UDMpa

Installation Guide

September 2020

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ACS MOTION CONTROL

UDMpa

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Revision History

Date	Revision	Description
September 2020	3.02	Formatting
July 2018	1.06	Added support for BISS-C and EnDAT 2.2 encoders
April 2018	1.05	Added caution for short circuit of motor phase
January 2018	1.04	Removed support for 3 Sin-Cos encoders
December 2017	1.03	Updated for STO, UL, EMC certifications Updated presentation for incremental digital encoders
August 2017	1.02	Updated list of supported motors
March 2017	1.01	Revoved support for absolute encoders
February 2017	1.00	First release

Conventions Used in this Guide

Text Formats

Format	Description
Bold	Names of GUI objects or commands
BOLD + UPPERCASE	ACSPL+ variables and commands
`Monospace + grey background`	Code example
Italic	Names of other documents
Blue	Hyperlink
[ ]	In commands indicates optional item(s)
|	In commands indicates either/or items

Flagged Text

	**Note** - includes additional information or programming tips.
	**Caution** - describes a condition that may result in damage to equipment.
	**Warning** - describes a condition that may result in serious bodily injury or death.
	**Model** - highlights a specification, procedure, condition, or statement that depends on the product model
	**Advanced** - indicates a topic for advanced users.

Related Documents

Documents listed in the following table provide additional information related to this document.

Authorized users can download the latest versions of the documents from www.acsmotioncontrol.com/downloads.

Document	Description
SPiiPlus Setup Guide	Provides guidance on how to configure and adjust the SPiiPlus systems to work with supported types of motors and feedback devices.
SPiiPlus MMI Application Studio User Guide	Explains how to use the SPiiPlus MMI Application Studio and associated monitoring tools.
PEG and MARK Operations Application Note	Provides detailed description, specification and operation instructions for PEG capabilities.
EtherCAT Network Diagnostics	An application note describing how to perform diagnostics of the EtherCAT network.
Dual Axis PEG	An application note describing dual axis PEG usage.
Using Absolute Encoders with ACS Products	An application note that addresses the physical connections, configurations and operation of absolute encoders with ACS networking products.
AN STO - Safe Torque Off Function	Provides the technical details for implementing the STO function.
NPMPC / NPAPC / UDMCB Functional Safety Manual	Describes the use of the STO function in the NPMPC/NPAPC and UDMCB.

Table of Contents

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List of Tables

1. Introduction

1.1 Document Scope

The document describes the installation information for the UDMPA including electrical interfacing, device compatibility, mounting, and ventilation.

1.2 Product Overview

The UDMPA is a dual-axis, EtherCAT slave PWM drive. The UDMPA has two drive supply voltage levels, 12V to 60Vdc and 12V to 100Vdc and provides continuous/peak current options of 3.3/10A, 6.6/20A, 10/30A, and 13.3/40A. Figure 1-1 shows the UDMPA interface block diagram.

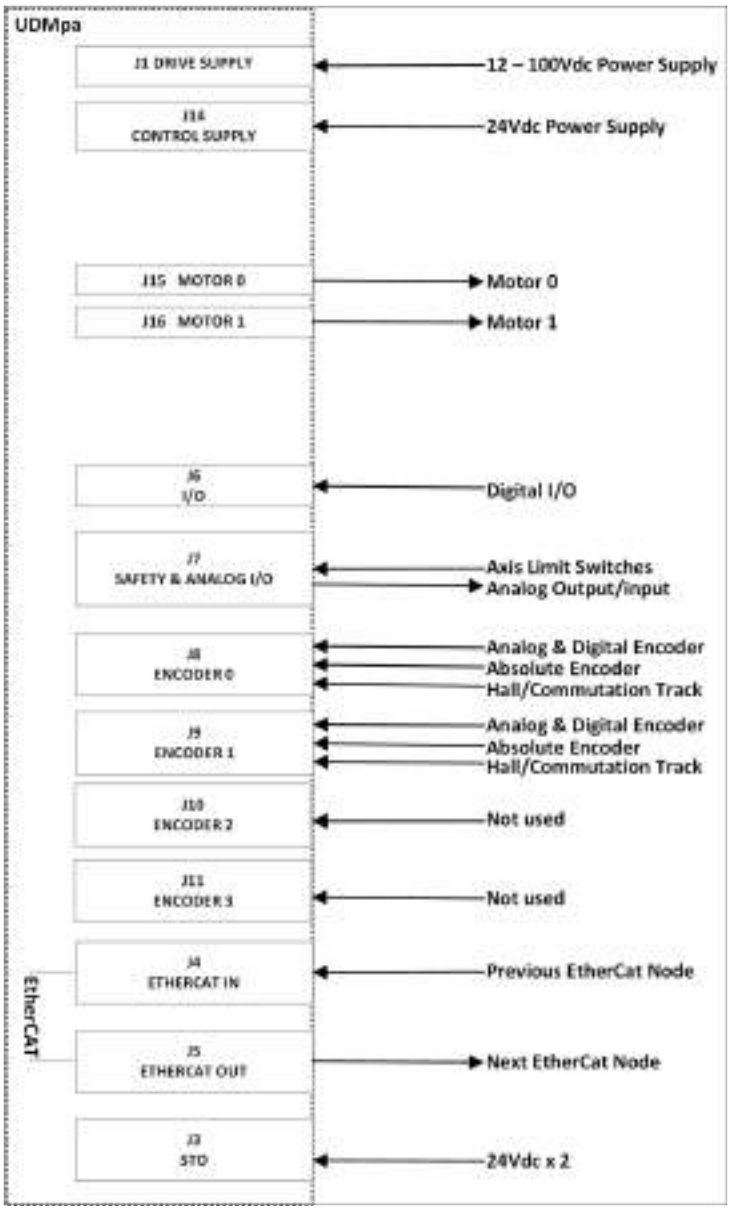

Figure 1-1. Interface block diagram

2. Detailed description

2.1 Connectors

The following figures and table show and describes the UDMPA connectors.

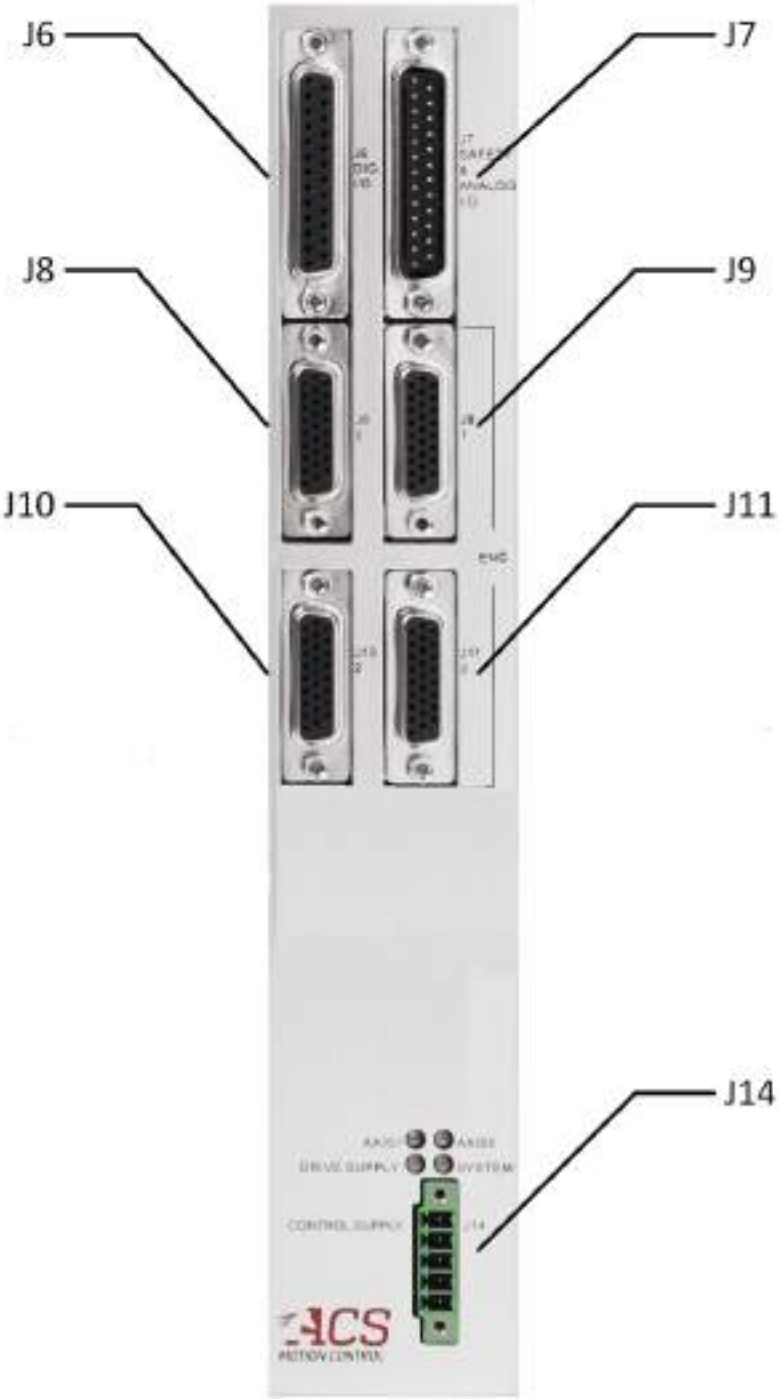

Figure 2-1. Connectors - Front View

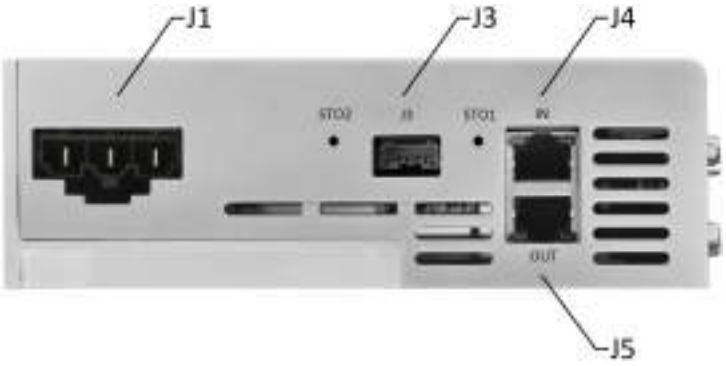

Figure 2-2. Connectors - Top View

Figure 2-3. Connectors - Bottom View

Table 2-1. Connections

Connector Assignment	Connector Name	Description
J1	Drive supply	12 - 60Vdc 12 - 100Vdc
J3	STO	Optional
J4	EtherCAT IN	
J5	EtherCAT OUT	
J6	Digital I/O	
J7	Safety & Analog I/O	
J8	Encoder 0	
J9	Encoder 1	
J10	Encoder 2	Not used
J11	Encoder 3	Not used

Connector Assignment	Connector Name	Description
J14	Control supply	
J15	Motor 0	
J16	Motor 1	

2.2 Indicators

2.2.1 LED Indicators

The following figures and table show and describe the UDMPA LED indicators.

Figure 2-4. LED Indicators

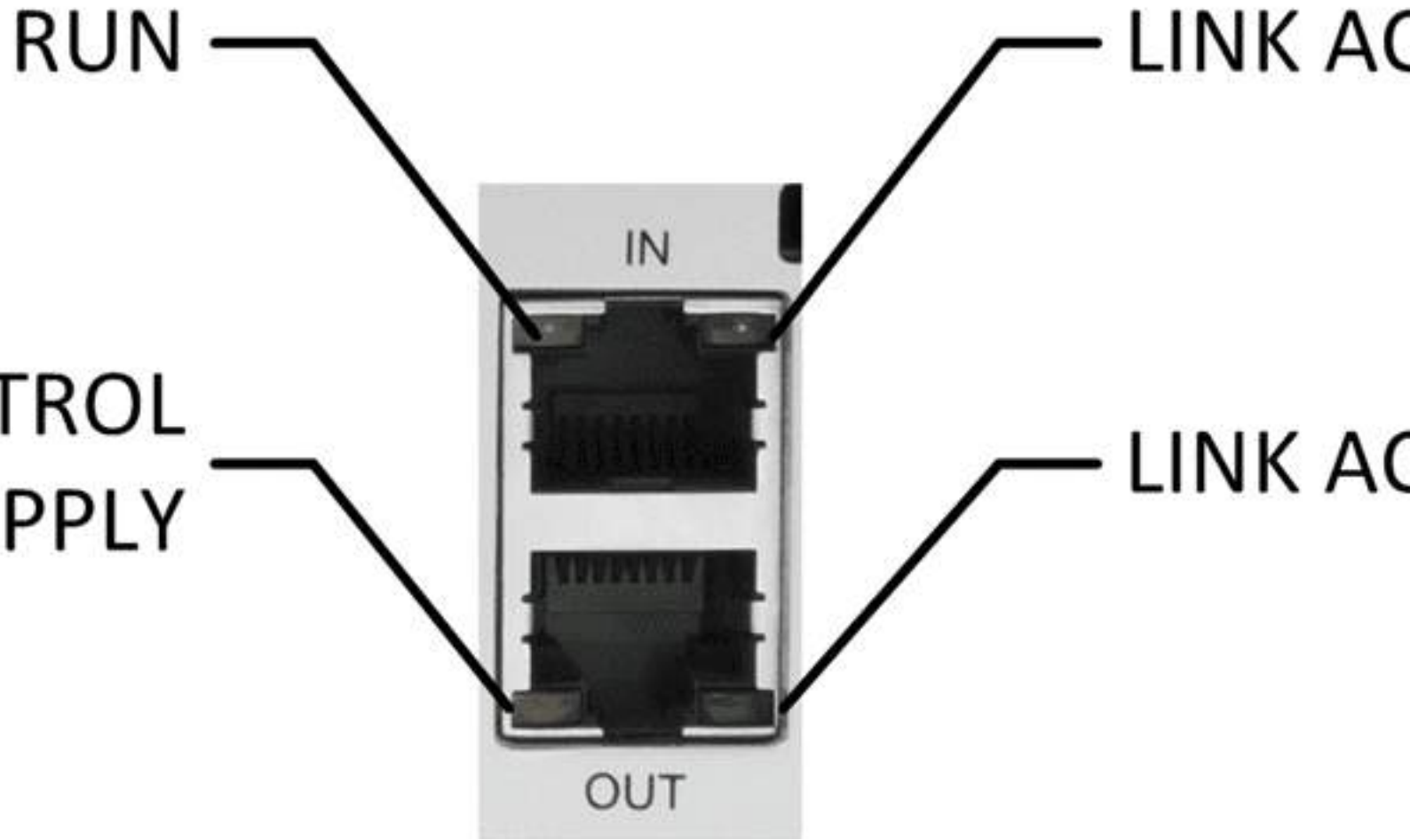

Figure 2-5. EtherCAT Indicators

Figure 2-6. STO Indicators

Table 2-2. LED Indicators Description

Indicator	Description	Remarks
Axis 0 Axis 1	One bicolor LED for each axis: > Green - Drive is enabled > Red - Drive fault > Off - Drive is disabled	AIXS0 (DRIVE0, MOTOR0) AIXS1 (DRIVE1, MOTOR1)
System	One bicolor LED: > Red - System Fault > Green - System OK > Blinking - Software command	
Drive supply	One green LED: > On - drive supply is OK. > Off - no drive supply is connected	
Control supply	One yellow LED: > On - Control supply is OK > Off - Control supply is not functioning	Located on J5
Link Act	Two green LEDs (one per Ethernet port) > On - Link without activity > Off - No cable is connected > Blinking - Link and active	
Run	Yellow LED: > On - network communication is OK > Blinking/Off - network communication error	Located on RJ45 Ethernet connector input port

Indicator	Description	Remarks
STO 1 STO 2	One green LED: > On - STO is deactivated.	

2.3 Package Content

The UDMPA package contains the following items:

- > UDMPA module
- > STO Connector Kit P/N: STO-ACC1 (supplied only for units ordered with STO)
- > Control supply mating connector (for J14), Phoenix MC 1,5/ 5-STF-3,81

2.4 Optional Accessories

2.4.1 Ethernet Cables

ACS offers the following Ethernet CAT5e cables:

Table 2-3. Ethernet Cables

Length [m]	Part Number
0.3	SP+ECAT-CA-30CM-00
0.5	SP+ECAT-CA-50CM-00
1	SP+ECAT-CA-1M-00
2	SP+ECAT-CA-2M-00
3	SP+ECAT-CA-3M-00
5	SP+ECAT-CA-5M-00
10	SP+ECAT-CA-10M-00
15	SP+ECAT-CA-15M-00
20	SP+ECAT-CA-20M-00

2.4.2 Mating Connectors Kit

P/N: UDMpa-ACC1

Description: Mating Connector Kit

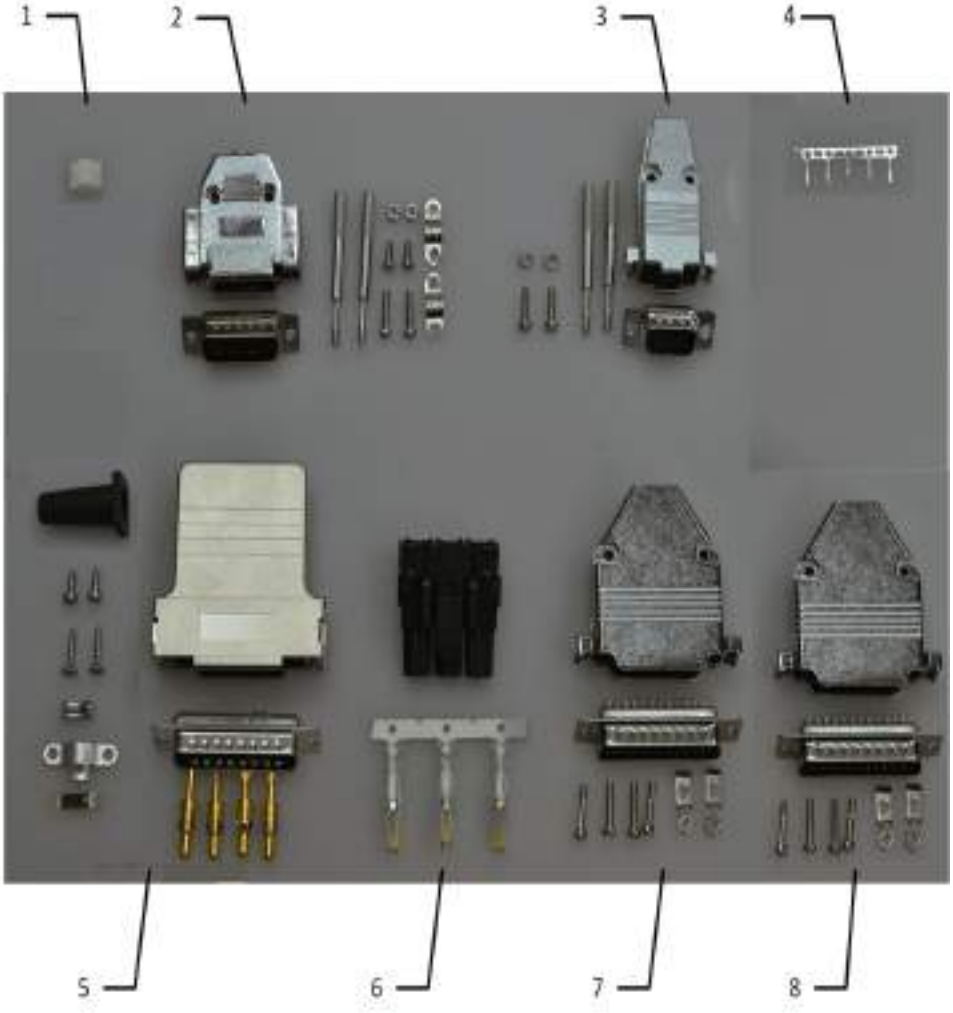

Figure 2-7. Mating Connectors Kit

Table 2-4. Mating Conenctor Kit

Reference	Quantity	Part Description	Connector	Manufacturer	PN
1	1	5-pin housing 2mm pitch NPB female	J3	JST	PAP-05V-S
2	4	D-type 26 pin high density male	J8,J9,J10,J11	Many	
3	2	D-type 15 pin high density male	Not used.	Many	

Reference	Quantity	Part Description	Connector	Manufacturer	PN
4	5	Crimp Contact for 26-22AWG wire	J3 pins	JST	SPHD-001T-P0.5
5	2	Sub D 9W4 male	J15,J16	FCT	FM9W4P-K120
6	1	Molex 3 pin up to 50A per contact housing	J1	Molex	42816-0312
7	1	D-type 25 pin male	J6	Many	
8	1	D-type 25 pin female	J7	Many	

2.4.3 STO Accessory Kit

P/N: STO-ACC1

Description:2 meter cable with flying leads

Figure 2-8. STO-ACC1 Accessory Kit

Table 2-5. STO-ACC1 Pinout

Pin	Wire Color	Signal
1	Black	STO1-
2	Red	STO1+
3	Yellow	EGND
4	White	STO2+
5	Black	STO2-

2.4.4 UDMpa-ACC2 Accessory Cable

P/N:UDMpa-ACC2

Description: UDMpa (J1) mating 2m flying lead cable.

Figure 2-9. UDMmc&NPXpm-ACC2 Accessory Cable

2.5 Order Part Number

The ordering part number (P/N) contains several characters (see example in Figure 2-10) that each specify a configuration characteristic ordered for the UDMPA module, as described in Table 2-7.

Figure 2-10. Label with Ordered P/N - Example

As an example, P/N UDMpa2AB0N0DABNNN would represent the configuration described in Table 2-6

Table 2-6. P/N Example

Field		1	2	3	4	5	6	7	8	9	10	11	12
P/N	UDMpa2AB0N0DABNNN	2	A	B	0	N	0	D	A	B	N	N	N

The UDMPA is shipped with the configuration set as ordered. Modifications can be done by ACS only.

Table 2-7. Configuration as indicated by P/N

Ordering Options	Field	Example User Selection	Available Ordering Option Values
Number of axes/drives	1	2	1,2
Current	2	A	A - 3.3/10A B - 6.6/20A C - 10/30A D - 13.3/40A
Maximum voltage	3	B	A - 60V B - 100V
500kHz SIN-COS encoder interface	4	0	0,1,2
Absolute encoders type	5	N	U - All, N - None, E _ EnDat 2.1,2.2 (digital only), B - Biss-A/B/C, I - SSI
Number of Absolute encoders interface*	6	0	0, 1, 2
Limit switch inputs	7	D	A - 5V, Source/PNP B - 5V, Sink/NPN C - 24V, Source/PNP D - 24V, Sink/NPN
Digital Inputs	8	A	A - 5V, two-terminal

Ordering Options	Field	Example User Selection	Available Ordering Option Values
			B - 24V, two-terminal
Digital Outputs	9	B	A - Source/PNP, 5V & 24V B - Sink/NPN, 5V & 24V
Special options	10	N	N - No
STO	11	N	Y - Yes N - No
Motor relays	12	N	Y - Yes N - No

*In a single axis configuration, dual feedback consumes one network axis.

3. Mounting and Cooling

- Unit should be mounted vertically, using M4 type Philips screws. The dimensions (in millimeters) are shown below.
- Leave sufficient clearance of 50 millimeters on all open sides for cable routing and free airflow.
- Unit operates in the temperature range of 0 to 40°C.
- See Environment for more information on environmental conditions and airflow.

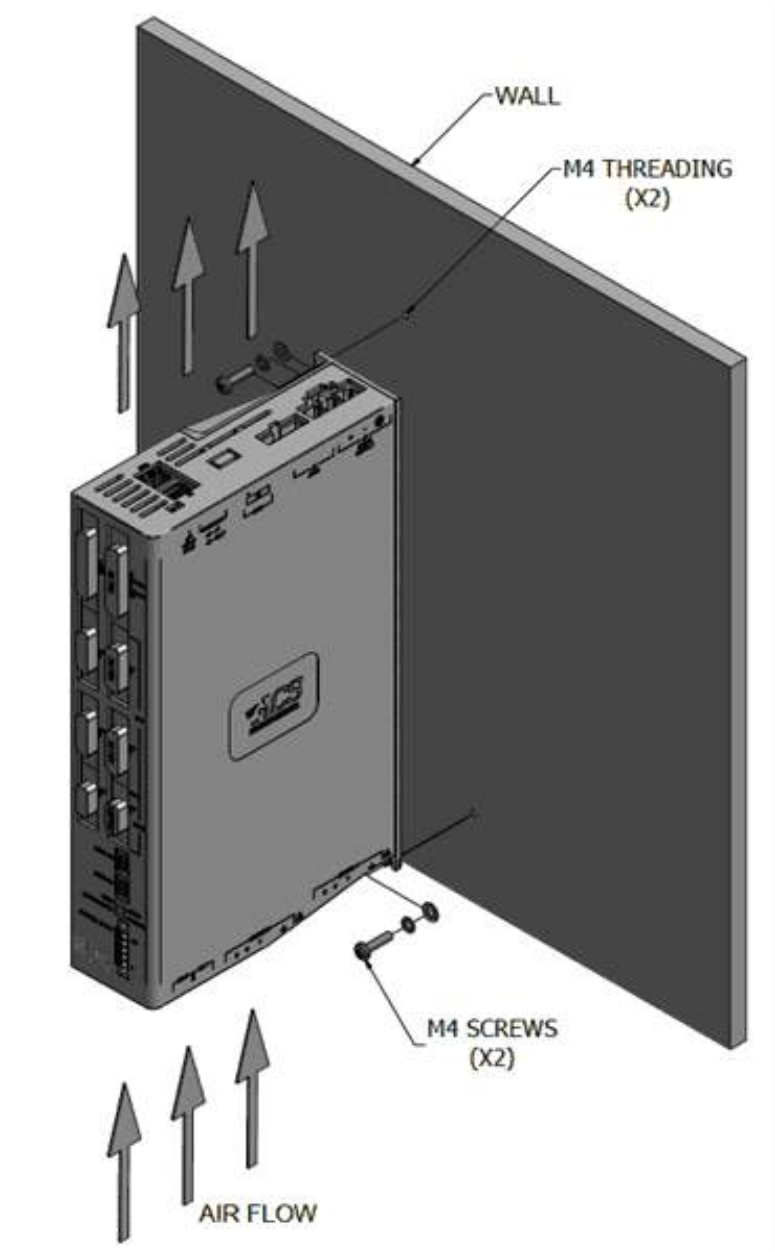

Figure 3-1. Airflow and Mounting

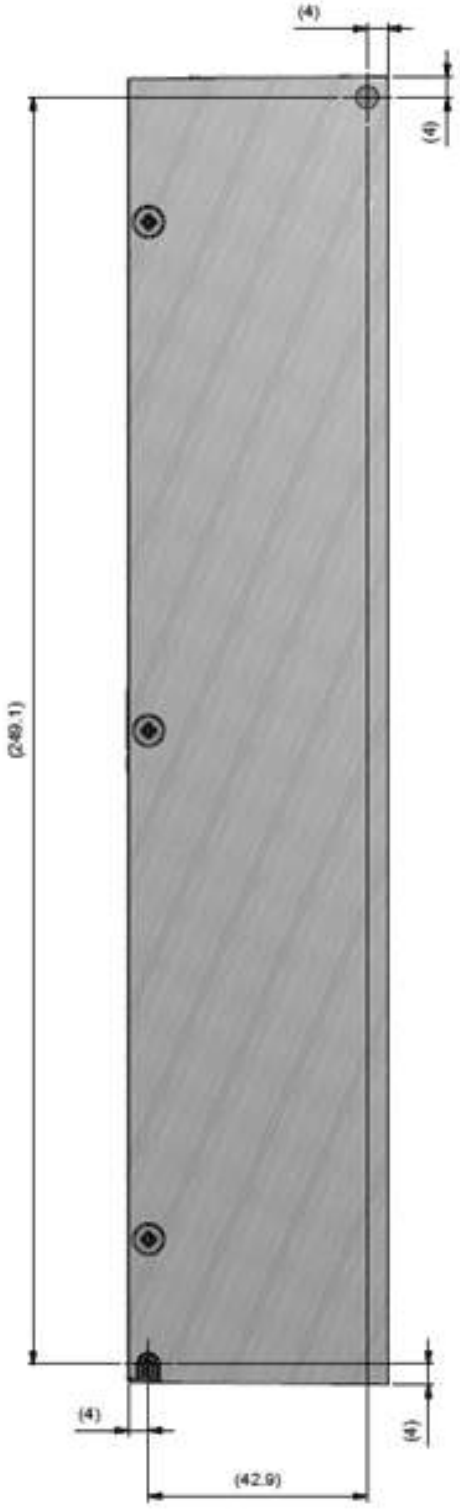

Figure 3-2. Dimensions - Rear (mounting side) View

Figure 3-3. Dimensions - Right Side View

4. Connections

This section describes how to interface with the UDMPA using proper safety, EMC and wiring guidelines.
The following diagram is a standard representation of connections and grounding. Specific settings and configurations are described in the subsections below.

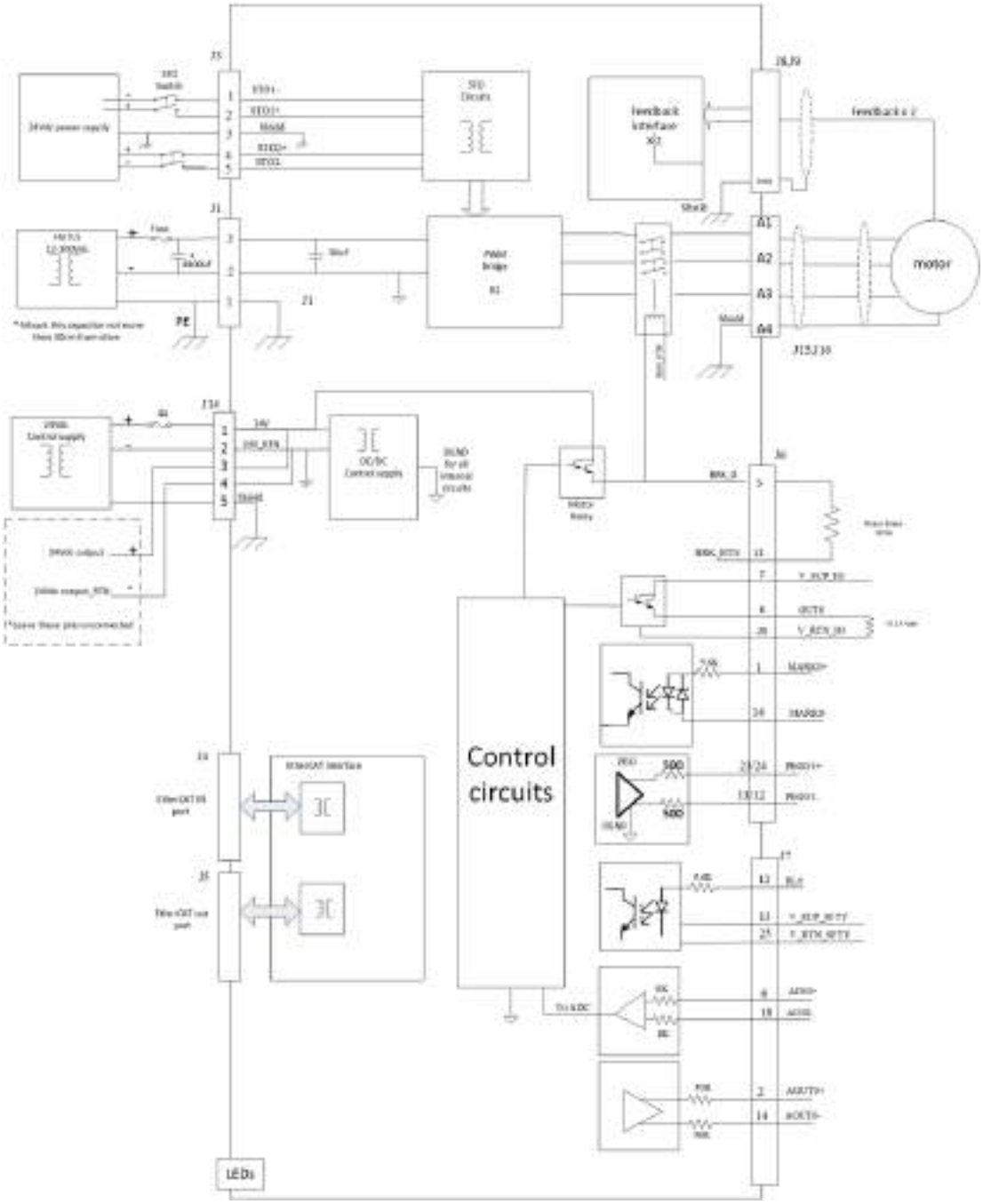

Figure 4-1. Connections and Grounding

4.1 Safety, EMC and Wiring Guidelines

Read this section carefully before beginning the installation process.

Make sure that the following guidelines and procedures are addressed and observed prior to powering up and while handling any of the EtherCAT network elements.

An STO module (Safe Torque Off) is an optional feature of the unit. Additional information can be found in STO (J3).

Installation and maintenance must be performed only by qualified personnel who have been trained and certified to install and maintain high power electrical and electro-mechanical equipment, servo systems, power conversion equipment and distributed networks.

Prior to powering up the system, ensure that all EtherCAT network devices are properly installed and grounded. Further ensure that all of the attached power and signal cables are in good operating condition. Maintenance should be performed only after the relevant network devices have been powered down, and all associated and surrounding moving parts have settled in their safe mode of operation. Certain drives require a longer time to fully discharge.

To avoid electric arcing and hazards to personnel and electrical contacts, avoid connecting and disconnecting the UDMPA while the power source is on.

When connecting the UDMPA to an approved isolated control and drive supply, connect it through a line that is separated from hazardous live voltages using reinforced or double insulation, in accordance with approved safety standards.

The UDMPA is not intended for use in safety-critical applications (such as life supporting devices) where a failure of the UDMPA can reasonably be expected to cause severe personal injury or death.

J1, J15 and J16 contain hazardous voltages of 100V PWM modulated.

Perform the following instructions to ensure safe and proper wiring:

- Whenever possible, use shielded cables with braided shield of at least 80%-95% coverage.
- Follow the guidance of below, based on the current rating of your UDMPA.
- Proper wiring, grounding and shielding are essential for ensuring safe, immune and optimal servo performance. After completing the wiring, carefully inspect all wires to ensure tightness, good solder joints and general safety.

Table 4-1. Wiring Guidelines

Item	Gauge	Twisted pair
Control power supply	18AWG	No
Drive power supply	12-16AWG	No
Motor	14-16AWG	No
Motor Brake	18AWG	No
Encoders	28AWG (up to 0.6A), 26AWG (up to 1A)	Yes

4.2 Connecting the UDMPA

To connect theUDMPA:

1. Ensure that all supplies are off when preparing the unit.
2. Connect the 24Vdc control supply to J14.
3. Connect the drive supply to J1.
4. Connect motor 0 to J15.
5. Connect motor 1 to J16.
6. Connect I/O to J6 and J7.
7. Connect EtherCAT-in from the previous device and EtherCAT-out J5 to next slave.
8. Turn on the control supply and verify communication with the unit.
9. Turn on the drive supply.

The supplies can be turned on and off in any order.

4.3 Power Supplies

The unit is fed by two power supplies:

> Drive Supply: 12-60Vdc or 12-100Vdc (J1)

> Control Supply: 24Vdc (J14)

The power supplies must be provided by the customer and need to be UL certified. Each power supply has a LED indicator on the unit.
The supplies can be switched on and off in any order. During emergency situations, the drive supply can be disconnected while the control supply should remain connected.

4.3.1 Drive Supply (J1)

An external isolated 12-60Vdc or 12-100Vdc power supply (not included with the unit) feeds the drives and the motors.

The drive supply must be connected to the unit via fuse. The fuse rating should be calculated according to the total input current of the unit and should not exceed the ratings below.

Table 4-2. Fuse Ratings

Unit	Maximum Fuse Rating
40A peak unit	30A
30A peak unit	20A
20A peak unit	15A

Unit	Maximum Fuse Rating
10A peak unit	10A

4.3.1.1 Drive Supply Guidelines

When selecting the drive power supply, use the following guidelines:

The UDMPA does not include a regeneration circuit. You must ensure that the DC drive supply voltage does not 63Vdc for 60Vdc version and 103V for 100Vdc drive. For more details contact your ACS representative.

- The power supply must be isolated.
- The power supply must be CE and UL approved.
- The power supply must be short circuit protected.
- The power supply must have very low noise and ripple.
- Make sure the power supply can absorb the regeneration energy from the motor when it decelerates. Otherwise an external regeneration circuit is needed.
- The power supply must be able to provide the peak current required by the motor (inductance load). Adding an external capacitor of 4400uF, installed as close as possible to the drive (no further than 30cm from the drive), can help the power supply to handle the peak current and reduce the bus current ripple.
- The power supply must be selected based on the power consumed by drive 1 and drive 2 (if applicable).
- An example of a suitable 48V/1500W power supply is the XP Power P/N HPU1K5PS48 supply.

4.3.1.2 Description

Label: J1 DRIVE SUPPLY

Connector: 3 pin header by Molex PN 42820-3228

Mating connector: 3 pin socket by Molex PN 42816-0312; Pin: Molex PN 42815-0042; Tool: Molex PN 63811-3800

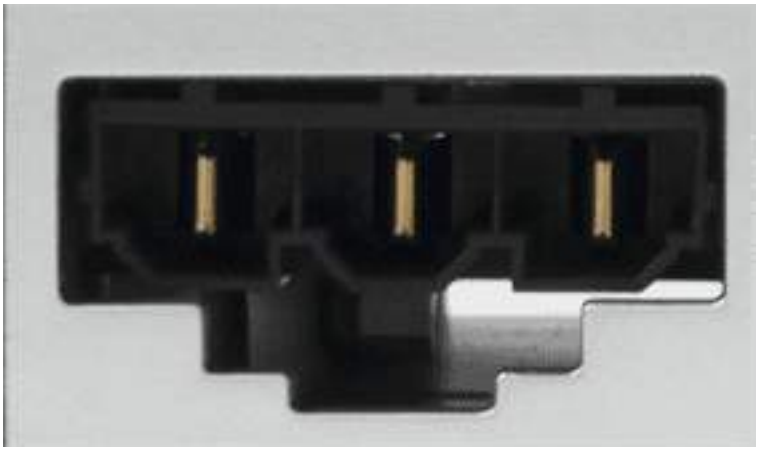

Figure 4-2. J1 - Drive Supply Connector

Table 4-3. J1 - Drive Supply Connector Pinout

Pin	Signal	Description
1	PE	Protected earth
2	VP-	Drive supply return
3	VP+	Drive supply positive edge

For better noise immunity, make a short between VP- and PE.

4.3.1.3 Connection Instructions

1. Use a low inductance cable with a minimum gauge of 12-16 AWG.
2. Route the drive supply and motor cables as far as possible from all other noise sensitive cables (such as encoders and I/O).
3. Connect a fast active fuse (NON-30A) between the unit and the external power supply.
4. If required, connect the External Regeneration Resistor Circuit
5. Connect the unit PE (Protective Earth) to the power supply PE point.

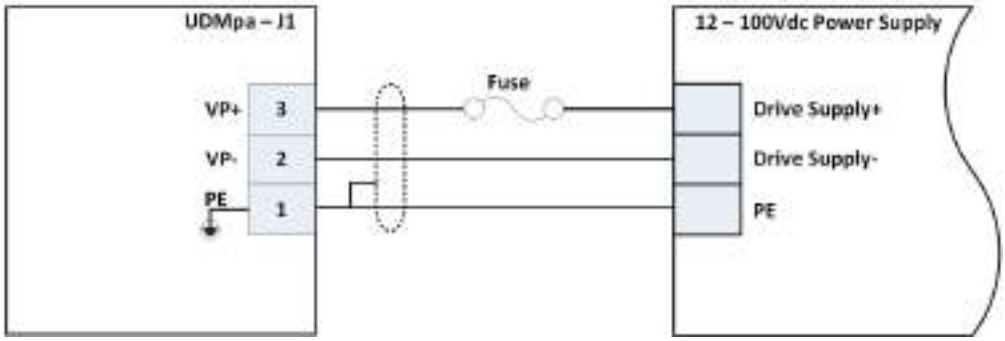

Figure 4-3. Drive Supply Connections

4.3.2 Control Supply (J14)

An external 24Vdc isolated power supply (not included with the unit) feeds all logic and control low voltage circuitry.

It is recommended to keep this power supply active (on) also during emergency stop situations, thus ensuring the continuing operation of the network, the controller, the feedback sensors and IOs.

The 24V control supply must be connected to the unit via 3A fuse.

4.3.2.1 Control Supply Guidelines

When selecting the control power supply, use the following guidelines:

- The power supply must be isolated.
- The power supply must be CE and UL approved.
- The power supply must be short circuit protected.
- The power supply must have very low noise and ripple.
- The maximum input current should not exceed 1A @ 21.6V when no external motor relays are used or 2A @ 21.6V when two external motor relays are used.
- An example of a suitable 24V/70W power supply is the XP Power P/N VCS70US24 supply.

4.3.2.2 Description

Label: J14 24V CONTROL SUPPLY

Connector: MC 1,5/ 5-GF-3,81, by PHOENIX, PN 1827897

Mating connector: MC 1,5/ 5-STF-3,81, by PHOENIX, PN 1827732

Figure 4-4. J14 - Control Supply Connector

Pin 1 is left most pin.

Table 4-4. J14 - Control Supply Pinout

Pin	Signal	Description
1	24VDC	+24V dc control supply
2	24V_RTN	24V dc control supply return
3	BRK_SUP	Brake supply output (leave this pin unconnected)
4	BRK_RTN	Brake supply output return (leave this pin unconnected)
5	SHIELD	Electrical ground

4.3.2.3 Connection Instructions

- Use a shielded cable with a minimum gauge of 18 AWG.
- Connect a 3A fuse between the UDMPA and the control supply.

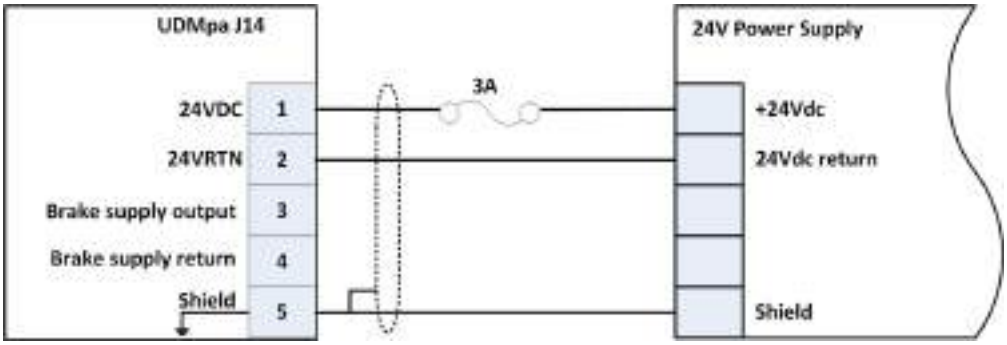

Figure 4-5. Control Supply Connections

4.4 STO (J3)

The UDMPA Safe Torque Off module is certified for use in safety applications up to and including SIL-3 according to:

- EN/IEC 61800-5-2 Ed. 2 (second environment)
- EN/ IEC 61800-5-1
- IEC 61508
- IEC 62061

Performance Level PLe and Category 3 according to:

- EN ISO 13849-1/-2

The STO (Safe Torque Off) inputs should be connected to a 24V (18Vdc to 33Vdc) source to enable the drives to generate current and feed the motors. When the 24V is removed from one or both STO inputs, the PWM signals to the power stages are blocked within 200msec. In addition, the controller is informed about this event within a few milliseconds. This delay (between informing the controller and blocking of the PWM signals of the drive) provides the controller the ability to bring all axes to a complete stop, or low velocity movement, in an orderly manner. The implementation of the STO guarantees that under any foreseen circumstances, failure or damage, any of following types of motors will not move:

- AC synchronous (DC brushless)
- Step motor
- AC asynchronous (AC induction)

4.4.1 Description

Label: J3 STO

Connector: 5 pin 2mm male by JST P/N SM05B-PASS-1

Mating connector: 5 pin 2mm female by JST P/N PAP-05V-S; Pin: SPHD-001T-P0.5

Figure 4-6. J3 - STO Connector

Table 4-5. J3 - STO Connector Pinout

Pin	Signal	Description
1	STO1-	STO input 1 inverted input
2	STO1+	STO input 1 non inverted input

Pin	Signal	Description
3	NC	Not connected
4	STO2+	STO input 2 non inverted input
5	STO2-	STO input 2 inverted input

4.4.2 Connection Instructions

The STO1 and STO2 are typically connected to a 24V source via an industry standard safety switch. This device disconnects the 24V upon opening a door, a light current tripping, or other safety related event. Details for handling STO are provided in the *Safe Torque Off Function Application Note* and the ***NPMPC NPAPC UDMCB Funtional Safety Manual***..

The STO circuit draws up to 50mA per STO input, with an inrush current of less than 500mA.

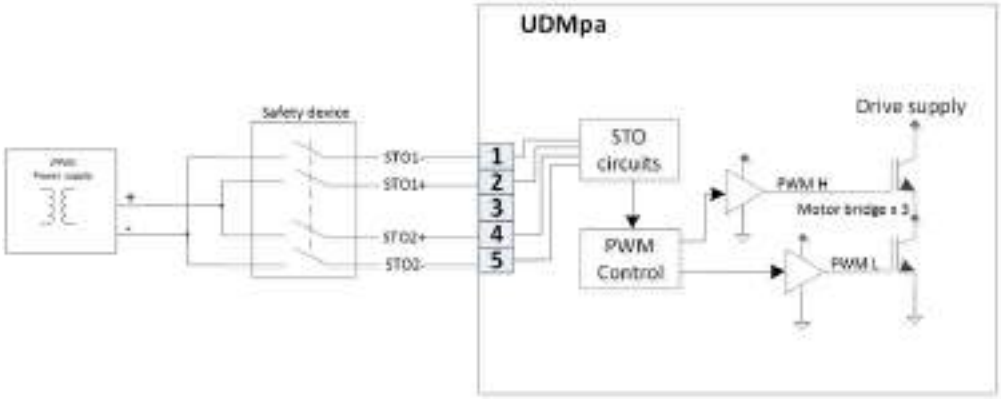

Figure 4-7. STO Connections

4.5 EtherCAT (J4, J5)

4.5.1 Description

Labels: J4 EtherCAT IN, J5 EtherCAT OUT

Connectors: standard RJ45

Mating connector: Ethernet plug, Standard Ethernet CAT5e cable

Figure 4-8. J4, J5 - EtherCAT Connectors

Table 4-6. J4, J5 - EtherCAT Connectors Pinout

Pin	Signal	Description
1	TD+	Positive transmit signal
2	TD-	Negative transmit signal
3	RD+	Positive receive signal
4	NC	Not connected
5	NC	Not connected
6	RD-	Negative receive signal
7	NC	Not connected
8	NC	Not connected

4.5.2 Connection Instructions

1. Use Ethernet cables CAT 5e or better. ACS offers standard cables in different lengths (see "Ethernet Cables" on page 15).
2. Connect EtherCAT cable between the EtherCAT master unit or preceding slave to J4 (ETHERCAT IN).

3. When the unit is not the last network node, connect EtherCAT cable between J5 and EtherCAT IN of the next EtherCAT slave.
4. When the unit is the last network node and a ring topology is used, connect J5 to the EtherCAT Master secondary port.
5. When the unit is the last network node and a line topology is used, leave J5 not connected.

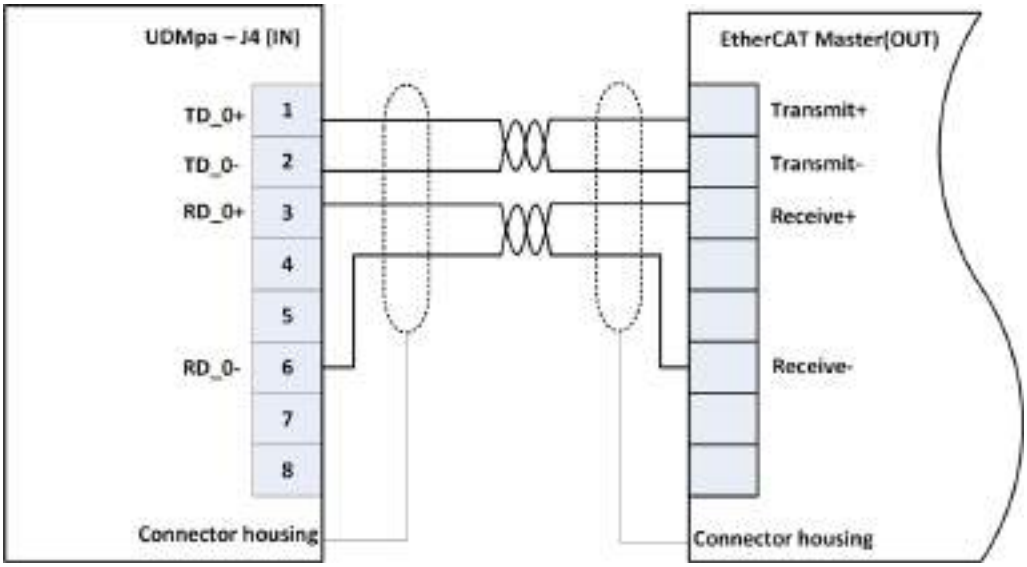

Figure 4-9. EtherCAT In (J4) Connection

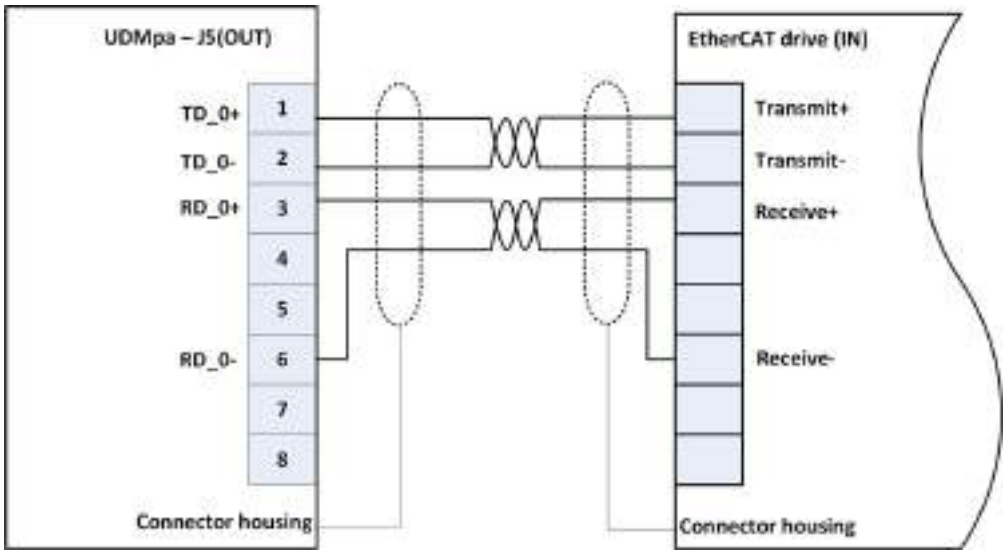

Figure 4-10. EtherCAT Out (J5) Connection

4.6 I/O

4.6.1 Digital I/O (J6)

4.6.1.1 Description

Label: J6 Digital I/O

Connector: D-type 25 pin female

Mating connector: D-type 25 pin male

Figure 4-11. J6 - Digital I/O Connector

Table 4-7. J6 - Digital I/O Connector Pinout

Pin	Signal	Description
1	MARK0+	Axis 0 , Mark input 0 non inverted (may be used as general purpose input)
2	MARK1+	Axis 1, Mark input 1 non inverted (may be used as general purpose input)
3	MARK2+	Axis 2, Mark input 2 non inverted (may be used as general purpose input)
4	MARK3+	Axis 3, Mark input 3 non inverted (may be used as general purpose input)
5	Motor relay_0	Motor relay 0
6	M.BRK0/OUT0	Mechanical brake 0 or digital output 0

Pin	Signal	Description
7	V_SUP_IO	Supply for the IO
8	Relay_V_SUP	Motor relay supply output (leave this pin unconnected)
9	NC	Not connected
10	DGND	Digital ground
11	PEG0-	PEG 0 output inverted (may be used as general purpose output) (SW programmable, default assignment encoder 0, see *PEG and MARK Operations Application Note*)
12	PEG1-	PEG 1 output inverted (may be used as general purpose output) (SW programmable, default assignment encoder 1, see *PEG and MARK Operations Application Note*)
13	DRV_1_ON	Drive 1 on status
14	MARK0-	Axis 0, Mark input 0 inverted (may be used as general purpose input)
15	MARK1-	Axis 1, Mark input 1 inverted (may be used as general purpose input)
16	MARK2-	Axis 2, Mark input 2 inverted (may be used as general purpose input)
17	MARK3-	Axis 3, Mark input 3 inverted (may be used as general purpose input)
18	Motor relay_1	Motor relay 1
19	M.BRK1/OUT1	Mechanical brake 1 or digital ouput 1
20	V_RTN_IO	Supply return for the IO
21	Relay_SUP_RTN	Motor relay supply return
22	NC	Not connected

Pin	Signal	Description
23	PEG0+	PEG 0 output non inverted (may be used as general purpose output) (SW programmable, default assignment encoder 0, see *PEG and MARK Operations Application Note*)
24	PEG1+	PEG 1 output non inverted (may be used as general purpose output) (SW programmable, default assignment encoder 1, see *PEG and MARK Operations Application Note*)
25	DRV_0_ON	Drive 0 on status
	Connector shell and front screw	SHIELD

4.6.1.2 Connection Instructions

1. Use shielded cables with twisted pairs, a minimum gauge of 24 AWG and up to 10 meters in length.
2. The diagrams below show connections options for different Digital I/O functions.

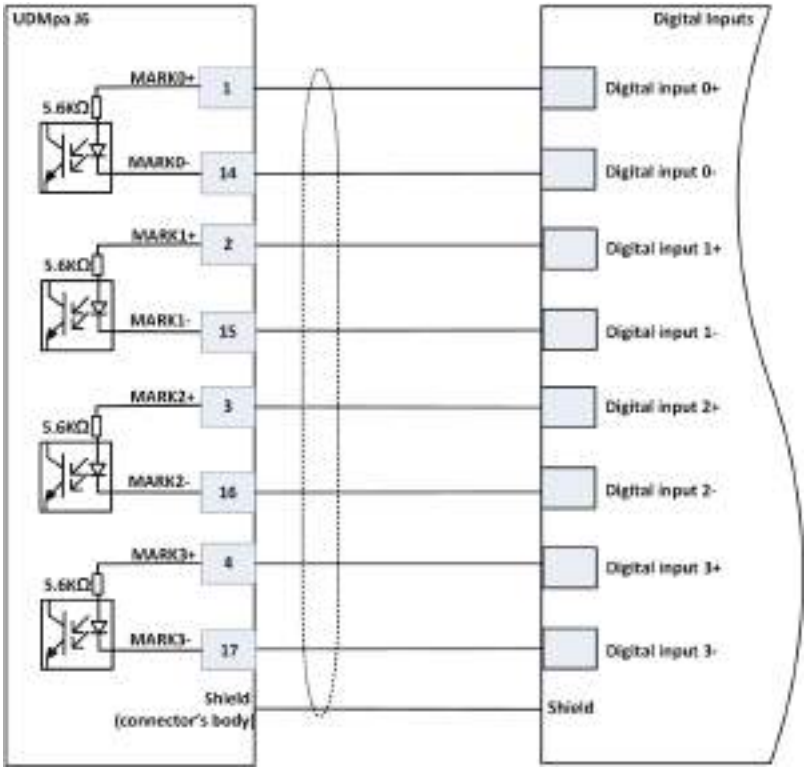

Figure 4-12. Mark Input Connection

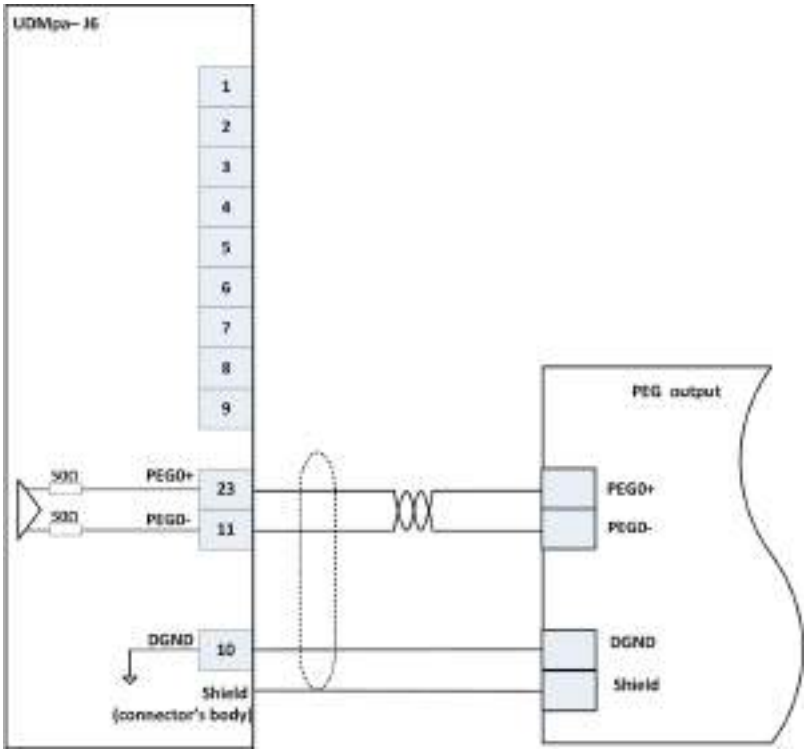

Figure 4-13. PEG Output Connection

PEG Output Connection

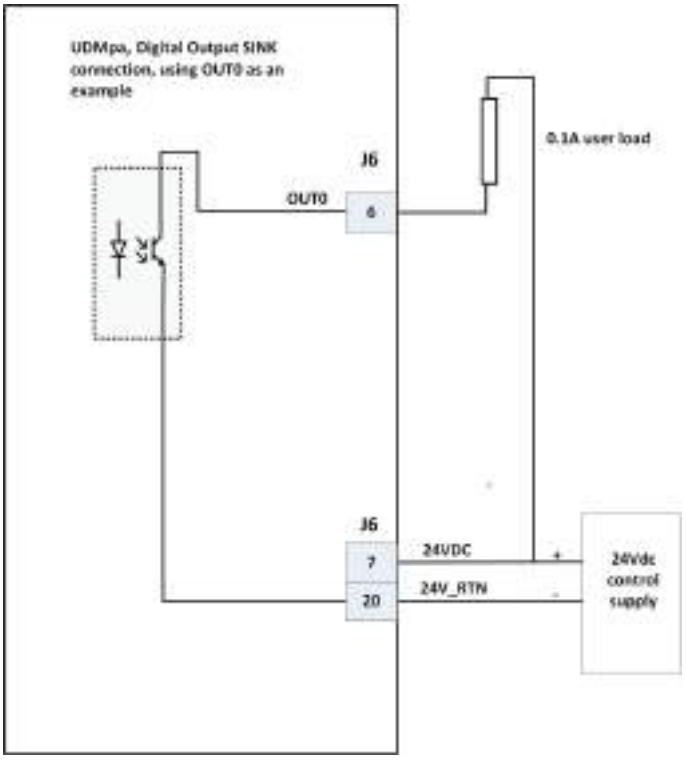

Figure 4-14. 24V Sink Output

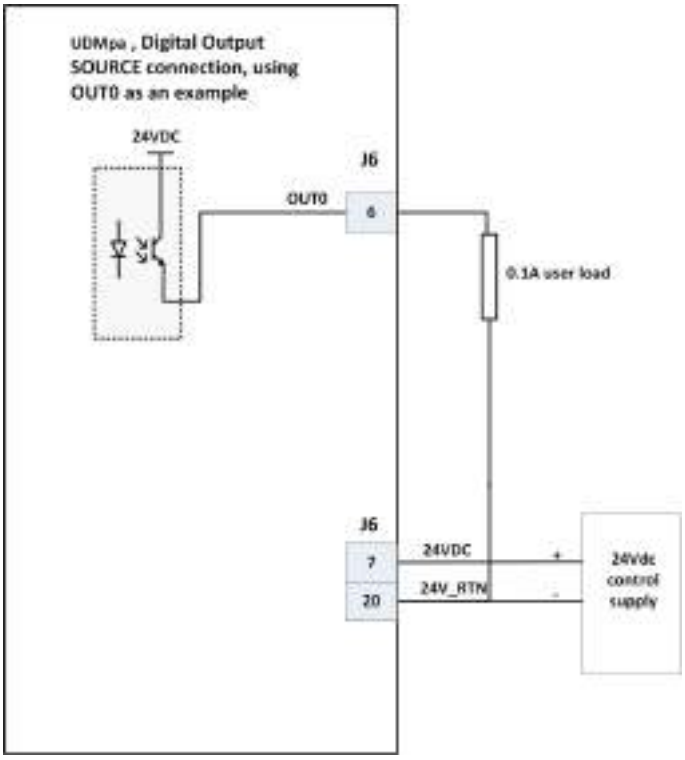

Figure 4-15. 24V Source Output

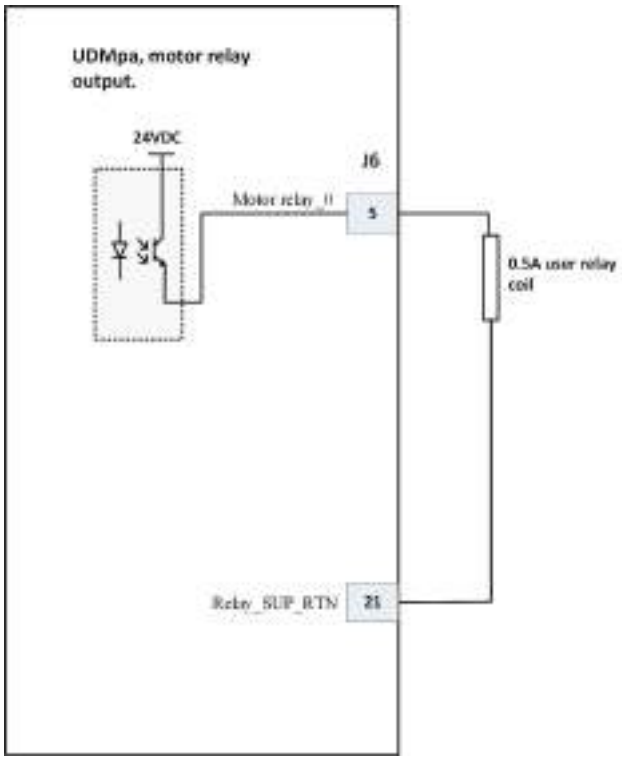

Figure 4-16. Motor Relay Output

4.6.2 Analog & Safety I/O Output(J7)

4.6.2.1 Description

Label: J7 Analog & Safety I/O Output

Connector: D-type 25 pin male

Mating connector: D-type 25 pin female

Figure 4-17. J7 - Analog & Safety I/O Output Connector

Table 4-8. Analog & Safety I/O Pinout

Pin	Name	Description
1	FGND	Analog ground for AIN and AOUT circuits.
2	AOUT0+	Analog output 0 non inverted
3	AOUT1+	Analog output 1 non inverted
4	NC	Not connected
5	NC	Not connected

Pin	Name	Description
6	AIN0+	Analog input 0
7	AIN1+	Analog input 1
8	NC	Not connected
9	NC	Not connected
10	NC	Not connected
11	1_RL	Axis 1 right limit
12	0_RL	Axis 0 right limit
13	V_SUP_SFTY	Safety supply
14	AOUT0-	Analog output 0 inverted
15	AOUT1-	Analog output 1 inverted
16	NC	Not connected
17	NC	Not connected
18	AIN0-	Analog input 0
19	AIN1-	Analog input 1
20	NC	Not connected
21	NC	Not connected
22	NC	Not connected
23	1_LL	Axis 1 left limit
24	0_LL	Axis 0 left limit
25	V_RTN_SFTY	Safety supply return
	Connector shell and front screw	SHIELD

4.6.2.2 Connection Instructions

1. Use shielded cables with twisted pairs, a minimum gauge of 24 AWG and up to 10 meters in length.
2. The diagrams below show connections options for different Analog I/O functions

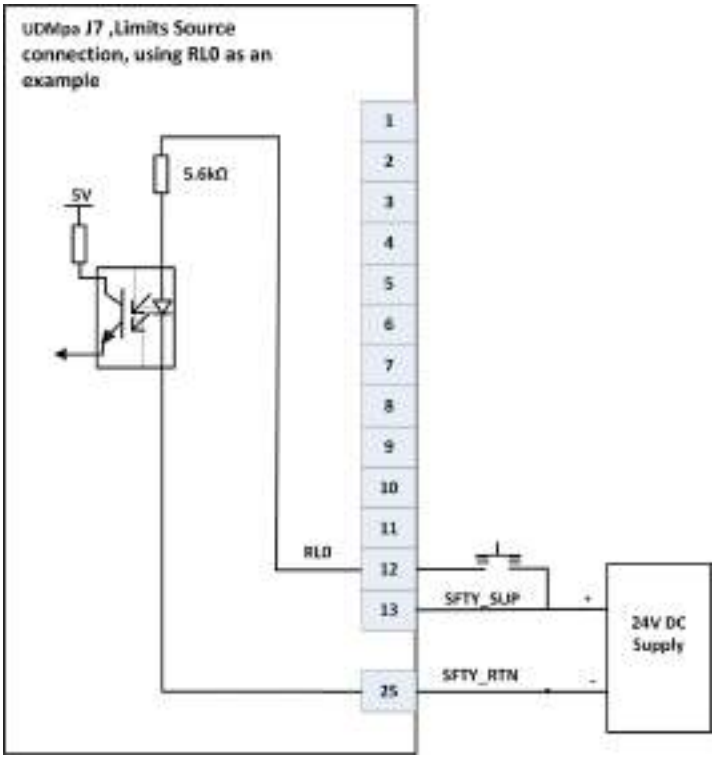

Figure 4-18. Limit Source Connection

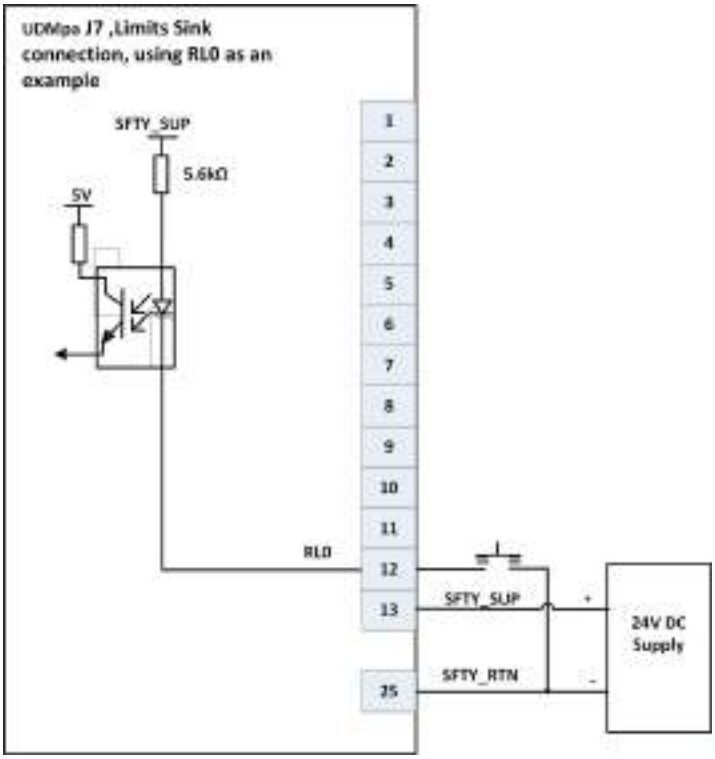

Figure 4-19. Limit Sink Connection

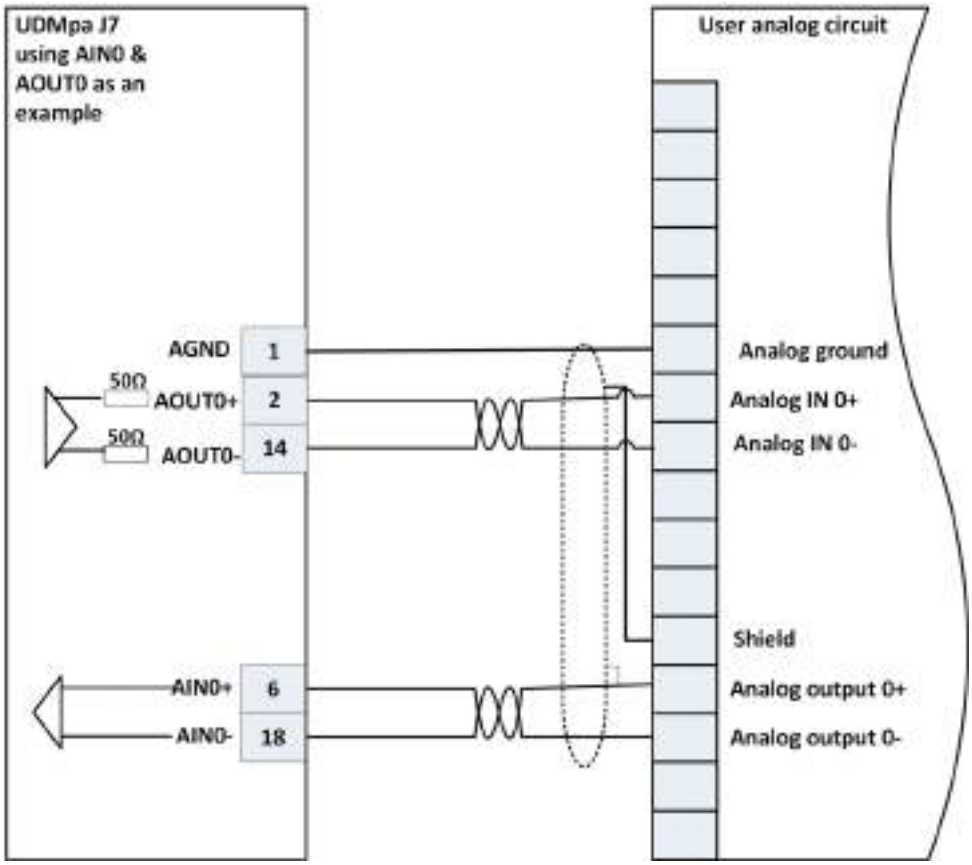

Figure 4-20. Analog I/O Connection

4.6.3 Encoder Feedback (J8-J11)

The following feedback types are supported:

1. Incremental Digital Encoder. Maximum frequency: 12.5MHz.
2. Analog SIN-COS Encoder. Maximum frequency: 500kHz.

4.6.3.1 Description

Label: J8 Encoder 0, J9 Encoder 1, J10 Encoder 2 (not used), J11 Encoder 3 (not used)

Connector: D-type 26 pin high density female

Mating connector: D-type 26 pin high density male

Figure 4-21. Encoder Connectors

Table 4-9. J8, J9 - Encoder Connectors Pinout

Pin	Signal	Description
1	$_CHA-	$ digital encoder, channel A inverted input, for differential encoder only.
2	$_CHB-	$ digital encoder, channel B inverted input for differential encoder only.

Pin	Signal	Description
3	$_CHI-	$ digital encoder, channel I (index) inverted input for differential encoder only.
4	$_HB	$ Motor Hall B (for axis 0 and 1 only.)
5	V_SUP_SFTY	Supply for limit switch input.
6	$_RL	Right limit (for axis 0 and 1 only.)
7	$_SIN-	$ Encoder SIN inverted input
8	$_COS-	$ Encoder COS inverted input
9	$_SC_I-	$ Encoder SIN-COS Index inverted input
10	$_CHA+	$ digital encoder, channel A non-inverted input, used for both single-ended and differential encoders.
11	$_CHB+	$ digital encoder, channel B non-inverted input, used for both single-ended and differential encoders
12	$_CHI+	$ digital encoder, channel I (index) non inverted input, used for both single-ended and differential encoders
13	X_HA	$ Motor Hall A (for axis 0 and 1 only.)
14	X_HC	$ Motor Hall C (for axis 0 and 1 only.)
15	$_LL	Left limit (for axis 0 and 1 only.)
16	$_SIN+	$ Encoder SIN non inverted input
17	$_COS+	$ Encoder COS non inverted input
18	$_SC_I+	$ Encoder SIN-COS Index non inverted input
19	5U	5V user supply for digital encoder and Hall
20	5U_RTN	5V return user supply for digital encoder, A return for $ motor temperature sensor and Hall
21	NC	not connected
22	MTMP_#	MTMP motor temperature sensor (for axis 0 and 1 only.)
23	MTMP_#_RTN	Return supply for MTMP (for axis 0 and 1 only.)

Pin	Signal	Description
24	V_RTN_SFTY	A return for limit switch input.
25	5F	5V user supply for analog encoder and Hall
26	5F_RTN	5V return user supply for analog encoder and Hall
	Connector shell and front screw	SHIELD

$ represents the encoder channel number 0 or 1

4.6.3.2 Connection Instructions

1. Use shielded cables with twisted pairs, a minimum gauge of 24 AWG and up to 10 meters in length.
2. The diagrams below show feedback connections options

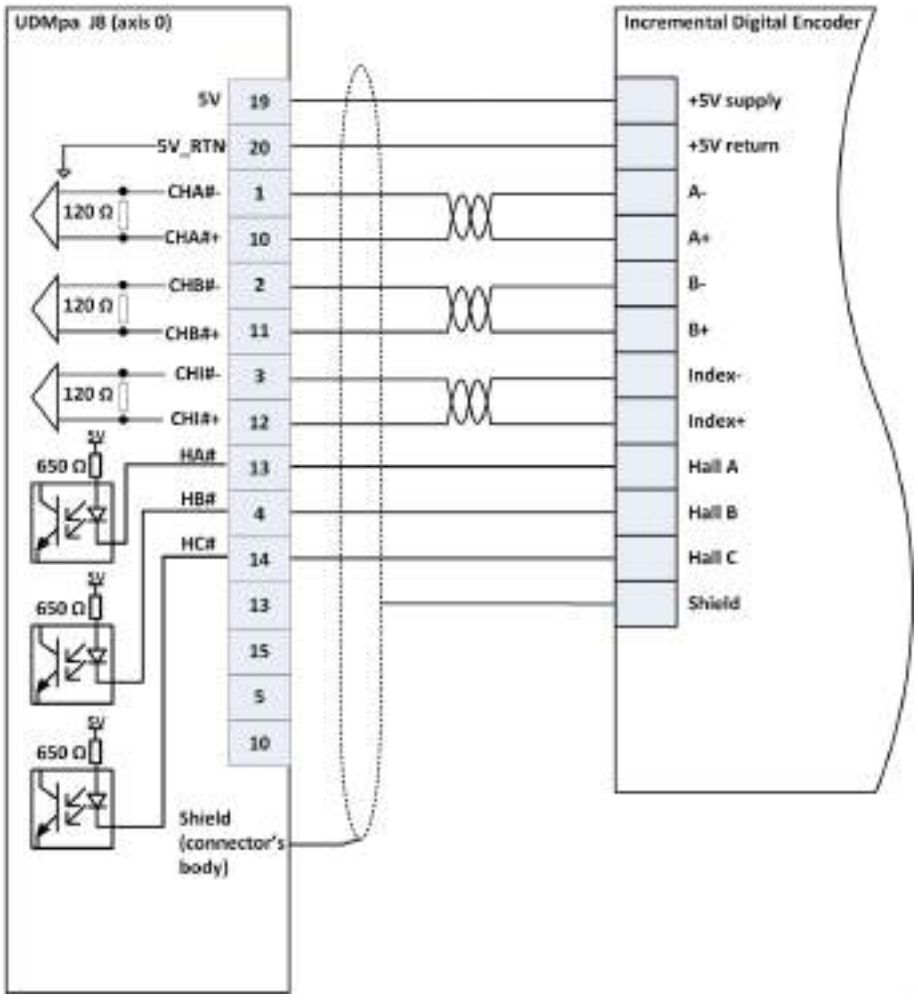

Figure 4-22. Incremental Digital Encoder - AqB Connection

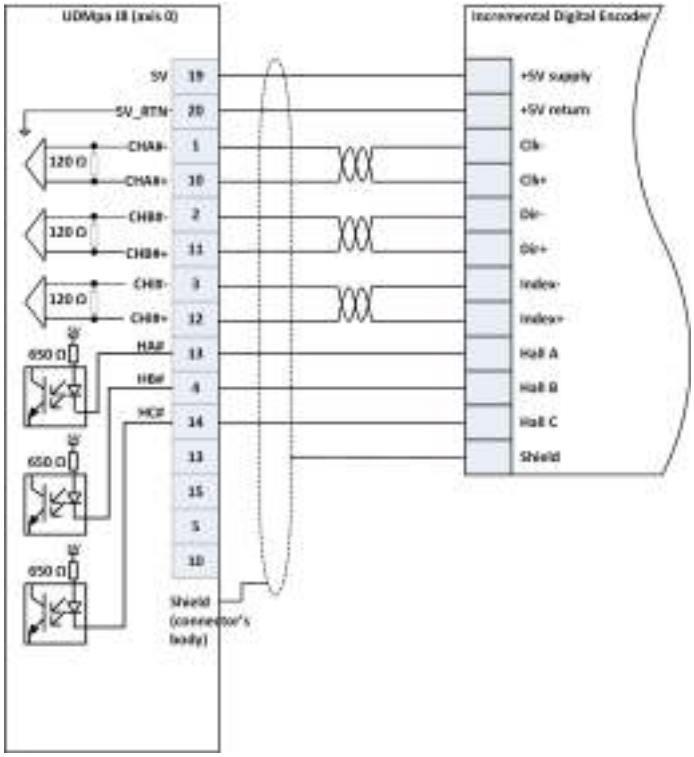

Figure 4-23. Incremental Digital Encoder -Clk-Dir Connection

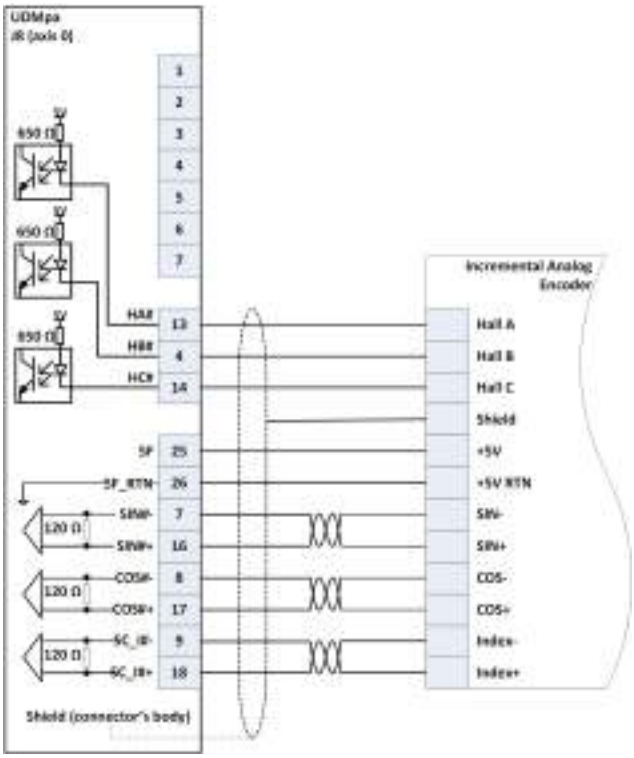

Figure 4-24. Analog SIN-COS Encoder

4.6.4 Motors (J15, J16)

4.6.4.1 Description

Label: J15 (Motor 0), J16 (Motor 1)

Connector: Sub D 9W4 female

Mating connector: Sub D 9W4 male. FTC PN FM9W4P-K120; Pin: FTC FMP005P103 (four required)

Figure 4-25. Motor Connectors

Table 4-10. J15, J16 - Motor Connectors Pinout

Pin	Signal	Description
A1	R_#	Motor R phase for DC brush, three-phase brushless motor, and the common phase for stepper
A2	S_#	Motor S phase for DC brush, three-phase brushless motor, and phase A- for stepper
A3	T_#	Motor T phase for three-phase brushles and-phase B- for stepper
A4	SHIELD/PE	Motor shield
1	MTMP_#	MTMP Motor temperature sensor
2	NC	Not connected
3	MTMP_#_RTN	Return supply for MTMP
4	NC	Not connected
5	SHIELD	SHIELD
	Connector shell and front screw	SHIELD

# Denotes motor number (0,1)

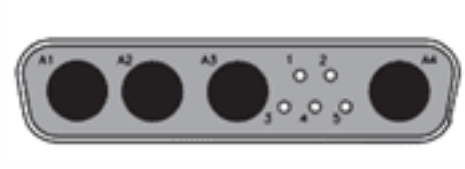

Figure 4-26. Motor Connector Pin Locations

4.6.4.2 Connection Instructions

1. Use a shielded cable with a minimum gauge of 16 AWG. It should be less than 20 meters long.
2. Route the motors' cable (and the drive supply cable) as far as possible from all other noise sensitive cables (such as encoders and I/O).
3. Connect the motors according to the figures below.

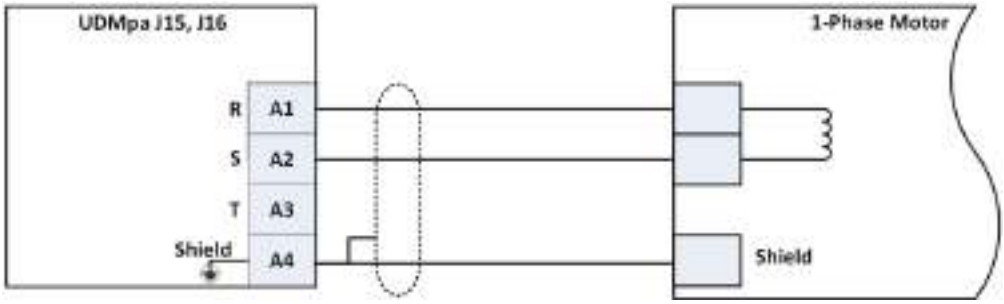

Figure 4-27. Single-phase motor

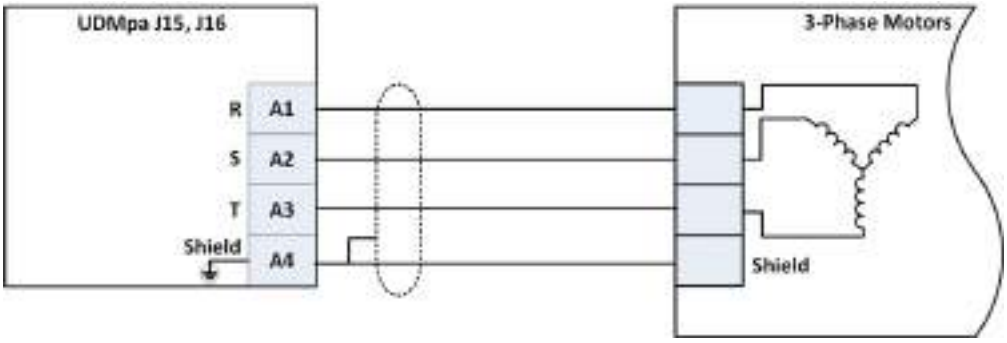

Figure 4-28. Three-phase Motor

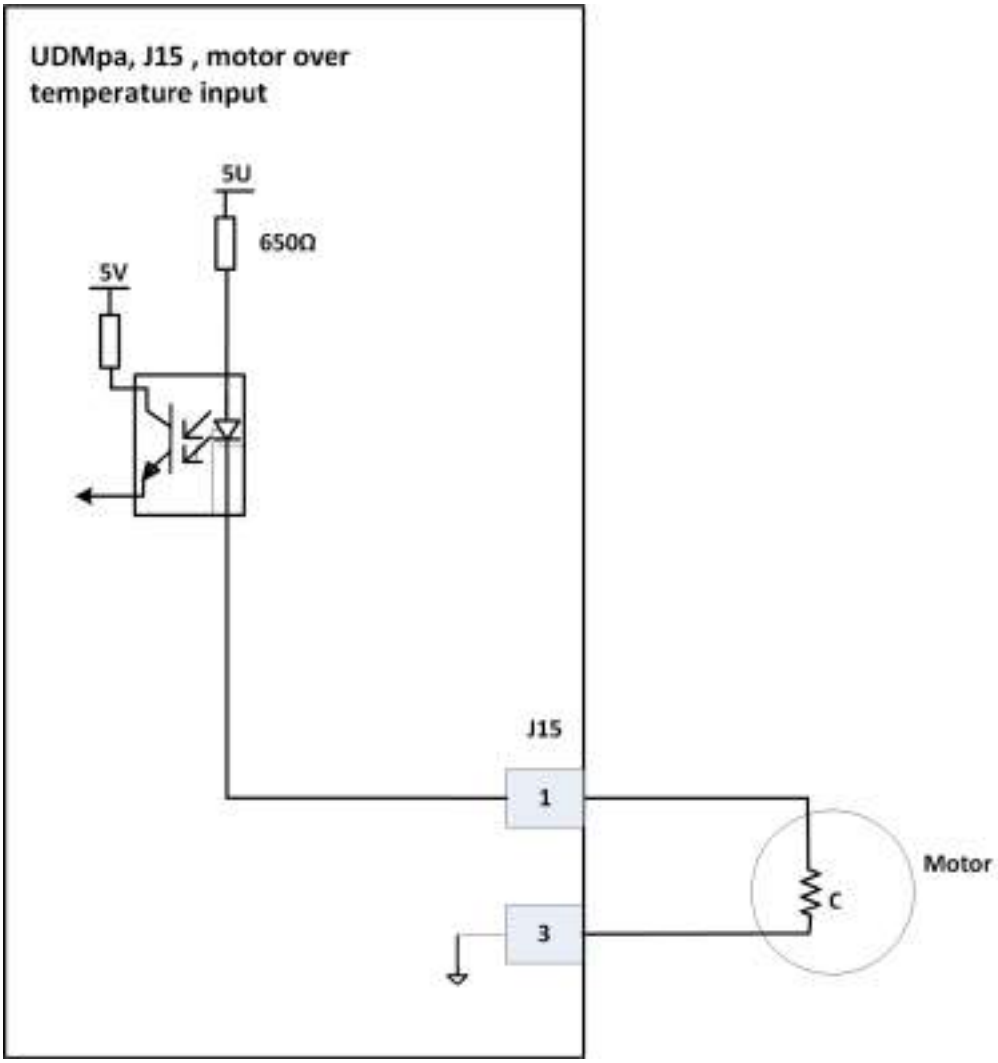

Figure 4-29. Motor Over Temperature Input

Connector J15 services Motor 0 and J16 services Motor 2.

If the motor over temperature protection is not used, then connect input pin 1 to input pin 3.

5. Product Specifications

Table 5-1. System Specifications

Feature	Specifications
Drives	> Type: Digital current control with field oriented control and space vector modulation > Current ripple frequency: 40 kHz > Current loop sampling rate: 20 kHz > Programmable current loop bandwidth: up to 5 kHz > Commutation type: Sinusoidal. Initiation with and without hall sensors > Switching method: Advanced unipolar PWM > Protection: > Over & under voltage > Phase to phase > Phase to ground short  Short circuit on one of the drives might damage the drive. > Over current > Over-temperature
Motor Drive Supply	> Range: 12Vdc to 60Vdc or 12Vdc to 100Vdc, recommended 96Vdc. > Current rating of the power supply should be calculated based on actual load. > Maximum In-rush current: 100A for 40uS @100Vdc > Designation: VP, VP_RTN  There is no regeneration circuit in this product, it's user responsibility to make sure that the DC drive supply voltage will not exceed the 63Vdc for 60Vdc version and 103V for 100Vdc drive.

Feature	Specifications
Control Supply	> Range: 24Vdc ± 10% > Maximum input current / power: 0.9A @21.6V/ 20W without motor brakes > With 2 motor brakes: 1.9A @ 21.6Vdc) / 42W > Protection: Reverse polarity (3A external fuse must be used) > Designation: 24V_CON_SUP, CON_RTN.  During emergency conditions there is no need to remove the 24Vdc control supply.
Motor Type	> Two- and three-phase permanent magnet synchronous (DC brushless/AC servo) > DC brush > Voice coil > Two- and three-phase stepper (micro-stepping open or closed loop)
Feedback	Types: > Incremental digital encoders (AqB) > Analog sin-cos > Hall input
Incremental Digital Encoder	> Two > A&B,I and Clk/Dir, Type: Differential RS-422 > Maximum rate: 50 million quad counts/sec (12.5MHz A & B input frequency) > Protection: Encoder error, not connected > Input termination: 120Ω (on each signal pair) > Encoder supply: 5.1-5.15V, 5V, 0.5A total for all encoders. > Designation: A: #_CHA±, B: #_CHB±, I: #_CHI±

Feature	Specifications

Sin-Cos Analog Encoder	> Two
	> Type: 1Vptp, differential
	> Programmable multiplication factor: x4 to x4096
	> Frequency: 500kHz
	> Format: SIN, COS and Index
	> Type:
	  > Differential input
	  > Input impedance: 120Ω±10%
	  > Encoder voltage range: 1V-PTP±10%
	  > Input voltage range: 1.25V-PTP
	> Encoder analog output supply: 5.1-5.15V, 5V, 1.5A total for all encoders.
	> ADC resolution: 12-bit
	> Diagnostics: Encoder error and encoder not connected
	> Designation: SIN±, COS±, SC_I±

Absolute Encoder (optional)	> EnDat 2.2 & 2.1 (digital only) > Biss - A/B/C > SSI
Hall inputs	> Two sets of three per axis > Input current: <7mA > Interfaces: 5V, Source input type, (open cathode), Reference DGND > Designation: $_HA, $_HB, $_HC
Digital I/O	For different I/O configurations see ordering options
Safety Inputs	> Left and right limit inputs per axis > Interface: Configured by ordering option: 5 or 24V and Sink(NPN) or Source(PNP), single-ended, opto-isolated, default: 24V source > Behavioral : No current ->limit off > Input current: 4-14mA > Designation: #_RL, #_LL (for axis 0 and 1 only)
Registration MARK Inputs	> Four, 24V±20%, opto-isolated, two terminals (High Speed Position Capture) > Input current 4-14mA > Maximum encoder frequency: 2MHz > Position latch: Both raising and falling edge (SW programmable) > Can be used as general purpose inputs > Frequency of events: 1/3*MPU cycles > Designation: MARK0±, MARK1±

Feature	Specifications
Digital Outputs	> General purpose / Mechanical Brake: Two > Interface: Configured by ordering option: Sink(NPN) or Source (PNP), 5/24V, opto-isolated, sink/source, Reference: V_RTN_IO, defult: 24V source > output drop 2.5V at 0.1A > Protection: short current > Designation: OUT0, OUT1
Motor relays (Optional)	> One per motor, 24V ±20% > Source, 0.5A Max > Reference: BRK_RTN > These output signals are used for external relays control (in addition to the internal ones).
PEG (Position Event Generator)	> (Position Event Generator): Two Pulse or State > Differential, RS422 > Pulse width: 26.6nSec to 1.75mSec > Maximum rate: 10MHz > Can be used as general purpose output > Allocation: By default, the PEG output pins are mapped to ACSPL+ variables. Other optional selections are SW programmable (see the *PEG and MARK Operations & Application Notes*). > Designation: PEG0±, PEG1±
Analog Inputs	> Two, ±10V, differential, 12 bit resolution > Max. input frequency: 1KHz > Offset: < 100mV > SNR: >58dB > Designation: AIN_#± (# represents the analog input number 0,1)
Analog Outputs	> Two, ±10V, differential, two terminal,10 bit resolution > Offset: ±100mV, Bandwidth: 5KHz > Max. output load: 10kΩ > Noise & Ripple: <25mV > Designation: AOUT_#± (# represents the analog output number 0,1)
Communication	> Two EtherCAT ports: In and Out > Interface: EtherCAT protocol > Speed: 100Mbps > Designation: Transmit: ETH#_TX±, Receive: ETH#_RX±
Environment	> Operating range: 0 to + 40°C > Storage and transportation range: -25 to +60°C > Humidity (operating range): 5% to 90% non-condensing

Feature	Specifications
Accessories	> NPM-Acc1: Mating connectors kit > STO-ACC1: STO cable > STO-ACC2: STO connector kit > Ethernet cables

Table 5-2. Drive Specifications

Feature	Specifications			
Per Drive	A	B	C	D
Continuous/peak current sin amplitude [A]	3.3/10	6.6/20	10/30	13.3/40
Continuous/peak current RMS per axis [A]	2.6/8	5.3/16	8/24	10.6/32
Maximum cont. Input current [A] @ continuous current	2.6	5.3	8	10.6
Maximum cont. Input current [A] @ peak current	8	16	24	32
Heat dissipation per axis[W] for 60V version (power loss in standby is 6[W]) (*i* = 1 or 2 ; number of drives)	6+*i* x 0.7	6+*i* x 1.7	6+*i* x 2.9	6+*i* x 4.1
Heat dissipation per axis[W] for 100V version (power loss in standby is 6[W]) (*i* = 1 or 2 ; number of drives)	6+*i* x 0.9	6+*i* x 2.1	6+*i* x 3.7	6+*i* x 5.6
Maximum cont./peak output power @ 60Vdc [W] (±5%) 12V - 60Vdc	150/460	310/920	470/1380	610/1850
Maximum cont./peak output power @ 100Vdc [W] (±5%) 12V - 100Vdc	260/780	520/1560	790/2340	1050/3120
Peak current time [sec]	1			

Feature	Specifications			
Minimum load inductance @100Vdc [mH] Can be derated linearly for lower voltages	0.05			
Type	3-phase NanoPWM bridge			
Phase Designation per axis	$_R, $_S, $_T			
Quantity	1 or 2			
Drive current loop measurement	12-bit			
Protections	> Short & over current: 60A±5% > Over temperature: 100°C (on PCB) > Over voltage > 106V±1% for 100Vdc drive > 66V±1% for 60Vdc drive > Under voltage: 9V±3%			
Per Module				
Control voltage input [Vdc]	24 ±10%			
Drive voltage input range [Vdc]	12 – 100 (96 recommended)			
Maximum drive voltage [Vdc]	(Vin motor) x 92%			
Maximum cont. input current per module [A]	5.2	10.6	16	21.2

Table 5-3. Motor Relay Specifications

Item	Description	Remarks
Designation	#_BRK	Per axis. There are two built-in relays that internally short the motor phases upon disable or drive fault. These two outputs provide up to 0.5A and work in parallel to the internal relay.
Type	24V±20%, opto-isolated, source Reference: BRK_RTN	The supply for the Brake is internal.

Item	Description	Remarks
Output current	0.5A per output	
Protection	Short current @4A	
Logic state	When enabled, this signal set to logic 1	

Table 5-4. Motor Over Temperature Specifications

Item	Description	Remarks
Designation	Motor over temperature: #_OVER_T	
Quantity	Two, one per motor	
Type	> Single-ended, opto-isolated > Reference: DGND	
Threshold	> Over temperature protection is on, when the impedance between $_Motor_OVER pin to ground is above 10kΩ > Over temperature protection is off, when the impedance between $_Motor_OVER pin to ground is below 1kΩ	When this protection is not used, the Motor_OVER pin should be shorted to ground.
Default state	Over temperature off = Low impedance <1kΩ	

5.1 STO

Table 5-5. STO Specifications

Item	Description	Remarks
Designation	STO1±, STO2±	
Quantity	2 inputs. One input shuts off the upper part of the motor bridge and second input shuts off the lower part of the bridge.	Both drives shut off simultaneously. All drives are disabled within 200mS.

Item	Description	Remarks
Interface	24V, two terminal for each input	
Input current (per input pin)	<50mA.	
Operation	No current = drive off.	

The UDMPA may be used with an external STO card.

5.2 Dimensions

- Length: 257 mm
- Depth: 155 mm
- Height: 50 mm

5.3 Weight

- 1.6Kg

5.4 Compliance with Standards

5.4.1 Environment

The operational temperature range is from 0 to + 40°C. General guidelines are below. Use these guidelines to determine when forced air cooling is required.

- The 60V version can work under full load within the operational temperature range.
- The 100V version has limitations as below:
  - A single-axis module can drive 13A without the need for forced air.
  - At 30^{0}C with no forced air, both axes can drive 13A simultaneously output current.
  - At 40^{0}C with no forced air, both axes can drive 11A simultaneously output current.
  - Using a 36CFM fan, the product works in its maximum output power within the operational temperature range (up to 40^{0}C).

At 22^{0}C with no forced air, the heatsink temperature can rise up to 30^{0}C in idle and up to 65^{0}C at maximum output power.

5.4.2 CE

- IEC 61800-3:2012(2.1nd Edition) follwing the provisions of 2014/30/EU directive
- EN61800-5-2 follwing the provisions of 2014/30/EU directive

5.4.3 Safety

- Functional safety

- EN 60204-1 : 2006 (+A1`:2009, + AC :2010 Stop Category 0)
- EN ISO 13849-1 : (+ AC :2009 Category 3; PL e)
- EN 62061 : 2005 (+ AC :2010, + A1 :2013 SIL CL 3)
- IEC61800-5-2:2016 Safe Totque Off (STO)
- EN 618000-5-1:2007
- IEC 618000-3 :2017

- Electrical safety
  - UL61800-5-1
  - IEC 61800-5-1:2007 (2nd Edition) follwing the provisions of 2014/35/EU (Low Voltage Directive)

5.4.4 RoHS

- Design complies with ROHS requirements.

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