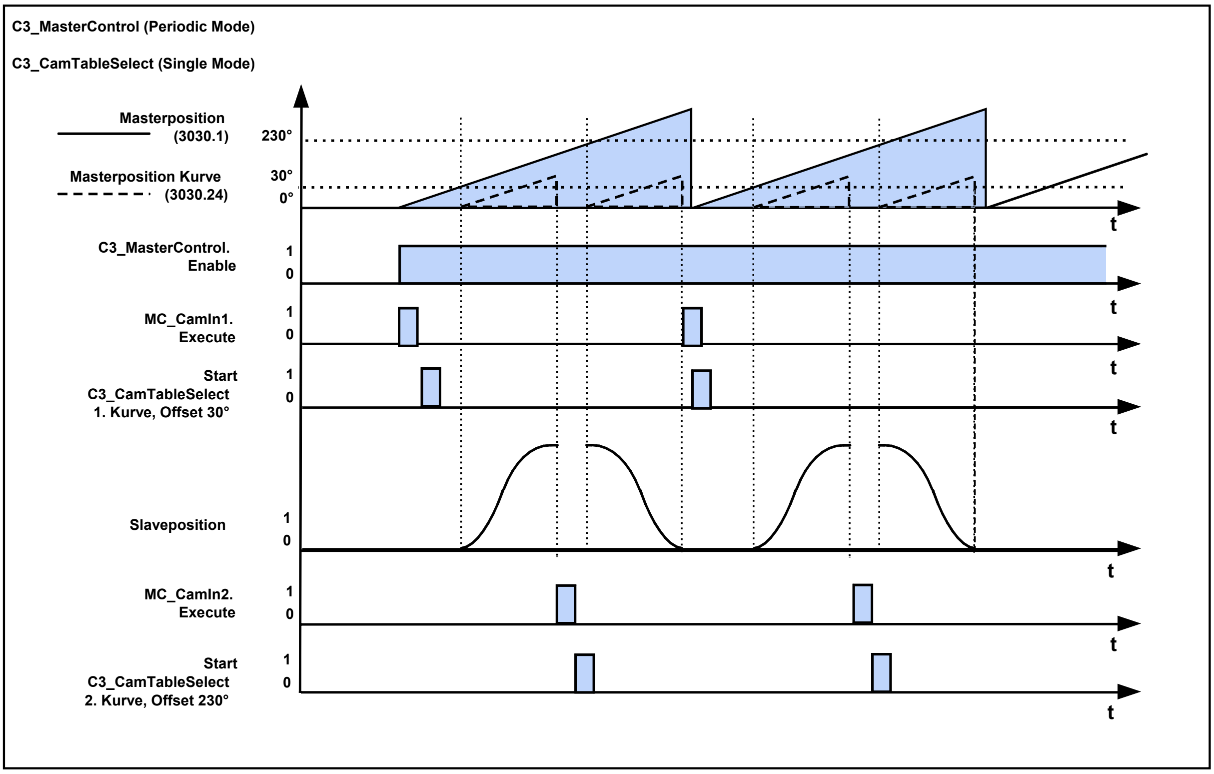
Boundary conditions:

- After the coupling of the axis, the curve generator (CST1) is started in relative mode with an offset of 30°.
  The start of the curve takes only place, if a master position of 30° is reached.
- The feed takes place via 100 master degrees (C3_CamTableSelect module): Mastercycle = 100).
- With the falling edge of EndofSegment of the CamTableSelect module (CTS1), the next movement will be triggered via CamIn2.
- CamIn2 starts via “InSynch the 2nd. C3_CamTableSelect (CTS2), whose curve will reset the slave to its previous position via the master position range between 100° and 230°.
- The sequence can be repeated with "EndofSegment" of this module.

Special feature:

- In this example, the curve shall be run through entirely, therefore MC_CamIn is started before C3_CamTableSelect. This is only possible with MC_CamIn.

Signal image:



5.7.9.7 Example 7: Curve operation with slave reg synchronization

The slave position in the curve mode is to be corrected in dependence of a registration mark: Slave-oriented reg synchronization.

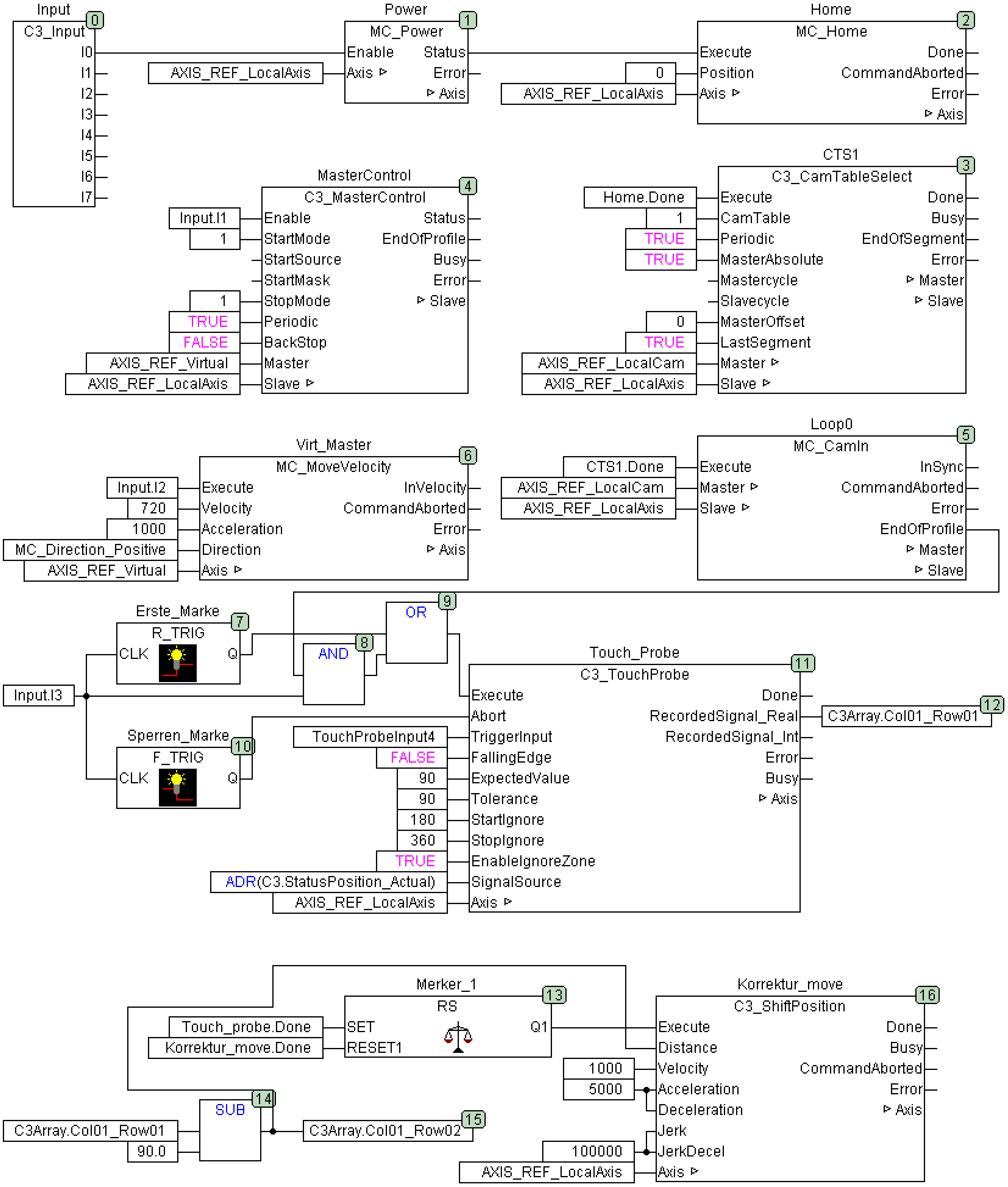
Corresponding files: Slave_Markenkorrektur_Example.C3P (Compax3 Project on Compax3 CD:\Examples\Example7)

Slave_Markenkorrektur_Example.pro (CoDeSys Project on the Compax3 CD:\\Examples\\Example7)

Control interface:

Input	Function
I0	Energize axis, homing, select curve, starting and coupling axis (static)
I1	Enable and start of the master position acquisition (static)
I2	Start virtual master
I3	Reg enable (static)
I4	Reg input (edge)
I5	Free
I6	Free
I7	Free

Solution:


Input
C3_Input
0
I0
I1
I2
I3
I4
I5
I6
I7
Power
MC_Power
1
Enable
Status
AXIS_REF_LocalAxis
Axis ⊳
Error
⊳ Axis
Home
MC_Home
2
Execute
Done
0
Position
CommandAborted
AXIS_REF_LocalAxis
Axis ⊳
Error
⊳ Axis
MasterControl
C3_MasterControl
4
Input.I1
Enable
Status
1
StartMode
EndOfProfile
StartSource
Busy
StartMask
Error
1
StopMode
⊳ Slave
TRUE
Periodic
FALSE
BackStop
AXIS_REF_Virtual
Master
AXIS_REF_LocalAxis
Slave ⊳
CTS1
C3_CamTableSelect
3
Home.Done
Execute
Done
1
CamTable
Busy
TRUE
Periodic
EndOfSegment
TRUE
MasterAbsolute
Error
Mastercycle
⊳ Master
Slavecycle
⊳ Slave
0
MasterOffset
TRUE
LastSegment
AXIS_REF_LocalCam
Master ⊳
AXIS_REF_LocalAxis
Slave ⊳
Virt_Master
MC_MoveVelocity
6
Input.I2
Execute
InVelocity
720
Velocity
CommandAborted
1000
Acceleration
Error
MC_Direction_Positive
Direction
⊳ Axis
AXIS_REF_Virtual
Axis ⊳
Loop0
MC_CamIn
5
CTS1.Done
Execute
InSync
AXIS_REF_LocalCam
Master ⊳
CommandAborted
AXIS_REF_LocalAxis
Slave ⊳
Error
EndOfProfile
⊳ Master
⊳ Slave
Erste_Marke
R_TRIG
7
CLK
Q
OR
9
AND
8
Input.I3
Touch_Probe
C3_TouchProbe
11
Execute
Done
Abort
RecordedSignal_Real
C3Array.Col01_Row01
12
Sperren_Marke
F_TRIG
10
CLK
Q
TouchProbeInput4
TriggerInput
RecordedSignal_Int
FALSE
FallingEdge
Error
90
ExpectedValue
Busy
90
Tolerance
⊳ Axis
180
StartIgnore
360
StopIgnore
TRUE
EnableIgnoreZone
ADR(C3.StatusPosition_Actual)
SignalSource
AXIS_REF_LocalAxis
Axis ⊳
Merker_1
RS
13
Touch_probe.Done
SET
Q1
Korrektur_move.Done
RESET1
Korrektur_move
C3_ShiftPosition
16
Execute
Done
Distance
Busy
1000
Velocity
CommandAborted
5000
Acceleration
Error
Deceleration
⊳ Axis
Jerk
100000
JerkDecel
AXIS_REF_LocalAxis
Axis ⊳
SUB
14
C3Array.Col01_Row01
90.0
C3Array.Col01_Row02
15

Boundary conditions:

- Setpoint position of the registration mark: 90°
- Ignore zone of the reg detection: 180° - 360°

curve

5.7.9.8 Example 8: Curve operation with master reg synchronization

The master position in the curve mode is to be corrected in dependence of a registration mark: Master oriented reg synchronization.

Corresponding files:

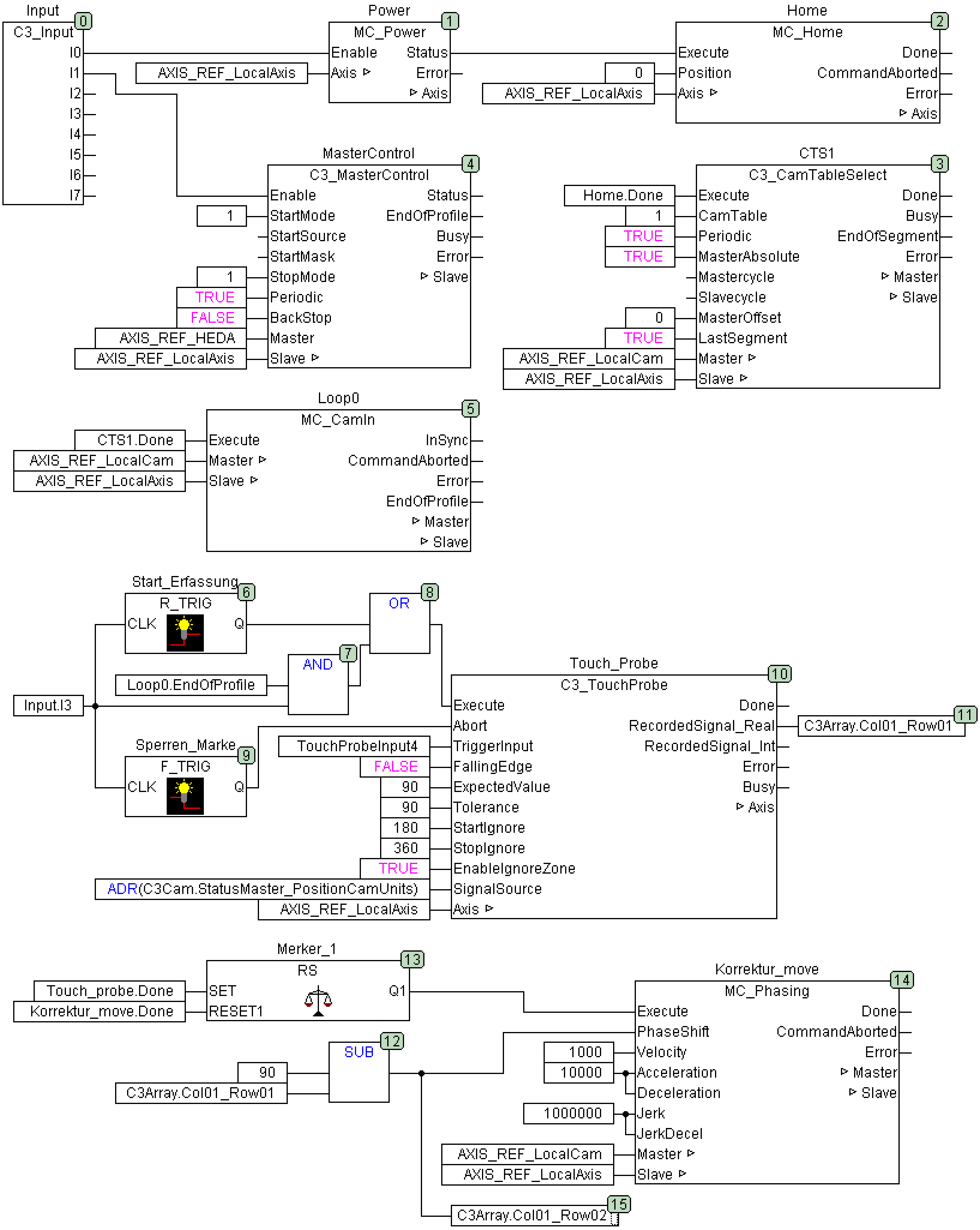
Master_Markenkorrektur.C3P (Compax3 Project auf Compax3 CD:\Examples\Example8)

Master_Markenkorrektur.pro (CoDeSys Project on the Compax3 CD:\Examples\Example8)

Control interface:

Input	**Function**
I0	Energize axis, homing, select curve, starting and coupling axis (static)
I1	Enable master acquisition (static)
I2	Start virtual master
I3	Reg enable (static)
I4	Reg input (edge)
I5	Free
I6	Free
I7	Free

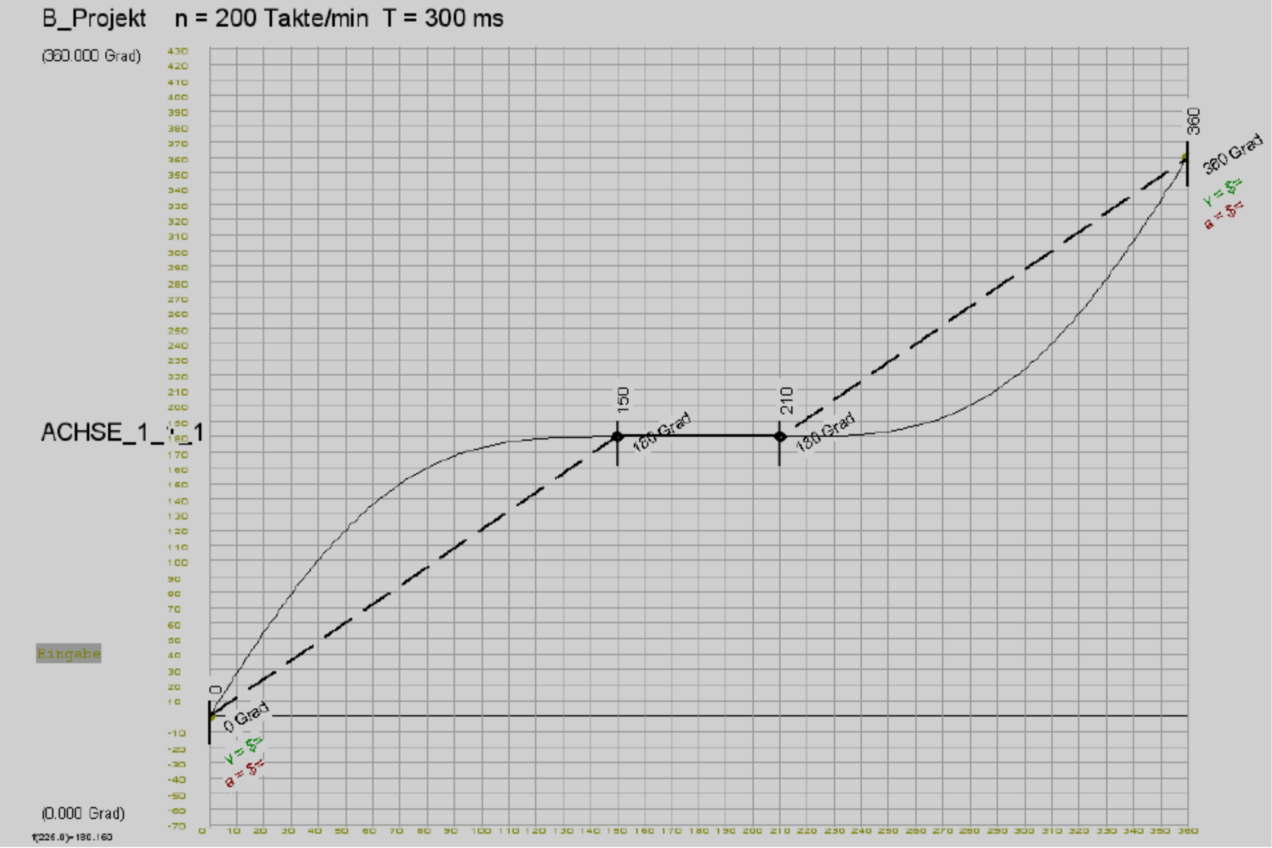
Solution:


Input
0
C3_Input
I0
I1
I2
I3
I4
I5
I6
I7
AXIS_REF_LocalAxis
Power
1
MC_Power
Enable
Status
Axis ⊳
Error
⊳ Axis
0
AXIS_REF_LocalAxis
Home
2
MC_Home
Execute
Done
Position
CommandAborted
Axis ⊳
Error
⊳ Axis
MasterControl
4
C3_MasterControl
Enable
Status
1
StartMode
EndOfProfile
StartSource
Busy
StartMask
Error
1
StopMode
⊳ Slave
TRUE
Periodic
FALSE
BackStop
AXIS_REF_HEDA
Master
AXIS_REF_LocalAxis
Slave ⊳
CTS1
3
C3_CamTableSelect
Home.Done
Execute
Done
1
CamTable
Busy
TRUE
Periodic
EndOfSegment
TRUE
MasterAbsolute
Error
Mastercycle
⊳ Master
Slavecycle
⊳ Slave
0
MasterOffset
TRUE
LastSegment
AXIS_REF_LocalCam
Master ⊳
AXIS_REF_LocalAxis
Slave ⊳
Loop0
5
MC_CamIn
CTS1.Done
Execute
InSync
AXIS_REF_LocalCam
Master ⊳
CommandAborted
AXIS_REF_LocalAxis
Slave ⊳
Error
EndOfProfile
⊳ Master
⊳ Slave
Start_Erfassung
6
R_TRIG
CLK
Q
OR
8
AND
7
Loop0.EndOfProfile
Input.I3
Touch_Probe
10
C3_TouchProbe
Execute
Done
Abort
RecordedSignal_Real
C3Array.Col01_Row01
11
Sperren_Marke
9
F_TRIG
CLK
Q
TouchProbeInput4
TriggerInput
RecordedSignal_Int
FALSE
FallingEdge
Error
90
ExpectedValue
Busy
90
Tolerance
⊳ Axis
180
StartIgnore
360
StopIgnore
TRUE
EnableIgnoreZone
ADR(C3Cam.StatusMaster_PositionCamUnits)
SignalSource
AXIS_REF_LocalAxis
Axis ⊳
Merker_1
13
RS
Touch_probe.Done
SET
Q1
Korrektur_move.Done
RESET1
Korrektur_move
14
MC_Phasing
Execute
Done
PhaseShift
CommandAborted
SUB
12
1000
Velocity
Error
90
10000
Acceleration
⊳ Master
C3Array.Col01_Row01
Deceleration
⊳ Slave
1000000
Jerk
JerkDecel
AXIS_REF_LocalCam
Master ⊳
AXIS_REF_LocalAxis
Slave ⊳
C3Array.Col01_Row02
15

Boundary conditions:

- Setpoint position of the registration mark: 90°.
- Slave standstill at 180°.
- The object C3Cam.StatusMaster_PositionCamUnits (o3030.24) is used as source for the C3_Touchprobe module and is set against the reg setpoint position.
- The adjustment movement is made via MC_Phasing (see the **signal image** (see on page 360) of the cam).

curve



5.7.9.9 Example case of damage

The axis should work in curve mode.
The master should be stopped in the case of an axis error. After the elimination and acknowledgement of the error, the axis shall synchronize and normal operation shall be resumed.

Corresponding files:

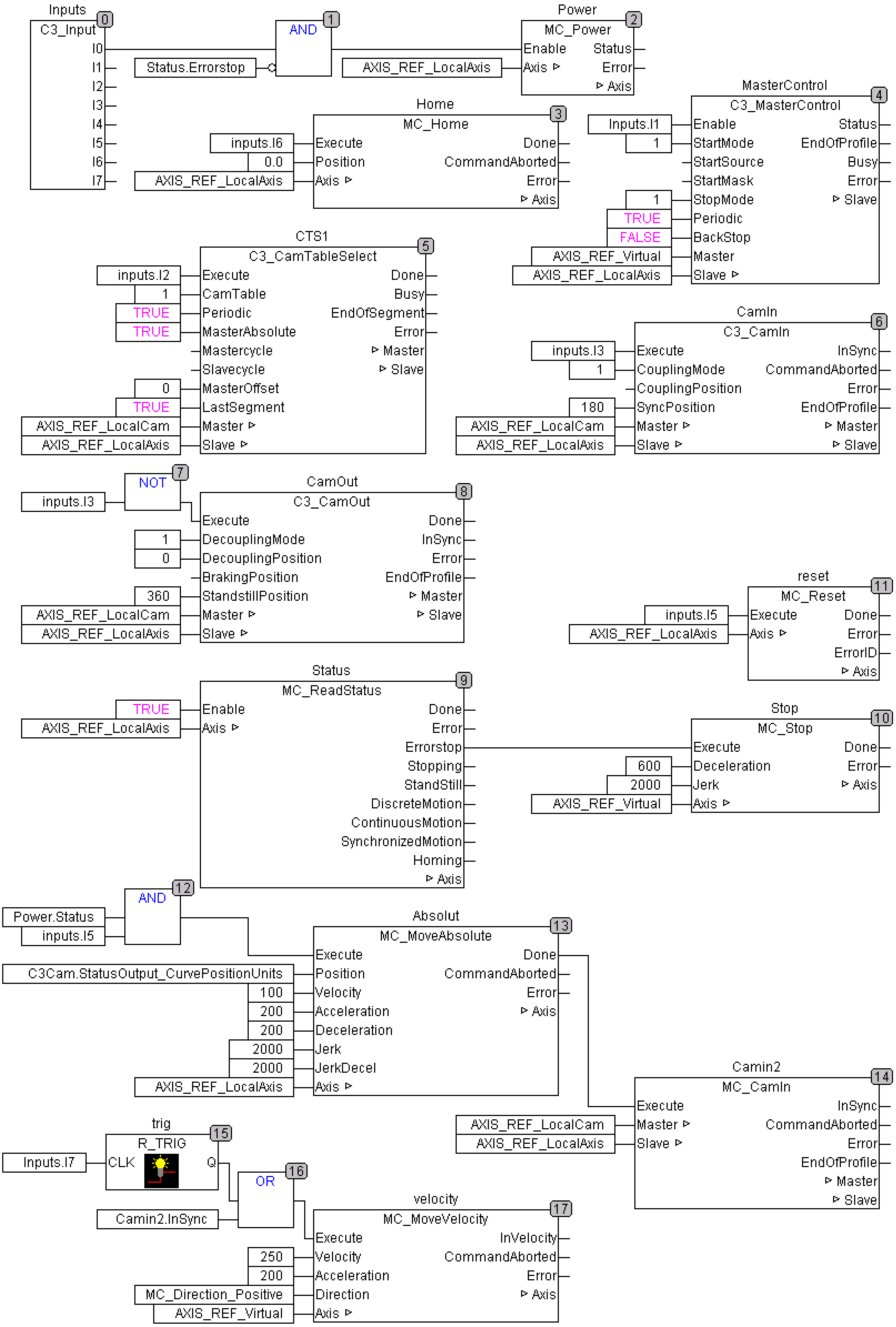
CamExampleHav.C3P (Compax3 Project on the Compax3 CD:\Examples\Examples_Haverie)

CamExampleHav.pro (CoDeSys Project on the Compax3 CD:\Examples\Examples_Haverie)

Control interface:

Input	Function
I0	Energize axis
I1	Enable and start of the master position detection
I2	Start of the curve cycle
I3	Coupling / Decoupling
I4	Free
I5	Error acknowledgement
I6	Homing
I7	Start of the virtual master

Solution:


Inputs
C3_Input
0
I0
I1
I2
I3
I4
I5
I6
I7
AND
1
Status.Errorstop
Power
MC_Power
2
Enable
Status
Axis ⊳
Error
⊳ Axis
AXIS_REF_LocalAxis
Home
MC_Home
3
inputs.I6
0.0
AXIS_REF_LocalAxis
Execute
Done
Position
CommandAborted
Axis ⊳
Error
⊳ Axis
MasterControl
C3_MasterControl
4
Inputs.I1
1
1
TRUE
FALSE
AXIS_REF_Virtual
AXIS_REF_LocalAxis
Enable
Status
StartMode
EndOfProfile
StartSource
Busy
StartMask
Error
StopMode
⊳ Slave
Periodic
BackStop
Master
Slave ⊳
CTS1
C3_CamTableSelect
5
inputs.I2
1
TRUE
TRUE
0
TRUE
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
Execute
Done
CamTable
Busy
Periodic
EndOfSegment
MasterAbsolute
Error
Mastercycle
⊳ Master
Slavecycle
⊳ Slave
MasterOffset
LastSegment
Master ⊳
Slave ⊳
CamIn
C3_CamIn
6
inputs.I3
1
180
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
Execute
InSync
CouplingMode
CommandAborted
CouplingPosition
Error
SyncPosition
EndOfProfile
Master ⊳
⊳ Master
Slave ⊳
⊳ Slave
NOT
7
inputs.I3
CamOut
C3_CamOut
8
1
0
360
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
Execute
Done
DecouplingMode
InSync
DecouplingPosition
Error
BrakingPosition
EndOfProfile
StandstillPosition
⊳ Master
Master ⊳
⊳ Slave
Slave ⊳
reset
MC_Reset
11
inputs.I5
AXIS_REF_LocalAxis
Execute
Done
Axis ⊳
Error
ErrorID
⊳ Axis
Status
MC_ReadStatus
9
TRUE
AXIS_REF_LocalAxis
Enable
Done
Axis ⊳
Error
Errorstop
Stopping
StandStill
DiscreteMotion
ContinuousMotion
SynchronizedMotion
Homing
⊳ Axis
Stop
MC_Stop
10
600
2000
AXIS_REF_Virtual
Execute
Done
Deceleration
Error
Jerk
⊳ Axis
Axis ⊳
AND
12
Power.Status
inputs.I5
Absolut
MC_MoveAbsolute
13
C3Cam.StatusOutput_CurvePositionUnits
100
200
200
2000
2000
AXIS_REF_LocalAxis
Execute
Done
Position
CommandAborted
Velocity
Error
Acceleration
⊳ Axis
Deceleration
Jerk
JerkDecel
Axis ⊳
Camin2
MC_CamIn
14
AXIS_REF_LocalCam
AXIS_REF_LocalAxis
Execute
InSync
Master ⊳
CommandAborted
Slave ⊳
Error
EndOfProfile
⊳ Master
⊳ Slave
trig
R_TRIG
15
Inputs.I7
CLK
Q
OR
16
Camin2.InSync
velocity
MC_MoveVelocity
17
250
200
MC_Direction_Positive
AXIS_REF_Virtual
Execute
InVelocity
Velocity
CommandAborted
Acceleration
Error
Direction
⊳ Axis
Axis ⊳

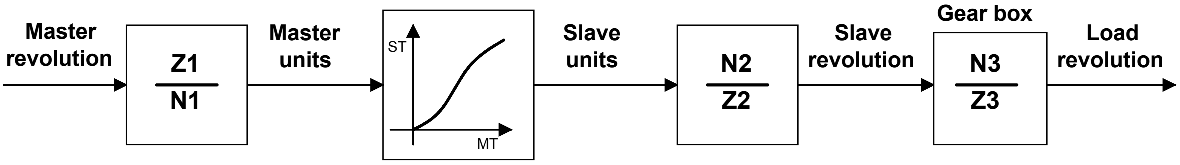
Boundary conditions:

- The ReadStatus module helps detect, if the axis is in the error state.
  An error will trigger the stop of the virtual axis, the curve cycle will stop, the curve generator (C3_CamTableSelect) will continue.
- After the stop of the master, the axis will also be at a standstill.
- The error is acknowledged via input I5; the axis will be energized again (see also the "AND" module at the input of MC_Power).
- If the axis is energized again and input I5 is present, the axis is moved to the current position of the curve output (MC_moveAbsolute) and at the end of the movement it is coupled again with MC_CamIn.
- The output "InSync" of the MC_CamIn (camin2) will re-start the virtual master and the cycle is continued.

5.7.9.10 Application note: Drift

Correct scaling of the reference values helps prevent drift.

For this, it is necessary to consider the conversions of the position signal:



Master / Slave / Load revolution: Master / Slave / Load revolutions:

Master / Slave units: Master / Slave - revolutions

Gear box: Gearbox

That is:

$$\frac{Z1}{N1} = \frac{\text{Travel distance per revolution master axis numerator}}{\text{Travel distance per motor revolution master axis denominator}}$$

(configured in the Compax3 ServoManager under "signal source")

$$\frac{Z2}{N2} = \frac{\text{Travel distance per revolution slave axis numerator}}{\text{Travel distance per revolution Slave axis Denominator}}$$

(configured in the Compax3 ServoManager under "configuration")

$$\frac{Z3}{N3} = \text{transmission ratio} \quad \frac{\text{Motor}}{\text{Load}}$$

$$\text{MT: Master clock distance} \quad \frac{\text{"Position Reset" Distance - Master Axis (M\_Units)}}{\text{"Position Reset" Distance - Master Axis (Denominator)}}$$

MT is rounded to 3 decimal places.

ST: Slave clock distance

Numerical Example:

Product: 314.871 long

14 products are to be transported per load revolution via a curve.

Gearbox: Motor/Load = 6949673 / 43890 => i = 158.3429...

1. Variant (with drift)

Load revolutions = (number of the products) * (length of a product) * (reciprocal of the travel path per motor revolution slave axis) * (gearbox load / motor)

$$\text{Load revolutions} = 14 * 314{,}871\text{mm} * \frac{N2}{Z2} * \frac{43890}{6949673}$$

$$14 * 314{,}871\text{mm} * \frac{43890}{6949673} = \frac{Z2}{N2} = \frac{193475634.66}{6949673}$$

This factor can not be expressed exactly in Compax3; the max. entry allowed in the Compax3 ServoManager:

$$\frac{1934756}{69496}$$

which causes drift.

2. Variant (without drift)

Slave clock distance = 1 product cycle

For this, the curve is created scaled to 1.

$$\text{Load revolutions} = 14 * 1\text{mm} * \frac{N2}{Z2} * \frac{43890}{6949673}$$

$$14 * 1\text{mm} * \frac{43890}{6949673} = \frac{Z2}{N2} = \frac{614460}{6949673}$$

This factor for the path per motor revolution can be expressed, no drift is generated!

5.8 Cam switching mechanism

In this chapter you can read about:

Please observe:

In the C3 powerPLmC, the "cam switching mechanism" function can only be programmed for a Compax3 slave axis with the T40 technology function.

5.8.1. Cam switching mechanism function overview

In this chapter you can read about:

Up to 36 cams can be programmed. They are divided into 2 cam types:

Serial cams

- 32 serial cams (Cam 0 ... 31) of which a cam is brought up once every 0.5 ms. The**cycle time**of the cams is: (**Highest active serial cam +1) * 0.5ms.**.
  Example: if cam 17 is the highest cam enabled, this results in a cycle time of: 18 * 0.5ms = 9ms
- If no fast cams are used, the numberof the serial cams per cycle (0.5ms) can be increased up to 4:
  The setting is made via object 3701.6. It applies:
  Cycle time = number of the serial cams *0.5ms / O3701.6 with the value range O3701.6 = 1, 2, 3, 4.

Fast cams

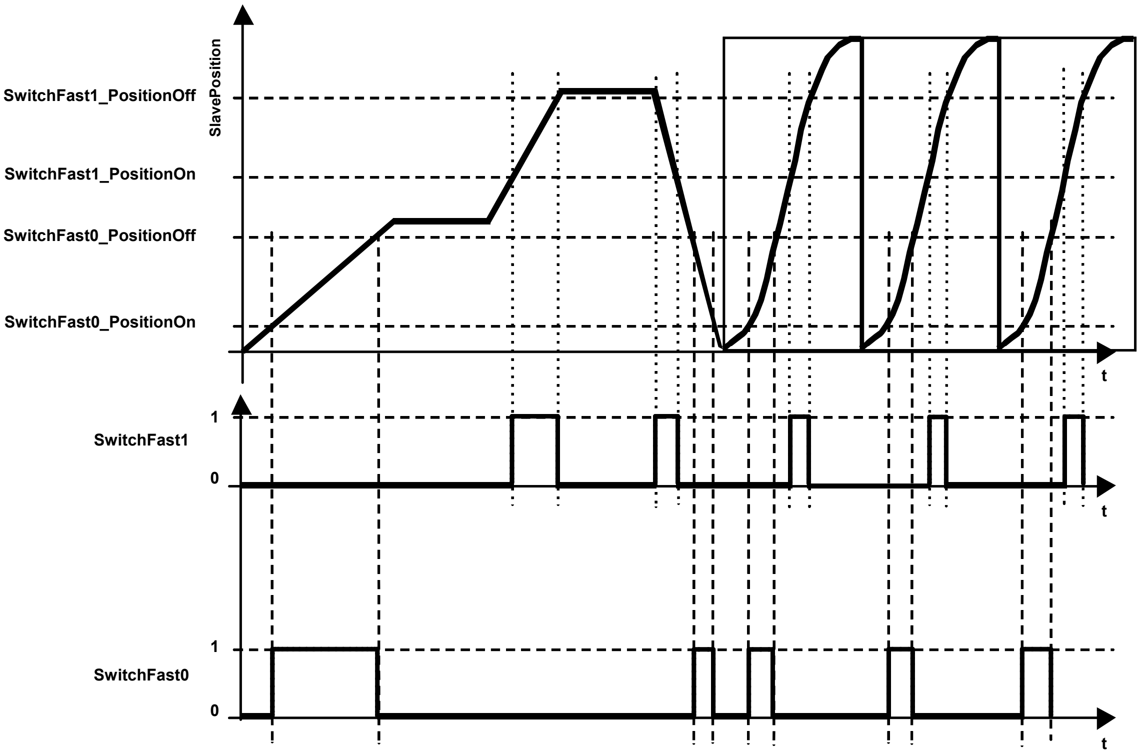
- 4 fast cams with a cycle time of 500µs (125µs per cam).
- When using fast cams, there is a cycle time of 0.5ms per cam for serial cams.
- With the **C3_OutputSelect** (see on page 430) module the fast cams can be put directly and without delay, independently of the cycle time of the IEC program, on the digital outputs O0 ... O3.

Cam functions

- Switching-on and switching-off position of each cam individually.
- Cams with compensation for dead time, with switching-on and switching-off anticipation for each cam.
- Individually adjustable cam source.
- Enable for each individual cam.
- Adjustable switching hysteresis for actual position value as a cam source.
- The outputs of the cams are objects.

5.8.1.1 Example of cam function

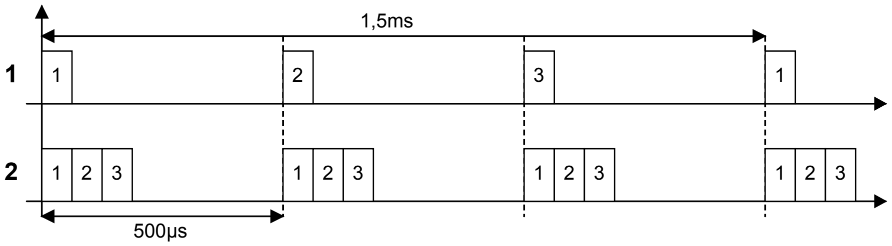
Example of cam function (without switching-on and switching-off anticipation)



5.8.1.2 Examples of a cam cycle

Example 1: Working cycles for:

- 3 fast cams and
- 3 serial cams

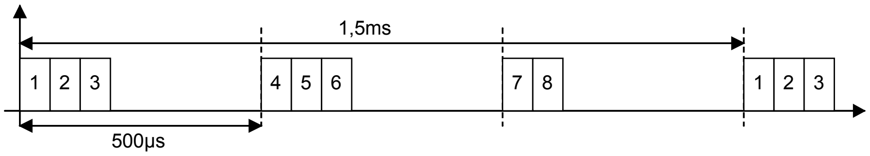


1: Serial cams

2: Fast cams

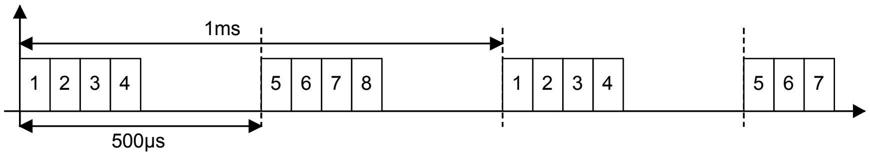
Example 2: Working cycles for:

- no fast cams,
- 8 serial cams and
- reduced cycle time (object O3701.6 = 3)



Example 3: Working cycles for:

- no fast cams,
- 8 serial cams and
- reduced cycle time (object O3701.6 = 4)



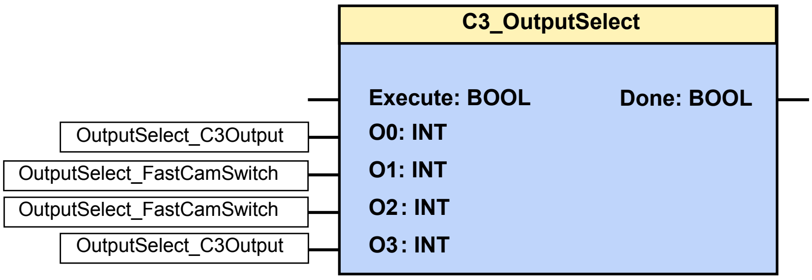
5.8.2. Redirect the fast cams directly to the physical output (C3_OutputSelect)

FB name	**C3_OutputSelect**	
Select source for digital outputs		
VAR_INPUT		
Execute	BOOL	Activates the module with a rising edge
O0	INT	Constant for source for the digital output 0
O1	INT	Constant for source for the digital output 1
O2	INT	Constant for source for the digital output 2
O3	INT	Constant for source for the digital output 3
VAR_OUTPUT		
Done	BOOL	Source selection executed

Note:

- The source selection for the outputs is executed with a rising edge of Execute.
- **Application for fast cams:**
  the fast cams are put directly and without delay to the digital outputs, independent of the cycle time of the IEC program.
- OutputSelect_C3Output allows to access the respective output directly via the IEC program (e.g. with the aid of C3_Output).
- OutputSelect_FastCamSwitch puts the respective fast cam to the output. The assignment is fixed, i.e. cam 0 would be put on O0, cam 1 would be put on output O1, etc.

Example:



- Source: output 0: C3_Output
- Source output 1: Fast cam 1
- Source output 2: Fast cam 2
- Source output 3: C3_Output

5.8.3. Objects of the cam switching mechanism

Object designations	Unit	Objects for serial cams		Objects for fast cams		valid from
Source **="1": Actual position** **="2": Setpoint position** **="3": Virtual Master** **="5": Master position (3030.1)**		Cam 0: ... Cam 31:	O3730.1 ... O3761.1	Cam 0: ... Cam 3:	O3710.1 ... O3713.1	VP*
Switching-on position	defined unit for positions	Cam 0: ... Cam 31:	O3730.2 ... O3761.2	Cam 0: ... Cam 3:	O3710.2 ... O3713.2	VP*
Switching-off position	defined unit for positions	Cam 0: ... Cam 31:	O3730.3 ... O3761.3	Cam 0: ... Cam 3:	O3710.3 ... O3713.3	VP*
Switch-on anticipation	1 ≡ 500µs	Cam 0: ... Cam 31:	O3730.4 ... O3761.4	Cam 0: ... Cam 3:	O3710.4 ... O3713.4	imme diately
Switch-off anticipation	1 ≡ 500µs	Cam 0: ... Cam 31:	O3730.5 ... O3761.5	Cam 0: ... Cam 3:	O3710.5 ... O3713.5	imme diately
Output **(the given object bit contains the cam switch status for further use)**		Cam 0: ... Cam 15 Cam 16 ... Cam 31:	O3701.3 Bit 0 ... O3701.3 Bit15 O3701.5 Bit 0 ... O3701.5 Bit15	Cam 0: ... Cam 3:	O3700.3 Bit 0 ... O3700.3 Bit 3	imme diately
Enable		Cam 0: ... Cam 15 Cam 16 ... Cam 31:	O3701.2 Bit 0 ... O3701.2 Bit15 O3701.4 Bit 0 ... O3701.4 Bit15	Cam 0: ... Cam 3:	O3700.2 Bit 0 ... O3700.2 Bit 3	imme diately
Hysteresis	defined unit for positions	With source = actual position: O3705.1 With source = Master position: O3705.5				VP*

The exact description of the objects can be found in the **object directory** (see on page 544).

The command VP (set objects to valid) can be executed as

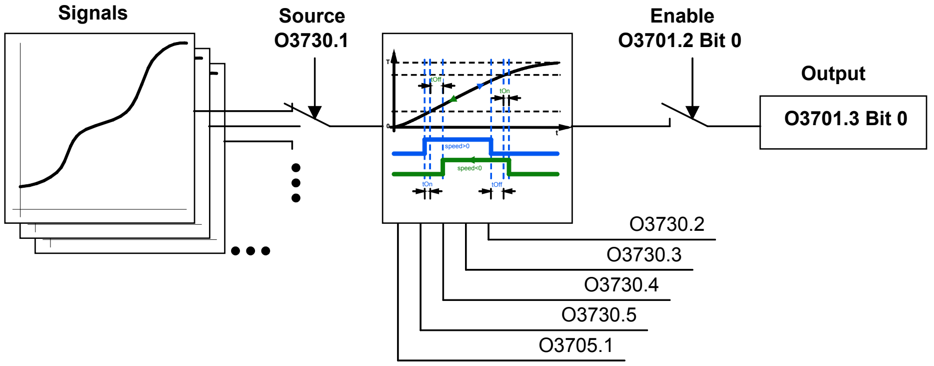
- global VP - for all objects or
- selective VP - only objects of the cam switching mechanism -

- Global VP: Write into object 210.11 with value <> 0

- Selective VP: Write into object 210.9 with value <> 0 (C3Plus.ValidParameter_CamControlledSwitches:=True)

The selective VP is executed faster and constitutes a smaller temporal strain!

Scheme of the object assignment example of the serial cam 0



Notes:

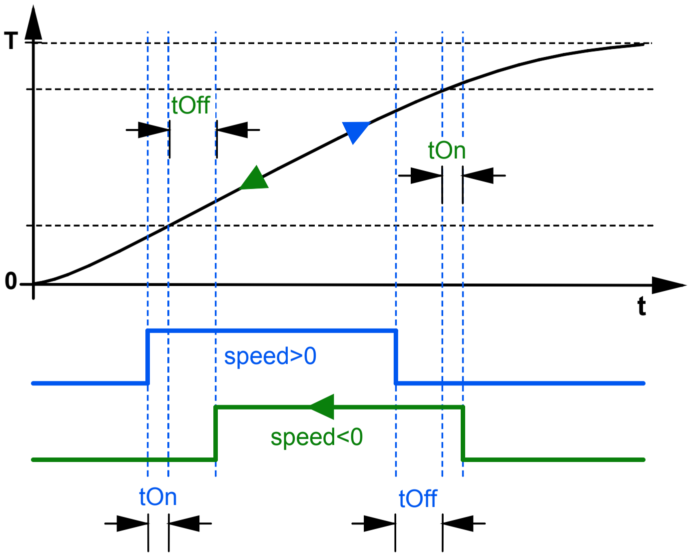
- You can write directly into a serial cam switch output that is not enabled (e. g. cam 0 => object3701.3 bit 0).
- After deactivating the cam, the last output status is kept. You can then define the status by directly writing into the object.

5.8.4. Behavior of the switch-on/switch-off anticipation

The switching-on and switching-off behavior of the actuating elements (delayed switching, reaction time) can be compensated via a reaction time (switching-on/off anticipation) that can be parametered for each individual cam.

Compax3 will calculate a corrected switching-on/ or off position by multiplying the reaction time with the current speed, so that the actuating element will switch at the actual switching position due to its delay; the actuating element delay is compensated.

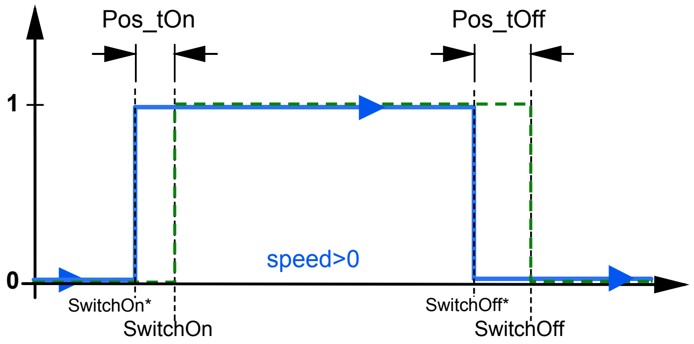
5.8.4.1 Behavior depending on the travel direction



tOn:	Switch-on anticipation
tOff:	Switch-off anticipation

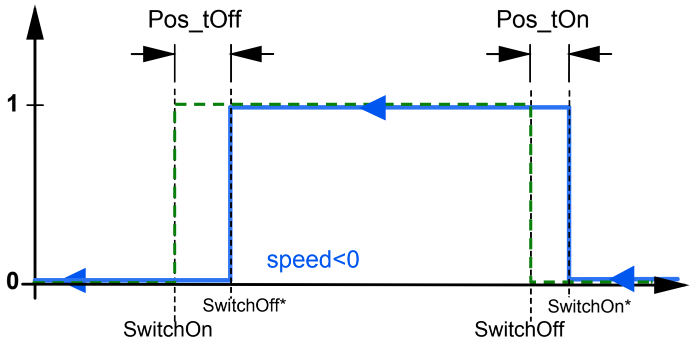
For the switching behavior depending on the position applies therefore:

Example: switching behavior at positive speed (speed>0)



SwitchOn:	Switching-on position
SwitchOn*:	corrected switching-on position
SwitchOff:	Switching-off position
SwitchOff*:	corrected switching-off position
Pos_tOn:	position difference calculated from the switch-on anticipation
Pos_tOff:	position difference calculated from the switch-off anticipation

Example: switching behavior at negative speed (speed<0)



SwitchOn:	Switching-on position
SwitchOn*:	corrected switching-on position
SwitchOff:	Switching-off position
SwitchOff*:	corrected switching-off position
Pos_tOn:	position difference calculated from the switch-on anticipation
Pos_tOff:	position difference calculated from the switch-off anticipation

N.B.! The switching-on resp. switching-off anticipation are exchanged with negative speed, as the cam

◆switches on at the switching-off position

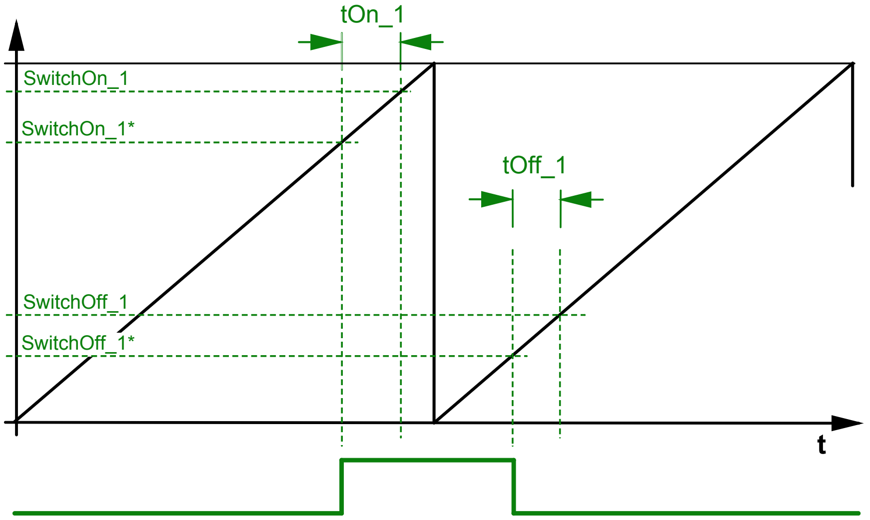
and

◆switches off at the switching-on position!

5.8.4.2 Switching behavior with reset operation

When leaving the positioning area, the positions are corrected accordingly.

The switching-off position may be smaller than the switching-on position:



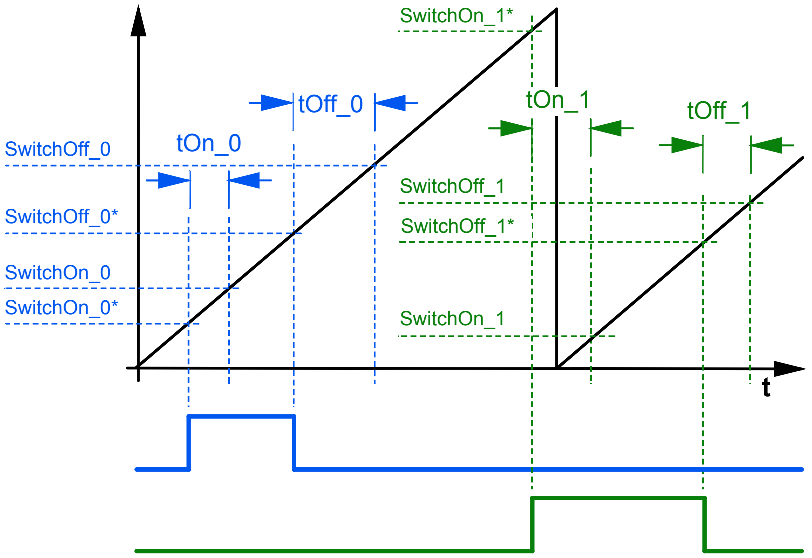
SwitchOn:	Switching-on position
SwitchOn*:	corrected switching-on position
SwitchOff:	Switching-off position
SwitchOff*:	corrected switching-off position
tOn:	Switch-on anticipation
tOff:	Switch-off anticipation

Note: With reset mode of the selected source, the switching position is limited to the area:

0 <= switching position < reset distance

i.e. That means that values < zero become zero, values > than the reset distance will become the reset distance-1LSB.

5.8.4.3 Switch-on anticipation is corrected via reset distance

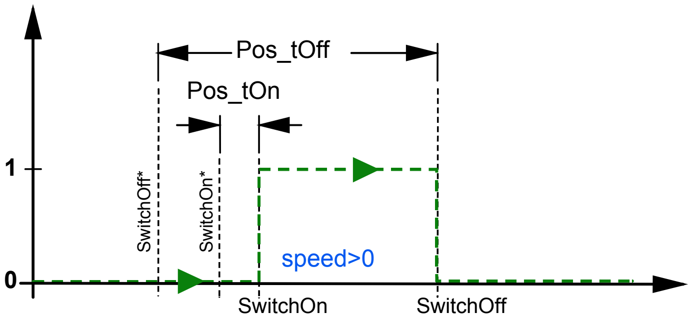


SwitchOn:	Switching-on position
SwitchOn*:	corrected switching-on position
SwitchOff:	Switching-off position
SwitchOff*:	corrected switching-off position
tOn:	Switch-on anticipation
tOff:	Switch-off anticipation

For cam_1 and _2

5.8.4.4 Note: No switching operation with overlapping cams

If it occurs that for example the switching-off position is < the switching-on position due to a movement caused by the reaction time compensation, no switching will take place. This case must be eliminated by choosing appropriate cam positions.



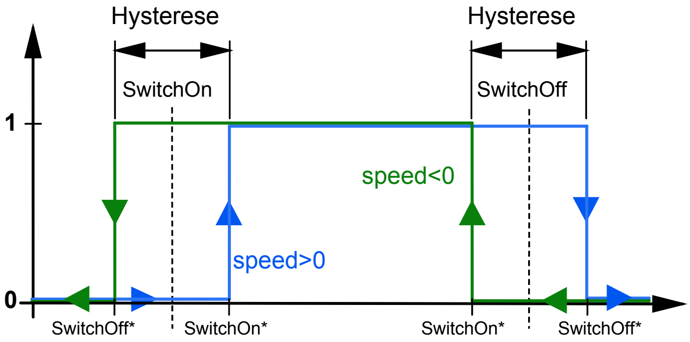
SwitchOn:	Switching-on position
SwitchOn*:	corrected switching-on position
SwitchOff:	Switching-off position
SwitchOff*:	corrected switching-off position
Pos_tOn:	position difference calculated from the switch-on anticipation
Pos_tOff:	position difference calculated from the switch-off anticipation

Please observe:

The position difference for the compensation of the switching delay rises with the speed.

5.8.5. Hysteresis

In order to avoid jitter of cams at the limits of the switching area (only relevant as source of cam with actual values) a switching hysteresis (the same for all cams) can be defined.



SwitchOn: Switching-on position

SwitchOn*: switching-on position corrected by the hysteresis

SwitchOff: Switching-off position

SwitchOff*: switching-off position corrected by the hysteresis

The hysteresis is preset as a position value.

Please observe: The hysteresis influences the switching-on and switching-off anticipation You should therefore set this value at the lowest possible level.

5.8.6. CoDeSys-Project for the configuration of the cams

You will find a CoDeSys project for the configuration of the cams with the following functions on the Compax3 CD under ..\Examples\CamSwitch\CamSwitch_Template.pro:

Configuration of the cam switching mechanism via IEC61131-3 in ST (structured text):

1.) Initializing some "example cams" (Module "Init_Cam_Switch")

- Configuration of sequential cams,
- Configuration of fast cams,
- Configuration of the hystereses,
- Activation of (fast) cams,
- Resetting outputs,
- Triggering selective VP

Global variables determine, which functions are used or are relevant:

CAMsourceActual - True: Actual position is used as master source

CAMfast - True: fast cams are being used

CAMnumber_per_cycle - 1..4: Number of cams implemented/500µs)

2.) Use of the cams in the IEC (Module "PLC_PRG")

- Execute module "Init_Cam_Switch" once,
- logic query with cams,
- logic combination with cams,
- Output of cams via digital outputs,
- Deactivating individual cams,
- Manupulating deactivated cams

5.8.7. Example: Working with fast cams

Setting 2 fast cams to the Compax3 outputs O2 and O3.

Related programs:

- ..\Examples\CamSwitch\2_schnelle_Nocken.C3P
- \Examples\CamSwitch\2_schnelle_Nocken.pro

Assignment: O0 = 1: Drive energized

O1 = 1: Machine zero approached

O2 = 1 fast cam 2 (170° ... 190°)

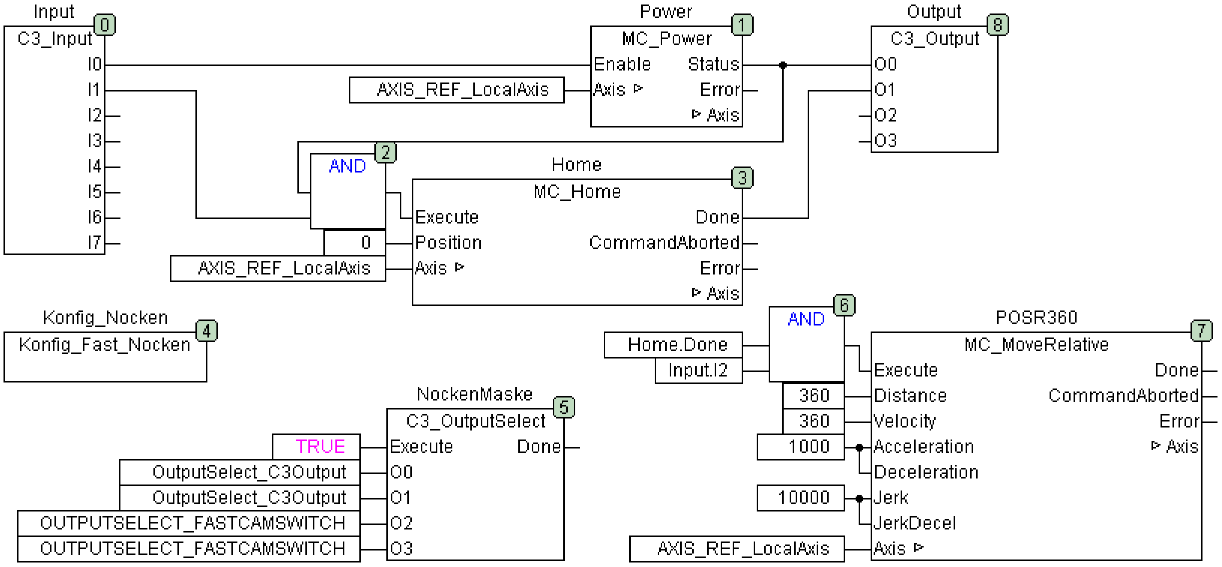
O3 = 1 fast cam 3 (290° ... 310°)

I0: Energize Drive

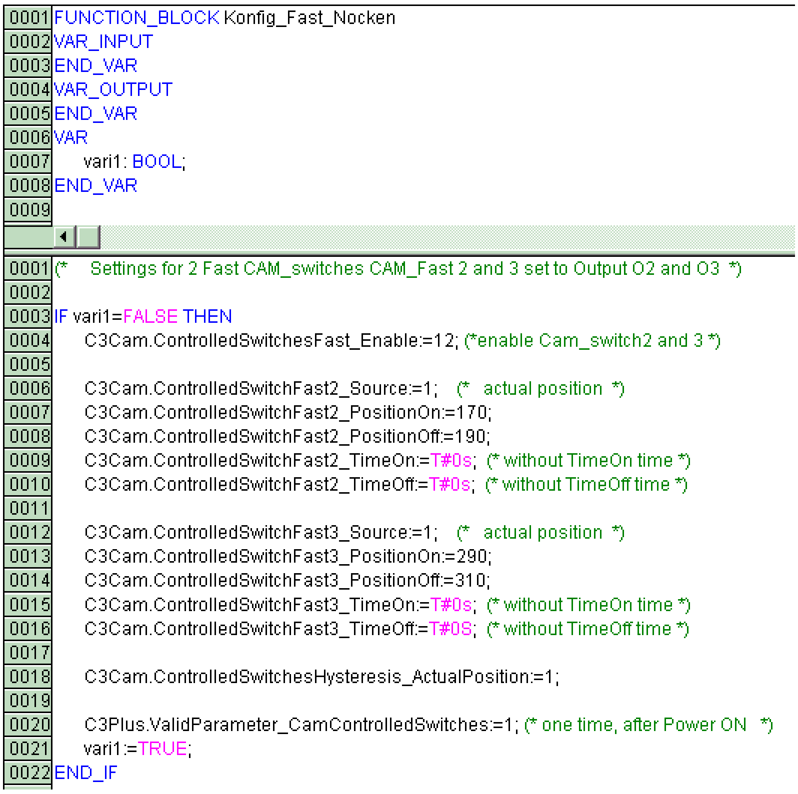
I1: Start searching machine zero

I2: Start of a 360° positioning (reset distance = 360°)

Solution:



ST Part



```
FUNCTION_BLOCK Konfig_Fast_Nocken
VAR_INPUT
END_VAR
VAR_OUTPUT
END_VAR
VAR
    vari1: BOOL;
END_VAR

```

```
(*   Settings for 2 Fast CAM_switches CAM_Fast 2 and 3 set to Output O2 and O3  *)

IF vari1=FALSE THEN
    C3Cam.ControlledSwitchesFast_Enable:=12; (*enable Cam_switch2 and 3 *)

    C3Cam.ControlledSwitchFast2_Source:=1;   (*   actual position  *)
    C3Cam.ControlledSwitchFast2_PositionOn:=170;
    C3Cam.ControlledSwitchFast2_PositionOff:=190;
    C3Cam.ControlledSwitchFast2_TimeOn:=T#0s;  (* without TimeOn time *)
    C3Cam.ControlledSwitchFast2_TimeOff:=T#0s;  (* without TimeOff time *)

    C3Cam.ControlledSwitchFast3_Source:=1;   (*   actual position  *)
    C3Cam.ControlledSwitchFast3_PositionOn:=290;
    C3Cam.ControlledSwitchFast3_PositionOff:=310;
    C3Cam.ControlledSwitchFast3_TimeOn:=T#0s;  (* without TimeOn time *)
    C3Cam.ControlledSwitchFast3_TimeOff:=T#0S;  (* without TimeOff time *)

    C3Cam.ControlledSwitchesHysteresis_ActualPosition:=1;

    C3Plus.ValidParameter_CamControlledSwitches:=1; (* one time, after Power ON  *)
    vari1:=TRUE;
END_IF
```

Note:

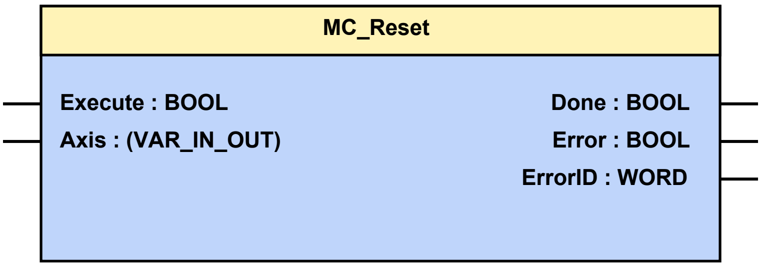
- With C3_OutputSelect the outputs O2 and O3 are assigned to the fast cams. Compax3 puts automatically the fast cams 2 and 3 to the outputs O2 and O3.
- The cam objects are set once after switching-on.

5.9 Error handling

In this chapter you can read about:

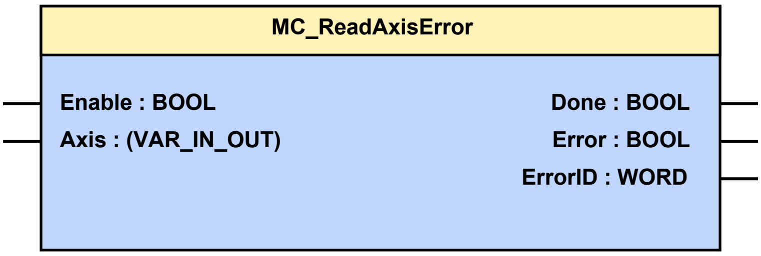
5.9.1. Acknowledging errors (MC_Reset)

FB name	**MC_Reset**	
Acknowledges errors (transition from "Errorstop" status to "Standstill" status).		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Execute	BOOL	Activates the module if there is a positive edge
VAR_OUTPUT		
Done	BOOL	Error successfully acknowledged, axis is in the "Standstill" state again
Error	BOOL	Acknowledge failed /not possible
ErrorID	WORD	Error description, according to error history
Note: ◆ After the error is successfully acknowledged, the power must be supplied to the power output stage again by a rising edge on the enable input of the MC_Power power module. ◆ The execution of the module may influence the **MC_Stop** (see on page 303) module outputs. ◆ C3 powerPLmC Note: This module is also available as group function block. You can then trigger this function for the entire Compax3 group.		



5.9.2. Reading axis errors (MC_ReadAxisError)

FB name	**MC_ReadAxisError**	
This function module displays axis errors.		
VAR_IN_OUT		
Axis	INT	Achs-ID (Bibliothekskonstanten)
VAR_INPUT		
Enable	BOOL	Activates the module
VAR_OUTPUT		
Done	BOOL	Output values available
Error	BOOL	Compax3 in error state
ErrorID	WORD	Current error description
Note: -		



5.9.3. Set error reaction (C3_SetErrorReaction)

FB name	**C3_SetErrorReaction**	
This module is used to define the error reaction. Note: The **error reaction** (see on page 563) cannot be changed for errors with standard reaction 5 (switch immediately to currentless (without ramp), close brake).		
VAR_INPUT		
Execute	BOOL	The defined error reaction is set for the selected error
ErrorID	WORD	Error number [hexadecimal] for which the error reaction should be set, e.g. 0x6281
Reaction	INT	Error response: 0: no reaction, error is deactivated. 1: Downramp actual speed; remain in position control state 2: Downramp the actual speed; then switch off controller
VAR_OUTPUT		
Done	BOOL	The defined error reaction was set
Error	BOOL	Error while executing module

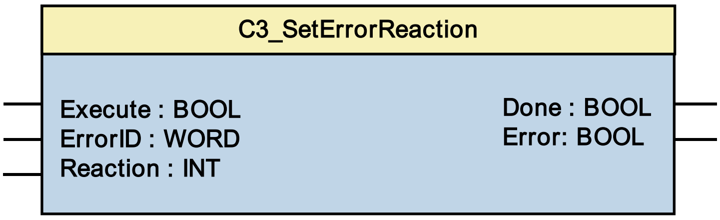
Note:

Error list **(see on page 563)**

- The error reaction settings from the configuration wizard are overwritten.
- The setting of the error mask is made internally via a C3 object. If the objects are saved permanently, the setting is memorized after Power off.

Please note:

- The C3_ErrorMask overwrites (depending on the calling-up order) the settings.
- The corresponding error reaction is valid for both axes (of Compax3F) as the case may be.
- The module will overwrite the settings made via the C3 ServoManager.
- If the ErrorID has an invalid error number, no change is effected.



5.9.3.1 Error reaction of IEC61131-3 modules with Release < R5-0

A changed **error reaction** (see on page 441, see on page 151) of the errors with reaction 2 (to reaction 1 or 0) is only considered at the "ERROR” output of the IEC61131-3 modules from targets of the Compax3 - Release R5-0.

Install the new targets and recompile your IEC program.

5.9.4. Switching off error messages (C3_ErrorMask)

FB name	**C3_ErrorMask**

This module is used to switch off error messages.
Selection between error reactions 2 and 0

VAR_INPUT

Execute	BOOL	The selected error mask is activated
Disable_PLC	BOOL	TRUE is used to switch off error 0x6281.
Disable_HEDA	BOOL	TRUE is used to switch off HEDA errors.
Disable_Fieldbus	BOOL	TRUE is used to switch off the errors 0x8120 and 0x8121.
Disable_MotorStalled	BOOL	TRUE is used to switch off error 0x7121.
Disable_Tracking	BOOL	TRUE is used to switch off error 0x7320.
Disable_IOShortCircut	BOOL	TRUE is used to switch off error 0x5380.
Disable_IOAddSupply	BOOL	TRUE is used to switch off error 0x5117.
Disable_BusVoltageLow	BOOL	Error 0x3222 is switched off with TRUE. Switch off only for commissioning! Note on Compax3H: always on FALSE, as operation <420VDC is not possible.
Disable_E5LimitSwitch	BOOL	TRUE is used to switch off error 0x54A0.
Disable_E6LimitSwitch	BOOL	TRUE is used to switch off error 0x54A1.
Disable_SoftwareLimit_Pos	BOOL	TRUE is used to switch off error 0x7323.*
Disable_SoftwareLimit_Neg	BOOL	TRUE is used to switch off error 0x7324.*

Error list (see on page 563)

Notes:

- The setting of the error mask is made internally with a C3 object. If the objects are saved permanently, the setting is memorized after Power off.

Please note:

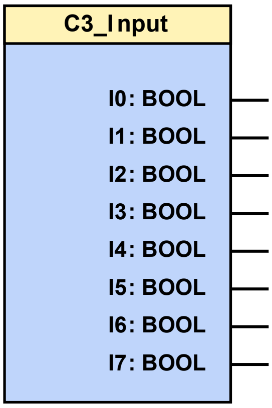
- In the active module, the given errors can no longer be changed to error reaction 1.
- With open inputs, the respective error is active, therefore you should assign the error messages you wish to eliminate with TRUE.
- The module will overwrite the settings made via the C3 ServoManager.
- * During operation with reset distance, these errors are active with a limit of 8 000 000; you should therefore switch off the errors in this operating mode by assignment to TRUE (with open input, a corresponding error is active).

5.10 Process image

In this chapter you can read about:

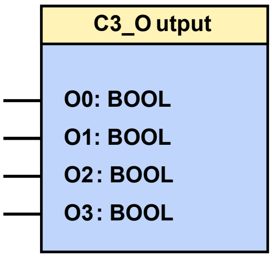
5.10.1. Reading digital inputs (C3_Input)

FB name	**C3_Input**	
Used to generate a process image of the digital inputs.		
VAR_INPUT		
I0 ... I7	BOOL	Displays the logic status of the respective input (with low active inputs, the physical statuses are negated).
Notes: the module should always be brought up at the beginning of the processing cycle.		



5.10.2. Write digital outputs (C3_Output)

FB name	**C3_Output**	
Used to generate a process image of the digital outputs.		
VAR_OUTPUT		
O0 ... O3	BOOL	Displays the status of the respective output.
Notes: the module should always be brought up at the end of the processing cycle.		

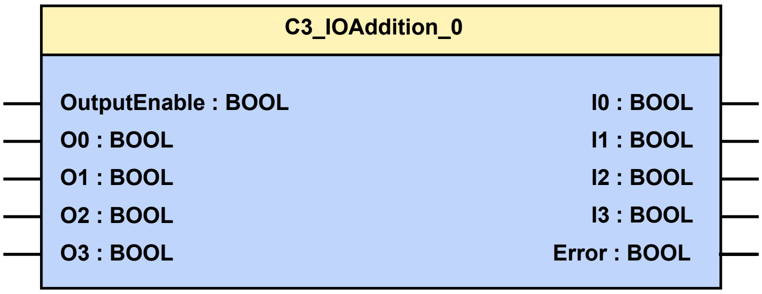


5.10.3. Reading/writing optional inputs/outputs

In this chapter you can read about:

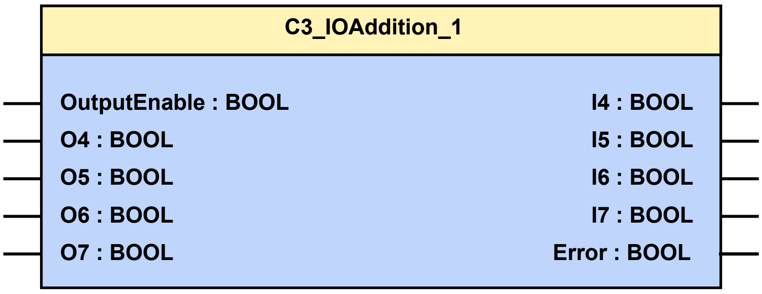
5.10.3.1 C3_IOAddition_0

FB name	**C3_IOAddition_0**	
Is used to create a process image of the optional digital inputs/outputs.		
VAR_INPUT		
I0 ... I3	BOOL	Displays the status of the respective input.
O0 ... O3	BOOL	Displays the status of the respective output.
Please note that the group of 4 may be assigned as **inputs or outputs** (see on page 608). You may only use either inputs or outputs exclusively. Notes: The module should always be brought up at the beginning (inputs) or end (outputs) of the processing cycle.		



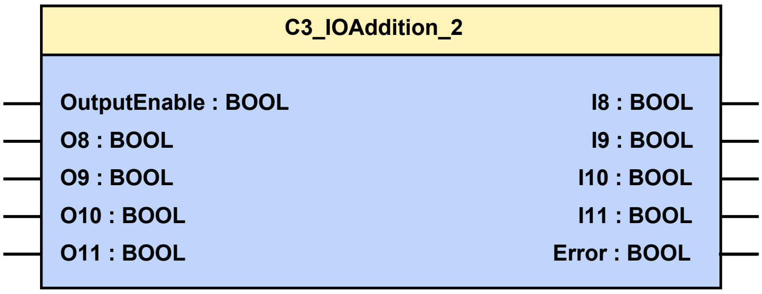
5.10.3.2 C3_IOAddition_1

FB name	**C3_IOAddition_1**	
Is used to create a process image of the optional digital inputs/outputs.		
VAR_INPUT		
I4 ... I7	BOOL	Displays the status of the respective input.
O4 ... O7	BOOL	Displays the status of the respective output.
Please note that the group of 4 may be assigned as **inputs or outputs** (see on page 608). You may only use either inputs or outputs exclusively. Notes: the module should always be brought up at the beginning of the processing cycle.		



5.10.3.3 C3_IOAddition_2

FB name	**C3_IOAddition_2**	
Is used to create a process image of the optional digital inputs/outputs.		
VAR_INPUT		
I8 ... I11	BOOL	Displays the status of the respective input.
O8 ... O11	BOOL	Displays the status of the respective output.
Please note that the group of 4 may be assigned as **inputs or outputs** (see on page 608). You may only use either inputs or outputs exclusively. Notes: the module should always be brought up at the beginning of the processing cycle.		

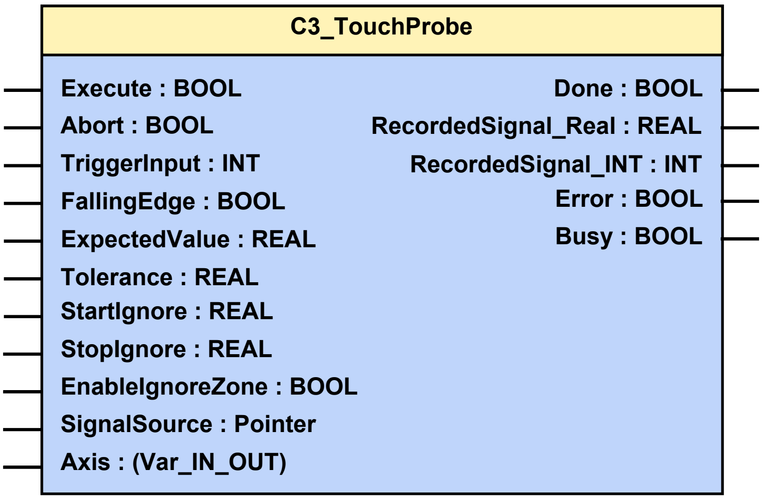


5.10.4. Memorizing the signals with the trigger event (C3_TouchProbe)

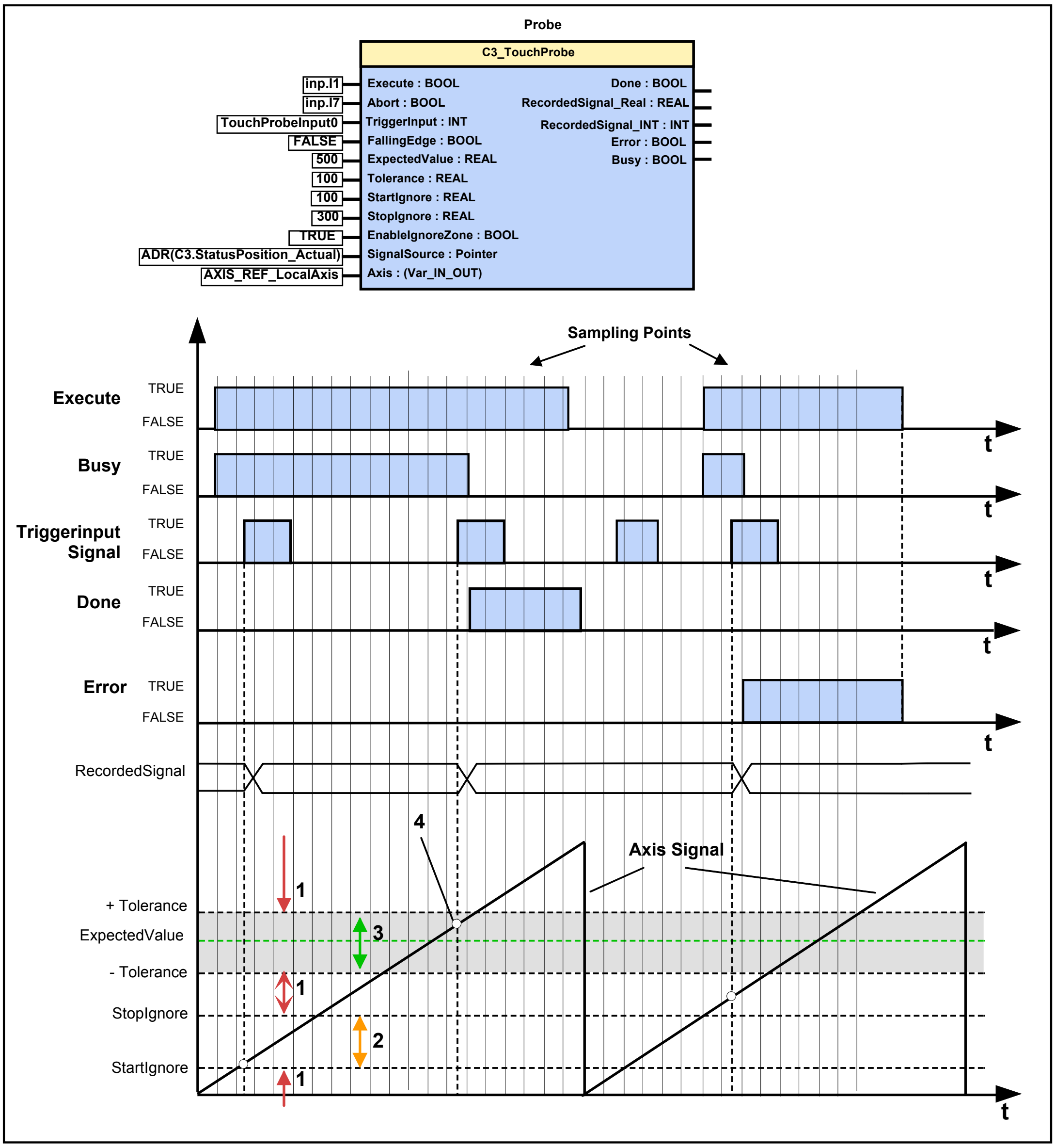
FB name	**C3_TouchProbe**	
Memorizing signals / objects with the trigger event - replaces the MC_TouchProbe module -		
VAR_IN_OUT		
Axis	INT	Axis ID (Library constants)
VAR_INPUT		
Execute	BOOL	Activates the module if there is a rising edge
SignalSource	Pointer	Selects the signal to be scanned. The ADR () must be used imperatively. The signal scanned must be in the REAL or the INT format.
FallingEdge	BOOL	If TRUE, it is triggered in the falling edge. The logical status after a possible input inversion is respected.
TriggerInput	INT	Selects the trigger input. Constant TouchProbeInputx (see note)
ExpectedValue	REAL	Value at which the trigger event is expected.
Tolerance	REAL	Tolerance interval around ExpectedValue, where the trigger event is accepted (always positive) (with reference to the signal source).
StartIgnore	REAL	The beginning of the range in which the trigger event will not be acknowledged with Done or Error (with reference to the signal source).
StopIgnore	REAL	The end of the range in which the trigger event will not be acknowledged with Done or Error (with reference to the signal source).
EnableIgnoreZone	BOOL	Activate IgnoreZone.
Abort	BOOL	Deactivate module.
VAR_OUTPUT		
Done	BOOL	Trigger event occurred within the tolerance interval and the signal was detected.
RecordedSignal_ Real	REAL	Value scanned at the time of the trigger event, if the source is available in the coDeSys "REAL format. Please respect the format information of the signal source (SignalSource)
RecordedSignal_ INT	INT	Value scanned at the time of the trigger event, if the source is available in the coDeSys "INT" format. Please respect the format information of the signal source (SignalSource)
Busy	BOOL	Module active and no scanning signal occurred outside the IgnoreZone.
Error	BOOL	Error while executing module.

Note:

- Temporal precision of signal recording: <1µs
- TriggerInput Trigger-input:
  via the constants "TouchProbeInput0" ... "TouchProbeInput7" (X12/6 - X12/14) the trigger signal input is selected.
- **Attention!**
  Only max. one entity of the module can be active as the hardware resources are only available once!
  Several entities being activated one after the other are permitted.



Example: Scanning the actual position, triggered via Input I0



1: Area where a **module error** is generated.

2: Ignore Zone: Area where **no module error** and **no Done** is generated.
The ranges 2 and 3 may not overlap. If they do, the ignore zone in range 3 is not effective.

3: ExpectedValueZone: Trigger signal in the permissible value range; this is confirmed with Done=TRUE.

4: RecordedSignal; is updated with every active edge of the TriggerInput signal upon Execute = TRUE.

- If the value of the signal (SignalSource) during the Trigger event is in the permissible value range between (ExpectedValue - Tolerance) and (ExpectedValue + Tolerance), this is confirmed with Done = TRUE; the RecordedSignal is updated.
- If the value of the signal (SignalSource) during the Trigger Event is between StartIgnore and StopIgnore (Ignore zone), the module will report neither error nor Done, the RecordedSignal is however updated.
- If the value of the signal (SignalSource) during the Trigger Event is outside the permissible value range and outside the zone between StartIgnore and StopIgnore (Ignore zone), the module will report an error, the RecordesSignal is updated.
- Within this range, the signals are read in with a temporal exactitude of <1µs (determined by linear interpolation).
- If a Trigger Signal occurs at Execute = False, the RecordedSignal is not updated.
- If **no** Trigger Signal comes up, Busy remains active until the module is reset to the original state with Abort.
- More examples with C3_Touchprobe (**example 7** (see on page 417) and **example 8** (see on page 420)).

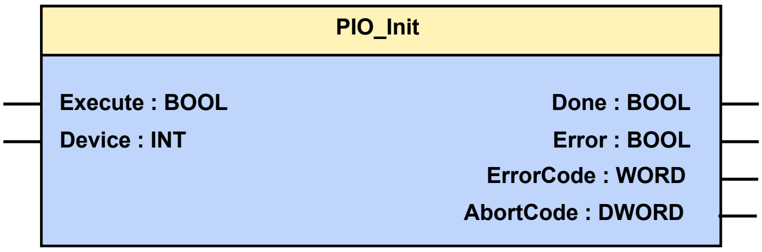
5.10.5. Integration of Parker I/Os (PIOs)

In this chapter you can read about:

In order to integrate PIOs via CANopen, the CANopen operating mode "**Master for PIOs** (see on page 501, see on page 502)" must be configured.

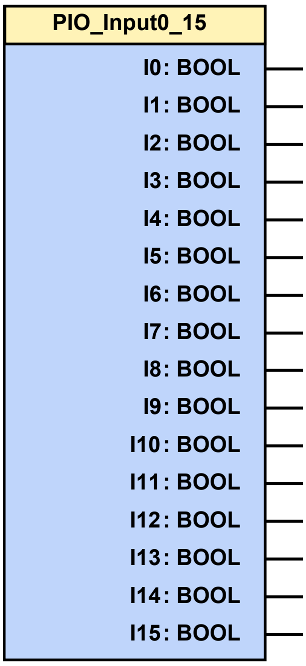
5.10.5.1 Initializing the PIOs (PIO_Init)

FB name	**PIO_Init**	
Initialization of the PIOs		
VAR_IN_OUT		
Device	INT	PIO - ID (Address)
VAR_INPUT		
Execute	BOOL	Activates the module if there is a positive edge
VAR_OUTPUT		
Done	BOOL	Initialization executed
Error	BOOL	An error occurred during initialization
ErrorCode	WORD	1 = no Parker device Additional errors can be found in the **error list** (see on page 563).
AbortCode	DWORD	**SDO abort code** (see on page 515)
Note: Please execute this module at the beginning of the IEC program.		



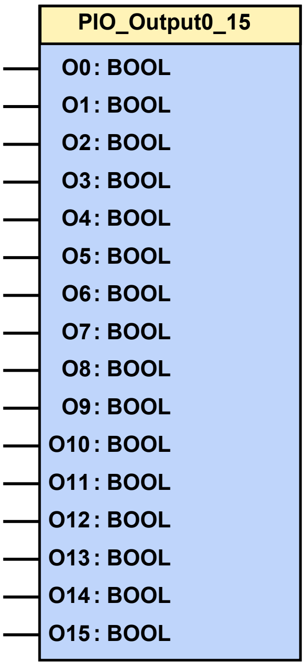
5.10.5.2 Reading the PIO inputs 0-15 (PIO_Inputx...y)

<table>
<tr><td>FB name</td><td colspan="2">PIO_Input0_15</td></tr>
<tr><td colspan="3">Is used for reading the respective inputs</td></tr>
<tr><td colspan="3">VAR_INPUT</td></tr>
<tr><td>I0 ... I15</td><td>BOOL</td><td>Displays the status of the respective input.</td></tr>
<tr><td colspan="3">Note: For the additional inputs, the following modules are available
PIO_Input16_31
PIO_Input32_47 and
PIO_Input48_63.
Please execute this module at the beginning of the IEC program (After PIO_INIT).</td></tr>
</table>



5.10.5.3 Writing the PIO outputs 0-15 (PIO_Outputx...y)

FB name	**PIO_Output0_15**	
Is used for writing on the respective outputs		
VAR_INPUT		
O0 ... O15	BOOL	Displays the status of the respective output.
Note: For the additional outputs, the following modules are available PIO_Output16_31 PIO_Output32_47and PIO_Output48_63. Please execute this module at the end of the IEC program.		



5.10.5.4 Example: Compax3 as CANopen Master with PIOs

- Compax3 control via PIOs.
- Configuration of the PIO connection with the C3 ServoManager.
- Initializing the PIO connection with the PIO_Init module
- Control of Compax3 via the digital PIOs and
- setpoint assignment via the analog PIOs

Related programs:

- ..\Examples\C3_with_PIOs\\T30_MasterPIO_ID2.C3P
- ..\Examples\C3_with_PIOs\\C3_PIO_CONNECTION_TEST.pro

Test setup: A PIO-347 for CANopen with:

- 1 PIO-602 (24V DC feed)
- 2 PIO-402 (8 digital inputs) for operation wired to a switch box
- 6 PIO-504 (24 digital outputs)
- 1 PIO-468 (4 analog inputs)
- 1 PIO-550 (2 analog outputs) analog output 0 is wired with analog input 0 for setpoint definition
- 1 PIO-600 (Bus terminal)
- a 24V power supply unit
- a C3 S025 F10 I21 T30 M11 with power- and 24V-cable
- a motor SMH 60 60 1.4...4 with motor- and resolver cable
- a CAN-bus cable for the connection of the Compax3 with the PIO coupler.
- a serial cable for the connection of the Compax3 with the PC
- a switch box for the operation of the 8 digital inputs of the PIOs.

Settings:

- Baud rate = 1Mbit
- Node address of the PIO = 5 (setting via the address switch on the device)
- Node address of the C3 = 2 (setting via the address switch on the device)

Control interface:

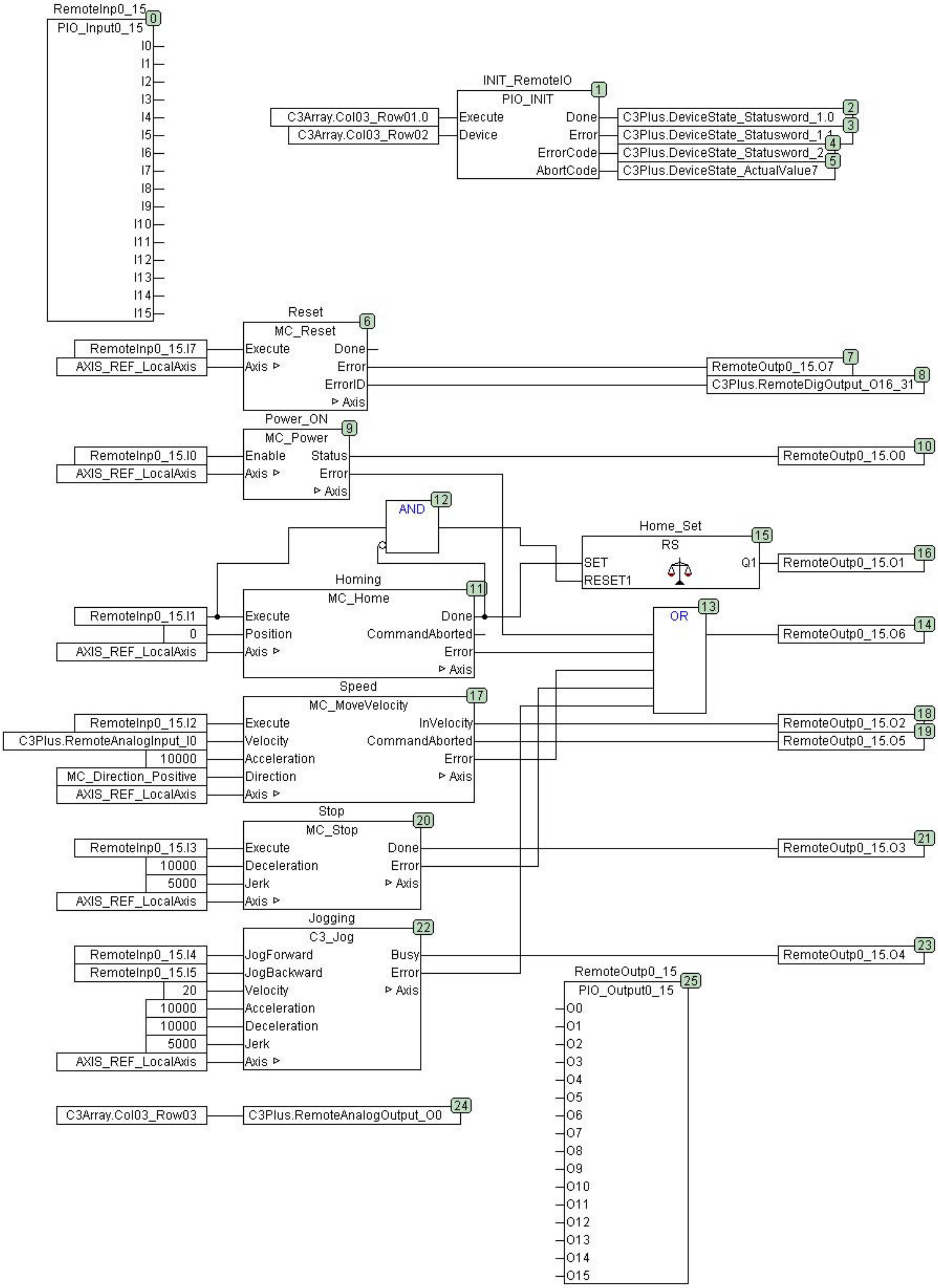
Digital input	**Function**	**Digital output**	**Function**
0	Energize axis	0	Axis is energized
1	Travel to MN (home)	1	MN (home) is accessed
2	Start MoveVelocity	2	Setpoint speed reached
3	Stop	3	Stop is present
4	JOG +	4	Manual function active
5	JOG -	5	MoveVelocity aborted
6	Free	6	Global module error display
7	Error reset	7	Error is present
Analog input		**Analog output**	
0	Setpoint speed		Setpoint speed specification

Additional Compax3 settings:

- Array_Col03_Row01=1; activates the PIO_Init module
- Array_Col03_Row02=5; address of the PIO
- Array_Col03_Row03=10; Default for the analog output0 ==> setpoint speed specification

If these values are stored in the Compax3, the PIO will be automatically initialized after Power On and started for PDO data exchange with Compax3.

Solution:


RemoteInp0_15
PIO_Input0_15
I0
I1
I2
I3
I4
I5
I6
I7
I8
I9
I10
I11
I12
I13
I14
I15
0
INIT_RemoteIO
PIO_INIT
1
C3Array.Col03_Row01.0
C3Array.Col03_Row02
Execute
Device
Done
Error
ErrorCode
AbortCode
C3Plus.DeviceState_Statusword_1.0
C3Plus.DeviceState_Statusword_1.1
C3Plus.DeviceState_Statusword_2
C3Plus.DeviceState_ActualValue7
2
3
4
5
Reset
MC_Reset
6
RemoteInp0_15.I7
AXIS_REF_LocalAxis
Execute
Axis
Done
Error
ErrorID
Axis
RemoteOutp0_15.O7
C3Plus.RemoteDigOutput_O16_31
7
8
Power_ON
MC_Power
9
RemoteInp0_15.I0
AXIS_REF_LocalAxis
Enable
Axis
Status
Error
Axis
RemoteOutp0_15.O0
10
AND
12
Home_Set
RS
15
SET
RESET1
Q1
RemoteOutp0_15.O1
16
Homing
MC_Home
11
RemoteInp0_15.I1
0
AXIS_REF_LocalAxis
Execute
Position
Axis
Done
CommandAborted
Error
Axis
OR
13
RemoteOutp0_15.O6
14
Speed
MC_MoveVelocity
17
RemoteInp0_15.I2
C3Plus.RemoteAnalogInput_I0
10000
MC_Direction_Positive
AXIS_REF_LocalAxis
Execute
Velocity
Acceleration
Direction
Axis
InVelocity
CommandAborted
Error
Axis
RemoteOutp0_15.O2
RemoteOutp0_15.O5
18
19
Stop
MC_Stop
20
RemoteInp0_15.I3
10000
5000
AXIS_REF_LocalAxis
Execute
Deceleration
Jerk
Axis
Done
Error
Axis
RemoteOutp0_15.O3
21
Jogging
C3_Jog
22
RemoteInp0_15.I4
RemoteInp0_15.I5
20
10000
10000
5000
AXIS_REF_LocalAxis
JogForward
JogBackward
Velocity
Acceleration
Deceleration
Jerk
Axis
Busy
Error
Axis
RemoteOutp0_15.O4
23
RemoteOutp0_15
PIO_Output0_15
25
O0
O1
O2
O3
O4
O5
O6
O7
O8
O9
O10
O11
O12
O13
O14
O15
C3Array.Col03_Row03
C3Plus.RemoteAnalogOutput_O0
24

5.11 Interface to C3 powerPLmC

In this chapter you can read about:

5.11.1. Interface module "PLmC_Interface"

The interface between a central IEC61131-3 user program on C3 powerPLmC and a local IEC61131-3 user program on a Compax3 servo axis T30 or T40 is created with the program module "PLmC_interface".

The " PLmC_Interface" module must be called up in each Compax3 T30 which is operated as a slave on a C3 powerPLmC.
With Compax3 T40 this is only necessary, if the slave axis is programmed directly (not with **operating mode: "**Slave on C3 powerPLmC) (Cam programming on C3 powerPLmC)**")**

The call-up must take place cyclically!

The module can be found in the "C3_PLmC_interface.lib" library, which must be integrated manually via the library manager, if required.

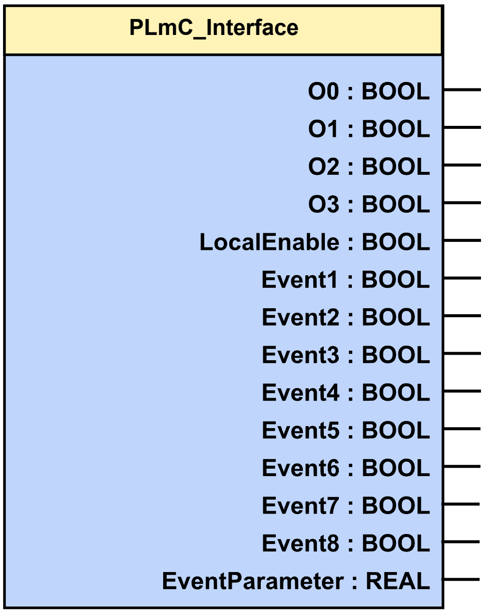
FB name	**PLmC_Interface**	
Interface module for the control of C3 powerPLmC		
VAR_OUTPUT		
O0	BOOL	Status of the digital output O0 on the C3 powerPLmC side
O1	BOOL	Status of the digital output O1 on the C3 powerPLmC side
O2	BOOL	Status of the digital output O2 on the C3 powerPLmC side
O3	BOOL	Status of the digital output O3 on the C3 powerPLmC side
LocalEnable	BOOL	Enable for the local IEC61131-3 program LocalEnable switches to FALSE for one cycle, if a command for this axis is activated on the C3 powerPLmC. This helps to avoid that the axis will receive different commands at a time.
Event1 ... Event8		factory use
EventParameter		factory use

Note:

- The execution of all local motion functions should be coupled with the LocalEnable output.
- Via the outputs O0...O3, the outputs set by C3 powerPLmC can be set out via the physical outputs with the aid of C3_Output.

Recipe array line 17... 32 assigned

Please note that the last 16 lines of the recipe array (C3Array.ColXX_Row17 to C3Array.ColXX_Row32) are reserved for the communication with C3 powerPLmC.



5.11.2. Cyclic data channel for C3T30 and C3T40

An additional communication channel (besides the one established by the Drive Interface which is not freely assignable) can be established between the programs of the C3 powerPLmC and a Compax3 axis via a freely usable cyclic data channel.

To do this, the assignment of the channel is defined on the side of the C3 powerPLmC in the controller configuration for the respective axis. The assignment is always bidirectional.

The following options are available for the communication between the two programs.

2x INT:

Assignment of the cyclic channel with 2 INT variables

Mapping to Compax3 objects

C3.PLmCToC3_INT1 / C3.PLmCToC3_INT2	from PLmC to Compax3
C3.C3ToPLmC_INT1 / C3.C3ToPLmC_INT2	from Compax3 to PLmC

Mapping to power PLmC variables

"Axis name".PLmCToC3_INT1	from PLmC to Compax3
"Axis name".PLmCToC3_INT2	from PLmC to Compax3
"Axis name".C3ToPLmC_INT1	from Compax3 to PLmC
"Axis name".C3ToPLmC_INT2	from Compax3 to PLmC

1x DINT: **Assignment of the cyclic channel with one DINT variable**

Mapping to Compax3 objects

C3.PLmCToC3_DINT	from PLmC to Compax3
C3.C3ToPLmC_DINT	from Compax3 to PLmC

Mapping to power PLmC variables

Axis name".PLmCToC3_DINT	from PLmC to Compax3
"Axis name".C3ToPLmC_DINT	from Compax3 to PLmC

1x REAL: **Assignment of the cyclic channel with one REAL variable**

Mapping to Compax3 objects

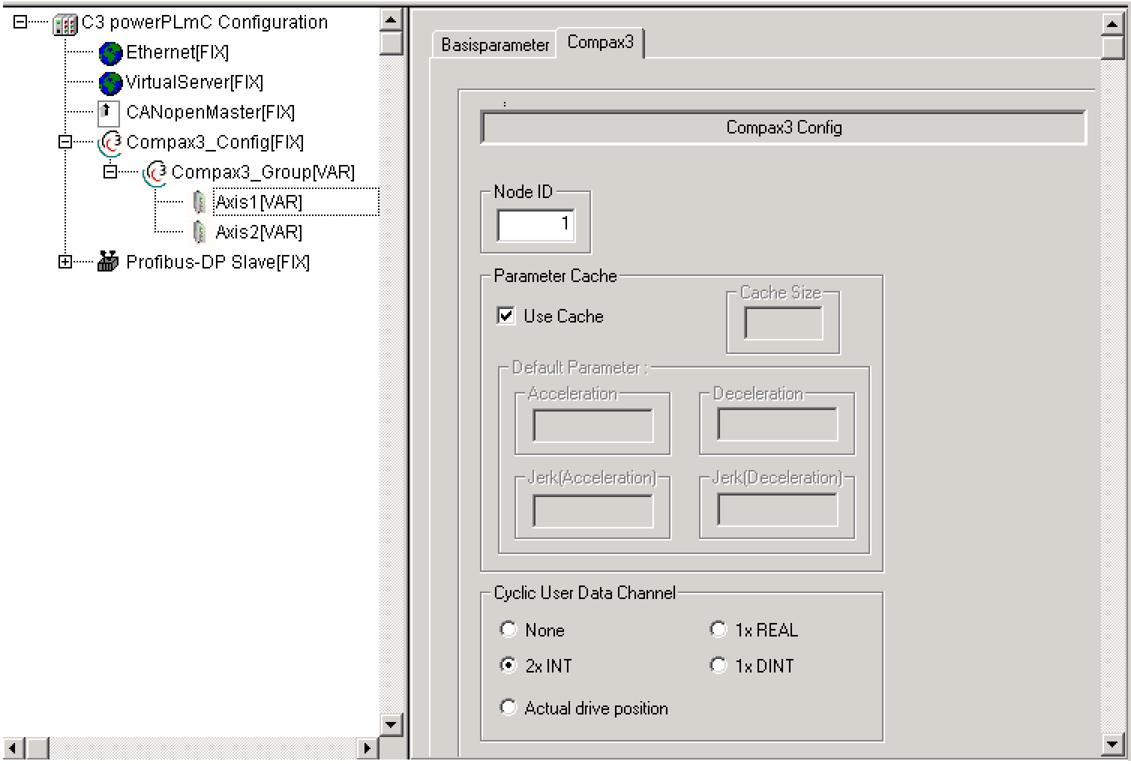
C3.PLmCToC3_REAL	from PLmC to Compax3
C3.C3ToPLmC_REAL	from Compax3 to PLmC

Mapping to power PLmC variables

"Axis name".PLmCToC3_REAL	from PLmC to Compax3
"Axis name".C3ToPLmC_REAL	from Compax3 to PLmC

Note: The use of INT or DINT variables is especially suitable for implementing a user-defined control word / status word between C3 powerPLmC IEC61131-3 program and Compax3 IEC61131-3 program.

Configuration of the data channel



Node ID: 1

☑ Use Cache

Cyclic User Data Channel

○ None
● 2x INT
○ Actual drive position
○ 1x REAL
○ 1x DINT

Note: If the cyclic data channel is not required, it can also be assigned to the actual position of the axis. This is then provided by the "**MC_ReadActualPosition** (see on page 307)" module. Therefore the value must not be continually read via the acyclic channel if the module is used; this reduces the bus load and the IEC cycle time.

5.11.3. Example: C3 powerPLmC Program & Compax3 Program

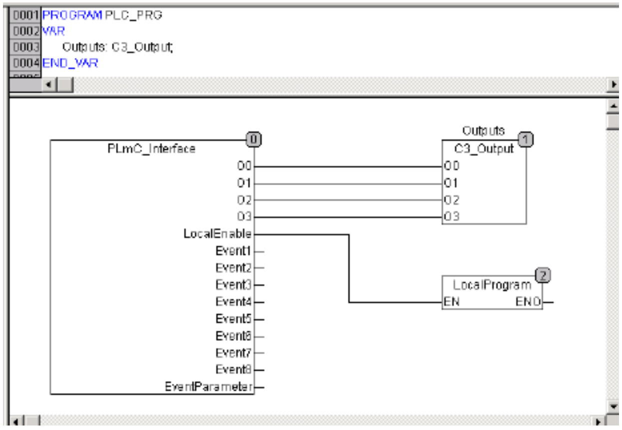
Task:

- Implementation of a mark synchronization in a Compaxa3 servo axis.
- Control of the program via the C3 powerPLmC via a user-defined control word / status word.

Main program on Compax3 (module PLC_PRG)

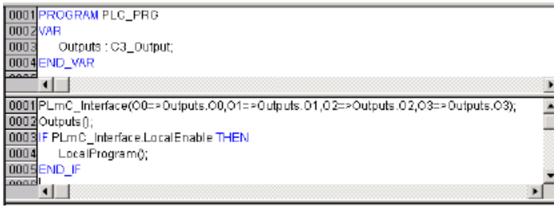
Cyclic call-up of the interface to powerPLmC in the PLC_PRG module

In CFC:



```
PROGRAM PLC_PRG
VAR
    Outputs: C3_Output;
END_VAR
```

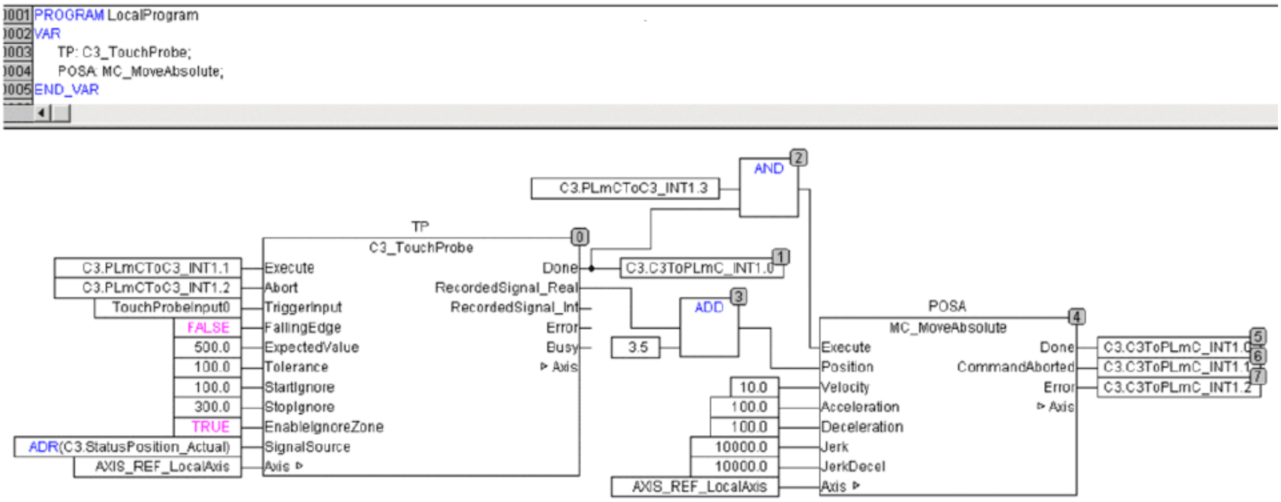
In ST:



```
PROGRAM PLC_PRG
VAR
    Outputs : C3_Output;
END_VAR
```

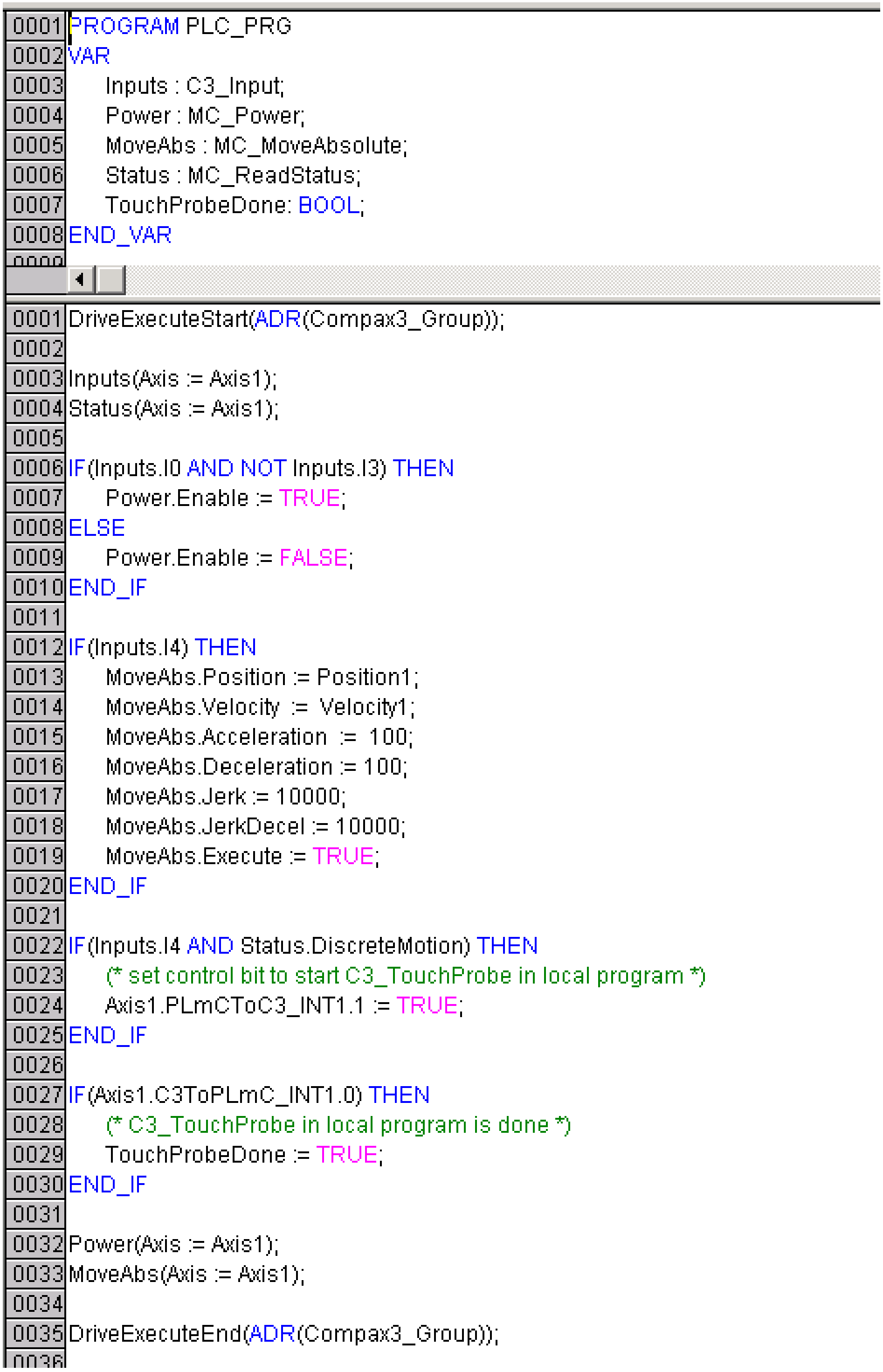
```
PLmC_Interface(O0=>Outputs.O0,O1=>Outputs.O1,O2=>Outputs.O2,O3=>Outputs.O3);
Outputs();
IF PLmC_Interface.LocalEnable THEN
    LocalProgram();
END_IF
```

Local Compax3 Program in the LocalProgram module



```
PROGRAM LocalProgram
VAR
    TP: C3_TouchProbe;
    POSA: MC_MoveAbsolute;
END_VAR
```

Program on C3 powerPLmC



```
PROGRAM PLC_PRG
VAR
    Inputs : C3_Input;
    Power : MC_Power;
    MoveAbs : MC_MoveAbsolute;
    Status : MC_ReadStatus;
    TouchProbeDone: BOOL;
END_VAR
```

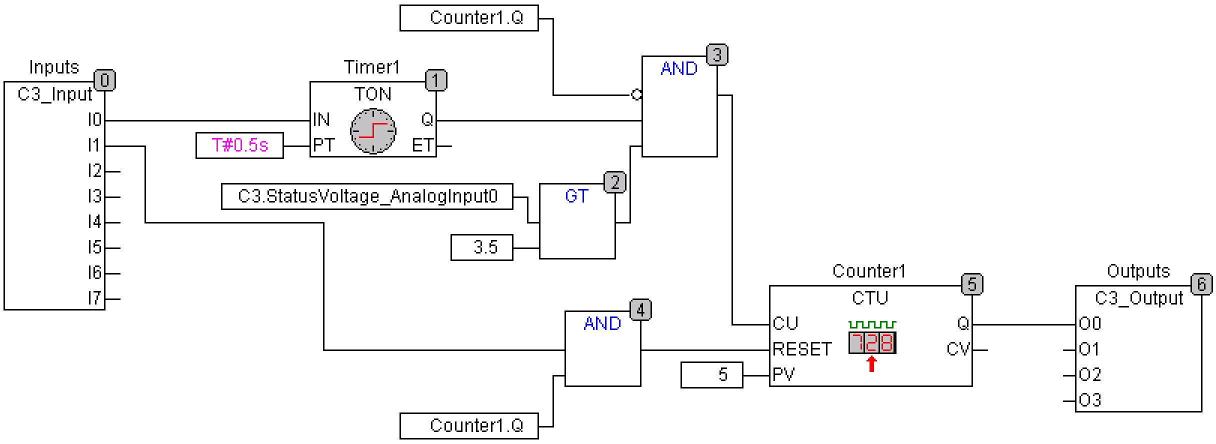
```
DriveExecuteStart(ADR(Compax3_Group));

Inputs(Axis := Axis1);
Status(Axis := Axis1);

IF(Inputs.I0 AND NOT Inputs.I3) THEN
    Power.Enable := TRUE;
ELSE
    Power.Enable := FALSE;
END_IF

IF(Inputs.I4) THEN
    MoveAbs.Position := Position1;
    MoveAbs.Velocity  :=  Velocity1;
    MoveAbs.Acceleration  :=  100;
    MoveAbs.Deceleration := 100;
    MoveAbs.Jerk := 10000;
    MoveAbs.JerkDecel := 10000;
    MoveAbs.Execute := TRUE;
END_IF

IF(Inputs.I4 AND Status.DiscreteMotion) THEN
    (* set control bit to start C3_TouchProbe in local program *)
    Axis1.PLmCToC3_INT1.1 := TRUE;
END_IF

IF(Axis1.C3ToPLmC_INT1.0) THEN
    (* C3_TouchProbe in local program is done *)
    TouchProbeDone := TRUE;
END_IF

Power(Axis := Axis1);
MoveAbs(Axis := Axis1);

DriveExecuteEnd(ADR(Compax3_Group));
```

5.12 IEC examples

In this chapter you can read about:

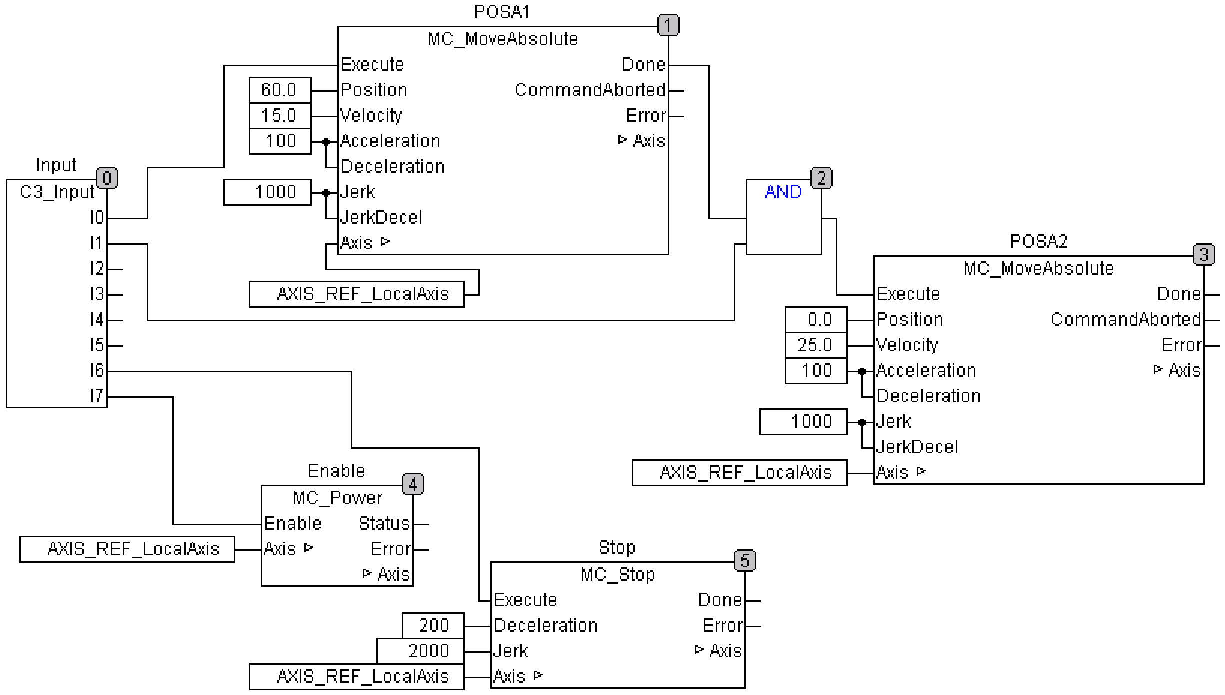
5.12.1. Example in CFC: Using Compax3-specific function modules and Compax3 objects

- Read in the process image of the digital inputs with the InputStatus module.
- Generate a process image of the digital outputs with the OutputStatus module.
- Digital input I0, used for counting an external event. The event is only detected as an event if
  - The I0 input is at TRUE for at least 0.5 seconds and
  - The voltage on analog input 0 exceeds the threshold value of 3.5 volts.
- When 5 of these events have been counted, the digital output is set to O0. At the same time, the program prevents additional events on the I0 from being counted. The counter state can be reset again with Input I1 as soon as it reaches a value of 5.



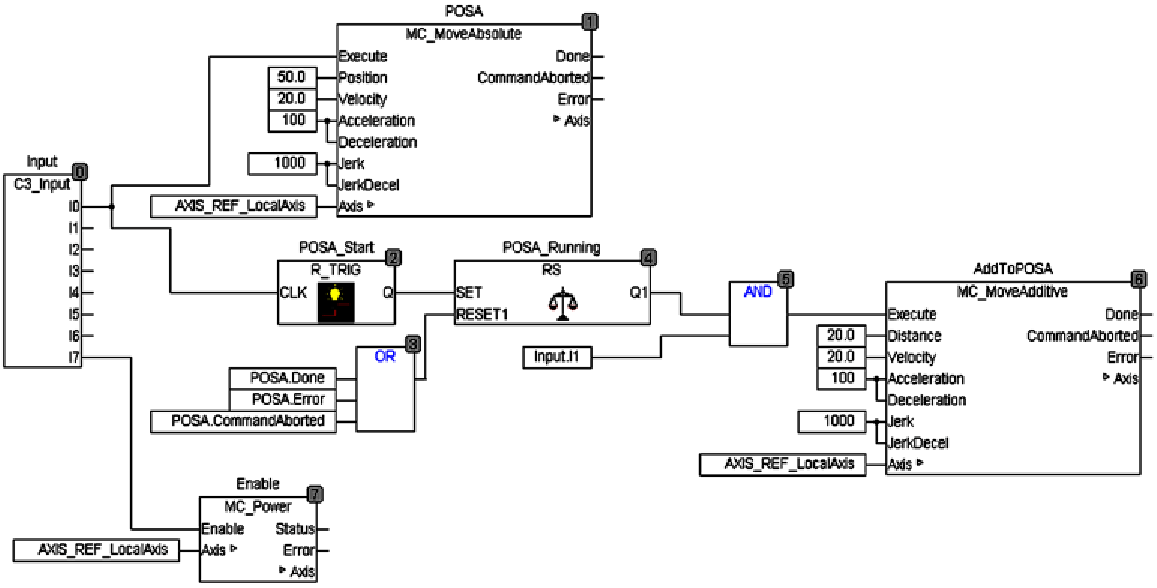
5.12.2. Example in CFC: Positioning 1

- Input I7 enables the power output stage
- Input I0 starts an absolute positioning process with fixed parameters
- Input I6 is used to stop the movement
- After positioning is complete, there will be a return to Position 0 as soon as Input I1 has been activated



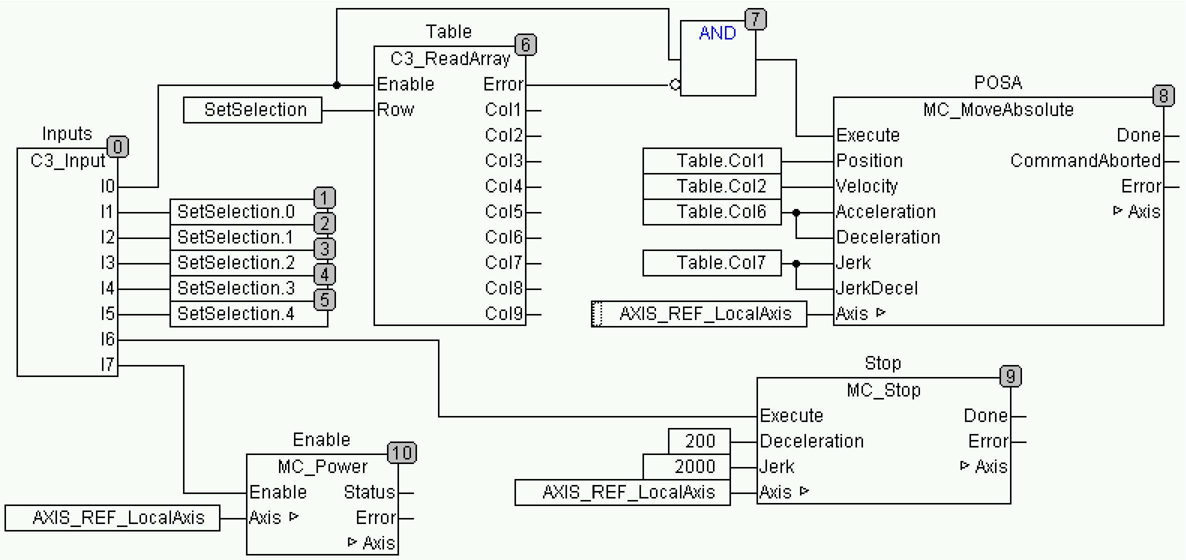
5.12.3. Example in CFC: Positioning 2

- Input I7 enables the power output stage
- Input I0 starts an absolute positioning process
- If an event (I1) occurs during the positioning, the target position will be moved back by 20 ("MoveAdditive")
- If an event occurs while positioning is not in progress, it has no effect



5.12.4. Example in CFC: Positioning with set selection

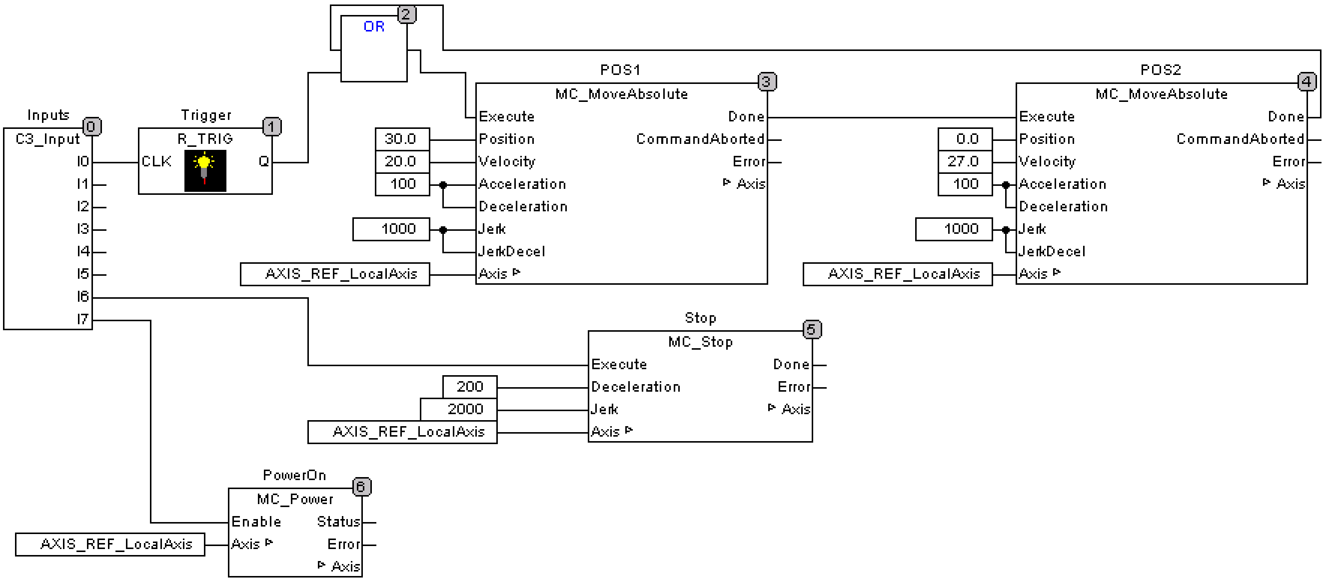
- Input I7 enables the power output stage
- The position, speed and ramps can be stored in the array (table) (for example input with the Compax3 ServoManager)
- The desired set can be selected with inputs I1 through I5 (binary coded)
- Input I0 starts the positioning (absolute positioning)
- Positioning that is in progress can be stopped with Input I6



5.12.5. Example in CFC: Cycle mode

Example a: Cycle mode

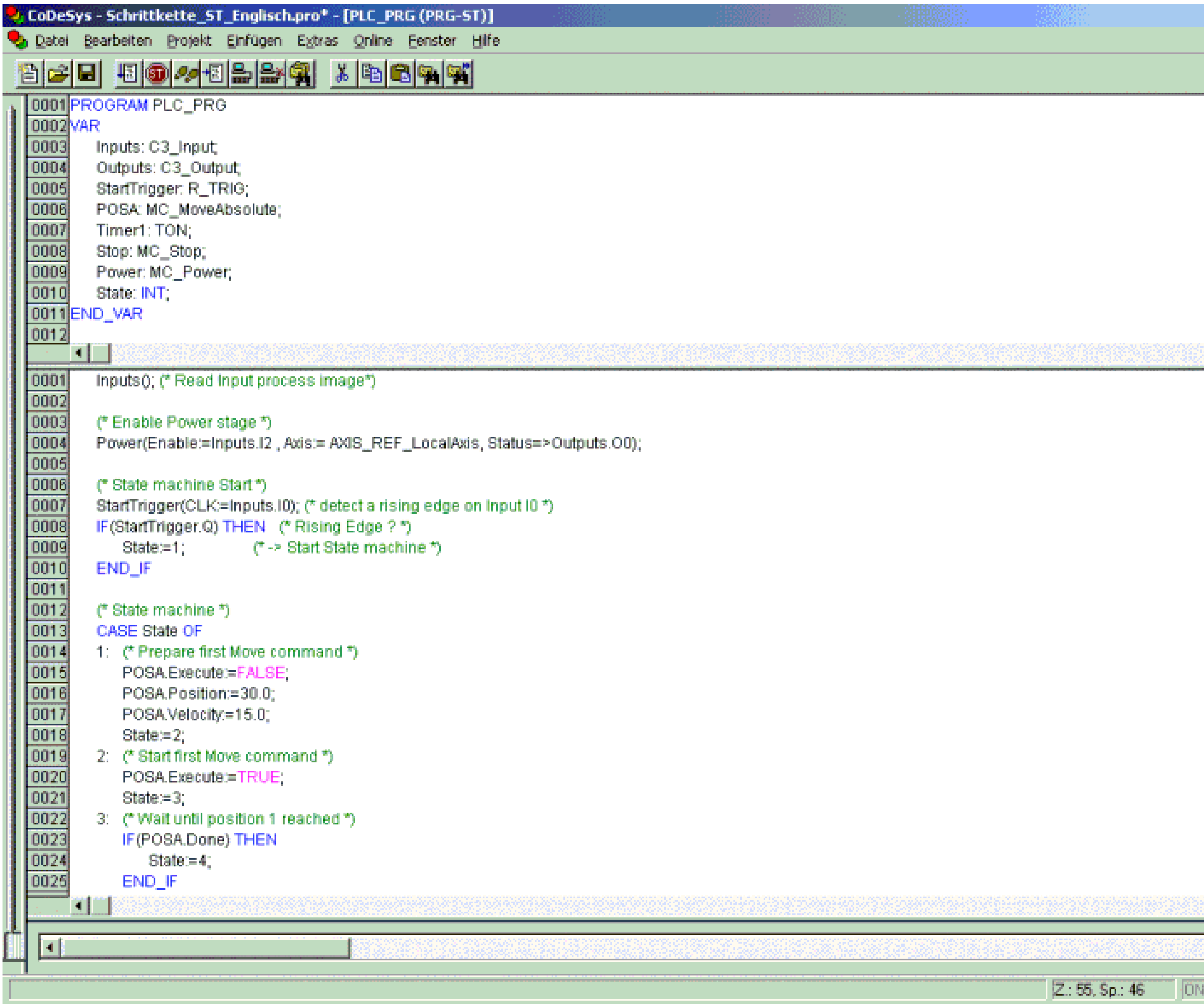
- Input I7 enables the power output stage
- Input I0 starts cyclical positioning. During this process, two positions are approached in alternation.
- Input I6 stops cycle mode



5.12.6. Example in ST: Cycle mode with a Move module

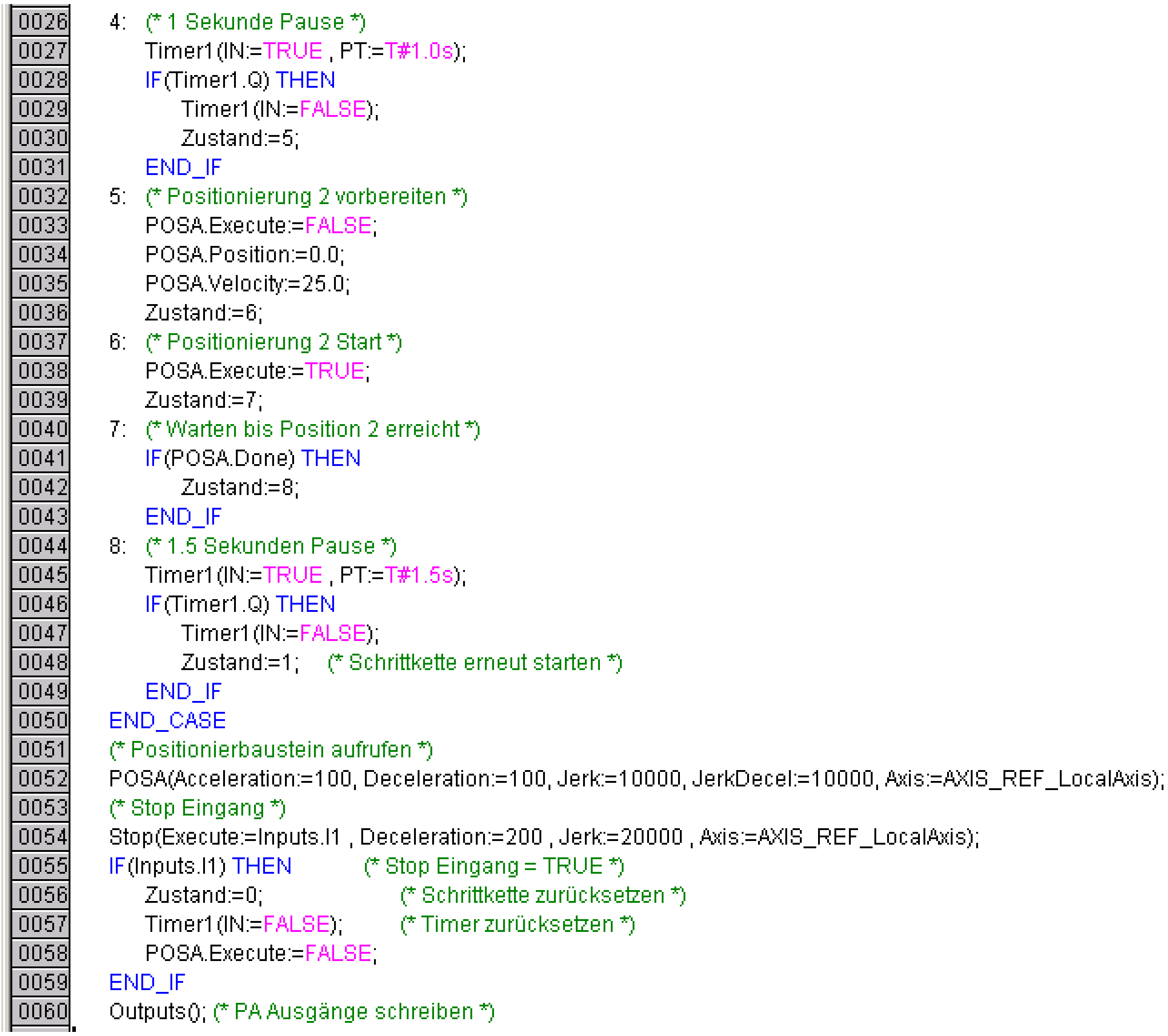
Input I2 enables the power output stage.

- Input I0 starts cycle mode. Two positions are approached alternately.
- There is a pause of 1 second after the first position is reached.
- There is a pause of 1.5 seconds after the second position is reached.
- Input I1 stops cycle mode.



```
PROGRAM PLC_PRG
VAR
    Inputs: C3_Input;
    Outputs: C3_Output;
    StartTrigger: R_TRIG;
    POSA: MC_MoveAbsolute;
    Timer1: TON;
    Stop: MC_Stop;
    Power: MC_Power;
    State: INT;
END_VAR

```

```
    Inputs(); (* Read Input process image*)

    (* Enable Power stage *)
    Power(Enable:=Inputs.I2 , Axis:= AXIS_REF_LocalAxis, Status=>Outputs.O0);

    (* State machine Start *)
    StartTrigger(CLK:=Inputs.I0); (* detect a rising edge on Input I0 *)
    IF(StartTrigger.Q) THEN   (* Rising Edge ? *)
        State:=1;              (* -> Start State machine *)
    END_IF

    (* State machine *)
    CASE State OF
    1:  (* Prepare first Move command *)
        POSA.Execute:=FALSE;
        POSA.Position:=30.0;
        POSA.Velocity:=15.0;
        State:=2;
    2:  (* Start first Move command *)
        POSA.Execute:=TRUE;
        State:=3;
    3:  (* Wait until position 1 reached *)
        IF(POSA.Done) THEN
            State:=4;
        END_IF
```



```
4:  (* 1 Sekunde Pause *)
    Timer1(IN:=TRUE , PT:=T#1.0s);
    IF(Timer1.Q) THEN
        Timer1(IN:=FALSE);
        Zustand:=5;
    END_IF
5:  (* Positionierung 2 vorbereiten *)
    POSA.Execute:=FALSE;
    POSA.Position:=0.0;
    POSA.Velocity:=25.0;
    Zustand:=6;
6:  (* Positionierung 2 Start *)
    POSA.Execute:=TRUE;
    Zustand:=7;
7:  (* Warten bis Position 2 erreicht *)
    IF(POSA.Done) THEN
        Zustand:=8;
    END_IF
8:  (* 1.5 Sekunden Pause *)
    Timer1(IN:=TRUE , PT:=T#1.5s);
    IF(Timer1.Q) THEN
        Timer1(IN:=FALSE);
        Zustand:=1;    (* Schrittkette erneut starten *)
    END_IF
END_CASE
(* Positionierbaustein aufrufen *)
POSA(Acceleration:=100, Deceleration:=100, Jerk:=10000, JerkDecel:=10000, Axis:=AXIS_REF_LocalAxis);
(* Stop Eingang *)
Stop(Execute:=Inputs.I1 , Deceleration:=200 , Jerk:=20000 , Axis:=AXIS_REF_LocalAxis);
IF(Inputs.I1) THEN          (* Stop Eingang = TRUE *)
    Zustand:=0;                 (* Schrittkette zurücksetzen *)
    Timer1(IN:=FALSE);          (* Timer zurücksetzen *)
    POSA.Execute:=FALSE;
END_IF
Outputs(); (* PA Ausgänge schreiben *)
```

5.13 Profibus: Simulate Profidrive profile (C3_ProfiDrive_Statemachine)

The function module can be found in the "C3_Profiles_lib" library and must be integrated via the library manager before use.

Notes on the use:

- The input values coming from the master control via the Profibus can be changed before they are transmitted to the Statemachine (e.g. I/Os).
- In the simplest case, the control word and the motion parameters (which may come from the Profibus) are manipulated by the IEC program.
- If the Statemachine is active, all motions must be executed via the Statemachine. Motions such as for example MoveAbsolute, MoveRelative; MoveAdditive; MoveVelocity; Gearing, Reg-related positioning are possible. Or with Compax3F: Force/pressure regulating.
- With the "control via PLC" bit (CW1 bit 10 = 1), the Statemachine takes the control for the drive (is active). This means that no functions concerning the device status (such as Power, MoveX) by other function/program modules are permitted. If "no control" is selected (CW1 bit 10 = 0), the device status can be changed via function/program modules.
- The Profidrive Statemachine works independently from the Profibus. I.e. it can also be used in connection with other busses.
- The Profidrive Statemachine contains states, which cannot be mapped to the PLCopen status machine.

FB name	**C3_ProfiDrive_Statemachine**	
With the aid of the Profibus function module, the PROFIdrive profile can be simulated. The profile is described in the help of the Compax3 I20T11 technology function (set operation is however not possible). The inputs of the module can be assigned as required.		
VAR_IN_OUT		
--	--	--
VAR_INPUT		
CW1	WORD	Control word according to Profidrive (see below)
CWadd	INT	additional control word: the following functions can be triggered in the positioning mode 0: no action 1: NOP (No Operation) 2: Stop 3: Homing Execution takes place with the "activate motion order" of CW1. The value must be reset to zero after the execution!
OperationMode	INT	Operating mode after Profidrive 1: Speed control 2: Positioning
Position	REAL	Position setpoint value for all positioning commands (MoveAbs, MoveRel, MoveAdd, RegSearch, RegMove preparation)
Velocity	REAL	Setpoint speed in operating mode 1 (speed control) and for MoveVelocity (not for positioning)
VelocityForPosition	REAL	Setpoint travel speed for positioning
VelocityForJog	REAL	Speed for JOG
Acceleration	DINT	Setpoint acceleration
Deceleration	DINT	Setpoint deceleration
DecelerationForStop	DINT	Deceleration for Stop
Jerk	DINT	Setpoint jerk

Master	INT	Source for Gearing - AXIS_REF_Physical (T30, T40) [e.g. encoder input X11] AXIS_REF_HEDA (T30, T40) AXIS_REF_Virtual (T40)
RatioNumerator	INT	Numerator for Gearing
RatioDenominator	INT	Denominator for Gearing
PositionForRegMove	REAL	Position for RegMove, necessary if RegSearch is executed and registration is detected. Note: The input is connected to the PositionOfRegMove output in the simplest case.
VelocityForRegMove	REAL	Speed for RegMove, necessary if RegSearch is executed and registration is detected. Note: The input is connected to the VelocityOfRegMove output in the simplest case.
CStatus1ForRegMove	WORD	- do not use - Command status 1 for RegMove end; necessary if RegSearch is executed and registration is detected
CStatus2ForRegMove	WORD	reserved!
ShortRampForRegMove	BOOL	Permits the Compax3 to calculate individual parameters for the RegMove positioning, if the set parameters would not reach the target.
RegMoveMode	INT	reserved!
IgnoreZoneStart	REAL	Registration mark-related positioning: Beginning of the ignore zone
IgnoreZoneStop	REAL	Registration mark-related positioning: End of the ignore zone
PositionReachedMode	BOOL	Mode for the generation of the PositionReached in the status word (CW1.10). TRUE: link to setpoint value
DisablePositiveDirection	BOOL	Block for positive direction
DisableNegativeDirection	BOOL	Block for negative direction
LimitErrorExtern	BOOL	reserved!
Override	REAL	reserved!
CStatus1In	WORD W	reserved!
CStatus2In	WORD	reserved!
VAR_OUTPUT		
ZSW1	WORD	Status word after Profidrive
OperationModeActual	INT	Active operating mode
PositionOfRegMove	REAL	Position transmitted to the RegMove command (cache memory) Note: The output is connected to the PositionForRegMove input in the simplest case.
VelocityOfRegMove	REAL	Velocity transmitted to the RegMove command (cache memory) Note: The input is connected to the VelocityForRegMove output in the simplest case.
CStatus2OfRegMove	WORD	reserved!
StatusMotor_off	BOOL	Motor is currentless (TRUE)
StatusMotor_standstill	BOOL	Status motor is energized at standstill (setpoint value) (TRUE)
CStatus1	WORD	reserved!
CStatus2	WORD	reserved!

Notes:

- You can call up directly the help for the Compax3 Profidrive device (I20T11) via the help installer (C3 ServoManager "?" Start C3 ServoManager Help Installer...) (select and open in the left window).
- On the Compax3 CD you will find an application example with additional explanations for the use of this module:
  C3 CD - directory....\Examples\Profidrive with T30T40\

6. Communication

In this chapter you can read about:

Here you will find the description of the fieldbus interfaces, which can be configured in the Compax3 ServoManager under the tree entry "configuring the communication".

Please note: The configuration of the process data (Mapping) is made wizard-guided with the Compax3 ServoManager.

If you perform the mapping directly via the master, you must go through this fieldbus wizard once; the Compax3 ServoManager will perform the necessary initializations.

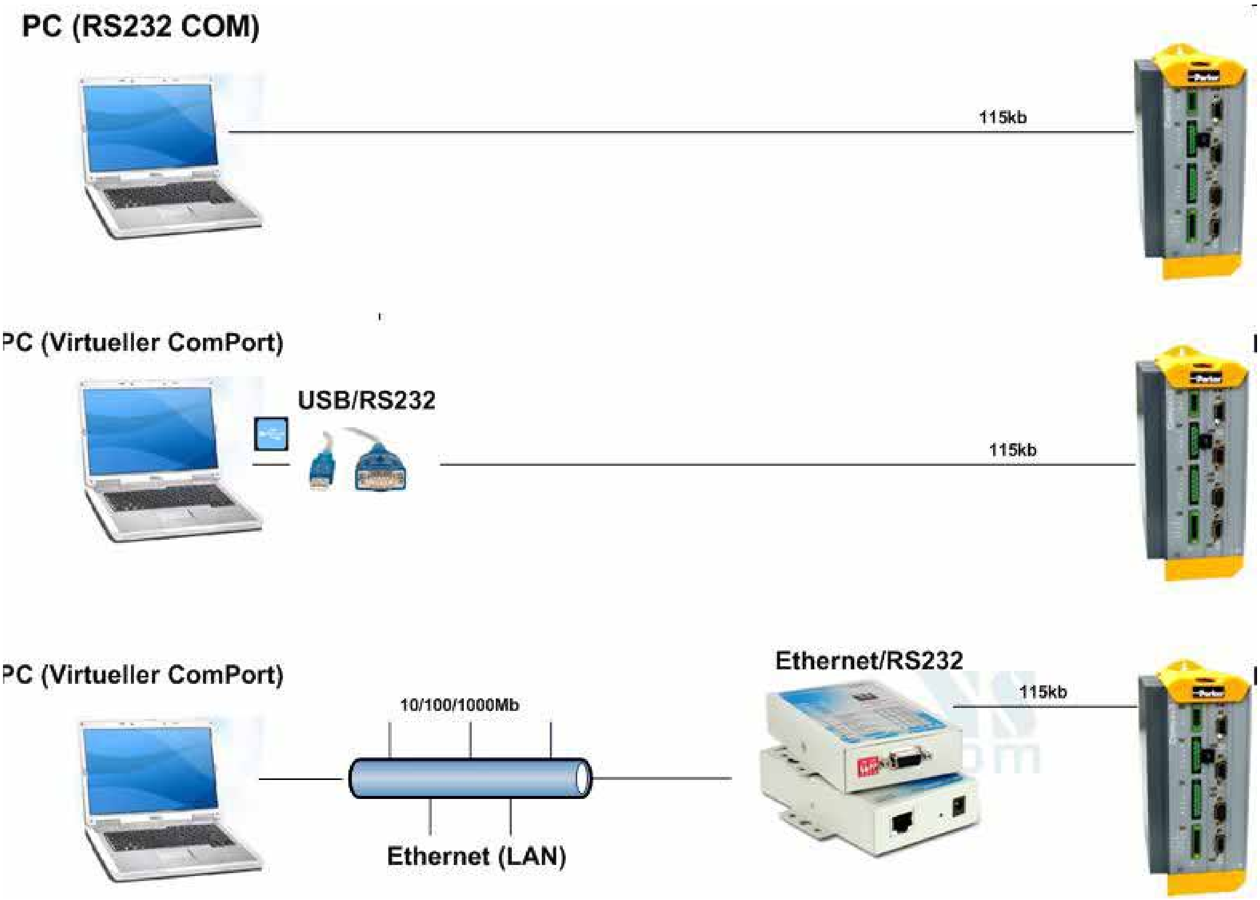
6.1 Compa3 communication variants

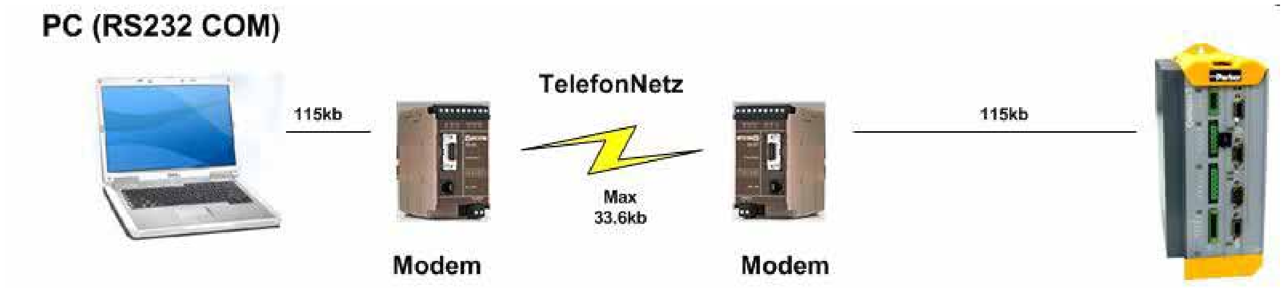
In this chapter you can read about:

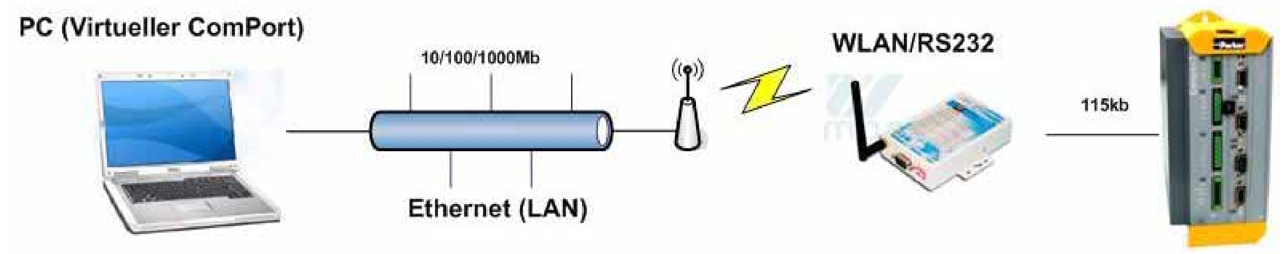
Overview of all possible communication modes between Compax3 devices and a PC.

6.1.1. PC <-> Compax3 (RS232)

PC <-> Compax3 (RS232): Connections to a device



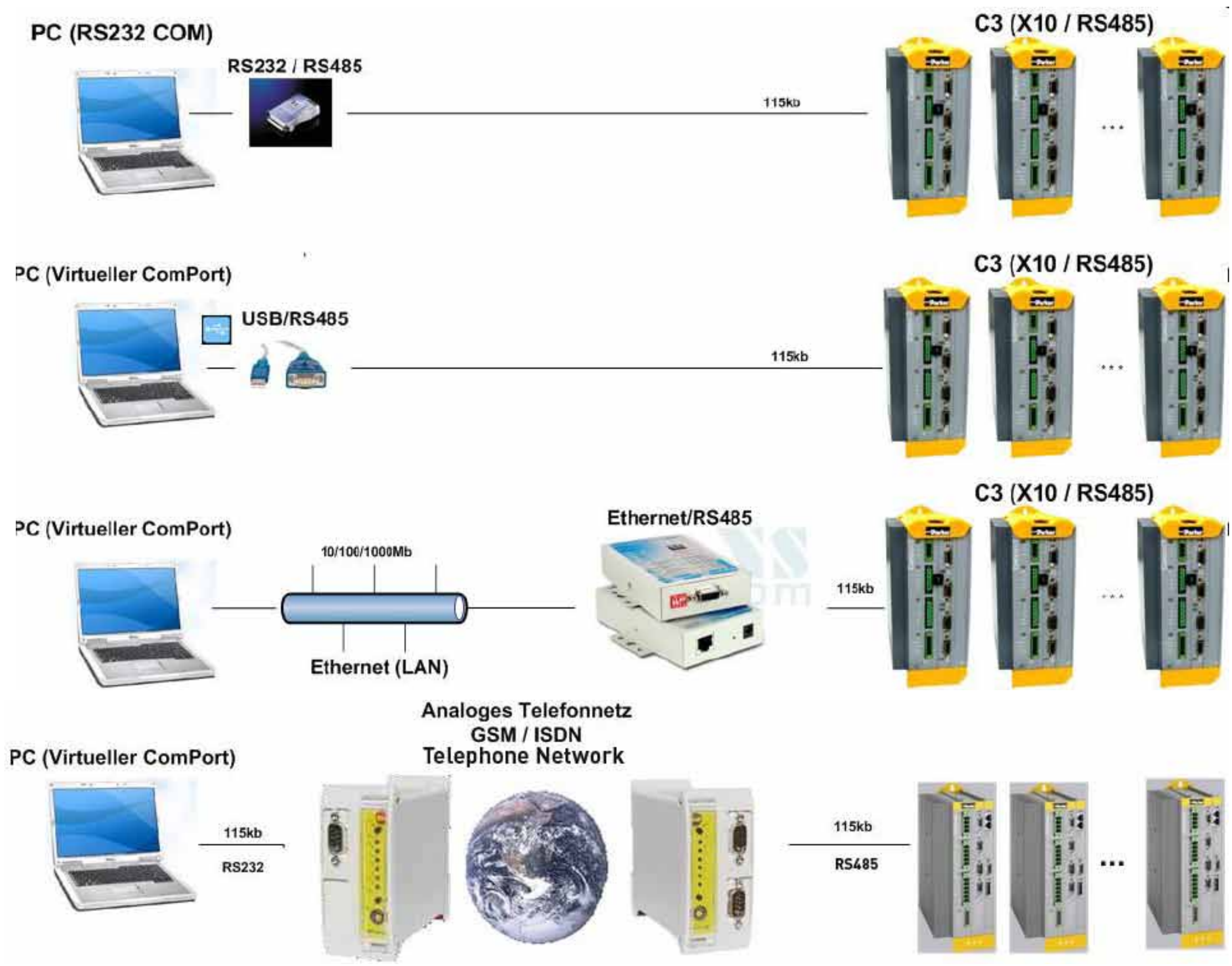

PC (RS232 COM)
115kb
TelefonNetz
Max
33.6kb
115kb
Modem
Modem

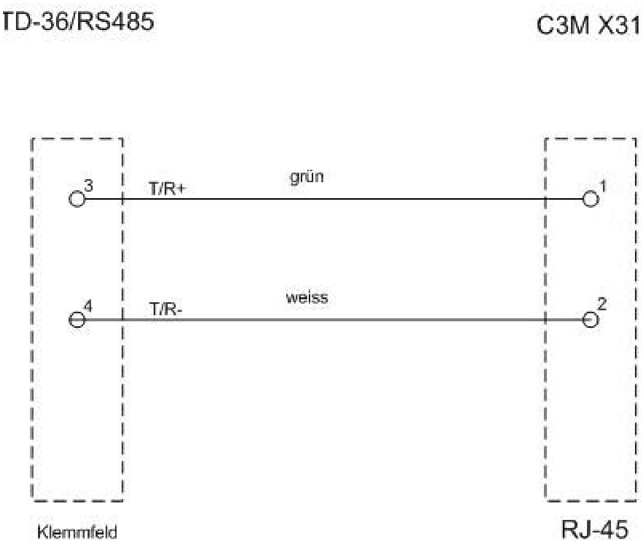

PC (Virtueller ComPort)
10/100/1000Mb
WLAN/RS232
115kb
Ethernet (LAN)


Analoges Telefonnetz
GSM / ISDN
Telephone Network
PC (Virtueller ComPort)
115kb
RS232
115kb
RS232

6.1.2. PC <-> Compax3 (RS485)

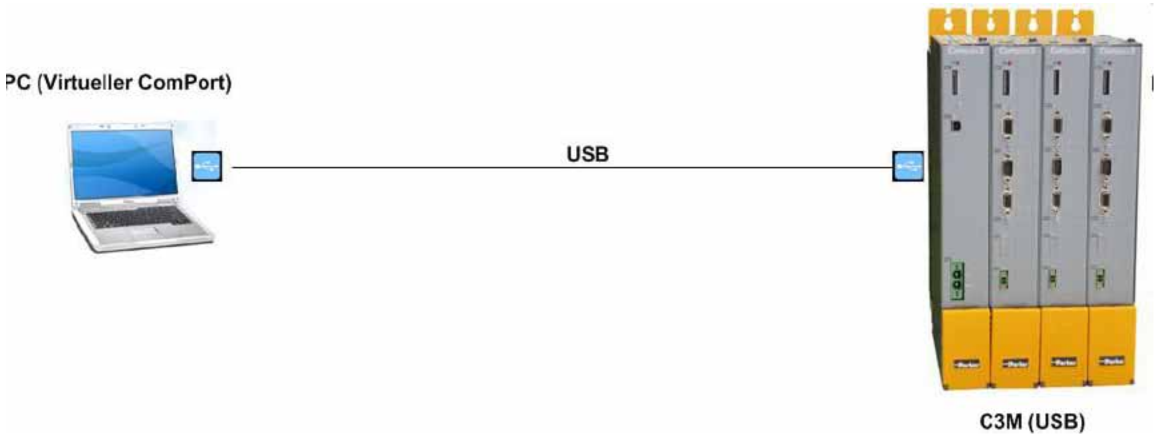
PC <-> Compax3 (RS485)

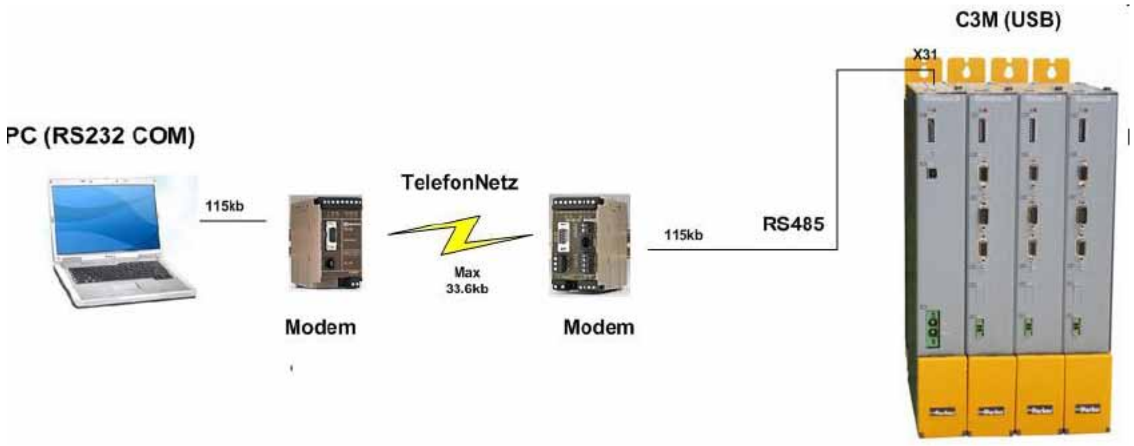


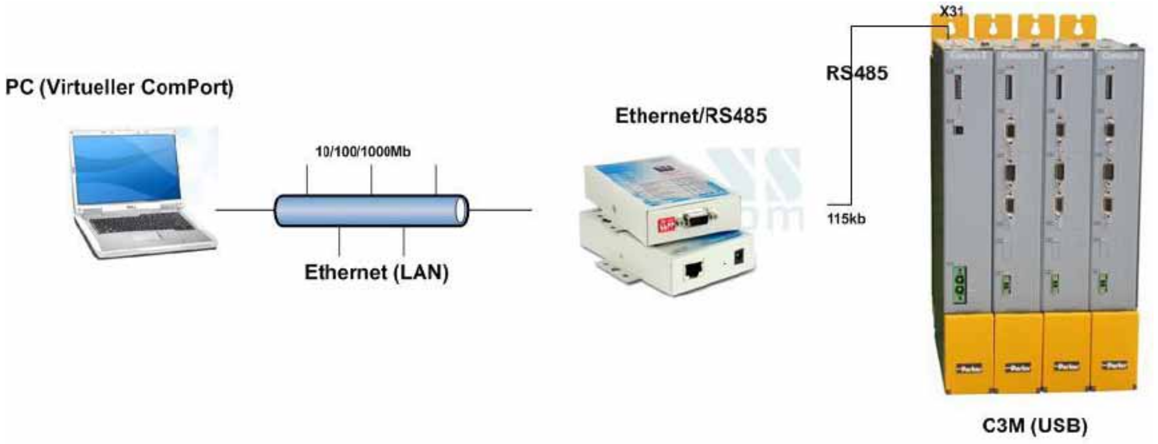


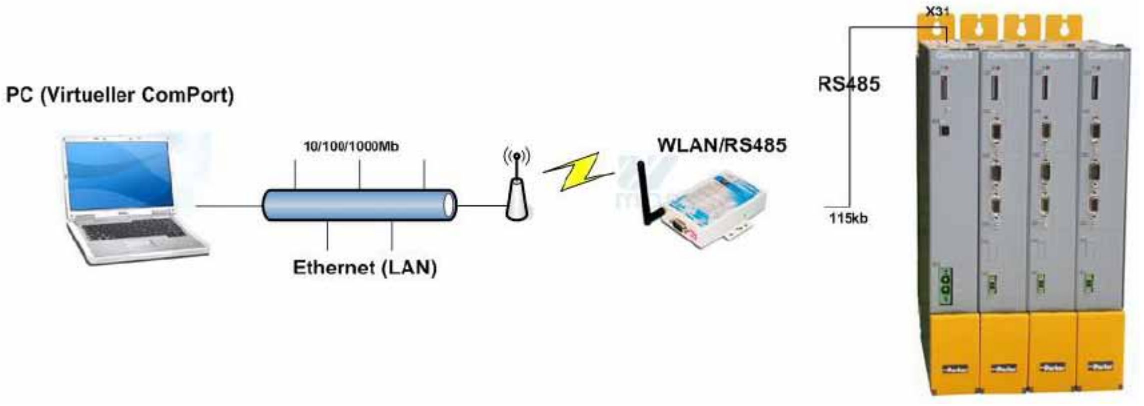
6.1.3. PC <-> C3M device combination (USB)

PC <-> C3M device combination

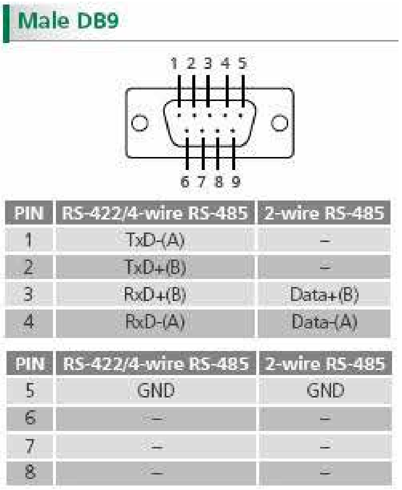








6.1.4. USB-RS485 Moxa Uport 1130 adapter



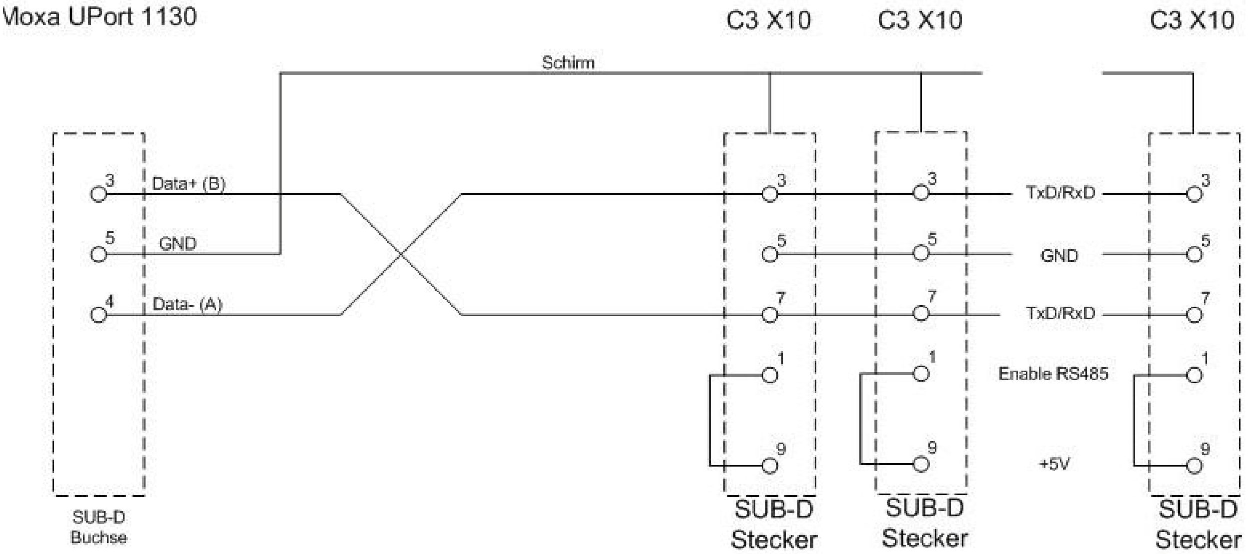
PIN	RS-422/4-wire RS-485	2-wire RS-485
1	TxD-(A)	–
2	TxD+(B)	–
3	RxD+(B)	Data+(B)
4	RxD-(A)	Data-(A)

PIN	RS-422/4-wire RS-485	2-wire RS-485
5	GND	GND
6	–	–
7	–	–
8	–	–

The serial UPort 1130 USB adapter offers a simple and comfortable method of connecting an RS-422 or RS-485 device to your laptop or PC. The UPort 1130 is connected to the USB port of your computer and complements your workstation with a DB9 RS-422/485 serial interface. For simple installation and configuration, Windows drivers are already integrated. The UPort 1130 can be used with new or legacy serial devices and supports both 2- and 4-wire RS-485. It is especially suited for mobile, instrumentation and point-of-sale (POS) applications.

Manufacturer link: **http://www.moxa.com/product/UPort_1130.htm**
http://www.moxa.com/product/UPort_1130.htm

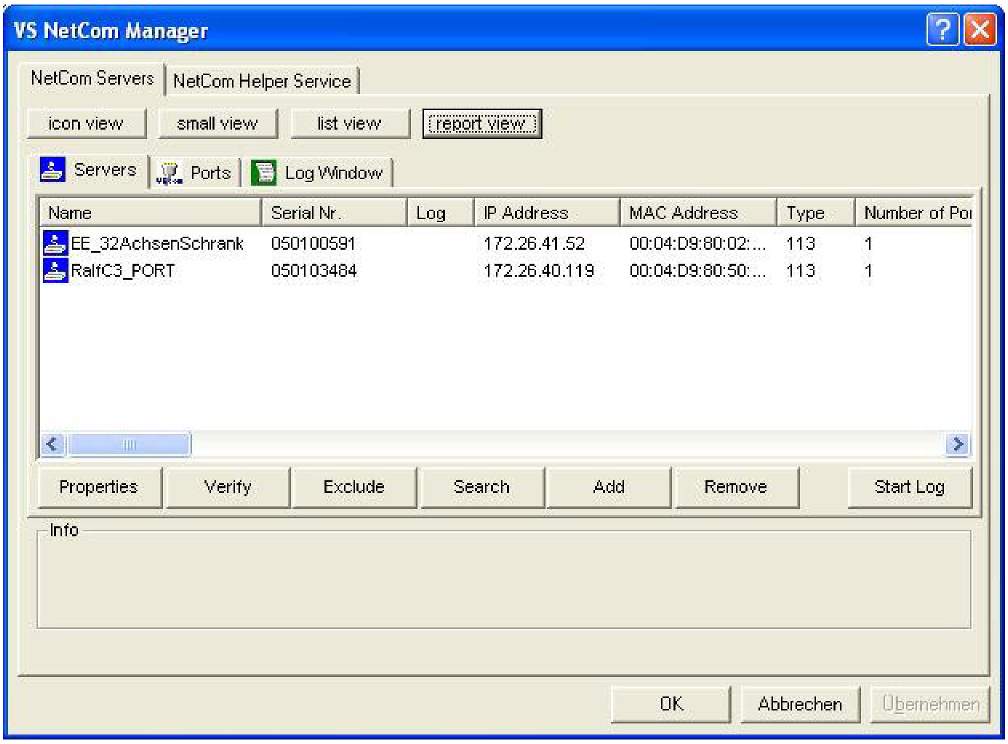
Connection plan for Compax3S:



6.1.5. ETHERNET-RS485 NetCOM 113 adapter

	Operation Mode	S1	S2	S3	S4
RS232	Configuration Port	Off	Off	Off	Off
	Data Port			On	On
	Factory settings			Off	On
RS422	Data Port	Off	On	On	On
RS485 by ART	4-wire	On	On	On	Off
	2-wire with Echo			Off	On
	2-wire without Echo			Off	Off
RS485 by RTS	4-wire	On	Off	On	Off
	2-wire with Echo			Off	On
	2-wire without Echo			Off	Off

Manufacturer link: **http://www.vscom.de/666.htm** (**http://www.vscom.de/666.htm**)



Name	Serial Nr.	Log	IP Address	MAC Address	Type	Number of Po
EE_32AchsenSchrank	050100591		172.26.41.52	00:04:D9:80:02:...	113	1
RalfC3_PORT	050103484		172.26.40.119	00:04:D9:80:50:...	113	1

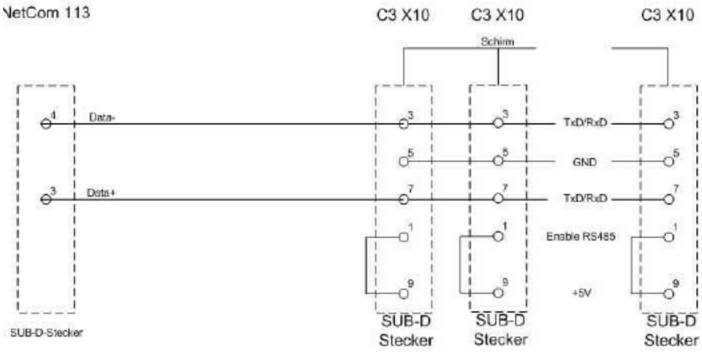
DIP Switch settings NetCom 113 for two-wire operation:

1ON 2ON 3off 4off (Mode: RS485 by ART (2 wire without Echo)

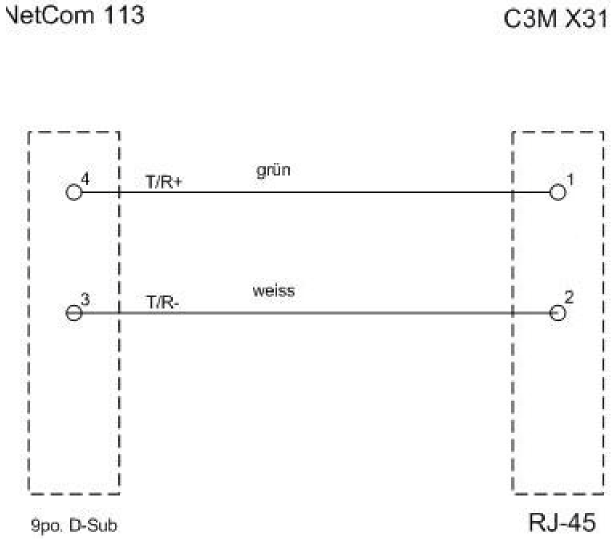
Communication settings C3S/C3M:

Object	Function	Value
810.1	Protocol	16 (two wire)
810.2	Baud rate	115200
810.3	NodeAddress	1..254
810.4	Multicast Address	

Connection plan NetCom113 <-> C3S :



Connection plan NetCom113 <-> C3M X31:



6.1.6. Modem MB-Connectline MDH 500 / MDH 504

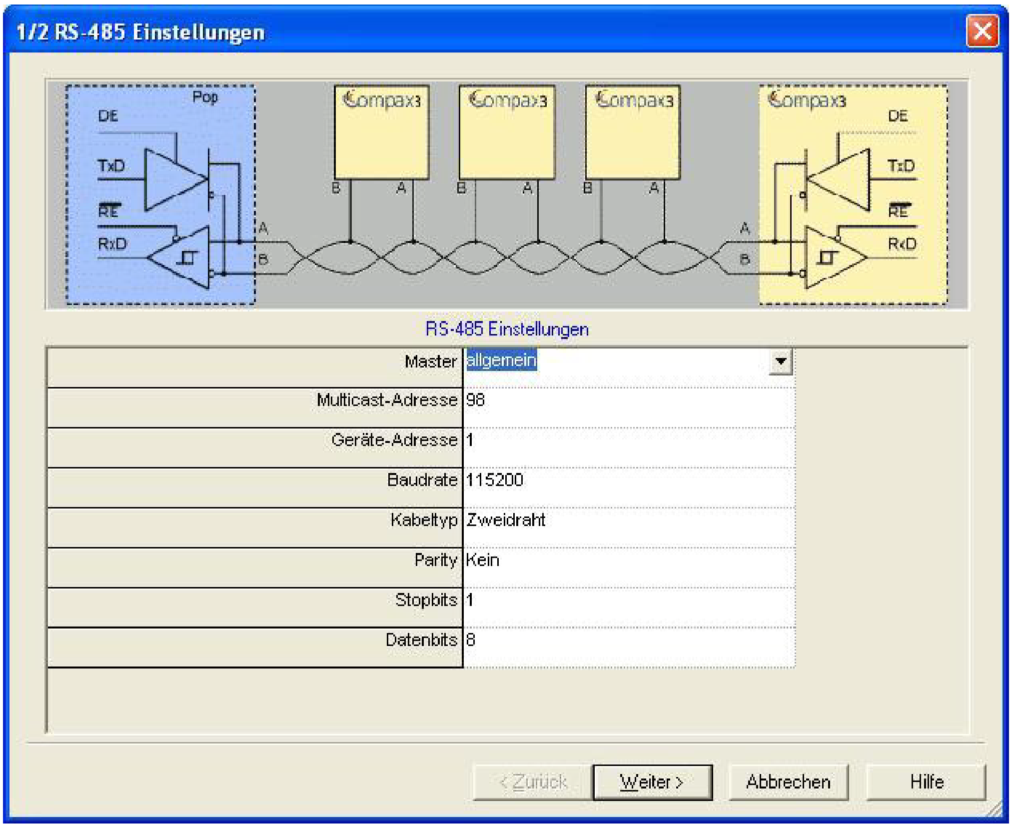
With the modems MDH500 and MDH504 manufactured by MB-Connectline, you can establish an independent connection. A virtual COM port is generated and the communication with the PC as well as the Compax3 takes place via RS232 or RS485.

It is not necessary to make any modem settings on the Compax3.

6.1.7. C3 settings for RS485 two wire operation

C3 ServoManager RS485 wizard settings:

download with configuration in RS232 mode°!



Master	allgemein
Multicast-Adresse	98
Geräte-Adresse	1
Baudrate	115200
Kabeltyp	Zweidraht
Parity	Kein
Stopbits	1
Datenbits	8

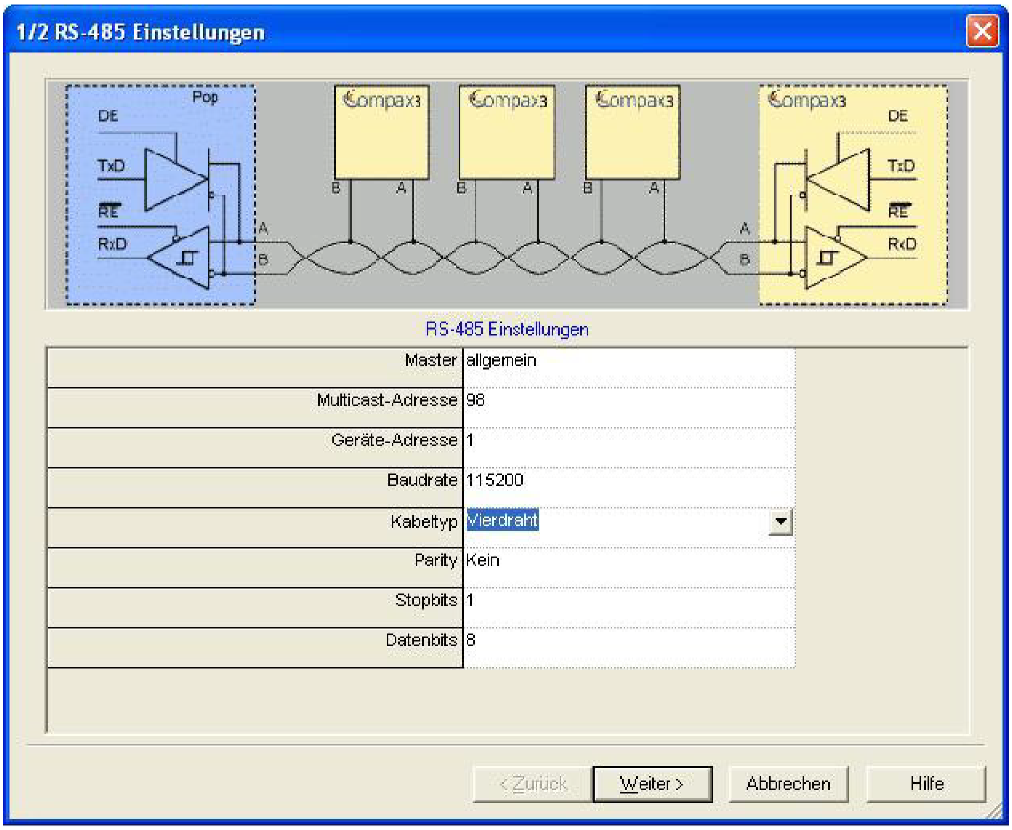
Communication settings C3S/C3M:

Object	Function	Value
810.1	Protocol	16 (two wire)
810.2	Baud rate	115200
810.3	NodeAddress	1..254
810.4	Multicast Address	

6.1.8. C3 settings for RS485 four wire operation

C3 ServoManager RS485 wizard settings:

download with configuration in RS232 mode



Master	allgemein
Multicast-Adresse	98
Geräte-Adresse	1
Baudrate	115200
Kabeltyp	Vierdraht
Parity	Kein
Stopbits	1
Datenbits	8

Communication settings C3S/C3M:

Object	Function	Value
810.1	Protocol	0 (4 wire)
810.2	Baud rate	115200
810.3	NodeAddress	1..254
810.4	Multicast Address	

6.2 COM port protocol

In this chapter you can read about:

You can communicate with Compax3 in order to read or write objects via plug X10 (or X3 on the mains module of Compax3M) on the front via a COM port (max. 32 nodes).

As a rule 2 records are possible:

- ASCII record: simple communication with Compax3
- Binary record: fast and secure communication with Compax3 by the aid of block securing.

Switching between the ASCII and the binary record via automatic record detection.

Interface settings **(see on page 629)**

Wiring RS232: **SSK1** (see on page 603)

RS485: as **SSK27** (see on page 604) / RS485 is activated by +5V on X10/1.

USB: SSK33/03 (only for Compax3M)

6.2.1. RS485 settings values

If “Master=Pop” is selected, only the settings compatible with the Pops (Parker Operator Panels) made by Parker are possible.

Please note that the connected Pop has the same RS485 setting values.

You can test this with the "PopDesigner" software.

"Master=General" makes all Compax3 settings possible.

Multicast Address You can use this address to allow the master to access multiple devices simultaneously.

Device Address The device address of the connected Compax3 can be set here.

Baud rate Adjust the transfer speed (baud rate) to the master.

Cable type Please choose between **two-wire and four-wire RS485** (see on page 67).

Protocol Adjust the protocol settings to the settings of your master.

6.2.2. ASCII - record

The general layout of a command string for Compax3 is as follows:

[Adr] command CR

Adr	RS232: no address RS485: Compax3 address in the range 0 ... 99 Address settings can be made in the C3 ServoManager under "RS485 settings"
Command	valid Compax3 command
CR	End sign (carriage return)

Command

A command consists of the representable ASCII characters (0x21 .. 0x7E). Small letters are converted automatically into capitals and blanks (0x20) are deleted, if they are not placed between two quotation marks.

Separator between places before and after the decimal is the decimal point (0x2E).

A numeric value can be given in the Hex-format if it is preceded by the “$” sign. Values can be requested in the Hex-format if the CR is preceded additionally by the “$” sign.

Answer strings

All commands requesting a numeric value from Compax3 are acknowledged with the respective numeric value in the ASCII format followed by a CR without preceding command repetition and following statement of unit. The length of these answer strings differs depending on the value.

Commands requesting an Info-string (e.g. software version), are only acknowledged with the respective ASCII character sequence followed by a CR, without preceding command repetition. The length of these answer strings is here constant.

Commands transferring a value to Compax3 or triggering a function in Compax3 are acknowledged by:

>CR

if the value can be accepted resp. if the function can be executed at that point in time.

If this is not the case or if the command syntax was invalid, the command is acknowledged with

!xxxxCR

.

The 4 digit error number **xxxx** is given in the HEX format; you will find the meaning in the **appendix** (see on page 563).

RS485 answer string

When using RS485, each answer string is preceded by a “*“" (ASCII - character: 0x2A).

Compax3 commands

Read object

RS232: O [$] Index , [$] Subindex [$]

RS485: Address O [$] Index , [$] Subindex [$]

The optional "$" after the subindex stands for "hex-output" which means that an object value can also be requested in hex;

For example "**O 0192.2**": (Object 402.2)

Write object ***RS232: O [$] Index , [$] Subindex = [$] Value [; Value2 ; Value3 ; ...]***

RS485: Address O [$] Index , [$] Subindex = [$] Value [; Value2 ; Value3 ; ...]

The optional “$” preceding Index, Subindex and value stands for “Hex-input” which means that Index, Subindex and the value to be transferred can also be entered in hex (e.g. **O $0192.2=$C8**).

6.2.3. Binary record

The binary record with block securing is based on 5 different telegrams:

- 2 request telegrams which the control sends to Compax3 and
- 3 response telegrams which Compax3 returns to the control.

Telegram layout

Basic structure:

Start code	**Address**	**Number of data bytes - 1**	**Data**				**Block securing**	
SZ	A	L	D0	D1	...	Dn	Crc(Hi)	Crc(Lo)

The start code defines the frame type and is composed as follows:

Bit		**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Frame type		**Frame identification**				**PLC**		**Gateway**	**Address**
RdObj	read object	1	0	1	0	x	1	x	x
WrObj	write object	1	1	0	0	x	1	x	x
Rsp	response	0	0	0	0	0	1	0	1
Ack	positive command acknowledgement	0	0	0	0	0	1	1	0
Nak	Negative command acknowledgement	0	0	0	0	0	1	1	1

Bits 7, 6, 5 and 4 of the start code form the telegram identification; Bit 2 is always “1”.

Bits 3, 1 and 0 have different meanings for the request and response telegrams.

The address is only necessary for RS484.

Request telegrams

-> Compax3

- the address bit (Bit 0 = 1) shows if the start code is followed by an address (only for RS485; for RS232 Bit 0 = 0)
- the gateway bit (Bit 1 = 1) shows if the message is to be passed on. (Please set Bit 1 = 0, as this function is not yet available)
- the PLC bit (Bit 3 = 1) allows access to objects in the PLC/Pop format
  U16, U32: for integer formats (see bus formats: Ix, Ux, V2)
  IEEE 32Bit Floating Point: for non integer formats (bus formats: E2_6, C4_3, Y2, Y4; without scaling)
  With Bit 3 = 0 the objects are transmitted in the DSP format.
  DSP formats:
  24 Bit = 3 Bytes: Integer INT24 or Fractional FRACT24
  48 Bit = 6 Bytes: Real REAL48 (3 Byte Int, 3 Byte Fract) / Double Integer DINT48 / Double Fractional DFRACT48

Response telegram

Compax3 ->

- Bits 0 and 1 are used to identify the response
- Bit 3 is always 0

The maximum number of data bytes in the request telegram is 256, in the response telegram 253.

The block securing (CRC16) is made via the CCITT table algorithm for all characters.

After receiving the start code, the timeout monitoring is activated in order to avoid that Compax3 waits in vain for further codes (e.g. connection interrupted) The timeout period between 2 codes received is fixed to 5ms (5 times the code time at 9600Baud)

Write object - WrObj telegram

SZ	Adr	L	D0	D1	D2	D3 ... Dn	Crc(Hi)	Crc(Lo)
0xCX		n	Index(Hi)	Index(Lo)	Subindex	Value	0x..	0x..

Describing an object by a value.

Positive acknowledgement - Ack-telegram

SZ	L	D0	D1	Crc(Hi)	Crc(Lo)
0x06	1	0	0	0x..	0x..

Answer from Compax3 if a writing process was successful, i.e. the function could be executed and is completed in itself.

Negative acknowledgement - Nak - telegram

SZ	L	D0	D1	Crc(Hi)	Crc(Lo)
0x07	1	F-No.(Hi)	F-No.(Lo)	0x..	0x..

Answer from Compax3 if access to the object was denied (e.g. function cannot be executed at that point in time or object has no reading access). The error no. is coded according to the DriveCom profile resp. the CiA Device Profile DSP 402.

Read object - RdObj - telegram

SZ	Adr	L	D0	D1	D2	D3	D4	D5	...	Dn	Crc(Hi)	Crc(Lo)
0xAX		n	Index1(Hi)	Index1(Lo)	Subindex1	Index2(Hi)	Index2(Lo)	Subindex2	...	...	0x..	0x..

Reading one or several objects

Answer - Rsp - telegram

SZ	L	D0 ... Dx-1	Dx ... Dy-1	Dy-D..	D ... D..	D ... Dn	Crc(Hi)	Crc(Lo)
0x05	n	Value1	Value 2	Value 3	Value ..	Value n	0x..	0x..

Answer from Compax3 if the object can be read.

If the object has no reading access, Compax3 answers with the Nak - telegram.

Example:

Reading object "StatusPositionActual" (o680.5):

Request: A5 03 02 02 A8 05 E1 46

Response: 05 05 FF FF FF FF FE 2D 07 B4

Writing into an Array (o1901.1 = 2350)

Request: C5 02 08 07 6D 01 00 09 2E 00 00 00 95 D5

Response: 06 01 00 00 BA 87

Block securing:

Checksum calculation for the CCITT table algorithm

The block securing for all codes is performed via the following function and the corresponding table:

The “CRC16” variable is set to “0” before sending a telegram.

Function call:

```
CRC16 = UpdateCRC16(CRC16, Character);
```

This function is called up for each Byte (Character) of the telegram.

The result forms the last two bytes of the telegram

Compax3 checks the CRC value on receipt and reports CRC error in the case of a deviation.

Function

```
const unsigned int _P CRC16_table[256] = {
   0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50a5, 0x60c6, 0x70e7,
   0x8108, 0x9129, 0xa14a, 0xb16b, 0xc18c, 0xd1ad, 0xe1ce, 0xf1ef,
   0x1231, 0x0210, 0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
   0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c, 0xf3ff, 0xe3de,
   0x2462, 0x3443, 0x0420, 0x1401, 0x64e6, 0x74c7, 0x44a4, 0x5485,
   0xa56a, 0xb54b, 0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
   0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6, 0x5695, 0x46b4,
   0xb75b, 0xa77a, 0x9719, 0x8738, 0xf7df, 0xe7fe, 0xd79d, 0xc7bc,
   0x48c4, 0x58e5, 0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
   0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969, 0xa90a, 0xb92b,
   0x5af5, 0x4ad4, 0x7ab7, 0x6a96, 0x1a71, 0x0a50, 0x3a33, 0x2a12,
   0xdbfd, 0xcbdc, 0xfbbf, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
   0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03, 0x0c60, 0x1c41,
   0xedae, 0xfd8f, 0xcdec, 0xddcd, 0xad2a, 0xbd0b, 0x8d68, 0x9d49,
   0x7e97, 0x6eb6, 0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
   0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a, 0x9f59, 0x8f78,
   0x9188, 0x81a9, 0xb1ca, 0xa1eb, 0xd10c, 0xc12d, 0xf14e, 0xe16f,
   0x1080, 0x00a1, 0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
   0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c, 0xe37f, 0xf35e,
   0x02b1, 0x1290, 0x22f3, 0x32d2, 0x4235, 0x5214, 0x6277, 0x7256,
   0xb5ea, 0xa5cb, 0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
   0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
   0xa7db, 0xb7fa, 0x8799, 0x97b8, 0xe75f, 0xf77e, 0xc71d, 0xd73c,
   0x26d3, 0x36f2, 0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
   0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9, 0xb98a, 0xa9ab,
   0x5844, 0x4865, 0x7806, 0x6827, 0x18c0, 0x08e1, 0x3882, 0x28a3,
   0xcb7d, 0xdb5c, 0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
   0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0, 0x2ab3, 0x3a92,
   0xfd2e, 0xed0f, 0xdd6c, 0xcd4d, 0xbdaa, 0xad8b, 0x9de8, 0x8dc9,
   0x7c26, 0x6c07, 0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
   0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba, 0x8fd9, 0x9ff8,
   0x6e17, 0x7e36, 0x4e55, 0x5e74, 0x2e93, 0x3eb2, 0x0ed1, 0x1ef0
};

unsigned int UpdateCRC16(unsigned int crc,unsigned char wert) {

unsigned int crc16;

crc16 = (CRC16_table[(crc >> 8) & 0x00FF] ^ (crc << 8)
  ^ (unsigned int)(value));

return crc16;

}
```

You will find this function on the Compax3 DVD under RS232_485\\Function UpdateCRC16.txt!

6.3 Remote diagnosis via Modem

In this chapter you can read about:

Caution!

As the transmission via modem may be very slow and interference-prone, the operation of the Compax3 ServoManager via modem connection is on your own risk!

The function setup mode as well as the ROLL mode of the oscilloscope are not available for remote diagnosis!

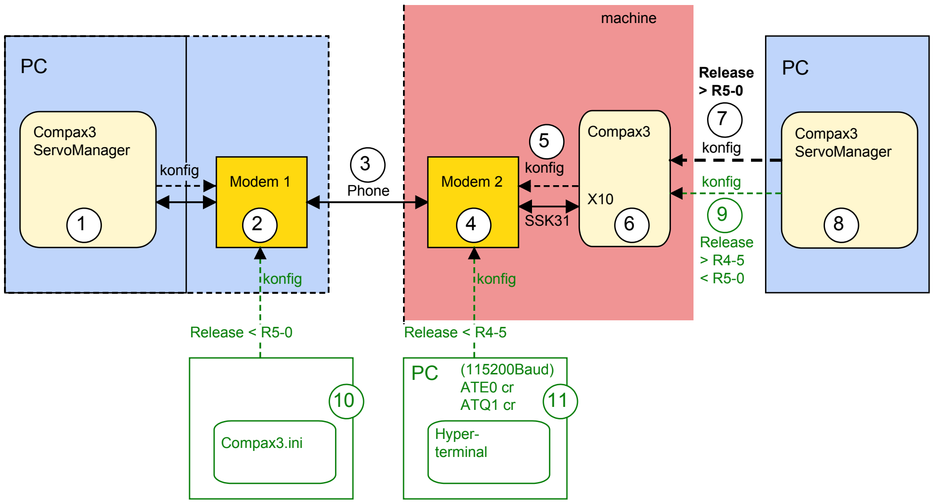
It is not recommended to use the logic analyzer in the Compax3 IEC61131-3 debugger due to the limited bandwidth.

Requirements:

For modem operation, a direct and stable telephone connection is required. Operation via a company-internal telephone system is not recommended.

6.3.1. Structure

Layout and configuration of a modem connection ServoManager - Compax3:



The green part of the drawing shows the proceeding for Compax3 release versions < R5-0!

The proceeding for Compax3 release versions < R5-0 is described in an application example (.../modem/C3_Appl_A1016_*language*.pdf on the Compax3 CD).

Connection Compax3 ServoManager <=> Compax3

The Compax3 ServoManager (1) establishes a RS232 connection with modem 1 (PC internal or external).

Modem 1 dials modem 2 via a telephone connection (3).

Modem 2 communicates with Compax3 (6) via RS232.

Configuration

Modem 1 is configured via the Compax3 ServoManager (1)

Modem 2 can be configured via Compax3 (on place), triggered by putting **SSK31** (see on page 607) on X10. For this, the device must be configured before. This can be made locally before the system / machine is delivered with the aid of the Compax3 ServoManager (8).

6.3.2. Configuration of local modem 1

- Menu "Options: Communication settings RS232/RS485..." must be opened
- Select "Connection via Modem"
- Under "name" you can enter a name for the connection
- Enter the target telephone number.
  Note: If an ISDN telephone system is operated within a company network, an additional "0" may be required in order to get out of the local system into the company network before reaching the outside line with an additional "0".
- The timeout periods are set to reasonable standard values according to our experience.
- Select the modem type.
  - For "user-defined modem", additional settings are only required, if the modem does not support standard AT commands.
    Then you can enter special AT commands.
  - **Hint**:When operating the local modem on a telephone system, it may be necessary to make a blind dialing. Here, the modem does not wait for the dialing tone.
- Select the COM interface where the modem is connected.
- Close the window and establish the connection with button (open/close COM port).
- The connection is interrupted when the COM port is closed.
- Select the modem type.
  - For "user-defined modem", additional settings are only required, if the modem does not support standard AT commands.
    Then you can enter special AT commands.
  - **Hint**:When operating the local modem on a telephone system, it may be necessary to make a blind dialing. Here, the modem does not wait for the dialing tone.

6.3.3. Configuration of remote modem 2

Settings in Compax3 under "configure communication: Modem settings":

- Modem initialization = "ON": After the SSK31 modem cable has been connected, Compax3 initializes the modem
- Modem initialization after Power On = "ON": After Power on of Compax3, the device initializes the modem
- Modem check = "ON": a modem check is performed
- The timeout periods are set to reasonable standard values according to our experience.
- Select the modem type.
  - For "user-defined modem", additional settings are only required, if the modem does not support standard AT commands.
    Then you can enter special AT commands.
  - **Hint**:When operating the local modem on a telephone system, it may be necessary to make a blind dialing. Here, the modem does not wait for the dialing tone.
- In the following wizard window, a specific download of the modem configuration can be made.

Note:

If a configuration download is interrupted, the original settings in the non volatile memory of the Compax3 are still available.
You have to finish the communication on the PC side and to reset the Compax3 via the 24V supply before you can start a new trial.

Reinitialization of the remote modem 2

Remove cable on Compax3 X10 and connect again!

6.3.4. Recommendations for preparing the modem operation

Preparations:

- Settings in Compax3 under "configure communication: Modem settings":
  - Modem initialization: "ON"
  - Modem initialization after Power On: "ON"
  - Modem check: "ON"
- Deposit SSK31 cable in the control cabinet.
- Install modem in the control cabinet and connect to telephone line.

Remote diagnosis required:

- On site:
  - Connect modem to Compax3 X10 via SSK31
  - Modem is automatically initialized
- Local:
  - Connect modem to telephone line
  - Establish cable connection to modem (COM interface)
  - Select "connection via modem" under "options: communication settings RS232/RS485...".
  - Select modem under "selection"
  - Enter telephone number
  - Select COM interface (PC - modem)
  - Establish connection with button (open/close COM port).

6.4 Profibus/Profinet

In this chapter you can read about:

I20/I32

The Profibus option is available on the Compax3 devices C3I20Txx**!**

The Profibus option is available on the Compax3 devices C3I20Txx**!**

Notes on the configuration of the Profibus master / Profinet controller

Before configuring the Profibus master / Profinet controller (e.g. S7), you will have to configure the Compax3 axis.

In the **Profibus/Profinet window** (see on page 488) of the configuration wizard you will receive the status message “Profibus/Profinet Telegram” with the information on the telegram which can be set in the master (PPO type).

6.4.1. Typical application with Bus and IEC61131

We recommend the following procedure to control the IEC61131-3 program via Profibus/Profinet:

- Use the control word (DeviceControl_Controlword_1) to control the PLCopen function modules (Execute, Enable) to activate the modules via Profibus/Profinet.
- The logical module outputs can be placed on the status word (DeviceState_Statusword_1).
- Place the control word and the status word on the cyclic process data channel.
- Connect variable module outputs of your IEC61131-3 program with the recipe array.
  - For rapid access, the values from the first 5 rows of the recipe array can be placed in the cyclic channel.
  - Additional values of the recipe array can be written acyclically.

Now you can use the bus to assign values, to activate function modules with the control word and to read the current status with the control word.

6.4.2. Profibus / Profinet configuration

In this chapter you can read about:

I20/I32

Following are described the input windows of the Profibus/Profinet configuration wizard.

Can be called up in the tree (Compax3 ServoManager, left window) under "configure configuration".

6.4.2.1 Configuration of the process-data channel

You can use the Process Data Channel (PZD) to exchange actual and Setpoint values cyclically between the Compax3 and the Profibus master / Profinet controller.

Adjusting the cyclic PZD:

The PZD is adjusted separately for the following transfer directions:

- Profibus-Master / Profinet controller ⇒ Compax3 (PAD)
- Compax3 ⇒ Profibus-Master / Profinet controller (PED)

set separately.

Maximum size of the process-data channel:

8 words (16 bytes) PAD and

8 words (16 bytes) PED

The objects that can be put on the process data channel can be found in the " Compax3 Objects **(see on page 544)"!**

Assignment of the process data channel

Assignment of the process data channel is automated in Compax3 ServoManager.

You select the objects which you want to put one after the other to the process input data (PED: Compax3 => PLC) and to the process output data (PAD: PLC => Compax3).

ServoManager continuously checks areas of the PZD that are free and enables additional input options correspondingly.

PPO type / PKW type, telegram size

Depending on the configuration that is set, the resulting PPO type is displayed in the "Profibus telegram" wizard window (in the status line of the wizard window). You can use this value for the configuration of the Profibus master.

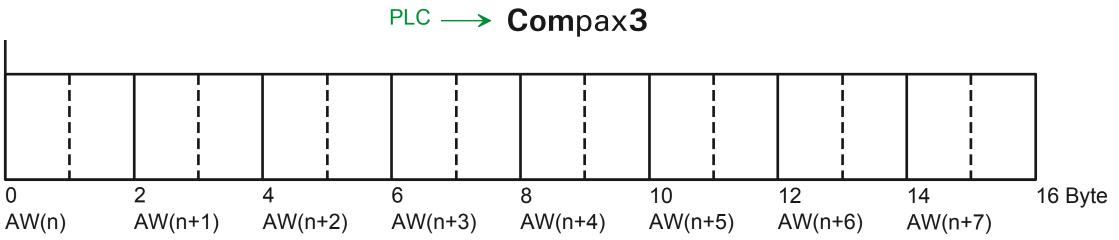
With Profinet, you can read out the PKW type and the telegram size for setting in the Profinet Controller.

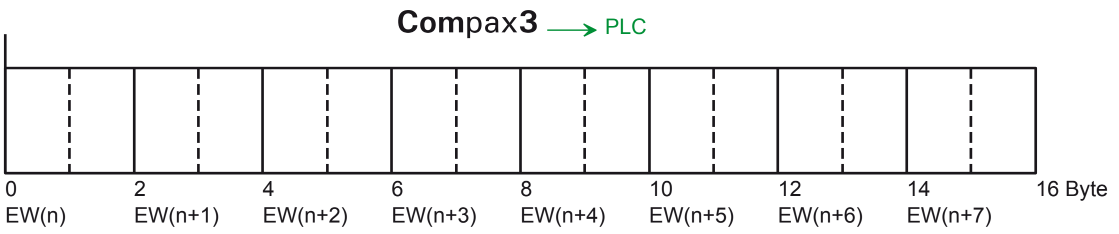
Assignment of the PZD

When data is read out of the Process Data Channel (PZD), the word width of the individual objects must be carefully noted.

Example: Assignment:

Object	**Word width**	**Assignment**	**Address**
POSITION_position	2	AW(n) & AW(n+1)	AD(n)
POSITION_speed	2	AW(n+2) & AW(n+3)	AD(n+2)
AnalogOutput0_DemandValue	1	AW(n+4)	AW(n+4)
AnalogOutput1_DemandValue	1	AW(n+5)	AW(n+5)
Array_Col1_Row1	2	AW(n+6) & AW(n+7)	AD(n+6)





6.4.2.2 PKW parameter channel

Parameter access with DPV0

In addition to cyclic data exchange, you can use the PKW mechanism for acyclic access to parameters.

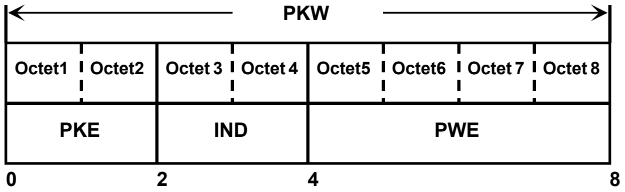
The PKW mechanism is implemented for Profibus master / Profinet controller without DPV1 functionality.

PKW: Parameter identification value

You can select between:

- **no PKW** - without acyclic parameter access.
- **PKW** - parameter access via a PKW length of 8 bytes.

PKW structure



Additional information on the **structure of the PKW** (see on page 492)

6.4.2.3 Error Reaction on Bus Failure

Here you can set how Compax3 shall respond to a react on a **Bus error** (see on page 563)l:

Possible settings for the error reaction are:

- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

6.4.3. Cyclic process data channel

The structure of the PZD is defined in the configuration menu: "Profibus/Profinet telegram" of the ServoManager.

6.4.3.1 Control and status word

The cyclic process data channel contains a control word and a status word both, freely available and 16 bits in size:

Control word: Profibus-Master / Profinet controller ⇒ Compax3

Status word: Compax3 ⇒ Profibus-Master / Profinet controller

6.4.4. Acyclic parameter channel

In this chapter you can read about:

Compax3 supports parameter access with DPV1.

6.4.4.1 Parameter access with DPV0: Required data channel

You can use the PKW mechanism for acyclic access to parameters in cyclic data exchange as well. This is made available to make it possible for the master/controller to have access to the important device parameters without DPV1 functionality.

The master/controller formulates an order in the PKW mechanism. Compax3 processes the order and formulates the response.

PKW structure:

Byte 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
PKE		IND		PWE			

PKW: Parameter identification value
PKE: Parameter identification (1st and 2nd byte) (see below)
IND: subindex* (3rd byte), 4th byte is reserved
PWE: Parameter value (5th through 8th byte or 5th through 12th byte with expanded PKW)

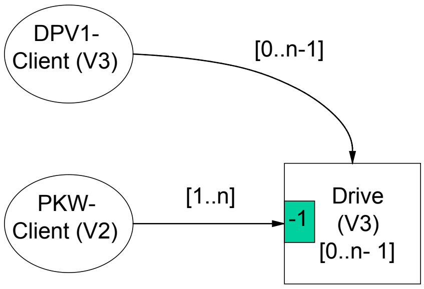
PKE structure:

Byte 1								**Octet 2**							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
AK				SPM	PNU										

AK: Order or response identification (value range 0 ... 15)
SPM: reserved
PNU: Parameter number

***Reference to the subindex**

The information for PNU subindex (parameter number) also applies to PROFIdrive profile Version 3, i.e., that the subindex is counted starting at 0, while for PROFIdrive profile Version 2 the subindex is counted starting at 1:



The result of this is as follows:

Profibus master based on PROFIdrive profile Version 3

The subindex of the Profibus No. (PNU) specified in the object list is directly valid.

Example: Example: PNU object forward speed control = 400.1 (as specified).

Profibus master based on PROFIdrive profile Version 2

The subindex of the Profibus No. (PNU) specified in the object list must be incremented by 1.

Example: PNU object forward speed control = 400.2

Order and response processing

Order/response identifications are defined so that it is apparent from the identification which fields of the PKW interface (IND, PWE) also need to be evaluated. To this may be added the distinction between parameter value and parameter description.

Order identification	**Order Master/Controller → Compax3**	**response identification Compax3 → Master/Controller**
0	No order	0
1	Request parameter value	1.2
2	Change parameter value (word)	1
3	Change parameter value (double word)	2
6	Request parameter value (array)	4.5
7	Change parameter value (array of word)	4
8	Change parameter value (array of double word)	5
9	Request number of array elements	6
14	Change object	14
15	Request object	15

Response identifications 7 and 8 are used for negative acknowledgements for problems.

Sequence

- The master/controller transfers an order to a Compax3.
- The master/controller repeats this order at least until a response is received from Compax3.
  This procedure ensures the transfer of orders / responses on the user level.
- Only one order is ever being processed at a time.
- Compax3 continues to make the response available until the master/controller formulates a new order.
- For responses containing parameter values, Compax3 always responds upon repetition with the current value (cyclic processing). This applies to all responses to the orders “Request parameter value”, “Request parameter value (Array)” and “Request object”.
- The PWE transfer of word sizes takes place with byte 7 and 8, while the transfer of double word sizes takes place with byte 5 through 8.

Explanation of response identification

Response identification	**Compax3 → Master/Controller response**
0	No response
1	Transfer value (word)
2	Transfer parameter value (double word)
4	Transfer parameter value (array of word)
5	Transfer parameter value (array of double word)
7	Order cannot be executed (with **error No.** (see on page 563))
8	No user level for PKW interface
9	factory use
10	factory use
14	Object value transferred
15	Object value transferred

Example: Changing the stiffness

Task:

Parameter / object change via PKW (DPV0)

The object "stiffness" will be set to 200%

Object stiffness: PNU 402.2; valid after VP

Format UNSIGNED 16 == 1 word == order identification = 2 == "Change parameter value (word)"

The master sends to Compax3:

PLC - Compax3

Octet 1								Octet 2								Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
PKE																IND		PWE			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex	-	MSB			LSB
AK					PNU																
2				0	402											3	0	200			
0	0	1	0	0	0	0	1	1	0	0	1	0	0	1	0						
0x21								0x92								0x3	0x0	0x0	0x0	0x0	0xC8

Compax3 responds with the same content, except with response identification = 1:

Compax3 - PLC

Octet 1								Octet 2								Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
PKE																IND		PWE			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex	-	MSB			LSB
AK					PNU																
1				0	402											3		200			
0	0	0	1	0	0	0	1	1	0	0	1	0	0	1	0						
0x11								0x92								0x3	0x0	0x0	0x0	0x0	0xC8

If no additional object needs to be changed, the new value can be set to valid with VP:

Object: Set objects to valid PNU 338.10 (because of DPV0 the **Subindex must be incremented by one** (see on page 492))

PLC - Compax3

Octet 1								Octet 2								Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
PKE																IND		PWE			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex	-	MSB			LSB
AK					PNU																
2				0	338											11		1			
0	0	1	0	0	0	0	1	0	1	0	1	0	0	1	0						
0x21								0x52								0xB	0x0	0x0	0x0	0x0	0x1

Compax3 responds with the same content, except with response identification = 1:

Compax3 - PLC

Octet 1								Octet 2								Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
PKE																IND		PWE			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex	-	MSB			LSB
AK					PNU																
1				0	338											11		1			
0	0	0	1	0	0	0	1	0	1	0	1	0	0	1	0						
0x11								0x52								0xB	0x0	0x0	0x0	0x0	0x1

Reading back the object set objects to valid makes it possible to check whether the command was performed. Byte 8 will the contain the value 0.

The change can be stored and will not be lost even if with a power failure by using the object "Save objects permanently".

Object: Save objects permanently PNU 339

PLC - Compax3

Octet 1								Octet 2								Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
PKE																IND		PWE			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex	-	MSB			LSB
AK					PNU																
2				0	339											0		1			
0	0	1	0	0	0	0	1	0	1	0	1	0	0	1	1						
0x21								0x53								0x0	0x0	0x0	0x0	0x0	0x1

Compax3 responds with the same content, except with response identification = 1:

Compax3 - PLC

Octet 1								Octet 2								Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
PKE																IND		PWE			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Subindex	-	MSB			LSB
AK					PNU																
1				0	339											0		1			
0	0	0	1	0	0	0	1	0	1	0	1	0	0	1	1						
0x11								0x53								0x0	0x0	0x0	0x0	0x0	0x1

Object Upload/download via Profibus/Profinet

All settings of Compax3 can be read using the Profibus/Profinet and written back to Compax3. This makes it easy to replace a device, for example.

Condition: Compax3 must be configured (once running through the configuration wizard followed by a download is enough; the configuration settings are, however, not relevant)

To implement this, the PKW mechanism has been changed.

Structure of modified PKW:

Byte 1	Octet 2	Octet 3	Octet 4	Octet 5	Octet 6	Octet 7	Octet 8
PKE		IND		PWE			

PKW: Parameter identification value

PKE: Parameter identification (1st and 2nd byte) (see below)

IND: object index (3rd byte high 4th byte low)

PWE: Parameter value (5th to 8th byte)

Structure of modified PKE:

Byte 1								**Octet 2**							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
AK=14 or 15				SPM	DF	DPZ		SI							

AK: Order or response identification

SPM: reserved

DF: Data format (DF=1 constant)

DPZ: data buffer access

SI: object subindex

Data buffer access:

For each object, 16 bytes must be read or written Since the size of the PWE channel is 4 bytes, each object must be read or written 4 times.

Sequence for reading / writing and object:

DPZ=0: Order executed	Object byte 1 ... 4 can be read / is being written
DPZ=1	Object byte 5...8 can be read / is being written
DPZ=2	Object byte 9...12 can be read / is being written
DPZ=3	Object byte 13...16 can be read / is being written

The data will either be read fro the PWE or written into the PWE.

Access algorithm for reading objects

- Object 20.2 written with value 0 (object 20.2 is a counter that specifies the next object to be read; the starting value is 0).
- Read object index and subindex in object 20.5.
  Format I32 of Object 20.5:

Not assigned	Index (high byte)	Index (low byte)	Subindex

- Read the object with the index and subindex read in object 20.5 and in save it in a table with the following structure: Index (2Byte), Subindex (1Byte), Contents (16Byte).
- Read the next object-Index and subindex in object 20.5.
- ....

This must be performed until index = 0xFFFF and until subindex = 0xFF.

Writing objects

Write the entire table to Compax3. Each index and subindex is written with the value stored in the table.

It should be noted in this regard that each time an object is written, the internal buffer must first be written with DPZ=1, 2, 3 and then the entire order is written with DPZ0.

6.4.4.2 Data formats of the bus objects

In this chapter you can read about:

Integer formats

Twos complement representation;

The highest order bit (MSB) is the bit after the sign bit (VZ) in the first byte.

VZ == 0: positive numbers and zero; VZ == 1: negative numbers

Type	Bit	8	7	6	5	4	3	2	1
Integer 8 **length: 1 Byte**		VZ	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Integer 16	MSB	VZ	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
Length: 1 Word	LSB	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Integer 32	MSB	VZ	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}
Length: 2 Words		2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}
		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
	LSB	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Unsigned - Formats

Type	Bit	8	7	6	5	4	3	2	1
Unsigned 8 **Length: 1 Byte**		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Unsigned 16	MSB	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
Length: 1 Word	LSB	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Unsigned 32	MSB	2^{31}	2^{30}	2^{29}	2^{28}	2^{27}	2^{26}	2^{25}	2^{24}
Length: 2 Words		2^{23}	2^{22}	2^{21}	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}
		2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8
	LSB	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Fixed point format E2_6

Linear fixed point value with six binary places after the decimal point. 0 corresponds to 0, 256 corresponds to 2^{14} (0x4000).

Twos complement representation;

MSB is the bit after the sign bit

VZ == 0: positive numbers and zero;

VZ == 1: negative numbers

Type	Bit	8	7	6	5	4	3	2	1
E2_6	MSB	VZ	2^8	2^7	2^6	2^5	2^4	2^3	2^2
Length: 1 Word	LSB	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}

Fixed point format C4_3

Linear fixed point value with three decimal places after the decimal point. 0 corresponds to 0 and 0,001 corresponds to 2^0 (0x0000 0001).

Structure like data type Integer32, value of the bits reduced by a factor of 1000.

Length: 2 Words

Bus format Y2 and Y4

Layout:

- Y2 like data type Integer16
- Y4 like data type Integer32

The values can be adjusted by a normalization factor.

The following rules apply:

- Normalization factor for Y2: Object 200.1, ... 200.5
- Normalization factor for Y4: Object 201.1, ... 201.5

There are different normalization factors for individual values

1. Y2 - normalization factors

- Object 200.1: NormFactorY2_Speed: Normalization factor for Y2 speeds
- Object 200.2: NormFactorY2_Position: Normalization factor for Y2 positions
- Object 200.3: NormFactorY2_Voltage: Normalization factor for Y2 voltages
- Object 200.5: NormFactorY2_Array_Col2: Normalization factor for Column 2 of the recipe array

2. Y4 - normalization factors

- Object 201.1: NormFactorY4_Speed: Normalization factor for Y4 speeds
- Object 201.2: NormFactorY4_Position: Normalization factor for Y4 positions
- Object 201.3: NormFactorY4_Voltage: Normalization factor for Y4 voltages
- Object 201.4: NormFactorY4_Array_Col1: Normalization factor for Column 1 of the recipe array

Meaning of the normalization factors

- Bit 5: Meaning of the normalization factor:
  - Bit 5 = "0": decimal factors 1, 1/10, 1/100, ..
    Bit 4 ... Bit 0: Normalization factor

#	Bit 4...0	Factor dec (Bit 5 = 0) yy0x xxxx	
0	00000	10^{0}	1
1	00001	10^{-1}	0.1
2	00010	10^{-2}	0.01
3	00011	10^{-3}	0.001
4	00100	10^{-4}	0,0001
5	00101	10^{-5}	0,00001
6	00110	10^{-6}	0.00001
7	00111	10^{-7}	0.00001
8	01000	10^{-8}	0.00000001
9	01001	10^{-9}	0.000000001

  - Bit 5 = "1": binary factors 4, 1/2, 1/4, 1/8, ...
    Bit 0 ... Bit 0: Normalization factor

#	Bit 4...0	Factor bin (Bit 5 = 1) yy1x xxxx	
32	00000	2^{0}	1
33	00001	2^{-1}	0.5
34	00010	2^{-2}	0.25
35	00011	2^{-3}	0.125
36	00100	2^{-4}	0,0625
37	00101	2^{-5}	0,03125
38	00110	2^{-6}	0.015625
39	00111	2^{-7}	0.0078125
40	01000	2^{-8}	0.00390625
41	01001	2^{-9}	0.001953125
42	01010	2^{-10}	0.0009765625
43	01011	2^{-11}	0.00048828125
44	01100	2^{-12}	0.000244140625
45	01101	2^{-13}	0,0001220703125
46	01110	2^{-14}	0.00006103515625
47	01111	2^{-15}	0.000030517578125
48	10000	2^{-16}	0.0000152587890625
49	10001	2^{-17}	0.00000762939453125
50	10010	2^{-18}	0.000003814697265625
51	10011	2^{-19}	0.0000019073486328125
52	10100	2^{-20}	0.00000095367431640625
53	10101	2^{-21}	0.000000476837158203125
54	10110	2^{-22}	0.0000002384185791015625
55	10111	2^{-23}	0.00000011920928955078125
56	11000	2^{-24}	0.000000059604644775390625

- Bit 15 ... Bit 6: reserved

Bit sequence V2

The V2 bus format is a bit sequence with a length of 16 bits.

Byte string OS

Octet string OS: String with variable length.

6.4.5. Simatic S7 -300/400 - modules

You can find the modules on the Compax3 DVD or in the internet under **http:/www.compax3.info/startup http://www.compax3.info/startup**.

You will find a description of these function modules in the help file !

6.5 CANopen

In this chapter you can read about:

I21 Function

The CANopen option is available with the Compax3 devices C3I21Txx**!**

6.5.1. CANopen - configuration

In this chapter you can read about:

Following are described the input windows of the CANopen configuration wizard.

Can be called up in the tree (Compax3 ServoManager, left window) under "configure configuration".

6.5.1.1 CANopen Operating Mode

CANopen Operating Modes:

- **Slave on C3 powerPLmC**:
  Compax3 as Slave on C3 powerPLmC integrated via the DriveInterface
  Note for C3I21T40: The cam programming is made in the slave axis
- **Slave**
  Compax3 is Slave of a CANopen Master; the CANopen configuration is made via the ServoManager
- **Slave with configuration via Master**
  Compax3 is Slave of a CANopen Master; the CANopen configuration is made via the Master
- **Master for PIOs**
  Compax3 as CANopen Master only for the operation of external digital and analog PIOs (Parker Input and Output modules).
  Please note: The device cannot be operated with an additional CANopen Master!
- **Slave on C3 powerPLmC (Cam programming on C3 powerPLmC)**
  Operating mode only available with I21T40!
  The programming of the device (C3I21T40) is only made on the C3 powerPLmC.

C3 Master PIO

In the "C3 Master PIO" operating mode, the input window for the CANopen PIO mapping is following:

Please state, how many words the process image of the PIOs will need, 1.. 4 words are possible.

The process image is transmitted via the process data objects as follows:

Digital Inputs: RPDO1

Analog Inputs: RPDO2

Digital Outputs: TPDO1

Analog Outputs: TPDO2

The inputs and outputs are stored in objects (O150.x ... O153.x).

Object 150.x: Digital Inputs

Object 151.x: Digital Outputs

Object 152.x: Analog Inputs

Object 153.x: Analog Outputs

The digital inputs and outputs can be read or written into in the IEC program via **modules** (see on page 449) in order to get an exact process image. Modules: PIO_Input0_15, PIO_Input16_31, PIO_Input32_47, PIO_Input48_63, PIO_Output0_15, PIO_Output16_31, PIO_Output32_47, PIO_Output48_63.

Before that, you must execute some initializations; this can be made with the aid of the **PIO_INIT** (see on page 449) module.

6.5.1.2 Error Reaction on Bus Failure

Here you can set how Compax3 shall respond to a react on a **Bus error** (see on page 563)l:

Possible settings for the error reaction are:

- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

6.5.1.3 Baud rate

Selecting the Baud rate.

Bear in mind that the maximum cable length depends on the Baud rate:

Baud rate	Maximum length
1Mbit/s	25m
800kbit/s	50m
500kbit/s	100 m
250kbit/s	250m
125kbit/s	500m
100kbit/s	700m
50kbit/s	1000m
20kbit/s	2500m

6.5.1.4 Possible PDO assignment

Via the process data objects (PDOs) actual values and Setpoint values are continually exchanged between Compax3 and the CANopen client.

4 cyclic PDOs are possible, they are configured with the help of the Compax3 ServoManager:

The PDOs are set separately for the transmission directions

- CANopen - Client ⇒ Compax3 (**RPDO**) (max. 16 words)
- Compax3 ⇒ CANopen - Client (**TPDO)** (max. 16 words)

set separately.

The objects that can be put on the process data channel can be found in the "**Compax3 Objects** (see on page 544)"!

6.5.1.5 Transmission cycle time

For the TPDOs a transmission cycle time can be set in each case.

This time specifies the time intervals at which Compax3 applies the cyclic data new to the respective PDO.

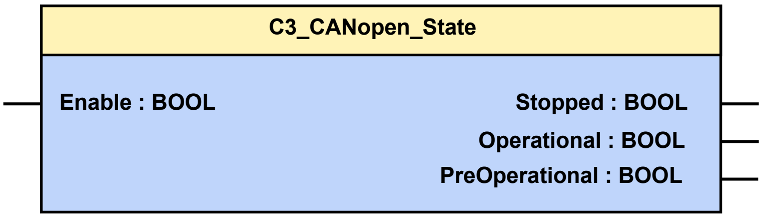
The minimum value is thereby 1ms.

6.5.2. Supporting IEC modules

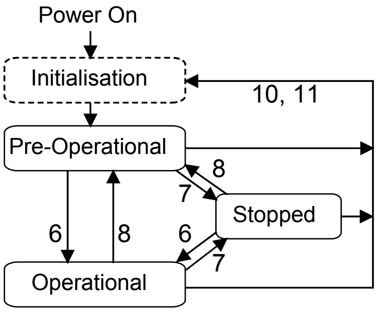
In this chapter you can read about:

6.5.2.1 This module is used to determine the status of the CANopen NMT status machine (C3_CANopen_State)

FB name	**C3_CANopen_State**	
This module is used to determine the status of the CANopen NMT status machine		
VAR_INPUT		
Enable	BOOL	Activating the module
VAR_OUTPUT		
Stopped	BOOL	CANopen node is in "Stopped" state
Operational	BOOL	CANopen node is in the "Operational" state (communication via process data and service data objects is possible)
PreOperational	BOOL	CANopen node is in the "PreOperational" state (communication via process data and service data objects is possible)



CANopen states



6: Start Remote Node

7: Stop Remote Node

8: Enter Pre-Operational State

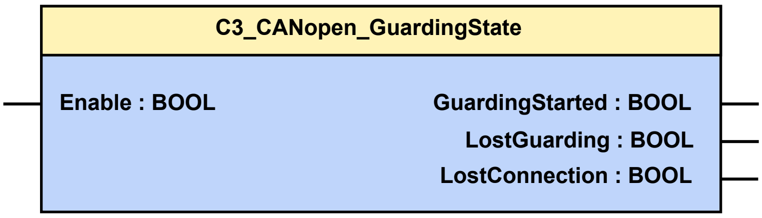
10: Reset Node

11: Reset Communication

The "Initialization" state is no fixed state but only a transition state.

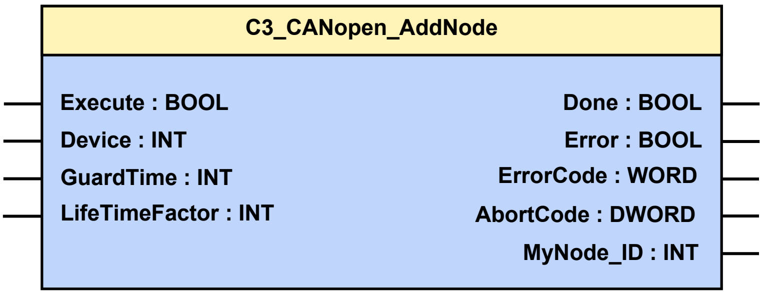
6.5.2.2 This module is used to determine the status during Nodeguarding (C3_CANopen_GuardingState)

FB name	**C3_CANopen_GuardingState**	
This module is used to determine the status during Nodeguarding		
VAR_INPUT		
Enable	BOOL	Activating the module
VAR_OUTPUT		
GuardingStarted	BOOL	The NMT master started the Nodeguarding procedure
LostGuarding	BOOL	The node did not receive a Nodeguarding RTR telegram from the NMT master during the Guarding time.
LostConnection	BOOL	The node did not receive a RTR telegram from the NMT Master during the "Node Life Time" (GuardingTime * LifeTimeFactor) and therefore considers the connection as interrupted.



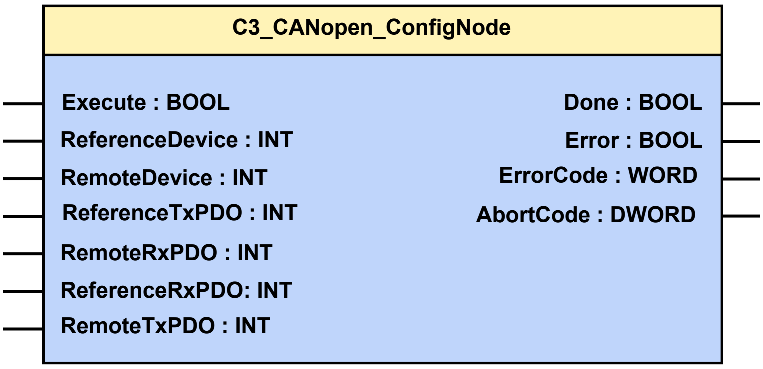
6.5.2.3 Insert new CANopen node (C3_CANopen_AddNode)

FB name	**C3_CANopen_AddNode**	
This module inserts a new CANopen node into the management list of the NMT master with the stated Node Guarding parameters and the current CANopen status PRE_OPERATIONAL.		
VAR_INPUT		
Execute	BOOL	Activating the module
Device	INT	Node-ID (1 ... 127)
GuardTime	INT	Guard time = 0
LifeTimeFactor	INT	Life Time Factor = 0
VAR_OUTPUT		
Done	BOOL	Function executed without error
Error	BOOL	Error occurred
ErrorCode	WORD	You will find the error code in the Compax3 **error list** (see on page 563).
AbortCode	DWORD	CANopen SDO **abort code** (see on page 515) upon error 65377 C3 CANopen **stack error** (see on page 507) no. upon error 65376
MyNode_ID	INT	Own Node_ID (NMT master)
Note: Compax3 must be CANopen master.		



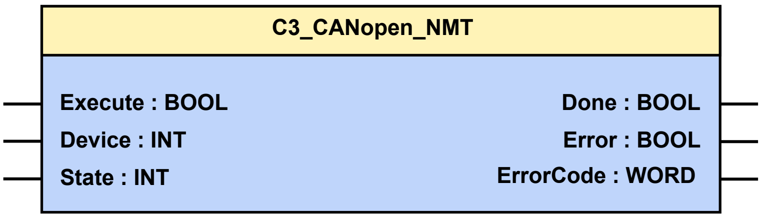
6.5.2.4 Establishing PDO connection between 2 CANopen nodes (C3_CANopen_ConfigNode)

<table>
<tr><td>FB name</td><td colspan="2">C3_CANopen_ConfigNode</td></tr>
<tr><td colspan="3">This module establishes a PDO connection between two CANopen nodes.
To do this, the module changes the COB-Ids of the 2nd node (RemoteDevice) to the COB-Ids of the 1st. node (ReferenceDevice).</td></tr>
<tr><td colspan="3">VAR_INPUT</td></tr>
<tr><td>Execute</td><td>BOOL</td><td>Activating the module</td></tr>
<tr><td>ReferenceDevice</td><td>INT</td><td>Node ID of the 1st. node (1 ... 127)</td></tr>
<tr><td>RemoteDevice</td><td>INT</td><td>Node ID of the 2nd. node (1 ... 127)</td></tr>
<tr><td>ReferenceTxPDO</td><td>INT</td><td>TxPDO number of the 1st. node (1 ... 4)</td></tr>
<tr><td>RemoteRxPDO</td><td>INT</td><td>TxPDO number of the 2nd. node (1 ... 4)</td></tr>
<tr><td>ReferenceRxPDO</td><td>INT</td><td>TxPDO number of the 1st. node (1 ... 4)</td></tr>
<tr><td>RemoteTxPDO</td><td>INT</td><td>TxPDO number of the 2nd. node (1 ... 4)
"0" do not establish connection</td></tr>
<tr><td colspan="3">VAR_OUTPUT</td></tr>
<tr><td>Done</td><td>BOOL</td><td>Function executed without error</td></tr>
<tr><td>Error</td><td>BOOL</td><td>Error occurred</td></tr>
<tr><td>ErrorCode</td><td>WORD</td><td>You will find the error code in the Compax3 error list (see on page 563).</td></tr>
<tr><td>AbortCode</td><td>DWORD</td><td>CANopen SDO abort code (see on page 515) upon error 65377
C3 CANopen stack error (see on page 507) no. upon error 65376</td></tr>
<tr><td colspan="3">Note: Compax3 must be CANopen master.</td></tr>
</table>



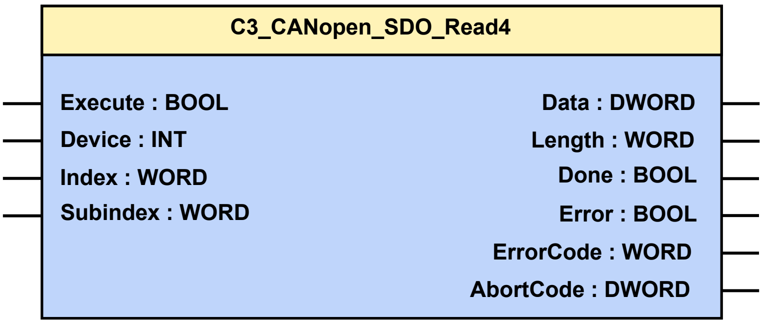
6.5.2.5 Sending NMT messages (C3_CANopen_NMT)

FB name	**C3_CANopen_NMT**	
This module allows to send NMT messages.		
VAR_INPUT		
Execute	BOOL	Activating the module
Device	INT	Node ID (0 ... 127) 0 = NMT-message is valid for all nodes
State	INT	State which the node must take on: START_REMOTE_NODE STOP_REMOTE_NODE ENTER_PRE_OPERATIONAL RESET_NODE RESET_COMMUNICATION (these are no constants; please enter therefore directly)
VAR_OUTPUT		
Done	BOOL	Function executed without error
Error	BOOL	Error occurred
ErrorCode	WORD	CANopen-Stack error no. 1 = not sufficient memory 2 = node is not in the management list 3 = node is already in the management list 4 = nodes are in the wrong state 11 = network object not available 12 = node 0 was selected 65378 = C3 has no master functionality
Note: Compax3 must be CANopen master.		



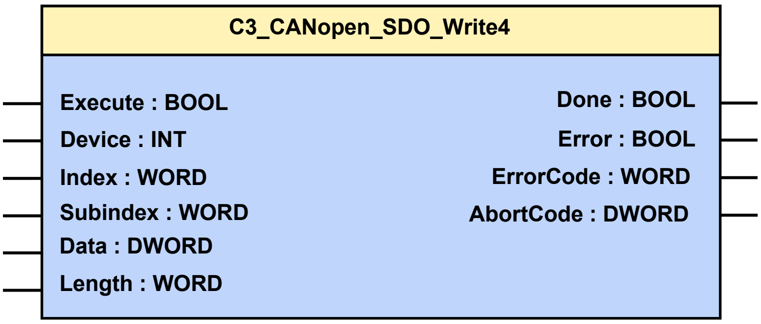
6.5.2.6 Reading an object in another node (C3_CANopen_SDO_Read4)

FB name	**C3_CANopen_SDO_Read4**	
This module allows to read an object with a max. length of 4 bytes in another node via SDO.		
VAR_INPUT		
Execute	BOOL	Activating the module
Device	INT	Node ID of the other node (1 ... 127)
Index	WORD	Object Index (CAN-No.)
Subindex	WORD	Object Subindex (CAN-No.)
VAR_OUTPUT		
Data	DWORD	Object data read in
Length	WORD	Data length in Byte
Done	BOOL	Function executed without error
Error	BOOL	Error occurred
ErrorCode	WORD	You will find the error code in the Compax3 **error list** (see on page 563).
AbortCode	DWORD	CANopen SDO **abort code** (see on page 515) upon error 65377 C3 CANopen **stack error** (see on page 507) no. upon error 65376
Note: Compax3 must be CANopen master.		



6.5.2.7 Writing an object in another node (C3_CANopen_SDO_Write4)

FB name	**C3_CANopen_SDO_Write4**	
This module allows to read an object with a max. length of 4 bytes in another node via SDO.		
VAR_INPUT		
Execute	BOOL	Activating the module
Device	INT	Node ID of the other node (1 ... 127)
Index	WORD	Object Index
Subindex	WORD	Object subindex
Data	DWORD	Object data which must be written
Length	WORD	Data length in Byte
VAR_OUTPUT		
Done	BOOL	Function executed without error
Error	BOOL	Error occurred
ErrorCode	WORD	You will find the error code in the Compax3 **error list** (see on page 563).
AbortCode	DWORD	CANopen SDO **abort code** (see on page 515) upon error 65377 C3 CANopen **stack error** (see on page 507) no. upon error 65376
Note: Compax3 must be CANopen master.		



6.5.3. CANopen communication profile

The CANopen communication objects described in this chapter are either set to sensible standard values or they are set under menu control with the help of the ServoManager.

The communication objects described below must be modified only for special deviating settings.

- CAN is an open system which has been standardized in the ISO 11898 and OSI reference model ISO 7498.
- CAN is Multi-Master compatible.
- Data transmission takes place with up to 8 Bytes useful data.
- The CAN objects are designated with an 11 Bit identifier (ID or COB-ID: CAN Object identifier). The identifier specifies the priority of the objects (the smaller the value of the object ID is, the higher is the priority level of the object).
- The COB-ID consists of the function code and the node ID:

Structure of the COB-ID

Bit 10	9	8	7	6	5	4	3	2	1	0
Function code				NodeID (1 ... 127)						

NodeID: The Compax3 device address is used here as standard value

CANopen characteristics (I21)

Baud rate [kBit/s]	◆20, 50, 100, 125, 250, 500, 800, 1000
EDS file	◆C3.EDS
Service data object	◆SDO1
Process data objects	◆PDO1, ... PDO4

6.5.3.1 Object types

The following table shows the preset COB-IDs:

Communication object type	Function code	COB - Identifier (dec)	COB - Identifier (hex)	Defined in Index...	Description	
Broadcast objects						
NMT	0000b	0	0h	-	Network management and identifier assignment	
SYNC	0001b	128	80h	1005h	CANSYNC	
TIME	0010b	256	100h	1012h	TIME is not implemented in Compax3.	
Point to point objects						
EMCY	0001b	129-255	81h-FFh	1014h	Error messages	
T-PDO1	0011b	385-511	181h-1FFh	1800h	Assignment via Index 1A00h	Transmit process data object (Compax3) max. 8 Byte
T-PDO2	0101b	641-767	281h-2FFh	1801h	Assignment via Index 1A01h	
T-PDO3	0111b	897-1023	381h-3FFh	1802h	Assignment via Index 1A02h	
T-PDO4	1001b	1153-1279	481h-1279h	1803h	Assignment via Index 1A03h	
R-PDO1	0100b	513-639	201h-27Fh	1400h	Assignment via Index 1600h	Receive process data objects (Compax3) max. 8 Byte
R-PDO2	0110b	769-895	301h-37Fh	1401h	Assignment via Index 1601h	
R-PDO3	1000b	1025-1151	401h-47Fh	1402h	Assignment via Index 1602h	
R-PDO4	1010b	1281-1407	501h-57Fh	1403h	Assignment via Index 1603h	
T-SDO1	1011b	1409-1535	581h-5FFh	1200h	Transmit service data object 1	
T-SDO2	-*	-*	-	1201h	Transmit service data object 2	
R-SDO1	1100b	1537-1663	601h-67Fh	1200h	Receive service data object 1	
R-SDO2	-*	-*	-	1201h	Receive service data object 2	
Node guard	1110b	1793-1919	701h-77Fh	100Eh	Check bus subscribers.	

* The SDO2 are not activated.

The standard value of the COB-ID for an object is calculated as follows: COB-ID = (Function code * 128) + Device address

The standard values of the COB-Ids can be changed via communication objects via SDOs.

<u>Application of the communication object types</u>

Transmission of real time data (faster transmission because higher priority)

T-PDO	Transmit process data object: Compax3 reply.
R-PDO	Receive process data object: send to Compax3.

Once only transmission, e. g. of parameters or program lines

T-SDO	Transmit service data object: Compax3 reply.
R-SDO	Receive service data object: send to Compax3.

6.5.3.2 Communication objects

General note:

Every CAN object which is created as array (with subindex) contains the number of entries in subindex 0.

CAN communication objects overview sorted according to CAN No.

CAN-No	Name	Bus format	Standard value	Minimum value	Maximum value	Access
0x1000	Device Type	Unsigned32	0x00020192	0x00000000	0xFFFFFFFF	const
0x1001	Error Register	Unsigned8	0x00	0x00	0xFF	ro
0x1005	COB-ID SYNC	Unsigned32	0x80000080	0x00000001	0xFFFFFFFF	rw
0x1006	Communication Cycle Period	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1007	Synchronous Window Length	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1008	Manufacturer Device Name	Visible_String	C3xxxxxxxxxxxxxxxxx			const
0x1009	Manufacturer Hardware Version	Visible_String	CTPxxxxxxxxLEIxxxxxxxx			const
0x100A	Manufacturer Software Version	Visible_String	V xxxxxxxxxxxxxxxxxxx			const
0x100C	Guard Time	Unsigned16	0x0000	0x0	0xFFFF	rw
0x100D	Life Time Factor	Unsigned8	0x00	0x0	0xFF	rw
0x1014	COB-ID EMCY	Unsigned32	0x000000FF	0x00000001	0xFFFFFFFF	rw
0x1015	Inhibit Time Emergency	Unsigned16	0x0	0x0	0xFFFF	rw
0x1018	**Identity Object** (see on page 514)	-				
0x1018.1	Vendor Id	Unsigned32	0x0	0x0	0xFFFFFFFF	ro
0x1018.2	Product Code	Unsigned32	0x0	0x0	0xFFFFFFFF	ro
0x1018.3	Revision number	Unsigned32	0x0	0x0	0xFFFFFFFF	ro
0x1018.4	Serial number	Unsigned32	0x0	0x0	0xFFFFFFFF	ro
0x1200	Server SDO1 Parameter	-				
0x1200.1	SDO1: COB-ID Client -> Server	Unsigned32	0x0000067F	0x00000001	0xFFFFFFFF	ro
0x1200.2	SDO1: COB-ID Server -> Client	Unsigned32	0x000005FF	0x00000001	0xFFFFFFFF	ro
0x1200.3	Node ID of the SDO1 client	Unsigned8	0x00	0x00	0xFF	rw
0x1201	Server SDO2 Parameter	-				
0x1201.1	SDO2: COB-ID Client -> Server	Unsigned32	0x800006E0	0x00000001	0xFFFFFFFF	rw
0x1201.2	SDO2: COB-ID Server -> Client	Unsigned32	0x800006E0	0x00000001	0xFFFFFFFF	rw
0x1201.3	Node ID of the SDO2 Client	Unsigned8	0x00	0x00	0xFF	rw
0x1400	Receive PDO1 communication parameters	-				
0x1400.1	RPDO1: COB-ID	Unsigned32	0x0000027F	0x00000001	0xFFFFFFFF	rw
0x1400.2	RPDO1: Transmission Type	Unsigned8	0xFE	0x00	0xFF	rw
0x1400.3	RPDO1: Inhibit Time	Unsigned16	0x0000	0x0000	0xFFFF	rw
0x1400.5	RPDO1: Event Timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1401	Receive PDO2 communication parameters	-				
0x1401.1	RPDO2: COB-ID	Unsigned32	0x0000037F	0x00000001	0xFFFFFFFF	rw
0x1401.2	RPDO2: Transmission Type	Unsigned8	0xFE	0x00	0xFF	rw
0x1401.3	RPDO2: Inhibit Time	Unsigned16	0x0000	0x0000	0xFFFF	rw
0x1401.5	RPDO2: Event Timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1402	Receive PDO3 communication parameter	-				
0x1402.1	RPDO3: COB-ID	Unsigned32	0x0000047f	0x0	0xFFFFFFFF	rw
0x1402.2	RPDO3: Transmission Type	Unsigned8	0xFE	0x0	0xFF	rw
0x1402.3	RPDO3: Inhibit Time	Unsigned16	0x0000	0x0	0xFFFF	rw
0x1402.5	RPDO3: Event Timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1403	Receive PDO4 communication parameter	-				
0x1403.1	RPDO4: COB-ID	Unsigned32	0x0000057f	0x0	0xFFFFFFFF	rw
0x1403.2	RPDO4: Transmission Type	Unsigned8	0xFE	0x0	0xFF	rw
0x1403.3	RPDO4: Inhibit Time	Unsigned16	0x0000	0x0	0xFFFF	rw
0x1403.5	RPDO4: Event Timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1600	Receive PDO1 mapping parameter	-				
0x1600.1	RPDO1 Mapping Entry 1	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1600.2	RPDO1 mapping entry 2	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1600.3	RPDO1 Mapping Entry 3	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1600.4	RPDO1 Mapping Entry 4	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw

0x1600.5	RPDO1 Mapping Entry 5	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1601	Receive PDO2 mapping parameter	-				
0x1601.1	RPDO2 mapping entry 1	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1601.2	RPDO2 Mapping Entry 2	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1601.3	RPDO2 Mapping Entry 3	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1601.4	RPDO2 Mapping Entry 4	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1601.5	RPDO2 Mapping Entry 5	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1602	Receive PDO3 mapping parameter	-				
0x1602.1	RPDO3 mapping entry 1	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1602.2	RPDO3 Mapping Entry 2	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1602.3	RPDO3 Mapping Entry 3	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1602.4	RPDO3 Mapping Entry 4	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1602.5	RPDO3 Mapping Entry 5	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1603	Receive PDO3 mapping parameter	-				
0x1603.1	RPDO4 mapping entry 1	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1603.2	RPDO4 Mapping Entry 2	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1603.3	RPDO4 Mapping Entry 3	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1603.4	RPDO4 Mapping Entry 4	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1603.5	RPDO4 Mapping Entry 5	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1800	Transmit PDO1 communication parameter	-				
0x1800.1	TPDO1: COB-ID	Unsigned32	0x000001FF	0x00000001	0xFFFFFFFF	rw
0x1800.2	TPDO1: Transmission Type	Unsigned8	0xFE	0x00	0xFF	rw
0x1800.3	TPDO1: Inhibit Time	Unsigned16	0x0000	0x0000	0xFFFF	rw
0x1800.5	TPDO1: Event Timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1801	Transmit PDO2 communication parameter	-				
0x1801.1	TPDO2: COB-ID	Unsigned32	0x000002FF	0x00000001	0xFFFFFFFF	rw
0x1801.2	TPDO2: Transmission Type	Unsigned8	0xFE	0x00	0xFF	rw
0x1801.3	TPDO2: Inhibit Time	Unsigned16	0x0000	0x0000	0xFFFF	rw
0x1801.5	TPDO2: Event Timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1802	Transmit PDO3 communication parameter	-				
0x1802.1	TPDO3: COB-ID	Unsigned32	0x000003ff	0x0	0xFFFFFFFF	rw
0x1802.2	TPDO3: Transmission Type	Unsigned8	0xFE	0x0	0xFF	rw
0x1802.3	TPDO3: Inhibit Time	Unsigned16	0x0000	0x0	0xFFFF	rw
0x1802.5	TPDO3: Event Timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1803	Transmit PDO4 communication parameter	-				
0x1803.1	TPDO4: COB-ID	Unsigned32	0x000004ff	0x0	0xFFFFFFFF	rw
0x1803.2	TPDO4: Transmission Type	Unsigned8	0xFE	0x0	0xFF	rw
0x1803.3	TPDO4: Inhibit Time	Unsigned16	0x0000	0x0	0xFFFF	rw
0x1803.5	TPDO4: Event Timer	Unsigned16	0x0	0x0	0xFFFF	rw
0x1A00	Transmit PDO1 mapping parameter	-				
0x1A00.1	TPDO1 mapping entry 1	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A00.2	TPDO1 Mapping Entry 2	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A00.3	TPDO1 Mapping Entry 3	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A00.4	TPDO1 Mapping Entry 4	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A00.5	TPDO1 Mapping Entry 5	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A01	Transmit PDO2 mapping parameter	-				
0x1A01.1	TPDO2 mapping entry 1	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A01.2	TPDO2 Mapping Entry 2	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A01.3	TPDO2 Mapping Entry 3	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A01.4	TPDO2 Mapping Entry 4	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A01.5	TPDO2 Mapping Entry 5	Unsigned32	0x00000000	0x00000000	0xFFFFFFFF	rw
0x1A02	Transmit PDO3 mapping parameter	-				
0x1A02.1	TPDO3 mapping entry 1	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A02.2	TPDO3 Mapping Entry 2	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A02.3	TPDO3 Mapping Entry 3	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A02.4	TPDO3 Mapping Entry 4	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw

0x1A02.5	TPDO3 Mapping Entry 5	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A03	Transmit PDO4 mapping parameter	-				
0x1A03.1	TPDO4 mapping entry 1	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A03.2	TPDO4 Mapping Entry 2	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A03.3	TPDO4 Mapping Entry 3	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A03.4	TPDO4 Mapping Entry 4	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw
0x1A03.5	TPDO4 Mapping Entry 5	Unsigned32	0x00000000	0x0	0xFFFFFFFF	rw

Identity Object (0x1018)

This object is composed as follows:

Vendor-ID (0x1018.1)

Is stored in the FBI-EEPROM binarily from addr. 56...59 (low...high). Current value = 0x02000089.

Product-Code (0x1018.2)

Is composed of the part of the order code "Faa Ibb Tcc Mdd" to 0xaabbccdd, i.e. the device with the order code C3S025V2F10I21T40M11 has the product code 0x10214011.
The product code is hex coded, but can be read decimally.

Revision number (0x1018.3)

Is composed of 5 digits of the software version no. of the DSP software and 3 digits of the SV no. of the FBI software, i.e. the device with the DSP SV no. 01.08.02 and the FBI SV no. 1.21 has the revision no. 0x10802121.

Serial number (0x1018.4)

Is stored in the CTP-EEPROM as a 10 digit ASCII string from addr. 56...65 (series number of the device). A C3 with the series number 1423440001 has the serial number 0x54D7F881.

Communication objects

The description of the CANopen communication objects can be found in the corresponding help file.

6.5.4. Acyclic parameter channel

In this chapter you can read about:

6.5.4.1 Service Data Objects (SDO)

Asynchronous access to the object directory of Compax3 is implemented with the help of the SDOs. The SDOs serve for parameter configuration and status interrogation. Access to an individual object takes place via the RS232 / RS485 index and subindex of the object directory.

Attention!
A SDO is a confirmed service, therefore the SDO reply telegram must always be awaited before a new telegram may be transmitted.

CiA405_SDO_Error (Abort Code): UDINT

In the case of an incorrect SDO transmission, the error cause is returned via the "abort code".

Abort Code	Description
0x0503 0000	”Toggle Bit” was not alternated
0x0504 0000	SDO Protocol ”time out”
0x0504 0001	Client/server command designator invalid or unknown
0x0504 0002	Unknown block size (block mode only)
0x0504 0003	Unknown block number (block mode only)
0x0504 0004	CRC error (block mode only)
0x0504 0005	Outside of memory
0x0601 0000	Access to this object is not supported
0x0601 0001	Attempted read access to a write only object
0x0601 0002	Attempted write access to a read only object
0x0602 0000	The object does not exist in the object directory
0x0604 0041	Object cannot be mapped in a PDO
0x0604 0042	Size and number of “mapped” objects exceeds max. PDO length
0x0604 0043	General parameter incompatibility
0x0604 0047	General incompatibility in the device
0x0606 0000	Access infringement due to a hardware error
0x0607 0010	Data type does not fit, length of the service parameter does not fit
0x0607 0012	Data type does not fit, length of the service parameter too large
0x0607 0013	Data type does not fit, length of the service parameter too small
0x0609 0011	Subindex does not exist
0x0609 0030	Outside parameter value range (only for write access operations)
0x0609 0031	Parameter value too large
0x0609 0032	Parameter value too small
0x0609 0036	Maximum value smaller than minimum value
0x0800 0000	General error
0x0800 0020	Date cannot be transmitted or saved
0x0800 0021	Date cannot be transmitted or saved due to local device management
0x0800 0022	Date cannot be transmitted or stored due to device status
0x0800 0023	Dynamic generation of the object directory is impossible or no object directory exists (the object directory is created from a file and an error occurs due to a defective file)

6.5.4.2 Object Up-/Download via RS232 / RS485

The up-/download takes place via the RS232 / RS485 objects C3_Request (Index 0x2200) and C3_Response (Index 0x2201). These have the data type octet string with a length of 20 bytes (octets). Write/read of a C3 object is carried out by writing of C3_Request with the corresponding data. When a C3 object is read, the data appear in the C3_Response object .

Meaning of the data from C3_Request

Byte 1	**Octet 2**	**Octet 3**	**Octet 4**	**Octet 5**	**Octet 6**	**...**	**...**	**Octet 19**	**Octet 20**
Request header				C3 object data (write)					
AK	Subindex	Index		D1	D2	...	...	D15	D16

AK: Job identifier; 3=read, 4= write

OD1..OD16: Object data; OD1 = High, OD16 = Low

Meaning of the data from C3_Response

Byte 1	**Octet 2**	**Octet 3**	**Octet 4**	**Octet 5**	**Octet 6**	**...**	**...**	**Octet 19**	**Octet 20**
Reply header				C3 object data (read)					
-	-	-	-	OD1	OD2	...	...	OD15	OD16

OD1..OD16: Object data; OD1 = High, OD16 = Low

Upload

RS232 / RS485		**O 1**	**O 2**	**O 3**	**O 4**	**O 5**	**O 6**	**O 7**	**O 8**	**...**	**O 20**
Access	Object	C3 object request/reply				C3 object data					
1. Write C3 object 20.2 with the value 0											
Write	0x2200.0	4	2	0	20	0	0	0	x	...	x
2. read next C3 object index/subindex in C3 object 20.5											
Write	0x2200.0	3	5	0	20	x	x	x	x	...	x
Read	0x2201.0	x	x	x	x	**I_hi**	**I_lo**	**Subi**	x	...	x
3. read the C3 object with the in index/subindex read in the C3 object 20.5											
Write	0x2200.0	3	**Subi**	**I_hi**	**I_lo**	x	x	x	x	...	x
Read	0x2201.0	x	x	x	x	D1	D2	D3	D4	...	D16
4. Store C3 object index, subindex and data D1...D16 in table											
5. Repeat steps 2 to 4 until I_hi = I_lo = Subi = 0xFF											

Download: Write the entire table of C3 objects.

RS232 / RS485		**O 1**	**O 2**	**O 3**	**O 4**	**O 5**	**O 6**	**O 7**	**O 8**	**...**	**O 20**
Access	Object	C3 object request/reply				C3 object data					
1. Write C3 object from the table											
Write	0x2200.0	4	**Subi**	**I_hi**	**I_lo**	D1	D2	D3	D4	...	D16
2. Repeat step 1 until the end of the table											

6.5.4.3 Data formats of the bus objects

Data formats of the bus objects (see on page 497)

6.6 DeviceNet

In this chapter you can read about:

I22 Function

Please note:

A changed assignment (mapping) of the Input/Output Message is accepted with Power off / Power on!

The length of the Input / Output Message is adapted to the real assignment (mapping) (2...32).

Statement of Conformance
http://www.compax3.de/C3_DeviceNet_Statement_of_Conformance.pdf (in the Internet)

Address or Baud rate settings (see on page 74)

Connector assignment (see on page 74)

6.6.1. DeviceNet Configuration

In this chapter you can read about:

Following are described the input windows of the configuration wizard.

Can be called up in the tree (Compax3 ServoManager, left window) under "configure configuration".

6.6.1.1 Error Reaction on Bus Failure

Here you can set how Compax3 shall respond to a react on a **Bus error** (see on page 563)l:

Possible settings for the error reaction are:

- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

6.6.2. DeviceNet object classes

In this chapter you can read about:

The DeviceNet object classes described in this chapter are either set to sensible standard values or they are set under menu control with the help of the ServoManager.

The communication objects described below must be modified only for special deviating settings.

DeviceNet characteristics (I22)

DeviceNet	◆ Predefined Master/Slave Connection Set ◆ Standard 2.0 Group-2-Slave ◆ Fieldbus I/O Data or Process Data (Polled, COS/Cyclic I/O and Bit Strobe)
Implemented object classes	◆ Identify, Message Router, DeviceNet, Assembly, Connection, Acknowledge Handler
Baud rate [kBit/s]	◆ 125, 250, 500
permissible cable length	◆ up to 500m on 125Bit/s, ◆ up to 200m on 250Bit/s, ◆ up to 100m on 500Bit/s,
Max. Number of participants	◆ 63 Slave
Insulation	◆ Isolated Device Physical Layer
EDS file	◆ C3_DeviceNet.EDS
Conformance (file in the Internet)	◆ **Statement of Conformance http://www.compax3.de/C3_DeviceNet_Statement_of_Conformance.pdf**
Further information:	◆ Application example (C3I22_DeviceNet.ZIP) on the Compax3 CD in the "\Examples" directory"

6.6.2.1 Overview of the DeviceNet object classes

Object name	Class ID	Instance ID	Description
Identify	0x01	1	Mandatory
Message Router	0x02	1	Mandatory
DeviceNet	0x03	1	Mandatory
Assembly	0x04	101-103	I/O Messages
Connection	0x05	1	Explicit Messages
		2	Polled I/O Data
		3	Bit Strobe
		4	Change of State (COS), Cyclic I/O Data
Acknowledge Handler	0x2B	1	Necessary for connection class ID 05hex, instance ID 04
Image of I/O Data	0x64	1	Manufacturer-specific object class image of I/O data
C3 object	0x65	20-3300	Manufacturer-specific object class C3 object

6.6.2.2 Object classes

Detailed information on the topic of "object classes" can be found in the online help of the device.

6.6.3. Data formats of the bus objects

Data formats of the bus objects (see on page 497)

6.7 Ethernet Powerlink / EtherCAT

In this chapter you can read about:

The Ethernet Powerlink option is available with the Compax3 devices C3I30Tx**x!**

The EtherCAT option is available on the Compax3 devices C3I31Txx**!**

6.7.1. Configuring Ethernet Powerlink / EtherCAT

In this chapter you can read about:

The Ethernet Powerlink or Ethercat configuration is made in a wizard. Can be called up in the tree (Compax3 ServoManager, left window) under "configure configuration".

6.7.1.1 CN Controlled Node (Slave)

Compax3 is the slave of an Ethernet / EtherCAT master; the bus configuration is made via the ServoManager

6.7.1.2 Slave mit Konfiguration via Master

Select "Slave mit Konfiguration via Master” if you make the operating mode setting and mapping via the master.

Then run through the wizard completely.

6.7.1.3 Error Reaction on Bus Failure

Here you can set how Compax3 shall respond to a react on a **Bus error** (see on page 563)l:

Possible settings for the error reaction are:

- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

6.7.1.4 Possible PDO assignment

Via the process data objects (RPDO and TPDO), actual values and Setpoint values are cyclically exchanged between Compax3 and the Ethernet Powerlink Controlled Nodes (Slaves). Please note that they put more strain on the fieldbus communication that the the transmission via SDO:

The cyclic PDOs are configured with the aid of the Compax3 ServoManager:

The PDOs are set separately for the transmission directions

- Slave ⇒ Compax3 (**RPDO**)
- Compax3 ⇒ Slave (**TPDO)**

The objects that can be put on the process data channel can be found in the " **Compax3 Objects** (see on page 544)"!

Acyclic data can be transmitted via SDO.

6.8 HEDA Bus

In this chapter you can read about:

HEDA: **H**igh **E**fficiency **D**ata **A**ccess: Option M10 or M11

- Real-time data transfer
- High-stage axis synchronization
- fixed transfer rate of 10MBit/s
- Jitter < 300ns (Bus) which results in a high synchronicity
- Peer-to-Peer communication
- maximum cable length 50m (greater lengths on request)
- 1 Master / 31 Slave: Individual HEDA axis address in the range between /1...32
- fixed cycle time of 0.5ms
- Synchronization of the scanning grid of the digital control loops and of the setpoint generation
- cyclic data exchange
- acyclic data exchange of time-uncritical values

HEDA wiring (see on page 609)

Function of the HEDA LEDs

Green LED (left)

HEDA module energized

Red LED (right)

Error in the receive area

Possible causes:

- at the Master
  - no slave sending back
  - Wrong cabling
  - Terminal plug is missing
  - several masters are sending in the same slot
- at the slave
  - several masters in the system
  - no master active
  - Terminal plug is missing
  - no transmission from one or several receive slots (neither by the master nor by another slave)

The configuration may take place in two different ways:

- HEDA standard: Simple Master -> Slave communication
- HEDA advanced: Extensive communication Master <-> Slave and Slave <-> Slave.

6.8.1. HEDA standard mode

In this chapter you can read about:

The HEDA option (option M10 or M11) can be used to send 4 process values in the "HEDA standard" operating mode from master to slave. A return transmission from Slave to Master is possible with "HEDA advanced".

First choose, if Compax3 is HEDA Master or HEDA Slave:

- HEDA Master in order to send process values
- HEDA Slave in order to receive process values

Please respect that only 1 HEDA station can be Master.

- Error reaction (from Compax3) at bus failure:
  - activated: Compax3 switches to error state in the case of a bus error. (Error reaction 2: Downramp / apply brake / de-energize.)
  - deactivated: Compax3 will ignore a bus error.

6.8.1.1 Error Reaction on Bus Failure

Here you can set how Compax3 shall respond to a react on a **Bus error** (see on page 563)l:

Possible settings for the error reaction are:

- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

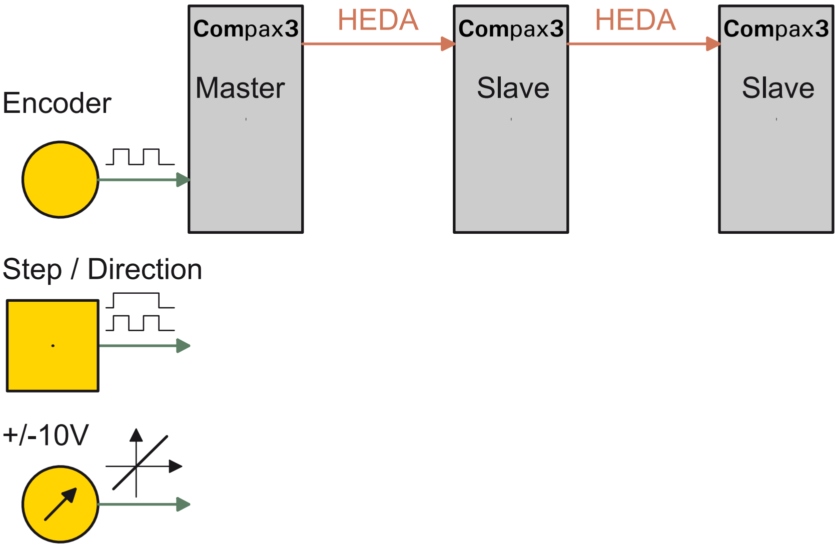
6.8.1.2 HEDA-Master

You can transmit 4 process values (one process value per channel) with max. 7 words (one process value per channel).

The 1st. process value (takes 3 words) is reserved for the axis synchronization.

You may choose between:

- Process - setpoint position (Object 2000.1)
- Process - actual position (Object 2200.2)
- Position as from external Setpoint value (Object 2020.1)
  Signal read into the master via Analogkanal 0 (X11/9 und X11/11), Encoder input or step/direction input .
  Principle:



Attention in the case of a configuration download with master-slave coupling (electronic gearbox, cam)

Switch Compax3 to currentless before starting the configuration download: Master and Slave axis

- Position from virtual Master (object 2000.2)

Additional 3 process values with altogether max. 4 words data can be transmitted. You can make your choice between the Compax3 PD objects.

Note: Please use the **coupling objects** (see on page 542) for axis coupling.

6.8.1.3 HEDA-Slave

In the HEDA slave, the transmitted process values are read and are assigned to objects in the configuration wizard (e. g. to array objects).

Objects with appropriate data width (corresponding to the process values read in) must be assigned.

The 1st process value is used as input process value (object 3920.1: HEDA SignalProcessing Input) for axis synchronization. The target for the process values 2, 3, 4 can be selected from a list in the configuration wizard.

6.8.2. HEDA expansion (HEDA advanced)

In this chapter you can read about:

6.8.2.1 The possibilities of the HEDA expansion

The HEDA option (option M10 or M11) can be used to exchange process values in the "HEDA advanced" operating mode.

- from Slave to Master
- from Slave to Master and
- from Slave to Slave.

6.8.2.2 Technical data of the HEDA interface / overview

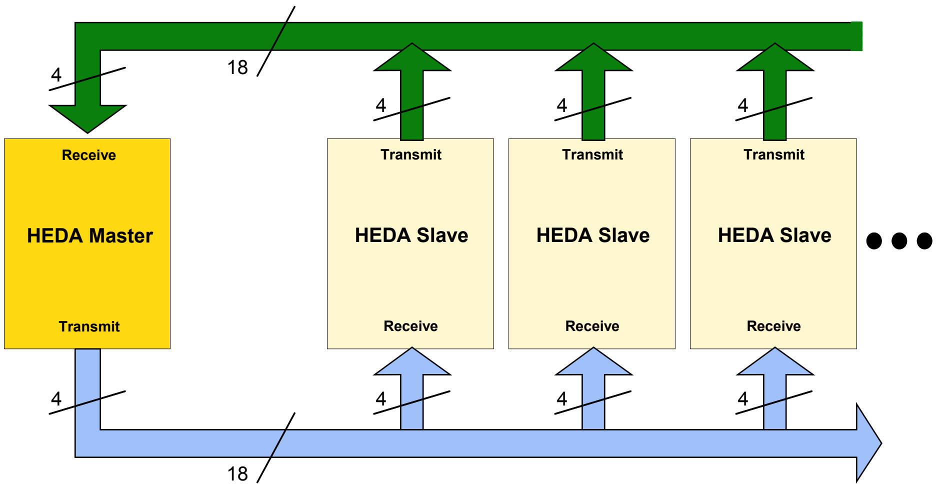
General HEDA data

- Synchronous, bidirectional, deterministic real-time bus.
- Bus access via time sharing (slots), Master/Slave, Producer/Consumer. ((synchronization exactitude <1µs).
- Bus cycle time 500µs, distributed into 20 time slots à 25µs.
- 18 slots cyclic transmitting and receiving data channels (Slot 0 .. 17).
- 2 slots reserved for acyclic communication.
- Telegrams (frames) with max. 7 words à 16 bit can be sent and received in a slot.
- Freely configurable assignment of the cyclic transmit(Tx)/receive(rx)-slots to the stations.
- The transmitting and receiving data are freely definable via mapping tables.
- Master-Slave as well as Slave-Slave communication (cross-communication) are possible.
- A master=>slave frame in slot x can be received by every slave.
- A master=>slave frame (cross-communication) in slot x can be received by every station.

Compax3-specific HEDA data:

- The Compaxa3 system cycle time is synchronized with the bus cycle time.
- System cycle time 500µs, distributed into 4 position control cycles à 125µs.
- For system-immanent reasons, only one slot is able to send and receive during the same position control cycle (every 125µs).
- Transmit- and receive slot can differ within one position controller cycle.
- The Master can receive frames from max. 4 Slaves received.

Principle:



Displayed are the number of the possible telegrams (Frames).

6.8.2.3 Definitions

DSP Format	Objects with this format: ◆ are not reset ◆ are not limited: they have a value range between -2^{23} and $2^{23}-1$ ◆ are suitable as coupling objects If the DSP Format is not selected, the objects are transmitted in the **described formats** (see on page 544). Please note that the **Bus formats Y2 and Y4** (see on page 498) are set against the normalization factors.
Frame	Telegram of process values with a data width of 7 words.
Mapping	Image of process data on a communication channel (slot)
Mapping table	Overview of process values that can be put on a communication channel (slot).
Coupling objects	Are suitable as master signals for electronic coupling and must be in the DSP format.
Receive	Received:
Slot	communication channel
Transmit	Send:
Process data	Objects, which are suitable for use in the cyclic data channel.

6.8.2.4 Calling up the HEDA wizard in the C3 ServoManager

The "HEDA Advanced" wizard can be found in the C3 ServoManager tree under communication.

Please observe:

The "HEDA advanced" wizard settings overwrite the settings of the HEDA standard wizard!

6.8.2.5 Configuration of the HEDA communication

In this chapter you can read about:

Error Reaction on Bus Failure

Here you can set how Compax3 shall respond to a react on a **Bus error** (see on page 563)l:

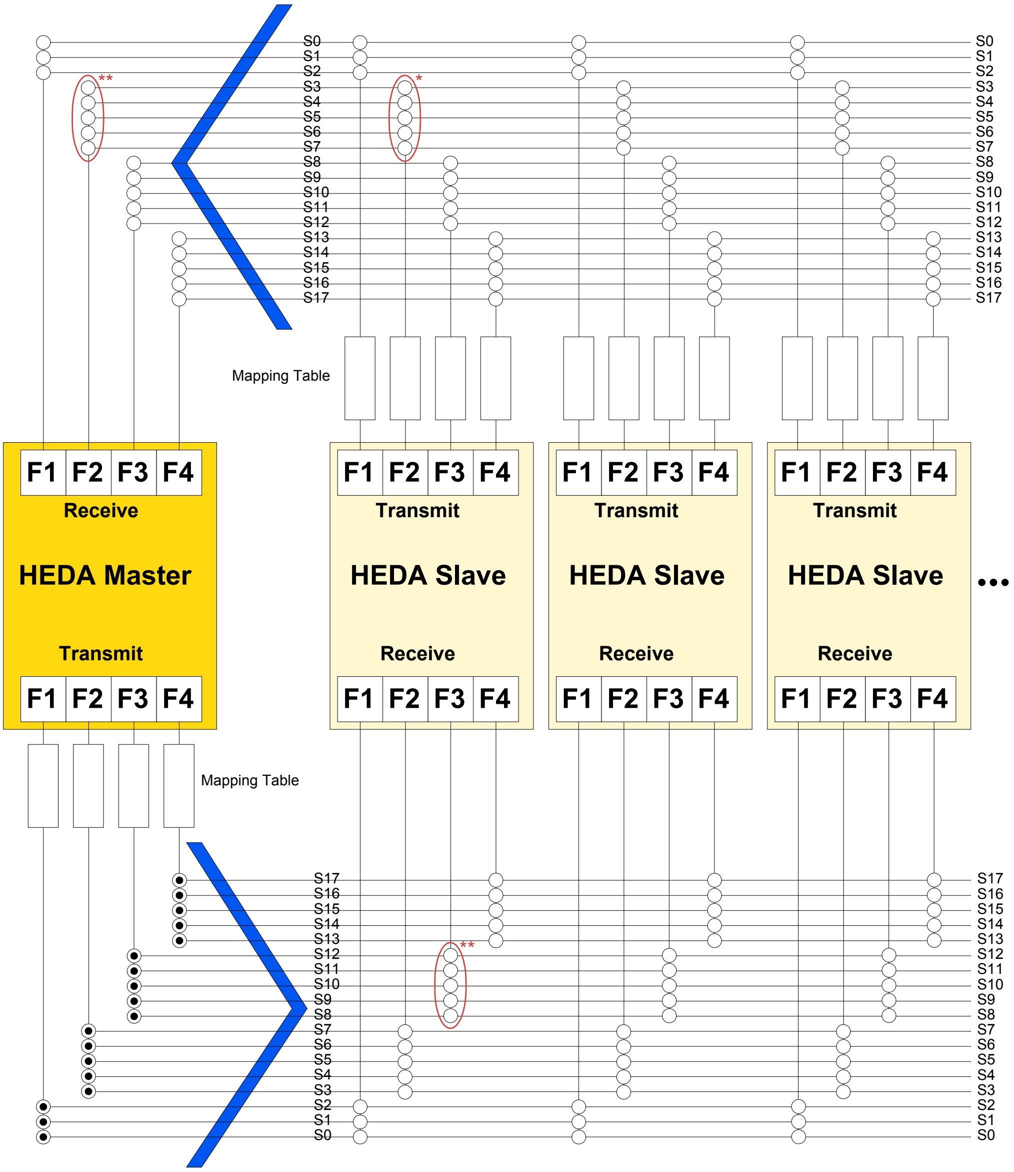
Possible settings for the error reaction are:

- No response
- Downramp / stop
- Downramp / stromlos schalten (standard settings)

Data transfer Master - Slave and back

In this chapter you can read about:

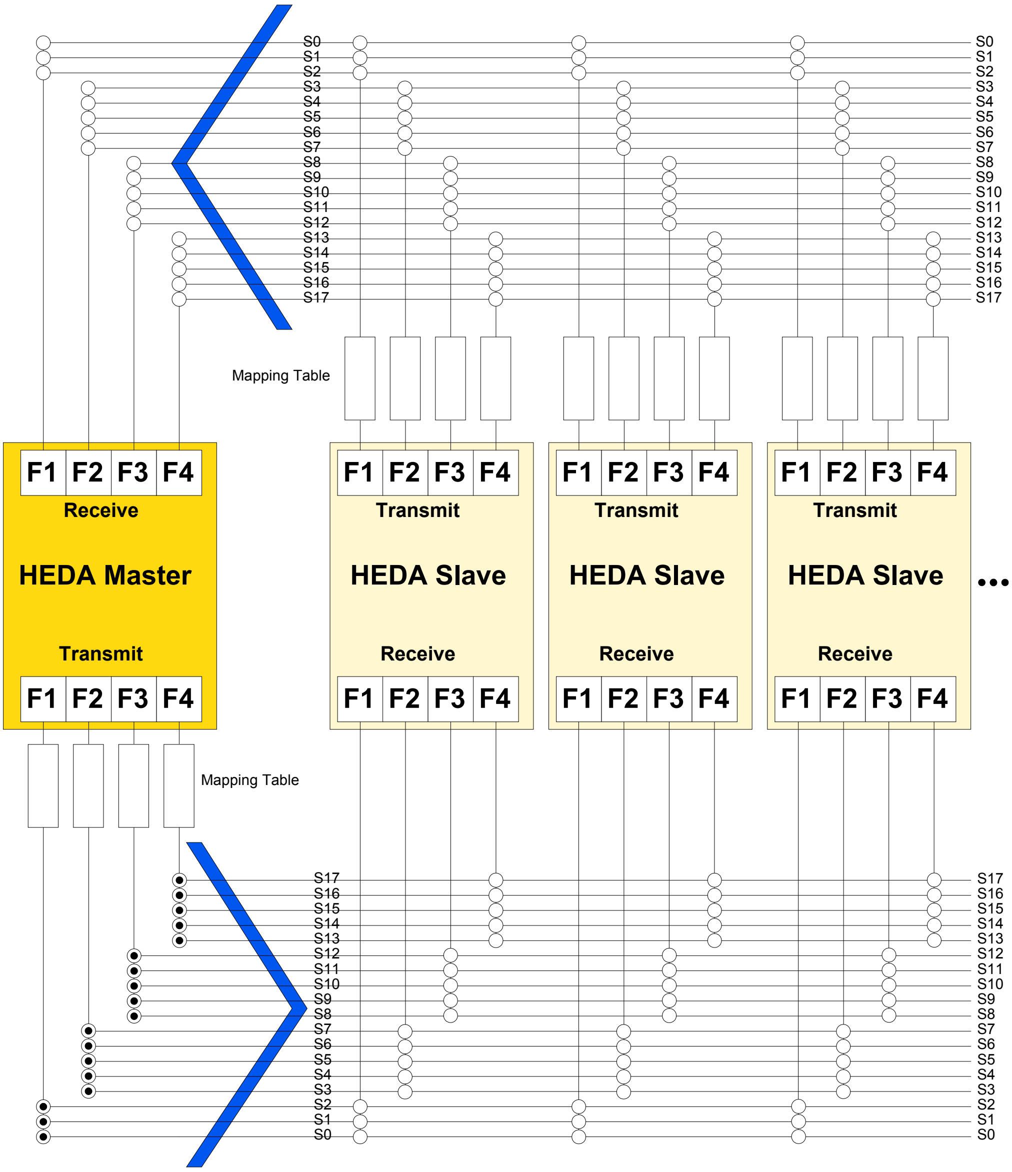
In standard applications the master sends process values to the slaves and reads the answers from the slaves.



* only one of the assigned slots per frame group may be activated on the slave transmit side (this is blocked by the C3 ServoManager)

* only one of the assigned slots per frame group may be activated on the master or slave receive side (this is blocked by the C3 ServoManager)

Print version available on the Internet
http://divapps.parker.com/divapps/eme/EME/downloads/compax3/HEDA-Formulare/HEDA-Standard.pdf



Functionality:

The master can send 4 different frames (F1,... F4). A frame can be sent from several slots:

Frame:	F1	F2	F3	F4
possible slots:	0 ... 2	3 ... 7	8 ... 12	13 ... 17

Each frame is assigned a mapping table number.

The individual slaves read in the slot from where their relevant data are sent.

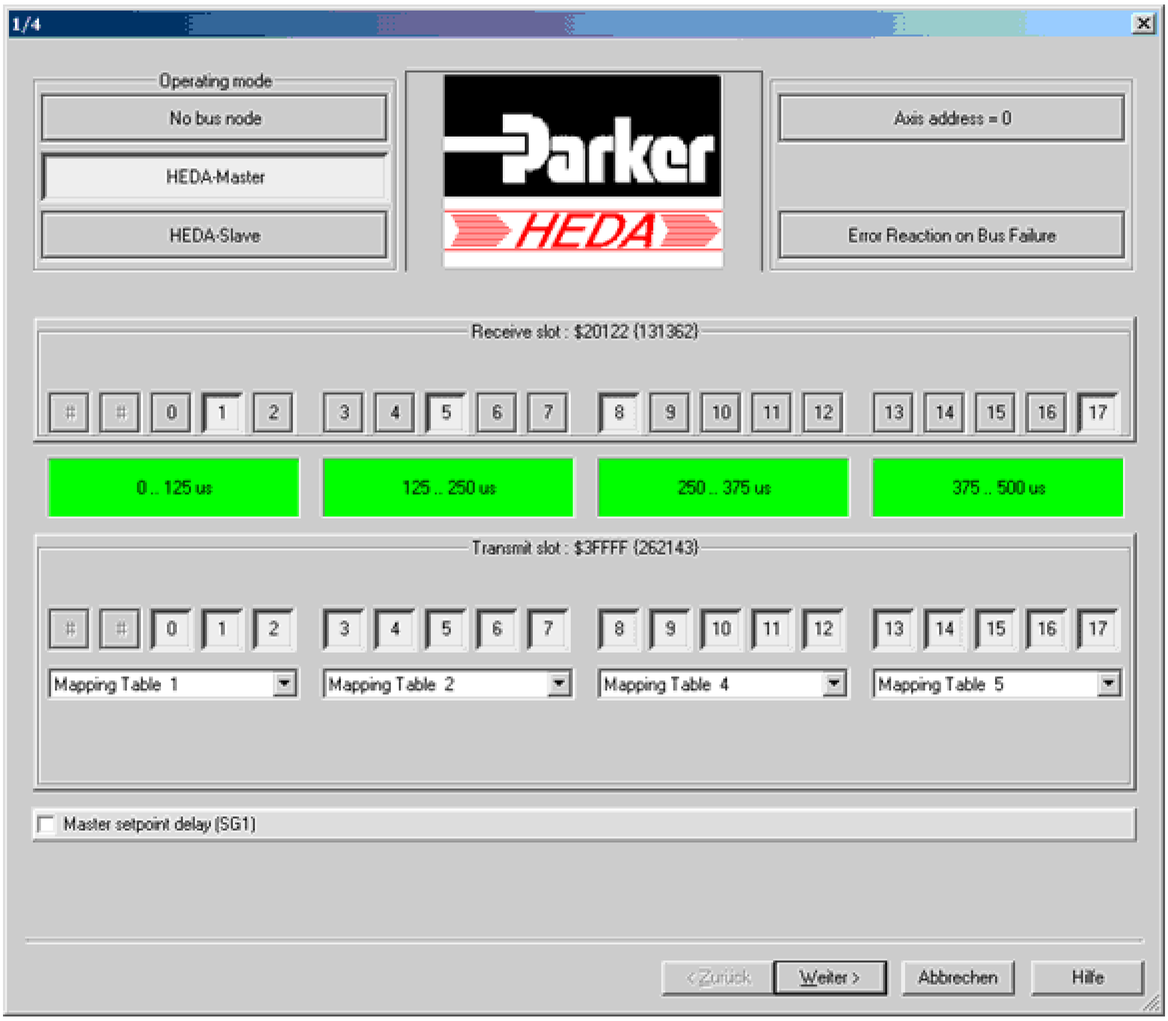
It is necessary to define a mapping table in the slave, stating where the individual process data are to be written (e.g. into an array-object).

The assignment of the mapping table is made via the mapping table number which is transferred via HEDA.
For this reason, the receive mapping table number and the transfer mapping table number must always be the same.

Important: **Receive**-Mapping table number = **Transmit**-Mapping-Table-Number

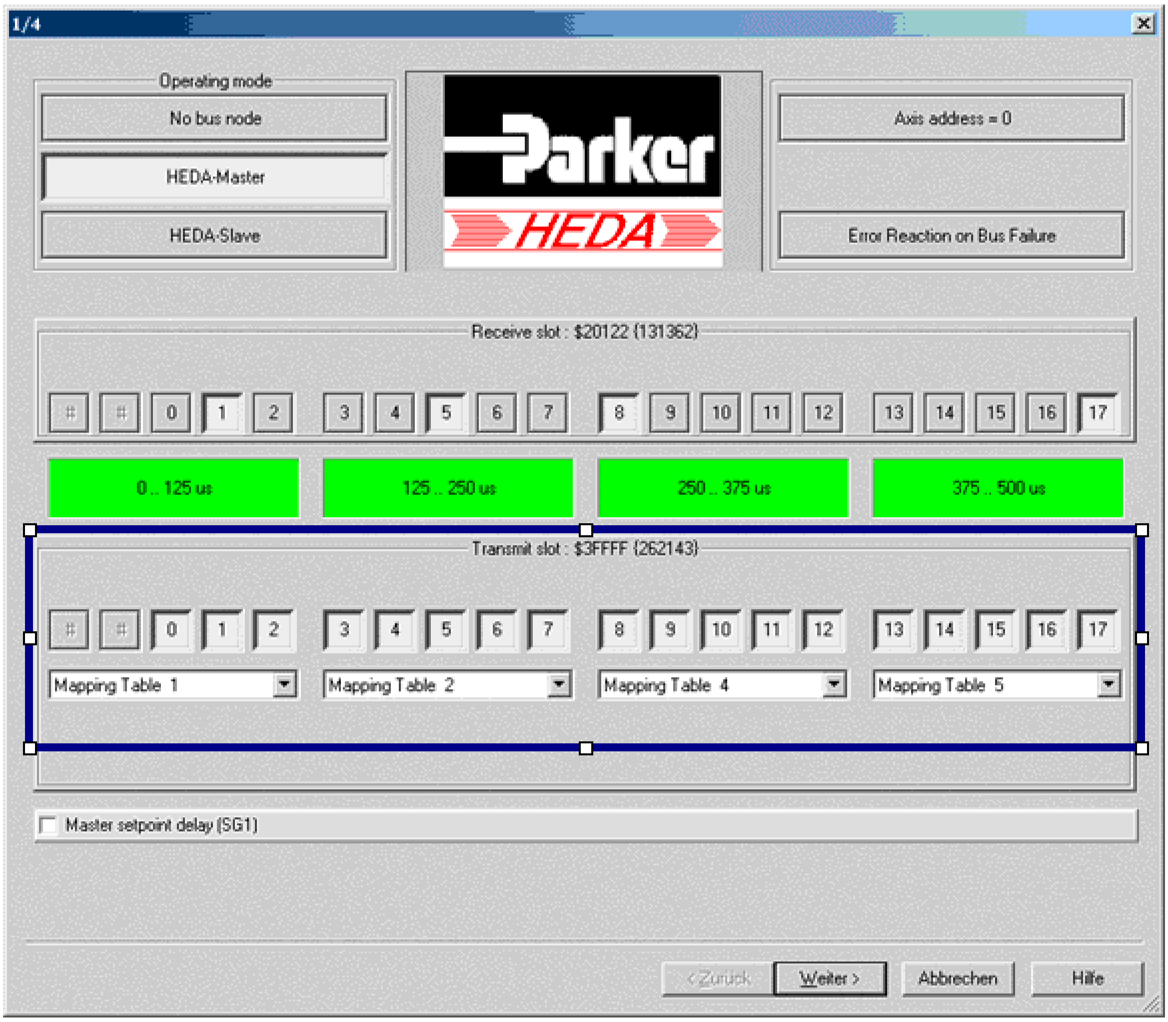
Setting the HEDA master

HEDA master settings:



- activate HEDA Master
- Axis address = 0
- Setting the error reaction (from Compax3) at bus failure:
  - activated: Compax3 switches to error state in the case of a bus error.
  - deactivated: Compax3 will ignore a bus error.
- By activating “Master setpoint delay (SG1), actualization takes place at the same time on the master and on the slave (by a delay on the master setpoint value).

Master transmission slots (Transmit Slots)



Important:

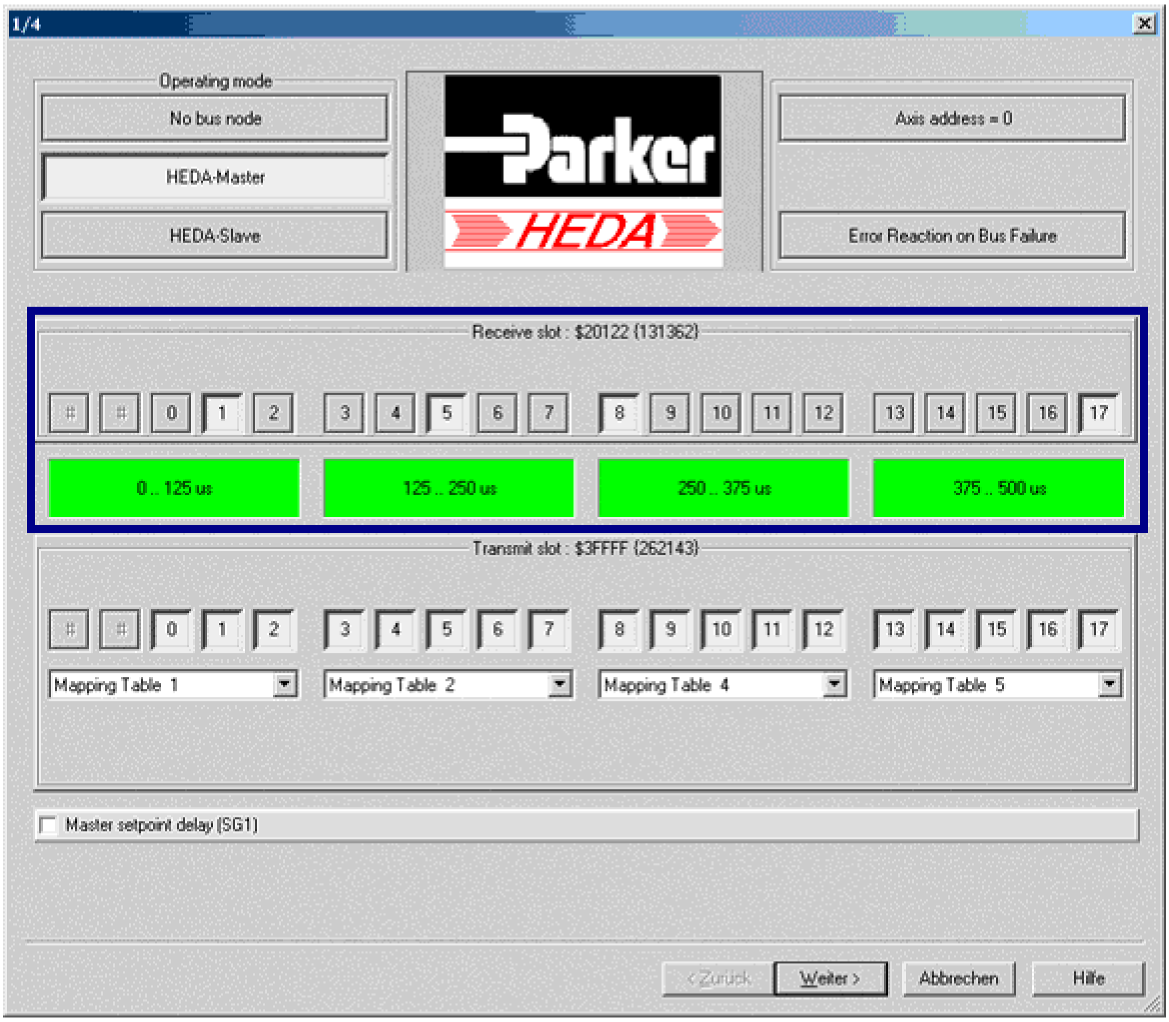
For standard applications (data transfer master - slave and back) all slots in the master must be transmitting.

- for this reason you should activate all transmit slots (0...17, in the lower area of the wizard window).
- Please assign, according to your requirements, a mapping table to each of the 4 transmit frames.

The contents of the transmit mapping table is defined in the next wizard window.

Master receive slots

Activate the receive slots from which the slave sends data (corresponding to the settings in the slave).



In each of the 125µs cycles (slot 0...2, slot 3...7, slot 8...12, slot 13...17) data can be received only via one slot, see also the **HEDA communication structure** (see on page 527).

The assignment of the data is made via the mapping table number (which was defined in the slave), this number is also received.

In the Wizard window "Receive Mapping table", it is defined under this mapping table number where the data received are to be written to.

Master Transmit Mapping Table (max. 4)

Here the transmit mapping tables, which were assigned to the max. assigned to 4 transmit 125µs cycles.

Procedure:

- Selection of the corresponding transmit mapping table.
- Selection of the Compax3 objects to be transmitted.
  - The assignment of the mapping table is permanently identified and displayed.
  - Up to 7 words are possible.
  - How many words are used by an **object** (see on page 544) depends on the **bus format** (see on page 497) / DSP format

Note:

For axis coupling, please use the **coupling objects** (see on page 542) in the **DSP format** (see on page 526) (selected by clicking on the DSP switch).

Please make sure that the DSP switch is activated on the master and the slave side in DSP format.

Master Receive Mapping Table (max. 4)

Please select the mapping table number, which was defined in the slave (under transmit mapping table).

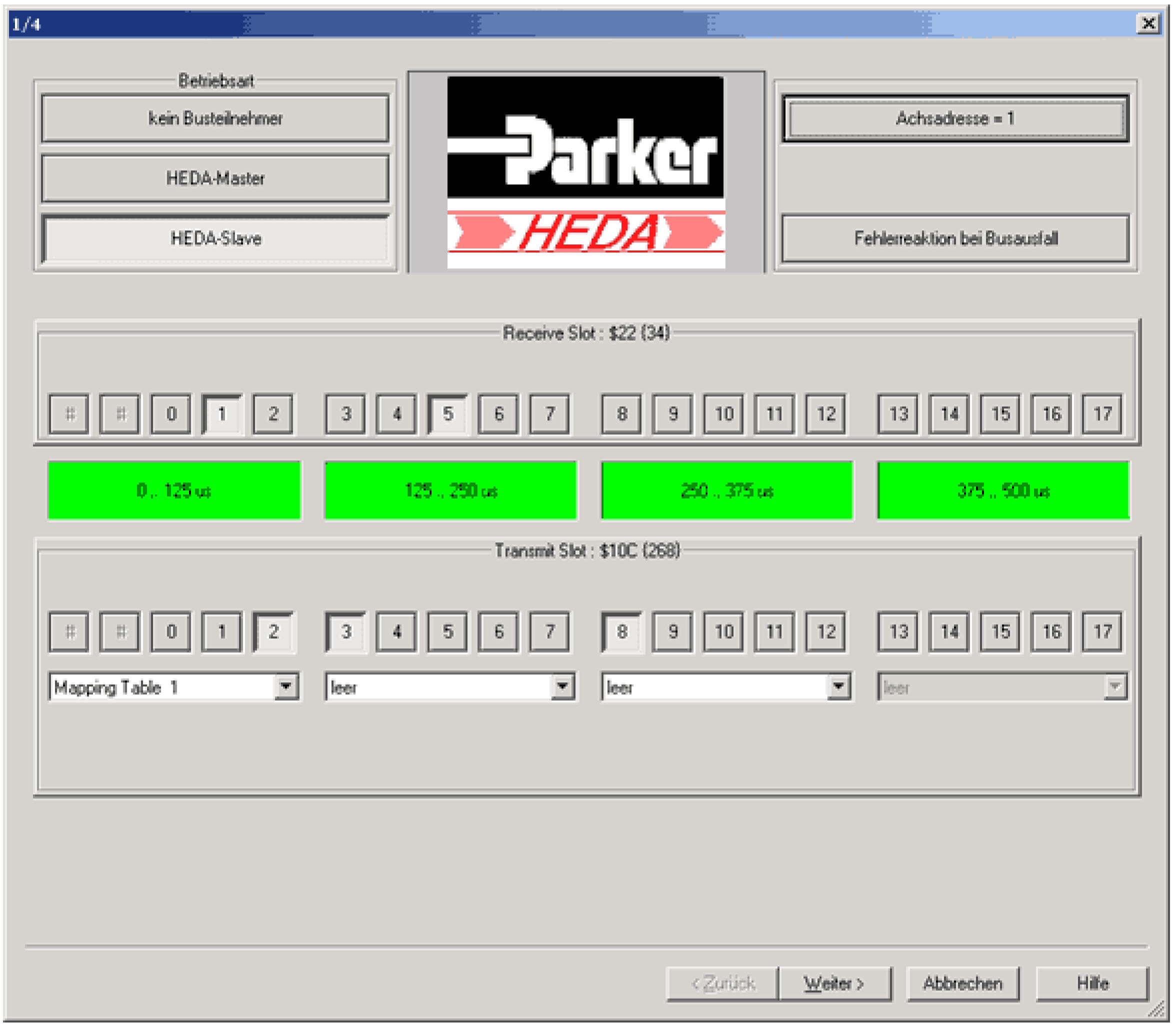
Please enter now, where the received data are to be written. (e. B. on an array object).

Please use the data formats as defined in the mapping table of the slave.

Note: For axis coupling, please use the **coupling object** (see on page 542) O3920.1 in the **DSP format** (see on page 526) as an input (selection by clicking on the DSP switch).

Please make sure that the DSP switch is activated on the master and the slave side in DSP format.

Setting the HEDA slave



Achsadresse = 1

Receive Slot : $22 (34)

Transmit Slot : $10C (268)

Mapping Table 1 | leer | leer | leer

HEDA slave settings:

- Activating the HEDA Slave
- Assigning the axis address = 0 (can be changed by clicking)
- Setting the error reaction (from Compax3) at bus failure:
  - activated: Compax3 switches to error state in the case of a bus error.
  - deactivated: Compax3 will ignore a bus error.

Slave receive slots

Activate the receive slots, from where the slave is to receive the data.

In each of the four 125µs cycles (slot 0...2, slot 3...7, slot 8...12, slot 13...17) data can be received only via one slot, see also the **HEDA communication structure** (see on page 527).

The assignment of the data is made via the mapping table number (which was defined in the master), this number is also received.

In the Wizard window "Receive Mapping table", it is defined under this mapping table number where the data received are to be written to.

Slave transmission slots (Transmit Slots)

Activate the transmit slots, from where the slave is to send the data.

In each of the four 125µs cycles (slot 0...2, slot 3...7, slot 8...12, slot 13...17) data can be transmitted only via one slot, see also the **HEDA communication structure** (see on page 527).

Please make sure, that no other slave can send on this slot.

Now you can assign a mapping table to each individual activated slot.

Please consider, that transmit mapping table numbers are only used once in one transmit/receive range.

The contents of the transmit mapping table is defined in the next wizard window.

Slave Transmit Mapping table

Here the transmit mapping tables, which were assigned to the transmit slots activated before, are defined.

Procedure:

- Selection of the corresponding transmit mapping table.
- Selection of the Compax3 objects to be transmitted.
  - The assignment of the mapping table is permanently identified and displayed.
  - Up to 7 words are possible.
  - How many words are used by an **object** (see on page 544) depends on the **bus format** (see on page 497).

Note: For axis coupling, please use the **coupling objects** (see on page 542) in the **DSP format** (see on page 526) (selected by clicking on the DSP switch).

Please make sure that the DSP switch is activated on the master and the slave side in DSP format.

Slave Receive Mapping table

Please select the mapping table number, which was defined in the master (under transmit mapping table).

Please enter now, where the received data are to be written.

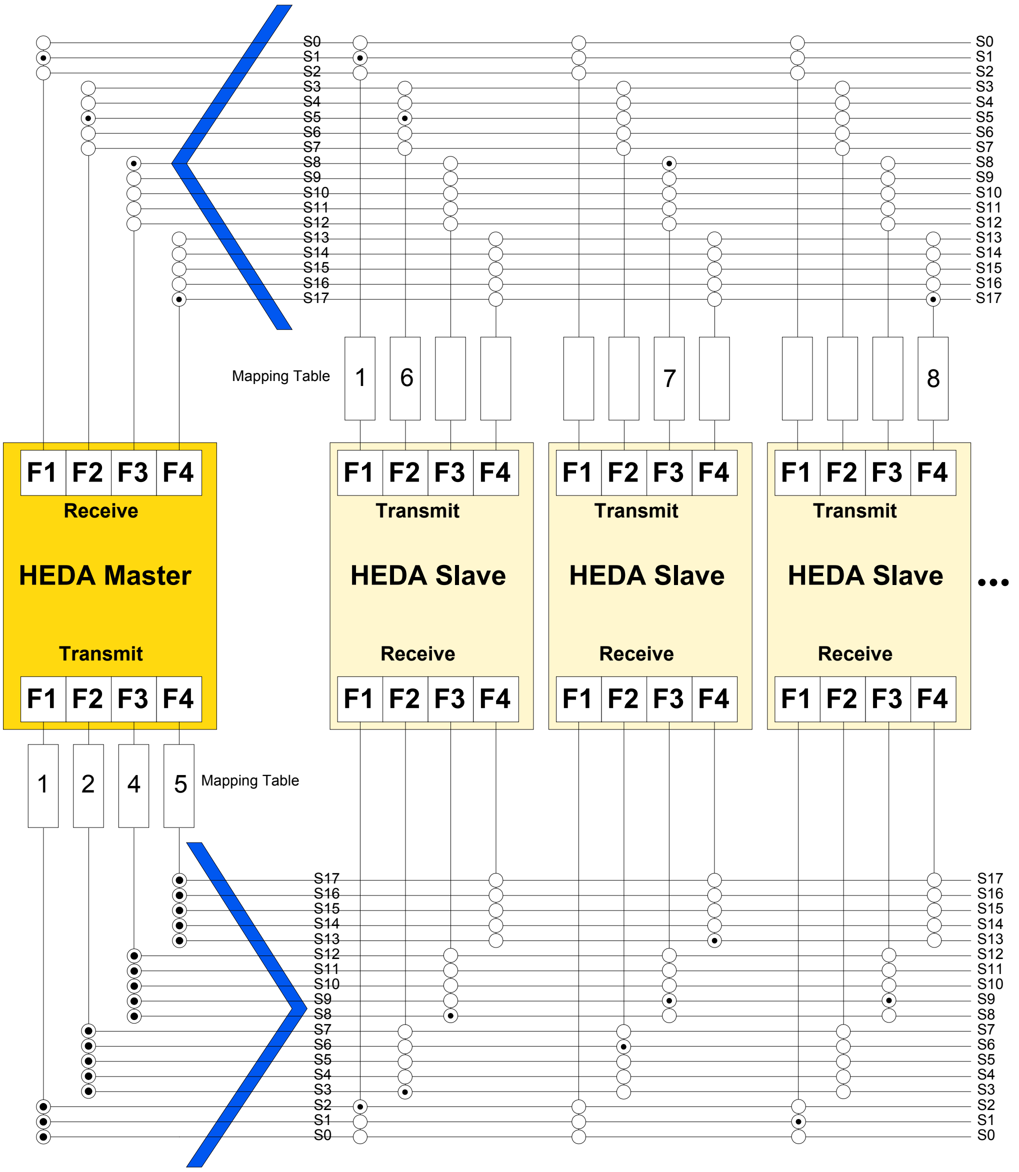
Please use the data formats as defined in the mapping table of the master.

Note: For axis coupling, please use the **coupling object** (see on page 542) O3920.1 in the **DSP format** (see on page 526) as an input (selection by clicking on the DSP switch).

Please make sure that the DSP switch is activated on the master and the slave side in DSP format.

Example: Communication Master - Slave and back

HEDA communication structure:



Master and Slave 1 to 3 (from left to right).

Task:

Master Transmit

- Master sends on:
  - Slot 0...2: Mapping table 1
  - Slot 3...7: Mapping table 2
  - Slot 8...12: Mapping table 4
  - Slot 13...17: Mapping table 5

Slave Receive

- Slave 1 reads on:
  - Slot 2: Mapping table 1
  - Slot 3: Mapping table 2 and
  - Slot 8: Mapping table 4
- Slave 2 reads on:
  - Slot 6: Mapping table 2
  - Slot 9: Mapping table 4 and
  - Slot 13: Mapping table 5.
- Slave 3 reads on
  - Slot 1: Mapping table 1 and
  - Slot 9: Mapping table 4.

Slave Transmit

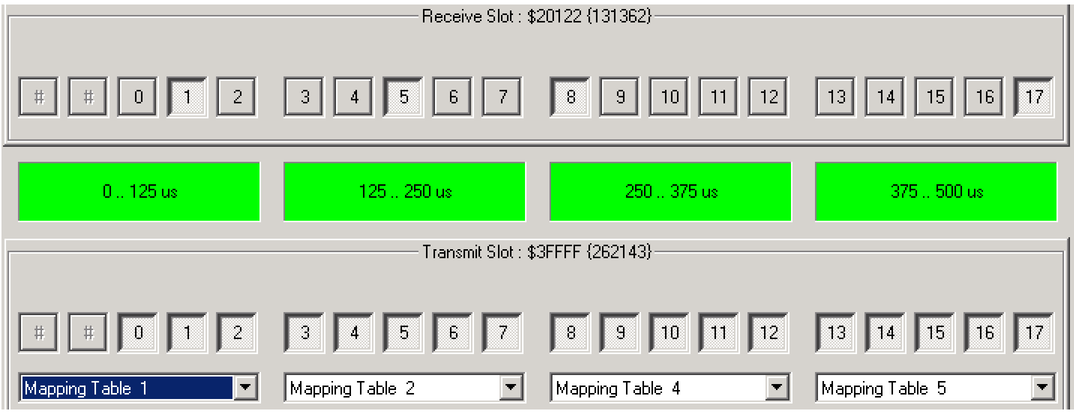
- Slave 1 sends on:
  - Slot 1: Mapping table 1
  - Slot 5: Mapping table 6
- Slave 2 sends on:
  - Slot 8: Mapping table 7
- Slave 3 sends on:
  - Slot 17: Mapping table 8

Master Receive

- Master receives on:
  - Slot 1: Mapping table 1
  - Slot 5: Mapping table 6
  - Slot 8: Mapping table 7
  - Slot 17: Mapping table 8

C3 ServoManger settings:

Slot - settings Master:



Receive Slot : $20122 (131362)

Transmit Slot : $3FFFF (262143)

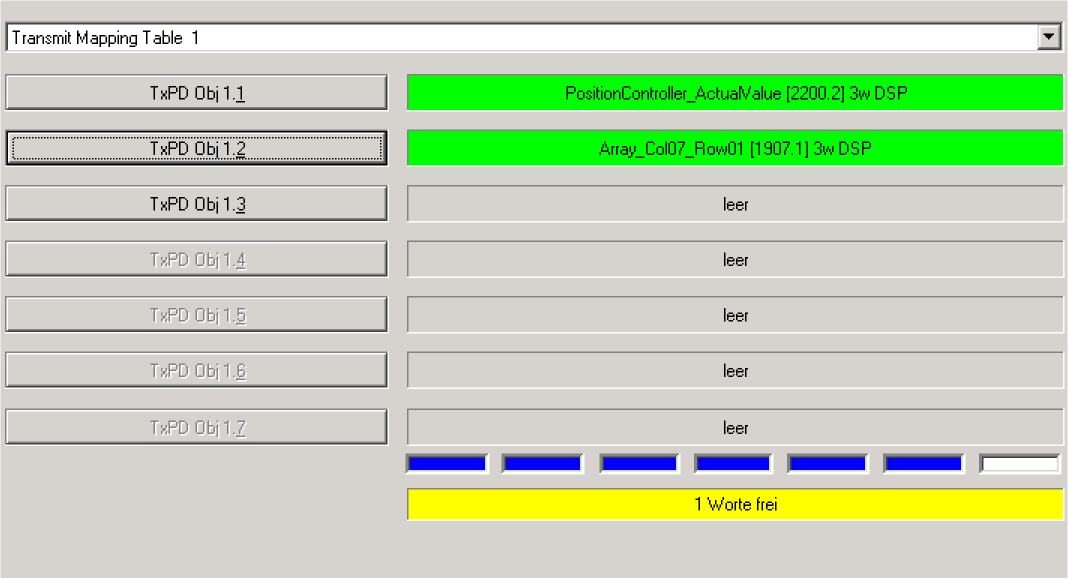
Mapping Table 1

Mapping Table 2

Mapping Table 4

Mapping Table 5

Example for transmit mapping table 1 on the master or slave

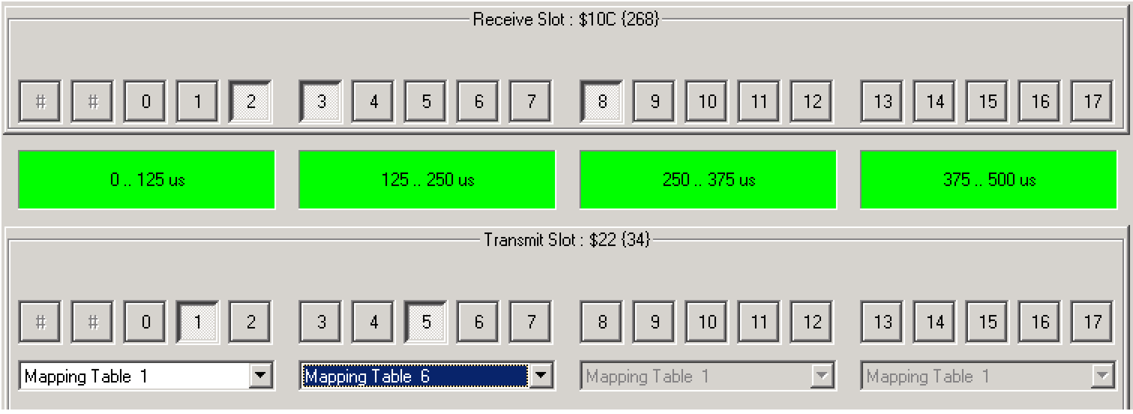


Transmit Mapping Table 1

TxPD Obj 1.1 PositionController_ActualValue [2200.2] 3w DSP
TxPD Obj 1.2 Array_Col07_Row01 [1907.1] 3w DSP
TxPD Obj 1.3 leer
TxPD Obj 1.4 leer
TxPD Obj 1.5 leer
TxPD Obj 1.6 leer
TxPD Obj 1.7 leer

1 Worte frei

Slot settings slave 1:

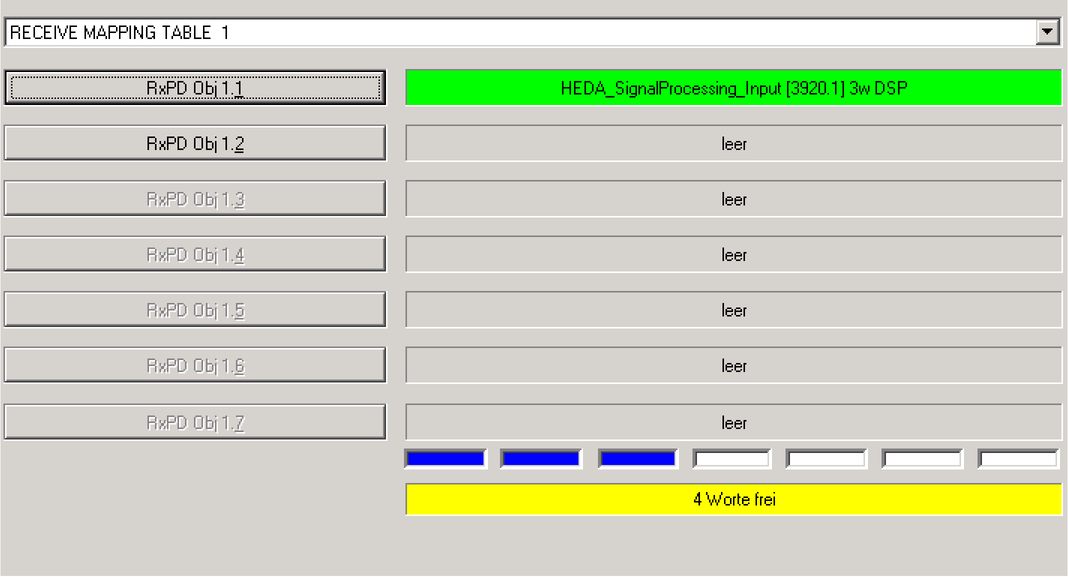


Receive Slot : $10C (268)

Transmit Slot : $22 (34)

Mapping Table 1 | Mapping Table 6 | Mapping Table 1 | Mapping Table 1

Example for receive mapping table 1 at slave 1 (is also valid for slave 3, master)



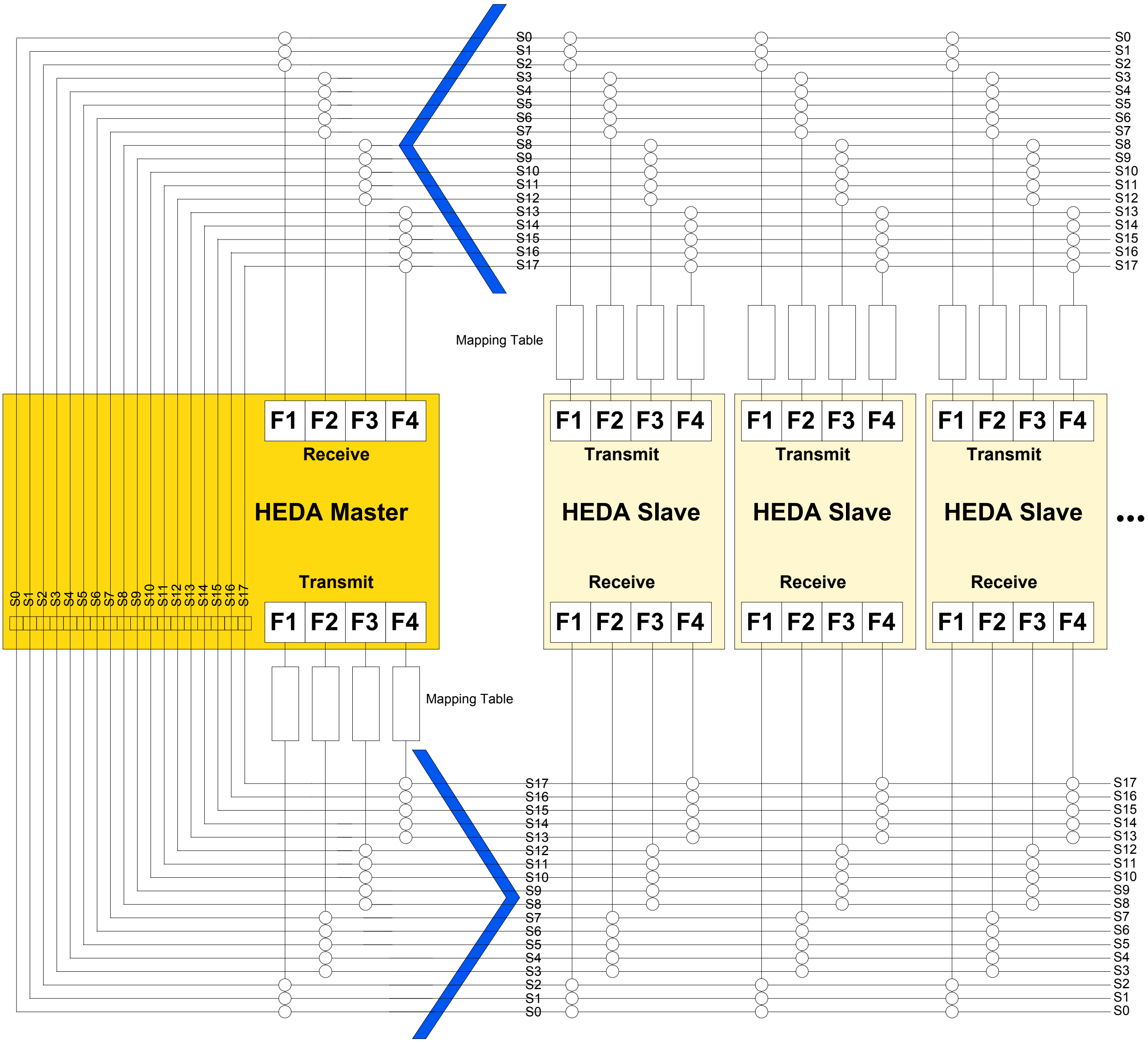
RECEIVE MAPPING TABLE 1

RxPD Obj 1.1 HEDA_SignalProcessing_Input [3920.1] 3w DSP
RxPD Obj 1.2 leer
RxPD Obj 1.3 leer
RxPD Obj 1.4 leer
RxPD Obj 1.5 leer
RxPD Obj 1.6 leer
RxPD Obj 1.7 leer

4 Worte frei

Data transfer from Slave to Slave.

HEDA communication structure with data transfer from Slave to Slave:



Print version available on the Internet
http://divapps.parker.com/divapps/eme/EME/downloads/compax3/HEDA-Formulare/HEDA_adv.pdf

If a transmit slot of the HEDA master is not assigned, the master will pass the received data directly on to the slaves (independent of his reading from this slot or not).

I.e. if a transmit slot of the master where a slave is sending is disabled, the data will be passed on and can be received from any slave on this slot.

It is, however, valid:

All transmit slots must send!

This is also true, if a slave sends on this slot.

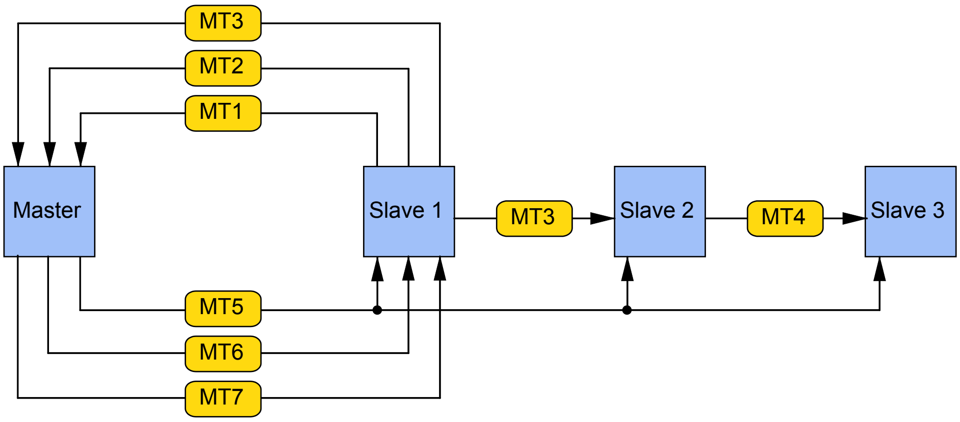
Please note:

Please ensure that all slots are used for transmission, the C3 ServoManager cannot verify this fact!

In order to verify this, please use the HEDA communication structure.

Example 1: Communication Master - Slave and Slave - Slave.

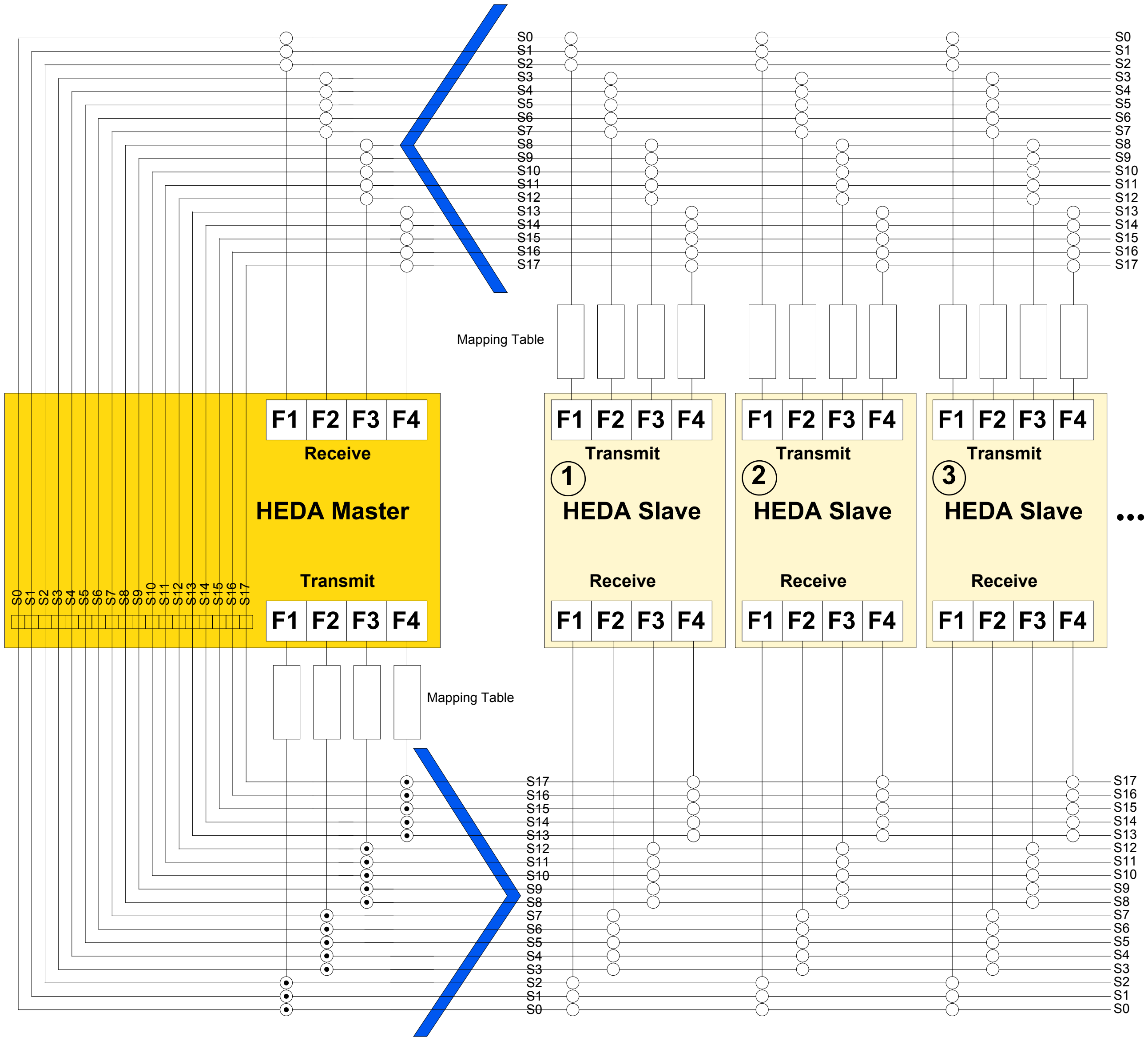
Task:



MT1 ... MT7: Mapping table 1... 7

Step-by-step setting of the HEDA communications:

Firstly, activate all transmit slots of the master in order to ensure that all transmit slots of the master are sending:



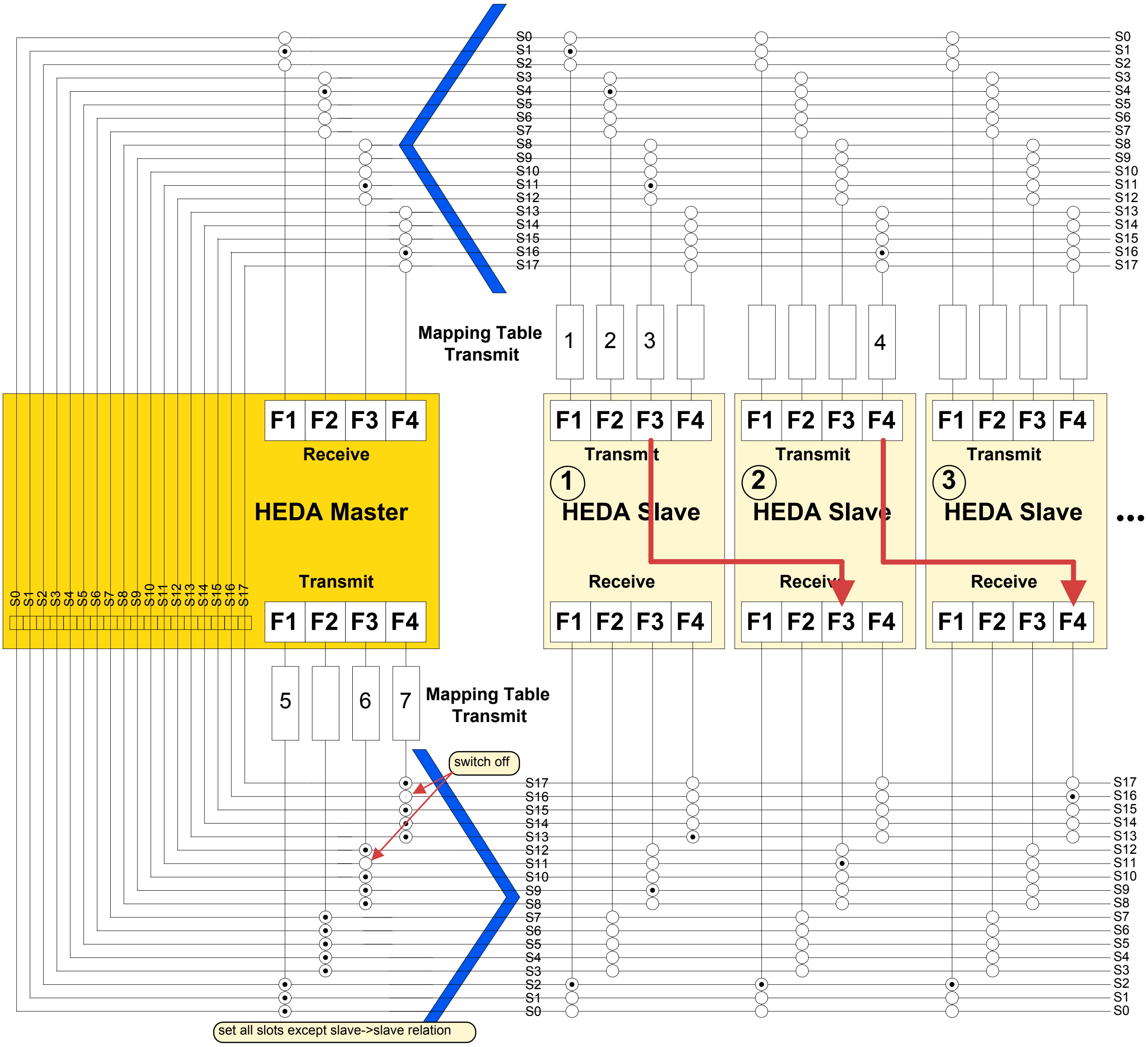
The mapping tables are now distributed to different slots:

Mapping Table	Slot	
MT1	1	Slave transmit range
MT2	4	
MT3	11	
MT4	16	
MT5	2 (& 0, 1)	Master transmit range
MT6	9 (& 8, 10, 12)	
MT7	13 (& 14, 15, 17)	

Note: The transmit slots where a slave-slave communication is taking place (Slot 11 & 16), must be deactivated in the master!

Otherwise, the master would overwrite the data of the slave.

This results in the following image:



The following objects are transmitted:

TRANSMIT (send)			RECEIVE	
Mapping Table	Source	Objects	Target	
1	S1	C3Array.Col01Row01 (1901.1)	M	C3Array.Col01Row01 (1901.1)
2	S1	C3Plus.DeviceState_Statusword1 (1000.3)	M	C3Array.Col03Row01 (1903.1)
3	S1	C3Plus.ProfileGenerators_SG1Position (2000.1)	M S2	C3Array.Col01Row02 (1902.1) C3Plus.HEDA_SignalProcessing_Input (3920.1)
4	S2	C3Plus.PositionController_DemandValue (2200.1)	S3	C3Plus.HEDA_SignalProcessing_Input (3920.1)
5	M	C3Plus.ProfilGenerators_PG2Position (2000.2)	S1 S2 S3	C3Plus.HEDA_SignalProcessing_Input (3920.1) C3Array.Col01Row05 (1901.5) C3Array.Col01Row05 (1901.5)
6	M	C3Plus.DeviceControl_Controlword1 (1100.3)	S1	C3Plus.DeviceControl_Controlword1 (1100.3)
7	M	C3Array.Col06Row01 (1906.1)	S1	C3Array.Col06Row01 (1906.1)

M: Master

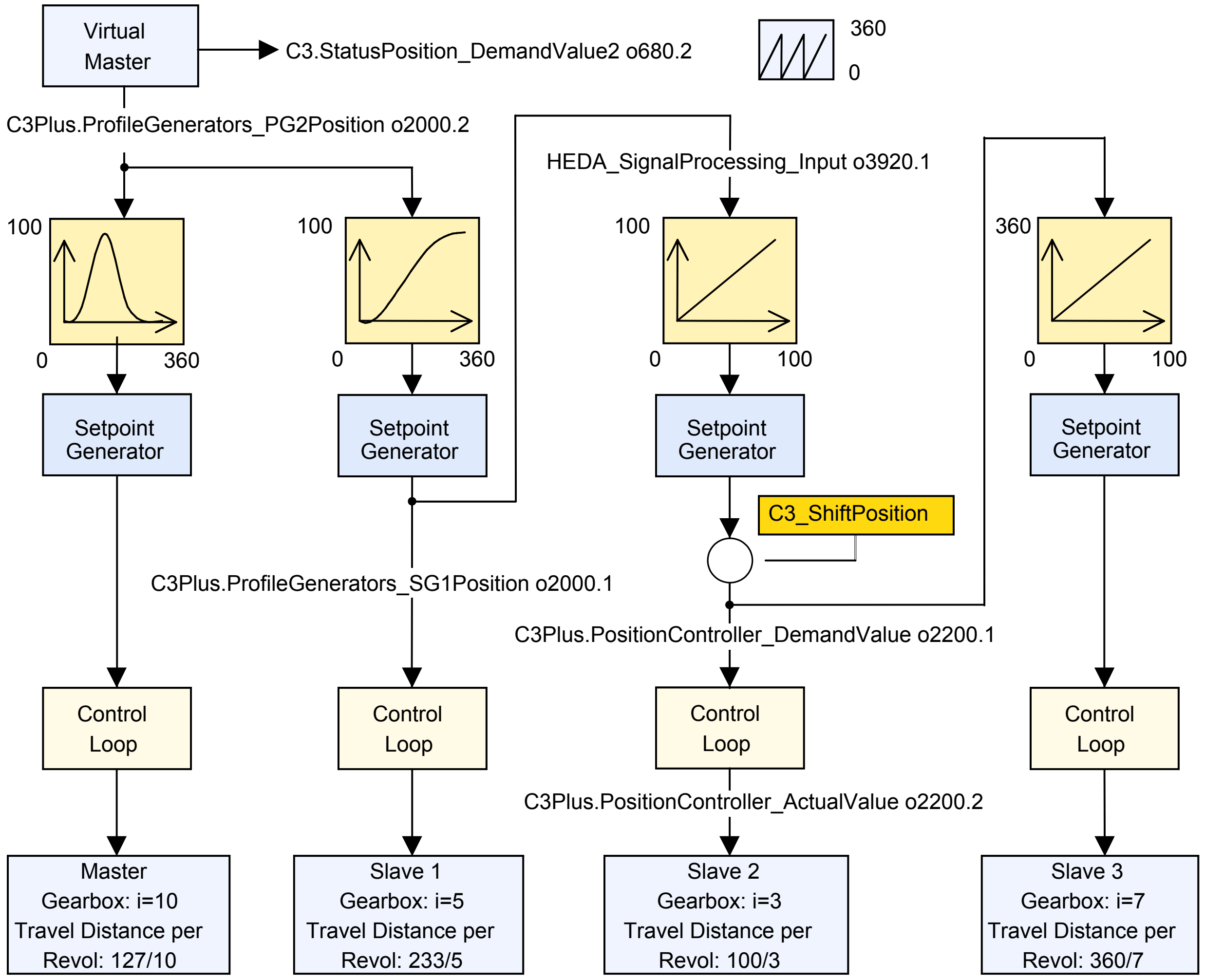
S1, S2, S3: Slave 1 ... 3

Word form for the objects to be transmitted on the internet http://divapps.parker.com/divapps/eme/EME/downloads/compax3/HEDA-Formulare/communications-table.doc.

Example 2: 4-axis application with HEDA

"Task:

- four-axis processing machine
- Setting the steps via virtual master
- Forwards and backwards movement with the master (closed curve)
- Linearized feed movement with Slave 1 = rotating blade (open curve)
- Position synchronous operation of slave 2 with respect to slave 1 with slip correction (use of C3_Shift_Position, only T40)
- Fixed position assignment of a turning axis slave 3 to slave 2 with consideration of the correction movement of slave 2



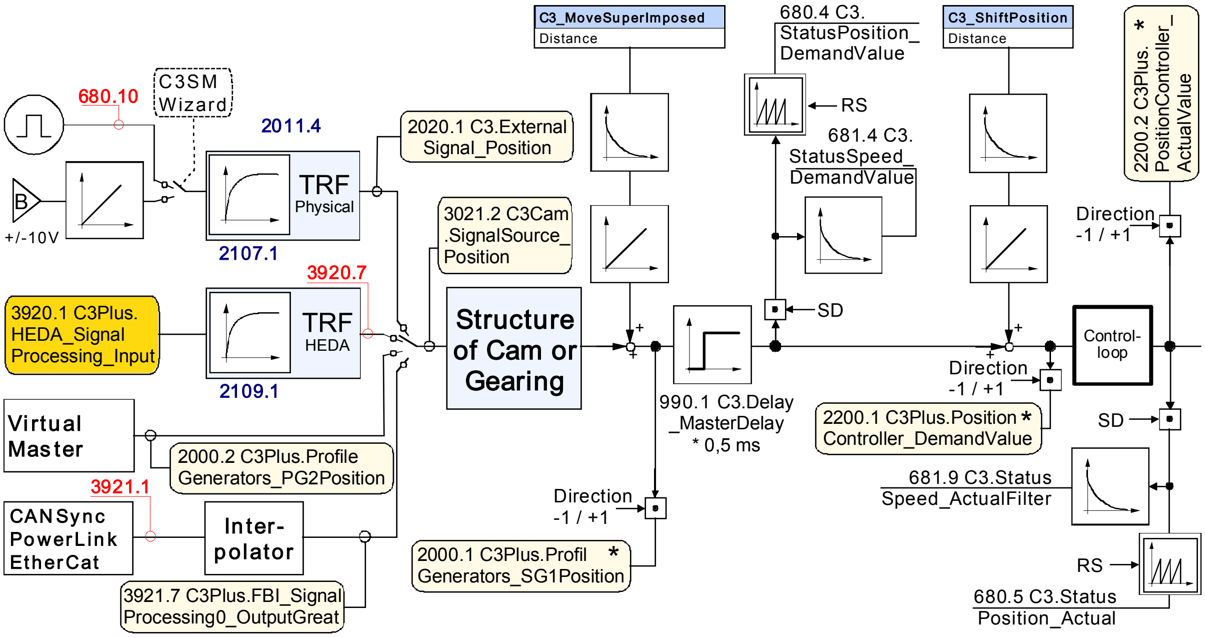
Master / Slave Configuration of the reference system

Configuration	Master	Slave 1	Slave 2	Slave 3
Travel distance per motor revolution				
◆ Numerator	127	**233**	**100**	360
◆ Denominator	10	**5**	**3**	7
Reset distance				
◆ Numerator	100	100	100	360
◆ Denominator	1	1	1	1
Signal source (Master axis)				
◆ Virtual Master				
◆ Reset distance	360			
◆ Use as current signal source	yes			
Source HEDA (Slave axis)				
◆ "Virtual master" as HEDA Master		yes	no	no
◆ Path per motor revolution of the HEDA Master				
◆ Numerator		not	**233**	**100**
◆ Denominator		required	**5**	**3**
◆ Create cams with the CamDesinger				
◆ Distance Counter Reset Position - Numerator	360	360	100	100
◆ Distance Counter Reset Position - Denominator	1	1	1	1

The C3 ServoManager projects (configuration) can be found on the Compax3 CD:...\Examples\HEDA\Master.c3p, slave1.c3p, slave2.c3p, slave3.c3p

6.8.3. Coupling objects

Coupling objects (framed objects) are suitable as master signal for electronic coupling and should be in the **DSP Format** (see on page 526).



Input value for HEDA couplings is object 3920.1.

Note: * These values are not even reset by a home run.

Direction -1 / +1: With direction inversion (in the configuration wizard) these coupling values are inverted, relative to the drive direction (factor -1).

6.9 Normalization factors

Under “configuring communication: normalization factors Y2/Y4", you can change the validation for individual objects (objects in the Y2 and Y4 format) via scaling factors.

In the wizard window, the object numbers that can be influenced are displayed at the right side of the factors.

7. Compax3 - Objects

In this chapter you can read about:

Compax3 objects are encapsulated in the "C3, C3Array, ..." modules in the IEC61131-3 programming environment (CoDeSys).

Enter the object names before the "." and the corresponding list of objects will appear.

Objects that are not described here are reserved objects!

Note on searching objects:

- If the object number is known, you can enter it directly in the index.
- In addition you can find the CoDeSys name of the objects in the index.

Note on bus numbers (PNU, CAN-No.):

The bus numbers of the array can be found in the description on column 1, line 1 (Object 1901.1)

Set objects to valid

Please note that certain objects are not valid (read by Compax3) immediately after a change. This is described in the heading "Valid after".

These objects are converted to internal variables the Compax3 "VP" command (write in object 210.10 with value <> 0).

Save objects permanently

It should also be noted that modified objects are not permanently stored in the Compax3, i.e. the changes are lost after the power (24 VDC) is turned off.

The object "Save objects permanently" (write in object 20.11 with value <> 0)" can be used to save objects in a flash memory so they are retained even if the power fails.

Please note the following:

- the IEC cycle time increases considerably (to approx. 1.5 seconds) during memorization.

- we therefore recommend NOT to execute this function during time-sensitive parts of the IEC program.

-PLC cycle time monitoring is deactivated when accessing this object

- Perform this command only when needed. The write cycles of the memory module are limited (up to 100 000 cycles).

The function is edge triggered and is executed upon a rising edge.

7.1 Object overview sorted by object no. (T40)

No.	Object name	Object	I20,I32 Bus No	I21,I30,I31 Bus No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
1.15	Device_ProfileID	Profibus profile number	965		OS	no	-	False	True
1.21	Device_FirmwareRelease	Version of firmware package		0x20FF	I32	no	immediately	False	True
20.1	ObjectDir_Objekts-->FLASH	Store objects permanently (bus)	339	0x2017	I16	no	immediately	False	True
20.10	C3.ObjectDir_ReadObjects	Read objects from Flash			I16	no	immediately	True	True
20.11	C3.ObjectDir_WriteObjects	Save objects permanently			I16	no	immediately	True	True
50.1	C3Plus.PLC_DemandCycleTime	Cycle time specification	352	0x201F.1	U16	no	immediately	True	True
50.3	C3Plus.PLC_ActualCycleTime	Status of cycle time of the control program	353	0x201F.2	U16	no	-	False	True
50.4	C3Plus.PLC_ActualCycleTimeMax	Status of maximum cycle time	354	0x201F.3	U16	no	immediately	False	True
84.2	DeviceSupervision_ThisDevice	Device number in the C3M combination			U16	no	-	True	True
84.3	DeviceSupervision_DeviceCounter	Number of devices in the C3M combination			U16	no	-	True	True
84.4	DeviceSupervision_DeviceAdr	Current RS485 address of the C3M			U16	no	-	True	True
84.5	DeviceSupervision_OperatingTime	Hours of operation of the PSUP in s			U32	no	-	True	True
85.1	Diagnostics_DeviceState	PSUP operating state			V2	no	-	True	True
85.2	C3Plus.Diagnostics_DCbus_Voltage	PSUP DC intermediate voltage			I16	no	-	True	True
85.3	C3Plus.Diagnostics_DCbus_Current	PSUP intermediate current			I16	no	-	True	True
85.4	C3Plus.Diagnostics_TemperatureHeatSink	PSUP heat dissipator temperature			I16	no	-	True	True
85.5	C3Plus.Diagnostics_RectifierLoad	PSUP usage in %			I16	no	-	True	True
85.7	Diagnostics_ChopperOn_Voltage	Chopper Switch-on threshold in V			I16	no	-	True	True
85.8	Diagnostics_ChopperOff_Voltage	Chopper Switch-off threshold in V			I16	no	-	True	True
85.9	Diagnostics_DCbus_VoltageMax	Reduced DC bus voltage in V			I16	no	-	True	True
86.1	ErrorHistoryPointer_LastEntry	Pointer to current error			U16	no	-	True	True
87.1	ErrorHistoryNumber_1	Error 1			U16	no	-	True	True
88.1	ErrorHistoryTime_1	Error point in time 1			U32	no	-	True	True
100.1	C3Plus.Controller_ControlwordDemand	Controller control word setpoint value			U16	no	immediately	True	True
100.2	C3Plus.Controller_Controlword	Controller control word actual value			U16	yes	immediately	True	True
110.1	C3Plus.Switch_DeviceFunction	Value of the function switch on C3M			U16	no	-	True	True
120.2	C3.DigitalInput_Value	Status of digital inputs			V2	yes	-	True	True
120.3	DigitalInput_DebouncedValue	Status of digital inputs	21	0x6100.1	V2	yes	-	True	True
121.2	C3.DigitalInputAddition_Value	Input word of I/O option	175	0x6100.2	V2	yes	-	True	True
133.2	C3.DigitalOutputAddition_Error	Error in I/O option	351	0x6300.4	V2	no	-	True	True
133.3	C3.DigitalOutputAddition_Value	Output word for I/O option	176	0x6300.2	V2	yes	immediately	True	True
133.4	C3.DigitalOutputAddition_Enable	Activate input/output option M10/M12	350	0x6300.3	V2	no	immediately	True	True
140.3	C3.DigitalOutputWord_DemandState	Command value of the digital outputs	22	0x6300.1	V2	yes	immediately	False	True
150.1	C3Plus.RemoteDigInput_I0_15	Digital PIO inputs 0...15		0x2080.1	V2	yes	immediately	False	True
150.2	C3Plus.RemoteDigInput_I16_31	Digital PIO inputs 16...31		0x2080.2	V2	yes	immediately	False	True
150.3	C3Plus.RemoteDigInput_I32_47	Digital PIO inputs 32...47		0x2080.3	V2	yes	immediately	False	True
150.4	C3Plus.RemoteDigInput_I48_63	Digital PIO inputs 48...63		0x2080.4	V2	yes	immediately	False	True
151.1	C3Plus.RemoteDigOutput_O0_15	Digital PIO outputs 0...15		0x2081.1	V2	yes	immediately	False	True
151.2	C3Plus.RemoteDigOutput_O16_31	Digital PIO outputs 16...31		0x2081.2	V2	yes	immediately	False	True
151.3	C3Plus.RemoteDigOutput_O32_47	Digital PIO outputs 32...47		0x2081.3	V2	yes	immediately	False	True
151.4	C3Plus.RemoteDigOutput_O48_63	Digital PIO outputs 48...63		0x2081.4	V2	yes	immediately	False	True
152.1	C3Plus.RemoteAnalogInput_I0	PIO analog input 0		0x2082.1	I16	yes	immediately	False	True
152.2	C3Plus.RemoteAnalogInput_I1	PIO analog input 1		0x2082.2	I16	yes	immediately	False	True
152.3	C3Plus.RemoteAnalogInput_I2	PIO analog input 2		0x2082.3	I16	yes	immediately	False	True
152.4	C3Plus.RemoteAnalogInput_I3	PIO analog input 3		0x2082.4	I16	yes	immediately	False	True
153.1	C3Plus.RemoteAnalogOutput_O0	PIO analog output 0		0x2083.1	I16	yes	immediately	False	True
153.2	C3Plus.RemoteAnalogOutput_O1	PIO analog output 1		0x2083.2	I16	yes	immediately	False	True
153.3	C3Plus.RemoteAnalogOutput_O2	PIO analog output 2		0x2083.3	I16	yes	immediately	False	True
153.4	C3Plus.RemoteAnalogOutput_O3	PIO analog output 3		0x2083.4	I16	yes	immediately	False	True
170.2	AnalogInput0_Gain	Gain analog input 0			C4_3	no	VP	True	True
170.3	C3Plus.AnalogInput0_FilterCoefficient	Filter of analog input 0			I16	no	VP	True	True
170.4	AnalogInput0_Offset	Analog input Offset 0			I16	no	immediately	True	True
171.2	AnalogInput1_Gain	Gain analog input 1			C4_3	no	VP	True	True
171.3	C3Plus.AnalogInput1_FilterCoefficient	Filter of analog input 1			I16	no	VP	True	True
171.4	AnalogInput1_Offset	Analog input offset 1			I16	no	immediately	True	True
200.1	NormFactorY2_Speed	Normalization factor for Y2 speeds	355.1	0x2020.1	V2	no	immediately	False	True

No.	Object name	Object	I20,I32 Bus No	I21,I30,I31 Bus No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
200.3	NormFactorY2_Voltage	Normalization factor for Y2 voltages	355.3	0x2020.3	V2	no	immediately	False	True
200.4	NormFactorY2_DemandValue3	Normalization factor for 1100.8	355.4	0x2020.4	V2	no	immediately	False	True
200.5	NormFactorY2_Array_Col2	Normalization factor recipe arrays column 2	355.5	0x2020.5	V2	no	immediately	False	True
200.6	NormFactorY2_DemandValue4	Normalization factor for 1100.9	355.6	0x2020.6	V2	no	immediately	False	True
200.7	NormFactorY2_ActualValue3	Normalization factor for 1000.8	355.7	0x2020.7	V2	no	immediately	False	True
200.8	NormFactorY2_ActualValue4	Normalization factor for 1000.9	355.8	0x2020.8	V2	no	immediately	False	True
200.9	NormFactorY2_DemandValue2_Y2	Normalization factor for 1100.14 1100.14			V2	no	immediately	False	True
200.10	NormFactorY2_ActualValue2_Y2	Normalization factor for 1000.14			V2	no	immediately	False	True
201.1	NormFactorY4_Speed	Scaling factor for Y4 speeds	356.1	0x2021.1	V2	no	immediately	False	True
201.2	C3Plus.NormFactorY4_Position	Scaling factor for Y4 positions	356.2	0x2021.2	V2	no	immediately	False	True
201.3	NormFactorY4_Voltage	Scaling factor for Y4 voltages	356.3	0x2021.3	V2	no	immediately	False	True
201.4	NormFactorY4_Array_Col1	Scaling factor recipe arrays column 1	356.4	0x2021.4	V2	no	immediately	False	True
201.5	NormFactorY4_DemandValue1	Normalization factor for 1100.6	356.5	0x2021.5	V2	no	immediately	False	True
201.6	NormFactorY4_DemandValue2	Normalization factor for 1100.7	356.6	0x2021.6	V2	no	immediately	False	True
201.7	NormFactorY4_ActualValue1	Normalization factor for 1000.6	356.7	0x2021.7	V2	no	immediately	False	True
201.8	NormFactorY4_ActualValue2	Normalization factor for 1000.7	356.8	0x2021.8	V2	no	immediately	False	True
201.11	NormFactorY4_FBI_SignalProcessing	Normalization factor for bus interpolation CANSync/EthernetPowerLink	356.11	0x2021.11	V2	no	immediately	False	True
201.12	NormFactorY4_DemandValue8	Normalization factor for 1100.13	356.12	0x2021.12	V2	no	immediately	False	True
201.13	NormFactorY4_ActualValue8	Normalization factor for 1000.13	356.13	0x2021.13	V2	no	immediately	False	True
210.1	C3Plus.ValidParameter_CurrentController	Set current controller to valid			U16	no	immediately	True	True
210.2	C3Plus.ValidParameter_FiltersRSDP	Set filter parameter to valid			U16	no	immediately	True	True
210.3	C3Plus.ValidParameter_SpeedController	Set parameter velocity controller/velocity observer to valid.			U16	no	immediately	True	True
210.4	C3Plus.ValidParameter_PositionController	Set position controller to valid			U16	no	immediately	True	True
210.5	C3Plus.ValidParameter_FeedForward	Set feedforward parameters to valid.			U16	no	immediately	True	True
210.6	C3.ValidParameter_Limits	setting limit values to valid.			U16	no	immediately	True	True
210.8	C3Plus.ValidParameter_Autocommutation	Set position auto commutation parameters to valid			U16	no	immediately	True	True
210.9	C3Plus.ValidParameter_CamControlledSwitches	Set cam switching mechanism parameters to valid	338.9	0x2016.9	U16	no	immediately	False	True
210.10	C3.ValidParameter_Global	Set objects to valid	338.10	0x2016.10	U16	no	immediately	True	True
295.10	SSI_Feedback_X11_Incr_Position	SSI feedback position (Increments)			I32	no	-	True	True
402.1	C3.Limit_SpeedPositive	Maximum permissible positive speed	317	0x2009	I16	no	VP	True	True
402.2	C3.Limit_SpeedNegative	Maximum permissible negative speed	318	0x200A	I16	no	VP	True	True
402.3	C3.Limit_CurrentPositive	Maximum permissible positive current	319	0x200B	I16	no	VP	True	True
402.4	C3.Limit_CurrentNegative	Maximum permissible negative current	320	0x200C	I16	no	VP	True	True
402.6	C3Plus.Limit_CurrentFine	Factor for the current limits		0x2093	I16	yes	immediately	True	True
410.2	C3.LimitPosition_Positive	positive end limit	321	0x607D.2	C4_3	no	immediately	True	True
410.3	C3.LimitPosition_Negative	negative end limit	322	0x607D.1	C4_3	no	immediately	True	True
410.6	C3.LimitPosition_LoadControlMaxPosDiff	Position difference load-motor (error threshold)			C4_3	no	VP	True	True
420.1	C3.PositioningAccuracy_Window	Positioning window for position reached	328	0x6067	C4_3	no	VP	True	True
420.2	C3.PositioningAccuracy_FollowingErrorWindow	Following error limit	330	0x6065	C4_3	no	VP	True	True
420.3	C3.PositioningAccuracy_FollowingErrorTimeout	Following Error Time	331	0x6066	U16	no	immediately	True	True
420.6	C3.PositioningAccuracy_PositionReached	Position reached			I32	no	-	True	True
420.7	C3.PositioningAccuracy_WindowTime	In Position Window Time	329	0x6068	U16	no	immediately	True	True
550.1	C3Plus.ErrorHistory_LastError	Current error (n)	115/947.0	0x603F/0x 201D.1	U16	yes	-	True	True
550.2	ErrorHistory_1	Error (n-1) in the error history	947.1	0x201D.2	U16	no	-	False	True
634.4	C3.AnalogOutput0_DemandValue	Setpoint for analog output 0	24	0x2019	I16	yes	immediately	True	True
635.4	C3.AnalogOutput1_DemandValue	Setpoint for analog output 1	103	0x201A	I16	yes	immediately	True	True
670.1	C3Plus.StatusTorqueForce_SetpointTorque	Status of setpoint torque			I32	no	-	True	True
670.2	C3Plus.StatusTorqueForce_ActualTorque	Status of actual torque			I32	no	-	True	True
670.3	C3Plus.StatusTorqueForce_SetpointForce	Status of setpoint force			I32	no	-	True	True
670.4	C3Plus.StatusTorqueForce_ActualForce	Status of actual force			I32	no	-	True	True
680.1	C3.StatusPosition_DemandValue1	Position command value of Profile transmitter1	0	0x2052	Y4	yes	-	True	True
680.2	C3.StatusPosition_DemandValue2	Status demand position virtual master	202	0x2042	Y4	yes	-	False	True

No.	Object name	Object	I20,I32 Bus No	I21,I30,I31 Bus No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
680.3	C3.StatusPosition_DemandValue3	Status of setpoint position of Superimposed motion	0	0	Y4	no	-	False	True
680.4	C3.StatusPosition_DemandValue	Status demand position	323	0x60FC	C4_3	yes	-	True	True
680.5	C3.StatusPosition_Actual	Status actual position	28	0x6064	C4_3	yes	-	True	True
680.6	C3.StatusPosition_FollowingError	Status of tracking error	100	0x60F4	C4_3	yes	-	True	True
680.8	C3Plus.StatusPosition_Actual_Y4	Status position actual value in the bus format Y4	119	0x2022	Y4	yes	-	False	True
680.10	C3.StatusPosition_EncoderInput5V	Status of encoder input 0 (5V)		0x2095.2	C4_3	yes	-	True	True
680.11	C3.StatusPosition_EncoderInput24V	Status of encoder input 0 (24V)			C4_3	yes	-	True	True
680.12	C3.StatusPosition_DemandController	Status demand position without absolute reference			C4_3	no	-	True	True
680.13	C3.StatusPosition_ActualController	Status actual position without absolute reference			C4_3	no	-	True	True
680.18	C3.StatusPosition_ActualNotReset	Status actual position (not reset)			C4_3	yes	-	True	True
680.20	StatusPosition_LoadControlDeviation	Position difference load-motor (unfiltered)			C4_3	no	-	True	True
680.21	C3.StatusPosition_LoadControlDeviationMax	Maximum position difference load-motor			C4_3	no	-	True	True
680.22	C3.StatusPosition_LoadControlDeviationFiltered	Position difference load-motor (filtered)			C4_3	no	-	True	True
680.23	C3.StatusPosition_LoadControlActual	Actual position of the load			C4_3	no	-	True	True
680.24	C3Plus.StatusPosition_SSI_AbsolutPosition_LoadUnits	AbsolutPosition of the SSI-feedback load unit			C4_3	no	-	True	True
680.25	C3Plus.StatusPosition_SSI_AbsolutPosition_MasterUnits	AbsolutPosition of the SSI-feedback master unit			C4_3	no	-	True	True
680.30	C3.StatusPosition_Referenced	Status of axis referenced			I16	no	-	True	True
680.32	C3Plus.StatusPosition_EncoderIncrements5V	Encoder position 0 (5V) in increments		0x2095.3	I32	yes	immediately	True	True
681.1	C3.StatusSpeed_DemandValue1	Speed setpoint value of profile transmitter1	337	0x2053	Y4	yes	-	True	True
681.2	C3.StatusSpeed_DemandValue2	Status demand speed virtual master	203	0x2043	Y4	yes	-	False	True
681.3	C3.StatusSpeed_DemandValue3	Speed of a superimposed motion			Y4	no	-	False	True
681.4	C3.StatusSpeed_DemandValue	Status demand speed of setpoint generator	324	0x606B	C4_3	yes	-	True	True
681.5	C3.StatusSpeed_Actual	Status actual speed unfiltered		0x6069	C4_3	yes	-	True	True
681.6	C3.StatusSpeed_Error	Status control deviation of speed	101	0x2027	C4_3	yes	-	True	True
681.7	StatusSpeed_ActualFiltered_Y2	Status of the actual filtered speed speed in the Y2 format	6	0x2023	Y2	yes	-	False	True
681.8	StatusSpeed_ActualFiltered_Y4	Status of the actual filtered peed in the Y4 format	117	0x2024	Y4	yes	-	False	True
681.9	C3.StatusSpeed_ActualFiltered	Status actual speed filtered	8	0x606C	C4_3	yes	-	True	True
681.10	C3.StatusSpeed_DemandSpeedController	Status demand speed controller input			C4_3	yes	-	True	True
681.11	C3.StatusSpeed_FeedForwardSpeed	Status speed feed forward			C4_3	no	-	True	True
681.12	C3.StatusSpeed_ActualScaled	Filtered actual speed			C4_3	no	-	True	True
681.13	C3.StatusSpeed_DemandScaled	Setpoint speed of the setpoint generator			C4_3	no	-	True	True
681.20	C3.StatusSpeed_LoadControl	Speed of the load feedback (unfiltered)			C4_3	no	-	True	True
681.21	C3.StatusSpeed_LoadControlFiltered	Speed of the load feedback (filtered)			C4_3	no	-	True	True
681.24	StatusSpeed_PositiveLimit	Positive speed limit currently effective			C4_3	no	-	True	True
681.25	StatusSpeed_NegativeLimit	Negative speed limit currently effective			C4_3	no	-	True	True
682.4	C3.StatusAccel_DemandValue	Status demand acceleration	325	0x200E	I32	no	-	True	True
682.5	C3.StatusAccel_Actual	Status of actual acceleration unfiltered			I32	no	-	True	True
682.6	C3.StatusAccel_ActualFilter	Status of filtered actual acceleration			I32	no	-	True	True
682.7	StatusAccel_FeedForwardAccel	Status acceleration feed forward			C4_3	no	-	True	True
683.1	C3.StatusDevice_ActualCurrent	Status of actual current value	112	0x6077	E2_6	yes	-	True	True
683.2	C3.StatusDevice_ActualDeviceLoad	Status of device load	334	0x2011	E2_6	no	-	True	True
683.3	C3.StatusDevice_ActualMotorLoad	Status of long-term motor load	335	0x2012	E2_6	no	-	True	True
683.4	C3.StatusDevice_DynamicMotorLoad	Status of short-term motor load			E2_6	no	-	True	True
683.5	C3.StatusDevice_ObservedDisturbance	Status of observed disturbance			C4_3	no	-	True	True
683.8	C3Plus.StatusDevice_MotorCurrent	Motor current in per thousand of the actual current limit		0x2094	I16	yes	-	False	True
683.9	C3.StatusDevice_ActualDeviceLoadLowFrequency	Status of device utilization at small electrical turning frequency			E2_6	no	-	True	True
684.1	C3.StatusTemperature_PowerStage	Status of power output stage temperature	337	0x2014	U16	no	-	True	True
684.2	C3.StatusTemperature_Motor	Status of motor temperature	336	0x2013	I16	no	-	True	True
684.4	C3Plus.StatusTemperature_TmotResistance	Status of motor temperature resistance value			U16	no	-	True	True
685.1	C3.StatusVoltage_AuxiliaryVoltage	Status of auxiliary voltage	326	0x200F	E2_6	no	-	True	True
685.2	C3.StatusVoltage_BusVoltage	Status DC bus voltage	327	0x6079	E2_6	no	-	True	True
685.3	C3.StatusVoltage_AnalogInput0	Status of analog input 0	23	0x2025	Y2	yes	-	True	True
685.4	C3.StatusVoltage_AnalogInput1	Status of analog input 1	102	0x2026	Y2	yes	-	True	True
688.1	C3.StatusCurrent_Reference	Status of setpoint current RMS (torque forming)			E2_6	no	-	True	True
688.2	C3.StatusCurrent_Actual	Status of actual current RMS (torque producing)			E2_6	yes	-	True	True
688.8	StatusCurrent_ControlDeviationIq	Status control deviation current control RMS			C4_3	no	-	True	True
688.9	StatusCurrent_PhaseU	Status of current phase U			C4_3	no	-	True	True
688.10	StatusCurrent_PhaseV	Status of current phase V			C4_3	no	-	True	True
688.11	StatusCurrent_ReferenceVoltageUq	Status of current control control signal			C4_3	no	-	True	True
688.13	C3.StatusCurrent_ReferenceJerk	Status of demand jerk setpoint generator			I32	no	-	True	True
688.14	StatusCurrent_FeedForwordCurrentJerk	Status of current & jerk feedforward			C4_3	no	-	True	True
688.17	C3Plus.StatusCurrent_FieldWeakeningFactor	Reciprocal of the field weakening factor FF			C4_3	no	-	True	True
688.18	C3.StatusCurrent_ReferenceDINT	Target current r.m.s.			I32	no	-	True	True
688.19	C3.StatusCurrent_ActualDINT	Actual current r.m.s.			I32	no	-	True	True
688.22	StatusCurrent_ReferenceVoltageVector	Provided voltage pointer			C4_3	no	-	True	True

No.	Object name	Object	I20,I32 Bus No	I21,I30,I31 Bus No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
688.29	StatusCurrent_VoltageUq	Provided voltage of quadrature current controller			C4_3	no	-	True	True
688.30	StatusCurrent_VoltageUd	Provided voltage of direct current controller			C4_3	no	-	True	True
688.31	StatusCurrent_DecouplingVoltageUd	Signal decoupling of direct current controller			C4_3	no	-	True	True
688.32	StatusCurrent_FeedForwardbackEMF	Signal EMC feedforward			C4_3	no	-	True	True
689.1	StatusHeda_RxPD	Receive string			OS	no	-	False	True
689.2	StatusHeda_TxPD	Transmit string			OS	no	-	False	True
690.5	StatusAutocommutation_Itterations	Current increase steps automatic commutation			U16	no	-	True	True
692.1	StatusFeedback_FeedbackSineDSP	Status of sine in signal processing			I32	yes	-	True	True
692.2	StatusFeedback_FeedbackCosineDSP	Status of cosine in signal processing			I32	yes	-	True	True
692.3	StatusFeedback_EncoderSine	Status of analog input sine			I32	no	-	True	True
692.4	StatusFeedback_EncoderCosine	Status of analog input cosine			I32	no	-	True	True
692.5	StatusFeedback_FeedbackVoltage[Vpp]	Status of feedback level			C4_3	no	-	True	True
814.10	C3Plus.SafetyMonitor_OperatingState	Status S3			U16	no	-	True	
814.11	C3Plus.SafetyMonitor_AlarmCode	Alarm no. S3			U16	no	-	True	
814.12	C3Plus.SafetyMonitor_ErrorCode	Error no. S3			U16	no	-	True	
814.13	C3Plus.SafetyMonitor_DiagnosticsBits0_15	DiagnoseBits0_15 S3			U16	no	-	True	
814.14	C3Plus.SafetyMonitor_DiagnosticsBits16_31	DiagnoseBits16_31 S3			U16	no	-	True	
814.15	C3Plus.SafetyMonitor_DiagnosticsBits32_47	DiagnoseBits32_47 S3			U16	no	-	True	
814.16	C3Plus.SafetyMonitor_DiagnosticsBits48_55	DiagnoseBits48_55 S3			U16	no	-	True	
814.20	SafetyMonitor_ProcessData	Total process data S3			OS	no	-	True	
814.21	C3Plus.SafetyMonitor_ProcessData_U16_1	Process data U16_1 of S3 (first 2 Bytes)			U16	no	-	True	
814.22	C3Plus.SafetyMonitor_ProcessData_U16_2	Process data U16_2 of S3 (Byte 3 and 4)			U16	no	-	True	
814.23	C3Plus.SafetyMonitor_ProcessData_U16_3	Process data U16_3 of S3 (Byte 5 and 6)			U16	no	-	True	
814.24	C3Plus.SafetyMonitor_ProcessData_U16_4	Process data U16_4 of S3 (Byte 7 and 8)			U16	no	-	True	
814.25	C3Plus.SafetyMonitor_ProcessData_U32_1	Process data U32_1 of S3 (first 4 Bytes)			U32	no	-	True	
814.26	C3Plus.SafetyMonitor_ProcessData_U32_2	Process data U32_2 of S3 (Byte 5 to 8)			U32	no	-	True	
814.27	C3Plus.SafetyMonitor_ProcessData_U32_3	Process data U32_3 of S3 (Byte 3 to 6)			U32	no	-	True	
820.3	C3Plus.CANopen_Node_ID	CANopen_Node_ID			U16	no	-	False	True
830.1	Profibus_Protocol	PPO-type selection switch			U16	no	immediately	False	True
830.2	Profibus_Baudrate	Baud rate			U32	no	-	False	True
830.3	Profibus_NodeAddress	Node address	918		U16	no	-	False	True
830.4	Profibus_TelegramSelect	Telegram selection switch	922		U16	no	immediately	False	True
830.6	Profibus_StandardSignalTable	List of Profidrive standard signals	923.x		U16	no	-	False	True
900.1	C3Plus.HEDA_State	Status HEDA			I16	no	immediately	False	True
900.12	HEDA_CRC_ErrorCounter	Error counter CRC (HEDA)			U32	no	immediately	False	True
900.13	HEDA_SyncErrorCounter	Error counter Sync (HEDA)			U32	no	immediately	False	True
950.1	FBI_RxPD_Mapping_Object_1	1. Object of the setpoint PZD (Profibus)	915.0		U16	no	immediately	False	True
950.2	FBI_RxPD_Mapping_Object_2	2. object of the Setpoint value PZD	915.1		U16	no	immediately	False	True
950.3	FBI_RxPD_Mapping_Object_3	3. object of the Setpoint value PZD	915.2		U16	no	immediately	False	True
950.4	FBI_RxPD_Mapping_Object_4	4. object of the Setpoint value PZD	915.3		U16	no	immediately	False	True
950.5	FBI_RxPD_Mapping_Object_5	5. object of the Setpoint value PZD	915.4		U16	no	immediately	False	True
950.6	FBI_RxPD_Mapping_Object_6	6. object of the Setpoint value PZD	915.5		U16	no	immediately	False	True
950.7	FBI_RxPD_Mapping_Object_7	7. object of the Setpoint value PZD	915.6		U16	no	immediately	False	True
950.8	FBI_RxPD_Mapping_Object_8	8. object of the Setpoint value PZD	915.7		U16	no	immediately	False	True
951.1	FBI_TxPD_Mapping_Object_1	1. object of actual value PZD	916.0		U16	no	immediately	False	True
951.2	FBI_TxPD_Mapping_Object_2	2. object of actual value PZD	916.1		U16	no	immediately	False	True
951.3	FBI_TxPD_Mapping_Object_3	3. object of actual value PZD	916.2		U16	no	immediately	False	True
951.4	FBI_TxPD_Mapping_Object_4	4. object of actual value PZD	916.3		U16	no	immediately	False	True
951.5	FBI_TxPD_Mapping_Object_5	5. object of actual value PZD	916.4		U16	no	immediately	False	True
951.6	FBI_TxPD_Mapping_Object_6	6. object of actual value PZD	916.5		U16	no	immediately	False	True
951.7	FBI_TxPD_Mapping_Object_7	7. object of actual value PZD	916.6		U16	no	immediately	False	True
951.8	FBI_TxPD_Mapping_Object_8	8. object of actual value PZD	916.7		U16	no	immediately	False	True
990.1	Delay_MasterDelay	Setpoint delay for bus master			I16	no	immediately	True	True
1000.3	C3Plus.DeviceState_Statusword_1	Status word SW	2	0x6041	V2	yes	immediately	False	True
1000.4	C3Plus.DeviceState_Statusword_2	Status word 2	4	0x201C	V2	yes	immediately	False	True
1000.5	C3Plus.DeviceState_ActualOperationMode	Operating mode display	128	0x6061	I16	yes	immediately	False	True
1100.1	C3Plus.DeviceControl_CommandOnRequest	Control command	108	0x2028	I16	yes	immediately	True	True

No.	Object name	Object	I20,I32 Bus No	I21,I30,I31 Bus No	Format	PD	Valid beginning	Device assignment	
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1100.3	C3Plus.DeviceControl_Controlword_1	Control word CW	1	0x6040	V2	yes	immediately	False	True
1100.4	C3Plus.DeviceControl_Controlword_2	Control word 2	3	0x201B	V2	yes	immediately	False	True
1100.5	C3Plus.DeviceControl_OperationMode	Operating mode	127/930	0x6060	I16	yes	immediately	False	True
1111.1	C3Plus.POSITION_position	Target position	27		C4_3	yes	immediately	True	True
1111.2	C3Plus.POSITION_speed	Speed for positioning and velocity control	111		C4_3	yes	immediately	True	True
1111.3	C3Plus.POSITION_accel	Acceleration for positioning	114	0x6083	U32	yes	immediately	True	True
1111.4	C3Plus.POSITION_decel	Deceleration for positioning	178/312	0x6084	U32	yes	immediately	True	True
1111.5	C3Plus.POSITION_jerk_accel	Acceleration jerk for positioning	313	0x2005	U32	no	immediately	True	True
1111.6	C3Plus.POSITION_jerk_decel	Deceleration jerk for positioning	314	0x2006	U32	no	immediately	True	True
1111.8	C3Plus.POSITION_resetpositon_mode	Continuous mode	0	0	U16	no	immediately	True	True
1111.13	C3Plus.POSITION_direction	Manipulation of the motion direction in reset mode			I32	no	immediately	True	True
1111.17	C3Plus.POSITION_turnaround	Direction inversion - lock			U16	no	immediately	True	True
1127.3	C3Plus.SPEED_speed	Setpoint speed in speed control operating mode	7		C4_3	yes	immediately	True	True
1130.1	C3Plus.HOMING_accel	Acceleration / deceleration MN (homing) run	300	0x609A	U32	no	immediately	True	True
1130.2	C3Plus.HOMING_jerk	Jerk for machine reference run	357	0x201E	U32	no	immediately	True	True
1130.3	C3Plus.HOMING_speed	Speed for machine reference run	301	0x6099.1	C4_3	no	immediately	True	True
1130.4	C3Plus.HOMING_mode	Adjusting the machine reference mode	302	0x6098	U16	no	immediately	True	True
1130.7	C3Plus.HOMING_edge_sensor_distance	Initiator adjustment	304	0x2000	C4_3	no	immediately	True	True
1130.13	HOMING_edge_position	Distance MN (zero) initiator - motor zero			C4_3	no	immediately	True	True
1141.4	C3Plus.GEAR_mode	Source selection Gearing		0x2055	U16	no	immediately	True	True
1141.7	GEAR_actual_masterposition	Position input value for Gearing		0x2058	C4_3	no	-	True	True
1141.8	GEAR_actual_master_speed	Master speed for Gearing			C4_3	no	-	True	True
1141.10	GEAR_FFW_mode	Control bits for feedforward with source CANSync/EthernetPowerLink/EtherCat		0x2097	U16	no	immediately	False	True
1200.1	C3Plus.PG2Control_CommandOnRequest	Control of virtual Master	200	0x2040	I16	yes	immediately	False	True
1211.13	C3Plus.PG2POSITION_direction	Manipulation of the motion direction in reset mode			I32	no	immediately	True	True
1900.1	C3Array.Pointer_Row	Pointer to table row	180	0x2300	U16	yes	immediately	True	True
1901.1	C3Array.Col01_Row01	variable Column 1 Row 1	130/341.1	0x2301.1	Y4	yes	immediately	True	True
1901.2	C3Array.Col01_Row02	Variable Column 1 Row 2	131/341.2	0x2301.2	Y4	yes	immediately	True	True
1901.3	C3Array.Col01_Row03	Variable Column 1 Row 3	132/341.3	0x2301.3	Y4	yes	immediately	True	True
1901.4	C3Array.Col01_Row04	Variable Column 1 Row 4	133/341.4	0x2301.4	Y4	yes	immediately	True	True
1901.5	C3Array.Col01_Row05	Variable Column 1 Row 5	134/341.5	0x2301.5	Y4	yes	immediately	True	True
1902.1	C3Array.Col02_Row01	variable Column 2 Row 1	135/342.1	0x2302.1	Y2	yes	immediately	True	True
1902.2	C3Array.Col02_Row02	variable Column 2 Row 2	136/342.2	0x2302.2	Y2	yes	immediately	True	True
1902.3	C3Array.Col02_Row03	variable Column 2 Row 3	137/342.3	0x2302.3	Y2	yes	immediately	True	True
1902.4	C3Array.Col02_Row04	Variable Column 2 Row 4	138/342.4	0x2302.4	Y2	yes	immediately	True	True
1902.5	C3Array.Col02_Row05	Variable Column 2 Row 5	139/342.5	0x2302.5	Y2	yes	immediately	True	True
1903.1	C3Array.Col03_Row01	variable Column 3 Row 1	140/343.1	0x2303.1	I16	yes	immediately	True	True
1903.2	C3Array.Col03_Row02	Variable Column 3 Row 2	141/343.2	0x2303.2	I16	yes	immediately	True	True
1903.3	C3Array.Col03_Row03	Variable Column 3 Row 3	142/343.3	0x2303.3	I16	yes	immediately	True	True
1903.4	C3Array.Col03_Row04	Variable Column 3 Row 4	143/343.4	0x2303.4	I16	yes	immediately	True	True
1903.5	C3Array.Col03_Row05	Variable Column 3 Row 5	144/343.5	0x2303.5	I16	yes	immediately	True	True
1904.1	C3Array.Col04_Row01	variable Column 4 Row 1	145/344.1	0x2304.1	I16	yes	immediately	True	True
1904.2	C3Array.Col04_Row02	Variable Column 4 Row 2	146/344.2	0x2304.2	I16	yes	immediately	True	True
1904.3	C3Array.Col04_Row03	Variable Column 4Row 3	147/344.3	0x2304.3	I16	yes	immediately	True	True
1904.4	C3Array.Col04_Row04	Variable Column 4 Row 4	148/344.4	0x2304.4	I16	yes	immediately	True	True
1904.5	C3Array.Col04_Row05	Variable Column 4 Row 5	149/344.5	0x2304.5	I16	yes	immediately	True	True
1905.1	C3Array.Col05_Row01	variable Column 5 Row 1	150/345.1	0x2305.1	I16	yes	immediately	True	True
1905.2	C3Array.Col05_Row02	Variable Column 5 Row 2	151/345.2	0x2305.2	I16	yes	immediately	True	True

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1905.3	C3Array.Col05_Row03	Variable Column 5 Row 3	152/345.3	0x2305.3	I16	yes	immediately	True	True
1905.4	C3Array.Col05_Row04	Variable Column 5 Row 4	153/345.4	0x2305.4	I16	yes	immediately	True	True
1905.5	C3Array.Col05_Row05	Variable Column 5Row 5	154/345.5	0x2305.5	I16	yes	immediately	True	True
1906.1	C3Array.Col06_Row01	variable Column 6 Row 1	155/346.1	0x2306.1	I32	yes	immediately	True	True
1906.2	C3Array.Col06_Row02	Variable Column 6 Row 2	156/346.2	0x2306.2	I32	yes	immediately	True	True
1906.3	C3Array.Col06_Row03	Variable Column 6 Row 3	157/346.3	0x2306.3	I32	yes	immediately	True	True
1906.4	C3Array.Col06_Row04	Variable Column 6 Row 4	158/346.4	0x2306.4	I32	yes	immediately	True	True
1906.5	C3Array.Col06_Row05	Variable Column 6 Row 5	159/346.5	0x2306.5	I32	yes	immediately	True	True
1907.1	C3Array.Col07_Row01	variable Column 7 Row 1	160/347.1	0x2307.1	I32	yes	immediately	True	True
1907.2	C3Array.Col07_Row02	Variable Column 7 Row 2	161/347.2	0x2307.2	I32	yes	immediately	True	True
1907.3	C3Array.Col07_Row03	Variable Column 7 Row 3	162/347.3	0x2307.3	I32	yes	immediately	True	True
1907.4	C3Array.Col07_Row04	Variable Column 7 Row 4	163/347.4	0x2307.4	I32	yes	immediately	True	True
1907.5	C3Array.Col07_Row05	Variable Column 7 Row 5	164/347.5	0x2307.5	I32	yes	immediately	True	True
1908.1	C3Array.Col08_Row01	variable Column 8 Row 1	165/348.1	0x2308.1	I32	yes	immediately	True	True
1908.2	C3Array.Col08_Row02	Variable Column 8 Row 2	166/348.2	0x2308.2	I32	yes	immediately	True	True
1908.3	C3Array.Col08_Row03	Variable Column 8 Row 3	167/348.3	0x2308.3	I32	yes	immediately	True	True
1908.4	C3Array.Col08_Row04	Variable Column 8 Row 4	168/348.4	0x2308.4	I32	yes	immediately	True	True
1908.5	C3Array.Col08_Row05	Variable Column 8 Row 5	169/348.5	0x2308.5	I32	yes	immediately	True	True
1909.1	C3Array.Col09_Row01	variable Column 9 Row 1	170/349.1	0x2309.1	I32	yes	immediately	True	True
1909.2	C3Array.Col09_Row02	Variable Column 9 Row 2	171/349.2	0x2309.2	I32	yes	immediately	True	True
1909.3	C3Array.Col09_Row03	Variable Column 9 Row 3	172/349.3	0x2309.3	I32	yes	immediately	True	True
1909.4	C3Array.Col09_Row04	Variable Column 9 Row 4	173/349.4	0x2309.4	I32	yes	immediately	True	True
1909.5	C3Array.Col09_Row05	Variable Column 9 Row 5	174/349.5	0x2309.5	I32	yes	immediately	True	True
1910.1	C3Array.Indirect_Col01	Indirect table access Column 1	181	0x2311	Y4	yes	immediately	True	True
1910.2	C3Array.Indirect_Col02	Indirect table access Column 2	182	0x2312	Y2	yes	immediately	True	True
1910.3	C3Array.Indirect_Col03	Indirect table access Column 3	183	0x2313	I16	yes	immediately	True	True
1910.4	C3Array.Indirect_Col04	Indirect table access Column 4	184	0x2314	I16	yes	immediately	True	True
1910.5	C3Array.Indirect_Col05	Indirect table access Column 5	185	0x2315	I16	yes	immediately	True	True
1910.6	C3Array.Indirect_Col06	Indirect table access Column 6	186	0x2316	I32	yes	immediately	True	True
1910.7	C3Array.Indirect_Col07	Indirect table access Column 7	187	0x2317	I32	yes	immediately	True	True
1910.8	C3Array.Indirect_Col08	Indirect table access Column 8	188	0x2318	I32	yes	immediately	True	True
1910.9	C3Array.Indirect_Col09	Indirect table access Column 9	189	0x2319	I32	yes	immediately	True	True
2000.1	C3Plus.ProfilGenerators_SG1Position	Position value of the setpoint encoder		0x2060	C4_3	yes	-	True	True
2000.2	C3Plus.ProfilGenerators_PG2Position	Position value of the setpoint encoder of the virtual axis		0x2061	C4_3	yes	-	False	True
2000.4	ProfilGenerators_SG1Speed	Speed of the setpoint encoder		0x2063	I32	yes	-	True	True
2000.5	ProfilGenerators_PG2Speed	Speed of the virtual axis		0x2064	I32	yes	-	False	True
2000.8	ProfilGenerators_PG2Accel	Acceleration of the virtual axis			I32	no	-	False	True
2010.1	C3.FeedForward_Speed	Velocity Feed Forward	400.1	0x2101.1	U16	no	VP	True	True
2010.2	C3.FeedForward_Accel	Acceleration feed-forward	400.2	0x2101.2	U16	no	VP	True	True
2010.4	C3.FeedForward_Current	Current feed-forward	400.4	0x2101.4	U16	no	VP	True	True
2010.5	C3.FeedForward_Jerk	Jerk feed-forward	400.5	0x2101.5	U16	no	VP	True	True
2010.20	FeedForward_EMF	EMC feedforward			U16	no	VP	True	True
2010.21	FeedForward_Valve	Valve feedforward			U16	no	VP	True	True
2010.23	C3.FeedForward_Speed_FFW	Speed feedforward (A1)			C4_3	no	VP	True	True
2010.24	C3.FeedForward_Speed_FFW	Acceleration feedforward (A1)			C4_3	no	VP	True	True
2011.1	C3.FeedForwardExternal_FilterSpeed	External Speed Feed Forward Filter Time Constant	401.1	0x2102.1	U16	no	VP	True	True
2011.2	C3.FeedForwardExternal_FilterAccel	External Acceleration Feed Forward Filter Time Constant	401.2	0x2102.2	U16	no	VP	True	True
2011.4	FeedForwardExternal_FilterSpeed_us	Filter time constant ext. Speed			U16	no	VP	True	True
2011.5	FeedForwardExternal_FilterAccel_us	Filter time constant ext. Acceleration			U16	no	VP	True	True
2020.1	C3.ExternalSignal_Position	Position from external signal source		0x2095.1	C4_3	yes	-	True	True
2020.2	C3.ExternalSignal_Speed	speed from external signal source			C4_3	yes	-	True	True
2020.6	C3Plus.ExternalSignal_Speed_Munits	Speed value of the external signal source			C4_3	yes	-	True	True
2020.7	C3Plus.ExternalSignal_Accel_Munits	Acceleration of the external signal source			I32	yes	-	True	True
2050.8	FeedForward_2_Valve	Valve feedforward auxiliary axis			U16	no	VP	True	True
2050.9	C3.FeedForward_2_Speed_FFW	Speed feedforward (A2)			C4_3	no	VP	True	True
2050.10	C3.FeedForward_2_Accel_FFW	Acceleration feedforward (A2)			C4_3	no	VP	True	True

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2100.2	C3.ControllerTuning_Stiffness	Stiffness (speed controller)	402.2	0x2100.2/ 0x2100.1	U16	no	VP	True	True
2100.3	C3.ControllerTuning_Damping	Damping (rotation speed controller)	402.3	0x2100.3	U16	no	VP	True	True
2100.4	C3.ControllerTuning_Inertia	Moment of Inertia	402.4	0x2100.4	U16	no	VP	True	True
2100.5	C3.ControllerTuning_FilterSpeed	Filter - Actual velocity	402.5	0x2100.5	U16	no	VP	True	True
2100.6	C3.ControllerTuning_FilterAccel	Filter - Actual acceleration	402.6	0x2100.6	U16	no	VP	True	True
2100.7	C3.ControllerTuning_SpeedDFactor	D-component of speed controller	402.7	0x2100.7	U16	no	VP	True	True
2100.8	C3.ControllerTuning_CurrentBandwidth	Current regulator bandwidth	402.8	0x2100.8	U16	no	VP	True	True
2100.9	C3.ControllerTuning_CurrentDamping	Current loop - Damping	402.9	0x2100.9	U16	no	VP	True	True
2100.10	C3.ControllerTuning_FilterSpeed2	Filter actual velocity 2			U16	no	VP	True	True
2100.11	C3.ControllerTuning_FilterAccel2	Filter actual acceleration 2			U16	no	VP	True	True
2100.20	ControllerTuning_ActuatingSpeedSignalFilt_us	Control signal filter of velocity control			U16	no	VP	True	True
2100.21	ControllerTuning_FilterAccel_us	Filter - Actual acceleration			U16	no	VP	True	True
2107.1	C3Plus.TrackingfilterPhysicalSource_TRFSpeed	Time constant tracking filter physical source			U16	no	VP	True	True
2109.1	C3Plus.TrackingfilterHEDA_TRFSpeed	Time constant tracking filter HEDA-process position			I16	no	VP	True	True
2110.1	C3Plus.TrackingfilterSG1_TRFSpeed	Time constant tracking filter setpoint encoder		0x2096	I16	no	VP	True	True
2110.3	C3Plus.TrackingfilterSG1_FilterSpeed	Filter effect of speed filter setpoint encoder			U16	no	VP	True	True
2110.4	C3Plus.TrackingfilterSG1_AccelFilter	Filter effect of acceleration filter setpoint encoder			U16	no	VP	True	True
2110.6	TrackingfilterSG1_FilterSpeed_us	Filter time constant velocity setpoint generator			U16	no	VP	True	True
2110.7	TrackingfilterSG1_AccelFilter_us	Filter time constant acceleration setpoint generator			U16	no	VP	True	True
2120.1	SpeedObserver_TimeConstant	Rapidity of the speed monitor			U32	no	VP	True	True
2120.5	SpeedObserver_DisturbanceFilter	Time constant disturbance filter			U32	no	VP	True	True
2120.7	SpeedObserver_DisturbanceAdditionEnable	Switch to enable disturbance compensation			I16	no	VP	True	True
2150.1	C3Plus.NotchFilter_FrequencyFilter1	Center frequency of notch filter 1			I16	no	VP	True	True
2150.2	C3Plus.NotchFilter_BandwidthFilter1	Bandwidth of notch filter 1			I16	no	VP	True	True
2150.3	C3Plus.NotchFilter_DepthFilter1	Depth of notch filter 1			I32	no	VP	True	True
2150.4	C3Plus.NotchFilter_FrequencyFilter2	Center frequency of notch filter 2			I16	no	VP	True	True
2150.5	C3Plus.NotchFilter_BandwidthFilter2	Bandwidth of notch filter 2			I16	no	VP	True	True
2150.6	C3Plus.NotchFilter_DepthFilter2	Depth of notch filter 2			I32	no	VP	True	True
2190.1	AutoCommutationControl_Ramptime	Ramp slope current slope AK			U16	no	VP	True	True
2190.2	AutoCommutationControl_InitialCurrent	Start current of automatic commutation			U16	no	VP	True	True
2190.3	AutoCommutationControl_PositionThreshold	Motion limit for automatic commutation			U16	no	VP	True	True
2190.4	AutoCommutationControl_MotionReduction	Motion reduction Automatic commutation			U16	no	VP	True	True
2190.7	AutoCommutationControl_StandstillThreshold	Optimization of the standstill threshold			U16	no	VP	True	True
2190.8	AutoCommutationControl_PeakCurrent	Reduction of the peak current			U16	no	VP	True	True
2190.10	AutoCommutationControl_Reset	Reset automatic commutation			U16	no	immediately	True	True
2200.1	C3Plus.PositionController_DemandValue	Position setpoint value (sequentially)			C4_3	yes	-	True	True
2200.2	C3Plus.PositionController_ActualValue	Position actual value (sequentially)			C4_3	yes	-	True	True
2200.11	C3Plus.PositionController_TrackingErrorFilter	Following error filter of the position controller			U16	no	VP	True	True
2200.20	C3Plus.PositionController_DeadBand	Deadband of position controller			C4_3	no	VP	True	True
2200.21	PositionController_FrictionCompensation	Friction compensation			I32	no	VP	True	True
2200.24	PositionController_TrackingErrorFilter_us	Time constant following error filter of position controller			U16	no	VP	True	True
2200.25	PositionController_IntegralPart	I term of position controller			U16	no	VP	True	True
2201.1	C3Plus.LoadControl_Enable	Activate load control			I16	no	immediately	True	True
2201.2	C3Plus.LoadControl_Command	Load control command mode			I16	no	immediately	True	True
2201.3	LoadControl_Status	Load control status bits			I16	no	-	True	True
2201.11	C3Plus.LoadControl_FilterLaggingPart	Time constant of position difference filter			U32	no	VP	True	True
2201.12	C3Plus.LoadControl_VelocityFilter	Time constant of the load-speed filter			I16	no	VP	True	True
2201.13	C3Plus.LoadControl_VelocityLimit	Load control intervention speed limitation			I16	no	VP	True	True
2210.1	SpeedController_DemandValue	Velocity setpoint value			I32	yes	-	True	True
2210.2	SpeedController_ActualValue	Actual (rotational) speed			I32	yes	-	True	True
2210.4	SpeedController_P_Part_Gain	P term quantifier			U16	no	VP	True	True
2210.5	SpeedController_I_Part_Gain	Weighting "I" term			U16	no	VP	True	True
2210.14	SpeedController_DemandValueAdditive	Manual or external velocity specification			I32	yes	immediately	True	True
2210.17	SpeedController_ActualBandwidth	Replacement time constant for the velocity control			I32	no	-	True	True
2210.19	C3Plus.SpeedController_ScalingDemandValueAdditive	Scaling for manual or external velocity specification			C4_3	no	immediately	True	True
2220.1	Q_CurrentController_Q_DemandValue	Quadrature Current CommandValue			I16	yes	-	True	True
2220.2	Q_CurrentController_Q_DemandValueAdditive	Manual or external cross current specification			I16	yes	immediately	True	True
2220.3	C3Plus.Q_CurrentController_Scaling_Q_DemandValueAdditive	Scaling for manual or external current specification			I16	no	immediately	True	True
2220.4	Q_CurrentController_Q_ActualValue	Cross-flow actual value			I16	yes	-	True	True
2220.20	Q_CurrentController_Inductance	Parameter motor inductance			I16	no	VP	True	True
2220.21	Q_CurrentController_Resistance	Parameter motor resistance			I16	no	VP	True	True
2220.22	Q_CurrentController_BackEMF	Parameter motor force constant			I16	no	VP	True	True
2220.27	Q_CurrentController_StructureSelection	Structure switch of current control			I16	no	VP	True	True
2230.20	D_CurrentController_Ld_Lq_Ratio	Ratio direct to quadrature inductance			U16	no	VP	True	True
2230.24	D_CurrentController_VoltageDecouplingEnable	Activation of the voltage decoupling			I16	no	VP	True	True

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2240.2	Magnetization current controller_IMrn_DemandValueTuning	Magnetization current quantifier (ASM)			I16	no	VP	True	True
2240.4	Magnetization current controller_Damping	Magnetization current controller attenuation(ASM)			I16	no	VP	True	True
2240.7	Magnetization current controller_Bandwidth	Magnetization current controller bandwidth (ASM)			I16	no	VP	True	True
2240.9	Magnetization current controller_SlipFrequency	Slip frequency quantifier (ASM)	0	0	I16	no	VP	True	True
2240.10	Magnetization current controller_RotorTimeConstant	Motor Time Constant quantifier	0	0	I16	no	VP	True	True
2240.11	Magnetization current controller_Field weakening speed	Reference speed quantifier (ASM)			I16	no	VP	True	True
3021.1	C3Cam.SignalSource_Select	Source of master position			U16	no	immediately	False	True
3021.2	C3Cam.SignalSource_Position	Status of position of selected master signal source			C4_3	yes	-	False	True
3021.10	C3Cam.SignalSource_InputAdditional	CAM Master position			C4_3	yes	immediately	False	True
3022.1	C3Cam.Manipulation_OffsetMasterposition	Master position offset			C4_3	no	immediately	False	True
3022.3	C3Cam.Manipulation_ScalefactorMasterGlobal	Global scaling factor for the master speed			C4_3	no	immediately	False	True
3022.6	C3Cam.Manipulation_OffsetMasterposition_Units	Offset Master position			C4_3	no	immediately	False	True
3030.1	C3Cam.StatusMaster_Position	Reset master position	207	0x2410	C4_3	yes	-	False	True
3030.7	C3Cam.StatusMaster_Enable	Status: Enable of master acquisition			U16	no	-	False	True
3030.12	C3Cam.StatusMaster_PhasingSum	Added up position sum of the master-side phasing			C4_3	no	-	False	True
3030.13	StatusMaster_InputSum	Free running master position after MP enable			C4_3	yes	-	False	True
3030.17	C3Cam.StatusMaster_EnableCam	Status: Enable of cam input			U16	no	-	False	True
3030.22	C3Cam.StatusMaster_SpeedUnits	Master speed [Units/s]			C4_3	no	-	False	True
3030.24	C3Cam.StatusMaster_PositionCamUnits	Master position at the beginning of the curve			C4_3	yes	-	False	True
3031.4	C3Cam.StatusData_ActualCurve	Current curve number			I16	no	-	False	True
3032.1	C3Cam.StatusOutput_Position	Slave position			C4_3	yes	-	False	True
3032.4	C3Cam.StatusOutput_AbsolutePositionGreat	Slave position (free running)			C4_3	yes	-	False	True
3032.24	C3Cam.StatusOutput_CurvePositionUnits	End of curve	208	0x2411	C4_3	yes	-	False	True
3310.1	C3.Multiturnemulation_Status	Status of the Multiturn emulation			I16	no	-	True	True
3700.2	C3Cam.ControlledSwitchesFast_Enable	enable fast cams	500.2	0x2400.2	U16	no	immediately	False	True
3700.3	C3Cam.ControlledSwitchesFast_Output	output for fast cams	204/500.3	0x2400.3	U16	yes	immediately	False	True
3701.2	C3Cam.ControlledSwitches_Enable0	enable of cam group 0	501.2	0x2401.2	U16	no	immediately	False	True
3701.3	C3Cam.ControlledSwitches_Output0	output of cam group 0	205/501.3	0x2401.3	U16	yes	immediately	False	True
3701.4	C3Cam.ControlledSwitches_Enable1	enable of cam group 1	501.4	0x2401.4	U16	no	immediately	False	True
3701.5	C3Cam.ControlledSwitches_Output1	output of cam group 1	206/501.5	0x2401.5	U16	yes	immediately	False	True
3701.6	C3Cam.ControlledSwitches_NumberPerCycle	Number of cams in one cycle			U16	no	immediately	False	True
3705.1	C3Cam.ControlledSwitchesHysteresis_ActualPosition	Hysteresis for cam switching mechanism, source "current position"			C4_3	no	VP	False	True
3705.5	C3Cam.ControlledSwitchesHysteresis_Masterposition	Hysteresis for cam switching mechanism, source "master position"			C4_3	no	VP	False	True
3710.1	C3Cam.ControlledSwitchFast0_Source	source of fast cam	502.1	0x2402.1	I16	no	VP	False	True
3710.2	C3Cam.ControlledSwitchFast0_PositionOn	switch-on position for fast cam	503.1	0x2403.1	C4_3	no	VP	False	True
3710.3	C3Cam.ControlledSwitchFast0_PositionOff	switch-off position for fast cam	504.1	0x2404.1	C4_3	no	VP	False	True
3710.4	C3Cam.ControlledSwitchFast0_TimeOn	switch-on anticipation of fast cam	505.1	0x2405.1	I16	no	immediately	False	True
3710.5	C3Cam.ControlledSwitchFast0_TimeOff	switch-off anticipation of fast cam	506.1	0x2406.1	I16	no	immediately	False	True
3730.1	C3Cam.ControlledSwitch00_Source	source of cam	507.1	0x2407.1	I16	no	VP	False	True
3730.2	C3Cam.ControlledSwitch00_PositionOn	switch-on position of cam	508.1	0x2408.1	C4_3	no	VP	False	True
3730.3	C3Cam.ControlledSwitch00_PositionOff	switch-off position of cam	509.1	0x2409.1	C4_3	no	VP	False	True
3730.4	C3Cam.ControlledSwitch00_TimeOn	switch-on anticipation of cam	510.1	0x240A.1	I16	no	immediately	False	True
3730.5	C3Cam.ControlledSwitch00_TimeOff	switch-off anticipation of cam	511.1	0x240B.1	I16	no	immediately	False	True
3920.1	C3Plus.HEDA_SignalProcessing_Input	Process input signal Slave			C4_3	yes	immediately	True	True
3920.7	C3Plus.HEDA_SignalProcessing_OutputGreat	Output of the Heda Tracking Filter			C4_3	no	-	True	True
3921.1	FBI_SignalProcessing0_Input	Interpolation input CanSync, PowerLink		0x2050	I32	yes	immediately	False	True
3921.7	C3Plus.FBI_SignalProcessing0_OutputGreat	Interpolation output of the Position CanSync, PowerLink			Y4	no	-	False	True
3921.8	C3Plus.FBI_SignalProcessing0_Source	Switching the position source of the interpolator			I16	no	immediately	False	True
3925.1	FBI_Interpolation_SubModeSelect	Interpolation method		0x60C0	I16	no	immediately	False	True
3925.20	FBI_Interpolation_VelocityInput	Velocity specification GEARING CanSync/EthernetPowerLink		0x2098	I32	yes	immediately	False	True
3925.21	FBI_Interpolation_AccelInput	Acceleration specification GEARING CanSync/EthernetPowerLink		0x2099	I32	yes	immediately	False	True
3925.22	FBI_Interpolation_VelocityStatus	Input speed of the differentiated input position O2121.1			C4_3	no	-	False	True
3925.23	FBI_Interpolation_AccelStatus	Input value of the acceleration of O3925.21			C4_3	no	-	False	True

7.2 Object overview sorted by object groups (T40)

In this chapter you can read about:

7.2.1. C3 objects

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
634.4	C3.AnalogOutput0_DemandValue	Setpoint for analog output 0	24	0x2019	I16	yes	immediately	True	True
635.4	C3.AnalogOutput1_DemandValue	Setpoint for analog output 1	103	0x201A	I16	yes	immediately	True	True
2100.8	C3.ControllerTuning_CurrentBandwidth	Current regulator bandwidth	402.8	0x2100.8	U16	no	VP	True	True
2100.9	C3.ControllerTuning_CurrentDamping	Current loop - Damping	402.9	0x2100.9	U16	no	VP	True	True
2100.3	C3.ControllerTuning_Damping	Damping (rotation speed controller)	402.3	0x2100.3	U16	no	VP	True	True
2100.6	C3.ControllerTuning_FilterAccel	Filter - Actual acceleration	402.6	0x2100.6	U16	no	VP	True	True
2100.11	C3.ControllerTuning_FilterAccel2	Filter actual acceleration 2			U16	no	VP	True	True
2100.5	C3.ControllerTuning_FilterSpeed	Filter - Actual velocity	402.5	0x2100.5	U16	no	VP	True	True
2100.10	C3.ControllerTuning_FilterSpeed2	Filter actual velocity 2			U16	no	VP	True	True
2100.4	C3.ControllerTuning_Inertia	Moment of Inertia	402.4	0x2100.4	U16	no	VP	True	True
2100.7	C3.ControllerTuning_SpeedDFactor	D-component of speed controller	402.7	0x2100.7	U16	no	VP	True	True
2100.2	C3.ControllerTuning_Stiffness	Stiffness (speed controller)	402.2	0x2100.2/ 0x2100.1	U16	no	VP	True	True
120.2	C3.DigitalInput_Value	Status of digital inputs			V2	yes	-	True	True
121.2	C3.DigitalInputAddition_Value	Input word of I/O option	175	0x6100.2	V2	yes	-	True	True
133.4	C3.DigitalOutputAddition_Enable	Activate input/output option M10/M12	350	0x6300.3	V2	no	immediately	True	True
133.2	C3.DigitalOutputAddition_Error	Error in I/O option	351	0x6300.4	V2	no	-	True	True
133.3	C3.DigitalOutputAddition_Value	Output word for I/O option	176	0x6300.2	V2	yes	immediately	True	True
140.3	C3.DigitalOutputWord_DemandState	Command value of the digital outputs	22	0x6300.1	V2	yes	immediately	False	True
2020.1	C3.ExternalSignal_Position	Position from external signal source		0x2095.1	C4_3	yes	-	True	True
2020.2	C3.ExternalSignal_Speed	speed from external signal source			C4_3	yes	-	True	True
2050.10	C3.FeedForward_2_Accel_FFW	Acceleration feedforward (A2)			C4_3	no	VP	True	True
2050.9	C3.FeedForward_2_Speed_FFW	Speed feedforward (A2)			C4_3	no	VP	True	True
2010.2	C3.FeedForward_Accel	Acceleration feed-forward	400.2	0x2101.2	U16	no	VP	True	True
2010.24	C3.FeedForward_Speed_FFW	Acceleration feedforward (A1)			C4_3	no	VP	True	True
2010.4	C3.FeedForward_Current	Current feed-forward	400.4	0x2101.4	U16	no	VP	True	True
2010.5	C3.FeedForward_Jerk	Jerk feed-forward	400.5	0x2101.5	U16	no	VP	True	True
2010.1	C3.FeedForward_Speed	Velocity Feed Forward	400.1	0x2101.1	U16	no	VP	True	True
2010.23	C3.FeedForward_Speed_FFW	Speed feedforward (A1)			C4_3	no	VP	True	True
2011.2	C3.FeedForwardExternal_FilterAccel	External Acceleration Feed Forward Filter Time Constant	401.2	0x2102.2	U16	no	VP	True	True
2011.1	C3.FeedForwardExternal_FilterSpeed	External Speed Feed Forward Filter Time Constant	401.1	0x2102.1	U16	no	VP	True	True
402.4	C3.Limit_CurrentNegative	Maximum permissible negative current	320	0x200C	I16	no	VP	True	True
402.3	C3.Limit_CurrentPositive	Maximum permissible positive current	319	0x200B	I16	no	VP	True	True
402.2	C3.Limit_SpeedNegative	Maximum permissible negative speed	318	0x200A	I16	no	VP	True	True
402.1	C3.Limit_SpeedPositive	Maximum permissible positive speed	317	0x2009	I16	no	VP	True	True
410.6	C3.LimitPosition_LoadControlMaxPosDiff	Position difference load-motor (error threshold)			C4_3	no	VP	True	True
410.3	C3.LimitPosition_Negative	negative end limit	322	0x607D.1	C4_3	no	immediately	True	True
410.2	C3.LimitPosition_Positive	positive end limit	321	0x607D.2	C4_3	no	immediately	True	True
3310.1	C3.Multiturnemulation_Status	Status of the Multiturn emulation			I16	no	-	True	True
20.10	C3.ObjectDir_ReadObjects	Read objects from Flash			I16	no	immediately	True	True
20.11	C3.ObjectDir_WriteObjects	Save objects permanently			I16	no	immediately	True	True
420.3	C3.PositioningAccuracy_FollowingErrorTimeout	Following Error Time	331	0x6066	U16	no	immediately	True	True
420.2	C3.PositioningAccuracy_FollowingErrorWindow	Following error limit	330	0x6065	C4_3	no	VP	True	True
420.6	C3.PositioningAccuracy_PositionReached	Position reached			I32	no	-	True	True
420.1	C3.PositioningAccuracy_Window	Positioning window for position reached	328	0x6067	C4_3	no	VP	True	True
420.7	C3.PositioningAccuracy_WindowTime	In Position Window Time	329	0x6068	U16	no	immediately	True	True
682.5	C3.StatusAccel_Actual	Status of actual acceleration unfiltered			I32	no	-	True	True
682.6	C3.StatusAccel_ActualFilter	Status of filtered actual acceleration			I32	no	-	True	True
682.4	C3.StatusAccel_DemandValue	Status demand acceleration	325	0x200E	I32	no	-	True	True
688.2	C3.StatusCurrent_Actual	Status of actual current RMS (torque producing)			E2_6	yes	-	True	True
688.19	C3.StatusCurrent_ActualDINT	Actual current r.m.s.			I32	no	-	True	True
688.1	C3.StatusCurrent_Reference	Status of setpoint current RMS (torque forming)			E2_6	no	-	True	True
688.18	C3.StatusCurrent_ReferenceDINT	Target current r.m.s.			I32	no	-	True	True

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
688.13	C3.StatusCurrent_ReferenceJerk	Status of demand jerk setpoint generator			I32	no	-	True	True
683.1	C3.StatusDevice_ActualCurrent	Status of actual current value	112	0x6077	E2_6	yes	-	True	True
683.2	C3.StatusDevice_ActualDeviceLoad	Status of device load	334	0x2011	E2_6	no	-	True	True
683.9	C3.StatusDevice_ActualDeviceLoadLowFrequency	Status of device utilization at small electrical turning frequency			E2_6	no	-	True	True
683.3	C3.StatusDevice_ActualMotorLoad	Status of long-term motor load	335	0x2012	E2_6	no	-	True	True
683.4	C3.StatusDevice_DynamicMotorLoad	Status of short-term motor load			E2_6	no	-	True	True
683.5	C3.StatusDevice_ObservedDisturbance	Status of observed disturbance			C4_3	no	-	True	True
680.5	C3.StatusPosition_Actual	Status actual position	28	0x6064	C4_3	yes	-	True	True
680.13	C3.StatusPosition_ActualController	Status actual position without absolute reference			C4_3	no	-	True	True
680.18	C3.StatusPosition_ActualNotReset	Status actual position (not reset)			C4_3	yes	-	True	True
680.12	C3.StatusPosition_DemandController	Status demand position without absolute reference			C4_3	no	-	True	True
680.4	C3.StatusPosition_DemandValue	Status demand position	323	0x60FC	C4_3	yes	-	True	True
680.1	C3.StatusPosition_DemandValue1	Position command value of Profile transmitter1	0	0x2052	Y4	yes	-	True	True
680.2	C3.StatusPosition_DemandValue2	Status demand position virtual master	202	0x2042	Y4	yes	-	False	True
680.3	C3.StatusPosition_DemandValue3	Status of setpoint position of Superimposed motion	0	0	Y4	no	-	False	True
680.11	C3.StatusPosition_EncoderInput24V	Status of encoder input 0 (24V)			C4_3	yes	-	True	True
680.10	C3.StatusPosition_EncoderInput5V	Status of encoder input 0 (5V)		0x2095.2	C4_3	yes	-	True	True
680.6	C3.StatusPosition_FollowingError	Status of tracking error	100	0x60F4	C4_3	yes	-	True	True
680.23	C3.StatusPosition_LoadControlActual	Actual position of the load			C4_3	no	-	True	True
680.22	C3.StatusPosition_LoadControlDeviationFiltered	Position difference load-motor (filtered)			C4_3	no	-	True	True
680.21	C3.StatusPosition_LoadControlDeviationMax	Maximum position difference load-motor			C4_3	no	-	True	True
680.30	C3.StatusPosition_Referenced	Status of axis referenced			I16	no	-	True	True
681.5	C3.StatusSpeed_Actual	Status actual speed unfiltered		0x6069	C4_3	yes	-	True	True
681.9	C3.StatusSpeed_ActualFiltered	Status actual speed filtered	8	0x606C	C4_3	yes	-	True	True
681.12	C3.StatusSpeed_ActualScaled	Filtered actual speed			C4_3	no	-	True	True
681.13	C3.StatusSpeed_DemandScaled	Setpoint speed of the setpoint generator			C4_3	no	-	True	True
681.10	C3.StatusSpeed_DemandSpeedController	Status demand speed controller input			C4_3	yes	-	True	True
681.4	C3.StatusSpeed_DemandValue	Status demand speed of setpoint generator	324	0x606B	C4_3	yes	-	True	True
681.1	C3.StatusSpeed_DemandValue1	Speed setpoint value of profile transmitter1	337	0x2053	Y4	yes	-	True	True
681.2	C3.StatusSpeed_DemandValue2	Status demand speed virtual master	203	0x2043	Y4	yes	-	False	True
681.3	C3.StatusSpeed_DemandValue3	Speed of a superimposed motion			Y4	no	-	False	True
681.6	C3.StatusSpeed_Error	Status control deviation of speed	101	0x2027	C4_3	yes	-	True	True
681.11	C3.StatusSpeed_FeedForwardSpeed	Status speed feed forward			C4_3	no	-	True	True
681.20	C3.StatusSpeed_LoadControl	Speed of the load feedback (unfiltered)			C4_3	no	-	True	True
681.21	C3.StatusSpeed_LoadControlFiltered	Speed of the load feedback (filtered)			C4_3	no	-	True	True
684.2	C3.StatusTemperature_Motor	Status of motor temperature	336	0x2013	I16	no	-	True	True
684.1	C3.StatusTemperature_PowerStage	Status of power output stage temperature	337	0x2014	U16	no	-	True	True
685.3	C3.StatusVoltage_AnalogInput0	Status of analog input 0	23	0x2025	Y2	yes	-	True	True
685.4	C3.StatusVoltage_AnalogInput1	Status of analog input 1	102	0x2026	Y2	yes	-	True	True
685.1	C3.StatusVoltage_AuxiliaryVoltage	Status of auxiliary voltage	326	0x200F	E2_6	no	-	True	True
685.2	C3.StatusVoltage_BusVoltage	Status DC bus voltage	327	0x6079	E2_6	no	-	True	True
210.10	C3.ValidParameter_Global	Set objects to valid	338.10	0x2016.10	U16	no	immediately	True	True
210.6	C3.ValidParameter_Limits	setting limit values to valid.			U16	no	immediately	True	True

7.2.2. C3Plus objects

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
170.3	C3Plus.AnalogInput0_FilterCoefficient	Filter of analog input 0			I16	no	VP	True	True
171.3	C3Plus.AnalogInput1_FilterCoefficient	Filter of analog input 1			I16	no	VP	True	True
820.3	C3Plus.CANopen_Node_ID	CANopen_Node_ID			U16	no	-	False	True
100.2	C3Plus.Controller_Controlword	Controller control word actual value			U16	yes	immediately	True	True
100.1	C3Plus.Controller_ControlwordDemand	Controller control word setpoint value			U16	no	immediately	True	True
1100.1	C3Plus.DeviceControl_CommandOnRequest	Control command	108	0x2028	I16	yes	immediately	True	True
1100.3	C3Plus.DeviceControl_Controlword_1	Control word CW	1	0x6040	V2	yes	immediately	False	True
1100.4	C3Plus.DeviceControl_Controlword_2	Control word 2	3	0x201B	V2	yes	immediately	False	True
1100.5	C3Plus.DeviceControl_OperationMode	Operating mode	127/930	0x6060	I16	yes	immediately	False	True
1000.5	C3Plus.DeviceState_ActualOperationMode	Operating mode display	128	0x6061	I16	yes	immediately	False	True
1000.3	C3Plus.DeviceState_Statusword_1	Status word SW	2	0x6041	V2	yes	immediately	False	True
1000.4	C3Plus.DeviceState_Statusword_2	Status word 2	4	0x201C	V2	yes	immediately	False	True
85.3	C3Plus.Diagnostics_DCbus_Current	PSUP intermediate current			I16	no	-	True	True
85.2	C3Plus.Diagnostics_DCbus_Voltage	PSUP DC intermediate voltage			I16	no	-	True	True
85.5	C3Plus.Diagnostics_RectifierLoad	PSUP usage in %			I16	no	-	True	True

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
85.4	C3Plus.Diagnostics_TemperatureHeatSink	PSUP heat dissipator temperature			I16	no	-	True	True
550.1	C3Plus.ErrorHistory_LastError	Current error (n)	115/947.0	0x603F/0x201D.1	U16	yes	-	True	True
2020.7	C3Plus.ExternalSignal_Accel_Munits	Acceleration of the external signal source			I32	yes	-	True	True
2020.6	C3Plus.ExternalSignal_Speed_Munits	Speed value of the external signal source			C4_3	yes	-	True	True
3921.7	C3Plus.FBI_SignalProcessing0_OutputGreat	Interpolation output of the Position CanSync, PowerLink			Y4	no	-	False	True
3921.8	C3Plus.FBI_SignalProcessing0_Source	Switching the position source of the interpolator			I16	no	immediately	False	True
1141.4	C3Plus.GEAR_mode	Source selection Gearing		0x2055	U16	no	immediately	True	True
3920.1	C3Plus.HEDA_SignalProcessing_Input	Process input signal Slave			C4_3	yes	immediately	True	True
3920.7	C3Plus.HEDA_SignalProcessing_OutputGreat	Output of the Heda Tracking Filter			C4_3	no	-	True	True
900.1	C3Plus.HEDA_State	Status HEDA			I16	no	immediately	False	True
1130.1	C3Plus.HOMING_accel	Acceleration / deceleration MN (homing) run	300	0x609A	U32	no	immediately	True	True
1130.7	C3Plus.HOMING_edge_sensor_distance	Initiator adjustment	304	0x2000	C4_3	no	immediately	True	True
1130.2	C3Plus.HOMING_jerk	Jerk for machine reference run	357	0x201E	U32	no	immediately	True	True
1130.4	C3Plus.HOMING_mode	Adjusting the machine reference mode	302	0x6098	U16	no	immediately	True	True
1130.3	C3Plus.HOMING_speed	Speed for machine reference run	301	0x6099.1	C4_3	no	immediately	True	True
402.6	C3Plus.Limit_CurrentFine	Factor for the current limits		0x2093	I16	yes	immediately	True	True
2201.2	C3Plus.LoadControl_Command	Load control command mode			I16	no	immediately	True	True
2201.1	C3Plus.LoadControl_Enable	Activate load control			I16	no	immediately	True	True
2201.11	C3Plus.LoadControl_FilterLaggingPart	Time constant of position difference filter			U32	no	VP	True	True
2201.12	C3Plus.LoadControl_VelocityFilter	Time constant of the load-speed filter			I16	no	VP	True	True
2201.13	C3Plus.LoadControl_VelocityLimit	Load control intervention speed limitation			I16	no	VP	True	True
201.2	C3Plus.NormFactorY4_Position	Scaling factor for Y4 positions	356.2	0x2021.2	V2	no	immediately	False	True
2150.2	C3Plus.NotchFilter_BandwidthFilter1	Bandwidth of notch filter 1			I16	no	VP	True	True
2150.5	C3Plus.NotchFilter_BandwidthFilter2	Bandwidth of notch filter 2			I16	no	VP	True	True
2150.3	C3Plus.NotchFilter_DepthFilter1	Depth of notch filter 1			I32	no	VP	True	True
2150.6	C3Plus.NotchFilter_DepthFilter2	Depth of notch filter 2			I32	no	VP	True	True
2150.1	C3Plus.NotchFilter_FrequencyFilter1	Center frequency of notch filter 1			I16	no	VP	True	True
2150.4	C3Plus.NotchFilter_FrequencyFilter2	Center frequency of notch filter 2			I16	no	VP	True	True
1200.1	C3Plus.PG2Control_CommandOnRequest	Control of virtual Master	200	0x2040	I16	yes	immediately	False	True
1211.13	C3Plus.PG2POSITION_direction	Manipulation of the motion direction in reset mode			I32	no	immediately	True	True
50.3	C3Plus.PLC_ActualCycleTime	Status of cycle time of the control program	353	0x201F.2	U16	no	-	False	True
50.4	C3Plus.PLC_ActualCycleTimeMax	Status of maximum cycle time	354	0x201F.3	U16	no	immediately	False	True
50.1	C3Plus.PLC_DemandCycleTime	Cycle time specification	352	0x201F.1	U16	no	immediately	True	True
1111.3	C3Plus.POSITION_accel	Acceleration for positioning	114	0x6083	U32	yes	immediately	True	True
1111.4	C3Plus.POSITION_decel	Deceleration for positioning	178/312	0x6084	U32	yes	immediately	True	True
1111.13	C3Plus.POSITION_direction	Manipulation of the motion direction in reset mode			I32	no	immediately	True	True
1111.5	C3Plus.POSITION_jerk_accel	Acceleration jerk for positioning	313	0x2005	U32	no	immediately	True	True
1111.6	C3Plus.POSITION_jerk_decel	Deceleration jerk for positioning	314	0x2006	U32	no	immediately	True	True
1111.1	C3Plus.POSITION_position	Target position	27		C4_3	yes	immediately	True	True
1111.8	C3Plus.POSITION_resetpositon_mode	Continuous mode	0	0	U16	no	immediately	True	True
1111.2	C3Plus.POSITION_speed	Speed for positioning and velocity control	111		C4_3	yes	immediately	True	True
1111.17	C3Plus.POSITION_turnaround	Direction inversion - lock			U16	no	immediately	True	True
2200.2	C3Plus.PositionController_ActualValue	Position actual value (sequentially)			C4_3	yes	-	True	True
2200.20	C3Plus.PositionController_DeadBand	Deadband of position controller			C4_3	no	VP	True	True
2200.1	C3Plus.PositionController_DemandValue	Position setpoint value (sequentially)			C4_3	yes	-	True	True
2200.11	C3Plus.PositionController_TrackingErrorFilter	Following error filter of the position controller			U16	no	VP	True	True
2000.2	C3Plus.ProfilGenerators_PG2Position	Position value of the setpoint encoder of the virtual axis		0x2061	C4_3	yes	-	False	True
2000.1	C3Plus.ProfilGenerators_SG1Position	Position value of the setpoint encoder		0x2060	C4_3	yes	-	True	True
2220.3	C3Plus.Q_CurrentController_Scaling_Q_DemandValueAdditive	Scaling for manual or external current specification			I16	no	immediately	True	True
152.1	C3Plus.RemoteAnalogInput_I0	PIO analog input 0		0x2082.1	I16	yes	immediately	False	True
152.2	C3Plus.RemoteAnalogInput_I1	PIO analog input 1		0x2082.2	I16	yes	immediately	False	True
152.3	C3Plus.RemoteAnalogInput_I2	PIO analog input 2		0x2082.3	I16	yes	immediately	False	True
152.4	C3Plus.RemoteAnalogInput_I3	PIO analog input 3		0x2082.4	I16	yes	immediately	False	True
153.1	C3Plus.RemoteAnalogOutput_O0	PIO analog output 0		0x2083.1	I16	yes	immediately	False	True

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
153.2	C3Plus.RemoteAnalogOutput_O1	PIO analog output 1		0x2083.2	I16	yes	immediately	False	True
153.3	C3Plus.RemoteAnalogOutput_O2	PIO analog output 2		0x2083.3	I16	yes	immediately	False	True
153.4	C3Plus.RemoteAnalogOutput_O3	PIO analog output 3		0x2083.4	I16	yes	immediately	False	True
150.1	C3Plus.RemoteDigInput_I0_15	Digital PIO inputs 0...15		0x2080.1	V2	yes	immediately	False	True
150.2	C3Plus.RemoteDigInput_I16_31	Digital PIO inputs 16...31		0x2080.2	V2	yes	immediately	False	True
150.3	C3Plus.RemoteDigInput_I32_47	Digital PIO inputs 32...47		0x2080.3	V2	yes	immediately	False	True
150.4	C3Plus.RemoteDigInput_I48_63	Digital PIO inputs 48...63		0x2080.4	V2	yes	immediately	False	True
151.1	C3Plus.RemoteDigOutput_O0_15	Digital PIO outputs 0...15		0x2081.1	V2	yes	immediately	False	True
151.2	C3Plus.RemoteDigOutput_O16_31	Digital PIO outputs 16...31		0x2081.2	V2	yes	immediately	False	True
151.3	C3Plus.RemoteDigOutput_O32_47	Digital PIO outputs 32...47		0x2081.3	V2	yes	immediately	False	True
151.4	C3Plus.RemoteDigOutput_O48_63	Digital PIO outputs 48...63		0x2081.4	V2	yes	immediately	False	True
814.11	C3Plus.SafetyMonitor_AlarmCode	Alarm no. S3			U16	no	-	True	
814.13	C3Plus.SafetyMonitor_DiagnosticsBits0_15	DiagnoseBits0_15 S3			U16	no	-	True	
814.14	C3Plus.SafetyMonitor_DiagnosticsBits16_31	DiagnoseBits16_31 S3			U16	no	-	True	
814.15	C3Plus.SafetyMonitor_DiagnosticsBits32_47	DiagnoseBits32_47 S3			U16	no	-	True	
814.16	C3Plus.SafetyMonitor_DiagnosticsBits48_55	DiagnoseBits48_55 S3			U16	no	-	True	
814.12	C3Plus.SafetyMonitor_ErrorCode	Error no. S3			U16	no	-	True	
814.10	C3Plus.SafetyMonitor_OperatingState	Status S3			U16	no	-	True	
814.21	C3Plus.SafetyMonitor_ProcessData_U16_1	Process data U16_1 of S3 (first 2 Bytes)			U16	no	-	True	
814.22	C3Plus.SafetyMonitor_ProcessData_U16_2	Process data U16_2 of S3 (Byte 3 and 4)			U16	no	-	True	
814.23	C3Plus.SafetyMonitor_ProcessData_U16_3	Process data U16_3 of S3 (Byte 5 and 6)			U16	no	-	True	
814.24	C3Plus.SafetyMonitor_ProcessData_U16_4	Process data U16_4 of S3 (Byte 7 and 8)			U16	no	-	True	
814.25	C3Plus.SafetyMonitor_ProcessData_U32_1	Process data U32_1 of S3 (first 4 Bytes)			U32	no	-	True	
814.26	C3Plus.SafetyMonitor_ProcessData_U32_2	Process data U32_2 of S3 (Byte 5 to 8)			U32	no	-	True	
814.27	C3Plus.SafetyMonitor_ProcessData_U32_3	Process data U32_3 of S3 (Byte 3 to 6)			U32	no	-	True	
1127.3	C3Plus.SPEED_speed	Setpoint speed in speed control operating mode	7		C4_3	yes	immediately	True	True
2210.19	C3Plus.SpeedController_ScalingDemandValueAdditive	Scaling for manual or external velocity specification			C4_3	no	immediately	True	True
688.17	C3Plus.StatusCurrent_FieldWeakeningFactor	Reciprocal of the field weakening factor FF			C4_3	no	-	True	True
683.8	C3Plus.StatusDevice_MotorCurrent	Motor current in per thousand of the actual current limit		0x2094	I16	yes	-	False	True
680.8	C3Plus.StatusPosition_Actual_Y4	Status position actual value in the bus format Y4	119	0x2022	Y4	yes	-	False	True
680.32	C3Plus.StatusPosition_EncoderIncrements5V	Encoder position 0 (5V) in increments		0x2095.3	I32	yes	immediately	True	True
680.24	C3Plus.StatusPosition_SSI_AbsolutPosition_LoadUnits	AbsolutPosition of the SSI-feedback load unit			C4_3	no	-	True	True
680.25	C3Plus.StatusPosition_SSI_AbsolutPosition_MasterUnits	AbsolutPosition of the SSI-feedback master unit			C4_3	no	-	True	True
684.4	C3Plus.StatusTemperature_TmotResistance	Status of motor temperature resistance value			U16	no	-	True	True
670.4	C3Plus.StatusTorqueForce_ActualForce	Status of actual force			I32	no	-	True	True
670.2	C3Plus.StatusTorqueForce_ActualTorque	Status of actual torque			I32	no	-	True	True
670.3	C3Plus.StatusTorqueForce_SetpointForce	Status of setpoint force			I32	no	-	True	True
670.1	C3Plus.StatusTorqueForce_SetpointTorque	Status of setpoint torque			I32	no	-	True	True
110.1	C3Plus.Switch_DeviceFunction	Value of the function switch on C3M			U16	no	-	True	True
2109.1	C3Plus.TrackingfilterHEDA_TRFSpeed	Time constant tracking filter HEDA-process position			I16	no	VP	True	True
2107.1	C3Plus.TrackingfilterPhysicalSource_TRFSpeed	Time constant tracking filter physical source			U16	no	VP	True	True
2110.4	C3Plus.TrackingfilterSG1_AccelFilter	Filter effect of acceleration filter setpoint encoder			U16	no	VP	True	True
2110.3	C3Plus.TrackingfilterSG1_FilterSpeed	Filter effect of speed filter setpoint encoder			U16	no	VP	True	True
2110.1	C3Plus.TrackingfilterSG1_TRFSpeed	Time constant tracking filter setpoint encoder		0x2096	I16	no	VP	True	True
210.8	C3Plus.ValidParameter_Autocommutation	Set position auto commutation parameters to valid			U16	no	immediately	True	True
210.9	C3Plus.ValidParameter_CamControlledSwitches	Set cam switching mechanism parameters to valid	338.9	0x2016.9	U16	no	immediately	False	True
210.1	C3Plus.ValidParameter_CurrentController	Set current controller to valid			U16	no	immediately	True	True
210.5	C3Plus.ValidParameter_FeedForward	Set feedforward parameters to valid.			U16	no	immediately	True	True
210.2	C3Plus.ValidParameter_FiltersRSDP	Set filter parameter to valid			U16	no	immediately	True	True
210.4	C3Plus.ValidParameter_PositionController	Set position controller to valid			U16	no	immediately	True	True
210.3	C3Plus.ValidParameter_SpeedController	Set parameter velocity controller/velocity observer to valid.			U16	no	immediately	True	True

7.2.3. C3Array objects

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
1901.1	C3Array.Col01_Row01	variable Column 1 Row 1	130/341.1	0x2301.1	Y4	yes	immediately	True	True
1901.2	C3Array.Col01_Row02	Variable Column 1 Row 2	131/341.2	0x2301.2	Y4	yes	immediately	True	True
1901.3	C3Array.Col01_Row03	Variable Column 1 Row 3	132/341.3	0x2301.3	Y4	yes	immediately	True	True
1901.4	C3Array.Col01_Row04	Variable Column 1 Row 4	133/341.4	0x2301.4	Y4	yes	immediately	True	True
1901.5	C3Array.Col01_Row05	Variable Column 1 Row 5	134/341.5	0x2301.5	Y4	yes	immediately	True	True
1902.1	C3Array.Col02_Row01	variable Column 2 Row 1	135/342.1	0x2302.1	Y2	yes	immediately	True	True
1902.2	C3Array.Col02_Row02	variable Column 2 Row 2	136/342.2	0x2302.2	Y2	yes	immediately	True	True
1902.3	C3Array.Col02_Row03	variable Column 2 Row 3	137/342.3	0x2302.3	Y2	yes	immediately	True	True
1902.4	C3Array.Col02_Row04	Variable Column 2 Row 4	138/342.4	0x2302.4	Y2	yes	immediately	True	True
1902.5	C3Array.Col02_Row05	Variable Column 2 Row 5	139/342.5	0x2302.5	Y2	yes	immediately	True	True
1903.1	C3Array.Col03_Row01	variable Column 3 Row 1	140/343.1	0x2303.1	I16	yes	immediately	True	True
1903.2	C3Array.Col03_Row02	Variable Column 3 Row 2	141/343.2	0x2303.2	I16	yes	immediately	True	True
1903.3	C3Array.Col03_Row03	Variable Column 3 Row 3	142/343.3	0x2303.3	I16	yes	immediately	True	True
1903.4	C3Array.Col03_Row04	Variable Column 3 Row 4	143/343.4	0x2303.4	I16	yes	immediately	True	True
1903.5	C3Array.Col03_Row05	Variable Column 3 Row 5	144/343.5	0x2303.5	I16	yes	immediately	True	True
1904.1	C3Array.Col04_Row01	variable Column 4 Row 1	145/344.1	0x2304.1	I16	yes	immediately	True	True
1904.2	C3Array.Col04_Row02	Variable Column 4 Row 2	146/344.2	0x2304.2	I16	yes	immediately	True	True
1904.3	C3Array.Col04_Row03	Variable Column 4Row 3	147/344.3	0x2304.3	I16	yes	immediately	True	True
1904.4	C3Array.Col04_Row04	Variable Column 4 Row 4	148/344.4	0x2304.4	I16	yes	immediately	True	True
1904.5	C3Array.Col04_Row05	Variable Column 4 Row 5	149/344.5	0x2304.5	I16	yes	immediately	True	True
1905.1	C3Array.Col05_Row01	variable Column 5 Row 1	150/345.1	0x2305.1	I16	yes	immediately	True	True
1905.2	C3Array.Col05_Row02	Variable Column 5 Row 2	151/345.2	0x2305.2	I16	yes	immediately	True	True
1905.3	C3Array.Col05_Row03	Variable Column 5 Row 3	152/345.3	0x2305.3	I16	yes	immediately	True	True
1905.4	C3Array.Col05_Row04	Variable Column 5 Row 4	153/345.4	0x2305.4	I16	yes	immediately	True	True
1905.5	C3Array.Col05_Row05	Variable Column 5Row 5	154/345.5	0x2305.5	I16	yes	immediately	True	True
1906.1	C3Array.Col06_Row01	variable Column 6 Row 1	155/346.1	0x2306.1	I32	yes	immediately	True	True
1906.2	C3Array.Col06_Row02	Variable Column 6 Row 2	156/346.2	0x2306.2	I32	yes	immediately	True	True
1906.3	C3Array.Col06_Row03	Variable Column 6 Row 3	157/346.3	0x2306.3	I32	yes	immediately	True	True
1906.4	C3Array.Col06_Row04	Variable Column 6 Row 4	158/346.4	0x2306.4	I32	yes	immediately	True	True
1906.5	C3Array.Col06_Row05	Variable Column 6 Row 5	159/346.5	0x2306.5	I32	yes	immediately	True	True
1907.1	C3Array.Col07_Row01	variable Column 7 Row 1	160/347.1	0x2307.1	I32	yes	immediately	True	True
1907.2	C3Array.Col07_Row02	Variable Column 7 Row 2	161/347.2	0x2307.2	I32	yes	immediately	True	True
1907.3	C3Array.Col07_Row03	Variable Column 7 Row 3	162/347.3	0x2307.3	I32	yes	immediately	True	True
1907.4	C3Array.Col07_Row04	Variable Column 7 Row 4	163/347.4	0x2307.4	I32	yes	immediately	True	True
1907.5	C3Array.Col07_Row05	Variable Column 7 Row 5	164/347.5	0x2307.5	I32	yes	immediately	True	True
1908.1	C3Array.Col08_Row01	variable Column 8 Row 1	165/348.1	0x2308.1	I32	yes	immediately	True	True
1908.2	C3Array.Col08_Row02	Variable Column 8 Row 2	166/348.2	0x2308.2	I32	yes	immediately	True	True
1908.3	C3Array.Col08_Row03	Variable Column 8 Row 3	167/348.3	0x2308.3	I32	yes	immediately	True	True
1908.4	C3Array.Col08_Row04	Variable Column 8 Row 4	168/348.4	0x2308.4	I32	yes	immediately	True	True
1908.5	C3Array.Col08_Row05	Variable Column 8 Row 5	169/348.5	0x2308.5	I32	yes	immediately	True	True
1909.1	C3Array.Col09_Row01	variable Column 9 Row 1	170/349.1	0x2309.1	I32	yes	immediately	True	True
1909.2	C3Array.Col09_Row02	Variable Column 9 Row 2	171/349.2	0x2309.2	I32	yes	immediately	True	True
1909.3	C3Array.Col09_Row03	Variable Column 9 Row 3	172/349.3	0x2309.3	I32	yes	immediately	True	True
1909.4	C3Array.Col09_Row04	Variable Column 9 Row 4	173/349.4	0x2309.4	I32	yes	immediately	True	True
1909.5	C3Array.Col09_Row05	Variable Column 9 Row 5	174/349.5	0x2309.5	I32	yes	immediately	True	True
1910.1	C3Array.Indirect_Col01	Indirect table access Column 1	181	0x2311	Y4	yes	immediately	True	True
1910.2	C3Array.Indirect_Col02	Indirect table access Column 2	182	0x2312	Y2	yes	immediately	True	True

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
1910.3	C3Array.Indirect_Col03	Indirect table access Column 3	183	0x2313	I16	yes	immediately	True	True
1910.4	C3Array.Indirect_Col04	Indirect table access Column 4	184	0x2314	I16	yes	immediately	True	True
1910.5	C3Array.Indirect_Col05	Indirect table access Column 5	185	0x2315	I16	yes	immediately	True	True
1910.6	C3Array.Indirect_Col06	Indirect table access Column 6	186	0x2316	I32	yes	immediately	True	True
1910.7	C3Array.Indirect_Col07	Indirect table access Column 7	187	0x2317	I32	yes	immediately	True	True
1910.8	C3Array.Indirect_Col08	Indirect table access Column 8	188	0x2318	I32	yes	immediately	True	True
1910.9	C3Array.Indirect_Col09	Indirect table access Column 9	189	0x2319	I32	yes	immediately	True	True
1900.1	C3Array.Pointer_Row	Pointer to table row	180	0x2300	U16	yes	immediately	True	True

7.2.4. Cam objects

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
3730.3	C3Cam.ControlledSwitch00_PositionOff	switch-off position of cam	509.1	0x2409.1	C4_3	no	VP	False	True
3730.2	C3Cam.ControlledSwitch00_PositionOn	switch-on position of cam	508.1	0x2408.1	C4_3	no	VP	False	True
3730.1	C3Cam.ControlledSwitch00_Source	source of cam	507.1	0x2407.1	I16	no	VP	False	True
3730.5	C3Cam.ControlledSwitch00_TimeOff	switch-off anticipation of cam	511.1	0x240B.1	I16	no	immediately	False	True
3730.4	C3Cam.ControlledSwitch00_TimeOn	switch-on anticipation of cam	510.1	0x240A.1	I16	no	immediately	False	True
3701.2	C3Cam.ControlledSwitches_Enable0	enable of cam group 0	501.2	0x2401.2	U16	no	immediately	False	True
3701.4	C3Cam.ControlledSwitches_Enable1	enable of cam group 1	501.4	0x2401.4	U16	no	immediately	False	True
3701.6	C3Cam.ControlledSwitches_NumberPerCycle	Number of cams in one cycle			U16	no	immediately	False	True
3701.3	C3Cam.ControlledSwitches_Output0	output of cam group 0	205/501.3	0x2401.3	U16	yes	immediately	False	True
3701.5	C3Cam.ControlledSwitches_Output1	output of cam group 1	206/501.5	0x2401.5	U16	yes	immediately	False	True
3700.2	C3Cam.ControlledSwitchesFast_Enable	enable fast cams	500.2	0x2400.2	U16	no	immediately	False	True
3700.3	C3Cam.ControlledSwitchesFast_Output	output for fast cams	204/500.3	0x2400.3	U16	yes	immediately	False	True
3705.1	C3Cam.ControlledSwitchesHysteresis_ActualPosition	Hysteresis for cam switching mechanism, source "current position"			C4_3	no	VP	False	True
3705.5	C3Cam.ControlledSwitchesHysteresis_Masterposition	Hysteresis for cam switching mechanism, source "master position"			C4_3	no	VP	False	True
3710.3	C3Cam.ControlledSwitchFast0_PositionOff	switch-off position for fast cam	504.1	0x2404.1	C4_3	no	VP	False	True
3710.2	C3Cam.ControlledSwitchFast0_PositionOn	switch-on position for fast cam	503.1	0x2403.1	C4_3	no	VP	False	True
3710.1	C3Cam.ControlledSwitchFast0_Source	source of fast cam	502.1	0x2402.1	I16	no	VP	False	True
3710.5	C3Cam.ControlledSwitchFast0_TimeOff	switch-off anticipation of fast cam	506.1	0x2406.1	I16	no	immediately	False	True
3710.4	C3Cam.ControlledSwitchFast0_TimeOn	switch-on anticipation of fast cam	505.1	0x2405.1	I16	no	immediately	False	True
3022.1	C3Cam.Manipulation_OffsetMasterposition	Master position offset			C4_3	no	immediately	False	True
3022.6	C3Cam.Manipulation_OffsetMasterposition_Units	Offset Master position			C4_3	no	immediately	False	True
3022.3	C3Cam.Manipulation_ScalefactorMasterGlobal	Global scaling factor for the master speed			C4_3	no	immediately	False	True
3021.10	C3Cam.SignalSource_InputAdditional	CAM Master position			C4_3	yes	immediately	False	True
3021.2	C3Cam.SignalSource_Position	Status of position of selected master signal source			C4_3	yes	-	False	True
3021.1	C3Cam.SignalSource_Select	Source of master position			U16	no	immediately	False	True
3031.4	C3Cam.StatusData_ActualCurve	Current curve number			I16	no	-	False	True
3030.7	C3Cam.StatusMaster_Enable	Status: Enable of master acquisition			U16	no	-	False	True
3030.17	C3Cam.StatusMaster_EnableCam	Status: Enable of cam input			U16	no	-	False	True
3030.12	C3Cam.StatusMaster_PhasingSum	Added up position sum of the master-side phasing			C4_3	no	-	False	True
3030.1	C3Cam.StatusMaster_Position	Reset master position	207	0x2410	C4_3	yes	-	False	True
3030.24	C3Cam.StatusMaster_PositionCamUnits	Master position at the beginning of the curve			C4_3	yes	-	False	True
3030.22	C3Cam.StatusMaster_SpeedUnits	Master speed [Units/s]			C4_3	no	-	False	True
3032.4	C3Cam.StatusOutput_AbsolutePositionGreat	Slave position (free running)			C4_3	yes	-	False	True
3032.24	C3Cam.StatusOutput_CurvePositionUnits	End of curve	208	0x2411	C4_3	yes	-	False	True
3032.1	C3Cam.StatusOutput_Position	Slave position			C4_3	yes	-	False	True

7.2.5. C3 objects (without CoDeSys objects)

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
170.2	AnalogInput0_Gain	Gain analog input 0			C4_3	no	VP	True	True
170.4	AnalogInput0_Offset	Analog input Offset 0			I16	no	immediately	True	True
171.2	AnalogInput1_Gain	Gain analog input 1			C4_3	no	VP	True	True

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
171.4	AnalogInput1_Offset	Analog input offset 1			I16	no	immediately	True	True
2190.2	AutoCommutationControl_InitialCurrent	Start current of automatic commutation			U16	no	VP	True	True
2190.4	AutoCommutationControl_MotionReduction	Motion reduction Automatic commutation			U16	no	VP	True	True
2190.8	AutoCommutationControl_PeakCurrent	Reduction of the peak current			U16	no	VP	True	True
2190.3	AutoCommutationControl_PositionThreshold	Motion limit for automatic commutation			U16	no	VP	True	True
2190.1	AutoCommutationControl_Ramptime	Ramp slope current slope AK			U16	no	VP	True	True
2190.10	AutoCommutationControl_Reset	Reset automatic commutation			U16	no	immediately	True	True
2190.7	AutoCommutationControl_StandstillThreshold	Optimization of the standstill threshold			U16	no	VP	True	True
2100.20	ControllerTuning_ActuatingSpeedSignalFilt_us	Control signal filter of velocity control			U16	no	VP	True	True
2100.21	ControllerTuning_FilterAccel_us	Filter - Actual acceleration			U16	no	VP	True	True
2230.20	D_CurrentController_Ld_Lq_Ratio	Ratio direct to quadrature inductance			U16	no	VP	True	True
2230.24	D_CurrentController_VoltageDecouplingEnable	Activation of the voltage decoupling			I16	no	VP	True	True
990.1	Delay_MasterDelay	Setpoint delay for bus master			I16	no	immediately	True	True
1.21	Device_FirmwareRelease	Version of firmware package		0x20FF	I32	no	immediately	False	True
1.15	Device_ProfileID	Profibus profile number	965		OS	no	-	False	True
84.4	DeviceSupervision_DeviceAdr	Current RS485 address of the C3M			U16	no	-	True	True
84.3	DeviceSupervision_DeviceCounter	Number of devices in the C3M combination			U16	no	-	True	True
84.5	DeviceSupervision_OperatingTime	Hours of operation of the PSUP in s			U32	no	-	True	True
84.2	DeviceSupervision_ThisDevice	Device number in the C3M combination			U16	no	-	True	True
85.8	Diagnostics_ChopperOff_Voltage	Chopper Switch-off threshold in V			I16	no	-	True	True
85.7	Diagnostics_ChopperOn_Voltage	Chopper Switch-on threshold in V			I16	no	-	True	True
85.9	Diagnostics_DCbus_VoltageMax	Reduced DC bus voltage in V			I16	no	-	True	True
85.1	Diagnostics_DeviceState	PSUP operating state			V2	no	-	True	True
120.3	DigitalInput_DebouncedValue	Status of digital inputs	21	0x6100.1	V2	yes	-	True	True
550.2	ErrorHistory_1	Error (n-1) in the error history	947.1	0x201D.2	U16	no	-	False	True
87.1	ErrorHistoryNumber_1	Error 1			U16	no	-	True	True
86.1	ErrorHistoryPointer_LastEntry	Pointer to current error			U16	no	-	True	True
88.1	ErrorHistoryTime_1	Error point in time 1			U32	no	-	True	True
3925.21	FBI_Interpolation_AccelInput	Acceleration specification GEARING CanSync/EthernetPowerLink		0x2099	I32	yes	immediately	False	True
3925.23	FBI_Interpolation_AccelStatus	Input value of the acceleration of O3925.21			C4_3	no	-	False	True
3925.1	FBI_Interpolation_SubModeSelect	Interpolation method		0x60C0	I16	no	immediately	False	True
3925.20	FBI_Interpolation_VelocityInput	Velocity specification GEARING CanSync/EthernetPowerLink		0x2098	I32	yes	immediately	False	True
3925.22	FBI_Interpolation_VelocityStatus	Input speed of the differentiated input position O2121.1			C4_3	no	-	False	True
950.1	FBI_RxPD_Mapping_Object_1	1. Object of the setpoint PZD (Profibus)	915.0		U16	no	immediately	False	True
950.2	FBI_RxPD_Mapping_Object_2	2. object of the Setpoint value PZD	915.1		U16	no	immediately	False	True
950.3	FBI_RxPD_Mapping_Object_3	3. object of the Setpoint value PZD	915.2		U16	no	immediately	False	True
950.4	FBI_RxPD_Mapping_Object_4	4. object of the Setpoint value PZD	915.3		U16	no	immediately	False	True
950.5	FBI_RxPD_Mapping_Object_5	5. object of the Setpoint value PZD	915.4		U16	no	immediately	False	True
950.6	FBI_RxPD_Mapping_Object_6	6. object of the Setpoint value PZD	915.5		U16	no	immediately	False	True
950.7	FBI_RxPD_Mapping_Object_7	7. object of the Setpoint value PZD	915.6		U16	no	immediately	False	True
950.8	FBI_RxPD_Mapping_Object_8	8. object of the Setpoint value PZD	915.7		U16	no	immediately	False	True
3921.1	FBI_SignalProcessing0_Input	Interpolation input CanSync, PowerLink		0x2050	I32	yes	immediately	False	True
951.1	FBI_TxPD_Mapping_Object_1	1. object of actual value PZD	916.0		U16	no	immediately	False	True
951.2	FBI_TxPD_Mapping_Object_2	2. object of actual value PZD	916.1		U16	no	immediately	False	True
951.3	FBI_TxPD_Mapping_Object_3	3. object of actual value PZD	916.2		U16	no	immediately	False	True
951.4	FBI_TxPD_Mapping_Object_4	4. object of actual value PZD	916.3		U16	no	immediately	False	True
951.5	FBI_TxPD_Mapping_Object_5	5. object of actual value PZD	916.4		U16	no	immediately	False	True
951.6	FBI_TxPD_Mapping_Object_6	6. object of actual value PZD	916.5		U16	no	immediately	False	True
951.7	FBI_TxPD_Mapping_Object_7	7. object of actual value PZD	916.6		U16	no	immediately	False	True
951.8	FBI_TxPD_Mapping_Object_8	8. object of actual value PZD	916.7		U16	no	immediately	False	True
2050.8	FeedForward_2_Valve	Valve feedforward auxiliary axis			U16	no	VP	True	True
2010.20	FeedForward_EMF	EMC feedforward			U16	no	VP	True	True
2010.21	FeedForward_Valve	Valve feedforward			U16	no	VP	True	True
2011.5	FeedForwardExternal_FilterAccel_us	Filter time constant ext. Acceleration			U16	no	VP	True	True
2011.4	FeedForwardExternal_FilterSpeed_us	Filter time constant ext. Speed			U16	no	VP	True	True
1141.8	GEAR_actual_master_speed	Master speed for Gearing			C4_3	no	-	True	True
1141.7	GEAR_actual_masterposition	Position input value for Gearing		0x2058	C4_3	no	-	True	True
1141.10	GEAR_FFW_mode	Control bits for feedforward with source CANSync/EthernetPowerLink/EtherCat		0x2097	U16	no	immediately	False	True

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
900.12	HEDA_CRC_ErrorCounter	Error counter CRC (HEDA)			U32	no	immediately	False	True
900.13	HEDA_SyncErrorCounter	Error counter Sync (HEDA)			U32	no	immediately	False	True
1130.13	HOMING_edge_position	Distance MN (zero) initiator - motor zero			C4_3	no	immediately	True	True
2201.3	LoadControl_Status	Load control status bits			I16	no	-	True	True
2240.7	Magnetization current controller_Bandwidth	Magnetization current controller bandwidth (ASM)			I16	no	VP	True	True
2240.4	Magnetization current controller_Damping	Magnetization current controller attenuation(ASM)			I16	no	VP	True	True
2240.11	Magnetization current controller_Field weakening speed	Reference speed quantifier (ASM)			I16	no	VP	True	True
2240.2	Magnetization current controller_IMrn_DemandValueTuning	Magnetization current quantifier (ASM)			I16	no	VP	True	True
2240.10	Magnetization current controller_RotorTimeConstant	Motor Time Constant quantifier	0	0	I16	no	VP	True	True
2240.9	Magnetization current controller_SlipFrequency	Slip frequency quantifier (ASM)	0	0	I16	no	VP	True	True
200.10	NormFactorY2_ActualValue2_Y2	Normalization factor for 1000.14			V2	no	immediately	False	True
200.7	NormFactorY2_ActualValue3	Normalization factor for 1000.8	355.7	0x2020.7	V2	no	immediately	False	True
200.8	NormFactorY2_ActualValue4	Normalization factor for 1000.9	355.8	0x2020.8	V2	no	immediately	False	True
200.5	NormFactorY2_Array_Col2	Normalization factor recipe arrays column 2	355.5	0x2020.5	V2	no	immediately	False	True
200.9	NormFactorY2_DemandValue2_Y2	Normalization factor for 1100.14 1100.14			V2	no	immediately	False	True
200.4	NormFactorY2_DemandValue3	Normalization factor for 1100.8	355.4	0x2020.4	V2	no	immediately	False	True
200.6	NormFactorY2_DemandValue4	Normalization factor for 1100.9	355.6	0x2020.6	V2	no	immediately	False	True
200.1	NormFactorY2_Speed	Normalization factor for Y2 speeds	355.1	0x2020.1	V2	no	immediately	False	True
200.3	NormFactorY2_Voltage	Normalization factor for Y2 voltages	355.3	0x2020.3	V2	no	immediately	False	True
201.7	NormFactorY4_ActualValue1	Normalization factor for 1000.6	356.7	0x2021.7	V2	no	immediately	False	True
201.8	NormFactorY4_ActualValue2	Normalization factor for 1000.7	356.8	0x2021.8	V2	no	immediately	False	True
201.13	NormFactorY4_ActualValue8	Normalization factor for 1000.13	356.13	0x2021.13	V2	no	immediately	False	True
201.4	NormFactorY4_Array_Col1	Scaling factor recipe arrays column 1	356.4	0x2021.4	V2	no	immediately	False	True
201.5	NormFactorY4_DemandValue1	Normalization factor for 1100.6	356.5	0x2021.5	V2	no	immediately	False	True
201.6	NormFactorY4_DemandValue2	Normalization factor for 1100.7	356.6	0x2021.6	V2	no	immediately	False	True
201.12	NormFactorY4_DemandValue8	Normalization factor for 1100.13	356.12	0x2021.12	V2	no	immediately	False	True
201.11	NormFactorY4_FBI_SignalProcessing	Normalization factor for bus interpolation CANSync/EthernetPowerLink	356.11	0x2021.11	V2	no	immediately	False	True
201.1	NormFactorY4_Speed	Scaling factor for Y4 speeds	356.1	0x2021.1	V2	no	immediately	False	True
201.3	NormFactorY4_Voltage	Scaling factor for Y4 voltages	356.3	0x2021.3	V2	no	immediately	False	True
20.1	ObjectDir_Objekts-->FLASH	Store objects permanently (bus)	339	0x2017	I16	no	immediately	False	True
2200.21	PositionController_FrictionCompensation	Friction compensation			I32	no	VP	True	True
2200.25	PositionController_IntegralPart	I term of position controller			U16	no	VP	True	True
2200.24	PositionController_TrackingErrorFilter_us	Time constant following error filter of position controller			U16	no	VP	True	True
830.2	Profibus_Baudrate	Baud rate			U32	no	-	False	True
830.3	Profibus_NodeAddress	Node address	918		U16	no	-	False	True
830.1	Profibus_Protocol	PPO-type selection switch			U16	no	immediately	False	True
830.6	Profibus_StandardSignalTable	List of Profidrive standard signals	923.x		U16	no	-	False	True
830.4	Profibus_TelegramSelect	Telegram selection switch	922		U16	no	immediately	False	True
2000.8	ProfilGenerators_PG2Accel	Acceleration of the virtual axis			I32	no	-	False	True
2000.5	ProfilGenerators_PG2Speed	Speed of the virtual axis		0x2064	I32	yes	-	False	True
2000.4	ProfilGenerators_SG1Speed	Speed of the setpoint encoder		0x2063	I32	yes	-	True	True
2220.22	Q_CurrentController_BackEMF	Parameter motor force constant			I16	no	VP	True	True
2220.20	Q_CurrentController_Inductance	Parameter motor inductance			I16	no	VP	True	True
2220.4	Q_CurrentController_Q_ActualValue	Cross-flow actual value			I16	yes	-	True	True
2220.1	Q_CurrentController_Q_DemandValue	Quadrature Current CommandValue			I16	yes	-	True	True
2220.2	Q_CurrentController_Q_DemandValueAdditive	Manual or external cross current specification			I16	yes	immediately	True	True
2220.21	Q_CurrentController_Resistance	Parameter motor resistance			I16	no	VP	True	True
2220.27	Q_CurrentController_StructureSelection	Structure switch of current control			I16	no	VP	True	True
814.20	SafetyMonitor_ProcessData	Total process data S3			OS	no	-	True	
2210.17	SpeedController_ActualBandwidth	Replacement time constant for the velocity control			I32	no	-	True	True
2210.2	SpeedController_ActualValue	Actual (rotational) speed			I32	yes	-	True	True
2210.1	SpeedController_DemandValue	Velocity setpoint value			I32	yes	-	True	True
2210.14	SpeedController_DemandValueAdditive	Manual or external velocity specification			I32	yes	immediately	True	True
2210.5	SpeedController_I_Part_Gain	Weighting "I" term			U16	no	VP	True	True
2210.4	SpeedController_P_Part_Gain	P term quantifier			U16	no	VP	True	True
2120.7	SpeedObserver_DisturbanceAdditionEnable	Switch to enable disturbance compensation			I16	no	VP	True	True
2120.5	SpeedObserver_DisturbanceFilter	Time constant disturbance filter			U32	no	VP	True	True

No.	Object name	Object	I20,I32 Bus-No	I21,I30,I31 Bus-No	Format	PD	Valid beginning	Device assignment	
								I11	Bus
2120.1	SpeedObserver_TimeConstant	Rapidity of the speed monitor			U32	no	VP	True	True
295.10	SSI_Feedback_X11_Incr_Position	SSI feedback position (Increments)			I32	no	-	True	True
682.7	StatusAccel_FeedForwardAccel	Status acceleration feed forward			C4_3	no	-	True	True
690.5	StatusAutocommutation_Itterations	Current increase steps automatic commutation			U16	no	-	True	True
688.8	StatusCurrent_ControlDeviationIq	Status control deviation current control RMS			C4_3	no	-	True	True
688.31	StatusCurrent_DecouplingVoltageUd	Signal decoupling of direct current controller			C4_3	no	-	True	True
688.32	StatusCurrent_FeedForwardbackEMF	Signal EMC feedforward			C4_3	no	-	True	True
688.14	StatusCurrent_FeedForwordCurrentJerk	Status of current & jerk feedforward			C4_3	no	-	True	True
688.9	StatusCurrent_PhaseU	Status of current phase U			C4_3	no	-	True	True
688.10	StatusCurrent_PhaseV	Status of current phase V			C4_3	no	-	True	True
688.11	StatusCurrent_ReferenceVoltageUq	Status of current control control signal			C4_3	no	-	True	True
688.22	StatusCurrent_ReferenceVoltageVector	Provided voltage pointer			C4_3	no	-	True	True
688.30	StatusCurrent_VoltageUd	Provided voltage of direct current controller			C4_3	no	-	True	True
688.29	StatusCurrent_VoltageUq	Provided voltage of quadrature current controller			C4_3	no	-	True	True
692.4	StatusFeedback_EncoderCosine	Status of analog input cosine			I32	no	-	True	True
692.3	StatusFeedback_EncoderSine	Status of analog input sine			I32	no	-	True	True
692.2	StatusFeedback_FeedbackCosineDSP	Status of cosine in signal processing			I32	yes	-	True	True
692.1	StatusFeedback_FeedbackSineDSP	Status of sine in signal processing			I32	yes	-	True	True
692.5	StatusFeedback_FeedbackVoltage[Vpp]	Status of feedback level			C4_3	no	-	True	True
689.1	StatusHeda_RxPD	Receive string			OS	no	-	False	True
689.2	StatusHeda_TxPD	Transmit string			OS	no	-	False	True
3030.13	StatusMaster_InputSum	Free running master position after MP enable			C4_3	yes	-	False	True
680.20	StatusPosition_LoadControlDeviation	Position difference load-motor (unfiltered)			C4_3	no	-	True	True
681.7	StatusSpeed_ActualFiltered_Y2	Status of the actual filtered speed speed in the Y2 format	6	0x2023	Y2	yes	-	False	True
681.8	StatusSpeed_ActualFiltered_Y4	Status of the actual filtered peed in the Y4 format	117	0x2024	Y4	yes	-	False	True
681.25	StatusSpeed_NegativeLimit	Negative speed limit currently effective			C4_3	no	-	True	True
681.24	StatusSpeed_PositiveLimit	Positive speed limit currently effective			C4_3	no	-	True	True
2110.7	TrackingfilterSG1_AccelFilter_us	Filter time constant acceleration setpoint generator			U16	no	VP	True	True
2110.6	TrackingfilterSG1_FilterSpeed_us	Filter time constant velocity setpoint generator			U16	no	VP	True	True

7.3 Detailed object list

A detailed object list can be found in the corresponding online help.

8. Status values

In this chapter you can read about:

A list of the status values supports you in optimization and commissioning.

Open the optimization function in the C3 ServoManager (double-click on optimization in the tree)

You will find the available status values in the lower right part of the window under selection (TAB) “Status values”.

You can pull them into the oscilloscope (upper part of the left side) or into the status display (upper part of the right side) by the aid of the mouse (drag and drop).

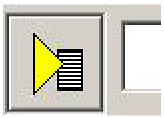
The status values are divided into 2 groups (user levels):

standard: here you can find all important status values

advanced: Advanced status values, require a better knowledge

Switching of the user level

The user level can be changed in the optimization window (left hand side lower part under selection (TAB) "optimization") with the following button.



8.1 D/A-Monitor

A part of the status values can be output via the D/A monitor channel 0 (X11/4) and channel 1 (X11/3).In the following status list under D/A monitor output: possible / not possible).

The reference for the output voltage can be entered individually in the reference unit of the status value.

Example: Output Object 2210.2: (actual speed unfiltered)

In order to get an output voltage of 10V at 3000prm , please enter rev/s (=3000rpm) as "value of the signal at 10V".

Hint

The unit of measurement of the D/A monitor values differs from the unit of measurement of the status values.

8.2 Status values

Additional information on the topic of "status values" can be found in the online help of the device.

9. Error

Standard error reactions:

Reaction 2: Downramp with "de-energize" **then apply brake** (see on page 289) and finally de-energize.

For errors with standard reaction 2 the **error reaction can be changed** (see on page 441, see on page 151).

Reaction 5: deenergize immediately (without ramps), apply brake.

Caution! A Z-axis may drop down due to the brake delay times

Most pending errors can be acknowledged with Quit!

The following errors must be acknowledged with Power on:

0x7381, 0x7382, 0x7391, 0x7392, 0x73A0

Object 550.1 displays error:
value 1 means "no error".

The errors as well as the error history can be viewed in the C3 ServoManager under optimization (at the top right of the optimization window).

9.1 Error list

Detailed information on the topic of the "error list" can be found in the online help of the device.

10. Order code

10.1 Order code device: Compax3

Example: C3S025V2F10I10T10M00	C3 ☐	☐	☐	☐	☐	☐	☐	☐
Device type: Compax3								
Single axis	S							--
Highpower	H							--
Multi-axis device	M							
Device currents static/dynamic; supply voltage								
2.5A / 5A ; 230VAC (single phase)	S	025	V2					--
6.3 A / 12.6 A ; 230VAC (1 phase)	S	063	V2					--
10A / 20A ; 230VAC (three phase)	S	100	V2					--
15A / 30A ; 230VAC (three phase)	S	150	V2					--
1.5A / 4.5A ; 400VAC (three phase)	S	015	V4					--
3.8 A / 7.5 A ; 400VAC (3 phase)	S	038	V4					--
7.5 A / 15.0 A ; 400VAC (3 phase)	S	075	V4					--
15.0 A / 30.0 A ; 400VAC (3 phase)	S	150	V4					--
30.0 A / 60.0 A ; 400VAC (3 phase)	S	300	V4					--
50A / 75A ; 400VAC (three phase)	H	050	V4					--
90A / 135A ; 400VAC (three phase)	H	090	V4					--
125A / 187.5A ; 400VAC (three phase)*	H	125	V4					--
155A / 232.5A ; 400VAC (three phase)*	H	155	V4					--
5.0A / 10,0A ; 400VAC (three phase)	M	050	D6					
10A / 20A ; 400VAC (three phase)	M	100	D6					
15A / 30A ; 400VAC (three phase)	M	150	D6					
60A 30A / ; 400VAC (three phase)	M	300	D6					
Feedback:								
Resolver				F10				
SinCos© (Hiperface)				F11				
Encoder, Sine-cosine with/without hall				F12				
Interface:								
Step/direction / analogue input					I10	T10	M00	
Positioning with inputs/outputs					I11	T11	M00	
Positioning via I/Os or RS232 / RS485/USB					I12			
Profibus DP V0/V1/V2 (12Mbaud)					I20			
CANopen					I21			
DeviceNet					I22			
Ethernet Powerlink					I30			
EtherCAT					I31			
Profinet					I32			
C3 powerPLmC (Multi-axis control)					C20		M00	
Technology functions:								
Positioning						T11		
Motion control programmable according to IEC61131-3						T30		
Motion control programmable according to IEC61131-3 & electronic cam extension						T40		
Options:								
no additional supplement							M00	
Expansion 12 digital I/Os & HEDA (Motionbus)							M10	
HEDA (Motionbus)							M11	
Expansion, 12 digital I/Os							M12	
Safety technology only C3M:								
Safe torque off	M		D6					S1
Extended safety technology	M		D6					S3

*external voltage supply for ventilator fan required. Available in two versions for single phase feed:
Standard: 220/240VAC: 140W, on request: 110/120VAC: 130W

10.2 Order code for mains module: PSUP

Example: PSUP10D6USBM00	PSU P		D6	USB	M00
Power module	P				
Nominal power; supply voltage					
10kW; 400 VAC (3-phase)		10	D6		
20kW; 400 VAC (3-phase)		20	D6		
30kW; 400 VAC (3-phase)		30	D6		
Interface:					
USB connection				USB	
Options:					
no additional supplement					M00

10.3 Order code for accessories

Order Code connection set for Compax3S

The corresponding connection sets are furnished with the device.				/	
for C3S0xxV2	ZBH 02/01	ZBH	0 2	/	0 1
for C3S0xxV4 / S150V4 / S1xxV2	ZBH 02/02	ZBH	0 2	/	0 2
for C3S300V4	ZBH 02/03	ZBH	0 2	/	0 3

Order code for PSUP/Compax3M connection set

The corresponding connection sets are furnished with the device.				/	
for C3M050D6, C3M100D6, C3M150D6	ZBH 04/01	ZBH	0 4	/	0 1
for C3M300D6	ZBH 04/02	ZBH	0 4	/	0 2
for PSUP10	ZBH 04/03	ZBH	0 4	/	0 3
PSUP20, PSUP30	ZBH 04/04	ZBH	0 4	/	0 4

Order code for feedback cables

					/	
for resolver (2	for MH / SMH motors		REK	4 2	/	... ...(1
for resolver (2	for MH / SMH motors	(cable chain compatible)	REK	4 1	/	... ...(1
for SinCos© – feedback (2	for MH / SMH motors	(cable chain compatible)	GBK	2 4	/	.. ...(1
for EnDat 2.1 (2	for MH / SMH motors	(cable chain compatible)	GBK	3 8	/	.. ...(1
Encoder – Compax3			GBK	2 3	/	... ...(1
for LXR linear motors		(cable chain compatible)	GBK	3 3	/	... ...(1
for BLMA linear motors		(cable chain compatible)	GBK	3 2	/	... ...(1

(x **Note on cable** (see on page 568)

Motor cable order code (2

					/	
for SMH / MH56 / MH70 / MH105(3	(1.5mm^2; up to 13.8A)		MOK	5 5	/	... ...(1
for SMH / MH56 / MH70 / MH105(3	(1.5mm^2; up to 13.8A)	(cable chain compatible)	MOK	5 4	/	... ...(1
for SMH / MH56 / MH70 / MH105(3	(2.5mm^2; up to 18.9A)		MOK	5 6	/	... ...(1
for SMH / MH56 / MH70 / MH105(3	(2.5mm^2; up to 18.9A)	(cable chain compatible)	MOK	5 7	/	... ...(1
for MH145 / MH205(4	(1.5mm^2; up to 13.8A)		MOK	6 0	/	... ...(1
for MH145 / MH205(4	(1.5mm^2; up to 13.8A)	(cable chain compatible)	MOK	6 3	/	... ...(1
for MH145 / MH205(4	(2.5mm^2; up to 18.9A)		MOK	5 9	/	... ...(1
for MH145 / MH205(4	(2.5mm^2; up to 18.9A)	(cable chain compatible)	MOK	6 4	/	... ...(1
for MH145 / MH205(4	(6mm^2; up to 32.3A)	(cable chain compatible)	MOK	6 1	/	... ...(1
for MH145 / MH205(4	(10mm^2; up to 47.3A)	(cable chain compatible)	MOK	6 2	/	... ...(1

(x **Note on cable** (see on page 568)

Order Code braking resistors

for C3S063V2 or C3S075V4	56Ω / 0.18kW$_{\text{cont.}}$	BRM	0	5	/	0	1
for C3S075V4	56Ω / 0.57kW$_{\text{cont.}}$	BRM	0	5	/	0	2
for C3S025V2 or C3S038V4	100Ω / 60W$_{\text{cont.}}$	BRM	0	8	/	0	1
for C3S150V4	47Ω / 0.57kW$_{\text{cont.}}$	BRM	1	0	/	0	1
for C3S150V2, C3S300V4 and PSUP20D6	4/01:15Ω / 0.57kW$_{\text{cont.}}$ 4/02:15Ω / 0.74kW$_{\text{cont.}}$	BRM	0	4	/	0	...
for C3S300V4 and PSUP20D6	4/03:15Ω / 1.5kW$_{\text{cont.}}$						
for C3S100V2	22Ω / 0.45kW$_{\text{cont.}}$	BRM	0	9	/	0	1
for C3H0xxV4	27Ω / 3.5kW$_{\text{cont.}}$	BRM	1	1	/	0	1
**for PSUP10D6 and PSUP20D6 2x30Ω parallel)	30Ω / 0.5kW$_{\text{cont.}}$	BRM	1	3	/	0	1
for PSUP10D6 (2x15Ω in series), PSUP20D6, PSUP30D6	15Ω / 0.5kW$_{\text{cont.}}$	BRM	1	4	/	0	1
for C3H1xxV4, PSUP30D6	18Ω / 4.5kW$_{\text{cont.}}$	BRM	1	2	/	0	1

Order code mains filter Compax3S

for C3S025V2 or S063V2	NFI	0	1	/	0	1
for C3S0xxV4, S150V4 or S1xxV2	NFI	0	1	/	0	2
for C3S300V4	NFI	0	1	/	0	3

Order code mains filter Compax3H

for C3H050V4	NFI	0	2	/	0	1
for C3H090V4	NFI	0	2	/	0	2
for C3H1xxV4	NFI	0	2	/	0	3

Order Code mains filter PSUP

for PSUP10	Reference axis combination 3x480V 25A 6x10m motor cable length	NFI	0	3	/	0	1
for PSUP10	Reference axis combination 3x480V 25A 6x50m motor cable length	NFI	0	3	/	0	2
for PSUP20 & PSUP30	Reference axis combination 3x480V 50A 6x50m motor cable length	NFI	0	3	/	0	3

Order code for mains filters

for PSUP30	Mains filter	LCG-0055-0.45 mH
for PSUP30	Mains filter with UL approval	LCG-0055-0.45 mH-UL

Order code for motor output filter (for Compax3S, Compx3M >20m motor cable)

up to 6,3 A rated motor current	MDR	0	1	/	0	4
Up to 16 A rated motor current	MDR	0	1	/	0	1
Up to 30A A rated motor current	MDR	0	1	/	0	2

Order code condenser module

for C3S300V4	1100µF	Modules	C4

Order code for interface cables and plugs

PC – Compax3 (RS232)		SSK	0	1	/	...	...(1
PC – PSUP (USB)		SSK	3	3	/	...	...
on X11 (Ref/Analog) and X13 at C3F001D2	with flying leads	SSK	2	1	/	...	...(1
on X12 / X22 (digital I/Os)	with flying leads	SSK	2	2	/	...	...(1
on X11 (Ref /Analog)	for I/O terminal block	SSK	2	3	/	...	...(1
on X12 / X22 (digital I/Os)	for I/O terminal block	SSK	2	4	/	...	...(1
PC ⇔ POP (RS232)		SSK	2	5	/	...	...(1
Compax3 ⇔ POP (RS485) for several C3H on request		SSK	2	7	/	../	...(6
Compax3 HEDA ⇔ Compax3 HEDA or PC ⇔ C3powerPLmC Compax3 I30 ⇔ Compax3 I30 or C3M-multi-axis communication Profinet, EtherCAT, Ethernet Powerlink		SSK	2	8	/	../	...(5
Compax3 X11 ⇔ Compax3 X11 (encoder coupling of 2 axes)		SSK	2	9	/	...	...(1
Compax3 X10 ⇔ Modem		SSK	3	1	/	...	
Compax3H adapter cable ⇔ SSK01 (length 15cm, delivered with the device)		SSK	3	2	/	2	0
Compax3H X10 RS232 connection control ⇔ Programming interface (delivered with the device)		VBK	1	7	/	0	1
Bus terminal connector (for the 1st and last Compax3 in the HEDA Bus/or multi-axis system)		BUS	0	7	/	0	1
Profibus cable (2	non prefabricated	SSL	0	1	/	...	...(1
Profibus plug		BUS	0	8	/	0	1
CAN bus cable (2	non prefabricated	SSL	0	2	/	...	...(1
CANbus connector		BUS	1	0	/	0	1

(x **Note on cable** (see on page 568)

Order Code operating module

Operating module (for Compax3S and Compax3F)	BDM	0	1	/	0	1

Order Code terminal block

for I/Os without luminous indicator	for X11, X12, X22	EAM	0	6	/	0	1
for I/Os with luminous indicator	for X12, X22	EAM	0	6	/	0	2

Order Code decentralized input terminals

PIO 2DI 24VDC 3.0ms	2-channel digital input terminal	PIO	4	0	0
PIO 4DI 24VDC 3.0ms	4-channel digital input terminal	PIO	4	0	2
PIO 8DI 24VDC 3.0ms	8-channel digital input terminal	PIO	4	3	0
PIO 2AI DC ±10V differential input	2-channel analog - Input terminal (±10V differential input)	PIO	4	5	6
PIO 4AI 0-10VDC S.E.	4 channel analog input terminal (0-10V signal voltage)	PIO	4	6	8
PIO 2AI 0-20mA differential input	2-channel analog - Input terminal (0-20mA differential input)	PIO	4	8	0

Order Code decentralized output terminals

PIO 2DO 24VDC 0.5A	2 channel digital output terminal (output voltage 0.5A)	PIO	5	0	1
PIO 4DO 24VDC 0.5A	4 channel digital output terminal (output voltage 0.5A)	PIO	5	0	4
PIO 8DO 24VDC 0.5A	8 channel digital output terminal (output voltage 0.5A)	PIO	5	3	0
PIO 2AO 0-10VDC	2 channel analog output terminal (0-10V signal voltage)	PIO	5	5	0
PIO 2AO 0-20mA	2-channel analog output terminal (0-20mA signal voltage)	PIO	5	5	2
PIO 2AO DC ±10V	2-channel analog output terminal (±10V signal voltage)	PIO	5	5	6

Order Code CANopen Fieldbus Coupler

CANopen Standard	max. Vectorial sum current for bus terminals 1650mA at 5V	PIO	3	3	7
CANopen ECO	max. Vectorial sum current for bus terminals 650mA at 5V	PIO	3	4	7

(1 Length code 1

Length [m]	1.0	2.5	5.0	7.5	10.0	12.5	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
Order code	01	02	03	04	05	06	07	08	09	10	11	12	13	14

Example:

SSK01/09: Length 25m

(2 Colors according to DESINA

(3 with motor connector

(4 with cable eye for motor terminal box

5 length code 2 for SSK28

Length [m]	0.17	0.25	0.5	1.0	3.0	5.0	10.0
Order code	23	20	21	01	22	03	05

(6 Order code: SSK27/nn/..

Length A (Pop - 1. Compax3) variable (the last two numbers according to the length code for cable, for example SSK27/nn/01)

Length B (1. Compax3 - 2. Compax3 - ... - n. Compax3) fixed 50 cm (only if there is more than 1 Compax3, i.e. nn greater than 01)

Number n (the last two digits)

Examples include:

SSK27/05/.. for connecting from Pop to 5 Compax3.

SSK27/01/.. for connecting from Pop to one Compax3

MOK55 and MOK54 can also be used for linear motors LXR406, LXR412 and BLMA.

(x **Note on cable** (see on page 568)

11. Compax3 Accessories

In this chapter you can read about:

11.1 Parker servo motors

In this chapter you can read about:

11.1.1. Direct drives

In this chapter you can read about:

11.1.1.1 Transmitter systems for direct drives

The Feedback option F12 makes it possible to operate linear motors as well as torque motors. Compax3 supports the following transmitter systems:

Special encoder systems for direct drives	**Option F12**
Analog hall sensors	◆ Sine-Cosine signal (max. 5Vss*; typical 1Vss) 90° offset ◆ U-V signal (max. 5Vss*; typical 1Vss) 120° offset.
Encoder (linear or rotatory)	◆ Sine-Cosine (max. 5Vss*; typical 1Vss) (max. 400kHz) or ◆ TTL (RS422) (max. 5MHz; track A o. B) with the following modes of commutation: ◆ **Automatic commutation** (see on page 570) or ◆ U, V, W or R, S, T commutation signals (NPN open collector) e.g. digital hall sensors, incremental encoders made by Hengstler (F series with electrical ordering variant 6)
Digital, bidirectional interface	◆ All EnDat 2.1 or EnDat 2.2 (Endat01, Endat02) feedback systems with incremental track (sine-cosine track) ◆ linear or rotary ◆ max. 400kHz Sine-Cosine
Distance coded feedback systems	◆ Distance coding with 1VSS - Interface ◆ Distance coding with RS422 - Interface (Encoder)

*Max. differential input between SIN- (X13/7) and SIN+ (X13/8).

The motor performs automatic commutation after:

- Power on,
- A configuration download or
- An IEC program download

The time duration (typically 5-10 sec) of automatic commutation can be optimized with the start current (see in the optimization display of the C3 ServoManager; given as a percentage of the reference current). Note that values that are too high will cause Error 0x73A6 to be triggered.

Typically the motor moves by 4% of the pitch length or, with rotary direct drives 4% of 360°/number of pole pairs - maximum 50%.

Note the following conditions for automatic commutation

- During automatic commutation the end limits are not monitored.
- Actively working load torques are not permitted during automatic commutation.
- Static friction deteriorates the effect of automatic commutation.
- With the exception of missing commutation information, the controller/motor combination is configured and ready for operation (parameters correctly assigned for the linear motor/drive). The transmitter and the direction of the field of rotation in effect must match.
- The auto-commutating function must be adapted to fit the mechanics if necessary during commissioning.

11.1.1.2 Linear motors

Parker offers you a number of systems of linear motor drives:

Linear motors	**Feed force (continuous/dynamic)**	**Stroke length:**
LMDT ironless linear servo motors:	26 ... 1463N	almost any
LMI iron-cored linear servo motors:	52 ... 6000N	64 ... 999mm
LXR Series Linear Motors	315N / 1000N	up to 3m
Linear motor module BLMA:	605N / 1720N	up to 6m

11.1.1.3 Torque motors

Parker offers you an extensive range of torque motors that can be adapted to your application. Please contact us for information.

Additional information can be found on the **Internet http://www.parker-eme.com** in the direct drives section.

11.1.2. Rotary servo motors

Parker offers you an extensive range of servo motors that can be adapted to your application. Please contact us for information.

Additional information can be found on the **Internet http://www.parker-eme.com/sm**

or on the DVD supplied in the documentations file.

Suitable servo motors for Compax3H are available on request!

11.2 EMC measures

In this chapter you can read about:

11.2.1. Mains filter

For radio disturbance suppression and for complying with the emission limit values for CE conform operationwe offer mains filters:

Observe the maximum permitted length of the connection between the mains filter and the device:

- unshielded <0.5m;
- shielded: <5m (fully shielded on ground e.g. ground of control cabinet)

Order code mains filter Compax3S

				/		
for C3S025V2 or S063V2	NFI	0	1	/	0	1
for C3S0xxV4, S150V4 or S1xxV2	NFI	0	1	/	0	2
for C3S300V4	NFI	0	1	/	0	3

Order Code mains filter PSUP

					/		
for PSUP10	Reference axis combination 3x480V 25A 6x10m motor cable length	NFI	0	3	/	0	1
for PSUP10	Reference axis combination 3x480V 25A 6x50m motor cable length	NFI	0	3	/	0	2
for PSUP20 & PSUP30	Reference axis combination 3x480V 50A 6x50m motor cable length	NFI	0	3	/	0	3

Order code for mains filters

for PSUP30	Mains filter	LCG-0055-0.45 mH
for PSUP30	Mains filter with UL approval	LCG-0055-0.45 mH-UL

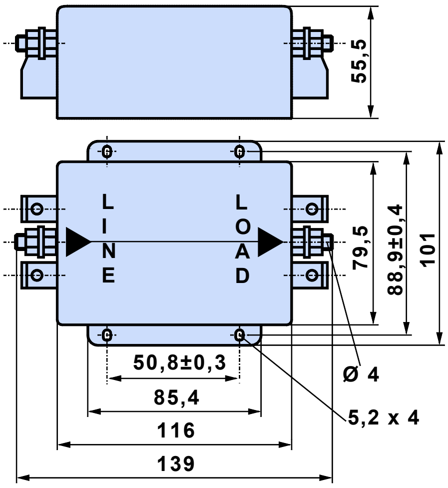
Order code mains filter Compax3H

				/		
for C3H050V4	NFI	0	2	/	0	1
for C3H090V4	NFI	0	2	/	0	2
for C3H1xxV4	NFI	0	2	/	0	3

11.2.1.1 Mains filter NFI01/01

for Compax3 S025 V2 and Compax3 S063 V2

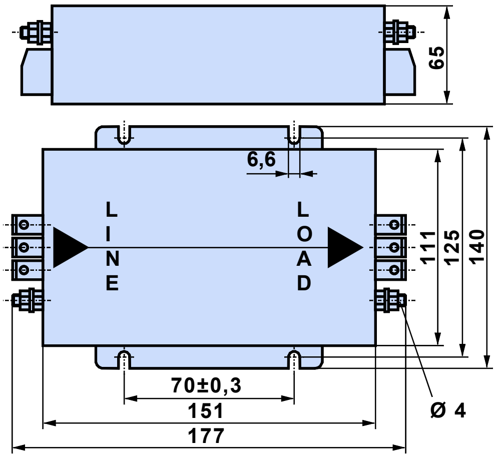
Dimensional drawing:



11.2.1.2 Mains filter NFI01/02

for Compax3 S0xx V4, Compax3 S150 V4 and Compax3 S1xx V2

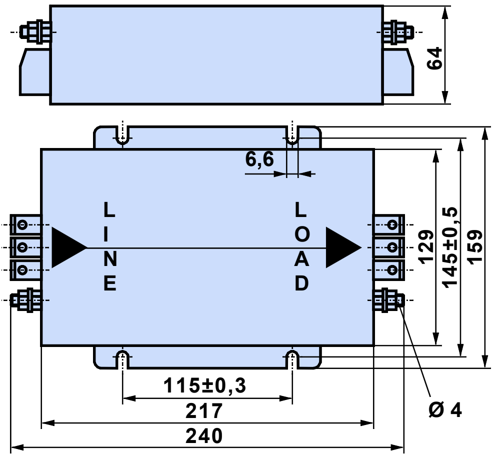
Dimensional drawing:



11.2.1.3 Mains filter for NFI01/03

for Compax3 S300

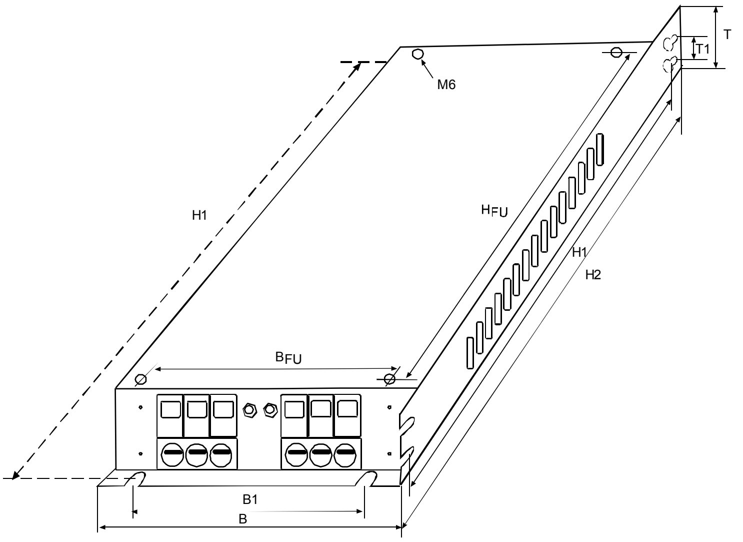
Dimensional drawing:



11.2.1.4 Mains filter NFI02/0x

Filter for mounting below theCompax3 Hxxx V4 housing

Dimensional drawing:



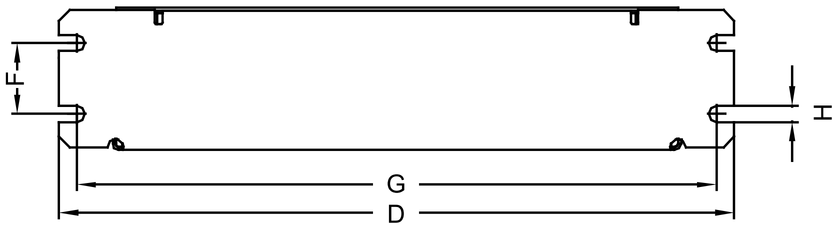
Stated in mm	**Filter type**	**Dimensions**				**Hole distances**			**Distances**		**Weight**	**Grounding clamp**	**Connection clamp**
		B	H	H2	T	B1	H1	T1	BFU	HFU	kg		
C3H050V4	NFI02/01	233	515	456	70	186	495	40	150	440	4.3	M6	16mm^2
C3H090V4	NFI02/02	249	715	649	95	210	695	40	150	630	8.5	M8	50mm^2
C3H1xxV4	NFI02/03	249	830	719	110				150	700	15.0	M10	95mm^2

11.2.1.5 Mains filter NFI03/01& NFI03/03

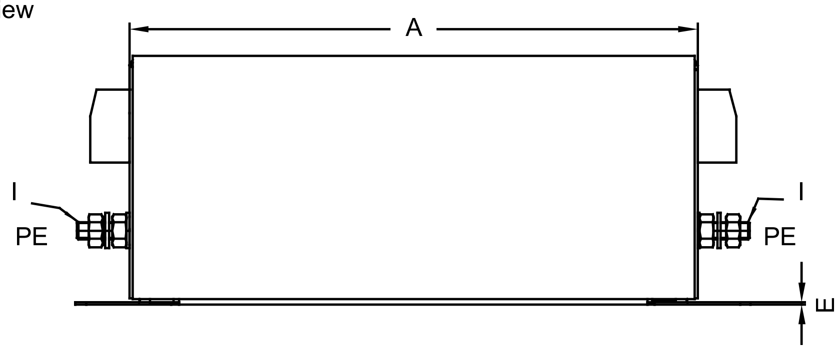
for PSUP10D6 and PSUP20D6

Dimensional drawing:

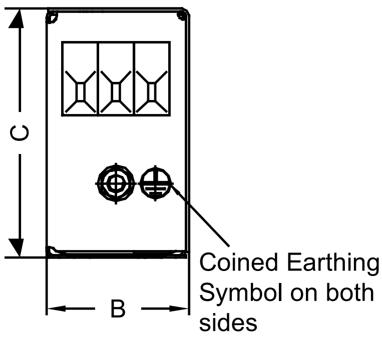
Bottom view



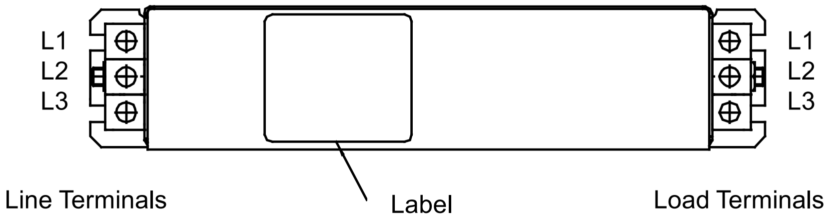
Side view



Front view



Top view



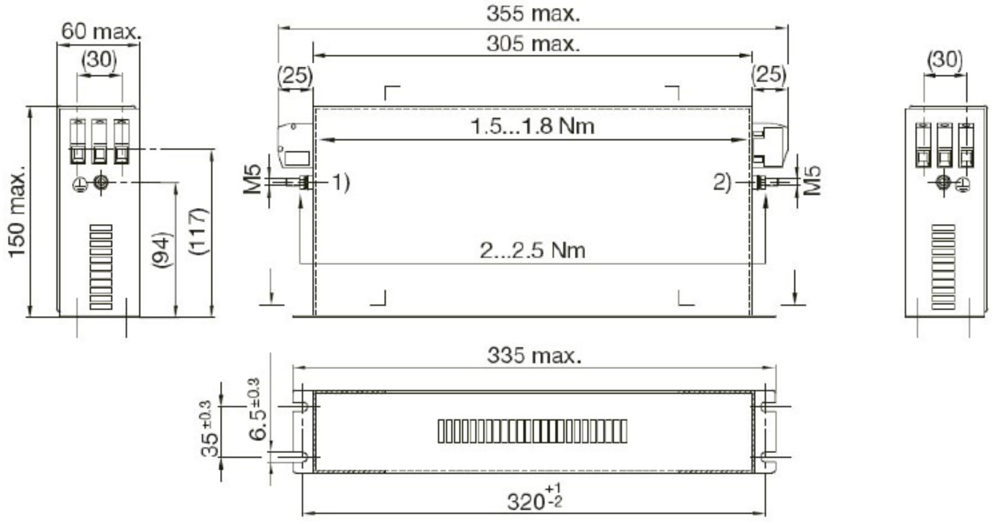
Filter type										**Weight**	**GND(I)**	**Connection clamp**
	A	B	C	D	I	F	G	H		kg		
NFI03/01	240	50	85	270	0.8	30	255	5.4		1.5	M5	$10mm^2$
NFI03/03	220	85	90	250	1.0	60	235	5.4		2.4	M6	$16mm^2$

Stated in mm

11.2.1.6 Mains filter NFI03/02

for PSUP10D6

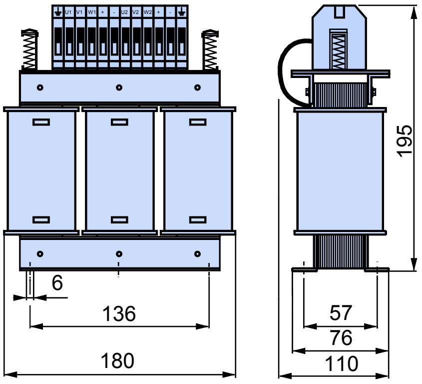
Dimensional drawing:



11.2.2.3 Motor output filter MDR01/02

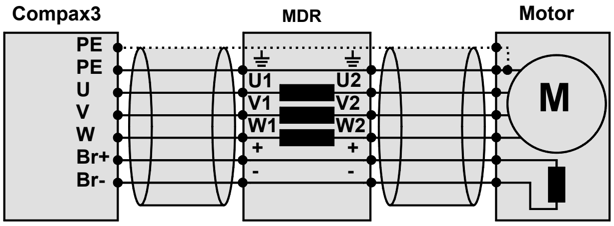
up to 30A nominal motor current (1.1mH)

Dimensional drawing:



Weight: 5.8kg

11.2.2.4 Wiring of the motor output filter



11.2.3. Mains filters

In this chapter you can read about:

Mains filters serve for reducing the low-frequency interferences on the mains side.

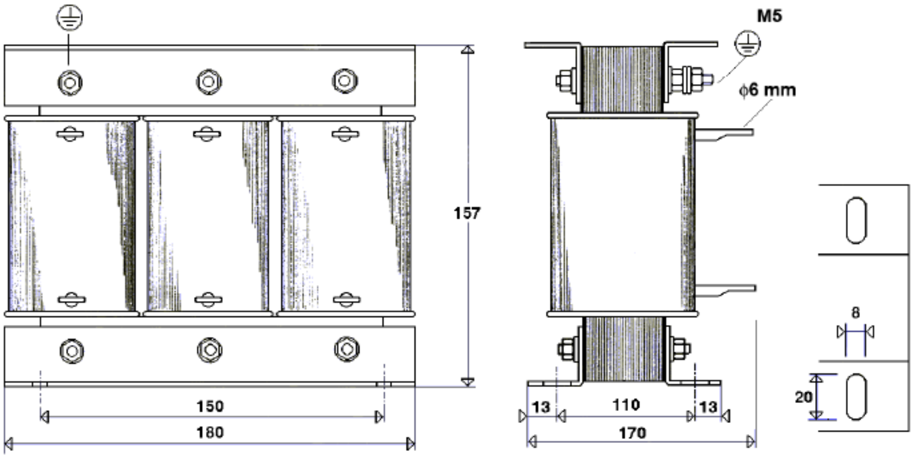
11.2.3.1 Mains filter for PSUP30

Required mains filter for the PSUP30: 0.45 mH / 55 A

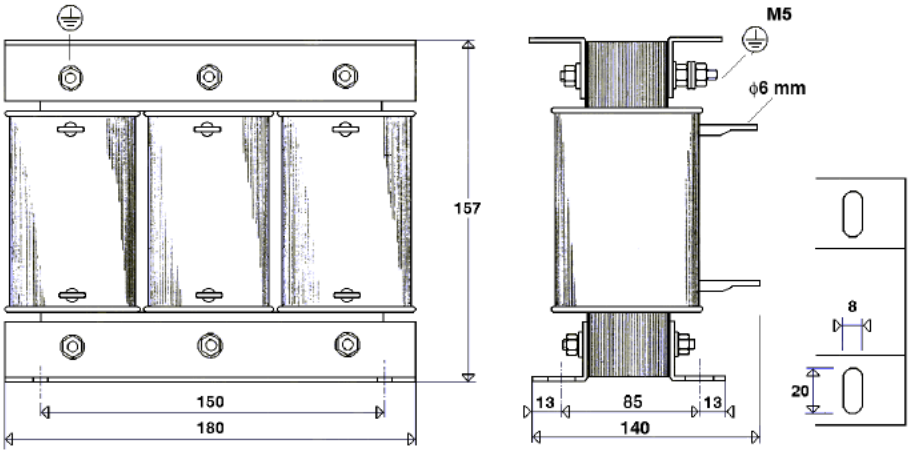
We offer the following mains filters:

- LCG-0055-0.45 mH (WxDxH: 180 mm x 140 mm x 157 mm; 10 kg)
- LCG-0055-0.45 mH-UL (with UL approval) (WxDxH: 180 mm x 170 mm x 157 mm; 15 kg)

Dimensional drawing: LCG-0055-0.45 mH



Dimensional drawing: LCG-0055-0.45 mH-UL



11.3 Connections to the motor

In this chapter you can read about:

Under the designation "REK.." (resolver cables) and "MOK.."(motor cables) we can deliver motor connecting cables in various lengths to order. If you wish to make up your own cables, please consult the cable plans shown below:

Motor cable order code (2

for SMH / MH56 / MH70 / MH105(3	(1.5mm^2; up to 13.8A)		MOK	5	5	/	...	...(1
for SMH / MH56 / MH70 / MH105(3	(1.5mm^2; up to 13.8A)	(cable chain compatible)	MOK	5	4	/	...	...(1
for SMH / MH56 / MH70 / MH105(3	(2.5mm^2; up to 18.9A)		MOK	5	6	/	...	...(1
for SMH / MH56 / MH70 / MH105(3	(2.5mm^2; up to 18.9A)	(cable chain compatible)	MOK	5	7	/	...	...(1
for MH145 / MH205(4	(1.5mm^2; up to 13.8A)		MOK	6	0	/	...	...(1
for MH145 / MH205(4	(1.5mm^2; up to 13.8A)	(cable chain compatible)	MOK	6	3	/	...	...(1
for MH145 / MH205(4	(2.5mm^2; up to 18.9A)		MOK	5	9	/	...	...(1
for MH145 / MH205(4	(2.5mm^2; up to 18.9A)	(cable chain compatible)	MOK	6	4	/	...	...(1
for MH145 / MH205(4	(6mm^2; up to 32.3A)	(cable chain compatible)	MOK	6	1	/	...	...(1
for MH145 / MH205(4	(10mm^2; up to 47.3A)	(cable chain compatible)	MOK	6	2	/	...	...(1

(x **Note on cable** (see on page 568)

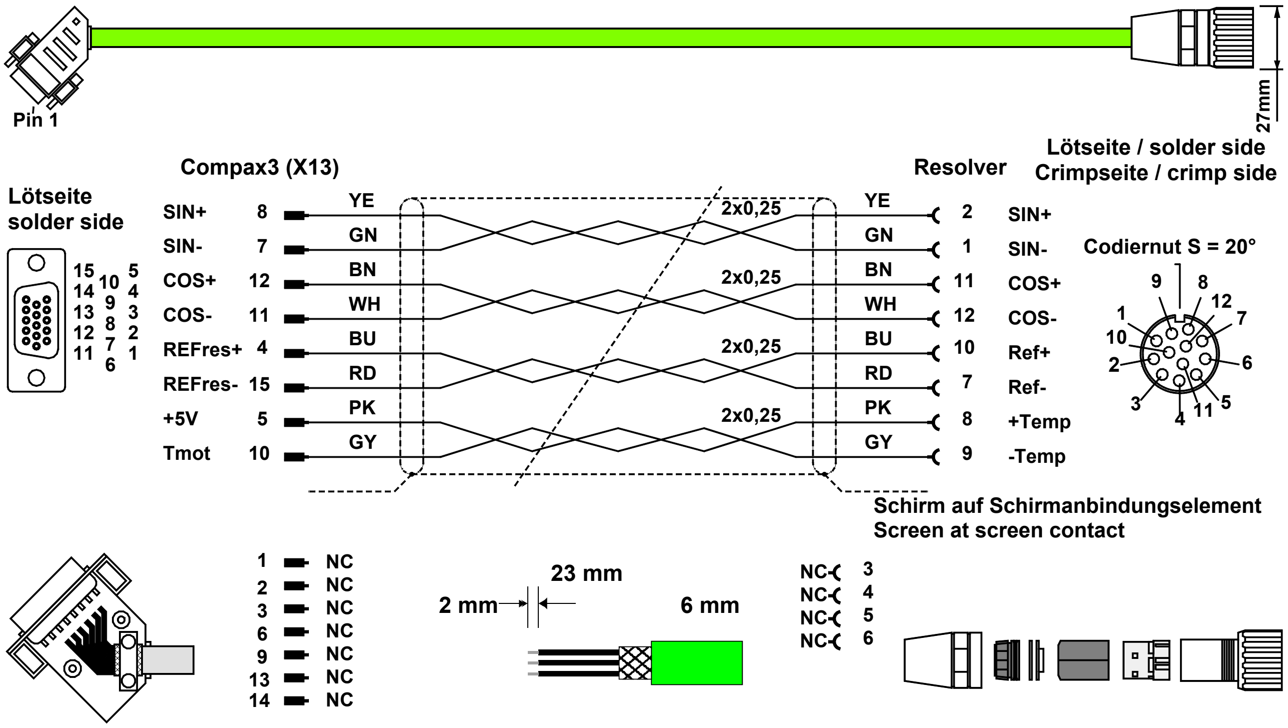
Order code for feedback cables

for resolver (2	for MH / SMH motors		REK	4	2	/	...	...(1
for resolver (2	for MH / SMH motors	(cable chain compatible)	REK	4	1	/	...	...(1
for SinCos© – feedback (2	for MH / SMH motors	(cable chain compatible)	GBK	2	4	/	..	...(1
for EnDat 2.1 (2	for MH / SMH motors	(cable chain compatible)	GBK	3	8	/	..	...(1
Encoder – Compax3			GBK	2	3	/	...	...(1
for LXR linear motors		(cable chain compatible)	GBK	3	3	/	...	...(1
for BLMA linear motors		(cable chain compatible)	GBK	3	2	/	...	...(1

(x **Note on cable** (see on page 568)

11.3.1. Resolver cable

REK42/..

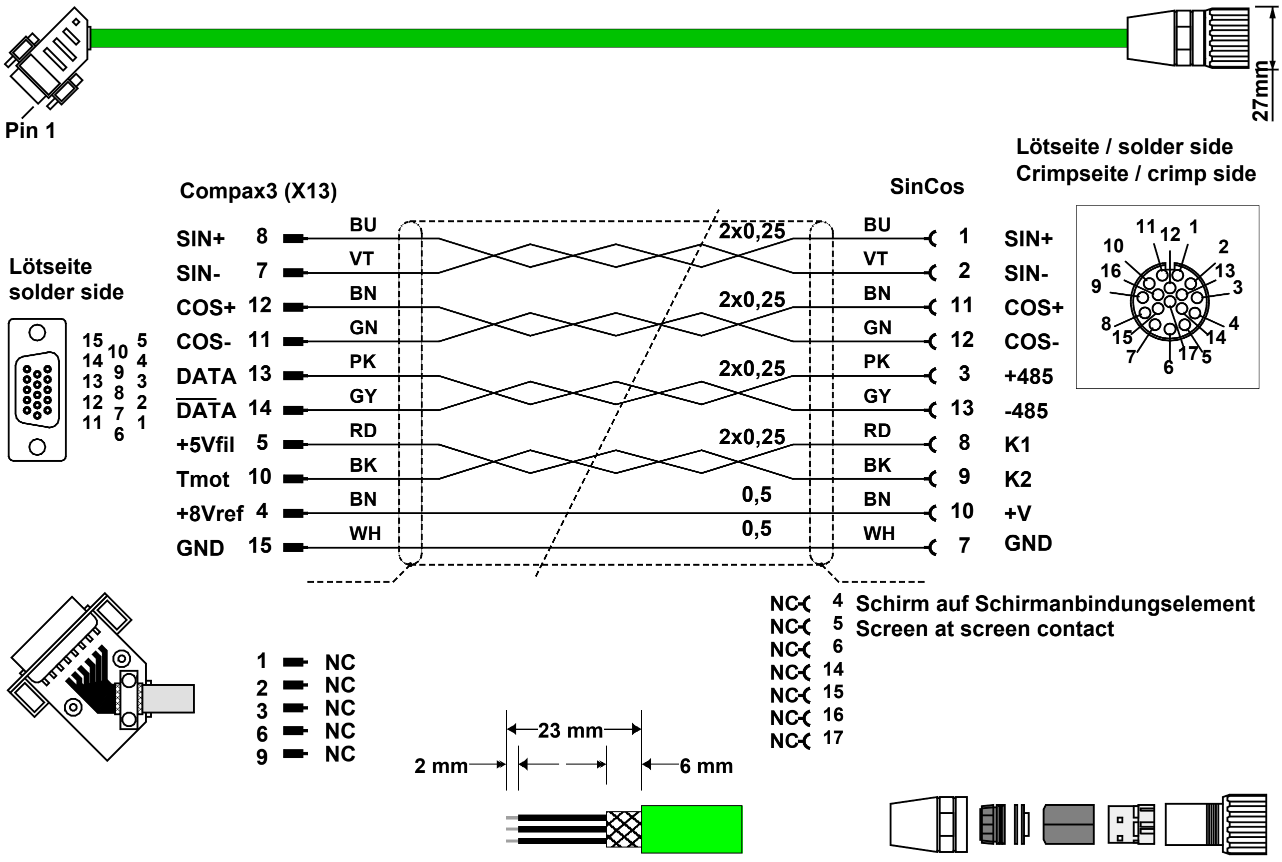


The same cable (with changed conductor coloring) is available under the designation REK41/.. in a version which is suitable for cable chain systems.

You can find the length code in the Chapter **Order Code Accessories** (see on page 565).

11.3.2. SinCos© cable

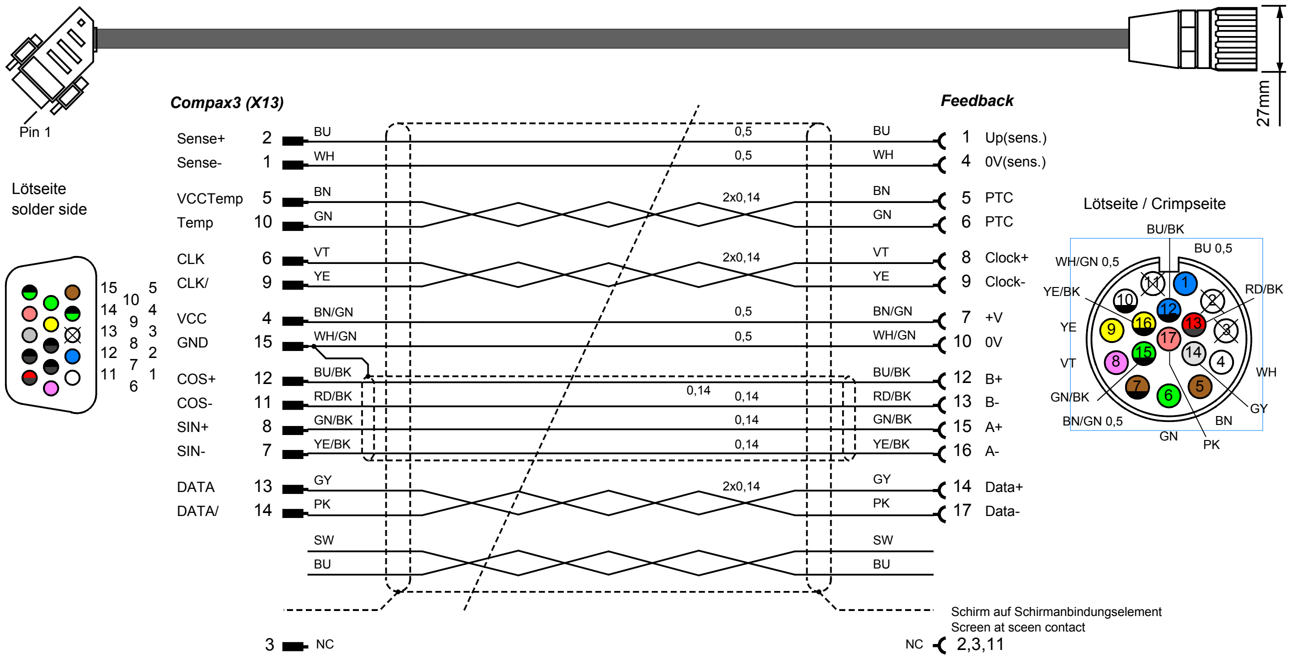
GBK24/..: Cable chain compatible



You can find the length code in the Chapter **Order Code Accessories** (see on page 565).

11.3.3. EnDat cable

GBK38/..: (cable chain compatible)

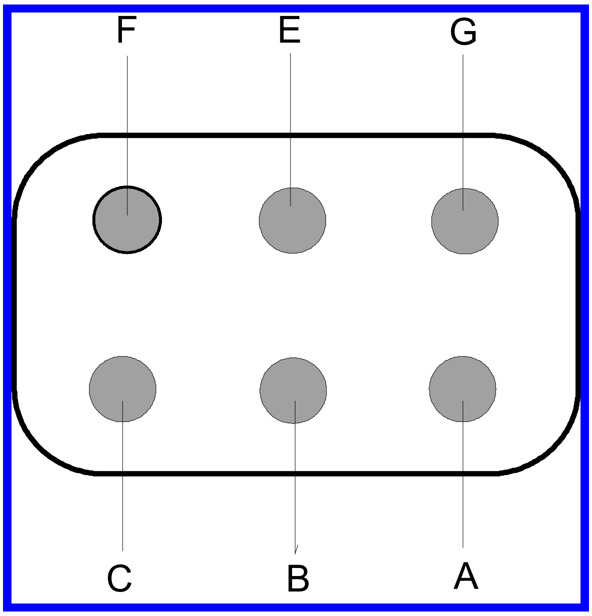


You can find the length code in the Chapter **Order Code Accessories** (see on page 565).

11.3.4. Motor cable

Cross-section / max. permanent load	**Motor connector SMH motors MH56, MH70, MH105**		**Motor terminal box MH145, MH205**	
	standard	**cable chain compatible**	**standard**	**cable chain compatible**
1.5 mm^2 / up to 13.8 A	MOK55	MOK54	MOK60	MOK63
2.5 mm^2 / up to 18.9 A	MOK56	MOK57	MOK59	MOK64
6 mm^2 / up to 32.3 A	-	-	-	MOK61
10 mm^2 / up to 47.3 A		--	-	MOK62

11.3.4.1 Connection of terminal box MH145 & MH205

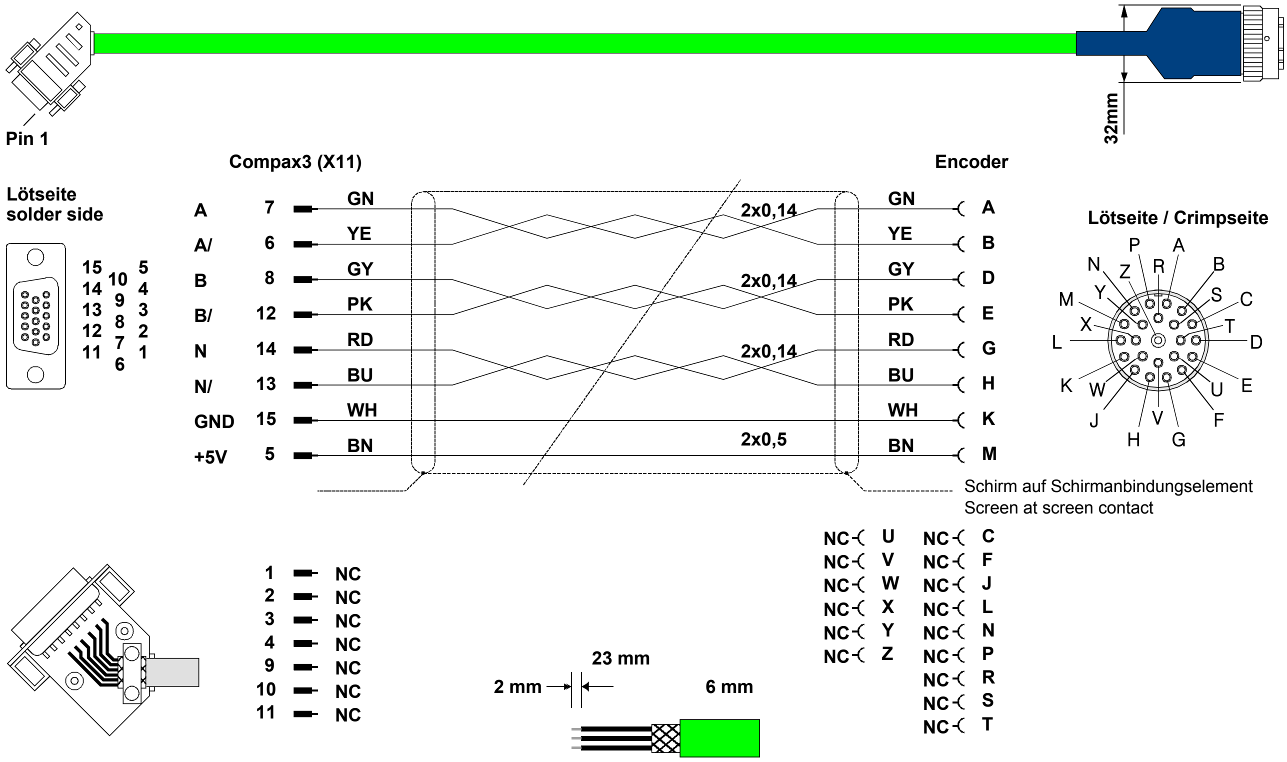


Terminal	Assignment
A	Phase U
B	Phase V
C	Phase W
E	Protective earth terminal
F	Brake (+ red for MH205)
G	Brake (- blue for MH205)

Additional designations can be found on the connection cable clamping board - motor (internal).

11.3.5. Encoder cable

GBK23/..: Connection Compax3 - Encoder



You can find the length code in the **Order Code Accessories** (see on page 565)

11.4 External braking resistors

In this chapter you can read about:

Danger!

Hazards when handling ballast resistors!

Housing temperature up to 200°C!

Dangerous voltage!

The device may be operated only in the mounted state!

The external braking resistors must be installed such that protection against contact is ensured (IP20).

Install the connecting leads at the bottom.

The braking resistors must be grounded.
We recommend to use a thrust washer for the BRM13 and BRM14.

Observe the instructions on the resistors (warning plate).

Please note that the length of the supply cable must not exceed 2m!

Ballast resistors for Compax3

Ballast resistor **(see on page 586)**	**Device**	**Rated output**
BRM08/01 (100Ω)	Compax3S025V2 Compax3S015V4 Compax3S038V4	60 W
BRM05/01 (56Ω)	Compax3S063V2 Compax3S075V4	180 W
BRM05/02 (56Ω)	Compax3S075V4	570 W
BRM10/01 (47Ω)	Compax3S150V4	570 W
BRM10/02 (470Ω)	Compax3S150V4	1500 kW
BRM04/01 (15Ω)	Compax3S150V2 Compax3S300V4 PSUP20D6	570 W
BRM04/02 (15Ω)	Compax3S150V2 Compax3S300V4 PSUP20D6	740 W
BRM04/03 (15Ω)	Compax3S300V4 PSUP20D6	1500 W
BRM09/01 (22Ω)	Compax3S100V2	570 W
BRM11/01 (27Ω)	Compax3H0xxV4	3500 W
BRM13/01 (30Ω)	PSUP10D6 PSUP20D6**	500 W
BRM14/01 (15Ω)	PSUP10D6* PSUP20D6	500 W
BRM12/01 (18Ω)	Compax3H1xxV4	4500 W

*for PSUP10D6 2x15Ω in series

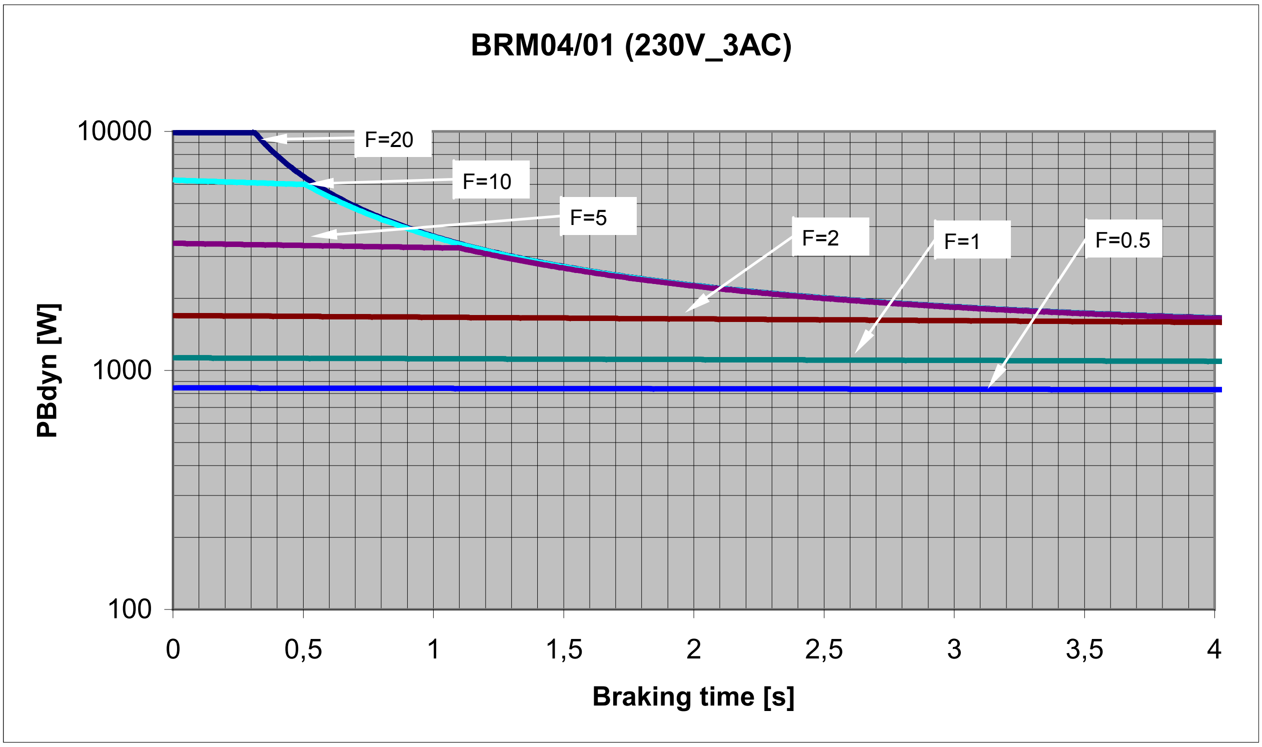
**for PSUP20D6 2x30Ω parallel

11.4.1. Permissible braking pulse powers of the braking resistors

In this chapter you can read about:

The diagrams show the permissible braking pulse powers of the braking resistors in operation with the assigned Compax3.

11.4.1.1 Calculation of the BRM cooling time



F = Factor

Cooling time = F * braking time

Example 1: For a braking time of 1s, a braking power of 1kW is required. The Diagram shows the following:

The required values can be found in the range between characteristic F = 0.5 and F = 1. In order to achieve operating safety, please select the higher factor, this means that the required cooling time is 1s.

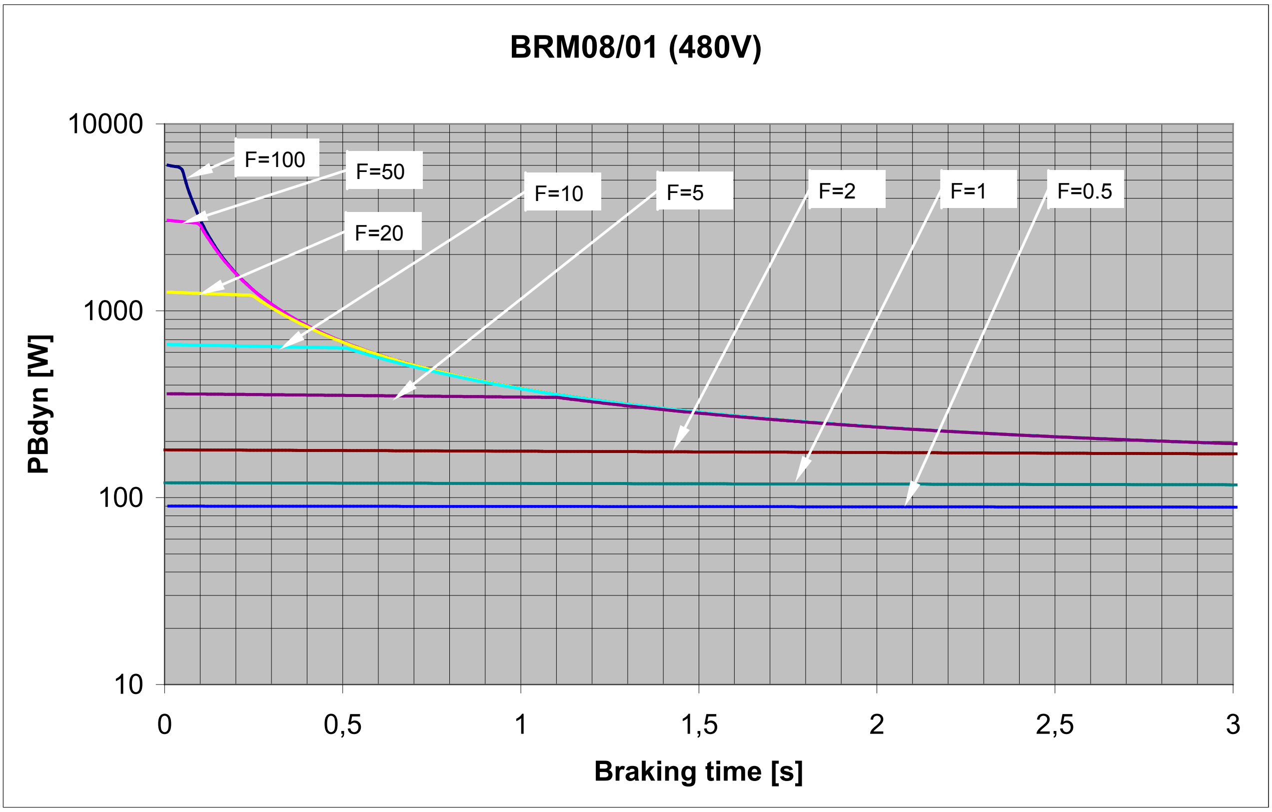
F	*	Braking time	= cooling time
1	*	1s	= 1s

Example 2: For a braking time of 0.5s, a braking power of 3kW is required. The Diagram shows the following:

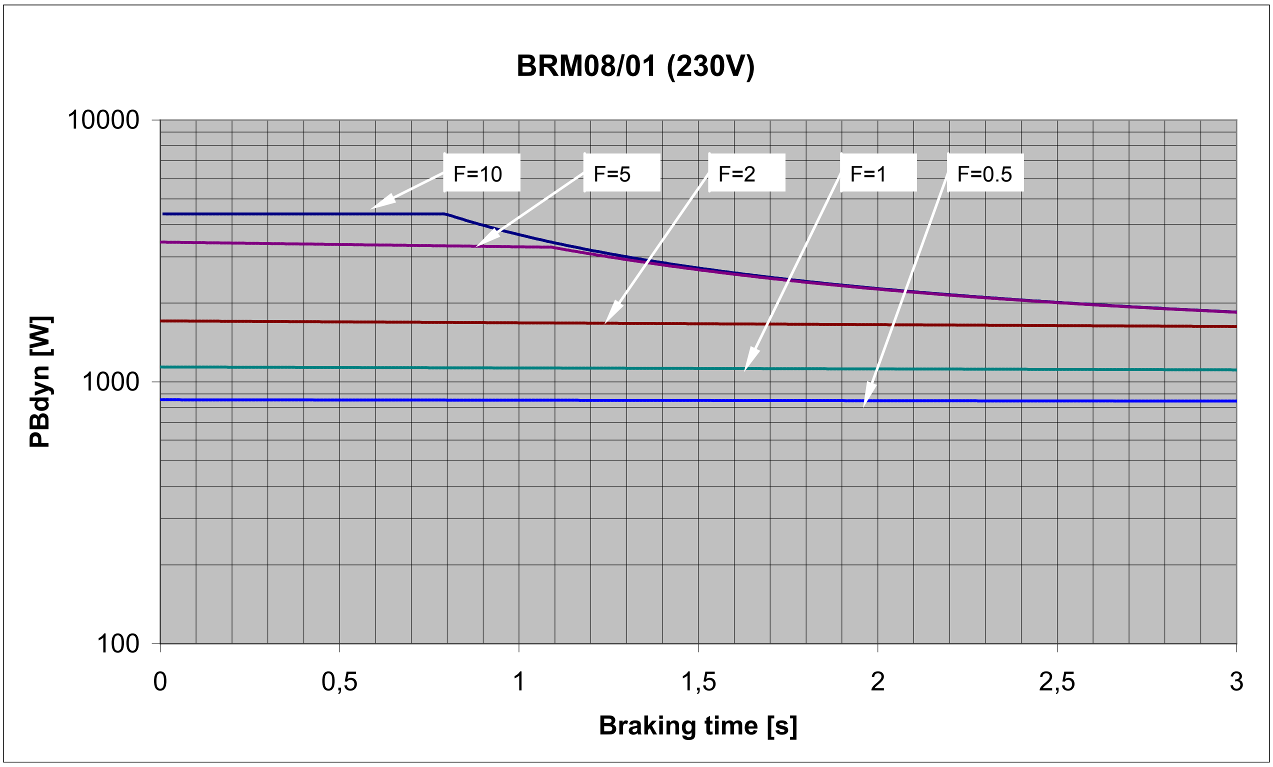
The required values can be found in the range between characteristic F = 2 and F = 5. In order to achieve operating safety, please select the higher factor, this means that the required cooling time is 2.5s.

F	*	Braking time	= cooling time
5	*	0.5s	= 2.5s

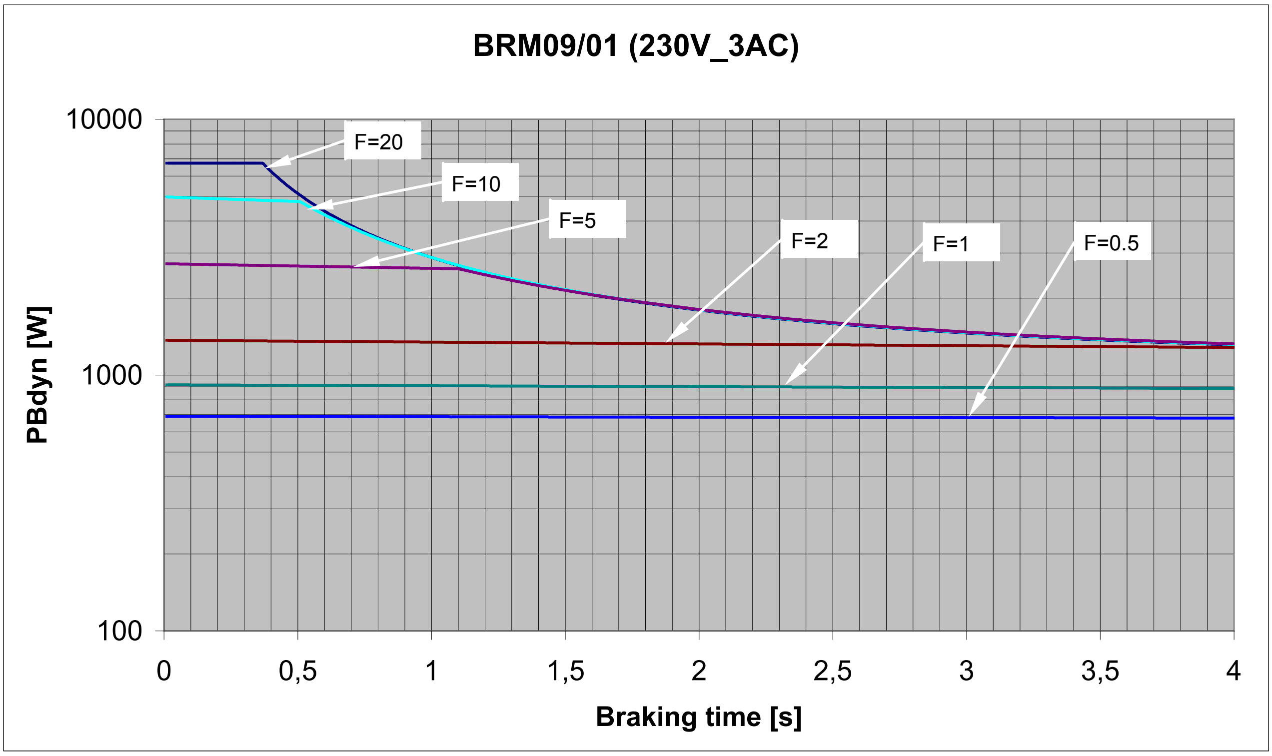
11.4.1.2 Permissible braking pulse power: BRM08/01 with C3S015V4 / C3S038V4



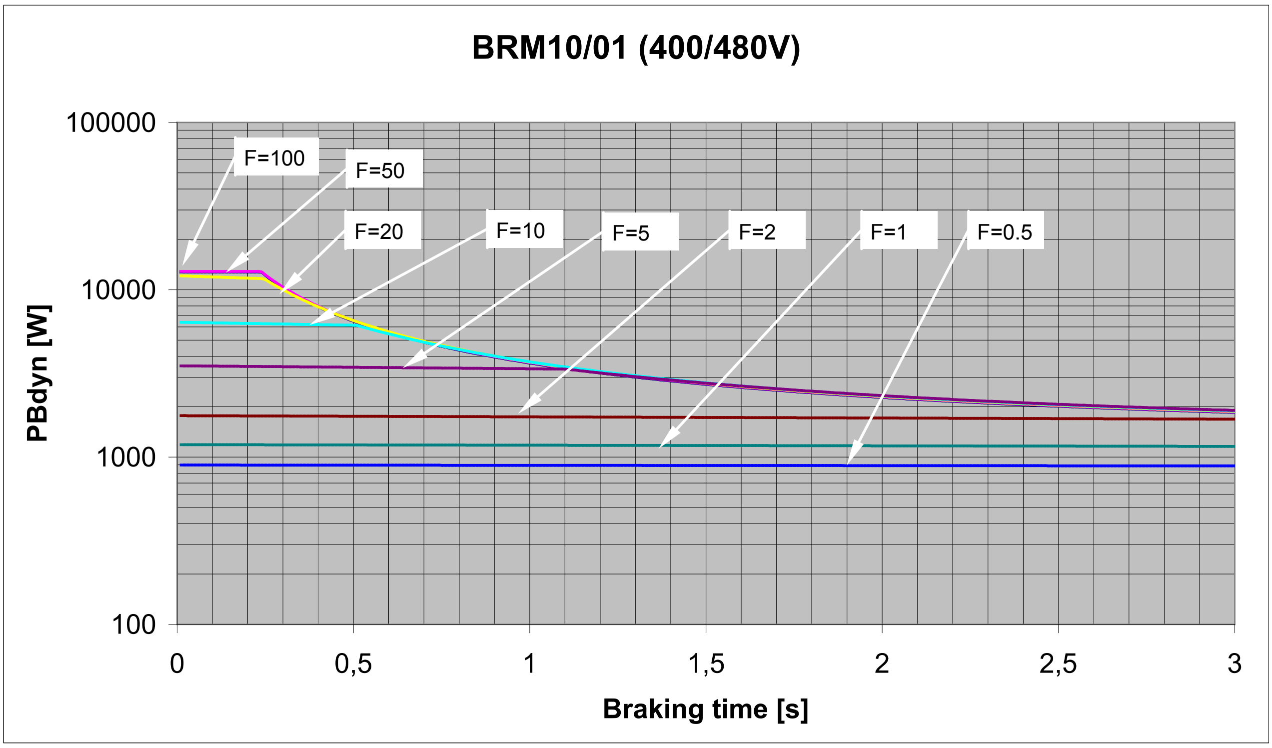
11.4.1.3 Permissible braking pulse power: BRM08/01 with C3S025V2



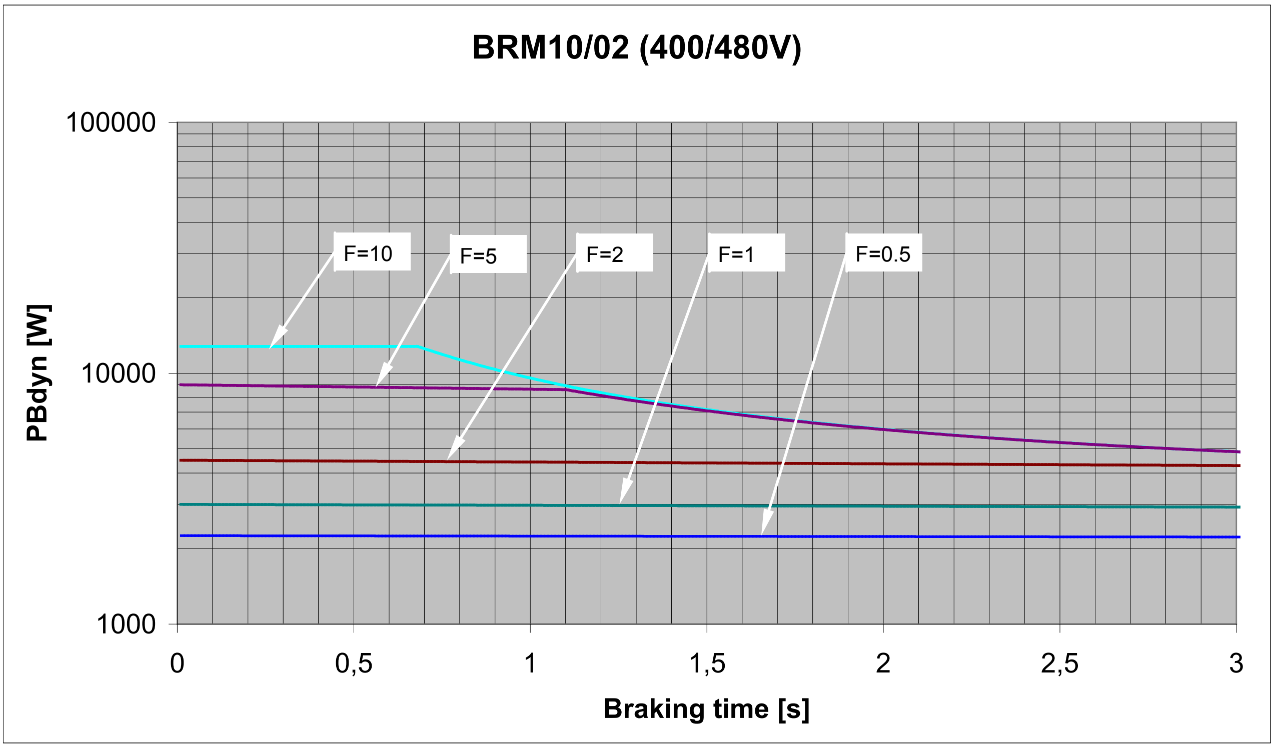
11.4.1.4 Permissible braking pulse power: BRM09/01 with C3S100V2



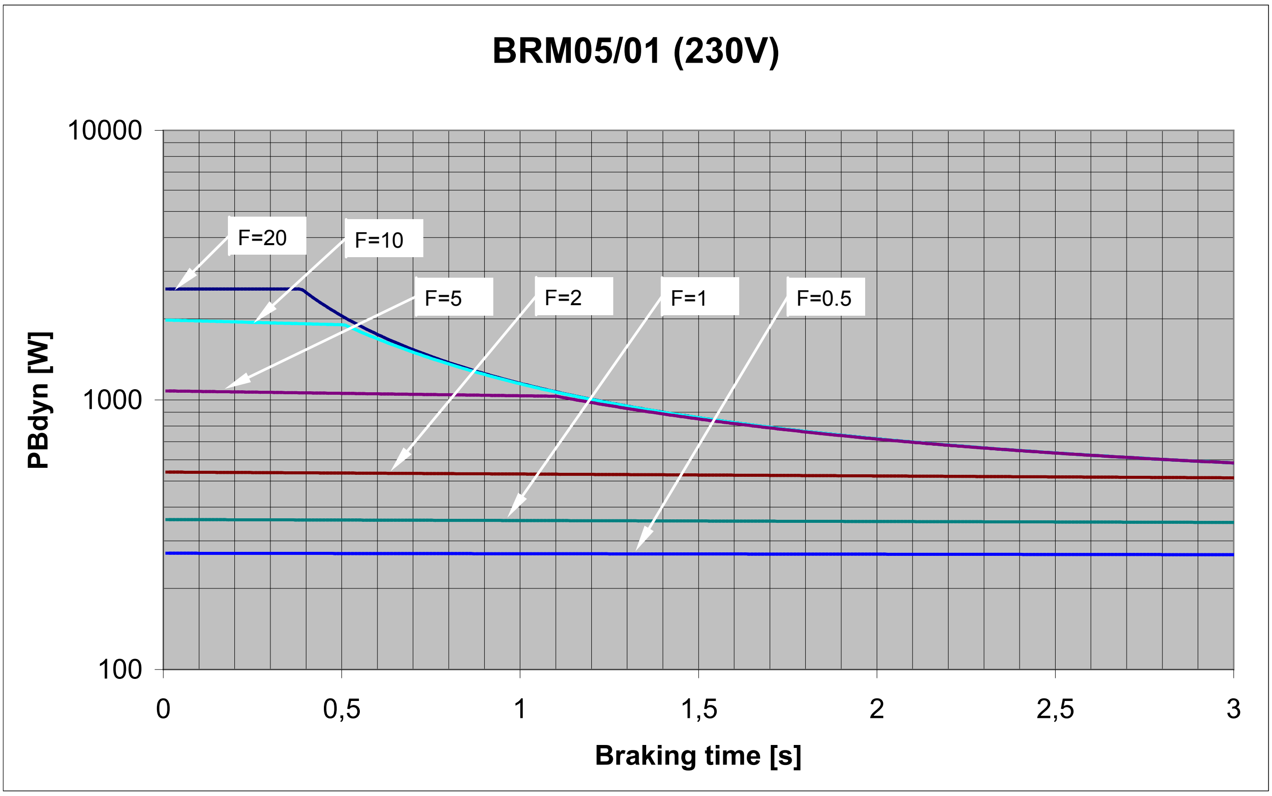
11.4.1.5 Permissible braking pulse power: BRM10/01 with C3S150V4



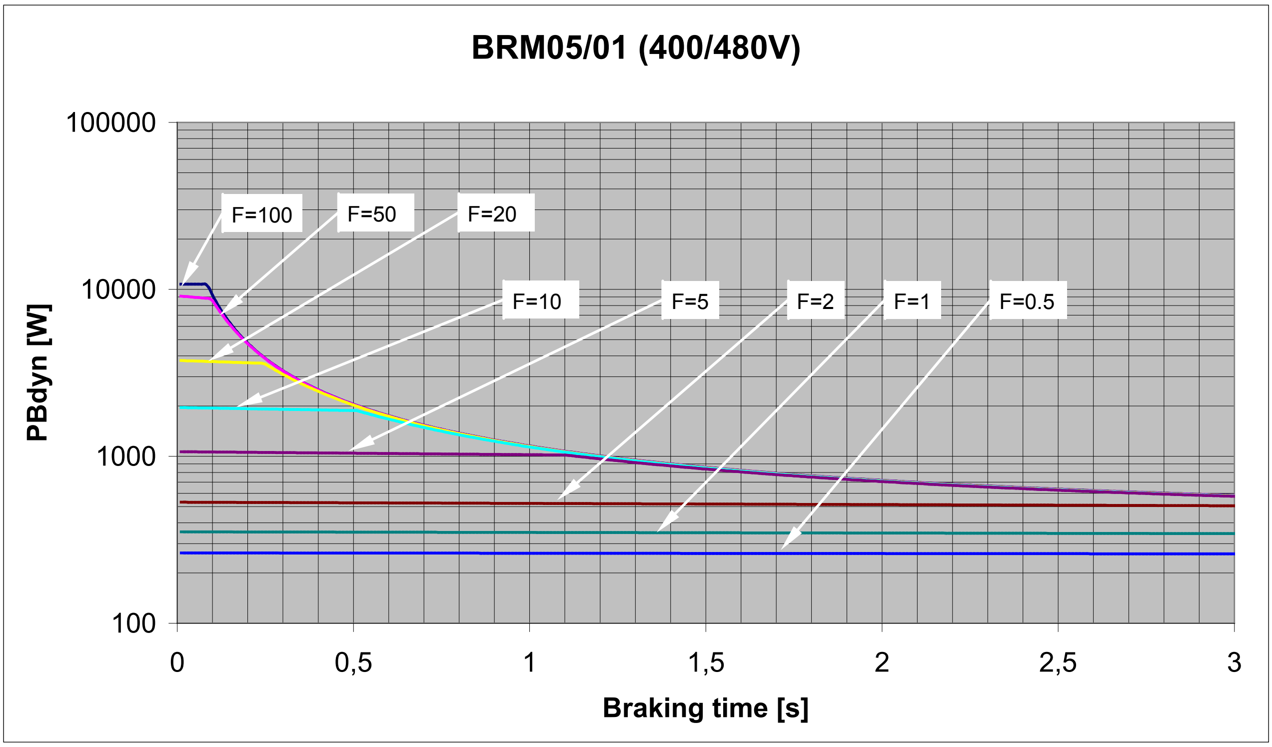
11.4.1.6 Permissible braking pulse power: BRM10/02 with C3S150V4



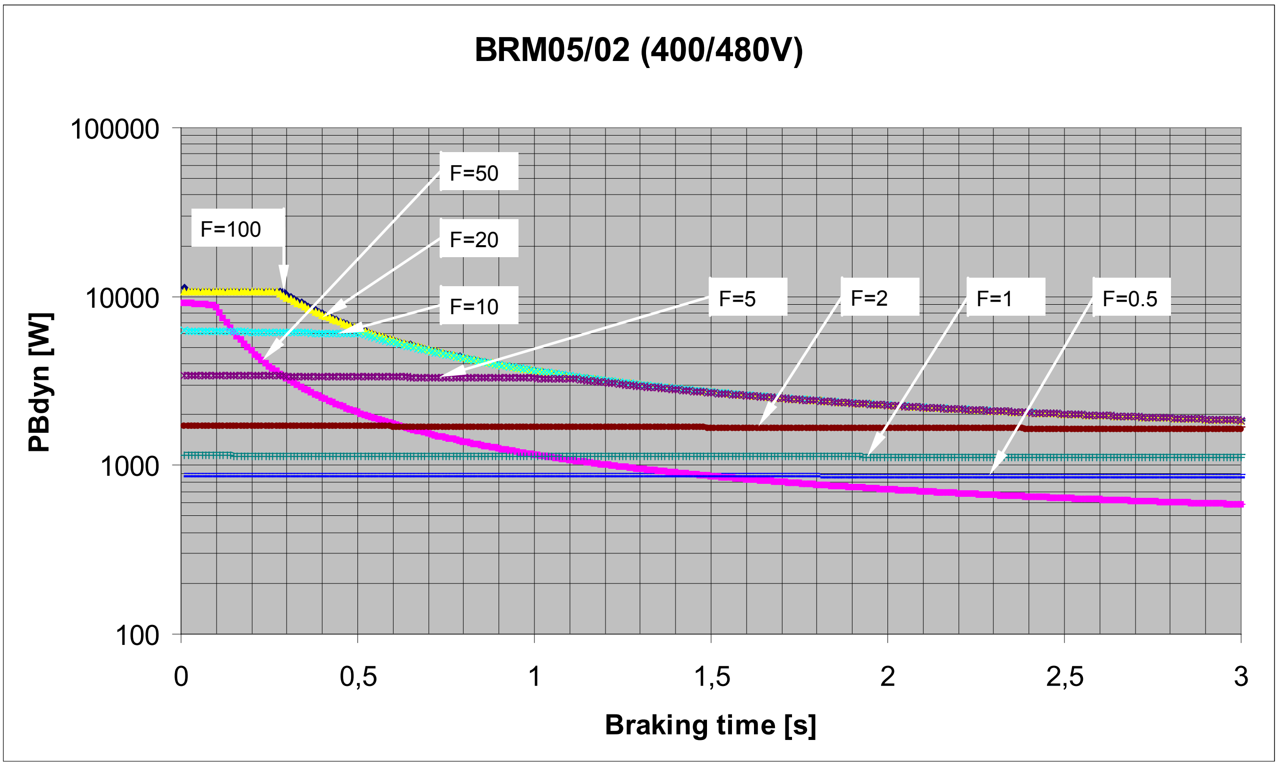
11.4.1.7 Permissible braking pulse power: BRM05/01 with C3S063V2



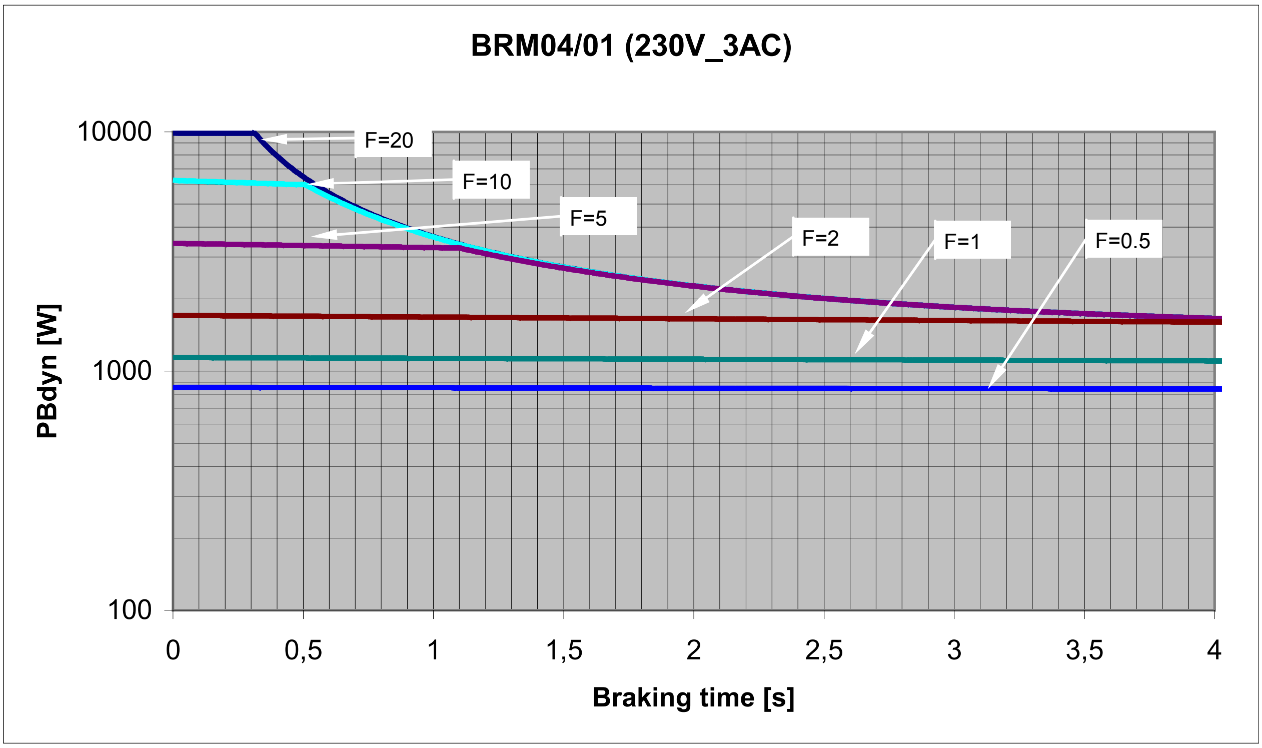
11.4.1.8 Permissible braking pulse power: BRM05/01 with C3S075V4



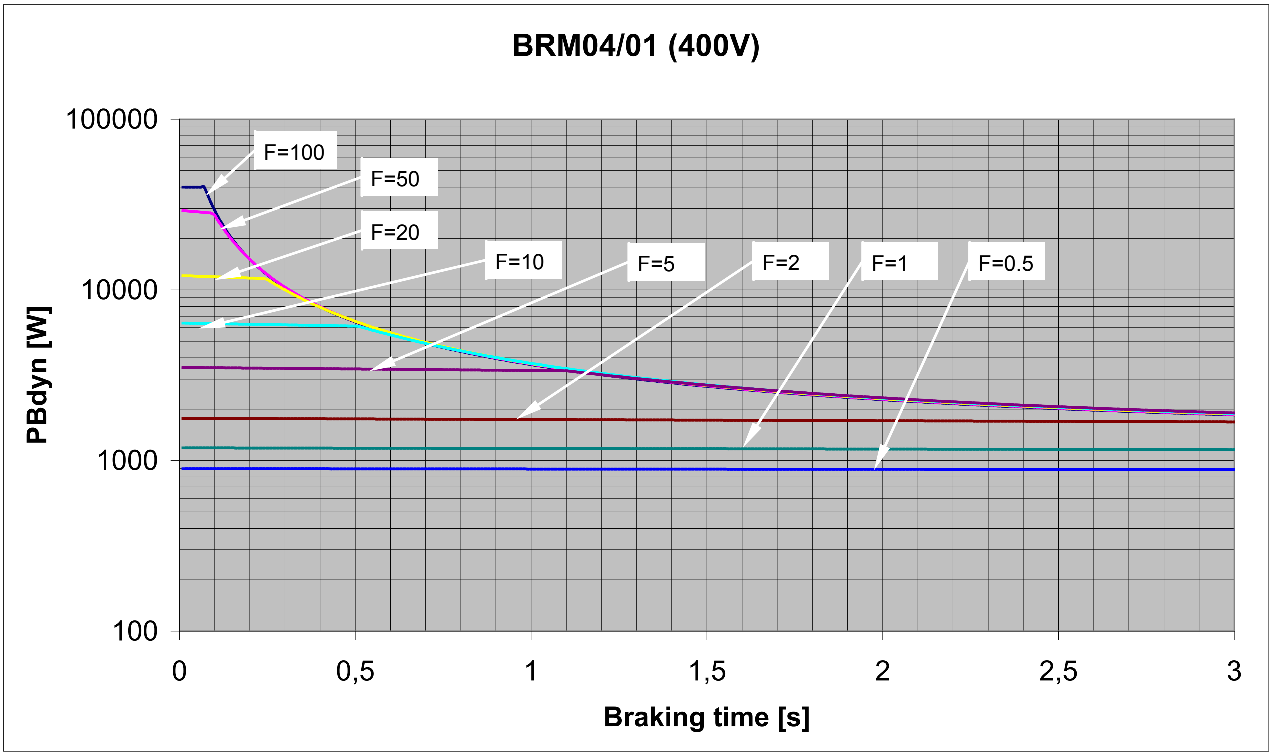
11.4.1.9 Permissible braking pulse power: BRM05/02 with C3S075V4



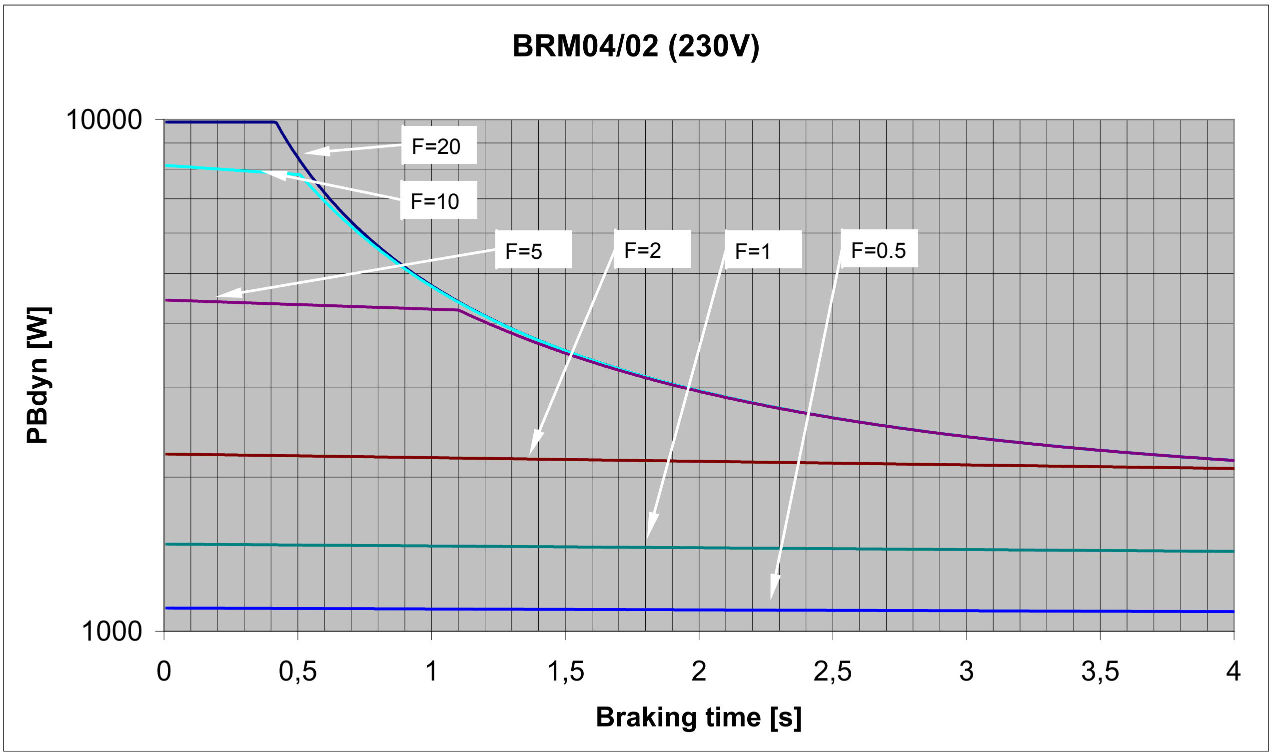
11.4.1.10 Permissible braking pulse power: BRM04/01 with C3S150V2



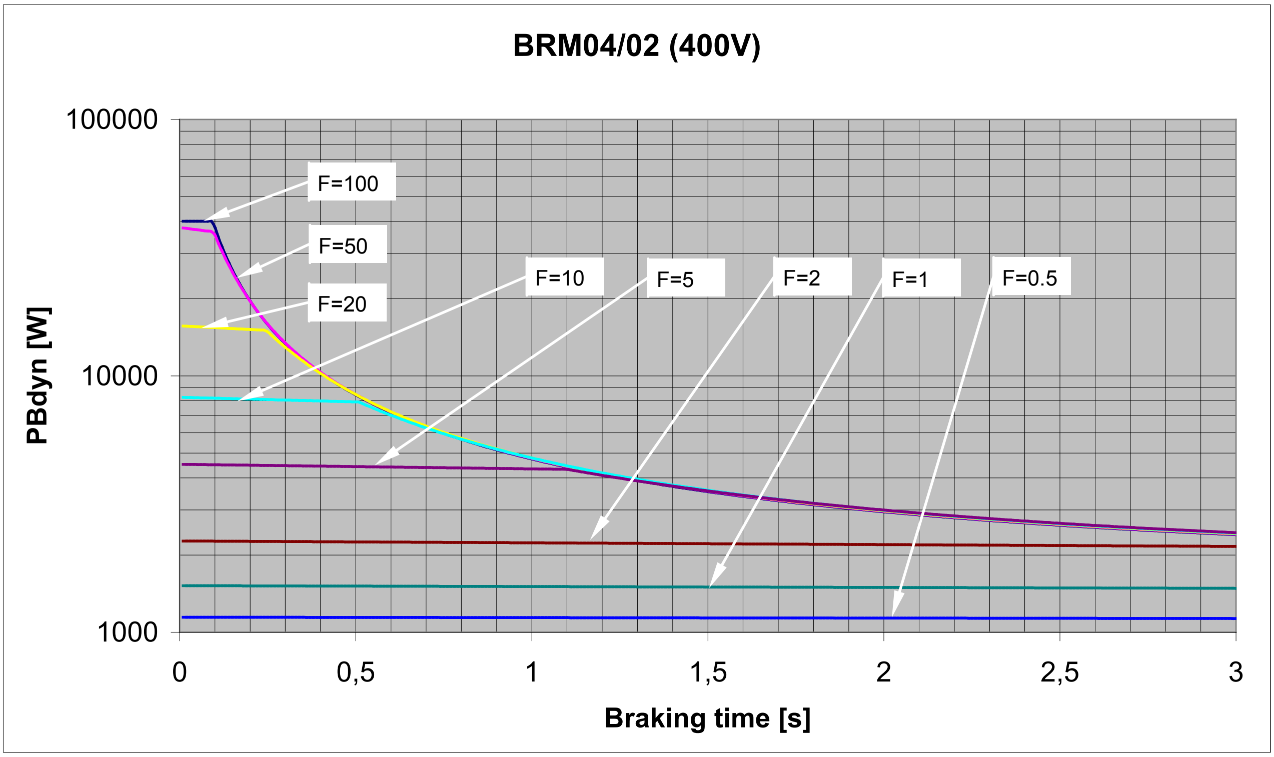
11.4.1.11 Permissible braking pulse power: BRM04/01 with C3S300V4



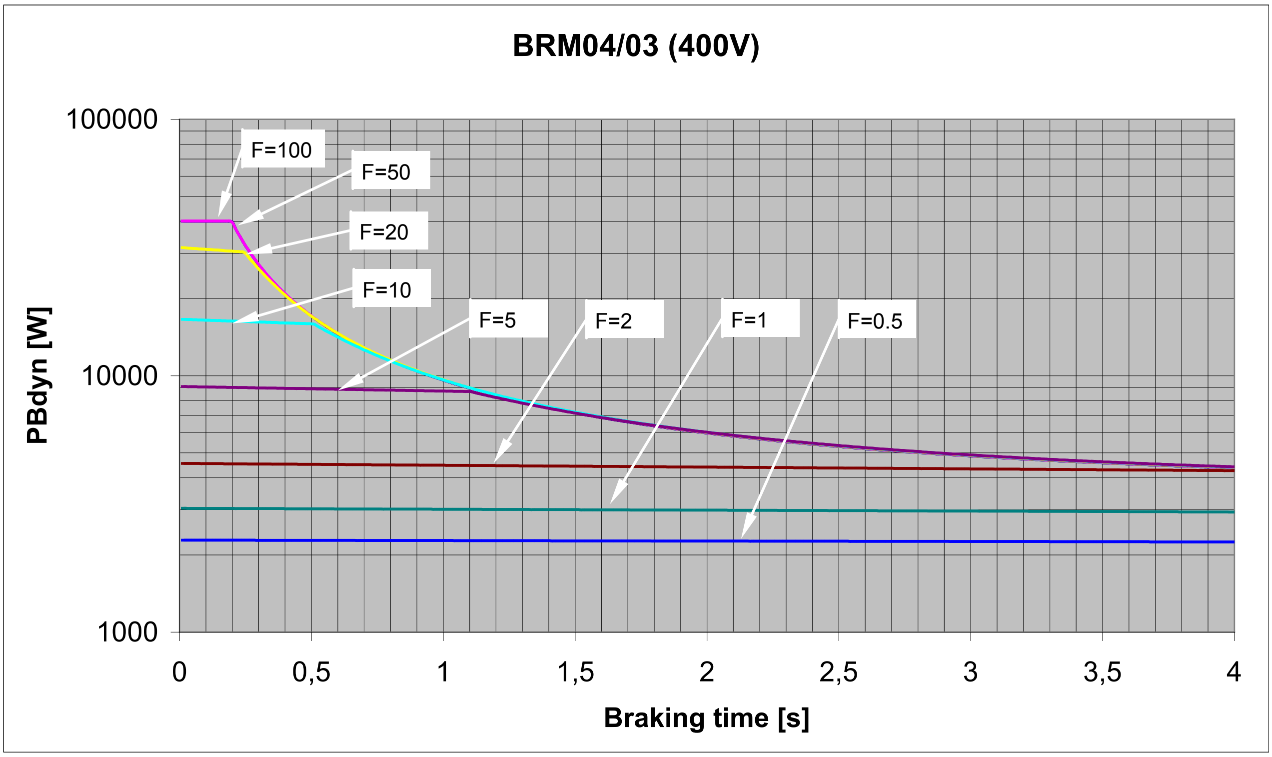
11.4.1.12 Permissible braking pulse power: BRM04/02 with C3S150V2



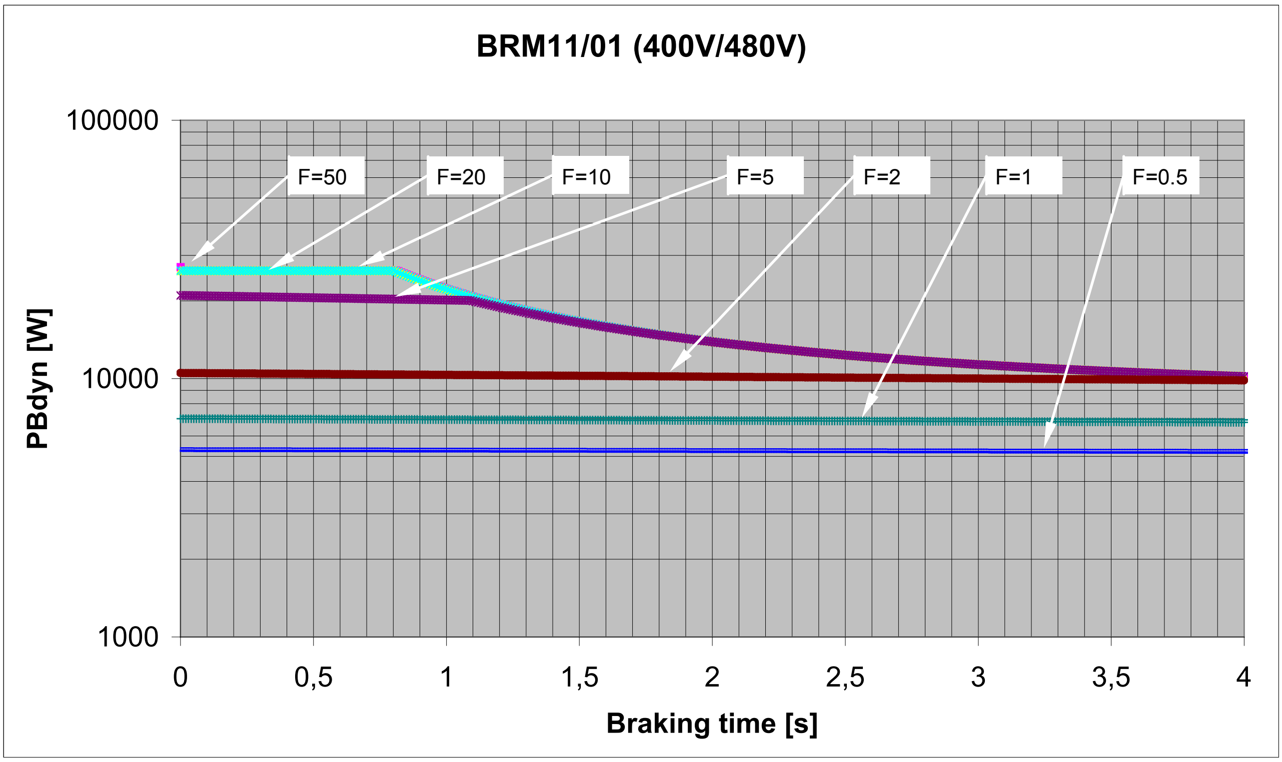
11.4.1.13 Permissible braking pulse power: BRM04/02 with C3S300V4



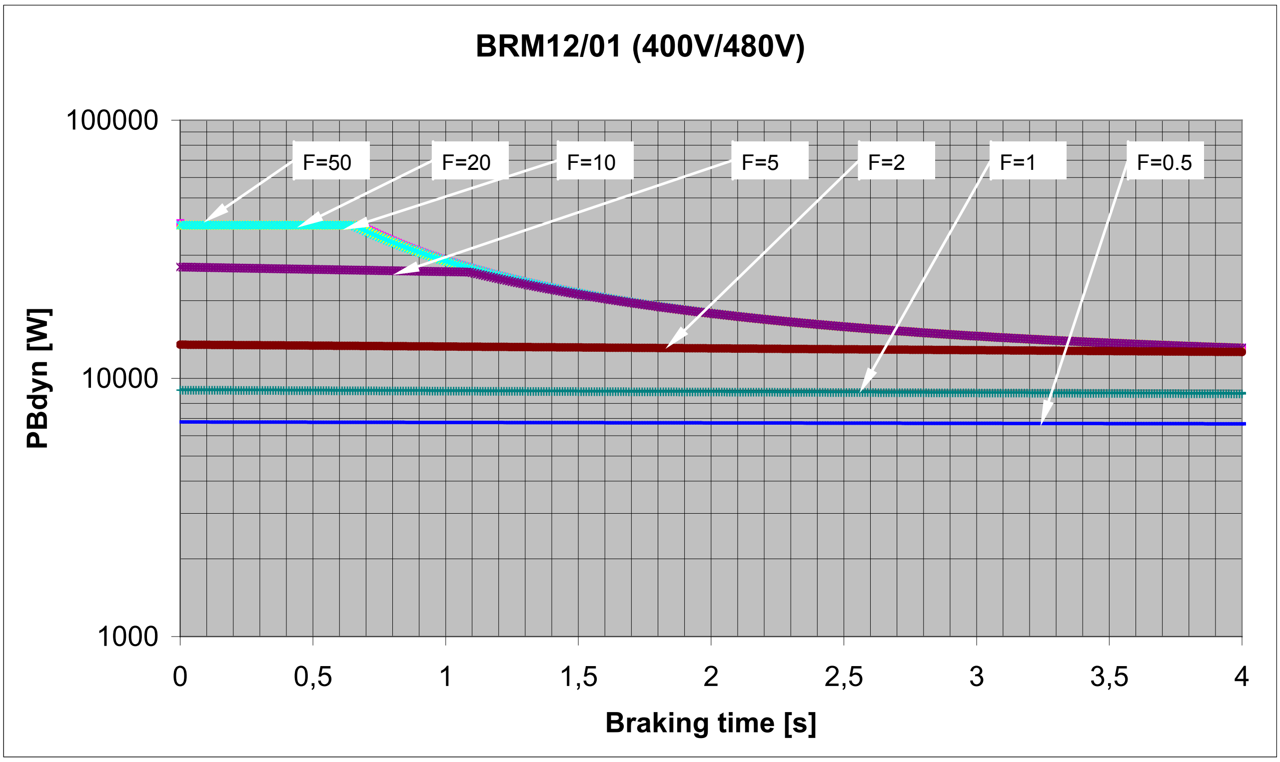
11.4.1.14 Permissible braking pulse power: BRM04/03 with C3S300V4



11.4.1.15 Permissible braking pulse power: BRM11/01 with C3H0xxV4



11.4.1.16 Permissible braking pulse power: BRM12/01 with C3H1xxV4



11.4.1.17 Permissible braking pulse power: BRM13/01 with PSUP10D6

on request

11.4.1.18 Permissible braking pulse power: BRM14/01 with PSUP10D6

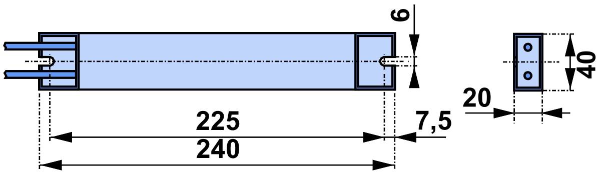
on request

11.4.2. Dimensions of the braking resistors

In this chapter you can read about:

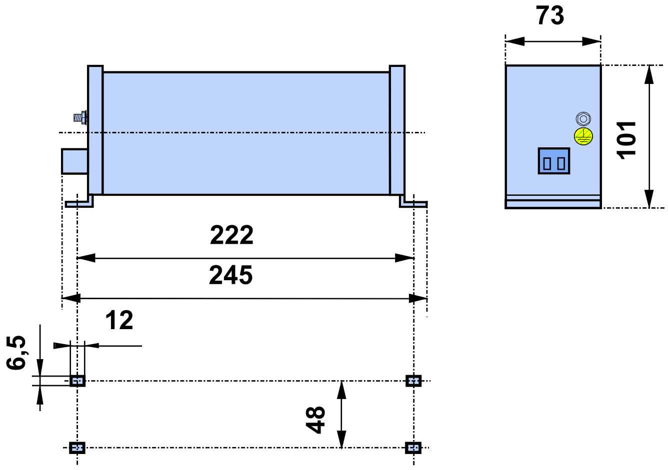
11.4.2.1 BRM8/01braking resistors

Dimensional drawing:



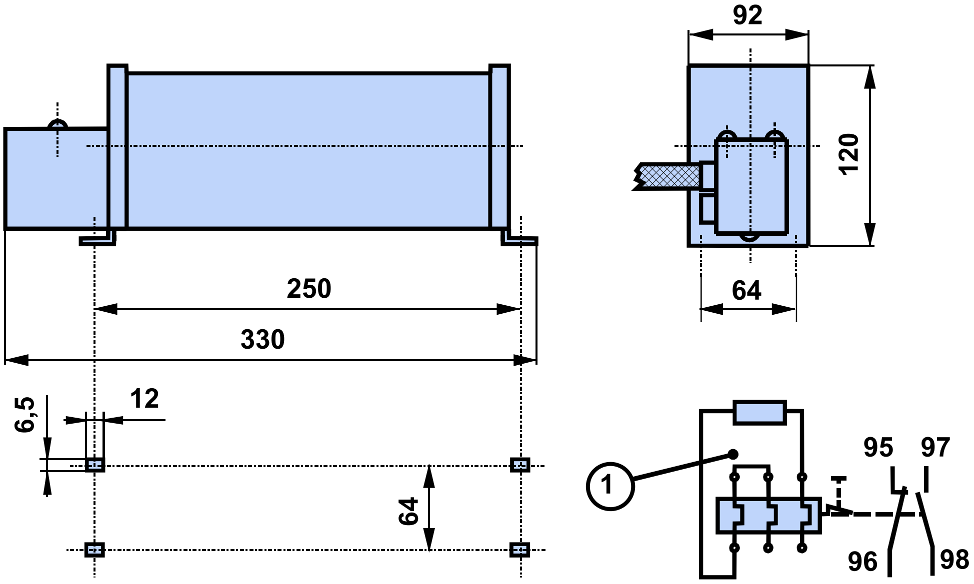
11.4.2.2 BRM5/01 braking resistor

Dimensional drawing:



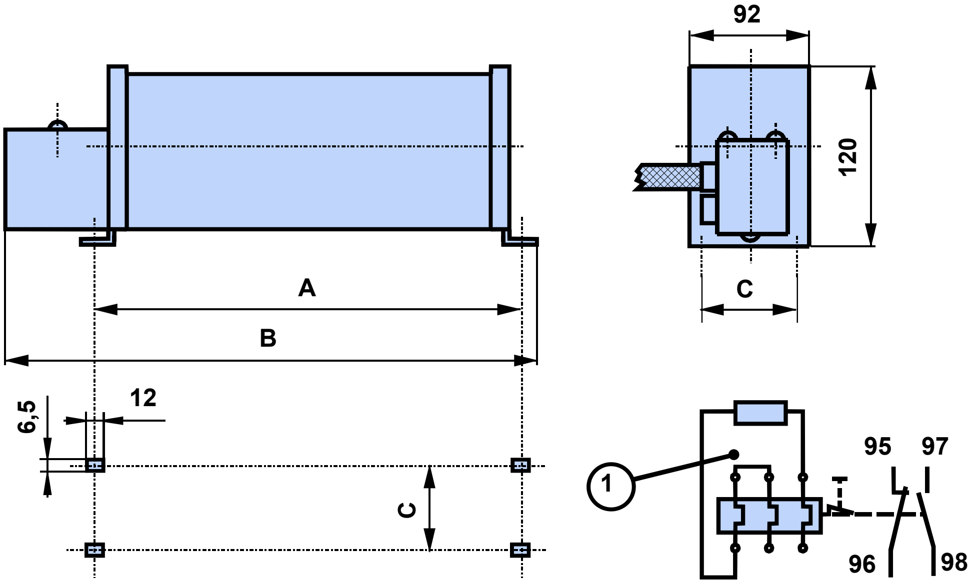
11.4.2.3 Braking resistor BRM5/02, BRM9/01 & BRM10/01

Dimensional drawing:



11.4.2.4 Ballast resistor BRM4/0x and BRM10/02

Dimensional drawing:



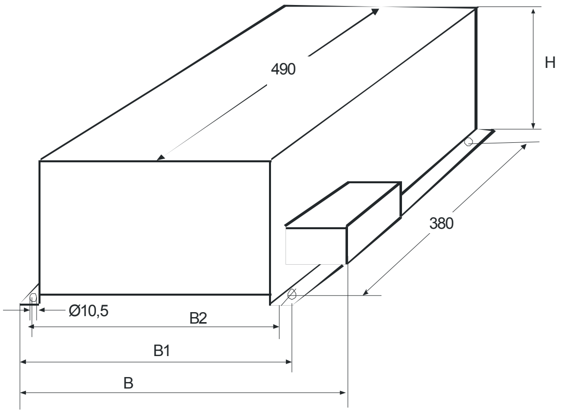
1: thermal overcurrent relay

Dimensions in mm:

Size:	BRM4/01	BRM4/02	BRM4/03 & BRM10/02
A	250	300	540
B	330	380	620
C	64	64	64

11.4.2.5 Braking resistor BRM11/01 & BRM12/01

Dimensional drawing:

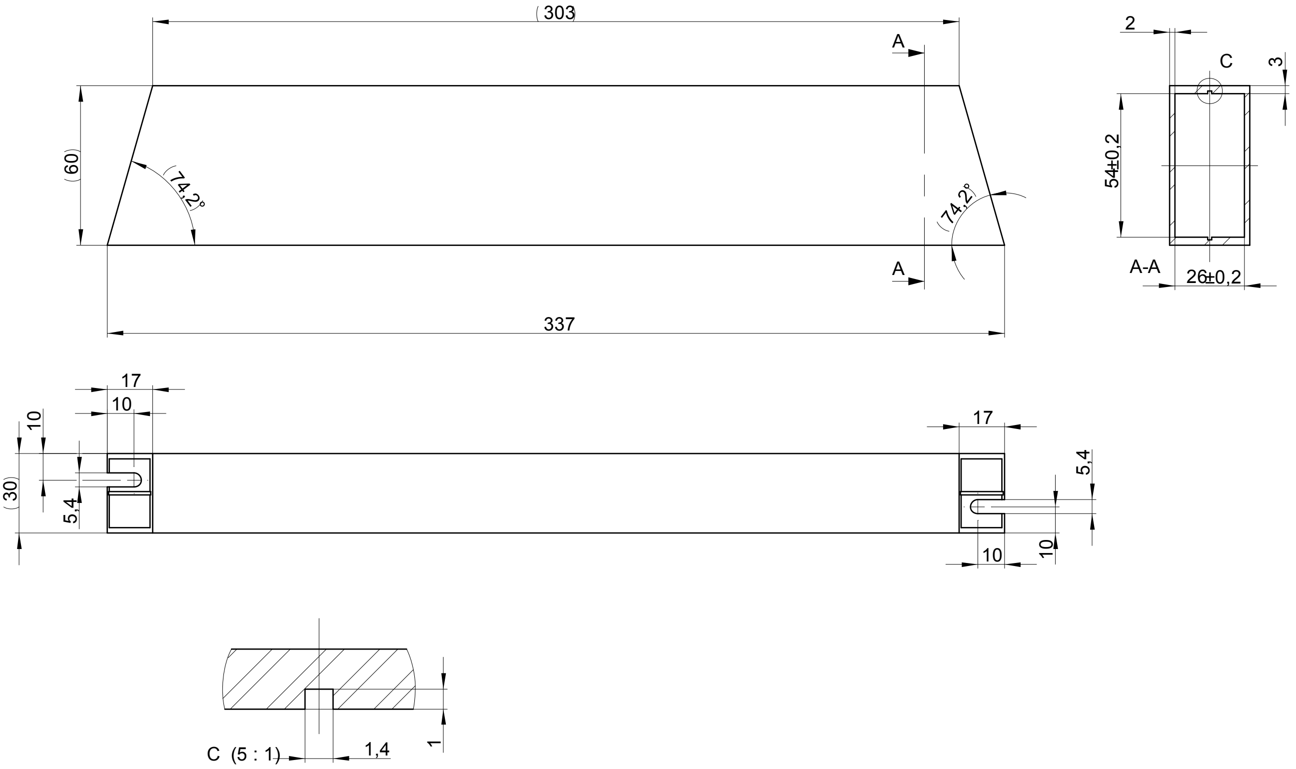


Dimensions in mm:

	BRM11/01	BRM12/02
B	330	
B1	295	
B2	270	
H	260	
Weight	6.0	7.0

11.4.2.6 Ballast resistor BRM13/01 & BRM14/01

Dimensional drawing:



Stated in mm

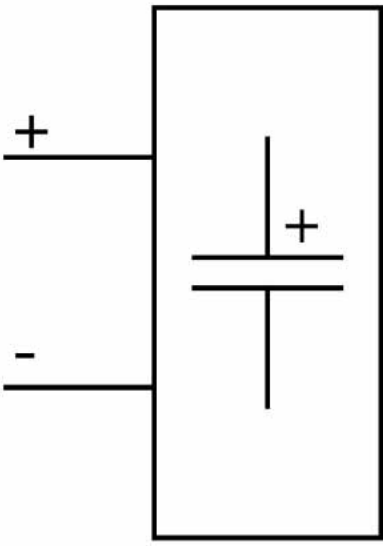
11.5 Condenser module C4

Order code condenser module

for C3S300V4	1100µF	Modules	C4

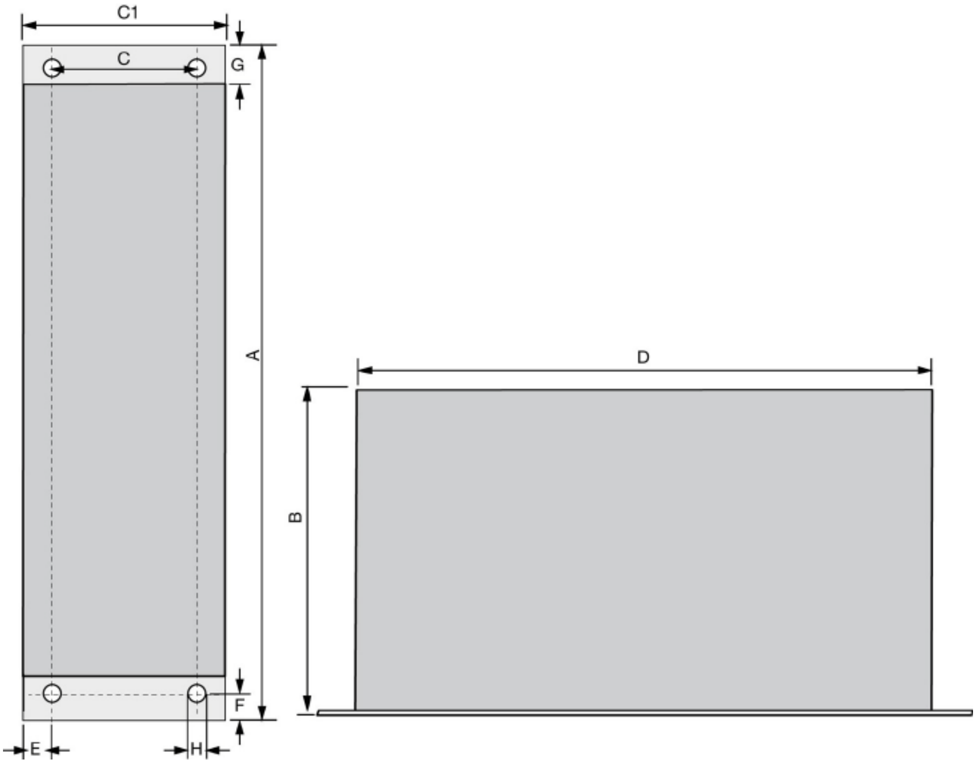
Technical Characteristics

Type	Capacity	Cable length
Module C4	1100µF	~30 cm



Dimensions in mm

Module C4	A	B	C	C1	D	E	F	G	H
	430	190	90	120	370	15	18	30	∅ 6



11.6 Operator control module BDM

Order Code operating module

Operating module (for Compax3S and Compax3F)	BDM	0	1	/	0	1

Flexible service and maintenance

Functions:

- Mobile or stationary handling: can remain on the unit for display and diagnostic purposes, or can be plugged into any unit.
- Can be plugged in while in operation
- Power supply via Compax3 servo control
- Display with 2 times 16 places.
- Menu-driven operation using 4 keys.
- Displays and changing of values.
- Display of Compax3 messages.
- Duplication of device properties and IEC61131-3 program to another Compax3 with identical hardware.
- Additional information can be found int he BDM manual This can be found on the Compax3 CD or on our Homepage: **BDM-manual** (**http://divapps.parker.com/divapps/EME/EME/Literature_List/dokumentationen/BDM.pdf**).

11.7 EAM06: Terminal block for inputs and outputs

Order Code terminal block

for I/Os without luminous indicator	for X11, X12, X22	EAM	0	6	/	0	1
for I/Os with luminous indicator	for X12, X22	EAM	0	6	/	0	2

The terminal block EAM06/.. can be used to route the Compax3 plug connector X11 or X12 for further wiring to a terminal strip and to a Sub-D plug connector.

Via a supporting rail (Design: ⊏ or ⊔) the terminal unit can be attached to a mounting rail in the switch cabinet.

EAM06/ is available in 2 variants:

- EAM06/01: Terminal block for X11, X12, X22 without luminous indicator
- EAM06/02: Terminal block for X12, X22 with luminous indicator

Corresponding connecting cables EAM06 - Compax3 are available:

- from X11 - EAM06/01: SSK23/..
- from X12, X22 - EAM06/xx: SSK24/..

EAM6/01: Terminal block without luminous indicator for X11, X12 or X22

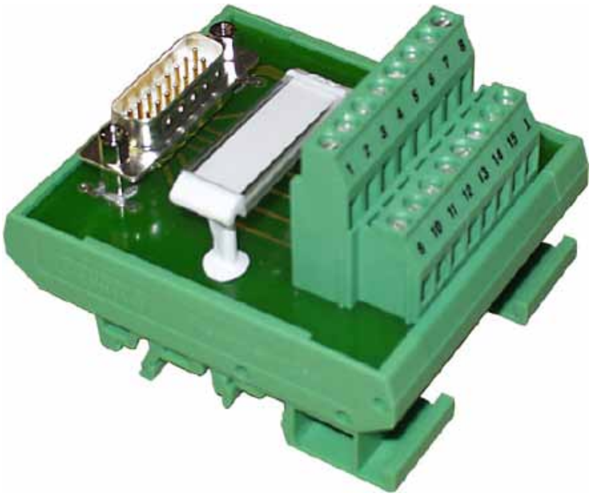


Figure similar

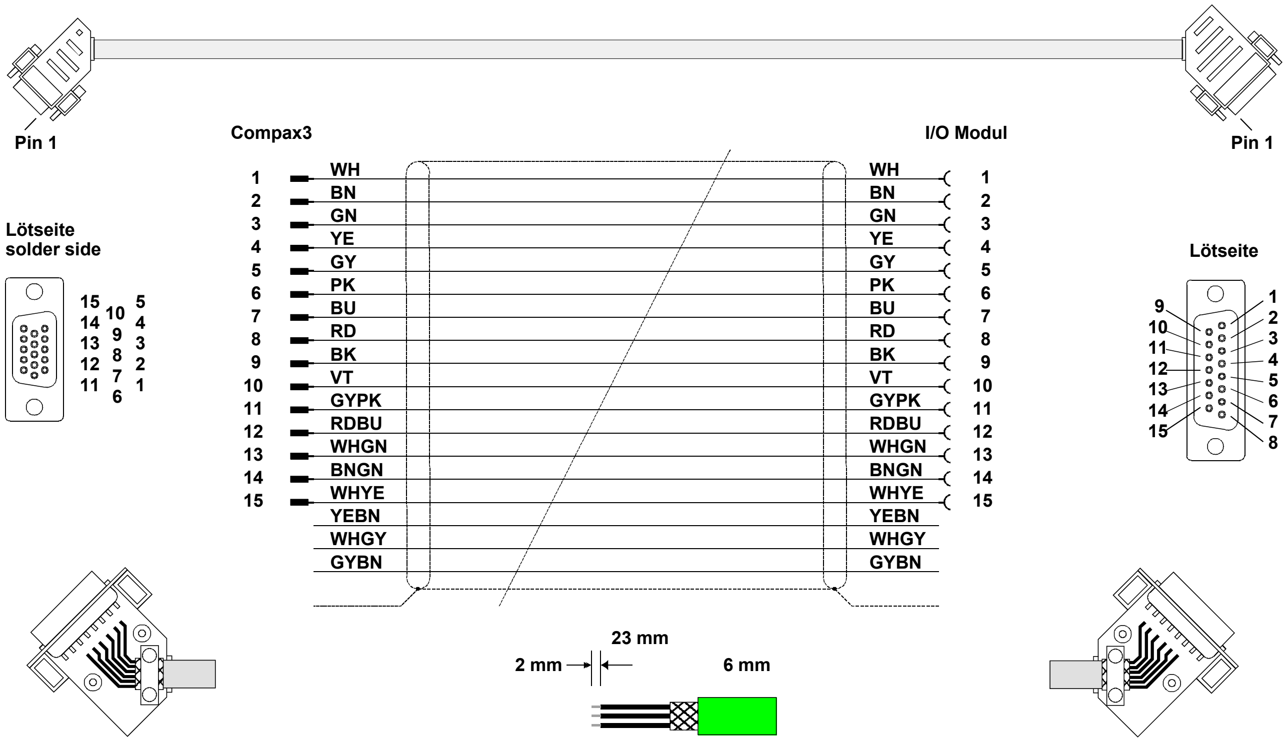
Width: 67.5 mm

EAM6/02: Terminal block with luminous indicator for X12, X22

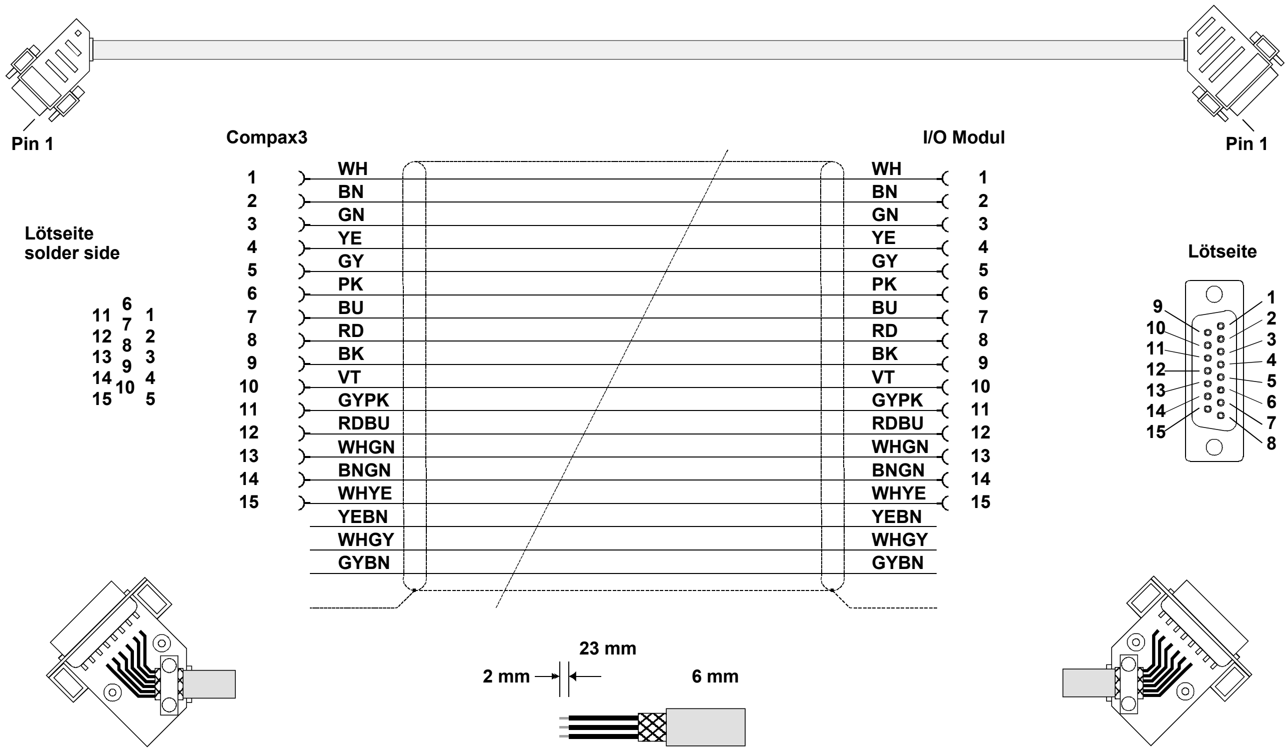
Figure similar

Width: 67.5 mm

Cable plan SSK23/..: X11 to EAM 06/01



Cable plan SSK24/..: X12 to EAM 06/xx



11.8 Interface cable

In this chapter you can read about:

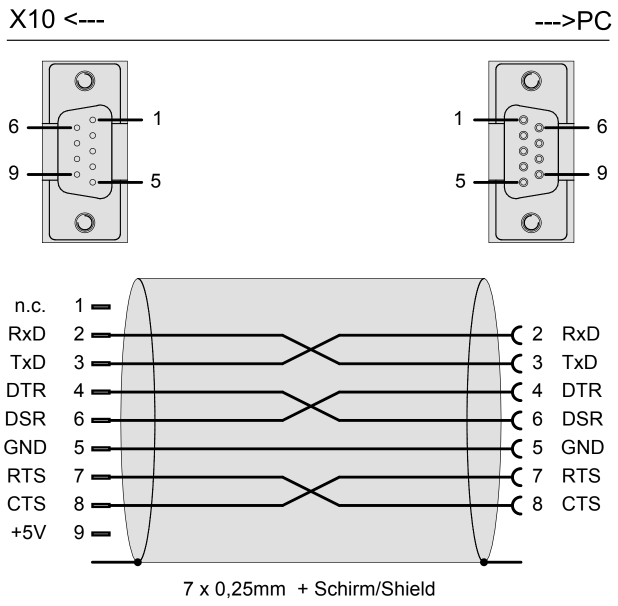
Order code for interface cables and plugs

PC – Compax3 (RS232)		SSK	0	1	/	...	...(1
PC – PSUP (USB)		SSK	3	3	/	...	...
on X11 (Ref/Analog) and X13 at C3F001D2	with flying leads	SSK	2	1	/	...	...(1
on X12 / X22 (digital I/Os)	with flying leads	SSK	2	2	/	...	...(1
on X11 (Ref /Analog)	for I/O terminal block	SSK	2	3	/	...	...(1
on X12 / X22 (digital I/Os)	for I/O terminal block	SSK	2	4	/	...	...(1
PC ⇔ POP (RS232)		SSK	2	5	/	...	...(1
Compax3 ⇔ POP (RS485) for several C3H on request		SSK	2	7	/	../	...(6
Compax3 HEDA ⇔ Compax3 HEDA or PC ⇔ C3powerPLmC Compax3 I30 ⇔ Compax3 I30 or C3M-multi-axis communication Profinet, EtherCAT, Ethernet Powerlink		SSK	2	8	/	../	...(5
Compax3 X11 ⇔ Compax3 X11 (encoder coupling of 2 axes)		SSK	2	9	/	...	...(1
Compax3 X10 ⇔ Modem		SSK	3	1	/	...	
Compax3H adapter cable ⇔ SSK01 (length 15cm, delivered with the device)		SSK	3	2	/	2	0
Compax3H X10 RS232 connection control ⇔ Programming interface (delivered with the device)		VBK	1	7	/	0	1
Bus terminal connector (for the 1st and last Compax3 in the HEDA Bus/or multi-axis system)		BUS	0	7	/	0	1
Profibus cable (2	non prefabricated	SSL	0	1	/	...	...(1
Profibus plug		BUS	0	8	/	0	1
CAN bus cable (2	non prefabricated	SSL	0	2	/	...	...(1
CANbus connector		BUS	1	0	/	0	1

(x **Note on cable** (see on page 568)

11.8.1. RS232 cable

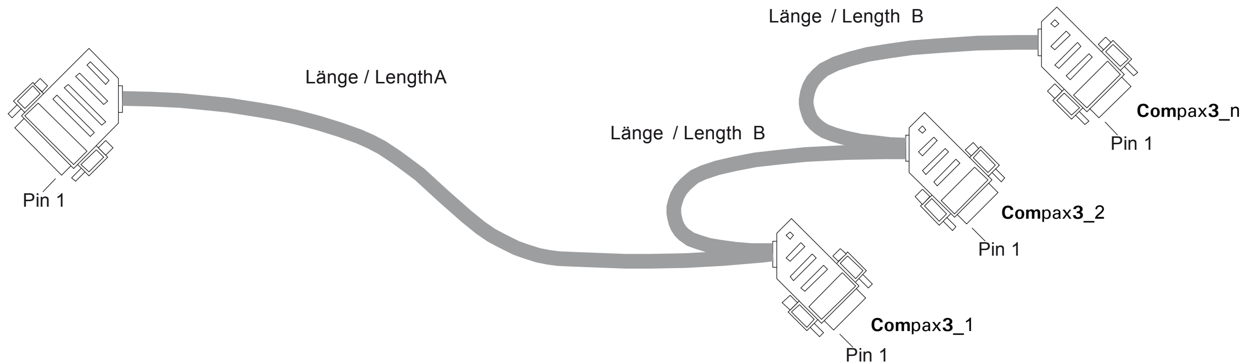
SSK1/..

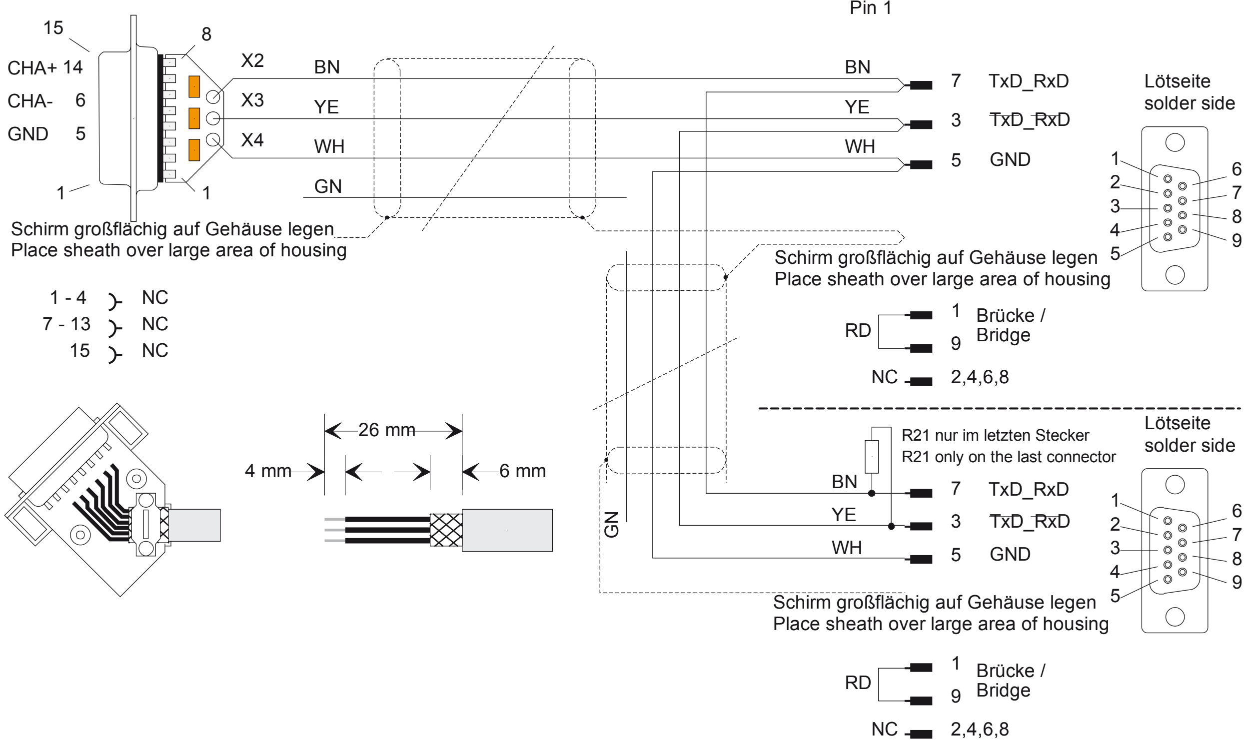


You can find the length code in the **Order Code Accessories** (see on page 565)

11.8.2. RS485 cable to Pop

SSK27: Connection Pop - Compax3 - Compax3 - ...





R21 = 220 Ohm

[6] Order code: SSK27/nn/..

Length A (Pop - 1. Compax3) variable (the last two numbers according to the length code for cable, for example SSK27/nn/01)

Length B (1. Compax3 - 2. Compax3 - ... - n. Compax3) fixed 50 cm (only if there is more than 1 Compax3, i.e. nn greater than 01)

Number n (the last two digits)

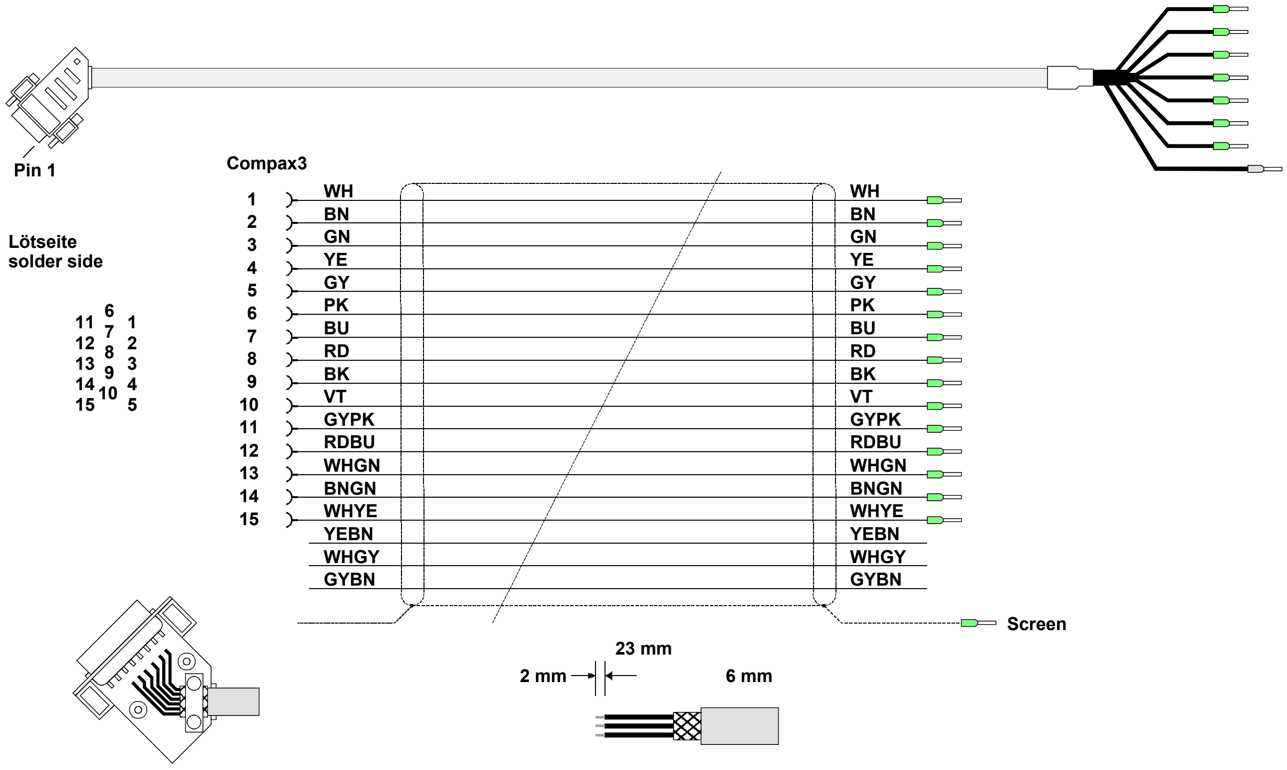
Examples include:

SSK27/05/.. for connecting from Pop to 5 Compax3.

SSK27/01/.. for connecting from Pop to one Compax3

11.8.3. I/O interface X12 / X22

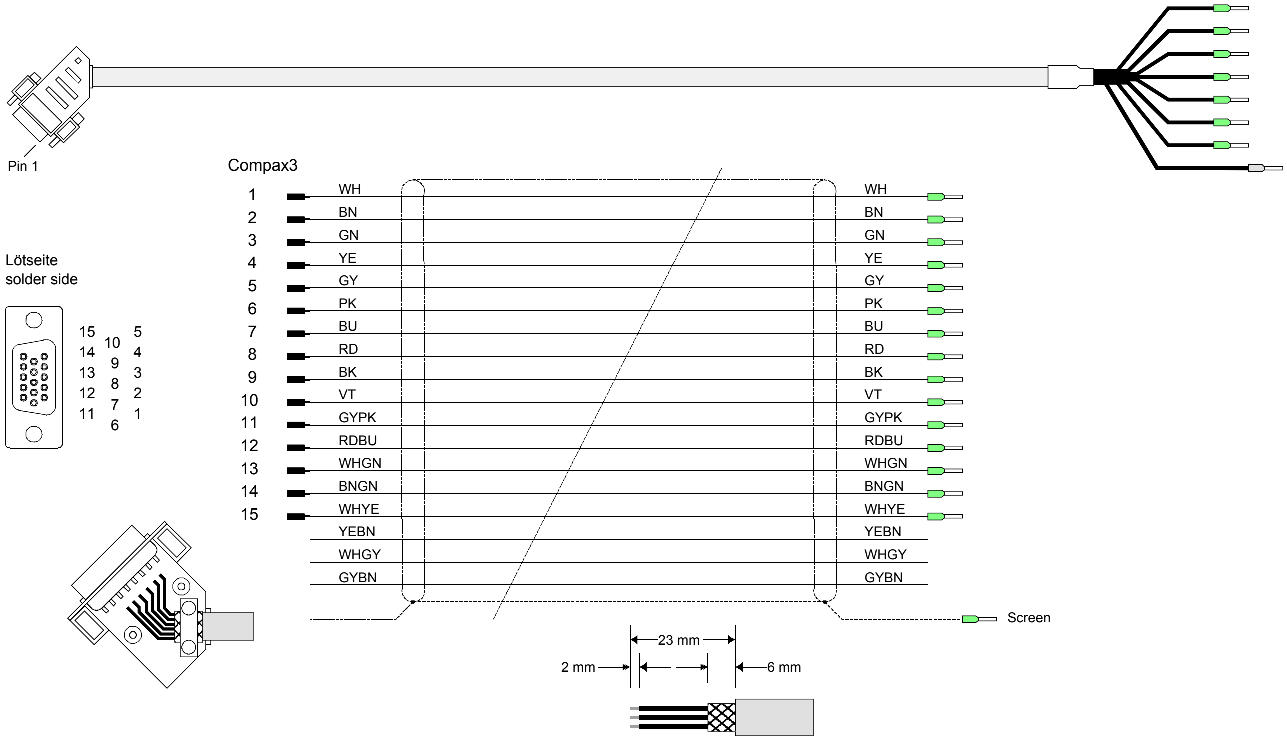
SSK22/..: Cable for X12 / X22 with flying leads



You can find the length code in the **Order Code Accessories** (see on page 565)

11.8.4. Ref X11

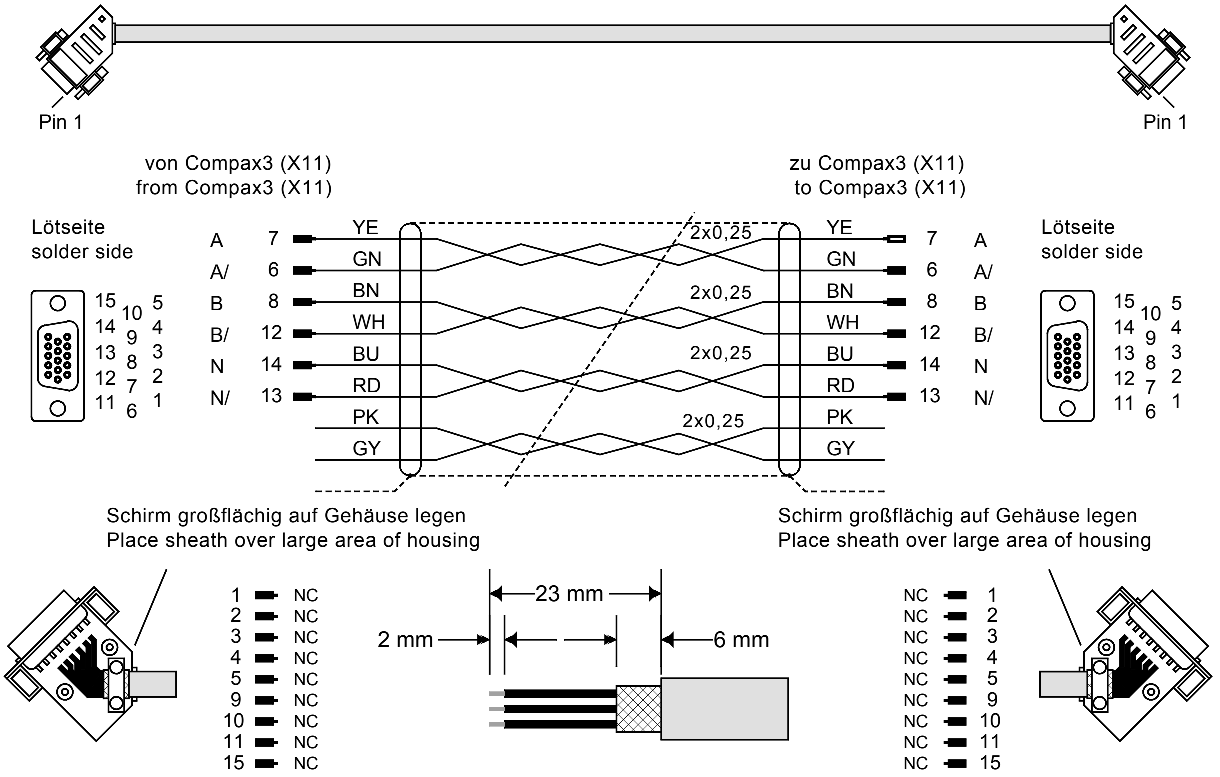
SSK21/..: Cable for X11 with open ends



You can find the length code in the **Order Code Accessories** (see on page 565)

11.8.5. Encoder coupling of 2 Compax3 axes

SSK29/..: Cable from Compax3 X11 to Compax3 X11

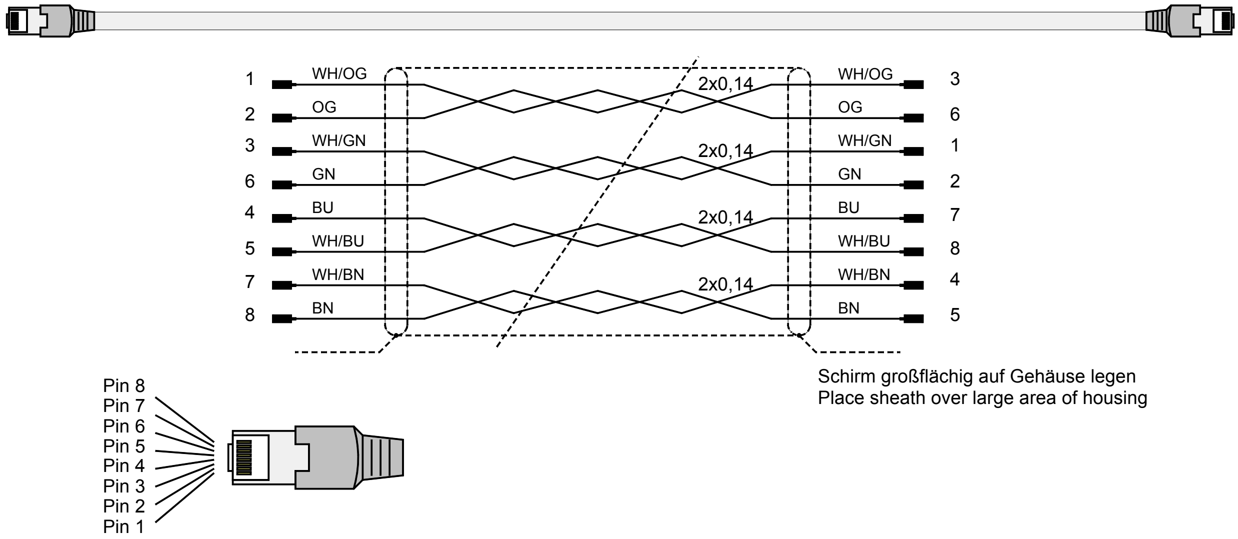


You can find the length code in the **Order Code Accessories** (see on page 565)

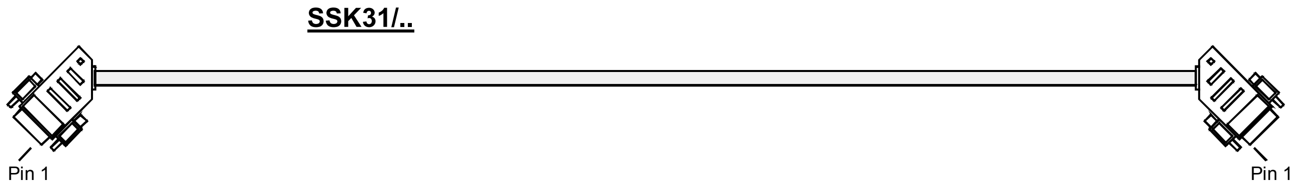
Compax3 HEDA ⬄ Compax3 HEDA or PC ⬄ C3powerPLmC
Compax3 I30 ⬄ Compax3 I30 or C3M-multi axis communication

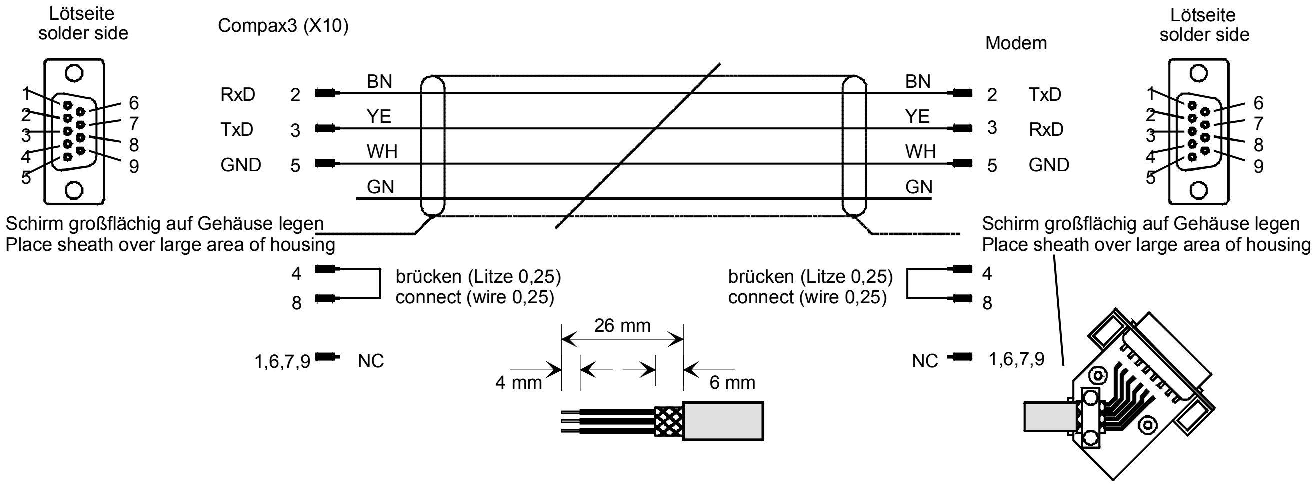
Profinet, EtherCAT, Ethernet Powerlink

Layout of SSK28:



11.8.6. Modem cable SSK31





You can find the length code in the **Order Code Accessories** (see on page 565)

11.9 Options M1x

In this chapter you can read about:

11.9.1. Input/output option M12

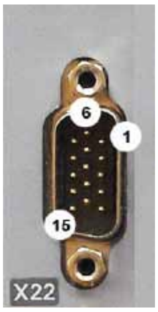
An optional input/output extension is available for Compax3. This option is named M12 and offers 12 digital 24V inputs/outputs (Ports) on X22.

The use of the option as inputs or outputs is programmable in groups of 4 (via the object 133.4).

The outputs are written via the object 133.3 "Output word for the I/O option"; this applies only for the ports defined as output.

The inputs are read via the object 121.2 " Input word for the I/O option"; all ports are being read, also the outputs.

11.9.1.1 Assignment of the X22 connector



Pin X22/	Input/output	I/O /X22 High density/Sub D	Access via IEC module:
1	n.c.	factory use	
2	O0/I0	Output 0 / Input 0 - adjustable	**C3_IOAddition_0** (see on page 444)
3	O1/I1	Output 1 / Input 1 - adjustable	
4	O2/I2	Output 2 / Input 2 - adjustable	
5	O3/I3	Output 3 / Input 3 - adjustable	
6	O4/I4	Output 4 / Input 4 - adjustable	**C3_IOAddition_1** (see on page 444)
7	O5/I5	Output 5 / Input 5 - adjustable	
8	O6/I6	Output 6 / Input 6 - adjustable	
9	O7/I7	Output 7 / Input 7 - adjustable	
10	O8/I8	Output 8 / Input 8 - adjustable	**C3_IOAddition_2** (see on page 445) (not 24VDC)
11	I	24 VDC power supply	
12	O9/I9	Output 9 / Input 9 - adjustable	
13	O10/I10	Output 10 / Input 10 - adjustable	
14	O11/I11	Output 11 / Input 11 - adjustable	
15	I	GND24V	

The assignment can be adjusted.

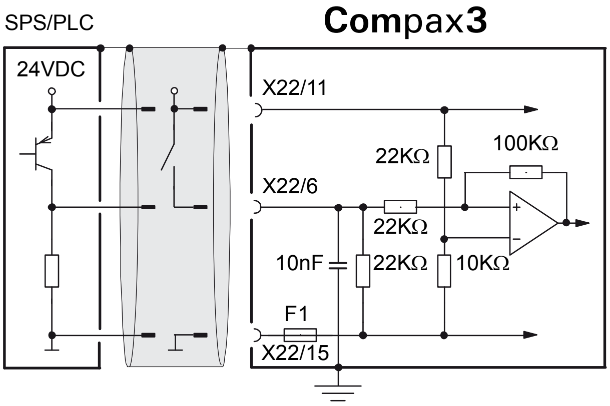
All inputs and outputs have 24V level.

Maximum load on an output: 100mA

Maximum capacitive load: 50nF (max. 4 Compax3 inputs)

Caution! The 24VDC power supply (X22/11) must be supplied from an external source and must be protected by a 1.2A delayed fuse!

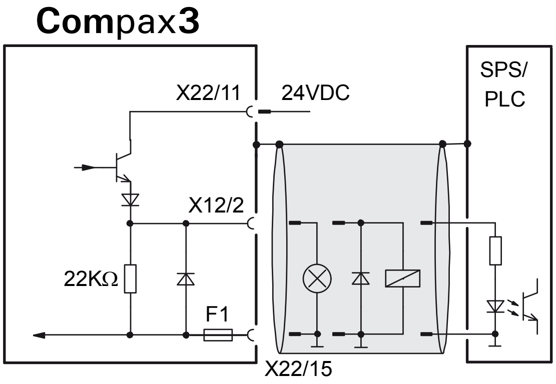
Input wiring of digital inputs



The circuit example is valid for all digital inputs!

F1: Quick action electronic fuse; can be reset by switching the 24VDC supply off and on again.

Output wiring of digital outputs

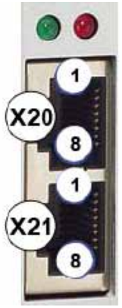


The circuit example is valid for all digital outputs!

The outputs are short circuit proof; a short circuit generates an error.

F1: Quick action electronic fuse; can be reset by switching the 24VDC supply off and on again.

11.9.2. HEDA (motion bus) - Option M11



	RJ45 (X20)	**RJ45 (X21)**
Pin	**HEDA in**	**HEDA out**
1	Rx	Tx
2	Rx/	Tx/
3	Lx	Lx
4	-	factory use
5	-	factory use
6	Lx/	Lx/
7	-	factory use
8	-	factory use

Function of the HEDA LEDs

Green LED (left)

HEDA module energized

Red LED (right)

Error in the receive area

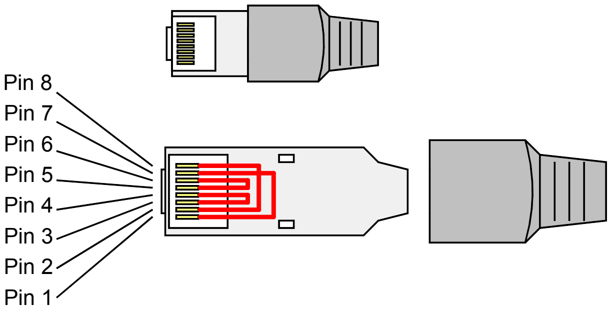
Possible causes:

- at the Master
  - no slave sending back
  - Wrong cabling
  - Terminal plug is missing
  - several masters are sending in the same slot
- at the slave
  - several masters in the system
  - no master active
  - Terminal plug is missing
  - no transmission from one or several receive slots (neither by the master nor by another slave)

HEDA-wiring:

Layout of SSK28 (see on page 567, see on page 606)

Design of the HEDA bus terminator BUS 07/01:



Jumpers: 1-7, 2-8, 3-4, 5-6

Function of the HEDA LEDs

Green LED (left)

HEDA module energized

Red LED (right)

Error in the receive area

Possible causes:

- at the Master
  - no slave sending back
  - Wrong cabling
  - Terminal plug is missing
  - several masters are sending in the same slot
- at the slave
  - several masters in the system
  - no master active
  - Terminal plug is missing
  - no transmission from one or several receive slots (neither by the master nor by another slave)

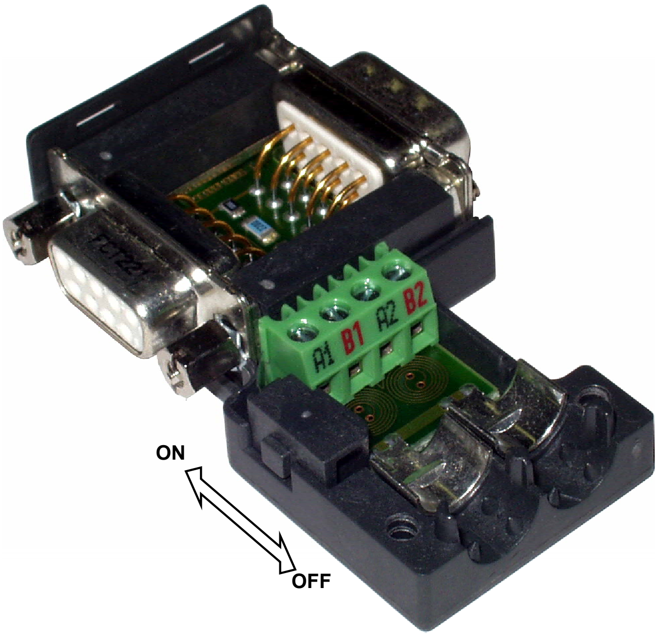
11.9.3. Option M10 = HEDA (M11) & I/Os (M12)

The M10 option includes the M12 input/output option and the HEDA M11 option.

11.10 Profibus plug BUS08/01

We offer a Profibus plug and special cable as sold be the meter for Profibus wiring:

- Profibus cable: SSL02/.. not prefabricated (color according to DESINA).
- Profibus plug: BUS8/01 with 2 cable inputs (for one incoming A1, B1 and one continuing Profibus cable- A2, B2 -) and screw terminals as well as a switch for activating the terminal resistor.
  The terminal resistor must be activated on the first and on the last node (= switch setting ON).



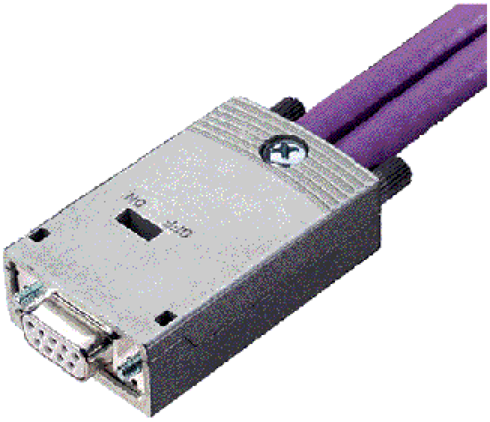
11.11 CAN - plug BUS10/01

We offer a CAN plug and special cable in any length to order for the CAN-bus wiring:

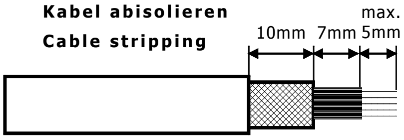
- CAN cable: SSL02/.. not prefabricated (color according to DESINA).
- CAN plug: BUS10/01 with 2 cable inputs and screw terminals as well as a switch for activating the terminal resistor.
  The terminal resistor must be activated on the first and on the last station (=switch setting ON).

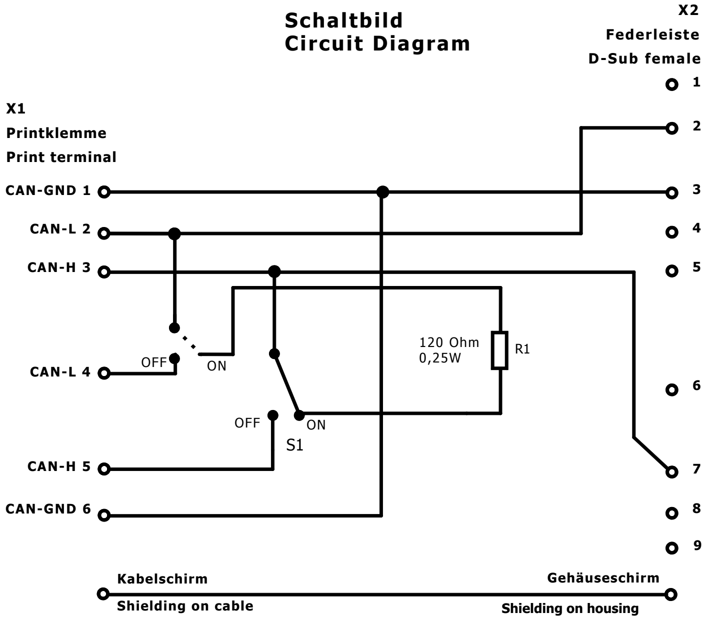
Note for integrated C3 powerPLmC (Compax3 interface designation "C1x")

- The CAN bus of the C3 powerPLmC does already contain a terminal resistor.
- Therefore it applies for the **C3 powerPLmC**:
  Put switch to OFF
  wire C3 powerPLmC always at the end of the CAN bus!



CAN wiring





11.12 PIO: External Inputs/Outputs

Additional external digital and analog inputs and outputs can be integrated via CANopen.

For this purpose we offer the Parker I/O system (PIO).

PIO offers the convenience of exceptionally simple installation. The individual modules can be installed and removed without any tools.

Available modules:

Order Code decentralized input terminals

PIO 2DI 24VDC 3.0ms	2-channel digital input terminal	PIO	4	0	0
PIO 4DI 24VDC 3.0ms	4-channel digital input terminal	PIO	4	0	2
PIO 8DI 24VDC 3.0ms	8-channel digital input terminal	PIO	4	3	0
PIO 2AI DC ±10V differential input	2-channel analog - Input terminal (±10V differential input)	PIO	4	5	6
PIO 4AI 0-10VDC S.E.	4 channel analog input terminal (0-10V signal voltage)	PIO	4	6	8
PIO 2AI 0-20mA differential input	2-channel analog - Input terminal (0-20mA differential input)	PIO	4	8	0

Order Code decentralized output terminals

PIO 2DO 24VDC 0.5A	2 channel digital output terminal (output voltage 0.5A)	PIO	5	0	1
PIO 4DO 24VDC 0.5A	4 channel digital output terminal (output voltage 0.5A)	PIO	5	0	4
PIO 8DO 24VDC 0.5A	8 channel digital output terminal (output voltage 0.5A)	PIO	5	3	0
PIO 2AO 0-10VDC	2 channel analog output terminal (0-10V signal voltage)	PIO	5	5	0
PIO 2AO 0-20mA	2-channel analog output terminal (0-20mA signal voltage)	PIO	5	5	2
PIO 2AO DC ±10V	2-channel analog output terminal (±10V signal voltage)	PIO	5	5	6

Order Code CANopen Fieldbus Coupler

CANopen Standard	max. Vectorial sum current for bus terminals 1650mA at 5V	PIO	3	3	7
CANopen ECO	max. Vectorial sum current for bus terminals 650mA at 5V	PIO	3	4	7

For additional information please refer to our **catalog http://apps.parker.com/divapps/eme/EME/Literature_List/dokumentationen/PIO_Prospekt%20dt.pdf**.

12. Technical Characteristics

Mains connection Compax3S0xxV2 1AC

Controller type	**S025V2**	**S063V2**
Supply voltage	Single phase 230VAC/240VAC 80-253VAC / 50-60Hz	
Input current	6Arms	13Arms
Maximum fuse rating per device (=short circuit rating)	10 A (MCB miniature circuit breaker, K characteristic)	16A (automatic circuit breaker K)

Mains connection Compax3S1xxV2 3AC

Controller type	**S100V2**	**S150V2**
Supply voltage	Three phase 3* 230VAC/240VAC 80-253VAC / 50-60Hz	
Input current	10Arms	13Arms
Maximum fuse rating per device (=short circuit rating)	16A	20A
	MCB miniature circuit breaker, K characteristic	

Mains connection Compax3SxxxV4 3AC

Controller type	**S015V4**	**S038V4**	**S075V4**	**S150V4**	**S300V4**
Supply voltage	Three phase 3*400VAC/480VAC 80-528VAC / 50-60Hz				
Input current	3Aeff	6Arms	10Arms	16Arms	22Arms
Maximum fuse rating per device(=short circuit rating)	6A	10A	16A	20A	25A
	MCB miniature circuit breaker, K characteristic				D*

Mains connection PSUP10D6

Device type PSUP10	**230V**	**400V**	**480V**
Supply voltage	230VAC ±10% 50-60Hz	400VAC ±10% 50-60Hz	480VAC ±10% 50-60Hz
Rated voltage	3AC 230V	3AC 400V	3AC 480V
Input current	22Arms	22Arms	18Arms
Output voltage	325VDC ±10%	565VDC ±10%	680VDC ±10%
Output power	6kW	10 kW	10 kW
Pulse power (<5s)	12kW	20kW	20kW
Power dissipation	60W	60W	60W
Maximum fuse rating per device (=short circuit rating)	Measure for line and device protection: MCB miniature circuit breaker (K characteristic) 25A in accordance with UL category DIVQ Recommendation: (ABB) S203UP-K 25(480VAC)		

Mains connection PSUP20D6

Device type PSUP20	**230V**	**400V**	**480V**
Supply voltage	230VAC ±10% 50-60Hz	400VAC ±10% 50-60Hz	480VAC ±10% 50-60Hz
Rated voltage	3AC 230V	3AC 400V	3AC 480V
Input current	44Arms	44Arms	35Arms
Output voltage	325VDC ±10%	565VDC ±10%	680VDC ±10%
Output power	12kW	20kW	20kW
Pulse power (<5s)	24kW	40kW	40kW
Power dissipation	120W	120W	120W
Maximum fuse rating per device (=short circuit rating) 2 circuit breakers in line are required	**Cable protection measure:** MCB (K characteristic) with a rating of 50A / 4xxVAC (depending on the input voltage) Recommendation: (ABB) S203U-K50 (440VAC) **Device protection measure:** Circuit breakers 80A / 700VAC per supply leg in accordance with UL category JFHR2 Requirement: Bussmann 170M1366 or 170M1566D		

Mains connection Compax3HxxxV4 3*400VAC

Device type Compax3	**H050V4**	**H090V4**	**H125V4**	**H155V4**
Supply voltage	Three-phase 3*400VAC 350-528VAC / 50-60Hz			
Input current	66Arms	95Arms	143Arms	164Arms
Output current	50Arms	90Arms	125Arms	155Arms
Maximum fuse rating per device(=short circuit rating) Branch circuit protection according to UL	80A	100A	160A	200A
	JDDZ Class K5 or H JDRX Class H			

Mains connection Compax3HxxxV4 3*480VAC

Device type Compax3	**H050V4**	**H090V4**	**H125V4**	**H155V4**
Supply voltage	Three-phase 3*480VAC 350-528VAC / 50-60Hz			
Input current	54Arms	82Arms	118Arms	140Arms
Output current	43Arms	85Arms	110Arms	132Arms
Maximum fuse rating per device(=short circuit rating) Branch circuit protection according to UL	80A	100A	160A	200A
	JDDZ Class K5 or H JDRX Class H			

Control voltage 24VDC Compax3S and Compax3H

Controller type	**Compax3**
Voltage range	21 - 27VDC
Current drain of the device	0.8 A
Total current drain	0.8 A + Total load of the digital outputs + current for the motor holding brake
Ripple	0.5Vpp
Requirement according to safe extra low voltage (SELV)	yes
Short-circuit proof	conditional (internally protected with 3.15AT)

Control voltage 24 VDC PSUP

Device type	**PSUP**
Voltage range	21 - 27VDC
Ripple	0.5Vpp
Requirement according to safe extra low voltage (SELV)	yes (class 2 mains module)
Current drain PSUP	PSUP10: 0.2A PSUP20 / PSUP30: 0.3A
Electric current drain Compax3M	C3M050D6: 0.85 3M100D6: 0.85A C3M150D6: 0.85A C3M300D6: 1.0 A + Total load of the digital outputs + current for the motor holding brake

Output data Compax3S0xx at 1*230VAC/240VAC

Controller type	**S025V2**	**S063V2**
Output voltage	3x 0-240V	3x 0-240V
Nominal output current	2.5Arms	6.3Arms
Pulse current for 5s	5.5Arms	12.6Arms
Power	1kVA	2.5kVA
Switching frequency	16kHz	16kHz
Power loss for In	30W	60W

Output data Compax3S1xx at 3*230VAC/240VAC

Controller type	**S100V2**	**S150V2**
Output voltage	3x 0-240V	3x 0-240V
Nominal output current	10Arms	15Arms
Pulse current for 5s	20Arms	30Arms
Power	4kVA	6kVA
Switching frequency	16kHz	8kHz
Power loss for In	80W	130W

Output data Compax3Sxxx at 3*400VAC

Controller type	**S015V4**	**S038V4**	**S075V4**	**S150V4**	**S300V4**
Output voltage	3x 0-400V				
Nominal output current	1.5Arms	3.8Arms	7.5Arms	15Arms	30Arms
Pulse current for 5s	4.5Arms	9.0Arms	15Arms	30Arms	60Arms*
Power	1kVA	2.5kVA	5kVA	10kVA	20kVA
Switching frequency	16kHz	16kHz	16kHz	8kHz	8kHz
Power loss for In	60W	80W	120W	160W	350W

* With cyclic peak currents (S8 or S9 operation), the device utilization (683.2) may not be > 70%; otherwise it is necessary to use a condenser module "**C4Module** (see on page 599)".

Output data Compax3Sxxx at 3*480VAC

Controller type	**S015V4**	**S038V4**	**S075V4**	**S150V4**	**S300V4**
Output voltage	3x 0-480V				
Nominal output current	1.5Arms	3.8Arms	6.5Arms	13.9Arms	30Arms
Pulse current for 5s	4.5Arms	7.5Arms	15Arms	30Arms	60Arms*
Power	1.25kVA	3.1kVA	6.2kVA	11.5kVA	25kVA
Switching frequency	16kHz	16kHz	16kHz	8kHz	8kHz
Power loss for In	60W	80W	120W	160W	350W

* With cyclic peak currents (S8 or S9 operation), the device utilization (683.2) may not be > 70%; otherwise it is necessary to use a condenser module “**C4Module** (see on page 599)”.

Output data Compax3Mxxx at 3*230VAC

Device type Compax3	**M050D6**	**M100D6**	**M150D6**	**M300D6**
Input voltage	325VDC ±10%			
Output voltage	3x 0-230V (0...500Hz)			
Nominal output current	5Arms	10Arms	15Arms	30Arms
Pulse current for 5s*	10Arms	20Arms	30Arms	60Arms
Power	2kVA	4kVA	6kVA	12kVA
Switching frequency	8kHz	8kHz	8kHz	8kHz
Power loss for In	70W+**	90W+**	120W+**	270W+**

*Electrical turning frequency for pulse current: f>5 Hz; with an electrical turning frequency of f<5 Hz, the maximum pulse current time is 100ms

** Maximum additional losses with option card 5 W.

Output data Compax3Mxxx at 3*400VAC

Device type Compax3	**M050D6**	**M100D6**	**M150D6**	**M300D6**
Input voltage	565VDC ±10%			
Output voltage	3x 0-400V (0...500Hz)			
Nominal output current	5Arms	10Arms	15Arms	30Arms
Pulse current for 5s*	10Arms	20Arms	30Arms	60Arms
Power	3.33kVA	6.66kVA	10kVA	20kVA
Switching frequency	8kHz	8kHz	8kHz	8kHz
Power loss for In	70W+**	90W+**	120W+**	270W+**

*Electrical turning frequency for pulse current: f>5 Hz; with an electrical turning frequency of f<5 Hz, the maximum pulse current time is 100ms

** Maximum additional losses with option card 5 W.

Output data Compax3Mxxx at 3*480VAC

Device type Compax3	**M050D6**	**M100D6**	**M150D6**	**M300D6**
Input voltage	680VDC ±10%			
Output voltage	3x 0-480V (0...500Hz)			
Nominal output current	4Arms	8Arms	12.5Arms	25Arms
Pulse current for 5s*	8Arms	16Arms	25Arms	50Arms
Power	3.33kVA	6.66kVA	10kVA	20kVA
Switching frequency	8kHz	8kHz	8kHz	8kHz
Power loss for In	70W+**	90W+**	120W+**	270W+**

*Electrical turning frequency for pulse current: f>5 Hz; with an electrical turning frequency of f<5 Hz, the maximum pulse current time is 100ms

** Maximum additional losses with option card 5 W.

Output data Compax3Hxxx at 3*400VAC

Controller type	**H050V4**	**H090V4**	**H125V4**	**H155V4**
Output voltage	3x 0-400V			
Nominal output current	50Arms	90Arms	125Arms	155Arms
Pulse current for 5s *	75Arms	135Arms	187.5Arms	232.5Arms
Power	35kVA	62kVA	86kVA	107kVA
Switching frequency	8kHz	8kHz	8kHz	8kHz
Power loss for In	880W	900W	1690W	1970W

* during low speeds, the overload time is reduced to 1s. Limit:

< 2.5 electric rev/s (= actual revolutions/s * number of pole pairs) resp. >2.5 pitch/s

Output data Compax3Hxxx at 3*480VAC

Controller type	**H050V4**	**H090V4**	**H125V4**	**H155V4**
Output voltage	3x 0-480V			
Nominal output current	43Arms	85Arms	110Arms	132Arms
Pulse current for 5s*	64.5Arms	127.5Arms	165Arms	198Arms
Power	35kVA	70kVA	91kVA	109kVA
Switching frequency	8kHz	8kHz	8kHz	8kHz
Power loss for In	850W	1103W	1520W	1800W

* during low speeds, the overload time is reduced to 1s. Limit:

< 2.5 electric rev/s (= actual revolutions/s * number of pole pairs) resp. >2.5 pitch/s

Resulting nominal and peak currents depending on the switching frequency

Compax3S0xxV2 at 1*230VAC/240VAC

Switching frequency*		**S025V2**	**S063V2**
16kHz	I_{nom}	**$2.5A_{rms}$**	**$6,3A_{rms}$**
	I_{peak} (<5s)	**$5.5A_{rms}$**	**$12,6A_{rms}$**
32kHz	I_{nom}	$2.5A_{rms}$	$5.5A_{rms}$
	I_{peak} (<5s)	$5.5A_{rms}$	$12,6A_{rms}$

Compax3S1xxV2 at 3*230VAC/240VAC

Switching frequency*		**S100V2**	**S150V2**
8kHz	I_{nom}	**-**	**$15A_{rms}$**
	I_{peak} (<5s)	**-**	**$30A_{rms}$**
16kHz	I_{nom}	**$10A_{rms}$**	$12.5A_{rms}$
	I_{peak} (<5s)	**$20A_{rms}$**	$25A_{rms}$
32kHz	I_{nom}	$8A_{rms}$	$10A_{rms}$
	I_{peak} (<5s)	$16A_{rms}$	$20A_{rms}$

Compax3S0xxV4 at 3*400VAC

Switching frequency*		**S015V4**	**S038V4**	**S075V4**	**S150V4**	**S300V4**
8kHz	I_{nom}	-	-	-	**$15A_{rms}$**	**$30A_{rms}$**
	I_{peak} (<5s)	-	-	-	**$30A_{rms}$**	**$60A_{rms}$**
16kHz	I_{nom}	**$1.5A_{rms}$**	**$3.8A_{rms}$**	**$7.5A_{rms}$**	$10.0A_{rms}$	$26A_{rms}$
	I_{peak} (<5s)	**$4.5A_{rms}$**	**$9.0A_{rms}$**	**$15.0A_{rms}$**	$20.0A_{rms}$	$52A_{rms}$
32kHz	I_{nom}	$1.5A_{rms}$	$2.5A_{rms}$	$3.7A_{rms}$	$5.0A_{rms}$	$14A_{rms}$
	I_{peak} (<5s)	$3.0A_{rms}$	$5.0A_{rms}$	$10.0A_{rms}$	$10.0A_{rms}$	$28A_{rms}$

Compax3S0xxV4 at 3*480VAC

Switching frequency*		**S015V4**	**S038V4**	**S075V4**	**S150V4**	**S300V4**
8kHz	I_{nom}	-	-	-	**$13.9A_{rms}$**	**$30A_{rms}$**
	I_{peak} (<5s)	-	-	-	**$30A_{rms}$**	**$60A_{rms}$**
16kHz	I_{nom}	**$1.5A_{rms}$**	**$3.8A_{rms}$**	**$6.5A_{rms}$**	$8.0A_{rms}$	$21.5A_{rms}$
	I_{peak} (<5s)	**$4.5A_{rms}$**	**$7.5A_{rms}$**	**$15.0A_{rms}$**	$16.0A_{rms}$	$43A_{rms}$
32kHz	I_{nom}	$1.0A_{rms}$	$2.0A_{rms}$	$2.7A_{rms}$	$3.5A_{rms}$	$10A_{rms}$
	I_{peak} (<5s)	$2.0A_{rms}$	$4.0A_{rms}$	$8.0A_{rms}$	$7.0A_{rms}$	$20A_{rms}$

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

Resulting nominal and peak currents depending on the switching frequency

Compax3MxxxD6 at 3*400VAC

Switching frequency*		**M050D6**	**M100D6**	**M150D6**	**M300D6**
8kHz	I_{nom}	$5A_{rms}$	$10A_{rms}$	$15A_{rms}$	$30A_{rms}$
	I_{peak} (<5s)	$10A_{rms}$	$20A_{rms}$	$30A_{rms}$	$60A_{rms}$
16kHz	I_{nom}	$3.8A_{rms}$	$7.5A_{rms}$	$10A_{rms}$	$20A_{rms}$
	I_{peak} (<5s)	$7.5A_{rms}$	$15A_{rms}$	$20A_{rms}$	$40A_{rms}$
32kHz	I_{nom}	$2.5A_{rms}$	$3.8A_{rms}$	$5A_{rms}$	$11A_{rms}$
	I_{peak} (<5s)	$5A_{rms}$	$7.5A_{rms}$	$10A_{rms}$	$22A_{rms}$

Compax3MxxxD6 at 3*480VAC

Switching frequency*		M050D6	M100D6	M150D6	M300D6
8kHz	I_{nom}	$4A_{rms}$	$8A_{rms}$	$12.5A_{rms}$	$25A_{rms}$
	I_{peak} (<5s)	$8A_{rms}$	$16A_{rms}$	$25A_{rms}$	$50A_{rms}$
16kHz	I_{nom}	$3A_{rms}$	$5.5A_{rms}$	$8A_{rms}$	$15A_{rms}$
	I_{peak} (<5s)	$6A_{rms}$	$11A_{rms}$	$16A_{rms}$	$30A_{rms}$
32kHz	I_{nom}	$2A_{rms}$	$2.5A_{rms}$	$4A_{rms}$	$8.5A_{rms}$
	I_{peak} (<5s)	$4A_{rms}$	$5A_{rms}$	$8A_{rms}$	$17A_{rms}$

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

Resulting nominal and peak currents depending on the switching frequency

Compax3HxxxV4 at 3*400VAC

Switching frequency*		H050V4	H090V4	H125V4	H155V4
8kHz	I_{nom}	$50A_{rms}$	$90A_{rms}$	$125A_{rms}$	$155A_{rms}$
	I_{peak} (<5s)	$75A_{rms}$	$135A_{rms}$	$187.5A_{rms}$	$232.5A_{rms}$
16kHz	I_{nom}	$33A_{rms}$	$75A_{rms}$	$82A_{rms}$	$100A_{rms}$
	I_{peak} (<5s)	$49.5A_{rms}$	$112.5A_{rms}$	$123A_{rms}$	$150A_{rms}$
32kHz	I_{nom}	$19A_{rms}$	$45A_{rms}$	$49A_{rms}$	$59A_{rms}$
	I_{peak} (<5s)	$28.5A_{rms}$	$67.5A_{rms}$	$73.5A_{rms}$	$88.5A_{rms}$

Compax3HxxxV4 at 3*480VAC

Switching frequency*		H050V4	H090V4	H125V4	H155V4
8kHz	I_{nom}	$43A_{rms}$	$85A_{rms}$	$110A_{rms}$	$132A_{rms}$
	I_{peak} (<5s)	$64.5A_{rms}$	$127.5A_{rms}$	$165A_{rms}$	$198A_{rms}$
16kHz	I_{nom}	$27A_{rms}$	$70A_{rms}$	$70A_{rms}$	$84A_{rms}$
	I_{peak} (<5s)	$40.5A_{rms}$	$105A_{rms}$	$105A_{rms}$	$126A_{rms}$
32kHz	I_{nom}	$16A_{rms}$	$40A_{rms}$	$40A_{rms}$	$48A_{rms}$
	I_{peak} (<5s)	$24A_{rms}$	$60A_{rms}$	$60A_{rms}$	$72A_{rms}$

The values marked with grey are the pre-set values (standard values)!

*corresponds to the frequency of the motor current

Resolution of the motor position

For option F10: Resolver	◆ Position resolution: 16 Bits (= 0.005°) ◆ Absolute accuracy: ±0.167°
For option F11: SinCos©	◆ Position resolution: 13.5 Bits / Encoder sine period => 0.03107°/encoder resolution

For option F12:	◆ Maximum position resolution
	  ◆ Linear: 24 Bits per motor magnet spacing
	  ◆ Rotary: 24 Bits per motor revolution
	◆ Resolution for Sine-Cosine encoders (e.g. EnDat) with 1Vss signal):
	13.5 bits / graduation of the scale of the encoder
	◆ For RS 422 encoders: 4x encoder resolution
	◆ Accuracy of the feedback zero pulse acquisition = accuracy of the feedback resolution.
	◆ Resolution for analog hall sensors with 1Vss signal: 13.5 Bits / motor magnet spacing

Accuracy

The exactitude of the position signal is above all determined by the exactitude of the feedback system used.

Motors and feedback systems supported

Motors
Direct drives
◆ Linear motors
◆ Torque motors
	◆ Sinusoidally commutated synchronous motors
	  ◆ Maximum electrical turning frequency: 1000Hz*
	  ◆ Max. velocity at 8 pole motors: 15000 rpm.
	  ◆ General max. Velocity: 60*1000/number of pole pairs in [rpm]
	  ◆ Max. number of poles = 600
	◆ Sinusoidal commutated asynchronous motors
	  ◆ Maximum electrical turning frequency: 1000Hz
	  ◆ Max. velocity: 60*1000/number of pole pairs - slip in [rpm].
	  ◆ Field weakening: typically up to triple (higher on request).
	◆ Temperature sensor: KTY84-130 (insulated in accordance with EN60664-1 or IEC60664-1)
	◆ 3 phase synchronous direct drives

Position encoder (Feedback)	**Option F10: Resolver**
LTN:	◆ RE-21-1-A05, RE-15-1-B04
Tamagawa:	◆ TS2610N171E64, TS2620N21E11, TS2640N321E64, TS2660N31E64
Tyco (AMP)	◆ V23401-T2009-B202
	Option F11: SinCos©
	◆ Singleturn (SICK|Stegmann) ◆ Multiturn (SICK|Stegmann) Absolute position up to 4096 motor revolutions. ◆ SEK52, SEL52, SEK37, SEL37, SEK160, SEK90 ◆ Rotary feedback with HIPERFACE® interface: e.g.: SRS50, SRM50, SKS36, SKM36, SEK52

* higher values on request

Special encoder systems for direct drives	**Option F12**
Analog hall sensors	◆ Sine-Cosine signal (max. 5Vss*; typical 1Vss) 90° offset ◆ U-V signal (max. 5Vss*; typical 1Vss) 120° offset.
Encoder (linear or rotatory)	◆ Sine-Cosine (max. 5Vss*; typical 1Vss) (max. 400kHz) or ◆ TTL (RS422) (max. 5MHz; track A o. B) with the following modes of commutation: ◆ **Automatic commutation** (see on page 570) or ◆ U, V, W or R, S, T commutation signals (NPN open collector) e.g. digital hall sensors, incremental encoders made by Hengstler (F series with electrical ordering variant 6)
Digital, bidirectional interface	◆ All EnDat 2.1 or EnDat 2.2 (Endat01, Endat02) feedback systems with incremental track (sine-cosine track) ◆ linear or rotary ◆ max. 400kHz Sine-Cosine
Distance coded feedback systems	◆ Distance coding with 1VSS - Interface ◆ Distance coding with RS422 - Interface (Encoder)

*Max. differential input between SIN- (X13/7) and SIN+ (X13/8).

Feedback error compensation

Feedback error compensation	◆ Automatic feedback error compensation (offset & amplification) for analog hall sensors and sine-cosine encoder can be activated in the MotorManager.

Motor holding brake output

Motor holding brake output	**Compax3**
Voltage range	21 – 27VDC
Maximum output current (short circuit proof)	1.6A
Securing of brake Compax3M	3.15A

Braking operation Compax3S0xxV2 1AC

Controller type	**S025V2**	**S063V2**
Capacitance / storable energy	560µF / 15Ws	1120µF / 30Ws
Minimum braking- resistance	100Ω	56Ω
Recommended nominal power rating	20 ... 60W	60 ... 180W
Maximum continuous current	8A	15A

Braking operation Compax3S1xxV2 3AC

Controller type	**S100V2**	**S150V2**
Capacitance / storable energy	780µF / 21Ws	1170µF / 31Ws
Minimum braking- resistance	22Ω	15Ω
Recommended nominal power rating	60 ... 450W	60 ... 600W
Maximum continuous current	20A	20A

Braking operation Compax3SxxxV4 3AC

Controller type	**S015V4**	**S038V4**	**S075V4**	**S150V4**	**S300V4**
Capacitance / storable energy 400V / 480V	235µF 37 / 21 Ws	235µF 37 / 21 Ws	470µF 75 / 42 Ws	690µF 110 / 61 Ws	1230µF 176 / 98 Ws
Minimum braking- resistance	100Ω	100Ω	56Ω	33Ω	15Ω
Recommended nominal power rating	60 ... 100W	60 ... 250W	60 ... 500 W	60 ... 1000 W	60 ... 1000 W
Maximum continuous current	10A	10A	15A	20A	30A

Braking operation Compax3MxxxD6 (axis controller)

Device type Compax3	**M050**	**M100**	**M150**	**M300**
Capacity/ storable energy	110µF/ 18Ws at 400V 10Ws at 480V	220µF/ 37Ws at 400V 21Ws at 480V	220µF/ 37Ws at 400V 21Ws at 480V	440µF/ 74Ws at 400V 42Ws at 480V

Braking operation of Compax3HxxxV4

Controller type	**H050V4**	**H090V4**	**H125V4**	**H155V4**
Capacitance / storable energy 400V / 480V	2600 µF 602 / 419 Ws	3150 µF 729 / 507 Ws	5000 µF 1158 / 806 Ws	5000 µF 1158 / 806 Ws
Minimum braking- resistance	24 Ω	15 Ω	8 Ω	8 Ω
Maximum continuous current	11 A	17 A	31 A	31 A

Ballast resistors for Compax3

Ballast resistor **(see on page 586)**	**Device**	**Rated output**
BRM08/01 (100Ω)	Compax3S025V2 Compax3S015V4 Compax3S038V4	60 W
BRM05/01 (56Ω)	Compax3S063V2 Compax3S075V4	180 W
BRM05/02 (56Ω)	Compax3S075V4	570 W
BRM10/01 (47Ω)	Compax3S150V4	570 W
BRM10/02 (470Ω)	Compax3S150V4	1500 kW
BRM04/01 (15Ω)	Compax3S150V2 Compax3S300V4 PSUP20D6	570 W
BRM04/02 (15Ω)	Compax3S150V2 Compax3S300V4 PSUP20D6	740 W
BRM04/03 (15Ω)	Compax3S300V4 PSUP20D6	1500 W
BRM09/01 (22Ω)	Compax3S100V2	570 W
BRM11/01 (27Ω)	Compax3H0xxV4	3500 W
BRM13/01 (30Ω)	PSUP10D6 PSUP20D6**	500 W
BRM14/01 (15Ω)	PSUP10D6* PSUP20D6	500 W
BRM12/01 (18Ω)	Compax3H1xxV4	4500 W

*for PSUP10D6 2x15Ω in series

**for PSUP20D6 2x30Ω parallel

Size / weight Compax3S

Controller type	Dimensions HxWxD [mm]	Weight [kg]
Compax3S025V2	191 x 84 x 172	2.0
Compax3S063V2	191 x 100 x 172	2.5
Compax3S015V4	248 x 84 x 172	3.1
Compax3S100V2	248 x 115 x 172	4.3
Compax3S150V2	248 x 158 x 172	6.8
Compax3S038V4	248 x 100 x 172	3.5
Compax3S075V4	248 x 115 x 172	4.3
Compax3S150V4	248 x 158 x 172	6.8
Compax3S300V4	380 x 175 x 172	10.9

Minimum mounting distance: 15mm at the sides, above & below 100mm

Protection type IP20

Drawings, Mounting **(see on page 83, see on page 89)**

Size / weight PSUP/Compax3M

Device type	Dimensions HxWxD [mm]	Weight [kg]
PSUP10D6	360 x 50 x 263	3.95
PSUP20D6 & PSUP30D6	360 x 100 x 263	6.3
Compax3M050D6	360 x 50 x 263	3.5
Compax3M100D6	360 x 50 x 263	3.6
Compax3M150D6	360 x 50 x 263	3.6
Compax3M300D6	360 x 100 x 263	5.25

Protection type IP20

Size / weight Compax3H

Mounting (see on page 83, see on page 89)

Controller type	Dimensions HxWxD [mm]	Weight [kg]
Compax3H050V4	453 x 252 x 245	17.4
Compax3H090V4	668.6 x 257 x 312	32.5
Compax3H125V4	720 x 257 x 355	41
Compax3H155V4	720 x 257 x 355	41

Protection class IP20 when mounted in a control cabinet (not for Compax3H1xxxV4)

Safety technology Compax3S

Safe torque-off in accordance with EN ISO 13849: 2008, Category 3, PL d/e Certified. **Test mark IFA 1003004**	◆ For implementation of the “protection against unexpected start-up” function described in EN1037. ◆ Please note the **circuitry examples** (see on page 92).

Compax3S STO (=safe torque off)

Nominal voltage of the inputs	24 V
Required isolation of the 24V control voltage	Grounded protective extra low voltage, PELV
Protection of the STO control voltage	1 A
Grouping of safety level	**STO switch-off via internal safety relay & digital input:** PL e, PFHd=2.98E-8 **STO switch-off via internal safety relay & fieldbus:** PL d, PFHd=1.51E-7 A MTTFd=15 of the external PLC and STO cycles/year < 500 000 are assumed.

Safety technology Compax3M

Safe torque-off in accordance with EN ISO 13849-1: 2007, Category 3, PL=e Certified. **Test mark MFS 09029**	◆ Please respect the stated safety technology on the **type designation plate** (see on page 17) and the **circuitry examples** (see on page 106)

Compax3M S1 Option: Signal inputs for connector X14

Nominal voltage of the inputs	24V
Required isolation of the 24V control voltage	Grounded protective extra low voltage, PELV
Protection of the STO control voltage	1A
Number of inputs **Signal inputs via optocoupler**	2 Low = 0...7V DC or open High = 15...30V DC I_{in} at 24V DC: 8mA
STO1/	Low = STO activated High = STO deactivated Reaction time max. 3ms
STO2/	Low = STO activated High = STO deactivated Reaction time max. 3ms
Switch-off time with unequal input statuses (max. reaction time)	20 seconds
Grouping of safety level	Category 3 PL=e (according to table 4 in EN ISO 13849-1 this corresponds to SIL 3) PFHd=4.29E-8

UL certification for Compax3S

conform to UL:	◆ according to UL508C
Certified	◆ E-File_No.: E235342

The UL certification is documented by a "UL" logo on the device (type specification plate).

“UL” logo:

UL-approval for PSUP/Compax3M

conform to UL:	◆ according to UL508C
Certified	◆ E-File_No.: E235342

The UL certification is documented by a “UL” logo on the device (type specification plate).

Insulation requirements

Enclosure rating	Protection class in accordance with EN 60664-1
Protection against human contact with dangerous voltages	In accordance with EN 61800-5-1
Overvoltage category	Voltage category III in accordance with EN 60664-1
Degree of contamination	Degree of contamination 2 in accordance with EN 60664-1 and EN 61800-5-1

Environmental conditions Compax3S and Compax3H

General ambient conditions	In accordance with **EN 60 721-3-1 to 3-3** Climate (temperature/humidity/barometric pressure): Class 3K3	
Permissible ambient temperature:		
Operation storage transport	0 to +45 °C class 3K3 –25 to +70 °C class 2K3 –25 to +70 °C class 2K3	
Tolerated humidity:	no condensation	
Operation storage transport	<= 85% class 3K3 <= 95% class 2K3 <= 95% class 2K3	(Relative humidity)
Elevation of operating site	<=1000m above sea level for 100% load ratings <=2000m above sea level for 1% / 100m power reduction please inquire for greater elevations	
Mechanic resonances:	EN 60068-2-6 (sinusoidal excitation)	
Sealing	Protection type IP20 in accordance with EN 60 529	

Cooling Compax3S and Compax3H

Cooling mode:	C3S025V2 ... S150V4: Convection C3S300V4 & C3H: Forced air ventilation with fan in the heat dissipator **Air flow rate:**459m^3/h (C3H)
Supply:	C3S300V4, C3H050, C3H090 internal C3H125, C3H155 external 220/240VAC: 140W, 2.5µF, Stator - 62Ω Optionally on request: 110/120VAC: 130W, 10µF, Stator - 16Ω **Circuit breaker:**3A

EMC limit values Compax3S and Compax3H

EMC interference emission	Limit values in accordance with EN 61 800-3, Limit value class C3/C4 without additional mains filter: **Information on C2 limit value classes** (see on page 23)
EMC disturbance immunity	Industrial area limit values in accordance with EN 61 800-3

Ambient conditions PSUP/Compax3M

General ambient conditions	In accordance with **EN 60 721-3-1 to 3-3** Climate (temperature/humidity/barometric pressure): Class 3K3	
Permissible ambient temperature:		
Operation storage transport	0 to +40 °C Class 3K3 -25 to +70 °C -25 to +70 °C	
Tolerated humidity:	no condensation	
Operation storage transport	<= 85% class 3K3 <= 95% <= 95%	(Relative humidity)
Elevation of operating site	<=1000m above sea level for 100% load ratings <=2000m above sea level for 1% / 100m power reduction please inquire for greater elevations	
Sealing	Protection type IP20 in accordance with EN 60 529	
Mechanic resonances:	Class 2M3, 20m/s^2;8-200Hz	

Cooling PSUP/Compax3M

Cooling mode:	Forced air ventilation with fan in the heat dissipator

EMV limit values PSUP/Compax3M

EMC interference emission	Limit values in accordance with EN 61 800-3, Limit value class C3 with mains filter.
EMC disturbance immunity	Industrial area limit values in accordance with EN 61 800-3

EC directives and applied harmonized EC norms

EC low voltage directive 2006/95/EG	**EN 61800-5-1,** Standard for electric power drives with settable speed; requirements to electric safety **EN 60664-1,** isolation coordinates for electrical equipment in low-voltage systems **EN 60204-1, machinery norm** partly applied
EC-EMC-directive 2004/108/EC	**EN 61800-3, EMC standard** Product standard for variable speed drives

COM ports

RS232	◆ 115200 baud ◆ Word length: 8 bits, 1 start bit, 1 stop bit ◆ Hardware handshake XON, XOFF
RS485 (2 or 4-wire)	◆ 9600, 19200, 38400, 57600 or 115200 baud ◆ Word length 7/8 bit, 1 start bit, 1 stop bit ◆ Parity (can be switched off) even/odd ◆ 2 or 4-wire
USB (Compax3M)	◆ USB 2.0 Full Speed compatible

Load position control

Dual Loop Option	◆ 2. Feedback system for **load position control** (see on page 158) possible.

Signal interfaces

Signal inputs / signal sources	◆ Encoder input track A/B (RS422) ◆ up to max. 10MHz ◆ Internal quadrature of the resolution ◆ Step / direction input (24V-level) Max. 300kHz at ≥50Ω source impedance and minimum pulse width of 1.6µs. ◆ +/-10V analog input 14Bit; 62.5µs scanning rate. ◆ **SSI - feedback** (see on page 155)
Signal outputs	◆ Encoder simulation ◆ 1...16384 increments/revolution or pitch ◆ Limit frequency 620kHz (track A or B) ◆ Bypass function for encoder feedback with feedback module F12.(Limit frequency 5MHz, track A or B).
Signal transmission	HEDA (Option M10 or M11) Transfer of process values: ◆ from Slave to Master ◆ from Slave to Master and ◆ from Slave to Slave.

IEC6113-3 functions

General	◆ Programming based on IEC61131-3 ◆ Up to 6000 instructions ◆ 650 16 bit variables ◆ 200 32 bit variables ◆ Recipe table with 288 variables ◆ 3x16-bit retain-variable ◆ 3x32-bit retain-variable
PLCOpen function modules	◆ Positioning: absolute, relative, additive, continuous ◆ Electronic Gearbox (Gearing) ◆ Machine Zero ◆ Stop, activating the drive, quit ◆ Position, device status, reading axis error
IEC61131-3 standard modules	◆ Up to 8 timers (TON, TOF, TP) ◆ Triggers (R_TRIG, F_TRIG) ◆ Flip-flops (RS, SR) ◆ Counters (CTU, CTD, CTUD)
Device-specific function modules	◆ generates an input process image ◆ Generates an output process image ◆ Access to recipe table
Inputs/Outputs	◆ 8 digital inputs (24V level) ◆ 4 digital outputs (24-V level) ◆ Optional addition of 12 inputs/outputs

T40 Functions: Cam

General	◆ Cam control function ◆ Programming based on IEC61131-3 ◆ Position of selected master signal source via: ◆ Encoder, Step / direction or +/-10V analog ◆ HEDA ◆ Virtual Master
Cam memory	◆ 10 000 interpolation points (master/slave in 24 bit format) saved failure save. ◆ Distance of interpolation points can be adapted to curve (non equidistant interpolation points) ◆ Linear interpolation between points
Linking curve segments	◆ Up to 20 cam segments can be produced. ◆ Virtually random cam links (forwards) ◆ Freely programmable, event-triggered curve branching. ◆ Scalable cam segments and complete cam profiles
Coupling and decoupling functions	◆ With the aid of a quadratic function. ◆ By means of a change-over function ◆ Without overspeeding by coupling over several master cycles. ◆ Virtually free set-up of the coupling and decoupling movement ◆ Master-guided coupling movement. ◆ Random standstill position
Reg synchronization	◆ Master or slave oriented (simultaneous, cam-independent). ◆ Highly precise mark recognition (accuracy < 1 µs)
Cam generation with renowned Nolte tool.	◆ Standard or extended range of functions ◆ Evaluation of the motion profiles.

Profibus ratings (I20)

Profile	◆ PROFIdrive Profile drive system V3
DP Versions	◆ DPV0/DPV1
Baud rate	◆ up to 12 MHz
Profibus ID	◆ C320
Device master file	◆ PAR_C320.GSD (can be found on the Compax3 - DVD)
Communication Simatic <-> Compax3	◆ Simatic S7-300/400 - modules for Compax3 I20 and a corresponding help file can be found on the Compax3 CD in the folder: ..\Profibus\S7-moduls\

Profinet Characteristics (I32)

Profile	◆ PROFIdrive profile drive technology V4.1
Profinet Version	◆ Profinet IO (RT)
Transmission mode	◆ 100BASE-TX (Full Duplex)
Profinet ID	◆ C332
Device master file	◆ GSDML-V2.1-Parker-Compax3-yyyymmdd.xml (can be found on the Compax3 DVD)
Communication Simatic <-> Compax3	◆ Simatic S7-300/400 - modules for Compax3 I32 and a corresponding help file can be found on the Compax3 CD in the folder..\Profibus\S7-moduls\ (the same modules as with Profibus)

CANopen characteristics (I21)

Baud rate [kBit/s]	◆ 20, 50, 100, 125, 250, 500, 800, 1000
EDS file	◆ C3.EDS
Service data object	◆ SDO1
Process data objects	◆ PDO1, ... PDO4

DeviceNet characteristics (I22)

DeviceNet	◆ Predefined Master/Slave Connection Set ◆ Standard 2.0 Group-2-Slave ◆ Fieldbus I/O Data or Process Data (Polled, COS/Cyclic I/O and Bit Strobe)
Implemented object classes	◆ Identify, Message Router, DeviceNet, Assembly, Connection, Acknowledge Handler
Baud rate [kBit/s]	◆ 125, 250, 500
permissible cable length	◆ up to 500m on 125Bit/s, ◆ up to 200m on 250Bit/s, ◆ up to 100m on 500Bit/s,
Max. Number of participants	◆ 63 Slave
Insulation	◆ Isolated Device Physical Layer
EDS file	◆ C3_DeviceNet.EDS
Conformance (file in the Internet)	◆ **Statement of Conformance http://www.compax3.de/C3_DeviceNet_Statement_of_Conformance.pdf**
Further information:	◆ Application example (C3I22_DeviceNet.ZIP) on the Compax3 CD in the "\Examples" directory"

Ethernet Powerlink (I30) / EtherCAT characteristics (I31)

Baud rate	◆ 100MBits (FastEthernet)
Bus file Ethernet Powerlink: EtherCAT:	◆ ◆ C3_EPL_cn.EDS ◆ C3_EtherCAT_xx.XML
Service data object	◆ SDO
Mapping objects	◆ 16 Words (16x16Bit)
Cycle time	◆ >=1ms
Synchronicity accuracy	◆ maximum jitter: +/-25µs

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