# TRIO
MOTION | TECHNOLOGY

A MEMBER OF THE **ESTUN** GROUP

# Flex-7

EtherCAT 128 AXIS MOTION COORDINATOR

# About this Manual

## Purpose

This manual provides the information required for the Selection, Wiring, Connection, Setup, Operation and Functions of the Flex-7 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. |
| WDOG ON | Setting the control word on EtherCAT to signal that the Drives may be Enabled. |
| WDOG OFF | Clear the control word to signal that the Drives must be Disabled. |
| Motion Perfect | The PC Tool for commissioning and programming the Trio product suite. |
| Pulse+Direction | An electronic output from the Motion Coordinator that produces one pulse per step of the motor position, with a second output to signal the direction of motion. |
| Motion-iX | The motion-centric programming language, an extension of BASIC. |
| EtherCAT | Ethernet based fieldbus for synchronised control of slave devices in real-time. |

# Revision History

| Date | Version | Revised Contents |
|------|---------|------------------|
| 18/10/24 | 1.00 | Initial release |
| 19/11/24 | 1.10 | Revised from initial release feedback. |
| 11/04/25 | 1.20 | Additional information added to support UL declaration |
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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 Flex-7.

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.

If the Trio product is used in a manner not specified by **Trio Motion Technology LTD**, the protection provided by the product may be impaired.

# Contents

# User Manual Flex-7

## Overview

The Motion Coordinator Flex-7 is based on Trio's high-performance ARM Cortex-A53 double-precision technology and provides up to 128 axes of coordinated motion using the EtherCAT bus system to connect to Drives and I/O.  Benefiting from a re-architected communications interface and a quad core processor the Flex-7 offers a step change in performance in Trio's Flexible Machine Controller range.  It is housed in a rugged plastic case with integrated earth chassis and incorporates three screened RJ45 Ethernet ports, a 24V DC power connector, micro SD card slot, two USB ports and a CAN port. The two upper RJ45 connectors are for standard Ethernet connection to the PC for programming and the lower connector is for the EtherCAT Fieldbus.  Filtered power supplies (DC/DC converters) are included so that it can be powered from the 24V DC logic supply present in most industrial cabinets.

It is designed to be configured and programmed for the application using a PC running Trio's Motion Perfect application software, and then may be set to run "standalone" if an external computer is not required for the final system. Programs and data are stored directly to FLASH memory, thus eliminating the need for battery backed storage.

The multi-tasking version of Motion-iX for the Flex-7 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.

## Programming

The multi-tasking ability of the Flex-7 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 processes 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.

The Flex-7 is fully compatible with Trio's Robot Programming System (RPS) and the user can decide to write programs using the powerful Motion iX functions or the RPS motion suit which is tailored to SCARA and other industrial robot systems.  Both RPS and Motion iX / IEC programs may be run on the same Motion Coordinator thus allowing the powerful Flex-7 to control many auxiliary motors as well as the robot arm(s).

# Display

The Flex-7 display features a number of display modes. The modes can be accessed by pressing the toggle button.
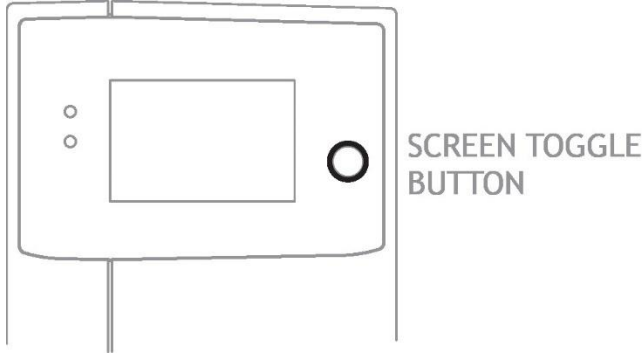


After 1 minute of idle time, the display will revert to screensaver mode (scrolling logo). Pressing the screen toggle button will return the display to the last display mode.

| # | Short Press | Long Press |
|---|---|---|
| 1 | Ethernet Information | N/A |
| 2 | EtherCAT Information | N/A |
| 3 | Device Information | N/A |
| 4 | Process Summary | N/A |
| 5 | Digital Inputs | Provides more detailed information on inputs |
| 6 | Digital Outputs | Provides more detailed information on outputs |

# I/O Capability

The Flex-7 has the ability to add up to 16 EtherCAT digital Flexslice input / output modules using the EBUS connector on the side. Modules are supported mechanically by a positive latch system that allows rapid assembly that results in a robust final assembly ready for clipping on the DIN rail.  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. The Flex-7 can have up to 1024 external Input and Output channels connected using a combination of the local EBUS and remote EtherCAT IO via the P366 bus coupler module.

# Real Time Clock (RTC)

The Flex-7 has an integrated Real-Time clock (RTC). It charges while the Flex is powered and should maintain good timekeeping for 20 days or more without power. The date and time can be set in several ways.

RTC accuracy is 5ppm max (0.5s per day) at 25deg C.

Motion Perfect can be used to synchronise the controller with the PC clock when connected in tool or sync mode.

You can also set the date and time from TrioBASIC by setting the DATE and TIME variables.

If your network has a connection to the internet and your gateway setting on the controller has been configured, you can enable NTP (Network Time Protocol) and update the date/time automatically to UTC. This mode is enabled by setting the date as follows: "DATE=01:01:2000". Setting the date by either of the other methods will disable the NTP setting. It can take several minutes for the controller to synchronise with the network time.

 The Operating System (OS) derives its own clock from the RTC at boot. It is good practice to power cycle the controller after a major time/date change so that the OS can adopt to the new setting. From a user's point of view, it will help the controller to maintain accurate file timestamps and logs. Note that due to a restriction in the OS, setting a historical date earlier than the 14th of February 2019 will be considered inaccurate and rounded up. This will not affect the RTC, and the controller will still track the date/time as was set.

# Communications

Two 100/1000BASE-T Ethernet ports are fitted as standard, and this is the primary communications connection to the Flex-7.  Protocols supported include Telnet (Client and Server), Modbus TCP (Client and Server), Ethernet IP (Server) and the Trio PCMotion DLL/ActiveX channel.

# Removable storage

The Flex-7 has a micro-SD Card slot which allows a simple means of transferring programs, firmware and data without a PC connection. Offering the OEM easy machine replication and servicing.



The memory slot is compatible with a wide range of SD/SDHC micro-SD cards up to 32GB using the FAT32 compatible file system.

# 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, variable electronic gearboxes and kinematic transform.

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.

## LED indicators

2 LEDs show the status of the power and the enable circuit. The enable circuit drives the watchdog relay and activates the pulse output signals
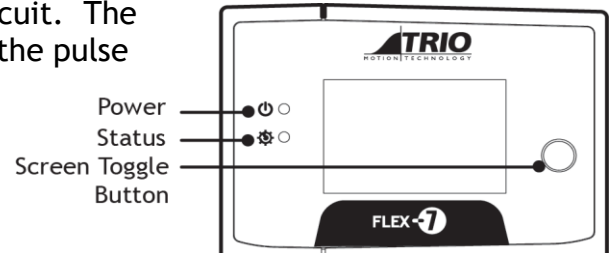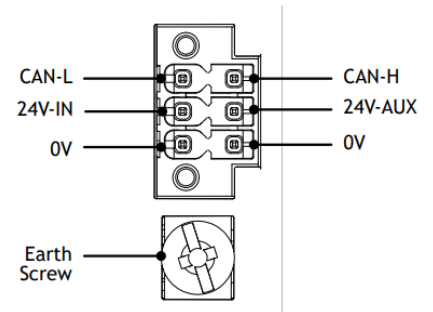
| ⏻ Power | Green power LED | Processor Running |
|---|---|---|
| ⚙ Status | Red LED | ON = WDOG Off<br>OFF = WDOG On |

## Connections to the Flex-7

24V power supply and CAN connector

A 6-pin connector is provided which has push-fit cable entry ports with spring clamp and positive push to release operation. Recommended wire cross section 0.20 .. 1.3 mm$^2$ / 24 AWG .. 16 AWG.

Note: Use copper conductors only. Use ferrules on all wires for best connection.

1. Connection: Push wire into hole of connector. No tools are necessary.

2. Removal: Push screwdriver against coloured button to release wire and pull wire out.
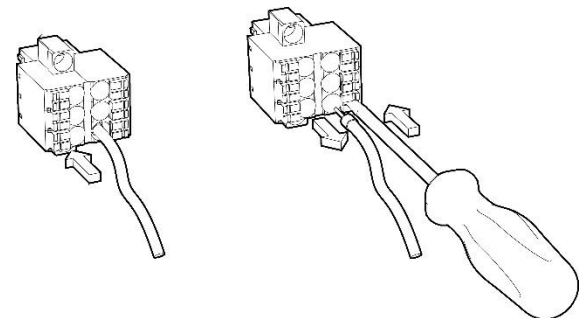
*24V-IN:*

The Flex-7 requires a Class 2 transformer power source within the range 21-29V, Minimum 1A.

*24V-AUX:*

Optional Secondary 18-29Vdc Input used for backup purposes when the voltage on the main PSU starts to drop i.e., battery, UPS

Minimum current 1A.

If 24V-IN drop below 21V, it will trigger a visual "W04: 24v" "undervoltage" warning on the display as well as a system warning flag on bit 4. This flag allows the end user to implement this warning in their own program/application and act upon.

24V-AUX can be use during a voltage undervoltage on 24V-IN as long as the battery charge allows it.

## *CAN communications*

The Flex 7 Motion Coordinator CAN port supports CAN bus communications to Trio (and 3rd party) CAN I/O expansions modules (listed on the website under Products > CAN I/O).

For Flex 7 CAN communication to Trio CAN modules, using Trio's custom CAN protocol is recommended, as it is mostly automated and simpler. Third party CAN nodes are not supported by Trio CAN protocol, meaning the CANOpen protocol must be used.

To power the controller & CAN bus, 24 Volts supply must be connected to the '24V-IN' & '0V' pins on the left side of the Flex 7 CAN port, and the 'CAN 24V' & 'CAN 0V' of each CAN module.

## *Basic steps for connecting a CAN network:*

- CAN-H/C-High must be connected in sequential order from the controller to the 1st module to the next and so on, until all modules are connected.
- CAN-L/C-Low must be connected in sequential order from the controller to the 1st module to the next and so on, until all modules are connected.
- On both the controller & last module, a 120 Ohm resistor should be connected between the CAN-H & CAN L pins, to dictate the start (controller) & end (last module) of the bus.
- Finally, the Shield pin must also be connected in sequential order from the controller's 'Earth Screw' to every module's Shield ( ⊪—) pin.

    The CAN I/O Modules port pins CAN-H, CAN-L, CAN-24V, CAN-0V & Shield are shown in the following diagram:
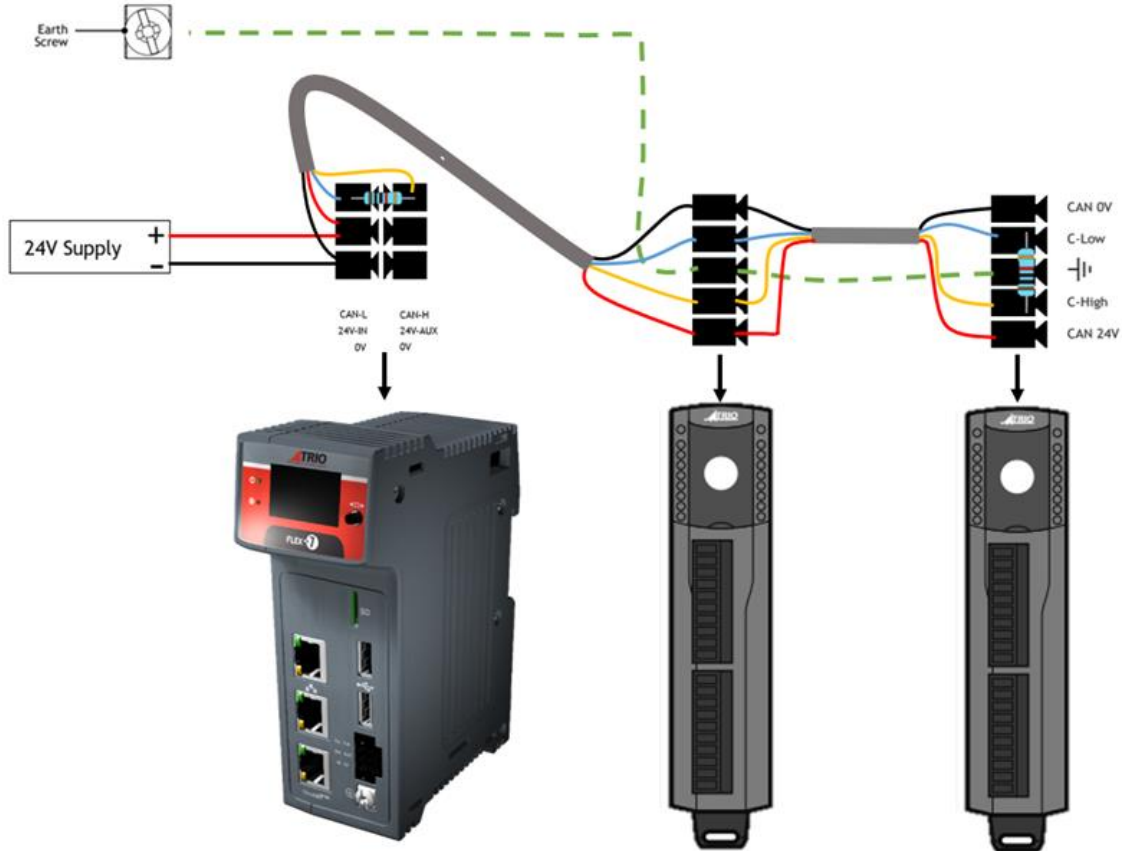
### *Ethernet port connection (x2) (Upper and Middle sockets)*

RJ45 socket 100/1000BASE-T

The Ethernet port is the default connection between the Motion Coordinator and the host PC running the Motion Perfect development application.

In addition, the Ethernet port will provide connection using common Ethernet industrial protocols such as Modbus and Ethernet IP.

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

These ports share an identical IP address that can be found using the display screen. The default IP address is: 192.168.0.250.

This can be changed in several ways, using Trio's Motion Perfect software it can be altered using the IP_Address command or creating an MC_CONFIG program on the control that sets the IP_Address.

If connecting to Motion Perfect is not an option, the IP address can be changed using a SD Card. This is done by creating a .txt file on a blank SD card and naming it "TRIOINIT.bas" Then write IP_Address = 192.168.0.191 or whichever address is required to the first line and save the file. The SD card is the inserted into the powered down control and the Flex-7 is then powered cycled. This will alter the IP address to what is specified in the .bas file.

### *EtherCAT port connection (Lower socket)*

RJ45 socket 100BASE-T

The Flex-7 acts as an EtherCAT master. EtherCAT drives and I/O devices are normally connected in a chain.

Straight through (patch) or cross-over cables can be used between EtherCAT devices.

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

### *USB port connection (x2)*

The USB sockets can be used with a USB thumb drive to provide external data storage. Each port can supply devices with up to 200mA at 5V DC, this amount is monitored and limited by the controller. These can be written to and read from using the file access channels (#40-#48) in TrioBASIC.

With the OPEN command you can substitute the SD designator with USB1 or USB2 to access the drives. With the FILE command, you append the drive name such as "USB1" as an additional parameter.

## *Registration*

Flex-7 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.  Precise position capture can then be done to enable operation of many machine types which include printing, cutting and scanning machines.

# System Warnings

There are several system warnings that can be triggered by incorrect inputs to the Flex-7 which are detailed bellow:

| Warning | Possible Cause | System Flag | Display message |
|---|---|---|---|
| EBUS Overcurrent | Attaching too many FlexSlices or a faulty slice drawing too much current on the EBUS 5V rail. | set **SYSTEM_WARNING.1** flag high | **"W01: EBUS","overcurrent"** on OLED display. |
| USB1 Overcurrent | Drawing excessive current (over 200mA) out of the USB 5V or a faulty USB device. | set **SYSTEM_WARNING.2** flag high | **"W02: USB1","overcurrent"** on OLED display |
| USB2 Overcurrent | Drawing excessive current (over 200mA) out of the USB 5V or a faulty USB device. | set **SYSTEM_WARNING.3** flag high | **"W03: USB2"** on OLED display |

| 24V-IN Undervoltage | Removing 24V-IN cable and leaving 24V-AUX, the PSU voltage could fail to provide the required voltage or a long DC voltage could create a voltage drop resulting in a lower voltage input to the Flex-7 | set **SYSTEM_WARNING.4** flag high | "W04: 24v","undervoltage" on OLED display |
|---|---|---|---|

# Expanding the system

The Flexslice system makes available a selection of digital and analogue I/O terminals as well as motion modules with analogue servo and pulse + direction outputs designed for precise positioning of stepper and servo motors via suitable drive technology. The digital I/O modules have high-speed functionality and can sample on each EtherCAT cycle. In addition, analogue modules and axis modules may be fitted to make a superbly tailored system that can be placed remotely from the master if needed.



All Flexslice modules support automatic addressing with the master able to automatically detect and configure the modules on startup. The Flex-7 supports up to 16 digital input/output modules which have a positive mechanical lock and bus connector, making a reliable "back-bone" style connection (EBUS). The complete assembly can be DIN rail mounted.
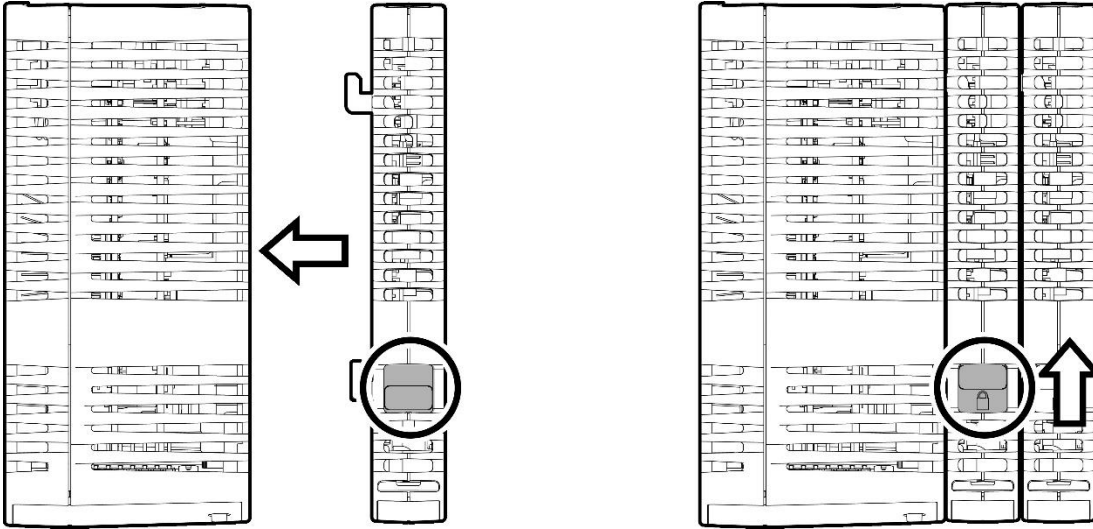
## EBUS loading

Internal power for each Flexslice module is provided from the P770 Flex-7. The maximum current available can supply up to 16 simple digital input / output modules. When other modules are attached such as the analogue or axis modules, extra power is needed for the internal microcontroller so the number of modules will therefore need to be reduced.

| Description | Thermocouple | RTD | Load Cell | 16 Output PNP | 16 Input PNP | Analogue 2 Servo Axis | Flex 3-Axis | 16 Output NPN | 16 Input NPN | 8 Analogue Outputs (V) | 8 Analogue Inputs (V) | 8 Analogue Inputs (A) | 32 Output NPN | 32 Input NPN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flexslice | P367 | P368 | P369 | P371 | P372 | P374 | P375 | P376 | P377 | P378 | P379 | P359 | P386 | P387 |
| Unit Load | 1.25 | 1.25 | 1.25 | 1 | 1 | 2.5 | 2 | 1 | 1 | 4 | 1.25 | 1.25 | 1 | 1 |
| Qty | | | | | | | | | | | | 1 | | |

| Total Load | 1.25 | (Max = 16) | | EBUS load Okay | | |
|---|---|---|---|---|---|---|

**Instructions**
1) Enter the quantity of each Flexslice in the system in the light green "Qty" boxes.
2) The total load will automatically update.
3) If the maximum load is exceeded a warning will be given.

EBUS load calculator

The table above shows the load weighting for a range of Flexslice modules. Multiply Unit Load by the quantity of modules of that type. The sum of all modules thus weighted must not exceed 16.

The EBUS load calculator may be downloaded from Trio's website.

## Support Software

Motion Perfect version 5 or later is required for configuration, programming and system debug. A PC running Microsoft Windows (Windows 10 or later recommended) is required. Download Motion Perfect from www.triomotion.com and install on the PC.

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.
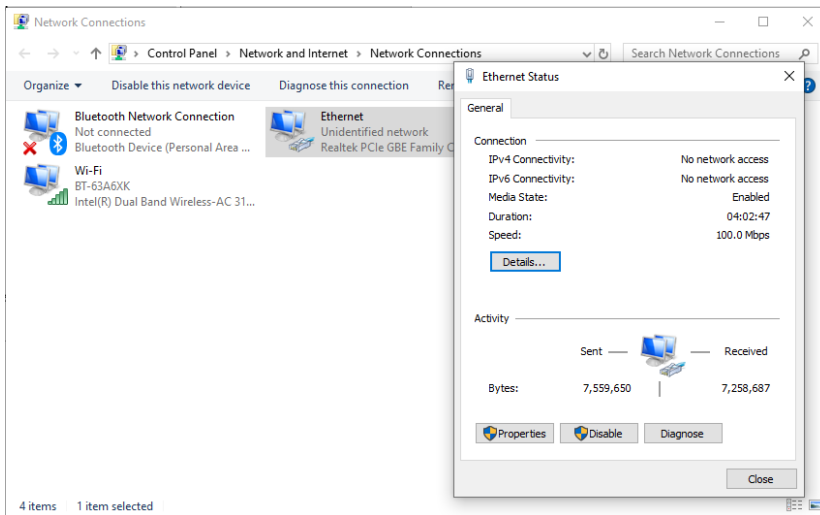


Click the Properties button and then select Internet Protocol Version 4 (TCP/IPv4).
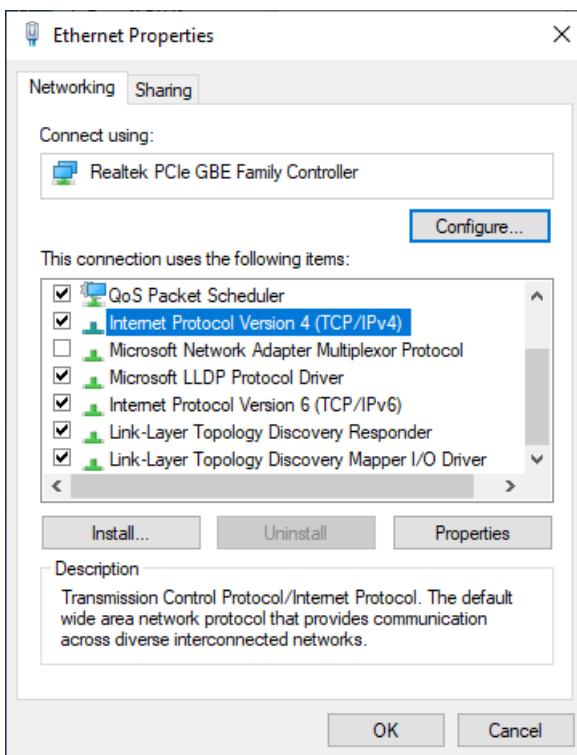


Click Properties and select Use the following IP address. Set an IP address in the same subnet as the Flex-7. Usually this will be 192.168.0.xxx.
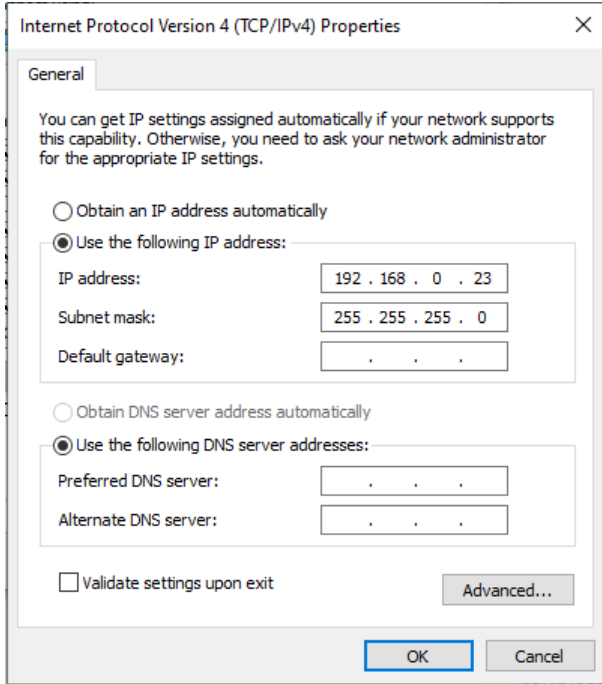
Click OK and close the Ethernet setup dialogues.

## Motion Perfect version 5

Launch Motion Perfect and select the IP address of the Flex-7.  As mentioned earlier, by default this will be 192.168.0.250.  Click the Apply and Connect button.
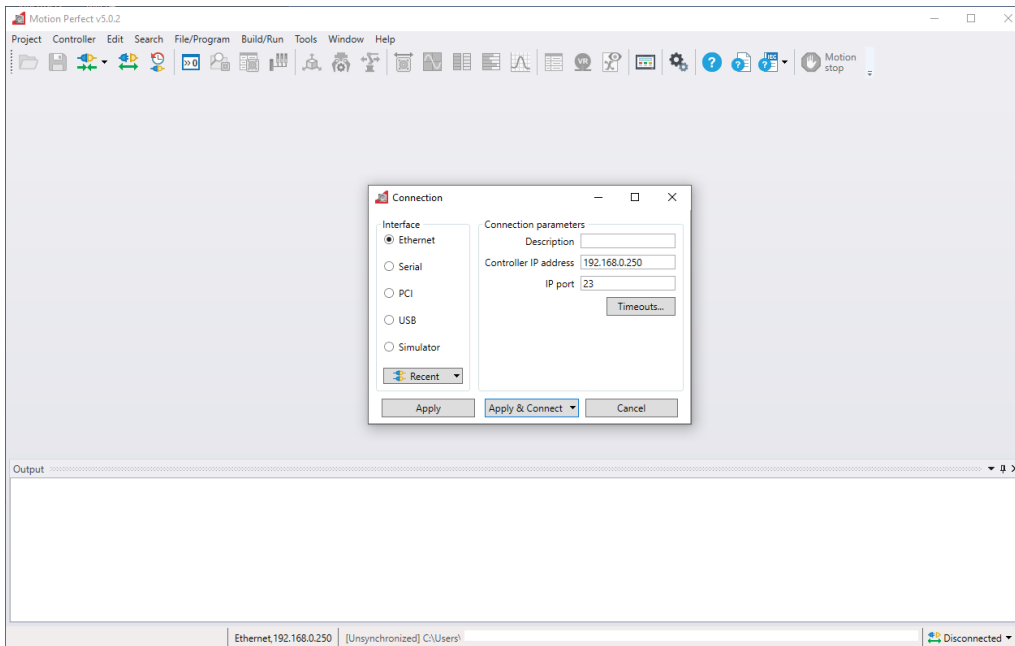
If the IP Address of the Flex-7 is not known, it can be found by cycling though the Flex-7 display screen. It is displayed on screen 1, mentioned in the earlier display section.
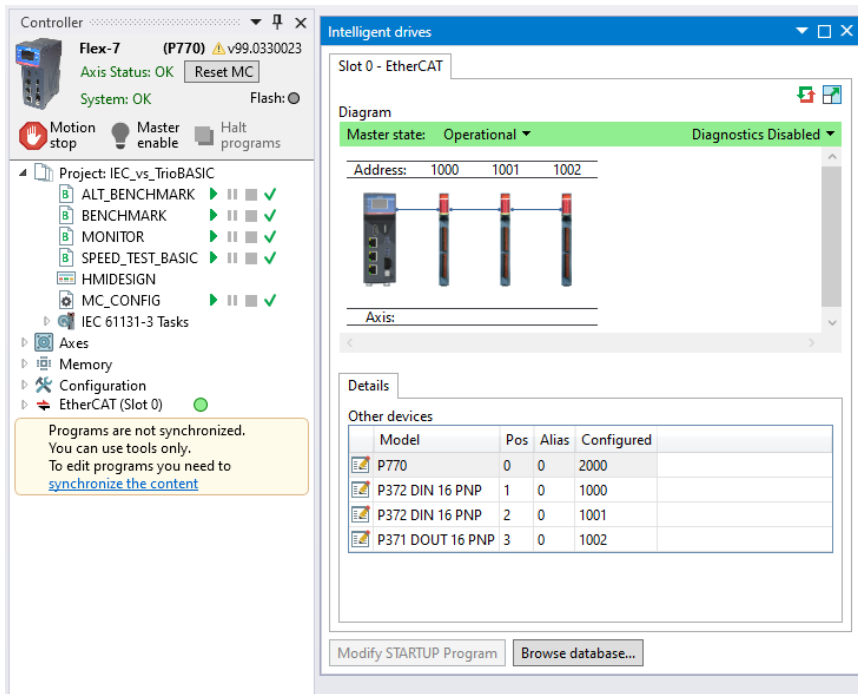


**Motion Perfect in Synchronised connection mode.**

# Software functions

The Flex-7 contains a stand-alone operating system which includes a rich set of built-in motion functions accessible from both the interpreted Motion iX text language and the IEC-61131-3 standard PLC language.  A short summary of the main functions is shown in the table below.

| Function name (Keyword) | Description | Notes |
|---|---|---|
| MOVE | Incremental move. One axis or multiple axes move at the programmed speed and acceleration. | SPEED sets vector speed. |
| MOVEABS | Absolute position move. Move one axis or multiple axes to position(s) referenced with respect to the zero (home) position. | |
| MOVECIRC | Moves 2 orthogonal axes in such a way as to produce a circular arc at the tool point. | |
| MHELICAL | Moves 2 orthogonal axes in such a way as to produce a circular arc at the tool point with a simultaneous linear move on a third axis. | |

| MSPHERICAL | Moves 3 orthogonal axes along a spherical path. | |
|---|---|---|
| MOVEABSSEQ | Allows a sequence of movements to be run from a pre-loaded table of position values. The moves can be automatically merged together using fillets. (circular arcs) | |
| MOVESP | Same as MOVE with addition of speed profile control for cutting and machining operations. | CORNER CONTROL enabled |
| MOVEABSSP | Same as MOVEABS with addition of speed profile control for cutting and machining operations. | |
| MOVECIRCSP | Same as MOVECIRC with addition of speed profile control for cutting and machining operations. | |
| MHELICALSP | Same as MHELICAL with addition of speed profile control for cutting and machining operations. | |
| MSPHERICALSP | Same as MSPHERICAL with addition of speed profile control for cutting and machining operations. | |
| CONNECT | Link 2 axes together so that one axis follows the other with a defined gear ratio. | |
| MOVELINK | Link 2 axes together temporarily with a defined ramp up and ramp down on the following axis. | Linear or S-curve acceleration profile |
| FLEXLINK | Link an axis to a driving axis with varying ratio over a base distance and programmable excitation distance. | |
| CAMBOX | User defined constantly changing ratio between the axis and its driving axis.  (Cam shape supplied by user program) | |
| MOVEPICK | Pre-defined pick and place profile.  User defined overlap and withdraw distances. | |

# EtherCAT network

EtherCAT slave devices may be added to make a network.  Device addresses will default to their position on the network with the local I/O being located first ahead of any external devices.  Addresses can be altered by settings in the slaves or in the master if required.
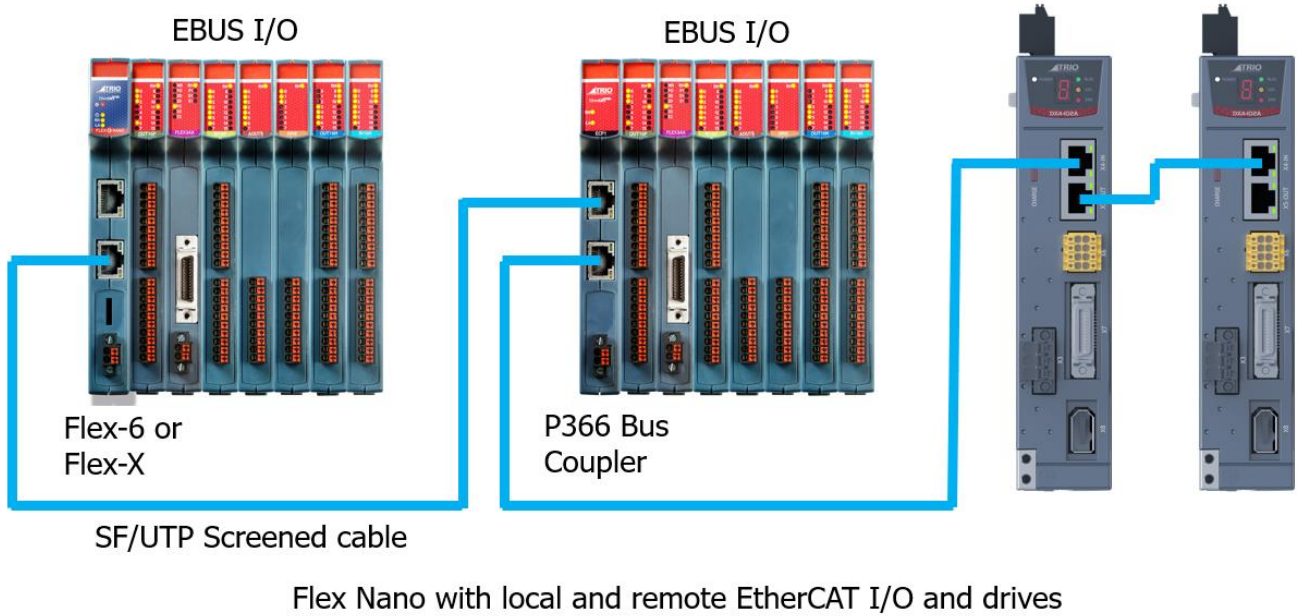
## *Example 1*
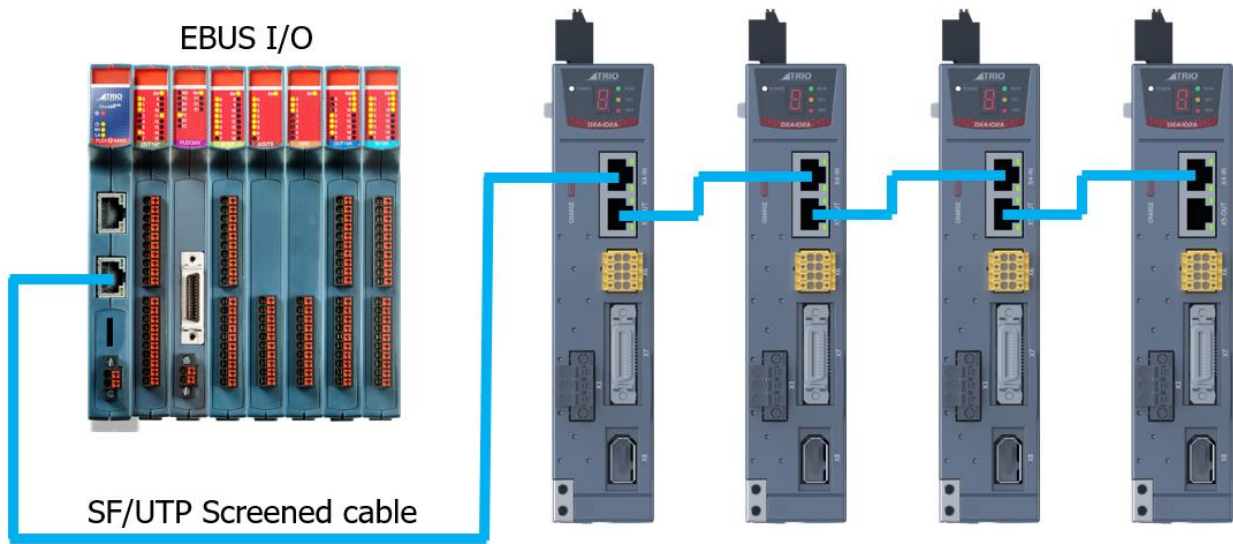


Flex Nano with local I/O and remote EtherCAT drives

## *Example 2*
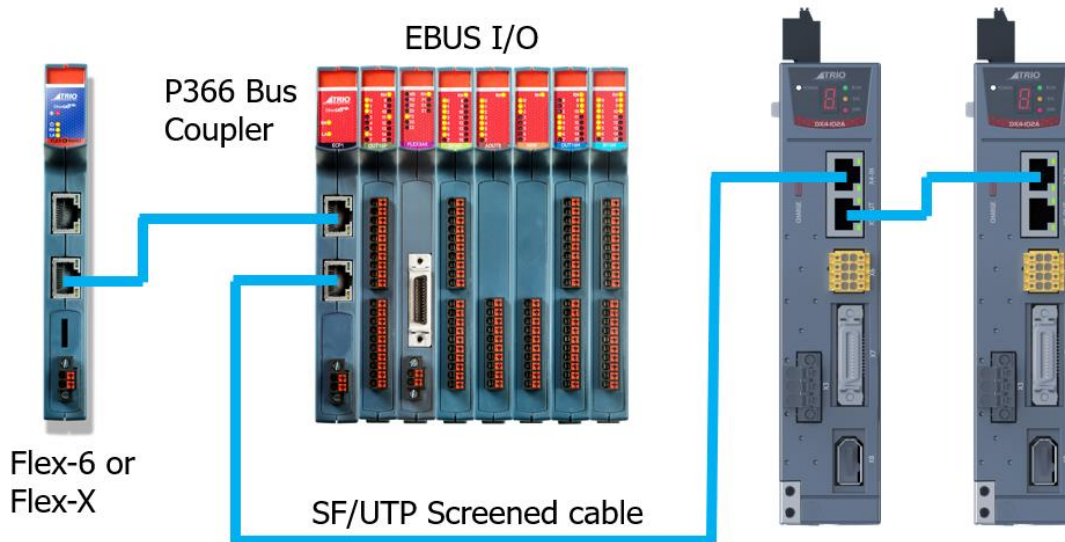


Flex Nano with remote EtherCAT I/O and drives

## *Example 3*



Flex Nano with local and remote EtherCAT I/O and drives

## Adding axes

Depending on the feature codes applied to the unit, the Flex-7 will be able to connect and start a certain number of axes (drives).

It is possible to extend the number of axes by purchasing a Feature Enable Code (FEC) from the original supplier of the Flex-7. The order code for axis extension is P914. Each P914 will provide a FEC to double the number of axes that can be initialised and run.

FECs are added via Motion Perfect.

FEC0 to FEC5 will enable 2x axes for each code.
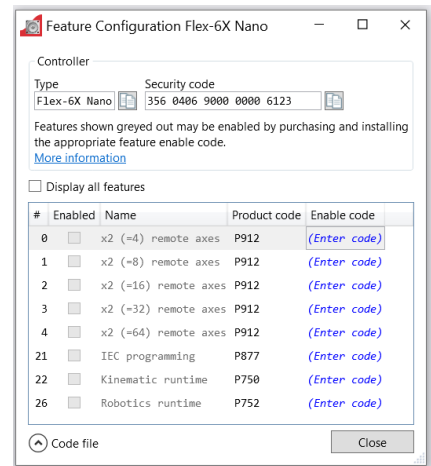


## Firmware recovery

In the unlikely event that the Motion Coordinator firmware becomes corrupted, and the processor will not start the Ethernet port and allow communication, the Flex-7, has a firmware recovery mode. The recovery is triggered by powering the Flex-7 with the SD card fitted, containing the r_770.zenc recovery file.

The following equipment is needed to complete the Firmware Recovery:

- Micro SD card formatted to FAT32. Max size 32GB.
- Firmware file for the Flex-7, downloaded from the Trio Website.

Rename the firmware file to r_770.zenc and copy it to the root folder on the micro-SD card.

With the power off, insert the micro-SD card into the slot and then turn on the power. Full instructions are given on the on-board display. The user will be prompted for a button press to begin the update. Update will take a little over 3 minutes, with progress being shown on the display. Please DO NOT REMOVE POWER until the display indicates it is safe to do so. After a reboot the IP address will have been restored to the default 192.168.0.250, subnet mask 255.255.255.0 and default gateway 192.168.0.255.

# Dimensions
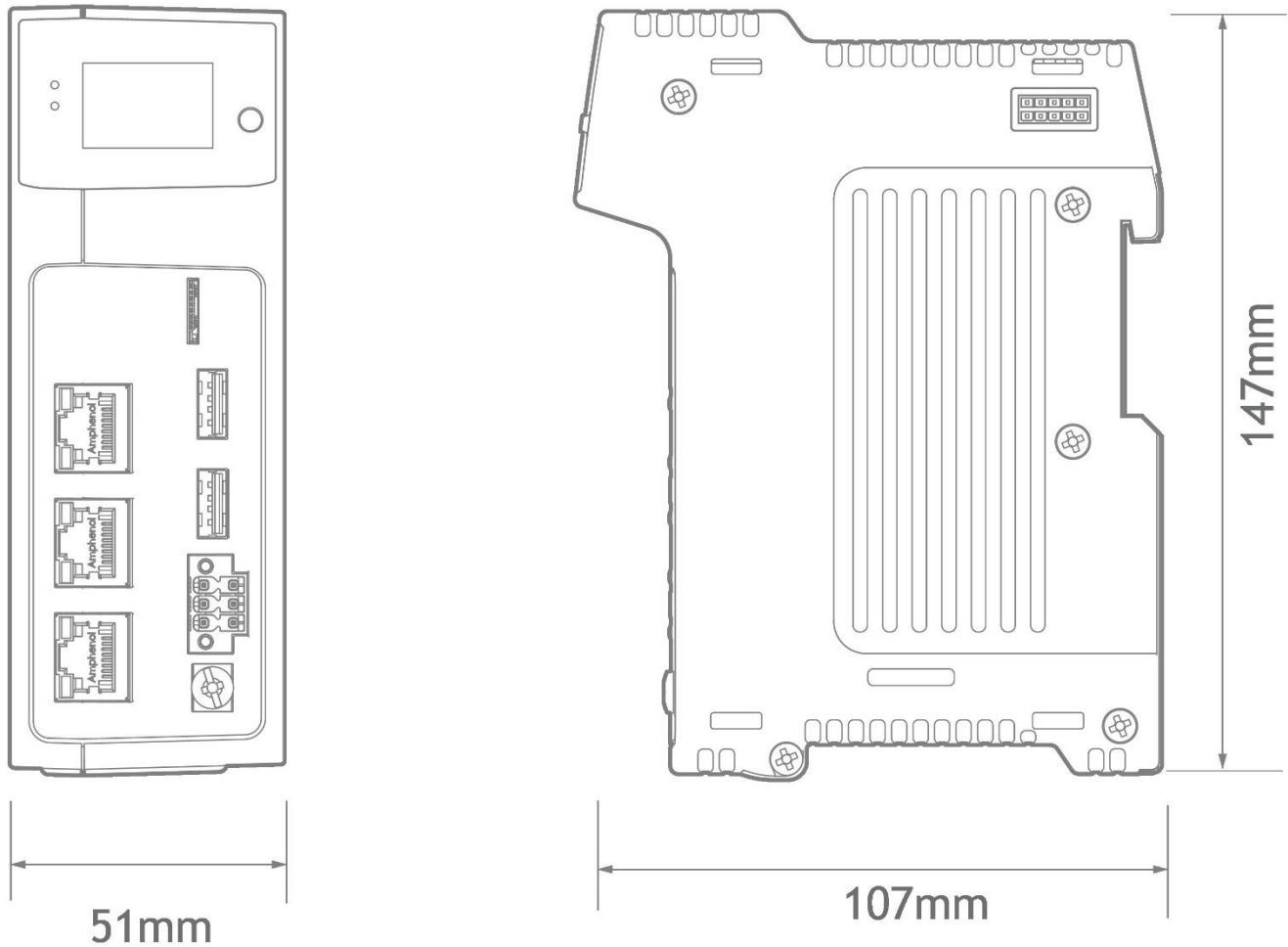
# Mounting

The Flex-7 has a standard DIN rail mount with over-centre clip operated by a lever on the lower face.  It must be installed vertically with the vents on the top and bottom faces, on an unpainted metal plate with DIN rail which is connected to earth.

The Flex-7 must be mounted in an enclosed cabinet, there must be an adequate volume of circulating air to maintain the environmental temperature within the operating temperature range.  If clearance is allowed for cable connections, there is no further limit on spacing next to other components that do not emit heat.

*Place below heat sources such as drives and power supplies.*

# Specifications

| Specification table | |
|---|---|
| Size | 147 mm x 107 mm x 51 mm (HxWxD) |
| Weight | 420g |
| Operating Temp. | 0 - 45 degrees C |
| EMC (CE) | EMISSIONS – EN IEC 61000-6-4 : 2019<br>IMMUNITY – EN IEC 61000-6-2 : 2019 |
| EMC (UKCA) | EMISSIONS – BS EN IEC 61000-6-4 : 2019<br>IMMUNITY – BS EN IEC 61000-6-2 : 2019 |
| Control Inputs<br>Via I/O expansion | Forward Limit<br>Reverse Limit<br>Datum Input<br>Feedhold Input |
| Communication Ports | 2 x Ethernet : 100/1000BASE-T multiple port connection.<br>EtherCAT : 100BASE-T cyclic at SERVO_PERIOD rate.<br>EBUS : Local EtherCAT bus for Flexslice Module expansion. |
| Position Resolution | 64 bit internal position registers |
| Speed Resolution | 32 bits. Speed may be changed at any time<br>Moves may be merged |
| Servo Cycle | 125µs minimum<br>1ms default<br>4ms maximum |

| | |
|---|---|
| Programming | Multi-tasking Motion iX system<br>IEC 61131-3 programming system.<br>Maximum 22 user processes. |
| Interpolation modes | Linear, circular, helical, spherical, CAM Profiles, speed control, software gearbox and linked motion.<br><br>Special profiles for Pick and Place, Dispensing and CNC. |
| Processor | ARM Cortex-A53 quad core, 1.2GHz max clock frequency. |
| Memory | 2GB LPDDR4 RAM<br><br>12 Mbyte user program memory<br>Automatic flash EPROM program and data storage |
| VR | 65536 global VR data in FLASH memory (automatic-store) |
| TABLE | 512000 x 64 bit TABLE memory |
| Real Time Clock | Super-capacitor support for 20 days of power off. Accuracy 5ppm max (o.5s per day) at 25deg C. |
| SD Card | SD/SDHC micro-SD Card FAT 32, up to 32 GB<br>Stores programs and data<br>Can be used for firmware update, user program installation and system recovery |
| Power Input | 24V-IN:<br><br>Power Supply requirement: 21-29 Vdc, 1A min, Class 2 power supply<br><br>24V-Aux:<br><br>Optional Secondary 18-29Vdc Input used for backup purposes when the voltage on the main PSU starts to drop i.e., battery, UPS |
| USB Power Output | 200mA at 5V DC maximum |
| Amplifier Enable Output | Software enable via EtherCAT |
| Product Code | P770 : Flex-7 EtherCAT Motion Coordinator (2 axes) |
| Axis upgrade code | P912 : FEC0 .. FEC5. Each code doubles the max. axis count |

# 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) | 1. Always connect ALL 0V current return wires<br><br>2. Do not use the screen for 0V current return<br><br>3. It is highly recommended to avoid connecting 0V across internal isolation barriers.<br>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.<br><br>4. Do not join together 0V from high power and / or noisy sources with the 0V from signal ports (incl. CAN bus DC input).<br><br>5. Do not use any controller 0V connection as a current return for peripheral devices. | 24V-IN supply 0V and 24V-AUX 0V are common but isolated from all other 0V. |
| All 24V DC ports | 1. 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 | 1. Maintain 150mm separation of parallel Class I and Class II cable (IEC 61000-5-2:1997)<br><br>2. Unless otherwise specified, all cables must be <30m in length | |
| Proximity to source of disturbance | 1. 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 | 1. Trio's products should always be installed within a locked cabinet with access limited to authorised personnel only. | |
| CAN bus | 1. Screened, twisted pair cable with characteristic impedance of 120 Ohm. (±10 Ohm)<br><br>2. Connect screen to Chassis at every node. | Connect controller side cable screen to Earth screw. |
| Ethernet | 1. TIA Cat5e, minimum.<br><br>2. Shielded cable.<br><br>3. Cable ≤30m in length. | Overall Foil Braided Shield with Unshielded Twisted Pairs.<br><br>Compliant with Industrial SF/UTP. |
| EMC Earth Connection | 1. Mount on bare metal backplane.<br><br>2. Use a minimum 10mm wide, braided conductor to connect backplane / chassis to PE.<br><br>3. Do not use circular cross-section wire. | When the Flex-7 metal din-rail 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.
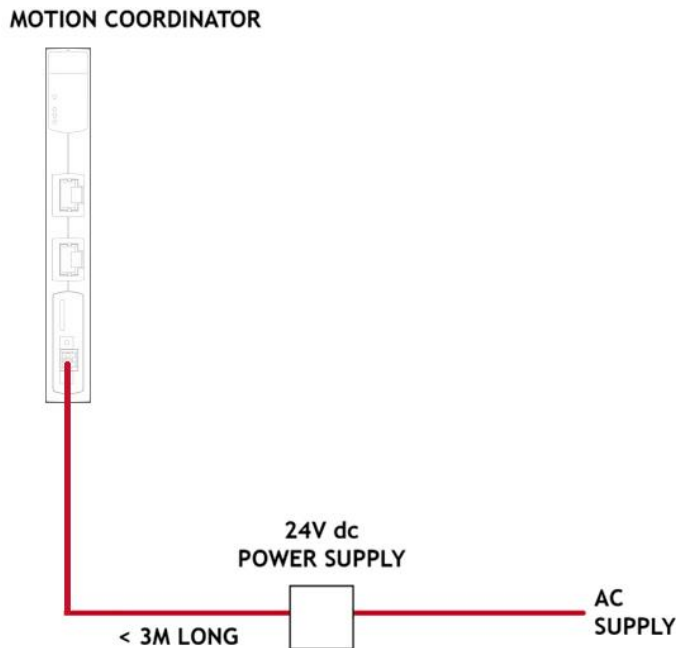


**Motion Coordinator with dedicated power source**

### *Distributed power supply*

If the device is connected to a distributed power supply <u>or</u> 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.
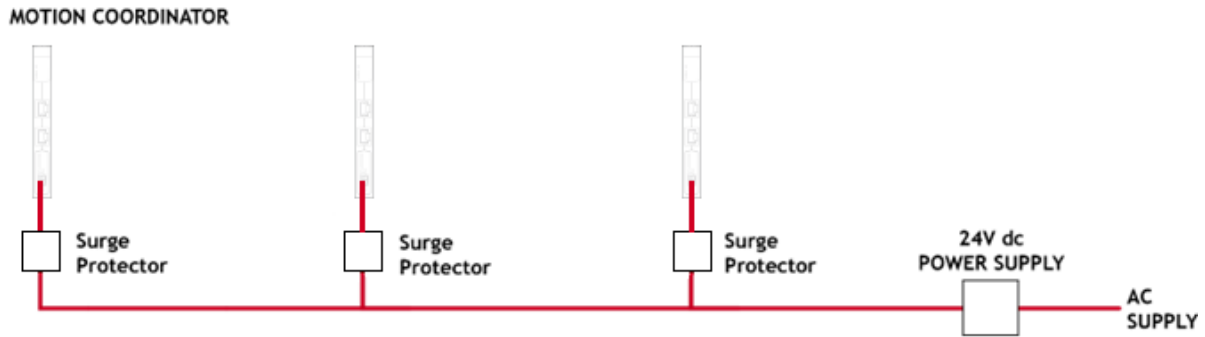
Distributed power supply with surge protection

## Surge protection device

| Protection device - Minimum specification | |
|---|---|
| Operating Voltage | 24V DC |
| Suppression Begins:<br>Stage Two<br>Stage Three | <br>30V<br>35V |
| Max. Clamp Volts for transients on the line:<br>Stage Two<br>Stage Three | <br>65V<br>77V |
| Surge Current (8/20mSec Pulse)<br>+ to -<br>+ to Earth<br>- to Earth | <br>9000A<br>4000A<br>4000A |
| Surge Energy (2mSec Pulse)<br>+ to -<br>+ to Earth<br>- to Earth | <br>94 Joules<br>44 Joules<br>44 Joules |
| Response Time | <5 nsec |
| Resistance to Earth:<br>Max Over-Voltage<br>Operating Voltage | <br>0.01 Ω<br>> 1 MΩ |

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