SPiiPlusCMnt

Installation Guide

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SPiiPlusCMnt

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Revision History

Date	Revision	Description
November 2020	3.03	EtherCAT Cycle Rate Table
September 2020	3.02	Correct number of axes for servo/step motors Formatting issues
July 2017	2.40	Updated MPU specifications for user memory (RAM) and Flash memory
January 2017	2.30	Rearranged document content for easier customer use Added package content and ordered part number sections Updated contents included in the SPii+CMntUDMpm-ACC1 mating connectors kit Added pictures of all mating connectors and included manufacturer part numbers (when applicable) Updated minimum load inductance to 1mH Added note that PEG does cannot work with absolute encoder input For J3 connector pinout, removed digital input 8 on pin 19
August 2016	NT2.25.20	Updated absolute encoder bidirectional schematic diagram Updated absolute encoder hiperface schematic diagram
May 2016	NT2.25.10	Updated STO note Updated related document list
April 2014		Remove horizontal mounting
Feb 2014		Remove horizontal mounting Converted to new document template
April 2014		MPU fan addition

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
AN STO Safe Torque Off Function	Provides the technical details for implementing the STO function for drives installed in ACS Motion Control systems.
MC4U Product Guide	Technical description of the MC4U Control Module integrated motion control product line.
SPiiPlus MMI Application Studio User Guide	Explains how to use the SPiiPlus MMI Application Studio and associated monitoring tools.
HSSI Expansion Modules Hardware and Software Guide	High-Speed Synchronous Serial Interface (HSSI) for expanded I/O, distributed axes, and nonstandard devices.
SPiiPlus Setup Guide	Provides guidance on how to configure and adjust the SPiiPlusNT systems to work with supported types of motors and feedback devices.
AN PEG and MARK Operations	Provides detailed description, specification and operation instructions for PEG capabilities
SPiiPlus Command & Variable Reference Guide	Describes all of the variables and commands available in the ACSPL+ programming language.
SPiiPlus ACSPL+ Programmer's guide	Provides practical instruction on how to use ACSPL+ to program your motion controller.
SPiiPlus C Library Reference Programmer's Guide	C++ and Visual Basic® libraries for host PC applications. This guide is applicable for all the SPiiPlus motion control products
SPiiPlus COM Library Programmer's Guide	COM Methods, Properties, and Events for Communication with the Controller.
SPiiPlus .NET Library Programmer's Guide	.NET Methods, Properties, and Events for Communication with the Controller.

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1. Description

1.1 Connectors

The following figures and table show and describe the SPiiPlusCMNT connectors, DIP switch, and jumper.

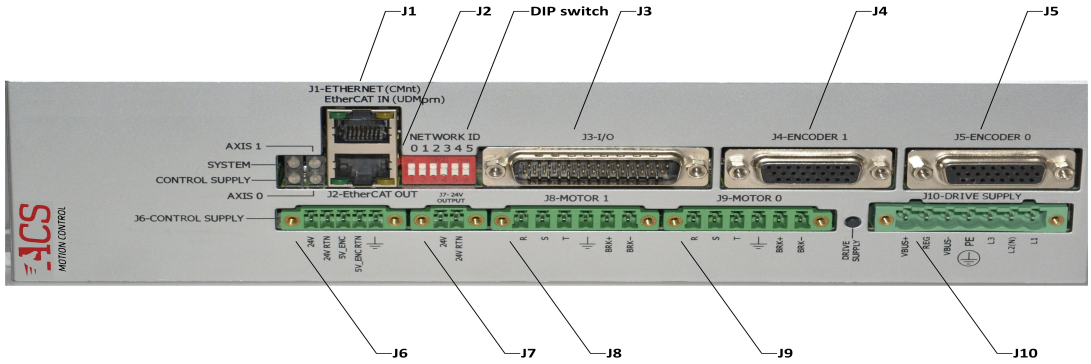


Figure 1-1. Front view - connectors and DIP switch

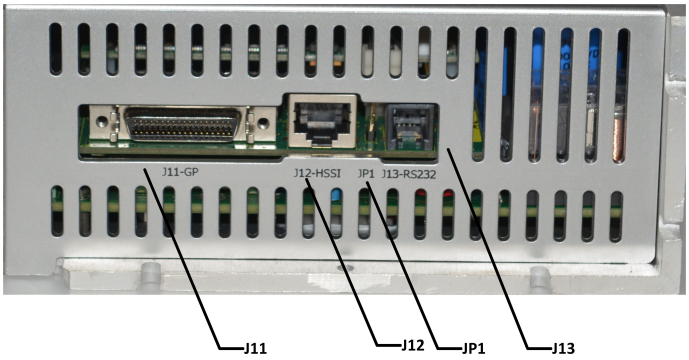


Figure 1-2. Right side view - connectors and jumper

Figure 1-3. Left side view - STO connector

Table 1-1. Connections

Connector assignment	Connector name	Description
J1	Ethernet	
J2	EtherCAT OUT	
J3	I/O	
J4	Encoder 1	
J5	Encoder 0	
J6	Conntrol supply	
J7	24V output	
J8	Motor 1	
J9	Motor 0	
J10	Drive supply	
J11	GP	
J12	HSSI	
J13	RS232	
J14	STO	

1.1.1 DIP switch and jumper

The following table describes the SPiiPlusCMNT DIP switch and jumper.

Table 1-2. DIP switch and jumper

DIP switch / Jumper	Description
DIP switch (NETWORK ID)	Not used
JP1	Intalled when running the MMI Application Studio Upgrade and Recovery Wizard (see *MMI Application Studio User Guide* for details).

In normal operation, the JP1 jumper setting is to remain in the factory configuration, that is, jumper not installed.

1.2 LED Indicators

The following figures and tables show and describe the SPiiPlusCMNT LED indicators.

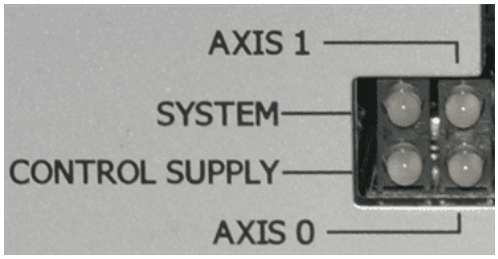


Figure 1-4. LED indicators

Figure 1-5. Drive supply indicator

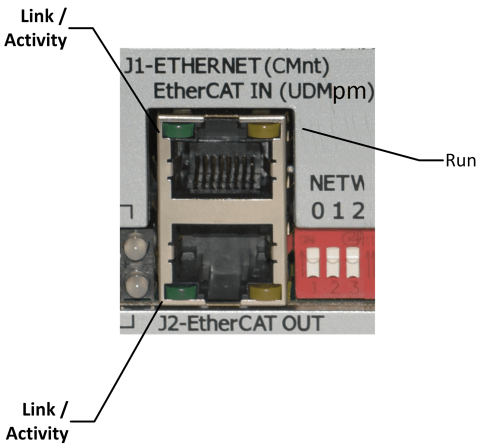


Figure 1-6. EtherCAT / Ethernet indicators

Table 1-3. LED indicators

Indication	Description
Axis 0 Axis 1	One bicolor LED for each drive: > Green - drive is enabled > Red - drive fault > Off – drive is disabled
System	One bicolor LED > Red – system fault > Green – system is OK > Blinking – software command
Control Supply	One green LED > On – control supply is On - voltage applied > Off - control supply is Off - voltage not applied
Link/Activity	Two green LEDs (one per port) > Off – No link > On – Link exists, no data transferred > Blinking – Data being transferred
Run	One yellow LED > Off – INIT state > On - Normal operation
Drive supply	One red LED > On - drive supply is On - voltage applied > Off – drive supply is Off - voltage not applied.

1.3 Package content

The package contains the following items:

- SPiiPlusCMNT module
- J6 Control supply mating connector (see J6 Control supply)
- J10 drive supply mating connector (see J10 Drive supply)
- SPiiPlus ADK Suite (current version)

> Connector kit for STO card (supplied only for units ordered with STO)

1.4 Optional accessories

1.4.1 Ethernet cables

ACS offers the following Ethernet CAT5e cables:

Table 1-4. Ethernet cables

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

1.4.2 Mating connectors kit

P/N: SPii+CMntUDMpm-ACC1

Description: SPiiPlusCMNT mating connectors kit

The mating connectors kit provides a set of mating connectors for the SPiiPlusCMNT. The kit includes:

Table 1-5. SPii+CMntUDMpm-ACC1 - Mating connectors kit contents

Quantity	Part description	Connector	Manufacturer	PN
1	D-type 44 pin high density female connector	J3	Unbranded / industry standard connector	NA
2	D-type cup 26 pin high density male connector	J4, J5	Unbranded / industry standard connector	NA

Quantity	Part description	Connector	Manufacturer	PN
1	Control supply output connector	J7	Phoenix	MC-1.5/2 STF 3.81
2	Motor connector	J8, J9	Phoenix	MC-1.5/6 STF 5.08
1	36 pin SCSI connector male, one piece cable housing, and metal shell with quick release latching	J11	Unbranded / industry standard connector	NA
1	Cable housing, 7 position with straight cable connection	J10	Phoenix	KGG-MSTB 2.5/7

1.4.3 J11 mating connector

P/N: SPii+CMntUDMpm-ACC2

Description: SPiiPlusCMNT J11 mating connector on a 2m cable with flying leads

The 2m SCSI connector to flying leads cable features a 36-wire flying leads end. The wire coding is shown below.

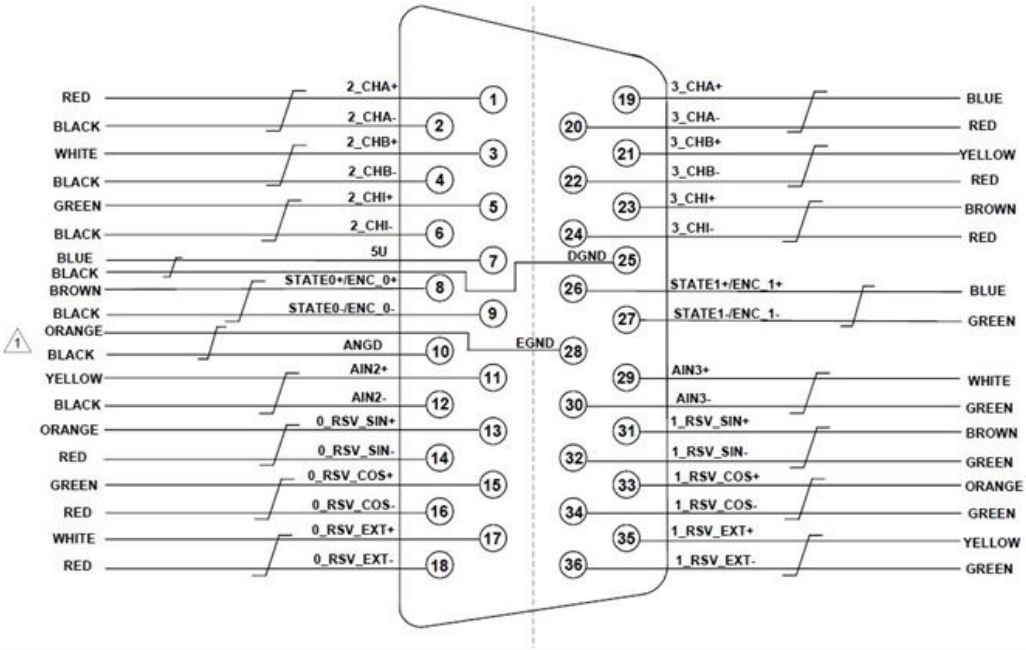


Figure 1-7. Cable kit

1.4.4 STO Accessory Kit

P/N: STO-ACC1

Description:2 meter cable with flying leads

Figure 1-8. STO-ACC1 accessory kit

Table 1-6. STO-ACC1 Pinout

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

1.5 Order part number

The ordering part number (P/N) contains several characters (see example in Figure 1-9) that each specify a configuration characteristic ordered for the SPiiPlusCMNT module, as described in Table 1-7.

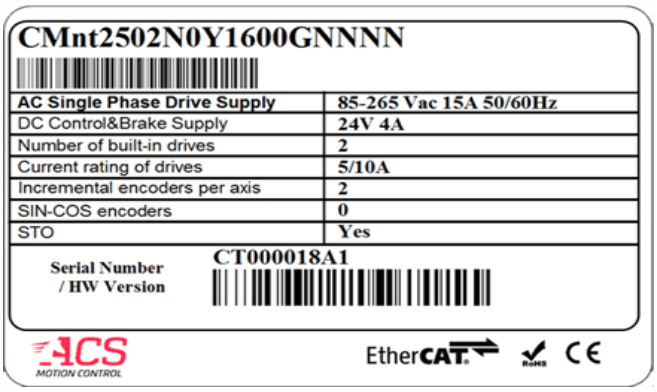


Figure 1-9. Label with ordered P/N example

Table 1-7. Configuration as indicated by P/N

Ordering options	Field	Example user selection	Available ordering option values
Number of built-in drives (85Vac - 265Vac)	1	2	1,2
Current rating of built-in drives (cont/peak)	2	5	2 - 2.5/5A, 5 - 5/10A, 7 - 7.5/15A
No. of 250kHz SIN-COS encoder interfaces	3	0	0, 1, 2
Encoder channels per aixs	4	2	1, 2
Absolute encoders type[1]	5	N	N- None, E- EnDat 2.1 (digital)/2.2, S- Smart-ABS, P- Panasonic, B- BiSS-A/B/C, H- Hiperface, R- Resolver, I- SSI
Number of absolute encoders interface	6	0	0, 1, 2
STO	7	Y	Y - Yes, N - No
Maximum number of axes	8	16	2(FOC), 4, 8, 16, 32

[1]All absolute encoder channels must be the same type

Ordering options	Field	Example user selection	Available ordering option values
ECAT 3rd party Servo Drive	9	0	Up to the maximum number of axes (FOC) - number of internal drives
ECAT 3rd party Step motor Drive (open & closed loop)	10	0	Up to the maximum number of axes (FOC) - number of internal drives
ECAT 3rd party IO EtherCAT node	11	G	W- 32 (included automatically FOC), X- 64
G-Code, Flexible configuration, Both	12	N	N- None, G- G-code, Flexible configuration (F), Both (T)
ServoBoost, number of axes supported	13	0	Not supported.
Input shaping	14	N	Y-Yes, N-No
I/O configuration	15	N	**N: Inputs & limits:** 24V/SOURCE (PNP), **Outputs:** 24V/SOURCE (PNP). **D:** Identical to (N). For compatibility reasons. **S: Inputs & limits:** 24V/SINK (NPN), **Outputs:** 24V/SOURCE (PNP). **U: Inputs:** 24V/SOURCE (PNP), **Limits:** 24V/SINK (NPN), **Outputs:** 24V/SOURCE (PNP)

As an example, P/N SPiiPlusCMnt2502N0Y1600GNNNN would represent the configuration described in Table 1-8 below.

Table 1-8. P/N example

Field		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
P/N	CMnt	2	5	0	2	N	0	Y	16	0	0	G	N	0	N	N

2. Mounting

The SPiiPlusCMNT is mounted vertically, using M4 type Phillips screws as shown. Use two retaining screws on each side.

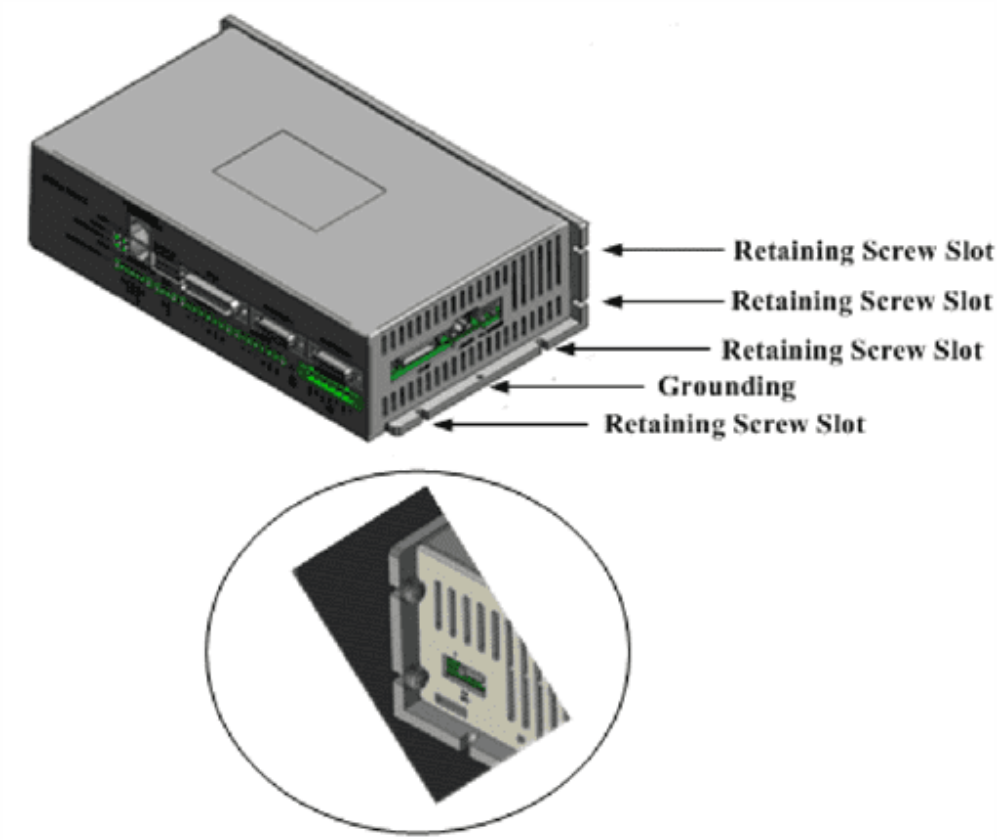


Figure 2-1. Retaining screw locations

When installing the SPiiPlusCMNT, an earth-ground must be connected as shown.

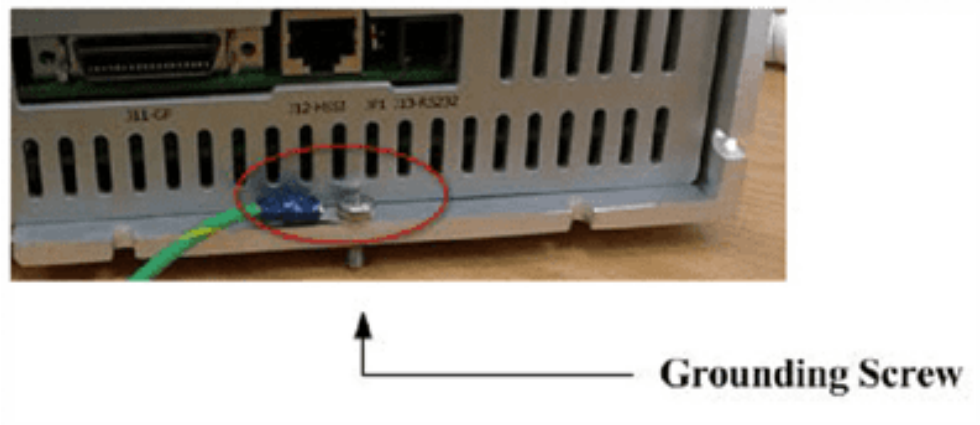


Figure 2-2. Grounding screw

3. Connections

The SPiiPlusCMNT can be operated as a standalone 2 axes control module, or as network master supporting up to 32 axes, of which 2 are internal to the product. For out-of-the-box operation, follow the stages provided in this manual and to the referred ACS documents. The product's operation depends on ordered features.

This section describes how to interface with the SPiiPlusCMNT using proper safety, EMC, and wiring guidelines. Figure 3-1 depicts theSPiiPlusCMNT recommended scheme for shielding, cable connections, and type of grounding. Specific settings and configurations are described in the subsections below.

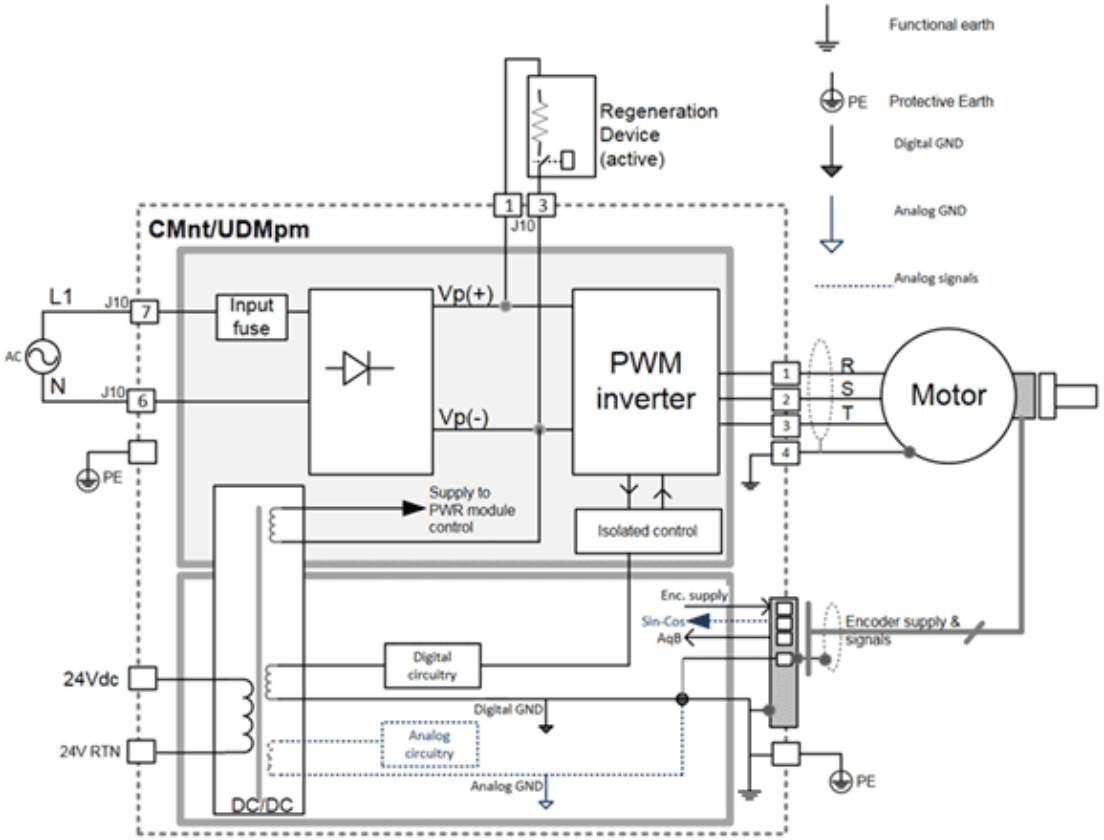


Figure 3-1. Grounding and shielding

3.1 Safety, EMC, and wiring guidelines

Make sure that the following guidelines and procedures are addressed and observed prior to powering and while handling any of the network elements. Observing these procedures is crucial in order to achieve safe and optimal operation of ACS networking provisions.

Installation and maintenance must be performed by qualified personnel only. Such a person must be 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 network components are properly installed mechanically, properly grounded, and that all attached power and signal cables are in good operating conditions.

Maintenance is to be performed only after the relevant network element has been powered down and all associated and surrounding moving parts have settled in their safe mode of operation. Certain drives require longer times in order to fully discharge.

In order to ensure that the internally stored energy has been fully discharged to a safe level that will not harm personnel exposed to the energy, allow a minimum of 5 minutes after powering down the SPiiPlusCMNT until handling or touching the unit. Provide special care while applying, removing, or touching connector J10 that contains (VBUS+ and VBUS-) bus voltage carrying wires.

Follow the hardware guide of each element and observe the residual discharge time specified. Avoid contact with electrostatic-sensitive components and take the required precautions.

All power terminals remain live for at least 5 minutes after the mains have been disconnected.

The SPiiPlusCMNT is powered up as long as an ACS inlet is connected to it. Therefore it is the responsibility of the user to provide an in-series switch or circuit breaker that disconnects all power-carrying signals which is readily and rapidly accessible to the operator. The disconnecting device must meet the requirements of IEC60947-1 or IEC60947-3 and the current rating must be not more than 20A. The disconnecting device must be in close proximity to the equipment, within easy reach of the operator, and be clearly marked as the disconnecting device for the SPiiPlusCMNT.

A power cord for the AC drive supply input must satisfy all the following:

- A conductor area of not less than 0.75mm^2
- A voltage rating of not less than 300V
- A temperature rating to 105°C or more
- Complies with IEC60227 or IEC60245

Only the Green –Yellow wire of the cable is to be used for connection to the protective conductor terminal.

3.1.1 Electro-magnetic immunity and interference considerations

The following recommendations help minimize electromagnetic interference to the power supply and neighboring equipment and improve electromagnetic immunity.

- Use an AC line filter and surge protection.
- Use a motor filter, such as the MC4U-MF (see Motor filter), between the drive and the motor. The filter is to be connected as close as possible to the drive's output connectors.

The motor filter requires air flow cooling.

> Use an EPCOS B84142-B25-R filter, or its equivalent, for AC supply interference protection.
> Use motor cables that are:
  > Shielded (meshwork of tinned, copper wire with high optical covering)
  > Can withstand high voltage withstand
  > Have a very low capacitance

The motor cables' shield is to be connected to motor connector pin 4 (see Connection instructions).

> ACS specifies and tests its products using motor cable lengths of up to 10m lengths. Route the motor cables as far as possible from sensitive-signal carrying cables such as encoder cables. Install the encoder cables according to manufacturer recommendations.
> Lightning protection on the supply AC lines is to be provided in the cabinet/machine where the ACS product is being used. It is recommended to install power surge lightning arrestors (varistors) between the AC terminals (L-N, L-PE, N-PE). ACS recommends using the MNF Wurth Electronic, MNF P/N 820422711 varistor.

3.2 Connecting the SPiiPlusCMNT

Product set up consists of the following stages:

Read the safety instructions in Personnel Safety Guidelines and adhere to them closely.

1. Connect control cables using pre-wired cables. For a cables' pin out and connector details refer to the following sections.
2. Apply control and drive supply voltages and observe the LEDs. If STO is included in the product, apply control supply to both STO1 and STO2 inputs in order to enable a drives' operation. Refer to *AN STO Safe Torque Off Function* regarding the STO specification.
3. Establish communication with the control module by using the SPiiPlus MMI Application Studio and SPiiPlus User Mode Driver and either the connection via J1 connector or the serial connection via J13, (refer to the *SPiiPlus Setup Guide* for details).
4. For operation and programming, refer to the *ACSPL+ Programmer's Guide* and the *SPiiPlus Command & Variable Reference Guide*.

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

3.3 Network master operation

Setting up the product as a network EtherCAT master, when ordered for up to 32 axes, IOs and Non- ACS network elements, requires additional stages in addition to those described in Connecting the SPiiPlusCMnt. All network elements must be powered and interfaced according to their hardware guides. CAT5 cables have to be connected in a daisy chain mode from the SPiiPlusCMNT EtherCAT Out (J2) connector to the first element's EtherCAT In port, and further connected from the first element's EtherCAT Out port to the next in line element's EtherCAT In port.

For all (ACS or non-ACS devices) connected network elements:

1. Connect to power supply and to relevant interfaces, according to each product's installation and operation guides.
2. Apply control and bus voltages as needed, and verify defined operation.

Setup of SPiiPlusCMNT as network master:

1. Establish communication with the slave drive control module by using SPiiPlus MMI Application Studio and SPiiPlus User Mode Driver, using either the connection via J1 connector or the serial connection via J13. Refer to *SPiiPlus Setup Guide* for details.
2. Setup slave drive: refer to *SPiiPlus Setup Guide*.
3. Setup of EtherCAT network: use the SPiiPlus MMI Application Studio **EtherCAT Configurator** module to define the network according to ordered elements and needed network configuration. Refer to the *SPiiPlus MMI Application Studio User Guide* for details.
4. Configure the network elements, axes, and IOs: use the SPiiPlus MMI Application Studio **System Configuration Wizard** module to configure all network elements, numbering and configuration. Refer to the *SPiiPlus MMI Application Studio User Guide* for details.
5. SPiiPlusCMNT operation and programming: refer to the *ACSPL+ Programmer's Guide*, and *SPiiPlus Command & Variable Reference Guide*.

3.4 Cooling

Airflow is to be provided by an external device, such as a fixed cooling fan.

3.4.1 Vertical installation with cooling fan

The SPiiPlusCMNT is mounted vertically. Apply forced cooling air such that the direction of air flow is from the bottom to the top as shown.

Figure 3-2. Vertical installation with cooling fan

3.5 Power supplies

The SPiiPlusCMNT is fed by two power supplies:

- Control supply: 24Vdc (J6)
- Drive supply: 85 to 265Vac (J10)

The power supplies must be provided by the customer and be UL certified. Each power supply has a LED indicator on the unit.

3.5.1 J6 Control supply

An external 24Vdc (±10%, maximal rating 4A/100W) isolated power supply (not included with the unit) feeds all logic and control low voltage circuitry.

Regular operation consumes 2A. An additional 1A per axis (maximum) is needed during motor mechanical brake activation.

3.5.1.1 Description

Label: J6 CONTROL SUPPLY

Connector	
Manufacturer	Phoenix
Type	MC-1.5/5 GF 3.81
Version	5 pin header, pitch 3.81mm
P/N	NA

Mating Connector	
Manufacturer	Pheonix
Type	MC-1.5/5 STF 3.81
Version	5 pin plug, pitch 3.81mm
P/N	NA

Table 3-1. J6 connector pinout

Pin	Name	Description
1	24V_SUP	24V_SUP 24V control supply
2	24V_RTN	24V control supply return
3	5V_ENC_EXT	External supply for Encoder
4	5V_ENC_EXT_R TN	External supply return for Encoder
5	EGND	Shield

3.5.2 J10 Drive supply

The SPiiPlusCMNT is supplied by an external isolated 85 to 265Vac single motor drive supply (not included with the unit). The AC supply is internally rectified to 120 to 370Vdc and the resulting DC voltage feeds the motor drives.

> The current is limited by a protective fuse and connector to 15A.

> The drive supply input fuse is rated 20A at 250Vac or 125Vdc.

When supplying DC voltage higher than 125Vdc, an appropriate external protection device (with respect to voltage and current ratings) must be used.

3.5.2.1 Description

Label: J10 DRIVE SUPPLY

Connector	
Manufacturer	Degson
Type	Plug-in terminal block
Version	2EDGRM-5.08, 7 pin, male
P/N	NA

Mating Connector	
Manufacturer	Degson
Type	Plug-in terminal block
Version	2EDGKFM-5.08, 7-pin, female
P/N	NA

Table 3-2. J10 connector pinout

Pin	Name	Description
1	VBUS+	Positive DC drive supply output - connect only when using an external regeneration circuit (see Regeneration) or externally increasing bus capacitance (consult ACS)

Pin	Name	Description
2	REG	Not connected (reserved for future use).
3	VBUS-	DC drive supply output - connect only when using an external regeneration circuit (see Regeneration) or externally increasing bus capacitance (consult)
4	PE	EGND, protected earth.
5	L3	Not connected (reserved for future use - 3-phase AC input not currently supported)
6	L2	AC input neutral
7	L1	AC input phase

3.6 Ethernet

All ACS products are tested with 50 m cables between adjacent nodes. At lengths of up to 100 m it is recommended to test performance as function of network complexity and operating environment.

3.6.1 J1 Ethernet connector

Label: J1 ETHERNET

Connector	
Manufacturer	Unbranded / industry standard connector
Type	Socket
Version	RJ-45 type 8 pin
P/N	NA

Mating Connector	
Manufacturer	Unbranded - industry standard connection

Mating Connector	
Type	Plug
Version	RJ-45 type 8 pin
P/N	NA

Table 3-3. J1 connector pinout

Pin	Name	Description
1	TD+	Positive transmit signal
2	TD-	Negative transmit signal
3	RD+	Positive receive signal
4	N/C	Not connected
5	N/C	Not connected
6	RD-	Negative receive signal
7	N/C	Not connected
8	N/C	Not connected

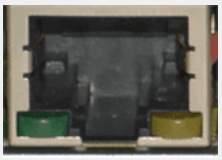
3.7 EtherCAT

All ACS products are tested with 50 m cables between adjacent nodes. At lengths of up to 100 m it is recommended to test performance as function of network complexity and operating environment.

3.7.1 J2 EtherCAT output connector

Label: J2 ETHERCAT OUT

Connector	
Manufacturer	Unbranded - industry standard connector
Type	Socket
Version	RJ-45 type 8 pin
P/N	NA



Mating Connector	
Manufacturer	Unbranded - industry standard connection
Type	Plug
Version	RJ-45 type 8 pin
P/N	NA

Mating Connector	
Manufacturer	Unbranded - industry standard connector
Type	Plug
Version	RJ-45 type 8 pin
P/N	NA

Mating Connector


Table 3-4. J2 connector pinout

Pin	Name	Description
1	TD+	Positive transmit signal
2	TD-	Negative transmit signal
3	RD+	Positive receive signal
4	N/C	Not connected
5	N/C	Not connected
6	RD-	Negative receive signal
7	N/C	Not connected
8	N/C	Not connected

3.8 I/O

3.8.1 J3 input / output connector

Label: J3 I/O

Connector	
Manufacturer	Unbranded - industry standard connector
Type	D-sub
Version	DB-44 high density male
P/N	NA

Connector


Mating Connector	
Manufacturer	Unbranded - industry standard connector
Type	D-sub
Version	DB-44 high density female
P/N	NA
	

Table 3-5. J3 connector pinout

Pin	Name	Description
1	OUT1	Digital Output 1
2	OUT3	Digital Output 3
3	OUT5	Digital Output 5
4	OUT7	Digital Output 7
5	IN1	Digital Input 1
6	IN3	Digital Input 3
7	0_LL	Axis 0 Left Limit
8	1_LL	Axis 1 Left Limit
9	ES+	E-STOP non-inverted input
10	AIN0-	Analog Input 0 inverted
11	AOUT0+	Analog Output 0 non-inverted

Pin	Name	Description
12	MARK1+	MARK 1 non-inverted
13	PEG0+	PEG 0 Output non-inverted
14	PEG1+	PEG 1 Output non-inverted
15	DGND	Digital ground
16	OUT0	Digital Output 0
17	OUT2	Digital Output 2
18	OUT4	Digital Output 4
19	OUT6	Digital Output 6
20	IN0	Digital Input 0
21	IN2	Digital Input 2
22	0_RL	Axis 0 Right Limit
23	1_RL	Axis 1 Right Limit
24	ES-	E-STOP inverted input
25	AIN0+	Analog Input 0 non-inverted
26	AIN1+	Analog Input 1 non-inverted
27	AOUT0-	Analog Output 0 inverted
28	MARK1-	MARK 1 inverted
29	PEG0-	PEG 0 Output inverted
30	PEG1-	PEG 1 Output inverted
31	V_SUP_IO	IO supply
32	V_RTN_IO	IO supply return
33	IN4	Digital Input 4
34	IN5	Digital Input 5
35	IN6/MARK2	Digital Input 6 or MARK 2

Pin	Name	Description
36	IN7/MARK3	Digital Input 7 or MARK 3
37	V_SUP_SFTY	Safety Supply
38	V_RTN_SFTY	Safety Supply Return
39	ANGD	Analog ground
40	AIN1-	Analog Input 1 inverted
41	AOUT1+	Analog Output 1 non-inverted
42	AOUT1-	Analog Output 1 inverted
43	MARK0+	MARK 0 non-inverted
44	MARK0-	MARK 0 inverted

V_RTN_IO is common for all Digital Inputs.

3.8.1.1 Connection schematics

Connection schematics are shown for the following:

- General purpose analog inputs
- Limit connections
- Emergency stop input
- Digital input connections
- Digital output connections

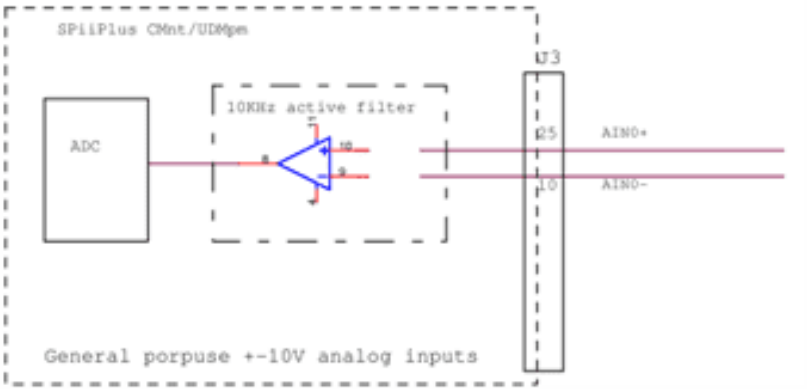


Figure 3-3. General purpose analog inputs

Ensure that the analog input's signal range does not exceed 20% of the specified range of ±10V.
Higher signals may cause abnormal behavior of the drive and effect its performance.

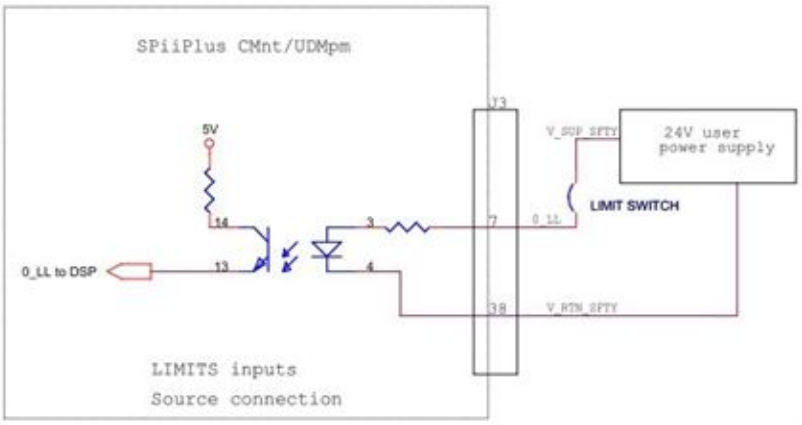


Figure 3-4. Limit connections

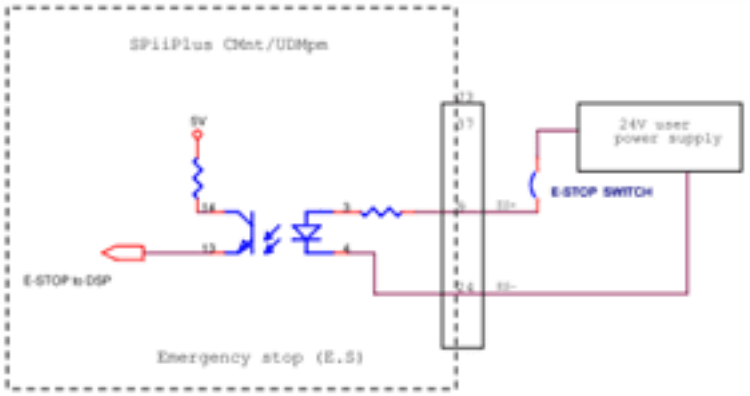


Figure 3-5. Emergency stop input

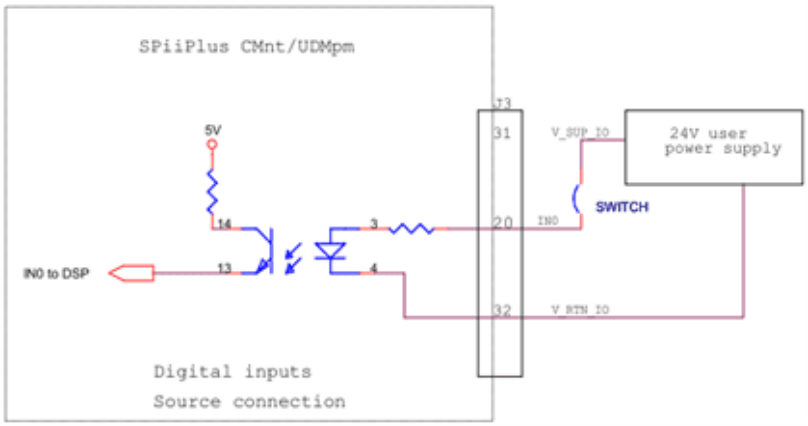


Figure 3-6. Digital input connections

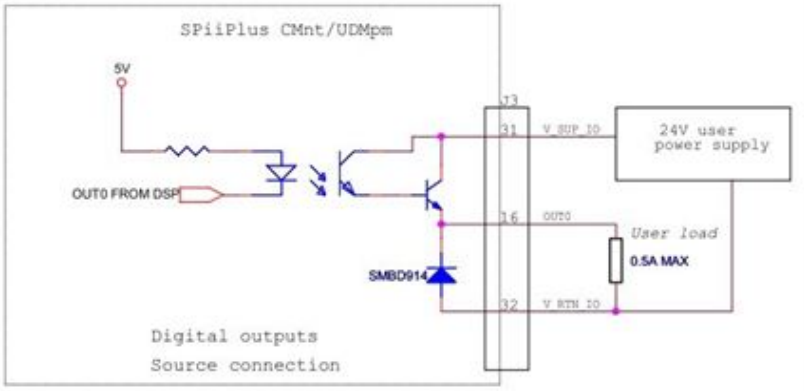


Figure 3-7. Digital output connections

Over current protection (per pin) is activated above 0.7 to 1.7A, causing the output enter a protected mode, without any message given to the user. The output self recovers upon returning to specified performance values.

3.8.1.2 Registration MARK Inputs

The following MARK inputs are supported: MARK0 and MARK1 (RS422), and two shared opto-isolated interfaces (IN6 and IN7, referred to as MARK2 and MARK3), and two regular digital inputs: IN4 and IN5. Each of the two encoders available per axis can be latched independently to two latching-registers (A and B, used as variables "MARK" and "MARK2", respectively) by the above MARK input signal sources, as detailed in Table 3-6.

Table 3-6. Registration MARK sources per encoder

Axis / Encoder	Latching Register	Dedicated Opto-Isolated RS422 Source	Shared Opto-Isolated Source	Shared Regular Input
Axis 0 Encoder 0	A	MARK0	IN6	
	B	MARK1	IN7	
Axis 0 Encoder 1	A	MARK0 MARK1	IN6	IN4
	B	MARK1	IN7	IN5
Axis 1 Encoder 0	A	MARK0 MARK1	IN6	
	B	MARK1	IN6 IN7	

Axis / Encoder	Latching Register	Dedicated Opto-Isolated RS422 Source	Shared Opto-Isolated Source	Shared Regular Input
Axis 1 Encoder 1	A	MARK0 MARK1	IN6	
	B	MARK1	IN7	

Latching register **A** is associated with the ACSPL+ variable: **MARK**; and latching register B is associated with the ACSPL+ variable: **M2ARK**. See *SPiiPlus Command & Variable Reference Guide* for details on these variables.

For the circuit description, refer to the digital input opto-isolated interface description in Figure 3-6.

The opto-isolated MARK inputs have a propagation delay of up to 200 ns. Regular Input MARK signals have a propagation delay of 50 ns.

The selection of the specific MARK signal is done by using the ACSPL+ ASSIGNFINS command for setting input pins assignment and mapping between FGP_IN signals to the bits of the IN variable (refer to the *SPiiPlus Command & Variable Reference Guide*).

3.8.1.3 Position Event Generation (PEG)

The SPiiPlusCMNT advanced Position Event Generator (referred to also as Output Compare) output supports incremental and random modes (256 events per burst). The maximal burst rate in random mode is 10Mhz.

The two PEG pulses and two PEG state TTL signals can be associated with any of the incremental or Sin-Cos encoders, to be used by any of the two axes, and can be programmed for polarity and shape. Their functionality is determined by three independent PEG engines.

The Incremental PEG mode provides the ability to generate a fixed width pulse whenever a fixed position interval has passed, starting at a predefined start point and ending at a predefined end point.

The Random PEG mode provides the ability to control a PEG pulse and a two-bit STATE vector at pre- defined positions, which are stored as a 256 member user-defined array.

Refer to the *PEG and MARK Operations Application Notes* for more details.

3.8.2 J7 24V output supply connector

Label: J7 24V OUTPUT SUPPLY

Connector	
Manufacturer	PHOENIX
Type	MC-1.5/2 GF 3.81

Connector	
Version	2 pin, pitch 3.81
P/N	NA

Mating Connector	
Manufacturer	PHOENIX
Type	MC-1.5/2 STF 3.81
Version	2 pin, pitch 3.81
P/N	NA

Table 3-7. J7 connector pinout

Pin	Name	Description
1	24V_SUP_OUT	24V logic supply output (up to 5A)
2	24V_RTN	24V logic supply return

3.8.3 J11 general purpose connector

Label: J11 GP

Connector	
Manufacturer	Unbranded - industry standard

Connector	
Type	D-sub SCSI
Version	36 pin female 1,27mm
P/N	NA

Mating Connector	
Manufacturer	Unbranded - industry standard
Type	D-sub SCSI
Version	36 pin SCSI male
P/N	NA

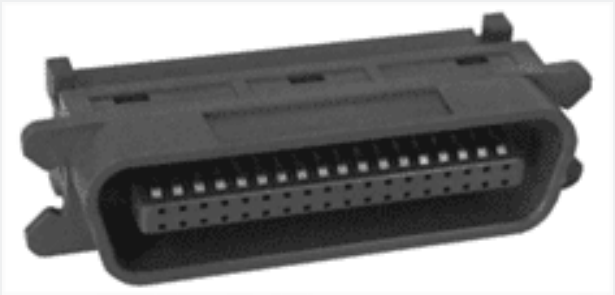


Table 3-8. J11 connector pinout

Pin	Name	Description
1	2_CHA+	Axis 2 Encoder A non-inverted input
2	2_CHA-	Axis 2 Encoder A inverted input
3	2_CHB+	Axis 2 Encoder B non-inverted input
4	2_CHB-	Axis 2 Encoder B inverted input
5	2_CHI+	Axis 2 Encoder Index non- inverted input
6	2_CHI-	Axis 2 Encoder Index inverted input

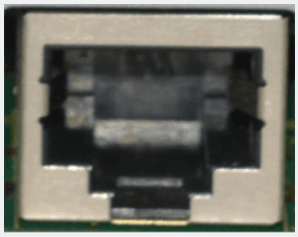
Pin	Name	Description
7	5U	5V user supply for Digital Encoder and Hall
8	STATE0+/ENC_0+	PEG STATE 0 non-inverted output or Encoder 0 non- inverted output
9	STATE0- /ENC_0-	PEG STATE 0 inverted output or Encoder 0 inverted output
10	ANGD	Analog ground
11	AIN2+	Analog Input 2 non-inverted
12	AIN2-	Analog Input 2 inverted
13	0_RSV_SIN+	Axis 0 Resolver SIN non-inverted input
14	0_RSV_SIN-	Axis 0 Resolver SIN inverted input
15	0_RSV_COS+	Axis 0 Resolver COS non- inverted input
16	0_RSV_COS-	Axis 0 Resolver COS inverted input
17	0_RSV_EXT+	Axis 0 Resolver EXT non-inverted output
18	0_RSV_EXT-	Axis 0 Resolver EXT inverted output
19	3_CHA+	Axis 3 Encoder A non-inverted input
20	3_CHA-	Axis 3 Encoder A inverted input
21	3_CHB+	Axis 3 Encoder B non-inverted input
22	3_CHB-	Axis 3 Encoder B inverted input
23	3_CHI+	Axis 3 Encoder Index non- inverted input
24	3_CHI-	Axis 3 Encoder Index inverted input
25	DGND	Digital ground
26	STATE1+/ENC_1+	PEG STATE 1 non-inverted output or Encoder 1 non- inverted output
27	STATE1- / ENC_1-	PEG STATE 1 inverted output or Encoder 1 inverted output
28	EGND	Shield

Pin	Name	Description
29	AIN3+	Analog Input 3 non-inverted
30	AIN3-	Analog Input 3 inverted
31	1_RSV_SIN+	Axis 1 Resolver SIN non-inverted input
32	1_RSV_SIN-	Axis 1 Resolver SIN inverted input
33	1_RSV_COS+	Axis 1 Resolver COS non- inverted input
34	1_RSV_COS-	Axis 1 Resolver COS inverted input
35	1_RSV_EXT+	Axis 1 Resolver EXT non-inverted output
36	1_RSV_EXT-	Axis 1 Resolver EXT inverted output

3.8.4 J12 HSSI connector

Label: J12

Connector	
Manufacturer	Unbranded - industry standard
Type	Socket
Version	RJ-45 type 8-pin
P/N	NA



Mating Connector	
Manufacturer	Unbranded - industry standard connection
Type	Plug
Version	RJ-45 type 8 pin
P/N	NA

Mating Connector


Table 3-9. J12 connection pinout

Pin	Name	Description
1	CONTROL_#+	Control signal non-inverted output for channel 0
2	CONTROL_#-	Control signal inverted output for channel 0
3	SER_DI_#+	Serial data non-inverted input for channel 0
4	SER_DI_#-	Serial data inverted input for channel 0
5	SER_DO_#+	Serial data non-inverted output for channel 0
6	SER_DO_#-	Serial data inverted output for channel 0
7	DGND	Digital ground
8	DGND	Digital ground

3.8.5 J13 RS232 COM1 Serial Port Connector

Label: J13 RS232

Connector	
Manufacturer	Unbranded - industry standard
Type	Socket
Version	RJ11 modular jack – 4P4C
P/N	NA

Connector


Mating Connector	
Manufacturer	Unbranded - industry standard
Type	Plug
Version	RJ11 plug for 4P4C
P/N	NA
	

Pin	Name	Description
1	RX232	RS-232 receive signal for communication port 1 (COM1)
2	TX232	RS-232 transmit signal for communication port 1 (COM1)
3	DGND	Digital ground.
4	SHIELD	Cable shield connection

3.8.6 J14 Safe Torque Off (STO)

STO is an optional feature. 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.

STO (The Safe Torque Off) is the fundamental safety capability needed to prevent motors from moving during a safety event.

STO capability prevents the moving of the motor using two hardware inputs, STO1 and STO2 that block the PWM signals to the power stage of the drive. A 24V (18Vdc to 33Vdc) must be connected to both inputs to enable the drive's regular operation. When the 24V is removed from one or both STO inputs, the PWM signals are blocked at least 50msec afterwards but not more than 200msec afterwards. In addition, the controller is informed about this event. 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:

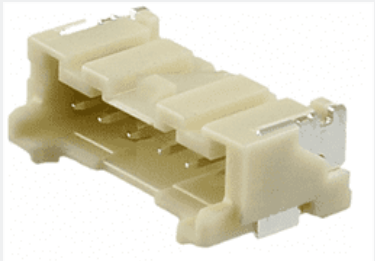
- AC synchronous / DC brushless
- Step motor

For DC brush motor, removing the 24V from both STO inputs, guarantees that under any foreseen circumstances, failure or damage, the motor will not move.

Usually, 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.

3.8.6.1 Description

Label: J14 STO

Connector	
Manufacturer	JST
Type	Shrouded header
Version	SM05B-PASS-1, 5 male, 5 pin, pitch 2mm
P/N	NA
	
Mating Connector	
Manufacturer	JST

Connector	
Type	Crimp position socket
Version	Housing: PAP-05V-S Contact: SPHD-001T-P0.5 female, 5 pin, pitch 2mm
P/N	PAP-05V-S

Table 3-10. J14 connection pinout

Pin	Name	Description
1	STO1-	Safety torque input 1 inverted input
2	STO1+	Safety torque input 1 non-inverted input
3	EGND	Electrical ground
4	STO2+	Safety torque input 2 non-inverted input
5	STO2-	Safety torque input 2 inverted input

3.8.6.2 Connection instructions

Figure 3-8 describes a wiring scheme of a safety relay, controlled in this example by a PLC safety device.

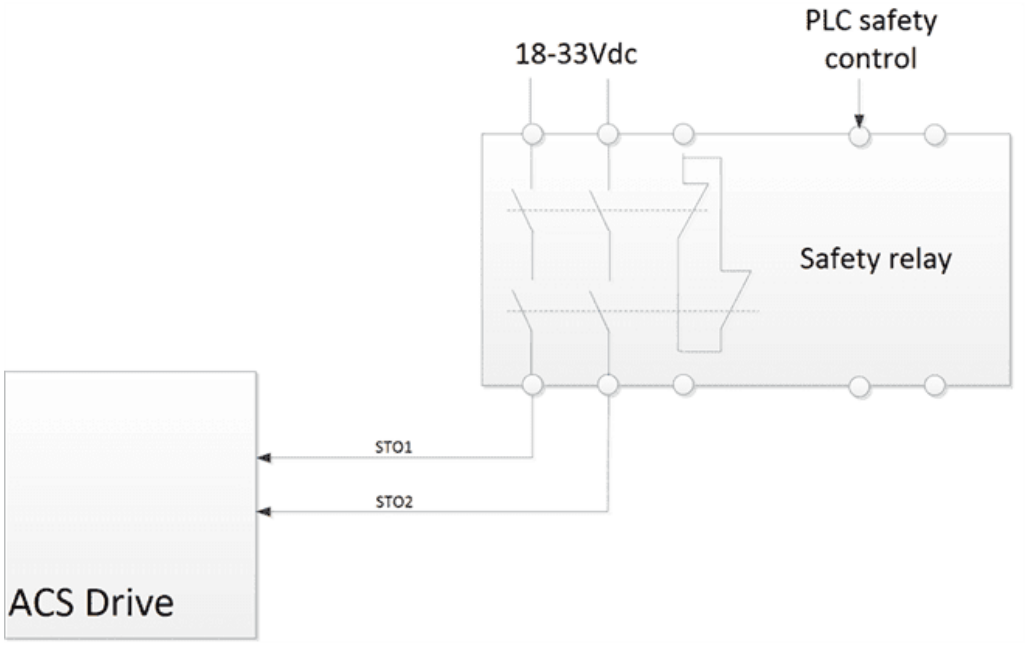


Figure 3-8. STO wiring scheme

The STO inputs can be also fed from a door switch, a light-curtain, or any other safety related controller.

Figure 3-9 describes a schematic STO implementation. The STO inputs feed the power (through additional circuitry which is not shown in the figure) to the upper and lower PWM drivers of the corresponding transistors.

The STO circuit is implemented on a dedicated module that plugs into all ACS products that support this functionality.

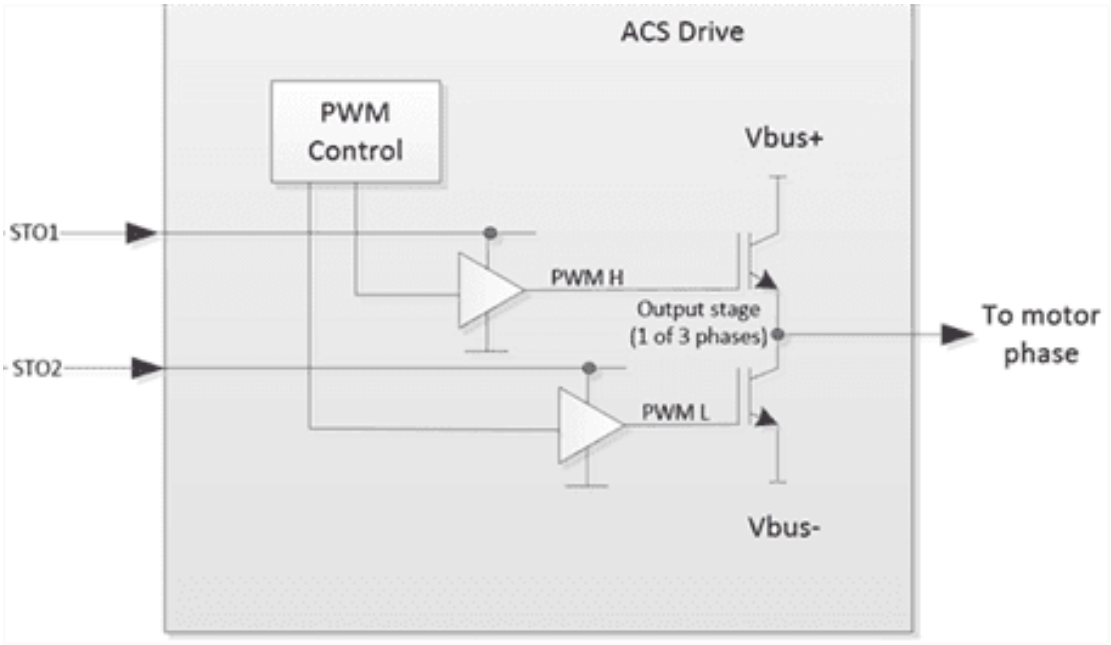


Figure 3-9. STO implementation

3.9 Encoder feedback

The following feedback types are supported:

1. Incremental digital encoder (1 or 2 per axis)
2. 250kHz analog SIN-COS encoder (optional 1 per axis)
3. Resolver (optional 1 per axis)
4. Hall sensors (1 set per axis)
5. Absolute digital encoder (optional 1 set per axis)

The type of encoder and the number of encoders per axis have to be specified when ordered, and cannot be modified at field level.

Dual feedback (dual loop) topology per axis is supported. The number of utilized network axes is identical to the number of digital encoders used. For example, when a dual feedback scheme is implemented for both axes, 4 network axes are consumed out of the total number of network axes supported and ordered for the specific SPiiPlusCMNTmaster.

3.9.1 J4 , J5 encoder connectors

Label: J4 1(Y), J5 0(X)

Connector	
Manufacturer	Unbranded - industry standard
Type	D-sub
Version	DB26 high density female
P/N	NA

Mating Connector	
Manufacturer	Unbranded - industry standard
Type	D-sub
Version	DB26 high density male
P/N	NA

Mating Connector


The dollar sign ($) in the table refers to the axis designations which can be 0 or 1 depending on the connector.

Table 3-11. J4, J5 connectors pinout

Pin	Name	Description
1	$_CHA-	$ Encoder A inverted input
2	$_CHB-	$ Encoder B inverted input
3	$_CHI-	$ Encoder Index inverted input
4	$_HB	$ Motor Hall B
5	V_SUP_SFTY	Supply for limits input
6	$_RL	$ Right Limit
7	$_SIN-	$ Encoder SIN inverted input
8	$_COS-	$ Encoder COS inverted input
9	$_SC_I-	$ Encoder SIN-COS Index inverted input
10	$_CHA+	$ Encoder A non-inverted input
11	$_CHB+	$ Encoder B non-inverted input
12	$_CHI+	$ Encoder Index non-inverted input
13	$_HA	$ Motor Hall A
14	$_HC	$ Motor Hall C
15	$_LL	$ Left Limit

Pin	Name	Description
16	$_SIN+	$ SIN non-inverted input
17	$_COS+	$ COS non-inverted input
18	$_SC_I+	$ Encoder SIN-COS Index non-inverted input
19	5U	5V user supply for Digital Encoder and HALL
20	5U_ RTN	5V return user supply for Digital Encoder, a return for $ Motor temperature sensor, and return for HALL
21	Shield	Shield
22	$_ MTMP	$ Motor Over-Temperature
23	V_RTN_ IO	Return supply IO (not used)
24	V_RTN_ SFTY	A return for Right and Left Limits input
25	5F	5V user supply for Analog Encoder and HALL
26	5F_RTN	5V return user supply for Analog Encoder and HALL

3.9.2 Absolute encoder interface

Absolute encoder's interfaces (pins and electrical circuitry) are shared with Digital Incremental (AqB) and with Sin-Cos encoder's interfaces, according to the table below:

Table 3-12. Absolute encoder reference

Absolute encoder type	Encoder's interface	Controller's interface
Endat 2.2	RS485 bidirectional Data	CHA
	RS422 Clock (encoder input)	CHB
Smart ABS / Panasonic	RS485 bidirectional Data	CHA
BiSS / SSI	RS485 bidirectional Data	CHA
	RS422 Clock (encoder input)	CHB (controller's output)

Absolute encoder type	Encoder's interface	Controller's interface
Hiperface	RS485 bidirectional Data	CHA
	Sin output	Cos input
	Cos output	Sin input

The digital bidirectional communication data channel is shared with CHA (data).

The Clock line interfaces to the controller's CHB.

Hiperface uses in addition to the digital bidirectional data channel the analog Sin and Cos interfaces, see Figure 3-13.

3.9.3 Connection schematics

Connection schematics are shown for the following:

- Incremental digital AqB encoder connections
- Hall sensors connection
- Sin-Cos encoder connections
- Absolute encoder hiperface schematic diagram
- Absolute encoder schematic diagram
- Absolute encoder biderctional schematic diagram

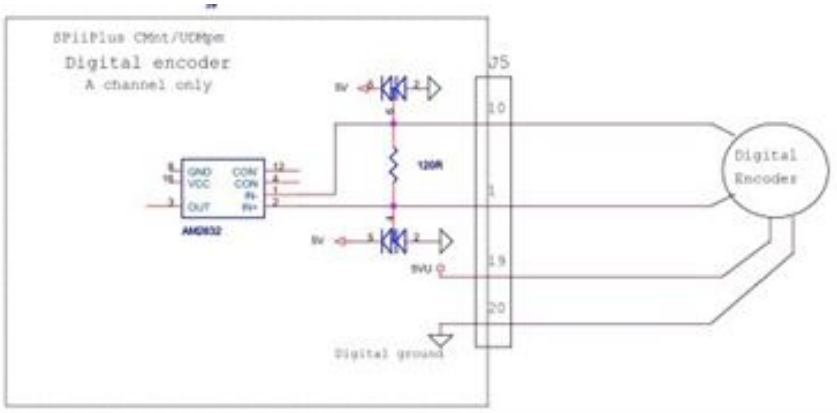


Figure 3-10. Incremental digital AqB encoder connections

The connection is a protected RS-422 differential line with 120Ω termination.

Encoders are fed by a 5V±5% 250mA supply (the total available current to all encoders) referenced to a digital ground. By special factory order, an additional encoder current supply of 5V/1A can be provided through the same line by connecting an external supply to the J6 connector and by an appropriate internal jumper setting.

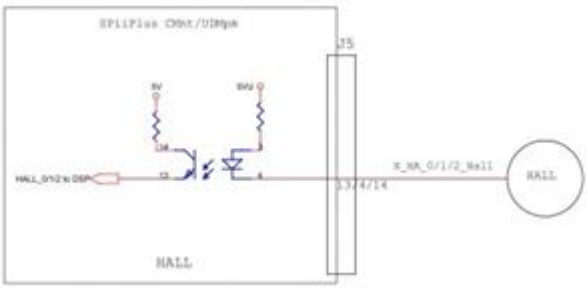


Figure 3-11. Hall sensors connection

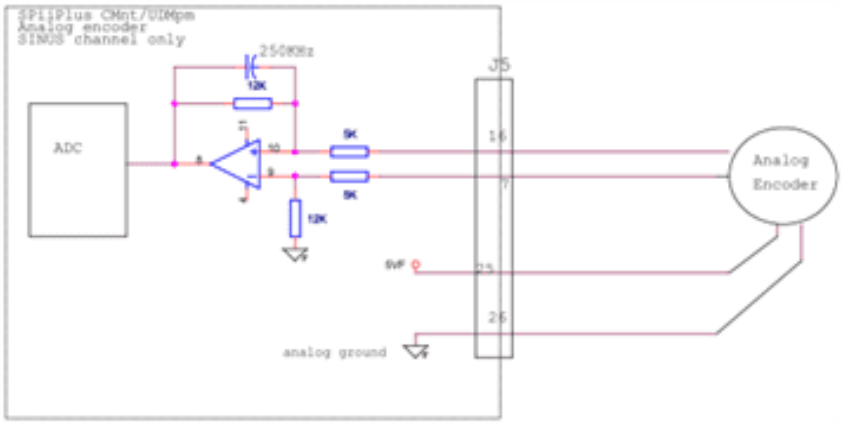


Figure 3-12. Sin-Cos encoder connections

The Sine, Cosine and Index signal interface has a 52dBm SNR and the Sin and Cos inputs are sampled at 20kHz, 12 bit resolution.

A software based Offset, Gain and Phase compensation can be set using the MMI Application Studio Sin Cos Encoder Compensation tool which optimizes and sets the compensation values, stores the optimized values and displays the results graphically.

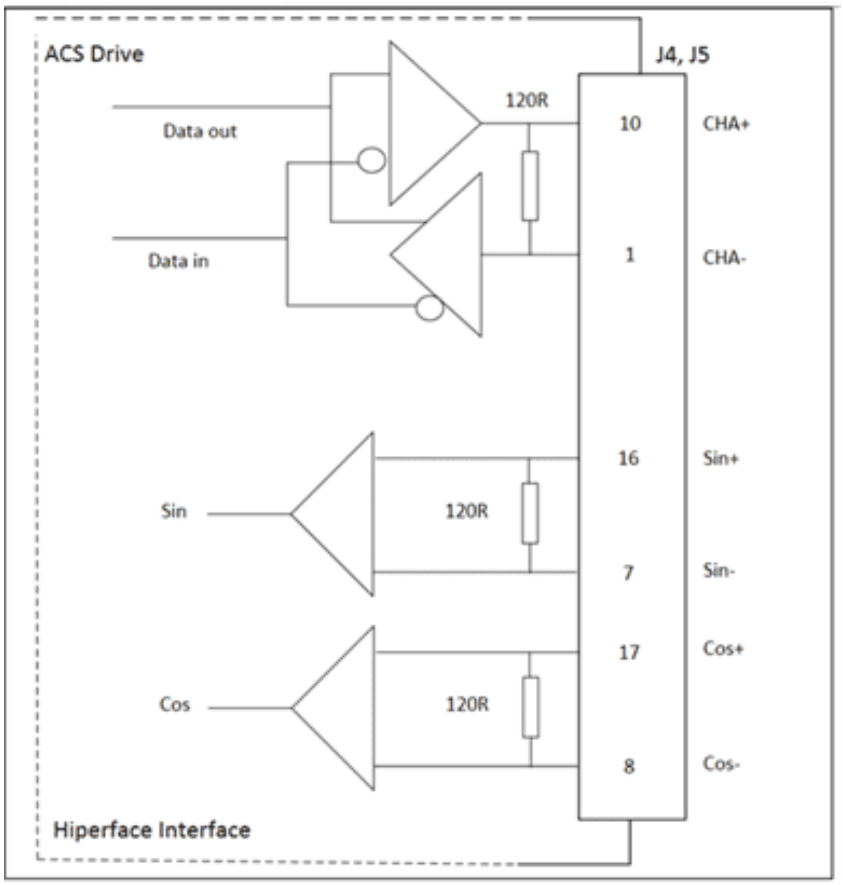


Figure 3-13. Absolute encoder hiperface schematic diagram

Bi-directional RS485 data channels uses CHA of the digital incremental encoder, and when clock is provided to the encoder, then CHB of the corresponding digital incremental encoder is used, see Figure 3-14 and Figure 3-15 .

The setting is performed by software.

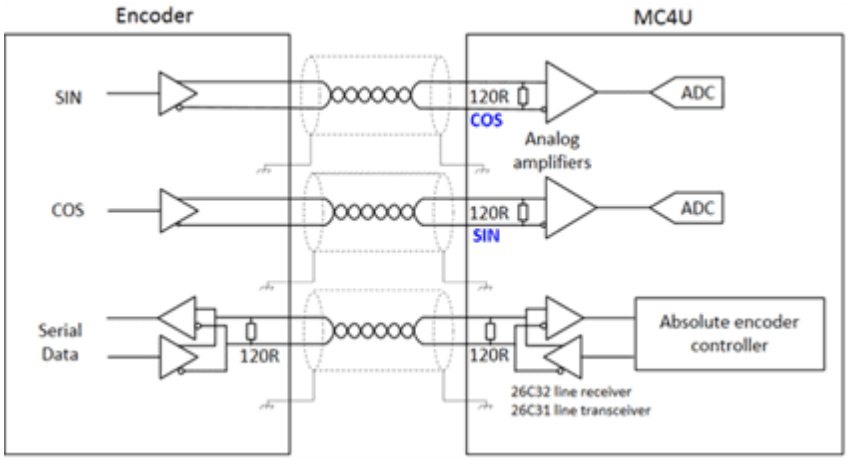


Figure 3-14. Absolute encoder schematic diagram

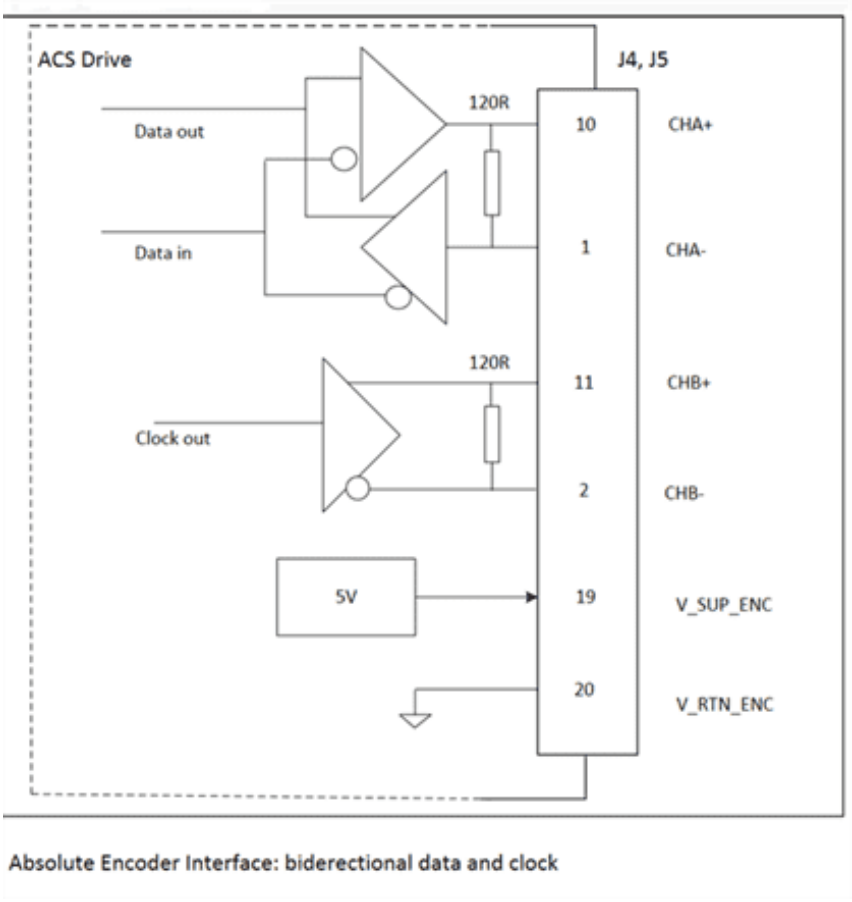


Figure 3-15. Absolute encoder biderctional schematic diagram

3.9.4 Encoder types and assignment

Certain constraints result from sharing internal resources and connector pins for the SPiiPlusCMNT. Detailed data for using an encoder with a resolver is employed in Encoder configurations with resolver and if no resolver is employed in Encoder configurations with no resolver.

3.9.4.1 Encoder configurations with resolver

Table 3-13 details all possible encoder configurations for the SPiiPlusCMNT if a resolver is employed.

Table 3-13. SPiiPlusCMNT encoder configuration with resolver

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Resolver 0 (J11)	Resolver 1 j (11)	Encoder 2 (j11)	Encoder 3 (J11)
2 (1 per axis)	0	0	Incremental	Incremental	Not used		Not used	
2 (1 per axis)	0	1	Incremental	Incremental			Not used	
			Incremental			Resolver		
				Incremental	Resolver			
2 (1 per axis)	0	2	Incremental	Incremental			Not used	
			Incremental			Resolver		
				Incremental	Resolver			
					Resolver	Resolver		

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Resolver 0 (J11)	Resolver 1 j (11)	Encoder 2 (j11)	Encoder 3 (J11)
2 (1 per axis)	1	0	Incremental	Incremental			Not used	
			Incremental	SIN-COS				
			SIN-COS	Incremental				

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Resolver 0 (J11)	Resolver 1 j (11)	Encoder 2 (j11)	Encoder 3 (J11)
2 (1 per aixs)	1	1	Incremental	Incremental			Not used	
			Incremental			Resolver		
				Incremental	Resolver			
			Incremental	SIN-COS				
			SIN-COS	Incremental				
			SIN-COS			Resolver		
				SIN-COS	Resolver			

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Resolver 0 (J11)	Resolver 1 j (11)	Encoder 2 (j11)	Encoder 3 (J11)
2 (1 per axis)	2	0	Incremental	Incremental	Not used		Not used	
			Incremental	SIN-COS				
			SIN-COS	Incremental				
			SIN-COS	SIN-COS				
2 (1 per aixs0	2	2	Any	Any	Resolver if SIN-COS is not used by J5	Resolver if SIN-Cos is not used by J4	Not used	
4 (2 per axis)	0	0	Incremental	Incremental			Incremental	Incremental

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Resolver 0 (J11)	Resolver 1 j (11)	Encoder 2 (j11)	Encoder 3 (J11)
4 (2 per axis)	0	1	Incremental	Incremental			Incremental	Incremental
			Incremental			Resolver		
				Incremental	Resolver			
4 (2 per axis)	0	2	Incremental	Incremental			Incremental	Incremental
			Incremental			Resolver		
				Incremental	Resolver			
					Resolver	Resolver		

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Resolver 0 (J11)	Resolver 1 j (11)	Encoder 2 (j11)	Encoder 3 (J11)
4 (2 per axis)	1	0	Incremental	Incremental			Incremental	Incremental
			Incremental	SIN-COS				
			SIN-COS	Incremental				

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Resolver 0 (J11)	Resolver 1 j (11)	Encoder 2 (j11)	Encoder 3 (J11)
4 (2 per axis)	1	1	Incremental	Incremental			Incremental	Incremental
			Incremental			Resolver		
				Incremental	Resolver			
			Incremental	SIN-COS				
			SIN-COS	Incremental				
			SIN-COS			Resolver		
				SIN-COS	Resolver			

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Resolver 0 (J11)	Resolver 1 j (11)	Encoder 2 (j11)	Encoder 3 (J11)
4 (2 per axis)	2	0	Incremental	Incremental			Incremental	Incremental
			Incremental	SIN-COS				
			SIN-COS	Incremental				
			SIN-COS	SIN-COS				
4 (2 per axis)	2	2	Any	Any	Resolver if SIN-COS is not used by J5	esolver if SIN-COS is not used by J4	Incremental	Incremental

3.9.4.2 Encoder configurations with no resolver

Table 3-14 details all possible encoder configurations for the SPiiPlusCMNT if a resolver is not employed.

Table 3-14. SPiiPlusCMNTencoder configuration without resolver

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Encoder 2 (J11)	Encoder 3 (J11)	Resolver 0 (J11)	Resolver 1 (J11)
2 (1 per axis)	0	0	Incremental	Incremental	Not used		Not used	
2 (1 per axis)	0	1	Incremental	Incremental	Not used		Not used	
			Incremental	Absolute				
			Absolute	Incremental				
2 (1 per axis)	0	2	Incremental	Incremental	Not used		Not used	
			Incremental	Absolute				
			Absolute	Incremental				
			Absolute	Absolute				

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Encoder 2 (J11)	Encoder 3 (J11)	Resolver 0 (J11)	Resolver 1 (J11)
2 (1 per axis)	1	0	Incremental	Incremental	Not used		Not used	
			Incremental	SIN-COS				
			SIN-COS	Incremental				
2 (1 per axis)	1	1	Incremental	Incremental	Not used		Not used	
			Incremental	Absolute				
			Absolute	Incremental				
			Incremental	SIN-COS				
			SIN-COS	Incremental				
			SIN-COS	Absolute				
			Absolute	SIN-COS				

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Encoder 2 (J11)	Encoder 3 (J11)	Resolver 0 (J11)	Resolver 1 (J11)
2 (1 per axis)	2	0	Incremental	Incremental	Not used		Not used	
			Incremental	SIN-COS				
			SIN-COS	Incremental				
			SIN-COS	SIN-COS				
2 (1 per axis)	2	2	Any	Any	Not used		Not used	
4 (2 per axis)	0	0	Incremental	Incremental	Incremental	Incremental	Not used	
4 (2 per axis)	0	1	Incremental	Incremental	Incremental	Incremental	Not used	
			Incremental	Absolute	Incremental	Incremental		
			Absolute	Incremental	Incremental	Incremental		

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Encoder 2 (J11)	Encoder 3 (J11)	Resolver 0 (J11)	Resolver 1 (J11)
4 (2 per axis)	0	2	Incremental	Incremental	Incremental	Incremental	Not used	
			Incremental	Absolute	Incremental	Incremental		
			Absolute	Incremental	Incremental	Incremental		
			Absolute	Absolute	Incremental	Incremental		
4 (2 per axis)	1	0	Incremental	Incremental	Incremental	Incremental	Not used	
			Incremental	SIN-COS	Incremental	Incremental		
			SIN-COS	Incremental	Incremental	Incremental		

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Encoder 2 (J11)	Encoder 3 (J11)	Resolver 0 (J11)	Resolver 1 (J11)
4 (2 per axis)	1	1	Incremental	Incremental	Incremental	Incremental	Not used	
			Incremental	Absolute	Incremental	Incremental		
			Absolute	Incremental	Incremental	Incremental		
			Incremental	SIN-COS	Incremental	Incremental		
			SIN-COS	Incremental	Incremental	Incremental		
			SIN-COS	Absolute	Incremental	Incremental		
			Absolute	SIN-COS	Incremental	Incremental		

Ordered			Possible combinations					
Incremental Digital Encoder	SIN COS Encoder	Resolver	Encoder 0 (J5)	Encoder 1 (J4)	Encoder 2 (J11)	Encoder 3 (J11)	Resolver 0 (J11)	Resolver 1 (J11)
4 (2 per axis)	2	0	Incremental	Incremental	Incremental	Incremental	Not used	
			Incremental	SIN-COS	Incremental	Incremental		
			SIN-COS	Incremental	Incremental	Incremental		
			SIN-COS	SIN-COS	Incremental	Incremental		
4 (2 per axis)	2	2	Any	Any	Incremental	Incremental	Not used	

3.9.4.3 External encoder supply connection

The SPiiPlusCMNT includes a built-in 5V/250mA encoder supply. If more current is needed or if an encoder (such as a Hiperface encoder) requires a different supply voltage level, an external supply can be applied to connector J6 (pins 5V_ENC_EXT and 5V_ENC_EXT_RTN). Figure 3-16 shows the external supply's connection to the SPiiPlusCMNT.

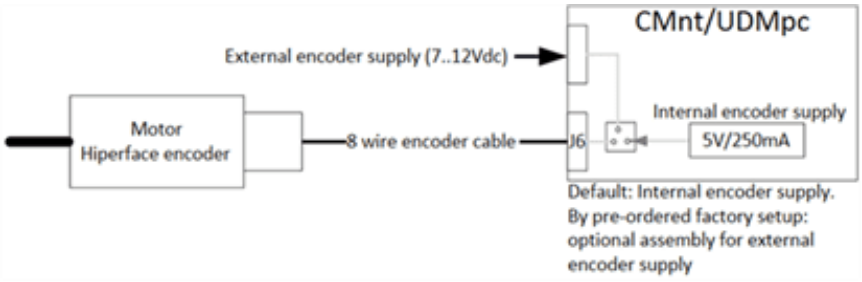


Figure 3-16. External power connection

Using an external encoder supply requires an internal hardware setup. This option must be pre-ordered.

3.10 Motors

3.10.1 J8, J9 motor connectors

Label: J8- MOTOR1, J9 –MOTOR0

Connector	
Manufacturer	Phoenix
Type	MC 1,5/ 6-GF-5,08
Version	6 pin, pitch 5.08 mm
P/N	NA

Mating Connector	
Manufacturer	Phoenix
Type	MC-1.5/6 STF 5,08
Version	6 pin, pitch 5.08
P/N	NA

The dollar sign ($) in the table refers to the axis designations which can be 0 or 1 depending on the connector.

Table 3-15. J8, J9 connector pinout

Pin	Signal	Description
1	R_$	Motor $ R phase

Pin	Signal	Description
2	S_$	Motor $ S phase
3	T_$	Motor $ T phase
4	EGND	EGND, protected earth.
5	BRK_$+	Mechanical brake non-inverted output
6	BRK_$-	Mechanical brake inverted output

3.10.2 Connection instructions

The selection of motor and parameter settings is done using the Adjuster Wizard of the SPiiPlus MMI Application Studio

A three-phase motor connection is depicted in Figure 3-17. An optional motor filter is shown in series between the drive and the motor. Use a shielded cable, terminated in the EGND pin which is internally connected to the chassis (PE). If needed, the shield/GND may be connected to the motor's chassis to provide a seamless common ground reference.

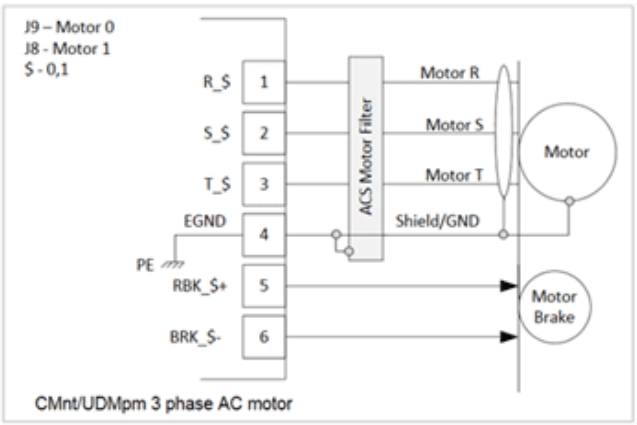


Figure 3-17. Three-phase motor connection

For DC brush motor connections do not connect phase T (Figure 3-18).

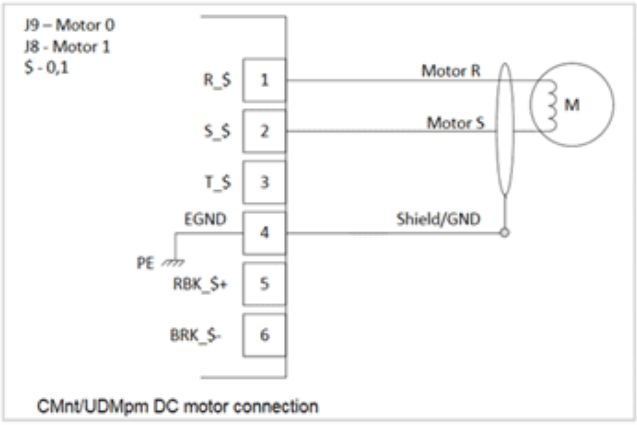


Figure 3-18. DC brush motor connection

For 2-phase step motors connect the motor phases between S-R and between T-R as shown in Figure 3-19.

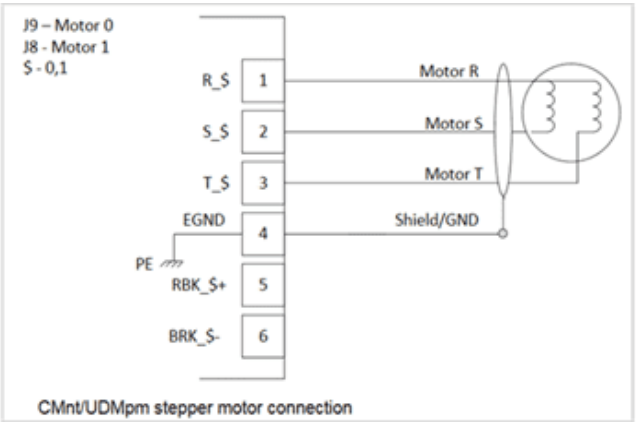


Figure 3-19. Two-phase motor connection

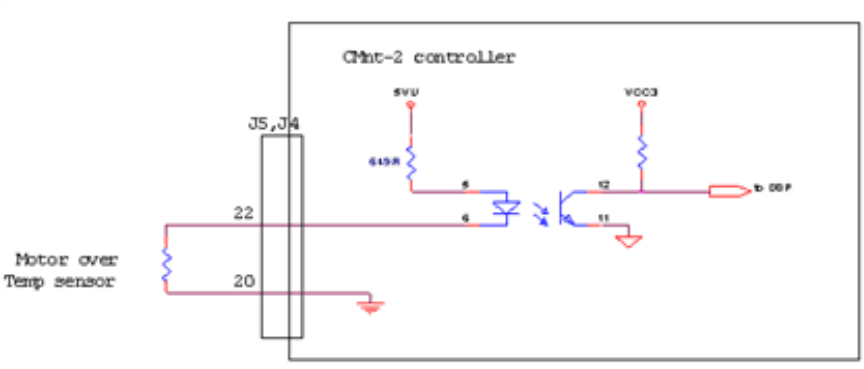


Figure 3-20. Motor over temperature connection

3.10.3 Motor filter

For dv/dt noise reduction it is recommended connecting the ACS Motor Filter (shown in Figure 3-21) in series between the drive and the motor. The motor filter is designed for 20/40A (RMS Continuous/Peak) current, 440/620Vac (RMS/Peak) voltage. For further details refer to the *MC4U Control Module Hardware Guide*.

Figure 3-21. Motor filter

3.10.4 Mechanical motor braking

Two 24V/1A mechanical brake control outputs are available, one output per axis. These outputs are powered by the 24V logic supply. The outputs are opto-isolated, and protected against shorts.

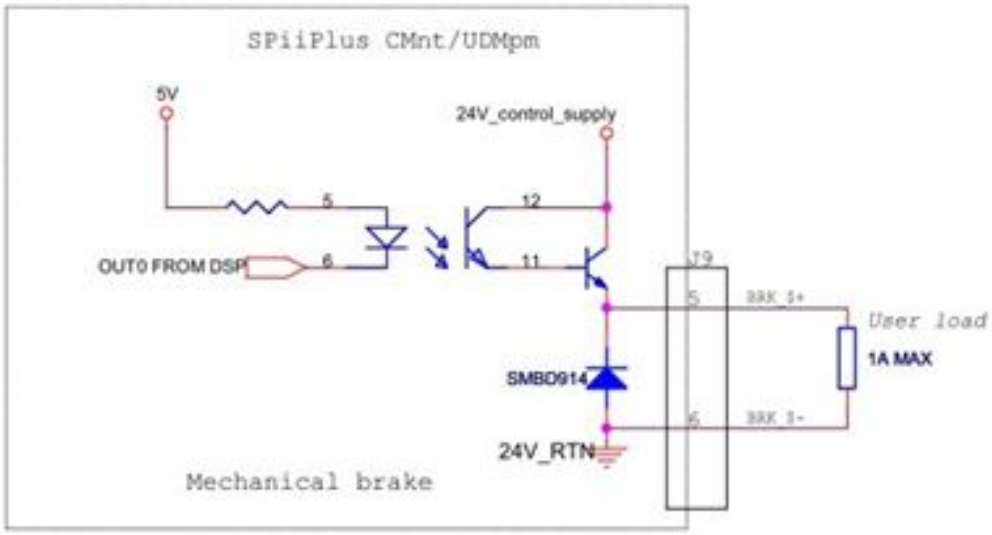


Figure 3-22. Mechanical brake

4. Specifications

4.1 EtherCAT Cycle Rate

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Table 4-1. CTIME Values for SPiiPlusCMNT (Rev. C1 and later) Controller

Controller	Number of Built-in Drives	Maximum Number of Axes	Number of Available ACSPL+ Buffers	Maximum Number of Simultaneously Running		Controller Cycle Time					ServoBoost Supported
				Motors	ACSPL+ Buffers	1 (msec) 2 (msec)	0.50 (msec)	0.25 (msec)	0.20 (msec)	Default Value (msec)	
SPiiPlus CMnt-1-x-x-x-x-x-02-...	1	2	10	2	10	√ (2)	√ (2,4)	-	-	0.5	-
SPiiPlus CMnt-1-x-x-x-x-x-04-...	1	4	10	4	10	√ (2)	√ (2,4)	-	-	0.5	-
SPiiPlus CMnt-1-x-x-x-x-x-08-...	1	8	10	8	10	√ (2)	√ (2,4)	-	-	0.5	-
SPiiPlus CMnt-1-x-x-x-x-x-16-...	1	16	16	16	16	√ (2)	√ (2,4)	-	-	1	-
SPiiPlus CMnt-1-x-x-x-x-x-32-...	1	32	32	32	32	√ (2)	√ (2,4)	-	-	1	-
SPiiPlus CMnt-2-x-x-x-x-x-02-...	2	2	10	2	10	√ (2)	√ (2,4)	-	-	0.5	-
SPiiPlus CMnt-2-x-x-x-x-x-04-...	2	4	10	4	10	√ (2)	√ (2,4)	-	-	0.5	-
SPiiPlus CMnt-2-x-x-x-x-x-08-...	2	8	10	8	10	√ (2)	√ (2,4)	-	-	0.5	-
SPiiPlus CMnt-2-x-x-x-x-x-16-...	2	16	16	16	16	√ (2)	√ (2,4)	-	-	1	-
SPiiPlus CMnt-2-x-x-x-x-x-32-...	2	32	32	32	32	√ (2)	√ (2,4)	-	-	1	-

(1) 2-axes Extended Segmented Motion (XSEG) with limitations: a. Segment length > 5 ms, b. IMM VEL = ... command shouldn't be used
(2) 6-axes Extended Segmented Motion (XSEG) with limitation: Segment length > 1 ms. The user's responsibility is to ensure that the USAGE doesn't exceed 80%.
(3) NetworkBoost (Ring Topology) with limitations: a. CTIME = 1 msec - up to 64 axes b. CTIME = 0.50 msec - up to 24 axes c. CTIME = 0.25 msec - up to 8 axes d. CTIME = 0.20 msec - up to 4 axes
(4) BPTP/2 command limited to 4 axes or less

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 voltage
	  > Phase-to-phase short circuit
	  > Short to ground
	  > Over- current
	  > Over-temperature

Supply	The module is fed by two power sources: > Motor AC supply > 24Vdc control supply
Motor drive supply	> Range: 85-265Vac or 120-370Vdc. > Inrush current: 3.75Arms for first 20ms following power-up  Current rating to be calculated based on actual load.
Control supply	> Range: 24Vdc ± 10% > Maximum input current / power: 4A / 100W  The module consumes 2A (50W) during regular operation (without motor brakes) An additional 2A are needed when the external motor brake feature is used
Motor types	> 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)
Motor brakes	Two, 1 per axis. 24V, 1A, opto-isolated. Powered by external 24Vdc Control Supply.

Feature	Specifications
Feedback	Standard: > Incremental digital encoders (AqB) > Hall inputs Optional: > Analog Sin-Cos > Absolute encoders 5V feedback supply with a total 250mA current available for feedback devices.
Incremental digital AqB	> Four, two per axis > A&B, I; Clk/Dir, > Type: Differential RS-422 > Max. Rate: 50 million encoder counts/sec. > Protection: Encoder error, not connected
Sin-Cos analog encoder (optional)	> Two, one per axis > Type: 1Vptp, differential > Programmable multiplication factor: x4 to -x4096 > Maximum frequency: 250kHz > Automatic compensation of Offset, Phase, and Amplitude > Maximum acceleration: 10^8 sine periods/sec^2 > ADC resolution: 12 bit > Protection: Encoder error, not connected
Sin-Cos digital output	The Sin-Cos inputs are available as digital outputs
Absolute encoders (optional)	EnDat 2.1(Digital)/ 2.2, Smart-ABS, Panasonic, BiSS-A/B/C, SSI, Hiperface Consult ACS customer suppoort for availability.
Hall	> Two sets of three per axis > Type: single-ended, 5V, source, opto-isolated > Input current: <7mA

Feature	Specifications
Resolver (optional)	> Two sensor inputs are available, 1 per axis. > 12bit resolution (4,096 counts/rev). > Excitation provided by a differential 10Vp-p ±5%/20KHz 35mA signal (RSV_EXT) > Inputs are 2 Sin-Cos differential 3.15V±25% signals.
Limit switch inputs	> Right Limit and Left Limit per axis > Interfaces: Configured by ordering option: 5 or 24V (default), Source (default) or Sink, single-ended, opto-isolated. > Input current: 4-14mA. > Input impedance: 5.6kΩ
Registration MARK inputs	> Four, 24V opto-isolated > Two are RS-422 with dedicated inputs > Two share the general purpose inputs 6 and 7
Digital inputs	> Eight single ended, opto-isolated > Interfaces: Configured by ordering option: 5 or 24V (default), Source (default) or Sink > Input current: 4-14mA
Digital outputs	> Eight, Single ended, opto-isolated > 0.5A per output, Up to 3A per 8 outputs > 24V (±20%) is externally user-provided, common to all signals. > Two GP outputs can be programmed to be used as the PEG Pulse outputs.  For further information, see *PEG and MARK Operations Application Notes*.
PEG (Position event generator)	> Signals: Two PEG_Pulse and two PEG_State > Differential, RS422 > Pulse width (RS-422): 26nSec to 1.75mSec. At maximal rate of 10MHz. > Pulse width (GP outputs): 0.75mSec to 1.75mSec. At maximal rate of 1kHz.

Feature	Specifications
HSSI	> One channel, RS-422 > For communication with ACS peripherals (proprietary protocol) such as HSSI-IO-16. > Up to 10m length.  Check support of HSSI modules with ACS.
Analog inputs	> Four, two per axis, ±10V, differential, 12bit resolution > Maximum input frequency: 10kHz > Offset: 100mV > Maximum sampling rate 250kHz
Analog outputs	> Two, one per axis, ±10V±10%, differential, 10 bit resolution, differential > Offset: <50mV > Maximum ripple: <50mV > Minimal input load: 10KΩ load
Communication	> EtherCAT: Node-to-node connectivity w/o redundancy. Two In & Out ports, 100 Mbit/sec, CoE and FoE protocols. 100m between adjacent nodes using ACS EtherCAT cables. > Ethernet port: 100 Mbps standard. TCP/IP, 10/100 Mbps. Cable length of up to 100m between adjacent network elements. > RS-232 port: Up to 115,200 baud serial communication for host communication. Rx, Tx and GND cross cable. Supports Modbus protocol as master or as slave.

Network Nodes - Supported Axis	> Being an EtherCAT network master, the product is ordered with the maximum number of supported network axes, whether ACS or non-ACS products (that have been approved by ACS).
	> The profile update rate is a function of this number:
	  > For up to 16 axes a profile update rate of 1 kHz and 2 kHz is provided.
	  > For 17 to 32 axes an update rate of 1 kHz is provided.
	  Number of I/O nodes does not impact the update rate.

Table 4-2. Drive power specifications

Part Number X – number of axes YY – special options	-X-0052-YY		
Number of axes	1 or 2		
MPU	MPU Cycle update rate: > For 2,4,6,8,16 axes: 2kHz > For 32 axes: 1kHz MPU-User Memory: RAM: 1Gb. Nonvolatile memory (Flash): 512Mb. Power up Time: 25sec.		
Input voltage range [Vac]	85 to 265		
Input voltage range [Vdc]	120 to 375		
Phase Current Cont./Peak, sine amplitude [A]	2.5 / 5	5 / 10	7.5 / 15
Phase Current Cont./Peak, RMS [A]	1.8 / 3.6	3.6 / 7.1	5.4 / 10.8
Peak current time [sec]	1		
Max. output voltage	(Vdc) x 1.41 x 88%		
Max. Input Cont./Peak power per axis @ at 230Vac [kVA]	0.9 /1.8	1.6	2.5
Max. output power (Cont./Peak) per axis @ 230Vac [kW]	0.55 / 1.1	1.1/2.2	1.6/3.2
Minimum load Inductance, at maximum motor voltage [mH]	1		
Max. Heat dissipation per axis @ 230Vac [W]	25	50	75

The maximal continuous/peak input currents as a function of maximal continuous/peak output power (at a given AC voltage input) are presented in Table 4-3. Efficiency of 68% at continuous and 66% at peak current performance.

Table 4-3. Input current vs. output power

Cont. /peak current	Cont. / peak power	AC voltage
11.7/11.7A	1007/1007W	@85Vac

Cont. /peak current	Cont. / peak power	AC voltage
12.9/17.4A	1485/2005W	@115Vac
12.9/17.4A	3676/ 7350W	@230Vac
16.3/34A	4304/ 8977W	@265Vac

The power bridge output voltage [Vrms] and maximal output power [Watt] per current rating and per axis, as function of single phase AC input voltage, is given belowin Table 4-4.

Table 4-4. Power output vs current

Cont / Peak	No. axes	85Vac	115Vac	230Vac	
5/10A	1	62V / 380W	86V / 529W	184V / 1128W	214V / 1307W
		52V / 637W	76V / 936W	174V / 2134W	204V / 2493W
	2	52V / 637W	76V / 936	174V / 2134W	204V / 2493W
		52V / 637W	76V / 936W	154V / 3778W	184V / 4496W
7.5/15A	1	57V / 524W	81V / 748W	179V / 1646W	209V / 1915W
		42V / 772W	66V / 1221W	164V / 3017W	194V / 3555W
	2	51V / 656W	75V / 970W	172V / 2366	201V / 2770W
		42V / 772W	66V / 1221W	134V / 4932W	164V / 6010W

4.2 STO

Table 4-5. STO Specifications

Item	Description	Remarks
Designation	STO1±, STO2±	

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

4.3 Safety and faults

Limit switches	Right Limit and Left Limit per axis. Opto-isolated, single-ended 24V± 20%, referenced to a common return signal. Activation at above 14mA.
Emergency Stop	One opto-isolated, 24V, 2-teminal signal. Activation above 14mA. Return line is common to Over-Temperature indication and Hall signals.
STO	2 signals per product, 24V and GND lines each, activated at 27mA min. Provides a standard, SIL-3 level delayed PWM drive discontinuation when activated. STO1 deactivates lower bridge and STO2 deactivates upper bridge of both drives
Mechanical Brake	One output per axis. 24V ±20%, opto-isolated current driving signals, 1A each. Protection against short circuit is provided. Power is provided internally from the 24V logic supply without additional protection.
Over temperature	Single-ended, opto-isolated, reference to 5U_RTN. Measured on the product heat sink, activated at 85-90 °C.
Over current	A per axis software indication when within the range below or higher: 5A model: 15A ±5% (14 – 16A) 7.5A model: 22A ±5% (21 – 23A)
Bus over voltage	A software indication at 442…467V
Bus under voltage	A software indication at 76…84V

Power Supply Not Ready	A software indication, active during the initial phase following power-up (soft start) for 4.5 – 5.5s
Motor short circuit	Phase-to-phase or phase-to-ground short detection by software. 5A model: 20A ±5% (19 – 21A) 7.5A model: 30A ±5% (28 – 32A)

4.3.1 Fault indications

The SPiiPlusCMNT supports hardware- and software-based fault indications for:

- Bus Over Voltage (442…467V)
- Bus Under Voltage (76…84V)
- AC Power Down
- Power Supply Not Ready (4.5-5.5 sec during transitional powering up, 'soft start')
- Over Temperature: Measured on the heat sink and activated at 85-90°C
- Motor Phase faults: Phase-to-Phase Short and Short-to-Ground
- Over Current: Measured per axis and reported to the user's application by software.
- Motor Over Temperature

4.3.2 Emergency stop

The Emergency Stop input is a two line, opto-isolated signal, fed from a 24V supply and activated at above 14mA as depicted in Figure 3-8.

4.3.3 Motor over temperature fault

The SPiiPlusCMNT provides one output signal per axis for connecting Motor Over Temperature fault sensors. The signal is single-ended, opto-isolated and referenced to a common ground for all faults as shown in Figure 3-20.

Indication is ON when the motor PTC is > 10kΩ, and is OFF when motor PTC impedance is < 1kΩ.

4.4 Communication

Host communication with the SPiiPlusCMNT can be via RS-232 or by Ethernet. The Ethernet connection may be either a direct connection (host to controller using a cross cable) or over a network. Selection of the communication channel and its parameters is done using the MMI Application Studio (refer to the ***SPiiPlus Setup Guide*** for details). Whenever possible, an Ethernet connection is preferred over RS232 because of the communication rate.

4.4.1 Network (EtherCAT) communication

Being an EtherCAT master, the SPiiPlusCMNT has a single EtherCAT OUT port which connects to the first network element in the network (see Figure 4-1).

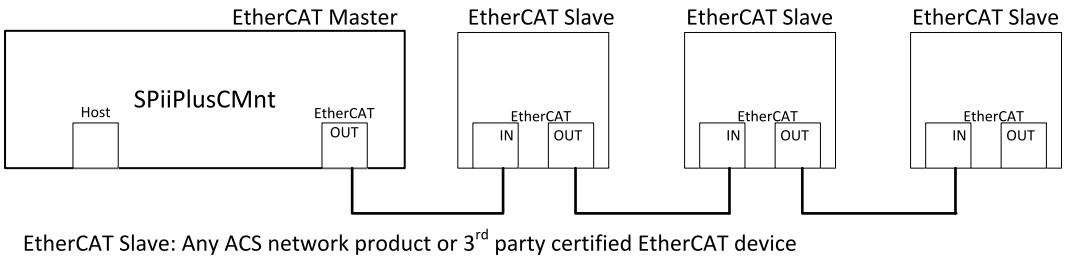

Figure 4-1. EtherCAT network connections

Cable type – use CAT5 or higher high quality cables. ACS provides such cables at varying lengths of 30 cm to 50 m, see Ethernet cables.

Cable lengths – all ACS products have been tested with 50 m cables between adjacent nodes. At lengths of up to 100 m one should carefully test performance as function of network complexity and operating environment.

When employing the SPiiPlusCMNT in an EtherCAT network, the MMI Application Studio EtherCAT Configurator tool is used for set up (refer to the *MMI Application Studio User Guide* for details).

4.5 Dimensions

The dimensions of the SPiiPlusCMNT are shown in Figure 4-2.

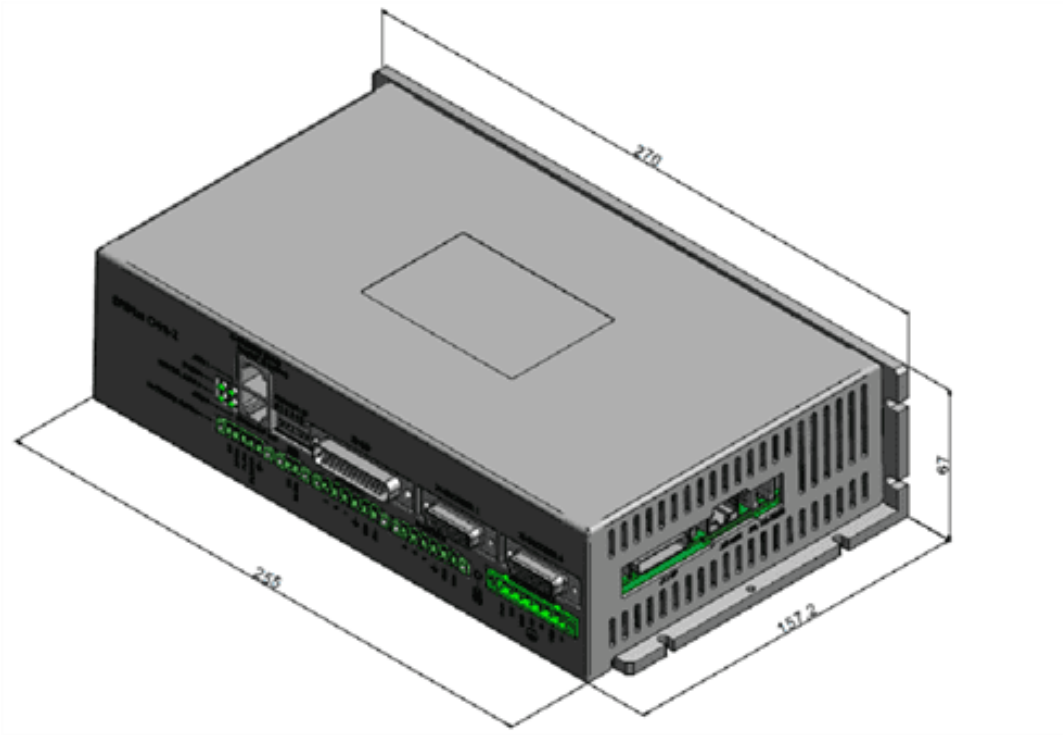

Figure 4-2. SPiiPlusCMNT dimensions

4.5.1 Regeneration

In order to absorb excess mechanical reverse energy translated into electrical energy during deceleration, and to avoid a voltage rise beyond the drive's overvoltage protection level, an

external active regeneration device should be used. A connectivity schematic is depicted in Figure 4-3. The rectified voltage bus (VBUS) is provided in the J10 connector. Use an external Regeneration unit (such as, Copley's Model 125 & 145), selected based on peak and continuous current, power, energy and bus voltages.

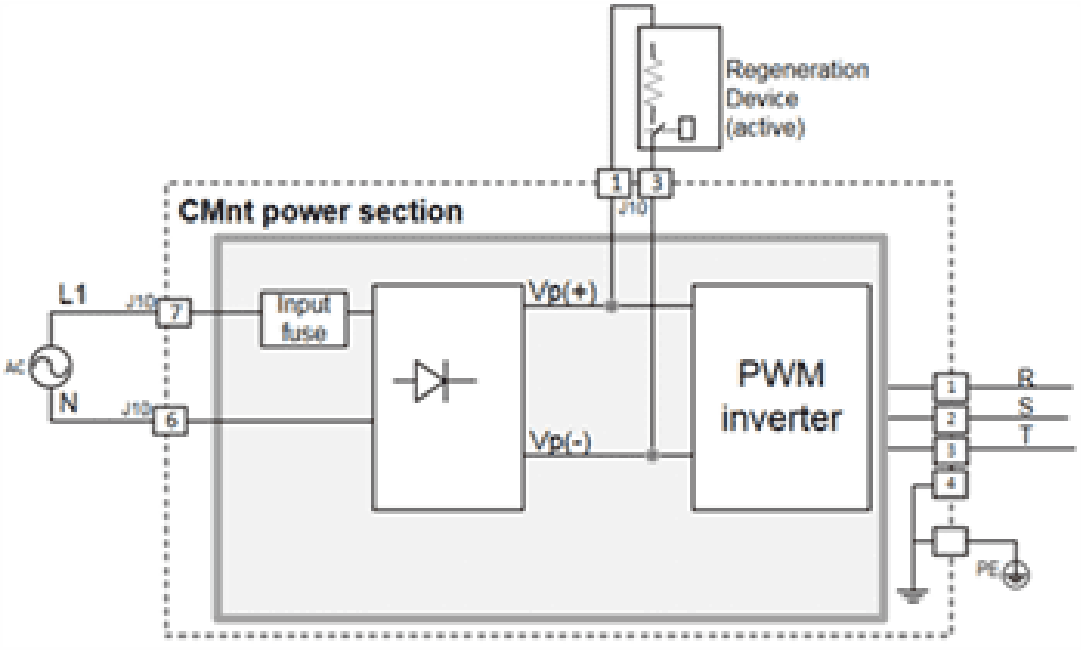

Figure 4-3. Regeneration connection

4.6 Weight

> 2.0kg

4.7 Compliance with standards

The SPiiPlusCMNT Dual Axis Control Module meets the requirements of the following standards:

EN 61326-1:2006	Industrial locations equipment, class A standard, under article 6(2) of EMC Directive 2004/108/EC (ACSEMC_EN.22513C)
IEC 61010-1:2001	Safety conformance, 2nd edition.
SEMI F42-0999:1999 SEMI F47-0200:2000	Voltage sag immunity

IEC 60068-2-6 Class 4M4 IEC 60068-2-29 Class 4M4 IEC 60068-2-56 Class 4K3	Sine vibration during operation (5-150 Hz, 3 axes, 10 m/s^2) 600 shocks, 150m/s2, 6ms 93%, 30C

4.7.1 Environment

Operating	0 to +50°C
Storage	-25 to +70°C
Humidity	5% to 90% non-condensing

4.7.1.1 Thermal considerations

Operate the SPiiPlusCMNT with forced air being applied.

Heat dissipated by the SPiiPlusCMNT negatively affects the operation of the MPU and the operation of the entire EtherCAT network controlled by it.

The standard unit generates maximal power with 115CFM air flow in ambient temperatures of up to 47°C (3.5Arms each axis in 5A model) and 36°C (5.3Arms each axis in 7A model).

An additional heat sink is not an option.

Figure 4-4 displays the losses (Watts) for 5A and 7.5A (peak sine Amps) drives as a function of rms current (Amps).

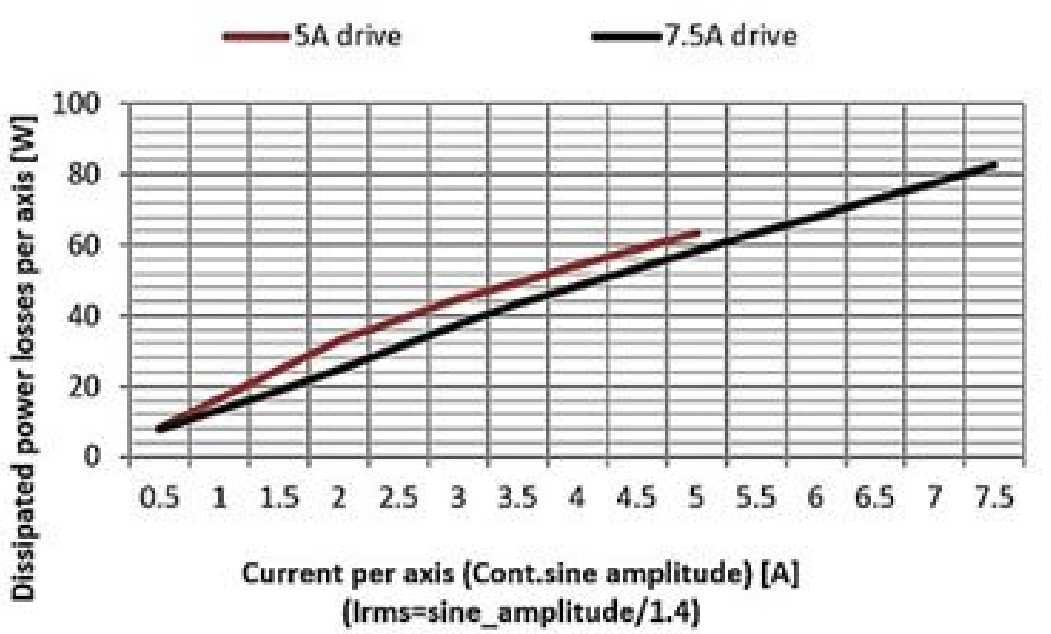

Figure 4-4. Dissipated power vs current

Figure 4-6 displays the maximal allowable ambient temperature (°C) at which the SPiiPlusCMNT can operate with SPiiPlusCMNTforced air flow (CFM) of various values.

Figure 4-5. Dissipated power vs temperature

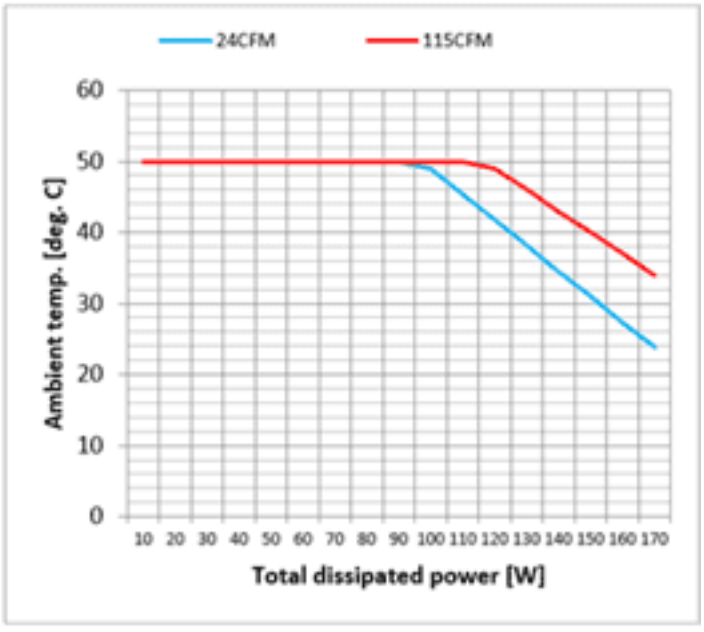

Figure 4-6. Dissipated power vs temperature

For example, to determine the overall power losses of both axes as a function of their rms current: from the chart in Figure 4-4 if the two 7.5A drives operate at 3.2Arms, a total of 2x50=100W has to

be dissipated. From Figure 4-5 with a minimal forced air flow of 24CFM the SPiiPlusCMNT can be operated at its maximal ambient temperature rating of 50°C.

Figure 4-6 also displays the maximal operational temperature as function of dissipated power when no ventilation is applied.

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