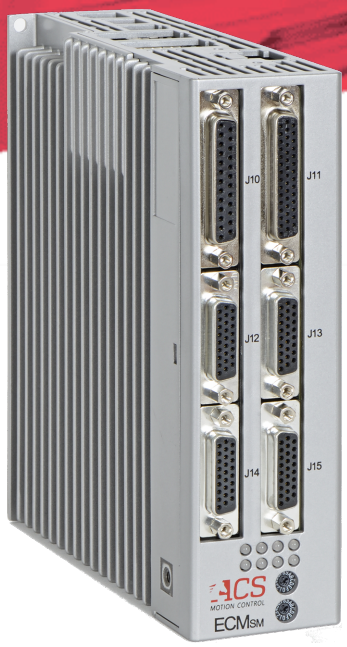

ECMsm

Installation Guide

June 2020

Document Revision: 1.00

ACS MOTION CONTROL

ECMsm

Release Date: June 2020

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Revision History

Date	Revision	Description
June 2020	1.0	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 www.acsmotioncontrol.com/downloads.

Document	Description
SPiiPlus Setup Guide	Provides guidance on how to configure and adjust the SPiiPlusNT 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.
NT PEG and MARK Operations Application Note	Provides detailed description, specification and operation instructions for PEG capabilities.
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.
Safe Torque Off Function	An application note providing the technical details for implementing the STO function for drives installed in ACS Motion Control systems.

Table of Contents

List Of Figures

List of Tables

1. Introduction

1.1 Document Scope

This document describes the installation information for the ECMsm.

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

2. Detailed Description

2.1 Package Content

The ECMsm package contains the following items:

- ECMsm
- Control supply mating connector (for J9): Phoenix MC 1,5/ 3-STF-3,81 BK(1753180)

- Drive supply mating connector, P/N: Molex 171692-0104

2.2 Connectors

Connectors are on the front panel.

Figure 2-1. Front Panel - Connectors

For details about the connectors, see Table 4-1

The ID switches are for EtherCAT support on other products which are implemented on the same hardware as ECMsm. They are inactive in the ECMsm configuration.

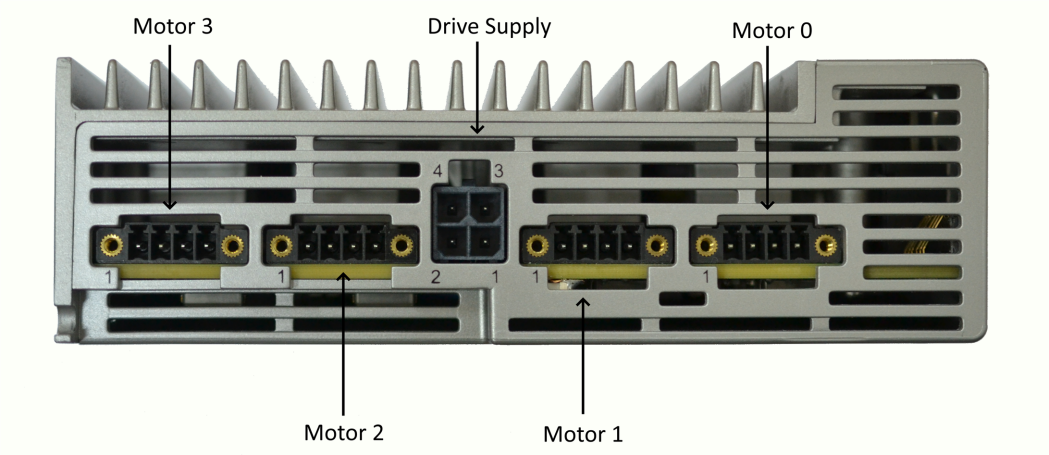


Figure 2-2. Bottom View

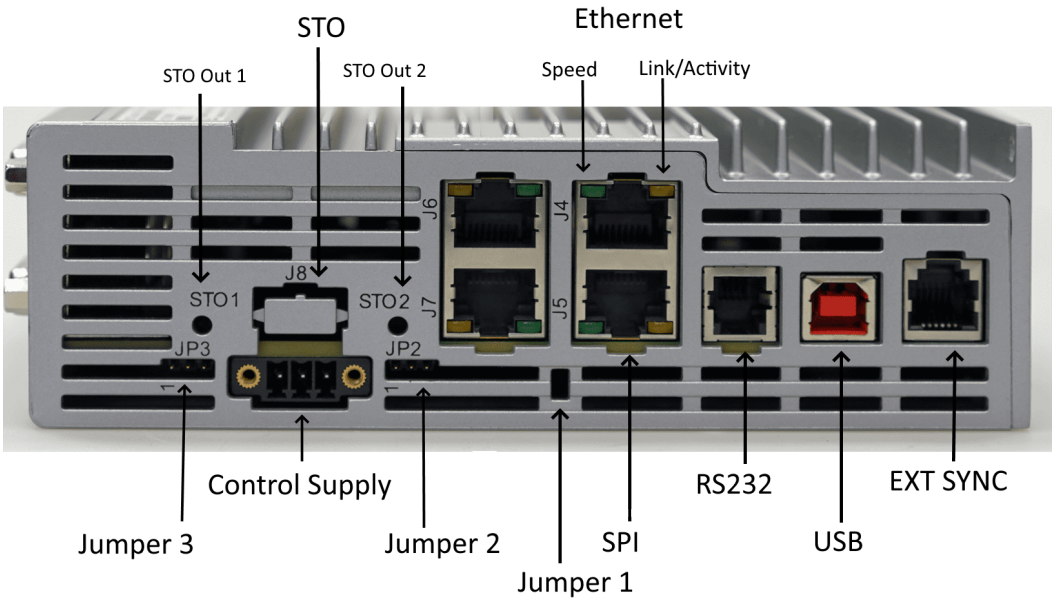


Figure 2-3. Top View

The J6 and J7 connections are for EtherCAT support on other products which are implemented on the same hardware as ECMsm. They are inactive in the ECMsm configuration.

2.3 Jumpers

Table 2-1. Jumpers

Jumper Name	Position 1-2	Position 2-3
JP1 Recovery	FW Recovery Mode	N/A
JP2 - SINK/SOURCE Selection for limits inputs	Source input type	Sink Input Type
JP3 - SINK/SOURCE selection for mechanical brake / digital outputs	Sink Output Type	Source Output Type

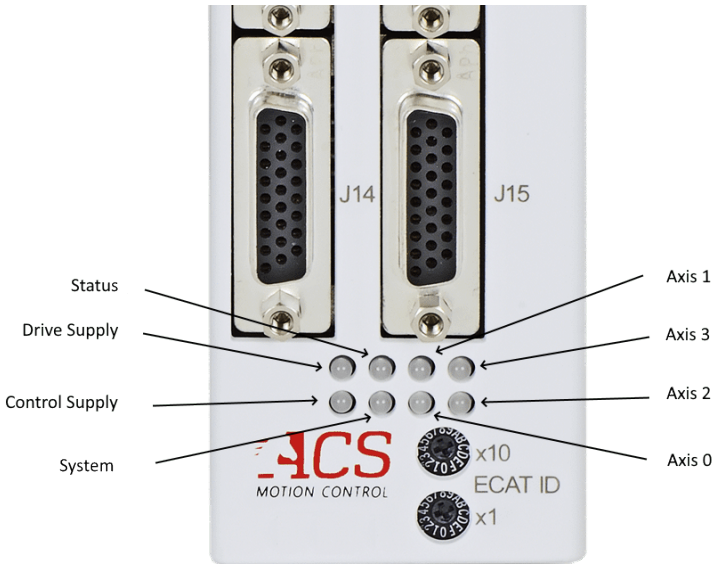
2.4 LED Indicators

Table 2-2. LED Indicators

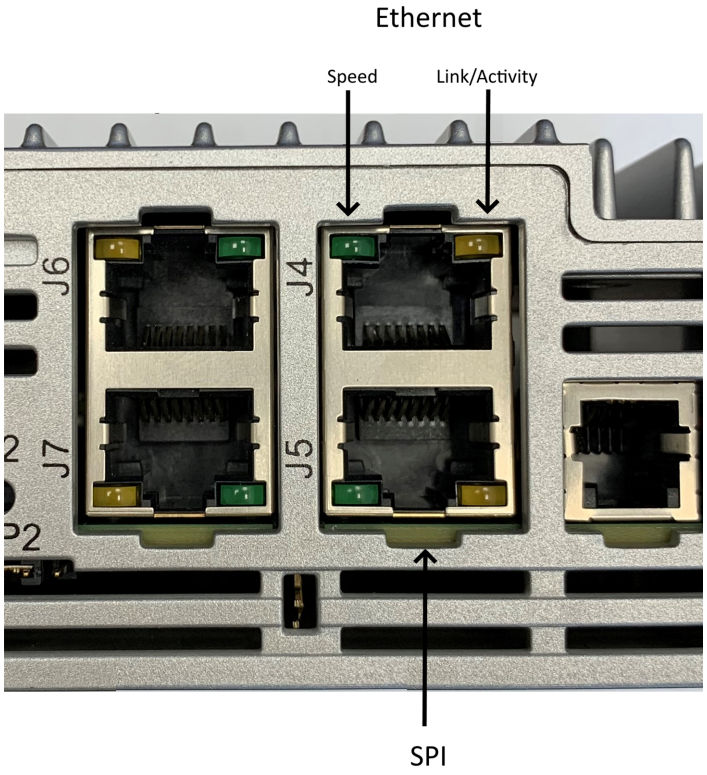
Designator	Description	Note
Control supply	Green > Off- Logic supply not functioning > On- power supply OK	
ECs_IN ECs_OUT Link/Activity	Green (one per connector) > Off- No link (no connection) > Blinking -Link and activity > On -Link without activity	Located on the RJ45 connectors. Right LED. Note: the left LED is not used
STATUS External network status	Bicolor > Green LED – according to "RUN Indicator" > Red LED – according to "ERROR Indicator"	According to ETG.1300 S ® V1.1.1
System	Bicolor > Red – System Fault > Green – System Ok	Located on the front

Designator	Description	Note
	> Blinking – Software command	
Axis status	Bicolor, one per axis > Off- axis disabled > Green- axis enabled > Red- fault	
Drive supply	Green > On - drive supply connected.	

The following image indicates the function of the LEDs on the front panel:



The following image indicates the function of the LEDs on the EtherCAT, Ethernet, and SPI connectors:



2.5 Optional Accessories

2.5.1 Mating Connector Kits

P/N: XDMsm-ACC1 Mating Connector Kit

Connector	Part Description	Manufacturer	Manufacturer P/N	Quantity
J16-MOTOR0, J17-MOTOR1, J19-MOTOR2, J20-MOTOR3	CONNECTOR MC 1,5/4-STF-3,81 BLACK NPB	PHOENIX CONTACT	1743074 (MC 1,5/ 4-STF-3,81 BK)	4
J9-Control Supply	CONNECTOR MC 1,5/3-STF-3,81 BK	PHOENIX CONTACT	1763180 (MC 1,5/ 4-STF-3,81 BK)	1

Connector	Part Description	Manufacturer	Manufacturer P/N	Quantity
J18-Drive Supply	CONN RCPT HSG 4POS 5.70MM	MOLEX	1716920104	1
	CONN SOCKET 14-16AWG CRIMP GOLD	MOLEX	1720630311	4
J10-LIMITS (25-pin)	CON D-type 2row 25pin Male Solde	AMPHENOL	G17S-2510-110-EU	1
	HOOD D-Type 25P STR Metal NPB	AMTEK	HOOD117-25V-L-A1/HOOD117-25VY-L	1
J11-I/O (44-pin)	D-TYPE CUP 44P HI-DNSTY ML NPB	NELTRON Industrial co.Ltd	5508-44P-02-F1	1
	HOOD D-Type 25P STR Metal NPB	AMTEK	HOOD117-25V-L-A1/HOOD117-25VY-L	1
J12-Encoder0, J13-Encoder1, J14-Encoder2, J15-Encoder3	D-TYPE CUP 26P HI-DNSTY ML NPB	AMPHENOL	G17TH-2610122EU	4
	HOOD plast+nickl 15P std EMI npb	AMPHENOL	G17Z15014-LF	4

2.5.2 STO Breakout Cable

P/N: STO-ACC2

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

Figure 2-4. STO-ACC2 Breakout Cable

Table 2-3. STO-ACC2 Pinout

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

2.5.3 SPI Breakout Cable

P/N: SPI-ACC1

Description: 10 meter cable with SPI mating connector on one end, connecting to J5. The other end has flying leads for connection to user equipment.

Figure 2-5. SPI Breakout Cable

2.5.4 RS232 Adapter Cable

P/N: 1. RS232-ACC1

Description: Cable with RS232 mating connector on one end and male D-Sub connector on the other.

Figure 2-6. RS232 Adapter

2.5.4.1 RS232 Pinout

	Name	Description
1	N/C	Not Connected
2	RXD	RS-232 Receive signal for communication port 1 (COM1)
3	TXD	RS-232 transmit signal for communication port 1 (COM1)
4	N/C	Not Connected
5	GND	Ground
6	N/C	Not Connected
7	N/C	Not Connected
8	N/C	Not Connected
9	N/C	Not Connected

2.6 Ordering Part Number

The ordering part number (P/N) contains several characters (see example in Figure 2-7) that each specify a configuration characteristic ordered for the ECMsm module, as described in Table 2-4.

Figure 2-7. Label with Ordered P/N - Example

Table 2-4. Configuration as Indicated by P/N

Ordering Options	Field	Example User Selection	Available Ordering Option Values
Number of axes/drives	1	2	2, 4
Current Rating (Amps peak of sine)	2	C	A - 1.25/2.5A B - 2.5/5A C - 5/10A
Number of 500 kHz SinCos encoder Channels	3	0	0,1,2,3,4
Number of Absolute Encoder Channels	4	3	0,1,2,3,4
Functional Safety	5	T	N=None, T=STO & SS1
Reserved for future use	6	N	N=N/A
Reserved for future use	7	N	N=N/A
Reserved for future use	8	N	N=N/A
Reserved for future use	9	N	N=N/A
Reserved for future use	10	N	N=N/A

As an example, P/N EDMsm-4C03T-NNNNN would represent the configuration described in Table 2-5 below.

Table 2-5. P/N Example

Field		1	2	3	4	5	6	7	8	9	10
P/N	ECMsm	4	C	0	3	T	N	N	N	N	N

Description: 4 axis 5/10A, 3x Absolute encoder, STO & SS1

3. Mounting and Cooling

- Unit must be mounted vertically when working with forced airflow, 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 ambient temperature range of 0 to 50°C. Above 40°C a fan providing at least 24 CFM must be used.

Figure 3-1. Airflow and Mounting

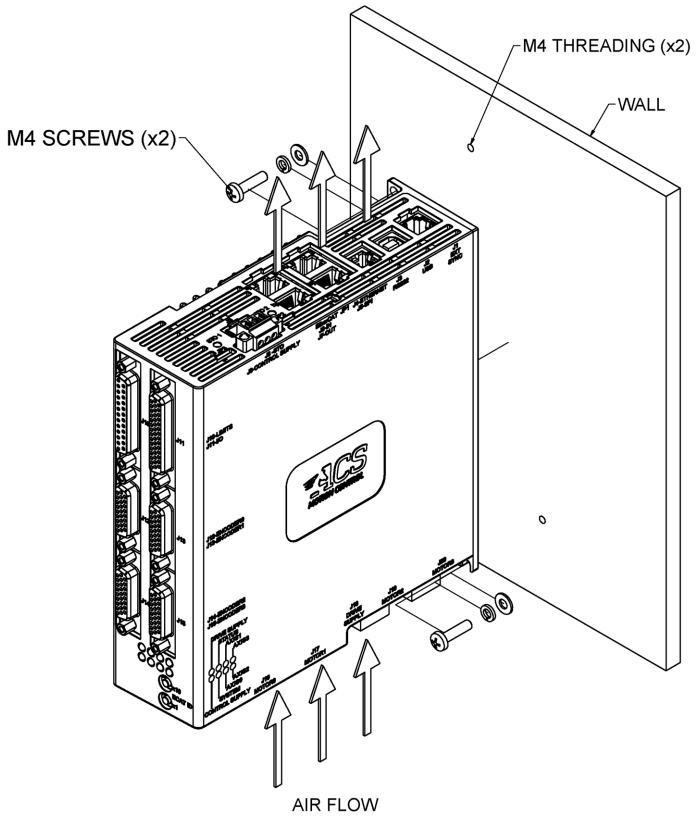
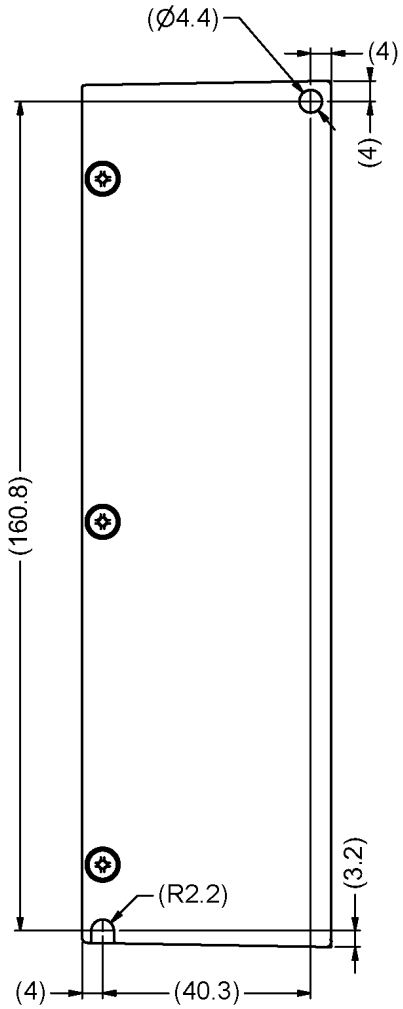


Figure 3-2. Dimensions - Rear (mounting side) View


(Ø4.4)
(4)
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(160.8)
(R2.2)
(3.2)
(4)
(40.3)

4. Connections

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

The USB connector is not intended for customer use.
The EXT SYNC connector is not in use.

Table 4-1. Connections

Connector Assignment	Connector Name	Connector Type	Mating Connector
J1	EXT SYNC	RJ11 socket 6 positions 4 contacts, shielded	RJ11 plug 6 positions 4 contacts
J2	USB	HIGH RETENTION USB TYPE B, shielded	USB plug type B
J3	RS232	RJ11 socket 4 positions 4 contacts, shielded	RJ11 plug 4 positions 4 contacts An adapter from RJ11 to standard DB9 is available, see RS232 Adapter Cable.
J5	SPI	RJ45 socket 8 positions 8 contacts, shielded, CAT 5e	RJ45 plug 8 positions 8 contacts, see SPI
J8	STO	JST 5 PIN 2mm male	JST 5 PIN 2mm female PAP-05V-S Pin type: SPHD-001T-P0.5 See STO and SS1-t (J8) (Certification Pending)
J9	Control Supply		MC 1,5/ 4-STF-3,81 BK, by Phoenix, P/N 1763180 See Control Supply (J9)
J10	LIMITS	D-type 25 pin female	D-type 25 pin male, see Limits
J11	I/O	D-type 44 pin high density female	D-type 44 pin high density male, see General I/O
J12	Encoder0	D-type 26 pin high density female	D-type 26 pin high density male, see Encoder Connectors

Connector Assignment	Connector Name	Connector Type	Mating Connector
J13	Encoder1	D-type 26 pin high density female	D-type 26 pin high density male Encoder Connectors
J14	Encoder2	D-type 26 pin high density female	D-type 26 pin high density male, see Encoder Connectors
J15	Encoder3	D-type 26 pin high density female	D-type 26 pin high density male, see Encoder Connectors
J16	MOTOR0		MC 1,5/ 4-STF-3,81 BK, by PHOENIX, P/N 1743074 See Motors
J17	MOTOR1		MC 1,5/ 4-STF-3,81 BK, by PHOENIX, P/N 1743074 See Motors
J18	DRIVE SUPPLY		Molex 171692-0104 Pin: Molex 1720630311 See Drive Supply
J19	MOTOR2		MC 1,5/ 4-STF-3,81 BK, by PHOENIX, P/N 1743074 See Motors
J20	MOTOR3		MC 1,5/ 4-STF-3,81 BK, by PHOENIX, P/N 1743074 See Motors

4.1 Safety, EMC and Wiring Guidelines

Read this section carefully before beginning the installation process.

An STO module (Safe Torque Off) is an optional feature of the unit. Additional information can be found in STO and SS1-t (J8) (Certification Pending).

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.

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

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

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 ECMsm.

> 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	18AWG	No
Drive power supply	14-16AWG	No
Motor	16-18AWG	No
Encoders	28AWG (up to 0.6A), 26AWG (up to 1A)	Yes

4.2 Power Supplies

The unit is fed by two power supplies:

> Drive Supply: 12 to 48Vdc (J18)

> Control Supply: 24Vdc (J9)

The power supplies must be provided by the customer and be UL certified. 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.

4.2.1 Drive Supply

An external isolated 12Vdc to 48Vdc 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 in the table.

The drive supply must be able to provide the peak current or inductance load required by the motor. An external capacitor of 4400µF can answer this need.

Table 4-3. Fuse Ratings

Driver	Ampere Rating	Voltage Rating	Interrupted Rating DC	Class	Example
1.25/2.5A	5A	250V	2Ka	K5	0NLN005.T from Littelfuse
2.5/5A	10A				0NLN010.T from Littelfuse
5/10A	20A				0NLN020.T from Littelfuse

4.2.1.1 Drive Supply Guidelines

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

The ECMsm does not include a regeneration circuit. You must ensure that the DC drive supply voltage does not exceed 52Vdc under any conditions. 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.
- 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 4400µF, installed as close as possible to the drives, 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 the drives.
- An example of a suitable 48V/1500W power supply is the XP Power P/N HPU1K5PS48 supply.

4.2.1.2 Drive Supply Description

Label: J18 DRIVE SUPPLY

Manufacturing P/N: 1716920104

Figure 4-1. J1 - Drive Supply Connector

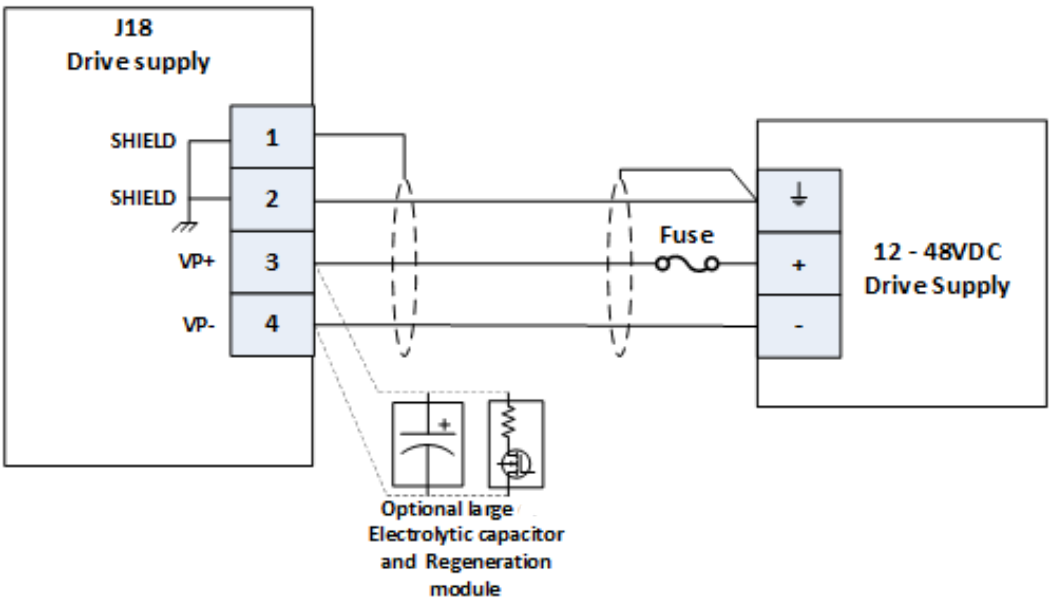
Table 4-4. J1 - Drive Supply Connector Pinout

Pin	Signal	Description
1	PE	Electrical Ground
2	PE	Electrical Ground
3	VP+	Drive supply positive edge
4	VP-	Drive supply return

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

4.2.1.3 Drive Supply Connection Instructions

1. Use a low inductance cable with a minimum gauge of 14-16 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 between the unit and the external power supply.
4. If required, connect the External Regeneration Resistor.
5. Connect the unit PE (Protective Earth) to the power supply PE point.



4.2.2 Control Supply (J9)

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.

4.2.2.1 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 minimum output power should be 40W.
- An example of a suitable 24V/50W power supply is the XP power, P/N VCS50US24.

4.2.2.2 Control_Supply_Description

Label: J9 24V CONTROL SUPPLY

Mating Connector: Phoenix MC 1,5/ 3-STF-3,81

Figure 4-2. J9 - Control Supply Connector

Table 4-5. J9 - Control Supply Pinout

Pin	Name	Description
1	24VDC	+24V dc control supply
2	24V_RTN	24V dc control supply return
3	SHIELD	Electrical Ground

4.2.2.3 Control Supply Connection Instructions

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

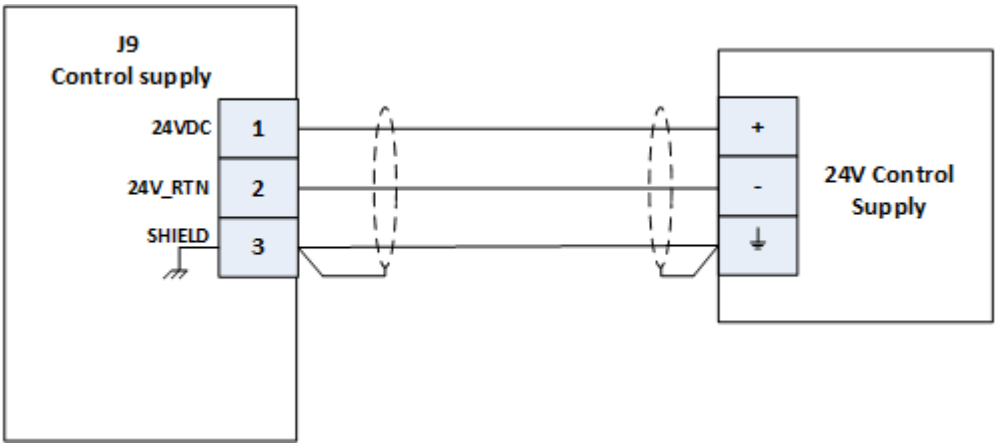


Figure 4-3. Control Supply Connections

4.3 SPI

4.3.1 SPI Description

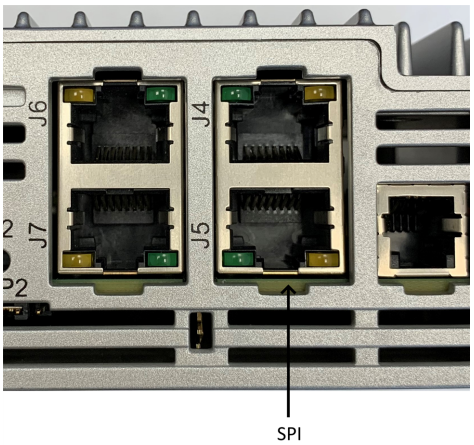
Label: J5 SPI

Connector: CAT 5e cable with flying leads

P/N: CB-20800-100/LF

Connector name	SPI
Connector assignment	J5
Manufacturer part number or type	RJ45 socket 8 positions 8 contacts, shielded, CAT 5e
Mating type	RJ45 plug 8 positions 8 contacts

Figure 4-4. SPI Connector



4.3.2 SPI Connection Pinout

	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)

	Name	Description
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

When using SPI in single-ended mode contact ACS technical support for more information.

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*.

4.3.3 SPI Software Interface

The ACSPL+ programming language supports SPI data communication through the use of the **SPICFG**, **SPIRXN**, **EXTOUT**, and **EXTIN** 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*.

4.4 STO and SS1-t (J8) (Certification Pending)

The Safe Torque Off module is intended 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

STO is an ordering option.

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 460msec. 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 slow 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 STO Description

Label: J8 STO

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

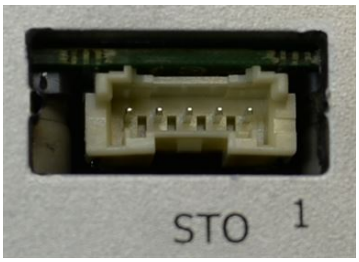


Figure 4-5. J8 - STO Connector

Table 4-6. J8 - 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
4	STO2+	STO input 2 non inverted input
5	STO2-	STO input 2 inverted input

4.4.2 STO 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*.

The STO circuit draws up to 50mA per STO input, with an inrush current of less than 70mA.

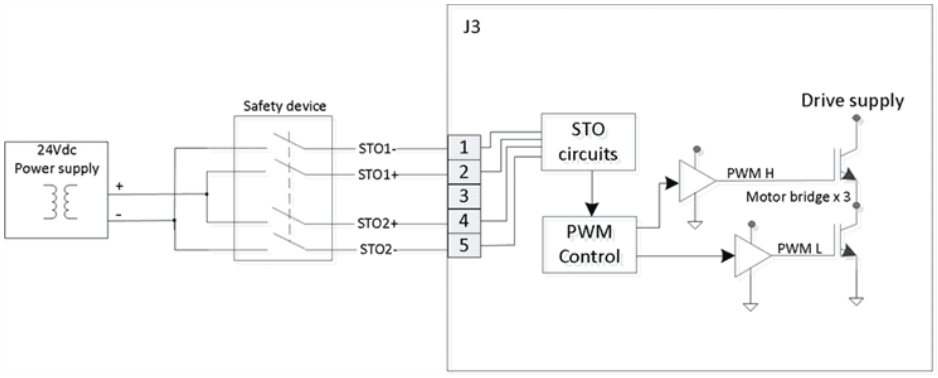


Figure 4-6. STO Connections

4.5 ID Chip Interface

4.5.1 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
Designation	ID Chip	
Quantity	4	1 per axis
Mode	Master	
Interface	1-wire serial protocol using a single data line plus ground reference for communication	

Contact ACS for more details

4.6 Ethernet

4.6.1 Ethernet Description

Label: J4 Ethernet

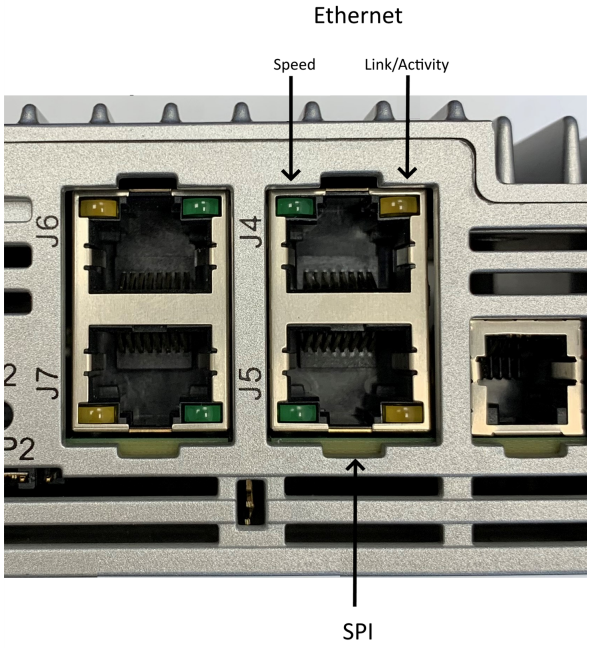
Connector: RJ45 socket 8 positions 8 contacts, shielded, CAT 5e

Mating Connector: RJ45 plug 8 positions 8 contacts

	Name	Description
1	TD+	Positive transmit signal
2	TD-	Negative transmit signal
3	RD+	Positive receive signal

	Name	Description
4	NC	Not connected
5	NC	Not connected
6	RD-	Negative receive signal
7	NC	Not connected
8	NC	Not connected

The Ethernet connector is illustrated in the image below:



4.6.2 Ethernet Connection Instructions

The following diagram illustrates the connection from the ECMsm to an Ethernet host.

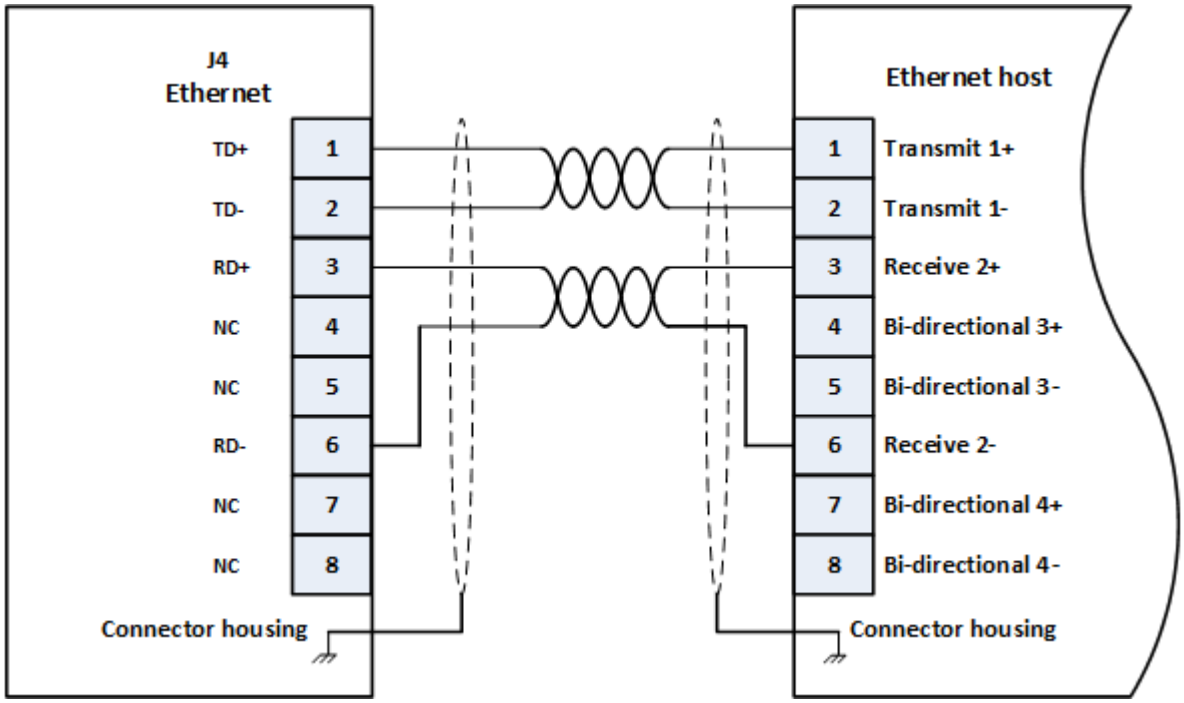


Figure 4-7. Ethernet connection to Ethernet host

4.7 I/O Interfaces

4.7.1 General I/O

4.7.1.1 I/O Description

Label: J11

Connector: D-type 44 pin high density female

Mating connector: D-type 44 pin high density male

Table 4-7. J11 - I/O Connector Pinout

Pin	Signal	Description
1	MARK0-	Axis 0 , Mark input 0 inverted
2	MARK1-	Axis 0, Mark input 1 inverted
3	MARK2-	Axis 1, Mark input 2 inverted
4	MARK3-	Axis 1, Mark input 3 inverted
5	DGND	Digital Ground

Pin	Signal	Description
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	OUT_CNFG_3-	Configurable output 3 inverted RS422
11	AIN0-/ TRQ_ CMD_0-	Analog input 0 inverted/ External analog command for axis 0 inverted
12	AIN1-/ TRQ_ CMD_1-	Analog input 1 inverted/ External analog command for axis 1 inverted
13	TRQ_CMD_2-	NA, reserved for future usage
14	TRQ_CMD_3-	NA, reserved for future usage
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	Mechanical brake 3 or Digital output 3
21	PEG0+	PEG 0 output non inverted
22	PEG1+	PEG 1 output non inverted
23	PEG2+	PEG 2 output non inverted
24	PEG3+	PEG 3 output non inverted
25	OUT_CNFG_3+	Configurable output 3 non-inverted RS422
26	AIN0+/ TRQ_ CMD_0+	Analog input 0 non inverted/ external analog command for axis 0 non inverted

Pin	Signal	Description
27	AIN1+/ TRQ_ CMD_1+	Analog input 1 non inverted/ external analog command for axis 1 non inverted
28	TRQ_CMD_2+	NA, reserved for future usage
29	TRQ_CMD_3+	NA, reserved for future usage
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	Mechanical brake 0 or Digital output 0
34	OUT1	Mechanical brake 1 or Digital output 1
35	OUT2	Mechanical brake 2 or Digital output 0
36	OUT_CNFG_0+	Configurable output 0 non-inverted RS422
37	OUT_CNFG_0-	Configurable output 0 inverted RS422
38	OUT_CNFG_1+	Configurable output 1 non-inverted RS422
39	OUT_CNFG_1-	Configurable output 1 inverted RS422
40	OUT_CNFG_2+	Configurable output 2 non-inverted RS422
41	OUT_CNFG_2-	Configurable output 2 inverted RS422
42	AOUT0+	Analog output 0 non inverted
43	AOUT0-	Analog output 0 inverted
44	AGND	Analog ground
	SHIELD	Connector shell and front screw

4.7.1.2 I/O Connection Instructions

The I/O connector, J11, can be configured to support Mark inputs, as indicated in the following diagram. See Registration MARK Inputs for details.

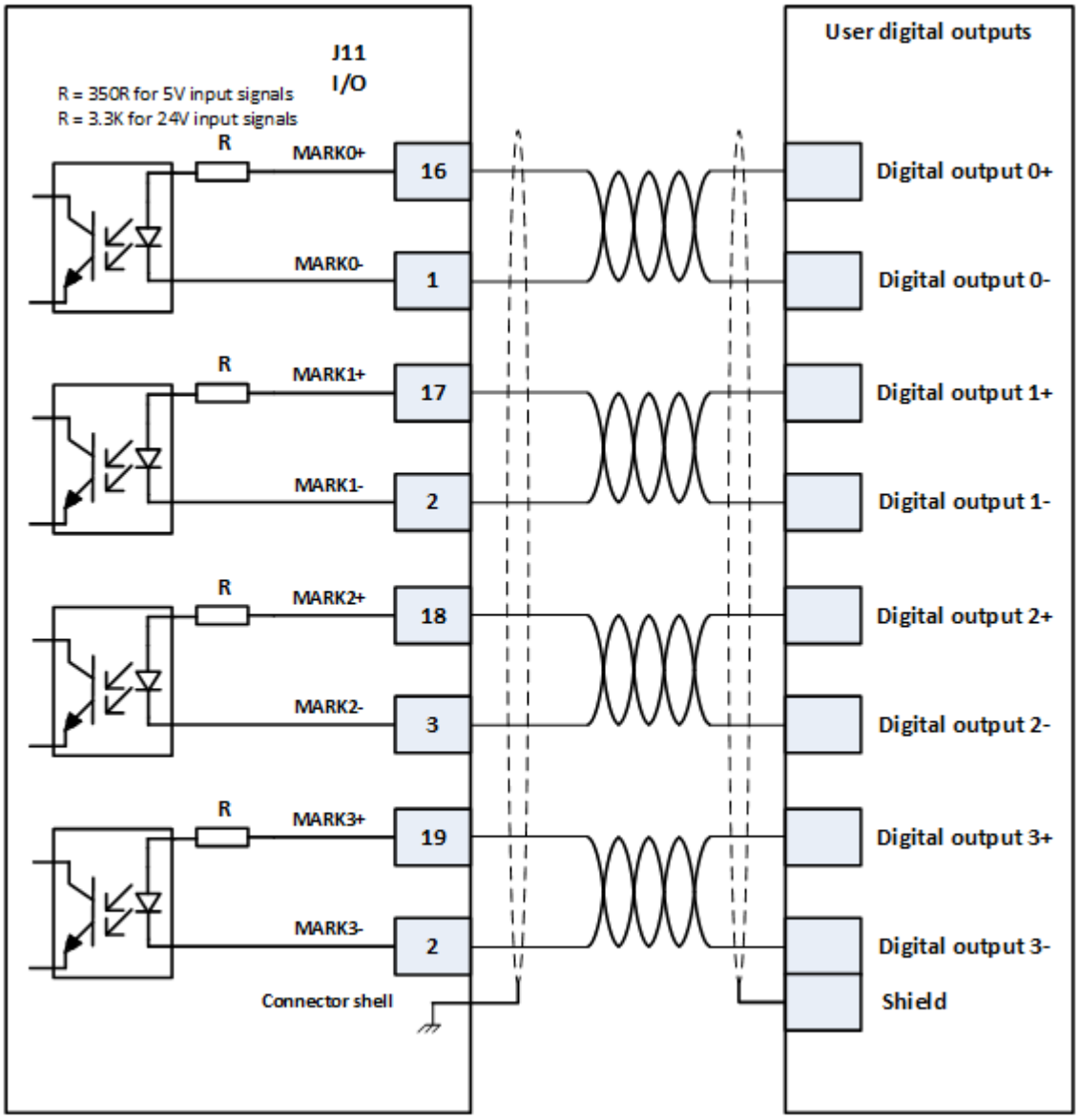


Figure 4-8. Mark Inputs Connection Diagram

J11 can also be used to support PEG outputs, as indicated in the following diagram. See PEG (Position Event Generator) for more details.

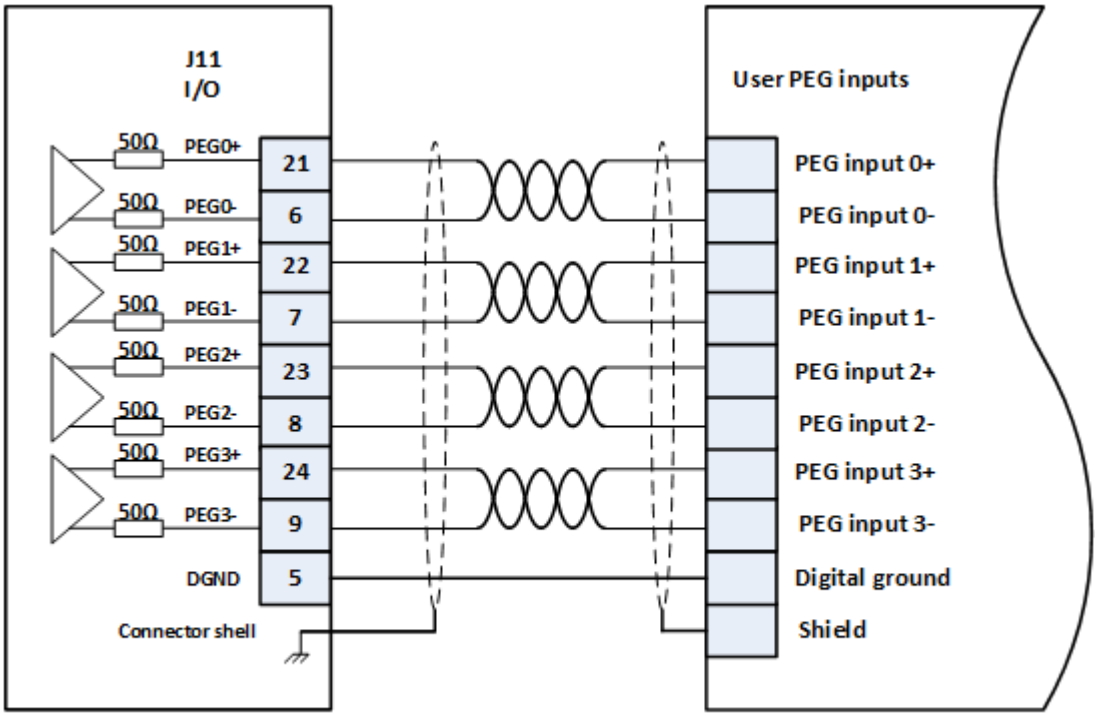


Figure 4-9. PEG Outputs Connection Diagram J11-I/O Connector

J11 can also be used to support various digital outputs to user devices, as shown in the following diagrams. See Digital Outputs for more details.

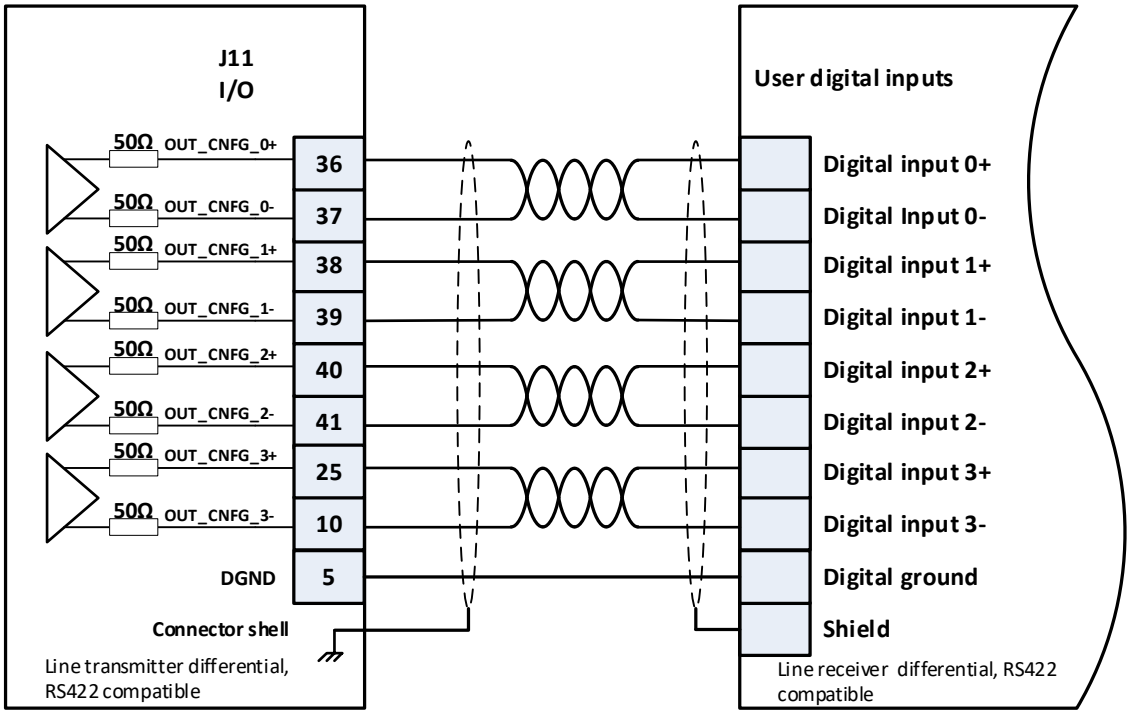


Figure 4-10. GP Analog Inputs and Outputs Connection Diagram, Connectors 0-3

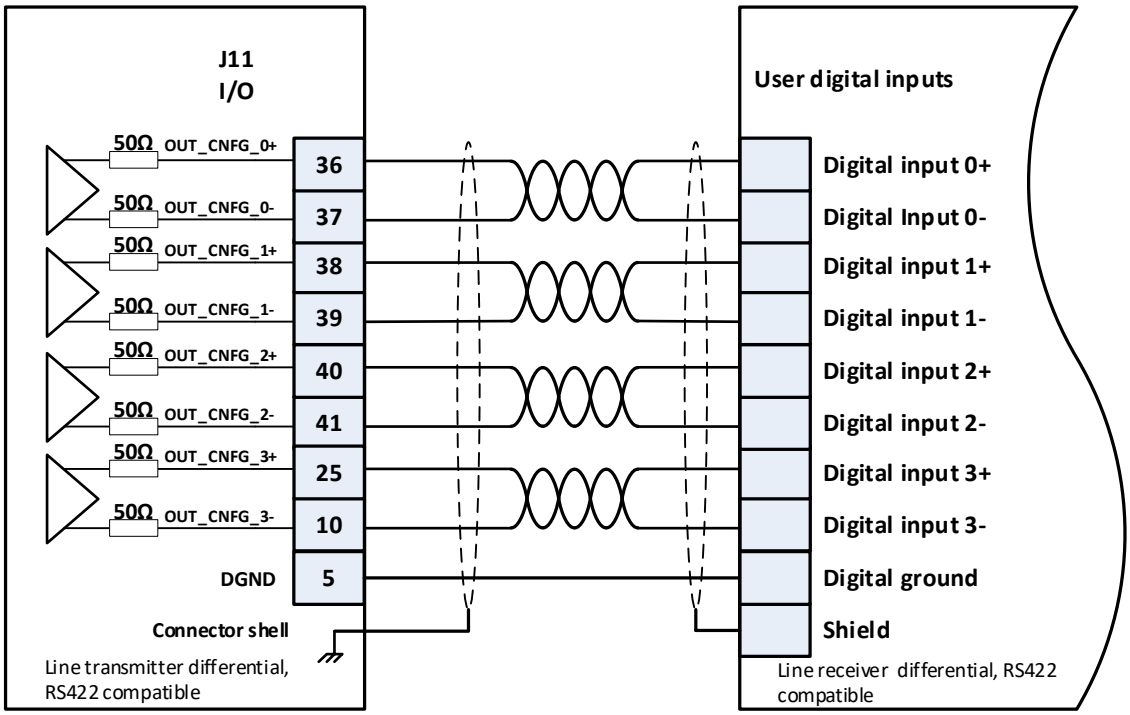


Figure 4-11. GP Analog Inputs and Outputs Connection Diagram, Connectors 4-7

Figure 4-12. J11 I/O Digital Output Support

J11 can also implement wiring for mechanical brakes and GP digital outputs in a source configuration.

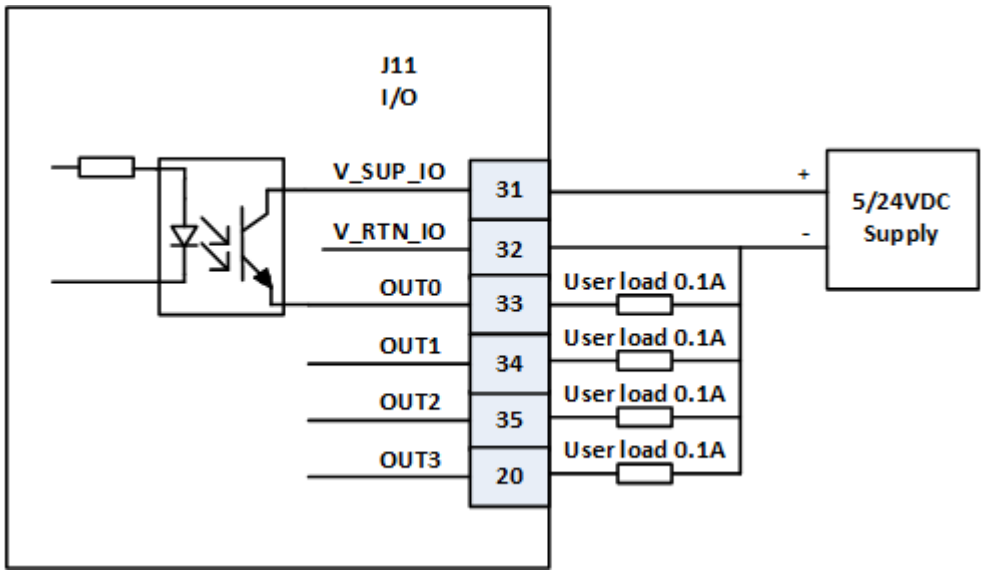


Figure 4-13. Mechanical Brake & GP Digital outputs source connection diagram

The connector can also be configured for the same purpose in a sink configuration.

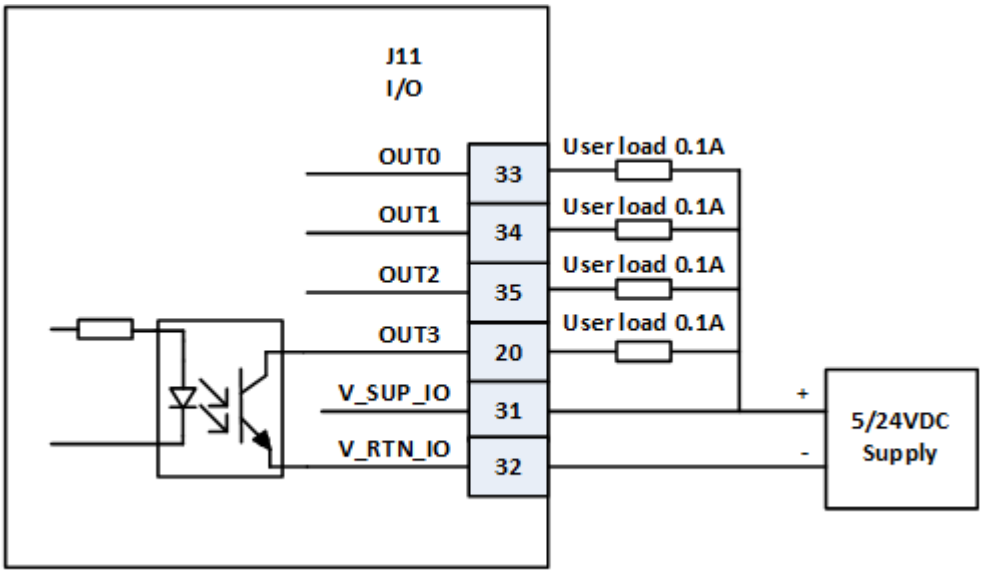


Figure 4-14. Mechanical Brake & GP Digital Outputs Sink Connection Diagram

Note the mapping of the mechanical brake outputs to the **OUT** command.

```
OUT(Axis).8 = 1 ! Activates the brake connected to OUT0
OUT(Axis).9 = 1 ! Activates the brake connected to OUT1
OUT(Axis).10 = 1 ! Activates the brake connected to OUT2
OUT(Axis).11 = 1 ! Activates the brake connected to OUT3
```

4.7.2 Limits

4.7.2.1 Limits Description

Label: J10 LIMITS

Connector: D-type 25 pin female

Mating Connector: D-type 25 pin male

Table 4-8. 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	OUT_CNFG_4+	Configurable output 4 non-inverted RS422
10	OUT_CNFG_5+	Configurable output 5 non-inverted RS422
11	OUT_CNFG_6+	Analog input 0 inverted/ External analog command for axis 0 inverted
12	OUT_CNFG_7+	Configurable output 7 non-inverted RS422
13	SA_MODE	N/A
14	V_RTN_SFTY	Safety supply return
15	0_RL	Axis 0 right limit
16	1_RL	Axis 0 mark input non inverted

	Name	Description
17	2_RL	Axis 2 right limit
18	3_RL	Axis 3 right limit
19	N/C	Not Connected
20	N/C	Not Connected
21	DGND	Digital ground
22	OUT_CNFG_4-	Configurable output 4 inverted RS422
23	OUT_CNFG_5-	Configurable output 5 inverted RS422
24	OUT_CNFG_6-	Configurable output 6 inverted RS422
25	OUT_CNFG_7-	Configurable output 7 inverted RS422
	SHIELD	Connector shell and front screw

4.7.2.2 Limits Connection Instructions

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

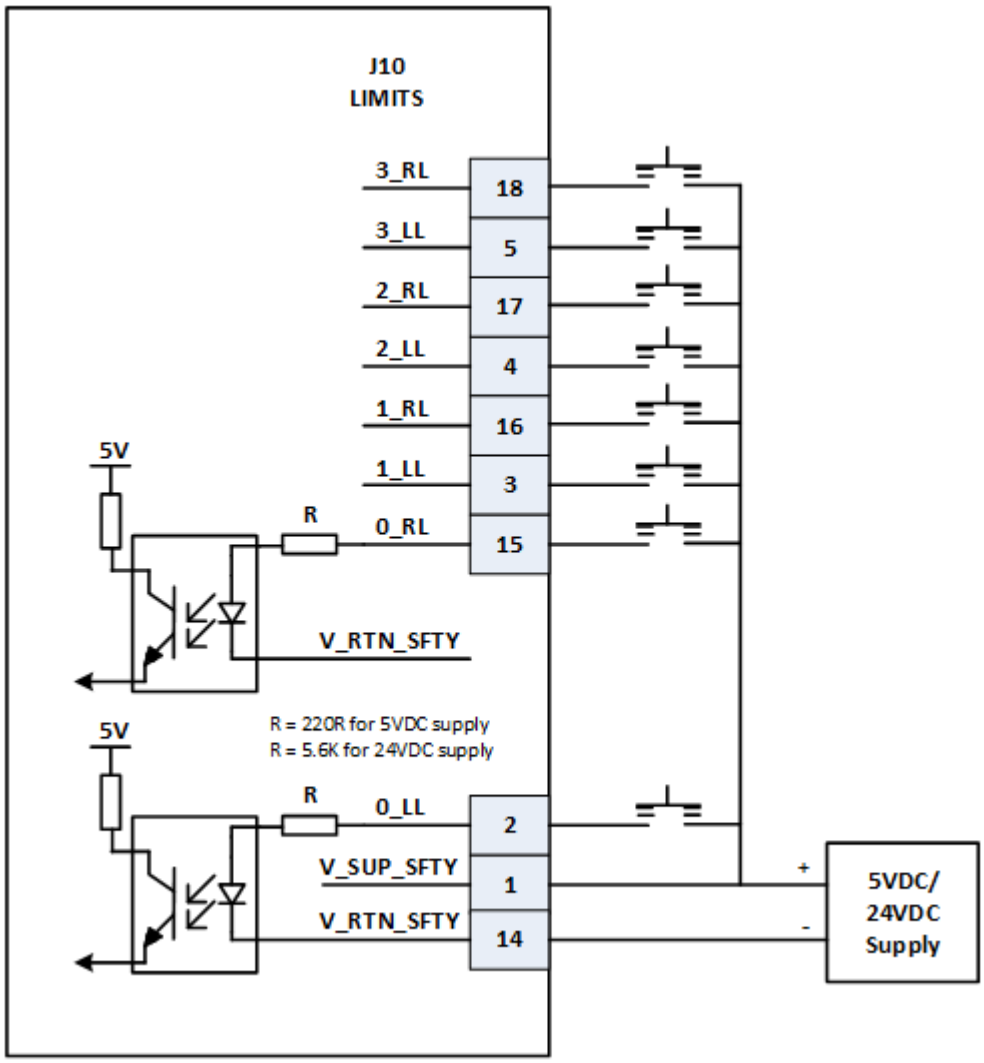


Figure 4-15. Left and Right Source Connection

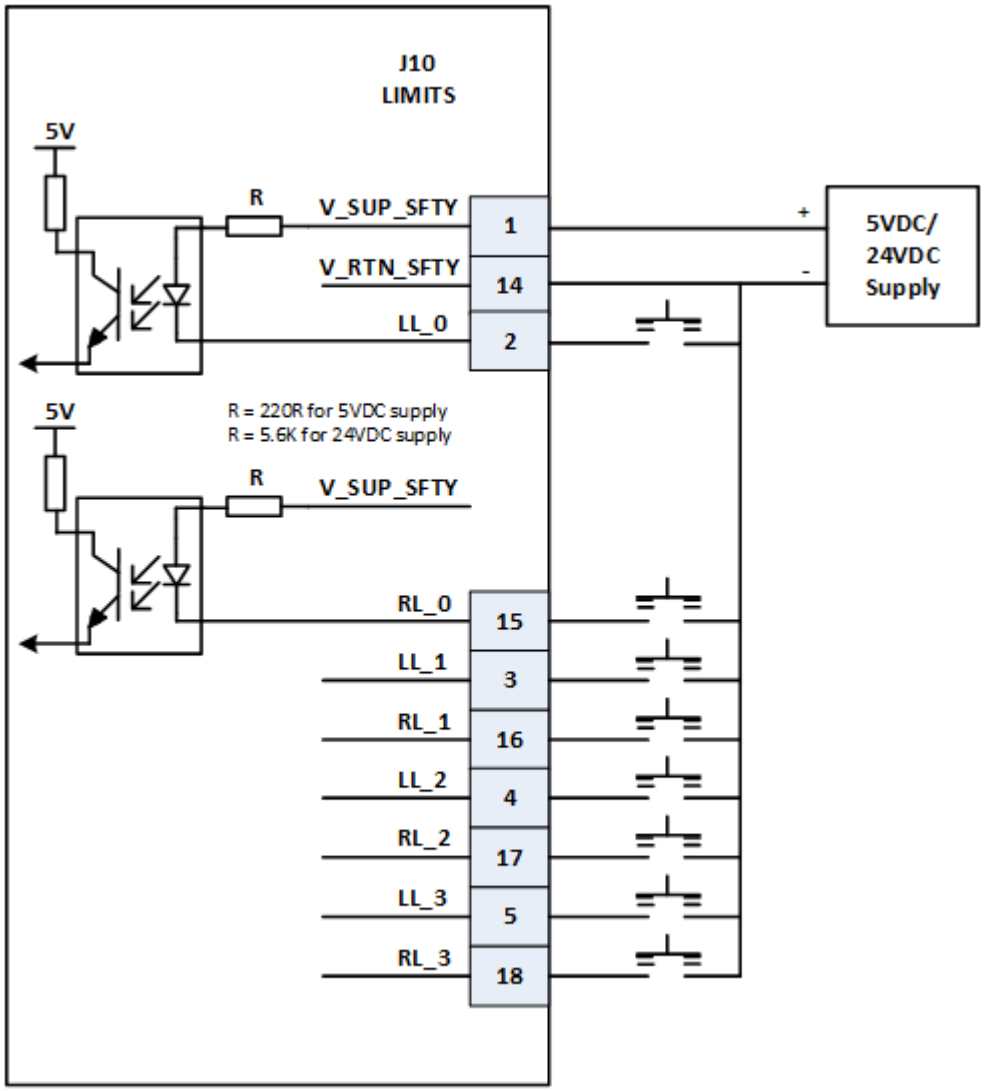


Figure 4-16. Left and Right Sink Connection

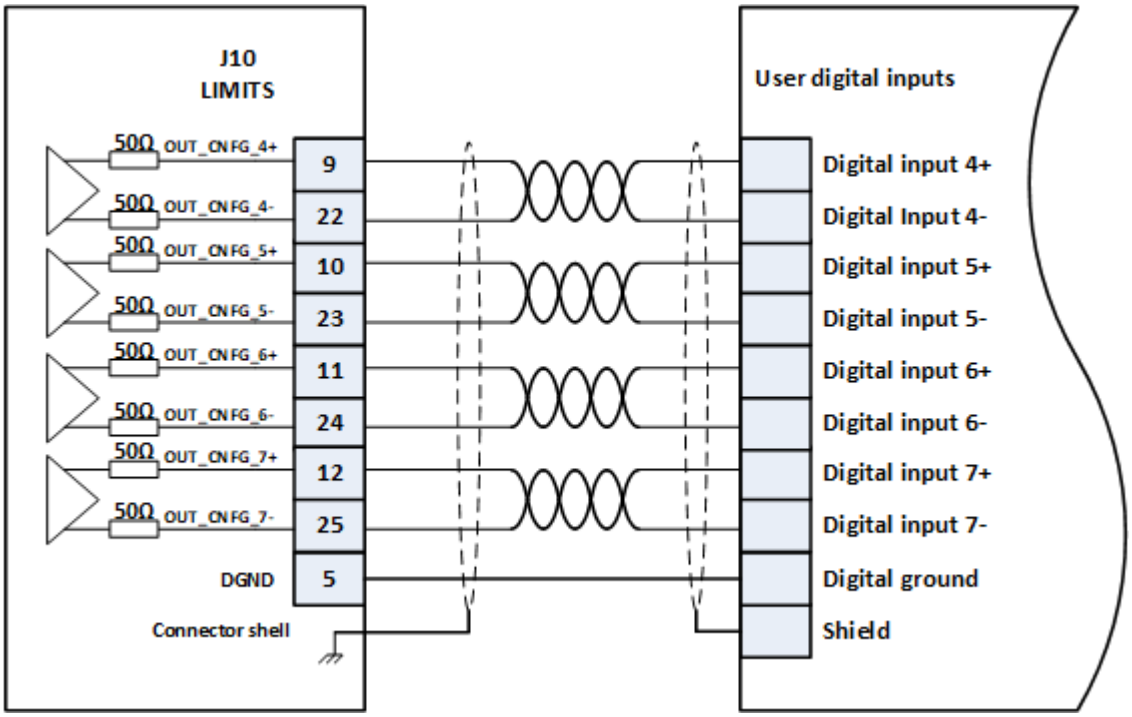


Figure 4-17. Configurable outputs 4-7 Connection Diagram

4.8 Encoder Connectors

4.8.1 Encoder Description

Connector Name	Encoder
Connector Assignment	Encoder 0 J12 Encoder 1 J13 Encoder 2 J14 Encoder 3 J15
Mating Connector	D-type 26 pin high density male

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 COS inverted output.

	Name	Description
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
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 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

	Name	Description
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.
25	5F	5V user supply for analog encoder and Hall
26	5F_RTN	5V 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.

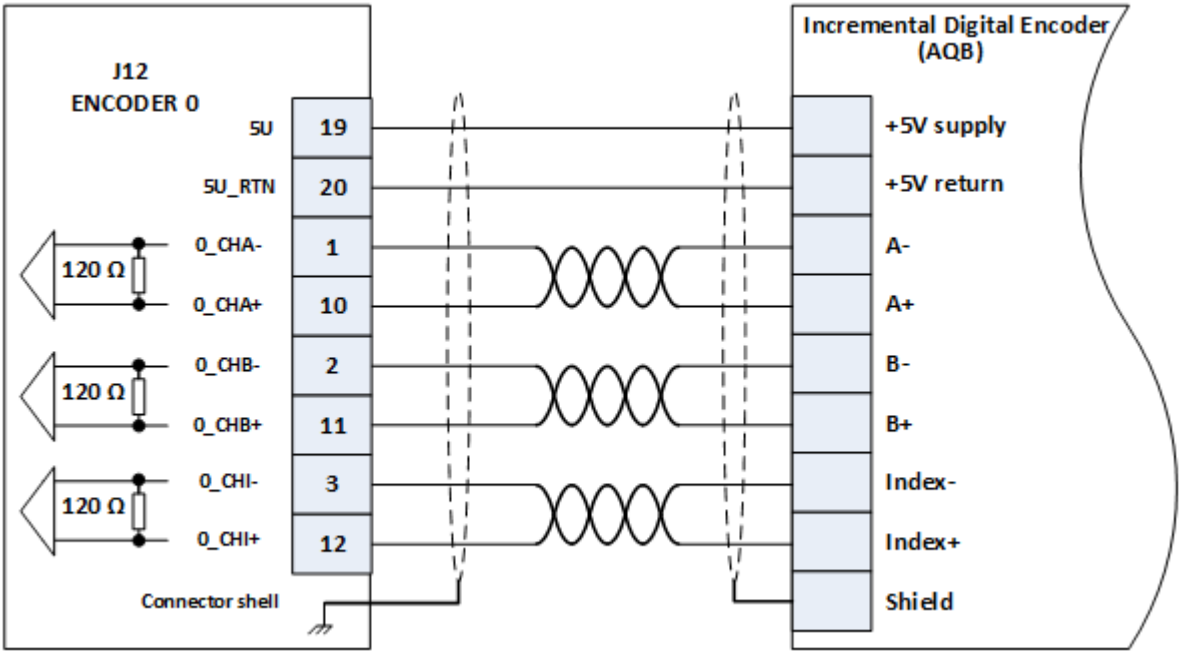


Figure 4-18. Incremental Digital Encoder (AqB) Connection

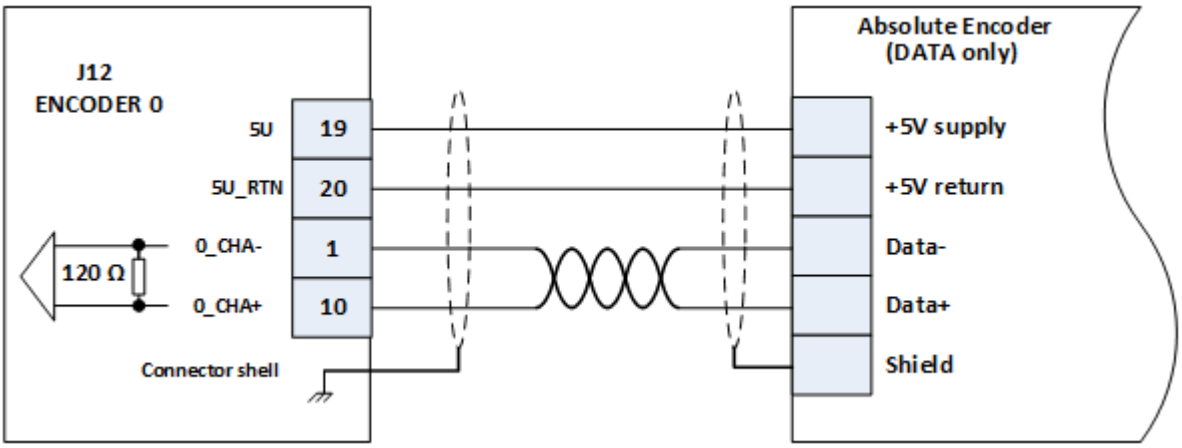


Figure 4-19. Absolute Encoder (Data Only) Connection

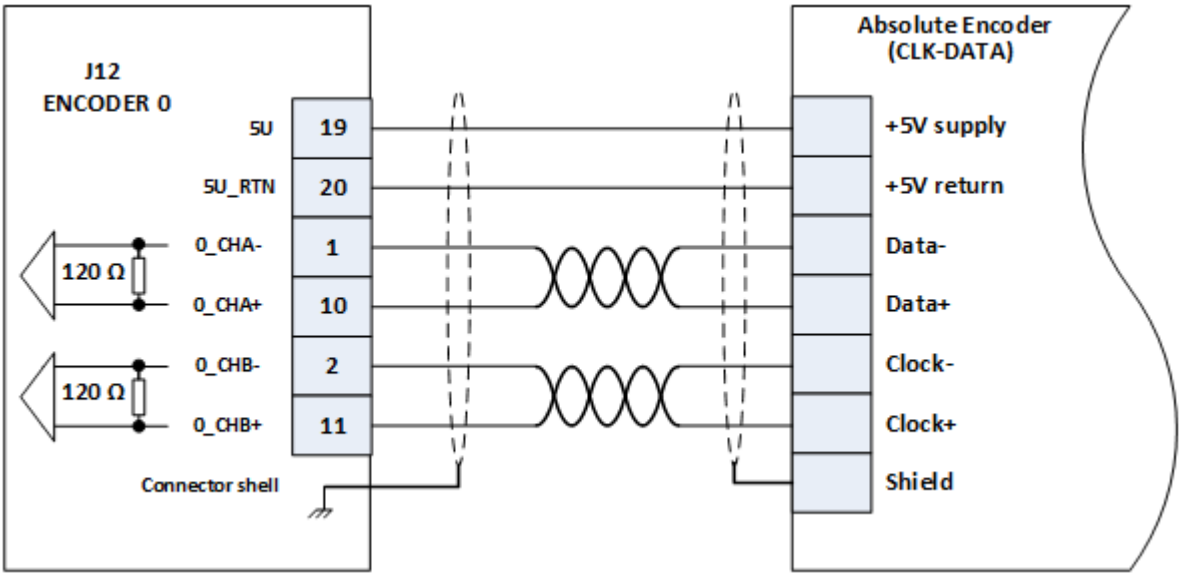


Figure 4-20. Absolute Encoder (CLK-Data) Connection Diagram

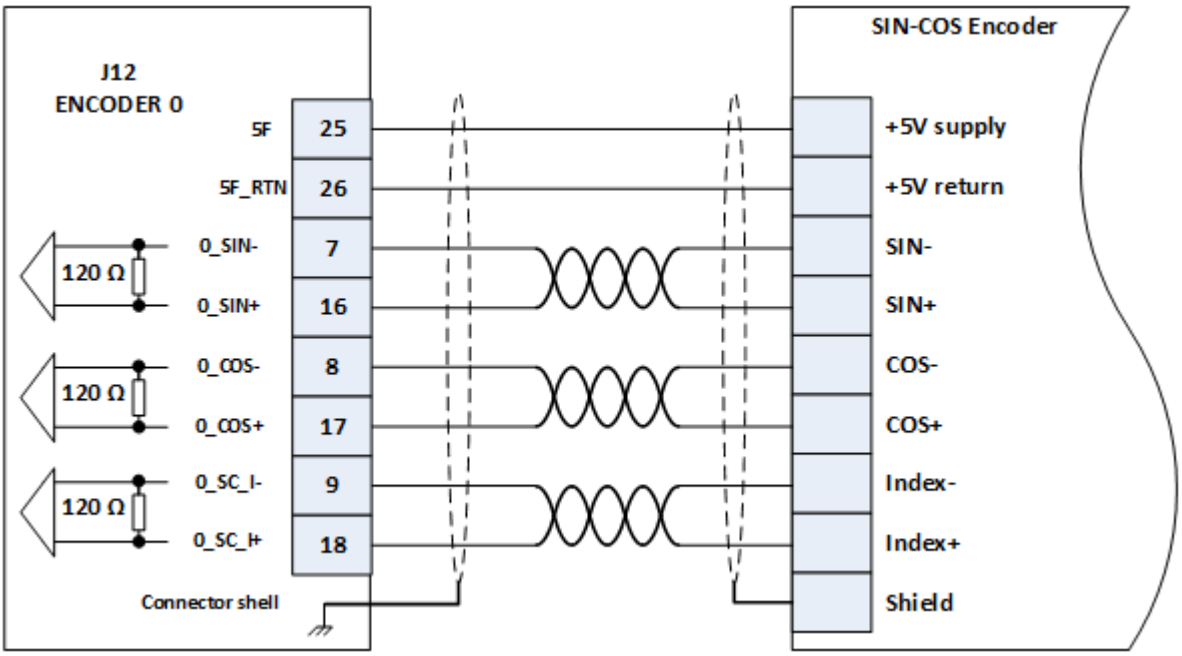


Figure 4-21. SinCos Connection

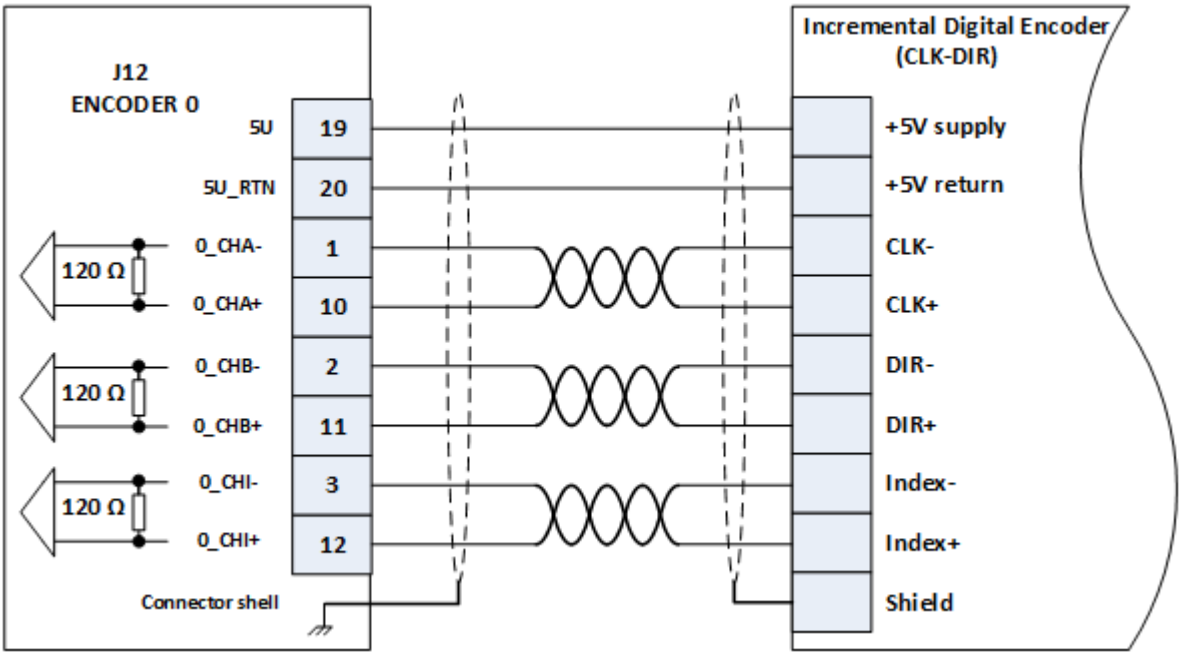


Figure 4-22. Incremental Digital Encoder (CLK-DIR) Connection

4.8.2.1 Additional Device Connections

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

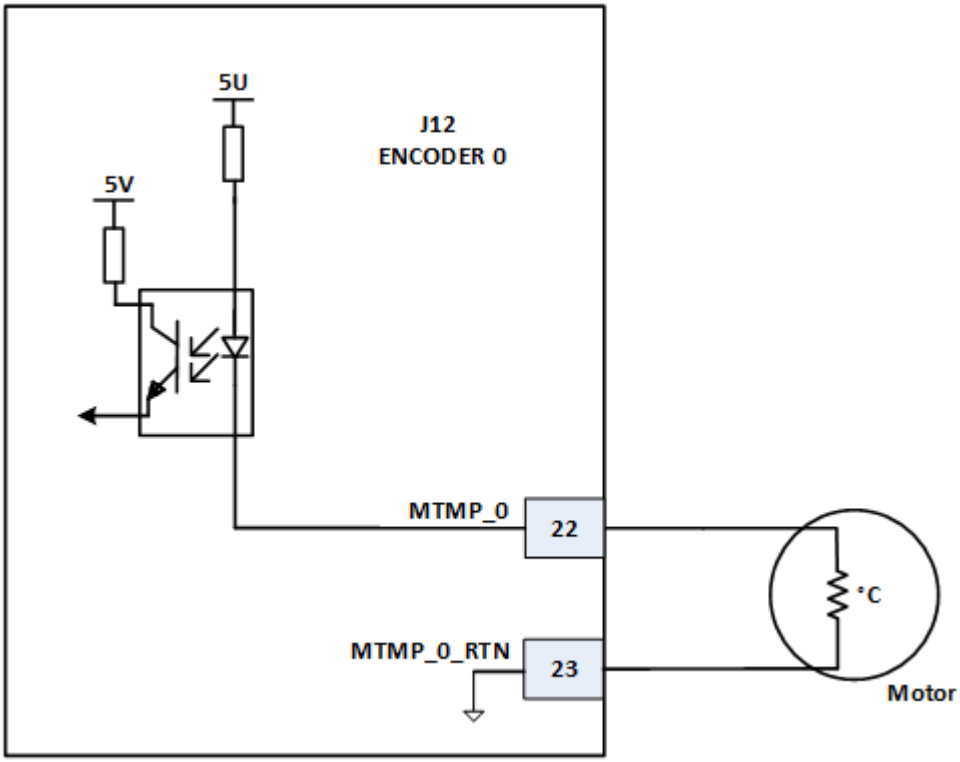


Figure 4-23. MTMP Motor Temperature Sensor Connection

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

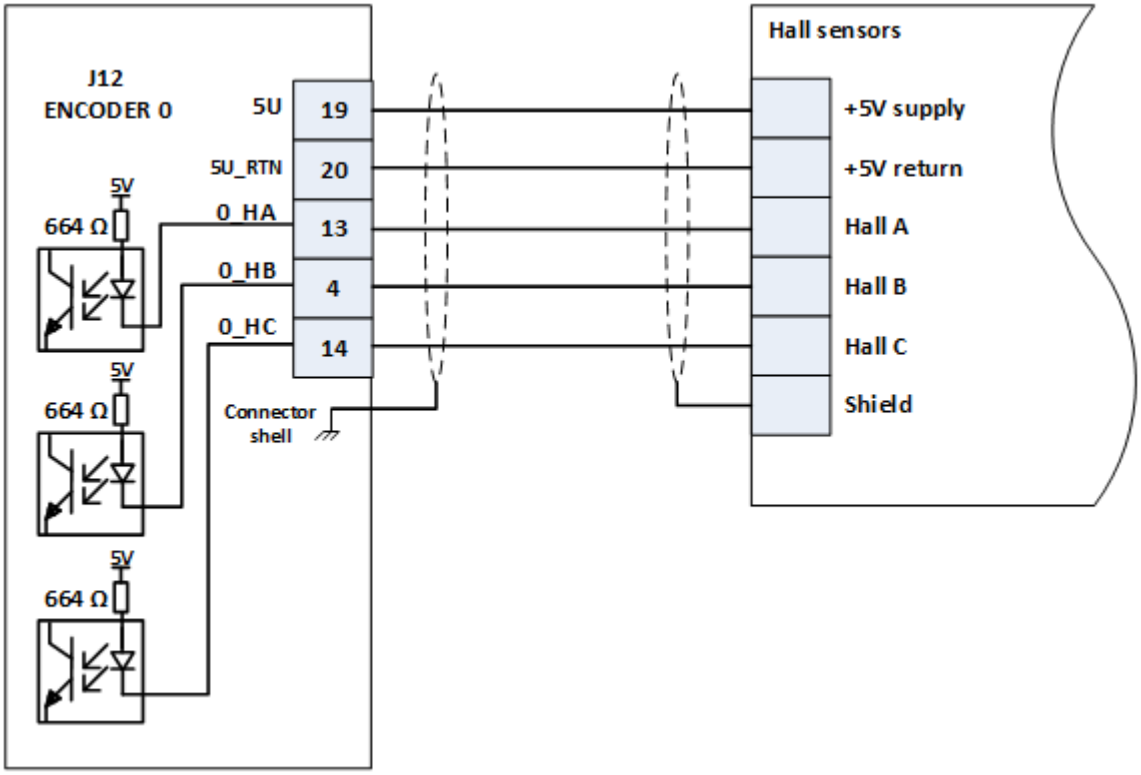


Figure 4-24. Hall Sensor Inputs Connection

Limit inputs may be connected to the limits connector, as shown in 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.

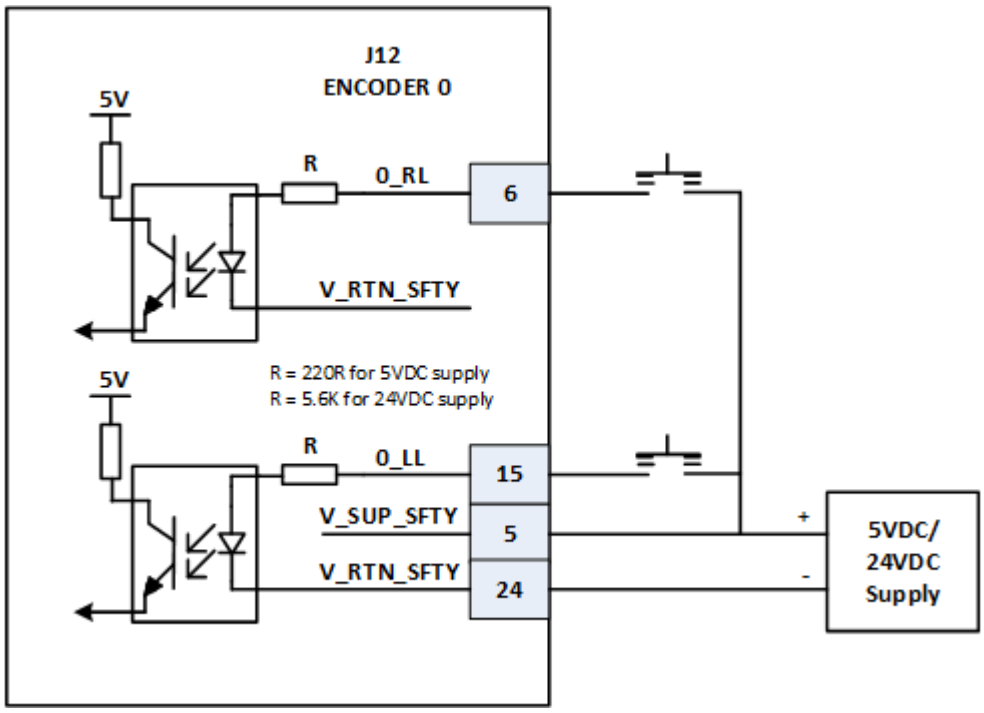


Figure 4-25. Left and Right Limit Source Connection

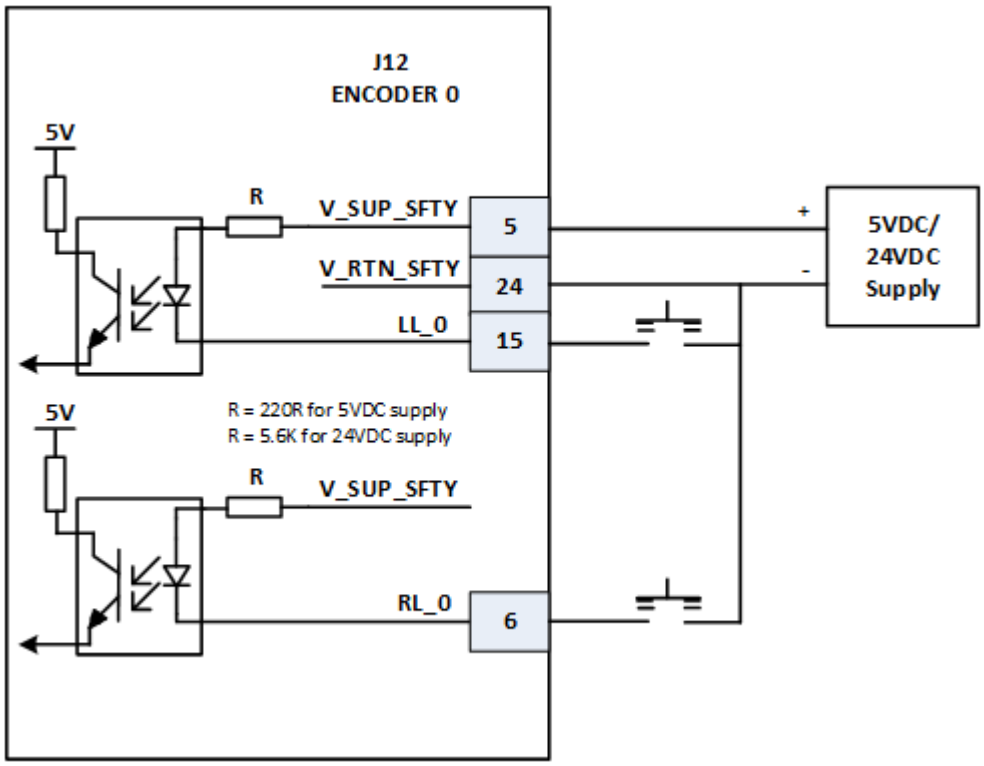


Figure 4-26. Left and Right Limit Sink Connection

4.9 Motors

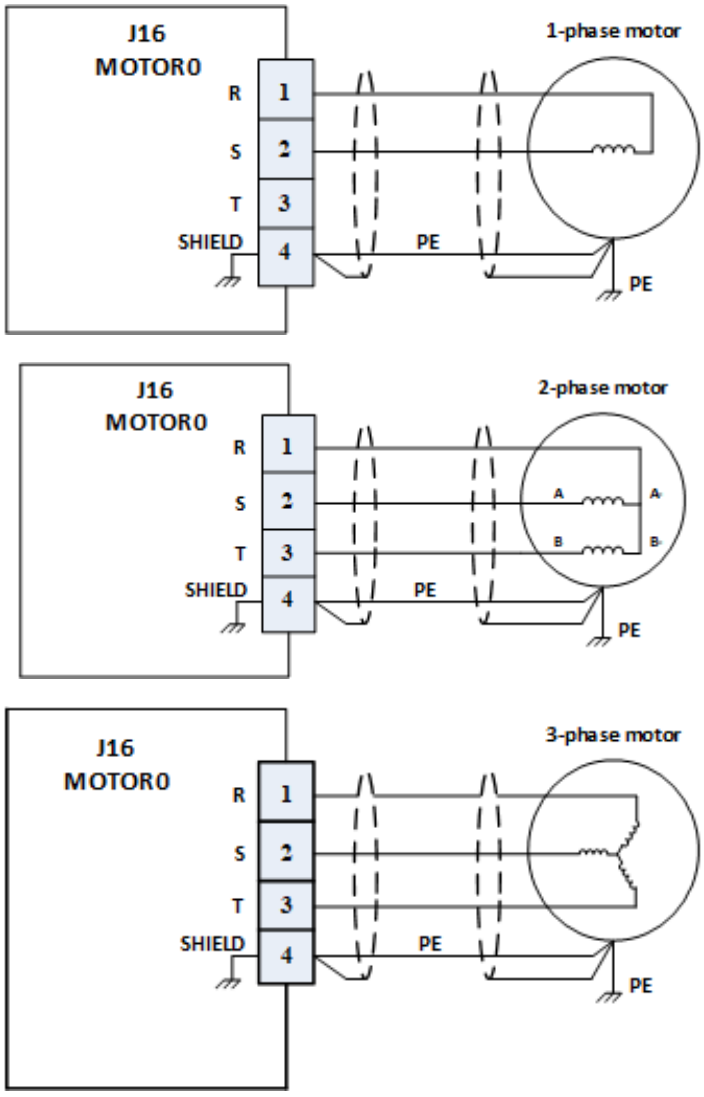
4.9.1 Motor Description

Connector Name	Motor
Connector Assignment	J16 for MOTOR0 J17 for MOTOR1 J19 for MOTOR2 J20 for MOTOR3
Mating type	MC 1,5/ 4-STF-3,81, by PHOENIX, PN 1827729

	Name	Description
1	R	Motor Phase R
2	S	Motor Phase S
3	T	Motor Phase T
4	SHIELD	Electrical Ground / Protective Earth

4.9.2 Motor Connection Instructions

1. Use a shielded cable with a minimum gauge of 18AWG. It should be less than 20 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.



5. Product Specifications

Table 5-1. System Specifications

Feature	Specifications
Drives	> Type: PWM three phase power bridge > Output Current (A): > > 1.25/2.5A Continuous/Peak sine amplitude > > 2.5/5A Continuous/Peak sine amplitude > > 5/10A Continuous/Peak sine amplitude > Maximum output voltage (Vrms): 32/31 (Continuous/peak) phase to phase (92% modulation) > PWM frequency: 20 kHz > Output power per axis (W): > > 47/94W (Continuous/peak) for 1.25/2.5A version > > 94/186W (Continuous/peak) for 2.5/5A version > > 186/363W (Continuous/peak) for 5/10A version > Minimum load inductance: 25 µH per phase at 48VDC > Commutation type: Sinusoidal. Initiation with and without hall sensors > Current dynamic range: > > 2000:1 (standard) > Protection: > > Short and over current: 14A ± 20% > > Over Temperature: 100°C (on the product's PCB) > > Over voltage: 55V±3% > > Under voltage: 10.7V±3%
Supply	The module is fed by two power sources: > Supply > 24Vdc control supply. During emergency conditions there is no need to remove the 24Vdc control supply.

Feature	Specifications
Motor Drive Supply	> Range: 12Vdc to 48Vdc > Maximum input current (continuous/peak), [Arms] > 1.0/2.0A for 1-axis 1.25/2.5A > 2.0/4.0A for 1-axis 2.5/5A > 4.0/8.0A for 1-axis 5/10A > 2.0/4.0A for 2-axis 1.25/2.5A > 4.1/8.0A for 2-axis 2.5/5A > 8.1/16.0A for 2-axis 5/10A > 4.1/8.1A for 4-axis 1.25/2.5A > 8.1/16.2A for 4-axis 2.5/5A > 16.2/32.2A for 4-axis 5/10A > Input power (continuous/peak), [W] > 49.4/97.6W for 1-axis 1.25/2.5A > 97.6 /193.8 W for 1-axis 2.5/5A > 193.8 /385.9 W for 1-axis 5/10A > 98.8 /195.1 W for 2-axis 1.25/2.5A > 195.1 /387.6 W for 2-axis 2.5/5A > 387.6 /771.8 W for 2-axis 5/10A > 197.6 /390.3 W for 4-axis 1.25/2.5A > 390.3 /775.2 W for 4-axis 2.5/5A > 775.2 /1543.6 W for 4-axis 5/10A > Inrush current: 100A for 40uS @48Vdc
Control Supply	> Range: 24Vdc ± 5% > Maximum input current: 1.5A @ 22.8Vdc > Protection: short circuit and reverse polarity
Motor Type	> 2/3 Phase DC brushless > DC brush > 2/3 and 5 phase step motors > Voice Coil Motors
Feedback	Standard > Incremental digital encoders (AqB) Optional: > Absolute encoders > SIN-COS encoder
Incremental Digital Encoder	> Four > Interface: Differential, RS422 (12.5MHz A & B input frequency appropriate to 50 million quadrature counts per second) > Maximum input frequency: 50M counts per second for differential > Protection: Encoder error, encoder not connected > Input termination: 120Ω (on each signal pair) > Encoder supply: 1.5A total for all digital encoders.

Feature	Specifications
Sin-Cos Analog Encoder (optional)	> Quantity: Four > Programmable multiplication factor: x4 to x4096 > Maximum frequency: 500kHz > Maximum acceleration with sin-cos encoder: 10^8 sin periods/second^2 > 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, 1.5A total for all analog encoders. > ADC resolution: 12-bit > Protection: Encoder error, not connected > Designation: SIN±, COS±, SC_I± (share the same inputs with analog Hall) > Squared SIN-COS: The squared signals of the SIN-COS are available for all encoders
Absolute Encoder (optional)	> Interface : Differential RS485 > Encoder supply : 1.5A total for all encoders. > Designation: #_CHA, #_CHB
Digital Hall inputs	> Four sets of three inputs > Input current: <7mA > Interfaces: 5V Single-ended, source, opto-isolated (open cathode), reference DGND > Designation: $_HA, $_HB, $_HC
Mechanical Brake & GP Digital output	> Quantity: 4 > Interface: 5/24V±20%,opto isolated, sink/source > Reference: V_RTN_IO > Output current: 0.1A per output > Output drop: 2.5V@0.1A > Protection: short current > Designation: OUT0, OUT1,OUT2,OUT3
Limit Switch Inputs	> Quantity: 2 per axis > Single-ended, 5/24V±20%,opto isolated, sink/source > Protection: short current > Behavior: No current= limit off. > Designation: #_RL, #_LL

Feature	Specifications
Registration MARK Inputs	> Four, 24V±20% > Interface: opto-isolated, two terminals > Maximum Encoder Frequency: <12.5MHz > Input propagation delay: <100nS > Position latch: Both raising and falling edge > Maximum Input current: <14mA > Max Capture Frequency: 500 Hz > Can be used as general purpose inputs > Designation: MARK0±, MARK1±, MARK2±, MARK3±

Digital Outputs	> Quantity: 8
	> Configurations:
	  > PEG State (OUT0-3)
	  > GP Output (OUT4-7)
	> Interface: Differential, RS422 compatible.
	> Designation: OUT_CNFG_#± where # is the output number from 0 to 7

PEG (Position Event Generator)	> (Position Event Generator): Four PEG State, P/D output pair, AqB output pair > Differential, RS422 compatible > Pulse width: 40 ns to 671 ms > 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±, PEG2±, PEG3±  PEG does not operate with absolute encoders.
Analog Inputs	> Two ±10V±5% or Single- ended 0-10V±5% > Max. input frequency: 1 KHz > Offset: < 100mV > SNR: >56dB > Designation: AIN_#± (# = analog output number 0-1) > Resolution: 12-bit
Analog Outputs	> Two ±10V, differential, two terminal, 10 bit resolution > Offset: ±50mV > Max. output load: 10kΩ > Noise & Ripple: <25mV > Non-linearity: <5%

Feature	Specifications
Ethernet Port	> Ethernet port for configuration > Interface: TCP/IP communication > Speed: 100 Mbps > Designation: Transmit: ETH#_TX±, Receive: ETH#_RX± > Default IP Address: 10.0.0.100

Table 5-2. Motor Over Temperature Specifications

Item	Description	Remarks
Designation	Motor over temperature: #_OVER_T	
Quantity	One per axis	
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	

Table 5-3. STO and SS1 (Optional)

Item	Description	Remarks
Designation	STO1± STO2±	
Quantity	2 inputs	Switch off all axes simultaneously. One input shuts off the upper part of the motor bridge and the other shuts off the lower part.
Interface	> 24V isolated, two terminals for each input	
Input current (per input pin)	> <70mA	
Behavioral	No current=drive off.	

Table 5-4. RS232

Item	Description	Remarks
Interface	Isolated	
Designation	COM1_TX COM1_RX	COM1
Quantity	1	
Speed	Up to 115,200 Baud rate	

Table 5-5. SPI

Item	Description	Remarks
Designation	SPI_MISO± (data master input / slave output)SPI_ MOSI± (data master output / slave input) SPI_SS± (chip select) SPI_CLK± (clock)	bi-directional interface supports master or slave mode

Item	Description	Remarks
Quantity	1	
Interface	Differential RS422	
Speed	4 MHz	
Data word length	8 words of 16 bits	

Table 5-6. Physical Parameters

Length	168 mm
Depth	158 mm
Height	48.3 mm
Weight	800 g

5.1 Dimensions

- Length: 168 mm
- Depth: 158 mm
- Height: 48.3 mm

5.2 Weight

- 800g

5.3 Compliance with Standards

5.3.1 Environment

The operational temperature range is from 0 to + 50°C. A fan providing 24 CFM must be used if the ambient temperature is greater than 40°C.

5.3.2 EMC

- IEC 61800-3: 2017, Part 3

5.3.3 Electrical Safety

- IEC 61800-5-1:2016, part 5-1

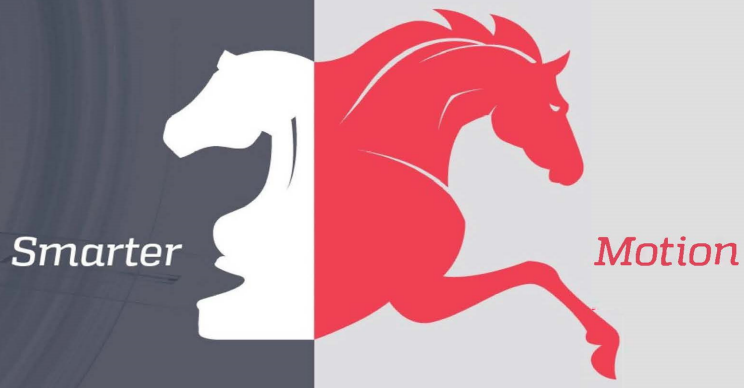
5.3.4 Functional Safety

- IEC 61800-5-2:2016 part 5-2
- IEC 61508 Part 1-7:2010

5.3.5 Mechanical Safety

- EN ISO 13849-1:2015, Part 1

- EN ISO 13849-2:2012, Part 2
- IEC 62061:2005 + A1:2012 + A2:2015
- IEC 60204-1:2016, Part 1



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