



# **SPIiPlus SDMnt Multi- Axis Step Motor EtherCAT Control Module**

**Hardware Guide**

Version NT 1.0

## SPiiPlus SDMnt Multi-Axis Step Motor EtherCAT Control Module

Version NT 1.0, 30 December 2010

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SPiiPlus SDMnt Multi-Axis Step Motor EtherCAT Control Module

**Changes in Version NT 1.0**

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# 1 About this Document

The SPiiPlus SDMnt Multi-Axis Step Motor EtherCAT Control Module is panel mounted, eight axis EtherCAT slave module. It can run seven two-phase unipolar step motors and one two-phase bipolar motor. This document provides detailed hardware information for the SPiiPlus SDMnt Control Module.

## 1.1 Conventions Used in this Document

### 1.1.1 Text Formats


Several text formats and fonts, illustrated in [Table 1](#), are used in the text to convey information about the text.


**Table 1 Text Format Conventions**


Text	Description
<b>BOLD CAPS</b>	ACSPL+ elements (commands, functions, operators, standard variables, etc.) when mentioned in the text. Software tool menus, menu items, dialog box names and dialog box elements.
<b>bold</b>	Emphasis or an introduction to a key concept.
<b>Blue Blue</b>	Links within this document, to web pages, and to e-mail addresses.
<i>Italics Blue</i>	Used to highlight referenced documentation.


### 1.1.2 Flagged Text


The following symbols are used for flagging text in this document:

<p><b>Note</b></p> 	<p><i>Notes include helpful information or tips.</i></p>
--	--

<p><b>Caution</b></p> 	<p><i>A Caution describes a condition that may result in damage to equipment.</i></p>
---	---

<p><b>Warning</b></p> 	<p><i>A Warning describes a condition that may result in serious bodily injury or death.</i></p>
---	--

<p><b>Advanced</b></p> 	<p><i>Indicates a topic for advanced users.</i></p>
--	---

<p><b>Model</b></p> 	<p><i>Highlights a specification, procedure, condition, or statement that depends on the product model.</i></p>
---	---

## 1.2 Terms and Definitions

The following terms are used in this document.

**Table 2 Terms**

Term	Definition
A2D	Analog to Digital
D2A	Digital to Analog
FW	Firmware
HSSI	High-Speed Synchronous Serial Interface
HW	Hardware
I <sup>2</sup> C	Inter-Integrated Circuit
MARK	Registration input that is used for latching current position with high precision
MPU	Motion Processing Unit
PEG	Position Event Generator
SPii	Second generation Servo Processor

## 2 SPiiPlus SDMnt Control Module Overview

The SPiiPlus SDMnt Multi-Axis Step Motor EtherCAT Control Module is a panel mounted, four or eight axis EtherCAT slave module designed for running step motors. It can run seven two-phase unipolar step motors and one two-phase bipolar motor.

The SPiiPlus SDMnt Control Module is designed for slaving to any ACS Motion Control EtherCAT Master. The unit operates over a 40Vdc bus and 3A current and up to 16 micro-step resolution

There are two SPiiPlus SDMnt Control Module versions:

- ❑ SPiiPlus-SDMnt-x-040A-003-yy - This unit is fed with 115/230 Vac nominal voltage and generates a 40 Vdc motor bus internally. The 40 Vdc is also available as an output to power other units.
- ❑ SPiiPlus-SDMnt-x-040D-003-yy - This unit is fed with 12-40 Vdc to power the motors. The unit does not have an internal 115/230 Vac to 40 Vdc supply.

where:

x - number of drives, 4 or 8

yy -

- 00 - Only for SPiiPlusNTM network
- 01 - Any EtherCAT network



**Figure 1 SPiiPlus SDMnt Multi-Axis Step Motor EtherCAT Control Module**

This chapter provides the SPiiPlus SDMnt Control Module technical details.

## 2.1 SPiiPlus SDMnt Control Module Dimensions

The following figures present the SPiiPlus SDMnt Control Module physical dimensions (in mm).

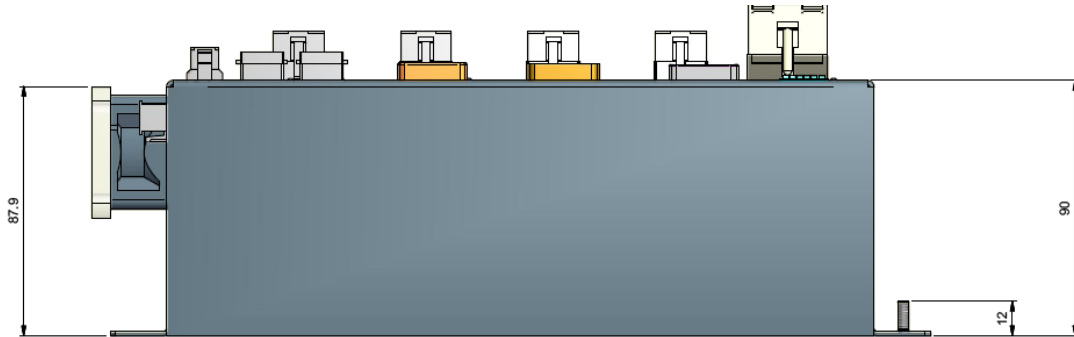


Figure 2 SPiiPlus SDMnt Control Module Dimensions from the Top

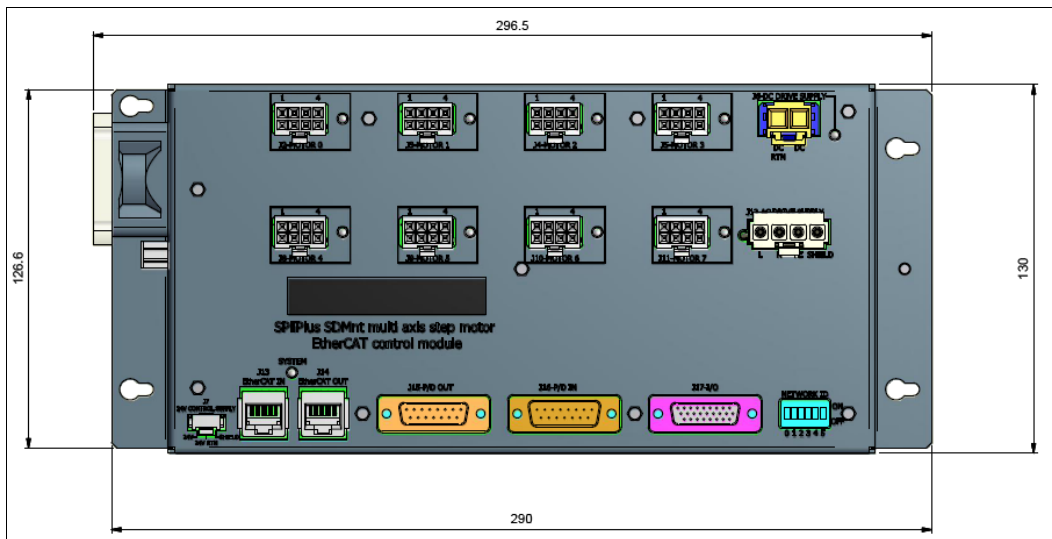
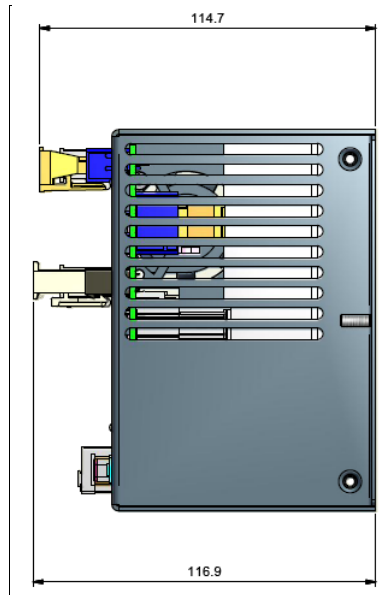


Figure 3 SPiiPlus SDMnt Control Module Dimensions from the Front



**Figure 4** SPiiPlus SDMnt Control Module Dimensions from the Side

## 2.2 SPiiPlus SDMnt Control Module Features

The principal features of the SPiiPlus SDMnt Control Module product line are:

- 1 Bipolar Motor Axis
- 7 Unipolar Motor Axes
- 4 Fast Inputs
- 4 Fast Outputs
- 2 Pulse/Direction Inputs
- 2 Pulse/Direction Outputs
- 2 Opto-isolated Slow Inputs
- 2 Opto-isolated Slow Outputs
- EtherCAT Input & Output Ports
- Internal 240W AC/DC Power Supply

The sections that follow provide specific details for each feature.

## 2.2.1 Control Supply Input

**Table 3** presents the SPiiPlus SDMnt Control Module Control supply input.

**Table 3 SPiiPlus SDMnt Control Module Control Supply Input**

	Description	Remarks
Signal Designation	24V, 24V_RTN	
Quantity	1	
Input Voltage	24 Vdc $\pm$ 10%	
Input Current	Maximum input current: 0.45 A @ 21.6 V	
Protection	Reverse polarity. Short current.	

### Note



*When it is needed to ensure that the motors are not powered, the Drive power supply has to be removed; however, the Control supply should remain connected.*

## 2.2.2 Drive Power Supply


The SPiiPlus SDMnt Control Module module is available in two versions, one with and one without an internal drive supply. The internal supply is limited to 240 W. Using an external supply, the total power extracted from the unit is 420 W.

### Caution



*SPiiplus SDMnt-8 includes a regeneration circuit for 117W, 10 Joules, 5% duty cycle. Care should be taken to keep the motor drive voltage below 44 V under any conditions; otherwise the unit may be damaged. The motor drive voltage can be measured on connector: J6 - DC Drive Supply Input/Output.*

- SPiiPlus-SDMnt-x-040A-003-yy - This unit is fed with 115/230 Vac nominal voltage and generates a 40 Vdc motor bus internally. The 40 Vdc is also available as an output to power other units.
- SPiiPlus-SDMnt-x-040D-003-yy - This unit is fed with 12-40 Vdc to power the motors, but does not include the 115/230 Vac to 40 Vdc supply.


 <p><b>Note</b></p>	<p><i>There is no restriction of the on-off sequence main power supplies, Drive supply and Control supply (24 V).</i></p>
--	---

**Table 4** presents the SPiiPlus SDMnt Control Module Drive power supply details.

**Table 4 SPiiPlus SDMnt Control Module Drive Power Supply**

	Description	Remarks
Signal Designation	N, L, PE	
Quantity	1	
Input Voltage	95Vac to 240Vac	Automatically selected.
Input Current	< 4 A @ 100 Vac	
Inrush Current < 2mS	< 60 A @ 230 Vac	
Output Voltage	40 V	The 40 V is available as an output DC drive supply to feed other slave modules via connector J9 (see <a href="#">Section 4.1</a> ).
Output Power (with internal supply).	240 W	
Maximum Output Current	< 5 A	

### 2.2.3 External DC Drive Supply Input

 <p><b>Caution</b></p>	<p><i>Use of an external 12-40 Vdc power supply is available only in the SPiiPlus SDMnt-x-040D-003-yy models. This voltage must be connected to the unit through a 16A fuse.</i></p>
---	--

**Table 5** presents the SPiiPlus SDMnt Control Module external DC Drive supply input details.

**Table 5 SPiiPlus SDMnt Control Module External DC Drive Supply Input**  
(page 1 of 2)

	Description	Remarks
Signal Designation	VP+, VP_RTN	
Quantity	1	
Input Voltage Range	12 - 40 Vdc	

**Table 5 SPiiPlus SDMnt Control Module External DC Drive Supply Input**  
(page 2 of 2)

	Description	Remarks
Input Current	< 10.5 A	
Inrush Current < 2mS	< 130 A @ 40 Vdc	
Protection	<input type="checkbox"/> Short Circuit: external fuse will blow <input type="checkbox"/> Reverse Polarity: external fuse will blow	

## 2.2.4 Unipolar Power Bridge

**Table 6** details the SPiiPlus SDMnt Control Module unipolar power bridge (per axis).

**Table 6 SPiiPlus SDMnt Control Module Unipolar Power Bridge**

	Description	Remarks
Signal Designation	OUTA, OUTA-, OUTB, OUTB-	Per axis
Quantity	7 (designated 1,2, 3,4,5,6,7)	
Type	Two-phase unipolar step motor. Microstepping -16 per full step. (3200 micro steps per revolution with a 1.8 step motor)	Step mode is programmable using the <b>SLCPRD\$</b> variable (see <a href="#">Section B.2 - Micro Stepping Configuration</a> ).
Output Current	Up to 3 A $\pm$ 5% per phase	1A,1.5A,2A or 3A which is programmable using the <b>XCURI\$</b> and <b>XCURV\$</b> variables (see <a href="#">Section B.3 - Current Amplitude Configuration</a> ).
Motor Configuration	Two-phase unipolar	
Protection	<input type="checkbox"/> Short Circuit: 4.5 A $\pm$ 5% (for recovery after short, 24V logic supply should be switched off/on) <input type="checkbox"/> Over Temperature: 80°C (on the transistor case. For recovery disable/enable the axis) <input type="checkbox"/> Over Voltage: 44 V $\pm$ 3% ) for recovery disable/enable the axis) <input type="checkbox"/> Under Voltage: 10 V $\pm$ 3% (for recovery disable/enable the axis)	

## 2.2.5 Power Bridge Bipolar

**Table 7** details the SPiiPlus SDMnt Control Module bipolar power bridge.

**Table 7 SPiiPlus SDMnt Control Module Bipolar Power Bridge**

	Description	Remarks
Signal Designation	OUT0A, OUT0A-, OUT0B, OUT0B-	The bipolar axis is axis number 0
Quantity	1 (designated 0)	
Type	Two-phase bipolar step motor. Microstepping -16 per full step. (3200 micro steps per revolution with a 1.8° step motor)	Does not support eighths step mode.
Output Current	Up to 3 A $\pm 5\%$ per phase	1A, 1.5A, 2A or 3A which is programmable using the <b>XCURI\$</b> and <b>XCURV\$</b> variables (see <a href="#">Section B.3 - Current Amplitude Configuration</a> ).
Motor Configuration	Two-phase bipolar	
Minimum Motor Inductance	> 7.5 mH @ 40 V	
Protection	<input type="checkbox"/> Short Circuit: 6A $\pm 5\%$ (for recovery disable/enable the axis) <input type="checkbox"/> Over Temperature: 80°C (on the transistor case. for recovery disable/enable the axis) <input type="checkbox"/> Over Voltage: 44 V $\pm 3\%$ (for recovery disable/enable the axis) <input type="checkbox"/> Under Voltage: 10 V $\pm 3\%$ (for recovery disable/enable the axis)	

## 2.2.6 Fast Input

**Table 8** details the SPiiPlus SDMnt Control Module fast input (via RS422).

**Table 8 SPiiPlus SDMnt Control Module Fast Input**

	Description	Remarks
Signal Designation	FIN2 - FIN5+, FIN2 - FIN5-	
Quantity	4 pairs	
Type	Differential RS422	
Default State	V < 0.2V input = not defined	

## 2.2.7 Fast Output

**Table 9** details the SPiiPlus SDMnt Control Module fast output (via RS422).

**Table 9 SPiiPlus SDMnt Control Module Fast Output**

	Description	Remarks
Signal Designation	FOUT2 - FOUT5+, FOUT2 - FOUT5-	
Quantity	4 pairs	
Type	Differential RS422	
Default State	Output = '0'	

## 2.2.8 Pulse/Direction Input

**Table 10** details the SPiiPlus SDMnt Control Module Pulse/Dir input.

**Table 10 SPiiPlus SDMnt Control Module Pulse/Dir Input**

	Description	Remarks
Signal Designation	PULSE_I_0±, PULSE_I_1±, DIR_I_0±, DIR_I_1±	Can be read by the <b>F2*</b> variables ( <b>F2POS</b> or <b>F2VEL</b> - see <i>SPiiPlus ACSPL+ Command &amp; Variable Reference Guide</i> ).
Quantity	2 pairs for Pulse, and 2 pairs for Direction	
Type	Differential RS422	
Default State	Pulse < 0.2 V, no counting	

## 2.2.9 Pulse/Direction Output

**Table 11** details the SPiiPlus SDMnt Control Module Pulse/Dir output.

**Table 11 SPiiPlus SDMnt Control Module Pulse/Dir Output**

	Description	Remarks
Signal Designation	PULSE_O_0±, PULSE_O_1±, DIR_O_0±, DIR_O_1±	Can be any one out of eight axes, programmable using <b>SLPROUT0</b> and <b>SLPROUT1</b> (see <i>SPiiPlus ACSPL+ Command &amp; Variable Reference Guide</i> ).
Quantity	2 pairs for Pulse, and 2 pairs for Direction	
Type	Differential RS422	
Default State	Pulse ='1' Dir ='0'	

## 2.2.10 General Purpose Inputs

**Table 12** details the SPiiPlus SDMnt Control Module General Purpose inputs.

**Table 12 SPiiPlus SDMnt Control Module General Purpose Inputs**

	Description	Remarks
Signal Designation	IN0+, IN0-  and  IN1+, IN1-	
Quantity	2	
Type	24 Vdc ±20%, Opto-isolated, floating cathode and anode (two pins).	Can be used as drive fault input from an external drive or as E-stop.
Input Current	< 15 mA	
Default State	No current, input = off	

## 2.2.11 General Purpose Outputs

**Table 13** details the SPiiPlus SDMnt Control Module General Purpose outputs.

**Table 13 SPiiPlus SDMnt Control Module General Purpose Outputs**

	Description	Remarks
Signal Designation	OUT0+, OUT0-  and  OUT1+, OUT1-	
Quantity	2	
Type	24 Vdc $\pm$ 20%, Opto-isolated, floating cathode and anode (two pins).	Can be used as an enable signal for external drives.
Output Current	< 50 mA	
Maximum Drop Output	< 1.7 V @ 50 mA	
Default State	No current, output = off	

## 2.2.12 EtherCAT Port

**Table 14** details the SPiiPlus SDMnt Control Module EtherCAT port.

**Table 14 SPiiPlus SDMnt Control Module EtherCAT Port**

	Description	Remarks
Signal Designation	Transmit: ETH#_TX $\pm$ Receive: ETH#_RX $\pm$	
Quantity	2	
Type	EtherCAT protocol	
Speed	100 Mbps	


## 2.3 Cooling Fan

The SPiiPlus SDMnt Multi-Axis Step Motor EtherCAT Control Module unit can simultaneously drive all axes at 1A without a cooling fan. However if more than 1A is required for all axes, or 3A for three axes and above, a cooling fan with a minimum 15 CFM must be added.

If needed, a cooling fan, P/N FA-1608K-100/LF, may be ordered from ACS Motion Control.

In any case, the maximum input power cannot be more than 420W.

## 2.4 EtherCAT Network Cable Limitation

<p><b>Caution</b></p> 	<p><i>For proper operation of the unit installed in an EtherCAT network strict adherence to the cable length limitations given in this section is required.</i></p>
---	---

The minimum cable length between units in an EtherCAT network is 1m; the maximum length is 25m.

## 2.5 EMC

With the installation of a ferrite ring (Ferroxcube MNF P/N T36/23/15-3C81) motor filter with 7 windings of the motor wire between the SPiiPlus SDMnt Control Module drive connector and the motor the unit complies with the following standards:

- EN 61326:2002
- SEMI F47-0200

## 2.6 Safety

The SPiiPlus SDMnt Control Module complies with the IEC 61010-1:01 standard.

## 2.7 Environmental Temperatures

The SPiiPlus SDMnt Control Module is designed for the following temperatures:

- Operating temperatures range: 0° to +40°C
- Storage and transport temperature range: -25° to +60°C

## 2.8 Ordering Options

This section presents the ordering options for the SPiiPlus SDMnt Control Module product line.

**Figure 5** illustrates the SPiiPlus SDMnt Control Module ordering code elements. These elements and options are described in **Table 15**.

### SPiiPlus SDMnt - Drive# - 040[A|D] - 003 - [Slave]


**Figure 5 SPiiPlus SDMnt Control Module Ordering Code Elements**

**Table 15 SPiiPlus SDMnt Control Module Ordering Code Description**

Element and Description	Options
SPiiPlus SDMnt - Product name	SPiiPlus SDMnt Control Module
Drive# - the number of integrated step drives	Where Drive# can be: 4 - for four drives 8 - for eight drives
040[A D] - input bus voltage supply, up to 40 Vdc	A - for 110 Vac/220 Vac input voltage (internal power supply included) D - for DC input voltage (internal power supply is not included)
003 - Current level of the integrated drives, 3 A	
Slave - slave option	Where Slave can be: 00 - slave to SPiiPlusNTM network controller 01 - slave to MC4Unt Control Module

## 3 Safety and EMC Guidelines

### 3.1 General Safety Guidelines

<b>Warning</b> 	<b><i>Read and understand the following precautions before operating the SPiiPlus SDMnt Control Module!</i></b>
---	---

Under emergency situations the unit should be completely disconnected from any power supply. The Left/Right Limits on ACS Motion Control products are designed for use in conjunction with customer-installed devices to protect driver load. The end user is responsible for complying with all Electrical Codes.

#### 3.1.1 Emergency Stop Device


1. Locate an emergency stop device at each operator control station and other operating stations where an emergency stop may be required.
2. The emergency stop device shall disconnect all electrical equipment connected to the SPiiPlus SDMnt Control Module from their respective power supplies.
3. It will not be possible to restore the circuit until the operator manually resets the emergency stop.
4. In situations with multiple emergency stop devices the circuit shall not be restored until all emergency stops devices are manually reset.

#### 3.1.2 Initial Logic State of Outputs

The relevance of analog and digital output pins is product and model dependent. The initial logic state of the inactive analog and digital pins is undefined. They may carry a potential of 5V relative to ground.

## 3.2 Grounding

Grounding system electrical components is crucial.

<p><b>Warning</b></p> 	<p><b><i>Verify that all electric circuits and electrical components, including motion controllers, power drives, motors, etc., have a grounding system. Grounding of AC and DC equipment must be in accordance with 29 CFR 1910.304(f).</i></b></p>
---	--

## 3.3 Fault & Error Handling

If, from any reason, communication with the master is lost, the SPiiPlus SDMnt Control Module goes into the Alarm state. In the Alarm state the following occurs:

- System and Axes LEDs are red.
- Pulse signal goes to default level (high)
- I/O goes to default (off, no current)
- Drive Enable goes to default state (disable).

To attempt recovery from the Alarm state:

1. Turn the 24 Vpower off.
2. Turn the 24 V on.

## 4 Electrical Interfaces

This chapter details the SPiiPlus SDMnt Control Module on-board connectors and connectivity.

### 4.1 Motor Connectors

Label: DRIVE1 J2 - MOTOR 0

DRIVE2 J3 - MOTOR 1

DRIVE3 J4 - MOTOR 2

DRIVE4 J5 - MOTOR 3

DRIVE2 J8 - MOTOR 4

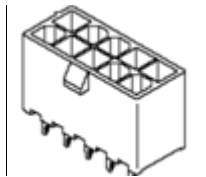
DRIVE3 J9 - MOTOR 5

DRIVE4 J10 - MOTOR 6


DRIVE2 J11 - MOTOR 7

Connector Type: 8-pin Molex 5566-08A-210 (0039288080)

Mating Type: Molex 5557-08R



The pinout for the Motor connectors is given in [Table 16](#).

<p><b>Caution</b></p> 	<p><i>The cable connecting the motor to the <b>DRIVE</b> connector must not be more than 3 meters in length; otherwise damage could occur to the unit.</i></p>
---	--

**Table 16 Motor Connector Pinout** (page 1 of 2)

Pin	Name	Description
1	OUTA+	Motor phase A+
2	OUTB+	Motor phase B+
3	COMMON_VP_A	DC Bus voltage common phase A (not applicable for bipolar axis)
4	EGND	Electrical ground/shield
5	OUTA-	Motor phase A-
6	OUTB-	Motor phase B-

**Table 16 Motor Connector Pinout** (page 2 of 2)

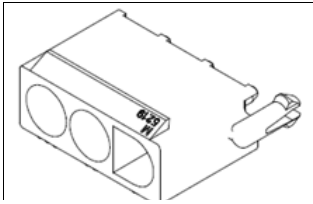
Pin	Name	Description
7	COMMON_VP_B	DC Bus voltage common phase B (not applicable for bipolar axis)
8	EGND	Electrical ground/shield

## 4.2 J12 - AC Drive Supply Input

Label: J12 AC DRIVE SUPPLY (INPUT)

Connector Type: 4-pin Molex (p/n 5219-04A-201 )

Mating Type: Molex p/n 0019091046



The pinout for the J12 connector is given in [Table 17](#).

**Table 17 J12 - AC Drive Supply Input Connector Pinout**

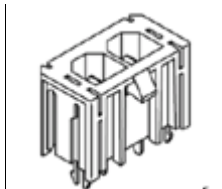
Pin	Name	Description
1	L	AC phase input
2	N	AC neutral input
3	PE	Electrical ground/PE
4	Shield	Shield

## 4.3 J6 - DC Drive Supply Input/Output

Label: J6 DC Drive SUPPLY (INPUT/OUTPUT)

Connector Type: 2-pin Molex p/n 0431600102

Mating Type: Molex p/n 0444412002



The pinout for the J6 connector is given in [Table 18](#).

**Table 18 J6 - DC Drive Supply Input/Output Connector Pinout**

Pin	Name	Description
1	VP+	DC drive supply output (input when no internal 40 V power supply exists)
2	VP_RTN	DC drive supply return

## 4.4 J13 - Ethernet Input Connector

Label: J13 ETHERNET INPUT

Connector Type: RJ45 CAT5

Mating Type: Ethernet plug



The pinout for the J13 connector is given in [Table 19](#).

**Table 19 J13 - Ethernet Input Connector Pinout**

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

## 4.5 J14 - Ethernet Output Connector

Label: J14 ETHERNET OUTPUT

Connector Type: RJ45 CAT5

Mating Type: Ethernet plug



The pinout for the J14 connector is given in [Table 20](#).

**Table 20 J13 - Ethernet Output Connector Pinout**

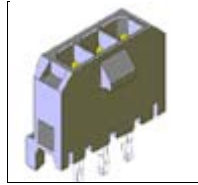
Pin	Name	Description
1	TD+	Positive transmit signal
2	TD-	Negative transmit signal
3	RD+	Positive receive signal
4	-	Not connected
5	-	Not connected
6	RD-	Negative receive signal
7	-	Not connected
8	-	Not connected

## 4.6 J7 - 24 Volt Control Supply

Label: J7 24V CONTROL SUPPLY

Connector Type: 3-pin Molex p/n 0436500315

Mating Type: Molex p/n 0436450300



The pinout for the J7 connector is given in [Table 21](#).

**Table 21 J7 - 24V Control Supply Connector Pinout**

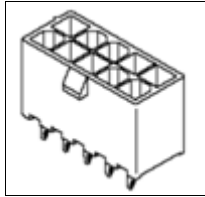
Pin	Name	Description
1	24V	24V control supply
2	24V_RTN	24V control supply return
3	PE	Electrical ground/PE

## 4.7 J1 - 24 Volt Fan

Label: J1 24V FAN

Connector Type: 4-pin Molex p/n 0039288040

Mating Type: Molex p/n 0039012045



The pinout for the J1 connector is given in [Table 22](#).

**Table 22 J1 - 24V Fan Connector Pinout**

Pin	Name	Description
1	24V	24V control supply
2	24V_RTN	24V control supply return
3	FAN FAULT	Fan Input fault (0= fault)
4	NC	Not Connected

## 4.8 J17 - Input/Output

Label: J17 IO

Connector Type: DB26 high density female

Mating Type: DB26 high density male



The pinout for the J17 connector is given in [Table 23](#).

**Table 23 J17 - I/O Connector Pinout (page 1 of 2)**

Pin	Name	Description
1	FIN2+	Fast input 0 non-inverted
2	FIN3+	Fast input 1 non-inverted
3	FIN4+	Fast input 2 non-inverted
4	FIN5+	Fast input 3 non-inverted
5	FOUT2+	Fast output 0 non inverted

**Table 23 J17 - I/O Connector Pinout** (page 2 of 2)

Pin	Name	Description
6	FOUT3+	Fast output 1 non inverted
7	IN0+	Digital input 0 non inverted
8	IN1+	Digital input 1 non inverted
9	OUT0+	Digital output 0 non inverted
10	FIN2-	Fast input 0 inverted
11	FIN3-	Fast input 1 inverted
12	FIN4-	Fast input 2 inverted
13	FIN5-	Fast input 3 inverted
14	FOUT2-	Fast output 0 inverted
15	FOUT3-	Fast output 1 inverted
16	IN0-	Digital input 0 inverted
17	IN1-	Digital input 1 inverted
18	OUT0-	Digital output 0 inverted
19	FOUT4+	Fast output 2 non inverted
20	FOUT4-	Fast output 2 inverted
21	FOUT5+	Fast output 3 non inverted
22	FOUT5-	Fast output 3 inverted
23	DGND	Digital ground
24	DGND	Digital ground
25	OUT1+	Digital output 1 non inverted
26	OUT1-	Digital output 1 inverted

## 4.9 J16 - Pulse/Direction Input

Label: J16 PULSE/DIR INPUT

Connector Type: 15-pin male DB

Mating Type: 15-pin female DB

The pinout for the J16 connector is given in [Table 24](#).

**Table 24 J16 - Pulse/Dir Input Connector Pinout** (page 1 of 2)

Pin	Name	Description
1	NC	Not Connected
2	DGND	Digital ground
3	NC	Not Connected
4	DIR_I_1+	Dir input 1 non inverted
5	DIR_I_0+	Dir input 0 non inverted
6	NC	Not Connected

**Table 24 J16 - Pulse/Dir Input Connector Pinout** (page 2 of 2)

Pin	Name	Description
7	PULSE_I_1+	Pulse input 1 non inverted
8	PULSE_I_0+	Pulse input 0 non inverted
9	NC	Not Connected
10	NC	Not Connected
11	DIR_I_1-	Dir input 1 inverted
12	DIR_I_0-	Dir input 0 inverted
13	NC	Not Connected
14	PULSE_I_1-	Pulse input 1 inverted
15	PULSE_I_0-	Pulse input 0 inverted

## 4.10 J15 - Pulse/Direction Output

Label: J15 PULSE/DIR OUTPUT

Connector Type: 15-pin male DB

Mating Type: 15-pin female DB

The pinout for the J15 connector is given in [Table 25](#).

**Table 25 J15 - Pulse/Dir Output Connector Pinout**

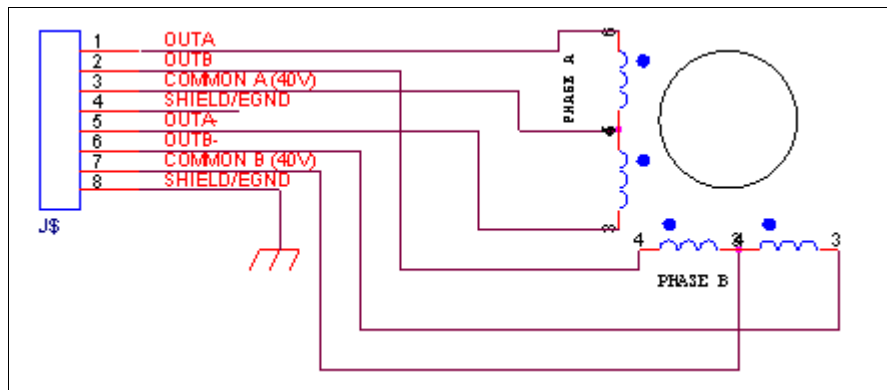
Pin	Name	Description
1	PULSE_O_0+	Pulse output 0 non inverted
2	PULSE_O_1+	Pulse output 1 non inverted
3	NC	Not Connected
4	DIR_O_0+	Dir output 0 non inverted
5	DIR_O_1+	Dir output 1 non inverted
6	NC	Not Connected
7	DGND	Digital Ground
8	NC	Not Connected
9	PULSE_O_0-	Pulse output 0 inverted
10	PULSE_O_1-	Pulse output 1 inverted
11	NC	Not Connected
12	DIR_O_0-	Dir output 0 inverted
13	DIR_O_1-	Dir output 1 inverted
14	NC	Not Connected
15	NC	Not Connected

## 4.11 SPiiPlus SDMnt Control Module Motor Connectivity

This section details the SPiiPlus SDMnt Control Module motor connectivity.

### 4.11.1 Two-Phase Unipolar Step Motor

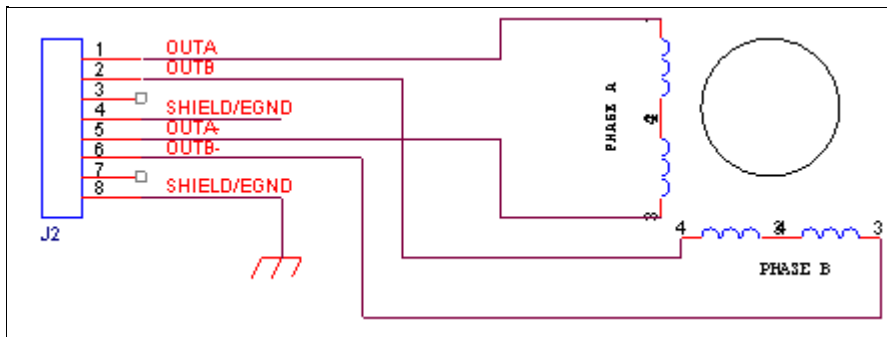
**Figure 6** depicts the connection of a two-phase unipolar step motor.



**Figure 6 Two-Phase Unipolar Step Motor Connection**

### 4.11.2 Two-Phase Bipolar Step Motor

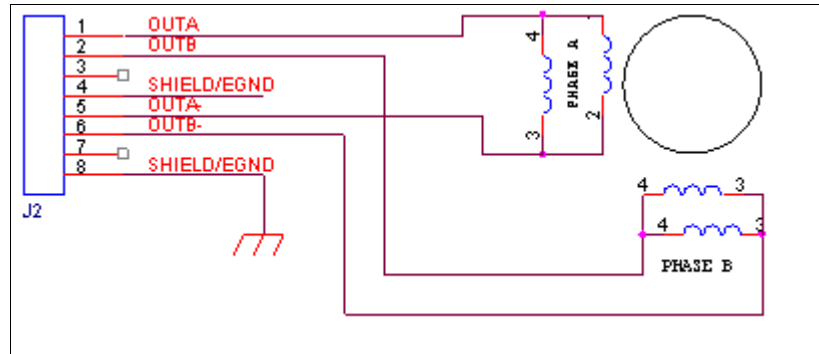
**Figure 7** depicts the connection of a two-phase bipolar step motor.



**Figure 7 Two-Phase Bipolar Step Motor Connection**

### 4.11.3 Two-Phase Bipolar Step Motor in Parallel

**Figure 8** depicts the connection of a two-phase bipolar step motor in parallel.



**Figure 8** Two-Phase Bipolar Step Motor in Parallel Connection

## 5 LED Indicators

**Table 26** details the function of each SPiiPlus SDMnt Control Module LED indicator.

**Table 26 SPiiPlus SDMnt Control Module LED Indicators**

Designator	Description	Remarks
24V	Yellow <input type="checkbox"/> Off - Logic supply is not functioning. <input type="checkbox"/> On - Power supply is ok.	Located on connector J14
Link/Activity	Green <input type="checkbox"/> Off- No link <input type="checkbox"/> Blinking -Link and activity <input type="checkbox"/> On -Link without activity	One located on connector J13 and one located on connector J14
Run	Yellow <input type="checkbox"/> Off -The device is in the INIT state <input type="checkbox"/> Blinking (slow) -The device is in the PRE-OPERATIONAL state <input type="checkbox"/> Single Flash - The device is in the SAFE-OPERATIONAL state <input type="checkbox"/> On -The device is in OPERATIONAL state <input type="checkbox"/> Flickering (fast) -The device is in the BOOTSTRAP state	Located on connector J13
System	Bicolor <input type="checkbox"/> Red -Communication fault (with the master) <input type="checkbox"/> Green - Communication is OK. <input type="checkbox"/> Blinking – SW command.	
Axis	Bicolor <input type="checkbox"/> Off - Axis is disabled <input type="checkbox"/> Green - Axis is enabled <input type="checkbox"/> Red - Axis fault	One per axis
DC drive supply	Green <input type="checkbox"/> On - 40V bus voltage exists <input type="checkbox"/> Off- No 40V bus voltage exists	

## Appendix A Unipolar Motor Selection

The following formula is employed when calculating the minimum continuous inductance required by a unipolar step motor:

$$I_{\text{cont\_min}} = \frac{V_{\text{BB}}}{R_{\text{total}}} \left( e^{\frac{T_{\text{off}}}{\tau}} - 1 \right)$$

Where:

$V_{\text{BB}}$  - the main power supply

$R_{\text{total}}$  - the total equivalent driver and motor resistance, where:

$R_{\text{total}} =$

$R_{\text{m}}$  (the motor phase resistance) +

$0.33\Omega$  (the power MOSFET ON resistance) +

$0.16\Omega$  (the internal current sensing resistor)


$\tau$  - the driver and motor equivalent time constant, where:

$\tau = [\text{the motor phase inductance}] / R_{\text{total}}$

Values of  $T_{\text{off}}$  are given in [Table 27](#).

**Table 27 Values of  $T_{\text{off}}$**

Driver Step Sequencing	Minimum Step Phase Current [ $I_{\text{step\_min}}$ , for 3A]	PWM Off Time [ $T_{\text{off}}$ , $\mu\text{S}$ ]
Full step	3	12
Half step	2.12	12
Quarter step	1.15	9
Eighth step	0.59	7
Sixteenth step	0.29	7

 <p><b>Note</b></p>	<p>For continuous operation the <math>I_{\text{cont\_min}}</math> value should be equal to or less than <math>I_{\text{step\_min}}</math>.</p>
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## Appendix B SPiiPlus SDMnt Control Module Configuration

This appendix provides details for SPiiPlus SDMnt-8 Control Module configuration.

### B.1 P/D Inputs and Outputs

The SPiiPlus SDMnt-8 Control Module provides two pairs of P/D (Pulse and Direction signals) inputs that can receive pulses from another SPiiPlus SDMnt Control Module or any other P/D generator device. The SPiiPlus SDMnt Control Module counters tracks the pulses, received from P/D inputs, and transfers counter value to the master controller as position feedback. The position values are reflected by **F2POS** variable, calculated velocity values are reflected by **F2VEL** variable. The variable index can be  $i$  or  $i+1$ , where  $i$  is an index of the first axis (axis #0) handled by the specific SPiiPlus SDMnt Control Module. The index  $i$  corresponds to P/D input 0,  $i+1$  corresponds to P/D input 1.

The SPiiPlus SDMnt Control Module also provides two pairs of P/D outputs that can generate the same pulses that are actually transferred to one of the 8 step axis. The pulses for the step axes are generated by the master controller and transferred over the network. The selection of each pulse that should be transferred to P/D outputs is done by the **SLPROUT** variable:

$SLPROUT(i) = \text{Axis}$  or  $SLPROUT(i+1) = \text{Axis}$ , where  $i$  is an index of the first axis (axis #0) handled by the specific SPiiPlus SDMnt Control Module.

#### Note



*Axis is a relative number which can be between 0 to 7.*

The index  $i$  defines P/D output 0,  $i+1$  defines P/D output 1.  $SLPROUT(i) = 15$  switches output pulses off.

This feature enables achieving a strict synchronization between two or several SPiiPlus SDMnt Control Modules, by using pulse from one SPiiPlus SDMnt Control Module as master position and sending to another SPiiPlus SDMnt Control Module (slave axis).

Default for **SLPROUT** variables is 0.

## B.2 Micro Stepping Configuration

The SPiiPlus SDMnt Control Module allows defining the number of micro steps: 2, 4, 8, 16. The micro steps are configured through the **SLCPRD** variable.

For SPiiPlus SDMnt Control Module channel 0 the values are:

SLCPRD( <i>i</i> )	Step Mode	Micro Steps
100..199	0	Full Step (70% current)
200	0	Full Step (70% current)
201..399	1	Half Step
400..799	2	Quarter Step
800..1599	2	Quarter Step
≥1600	3	Sixteenth Step

### Note



Where *i* is an index of the first axis (axis #0) handled by the specific SPiiPlus SDMnt Control Module

For SPiiPlus SDMnt Control Module channels 1-7:

SLCPRD( <i>i</i> )	Step Mode	Micro Steps
100..199	0	Full Step (70% current)
200	1	Full Step (100% current)
201..399	2	Half Step
400..799	4	Quarter Step
800..1599	5	Eighth Step
≥1600	6	Sixteenth Step

The default **SLCPRD** value sets step mode to 6 and micro steps to 16.

### B.3 Current Amplitude Configuration


The SPiiPlus SDMnt Control Module allows defining maximum current amplitudes of: 1A, 1.5A, 2A, 3A. The current levels are configured by the **XCURI**, **XCURV** variables as follows:

<b>XCURI(<i>i</i>), XCURV(<i>i</i>)</b>	<b>30%</b>	<b>50%</b>	<b>70%</b>	<b>100%</b>
Motor output maximal current (A)	1	1.5	2	3

The default **XCURI/XCURV** values set the current to 1.5A at standstill and 3A when moving.

### B.4 Decay Mode Configuration

The SPiiPlus SDMnt Control Module allows defining a Decay Mode.

 <p><b>Note</b></p>	<p><i>Decay Mode only affects the first SPiiPlus SDMnt Control Module axis.</i></p>
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The Decay Mode is configured by the **XRMS** variable as follows:

<b>XRMS(<i>i</i>)</b>	<b>0%</b>	<b>≤8%</b>	<b>≤26%</b>	<b>&gt;26%</b>
Percentage of Fast decay(A)	0%	8%	26%	100%
	( Slow Decay)	(7 cycles)	(23 cycles)	(Fast Decay)

The default **XRMS** value sets decay to fast. When the motion is at standstill, the decay is always set to slow.

