Softstart

Installation and maintenance instruction

PS D370 ... 840
690V-version

Contents

ABB

The softstarter rated marking plate

Type

Catalogue number

Rated current (range)

Main voltage level
and kW rating

Supply voltage

```
ABB          ABB Control
                Made in Sweden

PS D370      Acc. to IEC
1SFA 886 011-AUL   Ie, Ith 200-370 A
                 Ue      690 V
CE                       355 kW
             220-230V 50/60Hz
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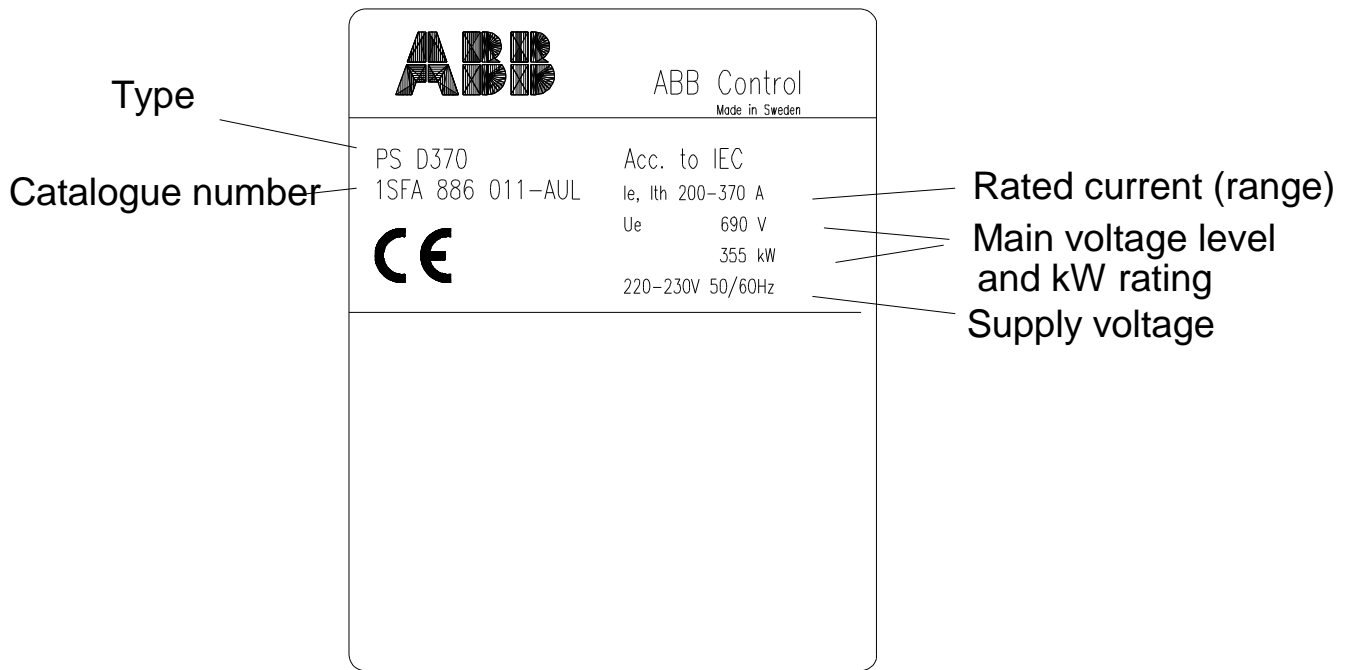
1A. Brief instructions

(for installations that require CE-marking see chapter 1B)

PS D370 ... 840 for 690V

| | | Softstart type |
		PS D370 ... 840 for 690V
Activity	*Item*	*Instruction*
Mounting	Softstarter unit	Vertical mounting for adequate cooling
	Semiconductor fuses	Not included Have to be ordered separately
	Overload relay	Not included Use ABB type T.....DU acc. to the recommended data. See technical data in the catalogue 1SFC 18850-EN
Connections		
	Protective earth	Connect the earth cable
	Main circuit	Connect supply side to terminals/ busbars 1, 3 and 5 Connect motor side to terminals/ busbars 2, 4, and 6
	Control circuit	Apply control voltage to terminals 1 and 2 on top of the softstarter. See page 5 Make sure that you have ordered correct control voltage. 220...240V **or** 110...127V. **Can not be changed after delivery**
	Start and stop	Connect the cables for start and stop signals to terminal 8 and 9. Connect also with a short wire terminals 7 and 10 (for PLC look at circuit diagram on page 30)
	Current limit	Delivered connected
Settings	Potentiometers	
	I_r	Set to rated motor current See label on the Softstarters front.
	I_{LIM}	Set to actual need. Too low of a value, and the motor may not accelerate.
	U_{INI}	30% standard value.
	U_{SD}	Start with setting on 100%
	START	10s standard value
	STOP	20s standard value
	Switches	
	PF	Energy saving. (Yes or No).
	Kick	Voltage kick during start. (Yes or No)
	SC	High current switch off. (Yes or No)
	TPF	Reaction time for energy saving function. Normal is standard. (Normal or slow)

Ready for start

1B. Brief instructions for installations that require CE-marking

Mandatory requirement by the European Union (EU)

All electrical installations that are to be used within EU must comply with the requirements to all relevant EU Directives, including the EMC directive (89/336/EEC). The OEM, panelbuilder or installer/contractor is responsible for that the requirements are fulfilled, and verified as well as to give the equipment the CE mark.

In principle the EMC directive states that no apparatus, equipment or systems are allowed to disturb or be disturbed by surrounding apparatus, equipment or systems. In order to meet this requirement the product cannot exceed maximum emission levels nor be below minimum immunity levels

The required levels differs upon where the system or equipment is installed, if it is made in a industry (environment 1) or in a public low voltage network (environment 2). In the Industry higher levels of emissions are allowed. At the same time these installations require a higher grade of immunity compared to the installations in public network. If there is a doubt in how to classify the installation the local utility can be asked or the owners of the transformer.

How do you fulfil the requirements?

There are several methods to verify that a system meets the set requirements.
- One way is to use CE-marked equipment and to install these according to the installation manual that is provided by the manufacturer. No further testing or verification is then needed as the manufacturer already has done the necessary work. This is the way ABB has chosen in order to simplify the usage of softstarters for systems and in other equipment.

- A more complicated way is to use non CE-marked apparatus, and then to verify and test each system separately. The manufacturer of the system and/or the assembled equipment is then responsible for the verification.

The following guidelines are to simplify and ensure that all installations always fulfil the above mentioned requirements acc to the EMC and LVD requirement. There is then no need to separately verify the system or assembly.

ABB's solution for installation that require CE-mark

Installations of softstarters type PSD in industrial network:

In softstarters PSD thyristors and microprocessors are used that can cause emission during operation. This emission can be reduced by using a by-pass contactor, that ensures that the system fulfils the compatibility requirement. Another advantage by using a by--pass contactor is that the total powerloss is reduced, and thus it is not needed to have extra fans for cooling if the softstarter is enclosed.

• **By-pass contactor:** When a by-pass contactor is used the softstarter is by-passed at continues operation, The by-pass contactor is connected in parallel to the softstarter that is only active during start and stop of the motor. The operation is simplified if the built in signal relay K5 (top of ramp / TOR) is used to control the by-pass contactor. The by-pass contactor is automatically in operation after completed start and will remain so during continuous operation. The Softstarter can still be in active status but no current will pass through it, instead all current will pass through the by-pass contactor.
For connection of the by-pass contactor, please see section 2.

• **Function PF** (Energy saving at low motor load): Can not be activated during operation with a by-pass contactor included.

• **Earthing:** The Softstarter has to be connected to earth.

Installation of Softstarters type PSD in public network:

In softstarters PSD thyristors and microprocessors are used that can cause emission/disturbances during operation. In public network the requirements only allow for low emission levels. In order to fulfil this requirement some actions must be taken.

Mounted in any metal enclosure with a by-pass contactor and using screened cables outside the enclosure the system fulfils the compatibility requirement. Another advantage by using a by-pass contactor is that the total powerloss is reduced, and thus it is not needed to have extra fans for cooling.
Below you will find closer description of each action;

• *By-pass contactor:* When a by-pass contactor is used the softstarter is by-passed at continuous operation, The by-pass contactor is connected in parallel to the softstarter that is only active during start and stop of the motor. The operation is simplified if the built in signal relay K5 (top of ramp / TOR) is used to control the by-pass contactor. The by-pass contactor is automatically in operation after completed start and will remain so during continuous operation. The Softstarter can still be in active status but no current will pass through it, instead all current will pass through the by-pass contactor.
For connection of the by-pass contactor, please see section 2.

• *Function PF* (Energy saving at low motor load): can not be activated during operation with a by-pass contactor included.

• *Earthing:* The Softstarter has to be connected to earth.

• *Enclosure:* Use any type of metal enclosure. Our recommendation is that you ensure that all details like door, box and assembly plate have a good earthing.

• *Cables:*
-Control cables : Use so called pair twisted signal cable where the connections are to be made to the softstarter. This type of cable always has a screen that shall be connected to earth.
-Power cables: Use a collectively (360º) screened / shielded power cable for feeding the motor, and when the softstarter is installed in a separate enclosure, also for the cable feeding the softstarter. Ensure that the screen is connected to earth. It is not necessary to use a special high frequency screened cable. Any type of conducting screen will do.

PS D370 ... 840 for 690V

Activity	Item	Instruction
Softstart type		
PS D370 ... 840 for 690V		
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	Semiconductor fuses	Not included Have to be ordered separately
	Overload relay	Not included Use ABB type T.....DU acc. to the recommended data. See technical data in the catalogue 1SFC 18850-EN
Connections	*Too comply with the EMC directive , see also instructions above*	
	Protective earth	Connect the earth cable
	Main circuit	Connect supply side to terminals/ busbars 1, 3 and 5 Connect motor side to terminals/ busbars 2, 4, and 6
	Control circuit	Apply control voltage to terminals 1 and 2 on top of the softstarter. See page 5 Make sure that you have ordered correct control voltage. 220...240V **or** 110...127V. **Can not be changed after delivery**
	Start and stop	Connect the cables for start and stop signals to terminal 8 and 9. Connect also with a short wire terminals 7 and 10 (for PLC look at circuit diagram on page 30)
	Current limit	Delivered connected
Settings	Potentiometers	
	I_r	Set to rated motor current See label on the Softstarters front.
	I_{LIM}	Set to actual need. Too low of a value, and the motor may not accelerate.
	U_{INI}	30% standard value.
	U_{SD}	Start with setting on 100%
	START	10s standard value
	STOP	20s standard value
	Switches	
	PF	Energy saving. (Yes or No). Has to be switched off to comply with EMC *directive, see instructions above*
		Voltage kick during start. (Yes or No)
	Kick	High current switch off. (Yes or No)
	SC	Reaction time for energy saving function.
	TPF	Normal is standard. (Normal or slow)

Ready for start

2 Mounting

Softstarter unit:
> The softstarter must be mounted so that the cooling air passes vertically over the heat sink. It must also be placed so that the cooling capacity is not decreased due to pollution or similar.
>
> Open type softstarters are mounted in a cubicle or other enclosure. Hole configuration according to information given on the dimension prints.
> When a "sealed" enclosure is requested, the size must be such that the heat generated by the thyristors can be carried off from the enclosure surface without the enclosure's inside temperature becoming too high.
> Ventilated enclosures can be considerably smaller. The size depends entirely on the ventilation and must be determined for each individual case.

Type	Rittal type	B	H	P	Air flow capac. fan
PS D370...570	PS4804	800	2000	400	285m³/h/105CFM
PS D720...840	PS4804	800	2000	400	570m³/h/270CFM

> **The ambient temperature outside the softstarter must <u>not exceed 50°C</u>.**
> The losses generated in a softstarter, at rated operational current, are given in the technical data. See technical data, section 7.

Semiconductor fuses
> The semiconductor fuses are not delivered built in the starter unit.
> Use the recommended fuses given in the technical data. The combination fuse size and softstarter allows the maximum use of starting time and current given for each softstarter without tripping.
> Two alternatives are listed; Busmann and Ferraz. See technical data, section 7.

Overload relays
> The PS D version is has not a built-in overload relay. Therefore we recommend you to use the ABB T...DU relays. This relay will protect both the motor and the softstarter from over-heating during start and continuous run. For heavy duty starts it is possible to use the type T...SU, but then the softstarter has to be derated to reach the starting capacity needed. Normally one size bigger softstarter compared with the used motor.
> Recommended relay, see technical data, section 7.

By-pass
> By-pass contactors are not delivered built in the softstarter unit. We recommend you to use the ABB type contactors. The by-pass contactor can be selected according to data for AC-1, using the rated motor current used, if the making and breaking capacity is higher then locked rotor current for the used motor, if it is a maincontactor selected according to data for AC-3. The signal relay T.O.R (K5) built in the softstarter can be used to operate the by-pass contactor. The contactor will then be closed during continuous run and no current will pass through the softstarter even if the softstarter is still running. When stopping the softstarter , the by-pass contactor will open and the softstarter takes over and makes a soft stop. See diagram for connections in chapter 3.
> When using a by-pass contactor bigger than EH300 we recommend to use a relay contactor between the signal relay K5 and the coil of the by-pass contactor.

3 Installation

3.1 PS D370 ... 840 for 690V.

Protective earth

Connect the protective earth at terminal marked ⏚
The terminal is placed on the right hand side on smaller units and directly on the mounting plate for medium and larger sizes.

Main circuits

The supply side of the softstarter has terminals marked 1, 3, 5.
The motor side is marked 2, 4, 6.
Note: Softstart PS D is not phase sequence sensitive.
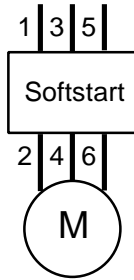
Control circuit

Apply control voltage at terminals marked 1 and 2. See below, "Power Supply"
Make sure that the ordered version corresponds to your rated voltage.
It is not possible to change the control voltage of the softstarter.
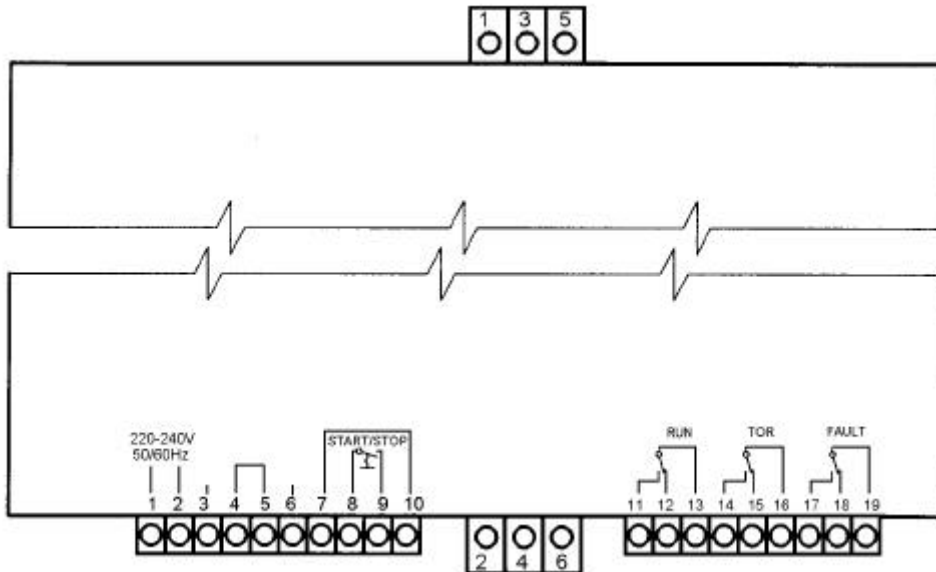
Power supply

110-127V, 50-60 Hz	Connect terminals no. 3 with no. 4 and no. 5 with no. 6
	Supply at terminals no. 1 and no. 2
220-240V, 50-60 Hz	Connect terminal no. 4 with no. 5
	Supply at terminals no. 1 and no. 2

Start/Stop signal: 24V, 10mA differential optocoupler input
  Alt. 1.   Internal supply (e.g.. push-button, relay); Connect terminal no. 7 with no. 10 and connect the push-button or relay between terminals no. 8 and no. 9.

  Alt. 2.   External supply (e.g.. +24V from PLC); Connect the external 0V to terminal no. 10 and connect the control signal to terminal no. 9.
  Note: No link between 7 and 10.

Relay outputs
  Switch over contacts for Run, TOR and Fault (terminals no. 11 - 19).
  Max. rated voltage 250V.
  Rated make capability 15A. Rated break capability 1,5A.   } AC-11
  If the softstarter shall be by-passed the "TOR" signal shall be used for this purpose.

When using a by-pass contactor
  The PF switch has to be switched off.
  Circuit diagram when using a by-pass contactor operated via the built in signal relay K5 (T.O.R)
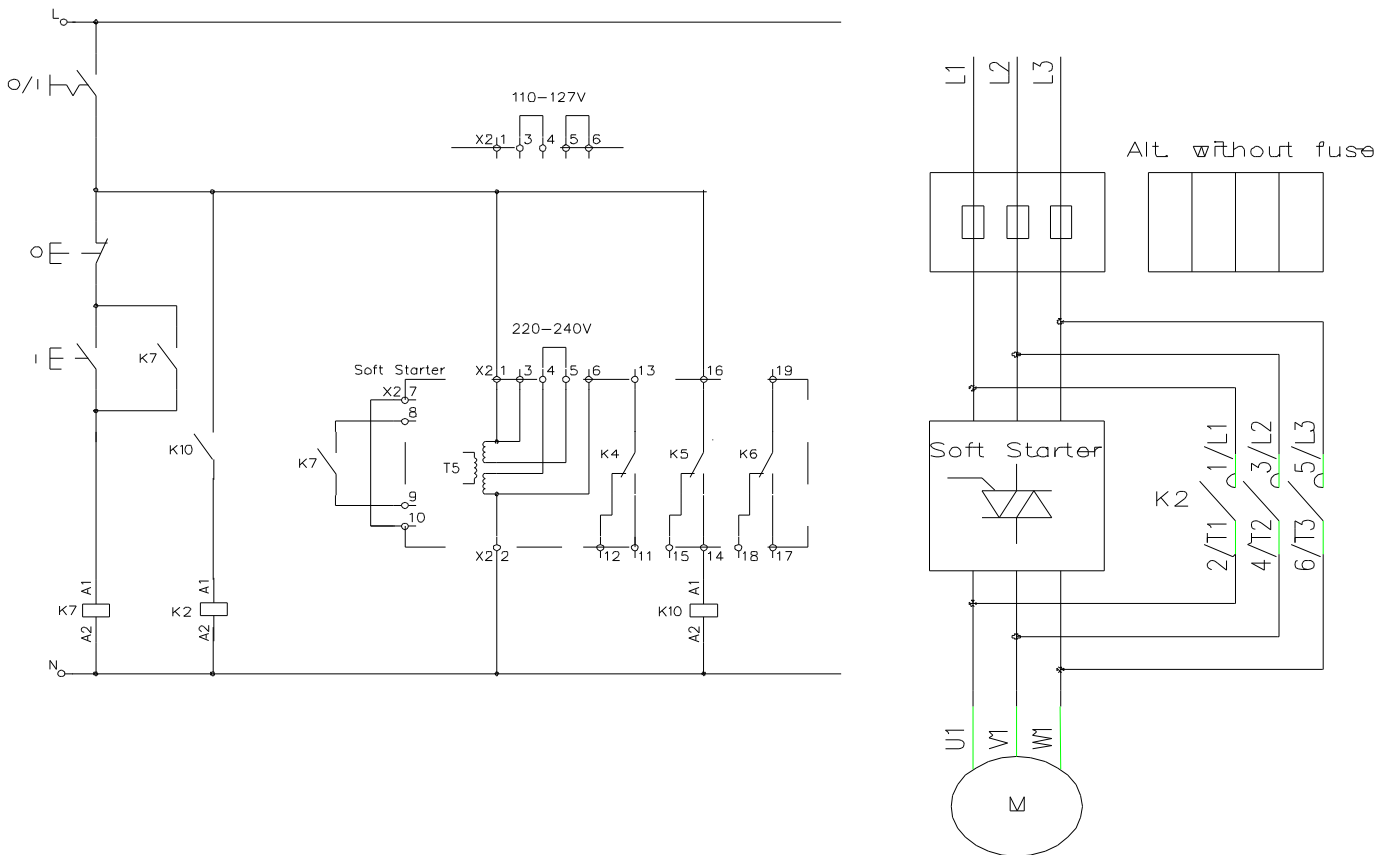
4. Description, settings, signals

General

PS D370 ... 840 are made for normal starting conditions for starting pumps, short conveyor belts, compressors, etc.
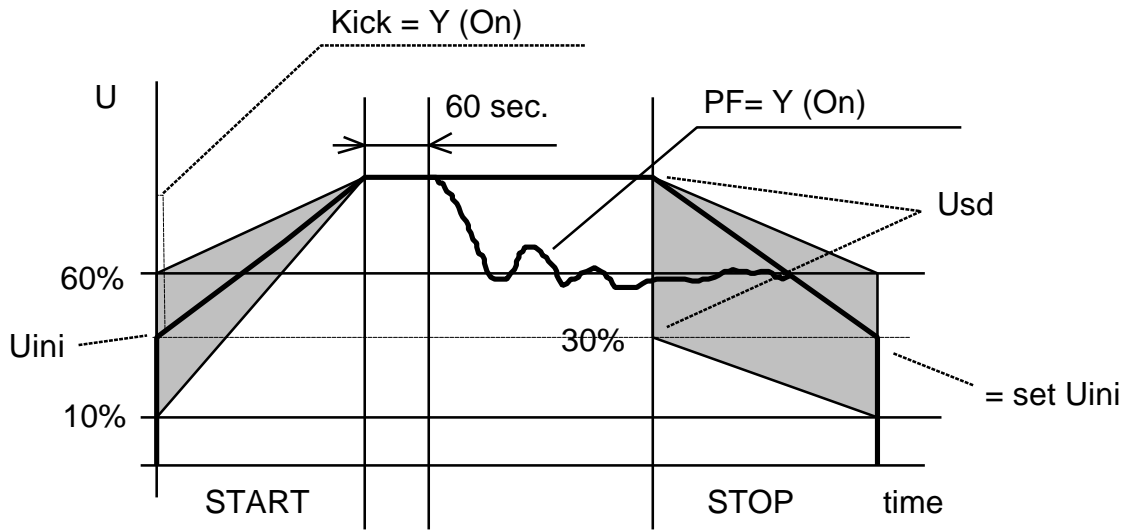
Rated Current

Selection of the motors rated current can be done from 50 - 100% of the softstarters rated current.   Knob = I_r

This will also set the tripping level for the electronic overload when enclosed.

Soft Start

Separately adjustable linear ramp with adjustable initial voltage.

Time:	Adjustable from 0.5 - 60 sec.	Knob = START
Initial voltage	Adjustable from 10 - 60 % of full voltage.	Knob = U_{INI}
	(If the current limit will always override the initial voltage)	
Kick start	90 % of full voltage during 0.5 sec, selectable yes/no	Switch = Kick

Soft Stop

Separately adjustable linear ramp with adjustable step-down voltage.
End voltage = Initial voltage (U INI).

Time:	Adjustable from 0 till 4 min (240 sec)	Knob = STOP
Step-down	Adjustable from 30 - 100 % of full voltage.	Knob = U_{SD}

Current Limit

Adjustable from 200 - 500% of the motors rated current   Knob = I_{LIM}

The current limit is active during the start ramp.

Energy Saving

Selectable yes/no, it is activated 60 sec after the start ramps end.   Switch = PF

High Current Switch Off

Selectable yes/no, if the current limit is overridden during more than 200 ms after "top of ramp", the softstarter turns off. Reset via a stop signal.   Switch = SC

Time constant of energy saving function

Selectable time constant, normal/slow.   Switch = TPF
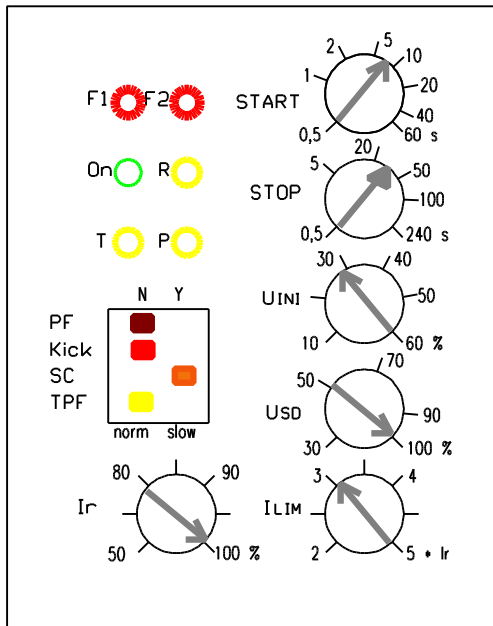
Signal lamps indicating

F1	Fault
F2	Fault
On	Supply voltage
R	Running
T	Completed start ramp
P	Active energy saving function

Potentiometers for setting -

START	Ramp time during start
STOP	Ramp time during stop
U_{INI}	Initial voltage
U_{SD}	Step down voltage
I_{LIM}	Current limit at start
I_r	Rated current of motor in % of I_e

Switches for selection of -

PF	Energy saving function, Yes/No
Kick	Kick start, Yes/No
SC	High current switch-off, Yes/No
TPF	Reaction time for energy saving function, Normal/Slow

4.1 PS D370.. 840 for 690V

LED's

F1: (red)	Fault signal for Phase loss, Thyristor fault, High current switch off.
F2: (red)	Fault signal for Over temperature, Fault on circuit board, Thyristor fault
On: (green)	Supply voltage. Illuminates when softstarter has control power.
R: (yellow)	Motor is running. Illuminates when the motor is energised from the softstarter.
T: (yellow)	Top of ramp. Start ramp is finished and stop ramp hasn't begun.
P: (yellow)	Energy saving is active

Fault codes

F1	Phase loss, High current switch off.
F2	Over temperature, Fault on circuit board,
F1 + F2	Thyristor fault (short circuit or open circuit)

Relay Signals

Run / K4	Motor is running. The motor is energised from the softstarter
TOR / K5	Top of ramp. Start ramp is finished and stop ramp hasn't begun. Can be used as a by-pass signal.
Fault / K6	Phase loss, Thyristor fault, Over temperature, High current switch off, Fault on circuit board,

Input

Start/Stop	Start when closed, stop when open, 24V, 20mA optocoupler differential input. +24V and 0V can be supplied from the board if no external supply is used.
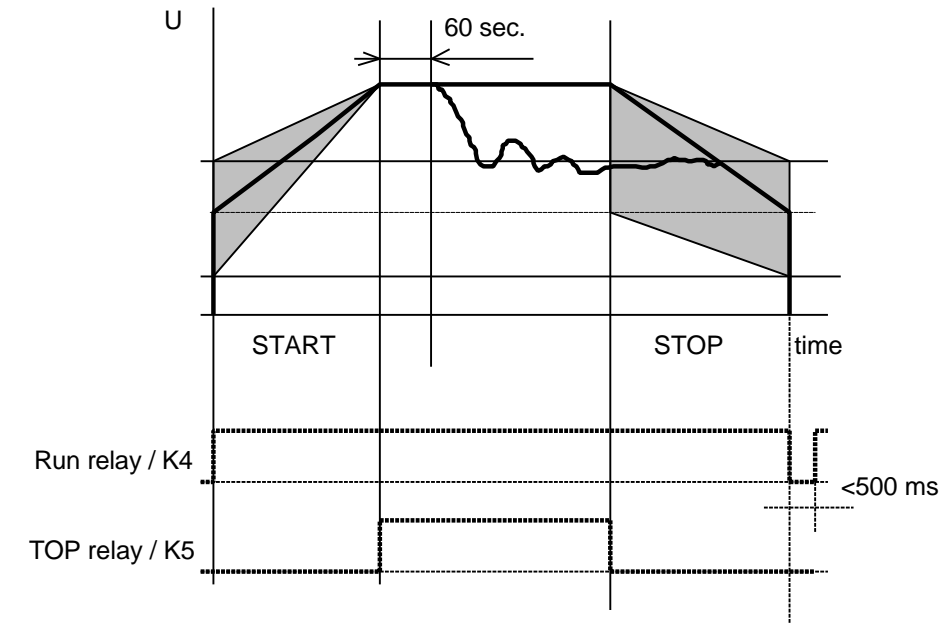
5. Operation and function

5.1 PS D370 ... 840 for 690V

Power on

When the softstarter is supplied with power the green LED "On" is illuminated and the board executes a self check routine. If there are faults, the LED's "F1" and "F2" indicate these.

Start

When the start/stop input is supplied with 24V (switch is closed) the soft start routine is executed and an increasing linear time-voltage ramp is applied to the motor,
Start voltage is selectable while the end voltage is always full voltage.
LED "R" and relay "Run" will indicate that a start has begun.
LED "T" and relay "TOR" will indicate that the start ramp has finished.
A 0,25 sec. pulse with voltage up to the current limit setting is applied to the motor at the beginning of the ramp if the switch 'kick' is in position "YES".
A soft start can be done with a shorted thyristor if the switch "PF" is in position "No" (LED's F1 and F2 will be illuminated, and relay "Fault" will be activated).

Stop

When the start signal is removed from the start/stop input the soft stop routine is executed and a decreasing linear time-voltage ramp is applied to the motor. Start and stop voltages are selectable (end voltage = initial voltage for start ramp).
LED "T" and relay "TOR" are switched off when the stop begins.
LED "R" and relay "RUN" are switched off when the stop ramp is finished

Current limit

(Start sequence) If the motor current reaches the level of the current limit, no higher voltage is applied to the motor unless the current decreases below the limit.
During a start sequence the softstarter can't limit the current for more than 240 sec.
When the start routine is finished (ramp time + max. 240 sec) the following will occur if the current hasn't decreased below the limit.
1. Switch "SC" is in position Yes:
The softstarter turns off
2. Switch "SC" is in position No:
Full voltage is applied to the motor

Energy saving

If the function is selected (switch "PF") a power factor optimisation commences 60 sec after the start-ramps end, this is indicated with the LED "P".
If a slower reaction on decreased load is requested, the switch "TPF" shall be put at position "slow".

High current switch off (SC)

If the current limit is overridden for more than 200 ms after "top of ramp", the softstarter turns off.
Reset via a stop signal.
The function is selectable with switch "SC", yes/no
Note: This is not complete short circuit protection, normal fuses for protecting the equipment from short circuit are always required.

Over temperature

If the heat sink becomes overheated a temperature sensor will turn off the softstarter.
Reset via a stop signal.

Thyristor fault

If a thyristor is damaged (short circuit or open circuit) the softstarter will indicate this.
If a thyristor is shorted a start can be accomplished if the energy saving function is not selected.

Phase loss

If one or more of the phases are missing when a start signal is applied, the softstarter will turn off and indicate a fault. Reset via a stop signal.

6. Trouble shooting

6.1 PS D for 690V

6.1.1 Different status on LED's and signal relays

● LED on   ■ Signal relay energised
○ LED off   □ Signal relay not activated

See next page	F1	F2	On	R	T	P	Run	TOR	Fault	
I	○	○	○	○	○	○	□	□	□	No control voltage on terminal 1 and 2
II	○	○	●	○	○	○	□	□	□	Control voltage supplied Ready for start
III	○	○	●	●	○	○	■	□	□	a) Control voltage supplied and start signal is given. b) Control voltage supplied and making ramp down during stop
IV	○	○	●	●	●	○	■	■	□	Normal continuous run. 100% voltage to the motor By-pass signal relay energised
V	○	○	●	●	●	●	■	■	□	Normal continuous run. 100% voltage to the motor By-pass signal relay energised Power factor optimising (energy saving) activated (Switch PF in position-Y,(On)
VI	●	○	●	○	○	○	□	□	■	Control voltage supplied and start signal is given. Fault F1 (See also fault code tables and flow diagram) a) Phase loss b) Switched off by the function "High current switch off" The switch SC has to be in Y-position (On) Reset Via stop signal
VII	○	●	●	○	○	○	□	□	■	Control voltage supplied. Fault F2 (See also fault code tables and flow diagram) a) Over temperature on heat sink b) Internal fault PCB Reset Via stop signal
VIII	●	●	●	○	○	○	□	□	■	Control voltage supplied. Fault F1+F2 (See also fault code tables and flow diagram) a) Shorted thyristor b) Semiconductor not conducting
IX	●	●	●	●	●	○	■	■	■	Continuous run with shorted thyristor (Switch PF must be in N-position, Off)

The motor does not start

Check the status on LED's and signal relays and read the explanation below.
See 6.1.1 for PS D without electronic overload protection and

Status signals

I

No control voltage
- Check voltage on terminals 1 and 2.
- Correct voltage level according to the rating plate?
- Are the cooling fans running?
- If everything is OK - Internal fault on the PCB

II

No starting signal present
- Check the circuit for start signal.
- a Connection between 7 and 10 present.
  Start signal present, closed circuit between terminal 8 and 9
- b PLC-connection
  Connected +24 DC to terminal 9 and
  -(OV) connected to terminal 10

VI (See also the fault codes and flow chart)

Alt. a)
Phase loss
- The main circuit contactor is not closing or closes to late. It must be closed within 100ms after start signal
- One or more phases missing due to tripped fuse

Alt. b)
High current switch off (The switch SC must have been in position Yes, otherwise no tripping due to overcurrent)
- The main circuit contactor is not closing or closes to late. It must be closed within 100ms after start signal
- One or more phases missing due to tripped fuse

VII (See also the fault codes and flow chart)

Over temperature
- Check to make sure the cooling fans are working.
- Clean the heat sink if it is dirty
- Check the temperature monitor under the front cover.
  Short circuit between terminals X3 1, 2.
  If LED F2 is off, then change the temperature monitor.

VIII (See also the fault codes and flow chart)

Alt. a)
Shorted thyristor
- The motor can start with shorted thyristor when switch PF is in N (Off) position.
  Then the status will be IX.
  Change the faulty thyristor at the next maintenance shutdown.

Alt. b)
One of the thyristors is not working / Open circuit between motor and starter
Too small motor in the circuit (too low current for the thyristors).
- Check the gate wiring under the front cover
- Change thyristor.

X (See also the fault codes and flow chart)

Tripped electronic overload (only for PS D and PS DH with electronic over load)
- There is an overload (too high load) on the motor shaft.
- It can also be too long starting time.
  Check if the current limit is set to a low value.
  If the value is set too low there is not enough torque for the start.
PS: It's not possible to reset the over load if the start signal is present.

Softstarter mode		Phase loss	Shorted thyr.	High current (SC)	High curr. (50ms)	Signal fault OL	Nom conducting thyristor	Over temp	Open circuit 2) 1 phase missing	Open circuit 2) >=2 phase missing	Over load
Without energy saving PF=No	Stand by	-	-	-	-	-	-	X	-		-
	After start signal a)	X	1)	-	-	-	X	X	X	3)	-
	Ramp up	X	-		-	-	X	X	X	-	-
	Normal run	X	-	X	-	-	X	X	X	-	-
	Stopping	X	-	X	-	-	X	X	X	-	-
With energy saving PF=Yes	Stand by	-	-	-	-	-	-	X	-	-	-
	After start signal a)	X	X	-	-	-	X	X	X	X	-
	Ramp up	X	X		-	-	X	X	X	X	-
	Dwell	X	X4)	X	-	-	X4)	X	X4)	X4)	-
	Optimise	X	X4)	X	-	-	X4)	X	X4)	X4)	-
	Stopping	X	X	X	-	-	X	X	X	X	-
Signal code		F1	F1+F2	F1 when selected	-	-	F1+F2	F2	F1+F2	F1+F2	-

1) Detecting the fault and gives a fault signal but the softstarter is able to run.
2) Open circuit means open circuit between softstarter and motor
3) Associated with an open circuit on the motor side with 2 or more phases missing. Although the fault is detected if the fault was present when the start signal was activated the system will not trip, i. e it is just an indication.
4) The F1+F2 fault signals are delayed when running with the function PF in position YES under 60 sec. from TOR is activated to PF have been activated. The fault have to be present longer then 5 sec. before tripping. During this 5 sec the LED F1 flashes. Then the LED F2 flashes for another 5 sec. If the fault remains or occur during these last five sec. it will trip with a F1+F2 signal. If no fault, it will go back to normal run.
a) When the fault is present before the start signal is given (closing between 8 and 9).

6.1.3 Flow chart

Fault code

```
            F1

Occurs when closing terminal 8 and 9 ( gives the start signal) ──── Yes ──────────────────────────┐
            No                                                                                       │
                                               ┌──────────────────────────────────────────────┐    │
                                               │   Check that all three phases are present     │── No faults ───┐
                                               │   Main contactor is closing too late          │               │
                                               │   Check the fuses                             │               │
                                               └──────────────────────────────────────────────┘               │
Occurs when ramping up ──── Yes ──────────────────────────┐                                                    │
            No                                             │                                                    │
                                                           │                                                    │
When reaching top of ramp ──── Yes ───────────────┐       │                                                    │
            No                                     │       │                                                    │
                                     ┌─────────────────────────────────────────────┐                           │
                                     │  The main contactor opens                    │── No faults ──────────┐   │
                                     │  Fuse blowed when starting up ( too long starting time )              │   │
                                     │  Overload trip and opens the main contactor │                         │   │
                                     └─────────────────────────────────────────────┘                         │   │
During cont. run ──── Yes ──────────────────────────┐                                                        │   │
            No                                       │                                                        │   │
                                     ┌──────────────────────────────────────────────┐                        │   │
                                     │  Check that the main contactor are closed all the time │── No faults ─┐│   │
                                     │    Interuptions in the main supply            │                        ││   │
                                     └──────────────────────────────────────────────┘                        ││   │
During ramp down ──── Yes ──────────────┐                                                                     ││   │
            No                          │                                                                     ││   │
                        ┌──────────────────────────────────────────────┐                                     ││   │
                        │  The main contactor opens before end of ramp  │── No faults ────────────────────────┘│   │
                        └──────────────────────────────────────────────┘                                      │   │
                                                                                                               │   │
                              Is the switch SC on?                                                             │   │
                          No                    Yes                                                            │   │
                                                                                                               
                                        High over current ( above set current limit)
                                                    No

            Faulty P.C.B
```

Fault code

F1+F2

Occurs when closing terminal 8 and 9 (gives the start signal) — Yes
No

Is the switch PF on? — Yes — Switch off PF
No

Occurs when ramping up
No

Possible to run?
(with fault signal)
Yes — No

When reaching top of ramp — Yes — By-pass contactor used?
No — No — Yes

Shorted thyristor

During cont. run
During ramp down

Is the switch PF on?
No — Yes

Switch off PF

Open motor circuit
Non conducting thyristor

No fault

PF is On — No

Yes

Short interuptions in the
supply network

No fault

Switch PF off

Make a new start

Faulty P.C.B

Fault code

F2

Over temp. heatsink

No overtemp.

Faulty temp. sensor
(check by disconnecting
the sensor from the main P.C.B)

Still F2 signal

Faulty P.C.B

7 Technical data

General data

		PS D Normal starts
Rated insulation voltage, U_i	V	690
Rated operational voltage, U_e	V	690
Motor output, P_e 690V	kW	355-800
Max. rated current I_e	A	370-840
Ambient temperature During operation *Reduce the rated operational current with 0,8% per °C above 40 ° C* During storage	°C °C	0-50 -40 - +70
Degree of protection		IP 00
Harmonic contents During start During operation	% %	5 2
Shortest interval between starts	ms	500
Settings Initial voltage during start Ramp time during start Ramp time during stop Current limit at start Rated motor current I_r Step down voltage	% s s % %	10-60 0,5-60 0,5-240 2-5 x I_e 50-100 100-30
Signal relay Rated operational voltage U_e Rated thermal current I_{th} Rated operational current I_e at AC 11 (U_e=250V)	V A A	250 5 1,5

Cross section of connectable cables

	PS D size	370...570	720	840

Main circuit
Connection clamp
  Cu-cable
  Al-cable
Connection bar
  Width x thickness
  Hole diameter
	
	mm²
	mm²
	
	mm
	mm
		
		-
		-
		
		25x6
		11
			
			-
			-
			
			40x6
			11
				
				-
				-
				
				50x6
				11

Control circuit Connection clamp	 mm²	 2,5	 2,5	 2,5
Signal relay Connection clamp	 mm²	 2,5	 2,5	 2,5

Size related data

Size	Starting capacity	Recommended overload relay		Max. power loss at max. I_e	Max. fusing rating main circuit [2]		Power requirements of control circuits
		Type	Current range A	W	Bussmann fuses	Ferraz fuses	VA

PS D

| Size	Starting capacity	Type	Current range A	W	Bussmann fuses	Ferraz fuses	VA
370	5xI_e for 7s	T450 DU	130-370	[1]	900A 170M5015[3]	900A 6,6 URD 32 D11 A 0900	90
470	5xI_e for 7s	T900 DU	265-470	[1]	1000A 170M5016[3]	1250A 6,6 URD 33 D11 A 1250	90
570	5xI_e for 7s	T900 DU	265-570	[1]	1500A 170M6018[3]	1250A 6,6 URD 33 D11 A 1250	90
720	5xI_e for 7s	T900 DU	465-720	[1]	1500A 170M6018[3]	2000A 6,6 URD 33 TTF 2000	90
840	5xI_e for 7s	T900 DU	465-840	[1]	1500A 170M6018[3]	2000A 6,6 URD 33 TTF 2000	90

1) Total power loss: $P_{Ltot} = (3 \times I_e \times 1,0) + 100$ (W)
2) For the control circuit: 6 A delayed
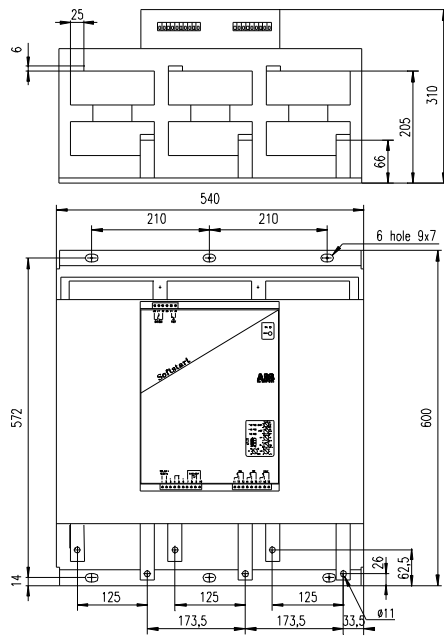3) Fuse holder 170H 3004
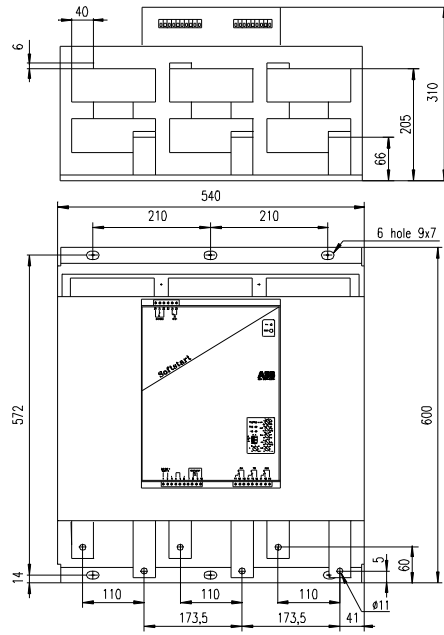
8 Circuit Diagrams

PS D for 690V
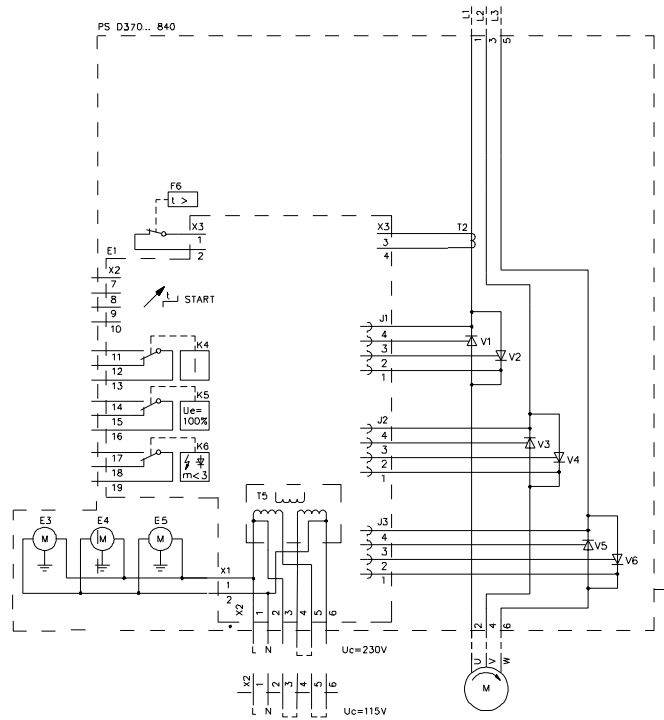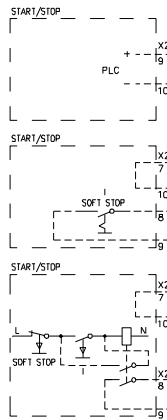
E1	**Circuit board**
E3-E5	**Fan**
F6	**Temperature monitor**
J1-J3	**Contact blocks**
K4	**Relay, actuated in operational position**
K5	**Relay, actuated at full voltage (Ue = 100%)**
K6	**Relay, fault signal**
T2	**Current transformer**
T5	**Control transformer**
V1-V6	**Thyristor**
X1-X3	**Terminal block**

9 Dimensions

PS D370 ... 570

PS D720

PS D840
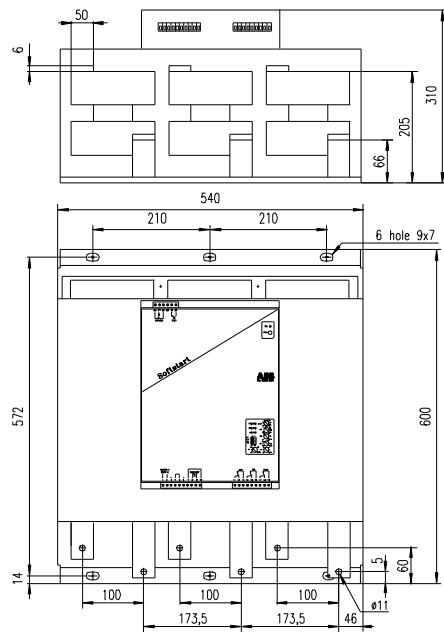
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