SPiiPlusEC

Installation Guide

December 2020

Document Revision: 3.03

ACS MOTION CONTROL

SPiiPlusEC

Release Date: December 2020

COPYRIGHT

© ACS Motion Control Ltd., 2020. All rights reserved.

Changes are periodically made to the information in this document. Changes are published as release notes and later incorporated into revisions of this document.

No part of this document may be reproduced in any form without prior written permission from ACS Motion Control.

TRADEMARKS

ACS Motion Control, SPiiPlus, PEG, MARK, ServoBoost, NetworkBoost and NanoPWN are trademarks of ACS Motion Control Ltd.

EtherCAT is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Any other companies and product names mentioned herein may be the trademarks of their respective owners.

www.acsmotioncontrol.com

support@acsmotioncontrol.com

sales@acsmotioncontrol.com

NOTICE

The information in this document is deemed to be correct at the time of publishing. ACS Motion Control reserves the right to change specifications without notice. ACS Motion Control is not responsible for incidental, consequential, or special damages of any kind in connection with using this document.

Revision History

Date	Revision	Description
December 2020	3.03	Formatting, EtherCAT Cycle Rate Table
December 2019	8.20	Corrected Serial Port Text
April 2019	8.10	Formatting Corrections
January 2018	8.00	Updated ordering options
January 2018	7.00	Added reference to COM2 for running the MMI Application Studio Upgrade and Recovery Wizard Recovery Task
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
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
`Monospace + grey background`	Code example
Italic	Names of other documents
Blue	Hyperlink
[ ]	In commands indicates optional item(s)
|	In commands indicates either/or items

Flagged Text

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

Related Documents

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

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

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

Table of Contents

1. Scope of document 9
1.1 Product overview 9
1.2 Communication channels 9
2. Description 11
2.1 Connectors 11
2.2 Indicators 12
2.3 Package Content 13
2.4 Order Part Number 13
3. Mounting 15
3.1 Location Planning 15
3.2 Mounting Procedure 15
4. Connections 17
4.1 Safety, EMC and Wiring Guidelines 17
4.1.1 General Safety Guidelines 18
4.2 Connecting the SPiiPlusEC 18
4.3 Powering the Unit 18
4.4 Recovering a non-functioning controller 18
4.5 J1, J2 EtherCAT 19
4.5.1 J1 EtherCAT Primary (A) 19
4.5.2 J2 EtherCAT Secondary (B) 19
4.6 J3 Ethernet 20
4.6.1 Connector Description 20
4.7 J4, J5 COM1, COM2 21
4.7.1 Connector Description 21
4.8 J6 Control Supply 22
4.8.1 Connector Description 22
5. Specifications 23
5.1 Communication 23
5.1.1 Control Supply Input 23
5.1.2 EtherCAT Ports (Primary and Secondary) 23
5.1.3 Ethernet 23
5.1.4 RS232 Serial Communication 24

5.2 Performance 24
5.3 EtherCAT Cycle Rate 25
5.4 Dimensions 26
5.5 Weight 26
5.6 Compliance with Standards 26
5.6.1 Environmental 26
5.6.2 RoHS 26

List Of Figures

Figure 2-1. SPiiPlusEC Interface 9
Figure 2-2. Connectors on Front and Top Panel 11
Figure 2-3. Indicators on Front and Top Panel 12
Figure 2-4. Label with ordered P/N - example 13
Figure 2-5. SPiiPlusEC Dimensions and Mounting Preparation Diagram 15
Figure 2-6. SPiiPlusEC Vertical Mounting Diagram 16
Figure 2-7. J6 Connections 22

List of Tables

Table 2-1. SPiiPlusEC Connectors 11
Table 2-2. SPiiPlusEC Indicators 12
Table 2-3. Conficguration as indicated by P/N 13
Table 2-4. Wiring Guidelines 18
Table 2-5. SPiiPlusEC J1 EtherCAT Primary (A) Pinout 19
Table 2-6. SPiiPlusEC J2 EtherCAT Secondary (B) Pinout 19
Table 2-7. SPiiPlusEC J3 Ethernet Pinout 20
Table 2-8. SPiiPlusEC J4, J5 COM1, COM2 Pinout 21
Table 2-9. SPiiPlusEC J6 Control Supply Pinout 22
Table 2-10. SPiiPlusEC Control Supply Input 23
Table 2-11. SPiiPlusEC EtherCAT Ports (Primary and Secondary) 23
Table 2-12. SPiiPlusEC Ethernet 23
Table 2-13. SPiiPlusEC RS232 Serial Communication 24
Table 2-14. SPiiPlusEC processing rate 24
Table 2-15. CTIME Values for SPiiPlusEC (Rev. B and later) Controller 25

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 (Intel® Atom™ N2600 1.6 GHz) 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.

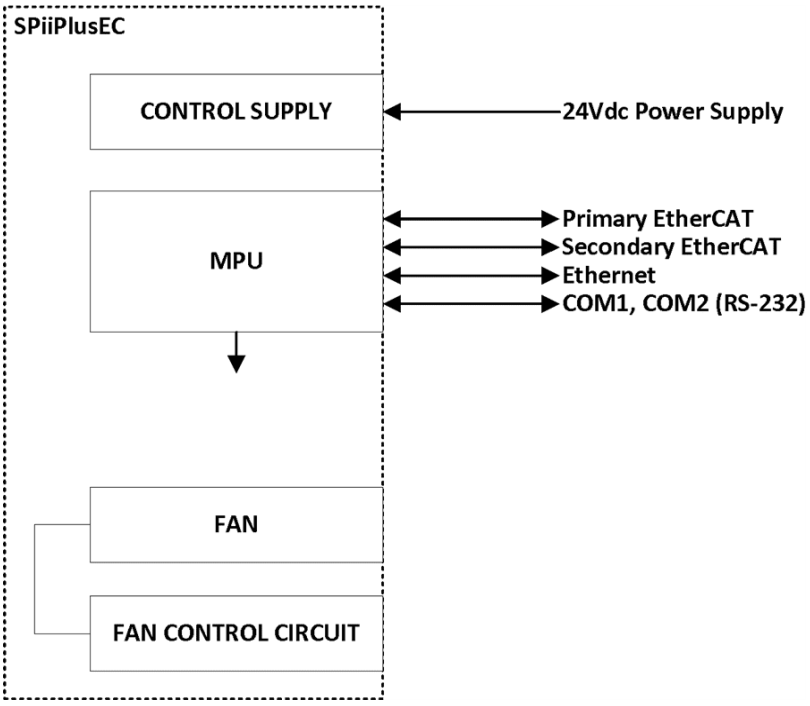

Figure 2-1. SPiiPlusEC Interface

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.

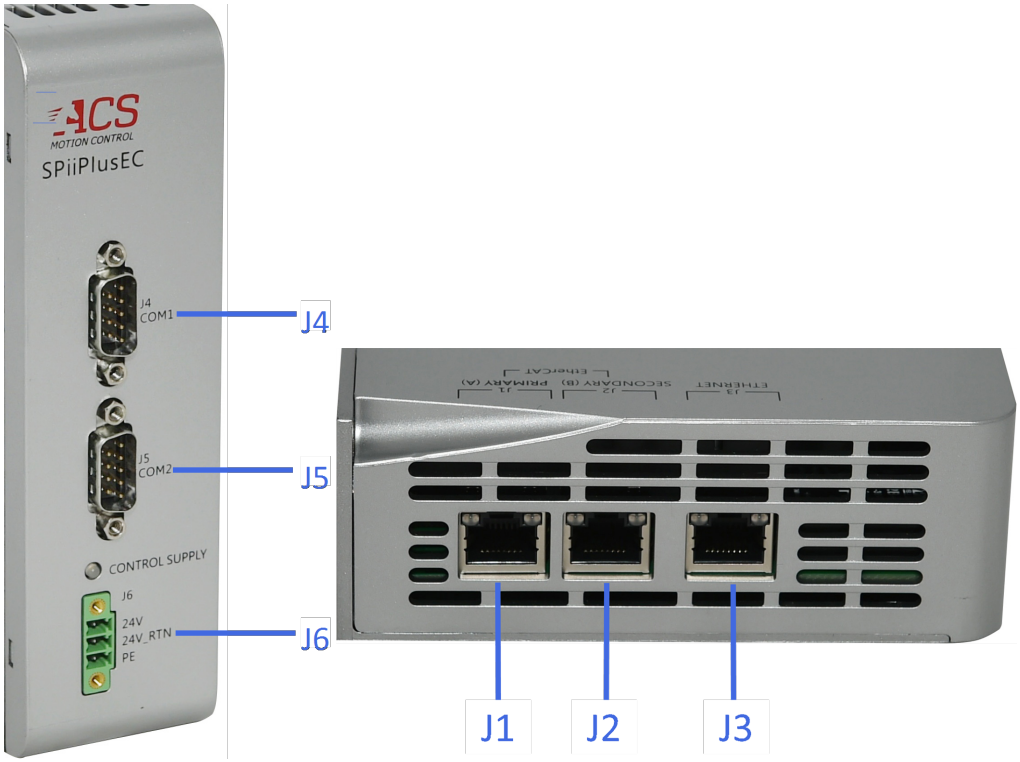

Figure 2-2. Connectors on Front and Top Panel

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
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).

2.2 Indicators

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

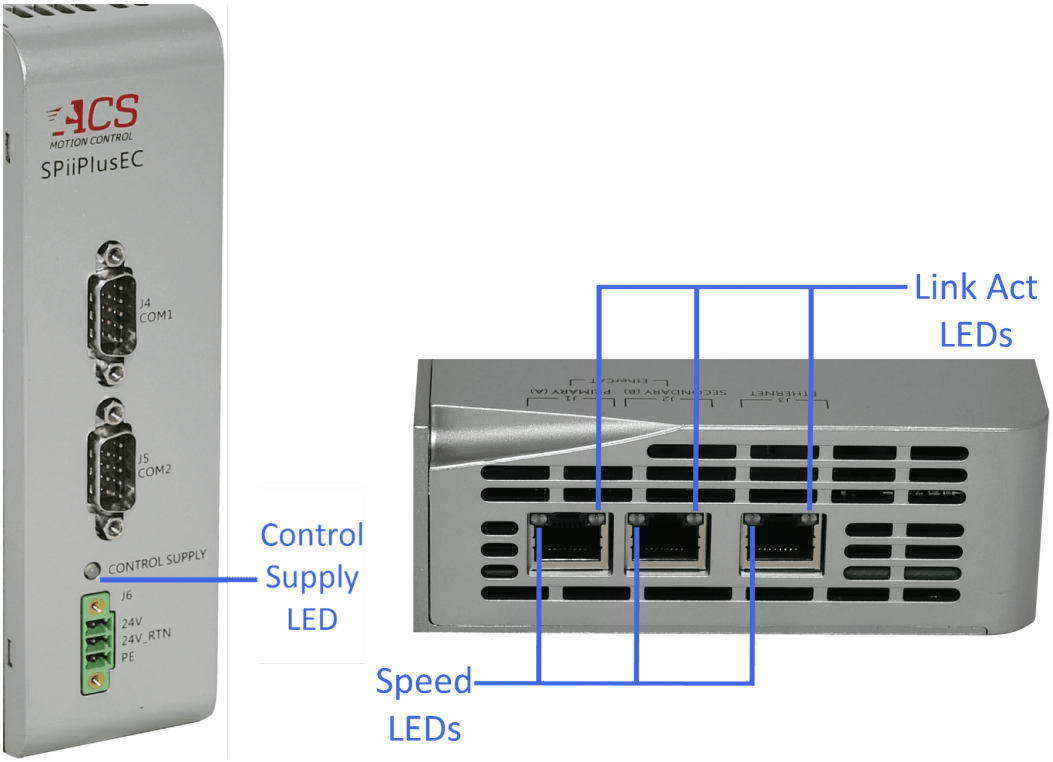

Figure 2-3. Indicators on Front and Top Panel

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

LED	Description
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.

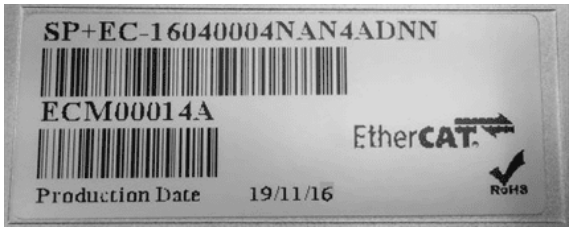

Figure 2-4. Label with ordered P/N - example

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

SPiiPlusEC Ordering Options	Field	Example User Selection	Available Ordering Option Values
Maximum number of axes	1	16	2,4,8,16,32,64
ECAT 3rd party Servo Drive	2	04	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	N	None (N), G-code
ServoBoost™, number of axes supported	6	A	0(N), 4(A), 8(B), 12(C),…60 (P), 64(Q)

SPiiPlusEC Ordering Options	Field	Example User Selection	Available Ordering Option Values
Input shaping	7	N	Yes (Y), No (N)
Maximum MPU cycle rate (kHz)	8	4	Default (D), 4kHz (4), 5kHz (5)
NetworkBoost™ (ring topology, cable failure detection and recovery) - Flexible configuration	9	A	None (N), NetworkBoost (A), B - Flexible configuration, C - Both
Number of ACSPL+ buffers/tasks	10	D	Default* (D), 16(A), 32(B), 64(C)
Board level version**	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)

An example Part Number of SP+EC16040004NAN4ADNN, would be set for the configuration described in the following table:

Field		1	2	3	4	5	6	7	8	9	10	11	12
PN	SP+EC	16	00	00	32	N	A	N	4	A	D	N	N

* Default number of ACSPL+ buffers/tasks is a function of the number of axis specified (field 1).

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

** Consult ACS with regards to availability and assembly instructions.

The SPiiPlusEC is shipped with the configuration set as ordered. Modifications can be done by ACS only.

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^{0}C.
- a 10 CFM velocity-controlled fan in the unit starts operating when the ambient temperature exceeds 28^{0}C.

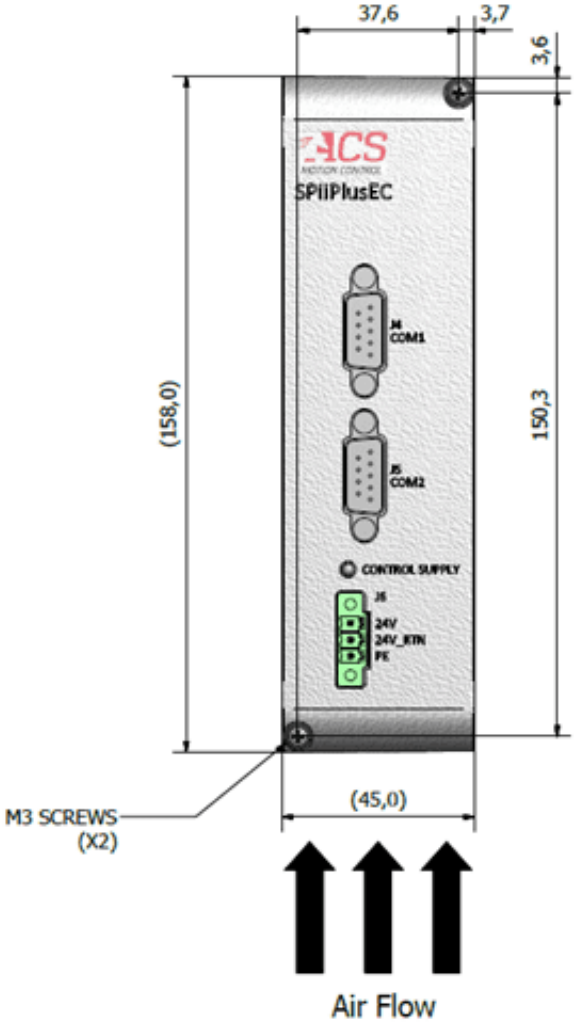

Figure 2-5. SPiiPlusEC Dimensions and Mounting Preparation Diagram

3.2 Mounting Procedure

- Use two M3 screws as shown in " SPiiPlusEC Vertical Mounting Diagram" on the next pageto mount the SPiiPlusEC on a vertical surface.

> Tighten the screws with a mximum torque of 3Kgf.

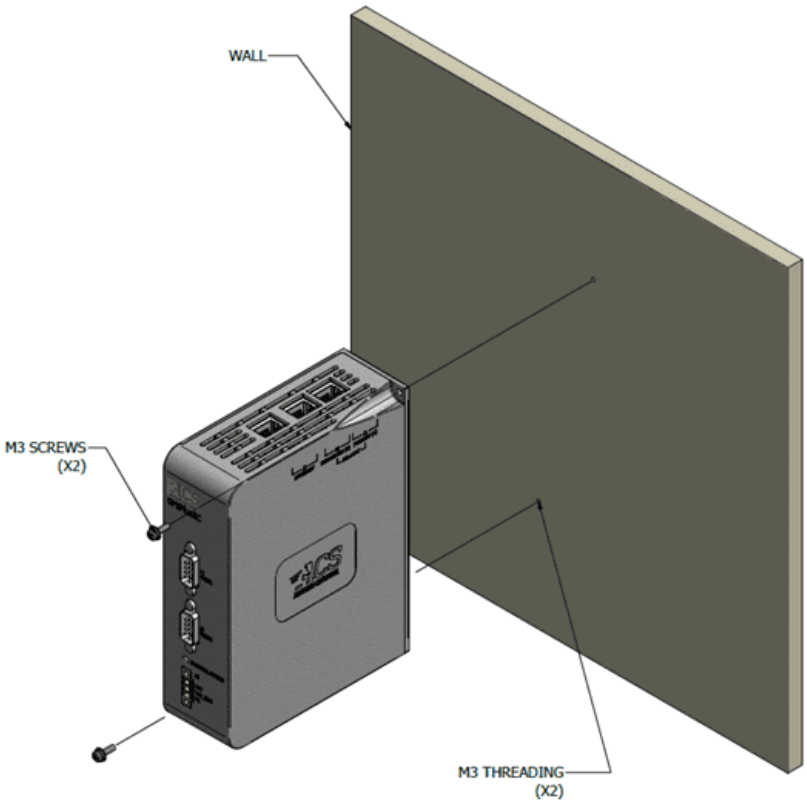

Figure 2-6. SPiiPlusEC Vertical Mounting Diagram

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 theSPiiPlusEC.

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

4.1.1 General Safety Guidelines

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

Ensure that you comply with all electrical regulations.

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

Pin	Signal	Description
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
4	BI+_D3	Bi-directional+ (for 1000Mb Ethernet only)
5	BI-_D3	Bi-directional- (for 1000Mb Ethernet only)

Pin	Signal	Description
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
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

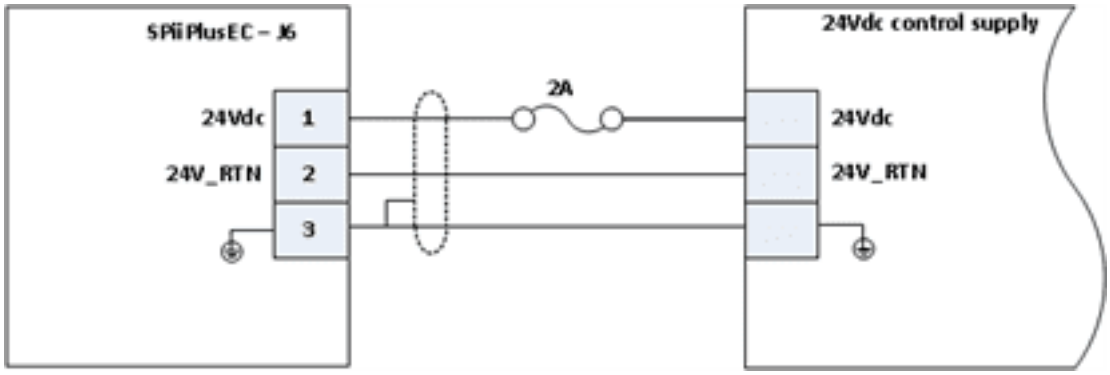

Figure 2-7. J6 Connections

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±20%	
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	

Item	Description	Remarks
Interface	Standard Ethernet LAN communication	
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) BPTP/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^{0}C.

A 10 CFM velocity-controlled cooling automatically starts operating when the operating temperature exceeds 30^{0}C.

> Storage temperature:-20^{0}C to +85^{0}C

> Humidity: 90%RH, non-dondensing

5.6.2 RoHS

> Design complies with ROHS requirements.

5 HaTnufa St.
Yokne'am Illit 2066717
Israel
Tel: (+972) (4) 654 6440 Fax: (+972) (4) 654 6443