ECMma

Installation Guide

February 2023

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ACS MOTION CONTROL

ECMma

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PATENTS

Israel Patent No. 235022
US Patent Application No. 14/532,023
Europe Patent application No.15187586.1
Japan Patent Application No.: 2015-193179
Chinese Patent Application No.: 201510639732.X
Taiwan(R.O.C.) Patent Application No. 104132118
Korean Patent Application No. 10-2015-0137612

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Revision History

Date	Revision	Description
February 2023	3.13.01	Correct diagrams, mechanical brake code
November 2022	3.13	Autofocus option, new release
September 2022	3.12.01	Add ripple check note for drive supply Correct Drive Supply pinout
July 2022	3.12	Add callouts for motor and drive supply pins
May 2022	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.
PEG and MARK Operations Application Note	Describes how to setup PEG1 and MARK Operations for SPiiPlus motion controllers
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 ECMma.

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

2. ECMma Product Overview

The **ECMma** is a member of the Economical Control Modules (ECM) series of compact, highly integrated all-in-one motion controller and drives solutions designed to meet the needs of OEMs with cost-sensitive motion control applications. Its unique multiprocessor architecture leverages powerful control algorithms to achieve best-in-class performance, while its universal servo drive technology enables the system designer to easily control most any type of motor or stage.

2.1 Product Specifications

Table 2-1. System Specifications

Feature	Specifications
Control Supply Input	> Input Range > 24Vdc ±5% > Maximum Input Current > <2A @ 22.8Vdc > Protection > Reverse polarity, Short Circuit
Drive Supply	> Type > DC Supply > Input voltage range, [Vrms]

Feature	Specifications
	> 24-150Vdc > Maximum input current per axis (continuous/peak), [Arms] > 4/8A for 5/10A > 8/16A for 10/20A > 12/24 for 15/30A > Input power per axis (continuous/peak), [W] > 636/1267 for 5/10A > 1272/2534 for 10/20A > 1215/2412 for 15/30A > Inrush current > 100A for 40uS @ 150Vdc > Protections > Reverse polarity External fuse will blow if reverse polarity is identified

Feature	Specifications
Motor Drive	> Type: PWM three phase power bridge > Quantity: 4 > Motor Configurations > 2/3 Phase DC brushless > DC brush > 2/3 phase step motors > Voice Coil > Output Current (A) > For 150V: > 5/10A continuous/Peak sine amplitude or > 10/20A continuous/Peak sine amplitude > For 100V: > 15/30A continuous/Peak sine amplitude > Maximum output voltage (Vrms) > 100V (phase to phase) for 150V > 66V (phase to phase) for 100V > PWM frequency (Khz) > 20Khz > Output power per axis (W) > 633/1258 (continuous/Peak) for 5/10A > 1266/2517 (continuous/Peak) for 10/20A > 1208/2393 (continuous/Peak) for 15/30A > Load inductance > >150µH Phase @ 150V > Electrical motor's time constant > 150µS > Current dynamic range > 1000:1 > Maximum Output Voltage > 94% of Drive Supply input voltage > Protections > Short current: 50A > Over current: Peak for 1sec. > Over temperature: 100°C (on the product's PCB) > Under voltage: 18V±3% > Over voltage: > 176V±3% for 150V > 120V±3% for 100V > Efficiency > >98% > EMC > The drive should comply with EMC without a motor filter. > No Regeneration circuit
Feedback	Standard > Incremental digital encoders (AqB)

Feature	Specifications
	Optional: > Absolute encoders > SIN-COS encoder
Incremental Digital Encoder	> Quantity: 4 > Interface: Differential, RS422 (12.5MHz A & B input frequency appropriate to 50 million quadrature counts per second) > Protection: Encoder error, encoder not connected > Input termination: 120Ω (on each signal pair) > Encoder supply: 5.0 - 5.25V, 1.5A total for all analog encoders.
SinCos Encoder	> Quantity: 4 > Type > Differential input > Input impedance 120Ω±10%. > Encoder voltage range 1Vptp±10% > Input Voltage range: 1.20Vptp > Maximum Frequency: 500 kHz > Encoder supply: 5.0 - 5.25V, 1.5A total for all analog encoders. > Squared SinCos: signals available for all encoders > ADC Resolution: 12-bit > Diagnostics: Encoder error, encoder not connected. > Compensation: Phase, Gain, and Offset
Absolute Encoder	> Quantity: 4 > Type: > EnDat2.1, 2.2 Heidenhain, 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 A6 Series > SSI > Sanyo ABS > Maximum Input Frequency > EnDat- 2MHz > Smart-Abs-2.5MHz > Biss-C- 10MHz > Panasonic- 2.5MHz > Sanyo- 2.5MHz > Interface : Differential RS485 > Encoder supply: 5.0 - 5.25V, 1.5A total for all analog encoders. > Designation: #_CHA, #_CHB

Feature	Specifications
Digital Hall inputs	> One set per axis > Input current: <7mA > Interfaces: 5V, Source input type, (open cathode). Reference DGND > Designation: $_HA, $_HB, $_HC
Mechanical Brake & GP Digital output	> Quantity: 8, four of which can be a brake or a GP output > Interface: 5/24V±20%, opto isolated, sink/source > Reference: V_RTN_IO > Output current: 100mA per output > Output drop: 2.5V @ 0.1A > Protection: short circuit > Maximum update rate: 1 kHz > Designation: OUT$
High Voltage Mechanical Brake Outputs	> Quantity: 2 > Logic mirrors output of OUT0, OUT1, but with higher current > Interface: 24V±20%,opto isolated, source Reference: BRK_RTN > Output Current: 0.5A per output > Designation: 0_BRK, 1_BRK
Limit Switch Inputs	> Quantity: 2 per axis > Single-ended, 5/24V±20%,opto isolated, sink/source > Behavior: No current= limit off. > Designation: #_RL, #_LL
Registration MARK Inputs or GP Digital Inputs	> Quantity: 4, shared with GP Inputs > Interface: opto-isolated, two terminals > Maximum encoder frequency: <12.5MHz > Maximum capture frequency : 1 per 2 MPU cycles > Position Latch: software programmable, rising or falling edge > Maximum Input Current: <18mA > Designation: MARK$±
GP Digital Inputs	> Quantity: 4, shared with MARK Inputs > Interface: 5/24V±20%, Opto-isolated, Two terminals. > Maximum Input Current: <18mA > Sample Rate: 1 per MPU cycle > Designation: MARK$±
PEG (Position Event Generator)	> Quantity: 4 > Differential, RS422 compatible > Pulse width: 40 ns to 671 ms > Maximum rate: 10MHz > Can be used as general purpose output

Feature	Specifications
	> Number of random PEG points: Unlimited > Designation: PEG#±  PEG does not operate with absolute encoders.
GP Analog Inputs	> Four ±10V±5% or Single- ended 0-10V±5% > Max. input frequency: 5 kHz > Offset: < 100mV > SNR: >54dB > Resolution: 12-bit > Designation: AIN_#±
GP Analog Outputs	> Two, differential, ±10V±10% > Offset: ±100mV > Max. output load: 10kΩ > Max. Update Frequency: 1 per MPU Cycle > Noise & Ripple: <25 mV > Non-linearity: <5% > Resolution: 10-bit > Designation: AOUT_#± (# = analog output number 0-1)
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
ID Chip	> Quantity: 1 per axis > Mode: Master > Interface: 1-wire serial protocol using a single data line plus ground reference for communication

Table 2-2. Motor Over Temperature Specifications

Item	Description	Remarks
Designation	Motor over temperature: #_ OVER_T	
Quantity	One	
Type	> Single-ended, opto-isolated > Reference: DGND	

Item	Description	Remarks
Threshold	> Over temperature protection is on, when the impedance between $_Motor_OVER pin to ground is above 1kΩ > 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 2-3. 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 2-4. RS232

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

Table 2-5. 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
Quantity	1	
Interface	Differential RS422	
Speed	4 MHz	
Data word length	1-16 bits	User configurable
Data Capacity	Up to 8 x SPI words Per MPU Cycle	

2.1.1 EtherCAT Cycle Rate

Table 2-6. CTIME Values for ECMma

Controller	Number of Internal Axes	Maximum Number of Axes	Default Number of Available ACSPL+ Buffers**	Maximum Number of Simultaneously Running		Controller Cycle Time					ServoBoost Supported
				Motors	ACSPL+ Buffers	1 (msec) 2 (msec)	0.50 (msec)***	0.25 (msec)*	0.20 (msec)*	Default Value (msec)	
ECMma-2xxxx-xxxxx	2	2	4	2	4	√	-	-	-	1	√
ECMma-4xxxx-xxxxx	4	4	4	4	4	√	-	-	-	1	√

* Supported Ordering option
** Up to 32/64 buffers supported with ordering option
*** 64 axes with Controller Cycle Time 0.50 (msec) supported with ordering option

2.1.2 Dimensions

- Length: 246mm
- Depth: 177mm
- Height: 55mm

2.1.3 Weight

- 2kg

2.1.4 Compliance with Standards

2.1.4.1 Environment

- The operational temperature range is from 0°C to + 50°C.

2.1.4.2 EMC (Pending)

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

2.1.4.3 Electrical Safety (Pending)

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

2.1.4.4 Functional Safety (Pending)

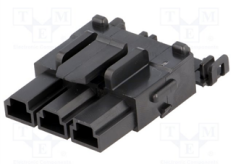
- EN61800-5-2 (defines STO)
- ISO13849 (defines PLe and CAT3)
- EN61508 (defines SIL3)

2.2 Package Contents

The ECMma package contains the following items:

- ECMma
- Control supply mating connector (J14): Phoenix MC 1,5/ 3-STF-3,81

- Drive supply mating connector (J17), P/N: Molex p/n 42816-0312



- Drive supply mating connector pins, P/N: Molex 42815-0042

> STO Connector Kit P/N: STO-ACC1 (supplied only for units ordered with STO)

2.3 Optional Accessories

2.3.1 Ethernet Cables

ACS offers the following Ethernet CAT5 cables:

Table 2-7. Ethernet Cables

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

2.3.2 Mating Connector Kits

P/N: XDMma-ACC1 Mating Connector Kit

Table 2-8. Connectors and Mating Connectors

Connector	Description	Manufacturer	P/N	Qty
J10-ENCODER0 J11-ENCODER1 J12-ENCODER2 J13-ENCODER3	HOOD plast+nickl 15P std EMI npb	Amphenol	G17Z15014-LF	4
J8-LIMITS J9-I/O	HOOD D-Type 25P STR Metal NPB	NELTRON AMTEKHOOD	5507M-25-7-LF HOOD117-25V-L-A1 HOOD117-25VY-L	2
J8-LIMITS	CON D-type 2row 25pin Male Solde	Amphenol	G17S-2510-110-EU	1

Connector	Description	Manufacturer	P/N	Qty
J10-ENCODER0 J11-ENCODER1 J12-ENCODER2 J13-ENCODER3	D-TYPE CUP 26P HI-DNSTY ML NPB	Amphenol NELTRON AMTEK McMurdoH	G17TH-2610122EU 5508-26P-01-F1 HDBS-M26SBNA-L DA26POL	4
J9-I/O	D-TYPE CUP 44P HI-DNSTY ML NPB	NELTRON McMurdo WCON	5508-44P-02-F1 HDA44POL 6210-44MNS0B01	1
J15-MOTOR0 J16-MOTOR1 J17-MOTOR2 J19-MOTOR3	MSTB 2,5 HC/ 4- STF-5,08 BK	PHOENIX	MSTB 2,5 HC/ 4-STF-5,08 BK	4

2.3.3 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 2-9. STO Cable Pinout

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

	Name	Description
4	STO2+	STO input 2 non inverted input
5	STO2-	STO input 2 inverted input

2.3.4 SPI Breakout Cable

P/N: SPI-ACC1

Description: 10 meter cable with SPI mating connector on one end, connecting to J4. The other end has flying leads for connection to user equipment.

Figure 2-2. SPI Breakout Cable

Table 2-10. 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-

2.3.5 RS232 Adapter Cable

P/N: RS232-ACC1

Description: Cable with RS232 mating RJ11 connector on one end and male D-Sub connector on the other.

Figure 2-3. RS232 Adapter

Table 2-11. RS232 Adapter Pinout

	Name	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal
3	TX232	RS-232 transmit signal
4	NC	Not connected.
5	DGND	Digital ground.
6	NC	Not connected.
7	NC	Not connected.
8	NC	Not connected.
9	NC	Not connected.

2.3.6 Ordering Part Number

The ordering part number (P/N) contains several characters (see example in Figure 2-4) that each specify a configuration characteristic ordered for the ECMma module, as described in Table 2-12.

Figure 2-4. Label with Ordered P/N - Example

Table 2-12. Configuration as Indicated by P/N

2.4 Ordering Options

	Field	Example selection by user	Optional Values
Number of Axes	1	4	2,4
Current Rating (Amps peak of sine)	2	B	A = (Reserved) B = All axes 5/10A up to 150Vdc C = All axes 10/20A up to 150Vdc D = All axes 15/30A up to 100Vdc
Number of 500 kHz SinCos Encoders[1]	3	1	0,1,2,3,4
Number of Absolute Encoders Channels[1]	4	1	0,1,2,3,4
Functional Safety	5	T	N=None, T=STO & SS1
Autofocus	6	N	N = No A = Autofocus
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] Multi-Channel feedback requires both a digital (incremental or absolute) and an analog feedback device.

Example: ECMma-1C11T-NNNNN

Description: 10/20A, 1 channel 500kHz SinCos, 1 channel absolute encoder, STO & SS1

Field		1	2	3	4	5	6	7	8	9	10
PN	**ECMMA**	1	C	1	1	T	N	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 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.
  - Up to 40°C without forced cooling
  - Up to 50°C with forced cooling 24 CFM in direction from the power connections to the communication connectors

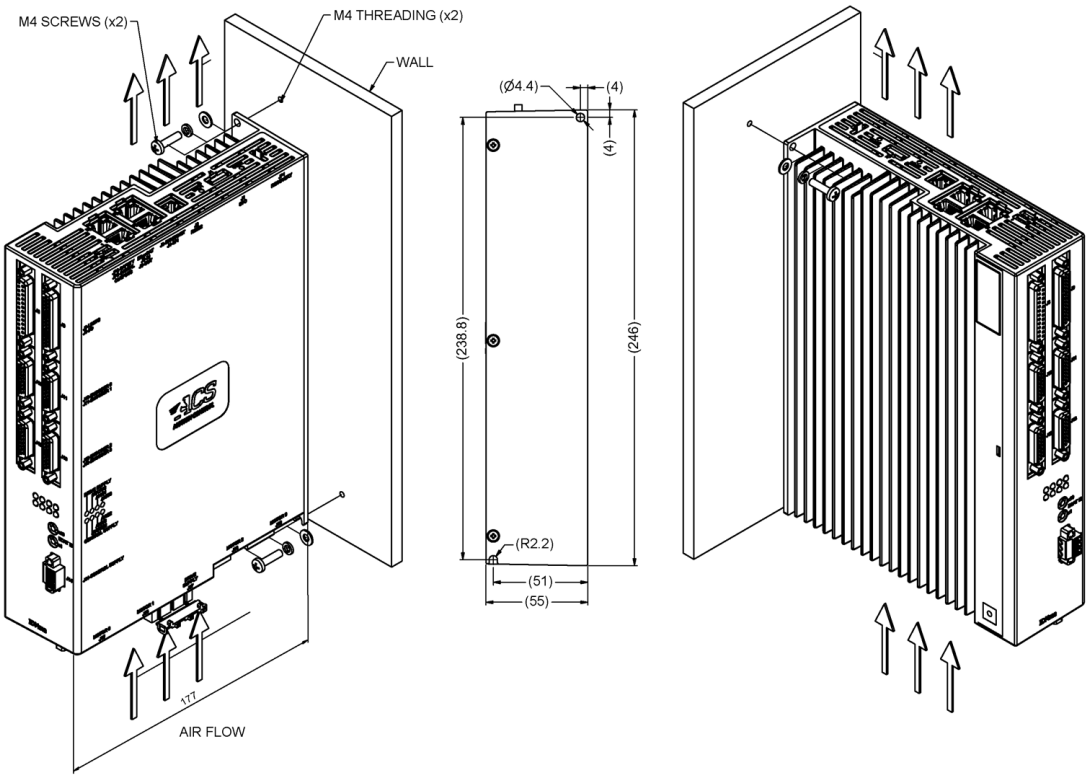


Figure 3-1. Airflow and Mounting

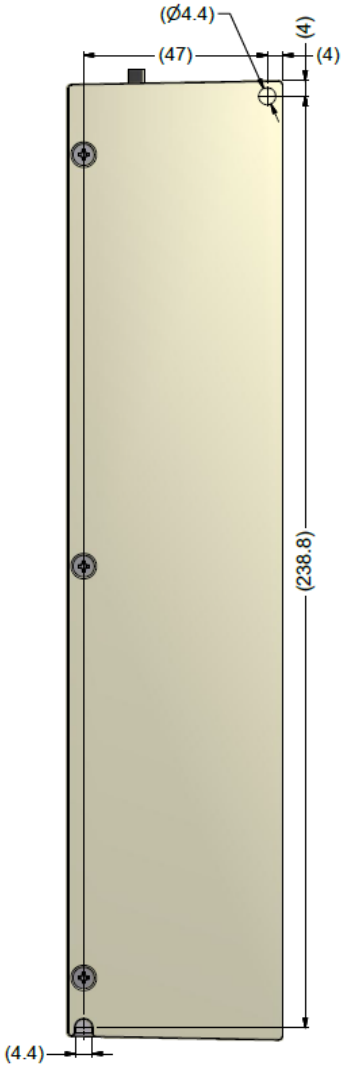


Figure 3-2. Dimensions - Rear (Mounting Side) View

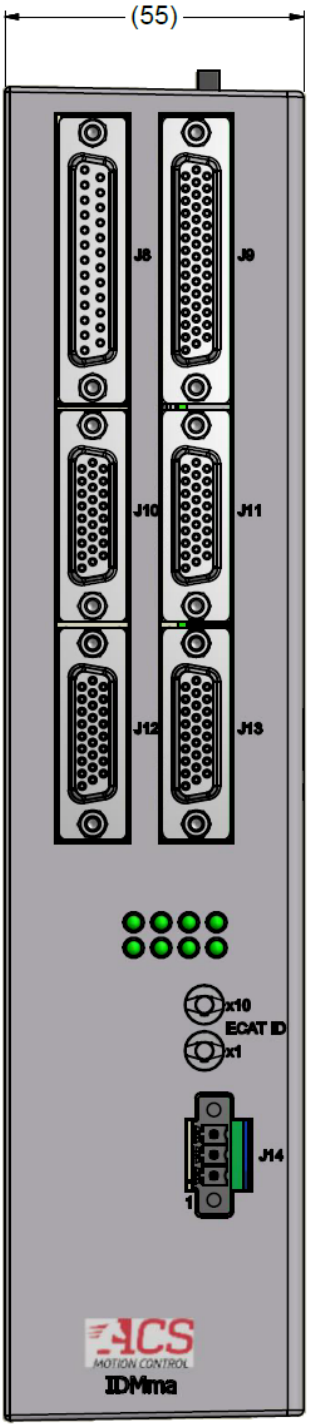


Figure 3-3. Dimensions - Front View

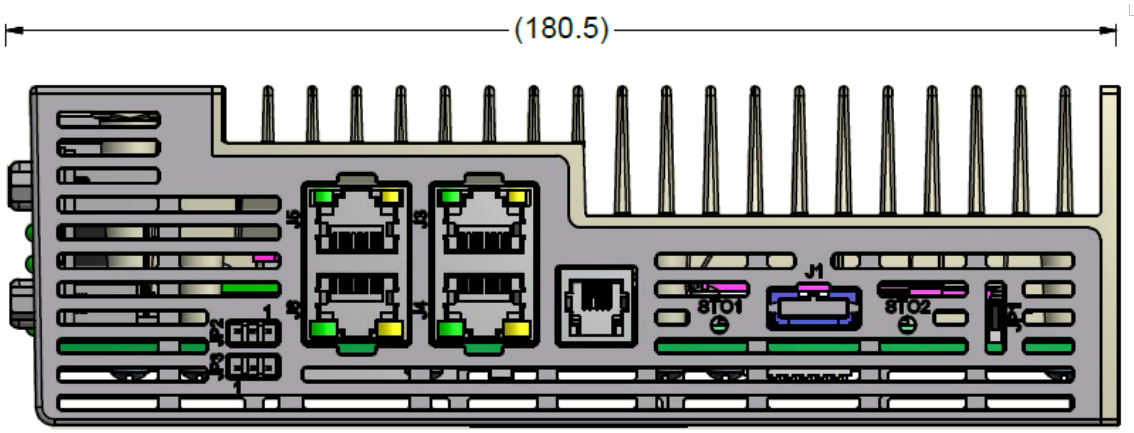


Figure 3-4. Dimensions - Side (Communications et. al. Connectors) View

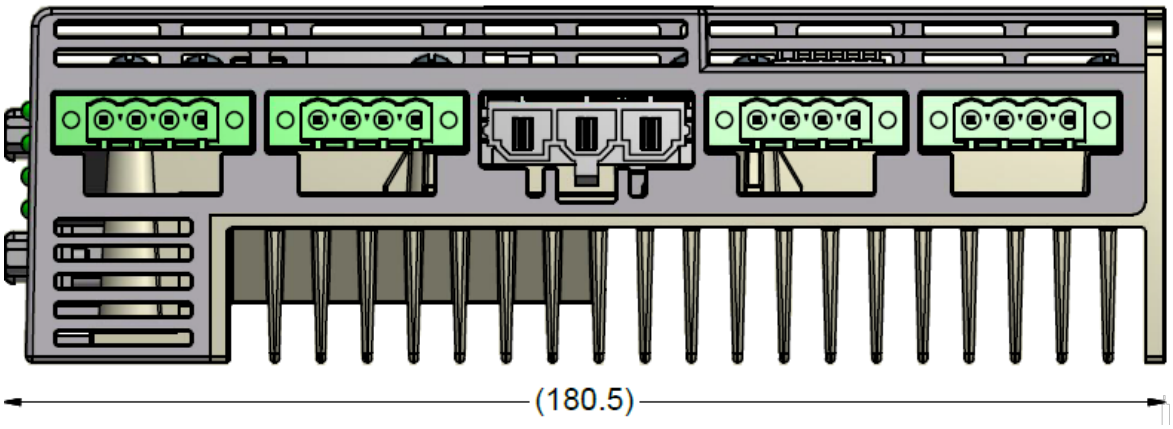


Figure 3-5. Dimensions - Side (Supply Connectors) View

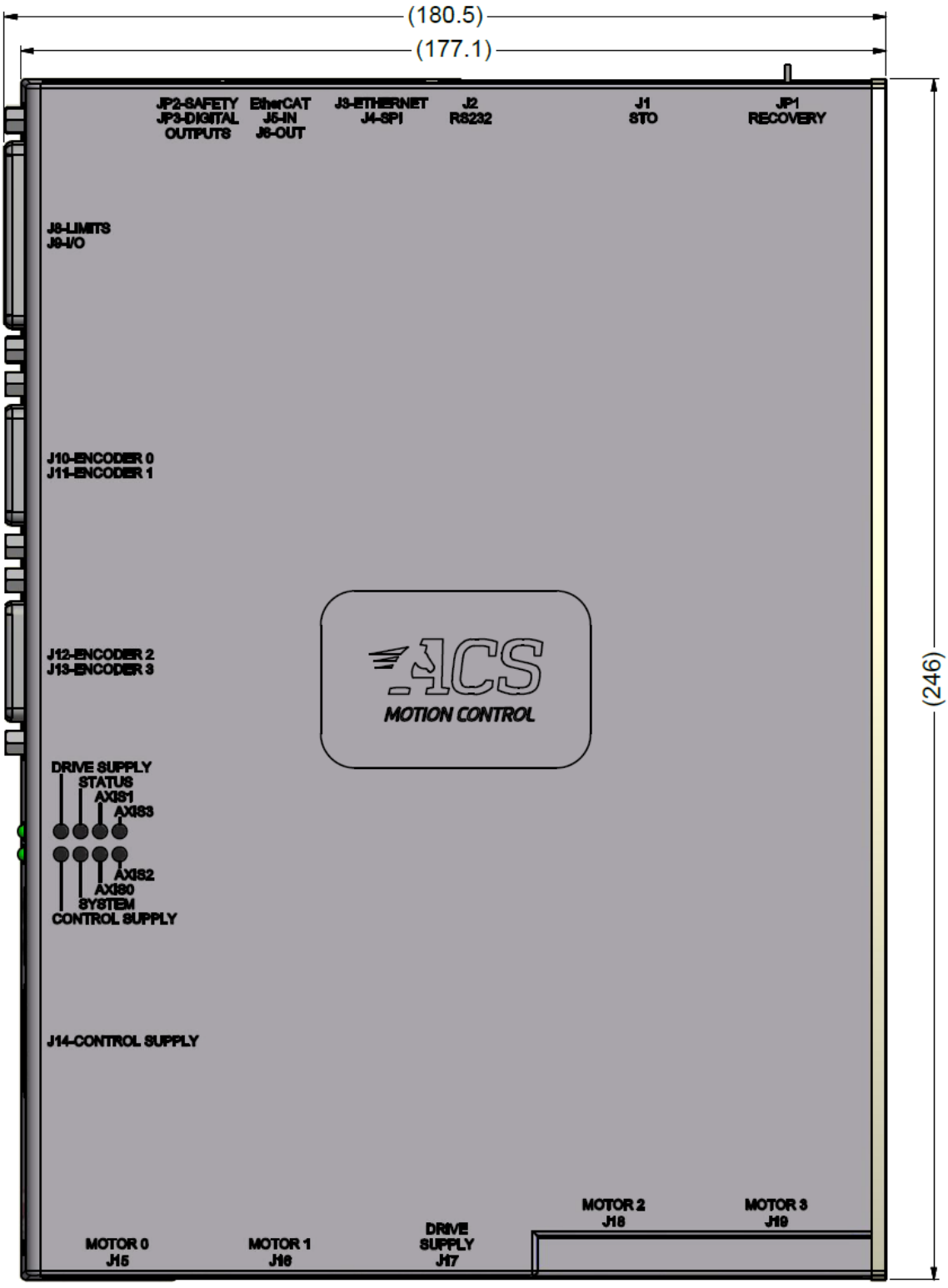


Figure 3-6. Dimensions - Top View

4. Connections

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

Connector assignment	Connector name	Mating connector
J1	STO	JST 5 PIN 2mm female PAP-05V-S Pin type: SPHD-001T-P0.5
J2	RS232	RJ11 Plug
J3	Ethernet	RJ45 plug 8 positions 8 contacts
J4	SPI	RJ45 plug 8 positions 8 contacts
J5		Not in Use
J6		Not in Use
J8	LIMITS	D-type 25 pin male
J9	I/O	D-type 44 pin high density male
J10	Encoder0	D-type 26 pin high density male
J11	Encoder1	D-type 26 pin high density male
J12	Encoder2	D-type 26 pin high density male
J13	Encoder3	D-type 26 pin high density male
J14	Control supply	Phoenix MC 1,5/ 3-STF-3,81
J15	MOTOR0	MSTB 2,5 HC/ 4-STF-5,08
J16	MOTOR1	MSTB 2,5 HC/ 4-STF-5,08
J17	DRIVE SUPPLY	3 pin socket Molex p/n 42816-0312 Pin: Molex p/n 42815-0042 Tool: Molex p/n 63811-3800
J18	MOTOR2	MSTB 2,5 HC/ 4-STF-5,08
J19	MOTOR3	MSTB 2,5 HC/ 4-STF-5,08

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 .

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.

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 ECMma while the power source is on.

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

J15 - J19 contain hazardous voltages above 150V 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 ECMma.
- 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 4-1. Wiring Guidelines

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

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

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

If the cable from the user's 150v drive supply to the ECMma is more than 1 meter, a capacitor of 4400µF (typically) should be added. It should be as close as possible to the drive supply connector.

Figure 4-1. Device Grounding Screw

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

4.2 Connectors

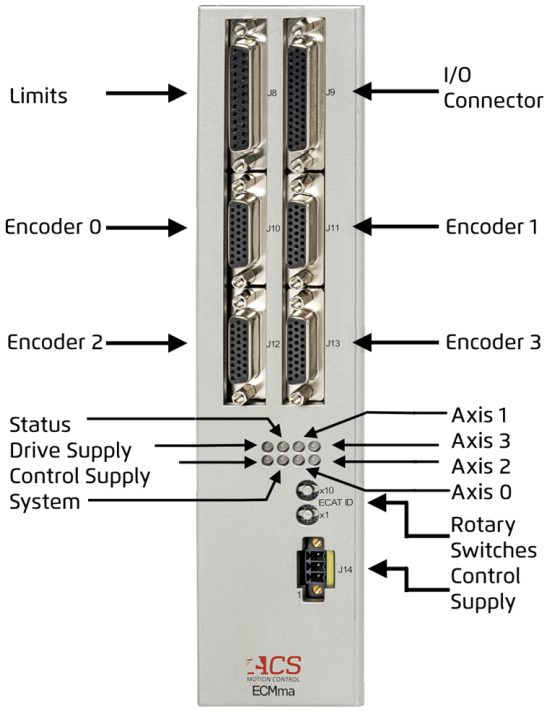


Figure 4-2. ECMma Front Panel Connectors

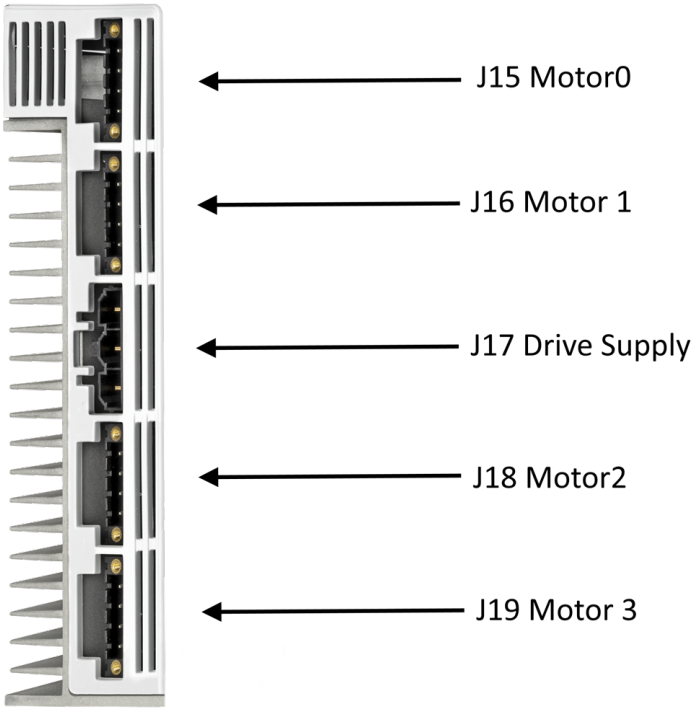


Figure 4-3. ECMma Drive and Motor Connectors

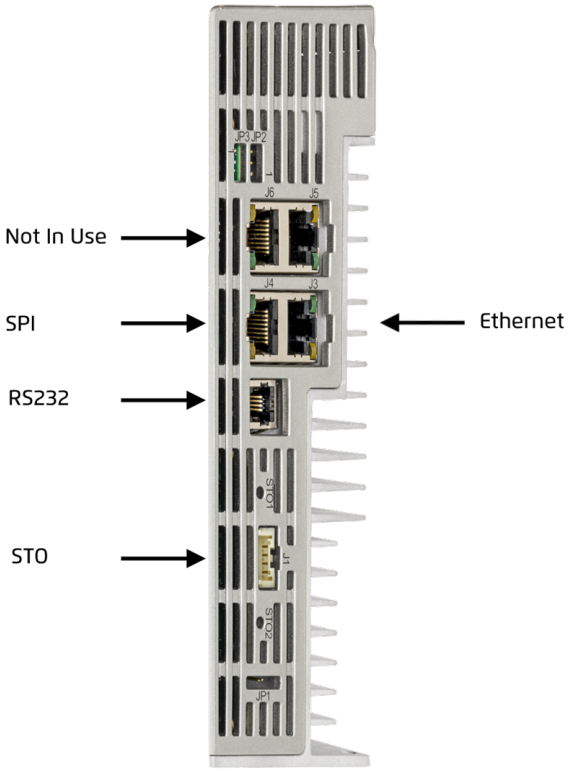


Figure 4-4. ECMma Communication Device Connectors

4.3 Jumpers

Table 4-2. 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

4.4 LED Indicators

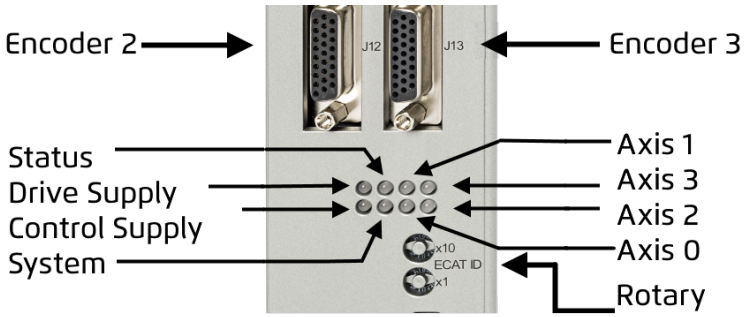


Figure 4-5. LED Indicators

Table 4-3. LED Indicators

Designator	Description	Note
Control supply	Green > Off- Logic supply not connected > On- power supply OK	
Ethernet Link/Activity	Yellow > Off- No link (no connection) > Blinking -Link and activity > On -Link without activity	Located on the Ethernet RJ45 connector. Right LED.
Ethernet Speed	Green > 100Mbit Yellow > 1000Mbit	Located on the Ethernet RJ45 connector. Left LED.
System	Bicolor > Red – System Fault > Green – System Ok > Blinking Green– Software command	

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

4.5 Communication Connectors

4.5.1 Ethernet

4.5.1.1 Ethernet Description

Label: J3 Ethernet

Connectors: standard RJ45

Mating connector: Ethernet plug, Standard Ethernet CAT5e cable

Table 4-4. Ethernet Pinout

	Name	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 Ethernet Connection Instructions

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

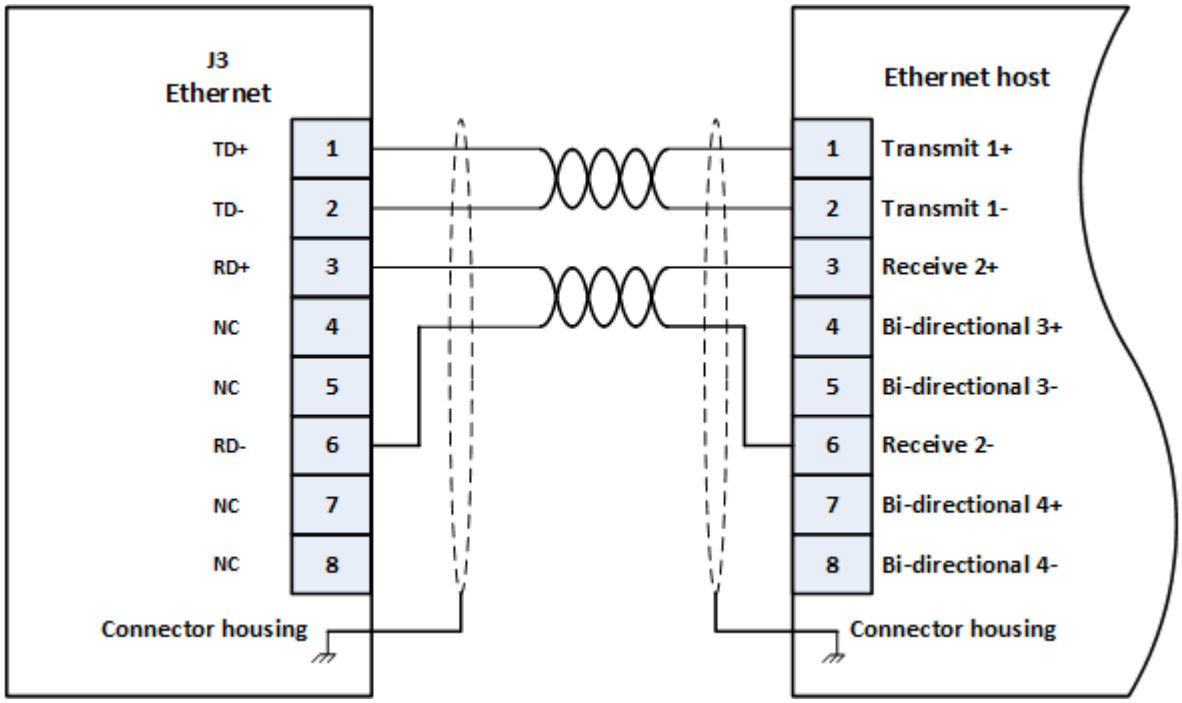


Figure 4-6. Ethernet connection to Ethernet host

4.5.2 SPI

4.5.2.1 SPI Description

Label: J12

Connector: RJ45 socket

Figure 4-7. RJ45 Cable

4.5.2.2 SPI Connection Pinout

Table 4-5. 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*.

4.5.3 RS232

4.5.3.1 RS232 Description

This port allows for RS232 Communication and for recovery.

Label: J14

Mating Connector: RJ11

Table 4-6. RS232 Connector Pinout

Pin	Signal	Description
1	RX232	RS-232 receive signal
2	TX232	RS-232 transmit signal
3	GND	Digital ground.
4	SHIELD	Cable shield connection

4.6 Power Supply Connectors

The unit is fed by two power supplies:

- Drive Supply: 24 to 150Vdc (J17)
- Control Supply: 24Vdc (J14)

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

An external isolated 24Vdc to 150Vdc power supply (not included with the unit) feeds the drives and the motors.

The drive supply must be connected to the unit via a fuse. The fuse rating should be calculated according to the total input current of the unit. The fuse type should be UL approved type ONLN0xx.T; the user should calculate the current and set the fuse type and rating.

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.

4.6.1.1 Drive Supply Guidelines

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

The ECMma does not include a regeneration circuit. You must ensure that the DC drive supply voltage never exceeds 170 VDC for 150V versions, and 115VDC for 100V versions. 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 150V power supply is the CSP-3000-250 from Mean Well.

4.6.1.2 Drive Supply Description

Label: J17 DRIVE SUPPLY

Mating type: 3 pin socket Molex p/n 42816-0312

Pin P/N: Molex p/n 42815-0042

Figure 4-8. J17 - Drive Supply Mating Connector

Table 4-7. J17 - Drive Supply Connector Pinout

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

Figure 4-9 indicates the positions of the drive supply pins, among others.

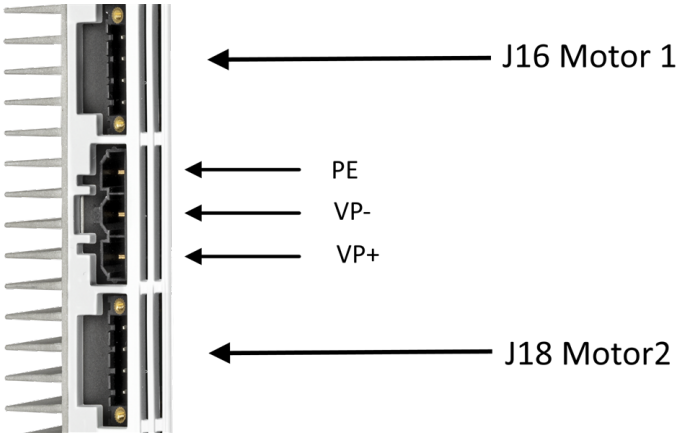


Figure 4-9. Connector Pins Diagram

4.6.1.3 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 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.

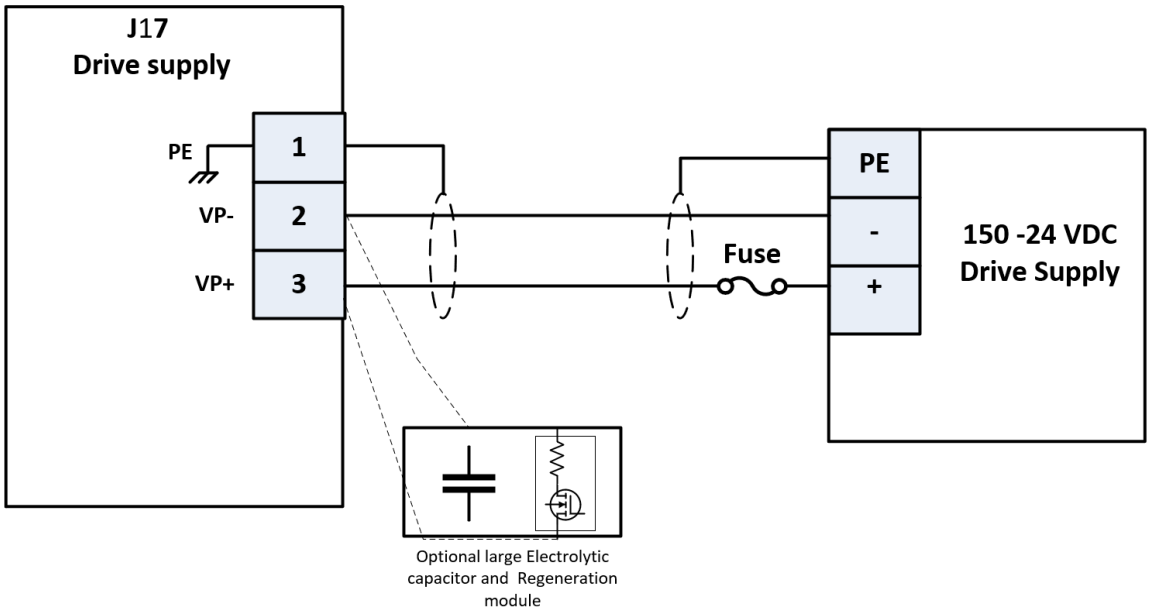


Figure 4-10. Drive Supply Connection Diagram

User should measure the ripple right next to the drive supply connector and verify that the voltage ripple is not more than 1V during motion. If the ripple is higher, external capacitors should be added close to the drive to reduce the ripple.

4.6.2 Control Supply

An external 24Vdc 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 24V control supply must be connected to the unit via a 3A 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 Supply Description

Label: J14 24V CONTROL SUPPLY

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

J14 - Control Supply Connector

Table 4-8. J14 - Control Supply Pinout

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

4.6.2.3 Control Supply Connection Instructions

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

Connect a 3A fuse between the ECMma and the control supply.

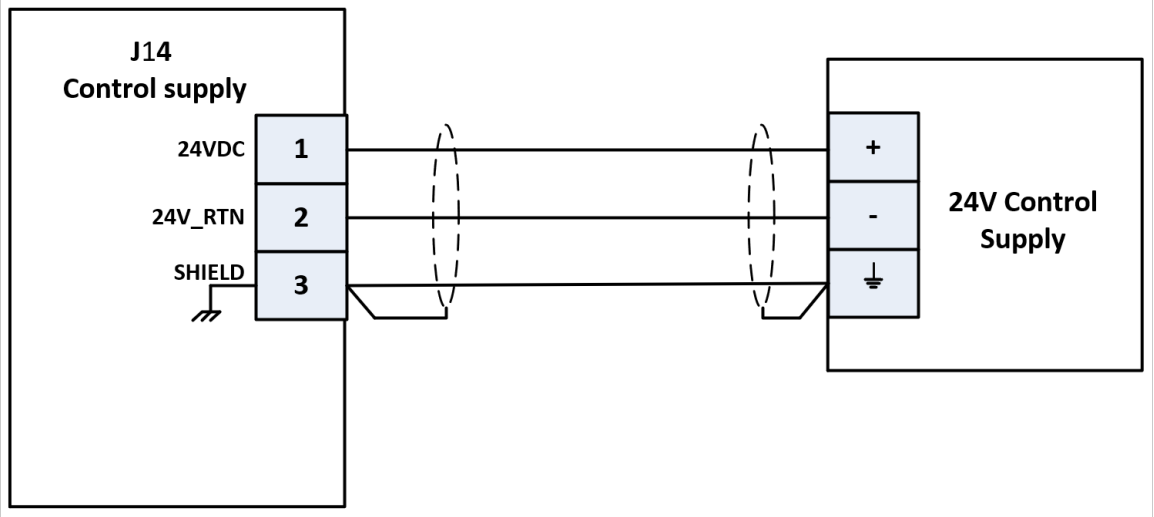


Figure 4-11. 24VDC Control Supply Connections

4.7 Motor Connectors

4.7.1 Motor Description

Connector Name	Motor
Connector Assignment	J15 for MOTOR0 J16 for MOTOR1 J18 for MOTOR2 J19 for MOTOR3
Mating type	Phoenix MSTB 2,5 HC/ 4-STF-5,08

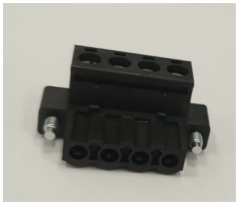


Figure 4-12. Mating Connector for Motor

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

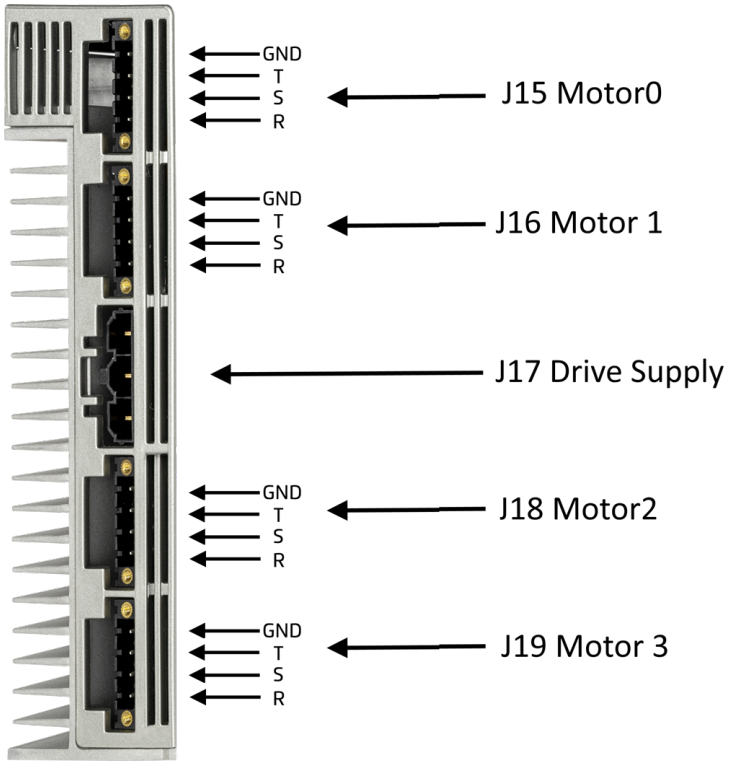


Figure 4-13. Motor Connection Pins

4.7.2 Motor Connection Instructions

1. Use a shielded cable with a minimum gauge of AWG. 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.

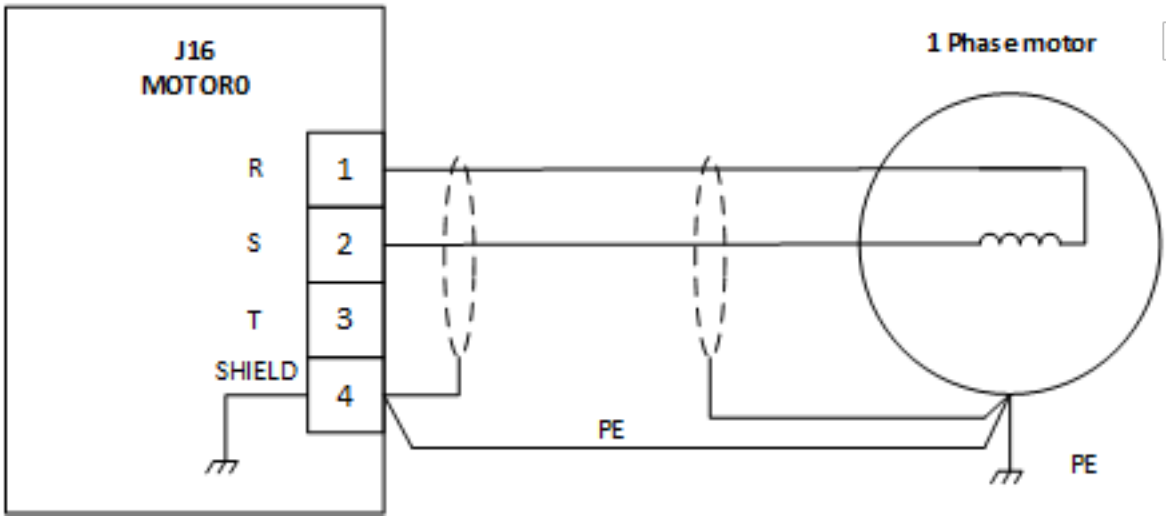


Figure 4-14. 1-Phase Motor Connection

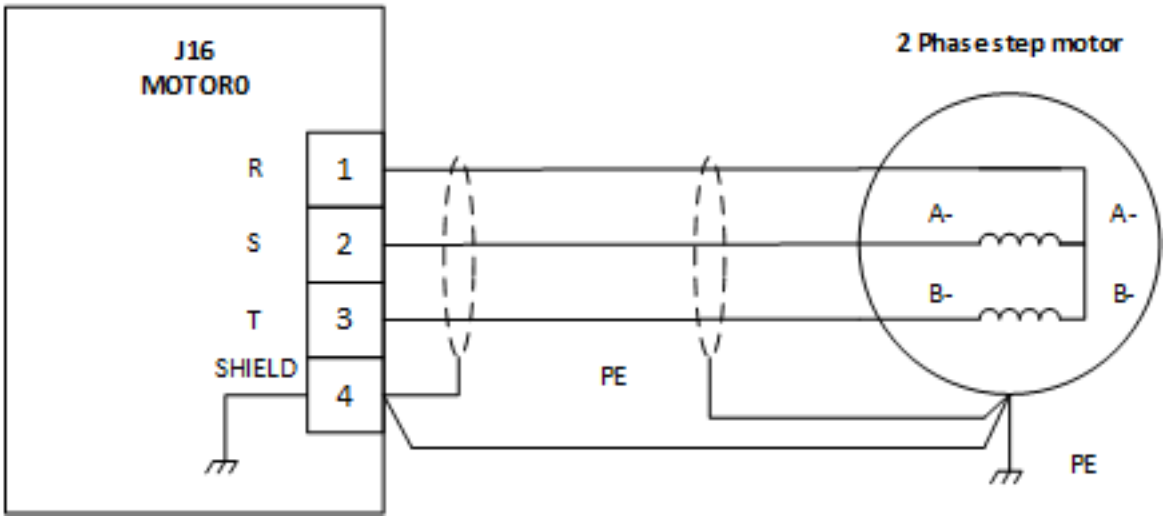


Figure 4-15. 2-Phase Motor Connection

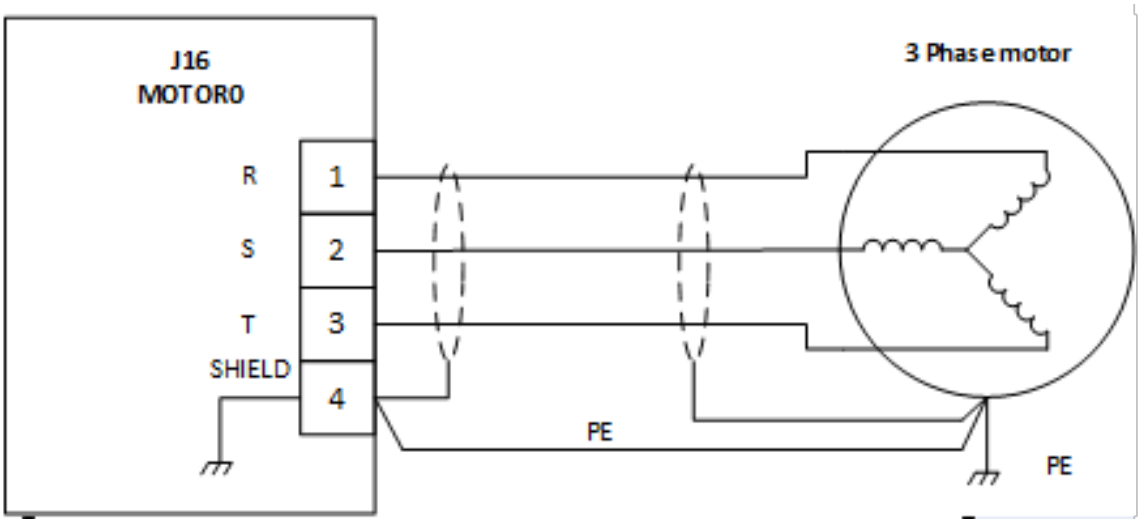


Figure 4-16. 3-Phase Motor Connection

4.8 Encoder Connectors

4.8.1 Encoder Description

Connector Name	Encoder
Connector Assignment	Encoder 0 J10 Encoder 1 J11 Encoder 2 J12 Encoder 3 J13
Mating Connector	D-type 26 pin high density male

Figure 4-17. 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
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.

	Name	Description
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
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.

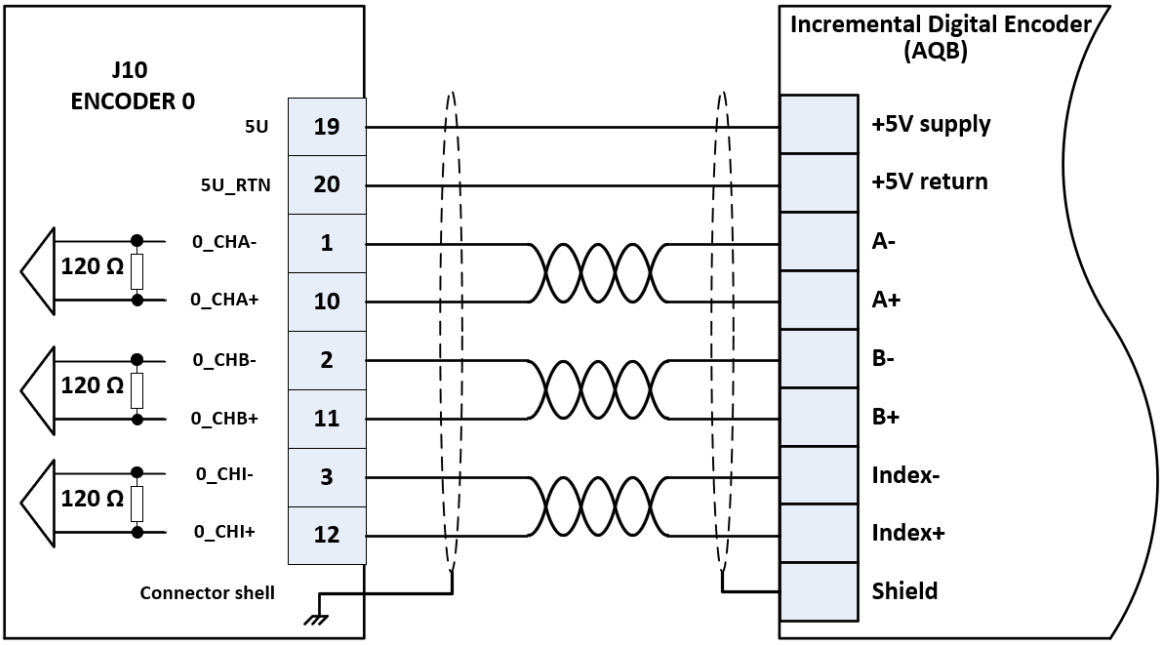


Figure 4-18. Incremental Digital Encoder (AqB) Connection

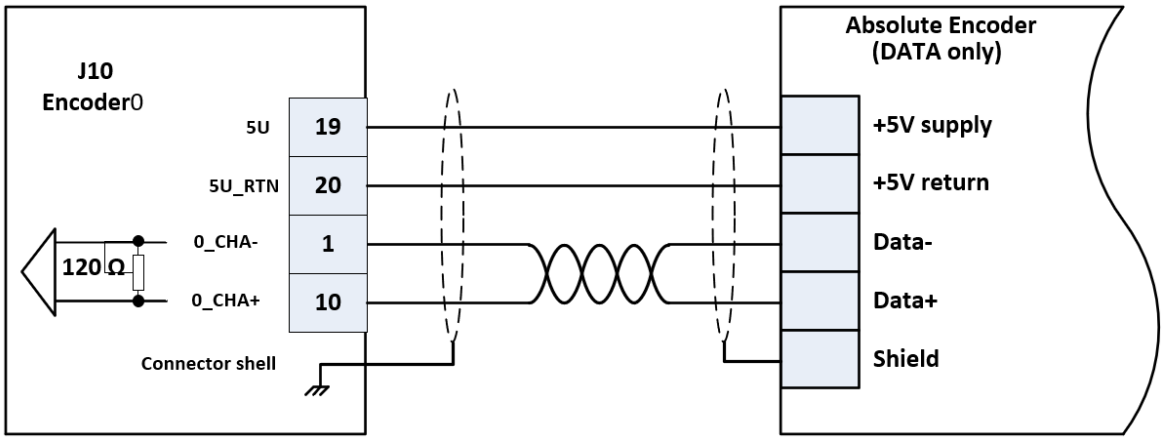


Figure 4-19. Absolute Encoder (Data Only) Connection

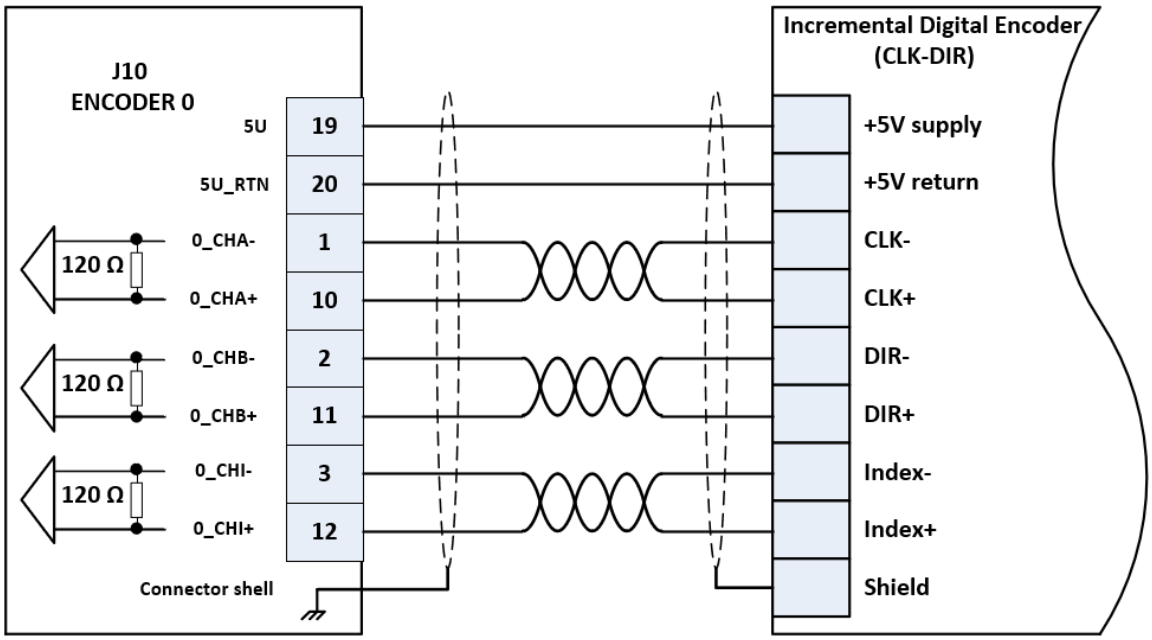


Figure 4-20. Incremental digital encoder (CLK-DIR) connection diagram

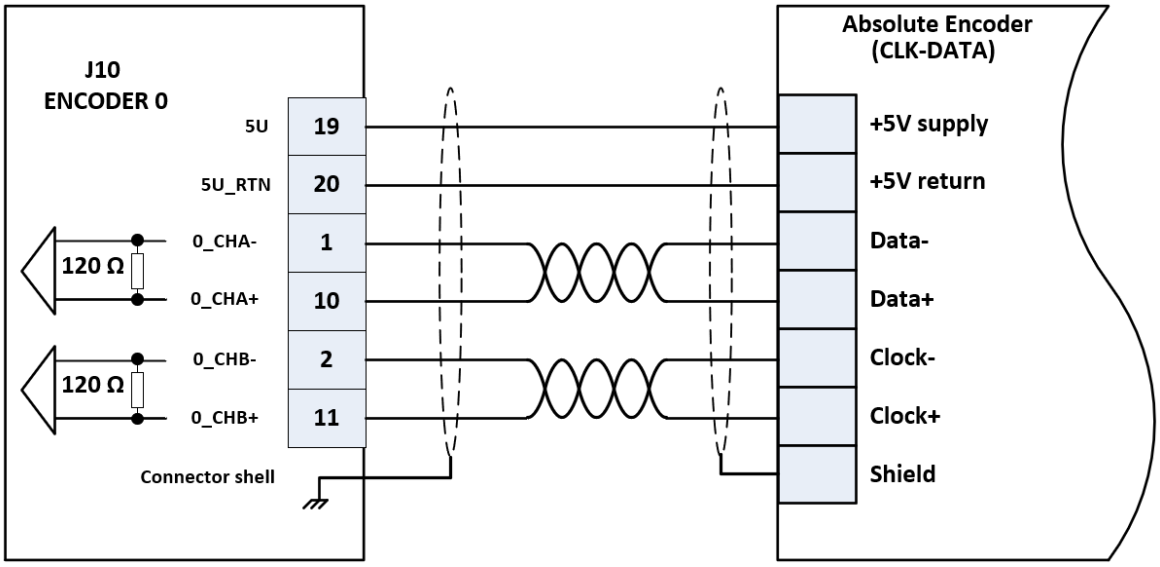


Figure 4-21. Absolute Encoder (CLK-Data) Connection Diagram

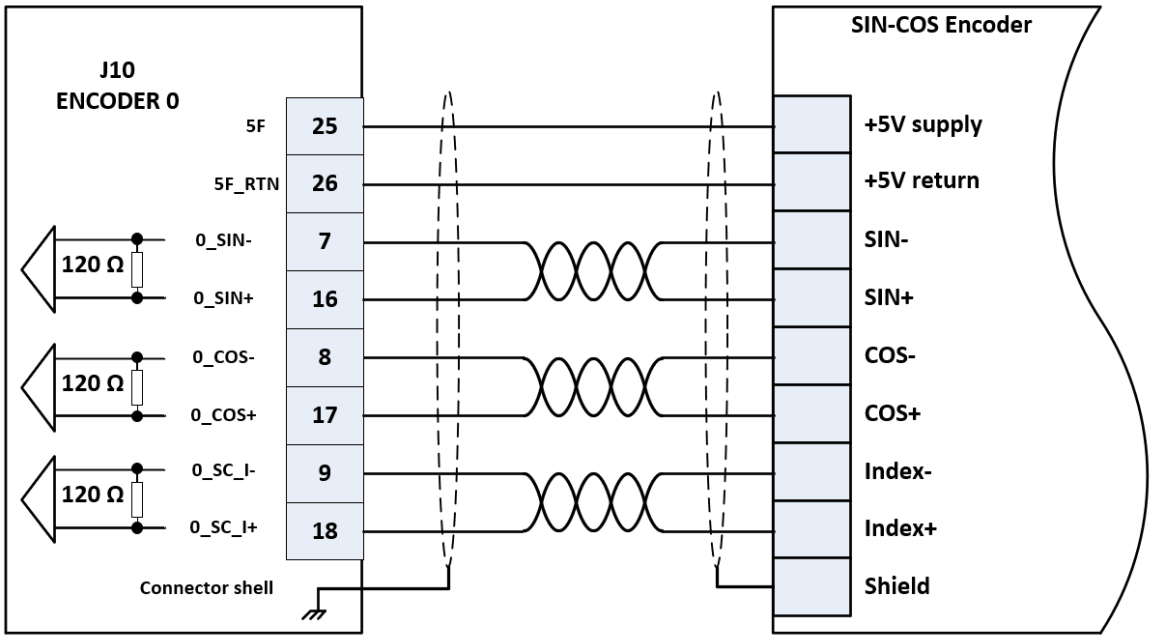


Figure 4-22. SinCos Connection Diagram

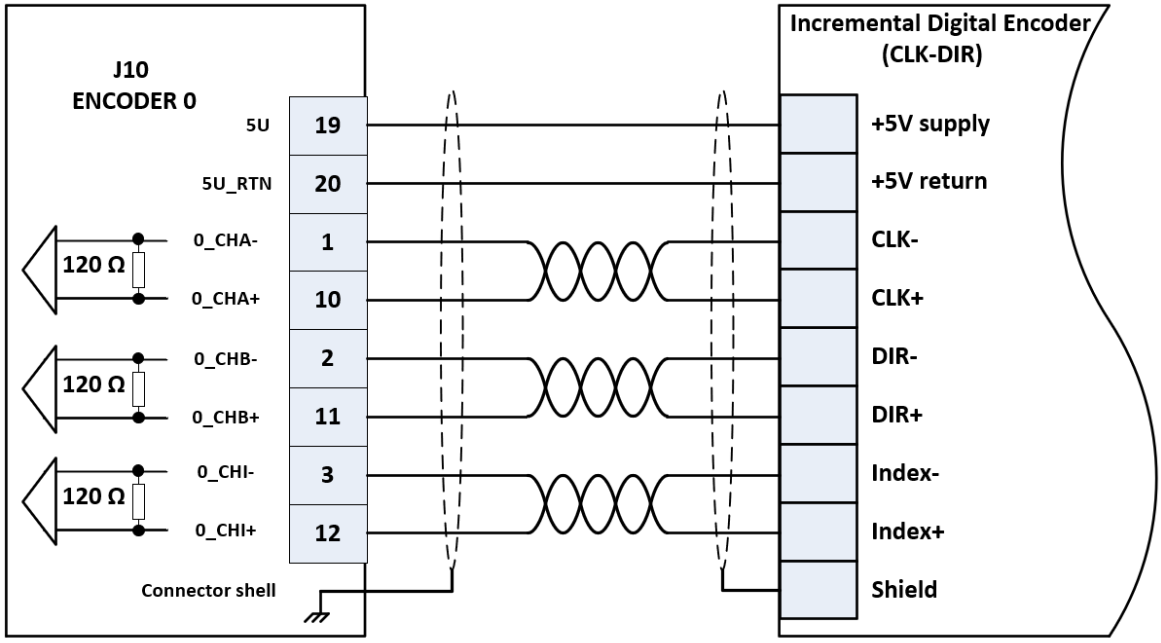


Figure 4-23. Incremental Digital Encoder (CLK-DIR) Connection

4.8.2.1 Additional Device Connections

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

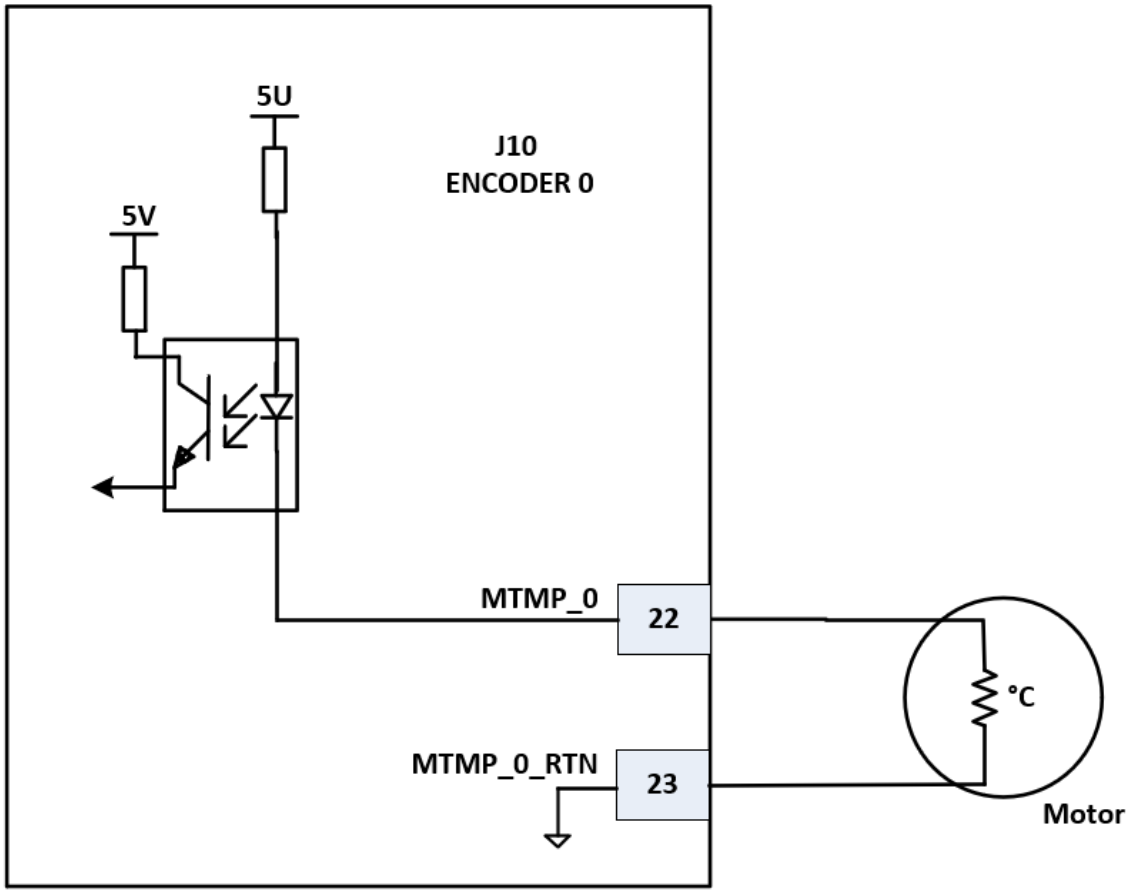


Figure 4-24. MTMP Motor Temperature Sensor Connection

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

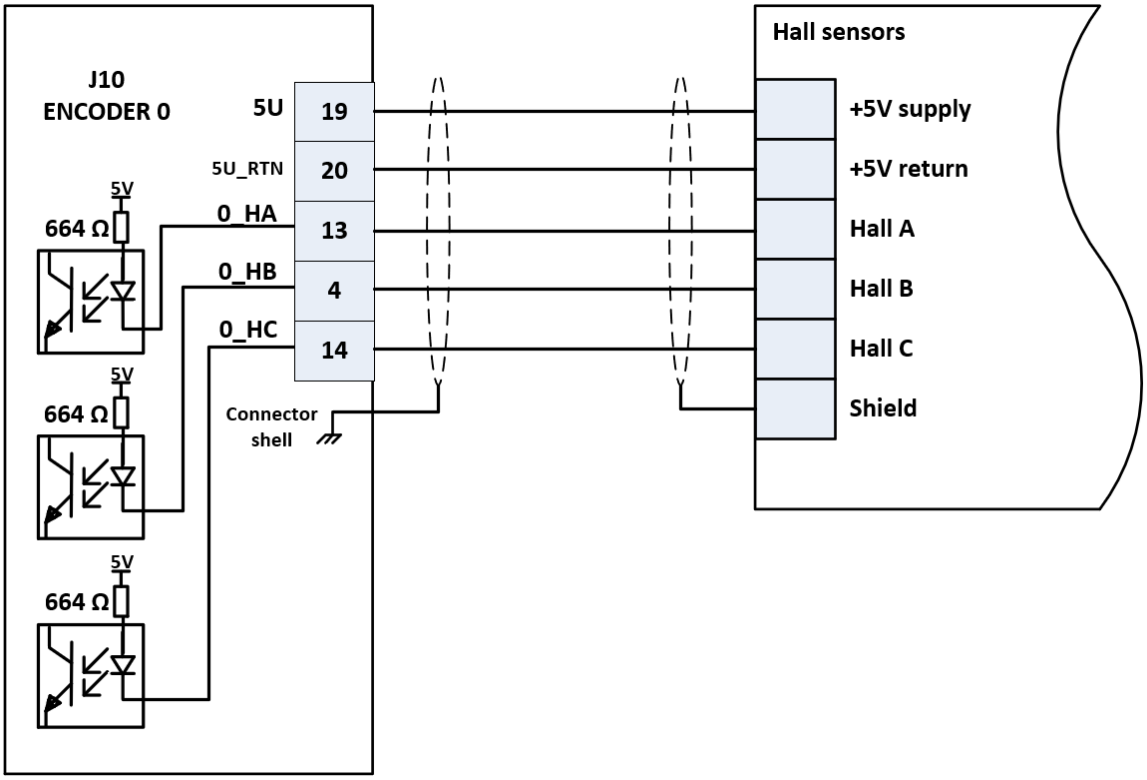


Figure 4-25. Hall Sensor Inputs Connection

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.

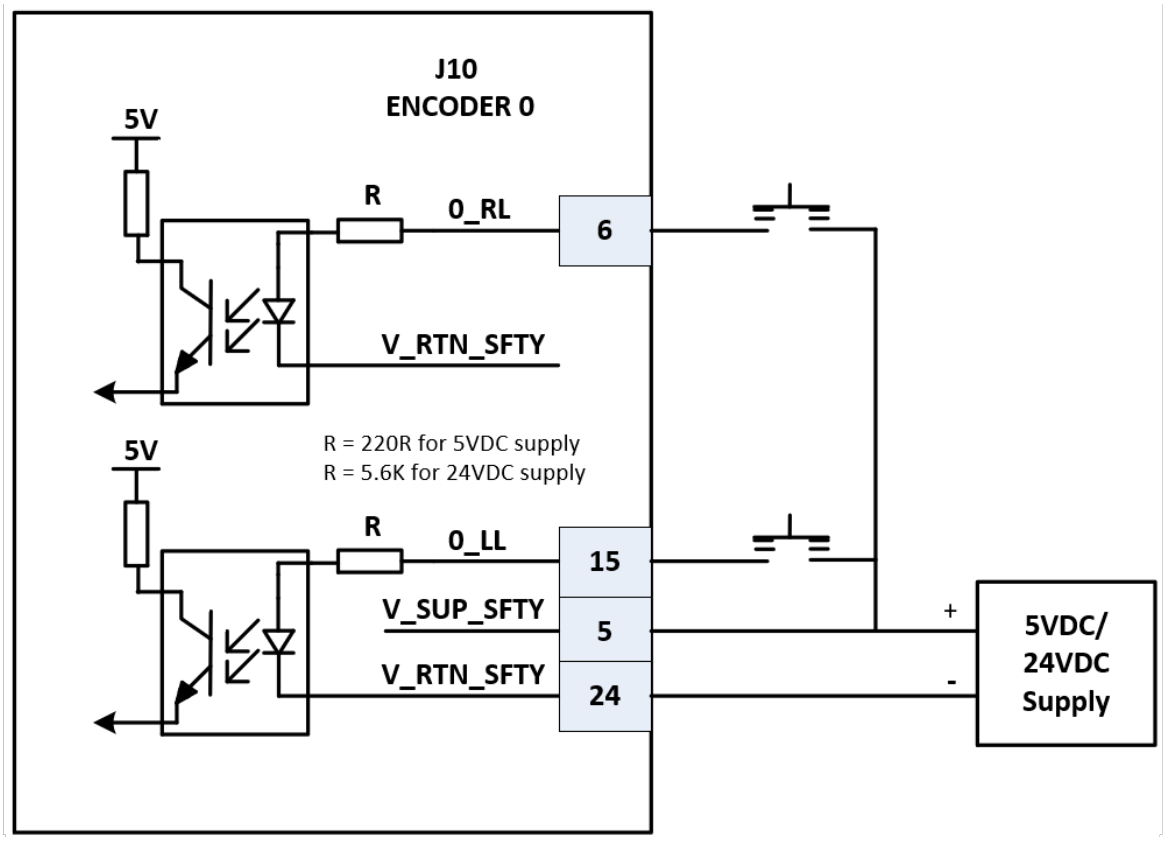


Figure 4-26. Left and Right Limit Source Connection

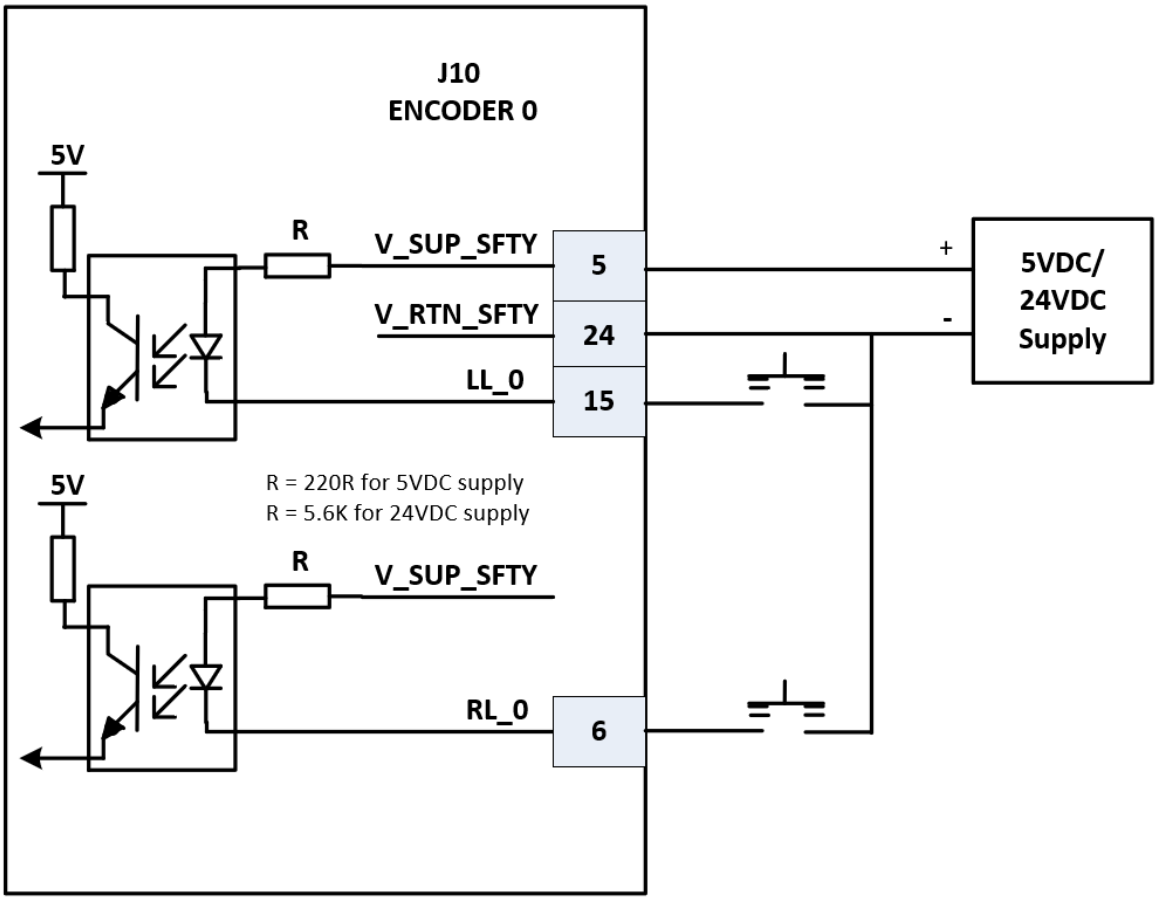


Figure 4-27. Left and Right Limit Sink Connection

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 4-28. 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	BRK1_H	Mechanical brake 1 (high power output)
11	AIN0-	GP Analog input 0 inverted input
12	AIN1-	GP Analog input 1 inverted input
13	AIN2-	GP Analog input 2 inverted input

	Name	Description
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	BRK3	Mechanical brake 3 or Digital output 11
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	BRK0_H	Mechanical brake 0 (high power output)
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	BRK0	Mechanical brake 0 or Digital output 8
34	BRK1	Mechanical brake 1 or Digital output 9
35	BRK2	Mechanical brake 2 or Digital output 10
36	OUT0	Digital output 0
37	OUT1	Digital output 1

	Name	Description
38	OUT2	Digital output 2
39	OUT3	Digital output 3
40	BRK_SUP	24V Brake supply
41	BRK_RTN	24V Brake supply return
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

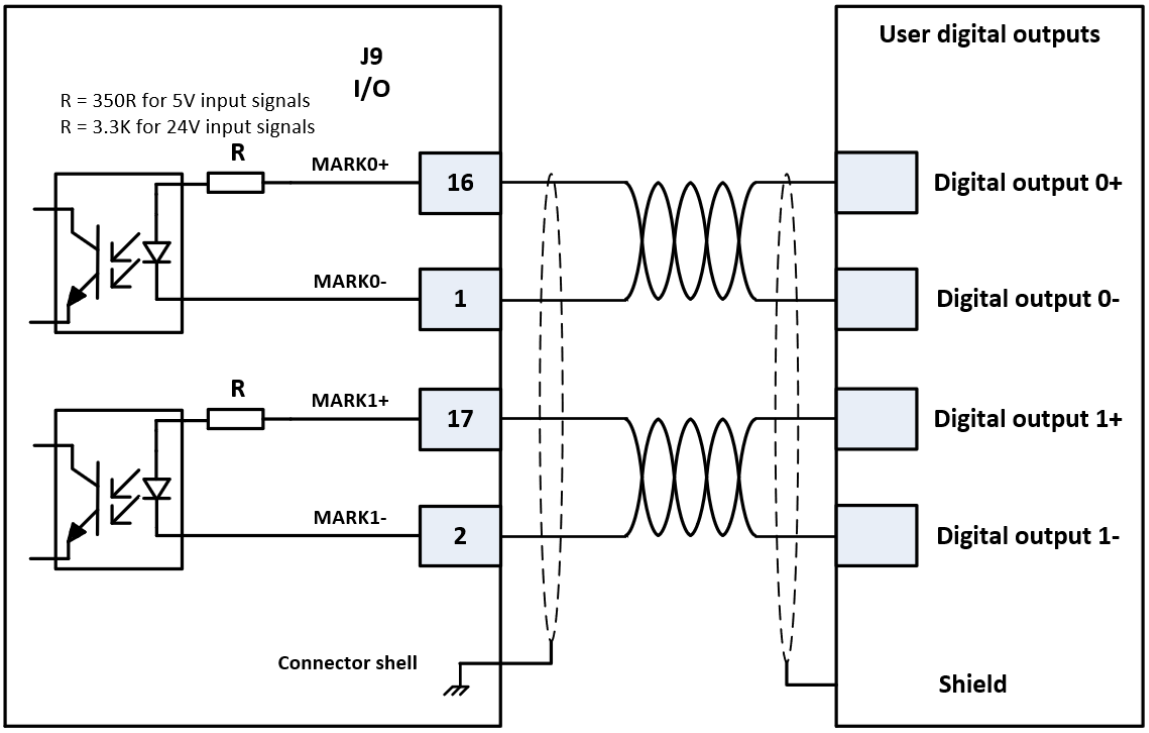


Figure 4-29. Mark inputs connection diagram, MARK0 and MARK1 for example J9 – I/O connector

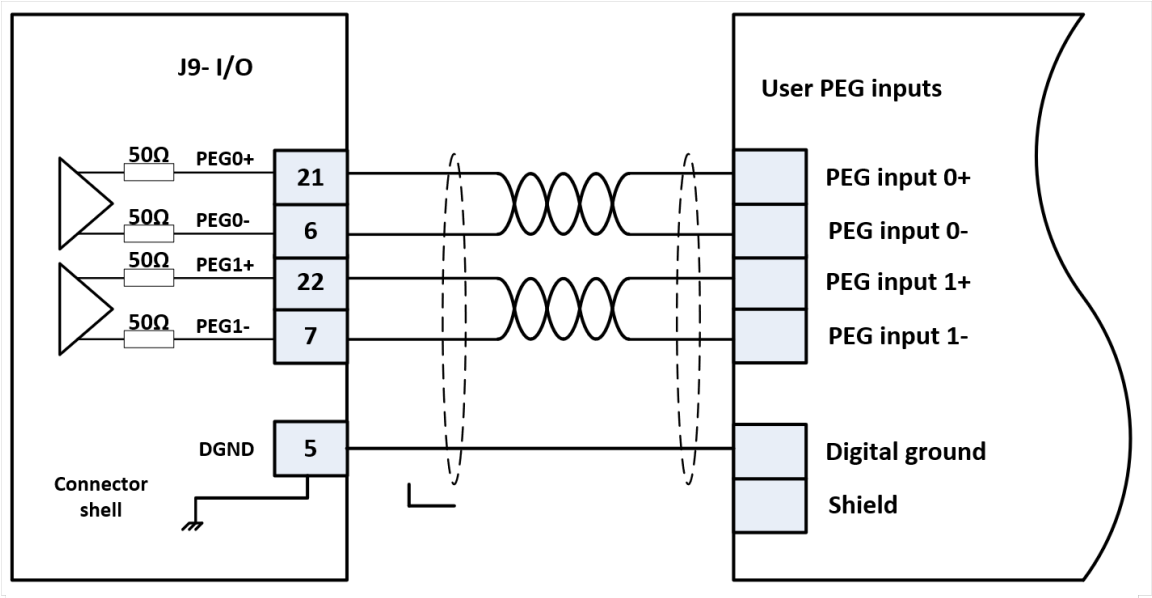


Figure 4-30. PEG Outputs Connection Diagram

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

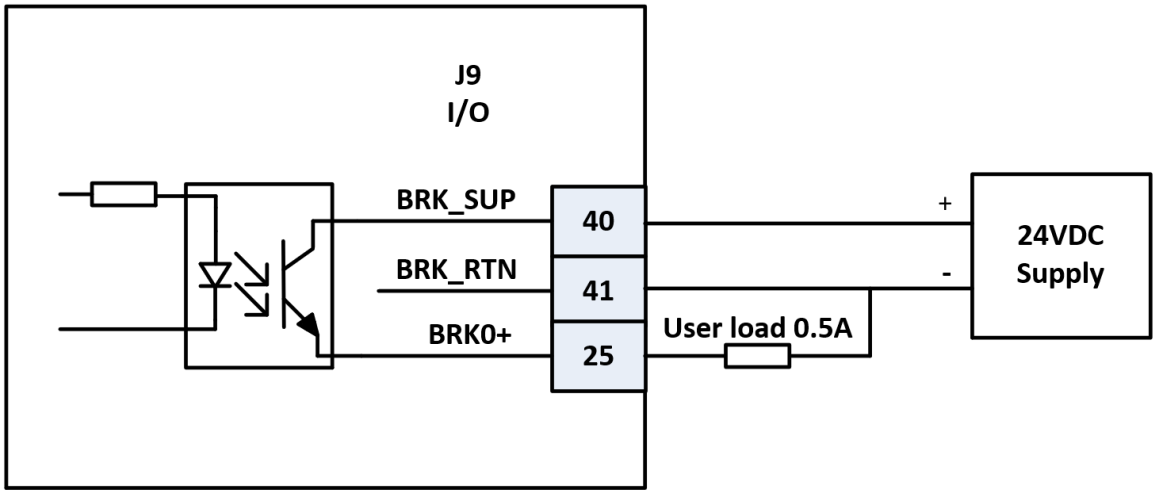


Figure 4-31. Mechanical brake connection diagram, J9 – I/O connector

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

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

The following code demonstrates configuration of OUT0-3 as a general-purpose digital output or as mechanical brake:

```
AA = 0    ! AA - axis designation (00-99)
NN = 0   ! NN - digital output index (00-99)
OO = 8   ! OO - specific output (00-99)
value = 0   ! value: 0 for GPIO, 2 for brake

loop 4
     AANNOO = AA * 10000 + NN * 100 + OO
     setconf(29, AANNOO , value )
     if value = 0 ! GPIO - brake not active
          MFLAGS(AA).#BRAKE = 0
     end
     if value = 2 ! Mechanical brake active
          MFLAGS(AA).#BRAKE = 1
     end
     AA = AA + 1;
     OO = OO + 1;
end
```

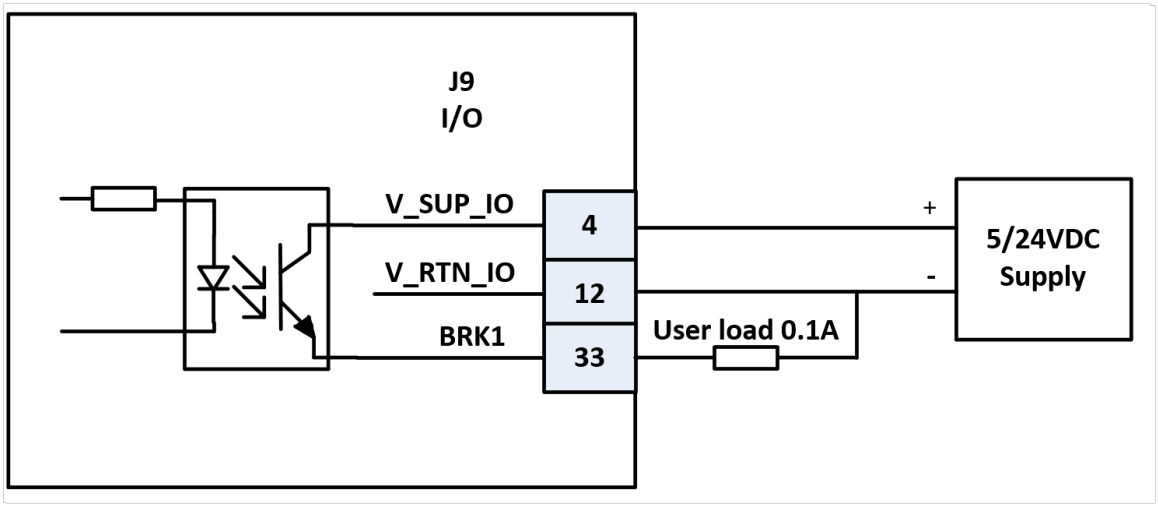


Figure 4-32. Digital outputs source connection diagram, J9 – I/O connector

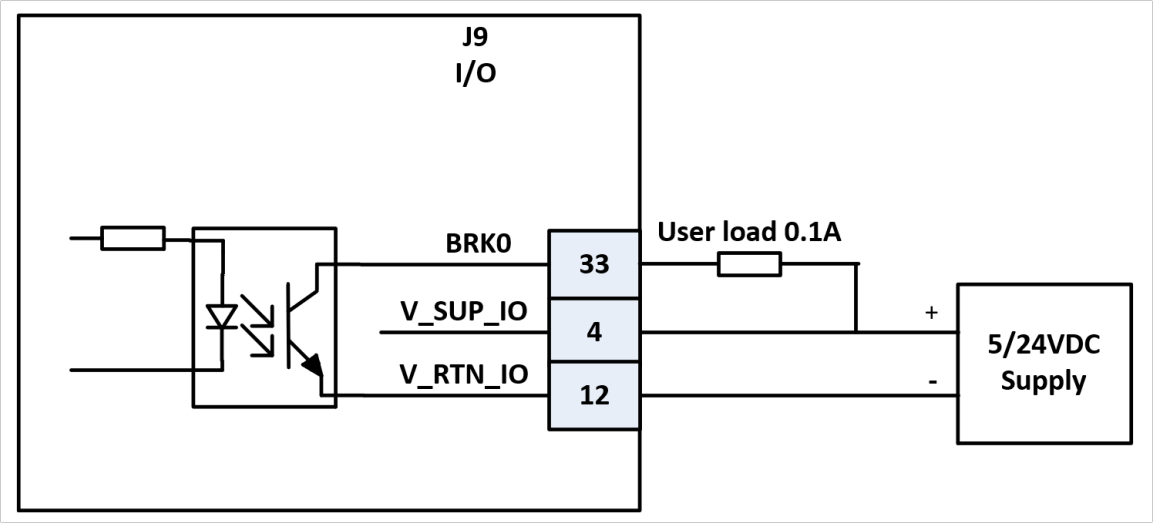


Figure 4-33. Digital outputs sink connection diagram, J9 – I/O connector

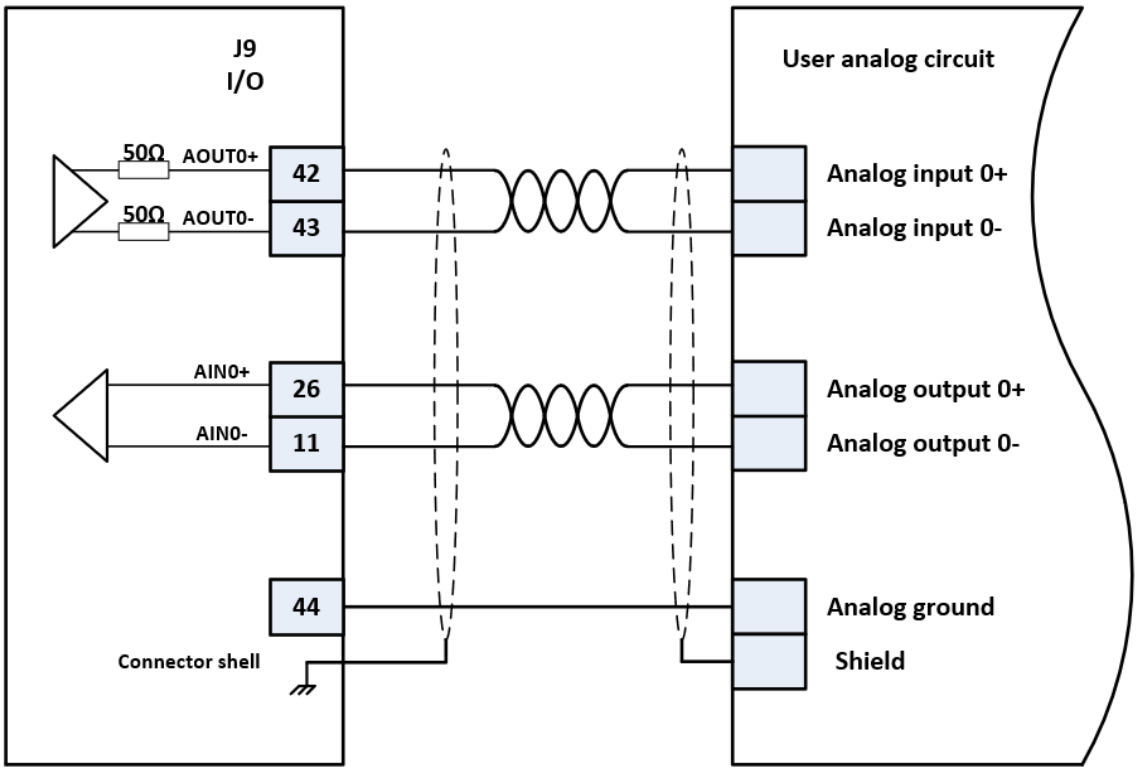


Figure 4-34. Analog GP I/O Connection Example

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 4-35. 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	SA_MODE	Internal use only
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

	Name	Description
18	3_RL	Axis 3 right limit
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.

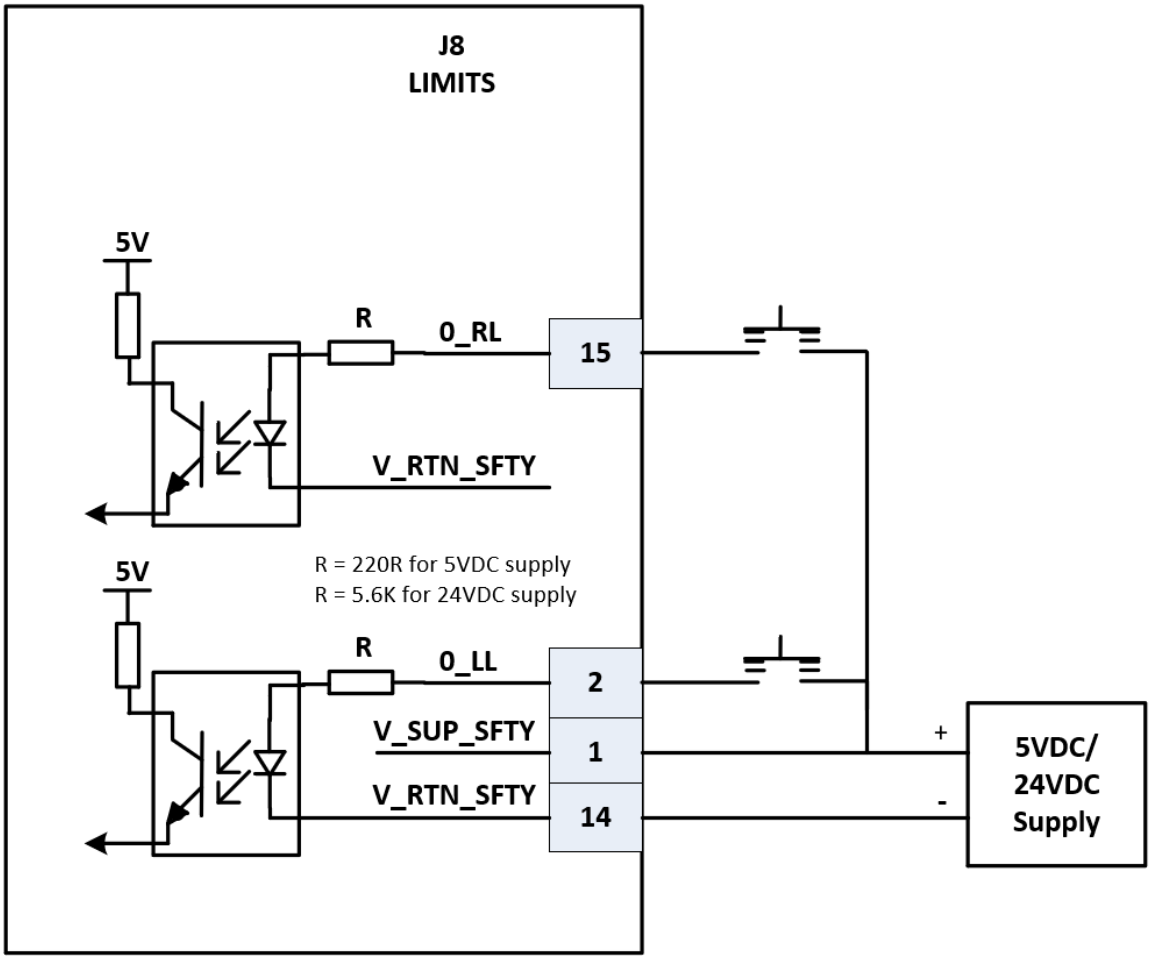


Figure 4-36. Left and Right Source Connection on Limits Connector

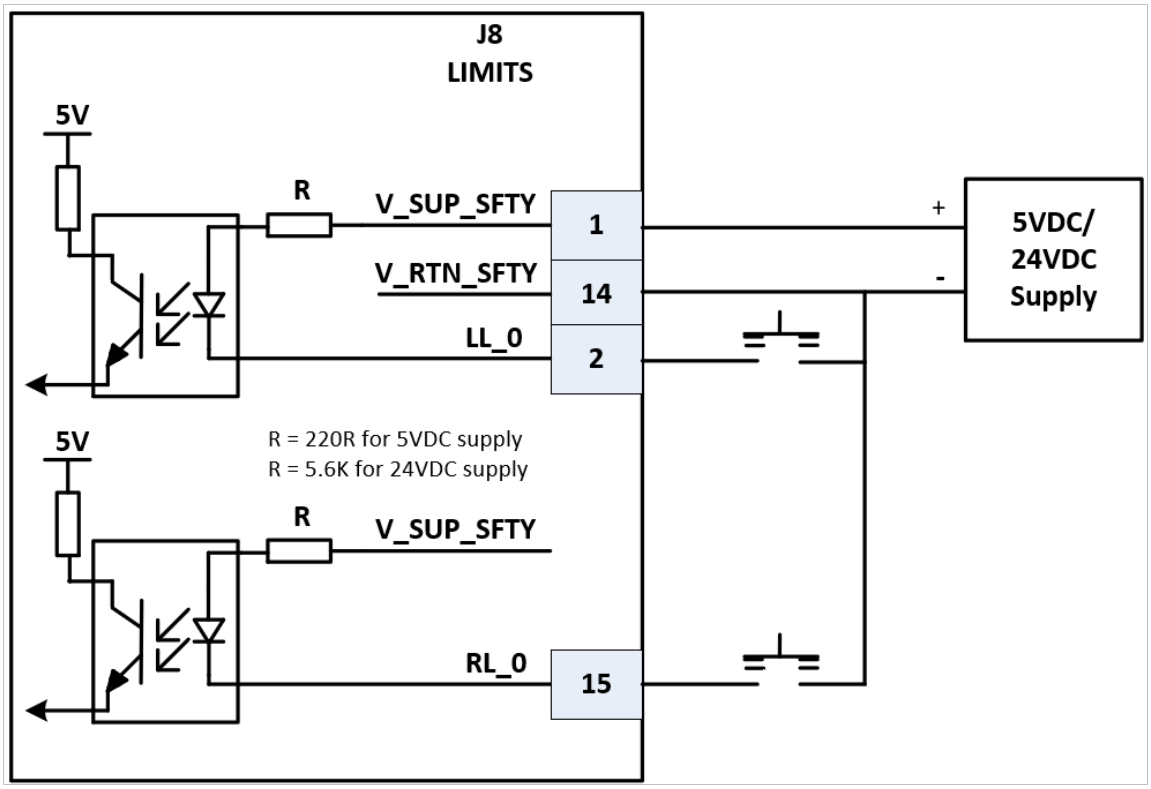


Figure 4-37. Left and Right Sink Connection on Limits Connector

4.10 Safe Torque Off (STO) Connector

4.10.1 STO Description

Label: J1 STO

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

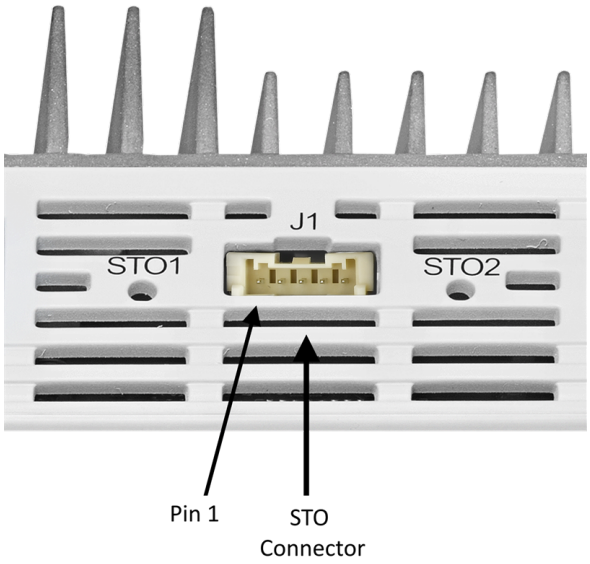


Figure 4-38. J1 - STO Connector

Figure 4-39. STO Mating Connector

Table 4-12. J1 - 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

4.10.2 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 40ms to 460ms, depending on the input supply voltage. For nominal 24V the STO input supply delay time is 110 – 230mSec. 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 *ECMma 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 50 mA per STO input, with an inrush current of less than 70 mA.

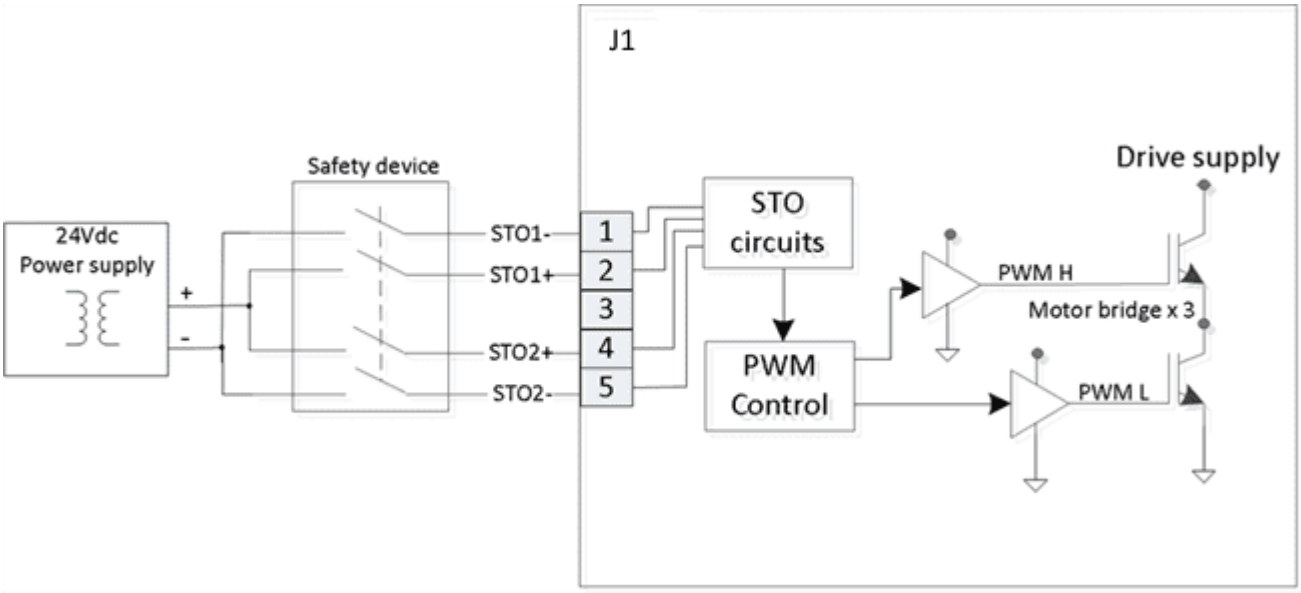


Figure 4-40. STO Connections

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
Designation	ID Chip	
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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