UDMmc

Installation Guide

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ACS MOTION CONTROL

UDMmc

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Revision History

Date	Revision	Description
December 2020	3.03	Added missing asterisk in Table 3-1
October 2020	3.02.01	More diagram corrections
September 2020	3.02	Formatting, correct limits diagrams
October 2018	1.40.40	Added motor protection
February 2018	1.40.30	Added safety notes.
January 2018	1.40.20	Added picture of product with grounding screw. Updated current input specifications for digital inputs and Registration MARK inputs
December 2017	1.40.10	Reformatted
August 2016	1.40	Updated related documents. Removed pending for UL-508C compliance.
May 2016	1.30	Added note concerning STO.
April 2016	1.20	Added UDMmc&NPXpm-ACC2 Accessory Cable. Added Pin numbers to J1 Connector diagram.

Date	Revision	Description
February 2016	1.10	Reformatted the document using new template. Added 5V Feedback supply and SSI as an Absolute encoder option. Added field column to Configuration as Indicated by P/N table. Removed configuration column in P/N Example table and removed table caption. In Mounting and Cooling section, changed the fan volumetric flow rate to 150CFM. In Safety, EMC and Wiring Guidelines section added notes about earthing, isolated power supply, and low voltage connections. In Drive Supply section added note providing the external fuse, maximum drive supply voltage, and shunt regulator specifications. In J5, J6, J8, J9 Feedback Sensor Connectors section changed the functionality of pin 13.
May 2014	1.00	Document creation

Conventions Used in this Guide

Text Formats

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

Flagged Text

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

Related Documents

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

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

Document	Description
SPiiPlus Command & Variable Reference Guide	Describes all of the variables and commands available in the ACSPL+ programming language.
SPiiPlus Setup Guide	Provides guidance on how to configure and adjust the SPiiPlus systems to work with supported types of motors and feedback devices.
SPiiPlus MMI Application Studio User Guide	Explains how to use the SPiiPlus MMI Application Studio and associated monitoring tools.
PEG and MARK Operations 2.21	Provides detailed description, specification and operation instructions for PEG capabilities
EtherCAT Network Diagnostics	An application note describing how to perform diagnostics of the EtherCAT network.
ACSPL+ Programmer's Guide	Provides practical instruction on how to use ACSPL+ to program your motion controller.
Motion Control Strategies to Obtain Consistent and Better Performance	An application note defining best method motion control strategies.
Gantry Control with Cross Moving Axis	An application note describing cross moving axis gantry control.
Dual Axis PEG	An application note describing dual axis PEG usage.
Safe Torque Off Function	An application note providing the technical details for implementing the STO function for drives installed in ACS Motion Control systems.

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1. UDMMC Overview

1.1 Description

The UDMmc (UDM-Universal Drive Module) is an EtherCAT dual and four-axis motor drive module that operates with ACS EtherCAT controllers.

The EtherCAT cycle update rate is controller dependent. Cycle update rates of up to 5kHz are supported.

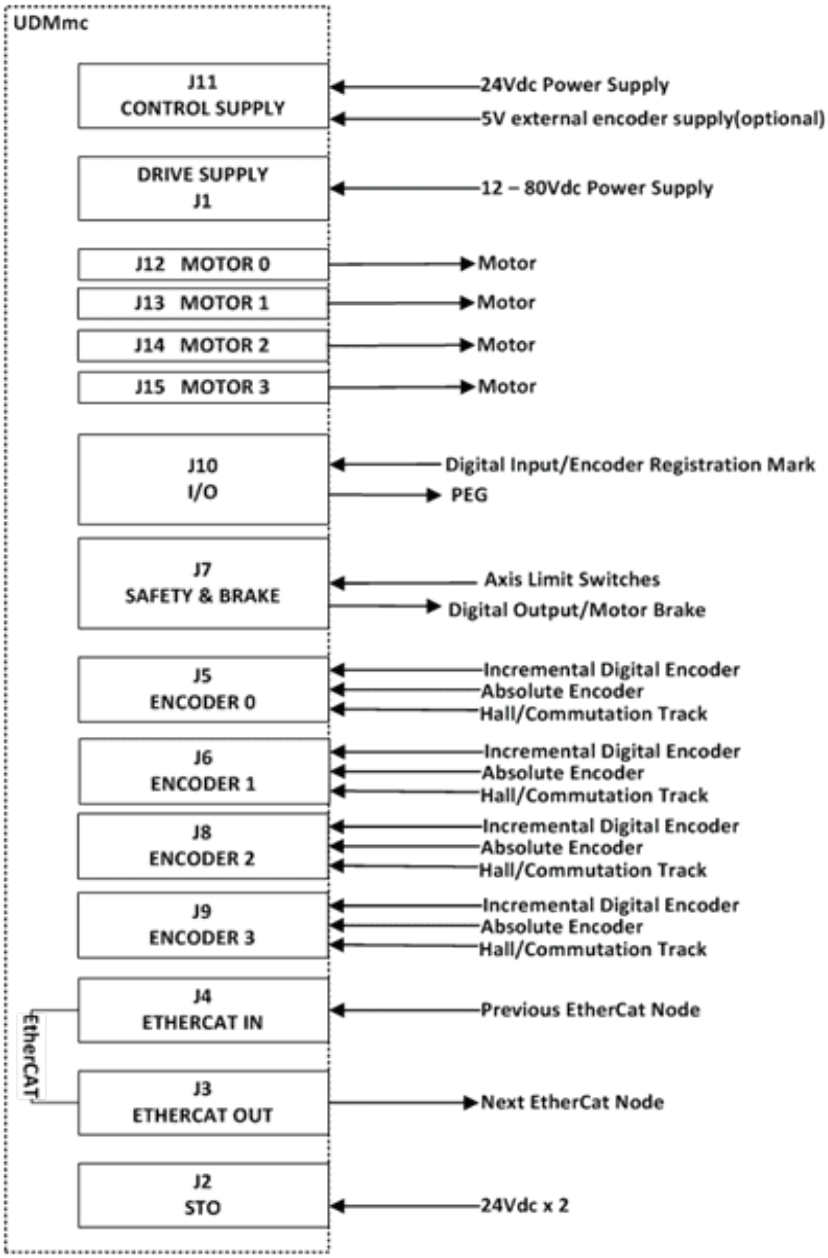

Figure 1-1. UDMmc Interface

1.2 Connectors location

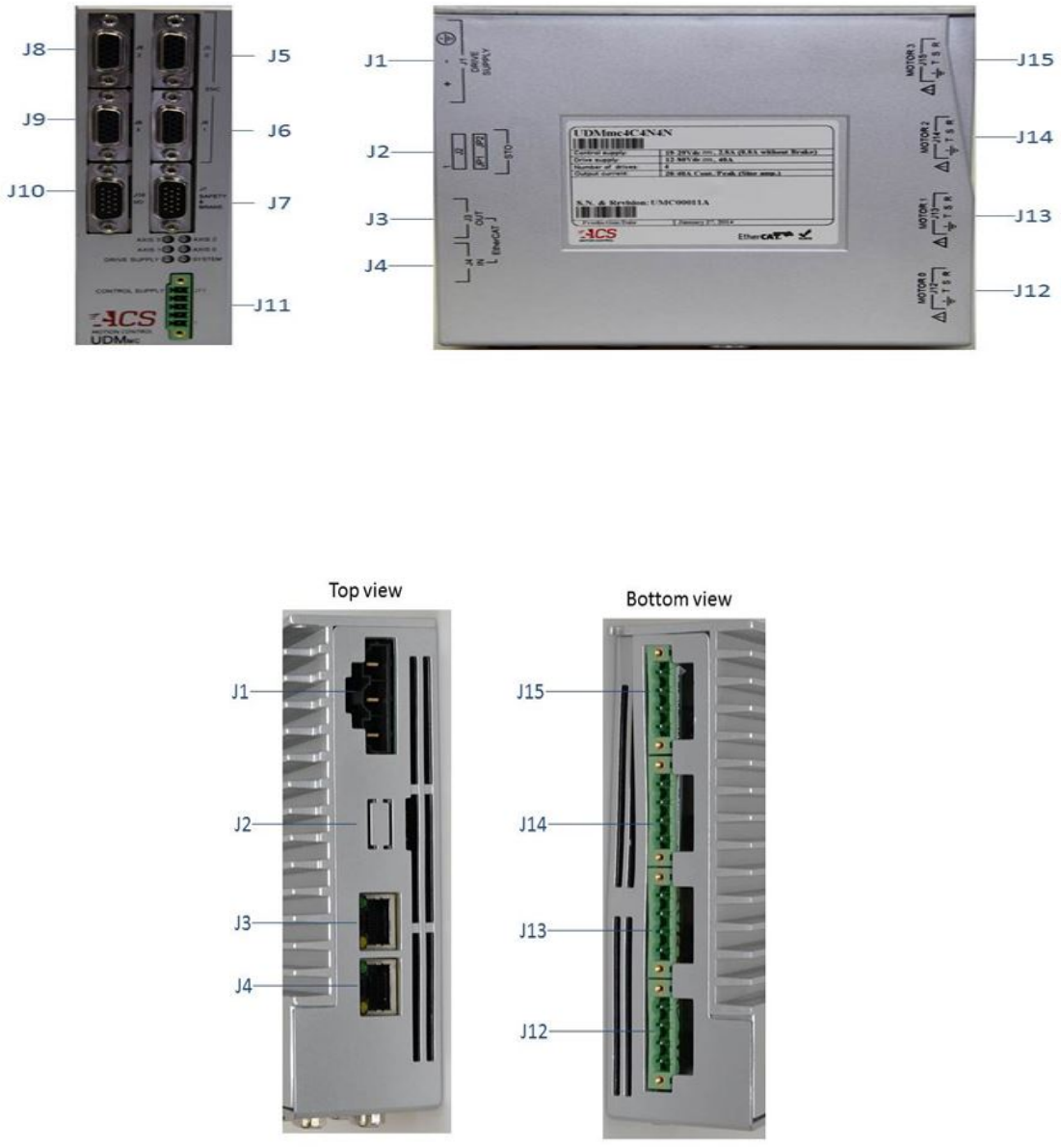

Figure 1-2. UDMmc Connectors – Location

1.3 Indicators

The following figures and tables show the location and description of the LED indicators on the UDMmc.

Table 1-1. LED indicators

Items	Description	Remarks
Axis 0 Axis 1 Axis 2 Axis 3	One bicolor LED for each > Green- Drive is enabled > Red- Drive fault > Off - Drive is disabled	On front panel
System	One bicolor LED > Red – System Fault > Green – System OK > Blinking – Software command	On front panel
Drive supply	One green LED > On – drive supply is ok. > Off- no drive supply is connected	On front panel
Control supply (J3 Yellow LED)	One Yellow LED, Off- Logic supply is not functioning On- Power supply is OK	EtherCAT OUT J3 Yellow LED
Link Act (J3, J4 Green LEDs)	Two green LEDs > Blinking – Linked and active > On –Link without activity > Off- No cable is connected	EtherCAT IN EtherCAT OUT
Run (J4 Yellow LED)	Yellow LED: > On - network communication is OK > Blinking/Off - network communication error	EtherCAT IN

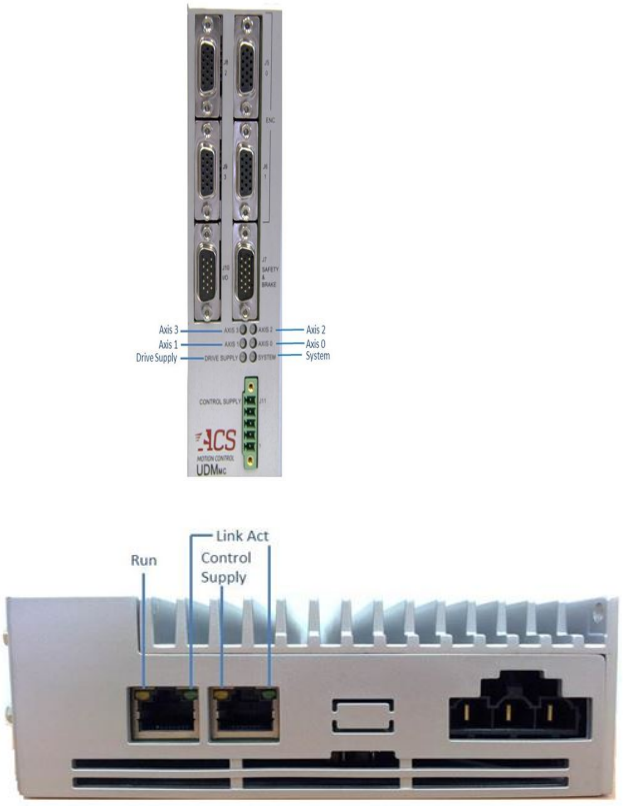

Figure 1-3. UDMmc Indicators – Front and Top Panels

1.4 Ordering Part Number

The ordering part number (P/N) contains 7 characters (see Figure 1-4) each specifying a configuration characteristic ordered for the UDMmc module, as explained in Table 1-2.

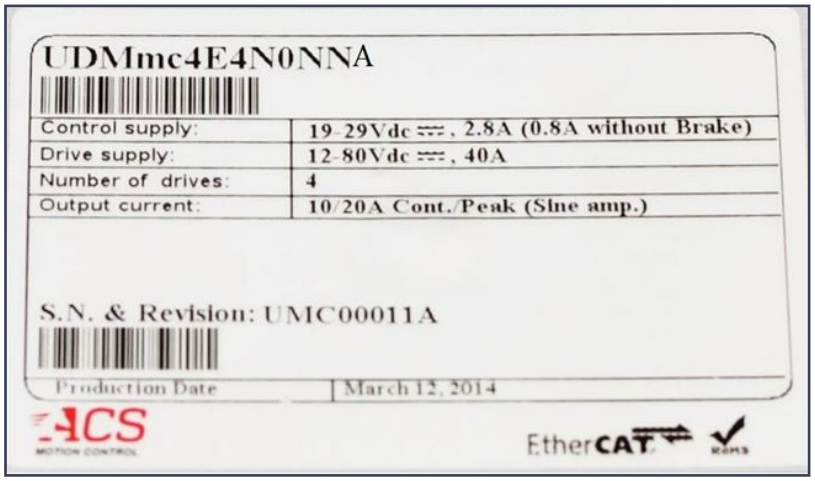

Figure 1-4. UDMmc Label with Ordering PN

Table 1-2. Configuration as Indicated by P/N

UDMmc Ordering Options	Field	Example User Selection	Available Ordering Option Values
Number of axes	1	4	2, 4
Continuous Current (Peak is double)	2	E	2x 5A (A), 2 x 10A (B), 2 x 20A (C), 4 x 2.5A (J), 4 x 5A (D), 4 x 10A (E), 4 x 20A (F) 2 x 5A & 2 x 10A (G) 2 x 5A & 2 x 20A (H) 2 x 10A & 2 x 20A (I)
Total number of digital incremental encoders	3	4	2, 4. For 4-axis unit select 4
Absolute encoders type	4	N	All - (U) None(N) EnDAT 2.1(Digital)/2.2(E) Smart Abs(S) Panasonic(P) BiSS-C (B) SSI(I)
Number of Absolute encoders interface	5	0	0,1,2,3,4
STO	6	N	Yes (Y), No (N)

UDMMC Ordering Options	Field	Example User Selection	Available Ordering Option Values
I/O configurations	7	N	(N) Inputs & limits: 24V,SOURCE (PNP), Outputs: 24V,SOURCE (PNP) (S) Inputs & limits: 24V,SINK (NPN). Outputs: 24V,SOURCE (PNP) (A) Inputs & limits: 5V/SOURCE (PNP). Outputs: 24V/SOURCE (PNP) (B) Inputs & limits: 5V/SINK (NPN). Outputs: 24V/SOURCE (PNP)
5V Feedback Supply	8	A	(A) Internal (B) External

An example Part Number of **UDMmc4E4N0NN**, would be set for the configuration described below.

Field		1	2	3	4	5	6	7	8
PN	UDMmc	4	E	4	N	0	N	N	A

When the product supports mixed current levels (G,H, I) axes 0, 1 are at the higher current level and axes 2, 3 are at the lower current level.
Gantry is supported by both 0,1 and 2,3 axes pairs.

The product is shipped with the configuration set as specified. The configuration cannot be modified by the user.

For more information regarding the various options refer to the following documents:

- *Motion Control Strategies to Obtain Consistent and Better Performance Application Note*
- *Gantry Control with Cross Moving Axis Application Note*
- *Dual axis PEG Application Note*
- *ACSPL+ Programmer Guide*

1.5 UDMMC Package Content

The UDMMC package contains the following items:

- UDMMC Module

- 24V Control Supply mating connector - Phoenix MC 1,5/ 5-STF-3,81
- If STO is ordered an STO mating connector- JST 5 PIN 2mm female PAP-05V-S is included.

1.6 Optional Accessories

UDMmc has three optional accessory kits:

- UDMmc-ACC1

  Mating connectors kit, see Table 1-3 and Figure 1-5.

- STO-ACC1

  Cable for STO with mating connector, see Figure 1-6.

- UDMmc&NPXpm-ACC2 Accessory Cable

  Mating 2m flying lead cable for drive supply, see Figure 1-7.

Table 1-3. UDMmc-ACC1 Kit Contents

Ref.	P/N	Qty	Manufacturer	Description
1	216AE09P0AB004	6	CHANT SINCERE or KELTRON	D-type 15 pin high density male HOOD HD-09-7; 9position RoHS
2	42816-0312	1	Molex	Molex 3 pin 50A plug
3	17EHD015SAA000	2	AMPHENOL	CON D-TYPE SOLDER CUP SOCKET 15P H.D NPB
4	1912207	4	Phoenix	MSTB 2,5 HC/ 4-STF-5,08
5	101AE-15MGPAAA3	4	CHANT SINCERE or KELTRON	D-type 15 pin high density male CON D-TPE SOLDER CUP 15P H.D NPB
6	42815-0042	3	Molex	Crimp Terminal, Female, 14 to 16 AWG

To assemble J1 mating connector, the following tool is needed: Molex p/n 63811-3800.

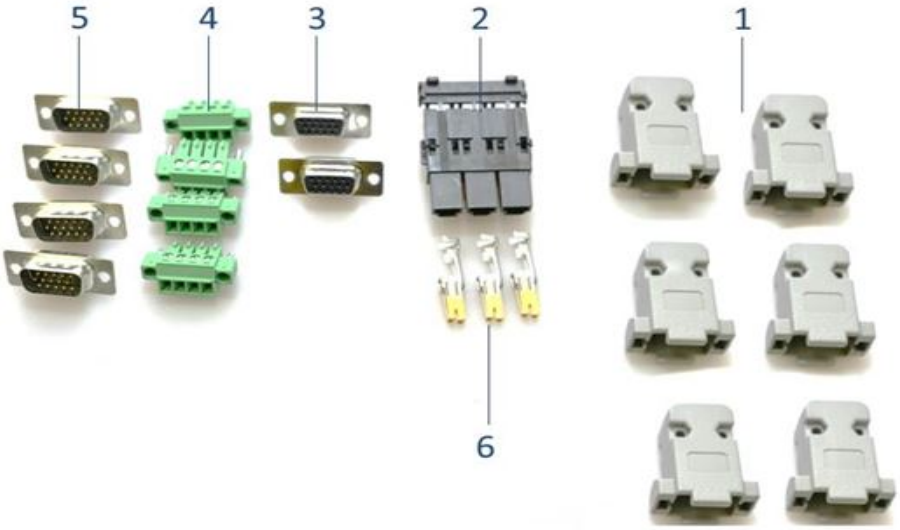

Figure 1-5. UDMmc-ACC1 Accessory Kit

Figure 1-6. UDMmc STO-ACC1 Accessory Kit

Figure 1-7. UDMmc&NPXpm-ACC2 Accessory Cable

2. Mounting and Cooling

UDMmc should be mounted vertically, using M4 type Philips screws. The dimensions (in millimeters) are shown in Figure 2-1.

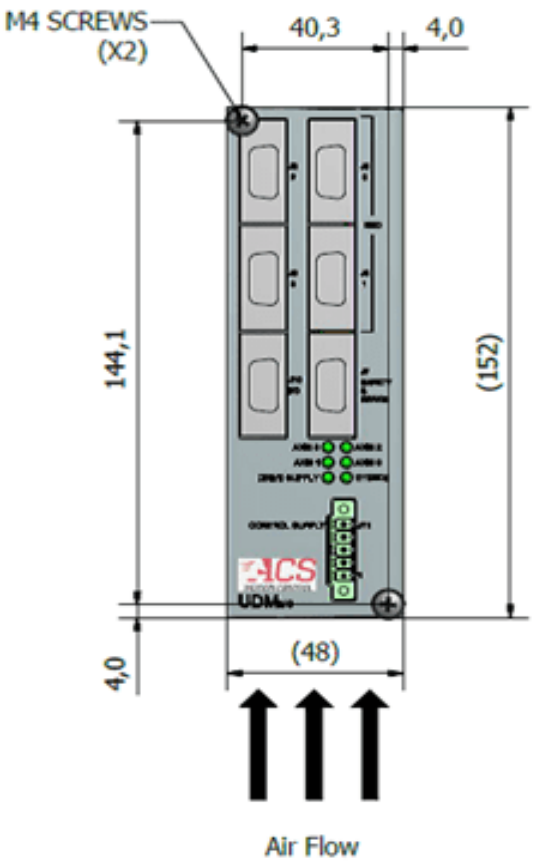

Figure 2-1. UDMmc Vertical Mounting

- UDMmc operates in temperature range of 0 to 50°C.
- Up to 2.4kW of total power, the unit can be operated at ambient temperature of 50°C without any forced cooling.
- At total power of 2.4kW to 3.2kW:
  - Ambient <30°C – No need for forced cooling
  - Ambient >30°C – Use a 150CFM fan
- At ambient temperature below 30°C the unit can be operated at the maximum total power of 3.2kW without forced cooling.
- Leave sufficient clearance of 25 millimeters on all open sides for cable routing and free air flow.
- STO temperature requirements

For units with STO, the maximum surrounding air temperature is not to exceed 40°C with forced cooling 150 CFM in vertical direction (in the direction from the motor drive output connectors towards Drive Supply connector J1).

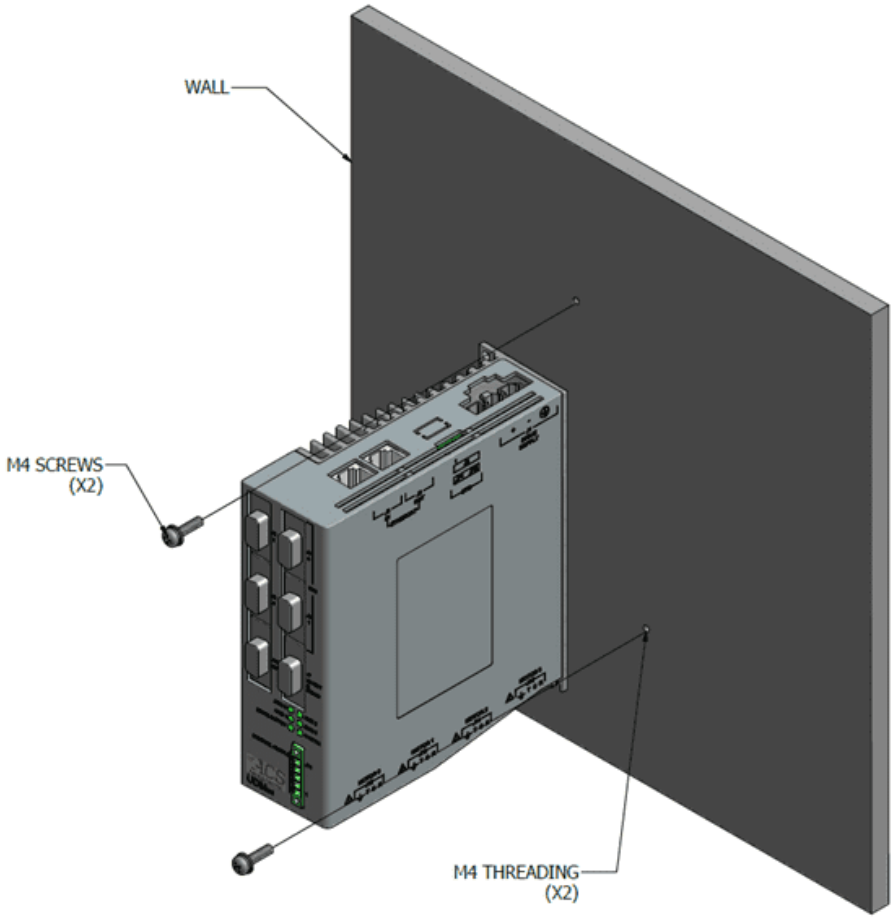

Figure 2-2. UDMmc Vertical Mounting

3. Connections

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

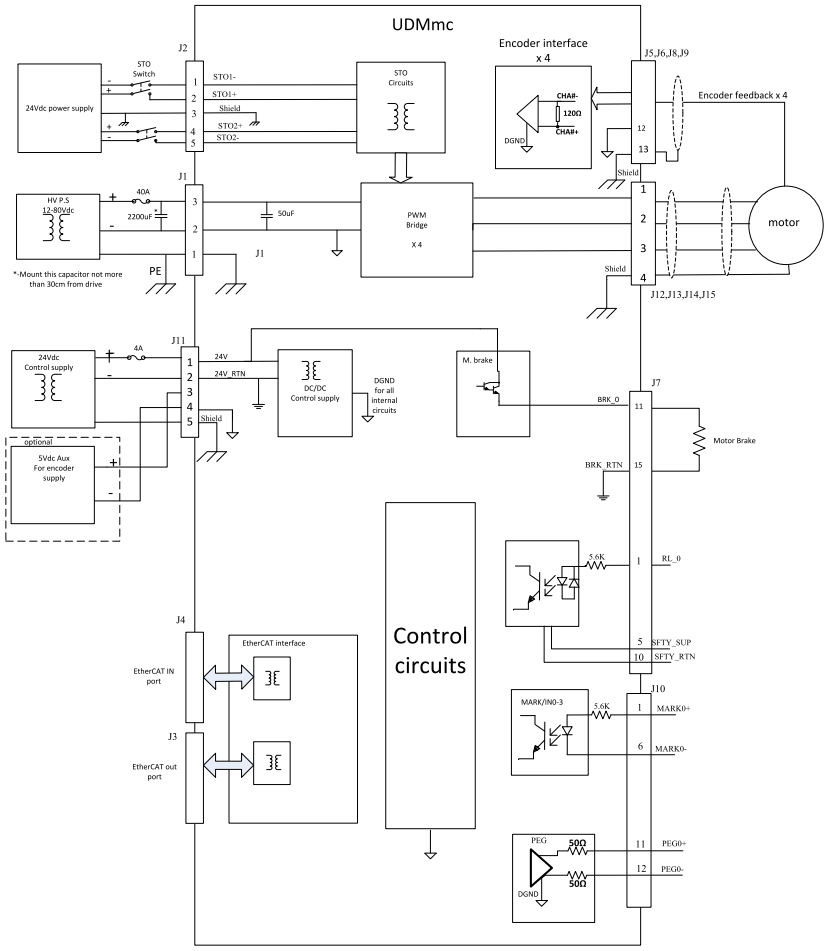

Figure 3-1. Overall Connections and Grounding

External encoder 5V supply input is not a standard options and requires HW change, please contact ACS about availability and ordering instructions.

Table 3-1. UDMmc Connections

Connector name	Description	Connector	Mating connector (part of UDMmc-ACC1 accessory kit*)
J1	Drive supply	3 pin header by Molex PN 42820-3228	3 pin socket by Molex* PN 42816-0312 Pin: Molex PN 42815-0042
J2	STO	5 pin 2mm male by JST PN SM05B-PASS-1	5 pin 2mm male by JST PN PAP-05V-S Pin: SPHD-001T-P0.5
J3	EtherCAT output	RJ45, 8P8C (for example Wurth Elektronik, PN 615008137421)	RJ45, 8P8C (for example Wurth Elektronik PN 615008137421) Mating cable with connectors: Standard Ethernet cables CAT5e.
J4	EtherCAT input	RJ45, 8P8C (for example Wurth Elektronik, PN 615008137421)	RJ45, 8P8C (for example Wurth Elektronik PN 615008137421) Mating cable with connectors: Standard Ethernet cables CAT5e.
J5	Encoder axis 0	D-type 15 pin high density, female.	D-type 15 pin high density, male*
J6	Encoder axis 1		
J7	Safety & Brake	D-type 15 pin high density, male.	D-type 15 pin high density, female*
J8	Encoder axis 2	D-type 15 pin high density, female.	D-type 15 pin high density, male*
J9	Encoder axis 3		

Connector name	Description	Connector	Mating connector (part of UDMmc-ACC1 accessory kit*)
J10	Digital I/O	D-type 15 pin high density, male.	D-type 15 pin high density, female*
J11	Control supply.	MC 1,5/ 5-GF-3,81, by PHOENIX, PN 1827897	MC 1,5/ 5-STF-3,81, by PHOENIX, PN 1827732*
J12	MOTOR0	MSTB 2,5 HC/ 4-GF-5,08, by PHOENIX, PN 1924101	MSTB 2,5 HC/ 4-STF-5,08, by PHOENIX, PN 1912207*
J13	MOTOR1		
J14	MOTOR2		
J15	MOTOR3		

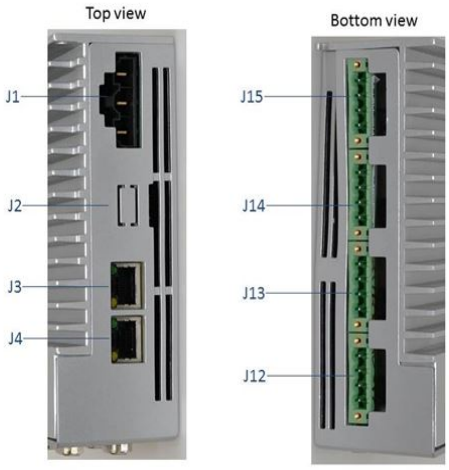

Figure 3-2. UDMMC Connections

3.1 Safety, EMC and Wiring Guidelines

Read this section carefully before beginning the installation process.

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

An STO module (Safe Torque Off) is an optional feature of the UDMMC additional information can be found in the STO (Safe Torque Off) section of this manual.

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

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

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

When connecting the UDMMC 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 earthing connection at the output to the motor is functional.
The earthing system for the motor is to be independent of the earthing system for the controller.
The earthing connection is the first to be connected and the last to be disconnected during connection/disconnection.

The unit is to be powered by an isolated floating power supply. Do not ground the positive output "+" of the power supply.

The low voltage connections, (DVC "A" circuits) are non-isolated ELV circuits. These are to be non-accessible or suitably insulated in the end product.

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

J12,J13,J14 and J15 contain hazardous voltages of 80V PWM modulated.

IP protection class: IP2X is provided. The end user shall provide an external enclosure IP3X.

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 Table 3-2 below, based on the current rating of your product.

Proper wiring, grounding and shielding are essential for ensuring safe, immune and optimal servo performance. After completing the wiring, carefully inspect all wires to ensure tightness, good solder joints and general safety.

Table 3-2. Wiring Guidelines

	Gauge	Twisted pair
Control power supply	18AWG	No
Drive power supply	12-16AWG	No

	Gauge	Twisted pair
Motor	14-16AWG	No
Motor Brake	18AWG	No
Encoders	28AWG (up to 0.6A), 26AWG (up to 1A)	Yes

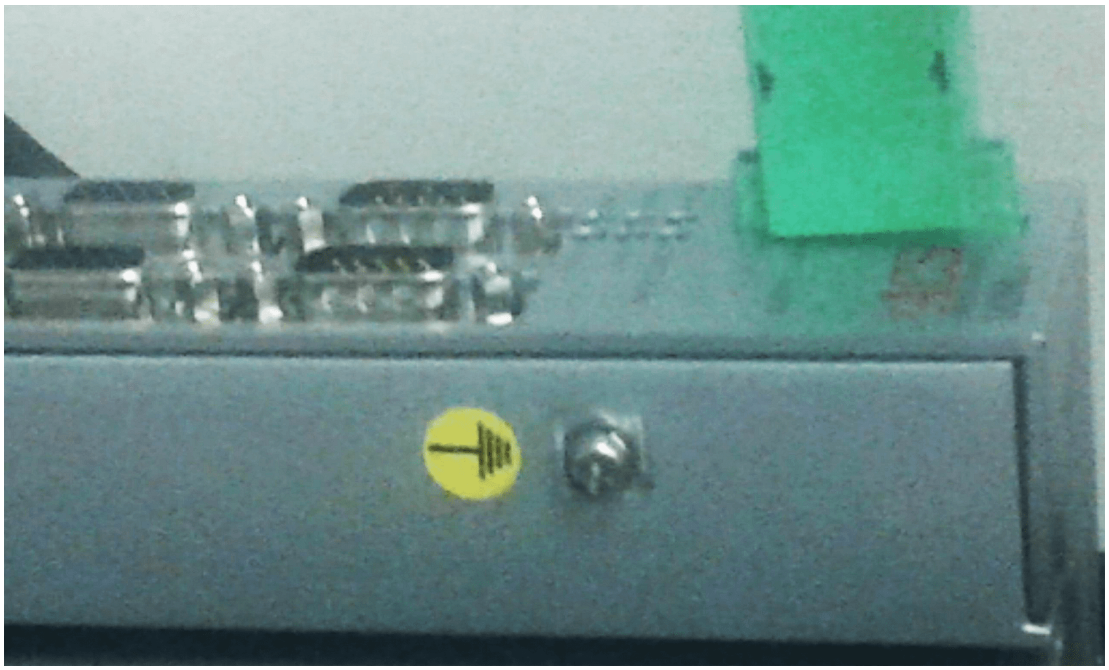

Figure 3-3. UDMmc grounding screw

3.2 Connecting the UDMmc

Connect the UDMmc as described below:

In some cases, not all steps below apply, for example when connecting to a single axis UDMmc, only Motor 0 connections are relevant.

1. Ensure that all supppes are off when preparing the unit.
2. Connect the 24Vdc Control supply to J11.
3. Connect the Drive supply to J1.
4. Connect motor 0 to J12.
5. Connect motor 1 to J13.
6. Connect motor 2 to J14.
7. Connect motor 3 to J15.

8. Connect the feedback sensors ENCODER0 for Motor 0 to J5, ENCODER1 for Motor 1 to J6, ENCODER2 for Motor 2 to J8 and ENCODER3 for Motor 3 to J9.
9. Connect IO, safety and Brake to J7 and J10.
10. Connect the EtherCAT IN cable (from the EtherCAT Master or another EtherCAT slave) to J4.
11. Connect J3 EtherCAT OUT to the next slave.
12. When the UDMmc is the last network node and a ring topology is used, connect J3 to the EtherCAT Master secondary port.
13. When the UDMmc is the last network node and a pne topology is not used, leave J3 not connected.

Once the unit is connected:

1. Turn on the 24Vdc control supply and verify communication with the UDMmc.
2. Turn on the 12 to 80Vdc drive supply.

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

3.3 Power Supplies

The UDMmc is fed by two power supplies:

> Control Supply - 24Vdc (J1)
> Drive Supply – 12 to 80Vdc (J2)

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

Each power supply has a LED indicator on the UDMmc.

3.3.1 Control Supply

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

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

The 24V control supply must be connected to the unit via 4A fuse.

3.3.1.1 24Vdc Power Supply Specifications

The 24Vdc power supply should comply with the specifications shown in Table 3-3.

Table 3-3. 24Vdc Power Supply Requirements

	Description
Type	Isolated Low noise UL certified
Output voltage range	24Vdc±20%
Output current	Minimum 3A (0.8A for internal circuits and 2A are needed for Brake)

Example: Lambda, P/N LS75-24 or LS100-24.

3.3.1.2 J11 - Control Supply Connector

Label: J11 24V CONTROL SUPPLY

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

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

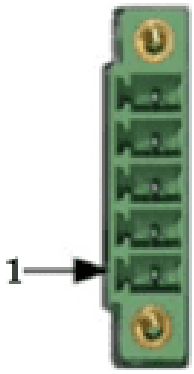

Figure 3-4. J11 - Control Supply Connector

Table 3-4. J11 - Control Supply Pinout

Pin	Signal	Description
1	24VDC	+24 Vdc
2	24VRTN	+24 Vdc return
3	ENC_SUP	Encoder external supply
4	ENC_RTN	Encoder external return
5	Shield	Electrical ground

If 0.5A is not sufficient for the encoders, an external 5Vdc supply can be used to feed the encoders. This 5Vdc should be connected to J11 pin 3 and 4.

External encoder 5V supply input is not a standard option and requires a HW change, please contact ACS about availability and ordering instructions.

3.3.1.3 Connection Instructions

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

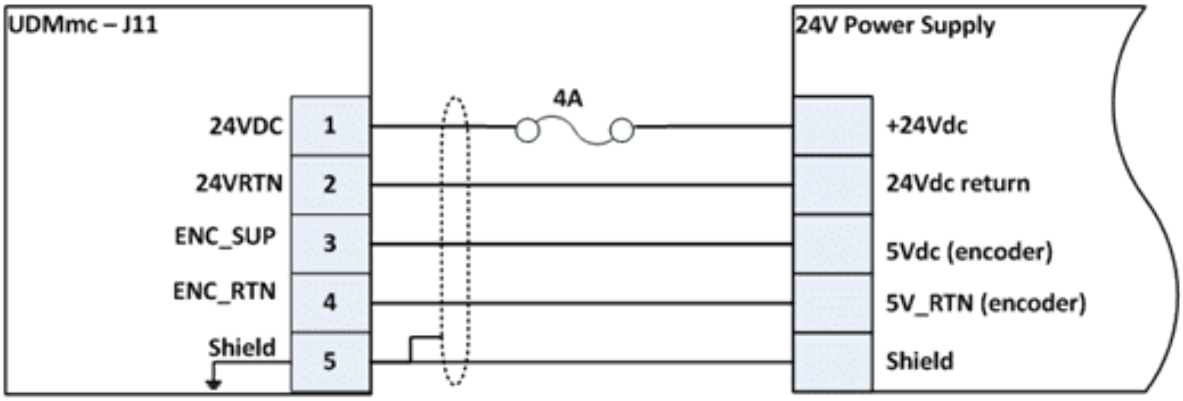

Figure 3-5. Control Supply Connections

3.3.2 Drive Supply

An external isolated 12Vdc to 80Vdc power supply (not included with the UDMmc) feeds the drives and the motors.

The Drive Supply must be connected to the unit via fuse. The fuse rating should be calculated according the total input current of the unit.

Unit is to be protected by an external fuse rated for 250Vac/125Vdc and not to exceed 40A with a short circuit rating 50kA in the positive ("+") supply conductor.

3.3.2.1 12V to 80V Drive Supply Specifications

This power supply should comply with the following specifications:

Table 3-5. 12V to 80V Drive Supply Requirements

	Description	Remarks
Type	Isolated	

	Description	Remarks
Output voltage range	12Vdc to 80Vdc	Output voltage should never exceed 83Vdc
Output current, maximum	40A	The total input current of the UDMmc is limited to 40A

The maximum drive supply should not exceed 80Vdc.

3.3.2.2 Motor Drive Protection

Table 3-6. Motor Drive Specifications

Protection	Value
Motor Phase short circuit	60A ±5%
Over temperature	100°C ±5%
Over voltage	85V ±5%
Under voltage	9V±5%

If the drive voltage raises due to regeneration, then it is recommended to:

1. Use a drive supply with maximum 75Vdc.
2. Add a shunt regulator (regeneration circuit) set to 80V±3%.

3.3.2.3 J1 - DRIVE SUPPLY Connector

Label: J1 DRIVE SUPPLY

- Connector:
  - 3 pin header by Molex PN 42820-3228
- Mating connector:
  - 3 pin socket by Molex PN 42816-0312
  - Pin: Molex PN 42815-0042
  - Tool: Molex PN 63811-3800

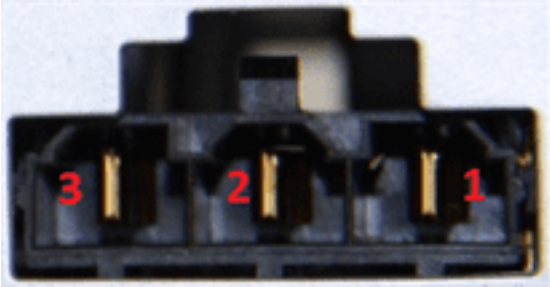

Figure 3-6. J1 - Drive Supply Connector

Table 3-7. J1 - Drive Supply Connector Pinout

Pin	Signal	Description
1	PE	Protective Earth
2	VP-	Drive Supply return
3	VP+	Drive Supply positive edge

3.3.2.4 Connection Instructions

The UDMmc is fed by a DC voltage in the range of 12Vdc to 80Vdc.
Under highest load conditions the instantaneous current drawn from the supply can be as high as 160A.
The selected power supply should be able to tolerate large and instantaneous variations in load current that are typical in motion control situations. The supply voltage should withstand minimal voltage drops and should not exceed 85Vdc under any circumstances.
A suitable power supply varies according to the specific apppcation characteristics and therefore cannot be predetermined, and should be chosen according to the particular system.
The supply should be placed as close as possible to the UDMmc unit.
Use a regeneration circuitry to pmit the voltage to 83Vdc.
Drive supply stabipty can be improved by mounting an external capacitor closer than 30cm from the UDMmc.

1. Use a low inductance cable with a minimum gauge of 12-16 AWG.
2. Route the drive supply and motor cables as far as possible from all other noise sensitive cables (such as encoders and I/O).
3. Connect a fast active fuse between the UDMmc and the external power supply. The fuse rating should be calculated according the total input current of the unit. It should not exceed 40A.

The recommended fuse is a Fast acting Rated current 40A. For example: Cooper Bussmann MNF P/N KTK-R-XX.

The UDMmc has no regeneration circuit. To keep the drive supply in range, an active regeneration device should be used. The drive supply must not exceed 83Vdc.

4. Connect the UDMmc PE (Protective Earth) to the power supply PE point.
5. For better noise immunity in noisy environments, consider making a short (by 16 AWG wire) between PE (J1 pin 1) to the VP- point (J1 pin 2).

Connecting J1 pin 1 to J1 pin 2 disrupts the isolation between the motor circuits and the PE (Protective Earth), and thus impacts the adherence to safety standards and regulation.

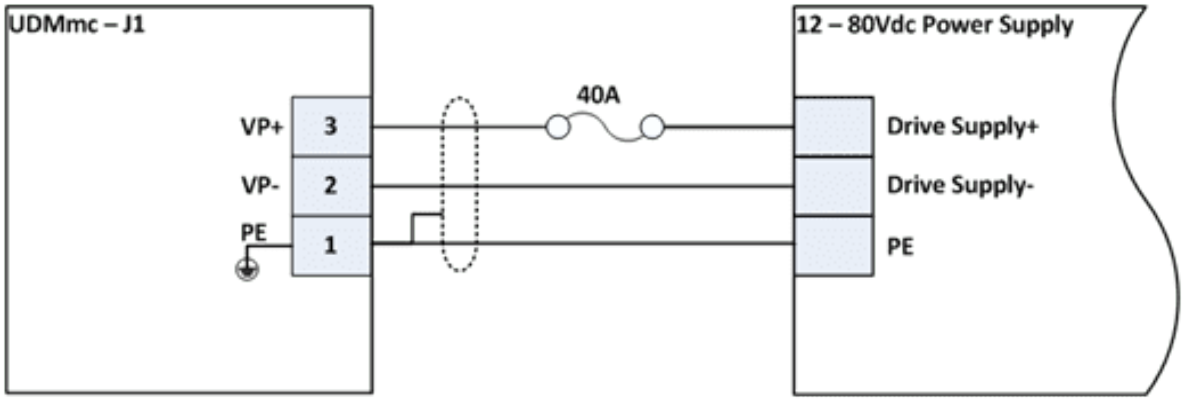

Figure 3-7. Drive Supply Connections

3.4 STO (Safe Torque Off)

The STO circuit functionality is designed and tested by ACS to comply with the requirements of EN ISO 13849-1, EN 62061 and IEC 61800-5-2 standards.

A 24V (18Vdc to 33Vdc) must be connected to both STO inputs 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 50msec to 200msec. In addition, the controller is informed about this event within a few milliseconds. This delay (between informing the controller and blocking of the PWM signals of the drive) provides the controller the ability to bring all axes to a complete stop, or low velocity movement, in an orderly manner. The implementation of the STO guarantees that under any foreseen circumstances, failure or damage, any of following types of motors will not move:

- AC synchronous (DC brushless)
- Step motor

- AC asynchronous (AC induction)

Usually, the STO1 and STO2 are connected to a 24V source via 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 Notes*.

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

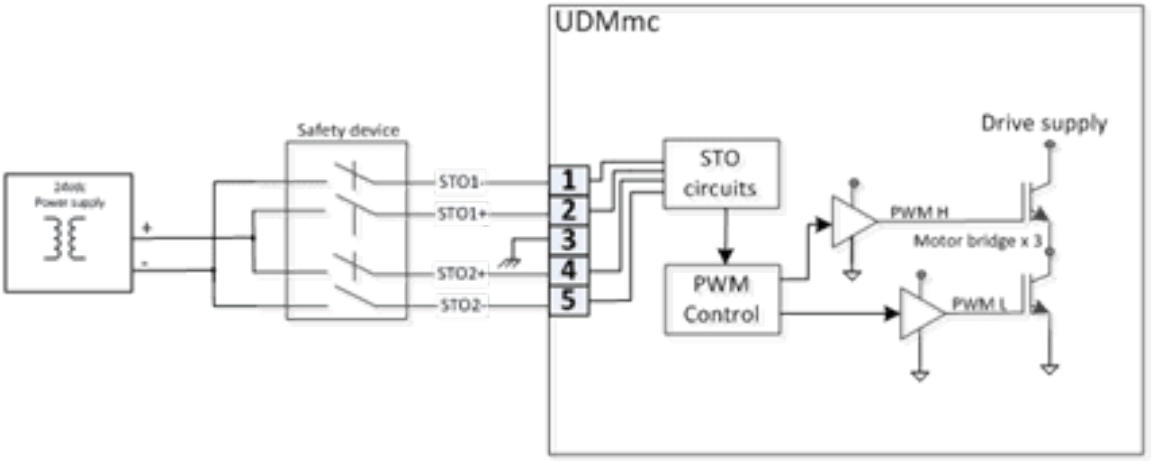

Figure 3-8. STO Connection

To watch the STO1 and STO2 input status, use the ACSPL+ command "LOCALST".

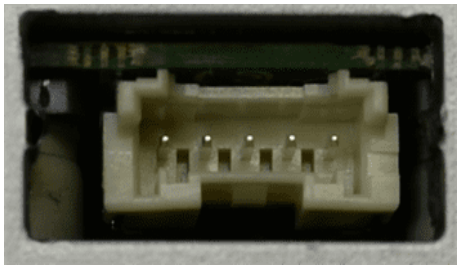

Figure 3-9. STO Connector

Label: J2 STO

- Connector:
  - 5 pin 2mm male by JST PN SM05B-PASS-1
- Mating connector:
  - 5 pin 2mm male by JST PN PAP-05V-S
  - Pin: SPHD-001T-P0.5

Table 3-8. STO Connectors Pin out

Pin	Signal	Description
1	STO1-	STO input 1 inverted input

Pin	Signal	Description
2	STO1+	STO input 1 non inverted input
3	EGND	Electrical ground
4	STO2+	STO input 2 non inverted input
5	STO2-	STO input 2 inverted input

3.5 Motors

NPA
PC
SPiiPlusCMHP/BASPiiPlusCMNTSPiiPlusESUDMCBUDMHP/BAUDMPAUDMSDIDMSMECMSMUDMSM supports the following rotary and linear motors:

- 1-phase (DC brush, moving coil), see Figure 3-11.
- 2-phase (AC synchronous, step motor), see Figure 3-12.
- 3-phase (AC Synchronous / DC Brushless step motor), see Figure 3-13.
- 5-phase (step motor. Consult company), see Figure 3-14.

For more details on each motor type, see www.acsmotioncontrol.com/downloads.

5-phase step motor support is not a standard option, please contact ACS about availability and ordering instructions.

3.5.1 J12 (MOTOR0), J13 (MOTOR1), J14 (MOTOR2), J15 (MOTOR3) Connectors

J12,J13,J14 and J15 contain hazardous voltages of 80Vdc PWM.

Label: J12 MOTOR0, J13 MOTOR1, J14 MOTOR2, J15 MOTOR3

Connector: MSTB 2,5 HC/ 4-GF-5,08, by PHOENIX, PN 1924101

Mating connector: MSTB 2,5 HC/ 4-STF-5,08, by PHOENIX, PN

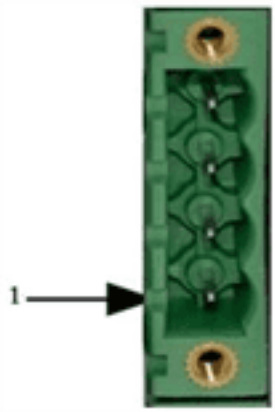

Figure 3-10. Motor Connectors

Table 3-9. Motor Connectors Pinout

Pin	Signal	Description
1	R	Motor R phase for brush, 3-phase brushless motor and the common phase for stepper.
2	S	Motor S phase for brush, 3-phase brushless motor and phase A- for stepper.
3	T	Motor T phase for 3-phase brushless and phase B- for stepper.
4	Shield	Motor shield

3.5.2 Connection Instructions

Use a shielded cable with a minimum gauge of 16 AWG. It should be less than 10 meters long.

Connect the motors according to Figure 3-11 through Figure 3-14.

5-phase setup motor control is not a standard feature. Please contact ACS if you need to control such a motor.

Only one 5 phase step motor can be used, connected to both J12 and J13 connectors.

Route the motors' cable (and the drive supply cable) as far as possible from all other noise sensitive cables (such as encoders and I/O).

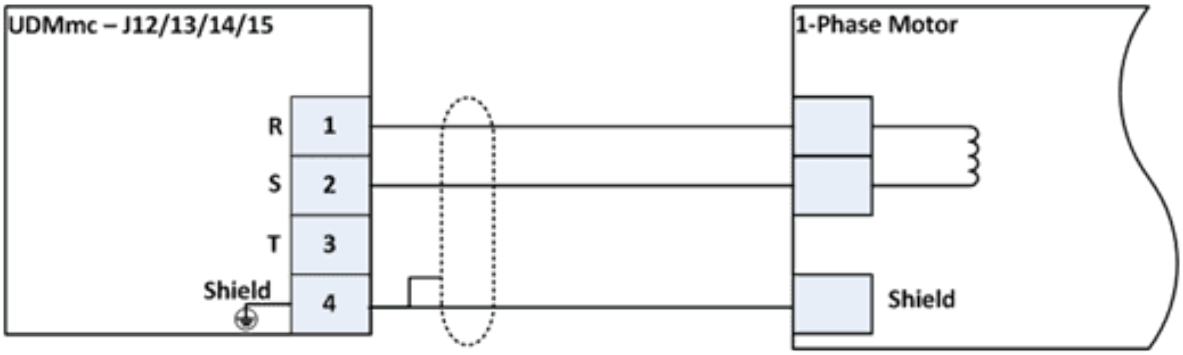

Figure 3-11. 1-Phase Motors (DC Brush, Voice Coil) Connections

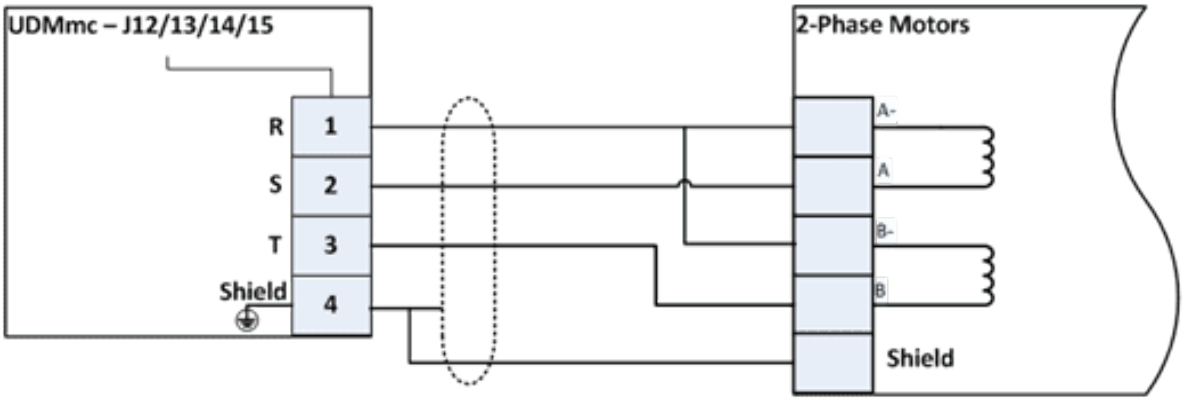

Figure 3-12. 2-Phase Motors (AC synchronous, Step Motor) Connections

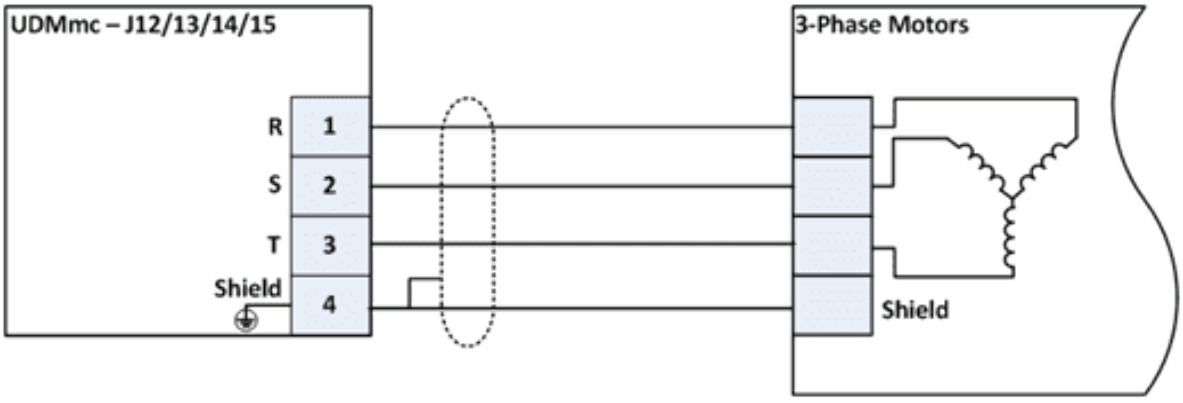

Figure 3-13. 3-Phase Motors (AC synchronous, Step Motor) Connections

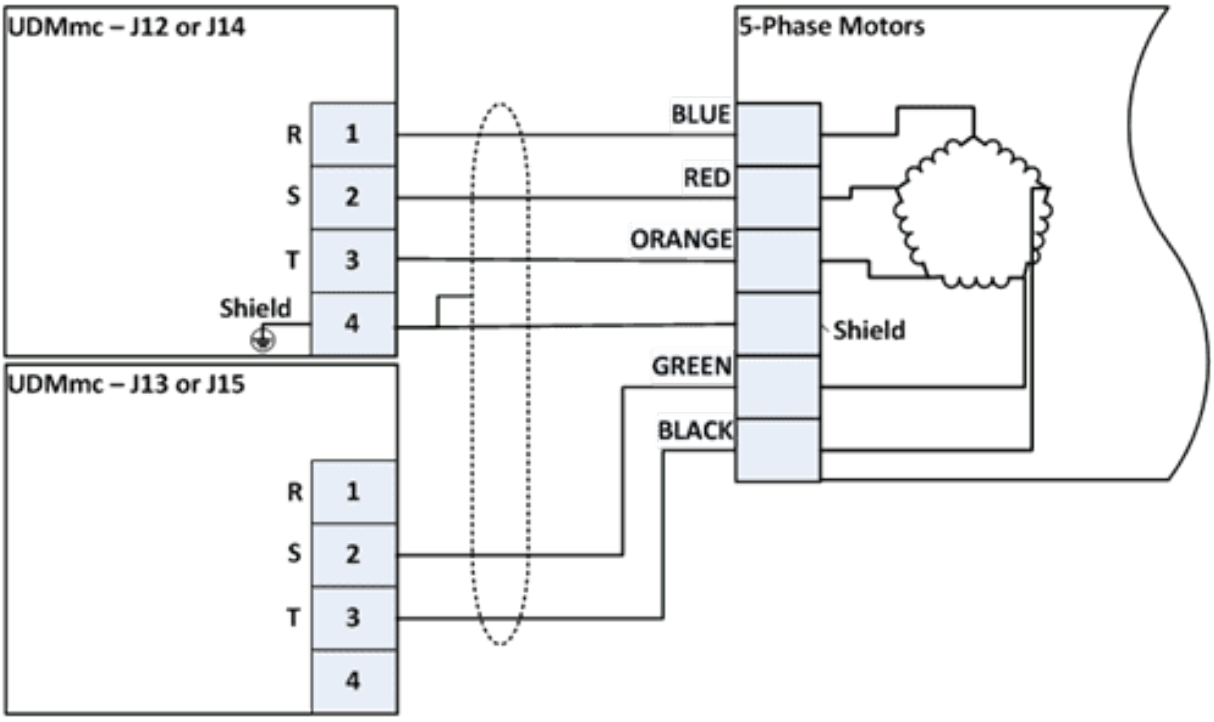

Figure 3-14. 5-Phase Step Motor Connections (example of an Oriental Motor)

3.6 Feedback Sensors

There are two digital position feedback sensors interfaces, supporting the following types of sensors:

- AqB,I and Clk/Dir (=Pulse/Dir) incremental digital encoders, differential and single-ended, with or without Hall sensors or commutation tracks.
- Absolute encoders with or without Hall sensors or commutation tracks. There are five types of interfaces:

Absolute serial encoders are of the following types:

- EnDat 2.1(Digital)/2.2
- BiSS-C
- Tamagawa Smart-Abs
- Panasonic

Encoder and Hall signals share the same connector.

Interfaces for absolute encoders are optional and must be specified when ordering the product.

All feedback sensors are powered by the

NPAPCSPiiPlusCMHP/BASPiiPlusCMNTSPiiPlusESUDMCBUDMHP/BAUDMPAUDMSDIDMSMECMSMUDMSM internal 5.1Vdc power supply. The total consumptions of all sensors (encoders and Hall) should not exceed 0.5A.

If 0.5A is not sufficient for the encoders, an external 5Vdc supply can be used to feed the encoders. This 5Vdc should be connected to J11 pin 3 and 4.

External encoder 5V supply input is not a standard option and requires HW change, please contact ACS about availability and ordering instructions.

Make sure that the actual voltage measured on the sensors contacts is above its minimum specification (>4.75Vdc).

3.6.1 J5, J6, J8, J9 (Encoder 0, Encoder 1, Encoder 2, Encoder 3) Feedback Sensor Connectors

Labels: J5 ENCODER 0, J6 ENCODER 1, J8 ENCODER 2, J9 ENCODER 3

Connector: D-type 15 pin high density, female.

Mating connector: D-type 15 pin high density, male.

Figure 3-15. Feedback Sensor Connectors

Table 3-10. Feedback Sensor Connectors

Pin	Signal	Description
1	$_CHA-	$ digital encoder, channel A inverted input, for differential encoder only. Absolute encoder Data-.
2	$_CHB-	$ digital encoder, channel B inverted input for differential encoder only. Absolute encoder CLK-.
3	$_CHI-	$ digital encoder, channel I (index) inverted input for differential encoder only.
4	$_HB	$ Motor Hall B

Pin	Signal	Description
5	NC	Not connected
6	$_CHA+	$ digital encoder, channel A non-inverted input, used for both single-ended and differential encoders. Absolute encoder Data+.
7	$_CHB+	$ digital encoder, channel B non-inverted input, used for both single-ended and differential encoders Absolute encoder CLK+.
8	$_CHI+	$ digital encoder, channel I (index) non inverted input, used for both single-ended and differential encoders
9	$_HA	$ Motor Hall A
10	NC	Not connected
11	V_SUP_ENC	Encoders 5V supply “+”:
12	V_RTN_ENC	Encoders 5V supply return:
13	SHIELD	Not connected
14	$_HC	$ Motor Hall C
15	NC	Not connected
	Connector shell and front screw locks M1, M2	SHIELD

* "$" represents the encoder channel number 0,1,2 or 3.

The shield signal in pin 13 has been removed in acting from recommendations recieved by UL. The shield of the feedback cable must be connected to the connector body/shell.

Hall sensors / commutation tracks are used for initial AC Synchronous motor commutation upon power up. Using Hall sensors / commutation tracks for commutation purposes is optional. The controller is able to perform sinusoidal commutation without Hall sensors / commutation tracks.

In feedback devices where there is a shared supply of limits and feedback, the following pins should be shorted: J7 pin 5 with J5/6/8/9 pin 11 and J7 pin 10 with J5/6/8/9 pin 12.

3.6.2 Connection Instructions

Use shielded cables with twisted pairs, a minimum gauge of 24 AWG and up to 10 meters in length.

Connect the encoders according to Figure 3-16, Figure 3-17, Figure 3-18, and Figure 3-19.

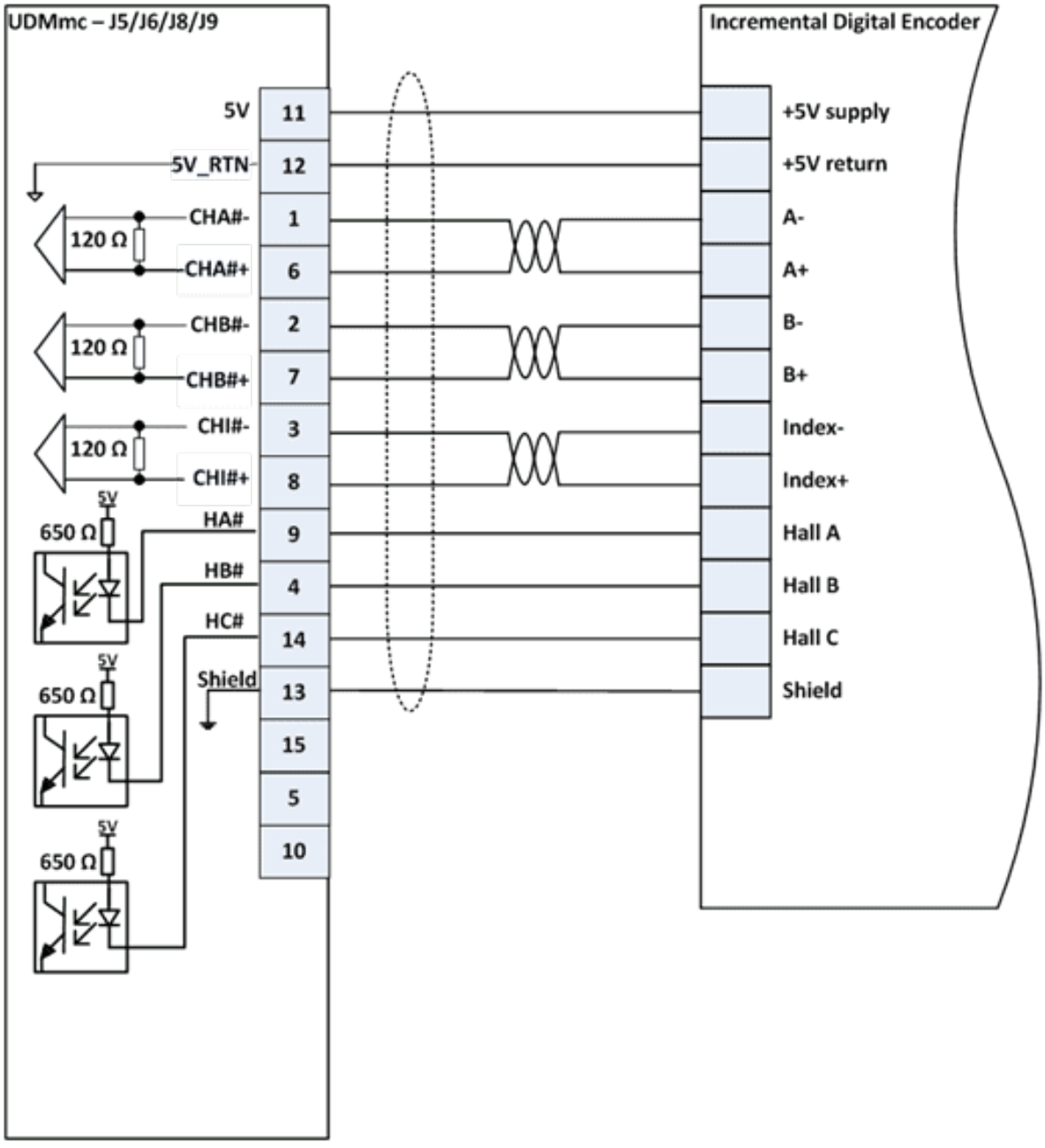

Figure 3-16. Incremental Digital Encoder with Hall / Commutation Tracks AqB,I Connections

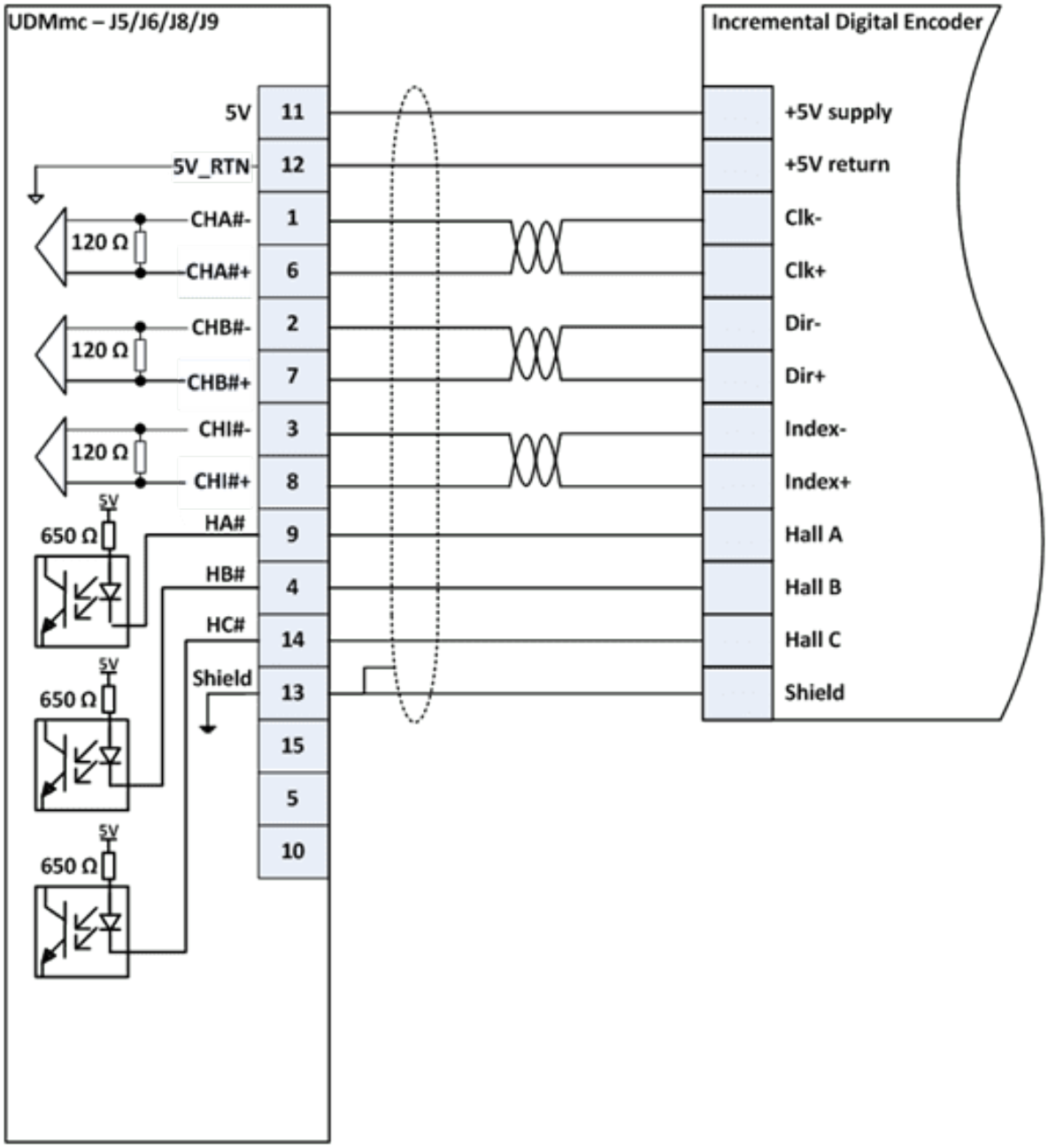

Figure 3-17. Incremental Digital Encoder with Hall / Commutation Tracks Clk/Dir, I Connections

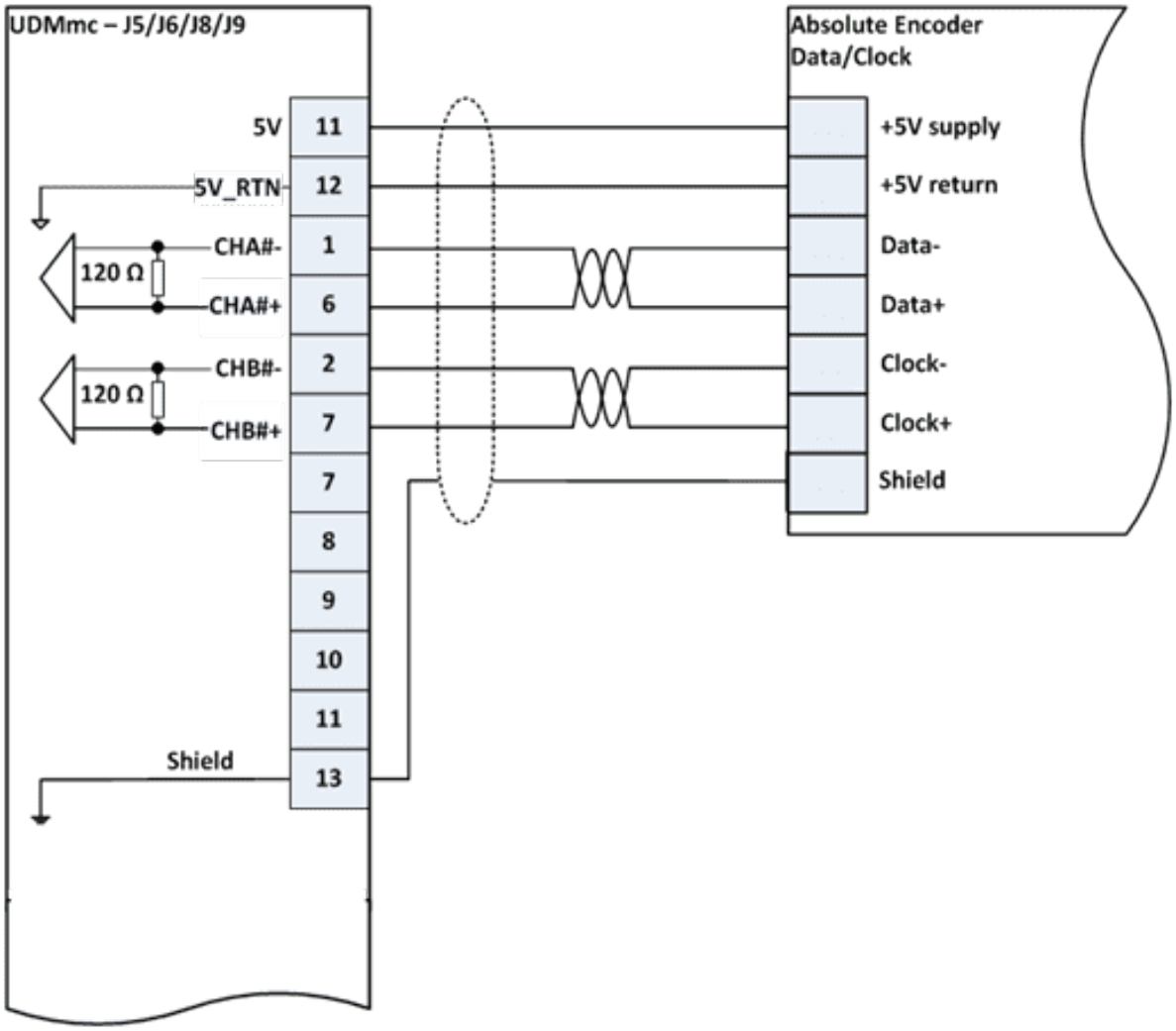

Figure 3-18. Absolute Serial Encoders with Data/Clock Connections
EnDat 2.1(Digital)/2.2, BiSS-C

In case of EnDat 2.1 encoder, the Analog Sin and Cos outputs are not used and should not be connected.

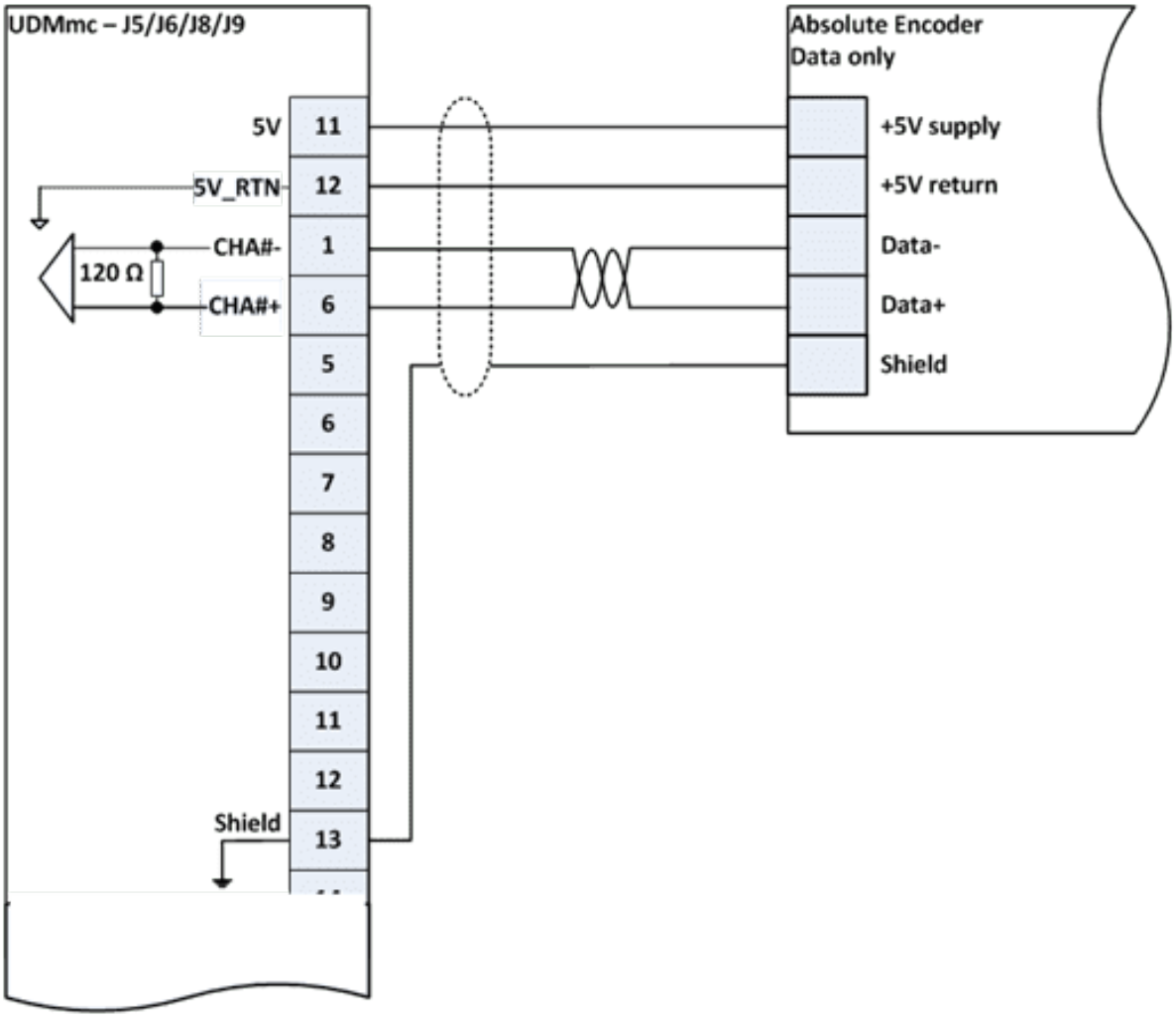

Figure 3-19. Absolute Serial Encoders with Data Line Only Connections (Tamagawa Smart-Abs, Panasonic)

3.7 Digital I/Os

The NPAPCSPiiPlusCMHP/BASPiiPlusCMNTSPiiPlusESUDMCBUDMHP/BAUDMPAUDMSDIDMSMECMSMUDMSM includes the following INPUT/OUTPUT connectors:

- Safety & Break I/O (J7)
- MARK & PEG I/O (J10)

With the
NPA
PC
SPiiPlusCM
HP/BASPiiPlusCMNTSPiiPlusESUDMCBUDMHP/BAUDMPAUDMSDIDMSMECMSMUDMSM
installed in a network, the user can obtain the exact mapping of the ACSPL+ IN and OUT variables to the connector pins for the device in the system through the MMI Application Studio. For detailed instructions, see the *SPiiPlus MMI Application Studio User Guide* under system configuration.

3.7.1 J7 – Safety and Break I/O Connector

Label: J7 SAFETY & BREAK

Connector: standard D-type, male, 15 pin high density.

Mating connector: standard D-type, female, 15 pin high density.

Figure 3-20. Safety & Break Connector

Table 3-11. Safety & Break Connector

Pin	Signal	Description
1	0_RL+	Axis 0 right limit
2	1_RL+	Axis 1 right limit
3	2_RL+	Axis 2 right limit
4	3_RL+	Axis 3 right limit
5	SFTY_SUP	IO supply input
6	0_LL+	Axis 0 left limit
7	1_LL+	Axis 1 left limit

Pin	Signal	Description
8	2_LL+	Axis 2 left limit
9	3_LL+	Axis 3 left limit
10	SFTY_RTN	IO supply return
11	BRK_0	Axis 0 Brake output
12	BRK_1	Axis 1 Brake output
13	BRK_2	Axis 2 Brake output
14	BRK_3	Axis 3 Brake output
15	BRK_RTN	Brake return.
	Connector shell and front screw locks M1, M2	SHIELD

3.7.1.1 Connection Instructions

Use shielded cables with twisted pairs, a minimum gauge of 24 AWG and up to 10 meters in length.

Connect a 24Vdc "Safety" power supply between pins 5 and 10.

3.7.1.2 24Vdc Safety Supply Specifications

The 24Vdc power supply should comply with the following specifications:

Table 3-12. 24Vdc I/O Power Supply Specifications

	Description
Type	Isolated Low noise UL certified
Output voltage range	24Vdc±20%
Output current	>1A

Example: Lambda, P/N LS100-24

3.7.2 J10 – Registration MARK Inputs & PEG Output

Label: J10 I/O

Connector: standard D-type, male, 15 pin high density.

Mating connector: standard D-type, female, 15 pin high density.

Figure 3-21. J10 – I/O Connector

Table 3-13. J10 - I/O Connector

Pin	Signal	Description
1	MARK0+	Axis 0 mark input non inverted
2	MARK1+	Axis 1 mark input non inverted
3	MARK2+	Axis 2 mark input non inverted
4	MARK3+	Axis 3 mark input non inverted
5	NC	Spare
6	MARK0-	Axis 0 mark input inverted
7	MARK1-	Axis 1 mark input inverted
8	MARK2-	Axis 2 mark input inverted
9	MARK3-	Axis 3 mark input inverted
10	NC	Spare
11	PEG0+	PEG 0 output non inverted
12	PEG0-	PEG 0 output inverted
13	NC	leave it not connected
14	NC	leave it not connected
15	DGND	Digital ground.
	Connector shell and front screw locks M1, M2	SHIELD

3.7.3 Connection Instructions

Use shielded cables with twisted pairs, a minimum gauge of 24 AWG and up to 10 meters in length.

3.7.3.1 Safety and Digital Inputs configuration

The safety and digital inputs (limit switch inputs, general purpose digital inputs, encoder registration mark inputs) are factory configured to one of the following:

N- Inputs & limits: 24V/SOURCE (PNP), outputs: 24V/SOURCE (PNP).

S- Inputs & limits: 24V/SINK (NPN). Outputs: 24V/SOURCE (PNP). A

A- Inputs & limits: 5V/SOURCE (PNP). Outputs: 24V/SOURCE (PNP).

B- Inputs & limits: 5V/SINK (NPN). Outputs: 24V/SOURCE (PNP).

The 4 digital inputs (IN0 to IN3) can be used as encoder registration mark inputs as well as general purpose inputs for any other need. For more details see the *PEG and MARK Operations Application Notes*.

Unused limit switch inputs can also be used as general purpose inputs.

To use limits as general purpose inputs, clear the default response to the fault, using the following command:

```
FDEF(<axis number>).#RL = 0
```

or

```
FDEF(<axis number>).#LL = 0
```

To monitor the status of such inputs use the following command:

```
FAULT(<axis_number>).#RL or FAULT(<axis_number>).#LL
```

Example of an automatic routine that disables the motor when such an input is activated:

```
ON FAULT(0).#RL;
      Disable (0);
RET;
```

For more information, see the *SPiiPlus Command & Variable Reference Guide*.

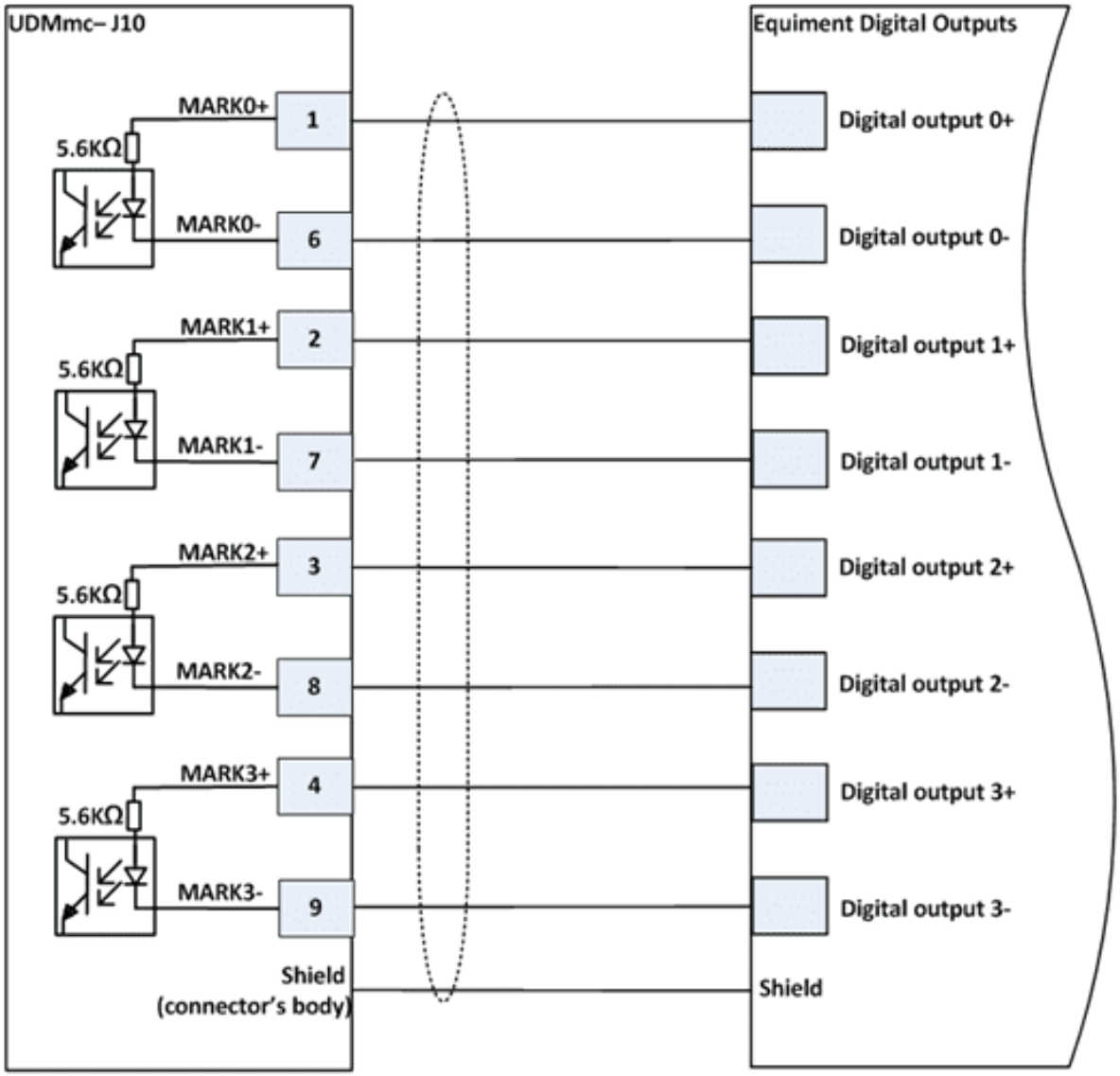

Figure 3-22. Registration MARK Inputs Two Terminal Connections

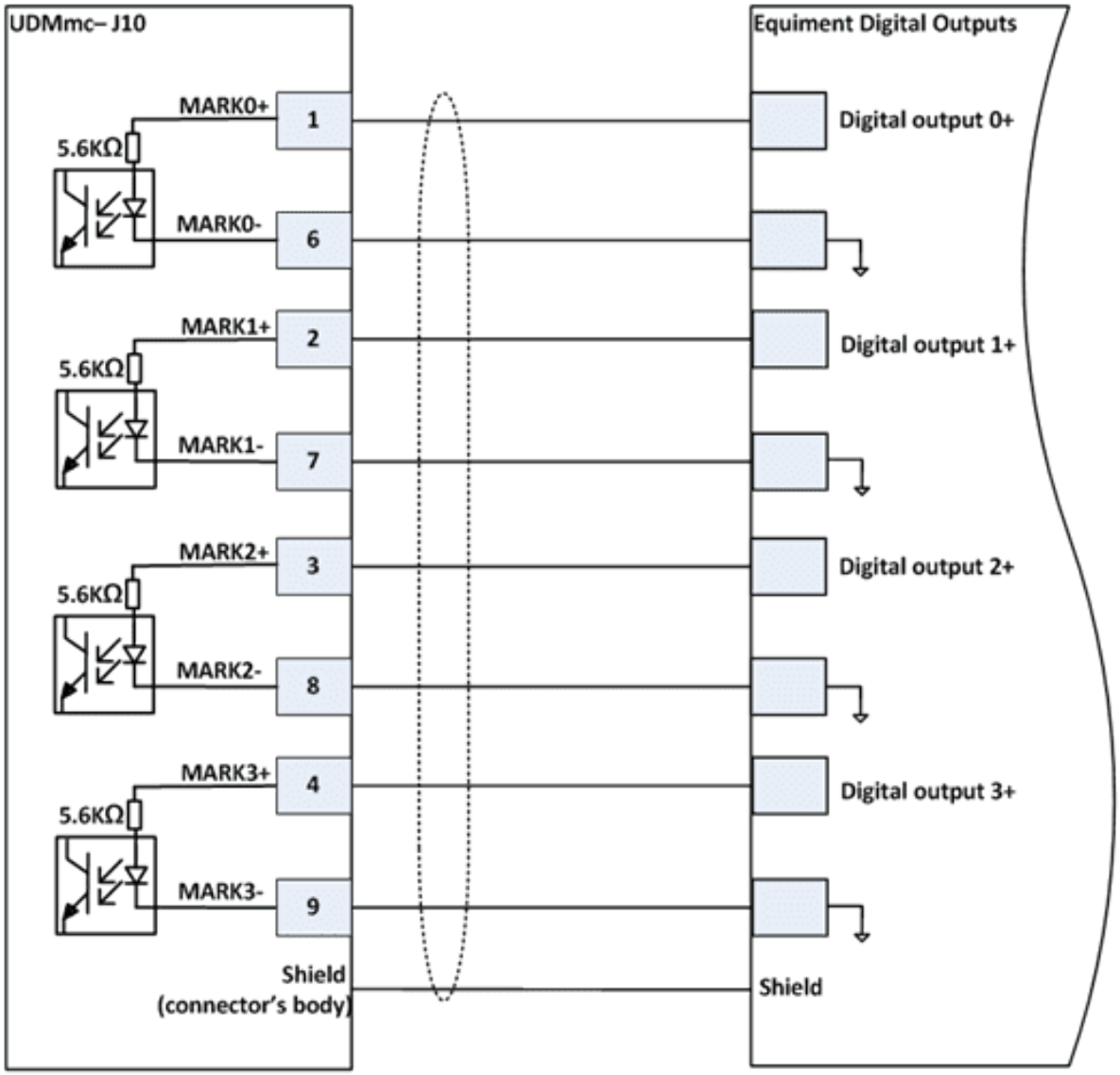

Figure 3-23. Registration MARK Inputs Single Ended Terminal Connections

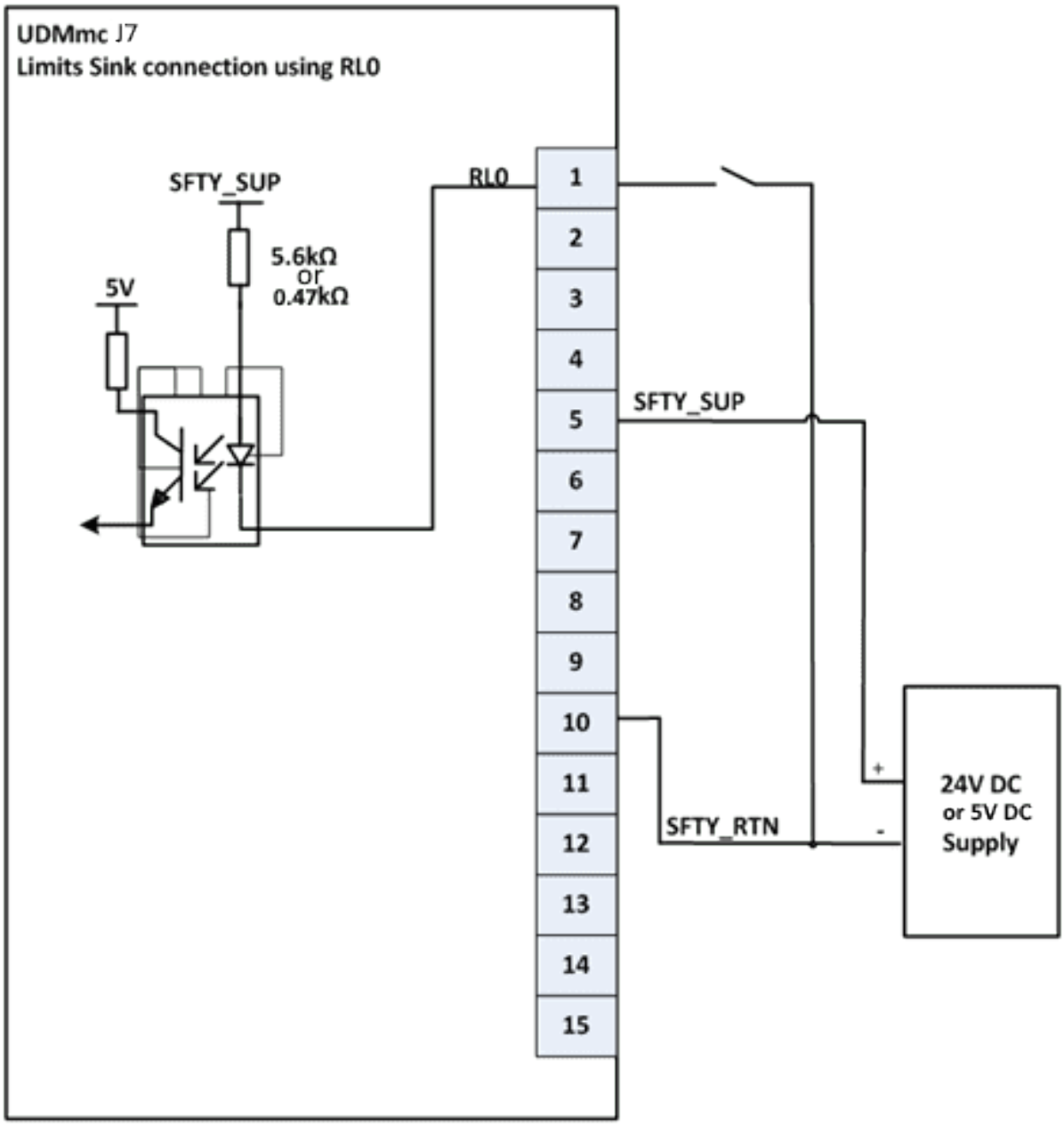

Figure 3-24. Example of Limit Inputs Sink (NPN) Type Connections (Outputs)

A 5 kΩ resistor should be used with a 24V DC source, 0.47 kΩ with a 5V DC source.

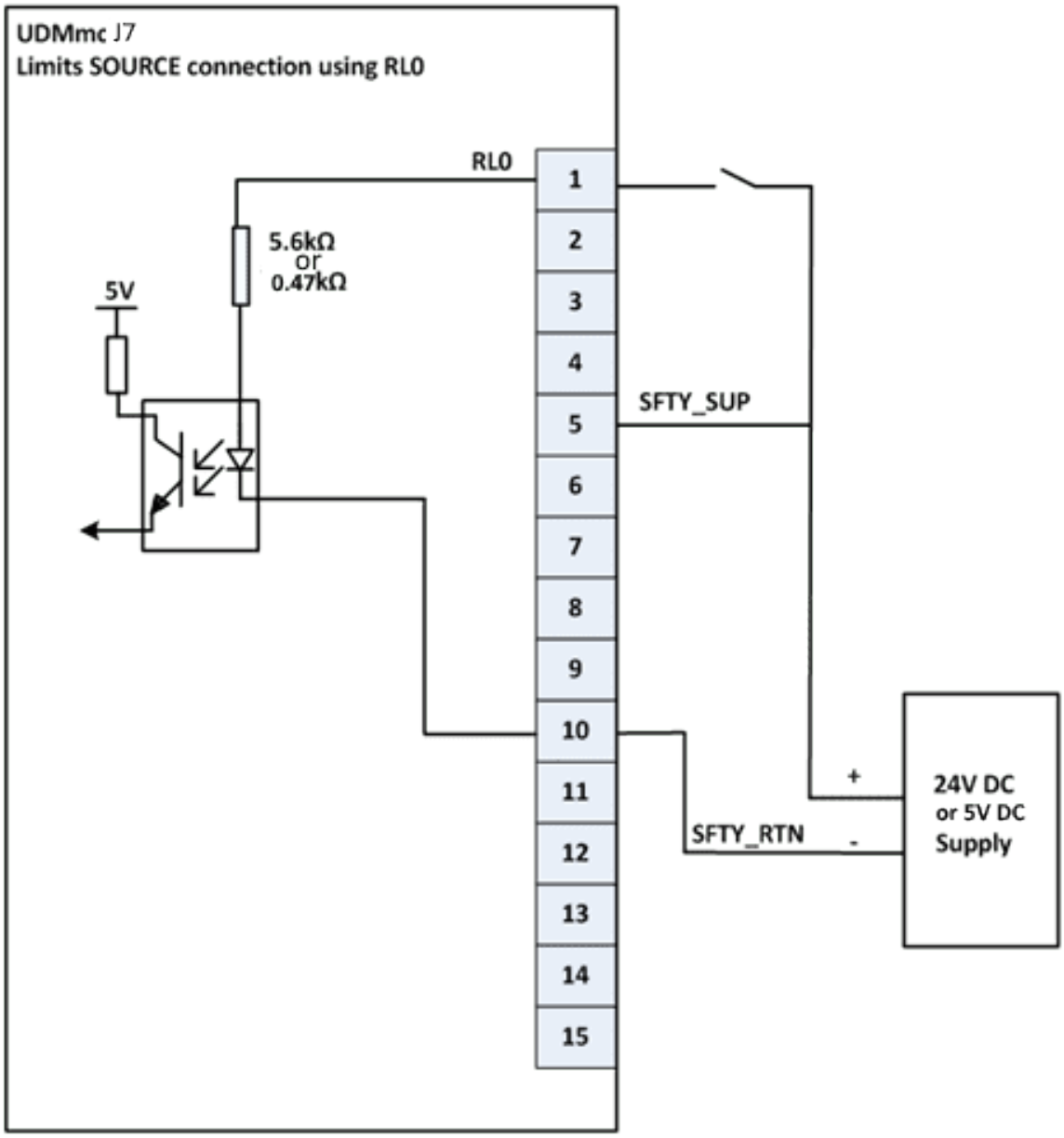

Figure 3-25. Example of Limit Inputs Source (PNP) Type Connections

A 5 kΩ resistor should be used with a 24V DC source, 0.47 kΩ with a 5V DC source.

3.7.3.2 Brake & PEG Outputs

The 4 opto-isolated, 24Vdc, 0.5A digital outputs are configured as Source (PNP) type.

The 4 motor brake outputs can be used as general purpose outputs.

Unused brake outputs can be used as general purpose outputs. For more information, see the *SPiiPlus Command & Variables Reference Guide*.

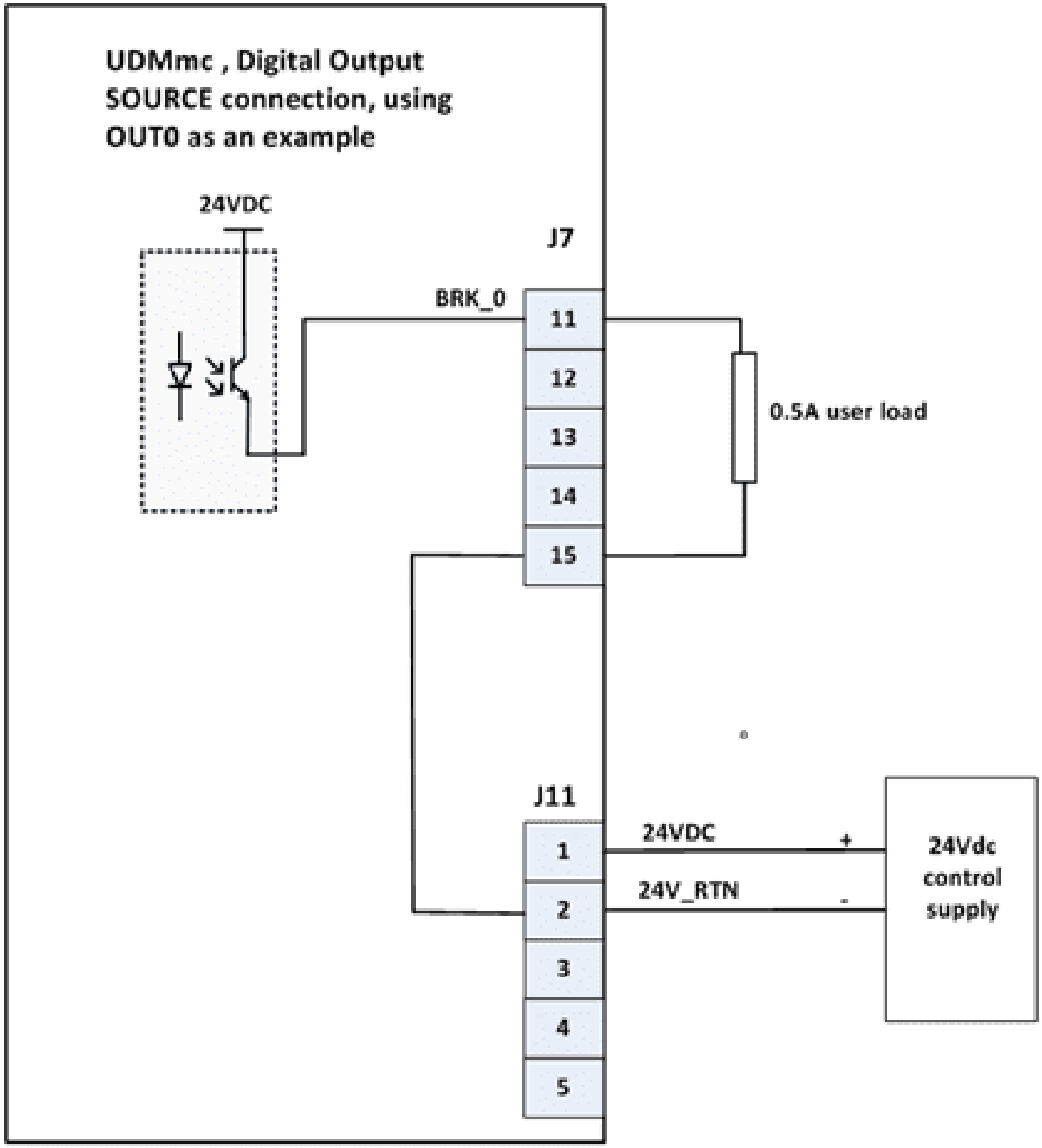

Figure 3-26. Example of Brake & Digital Outputs Source (PNP) Type Connections

3.7.3.3 Position Event Generation (PEG) Output

UDMmc has one PEG_Pulse output. The user can program the controller to generate pulses at the exact location(s) of an axis. See *SPiiPlus NT PEG and MARK Operations 2.21 Application Note*.

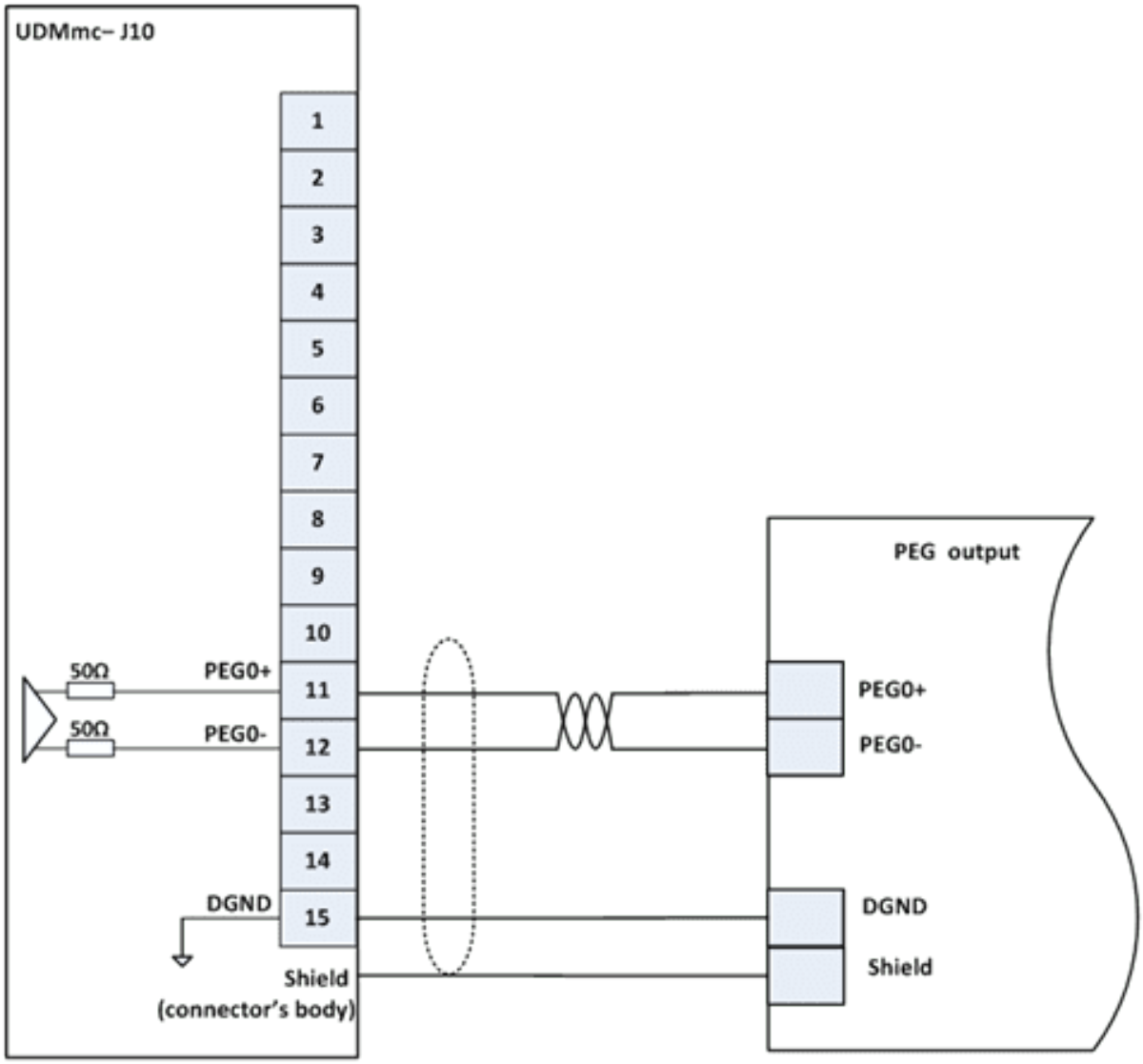

Figure 3-27. PEG Output Connections

3.8 EtherCAT

3.8.1 Connection Instructions

Use Ethernet cables CAT 5e or better. ACS offers standard cables in different lengths, see Optional Accessories.

Connect EtherCAT cable between the EtherCAT master unit or preceding slave to J4 (ETHERCAT IN).

When the UDMmc is not the last network node, connect EtherCAT cable between J3 and EtherCAT IN of the next EtherCAT slave.

When the UDMmc is the last network node and a ring topology is used, connect J3 to the EtherCAT Master secondary port.

When the UDMmc is the last network node and a line topology is used, leave J3 not connected.

3.8.2 J4 - EtherCAT IN and J3 – EtherCAT OUT

Labels: J4 EtherCAT IN, J3 EtherCAT OUT

Connectors: standard RJ45, 8P8C, (for example Wurth Elektronik, PN 615008137421)

Mating cable with connectors: Standard Ethernet cables CAT5e.

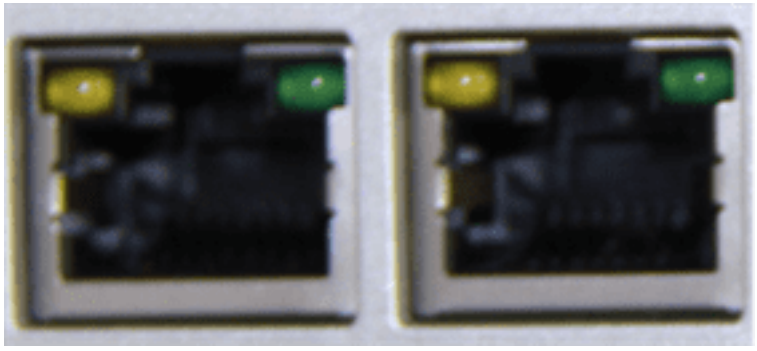

Figure 3-28. J4, J3 - EtherCAT Connector

Table 3-14. J4, J3 - EtherCAT Connector

Pin	Signal	Description
1	TD_0+	Transmit +
2	TD_0-	Transmit -
3	RD_0+	Receive +
4	--	Not connected
5	--	Not connected
6	RD_0-	Receive -
7	--	Not connected
8	--	Not connected

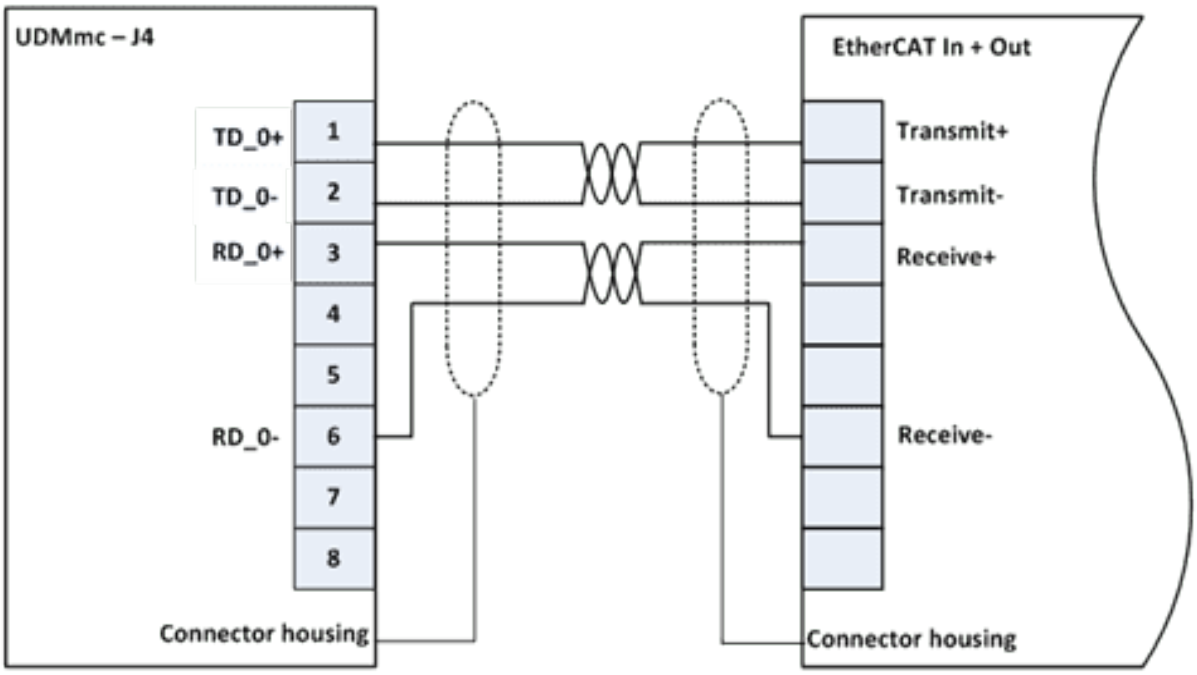

Figure 3-29. EtherCAT Connections

4. Product Specifications

This section provides detailed technical specifications of the UDMmc, including drive power ratings, interfaces, dimensions, environmental conditions, and standards.

Per Drive	2.5A	5A	10A	20A
Continuous/peak current Sine amplitude [A]	2.5/5	5/10	10/20	20/40
Continuous current RMS [A]	1.75/3.5	3.5/7	7/14	14/28
Heat dissipation [W]	1	1.2	3	8
Maximum cont./peak output power @80Vdc [W]	155/310	313/625	625/1250	1250/2500
Maximum cont Input current [A]	2	4	8	16
Peak current time [sec]	1			
Minimum load onductance @80Vdc {mH]. Can be derated for lower voltages.	0.05			
Per Module				
Maximum cont input current per module [A]	40			
Maximum motor voltage [Vdc]	(Vin motor) x 92%			

4.1 Drives

- Type: digital current control with field oriented control and space vector modulation:
  - Current ripple frequency: 40 kHz
  - Current loop sampling rate: 20 kHz
- Programmable current loop bandwidth: up to 5 kHz

- Commutation type: sinusoidal. initiation with and without hall sensors
- Switching method: advanced unipolar PWM
- Protection: over & under voltage, phase to phase and phase to ground short, over current, over temperature

4.2 Supply

The drive must be supplied by two power sources:

- motor supply
- 24Vdc control & logic supply

During emergency conditions there is no need to remove the 24Vdc control supply.

4.2.1 Motor Supply

Range: 12Vdc to 80Vdc

Current rating should be calculated based on actual load.

External shunt power resistor, activated at 83V, should be added in parallel to motor supply, which must not exceed 85V under any operating conditions.

4.2.2 Control Supply

- Control supply input voltage: 24Vdc ± 20%
- Maximum input power:
  - Without motor brakes:19W (0.8A @ 24Vdc)
  - With 4 motor brakes: 67W (2.8A @ 24Vdc)

4.3 Motor Type

DC Brush, Voice coil

2 & 3 phase AC synchronous (DC brushless servo) motor

2,3 & 5 phase step motor

Always using high resolution microstepping.

5-phase step motor support is not a standard feature. Please contact ACS if you need to control such a motor.

4.4 Feedback

Types: incremental digital encoders, optional: absolute encoders

4.4.1 Incremental Digital Encoder

Four, one per axis.

A&B,I and Clk/Dir, Type: Differential RS-422 or single-ended

Max. rate: RS-422 - 50M quad counts/sec, Single-ended: 2M quad counts/sec.

Protection: Encoder error, not connected

4.4.2 Absolute encoders (optional)

Up to four.

EnDat 2.1(Digital)/2.2, Panasonic, Smart-Abs, and BiSS-C

4.4.3 Hall inputs

Four, a set of three per axis. Type: single-ended, 5V, source, opto-isolated

Input current: <7mA

4.4.4 5V feedback supply

Feedback devices are fed by a 5V±5% supply.

Total current provided by the internal supply: 0.5A. If more current is needed, an external supply should be used, using the dedicated connector.

4.5 Digital I/O

AXIS LIMIT INPUTS: Eight, Two per axis.

TYPE: Single-ended, 5/24V±20%, opto isolated, sink/source.

Input current: 4-14mA per input

Unused limit inputs can be used as general purpose inputs.

4.5.1 STO

STO:

Current per input <50mA.

All drives are disabled within 50mS to 200mS

4.5.2 Registration MARK (High Speed Position Capture) Inputs

Registration MARK: (High Speed Position Capture) Inputs: Four, 24V±20%, opto-isolated, two terminals.

Can be configured as 'sink' or 'source'.

Input current: 4-14mA.

Can be used as general purpose inputs.

4.5.3 Motor Brake Outputs

Motor Brake Outputs: Four, opto-isolated, source, 24V±20%, 0.5A.

Can be used as general purpose outputs.

4.5.4 Position Event Generator (PEG)

Position Event Generator (PEG): One, RS422. Can be used as general purpose output.

Pulse width 26nSec to 1.75mSec.

Maximum rate: 10MHz

PEG does not work with absolute encoders.

4.6 Drive and Motor Protection

- Over & under Voltage
- Short circuit: Phase-to-phase, Short to ground
- Over current

The drive and motor over current (overload) protection parameters are defined and adjusted in the SPiiPlus MMI Application Studio. This is done in the Adjuster Wizard. Make sure that the over current (overload) protection tripping time at the adjustment will be not more than the following, where Ie is the rated motor current..

Motor current (*Ie)	Tripping time (sec)
7.2	12
1.5	353
1.2	711

The thermal memory retention values are also adjusted in the Adjuster Wizard. The slowest thermal memory retention behavior is shown in Figure 4-1 below, where:

- Blue for motor current 7.2*Ie
- Brown for motor current 1.5*Ie
- Yellow for motor current 1.2*Ie.

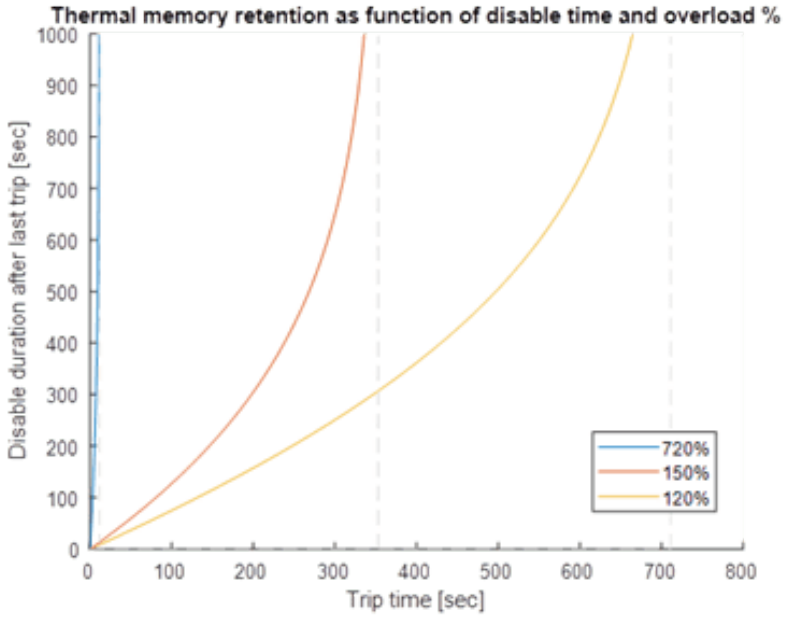

Figure 4-1. Thermal retention

These drives provide adjustable solid state motor overload (over current) protection, not speed-sensitive. If such protection is needed in the end-use product, it needs to be provided by additional means.

> Over temperature

4.7 Environment

Operation:

> for units without STO: 0 to + 50°C
> for units with STO: 0 to 40°C (see STO temperature requirements)

Storage and transportation: -25 to +60°C

Humidity (operating range): 5% to 90% non-condensing

4.8 Communication

Two EtherCAT ports, In and Out, RJ45 connector

4.9 Dimensions

152 x 138 x 48 mm^3

4.10 Weight

1,000 [gram]

4.11 Accessories

UDMmc-ACC1: Mating connectors kit for drives, encoders and I/Os

STO-ACC1: Cable for STO with mating connector

5. Compliance with Standards

Complies with the following standard:

5.1 CE

Safety: EN 61800-5-1 , Pending.

EMC: EN 61326:2002 , Pending.

Complies to the above standard, an AC line filter must be used.

Complies to the above standard, a Motor filter must be used.

5.2 Environment

The design complies with ROHS requirements.

5.3 UL

UL-508C

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