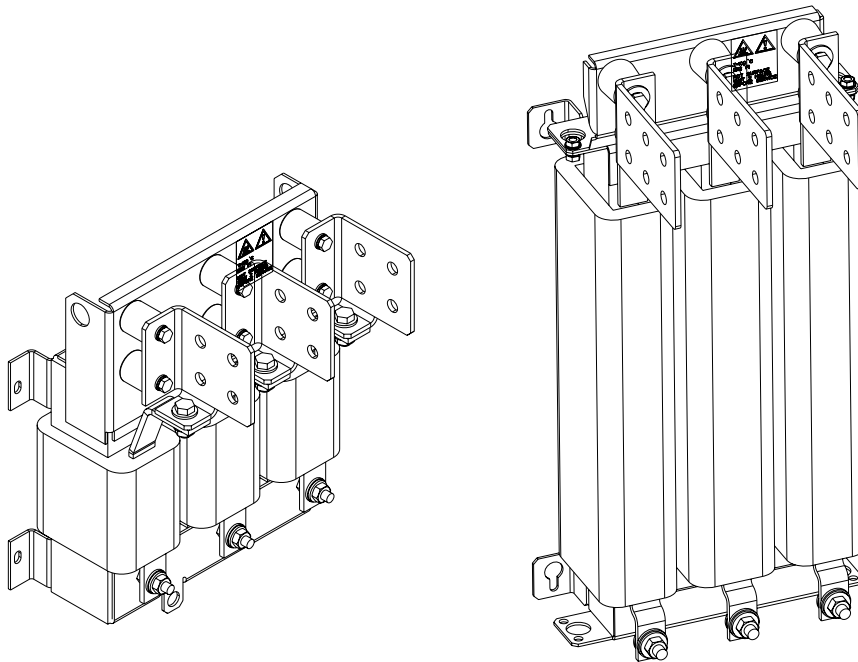


ACS800

Hardware Manual
du/dt Filters
FOCH0320-50
FOCH0260-70
FOCH0610-70



ACS800 Single Drive Manuals

HARDWARE MANUALS (appropriate manual is included in the delivery)

ACS800-01/U1 Hardware Manual 0.55 to 160 kW (0.75 to 200 HP)
3AFE64382101 (English)

ACS800-01/U1/04 Marine Supplement 0.55 to 160 kW (0.75 to 200 HP)
3AFE64291275 (English)

ACS800-11/U11 Hardware Manual 5.5 to 110 kW (7.5 to 125 HP)
3AFE68367883 (English)

ACS800-31/U31 Hardware Manual 5.5 to 110 kW (7.5 to 125 HP)
3AFE68599954 (English)

ACS800-02/U2 Hardware Manual 90 to 500 kW (125 to 600 HP)
3AFE64567373 (English)

ACS800-04 Hardware Manual 0.55 to 132 kW
3AFE68372984 (English)

ACS800-04/04M/U4 Hardware Manual 45 to 560 kW (60 to 600 HP)
3AFE64671006 (English)

ACS800-04/04M/U4 Cabinet Installation 45 to 560 kW (60 to 600 HP)
3AFE68360323 (English)

ACS800-07/U7 Hardware Manual 45 to 560 kW (50 to 600 HP)
3AFE64702165 (English)

ACS800-07/U7 Dimensional Drawings 45 to 560 kW (50 to 600 HP)
3AFE64775421

ACS800-07 Hardware Manual 500 to 2800 kW
3AFE64731165 (English)

ACS800-17 Hardware Manual 55 to 2500 kW (75 to 2800 HP)
3AFE68397260 (English)

ACS800-37 Hardware Manual 55 to 2700 kW (75 to 3000 HP)
3AFE68557925 (English)

- Safety instructions
- Electrical installation planning
- Mechanical and electrical installation
- Motor control and I/O board (RMIO)
- Maintenance
- Technical data
- Dimensional drawings
- Resistor braking

FIRMWARE MANUALS, SUPPLEMENTS AND GUIDES

(appropriate documents are included in the delivery)

Standard Application Program Firmware Manual
3AFE64527592 (English)

System Application Program Firmware Manual
3AFE64670646 (English)

Application Program Template Firmware Manual
3AFE64616340 (English)

Master/Follower 3AFE64590430 (English)

Pump Control Application Program Firmware Manual
3AFE68478952 (English)

Extruder Control Program Supplement 3AFE64648543 (English)

Centrifuge Control Program Supplement 3AFE64667246 (English)

Traverse Control Program Supplement 3AFE64618334 (English)

Crane Control Program Firmware Manual 3BSE11179 (English)

Adaptive Programming Application Guide
3AFE64527274 (English)

OPTION MANUALS (delivered with optional equipment)

Fieldbus Adapters, I/O Extension Modules etc.

du/dt Filters
FOCH0320-50
FOCH0260-70
FOCH0610-70

Hardware Manual

3AFE68577519 Rev B EN
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About this manual

What this chapter contains

The chapter describes the manual in short.

Target audience

The manual is intended for people who plan the installation, install, commission, use and service the du/dt filter. Read the manual before working on the filter. The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

The manual is written for readers worldwide. Both SI and imperial units are shown.

Safety

Only qualified specialists are allowed to install, commission and maintain the du/dt filter.



WARNING! Follow the safety instructions when installing, operating and servicing the drive. If ignored, physical injury or death may follow, or damage may occur to the drive, motor or driven equipment. Read the safety instructions before you work on the unit.

ACS800-01, ACS800-U1

Follow the safety instructions given in *ACS800-01/U1 Hardware Manual* [3AFE64382101 (English)].

ACS800-02, ACS800-U2

Follow the safety instructions given in *ACS800-02/U2 Hardware Manual* [3AFE64567373 (English)].

ACS800-04, ACS800-04M, ACS800-U4

Follow the safety instructions given in *ACS800-04 Hardware Manual 0.55 to 132 kW* [3AFE68372984 (English)] or *ACS800-04/04M/U4 Hardware Manual 45 to 560 kW* [3AFE64671006 (English)].

Mechanical installation and service

These instructions are intended for all who install and service the du/dt filter.



WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- The filter is heavy. Lift the filter by the lifting holes only.
- Ensure sufficient cooling.
- Ensure that the filter is grounded by the four fastening screws.
- Beware of hot surfaces. The surface temperature of the du/dt filter can exceed 150 °C (302 °F) during operation. Let the filter cool off for two hours before servicing it.



Contents

The chapters of this manual are briefly described below.

About this manual describes the manual.

Filter selection advises on selecting the appropriate du/dt filter for the drive.

Installation instructions contains mechanical and electrical installation instructions.

Technical data contains the technical specifications of the du/dt filter and its installation.

Dimensional drawings contains the dimensional drawings of the du/dt filters.

Liability

The installation examples in this manual are provided to help the installer in designing his/her installation.

Note: The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations.

Filter selection

What this chapter contains

The chapter advises on selecting the appropriate du/dt filter for the drive.

Output voltage of the drive

The output voltage waveform of an IGBT inverter generates voltage spikes higher than the intermediate circuit DC voltage of the drive at the motor terminals. The voltage spikes with the high du/dt values of the inverter can cause additional stress on the motor and motor cable insulation. This may shorten the motor life. Optional ABB du/dt filters protect the motor insulation system.

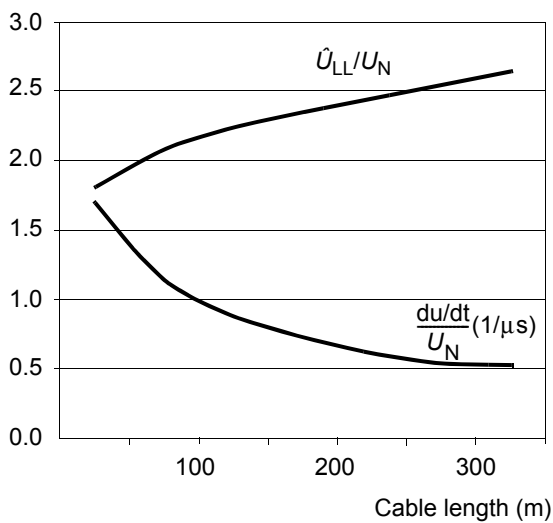
Graphs

The graphs below show the peak line-to-line voltage (\hat{U}_{LL}) and voltage change (du/dt) at the motor terminals as a function of the motor cable length. \hat{U}_{LL} and du/dt are scaled to the nominal line-to-line voltage (U_N). To calculate the actual peak voltage value in volts and du/dt value in volts per microsecond, multiply the values of the graph by the supply voltage (U_N).

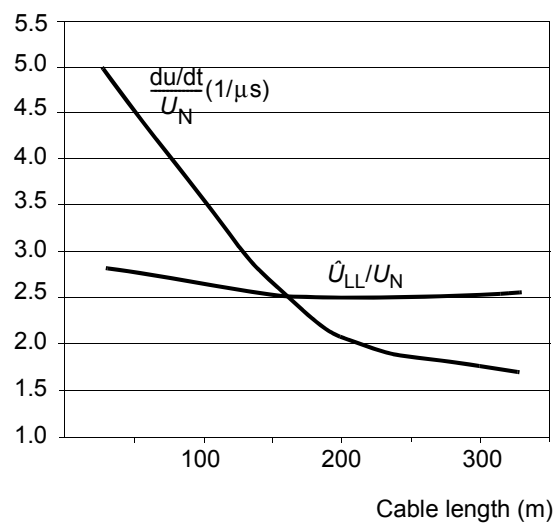
The values in the first graph are measured with an ABB du/dt filter while the second graph without any output filtering. The values in the second graph are only representative. The actual unfiltered du/dt values depend on the ACS800 drive type, and are usually in the range of 1 to 5 kV/microsecond.

In case of drives with an IGBT supply unit or resistor braking, the \hat{U}_{LL} and du/dt values are approximately 20% higher.

The voltage rise time can be calculated as follows: $\Delta t = 0.8 \cdot \hat{U}_{LL}/(du/dt)$.



With du/dt Filter



Without du/dt Filter

Filter selection

Step	What to do	See section	More information
1	Select a filter according to the drive type.	Filter selection table	The selected filter is suitable for most applications.
2	Check that the filter is suitable for your application regarding the cabling and load.	Checks	If the checks are passed, the filter selection is OK. If one of the conditions is not fulfilled, choose a bigger filter *, use two filters in series or different motor cabling.

* FOCH0260-70 cannot be replaced with a bigger filter due to the higher inductance in the FOCH0260-70.

Filter selection table

The du/dt filter types for ACS800-01/U1, ACS800-02/U2 and ACS800-04/U4/04M drives are given below. Check that the selected filter fulfils the requirements described under section [Checks](#).

ACS800-01/U1/02/U2/04/04M/U4 type			Frame size	du/dt filter type
400 V	500 V	690 V		
-	-	-0145-7	R6	FOCH0260-70
-0135-3	-0165-5	-0175-7	R6	FOCH0260-70
-0165-3	-0205-5	-0205-7	R6	FOCH0260-70
-	-	-0140-7	R7	FOCH0260-70
-0140-3	-0170-5	-0170-7	R7	FOCH0260-70
-0170-3	-0210-5	-0210-7	R7	FOCH0260-70
-0210-3	-0260-5	-0260-7	R7	FOCH0260-70
-0260-3	-0270-5	-	R8	FOCH0320-50
-	-0300-5	-	R8	FOCH0320-50
-	-0320-5	-	R8	FOCH0320-50
-0320-3	-0400-5	-0320-7	R8	FOCH0610-70
-0400-3	-0440-5	-0400-7	R8	FOCH0610-70
-0440-3	-0490-5	-0440-7	R8	FOCH0610-70
-0490-3	-0550-5	-0490-7	R8	FOCH0610-70
-	-0610-5	-0550-7	R8	FOCH0610-70
-	-	-0610-7	R8	FOCH0610-70

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Note: FOCH0610-70 can always be used instead of FOCH0320-50.

Checks

Long or several parallel motor cables, or special cable types may cause additional temperature rise in the filter. Therefore, check that the filter selected on the basis of the filter selection table, fulfils the application requirements:

- The motor cable length does not exceed the maximum allowed motor cable length given in the drive hardware manual.
- The energy loss in the du/dt filter does not exceed the maximum allowed value (E_{\max}) given in section [Maximum values table](#). The energy loss is calculated as follows:

$$E = \frac{1}{2} \cdot C \cdot (U_{\text{dc}})^2 \text{ where}$$

E $\hat{=}$ additional energy loss in the du/dt filter caused by the motor cable capacitances

C $\hat{=}$ total capacitance of the motor cable(s), i.e. the product of the capacitance/length value given in the cable catalogue and the length of the motor cable. In case of many motor cables, the total capacitance is the sum of the individual cable capacitances.

U_{dc} $\hat{=}$ average intermediate circuit DC voltage of the drive = approximately $1.35 \cdot U_{\text{N}}$

U_{N} $\hat{=}$ supply voltage.

- The current flow through the filter does not exceed the maximum allowed value given in section [Maximum values table](#).

Maximum values table

This table gives maximum allowed rms current (I_{thmax}) and energy dissipation (E_{max}) values for the du/dt filters. The filter will not overheat when these values are not exceeded.

Du/dt filter type	I_{thmax}^* (A)	E_{max} (mJ)
FOCH0260-70	289	200
	230	280
FOCH0320-50	445	260
	361	340
FOCH0610-70	720	120
	560	180
	445	260

* In temperatures above +40 °C (+104 °F) and/or altitudes above 1000 m (3281 ft), derate the I_{thmax} values as instructed on page 19.

Calculation example

An FOCH0610-70 du/dt filter has been selected for a drive which supplies three motors with the following cables in parallel:

- 100 m MCMK 3×50+16, $C = 0.6$ microF/km, $I_{th1} = 105$ A.
- 250 m MCMK 3×70+35, $C = 0.65$ microF/km, $I_{th2} = 148$ A.
- 300 m MCMK 3×120+70, $C = 0.8$ microF/km, $I_{th3} = 210$ A.

The total capacitance of the motor cables

$$C = 0.1 \times 0.6 \text{ microF} + 0.25 \times 0.65 \text{ microF} + 0.3 \times 0.8 \text{ microF} = 463 \text{ nF.}$$

The total continuous rms current of the motors

$$I_{th} = I_{th1} + I_{th2} + I_{th3} = 463 \text{ A.}$$

The supply voltage (U_N) is 660 V. Thus, the average intermediate circuit DC voltage of the drive

$$U_{dc} = 1.35 \times U_N = 1.35 \times 660 \text{ V} = 891 \text{ V.}$$

The additional energy loss in the du/dt filter

$$E = \frac{1}{2} \cdot C \cdot (U_{dc})^2 = \frac{1}{2} \times 463 \text{ nF} \times (891 \text{ V})^2 = 184 \text{ mJ.}$$

When 463 A and 184 mJ are compared to the values of *Maximum values table*, it can be seen that a filter of type FOCH0610-70 can be used.

Installation instructions

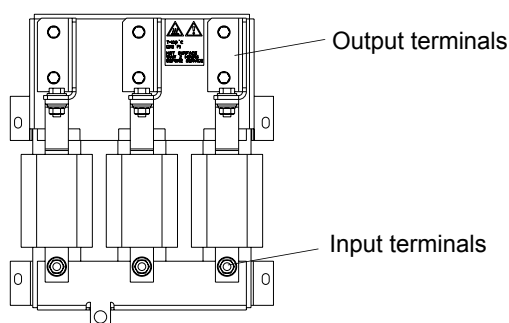
What this chapter contains

The chapter contains mechanical and electrical installation instructions.

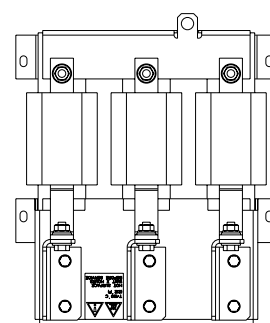
Planning the installation

See chapter [Technical data](#) for allowed ambient conditions, maximum cable length between the drive output and the filter, maximum motor cable length and other technical data.

See chapter [Dimensional drawings](#) for the dimensions and fastening holes. The filter can be mounted in an upright position with the output terminals up or down. Other mounting positions are possible with an extra fan.



Recommended mounting position



Alternative mounting position

Mounting plate

The filter must be mounted on a grounded metal plate or cabinet frame, or grounded separately. The structure must be of non-flammable material and strong enough to carry the weight of the unit.

Encasing

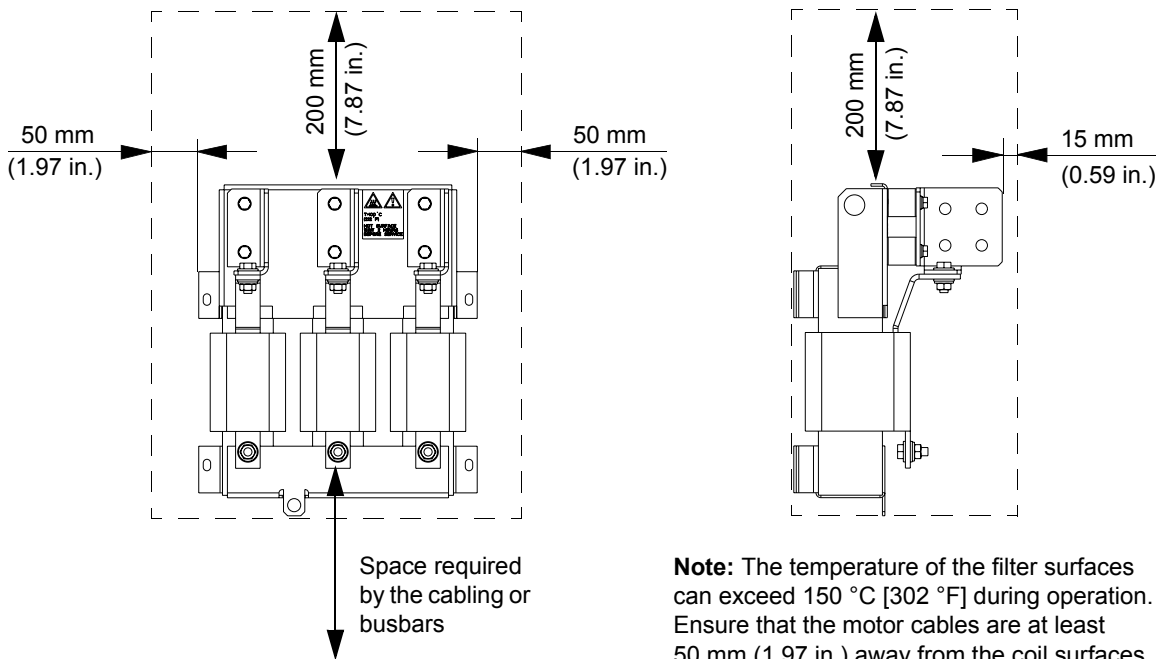
The unprotected (IP00) filter must be encased or placed in a cabinet according to the local safety requirements.

Electrical connections

Busbars are recommended for connections to the filter input terminals. If cables are used, they must be rated for at least 105 °C (221 °F). If the filter is not installed in the same cabinet as the drive, shielded symmetrical cable must be used between the drive cabinet and the filter enclosure.

Free space around the filter

Free space is required around the unit for cooling as follows. The distances apply to natural convection. With forced cooling, less free space is required.



Clearance distances from the input and output terminals and coil surfaces

Busbar and enclosure clearance distances from the input and output terminals and coil surfaces must be at least 15 mm (0.59 in.). Pay attention to the local regulations.

Note: Due to high temperature of the coil surfaces during operation, route the motor cables at least 50 mm (1.97 in.) away from the coil surfaces and secure them appropriately.

Cooling

The filters are designed to cool by natural convection. Ensure that there is enough fresh cooling air available and that the hot air can freely escape from the filter enclosure or cubicle. The air space above the filter is hot [up to 70 °C (158 °F) depending on the installation and operating conditions]. Take this into account in the cabinet design.

Tightening torques

The following table applies to grade 8.8 screws with or without joint compound.

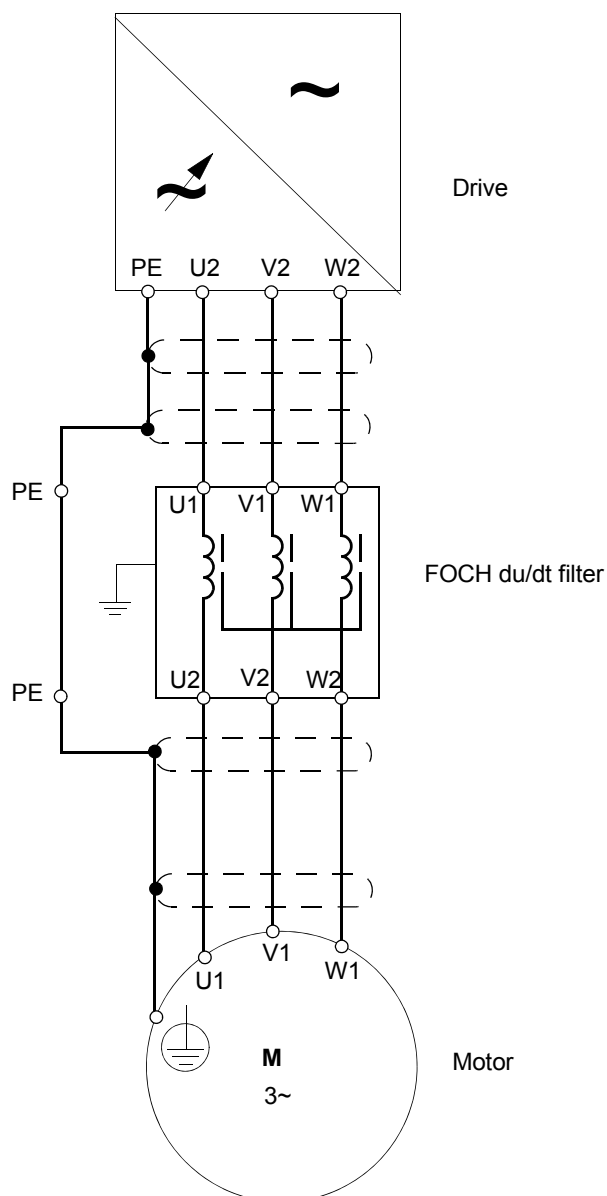
Screw size	Torque	
	Nm	lbf ft
M5	3.5	2.6
M6	9	6.6
M8	20	14.8
M10	40	29.5
M12	70	51.6
M16	180	132.8

Mechanical installation

Lift the filter by the lifting holes to the installation position. Fasten the filter with four screws at the fastening points in the mounting legs or with FOCH0320-50 and FOCH0610-70 alternatively with two screws in the upper mounting leg and four screws in the base plate of the filter core. See chapter [Dimensional drawings](#) for the dimensions and fastening holes.

Note: The fastening screws ground the filter electrically to the mounting plate. See section [Mounting plate](#).

Electrical installation



Grounding



WARNING! The filter is grounded by the four fastening screws. Ensure that the assembly surface is in electrical connection with the factory ground and that the surface is clean and unpainted.

Connections to input terminals U1, V1, W1

The input terminals (U1, V1, W1) of the filter are made of aluminium. Use cable lugs suitable for aluminium busbars and joint grease to avoid corrosion and to ensure good electrical connection. The oxide layer must be scrubbed off from the joints before applying the grease. It is recommended

- to use screws included in the delivery
- to retighten the connections 30 minutes after their installation.

Output terminals U2, V2, W2

The output terminals (U2, V2, W2) of the filter are tin-plated copper.

Strain relief of cables

Secure the cables mechanically.

Technical data

This chapter contains the technical specifications of the du/dt filter and its installation.

Input voltage (U_1): 380 ... 500 VAC 3-phase \pm 10%, 380 ... 690 VAC 3-phase \pm 10%.

Ratings, weights and maximum cable sizes:

Filter type	FOCH0320-50	FOCH0260-70	FOCH0610-70
Order code	68612209	68490308	68550505
U_N (V)	500	690	690
I_N (A)	445	289	720
L (microH)	22	35	22
Power loss (W)	520	370	760
Weight (kg, lb)	65 (143)	47 (104)	65 (143)
Maximum motor cable size in mm ²	3x(3x240)	3x(3x240)	3x(3x240)
Output connection size	M12	M12	M12
Input connection size	M12	M10	M12

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Derating:

The load capacity (current and power) decreases if the installation site altitude exceeds 1000 metres (3281 ft), or if the ambient temperature exceeds 40 °C (104 °F).

Temperature derating

In the temperature range +40 °C (+104 °F) to +50 °C (+122 °F), the rated output current is decreased 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 $100\% - 1 \frac{\%}{^\circ\text{C}} \cdot 10 \text{ }^\circ\text{C} = 90\%$ or 0.90. The output current is then $0.90 \cdot I_{\text{thmax}}$. For I_{thmax} , see [Maximum values table](#) on page 12.

Altitude derating

At altitudes from 1000 to 4000 m (3281 to 13123 ft) above sea level, the derating is 1% for every 100 m (328 ft). For a more accurate derating, use the *DriveSize* PC tool. The value calculated for the drive applies also to its du/dt filter.

Maximum drive output frequency: 120 Hz

Maximum cable length between the drive output and the filter: 3 m

Maximum motor cable length: 300 m. See also section [Checks](#) on page 11.

Degree of protection: IP00

Applicable standards and markings: EN 60204-1, EN 60529, EN 61800-3, EN 50178, CE marking, UL approved insulation system, cUL approval pending.

Ambient conditions

Environmental limits for the du/dt filter are given below. The du/dt filter 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 4000 m (13123 ft) above sea level [above 1000 m (3281 ft), see <i>Derating</i> on page 19.]	-	-
Air temperature	-15 to +50 °C (5 to 122 °F). See <i>Derating</i> on page 19.	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Relative humidity	5 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.		
	Chemical gases: Class 3C2 Solid particles: Class 3S2	Chemical gases: Class 1C2 Solid particles: Class 1S3	Chemical gases: Class 2C2 Solid particles: Class 2S2
Atmospheric pressure	70 to 106 kPa 0.7 to 1.05 atmospheres	70 to 106 kPa 0.7 to 1.05 atmospheres	60 to 106 kPa 0.6 to 1.05 atmospheres
Vibration (IEC 60068-2)	Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s ² (23 ft/s ²) (13.2 to 100 Hz) sinusoidal	Max. 1 mm (0.04 in.) (5 to 13.2 Hz), max. 7 m/s ² (23 ft/s ²) (13.2 to 100 Hz) sinusoidal	Max. 3.5 mm (0.14 in.) (2 to 9 Hz), max. 15 m/s ² (49 ft/s ²) (9 to 200 Hz) sinusoidal
Shock (IEC 60068-2-29)	Not allowed	Max. 100 m/s ² (330 ft./s ²), 11 ms	Max. 100 m/s ² (330 ft./s ²), 11 ms
Free fall	Not allowed	203 mm (7.99 in.)	203 mm (7.99 in.)

Dimensional drawings

The dimensions are given in millimetres and [inches] below.

FOCH0320-50 and FOCH0610-70

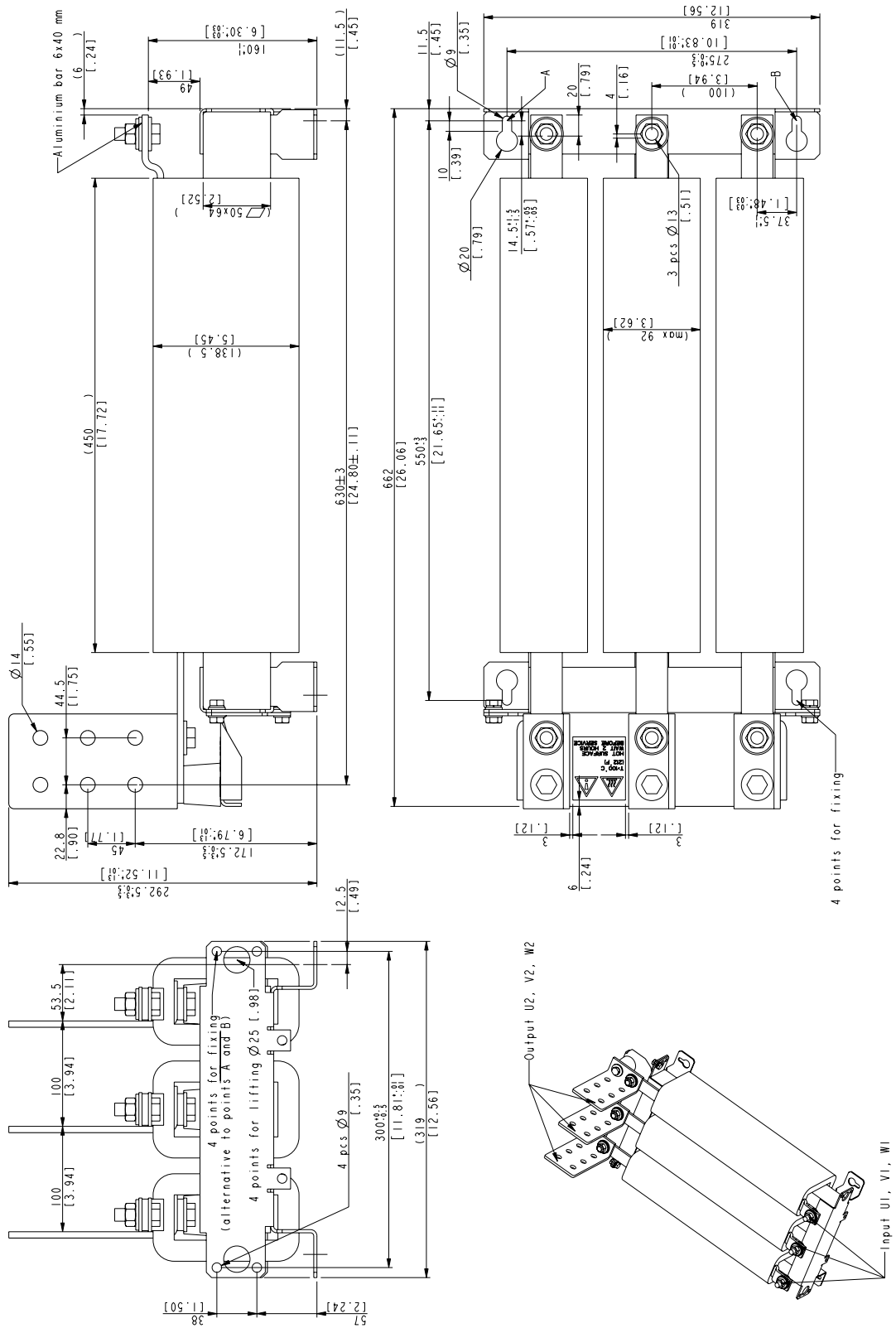




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