

PACMotion™ Servo Drives

INSTALLATION AND USER MANUAL



Warnings and Caution Notes as Used in this Publication

WARNING

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

CAUTION

Caution notices are used where equipment might be damaged if care is not taken.

DANGER

Danger notices are used in this publication to emphasize that failure to observe all precautionary signs on equipment may result in death or serious injury to personnel.

Note: Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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Section 1 Introduction

1.1 Document Revisions

Revision	Remarks
C	The hardware revision is a drop-in replacement with no functional change. The hardware revision does change the drive appearance by adding ports X11 and X12 to the drives. The X11 and X12 ports are not used in EtherCAT mode.
B	Updates to Document Titles
A	Initial Release

1.2 About this manual

This manual describes the PACMotion™ Servo Motors (PSD) digital drives and includes information needed to safely install a PSD. Manual updates can be downloaded from the Emerson support site located at the end of this manual.

PSD information can also be located in the following areas.

- WorkBench Online Help*: This software describes how to use your drive in common applications. It also provides tips for maximizing your system performance with the PSD. The *Online Help* includes the *Parameter and Command Reference Guide*, which provides information for the parameters and commands used to program the PSD>
- PACMotion Servos Accessories Guide* (GFK-3173): It provides information on accessories like cables and regen resistors used with the PSD.

1.3 Related Documentation

Manual Title	Document Number
PACMotion Servo Drives Installation and User Manual	GFK-3168
PACMotion Rotary Servo Motors Installation and User Manual	GFK-3169
PACMotion Servos Accessories Guide	GFK-3173
PACMotion Servos Secure Deployment Guide	GFK-3177

1.4 Safety

1.4.1 You should pay attention to this

This section helps you to recognize and avoid dangers to people and objects.

1.4.2 Specialist staff required!

Only properly qualified personnel are permitted to perform such tasks as transport, installation and setup. Qualified specialist staff are persons with expertise in transport, installation, assembly, commissioning and operation of electrotechnical equipment.

- Transport, storage, unpacking: only by personnel with knowledge of handling electrostatically sensitive components.
- Mechanical installation: only by personnel with mechanical expertise. Electrical installation: only by personnel with expertise in electrical engineering.
- Basic tests / setup: only by personnel with expertise in electrical engineering and drive technology.
- The qualified personnel must know and observe ISO 12100 / IEC 60364 / IEC 60664 and national accident prevention regulations.

1.4.3 Read the documentation!

Read the available documentation before installation and commissioning. Improper handling of the devices can cause harm to people or damage to property. The operator of systems using the drive system must ensure that all personnel who work with the drive read and understand the manual before using the drive.

1.4.4 Check Hardware Revision!

Check the Hardware Revision Number of the product (see product label). The product Hardware Revision Number must match the Hardware Revision Number in the IPI.

1.4.5 Pay attention to the technical data!

Adhere to the technical data and the specifications on connection conditions. If permissible voltage values or current values are exceeded, the devices can be damaged. Unsuitable motor or wrong wiring will damage the system components. Check the combination of drive and motor. Compare the rated voltage and current of the units.

1.4.6 Perform a risk assessment!

The manufacturer of the machine must generate a risk assessment for the machine, and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property. Additional requirements on specialist staff may also result from the risk assessment.

1.4.7 Automatic Restart!

The drive might restart automatically after power on, voltage dip or interruption of the supply voltage, depending on the parameter setting.

Risk of death or serious injury for humans working in the machine.

If the parameter DRV.ENDEFAULT is set to 1, then place a warning sign to the machine (Warning: Automatic Restart at Power On) and ensure, that power on is not possible, while humans are in a dangerous zone of the machine. In case of using an undervoltage protection device, you must observe EN 60204-1:2006 chapter 7.5 .

1.4.8 Observe electrostatically sensitive components!

The devices contain electrostatically sensitive components which may be damaged by incorrect handling. Electrostatically discharge your body before touching the device. Avoid contact with highly insulating materials (artificial fabrics, plastic film etc.). Place the device on a conductive surface.

1.4.9 Hot surface!

Drives may have hot surfaces during operation. The housing can reach temperatures above 80 °C. Risk of minor burns! Measure the temperature, and wait until the housing has cooled down below 40 °C before touching it.

1.4.10 Earthing!

It is vital that you ensure that the drive is safely earthed to the PE (protective earth) busbar in the switch cabinet. Risk of electric shock. Without low-resistance earthing no personal protection can be guaranteed.

1.5 Leakage Current!

Since the leakage current to PE is more than 3.5 mA, in compliance with IEC61800-5-1 the PE connection must either be doubled or a connecting cable with a cross-section >10 mm² must be used. Deviating measures according to regional standards might be possible.

1.5.1 High Voltages!

The equipment produces high electric voltages up to 900 V. Risk of electric shock. Do not open or touch the equipment during operation. Keep all covers and cabinet doors closed. During operation, drives may have uncovered live sections, according to their level of enclosure protection.

Lethal danger exists at live parts of the device. Built-in protection measures such as insulation or shielding may not be removed. Work on the electrical installation may only be performed by trained and qualified personnel, in compliance with the regulations for safety at work, and only with switched off mains supply, and secured against restart.

Never undo any electrical connections to the drive while it is live. There is a danger of electrical arcing with damage to contacts and personal injury. Wait at least 7 minutes after disconnecting the drive from the main supply power before touching potentially live sections of the equipment (such as contacts) or removing any connections.

Always measure the voltage in the DC bus link and wait until the voltage is below 50 V before handling components.

1.5.3 Functional Safety!

The STO safety implementation on the PSD is qualified. The assessment of the safety functions according to EN13849 or EN 62061 must finally be done by the user.

Reinforced Insulation

Thermal sensors, motor holding brakes and feedback systems built into the connected motor must have reinforced insulation (according to IEC61800-5-1) against system components with power voltage, according to the required application test voltage. All Emerson components meet these requirements.

Never modify the drive!

It is not allowed to modify the drive hardware without permission by the manufacturer. Opening the housing causes loss of warranty.

1.5.4 Use as Directed

The PACMotion Servo Drives (PSD) are exclusively intended for driving suitable synchronous servomotors with closed-loop control of torque, speed, and/or position.

PSDs are components that are built into electrical plants or machines and can only be operated as integral components of these plants or machines. The manufacturer of the machine used with a drive must generate a risk assessment for the machine. When the drives are built into machines or plant, the drive must not be used until it has been established that the machine or plant fulfills the requirements of the regional directives.

Cabinet and wiring

Drives must only be operated in a closed control cabinet suitable for the ambient conditions . Ventilation or cooling may be necessary to keep the temperature within the cabinet below 40 °C.

Use only copper conductors for wiring. The conductor cross-sections can be derived from the standard IEC 60204 (alternatively for AWG cross-sections: NEC Table 310-16, 75 °C column).

Power supply

The drives can be supplied by 1 or 3 phase industrial supply networks. Drives in the PSD series can be supplied as follows:

- IC830DPzzz06: 1 or 3 phase industrial supply networks (120 V and 240 V).
- IC830DPzzz07: 3 phase industrial supply networks (240 V, 400 V and 480 V).

Connection to other voltage types of supply networks is possible with an additional isolating transformer .

Periodic overvoltages between phases (L1, L2, L3) and the housing of the drive must not exceed 1000 V peak. In accordance with IEC 61800, voltage spikes (< 50 µs) between phases must not exceed 1000 V. Voltage spikes (< 50 µs) between a phase and the housing must not exceed 2000 V.

EMC filter measures for IC830DPzzz06 must be implemented by the user.

For the cases of group installations and of DC powered drives

PSD has not been evaluated by Emerson, UL, or TÜV for group installations nor are ratings defined for DC input voltage.

Group installations must be reviewed and evaluated by the user for branch circuit protection*, wire size, wire voltage rating, fuse protection, system dielectric requirements, overvoltage and input** current rating.

In case of DC supplied drives the built-in EMC filter will not work. The user is responsible to keep the conducted emissions and the immunity of the drive within the required noise levels.

* Special care must be taken in branch circuit design with mixed rating drives to avoid the smaller drives becoming the effective 'fuse' rather than the circuit protective fuse.

** The power supply system design must ensure inrush current protection by limiting input current during power up. DC supply polarity must be properly wired. Improper polarity of DC power will damage the drive and void warranty.

Motor voltage rating

The rated voltage of the motors must be at least as high as the DC bus link voltage divided by $\sqrt{2}$ produced by the drive ($U_{nMotor} \geq U_{DC}/\sqrt{2}$).

Safe torque off

Review the section "Use as Directed" in the STO chapter before using this safety function (according to ISO 13849 category 3).

1.5.5 Prohibited Use

Other use than that described in chapter "Use as directed" is not intended and can lead to personnel injuries and equipment damage. The drive may not be used with a machine that does not comply with appropriate national directives or standards. The use of the drive in the following environments is also prohibited:

- potentially explosive areas
- environments with corrosive and/or electrically conductive acids, alkaline solutions, oils, vapors, dusts
- ships or offshore applications

1.5.6 Warning notes placed on the product

IC830DP002407	IC830DP00306 ... P02406, P00307 ... P01206
<p>⚠ WARNING</p> <p>HIGH VOLTAGE!</p> <p>Wait 7 minutes after removing power before serving.</p> <hr/>	<p>⚠ WARNING</p> <p>HIGH VOLTAGE!</p> <p>Wait 5 minutes after removing power before serving.</p> <hr/>

If these signs are damaged, they must be replaced immediately.

Section 2 Product Life Cycle Handling

2.1 Transport

Transport the PSD in accordance with IEC 61800-2 as follows:

Transport only by qualified personnel in the manufacturer's original recyclable packaging. Avoid shocks while transporting.

Store at or below maximum stacking height, details see Section 2.3, *Storage*.

Transport only within specified temperature ranges: -25 to +70 °C, max. rate of change 20 K/hour, class 2K3.

Transport only within specified humidity: max. 95% relative humidity, no condensation, class 2K3.

The drives contain electrostatically sensitive components that can be damaged by incorrect handling. Electrostatically discharge yourself before touching the drive. Avoid contact with highly insulating materials, such as artificial fabrics and plastic films. Place the drive on a conductive surface.

If the packaging is damaged, check the unit for visible damage. Inform the shipper and the manufacturer of any damage to the package or product.

2.2 Packaging

Model	Package Dimensions (mm) HxWxL	Total Weight IC830DP (kg)
IC830DP00306 , -P00606	113 x 250 x 222	1.7
IC830DP1206	158 x 394 x 292	3.4
IC830DP02406	158 x 394 x 292	5
IC830DP00307, -P00607, -P01207	158 x 394 x 292	4.3
IC830DP02407	158 x 394 x 292	6.7

2.3 Storage

The PSD packaging consists of recyclable cardboard with inserts and a label on the outside of the box.

Store the PSD in accordance with IEC 61800-2 as follows:

- Store only in the manufacturer's original recyclable packaging. Store at or below maximum stacking height:
 - IC830DP00306 to 00606 models: 8 cartons,
 - IC830DP01206, x02406, x00307 to x02407 models: 6 cartons
- Store only within specified temperature ranges: -25 to + 55 °C, max. rate of change 20 K/hour, class 1K4.

- Storage only within specified humidity: 5 to 95% relative humidity, no condensation, class 1K3.
- Store in accordance with the following duration requirements: Less than 1 year: without restriction.

More than 1 year: capacitors must be re-formed before setting up and operating the drive. Re-forming procedures are in Section 2.3.1, *Capacitor Storage* .

2.3.1 Capacitor Storage

Valid for PSD:

Capacitors integrated in servo amplifiers may be uncharged to absolute zero level, if servo amplifiers are stored for longer than a year without being connected to mains voltage. If rated voltage is supplied to such a capacitor, then an extremely high charging current (depending on the charge characteristics curve) may flow for some time, which could overheat and destroy the capacitor or the PCB. Even load cycles during this phase result in high current peaks due to recharging processes.

The capacitors must be reformed therefore after long storage phases. The servo amplifier must be connected with single phase (to L1/L2 terminals) and low voltage (therefore low charging current) for about 30 minutes. We recommend using the **lowest** admitted rated mains supply voltage for the servo amplifier.

The safer, recommended procedure is the use of a variable transformer. If available, use a variable transformer to apply voltage in 50 Volt increments for at least 20 minutes at each step until rated voltage is reached, then hold the final (rated) voltage for at least 1 hour. In a separate operation, with all other electrical connections (including mains power) removed, apply 24VDC in the correct polarity across +24 V and GND for approximately 30 minutes.

If storage times of over a year are anticipated, the above capacitor re-forming processes may be avoided by simultaneously powering the servo amplifier with 24 VDC auxiliary power and full rated mains voltage for at least an hour at intervals of less than a year.

2.4 Installation, setup and normal operation

Installation and setup information are given in *the PACMotion PSD Installation and User Guide*, GFK-3168.

Normal operation tested for environmental class 3K3 according to IEC 61800-2 .

The manufacturer of the machine defines the necessary end user expertise based on the risk assessment for the machine and describes the requirements for normal operation based on the application.

2.5 Decommissioning

Note: Only professional staff who are qualified in electrical engineering are allowed to decommission parts of the system.

DANGER

LETHAL VOLTAGES!

There is a danger of serious personal injury or death by electrical shock or electrical arcing.

- Switch off the main switch of the switchgear cabinet. Secure the system against restarting.
- Block the main switch.

Wait at least 7 minutes after disconnecting.

2.6 Maintenance and cleaning

The device does not require maintenance. Opening the device voids the warranty. The inside of the unit can only be cleaned by the manufacturer.

Note: Do not immerse or spray the device. Avoid that liquid enters the device.

To clean the device exterior:

1. Decommission the device (see Section 2.5, Decommissioning).
2. Casing: Clean with isopropanol or similar cleaning solution.

DANGER

HIGHLY FLAMMABLE!

Risk of injury by explosion and fire. Observe the safety notes given on the cleaning liquid package.

Wait at least 30 minutes after cleaning before putting the device back into operation.

3. Protective grill on fan: Clean with a dry brush.

2.7 Disassembly

Note: Only professional staff who are qualified in electrical engineering are allowed to disassemble parts of the system.

1. Decommission the device (see Section 2.5, Decommissioning)
2. Check temperature.

WARNING

HIGHLY FLAMMABLE!

High Temperature! Risk of minor burns. During operation, the heat sink of the drive may reach temperatures above 80 °C (176 °F). Before touching the device, check the temperature and wait until it has cooled below 40 °C (104 °F).

Remove the connectors. Disconnect the potential earth connection last.

Demount: loosen the fastening screws. Remove the device.

2.8 System Repair

Note: Only professional staff who are qualified in electrical engineering are allowed to exchange parts of the drive system.

• DANGER

AUTOMATIC START!

During replacement work a combination of hazards and multiple episodes may occur.

Work on the electrical installation may only be performed by trained and qualified personnel, in compliance with the regulations for safety at work, and only with use of prescribed personal safety equipment.

2.8.1 Exchange of the device

Only the manufacturer can repair the device. Opening the device voids the warranty.

1. Decommission the device (see Section 2.5, Decommissioning)
2. Demount the device (see Section 2.7, *Disassembly*).
3. Send the device to the manufacturer.
4. Install a new device as described in the Installation Manual.
5. Setup the system as described in the Installation Manual.

2.8.2 Exchange of other drive system parts

If parts of the drive system (e.g. cables) must be replaced, proceed as follows:

1. Decommission the device (see Section 2.5, Decommissioning)
2. Exchange the parts.
3. Check all connections for correct fastening.
4. Setup the system as described in the Installation Manual.

Section 3 Package Supplied

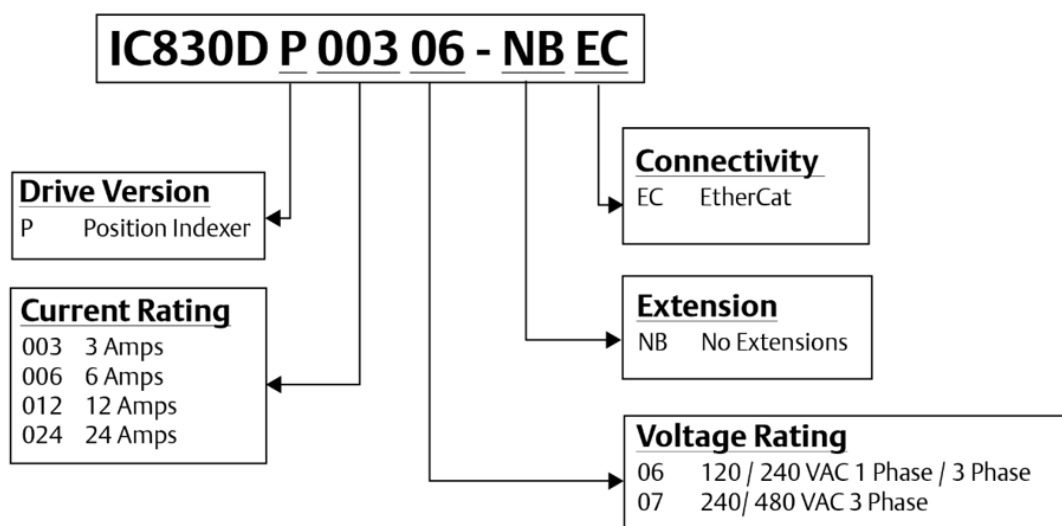
- DVD with the Setup software Workbench and product documentation.
- Various mating connectors and earthing plates

Note: The mating SubD and RJ45 connectors are not included in the package.

3.1 Part Number Scheme

Use the part number scheme for product identification only, not for the order process, because not all combinations of features are possible, always.

Figure 1: Part Number Scheme



Customization: this code includes language versions of printed material and customer specials.

3.2 PACMotion Servo Drive Hardware Revision – X11/X12 Ports

The hardware revision of the PACMotion Servo Drive has been updated, with no functional changes. The upgrade only affects the appearance of the drive, adding ports X11 and X12. It's important to note that these ports are not used in EtherCAT mode. The hardware revision is indicated by last two characters appended to the part number.

For example:

Part Number = IC830DP00306-NBEC-**CA**

CA is the hardware revision.

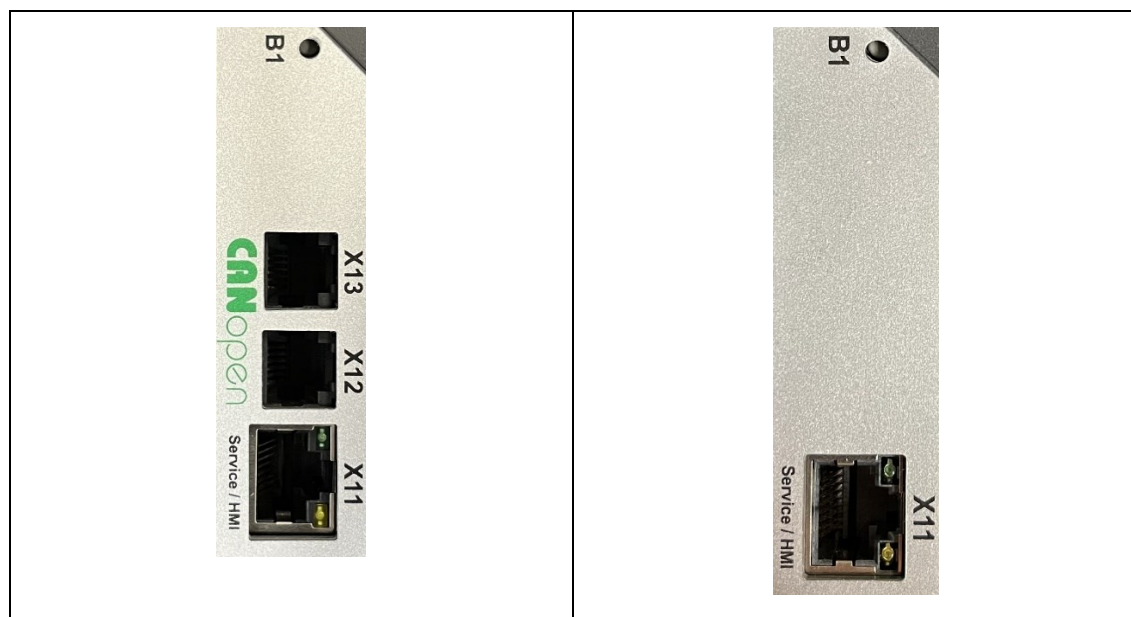
PACMotion Servo Drives that include ports X11 and X12 are shown in the table below.

Hardware Revision Numbers with X11 and X12 Ports

Part Number
IC830DP00306-NBEC-CA or later
IC830DP00307-NBEC-BA or later
IC830DP00606-NBEC-CA or later
IC830DP00607-NBEC-BA or later
IC830DP01206-NBEC-BA or later
IC830DP01207-NBEC-BA or later
IC830DP02406-NBEC-BA or later
IC830DP02407-NBEC-BA or later

The PACMotion Servo Drives with revised hardware can also be identified by looking at the top of the drive ports. They will appear as shown below.

Figure 2 Drive Top View with regard to X11 and X12 ports



Section 4 Technical Description and Data

4.1 The PSD Family of Digital Drives

Variant (short)	Description	Housing	Connectivity
IC830DP	Position Indexer drive adds the ability to command multiple motions, process I/O, make decisions, add time delays, modify drive process variables to the base drive.	Standard	EtherCAT

4.1.1 Standard features

- Supply voltage range 120 V to 480 V $\pm 10\%$. Several housing dimensions, depending on current and hardware options.
- Motion bus onboard, TCP/IP service channel onboard.
- Support for SFD, BiSS or HIPERFACE DSL® protocols onboard. Encoder emulation onboard and support for second feedback
- Safe Torque Off (STO) according to IEC 62061 SIL 2 onboard.
- Use with Synchronous servomotors, linear motors, and induction machines can be used.

4.1.2 Power section

- One or three phase supply, voltage range 120 to 480 V $\pm 10\%$, 50 to 400 Hz $\pm 5\%$ or DC. Connection to higher voltage mains only via isolating transformer, (\rightarrow # 103). Single phase supply possible with output power derating.
- B6 bridge rectifier, integral soft-start circuit. Fusing to be provided by the user.
- DC bus link voltage range 170 to 680 VDC, can be connected in parallel. Output stage IGBT module with floating current measurement.
- Regeneration circuit with dynamic distribution of the generated power between several drives on the same DC bus link circuit.
- Internal regeneration resistor for all PSD models (except IC830DP00306 and IC830DP00606), external regen resistors if required.

4.1.3 Integrated safety

Appropriate insulation/creepage distances and electrical isolation for safe electrical separation, per IEC 61800-5-1, between the power input/motor connections and the signal electronics.

Soft-start, overvoltage detection, short-circuit protection, phase-failure monitoring. Temperature monitoring of the drive and motor.

Motor overload protection: foldback mechanism

SIL 2 safe torque off in accordance with IEC 62061(\rightarrow # 54).

4.1.4 Auxiliary supply voltage 24V DC

From an external, safety approved 24 V \pm 10% power supply.

4.1.5 Operation and parameter setting

Using the setup software Workbench for setup via TCP/IP

4.1.6 Full digital control

- Digital current controller (670 ns)
- Adjustable digital velocity controller (62.5 μ s) Software option position controller (250 μ s)

4.1.7 Inputs/Outputs

- 1 programmable analog input (\rightarrow # 151)
- 1 programmable analog output (\rightarrow # 152)
- 7 programmable digital inputs (\rightarrow # 153)
- 2 programmable digital outputs (\rightarrow # 160)
- 1 Enable input (\rightarrow # 153)
- 1 STO input (\rightarrow # 54)
- additional digital inputs and outputs depending on variants (for example PSD)

4.1.8 Connectivity

- Inputs/Outputs (\rightarrow # 146)
- Encoder feedback output (\rightarrow # 144)
- Service Interface (\rightarrow # 172)
- Motion Bus interface (\rightarrow # 182)
- EtherCAT (\rightarrow # 83)

4.2 Ambient Conditions, Ventilation, and Mounting Position

Storage / Transport	(→ # 19) / (→ # 19)
Surrounding air temperature in operation	non UL/cUL regions: 0 to +40 °C under rated conditions +40 to +55 °C with continuous current derating 4 % per Kelvin
	UL/cUL regions: refer to UL approval (→ # 23)
Humidity in operation	Relative humidity 5 to 85%, no condensation, class 3K3
Site altitude	Up to 1000 meters above mean sea level without restriction 1,000 to max. 2,500 meters above mean sea level with power derating 1.5%/100 m
Pollution level	Pollution level 2 as per IEC 60664-1
Vibrations	Class 3M1 according to IEC 60721-3-3
Enclosure protection	IP 20 according to IEC 60529
Mounting position	Vertical (→ # 68)
Ventilation	Built-in fan (except IC830DP00306 type)
	Note: The drive shuts down (fault F234, motor has no torque) in case of excessively high temperature in the control cabinet. Make sure sufficient forced ventilation is supplied within the control cabinet.

4.3 Mechanical Data

Mechanical data	Units	IC830DP00306 IC830DP00606	IC830DP01206	IC830DP02406
Weight (standard width)	kg	1.1	2	3.7
Weight (extended width)	kg	1.3	2.2	4
Height, without connectors	mm	168	196	248
Height, with connectors	mm	200	225	280
Standard Width front/back	mm	54/59	72/78.4	96/100
Extended Width front/back	mm	84/89	91/96	96/100
Depth, without connectors	mm	156	187	228
Depth, with connectors	mm	185	< 215	<265
Weight (standard width)	kg	2.7	5.3	11.5
Weight (extended width)	kg	2.9	5.5	11.7
Height, without connectors	mm	256	306	385
Height, with connectors	mm	290	340	526
Standard Width front/back	mm	65/70	99/105	185/185
Extended Width front/back	mm	95/100	99/105	-
Depth, without connectors	mm	185	228	225
Depth, with connectors	mm	<225	<265	<265

4.5 Inputs/Outputs

Interface	Electrical Data
Analog inputs	±12 VDC Common Mode Rejection Ratio: > 30 dB at 60 Hz resolution 16 bit and full monotonic update rate: 16 kHz nonlinearity < 0.1% of full scale offset drift max. 250µV/°C input impedance > 13 kOhms
Analog outputs	±10 VDC max 20mA resolution 16 bit and full monotonic update rate: 4 kHz nonlinearity < 0.1% of full scale offset drift max. 250µV/°C short circuit protected to AGND output impedance 110 Ohms
Digital inputs	ON: 3.5 VDC to 30 VDC, 2 mA to 15 mA OFF: -2 VDC to 2 VDC, max.15 mA galvanic isolation for 250 VDC
Digital outputs	max. 30 VDC, 100 mA short circuit proof galvanic isolation for 250 VDC
Relay outputs	max. 30 VDC, 1A max. 42 VAC, 1 A time open/close 10ms isolation 400 VDC contact/coil

4.6 Electrical Data IC830DPzzz06

Electrical Data	Units	IC830D P00306	IC830D P00606	IC830D P01206	IC830D P02406
Rated supply voltage (L1/L2/L3)	V	3 x 120 V to 240 V ±10% 1 x 120 V to 240 V ±10%		3x240 V ±10%	
Rated supply input frequency	Hz	50 Hz to 400 Hz ±5% or DC			
Rated input power for S1 operation	kVA	1.2	2.38	3.82	7.6
Rated input current @ 40°C surrounding air temperature					
at 1x120 V	A	5.0	9.9	12	-
at 1x240 V	A	5.0	9.9	12	-
at 3x120 V	A	2.3	4.6	9.2	-
at 3x240 V	A	2.3	4.6	9.2	18.3
Permitted switch on/off frequency, mains	1/h	30			
Max. inrush current	A	10	10	10	20
Rated DC bus link voltage (Bus Turn on Delay 3ph 1 sec)	V	170 to 340			
Continuous output current (± 3%), single-phase or three-phase, @ 40°C surrounding air temperature					
at 120 V	Arms	3	6	12	-

Electrical Data	Units	IC830D P00306	IC830D P00606	IC830D P01206	IC830D P02406
at 240 V	Arms	3	6	12	24
Peak output current (for 5 s, ± 3%)	Arms	9	18	30	48
Continuous output power @ rated input current					
at 1x120 V	VA	312.5	625	1250	-
at 1x240 V	VA	625	1250	2500	-
at 3x120 V	VA	312.5	625	1250	-
at 3x240 V	VA	625	1250	2500	5000
Peak output power (for 1 s)					
at 1x120 V	kVA	0.937	1.875	3.125	-
at 1x240 V	kVA	1.875	3.750	6.250	-
at 3x120 V	kVA	0.937	1.875	3.125	-
at 3x240 V	kVA	1.875	3.750	6.250	10
Technical data for regen circuit	—	(→ # 42)			
Motor inductance min.					
at 120 V	mH	1.3	0.6	0.5	0.3
at 240 V	mH	2.5	1.3	1	0.6
Motor inductance max.	mH	250	125	100	60
Thermal dissipation, output stage disable	W	max. 20	max. 20	max. 20	max. 25
Thermal dissipation at rated current	W	31	57	137	175
Noise emission (low speed/high speed fan)	dB(A)	N/A	33/39	37/43	41/56
Aux. voltage supply (PELV)	V	24 V (±10%, check voltage drop)			
-current B, P, T types without/with motor brake	A	0.5 / 1.7	0.6 / 1.8	0.7 / 1.9	1.0 / 2.5
-current M type without/with motor brake	A	0.8 / 2.0	0.9 / 2.1	1.0 / 2.2	1.3 / 2.8

4.7 Electrical Data IC830DPzzz07

Electrical data	Units	IC830D P00307	IC830D P00607	IC830D P01207	IC830D P02407
Rated supply voltage (L1/L2/L3)	V	3 x 240 V to 480 V ±10%			
Rated supply input frequency	Hz	AC with 50 Hz to 400 Hz ±5% or DC			
Rated input power for S1 operation	kVA	2.24	4.49	7.65	15.2
Rated input current @ 40°C surrounding air temperature					
at 3x240 V	A	2.7	5.4	9.2	18.3
at 3x400 V	A	2.7	5.4	9.2	18.3
at 3x480 V	A	2.7	5.4	9.2	18.3

Electrical data	Units	IC830D P00307	IC830D P00607	IC830D P01207	IC830D P02407
Permitted switch on/off frequency, mains	1/h	30			
Max. inrush current (@480V, 20°C)	A	9	9	9	9
Rated DC bus link voltage (Bus Turn on Delay 3ph 1 sec)	V=	340 to 680			
Continuous output current (± 3%) @ 40°C surrounding air temperature					
at 240 V	Arms	3	6	12	24
at 400 V	Arms	3	6	12	24
at 480 V	Arms	3	6	12	24
Peak output current (for 5 s, ± 3%)	Arms	9	18	30	48
Continuous output power @ rated input current					
at 3x240 V	kVA	0.6	1.25	2.5	5
at 3x400 V	kVA	1	2	4.2	8.3
at 3x480 V	kVA	1.2	2.5	5	10
Peak output power (for 1 s)					
at 3x240 V	kVA	1.8	3.75	6.25	10
at 3x400 V	kVA	3	6.75	10.4	16.7
at 3x480 V	kVA	3.6	7.5	12.5	20
Technical data for regen circuit	—	(→ # 42)			
Motor inductance min.					
at 240 V	mH	3.2	1.6	1.3	0.6
at 400 V	mH	5.3	2.6	2.1	1
at 480 V	mH	6.3	3.2	2.5	1.2
Motor inductance max.	mH	600	300	250	120
Thermal dissipation, output stage disable	W	max. 20	max. 20	max. 20	max. 25
Thermal dissipation at rated current	W	102	129	153	237
Noise emission (low speed/high speed fan)	dB(A)	34/43	34/43	44/52	48/58
Aux. voltage supply (PELV)	V=	24 V (±10%, check voltage drop)			
-current B, P, T types without/with motor brake	A=	1 / 2.5	1 / 2.5	1 / 2.5	2 / 4
-current M type without/with motor brake	A=	1.3 / 2.8	1.3 / 2.8	1.3 / 2.8	2.3 / 4.3

* = motor holding brake is supplied with separated 24 V ±10% auxiliary voltage (→ # 118).

4.8 Performance Data

4.8.1 IC830DPzzz06

Performance Data	Units	IC830D P00606	IC830D P01206	IC830D P02406
Switching frequency of output stage	kHz	10	8	8
Voltage rise speed dU/dt	kV/μs	2.5		4.3
Bandwidth of current controller	kHz	2.5 to 4	2 to 3	
Bandwidth of velocity controller (scalable)	Hz	0 to 1000	0 to 800	0 to 600
Bandwidth of position controller (scalable)	Hz	1 to 250		

4.8.2 IC830DPzzz07

Performance Data	Units	IC830D P00307	IC830D P00607	IC830D P01207	IC830D P02407	IC830D P04807
Switching frequency of output stage	kHz	8	8	6	8	8
Voltage rise speed dU/dt	kV/μs	7.2				
Bandwidth of current controller	kHz	2.5 to 4		2 to 3		2 to 3
Bandwidth of velocity controller (scalable)	Hz	0 to 800	0 to 600			0 to 600
Bandwidth of position controller (scalable)	Hz	1 to 250				

4.9 Recommended Tightening Torques

Connector	Tightening Torque/Nm (see (→ # 23) for in-lbs values.)			
X1	0.2 to 0.25	0.2 to 0.25	0.2 to 0.25	0.2 to 0.25
X2	0.5 to 0.6	0.7 to 0.8	0.7 to 0.8	0.7 to 0.8
X3	0.5 to 0.6	0.5 to 0.6	0.7 to 0.8	0.7 to 0.8
X4	-	-	0.7 to 0.8	0.7 to 0.8
X7, X8, X21, X22, X23, X24, X35, X36	0.2 to 0.25	0.2 to 0.25	0.2 to 0.25	0.2 to 0.25
X14	-	-	1.7 to 1.8	1.7 to 1.8
X15, X16	-	-	0.2 to 0.25	0.2 to 0.25
PE block	1.7	1.7	1.7	1.7

4.11 Grounding System

AGND	Analog Ground
DCOM7/8	common line for digital inputs on I/O connector X7, X8
GND	24 V supply, STO input (up to IC830DP024), holding brake
STO-GND	STO-Enable inputs (IC830DP048)
0 V	internal digital ground, encoder emulation output, service channel

4.12 Fuses and breakers

EU Cartridge Fuses	US Cartridge Fuses
Types gS (gRL) or gG (gL), 400 V/500 V, time-delay	Class J, 600 V AC 200 kA, time-delay. The fuse must be UL and CSA listed.

Cartridge fuse holders: Combined with the standard fuse blocks, finger safe fuse holders must be used according to IEC 60529.

Examples Bussmann: CH Series Modular Fuse Holders, class J, 3 poles: CH30J3, CH14J3
Example Ferraz: Ultrasafe Fuse holders, class J, 3 poles: US3J3I

4.12.1 External power supply

Drive Model	Max. Ampere rating	Example class J Bussmann	Example class J Ferraz Shawmut
IC830DP00306	10A (Time-Delay)	LPJ10SP/DFJ10	AJT10/HSJ10
IC830DP00606	15A (Time-Delay)	LPJ15SP/DFJ15	AJT15/HSJ15
IC830DP01206	15A (Time-Delay)	LPJ15SP/DFJ15	AJT15/HSJ15
IC830DP02406	30A (Time-Delay)	LPJ30SP/DFJ30	AJT30/HSJ30
IC830DP00307	6A (Time-Delay)	LPJ6SP/DFJ6	AJT6/HSJ6
IC830DP00607	10A (Time-Delay)	LPJ10SP/DFJ10	AJT10/HSJ10
IC830DP01207	15A (Time-Delay)	LPJ15SP/DFJ15	AJT15/HSJ15
IC830DP02407	30A (Time-Delay)	LPJ30SP/DFJ30	AJT30/HSJ30

4.13 External 24 V supply

Drive Model	Max. Ampere rating	Example class J Bussmann	Example class J Ferraz Shawmut
all PSD	8A (Time-Delay)	LPJ8SP/DFJ8	AJT8

4.13.1 External regen resistor

Drive Model	Ampere rating@ 240V	Ampere rating@ 480V	UL region example:	CE Region example:
IC830DP003 to 012	10A	40A	FWP-xxA14F	110V to 400V: gRL xxA (gS)
IC830DP024	15A	50A		400V to 480V: aR xxA

4.13.2 External DC Bus link

Drive Model	Ampere rating	UL region example:	CE Region example:
IC830DP003 to 024	50A	FWP-50A14F	110V to 400V: gRL 50A (gS) 400V to 480V: aR 50A

4.14 Connectors

4.14.1 IC830DPzzz06 and IC830DPzzz07 types

Connector	Type	Max. Cross Section ¹	Current ²	Voltage ³
Control signals X7/X8	Terminal Connector, 10 poles	1.5 mm ² , 16 awg	10 A	250 V
Feedback X10	SubD 15pin HD (female)	0,5 mm ² , 21 awg	1 A	<100 V
Motion Bus X5, X6	RJ45	0,5 mm ² , 21 awg	1 A	<100 V
Encoder Emulation X9	SubD 9pin (male)	0,5 mm ² , 21 awg	1 A	<100 V

4.14.2 IC830DPzzz06 types (120V to 240V Mains Voltage Supply)

Connector	Type	Max. Cross Section ¹	Current ²	Voltage ³
24V/STO X1 (03 to 24A)	Terminal Connector, 3 poles	1.5 mm ² , 16 awg	8 A	160 V
Motor X2 (3 to 6 A)	Terminal Connector, 6 poles	2.5 mm ² , 14 awg	10 A	320 V
Motor X2 (12 to 24 A)	Terminal Connector, 6 poles	10 mm ² , 8 awg	30 A	1000 V
Power/Regen X3 (3 to 6A)	Terminal Connector, 7 poles	2.5 mm ² , 14 awg	10 A	320 V
Power/Regen X3 (12 A)	Terminal Connector, 8 poles	2,5 mm ² , 14 awg	16 A	320 V
Regen X3 (24 A)	Terminal Connector, 4 poles	10 mm ² , 8 awg	30 A	1000 V
Power X4 (24 A)	Terminal Connector, 4 poles	10 mm ² , 8 awg	30 A	1000 V

4.14.3 IC830DPzzz07 types (240V to 480V Mains Voltage Supply)

Connector	Type	Max. Cross Section ¹	Current ²	Voltage ³
24V/STO X1 (03 to 24A)	Terminal Connector, 3 poles	1.5 mm ² , 16 awg	8 A	160 V
Motor X2 (03 to 24A)	Terminal Connector, 6 poles	10 mm ² , 8 awg	30 A	1000 V
Regen X3 (03 to 24A)	Terminal Connector, 4 poles	10 mm ² , 8 awg	30 A	1000 V
Power X4 (03 to 24A)	Terminal Connector, 4 poles	10 mm ² , 8 awg	30 A	1000 V

¹single-line connection

²single-line connection with recommended conductor cross section (→ # 41)

³rated voltage with pollution level 2 (lowest values according to UL840 and IEC60664)

4.15 Cable and Wire Requirements

4.15.1 General

For information on the chemical, mechanical, and electrical characteristics of the cables please refer to the accessories manual or contact customer support.

To reach the maximum permitted cable length, you must use cable material with the following capacitance (phase to shield) requirements:

Motor cable: less than 150 pF/m Resolver/Encoder cable: less than 120 pF/m

Motor cables longer than 25 m may require the use of a motor choke.

Cable cross sections and requirements

The table below describes the recommended interface cross sections and cable requirements for single-axis systems in accordance with IEC 60204. For multi-axis systems, observe the specific operating conditions for your system.

Interface	Cross Section	Cable Requirements
AC connection	up to IC830DP006: 1.5 mm ² (16 awg) IC830DP012: 2.5 mm ² (14 awg) IC830DP024: 4 mm ² (12 awg)	600 V, minimum 75°C
DC bus link, regen resistor	IC830DP006: 1.5 mm ² (16 awg) IC830DP012 to 24: 2.5 mm ² (14 awg)	1000 V, minimum 75°C, shielded for lengths >0.20 m
Motor cables without choke, max. 25 m	up to IC830DP006: 1.5 mm ² (16 awg) IC830DP012: 2.5 mm ² (14 awg) IC830DP024: 4 mm ² (12 awg)	600 V, minimum 75°C, shielded, capacitance <150 pF/m
Motor cables with choke, 25 - 50 m	up to IC830DP006: 1.5 mm ² (16 awg) IC830DP012: 2.5 mm ² (14 awg) IC830DP024: 4 mm ² (12 awg)	600 V, minimum 75°C, shielded, capacitance <150 pF/m
SFD, max. 50 m	1x2x0.25 mm ² (24 awg) 1x2x0.50 mm ² (21 awg)	twisted pairs, shielded
SFD3, max. 25 m	1x2x0.50 mm ² (21 awg)	twisted pairs, shielded
Encoder, max. 50 m	7x2x0.25 mm ² (24 awg)	twisted pairs, shielded
Analog I/Os, max. 30 m	0.25 mm ² (24 awg)	twisted pairs, shielded
Digital I/Os, max. 30 m	0.5 mm ² (21 awg)	single line
Holding brake (motor) +24 V / GND, max 30 m	min. 0.75 mm ² (19 awg) max. 2.5 mm ² (14 awg)	600 V, minimum 75°C, shielded single line

4.16 Dynamic Braking

Dynamic braking is a method to slow down a servo system by dissipating the mechanical energy driven by the motor back EMF. The PSD has a built in advanced dynamic braking mode which operates fully in hardware. When activated, the drive shorts the motor terminals in phase with the back EMF (q axis) but continues to operate the non-force producing current loop (d-axis) with 0 current. This forces all of the dynamic braking current to be stopping current and insures the fastest stopping/amp of motor terminal current.

When current is not being limited, the mechanical energy is being dissipated in the motor resistance.

When current is being limited, energy is returned to the drive bus capacitors.

The drive also limits the maximum dynamic braking motor terminal current via the *DRV.DBILIMIT* parameter to insure that the drive, motor, and customer load do not see excessive currents/forces.

Whether and how the PSD uses dynamic braking depends on (*DRV.DISMODE*).

4.16.1 Regen circuit

When the amount of returned energy builds the bus capacitor voltage up enough the drive activates the regen circuit to start dumping the returned energy in the regen resistor (also called regenerative or brake resistor). This resistor could be internal or connected external to the drive, depending on drive model and drive wiring.

IC830DP00306 to IC830DP00606

No internal regen resistor. Depending on the application requirements, an external resistor can be connected.

IC830DP01206 to IC830DP02406 and IC830DP00307 to IC830DP02407

With internal resistor plus the ability to connect an external resistor depending on the application requirements.

External regen resistors are described in the GFK-3173, *PACMotion Servos Accessories Manual*.

4.16.2 Functional description

When the amount of returned energy builds the bus capacitor voltage up enough the drive activates the brake chopper to start dumping the returned energy in the regen resistor.

Individual drives, not coupled through the DC bus link circuit (+DC, -DC)

When the energy fed back from the motor has an average or peak power that exceeds the pre-set level for the regen power rating, the drive generates the warning "n521 Regen Over power". If the power increases past the fault level, the regen circuit will switch off.

With the regen circuit switched off, the drive internal DC bus link voltage is supervised. The drive reports an over-voltage fault if the DC bus threshold is exceeded. The drive power stage is disabled and the load coasts to a stop with the fault message "F501 Bus Over voltage" (→ # 197). The Fault contact (terminals X8/9-10) is opened (→ # 161) due to this fault.

Several drives coupled through the DC bus link (+DC, -DC)

Using the built-in regen circuit, several drives of the same series can be operated from a common DC-bus link (→ # 108), without any additional measures. 90% of the combined power of all the coupled drives is always available for peak and continuous power. The switch-off on

over voltage takes place as described under 1. (above) for the drive that has the lowest switch-off threshold (resulting from tolerances).

Note: Observe the regeneration time (some minutes) after full load with peak regen power.

4.16.3 Technical data for IC830DPzzz06

Technical data for the regen circuit depends on the drive type and the mains voltage. Supply voltages, capacitances, and switch-on voltages are all nominal values.

Brake circuit			Supply voltage 120 V / 240 V
Type	Rated data	Units	
IC830DPzzz06 all types	Switch-on threshold of regen circuit	V	380
	Overtoltage limit	V	420
	Maximum regen duty cycle	%	15*

Type	Rated data	Units	120 V / 240 V
IC830DP00106	External regen resistor	Ohm	33
	Maximum continuous regen power, external resistor	kW	0.48
	Peak regen power, external (1s)	kW	5.4
	Absorption energy in capacitors (+/- 20%)	Ws	60 / 20
	DC Bus Capacitance	µF	940
IC830DP00306	External regen resistor	Ohm	33
	Maximum continuous regen power, external resistor	kW	0.77
	Peak regen power, external (1s)	kW	5.4
	Absorption energy in capacitors (+/- 20%)	Ws	60 / 20
	DC Bus Capacitance	µF	940
IC830DP00606	External regen resistor	Ohm	33
	Maximum continuous regen power, external resistor	kW	1.5
	Peak regen power, external resistor (1s)	kW	5.4
	Absorption energy in capacitors (+/- 20%)	Ws	60 / 20
	DC Bus Capacitance	µF	940
IC830DP01206	Internal regen resistor	Ohm	15
	Continuous power, internal resistor	W	100
	Peak regen power, internal resistor (0.5s)	kW	11.7
	External regen resistor	Ohm	15
	Maximum continuous regen power, external resistor	kW	3
	Peak regen power, external resistor (1s)	kW	5.4
	Absorption energy in capacitors (+/- 20%)	Ws	160 / 55
	DC Bus Capacitance	µF	2460
IC830DP02406	Internal regen resistor	Ohm	8
	Continuous power, internal resistor	W	200
	Peak regen power, internal resistor (0.5s)	kW	22

Type	Rated data	Units	120 V / 240 V
	External regen resistor	Ohm	15
	Maximum continuous regen power, external resistor	kW	6
	Peak regen power, external resistor (1s)	kW	11.8
	Absorption energy in capacitors (+/- 20%)	Ws	180 / 60
	DC Bus Capacitance	µF	2720

* depends on connected regen resistor power

4.16.4 Technical data for IC830DPzzz07

Technical data for the regen circuit depends on the drive type and the mains voltage. Supply voltages, capacitances, and switch-on voltages are all nominal values.

Brake circuit			Supply voltage	
Type	Rated data	Units	240 V	400 V / 480 V
IC830DP zzz07 all types	Switch-on threshold of regen circuit	V	380	760
	Overvoltage limit	V	420	840
	Maximum regen duty cycle	%	15*	

Type	Rated data	Units	240 V	400 V / 480 V
IC830DP00307	Internal regen resistor	Ohm	33	
	Continuous power, internal resistor	W	80	
	Peak regen power, internal resistor (0.5s)	kW	5.5	22.1
	External regen resistor	Ohm	33	
	Continuous regen power, external resistor	kW	0.77	1.5
	Peak regen power, external (1s)	kW	5.4	21.4
	Absorption energy in capacitors (+/- 20%)	Ws	5	35 / 20
	DC Bus Capacitance	µF	235	
IC830DP00607	Internal regen resistor	Ohm	33	
	Continuous power, internal resistor	W	100	
	Peak regen power, internal resistor (0.5s)	kW	5.4	21.4
	External regen resistor	Ohm	33	
	Continuous regen power, external resistor	kW	1.5	3
	Peak regen power, external resistor (1s)	kW	5.4	21.4
	Absorption energy in capacitors (+/- 20%)	Ws	5	35 / 20
	DC Bus Capacitance	µF	235	
IC830DP01207	Internal regen resistor	Ohm	33	
	Continuous power, internal resistor	W	100	
	Peak regen power, internal resistor (0.5s)	kW	5.4	21.4
	External regen resistor	Ohm	33	
	Continuous regen power, external resistor	kW	3	6

Type	Rated data	Units	240 V	400 V / 480 V
	Peak regen power, external resistor (1s)	kW	5.4	21.4
	Absorption energy in capacitors (+/- 20%)	Ws	10	70 / 40
	DC Bus Capacitance	µF	470	
IC830DP02407	Internal regen resistor	Ohm	23	
	Continuous power, internal resistor	W	200	
	Peak regen power, internal resistor (0.5s)	kW	7.7	30.6
	External regen resistor	Ohm	23	
	Continuous regen power, external resistor	kW	6	12
	Peak regen power, external resistor (1s)	kW	7.7	30.6
	Absorption energy in capacitors (+/- 20%)	Ws	15	110 / 60
	DC Bus Capacitance	µF	680	

* depends on connected regen resistor power

4.16.5 Switch-On and Switch-Off Behavior

This chapter describes the switch-on and switch-off behavior of the PSD.

4.16.6 Behavior of “holding brake” function

Drives with an enabled holding brake function have a special timing for switching on and off the output stage (→ # 118). Events that remove the DRV.ACTIVE signal trigger the holding brake to apply. As with all electronic circuits, the general rule applies that there is a possibility of the internal holding brake module failing.

Functional safety, e.g. with hanging load (vertical axes), requires an additional mechanical brake which must be safely operated, for example by a safety control.

If velocity drops below threshold *CS.VTHRESH* or timeout occurs during a stop procedure, the brake is applied. Set parameter MOTOR.BRAKEIMM to 1 with vertical axes, to apply the motor holding brake (→ # 118) immediately after faults or Hardware Disable.

Behavior when undervoltage condition is present

The behavior in an undervoltage condition depends on the VBUS.UVMODE setting.

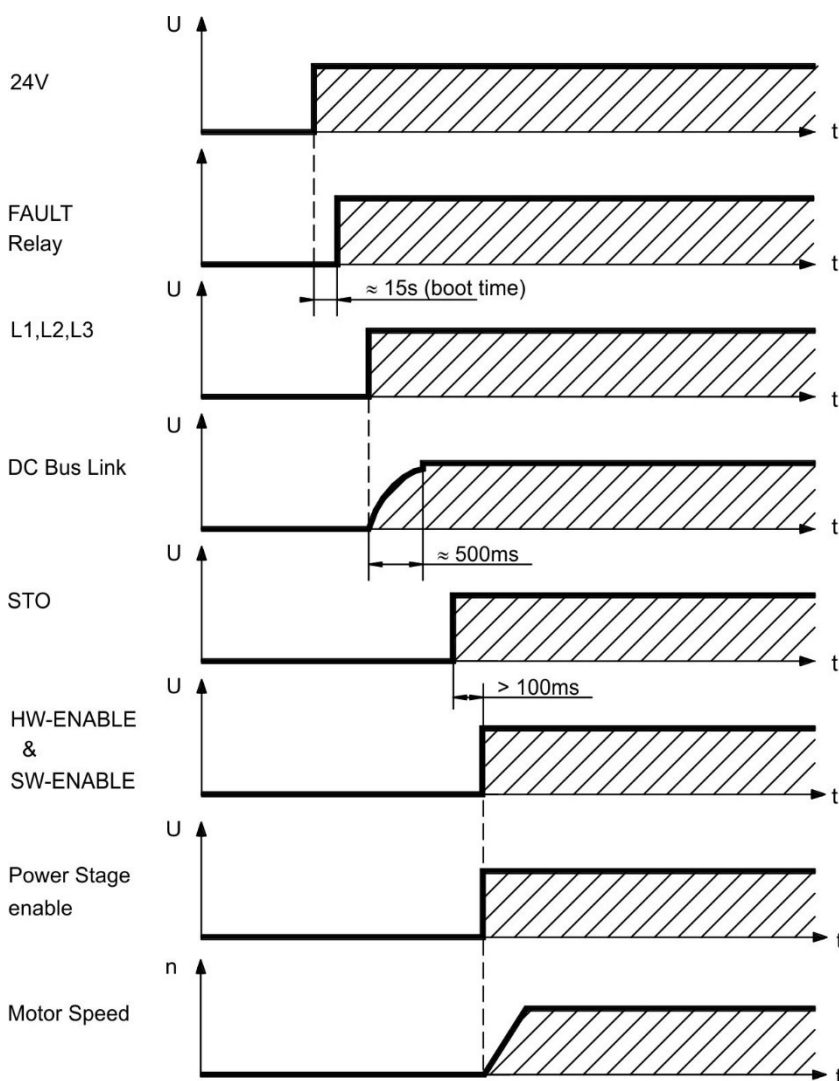
VBUS.UVMODE	DC Bus Undervoltage Mode. Consult the <i>Workbench Online Help</i> for configuring the parameter.
0	The drive will report a F502 undervoltage fault any time an undervoltage condition occurs.
1 (default)	The drive will report a warning n502 if not enabled. The drive will report a fault if the drive is enabled when the condition occurs, or an attempt is made to enable while an under voltage condition occurs.

Safety function STO

With the functional safe function STO, the drive can be secured on standstill using its internal electronics so that even when power is being supplied, the drive shaft is protected against unintentional restart. The chapter “Safe Torque Off (STO)” describes how to use the STO function (→ # 54).

4.16.7 Switch-on behavior in standard operation

Figure 3: Switch-On Behavior in Standard Operation



The diagram below illustrates the correct functional sequence for switching the drive on. Fault F602 occurs when STO (→ # 54) does not have current when HW enable becomes active.

4.16.8 Switch-off behavior

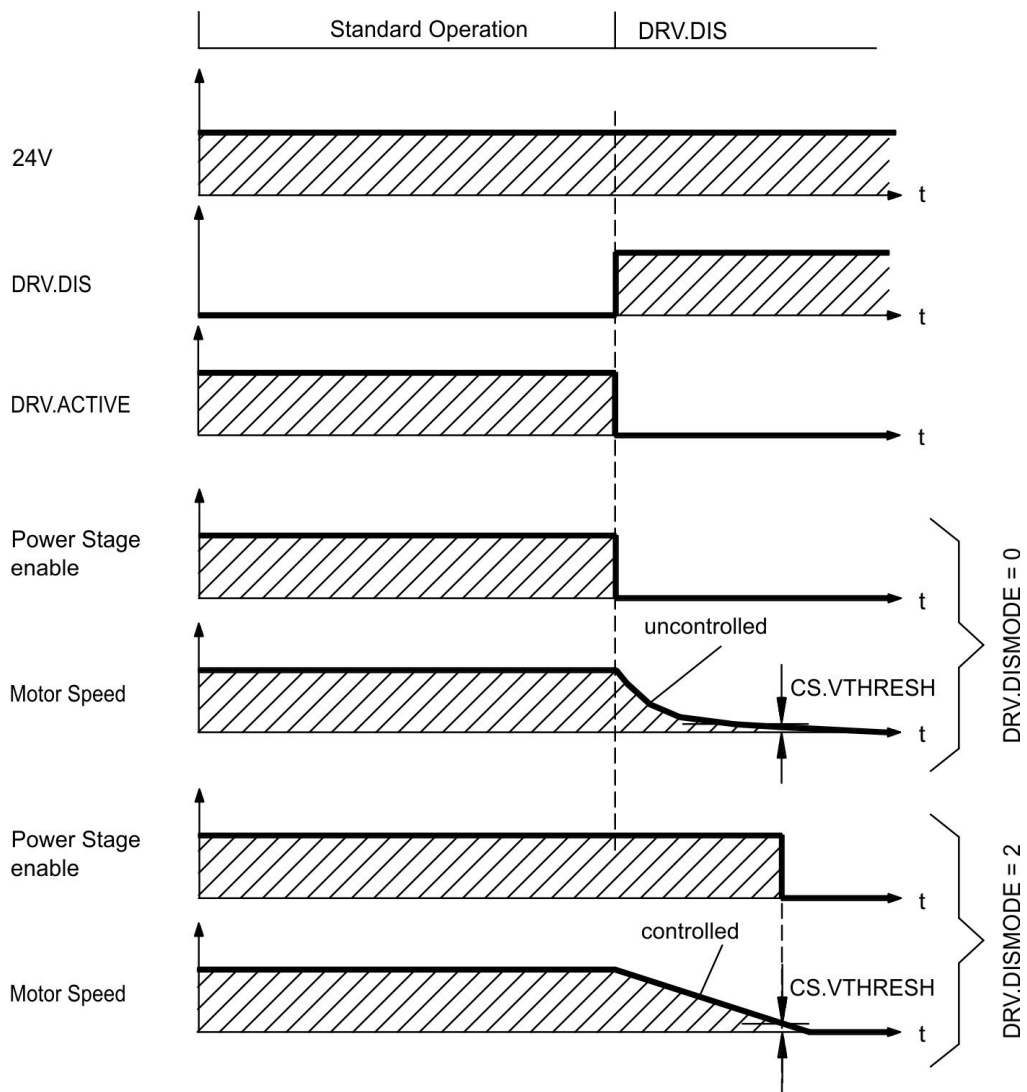
Note: The drive's 24 V supply must remain constant. Hardware Enable input disables the power stage immediately. Configured Digital Inputs and fieldbus commands can be used to perform controlled stops.

Switch-off behavior using the DRV.DIS command

The enable/disable button in Workbench issues a *drv.dis* command internally to the drive. See *Workbench Online Help* for configuring inputs and software commands. Sometimes this enable signal is called "Software Enable" (SW-Enable).

DRV.DISMODE E	DRV.DISMODE controls the behavior of the <i>drv.dis</i> command issued through Workbench, or terminal, or fieldbus. Consult the <i>Workbench Online Help</i> for configuring.
0	Disable axis immediately, if velocity drops below threshold <i>CS.VTHRESH</i> or timeout occurs brake is applied. Category 0 stop according to IEC 60204 (→ # 52).
2	Use controlled stop to disable drive, if velocity drops below threshold <i>CS.VTHRESH</i> or timeout occurs brake is applied. Category 1 stop according to IEC 60204 (→ # 52).

Figure 4: Switch-Off Behavior using DRV.DIS Command



If velocity drops below threshold $CS.VTHRESH$ or timeout occurs brake is applied (→ # 118).

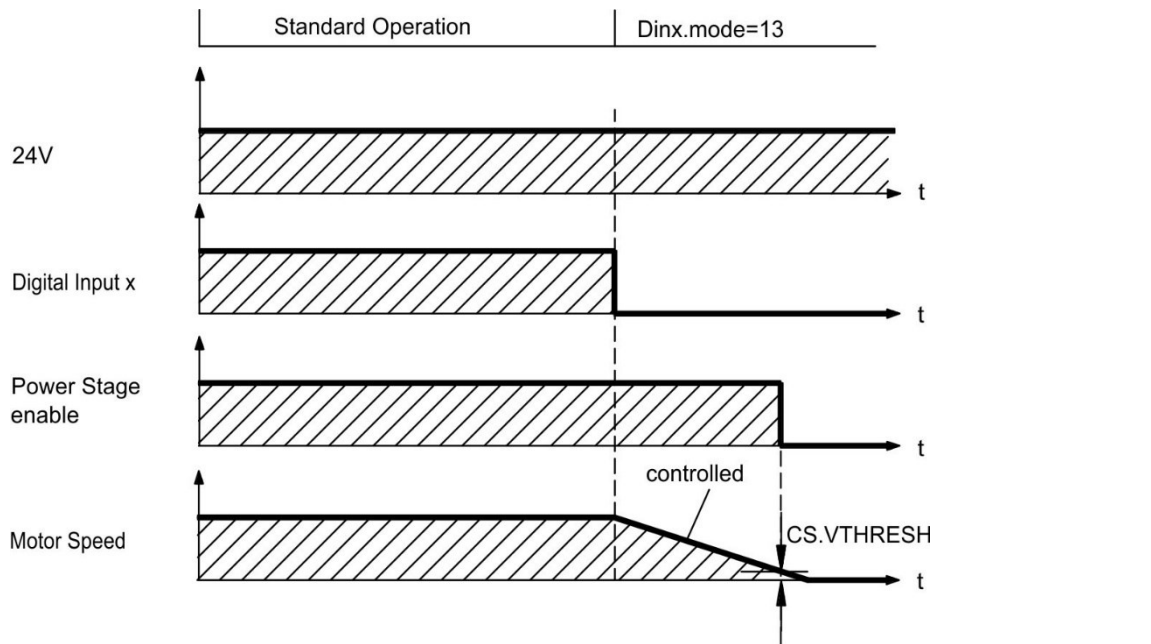
Switch-off behavior using a digital input (controlled stop)

This is a category 2 stop according to IEC 60204 (→ # 52).

A digital input can be configured to bring the motor to a controlled stop and then disable the drive and apply the holding brake.(if present). See the *Workbench Online Help* for information on configuring Digital Inputs.

If velocity drops below threshold *CS.VTHRESH* or timeout occurs brake is applied (→ # 118).

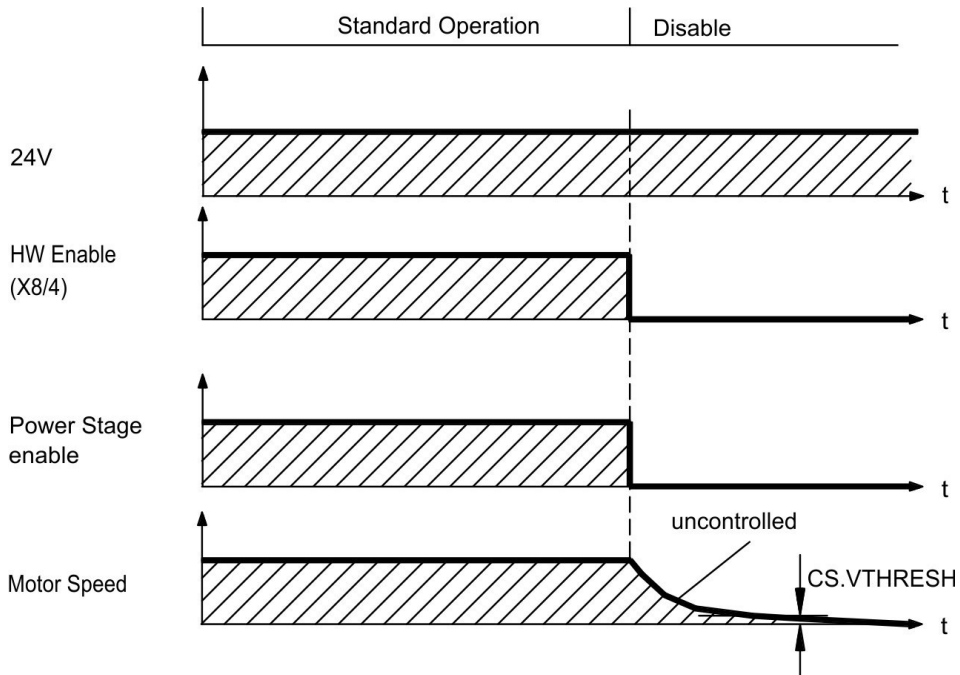
Figure 5: Switch-Off Behavior Using Digital Input



4.16.9 Switch-off behavior using HW Enable input (uncontrolled stop)

This is a category 0 stop according to IEC 60204 (→ # 52).

Figure 6: Switch-Off Behavior use HW Enabled Input



The hardware enable input disables the power stage immediately.

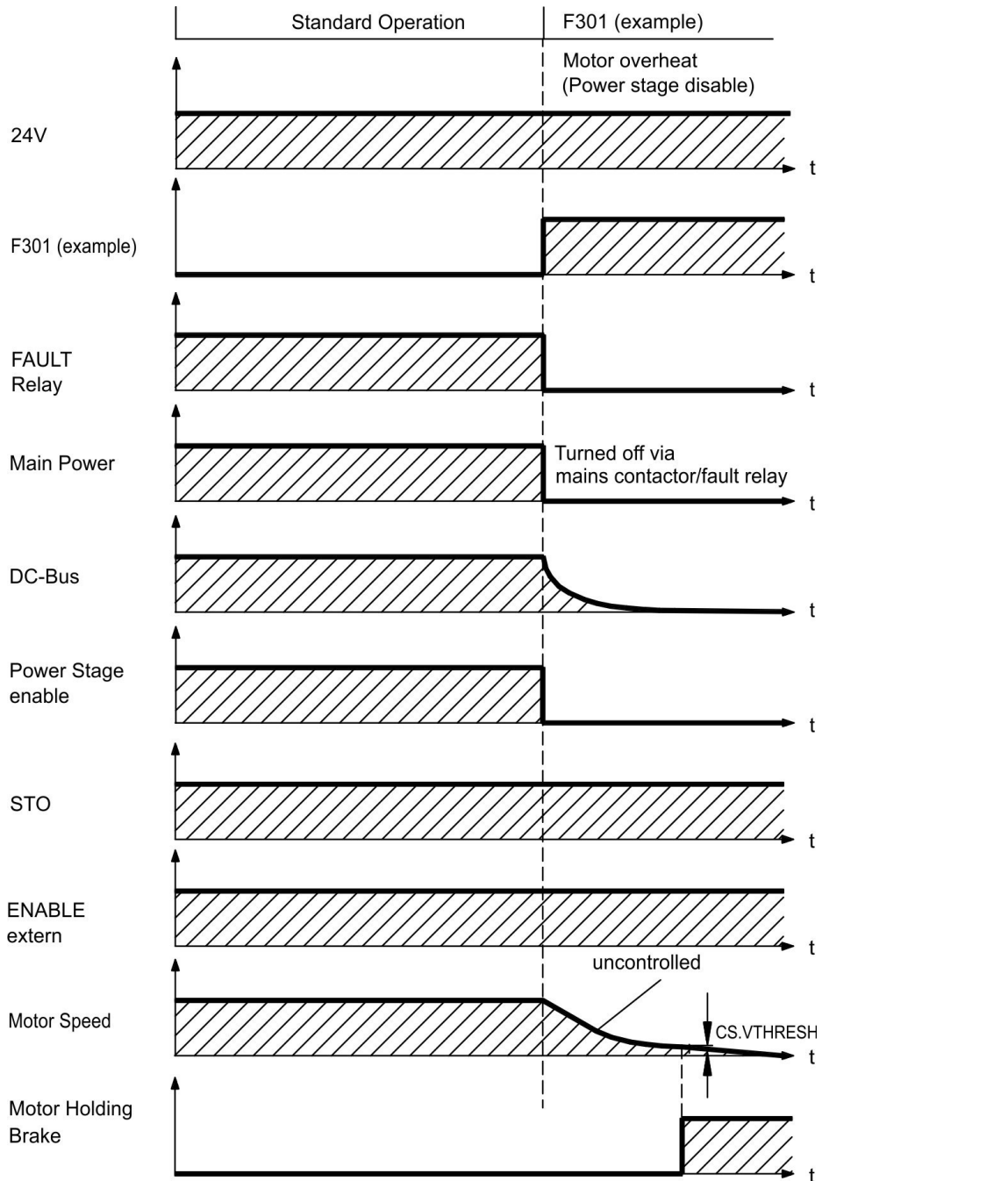
If velocity drops below threshold $CS.VTHRESH$ or timeout occurs the motor holding brake is applied (→ # 118). Set parameter $MOTOR.BRAKEIMM$ to 1 with vertical axes, to apply the motor holding brake immediately after Hardware Disable.

Switch-off behavior in the event of a fault

The behavior of the drive always depends on the fault type and the setting of a number of different parameters ($DRV.DISMODE$, $VBUS.UVFTHRESH$, $CS.VTHRESH$, and others; see *PACMotion Workbench Online Help* for more details). See the *Drive Fault and Warning Messages and Remedies* section of the *PACMotion Workbench Online Help* for a table describing the specific behavior of each fault. The following pages show examples for the possible fault behaviors.

Switch-off behavior for faults that cause an immediate power stage disable

Figure 7: Switch Off Behavior

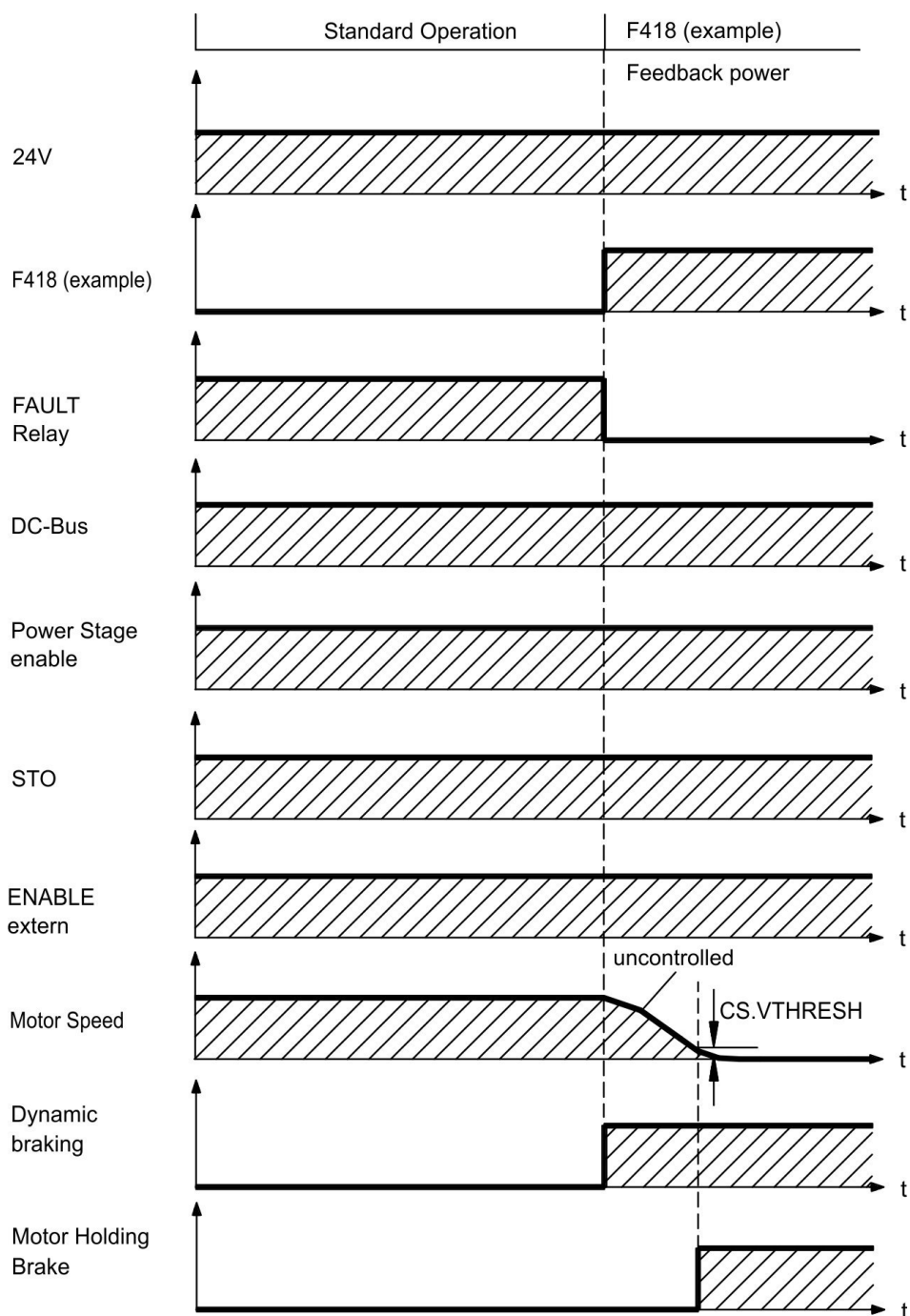


This is a category 0 stop according to IEC 60204 (→ # 52).

If velocity drops below threshold *CS.VTHRESH* or timeout occurs the motor holding brake is applied (→ # 118). Set parameter *MOTOR.BRAKEIMM* to 1 with vertical axes, to apply the motor holding brake immediately after faults.

Switch-off behavior for faults that cause dynamic braking

Figure 8: Switch-Off Behavior for Faults that Cause Dynamic Braking

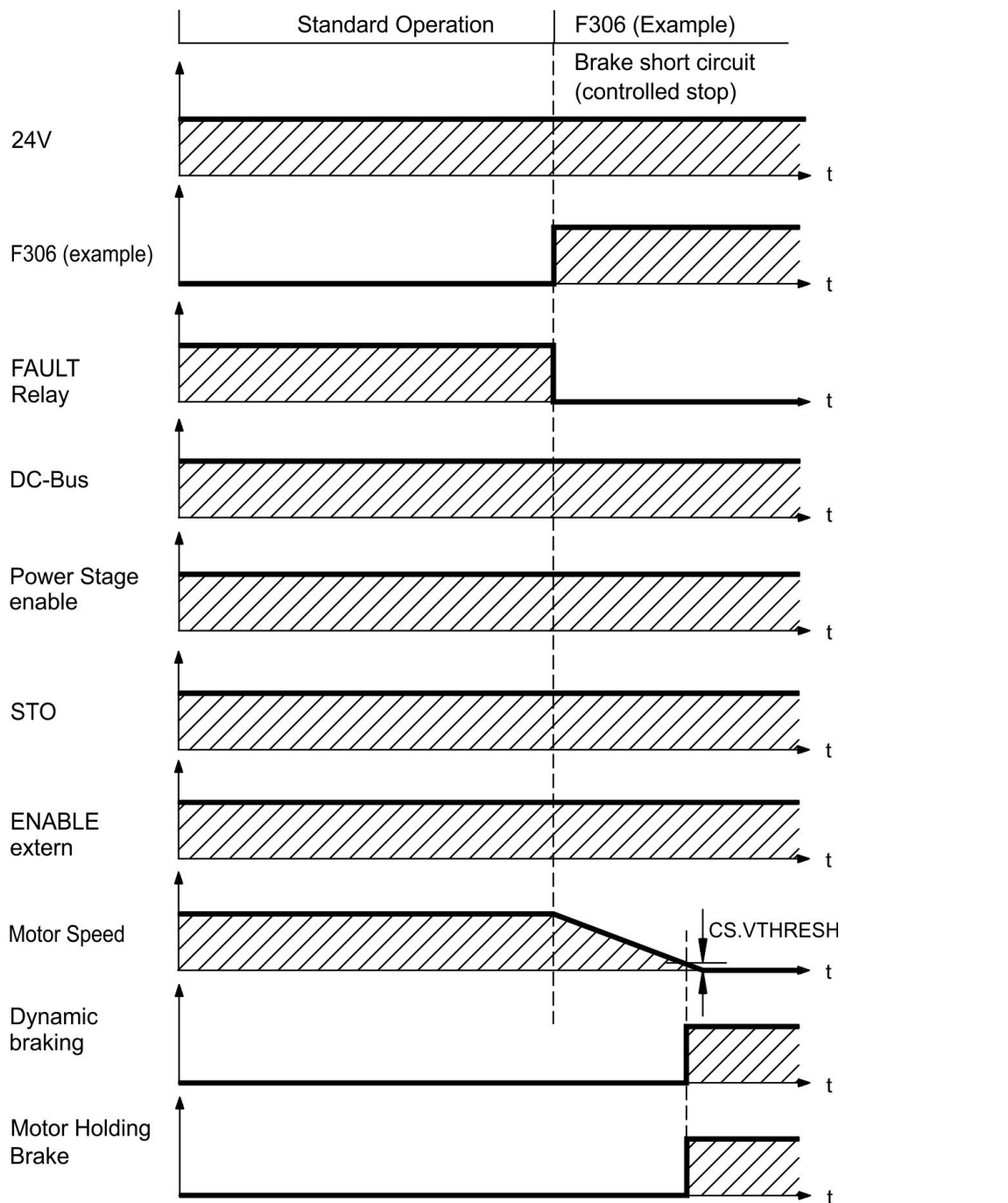


This is a category 0 stop according to IEC 60204 (→ # 52).

If velocity drops below threshold $CS.VTHRESH$ or timeout occurs brake is applied (→ # 118).

Switch-off behavior for faults that cause a controlled stop

Figure 9: Switch-off behavior for faults that cause a controlled stop



This is a category 1 stop according to IEC 60204 (→ # 52).

If velocity drops below threshold $CS.VTHRESH$ or timeout occurs brake is applied (→ # 118).

4.17 Stop / Emergency Stop / Emergency Off

The control functions Stop, Emergency Stop and Emergency Off are defined by IEC 60204. Notes for safety aspects of these functions can be found in ISO 13849 and IEC 62061.

Note: The parameter DRV.DISMODE must be set to 2 to implement the different stop categories.

Consult the *PACMotion Workbench Online Help* for configuring the parameter.

WARNING

No functional safety!

Serious injury could result when the load is not properly blocked. With vertical load the load could fall.

Functional safety, e.g. with hanging load (vertical axes), requires an additional mechanical brake which must be safely operated, for example by a safety control.

Set parameter MOTOR.BRAKEIMM to 1 with vertical axes, to apply the motor holding brake (→ # 118) immediately after faults or Hardware Disable.

The stop function shuts down the machine in normal operation. The stop function is defined by IEC 60204.

The Stop Category must be determined by a risk evaluation of the machine.

Stop function must have priority over assigned start functions. The following stop categories are defined.

4.17.1 Stop Category 0

Shut-down by immediate switching-off the energy supply to the drive machinery (this is an uncontrolled shut-down). With the approved safety function STO (→ # 54) the drive can be stopped using its internal electronics (IEC 62061 SIL2).

4.17.2 Stop Category 1

A controlled shut-down, whereby the energy supply to the drive machinery is maintained to perform the shut-down, and the energy supply is only interrupted when the shut-down has been completed.

4.17.3 Stop Category 2

A controlled shut-down, whereby the energy supply to the drive machinery is maintained.

Stop Category 0 and Stop Category 1 stops must be operable independently of the operating mode, whereby a Category 0 stop must have priority.

If necessary, provision must be made for the connection of protective devices and lock-outs. If applicable, the stop function must signal its status to the control logic. A reset of the stop function must not create a hazardous situation.

4.17.4 Emergency Stop

The Emergency Stop function is used for the fastest possible shutdown of the machine in a dangerous situation. The Emergency Stop function is defined by IEC 60204. Principles of emergency stop devices and functional aspects are defined in ISO 13850.

The Emergency Stop function will be triggered by the manual actions of a single person. It must be fully functional and available at all times. The user must understand instantly how to operate this mechanism (without consulting references or instructions).

Note: The Stop Category for the Emergency Stop must be determined by a risk evaluation of the machine.

In addition to the requirements for stop, the Emergency Stop must fulfil the following requirements:

Emergency Stop must have priority over all other functions and controls in all operating modes.

The energy supply to any drive machinery that could cause dangerous situations must be switched off as fast as possible, without causing any further hazards (Stop Category 0) or must be controlled in such a way, that any movement that causes danger, is stopped as fast as possible (Stop Category 1).

The reset must not initiate a restart.

4.17.5 Emergency Off

The Emergency Off function is used to switch-off the electrical power supply of the machine. This is done to prevent users from any risk from electrical energy (for example electrical impact). Functional aspects for Emergency Off are defined in IEC 60364-5-53.

The Emergency Off function will be triggered by the manual actions of a single person.

Note: The result of a risk evaluation of the machine determines the necessity for an Emergency Off function.

Emergency Off is done by switching off the supply energy by electro-mechanical switching devices. This results in a category 0 stop. If this stop category is not possible in the application, then the Emergency Off function must be replaced by other measures (for example by protection against direct touching).

4.18 Safe Torque Off (STO)

The STO safety implementation on the PSD is qualified. The safety circuit implementation used for the safety function "Safe Torque Off" in the drive is suited for SIL 2 according to IEC 62061 and PLd / CAT3 according to ISO 13849-1.

4.18.1 IC830DP003 up to IC830DP024

An additional digital input (STO) releases the power output stage of the drive as long as a 24 V signal is applied to this input. If the STO input goes open-circuit, then power will no longer be supplied to the motor, and the drive will lose all torque and coast to a stop.

Note: This input is not compatible with IEC 61131-2. You can thus achieve a category 0 stop (→ # 52) by using the STO input without switching a mains contactor.

4.18.2 Safety characteristic data

The subsystems (PSD) are described with the following characteristic data:

IC830DP003 up to IC830DP024

Function	Operation mode	ISO 13849-1	IEC 62061	PFH [1/h]	T _M [Years]	SFF [%]
STO	single channel	PL d, CAT 3	SIL 2	1.50E-07	20	100

Note: A very unlikely but possible event can happen, if within a very short time 2 not adjacent IGBTs will have a short circuit. In such case a movement of a maximum angle of 120° (electrical) can happen. This effect can only happen if the drive is in the function STO. If the total failure rate of the IGBT is 120 FIT normally for such short circuit 60 FIT will be valid (50:50 model). By such event 2 specific IGBTs have to fail at same time. The calculation shows a probability of $1.5 \cdot 10^{-15}$ per hour (without common cause failure). Even if the STO function will be issued for a whole year, this event will only happen every 100 Billion years.

4.18.3 Safety instructions

• WARNING

No Brake Power!

Serious injury could result when a suspended load is not properly blocked. The drive cannot hold a vertical load when STO is active.

Add a safe mechanical blocking (for instance, a motor-holding brake). Elevator applications are not allowed.

• DANGER

Automatic Restart!

Risk of death or serious injury for humans working in the machine. The drive might restart automatically after power on, voltage dip or interruption of the supply voltage, depending on the parameter setting. If parameter DRV.ENDEFAULT is set to 1,

then place a warning sign ("WARNING: Possible Automatic Restart" or similar) to the machine.

Ensure, that power on is not possible, while humans are in a dangerous zone of the machine.

CAUTION

High electrical voltage!

Risk of electrical shock! The STO function does not provide an electrical separation from the power output. If access to the motor power terminals is necessary, disconnect the drive from mains supply, consider the discharging time of the DC-Bus link.

Note: In case of single channel control: If the safety function STO is automatically activated by a control system, then make sure that the output of the control is monitored for possible malfunction. The monitoring can be used to prevent a faulty output from unintentionally activating the STO function. If the STO function is a single-channel system, erroneous engaging will not be recognized.

Note: It is not possible to perform a controlled brake if the drive controlled STO-Enable is off. If controlled braking before the use of the STO function is necessary, the drive must be braked and the input STO must be separated time-delayed from +24 V .

Note: In case of a specific double fault within a very short time (→ # 54) a single movement of a maximum angle of 120° (electrical) can happen. This effect can only happen if the drive is in the function STO. Even if the STO function will be issued for a whole year, this event will only happen every 100 Billion years.

4.18.4 Use as directed

The STO function is exclusively intended to provide a functional safe stop of the motion system. To achieve this functional safety, the wiring of the safety circuits must meet the safety requirements of IEC 60204, ISO 12100 and ISO 13849.

Note: Use the following functional sequence when the STO function is used:

1. Decelerate the axis in a controlled manner (speed setpoint = 0 V, controlled stop command via digital input or fieldbus).
2. When speed = 0 rpm, disable the drive (enable = 0 V).
3. If a suspended load is present, block the drive mechanically.
4. Activate the STO function.

4.18.5 Prohibited use

The STO function must not be used if the drive is to be made inactive for:

- Cleaning, maintenance and repair operations, long inoperative periods. In such cases, the entire system should be disconnected from the supply and secured (main switch).
- Emergency-Off situations. In an Emergency-Off situation, the main contactor is switched off (by the Emergency-Off button).

4.18.6 Technical data and pinout

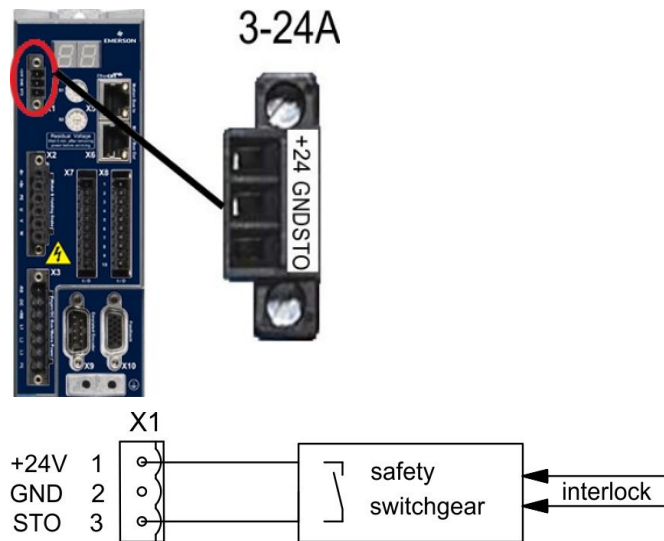
IC830DP003 up to IC830DP024

Reference ground is GND

24 V \pm 10%, 45 mA

Galvanic isolation for 250 VDC Reaction time < 10 ms

Figure 10: +24 GND STO



Pin	Signal	Description
1	+24	+24 VDC Auxiliary voltage
2	GND	24V Supply GND
3	STO	STO enable (Safe Torque Off)

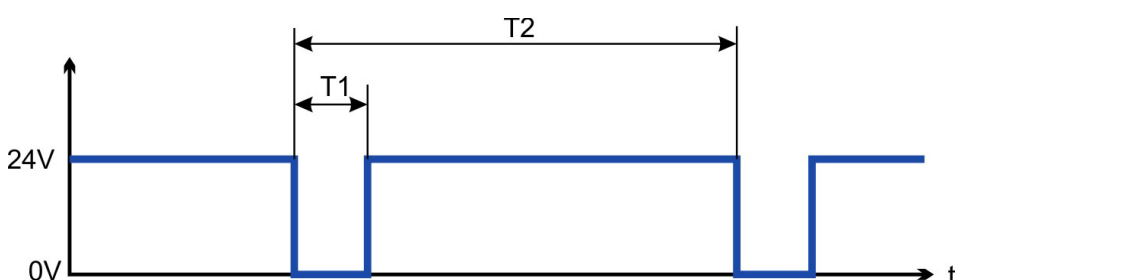
4.18.7 Enclosure, wiring

Since the drive meets IP20, you must select an enclosure that permits safe operation of the drive. The enclosure must at least meet IP54. Wiring remaining within the specified enclosure must meet the requirements of the standard IEC 60204-1 and ISO 13849-2 (Table D.4).

If you are wiring leads that are outside the specified enclosure (IP54), the cables must be laid durably (firmly), protected from outside damage (for example, by laying the cable in a duct), placed in different sheathed cables, or protected individually by grounding connection.

4.18.8 OSSD Test Pulses

Figure 11: OSSD Test Pulses



Safety controllers usually check their outputs periodically during the normal operation. These test procedures create pulses to the STO-Enable input.

Note: Test pulses with $T1 \leq 300 \mu\text{s}$ and $T2 \geq 200 \text{ms}$ will not have any influence to the safety relevant STO function.

Test pulses, which are outside of this specification, will switch the STO function, but will not create a dangerous situation.

4.18.9 Functional description

When STO function (Safe Torque Off) is not needed, then STO-Enable must be connected directly with +24 V. The STO function is then bypassed and cannot be used.

If the STO function is in use, then the STO-Enable must be connected to the output of a safety control or a safety relay, which at least meets the requirements of PLd, CAT 3 according to ISO 13849 (connection diagram: (→ # 61)).

SIL2/PLd Single Channel Control

With the single-channel control of the STO (SIL2/PLd) safety function, STO is switched by one output of a safety switching device (e.g. safety relay). Erroneous engaging will not be recognized. Therefore the output of the control must be supervised for possible malfunction.

STO	ENAB LE	Display	Motor has Torque	Safet y
0 V	0 V	n602	no	yes
0 V	+24 V	F602	no	yes
+24 V	0 V	opmode	no	no
+24 V	+24 V	opmode with 'dot'	yes	no

When STO function is engaged during operation by separating input STO from 24 V, the motor slows down without control and the drive displays the fault F602.

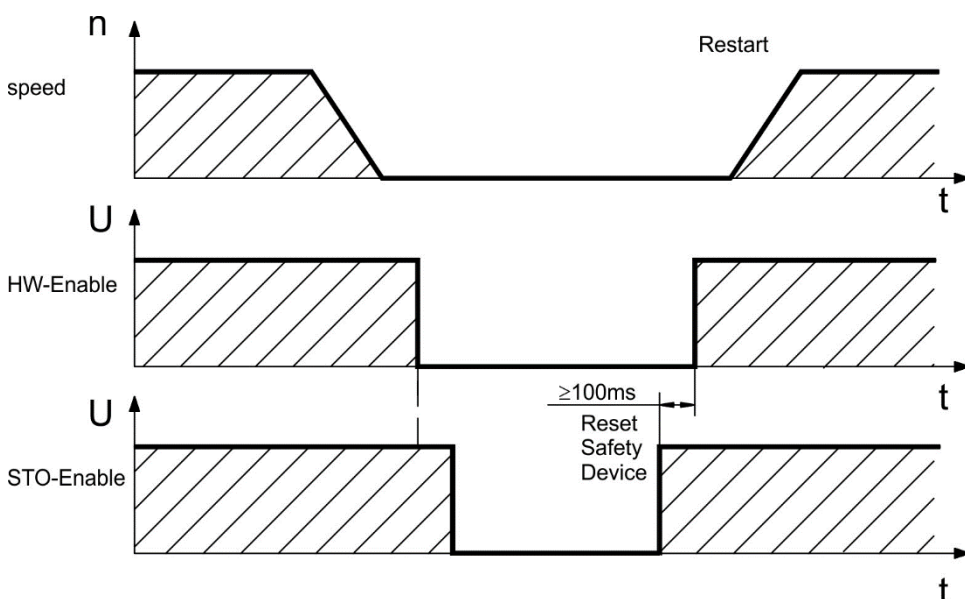
Signal diagram (sequence)

Single channel, IC830DP003 up to IC830DP024

The diagram below shows how to use the single channel STO function for a safe drive stop and fault free operation of the drive.

1. Decelerate the axis in a controlled manner (speed setpoint = 0 V, controlled stop).
2. When speed = 0 rpm, disable the drive (enable = 0 V).
3. Activate the STO function.

Figure 12: Signal Diagram



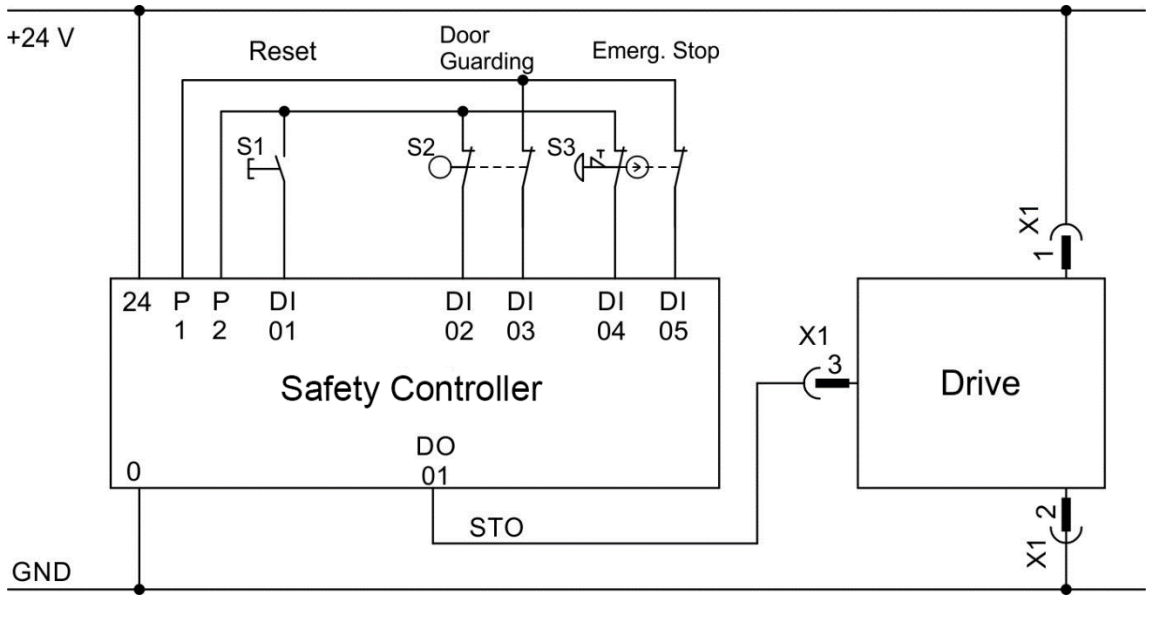
Wiring examples

Single channel SIL2/PLd with IC830DP003 to 024

The sample application below shows door guarding and emergency stop, controlled by a safety controller to switch the STO-Enable input of an IC830DP003 to 024 device to SIL2, PLd.

Note: Review the enclosure and wiring instructions (→ # 58).

Figure 13: Single channel SIL2/PLd with IC830DP003 to 024



Functional test

Single Channel control and Dual Channel control, SIL CL2 / PLd

Note: You must test the STO function after initial start of the drive, after each interference into the wiring of the drive, or after exchange of one or several components of the drive.

Method 1, drive remain enabled	Method 2, drive disabled
Stop drive, with setpoint 0V. Keep drive enabled. <div style="background-color: red; color: white; padding: 5px; margin: 10px 0;"> • DANGER </div> Do not enter hazardous area! Activate the STO function for example by opening protective screen. The fault contact opens, the net contactor releases, and the drive displays fault F602.	Stop all drives, with setpoint 0V, disable drive (Enable=0V). Activate the STO function, for example, by opening protective screen The drive displays warning n602.

Dual Channel control, SIL CL3 / PLe

To achieve PLe / SIL CL3, the safe switching of the pulse inhibitor must be tested periodically by analyzing the feedback signal from a safety control:

- at the start of a system,
- at the restart after triggering a protective device, at least every 8 hours by the operator.

The inputs STO-ENABLE 1 and STO-ENABLE 2 are switched in turns according to a defined test sequence. The switching state of the pulse inhibitor is available at the STO-Status outputs of the PSD and must be analyzed to achieve a sufficient diagnostic cover ratio:

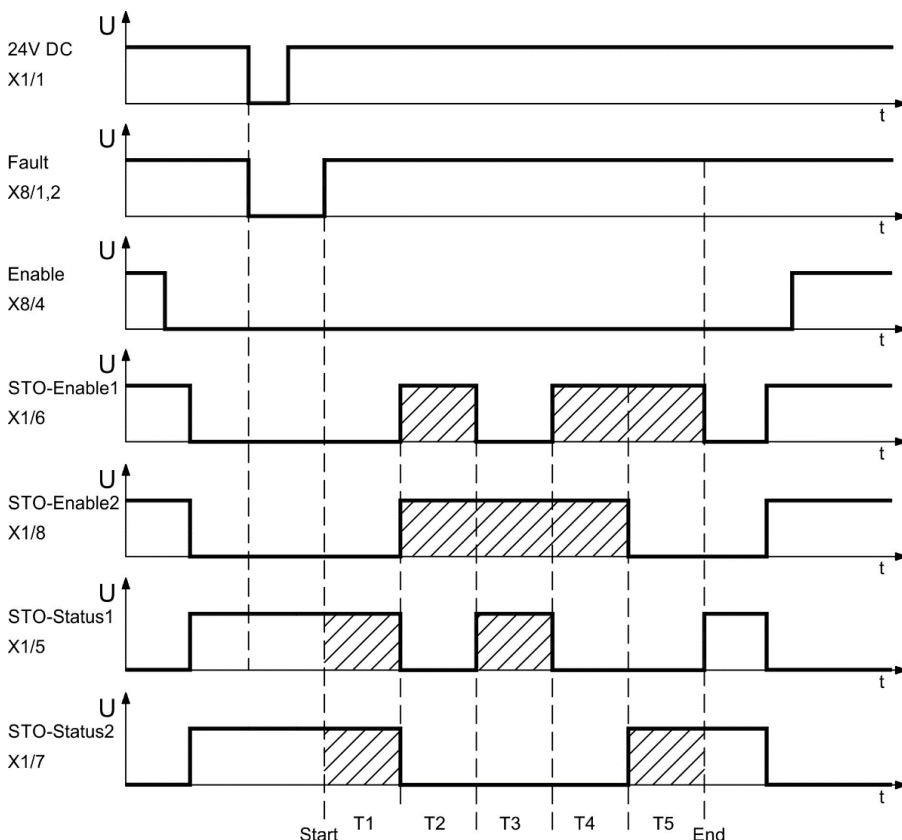
- Diagnostic with external not safe controller, test with dynamic sequence: test cycle: with each device start, minimum once per day.
 - diagnostic cover ratio: 60 %
- Diagnostic with external safe controller, test with dynamic sequence. test cycle: with each device start, minimum once per day.
 - diagnostic cover ratio: 90 %

The test sequence for the functional test of the safe pulse inhibitor must be performed as shown in the following time diagram.

Start conditions of the test sequence:

- Operational readiness FAULT = "1"
- Enable signal ENABLE = "0"
- STO-ENABLE 1 = "0"
- STO-ENABLE 2 = "0"

Figure 14: Dual Channel control, SIL CL3 / PLe



Legend:

FAULT: relay output, 1=ready to operate

STO-ENABLE 1: digital input, 1st switch-off path STO-ENABLE 2: digital input, 2nd switch-off path

STO-STATUS 1: digital output, switching state of 1st pulse inhibitor STO-STATUS 2: digital output, switching state of 2nd pulse inhibitor T1 ... T5: Test sequence

Start: Start of test sequence End: End of test sequence

4.19 Shock-hazard Protection

4.19.1 Leakage current

Leakage current via the PE conductor results from the combination of equipment and cable leakage currents. The leakage current frequency pattern includes a number of frequencies, whereby the residual-current circuit breakers definitively evaluate the 50 Hz current. For this reason, the leakage current cannot be measured using a conventional multimeter. As a rule of thumb, the following assumption can be made for leakage current on our low capacitance cables at a mains voltage of 400 V, depending on the clock frequency of the output stage: $I_{\text{leak}} = n \times 20 \text{ mA} + L \times 1 \text{ mA/m}$ at 8 kHz clock frequency at the output stage

$I_{\text{leak}} = n \times 20 \text{ mA} + L \times 2 \text{ mA/m}$ at a 16 kHz clock frequency at the output stage

(where I_{leak} =leakage current, n =number of drives, L =length of motor cable)

At other mains voltage ratings, the leakage current varies in proportion to the voltage.

Example: 2 x drives + a 25m motor cable at a clock frequency of 8 kHz: $2 \times 20 \text{ mA} + 25 \text{ m} \times 1 \text{ mA/m} = 65 \text{ mA}$ leakage current.

Note: Since the leakage current to PE is more than 3.5 mA, in compliance with IEC61800-5-1 the PE connection must either be doubled or a connecting cable with a cross-section $>10 \text{ mm}^2$ must be used. Use the PE terminal and the PE connection screws in order to fulfill this requirement.

- The following measures can be used to minimize leakage currents: Reduce the length of the engine cable.
- Use low capacitance cables (→ # 41).

4.19.2 Residual current protective device (RCD)

In conformity with IEC 60364-4-41 – Regulations for installation and IEC 60204 – Electrical equipment of machinery, residual current protective devices (RCDs) can be used provided the requisite regulations are complied with. The PSD is a 3-phase system with a B6 bridge. Therefore, RCDs which are sensitive to all currents must be used in order to detect any DC fault current. Refer to the chapter above for the rule of thumb for determining the leakage current. Rated residual currents in the RCDs:

10 to 30 mA	Protection against "indirect contact" (personal fire protection) for stationary and mobile equipment, as well as for "direct contact".
50 to 300 mA	Protection against "indirect contact" (personal fire protection) for stationary equipment

Note: Recommendation: In order to protect against direct contact (with motor cables shorter than 5 m) Emerson recommends that each drive be protected individually using a 30 mA RCD which is sensitive to all currents.

If you use a selective RCD, the more intelligent evaluation process will prevent spurious tripping of the RCD.

4.19.3 Isolating transformers

When protection against indirect contact is absolutely essential despite a higher leakage current, or when an alternative form of shock-hazard protection is sought, the PSD can also be operated via an isolating transformer (schematic connection (→ # 102). A ground-leakage monitor can be used to monitor for short circuits.

Keep the length of wiring between the transformer and the drive as short as possible.

Section 5 Mechanical Installation

5.1 Important Notes

- **WARNING**

High EMC Voltage Level!

Risk of electrical shock, if the servo amplifier (or the motor) is not properly EMC-grounded.

Do not use painted (i.e. non-conductive) mounting plates.

In unfavorable circumstances, use copper mesh tape between the earthing bolts and earth potential to deflect currents.

Note: Protect the drive from impermissible stresses. In particular, do not let any components become bent or any insulation distances altered during transport and handling. Avoid contact with electronic components and contacts.

Note: The drive will switch itself off in case of overheating. Ensure that there is an adequate flow of cool, filtered air into the bottom of the control cabinet, or use a heat exchanger (→ # 34).

Note: Do not mount devices that produce magnetic fields directly beside the drive. Strong magnetic fields can directly affect internal components. Install devices which produce magnetic field with distance to the drives and/or shield the magnetic fields.

5.2 Guide to Mechanical Installation

The following tools are required (at a minimum) to install the PSD; your specific installation may require additional tools:

- M4 hexagon socket-cap screws (ISO 4762) 3 mm T-handle Allen key
- No. 2 Phillips head screwdriver Small slotted screwdriver

Dimensions and mounting hole positions depend on the drive variant:

Drive Variant	Housing
IC830DP	Standard width (→ # 68)

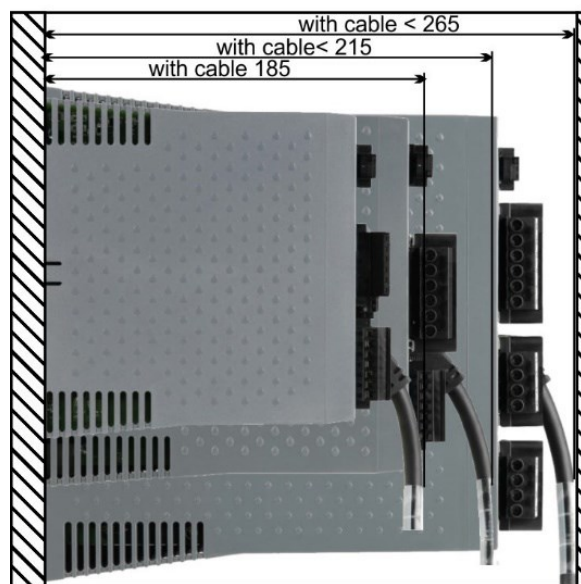
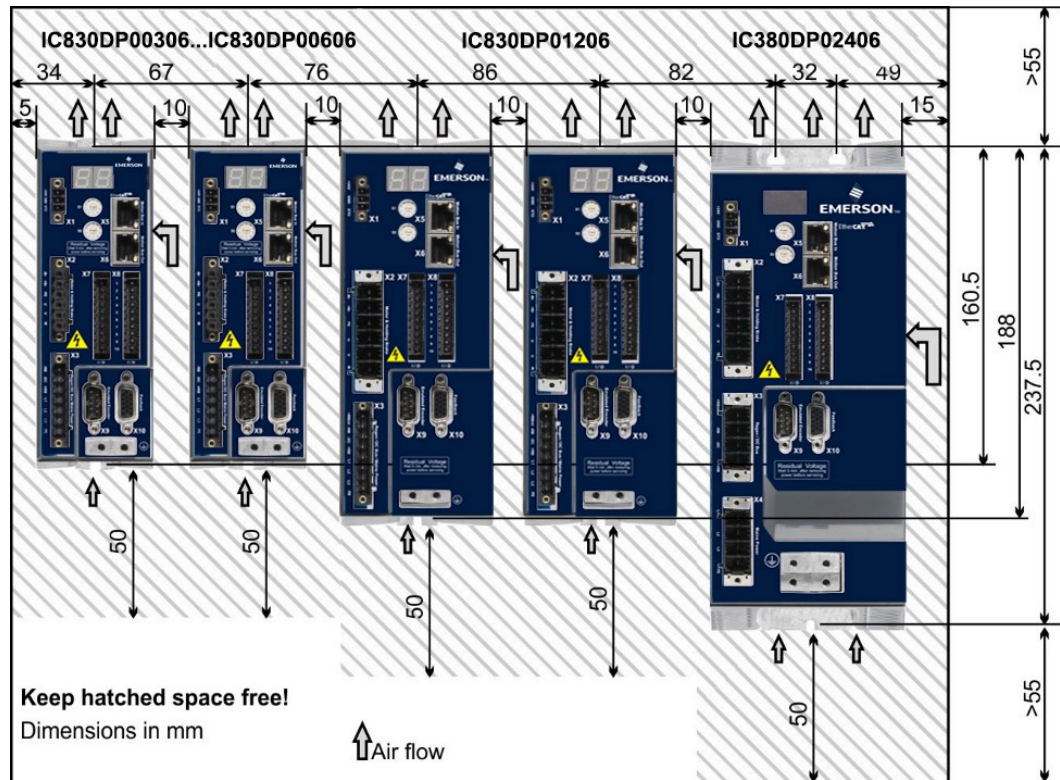
Install the drive unit as follows:

1. Prepare the site.
Mount the drive in a closed control cabinet (→ # 34). The site must be free from conductive or corrosive materials. For the mounting position in the cabinet (→ # 68) respectively (→ # 72).
2. Check ventilation.
Check that the ventilation of the drive is unimpeded, and keep within the permitted ambient temperature (→ # 34). Keep the required space clearance above and below the drive (→ # 68) respectively (→ # 72).
3. Check cooling system.
If cooling systems are used for the control cabinet, position the cooling system so that condensation water cannot drip onto the drive or peripheral devices.
4. Mount the drive.
Assemble the drive and power supply near each other on the conductive, grounded mounting plate in the cabinet.
5. Ground the drive.
For EMC-compliant shielding and grounding, (→ # 98). Ground the mounting plate, motor housing and CNC-GND of the control system.

5.3 Mechanical Drawings Standard Width

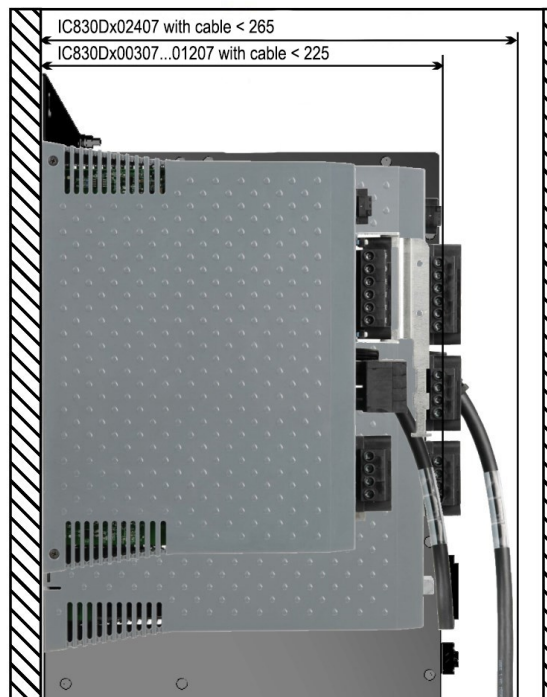
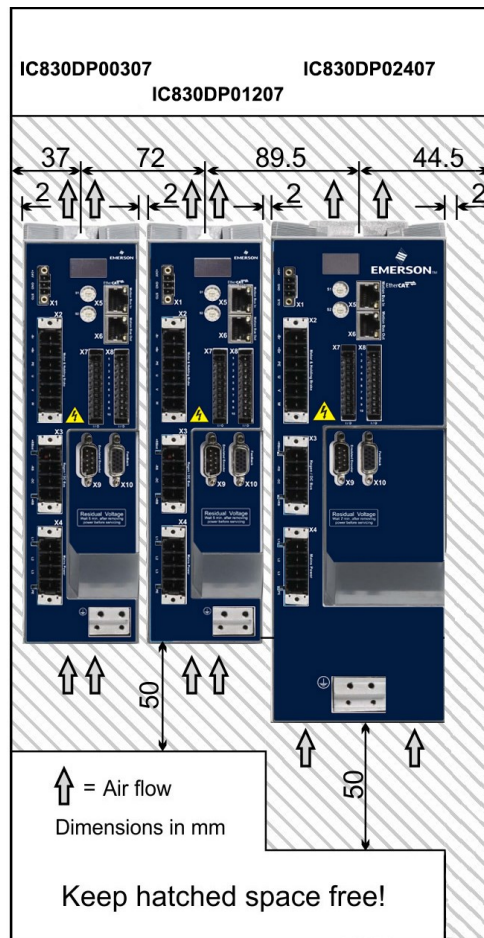
5.3.1 Control cabinet layout IC830DPzzz06, standard width

Figure 15: Housing Clearance for Installation



Material: M4 hexagon socket screws to ISO 4762, 3 mm T-handle Allen key

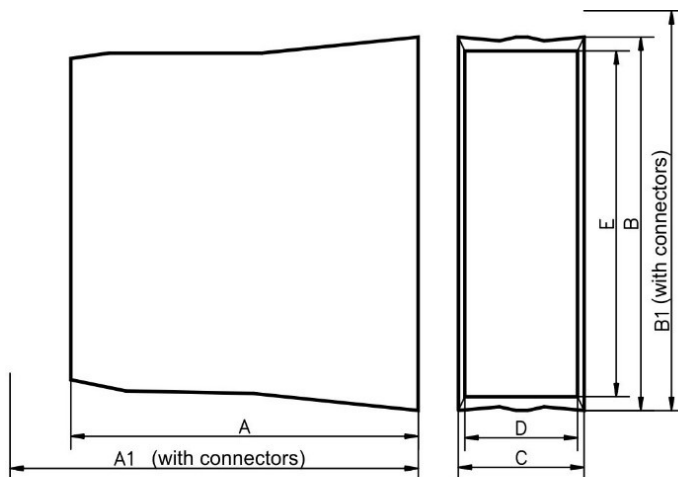
Figure 16: Housing Clearance for Installation (cont'd)



5.3.2 Control cabinet layout IC830DPzzz07, standard width

Material: M4 hexagon socket screws to ISO 4762, 3 mm T-handle Allen key

Figure 17: Control Cabinet Layout Schematic



Standard Width 110 - 230V	A	A1	B	B1	C	D	E
	mm	mm	mm	mm	mm	mm	mm
PSD 3A, 6A	156	185	168	200	59	54	150
PSD 12A	187	215	196	225	78.4	72	177
PSD 24A	228	265	248	280	100	96	217

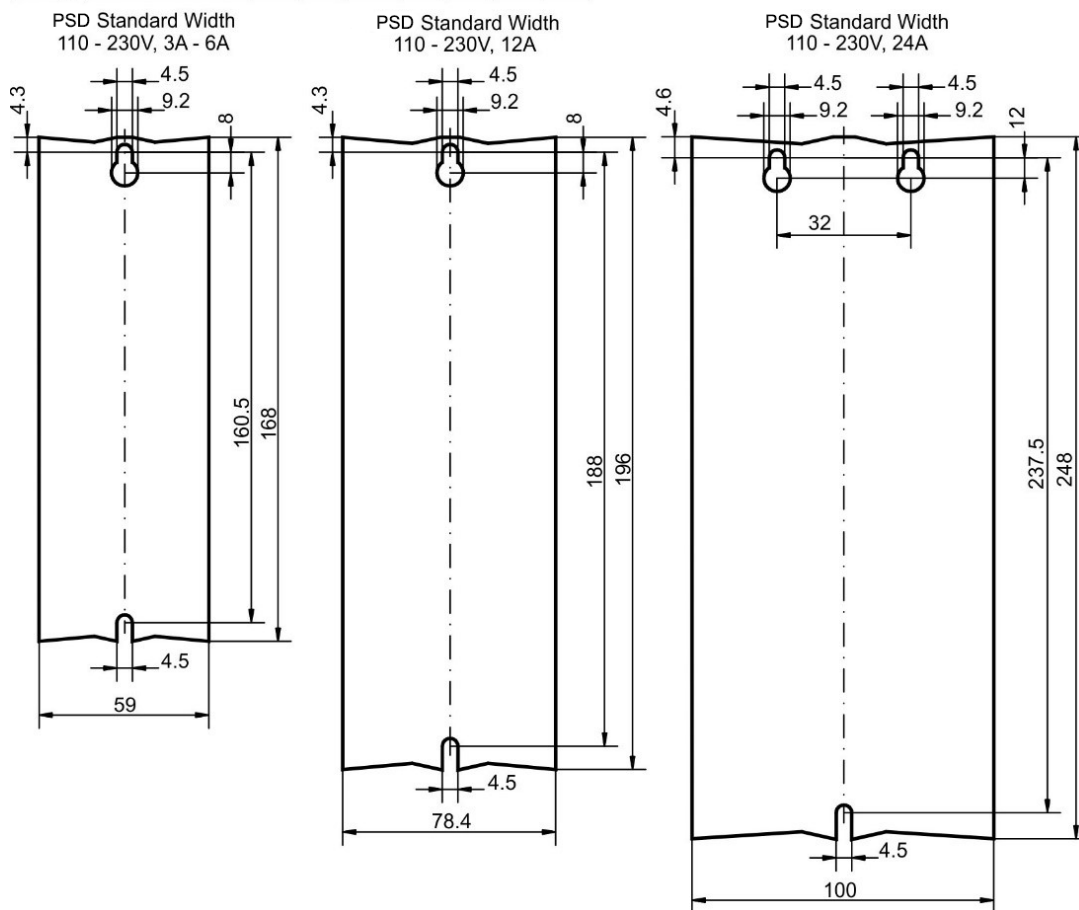
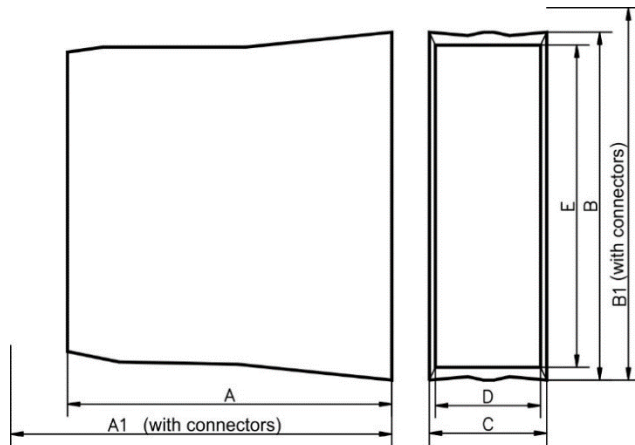
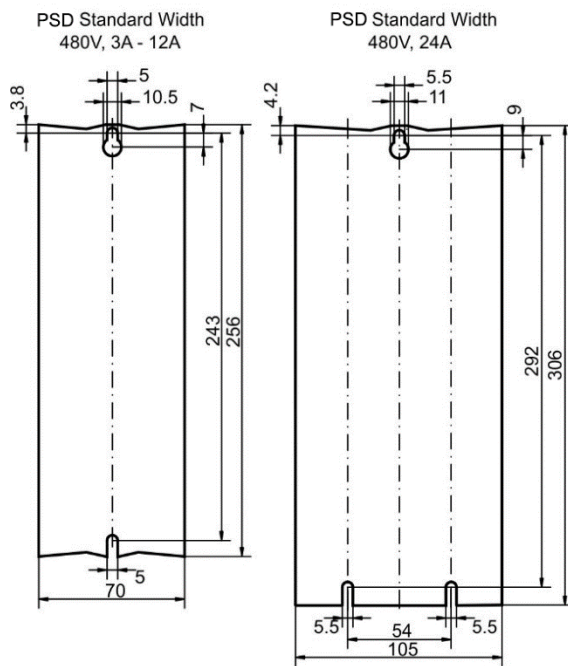


Figure 18: Control Cabinet Layout Schematic (cont'd)



Standard Width 480V	A	A1	B	B1	C	D	E
	mm	mm	mm	mm	mm	mm	mm
PSD 3A, 6A, 12A	185	221	256	290	70	65	232
PSD 24A	228	264	306	340	105	99	273



5.4 Important Notes

Note: Only professional staff who are qualified in electrical engineering are allowed to install the drive. Wires with color green with one or more yellow stripes must not be used other than for protective earth (PE) wiring.

WARNING

High Voltage up to 900 V!

There is a danger of serious personal injury or death by electrical shock or electrical arcing. Capacitors can still have dangerous voltages present up to 7 minutes after switching off the supply power. Control and power connections can still be live, even if the motor is not rotating.

Only install and wire the equipment when it is not live.

Make sure that the cabinet is safely disconnected (for instance, with a lock-out and warning signs).

Never remove electrical connections to the drive while it is live.

Wait at least 7 minutes after disconnecting the drive from the main supply power before touching potentially live sections of the equipment (e.g. contacts) or undoing any connections.

To be sure, measure the voltage in the DC bus link and wait until it has fallen below 50 V.

Note: Wrong mains voltage, unsuitable motor or wrong wiring will damage the drive. Check the combination of drive and motor. Compare the rated voltage and current of the units. Implement the wiring according to the connection diagram : (→ # 83) and following.

Make sure that the maximum permissible rated voltage at the terminals L1, L2, L3 or +DC, – DC is not exceeded by more than 10% even in the most unfavorable circumstances (see IEC 60204-1).

Note: Excessively high external fusing will endanger cables and devices. The fusing of the AC supply input and 24 V supply must be installed by the user, best values (→ # 39). Hints for use of Residual-current circuit breakers (RCD) (→ # 65).

Note: Since the leakage current to PE is more than 3.5 mA, in compliance with IEC61800-5-1 the PE connection must either be doubled or a connecting cable with a cross-section >10 mm² must be used. Deviating measures according to regional standards might be possible.

Note: The drive status must be monitored by the PLC to acknowledge critical situations. Wire the FAULT contact in series into the emergency off circuit of the installation. The emergency off circuit must operate the supply contactor.

Note: It is permissible to use the setup software to alter the settings of the drive. Any other alterations will invalidate the warranty.

5.5 Guide to electrical installation

Install the drive electrical system as follows:

1. Select cables in accordance with IEC 60204 (→ # 41).
2. Install shielding and ground the drive.

For EMC-compliant shielding and grounding, see (→ # 98)(→ # 83) ff.

Ground the mounting plate, motor housing and CNC-GND of the control system.

3. Wire the drive and connectors.

Observe the "Recommendations for EMI noise reduction": (→ # 98)

- Wire the FAULT contact in series into the emergency off circuit of the system. Connect the digital control inputs and outputs.
- Connect up analog ground (also if fieldbuses are used). Connect the analog input source, if required.
- Connect the feedback device. Connect the hardware option. Connect the motor cable
- Connect shielding at both ends. Use a motor choke if cable > 25m. Connect motor-holding brake, connect shielding at both ends.
- If required, connect the external regen resistor (with fusing).
- Connect the auxiliary supply (maximum permissible voltage values see electrical data (→ # 36) or (→ # 37).
- Connect the mains filter with IC830DPzzz06 (shielded lines between filter and drive). Connect the main electrical supply.
- Check maximum permitted voltage value (→ # 36) or (→ # 37).
- Check proper use of residual-current circuit breakers (RCD): (→ # 65) Connect the PC (→ # 172) for setting up the drive.

4. Check the wiring against the wiring diagrams.

5.6 Wiring

The installation procedure is described as an example. A different procedure may be appropriate or necessary, depending on the application of the equipment. Emerson can provide training courses for this procedure upon request.

DANGER

High electrical voltage up to 900 V!

There is a danger of serious personal injury or death by electrical shock or electrical arcing. Only install and wire the equipment when it is not live, that is, when neither the electrical supply nor the 24 V auxiliary voltage nor the supply voltages of any other connected equipment is switched on.

Make sure that the cabinet is safely disconnected (for instance, with a lock-out and warning signs). The individual voltages are switched on for the first time during setup.

Note: Only professional staff who are qualified in electrical engineering are allowed to install the drive. Wires with color green with one or more yellow stripes must not be used other than for protective earth (PE) wiring. When installing or replacing cables, use only standardized

components, which complies to the specifications in chapter 7.12 "Cable and Wire Requirements".

Note: The ground symbol, which you will find in all the wiring diagrams, indicates that you must take care to provide an electrically conductive connection with the largest feasible surface area between the unit indicated and the mounting plate in the control cabinet. This connection is for the effective grounding of HF interference, and must not be confused with the PE-symbol (PE = protective earth, safety measure as per IEC 60204).

Use the following connection diagrams:

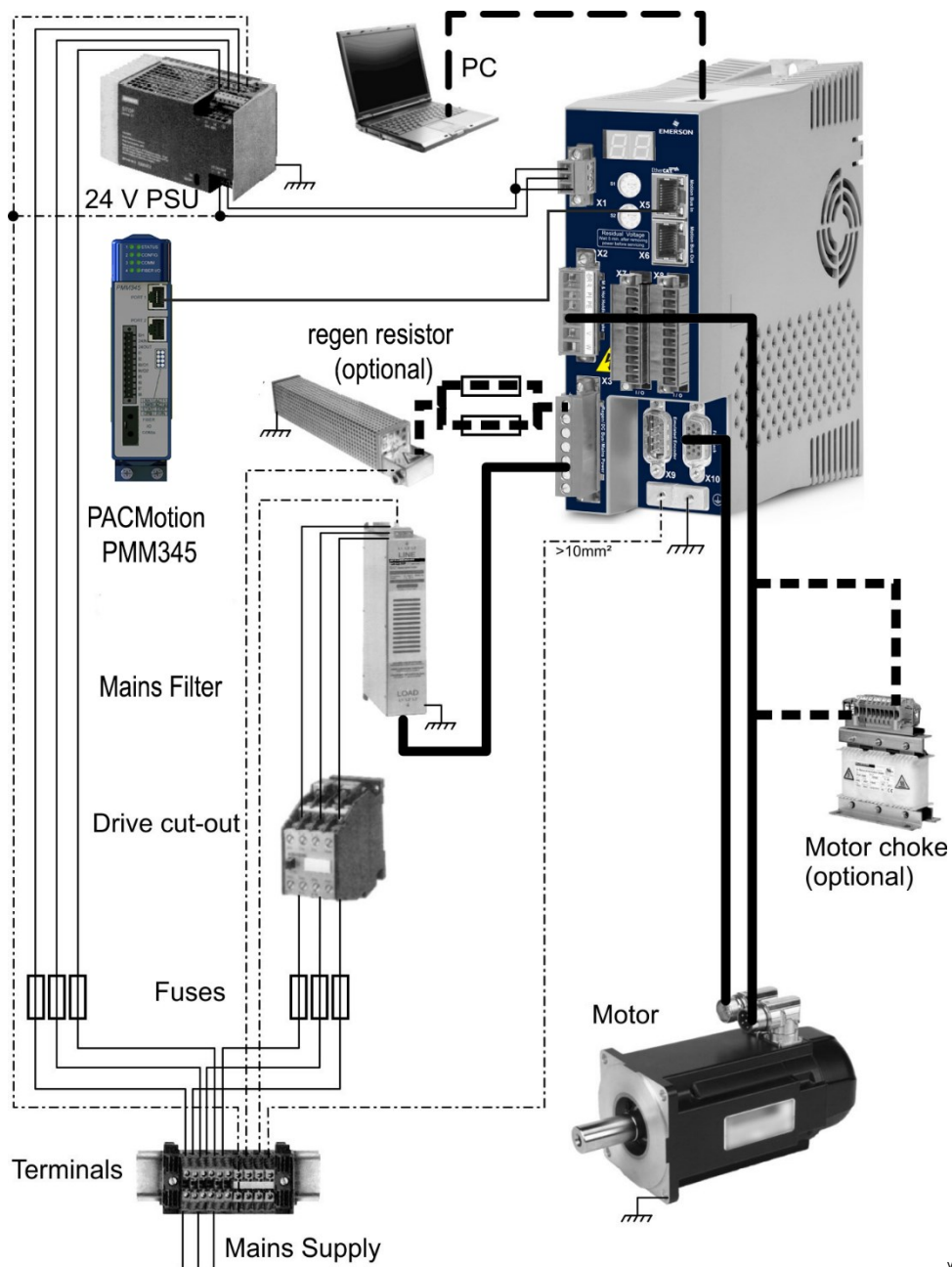
- Overview (all connections):
- IC830DP variant (→ # 83)
- Shielding: (→ # 98)
- Mains power: (→ # 105)
- DC Bus Link: (→ # 108)
- Motor: (→ # 116)
- Feedback: (→ # 121)
- Electronic gearing: (→ # 138)
- Encoder emulation: (→ # 140)
- Digital and analog inputs and outputs: (→ # 146) Service interface: (→ # 172)
- Motion bus interface (→ # 182)

5.7 Components of a servosystem

5.7.1 With IC830DPzzz06

Note: Cables drawn bold are shielded. Electrical ground is drawn with dash-dotted lines. Optional devices are connected with dashed lines to the drive. The required accessories are described in the accessories manual.

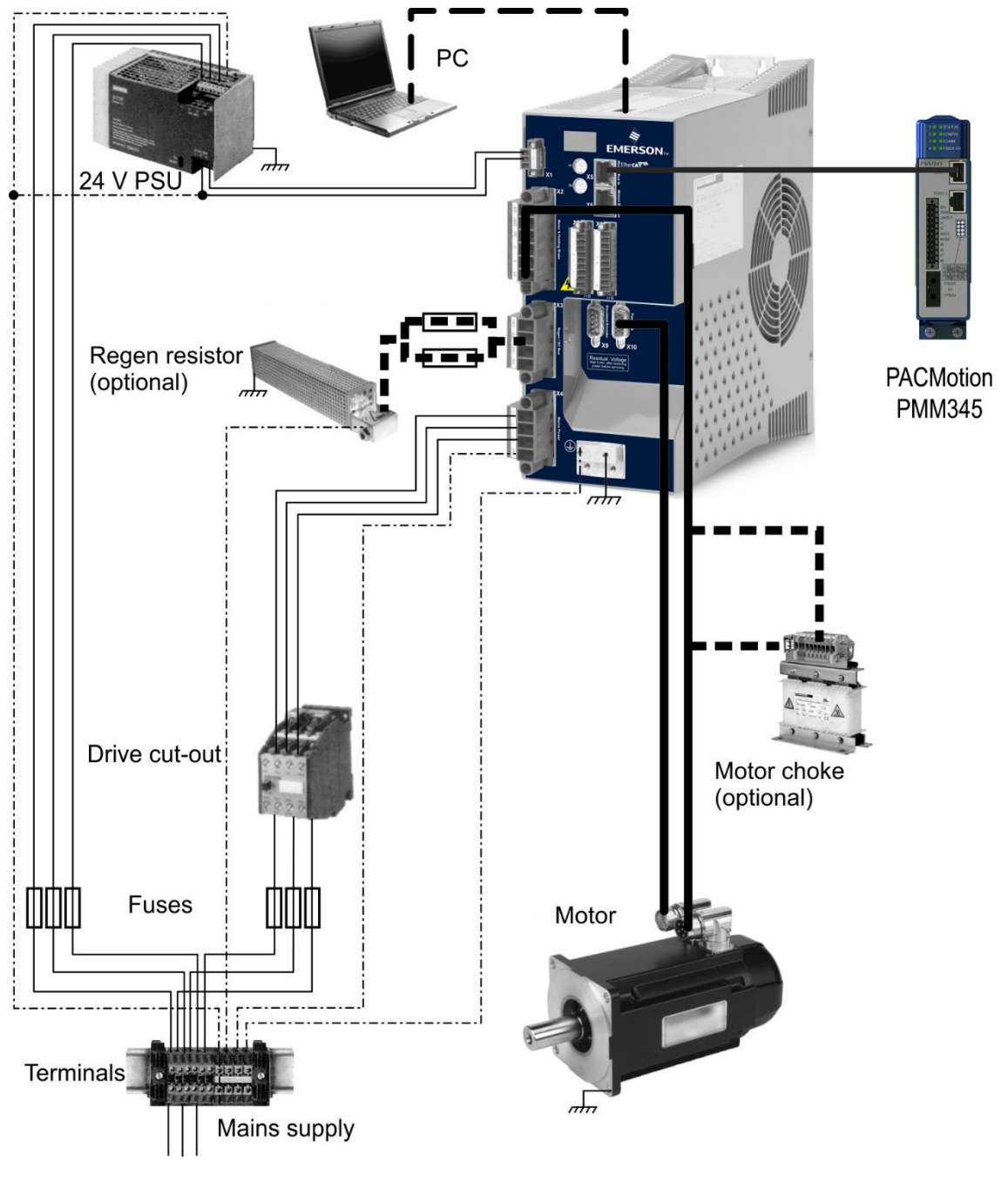
Figure 19: Components of a Servo System



With IC830DPzzz07

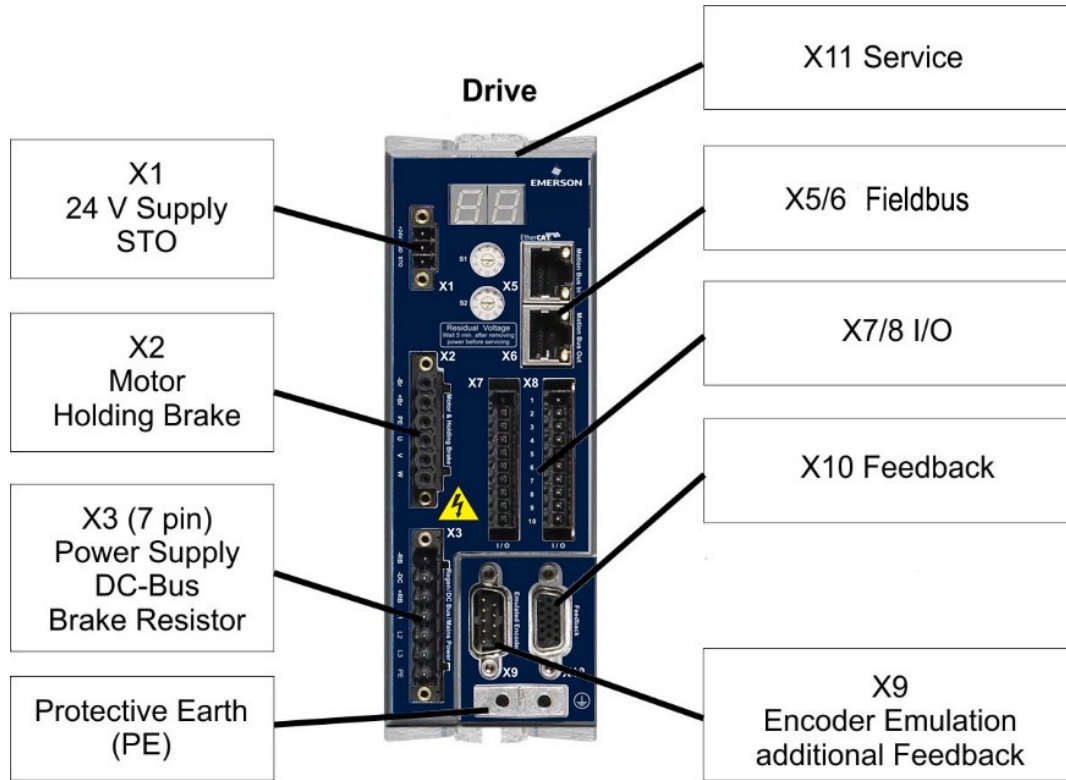
Note: Cables drawn bold are shielded. Electrical ground is drawn with dash-dotted lines. Optional devices are connected with dashed lines to the drive. The required accessories are described in the accessories manual.

Figure 20: IC830DPzzz07



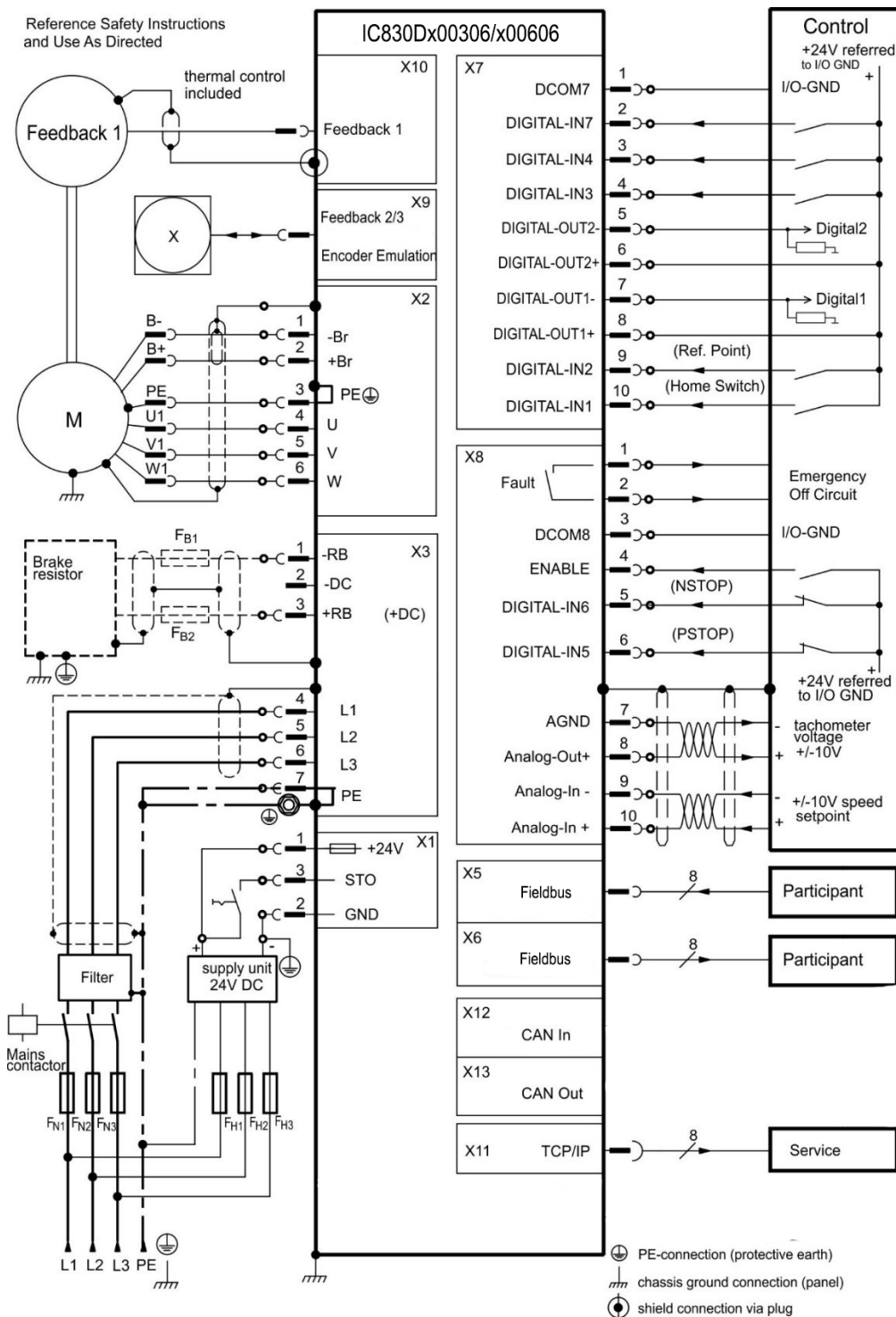
5.8 Connection Overview of IC830DP Drive Connectors

Figure 21: IC830DP Drive Connectors



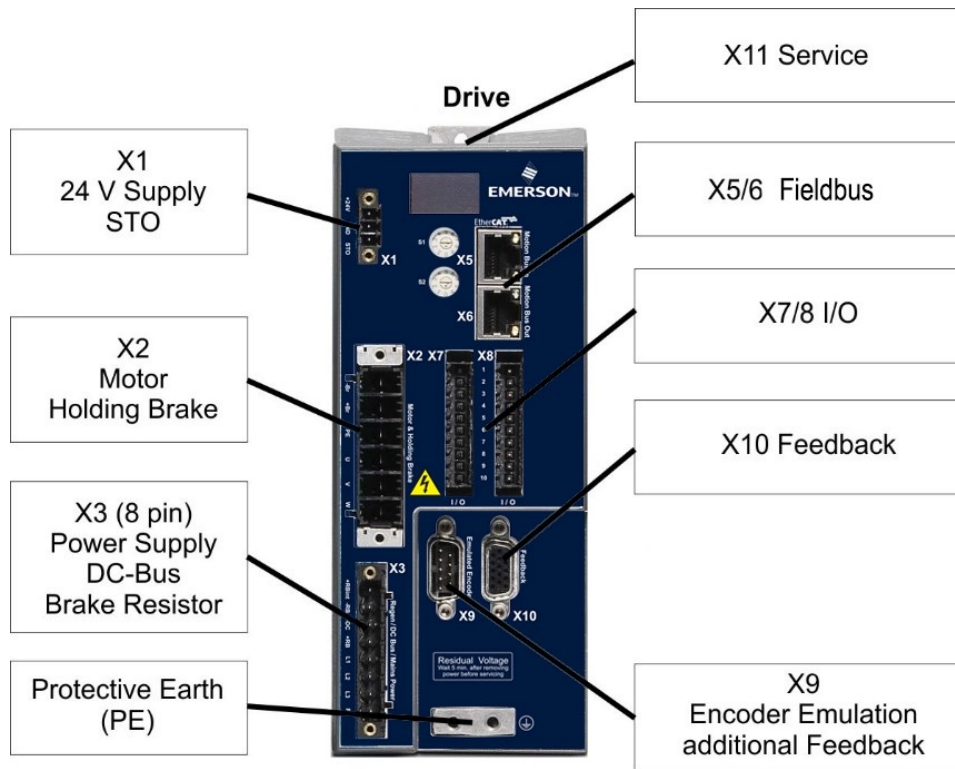
5.8.1 Connector assignment IC830DP00306, IC830DP00606

Figure 22: Wiring Configuration for IC830DP00306, IC830DP00606



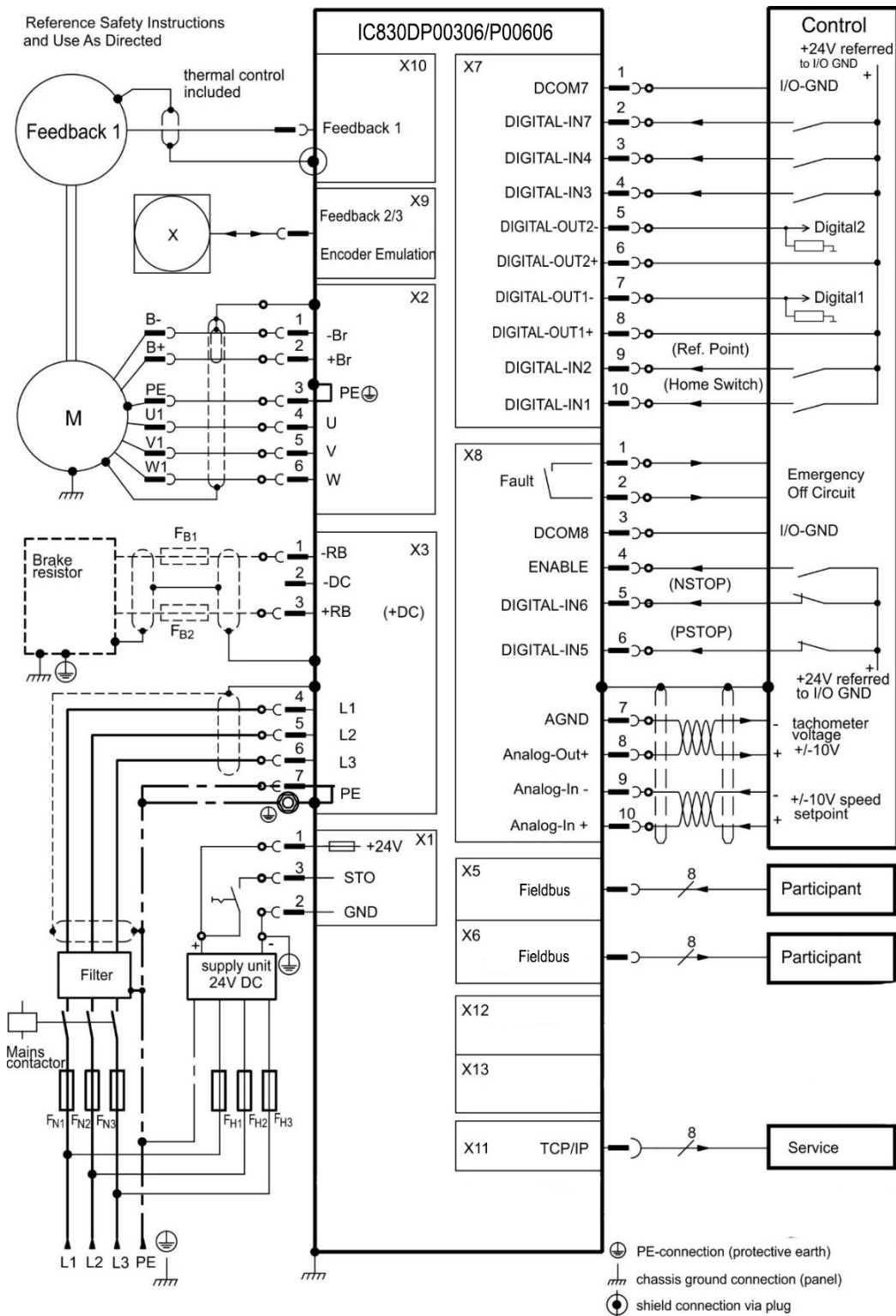
5.8.2 Connection diagram IC830DP00306, IC830DP00606

Figure 23: IC830DP00306 and -P00606



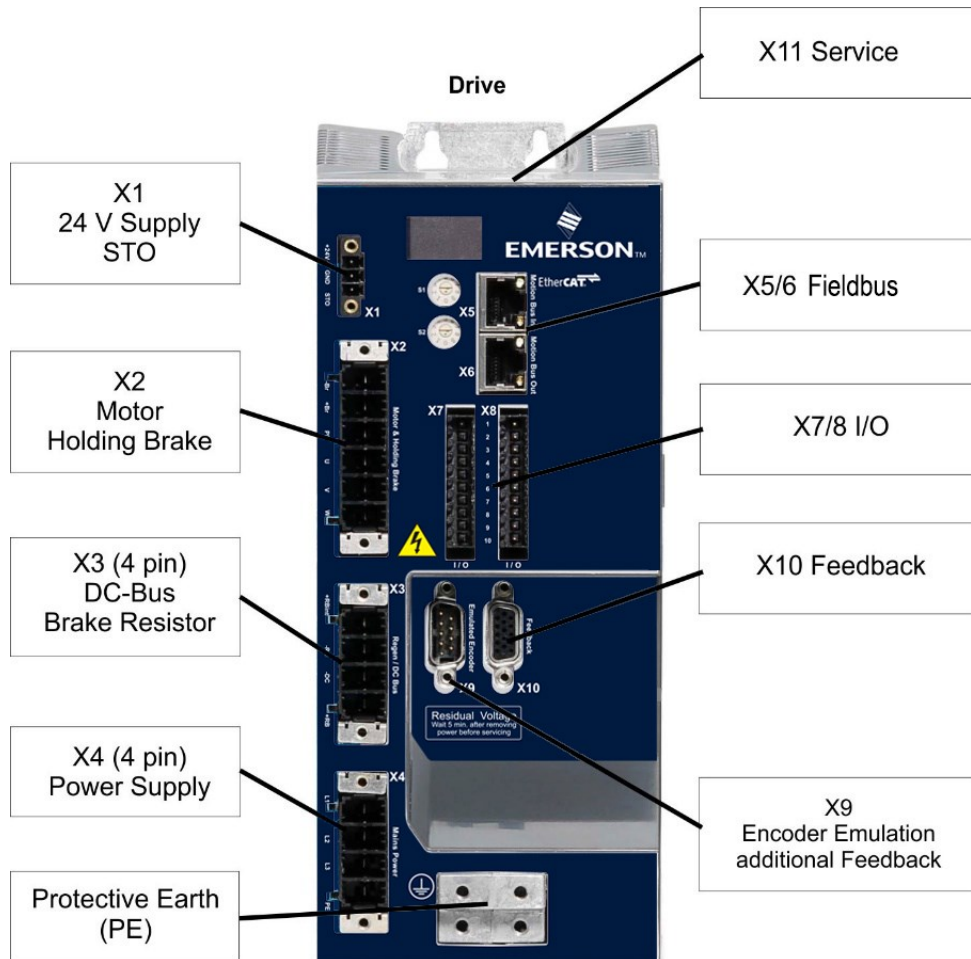
Connector assignment IC830DP01206.

Figure 24: IC830DP01206



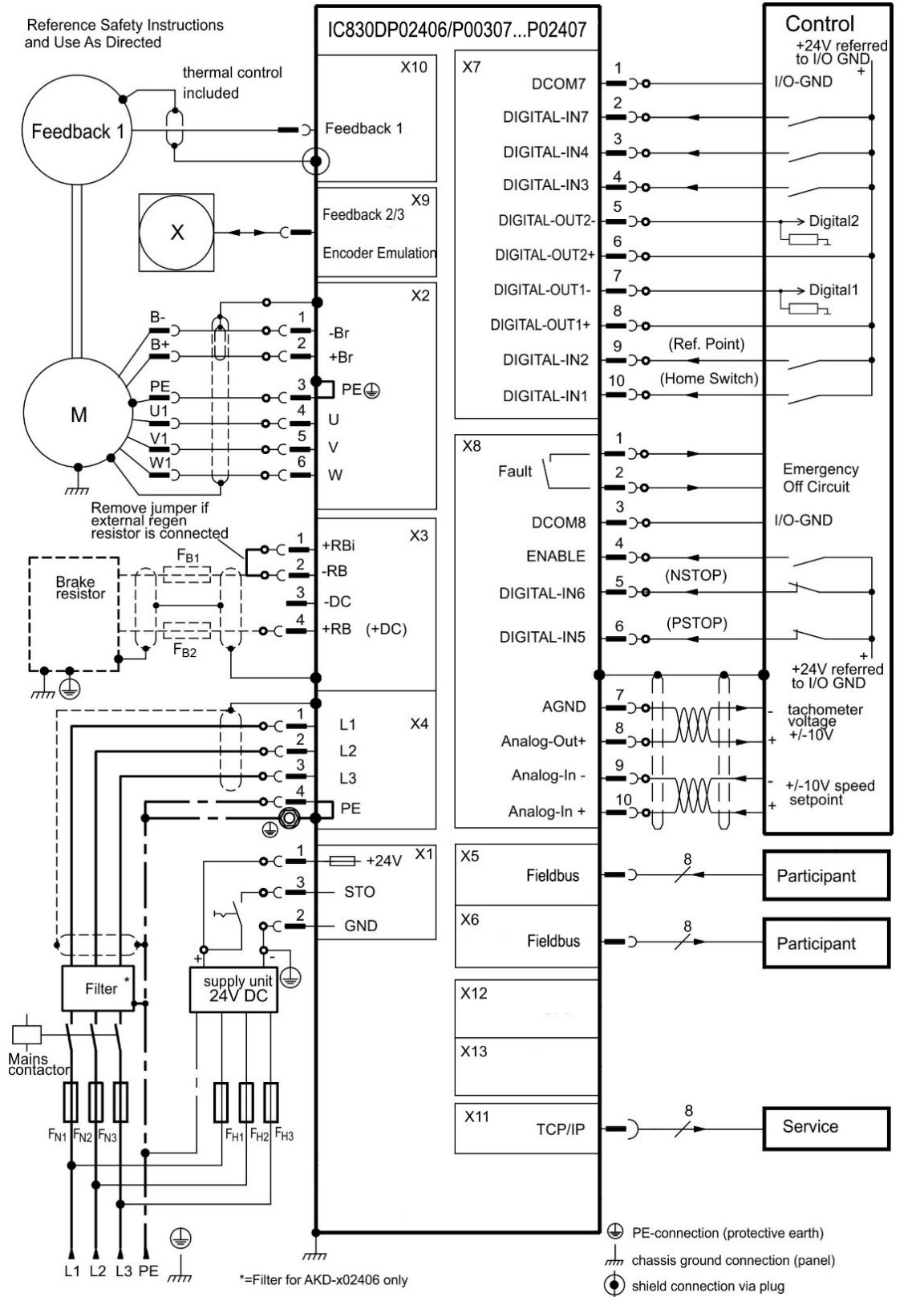
5.8.3 Connector Assignment for IC830DP02406 and IC830DP00307 to 02407

Figure 25: Connector Assignment for -P02406 and -P00307



5.8.4 Connection diagram IC830DP02406 and IC830DP00307 to 02407

Figure 26: Connection Diagram for -P02406, and -P00307 to -P02407



5.9 EMI Noise Reduction

• CAUTION

Electromagnetic Fields!

Electromagnetic radiation may, by acting on electrically conductive materials, lead to potential hazardous danger (warming, failure of implants).

Work on the electrical installation may only be performed by trained and qualified personnel, in compliance with the regulations for safety at work, and only with switched off mains supply, and secured against restart.

Grounding, equipotential bonding and radiation-reducing shields may not be removed.

5.9.1 Recommendations for EMI noise reduction

The following guidelines will help you to reduce problems with electrical noise in your application.

Ensure good connections between the cabinet components. Connect the back panel and cabinet door to the cabinet body using several conductive braids. Never rely on hinges or mounting bolts for ground connections.

Ensure good ground connection. Connect from cabinet to proper earth ground. Ground leads should be the same gauge as the leads to main power or one gauge smaller.

Use Emerson cables. Route power and control cables separately, Emerson recommends a distance of at least 200 mm to improve interference immunity.

Ground the shielding at both ends. Ground all shielding with large areas (low impedance), with metalized connector housings or shield connection clamps wherever possible. For cables entering a cabinet, connect shields on all 360° of the cable. Never connect a simple “pigtail.” For more information on shielding concepts, (→ # 99).

With separate mains filter, maintain separation of leads entering and exiting the mains filter (line power filter). Locate the filter as close as possible to the point where the incoming power enters the cabinet. If it is necessary for input power and motor leads to cross, cross them at 90°.

Feedback lines may not be extended, since the shielding would be interrupted and the signal processing may be disturbed. Install all feedback cables with an adequate cross-section, per IEC 60204 (→ # 41) and use the requested cable material to reach maximum cable length.

Splice cables properly. If you need to divide cables, use connectors with metal back- shells. Ensure that both shells connect along the full 360° of the shields.

Use differential inputs for analog signals. Noise susceptibility in analog signals is greatly reduced by using differential inputs. Use twisted-pair, shielded signal lines, connecting shields on both ends.

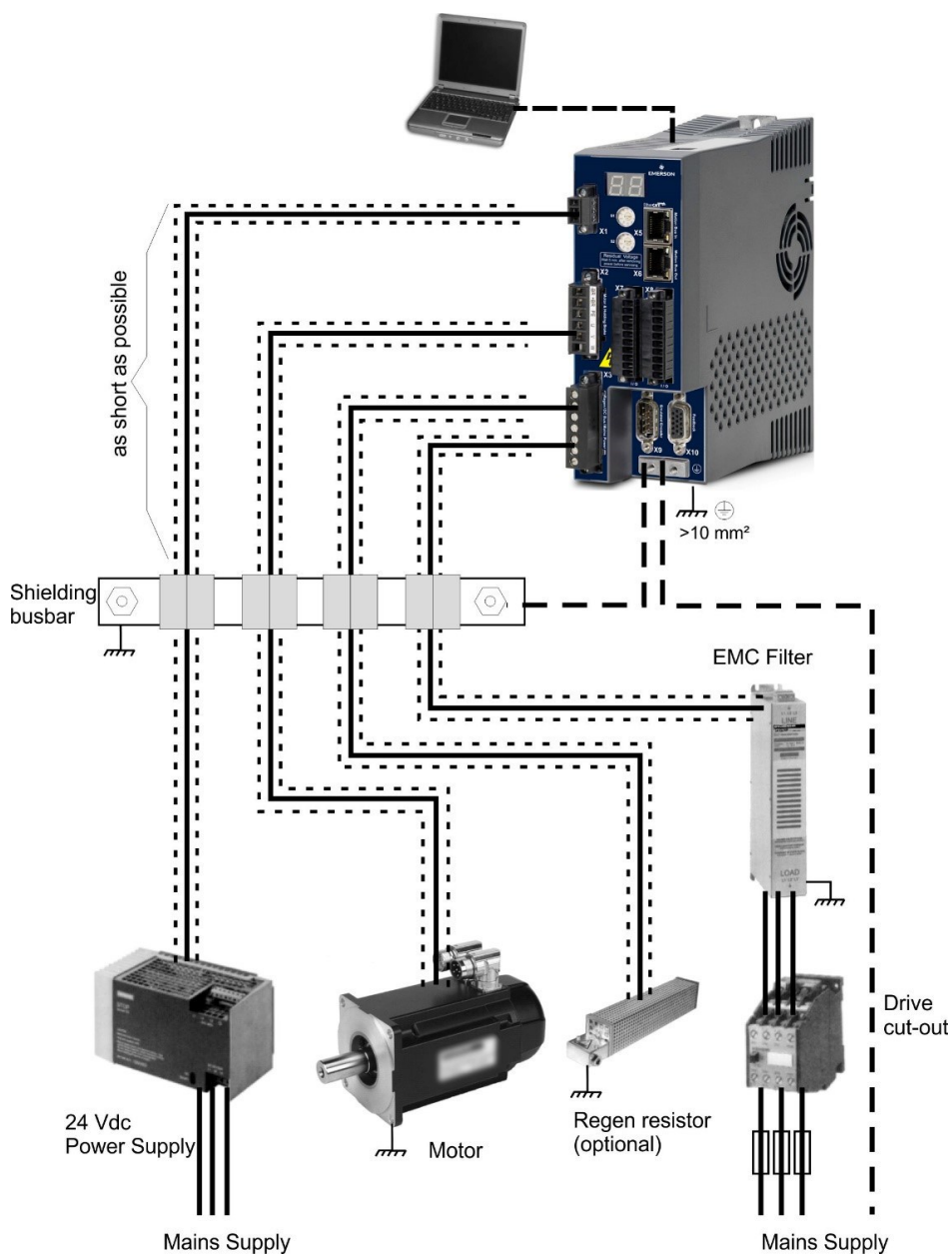
Cables between drives and filters or external regen resistors must be shielded. Install all power cables with an adequate cross-section, per IEC 60204 (→ #41) and use the requested cable material to reach maximum cable length.

5.9.2 Shielding with external shielding busbar

EMC filtering must be done externally by the user if necessary, which requires the use of shielded cables. Emerson recommends a star point shield connection, for example, with a shielding busbar.

Shielding Concept

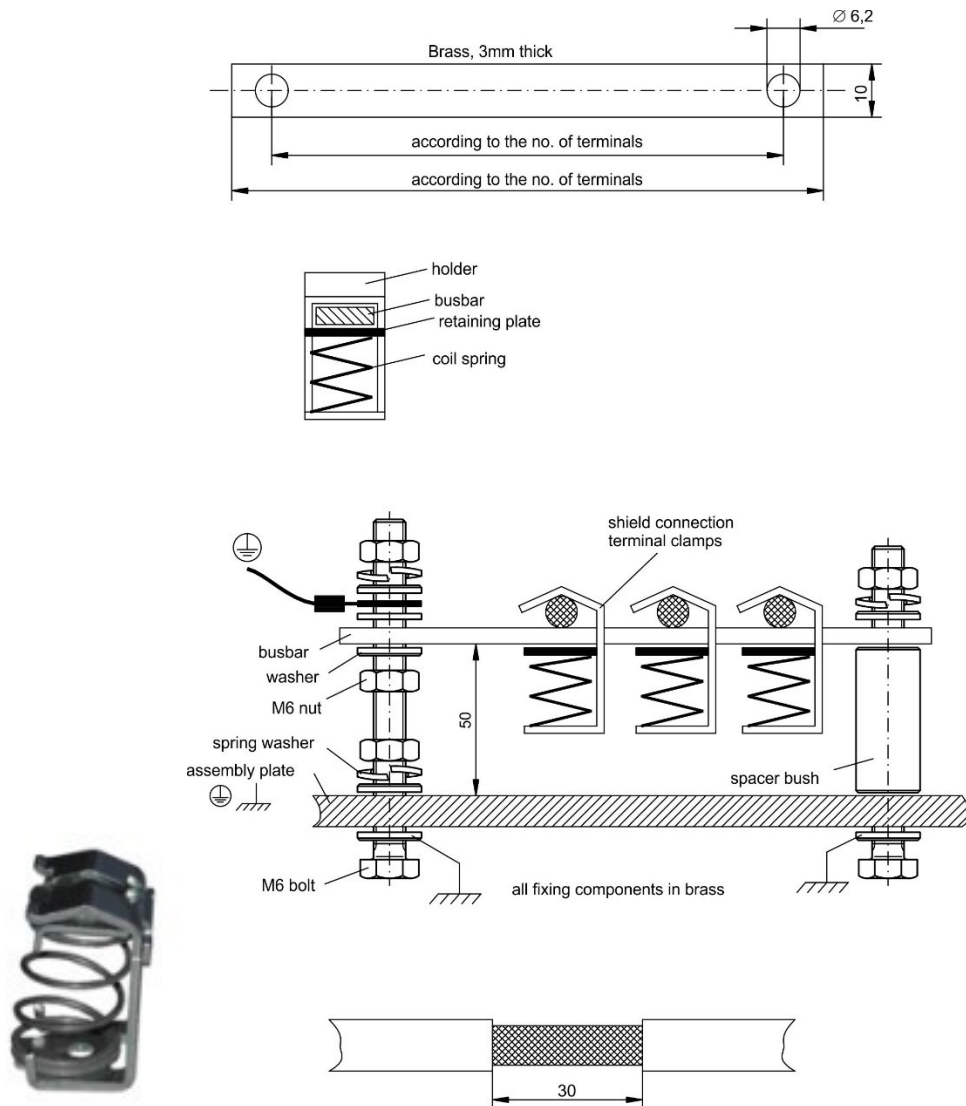
Figure 27: Shielding Concept



Shielding Busbar

The power cable shields (line in, motor cable, external regen resistor) can be routed to an additional busbar via shield clamps. Emerson recommends using shield clamps. A possible scenario for setting up a busbar for the above shield clamps is described below.

Figure 28: Shielding Bus Bar



1. Cut a busbar of the required length from a brass rail (cross-section 10 x 3 mm) and drill holes in it as indicated. All shield clamps required must fit between the drill holes.
2. Squeeze together the coil spring and the supporting plate and push the busbar through the opening in the holder.
3. Mount the busbar with the shield clamps fitted on the assembly plate. Use either metal spacer bushes or screws with nuts and accessories to maintain a spacing of 50 mm. Earth the bus- bar using a single conductor with a cross-section of at least 2.5 mm².
4. Strip the external cable sheath to a length of approx. 30 mm, taking care not to damage the braided shield. Push the shield clamp up and route the cable to it via the bus- bar.

5.9.3 Shielding connection to the drive

You can connect cable shielding directly to the drive by using grounding plates, shield connection clamps, and a motor connector with strain relief and grounding plate.

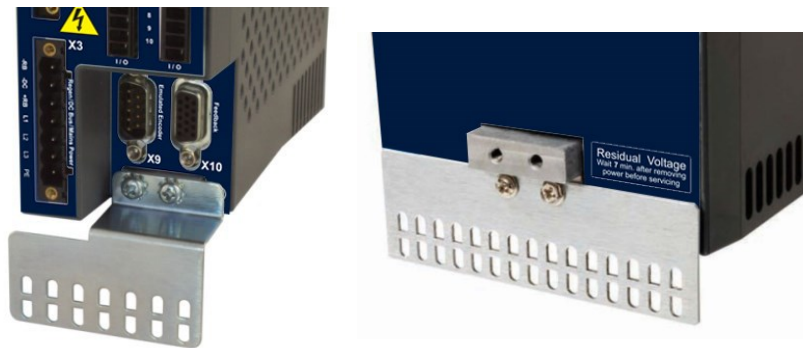
Grounding plates

Mount the grounding plates to the drive as shown in the photos below.

IC830DP0306 to P1206 types:

L-shape grounding plate (EU only)

Figure 29: IC830DP02406 & xzzz07 types: flat grounding plate



Shield connection clamps

Use shield connection clamps (see accessories manual). These hook into the grounding plate and ensure optimum contact between the shield and the grounding plate.

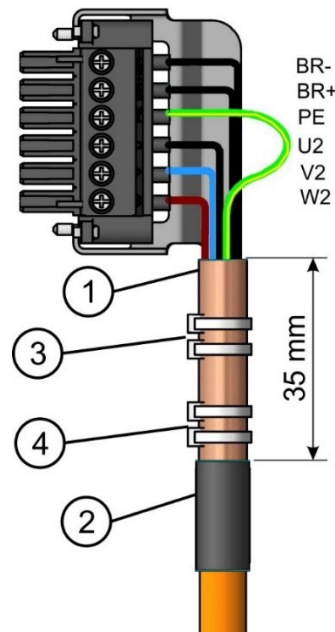
Emerson recommends using Phoenix Contact SK14 shield clamps with clamp range of 6-13mm.

Figure 30: Shield Connection Lamps



Motor connector X2 with shielding connection

Figure 31: Motor Connector X2 with Shielding Connection



Alternative connection for the motor power connection by mating connector with strain relief.

Strip the external cable sheath to a length of approx. 120 mm, taking care not to damage the braided shield. Push the braided shield (1) back over the cable and secure with a rubber sleeve (2) or shrink sleeve.

Shorten all the wires apart from the protective earth (PE) wire (green/yellow) by about 20 mm so that the PE wire is now the longest wire. Strip all wires and fit wire end ferrules.

Secure the braided shield of the cable to the shroud with a cable tie (3) and use a second tie (4) to fasten the cable.

Wire the connector as shown in the connection diagram. Plug in the connector to the socket on the front of the PSD.

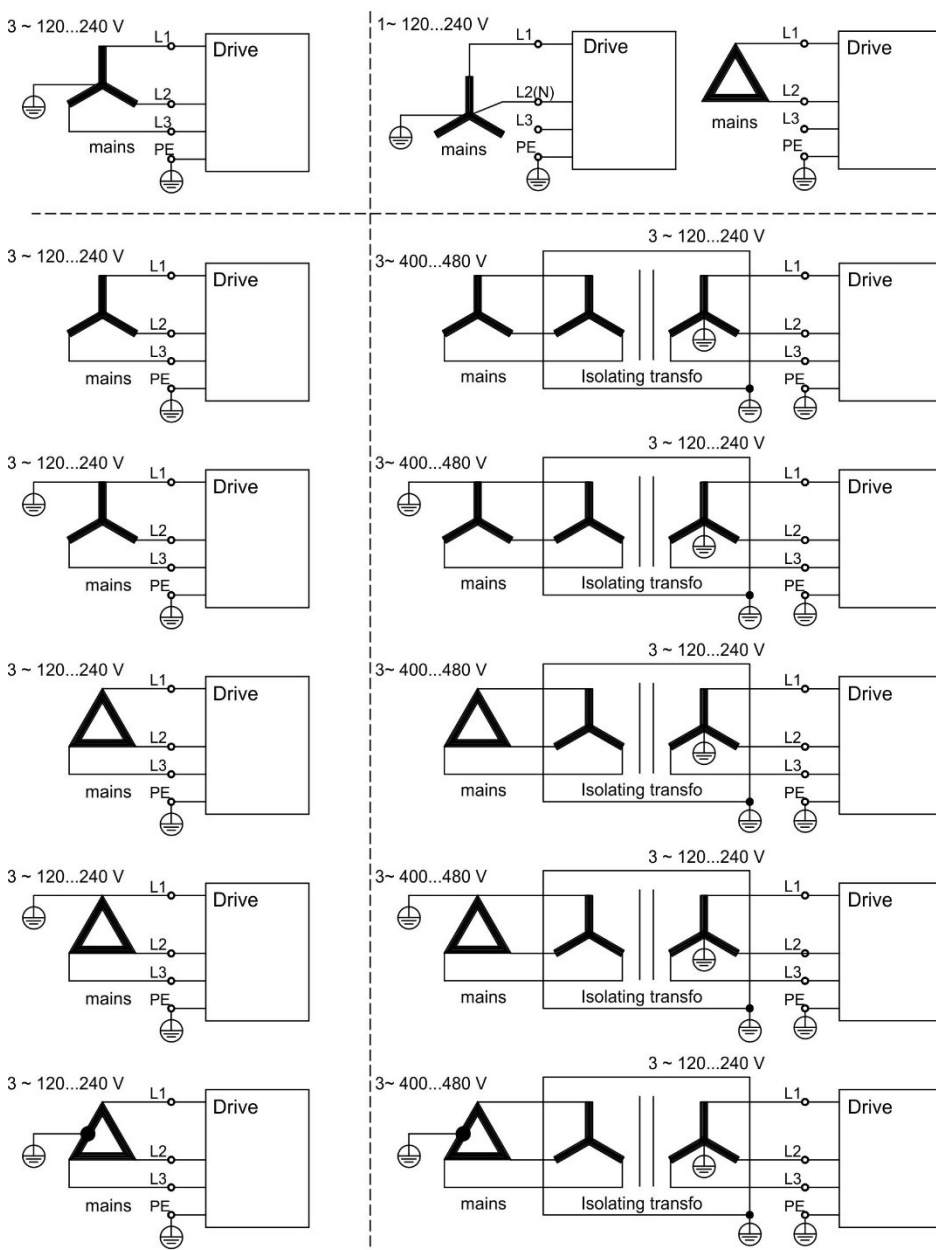
Screw the connector in place. This ensures that there is conductive contact over a large surface area between the braided shield and the front panel.

5.10 Electrical Supply Connection

5.10.1 Connection to various mains supply networks IC830DPzzz06 (120V to 240V)

Note: An isolating transformer is required for 400 to 480 V networks to get a maximum voltage of 240 V +10%.

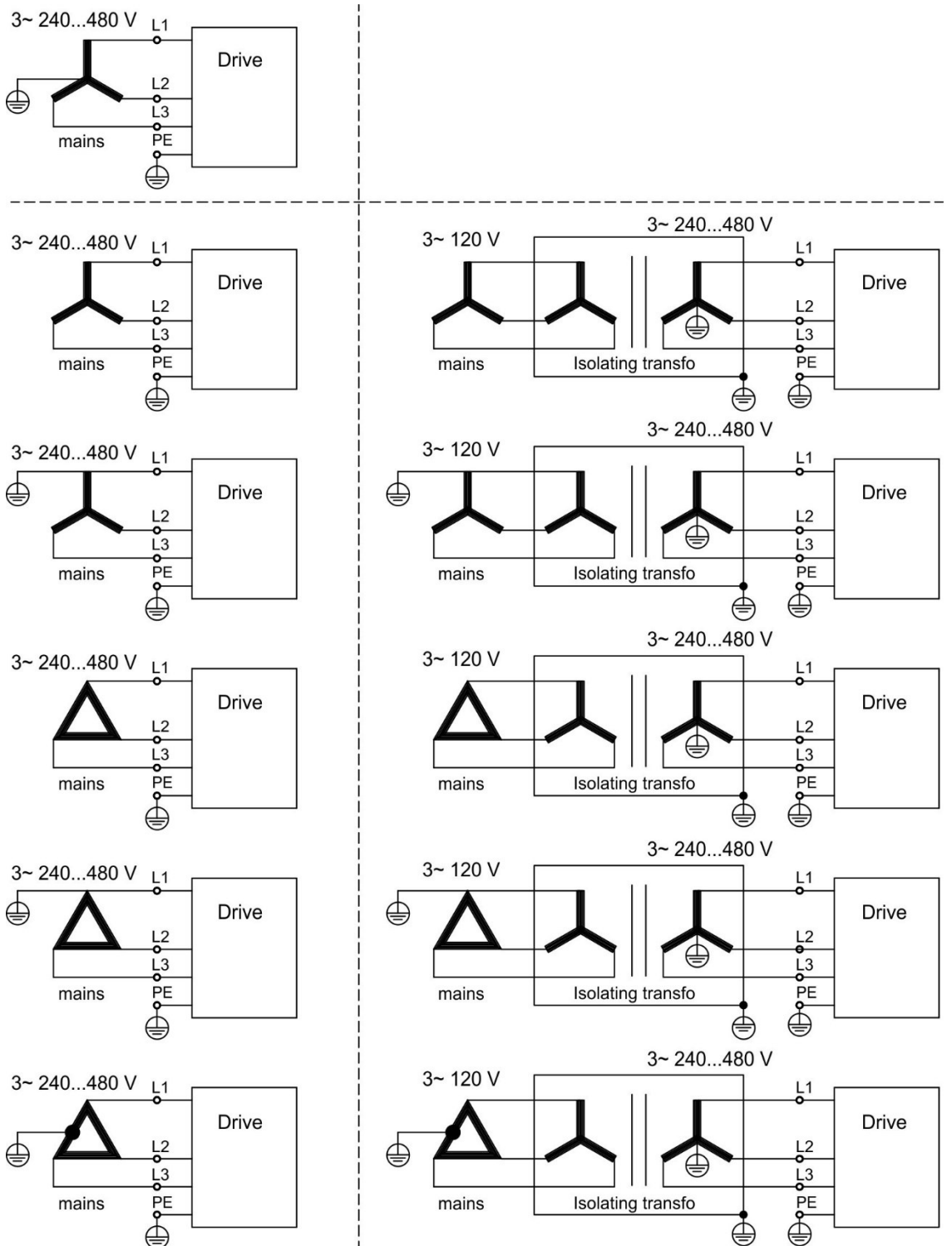
Figure 32: Connection to Various Mains Supply Networks -zzzz06 (120 V to 240 V)



5.10.2 Connection to various mains supply networks IC830DPzzz07 (240V to 480V)

Note: An isolating transformer is required for 120V networks to get a minimum voltage of 240 V +10%.

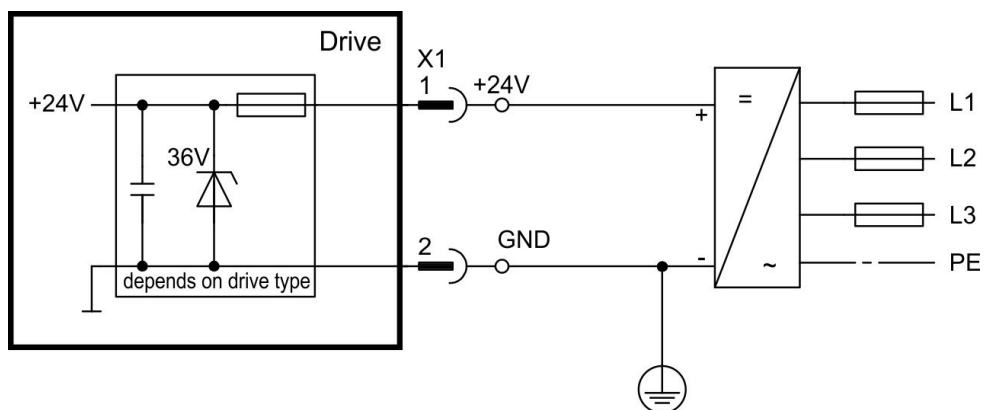
Figure 33: Connection to various mains supply networks IC830DPzzz07 (240V to 480V)



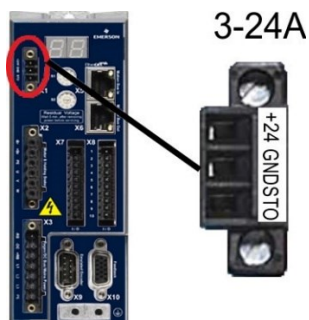
5.10.3 24 V auxiliary supply (X1)

The following diagram describes external 24 VDC power supply, electrically isolated, for example, via an isolating transformer. The required current rating depends on the use of motor brake card (→ # 36) or (→ # 37).

Figure 34: 24V Auxiliary Supply



IC830DP003 to 024, connector X1

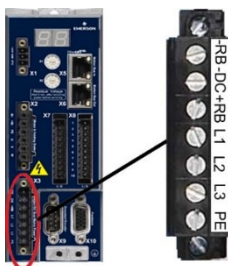


Pin	Signal	Description
1	+24	+24 VDC Auxiliary voltage
2	GND	24V Supply GND
3	STO	STO enable (Safe Torque Off)

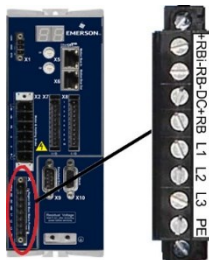
5.10.4 Mains supply connection (X3, X4)

Drives in the PSD series can be supplied as follows:

- IC830DPzzz06: 1 or 3 phase industrial supply networks (not more than 200 kA symmetrical rated current at 120 V and 240 V).
- IC830DPzzz07: 3 phase industrial supply networks (not more than 200 kA symmetrical rated current at 240 V, 400 V and 480 V).
- Connection to other voltage types of supply networks is possible with an additional isolating transformer (→ # 102). Periodic overvoltages between phases (L1, L2, L3) and the housing of the drive must not exceed 1000 V peak. In accordance with IEC 61800, voltage spikes (< 50 µs) between phases must not exceed 1000 V. Voltage spikes (< 50 µs) between a phase and the housing must not exceed 2000 V.



IC830DP00306 to IC830DP00606 (X3)		
Pin	Signal	Description
4	L1	Line 1
5	L2	Line 2
6	L3	Line 3
7	PE	Protective Earth



IC830DP01206 (X3)		
Pin	Signal	Description
5	L1	Line 1
6	L2	Line 2
7	L3	Line 3
8	PE	Protective Earth

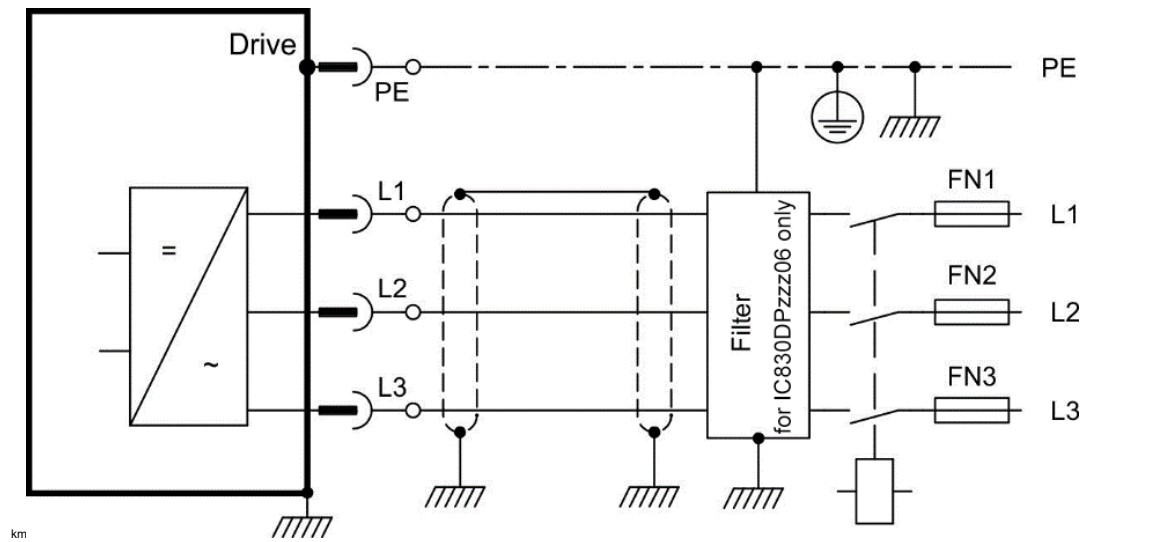


IC830DP02406 & IC830DP00307 to IC830DP02407 (X4)		
Pin	Signal	Description
1	L1	Line 1
2	L2	Line 2
3	L3	Line 3
4	PE	Protective Earth

Three phase connection

- Fuses, all PSD types
- 3-phase supply network, supply networks (→ # 102).
- Filtering for IC830DPzzz06 to be provided by the user. Fusing to be provided by the user (→ # 39).

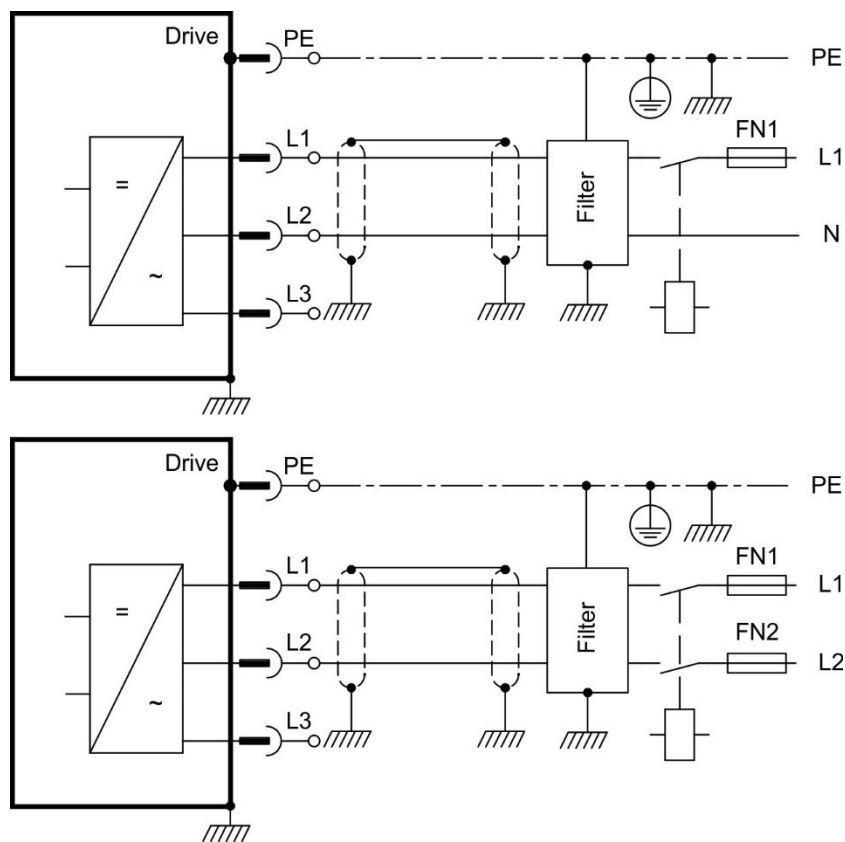
Figure 35: Three-Phase Connection



Single/Dual phase connection (IC830DP00306 to IC830DP01206 only)

- Single-phase supply network (120 V_{-10%} to 240 V_{+10%}) with neutral line or Two-phase supply network (120 V_{-10%} to 240 V_{+10%}) without neutral line Supply networks(→ # 102)
- Leave L3 open circuit
- Filtering to be provided by the user.
- Fusing (such as fusible cut-outs) to be provided by the user (→ # 39)

Figure 36: Single/Dual Phase Connection



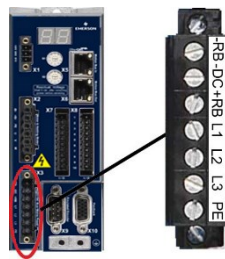
5.11 DC Bus link (X3, X14)

The DC bus link can be connected in parallel so that the regen power is divided between all the drives that are connected to the same DC bus link circuit. Every drive must have its own power connection to mains voltage, even if the DC bus link is used. Drives working regeneratively very often should be placed beside drives, which need energy. That reduces current flow on longer distances. For fuse type definition refer to (→ # 39).

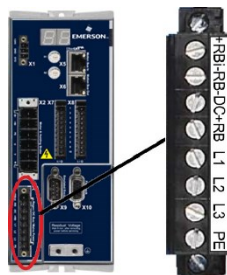
- The sum of the rated currents for all drives connected in parallel to an **IC830DP003 to 024**
- must not exceed 48 A. Examples: 024-024-024, 012-012-024-012
- Use 6 mm², unshielded single cores with a max. length of 200 mm; use 6 mm² shielded cables for longer lengths. In this case no fuse for line protection is required.
- Use 16 mm², unshielded single cores with a max. length of 30 mm; use 16 mm² shielded cables for longer lengths.

Note: Drives can be destroyed, if DC bus link voltages are different. Only drives with mains supply from the same mains (identical mains supply voltage) may be connected by the DC bus link.

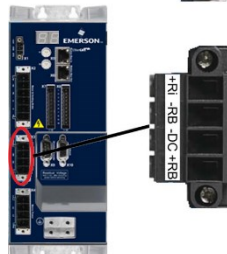
Note: The phase lost/ main control is not working on DC-Bus connected drives. A phase lost on a drive inside a DC Bus connection will be not detected. External phase monitoring to prevent overload of the rectifier is recommended.



IC830DP00306 to IC830DP00606 (X3)		
2	-DC	DC-Link Bus negative
3	+DC (+RB)	DC-Link Bus positive

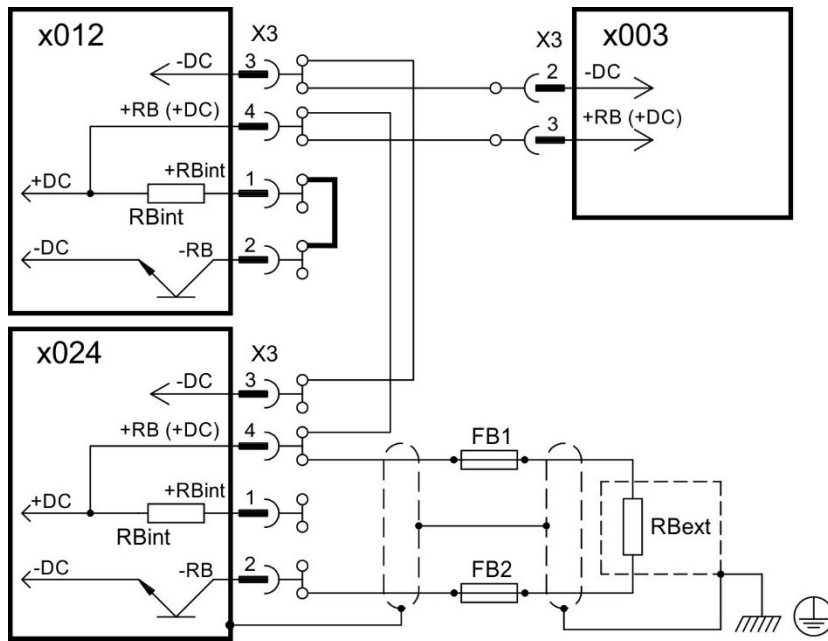


IC830DP01206 (X3)		
3	-DC	DC-Link Bus negative
4	+DC (+RB)	DC-Link Bus positive



IC830DP02406 & IC830DP00307 to IC830DP02407 (X3)		
3	-DC	DC-Link Bus negative
	+DC (+RB)	DC-Link Bus positive

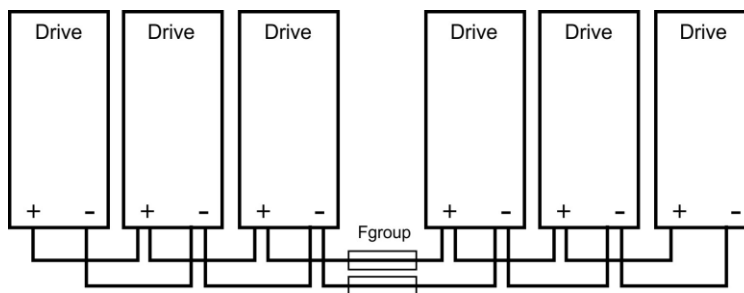
Figure 37: Wiring to Drives



5.11.1 DC Bus topology with Y connectors (24 A max.)

Without DC Bus fuses, other devices can become damaged or destroyed if, for example, a device fails due to an internal short circuit. If multiple drives are connected in parallel, then it is usual to insert DC Bus fuses (→ # 39). between groups of drives (with a group consisting of two or three devices, depending on the current) in order to limit any possible resulting damage. Fuses cannot avoid damage by current peaks completely.

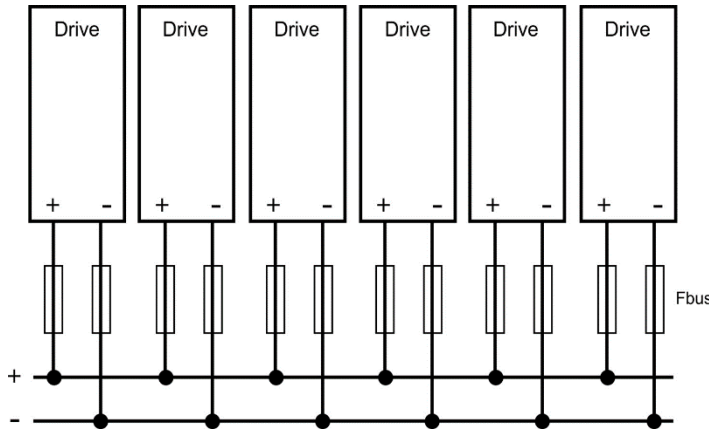
Figure 38: DC Bus Topology with Y Connectors



5.11.2 DC Bus topology with busbar

This wiring does not require Y connectors. If a device fails due to a short-circuit, only its DC Bus fuses (→ # 39). are tripped and the rest of the network continues uninterrupted. The solid busbars can conduct significantly larger currents, because the compensating current does not flow through the connector as above. For this reason, almost as many drives as desired can be connected in parallel in this form.

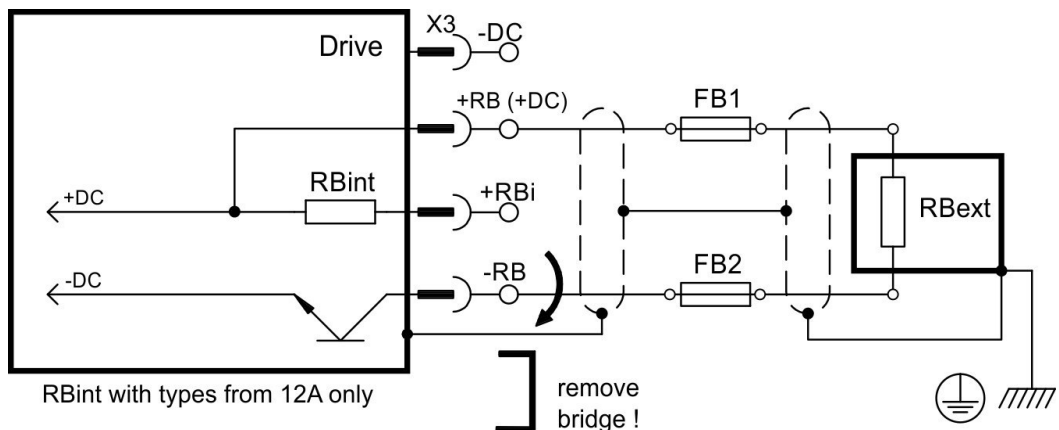
Figure 39: DC Bus Topology with Busbar



5.11.3 External regen resistor (X3)

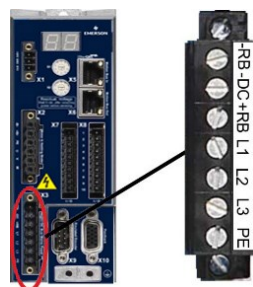
For technical data on the brake circuit (→ # 42).

Figure 40: External Regen Resistor (X3)



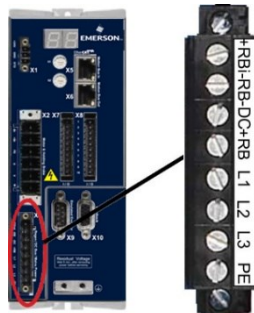
IC830DP003 to 024, regen connector X3

Drive Model	Ampere rating@230V	Ampere rating@480V	UL region example:	CE Region example (Siba):
IC830DP003 to 012	10 A	40 A	FW-xxA14F	110 V to 400 V: gRL(gS) 400 V to 480 V: aR
IC830DP024	15 A	50 A		



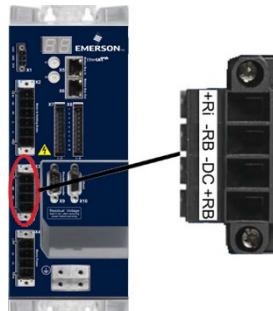
IC830DP00306 to IC830DP00606 (X3)

Pin	Signal	Description
1	-RB	External Regen Resistor negative
3	+RB	External Regen Resistor positive



IC830DP01206 (X3)

Pin	Signal	Description
1	+RBint	Internal Regen Resistor positive
2	-RB	External Regen Resistor negative
4	+RB	External Regen Resistor positive



IC830DP02406 & IC830DP00307 to IC830DP02407 (X3)

Pin	Signal	Description
2	-RB	External Regen Resistor negative
4	+RB	External Regen Resistor positive

5.12 Motor Power Connection (X2)

Together with the motor supply cable and motor winding, the power output of the drive forms an oscillating circuit. Characteristics such as cable capacity, cable length, motor inductance, and frequency (→ # 36) or (→ # 37) determine the maximum voltage in the system.

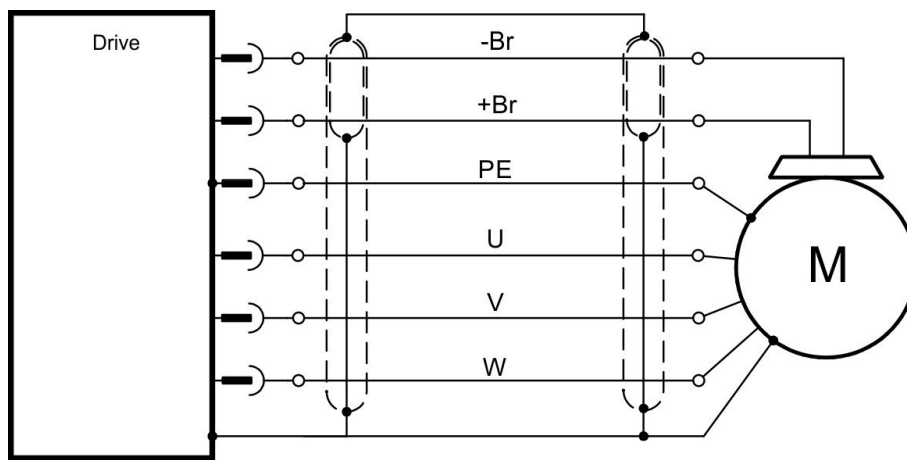
The PSD drive is able to protect the connected motor from overloading, if the parameters are set correctly and the thermal protection sensor is connected and supervised. With Emerson motors the valid data are automatically set by the internal motor database. Refer to parameter MOTOR.RTYPE for supported thermal sensors.

Note: the dynamic voltage rise can lead to a reduction in the motor operating life and, on unsuitable motors, to flashovers in the motor winding.

- Only install motors with insulation class F (acc. to IEC60085) or above.
- Only install cables that meet the requirements (→ # 41).

Note: With long motor cables leakage currents endanger the output stage of the drive. For cable lengths from 25 m to 50 m, a motor choke (3YL) must be wired into the motor cable (near the drive). Refer to your regional Accessories Manual for Emerson chokes.

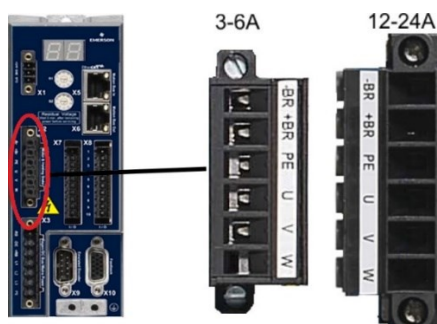
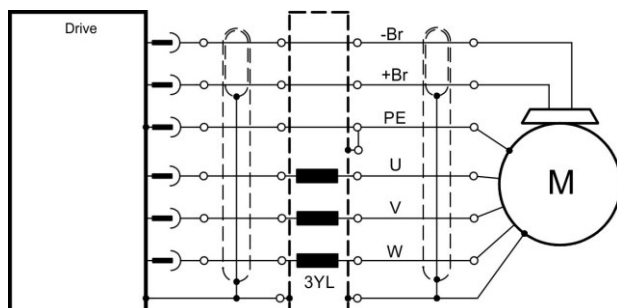
Figure 41: Motor power Connection



Cable length ≤ 25 m

Cable length >25 m

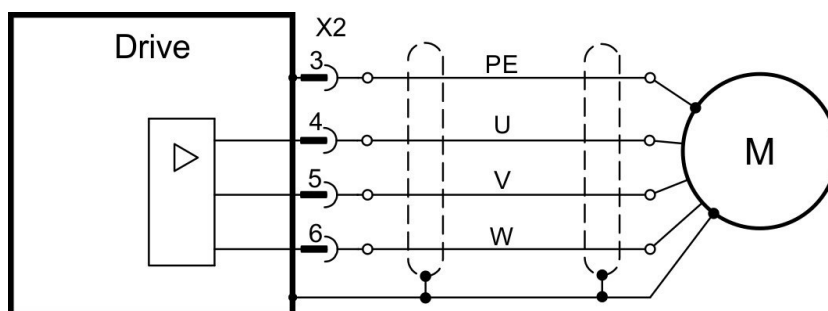
Figure 42: Cable Length < 25 M



	Signal	Description
1	-BR	Motor holding brake (→ # 118)
2	+BR	Motor holding brake (→ # 118)
3	PE	Protective earth (motor housing)
4	U	Motor phase U
5	V	Motor phase V
6	W	Motor phase W

5.12.1 IC830DP003 to 024, power connector X2

Figure 43: IC830DP003 to 024



5.13 Motor Brake Connection (X2, X15, X16)

A 24 V holding brake in the motor can be controlled directly by the drive. For proper function, check voltage drop, measure voltage at brake input and check brake function (on and off).

WARNING

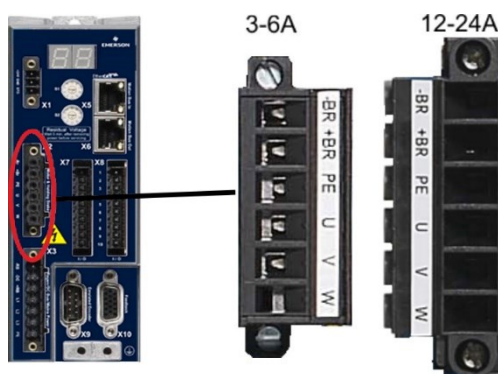
No Functional Safety!

Serious injury could result when the load is not properly blocked. This function does not ensure functional safety.

Functional safety, e.g. with hanging load (vertical axes), requires an additional mechanical brake which must be safely operated, for example by a safety control.

The Hardware Enable (connector X8 pin 4) does not initiate a controlled stop but switches off the power stage immediately.

Set parameter MOTOR.BRAKEIMM to 1 with vertical axes, to apply the brake immediately after faults or Hardware Disable.

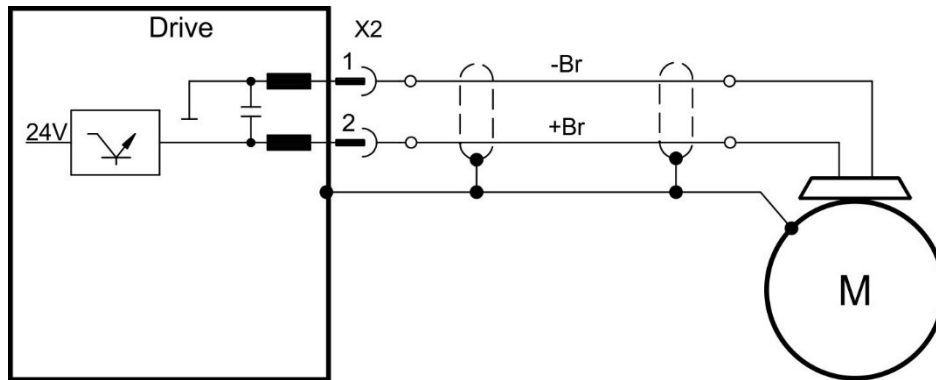


Pin	Signal	Description
1	-BR	Motor holding brake, negative
2	+BR	Motor holding brake, positive
3	PE	Protective earth (→ # 116)
4	U	Motor phase U (→ # 116)
5	V	Motor phase V (→ # 116)
6	W	Motor phase W (→ # 116)

5.13.1 IC830DP003 to 024, brake connector X2

Brake voltage supply via 24 V \pm 10% auxiliary voltage supply of the drive on X1. Maximum current depends on the drive type, see Technical Data (\rightarrow # 36) or (\rightarrow # 37).

Figure 44: ALD-x003 to 024, brake connector X2

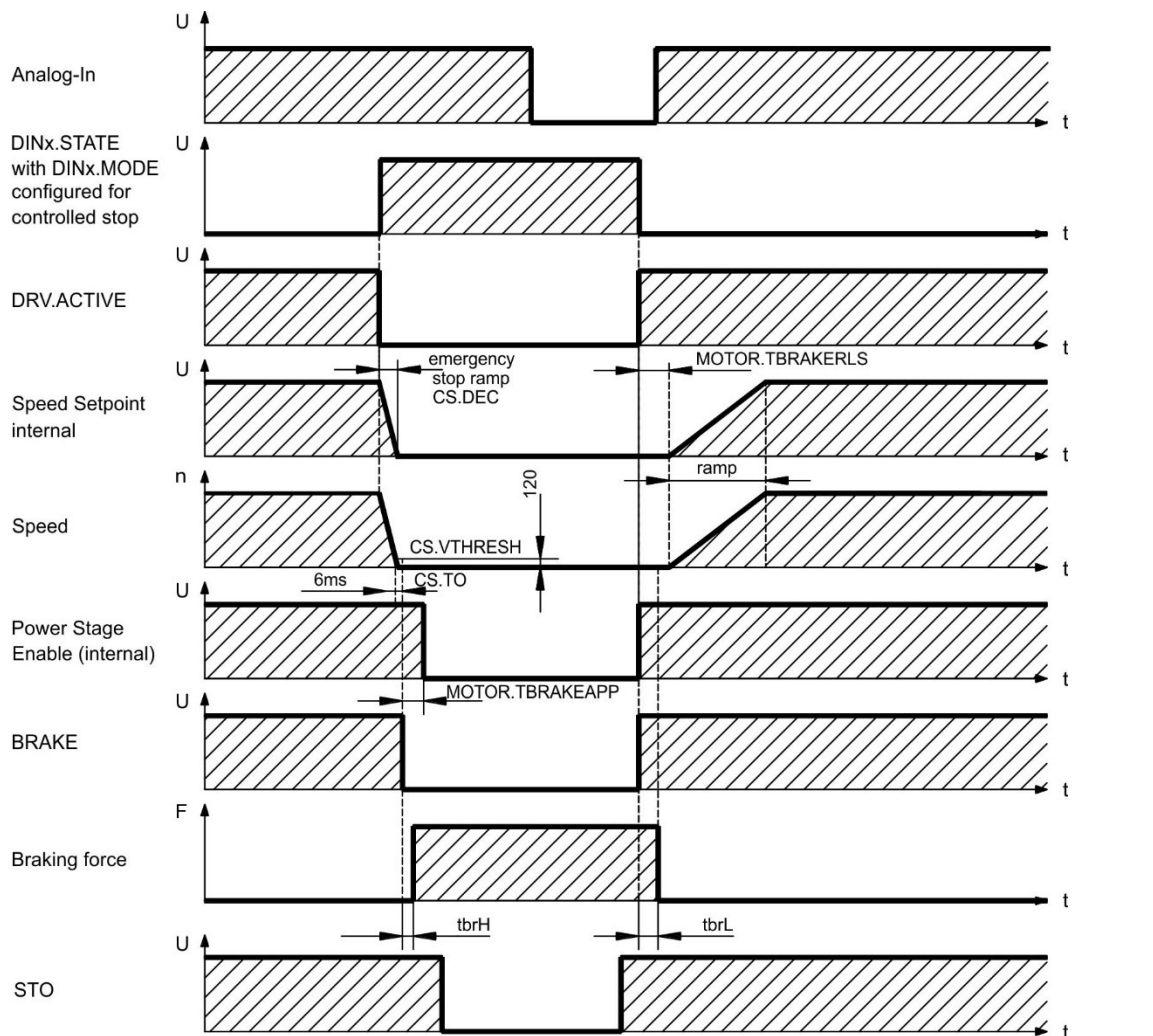


5.13.2 Functionality

The brake function must be enabled through a parameter. The diagram below shows the timing and functional relationships between the controlled stop signal, speed, and braking force. All values can be adjusted with parameters; values in the diagram are default values.

The speed setpoint of the drive is internally driven down an adjustable ramp (CS.DEC) to 0 V. With default values the output for the brake is switched on when the speed has reached 120 rpm (CS.VTHRESH) for at least 6 ms (CS.TO). The rise (t_{brH}) and fall (t_{brL}) times of the holding brake that is built into the motor are different for the various types of motor.

Figure 45: Brake Functionality



5.14 Feedback Connection (X10, X9, X7)

Every closed servo system normally requires at least one feedback device for sending actual values from the motor to the drive. Depending on the type of feedback device used, information will be fed back to the drive using digital or analog means.

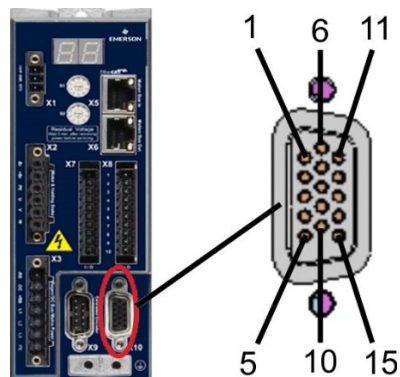
PSD supports the most common types of feedback device. Feedback functions are assigned with parameters in PACMotion Workbench, the setup software. Scaling and other settings are also performed in PACMotion Workbench. For a detailed description of the parameters, please refer to the PACMotion Workbench Online Help.

The table below provides an overview of the supported feedback types, their corresponding parameters, and a reference to the relevant connection diagram in each case.

Feedback Types	Wiring	Connector	FB1. SELECT	FB2. MOD E	FB3. MOD E
SFD	(→ # 125)	X10	41	-	-
SFD3	(→ # 126)	X10	45	-	-
SinCos Encoder BiSS B (analog)	(→ # 128)	X10	32	-	-
Encoder BiSS C (digital)	(→ # 129)	X10	34	-	-
SinCos Encoder Hiperface	(→ # 133)	X10	33	-	-

5.14.1 Feedback connector (X10)

Figure 46: Feedback Connector (x10)



Pin	SFD3	Hiperface	BiSS B (analog)
1	-	-	-
2	-	-	CLK+
3	-	-	CLK-
4	-	SEN+	SEN+
5	-	SEN-	SEN-
6	COM+	DAT+	DAT+
7	COM-	DAT-	DAT-
8	-	Th+	Th+
9	-	Th-	Th-
10	8 to 9 V	8 to 9 V	+5 V
11	0 V	0 V	0 V
12	-	SIN+	A+
13	-	SIN-	A-
14	-	COS+	B+
15	-	COS-	B-

CLK = CLOCK, DAT = DATA, SEN = SENSE, Th = thermal control,

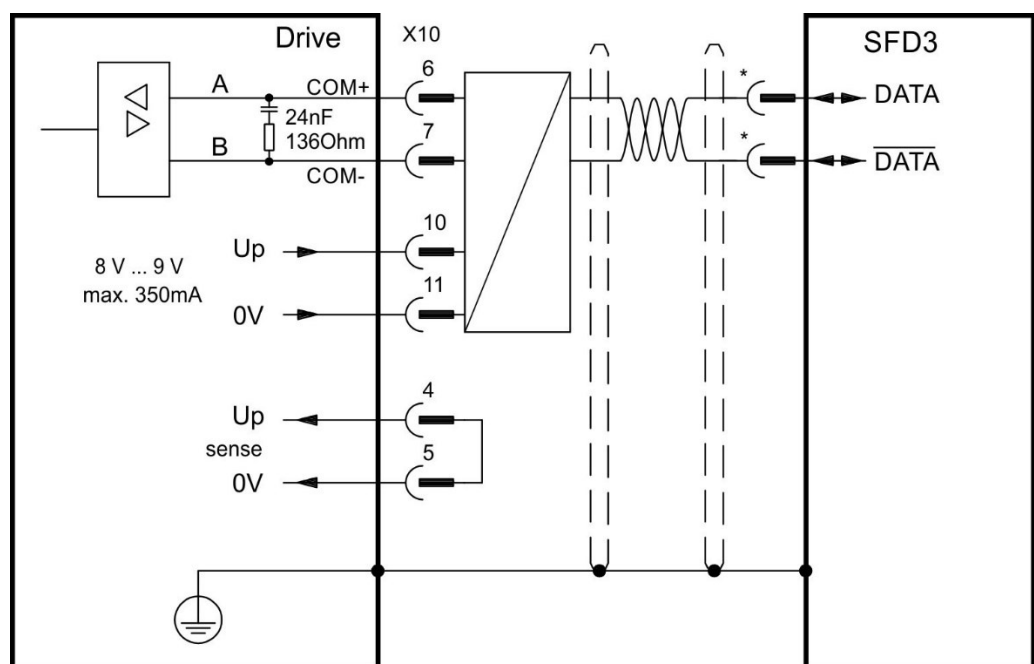
*= for PSD with "NB" (rev 8+) only

5.14.2 SFD3

The diagram below shows the connection of the two wire Emerson SFD3 feedback system. SFD3 can be used with the special Emerson cable. Maximum cable length is up to 25 m.

Type	FCTYPE	Up	Remarks
SFD3	45	8 to 9 V	from FW 1.11,with Emerson Cables only



Figure 47: SFD3



*For pin assignment on the motor side, refer to the motor documentation.

5.15 LED display

The LED seven-segment display indicates the status of the drive after the 24 V supply is switched on. If the service connection to the PC or to the PAC doesn't work, then the LED display is the only way to get information.

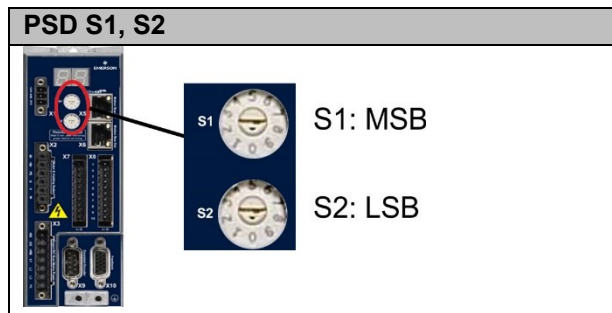
PSD two digits	PSD two + one digits
	
<p>PSD fault codes or warning codes are displayed constantly if present. Fault messages are coded with "F" or "E", warnings are coded with "n". The IP address can be flashed across the LED display if the B1 button is pressed.</p>	<p>The two digits LED display indicates the PSD messages. Fault messages are coded with "F", warnings are coded with "n".</p> <p>The one digit LED indicates the PSD messages of the PSD. Error messages are coded with "E", warnings (alarms) are coded with "A". Status of application programs are indicated as well. With push-buttons B2 and B3 a menu with several functions can be</p>

See PACMotion Workbench Online help for details.

Display Codes (overview)	Status
o0, o1, o2 ...	Normal operation, operation mode 0 or 1 or 2 ..., no faults
Fx	Fault (see (→ # 197)
nx	Warning (see (→ # 197)
IPx	Displaying drive IP address
--	Powered on and FPGA loading. If continuous then operational and resident FPGA images are corrupt.
[.]	Drive enabled
[.] (flashing)	Drive in an internal dynamic brake mode (DRV.ACTIVE =
dx	Firmware download

5.16 Rotary Switches (S1, S2)

Rotary switches can be used to select IP address or predefined functions for executing.



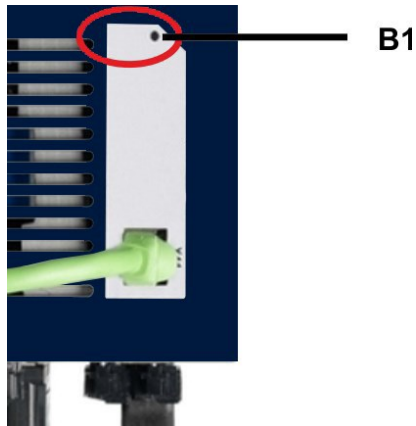
5.16.1 Rotary Switches S1 and S2 with PSD Drives

S	S	Function	Set while	Remarks
0	0	DHCP IP	24 V is OFF	The drive acquires its IP address from an external DHCP server, details see (→ #
x	y	Static IP	24 V is OFF	The IP address is 192.168.0.nn, valid values are 01 to 99, details see (→ # 174).

5.17 Push-Buttons (B1, B2, B3)

The push-buttons can be used to start predefined functions.

Figure 48: B1, B2, B3

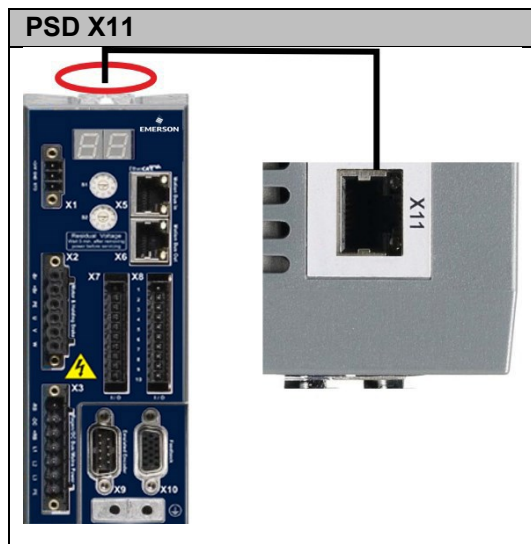


5.17.1 Push-Button B1 with PSD Drives

Function	Push button	Remarks
Display IP address	B1	Press short to display the IP address in the two digit display
Switches Drive Type of IC830DP***CC model	B1	Set rotary switches S1 to 8 and S2 to 9. Press B1 for 3 sec to switch over from CAN to EtherCAT or reverse.

5.18 Service Interface (X11)

Operating, position control, and motion-block parameters can be set up by using the setup software on an ordinary commercial PC (→ # 189).



Connect the service interface (X11) of the drive to an Ethernet interface on the PC directly or via a network hub/switch, **while the supply to the equipment is switched off**.

Use standard Cat. 5 Ethernet cables for connection (in some cases crossover cables will also work).

Confirm that the link LED on the PSD (the green LED on the RJ45 connector) and on your PC (or network Hub/Switch) are both illuminated. If both lights are illuminated, then you have a good electrical connection.

Color	Name	Indication
Green	Link	On = receive signal valid
Yellow	Activity	Blink = Transmit or Receive packet

5.18.1 Pinout X11

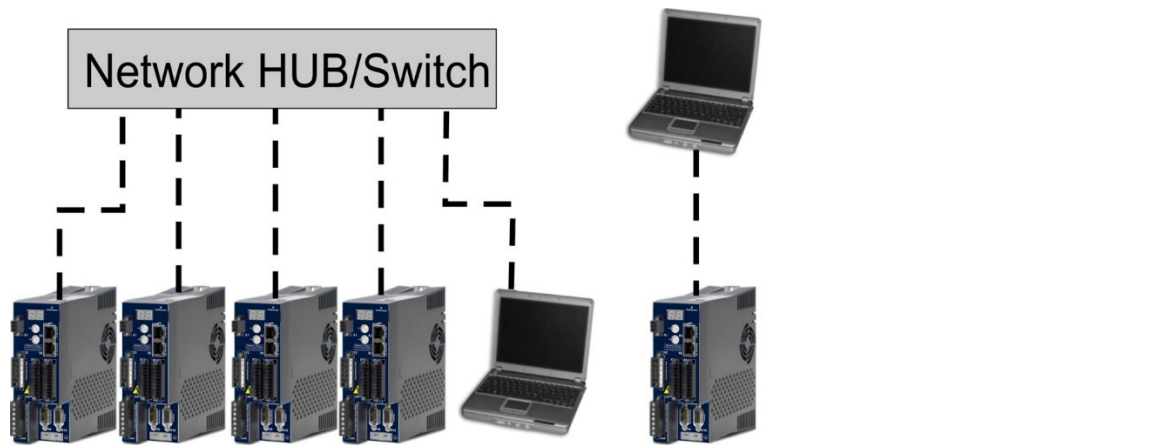
Pin	Signal	Pin	Signal
1	Transmit +	5	n.c.
2	Transmit -	6	Receive-
3	Receive+	7	n.c.
4	n.c.	8	n.c.

5.18.2 Service Bus Protocols X11

Protocol	Type	Connector
Modbus TCP	Service Bus	X11
Ethernet TCP/IP	Service Bus	X11

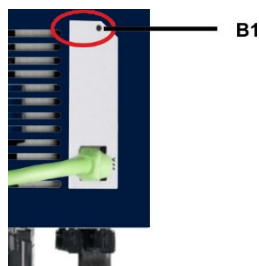
5.18.3 Possible Network Configurations

Figure 49: Network Configuration Example



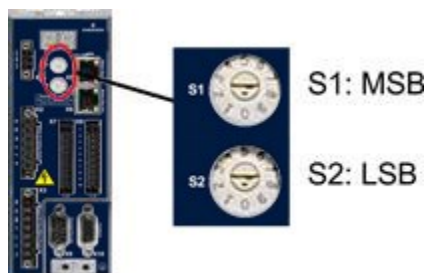
5.18.4 Setting the IP Address IC830DP

Figure 50: Setting IP Address



The IP address can be flashed across the LED display if the B1 button is pressed.

You can use the rotary switches to set the IP address of the PSD. For some fieldbuses, the rotary switches also set the node address of the drive for that specific network.



Rotary Switch	Drive IP Address
00	DHCP/AutoIP address. The IP address of the drive is obtained from the DHCP server on your network. If no DHCP server is found the IP addresses is an AutoIP address (it is internally generated following the AutoIP protocol and will be of the form 169.254.xx.xx).
01 to 99	Static IP Address. The IP address is 192.168.0.nn, where nn is the number from the rotary switch. This setting generates addresses in a range from 192.168.0.1to 192.168.0.99. Example:if S1 is set to 2 and S2 is set to 5 – the IP address is 192.168.0.25

The PC subnet mask must be set to 255.255.255.0 or 255.255.255.128 When connecting the PSD directly to a PC, use static IP addressing (not 00).

Static IP addressing

When connecting the drive directly to a PC, static IP addressing must be used. Set rotary switches S1 and S2 to a number different from 00 (see table above).

Dynamic IP addressing (DHCP and Auto-IP)

With S1 and S2 both set to 0, the drive is in DHCP mode. The drive will acquire its IP address from an external DHCP server if present in the network. If a DHCP server is not present, the drive will assume an Automatic Private IP Address of the form 169.254.x.x.

If your PC is directly connected to the drive, and set to obtain an IP address automatically in the TCP/IP settings, a connection will be established with both devices using compatible automatically generated addresses. It can take up to 60 seconds for a PC to configure an Automatic Private IP Address (169.254.x.x).

Changing the IP address

If the switches are altered while 24 V Logic power is supplied to the drive, you must switch off and then switch on again the 24 V supply voltage. This action will reset the address.

IP address mode

By default, the drive utilizes the method described above to acquire its IP address. A method of setting the IP address independent of the Rotary switches is available. More information is available in the PACMotion *Workbench Online Help* or in the Settings Screen-> Fieldbus-> TCP/IP screen in PACMotion Workbench.

Recovering Communications with a Drive on an Un-Reachable IP Address

If IP.MODE has been set to 1 (using software defined static IP), the drive will boot up on an IP Address that may be unreachable with the host computer's settings.

If the IP address prevents communication, the IP settings can be reset to default by the following procedure:

Set both rotary switches to 0

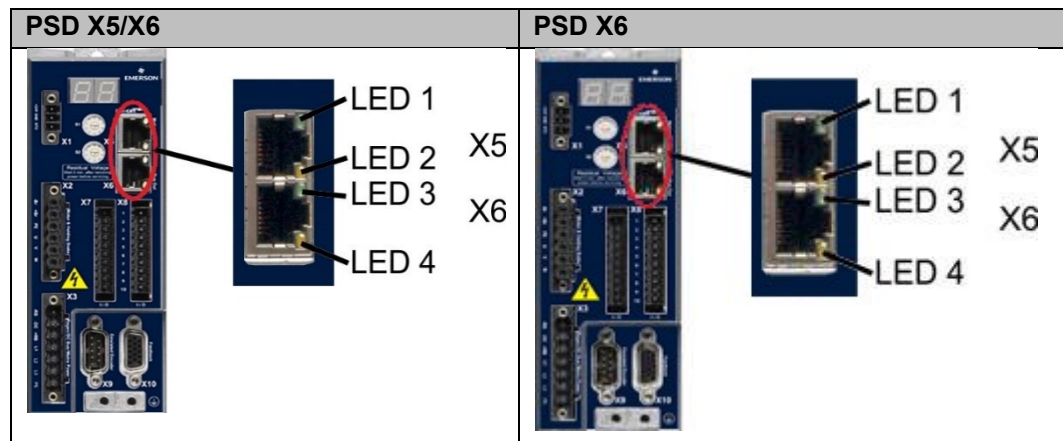
Hold down button B1 (top-side of drive) for 5 seconds.

The display will flash 0.0.0.0 and then attempt to discover an address by DHCP.

Without removing logic power from the drive, use PACMotion Workbench to connect to the drive, reconfigure the IP address settings as desired, and store the values to non-volatile memory.

5.19 EtherCat Interface (X5/X6/EtherCat)

The motion bus interface has RJ-45 connectors and can be used for communicating with various fieldbus devices depending on the used drive version.



Note: Do not connect the Ethernet line for the PC or PAC with the set up software to the motion bus interface X5/X6.

The set up Ethernet cable must be connected to X11.

Color	Name	Indication
Green	Link	On = receive signal valid
Yellow	Activity	Blink = Transmit or Receive packet

5.19.1 Pinout X5, X6, X11

Pi	Signal X5	Signal X6	Signal X11
1	Transmit +	Receive+	Transmit +
2	Transmit -	Receive-	Transmit -
3	Receive+	Transmit +	Receive+
4,	n.c.	n.c.	n.c.
6	Receive-	Transmit -	Receive-
7,	n.c.	n.c.	n.c.

5.19.2 Bus Protocols X5, X6, X11

Protocol	Type	Connectivity	Connec
EtherCAT	Motion	EC or CC	X5, X6

5.19.3 EtherCAT

PSD drives (connection variants EC) can be connected as slaves to the EtherCAT network (CoE) via RJ-45 connectors X5 (in port) and X6 (out port). The communication status is indicated by the built-in connector LEDs.

Drive variant	Connector	LED	Name	LED function	LED function
PSD	X5	LED1	Link In	active	not active
		LED2	Run	running	not running
PSD and PSD PDMM	X6	LED3	Link Out	active	not active
		LED4	-	-	-

Section 6 PSD Setup

6.1 Important Notes

Note: Only professional personnel with extensive knowledge in the fields of electrical engineering and drive technology are allowed to test and set up the drive.

DANGER

LETHAL VOLTAGE!

There is a danger of serious personal injury or death by electrical shock. Lethal danger exists at live parts of the device.

Built-in protection measures such as insulation or shielding may not be removed. Work on the electrical installation may only be performed by trained and qualified personnel, in compliance with the regulations for safety at work, and only with switched off mains supply, and secured against restart.

WARNING

AUTOMATIC RESTART!

Risk of death or serious injury for humans working in the machine. The drive might restart automatically after power on, voltage dip or interruption of the supply voltage, depending on the parameter setting. If parameter DRV.ENDEFAULT is set to 1, then place a warning sign ("WARNING: Possible Automatic Restart" or similar) to the machine.

Ensure, that power on is not possible, while personnel are in a dangerous zone of the machine.

CAUTION

HIGH TEMPERATURE!

Risk of minor burns. The heat sink of the drive can reach temperatures up to 80°C in operation.

Check the heat sink temperature before handling the drive.

Wait until the heat sink has cooled down to 40°C before touching it.

Note: If the drive has been stored for more than 1 year, you must re-form the capacitors in the DC bus link circuit. Re-forming procedures are described in 2.3.1, *Capacitor Storage* .

Note: Additional information on setting up the equipment:

Programming parameters and control loop behavior are described in the online help of the setup software.

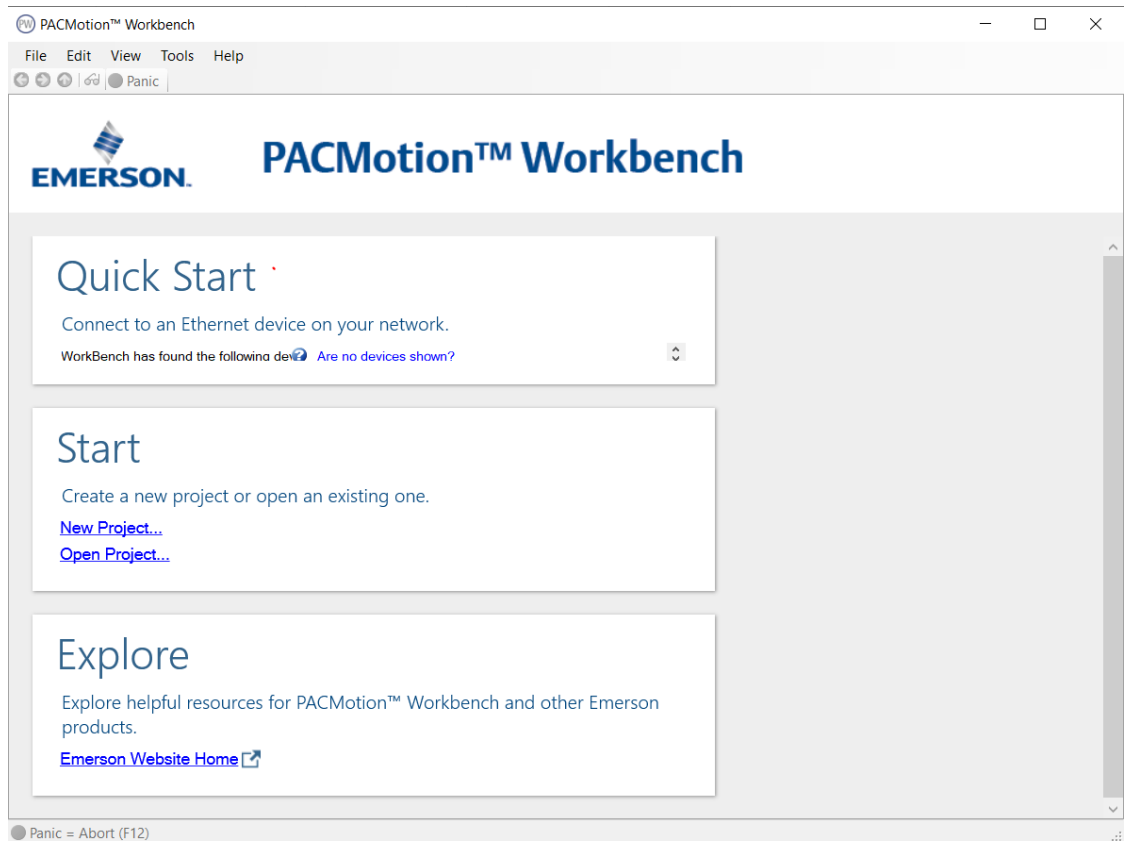
The setup of any fieldbus is described in the corresponding manual on the DVD.

6.2 Setup of PSD Drives

6.2.1 Setup software Workbench

This chapter describes the installation of the setup software PACMotion™ Workbench for PSD Drives.

Figure 51: PACMotion Workbench



Emerson offers training and familiarization courses on request.

6.2.2 Use as directed

The setup software is intended to be used for altering and saving the operating parameters for the PSD series of drives. The attached drive can be set up with the help of this software, and during this procedure the drive can be controlled directly by the service functions.

Only professional personnel who have the relevant expertise (→ # 14) are permitted to carry out online parameter setting for a drive that is running.

Sets of data that have been stored on data media are not safe against unintended alteration by other persons. Unexpected move could be the result if you use unchecked data. After loading a set of data you must therefore always check all parameters before enabling the drive.

6.2.3 Software description

Each drive must be adapted to the requirements of your machine. For most applications, you can use a PC and PACMotion Workbench (the drive setup software) to set up the operating conditions and parameters for your drive. The PC is connected to the drive by an Ethernet cable (→ # 172). The setup software provides the communication between the PC and PSD. You can find the setup software on the accompanying DVD and in the download area of the Emerson website.

With very little effort you can alter parameters and instantly observe the effect on the drive, since there is a continuous (online) connection to the drive. You can also read important actual values from the drive, which are displayed on the monitor of the PC (oscilloscope functions).

You can save sets of data on data media (archiving) and load them into other drives or use them for backup. You can also print out the data sets.

Most standard feedbacks (SFD3, BiSS, and HIPERFACE DSL) are plug-and-play compatible. Motor nameplate data is stored in the feedback device and read by the drive automatically at startup. Non-plug and play Emerson motors are stored in PACMotion Workbench and can be loaded with one-click using the Motor screen in the PACMotion Workbench software.

An extensive online help with integrated description of all variables and functions supports you in each situation.

6.2.4 Hardware requirements

The Service interface (X11, RJ45) of the drive is connected to the Ethernet interface of the PC by an Ethernet cable (→ # 172).

Minimum requirements for the PC:

- Processor: at least 1GHz
- Graphics adapter : Windows compatible, color RAM: 500 MB
- Drives : hard disk with at least 500 MB free space, DVD drive Interface : one free Ethernet Interface, or a Hub port or Switch port

6.2.5 Operating systems

Windows 7/8/10

PACmotion Workbench Version	OS	.Net Framework	Internet Explorer
2.4.x.x	Windows 7 (x86/x64)	4.8	10 or higher
	Windows 8 (x86/x64)		
	Windows 10 (x86/x64)		
2.0.0.x	Windows 7 (x86/x64)	4.6.1	10 or higher
	Windows 8 (x86/x64)		
	Windows 10 (x86/x64)		

Unix, Linux


The functioning of the software has not been tested for Windows running with Unix or Linux

6.2.6 Installation under Windows 7/8/10

The DVD includes an installation program for the setup software.

Installation of PACMotion Workbench

From PAC Machine Edition

From the Utility section in the ribbon bar, the user can select the **PACMotion Workbench**  button to start the application. If Workbench is not installed on the user's machine, a dialog window will appear with a link to Emerson's Customer Center. From there, the user can locate and download a licensed copy of PACMotion Workbench.

From DVD

Workbench installs automatically from the DVD included with the drive. Workbench is also available on the Emerson support site. (Links are provided at the end of this manual.)

Once the installation is complete, click the Workbench icon to start the program. Workbench will show a list of all the drives that it can find on your local network. Select the drive you wish to configure and then click **Next**.

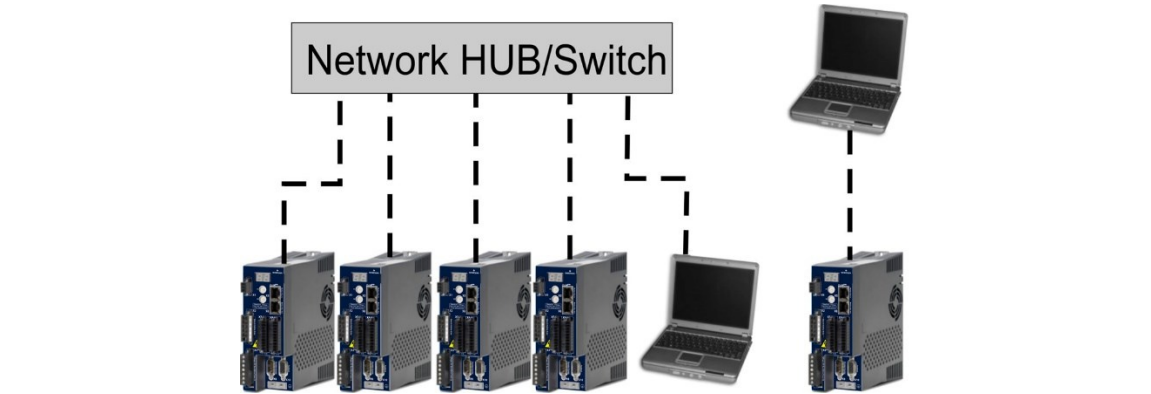
If multiple drives are detected, a drive can be uniquely identified using one of the following methods:

1. The MAC address of the drive. This address is printed on the sticker on the side of the drive.
2. The name of the drive. The drive name is set using Workbench. A new drive defaults to "No_Name."
3. Blinking the display. Select a drive and click **Blink** to force the display on the front of the drive to blink on and off for 20 seconds.

Connection to the Ethernet interface of the PC

Connect the interface cable to an Ethernet interface on your PC or to a Hub/Switch and to the service interface X11 of the PSD (→ # 172).

Figure 52: Connection to the Ethernet Interface of the PC



6.2.7 Initial Drive Test of the PSD

Unpacking, mounting, and wiring the PSD

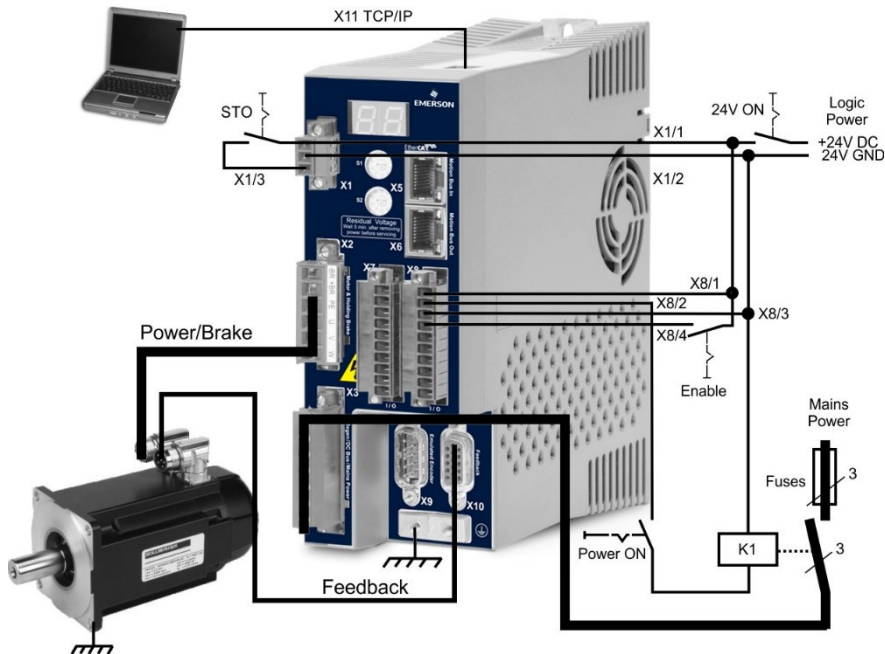
- Unpack the drive and accessories.
- Observe the safety instructions in the documentation.
- Mount the drive.
- Wire the drive or apply the minimum wiring for drive testing as described below.
- Make sure you have on hand the following information about the drive components:
 - rated mains supply voltage
 - motor type (motor data, if the motor type is not listed in the motor database)
feedback unit built into the motor (type, poles/lines/protocol)
 - moment of inertia of the load

Minimum wiring for drive test without load

Note: This wiring diagram is for general illustration only and does not fulfill any requirements for EMC, safety, or functionality of your application.

When connecting the PSD directly to a PC, static IP addressing (not 00) is recommended.

Figure 53: Minimum Wiring for Drive Test without Load



Set IP address

Set the drive IP address as described in (→ # 174).

Confirm connections

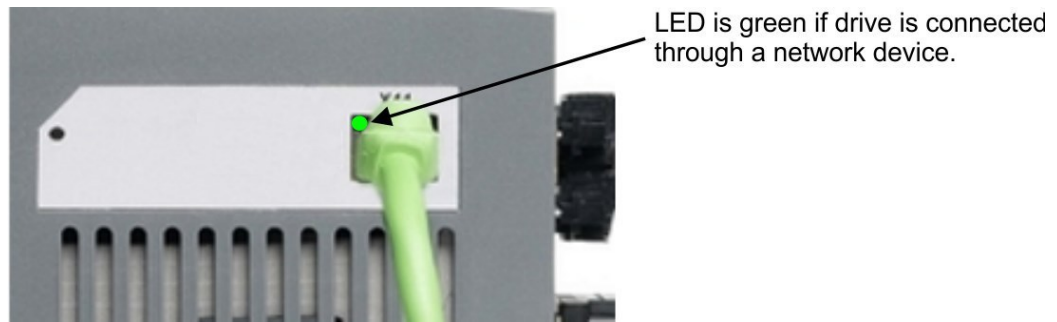
You can turn on logic power to the drive through the X1 connector (bus voltage is not needed for communications).

After power is supplied, the drive displays a sequence of LED flashes:

1. –
2. []
3.] [
4. I-P
5. Drive IP address, flashed sequentially (for example, 192.168.0.25).
6. Drive status (opmode "o0", "o1", or "o2") or fault code if the drive is in a fault condition.

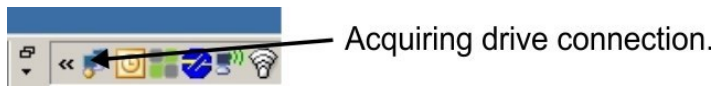
Confirm that the link LEDs on the drive (green LED on the RJ45 connector) and on your PC are both illuminated. If both LEDs are illuminated, then you have a working electrical connection.

Figure 54: LED



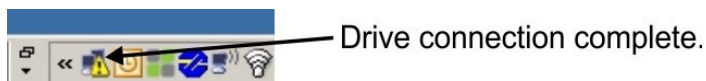
While the PC is connecting, your status bar will show the following acquiring icon:

Figure 55: Status Bar - Acquiring Connection



Wait for this icon to change to the limited functionality icon (this process can take up to one minute).

Figure 56: Status Bar – Connection Complete



Although Windows displays this limited functionality icon for the drive connection, the PC can communicate fully with the drive. Using PACMotion Workbench, you can now configure the drive through this connection.

Set drive IP address in PACMotion Workbench

If PACMotion Workbench does not automatically show your drive, then you can set the IP address manually in Workbench as follows:

1. Display the IP address. You can show the drive IP address on the drive display by pressing button B1. The display shows the digits and dots of the IP address in sequence (for example, 192.168.0.25).

Figure 57: B1 Button



2. Enter the drive IP address. Once the IP address has been determined, manually enter the drive IP address into the **Specify Address** box in Workbench. Then click **Next** to connect.

Enable the drive using the setup wizard

Once a connection to the drive has been established, the PSD Overview screen appears. Your drive appears in the navigation area on the left of the screen. Right click on your drive name and select **Setup Wizard** from the drop-down menu. The Setup Wizard guides you through the initial drive configuration, which includes a simple test motion.

After completing the Setup Wizard, your drive should be enabled. If the drive is not enabled, check the following:

3. The hardware enable (HW) must be in the enabled state (pin 4 on X8 connector).
4. The software enable (SW) must be in the enabled state. Activate using the **Enable/Disable** button on the upper toolbar on Workbench or in the Overview screen.
5. No faults may be present (click the **Clear Fault** button on the upper tool bar to clear any faults).

The status of HW enable, SW enable, and Faults is displayed in the lower toolbar of the Workbench software. The drive is connected if the lower right corner shows **Online**.

You can now use the Settings View in Workbench to complete advanced configuration of your drive.

6.3 Fault and Warning Messages

6.3.1 Fault and warning messages from the PSD



PSD fault codes or warning codes are displayed constantly if present. Fault messages are coded with "F", warnings are coded with "n".

When a fault occurs, the drive fault relay is opened, the output stage is switched off (motor loses all torque), or the load is dynamically braked. The specific drive behavior depends on the type of fault. The LED display on the front panel of the drive shows the number of the fault that occurred. If a warning is issued prior to the fault, the warning is shown on the LED and has the same number as the associated fault. Warnings do not trip the power stage of the drive or fault relay output.

The left side of the LED displays F (or E) for a fault or n for a warning. The right side displays the fault or warning number as follows: 1-0-1-[break]. The highest priority fault is displayed. Multiple faults may be present when a fault condition is occurring. Check the PACMotion Workbench Fault Screen or read the status of DRV.FAULTS through the controller or HMI for the entire list of faults.

Note: Eliminate errors and faults in compliance with work safety rules. Troubleshooting only by qualified and trained staff.

Note: More information about fault messages, remedy and clearing faults can be found in the PACMotion Workbench Online Help.

Code	Message/Warning
..	24V power (X1) overload or 5V (X9) shorted
F0	Reserved.
F101, n101	Firmware incompatible. The FPGA is a laboratory FPGA.
F102, n102	Resident firmware failed. Operational FPGA is not a default FPGA.
F103	Resident FPGA failed.
F104	Operational FPGA failed.
F105	Non-volatile memory stamp invalid.
F106	Non-volatile memory data.
n107	Positive limit switch triggered.
n108	Negative limit switch triggered.
F120	Failed to default parameters.
F121	Homing error.
F123, n123	Invalid motion task.
F124	Cogging Compensation non volatile memory data error (CRC).
F125, n125	Fieldbus synchronization frames lost.
F126, n126	Bode plot: too much movement.
F127	Incomplete emergency procedure.
F128	MPOLES/FPOLES not integer.
F129	Fieldbus Heartbeat lost.
F130	Secondary feedback supply over current.
F131	Secondary feedback A/B line break.
F132	Secondary feedback Z line break.
F133	Fault number changed to F138.
F134	Secondary feedback illegal state.
F135, n135	Fault on feedback 2 prevents remote commutation on feedback 1.
F136	Firmware and FPGA versions are not compatible.

Code	Message/Warning
n137	Homing and feedback mismatch.
F138	Instability during autotune.
F139	Target position overshoot due to invalid motion task activation.
n151	Not enough distance to move; motion exception.
n152	Not enough distance to move; following motion exception.
n153	Velocity limit violation, exceeding max limit.
n154	Following motion failed; check motion parameters.
n156	Target position crossed due to stop command.
n157	Homing index pulse not found.
n158	Homing reference switch not found.
n159	Failed to set motion task parameters
n160	Motion task activation failed.
n161	Homing procedure failed.
n163	MT.NUM exceeds limit.
n164	Motion task is not initialized.
n165	Motion task target position is out.
n167	SW limit switch traversed
n168	Invalid bit combination in the motion task control word.
n169	1:1 profile cannot be triggered on the fly.
n170	Customer profile table is not initialized.
n171	Motion task activation is currently pending
n174	Homing maximum distance exceeded
n179	Teaching of cogging compensation stopped before finishing.
n180	Cogging compensation not active. Axis needs to be homed first.
F201	Internal RAM failed.
F202	External RAM failed.
F203	Code integrity failed.
F204 to F232	EEPROM failure detected
F234 to F237	(n234 to n237) Temperature sensor high.
F240 to F243	(n240 to n243) Temperature sensor low.
F245	External fault.
F247	Bus voltage exceed allowed thresholds.
F248	Option board EEPROM corrupted.
F249	Option board downstream checksum.
F250	Option board upstream checksum.
F251	Option board watchdog.
F252	Firmware and option board FPGA types are not compatible.
F253	Firmware and option board FPGA versions are not compatible.
F256, n256	Analog Input, overvoltage
F257, n257	Analog Input, undervoltage
F301, n301	Motor overheated.
F302	Over speed.
F303	Run away.
F304, n304	Motor foldback.
F305	Brake open circuit.
F306	Brake short circuit.
F307	Brake applied during enable state.
F308	Voltage exceeds motor rating.
n309	Motor I ² t load.
F312	Brake released when it should be applied.
F401	Failed to set feedback type.
F402	Analog signal amplitude fault.
F404	Illegal Hall state (111, 000).
F405	BiSS watchdog fault.
F406	BiSS multicycle fault.
F407	BiSS sensor fault.
F408 to F416	SFD feedback fault.
F417	Broken wire in primary feedback.

Code	Message/Warning
F418	Primary feedback power supply.
F419	Encoder init procedure failed
F421	SFD position sensor fault
F423	Non volatile memory failure - Extended Multiturn
F438, n438	Deviation from predicted trajectory fault.
F439, n439	Following error (magnitude).
F450	Following error (presentation).
F451, n451	Tamagawa encoder: battery.
F452	Extended multiturn not supported with this feedback.
F453 to F459	Tamagawa encoder: communication.
F460	Tamagawa encoder: over speed.
F461	Tamagawa encoder: counting Error.
F462	Tamagawa encoder: counting overflow.
F463	Tamagawa encoder: overheat.
F464	Tamagawa encoder: multiturn error.
F465	Excessive shock detected by feedback device.
F467	Feedback fault on feedback 1 (see FB1.FAULTS for details). In case of BiSS: communications.
F468	FB2.SOURCE not set, remote commutation not possible.
F469	FB1.ENCRES is not power of two, remote commutation not possible.
F470	Feedback fault on feedback 3.
F471	Operation in Position Mode with Halls Only feedback not allowed.
F473	Wake & Shake - Insufficient movement
F475	Wake & Shake - Excess movement.
F476	Wake & Shake - Fine-coarse delta too large.
F478, n478	WWake & Shake - Over speed.
F479, n479	Wake & Shake - Loop angle delta too large.
F480	Wake & Shake - Fieldbus command velocity too high.
F481	Wake & Shake - Fieldbus command velocity too low.
F482	Wake & Shake - Commutation not initialized.
F483	Wake & Shake - Motor U phase missing.
F484	Wake & Shake - Motor V phase missing.
F485	Wake & Shake - Motor W phase missing.
F486	Input change rate exceeds maximum speed of emulated encoder.
F487	Wake & Shake - Validating positive movement Failed.
F489	Wake & Shake - Validating negative movement Failed.
F490	Wake & Shake - Validating commutation angle timed out.
F491	Wake & Shake - Validating commutation angle moved too far - bad comm angle.
F492	Wake & Shake - Validating commutation angle required more than MOTOR.ICONT.
F493	Invalid commutation detected – motor accelerating in the wrong
n495	Failed to process recorded cogging compensation table.
F501, n501	Bus over voltage.
F502	Bus under voltage. Warning issued prior to fault.
F503	Bus capacitor overload.
F504 to F518	Internal supply voltage fault
F519	Regen short circuit.
F521, n521	Regen over power.
F523	Bus over voltage FPGA
F524, n524	Drive foldback.
F525	Output over current.

Code	Message/Warning
F526	Current sensor short circuit.
F527	Iu current AD converter stuck.
F528	Iv current AD converter stuck.
F529	Iu current offset limit exceeded.
F530	Iv current offset limit exceeded.
F531	Power stage fault.
F532	Drive motor parameters setup incomplete.
F534	Failed to read motor parameters from feedback device.
F535	Power-board over-temperature fail.
F541, n541	AC input phase 1 missing.
F542, n542	AC input phase 2 missing.
F543, n543	AC input phase 3 missing.
F560	Regen near capacity, could not prevent over voltage.
F570, n570	Mains phase loss.
n580	Using derivate of position with sensorless feedback type in position
n581	Zero velocity with induction sensorless feedback type in position mode.
n582	Velocity has been limited, commutation frequency max. 599 Hz to meet ECCN-3A225 / AL-3A225 limits.
F587	Loss of all AC input phases.
n601	Modbus data rate is too high.
F602	Safe torque off.
n603	OPMODE incompatible with CMDSOURCE
n604	EMUEMODE incompatible with DRV.HANDWHEELSRC.
F621	Control Board CRC fault.
F623	Power Board CRC fault.
F624	Power Board Watchdog fault.
F625	Power Board Communication fault.
F626	Power Board FPGA not configured.
F627	Control Board Watchdog fault.
F630	FPGA cyclic read fault.
F631	Issue command timed out.
F701	Fieldbus runtime.
F702, n702	Fieldbus communication lost.
F703	Emergency timeout occurred while axis should disable.
F706, n706	Fieldbus cyclic setpoints missing.

Section 7 Troubleshooting the PSD

Drive problems occur for a variety of reasons, depending on the conditions in your installation. The causes of faults in multi-axis systems can be especially complex. If you cannot resolve a fault or other issue using the troubleshooting guidance presented below, customer support can give you further assistance.

Note: Eliminate errors and faults in compliance with work safety rules. Troubleshooting only by qualified and trained staff.

Note: ore information about error messages, causes, remedy and clearing errors can be found in the Workbench online help.

Problem	Possible Causes	Remedy
HMI message: Communication fault	<ul style="list-style-type: none"> Wrong cable used, cable plugged into wrong position on drive or PC Wrong PC interface selected 	<ul style="list-style-type: none"> Plug cable into the correct sockets on the drive and PC Select correct interface
Drive does not enable	<ul style="list-style-type: none"> HW Enable not wired HW or SW Enable not set 	<ul style="list-style-type: none"> Connect HW Enable (X8 pin 4) Apply 24V to HW Enable and select SW Enable in WorkBench / Fieldbus
Motor does not rotate	<ul style="list-style-type: none"> Drive not enabled Software enable not set Break in setpoint cable Motor phases swapped Brake not released Drive is mechanically blocked Motor pole no. set incorrectly Feedback set up incorrectly 	<ul style="list-style-type: none"> Apply ENABLE signal Set software enable Check setpoint cable Correct motor phase sequence Check brake control Check mechanics Set motor pole no. Set up feedback correctly
Motor oscillates	<ul style="list-style-type: none"> Gain is too high (speed controller) Feedback cable shielding broken AGND not wired up 	<ul style="list-style-type: none"> Reduce VL.KP (speed controller) replace feedback cable Join AGND to CNC-GND
Drive reports following error	<ul style="list-style-type: none"> Lrms or Ipeak set too low Current or velocity limits apply Accel/decel ramp is too long 	<ul style="list-style-type: none"> Verify motor/drive sizing Verify that IL.LIMITN/P, VL.LIMITN/P are not limiting the drive Reduce DRV.ACC/DRV.DEC
Motor overheating	<ul style="list-style-type: none"> Motor operating above its rating Motor current settings incorrect 	<ul style="list-style-type: none"> Verify motor/drive sizing Verify motor continuous and peak current values are set correctly

<p>Drive too soft</p>	<ul style="list-style-type: none"> • Kp (speed controller) too low • Ki (speed controller) too low • filters set too high 	<p>increase VL.KP (speed controller) increase VL.KI (speed controller) refer to documentation regarding reducing filtering (VL.AR*)</p>
<p>Drive runs roughly</p>	<ul style="list-style-type: none"> • Kp (speed controller) too high • Ki (speed controller) too high • Filters set too low 	<ul style="list-style-type: none"> • Reduce VL.KP (speed controller) reduce VL.KI (speed controller) • Refer to documentation regarding increasing filtering (VL.AR*)
<p>During installation, the message “Please wait while the installer finishes determining your disk space requirements” appears and never disappears.</p>	<ul style="list-style-type: none"> • MSI installer issue. • Harddisk space not sufficient 	<ul style="list-style-type: none"> • Cancel the installation and relaunch the installer (you may need to try several times, the problem is random). • Make sure that you have enough disk space on your hard disk (~500MB).

General Contact Information

Home link: <http://www.emerson.com/industrial-automation-controls>

Knowledge Base: <https://www.emerson.com/iac-support>

Technical Support

Americas

Phone: 1-888-565-4155
1-434-214-8532 (If toll free option is unavailable)

Customer Care (Quotes/Orders>Returns): customercare.mas@emerson.com
Technical Support: support.mas@emerson.com

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Customer Care (Quotes/Orders>Returns): customercare.cn.mas@emerson.com
Technical Support: support.mas.apac@emerson.com

Any escalation request should be sent to: mas.sfdcescalation@emerson.com

Note: If the product is purchased through an Authorized Channel Partner, please contact the seller directly for any support.

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