UDMcb

Installation and Carrier Board Design Guide

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ACS MOTION CONTROL

UDMcb

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Revision History

Date	Revision	Description
July 2018	1.07	Added support for BISS-C and EnDAT 2.2 encoders
April 2018	1.06	Added caution for short circuit of motor phase
January 2018	1.05	Removed support for 3 sin-cos encoders
January 2018	1.04	Updated current input specification for Registration MARK inputs
December 2017	1.03	Updated for STO, UL, EMC certifications Updated presentation for incremental digital encoders
August 2017	1.02	Updated list of supported motors
March 2017	1.01	Removed support for absolute encoders
January 2017	1.00	First release

Conventions Used in this Guide

Text Formats

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

Flagged Text

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

Related Documents

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

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

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

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1. Introduction

1.1 Document Scope

The UDMcb is a chip-like module mounted on a custom carrier circuit board. This document provides product installation instructions and design guidelines for the carrier board. The following are described:

- mechanical dimensions
- Electrical interface connectivity
- Carrier board design guidelines
  - Mechanical structure requirements
  - Circuits implemented on the carrier board

1.2 Product Overview

The UDMcb is a dual-axis PWM drive module. The UDMcb is a slave drive that works with any ACS EtherCAT controller. It operates with 12-60Vdc or 12-100Vdc (drive supply) and provides continuous/peak current options of 3.3/10A, 6.6/20A, 10/30A, and 13.3/40A.

1.2.1 Package Contents

The UDMcb package contains the following items:

- UDMcb module

1.2.2 Optional Accessories

None.

1.2.3 Order Part Number

The ordered part number (P/N) contains several characters, each which specify a configuration characteristic ordered for the UDMcb module, as shown on the following label and described in the following table.

Figure 1-1. UDMcb Label with Ordered P/N - Example

As an example, P/N UDMcb2AA0N0CBAN would represent the configuration described in the following table.

Table 1-1. UDMcb P/N example

Field		1	2	3	4	5	6	7	8	9	10

P/N	UDMcb	2	A	A	0	N	0	C	B	A	N

The UDMcb is shipped with the configuration ordered. Modifications can be done by ACS only.

Table 1-2. UDMcb Configuration as indicated by P/N

Ordering Options	Field	Example User Selection	Available Ordering Option Values
Number of axes/drives	1	2	1,2
Current	2	A	A - 3.3/10A B - 6.6/20A C - 10/30A D - 13.3/40A
Maximum voltage	3	A	A - 60V B - 100V
500kHz Sin-Cos encoder interface	4	0	0,1,2
Absolute encoders type	5	N	U - All N - None E - ENDat 2.2, 2.1 (digital only), B - Biss-A/B/C, I - SSI
Number of Absolute encoders interface*	6	0	0, 1, 2
Limit switch inputs	7	C	A - 5V, Source/PNP B - 5V, Sink/NPN C - 24V, Source/PNP D - 24V, Sink/NPN
Digital Inputs	8	B	A - 5V, two-terminal B - 24V, two-terminal
Digital Outputs	9	A	A - Source/PNP, 5V & 24V B - Sink/NPN, 5V & 24V
Special options	10	N	N - No

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

2. Mechanical Description

The UDMcB is a chip-like module which is mounted on a carrier printed circuit board. The carrier printed circuit board is customer provided. The overall dimensions of the UDMcB and the location of the mounting holes are shown in the following figure. For details on mounting the UDMcB onto a carrier board see Mechanical considerations.

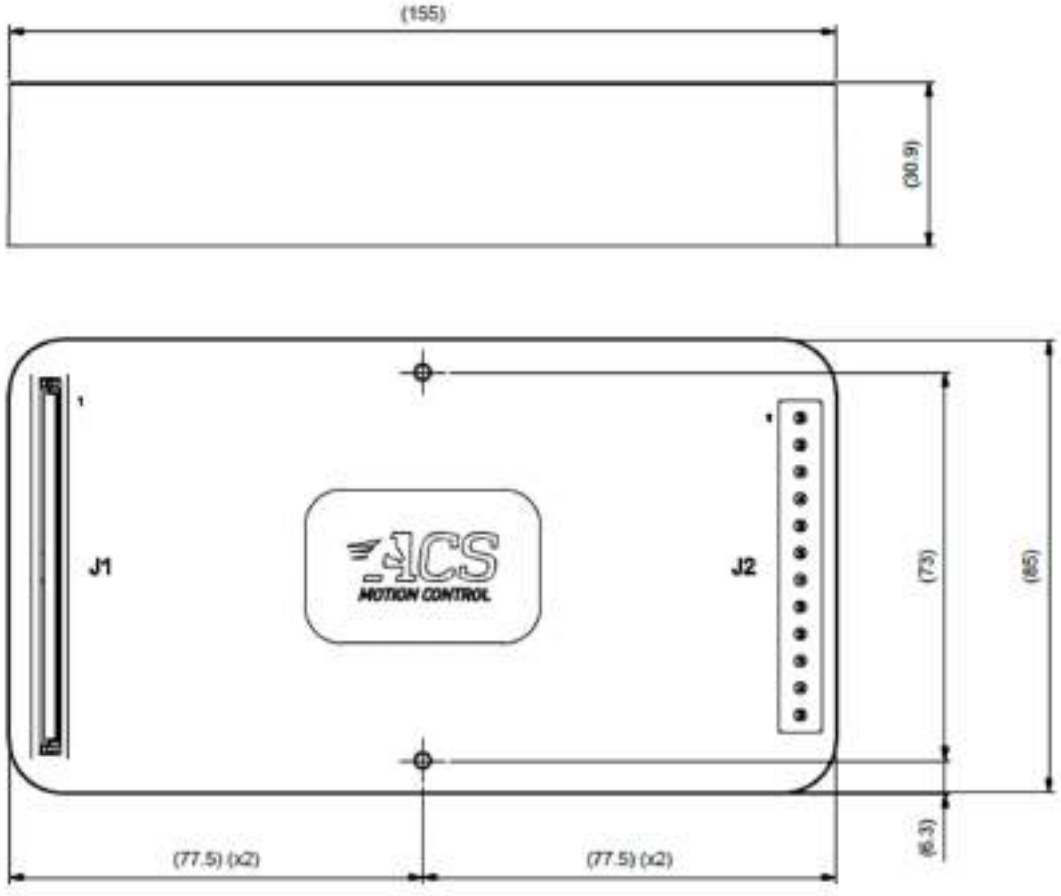

Figure 2-1. UDMcB Dimensions

3. Electrical Interface Description

This section describes how to interface with the UDMcb.

3.1 Connections

The following figure is a standard representation of connections and grounding. Specific settings and configurations are described in the following subsections. The connector assignments are in Table 3-1.

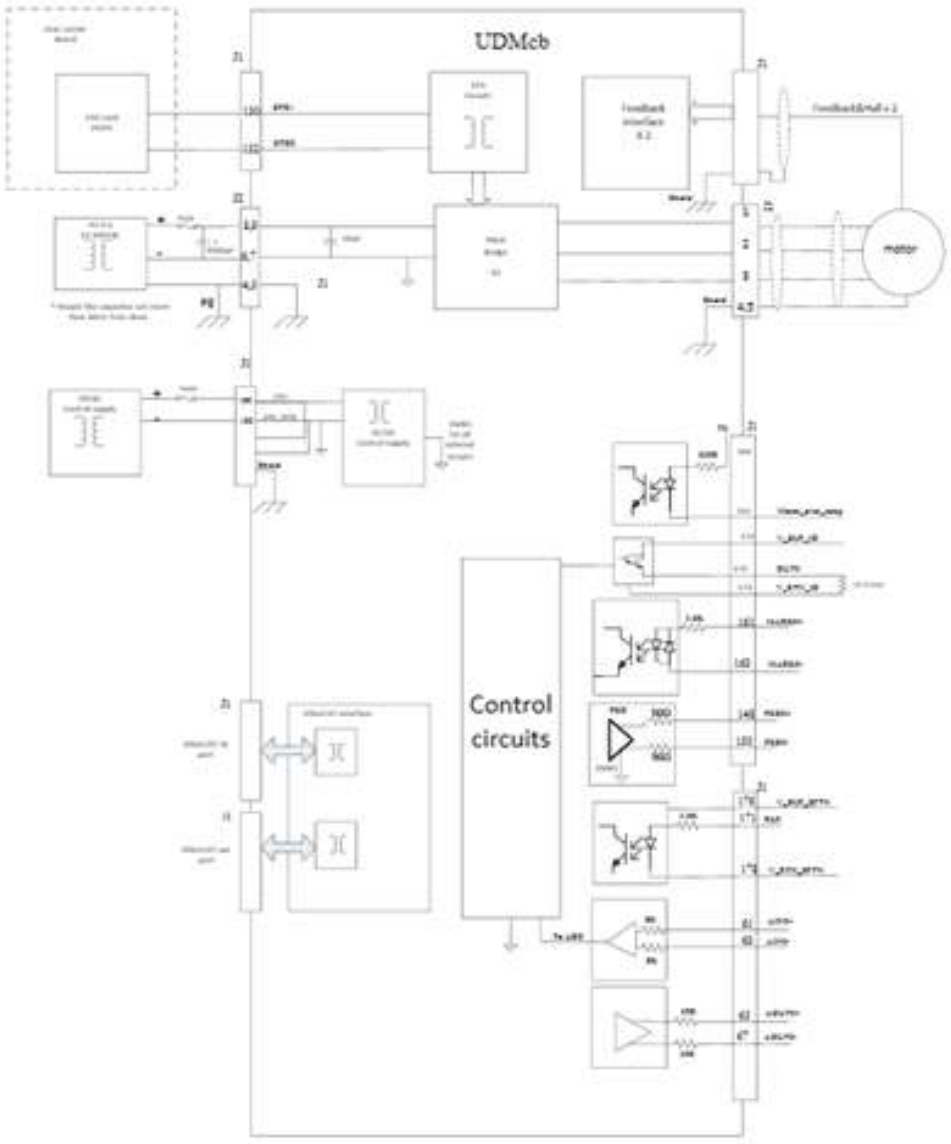

Figure 3-1. Connections and Grounding

Table 3-1. UDMcb Connections

Connector Assignment	Connector Name	Description
J1	Low power signals	Control power supply, encoders, I/Os, and all other low power signals
J2	High power signals	Drive power supply, motors

3.1.1 Position Feedback

The position feedback sensors supported by the UDMcb are the following:

- Incremental digital encoders
- Analog SIN-COS encoders

Specific settings and configurations are described in the subsections below.

3.1.1.1 Incremental Digital Encoder

The following incremental digital encoder types are supported:

- A,B,I
- A,B,I with Hall channels or commutation track
- Clk/Dir
- Clk/Dir with Hall channels or commutation track

The UDMcb module supports up to two incremental digital encoders.

The incremental digital encoder interface for A,B,I inputs and Hall signals is shown in Figure 3-2 and the interface for Clk/Dir inputs and Hall signals is show in Figure 3-3.

The internal UDMcb supply for digital encoders is limited to 0.5A. An encoders current consumption may exceed this value. A 5V power supply on the carrier board to supply the encoders is recommended.

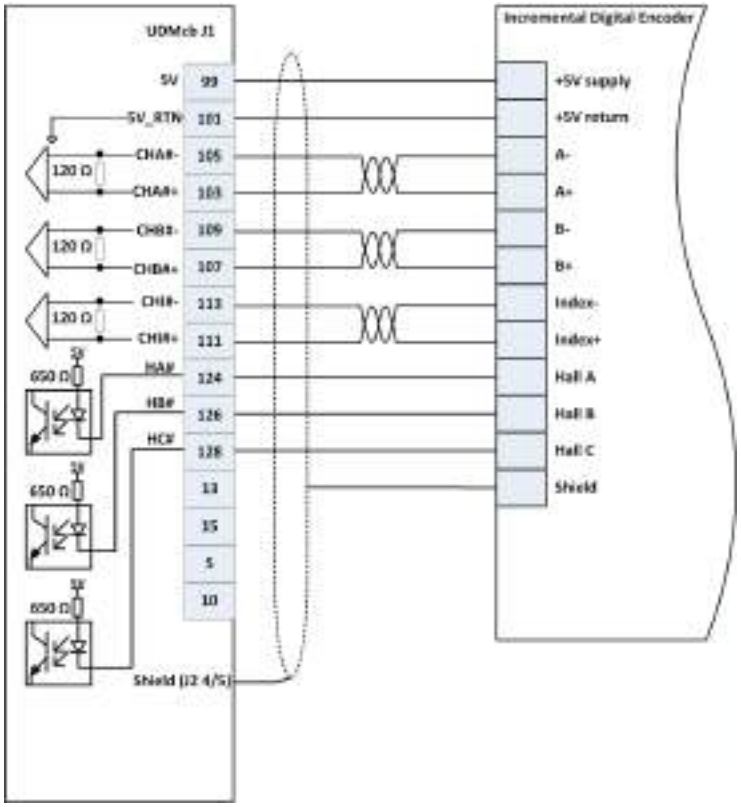

Figure 3-2. Incremental Digital Encoder - AqB Connection

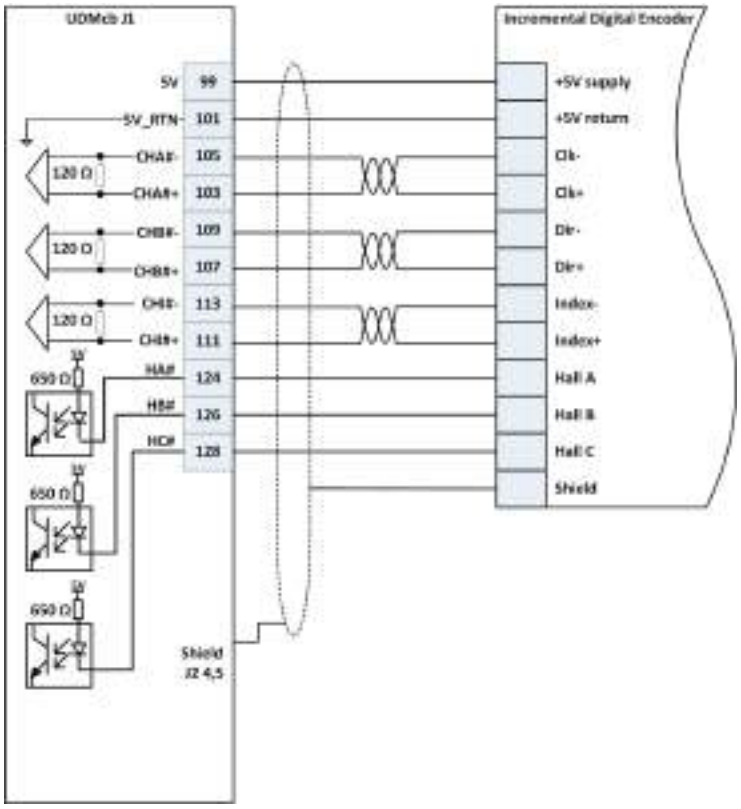

Figure 3-3. Incremental Digital Encoder - Clk/Dir Connection

3.1.1.2 Incremental Analog SIN-COS Encoder

The UDMcB module supports two analog SIN-COS encoders.

The analog SIN-COS encoder interface is shown in the following figure.

The internal UDMcB supply for analog SIN-COS encoders is limited to 0.5A. An encoders current consumption may exceed this value. A 5V power supply on the carrier board to supply the encoders is recommended.

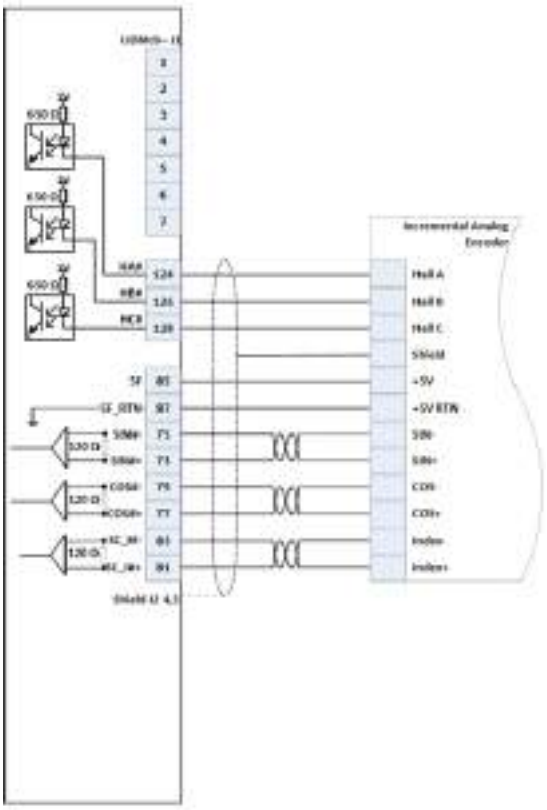

Figure 3-4. Analog SIN-COS Encoder

3.1.1.3 Commutation Feedback

Both digital Hall sensors or commutation tracks that are part of an incremental digital encoder are supported. Both utilize the same interface, see Incremental Digital Encoder for pin assignments.

3.1.1.4 Limit Switch Inputs

The UDMcB provides two limit switch inputs per axis. One left and one right. 5/24V, source/sink connection are factory setting and defined in the part number. See Limit switch inputs for detailed specifications.

Unused safety inputs can be used as a general purpose inputs. Figure 3-5 shows a 24V source connection and Figure 3-6 shows a 24V sink connection.

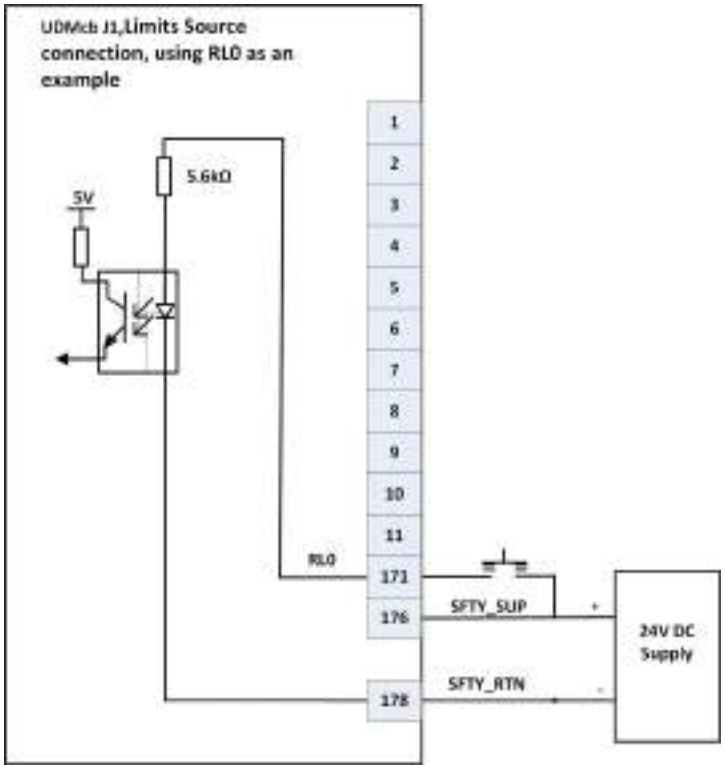

Figure 3-5. Limit Source Connection

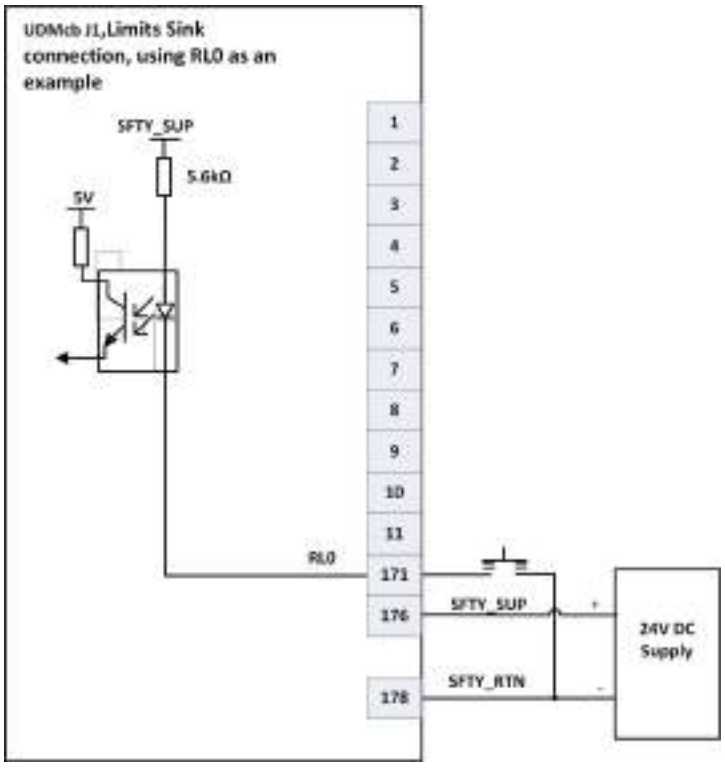

Figure 3-6. Limit Sink Connection

3.1.1.5 Analog I/O Connections

Two analog inputs and two analog outputs are provided, see Analog Inputs or Analog Outputs for detailed specifications. The following figure shows the analog I/O connection.

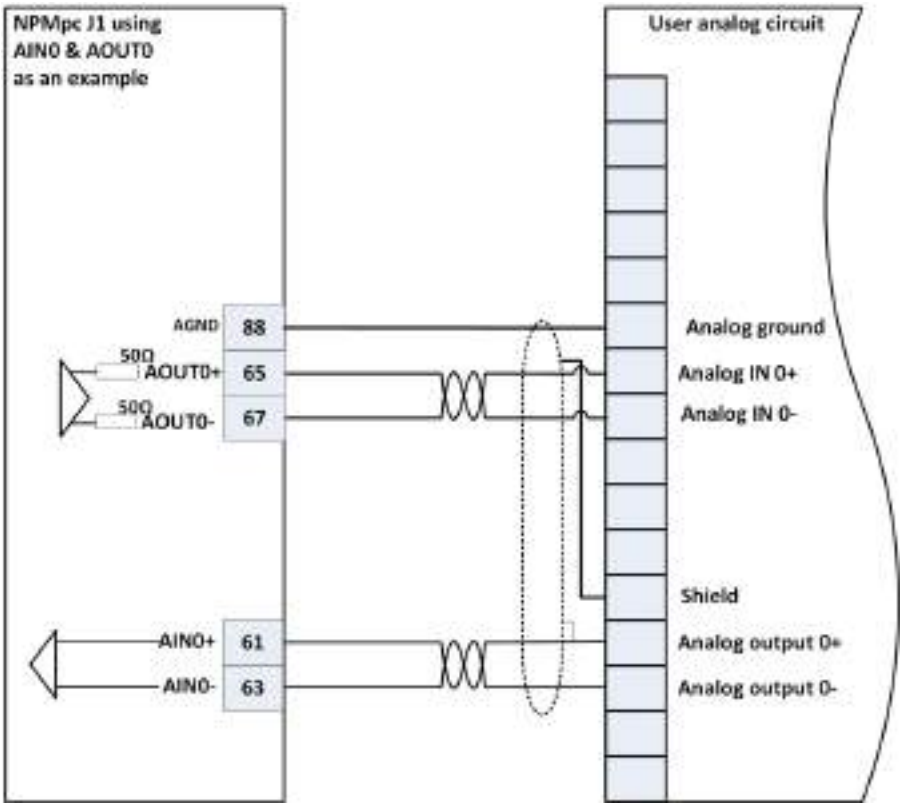

Figure 3-7. Analog I/O Connections

3.1.1.6 Digital Inputs

There are four digital MARK inputs. The configuration options are for either 24V or 5V and a current source or current sink. The selection is made when the UDMcb is ordered. See Registration MARK Inputs for detailed specifications. Unused digital inputs can be used for general purpose inputs. Figure 3-8 shows the digital input connection.

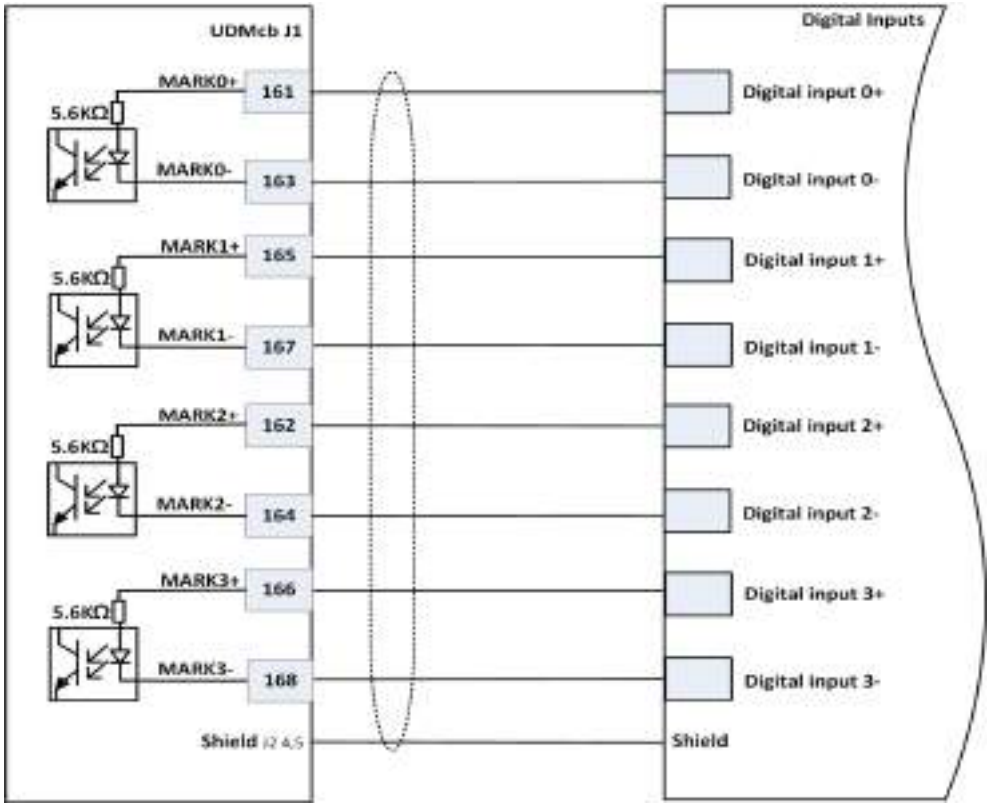

Figure 3-8. Digital Input Connections

3.1.1.7 Digital output and motor brake

There are two digital outputs available for motor brakes. Unused digital outputs can be used as general purpose outputs. 5/24V, source/sink connection are factory setting and defined in the part number. Figure 3-9 shows a 24V source connection and Figure 3-10 shows a 24V sink connection.

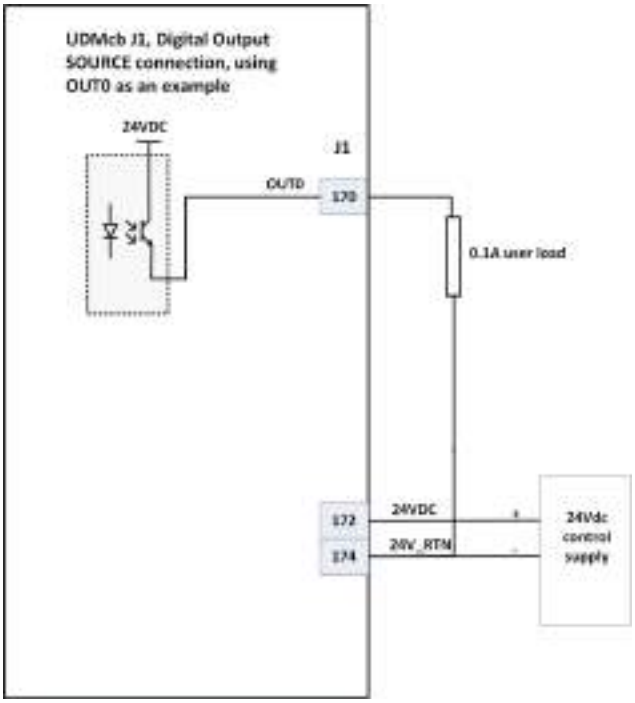

Figure 3-9. Digital Output 24V Source Connecton

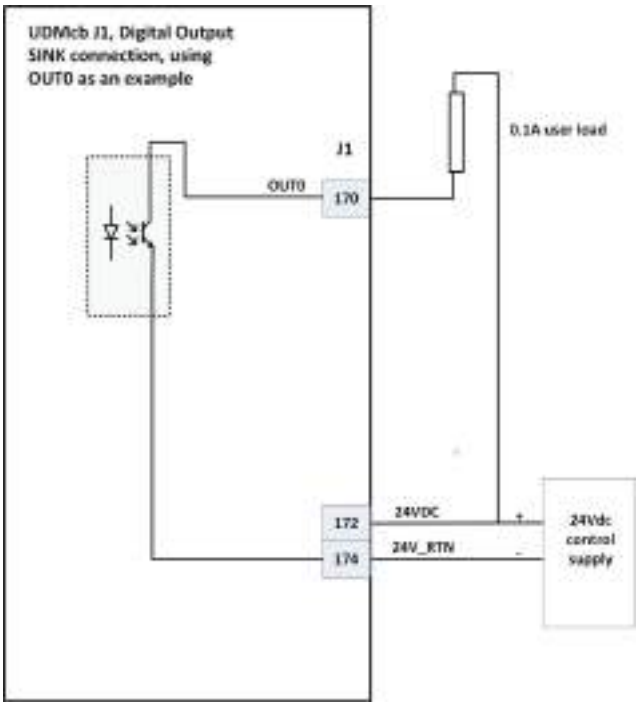

Figure 3-10. Digital Output 24V Sink Connection

3.1.1.8 Position Event Generator (PEG) Output

The UDMcb supports two PEG output signals. A PEG output signal is either a PEG pulse or PEG STATE signal. Unused PEG outputs can be used as general purpose outputs, see PEG (Position Event Generator) for detailed specifications. See *PEG and MARK Operations Application Note* for programming information. The following figure shows the digital PEG output connection.

The PEG operates either with an incremental digital encoder or with an analog encoder at an encoder zero crossing.

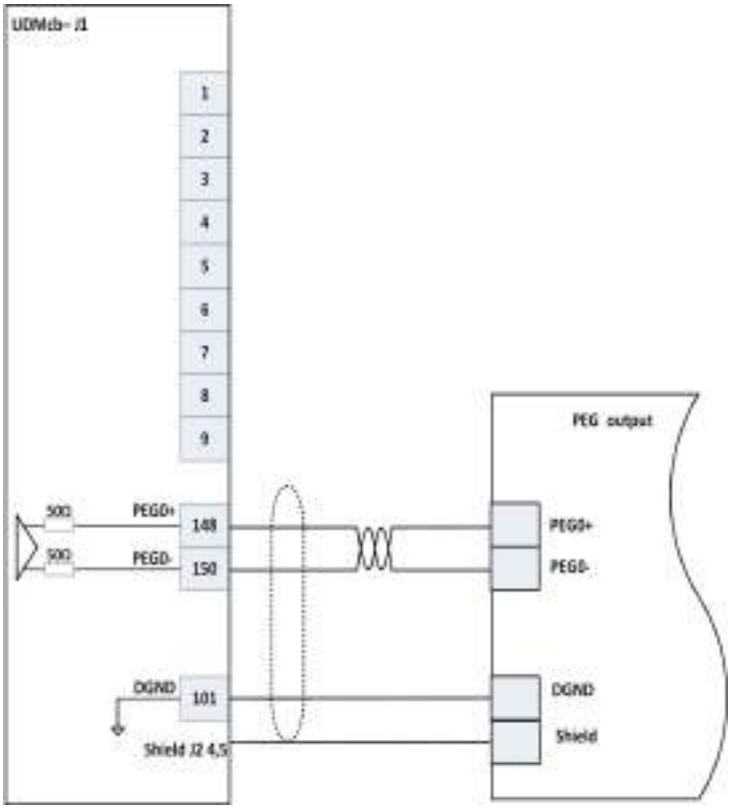

Figure 3-11. PEG Output Connection

3.1.2 Motors

The UDMcb supports the following motors:

- Two- and three-phase permanent magnet synchronous (DC brushless/AC servo)
- DC brush
- Voice coil
- Two- and three-phase stepper (micro-stepping open or closed loop)

For motor connections with relays see Motor connection with relays.

Figure 3-12 shows the connectivity diagram for a single-phase motor. Figure 3-13 shows the connectivity diagram for a three-phase motor.

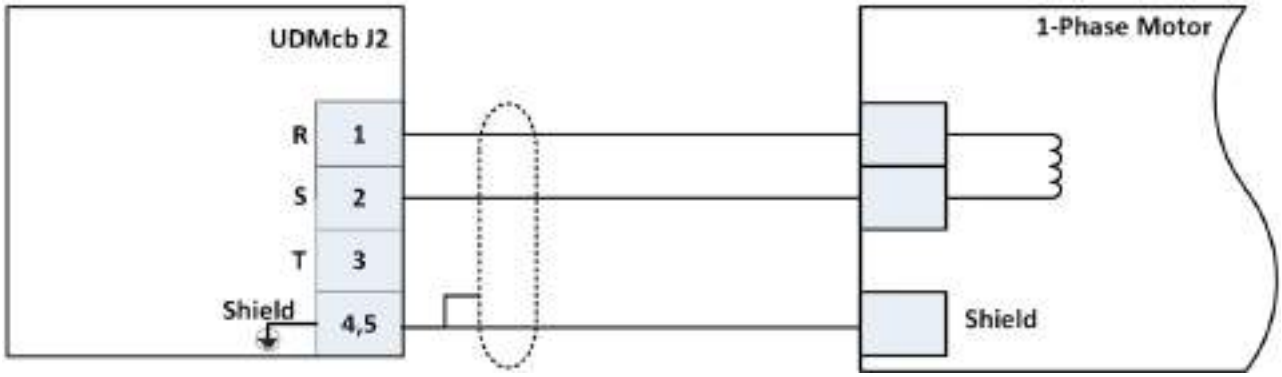

Figure 3-12. Single-Phase Motor Connections

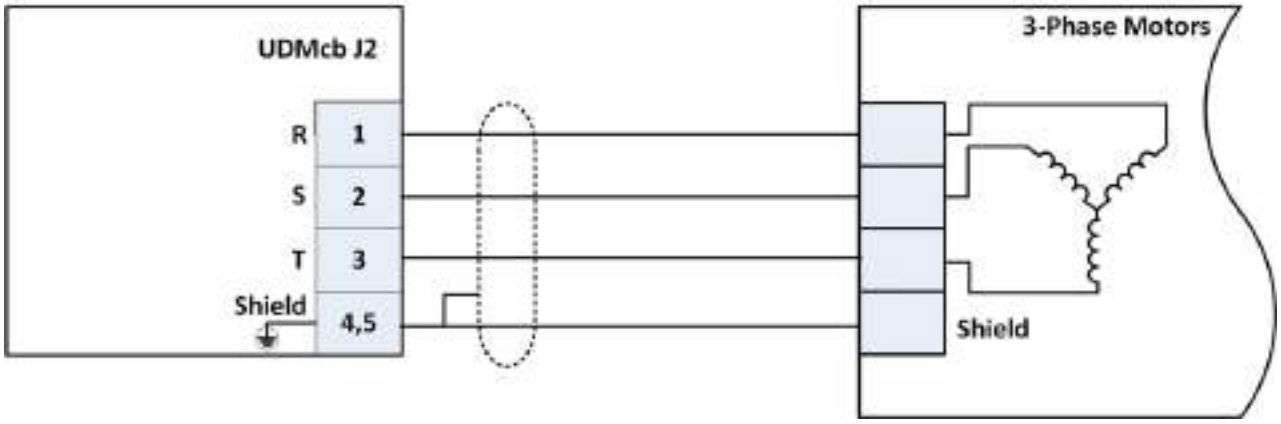

Figure 3-13. Three-Phase Motor Connections

3.1.3 Control and drive power supplies

The UDMcb is fed by two power supplies:

- 24Vdc control supply
- 12-60Vdc or 12-100Vdc drive supply

The supplies can be turned on and off in any order. During emergency situations, the drive supply can be disconnected while the control supply may remain connected.

3.1.3.1 Control Supply Guidelines

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

- The control power supply must be isolated.
- The control power supply must be CE and UL approved.
- The control power supply must be short circuit protected.
- The control power supply must have very low noise and ripple.
- The control power supply must be connected to the unit via 2A fuse.
- An example of a suitable 24V/50W control power supply is the XP Power P/N VCS50US24 supply.

> To comply with European standards (CE), it is recommended to use an AC line filter.

For detailed specifications including current load with and without motor relays see Control Supply. The following figure shows the control supply connections.

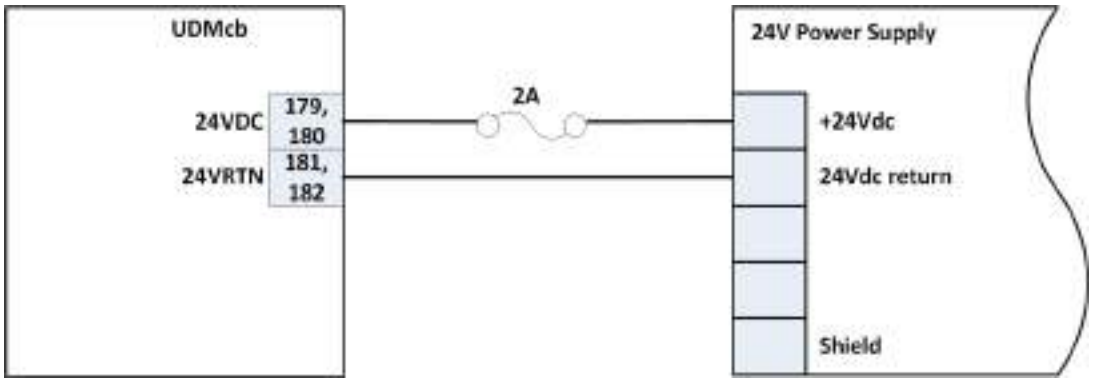

Figure 3-14. Control Supply Connections

3.1.3.2 Drive Supply Guidelines

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

> The drive power supply must be isolated.

> The drive power supply must be CE and UL approved.

> The drive power supply must be short circuit protected.

> The drive power supply must have very low noise and ripple.

There is no regeneration circuit in this product, it is the user's responsibility to make sure that the DC drive supply voltage will not exceed the 63Vdc for 60Vdc version and 103V for 100Vdc drive.

> The drive power supply must be able to provide the peak current required by the motor (inductance load). Adding an external capacitor of 4400uF, installed as close as possible to the drive (no further than 30cm from the drive), can help the power supply to handle the peak current and reduce the bus current ripple.

> The drive power supply must be selected based on the power consumed by drive 1 and drive 2 (if applicable).

> The drive power supply must be connected to the unit via fuse. The value of the fuse depends on the power supply voltage and the current consumption. A fast active fuse (NON-30A) is recommended.

> The HPU1K5PS48 by XP Power is an example for a 48Vdc/1500W drive power supply.

> To comply with European standards (CE), it is recommended to use an AC line filter. The value of the filter depends on the power supply voltage and the current consumption. The filter has to be as close as possible to the UDMcb.

For detailed specifications see Drive specifications. The following figure shows the drive supply connection.

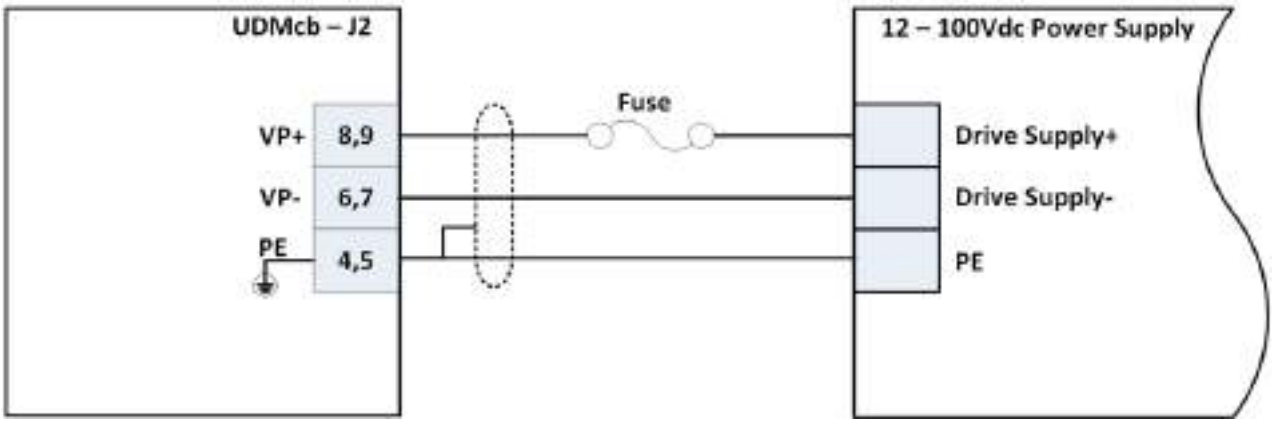

Figure 3-15. Drive Supply Connections

3.1.4 EtherCAT Connection Instructions

The UDMcb communicates through EtherCAT lines only. It has two ports. One In and one Out. The following figure shows the EtherCAT connection.

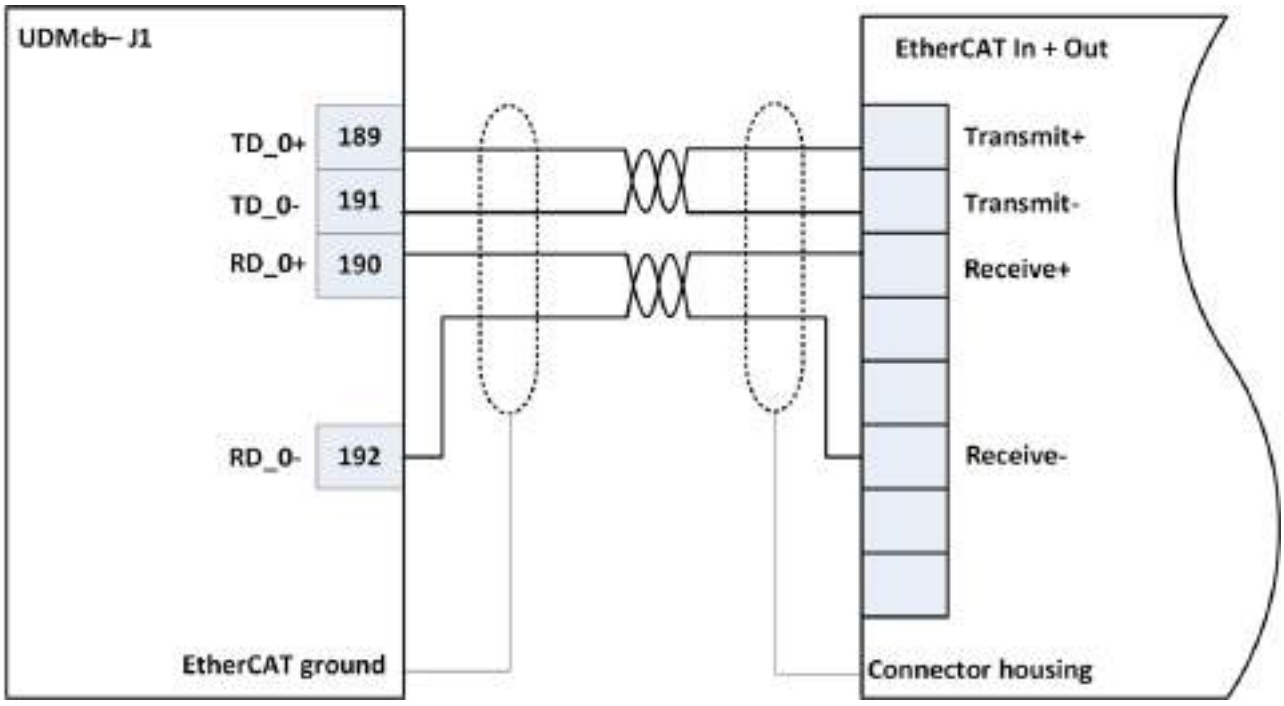

Figure 3-16. EtherCAT Connections

3.1.5 Low and High Power Signal Connectors

The following figure shows connector J1 and connector J2 for the UDMcb. Pin-1 and pin-2 on J1 and pin-1 on J2 are indicated with a red arrow, respectively.

Figure 3-17. UDMcb Connectors

3.1.5.1 J1 - Low Power Signals Connector

Label: J1

Figure 3-18 shows the connector on the UDMcb, Figure 3-19 shows the mating connector for the carrier board, and Table 3-2 lists the signal pinouts.

Figure 3-18. Connector: Molex P/N 536272074

Figure 3-19. Mating connector: Molex P/N 528852074

Mating connector: Molex P/N 528852074

Table 3-2. J1 - Low level signals pinout

Pin	Name	Description
1	AIN2+	Not used
2	AIN3+	Not used

Pin	Name	Description
3	AIN2-	Not used
4	AIN3-	Not used
5	AOUT2+	Not used
6	AOUT3+	Not used
7	AOUT2-	Not used
8	AOUT3-	Not used
9	CMD1_0+	Not used
10	CMD1_1+	Not used
11	CMD1_0-	Not used
12	CMD1_1-	Not used
13	SIN0+	Not used
14	SIN1+	Not used
15	SIN0-	Not used
16	SIN1-	Not used
17	COS0+	Not used
18	COS1+	Not used
19	COS0-	Not used
20	COS1-	Not used
21	SC_I_0+	Not used
22	SC_I_1+	Not used
23	SC_I_0-	Not used
24	SC_I_1-	Not used
25	1_DSW1	Not used
26	FLT1	Not used

Pin	Name	Description
27	1_DSW2	Not used
28	ENA1	Not used
29	1_DSW3	Not used
30	AXIS1_ DIS_LED	Axis 1 disable LED (red)
31	1_DSW4	Not used
32	AXIS1_ ENA_LED	Axis 1 enable LED (Green)
33	2_CHA+	Not used
34	3_CHA+	Not used
35	2_CHA-	Not used
36	3_CHA-	Not used
37	2_CHB+	Not used
38	3_CHB+	Not used
39	2_CHB-	Not used
40	3_CHB-	Not used
41	2_CHI+	Not used
42	3_CHI+	Not used
43	2_CHI-	Not used
44	3_CHI-	Not used
45	PEG1+	PEG output 1 non-inverted (SW programmable, default assignment encoder 1, see *PEG and MARK Operations Applicsation Note*)
46	DR_IN1_0	Not used

Pin	Name	Description
47	PEG1-	PEG output 1 inverted (SW programmable, default assignment encoder 1, see *PEG and MARK Operations Application Note*)
48	DRV_1_ON	Not used
49	1_HA	Motor 1 Hall A
50	1_HC	Motor 1 Hall C
51	1_HB	Motor 1 Hall B
52	1_OVER_T	Motor 1 over temperature input
53	7-SEG_1_A	Not used
54	7-SEG_1_E	Not used
55	7-SEG_1_B	Not used
56	7-SEG_1_F	Not used
57	7-SEG_1_C	Not used
58	7-SEG_1_G	Not used
59	7-SEG_1_D	Not used
60	7-SEG_1_DO	Not used
61	AIN0+	Analog input 0 non-inverted
62	AIN1+	Analog input 1 non-inverted
63	AIN0-	Analog input 0 inverted
64	AIN1-	Analog input 1 inverted
65	AOUT0+	Analog output 0 non-inverted
66	AOUT1+	Analog output 1 non-inverted
67	AOUT0-	Analog output 0 inverted
68	AOUT1-	Analog output 1 inverted

Pin	Name	Description
69	CMD0_0+	Not used
70	CMD0_1+	Not used
71	CMD0_0-	Not used
72	CMD0_1-	Not used
73	SIN0+	Axis 0 encoder - SIN non-inverted input
74	SIN1+	Axis 1 encoder - SIN non-inverted input
75	SIN0-	Axis 0 encoder - SIN inverted input
76	SIN1-	Axis 1 encoder - SIN inverted input
77	COS0+	Axis 0 encoder - COS non-inverted input
78	COS1+	Axis 1 encoder - COS non-inverted input
79	COS0-	Axis 0 encoder - COS inverted input
80	COS1-	Axis 1 encoder - COS inverted input
81	SC_I_0+	Axis 0 encoder - Index non-inverted input
82	SC_I_1+	Axis 1 encoder 1 - Index non-inverted input
83	SC_I_0-	Axis 0 encoder 0 - Index inverted input
84	SC_I_1-	Axis 1 encoder 1 - Index inverted input
85	5F	5.1V analog encoder supply output
86	5F	5.1V analog encoder supply output
87	AGND	Analog ground
88	FGND	Analog ground
89	AGND	Analog ground
90	AGND	Analog ground
91	0_DSW1	Not used
92	FLT0	Not used

Pin	Name	Description
93	0_DSW2	Not used
94	DRV_0_ ON	Not used
95	0_DSW3	Not used
96	DR_IN0_0	Not used
97	0_DSW4	Not used
98	ENA0	Not used
99	5U	5.1V digital encoder supply output
100	5U	5.1V digital encoder supply output
101	DGND	Digital ground
102	DGND	Digital ground
103	0_CHA+	Axis 0 digital encoder, channel A non-inverted input Squared SIN non-inverted output
104	1_CHA+	Axis 1 digital encoder 1, channel A non-inverted input Squared SIN non-inverted output
105	0_CHA-	Axis 0 digital encoder 0, channel A inverted input Squared Sin inverted output
106	1_CHA-	Axis 1 digital encoder 1, channel A inverted input Squared SIN inverted output
107	0_CHB+	Axis 0 digital encoder 0, channel B non-inverted input Squared Cos non-inverted output
108	1_CHB+	Axis 1 digital encoder, channel B non-inverted input Squared COS non-inverted output
109	0_CHB-	Axis 0 digital encoder, channel B inverted input Squared COS inverted output
110	1_CHB-	Axis 1 digital encoder,channel B inverted input Squared COS inverted output
111	0_CHI+	Axis 0 digital encoder, channel Index non-inverted input

Pin	Name	Description
112	1_CHI+	Axis 1 digital encoder 1, channel Index non-inverted input
113	0_CHI-	Axis 0 digital encoder 0, channel Index inverted input
114	1_CHI-	Axis 1 digital encoder 1, channel Index inverted input
115	TCK	Not used
116	VCC3	Not used
117	EMU0	Not used
118	TMS	Not used
119	EMU1	Not used
120	TDI	Not used
121	TRST	Not used
122	TDO	Servo processor
123	MPU_LED_ ENA	Communication LED green
124	0_HA	Motor 0 Hall A
125	MPU_LED_ DIS	Communication LED red
126	0_HB	Motor 0 Hall B
127	AXIS_0_ DIS_LED	Axis 0 disable LED (red)
128	0_HC	Motor 0 Hall C
129	AXIS_0_ ENA_LED	Axis) enable LED (green)
130	5V_STO_1	5V supply from STO card, input 1
131	STO1	STO1 input status (from STO card)
132	5V_STO_2	5V supply from STO card, input 2
133	STO2	STO2 input status (from STO card)

Pin	Name	Description
134	7-SEG_0_E	Not used
135	7-SEG_0_A	Not used
136	7-SEG_0_F	Not used
137	7-SEG_0_B	Not used
138	7-SEG_0_G	Not used
139	7-SEG_0_C	Not used
140	7-SEG_0_DO	Not used
141	7-SEG_0_D	Not used
142	RJ45_IN_D2P	Run LED for RJ45 input port anode (yellow LED)
143	SA_MODE	Not used
144	RJ45_IN_D2N	Run LED for RJ45 input port cathode (yellow LED)
145	RJ45_OUT_D2P	Control supply LED for RJ45 output port anode (yellow LED)
146	RJ45_IN_D1N	Link LED for RJ45 input port cathode (yellow LED)  The anode of this LED must be connected to 3.3V.
147	RJ45_OUT_D2N	Control supply LED for RJ45 output port cathode (yellow LED)
148	PEG0+	PEG0 output non-inverted (SW programmable, default assignment encoder 0, see *PEG and MARK Operations Application Note*)

Pin	Name	Description
149	RJ45_ OUT_D1N	Link LED for RJ45 output port cathode (yellow LED)  The anode of this LED must be connected to 3.3V.
150	PEG0-	PEG0 output inverted (SW programmable, default assignment encoder 0, see *PEG and MARK Operations Application Note*)
151	BRK0	Not used
152	0_OVER_T	Motor 0 over temperature input
153	BRK1	Control for dynamic brake relay of axis 1
154	NC	Not connected
155	NC	Not connected
156	NC	Not connected
157	NC	Not connected
158	NC	Not connected
159	NC	Not connected
160	NC	Not connected
161	MARK0+	Axis 0, Mark input 0 non-inverted
162	MARK2+	Axis 1, Mark input 2 non-inverted
163	MARK0-	Axis 0, Mark input 0 inverted
164	MARK2-	Axis 1, Mark input 2 inverted
165	MARK1+	Axis 0, Mark input 1 non-inverted
166	MARK3+	Aixs 1, Mark input 3 non-inverted
167	MARK1-	Axis 0, Mark input 1 inverted
168	MARK3-	Axis 1, Mark input 3 inverted

Pin	Name	Description
169	OUT1	General purpose digital output 1 or mechanical brake
170	OUT0	General purpose digital output 0 or mechanical brake
171	0_RL	Axis 0 right limit input
172	V_SUP_IO	Supply for general purpose digital output
173	0_LL	Axis 0 left limit input
174	V_RTN_IO	Supply return for general purpose digital output
175	1_RL	Axis 1 right limit input
176	V_SUP_ SFTY	Supply for safety input
177	1_LL	Axis 1 left limit input
178	V_RTN_ SFTY	Supply return for safety input
179	24V	24V control supply
180	24V	24V control supply
181	24V_RTN	24V control supply return
182	24V_RTN	24V control supply return
183	NC	Not connected
184	NC	Not connected
185	NC	Not connected
186	NC	Not connected
187	NC	Not connected
188	NC	Not connected
189	RJ45_IN_1	EtherCAT input RJ45 pin 1
190	RJ45_IN_3	EtherCAT input RJ45 pin 3
191	RJ45_IN_2	EtherCAT input RJ45 pin 2

Pin	Name	Description
192	RJ45_IN_6	EtherCAT input RJ45 pin 6
193	RJ45_IN_4	EtherCAT input RJ45 pin 4
194	RJ45_IN_7	EtherCAT input RJ45 pin 7
195	RJ45_ OUT_1	EtherCAT output RJ45 pin 1
196	RJ45_ OUT_3	EtherCAT output RJ45 pin 3
197	RJ45_ OUT_2	EtherCAT output RJ45 pin 2
198	RJ45_ OUT_6	EtherCAT output RJ45 pin 6
199	RJ45_ OUT_4	EtherCAT output RJ45 pin 4
200	RJ45_ OUT_7	EtherCAT output RJ45 pin 7

3.1.5.2 J2 - High Power Signal Connector

Label: J2

Figure 3-20 shows the connector on the UDMcb, Figure 3-21 shows the mating connector for the carrier board, and Table 3-3 lists the signal pinouts.

The connector on the UDMcb, Figure 3-21 and the mating connector for the carrier board are shown below, respectively. A table for the signal pinouts follows.

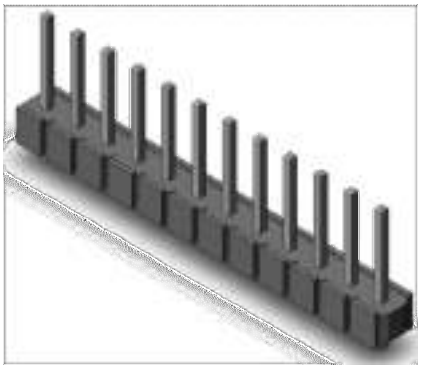

Figure 3-20. Connector: Samtec P/N HPW-12-04-T-S-200-511

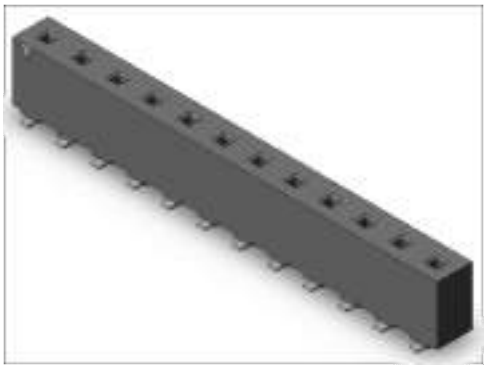

Figure 3-21. Mating connector: Samtec P/N HPF-12-02-T-S-LC

Table 3-3. J2 High power signals pinout

Pin	Name	Description
1	R1	Motor 1 R phase for three-phase motor
2	S1	Motor 1 S phase for three-phase motor
3	T1	Motor 1 T phase for three-phase motor
4	PE	Protected earth
5	PE	Protected earth
6	VP-	Drive supply return
7	VP-	Drive supply return
8	VP+	Drive supply positive edge
9	VP+	Drive supply positive edge
10	R0	Motor 0 R phase for three-phase motor
11	S0	Motor 0 S phase for three-phase motor
12	T0	Motor 0 T phase for three-phase motor

4. Carrier Board Design

This section provides guidelines for the UDMcb carrier board design. The following guidelines are given:

- Mechanical structure requirements
- Circuits implemented on the carrier board

The carrier board (internal ACS P/N SB-18027-100/LF) can be used as a design reference.

The following design files are available for authorized users from https://www.acsmotioncontrol.com/NPMpc#downloads.

File Name	File Type
printed circuit board	PCB
mechanical design	DXF
support bracket	PDF
UDMnp electrical design	OrCAD DSN

Table 4-1. UDMcb Carrier Design Reference Files

The NPMpm can be used as a prototype.

4.1 Mechanical considerations

When designing the carrier board, use the following guidelines:

- Traces between the UDMcb module and the end use connectors must be as short as possible.
- Use at least 2.5mm PCB thickness to insure mechanical stability and easy plug-in and out of the UDMcb connectors.

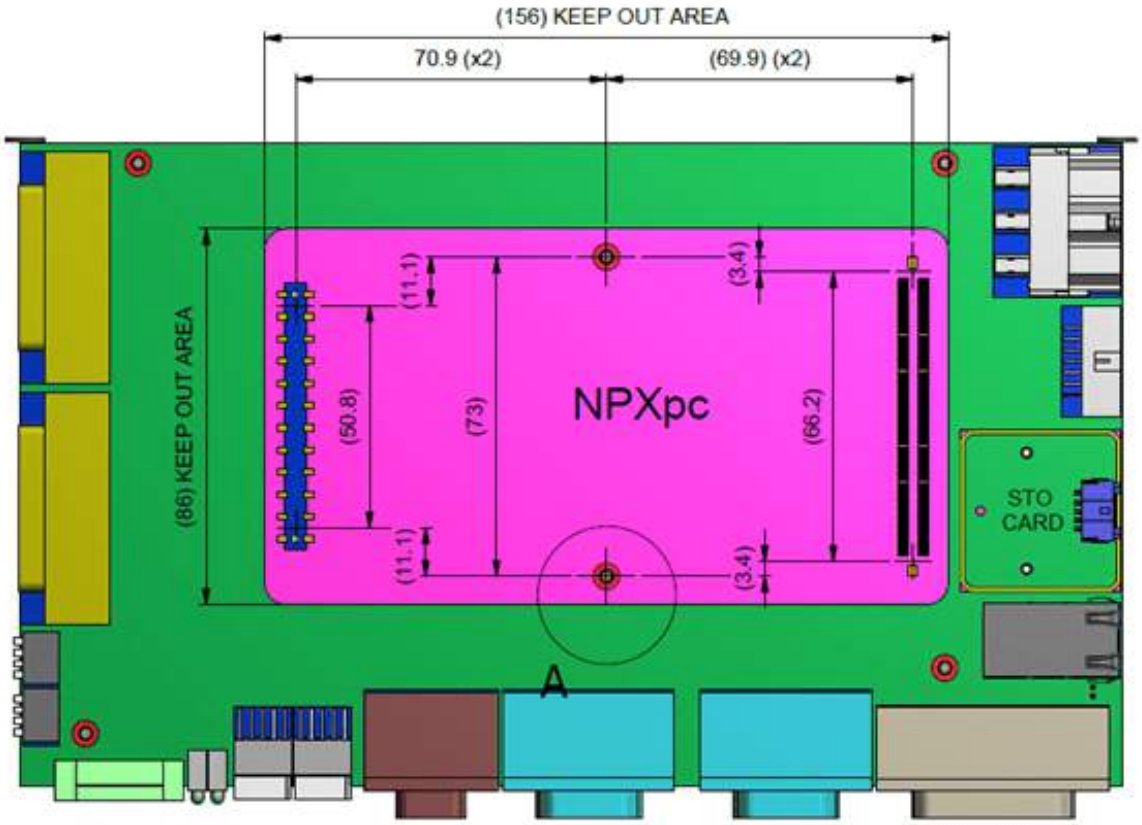

Figure 4-1. Carrier Board Layout

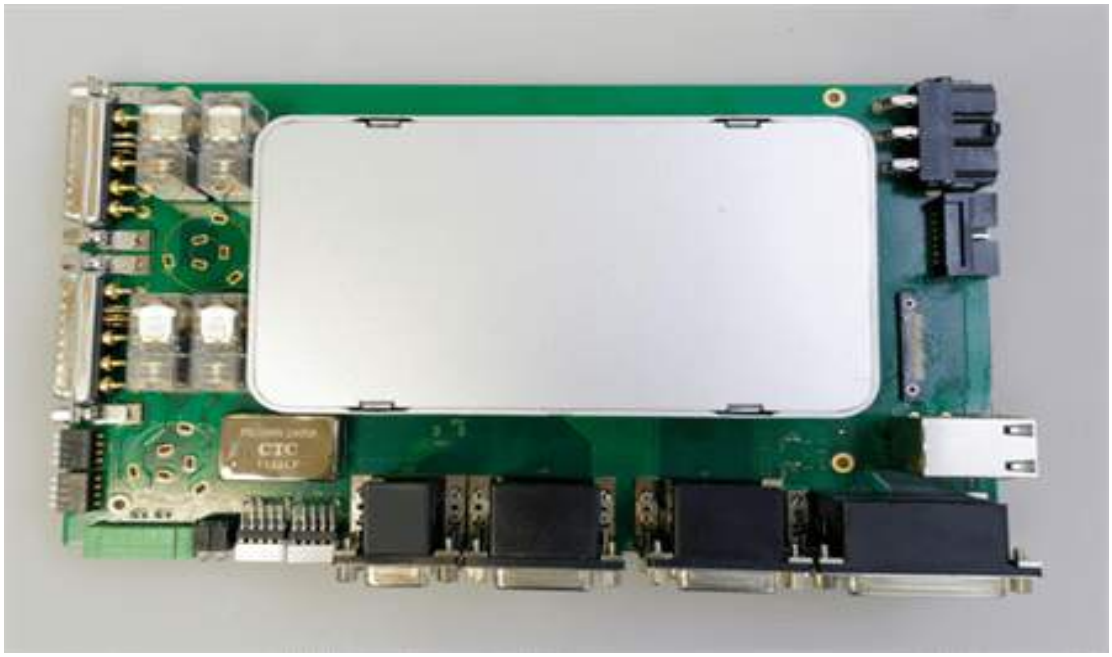

Figure 4-2. Top View

Figure 4-3. Isometric View

4.2 Electrical considerations

The carrier board should include interface circuits tailored to specific needs. This section provides guidelines including shielding, grounding, and a description of components such as resistors and capacitors.

The following are carrier board design guidelines:

- Observe industry standard practices for circuit layout.
- The traces must be as short as possible to minimize EMI.

> The width and thickness of the traces has to be calculated so that the temperature of the PCB will not exceed 100°C under any condition.

> Use ground planes wherever possible to minimize the inductance and the temperature of the traces.

4.2.1 Grounding

The UDMcB has groups of signals which utilize different grounds.

The following are carrier board design guidelines:

> Avoid cross conduction between the grounds to eliminate any cross talk and malfunction.

> Use a ground plane under the component-side and in last layer before print-side to protect the signals from EMI and to avoid radiated emission.

The following table shows the different signal groups.

Type of Signal or Circuit	Name	Description
Drive supply circuit	VP-	Drive supply return
PE/Shield	PE	Protected earth
Opto-isolated ground	24V_RTN V_RTN_SFTY V_RTN_IO	24V control supply return Supply return for safety input Supply return for general purpose digital output
Digital low level signals	DGND	
Analog signals	AGND	Analog ground for SIN-COS signals
EtherCAT communication signals	All EtherCAT signals are to be fully isolated from all other circuits.	

4.2.2 Separation between high and low power signals

> The high and low power traces must be kept as far away as possible from the feedback, control, and communication traces.

> Clearance and creepage between the high voltage circuit and the low voltage circuits must be according to UL61800-5-1 and EN61800-5-1.

> The carrier design should comply with related safety and EMC standards.

4.2.3 EMC guidelines

- Use a ground plane under the component-side and in last layer before print-side to protect the signals from EMI and to avoid radiated emission.
- Use internal planes to avoid cross talk between signals inside a group .

4.2.4 Considerations for each function

This section provides guidelines for the Implementation of the interfacing circuits including motor phase inductors and termination resistors.

Guidelines for the following are provided:

- Encoders
- Motor connection with relays
- Motor over temperature
- STO

4.2.4.1 Encoders

The has an internal 5V supply available for all encoders. The internal supply is limited to 0.5A. An encoders current consumption may exceed this value. A 5V power supply on the carrier board to supply the encoders is recommended. The module contains 120Ω termination for all Incremental digital encoder and analog SIN-COS encoder signals. Additional external termination is not required.

The pin assignments for digital encoder input signals may also be assigned to analog SIN-COS encoder squared output signals, see J1 - Low Power Signals Connector for details.

4.2.4.2 Motor connection with relays

The UDMcB provides control signals for two external motor relays, one per axis. The relays are not part of the product and should be implemented on the user side. The BRK0/1 signals will short circuit the motor phases if a drive is disabled or of a drive fault. When the drive is disabled, the relay closes, for detailed specifications see Motor Relay Specifications. The following figure shows the connections for motor relay.

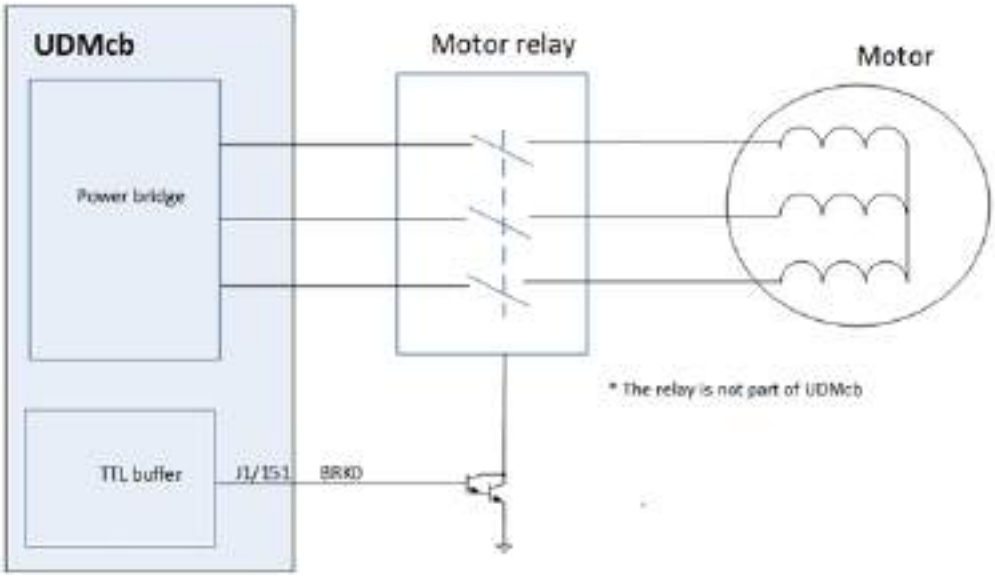

Figure 4-4. Motor Relay Connection

The motor connection without a relay is described in section Motors.

4.2.4.3 Motor Over Temperature

The UDMcb can be fed with a signal that the motor is overheated. One signal per axis is supported. The user can define the response of the controller. The default response is no action, see Motor Over Temperature Specifications for detailed specifications. Figure 4-5 shows the motor over temperature connection.

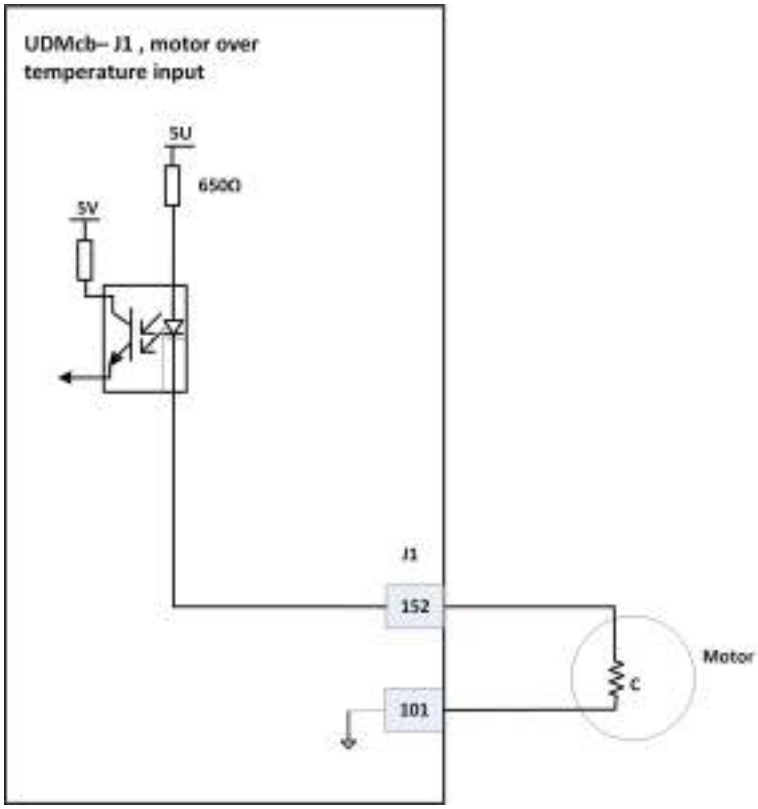

Figure 4-5. Motor Over-Temperature Connection

4.2.4.4 STO Connection Instructions

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

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

Performance Level PLe and Category 3 according to:

- EN ISO 13849-1/-2

The ACS STO module P/N SB-16530-200/LF is not part of the UDMcb and should be ordered separately.

The following figure shows the STO connection. For detailed information on STO, see *AN Safe Torque Off Function* and *NPMpc NPApc UDMcb Funtional Safety Manual*..

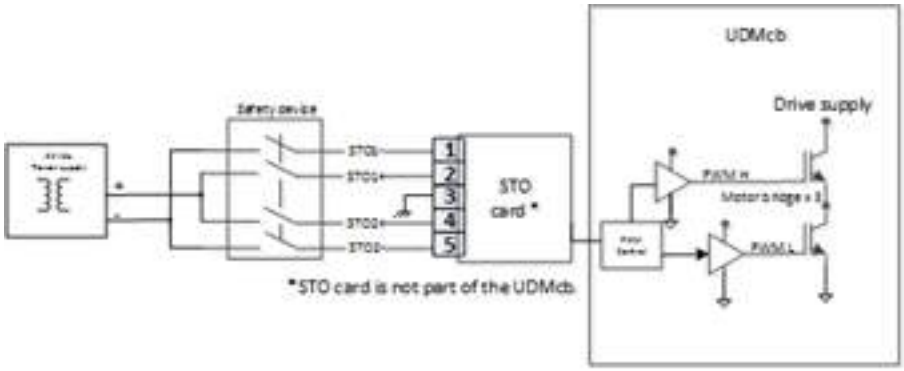

Figure 4-6. STO Connection

If the STO is not used:

1. Connect 5V to pin J1/130 (5V_STO_1) and pin J1/132 (5V_STO_2).
2. Connect pin J1/131 (STO1) and pin J1/133 (STO2) to DGND (pin 102) .

5. Product Specifications

Table 5-1. System specifications

Feature	Specifications

Drives	> Type: Digital current control with field oriented control and space vector modulation
	> Current ripple frequency: 40 kHz
	> Current loop sampling rate: 20 kHz
	> Programmable current loop bandwidth: up to 5 kHz
	> Commutation type: Sinusoidal. Initiation with and without hall sensors
	> Switching method: Advanced unipolar PWM
	> Protection:
	  > Over & under voltage
	  > Phase to phase short
	  > Phase to ground short
	  Short circuit on one of the drives might damage the drive.
	  > Over current
	  > Over-temperature

Supply	The module is fed by two power sources.: > Drive supply > 24Vdc control supply. During emergency conditions there is no need to remove the 24Vdc control supply.
Motor Drive Supply	> Range: 12Vdc to 60V or 12V-100Vdc > Current rating of the power supply should be calculated based on actual load. > Maximum In-rush current: 100A for 40uS @100Vdc > Designation: VP, VP_RTN  There is no regeneration circuit in this product, it's user responsibility to make sure that the DC drive supply voltage will not exceed the 63Vdc for 60Vdc version and 103V for 100Vdc drive.
Control Supply	> Range: 24Vdc ± 10% > Maximum input current / power: 1A @21.6V > Protection: Reverse polarity (2A external fuse must be used) > Designation: 24V_CON_SUP, CON_RTN.

Feature	Specifications
Motor Type	> Two- and three-phase permanent magnet synchronous (DC brushless/AC servo) > DC brush > Voice coil > Two- and three-phase stepper (micro-stepping open or closed loop)
Feedback	Standard: > Incremental digital encoders (AqB) > Analog SIN-COS > Hall inputs
Incremental Digital Encoder	> Two > A&B,I and Clk/Dir, Type: Differential RS-422 > Maximum rate: 50 million quad counts/sec (12.5MHz A & B input frequency) > Protection: Encoder error, not connected > Input termination: 120Ω (on each signal pair) > Encoder supply: 5.1-5.15V, 0.5A (DGND) total for all encoders. > Designation: A: #_CHA±, B: #_CHB±, I: #_CHI±

SIN-COS Analog Encoder	> Two
	> Type: 1Vptp, differential
	> Programmable multiplication factor: x4 to x4096
	> Maximum frequency: 500kHz
	> Format: SIN, COS and Index
	> Type:
	  > Differential input
	  > Input impedance: 120Ω±10%
	  > Encoder voltage range: 1V-PTP±10%
	  > Input voltage range: 1.25V-PTP
	> Encoder analog output supply: 5.1-5.15V, 0.5A (AGND) total for all encoders.
	> ADC resolution: 12-bit
	> Diagnostics: Encoder error and encoder not connected
	> Designation: SIN±, COS±, SC_I± (for axis 0 and 1 only)

Absolute Encoder (optional)	> EnDat 2.2 & 2.1 (digital only) > Biss-A/B/C > SSI
Hall inputs	> Two sets of three per axis > Input current: <7mA > Interfaces: 5V, Source input type, (open cathode), Reference DGND > Designation: $_HA, $_HB, $_HC

Feature	Specifications
Limit switch inputs	> Left and right limit inputs per axis > Interface: Configured by ordering option: 5 or 24V and Sink(NPN) or Source(PNP), single-ended, opto-isolated > Behavioral: No current = limit off > Input current: 4-14mA > Designation: #_RL, #_LL (for axis 0 and 1 only)
Registration MARK Inputs	> Four, 5/24V±20%, opto-isolated, two terminals (High Speed Position Capture) > Input current 4-14mA > Maximum encoder frequency: 2MHz > Position latch: Both raising and falling edge (SW programmable) > Can be used as general purpose inputs > Frequency of events: 1/3*MPU cycles > Designation: MARK0±, MARK1±
Digital Outputs	> General purpose / Mechanical Brake: Two > Interface: Configured by ordering option: Sink(NPN) or Source (PNP), 5/24V, opto-isolated, sink/source, Reference: V_RTN_IO > 100mA per output > Output drop 2.5V at 0.1A > Protection: short current > Designation: OUT0, OUT1
Motor relays	> One per motor, 24V ±20% > Source, 0.5A Max > Reference: BRK_RTN > These output signals are used for external relays control (in addition to the internal ones).
PEG (Position Event Generator)	> (Position Event Generator): Two Pulse or State > Differential, RS422 > Pulse width: 26nSec to 1.75mSec > Maximum rate: 10MHz > Can be used as general purpose output > Allocation: By default, the PEG output pins are mapped to ACSPL+ variables. Other optional selections are SW programmable (see the *PEG and MARK Operations Application Note*). > Designation: PEG0±, PEG1±
Analog Inputs	> Two, ±10V±5% or 0-10V±5%, differential, 12 bit resolution > Max. input frequency: 1KHz > Offset: < 100mV > SNR: >58dB > Designation: AIN_#± (# represents the analog input number)

Feature	Specifications
Analog Outputs	> Two, ±10V±5%, differential, two terminal, 10 bit resolution > Bandwidth: 5KHz > Offset: ±100mV > Maximum output load: 10KΩ > Noise & Ripple: <25mV > Designation: AOUT_#± (# represents the analog output number)
Communication	> Two EtherCAT: In and Out > Interface: EtherCAT protocol > Speed: 100Mbps > Designation: Transmit: ETH#_TX±, Receive: ETH#_RX±
Environment	> Operating range: 0 to + 40°C > Storage and transportation range: -25 to +60°C > Humidity (operating range): 5% to 90% non-condensing

Table 5-2. Drive specifications

Feature	Specifications			
Per Drive	A	B	C	D
Continuous/peak current sin amplitude [A]	3.3/10	6.6/20	10/30	13.3/40
Maximum continuous/peak input current RMS per axis [A]	2.6/8	5.3/16	8/24	10.6/32
Heat dissipation per axis[W] for 60V version (power loss in standby is 7[W]) (*i* = 1 or 2 ; number of drives)	6+*i* x 0.7	6+*i* x 1.7	6+*i* x 2.9	6+*i* x 4.1
Heat dissipation per axis[W] for 100V version (power loss in standby is 7[W]) (*i* = 1 or 2 ; number of drives)	6+*i* x 0.9	6+*i* x 2.1	6+*i* x 3.7	6+*i* x 5.6
Maximum cont./peak output power @ 60Vdc [W] (±5%)	150/460	310/920	470/1380	610/1850
Maximum cont./peak output power @ 100Vdc [W] (±5%)	260/780	520/1560	790/2340	1050/3120
Peak current time [sec]	1			

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

Table 5-3. Motor Relay Specifications

Item	Description	Remarks
Designation	#_BRK	Per axis. There are two built-in relays that internally short the motor phases upon disable or drive fault. These two outputs provide up to 0.5A and work in parallel to the internal relay.
Type	TTL level Reference: DGND	The supply for the Brake is internal.

Item	Description	Remarks
Output current	10mA per output	
Logic state	When enabled, this signal set to logic 1	

Table 5-4. Motor Over Temperature Specifications

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

5.1 STO

The UDMcB supports STO. The STO is applicable only when using ACS STO module P/N SB-16530-200/LF which is not part of the NPApc and should be ordered separately. For detailed information on STO, see *AN Safe Torque Off Function* and *NPMPC NPAPC UDMCB Funtional Safety Manual*...

Table 5-5. STO specifications

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

Item	Description	Remarks
		disabled within 200mS.
Interface	24V, two terminal for each input	
Input current (per input pin)	<50mA.	
Operation	No current -> drive off.	

The UDMcB supports STO. Implement the STO circuit on the carrier board. A STO board is available from ACS (ACS P/N SB-16530-100/LF). For detailed information on STO, see ***AN Safe Torque Off Function***.

5.2 Dimensions

- Length: 155mm
- Depth: 85mm
- Height: 30mm

5.3 Weight

- 320g

5.4 Compliance with Standards

5.4.1 Environment

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

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

At 22^{0}C with no forced air, the heatsink temperature can rise up to 35^{0}C in idle and up to 55^{0}C at maximum output power.

5.4.2 CE

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

- EN61800-5-2 follwing the provisions of 2014/30/EU directive

5.4.3 Safety

- Functional safety
  - EN 60204-1 : 2006 (+A1`:2009, + AC :2010 Stop Category 0)
  - EN ISO 13849-1 : (+ AC :2009 Category 3; PL e)
  - EN 62061 : 2005 (+ AC :2010, + A1 :2013 SIL CL 3)
  - IEC61800-5-2:2016 Safe Totque Off (STO)
  - EN 618000-5-1:2007
  - IEC 618000-3 :2017
- Electrical safety
  - UL61800-5-1
  - IEC 61800-5-1:2007 (2nd Edition) follwing the provisions of 2014/35/EU (Low Voltage Directive)

5.4.4 RoHS

- Design complies with ROHS requirements.

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