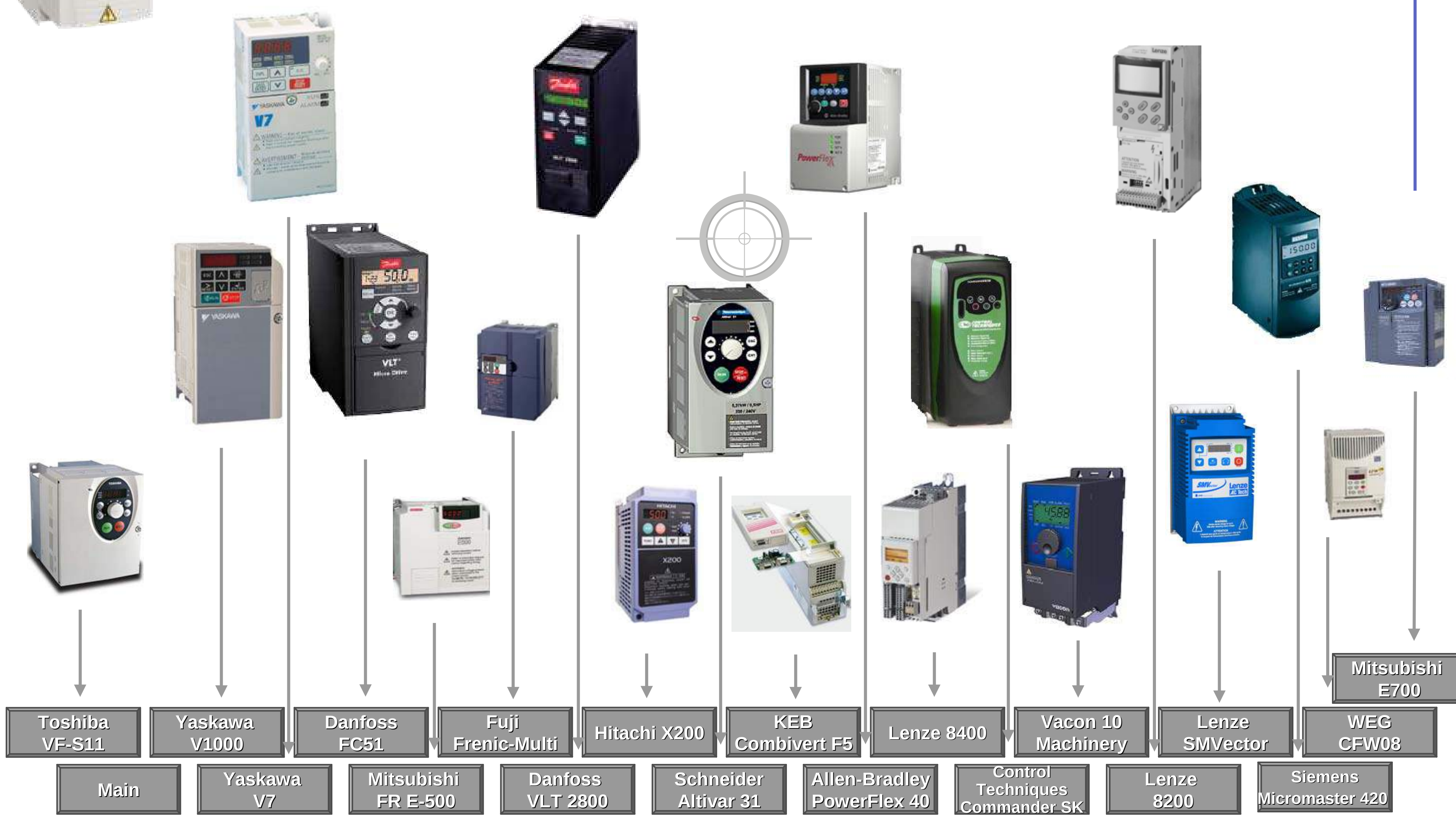
ACS350 Competitor comparison



ACS350 Competitor comparison



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Toshiba VF-S11

- The S11 provides maximum torque with precise speed control. It features an easy-to-use, quiet and compact design. It has a removable terminal board, larger terminals, bidirectional speed search and PID control. No other micro inverter delivers such reliable performance and extensive capabilities at such a competitive price.
- Sinusoidal PWM control, V/f constant, variable torque, vector control, PM motor control
- For power range 0.2 to 15 kW
- Easy Maintenance
- Easy-to-Use
- Built-In EMI Noise Filter
- Compact
- External communication modules are available with functionality for multiple drive connectivity.
- Applications
  - No specific industries or applications mentioned.

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Protection class

Toshiba VF-S11

- IP20 Enclosed type
- Another version VF-S11 IP54, can also be brought into compliance with IP55 specifications

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Toshiba VF-S11

Vibration

- Less than 5.9 m/s^2, 10 to 55 Hz

Shock

- N/A

Temperature

- Operating temperature -10 to +60°C
  - With ambient temperature > 40°C remove the protective seal from the top of VF-S11
  - Current derating required with ambient temperature > 50°C, if installed side-by-side > 40°C
- Storage temperature -20 to +65°C

Humidity

- 20 to 93% (free from condensation and vapor)

Altitude limitations

- 1000 m or less.

Acoustic noise

- 2.0 to 16.0 kHz (default 12 kHz)

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40°C
- +50°C with 10% current derating
- Storage temperature – 40°C to +70°C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Toshiba VF-S11

Voltage types and power range

- 1-phase 200 - 240 V -15%/ +10%
  - 0.2 to 2.2 kW (0.25 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.2 to 15 kW (0.25 to 20 hp)
- 3-phase 380 - 500 V –15%/ +10%
  - 0.4 to 15 kW (0.5 to 20 hp)
- 3-phase 525 – 600 V –15%/ +10%
  - 0.75 to 15 kW (1 to 20 hp)
- Voltage fluctuation ±10% with continuous 100% load

Power factor

- N/A

Supply frequency

- 50/60 Hz, tolerance ±5%

Supply networks

- N/A

DC bus connection

- Not available

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

DC bus connection

- N

Ratings 1-phase 200V

1-phase 200V		ABB	Toshiba	ABB ACS350		Toshiba VF-S11		Toshiba	
P_N	P_N	ACS350	VF-S11	I_{2N}	I_{2N}	I_{INV}	I_{INV}	VF-S11	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	VFS11S	A	A	A	A	names	
kW	hp	01X-		U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16								
0,2	0,25		2002PL			1,5	1,5	F2	
0,4	0,5	02A4-2	2004PL	2,4	2,2	3,3	3,3		R0
0,55	0,75								
0,75	1	04A7-2	2007PL	4,7	4,2	4,8	4,8	F3	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	2015PL	7,5	6,8	8,0	8,0	F5	R2
2,2	3	09A8-2	2022PL	9,8	8,8	11,0	11,0	F6	

Toshiba VF-S11

Overload ratings

- 150 % for 60 sec.
- 200 % for 0.5 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 200V

3-phase 200V		ABB	Toshiba	ABB ACS350		Toshiba VF-S11		Toshiba	
P_N	P_N	ACS350	VF-S11	I_{2N}	I_{2N}	I_{INV}	I_{INV}	VF-S11	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	VFS11	A	A	A	A	names	
kW	hp	03X-		U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16								
0,2	0,25		2002PM			1,5	1,5	F1	
0,4	0,5	02A4-2	2004PM	2,4	2,2	3,3	3,3		R0
0,55	0,75	03A5-2	2005PM	3,5	3,2	3,7	3,7	F2	
0,75	1	04A7-2	2007PM	4,7	4,2	4,8	4,8		R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	2015PM	7,5	6,8	8,0	8,0	F4	
2,2	3	09A8-2	2022PM	9,8	8,8	11,0	11,0	F5	R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2	2037PM	17,6	15,8	17,5	17,5	F6	
5,5	7,5	24A4-2	2055PM	24,4	21,96	27,5	27,5	F7	R3
7,5	10	31A0-2	2075PM	31,0	27,9	33,0	33,0		R4
11	15	46A2-2	2110PM	46,2	41,58	54,0	54,0	F8	
15	20		2150PM			66,0	66,0		

Toshiba VF-S11

Overload ratings

- 150 % for 60 sec.
- 200 % for 0.5 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 400V

3-phase 400V		ABB	Toshiba	ABB ACS350		Toshiba VF-S11		Toshiba	
P_N	P_N	ACS350	VF-S11	I_{2N}	I_{2N}	I_{INV}	I_{INV}	VF-S11	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	VFS11	A	A	A	A	names	
kW	hp	03X-		U_N=380-480 V		U_N=380-500 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	01A2-4	4004PL	1,2	1,1	1,5	1,5	F5	R0
0,55	0,75	01A9-4		1,9	1,7				
0,75	1	02A4-4	4007PL	2,4	2,2	2,3	2,3	F5	R1
1,1	1,5	03A3-4		3,3	3,0				
1,5	2	04A1-4	4015PL	4,1	3,7	4,1	4,1	F5	
2,2	3	05A6-4	4022PL	5,6	5,0	5,5	5,5	F6	
3	4	07A3-4		7,3	6,6				
4	5	08A8-4	4037PL	8,8	7,9	9,5	9,5	F6	
5,5	7,5	12A5-4	4055PL	12,5	11,3	14,3	14,3	F7	R3
7,5	10	15A6-4	4075PL	15,6	14,0	17,0	17,0		
11	15	23A1-4	4110PL	23,1	20,8	27,7	27,7	F8	
15	20	31A0-4	4150PL	31	27,9	33,0	33,0		R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Toshiba VF-S11

Overload ratings

- 150 % for 60 sec.
- 200 % for 0.5 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Toshiba VF-S11	ABB ACS350			Toshiba VF-S11			Toshiba VF-S11	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-	VFS11S	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	N/A	
kW	hp	01X-		W	H	D	W	H	D		Frame
0,12	0,16										
0,2	0,33		2002PL				72	130	130	F2	
0,4	0,5	02A4-2	2004PL	70	169	161					R0
0,55	0,75										
0,75	1	04A7-2	2007PL	70	169	161	72	130	140	F3	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	2015PL	105	169	165	105	130	150	F5	R2
2,2	3	09A8-2	2022PL				140	170	150	F6	

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Toshiba VF-S11	ABB ACS350			Toshiba VF-S11			Toshiba VF-S11	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-	VFS11S	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,2	0,33		2002PL				94	1,2	1,0	F2	
0,4	0,5	02A4-2	2004PL	118	1,9	1,2					R0
0,55	0,75										
0,75	1	04A7-2	2007PL	118	1,9	1,2	94	1,3	1,2	F3	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	2015PL	177	2,9	1,5	137	2,0	1,4	F5	R2
2,2	3	09A8-2	2022PL				238	3,6	2,2	F6	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Toshiba VF-S11	ABB ACS350			Toshiba VF-S11			Toshiba VF-S11	ASC350
		Type	Type	3-phase			3-phase			Frame names	
		ACS350-	VFS11	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,25		2002PM						120	F1	
0,4	0,5	02A4-2	2004PM				72	130			R0
0,55	0,75	03A5-2	2005PM						130	F2	
0,75	1	04A7-2	2007PM	70		161					R1
1,1	1,5	06A7-2			169						
1,5	2	07A5-2	2015PM				105	130	130	F4	
2,2	3	09A8-2	2022PM						150	F5	
3	4	13A3-2		105		165					R2
4	5	17A6-2	2037PM				140	170	150	F6	
5,5	7,5	24A4-2	2055PM	169	169	169	180	220	170	F7	R3
7,5	10	31A0-2	2075PM	260	181	169					R4
11	15	46A2-2	2110PM				245	310	190	F8	
15	20		2150PM								

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Toshiba VF-S11	ABB ACS350			Toshiba VF-S11			Toshiba VF-S11	ASC350
		Type	Type	3-phase			3-phase			Frame names	
		ACS350-	VFS11	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,2	0,25		2002PM				94	1,1	0,9	F1	
0,4	0,5	02A4-2	2004PM	118	1,9	1,2					R0
0,55	0,75	03A5-2	2005PM					1,2	1,1	F2	
0,75	1	04A7-2	2007PM								R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	2015PM				137	1,8	1,2	F4	
2,2	3	09A8-2	2022PM	177	2,9	1,5		2,0	1,3	F5	R2
3	4	13A3-2									
4	5	17A6-2	2037PM				238	3,6	2,2	F6	
5,5	7,5	24A4-2	2055PM	286	4,8	2,5	396	6,7	4,8	F7	R3
7,5	10	31A0-2	2075PM	471	8,0	4,4			4,9		R4
11	15	46A2-2	2110PM				760	14,4	9,3	F8	
15	20		2150PM						9,6		

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Toshiba VF-S11	ABB ACS350			Toshiba VF-S11			Toshiba VF-S11	ASC350
		Type	Type							Frame	
		ACS350-	VFS11	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	names	
kW	hp	03X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	01A2-4	4004PL	70	169	161	105	130	150	F5	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	4007PL				105	130	150	F5	R1
1,1	1,5	03A3-4									
1,5	2	04A1-4	4015PL				105	130	150	F5	
2,2	3	05A6-4	4022PL				140	170	150	F6	
3	4	07A3-4									
4	5	08A8-4	4037PL				140	170	150	F6	
5,5	7,5	12A5-4	4055PL	169		169	180	220	170	F7	R3
7,5	10	15A6-4	4075PL								
11	15	23A1-4	4110PL				245	310	190	F8	
15	20	31A0-4	4150PL	260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Toshiba VF-S11	ABB ACS350			Toshiba VF-S11			Toshiba VF-S11	ASC350
		Type	Type							Frame	
		ACS350-	VFS11	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	names	
kW	hp	03X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	01A2-4	4004PL	118	1,9	1,2	137	2,0	1,4	F5	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	4007PL				137	2,0	1,5	F5	R1
1,1	1,5	03A3-4				1,2					
1,5	2	04A1-4	4015PL				137	2,0	1,5	F5	
2,2	3	05A6-4	4022PL				238	3,6	2,3	F6	
3	4	07A3-4									
4	5	08A8-4	4037PL				238	3,6	2,5	F6	
5,5	7,5	12A5-4	4055PL	286	4,8	2,5	396	6,7	5,0	F7	R3
7,5	10	15A6-4	4075PL						5,1		
11	15	23A1-4	4110PL				760	14,4	9,6	F8	
15	20	31A0-4	4150PL	471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

DIN rail mounting as standard

Sideways mounting

Installation

Toshiba VF-S11

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Optional
Flange	No
Wall (sideways)	No
Heatsinkless	No
Side-by-side	Yes up to 40°C and seals removed from the top of the drive, derating required if > 40°C

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	0, with top seal on 50 mm

- Operational motor cable lengths: Information not available

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

Complies with EN61800-3

EN61000-3-2 with opt. chokes

EMC and harmonics

Toshiba VF-S11

- Filters
  - 1~240V and 3~500V series have a noise filter inside
  - External EMC filters available for all types, can be foot-mounted and side-mounted
- Chokes
  - AC/DC reactors as option
- EMC compliant motor cable lengths
  - Units with inbuilt filter comply with limits for conducted emissions in EN55011 Class A with 5 m motor cable length
  - With external EMC filter complies with limits for conducted emissions in EN55011
    - 3~240V: Class A 5 m, Class B 1 m
    - 1~240V and 3~500V: Class A 50 m, Class B 20 m
  - Note: Not tested for radiated emissions!
- THD
  - Information N/A

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

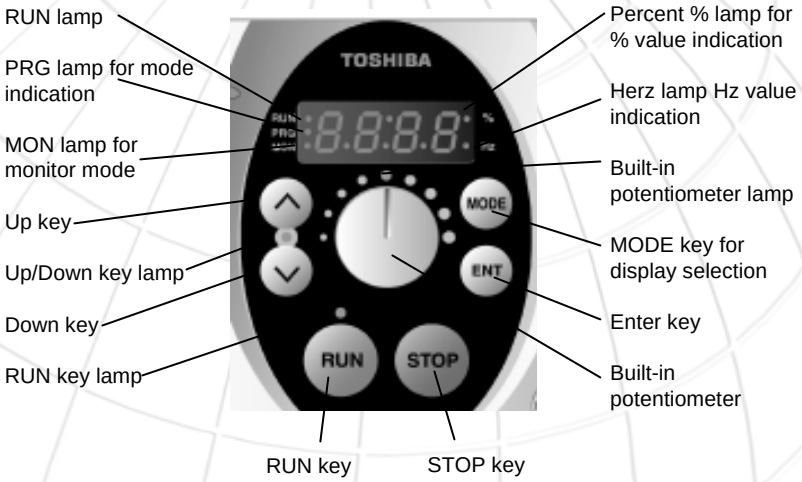
4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 [1])	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 [1])	-	30 m (100 ft)

- THD
  - EN61000-3-2 with optional chokes

User interface

Toshiba VF-S11

- Integrated 4-digit 7-segment LED display



- Optional
  - Remote panel (includes a frequency meter, a frequency regulator and RUN/STOP (forward/reverse run) switches)
  - Extension panel (LED indication section, RUN/STOP key, UP/DOWN key, Monitor key, and Enter key)

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Machine interface (I/O)

Toshiba VF-S11

Type	*Qty.*	*Programmable*
Digital inputs	6	Yes
Analog inputs	2	Yes
Pulse train input	-	
Relay outputs	2	Yes
Transistor outputs	1 open collector output, can be programmed to be used as pulse train output	Yes
Analog outputs	1	Yes

Specialities:

- 24V External supply

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Toshiba VF-S11

Protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU	Standard		
ModBus Plus	Option		
DeviceNet	Option		
Profibus DP	Option		
Metasys	Option		
Ethernet TCP/IP	Option		
Ethernet IP	Option		
Landis and Staefa	Option		

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

Motor control

Toshiba VF-S11

- Open Loop Vector, Constant Torque, Variable Torque
- PM motor control

Braking

- Inbuilt brake chopper for dynamic braking; requires external brake resistor
- DC braking with 0 to 100% braking rate for 0 to 20 seconds

Output frequency

- 0.5 – 500 Hz

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

3 User macros
17 languages

Macros and language versions

Toshiba VF-S11

- Macros
  - Torque boost macro setting function: 4 alternative settings
  - Parameter setting macro function: 5 alternative settings
- Languages
  - N/A

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Toshiba VF-S11

- One-Step Motor Auto Tuning
- Energy savings mode
- Bidirectional Speed Searchable to Detect a Spinning Motor and Start at that Speed Regardless of Direction
- PID Control with Built-in 24 VDC Power Supply for Process Transducer

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

(* Basic feature in ABB ACS350

Other advanced features

Toshiba VF-S11

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

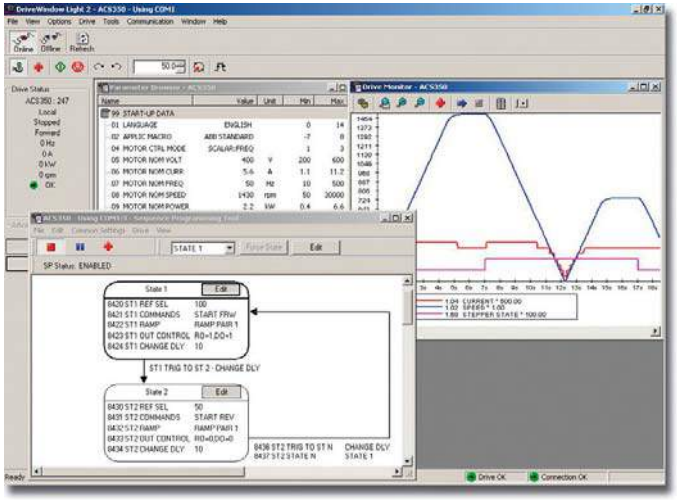
Other advanced features (cont)

Toshiba VF-S11

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Toshiba VF-S11

- Connection to a PC requires an optional RS232C or RS485 communication conversion unit

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Toshiba VF-S11

- Extension panel
- Remote panel
- Parameter writer
- EMC noise reduction filters (Foot mount and side mount installation)
- Internal communications devices (RS485, Modbus RTU, DeviceNET, LonWorks etc.)
- DIN rail kit
- AC / DC reactors
- Braking resistor
- Conduit pipe attachment kit (used for conformance to NEMA TYPE1)

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Detailed fault history with time

Maintenance

Toshiba VF-S11

- A warning signal is output to the display panel when the electrolytic capacitors on the main circuit, the cooling fan or the control board reach the replacement period
- The cooling fan is replaced easily, and the automatic on/off function provides extended product life
- Main circuit capacitors are designed with a 10-year lifetime (Average yearly temperature of 40˚C, operating 24 hours per day for 365 days at 80% of the current rating)

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Toshiba VF-S11

Approvals

- CE, UL, CSA

Compliance with

- EMC directive 89/336/EEC

- **Applicable standards**
  - EN 50178

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Toshiba VF-S11

Model: VFS11 4022PL-WN(4)

Drive rating: 380-500V
2.2 kW
5.5 A

Tester (experienced drive specialist) comments:

- Power terminals were generous in size but the control terminals were small. Additionally, each function (ie Analog Input, Relay Output, and Digital Inputs) had their own terminal block making wiring more difficult.
- The Start-up guide didn't provide any connection diagram for control.
- The Operator Panel provided Run and Stop buttons, Up and Down arrows, Mode and Ent Buttons as well as an integral speed pot. The display used four 7-segment LED's. Programming was not intuitive and the codes were difficult to read due to the LED segmentation.
- Wiring T1, T2 and T3 produced reverse motor rotation.
- The VFS11 hardware is identical to the Telemechanique ATV31 but the firmware and set-up appears to be different.
- Not sure the Motor ID run was successful. Following the instructions from D ROM User Manual indicated that the display should have indicated a message that the ID run was in-process but it never showed. Scrolling through the motor parameters indicated the ID run took place.
- The small ½ turn lock for opening the drives front cover is very cheap and won't last.

ABB ACS350

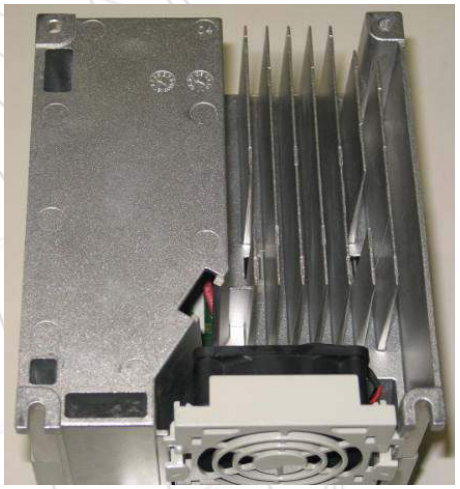
Model: ACS350-03U-05A6-4

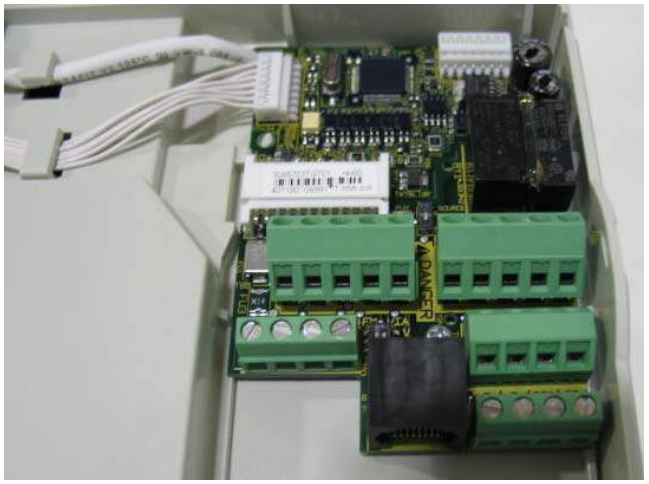
Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A

Parameter Settings:

9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

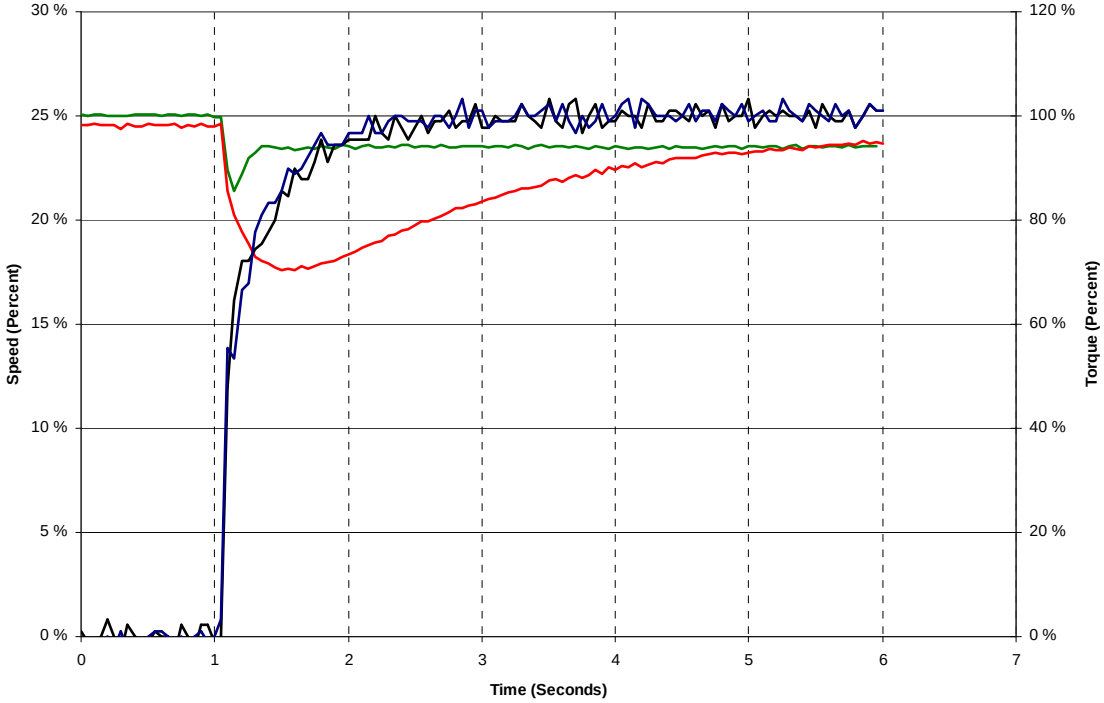
Photos of the tested unit

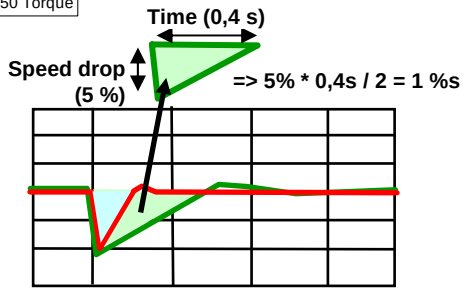




Impact load test – Dynamic speed accuracy (stiffness)

Motor is operated at ¼ rated RPM and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.

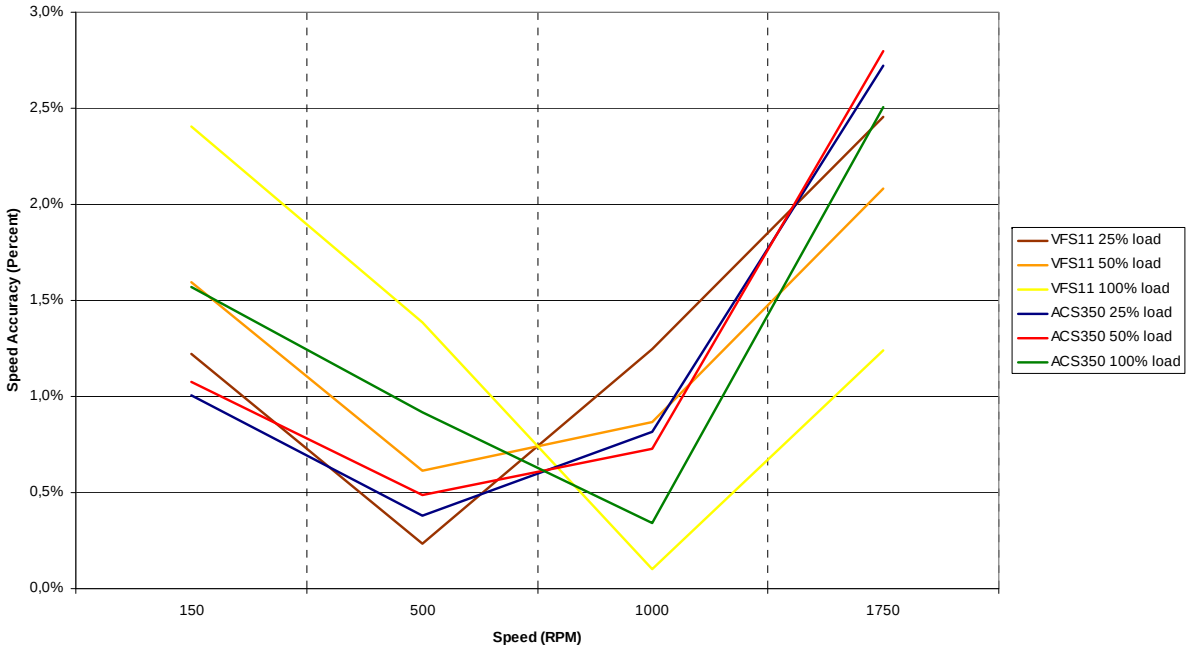




Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive works in case of disturbances. The ACS350 speed control default tuning is quite conservative to ensure that the controller is stable despite the motor used and its size compared to size of the inverter. The VSF11 has good dynamic speed accuracy despite the static speed error (cannot fully compensate for slip). The performance of the ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL).

Static speed accuracy

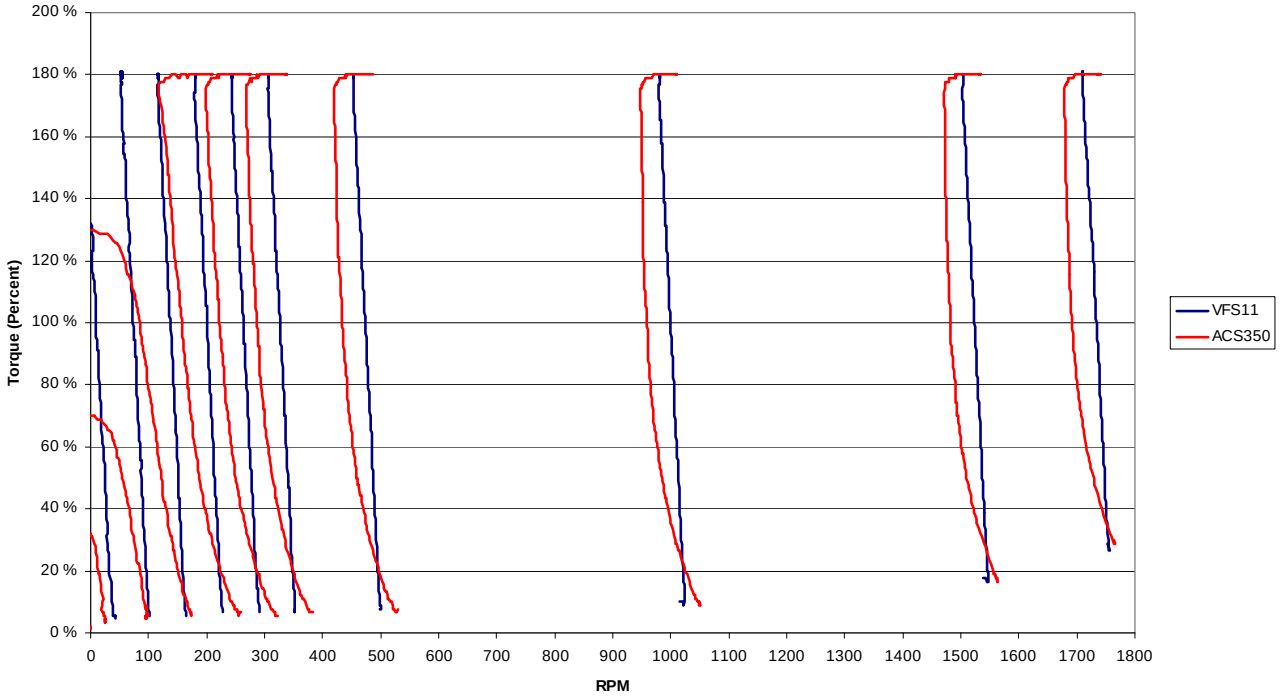
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 0%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), error [%] = $(n^*-n_{act}) * n_{N(mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Static speed error depends on on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). The ACS350 and VSF11 performed the test equally. The performance of ACS350 can be improved by tuning the speed controller (parameter group 23 SPEED CONTROL).

Maximum torque as a function of speed

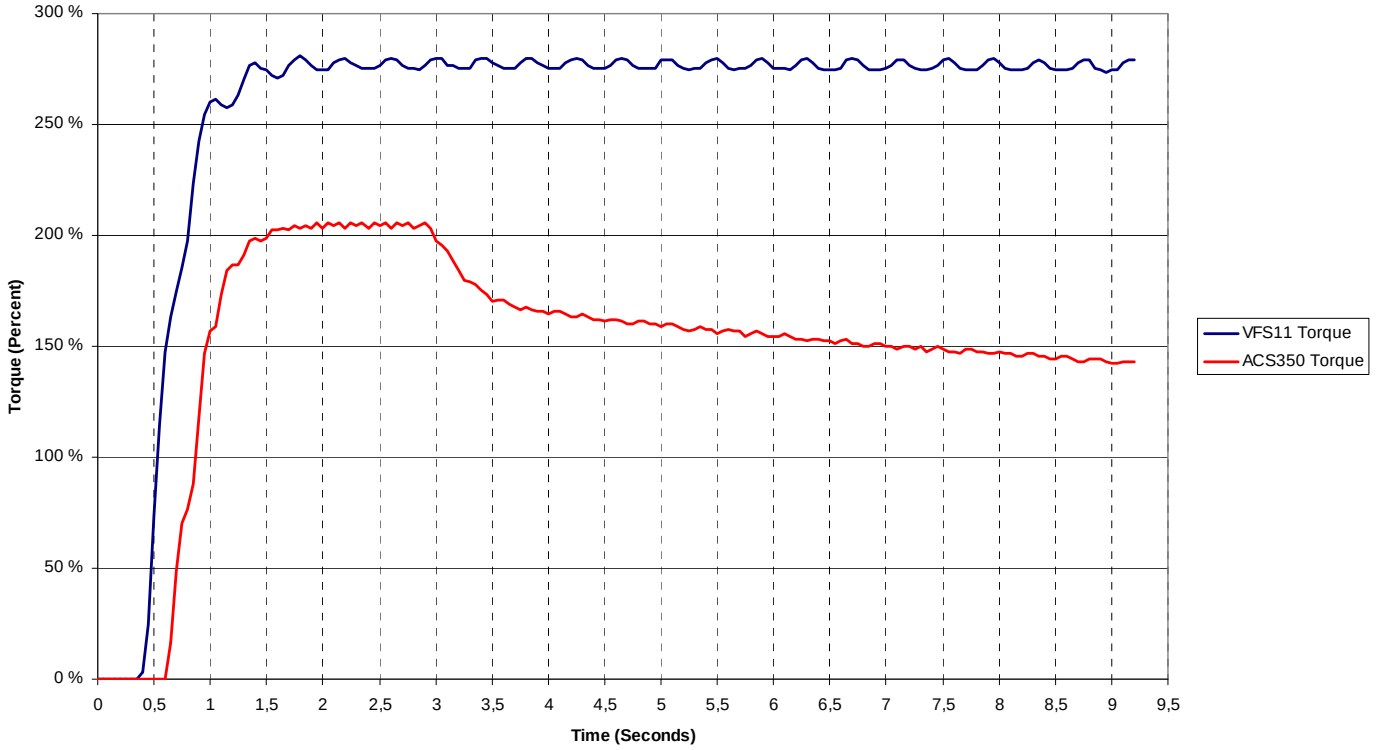
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The VSF11 has very good speed range because it could provide full output torque from 1700 rpm's down to 60 rpm's, VSF11 cannot fully compensate for slip. The ACS350 has good speed range as it could provide full output torque from 1700 rpm's down to 180 rpm's. The quite conservative speed controller tuning of ACS350 can be seen also in this test as a slight speed drop in each test point and it can be improved by tuning the speed controller (parameter group 23 SPEED CONTROL).

Maximum starting torque

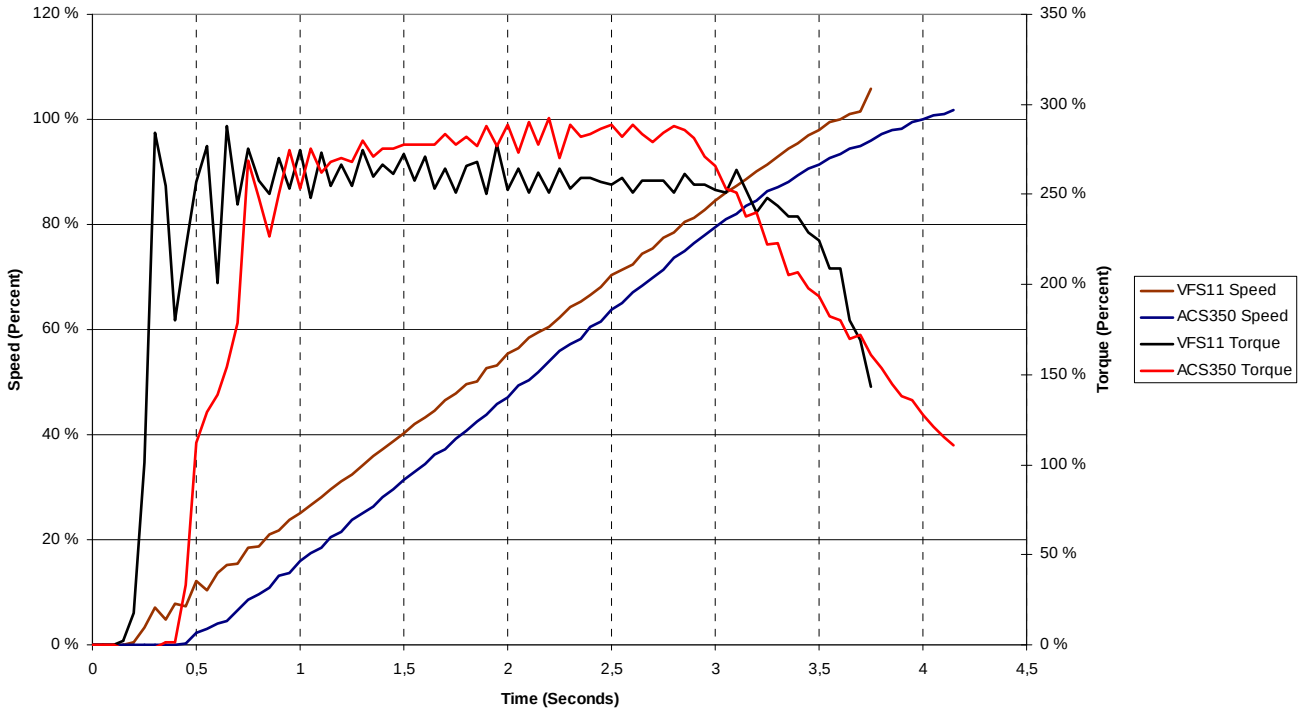
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



Both drives have good starting torque up to 200% in ACS350 and 275% in VSF11. Both drives also reach nominal torque within 1s. The ACS350 reduces torque to nominal value after 2 s due to current limiting. The VSF11 has bigger torque ripple possible due to current controller gain.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



Thanks to greater maximum output torque the VSF11 can accelerate the inertia to the reference within 3.6 sec. The ACS350 needs 4 seconds. The ACS350 provides maximum starting torque for two seconds then decreases torque based on current limiting. The VSF11 has significant torque ripple which may indicate the tuning of the current controller is not stable and could cause overcurrent trips.

Efficiency

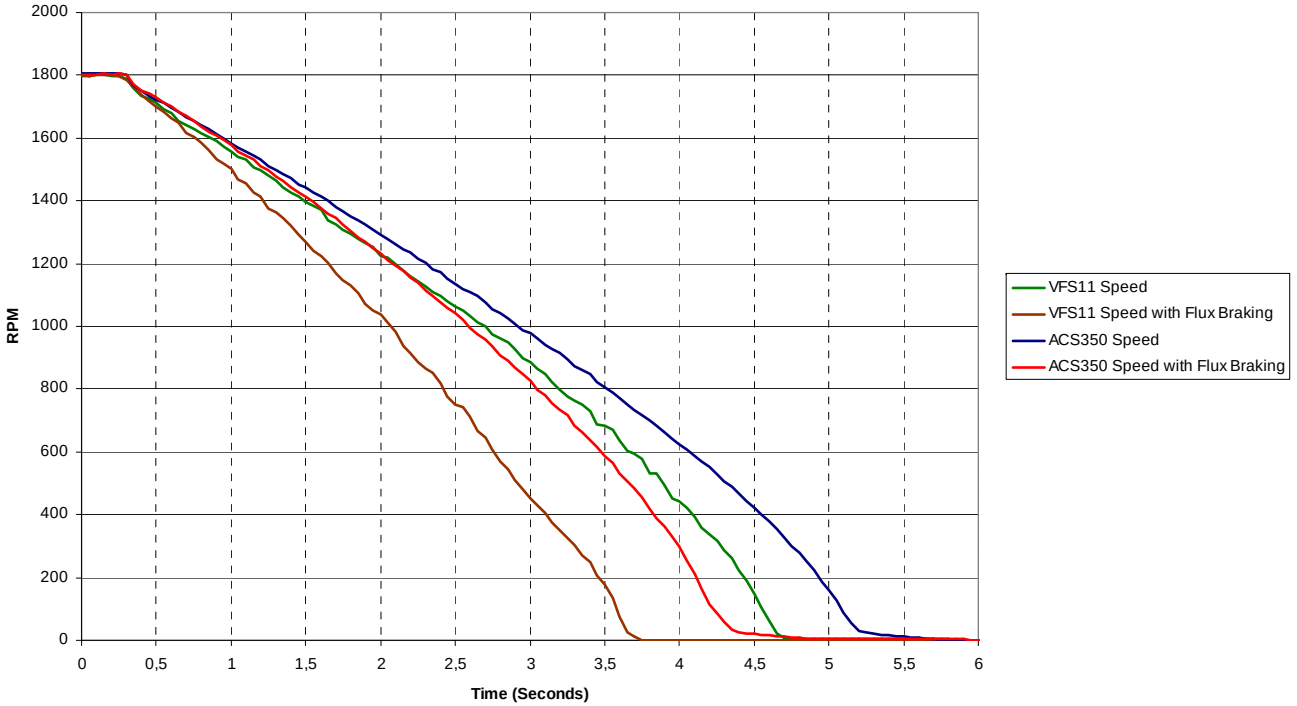
Using power analyzer, input power, speed and torque of AC motor are measured at 0, 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	VSF11
25%	87.0%	84.2%
50%	89.3%	87.8%
75%	89.0%	87.3%
100%	88.4%	86.9%

The test is performed at rated speed with different loads. ACS350 has higher efficiency at all load points.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



The ACS350 was able to decelerate to zero within 5,5 seconds. The ACS350 with flux braking shortened the deceleration time even more. VSF11 performed the test well and was able to decelerate to zero within 3.7 seconds.

ABB strengths

ACS350 advantages over Toshiba VF-S11

Wide power range	17 languages
DIN rail mounting as standard	Comprehensive SW
Sideways mounting	Cold configuration with FlashDrop
Complies with EN61800-3	
EN61000-3-2 with opt. chokes	Sequence programming
Bipolar analog input	Detailed fault history with time
3 User macros	RoHS compliance

For ACS350 advantages in performance, see the performance test slides

ACS350 Competitor comparison



















Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Yaskawa V1000

- V1000 is a compact and sensor-less, having all the features you expect from the world's leading inverter/drive manufacturer.
- Quality has a new formula
- Time and space saving 100% quaranteed
- Advanced performance
- Easy maintenance
- More performance & Quality in less space
- Sine wave PWM (V/f control, sensorless currect vector control (uses the actual flux current))
- For power range 0.12 / 0.18 kW to 15 / 18.5 kW (heavy duty / normal duty)
- Industries
  - Cranes / Hoists, Lift & Escalator, Textile, Food and Beverage, HVAC / Fan & Pump

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Protection class

Yaskawa V1000

- IP20 / NEMA Type 1 (with top cover)
- IP20 / Open-Chassis (without top cover)
- IP66/NEMA4 (dust/water-proof) future option

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Yaskawa V1000

Vibration

- Up to 1G at 10…20 Hz, Up to 0.65G at 20 to 50 Hz

Shock

- No information available

Temperature

- Operating temperature -10°C to +40°C (IP20/NEMA Type 1) or -10°C to +50°C (IP20/Open-Chassis)
- Storage temperature – 20 °C to +60 °C (short-term temperature during transportation)

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. The drive input voltage and the rated output current must be derated for 1% per 100 m above 1000m. The maximum altitude is 3000 m.

Acoustic noise

- 2…15 kHz, Low-noise Low carrier technology (Patent pending), Output current derating required
  - Above 10 kHz for HD drives up to 1.5 kW 1~200V
  - Above 8 kHz for all other HD drives
  - Above 2 kHz for all ND drives

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Yaskawa V1000

Voltage and power range

- 1-phase 200 - 240V -15%/+10%
  - 0.12 to 4 kW (1/6 to 5 hp), HD ratings
- 3-phase 200 - 240V -15%/+10%
  - 0.12 to 15 kW (1/6 to 20 hp), HD ratings
- 3-phase 380 - 480V -15%/+10%
  - 0.37 to 15 kW (0.5 to 20 hp), HD ratings

Power factor

- No information available

Supply frequency

- 50/60Hz, +5%

Supply networks

- Suitable for IT network. Drives available without EMC filter

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Yaskawa	ABB ACS350		Yaskawa V1000		Yaskawa	
P_N	P_N	ACS350	V1000	I_{2N}	I_{2N}	$I_{HD, IP20 single installation}$		V1000	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	01X-	VZAB	U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16		0P1xAA			0,8	0,8	F1	
0,18	0,24								
0,25	0,33		0P2xAA			1,6	1,6	F1	
0,4	0,50	02A4-2	0P4xAA	2,4	2,2	3,0	3,0	F2	R0
0,75	1	04A7-2	0P7xAA	4,7	4,2	5,0	5,0	F7	R1
1,1	1,50	06A7-2		6,7	6,0				
1,5	2	07A5-2	1P5xAA	7,5	6,8	8,0	8,0	F8	R2
2,2	3	09A8-2	2P2xAA	9,8	8,8	11,0	11,0	F10	
3	4								
4	5		4P0xAA			17,5	17,5	F12	

Yaskawa V1000

Overload ratings

- HD: 150% * I_{CT} for 1min
- ND: 120% * I_{VT} for 1min

Normal duty (ND) ratings exist: kW and A values of ND unit are same or smaller than one step bigger HD rating unit

Derating information

- Derating required above 40°C in all other cases than in single drive installation of IP20 Open type (output currents 70%...85% at 50°C depending on installation method)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 200V

3-phase 200V		ABB	Yaskawa	ABB ACS350		Yaskawa V1000		Yaskawa	ASC350
P_N	P_N	ACS350	V1000	I_{2N}	I_{2N}	$I_{HD, IP20 single installation}$		V1000	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-	VZA2	U_N=206-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16		0P1xAA			0,8	0,8	F1	
0,18	0,24								
0,25	0,33		0P2xAA			1,6	1,6	F1	
0,4	0,50	02A4-2	0P4xAA	2,4	2,2	3,0	3,0	F2	R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2	0P7xAA	4,7	4,2	5,0	5,0	F3	R1
1,1	1,50	06A7-2		6,7	6,0				
1,5	2	07A5-2	1P5xAA	7,5	6,8	8,0	8,0	F6	
2,2	3	09A8-2	2P2xAA	9,8	8,8	11,0	11,0	F7	R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2	4P0xAA	17,6	15,84	17,5	17,5	F9	
5,5	7,50	24A4-2	5P5xAA	24,4	21,96	25,0	25,0	F11	R3
7,5	10	31A0-2	7P5xAA	31,0	27,9	33,0	33,0		R4
11	15	46A2-2	011xAA	46,2	41,58	47,0	47,0	F14	
15	20		015xAA			60,0	60,0	F15	

Yaskawa V1000

Overload ratings

HD: 150% * I_{CT} for 1min, ND: 120% * I_{VT} for 1min

Normal duty (ND) ratings exist: ratings of ND unit are same or smaller than one step bigger HD unit

Derating information

- Derating required above 40°C in all other cases than in single drive installation of IP20 Open type (output currents 70%...85% at 50°C depending on installation method)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 400V

3-phase 400V		ABB	Yaskawa	ABB ACS350		Yaskawa V1000		Yaskawa	ASC350
P_N	P_N	ACS350	V1000	I_{2N}	I_{2N}	$I_{HD, IP20 single installation}$		V1000	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-	VZA4	U_N=380-480 V		U_N=380-480 V		N/A	Frame
0,12	0,16								
0,2	0,24		0P2xAA			1,2	1,2	F4	
0,4	0,50	01A2-4	0P4xAA	1,2	1,1	1,8	1,8	F5	R0
0,55	0,75	01A9-4		1,9	1,7				
0,75	1	02A4-4	0P7xAA	2,4	2,2	3,4	3,4	F7	R1
1,1	1,50	03A3-4		3,3	3,0				
1,5	2	04A1-4	1P5xAA	4,1	3,7	4,8	4,8	F8	
2,2	3	05A6-4	2P2xAA	5,6	5,0	5,5	5,5		
3	4	07A3-4	3P0xAA	7,3	6,6	7,2	7,2		
4	5	08A8-4	4P0xAA	8,8	7,9	9,2	9,2	F9	
5,5	7,50	12A5-4	5P5xAA	12,5	11,3	14,8	14,8	F11	R3
7,5	10	15A6-4	7P5xAA	15,6	14,0	18,0	18,0		
11	15	23A1-4	011xAA	23,1	20,8	24,0	24,0	F13	
15	20	31A0-4	015xAA	31	27,9	31,0	31,0	F14	R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Yaskawa V1000

Overload ratings

HD: 150% * I_{CT} for 1min, ND: 120% * I_{VT} for 1min

Normal duty (ND) ratings exist: ratings of ND unit are same or smaller than one step bigger HD unit

Derating information

- Derating required above 40°C in all other cases than in single drive installation of IP20 Open type (output currents 70%...85% at 50°C depending on installation method)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40°C and +50°C ambient)
- 1.8 x short-time overload, 2 sec

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Yaskawa V1000	ABB ACS350			Yaskawa V1000			Yaskawa V1000	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-	VZAB	W	H	D	W	H	D	N/A	Frame
0,12	0,16		0P1xAA				68	128	76	F1	
0,18	0,24										
0,25	0,33		0P2xAA				68	128	76	F1	
0,4	0,50	02A4-2	0P4xAA	70	169	161			108	F2	R0
0,75	1	04A7-2	0P7xAA	70	169	161	108		137,5	F7	R1
1,1	1,50	06A7-2									
1,5	2	07A5-2	1P5xAA	105	169	165	108	128	154	F8	R2
2,2	3	09A8-2	2P2xAA				140		163	F10	
3	4										
4	5		4P0xAA				170	128	180	F12	

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Yaskawa V1000	ABB ACS350			Yaskawa V1000			Yaskawa V1000	ASC350
		Type	Type	1-phase						Frame names	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-	VZAB	area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16		0P1xAA				87	0,7	0,6	F1	
0,18	0,24										
0,25	0,33		0P2xAA				87	0,7	0,6	F1	
0,4	0,50	02A4-2	0P4xAA	118	1,9	1,2		0,9	1,0	F2	R0
0,75	1	04A7-2	0P7xAA	118	1,9	1,2	138	1,9	1,7	F7	R1
1,1	1,50	06A7-2									
1,5	2	07A5-2	1P5xAA	177	2,9	1,5	138	2,1	1,8	F8	R2
2,2	3	09A8-2	2P2xAA				179	2,9	2,4	F10	
3	4										
4	5		4P0xAA				218	3,9	3,0	F12	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Yaskawa V1000	ABB ACS350			Yaskawa V1000			Yaskawa V1000	ASC350
		Type	Type	3-phase			3-phase			Frame	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	names	
kW	hp	03X-	VZA2	W	H	D	W	H	D	N/A	Frame
0,12	0,16		0P1xAA				68	128	76	F1	
0,18	0,24										
0,25	0,33		0P2xAA				68	128	76	F1	
0,4	0,50	02A4-2	0P4xAA				68	128	108	F2	R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	0P7xAA	70		161	68	128	128	F3	R1
1,1	1,50	06A7-2			169						
1,5	2	07A5-2	1P5xAA				108	128	129	F6	
2,2	3	09A8-2	2P2xAA				108	128	137,5	F7	
3	4	13A3-2		105		165					R2
4	5	17A6-2	4P0xAA				140	128	143	F9	
5,5	7,50	24A4-2	5P5xAA	169	169	169	140	254	140	F11	R3
7,5	10	31A0-2	7P5xAA	260	181	169					R4
11	15	46A2-2	011xAA				180	290	163	F14	
15	20		015xAA				220	358	187	F15	

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Yaskawa V1000	ABB ACS350			Yaskawa V1000			Yaskawa V1000	ASC350
		Type	Type	3-phase						Frame names	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	VZA2	area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16		0P1xAA				87	0,7	0,6	F1	
0,18	0,24										
0,25	0,33		0P2xAA				87	0,7	0,6	F1	
0,4	0,50	02A4-2	0P4xAA	118	1,9	1,2	87	0,9	0,9	F2	R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	0P7xAA			1,2	87	1,1	1,1	F3	R1
1,1	1,50	06A7-2									
1,5	2	07A5-2	1P5xAA				138	1,8	1,7	F6	
2,2	3	09A8-2	2P2xAA	177	2,9	1,5	138	1,9	1,7	F7	R2
3	4	13A3-2									
4	5	17A6-2	4P0xAA				179	2,6	2,4	F9	
5,5	7,50	24A4-2	5P5xAA	286	4,8	2,5	356	5,0	3,8	F11	R3
7,5	10	31A0-2	7P5xAA	471	8,0	4,4					R4
11	15	46A2-2	011xAA				522	8,5	5,5	F14	
15	20		015xAA				788	14,7	9,2	F15	

Fewer different frame sizes

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Yaskawa V1000	ABB ACS350			Yaskawa V1000			Yaskawa V1000	ASC350
		Type	Type							Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	VZA4	W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,24		0P2xAA				108	128	81	F4	
0,4	0,50	01A2-4	0P4xAA						99	F5	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	0P7xAA				108	128	137,5	F7	
1,1	1,50	03A3-4		70							
1,5	2	04A1-4	1P5xAA			161					
2,2	3	05A6-4	2P2xAA		169		108	128	154	F8	R1
3	4	07A3-4	3P0xAA								
4	5	08A8-4	4P0xAA				140		143	F9	
5,5	7,50	12A5-4	5P5xAA					254	140	F11	
7,5	10	15A6-4	7P5xAA	169		169					R3
11	15	23A1-4	011xAA				180	290	143	F13	
15	20	31A0-4	015xAA						163	F14	
18,5	25	38A0-4		260	181	169					R4
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Yaskawa V1000	ABB ACS350			Yaskawa V1000			Yaskawa V1000	ASC350
		Type	Type							Frame	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	names	
kW	hp	03X-	VZA4	area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,2	0,24		0P2xAA				138	1,1	1,0	F4	
0,4	0,50	01A2-4	0P4xAA			1,2		1,4	1,2	F5	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	0P7xAA				138	1,9	1,7	F7	
1,1	1,50	03A3-4		118	1,9						R1
1,5	2	04A1-4	1P5xAA			1,2	138	2,1	1,7	F8	
2,2	3	05A6-4	2P2xAA								
3	4	07A3-4	3P0xAA								
4	5	08A8-4	4P0xAA				179	2,6	2,4	F9	
5,5	7,50	12A5-4	5P5xAA				356	5,0	3,8	F11	
7,5	10	15A6-4	7P5xAA	285	4,8	2,5					R3
11	15	23A1-4	011xAA				522	7,5	5,2	F13	
15	20	31A0-4	015xAA					8,5	5,5	F14	
18,5	25	38A0-4		471	8,0	4,4					R4
22	30	44A0-4									

DIN rail mounting as standard

True side-by-side mounting

Installation

Yaskawa V1000

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Option
Flange	Option
Wall (sideways)	No
Heatsinkless	No
Side-by-side	No; requires 2 mm clearance, IP20/UL open type, 2 kHz and only up to 30°C

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	* Standard mounting 30 mm (& from brochure: 50 mm ≥ 5.5 kW) * Side-by-side mounting 2 mm

- Operational motor cable lengths: No direct information available
  - Autotuning parameter needs to be changed, when the cable length exceeds 50m
  - Carrier frequency needs to be set according to cable length: 15 kHz < 50m, 5 kHz 50m…100m, 2 kHz > 100m

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Yaskawa V1000

- Filters
  - Inbuilt EMC filter for 2nd environment C3, specified in type code of the drive
  - External EMC filters for category C1 as option
- Chokes
  - DC chokes as option for 0.12…0.4 kW 1~200V and 0.2…0.4 kW 400V units
- EMC compliant motor cable lengths
  - With external (Rasmi and/or Schaffner) filter Category C1 with max. cabel length 20 m, except
- THD
  - EN61000-3-2 with optional chokes, not available for all types

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

Yaskawa V1000

- Integral 5 digit panel display
  - Optionally frequency, current or set value
  - Error and status LED
- Optional LCD remote operator JVOP-180
  - LCD display operator with language support
- 2 different Remote operator cable options for connecting remote operator
  - Remote operator cable (1m) 72606-WV001
  - Remote operator cable (3m) 72606-WV003

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up Down	Changes parameters and their value/ increases reference Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Machine interface (I/O)

Yaskawa V1000

Type	*Qty.*	*Programmable*
Digital inputs	6	Yes
Analog inputs	2	Yes
Pulse train input	1	Yes
Photo-coupler outputs	2	Yes
Analog outputs	1	Yes
Relay outputs	1	Yes
Pulse train output	1	Yes

Specialities:

- 2-channel interface for safety relay (EN954-1 Safety Category 3)
- Optional 24V power supply module for the control, PS-UDC24 24V DC option board
- Srew-less terminals
- Control terminal board with memory (Patent pending)

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog inputs

Machine interface (fieldbus)

Yaskawa V1000

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232 or RS 485)	-		
MEMOBUS (RS-485/422)	Standard	115 kbit/s	
DeviceNet	Option		SI-N3
Profibus DP	Option		SI-P3
CANopen	Option		SI-S3
CompoNet	Option		A1000-CRT1
Modbus, Lonworks, Ethernet	Option		Coming later

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

Note: Fieldbus options are available as Communication option boards / cards

100% Phd braking for all types

500 Hz max. output frequency

Motor control

Yaskawa V1000

- Sensorless current vector control (uses flux current measurement)
- V/f control
- PM Open Loop Vector Control for applications employing synchronous PM motors (auto-tuning not possible)

Braking

- Braking transistor built-in
- Braking resistor unit as option available for drives up to 4 kW
- Short-term average deceleration torque 150% (up 1.5 kW), 100% (1.5 kW), 50% (2.2 kW), 20% (for bigger size)
- Continuous regenerative torque approx. 20%, with optional braking resistor 125%

Output frequency

- 0.1…400 Hz
- Frequency tolerance ± 0.01% (for digital set value in 25°C ± 10°C), ± 0.1% (for analogue set value in -10°C to +50°C)

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

User macros 3 pcs
17 languages

Macros and language versions

Yaskawa V1000

- Macros
  - Application presets available for many applications
    - Water supply pump
    - Conveyo
    - Air supply/exhaust fan
    - AHU (HVAC) fan
    - Compressor
    - Hoist
    - Traveling application
- Languages
  - Language support in the optional LCD remote operator

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Yaskawa V1000

- Noise suppression function decreases motor noise at low carrier frequencies (Low-noise technology, Patent pending) *(
- On-line tuning / tuning-less (electrical parameters governing the motor speed will be adjusted if any temperature deviation large enough occurs / motor resistance will be tuned during operation) (Patent pending)
- FBD's (Function Block Diagrams) programming (Patent pending)

*(= Basic feature in ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support (**
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement (**
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

(** = Basic feature in V1000

Other advanced features

Yaskawa V1000

- Control parameters saved to a control terminal board memory (possible to update a new inverter with a board containing settings)

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

Yaskawa V1000

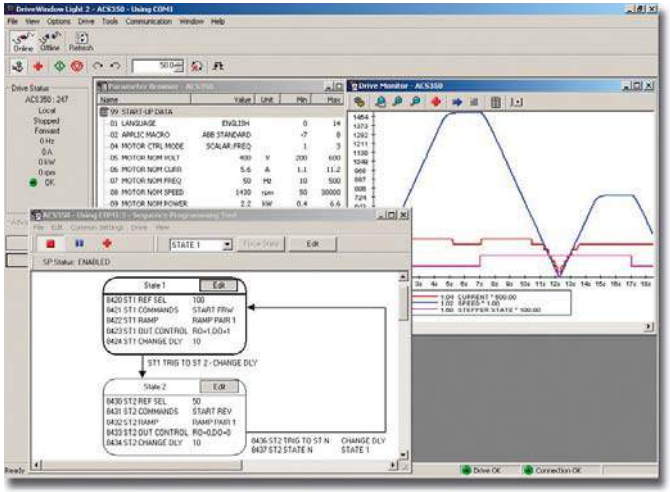
DWEZ: Customization by visual programming

- FBD's (Function Block Diagrams) programming (Patent pending)
- For customizing V1000 integration into a machine
- Requires Omron's CX-Drive 2.0 software

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Yaskawa V1000

- Access through optional RJ-45 / USB Adapter, type LVOP-181 USB converter
- CX-Drive and CX-One computer softwares
  - Configuration and monitoring software tools

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Yaskawa V1000

- LCD Remote Operator
- Remote Operator Extension Cable (1 or 3 m)
- 24V DC control board for power supply
- USB converter / USB cable
- Filters
- Fieldbuses
- DC chokes
- Braking resistor units
- DIN rail mounting brackets
- Panel Cit for External Mounting of Cooling Fin (Heatsink)

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Detailed fault history with time

Maintenance

Yaskawa V1000

- Designed for 10-years maintenance-free use under normal conditions
- Pre-maintenance function
  - Calculates the condition of electronic components and advice about their replacement based on hours of service, stress due to load, temperature, number of times powering up, output frequency, carrier frequency, etc.
- Screwless fan replacement
- Control parameters stored to a control terminal board memory; can be installed to replacement unit
- Statement given on a failure rate of less than 0.01% (ABB comment: with time zone of 15 years…now when products has not even entered market!)

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Yaskawa V1000

Approvals

- CE, UL, cUL, TUV

Compliance with

- Low Voltage Directives 73/23/EEC, 93/68/EEC
- RoHS directive 2002/95/EC with amandments

Applicable standards

- EN50178
- EN 954-1 Machinery Safety
- EN 6100-3-2
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Yaskawa V1000

Model: V10002P2xAA

Drive rating: 380-480V
2.2 kW / 3.0 HP
5.0 A (50 °C)

Tester (experienced drive specialist) comments:

- Power terminal clamps are very difficult to land wire. They are compression but use a small plate that must be lifted to insert wires. Using stranded wire is very difficult. Almost looks like they were made for ferrules
- Ground wires extremely difficult to land stranded wire. Must use a ring lung. Location of ground screws requires removal of conduit plate.
- Drive was not easy to mount because of not using keyholes.
- Sink/source switch on control board extremely small and hard to see switch position. Must use a flashlight to provide enough light to see switch position. Switches throw very small and hard to tell if it's in the correct position.
- Control terminal screws very small.
- Autotune was designed for uncoupled motor only.
- Brochure and ad indicates side-by-side mounting. User Manual indicates that side clearance for single drive is 30mm. For multiple drives side clearance required is 2 mm but de-rating must be taken be considered.
- Sourcing of digital inputs requires external power supply.
- Drive tripped on Overload during Fast Accel into Inertia and Torque vs Speed (60rpm reference) and didn't even register the 30 rpm reference.
- Quick Start Guide uses flowcharts and is hard to follow.
- No quick start parameter access
- Operator Panel uses Five 7 segment LED's along with Run/Stop button, Loc/Rem button, UP/Down arrow buttons, Enter, Escape and Reset and is fairly easy to use once you understand the parameter structure.

ABB ACS350

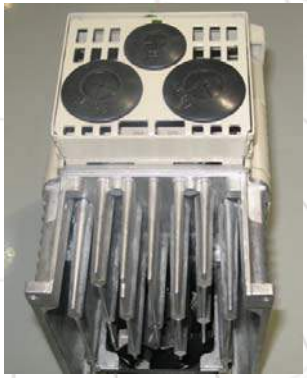
Model: ACS350-03U-05A6-4

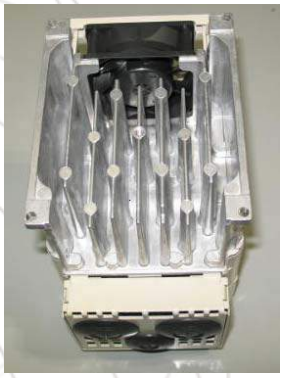
Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A (40 °C)
5.0 A (50 °C)

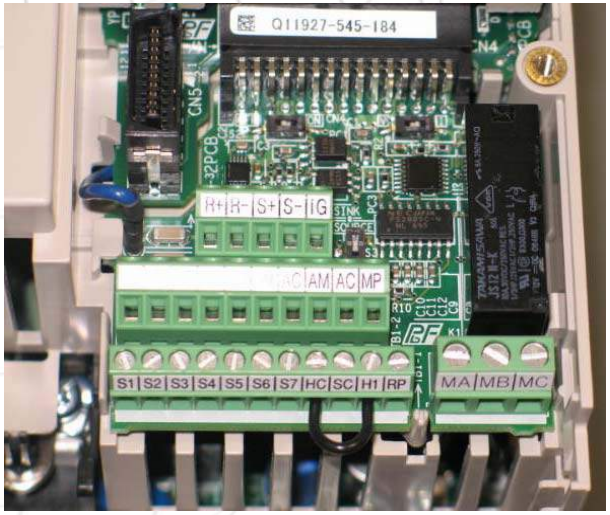
Parameter Settings:

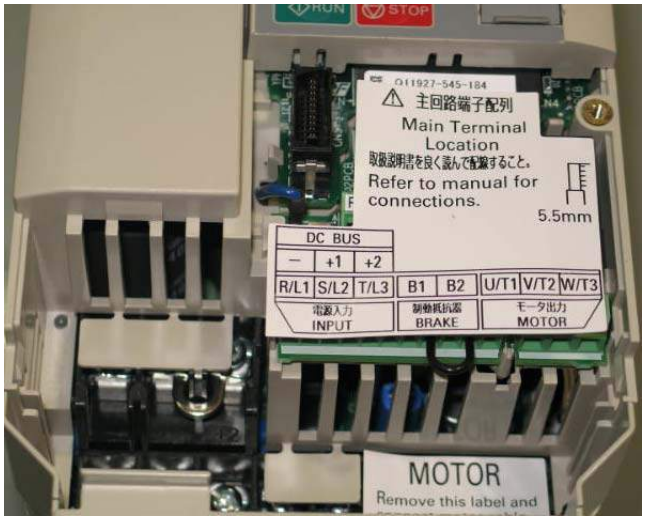
9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

Photos of the tested unit









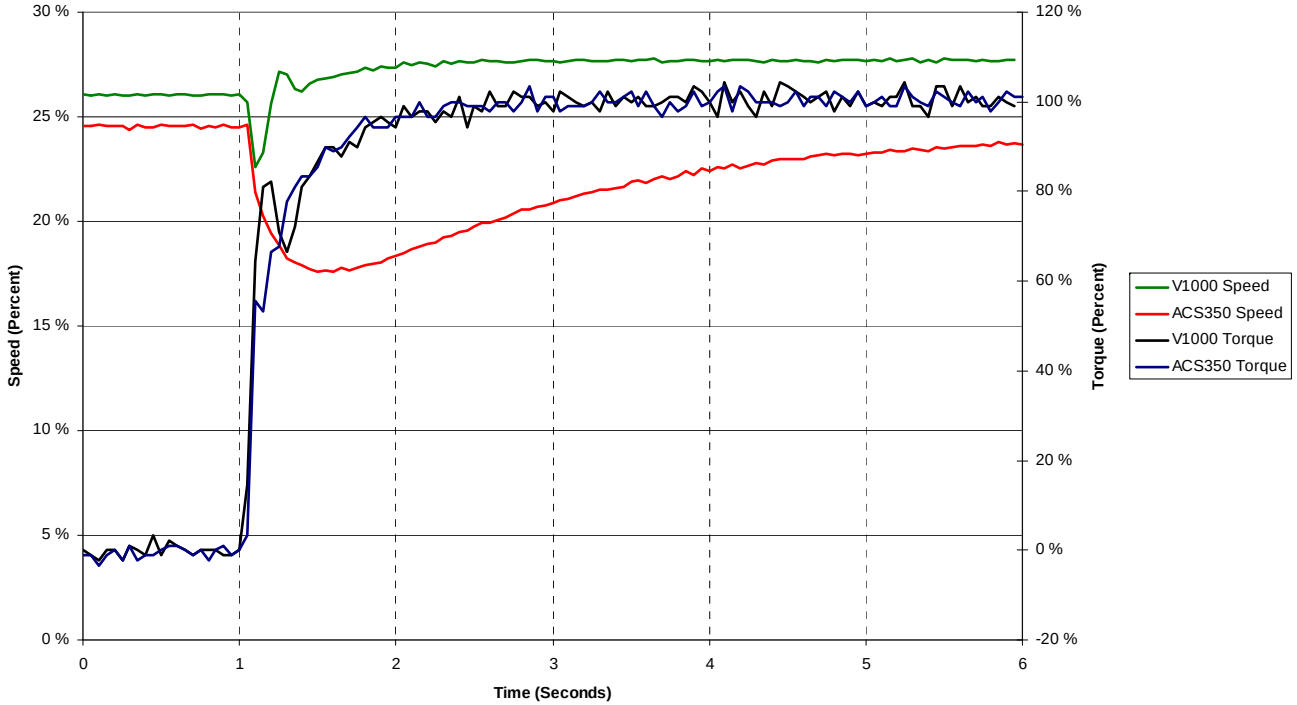
Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Impact load test – Dynamic speed accuracy (stiffness)

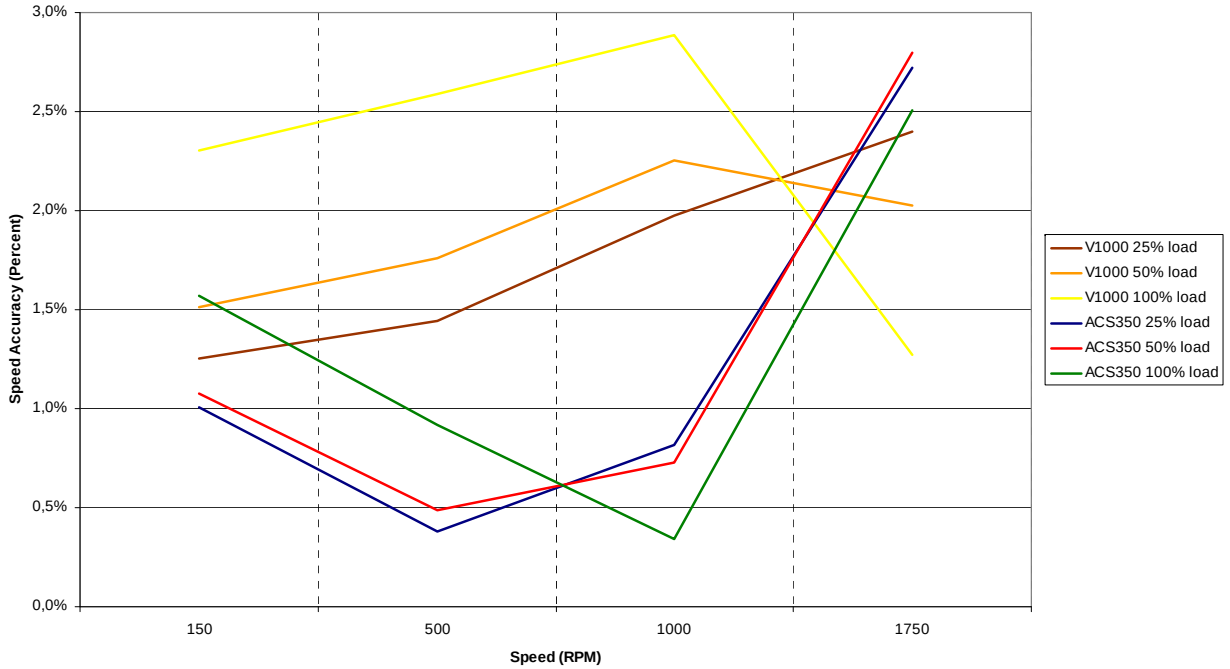
Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.



Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive works in case of disturbances. The ACS350 speed control default tuning is quite conservative to ensure that the controller is stable despite of motor used and its size compared to size of the inverter. The V1000 has better dynamic speed accuracy (small speed droop and short recovery time) but the performance of ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL).

Static speed accuracy

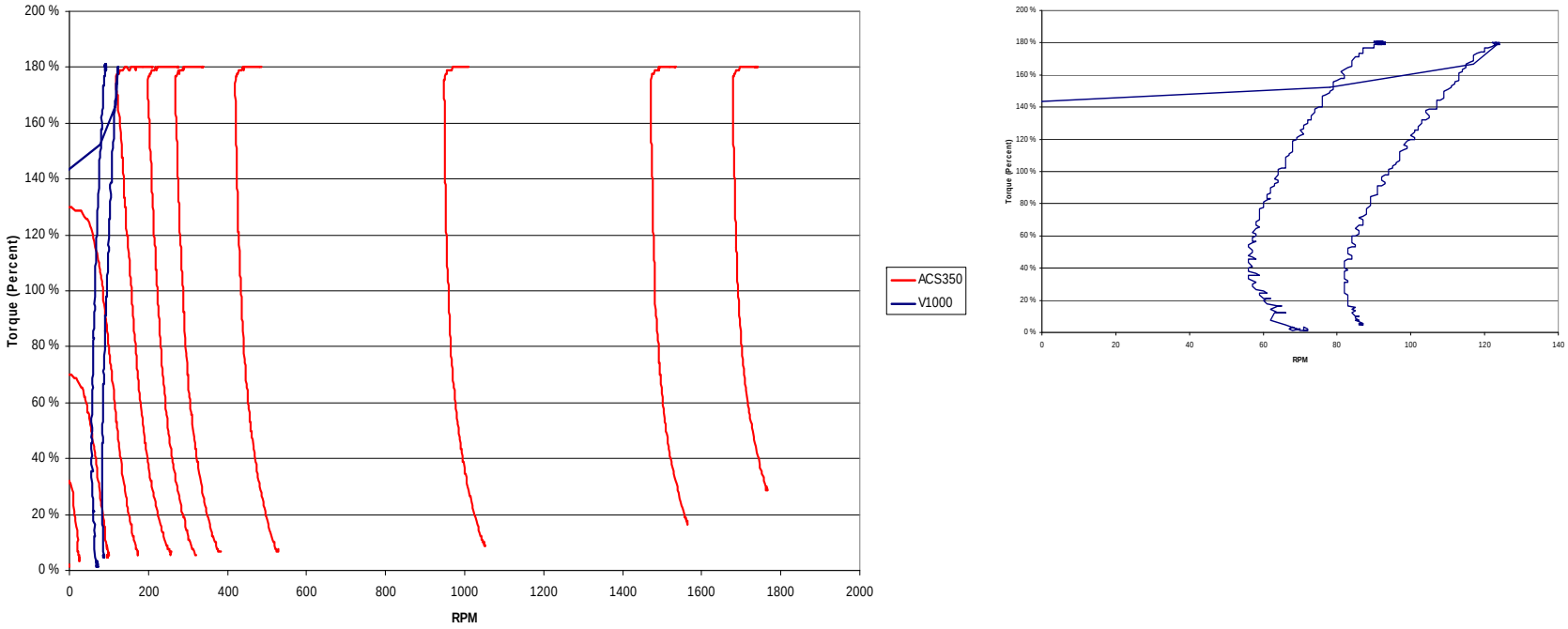
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 0%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), Speed Error [%] = $(n^*-n_{act}) / n_{N(mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Static speed error depends on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). The average of speed error is bigger in V1000 compared to ACS350, V1000 has also much greater maximum error.

Maximum torque as a function of speed

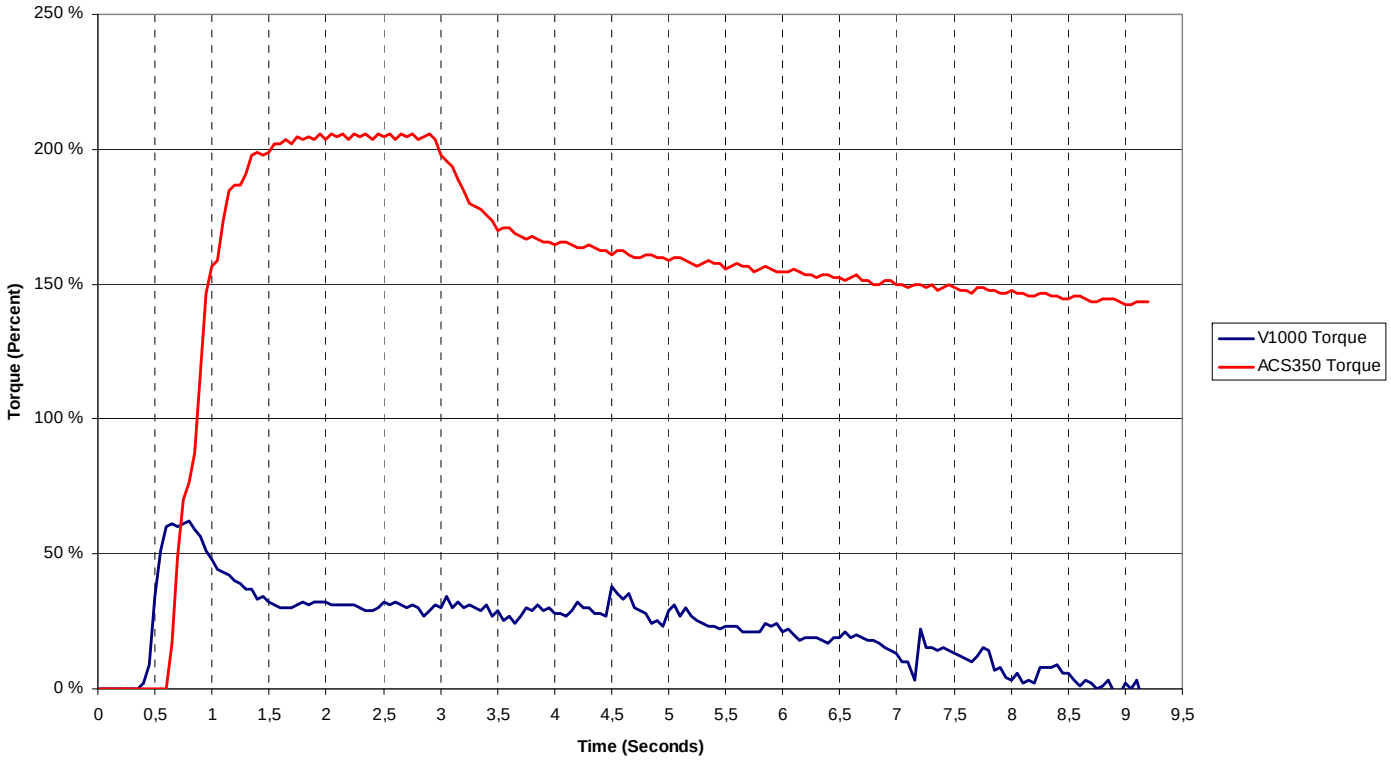
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The ACS350 has good speed range because it could provide full output torque from 1700 rpm's down to 180 rpm. The V1000 failed the test as it couldn't generate full torque on the whole speed area. V1000 tripped on overload during the test (60rpm reference) and didn't even register the 30 rpm reference.

Maximum starting torque

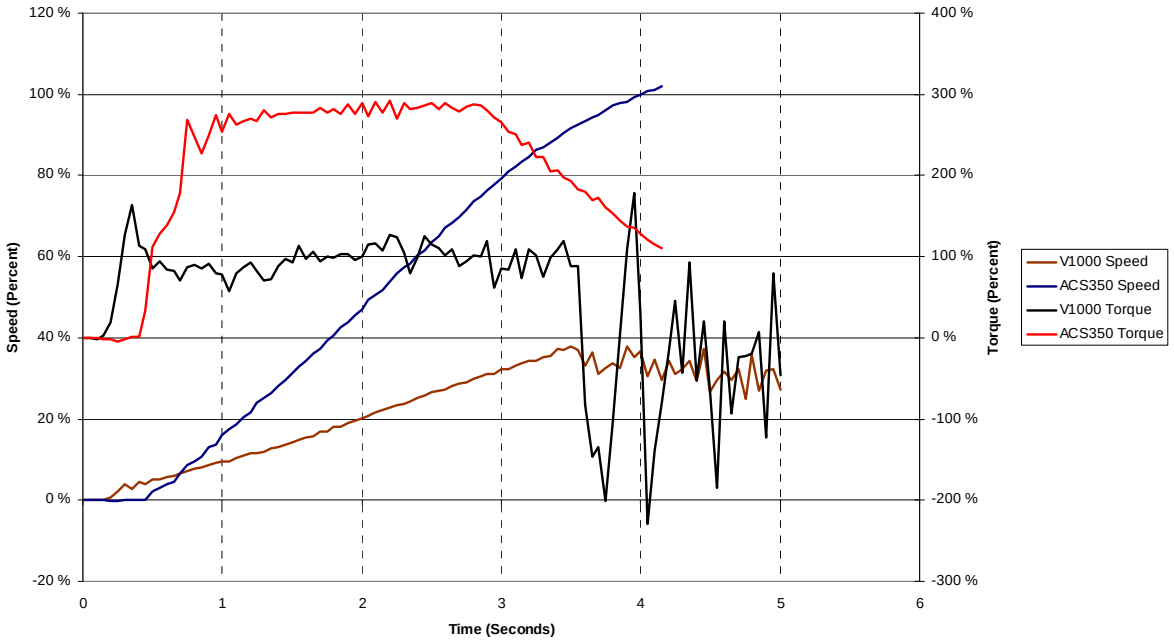
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



V1000: Test failed, drive tripped on overload (OL1). The behavior of the V1000 can cause significant problems in applications requiring high starting duty or high-inertia acceleration. ACS350 has good starting torque up to 200%.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 (0.95 kgm^2) inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



The ACS350 accelerates the load in 4 seconds. The V1000 failed the test, because it was not able to provide enough current to accelerate the motor past a few hundred rpm and on top of it all drive tripped on overload (OL1). The ACS350 provides maximum starting torque for two seconds after which it decreases its output based on current limiting. V1000 has significant problems in generating the torque.

Efficiency

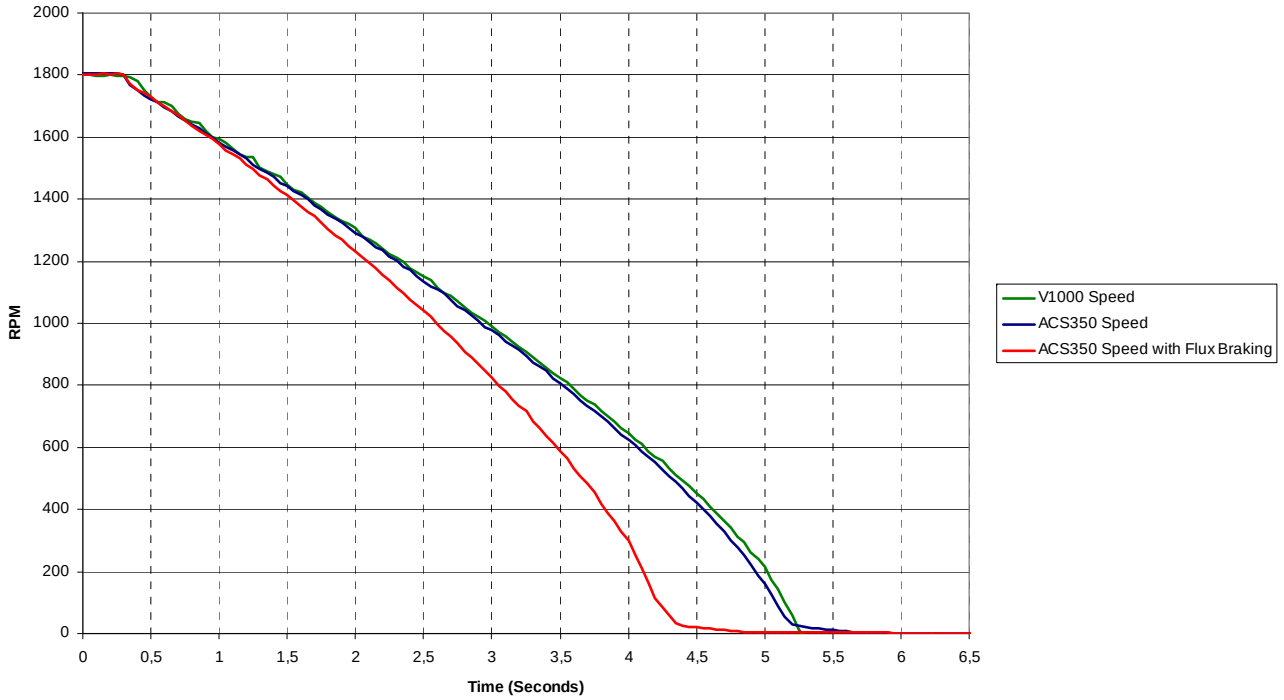
Using power analyzer, input power, speed and torque of AC motor are measured at 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	V1000
25%	87.0%	84.2%
50%	89.3%	90.0%
75%	89.0%	88.9%
100%	88.4%	88.9%

The test is performed at rated speed with different loads. Efficiencies of both drives were comparable at every load point.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



ACS350 was able to decelerate to zero within 5,5 seconds. ACS350 with flux braking shortened the deceleration time even more. The V1000 performed the test as well as the ACS350 without flux braking enabled.

ABB strenghts

ACS350 advantages over Yaskawa V1000

Wide power range	500 Hz max. output frequency
DIN rail mounting as standard	Application macros 7 pcs
True side-by-side mounting	User macros 3 pcs
EN61000-3-2 with opt. chokes	17 languages
2 detatchable control panel options	FlashDrop
Bipolar AI	Versatile options
100% Phd braking for all types	Detailed fault history with time



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Yaskawa V7

- Yaskawa V7 is a compact, cost-effective vector controlled inverter with enhanced performance and flexibility.
- For power range 0.1 to 7.5 kW
- Applications
  - Ideally suited for applications such as conveyors, grinders, centrifuges, pumps, fans, blowers, machine tools, packaging, food processing, and commercial laundry.

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Protection class

Yaskawa V7

- IP20
- NEMA1
- NEMA 4X/12 (option)
- IP65 special version for Europe by OMRON/YASKAWA

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Yaskawa V7

Vibration

- Up to 1G, at less than 20 Hz
- Up to 0.2G, at 20-50 Hz. No standard mentioned in the manual

Shock

- N/A

Temperature

- Operating temperature -10 to +40 °C
- Storage temperature -10 to +60 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating (value N/A)

Acoustic noise (PWM carrier commutation)

- 2,5 to 10kHz (2,5kHz step) and 14,5kHz

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C with 10% current derating
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Yaskawa V7

Voltage types and power range

- 1-phase 200 - 240 V -15%/ +10%
  - 0.1 to 7.5 kW (1/8 to 10 hp)
- 3-phase 200 - 230V +/-10%
  - 0.1 to 7.5 kW (1/8 to 10 hp)
- 3-phase 380 - 460 V –15%/ +10%
  - 0.4 to 7.5 kW (1/2 to 10 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60 Hz, tolerance ±5%

Supply networks

- Data N/A

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Yaskawa	ABB ACS350		Yaskawa V7		Yaskawa	
P_N	P_N	ACS350	V7	I_{2N}	I_{2N}	Rated Output Current		V7	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	V7AZ	A	A	A	A	names	
kW	hp	01X-		U_N=200-240 V		U_N=200-230 V		N/A	Frame
0,12	0,16		B0P1			0,8		F1	
0,25	0,33		B0P2			1,6		F1	
0,37	0,5	02A4-2		2,4	2,2				R0
0,55	0,75		B0P4			3,0		F4	
0,75	1	04A7-2		4,7	4,2				R1
1,1	1,5	06A7-2	B0P7	6,7	6,0	5,0		F8	
1,5	2	07A5-2	B1P5	7,5	6,8	8,0		F9	R2
2,2	3	09A8-2	B2P2	9,8	8,8	11,0		F11	
3	4								
4	5		B4P0			17,5		F12	

Yaskawa V7

Overload ratings

- 150 % for 60 sec.
- 200 % for 30 sec.
- 250 % peak

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 200V

3-phase 200V		ABB	Yaskawa	ABB ACS350		Yaskawa V7		Yaskawa	
P_N	P_N	ACS350	V7	I_{2N}	I_{2N}	Rated Output Current		V7	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-		U_N=200-240 V		U_N=200-230 V		N/A	Frame
0,12	0,16		20P1			0,8		F1	
0,25	0,33		20P2			1,6		F1	
0,37	0,5	02A4-2		2,4	2,2				R0
0,55	0,75	03A5-2	20P4	3,5	3,2	3,0		F2	
0,75	1	04A7-2		4,7	4,2				R1
1,1	1,5	06A7-2	20P7	6,7	6,0	5,0		F3	
1,5	2	07A5-2	21P5	7,5	6,8	8,0		F7	
2,2	3	09A8-2	22P2	9,8	8,8	11,0		F9	R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2	24P0	17,6	15,8	17,5		F10	
5,5	7,5	24A4-2	25P5	24,4	21,96	na		F13	R3
7,5	10	31A0-2	27P5	31,0	27,9	na			R4
11	15	46A2-2		46,2	41,58				

Yaskawa V7

Overload ratings

- 150 % for 60 sec.
- 200 % for 30 sec.
- 250 % peak

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 400V

3-phase 400V		ABB ACS350	Yaskawa V7	ABB ACS350		Yaskawa V7		Yaskawa V7	ASC350
P_N	P_N			I_{2N}	I_{2N}	Rated Output Current			
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-		U_N=380-480 V		U_N=380-460 V		N/A	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	01A2-4	40P20	1,2	1,1	1,2		F5	R0
0,55	0,75	01A9-4	40P40	1,9	1,7	1,8		F6	
0,75	1	02A4-4		2,4	2,2				R1
1,1	1,5	03A3-4	40P70	3,3	3,0	3,4		F8	
1,5	2	04A1-4	41P50	4,1	3,7	4,8		F9	
2,2	3	05A6-4	42P20	5,6	5,0	5,5			
3	4	07A3-4	43P00	7,3	6,6	7,2		F10	
4	5	08A8-4	44P00	8,8	7,9	9,2			
5,5	7,5	12A5-4	45P51	12,5	11,3	14,8		F13	R3
7,5	10	15A6-4	47P51	15,6	14,0	18,0			
11	15	23A1-4		23,1	20,8				
15	20	31A0-4		31	27,9				R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Yaskawa V7

Overload ratings

- 150 % for 60 sec.
- 200 % for 30 sec.
- 250 % peak

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Yaskawa V7	ABB ACS350			Yaskawa V7			Yaskawa V7	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16		B0P1				68	128	76	F1	
0,25	0,33		B0P2				68	128	76	F1	
0,37	0,5	02A4-2		70	169	161					R0
0,55	0,75		B0P4				68	128	131	F4	
0,75	1	04A7-2		70	169	161					R1
1,1	1,5	06A7-2	B0P7				108	128	140	F8	
1,5	2	07A5-2	B1P5	105	169	165			156	F9	R2
2,2	3	09A8-2	B2P2				140		163	F11	
3	4										
4	5		B4P0				170	128	180	F12	

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Yaskawa V7	ABB ACS350			Yaskawa V7			Yaskawa V7	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16		B0P1				87	0,7	0,6	F1	
0,25	0,33		B0P2				87	0,7	0,7	F1	
0,37	0,5	02A4-2		118	1,9	1,2					R0
0,55	0,75		B0P4				87	1,1	1,0	F4	
0,75	1	04A7-2		118	1,9	1,2					R1
1,1	1,5	06A7-2	B0P7				138	1,9	1,5	F8	
1,5	2	07A5-2	B1P5	177	2,9	1,5		2,2	1,5	F9	R2
2,2	3	09A8-2	B2P2				179	2,9	2,2	F11	
3	4										
4	5		B4P0				218	3,9	2,9	F12	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Yaskawa V7	ABB ACS350			Yaskawa V7			Yaskawa V7	ASC350
		Type	Type	3-phase			3-phase			Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16		20P1				68	128	76	F1	
0,25	0,33		20P2				68	128	76	F1	
0,37	0,5	02A4-2									R0
0,55	0,75	03A5-2	20P4				68	128	108	F2	
0,75	1	04A7-2		70		161					R1
1,1	1,5	06A7-2	20P7		169		68		128	F3	
1,5	2	07A5-2	21P5				108	128	131	F7	
2,2	3	09A8-2	22P2						140	F9	
3	4	13A3-2		105		165					R2
4	5	17A6-2	24P0				140	128	143	F10	
5,5	7,5	24A4-2	25P5	169	169	169	180	260	170	F13	R3
7,5	10	31A0-2	27P5	260	181	169					R4
11	15	46A2-2									

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Yaskawa V7	ABB ACS350			Yaskawa V7			Yaskawa V7	ASC350
		Type	Type	3-phase			3-phase			Frame names	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16		20P1				87	0,7	0,6	F1	
0,25	0,33		20P2				87	0,7	0,6	F1	
0,37	0,5	02A4-2									R0
0,55	0,75	03A5-2	20P4				87	0,9	0,9	F2	
0,75	1	04A7-2		118	1,9	1,2					R1
1,1	1,5	06A7-2	20P7				87	1,1	1,1	F3	
1,5	2	07A5-2	21P5				138	1,8	1,4	F7	
2,2	3	09A8-2	22P2					1,9	1,5	F9	R2
3	4	13A3-2		177	2,9	1,5					
4	5	17A6-2	24P0				179	2,6	2,1	F10	
5,5	7,5	24A4-2	25P5	286	4,8	2,5	468	8,0	4,6	F13	R3
7,5	10	31A0-2	27P5	471	8,0	4,4			4,8		R4
11	15	46A2-2									

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Yaskawa V7	ABB ACS350			Yaskawa V7			Yaskawa V7	ASC350
		Type	Type							Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	N/A	
kW	hp	03X-		W	H	D	W	H	D		Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	40P20	70	169	161	108	128	92	F5	R0
0,55	0,75	01A9-4	40P40						110	F6	
0,75	1	02A4-4									R1
1,1	1,5	03A3-4	40P70				108	128	140	F8	
1,5	2	04A1-4	41P50						156	F9	
2,2	3	05A6-4	42P20								
3	4	07A3-4	43P00				140		143	F10	
4	5	08A8-4	44P00								
5,5	7,5	12A5-4	45P51	169		169	180	260	170	F13	R3
7,5	10	15A6-4	47P51								
11	15	23A1-4									
15	20	31A0-4		260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Yaskawa V7	ABB ACS350			Yaskawa V7			Yaskawa V7	ASC350
		Type	Type							Frame names	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	40P20	118	1,9	1,2	138	1,3	1,0	F5	R0
0,55	0,75	01A9-4	40P40					1,5	1,1	F6	
0,75	1	02A4-4									R1
1,1	1,5	03A3-4	40P70			1,2	138	1,9	1,5	F8	
1,5	2	04A1-4	41P50					2,2	1,5	F9	
2,2	3	05A6-4	42P20						1,5		
3	4	07A3-4	43P00				179	2,6	2,1	F10	
4	5	08A8-4	44P00						2,1		
5,5	7,5	12A5-4	45P51	286	4,8	2,5	468	8,0	4,8	F13	R3
7,5	10	15A6-4	47P51						4,8		
11	15	23A1-4									
15	20	31A0-4		471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

Installation

DIN rail mounting as standard

Sideways mounting

Side by side mounting

Yaskawa V7

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Optional
Flange	No
Wall (sideways)	No
Heatsinkless	No
Side-by-side	No

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	30

- Cable connections made with screw connectors, cable entry from the bottom
- Attached with screws
- Motor lead length should not exceed 50 m

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Yaskawa V7

- Filters
  - Only the external filter is possible (class B).
  - Emission (conducted) , EN50082-2 (1995), EN55011 (1991) Class B
- Chokes
  - AC/DC chokes as external option (not sold by OMRON/YASKAWA)
- Motor cable lengths
  - Screened cable must be used to conform to the EMC standards. Max length is 20 m.
- THD
  - EN61000-3-2

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

Yaskawa V7

- Remotable LED 7 segment digital operator (by special frame mounting option& cable)
- Special remotable units w or w/o potentiometer and with IP protection are available
- Please notice the digital operator has the 2° analog input inside

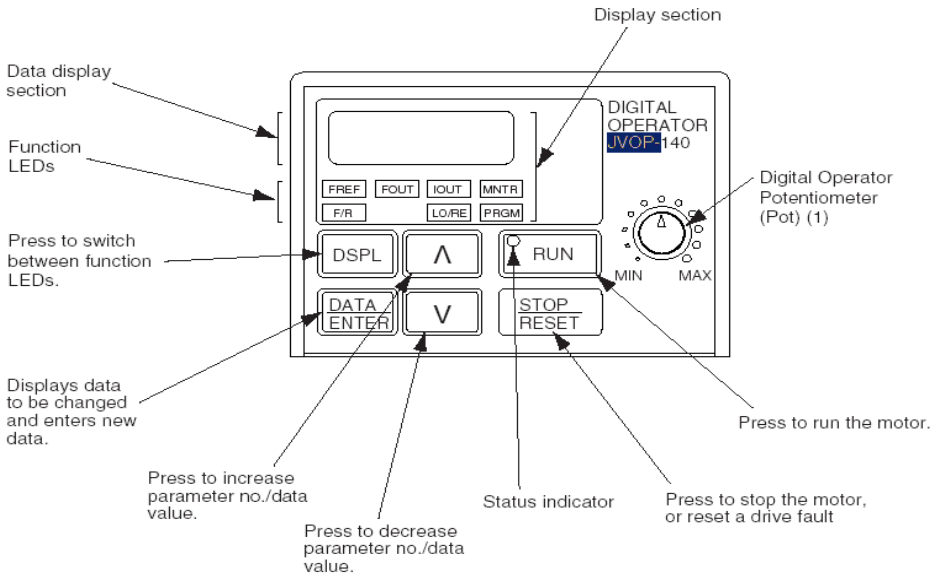


ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Machine interface (I/O)

Yaskawa V7

Type	*Qty.*	*Programmable*
Digital inputs	7	Yes (7 pnp/npn)
Analog inputs	1+1	Yes
Pulse train input	1	Yes
Relay outputs	1 (NO/NC)	Yes
Transistor outputs	2 (open collector photocoupled)	Yes
Analog outputs	1	Yes

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Yaskawa V7

Protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus (RS422 & RS485)	Standard	2.4 - 19.2 kbps	Up to 32 nodes
DeviceNet	Option	500, 250 or 125 kbps (switchable)	3G3MV-PDRT2
Profibus DP	Option	9,6 to 12Mbit/s	SI-P1 V7
CANopen	Option	1 Mbit/s	SI-S1/V7
Ethernet	N/A	N/A	
Mechatrolink II	Option	10Mb/s	SI-T V7

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

500 Hz max. output frequency

Motor control

Yaskawa V7

- Open Loop Vector Mode
- V/Hz Mode

Braking

- Integral braking transistor. To utilize the dynamic braking function, braking resistor (3% duty cycle) or a braking resistor unit (10 % duty cycle) is required.

Output frequency

- 0.1 – 400 Hz with both scalar and vector control
- PTC can be used in Analog input to protect motor

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

7 application macros
3 user macros
17 languages

Yaskawa V7

- 3-wire
- Motor Potentiometer
- PID Control
- Autotuning to acquire motor parameters

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Yaskawa V7

- DC Injection braking: adjustable amplitude, duration, current limited *(
- Torque boost: full range, auto *(
- Power loss ride-thru: 0.5 sec. *(
- Speed search *(
- Auto restart *(
- 3 Critical frequency rejection settings (*
- Slip Compensation (*
- PID with loss of feedback function *(

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

(* Basic feature in ABB ACS350

Other advanced features

Yaskawa V7

- Capability to use specialized firmware (e.g. Traverse function) but you need special Flash memory writer
- PLEASE CHECK if is correct to insert this feature here :
- Capability to install a PLC internal board:

	P10CD T-E Basic	P10CD T3-E Advanced
Expandable I/O	✗	✗
Inverter power sensing	✓	✓
Compobus/S or DeviceNet	✗	✗
1 relay outputs / 3 transistor	✓	✓
Integrated RS-422	✗	✓
Backup battery	✗	✓
Real Time Clock / Calendar	✗	✓

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

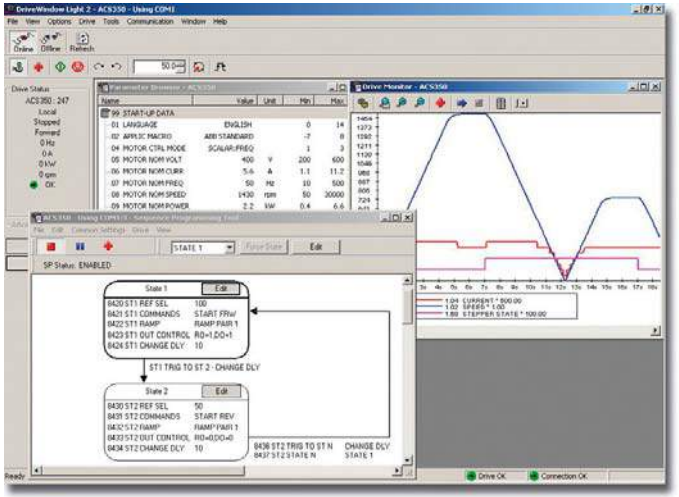
Yaskawa V7

- Parameter read/write/compare into the digital operator

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Yaskawa V7

- RS 232C communications to drive keypad port
- DriveWizard™ software tool
  - Windows based PC program designed to make commissioning and troubleshooting of Yaskawa drives as simple as possible
  - Provides user-friendly tools for viewing, manipulating, and exchanging data with the drive
  - Data can be retrieved, changed, stored, and graphed
- CASE (Custom Application Software Environment) software
  - Replaces the drive's standard software and adds new functionality or enhances existing standard functions.
  - Creates a dedicated area in memory for custom programming for OEM's & end users specific machine/application (confidential) and general release software (can be purchased at low cost and factory-installed in the drive) titles to solve market and application needs.

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Yaskawa V7

- EMC Filters
- Enclosure kits NEMA 4X/12
- Potentiometer (remote-mounted speed potentiometer)

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Yaskawa V7

- Cooling fan replacement
  - Easy to replace
  - Every five years
- Available spare parts
  - Fan
  - Panels (digital operator)

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Yaskawa V7

Approvals

- CE, UL, cUL

Applicable standards

- EN 61800-3:1996, EN61800-3, A11: 2001
- Emission (radiated)
- EN50081-2 (1993)
- Emission (conducted)
- EN50082-2 (1995)
- EN55011 (1991) Class B
- Motor overload protection according to NEC and CEC

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Yaskawa V7

Model: CIMR-V7AM-42P21

Drive rating: 380-460V
2.2 kW
5.5 A

Tester (experienced drive specialist) comments:

- The drive was easy to wire and operate. Size of terminals are generous.
- A hard copy User Manual was not proved but was available on the included CDROM. The hard copy Start-up Guide didn't provide adequate instructions for the operator panel.
- Digital inputs are sinking only. No +24Vdc power supply is available. This would require a customer to change their PLC logic or purchase a separate external power supply.
- If the motor manufacture were contacted and the rated slip, motor line-to-line resistance and leakage inductance were obtained and programmed improved motor performance could be obtained. This information, however, is typically not archived. No Motor Autoutune or Speed Regulator Autotune were provided.

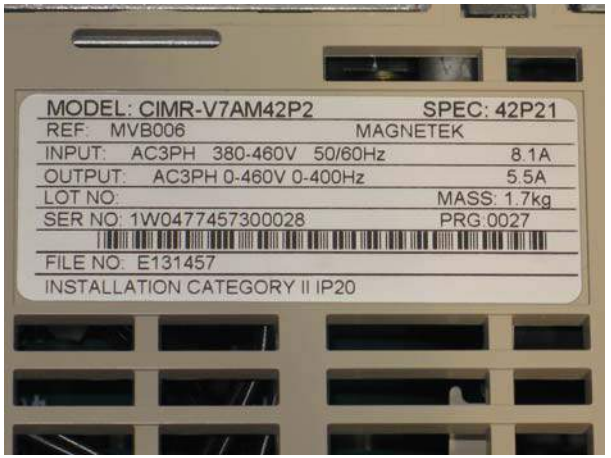
ABB ACS350

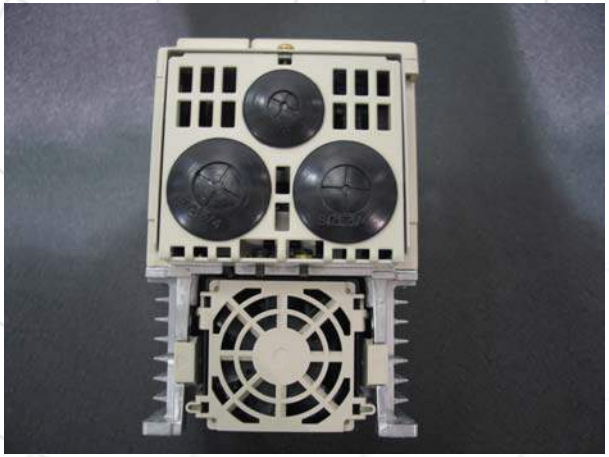
Model: ACS350-03U-05A6-4

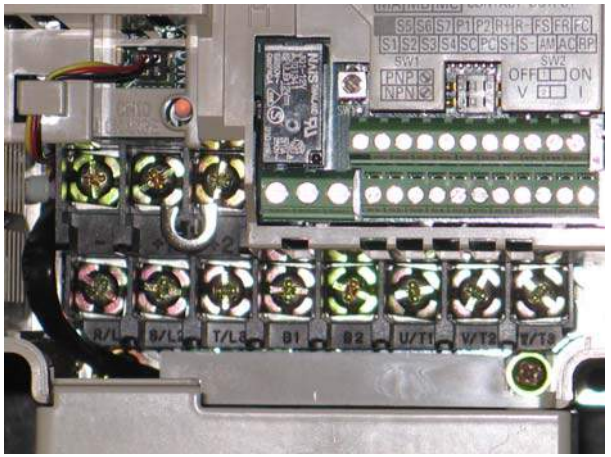
Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A

Parameter Settings: 9902 Torque
9904 Vector:Speed
9905 460V
9906 7.0A
9907 60Hz
9908 1765 RPM
9909 5.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

Photos of the tested unit

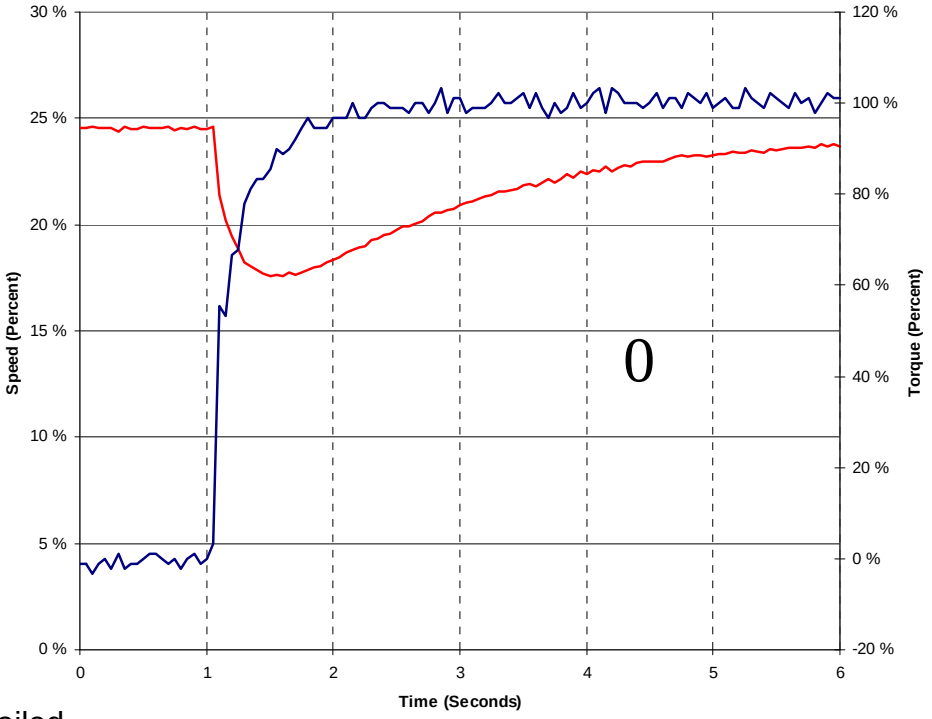


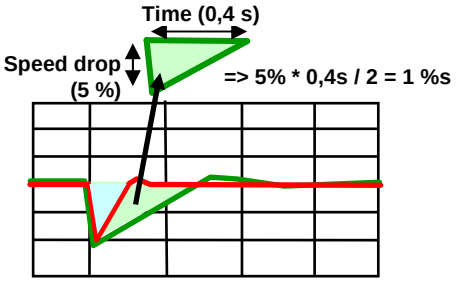




Impact load test – Dynamic speed accuracy (stiffness)

Motor is operated at ¼ rated RPM and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.



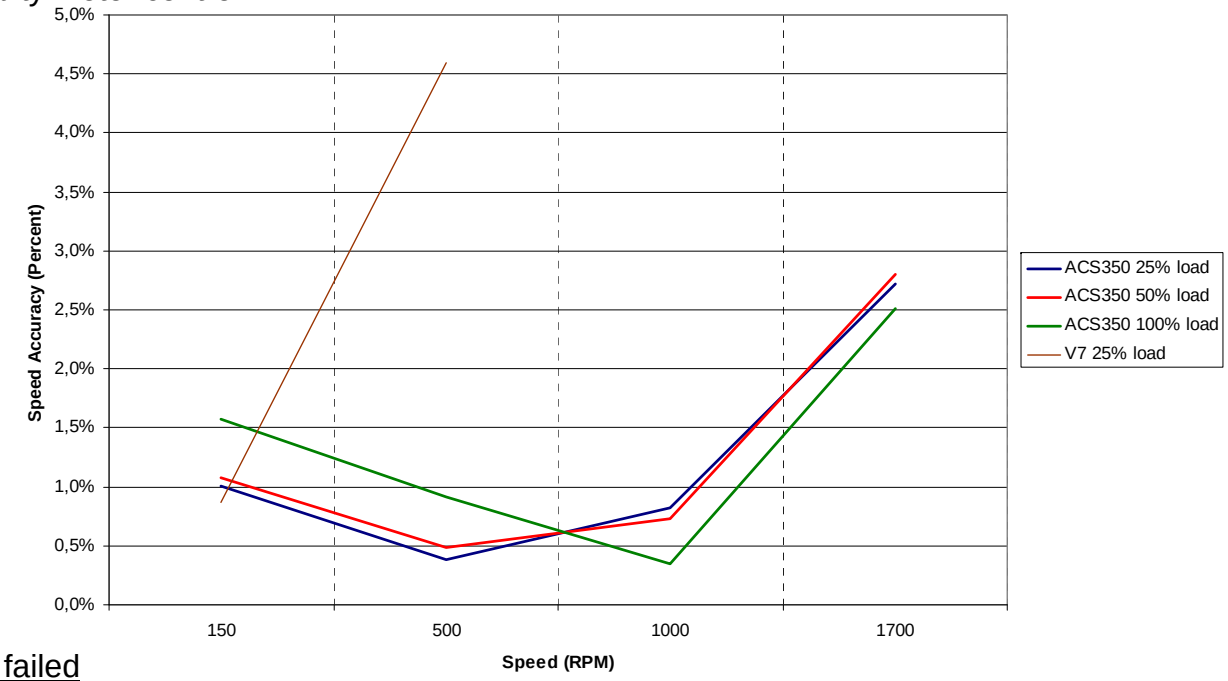


V7: Test failed

Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive works in case of disturbances. The ACS350 speed control default tuning is quite conservative to ensure that the controller is stable despite of motor used and its size compared to size of the inverter. The performance of the ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL).

Static speed accuracy

Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 0%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), error [%] = $(n^*-n_{act}) * n_{N(mot)}$. Speed (control) accuracy is essential feature for high quality motor control.

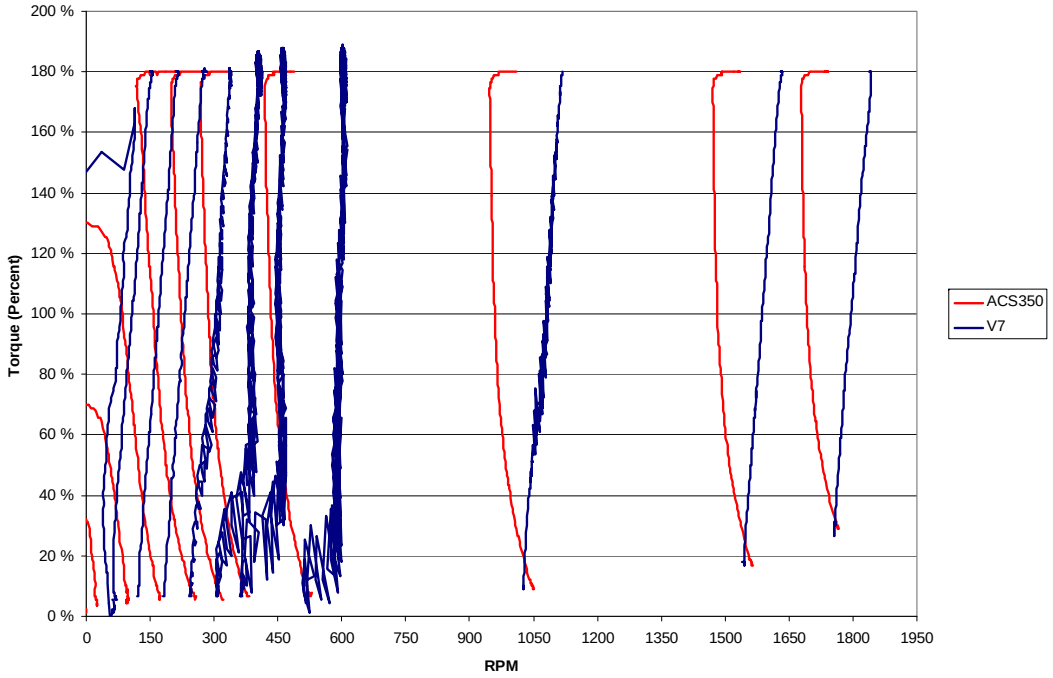


V7: Test failed

Static speed error depends on on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). The ACS350 has much better accuracy and linearity than the V7.

Maximum torque as a function of speed

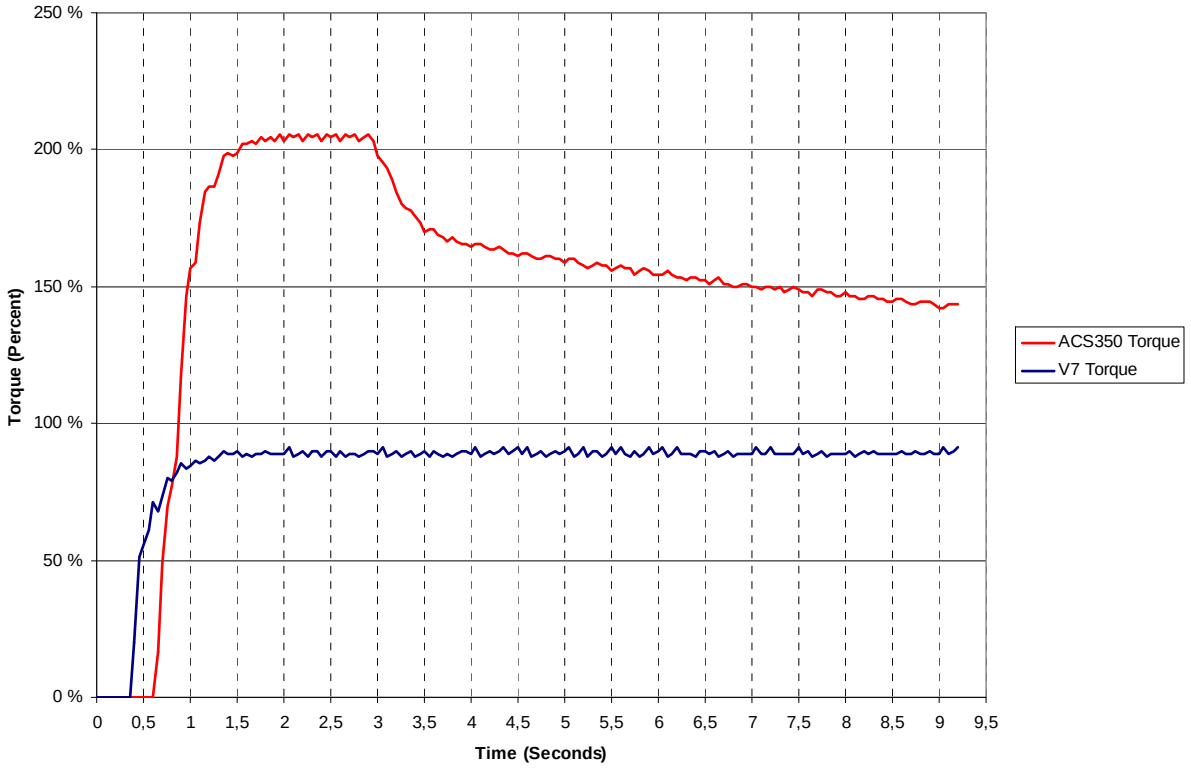
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The ACS350 has good speed range because it could provide full output torque from 1700 rpm's down to 180 rpm. The V7 has good speed range as it could generate at least 140% torque down to low speed area. V7 overcompensates for slip. Quite conservative speed regulator tuning of ACS350 can be seen in ACS350 response as a slight drop in speed.

Maximum starting torque

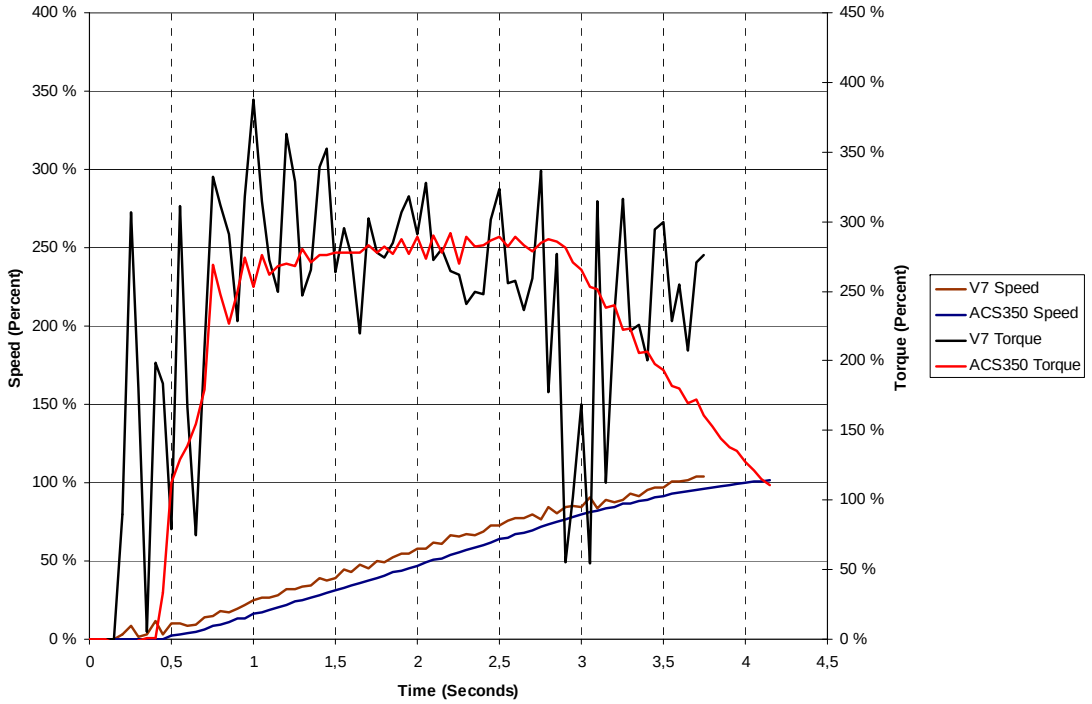
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



The ACS 350 has starting torque approximately double compared to the V7. The ACS350 reduces torque output to nominal after 2 seconds due to its current limit. The V7 does not feature an increase of torque. The behavior of the V7 can be a major problem in applications requiring high starting duty or high-inertia acceleration.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



ACS350 can accelerate the inertia to the reference within 4 sec. The V7 performs as well as ACS350. The ACS350 provides maximum starting torque for two seconds after which it decreases the torque based on current limiting. The V7 produces significant torque ripple which may indicate the tuning of the current controller is not stable which may cause nuisance overcurrent trips.

Efficiency

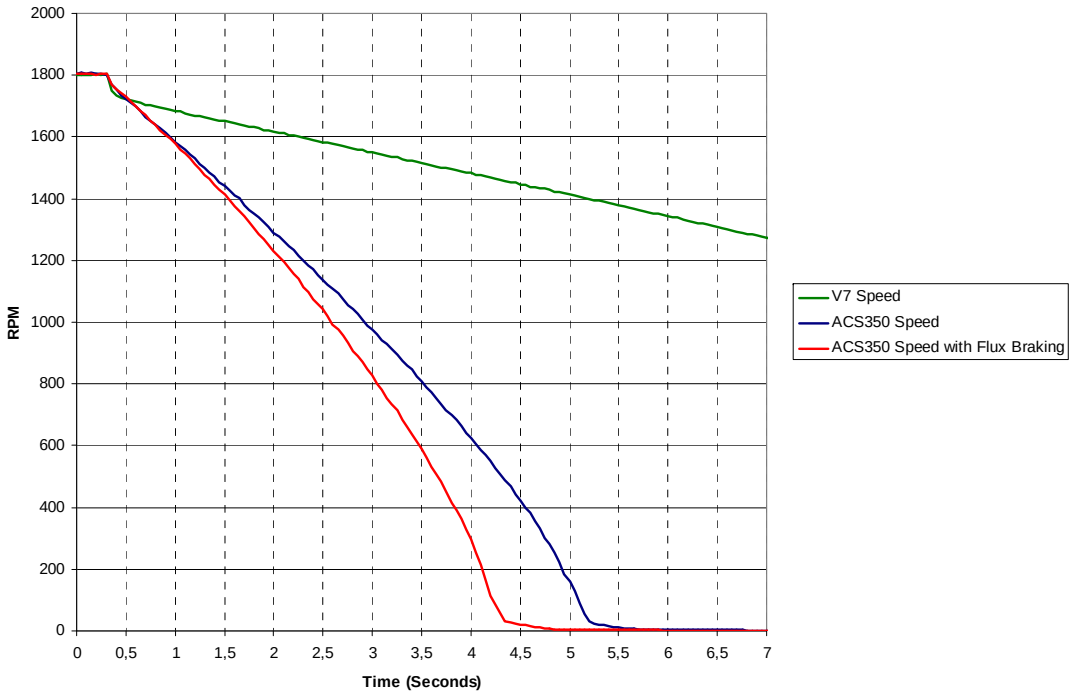
Using power analyzer, input power, speed and torque of AC motor are measured at 0, 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	V7
25%	87.0%	78.3%
50%	89.3%	89.6%
75%	89.0%	90.0%
100%	88.4%	88.8%

The test is performed at rated speed with different loads. ACS350 has higher efficiency at 25% load point but at other load points the efficiencies of both drives were comparable.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



V7: Test failed.

The ACS350 was able to decelerate to zero within 5 seconds. The ACS350 with flux braking shortened the deceleration time even more. The test could not be competed with the V7 due to it tripping after removing the run command.

ABB strengths

ACS350 advantages over Yaskawa V7

Wide power range	Modbus speed
I2hd 50°C ratings	500 Hz max. output frequency
Areas of 400 V units	7 application macros
Weights of 400 V units	3 user macros
DIN rail mounting as standard	17 languages
Sideways mounting	Comprehensive SW
Side by side mounting	FlashDrop
EN61000-3-2 with opt. chokes	Sequence programming
2 control panel options	Versatile options
Panel cover	Maintenance need indication
Bipolar AI	Detailed fault history with time

For ACS350 advantages in performance, see the performance test slides.



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Danfoss FC51

- VLT® Micro Drive is a genuine VLT® frequency converter with unsurpassed reliability, user-friendliness, condensed functionality, and extremely easy to commission. Terminal numbers are named in the same manner as in the rest of the VLT® family. It's developed and manufactured by Danfoss Drives, the leading drives experts since 1968 and creators of VLT® – The Real Drive.
- The perfect match for:
  - Industrial appliances
  - HVAC applications
  - OEM

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Danfoss FC51

- IP 20 (standard)
- IP21 (option)

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Operating temp. starting -10°C

Ambient specification

Danfoss FC51

Vibration

- 1.0 g

Shock

- N/A

Temperature

- 0°C to +40°C
  - Average measured temperature during 24 h maximum 35°C
  - With limited output starting from -10°C
- Storage / transport temperature -25 - +65/70 °C

Humidity

- Max. 5%–95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m up to 2000 m. From 2000 m to 3000 m contact Danfoss representative to discuss about PELV.

Acoustic noise

- Switching Frequency: 2 kHz, 4 kHz, 8 kHz, 16 kHz

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating and reduced lifetime.
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Danfoss FC51

Voltage types and power range

- 1 phase 200 - 240 V
  - 0.18 to 2.2 kW
- 3 phase 200 - 240 V
  - 0.25 to 3.7 kW
- 3 phase 380 - 480 V
  - 0.37 to 22 kW

Power factor

- True Power Factor (λ) ≥ 0.4 nominal at rated load
- Displacement Power Factor (cosφ) near unity (> 0.98)

Supply frequency

- 50/60 Hz

Supply networks

- Installation on isolated mains source, i.e. IT mains.

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Danfoss	ABB ACS350		Danfoss FC51		Danfoss	
P_N	P_N	ACS350	FC51	I_{2N}	I_{2N}	I_{INV}	I_{INV}	FC51	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	01X-		U_N=200-240 V		U_N=220-240 V		Frame	Frame
0,12	0,16								
0,18	0,25		PK18			1,2*		M1	
0,37	0,5	02A4-2	PK37	2,4	2,2	2,2*	1,2**		R0
0,55	0,75								
0,75	1	04A7-2	PK75	4,7	4,2	4,2*	2,2**	M1	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	P1K5	7,5	6,8	6,8*	4,2**	M2	R2
2,2	3	09A8-2	P2K2	9,8	8,8	9,6*	6,8**		

Danfoss FC51

*Nominal rating only temporarily available at 40°C. Continuous (24 h) nominal output current available at maximum 35°C.

**At 50°C currents estimated based on advise to use of one size bigger drive at 50°C.

Overload ratings

- 150% motor torque up to 1 minute

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 200V

3-phase 200V		ABB	Danfoss	ABB ACS350		Danfoss VLT 2800		Danfoss	ASC350
P_N	P_N	ACS350	FC51	I_{2N}	I_{2N}	I_{INV}	I_{INV}	FC51	
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-		U_N=200-240 V		U_N=220-240 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	02A4-2	PK37	2,4	2,2	2,2*		M1	R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2	PK75	4,7	4,2	4,2*	2,2**	M1	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	P1K5	7,5	6,8	6,8*	4,2**	M2	
2,2	3	09A8-2	P2K2	9,8	8,8	9,6*	6,8**	M3	R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2	P3K7	17,6	15,8	15,2*	9,6**	M3	
5,5	7,5	24A4-2		24,4	21,96				R3
7,5	10	31A0-2		31,0	27,9				R4
11	15	46A2-2		46,2	41,58				

Danfoss FC51

*Nominal rating only temporarily available at 40°C. Continuous (24 h) nominal output current available at maximum 35°C.

**At 50°C currents estimated based on advise to use of one size bigger drive at 50°C.

Overload ratings

- 150% motor torque up to 1 minute

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 400V

3-phase 400V		ABB	Danfoss	ABB ACS350		Danfoss VLT 2800		Danfoss	ASC350
P_N	P_N	ACS350	FC51	I_{2N}	I_{2N}	I_{INV}	I_{INV}	FC51	
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-		U_N=380-480 V		U_N=380-440 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	01A2-4	PK37	1,2	1,1	1,2*		M1	R0
0,55	0,75	01A9-4		1,9	1,7				
0,75	1	02A4-4	PK75	2,4	2,2	2,2*	1,2**	M1	R1
1,1	1,5	03A3-4		3,3	3,0				
1,5	2	04A1-4	P1K5	4,1	3,7	3,7*	2,2**	M2	
2,2	3	05A6-4	P2K2	5,6	5,0	5,7*	3,7**		
3	4	07A3-4	P3K0	7,3	6,6	7,2*	5,7**	M3	
4	5	08A8-4	P4K0	8,8	7,9	9,0*	7,2**		
5,5	7,5	12A5-4	P5K5	12,5	11,3	12,0*	9,0**		R3
7,5	10	15A6-4	P7K5	15,6	14,0	15,5*	12,0**		
11	15	23A1-4	P11K	23,1	20,8	23,0	15,5*	M4	
15	20	31A0-4	P15K	31	27,9	31,0	23,0		R4
18,5	25	38A0-4	P18K	38	34,2	37,0	31,0	M5	
22	30	44A0-4	P22K	44	39,6	43	37,0		

Danfoss FC51

*Nominal rating only temporarily available at 40°C. Continuous (24 h) nominal output current available at maximum 35°C.

**At 50°C currents estimated based on advise to use of one size bigger drive at 50°C.

Overload ratings

150% motor torque up to 1 minute

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Danfoss FC51	ABB ACS350			Danfoss FC51			Danfoss FC51	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-		W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25		PK18				70	150	148	M1	
0,37	0,5	02A4-2	PK37	70	169	161					R0
0,55	0,75										
0,75	1	04A7-2	PK75	70	169	161	70	150	148	M1	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	P1K5	105	169	165	75	176	168	M2	R2
2,2	3	09A8-2	P2K2								

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Danfoss FC51	ABB ACS350			Danfoss FC51			Danfoss FC51	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-		area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25		PK18				105	1,6	1,1	M1	
0,37	0,5	02A4-2	PK37	118	1,9	1,2					R0
0,55	0,75										
0,75	1	04A7-2	PK75	118	1,9	1,2	105	1,6	1,1	M1	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	P1K5	177	2,9	1,5	132	2,2	1,6	M2	R2
2,2	3	09A8-2	P2K2								

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Danfoss FC51	ABB ACS350			Danfoss FC51			Danfoss FC51	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2	PK37	70	169	161	70	150	148	M1	R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	PK75				70	150	148	M1	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	P1K5				75	176	168	M2	
2,2	3	09A8-2	P2K2	105		165	90	239	194	M3	R2
3	4	13A3-2									
4	5	17A6-2	P3K7				90	239	194	M3	
5,5	7,5	24A4-2		169	169	169					R3
7,5	10	31A0-2		260	181	169					R4
11	15	46A2-2									

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Danfoss FC51	ABB ACS350			Danfoss FC51			Danfoss FC51	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2	PK37	118	1,9	1,2	105	1,6	1,1	M1	R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	PK75				105	1,6	1,1	M1	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	P1K5				132	2,2	1,6	M2	
2,2	3	09A8-2	P2K2	177	2,9	1,5	215	4,2	3	M3	R2
3	4	13A3-2									
4	5	17A6-2	P3K7				215	4,2	3	M3	
5,5	7,5	24A4-2		286	4,8	2,5					R3
7,5	10	31A0-2		471	8,0	4,4					R4
11	15	46A2-2									

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Danfoss FC51	ABB ACS350			Danfoss FC51			Danfoss FC51	ASC350
		Type	Type								
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	PK37	70	169	161	70	150	148	M1	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	PK75				70	150	148	M1	R1
1,1	1,5	03A3-4									
1,5	2	04A1-4	P1K5				75	176	168	M2	
2,2	3	05A6-4	P2K2								
3	4	07A3-4	P3K0				90	239	194	M3	
4	5	08A8-4	P4K0								
5,5	7,5	12A5-4	P5K5	169		169					R3
7,5	10	15A6-4	P7K5								
11	15	23A1-4	P11K				125	292	241	M4	
15	20	31A0-4	P15K	260	181	169					R4
18,5	25	38A0-4	P18K				165	335	248	M5	
22	30	44A0-4	P22K								

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Danfoss FC51	ABB ACS350			Danfoss FC51			Danfoss FC51	ASC350
		Type	Type								
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	PK37	118	1,9	1,2	105	1,6	1,1	M1	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	PK75				105	1,6	1,1	M1	R1
1,1	1,5	03A3-4				1,2					
1,5	2	04A1-4	P1K5				132	2,2	1,6	M2	
2,2	3	05A6-4	P2K2								
3	4	07A3-4	P3K0				215	4,2	3	M3	
4	5	08A8-4	P4K0								
5,5	7,5	12A5-4	P5K5	286	4,8	2,5					R3
7,5	10	15A6-4	P7K5								
11	15	23A1-4	P11K				365	8,8	6,0	M4	
15	20	31A0-4	P15K	471	8,0	4,4					R4
18,5	25	38A0-4	P18K				553	13,7	9,5	M5	
22	30	44A0-4	P22K								

Installation

Danfoss FC51

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	No
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	0

Cable lengths

- Max. motor cable length, screened (shielded) 15 m
- Max. motor cable length, unscreened (unshielded) 50 m

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Danfoss FC51

- Filters
  - Built-in RFI filter
  - As an option, Danfoss offers line filters for improved harmonics performance
- Chokes
  - N/A
- EMC compliant motor cable lengths
  - Max. motor cable length, screened/armoured (EMC correct installation) 15 m
- THD
  - N/A

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

Danfoss FC5

Pluggable display, – with or without potentiometer

- LCP without potentiometer IP 54
- LCP with potentiometer IP 21
- Remote mounting kit
- LCP copy function
- Parameter numbers and values visible simultaneously
- Unit indications (A., V, Hz, RPM, %, s, HP and kW)
- Rotation direction indication
- Setup indication – 2 setup
- Removable during operation
- Up- and download functionality

Large figures, easy to read

- Display readable from distance
- Operation buttons are illuminated when active

Quick Menus

- A Danfoss defined Quick Menu
- Basic settings
- PI controller

Menu structure

- Based on the well-known matrix from the VLT® family
- Easy shortcut for the experienced user
- Edit and operate in different set-ups simultaneously

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Machine interface (I/O)

Danfoss FC51

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	-	-
Relay outputs	1	Yes
Transistor outputs	-	-
Analog outputs	1	Yes

Specialities:

- N/A

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Danfoss FC51

Protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU	Standard	N/A	RS 485 pluggable

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

100% Phd braking for all units

500 Hz max. output frequency

Motor control

Danfoss FC51

- VVC+
- U/f

Braking

- Brake resistors are available from Danfoss
- Brake not applicable for frame M1
- Micro drives from 1.5 kW and up have built in brake chopper

Output frequency

- 0–200 Hz (VVC+ mode)
- 0–400 Hz (U/f mode)

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Danfoss FC51

Quick Menus

- A Danfoss defined Quick Menu
- Basic settings
- PI controller

Language

- N/A

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Danfoss FC51

- Copy settings via local control panel *(
- Intuitive parameter structure *(
- Self-protecting features *(
- Process PI-controller *(
- Automatic Motor Adaptation (AMA) *(
- 150% motor torque up to 1 minute *(
- Flying start (catch a spinning motor) *(
- Smart Logic Controller *(

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Danfoss FC51

N/A

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

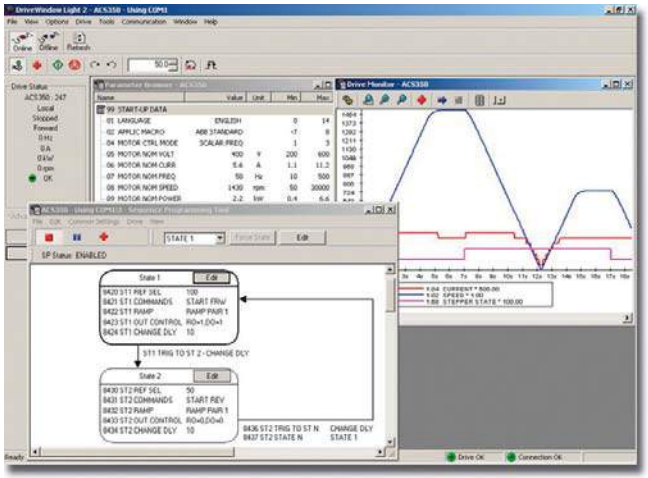
Danfoss FC51

N/A

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Danfoss FC51

- MCT 10 PC software
  - Ideal for commissioning and servicing the drive including guided programming of cascade controller, real-time clock, smart logic controller and preventive maintenance
- VLT Energy Box PC software
  - Comprehensive energy analysis tool, shows the drive payback time
- MCT 31 PC software
  - Harmonics calculations tool

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Danfoss FC51

- VLT Control Panel LCP 11 w/o potentiometer
- VLT Control Panel LCP 12 with potentiometer
- Remote Mounting Kit for LCP incl. 3 m cable
  - IP54 with LCP 11, IP21 with LCP 12
- Nema Type 1 kit for M1 frame
- Nema Type 1 kit for M2 frame
- Nema Type 1 kit for M3 frame
- De-coupling plate kit for M1 and M2 frames
- De-coupling plate kit for M3 frame
- De-coupling plate kit for M4 and M5 frames
- IP21 for M1 frame
- IP21 for M2 frame
- IP21 for M3 frame
- Type 1 for M4 frame
- Type 1 for M5 frame
- DIN rail mounting kit for M1
- Line Filters and brake resistors are available upon request

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Danfoss FC51

MCT 10

- Ideal for commissioning and servicing the drive including guided programming of cascade controller, real-time clock, smart logic controller and preventive maintenance

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Danfoss FC51

Approvals

- CE, C-tick, UL

Compliance with

- All factories are certified according to the ISO 14001 standard and fulfill the EU directives for Waste Electrical and Electronic Equipment (WEEE), General Product Safety directive (GPSD) and the Machinery Directive.
- Danfoss Drives phase out lead in all series and meet the RoHs directive

Applicable standards

- EMC standards, Emission:
  - EN 61800-3
  - EN 61000-6-3/4
  - EN 55011
  - IEC 61800-3
- EMC standards, Immunity:
  - EN 61800-3, EN 61000-6-1/2, EN 61000-4-2, EN 61000-4-3,
  - EN 61000-4-4, EN 61000-4-5, EN 61000-4-6

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Danfoss FC51

Model: FC51132F0022

Drive rating: 380-480V
2.2 kW / 3.0 HP
5.7 A (40 °C)

Tester (experienced drive specialist) comments:

- Control terminals are very small and when the operator panel is installed you can't access the screws. You must remove the operator panel to install control wiring.
- Connection diagram is imprinted on the side of the shipping container which made it easy to connect wiring.
- Very small mounting holes. Not keyholes and only three holes. Two on the top and one on the bottom.
- The operator panel is backlit LCD with Hand-Off-Auto keys, a Speed Pot, Arrows, Menu and Back keys. Operation was intuitive.
- Access to the quick start parameter list QM1 is easy. Only one press of the Menu key.
- Scrolling through parameter values was slow and tedious. It was very "hit and miss" due to showing parameter values to the hundredths place and then having significant overshoot while scrolling.
- Auto motor tuning wasn't straight forward. You set one parameter and then gave the drive a start command. It seemed to indicate the drive was tuning but after a few seconds a message came up on the display to PUSH followed by a character not seen on the panel. I think it should have been OK but the display didn't show it correctly.
- Changing parameter 0-03 from 50 to 60Hz configuration did not allow operation to 60Hz. All parameters were verified for 60Hz set-up but the motor never ran above 50Hz in Auto. Checked the Analog Input voltage and verified 10Vdc. In Hand the pot ran the motor to 60Hz. After downloading the complete Programming Manual from their website and searching I found a parameter called 6-15 Terminal 53 High Ref/Feedbk Val. The default was 50Hz. I changed this to 60Hz and the drive ran to maximum reference in Auto. This parameter should have been linked to the 50/60Hz motor parameter 0-03.
- When a warning message is displayed, and the condition clears, you had to press the Menu key to return to the status display.
- During the Impact Load test, while changing the reference from the second to the third reference point, the drive allowed significant overshoot to 2200 RPM causing the dynamometer to overspeed and fault.

ABB ACS350

Model: ACS350-03U-05A6-4

Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A (40 °C)

5.0 A (50 °C)

Parameter Settings:

9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

Photos of the tested unit

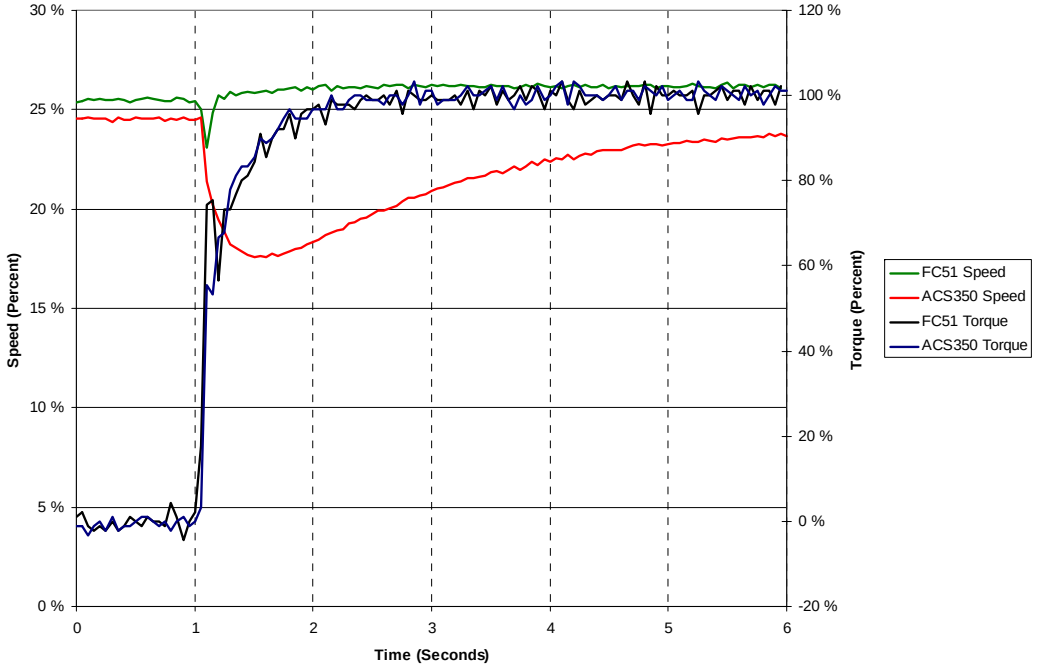
Mitsubishi E700

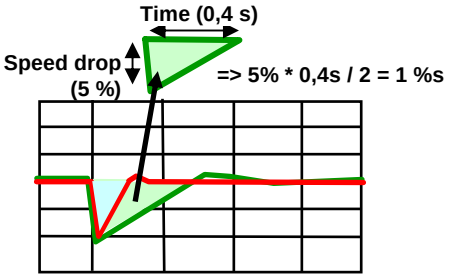
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Impact load test – Dynamic speed accuracy (stiffness)

Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.

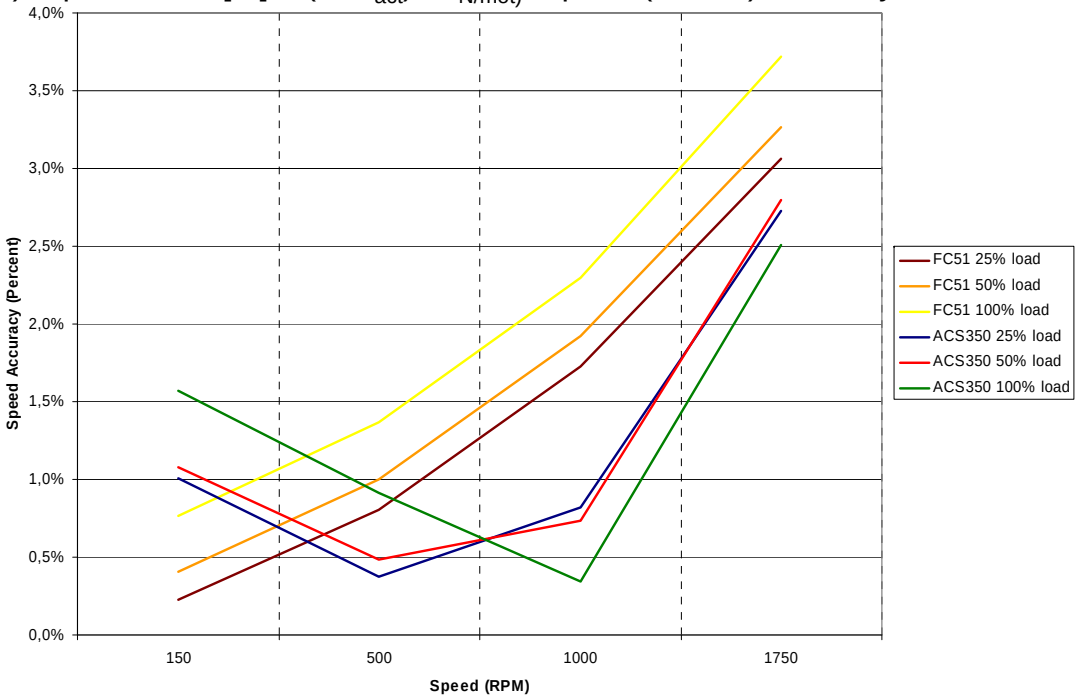




Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive operates in case of disturbances. The ACS350's speed control default tuning is quite conservative to ensure the controller is stable despite the motor used and its size compared to the size of the inverter. The FC51 drive has better dynamic speed accuracy (small speed droop and short recovery time) but the performance of ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL).

Static speed accuracy

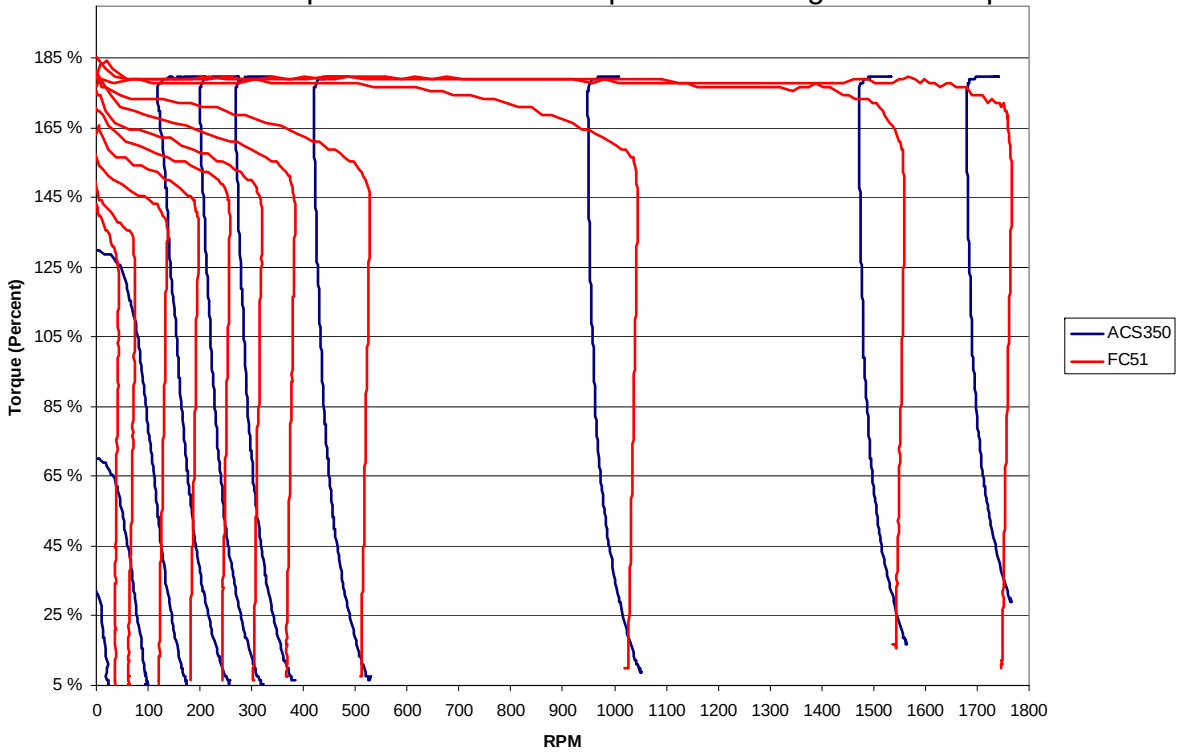
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 25%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), Speed Error [%] = $(n^*-n_{act}) / n_{N/mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Static speed error depends on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). The speed error of FC51 is more linear but has much greater maximum error. The performance of the ACS350 can be improved in this test by tuning the speed controller (parameter group 23 SPEED CONTROL).

Maximum torque as a function of speed

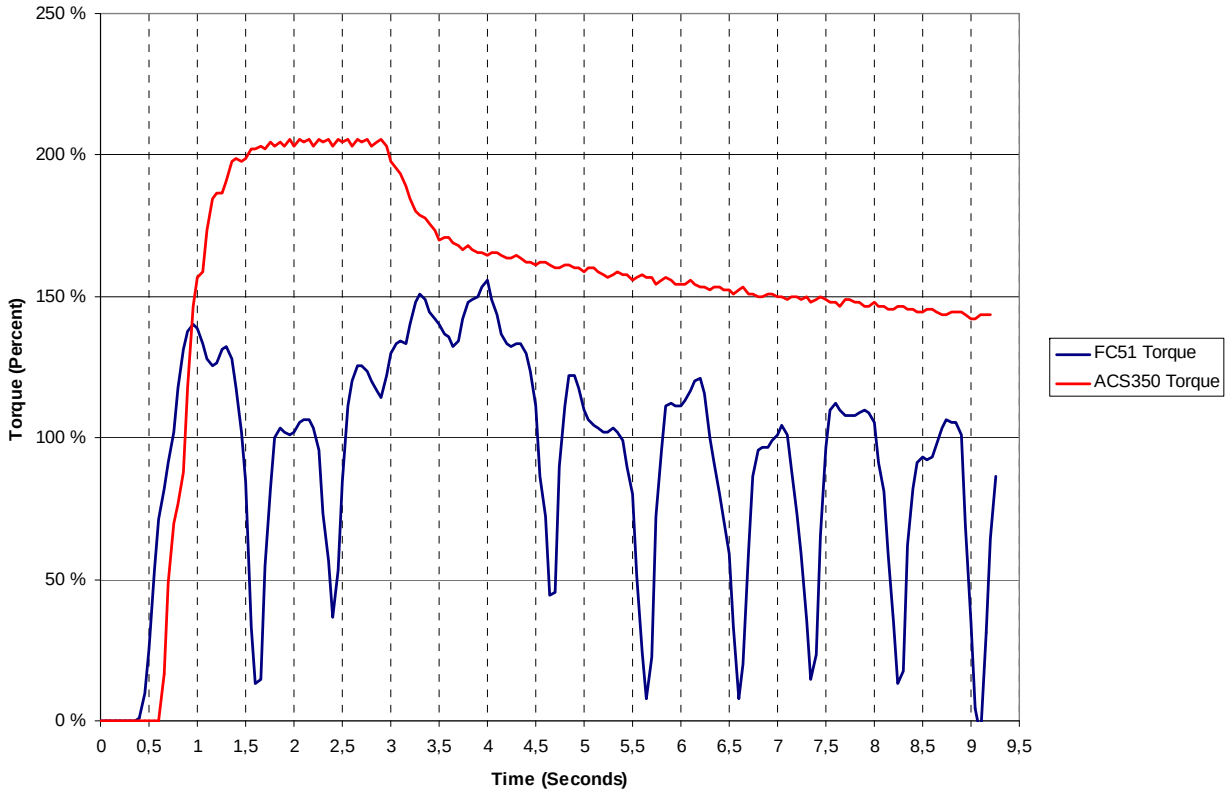
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The ACS350 has good speed range because it could provide full output torque from 1700 rpm's down to 180 rpm. The FC51 has good speed range as it could generate at least 100% torque on the whole speed area. But FC51 cannot maintain the torque for two seconds because the measured speed drops to zero due to limiting of current allowing the motor to stall. ACS350 can maintain the torque and has thus better overload functionality.

Maximum starting torque

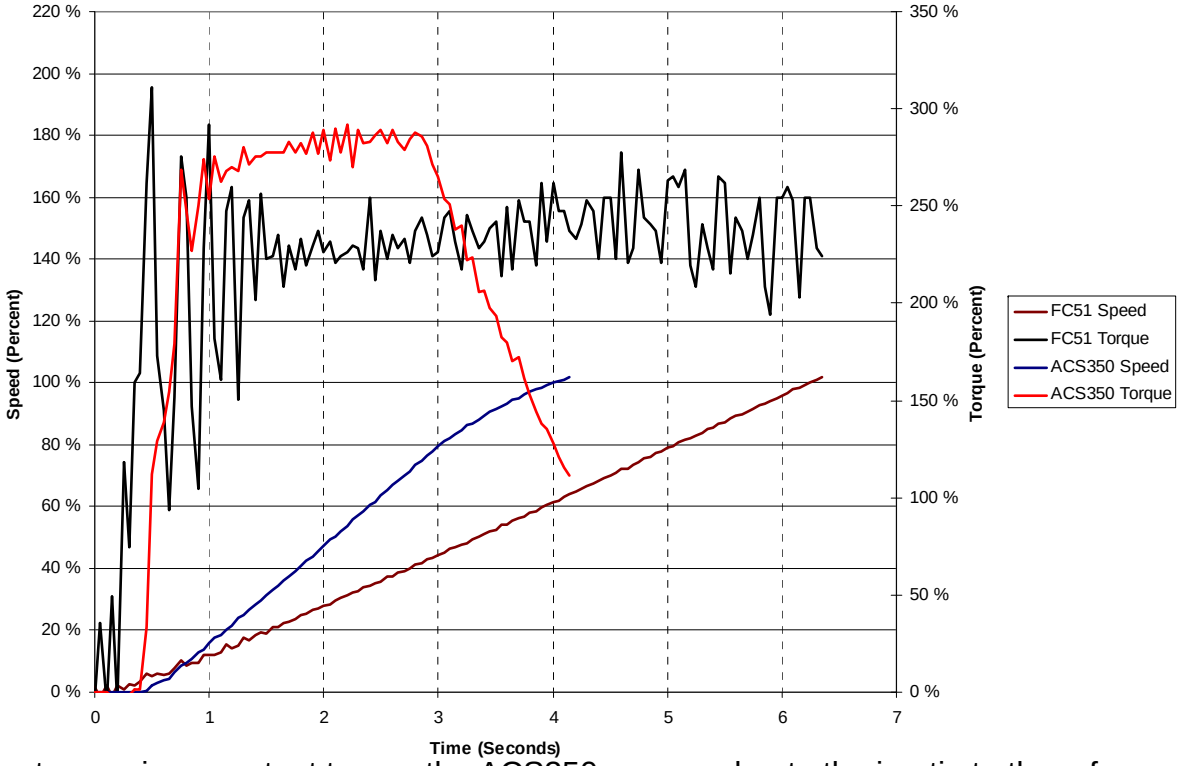
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



ACS350 has good starting torque up to 200%. ACS350 reduces torque after 2 s due to current limiting. The FC51 almost couldn't produce any appreciable torque and also exhibited huge torque ripple. The behavior of the FC51 can cause significant problems in applications requiring high starting duty or high-inertia acceleration.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 (0.95 kgm^2) inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



Thanks to greater maximum output torque the ACS350 can accelerate the inertia to the reference within 4 sec. The FC51 needs 6.5 seconds. The ACS350 provides maximum starting torque for two seconds then decreases torque based on current limiting. The FC51 produces significant torque ripple which may indicate the tuning of the current controller is not stable and could cause overcurrent trips.

Efficiency

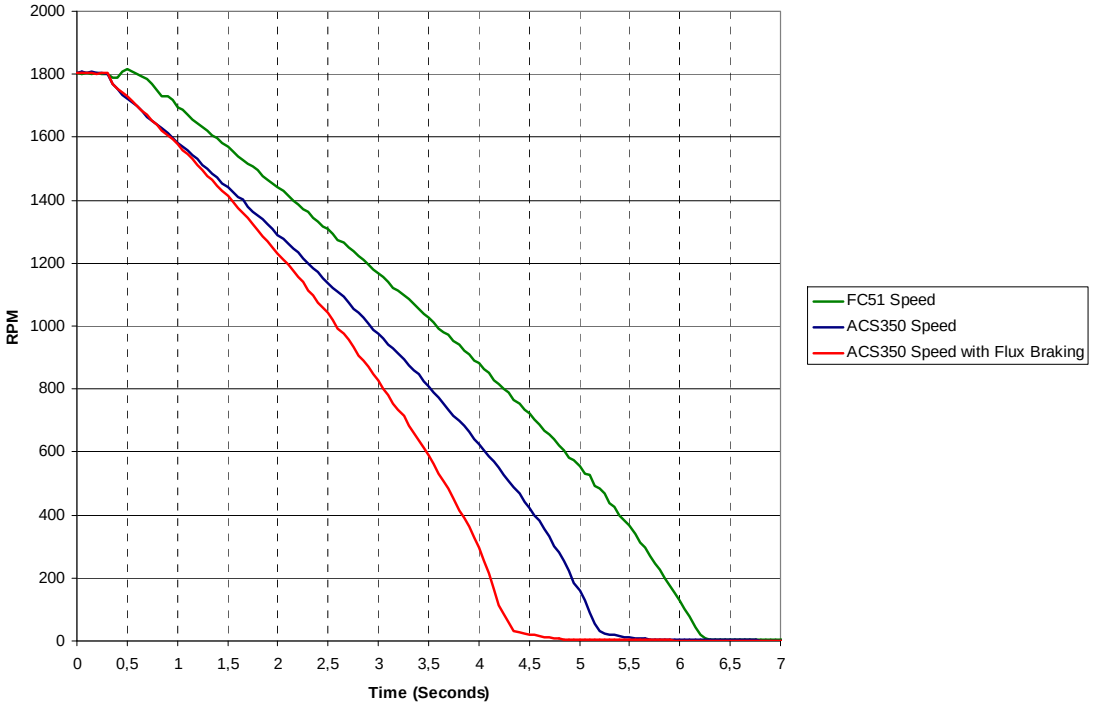
Using power analyzer, input power, speed and torque of AC motor are measured at 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	FC51
25%	87.0%	85.4%
50%	89.3%	90.0%
75%	89.0%	90.2%
100%	88.4%	89.5%

The test is performed at rated speed with different loads. The ACS350 has higher efficiency at 25% load but is comparable at all other points.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



ACS350 was able to decelerate to zero within 5,5 seconds. ACS350 with flux braking shortened the deceleration time even more. The FC51 didn't perform the test as well as the ACS350.

ABB strengths

ACS350 advantages over Danfoss FC51

Operating temp. starting -10°C	500 Hz max. output frequency
I2hd 50°C ratings	Application macros 7 pcs
Sideways mounting	User macros 3 pcs
EN61000-3-2 with opt. chokes	17 languages
Panel cover	Comprehensive SW
Bipolar AI	FlashDrop
Many plug-in fieldbus options	Sequence programming
100% Phd braking for all units	Maintenance need indication
	Detailed fault history with time



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Mitsubishi FR E-500

- The Mitsubishi FR-E 500 claims to provide optimized drive characteristics and environmentally friendly operation with advanced flux vector control and soft PWM control (randomized carrier frequency).
- Simplified installation and maintenance is visualized with easily accessible screw terminals for cable connections and replaceable cooling fans.
- For power range 0.4 to 7.5 kW
- Speciality in field bus sortiment is CC-Link, an open field bus standard.
- Applications
  - Textile machines, Material transport systems, Door and gate drives, Palettisers, material-handling technology,Pumps and ventilating.

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Mitsubishi FR E-500

- IP20 (standard)

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Ambient specification

Mitsubishi FR E-500

Vibration

- 5.9 m/s2 or less (Conforming to JIS C 0040).
- 0.6 G: resistance to vibrations from 10 to 55 Hz for 2 hours along all 3 axes

Shock

- 10 G (3 times each in 3 directions) Standard not mentioned.

Temperature

- Nominal ambient temperature is –10°C to +50°C (non-freezing)
- For selection of the load characteristics with variable torque the max. temperature is 40 °C (FR-E 540 only)
- Storage temperature -20°C to +65°C

Humidity

- Lower than 90 % (non-condensing)

Altitude limitations

- 1000 m or less (without derating). Higher by derating 3% for every extra 500 m (91 %) to 2500 m.

Acoustic noise

- 0.7…14.5 kHz

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40°C
- +50 °C with 10% current derating
- Storage temperature – 40 °C to +70°C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Mitsubishi FR E-500

Voltage types and power range

- 1-phase 200 - 240 V –15%/ +10%
  - 0.4 to 2.2 kW
- 3-phase 200 - 230 V
  - 0.4 to 7.5 kW
- 3-phase 380 - 480 V –15%/ +10%
  - 0.4 to 7.5 kW

Power factor

- N/A

Supply frequency

- 50/60 Hz, tolerance ±5%

Supply networks

- The filters are not designed for use in IT networks

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Mitsubishi	ABB ACS350		Mitsubishi FR E-500		Mitsubishi	
P_N	P_N	ACS350	FR E-500	I_{2N}	I_{2N}	I_{2hd}	I_{2hd}	FR E-500	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	FR-	A	A	A	A	names	
kW	hp	01X-	E520S-	U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16		0.1K			0,8	0,8	F1	
0,18	0,25		0.2K			1,4	1,4		
0,37	0,5	02A4-2	0.4K	2,4	2,2	2,5	2,5	F2	R0
0,55	0,75								
0,75	1	04A7-2	0.75K	4,7	4,2	4,1	4,1	F3	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2		7,5	6,8				R2
2,2	3	09A8-2		9,8	8,8				

Mitsubishi FR E-500

Overload ratings

- 150 % for 60 sec.
- 200 % for 0.5 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 200V

3-phase 200V		ABB	Mitsubishi	ABB ACS350		Mitsubishi FR E-500		Mitsubishi	
P_N	P_N	ACS350	FR E-500	I_{2N}	I_{2N}	Rated current		FR E-500	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	FR-	A	A	A	A	names	
kW	hp	03X-	E520-	U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16		0.1K			0,8	0,8	F1	
0,18	0,25		0.2K			1,4	1,4		
0,37	0,5	02A4-2	0.4K	2,4	2,2	2,5	2,5	F2	R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2	0.75K	4,7	4,2	4,1	4,1	F3	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	1.5K	7,5	6,8	7	7	F4	
2,2	3	09A8-2	2.2K	9,8	8,8	10	10		R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2	3.7K	17,6	15,8	16,5	16,5	F7	
5,5	7,5	24A4-2	5.5K	24,4	21,96	23,0	23,0	F8	R3
7,5	10	31A0-2	7.5K	31,0	27,9	31,0	31,0		R4
11	15	46A2-2		46,2	41,58				

Mitsubishi FR E-500

Overload ratings

- 150 % for 60 sec.
- 200 % for 0.5 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 400V

3-phase 400V		ABB	Mitsubishi	ABB ACS350		Mitsubishi FR E-500		Mitsubishi	ASC350
P_N	P_N	ACS350	FR E-500	I_{2N}	I_{2N}	I_{2hd}	I_{2hd}	FR E-500	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	FR-	A	A	A	A	names	
kW	hp	03X-	E540-	U_N=380-480 V		U_N=380-480 V		N/A	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	01A2-4	0.4K	1,2	1,1	1,6	1,4	F5	R0
0,55	0,75	01A9-4		1,9	1,7				
0,75	1	02A4-4	0.75K	2,4	2,2	2,6	2,2	F5	R1
1,1	1,5	03A3-4		3,3	3,0				
1,5	2	04A1-4	1.5K	4,1	3,7	4,0	3,8	F6	
2,2	3	05A6-4	2.2K	5,6	5,0	6,0	5,4		
3	4	07A3-4		7,3	6,6				
4	5	08A8-4	3.7K	8,8	7,9	9,5	8,7	F6	
5,5	7,5	12A5-4	5.5K	12,5	11,3	12,0	12,0	F9	R3
7,5	10	15A6-4	7.5K	15,6	14,0	17,0	17,0		
11	15	23A1-4		23,1	20,8				
15	20	31A0-4		31	27,9				R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Mitsubishi FR E-500

Overload ratings

- 150 % for 60 sec.
- 200 % for 0.5 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Mitsubishi FR E-500	ABB ACS350			Mitsubishi FR E-500			Mitsubishi FR E-500	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-	FR-	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-	E520S-	W	H	D	W	H	D	N/A	Frame
0,12	0,16		0.1K				68	128	76	F1	
0,18	0,25		0.2K								
0,37	0,5	02A4-2	0.4K	70	169	161			108	F2	R0
0,55	0,75										
0,75	1	04A7-2	0.75K	70	169	161	68	128	128	F3	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2		105	169	165					R2
2,2	3	09A8-2									

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Mitsubishi FR E-500	ABB ACS350			Mitsubishi FR E-500			Mitsubishi FR E-500	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-	FR-	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-	E520S-	area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16		0.1K				87	0,7	0,6	F1	
0,18	0,25		0.2K								
0,37	0,5	02A4-2	0.4K	118	1,9	1,2		0,9	0,8	F2	R0
0,55	0,75										
0,75	1	04A7-2	0.75K	118	1,9	1,2	87	1,1	1	F3	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2		177	2,9	1,5					R2
2,2	3	09A8-2									

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Mitsubishi FR E-500	ABB ACS350			Mitsubishi FR E-500			Mitsubishi FR E-500	ASC350
		Type	Type	3-phase			3-phase			Frame	
		ACS350-	FR-	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	names	
kW	hp	03X-	E520-	W	H	D	W	H	D	N/A	Frame
0,12	0,16		0.1K				68	128	76	F1	
0,18	0,25		0.2K								
0,37	0,5	02A4-2	0.4K	70	169	161			108	F2	R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	0.75K				68	128	128	F3	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	1.5K				108	128	131	F4	
2,2	3	09A8-2	2.2K	105		165					R2
3	4	13A3-2									
4	5	17A6-2	3.7K				170	128	138	F7	
5,5	7,5	24A4-2	5.5K	169	169	169	180	260	170	F8	R3
7,5	10	31A0-2	7.5K	260	181	169					R4
11	15	46A2-2									

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Mitsubishi FR E-500	ABB ACS350			Mitsubishi FR E-500			Mitsubishi FR E-500	ASC350
		Type	Type	3-phase			3-phase			Frame	
		ACS350-	FR-	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	names	
kW	hp	03X-	E520-	area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16		0.1K				87	0,7	0,6	F1	
0,18	0,25		0.2K								
0,37	0,5	02A4-2	0.4K					0,0	0,8	F2	R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	0.75K	118	1,9	1,2	87	1,1	1	F3	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	1.5K				138	1,8	1,7	F4	
2,2	3	09A8-2	2.2K								R2
3	4	13A3-2		177	2,9	1,5					
4	5	17A6-2	3.7K				218	3,0	2,2	F7	
5,5	7,5	24A4-2	5.5K	286	4,8	2,5	468	8,0	4,4	F8	R3
7,5	10	31A0-2	7.5K	471	8,0	4,4			4,9		R4
11	15	46A2-2									

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Mitsubishi FR E-500	ABB ACS350			Mitsubishi FR E-500			Mitsubishi FR E-500	ASC350
		Type	Type							Frame	
		ACS350-	FR-	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	names	
kW	hp	03X-	E540-	W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	0.4K	70	169	161	140	150	116	F5	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	0.75K				140	150	116	F5	R1
1,1	1,5	03A3-4									
1,5	2	04A1-4	1.5K				140	150	136	F6	
2,2	3	05A6-4	2.2K								
3	4	07A3-4									
4	5	08A8-4	3.7K				140	150	136	F6	
5,5	7,5	12A5-4	5.5K	169		169	220	150	148	F9	R3
7,5	10	15A6-4	7.5K								
11	15	23A1-4									
15	20	31A0-4		260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Mitsubishi FR E-500	ABB ACS350			Mitsubishi FR E-500			Mitsubishi FR E-500	ASC350
		Type	Type							Frame	
		ACS350-	FR-	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	names	
kW	hp	03X-	E540-	area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	0.4K	118	1,9	1,2	210	2,4	1,9	F5	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	0.75K				210	2,4	1,9	F5	R1
1,1	1,5	03A3-4				1,2					
1,5	2	04A1-4	1.5K				210	2,9	2,0	F6	
2,2	3	05A6-4	2.2K								
3	4	07A3-4									
4	5	08A8-4	3.7K				210	2,9	2,1	F6	
5,5	7,5	12A5-4	5.5K	286	4,8	2,5	330	4,9	3,8	F9	R3
7,5	10	15A6-4	7.5K								
11	15	23A1-4									
15	20	31A0-4		471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

DIN rail mounting
Sideways mounting
Side by side mounting

Installation

Mitsubishi FR E-500

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	No
Flange	No
Wall (sideways)	No
Heatsinkless	No
Side-by-side	No

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	10 (50)*

- * 50 mm is required for 5.5K and 7.5K inverters
- Screws or bolts, fixed screw terminals
- Vertical mounting
- Power and control connections allow the cable entry from the bottom
- Maximum wiring length:

Capacitance	0.1 K	0.2 K	0.4 K	0.75 K	1.5-7.5 K
Regular operation	200m	300 m	300 m	500 m	500 m
Quiet operation	30 m	100 m	200 m	300 m	500 m

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

Mitsubishi E700

EMC and harmonics

Mitsubishi FR E-500

- Filters
  - Manufacturer doesn't guarantee compliance with EMC standards Limits for conducted noise voltages: EN 61800-3
  - EMC standards, Emissions: EN 50081 when using external filters
- Chokes
  - AC/DC chokes as option
- Motor cable lengths
  - Maximum motor cable lengths according to EMC regulations:
  - Environment 1 (unrestricted distribution): up to 20 m (shielded)
  - Environment 1 (restricted distribution): up to 100 m (shielded)
  - 100 A limits of Environment 2: up to 100 m
- THD
  - N/A

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

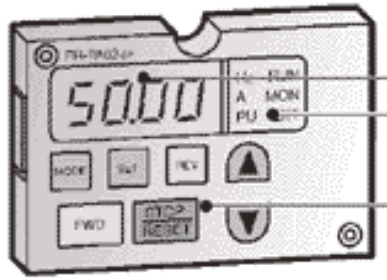
4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

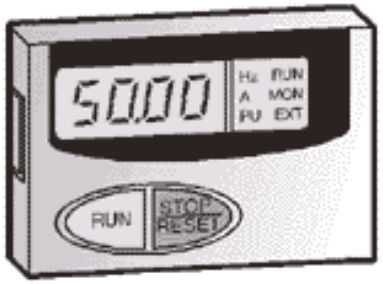
1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

Mitsubishi FR E-500





LED display

4-digit 7-segment display for indication of operational data, error codes, and several functions

Indication of unit and operating state

LED for indication of current unit:
- frequency (Hz)
- current (A)
- Indication of operating state: under operation (RUN)
- monitor mode (MON)
- operation via parameter unit (PU)
- external operation (EXT)

Function keys (behind the cover)

Keys for set-up, menu functions, and inverter start and stop

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Machine interface (I/O)

Mitsubishi FR E-500

Type	*Qty.*	*Programmable*
Digital inputs	7	Yes
Analog inputs	1	Yes
Pulse train input	N/A	N/A
Relay outputs	1	Yes
Transistor outputs	2	Yes
Analog outputs	1	Yes

Specialities:

- N/A

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Mitsubishi FR E-500

Protocol	*Standard /Optional*	*Baud rate*	*Notes*
RS 485	Standard	4.8 – 19.2 kbit/s	
CC-link	Optional	156 x 10 kBaud	Maximum transfer distance: 1200 m
DeviceNet	Optional	Up to 500 kbit/s	
Profibus DP	Optional	N/A	Connection of up to 42 inverters supported
CAN-Open	Optional	1 Mbaud/s	

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

500 Hz max. output frequency

Motor control

Mitsubishi FR E-500

- Open Loop Vector Mode
- V/Hz Mode

Braking

- Among the capacity range of 0.4 kW to 7.5 kW the inverter is equipped with an internal brake chopper as standard.
- For a braking torque higher than 20 % or a duty cycle higher than 30 % an external brake unit including the adequate brake resistors has to be installed. (Optional external brake unit).

Output frequency

- 0.2 – 400 Hz with vector control

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Mitsubishi FR E-500

N/A

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Mitsubishi FR E-500

- PID controller *(
- Flying start *(
- Optional multlingual parameter unit *(
- Inrush current limiter

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Mitsubishi FR E-500

The FR-PU07

- An optional parameter unit
- Can be installed on the enclosure or held in hand (Operations can be performed from FR-PU07 by connecting the connection cable (FRCB2) to the PU connector), size 135x83x14 mm
- LCD display with 8 languages
- Parameter setting values of maximum of three inverters can be stored
- Parameter upload and download, help function, parameter hiding by user group function
- A battery pack type (available soon) allows parameter setting and parameter copy without powering on the inverter
- Compatible with FR-S/E/A500, FR-F/E/700

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

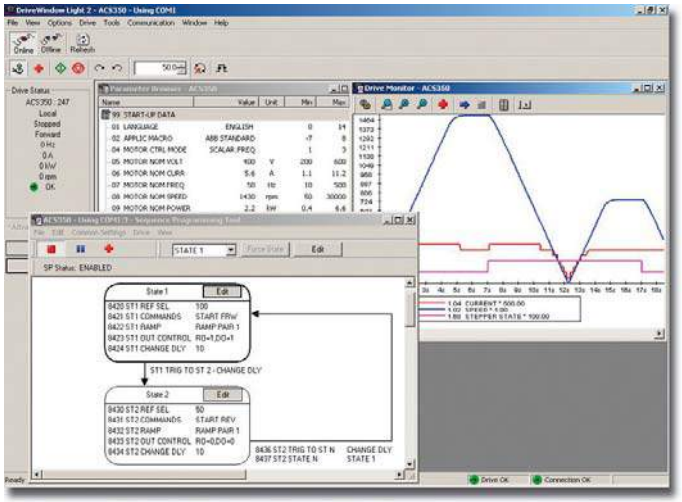
Mitsubishi FR E-500

N/A

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

PC connectivity and tools

Mitsubishi FR E-500

- Connection between PC and inverter via a RS485 network or directly via an SC-FR PC adapter cable available separately
- VFD Setup software package
  - MS Windows 3.11, WIN 95/98/XP and 2000 compatible world-wide standardised multi-language parameterisation software
  - Several frequency inverters can be set up, operated, and monitored simultaneously across a network or via a PC or notebook
  - The software package includes functions like system management, parameter settings, display and diagnostics, file management and help

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Mitsubishi FR E-500

- EMC Filters

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Mitsubishi FR E-500

- Smoothing capacitors
  - Changed every 5 years
- Cooling fan
  - Size 60x60 mm. Connected to control electronics board with adapter and mounted to the heatsink with 2 snap fits.
  - Life of the cooling fan bearing 10 000 – 35 000 hours. Cooling fan must be changed every 2 to 3 to years if run constantly.
  - The lifetime of the cooling fans can be extended significantly through a selective ON/OFF control specified by parameter 244.
- Note: There is no cooling fan in the FR-E 520S-0.4 k/0.75 k-EC and FR-E 540-0.4 k/0.75 k-EC.

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Mitsubishi FR E-500

Approvals

- CE, UL, cUL, CSA, VDE 0100, VDE 0105, VDE 0113
- VBG No. 4
- JIS C 0040

Compliance with

- Low Voltage Directive EN50178
- Quality assurance system ISO 9001
- Environmental system ISO 14001

Applicable standards

- Manufacturer doesn't guarantee compliance with EMC standards Limits for conducted noise voltages: EN 61800-3
- EMC standards, Emissions: EN 50081 when using external filters
- EN 50178 (Configuration of electrical systems and electrical equipment)

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Mitsubishi FR-E540

Model: FR-E540-3.7K-EC

Drive rating: 380-480V
3.7 kW
9.5 A

Tester (experienced drive specialist) comments:

- Accel and Decel both set to 1.0 seconds.
- The drives factory default for analog speed reference is 0 to 5Vdc.
- Changing parameters is not clearly explained in the User Manual. Using the set key is finally explained in small print on page 57 of the manual.
- The drive is very sensitive to speed and load changes. One would think the drive would perform very well given the large continuous current rating. This was proven to be untrue as the drive tripped during many of the tests. Possible this is due to lower bus capacitance making it more sensitive to overvoltage conditions.

ABB ACS350

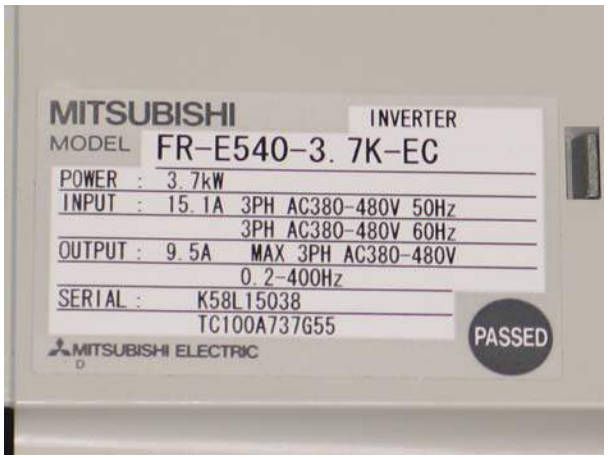
Model: ACS350-03U-08A8-4

Drive rating: 380-480V
4.0 kW / 5.0 HP
8.8 A

Parameter Settings:

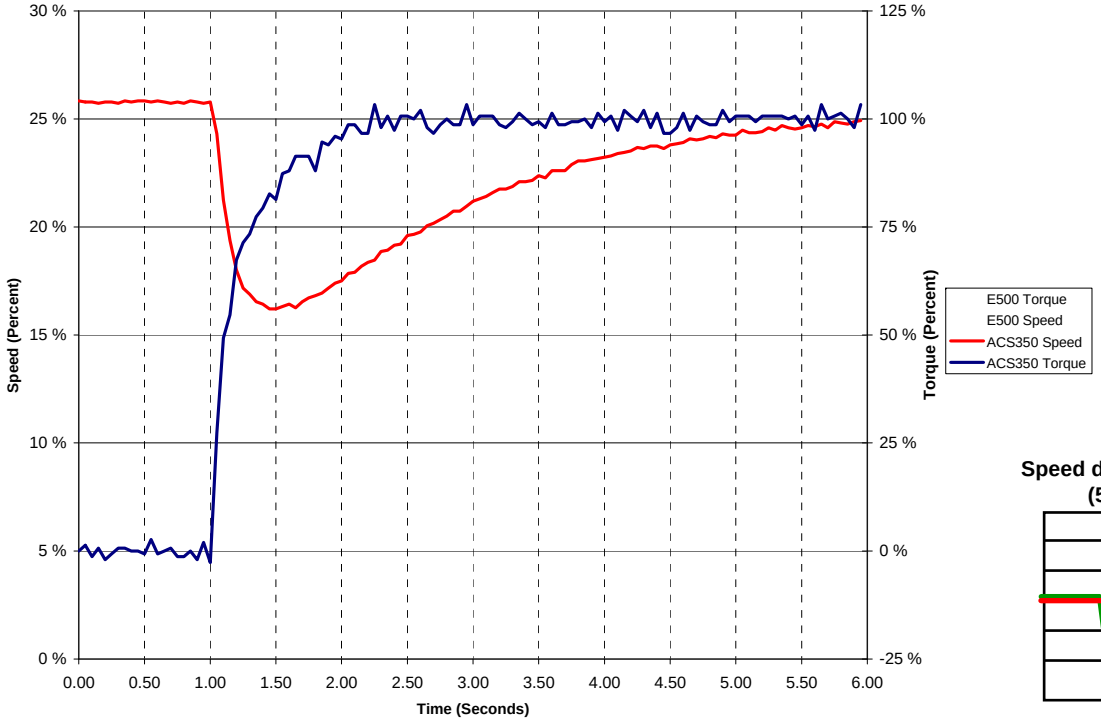
9902 Torque Control
9904 Vector:Speed
9905 460V
9906 7.0A
9907 60Hz
9908 1765 RPM
9909 5.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

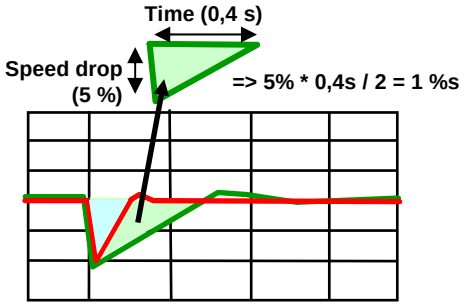
Photos of the tested unit



Impact load test – Dynamic speed accuracy (stiffness)

Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.

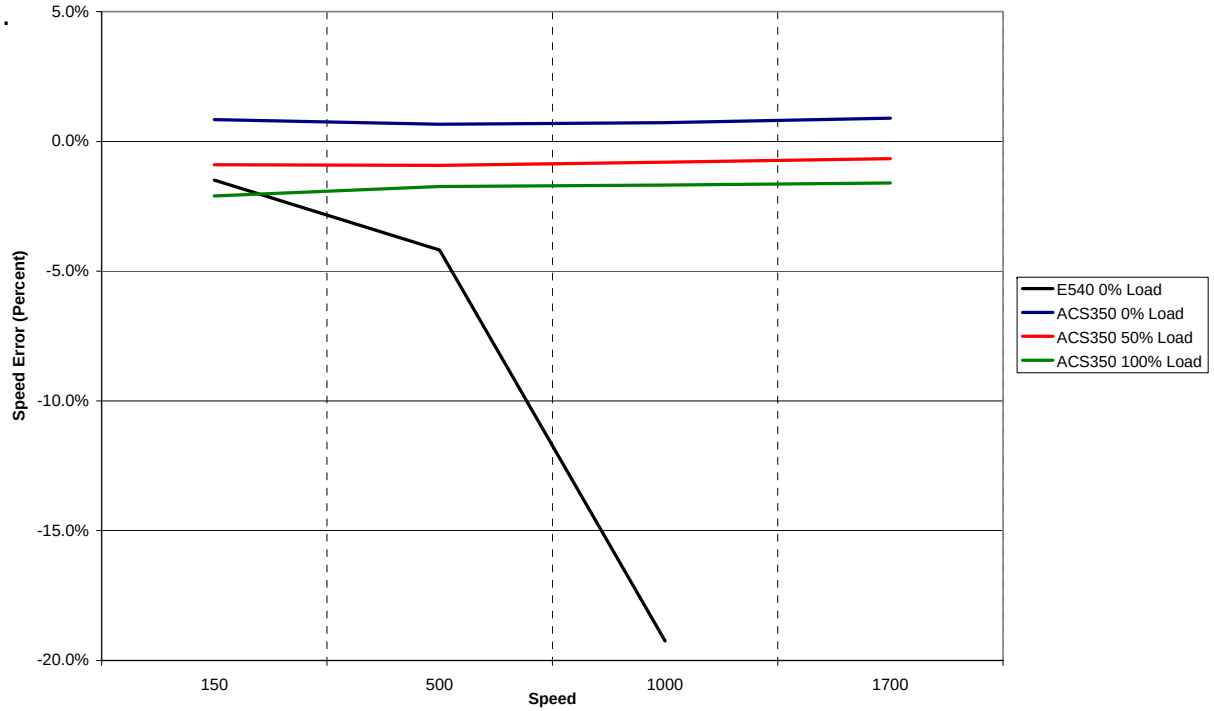




Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive works in case of disturbances. The ACS350 speed control default tuning is quite conservative to ensure that the controller is stable despite of motor used and its size compared to size of the inverter. The E540 drive failed the test because it tripped “(E.Ou2) regen. overvoltage shut-off during constant speed - check for sudden load changes” so no data is available.

Static speed accuracy

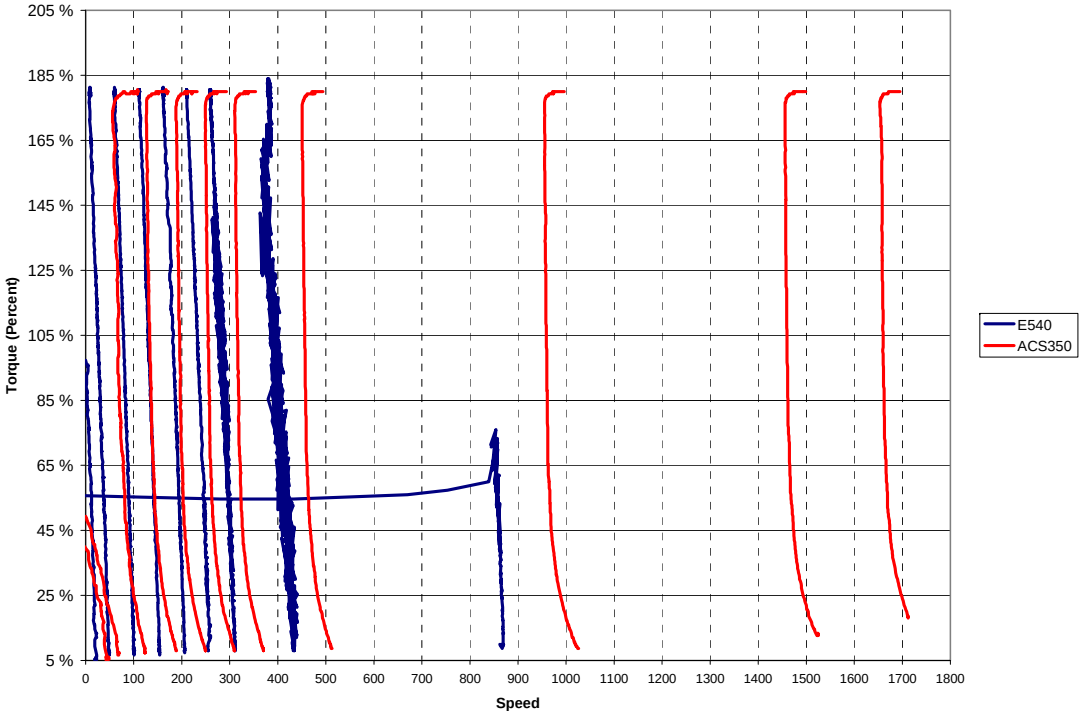
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 0%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), error [%] = $(n^*-n_{act}) * n_{N(mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Static speed error depends on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). The ACS350 has much better accuracy and linearity than the E540. The E540 also drive tripped “(E.Ou2) regen overvoltage shut-off during constant speed - check for sudden load changes” during the tests. The E540 could be only be measured without load.

Maximum torque as a function of speed

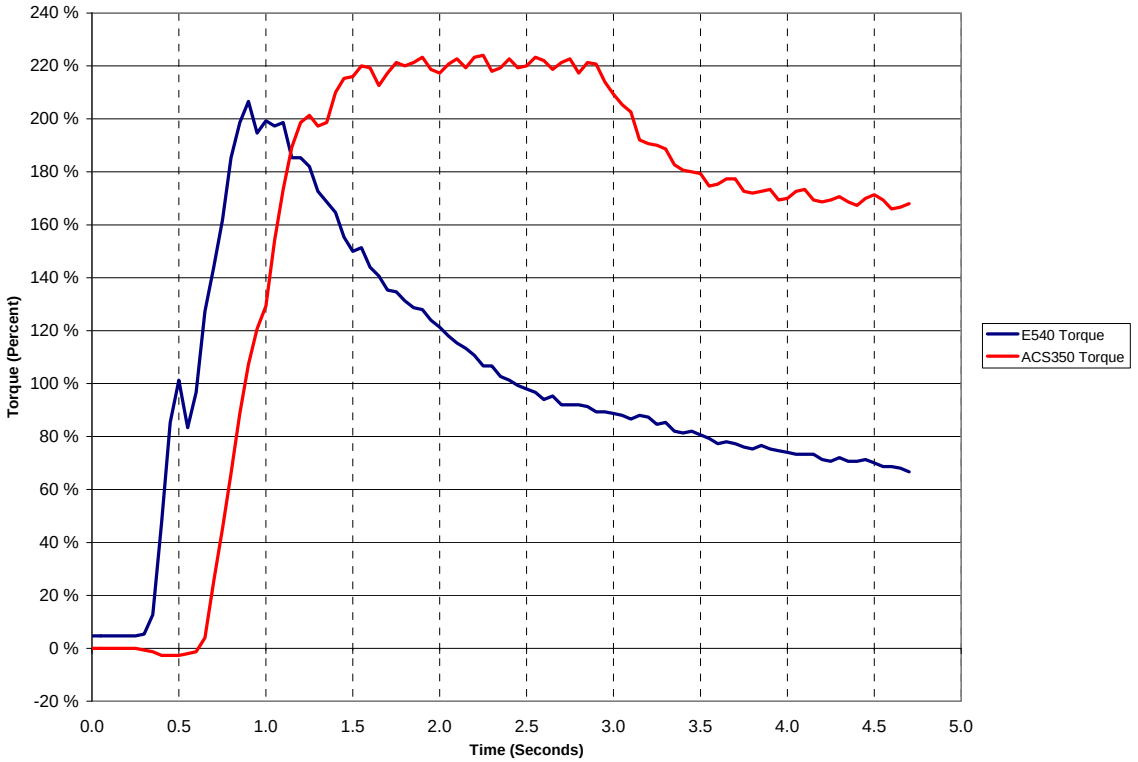
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The ACS350 has good speed range because it could provide full output torque from 1700 rpm's down to 180 rpm's and can maintain the torque for at least two seconds. The E530 drive tripped "(E.Ou2) regen overvoltage shut-off during constant speed - check for sudden load changes" during the test. The ACS350's speed range is better. The behavior of the E540 can cause severe problems in applications requiring high-inertia starting and wide speed range.

Maximum starting torque

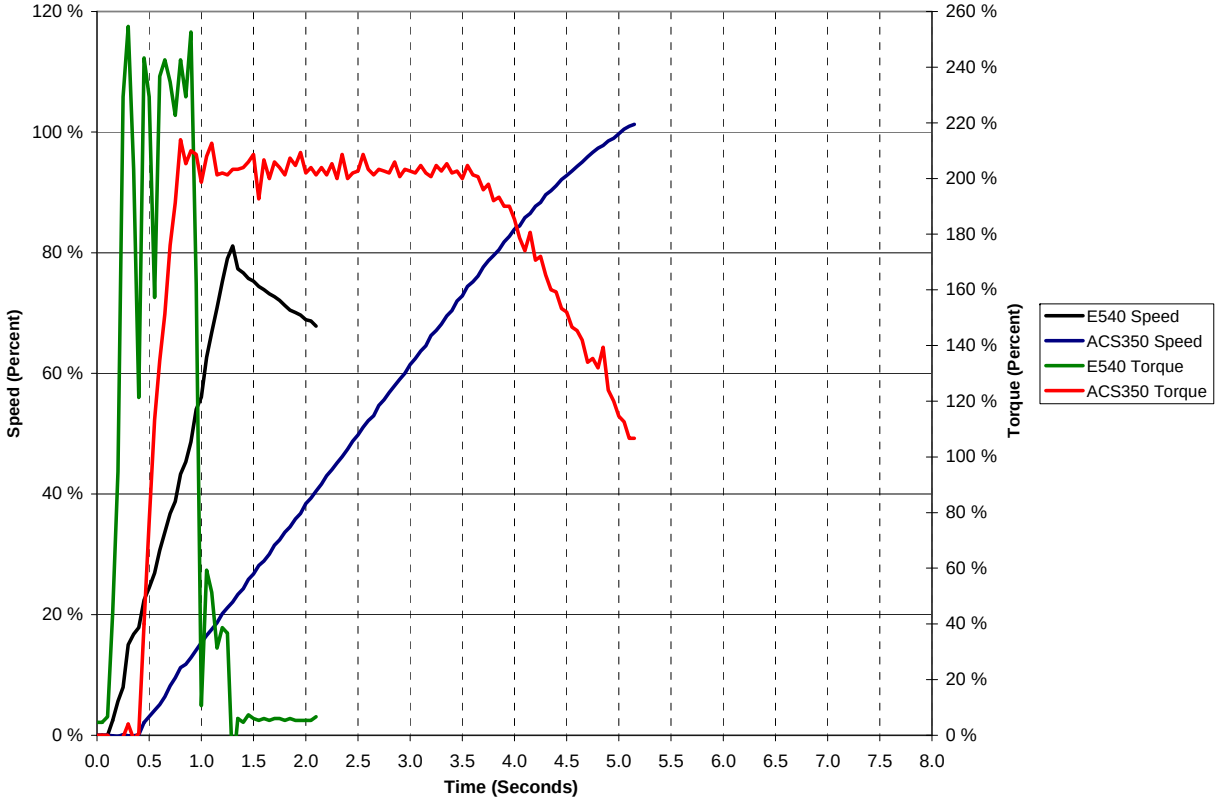
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



The ACS350 has good starting torque, up to 220%. The maximum starting torque of the E540 peaks at 200%. The E540 takes less time to reach nominal torque but reduces it to under nominal value after 2.5 s and cannot maintain the torque at the 1000 rpm speed reference. The ACS350 has better overload functionality and presumable the ACS350 will work better in applications requiring high starting torque or accelerating high-inertia loads.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



The ACS350 accelerates the load to the reference in five (5) seconds. The E540 failed the test, because the drive tripped “(E.Ou3) Regen overvoltage” during the test before reaching nominal speed.

Efficiency

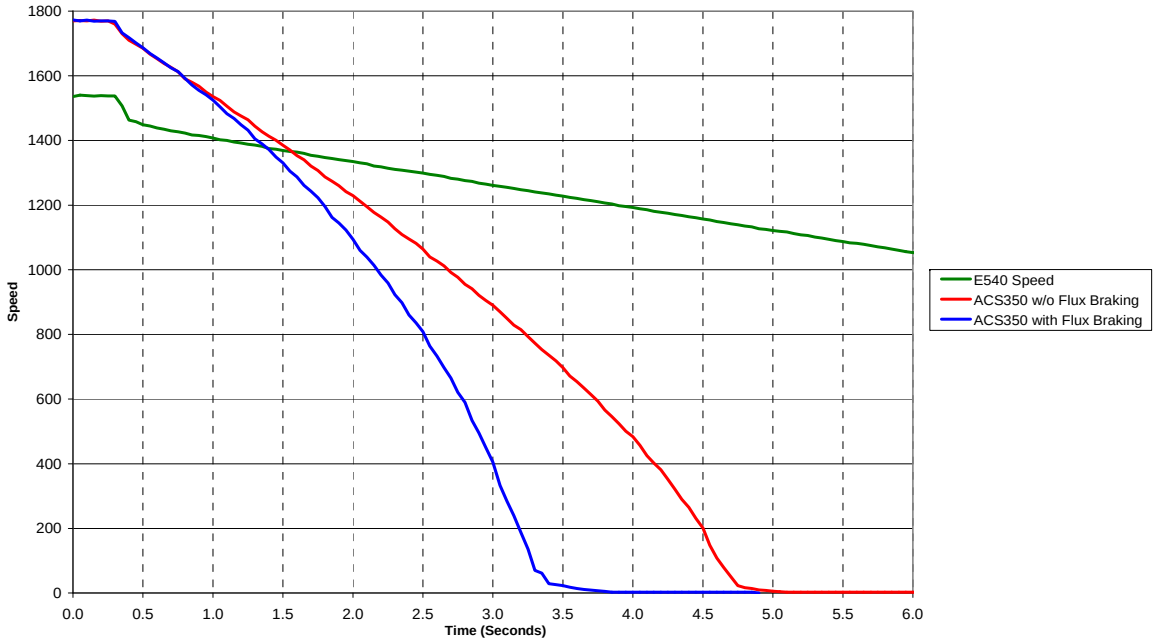
Using power analyzer, input power, speed and torque of AC motor are measured at 0, 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	FR-E540
25%	87.6%	88.6%
50%	90.6%	89.7%
75%	90.5%	90.2%
100%	90.2%	89.1%

The test is performed at rated speed with different loads. Both drives performed the test equally.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with or without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



The E540 failed the test because it tripped “(E.Ou3) Regen overvoltage shut-off during deceleration or stop - Check for sudden speed reduction” after the run command was removed. The ACS350 was able to decelerate the load to zero within 5 seconds. The ACS350, with flux braking, shortened the deceleration time even more. The E540 behavior will cause problems with applications with overhauling loads since it is very sensitive to bus overvoltage conditions.

ABB strengths

ACS350 advantages over Mitshubisi FR E-500

Wide power range	Pulse train
NEMA 1 kit option	Modbus speed
Areas of 400 V units	500 Hz max. output frequency
Volumes of 400 V units	Application macros 7 pcs
Weights of 400 V units	User macros 3 pcs
DIN rail mounting	17 languages
Sideways mounting	Comprehensive SW
Side by side mounting	FlashDrop
EN61000-3-2 with opt. chokes	Sequence programming
2 control panels	Versatile options
Panel mounting kit	Maintenance need indication
Panel cover	Detailed fault history with time
2 bipolar AI	

For ACS350 advantages in performance, see the performance test slides

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

ACS350 Competitor comparison




















Toshiba VF-S11

Yaskawa V1000

Danfoss FC51

Fuji Frenic-Multi

Hitachi X200

KEB Combivert F5

Lenze 8400

Vacon 10 Machinery

Lenze SMVector

WEG CFW08

Mitsubishi E700

Main

Yaskawa V7

Mitsubishi FR E-500

Danfoss VLT 2800

Schneider Altivar 31

Allen-Bradley PowerFlex 40

Control Techniques Commander SK

Lenze 8200

Siemens Micromaster 420

Summary Slide

Description

Fuji Frenic-Multi

- "With advanced technology built in, these new inverters can be used for multiple purposes"
- V/f control, dynamic torque-vector control (magnetic flow estimator)
- For power range 0.1 to 15 kW
- Gentler on the environment
- The highest standards of control and performance in its class
- Optimum for the operations specific to vertical and horizontal conveyance
- Simple and thorough maintenance
- Simple operation, simple wiring
- Consideration of peripheral equipment, and a full range of protective functions
- Fully compatible with network operation
- Global compatibility
- Industries
  - No specific areas mentioned

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Fuji Frenic-Multi

- IP20 / UL open type

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Fuji Frenic-Multi

Vibration

- 3 mm (vibration width): 2 to less than 9 Hz, 9,8 m/s^2: 9 to less than 20 Hz, 2 m/s^2: 20 to less than 55 Hz, 1 m/s^2: 55 to less than 200 Hz

Shock

- Information not available

Temperature

- Operating temperature -10 to +50°C
- When installed side-by-side -10 to +40°C
- Storage temperature – 25 °C to +65°C

Humidity

- 5 to 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher with derating factor: 1000 to 1500 m 0.97, 1500 to 2000 m 0.95, 2000 to 2500 m 0.91, 2500 to 3000 m 0.88.
- Over 2000 m insulate the interface circuit from the main power supply

Acoustic noise

- 0,75…15 kHz. Output current derating required when using ≥ 4 kHz.

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40°C
- +50°C max. of 10% current derating
- Storage temperature – 40°C to +70°C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz. Output current derating required when using ≥ 8 kHz.

Mains connections

Fuji Frenic-Multi

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.1 to 2.2 kW
- 3-phase 200 - 240V -15%...+10%
  - 0.1 to 15 kW
- 3-phase 380 - 480V -15%...+10%
  - 0.4 to 15 kW

Power factor

- Information not available

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Information not available

DC bus connection

- DC bus connection possible

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	FujiFrenic-	ABB ACS350		Fuji Frenic-Multi		Frenic-	
P_N	P_N	ACS350	Multi	I_{2N}	I_{2N}	Rated Output Current		Multi	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	FRN__	A	A	A	A	names	
kW	hp	01X-	E1S/E-7☐	U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,1	0,16		0.1			0,8	0,8	F3	
0,2	0,25		0.2			1,5	1,5		
0,4	0,5	02A4-2	0.4	2,4	2,2	1,1	1,1	F4	R0
0,55	0,75								
0,75	1	04A7-2	0.75	4,7	4,2	5,0	5,0	F6	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	1.5	7,5	6,8	8,0	8,0	F10	R2
2,2	3	09A8-2	2.2	9,8	8,8	11,0	11,0		

Fuji Frenic-Multi

Overload ratings

- 150% of rated current for 1 min
- 200% for 0,5 sec

Output current derating required when swzitching frequency ≥ 4 kHz and inverter continuously runs at 100% load.

Same current ratings in series without (S) and with (E) inbuilt EMC filter.

A filter (either inbuilt or separate) is required to confirm with EMC directives.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 200V

3-phase 200V		ABB	FujiFrenic-	ABB ACS350		Fuji Frenic-Multi		Frenic-	
P_N	P_N	ACS350	Multi	I_{2N}	I_{2N}	Rated Output Current		Multi	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	FRN_	A	A	A	A	names	
kW	hp	03X-	E1S-2□	U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,1	0,16		0.1			0,8	0,8	F1	
0,2	0,25		0.2			1,5	1,5		
0,4	0,5	02A4-2	0.4	2,4	2,2	3,0	3,0	F2	R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2	0.75	4,7	4,2	5,0	5,0	F5	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	1.5	7,5	6,8	8,0	8,0	F6	
2,2	3	09A8-2	2.2	9,8	8,8	11	11		R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2	3.7	17,6	15,8	17	17	F9	
5,5	7,5	24A4-2	5.5	24,4	21,96	25	25	F11	R3
7,5	10	31A0-2	7.5	31,0	27,9	33	33		R4
11	15	46A2-2	11	46,2	41,58	47	47	F13	
15	20		15			60	60		

Fuji Frenic-Multi

Overload ratings

- 150% of rated current for 1 min
- 200% for 0,5 sec

Output current derating required when swzitching frequency ≥ 4 kHz and inverter continuously runs at 100% load.

No series with inbuilt EMC filter available for 3~200 V. A filter is required to confirm with EMC directives.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 400V

3-phase 400V		ABB	FujiFrenic-	ABB ACS350		Fuji Frenic-Multi		Frenic-	
P_N	P_N	ACS350	Multi	I_{2N}	I_{2N}	Rated Output Current		Multi	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	FRN__	A	A	A	A	names	
kW	hp	03X-	E1S/E-4□	U_N=380-480 V		U_N=380-480 V		N/A	Frame
0,1	0,16								
0,2	0,25								
0,4	0,5	01A2-4	0.4	1,2	1,1	1,5	1,5	F7	R0
0,55	0,75	01A9-4		1,9	1,7				
0,75	1	02A4-4	0.75	2,4	2,2	2,5	2,5	F8	R1
1,1	1,5	03A3-4		3,3	3,0				
1,5	2	04A1-4	1.5	4,1	3,7	3,7	3,7	F10	
2,2	3	05A6-4	2.2	5,6	5,0	5,5	5,5		
3	4	07A3-4		7,3	6,6				
4	5	08A8-4	4.0	8,8	7,9	9,0	9,0	F10	
5,5	7,5	12A5-4	5.5	12,5	11,3	13	13	F12	R3
7,5	10	15A6-4	7.5	15,6	14,0	18	18		
11	15	23A1-4	11	23,1	20,8	24	24	F14	
15	20	31A0-4	15	31	27,9	30	30		R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Fuji Frenic-Multi

Overload ratings

- 150% of rated current for 1 min
- 200% for 0,5 sec

Output current derating required when swzitching frequency ≥ 4 kHz and load continuously at 100%.

Same current ratings for series without (S) and with (E) inbuilt EMC filter.

A filter (either inbuilt or separate) is required to confirm with EMC directives.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	FujiFrenic-Multi	ABB ACS350			Fuji Frenic-Multi			Frenic-Multi	ASC350
		Type	Type	1-phase			E series (inbuilt EMC filter)			Frame names	
		ACS350-	FRN_	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-	E1E-7☐	W	H	D	W	H	D	N/A	Frame
0,1	0,16		0.1				80	120	112	F3	
0,2	0,25		0.2								
0,4	0,5	02A4-2	0.4	70	169	161	80	120	127	F4	R0
0,55	0,75										
0,75	1	04A7-2	0.75	70	169	161	110	130	150	F6	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	1.5	105	169	165	140	180	194	F10	R2
2,2	3	09A8-2	2.2								

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	FujiFrenic-Multi	ABB ACS350			Fuji Frenic-Multi			Frenic-Multi	ASC350
		Type	Type	1-phase			E series (inbuilt EMC filter)			Frame names	
		ACS350-	FRN_	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-	E1E-7□	area	volume	weight	area	volume	weight	N/A	Frame
0,1	0,16		0.1				96	1,1	0,7	F3	
0,2	0,25		0.2								
0,4	0,5	02A4-2	0.4	118	1,9	1,2	96	1,2	0,8	F4	R0
0,55	0,75										
0,75	1	04A7-2	0.75	118	1,9	1,2	143	2,1	1,3	F6	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	1.5	177	2,9	1,5	252	4,9	2,5	F10	R2
2,2	3	09A8-2	2.2						3,0		

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	FujiFrenic-Multi	ABB ACS350			Fuji Frenic-Multi			Frenic-Multi	ASC350
		Type	Type	3-phase			S series (without EMC filter)			Frame names	
		ACS350-	FRN_	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	E1S-2□	W	H	D	W	H	D	N/A	Frame
0,1	0,16		0.1				80	120	92	F1	
0,2	0,25		0.2								
0,4	0,5	02A4-2	0.4	70	169	161	80	120	107	F2	R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	0.75				80	120	132	F5	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	1.5				110	130	150	F6	
2,2	3	09A8-2	2.2	105		165					R2
3	4	13A3-2									
4	5	17A6-2	3.7				140	180	151	F9	
5,5	7,5	24A4-2	5.5	169	169	169	180	220	158	F11	R3
7,5	10	31A0-2	7.5	260	181	169					R4
11	15	46A2-2	11				220	260	195	F13	
15	20		15								

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	FujiFrenic-Multi	ABB ACS350			Fuji Frenic-Multi			Frenic-Multi	ASC350
		Type	Type	3-phase			S series (without EMC filter)			Frame names	
		ACS350-	FRN_	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	E1S-2□	area	volume	weight	area	volume	weight	N/A	Frame
0,1	0,16		0.1				96	0,9	0,6	F1	
0,2	0,25		0.2								
0,4	0,5	02A4-2	0.4	118	1,9	1,2	96	1,0	0,7	F2	R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	0.75				96	1,3	0,8	F5	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	1.5				143	2,1	1,7	F6	
2,2	3	09A8-2	2.2	177	2,9	1,5					R2
3	4	13A3-2									
4	5	17A6-2	3.7				252	3,8	2,3	F9	
5,5	7,5	24A4-2	5.5	286	4,8	2,5	396	6,3	3,4	F11	R3
7,5	10	31A0-2	7.5	471	8,0	4,4			3,6		R4
11	15	46A2-2	11				572	11,2	6,1	F13	
15	20		15						7,1		

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	FujiFrenic-Multi	ABB ACS350			Fuji Frenic-Multi			Frenic-Multi	ASC350
		Type	Type				E series (inbuilt EMC filter)			Frame names	
		ACS350-	FRN_	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	E1E-4□	W	H	D	W	H	D	N/A	Frame
0,1	0,16										
0,2	0,25										
0,4	0,5	01A2-4	0.4	70	169	161	110	130	169	F7	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	0.75				110	130	193	F8	R1
1,1	1,5	03A3-4									
1,5	2	04A1-4	1.5				140	180	194	F10	
2,2	3	05A6-4	2.2								
3	4	07A3-4									
4	5	08A8-4	4.0				140	180	194	F10	
5,5	7,5	12A5-4	5.5	169		169	181,5	285	208	F12	R3
7,5	10	15A6-4	7.5								
11	15	23A1-4	11				220	332	250	F14	
15	20	31A0-4	15	260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	FujiFrenic-Multi	ABB ACS350			Fuji Frenic-Multi			Frenic-Multi	ASC350
		Type	Type				E series (inbuilt EMC filter)			Frame names	
		ACS350-	FRN_	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	E1E-4□	area	volume	weight	area	volume	weight	N/A	Frame
0,1	0,16										
0,2	0,25										
0,4	0,5	01A2-4	0.4	118	1,9	1,2	143	2,4	1,5	F7	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	0.75				143	2,8	1,6	F8	R1
1,1	1,5	03A3-4									
1,5	2	04A1-4	1.5			1,2	252	4,9	2,5	F10	
2,2	3	05A6-4	2.2								
3	4	07A3-4									
4	5	08A8-4	4.0				252	4,9	3,0	F10	
5,5	7,5	12A5-4	5.5	286	4,8	2,5	517	10,8	4,8	F12	R3
7,5	10	15A6-4	7.5						5,0		
11	15	23A1-4	11				730	18,3	8,1	F14	
15	20	31A0-4	15	471	8,0	4,4			9,1		R4
18,5	25	38A0-4									
22	30	44A0-4									

DIN rail mounting

Side-by-side mounting for all units

Installation

Fuji Frenic-Multi

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	No
Flange (option)	Yes for ≥ 5,5 kW
Wall (sideways)	No
Heatsinkless	No
Side-by-side	Yes for ≤ 4,0 kW with max. temperature +40°C

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	0 for < 5,5 kW, 10 for ≥ 5,5 kW

- Interchangeability attachment –option for replacing older Fuji inverters without machining
- Operational motor cable lengths:

  Information not available

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Fuji Frenic-Multi

- Inbuilt EMC filter for Category C2 In series E1E (comment: for ≥ 5,5 kW looks like factory installed footprint filter)
- External EMC filter for 1st environment as option for series E1S
- Chokes
  - DC reactors, Ferrite ring reactors, AC reactors and Output filters as option
- EMC compliant motor cable lengths:

	S series with optional external EMC filter, 15 kHz switching frequency
400V series 0.1… 7.5 kW	Category C1 25 m, Category C2 only conducted emissions 100 m
400 V series 11… 15 kW	Category C1 25 m Category C2 25 m
1~ 200 V series	Category C1 25 m Category C2 only conducted emissions 100 m

- THD
  - Information available in the catalogue for calculation of harmonic current

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 [1])	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 [1])	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

Fuji Frenic-Multi

- Removable keypad as standard
  - LED monitor, six keys, and five LED indicators.
  - Optional LAN extension cable (CB-☐S, 5/3/1 meters) for remote operation. A back cover for keypad replacement is delivered as standard.

- Multi-function keypad as option (TP-G1) for remote control and copying, requires optional extension cable
  - A 7-segment LED with five digits and large back-lighted liquid crystal panel
  - Storage of three complete inverter function sets
  - Gives guidance for operations

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

Start	Initiate operation of drive
Stop	Ceases operation of drive
Up	Changes parameters and their value/ increases reference
Down	Changes parameters and their value/ decreases reference
Loc/Rem	Changes drive state from local control to remote control
HELP	Built-in “Help” button
Soft key 1	Function changes according to state of panel
Soft key 2	Function changes according to state of panel

Machine interface (I/O)

Fuji Frenic-Multi

Type	*Qty.*	*Programmable*
Digital inputs	7	5 Yes, 2 terminals fixed for Forward and Reverse operation commands
Analog inputs	2	Yes
Pulse train input (requires optional PG interface card, max 30 kHz)	1	Yes
Relay outputs	2	Yes
Transistor outputs	2	Yes
Analog outputs	1	Optional for Pulse output use from same terminal
PLC terminal	1	

Specialities:

- One bipolar analog input (0 to ±10 V)
- PTC thermistor possible to connect to one analogue input
- Removable terminal block for easy wiring or replacing it with option boards PG interface-card for pulse train input or RS485 communication card
- DIO-card option, SY (synchronized operation) card option (ordered together with an inverter)

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input
- PTC thermistor possible to connect to one analogue input and output

Machine interface (fieldbus)

Fuji Frenic-Multi

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
Modbus RTU (RS 485)	Standard	Max. 38.4 kbps	Through keypad port
Modbus RTU (RS 485)	Option	Max. 38.4 kbps	OPC-E1-RS
DeviceNet	Option	500/250/125 kbps	OPC-E1-DEV
Profibus DP	Option		OPC-E1-PDP
CC-Link	Option		OPC-E1-CCL

- Fieldbus modules are of front installation type (adapters)

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

Motor control

Fuji Frenic-Multi

- V/f control
- Dynamic torque-vector control (magnetic fux estimator)
- V/f control (with sensor, when the PG interface card (option) is installed)

Braking

- Braking transistor available as standard
  - Max. braking torque 150%
  - Continuously 100% braking torque
  - Regenerative braking with braking resistor option 10%ED, cycle less than 100s

Output frequency

- 400 Hz as maximum output frequency

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Fuji Frenic-Multi

- No macros
- 6 languages available in the optional Multi-function keypad
  - Japanese, English, German, French, Spanish, Italian
  - On request available another multiple language version supporting Japanese, English, Chinese, Korean, simplified Chinese

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

FlashDrop
Sequency programming
Flux braking
List of changed parameters
Motor temperature measurement
2 PIDs

Fuji Frenic-Multi

- Automatic switching frequency control (decrease of switching freq. to protect the inverter depending on environmental temperature and output current) *(
- 2 settings for switching frequency, selectable with e.g. external signal (DI)
- 2 sets of motor data *(
- Optimum and minimum power control (minimizes power consumed by the inverter itself (inverter loss) and loss of the motor, comment: cooling fan on/off function, output voltage is controlled to minimize the total sum of the motor loss and inverter loss at a constant speed)
- Slip-compensation control (minimizes variations in speed control accuracy when load varies enabling shortening of cycle tact times) *(
- Automatic deceleration control (overvoltage tripping avoided by controlling of energy level generated and the dec. time) *(
- Hit & Stop control (stop mode including switch from torque limitation to current limitation and holding torque generation) for brake applications *(
- Inclusion of brake control signals *(
- Command (signal) loss detection with preset output frequency for command loss cases *(
- Overload stop function (when a load detection level is overstepped a predefined time, drive decelerates to stop) (*
- Overload avoidance operation (motor speed is reduced in case of sudden inverter temperature rise) *(
- Dummy alarm outputting function *(

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support (**
- Bipolar analog input (**
- Pulse train input and output (**
- IO and mains supply protection (**
- Flux braking
- Speed compensated stop (**
- Timer and counter start/stop
- Mechanical brake control (**
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog (**
- No shaft rotation with zero reference (**

(** Basic feature in Fuji Frenic-Multi

Other advanced features

Fuji Frenic-Multi

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

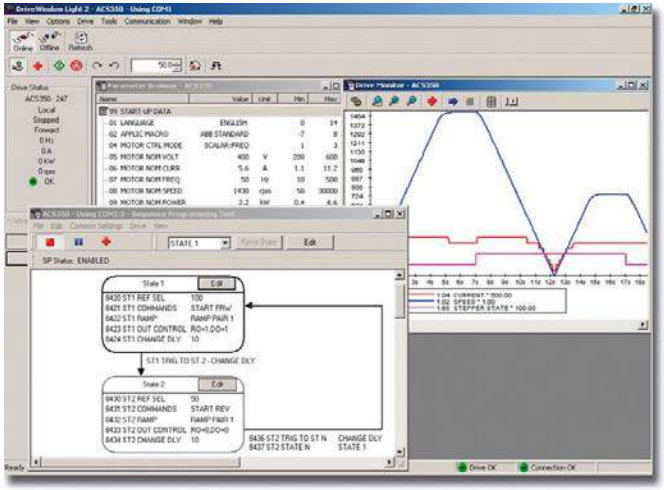
Other advanced features (cont)

Fuji Frenic-Multi

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Fuji Frenic-Multi

- As standard RS-485 communications from RJ-45 connector (keypad communications port), for connection to PC requires optional USB/RS-485 converter (includes USB cable to PC)
- Optional RS-485 communication card (OPC-E1-RS), replaces the standard interface card
- Loader software (PC software)
  - Windows GUI (graphical user interface) based
  - Inverter function settings
  - Upload/download all the function values to/from a file

ABB ACS350

- Easy access through RS 232 panel port
- DriveWindow Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Fuji Frenic-Multi

- Multi-function keypad TP-G1
- Extension cable for keypad CB-..S (..= 5/3/1 m)
- RS485 Communications card OPC-E1-RS
- PG interface cards OPC-E1-PG(3)
- Fieldbus interface cards
- Additional I/O card OPC-E1-DIO
- Attachment for external cooling PB-F1
- DC reactors DCR☐
- Output filters OFLE
- Ferrite ring reactors ACL
- EMC input filters
- AC reactors ACRE
- Interchangeability attachments MA-E1-☐☐
- Braking resistors DB☐☐- ☐

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Fuji Frenic-Multi

- Long-life design 87600h (=10 years) for limited life internal components (at 40°C with 80%*rated current)
  - Main circuit capacitors
  - Electrolytic capacitors on the PCBs
  - Cooling fan (fan in ≥1.5 kW types, comment: 2 fans at least in some types)
- Parameters for indication for/of
  - Replacing DC link bus capacitor
  - Replacing capacitors on the PCBs
  - Cumulative run time of cooling fan for replacement
  - Motor cumulative running time
  - Cumulative startup times
- Simple cooling fan replacement in 5.5 kW or higher models (comment: fan in all types ≥1.5 kW)
- Alarm history of the latest 4 failures with information (output frequency, I/O status, output current)

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Fuji Frenic-Multi

Approvals

- CE, UL, cUL

Compliance with

- Low Voltage Directive 73/23/EEC (LVD)
- EMC Directive 89/336/EEC (Electromagnetic Compatibility)
- RoHS directive 2002/95/EC with amandments (compliant except for interior soldering in the power module)

Applicable standards

- EN61800-3:1997 and EN61800-3/A11:2000
- Safety standards UL508C, C22.2No 14 (pending), EN50178:1997
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Fuji Frenic-Multi FRN

Model: FRN4.0E1E-4E

Drive rating: 380-480V
3.7 kW
9.0 A

Tester (experienced drive specialist) comments:

- Power terminals are saddle clamp but the clamps are too small. Motor and power are clearly marked. Recommending max 2mm2
- Control terminals are pre-backed out
- No possible strain relief for control cables
- Settings

F01	Freq Cmd Source = 1 (Term 12) => Defaults to keypad
F02	Start Stop source = Term FWD => Defaults to keypad
F03	Max HZ=60
F04	Base Hz=60
F05	Base Volts=460
F06	Max V=460
F07	ACC time 1=1
F08	DEC time 1=1
F37	Load Type= 2 Auto Boost
F42	Control Mode = 1 Dynamic Tq Vector
P03	Motor FLA = 7
P12	Rated Slip Freq = 1.17
P99	Motor Type = 1 Std non Fuji
H69	Tripless decel = 4 (no max time) can limit to 3X programmed decel or deactivate

- Relatively easy to understand programming for the LED operator used.
- Drive would only do a static tune. On rotate tune, each time it attempted to rotate it faulted and gave an Err7 Tune Error.
- Need a magnifying glass to read the font size in the Manual.
- Excellent speed torque curves. Over compensates for slip.

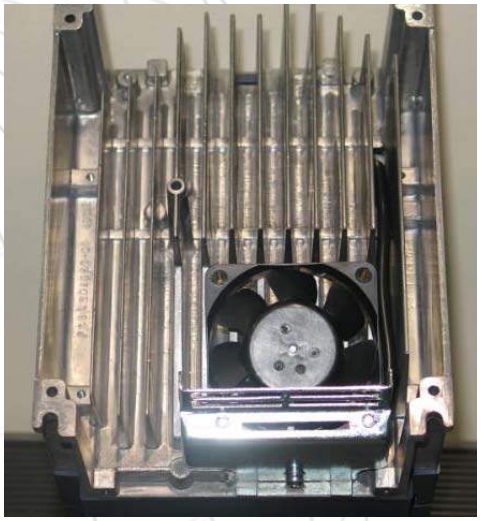
ABB ACS350

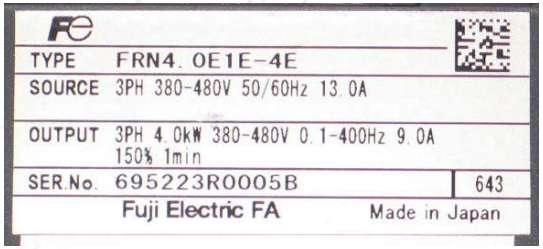
Model: ACS350-03U-08A8-4

Drive rating: 380-480V
4.0 kW / 5.0 HP
8.8 A

Parameter Settings:
9902 Torque Control
9904 Vector:Speed
9905 460V
9906 7.0A
9907 60Hz
9908 1765 RPM
9909 5.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

Photos of the tested unit





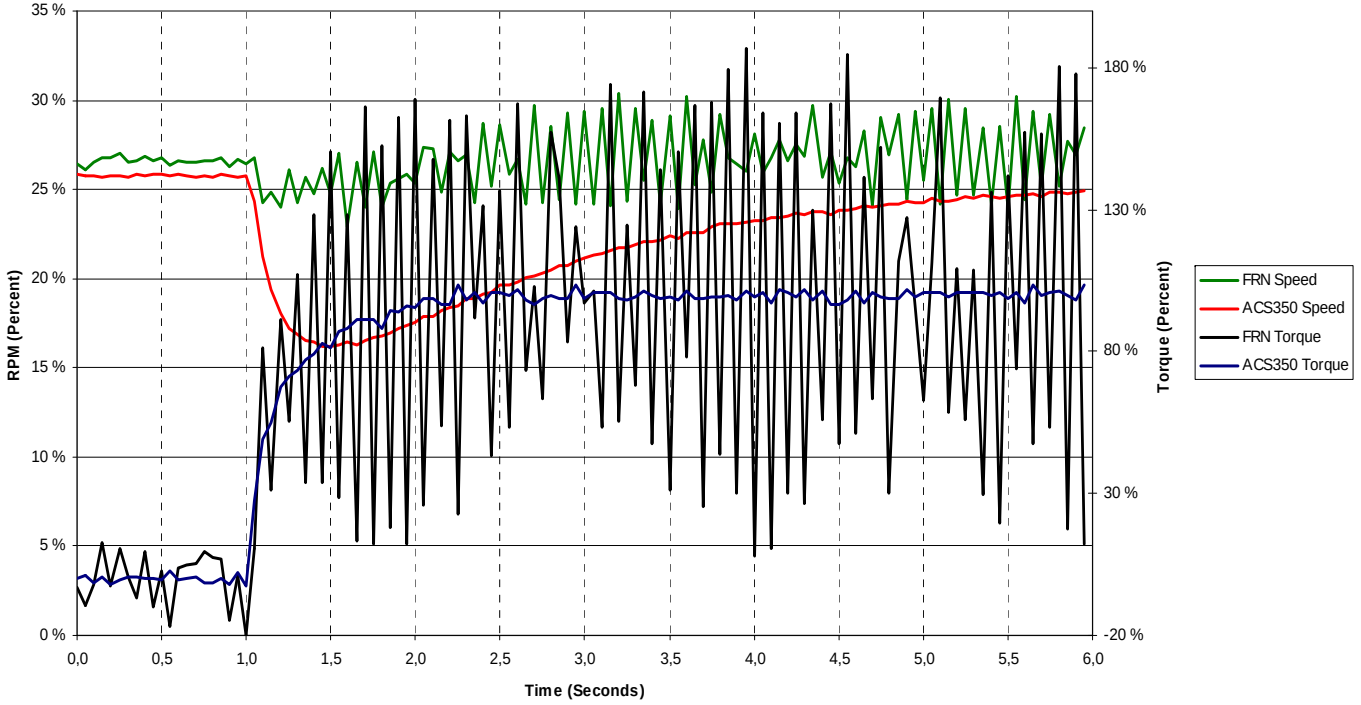
Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | **Fuji Frenic-Multi** | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Impact load test – Dynamic speed accuracy (stiffness)

Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.



Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive operates in case of disturbances. The ACS350's speed control default tuning is quite conservative to ensure the controller is stable despite the motor used and its size compared to the size of the inverter. The FRN has good dynamic speed accuracy despite the amount of speed and torque ripple. The performance of ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL).

Mitsubishi E700

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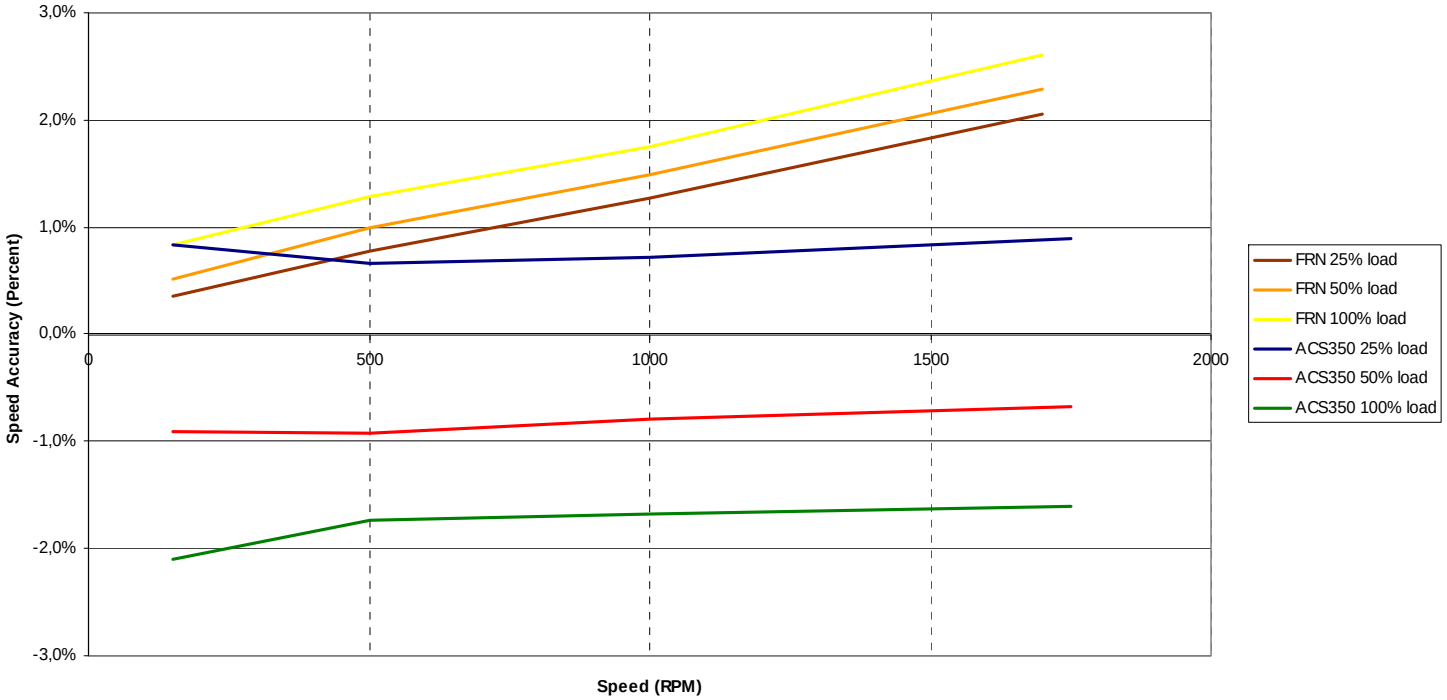
Static speed accuracy

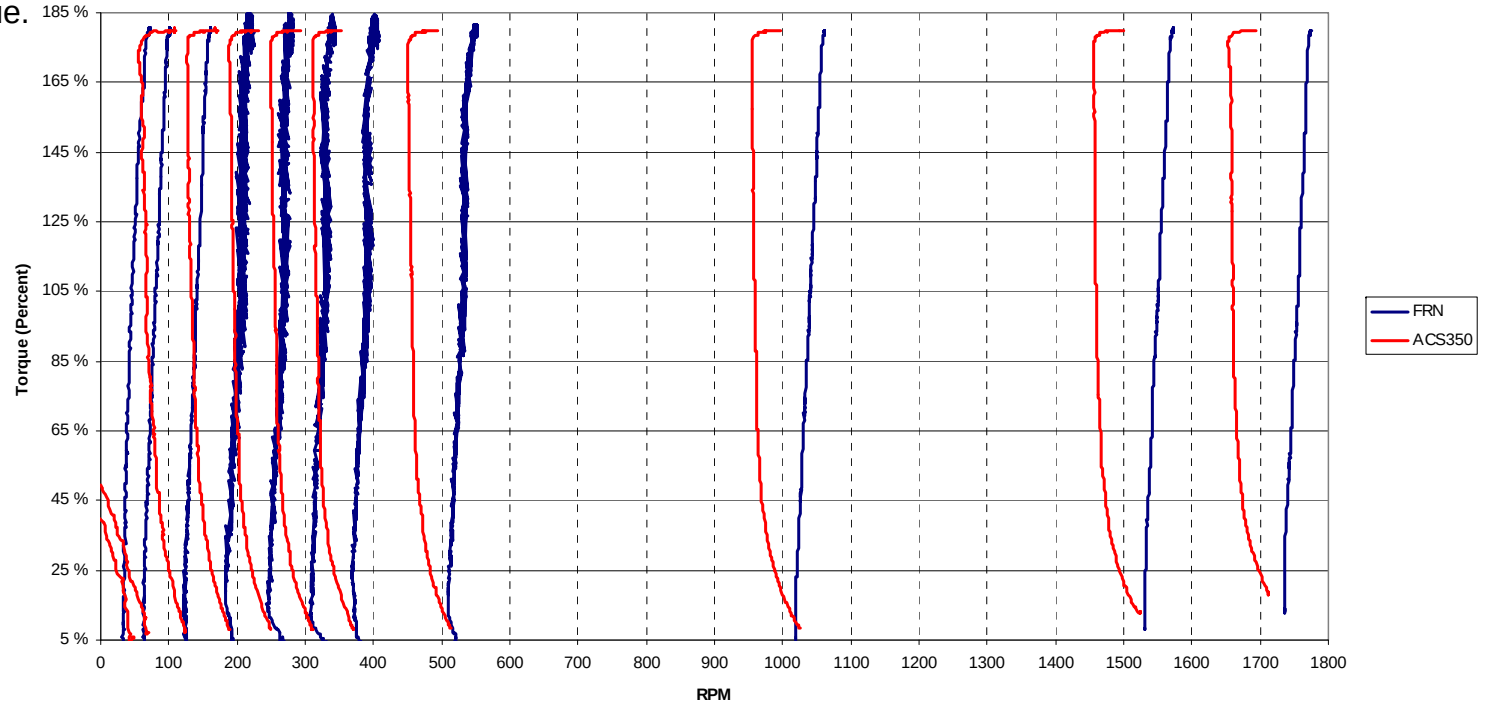
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 25%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), Speed Error [%] = $(n^*-n_{act}) / n_{N/mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Static speed error depends on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). The speed error of FRN is very linear as a function of speed and is quite insensitive to the load. FRN has greater maximum error indeed. Again the performance of the ACS350 can be improved in this test by tuning the speed controller (parameter group 23 SPEED CONTROL).

Maximum torque as a function of speed

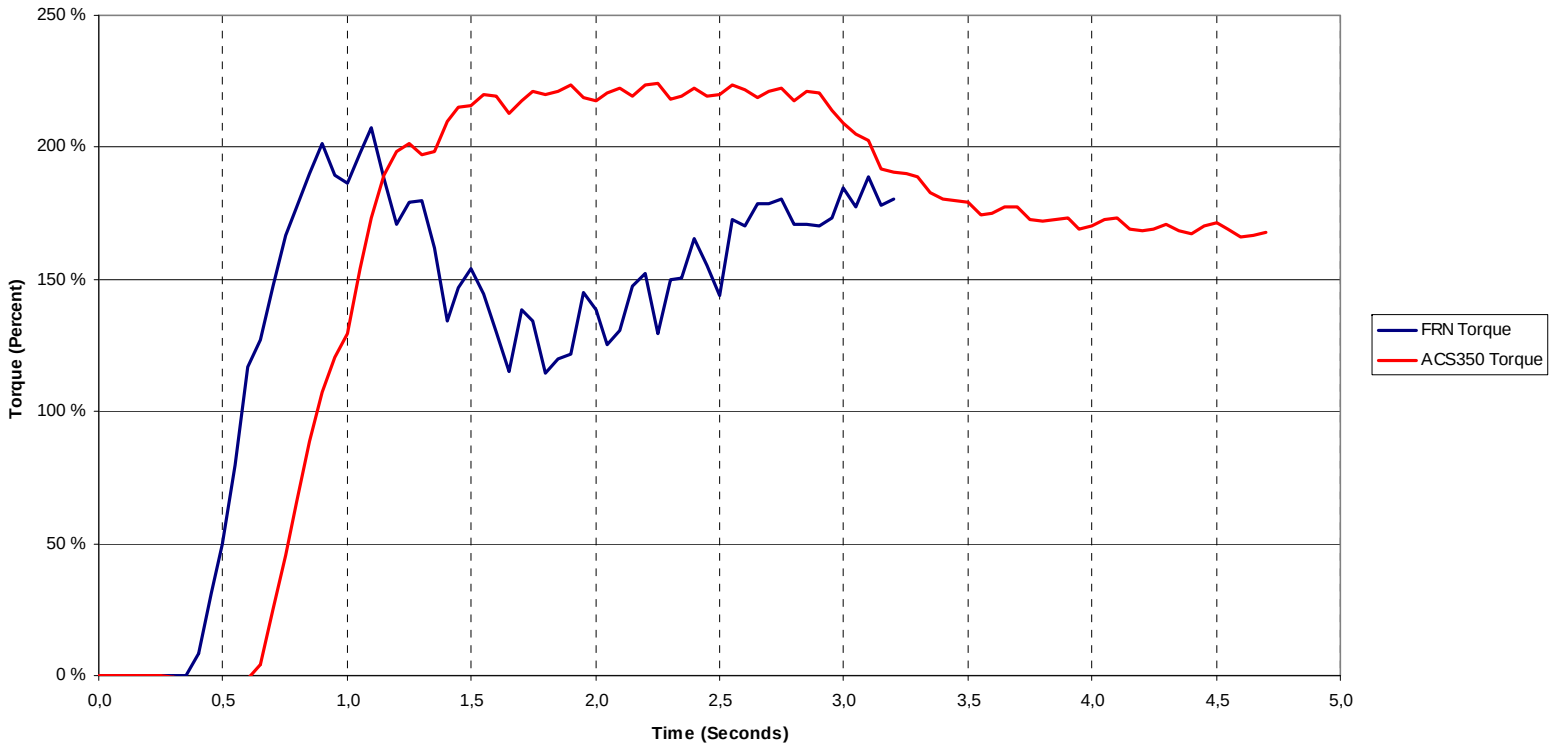
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



FRN has excellent speed torque curves. Over compensates for slip. The ACS350 has also good speed range because it could provide full output torque from 1700 rpm's down to 120 rpm. The quite conservative speed controller tuning of ACS350 can be seen also in this test as a slight speed drop in each test point and it can be improved by tuning the speed controller (parameter group 23 SPEED CONTROL).

Maximum starting torque

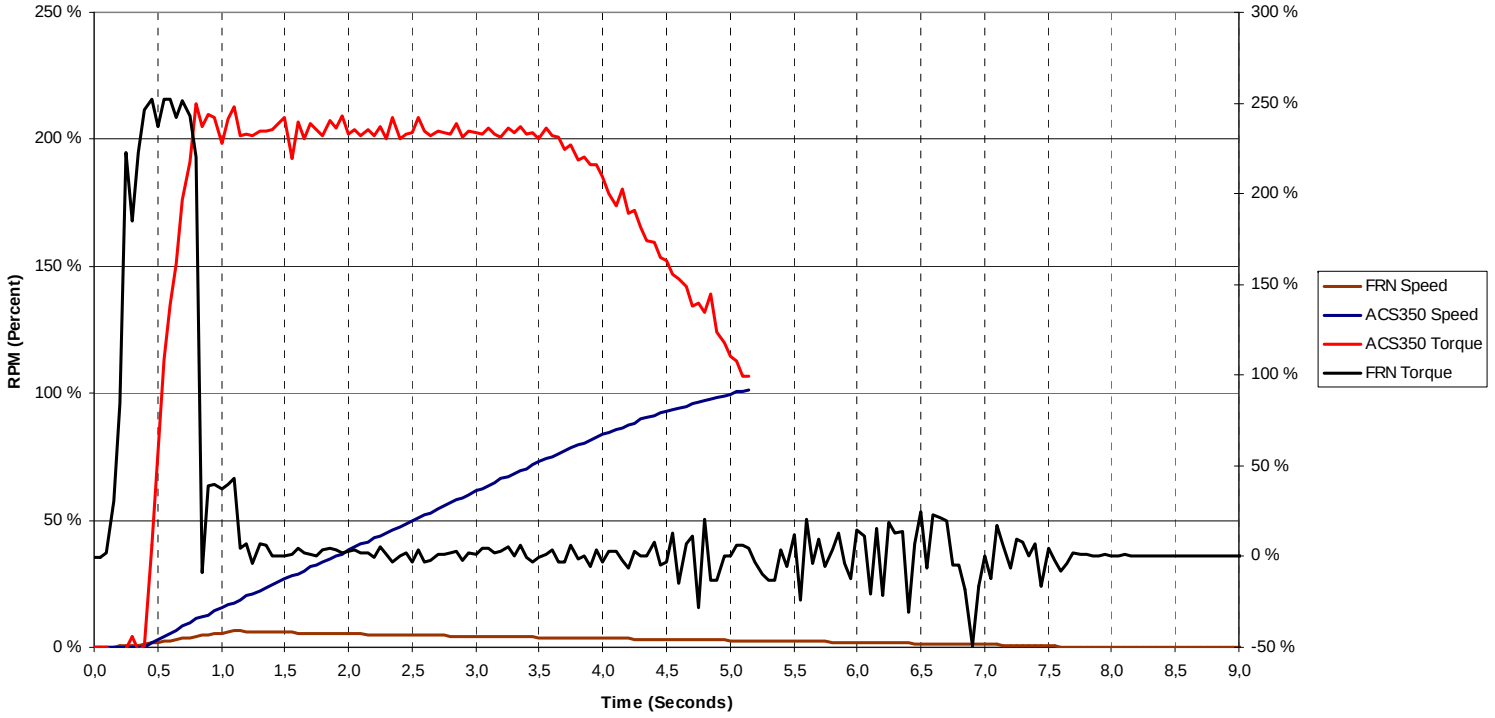
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



ACS350 has good starting torque up to 200%. ACS350 reduces torque after 2 s due to current limiting. The FRN could produce maximum torque of 200% only for 0.5s and also exhibited quite big torque ripple. The behavior of the FRN can be a problem in applications requiring high starting duty or high-inertia acceleration.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 (0.95 kgm^2) inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



FRN: Test failed.

Tester's comment: Tried to adjust current limiter and turn currrent limiter off with no change in results. Tried turning off stall prevention with no change in results. ACS350 has performed with 150% current limit.

Efficiency

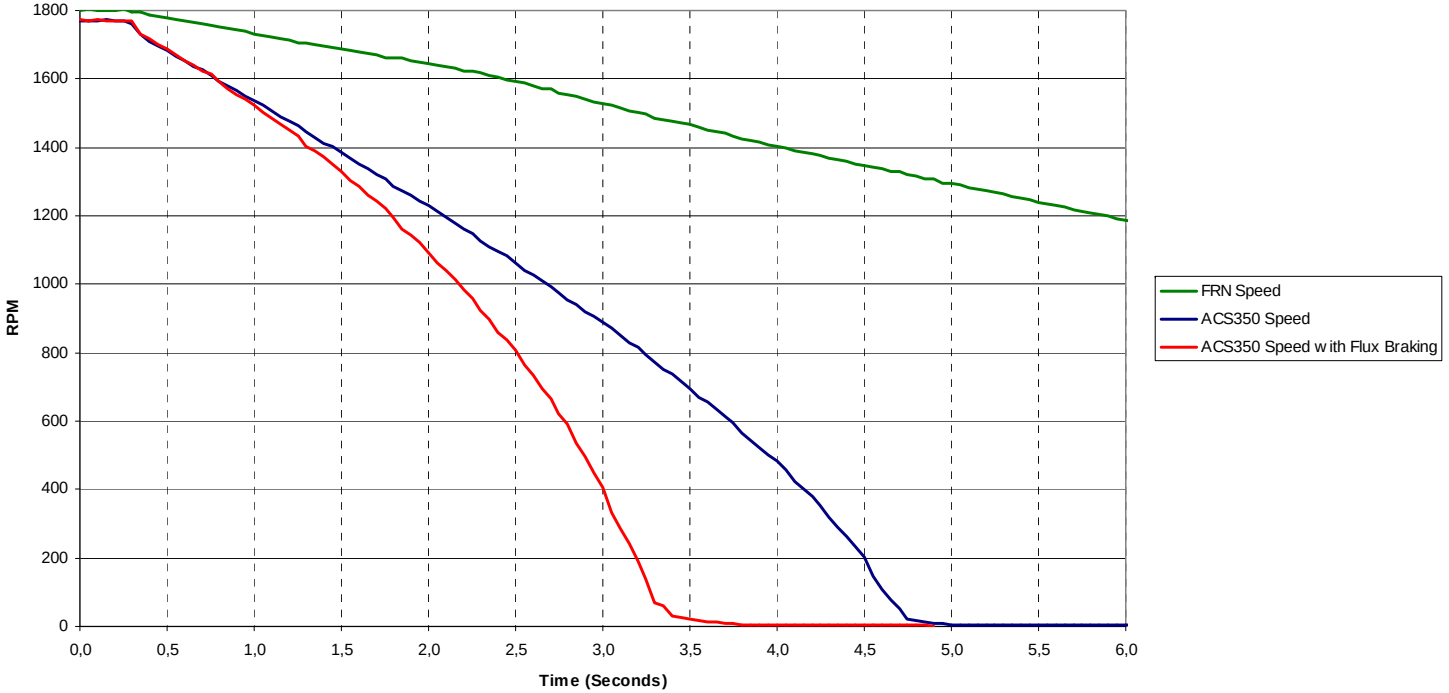
Using power analyzer, input power, speed and torque of AC motor are measured at 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	FRN
25%	87.6%	83.7%
50%	90.6%	97.0%
75%	90.5%	88.6%
100%	90.2%	87.5%

Both drives performed the test equally.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



ACS350 was able to decelerate to zero within 5,5 seconds. ACS350 with flux braking shortened the deceleration time even more. The FRN didn't perform the test as well as the ACS350 and the behaviour of FRN corresponds to performance when a drive trips on overvoltage fault.

ABB strenghts

ACS350 advantages over Fuji Frenic-Multi

Wide power range	Application macros 7 pcs
Volumes of 400 V units	User macros 3 pcs
Weights of 400 V units	17 languages
Versatile mounting possiblities	FlashDrop
DIN rail mounting	Sequence programming
Side-by-side mounting for all units	Flux braking
Assistant control panel option	List of changed parameters
Panel cover	Motor temperature measurement
Potentiometer option	2 PIDs
Fast Modbus connection	Maintenance need indication
500 Hz output frequency	Detailed fault history with time

For ACS350 advantages in performance, see the performance test slides



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | **Danfoss VLT 2800** | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Danfoss VLT 2800

- The VLT 2800 series is developed for the low power market, and is available in the power range 0.37 – 18.5 kW. This frequency converter is extremely compact and prepared for side-by-side mounting.
- For power range 0.37 to 18.5 kW
- The concept is modular with a power module and a control module.The VLT 2800 is available with the following accessories, e.g.
  - Output line reactors, RFI filter, LC + 1B RFI filters. These options can be combined.
- Another benefit offered by the VLT 2800 frequency converter is flexibility. The DC bus allows load sharing between all drives in the application saving energy and stopping all parts of the application simultaneously.
- A robust design, including a built-in RFI filter 1A makes the frequency converter compliant with the EMC directive EN 55011 1A requirement while the built-in fan protects the frequency converter, thus saving time at installation and service.

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Protection class

Danfoss VLT 2800

- IP 20
- NEMA 1, 4 and 4X (options)

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Nominal ratings available -10°C

Ambient specification

Danfoss VLT 2800

Vibration

- 0.7 g

Shock

- N/A

Temperature

- Operating temperature 0 - 45 ºC, 24-hour average max. 40 ºC during full-scale operation
- Min. ambient temperature at reduced performance -10ºC
- Storage/transportation temperature -25ºC to +65/70ºC

Humidity

- Lower than 95%

Altitude limitations

- 1000 m or less. Higher by derating of output current versus altitude.

Acoustic noise

- 3.0…10.0/14.0 kHz, current output automatically decreased with higher than 4.5 kHz switching frequency
- At a distance of 1 m from the unit at full load: below 55 dB(A)

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating and reduced lifetime.
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Danfoss VLT 2800

Voltage types and power range

- 1-phase 220 - 240 V ±10%
  - 0.37 to 3,7 kW
- 3-phase 200 - 240 V ±10%
  - 0.37 to 3.7 kW
- 3-phase 380 - 480 V ±10%
  - 0.55 to 18.5 kW

Power factor

- 0.90/1.0 at rated load

Supply frequency

- 50/60 Hz, tolerance ±10%

Supply networks

- If the frequency converter is supplied from an isolated mains source (IT mains) or TT/TN-S mains with grounded leg, the RFI switch is recommended to be turned off (OFF).

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Danfoss	ABB ACS350		Danfoss VLT 2800		Danfoss	
P_N	P_N	ACS350	VLT2800	I_{2N}	I_{2N}	I_{INV}	I_{INV}	VLT 2800	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	01X-		U_N=200-240 V		U_N=220-240 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	02A4-2	2803	2,4	2,2	2,2	-		R0
0,55	0,75		3805			3,2	-		
0,75	1	04A7-2	2807	4,7	4,2	4,2	-	F1	R1
1,1	1,5	06A7-2	2811	6,7	6,0	6	-		
1,5	2	07A5-2	2815	7,5	6,8	6,8	-		R2
2,2	3	09A8-2	2822	9,8	8,8	9,6	-	F2	
3	4								
3,7	5		2840			16	-	F3	

Danfoss VLT 2800

Overload ratings

- 160 % for 60 sec.
- 180 % for 0.5 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 200V

3-phase 200V		ABB	Danfoss	ABB ACS350		Danfoss VLT 2800		Danfoss	
P_N	P_N	ACS350	VLT2800	I_{2N}	I_{2N}	I_{INV}	I_{INV}	VLT 2800	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-		U_N=200-240 V		U_N=200-240 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	02A4-2	2803	2,4	2,2	2,2	-		R0
0,55	0,75	03A5-2	2805	3,5	3,2	3,2	-		
0,75	1	04A7-2	2807	4,7	4,2	4,2	-	F1	R1
1,1	1,5	06A7-2	2811	6,7	6,0	6,0	-		
1,5	2	07A5-2	2815	7,5	6,8	6,8	-		
2,2	3	09A8-2	2822	9,8	8,8	9,6	-	F2	R2
3	4	13A3-2		13,3	12,0				
3,7	5	17A6-2	2840	17,6	15,8	16,0	-	F3	
5,5	7,5	24A4-2		24,4	21,96				R3
7,5	10	31A0-2		31,0	27,9				R4
11	15	46A2-2		46,2	41,58				

Danfoss VLT 2800

Overload ratings

- 160 % for 60 sec.
- 180 % for 0.5 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 400V

3-phase 400V		ABB	Danfoss	ABB ACS350		Danfoss VLT 2800		Danfoss	ASC350
P_N	P_N	ACS350	VLT2800	I_{2N}	I_{2N}	I_{INV}	I_{INV}	VLT 2800	
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-		U_N=380-480 V		U_N=380-480 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	01A2-4		1,2	1,1				R0
0,55	0,75	01A9-4	2805	1,9	1,7	1,7	-	F1	
0,75	1	02A4-4	2807	2,4	2,2	2,1	-		R1
1,1	1,5	03A3-4	2811	3,3	3,0	3,0	-		
1,5	2	04A1-4	2815	4,1	3,7	3,7	-		
2,2	3	05A6-4	2822	5,6	5,0	5,2	-	F2	
3	4	07A3-4	2830	7,3	6,6	7,0	-		
4	5	08A8-4	2840	8,8	7,9	9,1	-		
5,5	7,5	12A5-4	2855	12,5	11,3	12,0	-	F3	R3
7,5	10	15A6-4	2875	15,6	14,0	16,0	-		
11	15	23A1-4	2880	23,1	20,8	24,0	-	F4	
15	20	31A0-4	2881	31	27,9	22,0	-		R4
18,5	25	38A0-4	2882	38	34,2	37,5	-		
22	30	44A0-4		44	39,6				

Danfoss VLT 2800

Overload ratings

- 160 % for 60 sec.
- 180 % for 0.5 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Danfoss VLT2800	ABB ACS350			Danfoss VLT 2800			Danfoss VLT 2800	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-		W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2	2803	70	169	161					R0
0,55	0,75		3805								
0,75	1	04A7-2	2807	70	169	161	75	200	168	F1	R1
1,1	1,5	06A7-2	2811								
1,5	2	07A5-2	2815	105	169	165					R2
2,2	3	09A8-2	2822				90	267,5		F2	
3	4										
3,7	5		2840				140	267,5	168	F3	

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Danfoss VLT2800	ABB ACS350			Danfoss VLT 2800			Danfoss VLT 2800	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-		area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2	2803	118	1,9	1,2					R0
0,55	0,75		3805								
0,75	1	04A7-2	2807	118	1,9	1,2	150	2,5	2,1	F1	R1
1,1	1,5	06A7-2	2811								
1,5	2	07A5-2	2815	177	2,9	1,5					R2
2,2	3	09A8-2	2822				240,75	4,0	3,7	F2	
3	4										
3,7	5		2840				374,5	6,3	3,7	F3	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Danfoss VLT2800	ABB ACS350			Danfoss VLT 2800			Danfoss VLT 2800	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2	2803	70	169	161	75	200	168	F1	R0
0,55	0,75	03A5-2	2805								
0,75	1	04A7-2	2807								R1
1,1	1,5	06A7-2	2811								
1,5	2	07A5-2	2815								
2,2	3	09A8-2	2822	105		165	90	267,5		F2	R2
3	4	13A3-2									
3,7	5	17A6-2	2840				140	267,5	168	F3	
5,5	7,5	24A4-2		169	169	169					R3
7,5	10	31A0-2		260	181	169					R4
11	15	46A2-2									

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Danfoss VLT2800	ABB ACS350			Danfoss VLT 2800			Danfoss VLT 2800	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2	2803	118	1,9	1,2	150	2,5	2,1	F1	R0
0,55	0,75	03A5-2	2805								
0,75	1	04A7-2	2807								R1
1,1	1,5	06A7-2	2811								
1,5	2	07A5-2	2815								
2,2	3	09A8-2	2822	177	2,9	1,5	240	4,0	3,7	F2	R2
3	4	13A3-2									
3,7	5	17A6-2	2840				374	6,3	3,7	F3	
5,5	7,5	24A4-2		286	4,8	2,5					R3
7,5	10	31A0-2		471	8,0	4,4					R4
11	15	46A2-2									

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Danfoss VLT2800	ABB ACS350			Danfoss VLT 2800			Danfoss VLT 2800	ASC350
		Type	Type								
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4		70	169	161					R0
0,55	0,75	01A9-4	2805				75	200	168	F1	R1
0,75	1	02A4-4	2807								
1,1	1,5	03A3-4	2811								
1,5	2	04A1-4	2815								
2,2	3	05A6-4	2822				90	267,5		F2	
3	4	07A3-4	2830								
4	5	08A8-4	2840								
5,5	7,5	12A5-4	2855	169		169	140		268	F3	R3
7,5	10	15A6-4	2875								
11	15	23A1-4	2880				200	505	244	F4	R4
15	20	31A0-4	2881	260	181	169					
18,5	25	38A0-4	2882								
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Danfoss VLT2800	ABB ACS350			Danfoss VLT 2800			Danfoss VLT 2800	ASC350
		Type	Type								
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4		118	1,9	1,2					R0
0,55	0,75	01A9-4	2805				150	2,5	2,1	F1	
0,75	1	02A4-4	2807								R1
1,1	1,5	03A3-4	2811			1,2					
1,5	2	04A1-4	2815								
2,2	3	05A6-4	2822				240	4,0	3,7	F2	
3	4	07A3-4	2830								
4	5	08A8-4	2840								
5,5	7,5	12A5-4	2855	286	4,8	2,5	374	10,0	6	F3	R3
7,5	10	15A6-4	2875								
11	15	23A1-4	2880				1010	24,6	18,5	F4	
15	20	31A0-4	2881	471	8,0	4,4					R4
18,5	25	38A0-4	2882								
22	30	44A0-4									

Installation

Danfoss VLT 2800

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	No
Flange	No
Wall (sideways)	No
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	0

- Screw connectors, fixed screw terminals
- Operational motor cable lenghts:
  - Unscreened/unarmoured motor cable 75 m, screened/armoured motor cable 40 m
  - With a motor coil up to 200 metres of unscreened/unarmoured motor cable or 100 metres of screened/armoured motor cable

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

EMC and harmonics

Danfoss VLT 2800

- Filters
  - Types with and without an integral 1A RFI-filter
  - Additional external 1B filter can be used together with inbuilt 1A filter to achieve longer motor cables or to comply with EN55011 class 1B conducted emissions
  - It is not possible to comply with EN55011 class 1B radiated emissions with any filter or filter combination
- Chokes
  - Motor coils (=output chokes) as option
- EMC compliant motor cable lengths for types with 1A inbuilt filter in EN55011 class 1A (2nd environment)
  - 1~200 V: 40 m, with additional 1B filter 100 m
  - 3~200V: 20 m
  - 3~480V up to 7.5 kW: 25 m, with additional 1B filter 50 m
- EMC compliant motor cable lengths in EN55011 class 1A (2nd environment)
  - 3~480V 11 – 18.5 kW: with 1B filter 50 m
- THD
  - All 3-phase 380-480 V units comply with EN 61000-3-2. Information on 1-phase units not available

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

2 detatchable control panel options

Panel cover

User interface

Danfoss VLT 2800

- Six-digit LED display
- Keys for changing parameters and shifting display function
- Indicator lamps
- Keys for local operation
- As option remote mount LCP (Local Control Panel) and LCP-2 remote mounting kit

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66.

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Machine interface (I/O)

Danfoss VLT 2800

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	1	Yes
Pulse train input	1	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- N/A

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Danfoss VLT 2800

Protocol	*Standard /Optional*	*Baud rate*	*Notes*
Metasys N2	Standard	N/A	
DeviceNet	Optional	Up to 500 kbit/s	
Profibus DP3	Optional	3Mbit/s	
Profibus DP12	Optional	12Mbit/s	

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

Motor control

Danfoss VLT 2800

- Open Loop Vector Mode
- V/Hz Mode

Braking

- Brake chopper built-in
- Braking resistors are not integrated into the frequency converter

Output frequency

- 1 – 1000 Hz with both scalar and vector control.

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Danfoss VLT 2800

N/A

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Danfoss VLT 2800

- A hand-auto function, that operates directly from the built-in control panel *(
- Quick menu includes all parameters basically needed for commissioning the drive
- Speed compensation; precise stop *(
- Automatic motor tuning (measures the stator resistance RS, measurements done without applying torque) *(
- Checks for missing motor phases *(

(* = Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Danfoss VLT 2800

- A power unit/control unit option that means components are more interchangeable between models and can be easily combined with other options and busses at a users' site

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

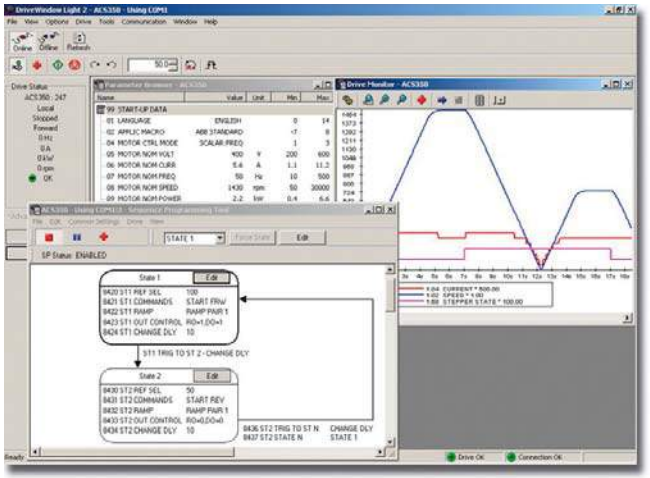
Danfoss VLT 2800

N/A

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Danfoss VLT 2800

- PC Software - MCT 10
- Planning a communication network offline. MCT 10 contains a complete frequency converter database
  - Commissioning frequency converters online
  - Saving settings for all frequency converters
  - Replacing a drive in a network
  - Expanding an existing network
  - Future developed drives will be supported
- Supports Profibus DP-V1 via a Master class 2 connection

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Danfoss VLT 2800

- NEMA 1, 4 and 4X kits
- Motor coils
- Remote mount LCP (Local Control Panel)
- LCP-2 remote mounting kit
- Dynamic brake chopper
- Brake resistors
- RFI filter (Class 1 Group A)
- RFI filter (Class 1 Group B)NEMA 1 and NEMA 4 APU enclosures
- All pulse/encoder inputs are galvanically isolated from the supply voltage (PELV)

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Danfoss VLT 2800

N/A

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Danfoss VLT 2800

Approvals

- CE, UL

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements

Applicable standards

- EN 61000-4-4 (IEC 61000-4-4): Burst transients Simulation of interference brought about by switching with contactors, relays or similar devices.
- EN 61000-4-5 (IEC 61000-4-5): Surge transients Simulation of transients brought about e.g. by lightning that strikes near installations.
- EN 61000-4-2 (IEC 61000-4-2) : Electrostatic discharges (ESD)Simulation of electrostatic discharges from human beings.
- EN 61000-4-3(IEC 61000-4-3): Incoming electromagnetic field radiation, amplitude modulated.Simulation of the effects of radar and radio broadcast devices as well as mobile communication devices.
- VDE 0160 class W2 test pulse: Mains transients Simulation of high-energy transients generated by breaks in master fuses, connection to phase advancer batteries and the like.
- EN 61000-4-6 (IEC 61000-4-6): RF Common mode Simulation of the effect from radio-transmitting equipment connected to connection cables.

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Danfoss VLT2800

Model: VLT2822

Drive rating: 380-480V
3.6 kVA (2.2 kW)
5.2 A

Tester (experienced drive specialist) comments:

- VLT2822 has violent current limit, chopping the waveform dramatically during current limit.
- You must install a hard jumper to achieve ramp to stop.
- Ramp-down time is the deceleration time from the rated motor frequency to 0 Hz, provided no overvoltage arises in the inverter because of generating operation of the motor, or if the generated current exceeds the current limit in parameter 221 Current limit ILIM."
- The 2.2 kW drive could not handle any load above 50 % w/o current limit and stall.
- I tried to use the autotune, but it rejected the motor values. Much like the Yaskawa and AC Tech drive if the motor rating is outside the drive rating the inductance and resistance values are outside the motor control data limits. I then had to reset to factory defaults before the drive could control the motor.
- Programming is relatively easy once you understand the parameter list but some parameters and keystrokes did not match the User Manual.
- Very old technology.

ABB ACS350

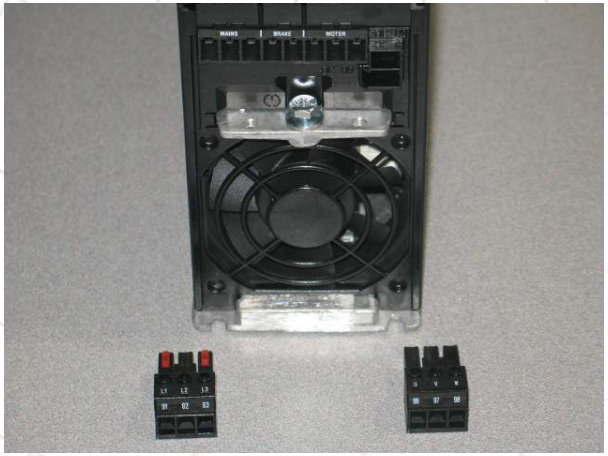
Model: ACS350-03U-05A6-4

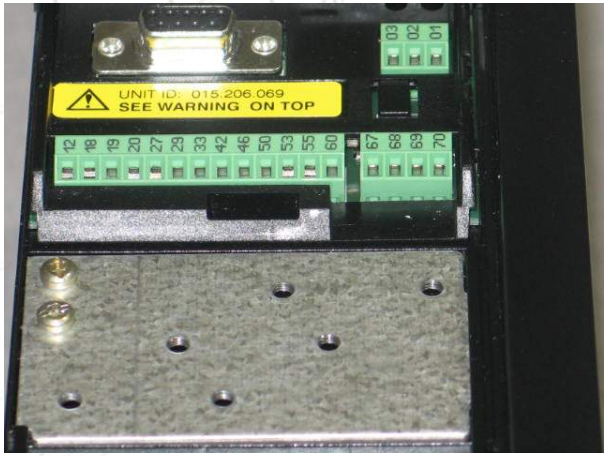
Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A

Parameter Settings:

9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

Photos of the tested unit





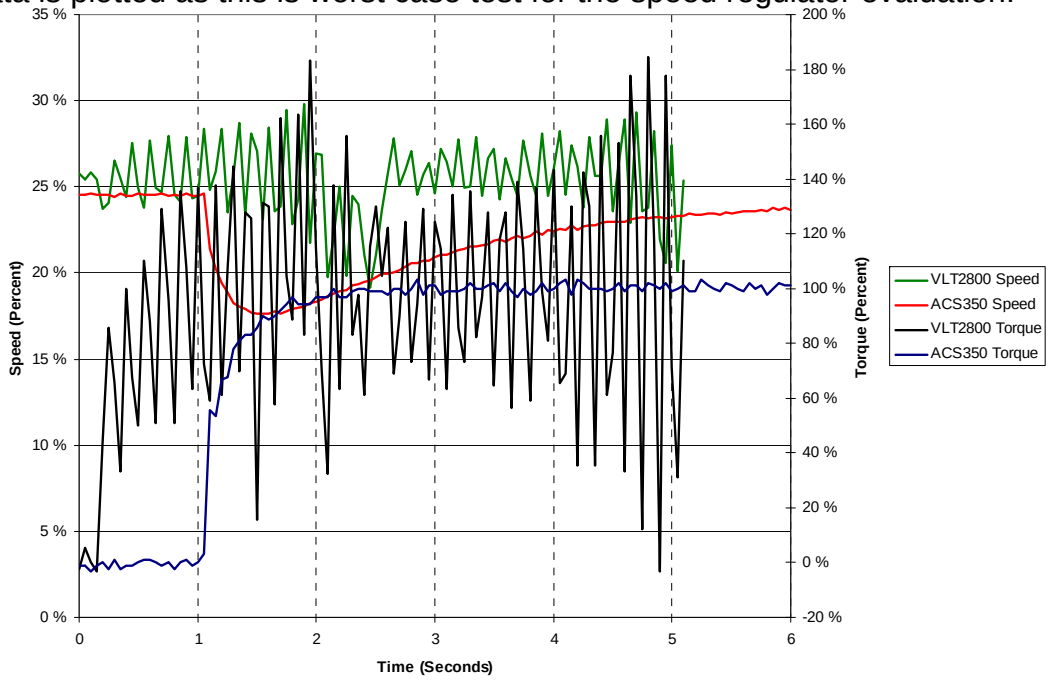
Mitsubishi E700

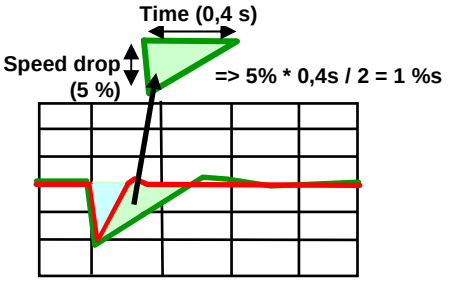
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | **Danfoss VLT 2800** | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Impact load test – Dynamic speed accuracy (stiffness)

Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.

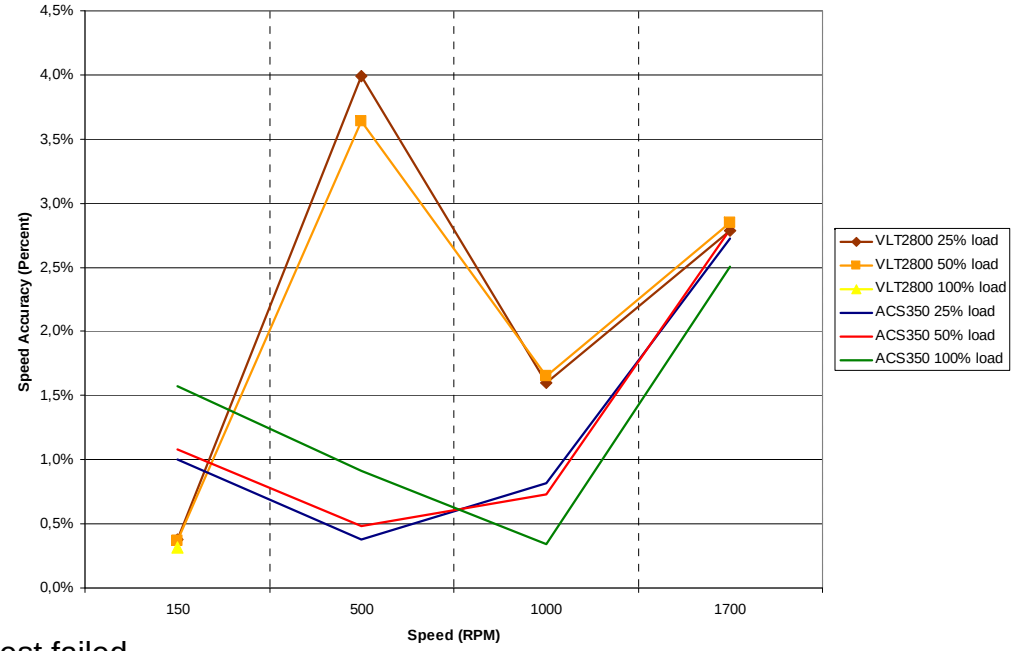




Tester comments: Extremely hard current limit spikes. Motor cogging very evident.
Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive works in case of disturbances. The ACS350 the speed control default tuning is quite conservative to ensure the controller is stable despite motor used and its size compared to size of the inverter. The performance of the ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL). The dynamic speed accuracy of the VLT2800 can not be estimated because drive was unstable during the test.

Static speed accuracy

Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 0%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), Speed Error [%] = $(n^*-n_{act}) / n_{N(mot)}$. Speed (control) accuracy is essential feature for high quality motor control.

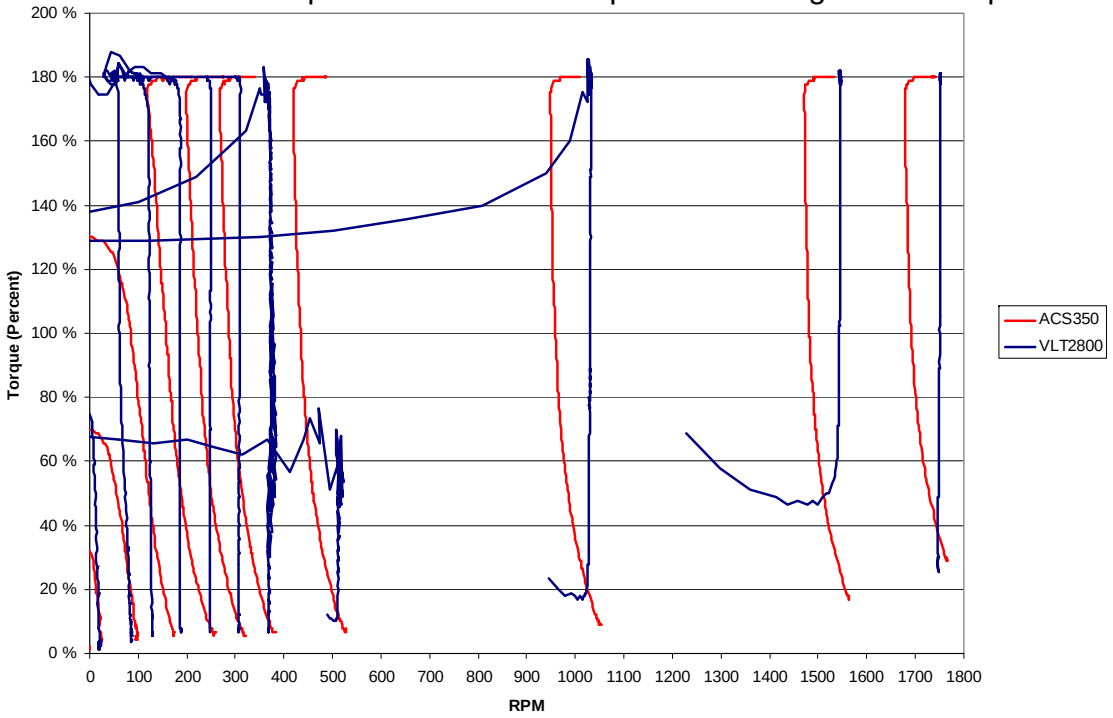


VLT 2800: Test failed.

Static speed error depends on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). The ACS350 has better accuracy in terms of load and speed. The VLT2800 could not handle any load above 50 % w/o current limit and stall (static speed accuracy could not be measured).

Maximum torque as a function of speed

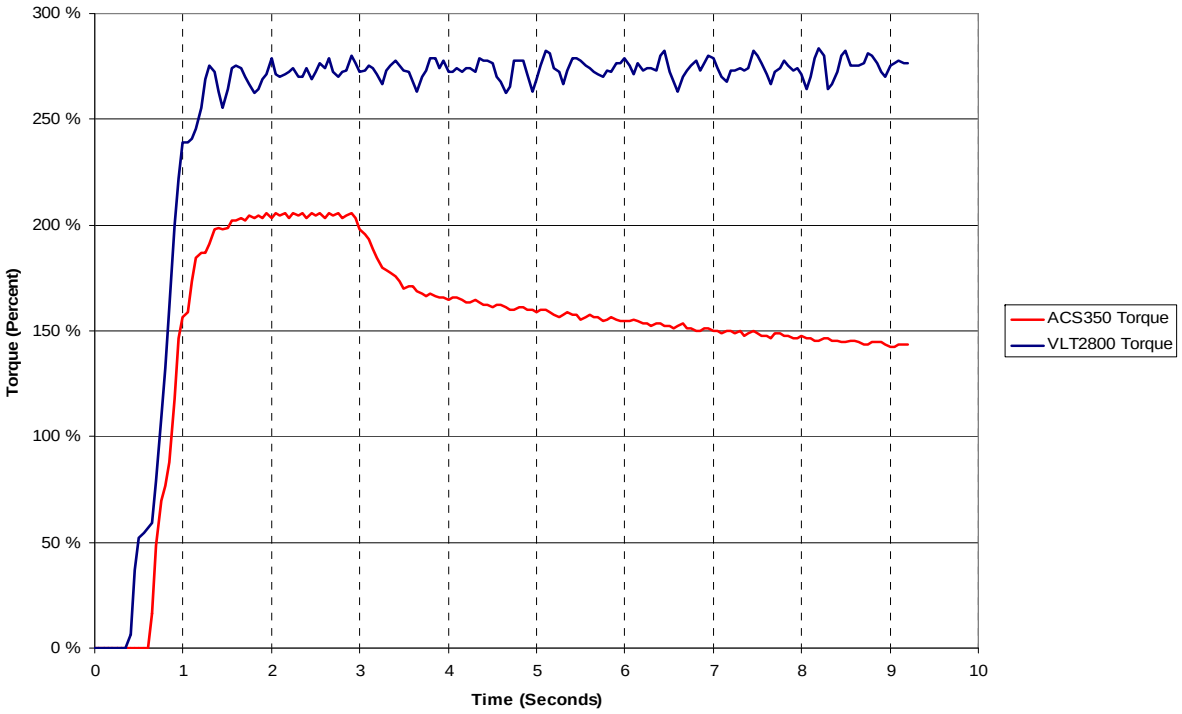
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The ACS350 has good speed range because it could provide at least full output torque from 1700 rpm down to 180 rpm and could maintain the torque for at least 2 seconds (better overloadability). The VLT2800 could provide 100% torque down to 60 rpm's but has problems to produce torque at some speed points. VLT2800 cannot maintain the torque for two seconds at some test points allowing the motor to stall. The behavior of VLT2800 can cause severe problems in applications requiring high-inertia starting and wide speed range.

Maximum starting torque

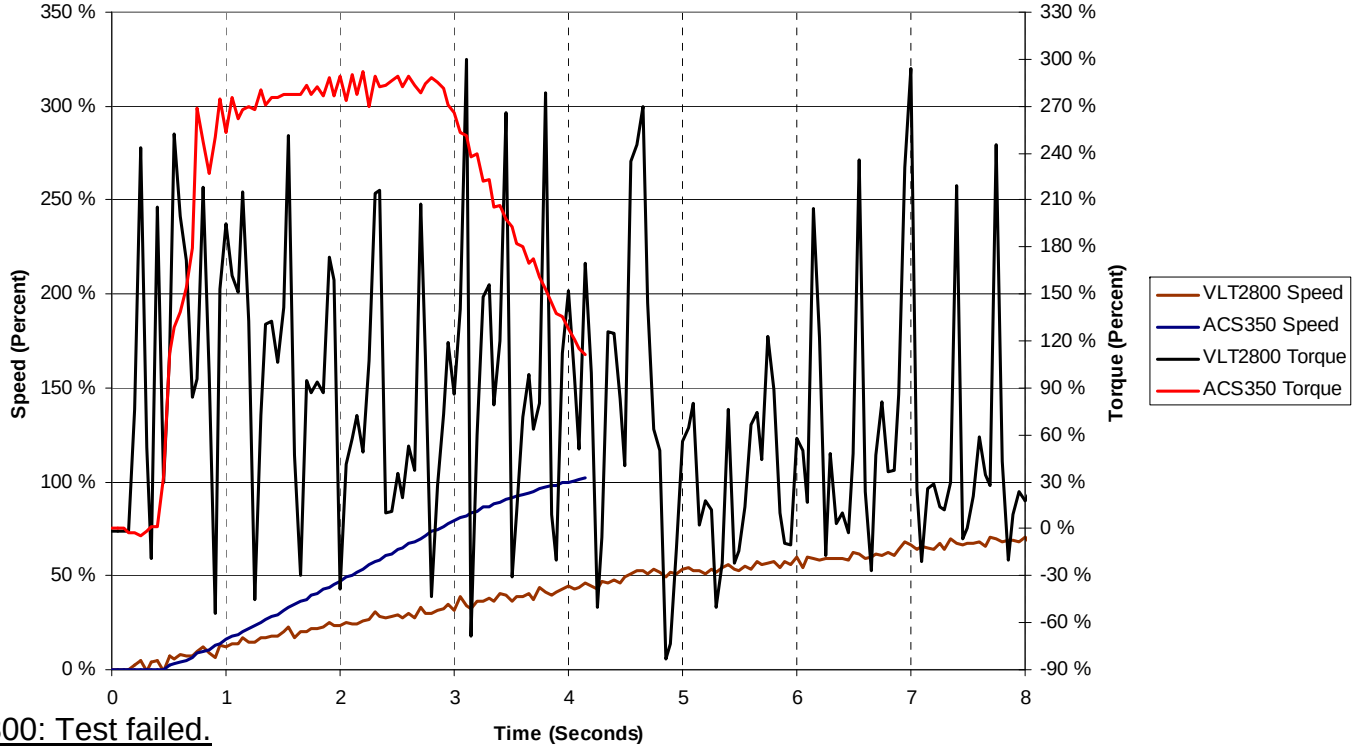
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



Both drives have good starting torque up to 200% in ACS350 and 275% in VLT2800. Both drives also reach nominal torque within 1s. The ACS350 reduces torque to nominal value after 2 s due to current limiting. The VLT2800 has significant torque ripple possible due to its violent current controller.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 (0.95 kgm^2) inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



VLT 2800: Test failed.

The ACS350 accelerates the load to the reference in 4 seconds. The VLT2800 failed the test, because the drive was not able to provide enough current to accelerate the motor past a few hundred rpm. It may indicate the tuning of the current controller is not stable and could cause also overcurrent trips. The ACS350 produces maximum starting torque for two seconds and then decreases torque output based on its current limit.

Efficiency

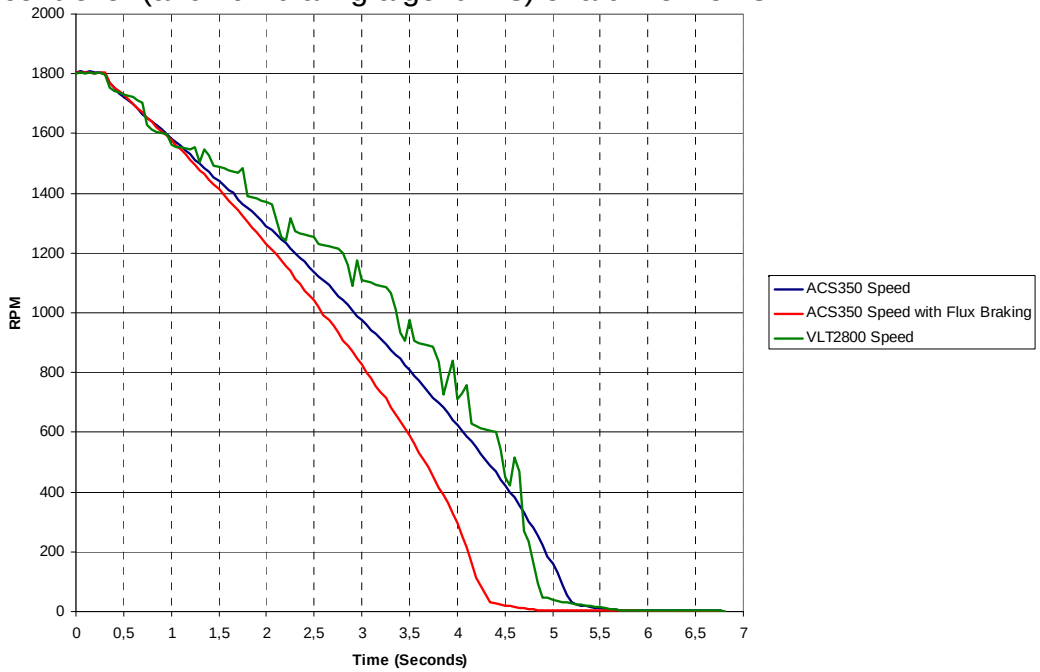
Using power analyzer, input power, speed and torque of AC motor are measured at 0, 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	VLT2800
25%	87.0%	79.4%
50%	89.3%	89.9%
75%	89.0%	89.6%
100%	88.4%	89.6%

The test is performed at rated speed with different loads. The ACS350 has higher efficiency at 25% load but is comparable at all other points.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braling algorithms) of a drive works.



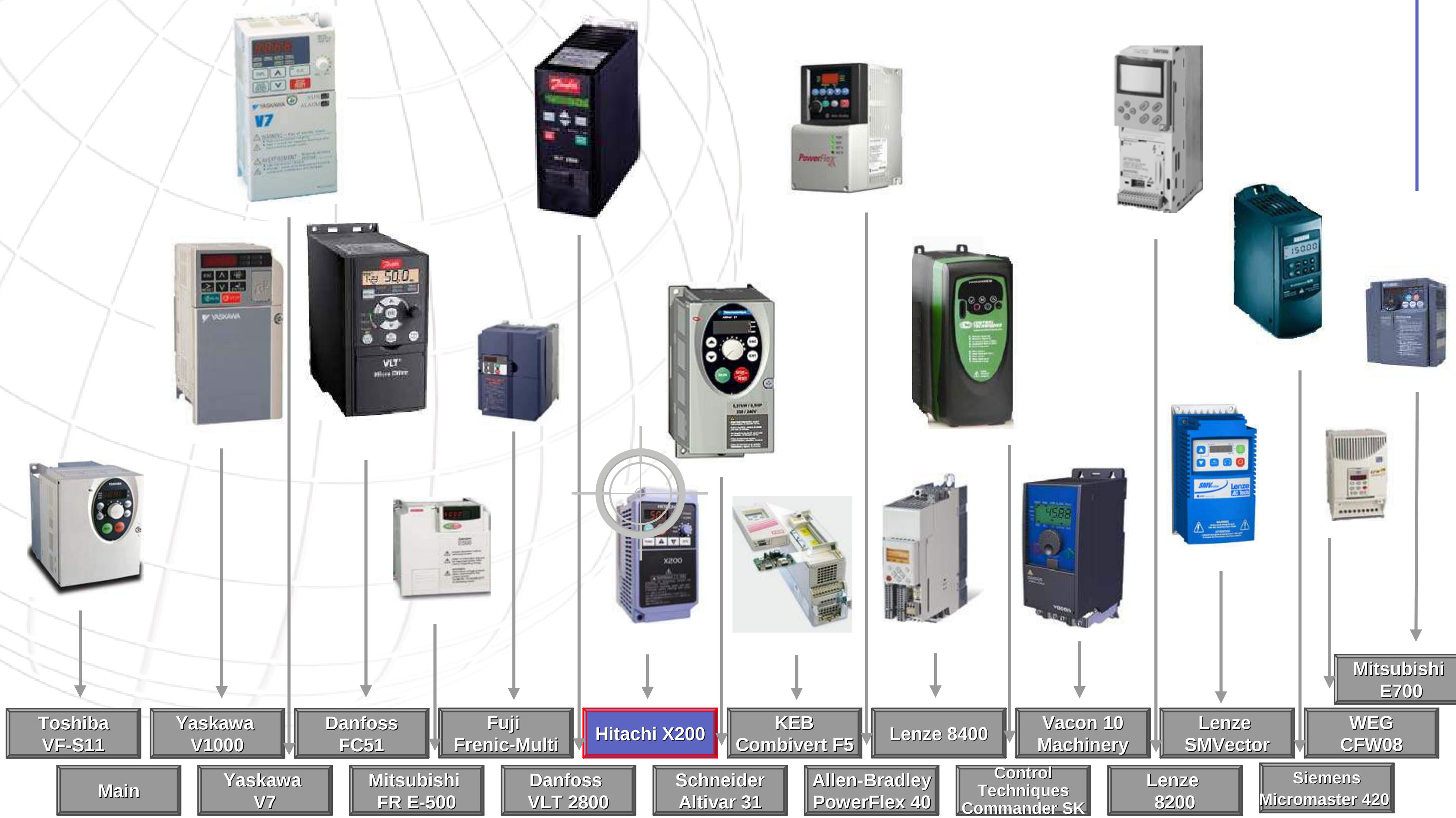
Tester comments: Error messages 12 (overcurrent) error 13 (Overload) and error 7 (DC Link Overvoltage) but drive did not trip. The ACS350 was able to decelerate to zero within 5 seconds. The ACS350 with flux braking shortened the deceleration time even more. The VLT2800 passed the test but did not stack up against the ACS350.

ABB strengths

ACS350 advantages over Danfoss VLT 2800

Wide power range	Many plug-in fieldbus options
Nominal ratings available -10°C	Application macros 7 pcs
I2hd 50°C ratings	User macros 3 pcs
Areas of units	17 languages
Volumes of units	Comprehensive SW
Weights of units	FlashDrop
DIN rail and sideways mounting	Sequence programming
2 detatchable control panel options	
Panel cover	Potentiometer option
Bipolar AI	Maintenance need indication

For ACS350 advantages in performance, see the performance test slides



Summary Slide

Description

Hitachi X200

- The economic drive solution for applications up to 7.5 kW. X200 frequency inverters are suitable for pump and fan applications as well as for common tasks in machine construction.
- The standard "Safe Stop" function according to EN954-1 class 3 provides additional functionality and cost effectiveness. With the integrated EMC filter the inverter fullfills EN61800-3 standard and is complying with standards like CE, UL, cUL, c-Tick and RoHS.
- Applications
  - pump and fan applications, common tasks in machine construction

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material h textile, printing, rubber and pla woodworking

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Protection class

Hitachi X200

- IP 20

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Hitachi X200

Vibration

- 5.9 m/s2 10…55 Hz /

Shock

- na

Temperature

- -10 to +50 °C (carrier derating required for ambient temperature higher than 40 °C), no freezing

Humidity

- 20 … 90 % humidity (non condensing)

Altitude limitations

- altitude 1000 m or less

Acoustic noise

- 2.0kHz to 12kHz

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

- **Hitachi X200**
- Voltage types and power range
- 1-phase 200 - 240 V +10 %, -15 %
  - 0.2 kW to 2.2 kW
- 3-phase 200 - 240V +10 %, -15 %
  - 0.2 kW to 2.2 kW
- 3-phase 380 - 480 V +10 %, -15 %
  - 0.4 kW to 7.5 kW
- Power factor
- Optional reactor for improving power factor
- Supply frequency
- 50/60 Hz ±5 %
- Supply networks
- N/A

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Hitachi	ABB ACS350		Hitachi X200		Hitachi	ASC350
P_N	P_N	ACS350	X200	I_{2N}	I_{2N}	I_{INV}	I_{INV}	X200	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	01X-		U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	02A4-2		2,4	2,2				R0
0,55	0,75		005SFEF			3,0			
0,75	1	04A7-2	007SFEF	4,7	4,2	4,0			R1
1,1	1,5	06A7-2	011SFEF	6,7	6,0	5,0			
1,5	2	07A5-2	015SFEF	7,5	6,8	7,1			R2
2,2	3	09A8-2	022SFEF	9,8	8,8	10,0			

Hitachi X200

Overload ratings

- 150 % for 60 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 200V

3-phase 200V		ABB	Hitachi	ABB ACS350		Hitachi X200		Hitachi	ASC350
P_N	P_N	ACS350	X200	I_{2N}	I_{2N}	I_{INV}	I_{INV}	X200	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-		U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	02A4-2		2,4	2,2				R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2	007NFU	4,7	4,2	4,0			R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	015NFU	7,5	6,8	7,1			
2,2	3	09A8-2	022NFU	9,8	8,8	10,0			R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2		17,6	15,8				
5,5	7,5	24A4-2		24,4	21,96				R3
7,5	10	31A0-2		31,0	27,9				R4
11	15	46A2-2		46,2	41,58				

Hitachi X200

Overload ratings

- 150 % for 60 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 400V

3-phase 400V		ABB	Hitachi	ABB ACS350		Hitachi X200		Hitachi	ASC350
P_N	P_N	ACS350	X200	I_{2N}	I_{2N}	I_{INV}	I_{INV}	X200	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-		U_N=380-480 V		U_N=380-500 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	01A2-4		1,2	1,1				R0
0,55	0,75	01A9-4		1,9	1,7				
0,75	1	02A4-4	007HFEF	2,4	2,2	3,3			R1
1,1	1,5	03A3-4		3,3	3,0				
1,5	2	04A1-4	015HFEF	4,1	3,7	5,0			
2,2	3	05A6-4	022HFEF	5,6	5,0	7,0			
3	4	07A3-4	030HFEF	7,3	6,6	10,0			
4	5	08A8-4	040HFEF	8,8	7,9	11,0			
5,5	7,5	12A5-4		12,5	11,3				R3
7,5	10	15A6-4		15,6	14,0				
11	15	23A1-4		23,1	20,8				
15	20	31A0-4		31	27,9				R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Hitachi X200

Overload ratings

- 150 % for 60 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Hitachi X200	ABB ACS350			Hitachi X200			Hitachi X200	ASC350
		Type	Type	1-phase			1-phase			Frame	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	names	
kW	hp	01X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,33										
0,4	0,5	02A4-2		70	169	161					R0
0,55	0,75		005SFEF				110	176	126		
0,75	1	04A7-2	007SFEF	70	169	161	110	176	126		R1
1,1	1,5	06A7-2	011SFEF				110	189	155		
1,5	2	07A5-2	015SFEF	105	169	165	110	189	155		R2
2,2	3	09A8-2	022SFEF				110	189	155		

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Hitachi X200	ABB ACS350			Hitachi X200			Hitachi X200	ASC350
		Type	Type	1-phase			1-phase			Frame	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	names	
kW	hp	01X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,2	0,33										
0,4	0,5	02A4-2		118	1,9	1,2					R0
0,55	0,75		005SFEF				222	2	1,5		
0,75	1	04A7-2	007SFEF	118	1,9	1,2	222	2	1,5		R1
1,1	1,5	06A7-2	011SFEF				293	3	2,4		
1,5	2	07A5-2	015SFEF	177	2,9	1,5	293	3	2,4		R2
2,2	3	09A8-2	022SFEF				293	3	2,5		

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Hitachi X200	ABB ACS350			Hitachi X200			Hitachi X200	ASC350
		Type	Type	3-phase			3-phase			Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	02A4-2		70	169	161					R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	007NFU				110	176	126		R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	015NFU				110	189	155		
2,2	3	09A8-2	022NFU	105		165	110	189	155		R2
3	4	13A3-2									
4	5	17A6-2									
5,5	7,5	24A4-2		169	169	169					R3
7,5	10	31A0-2		260	181	169					R4
11	15	46A2-2									

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Hitachi X200	ABB ACS350			Hitachi X200			Hitachi X200	ASC350
		Type	Type	3-phase			3-phase			Frame names N/A	Frame
		ACS350-	VFS11	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight		
0,12	0,16										
0,2	0,25										
0,4	0,5	02A4-2		118	1,9	1,2					R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	007NFU				222	2	1,5		R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	015NFU				293	3	2,4		
2,2	3	09A8-2	022NFU	177	2,9	1,5	293	3	2,5		R2
3	4	13A3-2									
4	5	17A6-2									
5,5	7,5	24A4-2		286	4,8	2,5					R3
7,5	10	31A0-2		471	8,0	4,4					R4
11	15	46A2-2									

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Hitachi X200	ABB ACS350			Hitachi X200			Hitachi X200	ASC350
		Type	Type				3-phase			Frame	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	names	
kW	hp	03X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	01A2-4		70	169	161					R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	007HFEF				110	189	155		R1
1,1	1,5	03A3-4									
1,5	2	04A1-4	015HFEF				110	189	155		
2,2	3	05A6-4	022HFEF				110	189	155		
3	4	07A3-4	030HFEF				110	189	155		
4	5	08A8-4	040HFEF				110	189	155		
5,5	7,5	12A5-4		169		169					R3
7,5	10	15A6-4									
11	15	23A1-4									
15	20	31A0-4		260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Hitachi X200	ABB ACS350			Hitachi X200			Hitachi X200	ASC350
		Type	Type				3-phase			Frame	
		ACS350-	VFS11	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	names	
kW	hp	03X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	01A2-4		118	1,9	1,2					R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	007HFEF				293	3	2,3		R1
1,1	1,5	03A3-4				1,2					
1,5	2	04A1-4	015HFEF				293	3	2,4		
2,2	3	05A6-4	022HFEF				293	3	2,4		
3	4	07A3-4	030HFEF				293	3	2,4		
4	5	08A8-4	040HFEF				293	3	2,4		
5,5	7,5	12A5-4		286	4,8	2,5					R3
7,5	10	15A6-4									
11	15	23A1-4									
15	20	31A0-4		471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

Installation

Hitachi X200

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	No
Flange	No
Wall (sideways)	No
Heatsinkless	Yes
Side-by-side	Yes (derating)

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	50

- Attached with screws
- Side-by-side mounting possible with derating
- Motor cable lengths
  - Shielded wire (screened cable) is required for motor wiring, and the length must be less than 5 meters.

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

EMC and harmonics

Hitachi X200

- Filters
  - EN61800-3 category C1 filter (EU 200 V class)
  - EN61800-3 category C2 filter (EU 400 V class)
- Chokes
  - DC link choke as option
  - Output and input side AC reactor as option
- Motor cable lengths
  - Shielded wire (screened cable) is required for motor wiring, and the length must be less than 5 meters (EMC recommendations)
- THD
  - N/A

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

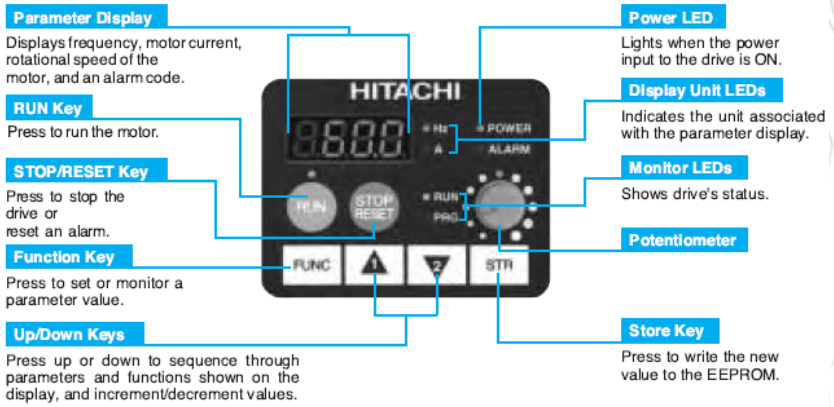
1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

Hitachi X200

- The digital operator can also be detached and used for remote-control.



- Options: Remote operator, copy unit, cable for digital operator

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Machine interface (I/O)

Hitachi X200

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	N/A	N/A
Relay outputs	3	Yes
Analog outputs	1	N/A

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Hitachi X200

Protocol	*Standard/ Optional*	*Baud rate*	*Notes*
RS485 with Modbus RTU	Standard	na	
Profibus	Option	na	
CanOpen	Option	na	

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

100% Phd braking
500 Hz mx. output frequency

Motor control

Hitachi X200

- V/f control, V/f variable (constant torque, reduced torque)

Braking

- DC braking
- Optional mechanical brake for some applications

Output frequency

- 0.5 … 400 Hz

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Hitachi X200

- Functions groups
  - “D” Monitoring functions
  - “F” Main profile parameters
  - “A” Standard functions
  - “B” Fine tuning functions
  - “C” Intelligent terminal functions
  - “H” Motor constant functions
  - “P” DeviceNet functions
  - “E” Error codes
- Languages
  - N/A

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Hitachi X200

- Pure analog monitor output
- Low load detection
- External thermistor terminal (PYC)
- Cooling-fan on/off
- Instantaneous power failure recovery
- Second motor setting
- 3-wire control
- Analog input selection
- Second acceleration/deceleration setting
- Jogging
- Auto-carrier frequency reduction
- Unattended start protection (USP)
- Analog input wire-break detection

(* = Basic feature in ABB ACS150

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Hitachi X200

- Remote operator
- Copy unit
- Cable for digital operator
- Reactor for improving power factor
- Noise filter
- ProDrive Software

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

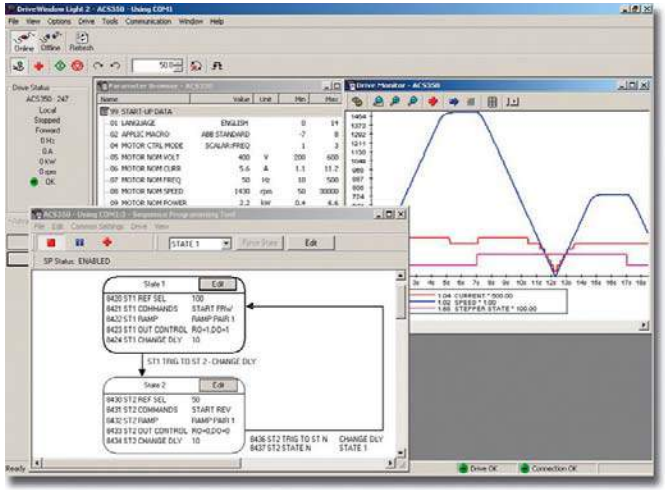
Hitachi X200

- ProDrive Software
  - Windows 98, 2000, XP supported
  - Engineering and expert tools for operational startup and testing
  - OPC client/server architecture
  - User-oriented configuration levels
  - Project data storage and export; for record-keeping and processing
  - Three different levels:
    - Parameter level
    - Function level
    - Application level

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Hitachi X200

- ProDrive Software

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Hitachi X200

- Remote operator
- Copy unit
- Cable for digital operator
- Reactor for improving power factor
- Noise filter

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Hitachi X200

- Monthly and yearly inspection chart
- Capacitor Life Curves
- Available spare parts
  - Fan
  - Case

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Hitachi X200

Approvals

- CE, UL, cUL, c-Tick and RoHS

Compliance with

- European Low Voltage Directive
- EMC directive (89/336/EEC)

Applicable standards

- EN61800-3
- EN954-1 class 3

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

ABB strenghts

ACS350 advantages over Hitachi X200

Wide power range	User macros 3 pcs
Sideways mounting	17 languages
EN61000-3-2 with opt. chokes	FlashDrop
2 control panel options	Sequence programming
Panel cover	Potentiometer option
Modbus speed	Maintenance need indication
100% Phd braking	Detailed fault history with time
500 Hz mx. output frequency	
Application macros 7 pcs	

For ACS350 advantages in performance, see the performance test slides




















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Altivar 31

- Altivar 31 saves space in the design and installation of your enclosures as it is exceptionally compact. Reduced size with integrated EMC level A filters, with possibility of side by side mounting providing a better solution to industrial environments, with operation up to +50°C without derating.
- For power range 0.18 kW to 15 kW
- Applications
  - Materials handling, pumps, ventilation, special machines, textile machines and packaging/packing...

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Altivar 31

- IP 20 without cover plate on upper part of cover
- ATV 31H…M2, ATV 31H…N4, available without EMC filter: IP 31 and IP 41 on upper part and IP 21 on connection terminals

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Altivar 31

Vibration

- Conforming to IEC/EN 60068-2-6:
  - 1.5 mm peak from 3 to 13 Hz
  - 1 gn from 13 to 150 Hz

Shock

- 15 gn for 11 ms conforming to IEC/EN 60068-2-27

Temperature

- Product with heatsink: -10°C to +50°C without derating, +60°C with derating.
- Enclosed product and drive kit: -10°C to +40°C without derating

Humidity

- 5…95 % without condensation or dripping water, conforming to IEC 60068-2-3

Altitude limitations

- 1000 m without derating. Higher derating 1% per additional 100 m.

Acoustic noise

- Derating required with higher than 4 kHz switching frequency

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Altivar 31

Voltage types and power range

- 1-phase 200 - 240 V
  - 0.18 to 2.2 kW
- 3-phase 200 - 240 V
  - 0.18 to 15 kW
- 3-phase 380 - 500 V
  - 0.37 to 15 kW
- 3-phase 525 - 600 V
  - 0.75 to 15 kW

Power factor

- N/A

Supply frequency

- 50/60 Hz, tolerance ±5%

Supply networks

- Data N/A

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB		ABB ACS350		Altivar 31			
P_N	P_N	ACS350	Altivar 31	I_{2N}	I_{2N}	In^2	In^2	Altivar 31	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	01X-	ATV31	U_N=200-240 V		U_N=200-240 V		Frame	Frame
0,12	0,16								
0,18	0,25		H018M2			1,5	1,5	3	
0,37	0,5	02A4-2	H037M2	2,4	2,2	3,3	3,3		R0
0,55	0,75		H055M2			3,7	3,7	4	
0,75	1	04A7-2	H075M2	4,7	4,2	4,8	4,8		R1
1,1	1,5	06A7-2	HU11M2	6,7	6,0	6,9	6,9	6	
1,5	2	07A5-2	HU15M2	7,5	6,8	8,0	8		R2
2,2	3	09A8-2	HU22M2	9,8	8,8	11,0	11	7	

Altivar 31

Overload ratings

- 150 % for 60 sec
- 185 % for 2 sec

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 200V

3-phase 200V		ABB		ABB ACS350		Altivar 31			
P_N	P_N	ACS350	Altivar 31	I_{2N}	I_{2N}	In^2	In^2	Altivar 31	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-	ATV31	U_N=200-240 V		U_N=200-240 V		Frame	Frame
0,12	0,16								
0,18	0,25		H018M3X			1,5	1,5	1	
0,37	0,5	02A4-2	H037M3X	2,4	2,2	3,3	3,3		R0
0,55	0,75	03A5-2	H055M3X	3,5	3,2	3,7	3,7	2	
0,75	1	04A7-2	H075M3X	4,7	4,2	4,8	4,8		R1
1,1	1,5	06A7-2	HU11M3X	6,7	6,0	6,9	6,9	5	
1,5	2	07A5-2	HU15M3X	7,5	6,8	8,0	8,0		
2,2	3	09A8-2	HU22M3X	9,8	8,8	11,0	11,0	6	R2
3	4	13A3-2	HU30M3X	13,3	12,0	13,7	13,7	7	
4	5	17A6-2	HU40M3X	17,6	15,8	17,5	17,5		
5,5	7,5	24A4-2	HU55M3X	24,4	21,96	27,5	27,5	8	R3
7,5	10	31A0-2	HU75M3X	31,0	27,9	33,0	33,0		R4
11	15	46A2-2	HD11M3X	46,2	41,58	54,0	54,0	9	
15	20		HD15M3X			66,0	66,0		

Altivar 31

Overload ratings

- 150 % for 60 sec
- 185 % for 2 sec

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 400V

3-phase 400V		ABB		ABB ACS350		Altivar 31		Altivar 31	ASC350
P_N	P_N	ACS350	Altivar 31	I_{2N}	I_{2N}	In^2	In^2		
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-	ATV31	U_N=380-480 V		U_N=380-500 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	01A2-4	H037N4	1,2	1,1	1,5	1,5	6	R0
0,55	0,75	01A9-4	H055N4	1,9	1,7	1,9	1,9		
0,75	1	02A4-4	H075N4	2,4	2,2	2,3	2,3		R1
1,1	1,5	03A3-4	HU11N4	3,3	3,0	3,0	3		
1,5	2	04A1-4	HU15N4	4,1	3,7	4,1	4,1		
2,2	3	05A6-4	HU22N4	5,6	5,0	5,5	5,5	7	
3	4	07A3-4	HU30N4	7,3	6,6	7,1	7,1		
4	5	08A8-4	HU40N4	8,8	7,9	9,5	9,5		
5,5	7,5	12A5-4	HU55N4	12,5	11,3	14,3	14,3	8	R3
7,5	10	15A6-4	HU75N4	15,6	14,0	17,0	17		
11	15	23A1-4	HD11N4	23,1	20,8	27,7	27,7	9	
15	20	31A0-4	HD15N4	31	27,9	33,0	33		R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Altivar 31

Overload ratings

- 150 % for 60 sec
- 185 % for 2 sec

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Altivar 31	ABB ACS350			Altivar 31			Altivar 31	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-	ATV31	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25		H018M2								
0,37	0,5	02A4-2	H037M2	70	169	161	72	145	130	3	R0
0,55	0,75		H055M2								
0,75	1	04A7-2	H075M2	70	169	161			140	4	R1
1,1	1,5	06A7-2	HU11M2				105	143	150	6	
1,5	2	07A5-2	HU15M2	105	169	165					R2
2,2	3	09A8-2	HU22M2				140	184	150	7	

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Altivar 31	ABB ACS350			Altivar 31			Altivar 31	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-	ATV31	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25		H018M2								
0,37	0,5	02A4-2	H037M2	118	1,9	1,2	104	1,4	1,05	3	R0
0,55	0,75		H055M2					1,5		4	
0,75	1	04A7-2	H075M2	118	1,9	1,2					R1
1,1	1,5	06A7-2	HU11M2				150	2,3	1,35	6	
1,5	2	07A5-2	HU15M2	177	2,9	1,5					R2
2,2	3	09A8-2	HU22M2				258	3,9	2,35	7	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Altivar 31	ABB ACS350			Altivar 31			Altivar 31	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	ATV31	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25		H018M3X								
0,37	0,5	02A4-2	H037M3X						120	1	
0,55	0,75	03A5-2	H055M3X				72	145			R0
0,75	1	04A7-2	H075M3X	70		161				2	
1,1	1,5	06A7-2	HU11M3X		169				130		R1
1,5	2	07A5-2	HU15M3X				105	143		5	
2,2	3	09A8-2	HU22M3X							6	
3	4	13A3-2	HU30M3X	105		165			150		R2
4	5	17A6-2	HU40M3X				140	184		7	
5,5	7,5	24A4-2	HU55M3X	169	169	169	180	232	170	8	R3
7,5	10	31A0-2	HU75M3X	260	181	169					R4
11	15	46A2-2	HD11M3X				245	330	190	9	
15	20		HD15M3X								

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Altivar 31	ABB ACS350			Altivar 31			Altivar 31	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	ATV31	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25		H018M3X								
0,37	0,5	02A4-2	H037M3X				104	1,3	0,9	1	
0,55	0,75	03A5-2	H055M3X					1,4		2	R0
0,75	1	04A7-2	H075M3X	118	1,9	1,2					
1,1	1,5	06A7-2	HU11M3X				150	2,0	1,3	5	R1
1,5	2	07A5-2	HU15M3X								
2,2	3	09A8-2	HU22M3X					3,9	1,4	6	
3	4	13A3-2	HU30M3X	177	2,9	1,5	258	3,9	2,4	7	R2
4	5	17A6-2	HU40M3X								
5,5	7,5	24A4-2	HU55M3X	286	4,8	2,5	418	7,1	4,7	8	R3
7,5	10	31A0-2	HU75M3X	471	8,0	4,4					R4
11	15	46A2-2	HD11M3X				809	15,4	9	9	
15	20		HD15M3X								

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Altivar 31	ABB ACS350			Altivar 31			Altivar 31	ASC350
		Type	Type								
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	ATV31	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	H037N4	70	169	161	105	143	150	6	R0
0,55	0,75	01A9-4	H055N4								
0,75	1	02A4-4	H075N4								R1
1,1	1,5	03A3-4	HU11N4								
1,5	2	04A1-4	HU15N4								
2,2	3	05A6-4	HU22N4				140	184	150	7	
3	4	07A3-4	HU30N4								
4	5	08A8-4	HU40N4								
5,5	7,5	12A5-4	HU55N4	169		169	180	232	170	8	R3
7,5	10	15A6-4	HU75N4								
11	15	23A1-4	HD11N4				245	330	190	9	
15	20	31A0-4	HD15N4	260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Altivar 31	ABB ACS350			Altivar 31			Altivar 31	ASC350
		Type	Type								
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	ATV31	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	H037N4	118	1,9	1,2	150	2,3	1,4	6	R0
0,55	0,75	01A9-4	H055N4								
0,75	1	02A4-4	H075N4								R1
1,1	1,5	03A3-4	HU11N4			1,2					
1,5	2	04A1-4	HU15N4								
2,2	3	05A6-4	HU22N4				258	3,9	2,4	7	
3	4	07A3-4	HU30N4								
4	5	08A8-4	HU40N4								
5,5	7,5	12A5-4	HU55N4	286	4,8	2,5	418	7,1	4,7	8	R3
7,5	10	15A6-4	HU75N4								
11	15	23A1-4	HD11N4				809	15,4	9	9	
15	20	31A0-4	HD15N4	471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

Installation

Altivar 31

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	No
Heatsinkless	Yes
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	50
Below	50
Left and right	50

- Cable connections made with screw connectors, cable entry from the bottom
- Attached with screws
- Motor cable lengths
  - 50 m (shielded cable)
  - 100 m (unshielded cable)

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Altivar 31

- Filters
  - Integrated class A EMC filter, class B optional
  - ATV 31H…M2, ATV 31H…N4, available without EMC filter
  - ATV 31…M2 and N4 drives feature built-in RFI filters.
- Chokes
  - Line chokes (option)
- EMC compliant motor cable lengths

Max. length of shielded cable		
	EN55011 Class A	EN55022 Class B
	m	m
1 phase 200-240 V	50	20
3 phase 200-240 V	5	-
3 phase 380-500 V	50	20

- THD
  - N/A

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

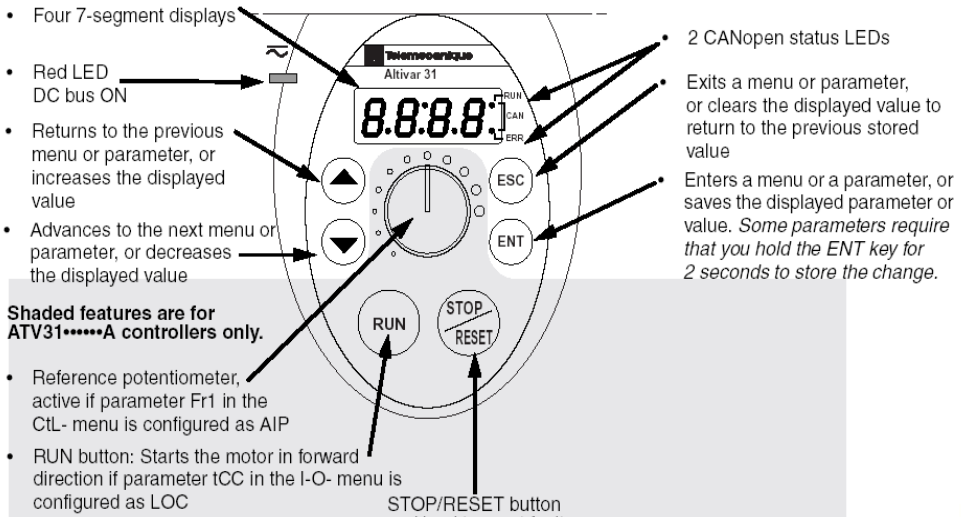
4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

Altivar 31



- IP65 remote terminal for fixing on door of enclosure

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

ATV31 Displayeps

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Machine interface (I/O)

Altivar 31

Type	*Qty.*	*Programmable*
Digital inputs	7	Yes
Analog inputs	1	Yes
Pulse train input	1	Yes
Relay outputs	1	Yes
Transistor outputs	-	-
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Altivar 31

Protocol	*Standard/ Optional*	*Baud rate*	*Notes*
Modbus	Standard (integrated)	4800, 9600 or 19200 bps	drives connected: 31
CANopen	Standard (integrated)	10, 20, 50, 125, 250, 500 kbps or 1 Mbps	drives connected: 127

- Other types of bus available via communication gateways: Ethernet TCP/IP, Fipio, Profibus DP, DeviceNet

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

100% Phd braking
500 Hz mx. output frequency

Motor control

Altivar 31

- Sensorless flux vector control with pulse width modulation (PWM) type motor control signal

- Braking
- External braking chopper option available
- DC Braking available as standard

Output frequency

- 1.0 – 400 Hz with both scalar and vector control

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Altivar 31

N/A

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Altivar 31

- Adjustment of acceleration and deceleration ramp times and profiles *(
- Adaptation of deceleration ramp, ramp switching
- Jog operation, + speed / - speed, save reference
- Preset speeds *(
- Reference switching *(
- Regulator and preset PI, "Manual-Automatic" start with PI *(
- Traverse control, limit switch management
- Motor switching *(
- Brake control *(
- Autotuning (on first power-up, on logic input, on each start command) *(
- Multi-assignment of logic inputs, positive and negative logic *(
- 2-wire / 3-wire control *(
- Automatic d.c. injection *(
- High switching frequency, noise reduction *(

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Altivar 31

N/A

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

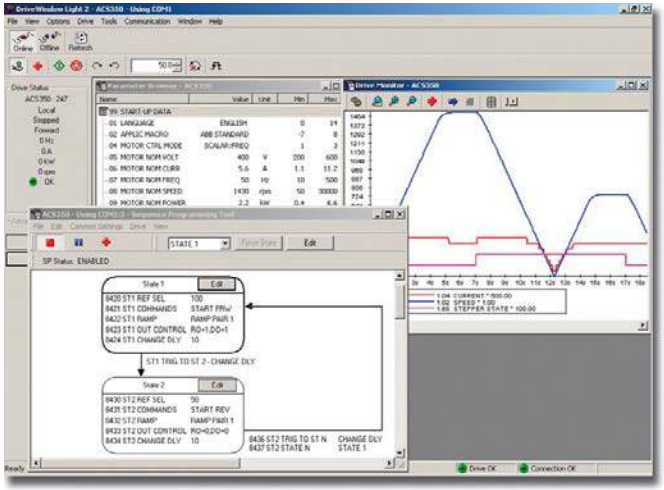
Altivar 31

N/A

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Altivar 31

- Connects to the 4-way connector under the terminal cover
- PC connection kit is required for connecting to laptop / PC (Comprises of: leads, adaptors & RS-232/RS485 convertor)
- Power*Suite* software available for drive configuration, on CD-ROM
  - In disconnected mode:
    - Preparation and memorization of configuration files: save to hard disk, CD-ROM, floppy disk, etc
    - Printing configurations
    - Exporting to desktop applications
  - In connected mode:
    - Configuration, adjustment, control and monitoring of the drive or starter
    - Transfer and comparison of configuration files between Power*Suite* and the drive or starter
    - Possibility of connecting to an Ethernet network
    - Software available in 5 languages: German, English, Spanish, French and Italian

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Altivar 31

- Anti-harmonic solutions
  - Line chokes
- Remedies for installation pollution
  - Additional EMC input filters
- Standards UL NEMA type 1
  - UL Type 1 kit
- High inertia machines, driving loads
  - Braking resistors
- DIN rail mounting
  - Plate for mounting on omega rail
- Remote operation
  - IP65 remote terminal for fixing on door of enclosure
- Limitation of dV/dt at motor terminals
  - Output filters for cable lengths greater than 50mATV 31H…A with local control Run/Stop and speed reference set by a potentiometer
- Drive kit
  - The drive kit enables you to create bespoke enclosures

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Altivar 31

N/A

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Altivar 31

Approvals

- CE, UL, cUL, CSA, NOM117, C-tick

Applicable standards

- EN50178 (Electronic equipment for use in power installations)
- EN61000-4-2 Level 3
- EN61000-4-3 Level 3
- EN61000-4-4 Level 4
- EN61000-4-5 Level 3 (power access)
- EN61800-3 Environments 1 and 2
- EN55011
- EN55022
- EN60068-2-6
- EN60068-2-27
- IEC60068-2-3

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Telemecanique Altivar 31

Model: ATV31HU30N4

Drive rating: 380-500V
2.2 kW / 3.0 HP
7.1 A (50 °C)

Tester (experienced drive specialist) comments:

- Accel and Decel both set to 1.0 seconds.
- Operator panel uses four 7-segment displays. All codes – very difficult to interpret.
- Operator panel doesn't have run/stop keys. Required to start and stop drive using terminal interface.
- 50Hz motor default with 72 Hz default maximum frequency. Applying 10V speed reference caused drive to run to maximum frequency.
- ID run more like first start ID run – no rotation.
- Cosine Phi needed for correct motor parameter setting. Default setting 0.88.
- No User Manual, only a Quick Start Guide. User Manual supplied on CDROM.
- Fairly easy to wire. Terminal marking labels on the inside of cover.

ABB ACS350

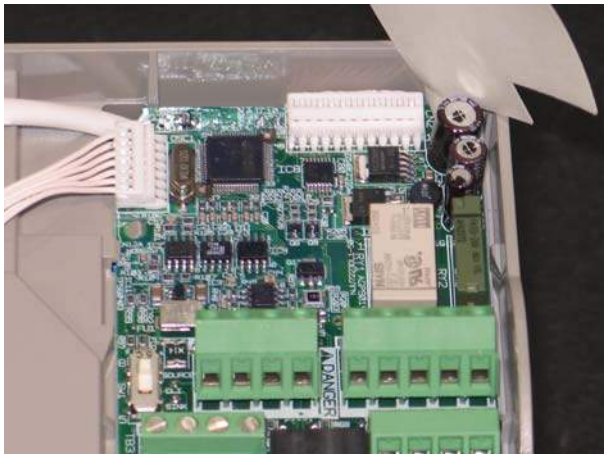
Model: ACS350-03U-05A6-4

Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A (40 °C)
5.0 A (50 °C)

Parameter Settings:

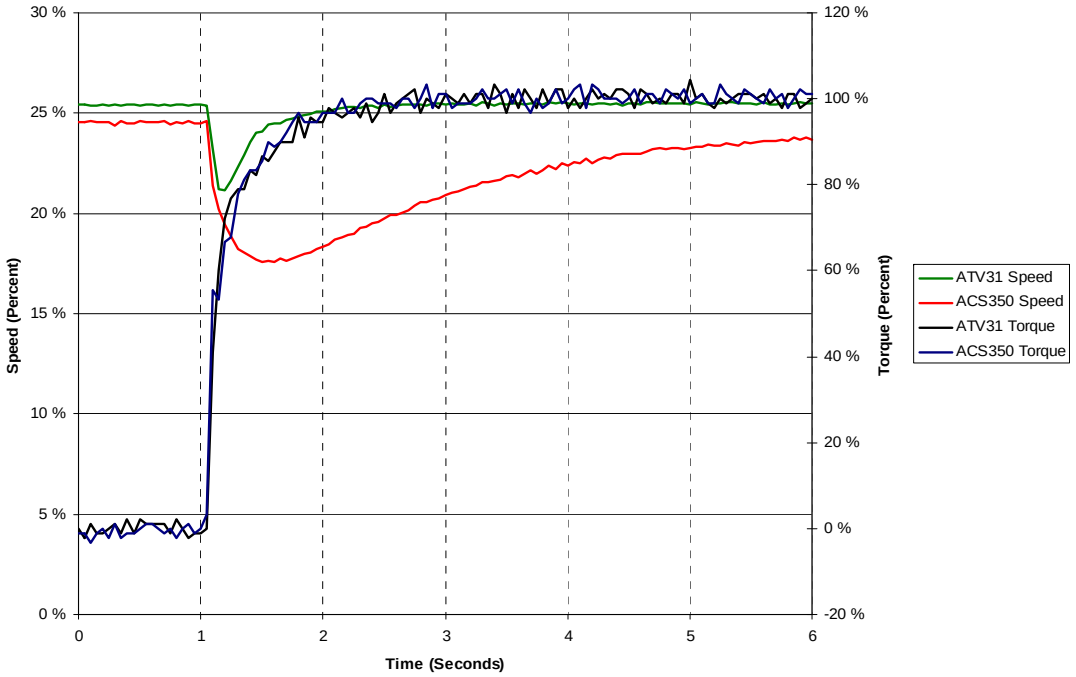
9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

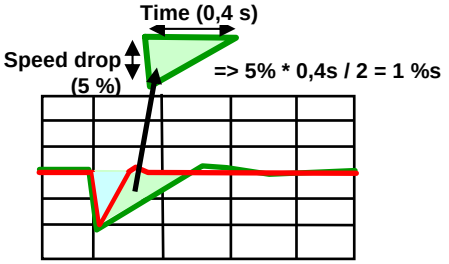
Photos of the tested unit



Impact load test – Dynamic speed accuracy (stiffness)

Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.

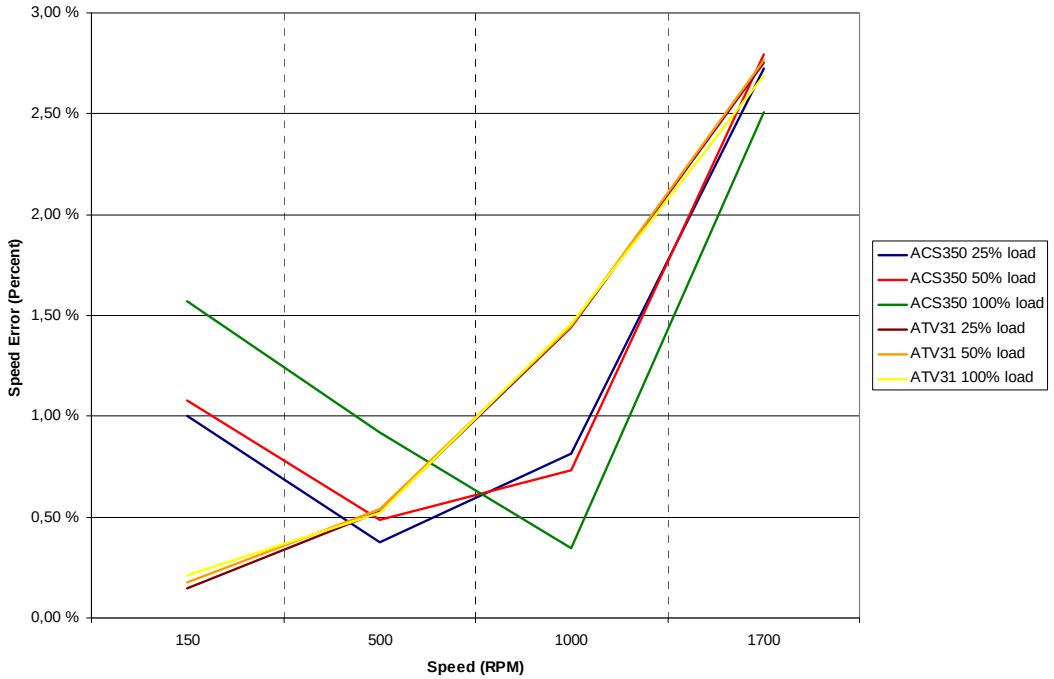




Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive operates in case of disturbances. The ACS350's speed control default tuning is quite conservative to ensure the controller is stable despite the motor used and its size compared to the size of the inverter. The ATV31 drive has better dynamic speed accuracy (small speed droop and short recovery time) but the performance of ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL).

Static speed accuracy

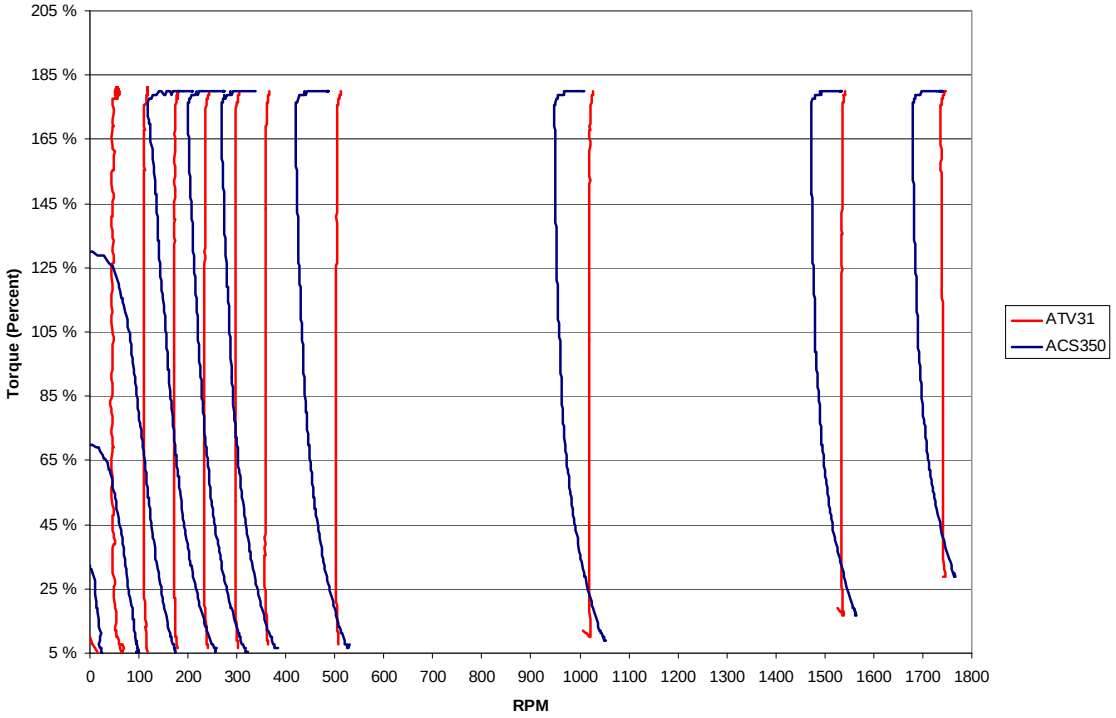
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 25%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), Speed Error [%] = $(n^*-n_{act}) / n_{N/mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Static speed error depends on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). ACS350 and ATV31 have equal maximum errors. The speed error of ATV31 is very linear as a function of speed and is insensitive to the load. Again the performance of the ACS350 can be improved in this test by tuning the speed controller (parameter group 23 SPEED CONTROL).

Maximum torque as a function of speed

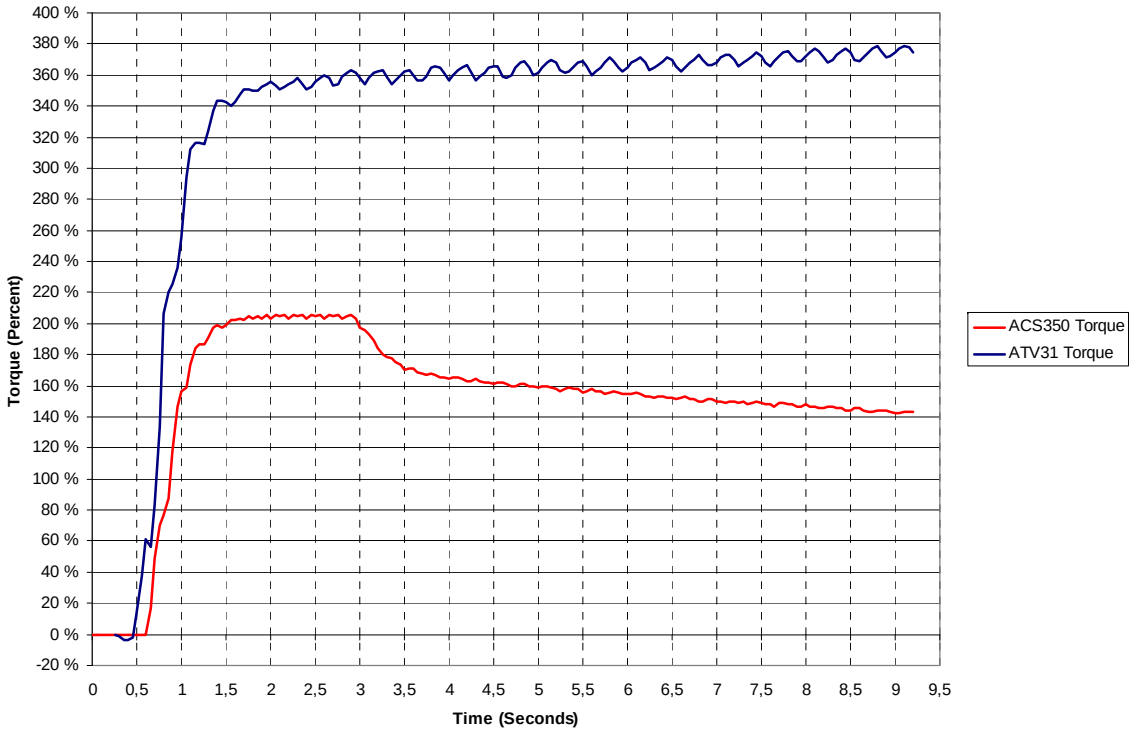
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



ATV31 has good speed range as it could provide full output torque from 1700 rpm's down to 60 rpm's. But it couldn't provide any torque at 30 rpm's. The speed range of the ACS350 is almost equal to the ATV31. The ACS350 couldn't provide 100% torque below 60 rpm's due to hardware limitation. The quite conservative speed controller tuning of ACS350 can be seen also in this test as a slight speed drop in each test point.

Maximum starting torque

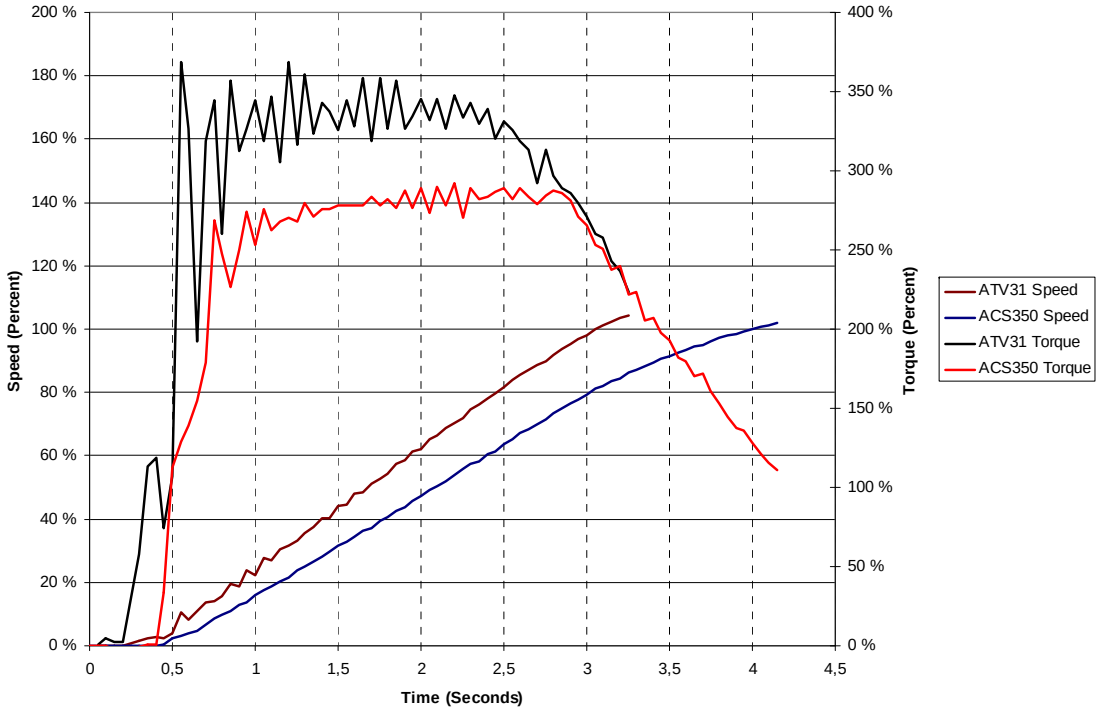
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



ACS350 has good starting torque up to 200%. The maximum starting torque with ATV31 is as big as 360%. Both drives reach nominal motor torque within 1 s. ACS350 reduces torque after 2 s due to current limiting. Presumable ATV31 will work well in applications with high starting duty or high-inertia starting. It is worth remarking that the rating of ATV31 is bigger (7.1 Amps) compared to the ATV31 (5.6 Amps) which explains the difference in percentual values.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 (0.95 kgm^2) inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



Rated at 7.1A (5.6 A for ACS350) and thus producing greater maximum output torque the ATV31 can accelerate the same inertia 1 second faster to the reference compared to ACS350. ACS350 produces the maximum starting torque for two seconds. After the overload cycle for two seconds, the ACS350 starts to reduce the overload current (torque) and causes the ACS350 speed curve to slow down.

Efficiency

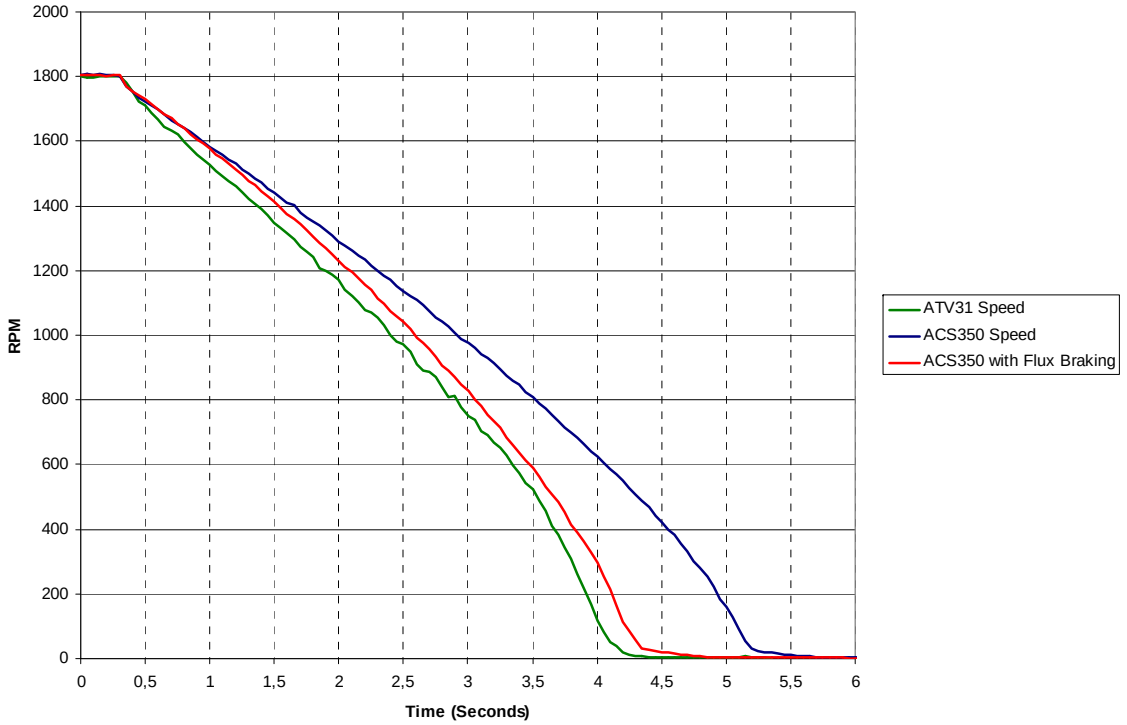
Using power analyzer, input power, speed and torque of AC motor are measured at 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	ATV31
25%	87.0%	84.6%
50%	89.3%	88.7%
75%	89.0%	89.7%
100%	88.4%	88.2%

The test is performed at rated speed with different loads. ACS350 has higher efficiency at 25% and 50% load point but at other load points the efficiencies of both drives were comparable.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



ACS350 was able to decelerate to zero within 5,5 seconds. ACS350 with flux braking shortened the deceleration time even more. The ATV31 performed the test as well as the ACS350 with flux braking enabled.

ABB strenghts

ACS350 advantages over Altivar 31

Wide power range	User macros 3 pcs
Sideways mounting	17 languages
EN61000-3-2 with opt. chokes	FlashDrop
2 control panel options	Sequence programming
Panel cover	Potentiometer option
Modbus speed	Maintenance need indication
100% Phd braking	Detailed fault history with time
500 Hz mx. output frequency	
Application macros 7 pcs	

For ACS350 advantages in performance, see the performance test slides

ACS350 Competitor comparison



















Summary Slide

Description

KEB Combivert F5

- The drive generation KEB COMBIVERT F5 offers the following features:
  - F5 basic: Standard inverters for open-loop applications with rated power of 0.37 to 15 kW
  - F5 compact: Universal line with extended software and I/O functionality up to 90 kW
  - F5 multi: Open-loop and closed-loop line of inverters for applications currently up to 900 kW
- Applications
  - packing, textiles, plastics, printing / paper industry, wood working, compressor, HVAC, pump, storage and transport technology and lift industry

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

KEB Combivert F5

- IP 20 standard
- IP 54 option

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

KEB Combivert F5

Vibration

- Install the inverter in a stationary location offering a firm mounting point with low vibration.

Shock

- na

Temperature

- Storage temperature -25 ... 70 °C
- Operation temperature -10 ... 45 °C, up to 90 kW 10… 40 °C

Humidity

- max. 95% without condensation

Altitude limitations

- Site altitude max. 2000m. With site altitudes over 1000m power reduction of 1% per 100m.

Acoustic noise

- 2…16 kHz

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

KEB Combivert F5

Voltage types and power range

- 1-phase 180 - 260 V
  - 0.37 to 15 kW
- 3-phase 180 - 260 V
  - 0.37 to 90 kW
- 3-phase 305 - 500 V
  - 0.37 to 90 kW
- 3-phase 600 - 760 V
  - 0.75 to 900 kW

Power factor

- Default value 0.90

Supply frequency

- 50 / 60 +/- 2

Supply networks

- IT mains or special network configurations are also available

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	KEB Combivert	ABB ACS350		KEB Combivert F5		KEB	
P_N	P_N	ACS350	F5	I_{2N}	I_{2N}	I_{INV}	I_{INV}	Combivert	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	01X-		U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	02A4-2		2,4	2,2				R0
0,55	0,75								
0,75	1	04A7-2	07.F5.B3A-0A0A	4,7	4,2	4,0		A	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	09.F5.B1B-2B0A	7,5	6,8	7,0		B	R2
2,2	3	09A8-2	10.F5.B1B-2A0A	9,8	8,8	10,0		B	

KEB Combivert F5

Overload ratings

- na

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 200V

3-phase 200V		ABB	KEB Combivert	ABB ACS350		KEB Combivert F5		KEB	ASC350
P_N	P_N	ACS350	F5	I_{2N}	I_{2N}	I_{INV}	I_{INV}	Combivert	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-		U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	02A4-2		2,4	2,2				R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2		4,7	4,2				R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	09.F5.B1B-2B0A	7,5	6,8	7,0		B	
2,2	3	09A8-2	10.F5.B1B-2A0A	9,8	8,8	10,0		B	R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2	12.F5.B1D-1A0A	17,6	15,8	16,5		D	
5,5	7,5	24A4-2	13.F5.B1E-160A	24,4	21,96	24,0		E	R3
7,5	10	31A0-2	14.F5.B1E-150A	31,0	27,9	33,0		E	R4
11	15	46A2-2	15.F5.C1G-150F	46,2	41,58	48,0		G	

Basic
Compact

KEB Combivert F5

Overload ratings

- na

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 400V

3-phase 400V		ABB	KEB Combivert	ABB ACS350		KEB Combivert F5		KEB	
P_N	P_N	ACS350	F5	I_{2N}	I_{2N}	I_{INV}	I_{INV}	Combivert	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-		U_N=380-480 V		U_N=380-500 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	01A2-4		1,2	1,1				R0
0,55	0,75	01A9-4		1,9	1,7				
0,75	1	02A4-4	07.F5.B3A-390A	2,4	2,2	2,6		A	R1
1,1	1,5	03A3-4		3,3	3,0				
1,5	2	04A1-4	09.F5.B3A-390A	4,1	3,7	4,1		A	
2,2	3	05A6-4	10.F5.B1B-3A0A	5,6	5,0	12,5		B	
3	4	07A3-4		7,3	6,6				
4	5	08A8-4	12.F5.B1B-350A	8,8	7,9	9,5		B	
5,5	7,5	12A5-4	13.F5.B1D-390A	12,5	11,3	12,0		D	R3
7,5	10	15A6-4	14.F5.B1D-380A	15,6	14,0	16,5		D	
11	15	23A1-4	15.F5.B1E-350A	23,1	20,8	24,0		E	
15	20	31A0-4	16.F5.B1E-340A	31	27,9	33,0		E	R4
18,5	25	38A0-4	17.F5.C1G-350F	38	34,2	42,0		G	
22	30	44A0-4	18.F5.C1G-340F	44	39,6	50		G	

Basic
Compact

KEB Combivert F5

Overload ratings

- na

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	KEB Combivert F5	ABB ACS350			KEB Combivert F5			KEB Combivert	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,33										
0,4	0,5	02A4-2		70	169	161					R0
0,55	0,75										
0,75	1	04A7-2	07.F5.B3A-0A0A	70	169	161	76	191	144	A	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	09.F5.B1B-2B0A	105	169	165	90	220	160	B	R2
2,2	3	09A8-2	10.F5.B1B-2A0A							B	

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	KEB Combivert F5	ABB ACS350			KEB Combivert F5			KEB Combivert	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,2	0,33										
0,4	0,5	02A4-2		118	1,9	1,2					R0
0,55	0,75										
0,75	1	04A7-2	07.F5.B3A-0A0A	118	1,9	1,2	145,2	2,1	0,9	A	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	09.F5.B1B-2B0A	177	2,9	1,5	198,0	3,2	2	B	R2
2,2	3	09A8-2	10.F5.B1B-2A0A							B	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	KEB Combivert F5	ABB ACS350			KEB Combivert F5			KEB Combivert	ASC350
		Type	Type	3-phase			3-phase			Frame names N/A	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D		Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	02A4-2		70	169	161					R0
0,55	0,75	03A5-2									
0,75	1	04A7-2									R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	09.F5.B1B-2B0A				90	220	160	B	
2,2	3	09A8-2	10.F5.B1B-2A0A	105		165				B	R2
3	4	13A3-2									
4	5	17A6-2	12.F5.B1D-1A0A				90	250	181	D	
5,5	7,5	24A4-2	13.F5.B1E-160A	169	169	169	130	290	208	E	R3
7,5	10	31A0-2	14.F5.B1E-150A	260	181	169				E	R4
11	15	46A2-2	15.F5.C1G-150F				170	340	255	G	

Basic
Compact

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	KEB Komivert F5	ABB ACS350			KEB Komivert F5			KEB Komivert	ASC350
		Type	Type	3-phase			3-phase			Frame names N/A	
		ACS350-	VFS11	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight		Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	02A4-2									R0
0,55	0,75	03A5-2									
0,75	1	04A7-2		118	1,9	1,2					R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	09.F5.B1B-2B0A				198,0	3,2	2	B	
2,2	3	09A8-2	10.F5.B1B-2A0A							B	R2
3	4	13A3-2		177	2,9	1,5					
4	5	17A6-2	12.F5.B1D-1A0A				225,0	4,1	3	D	
5,5	7,5	24A4-2	13.F5.B1E-160A	286	4,8	2,5	377,0	7,8	5	E	R3
7,5	10	31A0-2	14.F5.B1E-150A	471	8,0	4,4				E	R4
11	15	46A2-2	15.F5.C1G-150F				578,0	14,7	10	G	

Basic
Compact

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	KEB Combivert F5	ABB ACS350			KEB Combivert F5			KEB Combivert	ASC350
		Type	Type							Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	01A2-4		70	169	161					R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	07.F5.B3A-390A				76	191	144	A	R1
1,1	1,5	03A3-4									
1,5	2	04A1-4	09.F5.B3A-390A				76	191	144	A	
2,2	3	05A6-4	10.F5.B1B-3A0A				90	220	160	B	
3	4	07A3-4									
4	5	08A8-4	12.F5.B1B-350A							B	
5,5	7,5	12A5-4	13.F5.B1D-390A	169	169	169	90	250	181	D	R3
7,5	10	15A6-4	14.F5.B1D-380A							D	
11	15	23A1-4	15.F5.B1E-350A				130	290	208	E	
15	20	31A0-4	16.F5.B1E-340A	260	181	169				E	R4
18,5	25	38A0-4	17.F5.C1G-350F				170	340	255	G	
22	30	44A0-4	18.F5.C1G-340F							G	

Basic
Compact

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	KEB Combivert F5	ABB ACS350			KEB Combivert F5			KEB Combivert	ASC350
		Type	Type							Frame names	
		ACS350-	VFS11	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	01A2-4		118	1,9	1,2					R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	07.F5.B3A-390A				145,2	2,1	0,9	A	R1
1,1	1,5	03A3-4				1,2					
1,5	2	04A1-4	09.F5.B3A-390A				145,2	2,1	0,9	A	
2,2	3	05A6-4	10.F5.B1B-3A0A				198,0	3,2	2	B	
3	4	07A3-4									
4	5	08A8-4	12.F5.B1B-350A							B	
5,5	7,5	12A5-4	13.F5.B1D-390A	286	4,8	2,5	225,0	4,1	3	D	R3
7,5	10	15A6-4	14.F5.B1D-380A							D	
11	15	23A1-4	15.F5.B1E-350A				377,0	7,8	5	E	
15	20	31A0-4	16.F5.B1E-340A	471	8,0	4,4				E	R4
18,5	25	38A0-4	17.F5.C1G-350F				578,0	14,7	10	G	
22	30	44A0-4	18.F5.C1G-340F							G	

Basic
Compact

Installation

KEB Combivert F5

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	No
Flange	No
Wall (sideways)	No
Heatsinkless	Yes
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	150
Below	100
Left and right	30 (distance to wall)

- Max motor cable length when using shielded cable:
  - 10 m (Inverter size 05-10))
  - 50 m (Inverter size 12 and 20-27)
  - 100m (inverter size 13-19)

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

KEB Combivert F5

- Filters
  - Basic: integrated filter to EN 55011/B (option: B, D, E-housing)
  - Line-side EMC-filters - EN 55011- A/B (option)
  - Output filters (option)
  - Sinusoidal filters (option)
  - Combination filter for input/output
  - Harmonic filters (option)
- Chokes
  - Output chokes (option)
  - Line reactors (option)
- EMC compliant motor cable lengths
  - Units with integrated filter:
  - up to max. 5m line length and 4kHz operating frequency = Limit Value B (EN 55011)
  - up to max. 10m line length and 16kHz operating frequency = Limit Value A (EN 55022)
- THD
  - harmonic filter THD ≤ 8 %

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 [1])	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 [1])	-	30 m (100 ft)

- THD
  - EN61000-3-2 with optional chokes

User interface

KEB Combivert F5

- KEB Open operator (option)
  - The cost effective programmable hardware for software extension in single drive applications, (C- / assembler programming, free memory: 64k-flash, RS 232/485 connection).

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Machine interface (I/O)

KEB Combivert F5

Type	*Qty.*	*Programmable*
Digital inputs	5 (basic), 8 (compact)	Yes
Analog inputs	2 (basic&compact)	Yes, one
Pulse train input	-	-
Relay outputs	2 (basic&compact)	Yes
Transistor outputs	2 (compact)	-
Analog outputs	2 (compact)	Yes
Software inputs/outputs	4 (basic&compact)	Yes

Multi:

- Control options through plug-in feedback cards:
  - Resolver
  - TTL or HTL incremental encoder, initiator
  - SIN/COS- encoder
  - absolute value encoder
  - HIPERFACE®, ENDAT® or Tacho

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

KEB Combivert F5

Protocol	*Standard/ Optional*	*Baud rate*	*Notes*
CANopen	Optional		Potiental-free operator connection
Ethernet	Optional		Potiental-free operator connection
Modbus	Optional		Potiental-free operator connection
Profibus	Optional		Potiental-free operator connection
KEB-HSP 5/DIN66019-II	Optional		Potiental-free operator connection
Interbus	Optional		Potiental-free operator connection
DeviceNet	Optional		Potiental-free operator connection
Sercos interface	Optional		Potiental-free operator connection
Ethernet Powerlink	Optional		Potiental-free operator connection
EtherCat	Optional		Potiental-free operator connection

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

Motor control

KEB Combivert F5

- KEB - SMM (sensorless motor management)

Braking

- internal braking chopper (Basic&compact)

Output frequency

- up to 1600 Hz

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

KEB Combivert F5

- Basic and compact:
  - 8 free-to-programmable parameter sets including S-curve, ramp stop, Power-Off-function, DC-braking, PID technology regulator, electronic motor protection, brake control, internal timer, counter input
- Multi:
  - Decentralized automation in the drive actuator with
    - speed and torque control
    - position control
    - synchro-control, electronic gears
    - or customized solutions
- LCD-Operator, with a clear text display in 6 languages and menu-led keyboard operation as pluggable module for all F5 units.

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

KEB Combivert F5

- adaption to serial protocols
- industry-specific software
- potential-free operator connection and serial interfaces
- Basic%compact:
  - sampling time of the control terminals 2 ms
  - +/- intermediate circuit connection, internal braking chopper (standard up to housing size G), motor-PTC-analysis, hardware current control
  - controlled positioning to end position/counting pulse
  - optional: protection against accidental restart using voltage-free switching in driver section
- Multi:
  - speed and torque control
  - position control
  - synchro-control, electronic gears
  - or customized solutions like:
    - cam switches
    - electronic cams
    - single-axis positioning
    - rotary indexing positioning
    - register function

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

KEB Combivert F5

- Interface Operator, 00.F5.060-2000 / -2100 universal open KEB protocol for PC and PLC-connection RS 232 / 485-connection submin-D-9

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

KEB Combivert F5

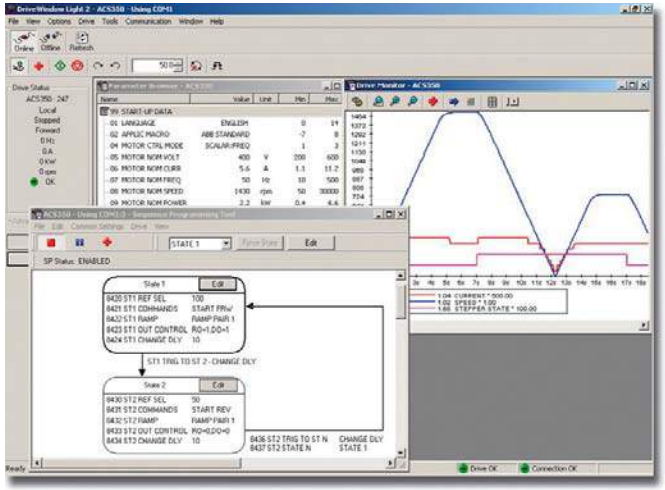
Combivis 5

- complete management of equipment settings
- display and setting of all parameters in up to 8 sets
- configuration of customized CP menu
- analysis of drive and control communication
- display of physical parameters and monitoring of operating data
- virtual oscilloscope function for real time monitoring and storage of drive parameters
- Accessory:
  - KEB - Interface cable RS 232
  - KEB - Service cable HSP5

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

KEB Combivert F5

- Available as COMBIVIS 5-/DOKU-CD or download from http://www.keb.de
- Accessory:
  - KEB - Interface cable RS 232
  - KEB - Service cable HSP5

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

KEB Combivert F5

- KEB Open operator
- COMBICONTROL C5
- Braking resistors
- Filter technology + chokes
- LCD-Operator
- Field bus interfacing

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

KEB Combivert F5

N/A

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

KEB Combivert F5

Approvals

- CE, cUL, RUS

Applicable standards

- Product standard EN 61800-2, -5-1
- Emitted interference EN 61800-3
- EN 61000-6-1…4
- Tested in accordance with EN 61800-3 /UL508C
- Standards for emitted interference EN 55011 Class B / EN 55022 Class A
- Standards for noise immunity IEC 1000-4-2 / -3 / -4 / -5/ -6
- Climatic category 3K3 in accordance with EN 50178

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

ABB strenghts

ACS350 advantages over KEB Combivert F5

Sideways mounting	User macros 3 pcs
EN61000-3-2 with opt. chokes	17 languages
2 control panel options	FlashDrop
Panel cover	Sequence programming
Modbus speed	Potentiometer option
100% Phd braking	Maintenance need indication
Application macros 7 pcs	Detailed fault history with time

For ACS350 advantages in performance, see the performance test slides



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

PowerFlex 40

- Designed with application versatility and robust performance in mind, the PowerFlex 40 features sensorless vector control and additional I/O capability. It is a cost-effective alternative.
- For power range 0.4 - 11 kW
- Sensorless vector and V/Hz control
- Applications
  - Machine tools, fans, pumps and conveyors
- PowerFlex 40P types
  - For power range 0.4 - 11 kW
  - Open and closed loop vector and V/Hz control
  - Common options and accessories with PF 40
  - Embedded Encoder/Pulse Train Inputs
  - DriveGuard® Safe-off (optional) for category 3 Safe-off
  - Applications: diverters, smart conveyors, packaging machines, palletizers, drafting machines, ring spinning machines and synthetic fiber spinning machines

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

PowerFlex 40

- IP 20 Open Type
- IP 30/NEMA 1/UL Type 1 (requires the installation of the PowerFlex 40 IP 30/NEMA 1/UL Type 1 option kit)

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

PowerFlex 40

Vibration

- 1G peak, 5 to 2000 Hz. (operating)

Shock

- 15G peak for 11ms duration (±1.0ms) (operating)

Temperature

- Operating temperature without derating
  - IP20, NEMA/UL Open Type, : –10 to +50°C
  - IP30, NEMA/ UL Type 1and IP66, NEMA/UL Type 4X: –10 to +40°C
  - Flange mounting: heatsink –10 to 40°C, drive –10 to 40°C
- Storage temperature -40° to +85°C

Humidity

- Lower than 95 % (noncondensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% for every extra 100 m

Acoustic noise

- 2-16 kHz, drive rating based on 4 kHz

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

PowerFlex 40

Voltage types and power range

- 1-phase 100 - 120V ±10%
  - 0.4 to 1.1 kW (0.5 to 1.5 hp)
- 1-phase 200 - 240V ±10%
  - 0.4 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V ±10%
  - 0.4 to 7.5 kW (0.5 to 10 hp)
- 3-phase 380 - 480V ±10%
  - 0.4 to 11 kW (0.5 to 15 hp)
- 3-phase 460 - 600V ±10%
  - 0.75 to 11 kW (1.0 to 15 hp)

Power factor

- Efficiency 97.5% (typical)

Supply frequency

- 50/60 Hz

Supply networks

- The MOVs connected to ground shall be disconnected if the drive is installed on an ungrounded distribution system. To disconnect these devices, remove a jumper inside the drive.

DC bus connection

- Available

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

DC bus connection

Ratings 1-phase 200V

1-phase 200V		ABB	PowerFlex	ABB ACS350		PowerFlex 40		PowerFlex	
P_N	P_N	ACS350	40	I_{2N}	I_{2N}	Output current		40	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	01X-	22B-	U_N=200-240 V		U_N=200-240 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,4	0,5	02A4-2	A2P3N104	2,4	2,2	2,3	2,3	B	R0
0,55	0,75								
0,75	1	04A7-2	A5P0N104	4,7	4,2	5,0	5,0	B	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	A8P0N104	7,5	6,8	8,0	8,0	B	R2
2,2	3	09A8-2	A012N104	9,8	8,8	12,0	12,0	C	

PowerFlex 40

Overload ratings

- 150 % for 60 sec.
- 200% for 3 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 200V

3-phase 200V		ABB	PowerFlex	ABB ACS350		PowerFlex 40		PowerFlex	
P_N	P_N	ACS350	40	I_{2N}	I_{2N}	Output current		40	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-	22B-	U_N=200-240 V		U_N=200-240 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,4	0,5	02A4-2	B2P3N104	2,4	2,2	2,3	2,3	B	R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2	B5P0N104	4,7	4,2	5,0	5,0	B	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	B8P0N104	7,5	6,8	8,0	8,0	B	
2,2	3	09A8-2	B012N104	9,8	8,8	12,0	12,0		R2
3	4	13A3-2		13,3	12,0				
3,7	5	17A6-2	B017N104	17,6	15,8	17,5	17,5	B	
5,5	7,5	24A4-2	B024N104	24,4	21,96	24,0	24,0	C	R3
7,5	10	31A0-2	B033N014	31,0	27,9	33,0	33,0		R4
11	15	46A2-2		46,2	41,58				

PowerFlex 40

Overload ratings

- 150 % for 60 sec.
- 200% for 3 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 400V

3-phase 400V		ABB	PowerFlex	ABB ACS350		PowerFlex 40		PowerFlex	ASC350
P_N	P_N	ACS350	40	I_{2N}	I_{2N}	Output current		40	
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-	22B-	U_N=380-480 V		U_N=380-480 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,4	0,5	01A2-4	D1P4N104	1,2	1,1	1,4	1,4	B	R0
0,55	0,75	01A9-4		1,9	1,7				
0,75	1	02A4-4	D2P3N104	2,4	2,2	2,3	2,3	B	R1
1,1	1,5	03A3-4		3,3	3,0				
1,5	2	04A1-4	D4P0N104	4,1	3,7	4,0	4,0	B	
2,2	3	05A6-4	D6P0N104	5,6	5,0	6,0	6,0		
3	4	07A3-4		7,3	6,6				
4	5	08A8-4	D010N104	8,8	7,9	10,5	10,5	B	
5,5	7,5	12A5-4	D012N104	12,5	11,3	12,0	12,0	C	R3
7,5	10	15A6-4	D017N104	15,6	14,0	17,0	17,0		
11	15	23A1-4	D024N104	23,1	20,8	24,0	24,0		
15	20	31A0-4		31	27,9				R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

PowerFlex 40

Overload ratings

- 150 % for 60 sec.
- 200% for 3 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	PowerFlex 40	ABB ACS350			PowerFlex 40			PowerFlex 40	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-	22B-	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,4	0,5	02A4-2	A2P3N104	70	169	161	100	168	136	B	R0
0,55	0,75										
0,75	1	04A7-2	A5P0N104	70	169	161	100	168	136	B	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	A8P0N104	105	169	165	100	168	136	B	R2
2,2	3	09A8-2	A012N104				130	246	180	C	

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	PowerFlex 40	ABB ACS350			PowerFlex 40			PowerFlex 40	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-	22B-	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,4	0,5	02A4-2	A2P3N104	118	1,9	1,2	168	2,3	2,2	B	R0
0,55	0,75										
0,75	1	04A7-2	A5P0N104	118	1,9	1,2	168	2,3	2,2	B	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	A8P0N104	177	2,9	1,5	168	2,3	2,2	B	R2
2,2	3	09A8-2	A012N104				320	5,8	4,3	C	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	PowerFlex 40	ABB ACS350			PowerFlex 40			PowerFlex 40	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	22B-	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,4	0,5	02A4-2	B2P3N104				100	168	136	B	R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	B5P0N104	70		161	100	168	136	B	R1
1,1	1,5	06A7-2			169						
1,5	2	07A5-2	B8P0N104				100	168	136	B	
2,2	3	09A8-2	B012N104								R2
3	4	13A3-2		105		165					
3,7	5	17A6-2	B017N104				100	168	136	B	
5,5	7,5	24A4-2	B024N104	169	169	169	130	246	180	C	R3
7,5	10	31A0-2	B033N014	260	181	169					R4
11	15	46A2-2									

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	PowerFlex 40	ABB ACS350			PowerFlex 40			PowerFlex 40	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	22B-	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,4	0,5	02A4-2	B2P3N104				168	2,3	2,2	B	R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	B5P0N104	118	1,9	1,2	168	2,3	2,2	B	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	B8P0N104				168	2,3	2,2	B	
2,2	3	09A8-2	B012N104								R2
3	4	13A3-2		177	2,9	1,5					
3,7	5	17A6-2	B017N104				168	2,3	2,2	B	
5,5	7,5	24A4-2	B024N104	286	4,8	2,5	320	5,8	4,3	C	R3
7,5	10	31A0-2	B033N014	471	8,0	4,4					R4
11	15	46A2-2									

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	PowerFlex 40	ABB ACS350			PowerFlex 40			PowerFlex 40	ASC350
		Type	Type								
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	22B-	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,4	0,5	01A2-4	D1P4N104	70	169	161	100	168	136	B	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	D2P3N104				100	168	136	B	R1
1,1	1,5	03A3-4									
1,5	2	04A1-4	D4P0N104				100	168	136	B	
2,2	3	05A6-4	D6P0N104				100	168	136		
3	4	07A3-4									
4	5	08A8-4	D010N104				100	168	136	B	
5,5	7,5	12A5-4	D012N104	169		169	130	246	180	C	R3
7,5	10	15A6-4	D017N104				130	246	180		
11	15	23A1-4	D024N104				130	246	180		
15	20	31A0-4		260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	PowerFlex 40	ABB ACS350			PowerFlex 40			PowerFlex 40	ASC350
		Type	Type								
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	22B-	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,4	0,5	01A2-4	D1P4N104	118	1,9	1,2	168	2,3	2,2	B	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	D2P3N104				168	2,3	2,2	B	R1
1,1	1,5	03A3-4				1,2					
1,5	2	04A1-4	D4P0N104				168	2,3	2,2	B	
2,2	3	05A6-4	D6P0N104				168	2,3	2,2		
3	4	07A3-4									
4	5	08A8-4	D010N104				168	2,3	2,2	B	
5,5	7,5	12A5-4	D012N104	286	4,8	2,5	320	5,8	4,3	C	R3
7,5	10	15A6-4	D017N104				320	5,8	4,3		
11	15	23A1-4	D024N104				320	5,8	4,3		
15	20	31A0-4		471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

Sideways mounting
Side by side mounting in 50°C

Installation

PowerFlex 40

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes (only frame B)
Flange	No
Wall (sideways)	No
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	125
Below	125
Left and right	0 when < 40°C, 25 mm from 40°C to 50°C

Motor Insulation Rating	Motor Cable
1000 Vp-p	15 m
1200 Vp-p	40 m
1600 Vp-p	170 m

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

PowerFlex 40

- Filters
  - Integral “S Type” EMC filter available on 1~240 V
  - External “S Type” and “L Type” EMC filters available for other types (only “L type” for 600V range)
- Chokes
  - AC/DC chokes as external option
- EMC compliant motor cable lengths:

Filter Type	EN61800-3 First Environment Restricted Distribution or Second Environment (2)	EN61800-3 First Environment Unrestricted Distribution (3)
Integral	10 meters (33 feet)	1 meter (3 feet)
External - S Type(1)	10 meters (33 feet)	1 meter (3 feet)
External - L Type(1)	100 meters (328 feet)	5 meters (16 feet)

(1) Refer to Appendix B for details on optional external filters.
(2) Equivalent to EN55011 Class A.
(3) Equivalent to EN55011 Class B.

- THD: Compliance with EN61000-3-2
  - 0.75 kW (1 HP) 1~and 3~240V drives and 0.37 kW (0.5 HP) 1~240V drives are suitable for installation on a private low voltage power network. Installations on a public low voltage power network may require additional external harmonic mitigation.
  - Other drive ratings meet the current harmonic requirements of EN61000-3-2 without additional external mitigation

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

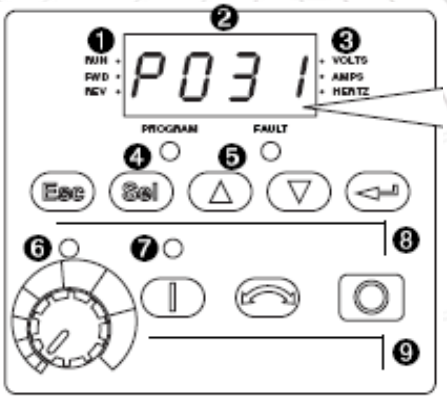
1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

PowerFlex 40

- Integral keypad with 4 digit display and LED indicators



No.	Name
1	Run / Direction status
2	Alphanumeric Display
3	Displayed units
4	Program status
5	Fault status
6	Potentiometer status
7	Start key status
8	Escape, Select, Up /Down arrows, Enter
9	Speed potentiometer with buttons Start, Reverse and Stop

- Remote kit for control panel

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Machine interface (I/O)

PowerFlex 40

Type	*Qty.*	*Programmable*
Digital inputs	4	Yes
Analog inputs	2	Yes
Pulse train input	N/A	N/A
Relay outputs	1	Yes
Transistor outputs	N/A	N/A
Analog outputs	1	Yes
Opto-coupled outputs	2	Yes

Specialities:

- One bipolar analog input

PowerFlex 40P

- Embedded Encoder/Pulse Train Inputs (standard)
- DriveGuard® Safe-off (optional) for category 3 Safe-off

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog inputs

Machine interface (fieldbus)

PowerFlex 40

Protocol	*Standard /Optional*	*Baud rate*	*Notes*
RS485 (DSI)	Standard	N/A	
Modbus RTU	Standard	N/A	
DeviceNet	Option	N/A	22-COMM-D
EtherNet/IP	Option	N/A	22-COMM-E
Profibus	Option	N/A	22-COMM-P
LonWorks	Option	N/A	22-COMM-L
BACnet	Option	N/A	22-COMM-B
ControlNet	Option	N/A	22-COMM-C

- All optional fieldbus modules require a Communication Adapter Cover
- External DSI™Communications Kit available for external mounting for 22-COMM communication options

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

100% Phd braking for all units

500 Hz max. output frequency

Motor control

PowerFlex 40

- Sensorless vector control
- V/Hz

Braking

- Integral brake transistor, available on 0.75 kW (1.0 HP) units and larger

Output frequency

- 0…400 Hz (programmable) with vector control

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

PowerFlex 40

N/A

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

PowerFlex 40

- Sensorless Vector Control develops high torque over a wide speed *(
- Variable PWM allows the drive to output more current at low frequencies *(
- Integral PID functionality enhances application flexibility *(
- Timer, Counter, Basic Logic and StepLogic functions can reduce hardware design costs and simplify control schemes *(
- Timer function: Relay or opto outputs controlled by drive performing timer function *(
- Counter function: Relay or opto outputs controlled by drive performing counter function *(
- Step Logic: Logic-based steps using preset speed settings. Each step can be programmed for a specific speed, direction and accel/decel profile. Drive outputs can be used to indicate which step is being performed. *(
- 10 most commonly programmed parameters are grouped together for fast and easy start up

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

PowerFlex 40

Pocket DriveExplorer for Pocket PC

- Tool to program and maintain Allen-Bradley drives
- Program can be loaded to Pocket PC devices such as Dell Axim's and HP iPAQ's
- Portable with many connection possibilities: Serial, Wi-Fi® and Bluetooth® wireless technology connectivity options
- Clear and big display with possibility to create own texts
- Requires a PC for loading program from a CD (incl. both Pocket PC and Windows CE versions) to the Pocket PC
- Parameter setting, uploading and downloading, Download new firmware to the drive and/or attached peripherals
- Utility tool for disabling editing possibility and limiting to saved connections
- Compatible with PowerFlex® 4, 4M, 40, 40P, 400 (Component Class) drives, PowerFlex® 70, 700, 700H, 700S (Architecture Class) drives, SCANport™ products and select peripherals, SMC Flex™

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

PowerFlex 40

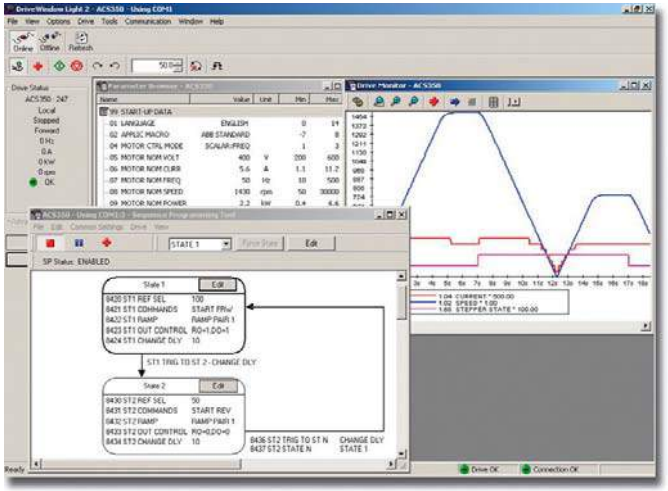
StepLogic

- Can be used to create a custom profile of frequency commands. Each “step” can be based on time, status of a Logic input or a combination of time and the status of a Logic input.
- The StepLogic sequence begins with a valid start command
- The logic for each function is determined by the four digits for each StepLogic parameter
- 8 StepLogic parameters available: A140 (Stp Log 0) to A147 (Stp Logic 7)

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

PowerFlex 40

- Integral RS-485 (DSI) communications can be used for programming from a PC. It can also be used in a multi-drop network configuration.
- Serial Converter Module (RS485 to RS232) provides connectivity to any controller with a DF1 port via DF1 protocol for e.g. use with DriveExplorer and DriveExecutive software
- DriveExplorer Software
  - Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online
- DriveExecutive Software
  - Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online and offline

ABB ACS350

- Easy access throught RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

PowerFlex 40

- Remote kit for control panel
- EMC filters S-type and L-type
- Fieldbuses
- Serial Converter Module (RS485 to RS232)
- RJ45 DSI Splitter Cable for connecting a second DSI peripheral device to the drive (one port as standard)
- Compact I/O Module
- Various cables for use with communication options
- IP30/NEMA 1/UL Type 1 Kit for drive
- IP30/NEMA 1/UL Type 1 Kit for drive and communication option
- Dynamic Brake Resistors
- Line reactors
- DC bus inductors

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

PowerFlex 40

N/A

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Standards

PowerFlex 40

Approvals

- CE, UL, cUL, CSA

Compliance with

- Low Voltage Directive 73/23/EEC with supplement
- EMC Directive 89/336/EEC
- National Codes and standards (NEC, VDE, BSI, etc.) and local codes outline provisions for safely installing electrical equipment

- **Applicable standards**
  - Low Voltage: EN 50178, EN 60204
  - EMC: EN 61800-3, EN 50081-1, EN 50082-2
  - EN61000-3-2

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Allen-Bradley PowerFlex 40

Model: 22B-D6P0N104

Drive rating: 380-480V
2.2 kW / 3.0 HP
6.0 A

Tester (experienced drive specialist) comments:

- Wiring power terminals is much easier because of grey plastic and easy to see saddle clamps. Depth of wire insertion is obvious and stripping guide is impressed into plastic cover. Size of terminals are generous.
- Factory jumper for coast stop input, like Danfoss
- No tie point for control cables
- Drive speed regulator has very aggressive default settings
- The problem of operating the drive “out of the box” using the operator panel identified with the Powerflex 70 has been corrected on this drive

ABB ACS350

Model: ACS350-03U-05A6-4

Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A

Parameter Settings:

9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

Photos of the tested unit

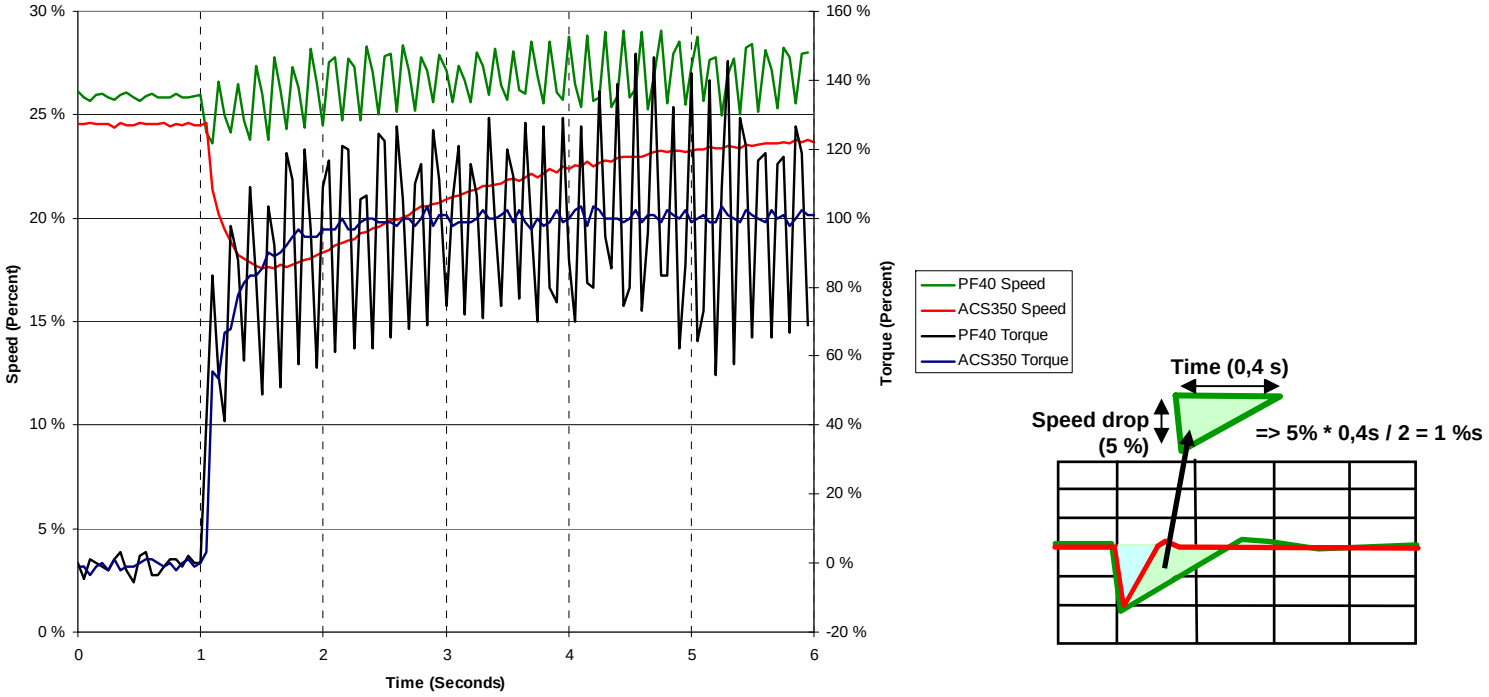
Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | **Allen-Bradley PowerFlex 40** | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Impact load test – Dynamic speed accuracy (stiffness)

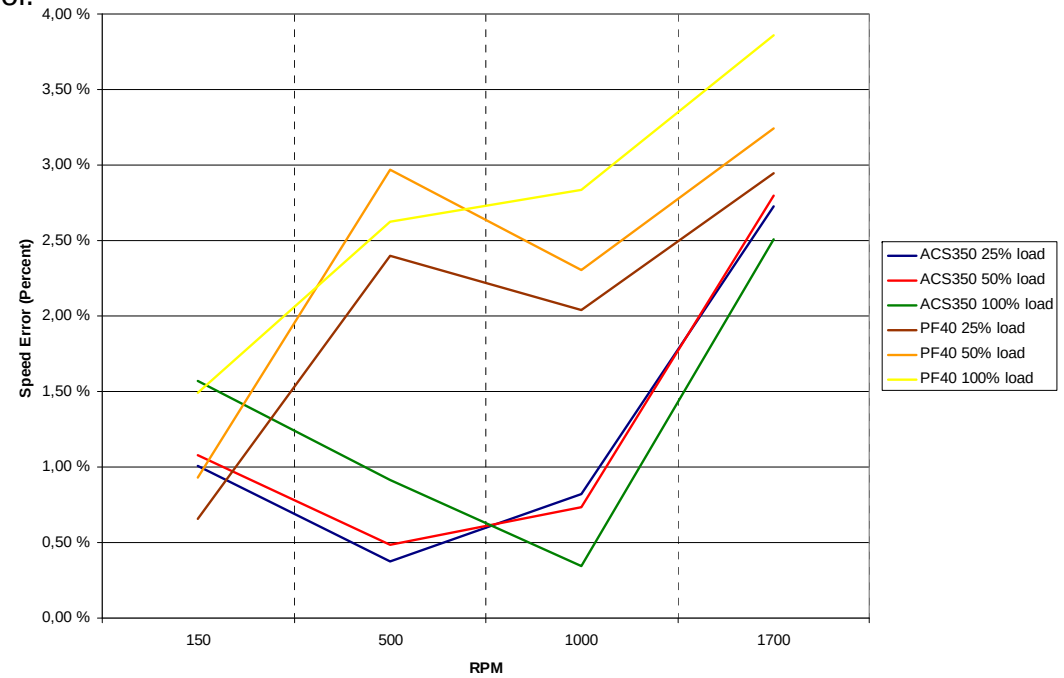
Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.



Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive works in case of disturbances. The ACS350 speed control default tuning is quite conservative to ensure that the controller is stable despite the motor used and its size compared to size of the inverter. The PF40 has good dynamic speed accuracy despite the amount of speed and torque ripple. The performance of the ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL).

Static speed accuracy

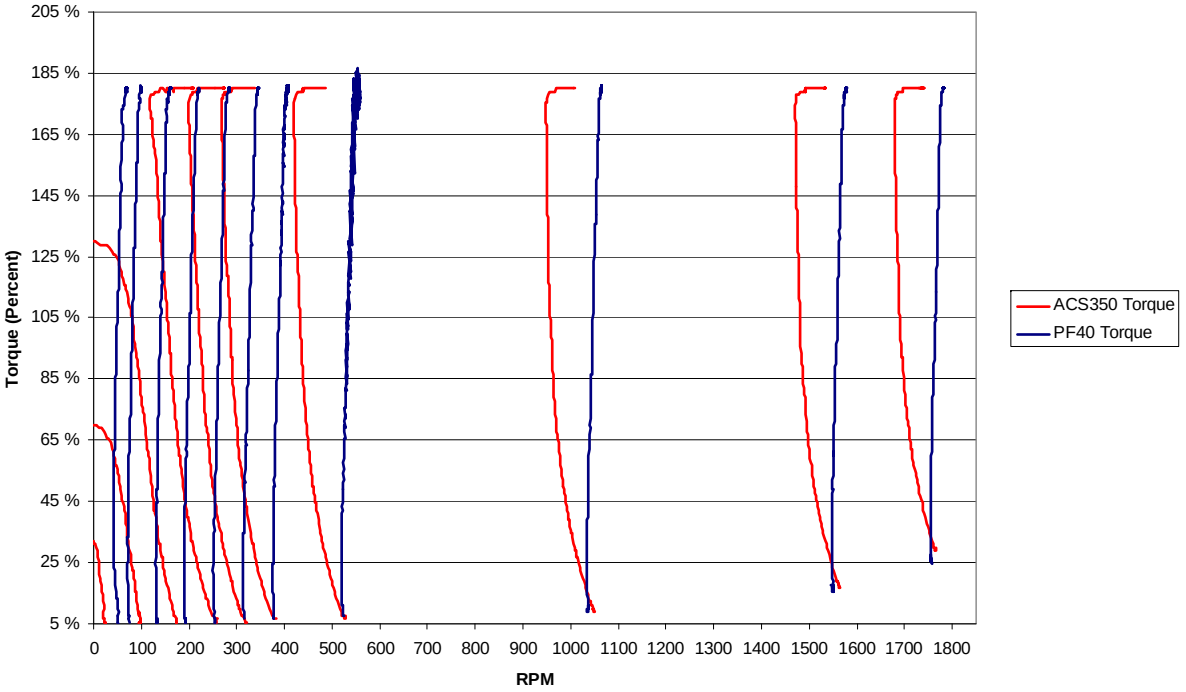
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 0%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), error [%] = $(n^*-n_{act}) * n_{N(mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Static speed error depends on on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). The ACS350 and PF40 performed the test equally. PF40 has bigger maximum error. The performance of ACS350 can be improved by tuning the speed controller (parameter group 23 SPEED CONTROL).

Maximum torque as a function of speed

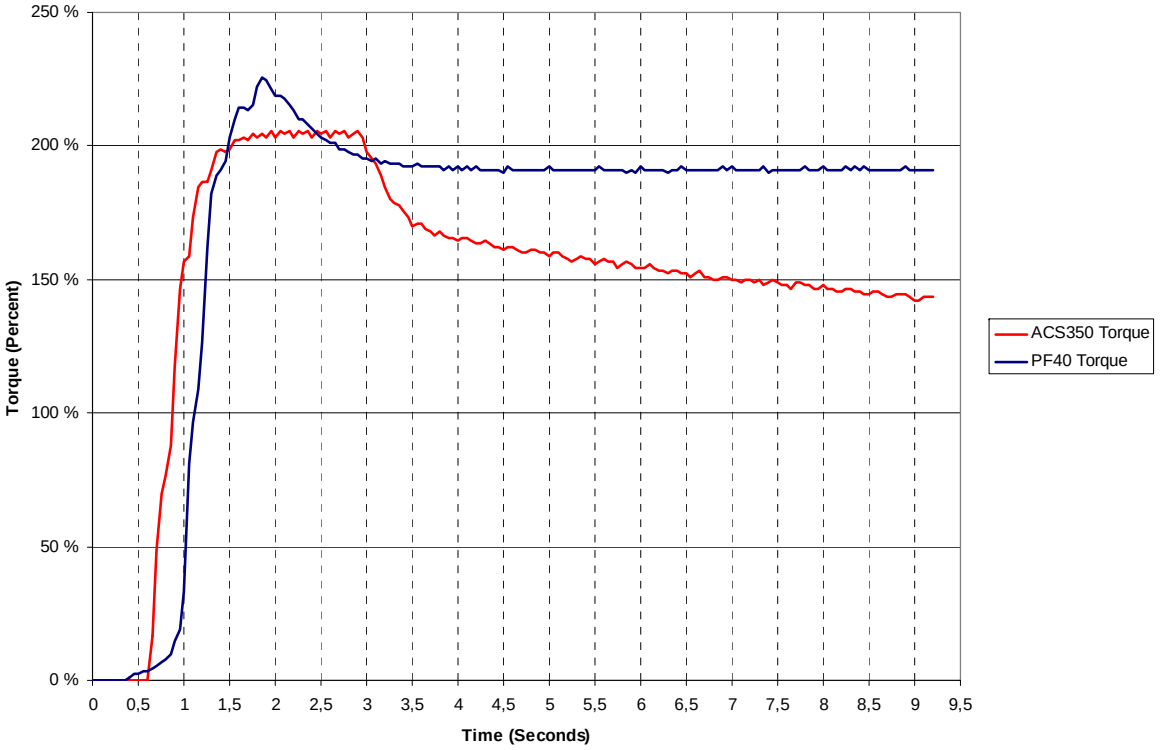
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The PF40 has very good speed range because it could provide full output torque from 1700 rpm's down to 30 rpm, PF40 overcompensates slightly for slip. The ACS350 has good speed range because it could provide full output torque from 1700 rpm's down to 180 rpm.

Maximum starting torque

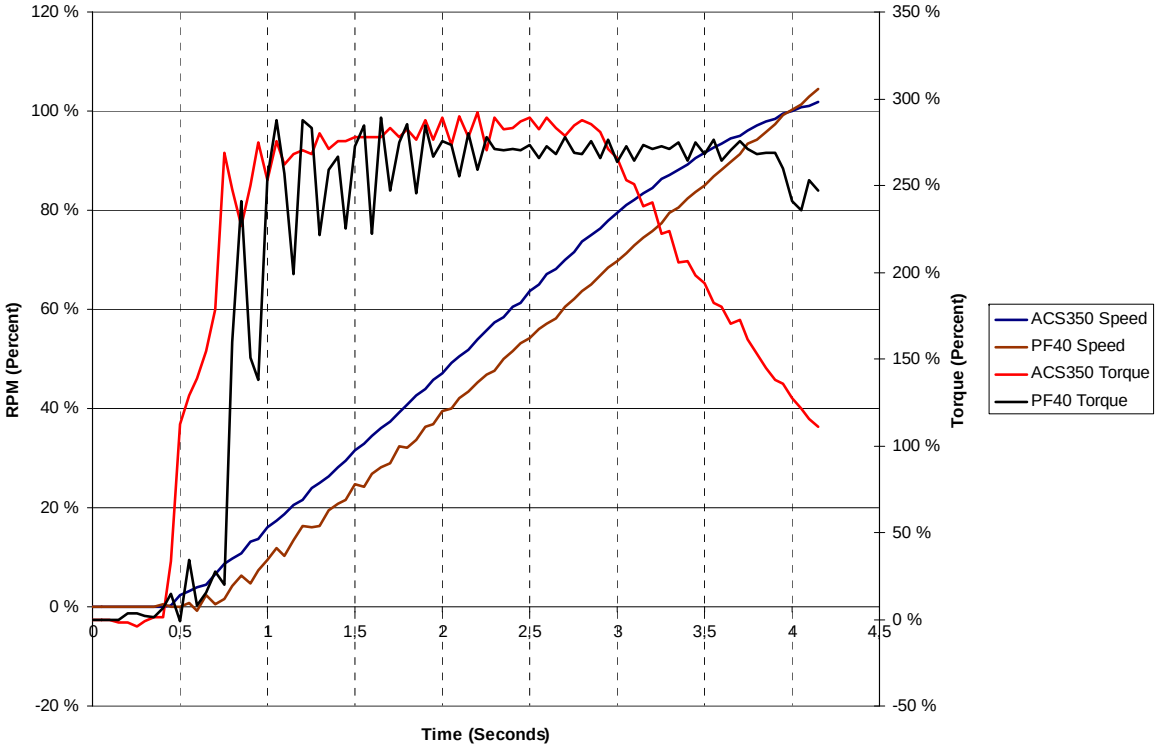
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



Both drives have good starting torque up to 200%. ACS350 reaches nominal torque within 1s, PF40 a bit slower. The ACS350 reduces torque to nominal value after 2 s due to current limiting.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



The PF40 accelerates the load to the reference in 4,0 seconds, as does the ACS350. The torque response time of the ACS350 is much faster but after the overload cycle of two seconds, the ACS350 reduces its overload current (torque) which causes the rate of acceleration to decrease so both drives end up with the same result.

Efficiency

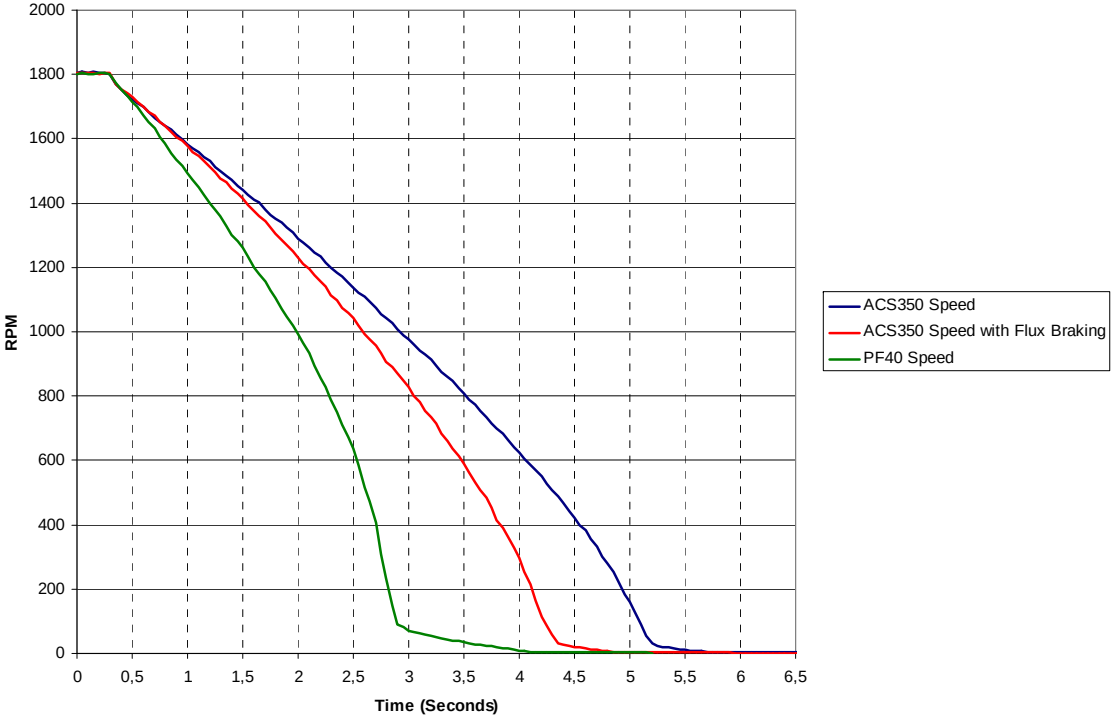
Using power analyzer, input power, speed and torque of AC motor are measured at 0, 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	PF40
25%	87.0%	82.0%
50%	89.3%	88.8%
75%	89.0%	89.9%
100%	88.4%	89.4%

The test is performed at rated speed with different loads. ACS350 has higher efficiency at 25% but at higher load points they are comparable.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with or without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works



The ACS350 was able to decelerate to zero within 5,5 seconds. The ACS350 with flux braking shortened the deceleration time even more. The PF40 performed the test better as ACS350 with flux braking functionality.

ABB strengths

ACS350 advantages over PowerFlex 40

Wide power range	100% Phd braking for all units
Areas of all units	500 Hz max. output frequency
Weights of all units	Application macros 7 pcs
Volumes of 400 V units	User macros 3 pcs
Sideways mounting	17 languages
Side by side mounting in 50°C	Cold configuration with FlashDrop
EN61000-3-2 with opt. chokes	Sequence programming
2 detatchable control panel options	Maintenance need indication
Panel cover	Detailed fault history with time
Pulse train	

For ACS350 advantages in performance, see the performance test slides

ACS350 Competitor comparison




















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | **Lenze 8400** | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Lenze 8400

- The new 8400 Inverter Drives have been designed for consistent process optimisation – throughout all phases of the value-added chain.
- The functionality and drive behaviour of the 8400 series (BaseLine, StateLine and HighLine) develop consistently from one to the next which makes your selection process simple.
- Modifications at a later date are no problem.
- The inverters are supplied in full including integrated shield connections.
- Applications
  - **8400 StateLine - for controlled movement,** palletizers, extruders, filling systems or travelling/variable speed drives.

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Lenze 8400

- IP20

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Lenze 8400

Vibration

- EN 61800-5-1:
  - 10 ... 57 Hz: ±0.075 mm amplitude
  - 57 ... 150 Hz: 1.0g

Shock

- na

Temperature

- Operation: -10 °C … +55 °C
- Storage: -25 °C ... +60 °C
- Transport: -25 °C ... +70 °C
- Output current derating: above +45 °C by 2.5%/°C

Humidity

- na

Altitude limitations

- 0 ... 4000 m amsl
- Rated output current derating Above 1000 m amsl by 5%/1000 m

Acoustic noise

- Noise emission EN 61800-3

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Lenze 8400

Voltage types and power range

- 1-ph 180 - 264 V +/- 0%
  - 0.25 to 2.2 kW
- 3-ph 320 - 550 V +/- 0%
  - 0.37 to 5.5 kW

Power factor

- N/A

Supply frequency

- 45 Hz -0% … 65 Hz +0%

Supply networks

- Data N/A

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Lenze	ABB ACS350		Lenze 8400		Lenze	
P_N	P_N	ACS350	8400	I_{2N}	I_{2N}	I_{INV}	I_{INV}	8400	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	01X-		U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	02A4-2		2,4	2,2				R0
0,55	0,75		5512			3,0	2,6		
0,75	1	04A7-2	7512	4,7	4,2	4,0	3,5		R1
1,1	1,5	06A7-2	1122	6,7	6,0	5,5	4,8		
1,5	2	07A5-2	1522	7,5	6,8	7,0	6,1		R2
2,2	3	09A8-2	2222	9,8	8,8	9,5	8,3		

Lenze 8400

Overload ratings

- 200 % overload current (3 s)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 200V

3-phase 200V		ABB	Lenze	ABB ACS350		Lenze 8400		Lenze	ASC350
P_N	P_N	ACS350	8400	I_{2N}	I_{2N}	I_{INV}	I_{INV}	8400	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-		U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	02A4-2		2,4	2,2				R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2		4,7	4,2				R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2		7,5	6,8				
2,2	3	09A8-2		9,8	8,8				R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2		17,6	15,8				
5,5	7,5	24A4-2		24,4	21,96				R3
7,5	10	31A0-2		31,0	27,9				R4
11	15	46A2-2		46,2	41,58				

Lenze 8400

Overload ratings

- 200 % overload current (3 s)

Note: Lenze 8400 3-phase 200V not available

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 400V

3-phase 400V		ABB	Lenze	ABB ACS350		Lenze 8400		Lenze	ASC350
P_N	P_N	ACS350	8400	I_{2N}	I_{2N}	I_{INV}	I_{INV}	8400	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-		U_N=380-480 V		U_N=380-500 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	01A2-4		1,2	1,1				R0
0,55	0,75	01A9-4	5514	1,9	1,7	1,8	1,6		
0,75	1	02A4-4	7514	2,4	2,2	2,4	2,1		R1
1,1	1,5	03A3-4	1124	3,3	3,0	3,2	2,8		
1,5	2	04A1-4	1524	4,1	3,7	3,9	3,4		
2,2	3	05A6-4	2224	5,6	5,0	5,1	4,5		
3	4	07A3-4	3024	7,3	6,6	7,3	6,4		
4	5	08A8-4	4024	8,8	7,9	9,5	8,3		
5,5	7,5	12A5-4	5524	12,5	11,3	13,0	11,4		R3
7,5	10	15A6-4		15,6	14,0				
11	15	23A1-4		23,1	20,8				
15	20	31A0-4		31	27,9				R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Lenze 8400

Overload ratings

- 200 % overload current (3 s)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Lenze 8400	ABB ACS350			Lenze 8400			Lenze 8400	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	N/A	
kW	hp	01X-		W	H	D	W	H	D		Frame
0,12	0,16										
0,2	0,33										
0,4	0,5	02A4-2		70	169	161					R0
0,55	0,75		5512				70	224	198		
0,75	1	04A7-2	7512	70	169	161					R1
1,1	1,5	06A7-2	1122				70	304	198		
1,5	2	07A5-2	1522	105	169	165	70	304	198		R2
2,2	3	09A8-2	2222				70	304	198		

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Lenze 8400	ABB ACS350			Lenze 8400			Lenze 8400	ASC350
		Type	Type	1-phase			1-phase			Frame	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	names	
kW	hp	01X-		area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,2	0,33										
0,4	0,5	02A4-2		118	1,9	1,2					R0
0,55	0,75		5512				157	3	na		
0,75	1	04A7-2	7512	118	1,9	1,2			na		R1
1,1	1,5	06A7-2	1122				213	8	na		
1,5	2	07A5-2	1522	177	2,9	1,5	213	8	na		R2
2,2	3	09A8-2	2222				157/213	8	na		

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Lenze 8400	ABB ACS350			Lenze 8400			Lenze 8400	ASC350
		Type	Type	3-phase			3-phase			Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	02A4-2		70	169	161					R0
0,55	0,75	03A5-2									
0,75	1	04A7-2									R1
1,1	1,5	06A7-2									
1,5	2	07A5-2									
2,2	3	09A8-2		105		165					R2
3	4	13A3-2									
4	5	17A6-2									
5,5	7,5	24A4-2		169	169	169					R3
7,5	10	31A0-2		260	181	169					R4
11	15	46A2-2									

Note: Lenze 8400 3-phase 200V not available

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Lenze 8400	ABB ACS350			Lenze 8400			Lenze 8400	ASC350
		Type	Type	3-phase			3-phase			Frame names N/A	
		ACS350-		(cm²)	(l)	(kg)	(cm²)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight		Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	02A4-2		118	1,9	1,2					R0
0,55	0,75	03A5-2									
0,75	1	04A7-2									R1
1,1	1,5	06A7-2									
1,5	2	07A5-2									
2,2	3	09A8-2		177	2,9	1,5					R2
3	4	13A3-2									
4	5	17A6-2									
5,5	7,5	24A4-2		286	4,8	2,5					R3
7,5	10	31A0-2		471	8,0	4,4					R4
11	15	46A2-2									

Note: Lenze 8400 3-phase 200V not available

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Lenze 8400	ABB ACS350			Lenze 8400				ASC350
		Type	Type							Frame names N/A	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D		Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	01A2-4		70	169	161					R0
0,55	0,75	01A9-4	5514				70	244	198		
0,75	1	02A4-4	7514								R1
1,1	1,5	03A3-4	1124				70	304	198		
1,5	2	04A1-4	1524								
2,2	3	05A6-4	2224				70	304	198		
3	4	07A3-4	3024				140	304	198		
4	5	08A8-4	4024								
5,5	7,5	12A5-4	5524	169		169					R3
7,5	10	15A6-4									
11	15	23A1-4									
15	20	31A0-4		260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Lenze 8400	ABB ACS350			Lenze 8400			Lenze 8400	ASC350
		Type	Type							Frame names N/A	
		ACS350-		(cm²)	(l)	(kg)	(cm²)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight		Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	01A2-4		118	1,9	1,2					R0
0,55	0,75	01A9-4	5514				157	3	na		
0,75	1	02A4-4	7514						na		R1
1,1	1,5	03A3-4	1124			1,2	213	8	na		
1,5	2	04A1-4	1524						na		
2,2	3	05A6-4	2224				213	8	na		
3	4	07A3-4	3024				213	8	na		
4	5	08A8-4	4024						na		
5,5	7,5	12A5-4	5524	286	4,8	2,5			na		R3
7,5	10	15A6-4									
11	15	23A1-4									
15	20	31A0-4		471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

Installation

Lenze 8400

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	No
Flange	Yes (up to 2.2 kW)
Wall (sideways)	No
Heatsinkless	Yes (up to 2.2 kW)
Side-by-side	na

Free space requirements

Location	*mm*
Above	na
Below	na
Left and right	na

- Motor cable lengths
  - 50 m (shielded cable)
  - 100 m (unshielded cable)

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Lenze 8400

- Filters
  - External LL RFI filters (Low Leakage): category C1 (option)
  - External SD RFI filter (Short Distance): category C1, category C2 (option)
  - External LD RFI filter (Long Distance): category C1, category C2 (option)
- Chokes
  - Mains chokes (option)
- EMC compliant motor cable lengths
  - External LL RFI filters: category C1 for 5 m shielded motor cable
  - External SD RFI filter: category C1 for 25 m shielded motor cable, category C2 for 50 m shielded motor cable
  - External LD RFI filter: category C1 for 50 m shielded motor cable, category C2 for 100 m shielded motor cable
- THD
  - N/A

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

- THD
  - EN61000-3-2 with optional chokes

User interface

Lenze 8400

- Keypad X400 option
  - Menu navigation
  - Graphics display with background lightning for clear presentation of information
  - 4 navigation keys, 2 context-sensitive keys
  - Adjustable RUN/STOP function
  - Hot-pluggable
  - Suitable for 8400 StateLine
  - Can also be used for 9400 Servo Drives

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Machine interface (I/O)

Lenze 8400

Type	*Qty.*	*Programmable*
Digital inputs	4	Yes
Analog inputs	1	Yes
Pulse train input	-	-
Relay inputs/outputs	1	Yes
Transistor outputs	-	-
Analog outputs	1	Yes

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Lenze 8400

Protocol	*Standard/ Optional*	*Baud rate*	*Notes*
CANopen	Standard (integrated)	Max 500 kBit/s (StateLine) 1000 kBit/s (HighLine)	
PROFIBUS	Optional communication module	9.6 … 12000 (automatic detection)	

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

100% Phd braking
500 Hz mx. output frequency

Motor control

Lenze 8400

- V/f control without encoder (linear or square-law)
- Sensorless vector control (torque/speed)

Braking

- Brake chopper integrated (400 V types)
- Brake resistor external (400 V types)

Output frequency

- Max 1000 Hz

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Lenze 8400

- Project creation
  - Limitation to 5 target systems
- Languages
  - German, English, French

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Lenze 8400

- Application-oriented commissioning (predefined application)
- Freely assignable user menu
- Data logger
- DC brake function
- Flying restart circuit
- S-ramps for smooth acceleration
- 15 fixed frequencies
- Masking frequencies
- PID controller
- Brake management for brake control with low rate of wear
- Logic functions (timer, AND, OR, comparator, arithmetic function)
- Programmable counter
- Function block interconnection for input and output signals

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Lenze 8400

- Diagnosis terminal X400
  - X400 keypad in a robust housing
  - Also suitable for installation in the control cabinet door
  - Menu navigation
  - Graphics display with background lightning for clear presentation of information
  - 4 navigation keys, 2 context-sensitive keys
  - Adjustable RUN/STOP function
  - Hot-pluggable
  - Incl. 2.5 m cable
  - IP20 enclosure, IP65 for control cabinet installation on front face
  - Suitable for 8400 StateLine and 8400 HighLine
  - Can also be used for 9400 Servo Drives

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

Lenze 8400

- L-force Engineer is the engineering tool for commissioning and diagnosing the 8400 Inverter Drive. The user interface is intuitive and easy to use. The clearly structured dialogs of the L-force Engineer are specially adapted to the requirements of the users.
- The following versions are available:
  - Engineer StateLevel
  - Engineer HighLevel

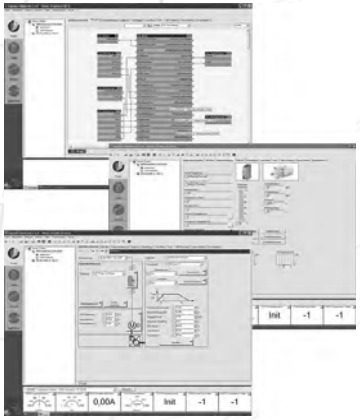
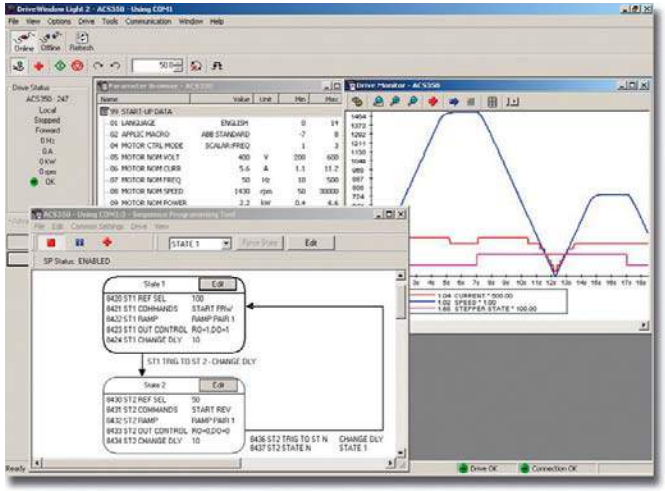


ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

PC connectivity and tools

Lenze 8400

- USB connection with USB system bus adapter
- Parallel interface with system bus adapter
- Diagnostic interface
  - USB connection with diagnostic adapter
- Engineering software L-force Engineer:
  - Simple and transparent project view even of complex projects – independently of the network view
  - High flexibility – functions can easily be post-installed
  - Own project documentation can be integrated into the project – all the information is available at one place and can easily be found
  - New graphics-based user interfaces for parameterising and configuring drives simplify work
  - Simple graphics-based configuration of communication – no need to work with complicated parameters.

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Lenze 8400

- Brake resistors
- Mains chokes
- RFI filter
- 24 V power supply units
- Brake switch
- USB diagnostic adapter
- Connecting cables for USB diagnostic adapters
- Keypad X400
- Diagnosis terminal X400
- PC system bus adapter
- Communication module PROFIBUS

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Lenze 8400

- Diagnostics and parameter setting using remote maintenance make for quick and cost-effective service all over the world. A memory module, integrated shield connections and pluggable terminals mean that drives can be replaced quickly and easily, thereby reducing machine downtimes.

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Lenze 8400

Approvals

- CE, UL 508C, RoHS

Compliance with

- Low-Voltage Directive (2006/95/EC)
- Power Conversion Equipment (file no. 132659)
- ISO 14001
- Applicable standards
  - EN 61800-3
  - EN 61800-5-1

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

ABB strenghts

ACS350 advantages over Lenze 8400

Wide power range	User macros 3 pcs
Sideways mounting	17 languages
EN61000-3-2 with opt. chokes	FlashDrop
2 control panel options	Sequence programming
Panel cover	Potentiometer option
Modbus speed	Maintenance need indication
100% Phd braking	Detailed fault history with time
500 Hz mx. output frequency	
Application macros 7 pcs	

For ACS350 advantages in performance, see the performance test slides



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Commander SK

- Commander SK is the benchmark in simple and compact AC variable speed drives for use with 3-phase AC induction motors.
- Open loop vector control, speed or torque control
- For power range 0.25 to 132 kW
- A compact footprint with space saving features
- Easy to connect, easy to configure and easy to install
- Reliable and productive with exceptional motor performance as you would expect from a Control Techniques drive
- Applications
  - Materials handling, pumps, mixers, fans...

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Commander SK

- IP 20
- NEMA 1 rating with optional cover

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Commander SK

Vibration

- Random : Standard: In accordance with IEC68-2-64 and IEC68-2-36: Test Fh
- Sinusoidal: Standard: IEC68-2-6: Test Fc
- Bump: Standard: IEC68-2-29: Test Eb

Shock

- 18 g, 6 ms, 100 times/direction for all 6 directions.

Temperature

- Operating temperature -10°C to +40°C
- Operation up to +55°C with derating

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m up to 3000 m maximum

Acoustic noise

- B size up to 0.75 kW < 30 (no fan) dBA
- B size above 0.75 kW < 42 –50 dBA

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating and reduced lifetime
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Commander SK

Voltage types and power range

- 1-phase 100 - 120V ±10%
  - 0.75 to 1.1 kW
- 1-phase 200 - 240 V ±10%
  - 0.37 to 2.2 kW
- 3-phase 200 - 240 V ±10%
  - 1.1 to 45 kW
- 3-phase 380 - 480 V ±10%
  - 0.37 to 132 kW
- 3-phase 500 - 575 V ±10%
  - 2.2 to 110 kW
- 3-phase 500 - 690 V ±10%
  - 15 to 132 kW

Power factor

- N/A

Supply frequency

- 48/62Hz

Supply networks

- Data N/A

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Commander	ABB ACS350		Commander SK		Commander SK	ASC350
P_N	P_N	ACS350	SK	I_{2N}	I_{2N}	Output Current			
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	01X-	SK	U_N=200-240 V		U_N=200-240 V		Frame	Frame
0,12	0,16								
0,25	0,33		A1200025			1,7	1,5		
0,37	0,5	02A4-2	A1200037	2,4	2,2	2,2	1,5	A	R0
0,55	0,75		A1200055			3,0	2,0		
0,75	1	04A7-2	A1200075	4,7	4,2	4,0	2,0		R1
1,1	1,5	06A7-2	BD200110	6,7	6,0	5,2	4,3	B	
1,5	2	07A5-2	BD200150	7,5	6,8	7	6,5		R2
2,2	3	09A8-2	CD200220	9,8	8,8	9,6	8,5	C	
3	4		DD200300			12,6		D	

Commander SK

Overload ratings

- 150 % for 60 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 200V

3-phase 200V		ABB	Commander	ABB ACS350		Commander SK		Commander SK	ASC350
P_N	P_N	ACS350		I_{2N}	I_{2N}	Output Current			
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-	SK	U_N=200-240 V		U_N=200-240 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	02A4-2		2,4	2,2				R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2		4,7	4,2				R1
1,1	1,5	06A7-2	BD200110	6,7	6,0	5,2	4,3	B	
1,5	2	07A5-2	BD200150	7,5	6,8	7,0	6,5		
2,2	3	09A8-2	CD200220	9,8	8,8	9,6	8,5	C	R2
3	3	13A3-2	2201	13,3	12,0	12,6	12,6	2	
4	5	17A6-2	2202	17,6	15,8	17	17,0		
5,5	7,5	24A4-2	2203	24,4	21,96	25	19,2		R3
7,5	11	31A0-2	3201	31,0	27,9	31	31,0	3	R4
11	15	46A2-2	3202	46,2	41,58	42	42,0		
15	20		4201			56	56,0	4	
18,5	25		4202			68	68,0		
22	30		4203			80	80		

Commander SK

Overload ratings

- 150 % for 60 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 400V

3-phase 400V		ABB	Commander	ABB ACS350		Commander SK		Commander SK	ASC350
P_N	P_N	ACS350	SK	I_{2N}	I_{2N}	Output Current			
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-	SK	U_N=380-480 V		U_N=380-480 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	01A2-4	B3400037	1,2	1,1	1,3	1,3		R0
0,55	0,75	01A9-4	B3400055	1,9	1,7	1,7	1,7		
0,75	1	02A4-4	B3400075	2,4	2,2	2,1	1,75	B	R1
1,1	1,5	03A3-4	B3400110	3,3	3,0	2,8	2,8		
1,5	2	04A1-4	B3400150	4,1	3,7	3,8	3,5		
2,2	3	05A6-4	C3400220	5,6	5,0	5,1	5,1		
3	3	07A3-4	C3400300	7,3	6,6	7,2	7,2	C	
4	5	08A8-4	C3400400	8,8	7,9	9,0	7,3		
5,5	10	12A5-4	2401	12,5	11,3	13	13		R3
7,5	10	15A6-4	2402	15,6	14,0	16,5	15,5	2	
11	20	23A1-4	2403	23,1	20,8	25	16,7		
15	25	31A0-4	3401	31	27,9	32	32		R4
18,5	30	38A0-4	3402	38	34,2	40	40	3	
22	30	44A0-4	3403	44	39,6	46	46		
30	50		4401			60	60		
37	60		4402			74	68,2	4	
45	75		4403			96	86,5		
55	100		5401			124	112,7	5	
75	125		5402			156	140		
90	150		6401			180	180	6	
110	150		6402			210	190		

Commander SK

Overload ratings

- 150 % for 60 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Commander SK	ABB ACS350			Commander SK			Commander SK	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-	SK	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,25	0,33		A1200025				75	140	145	A	
0,37	0,5	02A4-2	A1200037	70	169	161					R0
0,55	0,75		A1200055								
0,75	1	04A7-2	A1200075	70	169	161					R1
1,1	1,5	06A7-2	BD200110				85	190	156	B	
1,5	2	07A5-2	BD200150	105	169	165					R2
2,2	3	09A8-2	CD200220				100	240	173	C	

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Commander SK	ABB ACS350			Commander SK			Commander SK	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-	SK	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,25	0,33		A1200025								
0,37	0,5	02A4-2	A1200037	118	1,9	1,2	105	1,5	0,95	A	R0
0,55	0,75		A1200055						1		
0,75	1	04A7-2	A1200075	118	1,9	1,2					R1
1,1	1,5	06A7-2	BD200110				162	2,5	1,3	B	
1,5	2	07A5-2	BD200150	177	2,9	1,5			1,4		R2
2,2	3	09A8-2	CD200220				240	4,2	2,1	C	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Commander SK	ABB ACS350			Commander SK			Commander SK	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	SK	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2		70	169	161					R0
0,55	0,75	03A5-2									
0,75	1	04A7-2									R1
1,1	1,5	06A7-2	BD200110				85	190	156	B	
1,5	2	07A5-2	BD200150								
2,2	3	09A8-2	CD200220	105		165	100	240	173	C	R2
3	3	13A3-2	2201				155	368	219	2	
4	5	17A6-2	2202								
5,5	7,5	24A4-2	2203	169	169	169					R3
7,5	11	31A0-2	3201	260	181	169	250	368	260	3	R4
11	15	46A2-2	3202								
15	20		4201				310	510	298	4	
18,5	25		4202								
22	30		4203								

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Commander SK	ABB ACS350			Commander SK			Commander SK	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	SK	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2									R0
0,55	0,75	03A5-2									
0,75	1	04A7-2		118	1,9	1,2					R1
1,1	1,5	06A7-2	BD200110				162	2,5	1,3	B	
1,5	2	07A5-2	BD200150						1,4		
2,2	3	09A8-2	CD200220				240	4,2	2,1	C	R2
3	3	13A3-2	2201	177	2,9	1,5					
4	5	17A6-2	2202				570	12,5	7	2	
5,5	7,5	24A4-2	2203	286	4,8	2,5					R3
7,5	11	31A0-2	3201	471	8,0	4,4	920	23,9	15	3	R4
11	15	46A2-2	3202								
15	20		4201				1581	47,1	30	4	
18,5	25		4202								
22	30		4203								

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Commander SK	ABB ACS350			Commander SK			Commander SK	ASC350
		Type	Type								
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	SK	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	B3400037	70	169	161	85	190	156	B	R0
0,55	0,75	01A9-4	B3400055								
0,75	1	02A4-4	B3400075								R1
1,1	1,5	03A3-4	B3400110								
1,5	2	04A1-4	B3400150								
2,2	3	05A6-4	C3400220				100	240	173	C	
3	3	07A3-4	C3400300								
4	5	08A8-4	C3400400								
5,5	10	12A5-4	2401	169		169	155	368	219	2	R3
7,5	10	15A6-4	2402								
11	20	23A1-4	2403								
15	25	31A0-4	3401	260	181	169	250	368	260	3	R4
18,5	30	38A0-4	3402								
22	30	44A0-4	3403								
30	50		4401				310	510	298	4	
37	60		4402								
45	75		4403								
55	100		5401				310	820	298	5	
75	125		5402								
90	150		6401				310	1131	298	6	
110	150		6402								

Dimensions 400 V 3-phase: area, volume, weight

- Areas of 400 V units
- Volumes of 400 V units
- Weights of 400 V units

Dimensions 400 V		ABB ACS350	Commander SK	ABB ACS350			Commander SK			Commander SK	ASC350
		Type	Type								
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	SK	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	B3400037	118	1,9	1,2	162	2,5	1,2	B	R0
0,55	0,75	01A9-4	B3400055								
0,75	1	02A4-4	B3400075								R1
1,1	1,5	03A3-4	B3400110			1,2			1,3		
1,5	2	04A1-4	B3400150								
2,2	3	05A6-4	C3400220				240	4,2	2,1	C	
3	3	07A3-4	C3400300								
4	5	08A8-4	C3400400								
5,5	10	12A5-4	2401	286	4,8	2,5	570	12,5	7	2	R3
7,5	10	15A6-4	2402								
11	20	23A1-4	2403								
15	25	31A0-4	3401	471	8,0	4,4	920	23,9	15	3	R4
18,5	30	38A0-4	3402								
22	30	44A0-4	3403								
30	50		4401				1581	47,1	30	4	
37	60		4402								
45	75		4403								
55	100		5401				2542	75,8	55	5	
75	125		5402								
90	150		6401				3506	104,5	75	6	
110	150		6402								

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Installation

Commander SK

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes (A + B up to 1.5 kW)
Flange	No
Wall (sideways)	No
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	10

- Solid mounting feet (four holes) keyhole top feet and open lugs at bottom
- Spring loaded clamp terminals for control wires – for fast accurate wiring
- Standard screw terminals for power cables

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Commander SK

- Filters
  - Integral EMC Filters
  - Immunity - Compliant with EN61000-6-2 , EN61800-3 (Adjustable speed electric power drive - EMC product standard), IEEE C62.45 (Surge)
- Chokes
  - Data N/A
- Motor cable lengths
  - A size 70 m
  - B size 100 m
  - C size 100 m
- THD
  - Complies with harmonics standards EN61000-3-2 and IEC61000-3-2

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

2 control panel options
Control panel mounting kit
Panel cover

Commander SK

- 6 x 7 segment LED display with sign LED
- Parameter value or trip code
- Run, Stop keys
- Increase and decrease keys
- Mode key / reset key
- Cannot be remote mounted

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

Start	Initiate operation of drive
Stop	Ceases operation of drive
Up	Changes parameters and their value/ increases reference
Down	Changes parameters and their value/ decreases reference
Loc/Rem	Changes drive state from local control to remote control
HELP	Built-in “Help” button
Soft key 1	Function changes according to state of panel
Soft key 2	Function changes according to state of panel

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Machine interface (I/O)

Commander SK

Type	*Qty.*	*Programmable*
Digital inputs	4	Yes
Analog inputs	2	Yes
Pulse train input	-	Yes
Relay outputs	1	Yes
Transistor outputs	-	Yes
Analog outputs	1	Yes

Specialities:

N/A

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Commander SK

Protocol	*Standard /Optional*	*Baud rate*	*Notes*
Modbus RTU (RS485)	Standard	up to 38,400 bps	
DeviceNet	Option	N/A	
Profibus DP	Option	N/A	
CANopen	Option	N/A	
Ethernet	Option	N/A	
INTERBUS	Option	N/A	

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

Motor control

Commander SK

- Open Loop Vector Mode
- V/Hz Mode

Braking

- Braking chopper fitted as standard on all drives
- DC Braking available as standard

Output frequency

- 0–1500 Hz with both scalar and vector control

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

- Output frequency
- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Commander SK

N/A

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Commander SK

- Speed reference input: 0-10V, 0-20mA, 4-20mA, (-10 to +10V SM-I/O Lite option) *(
- 4 digital inputs- World (enable, run forward, run reverse, local/remote)- USA (not stop, run, jog, local/remote) *(
- 8 preset speeds
- Flying start *(
- Mains dip ride through *(
- Automatic no-spin autotune for fast performance optimisation
- Keypad access to all parameters for more demanding set-ups *(

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Commander SK

SmartStick

- A parameter storage memory option that enables parameters to be copied from one drive to another
- Finger-nail size and light weight
- Portable, no charging
- No interface or display
- No functionality in the SmartStick itself: no possibility to program the SmartStick with a PC tool, hide parameters etc.
- Gets parameters directly from a drive by selecting values for parameter no 28 “Parameter cloning”
- Upload and download a parameter set, Store a parameter set remotely away from the drive, Transfer a parameter set between drives
- The SmartStick may be inserted and removed from the drive while the power remains on
- Not compatible to other drive types

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Sequence programming as standard

Other advanced features (cont)

Commander SK

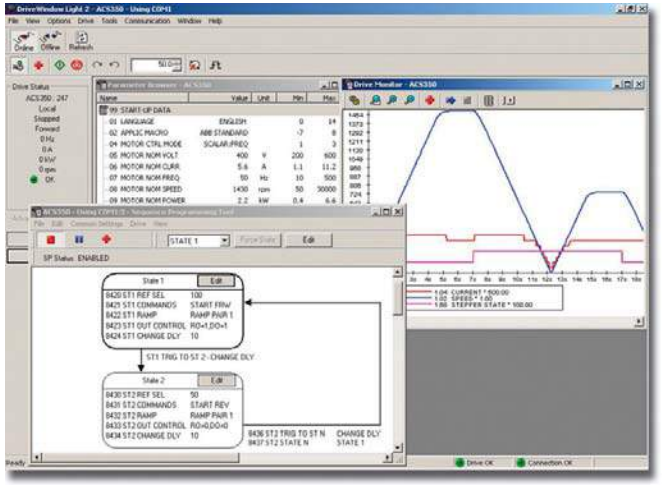
LogicStick

- By inserting a LogicStick option into the front of the drive, you quickly add memory for program storage that allows you to write a PLC ladder program using SyPTLite
- The drive is prioritised to execute all motor control related functions first and will use any remaining processing time to execute the SyPTLite ladder program as a background activity

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

PC connectivity and tools

Commander SK

- Connects into the RJ45 (Modbus RTU) bus under the front cover of the Commander SK – only a PC-to-drive cable option is required
- CTSoft (Control Techniques drive configuration software) is free of charge from the www.ControlTechniques.com web site and also comes with the drive on a CD-ROM disc
- The Communications Cable incorporates an isolated RS485 / RS232 converter with an industrial standard RJ45 connector for plugging into the Commander SK and a D-type connector for the PC / laptop
- CTSoft for drive status analysis, interrogate and program the drive
- The optional PC Communications Cable provides SELV (Safe Extra Low Voltage) isolation to protect the PC/ laptop and the user

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Commander SK

- Extra I/O (SM-I/O Lite)
- NEMA 1
- LogicStick
- Real Time Clock (SM-I/O Timer)

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Commander SK

N/A

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Commander SK

Approvals

- CE, UL, cUL, C-tick

Compliance with

- Quality assurance ISO 9002
- Environmental system ISO 14001

Applicable standards

- EN50178
- Electronic equipment for use in power installations
- EN61800-3
- EMC product standard for VSDs
- EN61000-6-2, EN61000-6-4, EMC generic industrial standards
- EN61000-6-3 (previously EN50081-1) (1-phase product)
- EN61000-6-4 (previously EN50081-2)
- IEC61800-3, EN50082-2
- UL 508C UL - Standard for Safety, Power Conversion Equipment
- EMC generic industrial standards
- EN61000-3-2
- EMC harmonic limits for equip up to 16 A
- EN61000-3-3
- EMC voltage flicker for equip < 16A
- Environmental Management Systems
- EN60249, IEC60326-1, IEC60326-5 & 6, relates to PCBs

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Control Techniques Commander SK

Model: SKC3400220

Drive rating: 380-480V
2.2 kW / 3.0 HP
5.1 A

Tester (experienced drive specialist) comments:

- Drive was easy to wire and easy to program, although the parameter access did not wrap, so for 90 parameters, it's a long journey from 0 up.
- Standard UVW wiring produced reverse rotation.
- The User Manual downloaded from the web has parameter groupings and numbering not present in the drive?
- There are minor adjustments for boost in constant V/Hz, but adjusting them caused the drive to produce zero torque.
- The mapping of parameters for torque mode are only available via software or special parameter mapping. It took considerable time to set up for torque mode.

ABB ACS350

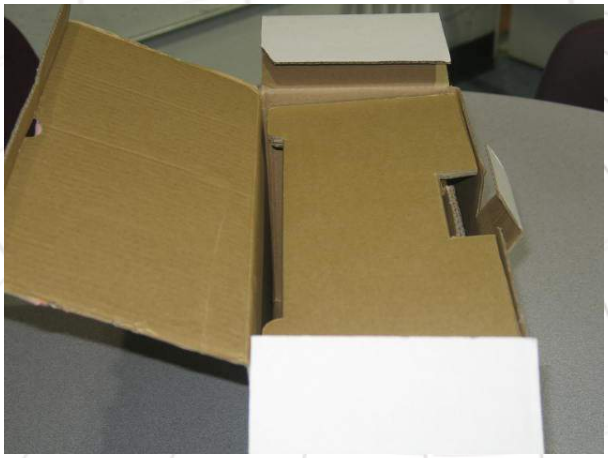
Model: ACS350-03U-05A6-4

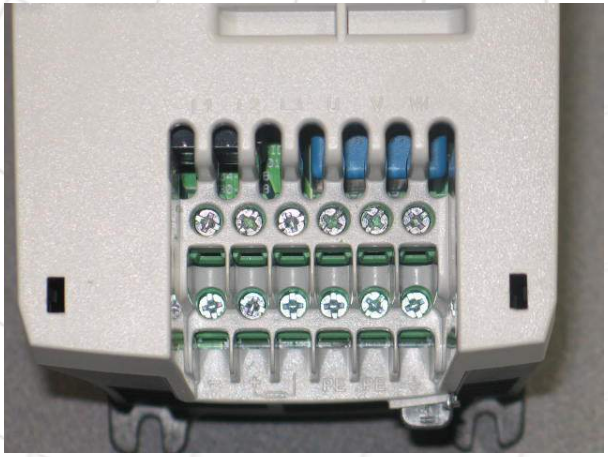
Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A

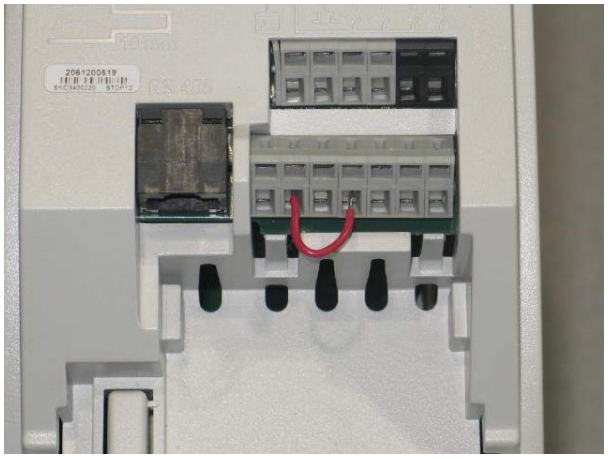
Parameter Settings:

9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

Photos of the tested unit

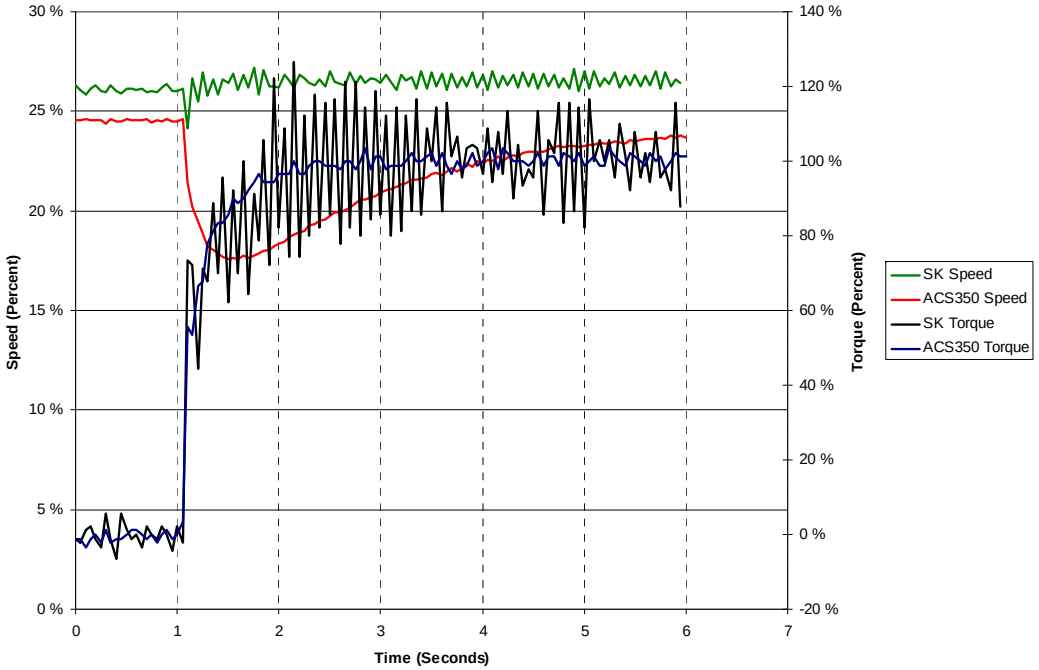


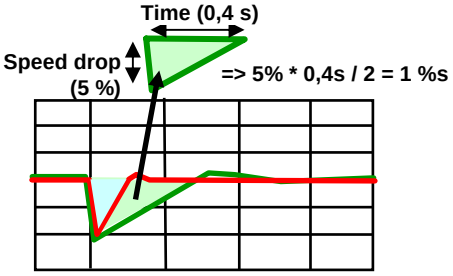




Impact load test – Dynamic speed accuracy (stiffness)

Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.

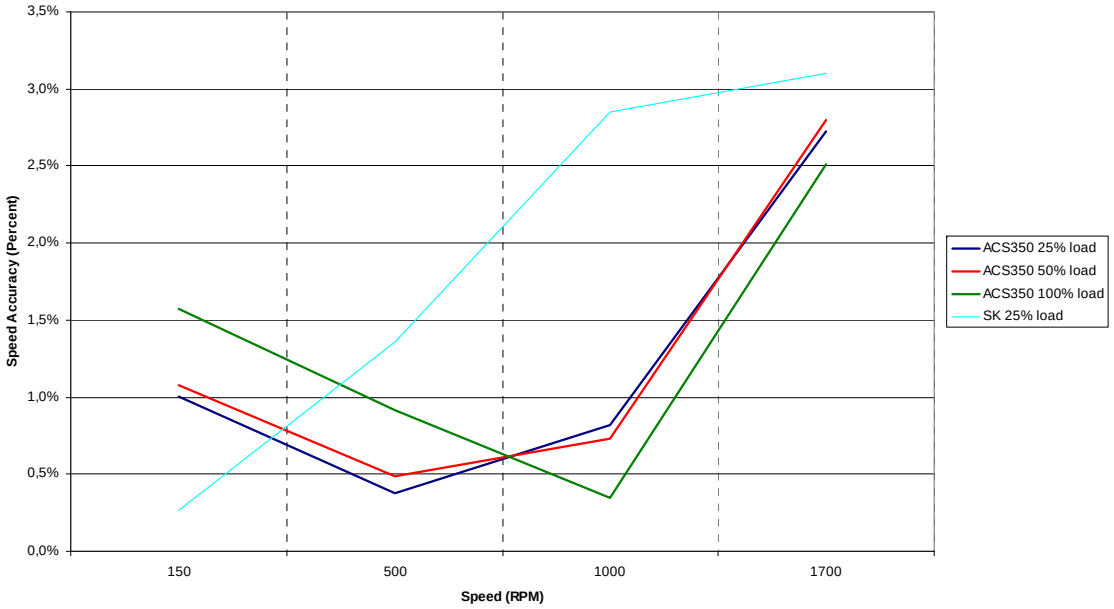




Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive works in case of disturbances. The ACS350 speed control default tuning is quite conservative to ensure that the controller is stable despite the motor used and its size compared to size of the inverter. The Commander SK has good dynamic speed accuracy despite the amount of speed and torque ripple. The performance of the ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL)

Static speed accuracy

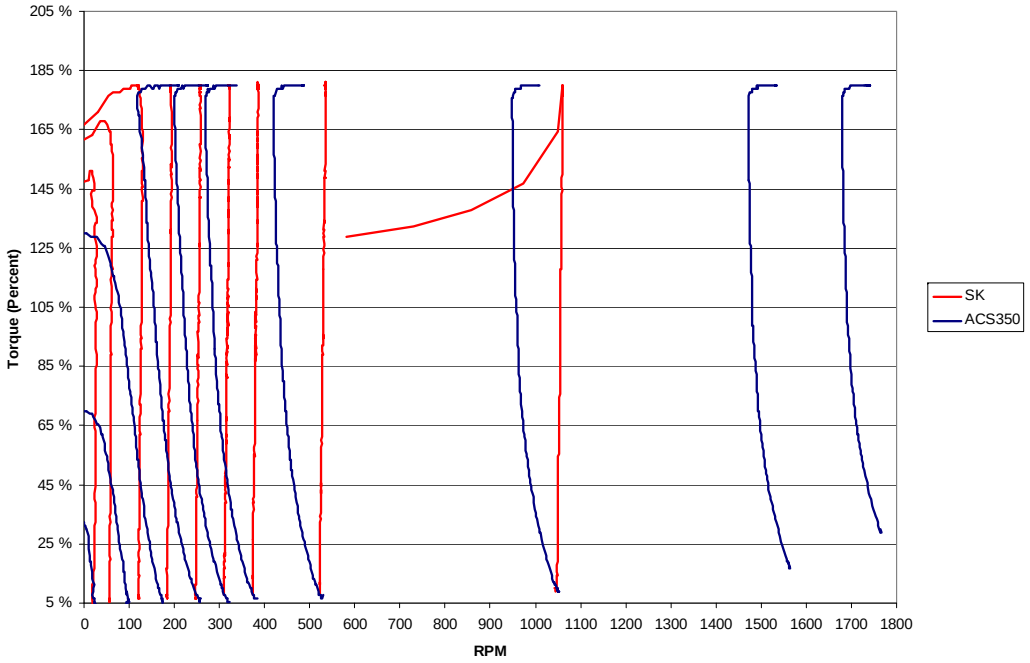
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 0%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), error [%] = ABS(n^*-n_{act}) * $n_{N(mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Tester comment: Drive tripped on overvoltage fault during initial speed reference at 50% load.
Static speed error depends on on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). It is worth remarking that the SK tripped on overvoltage after load release which may indicate some problems with its overvoltage controller. The 50% and 100% load points could not be measured with the SK because drive was not able to follow the speed reference (motor stalled).

Maximum torque as a function of speed

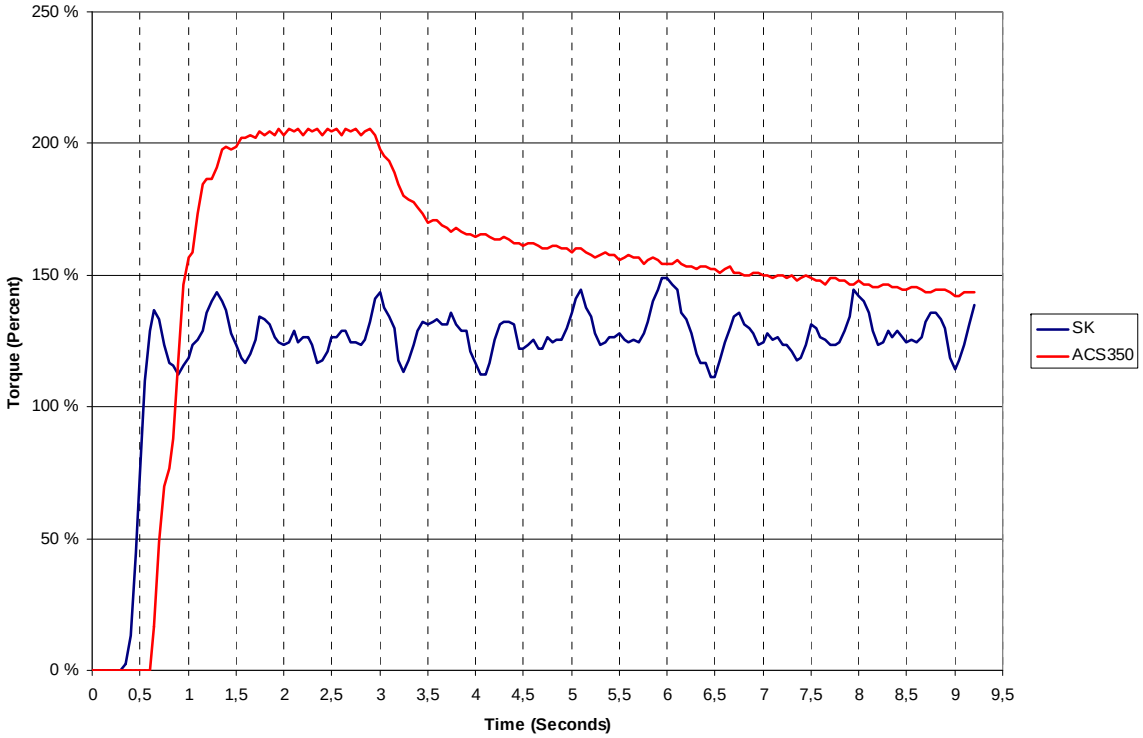
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The ACS350 has good speed range because it could provide full output torque from 1700 rpm's down to 180 rpm. The SK could provide 100% torque down to 30 rpms's but cannot maintain the torque for two seconds at some test points allowing the motor to stall as the load increases. The behavior of the SK can be a problem in applications requiring high-inertia starting and wide speed range. The quite conservative speed controller tuning of ACS350 can be seen also in this test as a slight speed drop in each test point and it can be improved by tuning the speed controller (parameter group 23 SPEED CONTROL).

Maximum starting torque

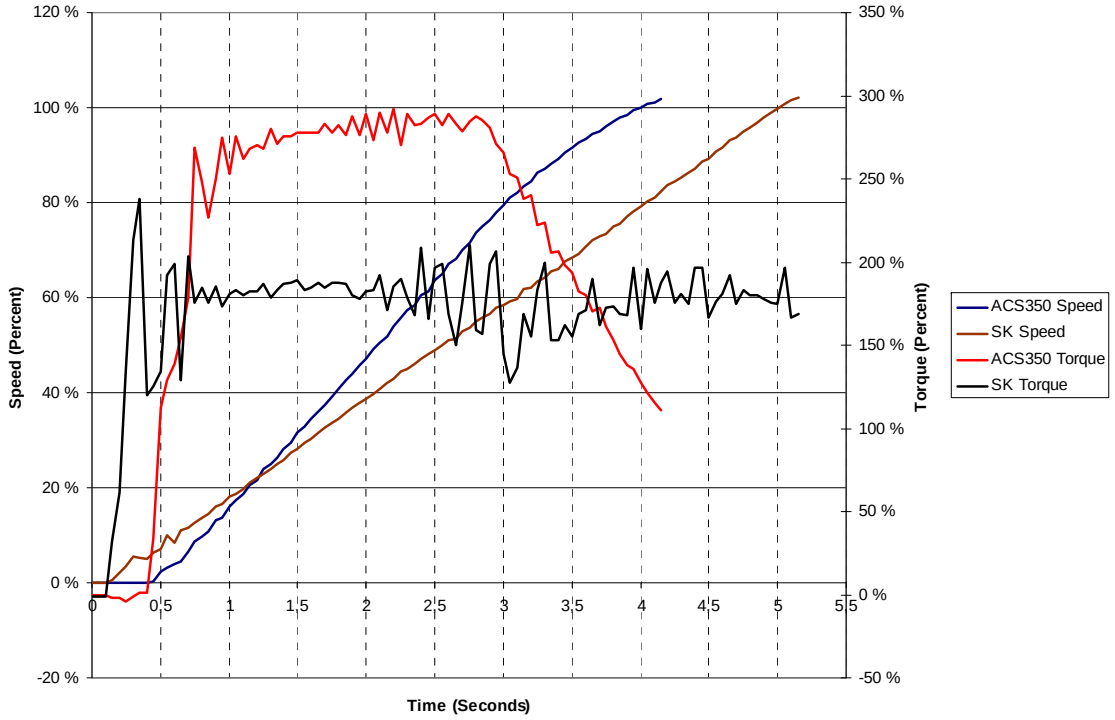
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



ACS350 has good starting torque up to 200%. ACS350 reduces torque after 2 s due to current limiting. The Commander SK could produce only 125% torque and also exhibited quite big torque ripple. The behavior of the SK can be a problem in applications requiring high starting duty or high-inertia acceleration.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 (0.95 kgm^2) inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



Thanks to greater maximum output torque the ACS350 can accelerate the inertia to the reference within 4 sec. The SK needs 5 seconds. The ACS350 provides maximum starting torque for two seconds then decreases torque based on current limiting. The Commander SK has significant torque ripple which may indicate the tuning of the current controller is not stable and could cause overcurrent trips.

Efficiency

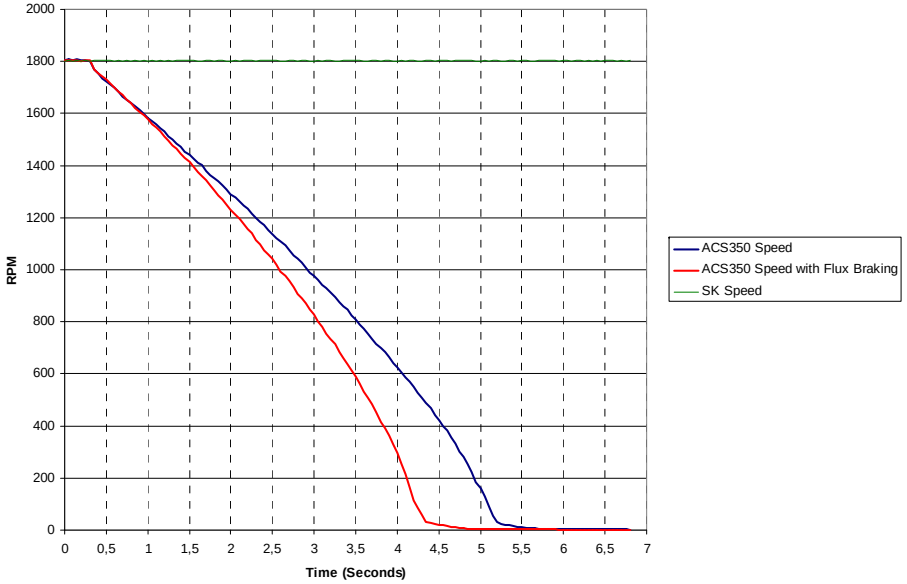
Using power analyzer, input power, speed and torque of AC motor are measured at 0, 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	SK
25%	87.0%	81.3%
50%	89.3%	90.0%
75%	89.0%	89.8%
100%	88.4%	89.4%

The test is performed at rated speed with different loads. The ACS350 has higher efficiency at 25% load but is comparable at all other points.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



Tester comments: Drive run enable was removed (verified +24Vdc was removed) but drive did not decelerate. ACS350 was able to decelerate to zero within 5,5 seconds. ACS350 with flux braking shortened the deceleration time even more. The competitor drive SK failed the test because drive tripped on “OV in Ramp with OV Controller active” nearly instantaneously after run command was removed. In SK Flux braking is only available for rapid deceleration. There was no difference in performance when using flux braking; just trip. SK seems to have problems with tuning of overvoltage controller and/or control algorithm.

ABB strengths

ACS350 advantages over Commander SK

Weights of 3~ 200 V units	ModBus speed
Areas of 400 V units	Application macros 7 pcs
Volumes of 400 V units	User macros 3 pcs
Weights of 400 V units	17 languages
Sideways mounting	Comprehensive SW
EN61000-3-2 with opt. chokes	FlashDrop high functionality
2 control panel options	Sequence programming as standard
Control panel mounting kit	Potentiometer option
Panel cover	Maintenance need indication
Bipolar AI	Detailed fault history with time
Pulse train	

For ACS350 advantages in performance, see the performance test slides



















Toshiba VF-S11
Yaskawa V1000
Danfoss FC51
Fuji Frenic-Multi
Hitachi X200
KEB Combivert F5
Lenze 8400
Vacon 10 Machinery
Lenze SMVector
WEG CFW08
Mitsubishi E700

Main
Yaskawa V7
Mitsubishi FR E-500
Danfoss VLT 2800
Schneider Altivar 31
Allen-Bradley PowerFlex 40
Control Techniques Commander SK
Lenze 8200
Siemens Micromaster 420

Summary Slide

Description

Vacon 10 Machinery

- The Vacon 10 is tailored to meet various customer needs and designed especially for OEM customers
- The functionality of the Vacon 10 is incorporated into the flexible control card, called the Application Interface (API). A set of API boards is offered as standard, but the API construction gives OEM customers a free hand to create applications or to specify API cards for their specific needs.
- Integrated EMC filters, intelligent navigation and a versatile application interface
- Reliable and of high quality, environment-friendly product
- Frequency control U/f and Open loop sensorless
- For power range 0.25 kW to 5.5 kW
- Main applications
  - Pumps and fans, material handling, conveyors, automatic doors and gates

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Vacon 10 Machinery

- IP20 (standard)
- IP21 and NEMA 1 (option)

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Vacon 10 Machinery

Vibration

- EN60068-2-6
- 5…150 Hz
- Displacement ampliture 1 (peak) mm at 5…15.8 Hz
- Max acceleration amplitude 1 G at 15.8…150 Hz

Shock

- IEC 68-2-27
- UPS Drop Test (for applicable UPS weights)
- Storage and shipping: max 15 G, 11 ms (in package)

Temperature

- Operating temperature -10°C (no frost) ... 50°C with rated loadability I_N
- Storage temperature – 40°C… +70°C

Humidity

- 0... 95% non-condensing, non-corrosive, no dripping water

Altitude limitations

- 0 ... 1000 m. 1% derating for each 100 m above 1000 m; max 2000 m

Acoustic noise

- 1…16 kHz; Factory default 6 kHz

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10°C to +40°C
- +50 °C max. of 10% current derating
- Storage temperature – 40°C to +70°C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Vacon 10 Machinery

Voltage and power range

- 1-phase 208 - 240 V (-15%, +10%)
  - 0.25 to 2.2 kW (0.33 to 3 hp)
- 3-phase 380 - 480V (-15%, +10%)
  - 0.37 to 5.5 kW (0.5 to 7.5 hp)

Power factor

- Information not available

Supply frequency

- 45…66 Hz

Supply networks

- Suitable for IT networks by removing EMC screw

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Vacon 10	ABB ACS350		Vacon 10 Machinery		Vacon 10	
P_N	P_N	ACS350	Machinery	I_{2N}	I_{2N}	I_{INV}	I_{INV}	Machinery	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-	Vacon 0010	A	A	A	A		
kW	hp	01X-	-1L-	U_N=200-240 V		U_N=208-240 V		Frame	Frame
0,12	0,16								
0,25	0,33		0001-2			1,7	1,7		
0,37	0,5	02A4-2	0002-2	2,4	2,2	2,4	2,4	MI1	R0
0,55	0,75		0003-2			2,8	2,8		
0,75	1	04A7-2	0004-2	4,7	4,2	3,7	3,7		R1
1,1	1,5	06A7-2	0005-2	6,7	6,0	4,8	4,8	MI2	
1,5	2	07A5-2	0007-2	7,5	6,8	7,0	7,0		R2
2,2	3	09A8-2	0011-2	9,8	8,8	11,0	11,0	MI3	

Vacon 10 Machinery

Overload ratings

- Overload capacity 1.5 x I_N max. 1 min/10 min)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 200V

3-phase 200V		ABB	Vacon 10	ABB ACS350		Vacon 10 Machinery		Vacon 10	ASC350
P_N	P_N	ACS350	Machinery	I_{2N}	I_{2N}	I_{INV}	I_{INV}	Machinery	
		Type		40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-		U_N=200-240 V		U_N=208-240 V			Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	02A4-2		2,4	2,2				R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2		4,7	4,2				R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2		7,5	6,8				
2,2	3	09A8-2		9,8	8,8				R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2		17,6	15,8				
5,5	7,5	24A4-2		24,4	21,96				R3
7,5	10	31A0-2		31,0	27,9				R4
11	15	46A2-2		46,2	41,58				

Vacon 10 Machinery

- Capable solution not available.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 400V

3-phase 400V		ABB ACS350	Vacon 10 Machinery	ABB ACS350		Vacon 10 Machinery		Vacon 10 Machinery	ASC350
P_N	P_N			I_{2N}	I_{2N}	I_{INV}	I_{INV}		
		Type		40° C	50° C	40° C	50° C		
		ACS350-	Vacon 0010	A	A	A	A		
kW	hp	03X-	-3L-	U_N=380-480 V		U_N=380-480 V			Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	01A2-4	0001-4	1,2	1,1	1,3	1,3		R0
0,55	0,75	01A9-4	0002-4	1,9	1,7	1,9	1,9	MI1	
0,75	1	02A4-4	0003-4	2,4	2,2	2,4	2,4		R1
1,1	1,5	03A3-4	0004-4	3,3	3,0	3,3	3,3		
1,5	2	04A1-4	0005-4	4,1	3,7	4,3	4,3	MI2	
2,2	3	05A6-4	0006-4	5,6	5,0	5,6	5,6		
3	4	07A3-4	0008-4	7,3	6,6	7,6	7,6		
4	5	08A8-4	0009-4	8,8	7,9	9,0	9,0	MI3	
5,5	7,5	12A5-4	0012-4	12,5	11,3	12,0	12,0		R3
7,5	10	15A6-4		15,6	14,0				
11	15	23A1-4		23,1	20,8				
15	20	31A0-4		31	27,9				R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Vacon 10 Machinery

Overload ratings

- Overload capacity 1.5 x I_N max. 1 min/10 min)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Vacon 10 Machinery	ABB ACS350			Vacon 10 Machinery			Vacon 10 Machinery	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-	Vacon 0010	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-	-1L-	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,25	0,33		0001-2								
0,37	0,5	02A4-2	0002-2	70	169	161	66	157	98	MI1	R0
0,55	0,75		0003-2								
0,75	1	04A7-2	0004-2	70	169	161					R1
1,1	1,5	06A7-2	0005-2				90	195	102	MI2	
1,5	2	07A5-2	0007-2	105	169	165					R2
2,2	3	09A8-2	0011-2				100	251	109	MI3	

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Vacon 10 Machinery	ABB ACS350			Vacon 10 Machinery			Vacon 10 Machinery	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-	Vacon 0010	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-	-1L-	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,25	0,33		0001-2								
0,37	0,5	02A4-2	0002-2	118	1,9	1,2	104	1,0		MI1	R0
0,55	0,75		0003-2								
0,75	1	04A7-2	0004-2	118	1,9	1,2					R1
1,1	1,5	06A7-2	0005-2				176	1,8		MI2	
1,5	2	07A5-2	0007-2	177	2,9	1,5					R2
2,2	3	09A8-2	0011-2				251	2,7		MI3	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Vacon 10 Machinery	ABB ACS350			Vacon 10 Machinery			Vacon 10 Machinery	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2		70	169	161					R0
0,55	0,75	03A5-2									
0,75	1	04A7-2									R1
1,1	1,5	06A7-2									
1,5	2	07A5-2									
2,2	3	09A8-2		105		165					R2
3	4	13A3-2									
4	5	17A6-2									
5,5	7,5	24A4-2		169	169	169					R3
7,5	10	31A0-2		260	181	169					R4
11	15	46A2-2									

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Vacon 10 Machinery	ABB ACS350			Vacon 10 Machinery			Vacon 10 Machinery	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2									R0
0,55	0,75	03A5-2									
0,75	1	04A7-2		118	1,9	1,2					R1
1,1	1,5	06A7-2									
1,5	2	07A5-2									
2,2	3	09A8-2									R2
3	4	13A3-2		177	2,9	1,5					
4	5	17A6-2									
5,5	7,5	24A4-2		286	4,8	2,5					R3
7,5	10	31A0-2		471	8,0	4,4					R4
11	15	46A2-2									

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Vacon 10 Machinery	ABB ACS350			Vacon 10 Machinery			Vacon 10 Machinery	ASC350
		Type									
		ACS350-	Vacon 0010	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	-3L-	W	H	D	W	H	D		Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	0001-4	70	169	161	66	157	98	MI1	R0
0,55	0,75	01A9-4	0002-4								
0,75	1	02A4-4	0003-4								R1
1,1	1,5	03A3-4	0004-4								
1,5	2	04A1-4	0005-4				90	195	102	MI2	
2,2	3	05A6-4	0006-4								
3	4	07A3-4	0008-4				100	251	109	MI3	
4	5	08A8-4	0009-4								
5,5	7,5	12A5-4	0012-4	169		169					R3
7,5	10	15A6-4									
11	15	23A1-4									
15	20	31A0-4		260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Vacon 10 Machinery	ABB ACS350			Vacon 10 Machinery			Vacon 10 Machinery	ASC350
		Type									
		ACS350-	Vacon 0010	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	-3L-	area	volume	weight	area	volume	weight		Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	0001-4	118	1,9	1,2	104	1,0		MI1	R0
0,55	0,75	01A9-4	0002-4								
0,75	1	02A4-4	0003-4								R1
1,1	1,5	03A3-4	0004-4			1,2					
1,5	2	04A1-4	0005-4				176	1,8		MI2	
2,2	3	05A6-4	0006-4								
3	4	07A3-4	0008-4				251	2,7		MI3	
4	5	08A8-4	0009-4								
5,5	7,5	12A5-4	0012-4	286	4,8	2,5					R3
7,5	10	15A6-4									
11	15	23A1-4									
15	20	31A0-4		471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

Installation

Vacon 10 Machinery

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	Information NA
Wall (sideways)	No
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	Information NA
Below	Information NA)
Left and right	Information NA

- Operational motor cable lengths:
  - Information not available

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Vacon 10 Machinery

- Filters
  - 230V: Complies with 1st environment category C2 with an internal RFI filter option (EMC level H)
  - 400V: Complies with 1st environment category C2 with an internal RFI filter option (EMC level H)
- Chokes
  - Information not available
- EMC compliant motor cable lengths
  - Information not available

THD

- Line current THD > 120%

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

THD

- EN61000-3-2 with optional chokes

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

User interface

Vacon 10 Machinery

- Integrated control panel
  - 7-segmement LED
  - Intelligent menu navigation

- Remote keypad
  - Information not available

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Bipolar AI

Pulse train

Machine interface (I/O)

Vacon 10 Machinery

Type	*Qty.*	*Programmable*
Digital inputs	6 (Full) / 3 (Llimited) / 1 (RS485)	Information NA
Analog inputs	2 (Full) / 1 (Llimited) / 0 (RS485)	Yes (Full) / No ((Llimited)
Pulse train input	-	-
Relay outputs	2 (Full) / 1 (Llimited) / 1 (RS485)	Information NA
Transistor outputs	-	-
Analog outputs	1 (Full) / 0 (Llimited) / 0 (RS485)	Information NA

Specialities:

- Vacon offers a set of APIs as standard, which is available from the shelf: API – Full, API – Limited, API – RS-485
- Design service for customer specific API board development
- External +24 V DC powering to maintain power in API board and field buses in case the main supply is disconnected

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Vacon 10 Machinery

Fieldbus protocol	*Standard/ Optional*	*Baud rate*	*Notes*
RS-232	-		
RS-485	Standard		
Modbus RTU	Standard		In all standard APIs

- In all standard APIs two terminals for serial buses: A for Modbus RTU and B for “Serial bus”
- Mentioned in brochure: “Several fieldbus options”

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

100% Phd braking for all units

500 Hz max. output frequency

Motor control

Vacon 10 Machinery

- Frequency control U/f and Open loop sensorless

Braking

- Brake chopper as standard in 3~400 V, 1.5 kW and higher
- Braking torque
  - 100% x T_N with brake option (only 400V, 1.5 kW)
  - 30% x T_N without brake option

Output frequency

- 0...320 Hz

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7pcs
User macros 3 pcs
17 languages

Vacon 10 Machinery

- Macros
  - Information not available
- Languages
  - No

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Vacon 10 Machinery

- PI controller as standard
- Temperature-controlled fan

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Vacon 10 Machinery

MCA - Micro Communication Adapter

- Optional adapter for enabling parameter upload and download without powering the drive
- Not a portable tool; connection to a PC required all the time
- Parameters are set with a PC tool
- The PC can be connected to the drive with a Micro Communication Adapter - MCA and a cable. There are two options for the cable: standard USB (option order code) and Vacon's own RS485 cable (option order code).
- No information on compatibility with other drive types

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

Vacon 10 Machinery

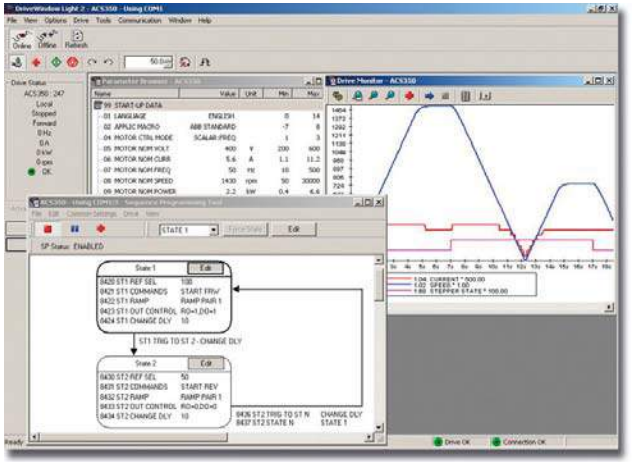
Vacon NC61131-3 Engineering Tool

- Used for creating customer-specific software. The software is a part of Vacon's design service concept but the software can also be created by the customer or a competent third party.

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Vacon 10 Machinery

- The Vacon 10 Machinery supports Vacon's standard Vacon PC tools, for example Vacon NCDrive, Vacon NCLoad and Vacon NC61131-3 Engineering Tool
- PC tools are available from www.vacon.com. The tools are intended for tasks such as commissioning, monitoring, loading various applications and application programming.
- The PC is connected to the drive with a Micro Communication Adapter - MCA (option order code) and a cable. There are two options for the cable: standard USB (option order code) and Vacon's own RS485 cable (option order code).

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Vacon 10 Machinery

- IP21 and NEMA1 enclosure
- Fieldbuses

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Vacon 10 Machinery

- Information not available

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Vacon 10 Machinery

Approvals

- CE, UL, cUL, IEC

Compliance with

- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC 721-3-3 Air quality, chemical vapours and particles)
- EN60068-2-6 Vibration
- IEC 68-2-27 Shock
- EN 61800-3 - EMC product standard for power drive system
- EN 61800-5-1 Safety
- EN 60204-1 Safety

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

ABB strenghts

ACS350 advantages over Vacon 10 Machinery

Wide power range	500 Hz max. output frequency
50°C ratings of 1~200 V units	Application macros 7 pcs
Ratings of 3~200 V units	User macros 3 pcs
50°C ratings of 400 V units	17 languages
EN61000-3-2 with opt. chokes	Portable FlashDrop tool
2 control panel options	Sequence programming
Panel cover	Versatile options
Bipolar AI	Maintenance need indication
Pulse train	Detailed fault history with time
100% Phd braking for all units	

ACS350 Competitor comparison



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Lenze 8200

- The 8200 Vector series is in short modular, compact and versatile. They are easy to use, able to communicate with all standard fieldbuses and offer good diagnostics options.
- The modular product range can provide a solution which, as well as meeting the requirements of your individual drive tasks, is also cost-effective.
- For power range 0.25–90 kW
- Applications
  - inverter the ideal solution for almost every application, e.g. in HVAC technology, material handling, and automation.

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Lenze 8200

- IP 20
- IP 65 (option)

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Lenze 8200

Vibration

- Acceleration stability up to 0.7g (Germanischer Lloyd, general conditions)

Shock

- N/A

Temperature

- Operation: all units -10°C to +50°C, (derate 2.5% per degree above 40°C)
- Units up to 11 kW -10°C to 55°C (derate 2.5% per degree above 40°C).

Humidity

- Humidity class F without condensation (average relative humidity 85 %).

Altitude limitations

- 0–4000 m. The rated output current should be derated by 5%/1000 m above sea level.

Acoustic noise

- Compliant with EN 61800-3 including A11 noise immunity.

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating
- Storage temperature –40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Lenze 8200

Voltage types and power range

- 1-phase 180 - 264 V
  - 0.25 to 2.2 kW
- 3-phase 180 - 264 V
  - 0.55 to 7.5 kW
- 3-phase 320 - 550 V
  - 0.55 to 90 kW

Power factor

- N/A

Supply frequency

- 50/60 Hz

Supply networks

- Operation in public supply networks (Limitation of harmonic currents according to EN 61000-3-2)

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB		ABB ACS350		Lenze 8200		Lenze	ASC350
P_N	P_N	ACS350	Lenze 8200	I_{2N}	I_{2N}	Rated output current		8200	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	01X-	E82EV	U_N=200-240 V		U_N=180-264 V		N/A	Frame
0,12	0,16								
0,18	0,25		251K2C0xx			1,7	1,3	F1	
0,37	0,5	02A4-2	371K2C0xx	2,4	2,2	2,4	1,8		R0
0,55	0,75		551K2C0xx			3	2,3	F2	
0,75	1	04A7-2	751K2C0xx	4,7	4,2	4,0	3,0		R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	152K2C0xx	7,5	6,8	7,0	5,3	F3	R2
2,2	3	09A8-2	222K2C0xx	9,8	8,8	9,5	7,1		

Lenze 8200

Overload ratings

- 180 % for 60 sec.
- 210 % for 3 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 200V

3-phase 200V		ABB		ABB ACS350		Lenze 8200		Lenze	
P_N	P_N	ACS350	Lenze 8200	I_{2N}	I_{2N}	Rated output current		8200	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-	E82EV	U_N=200-240 V		U_N=180-264 V		N/A	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	02A4-2		2,4	2,2				R0
0,55	0,75	03A5-2	551K2C0xx	3,5	3,2	3,0	2,3	F1	
0,75	1	04A7-2	751K2C0xx	4,7	4,2	4,0	3,0		R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	152K2C0xx	7,5	6,8	7,0	5,3	F2	
2,2	3	09A8-2	222K2C0xx	9,8	8,8	9,5	7,1		R2
3	4	13A3-2	302K2C0xx	13,3	12,0	12	9,0	F3	
4	5	17A6-2	402K2C0xx	17,6	15,8	19,8	14,9		
5,5	7,5	24A4-2	552K2C0xx	24,4	21,96	22,5	16,9	F4	R3
7,5	10	31A0-2	752K2C0xx	31,0	27,9	28,6	21,5		R4
11	15	46A2-2		46,2	41,58				

Lenze 8200

Overload ratings

- 180 % for 60 sec.
- 210 % for 3 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 400V

3-phase 400V		ABB		ABB ACS350		Lenze 8200		Lenze	
P_N	P_N	ACS350	Lenze 8200	I_{2N}	I_{2N}	Rated output current		8200	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	03X-	E82EV	U_N=380-480 V		U_N=320-550 V		N/A	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	01A2-4		1,2	1,1				R0
0,55	0,75	01A9-4	551K4C0xx	1,9	1,7	1,8	1,4	F2	
0,75	1	02A4-4	751K4C0xx	2,4	2,2	2,4	1,8		R1
1,1	1,5	03A3-4		3,3	3,0		0,0		
1,5	2	04A1-4	152K4C0xx	4,1	3,7	3,9	2,9	F3	
2,2	3	05A6-4	222K4C0xx	5,6	5,0	5,6	4,2		
3	4	07A3-4	302K4C0xx	7,3	6,6	7,3	5,5	F4	
4	5	08A8-4	402K4C0xx	8,8	7,9	9,5	7,1		
5,5	7,5	12A5-4	552K4C0xx	12,5	11,3	13,0	9,8		R3
7,5	10	15A6-4	752K4C0xx	15,6	14,0	16,5	12,4	F5	
11	15	23A1-4	113K4C0xx	23,1	20,8	23,5	17,6		
15	20	31A0-4		31	27,9				R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Lenze 8200

Overload ratings

- 180 % for 60 sec.
- 210 % for 3 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Lenze 8200	ABB ACS350			Lenze 8200			Lenze 8200	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-	E82EV	W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,18	0,25		251K2C0xx					120		F1	
0,37	0,5	02A4-2	371K2C0xx	70	169	161	60		140		R0
0,55	0,75		551K2C0xx					180		F2	
0,75	1	04A7-2	751K2C0xx	70	169	161					R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	152K2C0xx	105	169	165	60	240	140	F3	R2
2,2	3	09A8-2	222K2C0xx								

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Lenze 8200	ABB ACS350			Lenze 8200			Lenze 8200	ASC350
		Type	Type	1-phase			1-phase			Frame	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	names	
kW	hp	01X-	E82EV	area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,18	0,25		251K2C0xx				72	1,0	0,8	F1	
0,37	0,5	02A4-2	371K2C0xx	118	1,9	1,2					R0
0,55	0,75		551K2C0xx				108	1,5	1,2	F2	
0,75	1	04A7-2	751K2C0xx	118	1,9	1,2					R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	152K2C0xx	177	2,9	1,5	144	2,0	1,6	F3	R2
2,2	3	09A8-2	222K2C0xx								

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Lenze 8200	ABB ACS350			Lenze 8200			Lenze 8200	ASC350
		Type	Type	3-phase			3-phase			Frame	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	names	
kW	hp	03X-	E82EV	W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2		70	169	161					R0
0,55	0,75	03A5-2	551K2C0xx				60	180	140	F2	
0,75	1	04A7-2	751K2C0xx								R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	152K2C0xx				60	240	140	F3	
2,2	3	09A8-2	222K2C0xx	105		165					R2
3	4	13A3-2	302K2C0xx				100	240	140	F3	
4	5	17A6-2	402K2C0xx								
5,5	7,5	24A4-2	552K2C0xx	169	169	169	125	240	140	F4	R3
7,5	10	31A0-2	752K2C0xx	260	181	169					R4
11	15	46A2-2									

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Lenze 8200	ABB ACS350			Lenze 8200			Lenze 8200	ASC350
		Type	Type	3-phase			3-phase			Frame	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	names	
kW	hp	03X-	E82EV	area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2									R0
0,55	0,75	03A5-2	551K2C0xx				108	1,5	1,2	F2	
0,75	1	04A7-2	751K2C0xx	118	1,9	1,2					R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	152K2C0xx				144	2,0	1,6	F3	
2,2	3	09A8-2	222K2C0xx								R2
3	4	13A3-2	302K2C0xx	177	2,9	1,5	240	3,4	2,9	F3	
4	5	17A6-2	402K2C0xx								
5,5	7,5	24A4-2	552K2C0xx	286	4,8	2,5	300	4,2	3,6	F4	R3
7,5	10	31A0-2	752K2C0xx	471	8,0	4,4					R4
11	15	46A2-2									

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Lenze 8200	ABB ACS350			Lenze 8200			Lenze 8200	ASC350
		Type	Type							Frame	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	names	
kW	hp	03X-	E82EV	W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4		70	169	161					R0
0,55	0,75	01A9-4	551K4C0xx				60	180	140	F2	
0,75	1	02A4-4	751K4C0xx								R1
1,1	1,5	03A3-4									
1,5	2	04A1-4	152K4C0xx				60	240	140	F3	
2,2	3	05A6-4	222K4C0xx								
3	4	07A3-4	302K4C0xx				100			F4	
4	5	08A8-4	402K4C0xx								
5,5	7,5	12A5-4	552K4C0xx	169		169					R3
7,5	10	15A6-4	752K4C0xx				125			F5	
11	15	23A1-4	113K4C0xx								
15	20	31A0-4		260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Lenze 8200	ABB ACS350			Lenze 8200			Lenze 8200	ASC350
		Type	Type							Frame	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	names	
kW	hp	03X-	E82EV	area	volume	weight	area	volume	weight	N/A	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4		118	1,9	1,2					R0
0,55	0,75	01A9-4	551K4C0xx				108	1,5	1,2	F2	
0,75	1	02A4-4	751K4C0xx								R1
1,1	1,5	03A3-4				1,2					
1,5	2	04A1-4	152K4C0xx				144	2,0	1,6	F3	
2,2	3	05A6-4	222K4C0xx								
3	4	07A3-4	302K4C0xx				240	3,4	2,9	F4	
4	5	08A8-4	402K4C0xx								
5,5	7,5	12A5-4	552K4C0xx	286	4,8	2,5					R3
7,5	10	15A6-4	752K4C0xx				300	4,2	3,6	F5	
11	15	23A1-4	113K4C0xx								
15	20	31A0-4		471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

Installation

Lenze 8200

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	Yes
Wall (sideways)	Yes
Heatsinkless	Yes
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	0

- Attached with screws
- Max.permissable motor cable length:
  - 50 m (shielded cable)
  - 100 m (unshielded cable)

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Lenze 8200

- Filters
  - a built-in RFI filter (up to 11 kW) ensures compliance with EMC regulations
  - Integrated filter suits EN55011 levels A & B up to 11kW. Footprint filters available for larger powers
- Chokes
  - N/A
- EMC compliant motor cable lengths
  - NA
- THD
  - N/A

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
-

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

2 control panel options
Control panel mounting kit
Panel cover

Lenze 8200

Keypad XT

User-friendly menu structure and plain text display

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Bipolar AI as standard

Pulse train

Machine interface (I/O)

Lenze 8200

Type	*Qty.*	*Programmable*
Digital inputs	6	Yes
Analog inputs	2	Yes
Pulse train input	N/A	N/A
Relay outputs	2	Yes
Transistor outputs	N/A	N/A
Analog outputs	2	Yes

Specialities:

- Bipolar AI as an option

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Lenze 8200

Protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus (RS232 & RS485)	Standard	2.4 - 19.2 kbps	Up to 32 nodes
DeviceNet	Option	N/A	
Profibus	Option	N/A	
Interbus	Option	N/A	

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

Motor control

Lenze 8200

- Sensorless vector control
- V/Hz Mode

Braking

- N/A

Output frequency

- 0–650 Hz with both scalar and vector control

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Lenze 8200

- Pre-configured product macros for the 8200 vector including parts data and layout macros for dimensioning control cabinets

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Lenze 8200

- PID controller *(
- Flying restart with coasting motor *(
- Slip compensation *(
- Mains voltage compensation
- Load loss/belt monitoring *(
- Smooth start/stop along S ramps *(
- DC braking *(
- 4 freely parameterisable parameter sets which can be switched online

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Lenze 8200

N/A

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

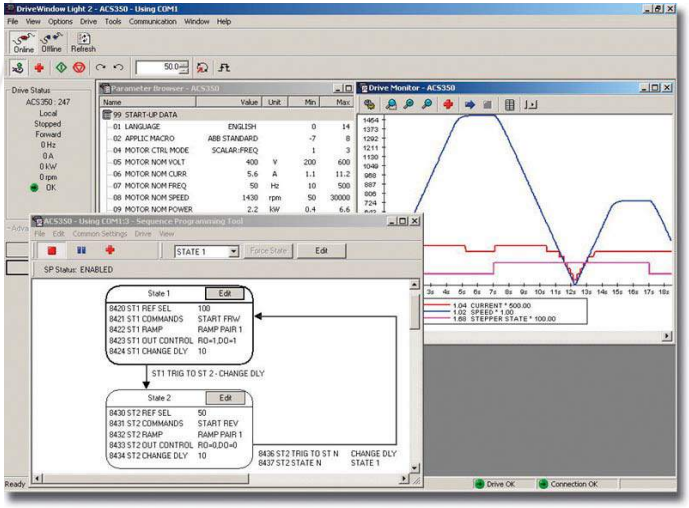
Lenze 8200

N/A

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Lenze 8200

- Dialogue-assisted operation
- Monitor window for displaying operating parameters and diagnostics
- Extensive help functions
- Loading and saving parameter files from and to the inverter
- Saving and printing out parameter settings as code lists
- Global Drive Control easy (GDCeasy)
  - Parameter settings can be saved, copied in accordance with requirements or printed out in list format. Diagnosing a running drive is simple with GDCeasy. For example, in fieldbus applications, the status of input and output signals can be called up online.
  - GDCeasy is free of charge and can be downloaded free from the Internet

ABB ACS350

- Easy access throught RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Lenze 8200

- Optional plug-in modules (2 up to 11kW, 3 on larger sizes)
  - Keypad
  - I/O expansion

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Lenze 8200

N/A

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Lenze 8200

Approvals

- CE, UL, cUL, DIN, VDE, GL

Compliance with

- CE conformance according to the Low-Voltage Directive
- CE conformance with the EU's EMC directive for generic drive configurations with frequency inverters

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Lenze 8200 vector

Model: E82EV222K4C000

Drive rating: 400/500V
2.2 kW / 3.0 HP
5.6 A

Tester (experienced drive specialist) comments:

- Drive had to be assembled: Operator Panel, Mounting feet, I/O card, all terminal blocks. Four boxes, three manuals, and a bag of parts.
- I/O card pinned to drive with header. Installed clip to hold it tight.
- Drive was difficult to program and all three manuals that came with it were nearly useless. They gave no information about parameters except how they were organized.
- No apparent DC bus regulator.
- All terminal blocks are plug–in.
- No label was with the drive.
- Very cheaply designed.

ABB ACS350

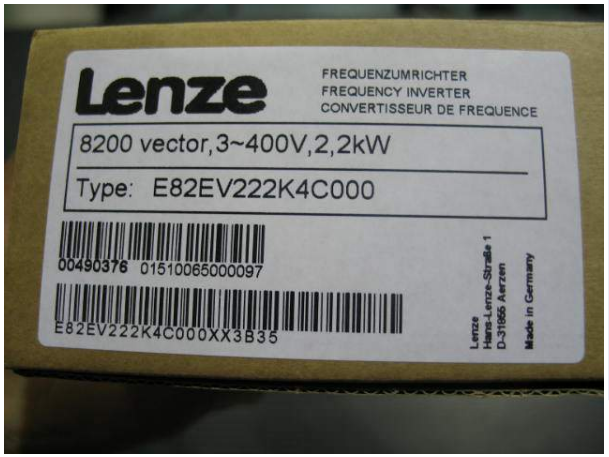
Model: ACS350-03U-05A6-4

Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A

Parameter Settings:

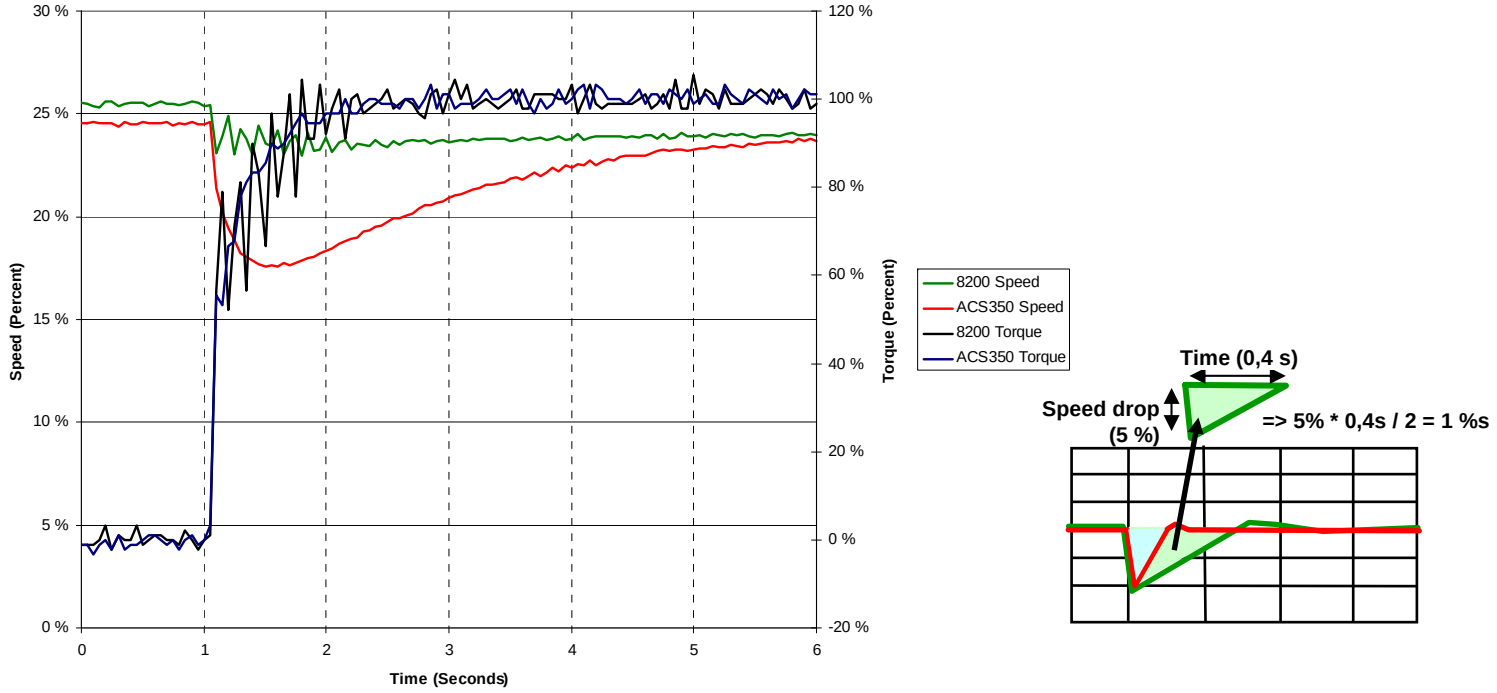
9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

Photos of the tested unit



Impact load test – Dynamic speed accuracy (stiffness)

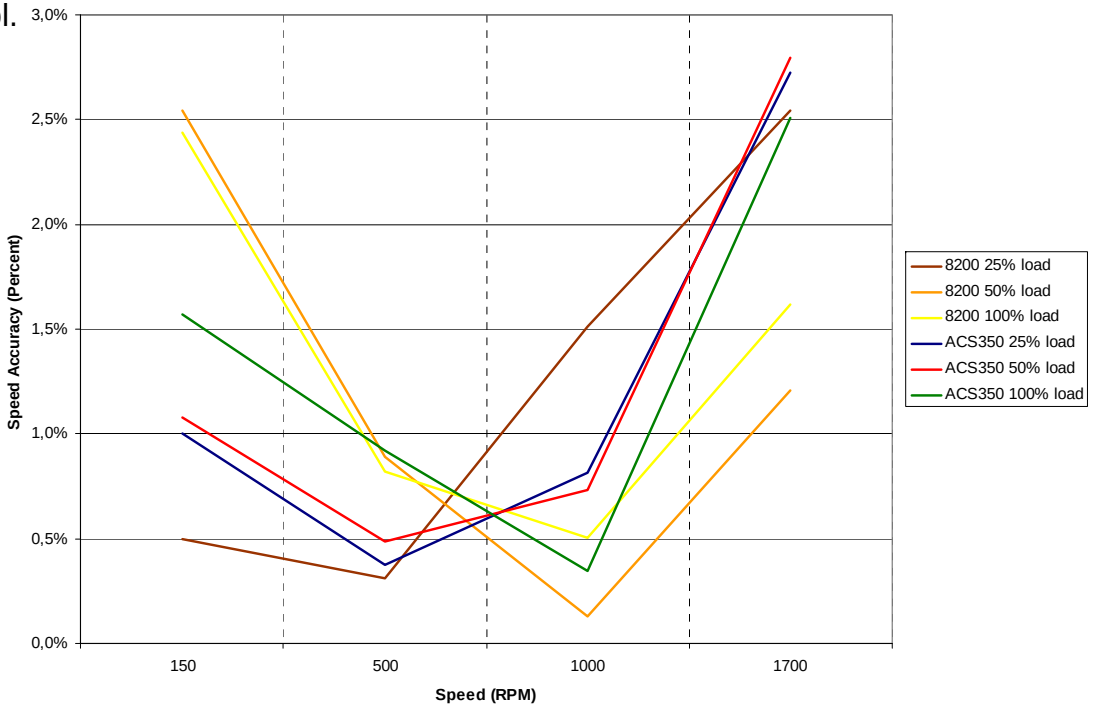
Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.



Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive works in case of disturbances. In ACS350 the speed control default tuning is quite conservative to ensure that controller is stable despite of the used motor and motor size compared to size of the inverter. The L8200 drive has better dynamic speed accuracy (small speed droop and short recovery time) but cannot fully compensate for slip. The performance of ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL).

Static speed accuracy

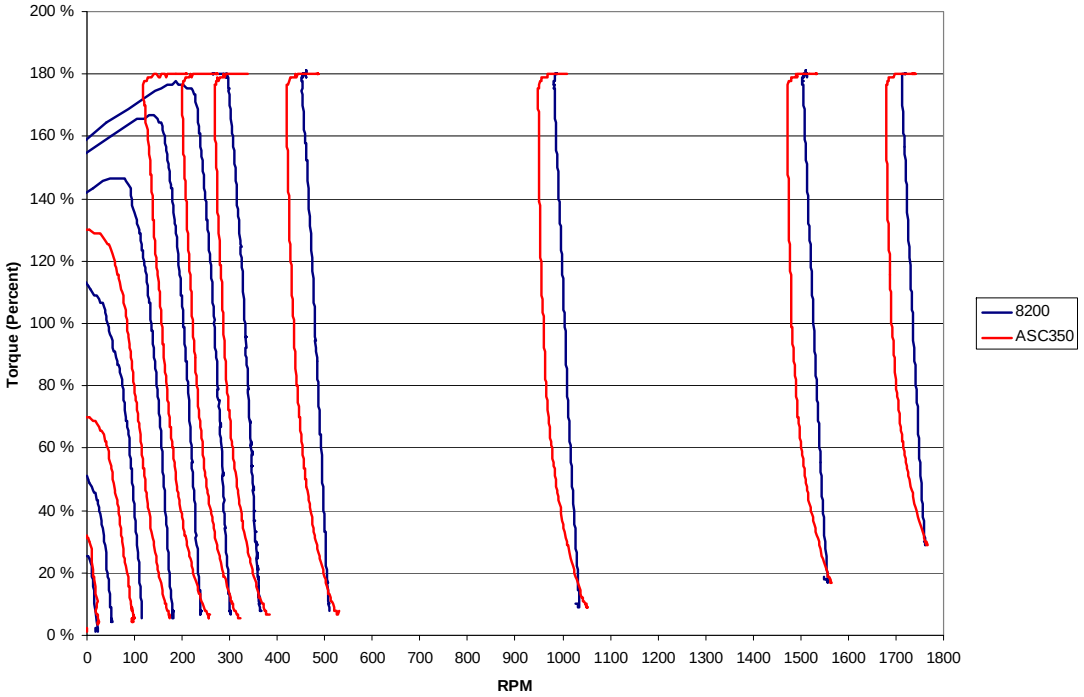
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 0%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), Speed Error [%] = $(n^*-n_{act}) / n_{N(mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Static speed error depends on on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in applications where good static accuracy is needed (e.g. extruders). The ACS350 and L8200 performed the test equally well, but L8200 has a bit more difference between test points. The performance of the ACS350 could be improved by tuning the speed controller (parameter group 23 SPEED CONTROL).

Maximum torque as a function of speed

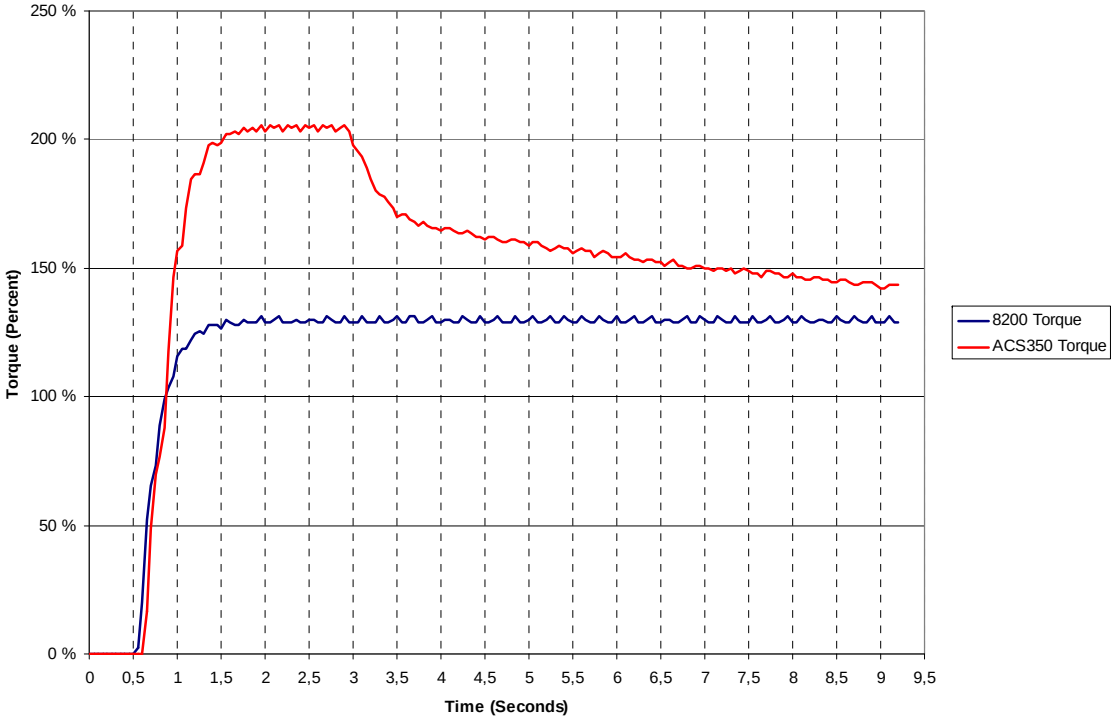
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The ACS350 has good speed range because it could provide full output torque from 1700 rpm's down to 180 rpm. The L8200 cannot maintain the torque for two seconds at lower speeds allowing the motor to stall due to current limiting. The ACS350 can maintain the torque without stalling the motor so it has better overload functionality. The quite conservative speed controller tuning of ACS350 can be seen also in this test as a slight speed drop in each test point and it can be improved by tuning the speed controller (parameter group 23 SPEED CONTROL).

Maximum starting torque

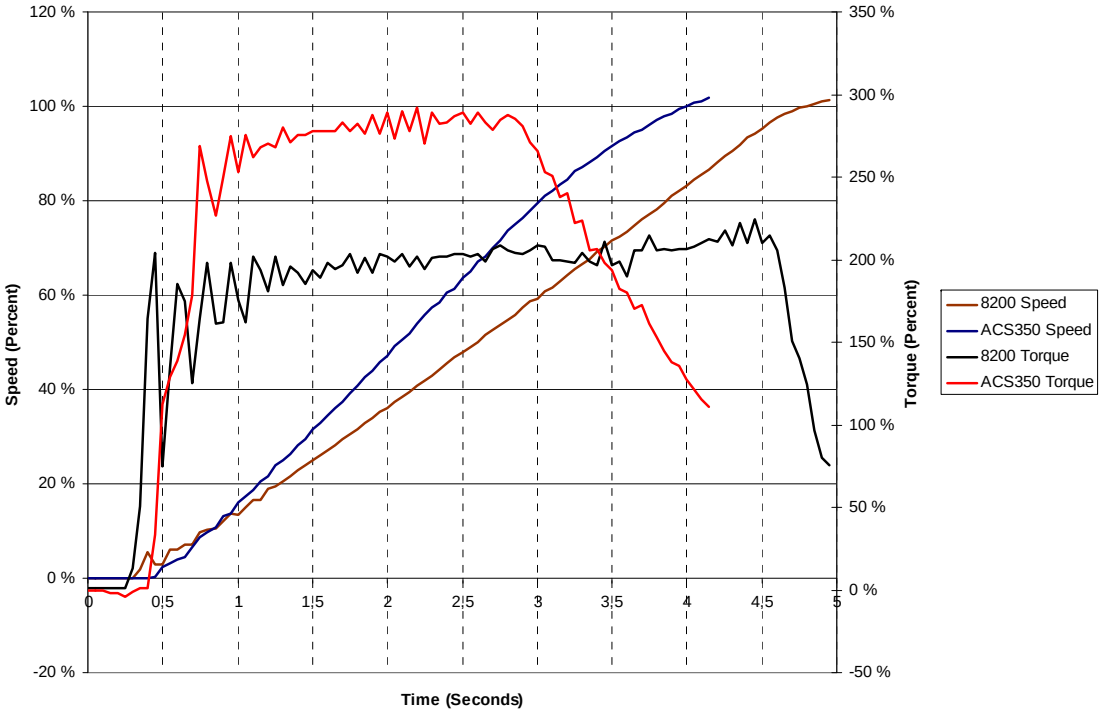
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



The ACS350 has good starting torque up to 200%. The maximum starting torque of the 8200 peaks at 125%. Presumable the ACS350 will work better in applications requiring high starting torque or accelerating high-inertia loads.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 (0.95 kgm^2) inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



Thanks to greater maximum output torque the ACS350 can accelerate the inertia to the reference within 4 sec. The L8200 needs 5 seconds. The ACS350 provides maximum starting torque for two seconds. After the overload cycle, the ACS350 reduces its overload current (torque) causing a decrease in the acceleration rate.

Efficiency

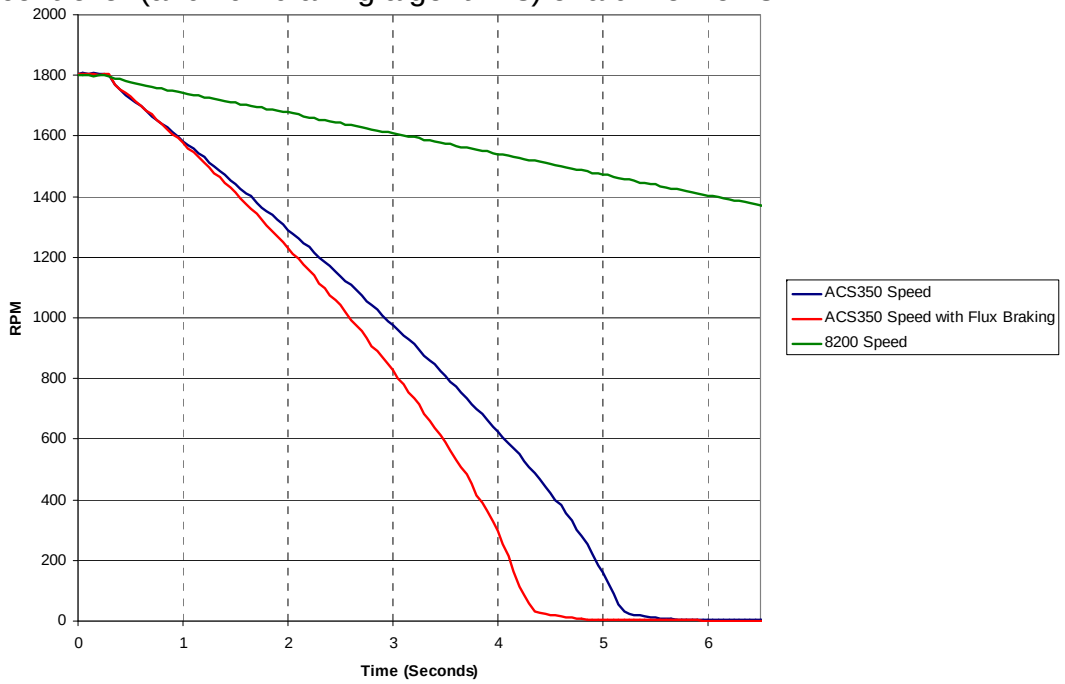
Using power analyzer, input power, speed and torque of AC motor are measured at 0, 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	L8200
25%	87.0%	91.9%
50%	89.3%	92.3%
75%	89.0%	91.9%
100%	88.4%	92.0%

The test is performed at rated speed with different loads. L8200 has slightly better efficiency at all load points. L8200 cannot handle fast acceleration or deceleration.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



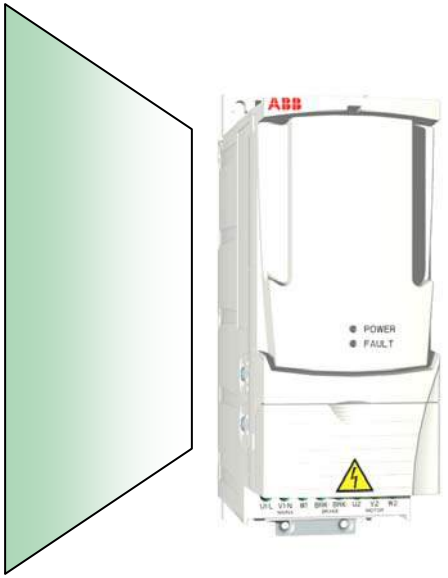
8200: Test failed.

The ACS350 was able to decelerate to zero within 5,5 seconds. The ACS350 with flux braking shortened the deceleration time even more. The L8200 does not seem to have an overvoltage controller because its performance is not acceptable.

ABB strengths

ACS350 advantages over Lenze 8200

I2hd 50°C ratings	Application macros 7 pcs
EN61000-3-2 with opt. chokes	User macros 3 pcs
2 control panel options	17 languages
Control panel mounting kit	Comprehensive SW
Panel cover	Cold parameterization with FlashDrop
Bipolar AI as standard	Sequence programming
Pulse train	Versatile options
Modbus speed	Maintenance need indication
100% Phd braking	Detailed fault history with time



For ACS350 advantages in performance, see the performance test slides



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Lenze SMVector

- The SMVector is in a class by itself when it comes to Flexibility, Performance and Simplicity
- Open loop flux vector control (speed or torque), additionally V/Hz, and Enhanced V/Hz
- For power range 0.25 to 18.5 kW
- The SMVector carries all the features required by demanding applications including four modes of operation (V/Hz, Enhanced V/Hz, Vector Speed, and Torque), high starting torque, auto-tuning, advanced low-speed control, and dynamic speed regulation.
- Promotes price leadership in packaging machinery, food processing machinery, material handling/conveying systems and HVAC systems

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Lenze SMVector

- IP31 (NEMA Type 1)
- IP54 (NEMA 12)
- IP65 (NEMA 4X)

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Lenze SMVector

Vibration

- 1.0 g

Shock

- N/A

Temperature

- Operating temperature -10 to 55 ºC, derate 2.5% per ºC above 40 ºC
- Storage temperature -20 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 0…1000 m. From 1000 m to 4000 m with 5% per 1000 m current derating

Acoustic noise

- 4 / 6 / 8 / 10 kHz

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating and reduced lifetime.
- Storage temperature -40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Lenze SMVector

Voltage types and power range

- 1-phase 120 / 240V
  - 0.25 to 0.75 kW
- 1-phase (or 3-phase) 200 / 240V
  - 0.25 (0.37) to 2.2 kW
- 3-phase 200 / 240V
  - 1.1 to 15 kW
- 3-phase 400 / 480V
  - 0.37 to 18.5 kW
- 3-phase 480 / 600V
  - 0.75 to 18.5 kW

Power factor

- N/A

Supply frequency

- 48…62 Hz

Supply networks

- N/A

DC connection

- Yes

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

DC connection

- ?

Ratings 1-phase 200V

1-phase 200V		ABB	Lenze	ABB ACS350		Lenze SMVector		Lenze	ASC350
P_N	P_N	ACS350	SMVector	I_{2N}	I_{2N}	I_{INV}	I_{INV}	SMVector	
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	01X-	ESV	U_N=200-240 V		U_N=200/240 V		Frame	Frame
0,12	0,16								
0,25	0,33		251N02SX			1,7	1,3		
0,37	0,5	02A4-2	371N02YX	2,4	2,2	2,4	1,8	G1	R0
0,55	0,75								
0,75	1	04A7-2	751N02YX	4,7	4,2	4,2	3,2	G1	R1
1,1	1,5	06A7-2	112N02YX	6,7	6,0	6,0	4,5	G2	
1,5	2	07A5-2	152N02YX	7,5	6,8	7,0	5,3		R2
2,2	3	09A8-2	222N02YX	9,8	8,8	9,6	7,2		

Lenze SMVector

Overload ratings

- No official information available
- 195 % for 10 sec. (from brochure picture)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 200V

3-phase 200V		ABB	Lenze	ABB ACS350		Lenze SMVector		Lenze	ASC350
P_N	P_N	ACS350	SMVector	I_{2N}	I_{2N}	I_{INV}	I_{INV}	SMVector	
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-	ESV	U_N=200-240 V		U_N=220/240 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	02A4-2		2,4	2,2				R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2		4,7	4,2				R1
1,1	1,5	06A7-2	112N02TX	6,7	6,0	6,0	4,5	G2	
1,5	2	07A5-2	152N02TX	7,5	6,8	7,0	5,3		
2,2	3	09A8-2	222N02TX	9,8	8,8	9,6	7,2		R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2	402N02TX	17,6	15,8	16,5	12,4	G3	
5,5	7,5	24A4-2	552N02TX	24,4	21,96	23,0	17,3	H1	R3
7,5	10	31A0-2	752N02TX	31,0	27,9	29,0	21,8		R4
11	15	46A2-2	113N02TX	46,2	41,58	42,0	31,5	J1	
15	20		153N02TX			54,0	40,5		

Lenze SMVector

Overload ratings

- No official information available
- 195 % for 10 sec. (from brochure picture)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 400V

3-phase 400V		ABB ACS350	Lenze SMVector	ABB ACS350		Lenze SMVector		Lenze SMVector	ASC350
P_N	P_N			I_{2N}	I_{2N}	I_{INV}	I_{INV}		
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-	ESV	U_N=380-480 V		U_N=400(/480) V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	01A2-4	371N04TX	1,2	1,1	1,3	1,0	G1	R0
0,55	0,75	01A9-4		1,9	1,7				
0,75	1	02A4-4	751N04TX	2,4	2,2	2,4	1,8	G1	R1
1,1	1,5	03A3-4	112N04TX	3,3	3,0	3,5	2,6	G2	
1,5	2	04A1-4	152N04TX	4,1	3,7	4,0	3,0		
2,2	3	05A6-4	222N04TX	5,6	5,0	5,5	4,1		
3	4	07A3-4		7,3	6,6				
4	5	08A8-4	402N04TX	8,8	7,9	9,4	7,1	G3	
5,5	7,5	12A5-4	552N04TX	12,5	11,3	12,6	9,5	H1	R3
7,5	10	15A6-4	752N04TX	15,6	14,0	16,1	12,1		
11	15	23A1-4	113N04TX	23,1	20,8	24,0	18,0	J1	
15	20	31A0-4	153N04TX	31	27,9	31,0	23,3		R4
18,5	25	38A0-4	183N04TX	38	34,2	39,0	29,3		
22	30	44A0-4		44	39,6				

Lenze SMVector

Overload ratings

- No official information available
- 195 % for 10 sec. (from brochure picture)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Lenze SMVector	ABB ACS350			Lenze SMVector			Lenze SMVector	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-	ESV	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,25	0,33		251N02SX				99	191	110		
0,37	0,5	02A4-2	371N02YX	70	169	161				G1	R0
0,55	0,75										
0,75	1	04A7-2	751N02YX	70	169	161	99	191	110	G1	R1
1,1	1,5	06A7-2	112N02YX				99	191	138	G2	
1,5	2	07A5-2	152N02YX	105	169	165					R2
2,2	3	09A8-2	222N02YX								

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Lenze SMVector	ABB ACS350			Lenze SMVector			Lenze SMVector	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-	ESV	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,25	0,33		251N02SX				189	2,1	0,9		
0,37	0,5	02A4-2	371N02YX	118	1,9	1,2				G1	R0
0,55	0,75										
0,75	1	04A7-2	751N02YX	118	1,9	1,2	189	2,1	0,9	G1	R1
1,1	1,5	06A7-2	112N02YX				189	2,6	1,3	G2	
1,5	2	07A5-2	152N02YX	177	2,9	1,5					R2
2,2	3	09A8-2	222N02YX								

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Lenze SMVector	ABB ACS350			Lenze SMVector			Lenze SMVector	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	ESV	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2		70	169	161					R0
0,55	0,75	03A5-2									
0,75	1	04A7-2									R1
1,1	1,5	06A7-2	112N02TX				99	191	138	G2	
1,5	2	07A5-2	152N02TX								
2,2	3	09A8-2	222N02TX	105		165					R2
3	4	13A3-2									
4	5	17A6-2	402N02TX				99	191	147	G3	
5,5	7,5	24A4-2	552N02TX	169	169	169	130	250	160	H1	R3
7,5	10	31A0-2	752N02TX	260	181	169					R4
11	15	46A2-2	113N02TX				175	313	205	J1	
15	20		153N02TX								

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Areas of 3~200 V units

Volumes of 3~200 V units

Weights of 3~200 V units

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Lenze SMVector	ABB ACS350			Lenze SMVector			Lenze SMVector	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	ESV	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	02A4-2		118	1,9	1,2					R0
0,55	0,75	03A5-2									
0,75	1	04A7-2									R1
1,1	1,5	06A7-2	112N02TX				189	2,6	1,3	G2	
1,5	2	07A5-2	152N02TX								
2,2	3	09A8-2	222N02TX	177	2,9	1,5					R2
3	4	13A3-2									
4	5	17A6-2	402N02TX				189	2,8	1,5	G3	
5,5	7,5	24A4-2	552N02TX	286	4,8	2,5	325	5,2	2,0	H1	R3
7,5	10	31A0-2	752N02TX	471	8,0	4,4					R4
11	15	46A2-2	113N02TX				548	11,2	N/A	J1	
15	20		153N02TX								

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Lenze SMVector	ABB ACS350			Lenze SMVector			Lenze SMVector	ASC350
		Type	Type								
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	ESV	W	H	D	W	H	D	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	371N04TX	70	169	161	99	191	110	G1	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	751N04TX				99	191	110	G1	R1
1,1	1,5	03A3-4	112N04TX				99	191	138	G2	
1,5	2	04A1-4	152N04TX								
2,2	3	05A6-4	222N04TX								
3	4	07A3-4									
4	5	08A8-4	402N04TX				99	191	147	G3	
5,5	7,5	12A5-4	552N04TX	169		169	130	250	160	H1	R3
7,5	10	15A6-4	752N04TX								
11	15	23A1-4	113N04TX				175	313	205	J1	
15	20	31A0-4	153N04TX	260	181	169					R4
18,5	25	38A0-4	183N04TX								
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Lenze SMVector	ABB ACS350			Lenze SMVector			Lenze SMVector	ASC350
		Type	Type								
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	ESV	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	371N04TX	118	1,9	1,2	189	2,1	0,9	G1	R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	751N04TX				189	2,1	0,9	G1	R1
1,1	1,5	03A3-4	112N04TX			1,2	189	2,6	1,3	G2	
1,5	2	04A1-4	152N04TX								
2,2	3	05A6-4	222N04TX								
3	4	07A3-4									
4	5	08A8-4	402N04TX				189	2,8	1,5	G3	
5,5	7,5	12A5-4	552N04TX	286	4,8	2,5	325	5,2	2,0	H1	R3
7,5	10	15A6-4	752N04TX								
11	15	23A1-4	113N04TX				548	11,2	N/A	J1	
15	20	31A0-4	153N04TX	471	8,0	4,4					R4
18,5	25	38A0-4	183N04TX								
22	30	44A0-4									

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

DIN rail, sideways and side-by-side mounting

Installation

Lenze SMVector

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	No
Flange	No
Wall (sideways)	No
Heatsinkless	No
Side-by-side	No

Free space requirements

Location	*mm*
Above	50
Below	50
Left and right	15

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Lenze SMVector

- Filters
  - Drive types ESVxxxNOxx**F** have integrated EMC filter; types available for
    - 1~ or 3~ 200/240V from 0.25 kW (3~ 0.37 kW) to 2.2 kW
    - 3~ 400/480 V from 0.37 kW to 2.2 kW
- Chokes
  - Information is not available
- EMC compliant motor cable lengths
  - Filtered drives can meet the class A limits of EN 55011 and EN 61800-3 Category 2 with a motor cable (low capacitance, core/core <75pF/m, core/shield <150pF/m) up to 10 meters

THD

- Information is not available

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

THD

- EN61000-3-2 with optional chokes

User interface

Lenze SMVector

- Integrated Local keypad & LED display
  - Vivid illumination
  - Four digit LED display
  - Movable decimal point
  - Five status LEDs
  - Status display
- Six button programming: Start, Stop, Forward/Reverse, Scroll up, Scroll down, Enter/Mode
- Optional remote external keypad
- NEMA 4X (IP65) types can be ordered without keypad and display

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66.

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Mitsubishi E700
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Machine interface (I/O)

Lenze SMVector

Type	*Qty.*	*Programmable*
Digital inputs	4	3 yes, 1 fixed start/stop
Analog inputs	2	1 0…10 VDC, 1 4…20 mA
Pulse train input	No	
Relay outputs	1	Yes
Digital outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Selector switch for negative or positive logic

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Lenze SMVector

Protocol	*Standard /Optional*	*Baud rate max.*	*Notes*
RS-485 / Modbus RTU	Optional	115.2 kbps	
DeviceNet	Optional	500 kbit/s	
Profibus	Optional		
CANopen	Optional	1 Mbit/s	
Ethernet / IP	Optional		
LECOM	Optional		

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

- Plug-in communication modules

Motor control

Lenze SMVector

- Open Loop Flux Vector (Speed or Torque Control)
- V/Hz (Constant or Variable)
- Enhanced V/Hz with Auto-tuning

Braking

- DC Injection Braking
- Optional Regenerative Braking

Output frequency

- 500 Hz Standard
- 1000 Hz Optional

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Lenze SMVector

- Macros
  - N/A

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Lenze SMVector

- Dynamic Torque Response
- Sophisticated Auto-tuning (Motor Calibration)
- Impressive Low Speed Operation
- PID Modes: Direct and Reverse Acting
- PID Sleep Mode

(* = Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Lenze SMVector

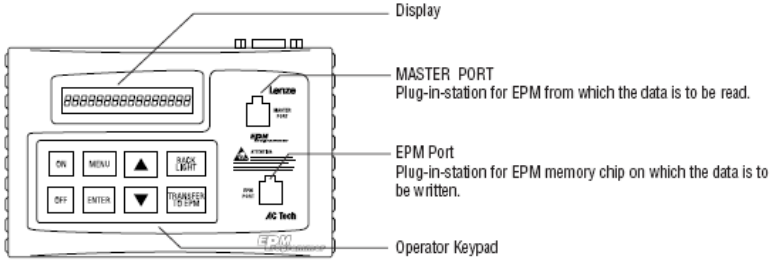
EPM, Electronic Programmable Memory

- For programming, storing, archive the drive's parameter configuration, and simplifying initial setup
- Uses a small size EPM memory chip (as standard in the drive) that plugs directly into the drives fascia; can be inserted to a unpowered drive
- The EPM chip needs to stay in the drive
- Three ways to program the EPM
  - With the SMVector integrated keypad
  - Programming in a Microsoft WindowsTM environment with Techlink
  - Programming with a portable EPM programmer - option having a 16-character text LCD display
    - EPM inserted into the programmer ⇨ parameters copied to EPM ⇨ EPM plugged into the drive
    - Battery chargeable, can also be used with 6 VDC/300 mA external power supply
    - Size 105x155x76 mm, weight 1.3 kg
    - Memory for storing up to 120 user specified parameter files
    - Possibility to set a password
    - Languages: EN, DE, FR, IT and ES
- Compatible with several Lenze and AC Tech inverter drive controllers (TMD/TML, SMD) and new SimpleServo products; operation and functionality may differ

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm, light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives



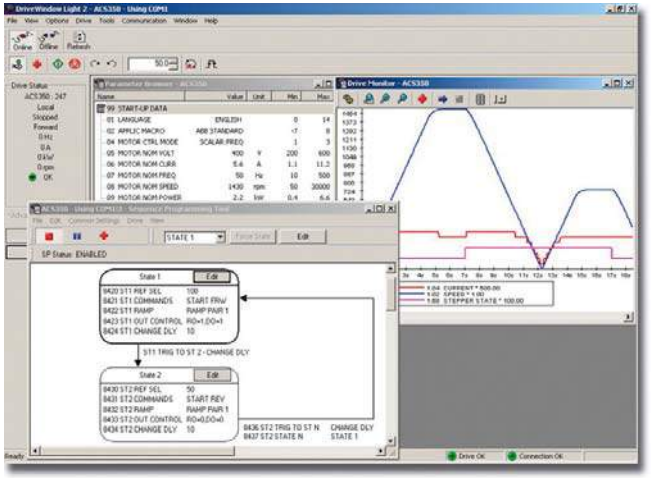
Other advanced features (cont)

Lenze SMVector

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

PC connectivity and tools

Lenze SMVector

- PC tool Techlink in Microsoft WindowsTM environment

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Lenze SMVector

- Remote external keypad
- EPM Programmer
- EPM memory chip
- Communication modules (fieldbuses)

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Lenze SMVector

- No cooling fans in NEMA 4X (IP65) models
- Fault history displays the last 8 faults

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Lenze SMVector

Approvals

- CE, UL, cUL, C-tick, GOST

Compliance with

- RoHS directive 2002/95/EC with amandments (at least NEMA 4X / IP65 types)

Applicable standards

- Low Voltage Directive (EN61800-5-1) (Europe)
- EMC Directive (EN61800-3) with Optional EMC filter
- The drive has been tested by Underwriters Laboratory (UL) and is an approved component in compliance with UL508 Safety Standard

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Lenze SMVector

Model: ESV222N04TX
Drive rating: 400-480V
2.2 kW / 3.0 HP
5.5 A / 4.8 A

Tester (experienced drive specialist) comments:

- The power and control terminals were generous in size.
- The plastic enclosure made the drive look like a plastic toy.
- The operator panel used four 7-segment LED's with Run & Stop keys, up & down Arrow keys, Mode key and Rev/Fwd key. Programming the drive was not intuitive. To gain access to the parameters you had to enter a password which was not clearly explained in the User Manual.
- The conduit box provided three cabling holes but did not supply any hole plugs.
- Standard power wiring produced reverse motor rotation.
- The motor terminals were on the left side while the input power terminals were located on the right. This is the only drive that has been tested that has been configured this way.
- The internal power supply was only +12Vdc.
- Sinking and Source required changing a switch and software parameter. The switch was difficult to find and required a flashlight to determine its position.
- Mounting holes were not keyholes
- To properly ID the motor you must first enter its Cosine Phi. Motor autotune is static only.
- The drive tripped on DC Bus Overvoltage or an Output Fault for the Efficiency, Overvoltage, Speed Accuracy and Harmonic Distortion tests. It also tripped on an Output Fault at the 500 RPM reference during the Torque versus Speed test.

ABB ACS350

Model: ACS350-03U-05A6-4
Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A

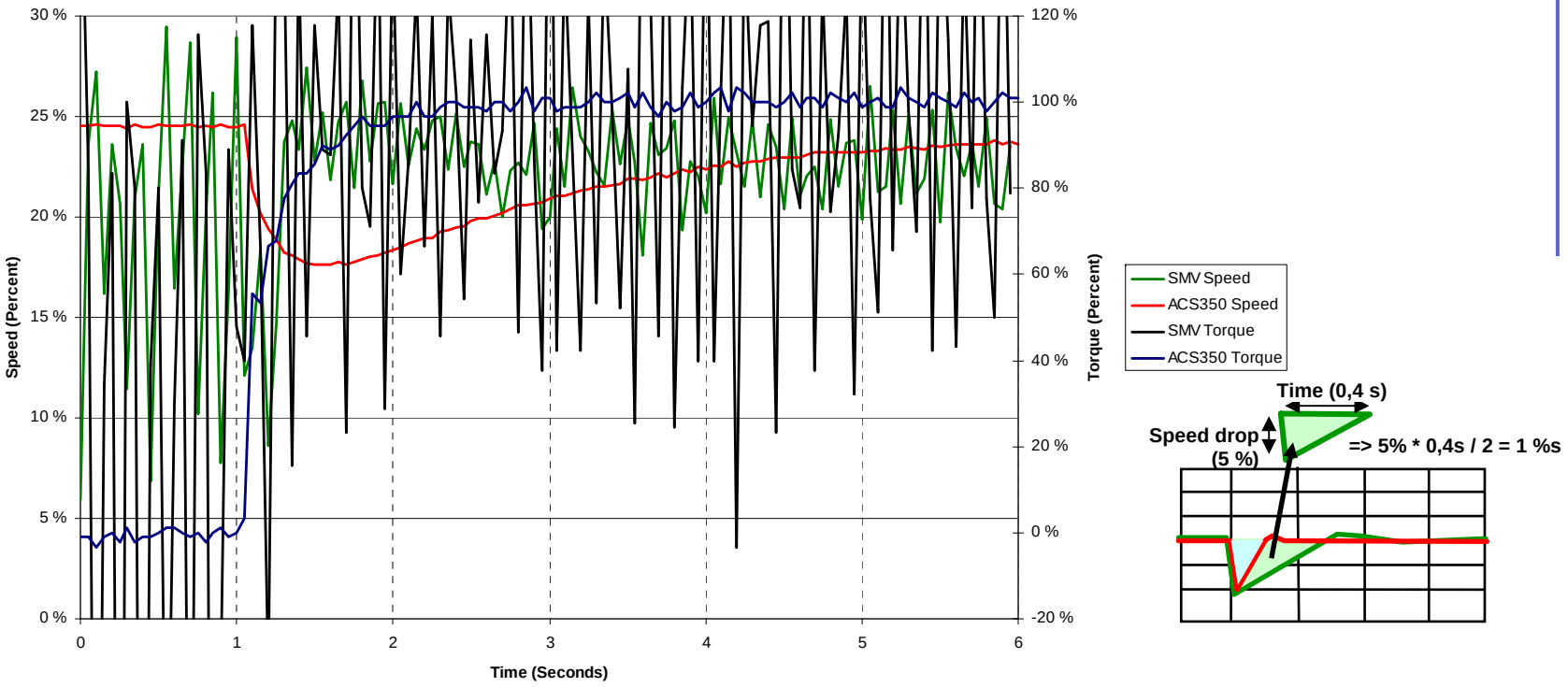
Parameter Settings:

9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

Photos of the tested unit

Impact load test – Dynamic speed accuracy (stiffness)

Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.

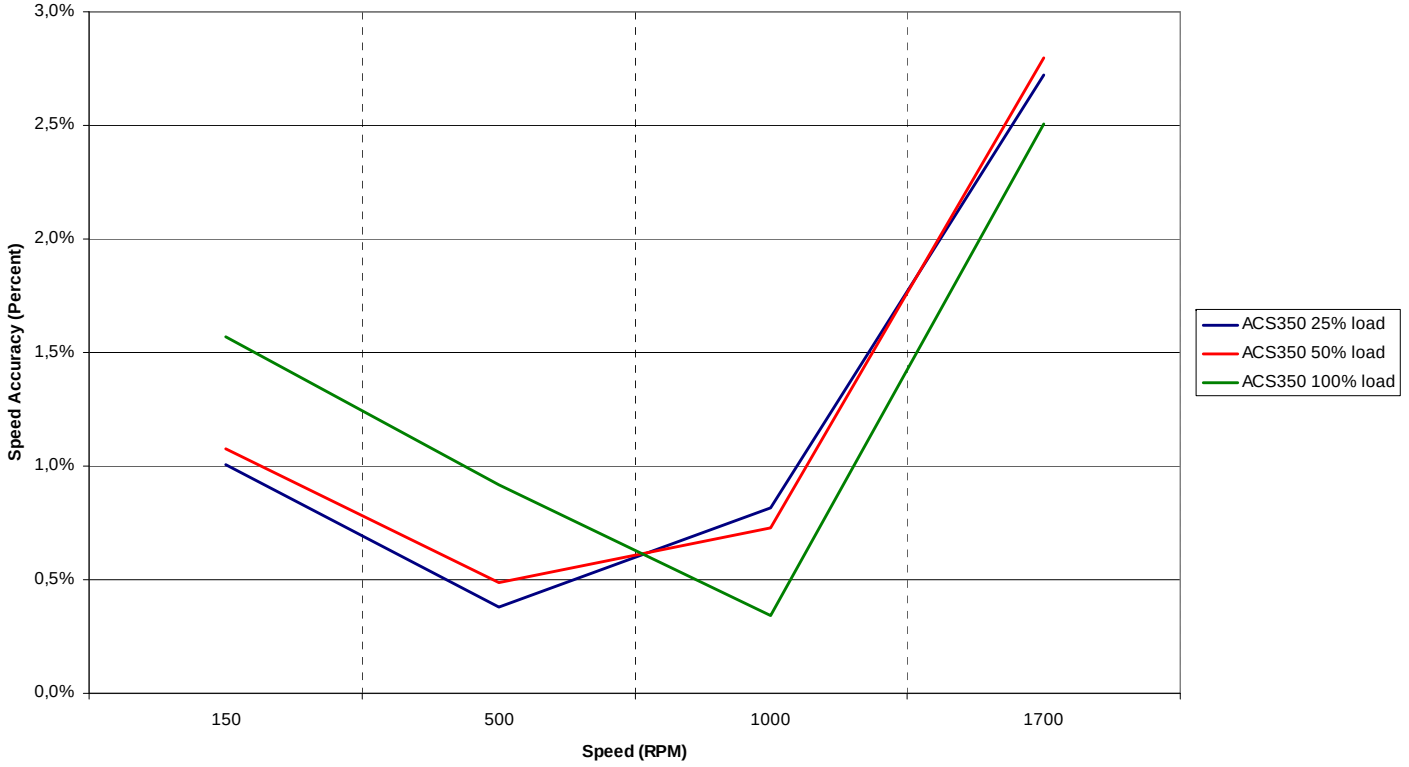


SMVector: Test failed.

Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive operates in case of disturbances. The ACS350's speed control default tuning is quite conservative to ensure the controller is stable despite the motor used and its size compared to the size of the inverter.

Static speed accuracy

Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 0%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), Speed Error [%] = $(n^*-n_{act}) / n_{N(mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



SMVector: Test failed.

Mitsubishi E700

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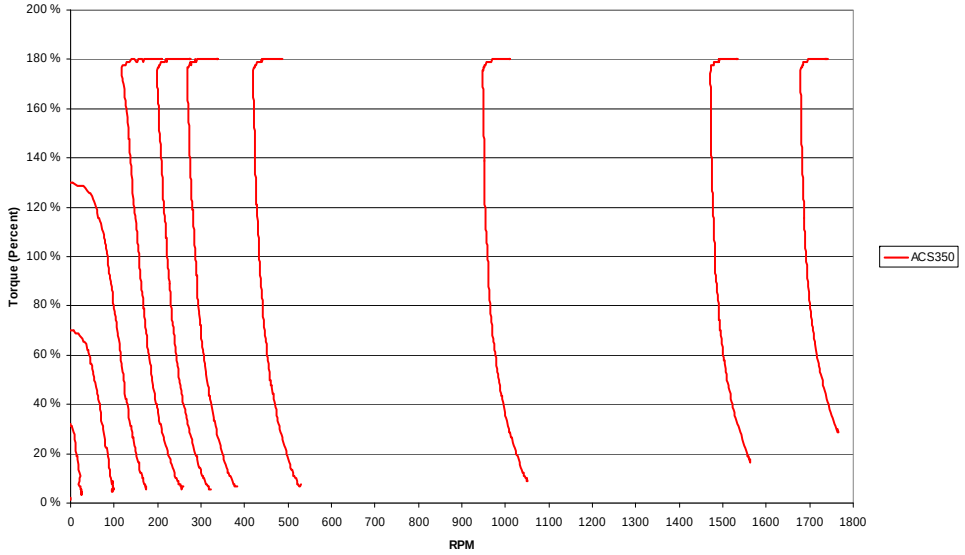
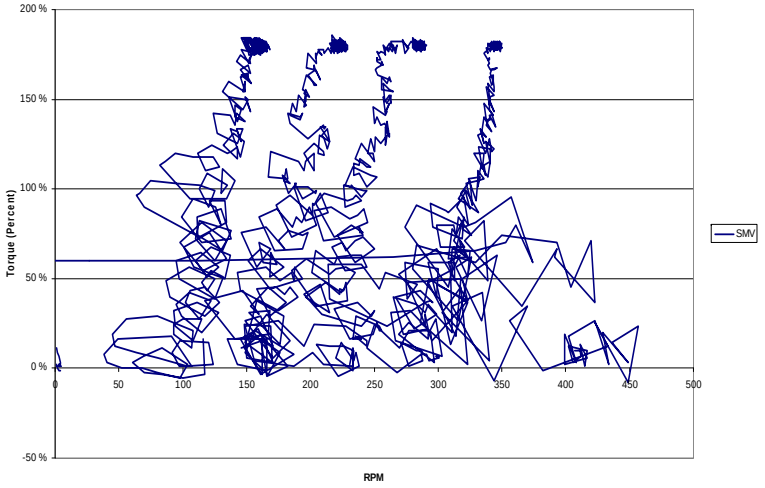
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Maximum torque as a function of speed

Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.





SMVector: Test failed. Tripped on DC Bus Overvoltage or an Output Fault. It also tripped on an Output Fault at the 500 RPM reference.

The ACS350 has good speed range because it could provide full output torque from 1700 rpm's down to 120 rpm. ACS350 can maintain the torque and has thus good overload functionality.

Mitsubishi E700

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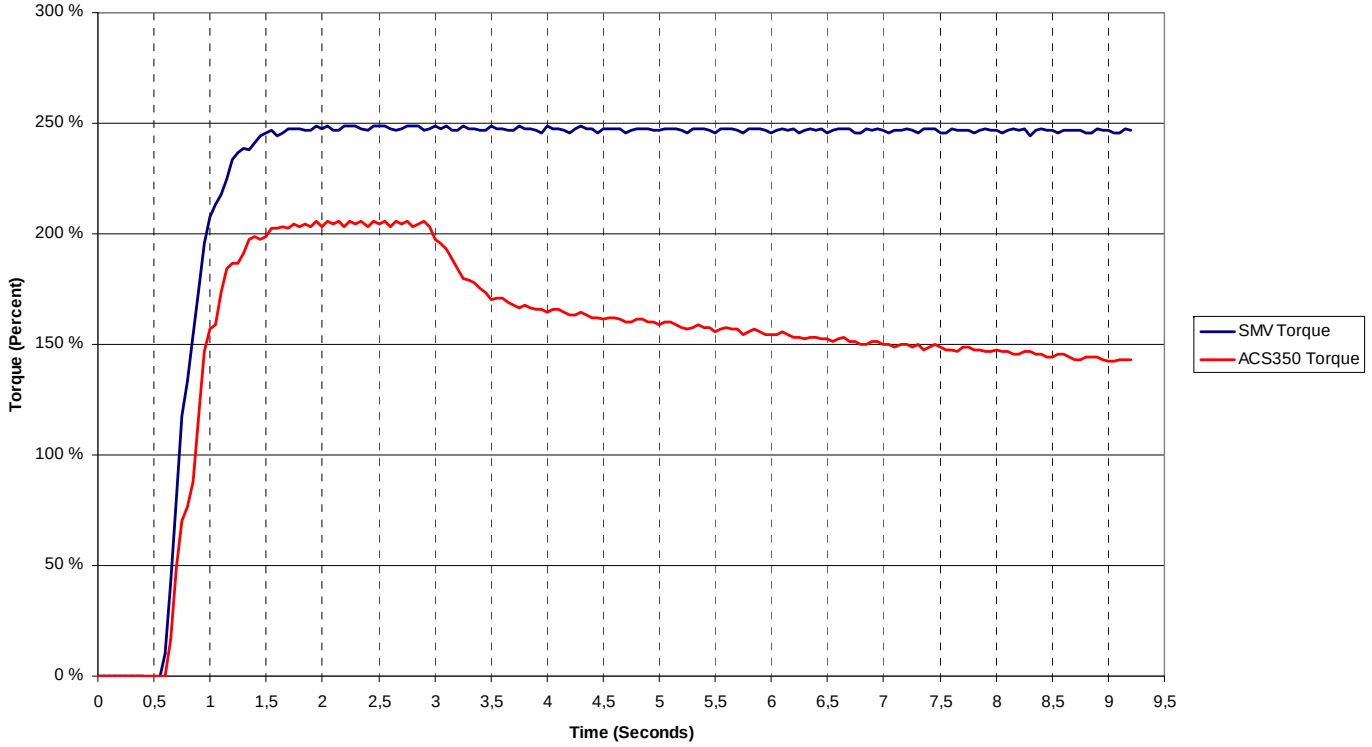
Maximum starting torque

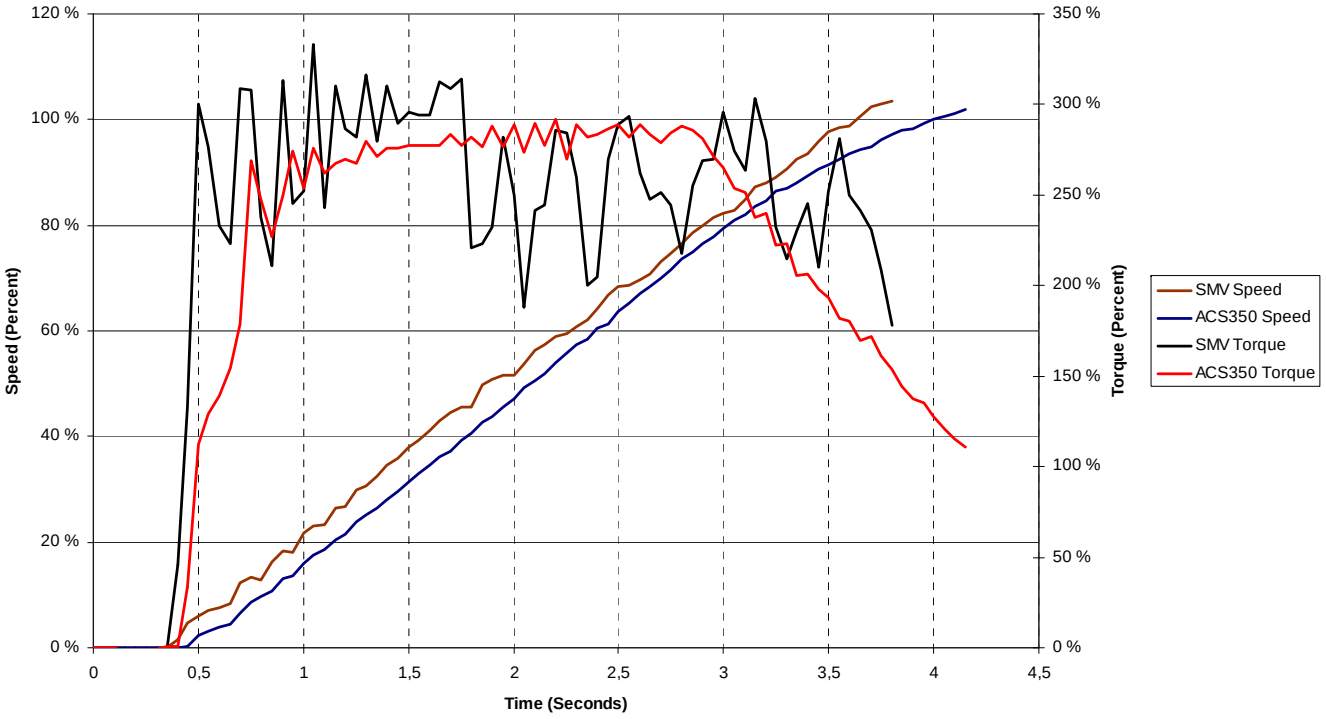
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



Both drives have good starting torque up to 200% in ACS350 and 250% in SMVector. Both drives also reach nominal torque within 1s. The ACS350 reduces torque to nominal value after 2 s due to current limiting. The SMVector has good overload capability producing the maximum torque continuously.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 (0.95 kgm^2) inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



Thanks to a bit greater maximum output torque the SMVector it can accelerate the inertia to the reference within 3.6 sec. The ACS350 needs 4 seconds. The ACS350 provides maximum starting torque for two seconds after which it decreases the torque based on current limiting. The SMVector produces significant torque ripple which may indicate the tuning of the current controller is not stable and could cause overcurrent trips.

Efficiency

Using power analyzer, input power, speed and torque of AC motor are measured at 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

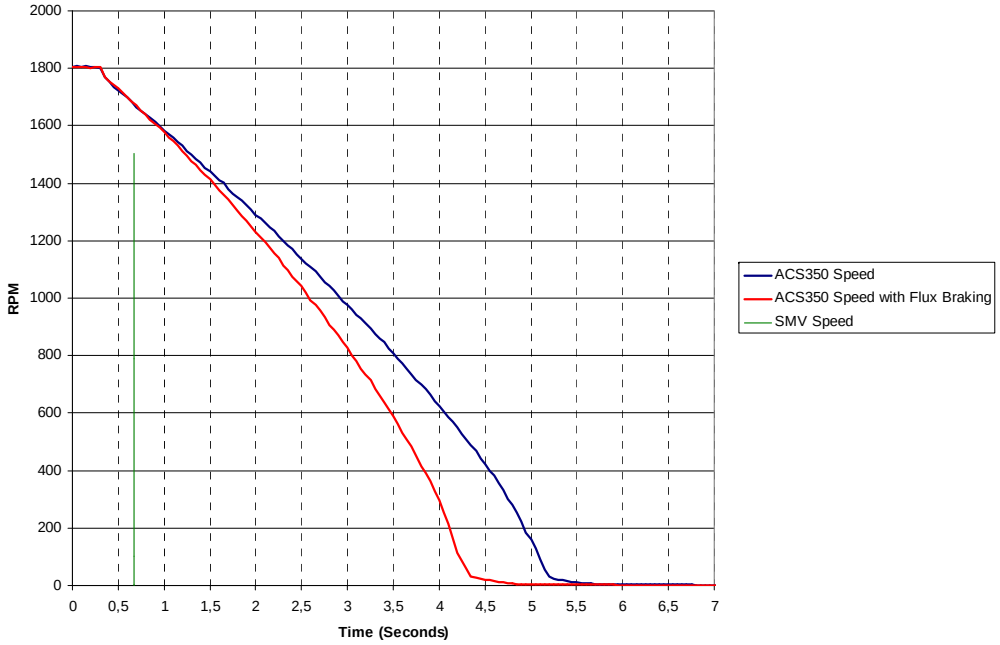
Load (Percent)	Efficiency	
	ACS350	SMVector
25%	87.0%	%
50%	89.3%	%
75%	89.0%	%
100%	88.4%	%

SMVector: Test failed.

The test is performed at rated speed with different loads.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braling algorithms) of a drive works.



ACS350 was able to decelerate to zero within 5,5 seconds. ACS350 with flux braking shortened the deceleration time even more. The SMVector didn't pass the test. The SMVector tripped on DC Bus Overvoltage.

ABB strengths

ACS350 advantages over Lenze SMVector

Wide power range	User macros 3 pcs
Areas of units	17 languages
Volumes of units	Light weight portable FlashDrop
Weights of units	Sequence programming
DIN rail, sideways and side-by-side mounting	Maintenance need indication
Bipolar AI	Detailed fault history with time
Application macros 7 pcs	

For ACS350 advantages in performance, see the performance test slides

ACS350 Competitor comparison



















Summary Slide

Description

Micromaster 420

- Our frequency inverters combine the highest technical quality with versatile functionality: the universal inverter Micromaster 420.
- Each frequency inverter belonging to the family allows flexible circuit connection of inputs and outputs for optimum link-up of a broad variety of digital and analog signals. And, due to its documented factory setting, it is immediately ready for use.
- For power range 0.12 - 11 kW
- Applications
  - Control of multiple drives via PID controller (motor/pump staging) integrated as standard Dry run detection for pump drives (belt failure detection) Low-energy mode.

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Micromaster 420

- IP20 (standard)

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Micromaster 420

Vibration

- Not allowed

Shock

- Not allowed

Temperature

- Operating temperature -10 to +50°C

Humidity

- Lower than 95 % (non-condensing)

Altitude limitations

- 1000 m max. without derating, from 1000 m to 4000 m derating required (permissible output current is 80% of nominal at 4000 m)

Acoustic noise

- N/A

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Micromaster 420

Voltage types and power range

- 1-phase 240V
  - 0.12 to 3 kW
- 3-phase 240V
  - 0.12 to 5.5 kW
- 3-phase 480V
  - 0.37 to 11 kW

Power factor

- Over 0.95

Supply frequency

- 47 Hz to 63 Hz

Supply networks

- Data N/A

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Micromaster	ABB ACS350		Micromaster 420		Micromaster	
P_N	P_N	ACS350	420	I_{2N}	I_{2N}	Output current		420	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	01X-	6SE6420-	U_N=200-240 V		U_N=200-240 V		Frame	Frame
0,12	0,16		2AB11-2AA1			0,9	0,9		
0,18	0,25		2AB12-5AA1			1,7	1,7		
0,37	0,5	02A4-2	2AB13-7AA1	2,4	2,2	2,3	2,3	A	R0
0,55	0,75		2AB15-5AA1			3,0	3,0		
0,75	1	04A7-2	2AB17-5AA1	4,7	4,2	3,9	3,9		R1
1,1	1,5	06A7-2	2AB21-1BA1	6,7	6,0	5,5	5,5		
1,5	2	07A5-2	2AB21-5BA1	7,5	6,8	7,4	7,4	B	R2
2,2	3	09A8-2	2AB22-2BA1	9,8	8,8	10,4	10,4		
3	4		2AB23-0CA1			13,6	13,6	C	

Micromaster 420

Overload ratings

- 150 % for 60 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 200V

3-phase 200V		ABB	Micromaster	ABB ACS350		Micromaster 420		Micromaster	
P_N	P_N	ACS350	420	I_{2N}	I_{2N}	Output current		420	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-	6SE6420-	U_N=200-240 V		U_N=200-240 V		Frame	Frame
0,12	0,16		2UC11-2AA1			0,9	0,9	A	
0,18	0,25		2UC12-5AA1			1,7	1,7		
0,37	0,5	02A4-2	2UC13-7AA1	2,4	2,2	2,3	2,3		R0
0,55	0,75	03A5-2	2UC15-5AA1	3,5	3,2	3,0	3,0		
0,75	1	04A7-2	2UC17-5AA1	4,7	4,2	3,9	3,9		R1
1,1	1,5	06A7-2	2UC21-1BA1	6,7	6,0	5,5	5,5	B	
1,5	2	07A5-2	2UC21-5BA1	7,5	6,8	7,4	7,4		
2,2	3	09A8-2	2UC22-2BA1	9,8	8,8	10,4	10,4		R2
3	4	13A3-2	2UC23-0CA1	13,3	12,0	13,6	13,6	C	
4	5	17A6-2	2UC24-0CA1	17,6	15,8	17,5	17,5		
5,5	7,5	24A4-2	2UC25-5CA1	24,4	21,96	22,0	22,0		R3
7,5	10	31A0-2		31,0	27,9				R4
11	15	46A2-2		46,2	41,58				

Micromaster 420

Overload ratings

- 150 % for 60 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Ratings 3-phase 400V

3-phase 400V		ABB	Micromaster	ABB ACS350		Micromaster 420		Micromaster	ASC350
P_N	P_N	ACS350	420	I_{2N}	I_{2N}	Output current		420	
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-		A	A	A	A		
kW	hp	03X-	6SE6420-	U_N=380-480 V		U_N=380-480 V		Frame	Frame
0,12	0,16								
0,18	0,25								
0,37	0,5	01A2-4	2UD13-7AA1	1,2	1,1	1,2	1,2		R0
0,55	0,75	01A9-4	2UD15-5AA1	1,9	1,7	1,6	1,6		
0,75	1	02A4-4	2UD17-5AA1	2,4	2,2	2,1	2,1	A	R1
1,1	1,5	03A3-4	2UD21-1AA1	3,3	3,0	3,0	3,0		
1,5	2	04A1-4	2UD21-5AA1	4,1	3,7	4,0	4,0		
2,2	3	05A6-4	2UD22-2BA1	5,6	5,0	5,9	5,9		
3	4	07A3-4	2UD23-0BA1	7,3	6,6	7,7	7,7	B	
4	5	08A8-4	2UD24-0BA1	8,8	7,9	10,2	10,2		
5,5	7,5	12A5-4	2UD25-5CA1	12,5	11,3	13,2	13,2		
7,5	10	15A6-4	2UD27-5CA1	15,6	14,0	18,4	18,4	C	R3
11	15	23A1-4	2UD31-1CA1	23,1	20,8	26,0	26,0		
15	20	31A0-4		31	27,9				
18,5	25	38A0-4		38	34,2				R4
22	30	44A0-4		44	39,6				

Micromaster 420

Overload ratings

- 150 % for 60 sec.

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C a
- nd +50 °C ambient)
- 1.8 x short-time overload, 2 sec.

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Micromaster 420	ABB ACS350			Micromaster 420			Micromaster 420	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-	6SE6420-	W	H	D	W	H	D	Frame	Frame
0,12	0,16		2AB11-2AA1								
0,18	0,25		2AB12-5AA1								
0,37	0,5	02A4-2	2AB13-7AA1	70	169	161	73	173	149	A	R0
0,55	0,75		2AB15-5AA1								
0,75	1	04A7-2	2AB17-5AA1	70	169	161					R1
1,1	1,5	06A7-2	2AB21-1BA1				149	202	172	B	
1,5	2	07A5-2	2AB21-5BA1	105	169	165					R2
2,2	3	09A8-2	2AB22-2BA1								
3	4		2AB23-0CA1				185	245	195	C	

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Micromaster 420	ABB ACS350			Micromaster 420			Micromaster 420	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-		(cm2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-	6SE6420-	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16		2AB11-2AA1				126	1,9	1,0	A	
0,18	0,25		2AB12-5AA1								
0,37	0,5	02A4-2	2AB13-7AA1	118	1,9	1,2					R0
0,55	0,75		2AB15-5AA1								
0,75	1	04A7-2	2AB17-5AA1	118	1,9	1,2					R1
1,1	1,5	06A7-2	2AB21-1BA1				301	5,2	3,3	B	
1,5	2	07A5-2	2AB21-5BA1	177	2,9	1,5					R2
2,2	3	09A8-2	2AB22-2BA1								
3	4		2AB23-0CA1				453	8,8	5,0	C	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Micromaster 420	ABB ACS350			Micromaster 420			Micromaster 420	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-	6SE6420-	W	H	D	W	H	D	Frame	Frame
0,12	0,16		2UC11-2AA1								
0,18	0,25		2UC12-5AA1								
0,37	0,5	02A4-2	2UC13-7AA1				73	173	149	A	R0
0,55	0,75	03A5-2	2UC15-5AA1								
0,75	1	04A7-2	2UC17-5AA1	70		161					R1
1,1	1,5	06A7-2	2UC21-1BA1		169						
1,5	2	07A5-2	2UC21-5BA1				149	202	172	B	
2,2	3	09A8-2	2UC22-2BA1								R2
3	4	13A3-2	2UC23-0CA1	105		165					
4	5	17A6-2	2UC24-0CA1				185	245	195	C	
5,5	7,5	24A4-2	2UC25-5CA1	169	169	169					R3
7,5	10	31A0-2		260	181	169					R4
11	15	46A2-2									

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Micromaster 420	ABB ACS350			Micromaster 420			Micromaster 420	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-		(cm2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	6SE6420-	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16		2UC11-2AA1								
0,18	0,25		2UC12-5AA1								
0,37	0,5	02A4-2	2UC13-7AA1				126	1,9	1,0	A	R0
0,55	0,75	03A5-2	2UC15-5AA1								
0,75	1	04A7-2	2UC17-5AA1	118	1,9	1,2					R1
1,1	1,5	06A7-2	2UC21-1BA1								
1,5	2	07A5-2	2UC21-5BA1				301	5,2	3,3	B	
2,2	3	09A8-2	2UC22-2BA1								R2
3	4	13A3-2	2UC23-0CA1	177	2,9	1,5					
4	5	17A6-2	2UC24-0CA1				453	8,8	5,0	C	
5,5	7,5	24A4-2	2UC25-5CA1	286	4,8	2,5					R3
7,5	10	31A0-2		471	8,0	4,4					R4
11	15	46A2-2									

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Micromaster 420	ABB ACS350			Micromaster 420			Micromaster 420	ASC350
		Type	Type								
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	Frame names	
kW	hp	03X-	6SE6420-	W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	2UD13-7AA1	70	169	161	73	173	149	A	R0
0,55	0,75	01A9-4	2UD15-5AA1								
0,75	1	02A4-4	2UD17-5AA1								R1
1,1	1,5	03A3-4	2UD21-1AA1								
1,5	2	04A1-4	2UD21-5AA1								
2,2	3	05A6-4	2UD22-2BA1				149	202	172	B	
3	4	07A3-4	2UD23-0BA1								
4	5	08A8-4	2UD24-0BA1								
5,5	7,5	12A5-4	2UD25-5CA1	169		169	185	245	195	C	R3
7,5	10	15A6-4	2UD27-5CA1								
11	15	23A1-4	2UD31-1CA1								
15	20	31A0-4		260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Micromaster 420	ABB ACS350			Micromaster 420			Micromaster 420	ASC350
		Type	Type								
		ACS350-		(cm2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-	6SE6420-	area	volume	weight	area	volume	weight	Frame	Frame
0,12	0,16										
0,18	0,25										
0,37	0,5	01A2-4	2UD13-7AA1	118	1,9	1,2	126	1,9	1,0	A	R0
0,55	0,75	01A9-4	2UD15-5AA1								
0,75	1	02A4-4	2UD17-5AA1								R1
1,1	1,5	03A3-4	2UD21-1AA1			1,2					
1,5	2	04A1-4	2UD21-5AA1								
2,2	3	05A6-4	2UD22-2BA1				301	5,2	3,3	B	
3	4	07A3-4	2UD23-0BA1								
4	5	08A8-4	2UD24-0BA1								
5,5	7,5	12A5-4	2UD25-5CA1	286	4,8	2,5	453	8,8	5,0	C	R3
7,5	10	15A6-4	2UD27-5CA1								
11	15	23A1-4	2UD31-1CA1								
15	20	31A0-4		471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

Installation

DIN rail mounting

Sideways mounting

Side by side mounting

Micromaster 420

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	No
Flange	No
Wall (sideways)	No
Heatsinkless	No
Side-by-side	No

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	N/A

- The connections for the control cables are screwless.
- Two mounting slots are combined with the metal back plate and may not be as secure as brackets or frame mounting holes.Optional gland plate covers lower mounting slot and prevents terminal cover being easily removed.
- All Inverters will operate at full specification with cable lengths up to 50m screened and 100 m unscreened.

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

EMC and harmonics

Micromaster 420

- Filters
  - No EMC filter as standard, product has compliance with standard EN 61800-3
  - All sizes available without built-in EMC filter. Sizes available with built in Class A EMC filter:
    - 240 V 1ph 0.12 kW to 3.0 kW
    - 240 V 3ph 3.0 kW to 5.5 kW
    - 480 V 3ph 2.2 kW to 11
- Chokes
  - Line commutating chokes, output chokes (option)
- Motor cable lengths
  - To achieve the performance levels needed to meet the relevant EMC standards, the motor cable lengths must not exceed 25m
- THD
  - N/A

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

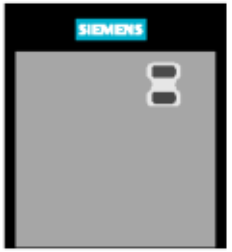
1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

Micromaster 420

- BOP basic operator panel for parameterizing an inverter
- AOP advanced operator panel with plain-text and multilingual display
- PC connection kits
- Assembly kits for mounting the operator panels in the control cabinet doors



Status Display Panel (Standard)

Basic Operator Panel (Option)

Advanced Operator Panel (Option)

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Mitsubishi E700
Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08
Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Machine interface (I/O)

Micromaster 420

Type	*Qty.*	*Programmable*
Digital inputs	3	Yes
Analog inputs	1	Yes
Pulse train input	N/A	N/A
Relay outputs	1	Yes
Transistor outputs	-	-
Analog outputs	1	Yes

Specialities:

- N/A

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Micromaster 420

Protocol	*Standard /Optional*	*Baud rate*	*Notes*
RS485 (DSI)	Integral	1200 to 57600	
Profibus	Option	N/A	
DeviceNet	Option	N/A	
CANopen	Option	N/A	

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

Motor control

Micromaster 420

- Open Loop Vector Mode
- V/Hz Mode

Braking

- Resistance braking with DC braking, compound braking, integrated brake chopper (integrated brake chopper only with 0.12 kW to 75 kW inverters).

Output frequency

- 0 – 650 Hz with vector control

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7 pcs
User macros 3 pcs
17 languages

Micromaster 420

- Advanced operator panel (AOP) multilingual

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Micromaster 420

- Parameterizable acceleration/ deceleration times (0 to 650 s) *(
- Compound braking for controlled rapid braking
- 4 skip frequencies for minimizing stress on the machine when resonance occurs
- Automatic restart *(
- Minimal stress on motor when inverter connected to rotating motor *(
- Prepared for use in IT networks *(
- Integrated protection/overload functions *(

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Micromaster 420

N/A

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

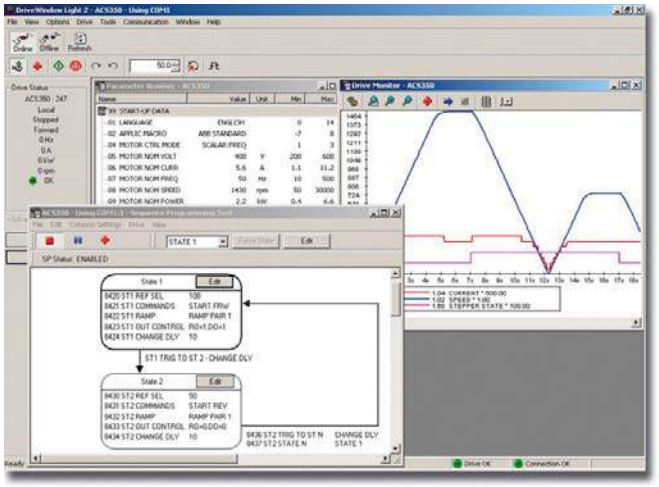
Micromaster 420

N/A

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



PC connectivity and tools

Micromaster 420

- PC connection kits
- PC commissioning tool, runs under Windows 95/NT
- Connecting to a PC / LaptopConnects to the RS485 terminals (14 & 15) under front cover
- An Isolated RS232 adapter board and standard RS232 cable is required
- Starter (start-up software) for guided commissioning of the Siemens Micromaster series is supplied on a CD with every inverter
- Drive monitor (start-up software) for list oriented programming is also supplied on the same CD

ABB ACS350

- Easy access throught RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Micromaster 420

- EMC filters Class A/B
- Line commutating chokes
- Output chokes
- Gland plates
- BOP basic operator panel for parameterizing an inverter
- AOP advanced operator panel with plain-text and multilingual display
- PC connection kits
- Assembly kits for mounting the operator panels in the control cabinet doors

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Micromaster 420

N/A

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

Micromaster 420

Approvals

- CE, UL, cUL, C-tick

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- EMC Directive 89/336/EEC with supplements
- Unfiltered units, all voltages and powers comply with EN61800-3 (EMC Drive Specific Standard).
- Frame size A units 400 to 480 V with external Class A footprint filters comply with EN50081-2 & EN50082-2
- Unfiltered units fitted with external Class B footprint filters comply with EN50081-1 & EN50082-1
- Quality assurance system ISO 9001

Applicable standards

- EN61000-3-2, EMC harmonic limits for equip up to 16 A
- EN61800-3
- EMC product standard for VSDs.
- EN61000-4-2, EN61000-4-3
- EN61000-4-4, EN61000-4-8
- EN60146-1-1, EN60204-1
- EN55011 for class A or B filters

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

Siemens MICROMASTER 420

Model: 6SE6420-2UD22-2BA1

Drive rating: 380-480V
2.2 kW
5.9 A

Tester (experienced drive specialist) comments:

- The commissioning is fairly straightforward but odd. You cannot just adjust parameters, you must be in commissioning mode.
- The wiring was easy for L1,2,3 and more difficult for U,V,W.
- The pressure plates on the terminals are “poorly” or “barely” self lifting. Marking of the terminals on the pictures in the start up guide are nice, but they are not duplicated on the drive.
- The drive is very sensitive to overvoltage tripping with no option except longer decel times or installation of a dynamic brake resistor.
- Failed “Fast acceleration to inertia” test. Not enough current to accelerate the motor past a few hundred RPM.
- Current control is awful (see Impact test).
- Speed /Torque curves at higher speed not available due to what appears to be violent current limit causing too rapid of deceleration.
- Efficiency and overvoltage controller tests would not run due to overvoltage tripping. Only possible to run test with 30 sec decel time.

ABB ACS350

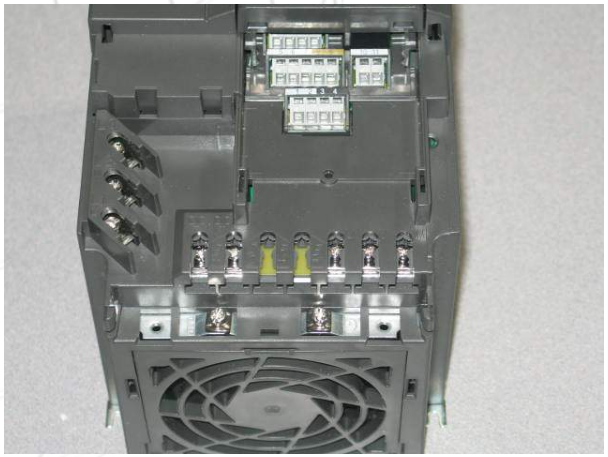
Model: ACS350-03U-05A6-4

Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A (40 °C)
5.0 A (50 °C)

Parameter Settings:

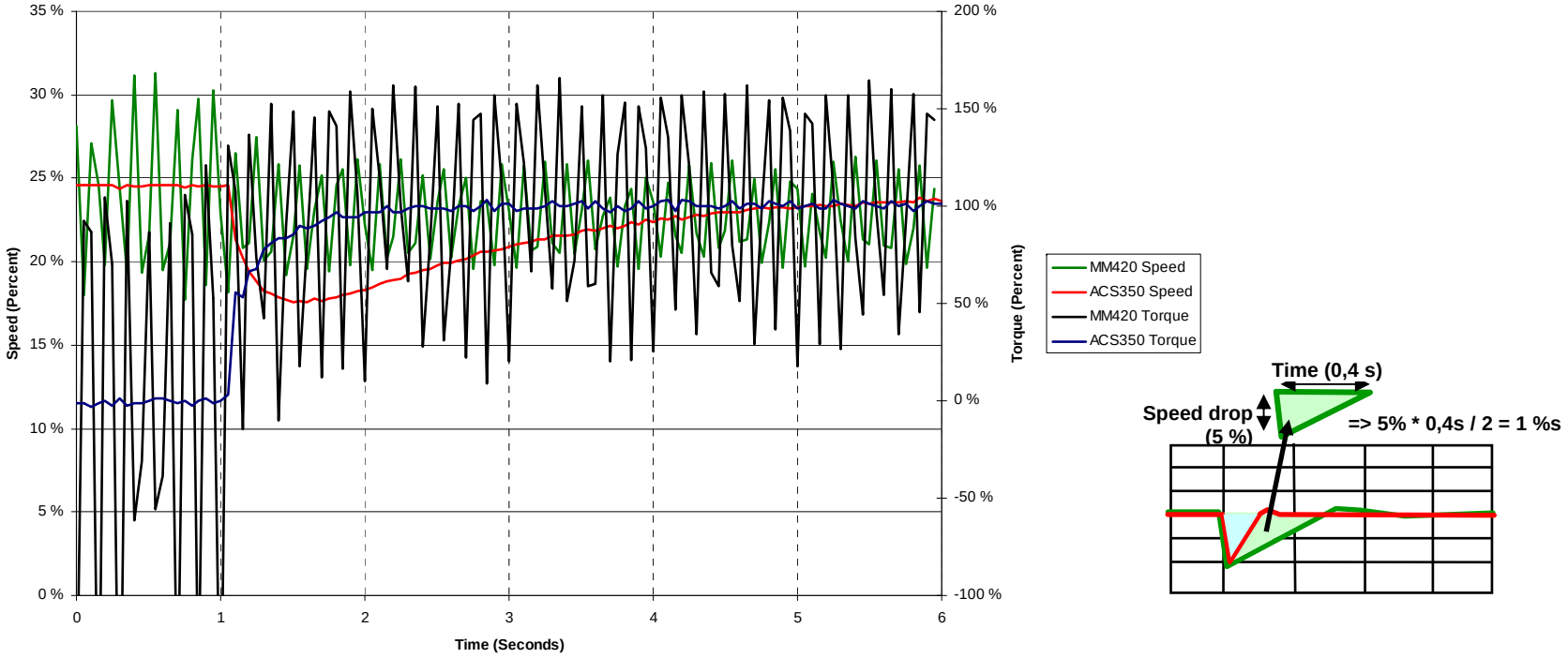
9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

Photos of the tested unit



Impact load test – Dynamic speed accuracy (stiffness)

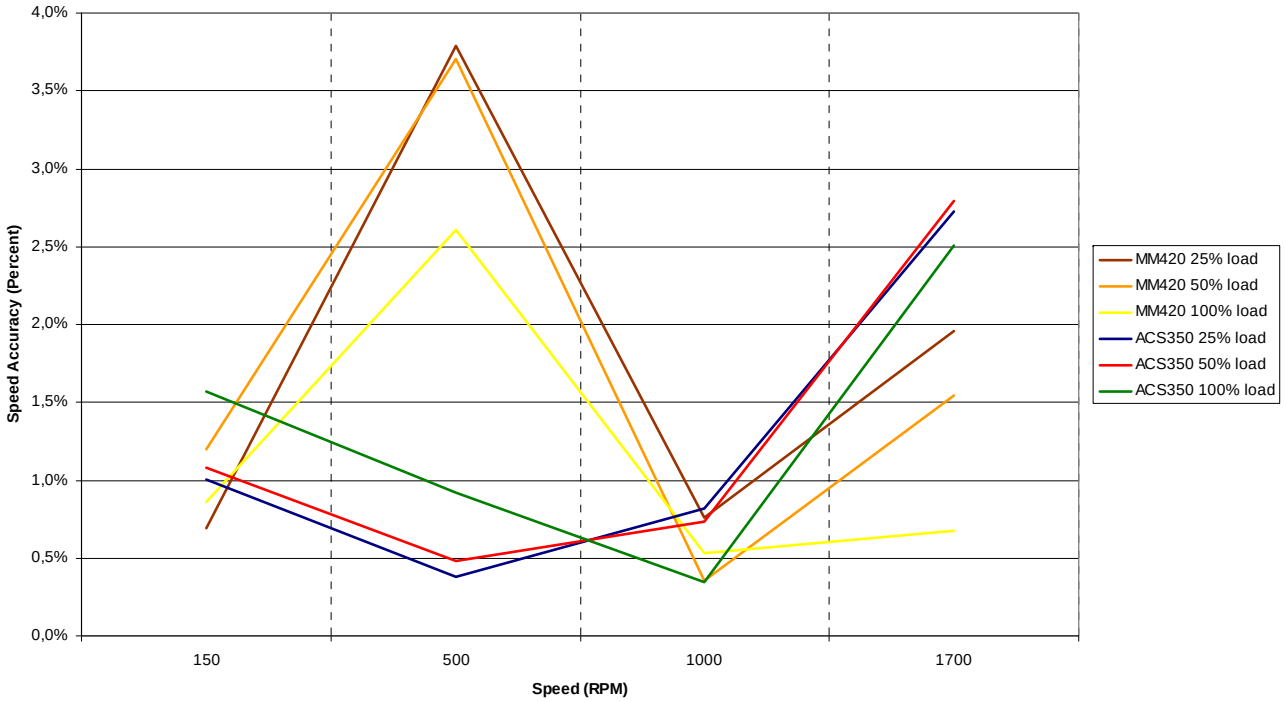
Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.



Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive works in case of disturbances. The ACS350 speed control default tuning is quite conservative to ensure that the controller is stable despite the motor used and its size compared to size of the inverter. The performance of the ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL). The dynamic speed accuracy of the MM420 can not be estimated because the drive was unstable during the test.

Static speed accuracy

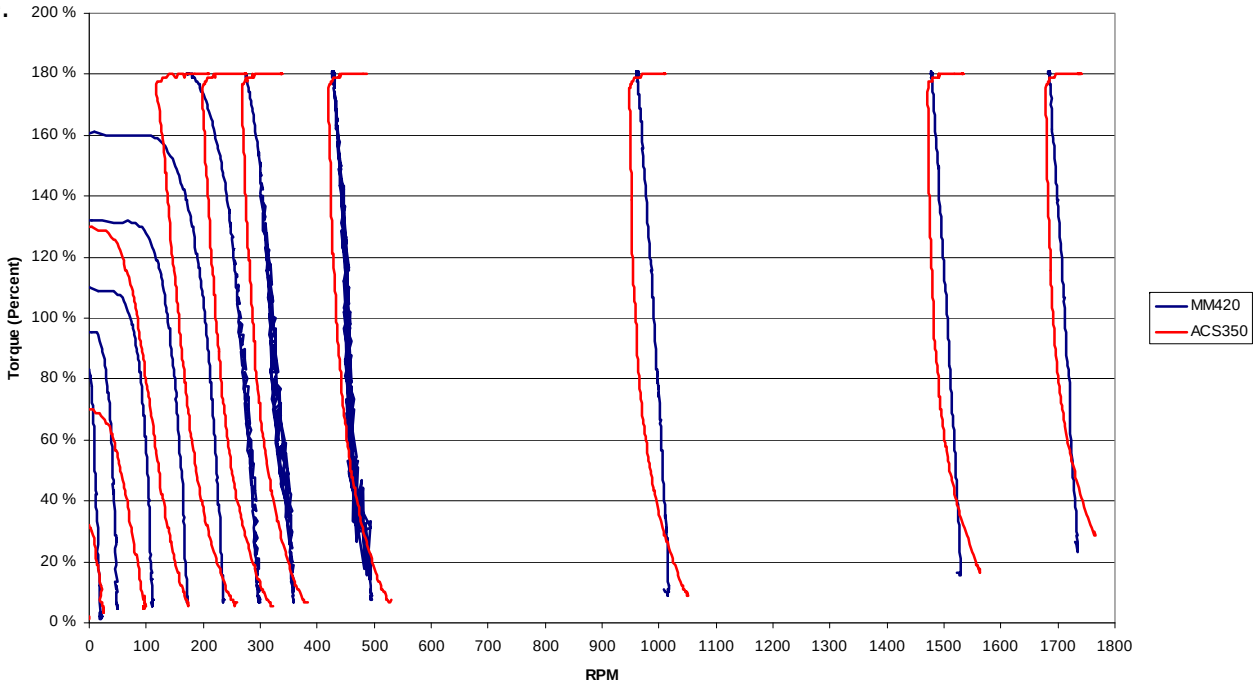
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 0%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), Speed Error [%] = $(n^*-n_{act}) / n_{N(mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Static speed error depends on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in application where good static accuracy is needed (e.g. extruders). ACS350 has good linearity in terms of load and speed. The maximum error and difference between test points were bigger in MM420.

Maximum torque as a function of speed

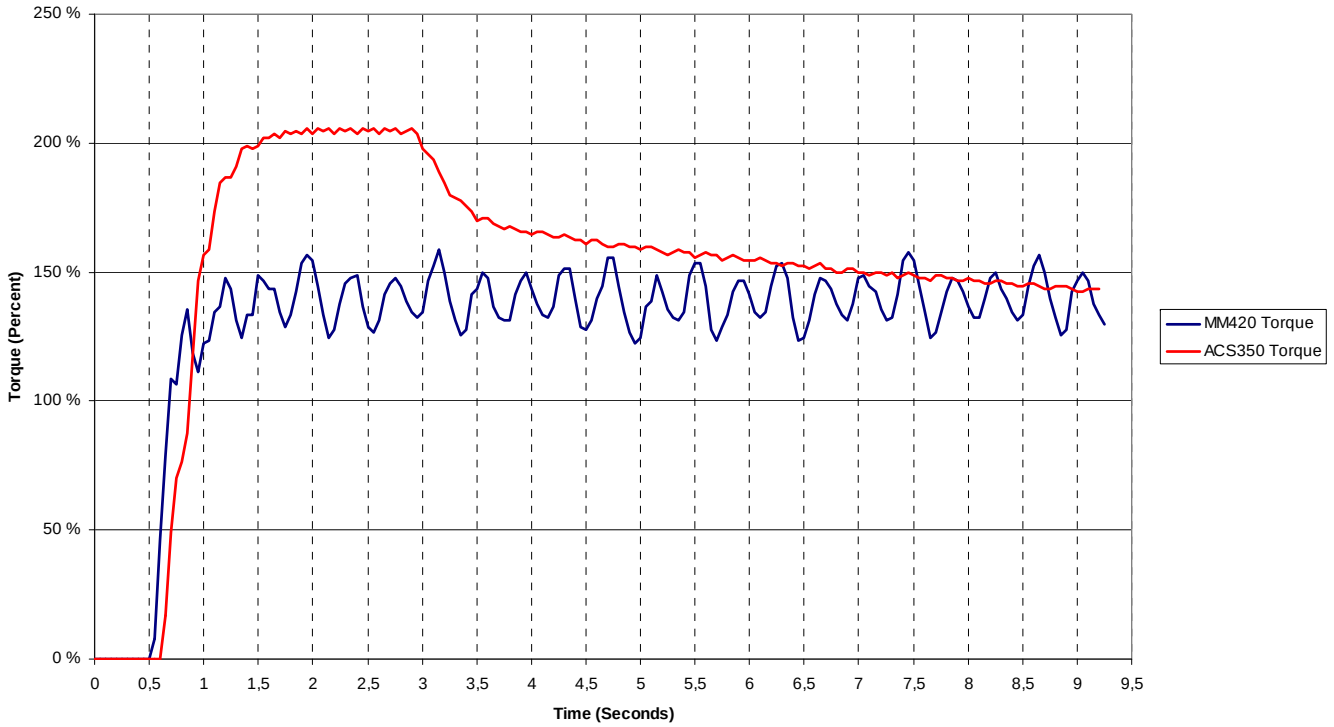
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The ACS350 has good speed range because it could provide full output torque from 1700 rpm's down to 180 rpm. The MM420 has good speed range as it could generate at least 100% torque down to low speed area. But at low speed area MM420 cannot maintain the torque for two seconds because the measured speed drops to zero due to limiting of current allowing the motor to stall. ACS350 can maintain the torque better and has thus better overload functionality. MM420 cannot fully compensate for slip and conservative speed regulator tuning can be seen also in ACS350 response.

Maximum starting torque

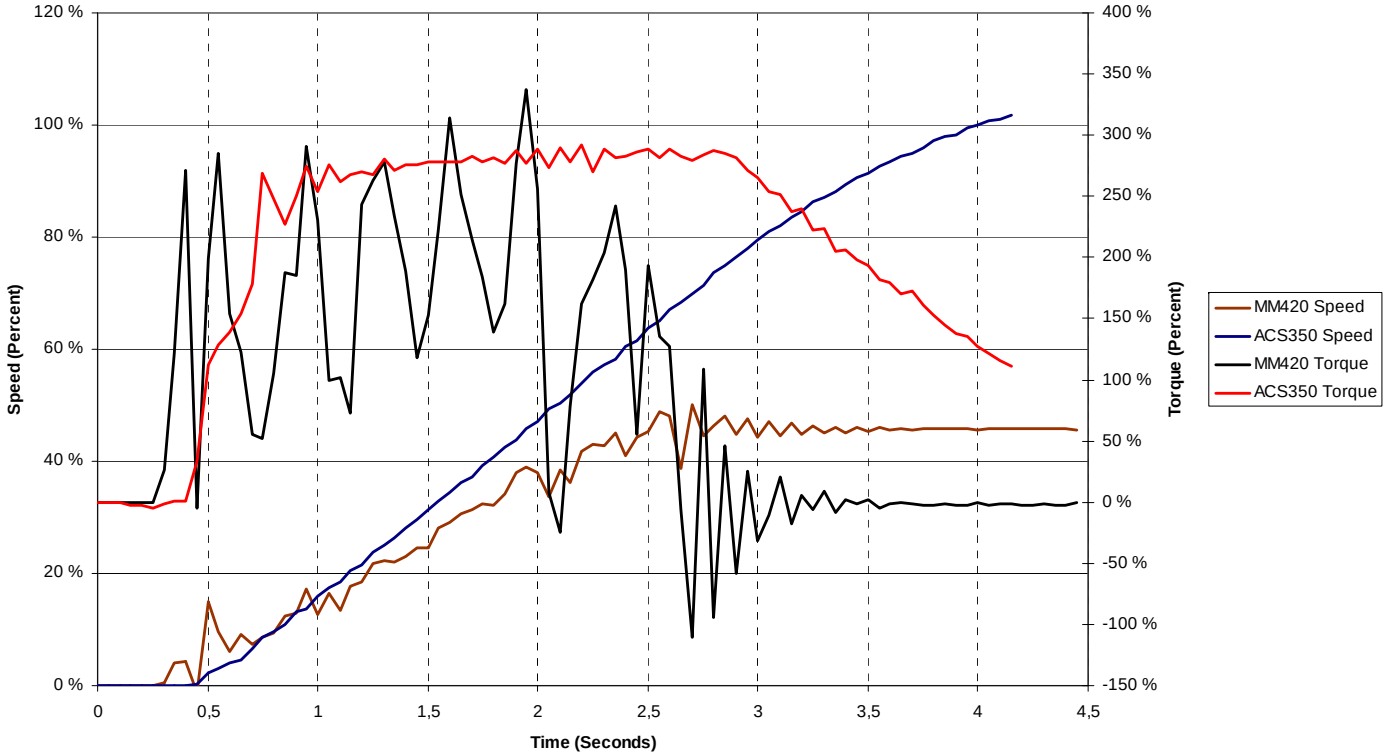
Motor output shaft is locked. Drive is given run command and 1000 rpm speed reference. Torque is measured with respect to time.



ACS350 has good starting torque up to 200%. MM420 can produce only 140%. Both drives also reach nominal torque within 1s. The ACS350 reduces torque to nominal value after 2 s due to current limiting. The MM420 has significant torque ripple possible due to its violent current controller. The ACS350 will work better in applications requiring high starting torque or high-inertia acceleration. The performance of MM420 is not satisfactory.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 (0.95 kgm^2) inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



The ACS350 accelerates the load in 4 seconds. The MM420 failed the test, because it was not able to provide enough current to accelerate the motor past a few hundred rpm. The ACS350 provides maximum starting torque for two seconds after which it decreases its output based on current limiting.

Efficiency

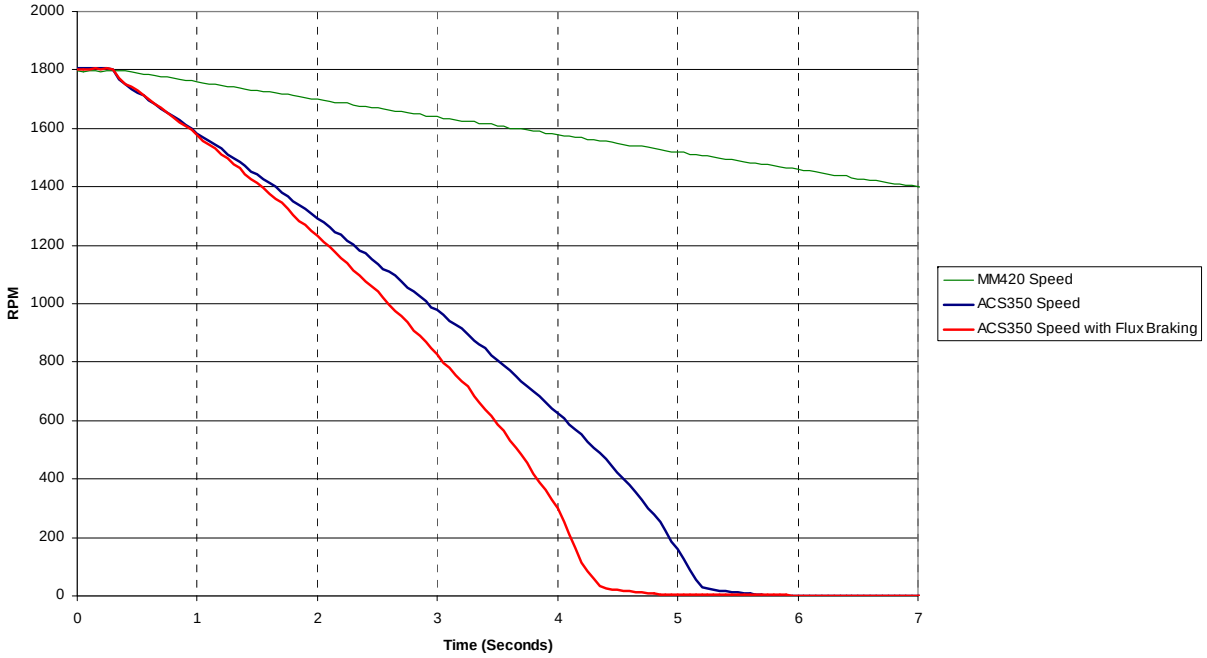
Using power analyzer, input power, speed and torque of AC motor are measured at 0, 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	MM420
25%	87.0%	86.2%
50%	89.3%	78.4%
75%	89.0%	89.9%
100%	88.4%	88.8%

The test is performed at rated speed with different loads. The ACS350 has much higher efficiency at 50% load but at other load points the efficiency of both drives is comparable.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



The ACS350 was able to decelerate the load to zero within 5 seconds. The ACS350, with flux braking, decreased the deceleration time even more. The MM420 failed the test because it tripped on “Overvoltage, DC bus too high, overcurrent and current limit.” The MM420 has some problems with its overvoltage controller because it is very sensitive to overvoltage conditions.

ABB strengths

ACS350 advantages over Micromaster 420

Wide power range	Application macros 7 pcs
NEMA 1 kit option	User macros 3 pcs
DIN rail mounting	17 languages
Sideways mounting	Comprehensive SW
Side by side mounting	FlashDrop
EN61000-3-2 with opt. chokes	Sequence programming
Bipolar AI	Maintenance need indication
Pulse train	Detailed fault history with time
Standard Modbus speed	

For ACS350 advantages in performance, see the performance test slides

ACS350 Competitor comparison



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW-08 | Mitsubishi E700

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

WEG CFW-08

- The WEG CFW-08 VSD series incorporate the most advanced technology and full features in a compact product, beyond a set of special functions available
- WEG CFW-08 VSDs are easy to install and operate and equipped with optimized software that can be easily set through a keypad
- Two versions available:
  - CFW-08: Standard features
  - CFW-08 Plus: Standard features, dead time compensation technique, analogue output, one additional AI, and one additional RO
- V/Hz and Sensorless vector control
- For power range 0.18 to 15 kW
- Main applications
  - Pumps, fans / blowers, conveyors, rollout tables, agitators, mixers

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

WEG CFW-08

- IP20 (standard)
- NEMA 1 (option)

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

WEG CFW-08

Vibration

- Avoid exposure to excessive vibration

Shock

- N/A

Temperature

- 0 ... 40 °C (up to 50 °C with output current derating 2% / °C)

Humidity

- 5 ... 90% non condensing

Altitude limitations

- 0 ... 1000 m (up tp 4000 m with output current derating 10% / 1000 m)

Acoustic noise

- IGBT Transistors – Frequencies : 2.5 / 5.0 / 10 / 15 kHz

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

WEG CFW-08

Voltage and power range

- 1-phase 200 - 240V: 200 / 220 / 230 / 240 V (+10%, -15%)
  - 0.18 to 2.2 kW (0.25 to 3 hp)
- 3-phase 200 - 240V: 200 / 220 / 230 / 240 V (+10%, -15%)
  - 0.25 to 9.5 kW (0.33 to 12.5 hp)
- 3-phase 380 - 480V: 380 / 400 / 415 / 440 / 460 / 480 V (+10%, -15%)
  - 0.18 to 15 kW (0.25 to 20 hp)
- 3-phase 500 - 600V (+10%, -15%)
  - 0.75 to7.5 kW (1 to 10 hp)

Power factor

- Displacement power factor > 0.98

Supply frequency

- 50 / 60 Hz +/- 2 Hz (48 ... 62 Hz)

Supply networks

- N/A

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB		ABB ACS350		CFW08		CFW08	ASC350
P_N	P_N	ACS350	CFW08	I_{2N}	I_{2N}	Rated Output Current		CFW08	
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-	CFW080	A	A	A	A	Frame	
kW	hp	01X-		U_N=200-240 V		U_N=200-240 V		names	Frame
0,12	0,16								
0,18	0,33		016S2024ESZ			1,6	1,3	1	
0,37	0,5	02A4-2	026S2024ESZ	2,4	2,2	2,6	2,1		R0
0,55	0,75								
0,75	1	04A7-2	040S2024ESZ	4,7	4,2	4,0	3,2	1	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	073B2024ESZ	7,5	6,8	7,3	5,8	2	R2
2,2	3	09A8-2	100B2024ESZ	9,8	8,8	10,0	8,0		

WEG CFW-08

Overload ratings

- Overload capacity 150% during 60 sec. every 10 min. (1.5 x rated current)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 200V

3-phase 200V		ABB		ABB ACS350		CFW08			
P_N	P_N	ACS350	CFW08	I_{2N}	I_{2N}	Rated Output Current		CFW08	ASC350
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-	CFW080	A	A	A	A	Frame	
kW	hp	03X-		U_N=206-240 V		U_N=200-240 V		names	Frame
0,12	0,16								
0,25	0,33		016B2024ESZ			1,6	1,3	1	
0,37	0,5	02A4-2	026B2024ESZ	2,4	2,2	1,6	1,3		R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2	040B2024ESZ	4,7	4,2	4,0	3,2	1	R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	073B2024ESZ	7,5	6,8	7,3	5,8	1	
2,2	3	09A8-2	100B2024ESZ	9,8	8,8	10,0	8,0	2	R2
3	4	13A3-2		13,3	12,0				
3,7	5	17A6-2	160T2024ESZ	17,6	15,8	16,0	12,8	2	
5,5	7,5	24A4-2	220T2024ESZ	24,4	22,0	22,0	17,6	3	R3
7,5	10	31A0-2	280T2024ESZ	31,0	27,9	28,0	22,4	4	R4
9,5	12,5	46A2-2	330T2024ESZ	46,2	41,6	33,0	26,4		

WEG CFW-08

Overload ratings

- Overload capacity 150% during 60 sec. every 10 min. (1.5 x rated current)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 400V

3-phase 400V		ABB		ABB ACS350		CFW08		CFW08	ASC350
P_N	P_N	ACS350	CFW08	I_{2N}	I_{2N}	Rated Output Current			
		Type	Type	40° C	50° C	40° C	50° C		
		ACS350-	CFW080	A	A	A	A	Frame	
kW	hp	03X-		U_N=380-480 V		U_N=380-480 V		names	Frame
0,18	0,25		010T3848ESZ			1,0	0,8		
0,25	0,33		010T3848ESZ			1,0	0,8		
0,37	0,5	01A2-4	016T3848ESZ	1,2	1,1	1,6	1,3	1	R0
0,55	0,75	01A9-4	016T3848ESZ	1,9	1,7	1,6	1,3		
0,75	1	02A4-4	026T3848ESZ	2,4	2,2	2,6	2,1		R1
1,1	1,5	03A3-4	027T3848ESZ	3,3	3,0	2,7	2,2	2	
1,5	2	04A1-4	043T3848ESZ	4,1	3,7	4,3	3,4		
2,2	3	05A6-4		5,6	5,0				
3	4	07A3-4	065T3848ESZ	7,3	6,6	6,5	5,2	2	
4	5	08A8-4		8,8	7,9				
4,5	6		100T3848ESZ			10,0	8,0	2	
5,5	7,5	12A5-4	130T3848ESZ	12,5	11,3	13,0	10,4	3	R3
7,5	10	15A6-4	160T3848ESZ	15,6	14,0	16,0	12,8		
11,3	15	23A1-4	240T3848ESZ	23,1	20,8	24,0	19,2	4	
15	20	31A0-4	300T3848ESZ	31	27,9	30,0	24,0		R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

WEG CFW-08

Overload ratings

- Overload capacity 150% during 60 sec. every 10 min. (1.5 x rated current)

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	CFW08	ABB ACS350			CFW08			CFW08	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-	CFW080	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	Frame	
kW	hp	01X-		W	H	D	W	H	D	names	Frame
0,12	0,16										
0,18	0,33		016S2024ESZ				75	151	131	1	
0,37	0,5	02A4-2	026S2024ESZ	70	169	161	75	151	131	1	R0
0,55	0,75										
0,75	1	04A7-2	040S2024ESZ	70	169	161	75	151	131	1	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	073B2024ESZ	105	169	165	115	200	150	2	R2
2,2	3	09A8-2	100B2024ESZ				115	200	150	2	

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	CFW08	ABB ACS350			CFW08			CFW08	ASC350
		Type	Type	1-phase			1-phase				
		ACS350-	CFW080	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	Frame	
kW	hp	01X-		area	volume	weight	area	volume	weight	names	Frame
0,12	0,16										
0,18	0,33		016S2024ESZ				113	1,5	1,0	1	
0,37	0,5	02A4-2	026S2024ESZ	118	1,9	1,2	113	1,5	1,0	1	R0
0,55	0,75										
0,75	1	04A7-2	040S2024ESZ	118	1,9	1,2	113	1,5	1,0	1	R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	073B2024ESZ	177	2,9	1,5	230	3,5	2,0	2	R2
2,2	3	09A8-2	100B2024ESZ				230	3,5	2,0	2	

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Yaskawa V7	ABB ACS350			CFW08			Yaskawa V7	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-	CFW080	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	Frame	
kW	hp	03X-		W	H	D	W	H	D	names	Frame
0,12	0,16										
0,25	0,33		016B2024ESZ				75	151	131	1	
0,37	0,5	02A4-2	026B2024ESZ								R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	040B2024ESZ	70		161	75	151	131	1	
1,1	1,5	06A7-2			169						R1
1,5	2	07A5-2	073B2024ESZ				75	151	131	1	
2,2	3	09A8-2	100B2024ESZ				115	200	150	2	
3	4	13A3-2		105		165					R2
3,7	5	17A6-2	160T2024ESZ				115	200	150	2	
5,5	7,5	24A4-2	220T2024ESZ	169	169	169	143	203	165	3	R3
7,5	10	31A0-2	280T2024ESZ	260	181	169	182	290	196	4	R4
9,5	12,5	46A2-2	330T2024ESZ								

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Yaskawa V7	ABB ACS350			CFW08			CFW08	ASC350
		Type	Type	3-phase			3-phase				
		ACS350-	CFW080	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	Frame	
kW	hp	03X-		area	volume	weight	area	volume	weight	names	Frame
0,12	0,16										
0,25	0,33		016B2024ESZ				113	1,5	1,0	1	
0,37	0,5	02A4-2	026B2024ESZ			1,2					R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	040B2024ESZ	118	1,9		113	1,5	1,0	1	
1,1	1,5	06A7-2				1,2					R1
1,5	2	07A5-2	073B2024ESZ				113	1,5	1,0	1	
2,2	3	09A8-2	100B2024ESZ				230	3,5	2,0	2	
3	4	13A3-2		177	2,9	1,5					R2
3,7	5	17A6-2	160T2024ESZ				230	3,5	2,0	2	
5,5	7,5	24A4-2	220T2024ESZ	286	4,8	2,5	290	4,8	2,5	3	R3
7,5	10	31A0-2	280T2024ESZ	471	8,0	4,4	528	10,3	6,0	4	R4
9,5	12,5	46A2-2	330T2024ESZ								

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	CFW08	ABB ACS350			CFW08			CFW08	ASC350
		Type	Type								
		ACS350-	CFW080	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	Frame	
kW	hp	03X-		W	H	D	W	H	D	names	Frame
0,18	0,25		010T3848ESZ								
0,25	0,33		010T3848ESZ								
0,37	0,5	01A2-4	016T3848ESZ				75	151	131	1	R0
0,55	0,75	01A9-4	016T3848ESZ								
0,75	1	02A4-4	026T3848ESZ								
1,1	1,5	03A3-4	027T3848ESZ	70		161	115	200	150	2	R1
1,5	2	04A1-4	043T3848ESZ								
2,2	3	05A6-4			169						
3	4	07A3-4	065T3848ESZ				115	200	150	2	
4	5	08A8-4									
4,5	6		100T3848ESZ				115	200	150	2	
5,5	7,5	12A5-4	130T3848ESZ				143	203	165	3	R3
7,5	10	15A6-4	160T3848ESZ	169		169					
11,3	15	23A1-4	240T3848ESZ				182	290	196	4	
15	20	31A0-4	300T3848ESZ								R4
18,5	25	38A0-4		260	181	169					
22	30	44A0-4									

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW-08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	CFW08	ABB ACS350			CFW08			CFW08	ASC350
		Type	Type								
		ACS350-	CFW080	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)	Frame	
kW	hp	03X-		area	volume	weight	area	volume	weight	names	Frame
0,18	0,25		010T3848ESZ				113	1,5	1,0	1	
0,25	0,33		010T3848ESZ								
0,37	0,5	01A2-4	016T3848ESZ	118	1,9	1,2					R0
0,55	0,75	01A9-4	016T3848ESZ								
0,75	1	02A4-4	026T3848ESZ								R1
1,1	1,5	03A3-4	027T3848ESZ			1,2	230	3,5	2,0	2	
1,5	2	04A1-4	043T3848ESZ								
2,2	3	05A6-4					230	3,5	2,0	2	
3	4	07A3-4	065T3848ESZ								
4	5	08A8-4									
4,5	6		100T3848ESZ				230	3,5	2,0	2	
5,5	7,5	12A5-4	130T3848ESZ	285	4,8	2,5	290	4,8	2,5	3	R3
7,5	10	15A6-4	160T3848ESZ								
11,3	15	23A1-4	240T3848ESZ				528	10,3	6,0	4	
15	20	31A0-4	300T3848ESZ	471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

Installation

WEG CFW-08

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Option (only frame 1)
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	No

Free space requirements

Location	*mm*
Above	30[1)], 35[2)], 40[3)], 50[4)]
Below	5[1)], 15[2)], 30[3)], 40[4)]
Left and right	50[1-3)],60[4)]

[1)] 1,6-7 A / 200-240 V, 1-4A / 380-480 V

[2)] 7,3-16 S / 200-240 V, 2,7-10 A / 380-480 V

[3)] 22 A / 200-240 V, 13-16 A / 380-480 V

[4)] 28-33 A / 200-240 V, 24-30 A / 380-480 V

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

WEG CFW-08

- Filters
  - EMC Filter with high Attenuation Capacity - Class A - internal
  - EMC Filter with high Attenuation Capacity - Class B - external
- Chokes
  - CM choke option
- EMC compliant motor cable lengths

Model	Length	EMC category
CFW080027T3848-CFW080160T3848	5 m	A2
CFW080016S2024-CFW080100B2024	10 m	A2
CFW080010T3848-CFW080040T3848	10 m	A2
CFW080027T3848-CFW080160T3848	10 m	A1
CFW080016S2024-CFW080160T2024	20 m	A1
CFW080010T3848-CFW080043T3848	20 m	A1
CFW08024T3848-CFW080300T3848	20 m	A2
CFW080240T3848-CFW08300T3848	100 m	A2

- THD
  - N/A

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 1))	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 1))	-	30 m (100 ft)

1) Categories according to IEC/EN 61800-3

- THD
  - EN61000-3-2 with optional chokes

User interface

WEG CFW-08

- Standard Model 7-segmement LED HMI-CFW08-P (Human Machine Interface)
  - Commands
    - On/Off , Parameter Setting (Programming of special functions)
    - Frequency Increment / Decrement (Speed)
    - JOG, Reversal of Direction of Rotation and Local /Remote Selection
  - Monitoring (Reading): Motor Output Frequency (Hz), DC Link Voltage (V), Value proportional to the frequency (Ex.:RPM), Heat Sink Temperature, Motor Output Current (A), Motor Output Voltage (V), Error / Fault Messages, Load Torque
- Optional model without keypad (with dummy cover / blanck keypad)
- Optional remote keypad with copy function

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Mitsubishi E700
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Machine interface (I/O)

WEG CFW-08

Type	*Qty.*	*Programmable*
Digital inputs	4	Yes
Analog inputs	1 (Plus version 2)	Yes
Pulse train input	-	-
Relay outputs	1 (Plus version 2)	Yes
Transistor outputs	-	-
Analog outputs	(Plus version 1)	Yes

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

WEG CFW08

Fieldbus protocol	*Standard/ Optional*	*Baud rate*	*Notes*
RS-232	Option		KCS-CFW08
RS-485	Option		KRS-485-CFW08
Modbus RTU	“Standard”		Requires KCS-CFW08 or KRS-485-CFW08 serial interface
ProfiBus DP	Option		KCS-CFW08 or KRS-485-CFW08 and MFM-01/PD
DeviceNet	“Standard”		Requires A4 control card and Device-Net interface (KFB-DN-CFW08)
CANopen	“Standard”		Requires A3 control card and CANopen interface (KFB-CO-CFW08)

ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

100% Phd braking for all units
500 Hz max. output frequency

Motor control

WEG CFW-08

- Scalar control V/Hz (linear or quadratic)
- Sensorless vector control VVC Voltage Vector Control (comment: no possibility for encoder feedback)

Braking

- DC braking (DC Current) option
- Dynamic braking
- Connection for the braking resistor (not available on the models 1,6A-2,6A-4,0A-7,0A/200-240V and on the models 1,0A-1,6A-2,6A-4,0A/380-480V)

Output frequency

- 0 ... 300 Hz

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Macros and language versions

Application macros 7pcs
User macros 3 pcs
17 languages

WEG CFW-08

- Macros
  - Not available
- Languages
  - Not available

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

WEG CFW-08

- Enabling password programmable *(
- Fault self-diagnosis and Auto-Reset *(
- Specific value indication (programmable) *(
- Slip compensation *(
- Manual and automatic I x R *(
- Programmable V/Hz Curve *(
- JOG Function (transitory speed pulses)
- COPY Function via remote keypad (HMI-CFW08-S) *(
- Linear and 'S'type ramp and double ramp *(
- Acceleration and deceleration ramps (independent) *(
- DC braking (DC Current) *(
- Multi-Speed Function (up to 8 pre-programmable speeds)
- FWD/REV and Local/Remote Operation selection *(
- PID Regulator (automatic level, pressure control, etc.) *(
- Starting with running motor (Flying Start) *(
- Rejection of critical or resonant frequencies (Skip Frequency) *(
- Operation during transitory line faults (Ridethru) *(
- Multipump control of max. 4 pumps, operation time considered LISÄTTY, , onko ACS350:ssä?
- Dead time compensation technique in CFW-08 Plus: Avoiding motor instability and providing increase of torque at low speeds LISÄTTY, onko ACS350:ssä?

*(= Basic feature in ABB ACS350

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

WEG CFW-08

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

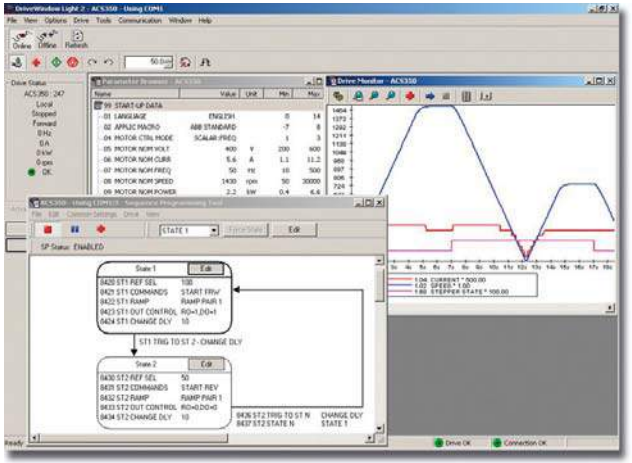
Other advanced features (cont)

WEG CFW-08

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



Mitsubishi E700
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PC connectivity and tools

WEG CFW-08

- Access through RS 232 or RS 485 communication, requires optional kit
- Programming Software via PC – SUPERDRIVE
  - Windows based software program that follows serial (RS 232 or RS 485) communication between a PC and all WEG Soft Starters and Variable (requires SUPERDRIVE Kit KSD-CFW08)
  - Frequency Drives (VFD)
  - For programming, documentation, and troubleshooting
  - Available for free download at www.weg.net

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

WEG CFW-08

- Several keypad options
- Several cable options for remote keypad
- RS-232 or RS-485 Serial Interfaces
- Fieldbuses*
- Interface for 120V digital input
- Interface for 120V digital input + Kit NEMA 1 or NEMA 2
- DIN rail mounting through 2HP
- Mounting options Fix-Kit M1 or M2 up to 7.5 kW
- NEMA1 kit
- EMC filters
- Chokes

*Requires optional RS-232 or RS-485 Interface

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

WEG CFW-08

- To avoid operation problems caused by harsh ambient conditions, such as high temperature, moisture, dirt, vibration or premature ageing of the components, periodic inspections of the inverter and installations are recommended
- It is recommended to replace the blowers after 40,000 hours of operation
- Cleaning instructions
  - Cooling system
  - Electronic boards

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Standards

WEG CFW-08

Approvals

- UL, cUL, CE, IRAM (ARGENTINA), C-Tick

Compliance with

- EMC Directive (89/336/EEC) as defined by the EMCProduct Standard for Adjustable Speed Electrical Power Drive Systems EN61800-3
- LVD 73/23/EEC - Low Voltage Directive / UL 508C

Applicable standards

- EN 61800-3 - EMC product standard for power drive system
- Industrial Environment
- IEC 146 – Semiconductors Inverters
- UL 508 C - Power conversion equipment
- EN 50178 - Electronic equipment for use in power installations
- EN 61010 – Safety requirements for electrical equipment for measurement, control and laboratory use

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

Performance analysis – Autodyne description

Test stand is used to characterize 2.2kW (3hp) heavy duty rated LVAC drives and allow ABB to compare accurate repeatable data against ABB's baseline products (ACS150, ACS350, ACS550, ACH550 and ACS800). The mechanical portion of the dynamometer consists of a 4kW (5hp) 1765 rpm 480VAC or 2,2 kW (3hp) 1755 rpm 460VAC vector duty motor with encoder (spinner motor) which is connected to the output of the drive under test (DUT). The spinner motor is connected through a in-line torque transducer to a 7.5 kW (10hp) 1750 rpm DC motor with encoder. Actual torque and speed information is fed to the dynamometer controller which is run by a desktop computer using a Windows™ based proprietary software program controlling electrical power supplied to the DUT and from the DUT to the spinner motor.

Essentially, tests are conducted "out of the box". However, an ID run and a speed regulator autotune are performed, if the drive is so equipped. All drives are tested in sensorless vector mode of operation.

Tested units in performance analysis

WEG CFW-08

Model: CFW080 065T3848EON1A1Z

Drive rating: 380-480V
2.2 kW / 3.0 HP
6.5 A

Tester (experienced drive specialist) comments:

- The hooded power and control terminals require you to virtually wire the drive with it upside down to ensure the wires go into the correct position.
- Two brass ferrules on the face of the drive near the bottom look like some kind of cover would be attached but nothing was provided nor mentioned in the User Manual.
- The Operator Panel plugs into the face of the drive and uses four 7-segment LED's, UP/Down arrow, Start/Stop, Prog, Jog, Fwd/Rev and Loc/Rem keys. Operation was fairly intuitive but the Prog key didn't always work requiring several attempts to enter a parameter change.
- No +24Vdc power supply for sourcing DI's. Requires an external power supply.
- The mounting holes were very small and would be difficult to use to install the drive.
- The default min frequency is 3 Hz.
- Parameter scrolling is tedious since the display is to the hundredths place .xx and does not speed up nor move the cursor to the tens or hundreds position.
- While programming the drive when you change P202 for Sensorless Vector Control it leapfrogs you to the motor parameters. This is not mentioned in the User Manual. After entering the motor data and running the ID run you can then scroll back to the other lower level parameters.
- Proper motor setup requires entering motor efficiency and power factor.
- Motor ID run is static only.
- The drive powers up with all parameters in "read only". You must set a parameter to permit adjustment. Cycling power resets this parameter requiring you to re-enter the value to permit parameter adjustment.
- DI4 is the default start/stop but the drive would not accept the +24Vdc start command. Reprogramming start/stop to DI1 and changing DI4 to not used permitted the drive to operate.
- The drive faulted on E00 Overcurrent during the Fast Accel Into Load test. It also faulted with E01 DC Link Overvoltage during the Impact Load test. It faulted on E00 during the Maximum Torque Test, E01 during the Overvoltage Control test and E00 during the Harmonic Distortion test.

ABB ACS350

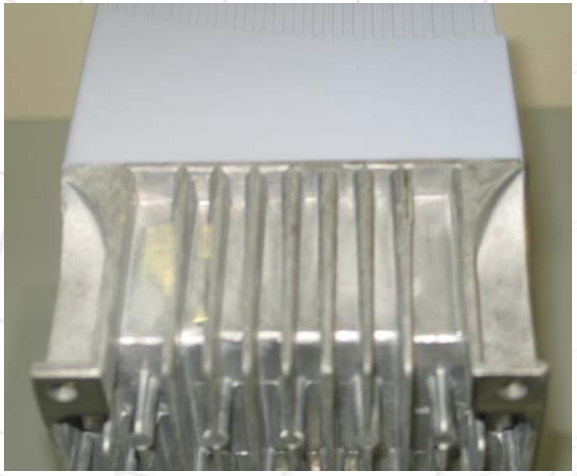
Model: ACS350-03U-05A6-4

Drive rating: 380-480V
2.2 kW / 3.0 HP
5.6 A

Parameter Settings:

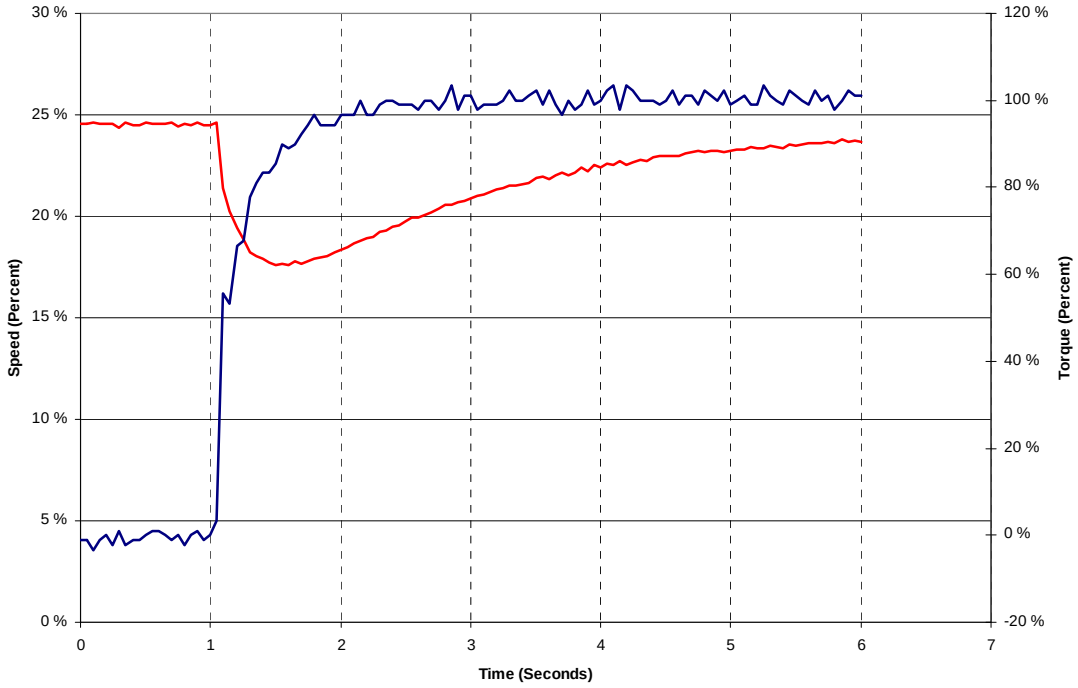
9902 Torque Control
9904 Vector:Speed
9905 460 V
9906 4.4 A
9907 60 Hz
9908 1755 RPM
9909 3.0 HP
9910 1 (on) then 0
2101 Auto
2201 Not Selected
2202 1.0 Second
2203 1.0 Second
2301 7.67
2302 1.5 Second

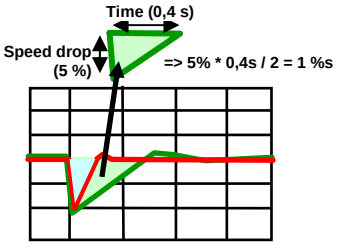
Photos of the tested unit



Impact load test – Dynamic speed accuracy (stiffness)

Motor is operated at 25% rated speed and 100% load is applied. Speed and torque are measured over time. Dynamic speed error (stiffness) is speed drop (% of nominal speed) times time of recovery (s) divided by 2. The 25% speed reference data is plotted as this is worst case test for the speed regulator evaluation.





Dynamic speed error depends on speed controller tuning. The smaller the stiffness %s figure the better the drive operates in case of disturbances. The ACS350's speed control default tuning is quite conservative to ensure the controller is stable despite the motor used and its size compared to the size of the inverter. The performance of ACS350 can be improved substantially by tuning the speed controller (parameter group 23 SPEED CONTROL). CFW08 failed the test due to trip on "E01 DC Link Overvoltage".

Mitsubishi E700

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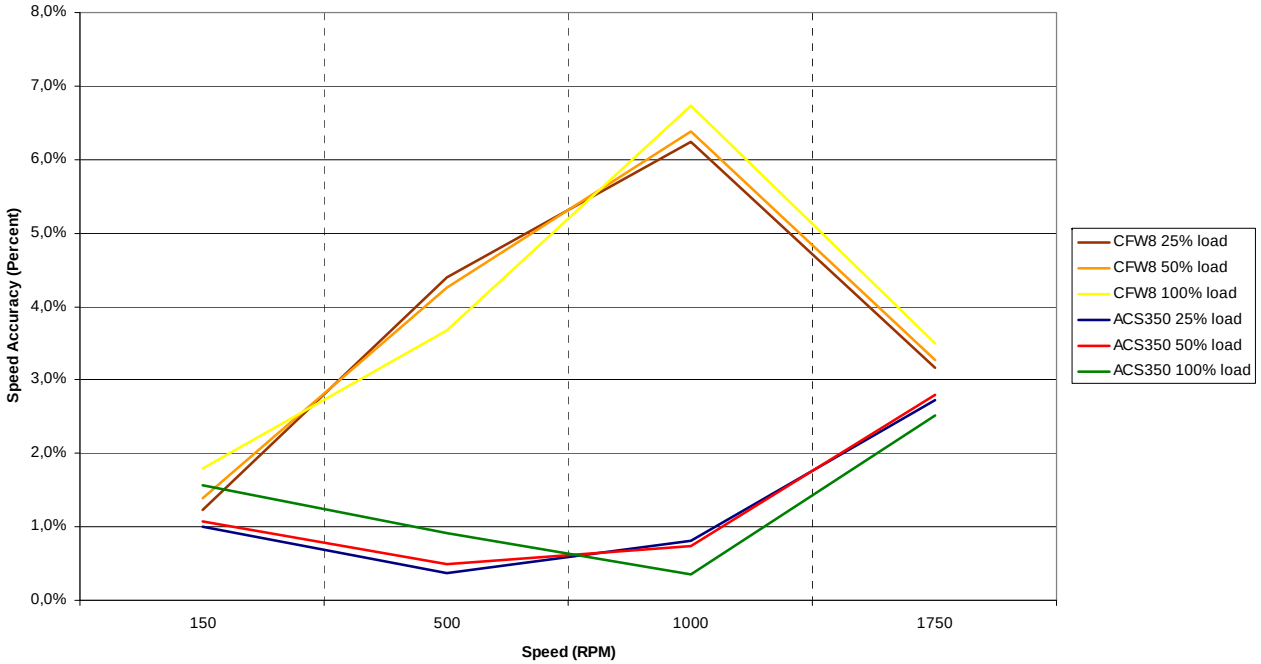
Static speed accuracy

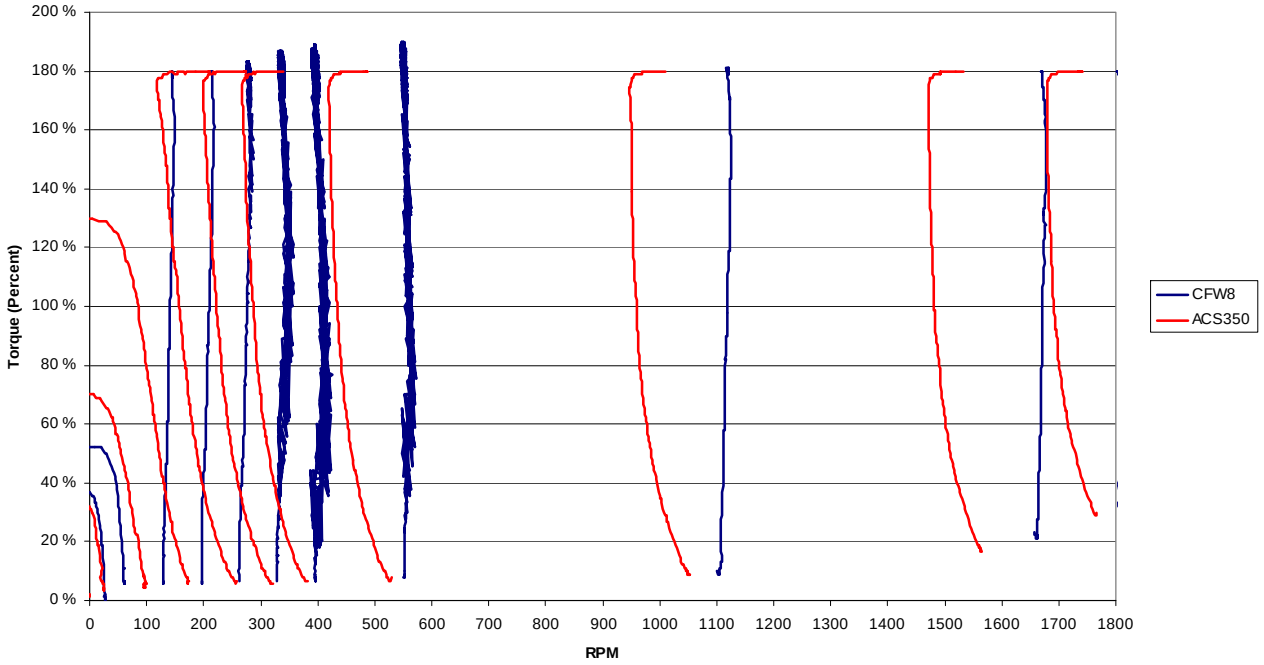
Drive is given speed references of 150, 500, 1000 and 1700 rpms and loads of 25%, 50% and 100%. The speed error in static situation (constant load and speed) is calculated as a ratio of the average speed error compared to motor nominal speed (1765 rpm), Speed Error [%] = $(n^*-n_{act}) / n_{N/mot)}$. Speed (control) accuracy is essential feature for high quality motor control.



Static speed error depends on the accuracy and quality of measurements (voltage, current, speed estimation). The smaller the error figure and difference between figures at partial and full load points, the better the drive works in application where good static accuracy is needed (e.g. extruders). ACS350 has good linearity in terms of load and speed. The maximum error and difference between test points were bigger in CFW08.

Maximum torque as a function of speed

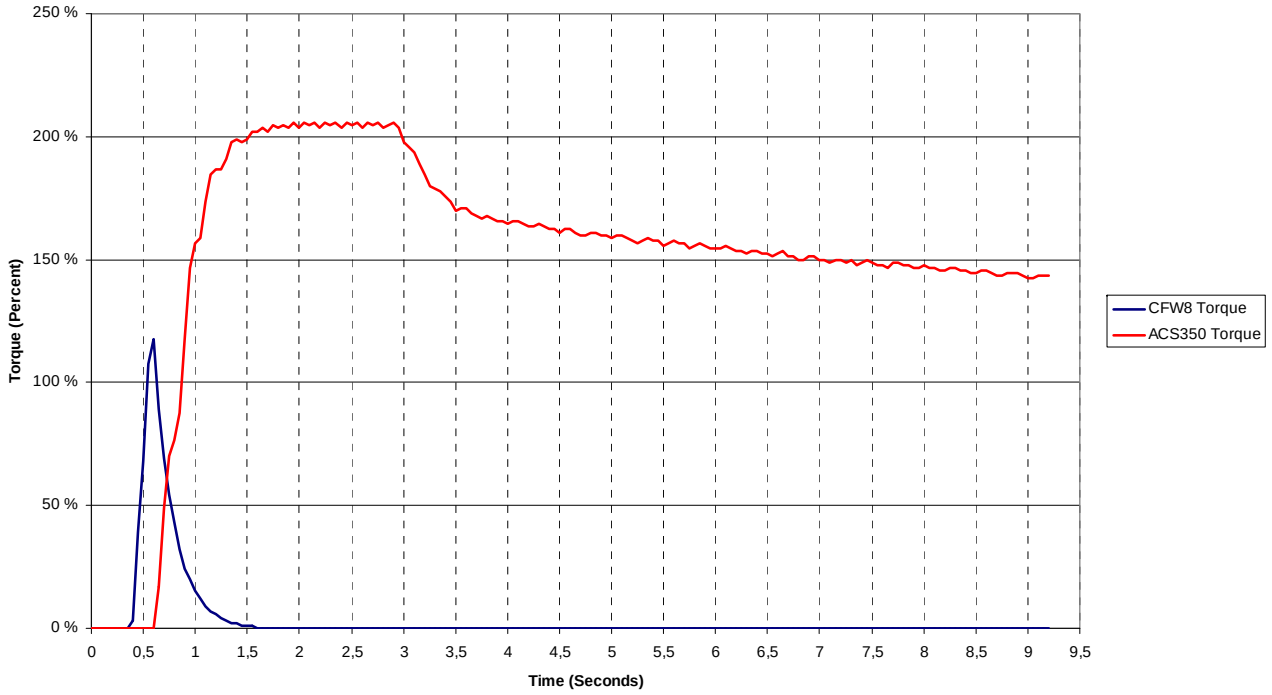
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



The ACS350 has good speed range because it could provide at least full output torque from 1700 rpm's down to 180 rpm. The CFW08 has good speed range as it could generate at least 180% torque down to low speed area. CFW08 overcompensates for slip. Quite conservative speed regulator tuning of ACS350 can be seen in ACS350 response as a slight drop in speed.

Maximum starting torque

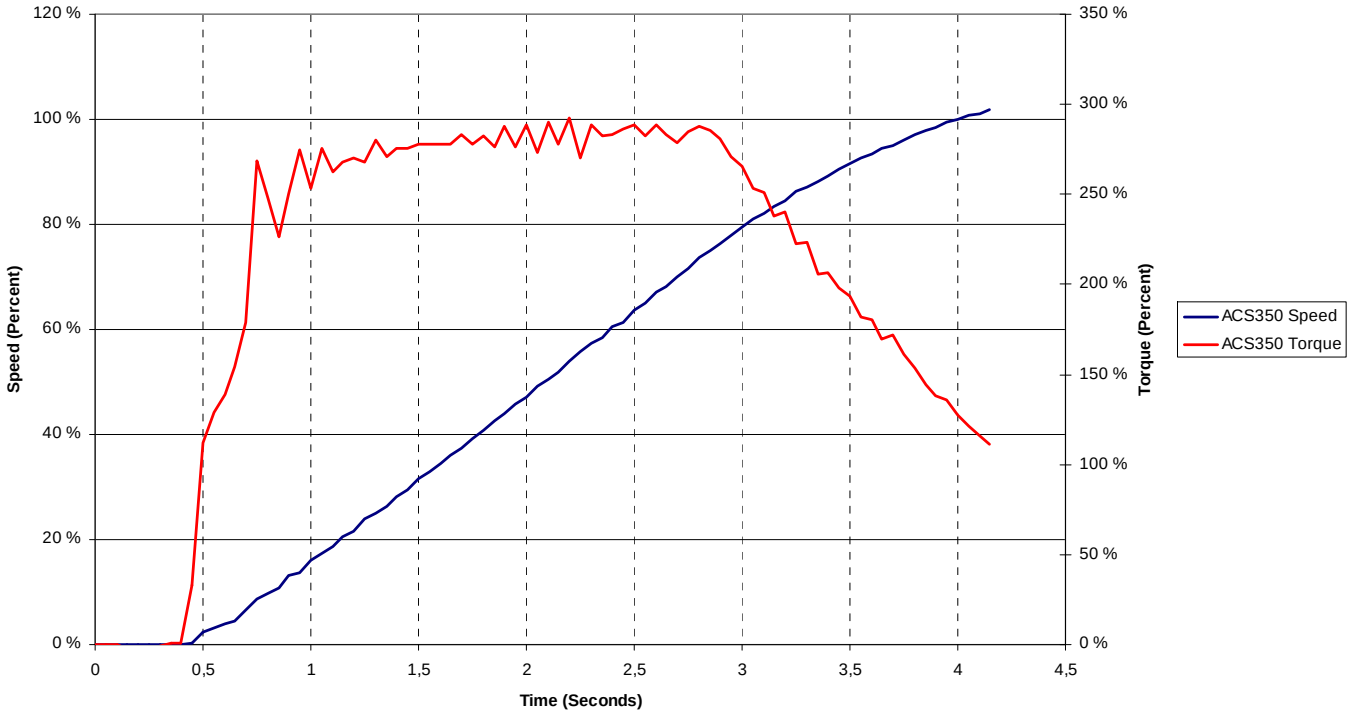
Drive is given speed reference of 30, 60, 120, 180, 240, 300, 360, 500, 1000, 1500 and 1700 rpm's. Load is gradually increased to 180% for 2 seconds, or until the motor stalls. The test describes the drive's speed range. The speed range is defined as the minimum speed the motor can operate from a given base speed and still generate 100% torque.



CFW08 failed the test because it faulted on "E00" during the test. The behavior of the CFW08 can cause significant problems in applications requiring high starting duty or high-inertia acceleration. ACS350 has good starting torque up to 200%.

Fast acceleration into inertia

Drive is given run command and zero speed reference. Dynamometer inertia simulation program places 22.5 lb-ft^2 (0.95 kgm^2) inertia on motor shaft and then drive is given 100% speed reference. Speed and torque are measured over time as drive accelerates motor into inertia. Drive acceleration rate is set to 1 second.



CFW08 failed test because it tripped on ”E00 Overcurrent” during the test.

Efficiency

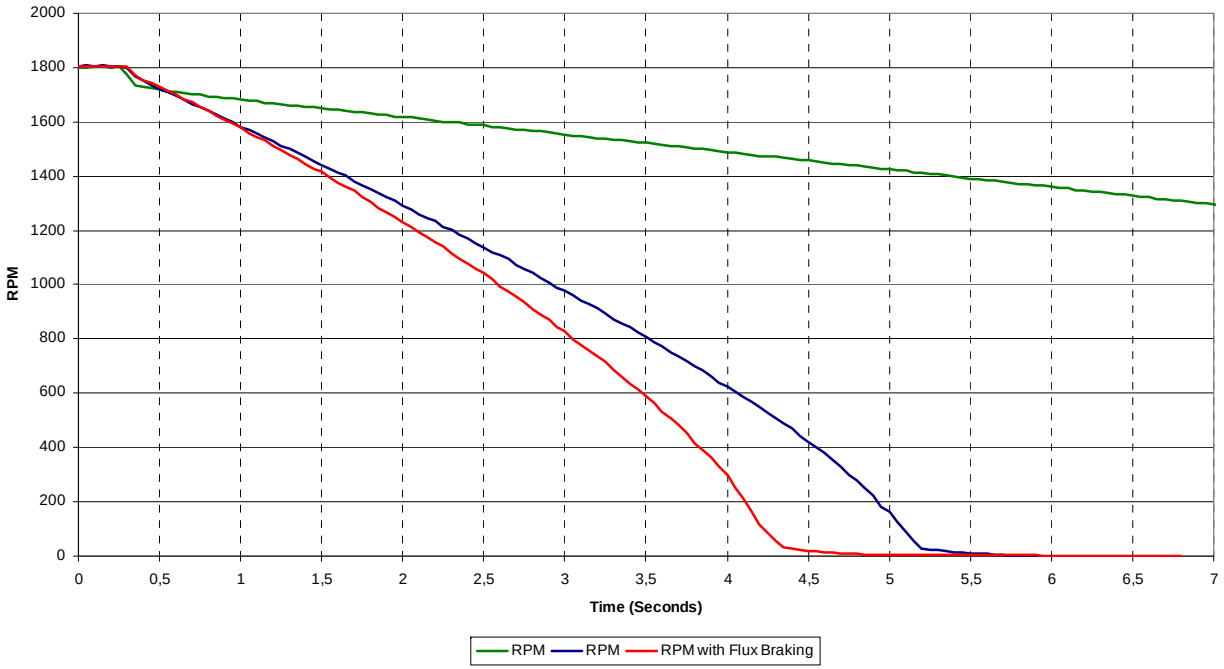
Using power analyzer, input power, speed and torque of AC motor are measured at 25%, 50%, 75% and 100% rated motor load. Since the comparison is made by using the same motor at the same operation point the figures reflect the efficiency of the inverter and the additional losses caused in the motor due to the inverter operation. The difference in total efficiency may be remarkable in total energy consumption.

Load (Percent)	Efficiency	
	ACS350	CFW08
25%	87.0%	81.5%
50%	89.3%	88.5%
75%	89.0%	89.0%
100%	88.4%	88.0%

The test is performed at rated speed with different loads. ACS350 has higher efficiency at 25% and 50% load point but at other load points the efficiencies of both drives were comparable.

Overvoltage control

With DUT operating at nominal line voltage and 100% rated speed, the run command will be removed from DUT. Time from the run command being removed until AC motor speed reaches 0 will be measured and recorded. DUT deceleration time will be set to 1 sec. The test measures the ability of drives to decelerate the load with and without flux braking (raising the magnetization level in the motor to convert kinetic energy to motor thermal energy). The shorter the time, the better the overvoltage controller (and flux braking algorithms) of a drive works.



ACS350 was able to decelerate to zero within 5,5 seconds. ACS350 with flux braking shortened the deceleration time even more. CFW08 failed the test due to trip on “E01 DC Link Overvoltage”.

ABB strenghts

ACS350 advantages over WEG CFW-08

Wide power range	500 Hz max. output frequency
l2hd 50°C ratings of units	Application macros 7 pcs
Side by side mounting	User macros 3 pcs
EN61000-3-2 with opt. chokes	17 languages
2 control panel options	Cold configuration with FlashDrop
Panel cover	Sequence programming
Bipolar AI	Versatile options
Pulse train	Maintenance need indication
Modbus as standard	Detailed fault history with time
100% Phd braking for all units	

ACS350 Competitor comparison



















Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08 | **Mitsubishi E700**

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Summary Slide

Description

Mitsubishi E700

- Top Level driving performance frequency inverter
- Extra High torque in the low speed range is possible
- Compact design expands flexibility of enclosure
- Advanced Auto and High Precision Tuning
- Compliance to RoHS (Restriction of hazardous substance) directive
- Long Design Life of 10 years for cooling fans, capacitors
- Integrated brake transistor
- Supports various communication networks
- Typical applications:
  - High Torque Conveyor belts, baggage handling, crane, hoisting gear, stages, pumps, fans, etc.

ABB ACS350

- ACS350 is a general machinery drive for the serial OEM business in a wide range of machinery applications
- Vector control
- For power range 0.37 to 22 kW
- Advanced functionality with sequence programming
- Unpowered drive configuration in 2 s
- Straightforward installation and integration
- Fast availability and service
- Industries
  - Food and beverage, material handling, textile, printing, rubber and plastic, woodworking

Protection class

Mitsubishi E700

- Enclosed-type structure IP20
- Totally enclosed structure IP40

ABB ACS350

- IP20 UL open (standard)
- NEMA 1 (option)
  - For finger protection
  - For conduit tube installation
  - For protection against dirt and dust

Ambient specification

Mitsubishi E700

Vibration

- 5.9m/s 2 or less

Shock

- conforming to

Temperature

- Ambient temperature -10°C to +50°C (non-freezing)
- -10°C to +40°C for totally-enclosed structure feature
- Storage temperature -20°C to +65°C

Humidity

- 90%RH maximum (non-condensing)

Altitude limitations

- Maximum 1000m above sea level

Acoustic noise

- 2kHz or more to perform low acoustic noise operation with the ambient temperature exceeding 40°C

ABB ACS350

Vibration

- Compliance with IEC 60721-3-3 (operation) and ISTA 1A (storage and transportation)

Shock

- Mechanical shocks are not allowed for the drive during operation
- Bump according to IEC 60068-2-29, 25g/1000pcs

Temperature

- Operating temperature -10 to +40 °C
- +50 °C max. of 10% current derating
- Storage temperature – 40 °C to +70 °C

Humidity

- Lower than 95% (non-condensing)

Altitude limitations

- 1000 m or less. Higher by derating 1% per 100 m over 1000 to 2000 m

Acoustic noise

- 4…16 kHz

Mains connections

Mitsubishi E700

Voltage types and power range

- 1 Ph 230V
  - 0.1 to 2.2kW (FR-E720S)
- 3 Ph 415V
  - 0.4 to 15.0kW (FR-E740)
- 3 Ph 230V
  - 0.1 to 15.0kW (FR-E720)
- 1 Ph 100V
  - 0.1 to 0.75kW (FR-E710W)

Power factor

- Power factor improving effect
  - FR-BEL approx.95%
  - FR-HEL approx.93%

Supply frequency

- 50/60 Hz, ±5%

Supply networks

- Data N/A

ABB ACS350

Voltage and power range

- 1-phase 200 - 240V +/-10%
  - 0.37 to 2.2 kW (0.5 to 3 hp)
- 3-phase 200 - 240V +/-10%
  - 0.37 to 15 kW (0.5 to 20 hp)
- 3-phase 380 - 480V +/-10%
  - 0.37 to 22 kW (0.5 to 30 hp)

Power factor

- Displacement power factor 0.98

Supply frequency

- 50/60Hz, ±5%

Supply networks

- Suitable for IT network. Drive operation in floating (IT) networks possible by disconnecting EMC filter

Ratings 1-phase 200V

1-phase 200V		ABB	Mitsubishi	ABB ACS350		Mitsubishi E700		Mitsubishi	ASC350
P_N	P_N	ACS350	E700	I_{2N}	I_{2N}	I_{INV}	I_{INV}	E700	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-		A	A	A	A	names	
kW	hp	01X-		U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	02A4-2		2,4	2,2				R0
0,55	0,75								
0,75	1	04A7-2		4,7	4,2				R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2		7,5	6,8				R2
2,2	3	09A8-2		9,8	8,8				

Mitsubishi E700

Overload ratings

- 150% 60s
- 200% 3s

Note: Mitsubishi E700 specifications not found

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 200V

3-phase 200V		ABB	Mitsubishi	ABB ACS350		Mitsubishi E700		Mitsubishi	
P_N	P_N	ACS350	E700	I_{2N}	I_{2N}	I_{INV}	I_{INV}	E700	ASC350
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	FR-E720-	A	A	A	A	names	
kW	hp	03X-		U_N=200-240 V		U_N=200-240 V		N/A	Frame
0,12	0,16		0.1K			0,8	0,8		
0,2	0,25		0.2K			1,5	1,5		
0,4	0,5	02A4-2	0.4K	2,4	2,2	3,0	3,0		R0
0,55	0,75	03A5-2		3,5	3,2				
0,75	1	04A7-2	0.75K	4,7	4,2	5,0	5,0		R1
1,1	1,5	06A7-2		6,7	6,0				
1,5	2	07A5-2	1.5K	7,5	6,8	8,0	8,0		
2,2	3	09A8-2	2.2K	9,8	8,8	11,0	11,0		R2
3	4	13A3-2		13,3	12,0				
4	5	17A6-2		17,6	15,8				
5,5	7,5	24A4-2	5.5K	24,4	21,96	24,0	24,0		R3
7,5	10	31A0-2	7.5K	31,0	27,9	33,0	33,0		R4
11	15	46A2-2	11K	46,2	41,58	47,0	47,0		
15	20		15K			60,0	60,0		

Mitsubishi E700

Overload ratings

- 150 % for 60 sec
- 200 % for 3 sec

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Ratings 3-phase 400V

3-phase 400V		ABB	Mitsubishi	ABB ACS350		Mitsubishi E700		Mitsubishi	ASC350
P_N	P_N	ACS350	E700	I_{2N}	I_{2N}	I_{INV}	I_{INV}	E700	
		Type	Type	40° C	50° C	40° C	50° C	Frame	
		ACS350-	FR-E740-	A	A	A	A	names	
kW	hp	03X-		U_N=380-480 V		U_N=380-500 V		N/A	Frame
0,12	0,16								
0,2	0,25								
0,4	0,5	01A2-4	016-EC	1,2	1,1	1,6	1,6		R0
0,55	0,75	01A9-4		1,9	1,7				
0,75	1	02A4-4	026-EC	2,4	2,2	2,6	2,6		R1
1,1	1,5	03A3-4		3,3	3,0				
1,5	2	04A1-4	040-EC	4,1	3,7	4,0	4,0		
2,2	3	05A6-4	060-EC	5,6	5,0	6,0	6,0		
3	4	07A3-4		7,3	6,6				
4	5	08A8-4		8,8	7,9				
5,5	7,5	12A5-4	120-EC	12,5	11,3	12,0	12,0		R3
7,5	10	15A6-4	170-EC	15,6	14,0	17,0	17,0		
11	15	23A1-4	230-EC	23,1	20,8	23,0	23,0		
15	20	31A0-4	300-EC	31	27,9	30,0	30,0		R4
18,5	25	38A0-4		38	34,2				
22	30	44A0-4		44	39,6				

Mitsubishi E700

Overload ratings

- 150 % for 60 sec
- 200 % for 3 sec

ABB ACS350

Overload ratings

- 1.5 x long time overload, 1min/10min (+40 °C and +50 °C ambient)
- 1.8 x short-time overload, 2 sec

Dimensions 200 V 1-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Mitsubishi E700	ABB ACS350			Mitsubishi E700			Mitsubishi E700	ASC350
		Type	Type	1-phase			1-phase			Frame names	
		ACS350-		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	01X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,33										
0,4	0,5	02A4-2		70	169	161					R0
0,55	0,75										
0,75	1	04A7-2		70	169	161					R1
1,1	1,5	06A7-2									
1,5	2	07A5-2		105	169	165					R2
2,2	3	09A8-2									

Note: Mitsubishi E700 specifications not found

Dimensions 200 V 1-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Mitsubishi E700	ABB ACS350			Mitsubishi E700			Mitsubishi E700	ASC350
		Type	Type	1-phase			1-phase			Frame names N/A	
		ACS350-		(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	01X-		area	volume	weight	area	volume	weight		Frame
0,12	0,16										
0,2	0,33										
0,4	0,5	02A4-2		118	1,9	1,2					R0
0,55	0,75										
0,75	1	04A7-2		118	1,9	1,2					R1
1,1	1,5	06A7-2									
1,5	2	07A5-2		177	2,9	1,5					R2
2,2	3	09A8-2									

Note: Mitsubishi E700 specifications not found

Dimensions 200 V 3-phase: width, height, depth

Dimensions 200 V		ABB ACS350	Mitsubishi E700	ABB ACS350			Mitsubishi E700			Mitsubishi E700	ASC350
		Type	Type	3-phase			3-phase			Frame names	
		ACS350-	FR-E720-	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16		0.1K								
0,2	0,25		0.2K								
0,4	0,5	02A4-2	0.4K								R0
0,55	0,75	03A5-2					68	128	80,5		
0,75	1	04A7-2	0.75K	70		161					R1
1,1	1,5	06A7-2			169						
1,5	2	07A5-2	1.5K				108	128	135,5		
2,2	3	09A8-2	2.2K								R2
3	4	13A3-2		105		165					
4	5	17A6-2									
5,5	7,5	24A4-2	5.5K	169	169	169	180	260	165,0		R3
7,5	10	31A0-2	7.5K	260	181	169					R4
11	15	46A2-2	11K				220	260	190,0		
15	20		15K								

Dimensions 200 V 3-phase: area, volume, weight

Dimensions 200 V		ABB ACS350	Mitsubishi E700	ABB ACS350			Mitsubishi E700	Mitsubishi E700	Mitsubishi E700	Mitsubishi E700	ASC350
		Type	Type	3-phase			3-phase			Frame names N/A	
		ACS350-	FR-E720-	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight		Frame
0,12	0,16		0.1K						0.5		
0,2	0,25		0.2K						0.5		
0,4	0,5	02A4-2	0.4K				87	0,7	0.7		R0
0,55	0,75	03A5-2									
0,75	1	04A7-2	0.75K	118	1,9	1,2			1,0		R1
1,1	1,5	06A7-2									
1,5	2	07A5-2	1.5K				138	1,9	1,4		
2,2	3	09A8-2	2.2K						1,4		R2
3	4	13A3-2		177	2,9	1,5					
4	5	17A6-2									
5,5	7,5	24A4-2	5.5K	286	4,8	2,5	468	7,7	4,3		R3
7,5	10	31A0-2	7.5K	471	8,0	4,4			4,3		R4
11	15	46A2-2	11K				572	10,9	9,0		
15	20		15K						9,0		

Dimensions 400 V 3-phase: width, height, depth

Dimensions 400 V		ABB ACS350	Mitsubishi E700	ABB ACS350			Mitsubishi E700			Mitsubishi E700	ASC350
		Type	Type							Frame names	
		ACS350-	FR-E740-	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)		
kW	hp	03X-		W	H	D	W	H	D	N/A	Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	01A2-4	016-EC	70	169	161	140	150	114		R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	026-EC								R1
1,1	1,5	03A3-4									
1,5	2	04A1-4	040-EC				140	150	135		
2,2	3	05A6-4	060-EC								
3	4	07A3-4									
4	5	08A8-4									
5,5	7,5	12A5-4	120-EC	169		169	220	150	147		R3
7,5	10	15A6-4	170-EC								
11	15	23A1-4	230-EC				220	260	190		
15	20	31A0-4	300-EC	260	181	169					R4
18,5	25	38A0-4									
22	30	44A0-4									

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Dimensions 400 V 3-phase: area, volume, weight

Dimensions 400 V		ABB ACS350	Mitsubishi E700	ABB ACS350			Mitsubishi E700			Mitsubishi E700	ASC350
		Type	Type							Frame names N/A	
		ACS350-	FR-E740-	(cm^2)	(l)	(kg)	(cm^2)	(l)	(kg)		
kW	hp	03X-		area	volume	weight	area	volume	weight		Frame
0,12	0,16										
0,2	0,25										
0,4	0,5	01A2-4	016-EC	118	1,9	1,2	210	2,4	1,4		R0
0,55	0,75	01A9-4									
0,75	1	02A4-4	026-EC								R1
1,1	1,5	03A3-4				1,2					
1,5	2	04A1-4	040-EC				210	2,8	1,9		
2,2	3	05A6-4	060-EC								
3	4	07A3-4									
4	5	08A8-4									
5,5	7,5	12A5-4	120-EC	286	4,8	2,5	330	4,9	3,2		R3
7,5	10	15A6-4	170-EC								
11	15	23A1-4	230-EC				572	10,9	9,0		
15	20	31A0-4	300-EC	471	8,0	4,4					R4
18,5	25	38A0-4									
22	30	44A0-4									

Installation

Mitsubishi E700

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	No
Heatsinkless	Yes
Side-by-side	Yes*

Free space requirements

Location	*mm*
Above	100
Below	100
Left and right	0-10*

* Side-by-side mounting at the ambient temperature of 40°C or less

	FR-E740-				
Carrier frequency	016	026	040	060	≥ 095
≤ 1 (1 kHz)	200 m	200 m	300 m	500 m	500 m
2 to 14,5 kHz	30 m	100 m	200 m	300 m	500 m

When shielded cables are used devide the values listed in the table by 2.

ABB ACS350

Mounting method	*Availability*
Wall (back)	Yes
DIN rail	Yes
Flange	No
Wall (sideways)	Yes
Heatsinkless	No
Side-by-side	Yes

Free space requirements

Location	*mm*
Above	80
Below	80
Left and right	0

- Installation with clamps and screws, cabinet support tools available
- Operational motor cable lengths:

Frame	Standard	With output chokes
R0	30 m	60 m
R1	50 m	100 m
R2	50 m	100 m
R3	50 m	100 m
R4	50 m	100 m

EMC and harmonics

Mitsubishi E700

- Filters
  - The inverter with filter pack (a package of power factor improving DC reactor, common mode core and capacitive filter) conforms to the Japanese harmonic suppression guideline.
  - The inverter itself can comply with the EMC Directive (2nd Environment) with the newly developed noise filter (EMC filter).
- Chokes
  - DC reactor option
  - AC reactor option
- EMC compliant motor cable lengths

Carrier frequency	≤ 14,5 kHz	≤ 8 kHz	≤ 2 kHz
Wiring lenght	≤ 50 m	50-100 m	≥ 100 m

- THD
  - N/A

ABB ACS350

- Filters
  - Inbuilt EMC filter for category C3 (2nd environment) as standard
  - External EMC filter for category C2 (1st environment) as option
- Chokes
  - AC input/output chokes as option
- EMC compliant motor cable lengths

4 kHz switching frequency	Internal EMC filter	Optional external EMC filter
Second environment (category C3 [1])	30 m (100 ft)	30 m (100 ft) minimum
First environment (category C2 [1])	-	30 m (100 ft)

- THD
  - EN61000-3-2 with optional chokes

User interface

Mitsubishi E700

- Mitsubishi inverter has a setting dial of course.
  - The scrolling speed of the dial was made to variable for more improved operability.
  - The nonslip setting dial is easier to turn.

  - An optional operation panel for an enclosure surface mounting can be connected.
  - In addition, an operation panel for conventional model (FRE500 series) can be connected.
  - The operation panel of the inverter cannot be removed.
  - The FR-PU07, an optional parameter unit, can be connected as well.

ABB ACS350

- 2 different detachable control panels
  - Assistant control panel – easy drive programming, multilingual alphanumeric display, assistant included (see Other Advanced functions)
  - Basic control panel – single line numeric display
- Potentiometer option
- Panel door mounting kit to Basic and Assistant panel. The enclosure class of the panel kit is IP54 or IP66

	Start	Initiate operation of drive
	Stop	Ceases operation of drive
	Up	Changes parameters and their value/ increases reference
	Down	Changes parameters and their value/ decreases reference
	Loc/Rem	Changes drive state from local control to remote control
	HELP	Built-in “Help” button
	Soft key 1	Function changes according to state of panel
	Soft key 2	Function changes according to state of panel

Machine interface (I/O)

Mitsubishi E700

Type	*Qty.*	*Programmable*
Digital inputs	0 (4 oprional)	Yes
Analog inputs	2	Yes
Pulse train input	1-	Yes
Relay outputs	1 (3 optional)	Yes
Open collector outputs	2	Yes
Analog outputs	1 (2 optional)	Yes

ABB ACS350

Type	*Qty.*	*Programmable*
Digital inputs	5	Yes
Analog inputs	2	Yes
Pulse train input	1 (i.e. digital input)	Yes
Relay outputs	1	Yes
Transistor outputs	1	Yes
Analog outputs	1	Yes

Specialities:

- Bipolar analog input

Machine interface (fieldbus)

Mitsubishi E700

Protocol	*Standard/ Optional*	*Baud rate*	*Notes*
EIA-485(RS-485)	Standard		
ModbusRTU	Standard		
CC-link	Plug-in option		
DeviceNet	Plug-in option		
PROFIBUS-DP	Plug-in option		
LonWorks	Plug-in option		

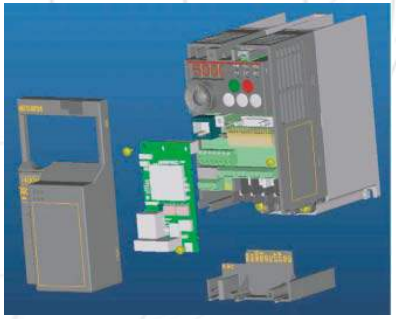


ABB ACS350

Fieldbus protocol	*Standard /Optional*	*Baud rate*	*Notes*
ModBus RTU (RS 232)	Standard	115.2 kbps	Through panel port
ModBus RTU (RS 485)	Option	115.2 kbps	FRSA-00, FMBA-01
DeviceNet	Option	500 kbit/s	FDNA-01
Profibus DP	Option	12 Mbit/s	FPBA-01
CANopen	Option	1 Mbit/s	FCAN-01
Ethernet	Option	10/100 Mbit/s	FENA-01

100% Phd braking
500 Hz mx. output frequency

Motor control

Mitsubishi E700

- V/F control
- Advanced magnetic flux vector control
- General-purpose magnetic flux vector control

Braking

- DC injection brake
- Optional brake resistor
- Optional high-duty brake resistor
- Optional brake unit

Output frequency

- 0.2 to 400Hz

ABB ACS350

- Sensorless vector control
- Scalar control

Braking

- Brake chopper available as standard
  - 100% * Phd for braking

Output frequency

- 500 Hz as maximum output frequency for scalar and vector control

Application macros 7 pcs
User macros 3 pcs
17 languages

Macros and language versions

Mitsubishi E700

- For simple variable-speed operation of the inverter, the initial setting of the parameters may be used as they are. Set the necessary parameters to meet the load and operational specifications. Parameter setting, change and check can be made from the operation panel.
- 8 languages
  - Japanese, English, German, French, Spanish, Italian, Swedish, Finnish

ABB ACS350

- Macros
  - ABB Standard
  - 3-wire
  - Alternate
  - Motor Potentiometer
  - Hand/auto
  - PID Control
  - Torque Control
  - User: Three user macros and Load FlashDrop set macro
- 17 languages
  - English, English (Am), German, Italian, Spanish, Portuguese, Dutch, French, Danish, Finnish, Swedish, Polish, Turkish, Russian, Czech, Hungarian, Korea, Chinese

Software features

Mitsubishi E700

- Automatic restart after instantaneous power failure function with frequency search
- Power-failure deceleration stop function/operation continuation at instantaneous power failure function
- Brake sequence mode, for mechanical brake control of the lift
- Regeneration avoidance function, regenerative overvoltage is less likely to occur in the pressing machine.
- Optimum excitation control, more energy saving is possible with the maximum motor efficiency control.
- Main circuit power supply DC input, DC power supply can be connected.
- Enhanced I/O terminal function, analog input (voltage/current) can be switched

ABB ACS350

- FlashDrop
- Sequence programming
- Fieldbus support
- Bipolar analog input
- Pulse train input and output
- IO and mains supply protection
- Flux braking
- Speed compensated stop
- Timer and counter start/stop
- Mechanical brake control
- User specified macros
- List of changed parameters
- Motor temperature measurement
- Process PID and external trim PID
  - Selectable drive operation if process feedback falls below the set minimum limit
  - Sleep function for the process PID control
- Fast and accurate jog
- No shaft rotation with zero reference

Other advanced features

Mitsubishi E700

- Parameter unit FR-PU07 (option)
  - Setting such as direct input method with a numeric keypad, operation status indication, and help function are usable.
  - The display language can be selected from 8 languages.
  - Parameter setting values of maximum of three inverters can be stored.
  - A battery pack type (available soon) allows parameter setting and parameter copy without powering on the inverter.

ABB ACS350

FlashDrop

- Tool for fast and safe selecting and setting drive parameters without power
- Palm-size 153x53x71mm and light weight 0.4 kg
- Portable and battery chargeable
- Keypad with LCD display
- Includes Drive PM (Drive parameter manager) software for PC to create, edit and copy parameter sets for FlashDrop
- Help function available
- Possibility to store 20 user specified parameter macros
- Parameter hiding, Parameter upload and download, Cold drive and Damaged drive parameterization
- Compatible also with ACS150, ACS550 and ACH550 drives

Other advanced features (cont)

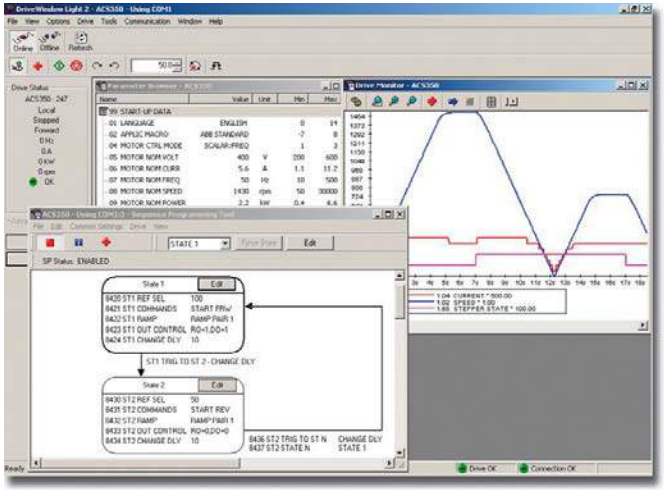
Mitsubishi E700

- With a provided USB connector, setting is easily done from a personal computer using the FR Configurator (to be released)

ABB ACS350

Sequence programming

- Application specific programming as standard
- New and easy way to preset sequences
- Reduces the need for an external programmable logic controller (PLC)
- DriveWindow Light software tool (as option) makes setting up the sequence programming parameters easy and draws the program graphically on the PC screen



Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

PC connectivity and tools

Mitsubishi E700

- An USB connector (mini-B connector) is provided as standard. The inverter can be easily connected without a USB-RS-485 converter.
- Wizard (interactive) function of the FR Configurator (inverter setup software) realizes setting support.
- In addition, a high-speed graph function with USB enables high speed sampling display.

ABB ACS350

- Easy access through RS 232 panel port
- Drive Window Light PC software
  - Browsing and editing of parameters
  - Parameter file handling
  - I/O Mapping table
  - Graphical monitoring of signals
  - Wizards (assistants)
  - Drive status monitoring
  - Sequence programming

Hardware options

Mitsubishi E700

- Plug-in options
  - I/O
  - Fieldbus
- Parameter unit
- AC reactor
- DC reactor
- Radio noise filter
- Line noise filter
- Brake resistor
- High-duty brake resistor
- Brake unit
- Resistor unit
- Discharging resistor
- Power regeneration common converter
- Stand-alone reactor dedicated for the FR-CV
- High power factor converter
- DIN rail attachment

ABB ACS350

- Control panels
  - Assistant control panel
  - Basic control panel
- Panel mounting kit
- 1st environment EMC filter
- Fieldbuses
- Input/output chokes
- NEMA 1 -kit
- Potentiometer
- Encoder interface module
- Brake resistors
- FlashDrop

Maintenance need indication

Detailed fault history with time

Maintenance

Mitsubishi E700

- Cooling fan replacement
  - Easy to replace
  - Every 10 years
- Capacitor
  - Design life of 10 years
- Wiring cover can be fitted after wiring
- Removable control terminal block
- Self-diagnostic alarm

ABB ACS350

- Cooling fan replacement
  - Very easy to replace
  - Every five years
- Capacitor reforming
  - Every two years when stored
- Battery replacement for Assistant Control Panel
  - Every ten years
- Available spare parts
  - Fan
  - Panels
  - Fieldbuses
- Maintenance assistant in the optional assistant control panel
  - Indication of the need for preventive maintenance of drive, the motor or run application
- Detailed fault history with time stamp available for max. 10 faults in optional Assistant control panel

Mitsubishi E700

Toshiba VF-S11 | Yaskawa V1000 | Danfoss FC51 | Fuji Frenic-Multi | Hitachi X200 | KEB Combivert F5 | Lenze 8400 | Vacon 10 Machinery | Lenze SMVector | WEG CFW08

Main | Yaskawa V7 | Mitsubishi FR E-500 | Danfoss VLT 2800 | Schneider Altivar 31 | Allen-Bradley PowerFlex 40 | Control Techniques Commander SK | Lenze 8200 | Siemens Micromaster 420

Standards

Mitsubishi E700

Approvals

- UL, cUL, EN (LVD), RoHS

Compliance with

- European Union's 73/23/EEC directive on low-voltage equipment
- 98/37/EC machinery directive
- ISO 9001 quality standard
- ISO 14001

Applicable standards

- EMC Directive (2nd Environment) with optional filter

ABB ACS350

Approvals

- CE, UL, cUL, C-tick, GOST-R

Compliance with

- Low Voltage Directive 73/23/EEC with supplements
- Machinery Directive 98/37/EC
- EMC Directive 89/336/EEC with supplements
- Quality assurance system ISO 9001
- Environmental system ISO 14001
- RoHS directive 2002/95/EC with amandments

Applicable standards

- IEC/EN 61800-5-1 - Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1 (1997) - Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
- IEC/EN 60529: 1991 - Degrees of protection provided by enclosures (IP code)
- IEC/EN 61800-3 (2004)- EMC product standard including specific test methods
- UL 508C UL - Standard for Safety, Power Conversion Equipment

ABB strenghts

ACS350 advantages over Mitsubishi E700

Wide power range	User macros 3 pcs
Sideways mounting	17 languages
EN61000-3-2 with opt. chokes	FlashDrop
2 control panel options	Sequence programming
Panel cover	Potentiometer option
Modbus speed	Maintenance need indication
100% Phd braking	Detailed fault history with time
500 Hz mx. output frequency	
Application macros 7 pcs	

For ACS350 advantages in performance, see the performance test slides