



SPiiPlusEC

Installation Guide

March 2024

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SPiiPlusEC

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PATENTS

Israel Patent No. 235022

US Patent Application No. 14/532,023

Europe Patent application No.15187586.1

Japan Patent Application No.: 2015-193179

Chinese Patent Application No.: 201510639732.X

Taiwan(R.O.C.) Patent Application No. 104132118

Korean Patent Application No. 10-2015-0137612

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Revision History

Date	Revision	Description
March 2024	3.14a	Correct control supply input range
July 2023	3.13.01.02	Factory default procedure
April 2023	3.13.01.01	Add note about MPU configuration
February 2023	3.13.01	Remove MPU details
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December 2019	8.20	Corrected Serial Port Text
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July 2017	6.00	Updated Ordering Options field 9 with flexible configuration and field 11 with Board level version Changed Amber speed LED indication to 1000Mit Changed the Green speed LED indication to 100Mbit Added picture of label Updated connector descriptions Reformatted document Changed revision numbering scheme
August 2016	05	Updated related documents
July 2016	04	Removed PLC option

Date	Revision	Description
February 2016	03	Updated product P/N Corrected Din rail mounting kit P/N Added mounting screw recommended torque
Nov 2014	02	Din rail mounting kit added to Package content
Oct 2014	01	First Release

Conventions Used in this Guide

Text Formats

Format	Description
Bold	Names of GUI objects or commands
BOLD + UPPERCASE	ACSPL+ variables and commands
<code>Monospace + grey background</code>	Code example
<i>Italic</i>	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 Documentation

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

Authorized users can download the latest versions of the documents from [ACS Downloads](#).

Document	Description
<i>SPiiPlus ACSPL+ Programmer's Guide</i>	Provides practical instruction on how to use ACSPL+ to program your motion controller.
<i>SPiiPlus Command & Variable Reference Guide</i>	Describes all of the variables and commands available in the ACSPL+ programming language.
<i>SPiiPlus MMI Application Studio User Guide</i>	Explains how to use the SPiiPlus MMI Application Studio and associated monitoring tools.
<i>EtherCAT Network Diagnostics</i>	An application note describing how to perform diagnostics of the EtherCAT network.
<i>SPiiPlus Setup Guide</i>	Provides guidance on how to configure and adjust the SPiiPlus systems to work with supported types of motors and feedback devices.

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1. Scope of document

This document describes the installation information for the SPiiPlusEC (SPiiPlus External Controller), including electrical interfacing, device compatibility, mounting, and ventilation.

SPiiPlusEC is supported by ACS Motion Control's firmware SPiiPlusNT-SC Ver. 2.27 and higher.

1.1 Product overview

The SPiiPlusEC is the next generation of the existing SPiiPlusNTM. It is equipped with a powerful MPU and provides enhanced processing power. The unit consists of a plastic enclosure and you can mount it using a panel or a din-rail.

The SPiiPlusEC main features includes:

- > Processing power for 8 axes at 5kHz.
- > Two EtherCAT ports to support network failure detection and recovery (*NetworkBoost™*).
- > One Ethernet host communication, up to 1GbE.
- > Two RS232 serial communication ports.
- > Panel and Din-rail mounting options.
- > LEDs indicators.

Figure 2-1 is a block diagram for the SPiiPlusEC.

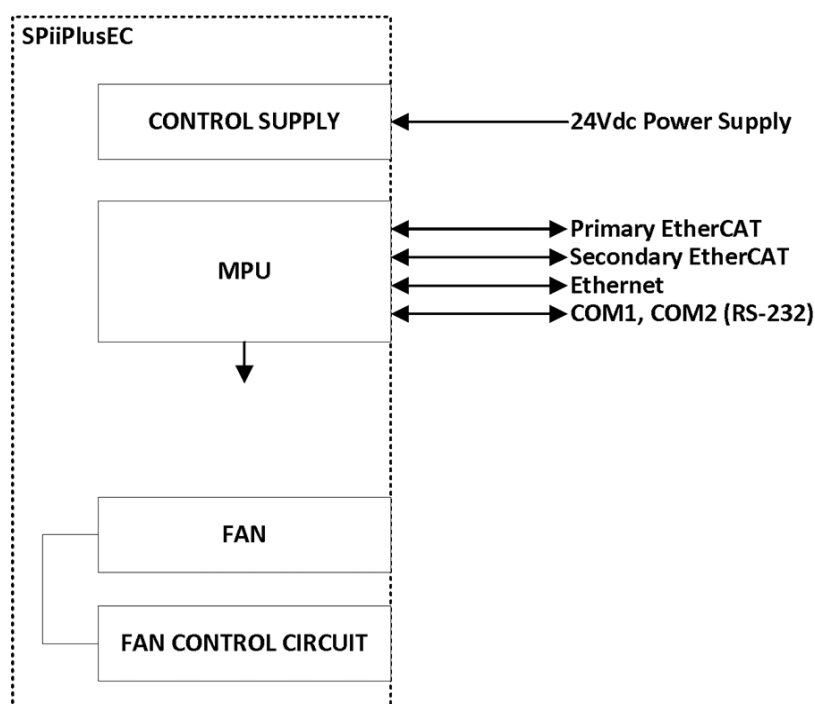


Figure 2-1. SPiiPlusEC Interface

1.2 Communication channels

The SPiiPlusEC supports the following Ethernet communication ports:

- > connection to host computer using TCP/IP protocol.

- > connection to real-time network components using EtherCAT protocol.



Optionally, you can use RS232 serial communication port for communications with the host.

2. Description

This section provides an overview of the SPiiPlusEC (SPiiPlus External Controller), the available product options and associated kits and accessories.

2.1 Connectors

Figure 2-2 and Table 2-1 show the location and description of the SPiiPlusEC connectors.

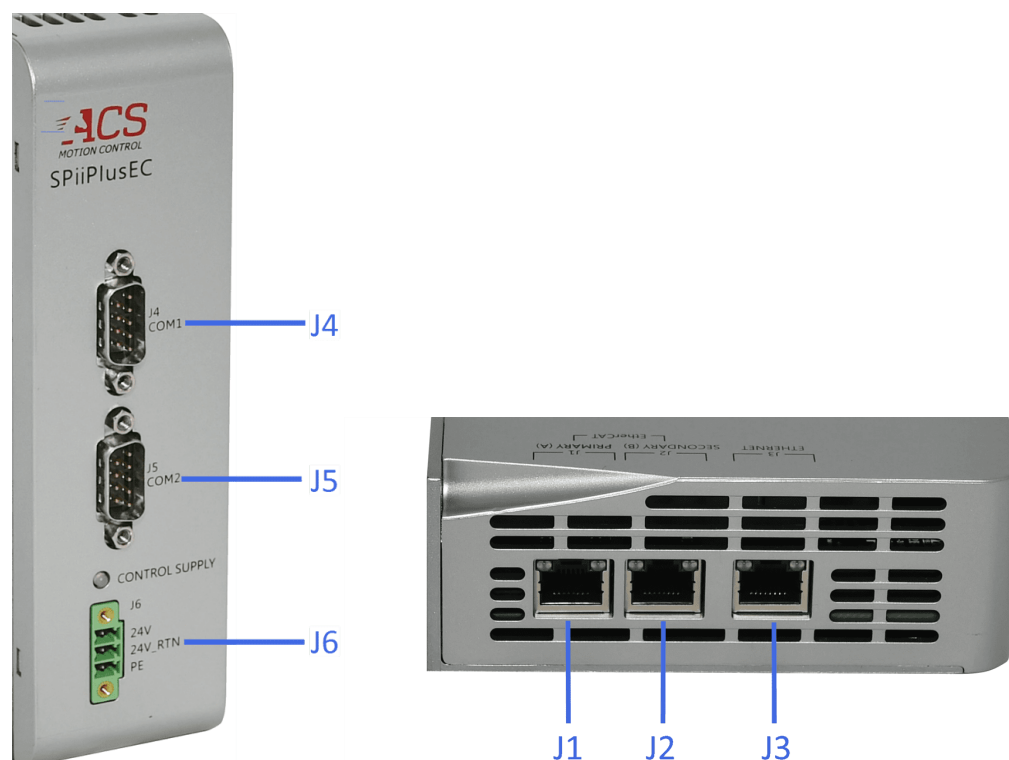


Figure 2-2. Connectors on Front and Top Panel

Table 2-1. SPiiPlusEC Connectors

Connector	Name	Type	Mating Connector
J1	EtherCAT primary (A)	RJ45	Ethernet plug
J2	EtherCAT secondary (B)	RJ45	Ethernet plug
J3	Ethernet	RJ45	Ethernet plug
J4	RS232 port COM1	D-type 9 pin male	D-type 9 pin female
J5	RS232 port COM2 *see note	D-type 9 pin male	D-type 9 pin female

Connector	Name	Type	Mating Connector
J6	Control supply	Phoenix MC 1,5/ 3-GF-3,81 1827871	Phoenix MC 1,5/ 3-STF-3,81 1827716



*When necessary, use RS232 communications over port COM2 to run the MMI Application Studio Upgrade and Recovery Wizard Recovery Task (see the MMI Application Studio User Guide for details).

2.1.1 Factory Default Reset

The SPiiPlusEC may be reset to factory defaults as follows:

1. Power down the device.
2. Connect the TX and RX pins of both RS232 COM ports with loopback plugs.
3. Power up the device and wait 3 minutes.
4. Power down the device, remove the loopback plugs.
5. Power up the device and configure as needed.

2.2 Indicators

Figure 2-3 and Table 2-2 show the location and description of the SPiiPlusEC indicators.

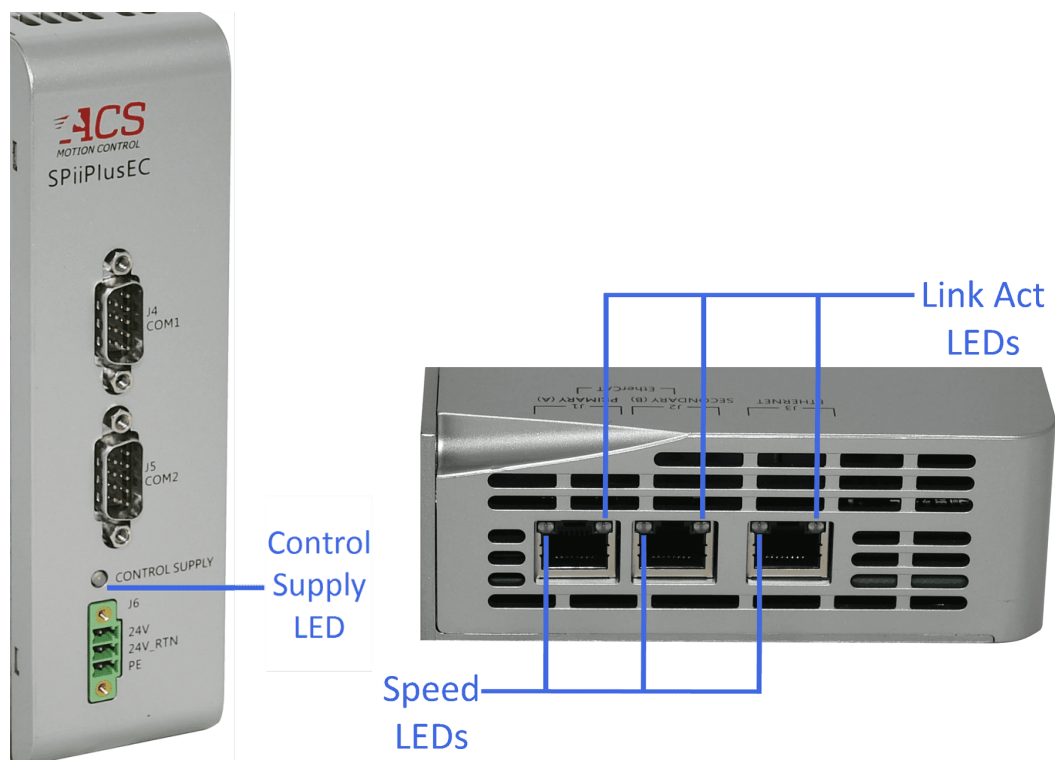


Figure 2-3. Indicators on Front and Top Panel

Table 2-2. SPiiPlusEC Indicators

LED	Description
Control supply	Green LED: > Off – Logic supply doesn't function. > On – Power supply is OK.
Link Act	3 green LEDs (one per Ethernet/EtherCAT port): > Off – No cable is connected. > Blinking – Link and activity > On – Link without activity
Speed	Three dual color LEDs (one per Ethernet/EtherCAT port): > Amber – 1000Mbit > Green – 100Mbit

2.3 Package Content

The SPiiPlusEC package contains the following items:

- > SPiiPlusEC Module
- > Software disc with SPiiPlus ADK Suite, latest available version
- > Din rail mounting kit: Part Number DINM-13-ACC

2.4 Order Part Number

The ordering part number (P/N) contains several characters (see example in [Figure 2-4](#)) that each specify a configuration characteristic ordered for the SPiiPlusEC.

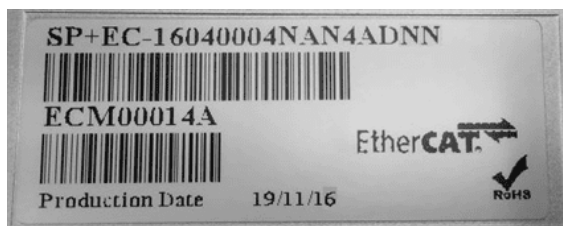


Figure 2-4. Label with ordered P/N - example

Table 2-3. Configuration as indicated by P/N

	Field	Example selection by user	Optional Values
Maximum number of axes	1	04	2,4,8,16,32,64
ECAT 3rd party Servo Drive	2	00	Up to the maximum number of axes
ECAT 3rd party Step motor Drive (open & closed loop)	3	00	Up to the maximum number of axes
ECAT 3rd party IO EtherCAT node	4	32	32, 64
G-Code, 5 Axis Coordinated Motion ¹	5	N	N - None F= 5 Axis Coordinated Motion D= G-Code & 5 Axis Coordinated Motion G - G-code
Number of ServoBoost and ServoBoost Plus Axes	6	A	N = None A = 4 axes ServoBoost B = 8 axes ServoBoost C = 8+ axes (equal to Max Number of Axes) ServoBoost J = 4 axes ServoBoost & ServoBoost Plus K = 8 axes ServoBoost & ServoBoost Plus L = 8+ axes (equal to Max Number of Axes) ServoBoost & ServoBoost Plus
Input shaping LearningBoost , Non-Linear Control Autofocus	7	Y	N = No Y = Input Shaping L = LearningBoost C = Non-Linear Control B = LearningBoost & Input Shaping D = Input Shaping & Non-Linear Control E = LearningBoost & Non-Linear Control F = LearningBoost & Input Shaping & Non-Linear Control G = AutoFocus H = Input Shaping & AutoFocus

	Field	Example selection by user	Optional Values
			J = LearningBoost & AutoFocus K = Non-Linear Control & Autofocus
Maximum MPU cycle rate (kHz) & MotionBoost	8	D	D - Default, 2 - 2kHz ² , 4 - 4kHz ⁴ , 5 - 5kHz ^{3,4}
NetworkBoost , Flexible configuration, Dual EtherCAT Network	9	N	N = None A = NetworkBoost B = Flexible Configuration C = NetworkBoost & Flexible Configuration D = Dual EtherCAT Network E = Dual EtherCAT Network & Flexible Configuration
Number of ACSPL+ Buffers & Real-Time C Function Support	10	D	D = Default ⁵ A = 16 B = 32 C = 64 E = Default & Real-Time C Function Support Enabled F = 16 & Real-Time C Function Support Enabled G = 32 & Real-Time C Function Support Enabled H = 64 & Real-Time C Function Support Enabled
Board level version ⁶	11	N	Y - Yes, N - No
XL Scan (unit per scanner)	12	N	None(N), 1,2,...9,10(A),11(B),12(C),13(D),14(E),15(F),16(G)

¹ Includes 3+ Axis SmoothPath and 3+ NURBS

² Only relevant for controllers with Max Number of Axes = 64

³ 16 axes and 5 kHz (requires Dual EtherCAT Network option)

⁴ Includes MotionBoost, 2 axis SmoothPath, 2 Axis NURBS and SmoothPTP

⁵ Default number of ACSPL+ buffers/tasks is a function of the number of axes specified (field 1)

Up to 8 axes - 10 buffers; 16 axes - 16 buffers; 32 axes - 32 buffers; 64 axes - 64 buffers

⁶ Consult ACS with regards to availability and assembly instructions

Example

Example: SP+EC-04000032NAYDNDNN

Field	1	2	3	4	5	6	7	8	9	10	11	12
PN SP+EC-	04	00	00	32	N	A	Y	D	N	D	N	N



The SPiiPlusEC is shipped with the ordered configuration.
Controllers with an MPU cycle rate of 4 to 5 kHz or 64 Axes receive Quad-Core CPUs.
For all other configurations, dual-core CPUs are provided.
Modifications are only possible at ACS's facilities.

3. Mounting

3.1 Location Planning

When planning the mounting location of the SPIiPlusEC, take into account the following:

- > unit dimensions (158 x 45 x 124 mm (6.22 x 1.771 x 4.881 in) - see "SPIiPlusEC Dimensions and Mounting Preparation Diagram" below.
- > sufficient clearance of 25 millimeters on all open sides for cable routing and free air flow.
- > the SPIiPlusEC operates in a temperature range of 0-50°C.
- > a 10 CFM velocity-controlled fan in the unit starts operating when the ambient temperature exceeds 28°C.

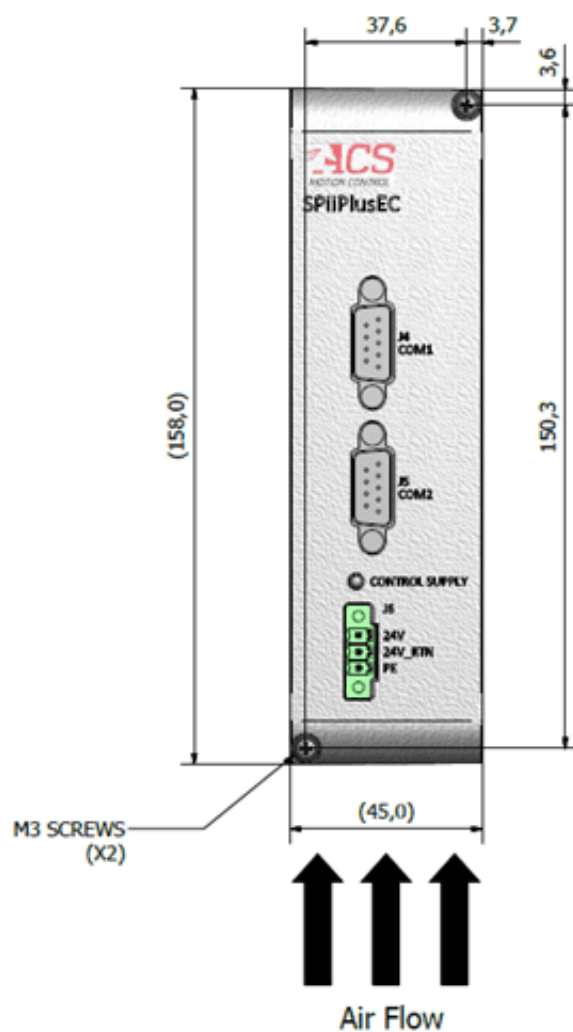


Figure 2-5. SPIiPlusEC Dimensions and Mounting Preparation Diagram

3.2 Mounting Procedure

- > Use two M3 screws as shown in "SPiiPlusEC Vertical Mounting Diagram" below to mount the SPiiPlusEC on a vertical surface.
- > Tighten the screws with a maximum torque of 3Kgf.

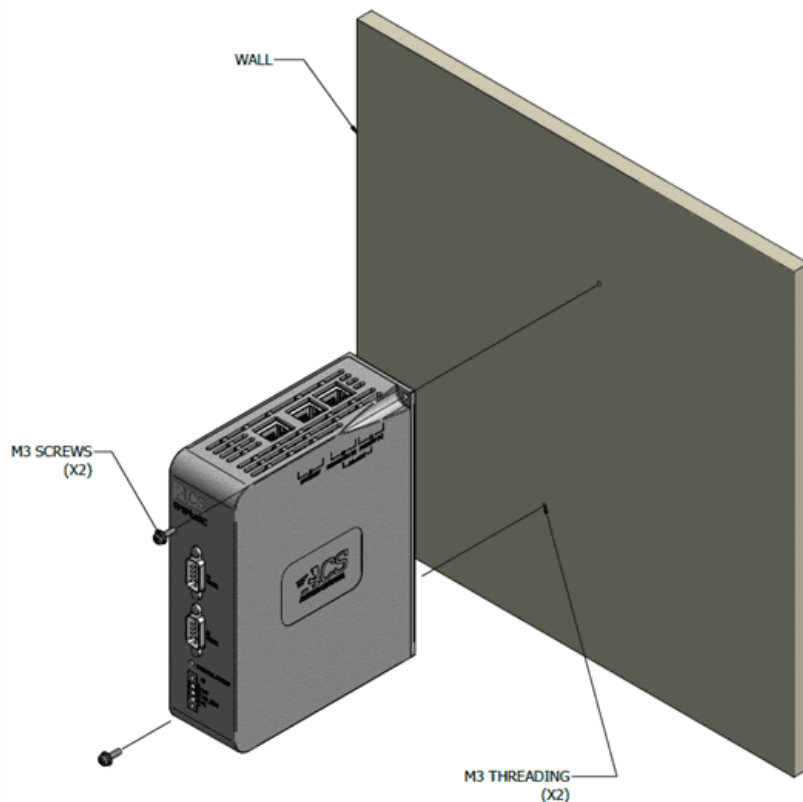


Figure 2-6. SPiiPlusEC Vertical Mounting Diagram

4. Connections

This section describes how to interface with the SPiiPlusEC while following proper safety, EMC and wiring guidelines.

4.1 Safety, EMC and Wiring Guidelines

Read this section carefully before beginning the installation process.

- > Make sure that the following guidelines and procedures are addressed and observed prior to powering up and while handling any of the EtherCAT network elements.
- > Installation and maintenance must be performed only by qualified personnel who have been trained and certified to install and maintain high power electrical and electro-mechanical equipment, servo systems, power conversion equipment and distributed networks.
- > Prior to powering up the system, ensure that all EtherCAT network devices are properly installed and grounded. Further ensure that all of the attached power and signal cables are in good operating condition. Maintenance should be performed only after the relevant network devices have been powered down, and all associated and surrounding moving parts have settled in their safe mode of operation. Certain drives, in the network, require a longer time to fully discharge.
- > To avoid electric arcing and hazards to personnel and electrical contacts, avoid connecting and disconnecting the SPiiPlusEC while the power source is on.
- > When connecting the SPiiPlusEC to an approved isolated control supply, connect it through a line that is separated from hazardous live voltages using reinforced or double insulation, in accordance with approved safety standards.



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

Perform the following instructions to ensure safe and proper wiring:

- > Whenever possible, use shielded cables with braided shield of at least 80%-95% coverage.
- > Proper wiring, grounding and shielding are essential for ensuring safe, immune and optimal servo performance. After completing the wiring, carefully inspect all wires to ensure tightness, good solder joints and general safety.
- > "Wiring Guidelines" on the next page details the recommended wiring based on the current rating of the SPiiPlusEC.

Table 2-4. Wiring Guidelines

Item	Gauge	Twisted pair	Remarks
Control Power Supply	18AWG	No	Length should be as short as possible
EtherCAT	CAT5e		
Ethernet	CAT6	-	For 1GbE Ethernet host communication



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

4.1.1 General Safety Guidelines



In an emergency, disconnect the unit from the power supply.



Ensure that you comply with all electrical regulations.



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

4.2 Connecting the SPiiPlusEC

Connect the SPiiPlusEC as follows:

1. Ensure that all supplies are off when preparing the unit.
2. Connect the 24Vdc control supply to J6.
3. Connect the PE ground to J6 pin 3.
4. Connect the EtherCAT primary cable from the input port of the first slave module in the EtherCAT network to J1.
5. If the EtherCAT network is configured for ring topology, connect the EtherCAT secondary cable from the output port of the last slave module in the EtherCAT network to J2.
6. Connect the Ethernet cable from the host computer to J3.
7. If required, connect RS-232 cables to J4 and J5.

4.3 Powering the Unit

1. Turn on the 24Vdc control supply and verify communication with the SPiiPlusEC.

4.4 Recovering a non-functioning controller



If the SPiiPlusEC has stopped functioning, then the controller can be recovered through the Recovery Task of the SPiiPlus MMI Application Studio Upgrade and Recovery Wizard, see *SPiiPlus MMI Application Studio User Guide*.

4.5 J1, J2 EtherCAT

4.5.1 J1 EtherCAT Primary (A)

Label: J1

Connector name	EtherCAT primary (A)
Connector assignment	J1
Manufacturer part number or type	RJ45
Mating type	Ethernet plug

Table 2-5. SPiiPlusEC J1 EtherCAT Primary (A) Pinout

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

4.5.2 J2 EtherCAT Secondary (B)

Connector name	EtherCAT secondary (B)
Connector assignment	J2
Manufacturer part number or type	RJ45
Mating type	Ethernet plug

Table 2-6. SPiiPlusEC J2 EtherCAT Secondary (B) Pinout

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



The cable shield must be connected to the connector body.

4.6 J3 Ethernet

4.6.1 Connector Description

Connector name	Ethernet
Connector assignment	J3
Manufacturer part number or type	RJ45
Mating type	Ethernet plug

Table 2-7. SPiiPlusEC J3 Ethernet Pinout

Pin	Signal	Description
1	TX+_D1	Positive transmit signal
2	TX-_D1	Negative transmit signal
3	RX+_D2	Positive receive signal

Pin	Signal	Description
4	BI+_D3	Bi-directional+ (for 1000Mb Ethernet only)
5	BI-_D3	Bi-directional- (for 1000Mb Ethernet only)
6	RX-_D2	Negative receive signal
7	BI+_D4	Bi-directional+ (for 1000Mb Ethernet only)
8	BI-_D4	Bi-directional- (for 1000Mb Ethernet only)



For 1000Mbps you must use CAT6 cable.

4.7 J4, J5 COM1, COM2

4.7.1 Connector Description

RS232 Serial Communications Ports

Connector name	COM1, COM2
Connector assignment	J4 - COM1 J5 - COM2
Manufacturer part number or type	D-type 9 pin male
Mating type	D-type 9 pin female

Table 2-8. SPiiPlusEC J4, J5 COM1, COM2 Pinout

Pin	Signal	Description
1	NC	Not connected
2	RXD	Receive signal for communication port
3	TXD	Transmit signal for communication port
4	NC	Not connected
5	DGND	Digital ground
6	NC	Not connected
7	NC	Not connected

Pin	Signal	Description
8	NC	Not connected

4.8 J6 Control Supply

4.8.1 Connector Description

Connector name	Control supply
Connector assignment	J6
Mating type	Phoenix MC 1,5/ 3-STF-3,81 - 1827716

Table 2-9. SPIIPlusEC J6 Control Supply Pinout

Pin	Signal	Description
1	24VDC	+24V dc control supply
2	24V_RTN	24V dc control supply return
3	SHIELD	SHIELD

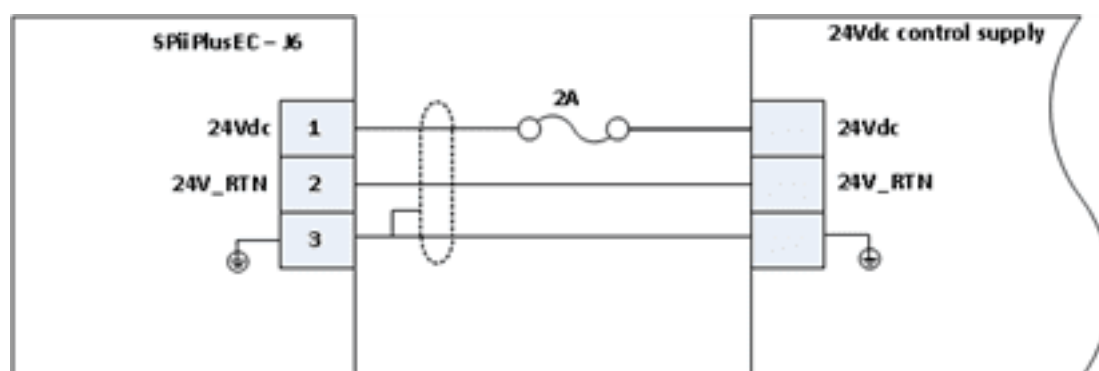


Figure 2-7. J6 Connections

5. Specifications

5.1 Communication

5.1.1 Control Supply Input

Table 2-10. SPIIPlusEC Control Supply Input

Item	Description	Remarks
Designation	24Vdc 24VRTN.	Note: Connect the control supply via 2A fuse.
Input range	24Vdc±10%	
Maximum Input current	0.8A @ 19V	
Protection	Reverse polarity	

5.1.2 EtherCAT Ports (Primary and Secondary)

Table 2-11. SPIIPlusEC EtherCAT Ports (Primary and Secondary)

Item	Description	Remarks
Designation	Transmit: ETH_TX± Receive: ETH_RX±	
Line Impedance	100Ω	
Quantity	2	EtherCAT input and output ports
Interface	TCP/IP 10/100Mbps or EtherCAT	
Speed	100Mbps	

5.1.3 Ethernet

Table 2-12. SPIIPlusEC Ethernet

Item	Description	Remarks
Designation	Transmit: ETH1_TX± Receive: ETH1_RX±	
Line Impedance	100Ω	
Quantity	1	
Interface	Standard Ethernet LAN communication	

Item	Description	Remarks
Speed	TCP/IP 10/100/1000Mbps	For 1000Mbps you must use CAT6 cable.

5.1.4 RS232 Serial Communication

Table 2-13. SPiiPlusEC RS232 Serial Communication

Item	Description
Designation	> COM1 > RXD1 receive signal > TXD1 transmit signal > COM2 > RXD2 receive signal > TXD2 transmit signal
Quantity	2
Speed	Up to 115,200 baud

5.2 Performance

The following table details the SPiiPlusEC processing rate:

Table 2-14. SPiiPlusEC processing rate

Number of axes	Minimum C_Time [ms]	Maximum MPU cycle rate [kHz]
2, 4, 8	0.2	5
2, 4, 8, 16	0.25	4
2, 4, 8, 16, 32	0.5	2
2, 4, 8, 16, 32, 64	1	1

5.3 EtherCAT Cycle Rate

Table 2-15. CTIME Values for SPiiPlusEC (Rev. B and later) Controller

Controller	Number of Built-in Drives	Maximum Number of Axes	Default Number of Available ACSPL+ Buffers**	Maximum Number of Simultaneously Running		Controller Cycle Time					ServoBoost Supported
				Motors	ACSPL+ Buffers	1 (msec) 2 (msec)	0.50 (msec)***	0.25 (msec)*	0.20 (msec)*	Default Value (msec)	
SPiiPlus EC-02-...	-	2	10	2	10	√ (2,3)	√ (2,3,4)	√ (2,3,4)	√ (2,3,4)	0.5	√
SPiiPlus EC-04-...	-	4	10	4	10	√ (2,3)	√ (2,3,4)	√ (2,3,4)	√ (2,3,4)	0.5	√
SPiiPlus EC-08-...	-	8	10	8	10	√ (2,3)	√ (2,3,4)	√ (2,3,4)	√ (1,3,4)	0.5	√
SPiiPlus EC-16-...	-	16	16	16	16	√ (2,3)	√ (2,3,4)	√ (2,3,4)	-	0.5	√
SPiiPlus EC-32-...	-	32	32	32	32	√ (2,3)	√ (2,3,4)	√ (2,3,4)	-	0.5	√
SPiiPlus EC-64-...	-	64	64	64	64	√ (2,3)	√ (2,3,4)	-	-	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⁾ BTP/2 command limited to 4 axes or less

*Supported ordering option.

**Up to 64 buffers supported with ordering option.

*** 64 axes with Controller Cycle Time 0.50 (msec) supported with ordering option

5.4 Dimensions

158 x 45 x 124 mm (6.22 x 1.771 x 4.881 in).

5.5 Weight

- > 450 g

5.6 Compliance with Standards

5.6.1 Environmental

- > Operating temperature: 0 to +55°C.



A 10 CFM velocity-controlled cooling automatically starts operating when the operating temperature exceeds 30°C.

- > Storage temperature: -20°C to +85°C
- > Humidity: 90%RH, non-dondensing

5.6.2 RoHS

- > Design complies with ROHS requirements.

Smarter



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