SPiiPlusES

Installation Guide

December 2020

Document Revision: 3.03

ACS MOTION CONTROL

SPiiPlusES

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Revision History

Date	Revision	Description
December 2020	3.03	EtherCAT Cycle Rate Table, Flexible Configuration in order part number
September 2020	3.02	Correct option 11 in ordering
December 2019	1.30	Moved to Flare, corrected serial port text
January 2018	1.20	Added reference to COM2 for running the MMI Application Studio Upgrade and Recovery Wizard Recovery Task
October 2017	1.10	Added to LED Indicators Description for StatusExt > LED OFF - Unit in state INIT > RUN state is displayed with a 180 degree phase shift to the ERROR state"
August 2017	1.00	First release

Conventions Used in this Guide

Text Formats

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

Flagged Text

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

Related Documents

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

The most updated version of the documents can be downloaded by authorized users from www.acsmotioncontrol.com/downloads.

Online versions for all ACS software manuals are available to authorized users at ACS Motion Control Knowledge Center.

Document	Description
ACS Components in XL Scan System Application Note	Gives the system setup and calibration procedures for the ACS components included in an XL *SCAN* scanning solution

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List of Tables

1. Introduction

The SPiiPlusES combines the powerful SPiiPlusEC Motion Controller with a high speed EtherCAT to EtherCAT bridge. It adds the powerful motion control capabilities of the SPiiPlusEC to any Automation Controller using EtherCAT and CiA402.

Features include:

- Synchronization for the clocks of the two EtherCAT networks
- Can be managed by any EtherCAT Automation Controller with CiA402 protocol
- Support for up to eight axes
- Support for up to 64 axes using manufacturer's specific commands
- 1, 2, 4 & 5kHz EtherCAT cycle rates
- Use of Beckhoff TwinCAT 3.1 a master application for EtherCAT

Beckhoff TwinCAT 3.1 is integrated into Microsoft Visual Studio.

1.1 Scope of document

The SPiiPlusES is both an EtherCAT master and/or an EtherCAT slave controller.

As an EtherCAT master, it manages an ACS network in a similar fashion to the SPiiPlusEC.

As a slave controller, it is designed to operate as a CiA402 multi-axis drive.

This manual is one in a three volume documentation set for the SPiiPlusES. It has two sections. The first section describes how to install and setup the SPiiPlusES. The second section, which is also published as a separate application note, describes how to use the SPiiPlusES as a CiA402 multi-axis drive.

The third manual in the set is the ***SPiiPlusES User Guide***. It describes the EtherCAT functionality for the SPiiPlusES. All manuals are available on the SPiiPlus ADK suite disk shipped with the product. The most updated version of these documents can be viewed and downloaded by authorized users from the ACS Knowledge Center at the following link: ACS Motion Control Knowledge Center.

1.2 Product Overview

- Combines the powerful SPiiPlusEC Motion Controller and an high speed EtherCAT to EtherCAT bridge
- Adds the powerful motion control capabilities of the SPiiPlusEC to any Automation Controller using EtherCAT and CiA402
- The clocks of the two EtherCAT networks can be synchronized
- Can be managed by any EtherCAT Automation Controller with CiA402 protocol
- Standard support for up to eight axes
- Support for up to 64 axes using manufacturer's specific commands

> 1, 2, 4 & 5kHz EtherCAT cycle rates

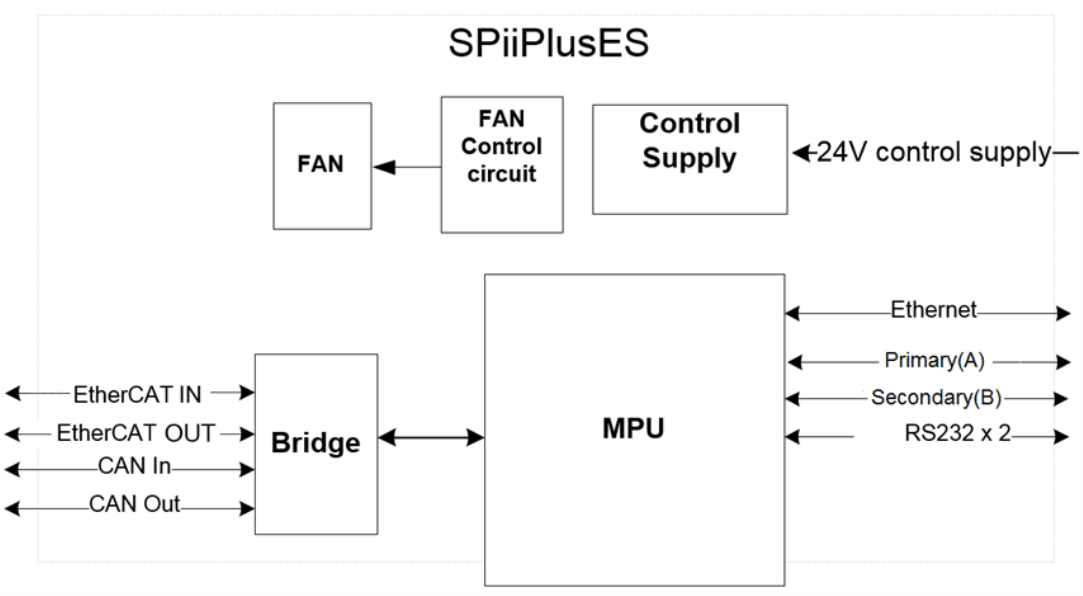


Figure 1-1. IDMSMECMSMUDMSM block diagram

2. Description

2.1 Connectors

The following figures and table show and describe the SPiiPlusES.

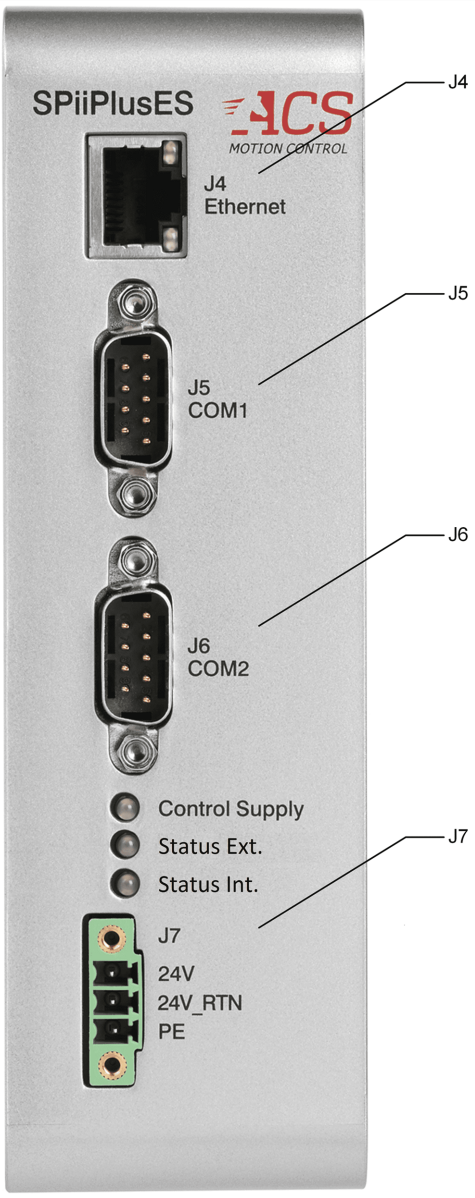


Figure 2-1. Connectors - front view

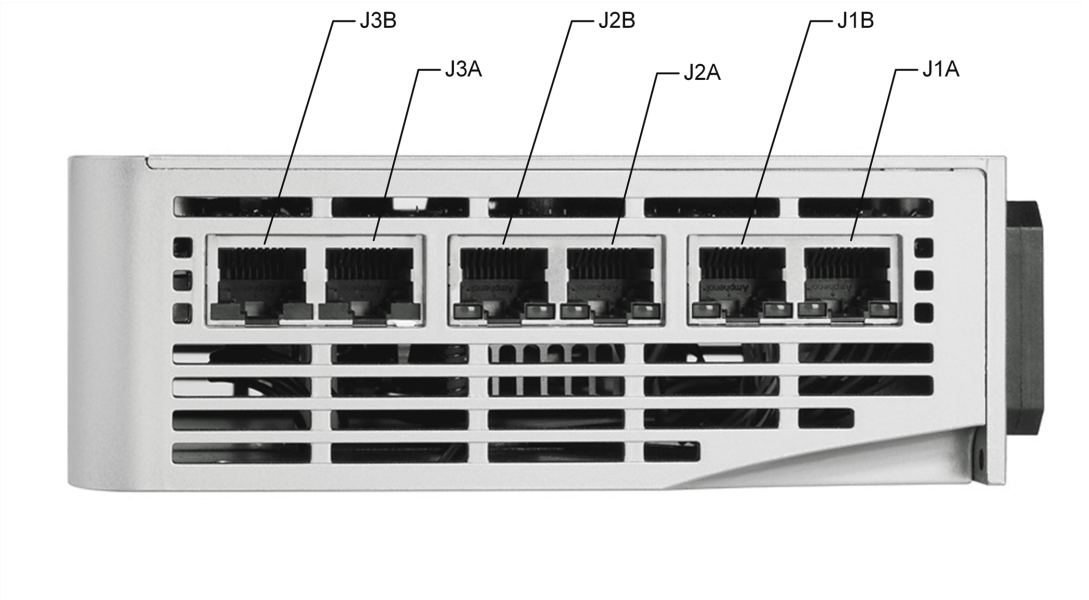


Figure 2-2. Connectors - top view

Table 2-1. Connections

Connector Assignment	Conenctor Name	Description
J1A	Primary(A)	Internal Network EtherCAT communication master 1
J1B	Secondary(B)	Internal Network EtherCAT communication master 2
J2A	EtherCAT IN	External Network EtherCAT slave communication input connector
J2B	EtherCAT OUT	External Network EtherCAT slave communication output connector
J3A	CAN IN	For future use
J3B	CAN OUT	For future use
J4	Ethernet	Ethernet to host communication
J5	COM1	RS232 communication port 1
J6	COM2 *see note	RS232 communication port 2

Connector Assignment	Conenctor Name	Description
J7		Control supply connector

*When necessary, use RS232 communication 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 LEDs and indicators

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

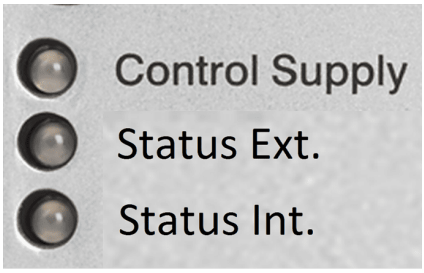


Figure 2-3. LED Indicators

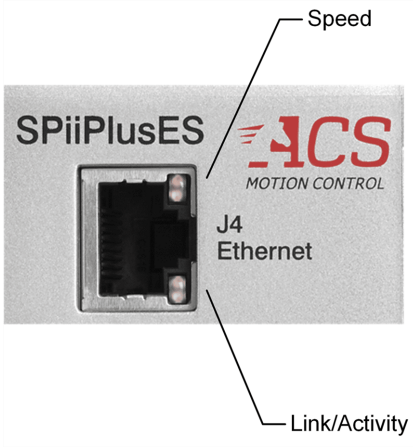


Figure 2-4. Ethernet Indicator

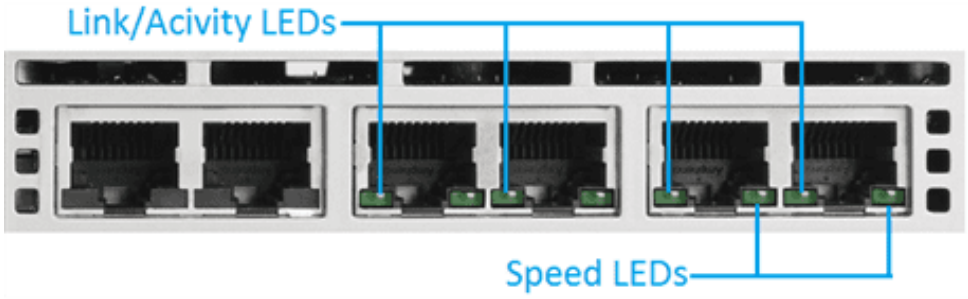


Figure 2-5. EtherCAT Indicators

Table 2-2. LED Indicators Description

Indicator	Description
Control Supply	One Green LED On: Control supply is OK. Off: Control supply is not functioning.
Status Ext.	One bi-color LED

Indicator	Description
	RUN state is displayed with a 180 degree shift to the ERROR state > Off: Unit in state INIT > Green LED > On: Unit in state Operational > Blinking: the device is in state PRE-OPERATIONAL > Single flash: the device is in state SAFE-OPERATIONAL > Red LED > On: A critical communication or application controller error has occurred > Blinking: General configuration error > Single flash: Slave device application has changed the EtherCAT state autonomously due to a local error > Double flash: an application watchdog timeout has occurred
Status Int.	One bi-color LED Green LED On: Successful power-up (master in OP state). Green LED blinking: > During power up > Open communication with host RED LED On: > Master out of OP state > Network Error RED LED blinking: Open communication with host
Ethernet Speed	One bi-color LED Yellow: 1000Mbit Green: 100Mbit
Ethernet Link/Activity	One yellow LED On: link without activity. Off: no cable is connected. Blinking: link and activity.
EtherCAT Link/Activity	Four green LEDs On: link without activity. Off: no cable is connected. Blinking: link and activity.

Indicator	Description
EtherCAT Speed	Two green LEDs On: 100 Mbit.

2.3 Package contents

The SPiiPlusES package contains the following items:

- SPiiPlusES module
- Control supply mating connector (for J7)
- Din rail mounting kit: PN DINM-13-ACC

2.4 Optional Accessories

2.4.1 Ethernet Cables

2.4.2 Ethernet Cables

ACS offers the following Ethernet CAT5 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

2.5 Ordering Part Number

The ordering part number (P/N) contains several characters (see Figure 2-6) that each specify a configuration characteristic ordered for the SPiiPlusES, as described in Table 2-3.

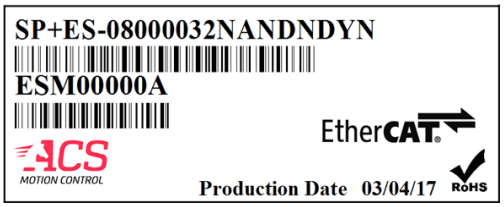


Figure 2-6. Label with order P/N example

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

SPiiPlusES Ordering Options	Field	Example User Selection	Available Ordering Option Values
Maximum number of axes	1	08	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 (FOC),64
PLC (IEC-61131-3), G-Code, or both	5	N	None (N), Y- PLC only, (G) G-code only, B - Both
ServoBoost™, number of axes supported	6	A	0(N), 4(A), 8(B), 12(C),…60(P), 64 (Q)
Input shaping	7	N	Yes (Y), No (N)
Maximum MPU cycle rate (kHz)	8	D	Default (D), 2kHz(2)*, 4kHz (4), 5kHz (5)
NetworkBoost™ - Flexible configuration	9	N	None (N), NetworkBoost (A), Flexible configuration (B), Both (C)
Number of ACSPL+ buffers/tasks	10	D	Default (D), 16(A), 32(B), 64(C)
Board level version	11	N	Reserved
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)

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

An example Part Number of SP+ES08000032NANDNDNN, 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+ES	08	00	00	32	N	A	N	D	N	D	N	N

3. Mounting and cooling

3.1 Mounting

> Unit to be mounted vertically using M3 type Philips screws as shown below.

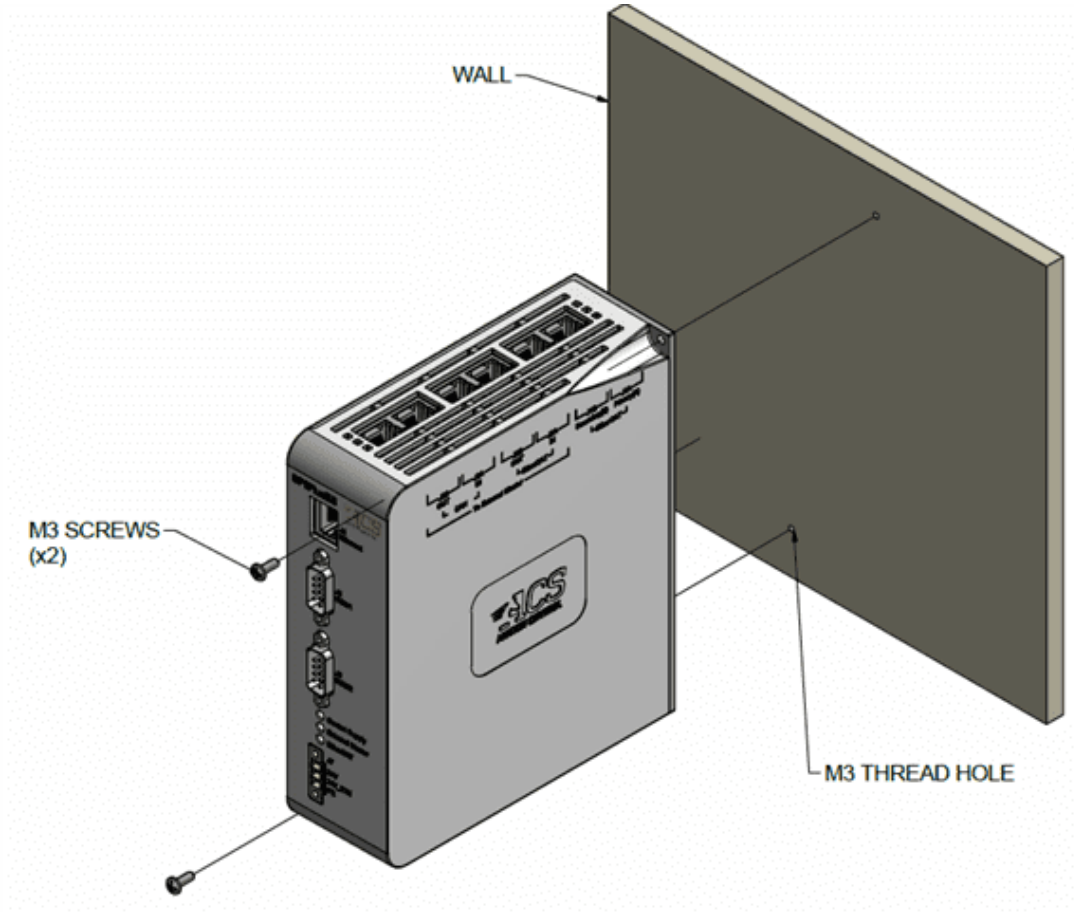


Figure 3-1. Wall installation

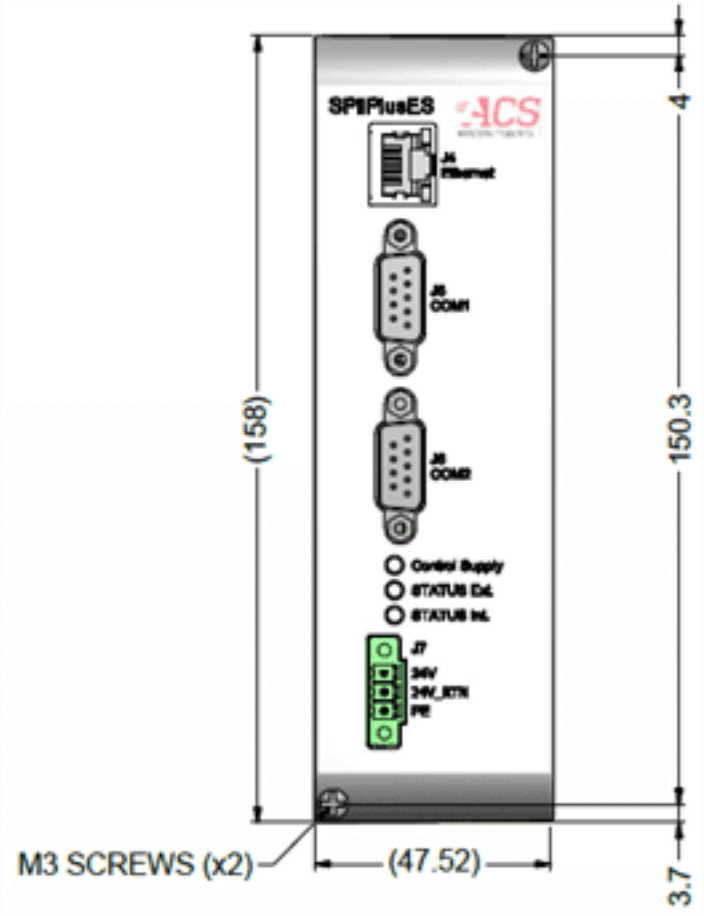


Figure 3-2. Mounting procedure

3.2 Cooling

The SPiiPlusES has a cooling fan. Allow for sufficient clearance for free air flow from the unit bottom.

4. Connections

This section describes how to interface with the SPiiPlusES using proper safety, EMC and wiring guidelines.

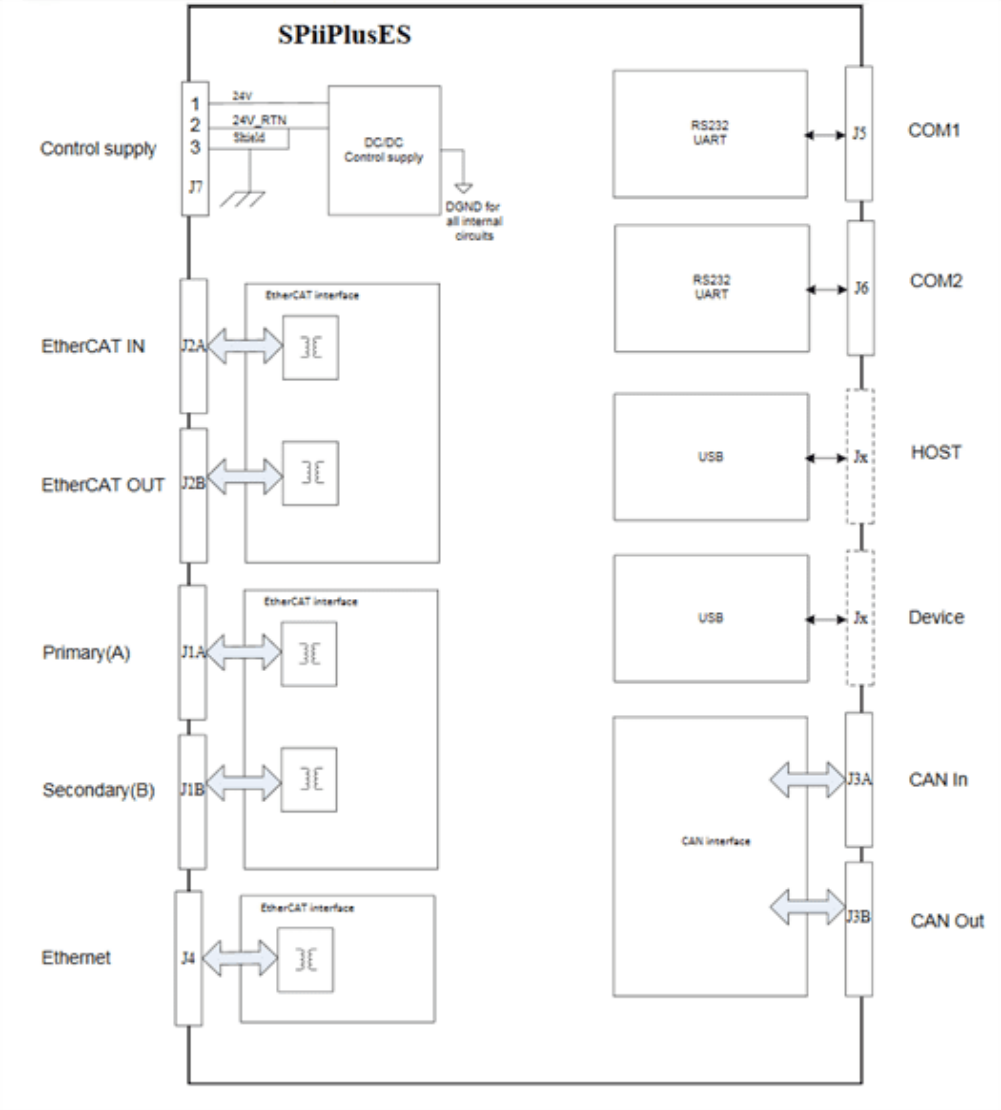


Figure 4-1. Connections and grounding

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 require a longer time to fully discharge.
- To avoid electric arcing and hazards to personnel and electrical contacts, avoid connecting and disconnecting the IDMSMECMSMUDMSM while the power source is on.
- When connecting the IDMSMECMSMUDMSM to an approved isolated control and drive 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 IDMSMECMSMUDMSMis not intended for use in safety-critical applications (such as life supporting devices) where a failure of the IDMSMECMSMUDMSMcan reasonably be expected to cause 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 and recommended interconnection cable lengths are below.

Table 4-1. Wiring Guidelines

Item	Gauge	Comments	Cable Length
Control Supply	18 AWG	Shielded cable	≤10m
Ethernet		CAT6 cable	≤100m
COM1, COM2 RS232 ports	18 AWG	Shielded cable	≤10m
EtherCAT		CAT5e or better	at least 50m

Use shielded cables.

4.2 Connecting the SPiiPlusES

The SPiiPlusES, is both an EtherCAT slave and/or and EtherCAT master controller. The next sections describe Connecting the SPiiPlusES as an EtherCAT Slave and Connecting the SPiiPlusES as an EtherCAT Master, respectively.

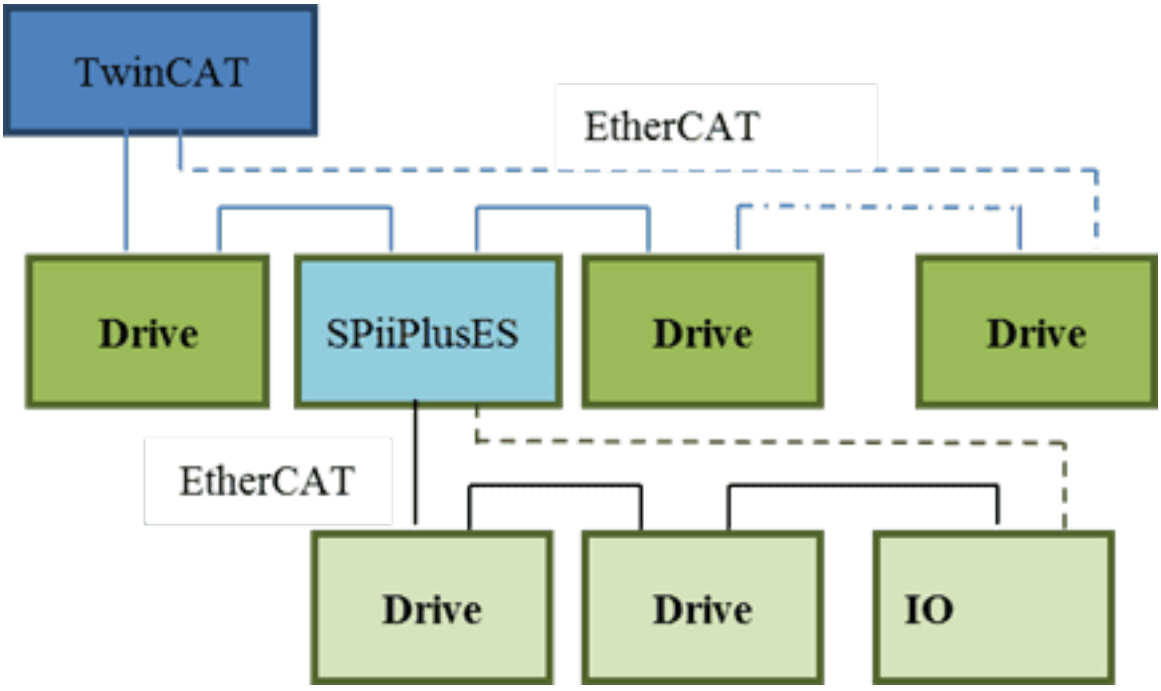


Figure 4-2. SPiiPlusES in a system

4.2.1 Connecting the SPiiPlusES as an EtherCAT Slave

The SPiiPlusES as an EtherCAT slave connects to an EtherCAT Master as part of a primary network. Use connector J2A (EtherCAT IN) and J2B (EtherCAT OUT).

General guidelines:

- If the SPiiPlusES is not the last slave network node, then connect from J2B (EtherCAT OUT) to the etherCAT input on the next etherCAT slave.
- If the SPiiPlusES is the last network node and a ring topology is in use, then connect from J2B (EtherCAT OUT) to the EtherCAT Master secondary port.
- If the SPiiPlusES is the last slave network node and a line topology is in use, then leave connector J2B (EtherCAT OUT) unconnected.

See for instructions to setup of the slave network including axis setup and tuning.

4.2.2 Connecting the SPiiPlusES as an EtherCAT Master

The SPiiPlusES as an EtherCAT master connects to the first slave network node from J1A [Primary (A)].

Guidelines for J1B[Secondary(B)]:

- If a line topology is in use for the secondary EtherCAT network, then leave J1B unconnected
- If a ring topology is in use for the secondary EtherCAT network, then is a ring topology, then J1B [Secondary(B)] is connected to the etherCAT output on the last slave network node.

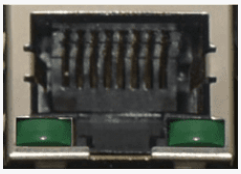
4.3 Internal Network Master Interfaces

4.3.1 Primary(A) J1A, Secondary(B) J1B

4.3.1.1 Connector description

Label: J1A Primary(A), J1B Secondary(B)

Connector	
Type	Socket
Version	RJ-45, 8 pin
P/N	



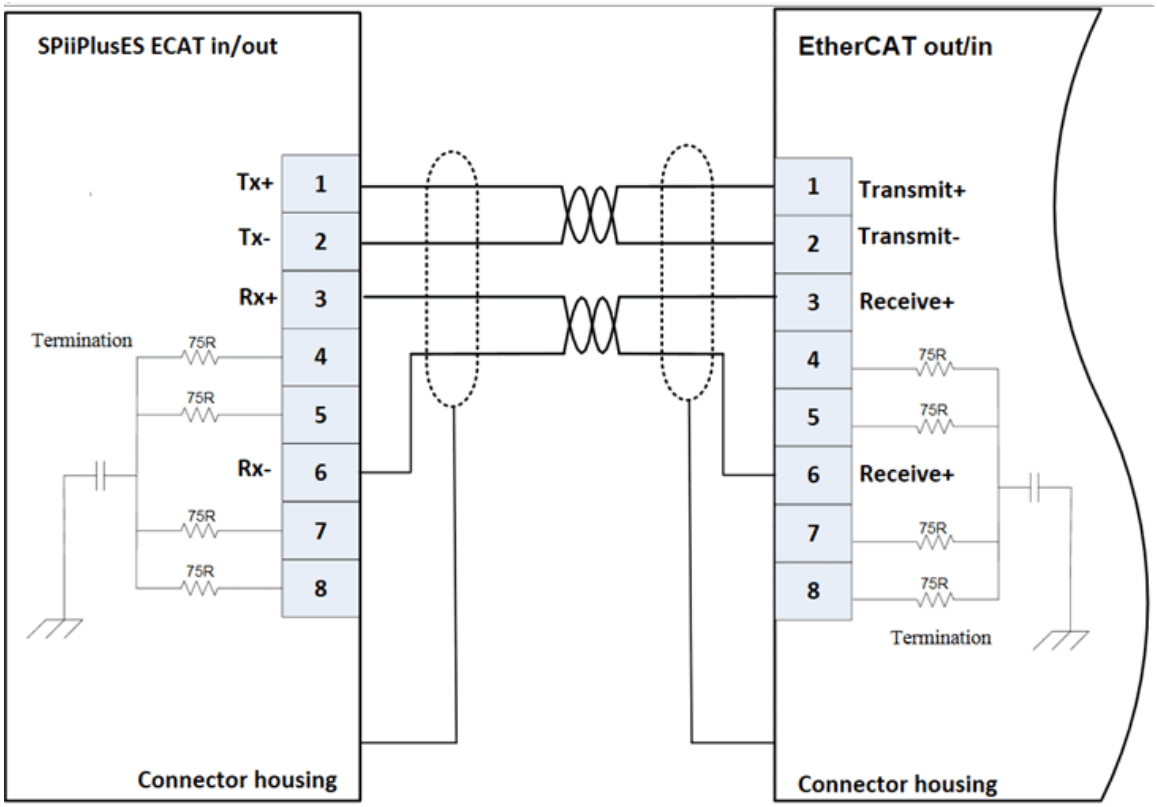
Mating Connector	
Type	Plug
Version	RJ-45, 8 pin
P/N	NA

Table 4-2. connector pinout

Pin	Name	Description
1	TD_0+	Transmit data +
2	TD_0-	Trasmit data -
3	RD_0+	Receive data +

Pin	Name	Description
4	Termination	Common mode termination
5	Termination	Common mode termination
6	RD_0-	Receive data -
7	Termination	Common mode termination
8	Termination	Common mode termination

4.3.1.2 Connection diagram



4.4 External Network Slave Interfaces

4.4.1 EtherCAT IN (J2A), EtherCAT OUT (J2B)

4.4.1.1 Connector description

Label: J2A EtherCAT IN, J2B EtherCAT OUT

See Connector description for connector description and pinout.

4.4.1.2 Connection diagram

See Connection diagram

4.4.2 CAN IN (J3A), CAN OUT (J3B) For future use

4.5 Ethernet (J4)

4.5.1 Connector description

Label: J4 Ethernet

See Connector description for connector description.

Table 4-3. J4 Ethernet connector pinout

Pin	Name	Description
1	TXD_1+	Transmit data 1 +
2	TXD_1-	Transmit data 1 -
3	RXD_2+	Receive data 2 +
4	BID_3+	Bidirectional 3 +
5	BID-3-	Bidirectional 3 -
6	RXD_2-	Receive data 2 -
7	BID_4+	Bidirectional 4 +
8	BID_4-	Bidirectional 4 -

4.5.2 Connection diagram

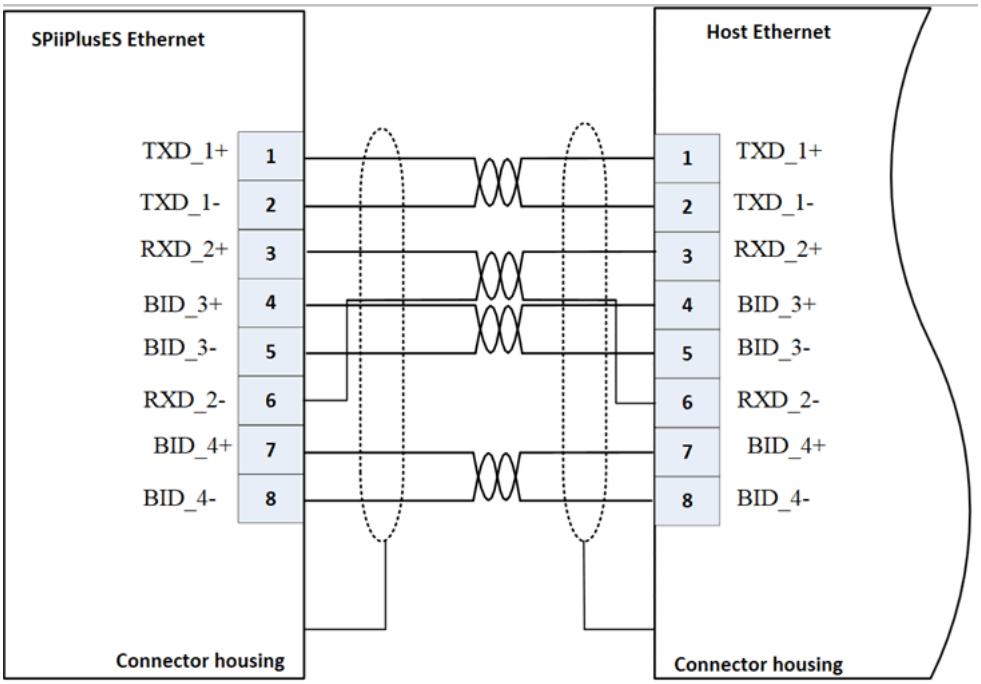


Figure 4-3. Ethernet wiring

4.6 COM1 (J5), COM2 (J6) RS232 Communication Ports

4.6.1 Connector description

RS232 Serial Communication Ports

Label: J5 COM1, J6 COM2

Connector	
Type	D-sub
Version	DB-9 male, threaded inserts, 4-40 UNC
P/N	EDH1M-40-GB-1-U
	

Mating Connector	
Type	D-sub

Mating Connector	
Version	DB-9 female, screw locks, 4-40 UNC
P/N	NA

Table 4-4. J4 Digital output connector pinout

Pin	Name	Description
1	DCD#	Carrier detect input
2	RXD#	Receive data input
3	TXD#	Transmit signal output
4	DTR#	Data terminal ready output
5	DGND#	Digital ground
6	DSR#	Data set ready input
7	RTS#	Request to send output
8	CTS#	Clear to send input
9	RI#	Request to send output

port number

4.6.2 Connection diagram

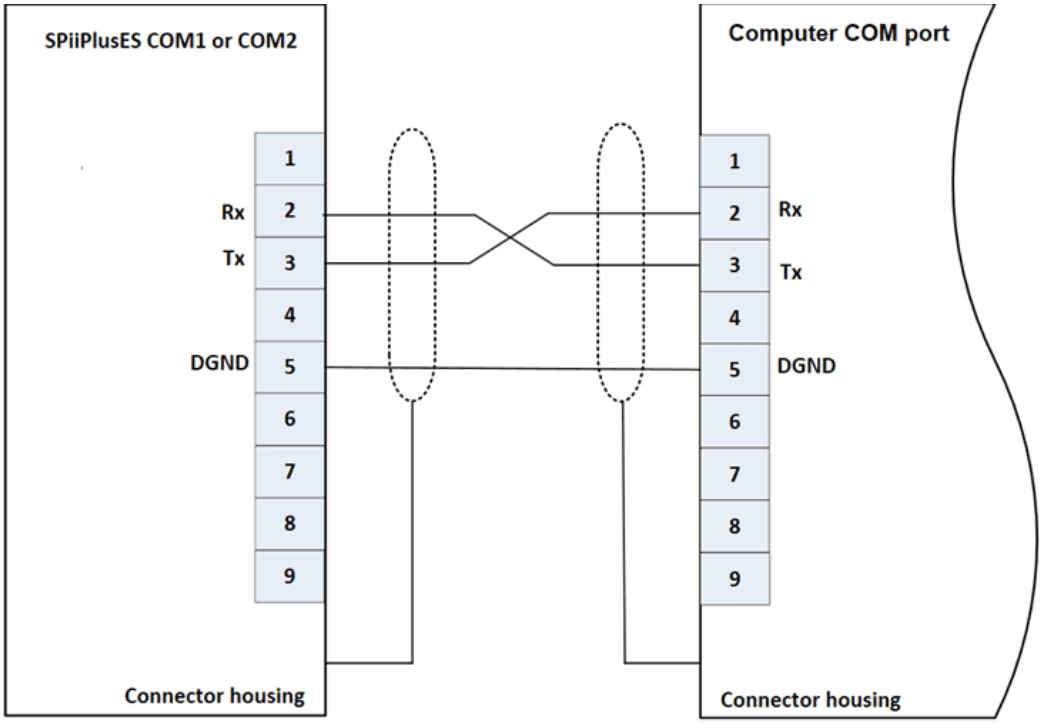


Figure 4-4. Crossover

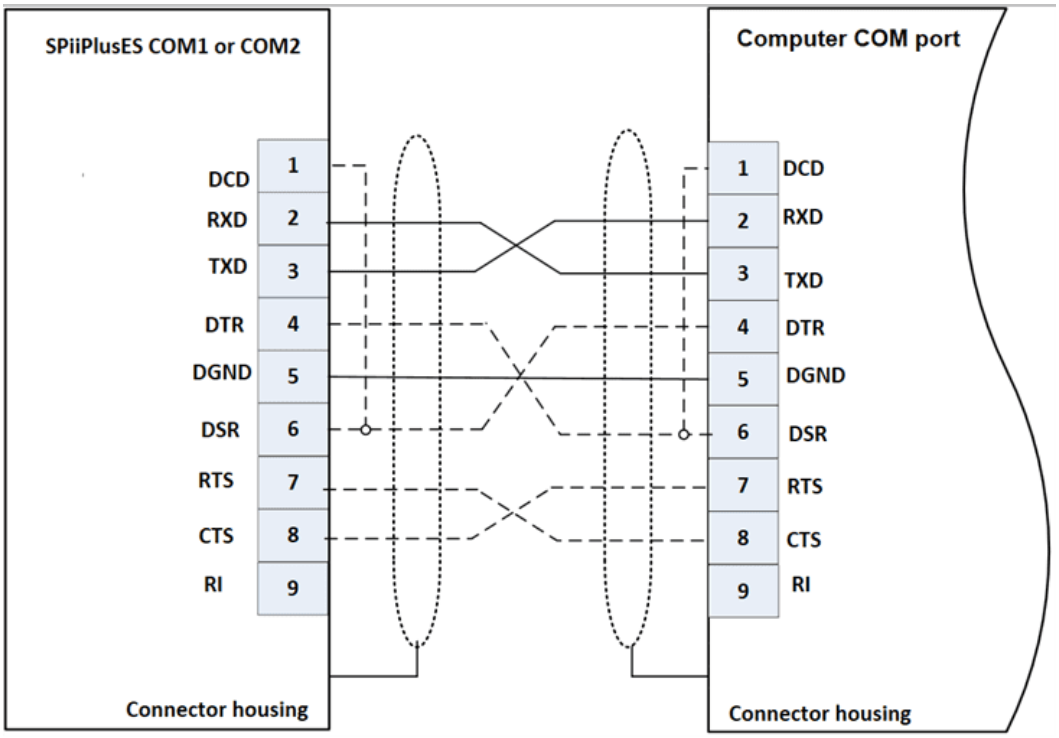


Figure 4-5. Handshake

4.7 Control Supply (J7)

The unit is fed by a 24V power supply.

The power supply must be provided by the customer and needs to be UL certified.

4.7.1 Connector description

Label: J7

Connector	
Manufacturer	Phoenix
Type	Header
Version	MC 1,5/ 3-GF-3,81
P/N	1827871

Mating Connector	
Manufacturer	Phoenix
Type	Plug
Version	MC 1,5/ 3-STF-3,81
P/N	1827716

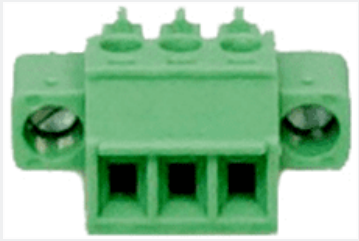


Table 4-5. J4 Digital output connector pinout

Pin	Name	Description
1	24VDC	+24Vdc

Pin	Name	Description
2	24VRTN	24Vdc supply return
3	PE	Protected earth

4.7.2 Connection diagram

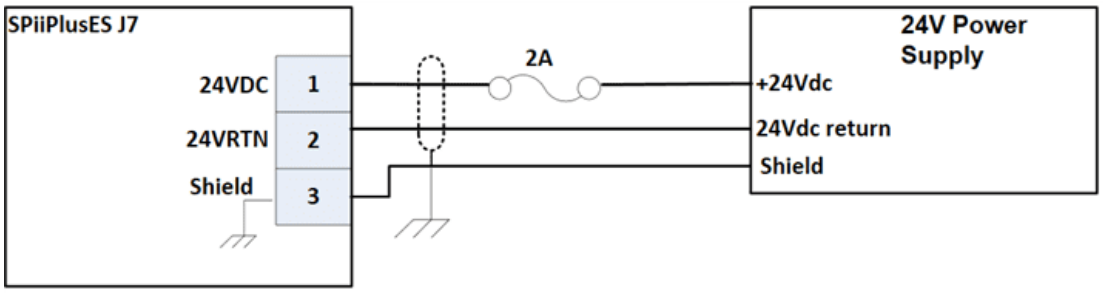


Figure 4-6. Control supply wiring

5. Product specifications

Table 5-1. System specifications

Feature	Specifications
Number of Axes	**As a Master:** Up to 64 axes **As a slave:** Up to 8 axes, Thousands of I/O's
Motion Types	> Multi-axis point-to-point, jog, tracking and sequential multi-point motion > Multi-axis segmented motion with look-ahead > Arbitrary path with PVT cubic interpolation > Third order profiles (S-curve) > Smooth on-the-fly change of target position or velocity > Inverse/Forward kinematics and coordinate transformations (at application level) > Master-slave with position and velocity locking (electronic gear/cam)
Programming	> ACSPL+ powerful motion language > Real-time program(s) execution > Up to 64 simultaneously running programs / threads > NC programs (G-code) > C/C++, .NET and many others standard languages
Supported EtherCAT Modules	**All ACS EtherCAT network modules** Refer to ACS web site for an updated list of modules www.acsmotioncontrol.com/products **Non ACS Modules** ACS qualifies drives and I/O modules made by other vendors Refer to ACS web site for an updated list of other vendor's supported modules www.acsmotioncontrol.com/downloads Other vendor's drives supported mode is Cyclic Synchronous Position (CSP) Additional modes are supported by some drives Contact ACS for details: sales@acsmotioncontrol.com
Host Communication Channels	**Serial**: two RS-232. Up to 115,200 bps **Ethernet:** One,100/1000 Mbs

Feature	Specifications
EtherCAT Ports	**Communication with an External EtherCAT Master:** EtherCAT In & EtherCAT Out, RJ45 connectors DS402 protocol **As an EtherCAT Master:** EtherCAT In & EtherCAT Out, RJ45 connectors *ServoBoost*™ (optional) - Automatic network failure detection and recovery using ring topology and redundancy
MPU	**Processor:** Intel® Atom™ N2600 1.6 GHz **Memory:** RAM - 1GB, Flash memory - 512MB **Cycle rate:** 1, 2, 4, 5 kHz (as a function of number of axes)
Power Supply	24Vdc ± 20%, < 0.8A Protection: reverse polarity

5.1 EtherCAT Cycle Rate

Table 5-2. CTIME Values for SPiiPlusES (Rev. D 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 ES-02-...	-	2	10	2	10	√ (2,3)	√ (2,3,4)	√ (2,3,4)	√ (2,3,4)	0.5	√
SPiiPlus ES-04-...	-	4	10	4	10	√ (2,3)	√ (2,3,4)	√ (2,3,4)	√ (2,3,4)	0.5	√
SPiiPlus ES-08-...	-	8	10	8	10	√ (2,3)	√ (2,3,4)	√ (2,3,4)	√ (1,3,4)	0.5	√
SPiiPlus ES-16-...	-	16	16	16	16	√ (2,3)	√ (2,3,4)	√ (2,3,4)	-	0.5	√
SPiiPlus ES-32-...	-	32	32	32	32	√ (2,3)	√ (2,3,4)	√ (2,3,4)	-	0.5	√
SPiiPlus ES-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

6. Compliance with standards

6.1 Dimensions

Dimensions	
Height (mm)	158
Width (mm)	48
Length (mm)	149.5

6.2 Weight

700g

6.3 Environment

6.3.1 Operating

Temperature range: -0 to + 50°C

Humidity range: 5% to 90% non-condensing

6.3.2 Storage

Temperature range: -25 to + 60°C

6.4 CE

EMC: EN 61326:2006 (pending)

6.5 RoHS

Design complies with ROHS requirements.

6.6 Dimensions

Dimensions	
Height (mm)	158
Width (mm)	48
Length (mm)	149.5

6.7 Weight

700g

6.8 Environment

6.8.1 Operating

Temperature range: -0 to + 50°C

Humidity range: 5% to 90% non-condensing

6.8.2 Storage

Temperature range: -25 to + 60°C

6.9 CE

EMC: EN 61326:2006 (pending)

6.10 RoHS

Design complies with ROHS requirements.

7. Operation

A SPiiPlusES module with eight-axes is used for most of the examples in this document.

7.1 Setup procedure

7.1.1 Setting up the SPiiPlusES as a master managing an ACS network

Use the MMI Application Studio and follow all procedures as would be used with the SPiiPlusEC to set up and tune a network.

All communication is via Ethernet.

This step can be done with the SPiiPlusES connected as a slave to an external master.

When configuring the external and internal EtherCAT networks, the controller cycle time (CTIME) must be identical.

Synchronization between internal and external master can take few seconds after external master starts up.

7.1.2 Adding ACS DS402 products as Slaves to a Beckhoff TwinCAT 3.1 system

Prior to executing the procedure, ensure that:

1. TwinCAT is connected to the device when it is part of the network
2. Copy relevant ESI for device file to TwinCAT 3.1 installation location
   a. For SPiiPlusES use one of the following files as appropriate:
      i. SPiiPlusES DS402 EtherCAT Slave Information File
      ii. SPiiPlusES Bridge EtherCAT Slave Information File
   b. For IDMsm use the IDMsm EtherCAT Slave Information file.
   c. For MP4U in bridge configuration use the MP4U DS402 Slave Information file.
3. Connect all cables
4. Power ON the device

When all the above is complete, the link and activity LEDs on the device will be ON.

Step 1 (described above) must be completed before executing this procedure.

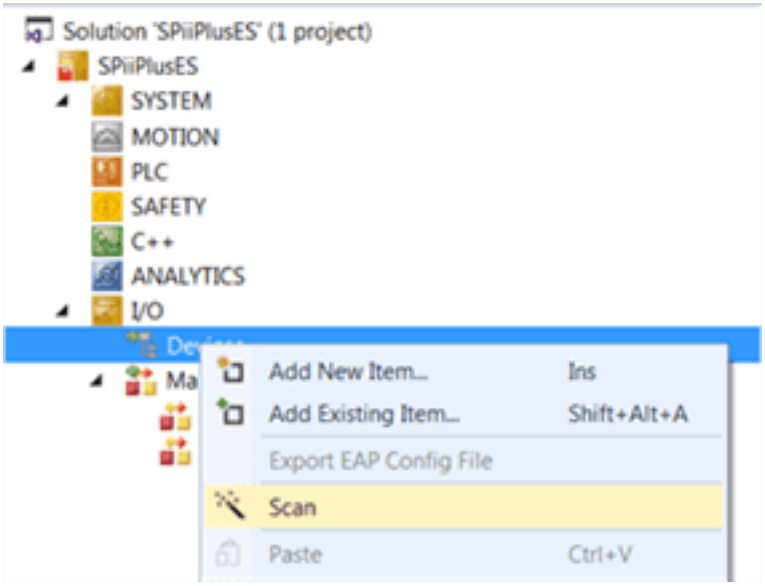
Adding the an ACS DS402 device as a slave to a Beckhoff TwinCAT 3.1 system/

1. Open TwinCAT 3.1 and create a new project. The new project is available in the Solution Explorer.

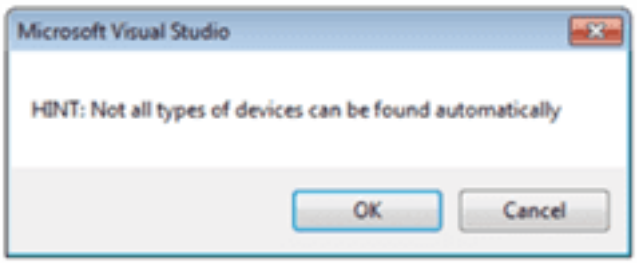
The online device search can be used if the TwinCAT system is in CONFIG mode.

TwinCAT can be set into this mode by selecting the icon in the menu bar or by "TwinCAT > "Restart TwinCAT (Config Mode)".

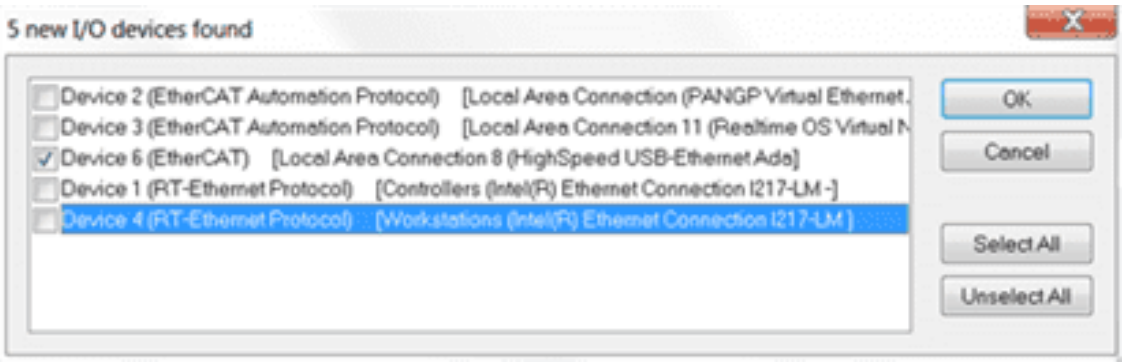
2. In the Solution Explorer for the newly created project, right click on **I/O > Devices**, then select **Scan**. A warning message is displayed.



3. Click **OK** to confirm the warning message. A window showing all scanned devices opens.

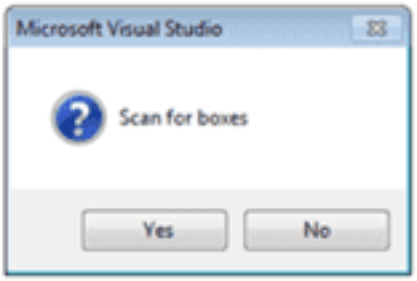


4. In the list of devices, select EtherCAT. Click **OK**. The following dialog is displayed.

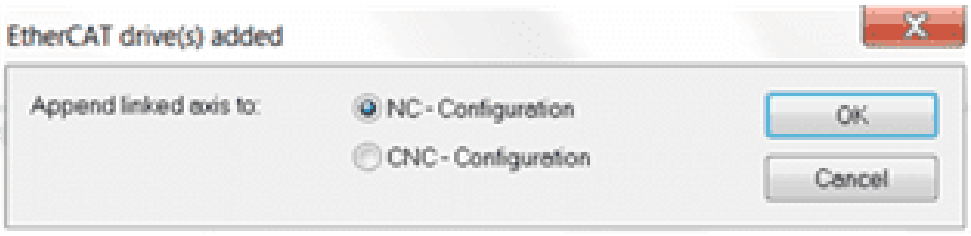


Make sure all other devices are not selected.

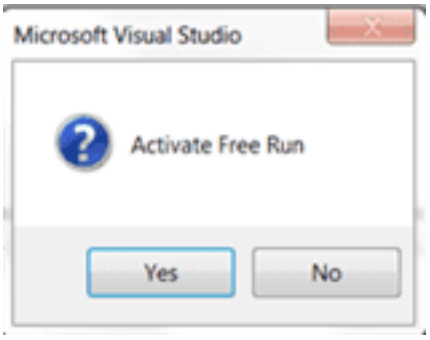
5. Click **Yes**. The following Add Drives Message window opens.



6. Select **NC-Configuration**. Click **OK**. The following dialog window opens.

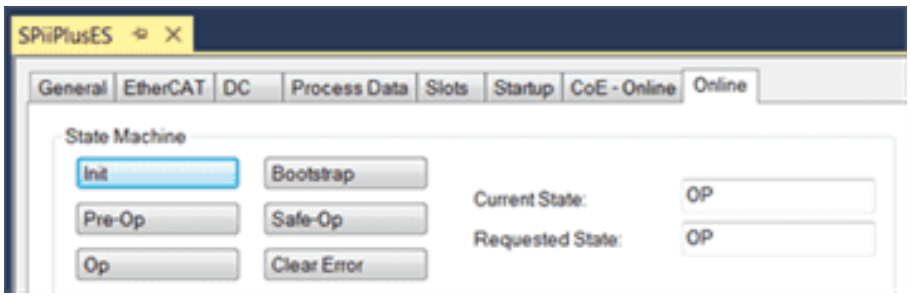


7. Click **Yes** to Activate Free Run. It is recommended to perform a device scan to verify the addition of the SPiiPlusES and its operational state.



8. Repeat step #2 above, followed by steps #3, #4, and #5 (if required). The device will be shown in the Solution Explorer tree under I/O Devices.

9. In the Solution Explorer tree, double-click the device name under the Devices > node. A device properties window opens.



10. Select the **Online** tab. The Online properties window opens. Verify that OP is displayed for Current State.

If the state is not OP, then the device is in an invalid state because of a fault. It must be resolved before proceeding.

7.2 Setting operation mode for one axis to CSP

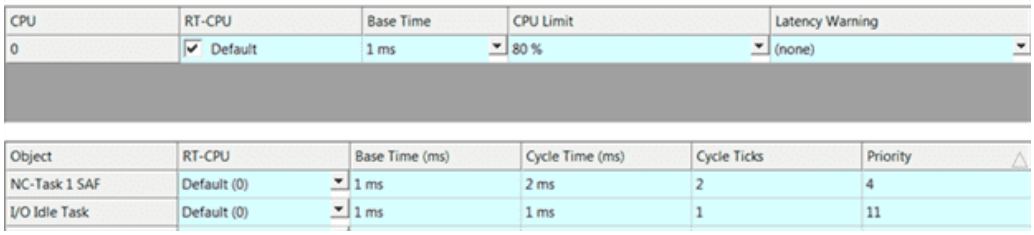
By default, each axis is associated to CSP (cyclic synchronous position mode).

TwinCAT NC module uses only CSP and cyclic synchronous velocity (CSV) modes. The SPiiPlusES supports CSP only.

7.2.0.1 Configuring Real-Time

7.2.1 Setting base time

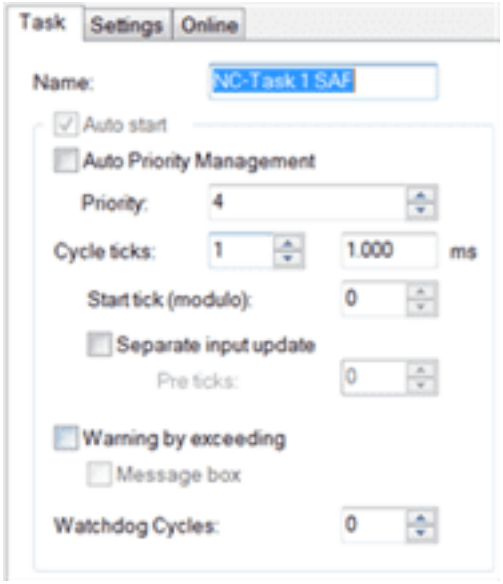
1. In the System Explorer tree, double-click **System > Real-Time**. The Real-Time configuration window opens.



2. Select the **Settings** tab. Change Base Time to **1 ms**.

7.2.2 Setting NC-task cycle time

1. In the Solution Explorer tree, double-**click Motion > NC-Task 1 SAF**. The following SAF Task Settings window opens.



2. Select the **Task** tab. Enter **1** for Cycle ticks.
3. Save the project.
4. Activate Configuration by clicking  icon or via the menu under “TwinCAT”.

The mode is changed from "Free-run" mode to "Real-time" mode.

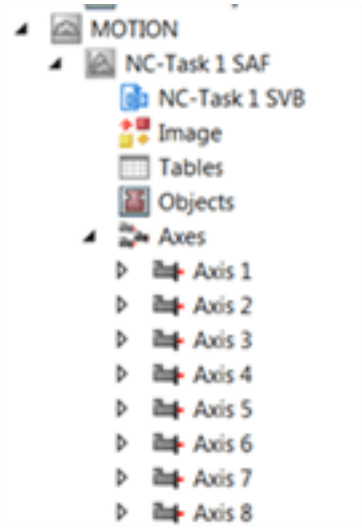
By default, the DC mode is used by the SPiiPlusES.

7.2.3 Motion example using CSP mode

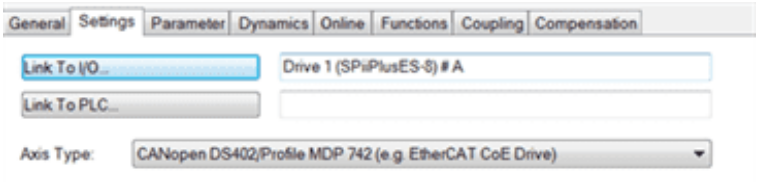
By default, all eight SPiiPlusES axes are linked to the TwinCAT NC module.

7.2.3.1 Setting axis parameters

1. In the Solution Explorer, double-click **Axis 1** under MOTION > NC-Task 1 SAF > Axes node. A properties window opens.

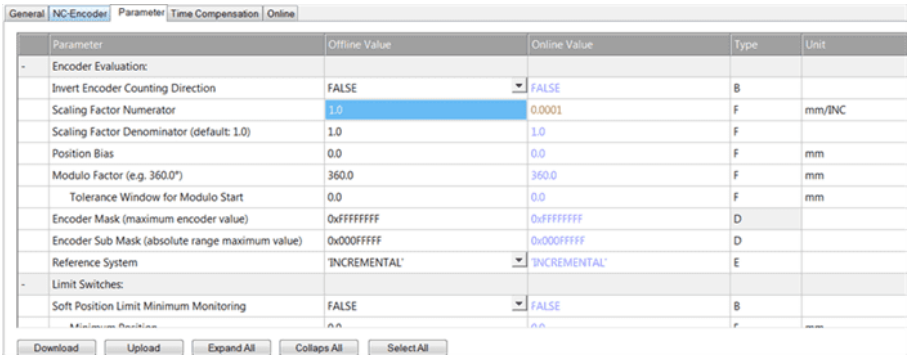


2. Select Settings tab. Verify that for Axis Type, "**CANopen DS/402/Profile ...**" is displayed.



3. In the Solution Explorer, select **Axis 1_Enc** under MOTION > NC-Task 1 SAF > Axes > Axes 1 node. A properties window opens.
4. Select the **Parameter** tab. Set the Scaling Factor Numerator to **1.0**.

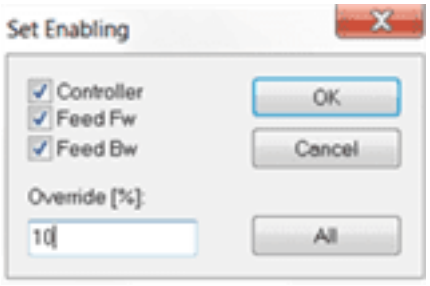
Use the ACSPL+ **EFAC** value for the relevant axis to set the scaling factor numerator and denominator. Also, it is necessary to update the DS402 position factor objects 0x6093:1 and 0x6093:2. It is recommended to update the values for these objects as given above.



5. Click **Download** to apply changes.
6. Activate Configuration as described above.

7.2.3.2 Enabling axes

1. Right click MOTION > NC-Task 1 SAF > Axes and select **Axis 1** (as in #1 above). A window opens.
2. Select **Online** tab. A Set Enabling dialog window opens
3. Click Controller, Feed Fw, Feed Bw, and set Override to 10%.



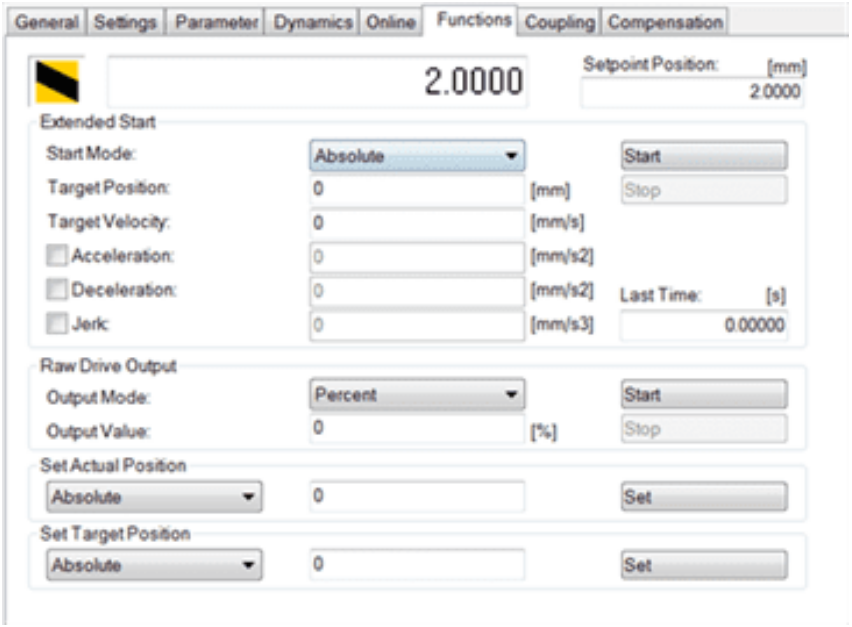
4. Click **OK**.

The enable process will execute ACSPL+ **ENABLE** command and run the commutation program in the relevant ACSPL+ buffer.

7.2.3.3 Selecting motion functions

After the axis is enabled, different motion functions can be selected in the "Functions" tab.

1. Open the Axis properties window as in Step 1 Setting Axis parameters above.
2. Select **Functions** tab. The functions property window opens.



3. All appropriate parameters for motion control are available.

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