SPiiPlus CMba/hp

Single/Dual/Triple Axis Control Module
Product Guide

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About this Document

This document presents the hardware details of the SPiiPlus CM and consists of the following sections:

Contents

Product Overview

The SPiiPlus CMba/hp (shown in Figure 1) is a state-of-the-art line of EtherCAT network master multi-axis machine and motion controllers with up to three digital drives. As an EtherCAT master, it controls ACS' line of EtherCAT servo and step motor drives and I/Os modules, as well as any (ACS certified) EtherCAT module that complies with the Can over EtherCAT (CoE) protocol.

Figure 1: SPiiPlus CMba/hp

SPiiPlus CM configurations:

- ❑ SPiiPlus CMba (standard)
- ❑ SPiiPlus CMhp (high performance)

The CMba and CMhp differ in the resolution (12 vs. 16 bits) of drives' current sensing, Sin/Cos Encoder and Analog inputs (+/-10V) sampling.

Ordering options:

Current levels: 5/10A, 10/20A. 15/30A (continuous/peak sine).

Number of axes: Up to 32 (4, 8, 16, 32)

P/D support: 4 axes (optional, can be ordered with or without). Occupies 4 network axes: 5,6,7,8

Sin-Cos encoders: 0, 1, 2, 3 (according to order)

Absolute encoders: 0, 1, 2, 3 (according to order)

SPiiPlus CMba/hp line supports both Sin-Cos and high-speed digital incremental encoders. An internal programmable multiplier (x4 to x65,536) can be ordered for any axis with Sin-Cos feedback. SPiiPlus CMba/hp line can operate as a standalone module, or can be connected to a host computer via an RS-232 serial port, or an Ethernet 10/100 BaseT port. All ports can be used simultaneously.

In network operation, all drives are highly synchronized by a distributed clock with accuracy better than 0.1 microsecond, and execute the control algorithms at a 20 kHz rate. As an EtherCAT Master, it can manage up to 32 axes and practically an unlimited number of I/Os. The product supports 1 or 2 kHz EtherCAT cycle rate updates. The SPiiPlus CMba/hp line is complemented by the SPiiPlus suite of software tools (the SPiiPlus MMI Application Studio) and with a built-in simulator. As network master, it supports all ACS drives and devices, as well as ACS-certified network devices made by other vendors.

The product is powered by a single or three phase 85 to 230Vac and by a separate 24Vdc control supply that keeps all low voltage signals alive during emergency conditions.

Changes in the network based SPiiPlusCMba/hp compared to a stand-alone SpiiPlus-CM

The differences between ACS stand alone SpiiPlus-CM and the network based line of SpiiPlus-CMba/hp should be noted:

- ○ Axis numbering and naming has changed as a result to the transition to network. Axes throughout the network are numbered 0 up to the maximal number of axes supported by the specific controller.
  The following letter-to-number translation is required in existing applications: X-0, Y-1, A-2, B-3.
- ○ P/D optional module: Number of P/D drives has increased to 4. The module includes 6 safety inputs
- ○ Number of incremental digital encoders has increased to 4
- ○ Analog inputs: 6 differential of 12/16bits (ba/hp), plus 2 of 12bit resolution are available

- Mechanical brake outputs: 3 of 1A, plus 3 of 50mA are available
- HSSI ports have decreased to 2
- Additional connector has been added: J29

Operation

The product can be operated as a standalone control module of up to 3 axes, or as network master supporting up to 32 axes, of which 3 (brush and brushless drives) or 7 (when a 4 stepper P/D option is ordered) are internal to the product. For out of box operation follow the steps detailed below, referring to the detailed information provided in this manual and to the referred ACS documents. Note that the product's operation depends on ordered features.

Cabling recommendations

For drive cables type selection follow the recommendations of motor supplier. As a general rule for all cables used, it is recommended using shielded (meshwork of tinned copper wire with high optical covering), high voltage withstand and very low capacitance cables. ACS specifies and tests this product using motor cable lengths of 10m. Motor cables should be routed as far as possible from sensitive-signal carrying cables such as encoder cables. Encoder cables should be selected according to the manufacturer's recommendations. The drive cables' shield should be connected to specified pin of the motor connector (refer to connector pin-outs in the sections that follow). For cables' pin out and connector details refer to SPiiPlus CMba/hp Connectors.

Standalone Control Module Operation

Product set up consists of the following stages:

	Please, read the safety instructions in **Personnel Safety Guidelines** and closely adhere to them.

Connect the supply and control cables (see Figure 5) using pre-wired cables, according to the recommended connectors and pin-out detailed in SPiiPlus CMba/hp Connectors.

Apply control and drive supply voltages and observe LEDs.

From your host computer, running SPiiPlus MMI Application Studio and SPiiPlus User Mode Driver, Establish communication with CMba/hp using either the Ethernet connection via the J6 connector, or serial connection via J7 or J28. Refer to the *SPiiPlusNT Setup Guide* for details.

Set up the product: refer to the *SPiiPlusNT Setup Guide*.

Operation and programming: refer to the *SPiiPlusNT Programmer's Guide*.

Network Master Operation

Setting up the product as a network EtherCAT master, when ordered for up to 32 axes, IOs and with any combination of ACS and Non-ACS network elements, requires additional stages in addition to those described above for standalone control module operation.

All network elements must be powered and interfaced according to their hardware guides. CAT5e cables have to be connected in a daisy chain mode from SPiiPlus CMba/hp EtherCAT Out (J5) connector to the first element's EtherCAT In port, and further connected from the first element's EtherCAT Out port to the EtherCAT In port of element next in line, and so on until all elements are connected. The network operates in this mode with no redundancy.

For all connected network elements, whether ACS or Non-ACS devices:

Connect to power supply and to relevant interfaces, according to each product's hardware and operation guides.

Apply control and bus voltages as needed, and verify correct operation.

Setup of SPiiPlus CMba/hp line as network master:

> From the host computer, running SPiiPlus MMI Application Studio and SPiiPlus User Mode Driver, Establish communication with CMba/hp using either the Ethernet connection via the J6 connector, or serial connection via J7 or J28. Refer to the *SPiiPlusNT Setup Guide* for details. Setup of EtherCAT network: use the SPiiPlus MMI Application Studio **EtherCAT Configurator** module to define the network according to ordered elements and needed network configuration. Refer to the *SPiiPlus MMI Application Studio User Guide* for details.
>
> Configure the network elements, axes, and IOs: use the SPiiPlus MMI Application Studio **System Configuration Wizard** module to configure all network elements, numbering and configuration. Refer to the *SPiiPlus MMI Application Studio User Guide* for details.
>
> For operation and programming: refer to the *SPiiPlusNT Programmer's Guide*, and *SPiiPlus Command & Variable Reference Guide*.

Axis Configurations and Options

The SPiiPlus CMba/hp line can control three internal drives and 4 P/D interfaces, depending on ordered model and on type of motors used. For example:

- ❑ One to three directly connected motors for servo motors (DC Brush, DC Brushless/AC Servo).
- ❑ Four directly connected drives for step motors in open loop (without position feedback).

The specific number and type of motors supported depends on the number of internal drives (one to three) and the step motor support (one to four) specified in the product's order.

Only HSSI IO-16 interface is supported.

Network axes consumption: The product has a total of four available encoders, regardless of the number of drives. As such, the product always consumes four network axes.

Encoder assignment to axes: A drive's encoder can be any of available encoder types: Digital incremental (AqB), Sin-Cos, or absolute.

In addition to the drive's encoder, additional encoders (up to a total of 4) can be used for extended servo configurations such as dual loop.

As such, a 1 axis product can have 1 encoder of any type assigned to axis 0, and use 3 additional encoders.
A 2 axis product can have 2 encoders of any type assigned to axis 0 and 1, and use 2 additional encoders.
A 3 axis product can have 3 encoders of any type assigned to axis 0, 1,2 and use 1 additional encoders.

Encoder 3(B) is always digital incremental, and others, up to a total of four, can be of any type.

- ❑ **Ordering options**: the total number of Sin-Cos and total number of absolute encoders has to be ordered as part of the product ordering. All absolute encoders have to be of same type.
- ❑ **Dual loop**: dual loop is supported for any axes combination.

Motor Connection

The built-in universal drives support 2- and 3-phase AC synchronous, AC induction, 2- and 3-phase step, and DC brush motors. Selection of motor and parameter setting is done using the Adjuster Wizard of the SPiiPlus MMI Application Studio (refer to *SPiiPlus MMI Application Studio User Guide*).

A 3-phase motor connection is depicted in Figure 2. An optional motor filter is shown in series between the drive and the motor. A shielded cable should be used, terminated in the EGND pin which is internally connected to the chassis (PE). If needed, the shield/GND may be connected to the motor's chassis to provide a seamless common ground reference.

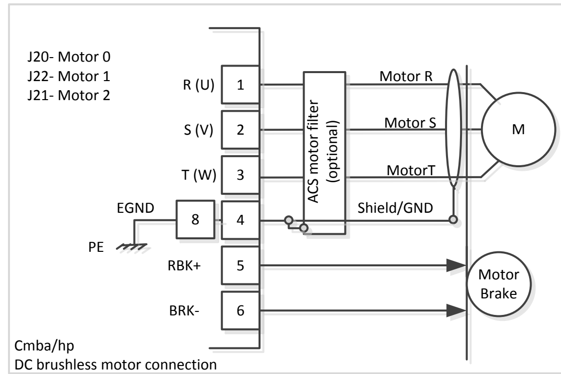


Figure 2: 3-Phase Motor Connection

For DC brush motor connections do not connect phase T (refer to Figure 3).

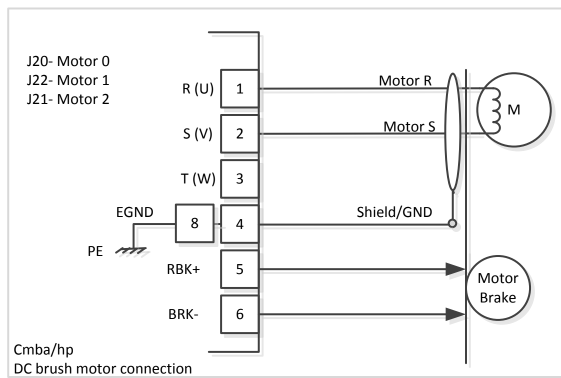


Figure 3: DC Brush Motor Connection

For 2-phase step motors connect the motor phases between S-R and between T-R as shown in Figure 4.

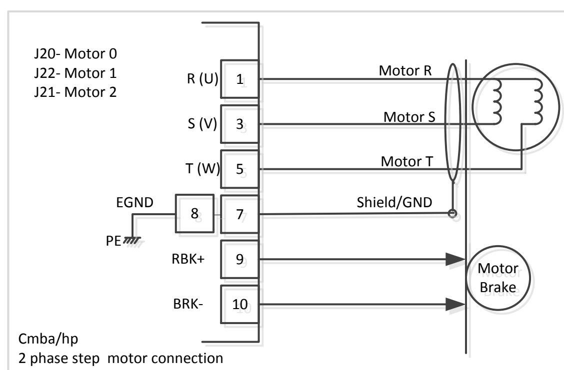


Figure 4: 2-Phase Step Motor Connection

SPiiPlus CMba/hp line Block Diagram

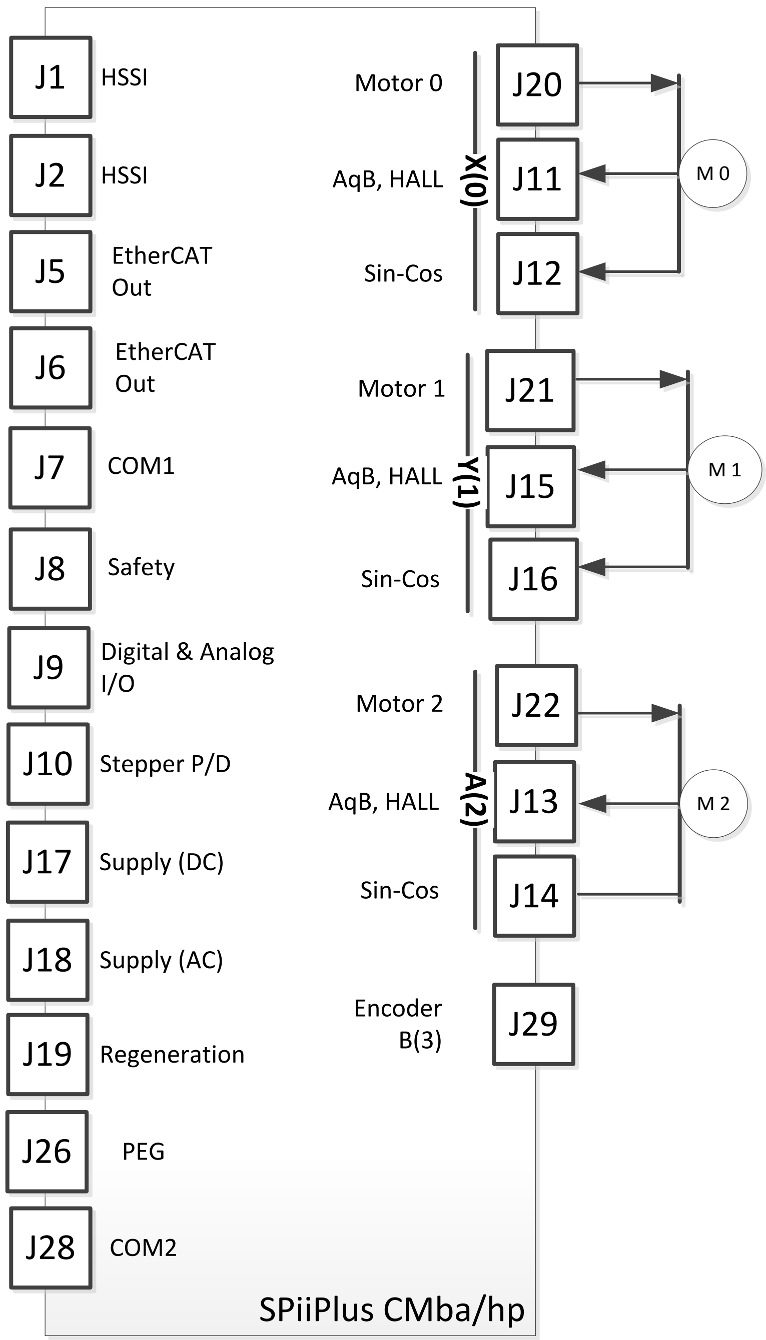


Figure 5: SPiiPlus CMba/hp Connector Diagram

Electro-Magnetic Immunity and Interference Considerations

Due consideration should be given to the following recommendations in order to minimize electromagnetic interference to power supply and neighboring equipment, and in order to improve electromagnetic immunity.

- AC line filter (EPCOS B84142-B25-R equivalent), for AC supply interference protection.
- Motor filters between the drive and the motor. The filters should be connected as close as possible to the drive's output connectors. Note that the filters require air flow cooling.
- For motor cables use shielded (meshwork of tinned, copper wire with high optical covering), high voltage withstand and very low capacitance cables. ACS specifies and tests its products using motor cable lengths of up to 10m lengths. Motor cables should be routed as far as possible from sensitive-signal carrying cables such as encoder cables. Encoder cables should be according to manufacturer's recommendation. The motor cables' shield should be connected to motor connector pin 4.
- Lightning protection on the supply AC lines should be provided in the cabinet/machine where the ACS product is being used. It is recommended to install power surge lightning arrestors (varistors) between the AC terminals (L-N, L-PE, N-PE). ACS recommends using the MNF Wurth Electronic, MNF P/N 820422711 varistor.

Regeneration

In order to absorb excess mechanical reverse energy translated into electrical energy during deceleration, and to avoid a voltage rise beyond the drive's overvoltage protection level, an internal 100R/100Watt resistor is provided. In order to apply this resistor, the user should shorten pins 1 and 3 in connector J19 as depicted in Figure 6.

For demanding motion profiles an external shunt can be connected to pins 2 and 3 of J19 (as depicted in Figure 7), thus bypassing the internal regeneration resistor.

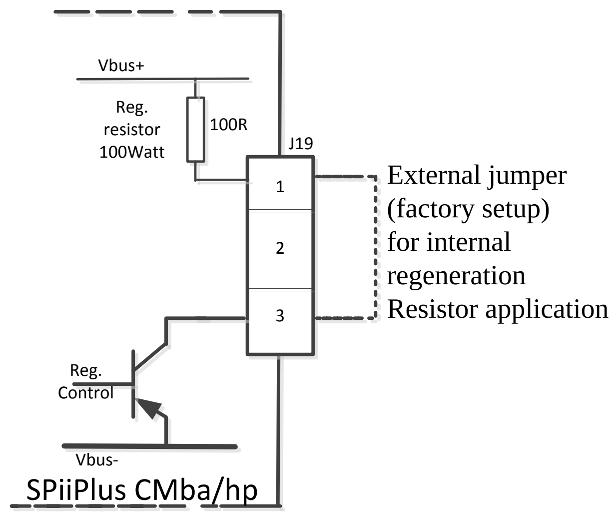


Figure 6: Internal Regeneration Connection

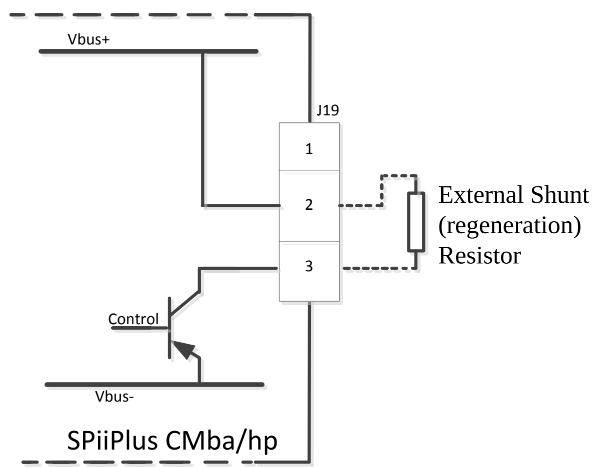


Figure 7: External Regeneration Connection

Mechanical Motor Braking

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

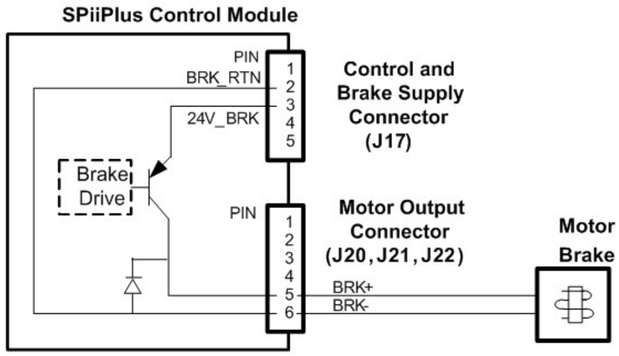


Figure 8: Mechanical Motor Brake

The mechanical brake outputs can be optionally used as General Purpose outputs from connector (J9).

Feedback

Encoder Types and Assignment

The SPiiPlus CMba/hp line supports multiple feedback types per each axis: Incremental digital (up to a total of 4 encoders which can be assigned to any axis. Sin-Cos analog (ordering option, 1 per axis), Hall sensors (1 set per axis) and absolute encoders (ordering option, up to 3 total, of same type). The type of encoder and the number of encoders has to be specified when ordering, and cannot be modified at field level.

Dual feedback (dual loop) topology per axis is supported. Note that in a multi-axis network configuration, the number of utilized network axes is identical to the number of digital encoders used. For example, when a dual feedback scheme is implemented for 2 axes, 4 network axes are consumed out of the total number of network axes supported and ordered for the specific SPiiPlus CMba/hp master.

Encoder Power Supply

The unit includes a built-in 5V±5% 1A(total) encoder supply.

Incremental Digital AqB Encoder

Each internal drive supports one or two incremental digital AqB encoders. The number of supported incremental encoders is by a factory setup and cannot be changed in the field.

The interface of each of the encoder’s A, B and Index signal is depicted in Figure 7.

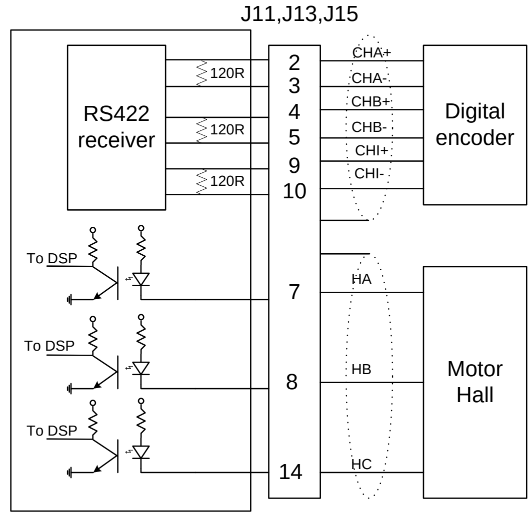


Figure 7: Incremental Digital AqB Encoder Connections

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

- Maximum rate: 10MHz which equals 40 million quadrature counts/sec
- Fault detection: 'Encoder error' (due to noise), and 'Encoder not connected' are detected.
- The encoders power supply is referenced to a digital ground.
- A, B, I and Clk/Dir modes of operation are supported.

Sin-Cos Encoders

Optionally, the product supports one Sin-Cos encoder per axis. This number of supported Sin-Cos encoders is set at the factory according to ordered license. The interface for the Sine, Cosine and Index signals (Figure 8) is differential, 1Vptp ±10%. The maximal input frequency is 250 kHz.

A license is an ACS permit to use or activate certain features within the product. A license is ordered as part of the product's purchasing configuration (prior to delivery), or after the product has been delivered and a need exists to expand the product's capabilities. When ordered as part of the product, the customer does not need to perform anything in order to activate the ordered features. When ordered after the product has been delivered, the customer has to download and activate the ACS-sent (by email) string to the controller, using the MMI.

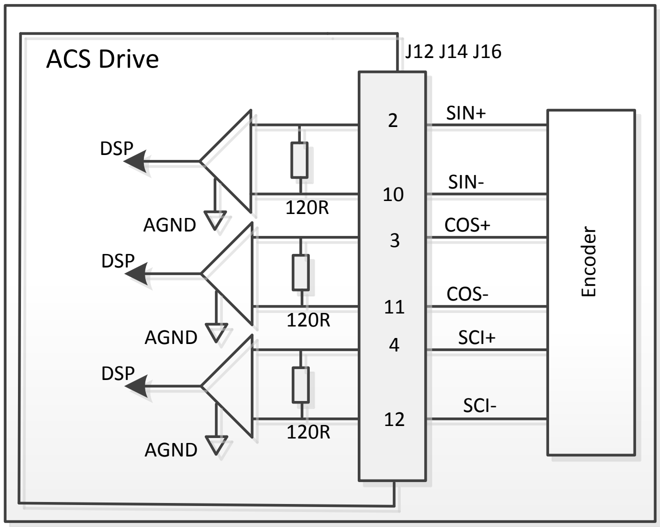


Figure 8: Sin-Cos Encoder Connections

Sin and Cos inputs are sampled in 20kHz at 12-bit resolution for SPiiPlus CMba, or 16-bit for SPiiPlus CMhp. A multiplication factor of 4 up to 65,536 (practically measured to be better than 4,096) is supported. A software based Offset, Gain and Phase compensations can be set using the SPiiPlus MMI Application Studio Sin Cos Encoder Compensation tool which optimizes and sets the compensation values, stores the optimized values and displays the results graphically. 'Encoder error' and 'Encoder Not Connected' are reported as faults.

Absolute Encoder Support

The SPiiPlus CMba/hp supports the following absolute encoders: Endat 2.2, SmartABS, BiSS (from V2.30) and Panasonic.

> The user should check with ACS regarding the particular required encoder type since many different versions exist per encoder standard.

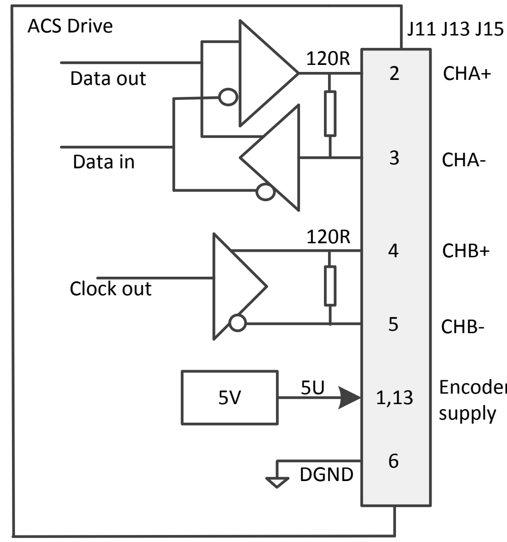
The absolute encoders' electrical interfaces and connector pins are shared with AqB digital encoder's functional pins: AqB encoder A± interface is used for bidirectional DATA transfer, and AqB encoder B± interface is used for clock transmission to applicable encoders. Refer to J11, J13 & J15 – HALL & Encoder Connectors for pin numbers.

Cable lengths: absolute encoders have been tested with cables length of up to 30 m with encoder supplier's provided cables. For encoder connection use a shielded twisted pair cable such as BELDEN 9506, or its equivalent.

The physical interface is automatically reconfigured following the encoder type selection. The encoder type must be pre-ordered as defined in the SpiiPlus CMba/hp part number.

An attempt to select an encoder type that does not match the actual ordered encoder results in an error.

Figure 9 depicts the physical connection of the SPiiPlus CMba/hp line and absolute encoders. Note that the serial clock line is used only when interfacing Endat 2.2.



Absolute Encoder Interface: biderectional data and clock

Figure 9: Absolute Encoder Connection

Pulse Direction Interface

The PD optional module consists of 4 Pulse Direction interfaces, each consisting of a Pulse output, Direction output, Enable output and Fault input signals. The PD module occupies 4 network axes, numbered 5,6,7 and 8. Refer to the schematics below for Pulse and Direction interfaces, Enable signal interface and 'source' and 'sink' configurations for the Fault signal.

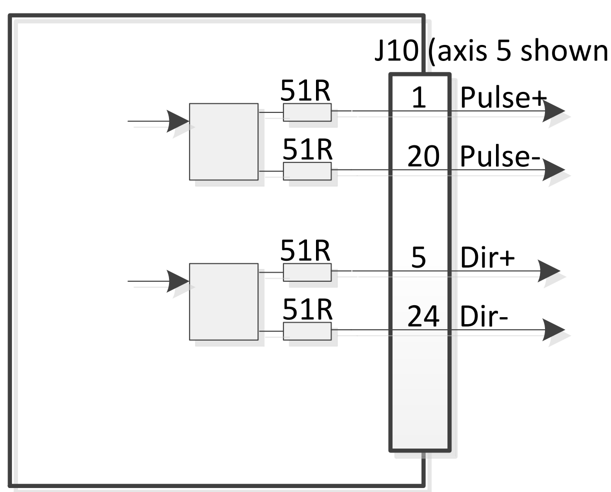
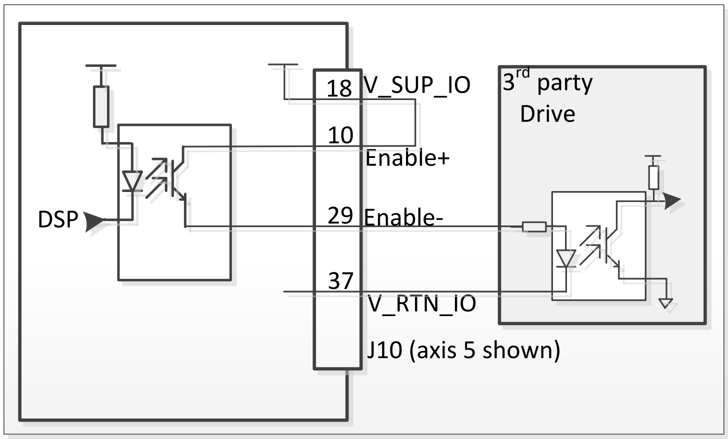


Figure 10 : Pulse and Direction electrical schematic



Drive Enable of P/D module (axis 5)

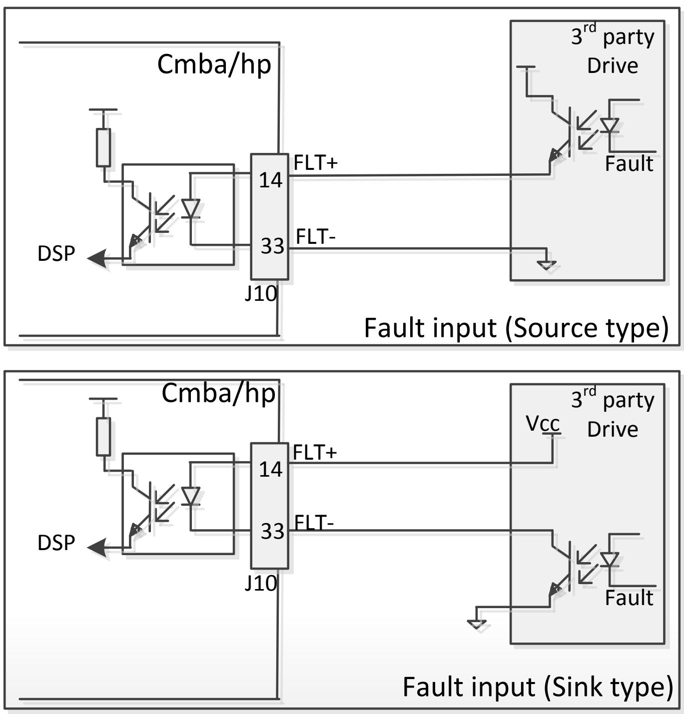


Figure 11: Fault signal electrical schematic, 'source' and 'sink' connectivity scheme.

Position Event Generation (PEG)

The SPiiPlus CMba/hp supports advanced Position Event Generator (referred to also as Position Output Compare) output signals for synchronous random and incremental timing generation. The two PEG Pulses and eight PEG STATE signals can be associated with any of the incremental encoders, and can be programmed for polarity and shape. The product supports 3 PEG generators, each of which can be associated with the available encoders.

The Incremental PEG mode provides the ability to generate a series of evenly spaced fixed width pulses, starting and ending at predefined start and end points.

The Random PEG mode provides the ability to control a PEG Pulse and a four-bit STATE vector at pre-defined positions, out of a 1024 member user-defined array per each PEG-generator. Moreover, since the PEG signals from each engine can be 'OR'ed so that they all result in a signal coming out of a single interface, a maximal array of 3x1024 position points per selected axis (3072 points) is supported.

For more details, see the *SPiiPlusNT PEG and MARK Operations Application Notes*.

Power Supplies

The SPiiPlus CMba/hp is fed by two supply sources: a 85-265Vac from an AC power supply to the motors (a rectified voltage bus) and a 24Vdc supply to the logic and control circuitry. Additionally, external voltage is provided for mechanical brake, digital outputs and for safety signals.

Control Supply

24Vdc (±10%), drawing maximally 2A.

Mechanical Brake

User supplied nominal 24Vdc (5-30Vdc), up to 3A.

Digital Input/ Output Supply

User provided 5Vdc (±10%) or 24Vdc (±20%), up to 0.8A. Detected automatically. Connected between the V_SUP_IO and V_RET_IO pins.

Safety Inputs Supply

User provided 5Vdc (±10%) or 24Vdc (±20%) up to 0.2A, detected automatically. Connected between the V_SUP_SFTY and V_RET_SFTY pins

Drive Power Supply

The product is fed by a single phase or a 3 phase AC supply:
Single phase supply: 85-265Vac, 18A RMS-up to 4200W continuous, 7200W peak (for 1 second).

Three phase supply: 230Vac phase-to-phase. Current per phase of up to 18A RMS for a total of 7300W continuous power, and 14,600W peak power (1 second for all phases).

Regeneration: SPiiPlus CMba/hp provides an internal regeneration shunt resistor rated at 100Ω/100W (continuous). If required, an external shunt resistor (rated >13Ω) should be deployed.

Integrated Digital Drives

Quantity: One, two or three.

Type: PWM, digital current control with space vector modulation

PWM Frequency: 20 kHz.

Current Loop Sampling rate: 20 kHz.

Control Algorithm: PI

Drive short circuit capability: 5kA

Phase Currents (sine wave amplitude):

- SPiiPlus CMba/hp line-1/2/3-A: 5A continuous; 10A peak (1 second). Maximum power per axis is 1370W continuous, 2740W peak.
- SPiiPlus CMba/hp line-1/2/3-B: 10A continuous; 20A peak (1 second). Maximum power per axis is 2740W continuous, 5480W peak.
- SPiiPlus CMba/hp line-1/2/3-C: 15A continuous; 30A peak (1 second). Maximum power per axis is 4110W continuous, 8220W peak.

Total Power, version A,B and C:

For single phase supply:

Continuous power of 2800W.
Peak power (1 second) of 5200W.

For three phase supply:

Continuous power of 5000W.
Peak power (1 second) of 10500W.

Signals to Directly-Connected P/D Stepper Drives

P/D Stepper Drive Commands:

- Quantity: four, depending on the model.
- Type: Pulse/Direction commands, differential, RS-422.
- Maximum Rate: Five million pulses/second.

Drive Enable Output:

- Quantity: One per stepper drive.
- Type: Two terminal, may be used as source (open emitter) or sink (open collector).
- Output Voltage Range: 5Vdc (±10%) or 24Vdc (±20%).
- Output Current: Up to 100mA.
- Propagation Delay:<1msec.

Drive Fault Input:

- Quantity: One per stepper drive.
- Type: Two terminals, may be used as source (open emitter) or sink (open collector).
- Input Voltage: 5Vdc (±10%) or 24Vdc (±20%), automatic detection.
- Propagation Delay: <1msec.

Digital Inputs and Outputs

Digital Outputs

SPiiPlus CMba/hp line provides 8 single ended, opto-isolated, 5V(±10%) or 24V ±20%, with 0.1A per output, up to a total of 0.8A for 8 outputs. IO supply is externally user-provided, common to all signals. 'Source' and 'sink' type of digital output connection are shown in Figure 11 and Figure 12. The selection between the configurations is a function of a side-panel user-accessible jumper J7. Refer to Table 4: SPiiPlus CM Jumpers for the jumper's location and picture.

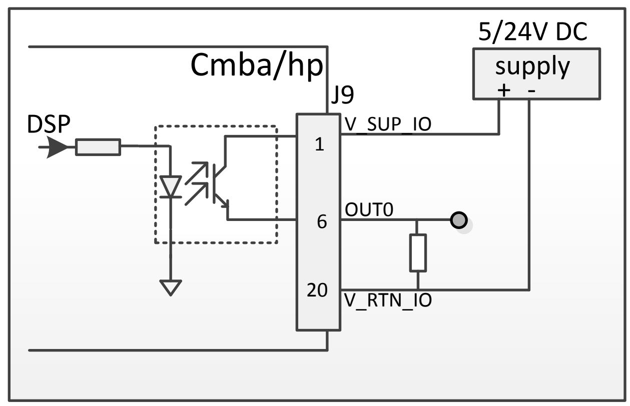


Figure 10: Digital Output Connection (source)

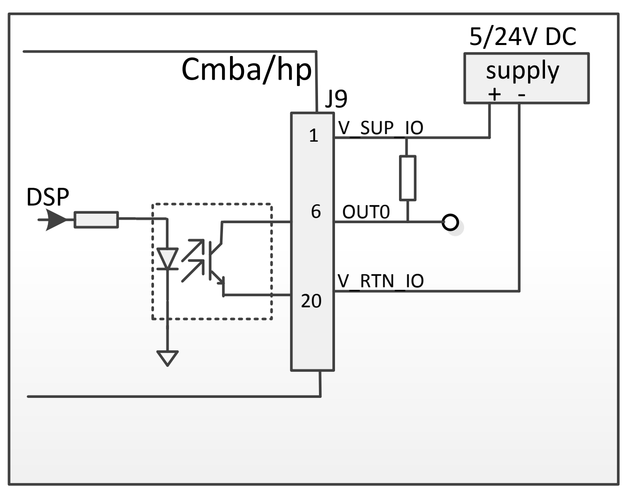


Figure 11: Digital Output Connection (sink)

Over current protection (per pin) is activated above 120mA, causing the output to enter a protected mode, without any message given to the user. The output self recovers upon returning to specified performance values.

Digital Inputs

SPiiPlus CMba/hp line provides 8 single ended, opto-isolated, 5Vdc (±10%) or 24Vdc (±20%), sink or source current driving inputs are available, as function of a side-panel user-accessible jumper J7. Refer to Table 4: SPiiPlus CM Jumpers for location and picture. The digital input connection is shown in Figure 12,Figure 13.

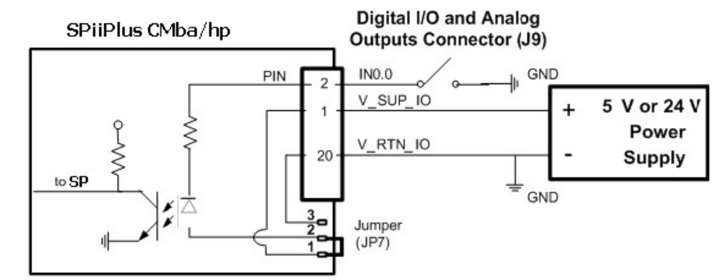


Figure 12: Sink Digital Inputs

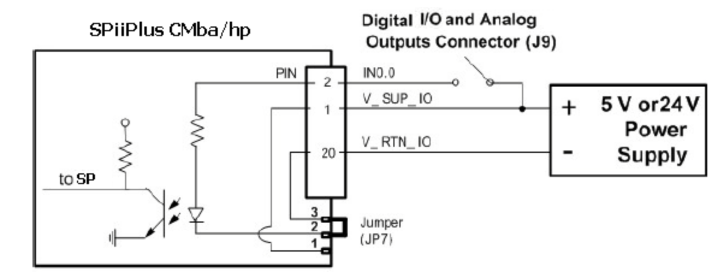


Figure 13: Source Digital Inputs

IN4-IN6 are shared with limits for PD axes 6 and 7.

Hall Sensors

One Hall sensor per drive (set of 3 single-ended, current driving lines) is available. The lines are opto-isolated with current sensitivity of 7mA. The connection for a HALL sensor is shown in Figure 7.

Registration MARK Inputs

There are four inputs that can be configured as MARK. If these inputs are not used for MARK, they can be used as General Purpose inputs.

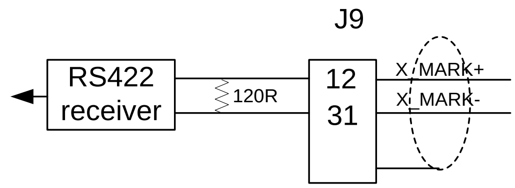


Figure 14: Differential Connection for MARK1 Input

The MARK input voltage is 5Vdc ±10% and its signal propagation rate is < 0.1µsec. The MARK signals are designed with ESD protection.

Analog Inputs and Outputs

General Purpose Analog Inputs

SPiiPlus CMba/hp line provides six differentials, ±10V ±5%, inputs with 12-bit for SPiiPlus CMba or 16-bit for SPiiPlus CMhp accuracy, with hardware low-pass filter set to 250 kHz and maximal sampling rate of 20kHz. The General Purpose Analog Input connections are shown in Figure 15.

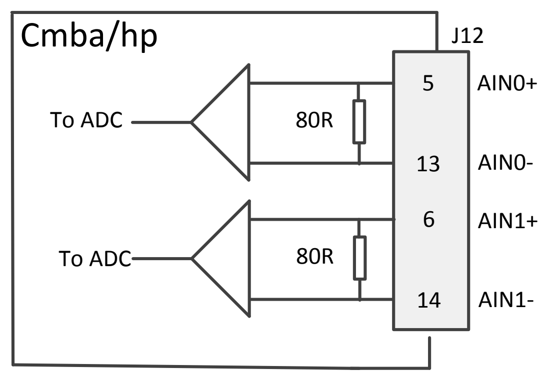
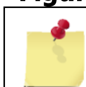


Figure 15: General Purpose Analog Inputs

	The user should ensure that the analog input's signal range does not exceed the specified range of ±10 V. Higher signals may cause abnormal behavior of the drive and affect its performance.

Joystick (Analog) Inputs

AIN6 and AIN7 single-end analog ±10V±5% 12 bit resolution 1.8KHz@3db bandwidth.

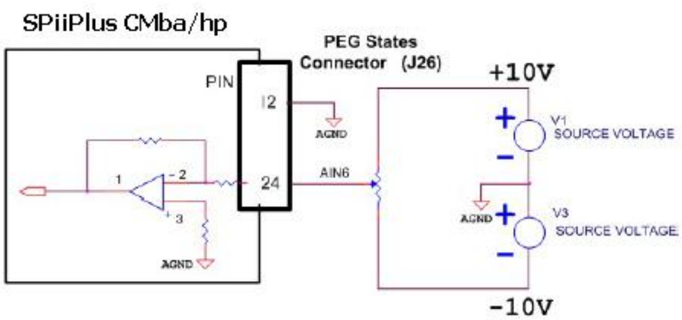


Figure 16: Single-axis Joystick Through AIN6

General Purpose Analog Outputs

SPiiPlus CMba/hp line provides two General Purpose Analog Outputs. The outputs are characterized by 10-bit resolution, differential ±10V ±5%, 50mV maximal offset, with 50mVp_p maximal ripple, and linearity better than 1%. Minimal 10KΩ load required.

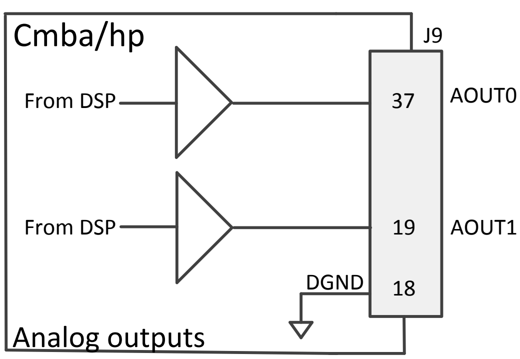


Figure 17: Analog output schematic diagram

Safety

Right and Left Limit inputs

Right Limit and Left Limit inputs per axis are available. The limit connections are shown in Figure 18.

An external user-accessible side-panel jumper (J8) enables configuration for sink or source for right limit and left limit inputs and for the emergency stop. For location of J8, see Figure 24.

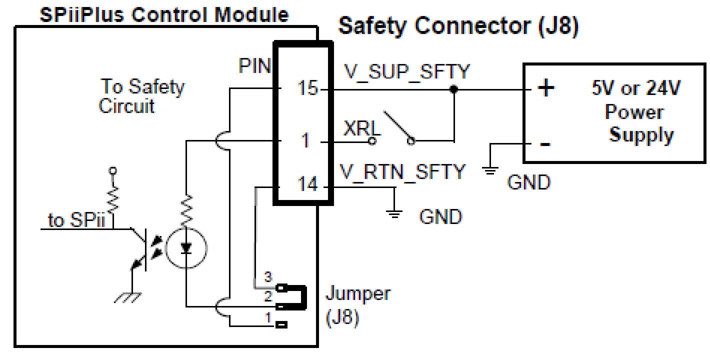


Figure 18: Right Limit (Source) schematic diagram

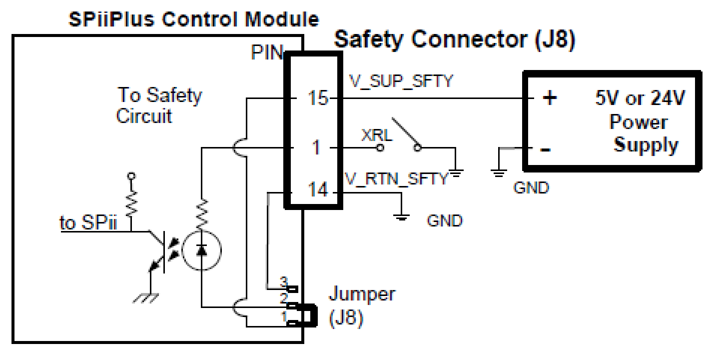


Figure 19: Right Limit (Sink) schematic diagram

Emergency Stop

The Emergency Stop input is a single, opto-isolated signal, fed from a 5V or 24V supply and activated at above 14mA.

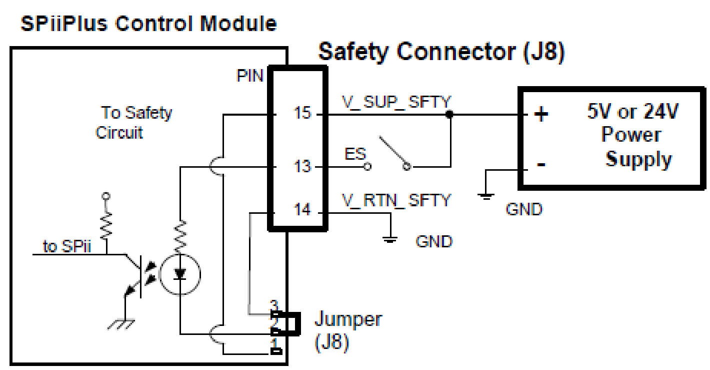


Figure 20: Emergency Stop Source Input

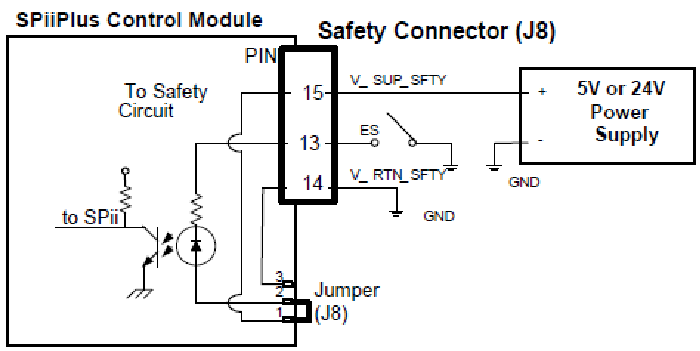


Figure 21: Emergency Stop (Sink) schematic diagram

Motor Over Temperature Fault

The SPiiPlus CMba/hp line provides one input signal per axis for connecting Motor Over Temperature fault sensors. The signal is single-ended, opto-isolated and referenced to a common ground for all faults as shown in Figure 22.

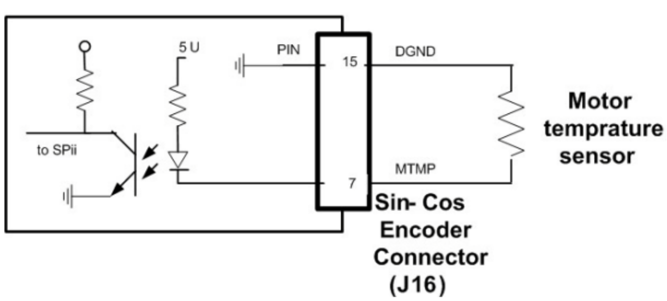


Figure 22: Motor Over Temperature Connection

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

LED Indicators

The SPiiPlus CMba/hp line has three sets of LED indicators as shown in Figure 23.

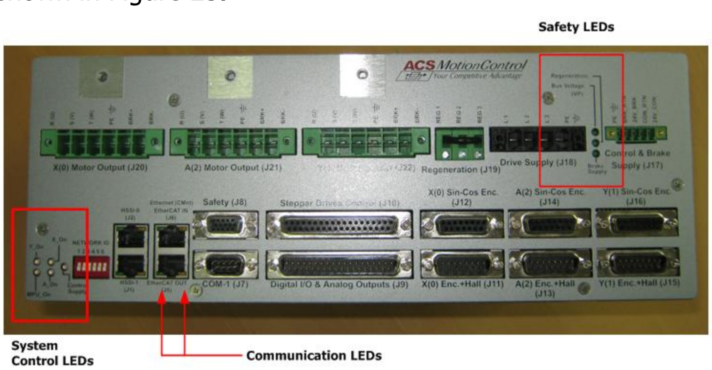


Figure 23: SPiiPlus CMba/hp LED Indicators

The LED indicators are as follows:

- ❑ System Control LEDs

Table 1 summarizes the meaning of the SPiiPlus CMba/hp line System Control LED indicators.

Table 1: SPiiPlus CMba/hp System Control LEDs

Indication	Description
Control Supply	Green, when on – power is applied
MPU_On	Bicolor. ❑ Red – Communication Fault ❑ Green – Communication ok ❑ Blinking – SW command
$_On	Bicolor, one per axis (X, Y and A), indicates axis' status. ❑ Off – Disabled ❑ Green – Enabled ❑ Red – Fault

- ❑ Communication LEDs

The Communication LEDs are located on the RJ45 connectors, Table 2 summarizes the meaning of the SPiiPlus CMba/hp line Communication LED indicators.

Table 2: SPiiPlus CMba/hp Communication LEDs

Indication	Description
Link/Activity	Green ❑ Off – No link ❑ On – Link exists, no data transferred ❑ Blinking – Data being transferred
Run	Yellow. ❑ Off – The unit is in the INIT state ❑ Blinking (slow) – The unit is in the PRE-OPERATIONAL state ❑ Single Flash – The unit is in the SAFE-OPERATIONAL state ❑ On – The unit is in the OPERATIONAL state ❑ Flickering (fast) – The unit is in the BOOTSTRAP state

- ❑ Safety LEDs

Table 3 summarizes the meaning of the SPiiPlus CMba/hp line Safety LED indicators.

Table 3: SPiiPlus CMba/hp Safety LEDs

Indication	Description
Bus Voltage	Green ❑ On – bus voltage exist ❑ Off – no bus voltage exist

Indication	Description
Regeneration	Green ❑ On – Regeneration circuit is ok ❑ Off – Regeneration circuit is failed ❑ Blinking – regeneration is active
Brake Supply	Green ❑ On – brake supply exist ❑ Off – no brake supply is exist.

SPiiPlus CMba/hp Jumpers

The SPiiPlus CM has three jumpers: JP5, JP7 and JP8, the locations of which are shown in Figure 24.

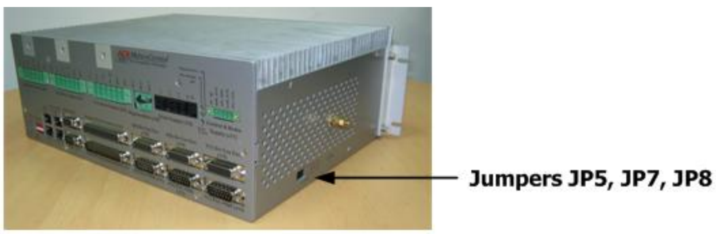


Figure 24: Jumper Locations

The function of each jumper is given in Table 4.

Table 4: SPiiPlus CM Jumpers

	Function	Default	Optional setting
JP5	Digital outputs SINK/SOURCE	SINK, 1-2	Source, 2-3
JP7	Digital inputs SINK/SOURCE	Source, 1-2	Sink, 2-3
JP8	Safety inputs SINK/SOURCE	Source, 1-2	Sink, 2-3

Jumper Configuration for Sink and Source

The factory default configuration of jumpers JP5, JP7, and JP8 is Sink (pins 1 and 2 are connected). The UDMba/hp provides configuration of digital inputs, digital outputs, and safety inputs.

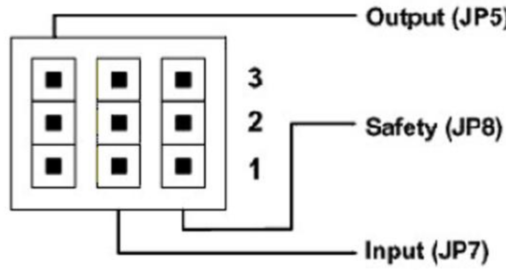


Figure 25: Sink or Source Jumper Configuration

- ❑ To set Sink configuration, install a jumper between pins 1 and 2.
- ❑ To set Source configuration, install a jumper between pins 2 and 3.

SPiiPlus CMba/hp DIP Switches

The SPiiPlus CMba/hp has 6 DIP switches, shown in Figure 26, that are used for setting the EtherCAT ID of the unit.

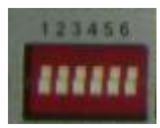


Figure 26: SPiiPlus CMba/hp line DIP Switches

The number is set by positioning the switches in either the OFF or ON position, where:

OFF - “0”

ON - “1”

DIP switch 1 is the least significant digit.

For example, if the switches are set as follows:

Switch 1 – OFF
Switch 2 – ON
Switch 3 – OFF
Switch 4 – ON
Switch 5 – OFF
Switch 6 - ON

The node number is: 101010 (or 42 in decimal).

Communication

Host Communication

Host communication with the SPiiPlus CMba/hp can be via COM1, COM2 or by Ethernet. The Ethernet connection may be either a direct connection (host to controller using a cross cable) or over a network. Selection of the communication channel and its parameters is done using the SPiiPlus MMI Application Studio (refer to the *SPiiPlus Setup Guide* for details). Whenever possible, an Ethernet connection is preferred over RS232 because of the communication rate.

EtherCAT Network Communication

Being an EtherCAT network element ("slave"), the UDMba/hp has EtherCAT IN and EtherCAT OUT ports, for connection with the product's neighboring network devices. UDMba/hp can be position anywhere in the network, including being the first device connected to the master. See Figure 27 for a schematic connectivity diagram. The UDMba/hp connected to an ACS master (in this case a CMba/hp, which in turn is connected to a host computer).

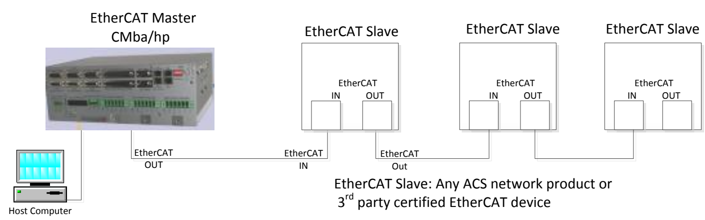


Figure 27: CMba/hp as master, with UDMba/hp and 3rd party drives as slaves in an EtherCAT network

Cable type – use CAT5e or higher high quality cables. ACS provides such cables at varying lengths of 30 cm to 50 m.

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

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

HSSI – Serial Interface to ACS Peripherals

One port is provided for communication with ACS peripherals: HSSI-IO-16.

Fault indicators

The table below summarizes all faults detected by the product and the resulting indications to the user.
All faults can be read as ACSPL+ variables within a user's application code.

The table lists warning messages displayed at the MMI for some of the messages, as well as the action taken by the controller upon critical fault detection.

Table 5: Faults and Warning Messages

Fault	**Fault conditions**	**Panel Indications (LED)**	**MMI warning message and action taken**
Bus overvoltage	DC bus voltage > 420Vdc	None	Warning message: Power supply too high. All internal drives are disabled.
Bus under voltage	DC bus voltage < 70Vdc	None	Warning message: Power supply too low. All internal drives are disabled.
Phase-Loss (for Three-Phase AC Input Supply Only)	One AC phase missing	None	Warning message: Power Down. All internal drives are disabled.
Power loss (1 phase)	AC power is missing	Bus Voltage(VP) OFF when AC power is lost	Warning message: Phase-Loss All internal drives are disabled.
Drive over-temp	Temperature on drive's power bridge >100±5ºC	None	Warning message: Temperature too high. All internal drives are disabled.
Short circuit Between Phases or Phase to Ground	Current in one of the integrated digital drive output phases exceed the maximum value	None	
Drive Over current.	Current in one of the integrated digital drive outputs exceeds the over current protection level	None	
Motor over-temp	Over temperature protection is On: Impedance between pin to ground is above 10KΩ. Over temperature protection is Off: Impedance between pin to ground is below 1KΩ	None	All internal drives are disabled.
Encoder faults	Disconnections or incorrect order in one or more encoder channels.	None	
Drive not Ready	Triggered when drive enable command is sent within five seconds of drive power on	None	
Power Supply Not Ready		None	User is notified by MMI if attempting to operate drive enable during first 4.5 - 5.5 sec ('soft start')
Communication lost		Red LED: Lost communication.	

Grounding and Shielding

Figure 28depicts the recommended scheme for shielding, cable connections and type of grounding.

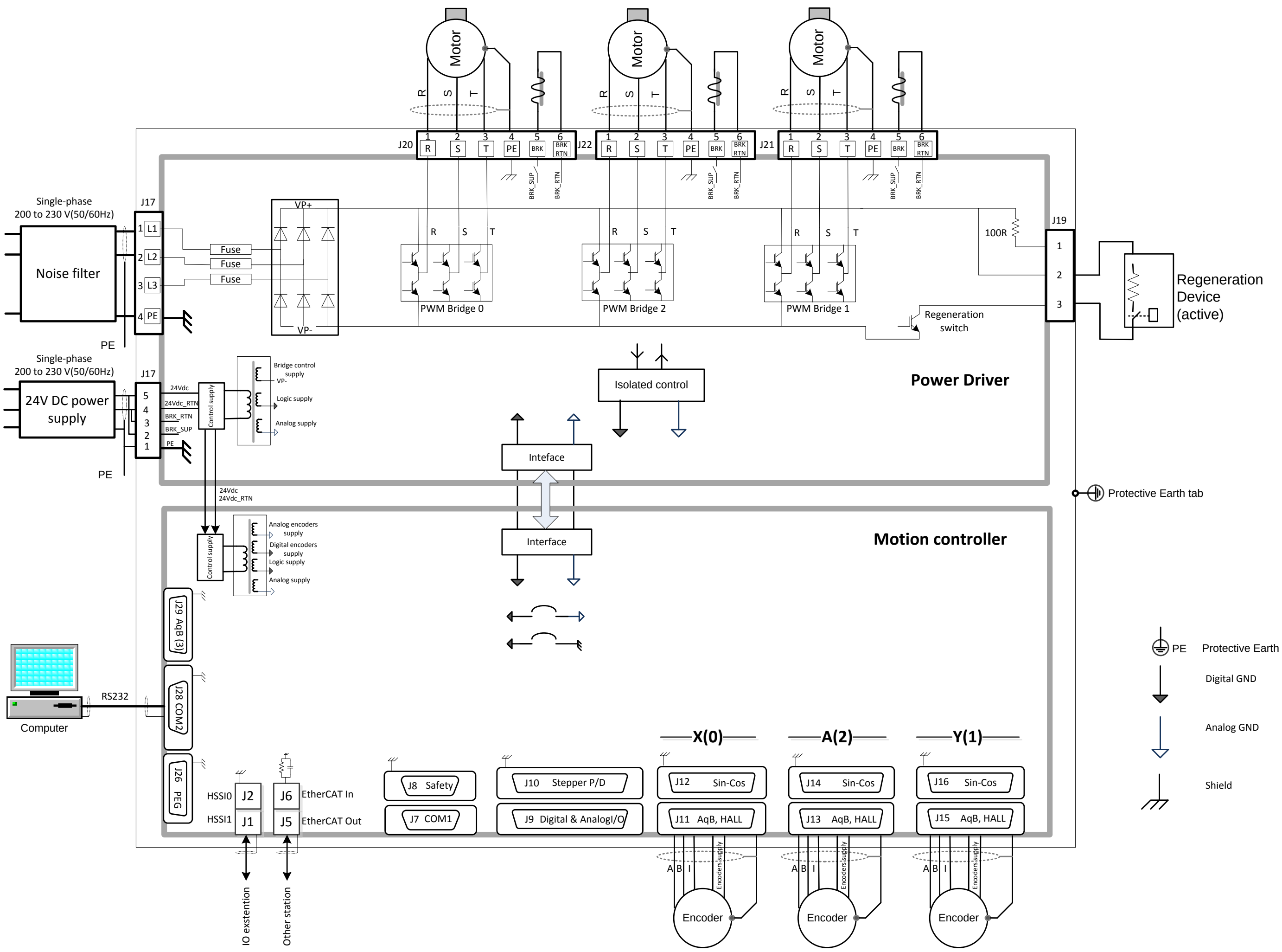


Figure 28: Grounding and Shielding

Personnel Safety Guidelines

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

Installation and maintenance must be performed by qualified personnel only. Such a person must be trained and certified to install and maintain high power electrical and electro-mechanical equipment, servo systems, power conversion equipment and distributed networks. Prior to powering up the system, ensure that all network components are properly installed mechanically, properly grounded and that all attached power and signal cables are in good operating conditions. Maintenance should be performed only after the relevant network element has been powered down, and all associated and surrounding moving parts have settled in their safe mode of operation. Certain drives require longer times in order to fully discharge.

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

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

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

The SPiiPlus CMba/hp is powered up as long as an ACS inlet is connected to it. Therefore it is the responsibility of the user to provide an in-series switch or circuit breaker that disconnects all power-carrying signals which is readily and rapidly accessible to the operator. The disconnecting device must meet the requirements of IEC60947-1 or IEC60947-3 and the current rating must be not more than 20A. The disconnecting device must be in close proximity to the equipment and within easy reach of the operator and be clearly marked as the disconnecting device for the SPiiPlusCMnt-2-320. A power cord with conductor area of not less than 0.75mm², with a voltage rating of not less than 300V, rated to 105ºC or more, and complying with IEC60227 or IEC60245 must be used for the AC drive supply input. Only the Green –Yellow wire of the cable is to be used for connection to the protective conductor terminal.

Dimensions and Installation

Unit Dimensions

The dimensions of the SPiiPlus CMba/hp are shown in the following figures.

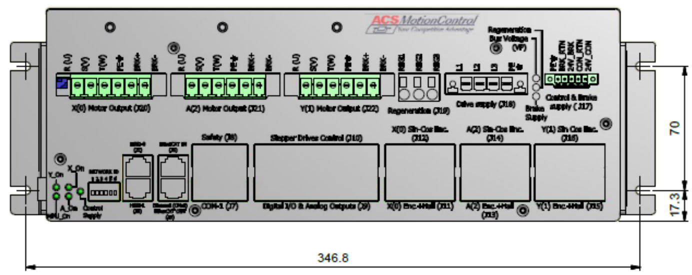


Figure 29: SPiiPlus CMba/hp Front

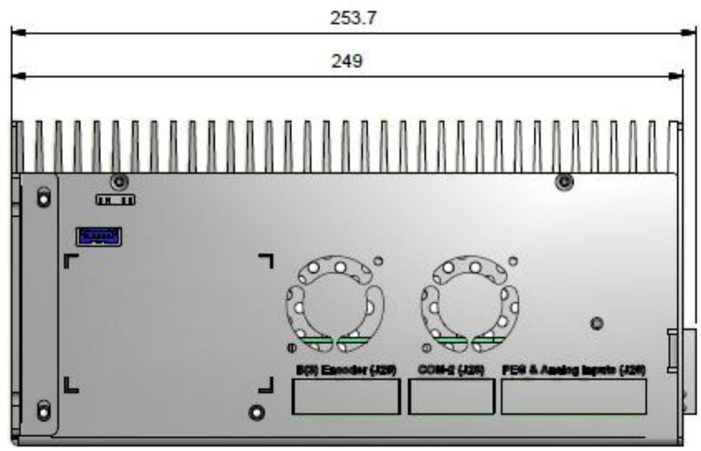


Figure 30: SPiiPlus CMba/hp Side

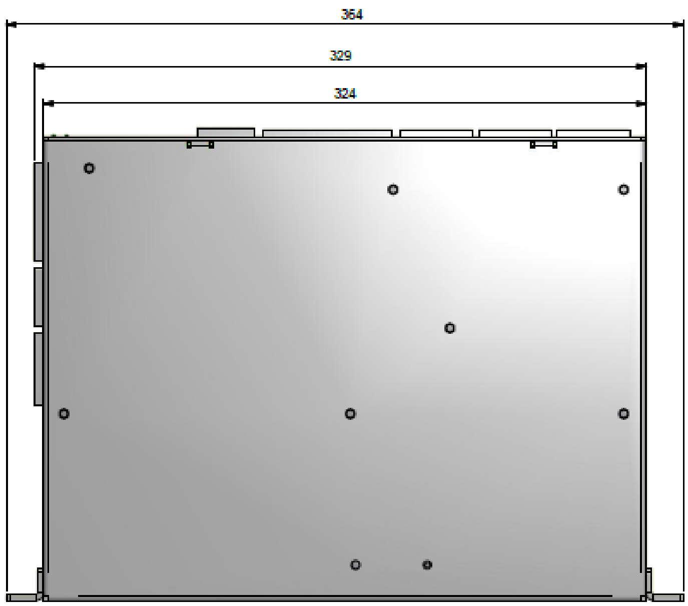


Figure 31: SPiiPlus CMba/hp Bottom

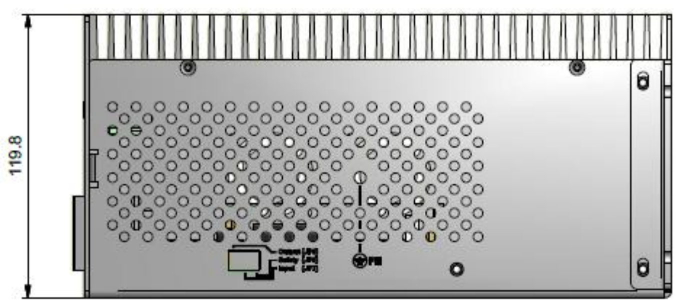


Figure 32: SPiiPlus CMba/hp Rear

SPiiPlus CMba/hp Specifications

This section presents the specifications for the SPiiPlus CMba/hp product line.

Control Supply Input Power

	Description	Remarks
Signal Designation	24V 24V_RTN	When it is needed to ensure that the motors are not powered, the Drive power supply should be removed. The Control supply, however, should stay connected.
Quantity	1	
Type	DC power supply for all internal circuits	
Input Voltage	Nominal voltage: 24Vdc ❑ Minimum voltage: 21.6Vdc ❑ Maximum voltage: 26.4Vdc	
Input Current	2A @ 21.6V	
Protection	❑ Input Reverse polarity ❑ Output Short current	

Brake Supply Input

	Description	Remarks
Signal Designation	24V_BRK BRK_RTN	
Quantity	1	
Type	DC power supply for mechanical brake	
Input Voltage	5-30Vdc	
Input Current	3A	
Protection	Short and over current.	

Drive Power Supply

	Description	Remarks
Signal Designation	L1, L2(N), L3 PE	
Quantity	1	
Type	Single or three phases, rectifier, motor drive supply with regeneration circuit.	
Input Voltage Range, [Vrms]	85-265Vac, single or three phase	
Frequency	Nominal frequency: 50-60Hz	
Input Current (Continuous/Peak), [Arms]	For single-phase input $18A_{RMS}$ For three phase $18A_{RMS}$	

	Description	Remarks
Input Power (Continuous/Peak), [W]	4200/7200W (single phase input) 7300/14600W (three phase input)	
Phase in series fuse	20A	
Output Voltage [V]	DC bus voltage (power supply output), maximum 375V	
Inrush Current	Maximum inrush current value is 3.75A rms measured for the first 20ms after power supply input voltage is applied.	
Protection	❑ Power down: AC input supply is disconnected or one AC input fuse is blown ❑ Under voltage: 80V±5% (76 – 84V) ❑ Power Supply Not Ready (Soft Start resistor protection): generates fault during the Soft Start period 4.5 – 5.5 Sec ❑ Over voltage: 440±5% (422 – 467V) ❑ Phase lost: one of the AC input supply phases is disconnected or fuse is blown.	

Power Bridge (Per Axis)

	Description	Remarks
Signal Designation	$_R $_S $_T	One set per axis
Quantity	3	
Type	PWM three phase power bridge	
Motor configuration	DC motor 2- or 3-phase motor 2-phase step motor	
Output Current [A]	5/10A Continuous/Peak sine amplitude (ver A) 10/20A Continuous /Peak sine amplitude (ver B) 15/30A Continuous /Peak sine amplitude (ver C)	The peak current is for 1 second
Output Voltage [V]	Axis maximum output voltage 320V phase-to-phase sine peak, or 226V RMS	
Output Power [W]	**Per axis power, for version A/B/C**: 1370/2740/4110W continuous. 2740/5480/8220W peak, for 1 second. **Total available power:** Single phase: 2800/5200W cont./Peak Three phase: 5000/10500W cont./Peak	The peak current is for 1 second

	Description	Remarks
Protection	Short current (phase-to-phase or phase to ground): ❑ For 5/10A axis: 25A ±5% ❑ For 10/20A axis: 50A ±5% ❑ For 15/30A axis: 60A ±5% Over current: ❑ For 5/10A axis: 15A ±5% ❑ For 10/20A axis: 30A ±5% ❑ For 15/30A axis: 45A ±5% Over temperature: 100ºc ±5%	

AqB Digital Encoder

	Description	Remarks
Signal Designation	A: #_CHA± B: #_CHB± I: #_CHI±	
Quantity	4	One set for axes 0(X), 1(Y), 2(A) and 3(B)
Type	Differential, RS422 compatible	
Maximum Input Frequency	10 MHz	10MHz A & B input frequency appropriate to 40 million quadrature counts per second.
Input Termination	120 Ω	
Encoder Supply	5.1V-5.35V 1A	
Protection	Encoder not connected, encoder error	Phase A detection only

SIN-COS Analog Encoder (Optional)

	Description	Remarks
Signal Designation	#_SIN± #_COS± #_SC_I±	
Quantity	3	For axes: 0(X), 1(Y) and 2(A)
Type	Analog Differential input, Encoder voltage range 1 Vptp ±10% Input Voltage range: 1.25 Vptp	
Maximum Input Frequency	< 250 KHz	
Input Termination	120 Ω	

	Description	Remarks
Resolution	❑ 12 bit SPiiPlus CMba-3 ❑ 16 bit SPiiPlus CMhp-3	
Multiplication	SPiiPlus CMba-3: Maximum useable multiplication factor – 4,096. Multiplication factor programmable range – 4 to 16,384 SPiiPlus CMhp-3 Maximum useable multiplication factor: 16,384. Multiplication factor programmable range: 4 to 65,536	
Compensations	Offset(HW for SPiiPlus CMhp only): Gain(SW) Phase(SW) Range: ±0.320V for HP Resolution 8-bit	Gain and phase: SW implementation
Encoder Supply Range	5.1 V - 5.35 V 1 A	
Protection	Encoder error and not connected	SW implementation

Absolute Encoder (Optional)

	Description	Remarks
Signal Designation	#_CHA #_CHB	
Quantity	3	For axes: 0(X), 1(Y) and 2(A)
Type	EnDat2.2, Smart-Abs, Panasonic, BiSS-C (from V2.30)	
Interface	RS485/RS422	
Input Termination	120 Ω	
Encoder Supply Range	5.1 V - 5.35 V 1 A	

HALL Inputs

	Description	Remarks
Signal Designation	$_HA $_HB $_HC	
Quantity	3	One set for each axis.
Type	Opto-isolated, Source input type, (open cathode)	DGND referenced.
Input Current	< 7 mA current	

Mechanical Brake High Power

	Description	Remarks
Signal Designation	#_BRK±	
Quantity	3	One per axis, on driver board connectors
Type	5-30 V, opto-isolated, source	
Output Current	1 A per output	
Reference Supply	Brake supply	
Protection	Short circuit	

Mechanical Brake Logic Signal

	Description	Remarks
Signal Designation	#_MBRK±	
Quantity	3	One per axis
Type	opto-isolated, sink	Operates from V_SUP_IO and V_RET_IO (5 V ±10% or 24 V ±20%,)
Output Current	50 mA per output	
Protection	Short circuit	

Safety Inputs

	Description	Remarks
Signal Designation	#_RL #_LL	
Quantity	2 per axis	P/D axes 6 and 7 without dedicated limits inputs. GP IO 4-7 can be used if needed
Type	Single-ended, opto-isolated, sink/source	Operates from V_SUP_SFTY and V_RET_SFTY (5 Vdc ±10% or 24 Vdc ±20%,)
Input Current	< 14 mA	

E-Stop Inputs

	Description	Remarks
Signal Designation	ES	
Quantity	1	
Type	Single-end, opto-isolated	Operates from V_SUP_SFTY and V_RET_SFTY (5 Vdc ±10% or 24 Vdc ±20%,)
Input Current	< 14 mA	

Digital Inputs

	Description	Remarks
Signal Designation	IN0…IN7	IN4-IN6 shared with limits for PD axes 6 and 7
Quantity	8	
Type	Single-ended, opto-isolated, sink/source	Operates from V_SUP_IO and V_RET_IO (5 V ±10% or 24 V ±20%,)
Input Current	< 14 mA	

Digital Outputs

	Description	Remarks
Signal Designation	OUT0…OUT7	
Quantity	8	
Type	Single-ended, opto-isolated, sink/source	Operates from V_SUP_IO and V_RET_IO (5 V ±10% or 24 V ±20%,)
Output Current	100 mA per output for total of 800 mA for all outputs	
Protection	Short circuit	

MARK Inputs

	Description	Remarks
Signal Designation	#_MARK1± #_MARK2±	Flexible allocation, see *SPiiPlusNT PEG and MARK Operations Application Notes*
Quantity	4	Two physical inputs per axis X and Y

	Description	Remarks
Type	Differential, RS422	
Input Impedance	120 Ω	

PEG Pulse

	Description	Remarks
Signal Designation	#_PEG±	Incremental and Random , see *SPiiPlusNT PEG and MARK Operations Application Notes*
Quantity	2 dedicated outputs available, with flexible assignment of signals.	
Type	Differential, RS422 compatible	

PEG STATE Pulse

	Description	Remarks
Signal Designation	#_STATE0± #_STATE1± #_STATE2± #_STATE3±	
Quantity	8 dedicated outputs available, with flexible assignment of signals.	
Type	Differential, RS422 compatible	

General Purpose Analog Inputs

	Description	Remarks
Signal Designation	AIN_#±	Where # is 0 through 5
Quantity	6	
Type	Differential input, ±10V±5%	Shares the same input with SIN-COS encoders, each SIN-COS uses two inputs.
Maximum Input Frequency	Low-pass filtered to 250kHz. Maximal sampling rate of 20kHz	
Resolution	SPiiPlus CMba: 12-bit ±10 V SPiiPlus CMhp: 16-bit ±10 V	
Offset	< 100 mV (measured with 0 V input)	

Joystick (Analog) Inputs

	Description	Remarks
Signal Designation	AIN_6 and AIN7	
Quantity	2	
Type	Single-end analog ±10 V ±5%	
Maximum Input Frequency Band Pass	< 2 KHz @3db	
Resolution	12-bit	
Offset	< 100 mV (measured with 0 V input)	

General Purpose Analog Outputs

	Description	Remarks
Signal Designation	AOUT_#±	
Quantity	2	
Type	Single-end, ±10 V ±5%	
Resolution	10 bit	
Offset	±50 mV	SW compensated
Minimum Output Load	10 KΩ	

Motor Over Temperature

	Description	Remarks
Signal Designation	#_OVER_T	
Quantity	3	
Type	Single-ended, opto-isolated Reference: $_MTMP_RTN	
Threshold	Over temperature protection is on, when the impedance between $_Motor_OVER pin to ground is above 10 KΩ Over temperature protection is off, when the impedance between $_Motor_OVER pin to ground is below 1 KΩ	

External P/D Drive Support (Option)

	Description	Remarks
Signal Designation	$_Pulse $_Dir $_ENA $_FLT	
Quantity	4	
Type	❑ P/D signals: Differential, RS422 ❑ Enable signals: Opto-isolated, two terminal with Max current and protection ❑ Fault signals: Opto-isolated, two terminal	Operates from external supply 5 Vdc ±10% or 24 Vdc ±20%
Maximum Frequency	5,000,000 pulses/second	
Minimum Pulse Width	80nS	
Maximum Pulse Width	81.88uS	

HSSI

	Description	Remarks
Signal Designation	H_CON ± H_DO_#± H_DI_#±	
Quantity	2	
Type	Differential, RS422	
Input Termination	120 Ω.	
HSSI Cable Length	< 20 m	

Ethernet & EtherCAT Ports

	Description	Remarks
Signal Designation	Transmit: ETH#_TX± Receive: ETH#_RX±	
Quantity	2	EtherCAT output port and host communication port
Type	EtherCAT protocol	
Speed	100 Mbps	

RS232 Serial Communication

	Description	Remarks
Signal Designation	COM$_TX COM$_RX	
Quantity	2	
Type	2 x RS232 or 1 x RS232 and 1x RS422	
Baud Rate	Up to 115,200	

Environment

Operating	0 to +40°C. Refer to operating condition section.
Storage	-25 to +60°C
Humidity	5% to 90% non-condensing

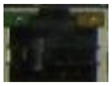
Applicable Standards

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

EMC	❑ EN 61326:2002 ❑ SEMI F47-0200
Safety	❑ IEC 61010-1:01 ❑ UL-508C

SPiiPlus CMba/hp Connectors

J1 & J2 – HSSI Connectors



Label: HSSI-0 (J2), HSSI-1 (J1)

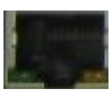
Connector Type: RJ45

Mating Type: Ethernet plug

Table 6: J1 & J2 Connector Pinout

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

J5 – EtherCAT Output Connector



Label: EtherCAT OUT (J5)

Connector Type: RJ45

Mating Type: Ethernet plug

Table 7: J1 Connector Pinout

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

J6 – Ethernet Input Connector

Label: Ethernet (J6)

Connector Type: RJ45

Mating Type: Ethernet plug

Table 8: J2 Connector Pinout

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

J7 - COM1 Connector

Label: COM-1 (J7)

Connector Type: DB9 male

Mating Type: DB9 female

Table 9: J7 Connector Pinout

Pin	Name	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal for communication port 1 (COM1)
3	TX232	RS-232 transmit signal for communication port 1 (COM1)
4	NC	Not Connected
5	DGND	Digital Ground
6	TX+	RS-422 positive transmit signal
7	TX-	RS-422 negative transmit signal

Pin	Name	Description
8	RX+	RS-422 positive receive signal
9	RX-	RS-422 negative receive signal

J8 – Safety Connector

Label: Safety (J8)

Connector Type: DB15 high density female

Mating Type: DB15 high density male

Table 10: J8 Connector Pinout

Pin	Name	Description
1	X(0)RL	X(0) axis right limit
2	X(0)LL	X(0) axis left limit
3	Y(1)RL	Y(1) axis right limit
4	Y(1)LL	Y(1) axis left limit
5	A(2)RL	A(2) axis right limit
6	A(2)LL	A(2) axis left limit
7	Not used	B(3) axis right limit
8	Not used	B(3) axis left limit
9	Z(4) PD0_RL	Pulse/Dir axis 4 right limit
10	Z(4) PD0_LL	Pulse/Dir axis 4 left limit
11	T(5) PD1_RL	Pulse/Dir axis 5 right limit
12	T(5) PD1_LL	Pulse/Dir axis 5 left limit
13	ES	Emergency stop
14	V_RTN_SFTY	Safety supply return
15	V_SUP_SFTY	Safety supply 5/24Vdc

J9 – Digital & Analog I/O Connector

Label: J9 I/O

Connector Type: DB37 male

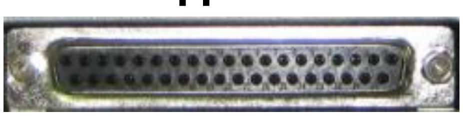
Mating Type: DB37 female

Table 11: J9 Connector Pinout

Pin	Name	Description
1	V_SUP_IO	Digital I/O supply 5/24Vdc
2	IN0	Digital input 0
3	IN2	Digital input 2
4	IN4	Digital input 4
5	IN6	Digital input 6
6	OUT0	Digital output 0
7	OUT2	Digital output 2
8	OUT4	Digital output 4
9	OUT6	Digital output 6
10	BRAKE_X(0)	Digital motor brake output for X(0) axis
11	BRAKE_A(2)	Digital motor brake output for A(2) axis
12	X(0)_MARK1+	Fast non-inverted MARK1 input for axis 0.
13	X(0)_MARK2+	Fast non-inverted MARK2 input for axis 0.
14	Y(1)_MARK1+	Fast non-inverted MARK1 input for axis 1.
15	Y(1)_MARK2+	Fast non-inverted MARK2 input for axis 1.
16	(0)_PEG_PULSE+	Fast non-inverted PEG PULSE output.
17	(1)_PEG_PULSE+	Fast non-inverted PEG PULSE output.
18	DGND	Digital Ground
19	AOUT1	Analog output 1
20	V_RTN_IO	Digital I/O supply return
21	IN1	Digital input 1
22	IN3	Digital input 3

Pin	Name	Description
23	IN5	Digital input 5
24	IN7	Digital input 7
25	OUT1	Digital output 1
26	OUT3	Digital output 3
27	OUT5	Digital output 5
28	OUT7	Digital output 7
29	BRAKE_Y(1)	Digital motor brake output for axis 1
30	BRAKE_B(3)	Digital motor brake output for axis 3
31	X(0)_MARK1-	Fast inverted MARK1 input for axis 0
32	X(0)_MARK2-	Fast inverted MARK2 input for axis 0
33	Y(1)_MARK1-	Fast inverted MARK1 input for axis 1
34	Y(1)_MARK2-	Fast inverted MARK2 input for axis 2
35	(0)_PEG_PULSE-	Fast inverted PEG PULSE output
36	(1)_PEG_PULSE-	Fast inverted PEG PULSE output
37	AOUT0	Analog output 0
	Connector metal case (SHIELD)	Cable shield connection

J10 – Stepper Drive Control Connector



This connector can only be used in conjunction with P/D.

Label: Stepper Drives Control (J10)

Connector Type: DB37 female

Mating Type: DB37 male

Table 12: J10 Connector Pinout

Pin	Name	Description
1	PULSE_4+	Pulse non-inverted command for axis 4 step motor driver
2	PULSE_5+	Pulse non-inverted command for axis 5 step motor driver
3	PULSE_6+	Pulse non-inverted command for axis 6 step motor driver
4	PULSE_7+	Pulse non-inverted command for axis 7 step motor driver
5	DIR_4+	Direction non-inverted command for axis 4 step motor driver
6	DIR_5+	Direction non-inverted command for axis 5 step motor driver
7	DIR_6+	Direction non-inverted command for axis 6 step motor driver
8	DIR_3+	Direction non-inverted command for axis 3 step motor driver
9	DGND	Digital Ground
10	ENA_0+	Drive enable sink output for axis 0 step motor driver
11	ENA_5+	Drive enable sink output for axis 5 step motor driver
12	ENA_6+	Drive enable sink output for axis 6 step motor driver
13	ENA_7+	Drive enable sink output for axis 7 step motor driver
14	FLT_4+	Drive fault source input for axis 4 step motor driver
15	FLT_5+	Drive fault source input for axis 5 step motor driver
16	FLT_6+	Drive fault source input for axis 6 step motor driver
17	FLT_7+	Drive fault source input for axis 7 step motor driver
18	V_SUP_IO	Digital I/O supply 5/24Vdc
19	SHIELD	Cable shield connection
20	PULSE_4-	Pulse inverted command for axis 4 step motor driver
21	PULSE_5-	Pulse inverted command for axis 5 step motor driver
22	PULSE_6-	Pulse inverted command for axis 6 step motor driver
23	PULSE_7-	Pulse inverted command for axis 7 step motor driver
24	DIR_4-	Direction inverted command for axis 4 step motor driver

Pin	Name	Description
25	DIR_5-	Direction inverted command for axis 5 step motor driver
26	DIR_6-	Direction inverted command for axis 6 step motor driver
27	DIR_7-	Direction inverted command for axis 7 step motor driver
28	DGND	Digital Ground
29	ENA_4-	Drive enable source output for axis 4 step motor driver
30	ENA_5-	Drive enable source output for axis 5 step motor driver
31	ENA_6-	Drive enable source output for axis 6 step motor driver
32	ENA_7-	Drive enable source output for axis 7 step motor driver
33	FLT_4-	Drive fault sink input for axis 4 step motor driver
34	FLT_5-	Drive fault sink input for axis 5 step motor driver
35	FLT_6-	Drive fault sink input for axis 6 step motor driver
36	FLT_7-	Drive fault sink input for axis 7 step motor driver
37	V_RTN_IO	Digital I/O supply return
	Connector metal case (SHIELD)	Cable shield connection

J11, J13 & J15 – HALL & Encoder Connectors

Label: X(0) Enc. + Hall (J11)

A(2) Enc. + Hall (J13)

Y(1) Enc. + Hall (J15)

Connector Type: DB15 male

Mating Type: DB15 female

The dollar sign ($) in the table refers to the axis designations which can be 0, 1 or 2 depending on the connector.

Table 13: J11, J13 & J15 Connectors Pinout

Pin	Name	Description
1	5U	5.1 V user supply to the $ Encoder and HALL, 200mA max
2	$_CHA+	$ Encoder A non-inverted input /Abs.encoder Data+
3	$_CHA-	$ Encoder A inverted input /Abs.encoder Data-
4	$_CHB+	$ Encoder B non-inverted input/Abs.encoder Clock+
5	$_CHB-	$ Encoder B inverted input /Abs.encoder Clock-
6	DGND	Digital Ground
7	$_HA	$ Motor HALL A
8	$_HB	$ Motor HALL B
9	$_CHI+	$ Encoder Index non-inverted input
10	$_CHI-	$ Encoder Index inverted input
11	$_MTMP_RTN	A return for $ Motor temperature sensor. (Internally connected to DGND)
12	SHIELD	Cable shield connection
13	5U	5 V user supply to the $ Encoder and HALL, 200mA max
14	$_HC	$ Motor HALL C
15	$_MTMP	$ Motor temperature sensor input. A normally closed sensor contact must be connected between pin 15 and pin 11. If no sensor is used, pin 15 must be shorted to pin 11 for proper operation.
	Connector metal case (SHIELD)	Cable shield connection

J12, J14 & J16 – SIN-COS Encoder Connector

Label: X(0) Sin-Cos Enc. (J12)

A(2) Sin-Cos Enc. (J14)

Y(1) Sin-Cos Enc. (J16)

Connector Type: DB15 female

Mating Type: DB15 male

	The dollar sign ($) in the table refers to the axis designations which can be 0, 1 or 2 depending on the connector.

Table 14: J12, J14 & J16 Pinout

Pin	Name	Description
1	5F	5.1V field supply to the $ SIN-COS Encoder 150mA max
2	$SIN+	$ Encoder SIN non-inverted input
3	$COS+	$ Encoder COS non-inverted input
4	$INDEX+	$ SIN-COS Encoder Index non-inverted input
5	AIN#+	Analog non-inverted input # (0 in J12, 2 in J14, 4 in J16)
6	AIN@+	Analog non-inverted input @ (1 in J12, 3 in J14, 5 in J16)
7	X_MTMP	X Motor temperature sensor input. A normally closed sensor contact must be connected between pin 15 and pin 7. If no sensor is used, pin 15 must be shorted to pin 7 for proper operation.
8	SHIELD	Cable shield connection
9	AGND	Analog Ground for 5F field supply
10	$SIN-	$ Encoder SIN inverted input
11	$COS-	$ Encoder COSinverted input
12	$INDEX-	$ SIN-COS Encoder Index inverted input
13	AIN#-	Analog non-inverted input # (0 in J12, 2 in J14, 4 in J16)
14	AIN@-	Analog non-inverted input @ (1 in J12, 3 in J14, 5 in J16)
15	DGND	Digital Ground (return for X Motor temperature sensor)
	Connector metal case (SHIELD)	Cable shield connection

J17 – Control & Brake Supply Connector

Label: Control & Brake Supply (J17)

Connector Type: PHOENIX 5 pin, MC-1.5/5 GF 3.81

Mating Type: PHOENIX 5 pin, MC-1.5/5 STF 3.81

Table 15: J17 Connectors Pinout

Pin	Name	Description
1	PE	Electrical Ground
2	BRK_RTN	Brake supply return
3	BRK_SUP	5/24Vdc brake supply
4	24V_RTN	24Vdc control supply return
5	24Vdc	24Vdc control supply

J18 – Drive Supply Connector

Label: Drive Supply (J18)

Connector Type: Weidmuller SV 7.62/4/90F

Mating Type: Weidmuller BVZB 7.62/4F

Table 16: J18 Connector Pinout

Pin	Name	Description
1	L1	Phase "L1" for 115/230Vac input (phase input for single phase supply)
2	L2	Phase "L2" for 115/230Vac

		input (neutral input for single phase supply)
3	L3	Phase “L3” for 230Vac input
4	PE	Electrical Ground

J19 – Regeneration Connector

Label: Regeneration (J19)

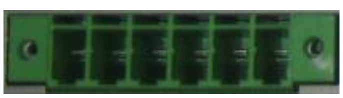
Connector Type: PHOENIX FRONT 2.5-H/SA5 3-pin terminal block

Mating Type: Direct wire

Table 17: J19 Connector Pinout

Pin	Name	Description
1	REG1	Internal regeneration Resistor
2	REG2	Vbus+ for external shunt application
3	REG3	Common regeneration pin

J20, J21 & J22 Motor Outputs Connector



Label: X(0) Motor Output (J20)

A(2) Motor Output (J21)

Y(1) Motor Output (J22)

Connector Type: PHOENIX 6-pin, PC 4/6-G-7.62

Mating Type: PHOENIX PC 4/6-STF-7,62

The dollar sign ($) in the table refers to the axis designations which can be 0, 1 or 2 depending on the connector.

Table 18: J20, J21 & J22 Connector Pinout

Pin	Name	Description
1	$R	$ Motor phase “R”
2	$S	$ Motor phase “S”
3	$T	$ Motor phase “T”
4	PE	Electrical Ground
5	$BRK+	5/24 Vdc 1 A brake output
6	$BRK-	Brake output return

J26 – PEG Connector

Label: PEG & Analog Inputs (J26)

Connector Type: DB25 female

Mating Type: DB25 male

Table 19: J26 Connector Pinout

Pin	Name	Description
1	(0)_PEG_PULSE+	Fast non-inverted PEG PULSE.
2	(0)_STATE0+	Fast non-inverted PEG STATE
3	(0)_STATE1+	Fast non-inverted PEG STATE
4	(0)_STATE2+	Fast non-inverted PEG STATE
5	(0)_STATE3+	Fast non-inverted PEG STATE
6	(1)_PEG_PULSE+	Fast non-inverted PEG PULSE output
7	(1)_STATE0+	Fast non-inverted PEG STATE
8	(1)_STATE1+	Fast non-inverted PEG STATE
9	(1)_STATE2+	Fast non-inverted PEG STATE
10	(1)_STATE3+	Fast non-inverted PEG STATE
11	GND	Digital Ground.
12	AGND	Analog Ground
13	AGND	Analog Ground
14	(0)_PEG_PULSE-	Fast inverted PEG PULSE output.
15	(0)_STATE0-	Fast inverted PEG STATE
16	(0)_STATE1-	Fast inverted PEG STATE
17	(0)_STATE2-	Fast inverted PEG STATE
18	(0)_STATE3-	Fast inverted PEG STATE
19	(1)_PEG_PULSE-	Fast inverted PEG PULSE output
20	(1)_STATE0-	Fast inverted PEG STATE
21	(1)_STATE1-	Fast inverted PEG STATE
22	(1)_STATE2-	Fast inverted PEG STATE
23	(1)_STATE3-	Fast inverted PEG STATE

Pin	Name	Description
24	AIN6	Analog input 6 (single-ended)
25	AIN7	Analog input 7 (single-ended)

J28 – COM2 Connector

Label: COM-2 (J28)

Connector Type: DB9 male

Mating Type: DB9 female

Table 20: J7 Connector Pinout

Pin	Name	Description
1	SHIELD	Cable shield connection
2	RX232	RS-232 receive signal
3	TX232	RS-232 transmit signal
4	NC	Not Connected
5	DGND	Digital Ground
6	NC	Not Connected
7	NC	Not Connected
8	NC	Not Connected
9	NC	Not Connected

J29 – B(3) Encoder Connector

Label: B(3) Encoder (J29)

Connector Type: DB15 male

Mating Type: DB15 female

Table 21: J29 Connector Pinout

Pin	Name	Description
1	5U	5.1V user supply to the Encoder and HALL, 200mA max
2	B(3)_CHA+	B(3)_ Encoder A non-inverted input
3	B(3)_CHA-	B(3)_ Encoder A inverted input
4	B(3)_CHB+	B(3)_ Encoder B non-inverted input
5	B(3)_CHB-	B(3)_ Encoder B inverted input
6	DGND	Digital Ground
7	NC	Not Connected
8	NC	Not Connected
9	B(3)_CHI+	Encoder Index non-inverted input
10	B(3)_CHI-	Encoder Index inverted input
11	DGND	Digital Ground
12	SHIELD	Cable shield connection
13	5U	5.1V user supply to the B Encoder and HALL, 200mA max
14	NC	Not Connected
15	B_MTMP	B Motor temperature sensor input. A normally closed sensor contact must be connected between pin 15 and pin 11. If no sensor is used, pin 15 must be shorted to pin 11 for proper operation.
	Connector metal case (SHIELD)	Cable shield connection

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Changes in Version NT2.25

Page	Change

Related Documents

The following documents provide additional details relevant to this guide:

Document	Description
SPiiPlusNT Setup Guide	A guide providing step-by-step instructions for setting up a SPiiPlusNT system.
SPiiPlus Command & Variable Reference Guide	Complete description of all variables and commands in the ACSPL+ programming language.
SPiiPlus C Library Reference	C++ and Visual Basic® libraries for host PC applications. This guide is applicable for all the SPiiPlus motion control products.
SPiiPlus COM Library Reference	COM Methods, Properties, and Events for Communication with the Controller.
SPiiPlus MMI Application Studio User Guide	A complete guide for using the SPiiPlus MMI Application Studio.
SPiiPlus Utilities User Guide	A guide for using the SPiiPlus User Mode Driver (UMD) for setting up communication with the SPiiPlus motion controller.
MC4U Control Module Hardware Guide	Technical description of the MC4U Control Module integrated motion control product line.
SPiiPlusNT PEG and MARK Operations Application Notes	Provides details on using the PEG commands in NT systems.
Safe Torque Off Function Application Notes	Provides details of the implementation of the STO function in SPiiPlusNT products.