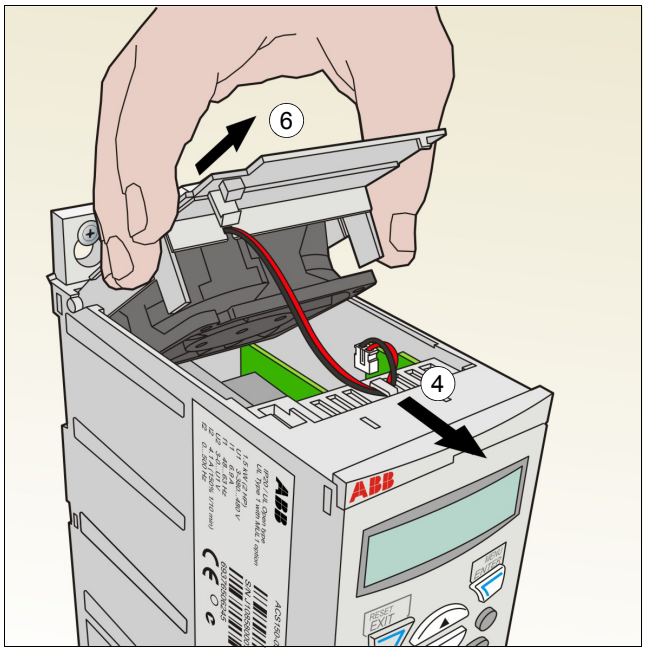
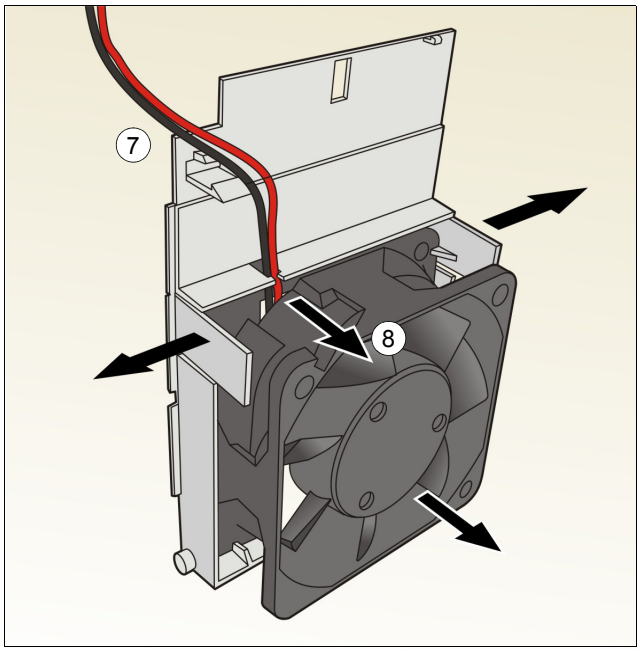
4. Free the fan cable from the clip.
5. Disconnect the fan cable.
6. Remove the fan holder from the hinges.
7. Free the fan cable from the clip in the fan holder.
8. Remove the fan from the holder.





9. Install the fan holder including the fan in reverse order.
10. Restore power.

Capacitors

Reforming the capacitors

The capacitors must be reformed if the drive has been stored for a year. See section *Type designation label* on page *22* for how to find out the manufacturing time from the serial number. For information on reforming the capacitors, refer to *Guide for capacitor reforming in ACS50, ACS55, ACS150, ACS310, ACS320, ACS350, ACS550 and ACH550* (3AFE68735190 [English]), available on the internet (go to http://www.abb.com and enter the code in the Search field.

Power connections

WARNING! Read and follow the instructions in chapter *Safety* on page *11*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Stop the drive and disconnect it from the power line. Wait for five minutes to let the drive DC capacitors discharge. Ensure by measuring with a multimeter (impedance at least 1 Mohm) that there is no voltage present.
2. Check the tightness of the power cable connections. Use the tightening torques given in section *Terminal and lead-through data for the power cables* on page *143*.
3. Restore power.

Control panel

Cleaning

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

Technical data

What this chapter contains

The chapter contains the technical specifications of the drive, for example, the ratings, sizes and technical requirements as well as provisions for fulfilling the requirements for CE and other marks.

Ratings

Current and power

The current and power ratings are given below. The symbols are described below the table.

Type ACS150- x = E/U[1)]	Input		Output					Frame size
	I_{1N}	I_{1N} (480 V)	I_{2N}	$I_{2,1min/10min}$	I_{2max}	P_N		
	A	A	A	A	A	kW	hp	
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)								
01x-02A4-2	6.1	-	2.4	3.6	4.2	0.37	0.5	R0
01x-04A7-2	11.4	-	4.7	7.1	8.2	0.75	1	R1
01x-06A7-2	16.1	-	6.7	10.1	11.7	1.1	1.5	R1
01x-07A5-2	16.8	-	7.5	11.3	13.1	1.5	2	R2
01x-09A8-2	21.0	-	9.8	14.7	17.2	2.2	3	R2
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)								
03x-02A4-2	4.3	-	2.4	3.6	4.2	0.37	0.5	R0
03x-03A5-2	6.1	-	3.5	5.3	6.1	0.55	0.75	R0
03x-04A7-2	7.6	-	4.7	7.1	8.2	0.75	1	R1
03x-06A7-2	11.8	-	6.7	10.1	11.7	1.1	1.5	R1
03x-07A5-2	12.0	-	7.5	11.3	13.1	1.5	2	R1
03x-09A8-2	14.3	-	9.8	14.7	17.2	2.2	3	R2
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)								
03x-01A2-4	2.2	1.8	1.2	1.8	2.1	0.37	0.5	R0
03x-01A9-4	3.6	3.0	1.9	2.9	3.3	0.55	0.75	R0
03x-02A4-4	4.1	3.4	2.4	3.6	4.2	0.75	1	R1
03x-03A3-4	6.0	5.0	3.3	5.0	5.8	1.1	1.5	R1
03x-04A1-4	6.9	5.8	4.1	6.2	7.2	1.5	2	R1
03x-05A6-4	9.6	8.0	5.6	8.4	9.8	2.2	3	R1
03x-07A3-4	11.6	9.7	7.3	11.0	12.8	3	4	R1
03x-08A8-4	13.6	11.3	8.8	13.2	15.4	4	5	R1

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[1)] E = EMC filter connected (metal EMC filter screw installed),
U = EMC filter disconnected (plastic EMC filter screw installed), US parametrization.

Symbols

Input

I_{1N}	continuous rms input current (for dimensioning cables and fuses)
I_{1N} (480 V)	continuous rms input current (for dimensioning cables and fuses) for drives with 480 V input voltage

Output

I_{2N}	continuous rms current. 50% overload is allowed for one minute every ten minutes.
$I_{2,1min/10min}$	maximum (50% overload) current allowed for one minute every ten minutes
I_{2max}	maximum output current. Available for two seconds at start, otherwise as long as allowed by the drive temperature.
P_N	typical motor power. The kilowatt ratings apply to most IEC 4-pole motors. The horsepower ratings apply to most NEMA 4-pole motors.
R0…R2	The ACS150 is manufactured in frame sizes R0...R2. Some instructions, technical data and dimensional drawings which only concern certain frame sizes are marked with the symbol of the frame size (R0...R2).

Sizing

Drive sizing is based on the rated motor current and power. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. Also the rated power of the drive must be higher than or equal to compared to the rated motor power. The power ratings are the same regardless of the supply voltage within one voltage range.

Note 1: The maximum allowed motor shaft power is limited to $1.5 \cdot P_N$. If the limit is exceeded, motor torque and current are automatically restricted. The function protects the input bridge of the drive against overload.

Note 2: The ratings apply at ambient temperature of 40 °C (104 °F).

In multimotor systems, the drive output current rating I_{2N} must be equal to or greater than the calculated sum of the input currents of all motors.

Derating

I_{2N}: The load capacity decreases if the installation site ambient temperature exceeds 40 °C (104 °F) or if the altitude exceeds 1000 meters (3300 ft) or the switching frequency is changed from 4 kHz to 8, 12 or 16 kHz.

Temperature derating, I_{2N}

In the temperature range +40 °C…+50 °C (+104 °F…+122 °F), the rated output current (I_{2N}) is decreased by 1% for every additional 1 °C (1.8 °F). The output current is calculated by multiplying the current given in the rating table by the derating factor.

Example If the ambient temperature is 50 °C (+122 °F), the derating factor is $100\% - 1 \frac{\%}{°C} \cdot 10\ °C =$ 90% or 0.90. The output current is then $0.90 \cdot I_{2N}$.

Altitude derating, I_{2N}

In altitudes 1000…2000 m (3300…6600 ft) above sea level, the derating is 1% for every 100 m (330 ft). For 3-phase 200 V drives, the maximum altitude is 3000 m (9800 ft) above sea level. In altitudes 2000…3000 m (6600…9800 ft), the derating is 2% for every 100 m (330 ft).

Switching frequency derating, I_{2N}

The drive derates itself automatically when parameter *2607* SWITCH FREQ CTRL = 1 (ON).

Switching frequency	**Drive voltage rating**	
	U_N = 200…240 V	**U_N = 380…480 V**
4 kHz	No derating	No derating
8 kHz	I_{2N} derated to 90%.	I_{2N} derated to 75% for R0 or to 80% for R1 and R2.
12 kHz	I_{2N} derated to 80%.	I_{2N} derated to 50% for R0, or to 65% for R1 and R2, and the maximum ambient temperature derated to 30 °C (86 °F).
16 kHz	I_{2N} derated to 75%.	I_{2N} derated to 50% and the maximum ambient temperature to 30 °C (86 °F).

When parameter *2607* SWITCH FREQ CTRL = 2 (ON (LOAD)), the drive controls the switching frequency towards the selected switching frequency *2606* SWITCHING FREQ if the drive's internal temperature allows.

Power cable sizes and fuses

Cable dimensioning for rated currents (I_{1N}) is shown in the table below together with the corresponding fuse types for short-circuit protection of the input power cable. **The rated fuse currents given in the table are the maximums for the mentioned fuse types. If smaller fuse ratings are used, check that the fuse rms current rating is larger than the rated I_{1N} current given in section *Ratings* on page *137*.** If 150% output power is needed, multiply current I_{1N} by 1.5. See also section *Selecting the power cables* on page *30*.

Check that the operating time of the fuse is below 0.5 seconds. The operating time depends on the fuse type, the supply network impedance as well as the cross-sectional area, material and length of the supply cable. In case the 0.5 seconds operating time is exceeded with the gG or T fuses, ultra rapid (aR) fuses in most cases reduce the operating time to an acceptable level.

Note: Larger fuses must not be used when the input power cable is selected according to this table.

Type ACS150- x = E/U	Fuses		Size of CU conductor in cablings							
	gG	UL Class T (600 V)	Supply (U1, V1, W1)		Motor (U2, V2, W2)		PE		Brake (BRK+ and BRK-)	
	A	A	mm^2	AWG	mm^2	AWG	mm^2	AWG	mm^2	AWG
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)										
01x-02A4-2	10	10	2.5	14	0.75	18	2.5	14	2.5	14
01x-04A7-2	16	20	2.5	14	0.75	18	2.5	14	2.5	14
01x-06A7-2	16/20 [1)]	25	2.5	10	1.5	14	2.5	10	2.5	12
01x-07A5-2	20/25 [1)]	30	2.5	10	1.5	14	2.5	10	2.5	12
01x-09A8-2	25/35 [1)]	35	6	10	2.5	12	6	10	6	12
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)										
03x-02A4-2	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-03A5-2	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-04A7-2	10	15	2.5	14	0.75	18	2.5	14	2.5	14
03x-06A7-2	16	15	2.5	12	1.5	14	2.5	12	2.5	12
03x-07A5-2	16	15	2.5	12	1.5	14	2.5	12	2.5	12
03x-09A8-2	16	20	2.5	12	2.5	12	2.5	12	2.5	12
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)										
03x-01A2-4	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-01A9-4	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-02A4-4	10	10	2.5	14	0.75	18	2.5	14	2.5	14
03x-03A3-4	10	10	2.5	12	0.75	18	2.5	12	2.5	12
03x-04A1-4	16	15	2.5	12	0.75	18	2.5	12	2.5	12
03x-05A6-4	16	15	2.5	12	1.5	14	2.5	12	2.5	12
03x-07A3-4	16	20	2.5	12	1.5	14	2.5	12	2.5	12
03x-08A8-4	20	25	2.5	12	2.5	12	2.5	12	2.5	12

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[1)] If 50% overload capacity is needed, use the larger fuse alternative.

Dimensions, weights and free space requirements

Dimensions and weights

Frame size	Dimensions and weights											
	IP20 (cabinet) / UL open											
	H1		H2		H3		W		D		Weight	
	mm	in	mm	in	mm	in	mm	in	mm	in	kg	lb
R0	169	6.65	202	7.95	239	9.41	70	2.76	142	5.59	1.1	2.4
R1	169	6.65	202	7.95	239	9.41	70	2.76	142	5.59	1.3/1.2 [1)]	2.9/2.6 [1)]
R2	169	6.65	202	7.95	239	9.41	105	4.13	142	5.59	1.5	3.3

[1)] U_N = 200…240 V: 1.3 kg / 2.9 lb, U_N = 380…480 V: 1.2 kg / 2.6 lb 00353783.xls J

Frame size	Dimensions and weights									
	IP20 / NEMA 1									
	H4		H5		W		D		Weight	
	mm	in	mm	in	mm	in	mm	in	kg	lb
R0	257	10.12	280	11.02	70	2.76	142	5.59	1.5	3.3
R1	257	10.12	280	11.02	70	2.76	142	5.59	1.7/1.6 [2)]	3.7/3.5 [2)]
R2	257	10.12	282	11.10	105	4.13	142	5.59	1.9	4.2

[2)] U_N = 200…240 V: 1.7 kg / 3.7 lb, U_N = 380…480 V: 1.6 kg / 3.5 lb 00353783.xls J

Symbols

IP20 (cabinet) / UL open

H1 height without fastenings and clamping plate

H2 height with fastenings, without clamping plate

H3 height with fastenings and clamping plate

IP20 / NEMA 1

H4 height with fastenings and connection box

H5 height with fastenings, connection box and hood

Free space requirements

Frame size	Free space required					
	Above		Below		On the sides	
	mm	in	mm	in	mm	in
R0…R2	75	3	75	3	0	0

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Losses, cooling data and noise

Losses and cooling data

Frame size R0 has natural convection cooling. Frame sizes R1…R2 are provided with an internal fan. The air flow direction is from bottom to top.

The table below specifies the heat dissipation in the main circuit at nominal load and in the control circuit with minimum load (I/O not in use) and maximum load (all digital inputs in the on state and the fan in use). The total heat dissipation is the sum of the heat dissipation in the main and control circuits.

Type ACS150- x = E/U	**Heat dissipation**						**Air flow**	
	Main circuit		**Control circuit**					
	Rated I_{1N} and I_{2N}		**Min**		**Max**			
	W	BTU/Hr	W	BTU/Hr	W	BTU/Hr	m^3/h	ft^3/min
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)								
01x-02A4-2	25	85	6.3	22	12.3	42	-	-
01x-04A7-2	46	157	9.6	33	16.0	55	24	14
01x-06A7-2	71	242	9.6	33	16.0	55	24	14
01x-07A5-2	73	249	10.6	36	17.1	58	21	12
01x-09A8-2	96	328	10.6	36	17.1	58	21	12
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)								
03x-02A4-2	19	65	6.3	22	12.3	42	-	-
03x-03A5-2	31	106	6.3	22	12.3	42	-	-
03x-04A7-2	38	130	9.6	33	16.0	55	24	14
03x-06A7-2	60	205	9.6	33	16.0	55	24	14
03x-07A5-2	62	212	9.6	33	16.0	55	21	12
03x-09A8-2	83	283	10.6	36	17.1	58	21	12
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)								
03x-01A2-4	11	38	6.7	23	13.3	45	-	-
03x-01A9-4	16	55	6.7	23	13.3	45	-	-
03x-02A4-4	21	72	10.0	34	17.6	60	13	8
03x-03A3-4	31	106	10.0	34	17.6	60	13	8
03x-04A1-4	40	137	10.0	34	17.6	60	13	8
03x-05A6-4	61	208	10.0	34	17.6	60	19	11
03x-07A3-4	74	253	14.3	49	21.5	73	24	14
03x-08A8-4	94	321	14.3	49	21.5	73	24	14

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Noise

Frame size	**Noise level**
	dBA
R0	<35
R1	52...55
R2	<62

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Terminal and lead-through data for the power cables

Frame size	Max cable diameter for NEMA 1		U1, V1, W1, U2, V2, W2, BRK+ and BRK-				PE			
	U1, V1, W1, U2, V2, W2		Max. terminal size flexible/rigid		Tightening torque		Max. clamp size solid or stranded		Tightening torque	
	mm	in	mm^2	AWG	N·m	lbf·in	mm^2	AWG	N·m	lbf·in
R0	16	0.63	4.0/6.0	10	0.8	7	25	3	1.2	11
R1	16	0.63	4.0/6.0	10	0.8	7	25	3	1.2	11
R2	16	0.63	4.0/6.0	10	0.8	7	25	3	1.2	11

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Terminal data for the control cables

Conductor size						Tightening torque
Solid or stranded		Stranded, with ferrule without plastic sleeve		Stranded, with ferrule with plastic sleeve		
Min/Max	Min/Max	Min/Max	Min/Max	Min/Max	Min/Max	
mm^2	AWG	mm^2	AWG	mm^2	AWG	See section *Control connection data* on page *146*.
0.14/1.5	26/16	0.25/1.5	23/16	0.25/1.5	23/16	

Electric power network specification

Voltage (U_1)	200/208/220/230/240 V AC 1-phase for 200 V AC drives 200/208/220/230/240 V AC 3-phase for 200 V AC drives 380/400/415/440/460/480 V AC 3-phase for 400 V AC drives Regular 10% variation from converter nominal voltage is allowed as default.
Short-circuit capacity	Maximum allowed prospective short-circuit current at the input power connection as defined in IEC 60439-1 and UL 508C is 100 kA. The drive is suitable for use in a circuit capable of delivering not more than 100 kA rms symmetrical amperes at the drive maximum rated voltage.
Frequency	50/60 Hz ± 5%, maximum rate of change 17%/s
Imbalance	Max. ±3% of nominal phase-to-phase input voltage

Motor connection data

Motor type	AC induction motor
Voltage (U_2)	0 to U_1, 3-phase symmetrical, U_{max} at the field weakening point
Short-circuit protection (IEC 61800-5-1, UL 508C)	The motor output is short-circuit proof by IEC 61800-5-1 and UL 508C.
Frequency	Scalar control: 0…500 Hz
Frequency resolution	0.01 Hz
Current	See section *Ratings* on page *137*.
Power limit	$1.5 \cdot P_N$
Field weakening point	10…500 Hz
Switching frequency	4, 8, 12 or 16 kHz
Maximum recommended motor cable length	**Operational functionality and motor cable length** The drive is designed to operate with optimum performance with the following maximum motor cable lengths. The motor cable lengths may be extended with output chokes as shown in the table.

Frame size	Maximum motor cable length	
	m	ft
Standard drive, without external options		
R0	30	100
R1…R2	50	165
With external output chokes		
R0	60	195
R1…R2	100	330

EMC compatibility and motor cable length

To comply with the European EMC Directive (standard IEC/EN 61800-3), use the following maximum motor cable lengths for 4 kHz switching frequency.

All frame sizes	Maximum motor cable length, 4 kHz	
	m	ft
With internal EMC filter		
Second environment (category C3 [1])	30	100
First environment (category C2 [1])	-	-
First environment (category C1 [1])	-	-
With optional external EMC filter		
Second environment (category C3 [1])	30 (at least) [2]	100 (at least) [2]
First environment (category C2 [1])	30 (at least) [2]	100 (at least) [2]
First environment (category C1 [1])	10 (at least) [2]	30 (at least) [2]

[1] See the new terms in section *Definitions* on page *148*.

[2] Maximum motor cable length is determined by the drive's operational factors. Contact your local ABB representative for the exact maximum lengths when using external EMC filters

Note 1: In multimotor systems, the calculated sum of all motor cable lengths must not exceed the maximum motor cable length given in the table.

Note 2: The internal EMC filter must be disconnected by removing the EMC screw (see section *Connection procedure* on page *42*) while using an external EMC filter.

Note 3: Radiated emissions are according to C2 with and without an external EMC filter.

Note 4: Category C1 with conducted emissions only. Radiated emissions are not compatible when measured with standard emission measurement setup and should be checked or measured on cabinet and machine installations case by case.

Control connection data

Analog input X1A: AI(1)	Voltage signal, unipolar	0 (2)…10 V, R_{in} > 312 kohm
	Current signal, unipolar	0 (4)…20 mA, R_{in} = 100 ohm
	Potentiometer reference value	
	(**X1A:** +10V)	10 V ± 1%, max. 10 mA, R < 10 kohm
	Resolution	0.1%
	Accuracy	±1%
Auxiliary voltage X1A: +24V		24 V DC ± 10%, max. 200 mA
Digital inputs X1A: DI1...DI5 (frequency input DI5)	Voltage	12…24 V DC with internal or external supply
	Max. voltage for digital inputs 30 V DC	
	Type	PNP and NPN
	Input impedance	2.4 kohm
Frequency input X1A: DI5	DI5 can be used either as a digital or as a frequency input.	
	Frequency input	Pulse train 0…16 kHz (DI5 only)
Relay output X1A: COM, NC, NO	Type	NO + NC
	Max. switching voltage	250 V AC / 30 V DC
	Max. switching current	0.5 A / 30 V DC; 5 A / 230 V AC
	Max. continuous current	2 A rms
Wire size	Relay connections	1.5...0.20 mm^2 /16...24 AWG
	I/O connections	1... 0.14mm^2/16...26 AWG
Torque	Relay connections	0.5 N·m / 4.4 lbf·in
	I/O connections	0.22 N·m / 2 lbf·in

Brake resistor connection

Short-circuit protection (IEC 61800-5-1, IEC 60439-1, UL 508C)	The brake resistor output is conditionally short-circuit proof by IEC/EN 61800-5-1 and UL 508C. For correct fuse selection, contact your local ABB representative. Rated conditional short-circuit current as defined in IEC 60439-1 and the short-circuit test current by UL 508C is 100 kA.

Efficiency

Approximately 95 to 98% at nominal power level, depending on the drive size and options

Degrees of protection

IP20 (cabinet installation) / UL open: Standard enclosure. The drive must be installed in a cabinet to fulfil the requirements for shielding from contact.

IP20 / NEMA 1: Achieved with an option kit (MUL1-R1) including a hood and a connection box.

Ambient conditions

Environmental limits for the drive are given below. The drive is to be used in a heated indoor controlled environment.

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	0 to 2000 m (6600 ft) above sea level (above 1000 m [3300 ft], see section *Derating* on page *138*)	-	-
Air temperature	-10 to +50 °C (14 to 122 °F). No frost allowed. See section *Derating* on page *138*.	-40 to +70 °C ±2% (-40 to +158 °F) ±2%	-40 to +70 °C (-40 to +158 °F)
Relative humidity	0 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed.		
	According to IEC 60721-3-3, chemical gases: Class 3C2 solid particles: Class 3S2. **Note:** The drive must be installed in clean air according to enclosure classification. **Note:** Cooling air must be clean, free from corrosive materials and electrically conductive dust.	According to IEC 60721-3-1, chemical gases: Class 1C2 solid particles: Class 1S2	According to IEC 60721-3-2, chemical gases: Class 2C2 solid particles: Class 2S2
Sinusoidal vibration (IEC 60721-3-3)	Tested according to IEC 60721-3-3, mechanical conditions: Class 3M4 2…9 Hz, 3.0 mm (0.12 in) 9…200 Hz, 10 m/s^2 (33 ft/s^2)	-	-
Shock (IEC 60068-2-27, ISTA 1A)	Not allowed during operation	According to ISTA 1A. Max. 100 m/s^2 (330 ft/s^2), 11 ms.	According to ISTA 1A. Max. 100 m/s^2 (330 ft/s^2), 11 ms.
Free fall	Not allowed	76 cm (30 in)	76 cm (30 in)

Materials

Drive enclosure

- PC/ABS 2 mm, PC+10%GF 2.5…3 mm and PA66+25%GF 1.5 mm, all in color NCS 1502-Y (RAL 9002 / PMS 420 C)
- hot-dip zinc coated steel sheet 1.5 mm, thickness of coating 20 micrometers
- extruded aluminium AlSi.

Package Corrugated cardboard.

Disposal

The drive contains raw materials that should be recycled to preserve energy and natural resources. The package materials are environmentally compatible and recyclable. All metal parts can be recycled. The plastic parts can either be recycled or burned under controlled circumstances, according to local regulations. Most recyclable parts are marked with recycling marks.

If recycling is not feasible, all parts excluding electrolytic capacitors and printed circuit boards can be landfilled. The DC capacitors contain electrolyte, which is classified as hazardous waste within the EU. They must be removed and handled according to local regulations.

For further information on environmental aspects and more detailed recycling instructions, please contact your local ABB distributor.

Applicable standards

The drive complies with the following standards:

- IEC/EN 61800-5-1: 2003 — Electrical, thermal and functional safety requirements for adjustable frequency a.c. power drives
- IEC/EN 60204-1: 2006 — Safety of machinery. Electrical equipment of machines. Part 1: General requirements. *Provisions for compliance:* The final assembler of the machine is responsible for installing
  - an emergency-stop device
  - a supply disconnecting device.
- IEC/EN 61800-3: 2004 — Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods
- UL 508C — UL Standard for Safety, Power Conversion Equipment, third edition.

CE marking

See the type designation label for the valid markings of your drive.

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage and EMC Directives.

Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3:2004) covers requirements stated for drives. See section *Compliance with the EN 61800-3:2004* on page *148*.

Compliance with the EN 61800-3:2004

Definitions

EMC stands for **E**lectro**m**agnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes establishments connected to a network not directly supplying domestic premises.

Drive of category C1: drive of rated voltage less than 1000 V, intended for use in the first environment.

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and commissioned only by a professional when used in the first environment.

Note: A professional is a person or organization having necessary skills in installing and/or commissioning power drive systems, including their EMC aspects.

Category C2 has the same EMC emission limits as the earlier class first environment restricted distribution. EMC standard IEC/EN 61800-3 does not any more restrict the distribution of the drive, but the using, installation and commissioning are defined.

Drive of category C3: drive of rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment.

Category C3 has the same EMC emission limits as the earlier class second environment unrestricted distribution.

Compliance

Category C1

The emission limits are complied with the following provisions:

1. The optional EMC filter is selected according to the ABB documentation and installed as specified in the EMC filter manual.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. For the maximum motor cable length with 4 kHz switching frequency, see section *Motor connection data* on page *144*.

WARNING! In a domestic environment, this product may cause radio inference, in which case supplementary mitigation measures may be required.

Category C2

The emission limits are complied with the following provisions:

1. The optional EMC filter is selected according to the ABB documentation and installed as specified in the EMC filter manual.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. For the maximum motor cable length with 4 kHz switching frequency, see section *Motor connection data* on page *144*.

WARNING! In a domestic environment, this product may cause radio inference, in which case supplementary mitigation measures may be required.

Category C3

The immunity performance of the drive complies with the demands of IEC/EN 61800-3, second environment (see page *148* for IEC/EN 61800-3 definitions).

The emission limits are complied with the following provisions

1. The internal EMC filter is connected (the screw at EMC is in place) or the optional EMC filter is installed.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. With the internal EMC filter: motor cable length 30 m (100 ft) with 4 kHz switching frequency. For the maximum motor cable length with an optional external EMC filter, see section *Motor connection data* on page *144*.

WARNING! A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

Note: It is not allowed to install a drive with the internal EMC filter connected on IT (ungrounded) systems. The supply network becomes connected to ground potential through the EMC filter capacitors which may cause danger or damage the drive.

Note: It is not allowed to install a drive with the internal EMC filter connected on a corner-grounded TN system as this would damage the drive.

UL marking

See the type designation label for the valid markings of your drive.

The UL mark is attached to the drive to verify that it meets UL requirements.

UL checklist

Input power connection – See section *Electric power network specification* on page *144*.

Disconnecting device (disconnecting means) – See section *Selecting the supply disconnecting device (disconnecting means)* on page *29*.

Ambient conditions – The drives are to be used in a heated indoor controlled environment. See section *Ambient conditions* on page *147* for specific limits.

Input cable fuses – For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. To fulfil this requirement, use the UL classified fuses given in section *Power cable sizes and fuses* on page *140*.

For installation in Canada, branch circuit protection must be provided in accordance with Canadian Electrical Code and any applicable provincial codes. To fulfil this requirement, use the UL classified fuses given in section *Power cable sizes and fuses* on page *140*.

Power cable selection – See section *Selecting the power cables* on page *30*.

Power cable connections – For the connection diagram and tightening torques, see section *Connecting the power cables* on page *41*.

Overload protection – The drive provides overload protection in accordance with the National Electrical Code (US).

Braking – The drive has an internal brake chopper. When applied with appropriately sized brake resistors, the brake chopper allows the drive to dissipate regenerative energy (normally associated with quickly decelerating a motor). Brake resistor selection is discussed in section *Brake resistors* on page *151*.

C-Tick marking

See the type designation label for the valid markings of your drive.

C-Tick marking is required in Australia and New Zealand. A C-Tick mark is attached to the drive to verify compliance with the relevant standard (IEC 61800-3 (2004) – Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods), mandated by the Trans-Tasman Electromagnetic Compatibility Scheme.

The Trans-Tasman Electromagnetic Compatibility Scheme (EMCS) was introduced by the Australian Communication Authority (ACA) and the Radio Spectrum Management Group (RSM) of the New Zealand Ministry of Economic Development (NZMED) in November 2001. The aim of the scheme is to protect the radio frequency spectrum by introducing technical limits for emission from electrical/ electronic products.

For fulfilling the requirements of the standard, see section *Compliance with the EN 61800-3:2004* on page *148*.

RoHS marking

See the type designation label for the valid markings of your drive.

The RoHS mark is attached to the drive to verify that drive follows the provisions of the European RoHS directive. RoHS = the restriction of the use of hazardous substances in electrical and electronic equipment.

Brake resistors

ACS150 drives have an internal brake chopper as standard equipment. The brake resistor is selected using the table and equations presented in this section.

Selecting the brake resistor

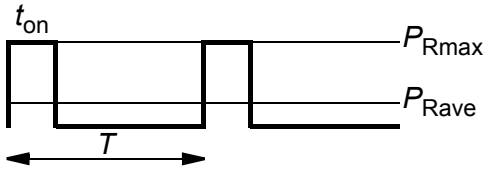
1. Determine the required maximum braking power P_{Rmax} for the application. P_{Rmax} must be smaller than P_{BRmax} given in the table on page *152* for the used drive type.
2. Calculate resistance R with Equation 1.
3. Calculate energy E_{Rpulse} with Equation 2.
4. Select the resistor so that the following conditions are met:
   - The rated power of the resistor must be greater than or equal to P_{Rmax}.
   - Resistance R must be between R_{min} and R_{max} given in the table for the used drive type.
   - The resistor must be able to dissipate energy E_{Rpulse} during the braking cycle T.

Equations for selecting the resistor:

Eq. 1. U_N = 200…240 V: $R = \frac{150000}{P_{Rmax}}$

U_N = 380…415 V: $R = \frac{450000}{P_{Rmax}}$

U_N = 415…480 V: $R = \frac{615000}{P_{Rmax}}$



Eq. 2. $E_{Rpulse} = P_{Rmax} \cdot t_{on}$

Eq. 3. $P_{Rave} = P_{Rmax} \cdot \frac{t_{on}}{T}$

For conversion, use 1 hp = 746 W.

where
R = selected brake resistor value (ohm)
P_{Rmax} = maximum power during the braking cycle (W)
P_{Rave} = average power during the braking cycle (W)
E_{Rpulse} = energy conducted into the resistor during a single braking pulse (J)
t_{on} = length of the braking pulse (s)
T = length of the braking cycle (s).

Resistor types shown in the following table are pre-dimensioned resistors using the maximum braking power with cyclic braking shown in the table. Resistors are available from ABB. Information is subject to change without further notice.

Type ACS150-x = E/U[1]	R_{min}	R_{max}	P_{BRmax}		Selection table by resistor type			
					CBR-V			Braking time [2]
	ohm	ohm	kW	hp	160	210	460	s
1-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)								
01x-02A4-2	70	390	0.37	0.5	•			90
01x-04A7-2	40	200	0.75	1	•			45
01x-06A7-2	40	130	1.1	1.5	•			28
01x-07A5-2	30	100	1.5	2	•			19
01x-09A8-2	30	70	2.2	3	•			14
3-phase U_N = 200…240 V (200, 208, 220, 230, 240 V)								
03x-02A4-2	70	390	0.37	0.5	•			90
03x-03A5-2	70	260	0.55	0.75	•			60
03x-04A7-2	40	200	0.75	1	•			42
03x-06A7-2	40	130	1.1	1.5	•			29
03x-07A5-2	30	100	1.5	2	•			19
03x-09A8-2	30	70	2.2	3	•			14
3-phase U_N = 380…480 V (380, 400, 415, 440, 460, 480 V)								
03x-01A2-4	200	1180	0.37	0.5		•		90
03x-01A9-4	175	800	0.55	0.75		•		90
03x-02A4-4	165	590	0.75	1		•		60
03x-03A3-4	150	400	1.1	1.5		•		37
03x-04A1-4	130	300	1.5	2		•		27
03x-05A6-4	100	200	2.2	3		•		17
03x-07A3-4	70	150	3.0	3			•	29
03x-08A8-4	70	110	4.0	5			•	20

[1] E=EMC filter connected (metal EMC filter screw installed), U=EMC filter disconnected (plastic EMC filter screw installed), US parametrization.

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[2] Braking time = maximum allowed braking time in seconds at P_{BRmax} every 120 seconds, at 40 °C ambient temperature.

Note: The brake resistors listed in the table are available in Europe. They do not apply to the USA. Contact your local ABB representative for more information.

Symbols

R_{min} = minimum allowed brake resistor that can be connected to the brake chopper
R_{max} = maximum allowed brake resistor that allows R_{max}
P_{BRmax} = maximum braking capacity of the drive, must exceed the desired braking power.

Ratings by resistor type	CBR-V 160	CBR-V 210	CBR-V 460
Nominal power (W)	280	360	790
Resistance (ohm)	70	200	80

WARNING! Never use a brake resistor with a resistance below the minimum value specified for the particular drive. The drive and the internal chopper are not able to handle the overcurrent caused by the low resistance.

Selecting the brake resistor cables

Use a shielded cable with the same conductor size as for drive input cabling (see section *Terminal and lead-through data for the power cables on page 143*). The maximum length of the resistor cable(s) is 5 m (16 ft).

Placing the brake resistor

Install all resistors in a place where they will cool.

WARNING! The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Air flowing from the resistor is of hundreds of degrees Celsius. Protect the resistor against contact.

Protecting the system in brake circuit fault situations

Protection of the system in cable and brake resistor short-circuit situations

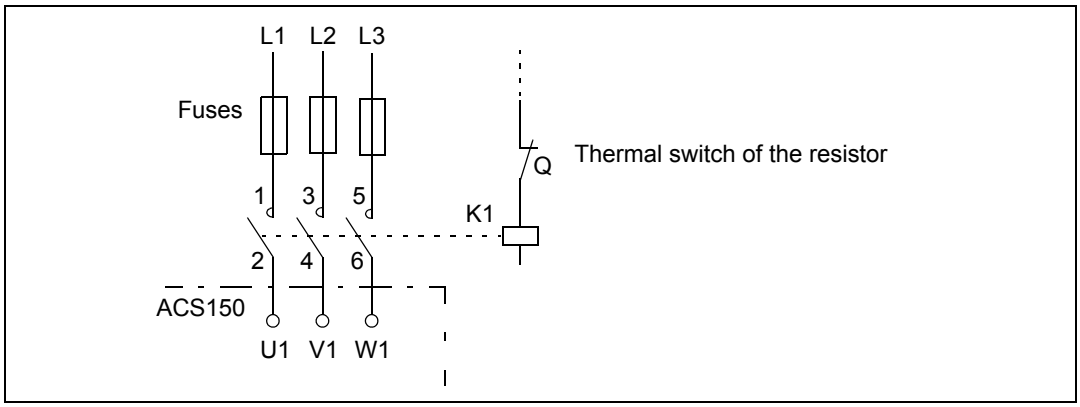
For short-circuit protection of the brake resistor connection, see *Brake resistor connection* on page *146*. Alternatively, a two-conductor shielded cable with the same cross-sectional area can be used.

Protection of the system in brake resistor overheating situations

The following setup is essential for safety – it interrupts the main supply in fault situations involving chopper shorts:

- Equip the drive with a main contactor.
- Wire the contactor so that it opens if the resistor thermal switch opens (an overheated resistor opens the contactor).

Below is a simple wiring diagram example.



Electrical installation

For the brake resistor connections, see the power connection diagram of the drive on page *41*.

Start-up

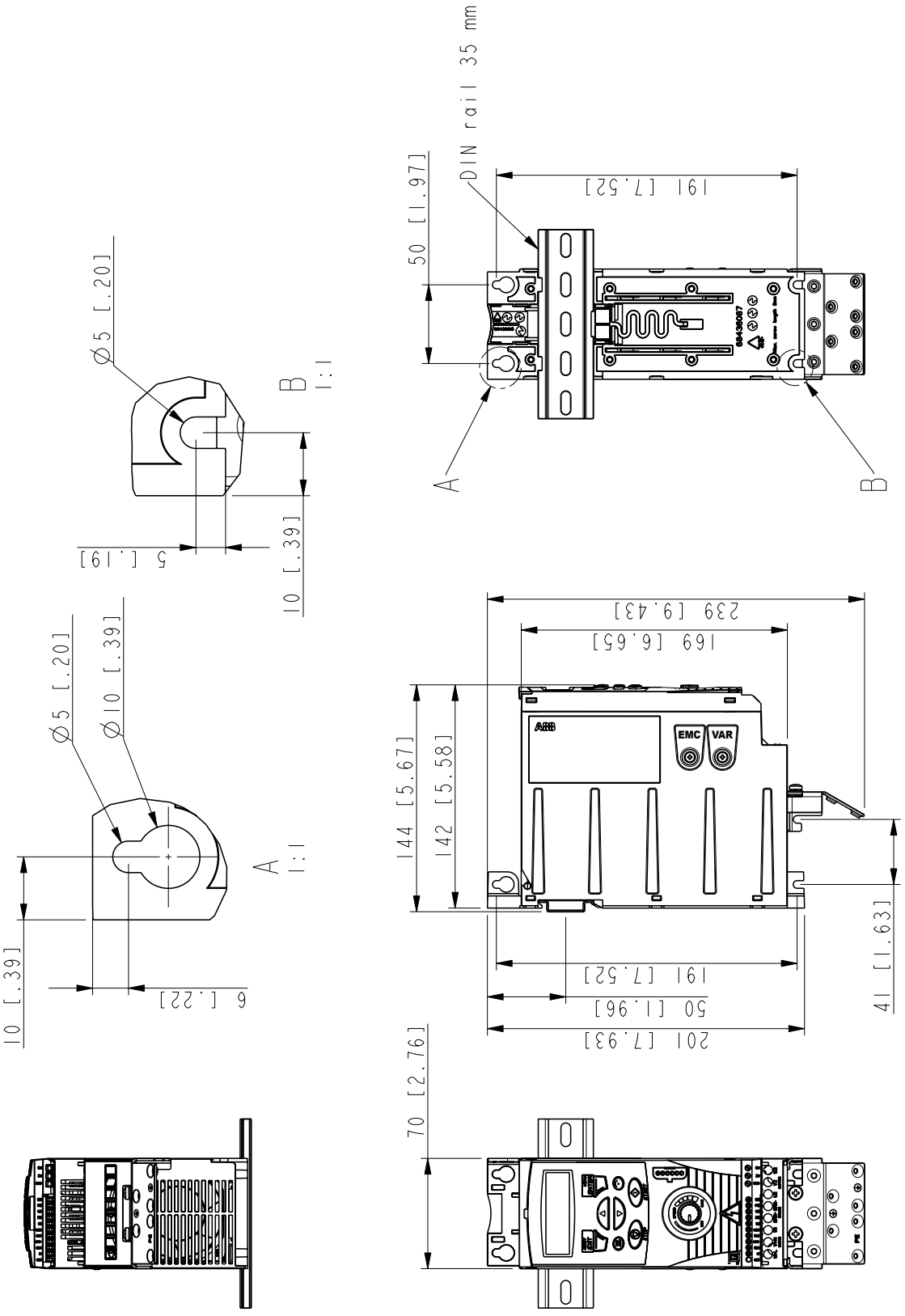
To enable resistor braking, switch off the drive's overvoltage control by setting parameter *2005* OVERVOLT CTRL to 0 (DISABLE).

Dimension drawings

Dimensional drawings of the ACS150 are shown below. The dimensions are given in millimeters and [inches].

Frame sizes R0 and R1, IP20 (cabinet installation) / UL open

R1 and R0 are identical except for the fan at the top of R1.



Frame sizes R0 and R1, IP20 (cabinet installation) / UL open

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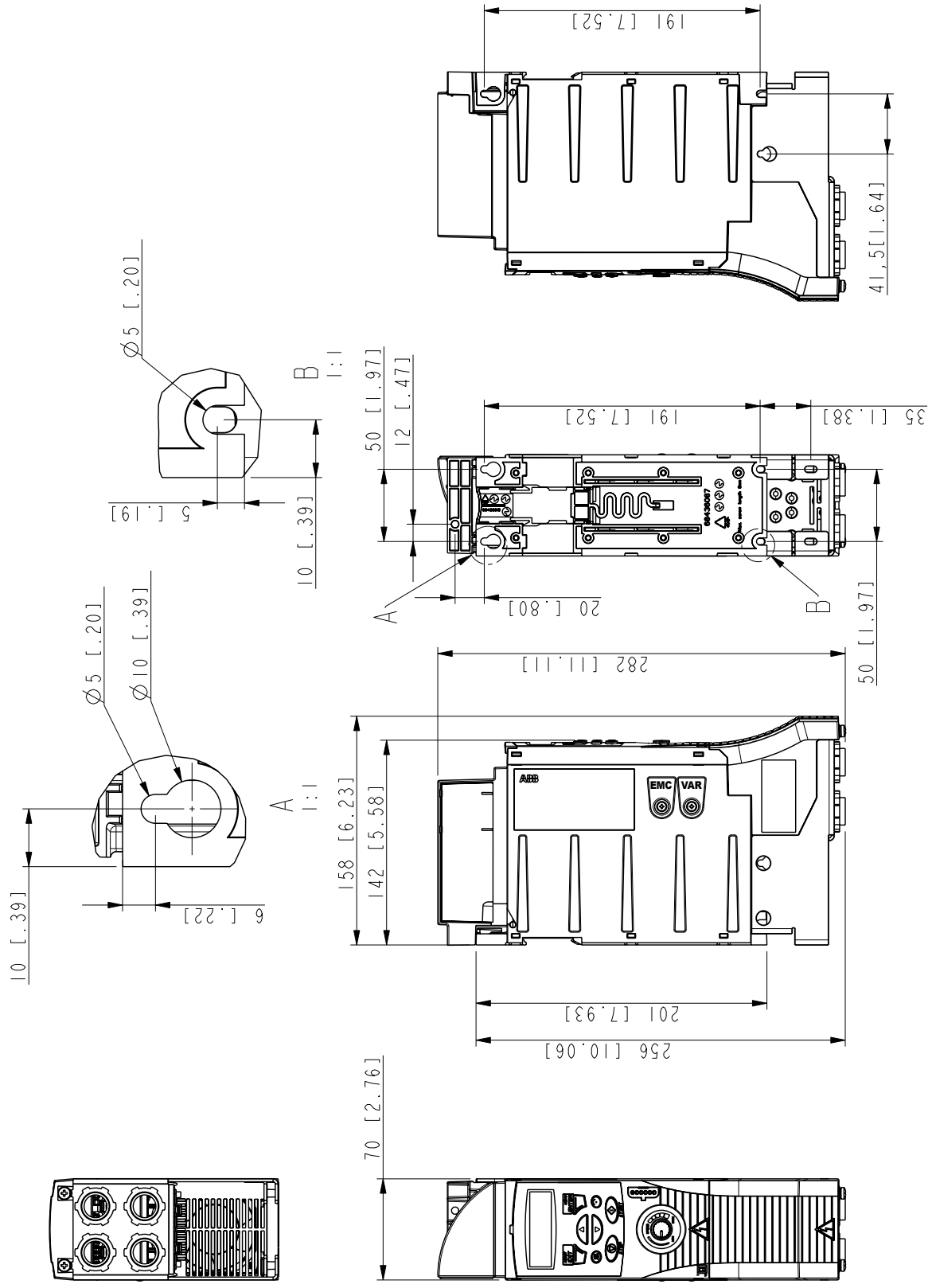
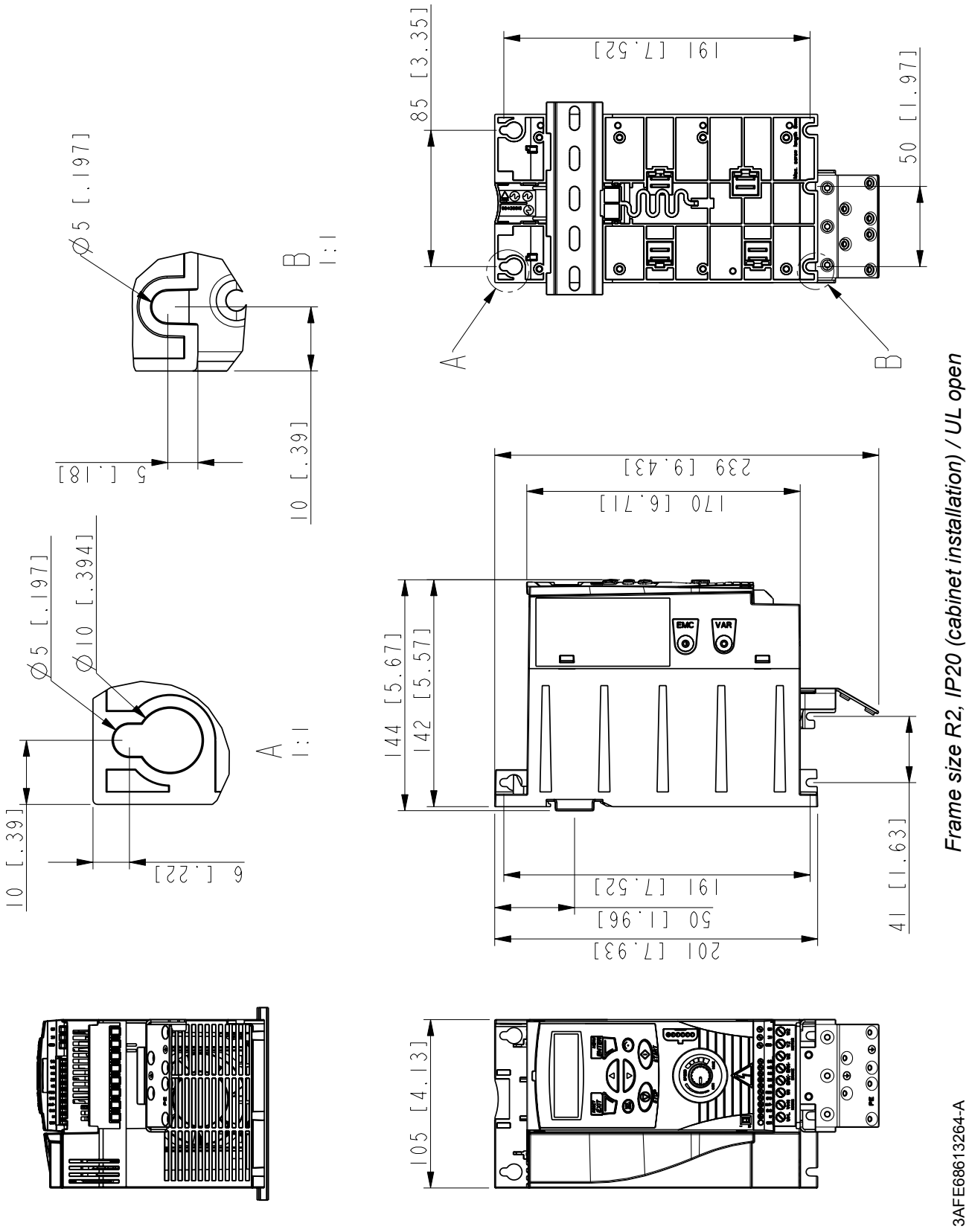
Frame sizes R0 and R1, IP20 / NEMA 1

R1 and R0 are identical except for the fan at the top of R1.

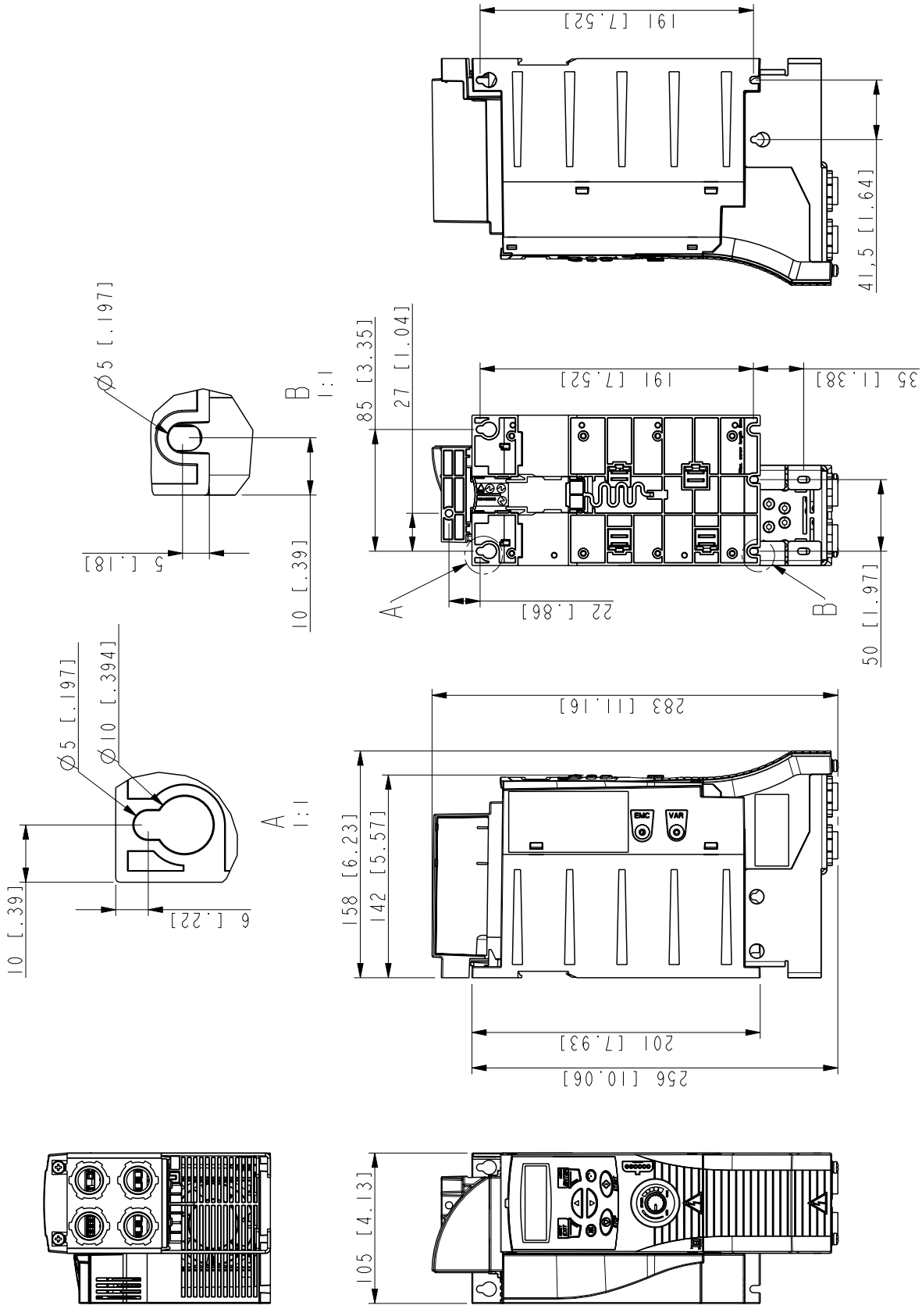


Frame size R2, IP20 (cabinet installation) / UL open



Frame size R2, IP20 (cabinet installation) / UL open

Frame size R2, IP20 / NEMA 1



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Appendix: Process PID control

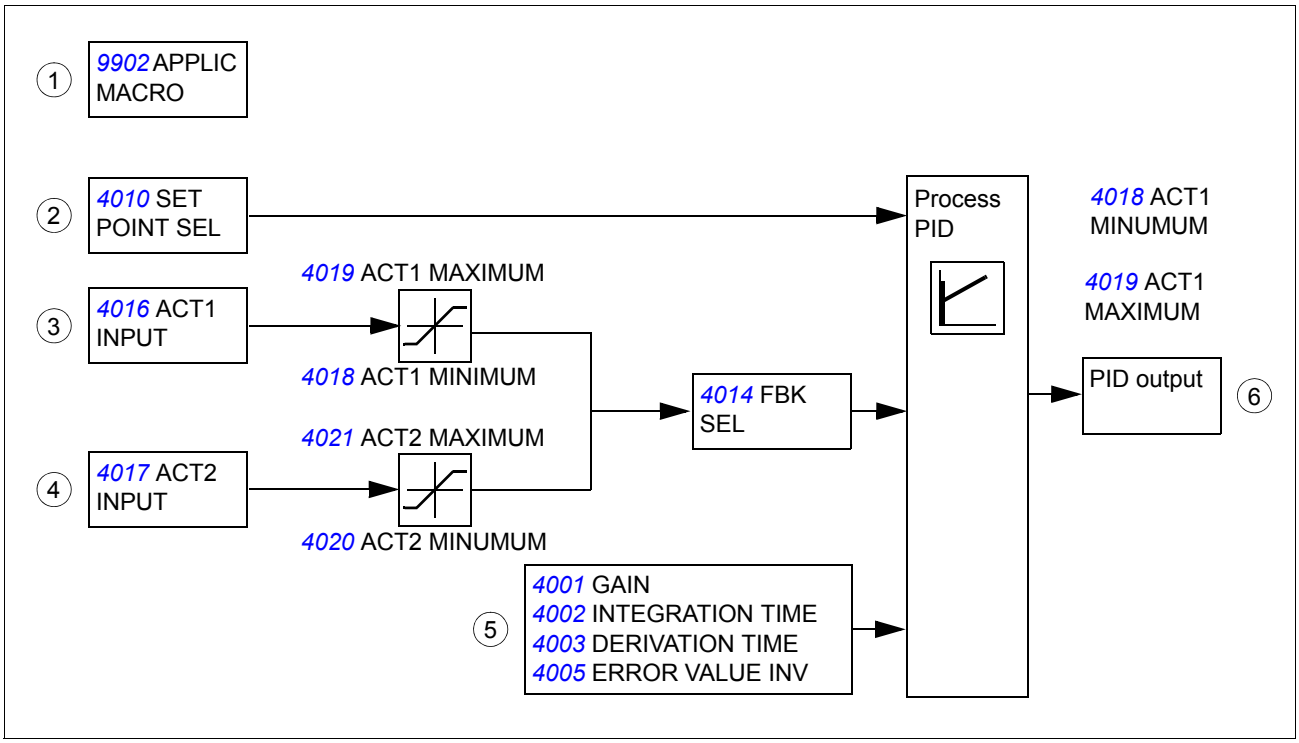
What this chapter contains

The chapter contains instructions on quick configuration of the process control, gives an application example and describes the PID sleep functionality.

Process PID control

There is a built-in PID controller in the drive. The controller can be used to control process variables such as pressure, flow or fluid level. In process PID control, a process reference (setpoint) is set with drive's integrated potentiometer. An actual value (process feedback) is connected to the drive's analog input. The process PID control adjusts the drive speed in order to keep the measured process quantity (actual value) at the desired level (setpoint).

Quick configuration of process PID control

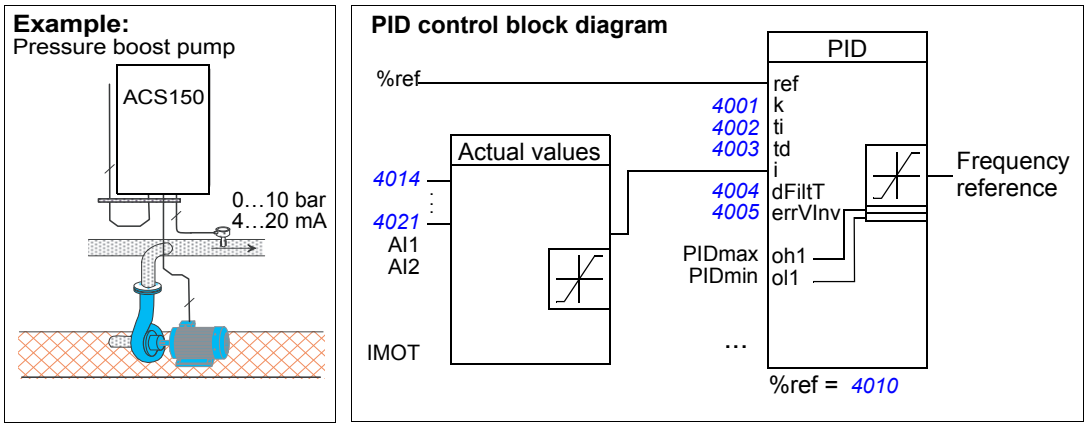


1. *9902* **APPLIC MACRO:** Set *9902* APPLICATION MACRO to 6 (PID CONTROL).
2. *4010* **SET POINT SEL:** Determine the source for the PID reference signal (PID setpoint) and define its scale (*4006* UNITS, *4007* UNIT SCALE).
3. *4014* **FBK SEL and** *4016* **ACT1 INPUT:** Select the process actual value (feedback signal) for the system and configure feedback levels (*4018* ACT1 MINUMUM, *4019* ACT1 MAXIMUM).

4. *4017* **ACT2 INPUT:** If a second feedback is used, configure also this actual value 2 (*4020* ACT2 MINIMUM and *4021* ACT2 MAXIMUM).
5. *4001* **GAIN,** *4002* **INTEGRATION TIME,** *4003* **DERIVATION TIME,** *4005* **ERROR VALUE INV:** Configure the desired gain, integration time, derivation time and error value inversion when needed.
6. **Activate PID output:** Check that *1106* REF2 SELECT is set to 19 (PID1OUT).

Pressure boost pump

The figure below shows an application example: The controller adjusts the speed of a pressure boost pump according to the measured pressure and the set pressure reference.



How to scale the PID actual (feedback) signal 0…10 bar / 4…20 mA

PID feedback is connected to AI1 and *4016* ACT1 INPUT is set to AI1.

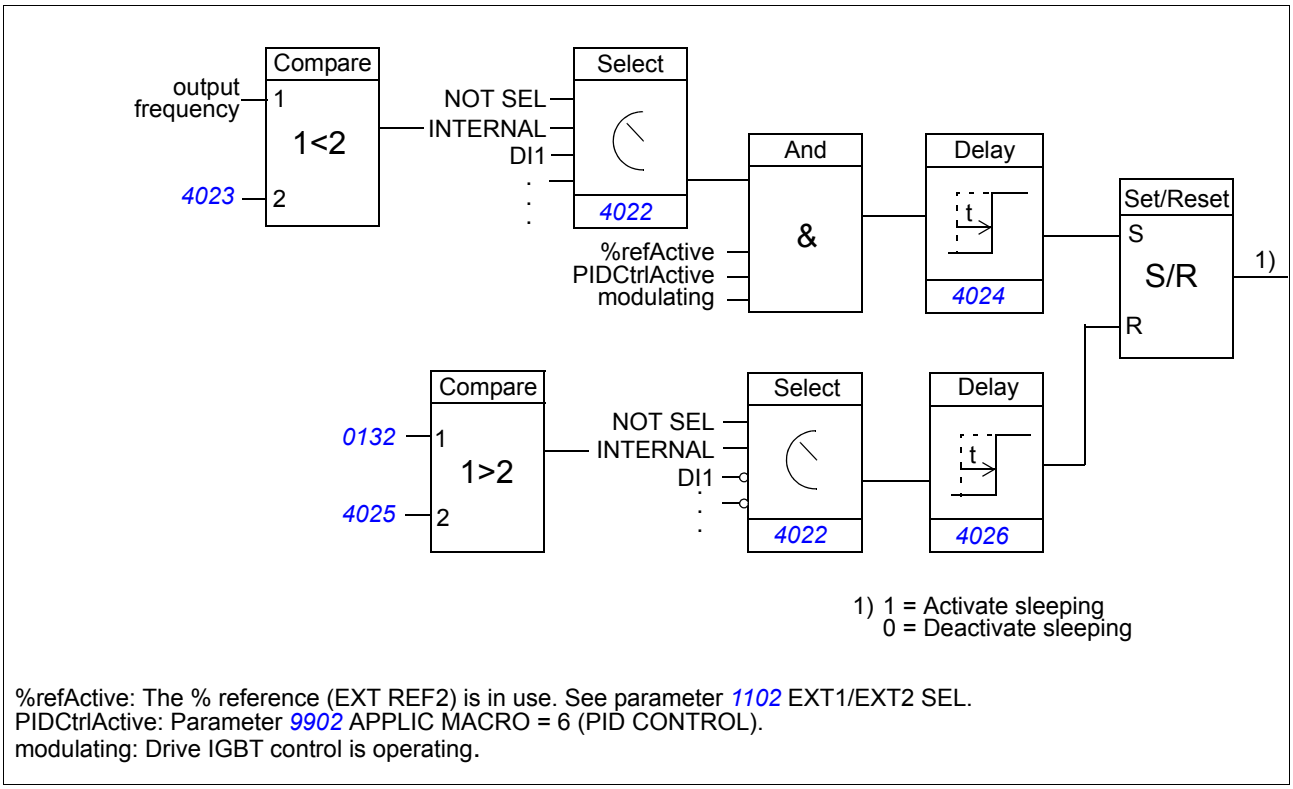
1. Set *9902* APPLICATION MACRO to 6 (PID CONTROL). Check scaling: 1301 MINIMUM AI1 as default 20% and 1302 MAXIMUM AI1 as default 100%. Check that *1106* REF2 SELECT is set to 19 (PID1OUT).
2. Set *3408* SIGNAL2 PARAM to 130 (PID1 FBK).
3. Set *3409* SIGNAL2 MIN to 0.
4. Set *3410* SIGNAL2 MAX to 10.
5. Set *3411* OUTPUT2 DSP FORM to 9 (DIRECT).
6. Set *3412* OUTPUT2 UNIT to 0 (NO UNIT).
7. Set *4006* UNITS to 0 (NO UNIT).
8. Set *4007* UNIT SCALE to 1.
9. Set *4008* 0% VALUE to 0.
10. Set *4009* 100% VALUE to 10.

How to scale the PID setpoint signal

1. Set *4010* SET POINT SEL to 19 (INTERNAL).
2. Set *4011* INTERNAL SETPNT to 5.0 ("bar" is not displayed on the drive control panel) as an example.

PID sleep functionality

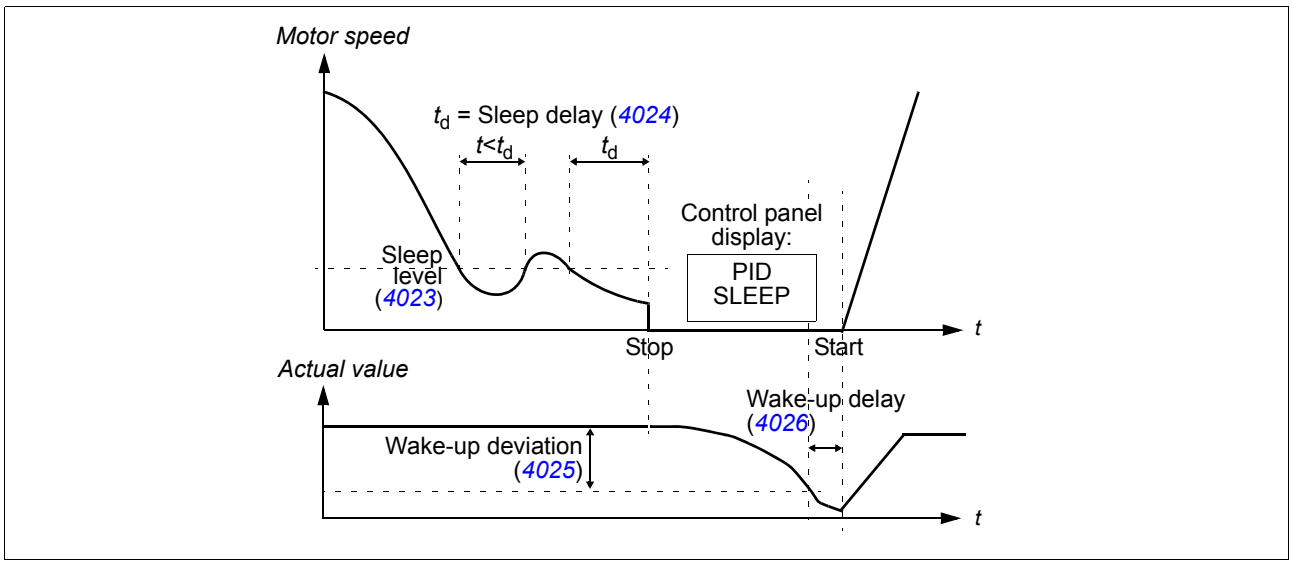
The block diagram below illustrates the sleep function enable/disable logic. The sleep function can be put into use only when the PID control is active.



%refActive: The % reference (EXT REF2) is in use. See parameter *1102* EXT1/EXT2 SEL.
PIDCtrlActive: Parameter *9902* APPLIC MACRO = 6 (PID CONTROL).
modulating: Drive IGBT control is operating.

Example

The time scheme below visualizes the operation of the sleep function.



Sleep function for a PID controlled pressure boost pump (when parameter *4022* SLEEP SELECTION is set to 7 = INTERNAL): The water consumption falls at night. As a consequence, the PID process controller decreases the motor speed. However, due to natural losses in the pipes and the low efficiency of the centrifugal pump at low speeds, the motor does not stop but keeps rotating. The sleep function detects the slow rotation, and stops the unnecessary pumping after the sleep delay has passed. The drive shifts into the sleep mode, still monitoring the pressure. The pumping restarts when the pressure falls under the allowed minimum level and the wake-up delay has passed.

Settings:

Parameter	**Additional information**
9902 APPLIC MACRO	PID control activation
4022 SLEEP SELECTION	Sleep function activation and source selection
4023 PID SLEEP LEVEL	Definition of the start limit for the sleep function
4024 PID SLEEP DELAY	Definition of the delay for the sleep start function
4025 WAKE-UP DEV	Definition of the wake-up deviation for the sleep function
4026 WAKE-UP DELAY	Definition of the wake-up delay for the sleep function

Parameters:

Parameter	**Additional information**
1401 RELAY OUTPUT 1	PID sleep function status through the relay output
Alarm	**Additional information**
PID SLEEP	Sleep mode

Declaration of Incorporation

(According to Machinery Directive 2006/42/EC)

Manufacturer: ABB Oy
Address: P.O Box 184, FIN-00381 Helsinki, Finland. Street address: Hiomotie 13,

herewith declare under our sole responsibility that the frequency converters with type markings:

ACS150-...
ACS350-...
ACS355-...

are intended to be incorporated into machinery or to be assembled with other machinery to constitute machinery covered by Machinery Directive 2006/42/EC and relevant essential health and safety requirements of the Directive and its Annex I have been complied with.

The technical documentation is compiled in accordance with part B of Annex VII, the assembly instructions are prepared according Annex VI and the following harmonised European standard has been applied:

EN 60204-1:2006 + A1:2009
Safety of machinery - Electrical equipment of machines- Part 1: general requirements

and that the following technical standard have been used:

EN 60529 (1991 + corrigendum May 1993 + amendment A1:2000)
Degrees of protection provided by enclosures (IP codes)

The person authorized to compile the technical documentation:

Name: Jukka Päri
Address: P.O Box 184, FIN-00381 Helsinki

The products referred in this Declaration of Incorporation are in conformity with Low voltage directive 2006/95/EC and EMC directive 2004/108/EC. The Declaration of Conformity according to these directives is available from the manufacturer.

ABB Oy furthermore declares that it is not allowed to put the equipment into service until the machinery into which it is to be incorporated or of which it is to be a component has been found and declared to be in conformity with the provisions of the Directive 2006/42/EC and with national implementing legislation, i.e. as a whole, including the equipment referred to in this Declaration.

ABB Oy gives an undertaking to the national authorities to transmit, in response to a reasoned request by the national authorities, relevant information on the partly completed machinery. The method of transmission can be either electrical or paper format and it shall be agreed with the national authority when the information is asked. This transmission of information shall be without prejudice to the intellectual property rights of the manufacturer.

Helsinki, 29.12.2009

Panu Virolainen

Vice President
ABB Oy

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/drives and selecting *Sales, Support and Service network*.

Product training

For information on ABB product training, navigate to www.abb.com/drives and select *Training courses*.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Go to www.abb.com/drives and select *Document Library – Manuals feedback form (LV AC drives)*.

Document library on the Internet

You can find manuals and other product documents in PDF format on the Internet. Go to www.abb.com/drives and select *Document Library.* You can browse the library or enter selection criteria, for example a document code, in the search field.

Contact us

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