UDMdx

Installation Guide

March 2023

Document Revision: 3.13.01.02

UDMdx

Release Date: March 2023

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Revision History

Date	Revision	Description
March 2023	3.13.01.02	Contents include STO_ACC2
March 2023	3.13.01.01	EMC certification
February 2023	1.00	Initial Version

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 below provide additional information related to this document.
The most updated version of the documents can be downloaded by authorized users from ACS Downloads.

Document	Description
SPiiPlus MMI Application Studio User Guide	Explains how to use the SPiiPlus MMI Application Studio and associated monitoring tools.
EtherCAT DS402 Products User Guide	Describes the functionality of the ACS DS402 drives
EtherCAT™ DS402 Products Configuration Examples with TwinCAT Application Note	Describes the installation information for the EtherCAT™ DS402 Products Configuration Examples with TwinCAT.
PEG and MARK Operations Application Note	Describes how to setup PEG1 and MARK Operations for SPiiPlus motion controllers
EtherCAT Network Diagnostics Application Note	Summarize all EtherCAT network related functions and variables that are currently supported
Using Absolute Encoders with ACS Products Application Note	This application note addresses the physical connections, configuration and operation of absolute encoders with ACS networking products.
Safe Torque Off Function Application Note	Provides the technical details for implementing the SS1-t/STO function for drives installed in ACS Motion Control systems.

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1. Introduction

1.1 Document Scope

This document describes the installation information for the UDMdx.

This document is intended for the use of engineers and technicians experienced in commissioning motion control systems.

2. UDMdx Product Overview

The **UDMdx** is a member of the Universal Drive Modules (UDM) series of drive solutions designed to meet the needs of OEMs with cost-sensitive motion control applications. Controllable by any ACS SPiiPlus Platform EtherCAT master, it leverages powerful servo control algorithms to maximize motion system performance, while its universal servo drive technology provides the system designer flexibility to control most any type of motor or stage.

The **UDMdx** drive supply accepts supplies of single-phase 100-240 VAC , 3-phase 100-240 VAC , or 3-phase 400 VAC. Control accepts a 24 VDC supply.

2.1 Product Specifications

2.1.1 System Specifications

2.1.1.1 Supplies and Motors

Table 2-1. Control Supply Input - J3

Items	Description	Comments
Input range	24 VDC ±5%	
Maximum Input current	4 A @ 21.6 VDC	
Protection	Reverse polarity	

Table 2-2. Drive Supply - J1

Feature	Description	Comments
Type	Single or three phases, rectifier, motor drive supply with built-in regeneration circuit.	
Input voltage range, [Vrms] AC	AC power supply: > 100-240VAC (+10% / -15%), single or three phase > 400 VAC (±10%) three phase supply	
Frequency	Nominal frequency: 50 Hz / 60 Hz	
Input current (continuous/peak), [Arms] for AC input [ADC]	For single phase input 240 VAC: > Drive "B": 28[1] / 41 For three phase input 240 VAC (phase-to-phase): > Drive "B": 29 / 50 For three phase input 400 VAC (phase-to-phase): > Drive "D": 25 / 49	Maximum value for both axes operating simultaneously [1]Continuous/peak input current and power are limited by input fuse 30 A.

Feature	Description	Comments
Input power (continuous/peak)	For single phase input 240 VAC: > Drive "B": 6675 W[1] / 9720 W For three phase input 240 VAC: > Drive "B": 11883 W / 20975 W For three phase input 400 VAC: > Drive "D": 17478 W / 33782 W	
Inrush current	Maximum inrush current value is 3.75 Arms measured for the first 20 ms after power supply input voltage is applied.	
Regeneration (built-in)	1. 100 Ω, 100 W for 240 VAC supply input 2. 260 Ω, 100 W for 400 VAC supply	User can connect external resistor via the drive supply connector. Minimum values: 15Ω for 240Vac 35Ω for 400Vac

Table 2-3. Motor Drive

Feature	Description	Comments
Quantity	2	
Type	PWM three phase power bridge	
Motor configuration	DC brush 2 and 3 phase brushless 2 and 3 phase stepper	
Output Current, continuous/peak sine amplitude	For drive supply 240 VAC: > Drive "B": 15 A / 30 A For drive supply 400 VAC: > Drive "D": 15 A / 30 A	The peak current is for 1 second
PWM Frequency	20 kHz for 240 VAC supply 10 kHz for 400 VAC supply	

Feature	Description	Comments
Output voltage, phase-to-phase, continuous/peak (Vrms)	> 221 V @ 240 VAC > 352 V @ 400 VAC	Maximum value at no load
	For single phase input 240Vac: > Drive "B": 206 / 185 For three phase input 240Vac: > Drive "B": 214 / 199 For three phase input 400Vac: > Drive "D": 322 / 308	Minimum values for all axes operating simultaneously
Output power per axis, continuous/peak	For single phase input 240Vac: > Drive "B": 3799 W / 6790 W For three phase input 240 VAC: > Drive "B": 4069 W / 7868 W For three phase input 400 VAC: > Drive "D": 5917 W / 11331 W	
Vbus modulation	92% for 240 VAC supply 88% for 400 VAC supply	

Table 2-4. Drive Supply and Motor Drive Protections

Drive Supply Protection	Power down: > AC input supply is disconnected, or one AC input fuse is blown Under voltage: > 80 V±5% (76 V – 84 V) for 240 VAC > 110V±5% for 400 VAC Power Supply Not Ready (Soft Start resistor protection): generates a fault during the Soft Start period: > 4.5–5.5 s for 240 VAC > 5-6 s for 400 VAC Over voltage: > 440 V ± 5% (422 V – 467 V) for 240 VAC > 734 V ± 2% (719 V – 749 V) for 400 VAC Phase lost: > One of the AC input supply phases is disconnected or fuse is blown. Relevant only to 3-phase connection.
Motor Drive Protection	Short circuit (phase to phase or phase to ground): > For 15/30 A axis: 60A ±5% Over current: > For 15/30 A axis: 42A ±5% Over temperature: > 80 °C ±5% on drive's power bridge

2.1.1.2 Motor Feedback

The UDMdx supports three types of encoders: incremental digital encoders (AQB) , analog SIN-COS encoders and digital absolute encoders. The standard product supports incremental digital encoders; SIN-COS and absolute encoders are optional.

Table 2-5. Incremental Digital Encoder

Items	Description	Comments
Quantity	4	
Interface	Differential, RS422	

Items	Description	Comments
Maximum input frequency	50M counts per second for differential	12.5 MHz A & B input frequency appropriate to 50 million quadrature counts per second.
Input termination	120 Ω	
Protection	Encoder not connected, encoder error	
Encoder supply	5.1-5.15 V, 1.5 A total for all digital encoders.	

Table 2-6. Optional SinCos Encoder

Feature	Description	Comments
Format	SIN, COS and Index	
Quantity	4	
Type	Differential input Input impedance 120 Ω ± 10%. Encoder voltage range 1 Vptp±10% Input Voltage range: 1.25 Vptp	
Maximum frequency	500 kHz @ 240VAC 250 kHz @ 400VAC	
Max Interpolation Factor	65,536	
Encoder output supply	5.1-5.15 V, 1.5 A total for all analog encoders.	
Squared SINCOS	The squared signals of the SINCOS are available for all encoders	

Table 2-7. Optional Absolute Encoders

Items	Description	Comments
Quantity	4	
Type	> Heidenhain EnDat2.1, 2.2 , based on ROQ 437 SERIES > Smart-Abs: Tamagawa, based on: SA35-17/33bit-LSP-5V > BiSS-A/B/C > Panasonic: based on AC Servo Motor MINAS A4 Series > SSI > Sanyo ABS	
Maximum input frequency	EnDat - 2 MHz Smart-Abs - 2.5 MHz Biss-C - 10 MHz Panasonic - 2.5 MHz Sanyo - 2.5 MHz	
Interface	Differential RS485	
Encoder supply	5.1-5.15 V, 1.5 A total for all digital encoders.	

2.1.1.3 I/O

Table 2-8. Digital Hall Inputs

Items	Description	Comments
Quantity	One set per axis	Supported on axes 0 and 1
Interface	5 V, Source input type, (open cathode). Reference DGND	
Input current	< 7 mA current.	

Table 2-9. Mechanical Brake

Items	Description	Comments
Quantity	2	
Type	5-30 V,opto isolated, source	
Output current	1 A per output	
Protection	Short circuit	
Reference supply	Brake supply	

Table 2-10. GP Digital Outputs

Items	Description	Comments
Quantity	8	
Interface	OUT0-OUT7, 5/24 V±20%, opto isolated, sink/source Reference: V_RTN_IO	
Output current	0.1 A per output	
Output drop	2.5 V @ 0.1 A	
Protection	Short circuit	

Table 2-11. Limit Inputs

Items	Description	Comments
Quantity	2 per axis	
Interface	Single-ended, 5/24 V±20%, opto isolated, sink/source	
Behavioral	No current= limit off.	
Input current	<14 mA.	

Table 2-12. MARK Inputs

Items	Description	Comments
Quantity	4	
Interface	5/24 V±20%,	

Items	Description	Comments
	Opto-isolated, Two terminals.	
Maximum encoder frequency	<12.5 MHz	
Input propagation delay	<1 µS	
Frequency of events	One per two MPU cycles	
Position latch	Both raising and falling edge	SW programmable
Maximum Input current	<14 mA	

Table 2-13. PEG Outputs

Items	Description	Comments
Quantity	4	
Interface	Differential, RS422 compatible.	
PEG Pulse width	26.6 nSec to 1.745 mSec	
Maximum PEG output rate	10 MHz	
Number of random PEG points	Unlimited	

Table 2-14. GP Analog Inputs

Items	Description	Comments
Quantity	4	
Interface	Differential input, ±10 V±5% or Single-ended 0-10 V±5%	

Items	Description	Comments
Maximum Input Frequency	5 kHz	
Sampling Rate	20 kHz	
Resolution	16-bit	
Offset	<100 mV	
SNR	>56 dB	

Table 2-15. GP Analog Outputs

Items	Description	Comments
Quantity	2	
Type	Differential, ±10 V±10% Single ended 0-5 V±10%	
Resolution	10-bit	
Offset	±100 mV	
Maximum output load	10 kΩ	
Noise & Ripple	<25 mV	
Non-linearity	<5%	

Table 2-16. Motor Over Temperature Inputs

Items	Description	Comments
Quantity	One per axis	
Type	Single-ended, opto-isolated Reference: DGND	

Items	Description	Comments
Threshold	Over temperature protection is on, when the impedance between $_Motor_OVER pin to ground is above 1 kΩ Over temperature protection is off, when the impedance between $_Motor_OVER pin to ground is below 1 kΩ. To enable the drive, ground this pin.	
Default state	Over temperature off = Low impedance < 1K	

Table 2-17. STO&SS1

Items	Description	Comments
Quantity	2 inputs Switch off all axes simultaneously	One shuts off the upper part of the motor bridge and one the lower part.
Interface	24 V isolated, two terminal for each input	
Input current (per input pin)	<60 mA.	
SS1 Delay	40-200 ms	
Behavioral	No current=drive off.	

Table 2-18. EtherCAT Ports

Items	Description	Comments
Quantity	2	Input/Output
Interface	EtherCAT protocol	
Speed	100 Mbps	
EtherCAT cycle rate	1,2,4,5 kHz	

Table 2-19. SPI

Items	Description	Comments
Quantity	1	
Mode	Master/Slave	
Interface	Differential RS422	
Speed	Up to 4 MHz	
Data word length	Up to 16-bits	

Table 2-20. 1-Wire interface

Items	Description	Comments
Quantity	2	One per axis
Mode	Master	
Interface	1-wire serial protocol using a single data line plus ground reference for communication	

2.1.2 Dimensions

- Length: 275 mm
- Depth: 250 mm
- Height: 96 mm

2.1.3 Weight

- 4.4 kg

2.1.4 Compliance with Standards

2.1.4.1 EMC (Pending)

- EN61326-3-1 under 2014/30/EU directive (STO)
- EN61800-3
- EN61800-5-2

2.1.4.2 Electrical Safety (Pending)

- IEC 61800-5-1
- UL-61800-5-1

2.1.4.3 Functional Safety (Pending)

- EN61800-5-2 (defines STO)
- ISO13849 (defines PLe and CAT3)
- EN61508 (defines SIL3)

2.1.4.4 ETG (Pending)

- This certification is given to products that conform to the EtherCAT Technology Group standard and successfully work with other certified devices.

2.2 Package Contents

The UDMdx package contains the following items:

- UDMdx
- Control supply mating connector (J3): Phoenix 5 pin, MC 1,5/ 5-STF-3,81 BK
- Drive supply mating connector (J1), Phoenix 7 pin, PC 5/ 7-STCL1-7,62
- STO Connector Kit P/N: STO-ACC2 (supplied only for units ordered with STO)

2.3 Optional Accessories

2.3.1 Mating Connector Kits

P/N: XDMdx-ACC1 Mating Connector Kit

Table 2-21. Connectors and Mating Connectors

Child Part	Part Description	Quantity	Manufct Code	Mnf. Part No.
AA-C15S4-000/LF	HOOD plast+nickl 15P std EMI npb	4	AMPHENOL	G17Z15014-LF
AA-HOOD0-025/LF	HOOD D-Type 25P STR Metal NPB	2	NELTRON	5507M-25-7-LF
AA-HOOD0-025/LF	HOOD D-Type 25P STR Metal NPB	2	AMTEK	HOOD117-25V-L-A1/HOOD117-25VY-L
CO-11105-100/LF	5-pin housing 2mm pitch NPB	1	JST	PAP-05V-S
CO-12625-000/LF	CON D-type 2row 25pin Male Solde	1	AMPHENOL	G17S-2510-110-EU

Child Part	Part Description	Quantity	Manufct Code	Mnf. Part No.
CO-13102-6HD/LF	D-TYPE CUP 26P HI-DNSTY ML NPB	4	AMPHENOL	G17TH-2610122EU
CO-13102-6HD/LF	D-TYPE CUP 26P HI-DNSTY ML NPB	4	NELTRON	5508-26P-01-F1
CO-13102-6HD/LF	D-TYPE CUP 26P HI-DNSTY ML NPB	4	AMTEK	HDBS-M26SBNA-L
CO-13102-6HD/LF	D-TYPE CUP 26P HI-DNSTY ML NPB	4	McMurdo	HDA26P0L
CO-13104-4HD/LF	D-TYPE CUP 44P HI-DNSTY ML NPB	1	NELTRON	5508-44P-02-F1
CO-13104-4HD/LF	D-TYPE CUP 44P HI-DNSTY ML NPB	1	McMurdo	HDA44P0L
CO-13104-4HD/LF	D-TYPE CUP 44P HI-DNSTY ML NPB	1	WCON	6210-44MNS0B01
CO-BLK04-381/LF	TERM BLOCK PLUG 4POS STR 3.81MM ,BLACK	1	PHOENIX	1743074
CO-PC56P-762/LF	PLUG 6P 41A 600V 7,62 NPB	2	PHOENIX	1778104

2.3.2 STO Breakout Cable

P/N: STO-ACC1

Description: 2 meter cable with the STO mating connector on one end and flying leads on the other.

Figure 2-1. STO-ACC1 Breakout Cable

Table 2-22. STO Cable Pinout

	Name	Description
1	STO1-	STO input 1 inverted input
2	STO1+	STO input 1 non inverted input
3	NC	not connected
4	STO2+	STO input 2 non inverted input
5	STO2-	STO input 2 inverted input

2.3.3 SPI Breakout Cable

P/N: SPI-ACC1

Description: 10 meter cable with SPI mating connector on one end, connecting to J12. The other end has flying leads for connection to user equipment.

Figure 2-2. SPI Breakout Cable

Table 2-23. SPI Cable Pinout

Pin	Wire Color	Signal
1	Green/White	SPI_MOSI+
2	Green	SPI_MOSI-
3	Red/White	SPI_MISO+
4	Blue	SPI_CLK+
5	Blue/White	SPI_CLK-
6	Red	SPI_MISO-
7	Black/White	SPI_SS+
8	Black	SPI_SS-

2.4 Ordering Part Number

The ordering part number (P/N) contains several characters that each specify a configuration characteristic ordered for the UDMdx module, as described in Table 2-24.

Table 2-24. Configuration as Indicated by P/N

	Field	Example selection by user	Optional Values
Number of Axes	1	2	1, 2
Current Rating (Amps peak of sine)	2	B	A = Reserved B = 15/30A @ 100-240VAC C = Reserved D = 15/30A @ 400VAC
Number of 500 kHz SinCos Encoders[1]	3	1	0, 1, 2
Reserved	4	0	N = N/A
Number of Absolute Encoders Channels	5	1	0, 1, 2, 3, 4
Functional Safety	6	T	N = None, T = STO & SS1
Reserved	7	N	N = N/A
Reserved	8	N	N = N/A
Reserved	9	N	N = N/A
Reserved	10	N	N = N/A

[1]The 400VAC version supports a maximum 250kHz SinCos Encoder

Example: UDMdx-2B101T-NNNN Description: 2 axis 15/30A @ 100-240VAC, 1 SinCos 500 kHz encoders, 1 Absolute encoder, STO & SS1

Field		1	2	3	4	5	6	7	8	9	10
PN	**UDMdx**	2	B	1	0	1	T	N	N	N	N

3. Mounting and Cooling

> Unit must be mounted vertically, using M4 type Philips screws. The dimensions (in millimeters) are shown below.

> Leave clearance of 50 millimeters around all sides of the device to allow cable routing and free airflow.

> Unit operates in the ambient temperature range of 0° to 40 °C. Both axes can work at maximum 7.5A @ 40 °C without forced air. Above 7.5A, a fan providing 120CFM should be used.

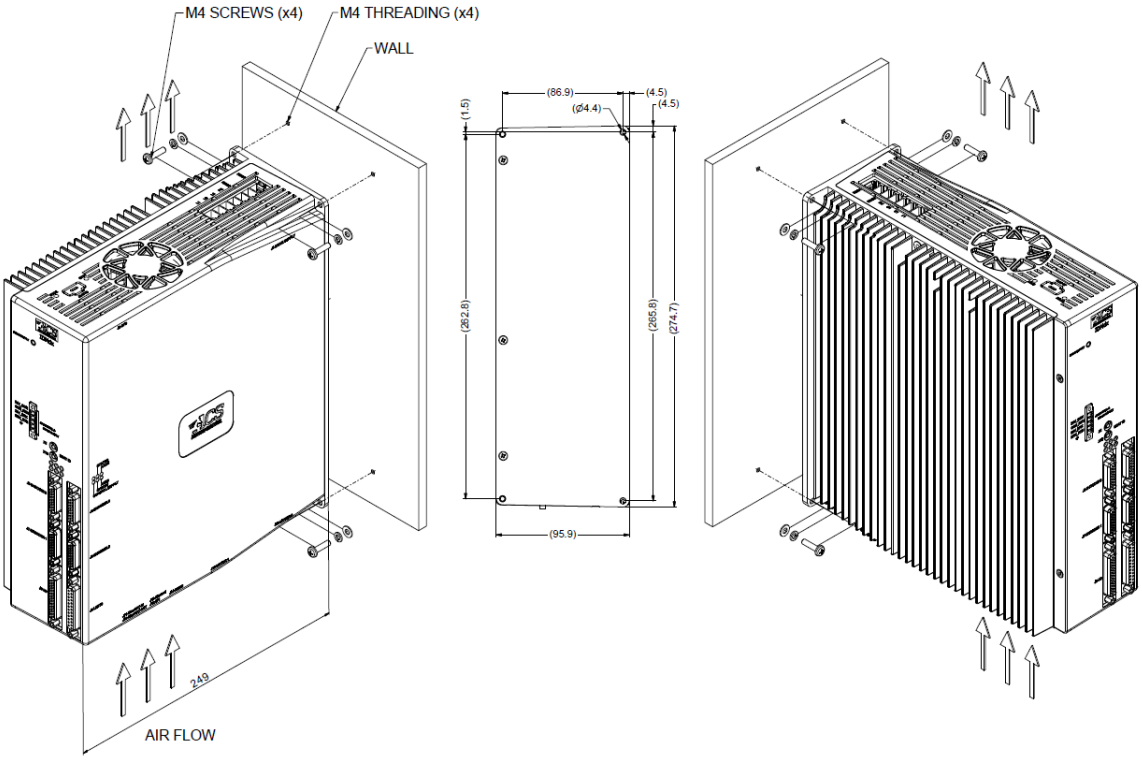

Figure 3-1. Airflow and Mounting

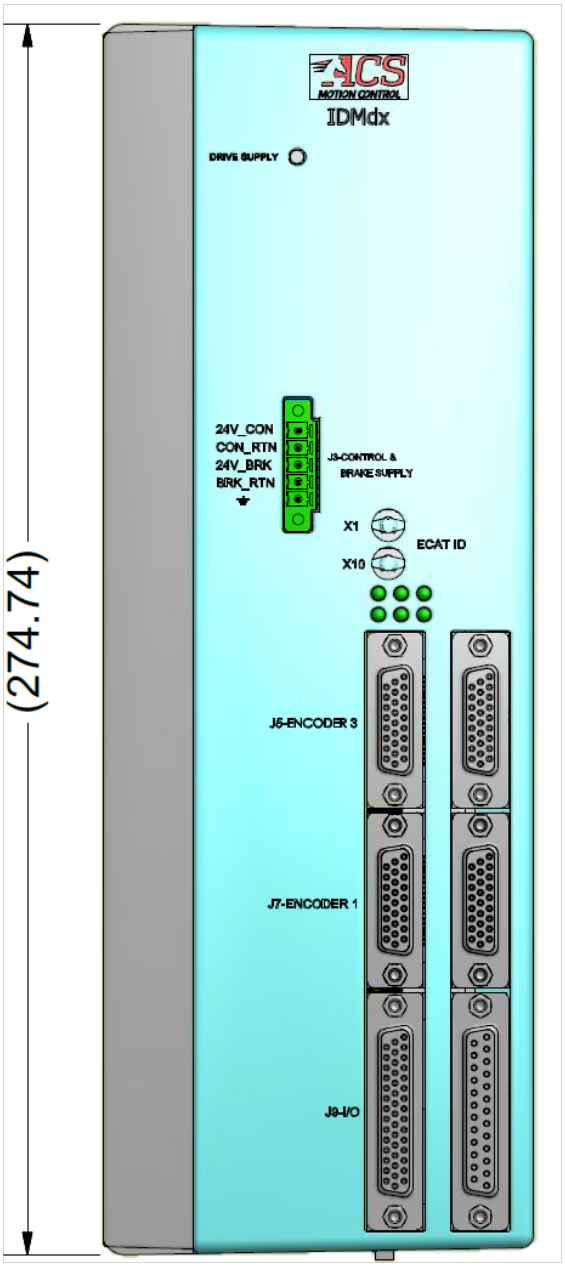

Figure 3-2. Dimensions - Front View

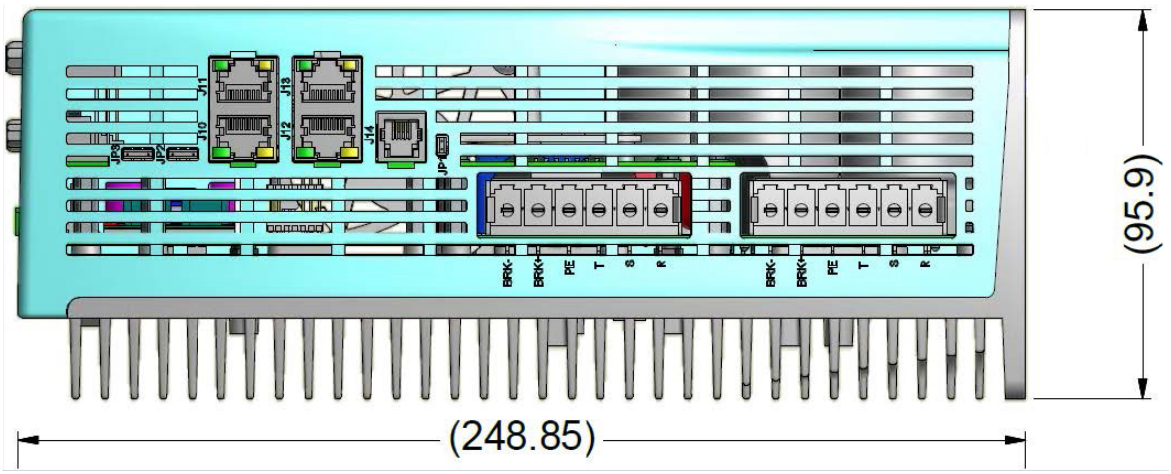

Figure 3-3. Dimensions - Side (Communications, Motor Connectors) View

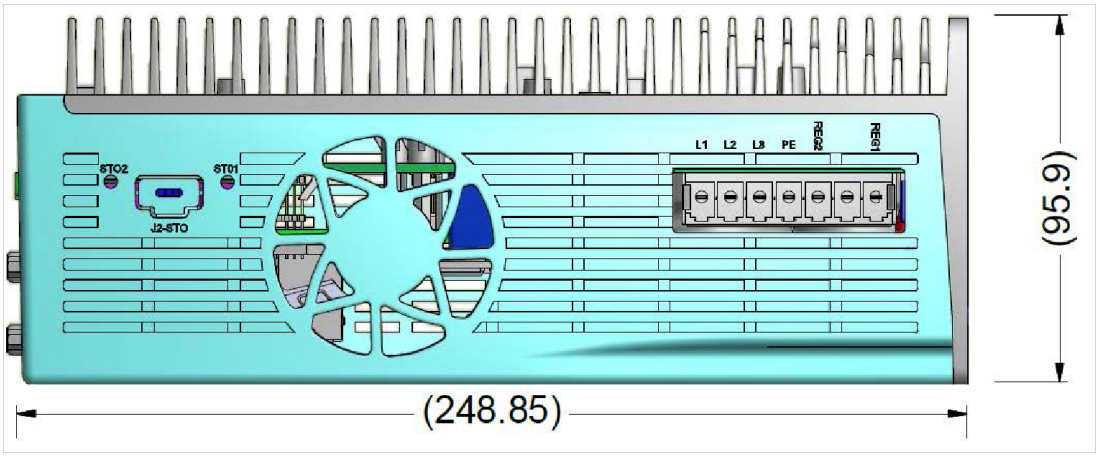

Figure 3-4. Dimensions - Side (Drive Supply) View

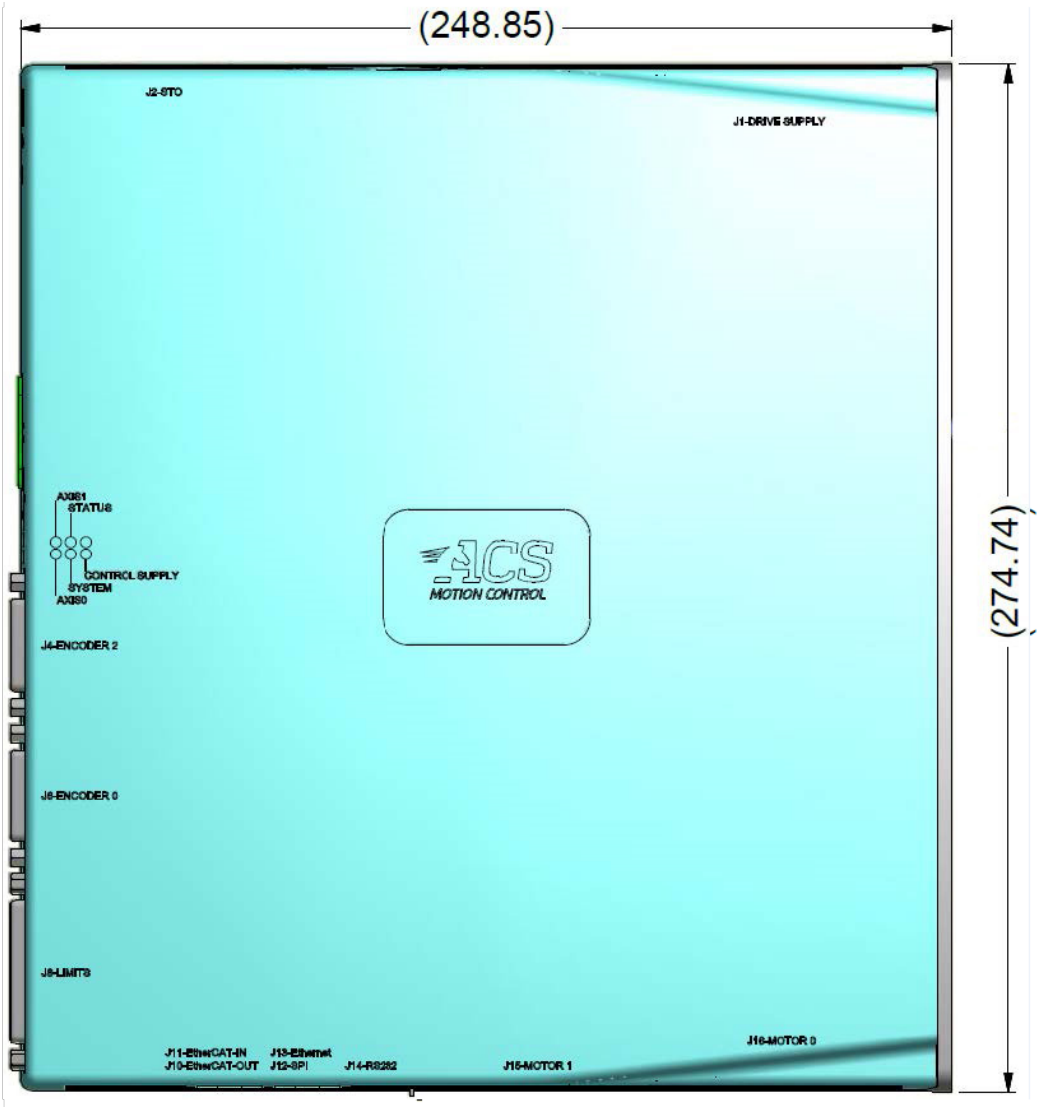

Figure 3-5. Dimensions - Top View

3.1 Power Losses

Drive supply total power losses at continuous input current	For single phase input 240 VAC: 1. Drive "B": 70 W For three phase input 240 VAC: 2. Drive "B": 146 W For three phase input 400 VAC: 1. Drive "D": 119 W	Maximum value for both axes operating simultaneously
Motor drive power loss per axis	For 240 VAC: > Drive "B": 106 W For 400 VAC:	

	> Drive “D”: 79 W	
Internal circuits power loss	20 W	

4. Connections

This section describes how to interface with the UDMdx using proper safety, EMC and wiring guidelines.

Table 4-1. Connector List

Connector Assignment	Connector Name	Mating Connector
J1	DRIVE SUPPLY	Manufacturer: Phoenix Mnf. p.n.: PC 5/ 7-STCL1-7,62
J2	STO	JST 5 PIN 2mm female PAP-05V-S Pin type: SPHD-001T-P0.5
J3	Control & brake supply	Phoenix 5 pin, MC 1,5/ 5-STF-3,81 BK (1743171)
J4	Encoder2	D-type 26 pin high density male
J5	Encoder3	D-type 26 pin high density male
J6	Encoder0	D-type 26 pin high density male
J7	Encoder1	D-type 26 pin high density male
J8	LIMITS	D-type 25 pin male
J9	I/O	D-type 44 pin high density male
J10	EtherCAT OUT	RJ45 plug 8 positions 8 contacts
J11	EtherCAT IN	RJ45 plug 8 positions 8 contacts
J12	SPI	RJ45 plug 8 positions 8 contacts
J13	N/A	Not Applicable
J14	N/A	Not Applicable
J15	MOTOR1	Manufacture: Phoenix, p.n. PC 5/ 6-STCL1-7,62
J16	MOTOR0	Manufacture: Phoenix, p.n. PC 5/ 6-STCL1-7,62

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 the section on STO.

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 UDMdx while the power source is on.

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

The motor connectors, J15 & J16 contain hazardous voltages above 400V 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 UDMdx.
- Proper wiring, grounding and shielding are essential for ensuring safe, dependable, and optimal servo performance. After completing the wiring, carefully inspect all wires to ensure tightness, good solder joints, and general safety.

Table 4-2. Wiring Guidelines

Item	Gauge	Twisted pair
Control power supply	18 AWG	No
Drive power supply	14-16 AWG	No

Item	Gauge	Twisted pair
Encoders	28 AWG (up to 0.6 A), 26AWG (up to 1 A)	Yes

Connecting or disconnecting the motor without disabling the drive first can potentially damage the drive.

Figure 4-1. Device Grounding Screw

Ground the device using a M4x6 screw and a spring washer.

4.2 Connectors

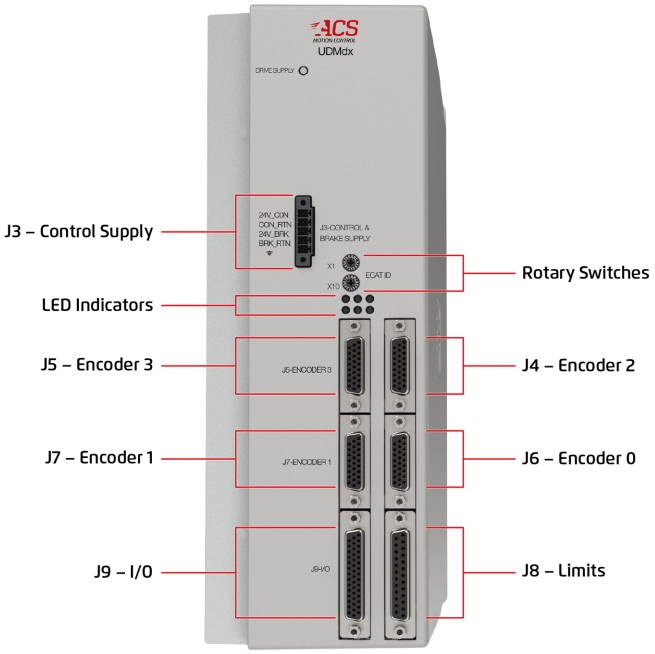

Figure 4-2. UDMdx Front Panel Connectors

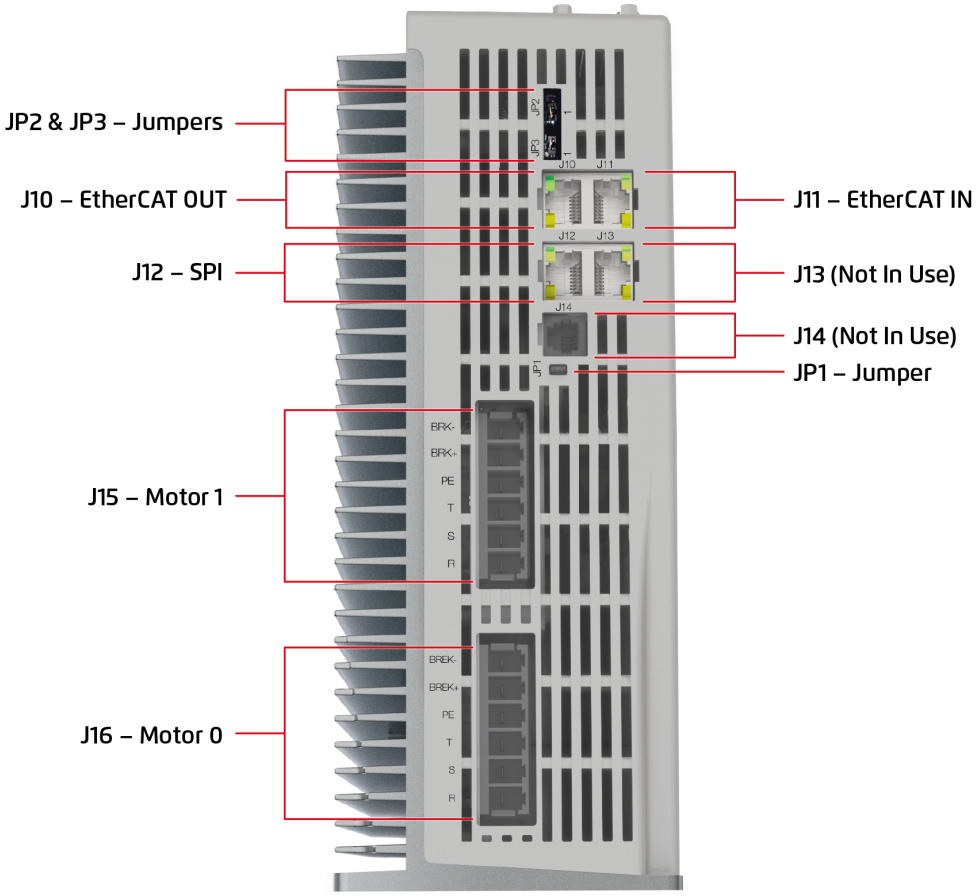

Figure 4-3. UDMdx Motor and Communication Connectors

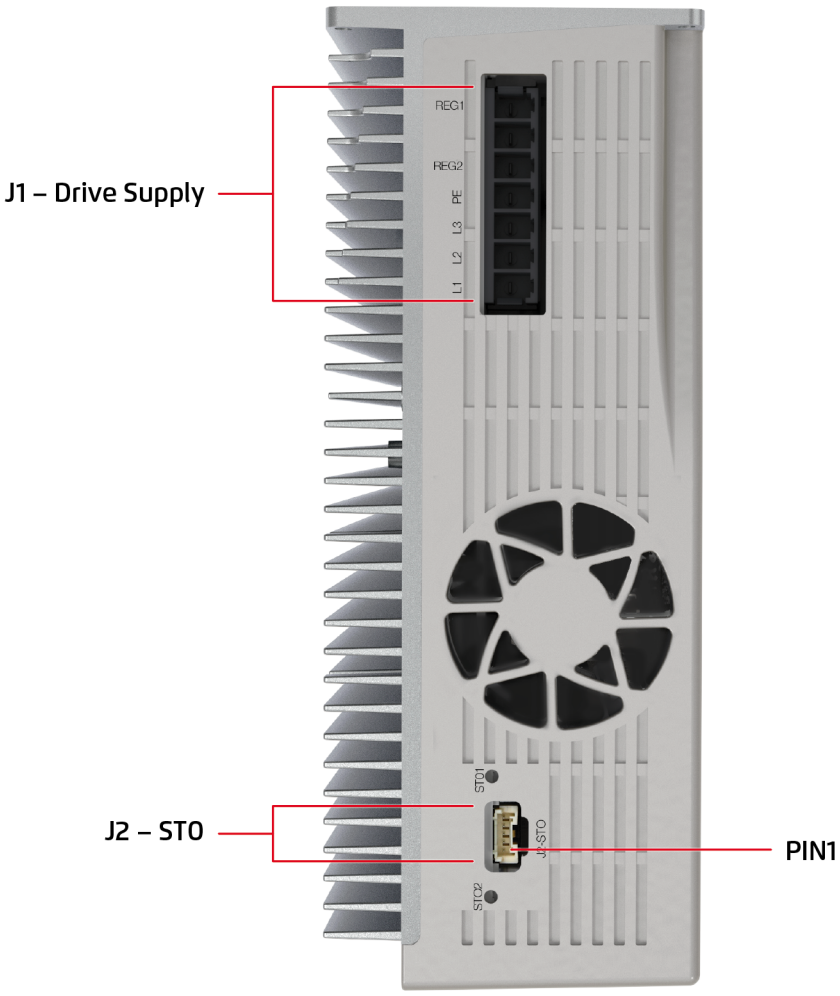

Figure 4-4. UDMdx Drive Supply and STO Connectors

4.3 Jumpers

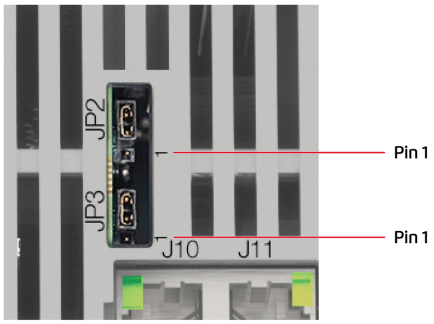

Figure 4-5. JP2-JP3 Pin Locations

Table 4-3. Jumpers

Jumper Name	Position 1-2	Position 2-3
JP1 Recovery (default open)	FW Recovery Mode	N/A
JP2 - Limits inputs configuration (sink/source)	Sink Input Type	Source Input type (default)
JP3 - Mechanical brake / digital outputs configuration (sink/source)	Source Output Type (default)	Sink Output Type

4.4 LED Indicators

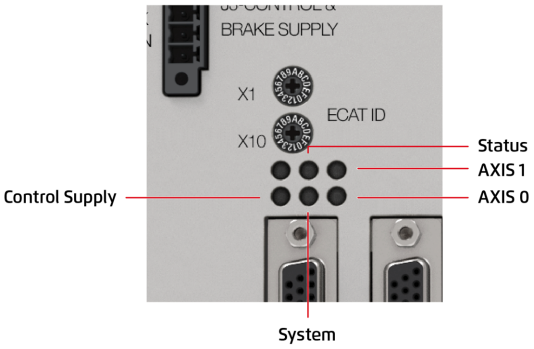

Figure 4-6. LED Indicators on Front Panel

Table 4-4. LED Indicators

Designator	Description	Note
Control supply	One, green Off - Logic supply doesn't function. On - power supply is OK	
ECs_IN ECs_OUT	Green (one per connector) > Off - No link (no connection) > Blinking - Link and activity > On - Link without activity	
Ethernet Link/Activity		Not Applicable
Ethernet Speed		Not Applicable
STATUS External network status	Bicolor > Green - According to "RUN Indicator" > Red - According to "ERROR Indicator"	
System	Bicolor > Red - System Fault > Green - System OK > Blinking - Software command	
Axis status	One per axis, bicolor > Off - Disable > Green - Drive is enabled > Red - Drive fault	
Drive supply	One, red > On - Drive supply connected > Off - No bus voltage	

4.5 Communication Connectors

4.5.1 EtherCAT

4.5.1.1 EtherCAT Description

Labels: J11 EtherCAT IN, J10 EtherCAT OUT

Connectors: standard RJ45

Mating connector: Ethernet plug, Standard Ethernet CAT5e cable

Figure 4-7. J11, J10 - EtherCAT Connectors

Table 4-5. J11, J10 - EtherCAT Connector 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

4.5.1.2 EtherCAT Connection Instructions

1. Use Ethernet cables CAT 5e or better. ACS offers standard cables in different lengths.
2. When the unit is the last network node and a ring topology is used, connect J10 to the EtherCAT Master secondary port. See Figure 4-12.

The following diagrams illustrate the wiring of the UDMdx to EtherCAT Slave or Master Devices.

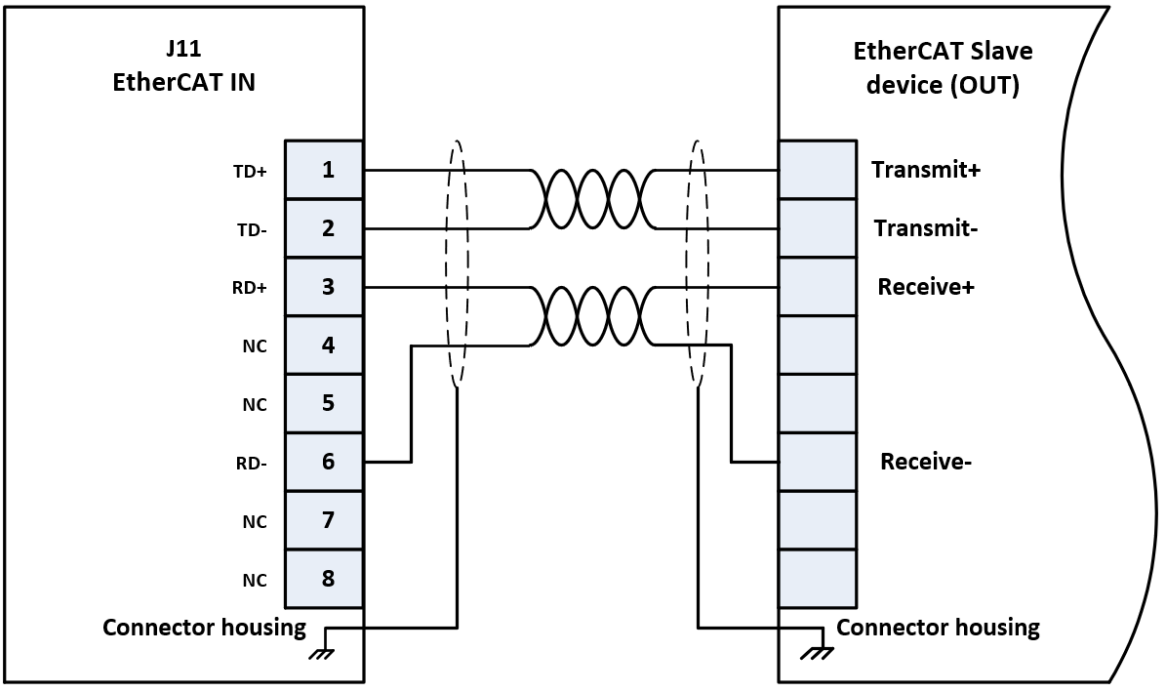

Figure 4-8. EtherCAT In (J11) Connection to Slave

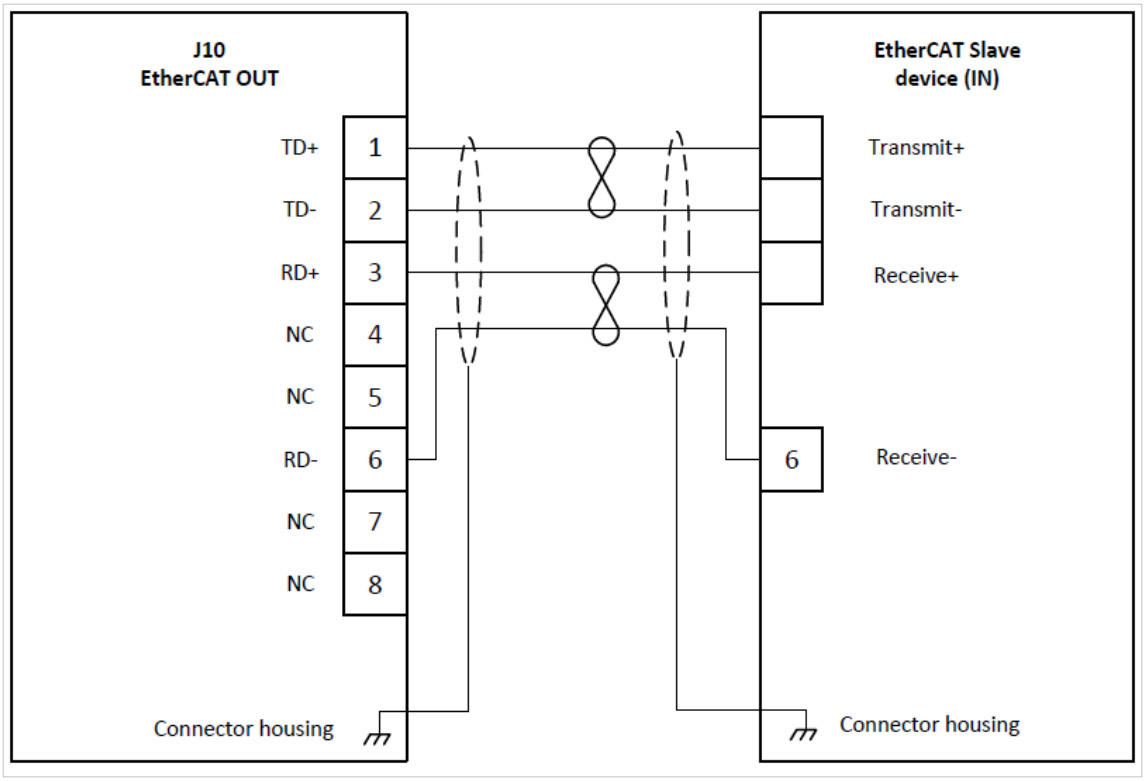

Figure 4-9. EtherCAT Out (J10) Connection to Slave

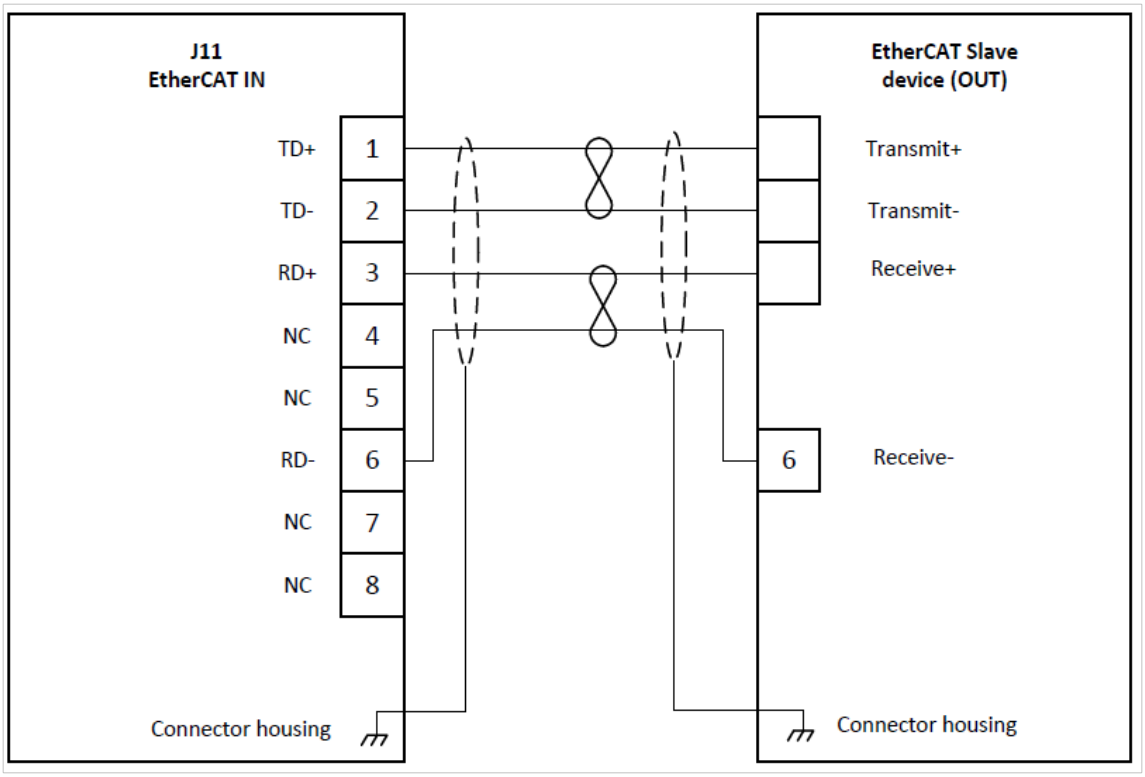

Figure 4-10. EtherCAT IN connection to external EtherCAT Master device

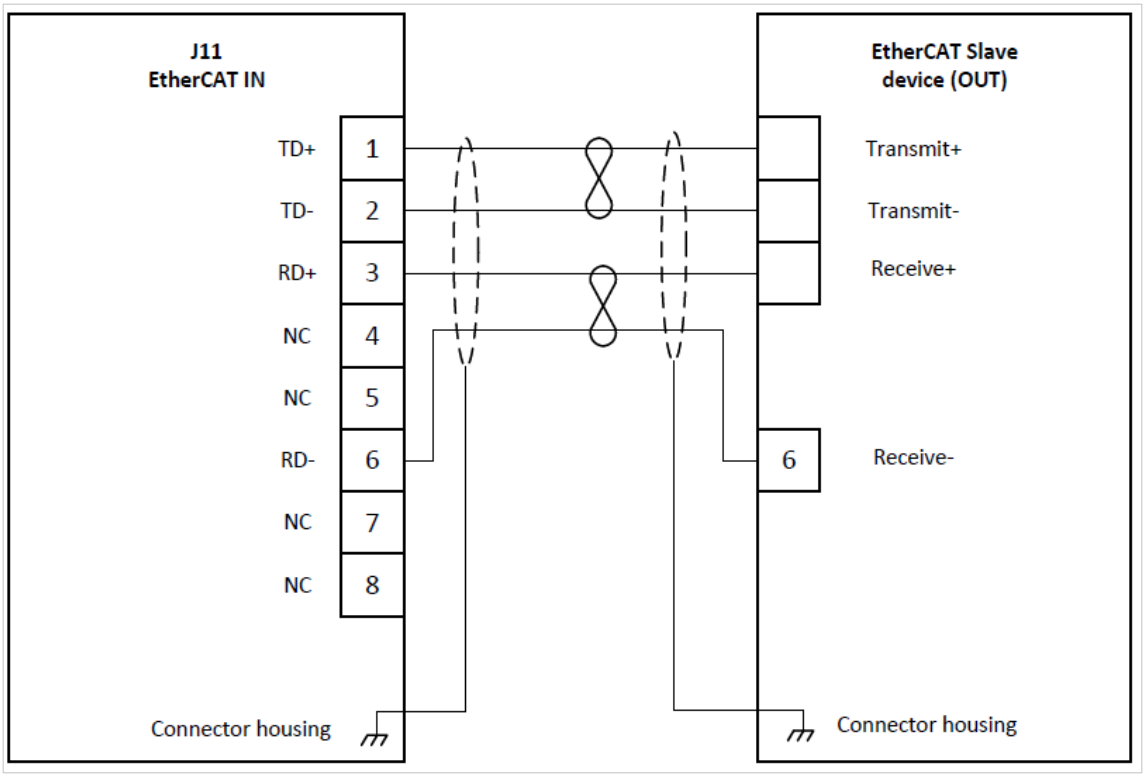

Figure 4-11. EtherCAT IN connection to external EtherCAT Master device

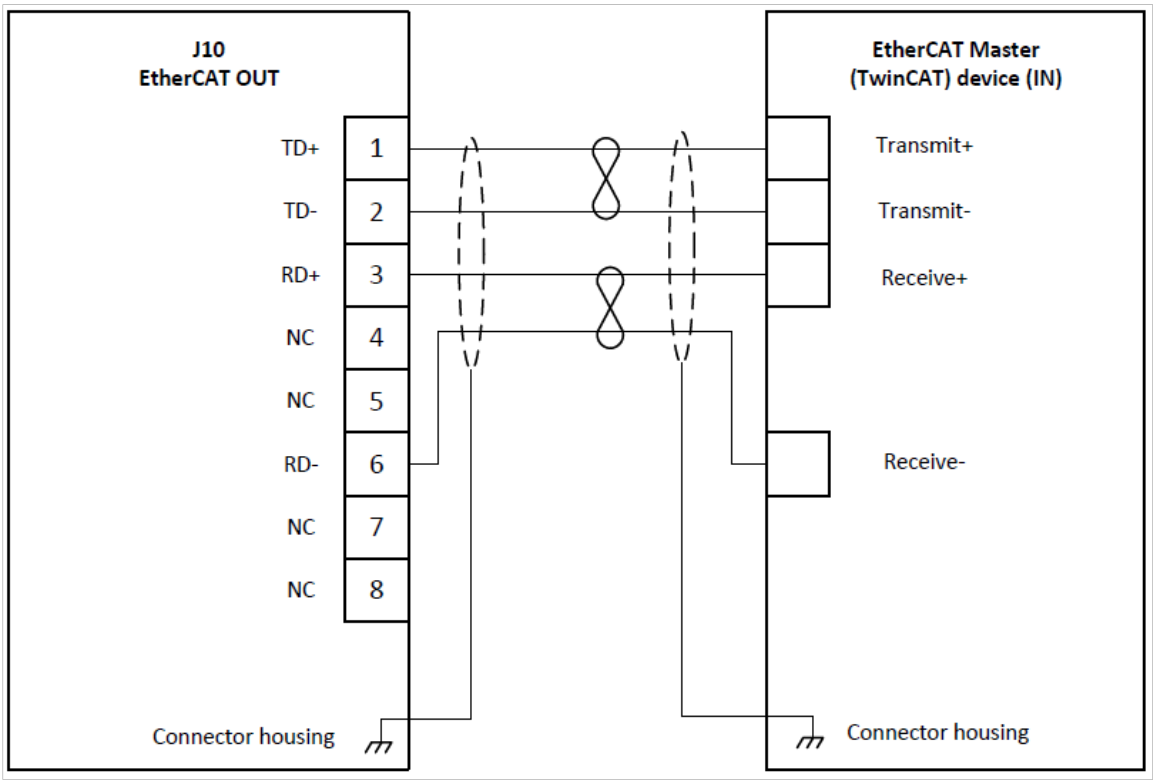

Figure 4-12. EtherCAT OUT Connection to External EtherCAT Master

Figure 4-12 illustrates the connection to an external master which is the last node in a ring topology.

4.5.2 SPI

4.5.2.1 SPI Description

Label: J12

Connector: RJ45 socket

Figure 4-13. RJ45 Cable

4.5.2.2 SPI Connection Pinout

Table 4-6. SPI Connection Pinout

Pin	Name	Description
1	SPI_MOSI+	SPI data master output / slave input non inverted
2	SPI_MOSI-	SPI data master output / slave input inverted
3	SPI_MISO+	SPI data master input / slave output non inverted
4	SPI_CLK+	SPI clock non inverted (bi-directional interface for master and slave mode)
5	SPI_CLK-	SPI clock inverted (bi-directional interface for master and slave mode)
6	SPI_MISO-	SPI data master input / slave output inverted
7	SPI_SS+	SPI slave select non inverted (bi-directional interface for master and slave mode)
8	SPI_SS-	SPI slave select inverted (bi-directional interface for master and slave mode)
	SHIELD	Connector shell

The SPI is a high-speed synchronous serial interface, allows a serial bit stream of programmed length to be shifted into and out of the drive.

The SPI is normally used for communications between the ACS drive and external peripherals.

The SPI can be configured as master or slave, up to 8 words of 16 bits. For more information refer to the section on SPI support in the *ACSPL+ Programmer's Guide*.

4.5.2.3 SPI Software Interface

The ACSPL+ programming language supports SPI data communication through the use of the **SPICFG** and **SPIWRITE** commands. For further details see the descriptions of the commands in the *ACSPL+ Commands and Variables Guide* and the section on the SPI interface in the *ACSPL+ Programmer's Guide*.

4.6 Power Supply Connectors

The unit is fed by two power supplies:

- Drive Supply: 100-240 VAC or 400 VAC (J1)
- Control Supply: 24 VDC (J3)

The power supplies must be provided by the customer and be UL certified or equivalent. Each power supply input 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.

4.6.1 Drive Supply

4.6.1.1 Drive Supply Description

Label: J1 DRIVE SUPPLY

Mating type: Phoenix 7 pin, PC 5/ 7-STCL1-7,62

Table 4-7. J1 - Drive Supply Connector Pinout

	Name	Description
1	L1	AC input phase 1
2	L2	AC input phase 2 (Neutral for single phase connection)
3	L3	AC input phase 3 (N/A for single phase connection)
4	PE	EGND, protected earth.
5	REG 2	External regeneration resistor terminal 2
6	NC	Not connected
7	REG 1	External regeneration resistor terminal 1

4.6.1.2 Drive Supply Connection Instructions

1. Use a low inductance cable with a minimum gauge of 14 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 the unit PE (Protective Earth) to the power supply PE point.

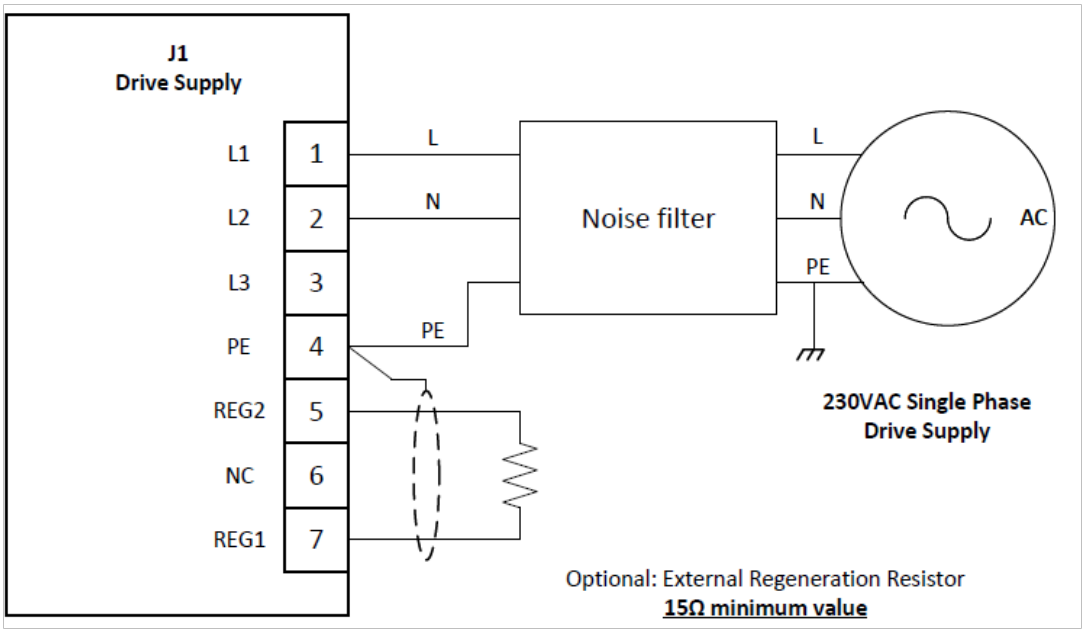

Figure 4-14. Single Phase Drive Supply Connection Diagram

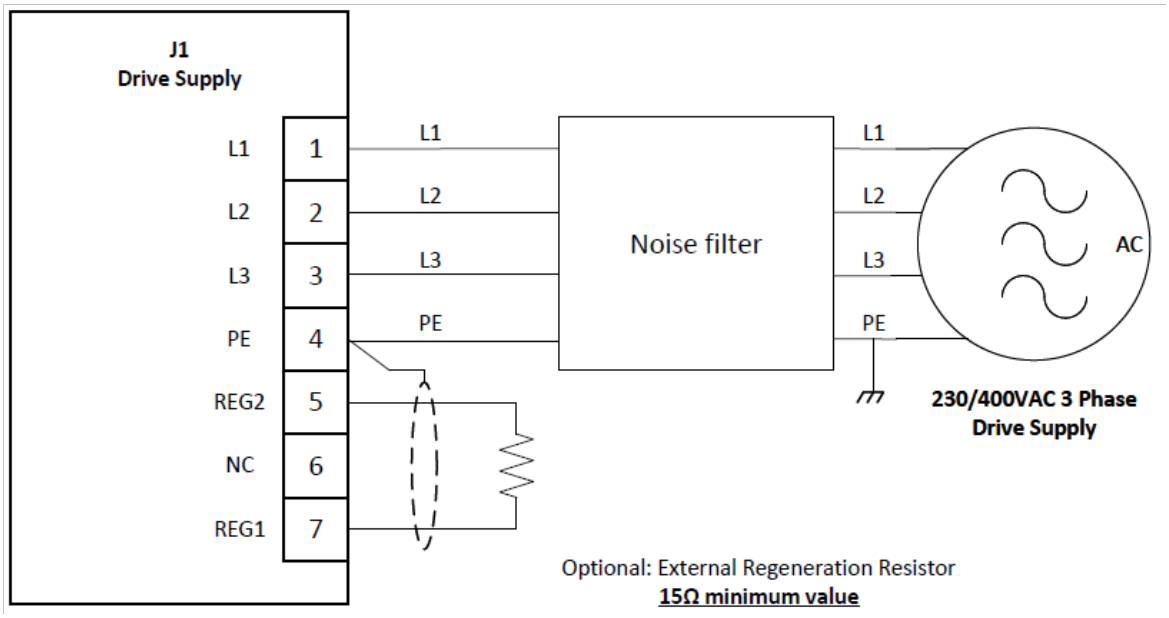

Figure 4-15. 3-Phase Drive Supply Connection Diagram

4.6.2 Control Supply

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

This power supply should remain active (on) even during emergency stop situations, thus ensuring the continuing operation of the network, the controller, the feedback sensors and I/Os.

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

4.6.2.1 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.
- An example of a suitable 24VDC/50W power supply is the XP Power, P/N VCS50US24.

4.6.2.2 Control and Brake Supply Description

Label: J3 24 V CONTROL SUPPLY

Mating Connector: Phoenix 5 pin, MC-1.5/5 STF 3.81

Control Supply Mating Connector

Table 4-8. Control Supply Pinout

	Name	Description
1	⏚	Electrical ground
2	BRK_RTN	Brake supply return
3	24V_BRK	5/24 VDC brake supply
4	CON_RTN	24 VDC control supply return
5	24V_CON	24 VDC control supply

4.6.2.3 Control Supply Connection Instructions

- Use a shielded cable with a minimum gauge of 18 AWG.

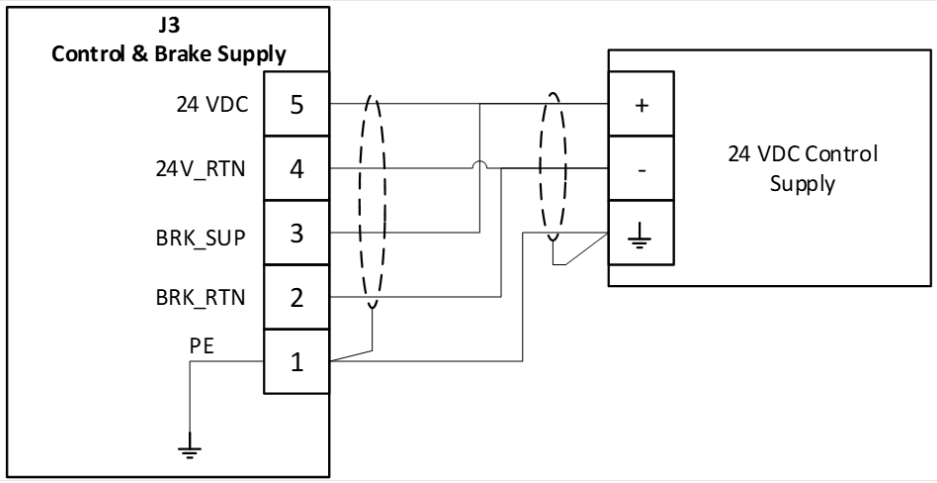

Figure 4-16. 24 VDC Control Supply Connections

4.7 Motor Connectors

4.7.1 Motor Description

Connector Name	Motor Output 0, 1
Connector Assignment	J16 for MOTOR0 J15 for MOTOR1
Mating type	PC 5/ 6-STCL1-7,62 (1778104)

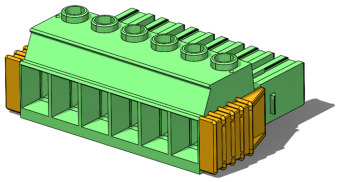

Figure 4-17. Mating Connector for Motor

	Name	Description
1	$R	$ Motor phase “R”
2	$S	$ Motor phase “S”
3	$T	$ Motor phase “T”
4	PE	Electrical ground
5	$BRK +	5/24 VDC 1 A brake output
6	$BRK -	Brake output return

4.7.2 Motor Connection Instructions

1. Use a shielded cable with a minimum gauge of 16 AWG. It should be less than 10 meters long.
2. Route the motor's 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.

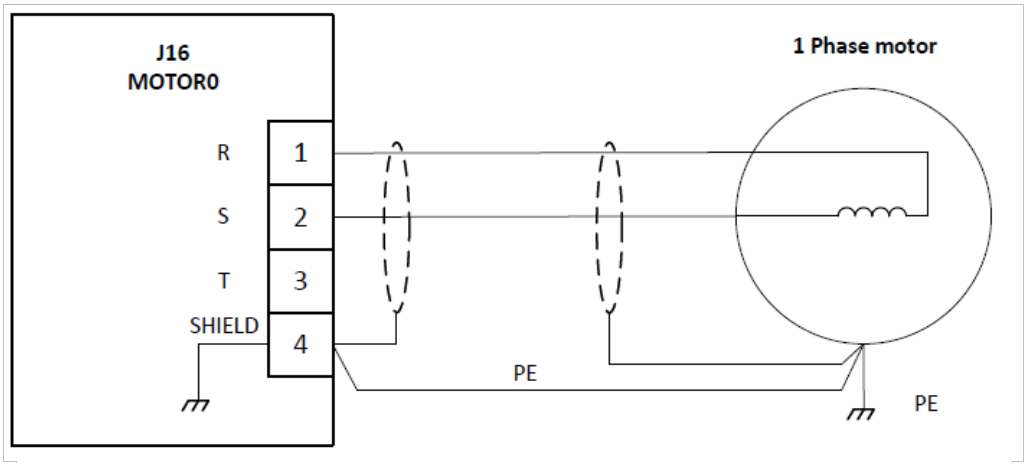

Figure 4-18. 1-Phase Motor Connection

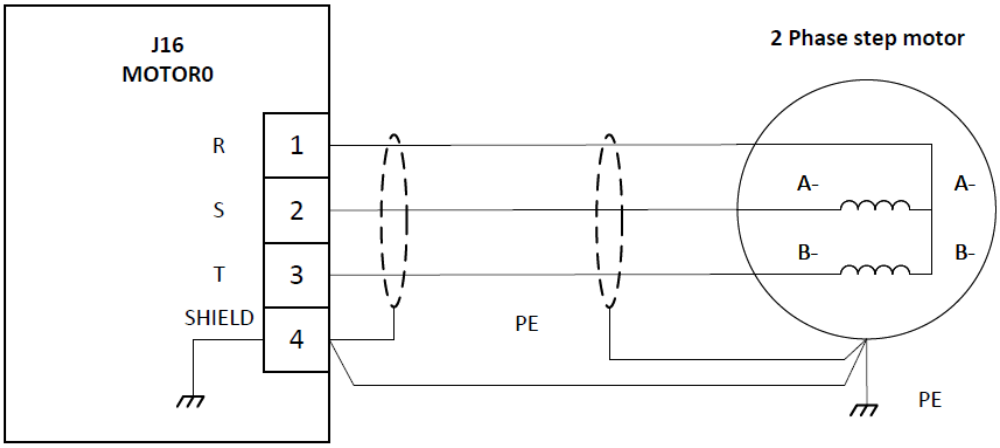

Figure 4-19. 2-Phase Motor Connection

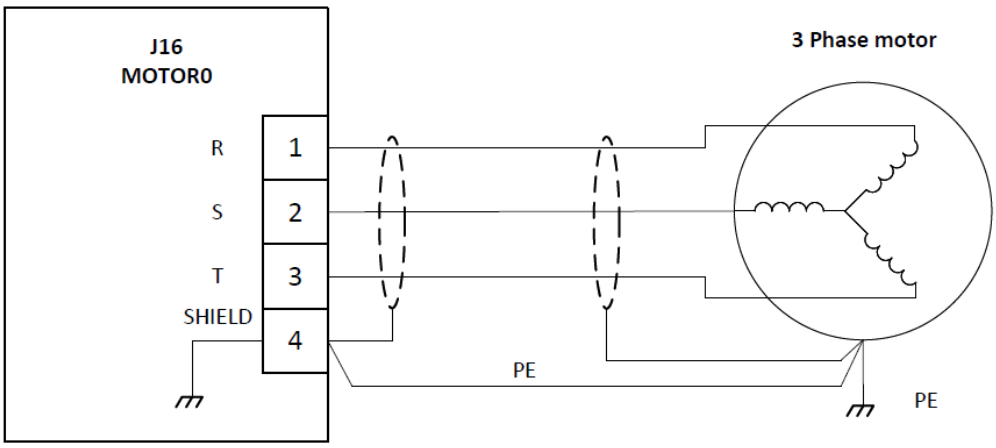

Figure 4-20. 3-Phase Motor Connection

4.8 Encoder Connectors

4.8.1 Encoder Description

Connector Name	Encoder
Connector Assignment	Encoder 0 J6 Encoder 1 J7 Encoder 2 J4 Encoder 3 J5
Mating Connector	D-type 26 pin high density male

Figure 4-21. Encoder Mating Connector

Table 4-9. Encoder Connector Pinout

	Name	Description
1	$_CHA-/ SQR_SIN$-	$ digital encoder, channel A inverted input, for differential encoder only Absolute encoder Data- Squared SIN inverted output
2	$_CHB-/ SQR_COS$-	$ digital encoder, channel B inverted input for differential encoder only Absolute encoder CLK- Squared inverted output
3	$_CHI-	$ digital encoder, channel I (index) inverted input for differential encoder only
4	$_HB	$ Motor Hall B
5	V_SUP_ SFTY	Supply for limits input
6	$_RL	Right limit
7	$_SIN-	$ Encoder SIN inverted input

	Name	Description
8	$_COS-	$ Encoder COS inverted input
9	$_SC_I-	$ Encoder SIN-COS Index inverted input
10	$_CHA+/ SQR_SIN$+	$ digital encoder, channel A non-inverted input, used for both single-ended and differential encoders Absolute encoder Data+ Squared SIN non inverted output
11	$_CHB+/ SQR_COS$+	$ digital encoder, channel B non-inverted input, used for both single-ended and differential encoders Absolute encoder CLK+ Squared COS non inverted output.
12	$_CHI+	$ digital encoder, channel I (index) non inverted input, used for both single-ended and differential encoders
13	X_HA	$ Motor Hall A
14	X_HC	$ Motor Hall C
15	$_LL	Left limit
16	$_SIN+	$ SIN non inverted input
17	$_COS+	$ Encoder COS non inverted input
18	$_SC_I+	$ Encoder SinCos Index non inverted input
19	5U	5 V user supply for digital encoder and Hall
20	5U_RTN	5 V return user supply for digital encoder, A return for $ Motor temperature sensor and Hall
21	ID_chip	Bidirectional interface with 1-wire slave devices
22	MTMP_#	MTMP Motor temperature sensor
23	MTMP_#_ RTN	Return supply for MTMP
24	V_RTN_ SFTY	A return for limits input.

	Name	Description
25	5F	5 V user supply for analog encoder and Hall
26	5F_RTN	5 V return user supply for analog encoder and Hall
	SHIELD	Connector shell and front screw

4.8.2 Encoder Connection Instructions

The following tables specify the encoder connections for the various possible configurations.

Combining an absolute encoder with an incremental TTL encoder is not supported. Other combinations may be supported. For further information, contact ACS support.

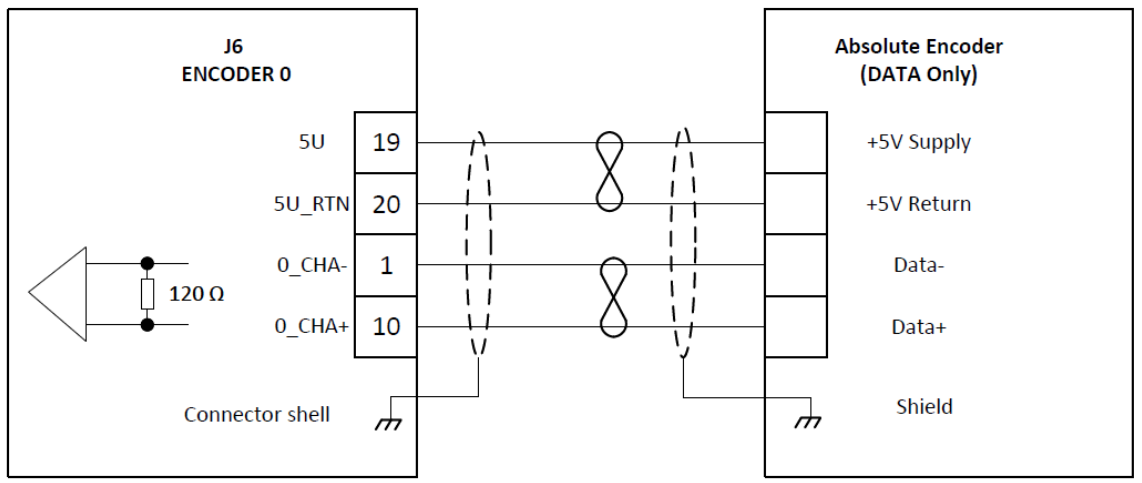

Figure 4-22. Absolute Encoder (Data Only) Connection

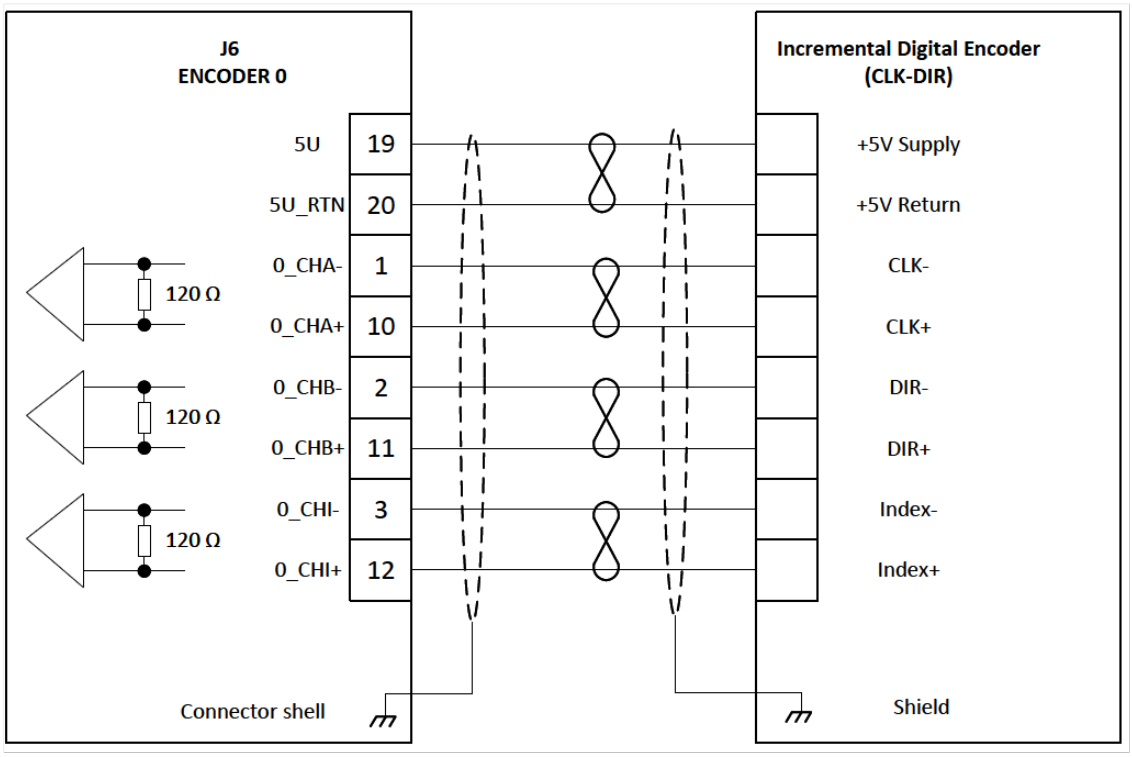

Figure 4-23. Incremental Digital Encoder (CLK-DIR)

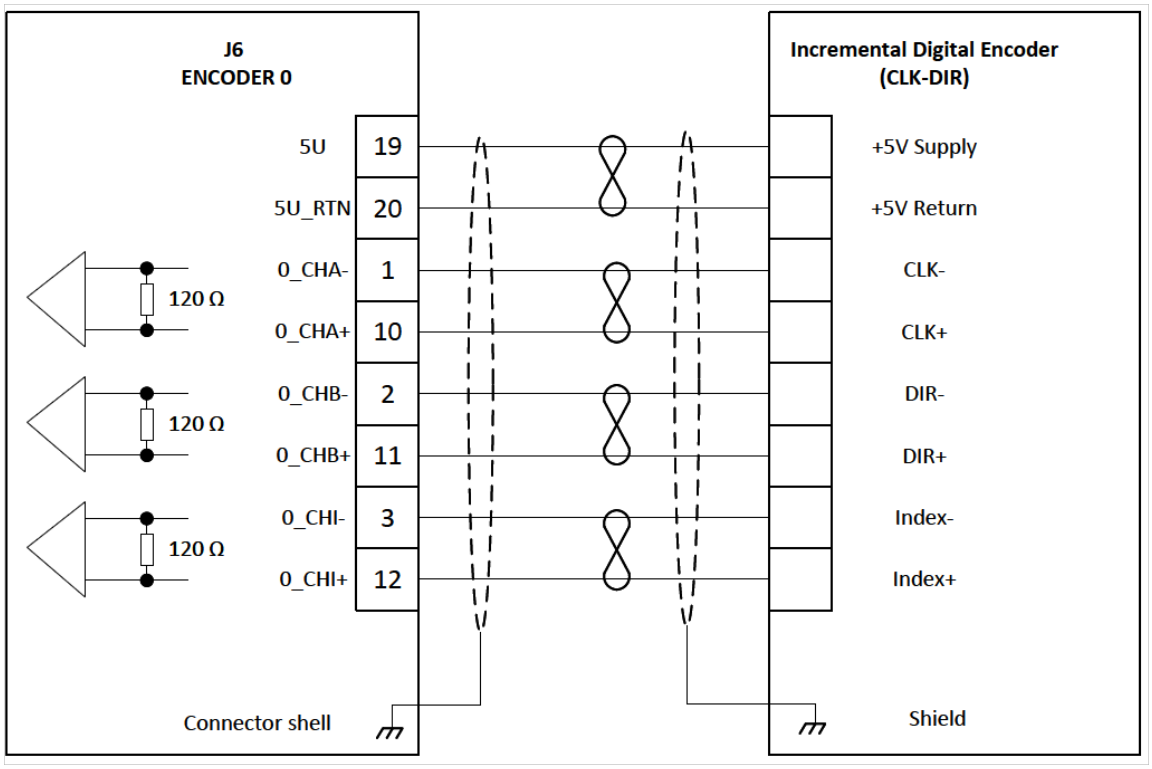

Figure 4-24. Incremental digital encoder (AqB) connection diagram

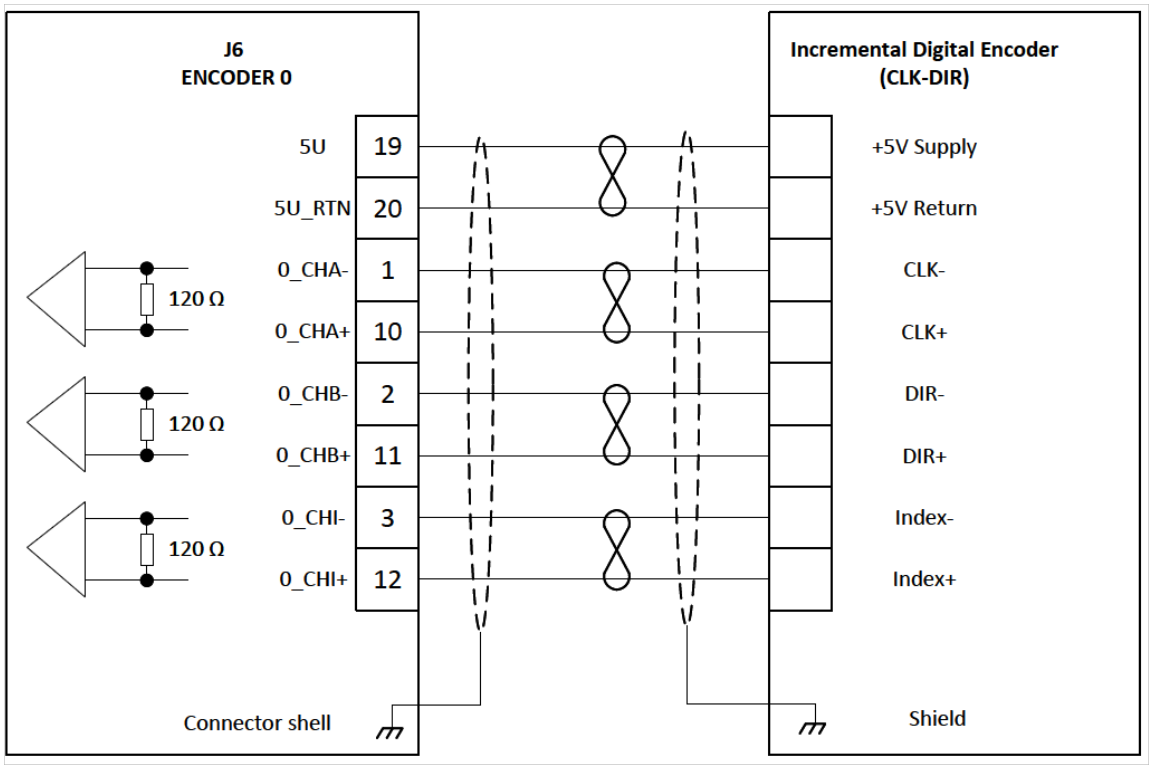

Figure 4-25. Absolute Encoder (CLK-Data) Connection Diagram

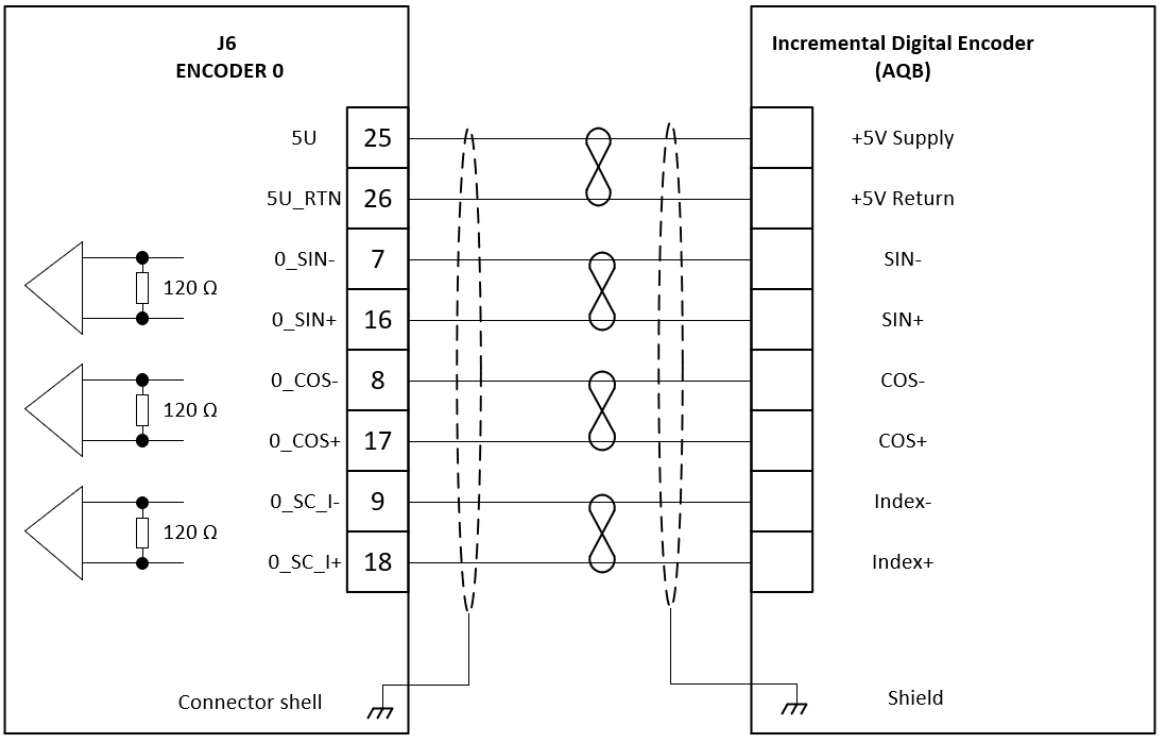

Figure 4-26. SinCos Connection Diagram

4.8.2.1 Additional Device Connections

The system can include an MTMP Motor Temperature sensor, connected according to the following diagram.

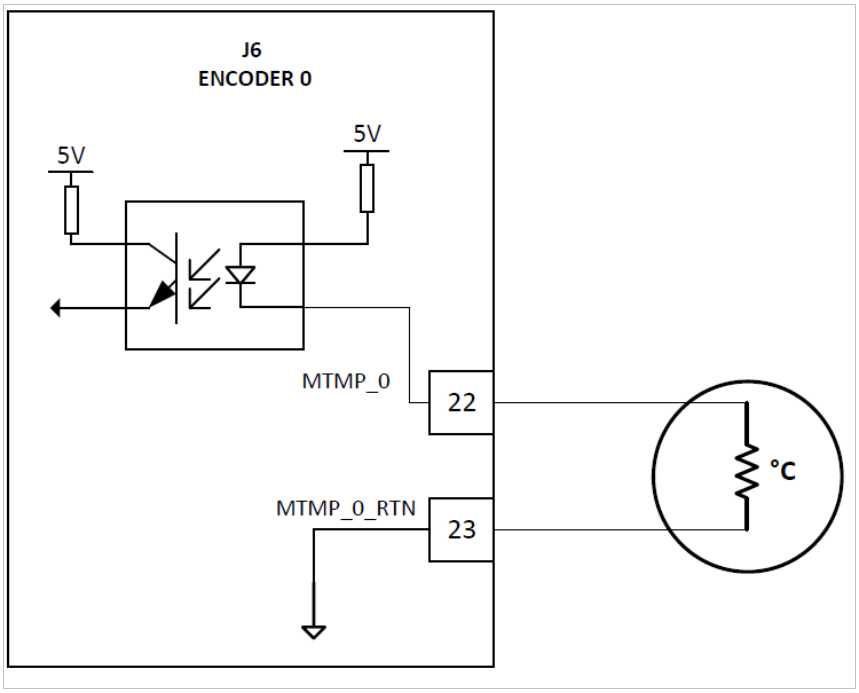

Figure 4-27. MTMP Motor Temperature Sensor Connection

A Hall sensor can also be connected, according to the following diagram.

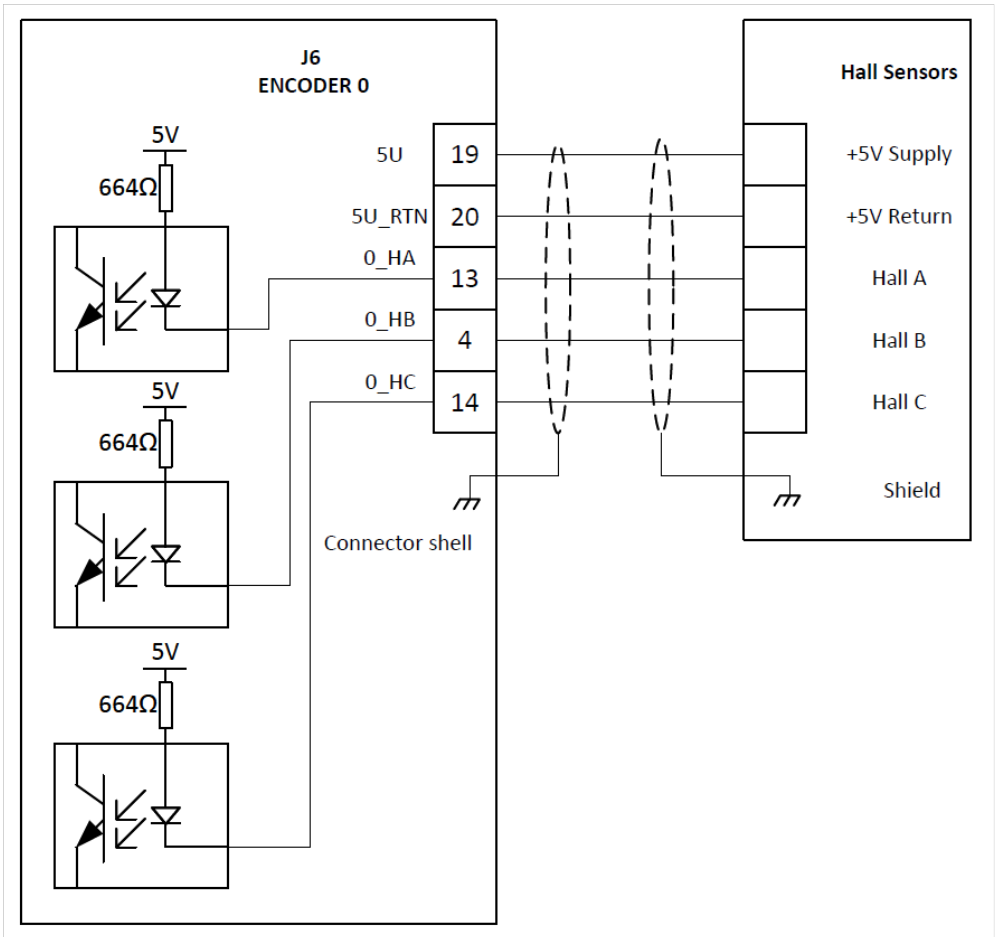

Figure 4-28. Hall Sensor Inputs Connection

Limit inputs may be connected to the limits connector, as shown in the Limits Connection Instructions section. They may also be added to the encoders connector in sink or source configuration, as shown in the following two images. The examples show connections to Encoder 0, but other connectors may be used with the appropriate modifications.

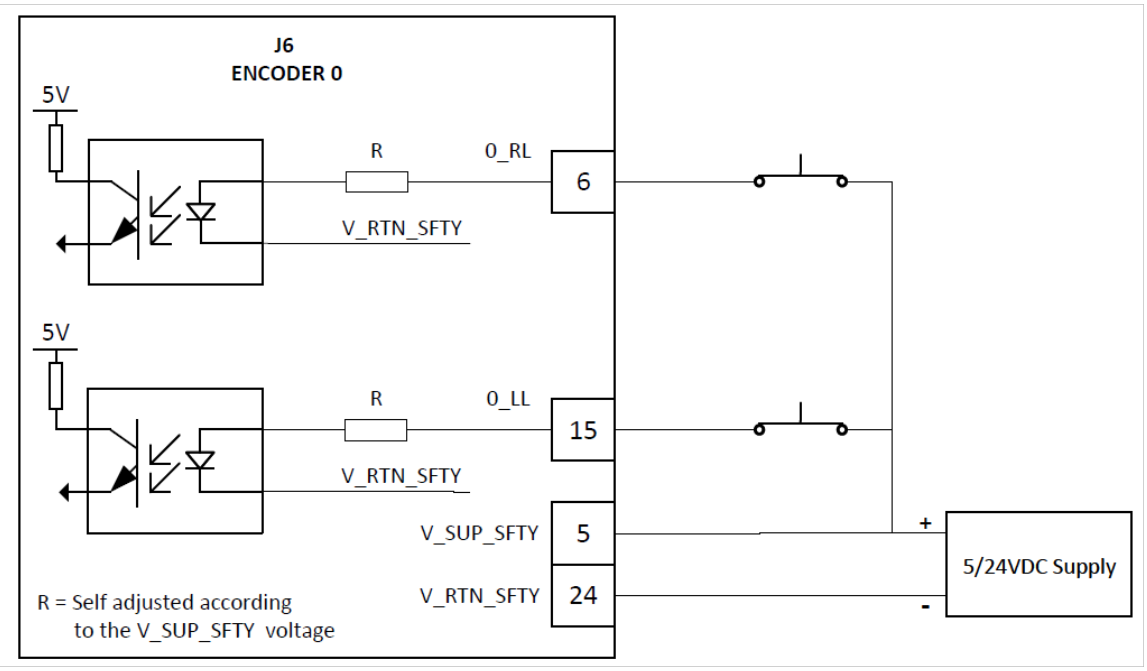

Figure 4-29. Left and Right Limit Source Connection on J6, Encoder 0

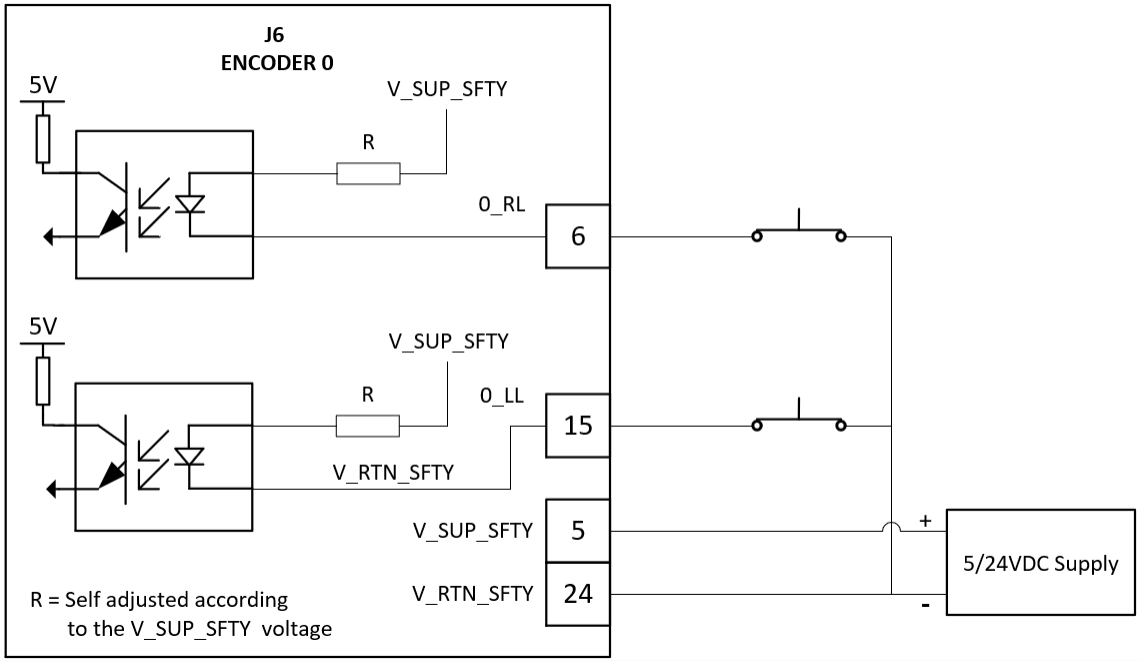

Figure 4-30. Left and Right Limit Sink Connection on J6, Encoder 0

When voltage is supplied to V_SUP_SFTY and V_RTN_SFTY the device automatically determines the voltage supplied to the limit inputs.

4.9 I/O Interface Connectors

4.9.1 General I/O

4.9.1.1 I/O Description

Label: J9

Connector: D-type 44 pin high density female

Mating connector: D-type 44 pin high density male

Figure 4-31. Mating Connector Example

Table 4-10. J9 - I/O Connector Pinout

	Name	Description
1	MARK0-	Axis 0 mark input inverted
2	MARK1-	Axis 1 mark input inverted
3	MARK2-	Axis 2 mark input inverted
4	MARK3-	Axis 3 mark input inverted
5	DGND	Digital ground
6	PEG0-	PEG 0 output inverted
7	PEG1-	PEG 1 output inverted
8	PEG2-	PEG 2 output inverted
9	PEG3-	PEG 3 output inverted
10	NC	Not connected
11	AIN0-	GP Analog input 0 inverted input
12	AIN1-	GP Analog input 1 inverted input
13	AIN2-	GP Analog input 2 inverted input
14	AIN3-	GP Analog input 3 inverted input
15	AOUT1-	Analog output 1 inverted
16	MARK0+	Axis 0 mark input non inverted
17	MARK1+	Axis 1 mark input non inverted
18	MARK2+	Axis 2 mark input non inverted
19	MARK3+	Axis 3 mark input non inverted
20	OUT3	Digital output 3
21	PEG0+	PEG 0 output non inverted
22	PEG1+	PEG 1 output non inverted
23	PEG2+	PEG 2 output non inverted

	Name	Description
24	PEG3+	PEG 3 output non inverted
25	NC	Not connected
26	AIN0+	GP Analog input 0 non-inverted input
27	AIN1+	GP Analog input 1 non-inverted input
28	AIN2+	GP Analog input 2 non-inverted input
29	AIN3+	GP Analog input 3 non-inverted input
30	AOUT1+	Analog output 1 non inverted
31	V_SUP_IO	Supply for the IO
32	V_RTN_IO	Supply return for the IO
33	OUT0	Digital output 0
34	OUT1	Digital output 1
35	OUT2	Digital output 2
36	OUT4	Digital output 4
37	OUT5	Digital output 5
38	OUT6	Digital output 6
39	OUT7	Digital output 7
40	NC	Not connected
41	NC	Not connected
42	AOUT0+	Analog output 0 non inverted
43	AOUT0-	Analog output 0 inverted
44	AGND	Analog ground
	SHIELD	Connector shell and front screw

4.9.1.2 I-O Connection Instructions

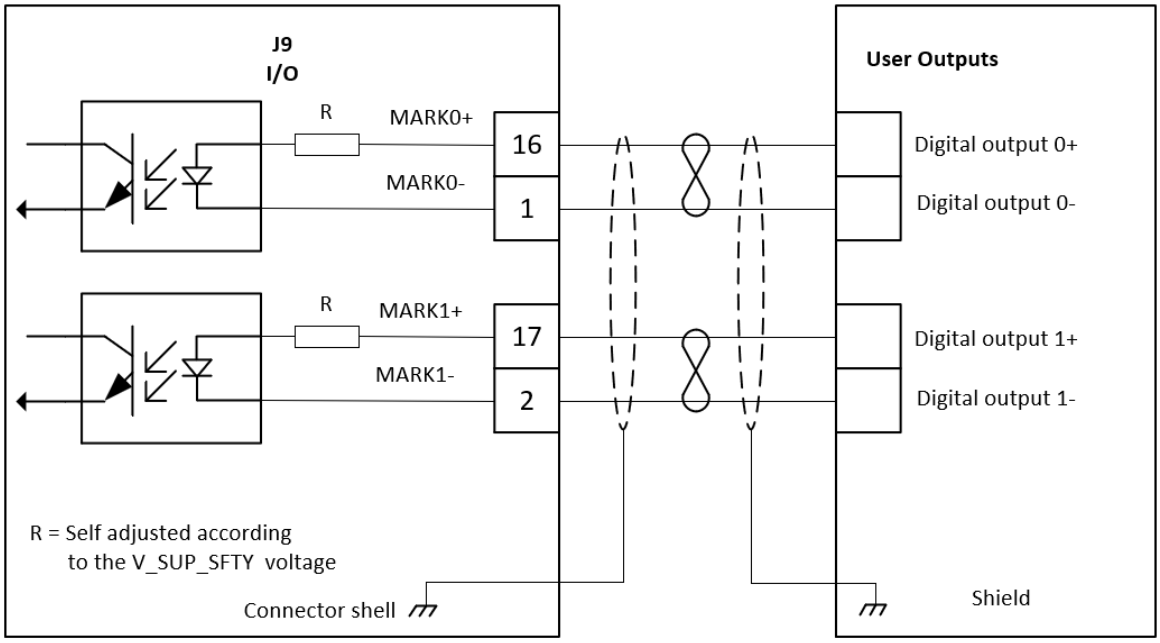

Figure 4-32. Mark inputs connection diagram, MARK0 and MARK1 for example J9 – I/O connector

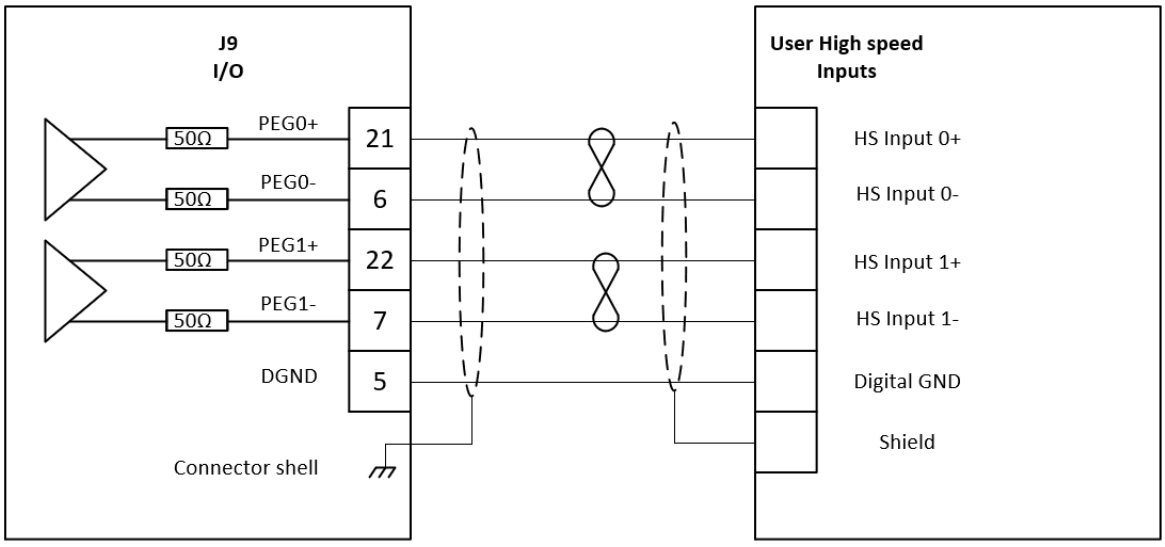

Figure 4-33. PEG Outputs Connection Diagram

The following diagram describes the connection of the I/O outputs to a mechanical brake.

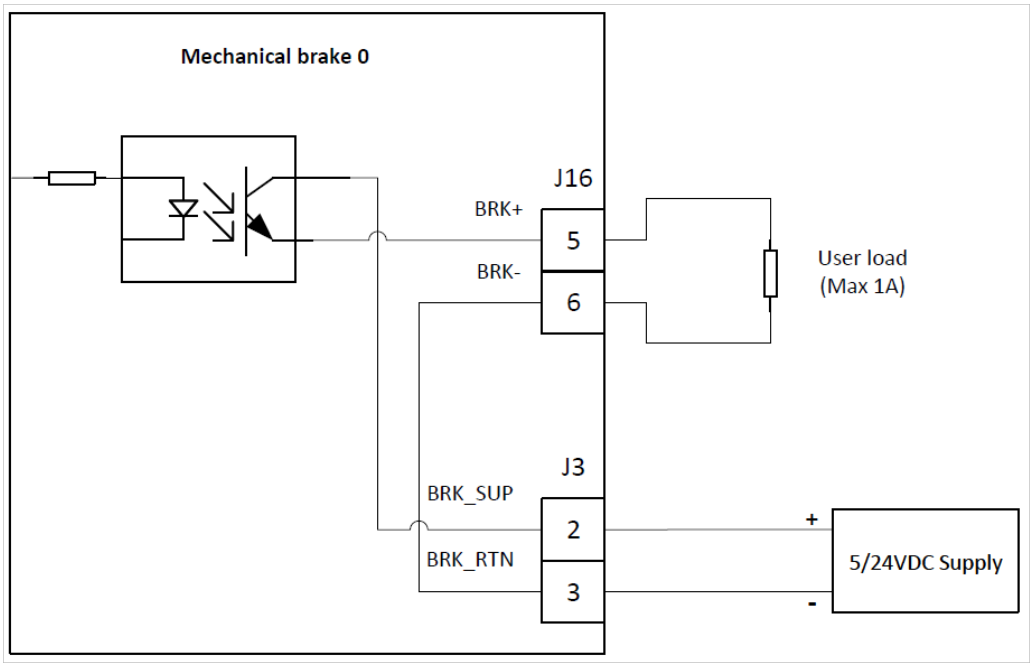

Figure 4-34. Mechanical Brake Connection Diagram, J3 – I/O Connector

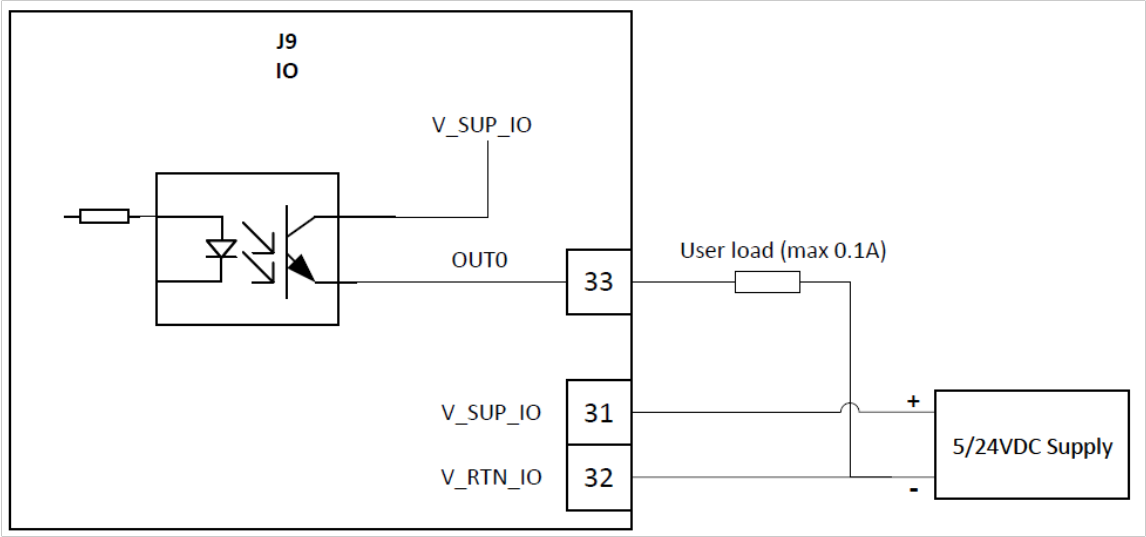

Figure 4-35. Digital Outputs Source Connection Diagram, J9 – I/O Connector

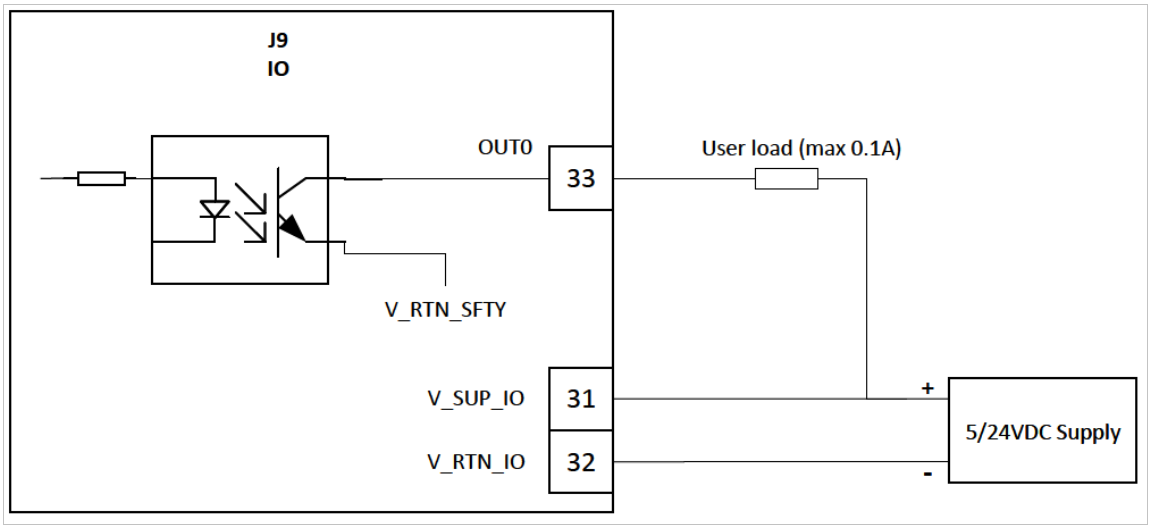

Figure 4-36. Digital Outputs Sink Connection Diagram, J9 – I/O Connector

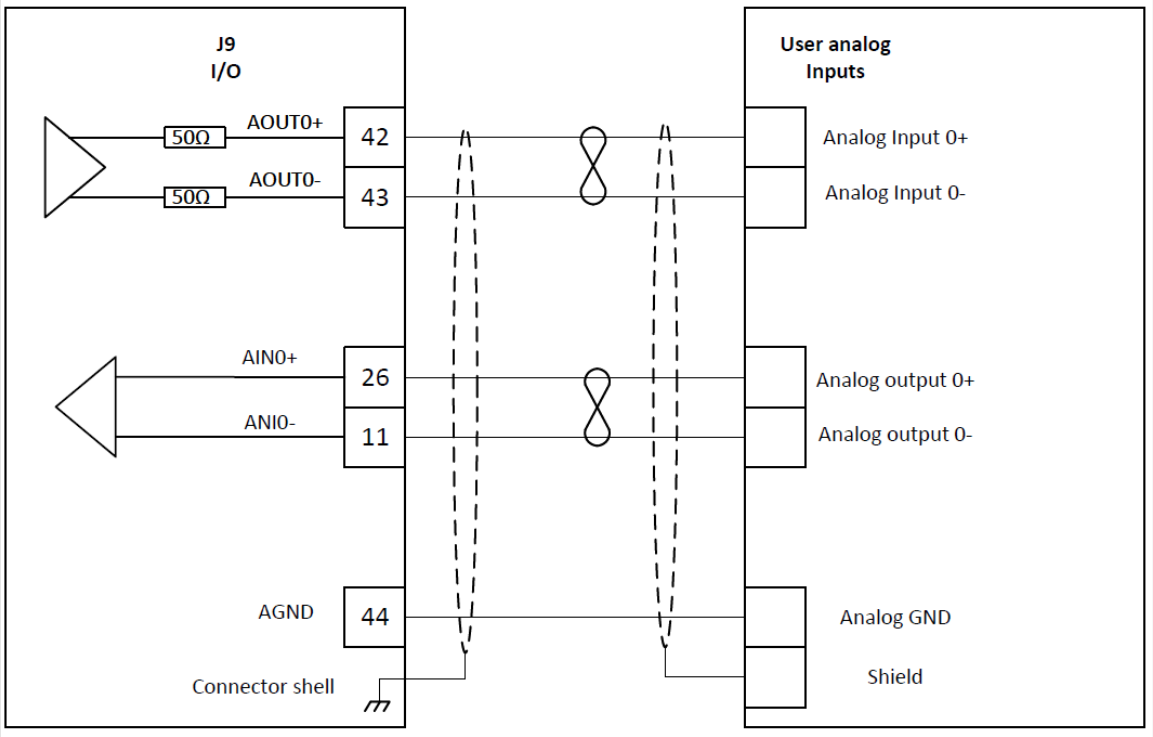

Figure 4-37. Analog GP I/O Connection Example

4.9.2 Limits

4.9.2.1 Limits Description

Label: J8 LIMITS

Connector: D-type 25 pin female

Mating Connector: D-type 25 pin male

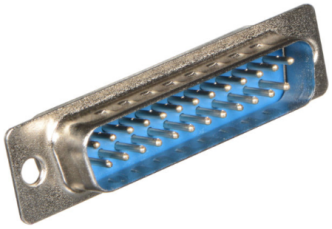

Figure 4-38. 25-Pin Mating Connector

Table 4-11. Limits Connector Pinout

	Name	Description
1	V_SUP_SFTY	Safety supply
2	0_LL	Axis 0 left limit
3	1_LL	Axis 1 left limit
4	2_LL	Axis 2 left limit
5	3_LL	Axis 3 left limit
6	N.C.	Not Connected
7	N.C.	Not Connected
8	N.C.	Not Connected
9	N.C.	Not connected
10	N.C.	Not connected
11	N.C.	Not connected
12	N.C.	Not connected
13	N.C	Not connected
14	V_RTN_SFTY	Safety supply return
15	0_RL	Axis 0 right limit
16	1_RL	Axis 1 right limit
17	2_RL	Axis 2 right limit
18	3_RL	Axis 3 right limit

	Name	Description
19	N.C.	Not connected
20	N.C.	Not connected
21	DGND	Digital ground
22	N.C	Not connected
23	N.C	Not connected
24	N.C	Not connected
25	N.C	Not connected
	SHIELD	Connector shell and front screw

4.9.2.2 Limits Connection Instructions

The following diagrams specify the configuration of the limits connector for various possible configurations.

When voltage is supplied to V_SUP_SFTY and V_RTN_SFTY the device automatically determines the voltage supplied to the limit inputs.

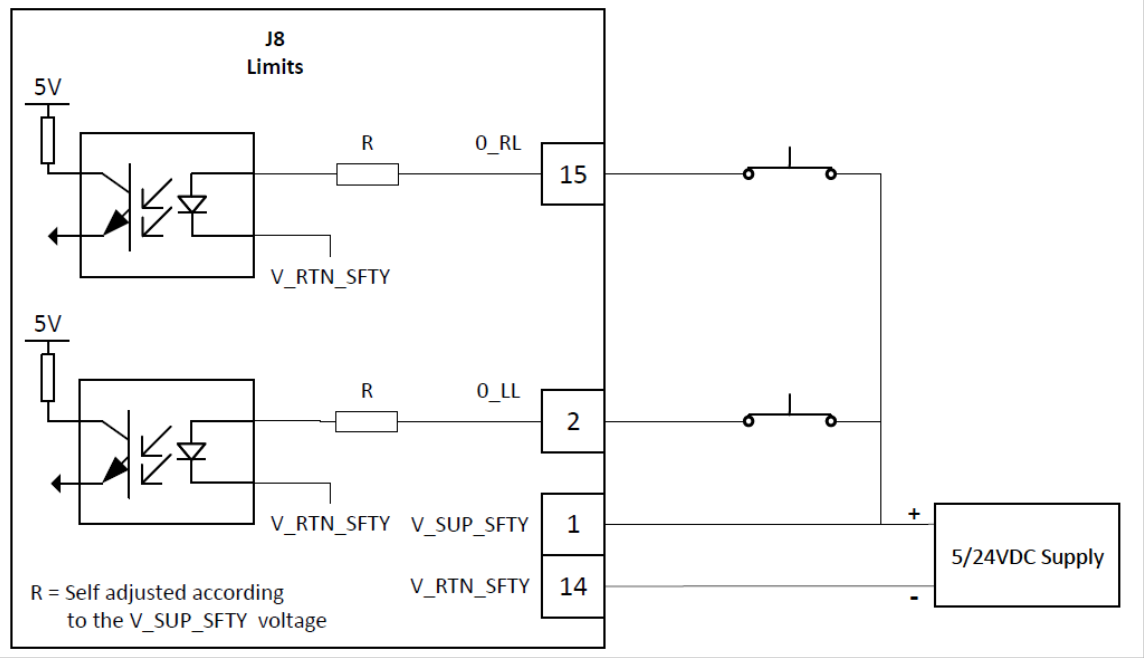

Figure 4-39. Left and Right Source Connection on Limits Connector

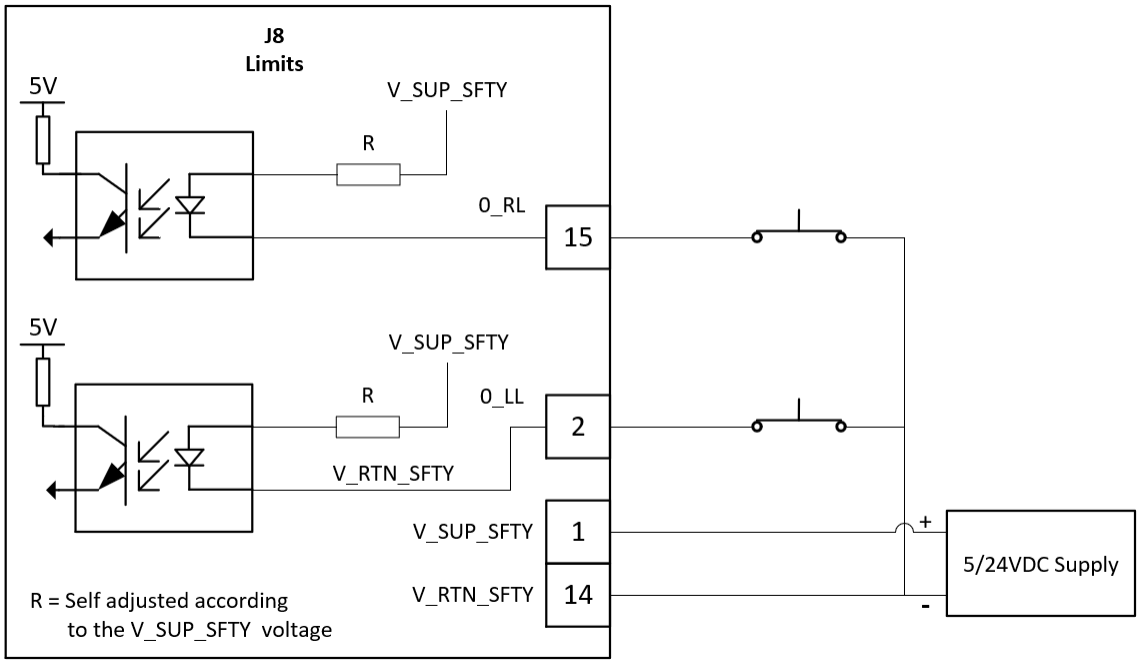

Figure 4-40. Left and Right Sink Connection on Limits Connector

4.10 Safe Torque Off (STO) Connector

4.10.1 STO Description

Label: J2 STO

Mating connector: 5 pin 2 mm female by JST P/N PAP-05V-S

Pin: SPHD-001T-P0.5

Figure 4-41. STO Mating Connector

Table 4-12. J2 - STO Connectors Pinout

Pin	Signal	Description
1	STO1-	STO input 1 inverted input
2	STO1+	STO input 1 non inverted input
3	NC	Not connected

Pin	Signal	Description
4	STO2+	STO input 2 non inverted input
5	STO2-	STO input 2 inverted input

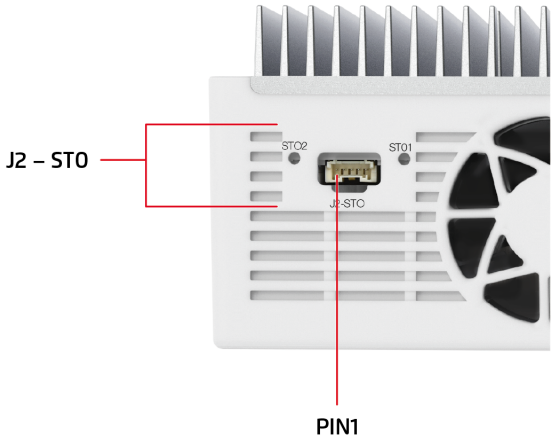

Figure 4-42. STO Pin 1 Location

4.10.2 SS1-t Description

The SS1-t function provides a delay time between the emergency stop request and the point at which the drive is switched to the torque off mode (STO). During this time the motor will be decelerated by the controller to zero speed. It is important to mention here, that SS1-t does not monitor the deceleration ramp of the drive. The intention of using the SS1-t instead of the pure STO function is to decrease the time which the drive requires to reach standstill.

The delay time is in the range of 40 to 200 ms, depending on the input supply voltage. For nominal 24 V the STO input supply delay time is about 90 ms. If the delay is outside this range the controller generates a fault and disables the drive. The deceleration of the motors due to STO/SS1 is not automatic and requires a special user application.

For more details refer to the *UDMdx Safety Manual*.

4.10.3 STO Connection Instructions

The STO1 and STO2 are typically connected to a 24 V source via an industry standard safety switch. This device disconnects the 24 V 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*.

The STO circuit draws up to 60 mA per STO input, with an inrush current of less than 70 mA.

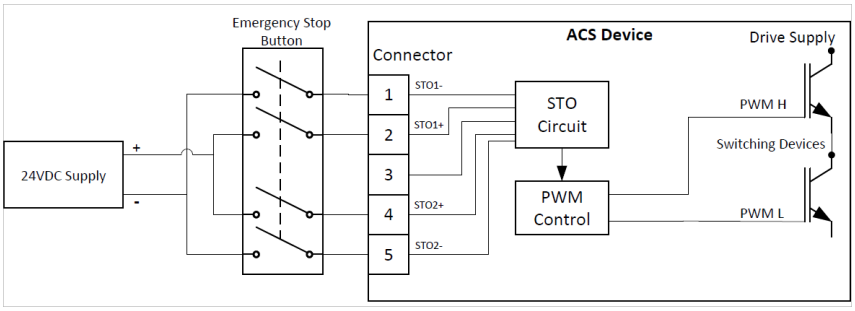

Figure 4-43. STO Connections

4.11 ID Chip Interface

4.11.1 ID Chip Interface Description

The ID Chip interface is a 1-Wire communication interface for automatically identifying parameters of stages supporting the feature

Connector: Pin 21 on encoder connector

Items	Description	Remarks
Quantity	1 per encoder channel	
Mode	Master	
Interface	1-wire serial protocol using a single data line plus ground reference for communication	

Contact ACS for more details

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