
ABB INDUSTRIAL DRIVES

ACS880 multidrive for high-speed test benches

Supplement

ACS880 multidrive for high-speed test benches

Supplement

Table of contents



Table of contents

1 Safety

Electrical safety precautions	9
Additional instructions and notes	10
Optical components	11
Printed circuit boards	11
Hot surfaces	11
Additional instructions for permanent magnet motor drives	12
Safety in installation, start-up, maintenance	12
Safety in operation	12

2 Introduction

3 Description of the high-speed option

The BLHF-2x-7 filter	17
BLHF-2x-7 layout and connections	18
Terminal block X30	19
Type designation label	19
Connection diagram	20
Ordering information	21
Cabinet-built ACS880 multidrives	21
Restrictions and notes	21
Layout	22
ACS880 multidrive modules	22

4 Planning the drive system

Dimensioning flowchart	23
Loading of BLHF filters	24
Output contactor	25
Supply network	25
EMC compliance	25
Brake chopper	25
Encoder	26
Mechanical design	26
IGBT supply unit dimensioning	27

5 Start-up

Preparing the Drive Composer pro PC tool	29
Special settings related to high-speed drives	31
Limits	31
Dual use and maximum output frequency	31
Voltage reserve	32
Switching frequency reference	32
Internal speed limitation	32
Encoder drift detection	32
Overcurrent fault limit	32



Motor temperature protection	32
Motor ambient temperature	32
Motor model temperature adaptation	33
Encoder settings	33
Encoder interface	33
Example: EnDat absolute encoder	33
Checking the encoder position signal	35
Verifying that the rotor position is known by motor control	36
Motor parameter settings	36
Identification (ID) run	37
Performing a Standstill ID run and checking the direction of rotation	37
Activating encoder feedback	38
Performing a Normal ID run	38
Autophasing	39
Starting the drive	40

6 Maintenance

Fans	44
Replacing the fan of the filter	44
Replacing the filter module	45

7 Technical data

BLHF filter modules	51
Definitions	51
Current derating	52
Power loss	52
Noise	52
Auxiliary circuit current consumption	53
Definitions	53
Inverter units for increased switching frequency	53
Definitions	54
Switching frequency and output frequency derating	54
Ambient temperature and altitude derating	54
Inverter modules used	55
Surrounding air temperature	55
Maximum motor cable length	55
Protection classes	56
Weights	56
Dimensions	56
Cabinet-built filter unit	56
Filter module	57
BLFH-2x-7 internal circuit diagram	58
Circuit diagram example: ACS880-104 with BLHF filter	60
001a	60
002a	61
004a	62
005a	63
006a	64
020a	65
020b	66
021a	67

040a	68
040b	69
040c	70
040d	71
041a	72
061a	73
061b	74
095a	75

Further information



1

Safety

Electrical safety precautions

These electrical safety precautions are for all personnel who do work on the drive, motor cable or motor.

**WARNING!**

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrical professional, do not do installation or maintenance work.

Do these steps before you begin any installation or maintenance work.

1. Clearly identify the work location and equipment.
 2. Disconnect all possible voltage sources. Make sure that re-connection is not possible. Lock out and tag out.
 - Open the main disconnecting device of the drive.
 - Open the charging switch if present.
 - Open the disconnecter of the supply transformer. (The main disconnecting device in the drive cabinet does not disconnect the voltage from the AC input power busbars of the drive cabinet.)
 - If the drive is equipped with a DC/DC converter unit (optional) or a DC feeder unit (optional): Open the DC switch-disconnector ([Q11], option +F286 or +F290) of the unit. Open the disconnecting device of the energy storage connected to the unit (outside the drive cabinet).
 - Open the auxiliary voltage switch-disconnector (if present), and all other possible disconnecting devices that isolate the drive from dangerous voltage sources.
-

- If you have a permanent magnet motor connected to the drive, disconnect the motor from the drive with a safety switch or by other means.
 - Disconnect all dangerous external voltages from the control circuits.
 - After you disconnect power from the drive, always wait 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
 4. Take special precautions when close to bare conductors.
 5. Measure that the installation is de-energized. Use a quality voltage tester. If the measurement requires removal or disassembly of shrouding or other cabinet structures, obey the local laws and regulations applicable to live working (including – but not limited to – electric shock and arc protection).
 - Before and after measuring the installation, verify the operation of the voltage tester on a known voltage source.
 - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is zero.
 - Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is zero.

Important! Repeat the measurement also with the DC voltage setting of the tester. Measure between each phase and ground. There is a risk of dangerous DC voltage charging due to leakage capacitances of the motor circuit. This voltage can remain charged for a long time after the drive power-off. The measurement discharges the voltage.
 - Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding (PE) terminal is zero. In cabinet-built drives, measure between the drive DC busbars (+ and -) and the grounding (PE) busbar.
 6. Install temporary grounding as required by the local regulations.
 7. Ask for a permit to work from the person in control of the electrical installation work.

Additional instructions and notes



WARNING!

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrical professional, do not do installation or maintenance work.

- Keep the cabinet doors closed when the drive is powered. With the doors open, a risk of a potentially fatal electric shock, arc flash or high-energy arc blast exists.
 - Make sure that the electrical power network, motor/generator, and environmental conditions agree with the drive data.
 - Do not do insulation or voltage withstand tests on the drive.
 - If you have a cardiac pacemaker or other electronic medical device, keep away from the area near motor, drive, and the drive power cabling when the drive is in operation. There are electromagnetic fields present which can interfere with the function of such devices. This can cause a health hazard.
-

- ABB does not recommend attaching the cabinet by arc welding. If you have to, obey the welding instructions in the drive manuals.
- Remove the code labels attached to mechanical parts such as busbars, shrouds and sheet metal parts before installation. They may cause bad electrical connections, or, after peeling off and collecting dust in time, cause arcing or block the cooling air flow.

Note:

- When the drive is connected to the input power, the motor cable terminals and the DC bus are at a dangerous voltage.
After disconnecting the drive from the input power, these remain at a dangerous voltage until the intermediate circuit capacitors have discharged.
- External wiring can supply dangerous voltages to the relay outputs of the control units of the drive.
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is not effective against deliberate sabotage or misuse.

■ Optical components

**WARNING!**

Obey these instructions. If you ignore them, damage to the equipment can occur.

- Handle the fiber optic cables with care.
- When you unplug the fiber optic cables, always hold the connector, not the cable itself.
- Do not touch the ends of the fibers with bare hands as the ends are extremely sensitive to dirt.
- Do not bend the fiber optic cables too tightly. The minimum allowed bend radius is 35 mm (1.4 in).

■ Printed circuit boards

**WARNING!**

Use a grounding wristband when you handle printed circuit boards. Do not touch the boards unnecessarily. The boards contain components sensitive to electrostatic discharge.

Hot surfaces

**WARNING!**

Beware of hot surfaces. Some parts, such as the inside surfaces of the filter cubicle, heatsinks of power semiconductors, and brake resistors, become hot during use and remain hot for a while after disconnection of the electrical supply.

Additional instructions for permanent magnet motor drives

■ Safety in installation, start-up, maintenance

These are additional warnings concerning permanent magnet motor drives. The other safety instructions in this chapter are also valid.



WARNING!

Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

If you are not a qualified electrical professional, do not do installation or maintenance work.

- Do not do work on the drive when a rotating permanent magnet motor is connected to it. A rotating permanent magnet motor energizes the drive including its input and output power terminals.

Before installation, start-up and maintenance work on the drive:

- Stop the drive.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like belt, nip, rope, etc.
- Do the steps in section [Electrical safety precautions \(page 9\)](#).
- If the motor is connected to an inverter unit with a DC switch-disconnector, open the disconnector, lock it, and tag it. If the motor is connected to an inverter unit without the DC switch, remove the fuses in between the inverter module(s) and the drive DC link.
- Install temporary grounding to the drive output terminals (T1/U, T2/V, T3/W). Connect the output terminals together as well as to the PE.

During the start-up:

- Make sure that the motor cannot run overspeed, for example, driven by the load. Motor overspeed causes overvoltage that can damage or destroy the capacitors in the intermediate circuit of the drive.

■ Safety in operation



WARNING!

Make sure that the motor cannot run overspeed, for example, driven by the load. Motor overspeed causes overvoltage that can damage or destroy the capacitors in the intermediate circuit of the drive.

2

Introduction

This supplement describes the high-speed drive option available as part of the ACS880 multidrive product offering. The option is available for both cabinet-built ACS880 multidrive and ACS880 multidrive modules.

The supplement includes a description of the option as well as additional dimensioning, start-up and maintenance instructions, and technical data. Apart from what is stated in this supplement, the standard instructions delivered with the drive apply. See

- [*ACS880 multidrive cabinets and modules safety instructions \(3AUA0000102301 \[English\]\)*](#)
 - [*ACS880 multidrive cabinets and modules electrical planning instructions \(3AUA0000102324 \[English\]\)*](#)
 - Cabinet-built ACS880 multidrive: [*ACS880-107 inverter units hardware manual \(3AUA0000102519 \[English\]\)*](#)
 - Cabinet-built ACS880 multidrive: [*ACS880 multidrive cabinets mechanical installation instructions \(3AUA0000101764 \[English\]\)*](#)
 - ACS880 multidrive modules: [*ACS880-104 inverter modules hardware manual \(3AUA0000104271 \[English\]\)*](#)
 - ACS880 multidrive modules: [*Drive modules cabinet design and construction instructions \(3AUA0000107668 \[English\]\)*](#).
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3

Description of the high-speed option

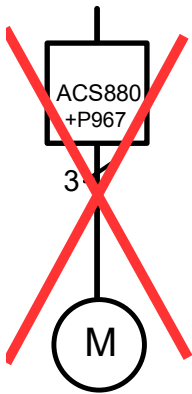
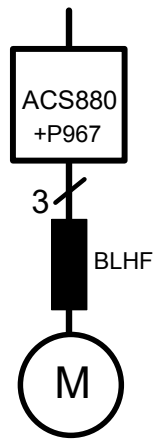
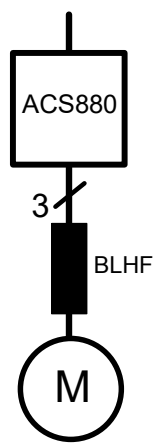
The high-speed option is intended for test bench applications with high-speed permanent magnet motors rotating at up to 25000 rpm (with 3 pole pairs, corresponding to a maximum frequency of 1250 Hz). The option involves installing a BLHF-2x-7 filter to the drive output.

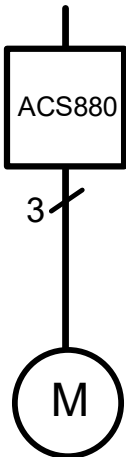
High output frequencies inherently require high switching frequencies. With inverter modules and units, option code +P967 denotes hardware that enables switching frequencies up to 13.33 kHz for 400 and 500 V modules and up to 12 kHz for 690 V modules. See [Inverter units for increased switching frequency \(page 53\)](#).

The standard control program supports output frequencies up to 598 Hz. For higher output frequencies, the inverter unit must be equipped with dual-use license +N8200.

Note: Drives that are able to operate above 600 Hz are considered dual-use goods, and can be subject to export and import restrictions.

16 Description of the high-speed option

	<u>Inverter modules with +P967, no BLHF filter</u> NOT ALLOWED. The du/dt of the motor voltage increases potentially enough to damage the insulation. (Inverter modules with +P967 are not able to sufficiently limit the du/dt.)
	<u>Inverter modules with +P967; BLHF filter when output filter is requested by motor data sheet</u> OK for a maximum switching frequency of 13.3 kHz (with 400...500 V units) or 12 kHz (with 690 V units) In the diagram, "BLHF" denotes either • ACS880 cabinet-built multidrive option +E230, +E231 or +2E231, or • BLHF-2x-7 filter module(s) available in the ACS880 multidrive modules product offering.
	<u>Inverter modules without +P967; BLHF filter when output filter is requested by motor data sheet</u> OK for a maximum switching frequency of 10.5 kHz (with 400...500 V units) or 7.5 kHz (with 690 V units) In the diagram, "BLHF" denotes either • ACS880 cabinet-built multidrive option +E230, +E231 or +2E231, or • BLHF-2x-7 filter module(s) available in the ACS880 multidrive modules product offering.

 The diagram shows a square box labeled 'ACS880' representing the inverter module. A vertical line connects the bottom of the box to a circle labeled 'M' representing the motor. On this vertical line, there is a switch symbol (a diagonal line with a small circle at its end) and the number '3' next to it, indicating a 3-phase connection.	<u>Inverter modules without +P967, no BLHF filter when no output filter is requested by motor data sheet</u> OK for a maximum switching frequency of 10.5 kHz (with 400...500 V units) or 7.5 kHz (with 690 V units)
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The BLHF-2x-7 filter

The filter module is an inductor-type filter that is available in two types:

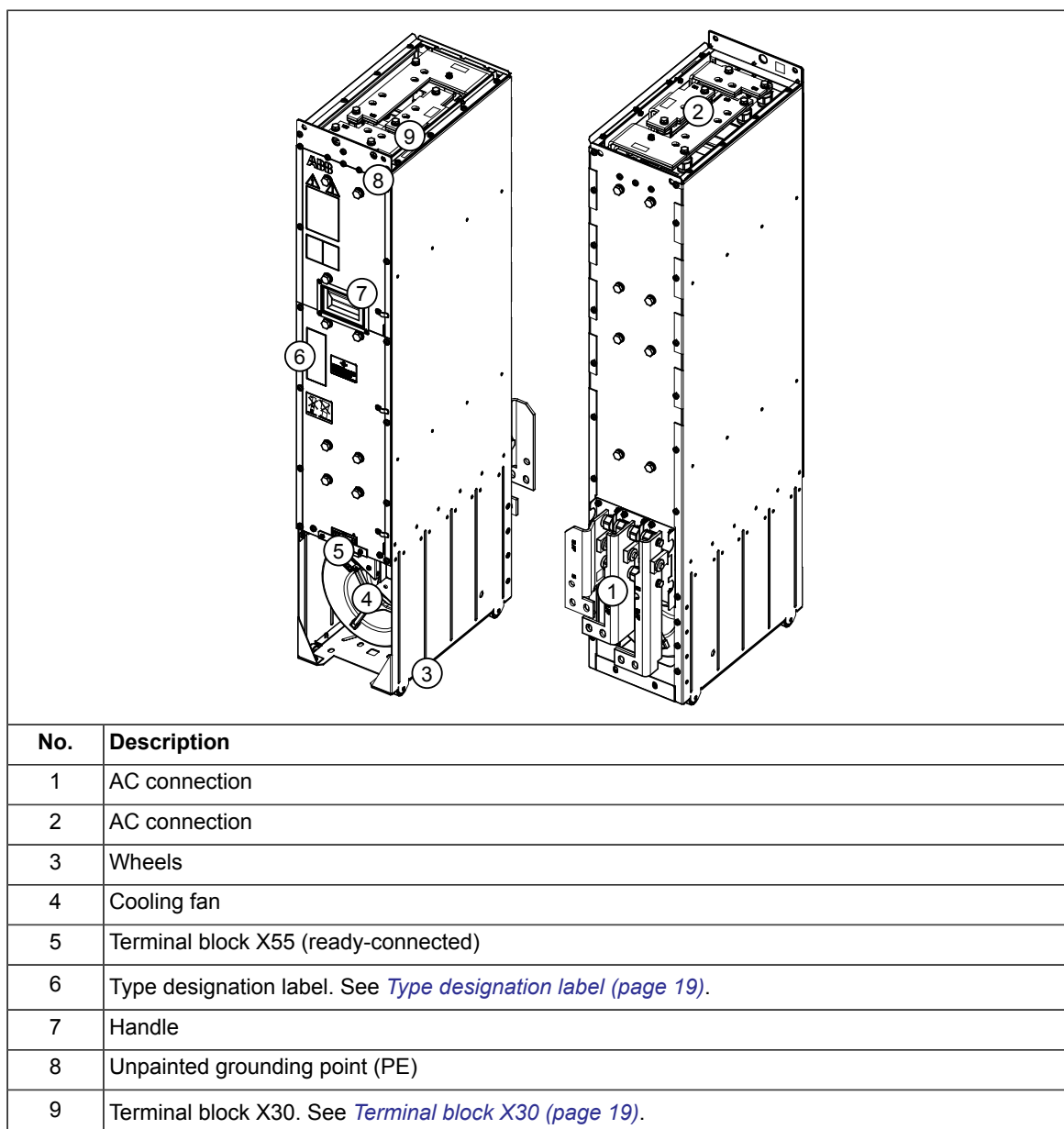
- BLHF-21-7: 40 μ H, 1400 A
- BLHF-22-7: 20 μ H, 2000 A

The suitable filter inductance should be chosen according to motor data.

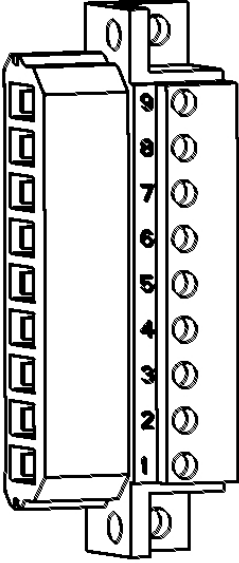
The filter module has a direct-on-line cooling fan powered by the 3-phase supply. The fan is controlled on and off by a 230/115 volt signal.

There are thermal breakers installed in the three windings as well as a fourth one in the lower part of the module.

■ BLHF-2x-7 layout and connections



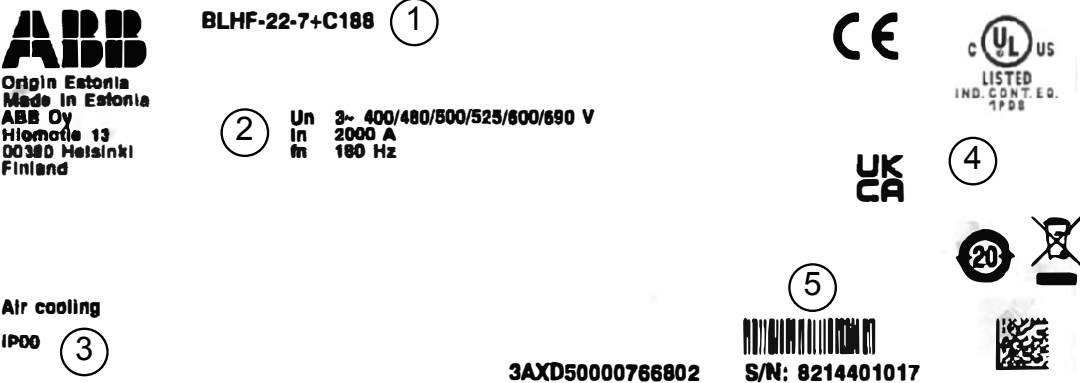
Terminal block X30

	9	Control of DOL fan contactor N (230 V AC or 115 V AC)	
	8	Control of DOL fan contactor L (230 V AC or 115 V AC)	
	7	Normally-open feedback contact 14 from DOL fan contactor	
	6	Normally-open feedback contact 13 from DOL fan contactor	
	5	TP2, thermal cutoff circuit	
	4	TP1, thermal cutoff circuit	
	3	+C188: DOL fan W	400 V AC or option +G427: 208 V AC
	2	+C188: DOL fan V	
	1	+C188: DOL fan U	

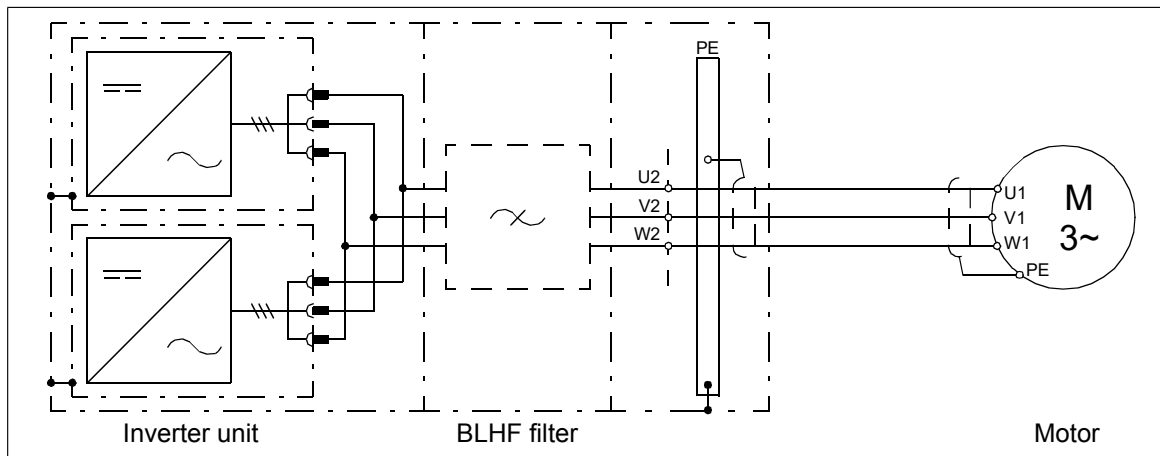
Type designation label

The type designation label includes ratings, appropriate markings, a type designation and a serial number, which allow the identification of each unit. A sample label is shown below.

Quote the complete type designation and serial number when contacting technical support.

	
1	Type designation
2	Ratings
3	Cooling method; degree of protection
4	Valid markings
5	Serial number

Connection diagram



Ordering information

■ Cabinet-built ACS880 multidrives

In a cabinet-built multidrive, the following option codes for high-speed filter units (HSFU) are selectable.

Option code	Filter type	Cubicle width (mm)	L (μH)	I_n (A)
+E230 +C188	BLHF-21-7	500	40	1400
+E231 +C188	BLHF-22-7	500	20	2000
+2E231 +C188	2 × BLHF-22-7	700	40	2000

Restrictions and notes

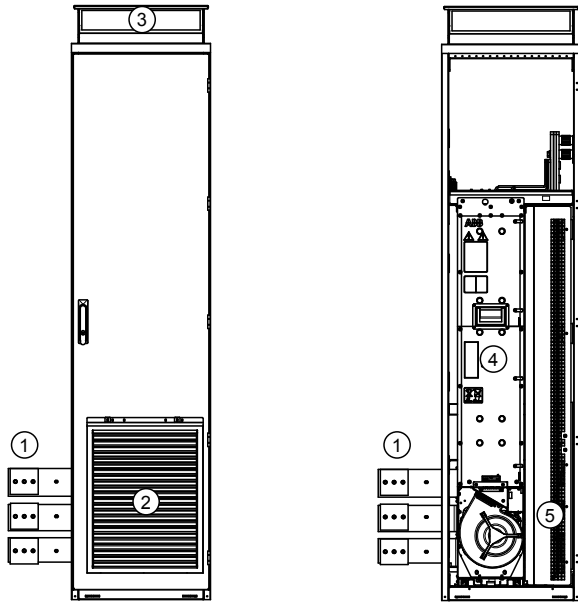
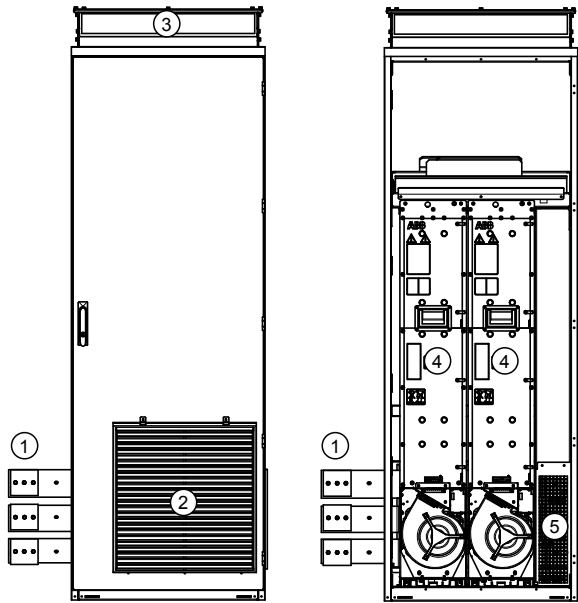
- Code +C188 denotes a 3-phase direct-on-line fan (400 V AC 50/60 Hz or 320 V AC 60 Hz).
- Option +C183 (heating element) is available for cabinet-built multidrives.
- Options +B055 (IP54 [UL Type 12] degree of protection) and +F270 (output grounding switch) are not available.
- The drive control cubicle (DCU) is located between the inverter unit and the filter unit. The standard width of the DCU is 300 mm; 400 mm is optionally available.
- A common motor terminal cubicle (OPU), output disconnect cubicle (ODU) or output contactor cubicle (OCU) is required. The table below shows the possible output configurations and output cubicle widths.

Note: An output contactor is recommended. The contactor should open whenever the drive trips on a fault. This prevents the voltage generated by a rotating motor from energizing the drive.

Option code	Common motor terminal cubicle (OPU)	Output disconnect (ODU) or contactor (OCU) cubicle
+E230 +C188	400 mm (default) 600 mm (optional)	600 mm
+E231 +C188 +2E231 +C188	400 mm (default with bottom exit) 600 mm (top exit, optional with bottom exit)	

- The stop category 1 emergency stop methods (as specified by IEC 60204-1) available for the drive are SS1-t (Safe Stop 1 time controlled, as specified by IEC 61800-5-2). SS1-r (Safe Stop 1 ramp monitored) emergency stop methods implemented with FSO-xx modules are not certified for use in the high-speed region.

Layout

HSFU with one filter module	
	
HSFU with two filter modules	
	
No.	Description
1	AC input from drive control cubicle (DCU)
2	Cooling air intake
3	Cooling air outlet
4	Filter module
5	AC output to common motor terminal cubicle (OPU), output disconnector cubicle (ODU) or output contactor cubicle (OCU)

■ ACS880 multidrive modules

Refer to *ACS880-104 inverter modules hardware manual* (3AUA0000104271 [English]).

4

Planning the drive system

Dimensioning flowchart

The following chart presents the basic dimensioning process.

Consult your local ABB representative for dimensioning assistance. (ABB representatives can refer to a dimensioning tool using document code 3AXD10000595407.)

Determine the nominal voltage of the drive according to the nominal voltage of the motor (see the motor data sheet).



Check the motor data sheet for recommended filter inductance and minimum switching frequency.



Check the motor data sheet for current requirement.



Based on the current and switching frequency, use the dimensioning tool to determine the suitable inverter unit.



Select the output filter as required by the motor data sheet. The selection is based on motor current and frequency.



Select the IGBT supply unit based on topology – either a multidrive with the power transferred between inverters by the DC link, or two separate four-quadrant drives.

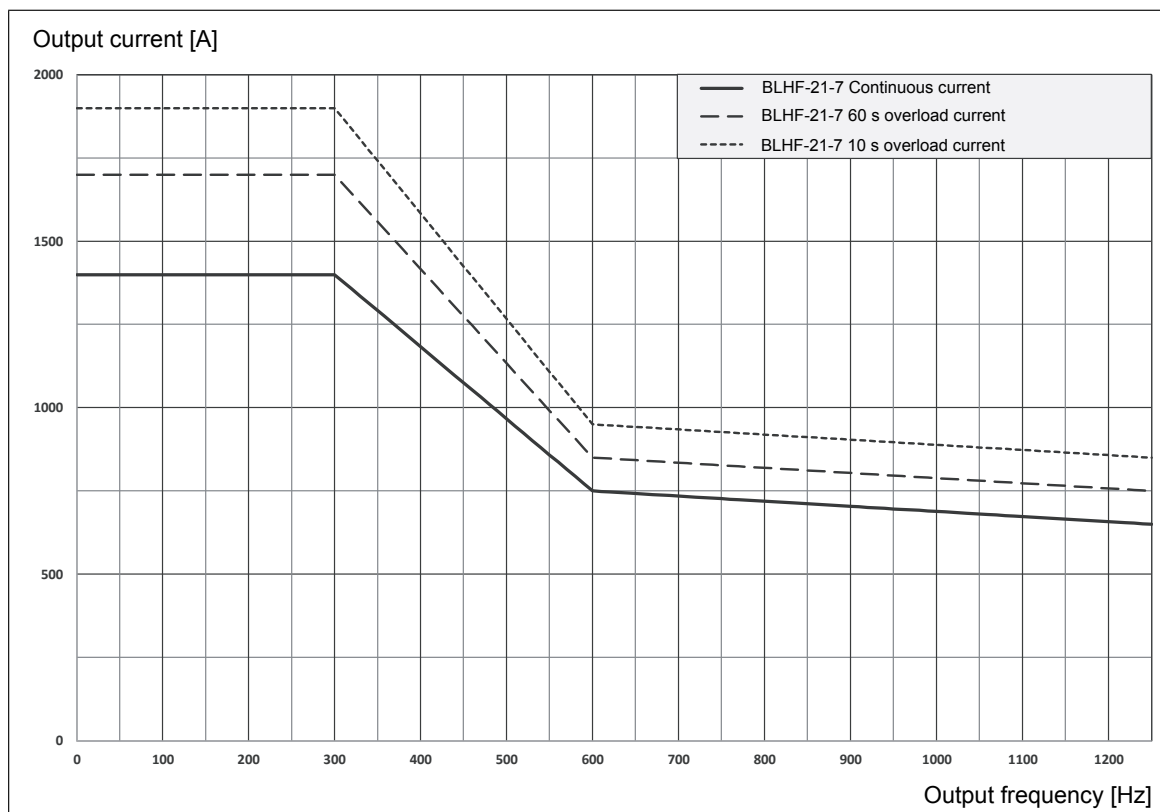
Loading of BLHF filters

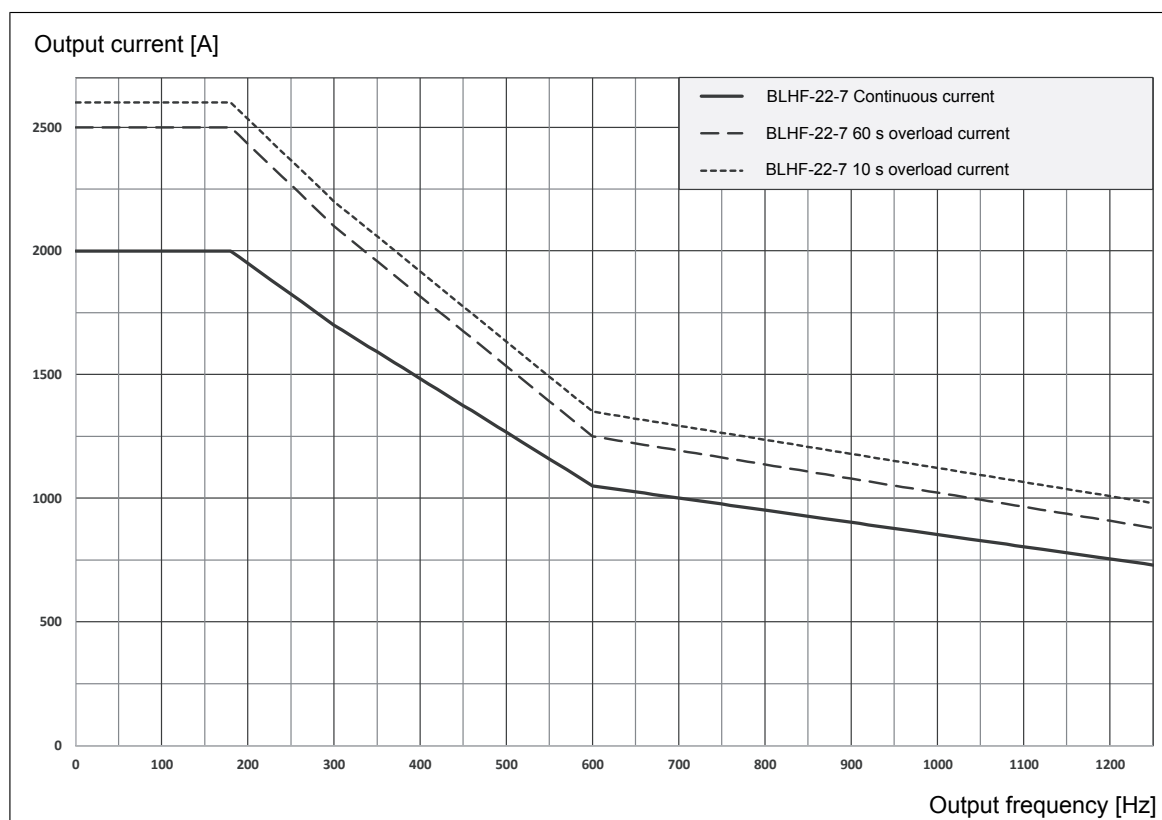
Parameter	Symbol	BLHF-21-7	BLHF-22-7
Nominal current	I_n	1400 A	2000 A
Overload current (60 seconds out of 10 minutes)	$I_{ol,60s}$	1700 A	2500 A
Overload current (10 seconds out of 10 minutes)	$I_{ol,10s} (I_{max})$	1900 A	2600 A

The filter can be overloaded for the specified time during a 10-minute period. For the remaining time of the period (t_{rest}), the thermal current (I_{rest}) must remain below the continuous current (I_{cont}).

$$I_{cont} > \sqrt{\frac{I_{ol}^2 t_{ol} + I_{rest}^2 t_{rest}}{t_{ol} + t_{rest}}}$$

The diagrams below show the allowable current as a function of output frequency for BLHF-21-7 and BLHF-22-7 respectively.





Output contactor

To improve safety in case of a short-circuit in the drive system, it is recommended to install an output contactor (or breaker) between the drive output and the motor. The contactor should open in case the drive trips on a fault.

In general, because of skin effect, the current rating of the contactor at 50/60 Hz must be derated for higher output frequencies. Consult the manufacturer of the contactor for dimensioning information.

Supply network

An IT supply network system with a dedicated transformer is recommended.

EMC compliance

Drives with high-speed filters are always category C4 as per IEC/EN 61800-3. See [ACS880 multidrive cabinets and modules electrical planning instructions \(3AUA0000102324 \[English\]\)](#).

Brake chopper

If the motor is rotating at a high speed and the AC supply is disconnected, the back-EMF voltage generated by the motor is rectified by the zero diodes in the output stage of the drive, and fed into the intermediate DC circuit. The peak voltage is $\sqrt{2} \times$ back-EMF voltage, so if the back-EMF voltage generated by the motor is high enough, the resulting DC voltage can potentially damage the drive. To avoid this, the drive can be equipped with a brake chopper and brake resistors.

For more information, see *NBRA-6xx braking choppers installation and start-up guide (3AFY 58920541 [English])*.

Encoder

The maximum pulse frequency of the encoder must be checked. With ACS880 encoder interface modules, the maximum pulse frequency is typically 500 kHz (see the technical data section of the appropriate interface manual).

To calculate, first find out

- the maximum motor speed $n_{\max}$ in rpm, and
- the number of encoder pulses per revolution.

Example: A sine-cosine encoder generates 600 pulses per revolution, and the maximum motor speed is 20000 rpm. The maximum pulse frequency equals $600 \times 20000/60 = 200000 = 200$ kHz. This is OK with an FEN-11 interface.

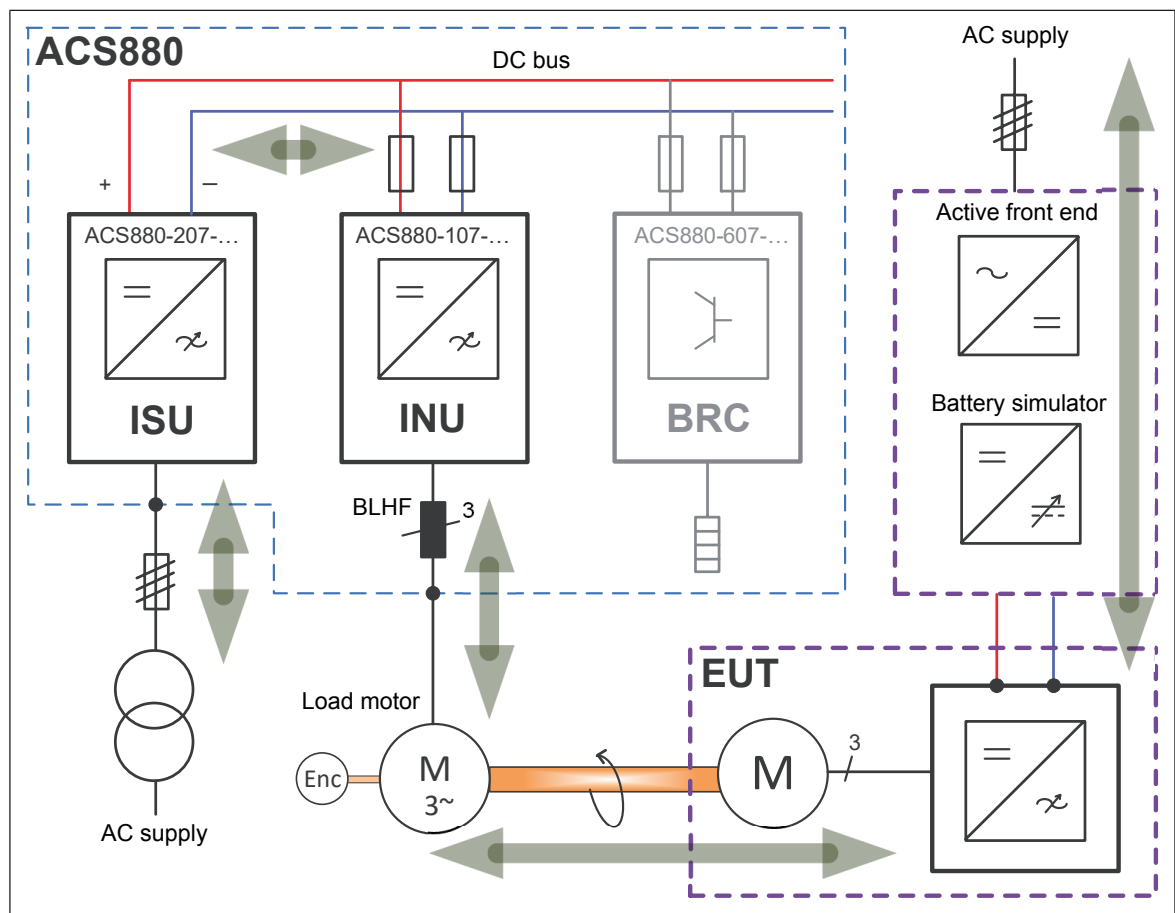
Mechanical design

The filter generates a considerable amount of heat, so no heat-sensitive components should be installed in the filter cubicle. Filter cubicle designs in IP54 are not available either for ACS880-104 or ACS880-107.

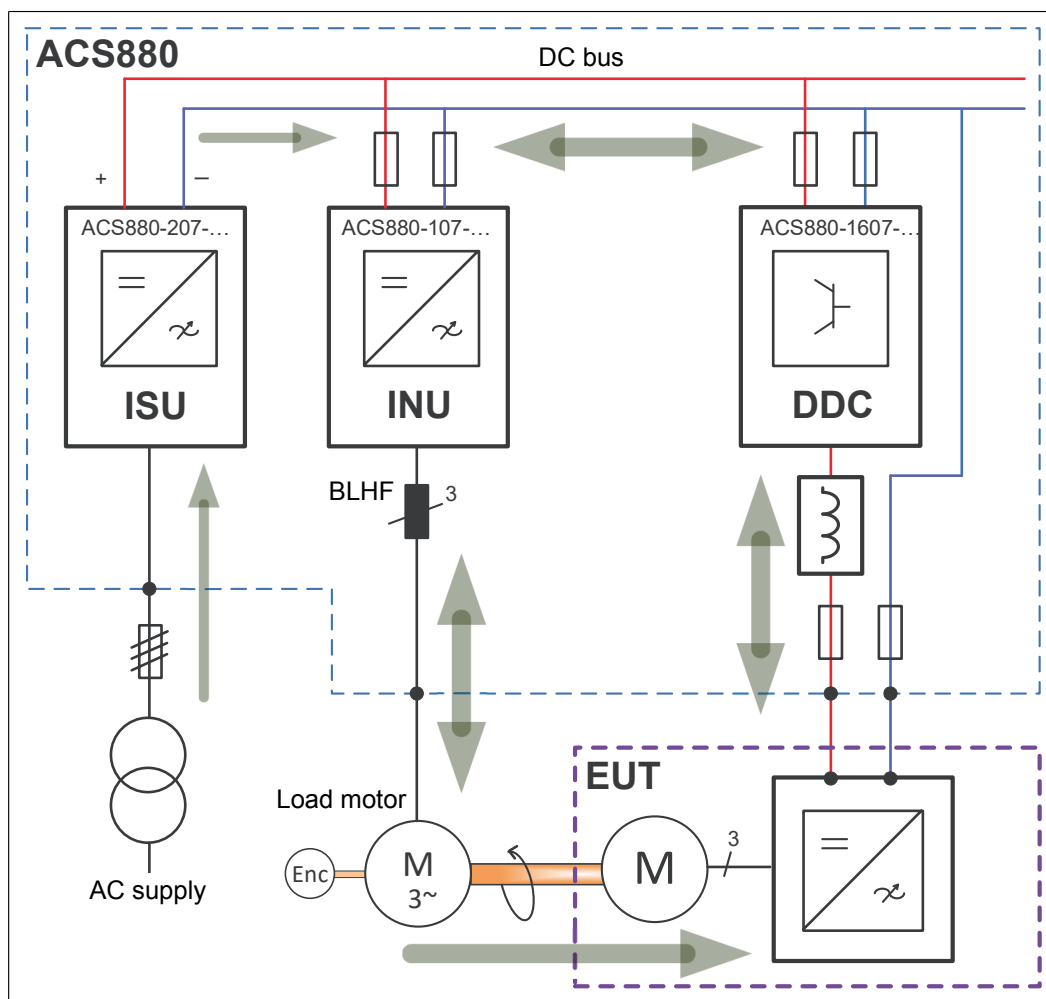
IGBT supply unit dimensioning

The dimensioning of the IGBT supply is partly dependent on whether the energy between the motors of the test setup is transferred via the DC bus or the AC supply network.

The diagram below shows a test bench setup where both the load motor and the equipment under test (EUT) are individually supplied from the AC network. The braking energy from either motor can also individually be fed back to the supply network through regenerative converters. In this setup, the IGBT supply unit (ISU) must be dimensioned to handle the full power required for the load motor. A brake chopper (BRC) and resistor can be fitted if the back-EMF voltage of the load motor is high enough to potentially cause damage if the inverter is coast-stopped at high speed.



The diagram below shows a test bench setup for electric vehicle motor converters. The converter and motor under test (EUT) is fed from a multidrive drive system through a DC/DC converter (DDC) that simulates a battery. The load motor is controlled by an inverter unit (INU) in the same drive system. The braking energy received from either motor is fed back to the DC bus of the drive, and is available for the other motor. In normal operation, the IGBT supply unit (ISU) only needs to compensate for the internal losses within the drive, and can be be dimensioned for a lower power rating than the INU (or the ISU in the previous example). However, in an emergency stop situation, the ISU must be able to handle the power that is needed for stopping the motors unless other means (such as a brake chopper) are present. The ISU must also be able to supply enough power for the motors for a successful identification (ID) run.



5

Start-up

This chapter contains settings that are specific to high-speed drives. For a general start-up sequence of the drive system, refer to the hardware manuals of the supply and inverter units.



WARNING!

Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

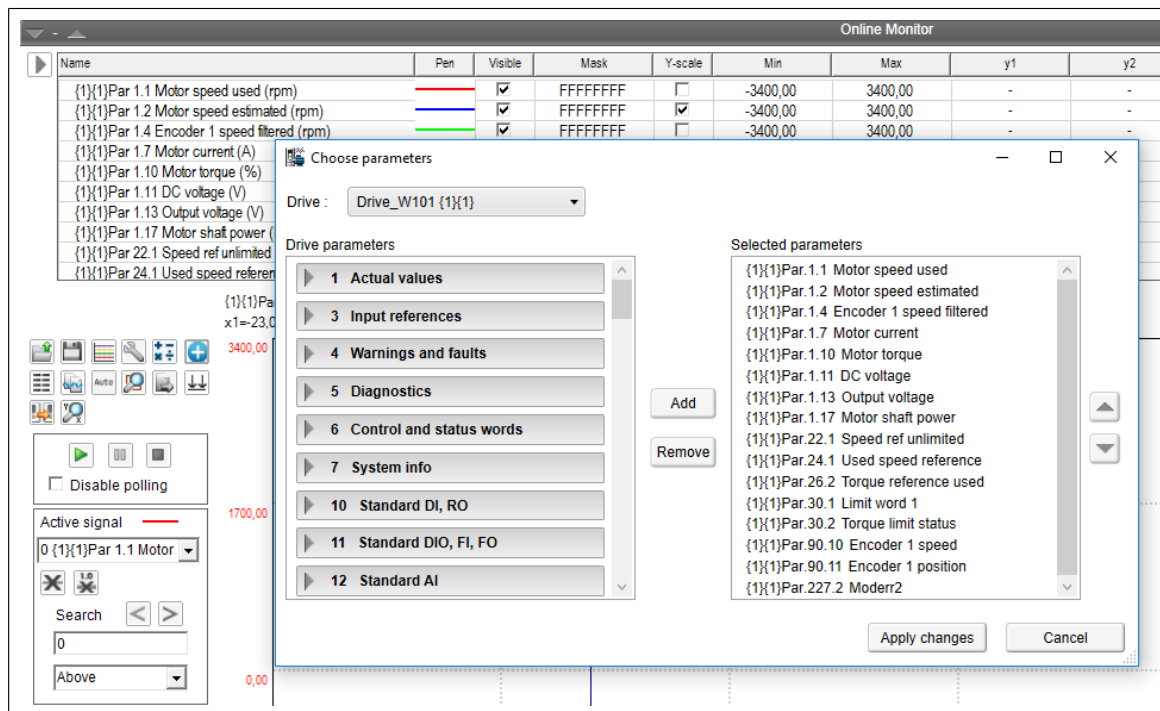
Preparing the Drive Composer pro PC tool

During commissioning, some service-level parameters need be monitored. To make those parameters visible, enter the value 170708 into parameter 96.2 *Pass code*.

96. System						
1	Language	English	NoUnit	Not selected		
2	Pass code		NoUnit			
3	Access levels active	0b0001	NoUnit	0b0000	0b1111...	0b0000

Create a measurement table by clicking .

30 Start-up



Add the following signals:

- 1.02 Motor estimated speed
- 1.04 Encoder 1 speed
- 24.02 Used speed feedback
- 1.07 Motor current
- 1.10 Motor torque
- 1.11 DC voltage
- 24.01 Used speed reference
- 26.02 Torque reference used
- 227.02 Moderr2 (error between measured and estimated speed, scaled -1...1)
- 227.03 Id filtered
- 227.04 Iq filtered
- 98.15 Position offset user
- 6.11 Main status word
- 30.01 Limit word 1
- 30.02 Torque limit status
- (90.11 Encoder position) (during encoder test).

Scale each parameter to a suitable range.

Click on the Tool button () to define the general monitor settings. Finally, click on Save.

You can re-open the same monitoring configuration later by choosing Open... . Note that, in future sessions, you will have to enable service-level parameters again to be able to record those signals.

Always start recording before you start the motor.

Special settings related to high-speed drives

■ Limits

Set parameters in group *30 Limits*:

- Maximum current limits



WARNING!

Make sure to set the current limits to either the motor nominal current values, or according to short-time motor overload current values if given in the motor data sheet. This is important because the inverter current rating can be much higher than the motor current rating because of required inverter current derating at high speeds.

- Maximum speed limits
- Overspeed trip margin
- Minimum and maximum torque limits
- Disable overvoltage control if an IGBT supply unit is in use. Use a brake chopper and resistor assembly for overvoltage protection.
- Disable undervoltage control. In case of an AC supply break, any test run in progress will be interrupted. If undervoltage control is needed during supply breaks, use a UPS to power the essential auxiliary circuits of the drive system.

■ Dual use and maximum output frequency

If an output frequency above 598 Hz is required, the inverter modules must be equipped with a dual-use license (option +N8200). The license enables higher output frequencies when bit 0 (*Dual use*) is set in parameter *95.21 HW options word 2*.

■ Voltage reserve

Use parameter *97.04 Voltage reserve* to apply a +2% voltage reserve. This is recommended with permanent magnet motors to prevent instability in the field weakening area.

■ Switching frequency reference

To enable a custom switching frequency reference setting, set parameter *97.09 Switching freq mode* to *Custom*. Check the motor data sheet for the recommended switching frequency and enter it into parameter *97.01 Switching frequency reference*. In case no switching frequency recommendation is indicated by the motor data sheet, set the parameter to at least 8...10 times the maximum motor frequency.

Note: Observe the maximum switching frequency of the inverter modules in use.

An alternative is to use an adaptive switching frequency in relation to the output frequency. To enable this, set bit 1 (*High speed mode*) in parameter *95.15 Special HW settings*. Enter the minimum switching frequency into *97.02 Minimum switching frequency*. In service-level parameter *97.26 High speed sw freq slope*, enter a value so that the output frequency multiplied by this value corresponds to the effective switching frequency.



WARNING! If adaptive switching frequency is used, make sure the current ripple caused by a lower switching frequency does not heat the motor up excessively. Consult the motor manufacturer.

■ Internal speed limitation

By default, the torque control calculates an internal, safe speed limit for the motor. If the drive is equipped with a brake chopper, you can disable the internal speed limitation in service-level parameter *30.32 Speed limit internal*. The brake chopper will ensure safe operation if the drive trips on a fault when the motor is operating in the field weakening area above the internal speed limit.

■ Encoder drift detection

Drift (ie. slip) detection of the motor encoder is active by default, and can cause nuisance faults in high-speed applications (for example, a false 7301/A7B0 event with auxiliary code 0004). Disable the detection in service-level parameter *90.47 Enable motor encoder drift detection*.

■ Overcurrent fault limit

To protect the motor from demagnetization in case of inverter derating and an overcurrent fault, a custom overcurrent fault limit can be set using parameter *31.42 Overcurrent fault limit*. The parameter defines the maximum peak current of one phase. If the parameter is set to 0.00 A, an automatic, internal limit is in use.

■ Motor temperature protection

Rotor temperature measurement is highly recommended as overheating can permanently demagnetize the rotor magnets. Some motors are equipped with infrared sensors measuring the rotor temperature. Stator temperature measurement will not reliably indicate rotor temperature.

■ Motor ambient temperature

Set parameter *35.50 Motor ambient temperature* before the ID run.

■ Motor model temperature adaptation

Enable adaptation of temperature-dependent parameters, and select a suitable source, using parameter **97.15 Motor model temperature adaptation**. If Pt100 sensors in the stator windings are used as temperature feedback, set service-level parameter **97.17 Rotor temperature factor** to an initial value of 50%. This will help avoid overcompensation if torque accuracy is critical.

Encoder settings

Encoder feedback is usually needed in test bench applications to provide actual rotor position and speed feedback. Both incremental and absolute encoders can be used.

■ Encoder interface

Select the encoder interface type in parameter **92.01 Encoder 1 type**.

92.01 Encoder 1 type	Selects the type of encoder/resolver 1.	<i>None configured</i>
None configured	None.	0
TTL	TTL. Module type (input): FEN-01 (X31), FEN-11 (X41) or FEN-21 (X51).	1
TTL+	TTL+. Module type (input): FEN-01 (X32).	2
Absolute encoder	Absolute encoder. Module type (input): FEN-11 (X42).	3
Resolver	Resolver. Module type (input): FEN-21 (X52).	4
HTL	HTL. Module type (input): FEN-31 (X82).	5
HTL 1	HTL. Module type (input): FSE-31 (X31).	6
HTL 2	HTL. Module type (input): FSE-31 (X32). Not supported at the time of publication.	7

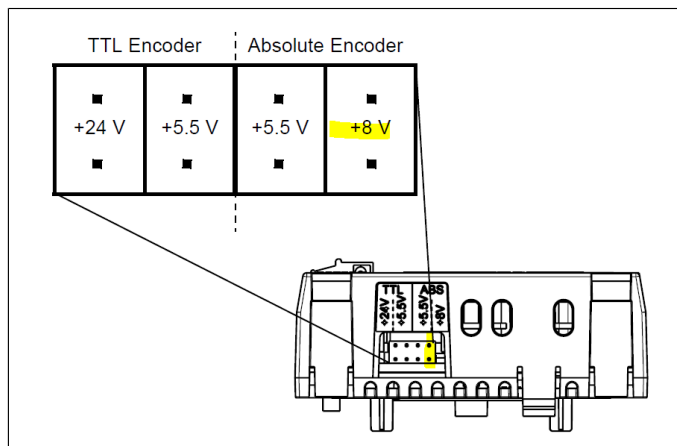
■ Example: EnDat absolute encoder

1. Switch off the 24 V power supply to the inverter control unit.
2. Set the voltage selection jumper on the FEN-11 interface module according to the encoder supply voltage.

Electrical data

Polarity protected	Yes
Current consumption	100 mA at 5 Vdc
Absolute accuracy	± 180 arcsec
Power supply	3.6...14 Vdc

34 Start-up



3. Insert the FEN-11 module into a free slot (1...3) on the control unit.
4. Connect the encoder cable according to the encoder data sheet and the FEN-11 manual. Connect the cable plug to X42 on the FEN-11.
5. Switch on the power to the inverter control unit.
6. Activate the encoder interface module in parameter *91.11 Module 1 type*. Select the slot in *91.12 Module 1 location*.

91. Encoder module settings			
1	FEN DI status	0b0000	NoUnit
2	Module 1 status	FEN-11	NoUnit
3	Module 2 status	No option	NoUnit
4	Module 1 temperature	0	°C
6	Module 2 temperature	0	°C
10	Encoder parameter refresh	Done	NoUnit
11	Module 1 type	FEN-11	NoUnit
12	Module 1 location	Slot 2	NoUnit

7. Set the encoder parameters in group *92 Encoder 1 configuration*.

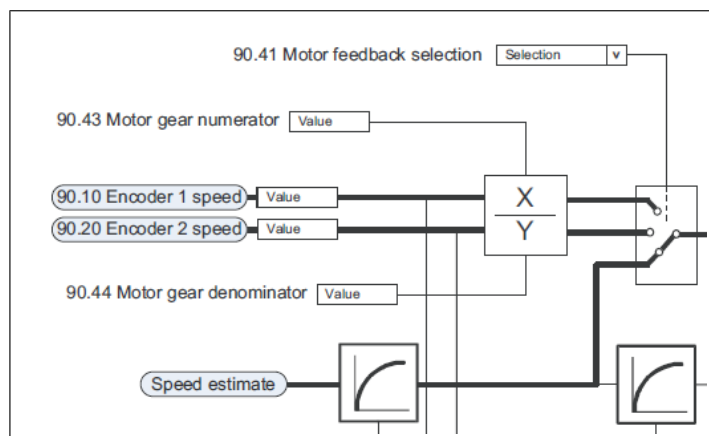
Encoder config	
Type	PSE
Model	903
Shaft type	Ø11 mm with key nut
Flange type	Euro-flange (B10 - type)
Output interface	EnDat 2.2 with additional 1Vpp signals
Absolute resolution	25 bit (13 bit singleturn + 12 bit multiturn)
Incremental signal resolution	32 ppr 1Vpp (Sinusoidal)
Connection type	Cable
Connecting direction	Radial
Cable length	5.00 m

92. Encoder 1 configuration		
1	Encoder 1 type	Absolute encoder
2	Encoder 1 source	Module 1
10	Pulses/revolution	32
11	Pulse encoder type	EnDat
12	Zero pulse enable	Disable
13	Position data width	13
14	Revolution data width	12
20	Encoder cable fault func	Fault
30	Serial link mode	Initial position
31	EnDat max calculation time	50 ms
32	SSI cycle time	100 us
33	SSI clock cycles	2
34	SSI position msb	1
35	SSI revolution msb	1
36	SSI data format	Binary
37	SSI baud rate	100 kBit/s
40	SSI zero phase	315-45 deg

When parameter 92.30 *Serial link mode* is set to *Initial position*, the position of the motor is updated only at power-on. The encoder used in this example indicates the position in the serial link message and separate sine-cosine hardware signals.

Note: Validate any parameter changes using parameter 91.10 *Encoder parameter refresh*.

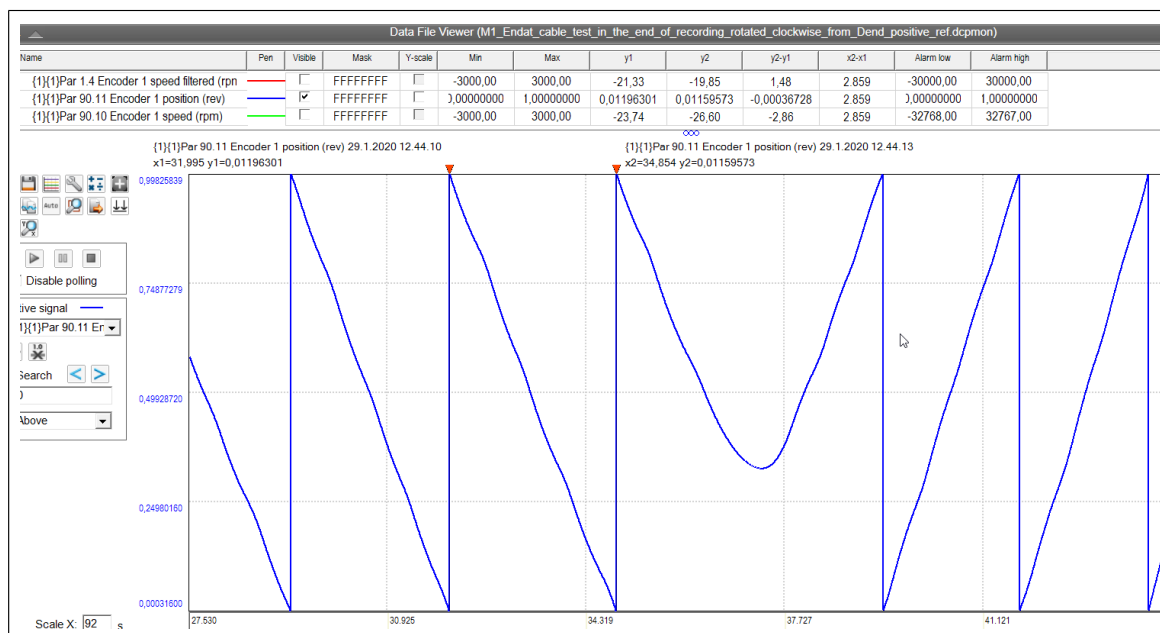
If encoder wiring is OK and the encoder shaft is rotated in the positive direction, the encoder should indicate a positive speed value. If the encoder indicates a negative value, change parameter 90.43 *Motor gear numerator* to -1. This will internally reverse the polarity between 90.01 *Encoder 1 speed* and the speed regulator (as shown by 24.02 *Used speed feedback*).



Note: With a sine-cosine encoder, do not attempt to reverse the polarity by swapping the sine and cosine channels in the wiring.

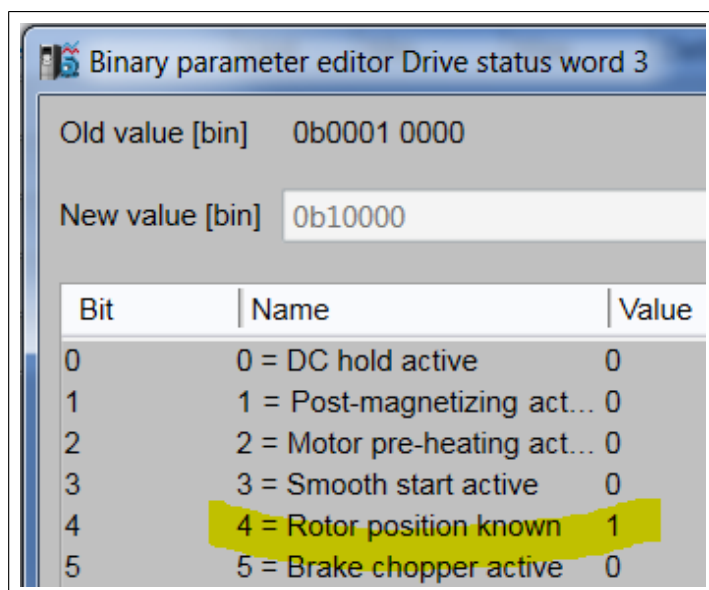
■ Checking the encoder position signal

Check the waveform generated by the encoder in parameter 90.11 *Encoder 1 position*. In the sample diagram below, the position value 0...1 corresponds to 0...360 degrees. On the left, the encoder indicates slow reverse rotation; on the right, there is forward rotation.



■ Verifying that the rotor position is known by motor control

When parameter 21.13 *Autophasing mode* is set to *Turning with Z-pulse*, and the motor is started for the first time after power-on, it will rotate slowly until a zero pulse is detected. After that, the control is released internally and starts to follow the reference. The status of the zero pulse can be seen in 6.21 *Drive status word 3*.



With an incremental encoder, bit 4 is set when the first zero pulse is received after power-on. With a sine-cosine encoder, bit 4 is set when the autophasing function requests motor start.

Motor parameter settings

Enter motor data in parameter group 99 *Motor data* using the values from the motor type designation label.

The motor data sheet can state several operating points at different speeds. The nominal motor values are usually taken from the operating point that is closest to the corner point where the current value starts to decrease. In the sample data sheet below, the torque

reference value of 100% in the drive corresponds to the nominal torque at operating point 2.

Parameter	Operating point			
	1	2	3	4
Speed	500 rpm	4600 rpm	9173 rpm	10000 rpm
Torque	1250.0 N·m	1250.0 N·m	626.8 N·m	575.0 N·m
Power	65.4 kW	602.1 kW	602.1 kW	602.1 kW
Terminal voltage	45.7 V	390.9 V	689.9 V	689.8 V
Synchronous generated voltage	34.8 V	319.7 V	651.4 V	716.6 V
Current	1102.8 A	1100.6 A	551.5 A	524.7 A
Frequency	33.3 Hz	306.7 Hz	611.5 Hz	666.7 Hz
Cos phi	0.857	0.833	0.950	1.000
Efficiency	87.5%	97.0%	96.2%	96.1%

Identification (ID) run



WARNING! Before activating the ID run, check that it is allowable to run the motor, that the machinery coupled to the motor can be run, and that the motor can be stopped safely.

■ Performing a Standstill ID run and checking the direction of rotation

At first, it is recommended to perform a Standstill ID run to check the direction of rotation and to activate encoder feedback.

Start monitoring in Drive Composer pro, select *Standstill* in parameter 99.13 *ID run requested*, and start the motor in local control. The motor shaft will not rotate during a Standstill ID run.

After the ID run completes, start the drive to a slow speed (such as 100 rpm) if possible and check the direction of rotation. If necessary, change parameter 99.16 *Motor phase order*. Alternatively, correct the physical cabling between the drive and the motor.

16	Motor phase order	U V W	NoUnit	U V W
18	Sine filter inductance	U V W	mH	0,000 100000,... 0,233
19	Sine filter capacitance	U V W	uF	0,00 100000,... 180,00

The value will be saved to permanent memory within one minute provided that the inverter control unit is kept powered. An immediate save can be done using parameter 96.07 *Parameter save manually*.

Save the monitored values in Drive Composer pro.

Disconnect and reconnect the power to the drive. This is essential especially if the phase order was changed by parameter.

In Drive Composer pro, enable the service-level parameters and start monitoring.

Start the drive again to a slow speed. Check that the motor rotates in the correct (forward) direction with a positive speed reference.

■ Activating encoder feedback

With the motor running at a slow speed (eg. 100 rpm), check that parameters *1.02 Motor estimated speed* and *24.02 Used speed feedback* are equal both in value and sign. (1.04 Encoder speed 1 can be different; see section [Encoder settings](#).) Save the monitoring file in Drive Composer pro.

Set parameter *90.41 Motor feedback selection* to *Encoder 1*.

41	Motor feedback selection	Encoder 1	NoUnit	Estimate
42	Motor speed filter time	Estimate	ms	0 10000
43	Motor gear numerator	Encoder 1	NoUnit	-21474... 214748...
44	Motor gear denominator	Encoder 2	NoUnit	-21474 214748

It is recommended to reboot the control unit at this point either by cycling the power to it or by using parameter *96.08 Control board boot*.

After the reboot, enable service-level parameters again and start monitoring in Drive Composer pro.

Start the drive to 100 rpm and check that the polarities of *24.02 Used speed feedback* and *24.01 Used speed reference* match.

■ Performing a Normal ID run

If possible, a "rotating" ID run should be run. This can most conveniently be done when the motor shaft is not yet coupled to the machinery. For a permanent magnet motor, the Normal, Reduced and Advanced ID run methods are identical.

Before activating the ID run, check that the speed limits in parameter group 30 are high enough, ie. set according to nominal motor values.

Start monitoring in Drive Composer pro. Select the *Normal* ID run in parameter *99.13 ID run requested*. Start the motor in local control in Drive Composer pro.

99. Motor data				
3	Motor type	Permanent magn...	NoUnit	Asynchronous...
4	Motor control mode	DTC	NoUnit	DTC
6	Motor nominal current	349,0	A	0,0 6400,0
7	Motor nominal voltage	330,0	V	0,0 800,0
8	Motor nominal frequency	70,50	Hz	0,00 1000,00
9	Motor nominal speed	2115	rpm	0 30000
10	Motor nominal power	360,00	kW	0,00 10000,00
11	Motor nominal cos φ	0,00	NoUnit	0,00 1,00
12	Motor nominal torque	0,000	Nm	0,000 400000...
13	ID run requested	None	NoUnit	None
14	Last ID run performed	None		None
15	Motor polepairs calculated	Normal		1000 0
16	Motor phase order	Reduced		U V W
18	Sine filter inductance	Autophasing	0000,...	0,233
19	Sine filter capacitance	Current measurement calibration	0000,...	180,00
200. Safety				
		Advanced		
		Advanced Standstill		

After the ID run finishes, save the monitoring file.

Now, the measured BackEMF voltage can be calculated by multiplying *98.08 PM flux user* by *99.07 Motor nominal voltage*. *98.08 PM flux user* is a factor value and indicates how close the BackEMF voltage given in *99.07 Motor nominal voltage* is to the measured voltage. If 98.08 is 1.00, the two voltages are equal.

If 98.08 is greater than 1.2 or smaller than 0.8, a new value can be calculated for 99.07 *Motor nominal voltage*, and the ID run repeated.

The following image shows the user motor parameters as calibrated by the ID run.

98. User motor parameters			
1	User motor model mode	Not selected	NoUnit
2	Rs user	0.01022	p.u.
3	Rr user	0.00000	p.u.
4	Lm user	0.00000	p.u.
5	SigmaL user	0.00000	p.u.
6	Ld user	0.70616	p.u.
7	Lq user	0.68246	p.u.
8	PM flux user	1.08177	p.u.
9	Rs user SI	0.00236	Ohm
10	Rr user SI	0.00000	Ohm
11	Lm user SI	0.00	mH
12	SigmaL user SI	0.00	mH
13	Ld user SI	0.06	mH
14	Lq user SI	0.05	mH
15	Position offset user	147.6	deg

Autophasing

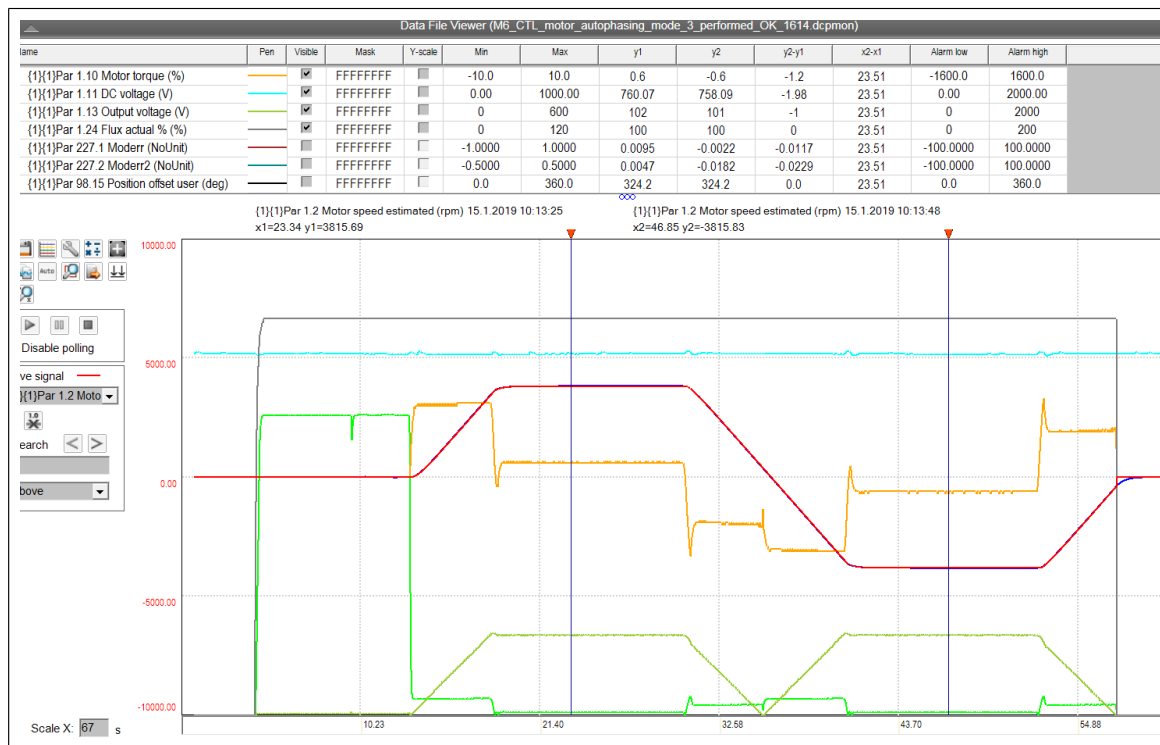
Autophasing is a measurement routine that determines the angular position of the magnetic flux of a permanent magnet synchronous motor. The motor control requires the absolute position of the rotor flux to accurately control the motor torque. In closed-loop control, autophasing is performed automatically as part of the Normal, Reduced or Advanced ID run. It can also be selected as a stand-alone routine in parameter 99.13 *ID run requested*. At the end of the autophasing routine, the offset between the measured rotor position and the rotor flux is written into parameter 98.15 *Position offset user*.

13	ID run requested	None	NoUnit	None
14	Last ID run performed	None		None
15	Motor polepairs calculated	1000	0	
16	Motor phase order	U V W		
18	Sine filter inductance	0.0000,...	0.233	
19	Sine filter capacitance	0.0000,...	180.00	
200. Safety				

With high-speed motors, it is recommended to use enhanced autophasing mode by setting service-level parameter 227.32 *ID run feature testing* to the value of 3 temporarily.

To start autophasing, set 99.13 *ID run requested* to *Autophasing*. Give a start command from Drive Composer pro in local control mode. The routine will rotate the motor in both directions to find the angle offset. The sample diagram below shows the behavior of selected drive signals during an enhanced autophasing routine.

40 Start-up



Perform autophasing a few times to be sure that you get consistent results. For example, if you perform autophasing three times and the offset is detected as 61.2°, 61.4° and 61.4°, set 98.15 manually to 61.3°.

To make the drive use the newly-determined offset, set 98.01 *User motor model mode* to *Motor parameters & position offset*.

98. User motor parameters				
1	User motor model mode	Motor parameter	NoUnit	Not selected
2	Rs user	Not selected	00 0,50000	0,00000
3	Rr user	Motor parameters	00 0,50000	0,00000
4	Lm user	Position offset	00 10,00000	0,00000
		Motor parameters & position offset		

Save the parameters to the PC. Return 227.32 *ID run feature testing* to its default value of 1.

Starting the drive

Restart the monitoring of signals in Drive Composer pro.

Start the drive to a slow speed (eg. 100 rpm). With a positive speed reference, parameter 1.10 *Motor torque* will indicate small positive values when the motor is running at a constant speed without load.

Increase speed carefully step-by-step up to the maximum allowed speed. Be ready to coast-stop the drive if something unexpected happens. Look for any vibration in motor torque, motor current and *Moderr2*. (High-speed test benches often have vibration sensors connected to a PLC.) Repeat the test into the opposite direction of rotation. Check that the polarities of parameters 24.02 *Used speed feedback* and 24.01 *Used speed reference* match.

As an overall indicator of the validity of motor parameter settings, service-level parameters 227.01 *Moderr* and 227.02 *Moderr2* should remain close to zero (in practice, between -0.3 and +0.3) in a static situation.

After finishing the test runs, switch the drive from local to remote mode to be controlled by the PLC. Whenever necessary, set up the fieldbus interfaces and other relevant parameters.

6

Maintenance

This chapter describes the maintenance actions specifically related to the BLHF filter. For other maintenance actions, see *ACS880-107 inverter units hardware manual* (3AUA0000102519 [English]) or *ACS880-104 inverter modules hardware manual* (3AUA0000104271 [English]).

Fans

The lifespan of the cooling fans of the drive depends on the running time, ambient temperature and dust concentration. See the firmware manual for the actual signal which indicates the running time of the cooling fan. Reset the running time signal after fan replacement.

Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

■ Replacing the fan of the filter

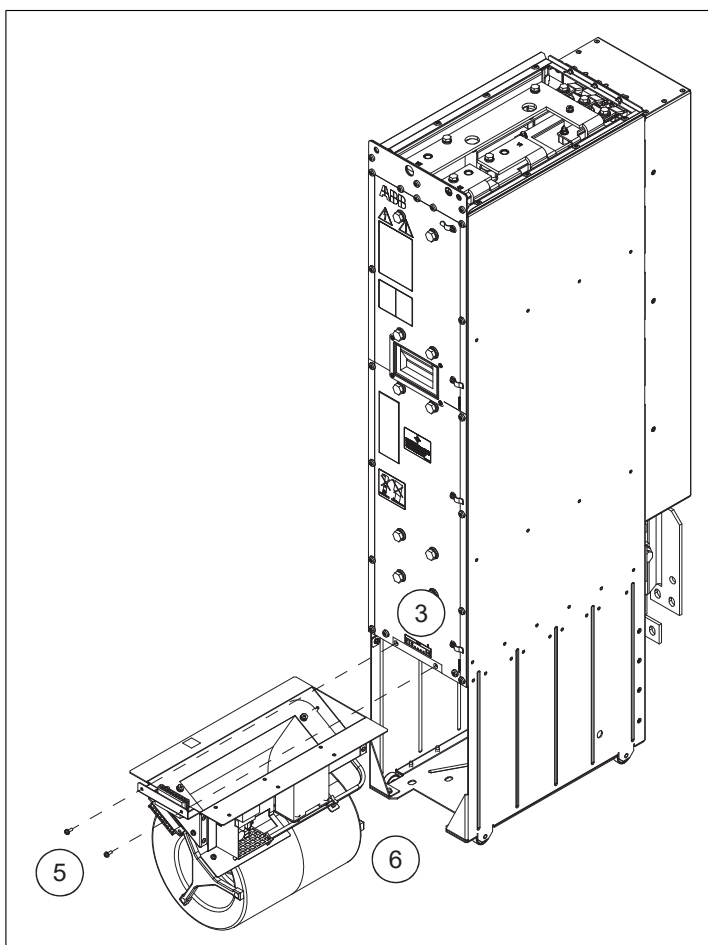


WARNING!

Obey the safety instructions given in *ACS880 multidrive cabinets and modules safety instructions* (3AUA0000102301 [English]). If you ignore the safety instructions, injury or death, or damage to the equipment can occur.

If you are not a qualified electrical professional, do not do installation or maintenance work.

1. Stop the drive and do the steps in section [Electrical safety precautions \(page 9\)](#) before you start the work.
 2. Open the door.
 3. Remove the two locking screws of fan supply plug connector.
 4. Pull the plug connector downwards to unplug the fan wiring.
 5. Remove the screws in front of the fan unit.
 6. Pull the fan unit out.
 7. Install a new fan in reverse order.
-



Replacing the filter module

Note: The equipment pictured may differ from the actual hardware, but the filter replacement procedure will apply.

Refer to the drawings below.



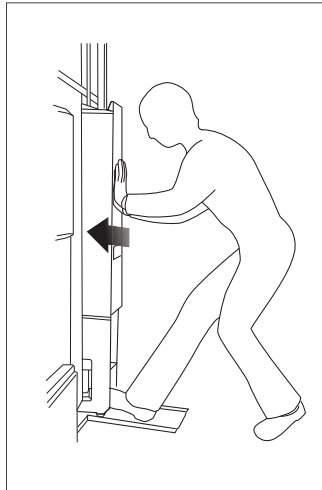
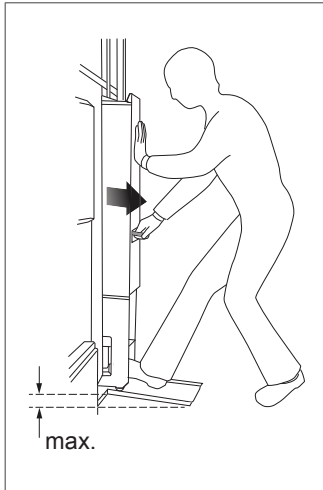
WARNING!

Obey the safety instructions. If you ignore them, injury or death, or damage to the equipment can occur.



WARNING!

- Do not use the module extraction/installation ramp with plinth heights which exceeds the maximum allowed height.
- Secure the module extraction/installation ramp carefully.
- Push the module into the cabinet and pull it from the cabinet carefully preferably with help from another person. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back. Keep your fingers away from the edges of the front flange of the module.



- Do not roll the module on its wheels for a longer distance than what is required for inserting or extracting the module. To move the module to or from the vicinity of the cabinet, lay the module on its side on a pallet or equivalent, and use a forklift or pallet truck.
- Be careful when handling a tall module. The module overturns easily because it is heavy and has a high center of gravity. Whenever possible, secure the module with chains. Do not leave an unsupported module unattended especially on a sloping floor.



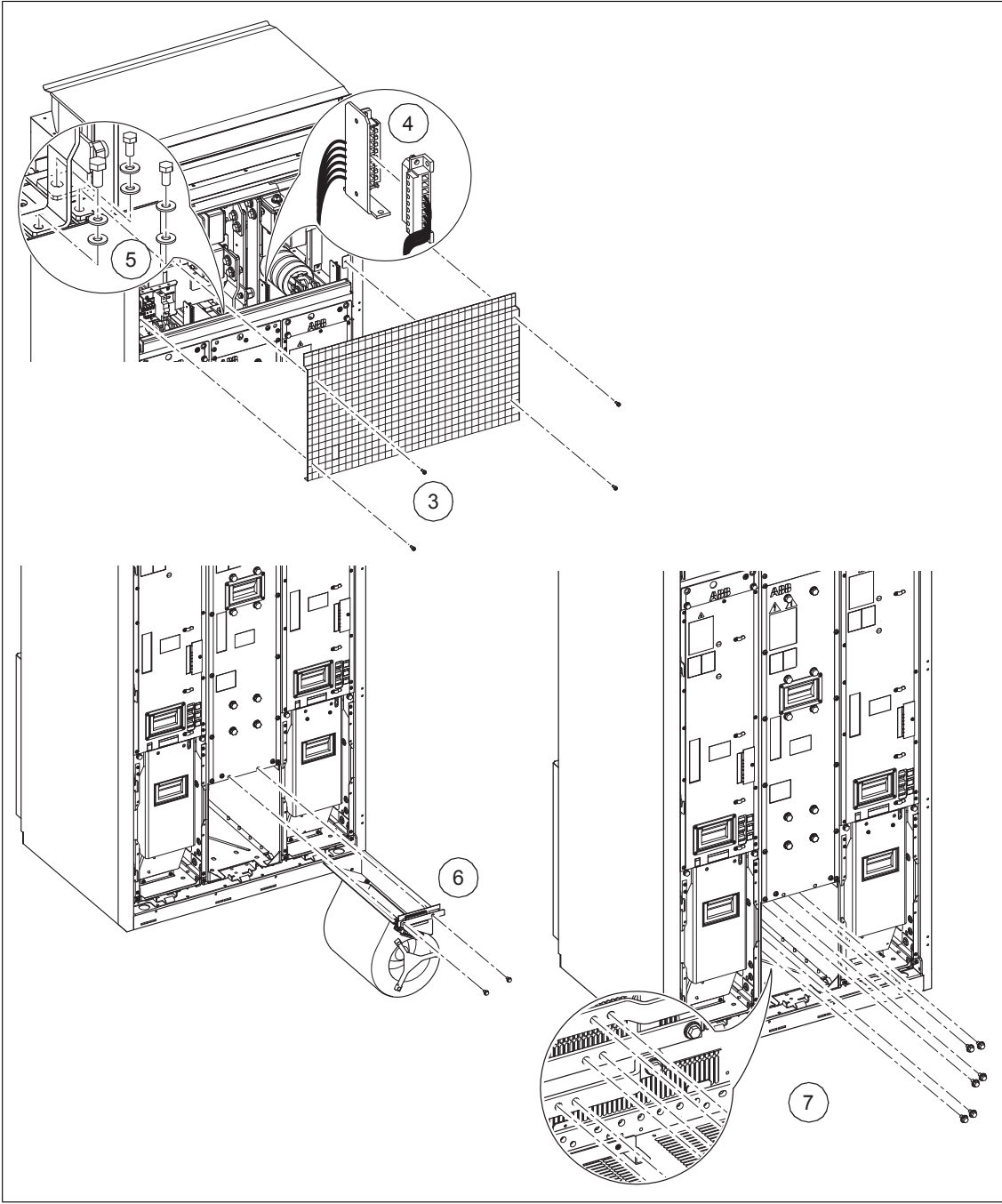
- Wear protective gloves and long sleeves! Some parts have sharp edges.

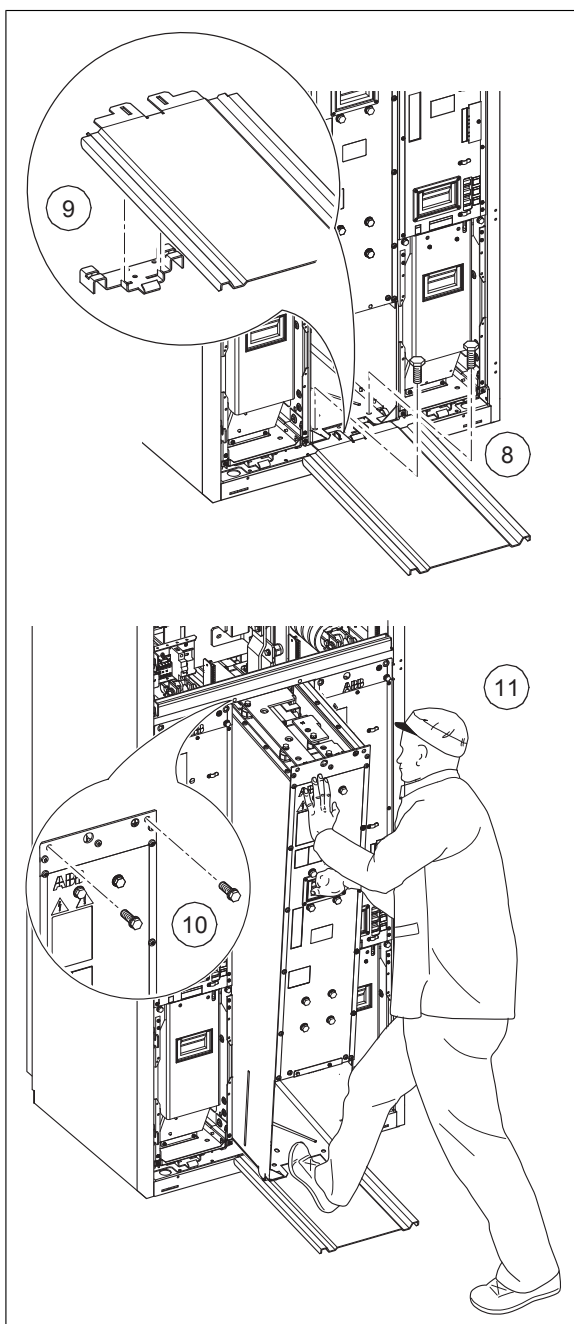
Note: As an alternative to using the extraction/installation ramp, a lifter is available from ABB Service. For more information, contact ABB Service, or see *Lifter for air-cooled drive modules user's guide* (3AXD50000332588 [English]).

1. Stop the drive (if running) and do the steps in section [Electrical safety precautions \(page 9\)](#) before you start the work.
 2. Open the cubicle door.
 3. Undo the four screws of the shroud in the upper part of the cubicle. Remove the shroud.
 4. Unplug the signal connector cable on top of the module.
 5. Remove the screws that connect the busbars to the top of the filter module. Be careful not to drop the screws into the module.
 6. Remove the fan of the filter module. Unplug the signal connector cable and remove the screws in front of the fan.
 7. Remove the fastening screws in the busbar behind the module.
 8. Remove the two screws that fasten the bottom of the module to the base of the cabinet.
 9. Install the module extraction/installation ramp: lift the ramp against the cabinet base so that the hooks of the base go into the ramp's holes.
 10. Remove the two fastening screws that fasten the top of the module to the cabinet frame.
 11. Pull the module carefully out of the cabinet along the ramp. While pulling on the handle, keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.
 12. Replace the module: install the module in reverse order. Mind you fingers. Keep a constant pressure with one foot on the base of the module to prevent the module from falling on its back.

Note: Be careful not to break the fastening screws: tighten the fastening screws of the module to 22 N·m (16.2 lbf·ft) and fastening bolts of the DC output busbars to 70 N·m (51.6 lbf·ft).

 - Plug the module signal wire set to the module signal connector.
 - Fasten the shrouds.
 13. Remove the module extraction/installation ramp and close the cabinet doors.
-





7

Technical data

BLHF filter modules

Code +C188 denotes a 3-phase direct-on-line fan (400 V AC 50/60 Hz or 320 V AC 60 Hz), which is the default. Option +C188+G427 (3-phase 208 V AC direct-on-line cooling fan) is available in the ACS880 multidrive modules product range.

Option +C183 (heating element) is available for cabinet-built ACS880 multidrive for both filter types.

Filter type	L	I_n	I_{max}	f_{out}	f_{sw}	U_{nom}	Airflow	
	μH	A	A	Hz	kHz	V	m ³ /h	ft ³ /min
BLHF-21-7 +C188 (+G427)	40	1400 ($f_{out} \leq 300 \text{ Hz}$)	1900 ($f_{out} \leq 300 \text{ Hz}$)	0...1250	5...14	690	1500	880
BLHF-22-7 +C188 (+G427)	20	2000 ($f_{out} \leq 180 \text{ Hz}$)	2600 ($f_{out} \leq 180 \text{ Hz}$)	0...1250	5...14	690	1500	880

■ Definitions

L	Inductance (-0 ... +10%)
I_n	Nominal RMS current
I_{max}	Maximum RMS current
f_{out}	Drive output frequency
f_{sw}	Switching frequency
U_{nom}	Nominal line-to-line RMS voltage

Airflow	Flow of cooling air required by the filter module
---------	---

■ Current derating

See section [Loading of BLHF filters \(page 24\)](#).

■ Power loss

Filter type	f (Hz)	Power loss at f (W)
BLHF-21-7 (filter module only)	300	5830
BLHF-22-7 (filter module only)	180	5090
+E230 (HSFU cabinet with BLHF-21-7)	300	6060
+E231 (HSFU cabinet with BLHF-22-7)	180	5550
+2E231 (HSFU cabinet with 2×BLHF-22-7)	180	10370

■ Noise

The noise levels shown below are LAeq sound levels for cabinet-installed filters at a distance of 1 meter.

Filter type	Noise (dB)
+E230 (HSFU cabinet with BLHF-21-7)	77
+E231 (HSFU cabinet with BLHF-22-7)	80
+2E231 (HSFU cabinet with 2×BLHF-22-7)	80

■ Auxiliary circuit current consumption

Component	U_N	f	I_{cont}	I_{start}	P_{cont}
	V	Hz	A	A	W
Cooling fan (+C188)	400 V AC $\pm 10\%$	50	1.50	3.00	-
	400 V AC $\pm 10\%$	60	1.90	3.80	-
	320 V AC $\pm 10\%$	60	-	4.40	-
Cooling fan (+C188+G427)	208 V AC $\pm 10\%$	60	2.88	-	-
Heating element (option +C183)	115 V AC	60	-	-	13
	230 V AC	50/60	-	-	13

Definitions

U_N	Voltage requirement
f	Supply frequency
I_{cont}	Continuous current consumption
I_{start}	Calculated load current at start
P_{cont}	Continuous input power

Inverter units for increased switching frequency

The table below shows the inverter units for increased switching frequency (ie. with option +P967), available as modules or as cabinet-built. Note that +P967 is not always needed in high-speed applications – see [Description of the high-speed option \(page 15\)](#).

Option +C183 (heating element) is available for all types in the cabinet-built ACS880 multidrive range. +G304 (single-phase 115 V AC fan supply voltage) is available for all listed types with both cabinet-built ACS880 multidrive and ACS880 multidrive modules.

Inverter unit type		Frame size	Input ratings	Output ratings		
				No-overload use	Light-over-load use	Heavy-duty use
as modules	cabinet-built		I_1	I_2	I_{Ld}	I_{Hd}
ACS880-104-...	ACS880-107-...		A	A	A	A
$U_N = 400 \text{ V}$						
1250A-3+E205+P967		2×R8i	1406	1250	1200	935
1860A-3+E205+P967		3×R8i	2093	1860	1786	1391
2450A-3+E205+P967		4×R8i	2756	2450	2352	1833
3050A-3+E205+P967		5×R8i	3431	3050	2928	2281
3640A-3+E205+P967		6×R8i	4095	3640	3494	2723
4250A-3+E205+P967		7×R8i	4826	4250	4080	3179
4860A-3+E205+P967		8×R8i	5468	4860	4666	3635
$U_N = 500 \text{ V}$						
1150A-5+E205+P967		2×R8i	1294	1150	1104	860
1710A-5+E205+P967		3×R8i	1924	1710	1642	1279

Inverter unit type		Frame size	Input ratings	Output ratings		
				No-overload use	Light-over-load use	Heavy-duty use
as modules	cabinet-built		I_1	I_2	I_{Ld}	I_{Hd}
ACS880-104-...	ACS880-107-...		A	A	A	A
2260A-5+E205+P967		4×R8i	2543	2260	2170	1690
2810A-5+E205+P967		5×R8i	3161	2810	2698	2102
3360A-5+E205+P967		6×R8i	3780	3360	3226	2513
3920A-5+E205+P967		7×R8i	4410	3920	3763	2932
4480A-5+E205+P967		8×R8i	5040	4480	4301	3351
$U_N = 690\text{ V}$						
1170A-7+E205+P967		2×R8i	1316	1170	1123	875
1740A-7+E205+P967		3×R8i	1958	1740	1670	1302
2300A-7+E205+P967		4×R8i	2588	2300	2208	1720
2860A-7+E205+P967		5×R8i	3218	2860	2746	2139
3420A-7+E205+P967		6×R8i	3848	3420	3283	2558
3990A-7+E205+P967		7×R8i	4489	3990	3830	2985
4560A-7+E205+P967		8×R8i	5130	4560	4378	3411
5130A-7+E205+P967		9×R8i	5771	5130	4925	3837
5700A-7+E205+P967		10×R8i	6413	5700	5472	4264

■ Definitions

U_N	Nominal AC supply voltage of drive system
I_1	Nominal rms input current
I_2	Nominal output current (available continuously with no over-loading)
I_{Ld}	Continuous rms output current allowing 10% overload for 1 minute every 5 minutes
I_{Hd}	Continuous rms output current allowing 50% overload for 1 minute every 5 minutes

■ Switching frequency and output frequency derating

Contact your local ABB representative for information.

■ Ambient temperature and altitude derating

See *ACS880-107 inverter units hardware manual* (3AUA0000102519 [English]) or *ACS880-104 inverter modules hardware manual* (3AUA0000104271 [English]).

■ Inverter modules used

Inverter unit type		Modules used	
as modules	cabinet-built	Qty	Module type
ACS880-104-...	ACS880-107-...		ACS880-104-...
U _N = 400 V			
1250A-3+E205+P967		2	0640A-3+E205+P967
1860A-3+E205+P967		3	0640A-3+E205+P967
2450A-3+E205+P967		4	0640A-3+E205+P967
3050A-3+E205+P967		5	0640A-3+E205+P967
3640A-3+E205+P967		6	0640A-3+E205+P967
4250A-3+E205+P967		7	0640A-3+E205+P967
4860A-3+E205+P967		8	0640A-3+E205+P967
U _N = 500 V			
1150A-5+E205+P967		2	0590A-5+E205+P967
1710A-5+E205+P967		3	0590A-5+E205+P967
2260A-5+E205+P967		4	0590A-5+E205+P967
2810A-5+E205+P967		5	0590A-5+E205+P967
3360A-5+E205+P967		6	0590A-5+E205+P967
3920A-5+E205+P967		7	0590A-5+E205+P967
4480A-5+E205+P967		8	0590A-5+E205+P967
U _N = 690 V			
1170A-7+E205+P967		2	0600A-7+E205+P967
1740A-7+E205+P967		3	0600A-7+E205+P967
2300A-7+E205+P967		4	0600A-7+E205+P967
2860A-7+E205+P967		5	0600A-7+E205+P967
3420A-7+E205+P967		6	0600A-7+E205+P967
3990A-7+E205+P967		7	0600A-7+E205+P967
4560A-7+E205+P967		8	0600A-7+E205+P967
5130A-7+E205+P967		9	0600A-7+E205+P967
5700A-7+E205+P967		10	0600A-7+E205+P967

Surrounding air temperature

0...40 °C (+32...104 °F)

Maximum motor cable length

50 m (164 ft)

Protection classes

Degrees of protection (IEC/EN 60529)	Cabinet-built filter units (HSFU): IP22 (standard), IP42 (option +B054) BLHF-2x-7 filter modules and ACS880-104 inverter modules: IP00
Enclosure types (UL50)	Cabinet-built filter units (HSFU): Type 1 (standard), Type 1 (option +B054). For indoor use only. BLHF-2x-7 filter modules and ACS880-104 inverter modules: Type Open
Overvoltage category (IEC/EN 60664-1)	III, except for auxiliary power connections (fan, control, heating, lighting etc) which are category II.
Protective class (IEC/EN 61800-5-1)	I

Weights

Filter module/unit	Weight (kg)	Weight (lbs)
BLHF-21-7	282	620
BLHF-22-7	282	620
(HSFU) +E230, +E231	550	1210
(HSFU) +2E231	770	1700

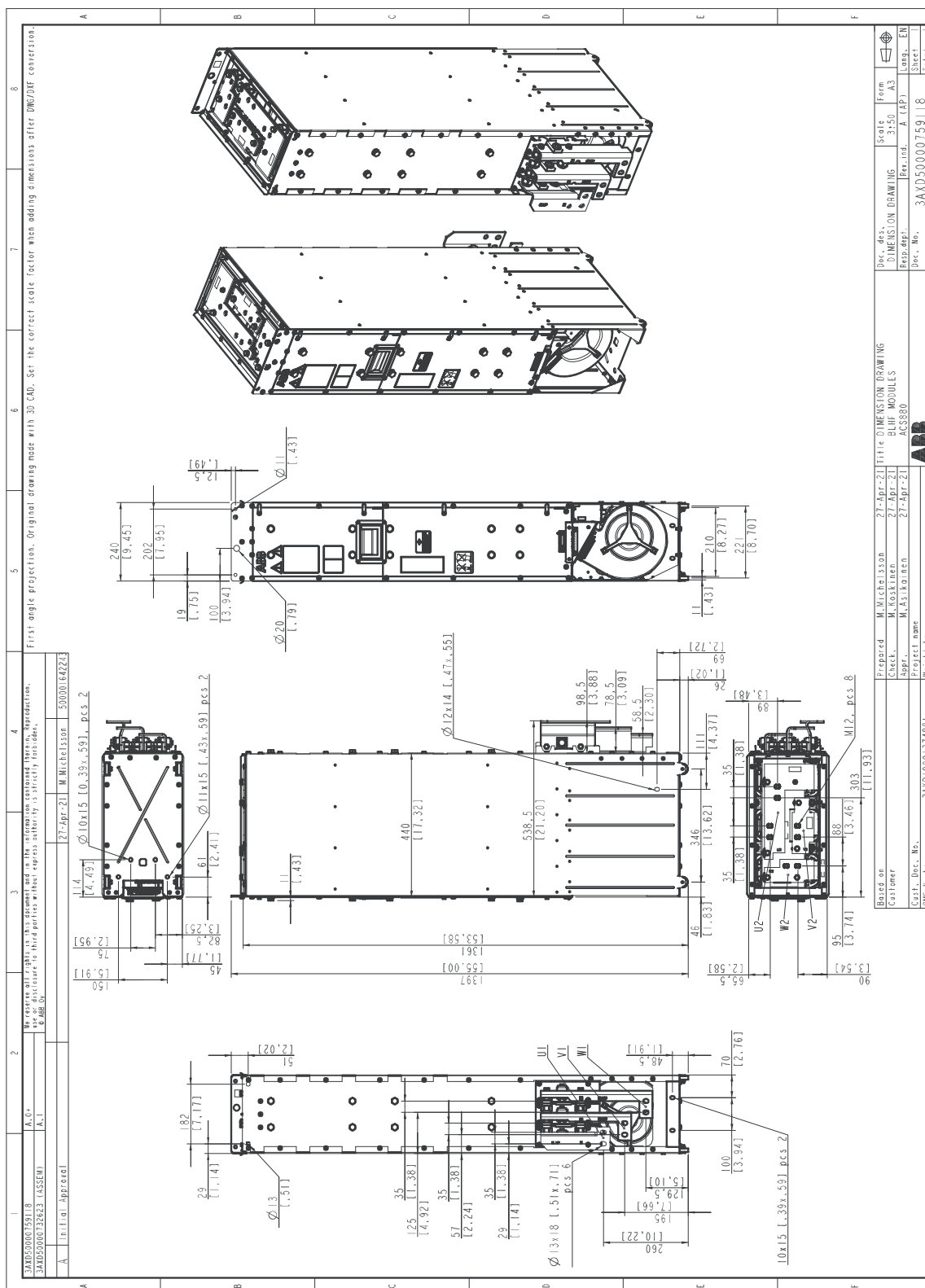
Dimensions

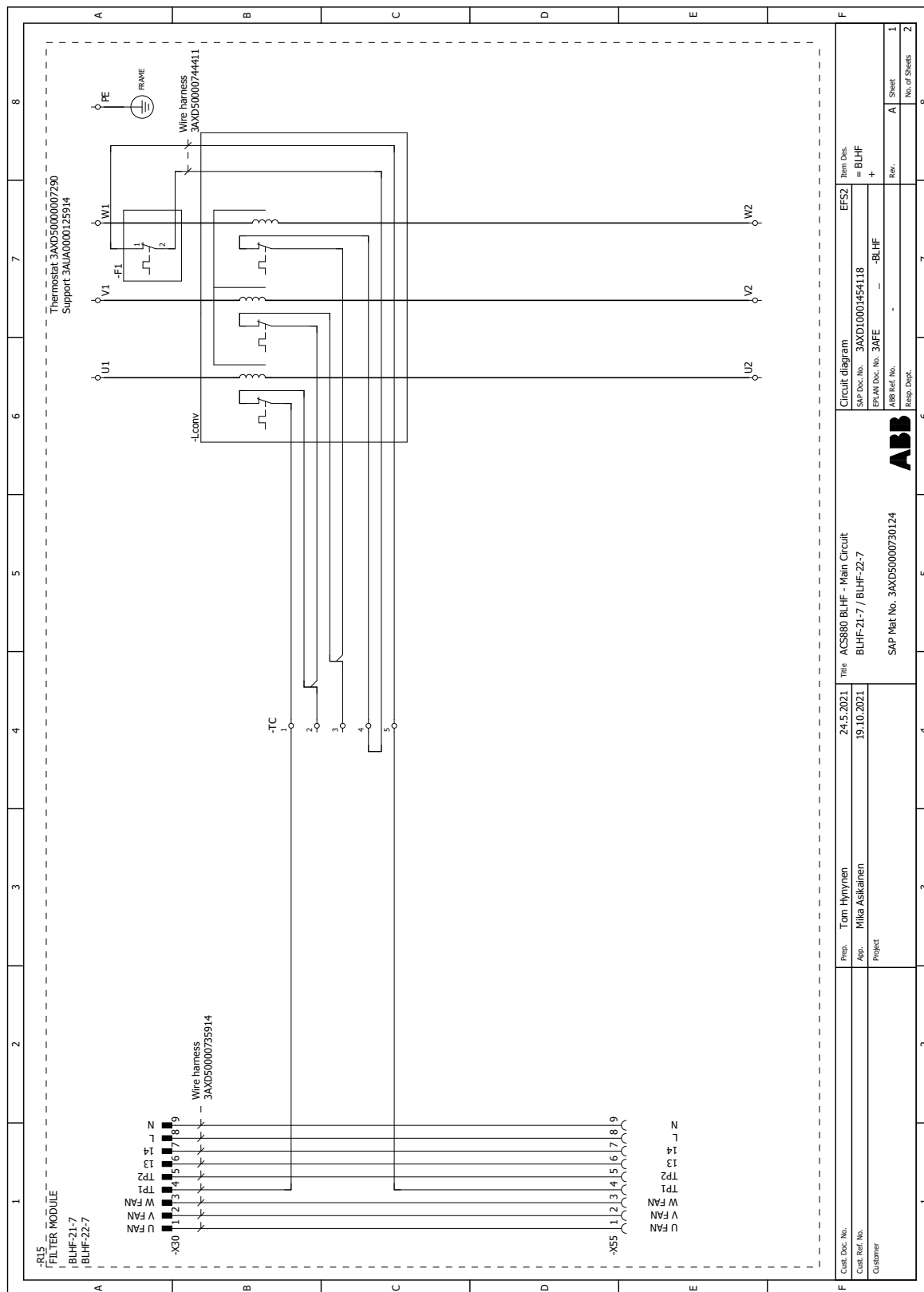
■ Cabinet-built filter unit

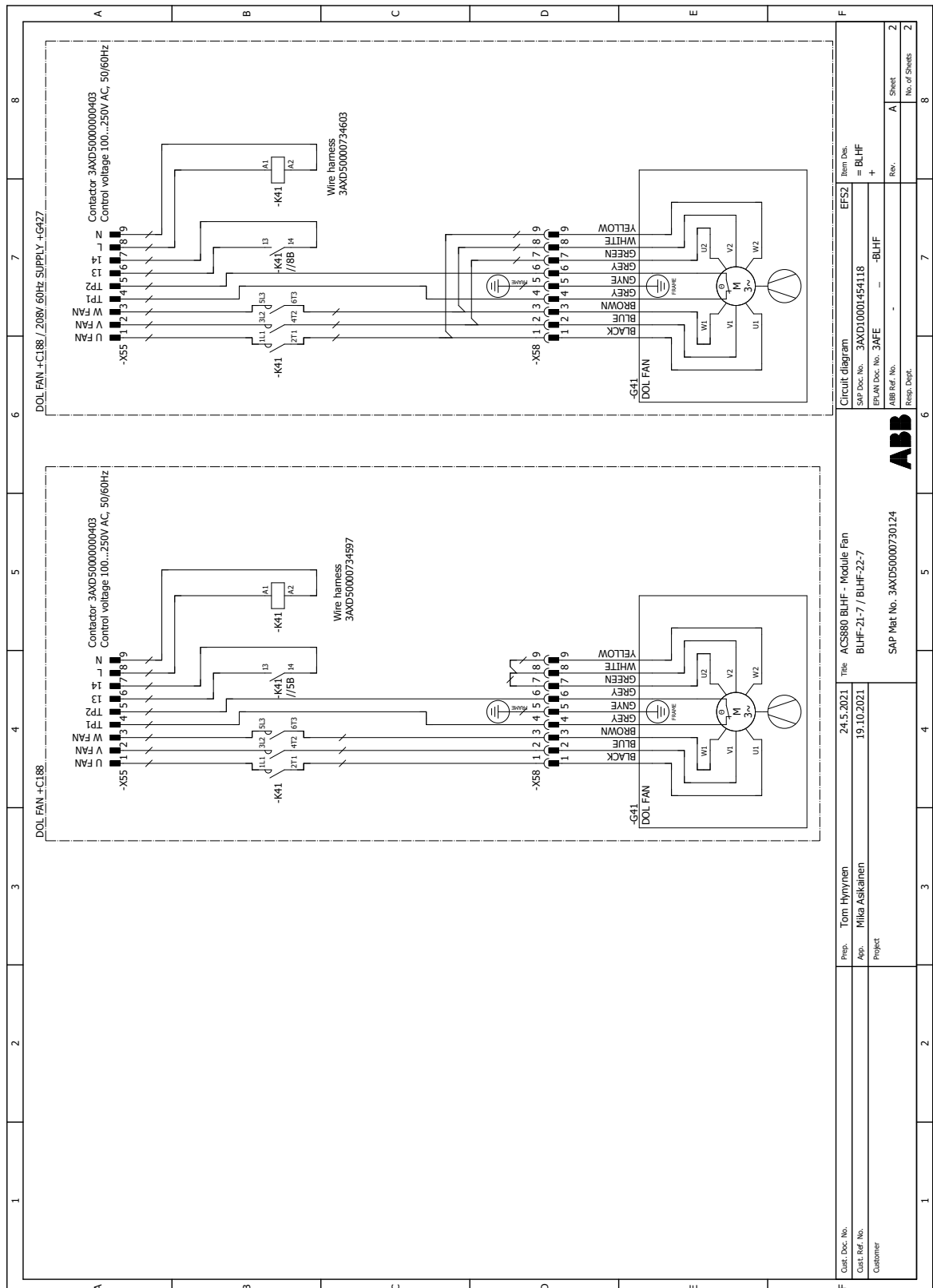
- Unit with one filter module: the nominal width of the cabinet line-up is increased by 500 mm.
- Unit with two filter modules: the nominal width of the cabinet line-up is increased by 700 mm.

Note: A common motor terminal cubicle (OPU), output disconnecter cubicle (ODU) or output contactor cubicle (OCU) is required.

- **Filter module**

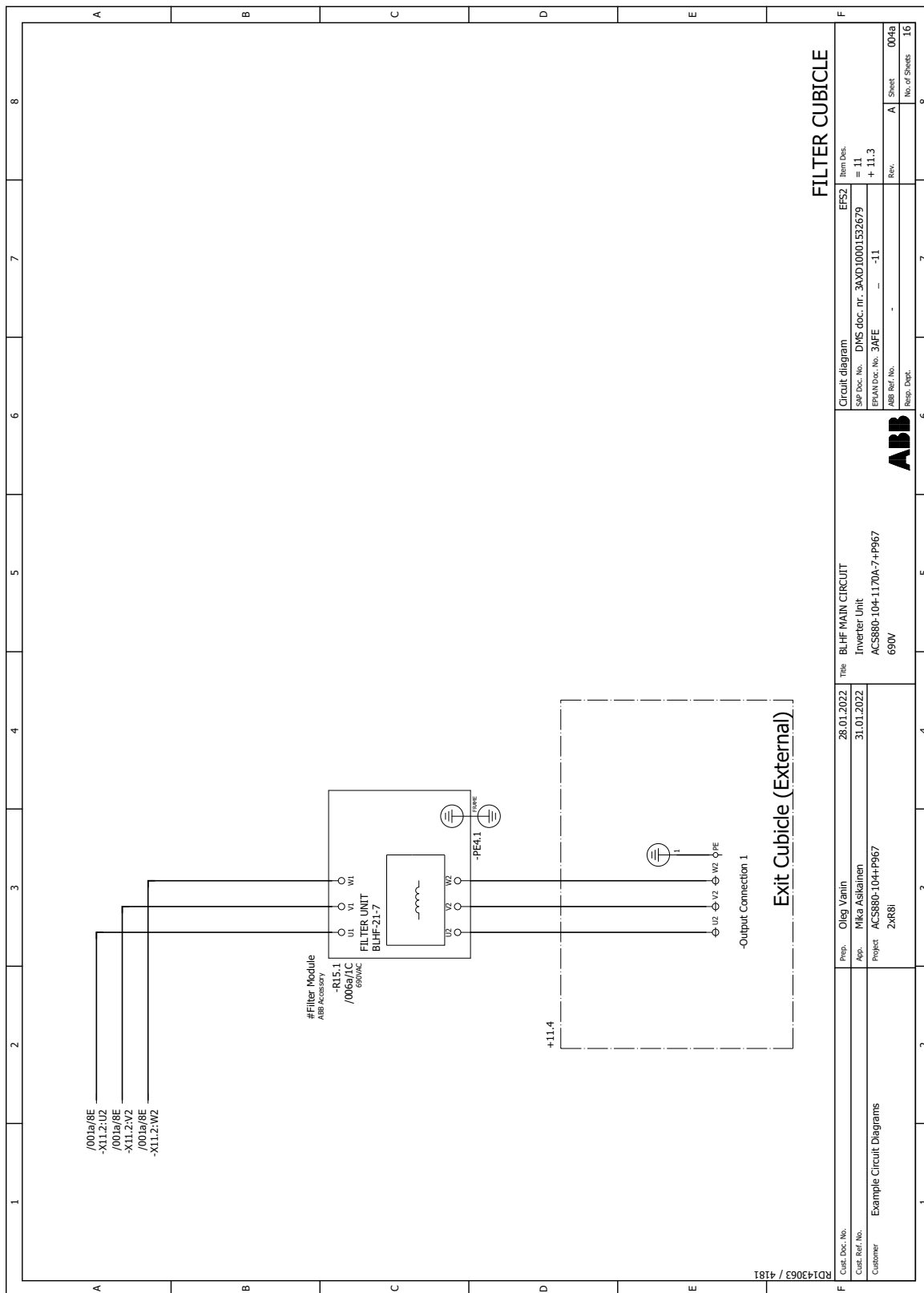


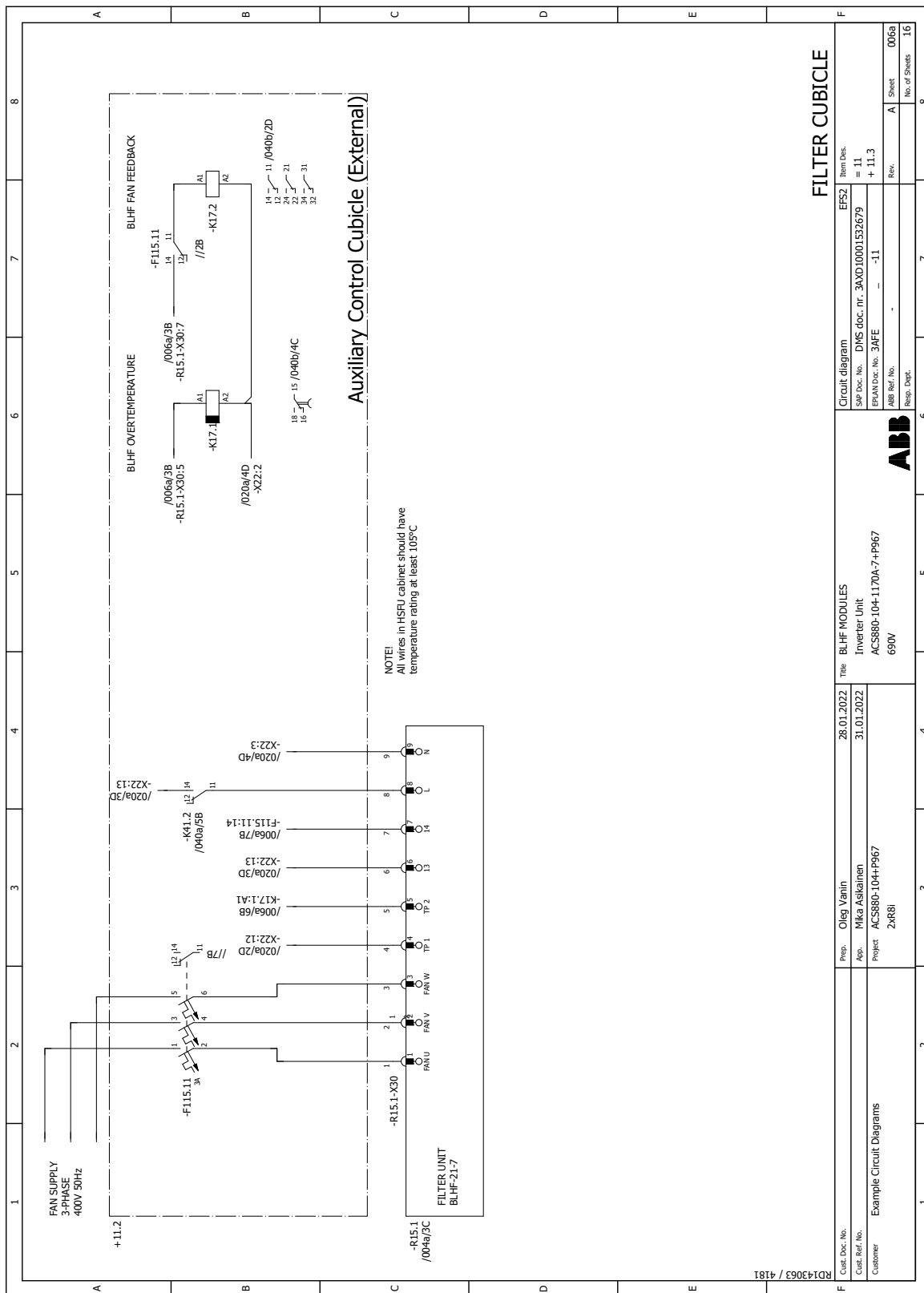




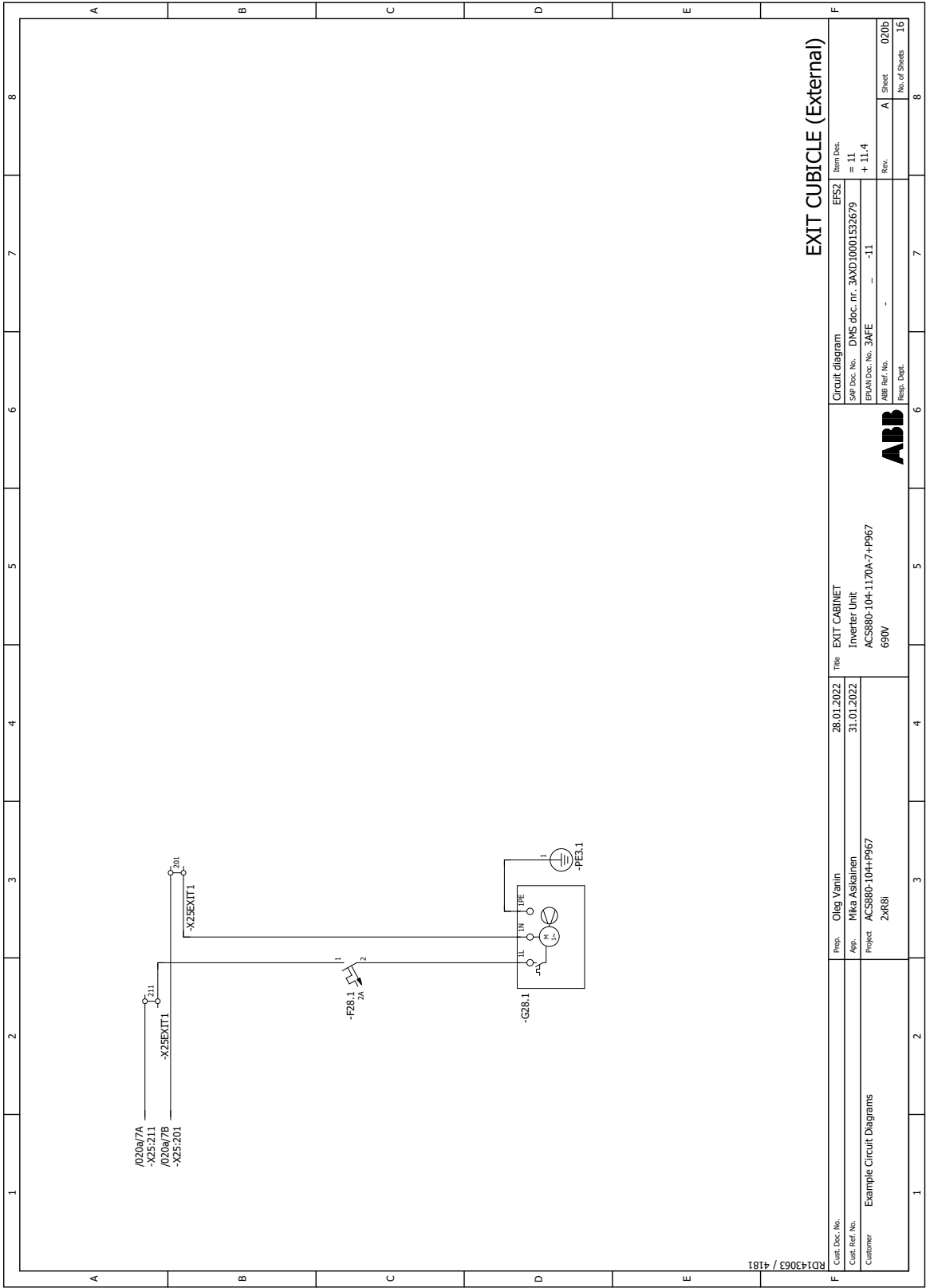
Circuit diagram example: ACS880-104 with BLHF filter

■ **004a**

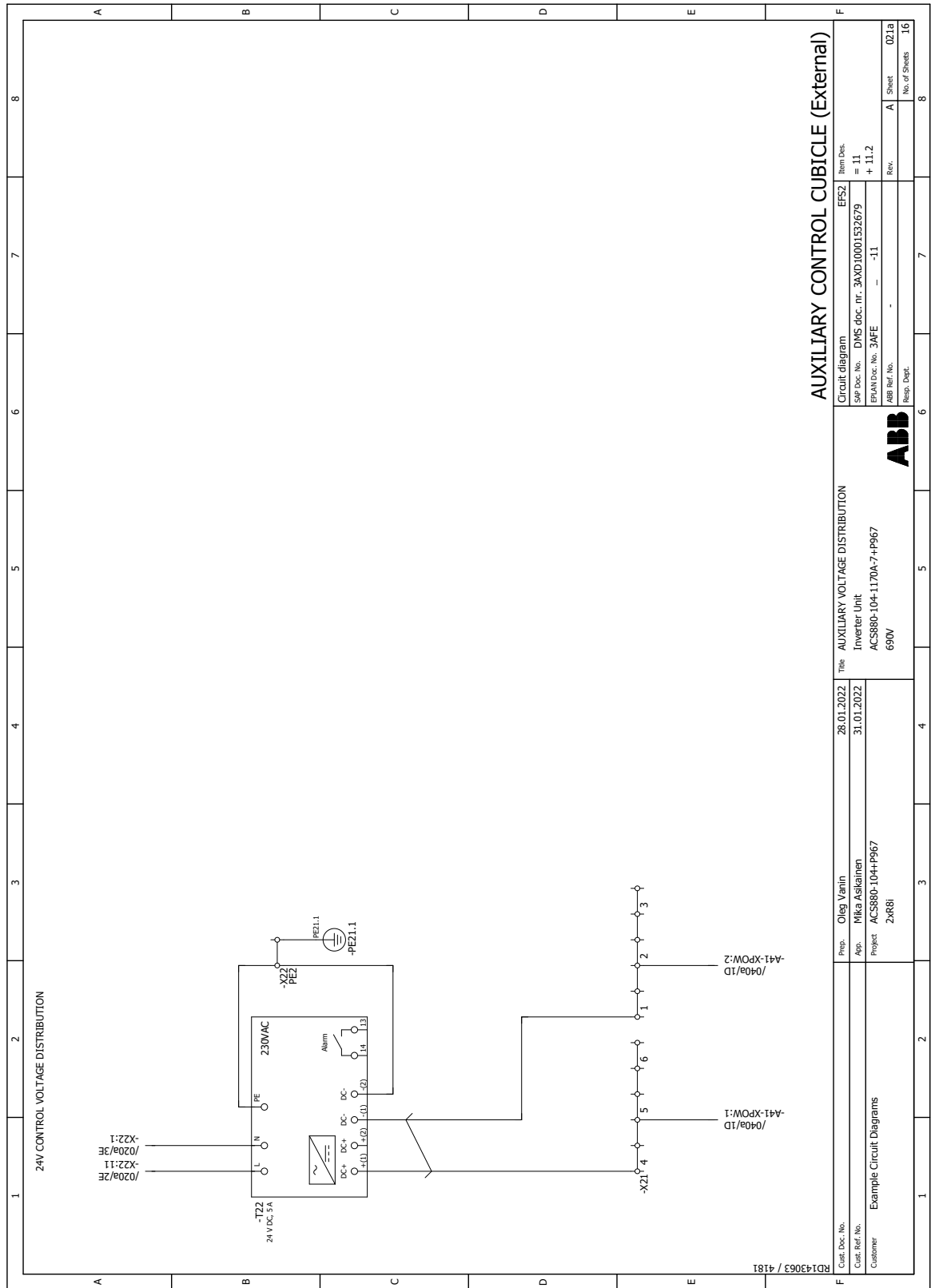




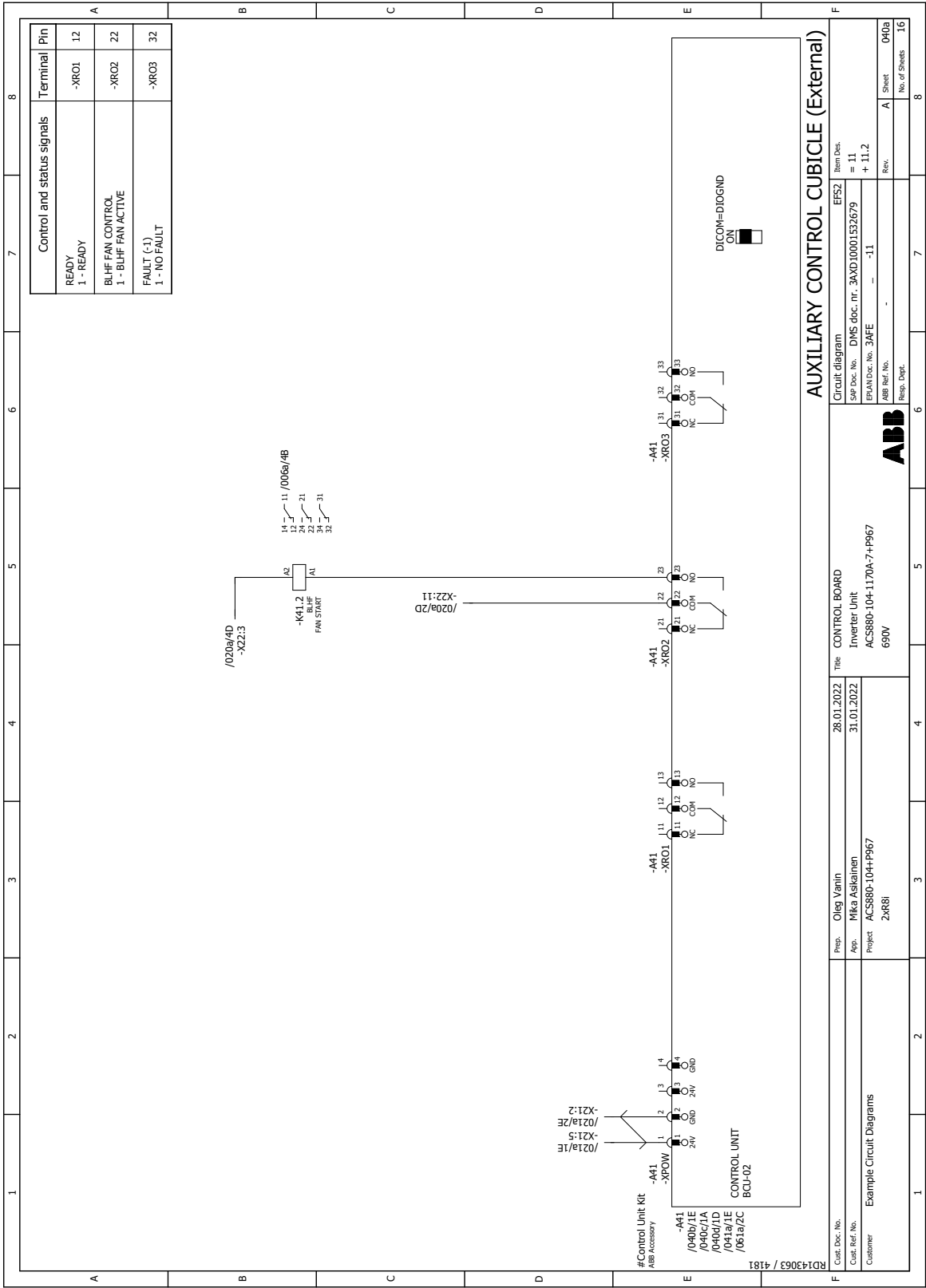
020b



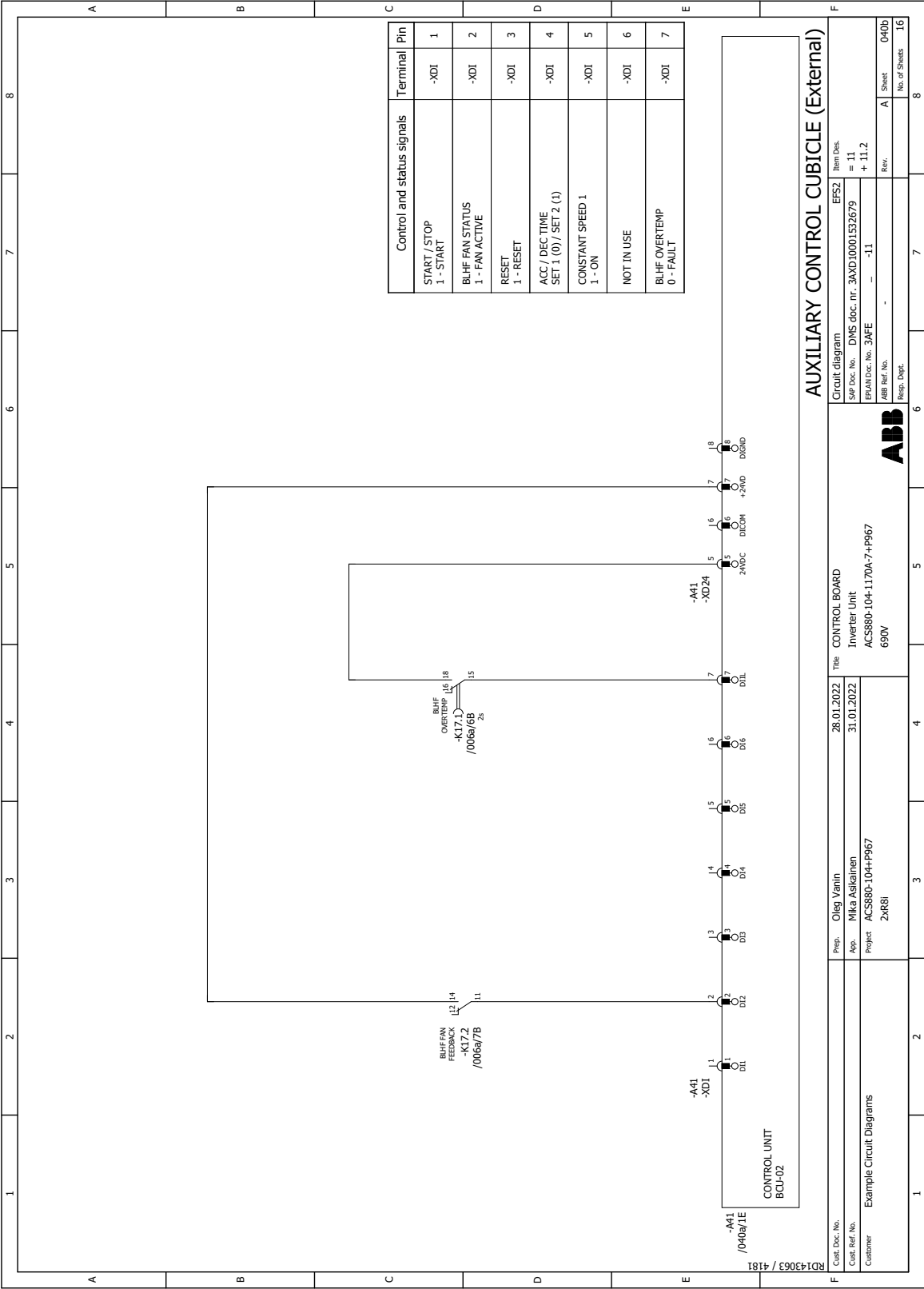
■ **021a**



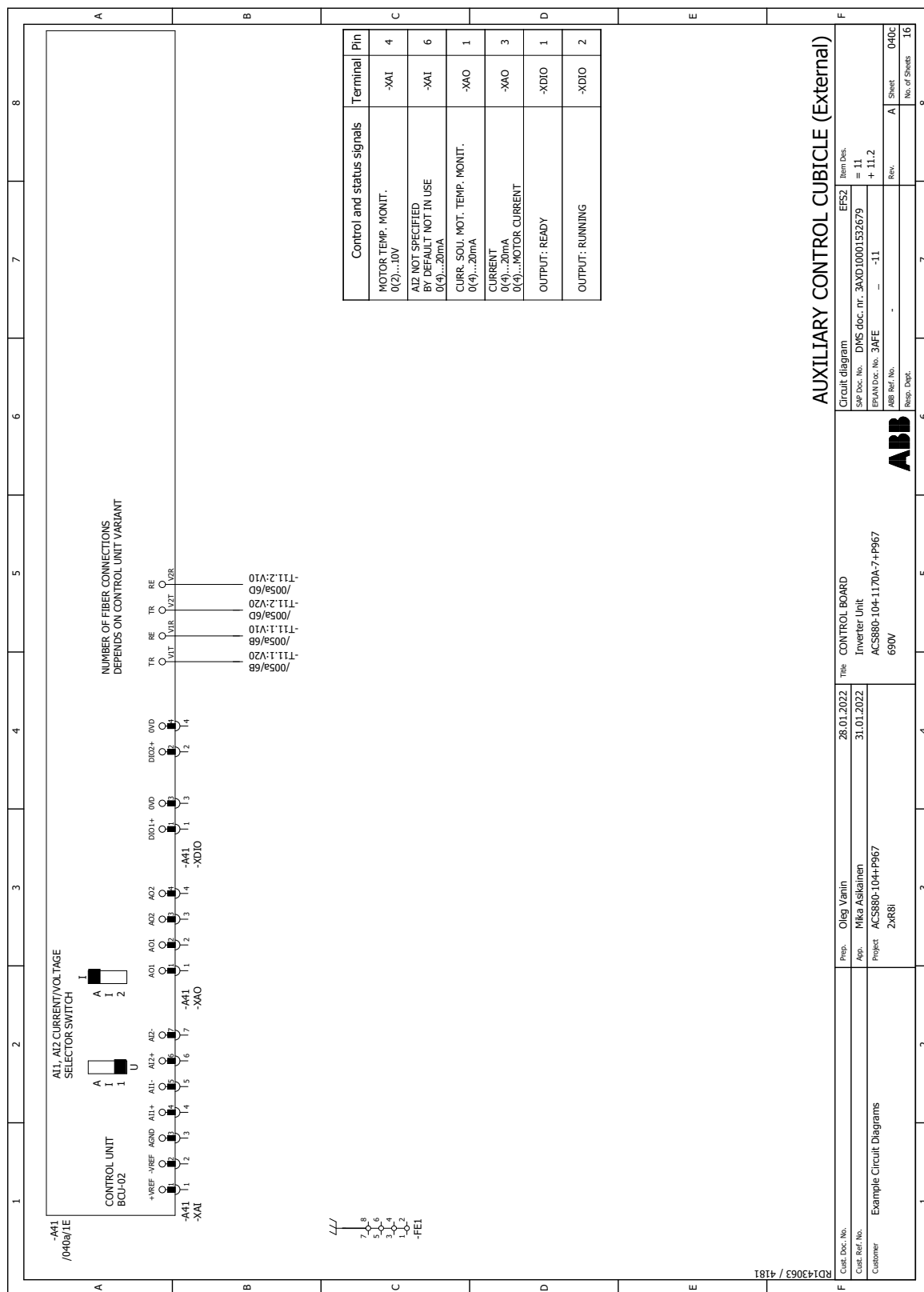
040a

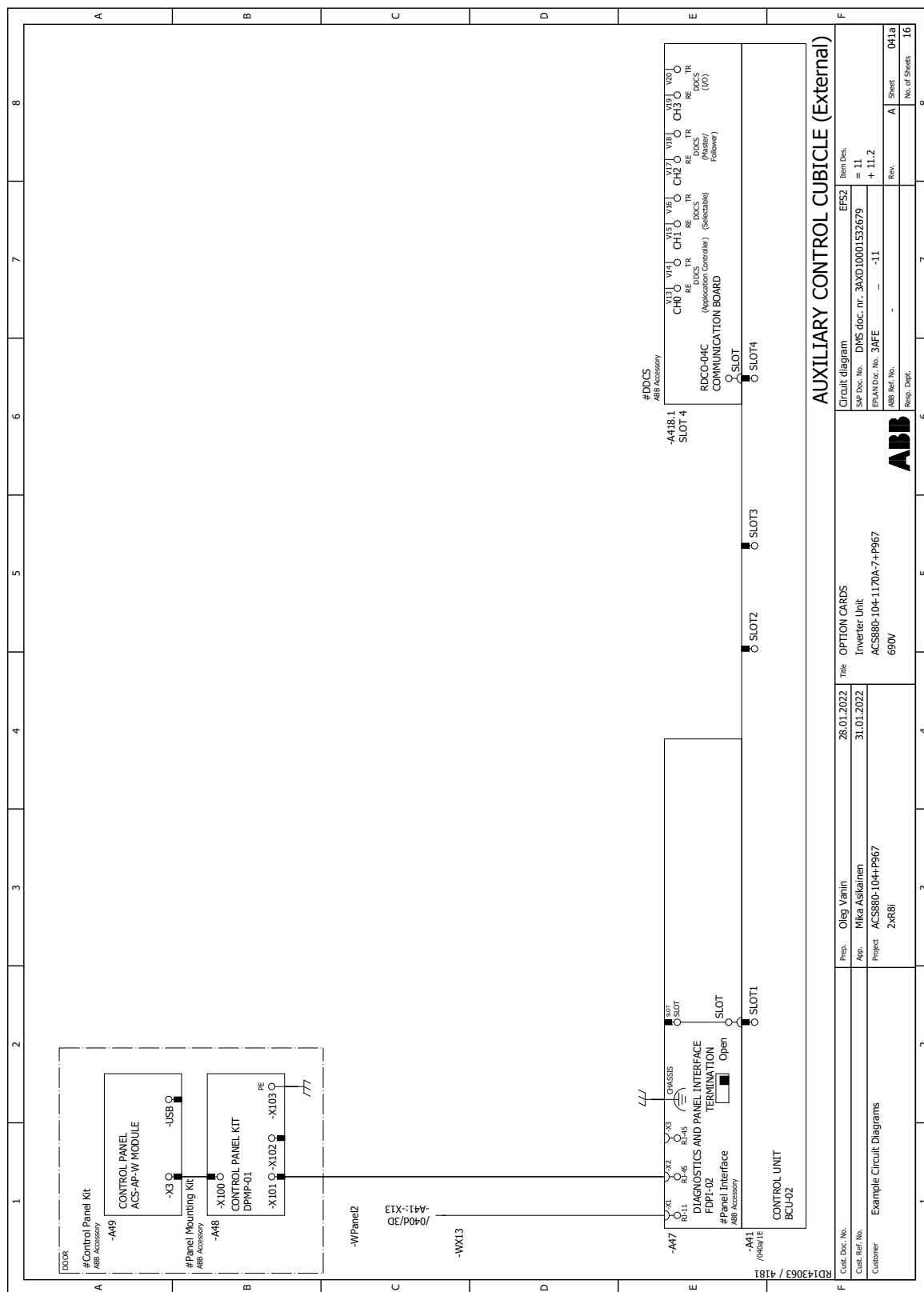


040b

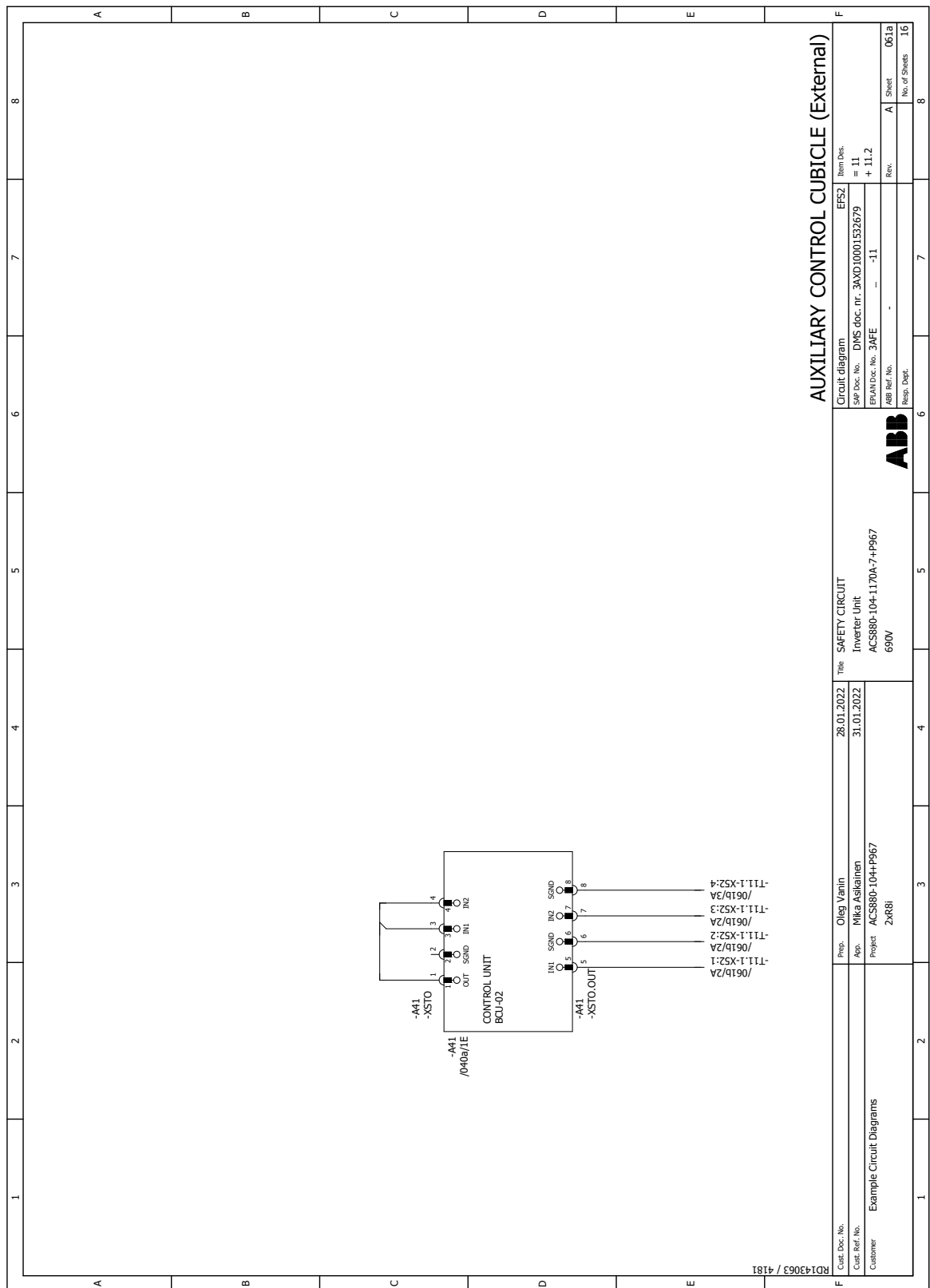


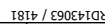
■ **040c**





■ **061a**





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/searchchannels.

Product training

For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB manuals

Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

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