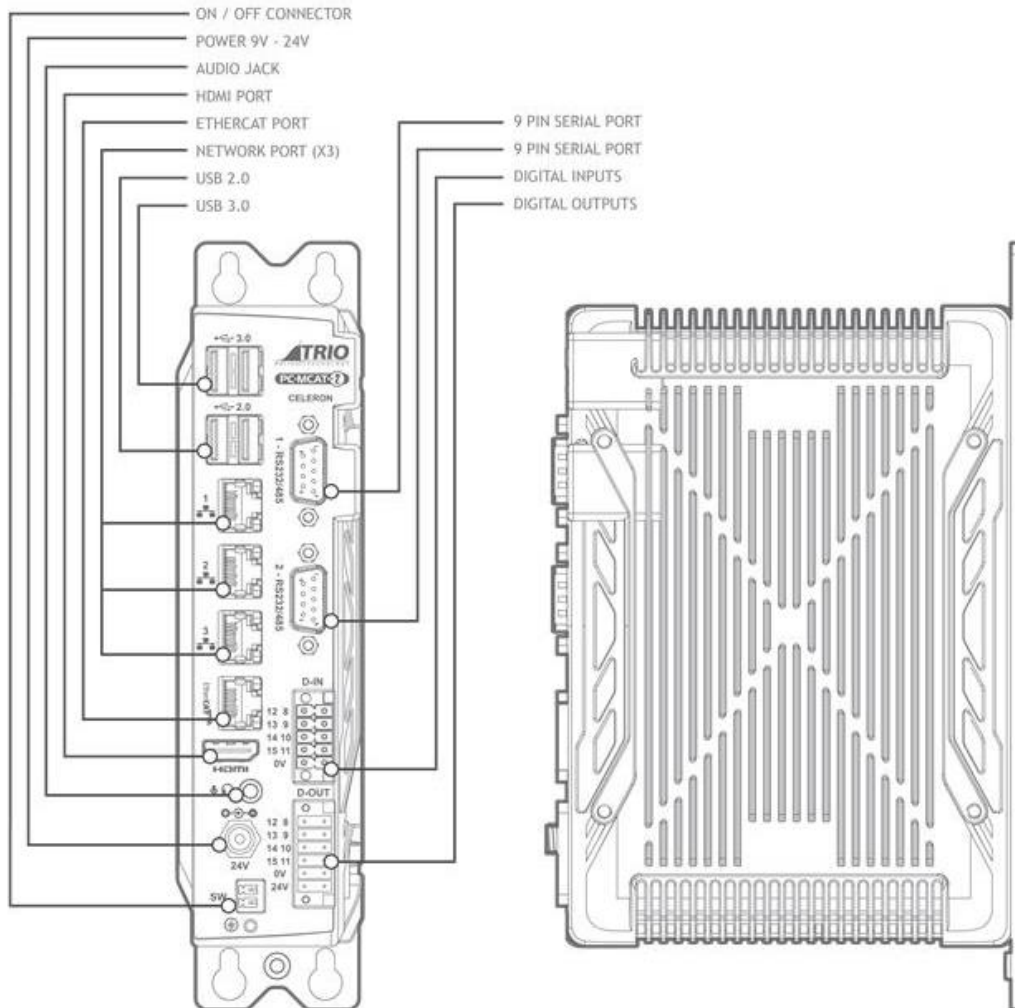




A MEMBER OF THE **ESTUN** GROUP



PC-MCAT-2

64 AXIS MOTION COORDINATOR

P780 - P781 - P782 - P783

USER MANUAL

About this Manual

Purpose

This manual provides the information required for the Selection, Wiring, Connection, Setup, Operation and Functions of the PC-MCAT-2 *Motion Coordinator*.

Please read and understand this manual to ensure correct usage of the product.

Terms

Terms that may be used in this manual are defined as follows.

Term	Meaning
Axis	A software control that operates a Servo or Stepper Motor.
Drive	A Servo or Stepper Drive, which is used for controlling the Motor.
Servo System	A Servo Control System that includes a Motor, a Drive, a host controller (Motion Coordinator) and peripheral devices.
Motion Perfect	The PC Tool for commissioning and programming the Trio product suite.

Revision History

Date	Version	Revised Contents
07 Mar 2023	1.00	Draft
20 June 2023	1.01	Updated Specification Table, Updated PC-MCAT-2 tray image
19 July 2023	1.10	Updated Specification Table, minor formatting changes
05 Sept 2023	1.11	Updated Formatting and Images, Added FEC instillation instructions

All goods supplied by Trio are subject to Trio's standard terms and conditions of sale.
This manual applies to systems based on the *Motion Coordinator* PC-MCAT-2.

The material in this manual is subject to change without notice. Despite every effort, in a manual of this scope errors and omissions may occur. Therefore, Trio Motion Technology Ltd. cannot be held responsible for any malfunctions or loss of data as a result.

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Safety Warning



During the installation or use of a control system, users of Trio products must ensure there is no possibility of injury to any person, or damage to machinery.

Control systems, especially during installation, can malfunction or behave unexpectedly.

Users must ensure that in all cases of normal operation, controller malfunction, or unexpected behaviour, the safety of operators, programmers or any other person is totally ensured.

This product contains a lithium battery. Care should be taken when handling this product and if the product is damaged the batteries must be quarantined and inspected.



Caution, this product may become hot during operations. Care should be taken when holding it.

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User Manual PC-MCAT-2

Overview

Trio's PC-MCAT-2 is an innovative "Motion + PC Solution". A powerful multi-core Intel processor is used to drive both a high-performance motion controller and a compact PC that can run user applications under Windows. The PC-MCAT-2 software uses a real-time extension to allow both Windows and the motion controller to run directly on their own processor cores. The PC-MCAT-2 is housed in a rugged metal case with integrated earth chassis and incorporates all the isolation circuitry necessary for direct connection to external equipment in an industrial environment.

PC applications can communicate with the Trio *Motion Coordinator* running on its dedicated processor core using fast shared memory. Machine control sequences can either be made in multi-tasking TrioBASIC / IEC61131 of the *Motion Coordinator* or can be written as a PC application (for example in "C#") sending motion + I/O requests through to the *Motion Coordinator*. Trio's *Motion Perfect v5* application development tool can be run directly on the PC-MCAT or remotely on a laptop via Ethernet.

The Multi-tasking version of Motion-iX for the PC-MCAT-2 allows up to 22 Motion-iX programs to be run simultaneously on the controller using pre-emptive multi-tasking. In addition, the operating system software includes the IEC 61131-3 standard run-time environment that has access to the full library of motion functions.



Power Connection

The 24V Main connection is the primary supply to the PC-MCAT-2. The PC-MCAT-2 will begin its power up cycle automatically when the power source is connected.

The power source required will vary depending on which variant is being used the details are provided in the following table:



Celeron	I3	I5	I7
72W	84W	84W	84W
3.0A	3.5A	3.5A	3.5A



NOTE: Do not remove the power source from the PC-MCAT-2 without powering the unit down through windows or by using EX(2) in the command line in Motion Perfect to turn the unit off.

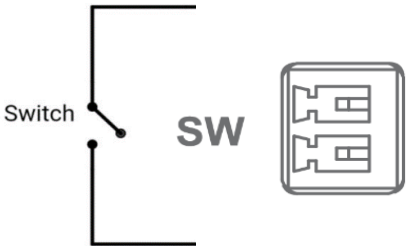
There are several EX() commands that can be used in the command line of Motion Perfect to change the state of the firmware. These are as follows:

Command	Effect
EX(0)	Shuts down and then reinitialises the EtherCAT network.
EX(1)	Stops all programs running and then shuts down the Controller firmware.
EX(2)	Stops all programs running, shuts down the Controller firmware and then begins a windows shut down sequence.
EX(3)	Stops all programs running, shuts down the Controller firmware and then begins a windows restart sequence.

IN(1) is an internal signal that can be monitored within a program running in the PC-MCAT. IN(1) is activated when windows request a shutdown, this can be used to monitor the state of windows.

Power Switch

The PC-MCAT-2 has the capability to add a normally open switch that allows the PC-MCAT-2 power-up cycle to be or turned off without removing and reapplying the power source. This is done by wiring a normally open switch into the switch inputs. Pressing the switch will close the circuit and begin the power up sequence if the device is off. If the device is already on, pressing the switch will begin the EX(2) sequence described in the previous section.



Programming

The Multi-tasking ability of the PC-MCAT-2 allows parts of a complex application to be developed, tested, and run independently, although the tasks can share data and motion control hardware. The 22 available tasks can be used for Motion-iX or IEC 61131-3 programs,

or a combination of both can be run at the same time, thus allowing the programmer to select the best features of each.

In addition, user programs may be added to the Windows environment that communicate with the Motion Control profile generator via a shared memory interface. Trio provides an API to enable Windows programming to be done easily using whichever programming language or system suits the application.

Default User Information

The default user ID is “Trio” and this account is accessed with the default password “**trio**”. The device's internal computer name is set to the Trio serial number.

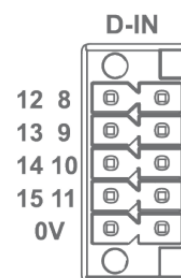
I/O Capability

The PC-MCAT-2 is fitted with Digital I/O which includes eight input and eight output channels. These PNP inputs and outputs have a response time of 10ms. Their I/O's voltage thresholds are 5V to 24V.

The PC-MCAT-2 can add up to 1024 external Input and Output channels using the Trio Flexslice I/O range via the P366 bus coupler module. These may be used for system interaction or may be defined to be used by the controller for end of travel limits, soft registration, datuming and feedhold functions if required. Third-party EtherCAT I/O modules may also be used if compatible with Trio's EtherCAT master software stack. See EtherCAT documentation and ESI file importing features within *Motion Perfect* version 5.

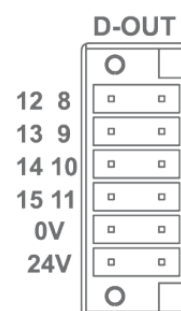
DIGITAL INPUTS

The digital inputs require 0V to be wired to one of the bottom pins as shown in the diagram. The bottom two pins are linked internally, and the input pins are activated by a voltage of 24V. They can be monitored through controller programs or the Motion Perfect I/O tool.



DIGITAL OUTPUTS

The digital outputs require both 24V to be wired into one of the bottom two pins (marked 24V) and 0V to be wired into the pair of pins above the bottom pair (marked 0V) as shown in the diagram. The 0V pair and 24V pair of pins are linked internally. The digital outputs can be activated through controller programs or manually through the Motion Perfect I/O tool.



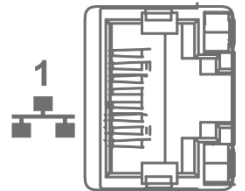
Communications

The PC-MCAT-2 has 4 RJ45 ports. The top 3 are Ethernet numbered 1 to 3 from the top down. The bottom port is dedicated to EtherCAT communications.

Ethernet Communications

Ethernet is the primary communication connection to the PC-MCAT-2. Protocols supported include Telnet (Client and Server), Modbus TCP (Server) and the TrioPCMotion DLL/ActiveX connection.

The factory default settings for Ethernet port 1 is a fixed IP address of 192.168.0.250 and the windows DHCP operation on Ethernet port 2 and Ethernet port 3. Ports 2 and 3 therefore require connection to a network that includes a DHCP server to set up a valid IP address. The upper sockets may be used for a point-to-point connection with a device that also has a fixed IP address in the same sub-net range.



IP Address Reset

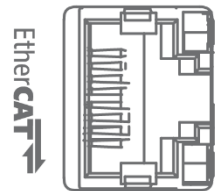
To reset the IP address, IP gateway and IP net mask, connect a monitor, keyboard and mouse to the HDMI and USB ports. Open the Ethernet port properties in Windows and select IPV4 properties. Select the IP address mode and values as required.

EtherCAT

The motion controller's own dedicated EtherCAT master port is the bottom RJ45 connector. This support real-time control of EtherCAT devices with network cycle times down to 125µs. EtherCAT slaves such as servo drives and I/O devices are normally connected in a chain to the lower RJ45 socket.

EtherCAT standard pin assignment:

Pin	Signal	Description
1	TD+	Transmission data +
2	TD-	Transmission data -
3	RD+	Receive data +
6	RD-	Receive data -



Minimum cable specification: CAT 5e shielded SF/UTP cable is recommended.

Serial Communications

There are 2 serial communication ports that allow for RS232 and RS485 communications. The port one is set by default to **RS232** and the port 2 is set to **RS485** (two wire) by default. The maximum baud rate is 115200 bits/sec.

COM ports standard pin assignment:

Pin	RS232	RS485
1		TX-/RX-
2	RX	TX+/RX+
3	TX	
5	GND	GND

COM Port 1 is assigned to communications channel #1 in Motion Perfect and COM Port 2 is assigned to channel #2 by default. Additional information about using the serial ports can be found in the help file for the “print” command.



Adjusting Serial Communication ports

1. During the booting process repeatedly press the Delete Key to enter the BIOS menu.
2. Move the cursor key to select the “Advanced” item and enter “Super IO Configuration”.
3. If you need to adjust the COM1 port mode, enter "COM1", in "Function Settings", you can adjust "RS-232" or "RS-485" mode. As shown in the figure below, the RS-232 mode can be adjusted to RS-485 mode.
4. The COM2 mode adjustment steps are the same as COM1 steps.
5. After adjustment, press F4 and enter to save and exit.

Audio Port

The audio port can be used for inputting and outputting audio and the settings can be accessed through windows.

Removable Storage

The PC-MCAT-2 uses the Windows operating system to organise external data storage using any Windows 10 compatible storage device. E.g. USB stick, external hard drive / SSD drive etc.

Axis Positioning Functions

The motion control generation software receives instructions to move an axis or axes from the Motion-iX or IEC 61131-3 language which is running concurrently on the same processor. The motion generation software provides control during operation to ensure smooth, coordinated movements with the velocity profiled as specified by the controlling program. Linear interpolation may be performed on groups of axes, and circular, helical or spherical interpolation in any two/three orthogonal axes. Each axis may run independently, or they may be linked using interpolation, electronic gearboxes and simple kinematics.

Consecutive movements may be merged to produce continuous path motion and the user may program the motion using programmable units of measurement (e.g. mm, inches, revs etc.). The module may also be programmed to control only the axis speed. The positioner checks the status of end of travel limit switches which can be used to cancel moves in progress and alter program execution.

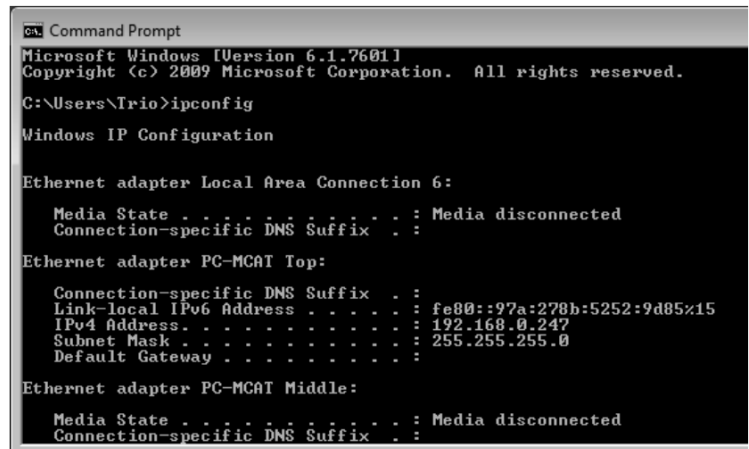
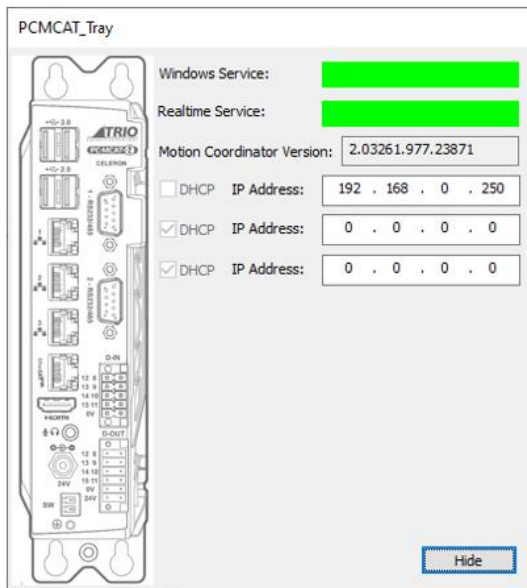
Registration

PC-MCAT-2 requires servo and stepper drives connected by EtherCAT to support the CiA402 Touch Probe system. With the touch probe objects included in the cyclic data PDO, the Motion Coordinator programs can use the REGIST command to access the registration inputs and functions in the remote drives.

Network Setup

If the PC-MCAT-2 is connected to a network, its IP address may be given by the network DHCP address server. Use the windows command line to discover the IP address given or check the PC-MCAT tray application. This application is accessed by right clicking on the PC-MCAT logo on the bottom right of the windows toolbar and click show.

Software

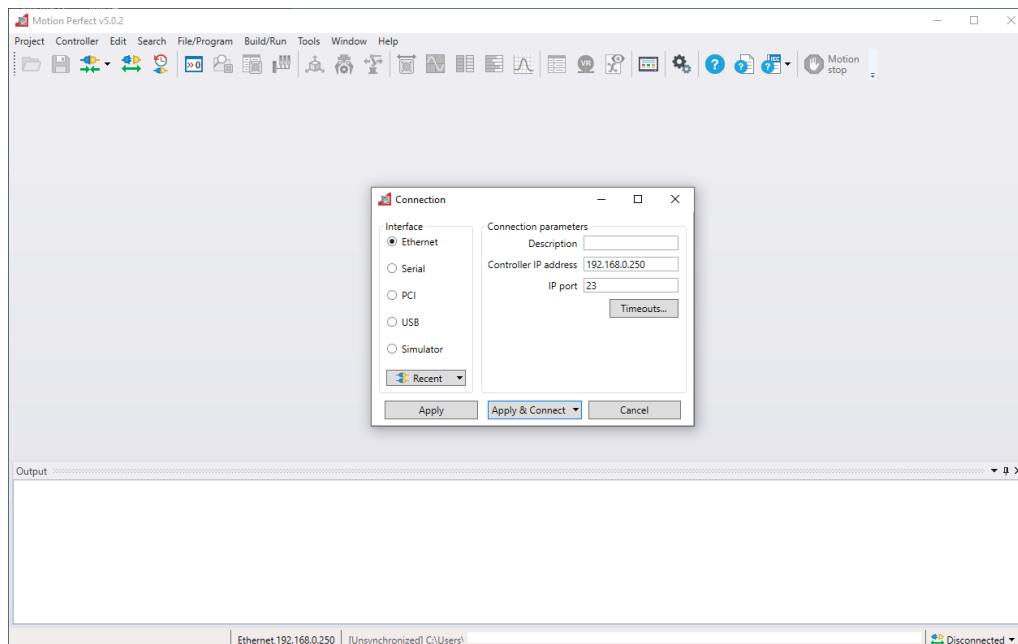


Motion Perfect version 5.3 or later is required for configuring, programming and system debug. This can be used either on the PC-MCAT-2 itself, or on a remote PC connected to the PC-MCAT-2 via Ethernet.

Running Motion Perfect on PC-MCAT-2

PC-MCAT-2 comes with a version of *Motion Perfect* pre-installed. The latest version can be downloaded from www.triomotion.com.

Launch *Motion Perfect* and select the IP address of the PC-MCAT-2. To connect to the PC-MCAT-2 controller, set the IP Address to 127.0.0.1 for internal communications with the Trio firmware that runs in real-time. Click the Apply and Connect button.



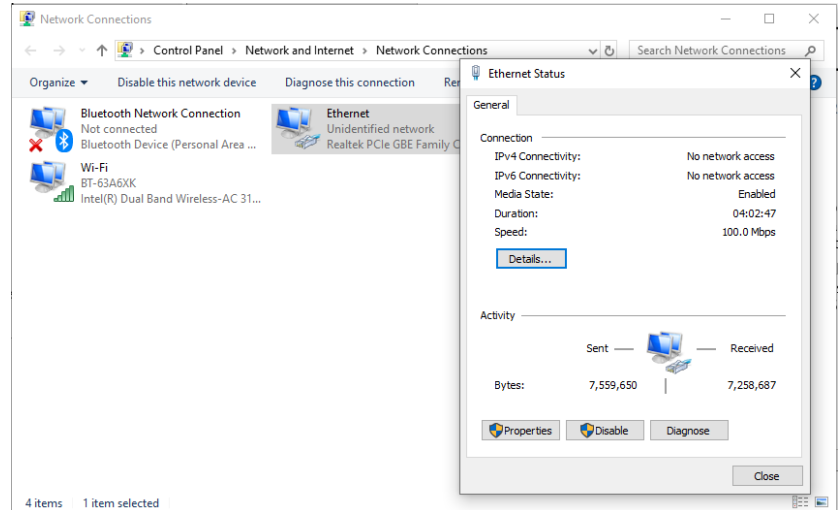
Running Motion Perfect on a remote PC

A PC running Microsoft Windows (Windows 10 or later recommended) is required.

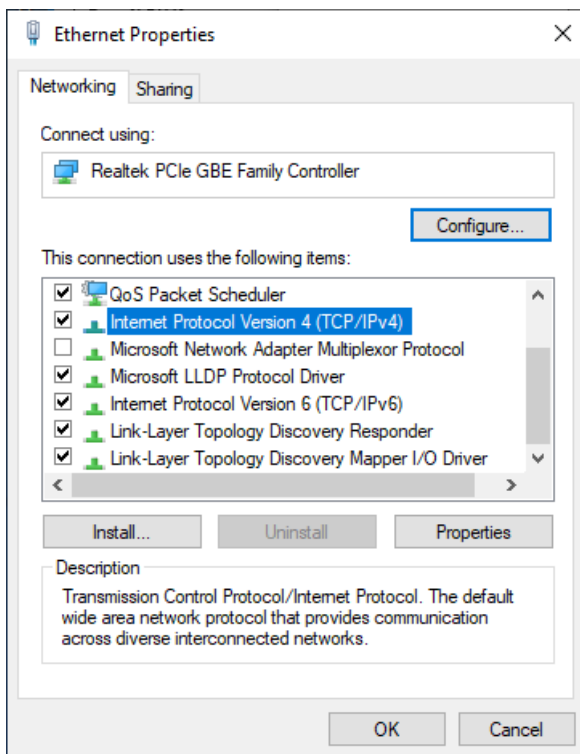
Download *Motion Perfect* from www.triomotion.com and install on either a remote PC or on the PC-MCAT itself.

Connection is via the Ethernet port. Ensure that the PC has a valid Ethernet Address. For single point-to-point connection, a fixed IP address must be set in the PC. Go to Settings, Network and Internet then open Change Adapter Settings. Open the Ethernet port.

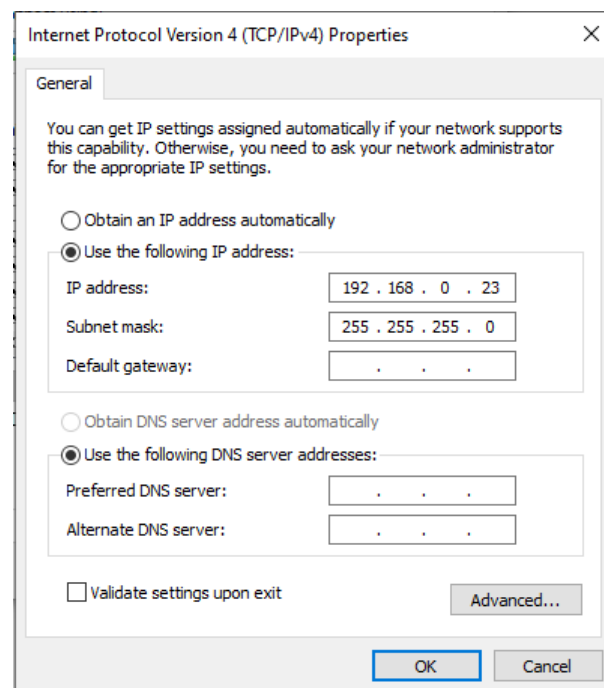
Click the Properties button and then select Internet Protocol Version 4 (TCP/IPv4).



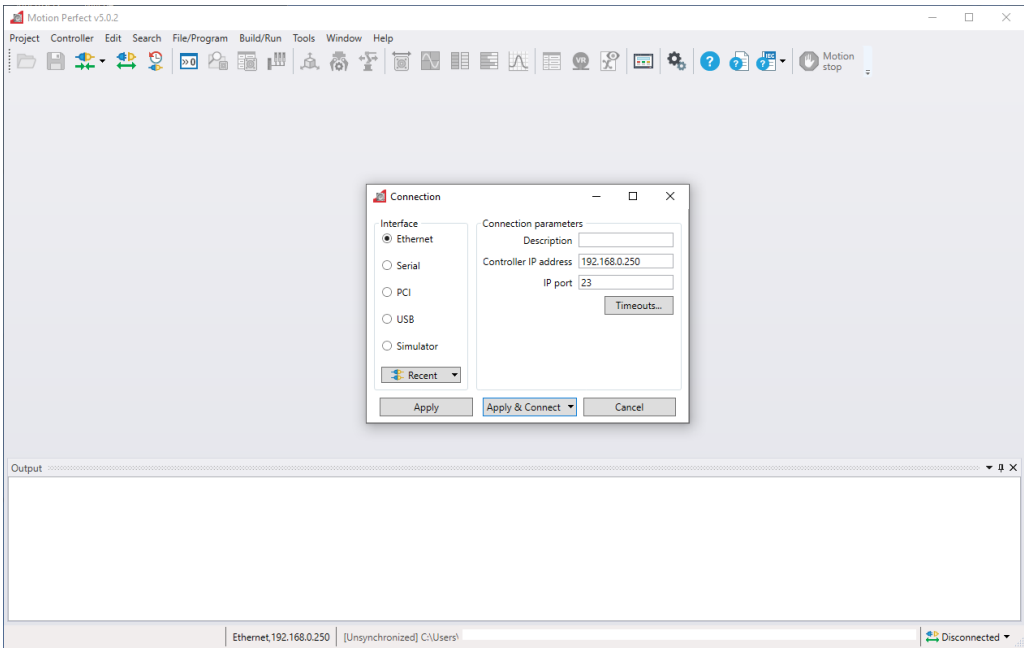
Click Properties and select Use the following IP address. Set an IP address in the same subnet as the PC-MCAT-2. Usually this will be 192.168.0.xxx.



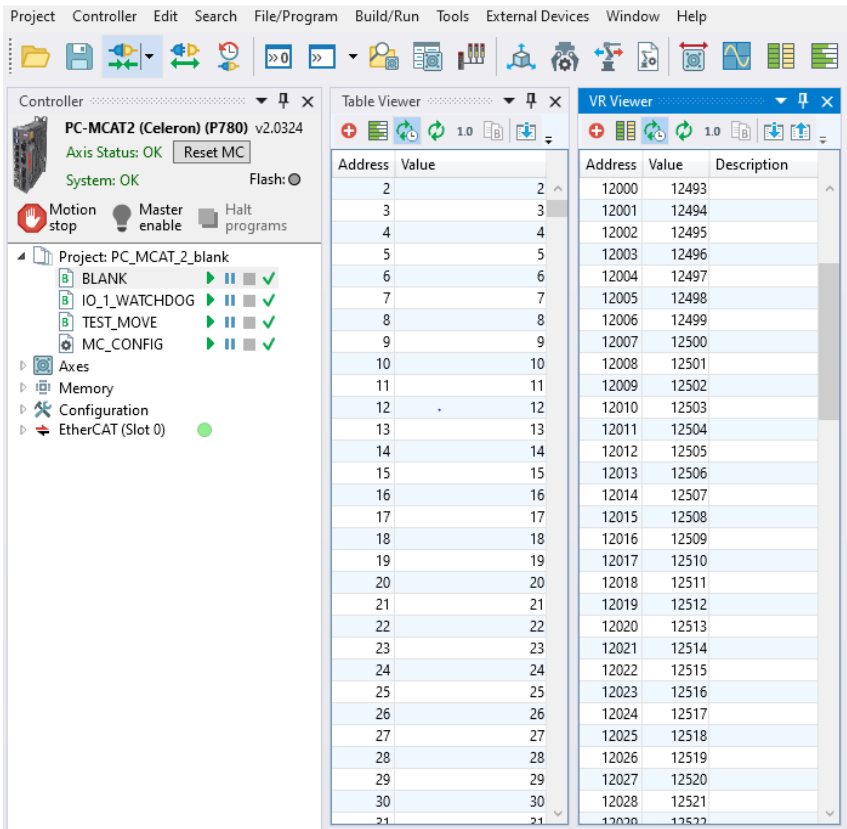
Click OK and close the Ethernet setup dialogues.



Launch *Motion Perfect* and select the IP address of the PC-MCAT-2. By default, this will be 192.168.0.250. Click the Apply and Connect button.



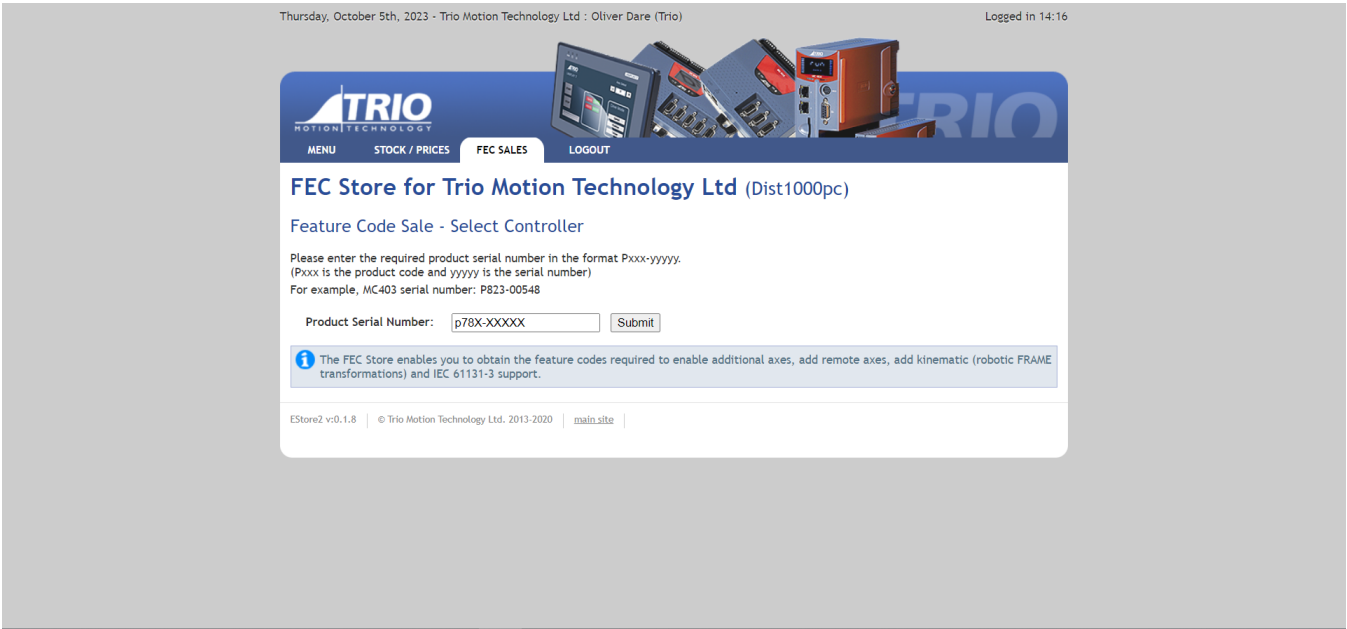
Below is an example screen shot of Motion Perfect in Synchronised connection mode.



Installing FEC codes

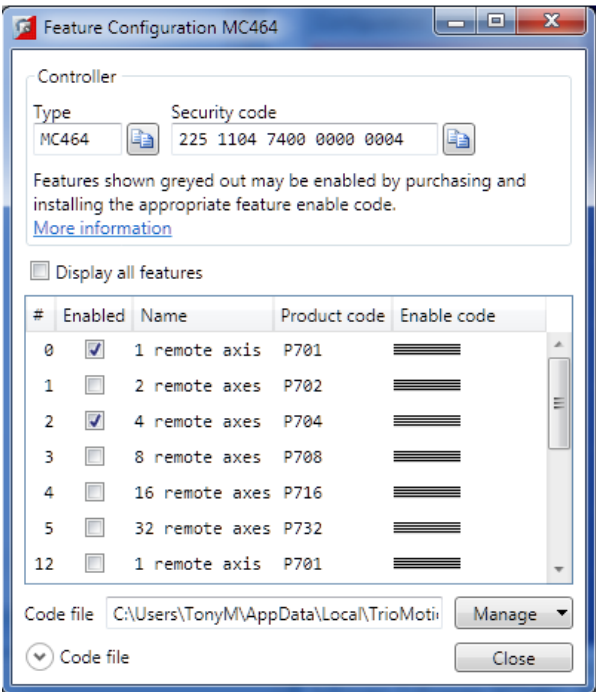
Trio Controllers have features which can be enabled by the user. The features are enabled using the "Feature Configuration" tool in Motion Perfect.

The features are made available by purchasing feature enable codes from Trio Motion Technology Ltd using the Estore tab.



When purchasing feature codes, you will need to supply the Product code for your controller to ensure that you get the correct codes.

To manually enter a new code, you must load motion perfect and load the Feature Configuration panel under the controller tab when in sync mode. Select the appropriate "Enable" Code" cell in the feature grid and enter the code, being careful to get the case of the characters correct. If the code is entered correctly then the "Enabled" check box for the feature should become enabled and allow the user to enable and disable the feature.



Firmware

The PC-MCAT-2 comes pre-installed with the firmware version which was released to production at the time of manufacture. Newer versions may be available to download from the Trio website and it is recommended to check if an update is available before using the Motion Coordinator for an application.

New firmware can be installed using the Windows installer and requires the connection of a Monitor, keyboard and Mouse to the PC-MCAT-2 ports.

All applications programs will be deleted when the new firmware is installed

Before Running the windows installer, input the EX(1) command in channel 0 in Motion Perfect to deactivate the controller firmware. Ensure that you have a copy of any programs that are running on the PC-MCAT-2. Typically, this will be the *Motion Perfect* project file.

After a new version of the PC-MCAT-2 software has been installed, it will be necessary to connect *Motion Perfect* to re-download any programs resident on the PC-MCAT-2.

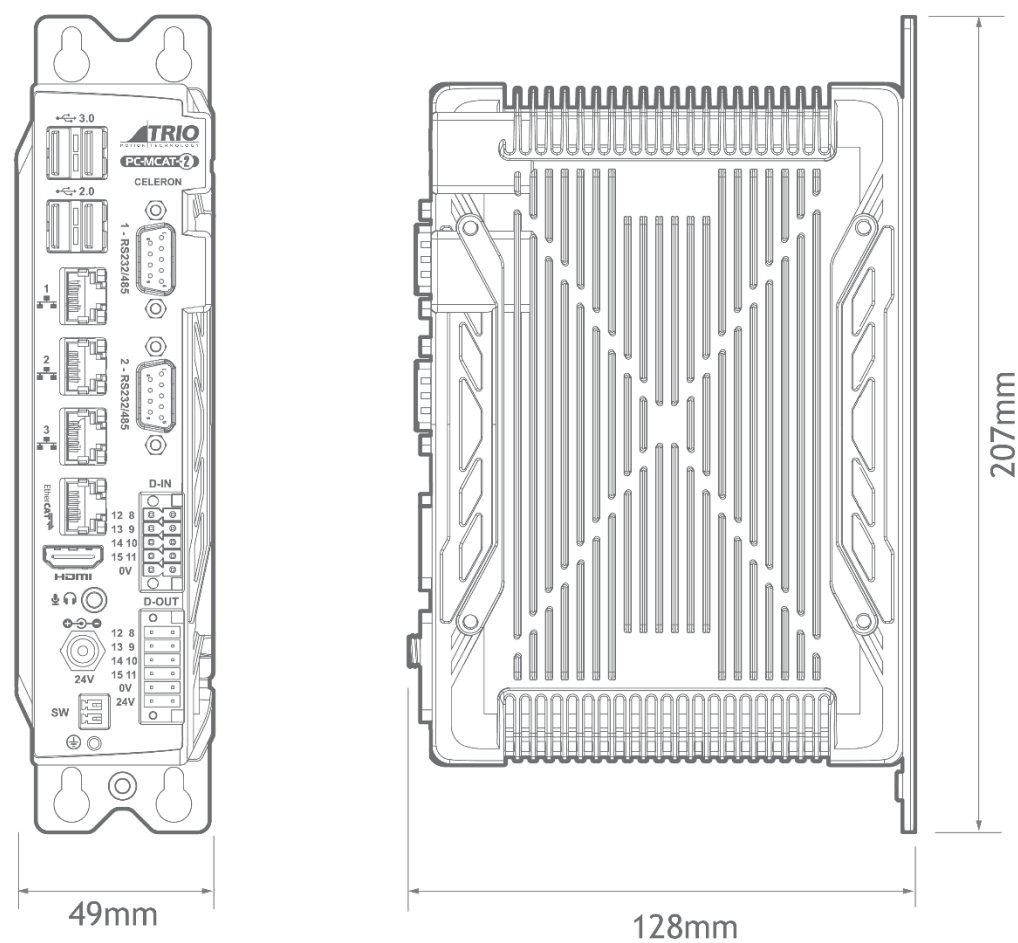
Remote Connection

The PC-MCAT-2 comes with the windows firewall defender activated for the security benefits it provides. However, this does limit certain features such as the ability to connect to the unit through remote desktop applications. To disable this feature, you can use the following procedure:

1. Select the **Start** button > **Settings** > **Update & Security** > **Windows Security** and then **Firewall & network protection**. Open Windows Security settings
2. Select a network profile: **Domain network**, **Private network**, or **Public network**.
3. Under **Microsoft Defender Firewall**, switch the setting to **On**. If your device is connected to a network, network policy settings might prevent you from completing these steps. For more info, contact your administrator.
4. To turn it off, switch the setting to **Off**.

Please be aware turning off Microsoft Defender Firewall could make your device (and network if you have one) more vulnerable to unauthorized access. If there's an app you need to use that's being blocked, you can allow it through the firewall, instead of turning the firewall off.

Dimensions



Mounting

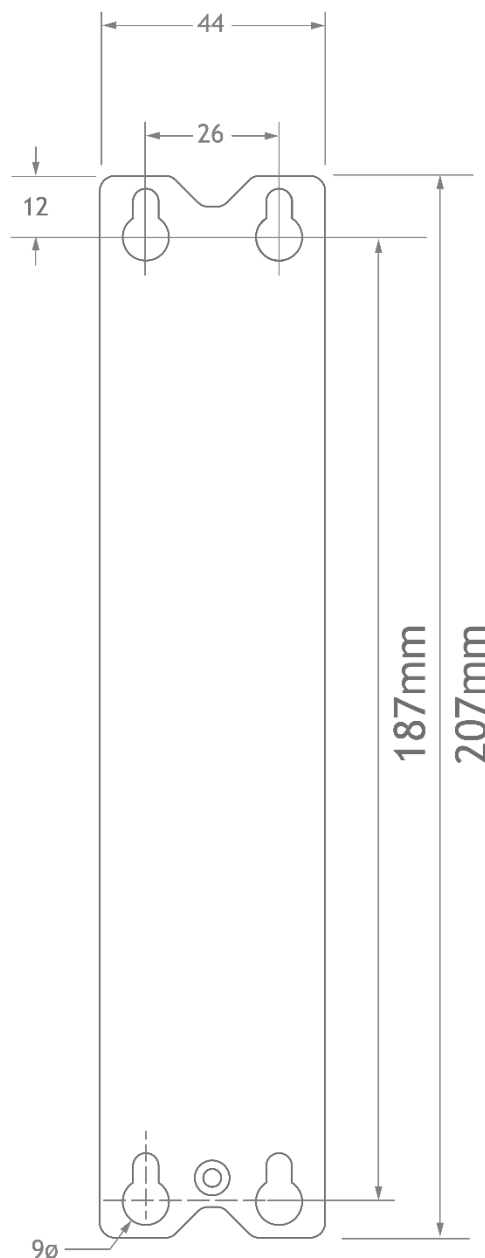
M4 screws should be used in 4 places to mount the PC-MCAT-2 to an unpainted metal panel.

The best EMC performance is obtained when the PC-MCAT-2 is attached from the shield screw (marked) using a flat braided conductor with a cross section of 4mm x 1mm. Do **NOT** use a circular section wire or run the braid to a central star point.

Ventilation

When the PC-MCAT-2 is mounted in an enclosed cabinet, there must be an adequate volume of circulating air to maintain the environmental temperature within the operating temperature range.

Place below heat sources such as drives and power supplies.



Specifications

Description	Celeron (P780)	I3 (P781)	I5 (P782)	I7 (P783)
CPU	Intel Celeron J6412	Intel Core i3 8145U	Intel Core i5 8265U	Intel Core i7 8565U
Memory	4GB DDR4 2400MHz	4GB DDR4 2400MHz	8GB DDR4 2600MHz	8GB DDR4 2600MHz
SSD	64GB	128GB	128GB	256GB
Display	Intel HD Graphics 3000, 1x HDMI, 1920x1080@60Hz	Intel HD Graphics 3000, 1x HDMI, 1920x1080@60Hz	Intel HD Graphics 3000, 1x HDMI, 1920x1080@60Hz	Intel HD Graphics 3000, 1x HDMI, 1920x1080@60Hz
Operating System	Windows 10	Windows 10	Windows 10	Windows 10
Axes				
Max Axes	64	64	64	64
Max Networked Axes	64	64	64	64
Max Virtual Axes	64	64	64	64
Performance				
Cores	4 (4 Threads)	2 (4 Threads)	4 (8 Threads)	4 (8 Threads)
CPU Mark*	3841	3806	6019	6149
Maths precision	IEEE 457 Double	IEEE 457 Double	IEEE 457 Double	IEEE 457 Double
Position register precision	64 bit	64 bit	64 bit	64 bit
Execution benchmark	345 lines/ms	495 lines/ms	573 lines/ms	601 lines/ms
Real time clock	yes	yes	yes	yes
Table memory	512000 values	512000 values	512000 values	512000 values
Maximum VR variable	65536	65536	65536	65536
Maximum servo period	2000 μ s	2000 μ s	2000 μ s	2000 μ s
Minimum servo period	125 μ s	125 μ s	125 μ s	125 μ s
Interfaces				
EtherCAT	1 Port	1 Port	1 Port	1 Port
Ethernet	3 Ports	3 Ports	3 Ports	3 Ports

RS232/RS485	Yes	Yes	Yes	Yes
USB 3.0	2	4	4	4
USB 2.0	2	0	0	0
HDMI	Yes	Yes	Yes	Yes
Sound Port	Yes	Yes	Yes	Yes
On / Reset	Remote swich	Remote swich	Remote swich	Remote swich
Protocols				
Ethernet/IP	No	No	No	No
PROFINET IO	No	No	No	No
MODBUS-RTU**	Yes	Yes	Yes	Yes
MODBUS-TCP**	Yes	Yes	Yes	Yes
Serial COM Ports				
Maximum Baud Rate	11520 bits/sec	11520 bits/sec	11520 bits/sec	11520 bits/sec
RS485 Type	2 Wire	2 Wire	2 Wire	2 Wire
RS232 Hardware Handshake	No	No	No	No
External I/O				
24V digital outputs	8	8	8	8
24V digital inputs	8	8	8	8
Opto isolated	Yes	Yes	Yes	Yes
Response Time	10 ms	10 ms	10 ms	10 ms
Programming				
Trio Basic	Yes	Yes	Yes	Yes
DXF in	Yes	Yes	Yes	Yes
G-code	Yes	Yes	Yes	Yes
HPGL	Yes	Yes	Yes	Yes
IEC61131	Option	Option	Option	Option

Kinematic	Option	Option	Option	Option
Maximum programs	32	32	32	32
Maximum tasks	22	22	22	22
Software				
Motion Perfect version	5.3	5.3	5.3	5.3
Physical				
Maximum operating temperature	40°C	40°C	40°C	40°C
Minimum operating temperature	-10°C	-10°C	-10°C	-10°C
Mount	Panel	Panel	Panel	Panel
Depth	128.0mm	128.0mm	128.0mm	128.0mm
Height	207.0mm	207.0mm	207.0mm	207.0mm
Width	49.0mm	49.0mm	49.0mm	49.0mm
Weight	1280g	1280g	1340g	1340g
Power				
Power rating	72W	84W	84W	84W
Recommended Supply current	3.0A	3.5A	3.5A	3.5A
Recommended Supply voltage	24V	24V	24V	24V
Supply tolerance	+/-10%	+/-10%	+/-10%	+/-10%
Certification				
CE	Yes	Yes	Yes	Yes
RoHS	Yes	Yes	Yes	Yes
UL ***	Yes	Yes	Yes	Yes

*Values taken from www.cpubenchmark.net

**Only server functionality

***Test to UL standards by nationally recognised testing laboratory

Electromagnetic Compatibility

Trio Motion Technology products are certified to comply with the requirements of Annex I to the Directive 2014/30/EU on Electromagnetic disturbance and Electromagnetic immunity. To achieve this compliance, certain requirements or best engineering practices must be implemented by the corresponding system designer.

Intended conditions of use

Trio Motion Technology products are designed for operation in Industrial environments with high noise levels that may induce currents or electrical potentials that are damaging to microelectronics. Our products are nevertheless designed and tested to withstand the level of electromagnetic disturbance common to these environments, on the provision that the appropriate EMC guidelines have been employed by a qualified competent system integrator.

The Trio Motion Technology product range is designed to be integrated, by the customer, as a control system for industrial machines and auxiliary equipment.

EMC Considerations

Electromagnetic Interference problems can usually be avoided by careful wiring and following a few basic rules.

- Mount noise generators such as contactors, solenoid coils and relays as far away as possible from the Motion Coordinator.
- Where possible use solid-state contactors and relays.
- Fit suppressors across coils and contacts.
- Place high voltage cables in separate trunking to low voltage and signal cables.
- Ensure all the modules have a secure earth connection.
- Where screened cables are used, terminate the screen with a [360 degree termination](#) rather than a “pig-tail”. Connect both ends of the screen to earth. The screening should be continuous, even where the cable passes through a cabinet wall or connector.

These are just general guidelines and for more specific advice, see the installation requirements later in this chapter.

The consideration of EMC implications is more important than ever since the introduction of the EC EMC directive which makes it a legal requirement for the supplier of a product to the end customer to ensure that it does not cause interference with other equipment and that it is not itself susceptible to interference from other equipment.

Product specific requirements

Trio Motion’s extensive product and application knowledge combined with product testing reflect that the best immunity is achieved by placing some constraint on the system into which the product is being integrated. The information is presented in this section for the commissioning engineer.

Feature	Requirements	Notes
0V wire (current return)	- Always connect ALL 0V current return wires - Do not use the screen for 0V current return - It is highly recommended to avoid connecting 0V across internal isolation barriers. If a single 24V supply is used for the main power and IO power then these two isolated 0V will have to be connected but this should only be done if the 24V supply is free from switching noise - Do not join together 0V from high power and / or noisy sources with the 0V from signal ports (incl. CAN bus DC input) - Do not use any controller 0V connection as a current return for peripheral devices	24V supply 0V is isolated. 24V IO supply is isolated.
All 24V DC ports	It is highly recommended to use surge filters on all DC supply and 0V return. If more than one device is connected to the same PSU then this is a requirement. See Surge Protection below.	
Cable routing	- Maintain 150mm separation of parallel Class I and Class II cable (IEC 61000-5-2:1997) - Unless otherwise specified, all cables must be <30m in length	
Proximity to source of disturbance	Place controllers and expansion modules as far from mains cables, mains filters, contactors, circuit breakers, drives, transducers or other high power sources of EM disturbance as physically possible within the enclosure design.	
Enclosure / Safety Cabinet design	Trio's products should always be installed within a locked cabinet with access limited to authorised personnel only.	
Differential Stepper / Encoder Signals	- Screened, twisted pair cable. - Connect screen to metal chassis at both ends (See Cable Shields) 0V reference connected at both ends.	
CAN bus	- Screened, twisted pair cable with characteristic impedance of 120 Ohm. (± 10 Ohm) - Connect screen to Chassis at every node.	Connect screen to Aux connector shell at PC-MCAT. 0V on Aux connector, pins 4, 8 and 12 are common 0V.
Digital I/O	It is highly recommended to use a separate PSU and 0V return. (The I/O is internally isolated from the main 24V supply input.)	

ADC / DAC	• Use DAC 0V reference pin not common 0V	0V on Aux connector.
RS232 / RS422 / RS485 Serial ports	• Screened cable. • Connect screen to Chassis at both ends. • 0V reference connected at both ends.	Connect screen to Aux connector shell. 0V on Aux connector, pins 4, 8 and 12 are common 0V.
Ethernet	• TIA Cat5e, minimum. • Shielded cable. • Cable $\leq 30\text{m}$ in length.	Overall Foil Braided Shield with Unshielded Twisted Pairs. Compliant with Industrial SF/UTP.
EMC Earth Connection	• Mount on bare metal backplane. • Use a minimum 10mm wide, braided conductor to connect backplane / chassis to PE. • Do not use circular cross-section wire.	When the PC-MCAT is screwed directly to the panel, the metal chassis provides the required EMC earth connection.

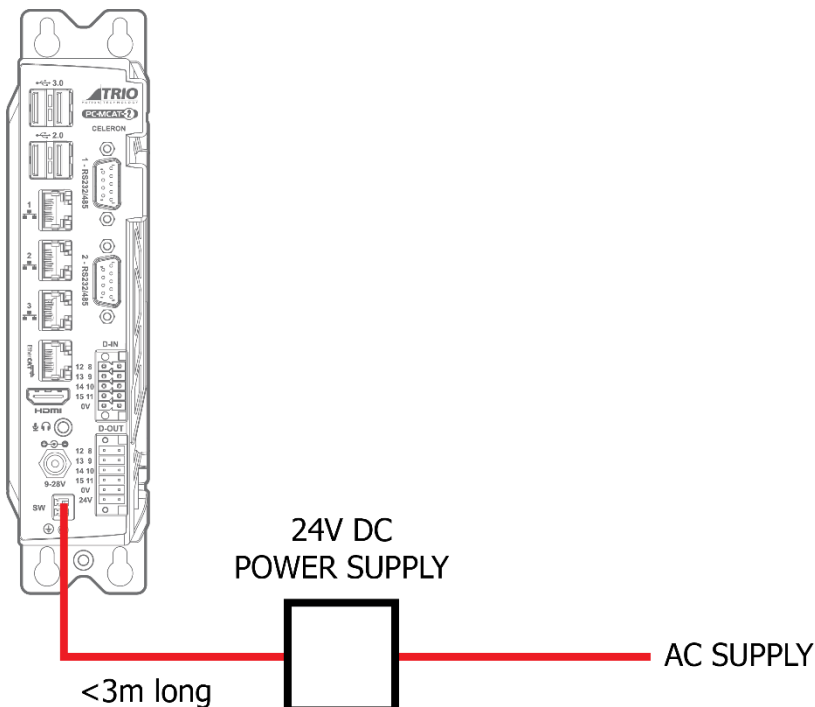
Recommended Installation

The following diagrams and information detail the typically required Surge Protection, EMC Earth and Cable Shields however more comprehensive information can be found in the corresponding Product Technical Manual (available at www.triomotion.com)

Surge Protection

Single power supply

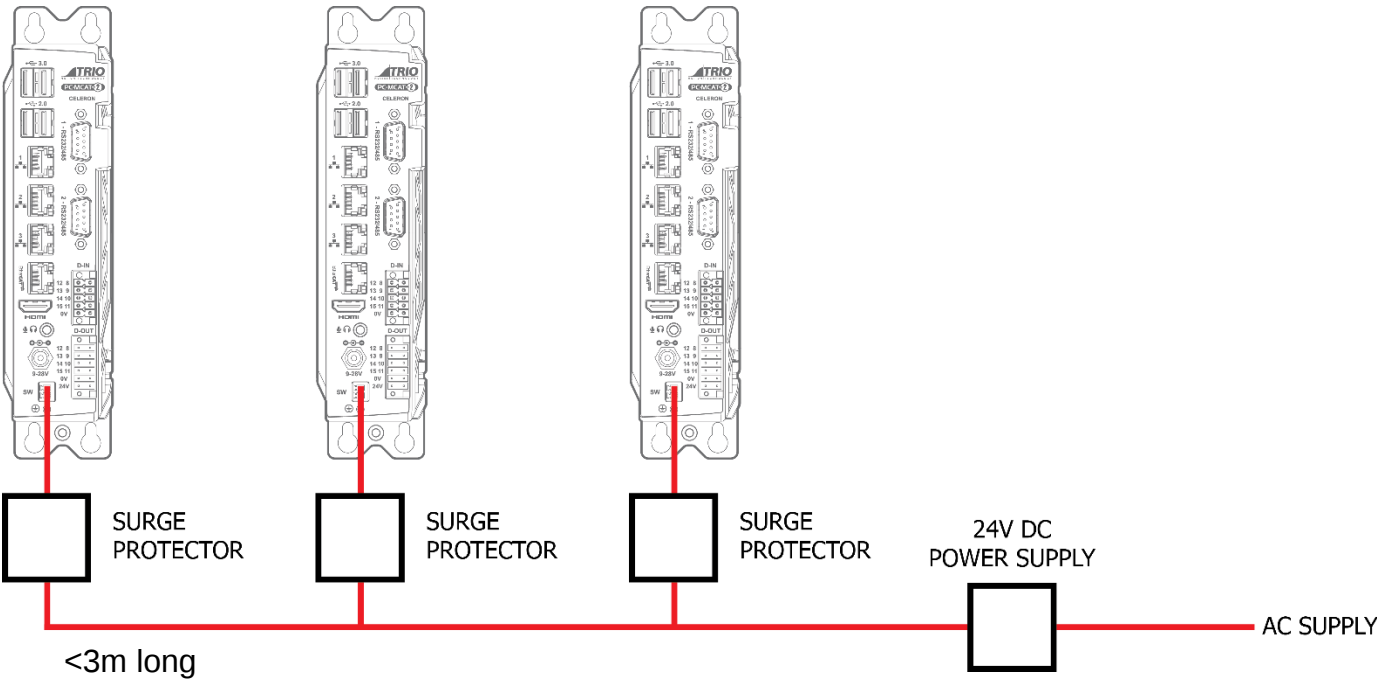
Where the device is supplied with 24V dc from one dedicated 24V power source and the connecting cable is less than 3 metres, there is no need for a separate surge protection device.



Motion Coordinator with dedicated power source

Distributed power supply

If the device is connected to a distributed power supply or the cable length between the power source and the device is longer than 3 metres, then a surge protection device must be fitted to comply with the CE EMC directive.



Distributed power supply with surge protection

Surge protection device

Protection device - Minimum specification	
Operating Voltage	24V dc
Suppression Begins:	
Stage Two	30V
Stage Three	35V
Max. Clamp Volts for transients on the line:	
Stage Two	65V
Stage Three	77V
Surge Current (8/20mSec Pulse)	
+ to -	9000A
+ to Earth	4000A
- to Earth	4000A
Surge Energy (2mSec Pulse)	
+ to -	94 Joules
+ to Earth	44 Joules
- to Earth	44 Joules
Response Time	<5 nsec
Resistance to Earth:	
Max Over-Voltage	0.01 Ω

Operating Voltage	> 1 MΩ
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