Kollmorgen Essentials Drive

3, 6, 12 Amp Single-Axis Servo Drive with Functional Safety Option 1, STO - SIL2

Installation Manual, English

Manual Edition: A (BETA VERSION), March 2025

Safety Edition: BETA VERSION, March 2025

Valid for Kollmorgen Essentials Drive Hardware Revision A (BETA VERSION)

Part Number XX

Original Document

For safe and proper use, follow these instructions.
Keep for future use.

KOLLMORGEN

A REGAL REXNORD BRAND

Record of Document Revisions

Edition	Remarks
A, WIP	First edition
...	Table with lifecycle information of this document (➜ # 1)

Hardware Revision (HR)

Kollmorgen Essentials Drive	Firmware	WorkBench	KAS-IDE	Remarks

Trademarks

- Regal Rexnord and Kollmorgen are trademarks of Regal Rexnord Corporation or one of its affiliated companies.
- Kollmorgen Essentials Drive is a registered trademark of Kollmorgen Corporation.
- SafeMotion is a registered trademark of Kollmorgen Corporation.
- EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
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- SIMATIC is a registered trademark of SIEMENS AG.
- Windows is a registered trademark of Microsoft Corporation.

Current patents

- US Patent 2017/0211640A1 (method and apparatus for power saving, fail-safe control of an electromechanical brake)
- US Patent 10,840,696 (method and apparatus for limiting the output voltages of switching mode power supplies)
- US Patent 81,542,28 (Dynamic Braking For Electric Motors)
- US Patent 82,140,63 (Auto-tune of a Control System Based on Frequency Response), patent expired
- US Patent 10,374,468 (System and method for improved DC power line communication)
- US Patent 10,520,050 (Method and apparatus for power-saving, fail-safe control of an electromechanical brake)
- US Patent 10,840,696 (Method and apparatus for limiting the output voltages of switch mode power supplies)

Patents referring to fieldbus functions are listed in the matching fieldbus manual.

Technical changes which improve the performance of the device may be made without prior notice!

Table of Contents

1   Welcome to Kollmorgen Essentials

This section should provide an overview of what Kollmorgen Essentials is,

Ease of use

Components

Compliance when the drive is used in the system with an Essentials motor and cable.

2   General

2.1   About this Installation Manual

This Installation Manual describes the Kollmorgen Essentials Drive series of digital drives and includes information to safely install the product.
Manual updates can be downloaded from the Kollmorgen website (www.kollmorgen.com).

Product information for use consists of:

- *Safety Notes*: Multilingual document with safety information, part of product delivery in Europe, printed on paper DIN A5.
- *Installation Manual*: Describes the product series of digital drives and includes information to safely install it. Contact Kollmorgen customer support for a free printed copy of the installation manual.
- *WorkBench Online Help:* Describes how to use your drive in common applications. It also provides tips for maximizing the system performance with your product. The *Online Help* includes the *Parameter and Command Reference Guide* which provides information for the parameters and commands used to program your drive.
- *EtherCAT® Communication*: Describes how to use your drive in EtherCAT applications.
- *EtherNet/IP™ Communication*: Describes how to use your drive in EtherNet/IP applications.
- *PROFINET® Communication*: Describes how to use your drive in PROFINET applications.
- *Accessories Manual*: Provides information for accessories like cables and regen resistors used with your product. Regional variants of this manual exist.

2.2   Symbols Used

2.2.1 Warning Symbols

Symbol	Indication
⚠ DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates situations which, if not avoided, could result in property damage.
NOTE	This symbol indicates important notes.
	High Noise Pollution. The type of danger is specified by the text next to the symbol.
	Warning of a danger (general). The type of danger is specified by the text next to the symbol.
	Warning of danger from electricity and its effects.
	Warning of danger from hot surface.
	Warning of danger from suspended loads.
	Warning of danger from automatic start.
	Warning of danger from molten particle projection.

2.2.2 Drawing Symbols

Symbol	Description	Symbol	Description
⊥	Signal ground	◇	Diode
⏚	Chassis ground	⊐	Relay
⏚	Protective earth	■▬	Relay switch off delayed
⏷	Resistor	＼	Normally open contact
⏽	Fuse	⏽	Normally closed contact
🔥	State-of-the-art firewall	⎓	EMC filter

2.3   Abbreviations Used

Abbreviations related to functional safety (➜ # 106).

Abbreviation	Meaning
(→ # 53)	"see page 53" in this document
→ xyz	"see chapter xyz" in this document
Ω	Ohms
A#, AXIS#	A# or AXIS# are placeholders for the axis number. Used with parameters or signal names
AGND	Analog ground
AquadB	In quadrature output, used for incremental encoder emulation
AMSL	Above mean sea level
Axis	Depends on context, either one drive output stage or one load axis of the full motion system.
CAT	Category
CE	Communité Européenne
COM	Serial interface for a personal computer
DGND	Digital ground
EEPROM	Electrically erasable programmable memory
EEO	Emulated Encoder Output
EMC	Electromagnetic compatibility
EMF	Electromagnetic force
FS1, FS2, FS3	Functional Safety Option 1, 2, 3
FSoE	Fail safe over EtherCAT
KAS	Kollmorgen Automation Suite
KAS IDE	Setup software (Kollmorgen Automation Suite Integrated Development Environment)
KDN	Kollmorgen Developer Network
LED	Light-emitting diode
LSB	Low significant byte (or bit)
MSB	Most significant byte (or bit)
NI	Zero pulse
OSSD	Output Signal Switching Device
PE	Protective earth
PELV	Protective Extra Low Voltage
PLC	Programmable logic control
PWM	Pulse-width modulation
RAM	Random access memory (volatile memory)
RBrake/RB	Regen resistor (also called a brake resistor)
RBext	External regen resistor
RBint	Internal regen resistor
RCD	Residual current device
RES	Resolver
S1	Continuous operation
tbd	To be determined (in process)
VAC	Volts, alternating current
VDC	Volts, direct current

3 Product Safety

To avoid possible damage, read and follow the instructions.

3.1 You should pay attention to this

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

Specialist staff required!

The devices are intended for industrial applications.

Machine builders must employ qualified personnel. Qualified personnel are people who have been trained to transport, install, commission, and operate electrical drives.

- 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.

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.

Check Hardware Revision!

Check the Hardware Revision Number of the product (see product label). This number is the link between your product and the manual. The product Hardware Revision Number must match the Hardware Revision Number on the cover page of the manual.

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.

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.

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 the parameter AXIS#.ENDEFAULT is set to 1, then place a warning sign on the machine (Warning: Automatic Restart at Power On) and ensure, that power on is disabled, 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 .

ATTENTION: The drive can be ready to operate when 24V are applied to STO inputs.

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.

Hot surface!

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

Earthing!

Risk of electric shock! Ensure that the drive is safely earthed to the PE (protective earth) busbar in the switch cabinet. Without low-resistance earthing personal protection is at risk.

Leakage Current!

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

High voltages!

The equipment produces high electric voltages up to 900V. Lethal danger exists at live parts of the device. Do not open or touch the equipment during operation. Keep all covers and cabinet doors closed. 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 5 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.

Projection of molten particles!

If particles fall into the drive or the drive has been damaged, molten drive component particles may be ejected causing injuries. Shut down the drive and wear appropriate protective gear during maintenance work, troubleshooting and fault rectification. (➜ # 25)

Functional Safety!

You are responsible for the assessment of the safety functions according to EN 13849 or EN 62061.

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 Kollmorgen components meet these requirements.

Never modify the drive!

Never open the cover of the drive, as the electronic components installed there generate dangerous high voltages. Even after disconnection from the mains, the components often still carry high voltage.
Therefore, the drive may only be opened by authorized specialist personnel.

Kollmorgen can't be held accountable for any defects, malfunctions or degradations resulting from users opening up the device. In case of damage or malfunction, send the drive for repair or replacement.

High noise pollution!

Fans generate noise of up to 9076 dBA when operating at maximum load. This can lead to hearing damage. Keep the cabinet doors closed during operation. Use ear protection if the control cabinet has to be opened during servicing. The operator must provide ear protection and monitor its use depending on the daily noise exposure level determined.

3.2 Use as Directed

Use your Kollmorgen Essentials Drive exclusively with the Kollmorgen Essentials Motor and Cables.

The Kollmorgen Essentials Drives are exclusively intended for driving suitable synchronous servomotors with closed-loop control of torque, speed, and/or position.

Your drive is a component that is built into electrical plants or machines and can only be operated as integral component of these plants or machines. The manufacturer of the machine used with a drive must conduct a risk assessment for the machine. When the drive is built into a machine or plant, it must not be used until it has been established that the machine or plant fulfills the requirements of the regional rules, laws and regulations.

Cabinet and wiring

Only operate your device in a closed control cabinet suitable for the ambient conditions (➔ # 33). Make sure to keep the temperature within the cabinet within the acceptable limits with help of ventilation or cooling.

Only use 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, 2 or 3 phase (TN-S or TT) or DC industrial supply networks.

Drives in the Kollmorgen Essentials Drive series can be supplied as follows:

- KED-SPM-6V:
  1, 2 or 3 phase industrial supply networks: 120 V or 240 V_{AC} nominal.
  DC supply networks: 17 V_{DC} to 370 V_{DC}
- KED-SPM-6V:
  1, 2 or 3 phase industrial supply networks: 240 V, 400 V, or 480 V_{AC} nominal.
  DC supply networks: 34 V_{DC} to 740 V_{DC}.

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

Periodic overvoltage's between phases (L1, L2, L3) and the PE/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 PE/housing must not exceed 2000 V.

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 ($U_{nMotor} >= U_{DC}/\sqrt{2}$).

Functional Safety

NOTICE

- The network, to which the drive is connected, must be secured according to state-of-the-art information technology security requirements.
- The user IT specialists shall analyze whether further security requirements are applicable to ensure functional safety.

Review the chapter "Use as Directed" in the Functional Safety section before using safety functionality.

3.3 Prohibited Use

Other use than that described in the previous "Use as Directed" section 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 laws,
- rules,
- regulations and
- applicable 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

NOTICE   The drive must not be connected directly to the Internet. If the network, to which the drive is connected, is not secured according to state-of-the-art information technology, this could be a security risk.

3.4 Warning Note Labels

3.4.1 Notes placed on the product

Kollmorgen Essentials Drive			
Attention Before installing or servicing, refer to the installation manual and safety instructions.	**Residual Voltage** Wait 5 minutes after removing power before servicing.	**Hot Surface** Do not touch heatsink.	**Protective Earth** Always connect ground wire to terminal with this symbol.

3.4.2 Adhesive label in the package

NOTICE   Follow the instructions given on the adhesive labels in the package.
If a warning note label is damaged, it must be replaced immediately.

3.5 Shock-hazard Protection

3.5.1 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. Contact our application department for help to calculate the leakage current in your application.

NOTE	Since the leakage current to PE is more than 3.5mA, in compliance with IEC 61800-5-1 the PE connection must either be doubled or a connecting cable with a cross-section >10mm² must be used. Use the PE terminal and the PE connection screws in order to fulfill this requirement.

Use the following measures to minimize leakage currents:

- Reduce the length of the motor cable.
- Use low capacitance motor cables (→ # 47)

3.5.2 Residual current protective device (RCD)

In conformity with IEC 60364-4-41 – Regulations for installation and IEC 60204 – Electrical equipment of machinery, you can use residual current protective devices (RCDs) provided the requisite regulations are complied with.
The drive is a 3-phase system with a B6 bridge. Use RCDs which are sensitive to all currents in order to detect any DC fault 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 30 mA	Protection against "indirect contact" (personal fire protection) for stationary equipment

Recommendation:

Protect each drive individually using a 30mA RCD which is sensitive to all currents to secure against direct contact (with motor cables shorter than 5m).

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

3.5.3 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 drive can also be operated by using an isolating transformer. Use a ground-leakage monitor to detect short circuits.

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

3.6   Stop / Emergency Stop / Emergency Off

The control functions Stop, Emergency Stop, and Emergency Off are defined by IEC 60204.

Notes for functional safety aspects of these functions can be found in ISO 13849 and IEC 62061.

NOTE   The parameter AXIS#.DISMODE must be set to implement the different stop categories for software disabling. Consult the *WorkBench Online Help* for configuring the parameter.
Only STO (stop category 0) is a certified safety function.

⚠ **WARNING**   **Vertical load could fall!**

Serious injury could result when the load is not properly blocked. The internal brake function does not ensure functional safety.
- Functional safety, e. g. with hanging loads (vertical axis) requires one or more safe brakes, depending on required safety level. These brakes must be controlled by an external safe brake controller.
- The STO and Hardware Enable (if configured) do not initiate a controlled stop but switches off the power stage immediately.
- Set parameter AXIS#.MOTOR.BRAKEIMM to 1 with vertical axes, to apply the brake immediately after faults or Hardware Disable.
- Risk assessment of the application determines the necessary measures.

3.6.1 Stop

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

NOTE   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:

Stop Category 0

Shut-down by immediate switching-off the energy supply to the drive machinery (this is an uncontrolled shut-down).
For stop without using safety functions like STO, set AXIS#.DISMODE to 0.
The safety function STO stops the drive as required by Stop Category 0 (IEC 62061).

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.
To achieve this behavior, set AXIS#.DISMODE to 2.

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. Hardwired STO has always the highest priority.

If necessary, provision must be made for the connection of protective devices and lock-outs. A reset of the stop function must not create a hazardous situation.

3.6.2 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 fulfill 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.

3.6.3 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 (e.g., by protection against direct touching).

4   Product Life Cycle Handling

4.1 Transport

Transport the Kollmorgen Essentials Drive in accordance with IEC 61800-2 as follows:

- Transport only by qualified personnel in the manufacturer's original recyclable packaging.
- **NOTICE:** Avoid shocks while transporting.
- Vibration/Shock: Kollmorgen Essentials Drive is tested for environmental class 2M1 of IEC 60721-3-2.
- Store at or below maximum stacking height 8 cartons (see "Storage" (➔ # 22))
- 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 at +40°C, no condensation, class 2K3.

| **NOTICE** | 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.

4.2 Packaging

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

Model	Package (mm) HxWxL	Total Weight (kg)
KED6V03/KED-6V06	113 x 250 x 222	1.7
KED-6V12/KED-7V03	158 394 x 292	3.4
KED-7V06/KED-7V12	158 x 394 x 292	4.3

| **NOTE** | **Mating connectors**
- X10 (DC Input) and X3 (AC Input) are included with the "-A" at the end of the model number.
- X1 (motor power) and X23 (Motor feedback) are provided on the hybrid motor cable (purchased separately).
- X1, RJ45 and DB9 (9-pin D-sub) are always part of the used cables. |

Other connectors and cables need to be provided by the user.

4.3 Storage

Store the Kollmorgen Essentials Drive in accordance with EN 61800-2 as follows:

- Store only in the manufacturer's original recyclable packaging.
- Store at or below a maximum stacking height of 8 cartons.
- Store only within the specified temperature ranges:
  - -25 to +55 °C, max. rate of change 20 K/hour, class 1K4.
- Store only within the 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 described in the KDN (Forming).

4.4   Installation, Setup, and Normal operation

- Mechanical installation (➔ # 41)
- Electrical installation (➔ # 44)
- Setup (➔ # 86)

Normal operation tested for environmental class 3K3 according to EN 61800-2 (➔ # 33).
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.

4.5   Decommissioning

NOTICE   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.

1. Switch off the main switch of the switchgear cabinet.
2. Secure the system against restarting.
3. Block the main switch.
4. Wait at least 5 minutes after disconnecting.

4.6   Maintenance and Cleaning

The device does not require maintenance, it should be inspected once a year by professional staff.

NOTICE   Do not immerse or spray the device.
Avoid that liquid enters the device.
The inside of the unit can only be cleaned by the manufacturer.
Opening the device voids the warranty.

4.6.1 Cleaning Procedure

1. Decommission the device.
   See "Decommissioning" (➔ # 23).
2. Casing: Clean with Isopropanol or similar cleaning solution.
   CAUTION: 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.

4.7   Disassembly

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

1. Decommission the device.
   See "Decommissioning" (➔ # 23).
2. Check temperature.
   CAUTION: 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).
3. Remove the connectors.
   Disconnect the potential earth connection last.

4. Demount: Loosen the fastening screws.
   Remove the device.

4.8 System Repair

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

CAUTION: **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.

4.8.1 Exchange of the Device

Only the manufacturer can repair the device.

Opening the device or housing voids the warranty.

1. Decommission the device.
   See "Decommissioning" (➜ # 23).
2. Demount the device.
   See "Disassembly" (➜ # 23).
3. Send the device to the manufacturer.
   See "Disposal" (➜ # 25).
4. Install a new device as described in the Installation Manual.
5. Setup the system as described in the Installation Manual.

4.8.2 Exchange of Other Drive System Parts

Use this procedure if parts of the drive system (e.g., cables) must be replaced.

1. Decommission the device.
   See "Decommissioning" (➜ # 23).
2. Exchange the parts.
3. Check all connections for correct fastening.
4. Setup the system as described in the Installation Manual.

4.9 Disposal

NOTICE • To dispose the unit properly, contact a certified electronic scrap disposal merchant.

In accordance with the WEEE-2012/19/EU guideline and similar, the manufacturer accepts returns of old devices and accessories for professional disposal. The sender needs to cover the costs for the transport.

Contact Kollmorgen to clarify the logistics.

Send the device in the original packaging to the manufacturer address:

North America	South America
KOLLMORGEN 201 West Rock Road Radford, VA 24141, USA	**Altra Industrial Motion do Brasil** Equipamentos Industriais LTDA. Avenida João Paulo Ablas, 2970 Jardim da Glória, Cotia – SP CEP 06711-250, Brazil
Europe	**Asia**
KOLLMORGEN s.r.o Evropská 864664 42 Modřice, Brno Czech Republic	**KOLLMORGEN** Room 302, Building 5, Lihpao Plaza, 88 Shenbin Road, Minhang District, Shanghai, China.

5   Package

5.1 Package Supplied

The package includes:

- Kollmorgen Essentials Drive
- Printed copy of *Kollmorgen Essentials Drive Safety Notes*
- Panel safety label
- **ATTENTION**: Drive is ready to operate with pre-configured STO function.

> **NOTE**
>
> **Mating connectors**
> - X10 (DC Input) and X3 (AC Input) are included with the "-A" at the end of the model number.
> - X1 (motor power) and X23 (Motor feedback) are provided on the hybrid motor cable (purchased separately).
> - X1, RJ45 and DB9 (9-pin D-sub) are always part of the used cables.
>
> Other connectors and cables need to be provided by the user.

Accessories sold separately

Accessories may be ordered separately if required, see (➜ Accessories for Kollmorgen Essentials # 123).

- EMC filters for mains supply voltage, categories C2 or C3
- External regen resistor
- Mating connector kits
- Motor chokes
- Hybrid motor cables with connectors

5.2 Nameplate

A nameplate is attached to the side of the drive. The picture below is similar to the nameplate on the device.
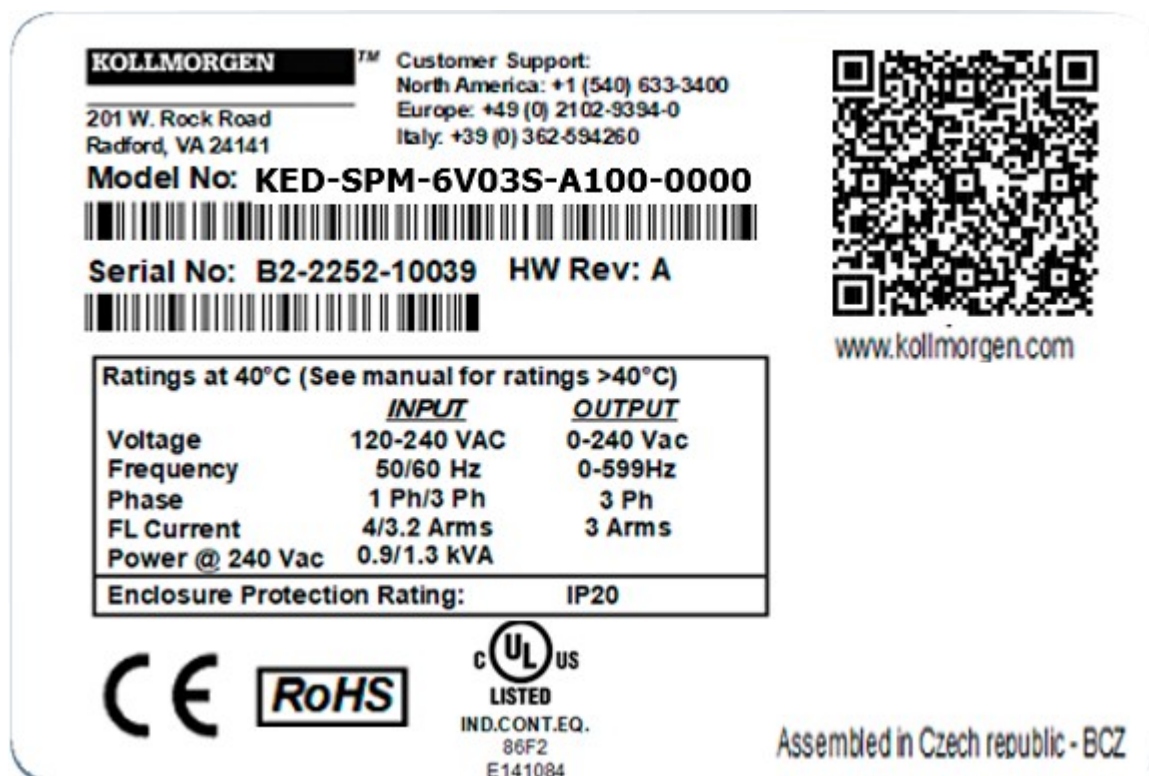
5.3 Part Number Scheme

Use the part number scheme for product identification only.

NOTE	**Mating connectors**
	• X10 (DC Input) and X3 (AC Input) are included with the "-A" at the end of the model number.
	• X1 (motor power) and X23 (Motor feedback) are provided on the hybrid motor cable (purchased separately).
	• X1, RJ45 and DB9 (9-pin D-sub) are always part of the used cables.

Other connectors and cables need to be provided by the user.

KED - S P M - 7V 03 S - A 1 00 - 0000 - A

Family
Kollmorgen Essentials Drive

Format
S   Servo IP20

Drive Version
P   Position Indexer

Connectivity Option
M   Multi Ethernet

Voltage
6V   Medium voltage
7V   High voltage

Current Rating
03    $3\,A_{RMS}$
06    $6\,A_{RMS}$
12    $12\,A_{RMS}$

Connectors
A   with connectors

Customization
0000   Standard

Connector options
00   2 wire feedback (SFD-M)

Functional Safety (FS)
1   STO

Platform Revision
A   *TBD*

Options
S   Single Axis
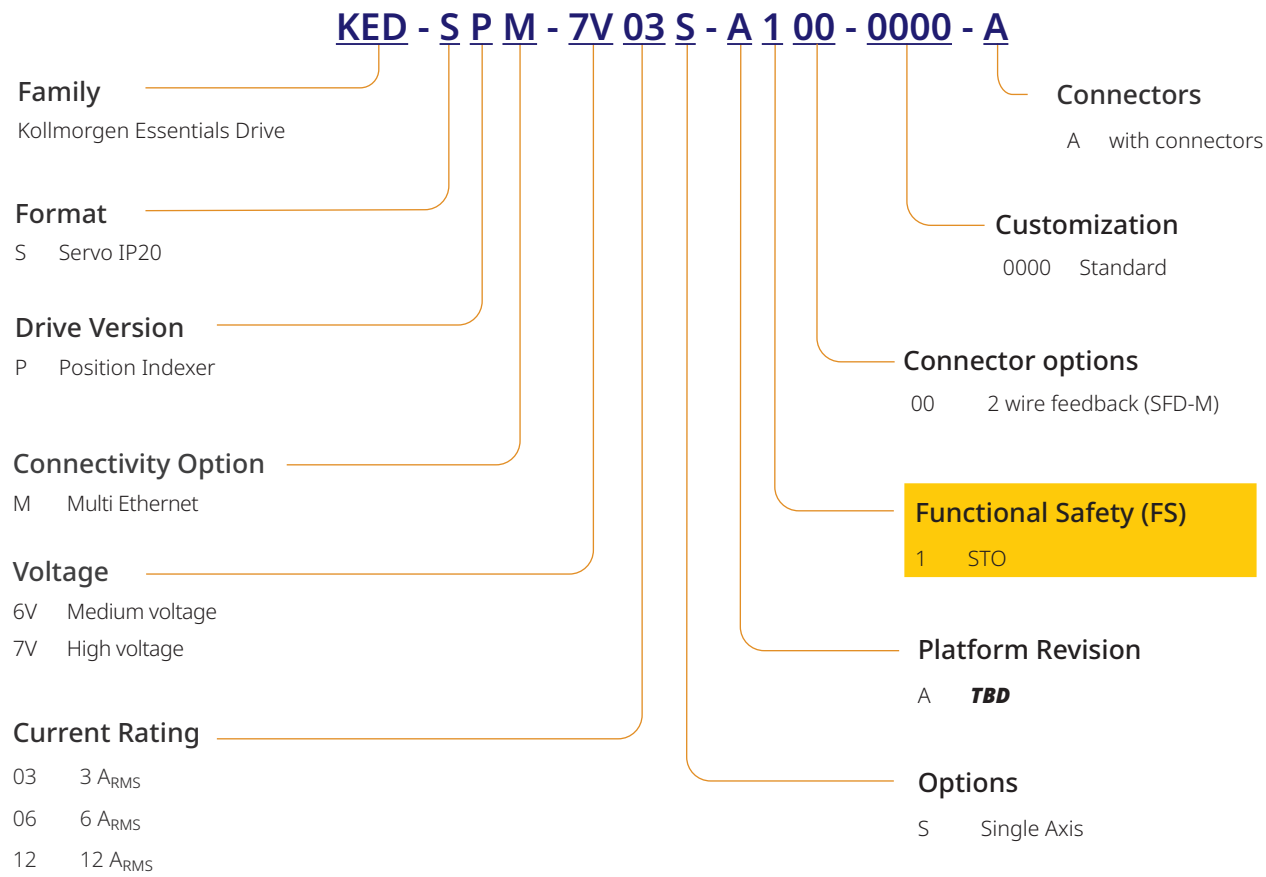
6   Technical Description and Data

6.1 The Family of Kollmorgen Essentials Drives

Available Kollmorgen Essentials Drive versions

Connectivity	Rated Voltages	Current	Axis	Rev	Funct. Safety
M: Multi-Ethernet (EtherNet/IP, EtherCAT, PROFINET)	**6V**: 120/240VAC 1~ 240VAC 3~ 170/340 VDC **7V**: 240/400/480VAC 3~ 340/565/680 VDC	**03**: 3A **06**: 6A **12**: 12A	**S**: Single Axis	A	**1**:SIL2 STO

Standard features

- Support for secondary incremental position input
- 2 high-speed and 2 regular speed digital inputs, 2 digital outputs
- Single axis
- Supply voltages:
  - DC
  - AC single phase, split phase, three phase AC neutral or leg grounded
  - Single or group supply, single or group mains fusing
- Industrial Ethernet on board
- SFD-M, SFD3, HIPERFACE DSL motor feedback support
- Step/Direction input
- Use with AC synchronous servomotors and open loop induction machines

Power section

- Single or three phase AC supply, 5% to 110% of rated AC voltage over 47 to 63 Hz. Connection to higher AC voltage mains only by using isolating transformer.
- DC supply, voltage range 5% to 110% of rated DC voltage. Fusing to be provided by the user.
- Three phase bridge rectifier, integral soft-start circuit.
- DC bus link voltage can be connected in parallel for power sharing.
- Floating current sensors measure actual motor current
- Regenerative circuit with dynamic distribution of the generated power between several drives on the same DC bus link circuit.
- Optional external regen resistor if required

Functional Safety Option

- FS1: STO; SIL2 PLd, command by I/O (➔ # 109)

Electrical 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, over voltage detection, short-circuit protection, phase-loss detection.
- Temperature monitoring of the drive and motor.
- Electronic motor overload protection: foldback mechanism or optional fault response.

Auxiliary supply voltage 24 VDC

- From an external, safety approved 24V ±10% power supply (PELV).

Parameter setting

- WorkBench Software for setup via USB
- Download control parameter packages via Industrial Ethernet

Full digital control

- Digital current loop (update 1.28 μs / command 62.5 μs)
- Digital velocity loop (update period 62.5 μs)
- Digital position loop (update period 250 μs)

Inputs/Outputs (X21)

- 2 high-speed and 2 regular speed digital inputs
- 2 digital outputs

Connectivity

- Feedback input (➜ # 1)
- Digital Inputs/Outputs (➜ # 1)
- Service Interface (➜ # 81)
- Industrial Ethernet interface (➜ # 78)

Accessories

- Connector kit with mating connectors X3 and X10

For accessories refer to the (➜ Accessories for Kollmorgen Essentials # 123).

6.2 Ambient Conditions, Ventilation and Mounting Position

Storage, Transport	(➜ # 22)
Normal operation	Environmental class 3K3 according to IEC 61800-2
Surrounding temperature in operation	• 0 to +40°C under rated • +40°C to +55°C with output current derating 2% per Kelvin
Humidity in operation	Relative humidity 5 to 85%, no condensation, IEC 61800-2 class 3K3
Site altitude	• Up to 1,000m AMSL (above mean sea level): no restriction • 1,000 to 2,000m AMSL: power derating 1.5%/100m • Maximum altitude: 2,000m AMSL
Pollution level	Pollution level 2 as per IEC 60664-1
Vibration	Class 3M1 according to IEC 61800-2
Shock	Class L according to IEC 61800-2
Drive protection	IP 20 according to IEC 60529
Drive EMC immunity	Increased immunity according to EN 61800-5-2
Mounting	Vertical position, in a cabinet with protection of at least IP 54 Minimum cabinet size (WxHxD): XXX x XXX x XXXmm
Ventilation	Built-in fan in all drive variants
NOTICE	The drive shuts down in case of excessively high temperature in the control cabinet. Make sure sufficient forced ventilation is supplied within the control cabinet.

6.3 Mechanical Data

	Unit	6V03	6V06	6V12
Weight	kg	1.1	1.1	2.0
Width	mm	60	60	70
Height, without connectors	mm	172	172	200
Height, with connectors	mm	190	190	225
Depth, without connectors	mm	165	165	202
Depth, with connectors	mm	210	210	255

NOTE   Dimension Drawing see section Mechanical Installation (➜ # 41).

6.4   Performance Data

Performance Data	Units	Kollmorgen Essentials Drive		
		6V03/ 6V06	6V12/ 7V03	7V06/ 7V12
High/Quiet PWM Switching Frequency (optional setting)(dynamic)	kHz	tbd	tbd	tbd
Nominal/High Load PWM Switching Frequency (dynamic)	kHz	tbd	tbd	tbd
High Load Stalled PWM Switching Frequency (dynamic)	kHz	tbd	tbd	tbd
Max. Voltage rise speed dU/dt	kV/µs	tbd	tbd	tbd
Current Loop Update Period	µs	1.28	1.28	1.28
Velocity Loop Update Period	µs	62.5	62.5	62.5
Position Loop Update Period	µs	250	250	250
Max. Current Loop Bandwidth	Hz	tbd	tbd	tbd
Max. Velocity Loop Bandwidth	Hz	tbd	tbd	tbd
Max. Position Loop Bandwidth	Hz	tbd	tbd	tbd
Max. Motor Electrical Frequency	Hz	tbd	tbd	tbd

6.5   Electrical Data

6.5.1 Mains supply data, 1 phase AC

Input data	Units	6V03	6V06	6V12
Operational supply voltage (line to line)	VAC	TBD to 265		
Rated supply voltage	VAC	100 to 240		
Rated supply input frequency (±5%)	Hz	50 to 60		
Permitted switch on/off frequency	1/h	30		
Rated input VA at 240 V	kVA	1.2	2.4	2.9
Rated input current	A	5.0	9.9	12
Max. inrush current	A	10		
Rated DC bus link voltage	VDC	300		

6.5.2 Mains supply data, 3 phase AC

Input data	Units	6V03	6V06	6V12	7V03	7V06	7V12
Operational supply voltage (Line to Line)	VAC	TBD to 265			24 to 525		
Rated supply voltage	VAC	100 to 240			200 to 480		
Rated supply input frequency (±5%)	Hz	50 to 60					
Permitted switch on/off frequency	1/h	30					
Rated input VA at 240 V (* at 480 V)	kVA	1.0	1.9	3.8	2.2*	4.5*	7.7*
Rated input current	A	2.3	4.6	9.2	2.7	5.4	9.2
Max. inrush current	A	10					
Rated DC bus link voltage	VDC	140 to 340			280 to 680		

6.5.3 Mains supply data, DC

Input data	Units	6V03	6V06	6V12	7V03	7V06	7V12
Operational supply voltage (DC+ to DC-)	VDC	TBD to 370			34 to 740		
Rated supply voltage	VDC	100 to 340			200 to 680		
Permitted switch on/off frequency	1/h	30					
Rated input power at 340 V (* at 680 V)	kW	TBD	TBD	TBD	TBD*	TBD*	TBD*
Rated input current	A	TBD	TBD	TBD	TBD	TBD	TBD
Max. inrush current through AC input	A	10					
Rated DC bus link voltage	VDC	100 to 340			200 to 680		

6.5.4 Output data

	Units	6V03	6V06	6V12	7V03	7V06	7V12
Continuous output current (± 3%)	Arms	3	6	12	tbd	3	6
Peak output current (for 5s, ±3%)	Arms	9	18	30	tbd	9	18
Continuous motor shaft output power at rated input current							
at 1 x 120 VAC	kW	0.22	0.44	0.875	tbd	-	-
at 1 x 240 VAC	kW	0.44	0.875	1.8	tbd		
at 3 x 120 VAC	kW	0.31	0.625	1.25	tbd	-	-
at 3 x 240 VAC	kW	0.625	1.25	2.5	tbd	0.625	1.25
at 3 x 400 VAC	kW	-	-	-	-	1.05	2.1
at 3 x 480 VAC	kW	-	-	-	-	1.25	2.5
at 170 VDC	kW	0.31	0.625	1.25	tbd	-	-
at 340 VDC	kW	0.625	1.25	2.5	tbd	0.625	1.25
at 565 VDC	kW	-	-	-	-	1.05	2.1
at 680 VDC	kW	-	-	-	-	1.25	2.5
Peak output power (for 1 s)							
at 1 x 120 VAC	kW	1.1	2.1	4.1	tbd	-	-
at 1 x 240 VAC	kW	2.1	4.2	6.3	tbd	-	-
at 3 x 120 VAC	kW	1.5	3	4.5	tbd	-	-
at 3 x 240 VAC	kW	3.0	6.0	9.0	tbd	3.0	6.0
at 3 x 400 VAC	kW	-	-	-	-	5.0	10
at 3 x 480 VAC	kW	-	-	-	-	6.0	12
at 170 VDC	kW	1.5	3	4.5	tbd	-	-
at 340 VDC	kW	3.0	6.0	9.0	tbd	3.0	6.0
at 565 VDC	kW	-	-	-	-	5.0	10
at 680 VDC	kW	-	-	-	-	6.0	12
Thermal dissipation, disabled	W	12	12	12	tbd	12	12
Thermal dissipation at rated current	W	50	80	140	tbd	65	105
Motor inductance							
minimum at 120 VAC	mH	1.2	0.6	0.3	tbd	-	-
minimum at 240 VAC	mH	2.4	1.2	0.6	tbd	3.1	1.5
minimum at 400 VAC	mH	-	-	-	-	5.1	2.6
minimum at 480 VAC	mH	-	-	-	-	6.1	3.1
maximum	mH	240	120	60	tbd	610	310
Regeneration Braking		(➔ # 37)					
Brake output							
Voltage (±10%)	VDC	24					
Output under current fault	mA	100 (required for fault detection)					
Output over current fault	A	2.25 (required for fault detection)					
Output current, maximum	A	2.1					

6.5.5 Steady State Control Current per Brake Option

Auxiliary 24 VDC (±10%, check voltage drop) Supply Voltage (PELV)	Units	Current
Base current with NO brake	A	< 1
Total current with brake	A	< 2.8

6.6   Electrical Motor Braking

6.6.1 Drive dynamic braking

Drive Dynamic braking is a method to slow down a servo system by dissipating the mechanical energy driven by the motor back EMF.

NOTE	Drive dynamic braking is not functional safe.

The drive has a built in advanced drive dynamic braking mode which operates fully in hardware. When activated, the drive powers the motor terminals with voltages to maximize the stopping force per amount of motor current. This advanced method forces all of the dynamic braking current to be stopping current and insures the fastest stopping per ampere of motor terminal current.

- When current is not being limited, the mechanical energy is being dissipated in the motor winding 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 by using the *AXIS#.DBILIMIT* parameter to insure that the drive, motor, and customer load do not see excessive currents/forces.

Whether and how the drive uses dynamic drive braking depends on *AXIS#.DISMODE*.

6.6.2 Regeneration braking

When the amount of returned energy from the motor builds the bus capacitor voltage up enough the drive activates the regenerative braking circuit to start dumping the returned energy in the regen resistor (also called regenerative resistor or brake resistor). The drive supports the ability to connect an external resistor depending on the application requirements.

NOTE	For more information on external regen resistors, see the (➔ Accessories for Kollmorgen Essentials # 123).

6.6.2.1   Functional description

1. 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 preset level for the brake power rating, the drive generates the warning "W2010 Regen Energy Critical". If the power exceeds the set fault level, the regenerative circuit will switch off and the drive will disable.

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

Using the built-in regenerative circuit, several drives of the same series can be operated from a common DC-bus link (➔ # 1), without any additional measures. 90% of the combined power of all the coupled drives is always available for peak and continuous power. If the power of the drive with the lowest switch-off threshold (resulting from tolerances) exceeds the set fault level, the regenerative circuit will switch off on that drive.

Switch-off on over voltage: With the regenerative circuit switched off, the returned energy is not dissipated and therefore the DC-bus link level increases. The drive reports an over-voltage fault if the DC-bus voltage threshold is exceeded. When this happens, the drive power stage is immediately disabled and the load coasts to a stop with the fault message "F2006 Bus Over voltage".

NOTE	Observe the regeneration time (some minutes) after full load with peak brake power.

6.6.2.2   Technical data – 240V drives

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

Brake circuit

Model	Rated data	Units	AC Supply 120V / 240V
KED-6V03 KED-6V06 KED-6V12	Regen start voltage at rated supply voltage	V	380
	Overvoltage limit	V	420
	Maximum regenerative duty cycle	%	35*
	External regen resistor (recommended 33 Ω)	Ω	>23
	Continuous brake power, external resistor	kW	3
	Peak brake power, external (1s)	kW	5 / 14
KED-6V03 KED-6V06	Absorption energy in capacitors (± 20%)	Ws	TBD
	DC Bus Capacitance	µF	1120
KED-6V12	Absorption energy in capacitors (± 20%)	Ws	9 / 35
	DC Bus Capacitance	µF	2460

* depends on connected regen resistor power.

6.6.2.3   Technical data – 480V drives

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

Brake circuit

* depends on connected regen resistor power.

6.7   LED and Push-button B1

LED

The Kollmorgen Essentials Drive has an LED on its front side that indicates the status by a bi-color red-green light.
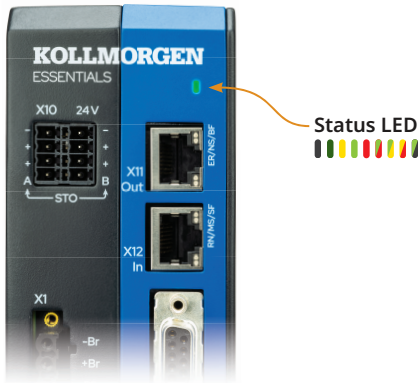
Color	State
Dark	Control board unpowered
Dark, yellow flash	Control board powered, disabled, no faults, warnings
Dark, green flash	Control board powered, disabled, no faults, no warnings
Dimly green	Control board powered but still booting up
Green	Control board powered, enabled, no faults, no warnings
Green/Red blink	Control board powered, downloading in progress
Green, dark flash	Control board powered, dynamic brake active, no faults
Green, yellow flash	Control board powered, enabled, no faults, warnings
Yellow/Red blink (10 seconds)	Control board powered, DRV.BLINKDISPLAY command executed
Red	Control board powered, faults

Push button B1

The Kollmorgen Essentials Drive has a push-button B1 on its top side.

B1 Functions	Description
"Fall back" mode	Press this button during power up to run in recovery mode. This mode allows for a firmware file to be downloaded through WorkBench in case the firmware in the drive has been corrupted.

7   Mechanical Installation

7.1   Important Notes

⚠ **CAUTION**	**High EMC Voltage Level!**
Risk of electrical shock, if the servo amplifier (or the motor) is not properly EMC-grounded.
• Use electrically conductive mounting plates, e. g. made of aluminum or galvanized steel.
• In unfavorable circumstances, use copper mesh tape between the earthing bolts and earth potential to deflect currents.

⚠ **WARNING**	**Projection of molten particles!**
If particles fall into the drive or the drive has been damaged, molten drive component particles may be ejected causing injuries. Shut down the drive and wear appropriate protective gear during maintenance work, troubleshooting and fault rectification.(➜ # 25)

NOTICE	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.

7.2   Guide to Mechanical Installation

You need at least the following tools to install your drive:

- M5 hexagon socket-cap screws (ISO 4762)
- 4 mm hexagon ball head screwdriver
- No. 2 Phillips head screwdriver
- Small slotted screwdriver

Your specific installation may require additional tools.

NOTICE	Do not mount the drive right next to devices that produce magnetic fields. Strong magnetic fields can directly affect internal components. Install the drive with distance to such devices and/or shield the magnetic fields.

Install the drive unit as follows:

1. Mount the drive in a closed control cabinet (ambient conditions (➜ # 33). The site must be free from conductive or corrosive materials. For the mounting position in the cabinet see (➜ # 42).
2. Check that the ventilation of the drive is unimpeded and keep within the permitted ambient temperature (➜ # 33). Keep the required space clearance above and below the drive (➜ # 42).
3. Ensure that there is an adequate flow of cool, filtered air into the bottom of the control cabinet, or use a heat exchanger (➜ # 33).
   Notice: The drive will switch itself off in case of overheating.
4. If you are using a cooling system for the control cabinet, position the cooling system in a way that condensation water cannot drip onto the drive or peripheral devices.
5. Assemble the drive and power supply next to each other on the conductive, grounded mounting plate in the cabinet.
6. Ground the mounting plate, motor housing and CNC-GND of the control system. For EMC-compliant shielding and grounding see (➜ # 49).

7.3   Dimensions

NOTE	Mounting: 2 x M5 hexagon socket screws to ISO 4762, 4mm hexagon ball head screwdriver

	Kollmorgen Essentials Drive		
Parameter	**Unit**	**6V03**	**6V06**	**6V12**
Weight (without mating connectors)	kg	<1.1	<1.1	<2.0
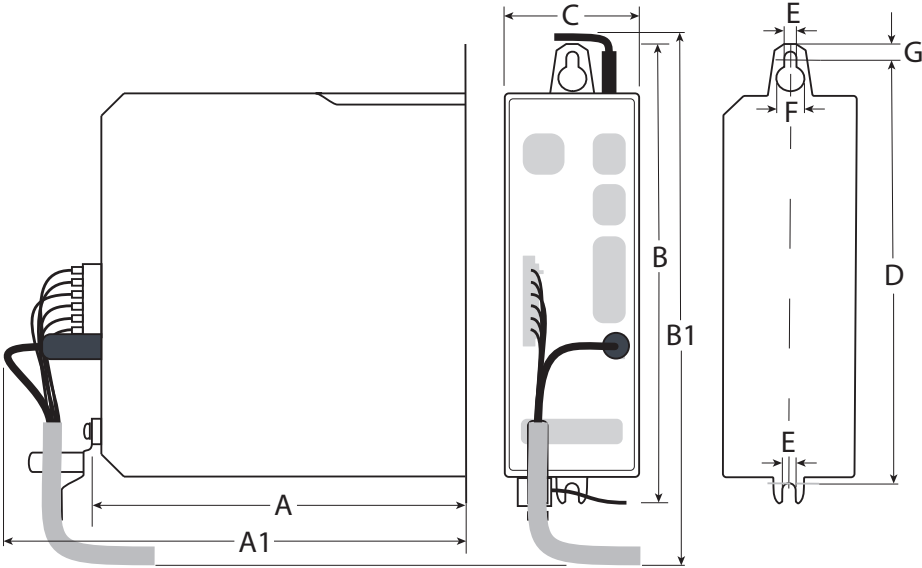
NOTE Outline width and height dimensions are measured on footprint level (mounting plate). Dimensions on the front plate are slightly smaller.

Keep hatched space free! Air flow
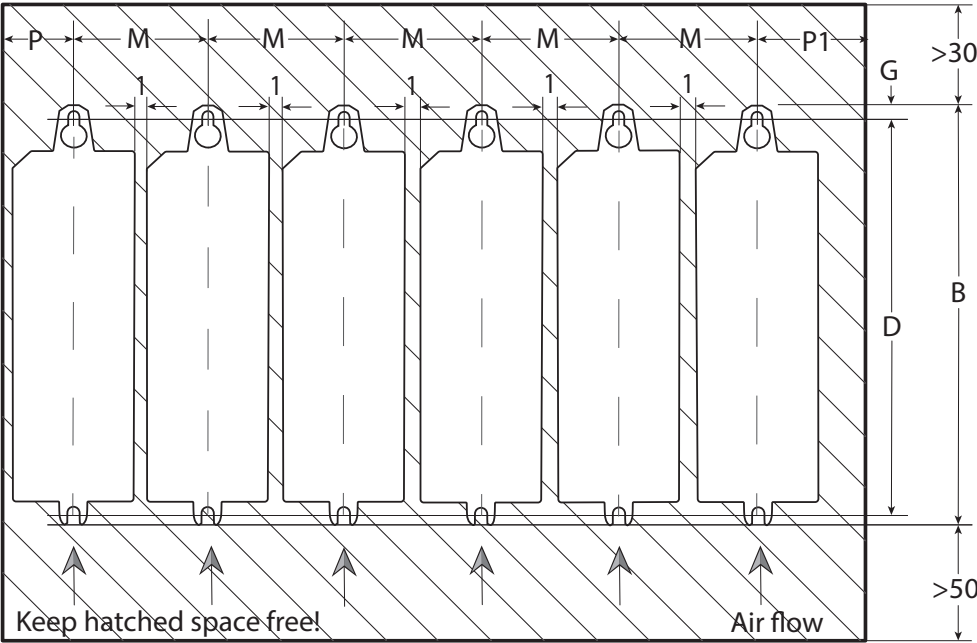
Model	Unit	A	A1	B	B1	C	D	E	F	G	H	M	P	P1
KED-6V03/KED-6V06	mm	165	225	210	215	60	196.1	3	5.7		N/A	61	?	?
KED-6V12	mm	202	262	238.8	243	70	224.5	3	5.7		N/A	71	?	?

8 Electrical Installation

8.1   Important Notes

NOTICE	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.

> **⚠ DANGER**   **High Voltage up to 900V!**
>
> 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 5 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 5 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.
>
> **⚠ WARNING**   **Projection of molten particles!**
>
> If particles fall into the drive or the drive has been damaged, molten drive component particles may be ejected causing injuries. Shut down the drive and wear appropriate protective gear during maintenance work, troubleshooting and fault rectification.(➜ # 25)

NOTICE	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 matching connection diagram, see (➜ # 1) 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).
NOTICE	Excessively high external fusing will endanger cables and devices. The fusing of the mains power and logic power must be installed by the user. Hints for use of Residual-current circuit breakers (RCD) (➜ # 18).
NOTICE	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.
NOTICE	The drive status shall be monitored by the PLC to acknowledge critical situations. We recommend wiring the ready to operate relay 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 WorkBench to change the settings of the drive. Any other alteration will invalidate the warranty.

8.2   Guide to electrical installation

Kollmorgen recommends to install the drive electrical system as follows:

1. Select cables in accordance with IEC 60204 (➜ # 1).
2. Install shielding and ground the drive.
   For EMC-compliant shielding and grounding, see (➜ # 49).
   Ground the mounting plate, motor housing and CNC-GND of the control system.
3. For functional safety information, see (➜ # 102).
4. Wire the drive and connectors.
   Observe the "Recommendations for EMI noise reduction": (➜ # 49).

- Wire the Safe Torque Off (STO) inputs into the emergency off circuit of the system.
- Connect the digital control inputs and outputs.
- Connect the motor hybrid cable
- Connect shielding at both ends and ground cable to drive via cable clamp.
- If required, connect the external regen resistor (with fusing).
- Connect the mains filter FN2090/FN3288 for second environment requirements to product category C2.
- Connect the auxiliary voltage supply
- Connect the main electrical supply.
  Check maximum permitted voltage value (➔ # 34).
- Check proper use of residual-current circuit breakers (RCD): (➔ # 18).
- Connect the PC (➔ # 81) for setting up the drive.

5. Check the wiring against the wiring diagrams:

Wiring reference	Page
Overview	(➔ # 55)
Connector pinout	(➔ # 55)
Mains power supply	(➔ # 60)
Logic power supply	(➔ # 70)
DC Bus Link	(➔ # 71)
External Regen Resistor	(➔ # 74)
Motor cable connection	(➔ # 75)
Motor Holding Brake	(➔ # 76)
Feedback Connection	(➔ # 77)
Industrial Ethernet interface	(➔ # 78)
Service interface	(➔ # 81)
Digital I/O	(➔ # 1)
Functional Safety option 1	(➔ # 109)

8.3 Wiring

NOTICE	Only professional staff who is 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 comply to the cable and wire requirements (➜ # 47).

8.3.1 General

⚠ DANGER   **High Voltage up to 900V!**

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 24V 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	The chassis ground symbol, which is used 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).

8.3.2 Mating connectors

Mating connector overview

#	Description	Type	Max. Cross Section
X1	Motor, holding brake	Connector, 4 pol. power	10 mm², 8 awg
X3	Mains power, regen resistor, DC-Bus	Connector or T-type, 8 pol.	6 mm², 10 awg
X10	24V power supply, STO input	Connector, 8 pol.	2.5 mm², 14 awg
X21	I/O control signals	Connector, DB9 (9-pin D-sub)	1.5 mm², 16 awg
X23	Motor feedback	2-pin connector	

8.3.3 Cable and Wire Requirements

The Kollmorgen Essentials Drive has one motor cable (X1) which you can use for all motors.

For information on the chemical, mechanical, and electrical characteristics of the cable please refer to the *Kollmorgen 2G Cable Guide* or contact our customer support.

Motor cable (X1):

- Max. cable length: 25m / 50m with choke
  Notice: Cables should not exceed the maximum lengths. The recommended maximum cable length of motor cables depends on the used cable material and the feedback type. Cable functionality is only guaranteed up to the maximum length when using unmodified Kollmorgen engineered cables.
- Supports SFD-M, SFD3 and HIPERFACE DSL

I/O cable (X21):

- Maximum distance for unshielded I/O lines is 3m inside the cabinet.
- If the I/O cable leaves the cabinet, ensure EMC shielding.

8.3.3.1 Cable cross sections and requirements

The tables below describe the recommended interface cross sections and cable requirements related to Kollmorgen Essentials Drive in accordance with IEC 60204.

| Power Cables		Cross Section		Remarks
		EU	US	
Mains supply	3 A: 6 A: 12 A:	1.5 mm² 1.5 mm² 1.5 mm² 2.5 mm² 2.5 mm² 6 mm²	14 awg 14 awg 14 awg 14 awg 14 awg 10 awg	600 V rated ,minimum 75°C
24 V supply	max.	2.5 mm²	14 awg	Single core Flexible Class 5
DC bus link, Regen resistor	3/6 A: 12 A: 24 A:	1.5 mm² 2.5 mm² 6 mm²	14 awg 14 awg 10 awg	1000 V rated, min. 75°C, shielded for lengths >0.20 m
Digital I/Os		0.5 mm²	20 awg	single core

8.3.4 Protective Earth Connection

Protective Earth connection of the system components is a safety measure per IEC 60204. Ensure the proper grounding of all components with the PE rail in the control cabinet as reference potential. Connect each ground individually with the intended grounding cable (neutral point connection).

The leakage current from Kollmorgen Essentials Drive against PE is more than 3.5 mA. In accordance with EN 61800-5-1, the PE connection must therefore either be double implemented or a connection cable with >10 mm² cross-section used.

In order to keep the impedance as low as possible, we recommend a copper earthing strap for the PE connection on the PE block.

NOTE	Wire the PE connections immediately after installing the devices as the first electrical connection. Now you insert all the other lines and connectors. For disassembly, release the PE connections as the last connection.
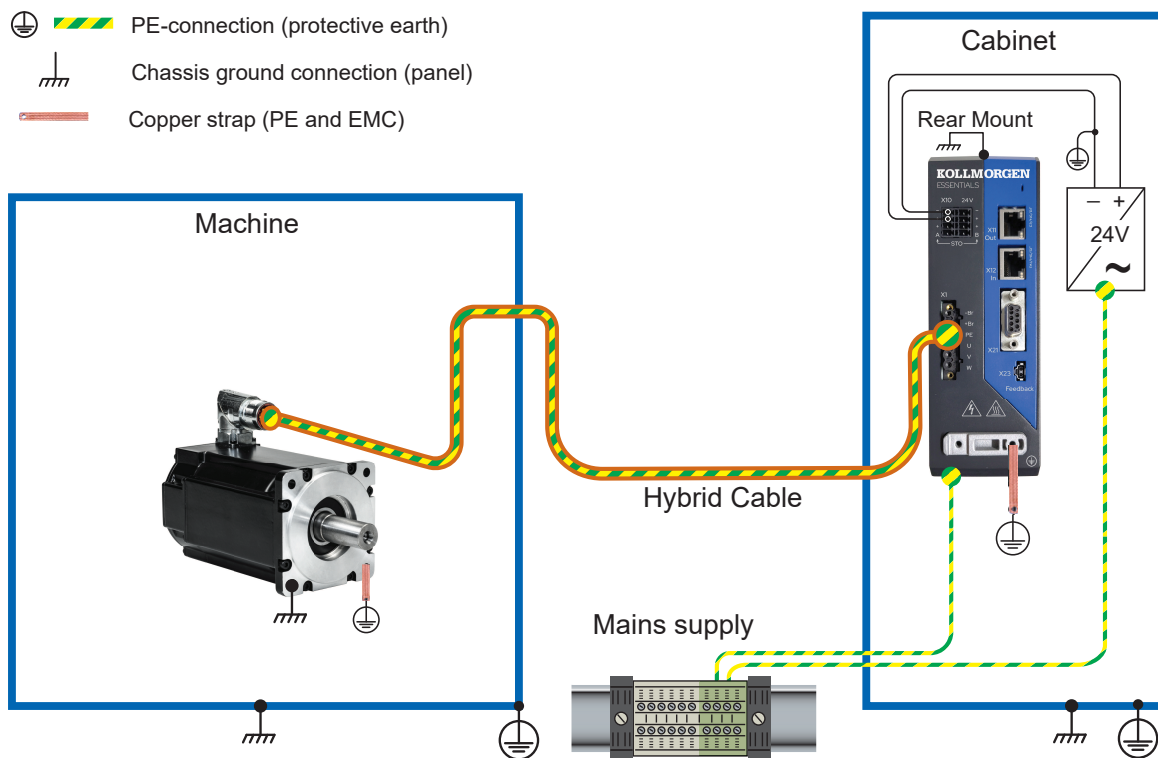
NOTE	For the use of residual current protective devices (RCD), refer to (➔ # 1).

8.4   EMI Noise Reduction

⚠ **CAUTION**   **Electromagnetic fields!**

Electromagnetic radiation may lead to potential hazardous danger (warming, failure of implants), when acting on electrically conductive materials.
- 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.
- Do not remove grounding, equipotential bonding and radiation-reducing shields.

8.4.1 Reducing EMI noise

With the help of the following instructions, you can reduce electrical interference in the 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, but must cover the regional legal requirements, example (➜ # 1).
- **Use Kollmorgen cables.** Route power and control cables separately, Kollmorgen recommends a distance of at least 200mm 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, (➜ # 50).
- **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°.
- **Observe cable length limits.** Maximum distance for unshielded I/O lines is 3m inside the cabinet. If the I/O cable leaves the cabinet, it must be EMC shielded.
- **Do not extend feedback lines and hybrid cables, 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 (➜ # 1) and use the requested cable material to reach maximum cable length.
- **Splice cables properly.** If you need to divide cables, use connectors with metal backshells. 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.
- **Shield cables between drives and filters or external regen resistors.** Install all power cables with an adequate cross-section per IEC 60204 (➜ # 1) and use the requested cable material to reach maximum cable length.
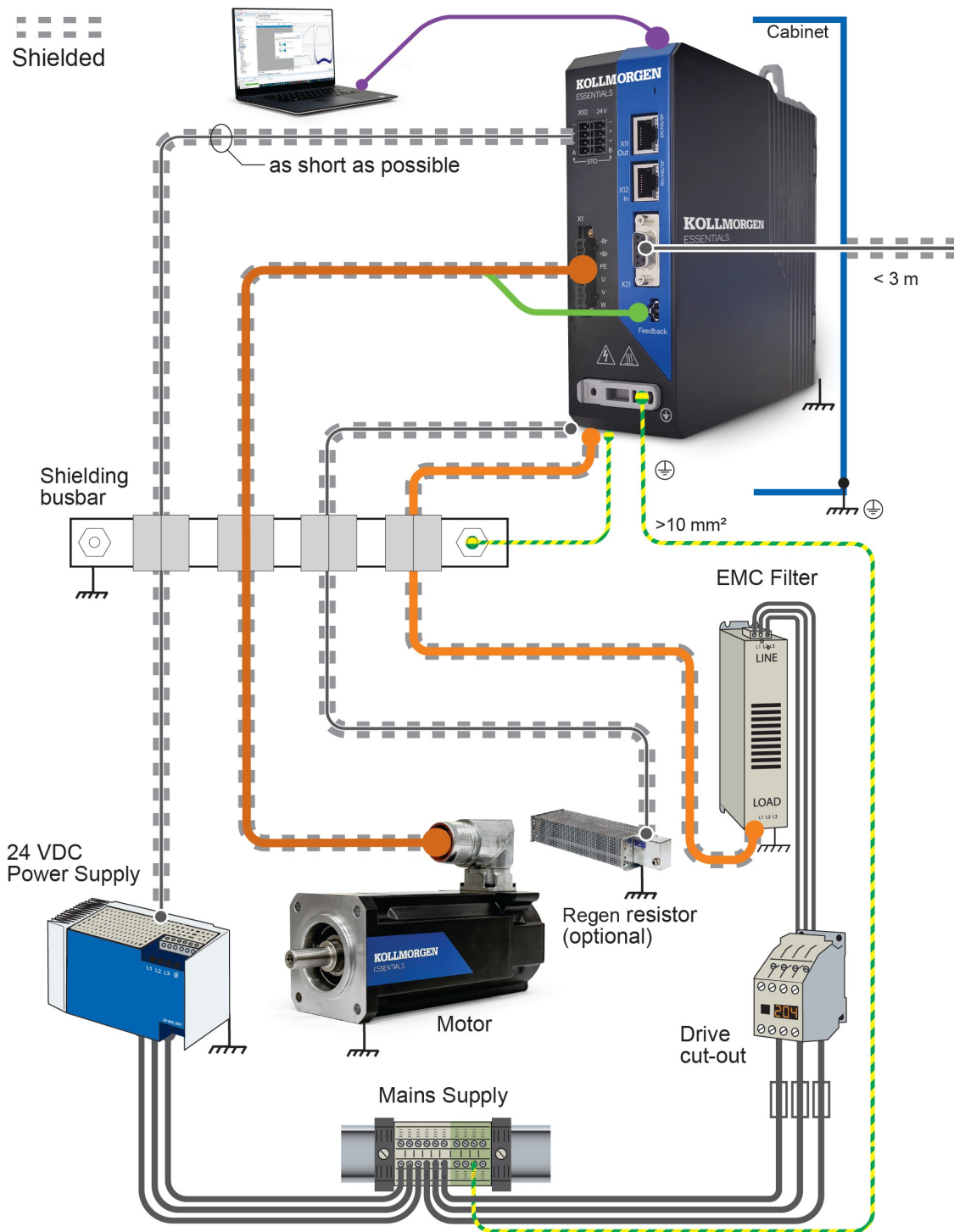
8.4.2 Shielding with External Shielding Busbar

Kollmorgen recommends a star point shield connection, for example, with a shielding busbar.

8.4.2.1   Shielding Concept

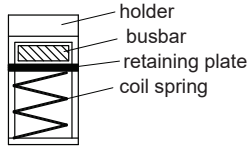Example with Kollmorgen Essentials Drive, EMC filter and external regen resistor.
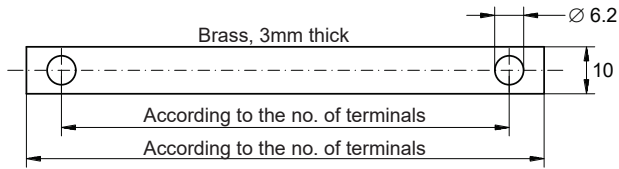
8.4.2.2 Shielding Busbar - TBD

The power cable shields (line in, motor cable, external regen resistor) can be routed to an additional busbar via shield clamps.

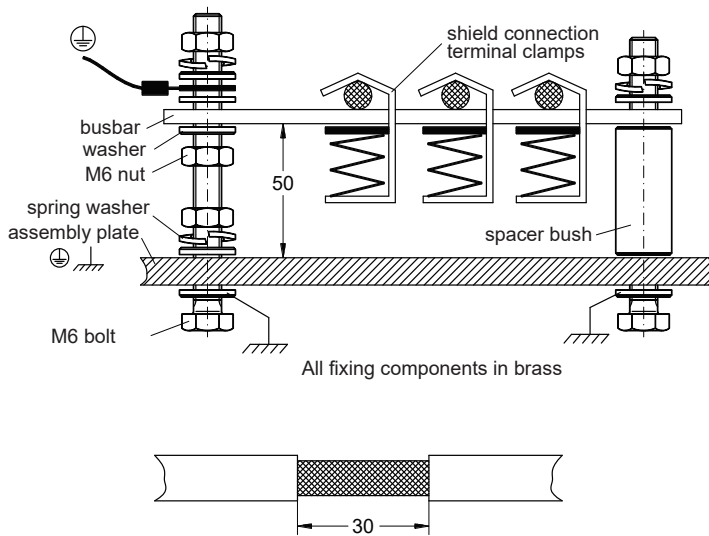Kollmorgen recommends using Weidmüller KLBÜ shield clamps.

A possible scenario for setting up a busbar for the above shield clamps is described below.

Brass, 3mm thick
∅ 6.2
10
According to the no. of terminals
According to the no. of terminals

holder
busbar
retaining plate
coil spring

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.

⚠ **CAUTION**

Risk of injury due to the spring force of the coil spring.
Use pincers.

---

shield connection
terminal clamps

busbar
washer
M6 nut
50
spring washer
assembly plate
spacer bush
M6 bolt

All fixing components in brass

30

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 busbar 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 busbar.

NOTICE

Make sure there is good contact between the shield clamp and the braided shield.

8.4.3 Shielding Connection to the Drive

8.4.3.1   Shielding Concept
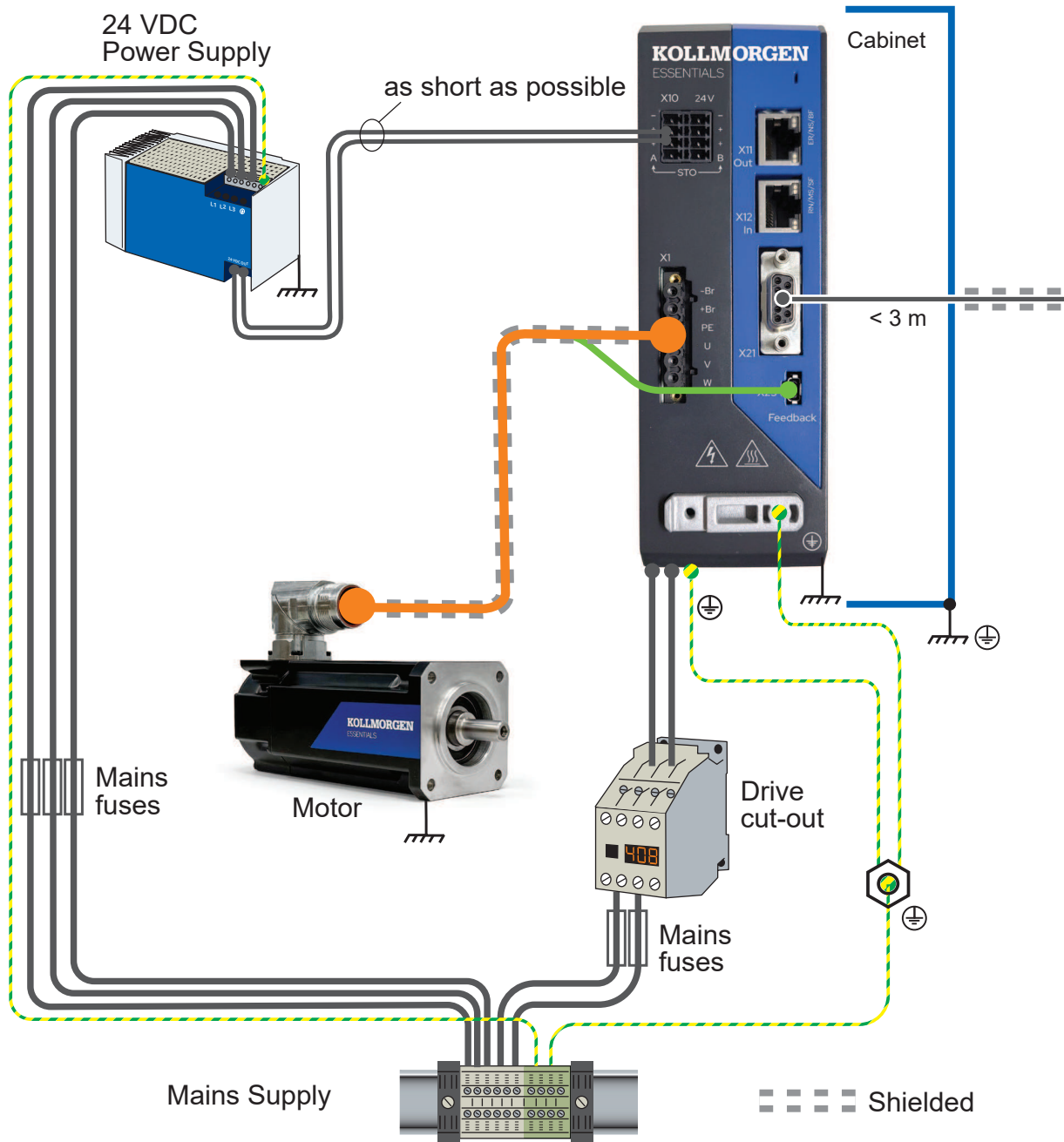
8.4.3.2 Grounding Shield Connection Clamp

A grounding shield clamp is mounted to the drive.

Kollmorgen Essentials Cables are supplied with the shield connection clamp. Push the cable into the spring clamp so that the exposed cable shield makes good contact with the shield clamp.

For strain relief, tighten a metal cable tie (preferred) or plastic zip tie around the insulated cable and the notch toward the bottom of the shield.

For extra grounding in high EMI environments, add a tie across the prongs of the clamp to ensure a very tight ground connection.
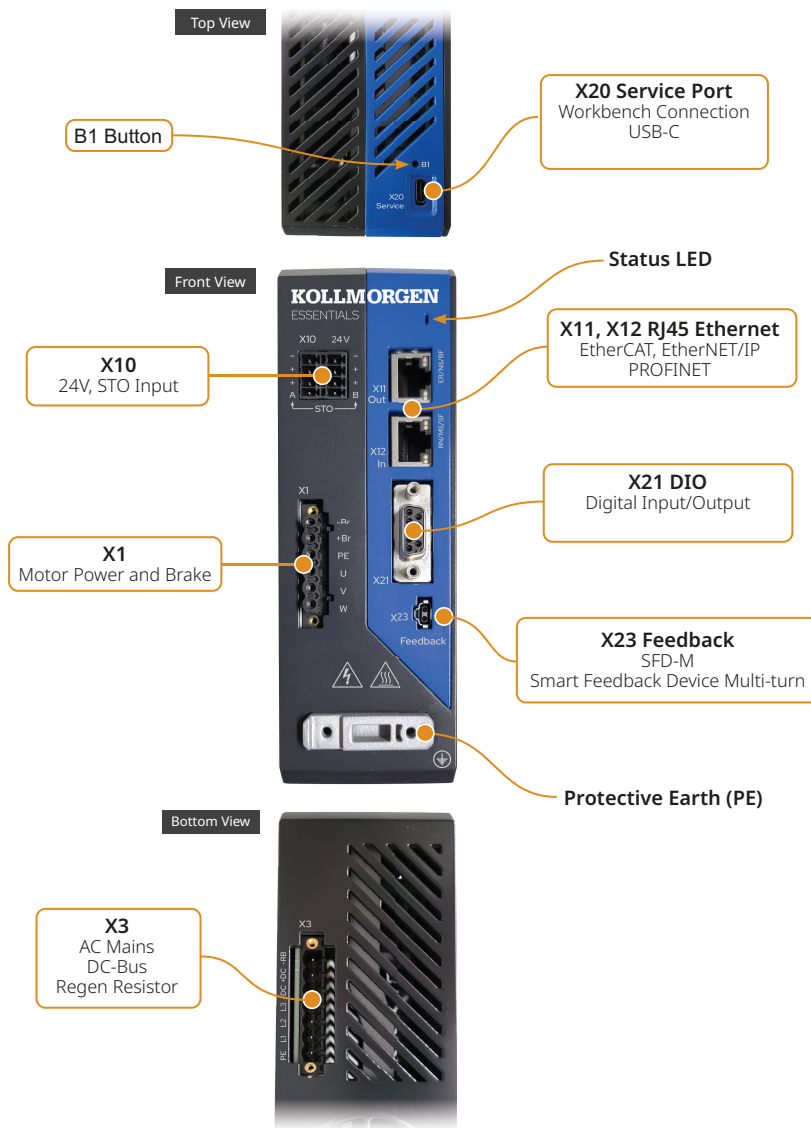
	Use shield connection clamps (see the (➜ Accessories for Kollmorgen Essentials # 123)). The clamp screws into the chassis grounding block to ensure an optimal connection between the cable shield and the drive chassis. Kollmorgen recommends using Phoenix Contact SK14 shield clamps with cable clamp range of 6-13mm.

8.5 Connection Overview

8.5.1 Connector Position – Kollmorgen Essentials Drive 6V03/06

The graphic shows a drive with supply voltage 110 to 240V.

Top View

B1 Button

X20 Service Port
Workbench Connection
USB-C

Status LED

Front View

X10
24V, STO Input

X11, X12 RJ45 Ethernet
EtherCAT, EtherNET/IP
PROFINET

X21 DIO
Digital Input/Output

X1
Motor Power and Brake

X23 Feedback
SFD-M
Smart Feedback Device Multi-turn

Protective Earth (PE)

Bottom View

X3
AC Mains
DC-Bus
Regen Resistor

8.5.2 Connector Position – Kollmorgen Essentials Drive 6V12/7V03

IMAGE

8.5.3 Wiring Overview
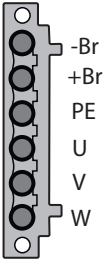
8.5.3.1   240V Kollmorgen Essentials Drive

IMAGE

8.5.4 Connector Pinout

Information to wiring, mating connectors and cables (➜ # 47).

8.5.4.1 X1: Motor power and brake

X1 specifications

Pinout diagram	Specifications
X1 -Br +Br PE U V W	• 6 pin, pitch 5.08 / 7.62mm • 6 slotted conductor screws, tightening torque: 0.5-0.6 Nm • 2 locking screws: 0.3Nm • Motor power, motor brake

X1 pinout

Pin	Signal	Description
1	BRAKE-	Negative connection to the mechanical brake
2	BRAKE+	Positive connection to the mechanical brake
3	PE	Protective earth
4	U	Connection to motor phase
5	V	Connection to motor phase
6	W	Connection to motor phase

8.5.4.2 X3: Mains, regen resistor, DC-Bus

X3 specifications

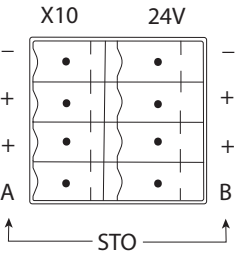| Pinout diagram	Specifications
X3	• Mains supply, external regen resistor, DC bus **KED-6V03/KED-6V06:** • 7 pin, pitch 5.08mm • Tightening torque for mounting screws: 0.3Nm • Tightening torque for ladder screws: 0.5-0.6Nm **KED-6V12/KED-7V03:** • 7 pin, pitch 6.35mm • Tightening torque for mounting screws: 0.3Nm • No screw contacts

X3 pinout

Pin	Signal	Description
1	-RB	Negative end of braking resistor*
2	+DC_BUS	Positive DC bus; positive end of braking resistor*
4	-DC_BUS	Negative DC bus
5	AC_L3	Mains input phase
6	AC_L2	Mains input phase
7	AC_L1	Mains input phase
8	PE	Protective earth

*mounted externally

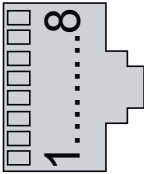### 8.5.4.3 X10: 24 VDC and STO input

X10 specifications

Pinout diagram	Specifications
X10 24V − + + A STO − + + B	• 4x2 pin, pitch 3.5mm • Spring clamps • 24 VDC supply voltage, STO inputs

X10 pinout

Pin	Signal
1A	GND_24V
2A	+24V
3A	+24V
4A	STO-A
1B	GND_24V
2B	+24V
3B	+24V
4B	STO-B

8.5.4.4 X11/12: Industrial Ethernet

X11/12 specifications

Pinout diagram	Specifications
X11/12 8 ... 1	• RJ45 with built-in green/red dual-color LED • EtherCAT, EtherNet/IP, PROFINET • Interface Details: (➔ # 78)

X11/12 pinout

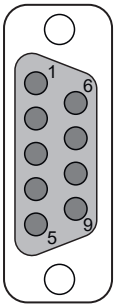| Pin	Signal	Description	Pin	Signal	Description
1	Tx+	Transmit +	5	Term.	Termination
2	Tx-	Transmit -	6	Rx-	Receive -
3	Rx+	Receive +	7	Term.	Termination
4	Term.	Termination	8	Term.	Termination

8.5.4.5 X20: Service

X20 specifications

Connector at computer	Connector at drive	Length	Image	Right-angle connector at drive	Spec	Type
A male	C male	< 3m			USB 2.0	Data transfer and charge
C	C	< 3m			USB 2.0	Data transfer and charge

8.5.4.6 X21: I/O

X21 specifications

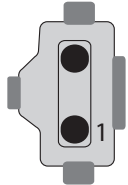| Pinout diagram	Specifications
X21	• DB9 (9-pin D-sub), female • Locking screws, tightening torque: 0.4Nm (3.5inlbs) • 4 Digital-In, 2 Digital-Out

X21 pinout

Pin	Signal	Description
1	DIN1	High-speed digital input, 24V signalling
2	DIN2	High-speed digital input, 24V signalling
3	DIN3	Slow digital input, 24V signalling
4	DIN4	Slow digital input, 24V signalling
5	GND_IO	Common for digital inputs
6	DOUT1+	Digital output 1, positive connection
7	DOUT1-	Digital output 1, negative connection
8	DOUT2+	Digital output 2, positive connection
9	DOUT2-	Digital output 2, negative connection

8.5.4.7 X23: SFD-M Feedback

X23 specifications

Pinout diagram	Specifications
X23	• IEC 63171-6 connector • Single-cable feedback

X23 pinout

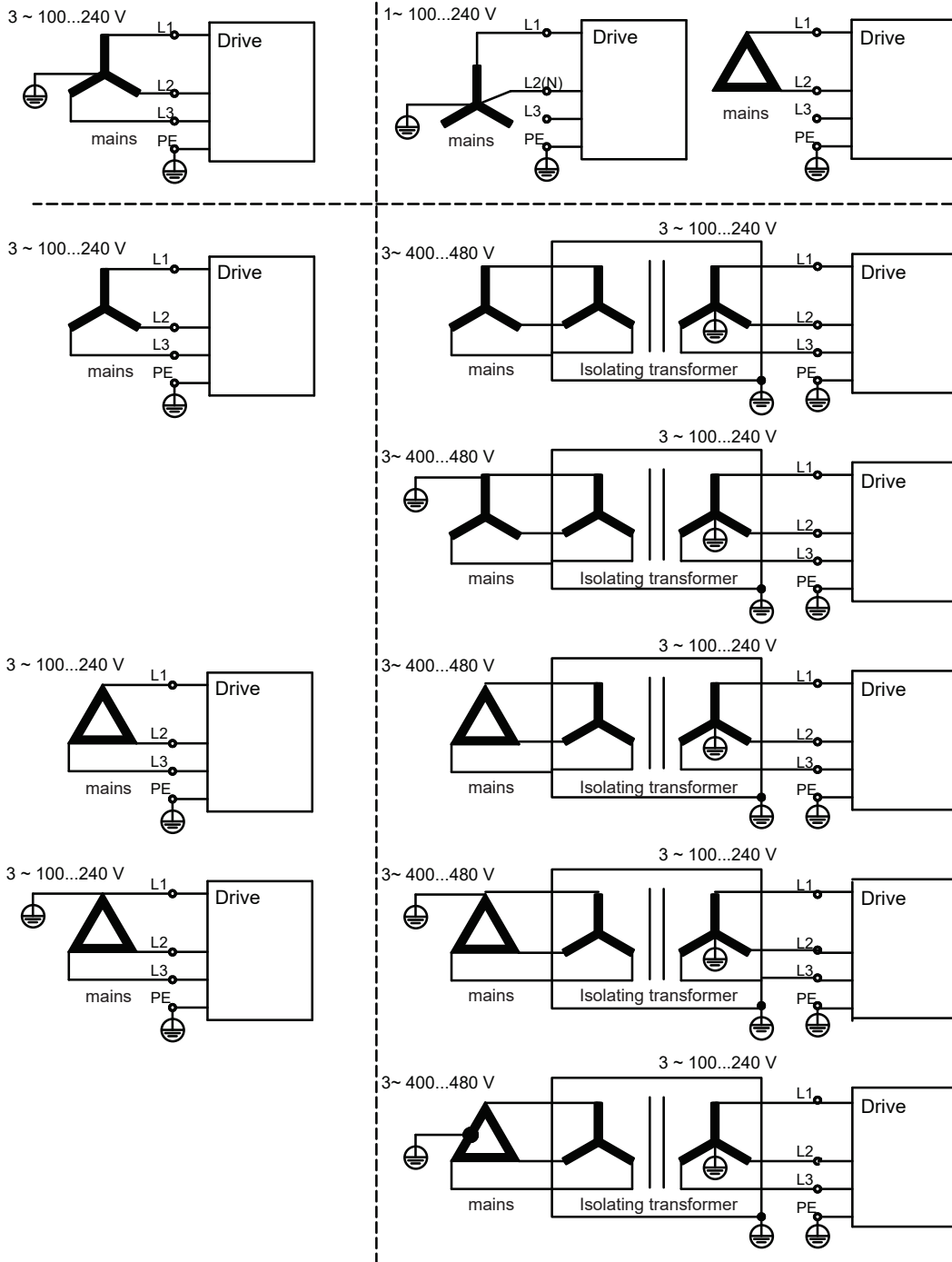| Pin	Signal	Description
1	DP+	Data+ with +12V
2	DP-	Data- with 0V

8.6   Power and Logic Voltage Supply (X3/X10)

8.6.1 Electrical Supply Connection

8.6.1.1   Connection to various mains supply networks – 240V drive

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

8.6.2 Mains Power Supply Connector X3

Drives in the Kollmorgen Essentials Drive series can be supplied as follows:

240V drive with 3 and 6A$_{rms}$

- 1, 2 or 3 phase industrial AC supply networks (TN-S or TT, see KDN): (➔ # 34)
- DC supply networks: (➔ # 34)

240V drive with 12A$_{rms}$

- 3 phase industrial AC supply networks (TN-S or TT, see KDN): (➔ # 34)
- DC supply networks: (➔ # 34)

For connection to corner grounded delta supply networks contact Kollmorgen customer support.

Periodic overvoltages between phases (L1, L2, L3) and the PE/housing of the drive must not exceed 1,000V peak. In accordance with IEC 61800, voltage spikes (< 50 μs) between phases must not exceed 1,000V. Voltage spikes (< 50 μs) between a phase and the PE/housing must not exceed 2,000V.

- 8/4 pin, pitch 7.62/10.16 mm
- Wiring example:
  - 1 phase AC supply (➔ # 61)
  - 2 phase AC supply (➔ # 61)
  - 3 phase AC supply (➔ # 62)
  - DC supply (➔ # 63)
- the drive requires external EMC filter for use in industrial environment, product category C.
- Mating connector data (➔ # 47)
- Fusing with different system structures (➔ # 65) ff

IMAGE of connector TBD

Pin	Label	Signal	1~ Supply	2~Supply	3~ Supply	DC Supply
1	PE	PE	Protective earth	Protective earth	Protective earth	Protective earth
2	R	L1	Phase L1	Phase L1	Phase L1	+ DC
3	S	L2	n.c.	n.c.	Phase L2	n.c.
4	T	L3	Neutral N	Phase L2	Phase L3	- DC

For DC supply: observe notes (➔ # 63).

8.6.2.1 Wiring examples mains power supply
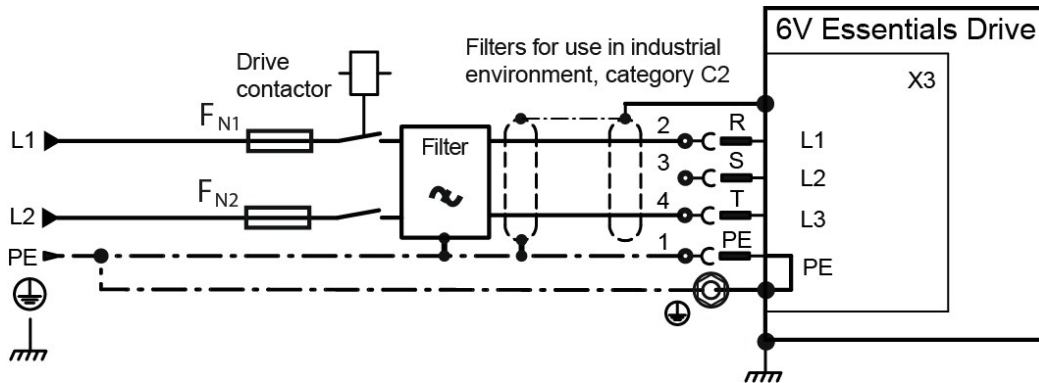
One phase AC mains (240V drive)

- Directly to one phase supply network with neutral line.

- Activate single phase supply (VBUS.THREEPHASE = 0).
- Set VBUS.ACNOMINAL to desired nominal AC line voltage for lines other than nominal rated VAC.
- For complete information refer to WorkBench Help.
- You need to provide AC line filtering. Use filter type FN2090 and refer to the (➔ Accessories for Kollmorgen Essentials # 123) for more information. Use a shielded cable between filter and drive.
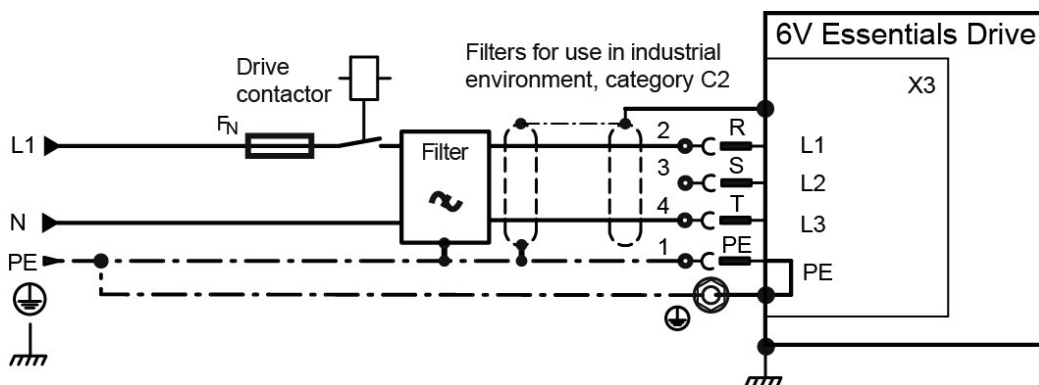
### Two phases AC mains (240V drive)

- Directly to two-phase supply network without neutral line.

- Activate single phase supply (VBUS.THREEPHASE = 0).
- Set VBUS.ACNOMINAL to desired nominal AC line voltage for lines other than nominal rated VAC.

- For complete information refer to WorkBench Help.
- You need to provide AC line filtering. Use filter type FN2090 and refer to the (➜ Accessories for Kollmorgen Essentials # 123) for more information. Use a shielded cable between filter and drive.

Three phases AC mains (240V drive)

- Directly to 3-phase supply network.
- Activate 3-phase supply (VBUS.THREEPHASE = 1).
- Set VBUS.ACNOMINAL to desired nominal AC line voltage for lines other than nominal rated VAC.
- For complete information refer to WorkBench Help.
- You need to provide AC line filtering. Use filter type FN2090 and refer to the (➜ Accessories for Kollmorgen Essentials # 123) for more information. Use a shielded cable between filter and drive.
  - 240V drive with 3 and 12 A_{rms}:
    Motor cable < 10 m: use filter FN 3288 in industrial environment, category C2.
    Motor cable ≥ 10 m: use filter FN 3288 in industrial environment, category C3.
  - 480V drive with 03...12 A_{rms}:
    Motor cable < 10 m: no filter, in industrial environment, category C2.
   Motor cable ≥ 10 m: no filter, in industrial environment, category C3.
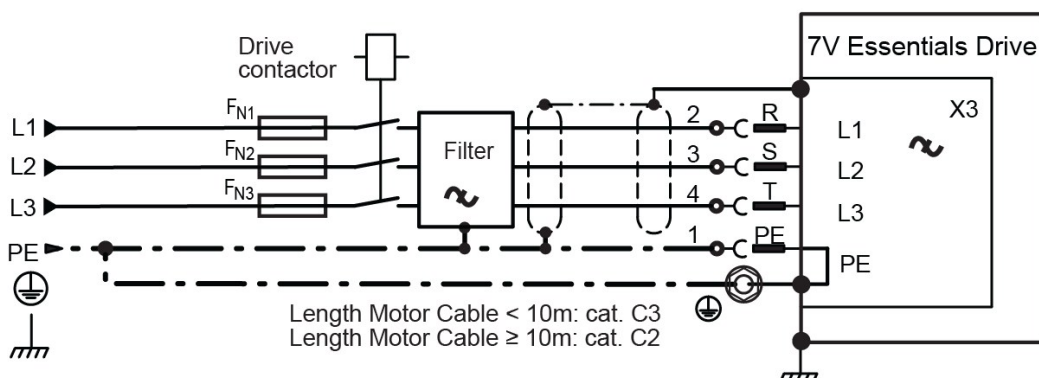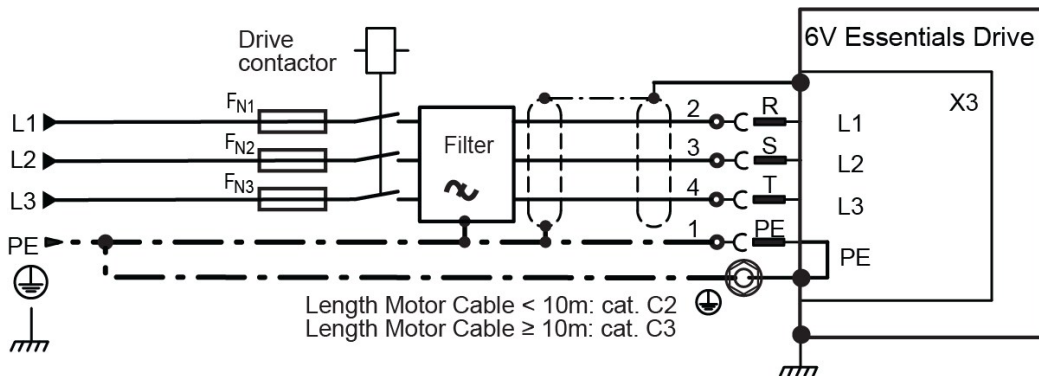
DC supply

- Activate DC supply (VBUS.DCOPERATION = 1) and set VBUS.DCNOMINAL.
- You need to provide DC supply filtering.

<u>DC supply to mains lines R/T (L1/L3)</u>

DC power source is connected to the drive AC line inputs. This wiring provides soft start of the energy storage capacitors inside the drive and the AC rectifier diodes prevents motor regeneration energy from returning to the dc power source. That is, by powering the drive from the AC line input connections, the drive's energy absorption and energy dissipation mechanisms can work normally.
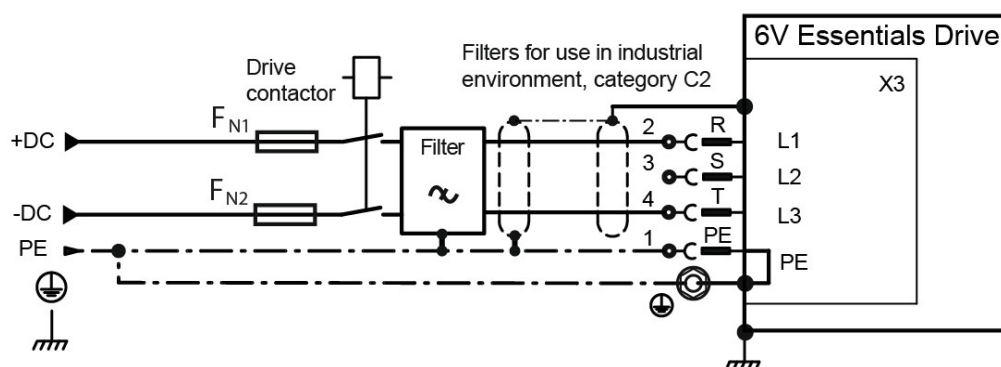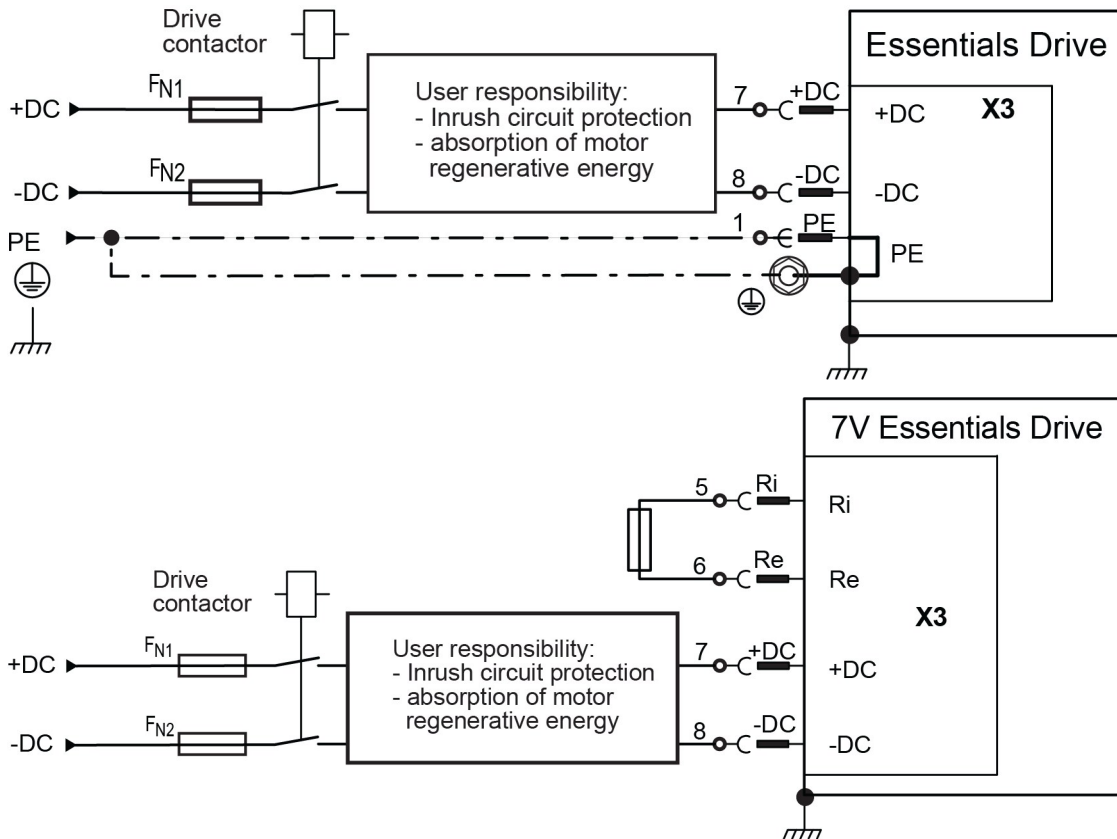
DC Supply to DC Bus line X3

> As a user you are responsible for current and power management when
> using additional external devices and when wiring DC power supply to the drive DC Bus terminal X3. For more information refer to (LINK).
>
> **User responsibility:**
>
> - The power supply system design must ensure inrush current protection by limiting input current during power up.
> - Provide a means to safely absorb energy from the motor when slowing down/regenerating. UL Rating for DC requires that DC is created from an AC source. Other forms of DC are not covered by the UL listing.
> - Wire DC supply polarity properly. Improper polarity of DC power will damage the drive and void warranty.

8.6.2.2   Fusing

Fuse types	Description
US fuses	- Class J, 600VAC, 200kA SCCR, time-delay - must be UL and CSA listed Alternate fuses and breakers to Class J must have similar or better Ip and I²T performance per UL 508A SB4.2 at max. 10kA SCCR rating.
EU fuses	- Types gS or gG, 400V/500V, time-delay - max. 10kA SCCR
Semiconductor	- max. 65kA SCCR
Fuse holders	Use finger-safe fuse holders according to EN 60529 in combination with the standard fuse blocks.
Automatic circuit breakers	- max. 30A - max. 10kA SCCR
Group installation fusing	- max. 30A

AC supply, single drives, line fusing
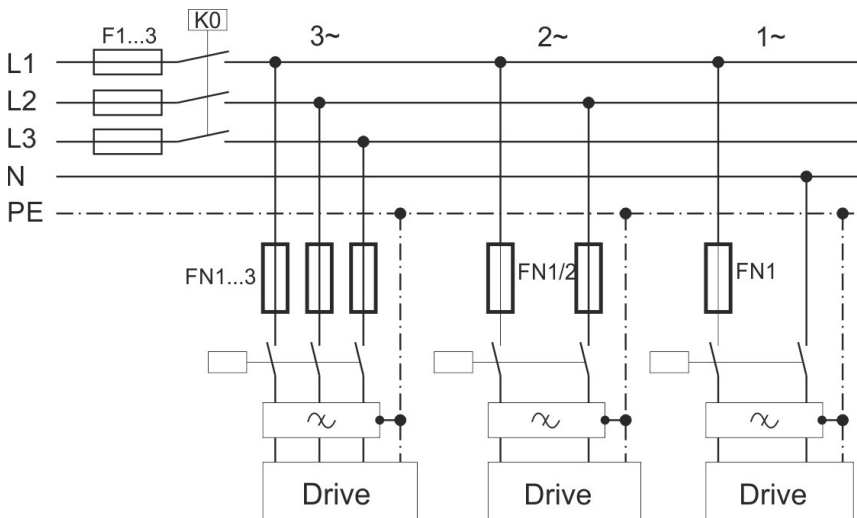
- F1, F2, F3: depends on sum of application's required input currents and cabinet requirements.
- Filters for special EMC requirements only (➔ # 124).
- FN1, FN2, FN3 maximum rating: 30A.
- FN1, FN2, FN3 recommended rating see table below:

Drive Model	FN1, FN2, FN3: Ampere rating	Example class J Eaton Bussmann	Example class J Mersen
??			

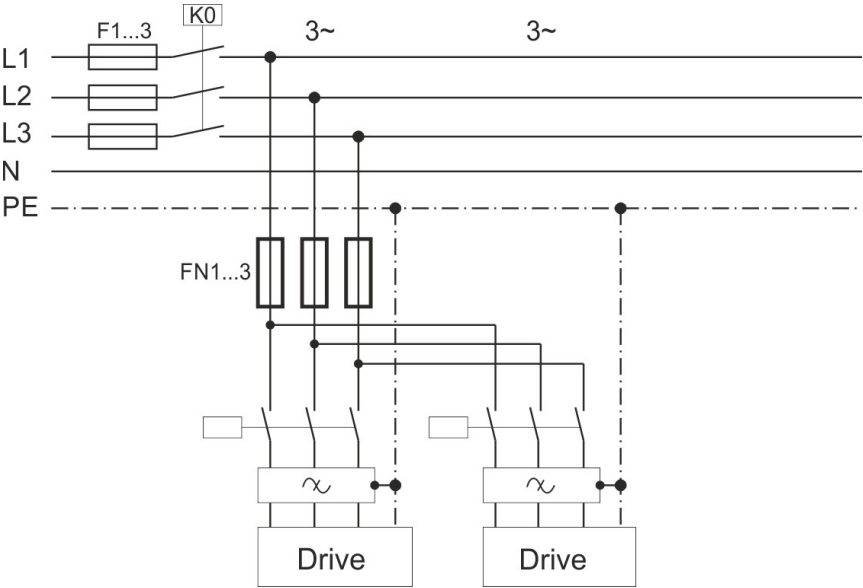| Drive Model	FN1, FN2, FN3: Ampere rating	Semi-conductor Eaton/Bussmann	Semi-conductor Mersen
??			

AC supply, group of drives, line fusing

- F1, F2, F3: depends on sum of application's required input currents and cabinet requirements.
- Filters for special EMC requirements only (→ # 124).
- FN1, FN2, FN3 maximum rating: fuse size for group installation is limited to 30A max. and 32A max. for Semiconductor fuses.
- FN1, FN2, FN3 rating should be 1.25 * sum current.

| Group sum current	FN1, FN2, FN3: Ampere rating	Eaton Bussmann	Mersen
??			

IMAGE

AC supply, single drives, automatic circuit breakers
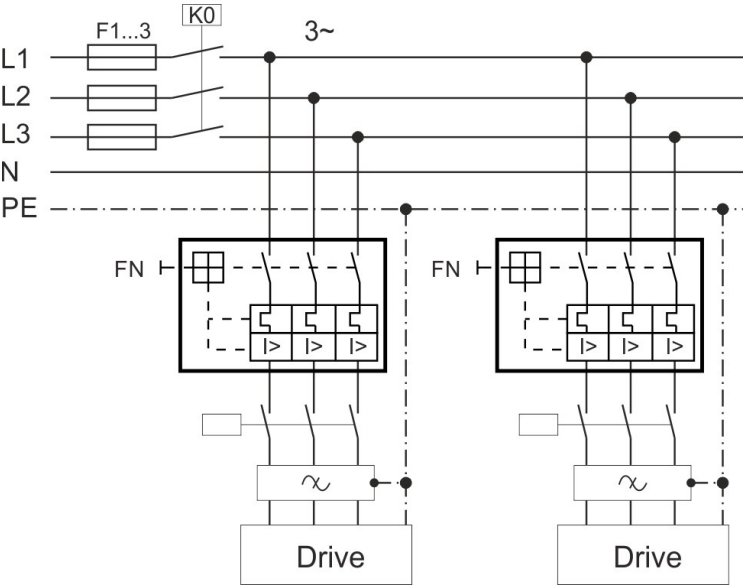
- F1, F2, F3: depends on the sum of application's required input currents and cabinet requirements.
- Filters for special EMC requirements only (➔ # 124).
- FN maximum rating: 30 A
- FN recommended rating and regional approvals see table below:

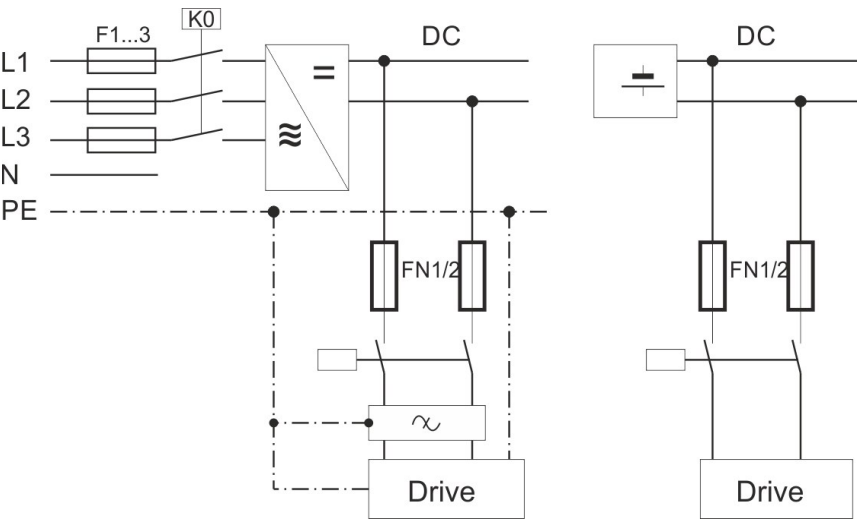| Drive Model	Ampere rating	SCCR rating	Example ABB
??			

AC supply, group of drives, automatic circuit breakers
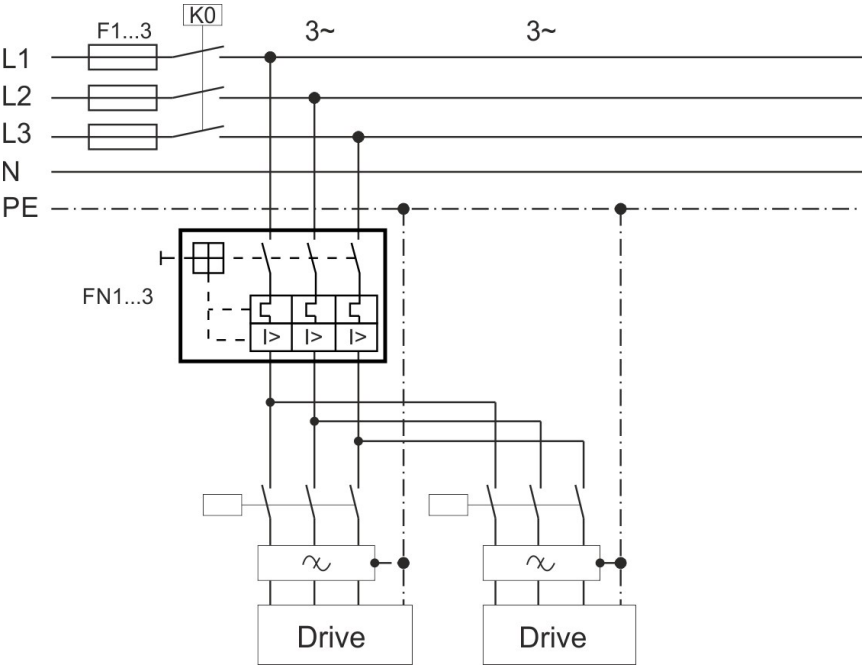
- F1, F2, F3: depends on sum of application's required input currents and cabinet requirements.
- Filters for special EMC requirements only (➔ # 124).
- FN maximum rating: circuit breaker size for group installation is limited to 30 A max.
- FN rating should be 1.25 * sum current.
- FN recommended rating and regional approvals see table below:

Group sum current	Ampere rating	SCCR rating	Example UL ABB
240V Kollmorgen Essentials Drive			
??			
480V Kollmorgen Essentials Drive			
??			

DC supply, single drives, line fusing

- F1, F2, F3: depends on sum of application's required input currents and cabinet requirements.
- Filters for special EMC requirements only (➔ # 124).
- FN1, FN2 maximum rating 30A
- FN1, FN2 recommended rating see table below:

Drive Model	Ampere rating	Example Eaton Bussmann	Example Mersen
??			

8.6.3 Auxiliary Voltage Power Supply Connector X10

The following diagram describes external 24 VDC power supply (PELV). The required supply current rating depends on the use of motor brake (➔ # 34).

IMAGE	• 2x4 pin, pitch 3.5mm • T-type mating connector data (➔ # 47) • Undervoltage fault limit 19V • Overvoltage fault limit 30V

Pin	Signal	Description
1	+ 24 V	+24VDC supply voltage, PELV
2	GND	Ground for 24VDC supply voltage, PELV

For control supply current requirement specifications see section (➔ # 37).

8.6.3.1 Fusing

Use 24 VDC supply manufacturer's recommendation for fusing.

8.6.3.2   Wiring example 24 VDC supply

Maximum current for one string of daisy-chained X10T connectors is 8A. The sum of the control currents of the connected drives should not exceed 8A. 24V consumption data TBD

Possible connections:

- 5 drives in line, no brakes
- 3 drives in line, with brakes
- in a ring connection the number of drives can be doubled

Wiring example with three phase power supply unit:

IMAGE

8.7   DC Bus Link Connector X3

The DC bus link can be connected in parallel so that the power returned from slowing down motors 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 sharing the same branch, over current protection devices, even if the DC bus link is used. Drives working generatively very often should be placed beside drives, which need energy. That reduces current flow on longer distances.

NOTICE	The drives can be destroyed if DC bus link voltages are different. Only drives with mains supply that share the same AC branch, over current protection devices (identical mains supply voltage) may have the DC bus links interconnected. Interconnection of DC bus links works best in systems powered by 3-phase AC or DC power. Consult Kollmorgen for DC bus linking with single phase AC power input.
NOTE	The sum of the application currents in the connected in parallel DC bus wires must not exceed 48 A.
	Wiring: 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.

| Image TBD - X3 to KED STO	- Mains supply, external regen resistor, DC bus **KED-6V03/KED-6V06:** 7 pin, pitch 5.08mm - Tightening torque for mounting screws: 0.3Nm - Tightening torque for ladder screws: 0.5-0.6Nm **KED-6V12/KED-7V03:** 7 pin, pitch 6.35mm - Tightening torque for mounting screws: 0.3Nm - No screw contacts Mating connector data (➔ # 47)

Pin	Label	Signal	Description
7	+DC	+DC	DC Bus link positive
8	-DC	-DC	DC Bus link negative

NOTE	In addition to the sum of the axes currents ($I_{1...n}$) in parallel DC bus groupings being less than 48 A, the sum of the AC input currents ($A_{1...n}$) must be less than 30 A (32 A when semiconductor fuses are used). The maximum number of axes is limited to 8 drive enclosures per group installation. Group AC fusing and breaker guidelines should also be followed for DC bus groupings.(➔ # 1)

$$\sum I_1 c \ldots I_n c < 48\ \text{A}$$

OR

8 MAX.

OR

$$\sum A_1 \ldots A_n < 30\ \text{A}$$
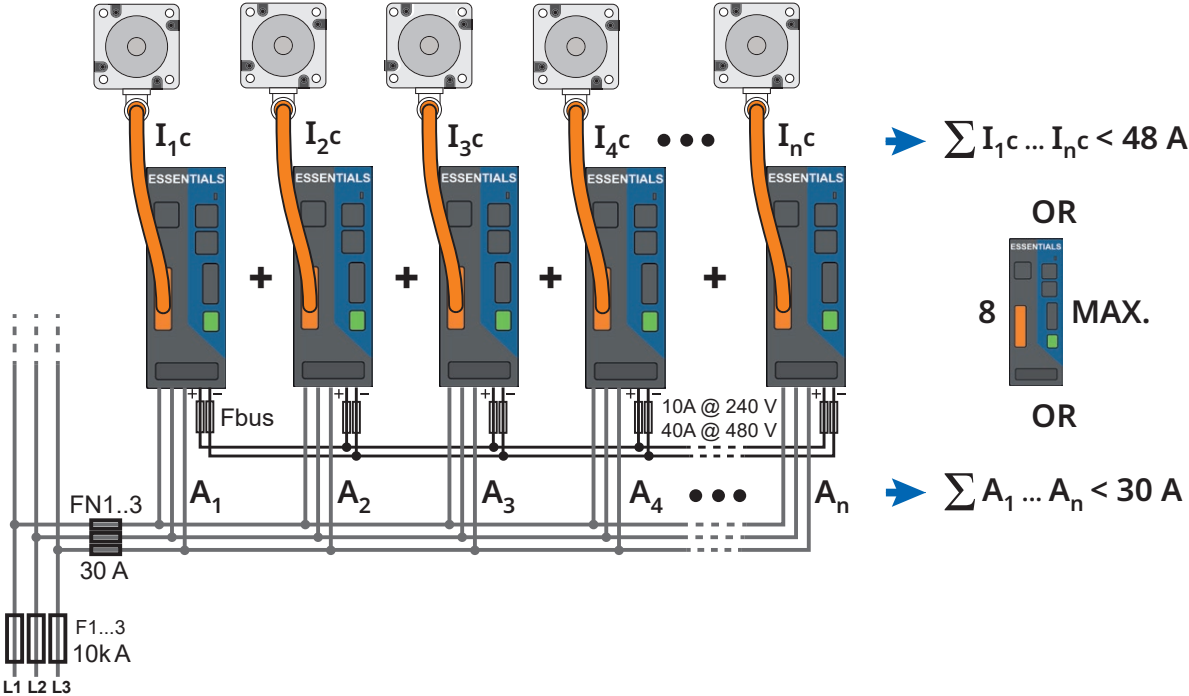
8.7.1 Fusing

External regen fusing FB1/FB2 (➜ # 74). DC bus link fusing depends on topology (see (➜ # 71)).

Wiring topology	Ampere rating@240V	Ampere rating@480V	Example Eaton:	Example Mersen:
240V Kollmorgen Essentials Drive				
Group: Fgroup	max. 30 A	na	DFJ-30	HP6M30
Busbar: Fbus	max. 15 A	na	DFJ-15	HP6M15
480V Kollmorgen Essentials Drive				
Group: Fgroup	max. 30 A		FWP-30B	HP10M30
Busbar: Fbus	max. 15 A		FWP-15B	HP10M15

|	
~	Also follow group AC fusing and breaker guidelines when sharing or grouping regen resistors. (➜ # 60)

Wiring example

Image TBD

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 (Fgroup) 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. Fgroup fuses cannot avoid damage by current peaks completely.
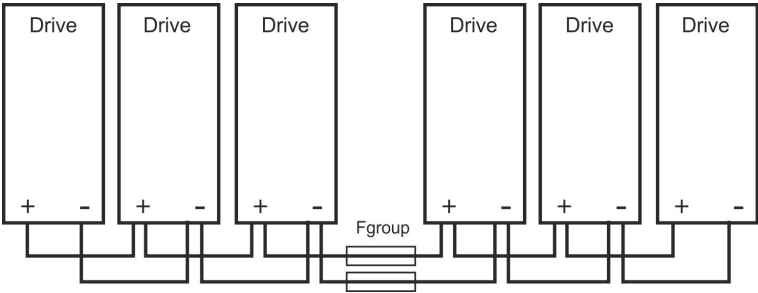
8.7.2 Wiring example with busbar

If a device fails in this system due to a short-circuit, only its fuses (Fbus) are tripped and the rest of the network continues uninterrupted. The solid busbars can conduct significantly larger currents than T connectors, because the compensating current does not flow through the connector as above.
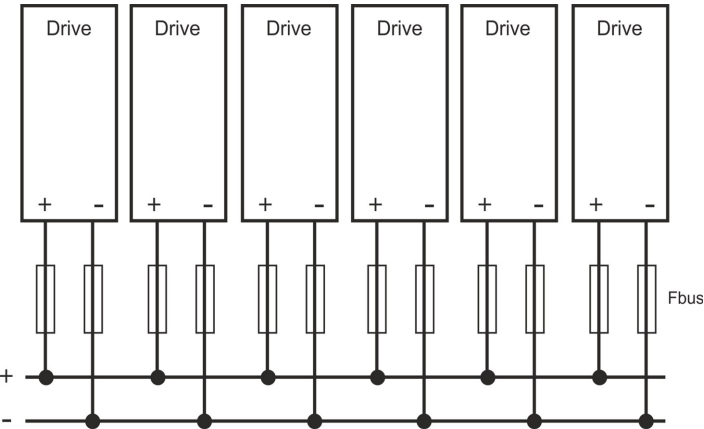
8.8   Regen Resistor Connector X3

For technical data on the regenerative brake circuit refer to (➔ # 37).

NOTE	You are responsible for fusing (such as fusible cut-outs or power switches).

| Image TBD - X3 to KED STO	• Mains supply, external regen resistor, DC bus **KED-6V03/KED-6V06:** • 7 pin, pitch 5.08mm • Tightening torque for mounting screws: 0.3Nm • Tightening torque for ladder screws: 0.5-0.6Nm **KED-6V12/KED-7V03:** • 7 pin, pitch 6.35mm • Tightening torque for mounting screws: 0.3Nm • No screw contacts • Mating connector data (➔ # 47). • Refer to the WorkBench online help for parameter setting (REGEN.EXT, REGEN.REXT, REGEN.WATTEXT)

Pin	Label	Signal	Description
6	Re	-RB	external Regen resistor -
7	+DC	+RBext	external Regen resistor +

8.8.1 Fusing and Wiring

FB1 / FB2 fusing

Drive Model	Ampere rating@240V	Ampere rating@480V	Example: Eaton	Example: Siba
all Kollmorgen Essentials Drives	10A	40A	FWP-xxA14F	110V to 400V: gRL(gS) 400V to 480V: aR

External Regen Resistor

REGEN.TEXT = -1
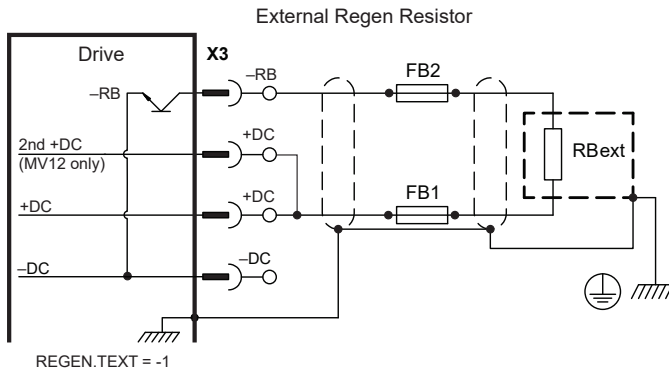
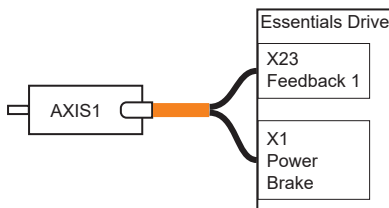## 8.9 Motor Power, Brake, and Feedback Connection

The 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 Kollmorgen motors the valid data are automatically set by the WorkBench motor database. Refer to parameter AXIS#.MOTOR.RTYPE for supported thermal sensors.

NOTICE 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 (➜ # 1).

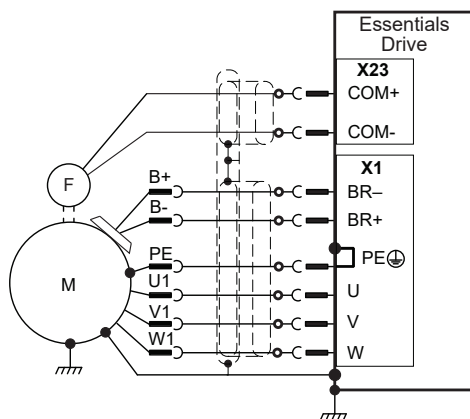### 8.9.1 Motor Connectivity Example

For grounding shield connection, see (➜ # 53)

8.9.2 Motor Cable Connection

Motors with two wire feedback systems like SFD-M or HIPERFACE DSL can be connected to the drive by using a single Kollmorgen hybrid cable.

8.9.2.1 Motor power and brake connector X1

- X1 (Feedback 1)
  - Motor Power: 4 pin, pitch 7.62 mm
  - Motor Brake: 2 pin, pitch 3.81 mm
  - Motor Feedback: 2 pin, pitch 3.81 mm
- Cable length: (➜ # 1)
- Use Kollmorgen cables
- Mating connector data (➜ # 1).
- Feedback types: SFD-M, HIPERFACE DSL
  - Rated voltage 11V.
  - Rated current is 350mA

8.9.2.2 Motor Leads to X1 Drive Connector

Pin	Signal	Description
1	BRAKE-	Negative connection to the mechanical brake
2	BRAKE+	Positive connection to the mechanical brake
3	PE	Protective earth
4	U	Connection to motor phase
5	V	Connection to motor phase
6	W	Connection to motor phase

8.9.2.3 Motor Feedback Cable Connector to X23 Drive Connector

Pin	Signal	Description
1	COM+	SFD-M / HDSL Positive Signal
2	COM-	SFD-M / HDSL Negative Signal

8.9.3 Motor Holding Brake Connection

A 24V 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).

The brake is powered by the 24V auxiliary supply on X10. Minimum and maximum brake current see Electrical Data (➔ # 36).

Connector	Usable for
X1	Motor brake

|	
⚠️	**⚠WARNING** **No functional safety!**
	Serious injury could result when the load is not properly blocked. The internal brake function does not ensure functional safety.
	• The Hardware Enable does not initiate a controlled stop but switches off the power stage immediately.
	• Set parameter AXISx.MOTOR.BRAKEIMM to 1 with vertical axes, to apply the brake immediately after faults or Hardware Disable.

Pinout X1

| Pin	Signal	Description
B+	BR+	Brake positive line
B-	BR-	Brake negative line

Wiring

Usually the brake line is part of Kollmorgen cable connection to X1 (➔ # 1).
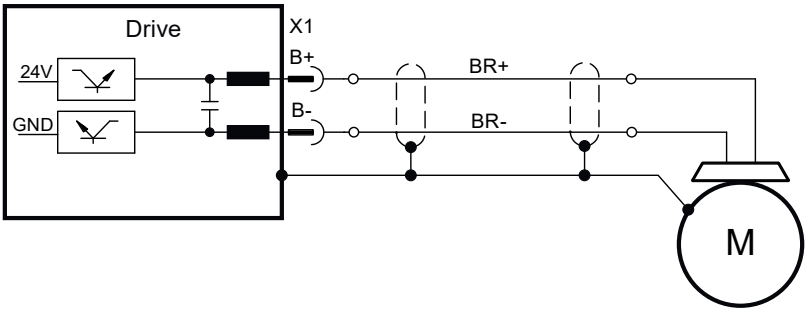
Functionality

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.
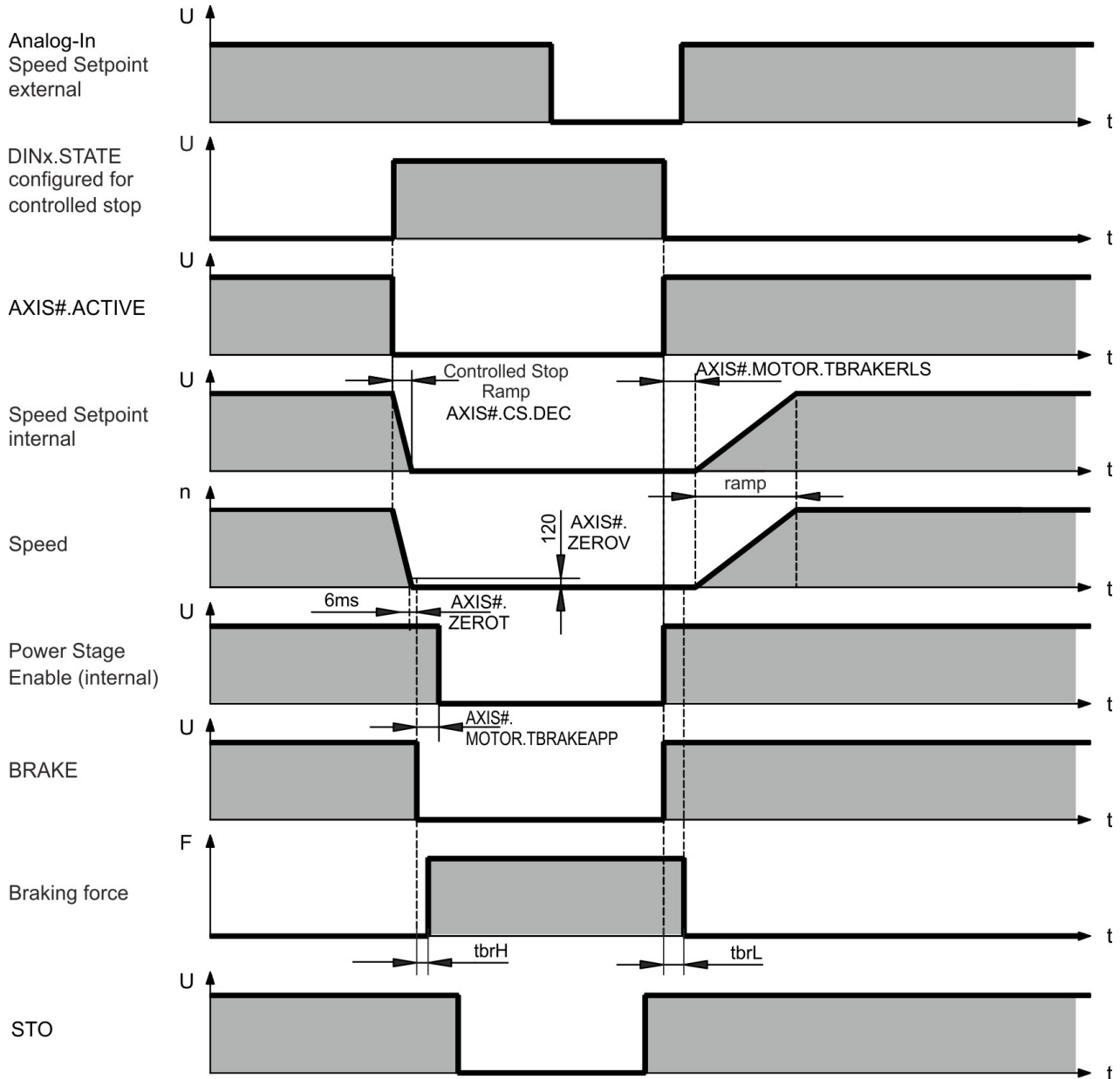
The drive speed setpoint is internally driven down an adjustable ramp (AXISx.CS.DEC) to 0 V.

With default values the output for the brake is switched on when the speed has reached 5 rpm (AXISx.ZEROV) for at least 6 ms (AXISx.ZEROT). 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.

8.10 Feedback Connector X23

The Kollmorgen Essentials Drive offers one feedback channel.

The usage of this feedback channel may be freely configured in the software, subject only to a few restrictions that are not physically sensible.

Cable length

Feedback Type	Max. cable length
SFD-M	25m / 50m*
SFD-3	25m / 50m*

*with choke

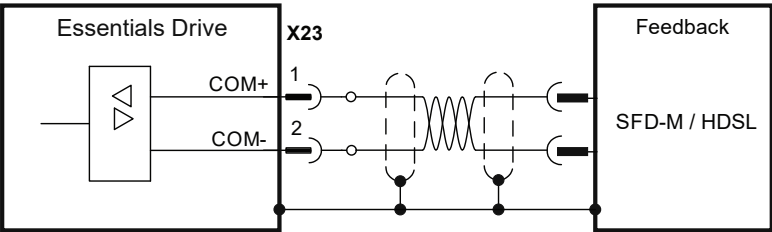### Specifications

- 2-wire connection with 12V signal
- SFD3, SFD-M and HIPERFACE DSL are supported
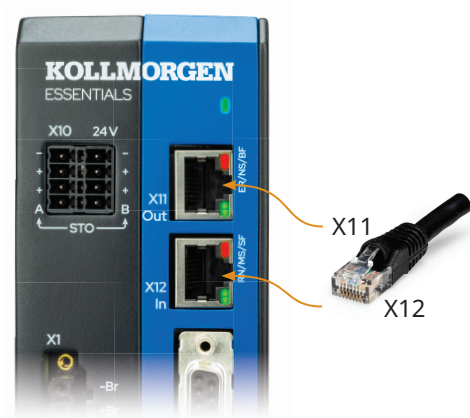- Up to 350mA available from 11V...12V at the drive

Wiring diagram

The diagram below shows the connection of the two-wire SFD3/SFD-M feedback system.

8.11 Industrial Ethernet Interface Connector X11/X12

The Industrial Ethernet interface has two RJ45 connectors with two associated LEDs at each port.

- RJ45 with built-in green/red bi-color LED
- EtherCAT®
- EtherNet/IP®
- PROFINET®

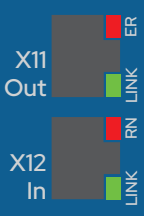| NOTICE	Industrial Ethernet interface X11/X12 pinout depends on the protocol used. Refer to the matching fieldbus communication manual.

Link/Activity LED

The link/activity LED at each port is green.

| LED	Meaning
Off	no connection
Lit	LINK: connection
Flashes	activity (packets detected)

8.11.1 EtherCAT®

The Kollmorgen Essentials Drive can be connected as a slave to the EtherCAT® network (CoE) by using RJ45 connectors X11 (out port) and X12 (in port). The communication status is indicated by the built-in connector LEDs.

	Port	LED Indicator		Function
	X11 Out	ER "ERROR"		Returns potentials communication failures:
			▪	Off = No Error
			▪	Blinking = Invalid configuration
			▪	Single Flash = Local error
			▪	Double Flash = Process data watchdog
		Link/ Activity	▪	On/Blinking: Physical link/Data Traffic on.
			▪	Static off: No link.
	X12 In	RN "RUN"		Returns the device state:
			▪	Off = INIT
			▪	Blinking = PRE-OPERATIONAL
			▪	Single Flash = SAFE-OPERATIONAL
			▪	On = OPERATIONAL
			▪	Flickering = Initialization or BOOTSTRAP
		Link/ Activity	▪	On/Blinking: Physical link/Data Traffic on.
			▪	Static off: No link.

Bus topology example (EtherCAT®)

We suggest to use Kollmorgen ENCP cables. For more possible system solutions refer to the WorkBench Online Help.
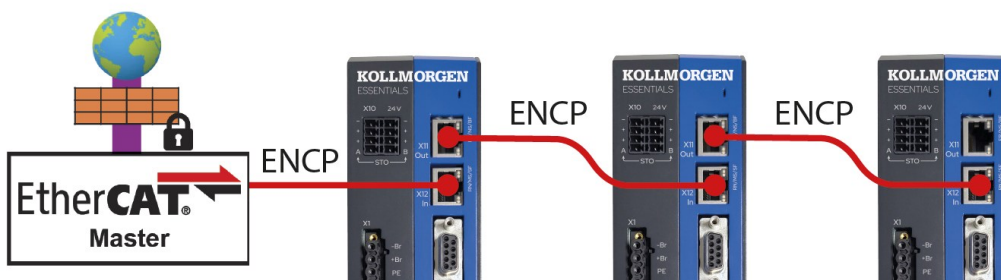
Communication profile

For EtherCAT® communication profile description refer to the manual *AKD2G EtherCAT® Communication*.
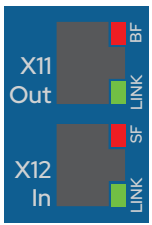
8.11.2 PROFINET

The Kollmorgen Essentials Drive can be connected as a slave to a PROFINET network by using RJ45 connectors X11 (Port 2) and X12 (Port 1). PROFINET RT or IRT protocols can be used.

Address

Set the fieldbus address automatically.

LEDs

The communication status is indicated by the built-in connector LEDs.

|	Port	LED Indicator		Function
	X11 Out	BF	🟥	ON = No Configuration, low speed, no link
			⬛	OFF = No Error
			🟥	Flashing 2Hz = No data exchange
		Link/ Activity	🟩	ON = Connection to the Ethernet
			⬛	OFF = No connection to the Ethernet
			🟩	Flashing = Sends/receives Ethernet frames
	X12 In	SF	🟥	ON = Watchdog timeout; channel / generic / extended diagnosis present; system error
			⬛	OFF = No Error
			🟥	Flashing 2Hz = DCP signal service is initiated via the bus
		Link/ Activity	🟩	ON = Connection to the Ethernet
			⬛	OFF = No connection to the Ethernet
			🟩	Flashing = Sends/receives Ethernet frames

Bus topology example (PROFINET)

We recommend to use ENCP cables. For more possible system solutions refer to the WorkBench Online Help.
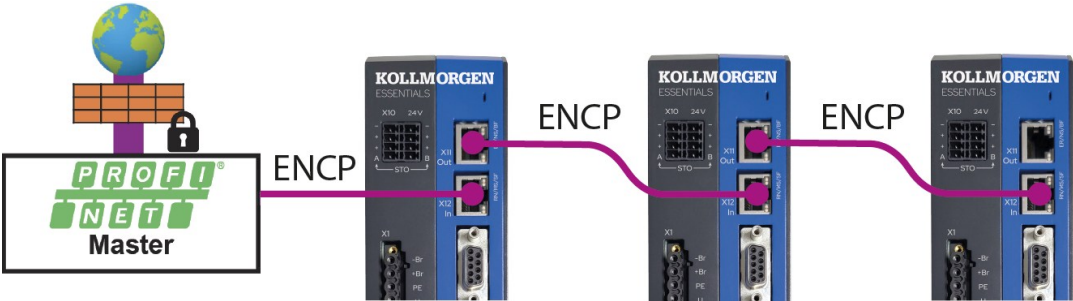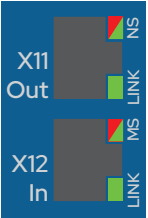
Communication profile

For PROFINET communication profile description refer to the manual *AKD2G PROFINET Communication*.

8.11.3 EtherNet/IP

The Kollmorgen Essentials Drive can be connected as a slave to an EtherNet/IP network by using RJ45 connectors X11 (Port 2) and X12 (Port 1). The communication status is indicated by the built-in connector LEDs.

	LED Indicator		Status	Function
		🟩	On	Connection
		🟩	Flashing	No Connection
	Network Status (NS)	⬛	Off	No power, No IP Address
		🟥	On	Duplicate IP Address
		🟥	Flashing	Connection Time-Out
		🟥	Flashing	Self-Test
	Link/Activity	🟩	On	Ethernet Connection
		⬛	Off	No Ethernet Connection
		🟩	On	Device Operational
		🟩	Flashing	Standby
	Module Status (MS)	⬛	Off	No Power
		🟥	On	Unclearable Fault
		🟥	Flashing	Clearable Fault
		🟥	Flashing	Self-Test
	Link/Activity	🟩	On	Ethernet Connection
		⬛	Off	No Ethernet Connection

Bus topology example (EtherNet/IP)

We suggest to use Kollmorgen ENCP cables. For more possible system solutions refer to the WorkBench Online Help.
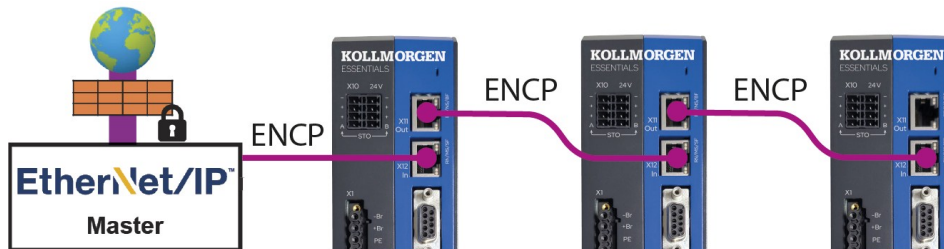
8.12 Service Interface Connector X20

The Service Interface X20 provides USB connection to a PC running WorkBench software for configuration, firmware updates and diagnostics.

8.12.1 Cables

Use standard USB-C data cables up to 2m length. One end of the cable must have a USB-C connector to plug into the drive. The other end which connects to a PC or USB hub may be USB-C or USB-A.

Use a standard USB hub for connections longer than 2m. For extreme lengths, use an active bidirectional optical USB cable up to 30m. Optical USB cables require a powered USB hub between the drive and the optical cable.

Note: For ease of access in a cabinet, you can use a cable with a 90 degree USB-C connector.

NOTICE Use data cables!
Some inexpensive USB cables are only designed for providing charging power.
These will not work for communicating with the drive.

8.12.2 Ferrites

In an electrically noisy environment, ferrites on the USB cable may be helpful to avoid inconsistent communications. A ferrite is most helpful on the PC end of the cable. Snap-on ferrite cores and USB cables with built-in ferrites are commonly available.

8.12.3 Network Configuration

8.12.4 Connection Examples

Standard USB-C to USB-C or USB-A cable (up to 2m)

Servo Drive (X20 USB-C)	≤ 2m	PC (USB-C or USB-A)
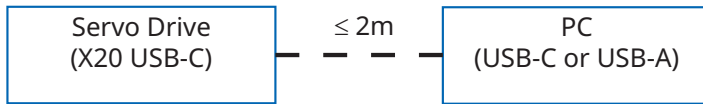
USB Hub for connections up to 4m

Servo Drive (X20 Interface)	≤ 2m	USB Hub (USB-C)	≤ 2m	PC (USB-C or USB-A)

Active bidirectional optical USB cable

Servo Drive (X20 Interface)	≤ 2m	Powered USB Hub (USB-C)	≤ 30m	PC (Optical USB)
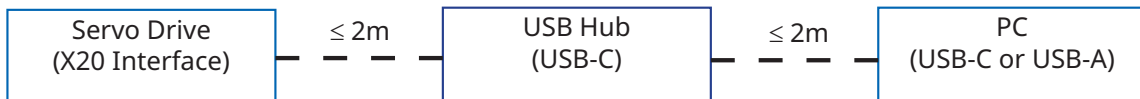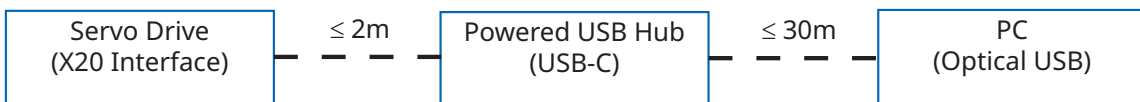
USB Hub with multiple drives

Servo Drive 1 (X20 Interface)		USB Hub (USB-C)		PC (USB-C or USB-A)
Servo Drive 2 (X20 Interface)				
Servo Drive 3 (X20 Interface)				
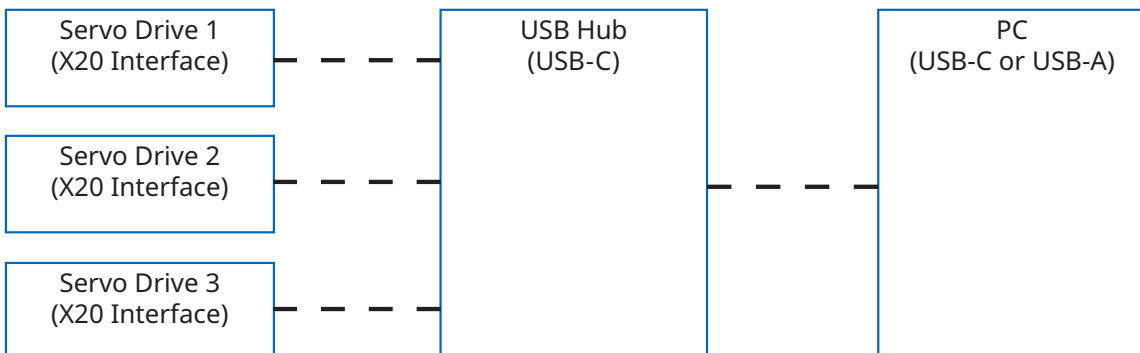
8.13   Digital I/O – X21

The drive provides 4 digital inputs and 2 digital outputs on the X21 DB9 (9-pin D-sub) port.

All inputs and outputs can be used to initiate pre-programmed actions. A list of actions is included in WorkBench. If an input, or output is programmed, it must be saved to the drive.

NOTICE	Maximum distance for unshielded I/O lines is 3m inside the cabinet. If the I/O cable leaves the cabinet, it must be EMC shielded.
NOTE	Depending on the selected function, the inputs are high or low active. Digital input filter can be set in WorkBench to change sensitivity of the inputs (see Online Help).

Type 1 digital inputs according to IEC61131-2 have the following input voltage current characteristics:
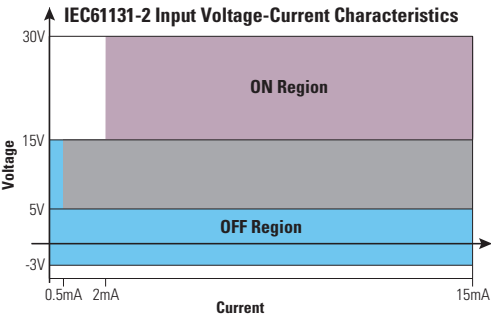
Channel	Type	Explanation
DIN1, DIN2	Fast, 24V, 61131-2 Type 1 input	An isolated, current sinking digital input referred to GND_24V. The threshold and current characteristics are IEC61131-2 Type 1. The activation delay (0->1) is <1µs and the de-activation delay (1->0) is <1µs. Additional filtering also takes place in the FPGA with selectable filter values. Can also support quadrature feedback.
DIN3, DIN4	Slow, 24V, 61131-2 Type 1 input	An isolated, current sinking digital input referred to GND_24V. The threshold and current characteristics are IEC61131-2 Type 1. The activation delay (0->1) is on the order of 5µs and the de-activation delay (1- >0) is on the order of 500µs. Additional filtering also takes place in the FPGA with selectable filter values.
DOUT1, DOUT2	Slow, 24V, Digital output	An isolated pair of volt-free contacts. Collector (+) and emitter (-) brought out to separate pins. 100mA rated with latch off upon over-current.

8.13.1 X21 Connector Pinout
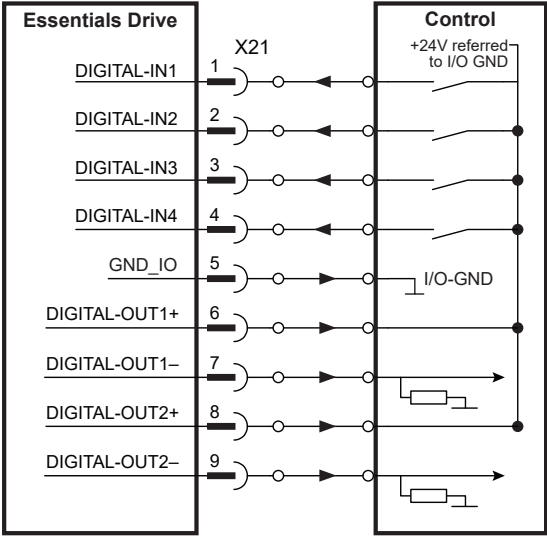
9   Setup

9.1 Important Notes

NOTICE

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.
- In normal operation, the cabinet door must be closed and the device must not be touched.

⚠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 AXIS#.ENDEFAULT is set to 1,

- then place a warning sign ("WARNING: Possible Automatic Restart" or similar) to the machine.
- ensure, that power on is enabled, while humans 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.

⚠WARNING   **Projection of molten particles!**

If particles fall into the drive or the drive has been damaged, molten drive component particles may be ejected causing injuries. Shut down the drive and wear appropriate protective gear during maintenance work, troubleshooting and fault rectification.(➜ # 25)

NOTICE

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 the KDN (Forming).

NOTE

Additional information on setting up the equipment:

- Programming parameters and control loop behavior are described in the AKD2G User Manual (Online Help), see Configuring the Command Source and Operating Mode.
- The setup of any fieldbus is described in the corresponding manual.

9.2 Guide to Drive Setup

Setup your drive in two major steps:

1. Drive setup (this section). This section presents an example to test the drive initially. If the drive (motor, feedback, control circuits, I/Os) is well parameterized, then proceed with step 2.
2. Functional Safety setup (→ # 114) .

9.2.1 Initial Drive Test Procedure

9.2.1.1 Unpacking, mounting, and wiring the Kollmorgen Essentials Drive

1. Unpack the drive and accessories.
2. Mount the drive.
3. Wire the drive or apply the minimum wiring for drive testing as described below.
4. 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

9.2.1.2 Minimum wiring for drive test without load, example

| **NOTICE** | This wiring diagram based on default settings is for general illustration only and does not fulfill any requirements for EMC, functional safety, or functionality of your application. |

Image TBD - Min Drive test wiring no load

9.2.1.3 Confirm connections (example: directly to PC)

You can turn on logic power to the drive through the X10 connector (mains power voltage is not needed for communications).
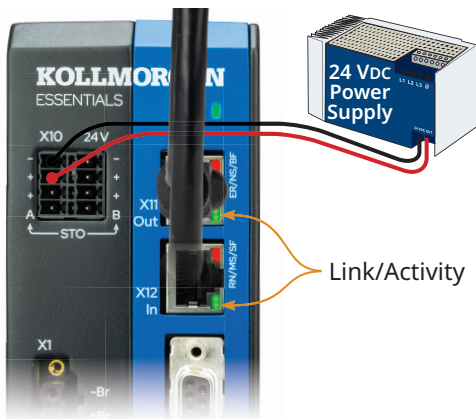
Confirm that the link LEDs on the drive (green LED on the RJ45 connector) and on your PC are both illuminated. If both LEDs are illuminated, then you have a working electrical connection.

Use WorkBench to configure the drive by using the service interface.
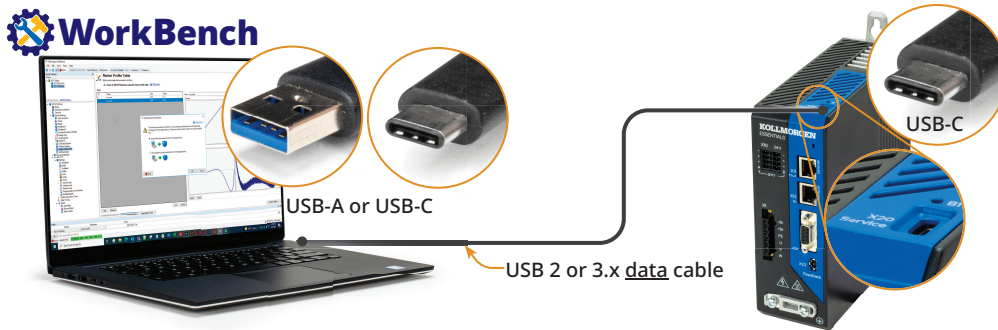
9.2.1.4 Industrial Ethernet Setup

Before connecting the drive to a PLC

1. Select the desired Industrial Ethernet type through the WorkBench software.
2. Follow the instructions in this manual to install WorkBench and connect to the drive.
3. Select the desired protocol in Express Setup or in the Industrial Ethernet view in Full Setup.

After selecting the protocol, set the device address.

PROFINET

Set the station name and IP address manually through the PROFINET master.

EtherNet/IP

Set the IP address for EtherNet/IP from the Industrial Ethernet view in WorkBench.

9.2.1.5 Install and start WorkBench

WorkBench is available on the Kollmorgen website. Select the install file and follow the instructions given by the installer.

Once the installation is complete, click the WorkBench icon to start the program.

9.2.1.6 Setup the axis in WorkBench

Use the setup wizard and

1. Connect the axis
2. Setup the axis
3. Save the parameter set to the drive

Refer to the WorkBench Online Help for details.

9.2.1.7 Enable the axis (Hardware)

1. Switch on 24V to X10 using any of the (+) and (-) pins. This will power on the drive logic.
2. Switch on 24V to the STO inputs (A) and (B) on X10. This will allow the drive to be enabled.

NOTE	• The X10 (+) pins are all internally connected allowing logic power to be bussed across multiple drives. The same is true for X10 (-) pins
	• If machine STO is not required at this point, the plug is setup to easily jumper 24V from (+) to (A) on the left side of the plug, and from (+) to (B) on the right side of the plug. This will allow the drive to be enabled. For use in a machine, the input voltage to (A) and (B) is provided by the machine safety circuit.

9.2.1.8 Move the motor axis

1. Select the Axis in WorkBench
2. Under Motion, select **Service Motion**
3. Select **Reversing**, check the default velocity and time settings for plausibility
4. Select **Start**.

9.2.1.9 Tune the axis

Details see *WorkBench Online Help*

9.2.2 WorkBench Installation

This chapter describes the installation of the WorkBench software for the Kollmorgen Essentials Drive. Kollmorgen offers training and familiarization courses on request.
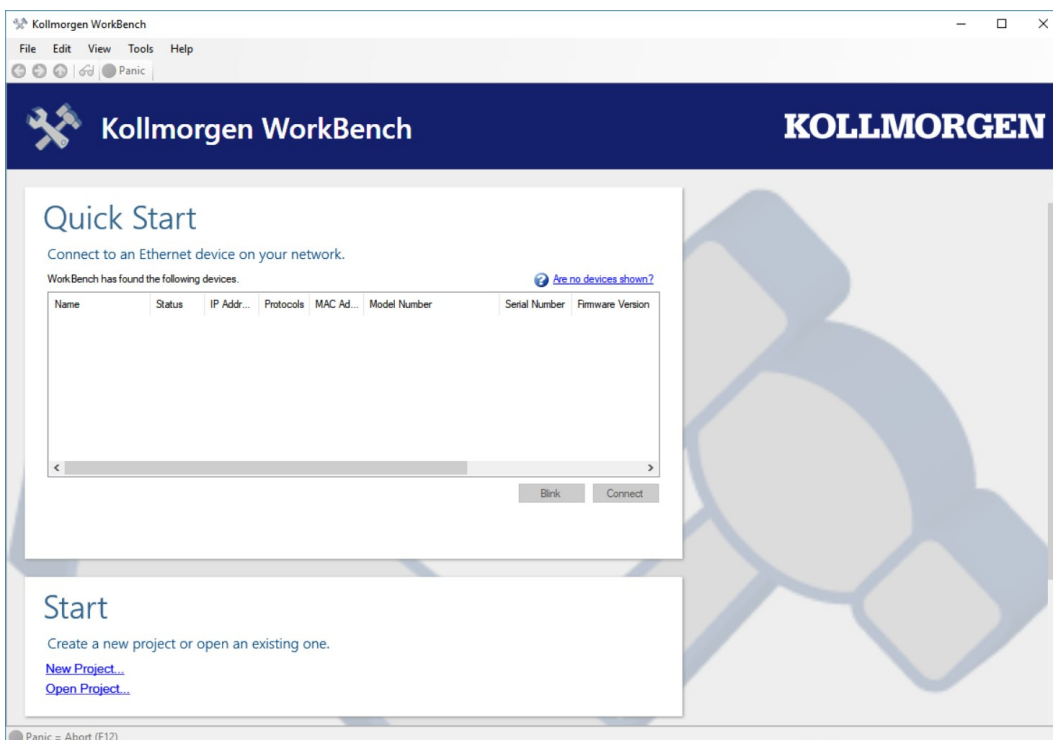
9.2.2.1 Use as directed

With the software to set up your drive you can alter and save the operating parameters for the Kollmorgen Essentials Drive series. The attached drive can be set up with the help of this software. 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. The use of unchecked data can result in unexpected movement. After loading a set of data always validate parameters which are relevant for the application before enabling the drive.

9.2.2.2   Software description

Each drive must be configured according to the requirements of your machine. For most applications you can use a PC and WorkBench (the software to setup your drive) to set up the operating conditions and parameters for your drive.

An Ethernet cable connects the PC with the drive (→ # 1), WorkBench establishes the communication between PC and drive.
Please find the software to set up your drive in the download area of the Kollmorgen website.

With WorkBench you can

- easily change parameters and directly see what happens with your drive due to a continuous online connection to the drive,
- read important and actual values from the drive which are displayed on the PC (oscilloscope functions),
- save data sets on data media (archiving) and load them onto other drives or use them for backup and
- print data sets.

Most standard feedback systems 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 Kollmorgen motors are stored in WorkBench and can be loaded with one-click using the Motor screen in the software.

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

9.2.2.3   Hardware requirements

The Service Interface X20 provides USB connection to a PC running WorkBench software for configuration, firmware updates and diagnostics.

Minimum requirements for the PC:

Processor: at least 1 GHz
RAM: 2 GB
Graphics adapter: Windows compatible, color, minimum 1024 x 768 dpi
Drives: hard disk with at least 500 MB free space
Interface: one free Ethernet Interface or Switch port

9.2.2.4   Operating systems

Windows 7/8/10/11

- WorkBench works with Windows 7, 8, 10 and 11
- .Net framework 4.8.1 or higher is required
- Visual C++ Redistributable (2010, 2013, 2015)
- Internet Explorer 10 or higher

Unix, Linux

The software does not run on Unix/Linux.

9.2.2.5 Installation under Windows 7/8/10/11

Use WorkBench to setup your drive. You can download the latest version from the Kollmorgen website.

Install the WorkBench as follows:

1. Download one of the following installation packages from www.kollmorgen.com:

- Standard installation: Contains the application with complete help files. Dependencies like for example the .NET Framework will be downloaded from the internet if not already installed.
- Full installation: Contains the application with complete help files and embedded dependencies like for example the .NET Framework.

2. After complete download, double-click on the downloaded file and follow the instructions.

Ethernet interface connection

- Connect the interface cable to an Ethernet interface on your PC and to the service interface X20 (➜ # 81).

9.3 Switch-On and Switch-Off Behavior

This chapter describes the switch-on and switch-off behavior of the Kollmorgen Essentials Drive with STO.

Behavior of "holding brake" function

Drives with an enabled holding brake function have a special timing for switching on and off the output stage (➜ # 1). Events that remove the AXIS#.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.

If the drive detects the motor to be at zero velocity (as configured by AXIS#.ZEROT and AXIS#.ZEROV) or timeout occurs during a stop procedure, the brake is applied. Set parameter AXIS#.MOTOR.BRAKEIMM to 1 with vertical axes, to apply the motor holding brake (➜ # 1) 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 WorkBench Online Help for configuring the parameter.
0	The drive will report a F2007 undervoltage fault any time an undervoltage condition occurs.
1 (default)	The drive will report a warning W2007 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.

9.3.1 Switch-on Behavior in Standard Operation

The diagram below illustrates the correct functional sequence for switching the drive on.

U

24V

t

Ready to operate

t

≈ 15s (boot time)

U

Main Power

t

U

DC Bus Link

t

≈ 500ms

U

STO

t

U

HW-ENABLE
&
Fieldbus/SW-
ENABLE

> 100ms

t

U

Power Stage
enable

t

n

Motor Speed

t
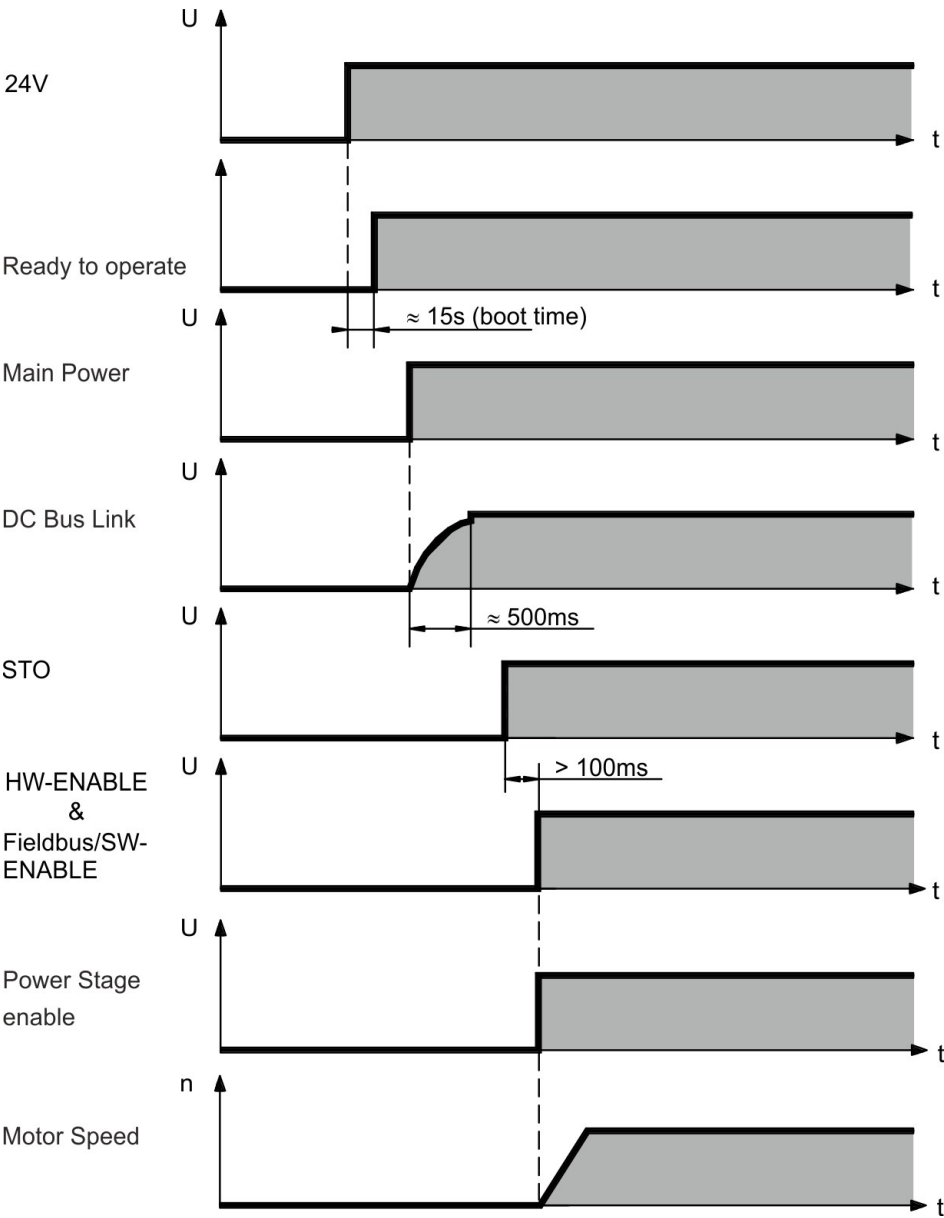
9.3.2 Switch-off Behavior

| **NOTE** | The drive's 24V supply must remain constant. STO disables the power stage immediately. Configured digital inputs and fieldbus commands can be used to perform controlled stops. |

9.3.2.1 Switch-off behavior using the AXIS#.DIS command

The enable/disable button in WorkBench issues a *AXIS#.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).

AXIS#. DISMODE	*AXIS#.DISMODE* controls the behavior of the *AXIS#.DIS* command issued through WorkBench, or terminal, or fieldbus.
0	Disable axis immediately, if the drive detects the motor to be at zero velocity *AXIS#.ZEROV* or timeout occurs brake is applied. Category 0 stop according to IEC 60204 (➜ # 19).
2	Use controlled stop to disable drive, if the drive detects the motor to be at zero velocity *AXIS#.ZEROV* or timeout occurs brake is applied. Category 1 stop according to IEC 60204 (➜ # 19).
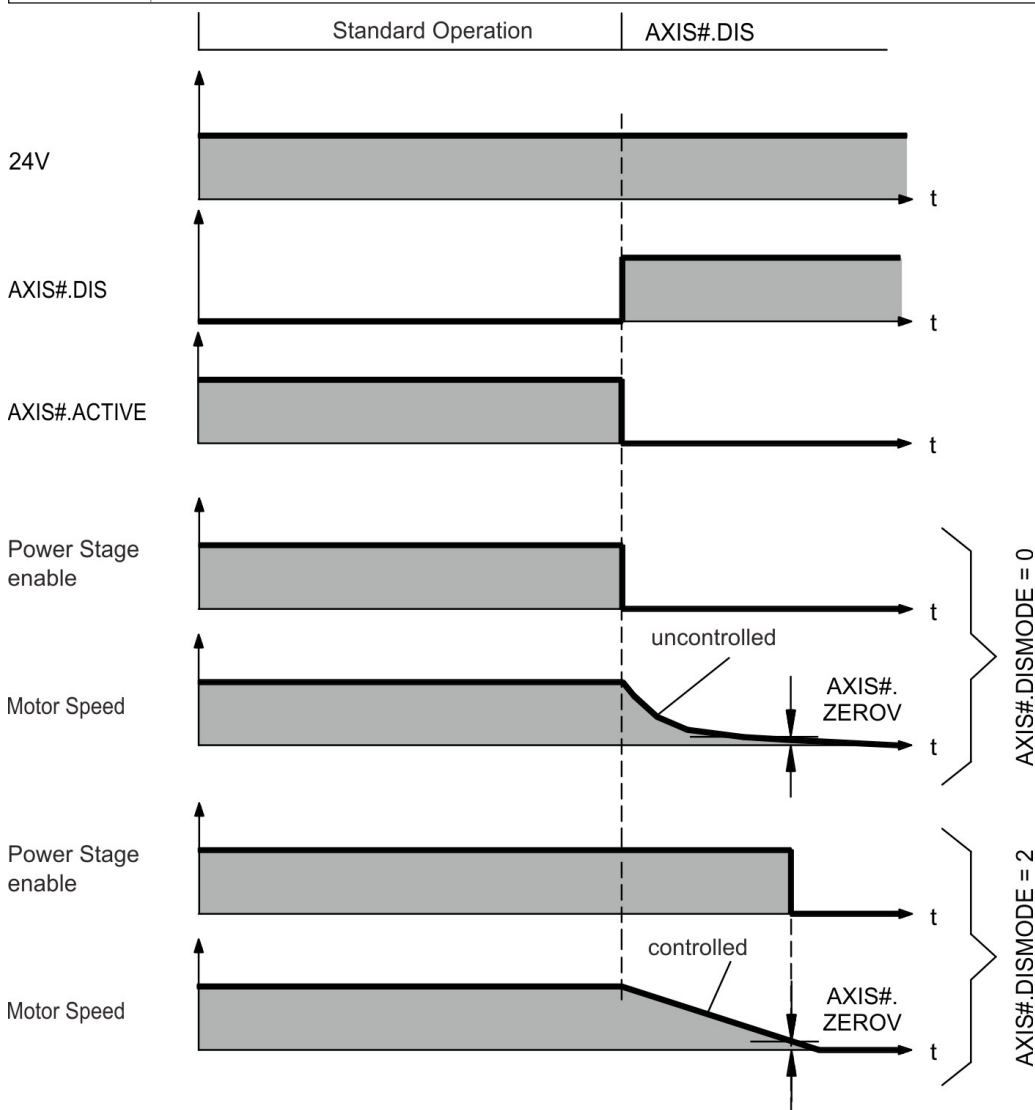
If the drive detects the motor to be at zero velocity (AXIS#.ZEROV) or timeout occurs (AXIS#.ZEROT), the motor brake is applied (➜ # 1).

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

This is a category 1 stop according to IEC 60204 (➔ # 19).
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.
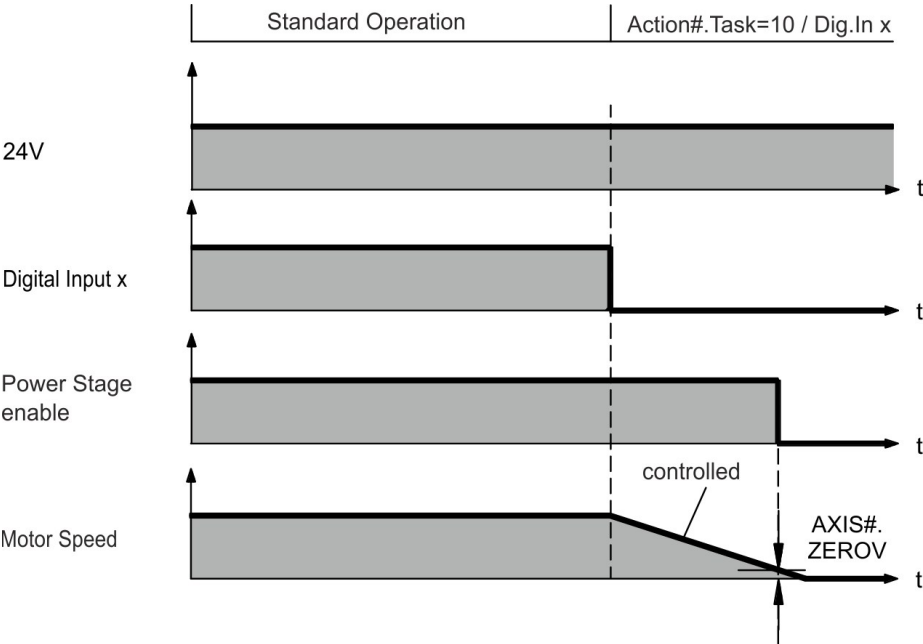
If the drive detects the motor to be at zero velocity (AXIS#.ZEROV) or timeout occurs (AXIS#.ZEROT), the motor brake is applied (➔ # 1).

9.3.2.3   Switch-off behavior using STO input (uncontrolled stop)

This is a category 0 stop according to IEC 60204 (➔ # 19).
The STO input disables the power stage immediately.
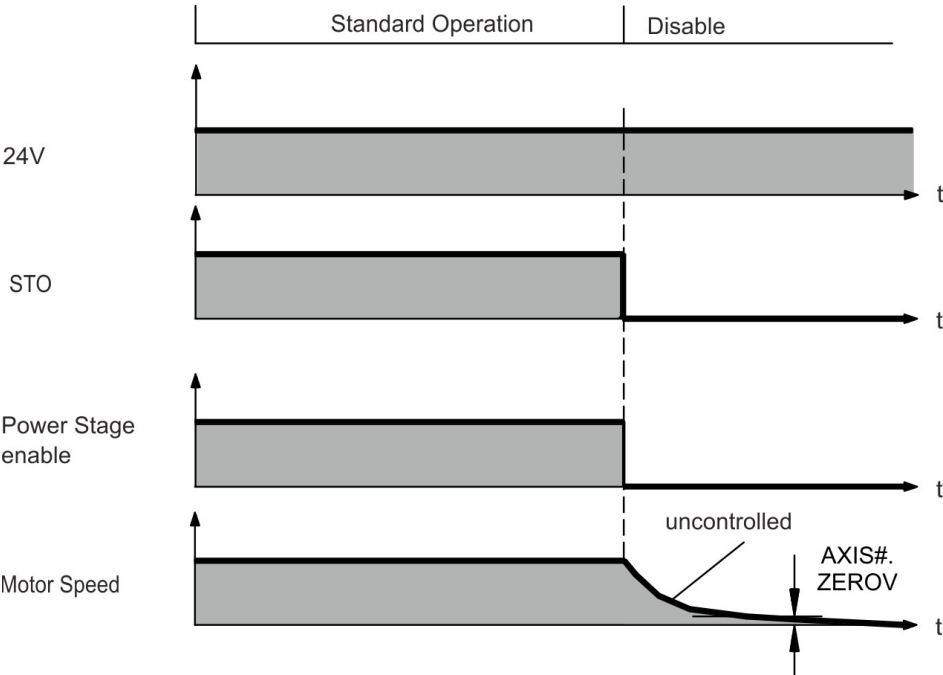
If the drive detects the motor to be at zero velocity (AXIS#.ZEROV) or timeout occurs (AXIS#.ZEROT), the motor brake is applied (➔ # 1). Set parameter AXIS#.MOTOR. BRAKEIMM to 1 with vertical axes, to apply the motor holding brake immediately after STO.

9.3.2.4 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 (AXIS#.DISMODE, VBUS.UVFTHRESH, AXIS#.ZEROV, and others; see the *WorkBench Online Help* for more details). See the *Drive Fault and Warning Messages and Remedies* section of the *WorkBench User Manual* for a table describing the specific behavior of each fault. The next pages show examples for the possible fault behaviors. The fault relay output (DOUT9) switches the main contactor (Emergency Off circuit).

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

This is a category 0 stop according to IEC 60204 (➔ # 19).

If the drive detects the motor to be at zero velocity (AXIS#.ZEROV) or timeout occurs (AXIS#.ZEROT), the motor brake is applied (➔ # 1). Set parameter AXIS#.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

This is a category 2 stop according to IEC 60204 (➜ # 19).
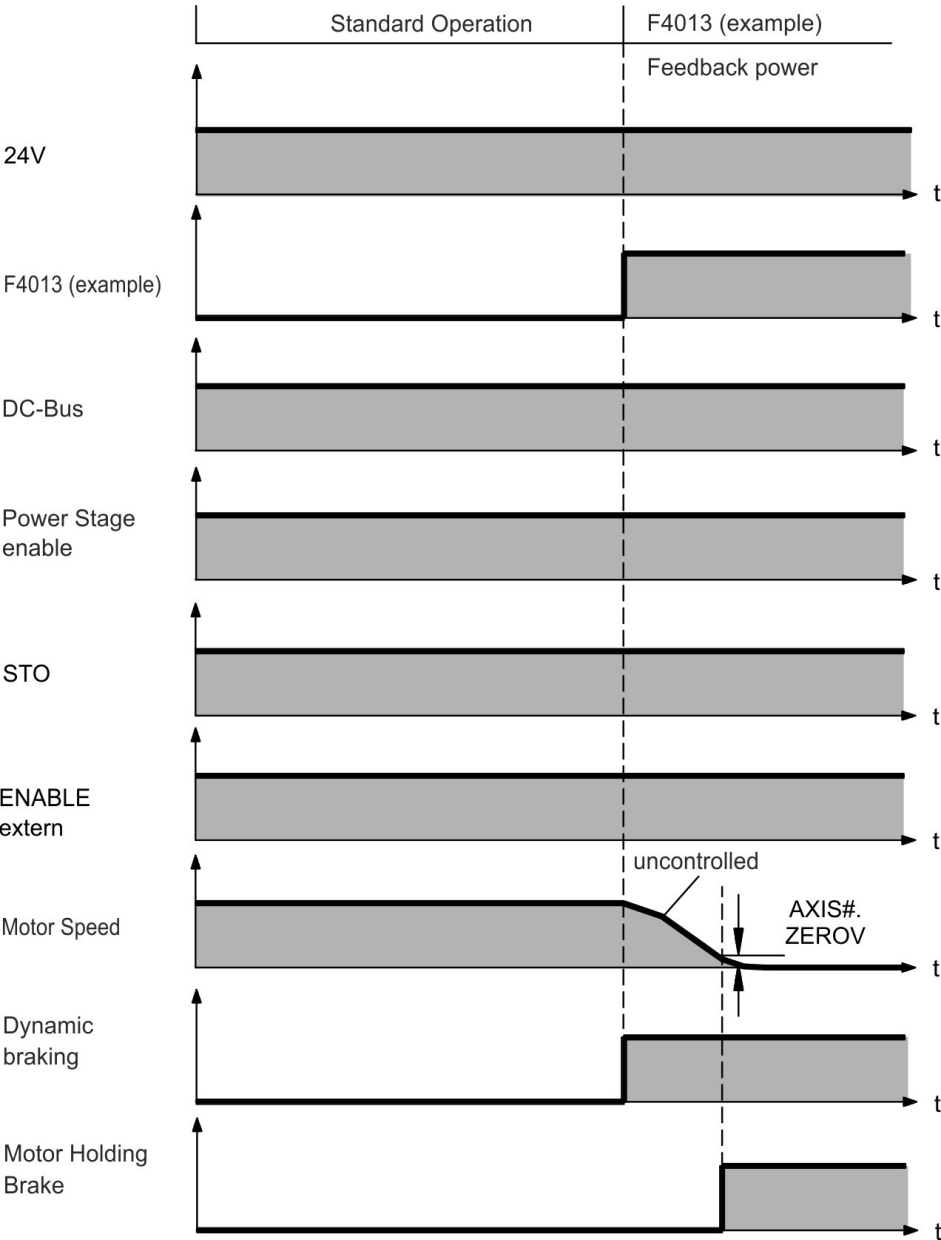
If the drive detects the motor to be at zero velocity (AXIS#.ZEROV) or timeout occurs (AXIS#.ZEROT), the motor brake is applied (➜ # 1).

Switch-off behavior for faults that cause a controlled stop
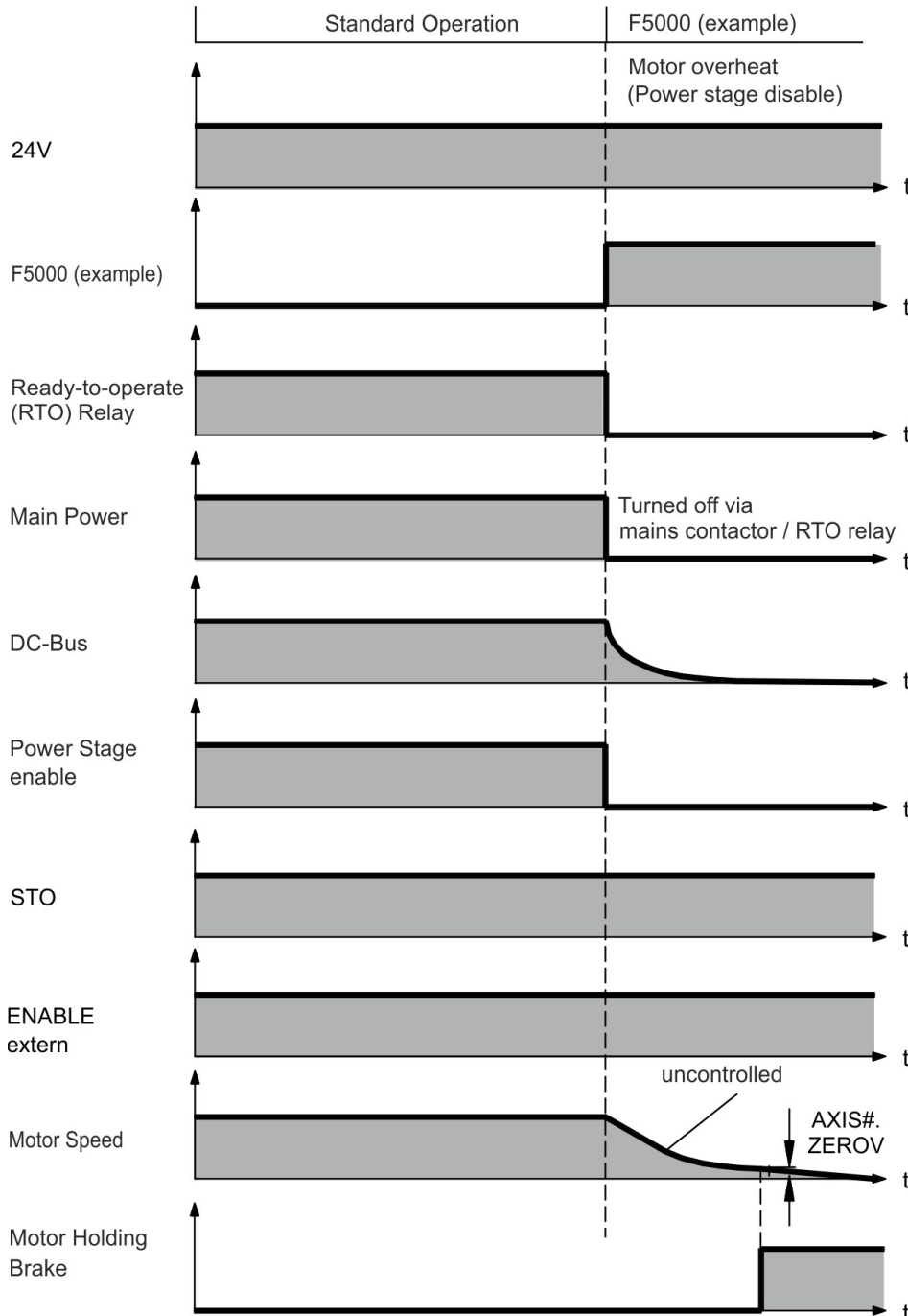
This is a category 2 stop according to IEC 60204 (→ # 19).
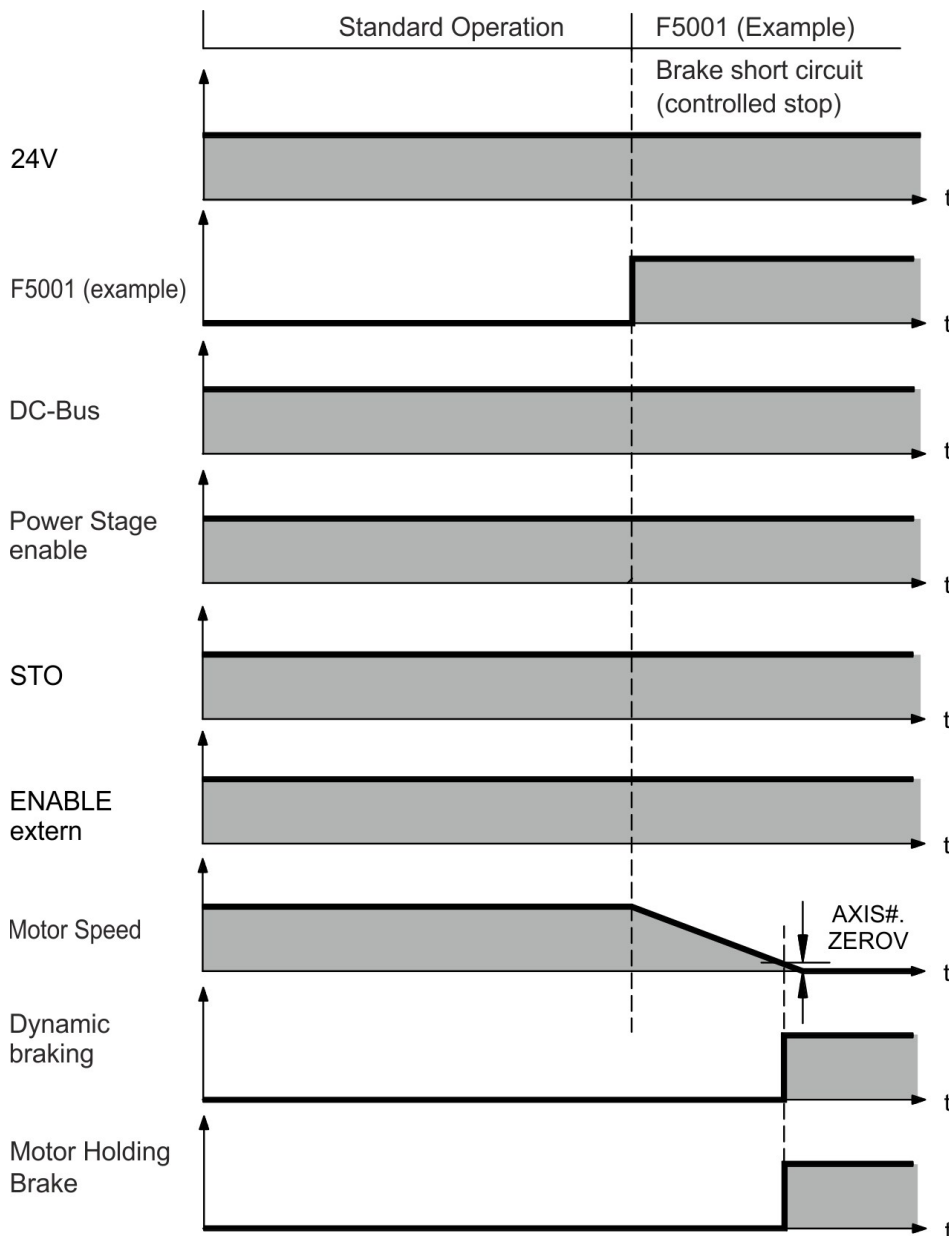
If the drive detects the motor to be at zero velocity (AXIS#.ZEROV) or timeout occurs (AXIS#.ZEROT), the motor brake is applied (→ # 1).

9.4 Fault and Warning Messages

Definition

A fault is generally a notification of a critical system failure which will stop machine operation. Depending on the severity of the fault will depend on which system-stop mechanism is used.

A warning is generally a notification to the user which is not critical and does not require the machine to immediately shut off.

Faults and Warnings follow the same pattern and are identified by a four digit code:

G G X X, where GG is a two digit group code, and XX is a two digit ID.

GG	Group	GG	Group
10	System	4#	Feedback (# indicates feedback number)
11	File	50	Motor
15	Hardware	55	Wake and Shake
20	Power	60	Motion
25	Temperature	70	Fieldbus
30	Software	90	Safety

The following ways will help you identify a system failure:

1. Visible inspection: See status LED on the front side of the drive (➜ # 38).
2. Via Fieldbus: Fault status will be reported to higher level PLC.
3. Via Service port: Connect the drive directly to your PC via USB and identify any errors with WorkBench.

NOTICE	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 WorkBench User Manual.

9.5 Troubleshooting

Drive problems occur for a variety of reasons, depending on the conditions in your installation. If you cannot resolve a fault or other issue using the troubleshooting guidance presented below, customer support can give you further assistance.

NOTICE	Eliminate errors and faults in compliance with work safety rules. Troubleshooting only by qualified and trained staff.
NOTE	More details on the removal of faults can be found in the WorkBench User Manual.

Problem	Possible Causes	Remedy
HMI message: Communication fault	1. wrong cable used, cable plugged into wrong position on drive or PC 2. wrong PC interface selected	1. plug cable into the correct sockets on the drive and PC 2. select correct interface
Drive does not enable	1. HW Enable configured but not wired 2. HW or SW Enable not set	1. connect HW Enable to the selected input 2. Apply 24V to HW Enable and select SW Enable in WorkBench / Fieldbus
Motor does not rotate	1. drive not enabled 2. software enable not set 3. break in setpoint cable 4. motor phases swapped 5. brake not released 6. drive is mechanically blocked 7. motor pole no. set incorrectly 8. feedback set up incorrectly	1. apply ENABLE signal 2. set software enable 3. check setpoint cable 4. correct motor phase sequence 5. check brake control 6. check mechanics 7. set motor pole no. 8. set up feedback correctly
Motor oscillates	1. gain is too high (speed controller) 2. feedback cable shielding broken 3. AGND not wired up	1. reduce AXIS#.VL.KP (speed controller) 2. replace feedback cable 3. join AGND to CNC-GND
Drive reports following error	1. Irms or Ipeak set too low 2. current or velocity limits apply 3. accel/decel ramp is too long	1. verify motor/drive sizing 2. verify that AXIS#.IL.LIMITN/P, AXIS#.VL.LIMITN/P are not limiting the drive 3. reduce AXIS#.ACC/AXIS#.DEC
Motor overheating	1. motor operating above its rating 2. motor current settings incorrect	1. verify motor/drive sizing 2. verify motor continuous and peak current values are set correctly
Drive too soft	1. AXIS#.VL.Kp (velocity) too low 2. AXIS#.VL.Ki (velocity) too low 3. filters set too high	1. increase AXIS#.VL.KP (velocity) 2. increase AXIS#.VL.KI (velocity) 3. refer to documentation regarding reducing filtering (AXIS#.VL.AR*)
Drive runs roughly	1. AXIS#.VL.Kp (velocity) too high 2. AXIS#.VL.Ki (velocity) too high 3. filters set too low	1. reduce AXIS#.VL.KP (velocity) 2. reduce AXIS#.VL.KI (velocity) 3. refer to documentation regarding increasing filtering (AXIS#.VL.AR*)

10   Safety Manual for FS1

Revision History for Safety Manual

Revision	Remarks
S101, ??/2025	Functional Safety Option 1

The Safety Manual is valid for:

Kollmorgen Essentials Drive with Functional Safety Option 1 (FS1)

KED - xxx - xxxxx - x1xx - xxxx

Safety Functions: STO; SIL2 PLd, activation by digital I/O

Hardware Revision	Drive Firmware	WorkBench
A (BETA VERSION)		

Contents:

10.1 General Notes

Resulting Functional Safety classification (SIL and/or PL level) is calculated across the drive system. The drive system usually consists of the following:

- motion controller (e.g. AKC/KAS),
- safety controller (e.g. KSM),
- servo drives (Kollmorgen Essentials Drive) and servo motors (e.g. Kollmorgen Essentials Motor),
- motor brakes, feedback systems,
- cables to connect drive and motor,
- sensors/actors

The safety properties listed in this chapter can be reached with Kollmorgen components.

| **NOTICE** | Ensure the compliance of the application with all relevant directives and local electrical code. You are responsible for implementation and validation of the drive system and safety system. |

Only properly qualified personnel are permitted to perform installation, setup and verification/validation tasks.

- Mechanical installation: only by qualified personnel with mechanical expertise according to IEC 60417-6183.
- Electrical installation: only by qualified personnel with electrotechnical expertise according to IEC 60417-6182.
- Parameterizing Functional Safety: only by trained personnel with expertise appropriate to the complexity and safety integrity level of the drive system.
- Verification/Validation: only by trained personnel after any changes to the installation. The expertise of the personnel must be appropriate to the complexity and safety integrity level of the drive system.

| **NOTE** | Safe State (= STO Active): | In a safe state the drive removes the motor torque from all axes. |

⚠ **CAUTION** **High electrical voltage!**

Risk of electrical shock! The safety functions do not provide an electrical separation from the power output. If manual access to the motor or drive power terminals is necessary,

- disconnect the drive from mains supply,
- consider the discharging time of the DC-Bus link,
- ensure the cabinet is safely disconnected and protected against unintended switch-on (for instance, with a lock-out and warning signs).

⚠ **WARNING** **Projection of molten particles!**

If particles fall into the drive or the drive has been damaged, molten drive component particles may be ejected causing injuries. Shut down the drive and wear appropriate protective gear during maintenance work, troubleshooting and fault rectification.(➜ # 25)

10.1.1 Use as directed

Safety functions are intended to reduce the risk of the machine operation to the required tolerable risk. To achieve functional safety, the wiring of the safety circuits must meet the safety requirements of IEC 60204, ISO 12100 and ISO 13849.

NOTICE	- The network the drive is connected to must be secured according to state-of-the-art information technology security requirements. - The IT specialists shall analyze whether further security requirements are applicable to ensure functional safety. - The drive firmware can be updated. The parameter sets must be reloaded, verified and proof tested before normal operation is started. - In certain types of machinery, two motors drive a single mechanical axis. It is the responsibility of the user to ensure that a fault reaction on the first motor-drive set is also carried out on the second motor-drive set and vice versa. Safe I/O and/or a safe fieldbus such as FSoE can be used to achieve this.

10.1.2 Prohibited use

The safety functions must not be used if the drive is to be made inactive for Emergency-Off situations. In an Emergency-Off situation, the main relay is switched off by the Emergency-Off button.

The STO function requires two-channel control if the performance level SIL2 / PLd Cat.3 in the system is to be achieved. The connection of a constant 24 VDC voltage to one of the STO inputs is not permitted if the safety function is to be used.

Never modify the drive!

Never open the cover of the drive, as the electronic components installed there generate dangerous high voltages. Even after disconnection from the mains, the components often still carry high voltage.
Therefore, the drive may only be opened by authorized specialist personnel.

Kollmorgen can't be held accountable for any defects, malfunctions or degradations resulting from users opening up the device. In case of damage or malfunction, send the drive for repair or replacement.

10.1.3 Abbreviations used for functional safety

More abbreviations see (➔ # 11).

Abbreviation	Meaning
A#, AXIS#	A# or AXIS# are placeholders for the axis number. Used with parameters (AXIS#.SAFE.STO.ACTIVE) or signal names (STO-A-A#)
(➔ # 53)	"see page 53" in this document
➔ xyz	"see chapter xyz" in this document
CCF	Common Cause Failure
FS1	Functional Safety Option 1 (STO)
HFT	Hardware Fault Tolerance
MTTFd	Mean time to dangerous failure
OSSD	Output Switching Signal Device
PELV	Protective Extra Low Voltage
PFH	Probability of dangerous failure per hour
PL	Performance Level
SC	Systematic Capability
SFF	Safe Failure Fraction
SIL	Safety Integrity Level
STO	Safe Torque Off
TM	Mission Time

10.1.4 Enclosure, wiring

Enclosure

Since the drive meets IP20, you must select an enclosure that permits safe operation of the drive. The enclosure must at least meet IP54 .

Transport in accordance with IEC 61800-2	
NOTE	Transport only in the manufacturer's original recyclable packaging.
Temperature	-25 to +70 °C, maximum rate of change 20 K/hour, class 2K3.
Relative Humidity	max. 95% at +40 °C, no condensation, class 2K3.
Shock	**NOTICE:** Avoid shocks while transporting. Drive modules are tested for environmental class 2M1 of IEC 60721-3-2.

Storage in accordance with IEC 61800-2	
Temperature	-25 to +55 °C, maximum rate of change 20 K/hour, class 1K4.
Relative Humidity	5 to 95% , no condensation, class 1K3.

Operation in accordance with IEC 61800-2	
Environmental Class	Environmental class 3K3
Temperature	Internal regen resistor used: • 0 to +40 °C under rated conditions • +40 to +60 °C with current derating 3 % per Kelvin Internal regen resistor not used: • 0 to +50 °C under rated conditions • +50 to +60 °C with current derating 2% per Kelvin
Relative Humidity	5 to 85%, no condensation, IEC 61800-2 class 3K3
Site Altitude	• Up to 1000 m above mean sea level (AMSL): no restriction • 1,000 to 2,000 m AMSL: power derating 1.5%/100 m • Maximum altitude: 2000 m AMSL
Drive EMC Immunity	Increased immunity according to EN 61800-5-2
Drive Pollution Level	Pollution level 2 as per IEC 60664-1
Drive Vibration Class	Class 3M1 according to IEC 61800-2
Drive Shock Class	Class L according to IEC 61800-2
Drive Protection Class	IP20 according to IEC 60529
Enclosure	Minimum cabinet size (WxHxD): 406 x 406 x 254 mm
Enclosure Protection	At least IP 54 according to IEC 60529

Wiring

Wiring inside the specified enclosure (IP54) must meet the requirements of the standard IEC 60204-1 and ISO 13849-2 (Table D.4). Use copper wires, 0.5 mm² (20 awg), wire ferrules. Maximum distance for unshielded I/O lines is 3 m inside the cabinet. If the I/O cable leaves the cabinet, it must be EMC shielded.

Wiring outside the specified enclosure must be laid durably protected from outside damage (for example, by laying the cable in a duct, placed in different sheathed cables, or protected individually by grounding connection).

NOTICE	When wiring the digital inputs and outputs, take care that short circuits between the inputs, outputs, or to supply lines are avoided.

10.2   Verification

Check and verify the STO wiring (examples (→ # 110)). The installation must be verified by trained personnel after any changes to the installation. The expertise of the personnel must be appropriate to the complexity and safety integrity level of the drive system.

Diagnostic test

| **NOTICE** | You must test the STO function after initial start of the axis, after each intervention into the wiring of the system, or after exchange of one or several components of the drive system. The proof test interval is one year to meet the required PFH. |

Precondition: AXIS#.SAFE.STO.REPORTFAULT = 1

Warning: Do not enter hazardous area during proof test!

Method 1, axis remains enabled	Method 2, axis disabled
1. Stop the axis to standstill.	1. Stop the axis to standstill.
2. **Caution: Block vertical load.**	2. **Caution: Block vertical load.**
3. Keep the axis enabled.	3. Disable the axis.
4. Activate the STO function for example by opening the protective screen.	4. Activate the STO function, for example, by opening the protective screen
5. The axis displays fault F9000.	5. The axis displays fault W9000.

10.3 Safety Function Option 1 (I/O, SIL2 PLd)

The safety function STO on the Kollmorgen Essentials Drive with functional safety option 1 is certified.

| **NOTICE** | The drive is ready to operate with pre-configured STO function. |

Standards

Standard	Content
ISO 13849:2023	Safety of machinery: Safety-related parts of control systems
IEC 62061:2021	Functional safety of electrical/electronic/programmable electronic safety-related systems

Available Safety Functions

Abbr.	Function	Activation	Refer to
STO	Safe Torque Off	Safe digital inputs for one or for both axis	(➔ # 110)

10.3.1 Safety Properties Overview

OSSD test pulses are not required. The inputs however are compatible with safety equipment that emits test pulses. Incoming test pulses of up to 1 ms duration are ignored. The dwell time of the test pulses should not exceed 10%.

The hardware fault tolerance is HFT = 1 according to IEC 61508. Two faults might lead to loss of the safety functions.

The systematic capability according to IEC 61508 for the safety-related subsystems of the drive are SC = 2. TM = 20 Years, SFF = 75%.

Function	ISO 13849-1	MTTF$_d$ Years	DC$_{AVG}$ [%]	IEC 62061	PFH [1/h]	CCF [%]	Response Time
STO dual channel	PL d, Cat. 3	TBD	TBD	TBD	TBD	TBD	TBD

10.3.2 Technical Data

| **NOTE** | Safe inputs are fixed to the STO function. |
| | When STO function (Safe Torque Off) is not needed, then all STO inputs must be connected directly with +24 V. The STO function is then bypassed and cannot be used. |

I/O hardware data

- Reference ground is DGND
- Galvanic isolation for 60 VDC
- Activation delay about 5 µs
- De-activation delay about 500 µs
- Use 24 VDC ±15% PELV power supply
- High level 17 VDC to 30 VDC, 5 mA to 6 mA
- Low level 0 VDC to 5 VDC, max.1 mA

Pinout

X10	Signal	Description
A11	STO-A-A1	STO channel A (for axis 1)
B11	STO-B-A1	STO channel B (for axis 1)

Parameters

Parameter	Description
AXIS1.SAFE.STO.A	Reads the status of STO input channel A.
AXIS1.SAFE.STO.B	Reads the status of STO input channel B.
AXIS1.SAFE.STO.ACTIVE	Reads the STO status.
AXIS1.SAFE.STO.REPORTFAULT	F9000 and W9000 are triggered, if set to 1 (default).

| **NOTE** | For parameter description refer to the *Safety Parameters Reference Guide*(➔ # 117). |

Factory Default Settings

- The drive is ready to operate with pre-configured STO function.
- AXIS1.SAFE.STO.REPORTFAULT is set to 1.

10.3.3 STO (Safe Torque Off)

Safe Torque Off description for drive option Functional Safety 1.

STO is suited for SIL 2 according to IEC 62061 and PLd / Cat.3 according to ISO 13849-1. It is a type A subsystem according to IEC 61508.

This safety function turns off the drive output stage that powers the motor and corresponds to an uncontrolled stop according to IEC 60204-1, category 0.

10.3.3.1 Important Notes

| **NOTICE** | The safety properties given in this documentation refer to the device Kollmorgen Essentials Drive with functional safety option 1. You need to determine the safety properties of the safety chain. |

| ⚠**WARNING** | **Vertical load could fall!** |
| 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). |

10.3.3.2 Activation

The digital STO inputs (channel A and B) must be connected to the output of a safety device, which at least meets the requirements of PLd, Cat. 3 according to ISO 13849. Technical data of the safe inputs (➔ # 109).

If one of the STO inputs goes open-circuit or 0V, then power supply to the motor stops within 3.5ms (?). The motor will lose all torque and coast to a stop.

If the drive detects that the two STO inputs are in a different state for longer than 100ms (?), then a simultaneity fault F9005 occurs (➔ # 113).

| **NOTE** | Review the enclosure and wiring instructions (➔ # 107). |

Wiring example STO, SIL2/PLd, Emergency Stop

Note: AXIS1.SAFE.STO.REPORTFAULT should be set to 1 if STO is activated by a switch.

IMAGE

10.3.3.3 Restart

Examples

|	AXIS1.SAFE.STO. REPORTFAULT = 1	AXIS1.SAFE.STO. REPORTFAULT = 0
Example 1: Axis 1 was disabled, STO is activated	Message W9000 Restart: 1. deactivate STO 2. enable axis 1	Restart: 1. deactivate STO 2. enable axis 1
Example 2: Axis 1 was enabled, STO is activated	Messages W9000 and F9000 Restart: 1. disable axis 1 2. deactivate STO 3. clear fault 4. enable axis 1	Restart: 1. deactivate STO
Example 3: Axis 1 was disabled, STO is activated faulty	Message F9005 Restart: 1. check wiring 2. remedy the cause 3. deactivate STO 4. clear fault 5. enable axis 1	Message F9005 Restart: 1. check wiring 2. remedy the cause 3. deactivate STO 4. clear fault 5. enable axis 1

10.3.3.4 Timing

Example.
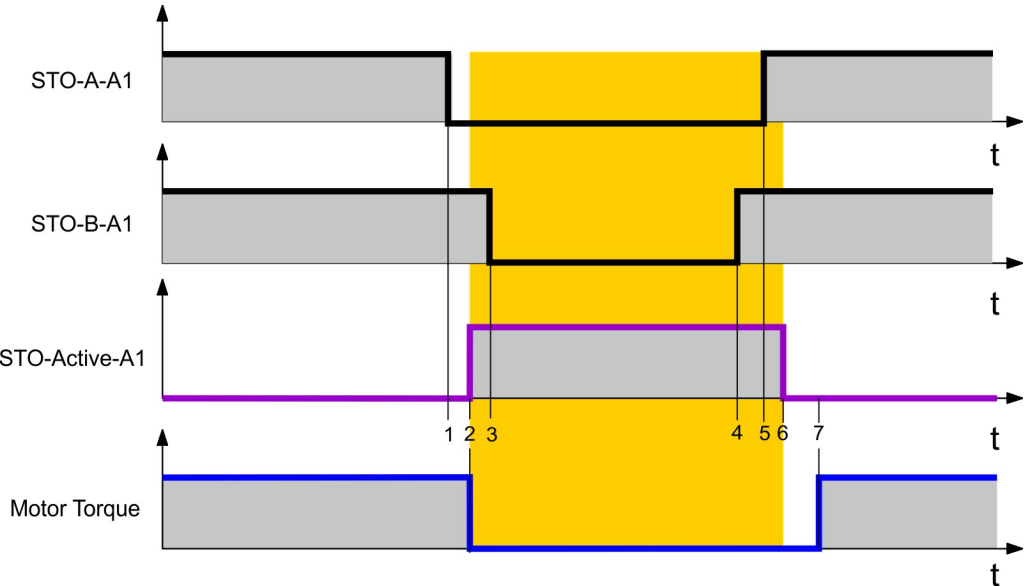
Timing	max	Remarks
t1		STO channel A enabled (0 V)
t1 to t2	TBD	STO enable delay (response time)
t2		STO active
t3		STO channel B enabled (0 V)
t1 to t3	TBD	accepted delay between dual channel edges
t4		STO channel B disabled (+24 V)
t5		STO channel A disabled (+24 V)
t4 to t5	TBD	accepted delay between dual channel edges
t5 to t6	TBD	STO release delay
t6		STO release
t6 to t7		Zero if AXIS#.SAFE.STO.REPORTFAULT=0 Until 'no fault' if AXIS#.SAFE.STO.REPORTFAULT=1
t7		Power section released.

10.3.3.5 Safety Diagnostic view in WorkBench

The WorkBench view "Safety Diagnostic" shows the current status on the safe inputs (AXIS#.SAFE.STO.A / AXIS#.SAFE.STO.B) and the logical status of the STO function for every axis.
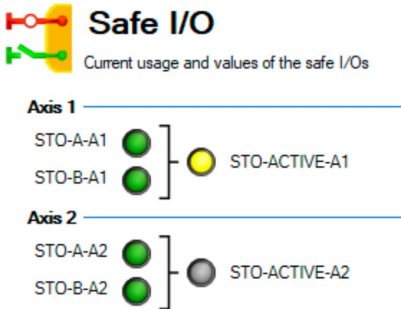
10.3.3.6   Fault Reaction / Failure Messages

With the dual-channel control of the STO (SIL2/PLd Cat.3) safety function, the switch-off paths STO-A-A# and STO-B-A# are switched separately by two outputs of a safety controller.

W9000 and F9000 are conditioned by the value of AXIS#.SAFE.STO.REPORTFAULT.

AXIS#.SAFE.STO.REPORTFAULT set to 1 (default)

STO-A-A#	STO-B-A#	ENABLE	Drive Message	Motor Torque	Safe State
0 V	0 V	0 V	W9000	No	Yes
0 V	0 V	+24 V	F9000	No	Yes
+24 V	+24 V	0 V	-	No	No
+24 V	+24 V	+24 V	-	Yes	No
+24 V	0 V	0 V	F9005*	No	Yes
+24 V	0 V	+24 V	F9005*	No	Yes
0 V	+24 V	0 V	F9005*	No	Yes
0 V	+24 V	+24 V	F9005*	No	Yes

* different status of STO-A/B for more than 100 ms
A#: A1 for axis 1 or A2 for axis 2.

AXIS#.SAFE.STO.REPORTFAULT set to 0

STO-A-A#	STO-B-A#	ENABLE	Drive Message	Motor Torque	Safe State
0 V	0 V	0 V	W9000	No	Yes
0 V	0 V	+24 V	W9000	No	Yes
+24 V	+24 V	0 V	-	No	No
+24 V	+24 V	+24 V	-	Yes	No
+24 V	0 V	0 V	F9005*	No	Yes
+24 V	0 V	+24 V	F9005*	No	Yes
0 V	+24 V	0 V	F9005*	No	Yes
0 V	+24 V	+24 V	F9005*	No	Yes

* different status of STO-A/B for more than 100 ms
A#: A1 for axis 1 or A2 for axis 2.

10.4   Settings

Push button B1

The Kollmorgen Essentials Drive has a push-button B1 on its top side.

B1 Functions	Description
"Fall back" mode	Press this button during power up to run in recovery mode. This mode allows for a firmware file to be downloaded through WorkBench in case the firmware in the drive has been corrupted.

10.5   Safety Faults, Safety Warnings

The Kollmorgen Essentials Drive with safety option 1 does not have safety failure modes.

10.5.1 Drive Safety Faults

NOTE	More information about drive fault messages, remedy and clearing faults can be found in the WorkBench User Manual.

Fault	Description	Cause	Remedy
F9000	Safe Torque Off	STO function has been triggered while the axis is enabled.	See (➜ # 1, STO (Safe Torque Off))
F9004	Safe Torque Off digital and analog lines don't match	Hardware fault on the power board.	Restart drive. If issue persists, contact technical support.
F9005	STO Simultaneity	The two STO inputs did not change state within 100ms of each other.	Check wiring and safety apparatus

10.5.2 Safety Warnings

NOTE	More information about drive warnings can be found in the WorkBench User Manual.

Warning	Description	Cause	Remedy
W9000	Safe Torque Off	STO function has been triggered.	See (F9000 , ➜ # 116)

10.5.3 Troubleshooting Functional Safety

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

Problem	Possible Causes	Remedy causes
A group "90" safety fault or safety warning message is visible in the drive LCD display	Refer to the Drive Safety Fault and Warning tables (➜ # 116).	
A fault or warning message of another group than "90" is visible in the drive LCD display	Refer to the drive fault and drive warnings tables (➜ # 99) and more detailed descriptions in the WorkBench User Manual.	
Safety faults and warnings are not visible/reported	AXIS#.SAFE.STO. REPORTFAULT is set to 0	Set AXIS#.SAFE.STO. REPORTFAULT to 1
STO cannot be deactivated (no torque)	1. External safety device defective. 2. STO wiring defective. 3. Auxiliary voltage low. 4. STO inputs defective. 5. F9004 visible 6. F9005 visible. 7. OSSD pulses too long (>1ms). 8. STO channels are unequal for more than 100ms.	1. Check external safety device. 2. Check STO wiring for short-circuit or similar. 3. Check voltage level (➜ # 109) . 4. Send drive to manufacturer for repair. 5. Send drive to manufacturer for repair. 6. Check safety hardware system. 7. Check safety controller. Switch off OSSD. 8. Check external safety device.
Drive does not enable	1. STO is still active.	1. Deactivate STO prior to HW Enable.

10.6 Functional Safety Parameter Reference

Abbreviations

- Acc. = Access: RO = Read Only, RW = Read/Write, WO = Write Only
- N/A = Not Available, Y = Yes, N = No
- Parameters are sorted alphanumerically

Parameters related to safety functions	Acc.	Default	Parameter Package	CAN over EtherCAT		
				Axis1 Index 0x....	Axis2 Index 0x....	Sub
AXIS#.SAFE.STO.A	RO	N/A	N/A	5007	5107	3
AXIS#.SAFE.STO.ACTIVE	RO	N/A	N/A	5007	5107	2
AXIS#.SAFE.STO.B	RO	N/A	N/A	5007	5107	4
AXIS#.SAFE.STO.REPORTFAULT	RW	1	Drive	5007	5007	1

10.6.1 Safety Parameters, sorted alphanumeric

10.6.1.1 AXIS#.SAFE.STO.A

Description

Indicates the state for STO-A input.

Value	Description
1	24V present (STO inactive, allowed to enable)
0	24V not present (STO active, axis disabled)

Context

For complete STO information refer to " STO (Safe Torque Off)" (➜ # 110).

Versions

Action	Version	Notes
Implemented	02-00-00-000	

General Information

Type	Read Only
Units	N/A
Range	0 or 1
Default Value	N/A
Data Type	Integer
Stored in Non-Volatile Memory	No

10.6.1.2 AXIS#.SAFE.STO.B

Description

Indicates the state for STO-B input.

Value	Description
1	24V present (STO inactive, allowed to enable)
0	24V not present (STO active, axis disabled)

Context

For complete STO information refer to " STO (Safe Torque Off)" (➔ # 110).

Versions

Action	Version	Notes
Implemented	02-00-00-000	

General Information

Type	Read Only
Units	N/A
Range	0 or 1
Default Value	N/A
Data Type	Integer
Stored in Non-Volatile Memory	No

10.6.1.3 AXIS#.SAFE.STO.ACTIVE

Description

Indicates the Safe Torque Off (STO) state of the axis.

Value	Description
1	STO active (inputs +0V)
0	STO inactive (inputs 24V)

Context

For complete STO information refer to " STO (Safe Torque Off)" (➔ # 110).

Versions

Action	Version	Notes
Implemented	02-00-00-000	

General Information

Type	Read Only
Units	N/A
Range	0 or 1
Default Value	N/A
Data Type	Integer
Stored in Non-Volatile Memory	No

10.6.1.4   AXIS#.SAFE.STO.REPORTFAULT

Description

This parameter controls whether a Safe Torque Off (STO) fault F9000 will be created when STO is activated while the axis is enabled. The STO warning W9000 is always generated if this parameter is 1 and the STO function is active.

Value	Description
1	W9000 / F9000 are generated when axis is enabled and an STO occurs (default)
0	W9000 / F9000 are not generated

Context

For complete STO information refer to " STO (Safe Torque Off)" (→ # 110).

Versions

Action	Version	Notes
Implemented	02-00-00-000	

General Information

Type	Read/Write
Units	N/A
Range	0 or 1
Default Value	1
Data Type	Integer
Stored in Non-Volatile Memory	Yes

11   Accessories for Kollmorgen Essentials

This section is in progress.

12   Approvals – TBD

| NOTICE | If the drive is labeled Beta, approvals are pending. |

13   Index

14   Record of Document Revisions

Edition	Remarks
A, WIP	First edition
...	Table with lifecycle information of this document (➔ # 1)

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Kollmorgen Support Locations

North America
Kollmorgen
201 West Rock Road
Radford, VA 24141, USA

Web:	www.kollmorgen.com
Email:	kollmorgen.support@regalrexnord.com
Tel.:	+1-540-633-3545
Fax:	+1-540-639-4162

Europe
Kollmorgen Europe GmbH
Pempelfurtstr. 1
40880 Ratingen, Germany

Web:	www.kollmorgen.com
Email:	Technical.Support.EU@regalrexnord.com
Tel.:	+49-2102-9394-0
Fax:	+49-2102-9394-3155

South America
Altra Industrial Motion do Brasil
Equipamentos Industriais LTDA.
Avenida João Paulo Ablas, 2970
Jardim da Glória, Cotia – SP
CEP 06711-250, Brazil

Web:	www.kollmorgen.com
Email:	kollmorgen.contato@regalrexnord.com
Tel.:	(+55 11) 4615-6300

China and SEA
KOLLMORGEN
Room 302, Building 5, Libao Plaza,
88 Shenbin Road, Minhang District,
Shanghai, China.

Web:	www.kollmorgen.cn
Email:	Sales.China@regalrexnord.com
Tel.:	+86-400 668 2802

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