Cat. No.
I57E-EN-05

OMRON

Trajexia machine control system

TJ2-MC64, TJ2-MC02, TJ1-ML04, TJ1-ML16, TJ1-PRT, TJ1-DRT, TJ1-CORT, TJ1-FL02, TJ2-KS02, GRT1-ML2
TJ2-ECT04, TJ2-ECT16, TJ2-ECT64, GRT1-ECT, 3G3AX-MX2-MRT, 3G3AX-RX-MRT

HARDWARE REFERENCE MANUAL

Notice

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual. The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to property.

Definition of precautionary information

WARNING
Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

Caution
Indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury, or property damage.

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Revision 5.0

About this manual

This manual describes the installation and operation of the Trajexia Machine Control System.
Please read this manual and the related manuals listed in the following table carefully and be sure you understand the information provided before attempting to install or operate the Trajexia Machine Control units. Be sure to read the precautions provided in the following section.

Name	Cat. No.	Contents
Trajexia motion control system QUICK START GUIDE	I50E	Describes how to get quickly familiar with Trajexia, moving a single axis using MECHATROLINK-II, in a test set-up.
Trajexia machine control system HARDWARE REFERENCE MANUAL	I57E	Describes the installation and hardware specification of the Trajexia units, and explains the Trajexia system philosophy.
Trajexia machine control system PROGRAMMING MANUAL	I58E	Describes the BASIC commands to be used for programming Trajexia, communication protocols and Trajexia Studio software, gives practical examples and troubleshooting information.
Sigma-II Servo Drive manual	SIEP S800000 15	Describes the installation and operation of Sigma-II Servo Drives
Sigma-III with MECHATROLINK interface manual	SIEP S800000 11	Describes the installation and operation of Sigma-III Servo Drives with MECHATROLINK-II interface
Sigma-V Servo Drive manual	SIEP S800000-44 SIEP S800000-46 SIEP S800000-48	Describes the installation and operation of Sigma-V Servo Drives
JUNMA series Servo Drive manual	TOEP-C71080603 01-OY	Describes the installation and operation of JUNMA Servo Drives
V7 Inverter	TOEP C71060605 02-OY	Describes the installation and operation of V7 Inverters
F7Z Inverter	TOE S616-55 1-OY	Describes the installation and operation of F7Z Inverters
G7 Inverter	TOE S616-60	Describes the installation and operation of G7 Inverters
JUSP-NS115 manual	SIEP C71080001	Describes the installation and operation of the MECHATROLINK-II application module
SI-T MECHATROLINK interface for the G7 & F7	SIBP-C730600-08	Describes the installation and operation of MECHATROLINK-II interfaces for G7 and F7 Inverters
ST-T/V7 MECHATROLINK interface for the V7	SIBP-C730600-03	Describes the installation and operation of MECHATROLINK-II interfaces for V7 Inverters
MECHATROLINK IO Modules	SIE C887-5	Describes the installation and operation of MECHATROLINK-II input and output modules and the MECHATROLINK-II repeater
SYSMAC CS/CJ Series Communications Commands	W342	Describes FINS communications protocol and FINS commands
Omron Smartslice GRT1-Series, slice I/O units, Operation manual	W455-E1	Describes the installation and operation of Omron slice I/O units
OMNUC G-Series user's manual	I566-E1	Describes the installation and operation of G-series Servo Drives
Accurax G5 user's manual	I572-E1	Describes the installation and operation of Accurax G5 Servo Drives
Trajexia Studio user manual	I56E-EN	Describes the use of Trajexia Studio programming software
Omron Accurax G5 EtherCAT user's manual	I573-E1 I576-E1	Describes the installation and operation of Accurax EtherCAT Servo Drives

Name	Cat. No.	Contents
MX2 User's manual	I570-E2	Describes the installation and operation of the MX2-A_ Inverter
3G3AX-MX2-ECT User's manual	I574-E1	Describes the installation and operation of the 3G3AX-MX2-ECT EtherCAT Communication Unit
GX-series EtherCAT Slave Units User's manual	W488-E1	Describes the installation and operation of the GX-series EtherCAT Slave Units
FZM1 Series User's manual	Q178-E1	Describes information on settings and specifications of the FZM1 Vision Sensor
FZM1 EtherCAT Communication manual	Q179-E1	Describes the communication with the FZM1 Vision Sensor through EtherCAT
FQ-M User's Manual	Z314-E1	Provides information regarding functions, performance and operating methods that are required for using the FQ-M.
Accurax G5 servo system Users's manual	I571-E2	This manual contains the information you need to know to correctly use the Accurax G5 and peripheral equipment.

WARNING
Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

Functions supported by unit versions

During the development of Trajexia new functionality will be added to the controller unit after market release.
This functionality is implemented in the firmware, and/or the FPGA of the controller unit.
In the table below, the overview of the applicable functionality is shown related to the firmware and FPGA version of the TJ2-MC__.

Functionality	TJ2-MC__ Firmware version	TJ2-MC__ FPGA version
Initial release	V2.0077	7
EtherNet/IP support added	V2.0083	7
EtherCAT support added	V2.0132	7
Support for GX-series I/O, FZM1-ECT	V2.0152	7
Support for GX-JC03/JC06, FQ-M	V2.0170	7
Support for TJ2-MC02, TJ2-KS02 and RX-ECT	V2.0192	7

Verify the firmware and FPGA versions of the TJ2-MC__

Connect the TJ2-MC__ to Trajexia Studio software. Refer to the Programming Manual.
Open the terminal window and type the following commands:

Type `PRINT VERSION` in the terminal window. The version parameter returns the current firmware version number of the motion controller.
Type `PRINT FPGA_VERSION SLOT(-1)` in the terminal window. The parameter returns the current FPGA version number of the TJ2-MC__.

1 Safety warnings and precautions

1.1 Intended audience

This manual is intended for personnel with knowledge of electrical systems (electrical engineers or the equivalent) who are responsible for the design, installation and management of factory automation systems and facilities.

1.2 General precautions

The user must operate the product according to the performance specifications described in this manual.
Before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, safety equipment, petrochemical plants, and other systems, machines and equipment that can have a serious influence on lives and property if used improperly, consult your OMRON representative.

1.3 Safety precautions

WARNING
Do not attempt to take the Unit apart and do not touch any of the internal parts while power is being supplied.
Doing so may result in electrical shock.

WARNING
Do not touch any of the terminals or terminal blocks while power is being supplied.
Doing so may result in electric shock.

WARNING
Never short-circuit the positive and negative terminals of the batteries, charge the batteries, disassemble them, deform them by applying pressure, or throw them into a fire.
The batteries may explode, combust or leak liquid.

WARNING
Fail-safe measures must be taken by the customer to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes.
Not doing so may result in serious accidents.

WARNING
Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided by the customer as external circuits, i.e., not in the Trajexia motion controller.
Not doing so may result in serious accidents.

WARNING
When the 24 VDC output (I/O power supply to the TJ2) is overloaded or short-circuited, the voltage may drop and result in the outputs being turned off.As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.

WARNING
The TJ2 outputs will go off due to overload of the output transistors (protection). As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.

WARNING
The TJ2 will turn off the WDOG when its self-diagnosis function detects any error.As a countermeasure for such errors, external safety measures must be provided to ensure safety in the system.

WARNING
Provide safety measures in external circuits, i.e., not in the Trajexia Motion Controller (referred to as "TJ2"), in order to ensure safety in the system if an abnormality occurs due to malfunction of the TJ2 or another external factor affecting the TJ2 operation.
Not doing so may result in serious accidents.

WARNING
Do not attempt to disassemble, repair, or modify any Units.
Any attempt to do so may result in malfunction, fire, or electric shock.

Caution
Confirm safety at the destination unit before transferring a program to another unit or editing the memory.
Doing either of these without confirming safety may result in injury.

Caution
User programs written to the Motion Control Unit will not be automatically backed up in the TJ2 flash memory (flash memory function).

Caution
Pay careful attention to the polarity (+/-) when wiring the DC power supply.A wrong connection may cause malfunction of the system.

Caution
Tighten the screws on the terminal block of the Power Supply Unit to the torque specified in this manual.
Loose screws may result in burning or malfunction.

1.4 Operating environment precautions

Caution
Do not operate the Unit in any of the following locations.
Doing so may result in malfunction, electric shock, or burning.
- Locations subject to direct sunlight.
- Locations subject to temperatures or humidity outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.

Caution
Take appropriate and sufficient countermeasures when installing systems in the following locations.
Inappropriate and insufficient measures may result in malfunction.
- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.

Caution
The operating environment of the TJ2 System can have a large effect on the longevity and reliability of the system.
Improper operating environments can lead to malfunction, failure, and other unforeseeable problems with the TJ2 System.
Make sure that the operating environment is within the specified conditions at installation and remains within the specified conditions during the life of the system.

1.5 Application precautions

WARNING
Do not start the system until you check that the axes are present and of the correct type.
The numbers of the Flexible axes will change if MECHATROLINK-II network errors occur during start-up or if the MECHATROLINK-II network configuration changes.
Not doing so may result in unexpected operation.

WARNING
Check the user program for proper execution before actually running it in the Unit.
Not checking the program may result in an unexpected operation.

WARNING
AXIS_OFFSET is fixed to a unit number. Changing the position of the attached units can therefore result in a different axis allocation.
This can result in serious injury and/or significant damage.

WARNING
Always connect the EtherCAT master port to the IN port of the first slave. Not doing so can result in unreliable communication and changes to address and axes assignment of EtherCAT slaves.

WARNING
Do not swap connections between the IN and OUT port of EtherCAT slaves. This can result in changes of address and axes assignment of EtherCAT slaves.

WARNING
Do not connect or disconnect EtherCAT slaves while the system is operational. Doing so can result in unreliable communication.

Caution
Always use the power supply voltage specified in this manual.
An incorrect voltage may result in malfunction or burning.

Caution
Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable.
An incorrect power supply may result in malfunction.

Caution
Install external breakers and take other safety measures against short-circuiting in external wiring.
Insufficient safety measures against short-circuiting may result in burning.

Caution
Do not apply voltage to the Input Units in excess of the rated input voltage.
Excess voltage may result in burning.

Caution
Do not apply voltage or connect loads to the Output Units in excess of the maximum switching capacity.
Excess voltage or loads may result in burning.

Caution
Disconnect the functional ground terminal when performing withstand voltage tests.
Not disconnecting the functional ground terminal may result in burning.

Caution
Always connect to a class-3 ground (to 100Ω or less) when installing the Units.
Not connecting to a class-3 ground may result in electric shock.

Caution
Always turn off the power supply to the system before attempting any of the following.
Not turning off the power supply may result in malfunction or electric shock.

- Mounting or dismounting expansion Units, CPU Units, or any other Units.
- Assembling the Units.
- Setting dipswitches or rotary switches.
- Connecting or wiring the cables.
- Connecting or disconnecting the connectors.

Caution
Be sure that all mounting screws, terminal screws, and cable connector screws are tightened to the torque specified in this manual.
Incorrect tightening torque may result in malfunction.

Caution
Leave the dust protective label attached to the Unit when wiring.
Removing the dust protective label may result in malfunction.

Caution
Remove the dust protective label after the completion of wiring to ensure proper heat dissipation.
Leaving the dust protective label attached may result in malfunction.

Caution
Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals.
Connection of bare stranded wires may result in burning.

Caution
Double-check all the wiring before turning on the power supply.
Incorrect wiring may result in burning.

Caution
Wire correctly.
Incorrect wiring may result in burning.

Caution
Mount the Unit only after checking the terminal block completely.

Caution
Be sure that the terminal blocks, expansion cables, and other items with locking devices are properly locked into place.
Improper locking may result in malfunction.

Caution
Confirm that no adverse effect will occur in the system before changing the operating mode of the system.
Not doing so may result in an unexpected operation.

Caution
Resume operation only after transferring to the new CPU Unit the contents of the VR and table memory required for operation.
Not doing so may result in an unexpected operation.

Caution
When replacing parts, be sure to confirm that the rating of a new part is correct.
Not doing so may result in malfunction or burning.

Caution
Do not pull on the cables or bend the cables beyond their natural limit. Doing so may break the cables.

Caution
Before touching the system, be sure to first touch a grounded metallic object in order to discharge any static build-up.
Otherwise it might result in a malfunction or damage.

Caution
UTP cables are not shielded. In environments that are subject to noise use a system with shielded twisted-pair (STP) cable and hubs suitable for an FA environment.
Do not install twisted-pair cables with high-voltage lines.
Do not install twisted-pair cables near devices that generate noise.
Do not install twisted-pair cables in locations that are subject to high humidity.
Do not install twisted-pair cables in locations subject to excessive dirt and dust or to oil mist or other contaminants.

Caution
Use the dedicated connecting cables specified in operation manuals to connect the Units.
Not doing so may result in malfunction of the system.

Caution
Outputs may remain on due to a malfunction in the built-in transistor outputs or other internal circuits.
As a countermeasure for such problems, external safety measures must be provided to ensure the safety of the system.

Caution
The TJ2 will start operating in RUN mode when the power is turned on and if a BASIC program is set to Auto Run mode.

Caution
Always check the “Status-Words” of each GRT1-ML2 and GRT1-ECT SmartSlice coupler.
Not doing so can lead to missing or incorrect I/O data.

Caution
Always check the status of the connected MECHATROLINK-II devices in a BASIC program.
Not doing so may result in an unexpected operation.

Caution
The TJ1-CORT unit is developed to exchange I/O data between the Trajexia system and a CANopen network.
The TJ1-CORT is not able to exchange motion commands.
Using the TJ1-CORT to exchange motion commands may result in unexpected operation.

Caution
Although the TJ2-MC__ in most cases is backwards compatible with TJ1-MC__, applications written for TJ1-MC__ must be tested carefully when running on TJ2-MC__.
Not doing so may result in unexpected operation.

Caution
When using multiple TJ1-ML__ units, do not swap the MECHATROLINK-cables. This can result in different axis allocation. This can result in serious injury and/or significant damage.

1.6 Unit assembly precautions

Caution
nstall the unit properly.
Improper installation of the unit may result in malfunction.

Caution
Be sure to mount the TJ1-TER supplied with the TJ2-MC__ to the right most Unit.
Unless the TJ1-TER is properly mounted, the TJ2 will not function properly.

1.7 Conformance to EC Directives Conformance

1.7.1 Concepts

The concepts for the directives EMC and Low Voltage are as follows:

EMC Directives
OMRON devices that comply with EC Directives also conform to the related EMC standards so that they can be more easily built into other devices or machines. The actual products have been checked for conformity to EMC standards. Whether the products conform to the standards in the system used by the customer, however, must be checked by the customer.
EMC-related performance of the OMRON devices that comply with EC Directives will vary depending on the configuration, wiring, and other conditions of the equipment or control panel in which the OMRON devices are installed. The customer must, therefore, perform final checks to confirm that devices and the over-all machine conform to EMC standards.

Low Voltage Directive
Always ensure that devices operating at voltages of 50 to 1,000 VAC or 75 to 1,500 VDC meet the required safety standards.

1.7.2 Conformance to EC Directives

The Trajexia Motion Controllers comply with EC Directives.
To ensure that the machine or device in which a system is used complies with EC directives, the system must be installed as follows:

1. The system must be installed within a control panel.
2. Reinforced insulation or double insulation must be used for the DC power supplies used for the communications and I/O power supplies.

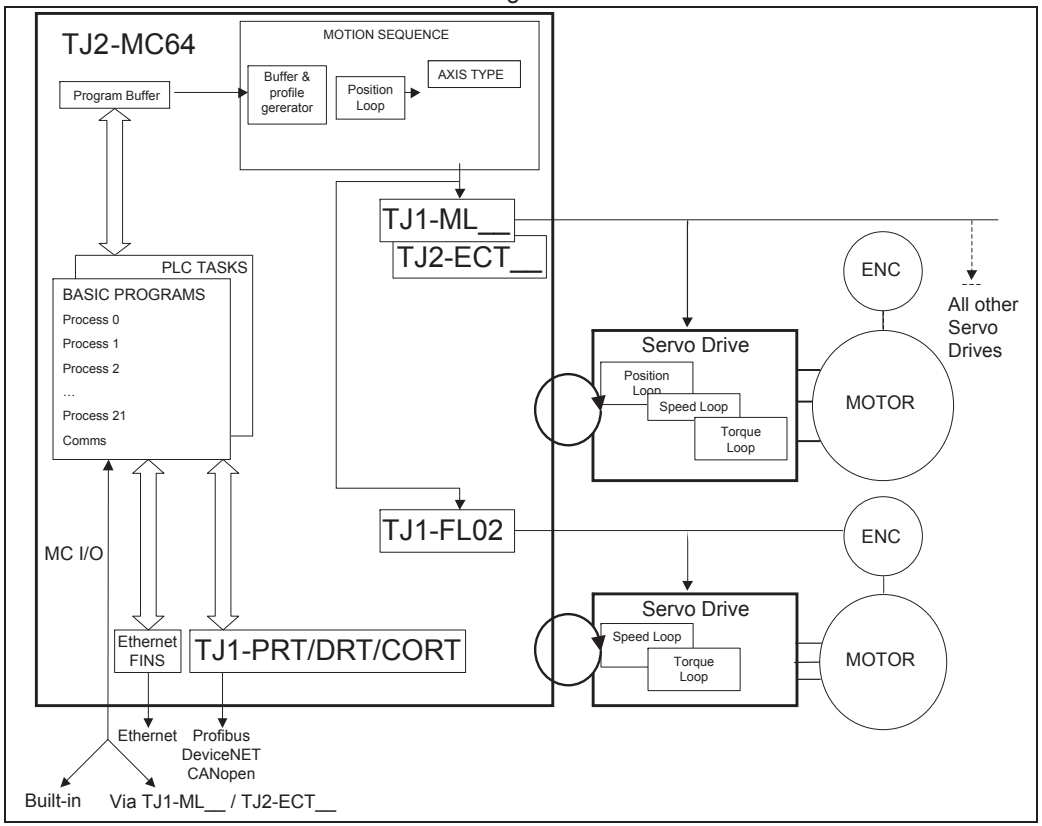
2 System philosophy

2.1 Introduction

The system philosophy is centred around the relationship between:
- System architecture
- Cycle time
- Program control and multi-tasking
- Motion sequence and axes
- Motion buffers

A clear understanding of the relationship between these concepts is necessary to obtain the best results for the Trajexia system.

fig. 1



2.1.1 Glossary

Motion sequence
The Motion Sequence is responsible for controlling the position of the axes.

Servo period
Defines the frequency at which the Motion Sequence is executed. The servo period must be set according to the configuration of the physical axes. The available settings are 0.25ms, 0.5ms, 1ms or 2ms.

Cycle time
Is the time needed to execute one complete cycle of operations in the TJ2-MC__. The cycle time is divided in 4 time slices of equal time length, called "CPU slots". The cycle time is 1ms if **SERVO_PERIOD**=0.25ms, 0.5ms or 1ms and 2ms if the **SERVO_PERIOD**=2ms.

CPU slots

The operations executed in each CPU slot are:

CPU slot	Operation
First CPU slot	BASIC and/or PLC execution Motion Network update (if **SERVO_PERIOD**=0.25ms)
Second CPU slot	BASIC and/or PLC execution Motion Network update (if **SERVO_PERIOD**=0.25ms or 0.5ms)
Third CPU slot	Internal houskeeping Motion Network update (if **SERVO_PERIOD**=0.25ms)
Fourth CPU slot	BASIC and/or PLC execution Motion Network update (all **SERVO_PERIODs)**

Program

A program is a piece of BASIC code.

Process

Is a program in execution with a certain priority assigned. Low Priority BASIC programs get assigned to process 0 to 19 and High Priority BASIC programs get assigned to Process 20 and 21. First the process priority, High or Low, and then the process number, from high to low, will define to which CPU slot the process will be assigned. Process 22 to 24 are for internal housekeeping.
Each PLC task will get assigned to process 27 to 42. Process 25 and 26 are for internal housekeeping of the PLC engine.

2.2 Motion control concepts

The TJ2-MC__ offers these types of positioning control operations:
1. Point-to-Point (PTP) control
2. Continuous Path (CP) control
3. Electronic Gearing (EG) control.

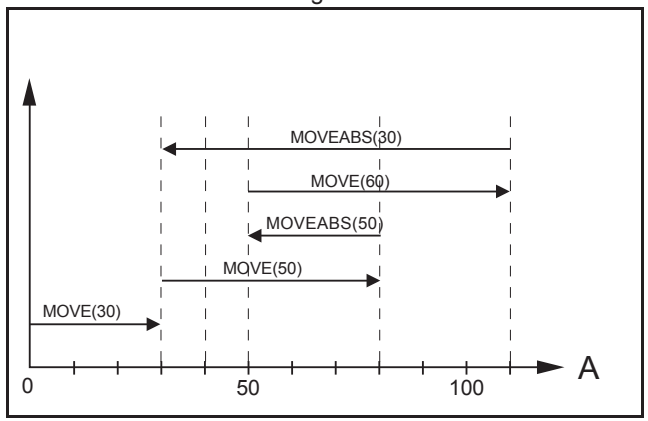
This section introduces some of the commands and parameters used in the BASIC programming of the motion control application.

Coordinate system
Positioning operations performed by the TJ2-MC__ are based on an axis coordinate system. The TJ2-MC__ converts the position data from either the connected Servo Drive or the connected encoder into an internal absolute coordinate system.

The engineering unit that specifies the distances of travelling can be freely defined for each axis separately. The conversion is performed through the use of the unit conversion factor, which is defined by the **UNITS** axis parameter. The origin point of the coordinate system can be determined using the **DEFPOS** command. This command re-defines the current position to zero or any other value.

A move is defined in either absolute or relative terms. An absolute move takes the axis (A) to a specific predefined position with respect to the origin point. A relative move takes the axis from the current position to a position that is defined relative to this current position. The figure shows an example of relative (command **MOVE**) and absolute (command **MOVEABS**) linear moves.

fig. 2



2.2.1 PTP control

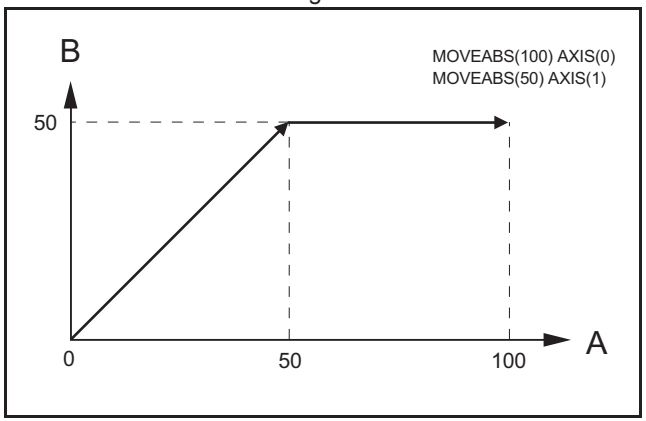
In point-to-point positioning, each axis is moved independently of the other axis. The TJ2-MC__ supports the following operations:

- Relative move
- Absolute move
- Continuous move forward
- Continuous move reverse.

Relative and absolute moves

To move a single axis either the command **MOVE** for a relative move or the command **MOVEABS** for an absolute move is used. Each axis has its own move characteristics, which are defined by the axis parameters.
Suppose a control program is executed to move from the origin to an axis no. 0 (A) coordinate of 100 and axis no. 1 (B) coordinate of 50. If the speed parameter is set to be the same for both axes and the acceleration and deceleration rate are set sufficiently high, the movements for axis 0 and axis 1 will be as shown in the figure.
At start, both the axis 0 and axis 1 moves to a coordinate of 50 over the same duration of time. At this point, axis 1 stops and axis 0 continues to move to a coordinate of 100.

fig. 3



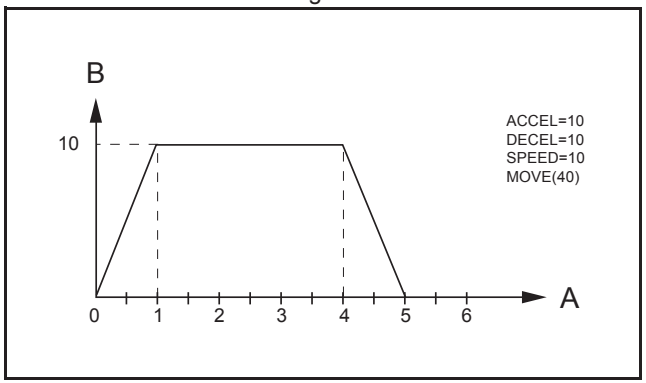
The move of a certain axis is determined by the axis parameters. Some relevant parameters are:

Parameter	Description
UNITS	Unit conversion factor
ACCEL	Acceleration rate of an axis in units/s^2
DECEL	Deceleration rate of an axis in units/s^2
SPEED	Demand speed of an axis in units/s

Defining moves

The speed profile in this figure shows a simple **MOVE** operation. Axis A is the time, axis B is the speed. The **UNITS** parameter for this axis has been defined for example as meters. The required maximum speed has been set to 10 m/s. In order to reach this speed in one second and also to decelerate to zero speed again in one second, both the acceleration as the deceleration rate have been set to 10 m/s^2. The total distance travelled is the sum of distances travelled during the acceleration, constant speed and deceleration segments. Suppose the distance moved by the **MOVE** command is 40 m, the speed profile is given by the figure.

fig. 4



The two speed profiles in these figures show the same movement with an acceleration time respectively a deceleration time of 2 seconds. Again, Axis A is the time, axis B is the speed.

fig. 5

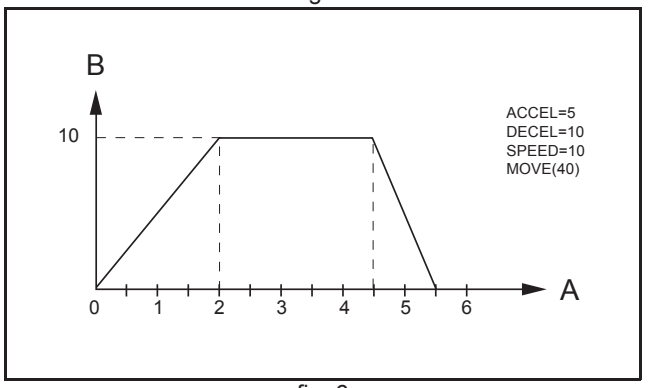
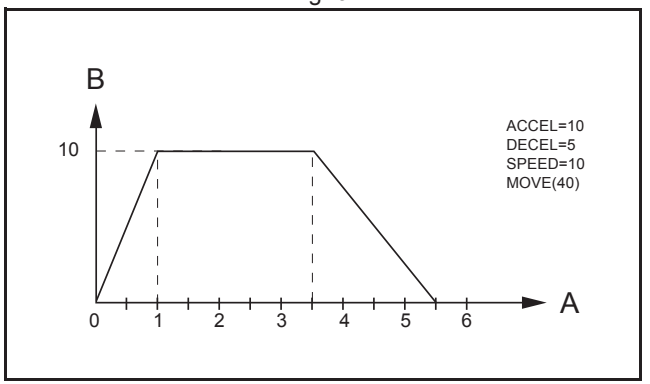


fig. 6



Move calculations

The following equations are used to calculate the total time for the motion of the axes.

- The moved distance for the **MOVE** command is *D*.
- The demand speed is *V*.
- The acceleration rate is *a*.
- The deceleration rate is *d*.

Acceleration time = $\frac{V}{a}$

Acceleration distance = $\frac{V^2}{2a}$

Deceleration time = $\frac{V}{d}$

Deceleration distance = $\frac{V^2}{2d}$

Constant speed distance = $D - \frac{V^2(a+d)}{2ad}$

Total time = $\frac{D}{V} + \frac{V(a+d)}{2ad}$

Continuous moves

The **FORWARD** and **REVERSE** commands can be used to start a continuous movement with constant speed on a certain axis. The **FORWARD** command moves the axis in positive direction and the **REVERSE** command in negative direction. For these commands also the axis parameters **ACCEL** and **SPEED** apply to specify the acceleration rate and demand speed.
Both movements can be cancelled by using either the **CANCEL** or **RAPIDSTOP** command. The **CANCEL** command cancels the move for one axis and **RAPIDSTOP** cancels moves on all axes. The deceleration rate is set by **DECEL**.

2.2.2 CP control

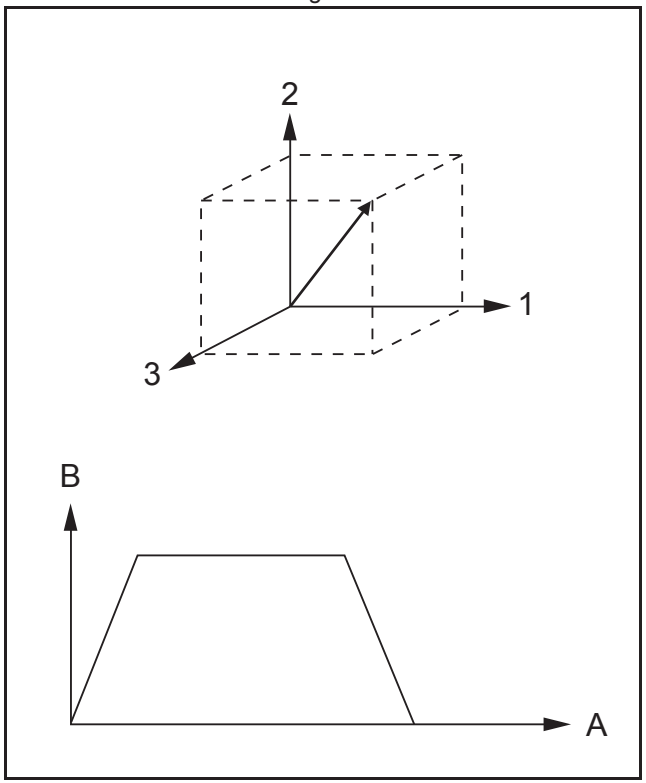
Continuous Path control enables to control a specified path between the start and end position of a movement for one or multiple axes. The TJ2-MC__ supports the following operations:

- Linear interpolation
- Circular interpolation
- CAM control.

Linear interpolation

In applications it can be required for a set of motors to perform a move operation from one position to another in a straight line. Linearly interpolated moves can take place among several axes. The commands **MOVE** and **MOVEABS** are also used for the linear interpolation. In this case the commands will have multiple arguments to specify the relative or absolute move for each axis.
Consider the three axis move in a 3-dimensional plane in the figure. It corresponds to the **MOVE(50,50,50)** command. The speed profile of the motion along the path is given in the diagram. The three parameters **SPEED**, **ACCEL** and **DECEL** that determine the multi axis movement are taken from the corresponding parameters of the base axis. The **MOVE** command computes the various components of speed demand per axis.
A is the time axis, B is the speed axis.

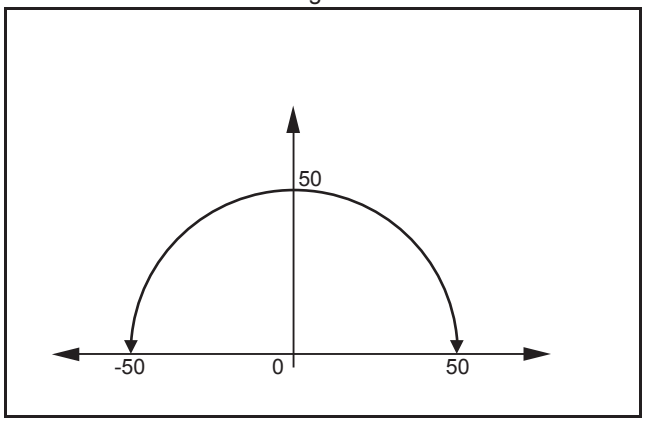
fig. 7



Circular interpolation

It may be required that a tool travels from the starting point to the end point in an arc of a circle. In this instance the motion of two axes is related via a circular interpolated move using the **MOVECIRC** command.
Consider the diagram in the figure. It corresponds to the **MOVECIRC (-100,0,-50,0,0)** command. The centre point and desired end point of the trajectory relative to the start point and the direction of movement are specified. The **MOVECIRC** command computes the radius and the angle of rotation. Like the linearly interpolated **MOVE** command, the **ACCEL**, **DECEL** and **SPEED** variables associated with the base axis determine the speed profile along the circular move.

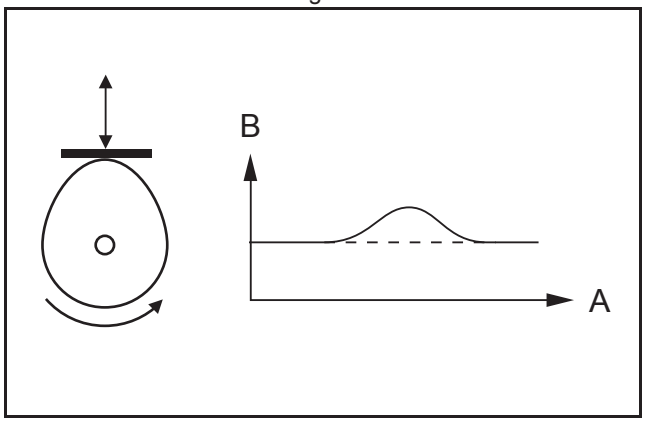
fig. 8



CAM control

Additional to the standard move profiles the TJ2-MC__ also provides a way to define a position profile for the axis to move. The **CAM** command moves an axis according to position values stored in the TJ2-MC__ Table array. The speed of travelling through the profile is determined by the axis parameters of the axis.
The figure corresponds to the command **CAM(0,99,100,20)**. A is the time axis, B is the position axis.

fig. 9



2.2.3 EG control

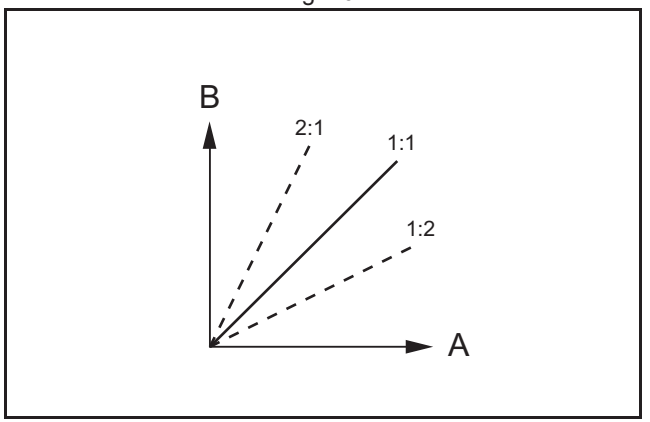
Electronic Gearing control allows you to create a direct gearbox link or a linked move between two axes. The MC Unit supports the following operations.

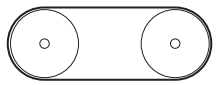
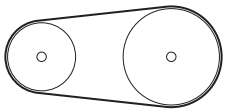
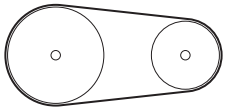
- Electronic gearbox
- Linked CAM
- Linked move
- Adding axes

Electronic gearbox

The TJ2-MC__ is able to have a gearbox link from one axis to another as if there is a physical gearbox connecting them. This can be done using the **CONNECT** command in the program. In the command the ratio and the axis to link to are specified.
In the figure, A is the Master axis, and B is the **CONNECT** axis.

fig. 10

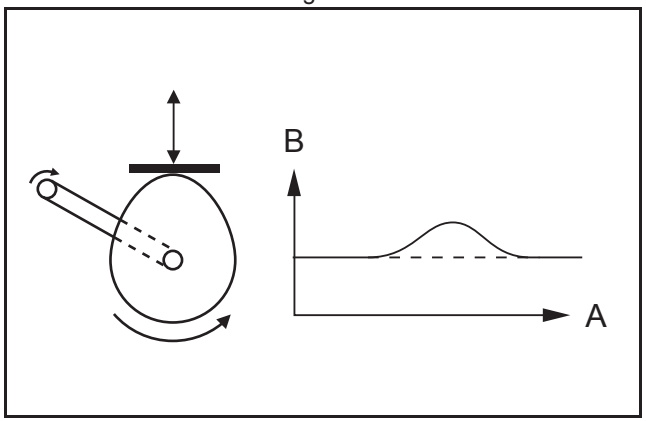


Axes		Ratio	CONNECT command
0	1		
		1:1	**CONNECT(1,0) AXIS(1)**
		2:1	**CONNECT(0.5,0) AXIS(1)**
		1:2	**CONNECT(2,0) AXIS(1)**

Linked CAM control

Next to the standard CAM profiling tool the TJ2-MC__ also provides a tool to link the CAM profile to another axis. The command to create the link is called **CAMBOX**. The travelling speed through the profile is not determined by the axis parameters of the axis but by the position of the linked axis. This is like connecting two axes through a cam.
In the figure, A is the Master axis (0) position, and B is the **CAMBOX** Axis (1) position.

fig. 11

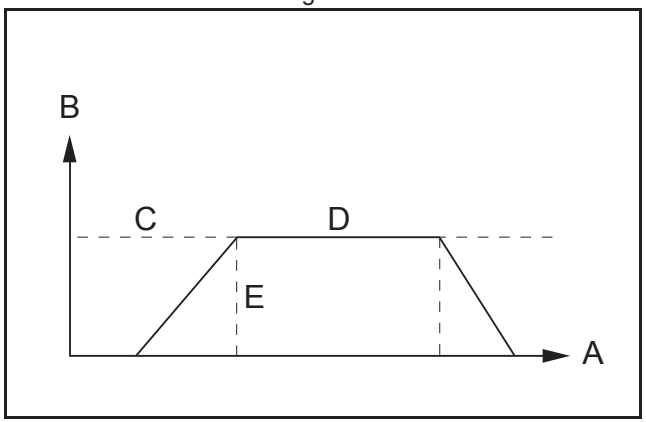


Linked move

The **MOVELINK** command provides a way to link a specified move to a master axis. The move is divided into an acceleration, deceleration and constant speed part and they are specified in master link distances. This can be particularly useful for synchronizing two axes for a fixed period.
The labels in the figure are:

A. Time axis.
B. Speed axis.
C. Master axis (1).
D. Synchronized.
E. **MOVELINK** axis (0).

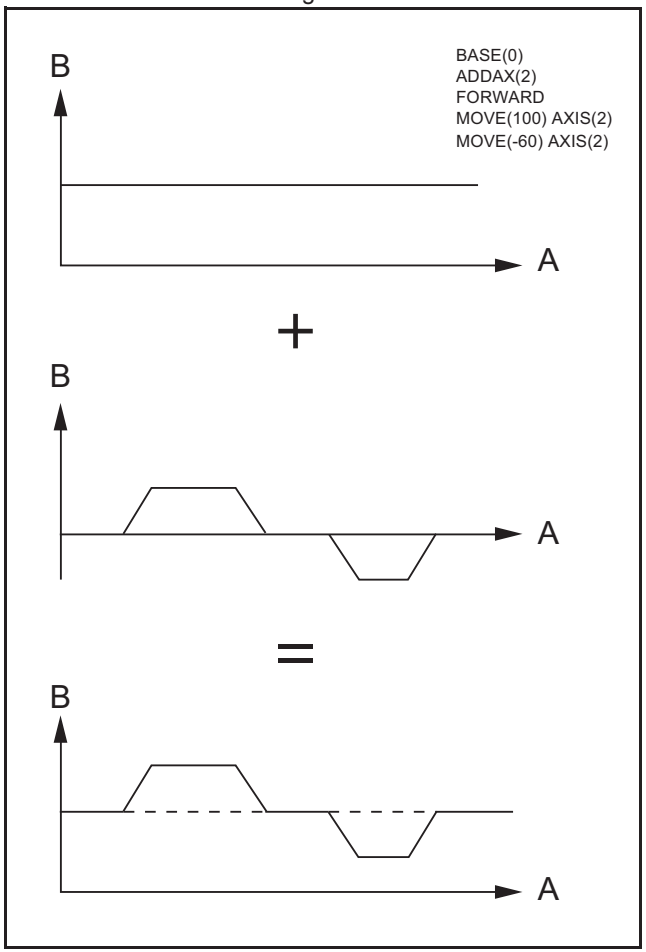
fig. 12



Adding axes

It is very useful to be able to add all movements of one axis to another. One possible application is for instance changing the offset between two axes linked by an electronic gearbox. The TJ2-MC__ provides this possibility by using the **ADDAX** command. The movements of the linked axis will consists of all movements of the actual axis plus the additional movements of the master axis.
In the figure, A is the time axis and B is the speed axis.

fig. 13



2.2.4 Other operations

Cancelling moves

In normal operation or in case of emergency it can be necessary to cancel the current movement from the buffers. When the **CANCEL** or **RAPIDSTOP** commands are given, the selected axis respectively all axes will cancel their current move.

Origin search

If the encoder feedback for controlling the position of the motor is incremental, it means that all movement must be defined with respect to an origin point. The **DATUM** command is used to set up a procedure whereby the TJ2-MC__ goes through a sequence and searches for the origin based on digital inputs and/or Z-marker from the encoder signal.

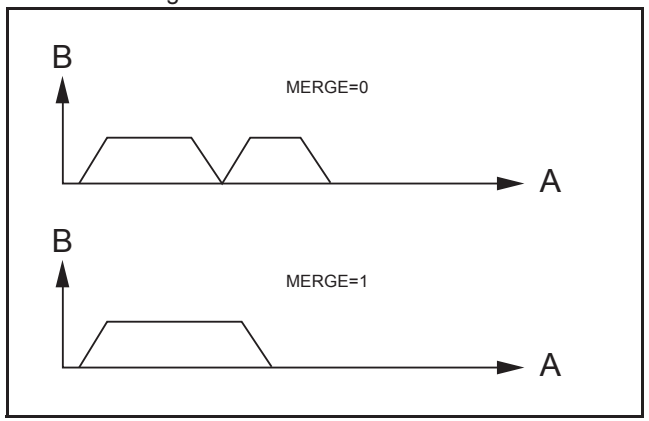
Print registration

The TJ2-MC__ can capture the position of an axis in a register when an event occurs. The event is referred to as the print registration input. On the rising or falling edge of an input signal, which is either the Z-marker or an input, the TJ2-MC__ captures the position of an axis in hardware. This position can then be used to correct possible error between the actual position and the desired position. The print registration is set up by using the **REGIST** command.
The position is captured in hardware, and therefore there is no software overhead and no interrupt service routines, eliminating the need to deal with the associated timing issues.

Merging moves

If the **MERGE** axis parameter is set to 1, a movement is always followed by a subsequent movement without stopping. The figures show the transitions of two moves with **MERGE** value 0 and value 1.
In the figure, A is the time axis and B is the speed axis.

fig. 14



Forced speed moves

Motion commands (like **MOVE**) use the axis **SPEED** parameter when being executed. The force-speed motion commands (like **MOVESP**) use the **FORCE_SPEED** speed paramater which is stored in the motion buffer together with the move command. This allows for controlling the speed per motion command.

Jogging

Jogging moves the axes at a constant speed forward or reverse by manual operation of the digital inputs. Different speeds are also selectable by input. Refer to the **FWD_JOG**, **REV_JOG** and **FAST_JOG** axis parameters.

2.3 Servo system principles

The servo system used by and the internal operation of the TJ2-MC__ are briefly described in this section.

2.3.1 Semi-closed loop system

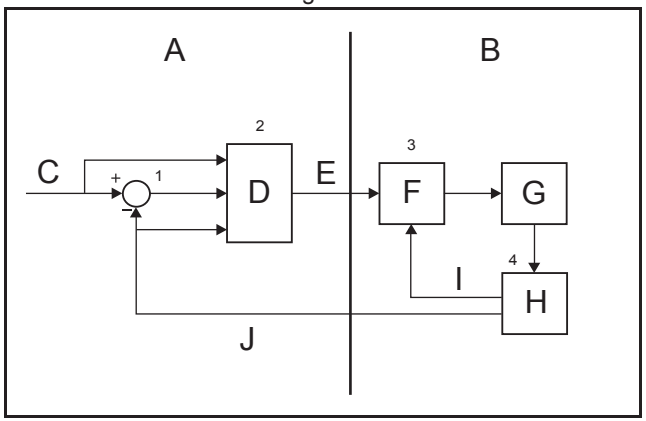
The servo system of the TJ2-MC__ uses a semi-closed or inferred closed loop system. This system detects actual machine movements by the rotation of the motor in relation to a target value. It calculates the error between the target value and actual movement, and reduces the error through feedback.

2.3.2 Internal operation of the TJ2-MC__

Inferred closed loop systems occupy the mainstream in modern servo systems applied to positioning devices for industrial applications. The figure shows the basic principle of the servo system as used in the TJ2-MC__.

1. The TJ2-MC__ performs actual position control. The main input of the controller is the Following Error, which is the calculated difference between the demand position and the actual measured position.
2. The Position Controller calculates the required speed reference output determined by the Following Error and possibly the demanded position and the measured position. The speed reference is provided to the Servo Drive.
3. The Servo Drive controls the rotational speed of the servo motor corresponding to the speed reference. The rotational speed is proportional to the speed reference.
4. The rotary encoder generates the feedback pulses for both the speed feedback within the Servo Drive speed loop and the position feedback within the TJ2-MC__ position loop.

fig. 15



The labels in the figure are:

A. TJ2-MC__.
B. Servo system.
C. Demand position.
D. Position control.
E. Speed reference.

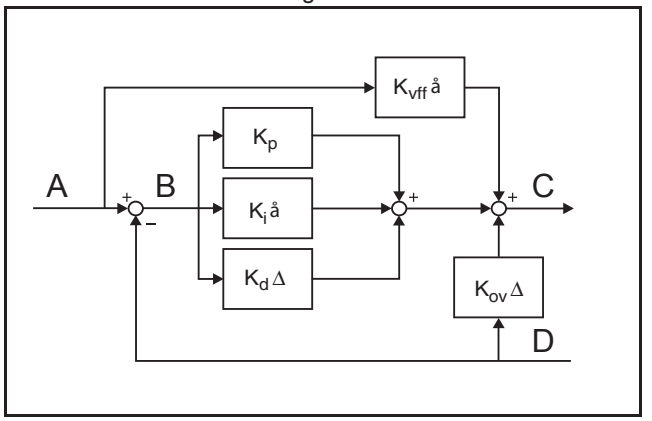
F. Speed control.
G. Motor.
H. Encoder.
I. Measured speed.
J. Measured position.

2.3.3 Position loop algorithm in the CPU

The servo system controls the motor by continuously adjusting the speed reference to the Servo Drive. The speed reference is calculated by the motion control algorithm of the TJ2-MC__, which is explained in this section. The motion control algorithm uses the demand position (A), the measured position (D) and the Following Error (B) to determine the speed reference. The Following Error is the difference between the demanded and measured position. The demand position, the measured position and the Following Error are represented by the axis parameters **MPOS**, **DPOS** and **FE**. Five gain values have been implemented for the user to be able to configure the correct control operation for each application.
C is the output signal.

- Proportional gain
  The proportional gain K_p creates an output O_p that is proportional to the Following Error E.
  $O_p = K_p \cdot E$
  All practical systems use proportional gain. For many just using this gain parameter alone is sufficient. The proportional gain axis parameter is called **P_GAIN**.
- Integral gain
  The integral gain K_i creates an output O_i that is proportional to the sum of the Following Errors that have occurred during the system operation.
  $O_i = K_i \cdot \acute{O}E$
  Integral gain can cause overshoot and so is usually used only on systems working at constant speed or with slow accelerations. The integral gain axis parameter is called **I_GAIN**.
- Derivative gain
  The derivative gain K_d produces an output O_d that is proportional to the change in the Following Error E and speeds up the response to changes in error while maintaining the same relative stability.

fig. 16



$O_d = K_d \cdot \ddot{A}E$
Derivative gain may create a smoother response. High values may lead to oscillation. The derivative gain axis parameter is called **D_GAIN**.

- Output speed gain
  The output speed gain K_{ov} produces an output O_{ov} that is proportional to the change in the measured position P_m and increases system damping.
  $O_{ov} = K_{ov} \cdot \ddot{A}P_m$
  The output speed gain can be useful for smoothing motions but will generate high Following Errors. The output speed gain axis parameter is called **OV_GAIN**.
- Speed feed forward gain
  The speed feedforward gain K_{vff} produces an output O_{vff} that is proportional to the change in demand position P_d and minimizes the Following Error at high speed.
  $O_{vff} = K_{vff} \cdot \ddot{A}P_d$
  The parameter can be set to minimise the Following Error at a constant machine speed after other gains have been set. The speed feed forward gain axis parameter is called **VFF_GAIN**.

The default settings are given in the table along with the resulting profiles. Fractional values are allowed for gain settings.

Gain	Default value
Proportional gain	0.1
Integral gain	0.0
Derivative gain	0.0
Output speed gain	0.0
Speed feedforward gain	0.0

2.3.4 Position loop algorithm in the Servo Drive

Refer to the Servo Drive manual for details.

2.4 Trajexia system architecture

The system architecture of the Trajexia is dependant upon these concepts:
- Program control
- Motion Sequence
- Motion buffers
- Communication
- Peripherals

These concepts depend upon the value set in the **SERVO_PERIOD** parameter. The relationship between the value of **SERVO_PERIOD** and the different concepts of the system architecture are describes as follows.

2.4.1 Program control

Programs make the system work in a defined way. The programs are written in a language similar to BASIC and control the application of the axes and modules. 22 Programs can be executed in parallel. The programs can be set to run at system power-up, started and stopped from other programs and executed from Trajexia Studio / CX-Motion Pro.
Programs execute commands to move the axes, control inputs and outputs and make communication via BASIC commands.

2.4.2 Motion sequence

The motion sequence controls the position of all 64 axes with the actions as follows:
- Reading the Motion buffer
- Reading the current Measured Position (MPOS)
- Calculating the next Demanded Position (DPOS)
- Executing the Position loop if it is done in the CPU
- Sending the Axis reference
- Error handling

2.4.3 Motion buffers

Motion buffers are the link between the BASIC commands and the Axis control loop. When a BASIC motion command is executed, the command is stored in one of the buffers. During the next motion sequence, the profile generator executes the movement according to the information in the buffer. When the movement is finished, the motion command is removed from the buffer. The TJ2-MC__ can have up to 64 motion buffers, which is defined by the **LIMIT_BUFFERED** system parameter.

2.4.4 Communication

A set of BASIC communication commands are used to configure the communications. When the Trajexia is a communication slave (as in the PROFIBUS communication) it is only necessary to configure the communication in an initial task. The values are exchanged from the configured global variables in a transparent way. When the Trajexia is a communications master, the BASIC communication commands are used to write and read.

2.4.5 Peripherals

All inputs and outputs are used with the set of parameters (**IN**, **OP**, **AIN**, **AOUT**). The inputs and outputs are automatically detected and mapped in Trajexia. Inverters are considered a peripheral device and have a set of BASIC commands to control them. Various MECHATROLINK-II input and output modules can be connected to a TJ1-ML__ unit. Various EtherCAT input and output modules can be connected to a TJ1-ECT__ unit.

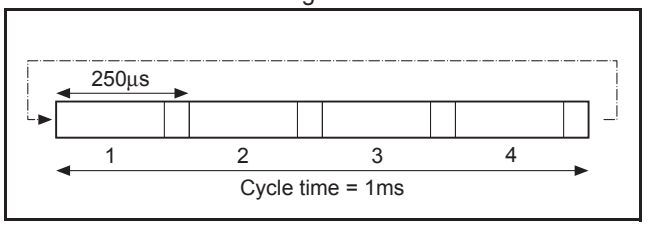
2.5 Cycle time

All processes in the Trajexia system are based on the cycle time. The cycle time is divided into four CPU slots:

- 250µs time intervals for a **SERVO_PERIOD** of 0.25, 0.5 and 1.0ms
- 500µs time intervals for a **SERVO_PERIOD** of 2.0ms

The processes that can be carried out in each time interval depends on the **SERVO_PERIOD** that is set.

fig. 17



The operations executed in each CPU slot are:

CPU slot	Operation
CPU slot 1	Execute whichever comes first in the list: • Low priority BASIC Program, or • High priority BASIC Program, or • PLC
CPU slot 2	Execute whichever comes first in the list: • PLC, or • High priority BASIC Program, or • Low priority BASIC Program
CPU slot 3	System processes
CPU slot 4	Execute whichever comes first in the list: • High priority BASIC Program, or • PLC, or • Low priority BASIC Program

In each of the three CPU slots (1, 2 and 4) the type (High or Low priority BASIC programs or PLC) is executed which comes first in the list. Only processes of that type will then be executed in that slot.

Example 1

Executing one High and two Low priority BASIC programs.

- CPU slot 1: Low priority BASIC programs executed alternating
- CPU slot 2: High priority BASIC program executed
- CPU slot 4: High priority BASIC program executed

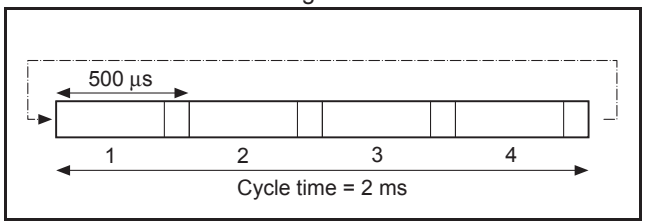
Special case: in case both Low and High priority BASIC programs are running in parallel to the PLC, CPU slot 1 executes the Low and High priority BASIC programs alternately.

Example 2

Executing one High and two Low priority BASIC programs in parallel to the PLC:

- CPU slot 1: Running High and low priority BASIC programs alternately
- CPU slot 2: PLC
- CPU slot 4: High priority BASIC program executed

fig. 18



Note
The Motion sequence execution depends on setting of the **SERVO_PERIOD** parameter.

2.5.1 Servo period

The **SERVO_PERIOD** can be set at 0.25, 0.5, 1 or 2ms. The processes that take place within the cycle time depend on the setting of the **SERVO_PERIOD** parameter. The **SERVO_PERIOD** parameter is a Trajexia parameter that must be set according to the system configuration.
The factory setting is 1ms (**SERVO_PERIOD=1000**). A change is set only after a restart of the TJ2-MC__.

Note
With MECHATROLINK-II only Sigma-V Servo Drive support the 0.5 ms transmission cycle.

Servo period rules MECHATROLINK-II
The number of axes and MECHATROLINK-II devices in the Trajexia system determines the value of the **SERVO_PERIOD** system parameter.
There are 3 types of MECHATROLINK-II devices that are supported by the TJ2-MC__ units:

- Servo Drives
  The TJ2-MC__ considers Servo Drives as axes.
- Inverters
  By default, Inverters are not considered as axes, although this can be changed by command.
- I/O units and slice bus couplers
  The TJ2-MC__ does not consider I/O units (analog and digital, counter and pulse) and SmartSlice bus couplers as axes.

You must obey the most restrictive rules when you set the **SERVO_PERIOD** parameter. An incorrect value of the **SERVO_PERIOD** parameter results in an incorrect detection of the MECHATROLINK-II devices.

The most restrictive rules are given in the tables below. For each unit the table lists the maximum number of devices the unit can control at the given **SERVO_PERIOD** setting.

SERVO_PERIOD	TJ2-MC64[1]	TJ2-MC02[2]	TJ1-ML16	TJ1-ML04
0.25 ms[3]	16 axes	3 axes	N/A	N/A
0.5 ms	32 axes	3 axes	4 devices	4 devices
1.0 ms	64 axes	3 axes	8 devices	4 devices
2.0 ms	64 axes	3 axes	16 devices	4 devices

1. Total number of axes: real + virtual
2. Maximum number of real axes. For maximum number of virtual axes see TJ2-MC64
3. MECHATROLINK-II does not support 0.25 ms

Servo period rules EtherCAT

The number of axes with an EtherCAT network is restricted by the **SERVO_PERIOD** system parameter, the type of axis and the type of EtherCAT master unit.

There are 3 types of EtherCAT devices that are supported by the TJ2-MC__ units:

- Devices with feedback: Servo Drives
  The TJ2-MC__ considers Servo Drives as axes. Maximum number restricted by the **SERVO_PERIOD** and EtherCAT master type.
- Devices without feedback: Inverters
  The TJ2-MC__ considers EtherCAT Inverters as axes, but the maximum number is not restricted by the EtherCAT master type. Maximum number restricted by the **SERVO_PERIOD**.
- I/O units
  The TJ2-MC__ does not consider I/O units as axes.

SERVO_PERIOD	TJ2-MC64[1]	TJ2-MC02[2]	TJ2-ECT04	TJ2-ECT16	TJ2-ECT64[3]
0.25 ms[4]	16 axes	3 axes	N/A	N/A	N/A
0.5 ms	32 axes	3 axes	4 axes	10 axes	10 axes
1.0 ms	64 axes	3 axes	4 axes	16 axes	26 axes
2.0 ms	64 axes	3 axes	4 axes	16 axes	47 axes

1. Total number of axes: real + virtual
2. Maximum number of real axes. For maximum number of virtual axes see TJ2-MC64
3. Maximum number of axes depend on the firmware version.
4. The EtherCAT units do not yet support 0.25 ms

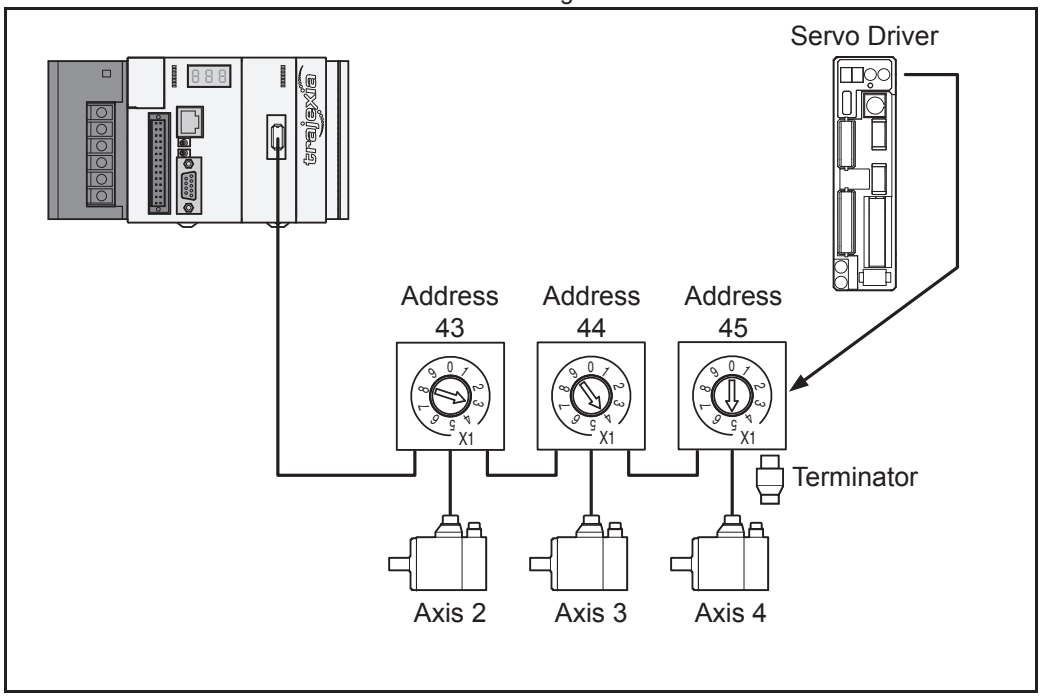
Configuration examples

Example 1

- 1x TJ2-MC__
- 1x TJ1-ML04
- 3x G-Series Servo Drive
- **SERVO_PERIOD** = 1ms

TJ2-MC__ Supports 0.25ms **SERVO_PERIOD** with 3 axes.
TJ1-ML04 Supports 0.5ms **SERVO_PERIOD** with 3 devices.
G-Series supports 1ms **SERVO_PERIOD**. This is the limiting factor.

fig. 19

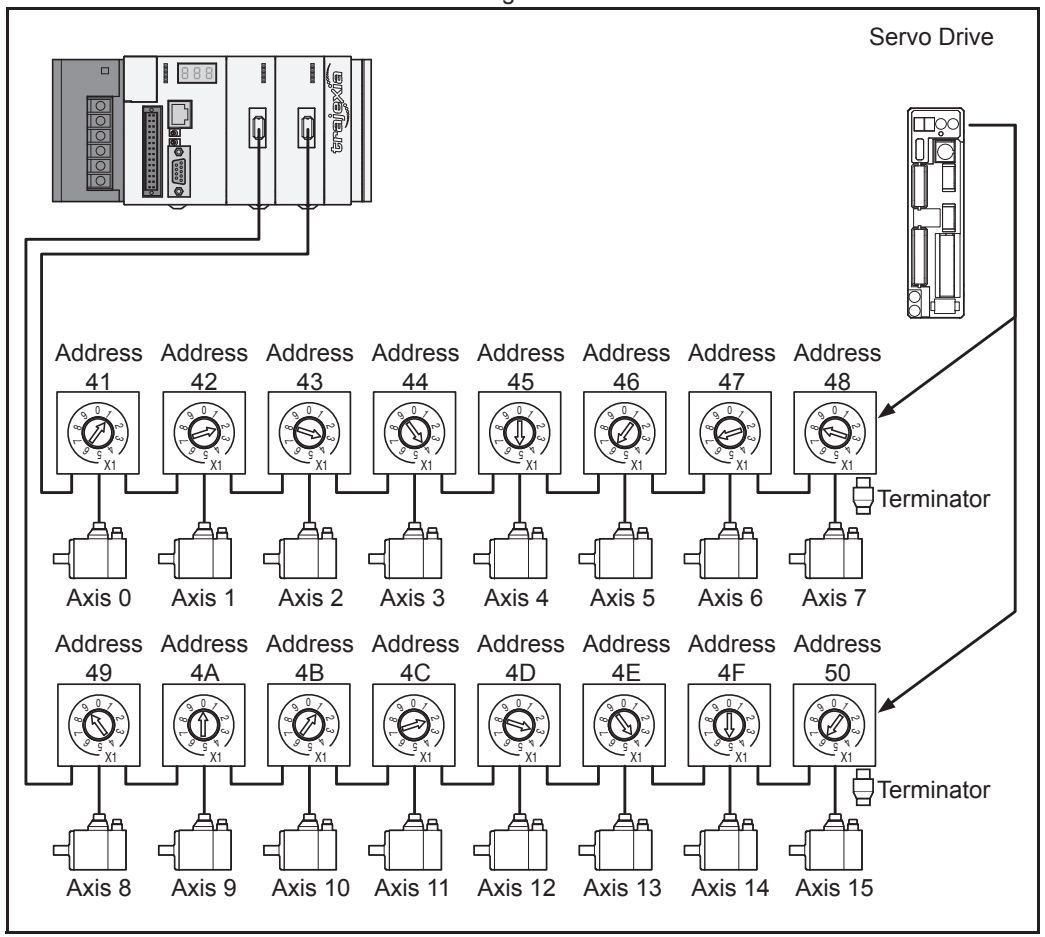


Example 2

- 1x TJ2-MC__
- 2x TJ1-ML16
- 16x G-Series Servo Drive
- **SERVO_PERIOD** = 1ms

TJ2-MC__ supports 0.25ms **SERVO_PERIOD** with 16 axes.
TJ1-ML16 supports 1ms **SERVO_PERIOD** with 8 devices.
G-Series supports 1ms **SERVO_PERIOD**.

fig. 20

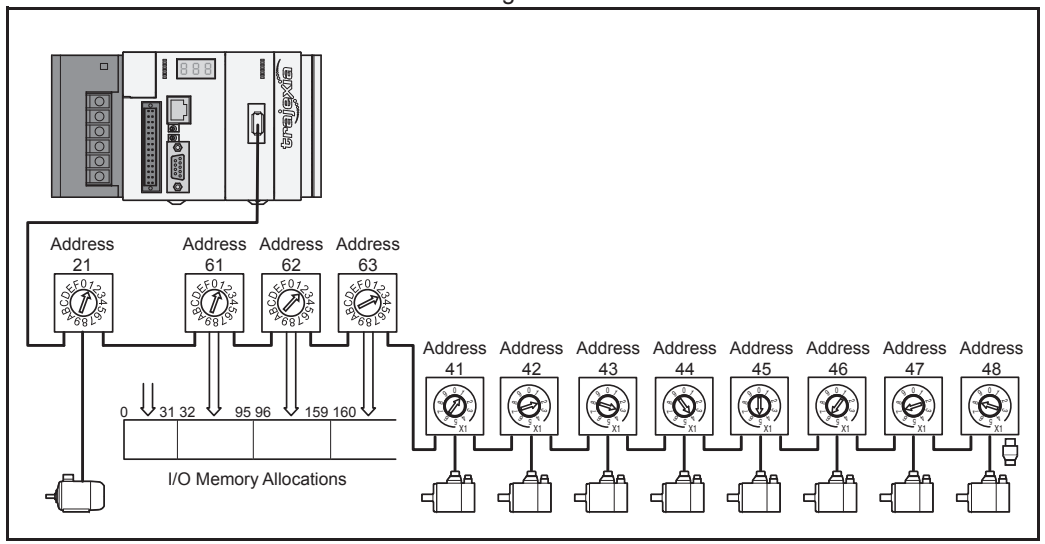


Example 3

- 1x TJ2-MC__
- 1x TJ1-ML16
- 8x G-Series Servo Drive
- 1x F7Z Inverter with SI-T interface
- 3x MECHATROLINK-II I/Os
- **SERVO_PERIOD** = 2.0ms

TJ1-ML16 supports 2.0ms **SERVO_PERIOD** with 12 devices. This is the limiting factor.
G-Series Servo Drive supports 1.0ms **SERVO_PERIOD**.
SI-T supports 1ms.
MECHATROLINK-II I/Os support 1.0ms.

fig. 21

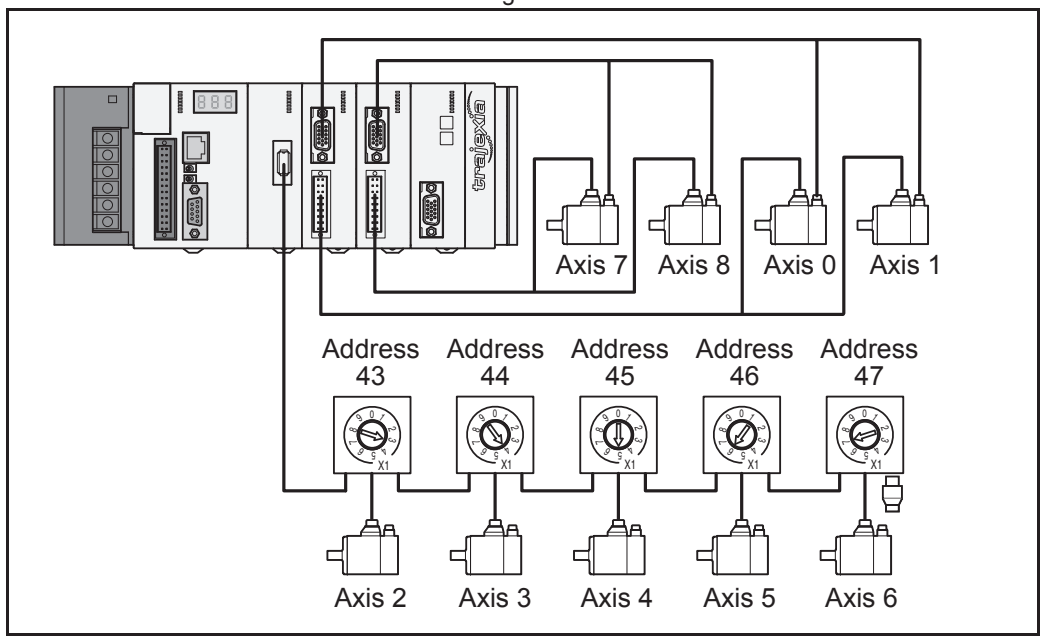


Example 4

- 1x TJ2-MC__
- 1x TJ1-ML16
- 2x TJ1-FL02
- 1x TJ1-PRT (does not influence in the **SERVO_PERIOD**)
- 5x G-Series Servo Drive
- **SERVO_PERIOD** = 1.0ms

TJ2-MC__ supports 0.5ms **SERVO_PERIOD** with 9 axes
(5 MECHATROLINK-II servo axes and 4 TJ1-FL02 axes)
TJ1-ML16 supports 1.0ms **SERVO_PERIOD** with 5 devices
TJ1-FL02 supports 0.5ms **SERVO_PERIOD** (2 axes each module)
Sigma-II supports 1.0ms **SERVO_PERIOD**.

fig. 22

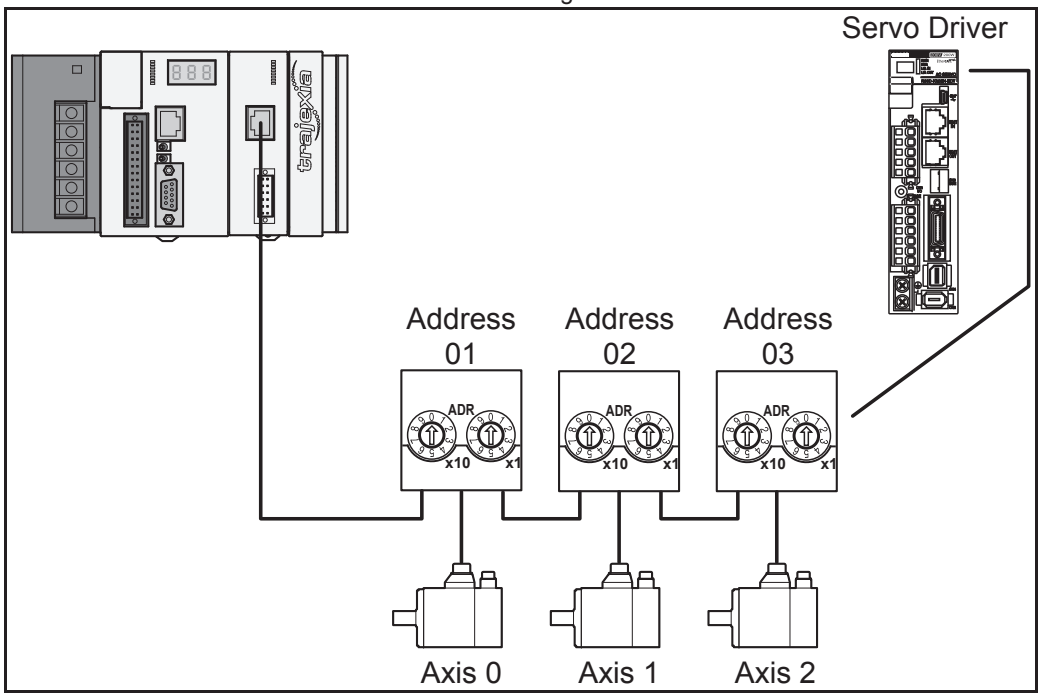


Example 5

- 1x TJ2-MC__
- 1x TJ2-ECT04
- 3x Accurax G5 Servo Drive
- **SERVO_PERIOD** = 0.5ms

TJ2-MC__ Supports 0.25ms **SERVO_PERIOD** with 3 axes.
TJ2-ECT04 Supports 0.5ms **SERVO_PERIOD** with 3 devices.
Accurax G5 supports 0.5ms **SERVO_PERIOD**.

fig. 23



2.6 Program control and multi-tasking using BASIC programs only

The Trajexia system has programs, processes and multi tasking control.

2.6.1 Program control

The Trajexia system can control 22 processes that are written as BASIC programs. When the program is set to run, the program is executed. Processes 0 to 19 are low priority, 20 and 21 are high priority.

2.6.2 Processes

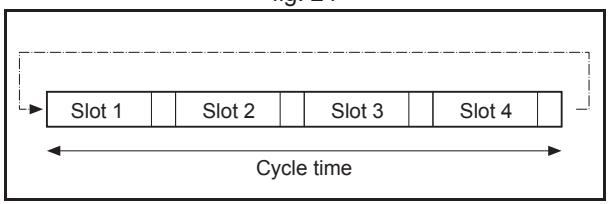
The "Terminal Window" of Trajexia Studio has its own process (process 22). This terminal window is used to write direct BASIC commands to the TJ2-MC__ independent to other programs. These commands are executed after you press the Enter button.

2.6.3 Multi-tasking

Each cycle time is divided into 4 time slots. User processes run in 3 slots according to the priority and type of the process. The rules which type of process is run in which slot are defined in the table below.

CPU slot	Operation
CPU slot 1	Execute whichever comes first in the list: • Low priority BASIC Program, or • High priority BASIC Program, or • PLC
CPU slot 2	Execute whichever comes first in the list: • PLC, or • High priority BASIC Program, or • Low priority BASIC Program
CPU slot 3	System processes

fig. 24



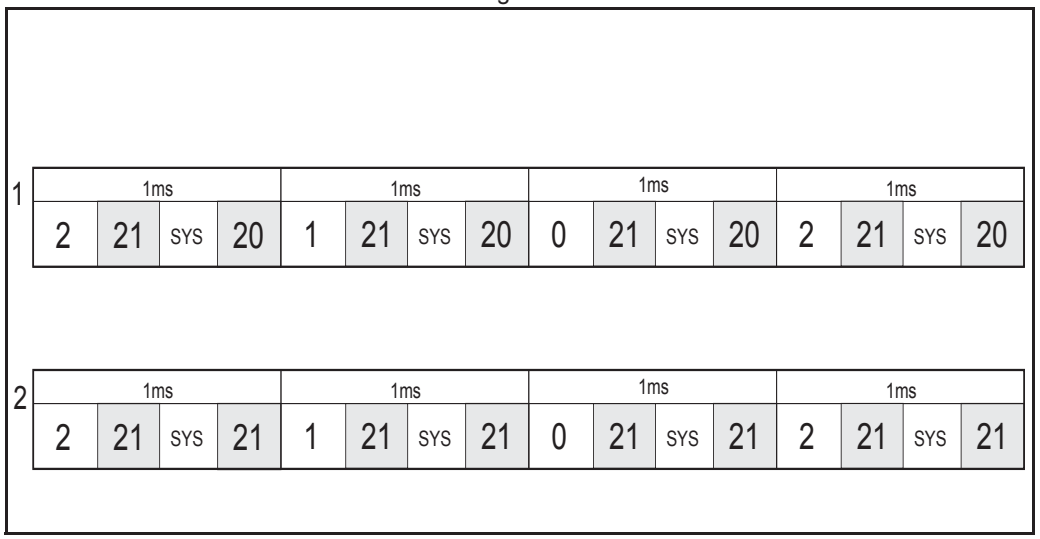
CPU slot	Operation
CPU slot 4	Execute whichever comes first in the list: • High priority BASIC Program, or • PLC, or • Low priority BASIC Program

In each of the three CPU slots (1, 2 and 4) the type (High or Low priority BASIC programs or PLC) is executed which comes first in the list. Only processes of that type will then be executed in that slot. Processes of the same type will be executed alternately.

2.6.4 Multi-tasking examples

In the example 1, there are two high-priority processes (20 and 21) and 3 low-priority processes (0, 1 and 2). The first slot will execute low-priority processes (first in the list). The second and fourth slots will execute the high-priority processes. In this example the high-priority processes are executed every cycle. The low-priority processes are executed once every 3 cycles. Therefore the high-priority processes run 3 times faster than the low-priority processes.
In the middle example, there is only one high-priority process (21). The high-priority process now runs twice every cycle and therefore runs 6 times faster than the low-priority processes.
In the lower example, there are no high-priority processes. Therefore, all slots can be used for the low-priority processes. All 3 processes get (in average) the same number of slots per cycle and therefore run with the same speed.

fig. 25



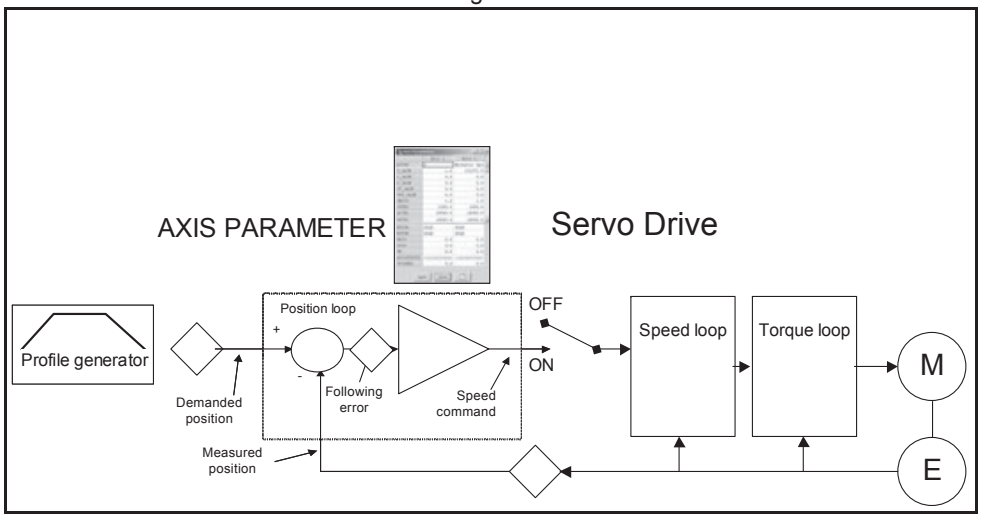
2.7 Motion sequence and axes

Motion sequence is the part of the TJ2-MC__ that controls the axes. The actual way that the motion sequence operates depends on the axis type. The axis type can be set and read by the parameter **ATYPE**. At start-up the Trajexia system automatically detects the configuration of the axes.

- The default value for the parameter **ATYPE** for MECHATROLINK-II axes is 40 (MECHATROLINK-II position).
- The default value for the parameter **ATYPE** for EtherCAT Servo axes is 65 (CSP or Cyclic Synchronous Position mode).
- The default value for the parameter **ATYPE** for EtherCAT Inverter axes is 68 (VL or Velocity mode).
- The default value for the parameter **ATYPE** for the TJ1-FL02 axes is 44 (Servo axis with an incremental encoder).

All non allocated axes are set as a virtual axis. The value for the parameter **ATYPE** is 0.
Every axis has the general structure as shown in fig. 26.

fig. 26



The motion sequence which will be executed at the beginning of each servo period will contain the following elements:

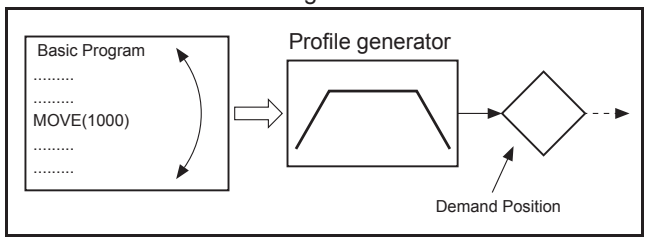
1. Transfer any moves from BASIC process buffers to motion buffers (see section 2.8).
2. Read digital inputs.
3. Load moves. (See note.)
4. Calculate speed profile. (See note.)
5. Calculate axis positions. (See note.)
6. Execute position servo. For axis 0 this also includes the Servo Drive communications. (See note.)
7. Update outputs.

Note
Each of these items will be performed for each axis in turn before moving on to the next item.

2.7.1 Profile generator

The profile generator is the algorithm that calculates the demanded position for each axis. The calculation is made every motion sequence.
The profile is generated according to the motion instructions from the BASIC programs.

fig. 27



2.7.2 Position loop

The position loop is the algorithm that makes sure that there is a minimal deviation between the measured position (**MPOS**) and the demand position (**DPOS**) of the same axis.

2.7.3 Axis sequence

- The motion controller applies motion commands to an axis array that is defined with the **BASE** command. If the motion command concerns one axis, it is applied to the first axis in the **BASE** array. If the motion command concerns more than one axis, and makes an orthogonal move, the axes are taken from the array in the order defined by the **BASE** command. For more information on the **BASE** command and the definition of the axis sequence in an axis array, refer to the Trajexia Programming Manual, chapter 3 (BASIC commands).
- If **SERVO=OFF** for one axis, the motion commands for that axis are ignored.
- If the Following Error (**FE**) in one axis exceeds the parameter value **FELIMIT**, the next action occurs:
  - **WDOG** is set to **OFF** and all axes stop.
  - **SERVO** for the axis that causes the error goes to **OFF**.
  - The current move is cancelled and removed from the buffer.

2.7.4 Type of axis

ATYPE	Applicable to	Name	Description
0	All axes	Virtual axis	Internal axis with no physical output. It is the only valid setting for non-allocated axes. That is, those that are not MECHATROLINK-II servos or a flexible axis.
40	MECHA-TROLINK-II Servo Drives connected to a TJ1-ML__	MECHA-TROLINK-II Position (Default)	Position loop in the Servo Drive. TJ2-MC__ sends position reference to the Servo Drive via MECHATROLINK-II.
41		MECHA-TROLINK-II Speed	Position loop in the Trajexia. TJ2-MC__ sends speed reference to the Servo Drive via MECHATROLINK-II.
42		MECHA-TROLINK-II Torque	Position loop in the Trajexia. TJ2-MC__ sends torque reference to the Servo Drive via MECHATROLINK-II.
43	External Drive connected to a TJ1-FL02	Stepper output	Pulse and direction outputs. Position loop is in the Drive. TJ1-FL02 sends pulses and receives no feed back.
44		Servo axis (Default) Encoder	Analogue servo. Position loop is in the TJ2-MC__. The TJ1-FL02 sends speed reference and receives position from an incremental encoder.
45		Encoder output	The same as stepper, but with the phase differential outputs emulating an incremental encoder.
46		Absolute Tamagawa	The same as servo axis but the feedback is received from a Tamagawa absolute encoder.
47		Absolute EnDat	The same as servo axis but the feedback is received from an EnDat absolute encoder.
48		Absolute SSI	The same as servo axis but the feedback is received from an SSI absolute encoder.

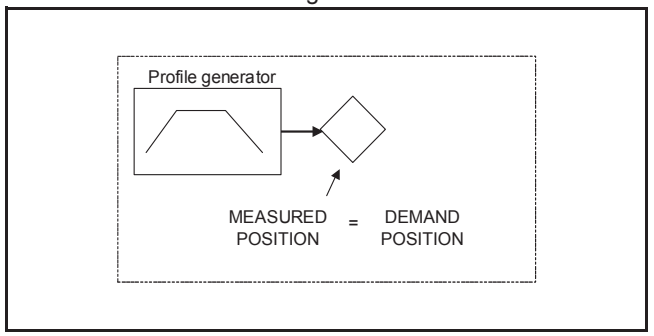
ATYPE	Applicable to	Name	Description
49	TJ1-ML__	Inverter as axis	Inverters (with built-in encoder interface) are controlled on the MECHATROLINK-II bus as servo axes.
60	External Drive connected to a TJ1-FL02	Stepper input	Feedback through pulse and direction inputs.
65	EtherCAT Servo Drives connected to a TJ2-ECT__	EtherCAT CoE CSP	Position loop in the Servo Drive. TJ2-MC__ sends position reference to the Servo Drive via EtherCAT.
66		EtherCAT CoE CSV	Position loop in the Servo Drive. TJ2-MC__ sends velocity reference to the Servo Drive via EtherCAT.
67		EtherCAT CoE CST	Position loop in the Servo Drive. TJ2-MC__ sends torque reference to the Servo Drive via EtherCAT.
68	EtherCAT Inverters connected to a TJ2-ECT__	EtherCAT CoE VL	Open-loop velocity control of Inverters connected through EtherCAT, according Velocity mode of CiA402.
69	EtherCAT encoders connected to a TJ2-ECT__	EtherCAT encoder	Feedback from encoder connected to EtherCAT
80	Servo Drives connected to a TJ2-KS02	Accurax G5 Position (Default)	Position loop in the Servo Drive. TJ2-MC__ sends position reference to the Servo Drive via the TJ2-KS02.
81		Accurax G5 Speed	Position loop in the Trajexia. TJ2-MC__ sends speed reference to the Servo Drive via the TJ2-KS02
82		Accurax G5 Torque	Position loop in the Trajexia. TJ2-MC__ sends torque reference to the Servo Drive via the TJ2-KS02

Virtual axis ATYPE=0

The main use cases of a virtual axis are:

- As perfect master axis of the machine. All the other axes follow this virtual master axis.
- As auxiliary axis to split a complex profile into two or more simple movements, each assigned to a virtual axis. These movements can be added together with the BASIC command **ADDAX** then assigned to a real axis

fig. 28



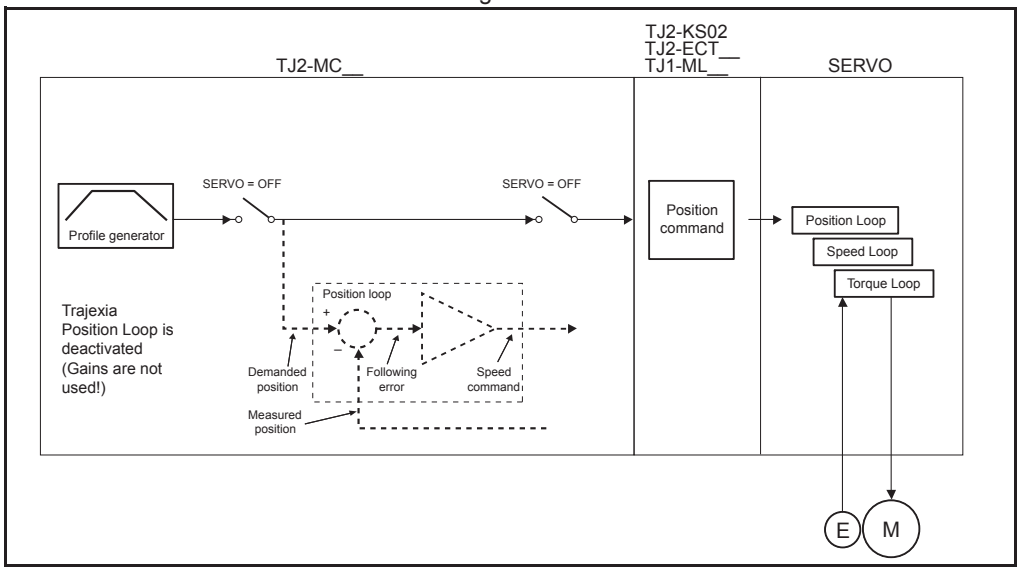
MECHATROLINK-II position ATYPE=40

With **SERVO = ON**, the position loop is closed in the Servo Drive. Gain settings in the TJ2-MC__ have no effect. The position reference is sent to the Servo Drive.

Note
Although **MPOS** and **FE** are updated, the real value is the value in the Servo Drive. The real Following Error can be monitored by the **DRIVE_MONITOR** parameter by setting **DRIVE_CONTROL = 2**.

Note
The MECHATROLINK-II position **ATYPE = 40** is the recommended setting to obtain a higher performance of the servo motor.

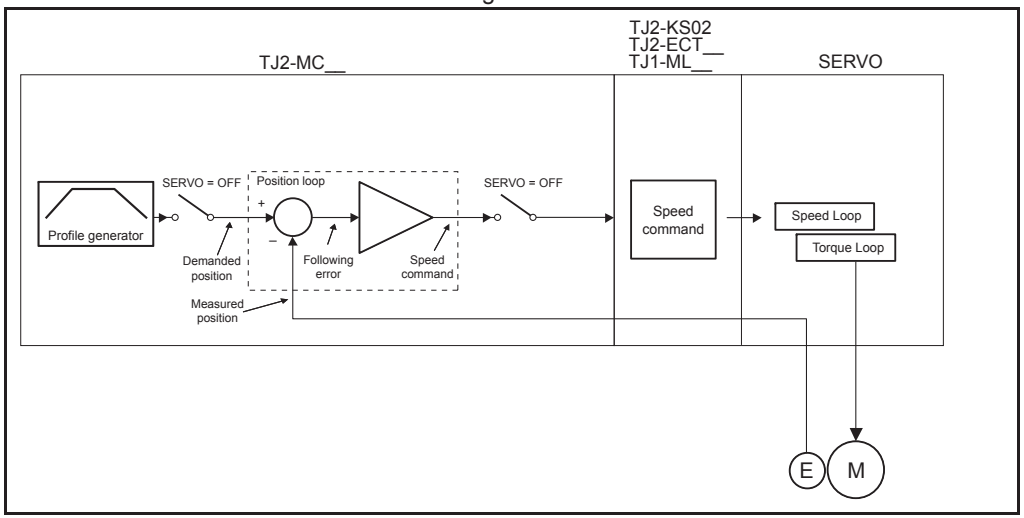
fig. 29



MECHATROLINK-II speed ATYPE=41

With **SERVO = ON**, the speed loop is closed in the TJ2-MC__. Speed reference is sent to the Servo Drive. This setting is not recommended, since there is one cycle delay in the loop (DPOS(n) is compared with MPOS(n-1)).
With **SERVO = OFF**, the speed reference is sent via **S_REF** command. 0x40000000 means maximum speed of the servomotor. This is the recommended setting.

fig. 30

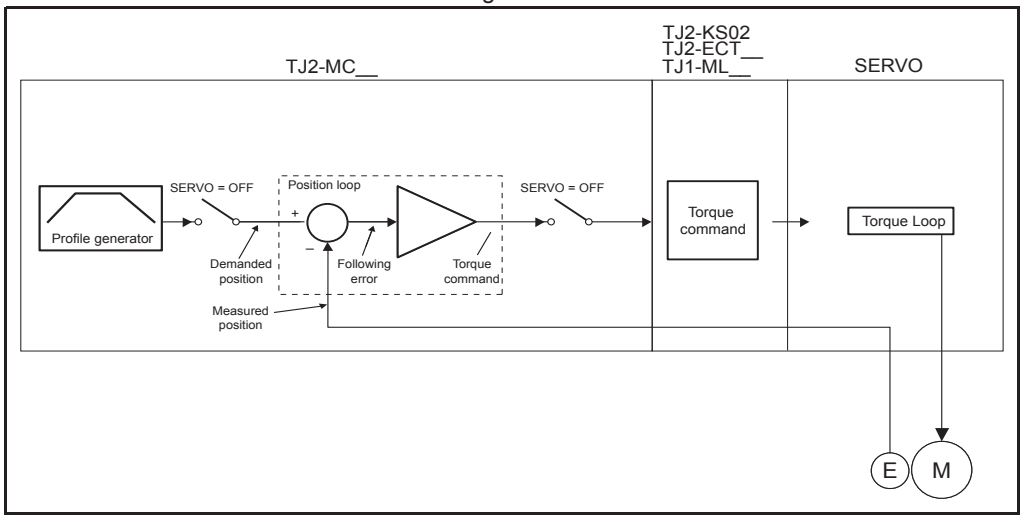


MECHATROLINK-II torque ATYPE=42

With **SERVO = ON**, the torque loop is closed in the TJ2-MC__. The torque reference in the Servo Drive depends on the **FE** and the gain.
With **SERVO = OFF**, the torque reference is sent directly via the **T_REF** command. 0x40000000 is the maximum torque of the servomotor.

Note
To monitor the torque in the servo in **DRIVE_MONITOR**, set **DRIVE_CONTROL=11**.

fig. 31



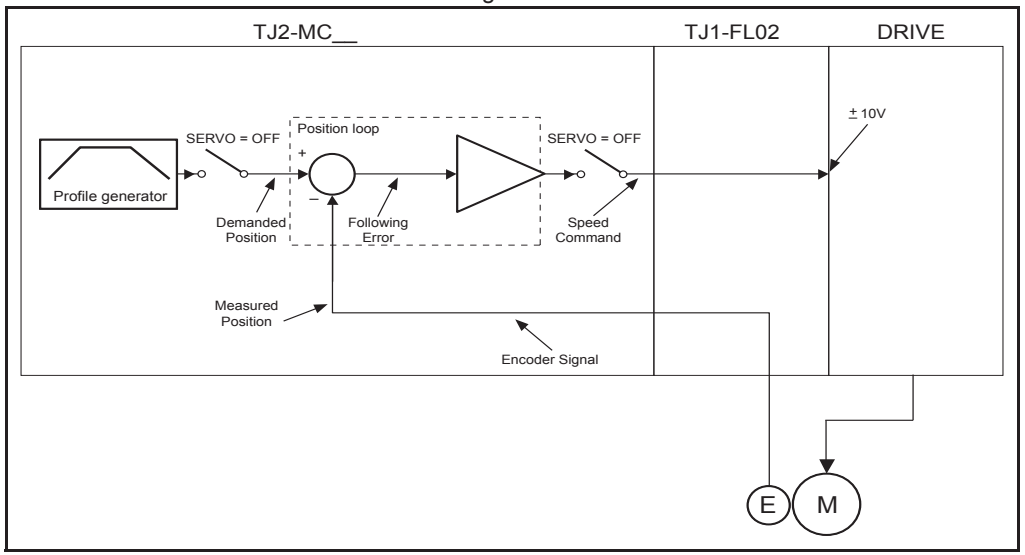
Stepper output ATYPE=43

The position profile is generated and the output from the system is a pulse train and direction signal. This is useful to control a motor via pulses or as a position reference for another motion controller.

Servo axis ATYPE=44

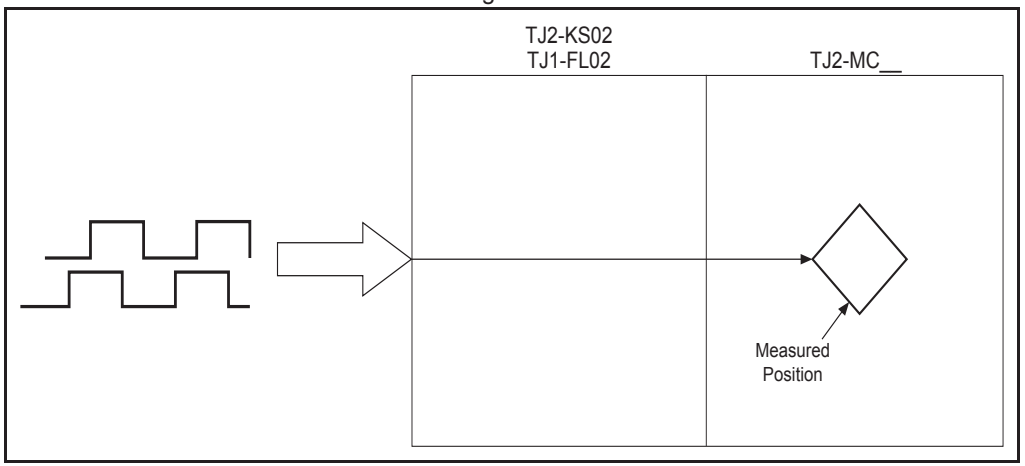
With **SERVO = ON** this is an axis with an analogue speed reference output and incremental encoder feedback input. The position loop is closed in the TJ2-MC__ which sends the resulting speed reference to the axis.

fig. 32



With **SERVO = OFF**, the position of the external incremental encoder is read. The analogue output can be set with BASIC commands only and can be used for general purposes.

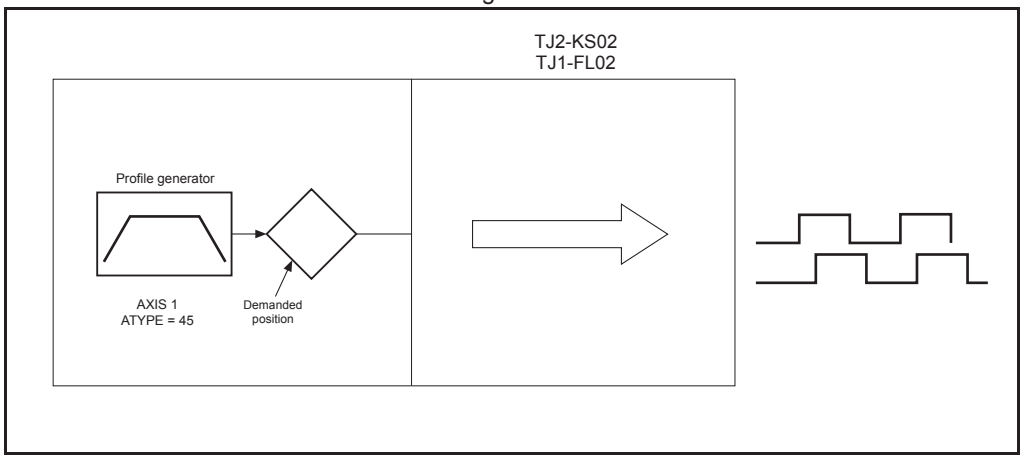
fig. 33



Encoder output ATYPE=45

The position profile is generated and the output from the system is an incremental encoder pulse. This is useful to control a motor via pulses or as a position reference for another motion controller.

fig. 34



Absolute Tamagawa encoder ATYPE=46

With **SERVO = ON**, this is an axis with analogue speed reference output and absolute Tamagawa encoder feedback. The position loop is closed in the TJ2-MC__ and the resulting speed reference is sent to the axis.
With **SERVO = OFF**, the position of the external absolute Tamagawa encoder is read. The analogue output can be set with BASIC commands only and can be used for general purposes.

Absolute EnDat encoder ATYPE=47

With **SERVO = ON**, this is an axis with analogue speed reference output and absolute EnDat encoder feedback. The position loop is closed in the TJ2-MC__ and the resulting speed reference is sent to the axis.
With **SERVO = OFF**, the position of the external absolute EnDat encoder is read. The analogue output can be set with BASIC commands only and can be used for general purposes.

Absolute SSI encoder ATYPE=48

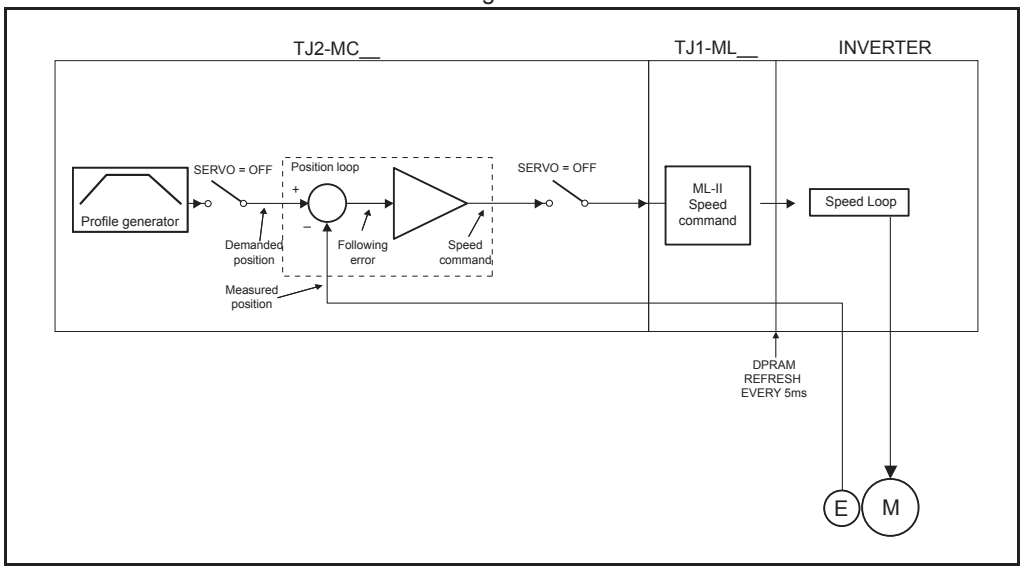
With **SERVO = ON**, this is an axis with analogue speed reference output and absolute SSI encoder feedback. The position loop is closed in the TJ2-MC__ and the resulting speed reference is sent to the axis.
With **SERVO = OFF**, the position of the external absolute SSI encoder is read. The analogue output can be set with BASIC commands only and can be used for general purposes.

MECHATROLINK Inverter axis ATYPE=49

This type allows Inverters (with built-in encoder interface) to be controlled on the MECHATROLINK-II bus as servo axes.
From the controller point of view, Inverter axes are handled the same as servo axes in MECHATROLINK-II Speed Mode (**ATYPE=41**).
Unlike the other axis types, this Inverter axis must be defined programmatically with function 8 of the command **INVERTER_COMMAND**.

The Speed command to the Inverter and the feedback from the encoder is refreshed in the Inverter every 5 ms. This is a DPRAM limitation. This means that the use of the Inverter is similar to the use of a Servo Drive, but the performance is lower.

fig. 35



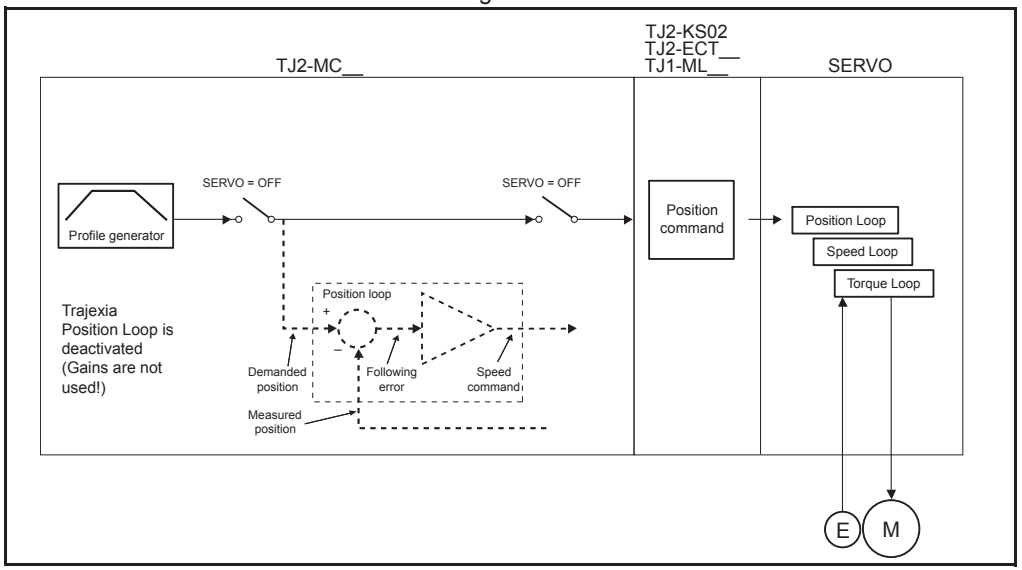
EtherCAT Cyclic Synchronous Position (CSP) ATYPE=65

With **SERVO = ON**, the position loop is closed in the Servo Drive. Gain settings in the TJ2-MC__ have no effect. The position reference is sent to the Servo Drive.

Note
Although **MPOS** and **FE** are updated, the real value is the value in the Servo Drive. The real Following Error can be monitored by the **DRIVE_MONITOR** parameter by setting **DRIVE_CONTROL = 5**.

Note
The EtherCAT position **ATYPE = 65** is the recommended setting to obtain a higher performance of the servo motor.

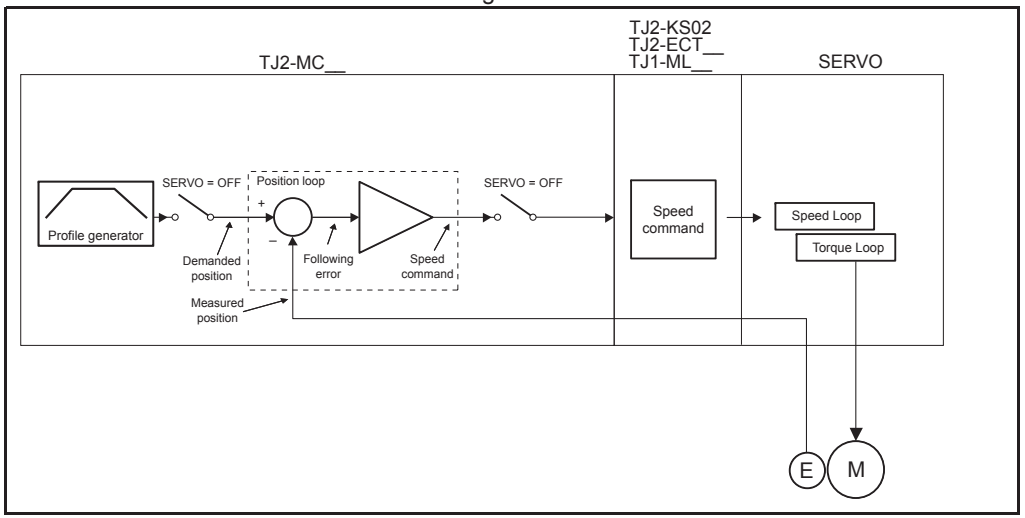
fig. 36



EtherCAT Cyclic Synchronous Speed (CSV) ATYPE=66

With **SERVO = ON**, the speed loop is closed in the TJ2-MC__.
Speed reference is sent to the Servo Drive. This setting is not recommended, since there is one cycle delay in the loop (DPOS(n) is compared with MPOS(n-1)).
With **SERVO = OFF**, the speed reference is sent via **S_REF** command and is specified in units/s.This is the recommended setting.

fig. 37



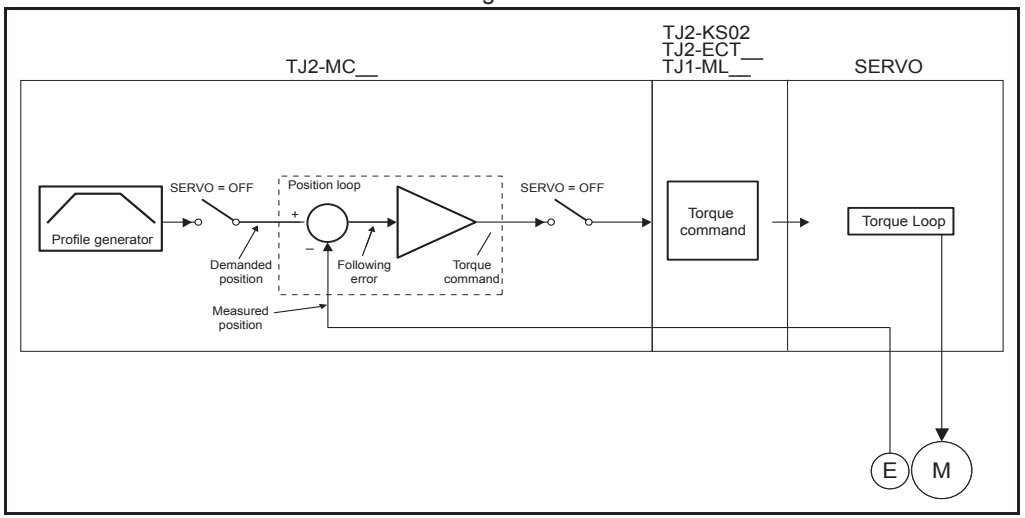
EtherCAT Cyclic Synchronous Torque (CST) ATYPE=67

With **SERVO = ON**, the torque loop is closed in the TJ2-MC__. The torque reference in the Servo Drive depends on the **FE** and the gain.
With **SERVO = OFF**, the torque reference is sent directly via the **T_REF** command. The units of the torque reference is 0.1%, so 1000 is equal to 100% rated torque.

Note
To monitor the torque in the Servo Drive in **DRIVE_MONITOR**, set **DRIVE_CONTROL=4**

Note
Make sure object 3317h (Speed Limit Selection) is set to 0, and set the speed limit in object 3321h (Speed Limit Value Setting).

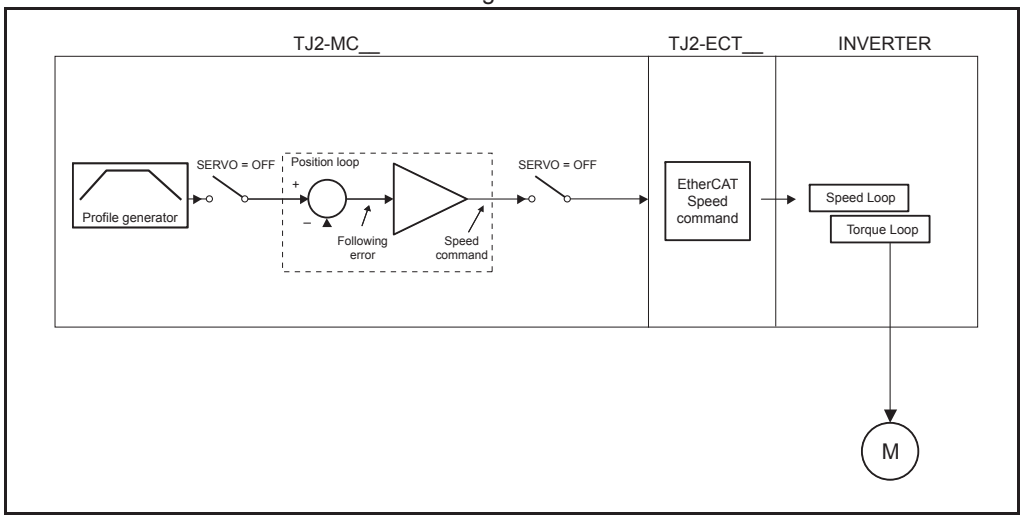
fig. 38



EtherCAT Velocity (VL) ATYPE=68

With **SERVO = OFF**, the speed reference is sent via **S_REF** command.

fig. 39



EtherCAT Encoder ATYPE=69

With **SERVO = OFF**, the position of the external EtherCAT incremental encoder is read.

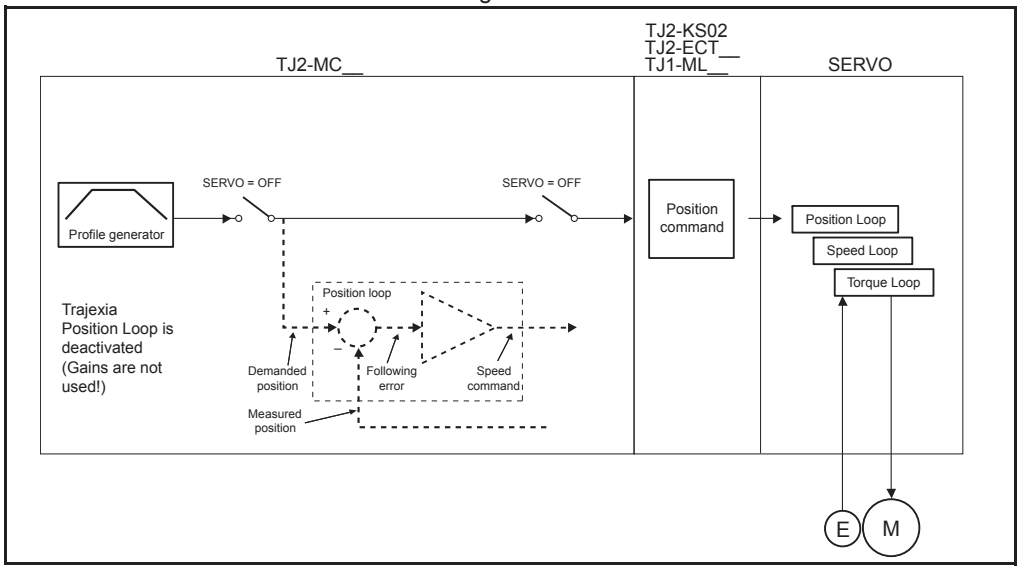
Accurax G5-A/P position ATYPE=80

With **SERVO = ON**, the position loop is closed in the Servo Drive. Gain settings in the TJ2-MC__ have no effect. The position reference is sent to the Servo Drive.

Note
Although **MPOS** and **FE** are updated, the real value is the value in the Servo Drive. The real Following Error can be monitored by the **DRIVE_MONITOR** parameter by setting **DRIVE_CONTROL = 4**.

Note
ATYPE = 80 is the recommended setting to obtain a higher performance of the servo motor.

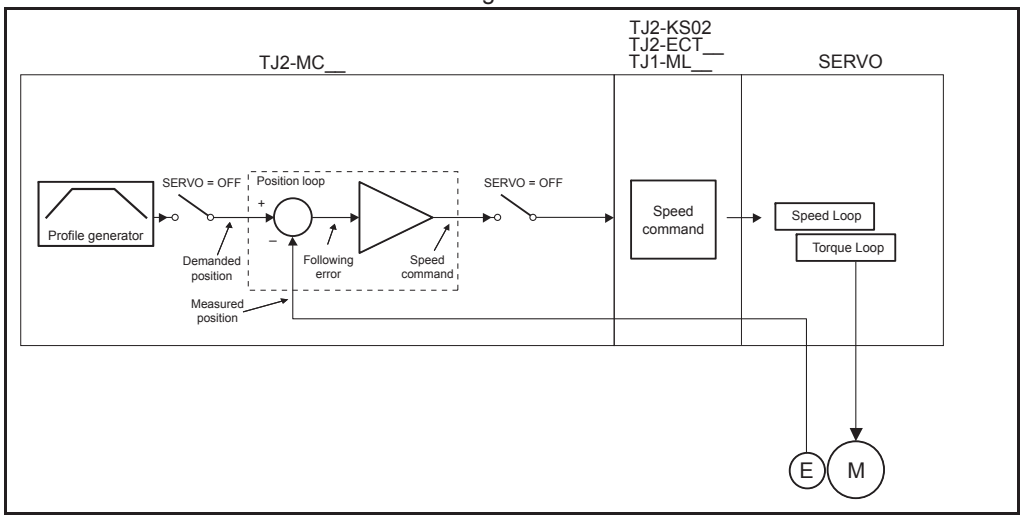
fig. 40



Accurax G5-A/P position ATYPE=81

With **SERVO = ON**, the speed loop is closed in the TJ2-MC__. Speed reference is sent to the Servo Drive. This setting is not recommended, since there is one cycle delay in the loop (DPOS(n) is compared with MPOS(n-1)).
With **SERVO = OFF**, the speed reference is sent via **S_REF** command and is specified in pulses/s.This is the recommended setting.

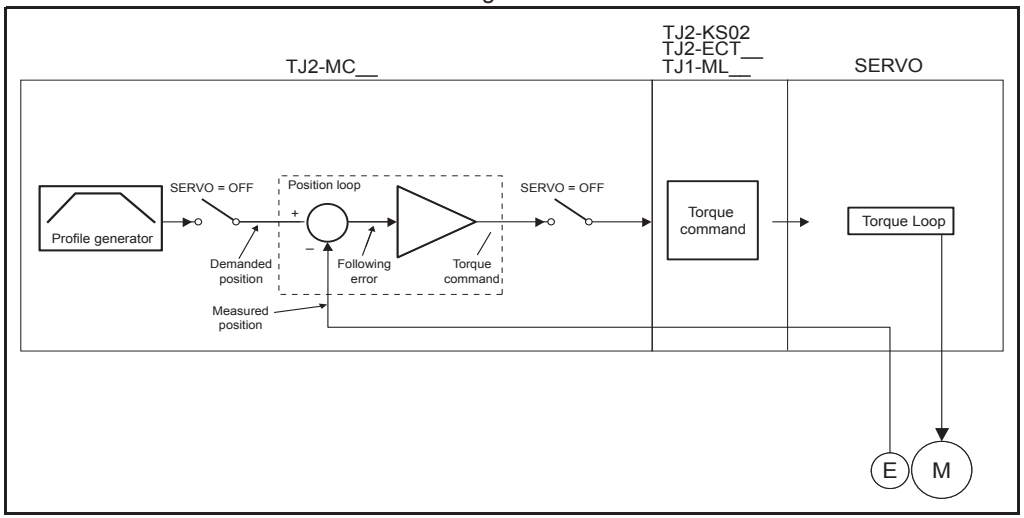
fig. 41



Accurax G5-A/P torque ATYPE=82

With **SERVO = ON**, the torque loop is closed in the TJ2-MC__. The torque reference in the Servo Drive depends on the **FE** and the gain.
With **SERVO = OFF**, the torque reference is sent directly via the **T_REF** command. The units of the torque reference is 0.1%, so 1000 is equal to 100% rated torque.

fig. 42



Summary of axis types and control modes

The following table lists the axis types and their recommended modes for speed control, position control and torque control.

ATYPE	SERVO	Mode	Comment
40	OFF	Position (MECHATROLINK-II)	The position loop is closed in the Servo Drive. No new motion command is allowed.
40	ON	Position (MECHATROLINK-II)	Recommended mode for position control with MECHATROLINK-II axes.
41	OFF	Speed (MECHATROLINK-II)	Recommended mode for speed control with MECHATROLINK-II axes. Set the speed with **S_REF**.
41	ON	Position via speed (MECHATROLINK-II)	The position loop is closed in Trajexia. This gives lower performance than closing the position loop in the Servo Drive.
42	OFF	Torque (MECHATROLINK-II)	Recommended mode for torque control with MECHATROLINK-II axes. Set the torque with **T_REF**.
42	ON	Position via torque (MECHATROLINK-II)	The position loop is closed in Trajexia. The output of the position loop is sent as the torque reference to the Servo Drive.
44, 46, 47, 48	OFF	Speed (Flexible Axis)	Recommended mode for speed control with Flexible Axis.
44, 46, 47, 48	ON	Position (Flexible Axis)	The position loop is closed in Trajexia. Recommended mode for position control with Flexible Axis.
49	OFF	Speed (MECHATROLINK-II)	Inverter (with built-in encoder interface) controlled on the MECHATROLINK-II bus as a servo axis. Set the speed with **S_REF**.
49	ON	Position (MECHATROLINK-II)	Inverter (with built-in encoder interface) controlled on the MECHATROLINK-II bus as a servo axis. The position loop is closed in Trajexia.

ATYPE	SERVO	Mode	Comment
65	OFF	Position (EtherCAT)	The position loop is closed in the Servo Drive. No new motion command is allowed.
65	ON	Position (EtherCAT)	Recommended mode for position control with EtherCAT Servo axes.
66	OFF	Speed (EtherCAT)	Recommended mode for speed control with EtherCAT Servo axes. Set the speed with **S_REF**.
66	ON	Position via speed (EtherCAT)	The position loop is closed in Trajexia. This gives lower performance than closing the position loop in the Servo Drive.
67	OFF	Torque (EtherCAT)	Recommended mode for torque control with EtherCAT Servo axes. Set the torque with **T_REF**.
67	ON	Position via torque (EtherCAT)	The position loop is closed in Trajexia. The output of the position loop is sent as the torque reference to the Servo Drive.
68	OFF	Velocity (EtherCAT)	Inverter controlled on the EtherCAT bus as an axis. Set the speed with **S_REF**.
69	OFF	Position (EtherCAT)	Position reference from an encoder connected to the EtherCAT network.
80	OFF	Position (Accurax G5)	The position loop is closed in the Servo Drive. No new motion command is allowed.
80	ON	Position (Accurax G5)	Recommended mode for position control with axes controlled by the TJ2-KS02
81	OFF	Speed (Accurax G5)	Recommended mode for speed control with axes controlled by the TJ2-KS02. Set the speed with **S_REF**.
81	ON	Position via speed (Accurax G5)	The position loop is closed in Trajexia. This gives lower performance than closing the position loop in the Servo Drive.
82	OFF	Torque (Accurax G5)	Recommended mode for torque control with axes controlled by the TJ2-KS02. Set the torque with **T_REF**.

ATYPE	SERVO	Mode	Comment
82	ON	Position via torque (Accurax G5)	The position loop is closed in Trajexia. The output of the position loop is sent as the torque reference to the Servo Drive.

2.8 Motion buffers

The motion buffer is a temporary store of the motion instruction from the BASIC program or PLC task to the profile generator.
The BASIC program continues while the instruction waits in the buffer.
There are three types of buffer:

- **MTYPE**. The current movement that is being executed. **MTYPE** relates to the axis and not to the process.
- **NTYPE**. The new movement that waits for execution. **NTYPE** relates to the axis and not to the process. NTYPE is the first entry of the Look Ahead buffer which size is defined by **LIMIT_BUFFERED**.
- Process Buffer. The third buffered movement cannot be monitored. The process buffer relates to the process and not to the axis.

It is possible to check if the process buffer is full by checking the **PMOVE** process parameter.

When a motion instruction is executed, the instruction is loaded into the process buffer and distributed to the corresponding axis buffer in the next motion sequence.
If all buffers are full and an additional motion instruction is executed, the BASIC program stops execution until a process buffer is free for use. In case of a PLC task the motion Function Block will signal that the motion instruction cannot be loaded in the buffer.

fig. 43

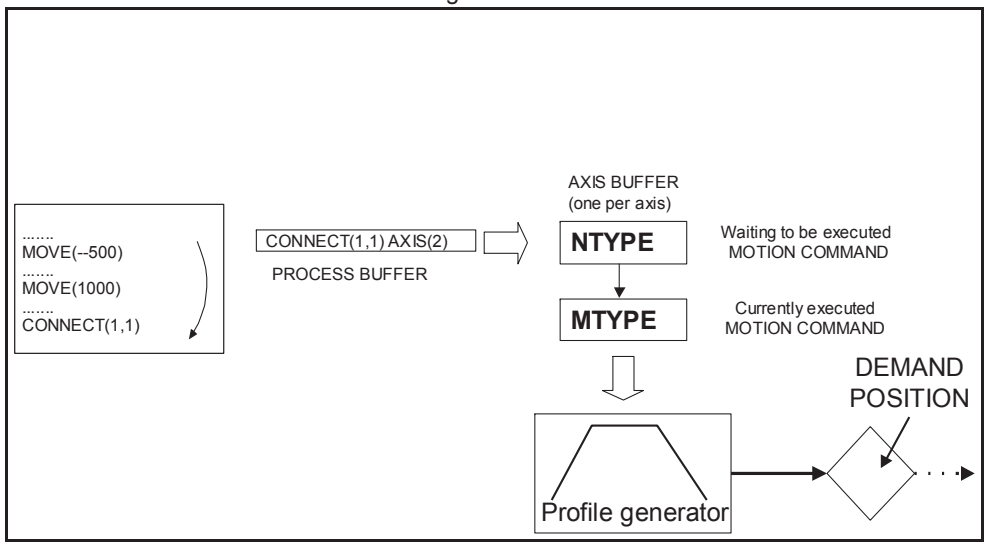
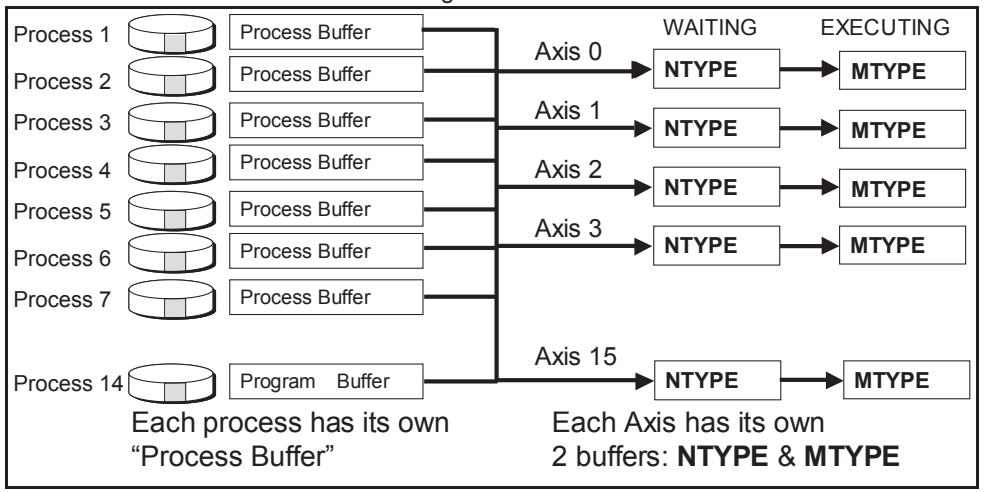
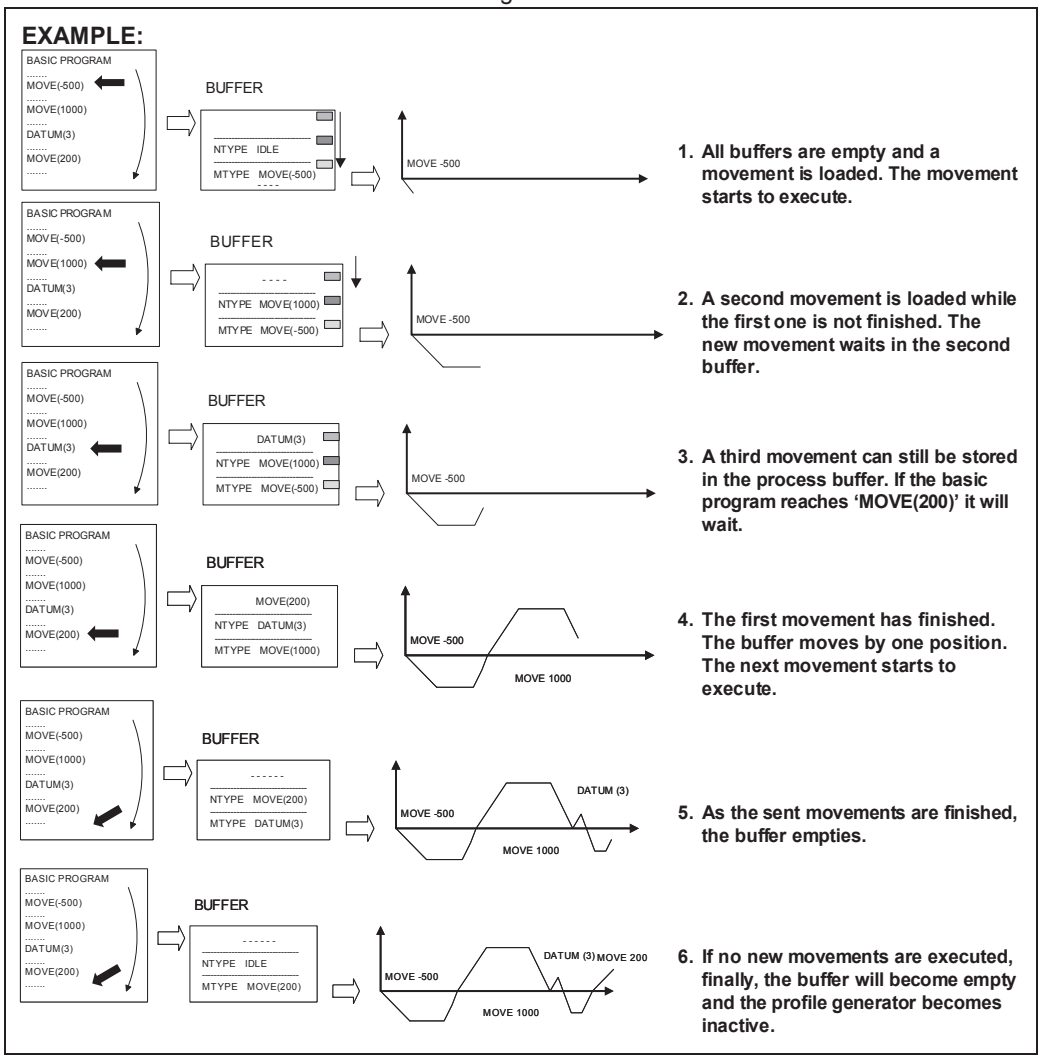


fig. 44



Example of buffered instructions:

fig. 45



2.9 Mechanical system

2.9.1 Inertia ratio

The inertia ratio is a stability criterion. The higher the inertia of the load in relation to the inertia of the motor, the lower the gains you can set in your system before you reach oscillation, and the lower the performance you can reach.
With a ratio of 1:30 for small Servo Drives and a ratio of 1:5 for big Servo Drives you can reach the maximum dynamic of the motor-Drive combination.

2.9.2 Rigidity

If a machine is more rigid and less elastic, you can set higher gains without vibration, and you can reach higher dynamic and lower Following Error.

2.9.3 Resonant frequency

A mechanical system has at least one resonant frequency. If you excite your mechanical system to the resonant frequency, it starts oscillating. For motion systems, it is best to have mechanical systems with a very high resonant frequency, that is, with low inertia and high rigidity.
The resonant frequency of the mechanical system is the limit for the gain settings.

3 Hardware reference

3.1 Introduction

Trajexia is OMRON's motion platform that offers you the performance and the ease of use of a dedicated motion system.

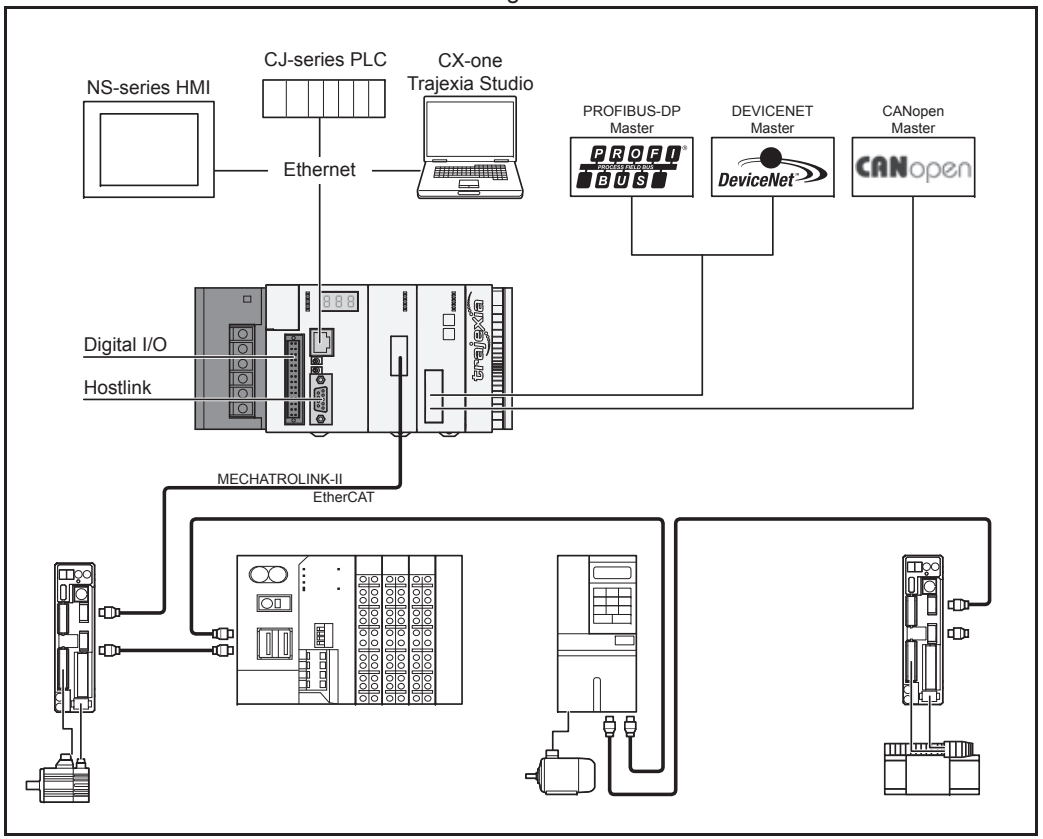
Trajexia is a stand-alone modular system that allows maximum flexibility and scalability. At the heart of Trajexia lies the TJ2 multi-tasking machine controller. Powered by a 64-bit processor, it can do motion tasks such as e-cam, e-gearbox, registration control and interpolation, all via simple motion commands.

Trajexia offers control of up to 64 axes over a MECHATROLINK-II or EtherCAT network or traditional analogue or pulse control with independent position, speed or torque control for every axis. And its powerful motion instruction set makes programming intuitive and easy.

You can select from a wide choice of best-in-class rotary, linear and direct-drive Servo systems as well as Inverters. The system is scalable up to 64 axes, Inverters or I/O modules.

The TJ2-MC__ also contains an IEC 61131-3 compliant soft PLC, capable of controlling I/O and performing motion.

fig. 1



3.1.1 Trajexia High-Lights

The main high-lights of the trajexia system are as follows:

Direct connectivity via Ethernet
Trajexia's built-in Ethernet interface provides direct and fast connectivity to PCs, PLCs, HMIs and other devices while providing full access to the CPU and to the Drives over a MECHATROLINK-II or EtherCAT network. It allows explicit messaging over Ethernet and through MECHATROLINK-II or EtherCAT to provide full transparency down to the actuator level, and making remote access possible.

Keep your know-how safe
By preventing access to the programs in the controller Trajexia guarantees complete protection and confidentiality for your valuable know-how.

Serial Port and Local I/Os
A serial connector provides direct connectivity with any OMRON PLC, HMIs or any other field device. 16 Inputs and 8 outputs are freely configurable embedded I/Os in the controller to enable you to tailor Trajexia to your machine design.

MECHATROLINK-II Master
The MECHATROLINK-II master performs control of up to 64 Servo Drives, Inverters or I/Os while allowing complete transparency across the whole system. MECHATROLINK-II offers the communication speed and time accuracy essential to guarantee perfect motion control of Servo Drives. The motion cycle time is selectable between 0.5 ms, 1 ms or 2 ms.

EtherCAT Master
EtherCAT is an open high-speed industrial network system that conforms to Ethernet (IEEE802.3). Each node achieves a short cycle time by transmitting Ethernet frames at high speed. A mechanism that allows sharing clock information enables high-precision synchronization control with low communications jitter.
The EtherCAT master performs control of up to 64 Servo Drives, Inverters or I/Os while allowing complete transparency across the whole system. The motion cycle time is selectable between 0.25 ms, 0.5 ms, 1 ms or 2 ms.

TJ1-FL02 (Flexible Axis Unit)
The TJ1-FL02 allows full control of two actuators via an analogue output or pulse train. The module supports the main absolute encoder protocols allowing the connection of an external encoder to the system.

TJ2-KS02 (G5 Serial Interface Unit)
The TJ2-KS02 allows full control of up to two Accurax G5-A/P Servo Drives through a serial interface. In addition the module supports incremental and absolute encoders allowing the connection of an external encoder to the system.

Drives and Inverters
A wide choice of rotary, linear and direct-drive Servo systems as well as Inverters are available to fit your needs in compactness, performance and reliability.

Remote I/Os
The I/Os on the MECHATROLINK-II and EtherCAT network provide for system expansion while keeping the devices under one motion bus.

PROFIBUS-DP
The PROFIBUS-DP slave allows connectivity to the PROFIBUS network in your machine.

DeviceNet
The DeviceNet slave allows connectivity to the DeviceNet network in your machine.

CANopen
The CANopen master allows connectivity to the CANopen network in your machine.

Modbus
Both ModbusRTU via serial and ModbusTCP via Ethernet are supported to be able to connect to masters supporting the same interface.

3.1.2 Trajexia Studio and CX-Motion Pro

One software

Trajexia's intuitive and easy programming tool, based on the Motion BASIC instruction set, includes dedicated commands for linking axes, e-cams, e-gearboxes, etc. Multi-tasking provides flexibility in application design. The motion commands are "buffered" so the BASIC programs are executed while motion movements are executed.

Note
Trajexia Studio and CX-Motion Pro are the same software. Trajexia Studio is supplied standalone where CX-Motion Pro is part of the CX-One automation suite.

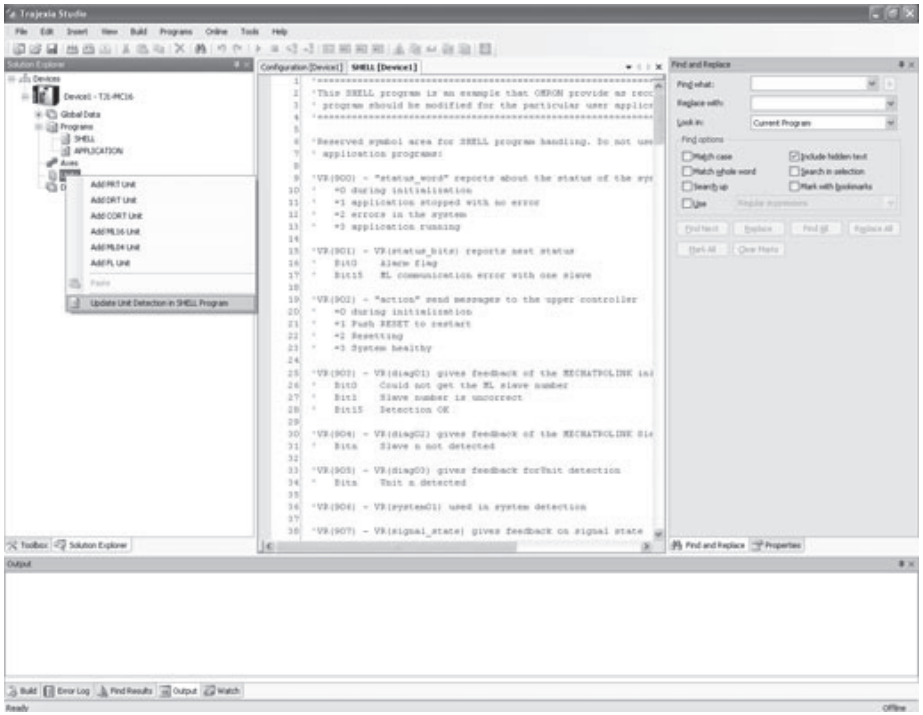
One connection

The parameters and functions inside the Drives on the MECHATROLINK-II and EtherCAT network are fully accessible from the Ethernet connection.

One minute

Trajexia Studio includes advanced debugging tools, including trace and oscilloscope functions, to ensure efficient operation and minimum downtime. The Servo Drives, Inverters and I/Os connected to the MECHATROLINK-II and EtherCAT motion bus are automatically identified and configured, allowing you to set up your system in minutes.

fig. 2



3.1.3 This manual

This Hardware Reference Manual gives the dedicated information for:

- The description, connections and use of the Trajexia units
- The description, connections and use of the MECHATROLINK-II slaves
- The description, connections and use of the EtherCAT slaves
- A detailed philosophy of the system design to obtain the best results for Trajexia

3.2 All units

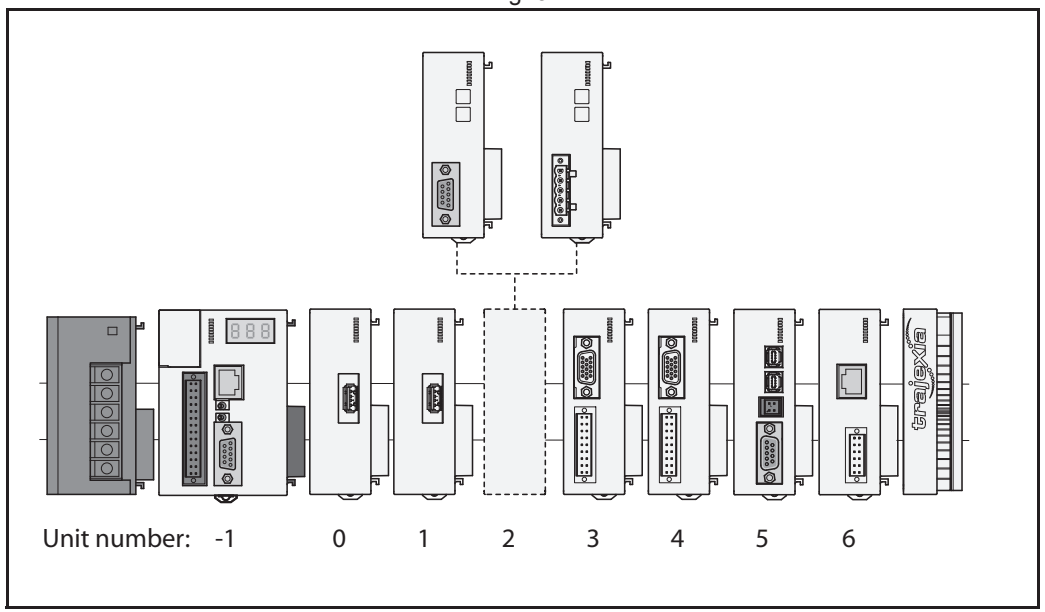
3.2.1 System installation

A Trajexia system consists of these units:
- A Power Supply Unit.
- A TJ2-MC__ (Machine Controller Unit).
- Up to 7 expansion units.
- A TJ1-TER (Terminator Unit).

The expansion units (unit numbers 0-6) can be arranged in any order. The TJ2-MC__ autodetects all units.

A Trajexia system with a TJ2-MC__ can include:
- 0 to 4 TJ1-ML__ units (MECHATROLINK-II Master Unit).
- 0 to 1 TJ2-ECT__ units (EtherCAT Master Unit)
- 0 to 7 TJ1-FL02 units.
- 0 to 7 TJ2-KS02 units.
- 0 or 1 TJ1-PRT (PROFIBUS-DP Slave Unit) or TJ1-DRT units (DeviceNet Slave Unit)[1].
- 0 or 1 TJ1-CORT units (CANopen Master Unit).

fig. 3

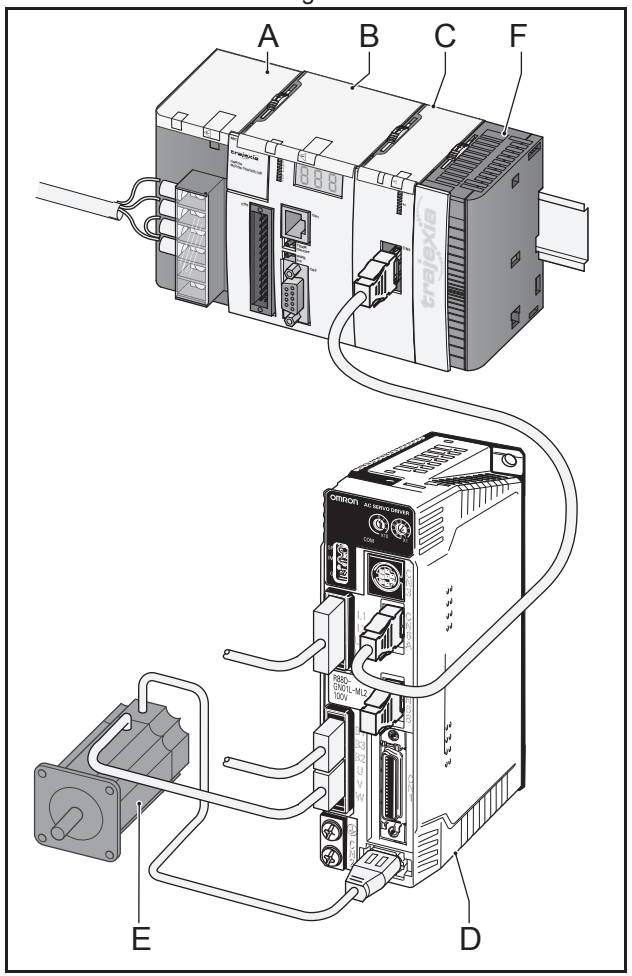


1. Trajexia does not support both a TJ1-PRT and a TJ1-DRT unit in the same system.

The figure is an example of a simple configuration.

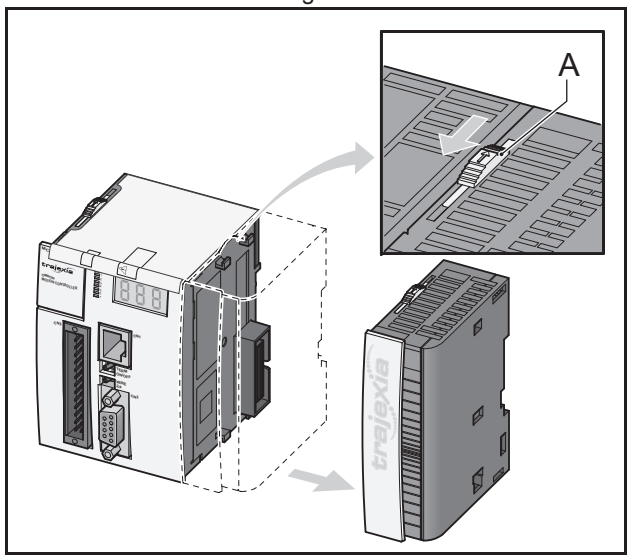
A. Power supply
B. TJ2-MC__.
C. TJ1-ML__.
D. G-Series Servo Drive
E. G-Series Servo motor
F. TJ1-TER.

fig. 4



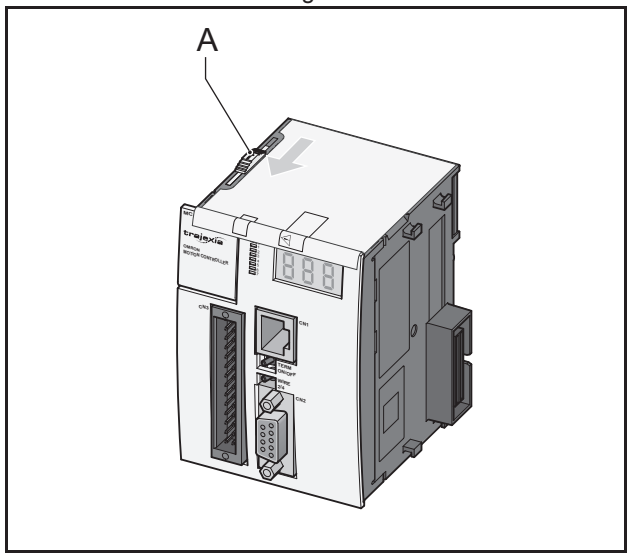
1. Remove all the units from the packaging. Make sure all units are complete.
2. Do not remove the protection labels from the units.
3. To disconnect the TJ2-MC__ and the TJ1-TER, push the clips (A) on top and bottom of the TJ1-TER to the front.
4. Disconnect the TJ1-TER from the TJ2-MC__.

fig. 5



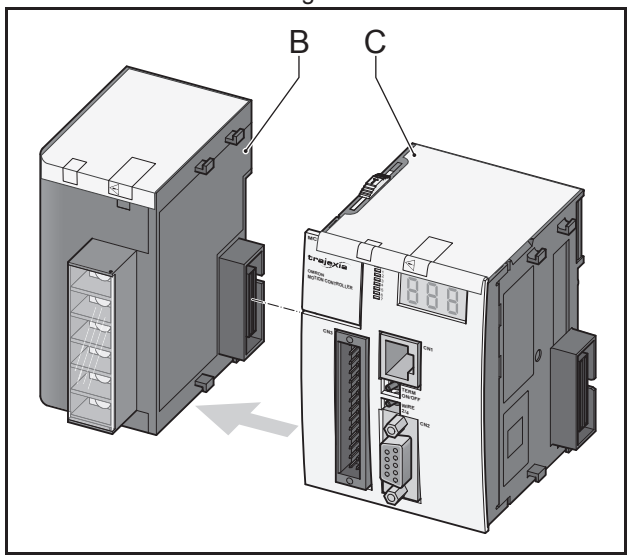
5. Push the clips (A) on top and bottom of all the units to the front.

fig. 6



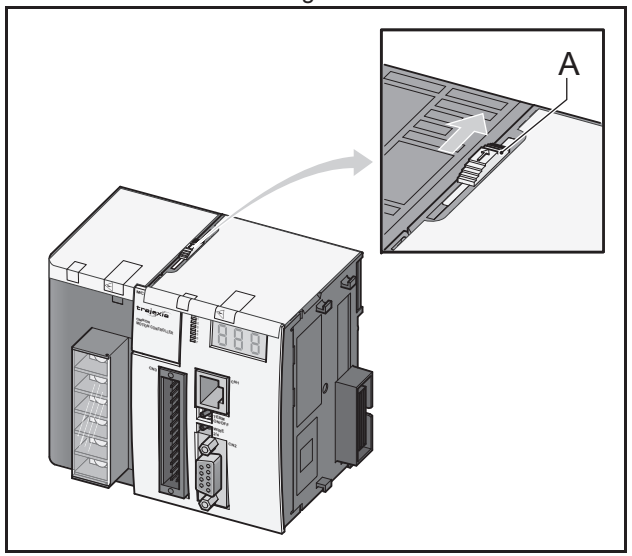
6. Attach the TJ2-MC__ (C) to the Power Supply Unit (B).

fig. 7



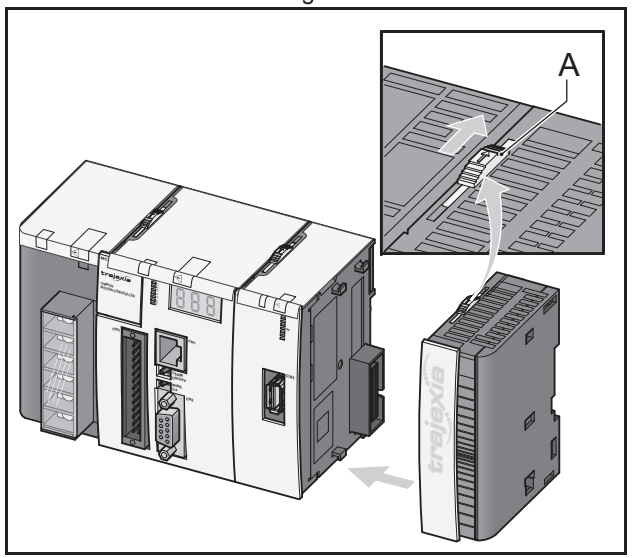
7. Push the clips (A) on top and bottom to the rear.

fig. 8



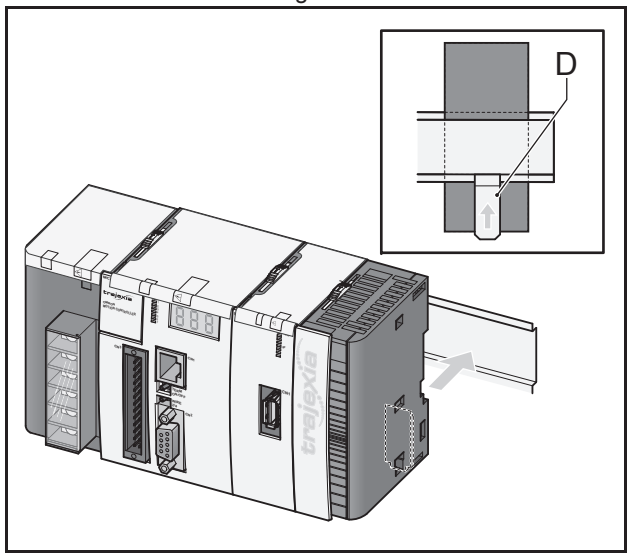
8. Repeat the previous two steps for all other units.
9. Make sure the last unit is the TJ1-TER.

fig. 9



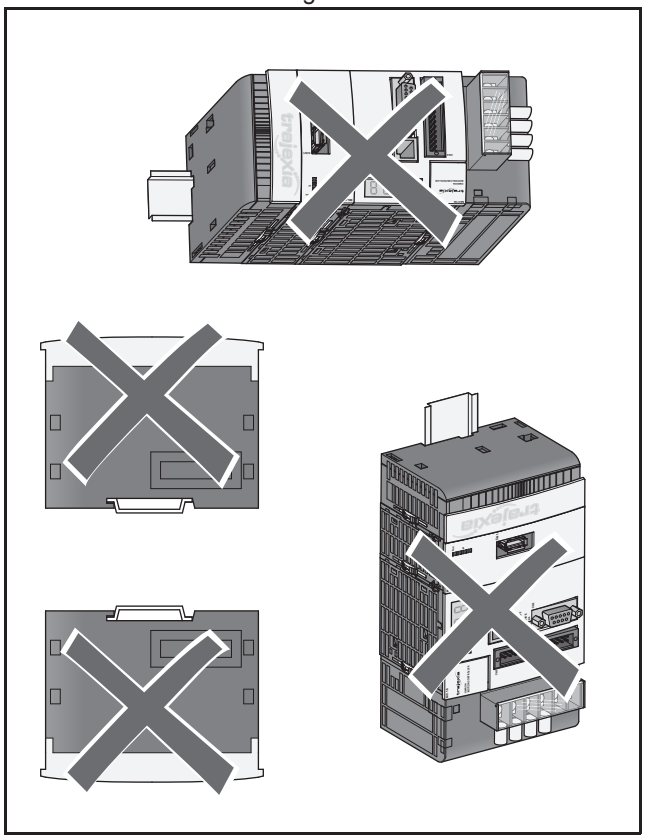
10. Pull down all the clips (D) on all units.
11. Attach the Trajexia system to the DIN rail in an upright position to provide proper cooling. The recommended DIN rail is of type PFP-100N2, PFP-100N or PFP-50N.
12. Push all the clips (D) up on all units.
13. After you complete the wiring of the units, remove the protection labels from the units.

fig. 10



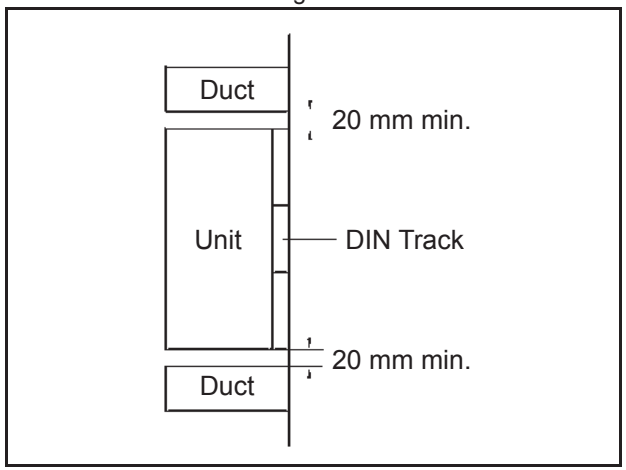
14. Do not install the Trajexia units in one of these positions:
- Upside down.
- With the top side forward.
- With the bottom forward.
- Vertically.

fig. 11



15. When you design a cabinet for the units, make sure that the cabinet allows at least 20 mm of space around the units to provide sufficient airflow. We advise to allow at least 100 mm of space around the units.

fig. 12



3.2.2 Environmental and storage for all units

Item	Specification
Ambient operating temperature	0 to 55°C
Ambient operating humidity	10 to 90% RH. (with no condensation)
Ambient storage temperature	-20 to 70°C (excluding battery)
Ambient storage humidity	90% max. (with no condensation)
Atmosphere	No corrosive gases
Vibration resistance	10 to 57 Hz: (0.075 mm amplitude): 57 to 100 Hz: Acceleration: 9,8 m/s2, in X, Y and Z directions for 80 minutes
Shock resistance	147 m/s^2, 3 times each X, Y and Z directions
Insulation resistance	20 MΩ
Dielectric strength	500 VAC
Protective structure	IP20
International standards	CE, EN 61131-2, cULus, Lloyds RoHS compliant

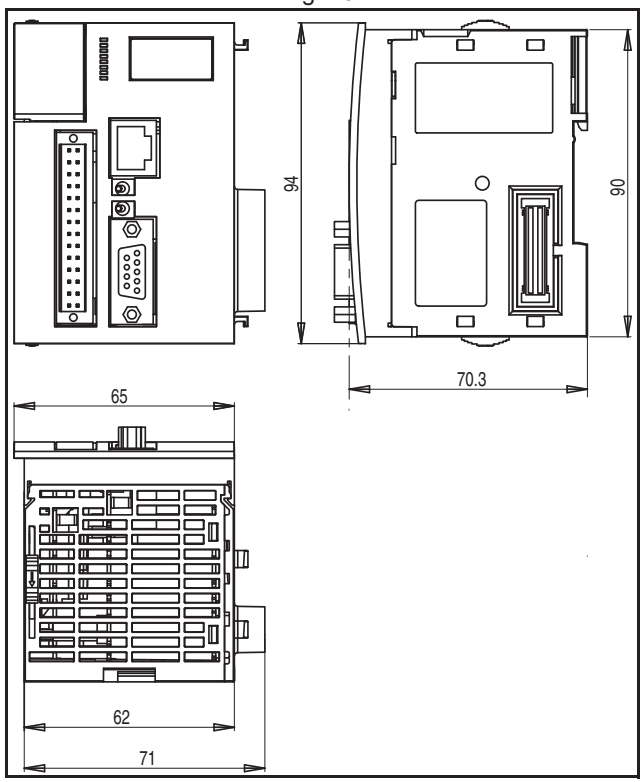
3.2.3 Unit dimensions

The dimensions for the units of the Trajexia system are as follows:

Trajexia machine controller

All measurements are in mm.

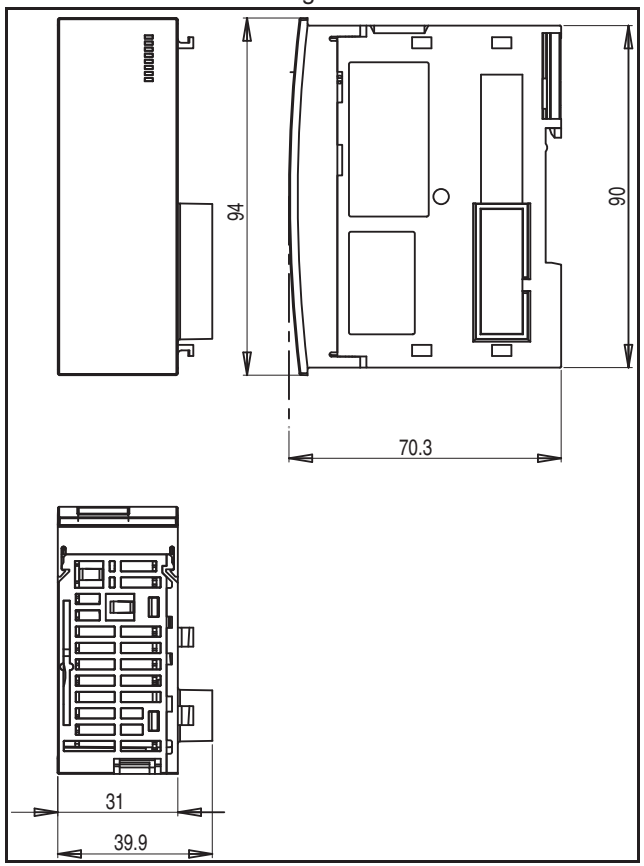
fig. 13



Trajexia units

All measurements are in mm.

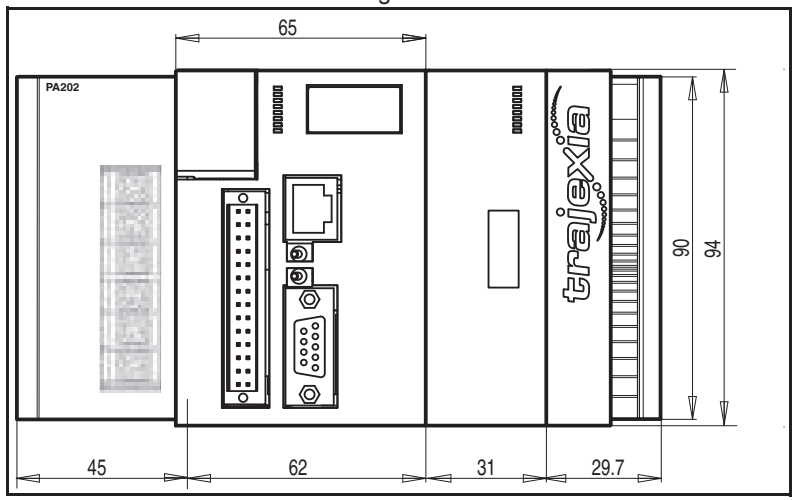
fig. 14



Trajexia system

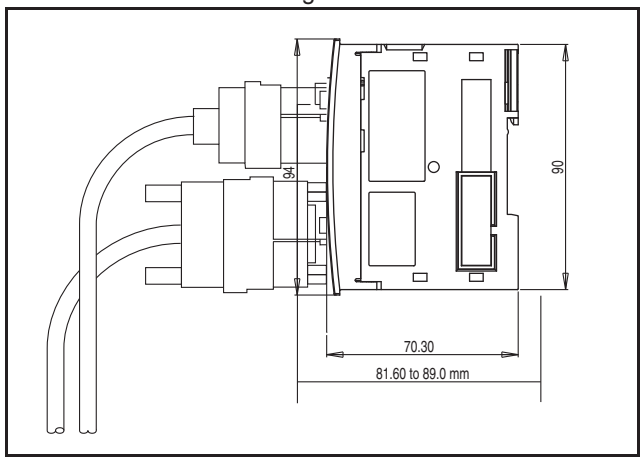
All measurements are in mm.

fig. 15



The installation depth of the Trajexia system is up to 90 mm, depending on the modules that are mounted. Allow sufficient depth in the control cabinet.

fig. 16

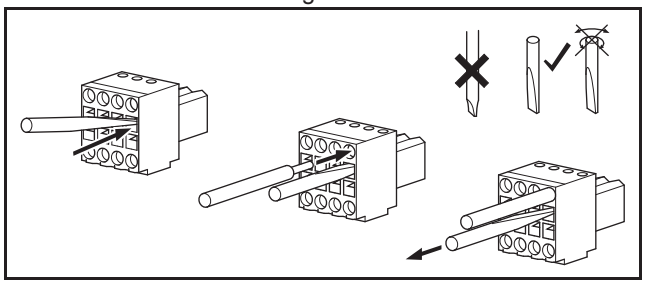


3.2.4 Wire the I/O connectors

To wire the I/O connectors of the TJ2-MC__, TJ1-FL02, TJ2-ECT__ and TJ2-KS02 units, do these steps:

1. Strip the wires.
2. To make it easier to insert the wires, twist them.
3. If necessary, crimp the plain (top) ferrules or the collared (bottom) ferrules.
4. Insert the screwdriver into the inner (square) hole. Push firmly.
5. Insert the wire into the outer (circular) hole.
6. Remove the screwdriver.
7. Make sure that there are no loose strands.

fig. 17



Wiring specifications

Item	Specification
Wire types	0.14–1.0 mm^2 Solid, stranded or stranded with ferrule: • Crimp ferrules according to DIN46228/1 • Crimp ferrules wit plastic collar according to DIN46228/4 • With recommended tool Weidmüller PZ6
Insertion tool	2.5 mm flat-bladed screwdriver
Recommended ferrule types	Weidmüller AEH H0,14/12 AEH H0,25/12 AEH H0,34/12
Stripping length	7 mm without ferrules (tolerance: +1 mm, –0 mm) 10 mm with ferrules (tolerance: +1 mm, –0 mm)

Conductor size

Item	Specification
Clamping range	0.08–1.0 mm^2
Wires without ferrule	0.5–1.0 mm^2
Wires with ferrule	AEH H0,14/12, 0.13 mm^2 AEH H0,25/12, 0.25 mm^2 AEH H0,34/12, 0.34 mm^2

3.3 Power Supply Unit (PSU)

3.3.1 Introduction

The PSU supplies power to the other units in the Trajexia system. You can use three different types of Power Supply Unit with the Trajexia system:

- CJ1W-PA202
- CJ1W-PA205R
- CJ1W-PD025.

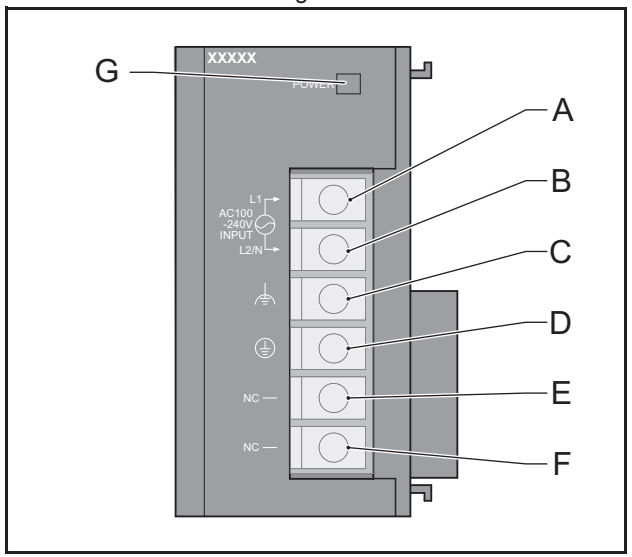
3.3.2 PSU Connections

Each Power Supply Unit has six terminals:

Item	CJ1W-PA202	CJ1W-PA205R	CJ1W-PD025
A	110 - 240 VAC input	110 - 240 VAC input	24 VDC input
B	110 - 240 VAC input	110 - 240 VAC input	0 V input
C	Line earth	Line earth	Line earth
D	Earth	Earth	Earth
E	N/C	Wdog relay contact[1]	N/C
F	N/C	Wdog relay contact	N/C

1. Terminals E and F for the CJ1W-PA205R are relay contacts that close when Wdog is enabled. Refer to the BASIC Commands in the Programming manual.

fig. 18



Caution
Always connect to a class-3 ground (to 100Ω or less) when installing the Units.
Not connecting to a class-3 ground may result in electric shock.

Caution
A ground of 100Ω or less must be installed when shorting the GR and LG terminals on the Power Supply Unit.
Not connecting a ground of 100Ω or less may result in electric shock.

Each Power Supply Unit has one green LED (G). This LED comes on when you connect the Power Supply Unit to the power source.

Caution
Tighten the screws of the power supply terminal block to the torque of 1.2 N·m. Loose screws can result in short-circuit, malfunction or fire.

3.3.3 PSU Specifications

Power Supply Unit	Input voltage	Maximum current consumption		Output power
		5 V group	24 V group	
CJ1W-PA202	110 - 240 VAC	2.8 A	0.4 A	14 W
CJ1W-PA205R	110 - 240 VAC	5.0 A	0.8 A	25 W
CJ1W-PD025	24 VDC	5.0 A	0.8 A	25 W

Caution
The amount of current and power that can be supplied to the system is limited by the capacity of the Power Supply Unit. Refer to this table when designing your system so that the total current consumption of the units in the system does not exceed the maximum current for each voltage group.
The total power consumption must not exceed the maximum for the Power Supply Unit.

3.3.4 PSU box contents

- Safety sheet.
- Power Supply Unit.
- Protection label attached to the top surface of the unit.

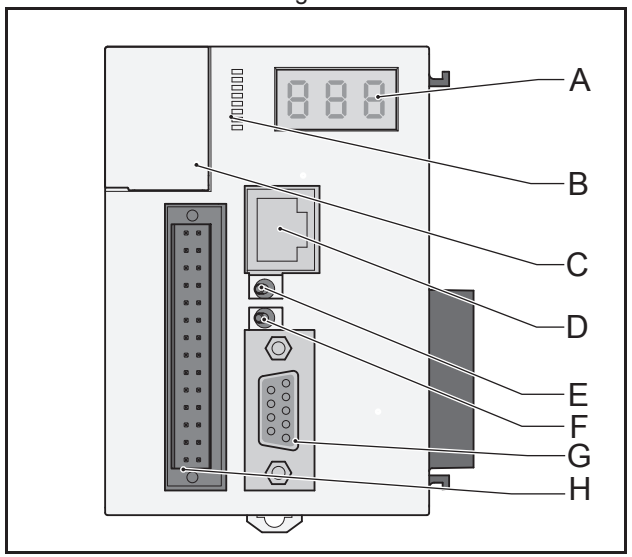
3.4 TJ2-MC__

3.4.1 Introduction

The TJ2-MC__ is the heart of the Trajexia system. You can program the TJ2-MC__ with the BASIC programming language to control the expansion units and the Servo motors attached to the expansion units. Refer to the Programming Manual.
The TJ2-MC__ has these visible parts:

Part	Description
A	LED display
B	I/O LEDs 0 - 7
C	Battery
D	Ethernet connector
E	TERM ON/OFF switch
F	WIRE 2/4 switch
G	Serial connector
H	28-pin I/O connector

fig. 19

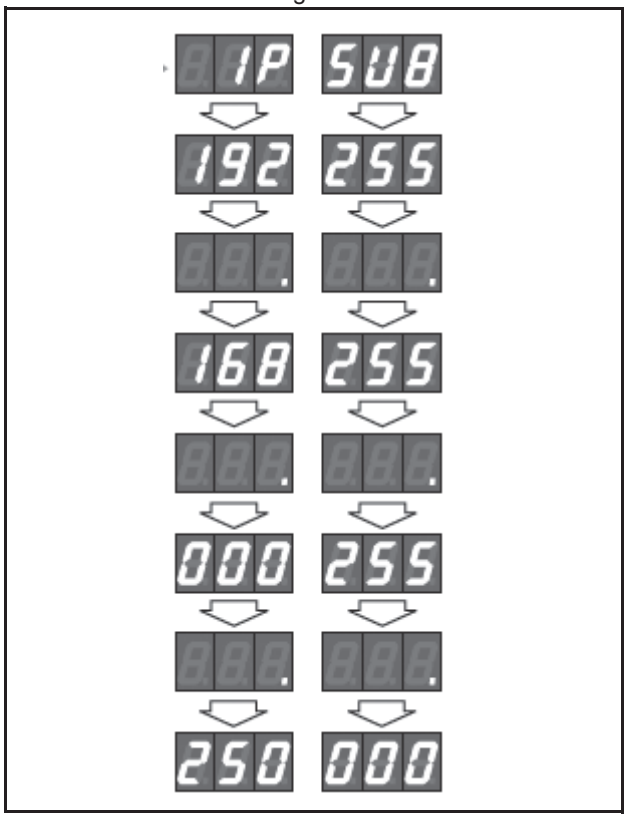


3.4.2 LED Display

The LED display shows the following information:

Information	When
IP address and sub-net mask	Shows 3 times when you connect the Trajexia system to the power supply.
IP address	Shows 4 times when you connect an Ethernet cable to the Ethernet connector of the TJ2-MC__ and to a PC.
RUN	When the TJ2-MC__ operates a Servo Drive.
OFF	When the TJ2-MC__ does not operate a Servo Drive.
ERR + code	When an error occurs in the Trajexia system. The code is the error code. Refer to troubleshooting chapter in the Programming Manual.

fig. 20

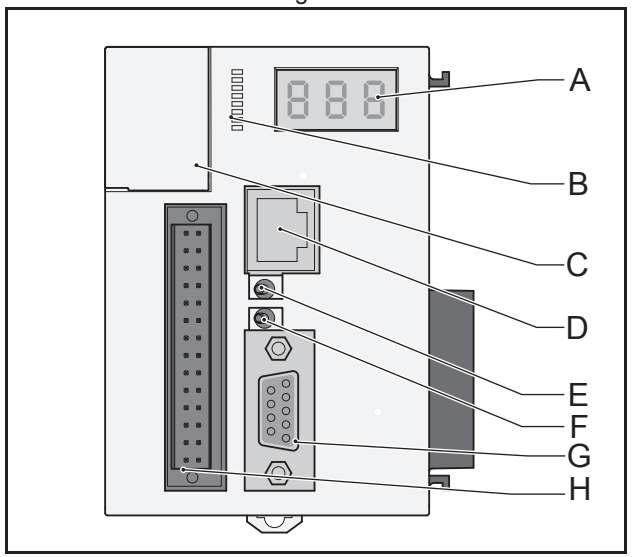


3.4.3 TJ2-MC__ Connections

The TJ2-MC__ comes with these connectors:
- One Ethernet connector, to connect to a PC or Ethernet network (D)
- One serial connector (G).
- One 28-pin I/O connector (H).

The parts for the serial connector and the 28-pin connector are supplied.

fig. 21



Ethernet connector

The Ethernet connector is used to connect the TJ2-MC__ to a PC or Ethernet network. The Ethernet connector is the only connection that can be used to program the system. Use either a crossover or a Ethernet patch cable for this connection. If you connect the PC directly to the TJ2-MC__, and not via a hub or any other network device, the PC must have a fixed IP address.
The TJ2-MC__ automatically detects when a cable is connected to the Ethernet connector.

BASIC installation precautions

Make sure that the Ethernet system is to the IEEE Std 802.3 standard.
Do not install the Ethernet system near a source of noise.

Environmental precautions

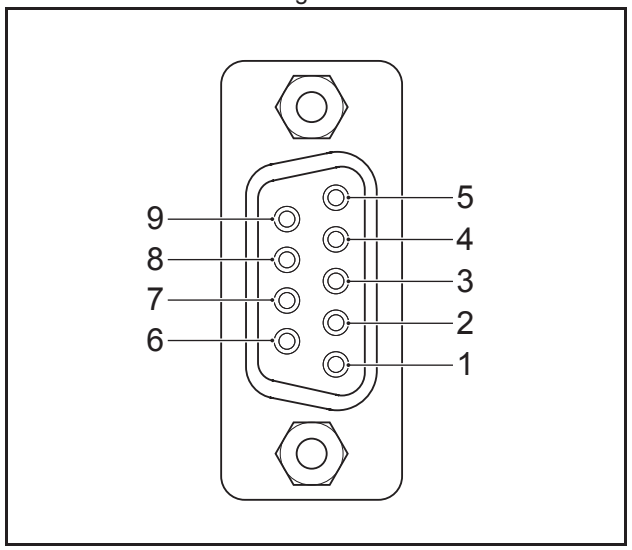
UTP cables are not shielded. In environments that are subject to noise use a system with shielded twisted-pair (STP) cable and hubs suitable for an FA environment.
Install twisted-pair cables away from high-voltage lines and devices that generate noise.
Install twisted-pair cables in locations that are free of high humidity and excessive dust and contaminates.

Serial connector

The serial connector allows for three communication standards:

- RS232.
- RS422.
- RS485.

fig. 22



Pin	Communication	Connection
1	RS422/RS485	/Tx
2	RS232	Tx
3	RS232	Rx
4	N/C	N/C
5	N/C	N/C
6	RS422/RS485	/Rx
7	RS422/RS485	Tx
8	RS422/RS485	Rx
9	RS232	0 V

TERM ON/OFF Switch

Sets the termination on/off of the RS422 / 485 serial connection. The setting of the TERM ON/OFF switch depends on the communication standard of the serial connection and the position of the TJ2-MC__ in the network:

Communication standard	Position of the TJ2-MC__	Setting of the TERM ON/OFF switch
RS422 or RS485	First or last	Left (on)
RS422 or RS485	Not the first and not the last	Right (off)

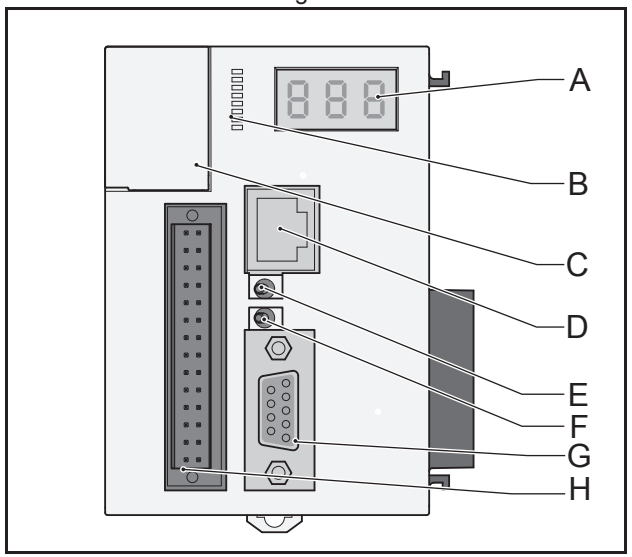
WIRE 2/4 Switch

The WIRE 2/4 switch sets the communication standard for the RS422/485 serial connection. To use one of the communication standards, do this:

Communication standard	How to select it
RS422	Set the WIRE 2/4 switch right
RS485	Set the WIRE 2/4 switch left

Note
In RS485 mode, the transmit pair is connected to the receive pair.

fig. 23

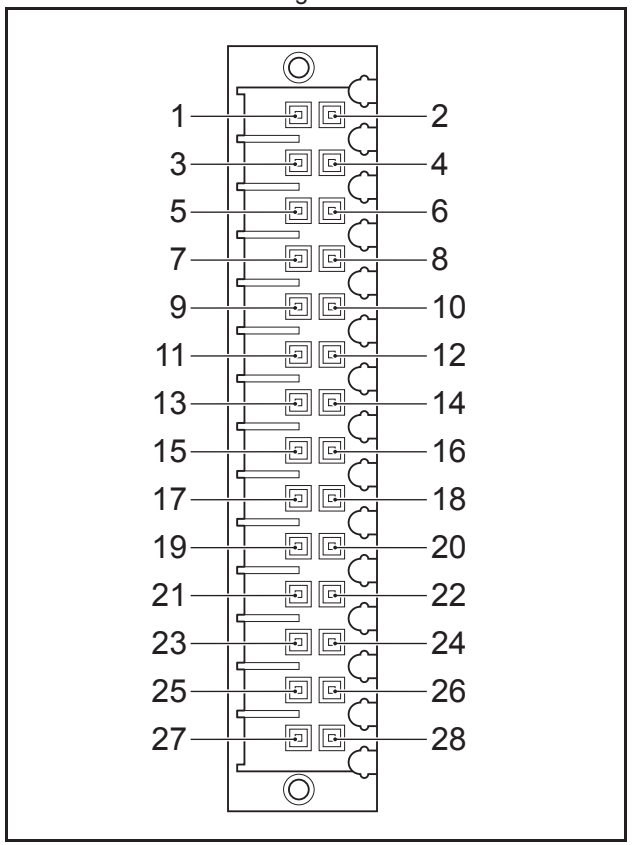


28-Pin I/O connector

The 28 pin connector is a Weidmuller connector designation:
B2L 3.5/28 LH.

Pin	Connection	Pin	Connection
1	0 V input common	2	0 V input common
3	Input 0	4	Input 1
5	Input 2	6	Input 3
7	Input 4	8	Input 5
9	Input 6	10	Input 7
11	Input 8	12	Input 9
13	Input 10	14	Input 11
15	Input 12	16	Input 13
17	Input 14	18	Input 15
19	Output 8	20	Output 9
21	Output 10	22	Output 11
23	Output 12	24	Output 13
25	Output 14	26	Output 15
27	0 V output common	28	24V Power supply Input for the Outputs.

fig. 24



LEDs 0 - 7

The I/O LEDs reflect the activity of the input and outputs. You can use the BASIC **DISPLAY=n** command to set the LEDs.
The table below lists the configuration for LEDs 0 - 7 and the **DISPLAY=n** command where **n** ranges from 0 to 7.

LED label	n=0	n=1	n=2	n=3	n=4[1]	n=5	n=6	n=7
0	IN 0	IN 8	IN 16	IN 24	OUT 0	OUT 8	OUT 16	OUT 24
1	IN 1	IN 9	IN 17	IN 25	OUT 1	OUT 9	OUT 17	OUT 25
2	IN 2	IN 10	IN 18	IN 26	OUT 2	OUT 10	OUT 18	OUT 26
3	IN 3	IN 11	IN 19	IN 27	OUT 3	OUT 11	OUT 19	OUT 27
4	IN 4	IN 12	IN 20	IN 28	OUT 4	OUT 12	OUT 20	OUT 28
5	IN 5	IN 13	IN 21	IN 29	OUT 5	OUT 13	OUT 21	OUT 29
6	IN 6	IN 14	IN 22	IN 30	OUT 6	OUT 14	OUT 22	OUT 30
7	IN 7	IN 15	IN 23	IN 31	OUT 7	OUT 15	OUT 23	OUT 31

1. Outputs 0 to 7 are not physical outputs.

For example, if you use the **DISPLAY=1** command, LED 5 reflects the activity of the input in 13 (pin16) of the 28-pin I/O connector.

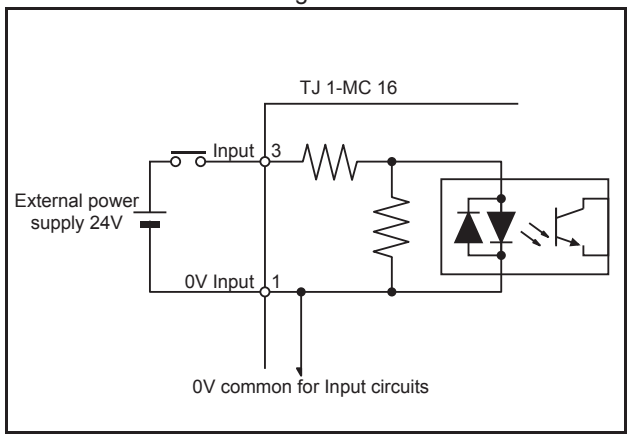
Digital inputs

The following table and illustration details the digital input (Input 0 to Input 15) specifications for the I/O:

Item	Specification
Type	PNP/NPN
Maximum voltage	24 VDC + 10%
Input current	5 mA at 24 VDC
ON voltage	14.4 VDC
OFF voltage	5.0 VDC max.

The timings are dependant upon the servo period of the TJ2_MC__, and include physical delays in the input circuit.
Maximum response times of 1250 μs (for servo periods of 0.5 ms or 1.0 ms) or 2500 μs (for a servo period of 2.0 ms) are achieved between a change in the input voltage and a corresponding change in the IN Parameter.

fig. 25



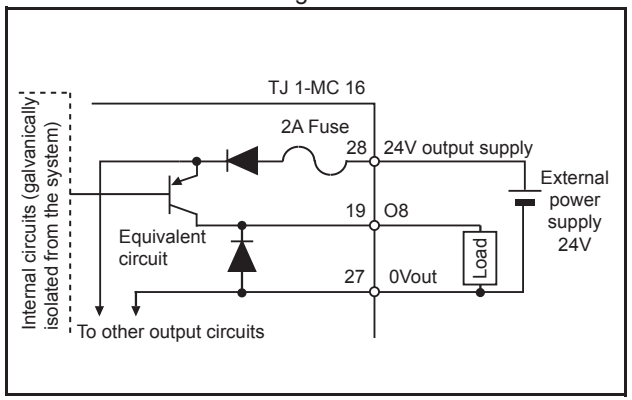
Digital outputs

The following table and illustration details the digital output (O8 to O15) specifications:

Item	Specification
Type	PNP
Maximum voltage	24 VDC + 10%
Current capacity	100 mA each output (800 mA for a group of 8)
Max. Voltage	24 VDC + 10%
Protection	Over current, Over temperature and 2A fuse on Common

The timings are dependant upon the servo period of the TJ2-MC__, and include physical delays in the output circuit.

fig. 26

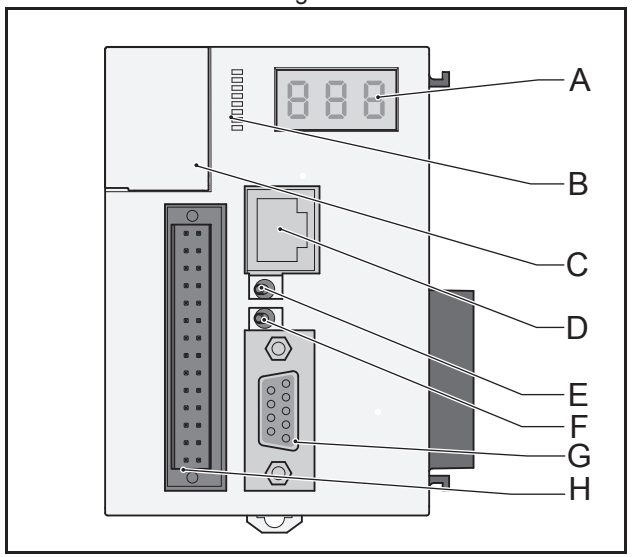


Maximum response times of 250 μs on and 350 μs off (for servo periods of 0.5 ms or 1.0 ms) or 500 μs on and 600 μs off (for a servo period of 2.0 ms) are achieved between a change in the OP parameter and a corresponding change in the digital output circuit.

3.4.4 Battery

The backup battery provides power to the RAM, where global variables are stored, and real Time Clock when the power supply is off. You must replace it every five years. The part number of the backup battery is CJ1W-BAT01. To replace the battery the power must not be off for more than five minutes to ensure no backup memory loss. If the TJ2-MC__ has not been on, set the unit to on for at least five minutes before you replace the battery else the capacitor that gives backup power to the memory is not fully changed and backup memory may be lost before the new battery is inserted.

fig. 27



3.4.5 TJ2-MC__ Specification

Item	Specification	
	TJ2-MC64	**TJ2-MC02**
Power supply	5 VDC and 24 VDC (supplied by a Power Supply Unit)	
Total power consumption	3.1 W	
Current consumption	620 mA at 5 VDC	
Approximate weight	230 g	
Number of real axes	64	3
Real Time Clock	Yes	
Servo period	0.25 ms, 0.5 ms, 1 ms or 2 ms	
Programming languages	• BASIC-like motion language • IEC 61131-3 LD and ST	
Multi-tasking	Up to 22 BASIC programs Up to 16 PLC tasks	Up to 22 BASIC programs
Digital I/O	16 digital inputs and 8 digital outputs, freely configurable	
Measurement units	User-definable	
Available memory for user programs	8 MB	
Data storage capacity	Up to 32 MB Flash data storage	
Saving program data	• RAM and Flash-ROM memory backup • Battery backup	
Saving program data on the PC	Trajexia Studio software manages backups on the hard-disk of the PC	
Communication connectors	• 1 Ethernet connection • 2 serial connections	
Firmware update	Via Trajexia Studio / CX-Motion Pro software	
Electrical characteristics of the Ethernet interface	Conforms to IEEE 802.3 (100BaseT)	

Item	Specification	
	TJ2-MC64	TJ2-MC02
Ethernet supported protocols	• TELNET • FINS server and client • ModbusTCP slave • EtherNet/IP slave	
Ethernet connector	RJ45	

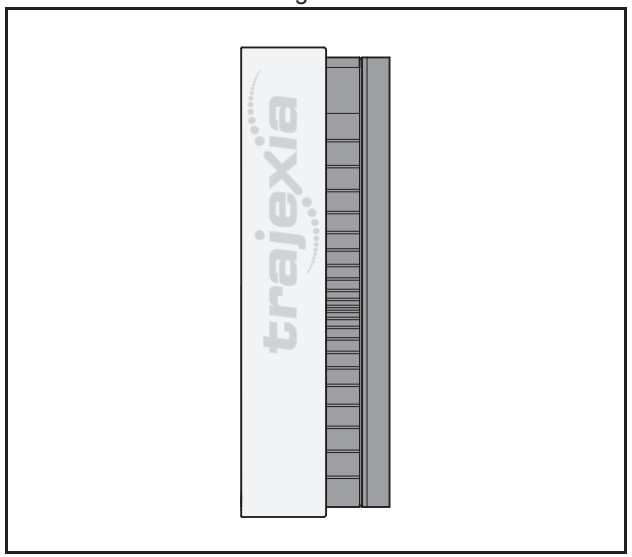
Serial connectors 1 and 2

Item	Specification
Electrical characteristics	• PORT1: RS232C, non-isolated • PORT2: RS485/RS422A, isolated
Connector	SUB-D9 connector
Baud rate	1200, 2400, 4800, 9600, 19200 and 38400 bps
Transmission format, databit length	7 or 8 bit
Transmission format, stop bit	1 or 2 bit
Transmission format, parity bit	Even/odd/none
Transmission mode	• RS232C: Point-to-point (1:1) • RS422/485: Point-to-multipoint (1:N)
Transmission protocol	• Host link master protocol • Host link slave protocol • ModbusRTU slave protocol • ASCII general purpose
Galvanic isolation	RS422/485 connector only
Communication buffers	254 bytes
Flow control	None
Terminator	Yes, selected by switch
Maximum cable length	• RS232C: 15 m • RS422/485: 100 m

3.4.6 TJ1-TER

The TJ1-TER makes sure that the internal data bus of the Trajexia system functions correctly. A Trajexia system must always contain a TJ1-TER as the last unit.

fig. 28



3.4.7 TJ2-MC__ box contents

- Safety sheet.
- TJ2-MC__ (battery included).
- Protection label attached to the top surface of the TJ2-MC__.
- TJ1-TER, attached to the TJ2-MC__.
- Parts for a serial connector.
- Parts for an I/O connector.
- Two metal DIN-rail clips, to prevent the Trajexia system from sliding off the rail.
- White clip, to replace the yellow clip of the Power Supply Unit.

3.5 TJ1-ML__

3.5.1 Introduction

The TJ1-ML__ controls MECHATROLINK-II devices in a cyclic and deterministic way. MECHATROLINK-II slaves can be:

- Servo Drives.
- Inverters.
- I/Os.

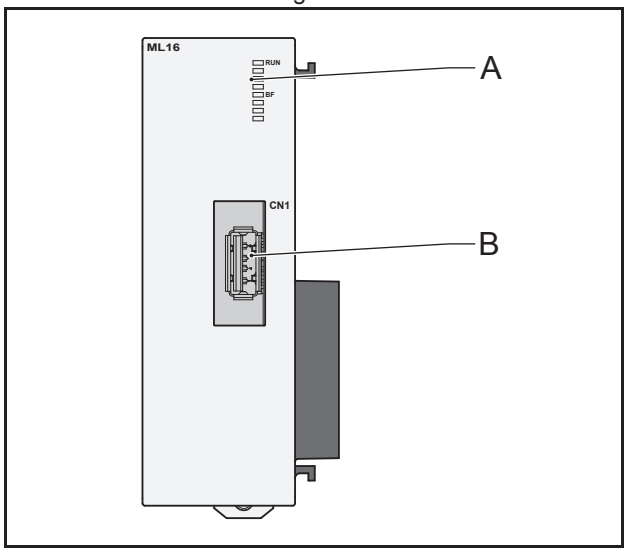
The TJ1-ML__ has these visible parts:

Part	Description
A	LED indicators
B	CN1 MECHATROLINK-II bus connector

Together the TJ1-ML__ and its devices form a serial network. The first unit in the network is the TJ1-ML__.

- One TJ1-ML16 can control 16 devices.
- One TJ1-ML04 can control 4 devices.

fig. 29



3.5.2 LEDs description

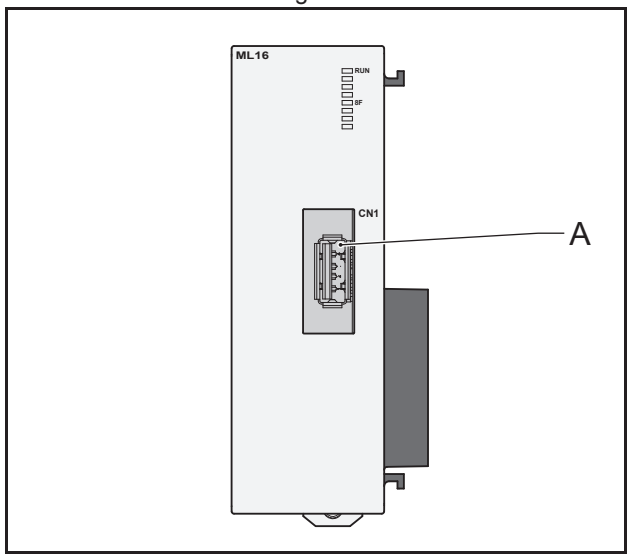
Label	Status	Description
run	off	Start-up test failed. Unit not operational Operation stopped. Fatal error
	on	Start-up test successful. Normal operation
BF	off	Normal operation
	on	A fault in the MECHATROLINK-II bus
-		Reserved

3.5.3 TJ1-ML__ connection

The MECHATROLINK-II bus connector (A) fits a MECHATROLINK-II connector. Use this connector to connect the TJ1-ML__ to a MECHATROLINK-II network.

The MECHATROLINK-II network must always be closed by the MECHATROLINK-II terminator.

fig. 30

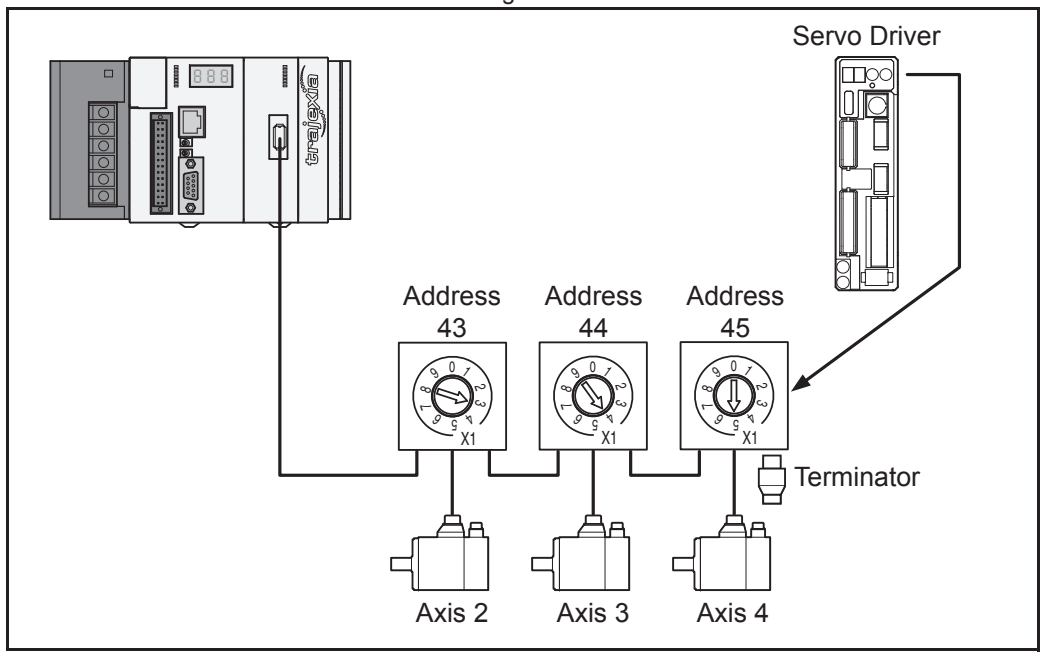


Example connections

Example 1

- 1 x TJ2-MC64
- 1 x TJ1-ML__
- 3 x G-Series Servo Drive
- 1 x MECHATROLINK-II terminator

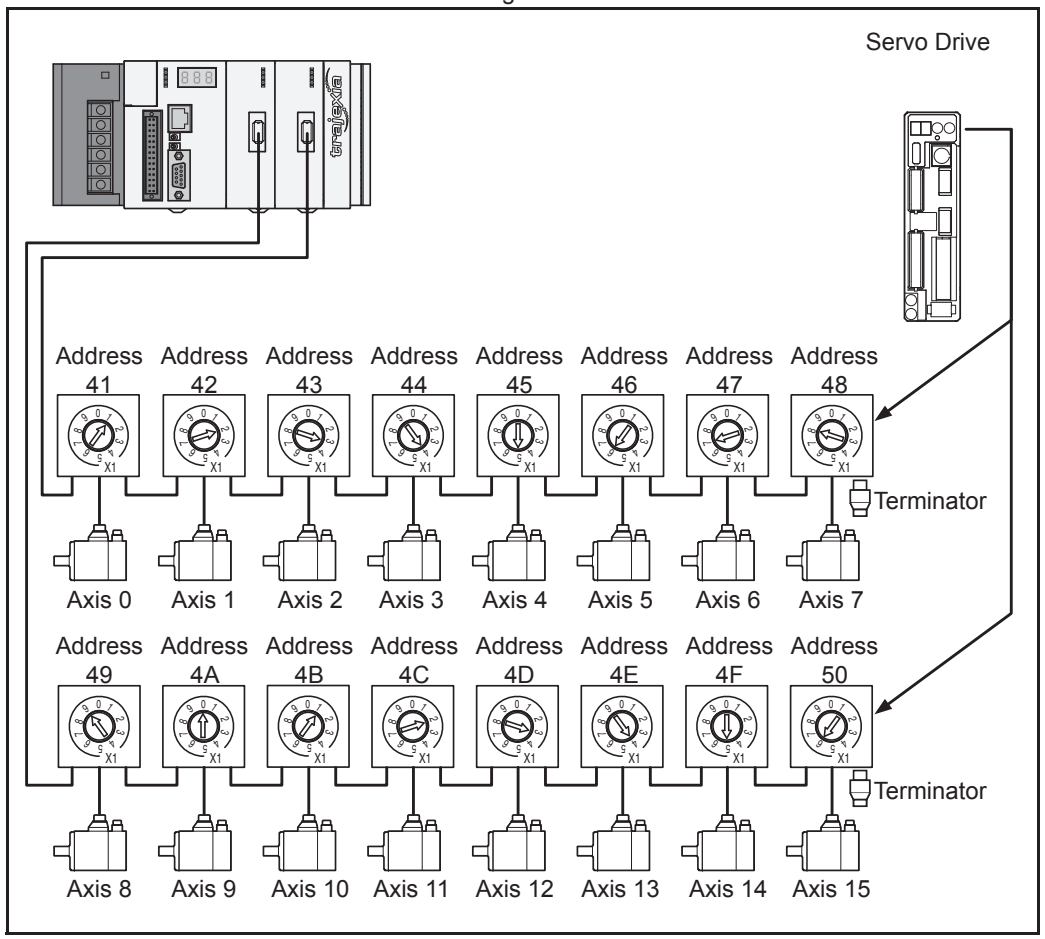
fig. 31



Example 2

- 1 x TJ2-MC64
- 2 x TJ1-ML16
- 16 x G-Series Servo Drive
- 2 x MECHATROLINK-II terminator

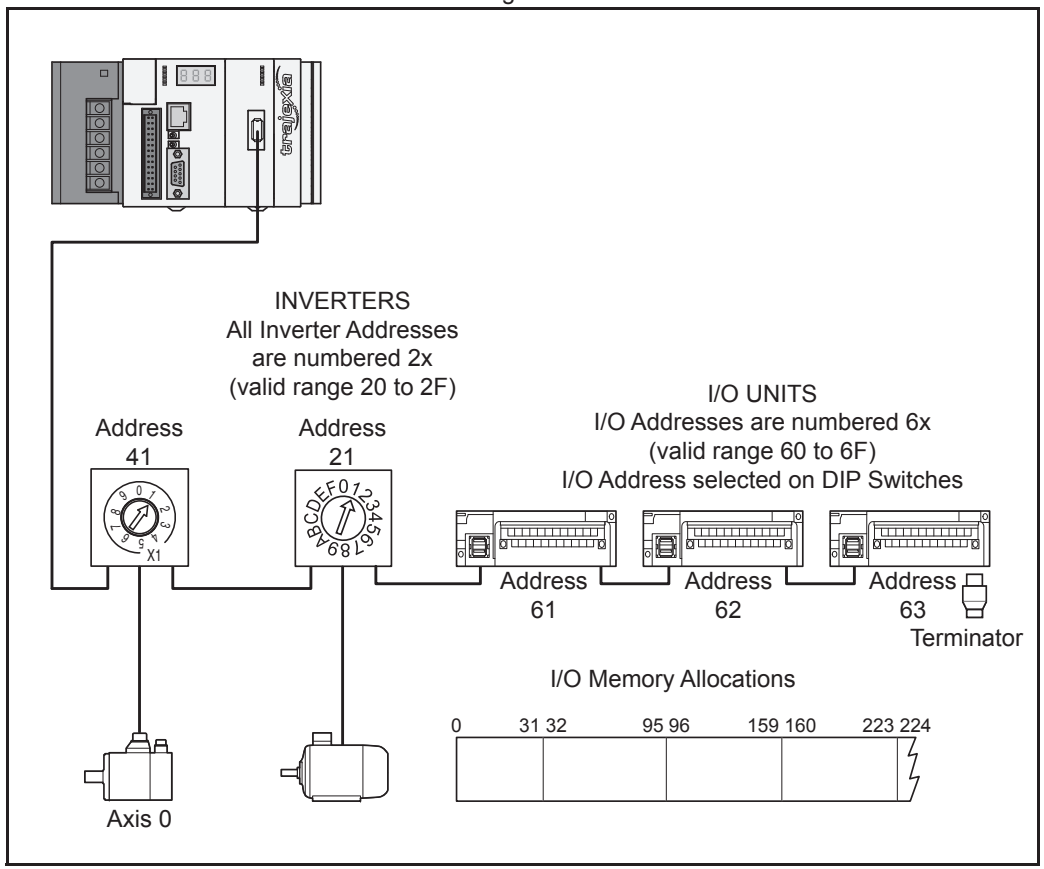
fig. 32



The MECHATROLINK-II Units can control different combinations of axes, Inverters and I/O units.
Example 3

- 1 x TJ2-MC__
- 1 x TJ1-ML16
- 1 x G-Series Servo Drive
- 1 x Inverter
- 3 x I/O units
- 1 x MECHATROLINK-II terminator

fig. 33



3.5.4 TJ1-ML__ specifications

Item	Specification	
	TJ1-ML04	**TJ1-ML16**
Power supply	5 VDC (supplied by the TJ2-MC__)	
Total power consumption	1.0 W	
Current consumption	200 mA at 5 VDC	
Approximate weight	75 g	
Number of controlled devices	4	16
Controlled devices	• G-Series and Accurax G5 Servo Drives • Sigma-II, Sigma-V and Junma-ML Servo Drives • I/Os • V7, F7 and G7 Inverters • V1000 and A1000 Inverters	
Electrical characteristics	Conforms to MECHATROLINK-II standard	
Communication connection	1 MECHATROLINK-II master connector	
Transmission speed	10 Mbps	
Servo period	0.5 ms, 1 ms or 2 ms	
Transmission distance without a repeater	Up to 50 m	

TJ1-ML__ related devices

Name	Remarks	Model
Distributed I/O modules	MECHATROLINK-II SmartSlice coupler	GRT1-ML2
	64-point digital input and 64-point digital output (24 VDC sinking)	JEPMC-IO2310
	64-point digital input and 64-point digital output (24 VDC sourcing)	JEPMC-IO2330
	Analogue input: -10V to +10 V, 4 channels	JEPMC-AN2900
	Analogue output: -10 V to +10 V, 2 channels	JEPMC-AN2910
MECHATROLINK-II cables	0.5 meter	JEPMC-W6003-A5
	1 meters	JEPMC-W6003-01
	3 meters	JEPMC-W6003-03
	5 meters	JEPMC-W6003-05
	10 meters	JEPMC-W6003-10
	20 meters	JEPMC-W6003-20
	30 meters	JEPMC-W6003-30
MECHATROLINK-II terminator	Terminating resistor	JEPMC-W6022
MECHATROLINK-II interface unit	For Sigma-II series Servo Drives (firmware version 39 or later)	JUSP-NS115
	For Varispeed V7 Inverter (For the supported version details of the Inverter, contact your OMRON sales office).	SI-T/V7
	For Varispeed F7, G7 Inverter (For the supported version details of the Inverter, contact your OMRON sales office).	SI-T

3.5.5 TJ1-ML__ box contents

MECHATROLINK-II Interface Unit box:
- Safety sheet.
- TJ1-ML__.
- Protection label attached to the top surface of the unit.

3.5.6 Related BASIC commands

The following BASIC commands are related to the TJ1-ML__:
- **ATYPE**
- **MECHATROLINK**
- **AXIS_OFFSET**

For more information, refer to the Trajexia Programming Manual.

3.5.7 MECHATROLINK-II Servo Drives

A MECHATROLINK-II Servo Drive is designed to do position control in Trajexia. In every MECHATROLINK-II cycle, the TJ2-MC__ receives the position feedback from the Servo Drive via the TJ1-ML__. The TJ2-MC__ sends either the target position, speed or torque to the receiver, depending on the axis type.
Other functionality of the Servo Drive is available but refreshed at slower rate.
A Servo Drive is considered an axis by the TJ2-MC__.
When you connect a servo to the Trajexia, the parameter does not change automatically so, depending on the application, you may have to change values.

3.5.8 MECHATROLINK-II G-series Servo Drives

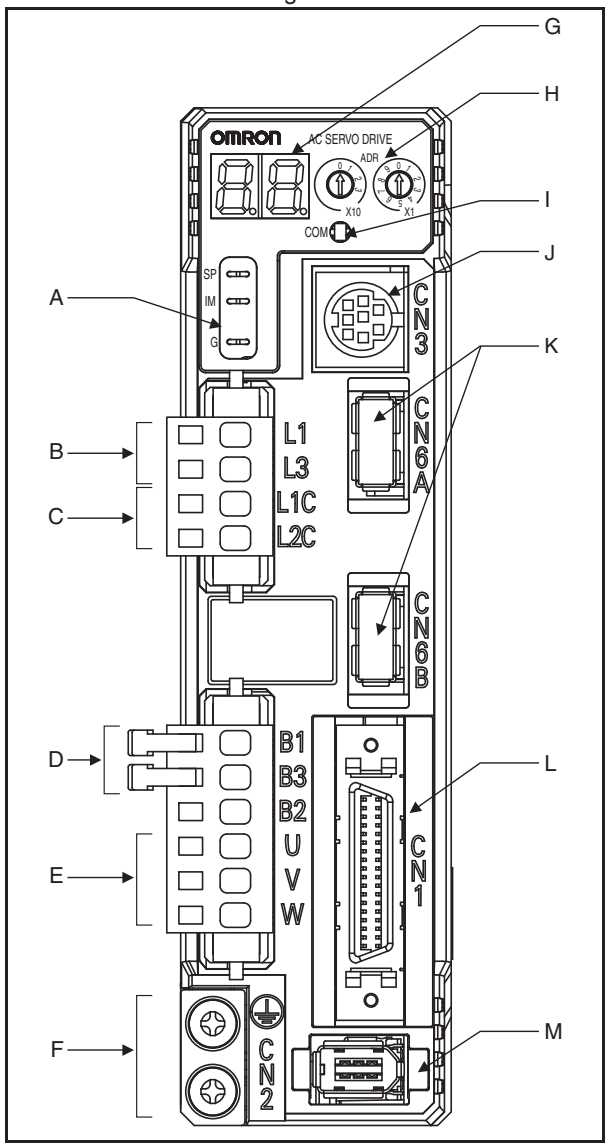
You can also connect a G-series Servo Drive to a Trajexia system.

Label	Terminal/LED	Description
A	SP, IM, G	Analog monitor check pins
B	L1, L2, L3	Main-circuit power terminals
C	L1C, L2C	Control-circuit power terminals
D	B1, B2, B3	External Regeneration Resistor connection terminals
E	U, V, W	Servomotor connection terminals
F	---	Protective ground terminals
G	---	Display area
H	---	Rotary switches
I	COM	MECHATROLINK-II communications status LED indicator
J	CN3	RS-232 communications connector
K	CN6A, CN6B	MECHATROLINK-II communications connector
L	CN1	Control I/O connector
M	CN2	Encoder connector

LED indicators

LED	Description
COM	Lit: MECHATROLINK-II communication in progress Not lit: No MECHATROLINK-II communication

fig. 34



Address settings (SW1)

Set the address selector of the G-series Servo Drive to the required node address by using the X1 (right) and X10 (left) rotary switches.
The setting range for the node address setting rotary switch is 1 to 31. The actual station address used on the network will be the sum of the rotary switch setting and the offset value of 40h. These node addresses correspond to axis numbers 0 (node address = 1) to 30 (node address = 31). A maximum of 31 different node addresses can be set. To support more Drives an offset can be added to map duplicated node addresses to unique axis numbers. This offset (**AXIS_OFFSET**) needs to be specified per TJ1-ML__. Please note that the node address per TJ1-ML__ needs to be unique.

Example:

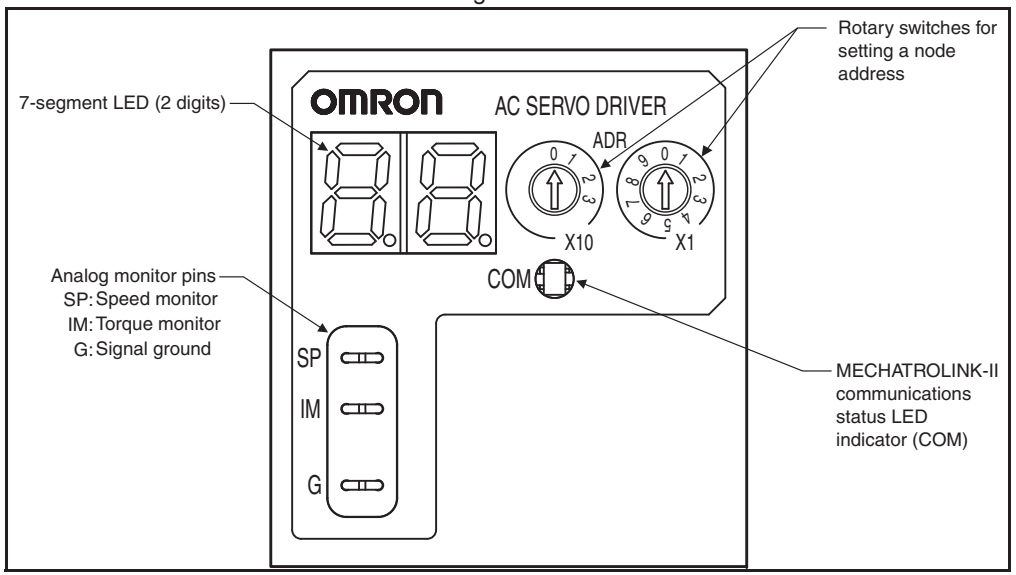
TJ2-MC__ + 2 x TJ1-ML16 + 32 Drives (16 per TJ-ML16)
First TJ1-ML16:

- Node address range: 1 to 16
- **AXIS_OFFSET SLOT(0) = 0**
- Assigned axis numbers: 0 to 15

Second TJ1-ML16

- Node address range: 1 to 16
- **AXIS_OFFSET SLOT(1) = 16**
- Assigned axis numbers: 16 to 31

fig. 35



WARNING
When using multiple TJ1-ML__ units, do not swap the MECHATROLINK-cables. This can result in different axis allocation. This can result in serious injury and/or significant damage.

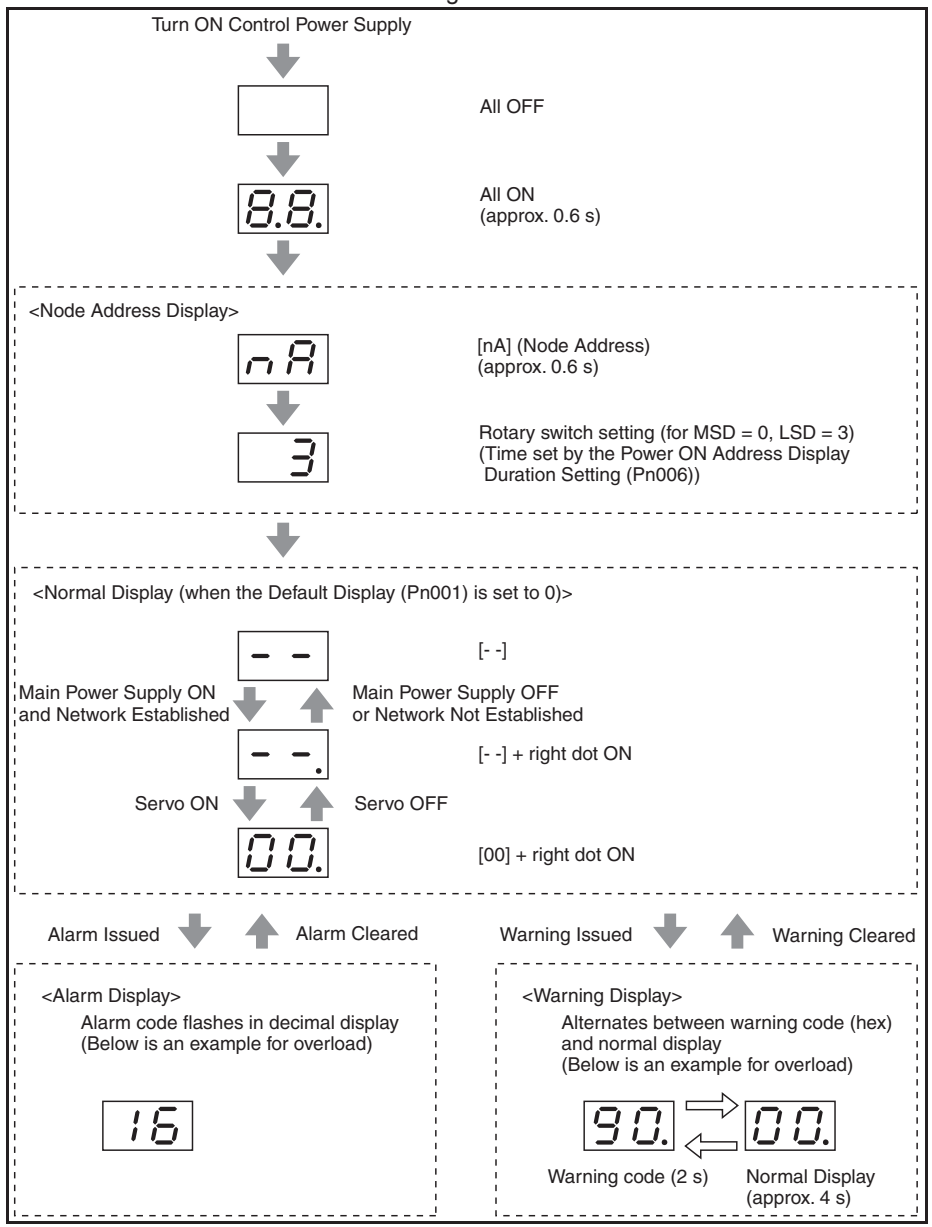
Note
The node address is only loaded once when the control power supply is turned ON. Changes made after turning the power ON will not be applied until the power is turned ON next time. Do not change the rotary switch setting after turning the power ON.
If the rotary switch setting is not between 1 and 31, a node address setting error (alarm code 82) will occur.

7-segment LED

The display of the 7-segment LED on the front panel is shown below.

When the power is turned ON, the node address set with the rotary switch is displayed, followed by the display content set by the Default Display (Pn001) parameter. When an alarm occurs, the alarm code will be displayed. When a warning occurs, the warning code will be displayed.

fig. 36

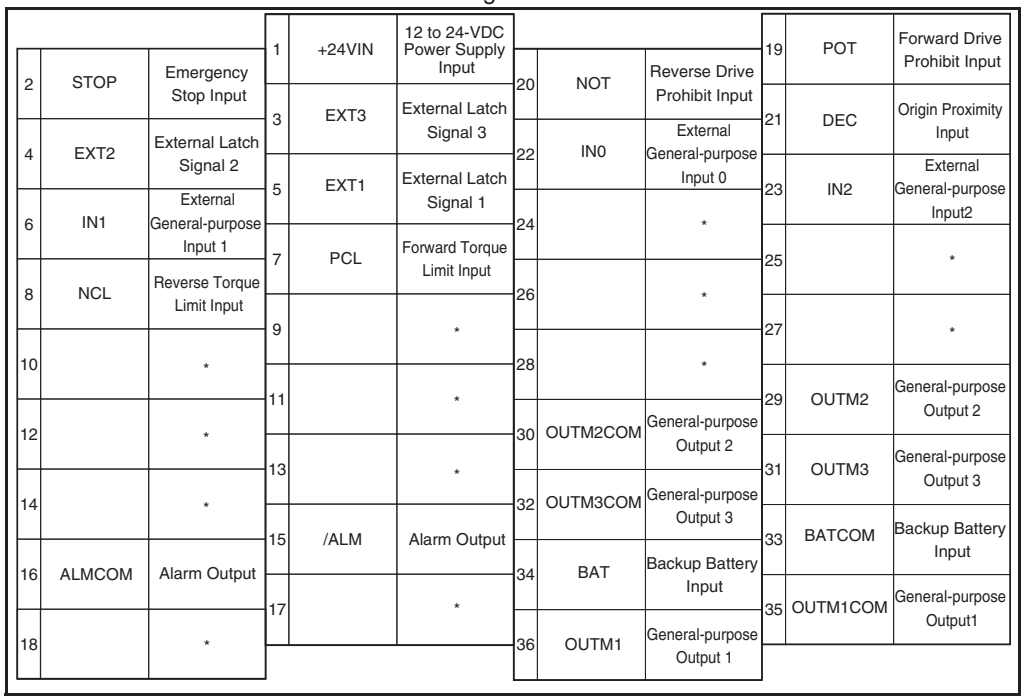


CN1 I/O Signal connector

The table below shows the pin layout for the I/O signal connector (CN1).

Pin	I/O	Code	Signal name
1	Input	+24VIN	12 to 24-VDC Power Supply Input
2	Input	STOP	Emergency Stop Input
3	Input	EXT3	External Latch Signal 3
4	Input	EXT2	External Latch Signal 2
5	Input	EXT1	External Latch Signal 1
6	Input	IN1	External general-purpose Input 1
7	Input	PCL	Forward Torque Limit Input
8	Input	NCL	Reverse Torque Limit Input
19 to 20	Input	POT	Forward Drive Prohibit Input
		NOT	Reverse Drive Prohibit Input
21	Input	DEC	Origin Proximity Input
22	Input	IN0	External general-purpose Input 0
23	Input	IN2	External general-purpose Input 2
11 to 14	Input	---	Spare inputs. Do not connect anything to these inputs.
9 to 10	Input	---	Spare inputs. Do not connect anything to these inputs.
27 to 28	Input	---	Spare inputs. Do not connect anything to these inputs.
34	Input	BAT	Backup Battery Input
33	Input	BATCOM	
17 to 18	Input	---	Spare inputs. Do not connect anything to these inputs.
24 to 26	Input	---	Spare inputs. Do not connect anything to these inputs.

fig. 37



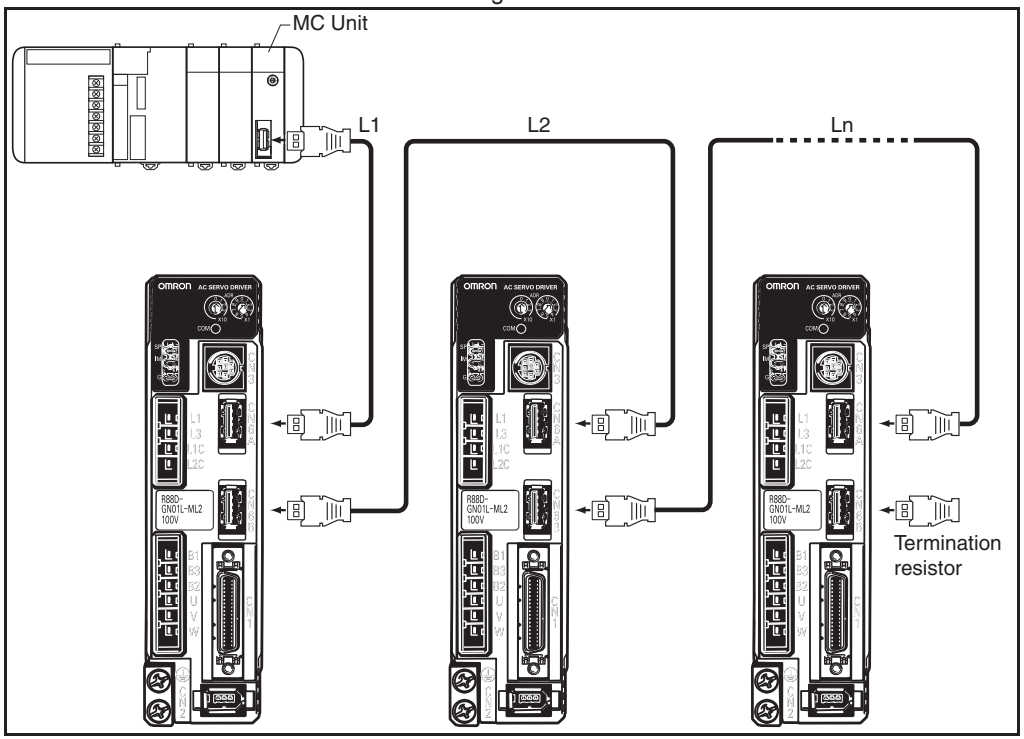
Pin	I/O	Code	Signal name
15	Output	/ALM	Alarm Output
16	Output	ALMCOM	
29	Output	OUTM2	General-purpose Output 2 (READY)
30	Output	OUTM2COM	
31	Output	OUTM3	General-purpose Output 3 (CLIM)
32	Output	OUTM3COM	
36	Output	OUTM1	General-purpose Output 1 (BKIR)
35	Output	OUTM1COM	
Shell	---	---	FG

MECHATROLINK-II connectors (CN6A & CN6B)

Connect the G-series Servo Drive to the MECHATROLINK-II network using the CN6A and CN6B connectors. Use one of the MECHATROLINK-II connectors to connect to the previous MECHATROLINK-II device or the TJ1-ML__. Use the other MECHATROLINK-II connector to connect to the next MECHATROLINK-II device, or to connect a MECHATROLINK-II terminator.

Note
Cable length between nodes (L1, L2, ... Ln) should be 0.5 m or longer.
Total cable length should be L1 + L2 + ... + Ln = 50 m max.

fig. 38



CN2 encoder input connector

The table below shows the pin layout for the encoder connector.

Pin	Signal	Name
1	E5V	Encoder power supply +5 V
2	E0V	Encoder power supply GND
3	BAT+	Battery +
4	BAT-	Battery -
5	PS+	Encoder +phase S input
6	PS-	Encoder -phase S input
Shell	FG	Shield ground

CNA power supply connector

The table below shows the pin layout for the CNA power supply connector.

Pin	Signal	Name
1	L1	Main circuit power supply input
2	L2	
3	L3	
4	L1C	Control circuit power supply input
5	L2C	

CNB servo motor connector

The table below shows the pin layout for the CNB servo motor connector.

Pin	Signal	Name
1	B1	External Regeneration Resistor connection terminals
2	B2	
3	B3	
4	U	Servomotor connection terminals
5	V	
6	W	

Related BASIC commands

The following BASIC commands are related to the MECHATROLINK-II G-series Servo Drives:

- **ATYPE**
- **AXIS**
- **AXIS_ENABLE**
- **AXISSTATUS**
- **DRIVE_ALARM**
- **DRIVE_CLEAR**
- **DRIVE_CONTROL**
- **DRIVE_INPUTS**
- **DRIVE_MONITOR**
- **DRIVE_READ**
- **DRIVE_RESET**
- **DRIVE_STATUS**
- **DRIVE_WRITE**

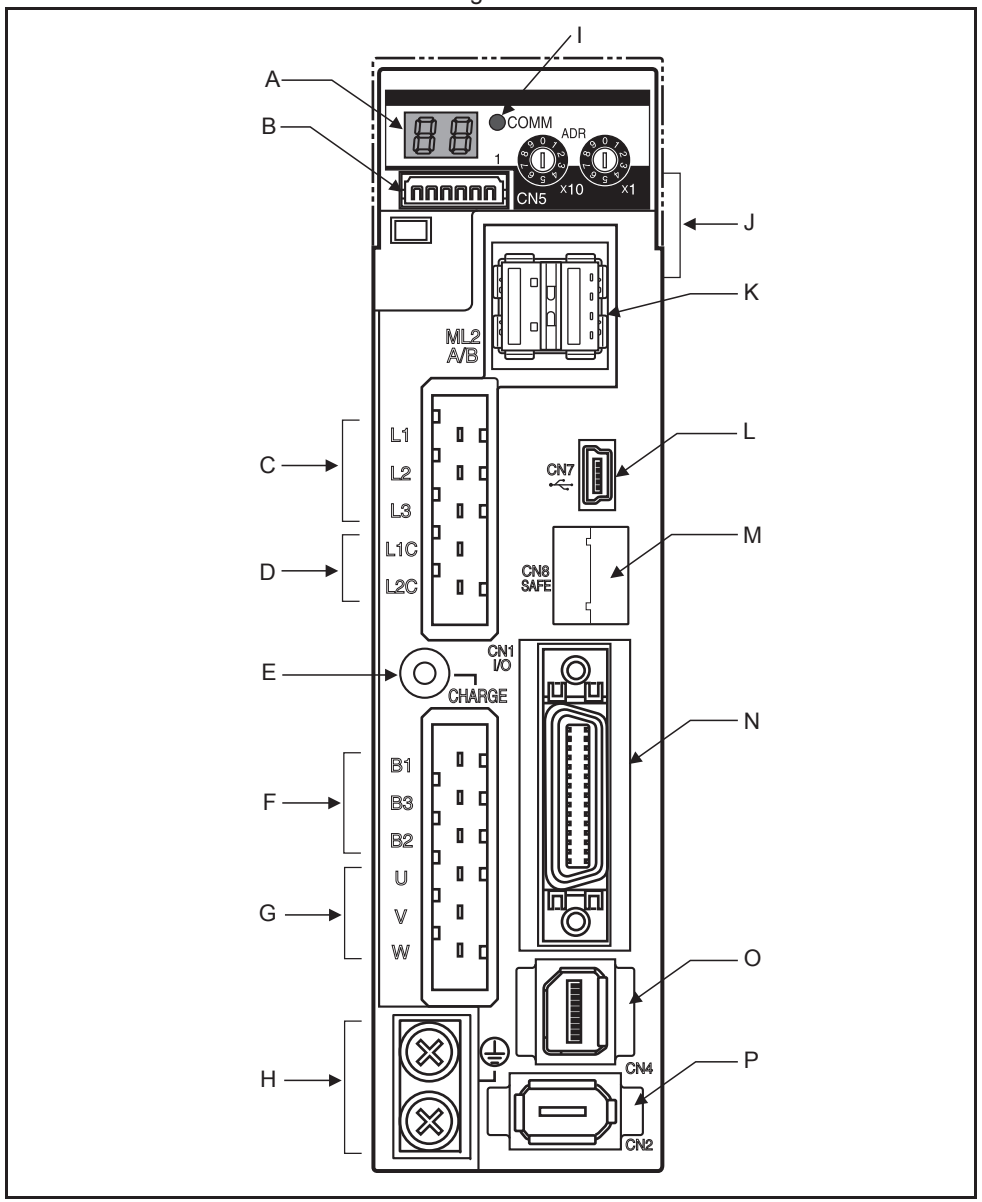
For more information, refer to the Trajexia Programming Manual.

3.5.9 MECHATROLINK-II Accurax G5 Servo Drives

You can also connect an Accurax G5 Servo Drive to a Trajexia system.

Label	Terminal/LED	Description
A	---	Display area
B	CN5	Analog monitor check pins
C	L1, L2, L3	Main-circuit power terminals
D	L1C, L2C	Control-circuit power terminals
E	CHARGE	Charge lamp
F	B1, B2, B3	External Regeneration Resistor connection terminals
G	U, V, W	Servomotor connection terminals
H	---	Protective ground terminals
I	COMM	MECHATROLINK-II communications status LED indicator
J	---	Rotary switches
K	CN6A, CN6B	MECHATROLINK-II communications connector
L	CN7	USB connector
M	CN8	Connector for safety function devices
N	CN1	Control I/O connector
O	CN4	Full-closed encoder connector
P	CN2	Encoder connector

fig. 39



MECHATROLINK-II Communications Status LED Indicator

The table below shows the LED indication status and the corresponding conditions of the communications.

LED status	Communications status
Not lit	No communication is established.
Green Flash	Asynchronous communications is established.
Green Light	Synchronous communications is established.
Red Flash	A clearable error occurred in MECHATROLINK-II communications. • Communications error (Err83.0) • Transmission cycle error (Err84.0) • SSYNC_SET error (Err84.4) • Watchdog data error (Err86.0) • Transmission cycle setting error (Err90.0) • CONNECT error (Err90.1) • SYNC command error (Err91.0)
Red Light	A non-clearable error occurred in MECHATROLINK-II communications. • Node address setting error (Err82.0) • SYNC process error (Err84.3)

Note

If any of communication related error occurs while an error that is not related to MECHATROLINK-II communications happens, the MECHATROLINK-II Communications Status LED Indicator follows the corresponding communications status as shown above.

Address settings (SW1)

Set the address selector of the Accurax G5 Servo Drive to the required node address by using the X1 (right) and X10 (left) rotary switches.
The setting range for the node address setting rotary switch is 1 to 31. The actual station address used on the network will be the sum of the rotary switch setting and the offset value of 40h.
A maximum of 31 different node addresses can be set. To support more Drives an offset can be added to map duplicated node addresses to unique axis numbers. This offset (**AXIS_OFFSET**) needs to be specified per TJ1-ML__. Please note that the node address per TJ1-ML__ needs to be unique.

Example:

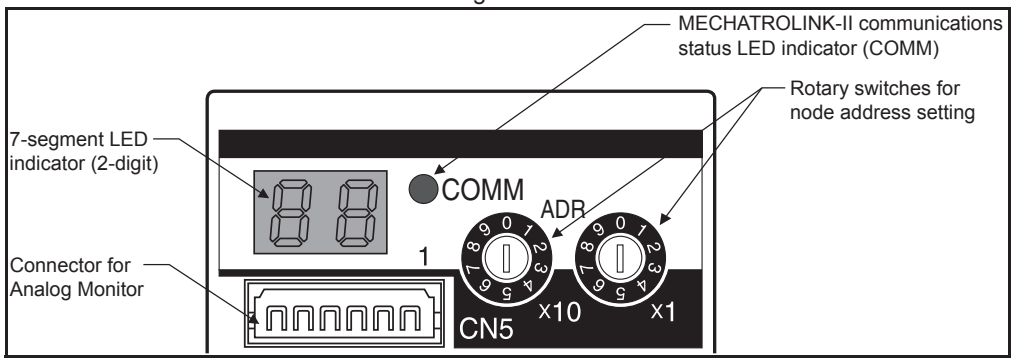
TJ2-MC64 + 2 x TJ1-ML16 + 32 Drives (16 per TJ-ML16)
First TJ1-ML16:

- Node address range: 1 to 16
- **AXIS_OFFSET SLOT(0) = 0**
- Assigned axis numbers: 0 to 15

Second TJ1-ML16

- Node address range: 1 to 16
- **AXIS_OFFSET SLOT(1) = 16**
- Assigned axis numbers: 16 to 31

fig. 40



WARNING
When using multiple TJ1-ML__ units, do not swap the MECHATROLINK-cables. This can result in different axis allocation. This can result in serious injury and/or significant damage.

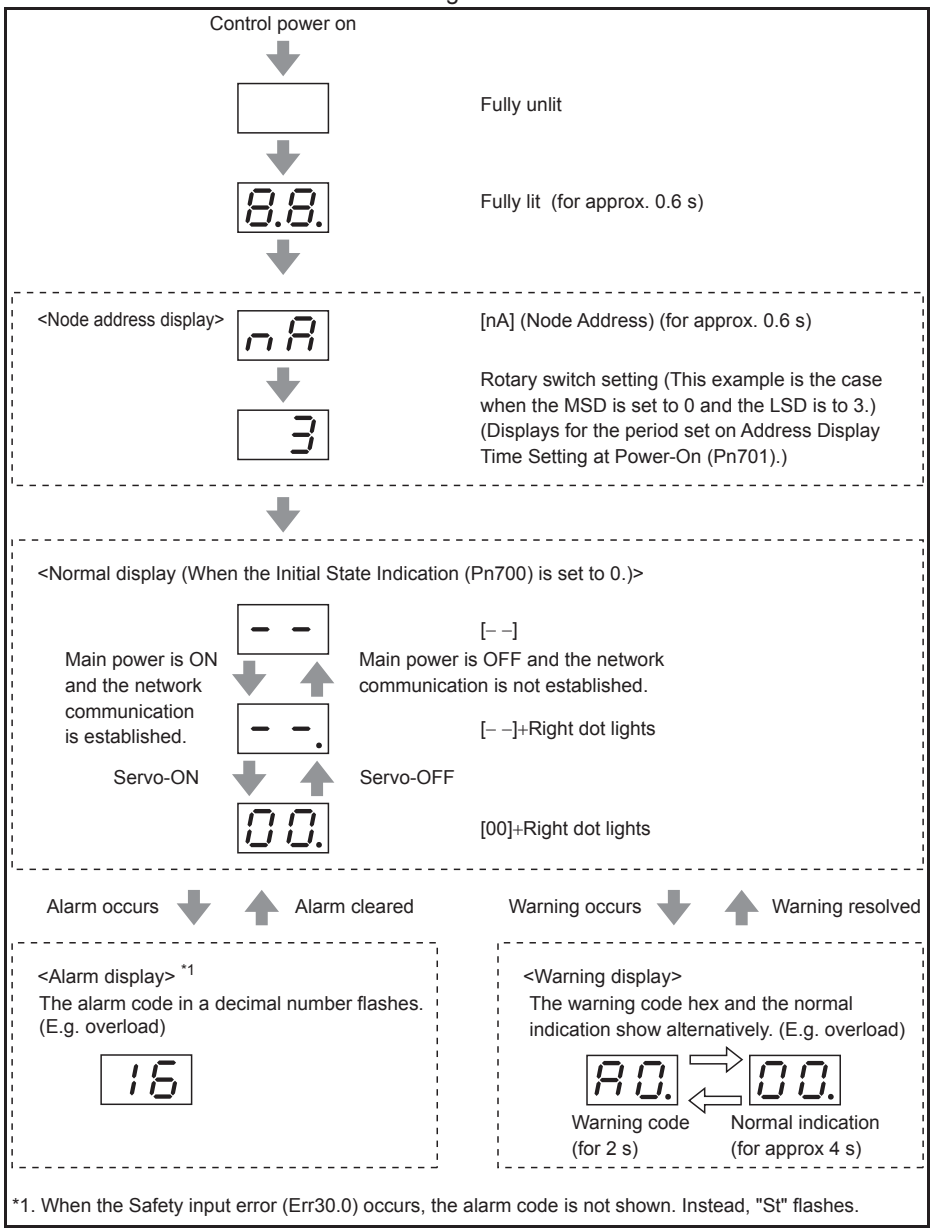
Note
The node address set by the rotary switch is read only once when the control power is turned on. Any changes made by the rotary switches after the power-on are not reflected to the Controller. Such changes become effective only after the subsequent power-on following to a power-off. Do not change the rotary switch setting after the power-on.

Note
The settable range for a node address is between 1 and 31. The node address used over the network is the value obtained by adding the offset 40h to the rotary switch set value. If any value over or under the range is set, the Node address setting error (Err82.0) occurs.

7-segment LED

The 7-segment LED indicator is on the front panel.
When the power is turned on, it shows the node address that is set by the rotary switches. Then the indication changes in accordance with the setting on the Default Display (Pn700). If any alarming error occurs, it indicates the error number (Errxxx) as the alarm code. If any warning situation occurs, it indicates the warning number as the warning code.

fig. 41

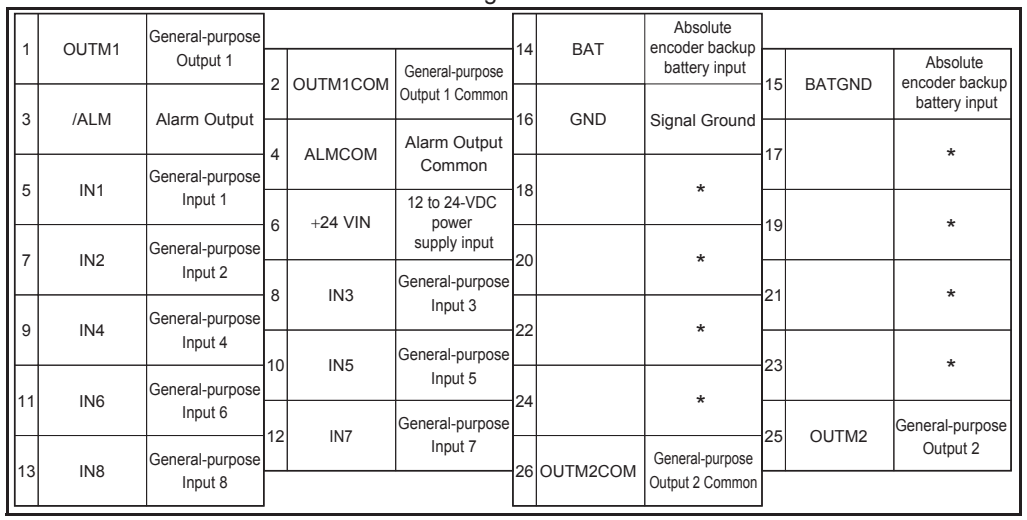


CN1 I/O Signal connector

The table below shows the pin layout for the I/O signal connector (CN1).

Pin	I/O	Code	Signal name
6	Input	+24 VIN	12 to 24-VDC Power Supply Input
5	Input	IN1	General-purpose Input 1
7	Input	IN2	General-purpose Input 2
8	Input	IN3	General-purpose Input 3
9	Input	IN4	General-purpose Input 4
10	Input	IN5	General-purpose Input 5
11	Input	IN6	General-purpose Input 6
12	Input	IN7	General-purpose Input 7
13	Input	IN8	General-purpose Input 8
3	Output	/ALM	Alarm output
4	Output	ALMCOM	
1	Output	OUTM1	General-purpose Output 1
2	Output	OUTM1COM	
25	Output	OUTM2	General-purpose Output 2
26	Output	OUTM2COM	
14	---	BAT	Backup Battery Input
15	---	BATGND	
16	---	GND	Signal ground
17 to 24	Input	---	Spare inputs. Do not connect anything to these inputs.
Shell	---	---	FG

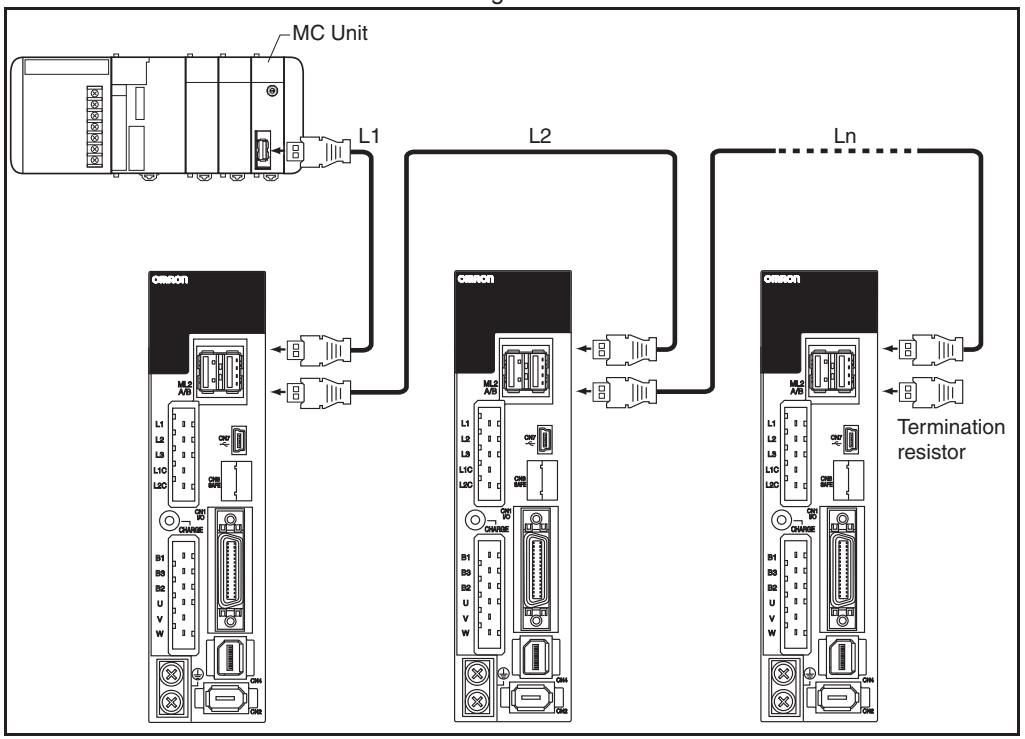
fig. 42



MECHATROLINK-II connectors (CN6A & CN6B)

Connect the Accurax G5 Servo Drive to the MECHATROLINK-II network using the CN6A and CN6B connectors. Use one of the MECHATROLINK-II connectors to connect to the previous MECHATROLINK-II device or the TJ1-ML__. Use the other MECHATROLINK-II connector to connect to the next MECHATROLINK-II device, or to connect a MECHATROLINK-II terminator.

fig. 43



Note
Cable length between nodes (L1, L2, ... Ln) should be 0.5 m or longer.
Total cable length should be L1 + L2 + ... + Ln = 50 m max.

CN2 Encoder input connector

The table below shows the pin layout for the encoder connector.

Pin	Signal	Name
1	E5V	Encoder power supply +5 V
2	E0V	Encoder power supply GND
3	BAT+	Battery +
4	BAT-	Battery -
5	PS+	Encoder +phase S input
6	PS-	Encoder -phase S input
Shell	FG	Shield ground

CN4 External encoder connector

The table below shows the pin layout for the external encoder connector.

Pin	Signal	Name
1	E5V	Encoder power supply +5 V
2	E0V	Encoder power supply GND
3	PS+	Encoder +phase S input
4	PS-	Encoder -phase S input
5	EXA+	Encoder +phase A input
6	EXA-	Encoder -phase A input
7	EXB+	Encoder +phase B input
8	EXB-	Encoder -phase B input
9	EXZ+	Encoder +phase Z input
10	EXZ-	Encoder -phase Z input
Shell	FG	Shield ground

CN5 Monitor connector

The table below shows the pin layout for the CN5 monitor connector.

Pin	Signal	Name
1	AM1	Analog monitor output 1
2	AM2	Analog monitor output 2
3	GND	Analog monitor ground
4	---	Reserved: do not connect.
5	---	Reserved: do not connect.
6	---	Reserved: do not connect.

CN7 USB Connector

The table below shows the pin layout for the CN7 USB connector.

Pin	Signal	Name
1	VBUS	USB signal terminal
2	D+	
3	D-	
4	---	Reserved: do not connect.
5	SENGND	Signal ground

CN8 Safety connector

The table below shows the pin layout for the CN8 safety connector.

Pin	Signal	Name
1	---	Reserved: do not connect.
2	---	Reserved: do not connect.
3	SF1-	Safety input 1
4	SF1+	
5	SF2-	Safety input 2
6	SF2+	
7	EDM-	EDM output
8	EDM+	
Shell	FG	Shield ground

CNA Power supply connector

The table below shows the pin layout for the CNA power supply connector.

Pin	Signal	Name
1	L1	Main circuit power supply input
2	L2	
3	L3	
4	L1C	Control circuit power supply input
5	L2C	

CNB Servo motor connector

The table below shows the pin layout for the CNB servo motor connector.

Pin	Signal	Name
1	B1	External Regeneration Resistor connection terminals
2	B2	
3	B3	
4	U	Servomotor connection terminals
5	V	
6	W	

Related BASIC commands

The following BASIC commands are related to the MECHATROLINK-II Accurax G5 Servo Drives:

- **ATYPE**
- **AXIS**
- **AXIS_ENABLE**
- **AXISSTATUS**
- **DRIVE_ALARM**
- **DRIVE_CLEAR**
- **DRIVE_CONTROL**
- **DRIVE_INPUTS**
- **DRIVE_MONITOR**
- **DRIVE_READ**
- **DRIVE_RESET**
- **DRIVE_STATUS**
- **DRIVE_WRITE**

For more information, refer to the Trajexia Programming Manual.

3.5.10 Yaskawa MECHATROLINK-II Servo Drives

You can also connect the following Yaskawa Servo Drives:
- Sigma-II series Servo Drive with a JUSP-NS115 MECHATROLINK-II interface unit
- Sigma-V series Servo Drive
- Junma series Servo Drive

For details please refer to the manuals of these Drives.

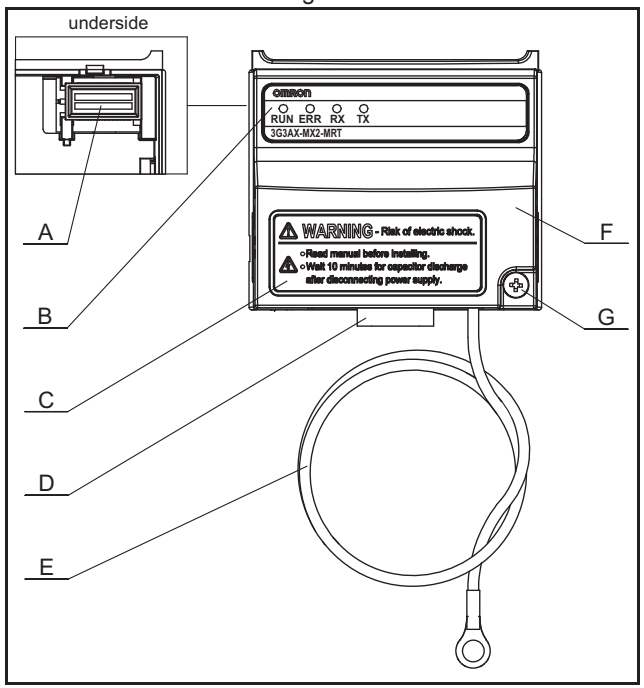
3.5.11 MECHATROLINK-II Inverter MX2

The 3G3AX-MX2-MRT-E allows controlling, monitoring and parameterization of an MX2 Inverter via a MECHATROLINK-II network. The 3G3AX-MX2-MRT-E serves as a gateway that passes communicated register values from the MECHATROLINK-II network to the MX2 Inverter and vice versa.

The illustration shows the external appearance of the 3G3AX-MX2-MRT-E Unit.
A. Option board connector
B. LED indicators (RUN, ERR, RX, TX)
C. Warning label
D. Fieldbus connector
E. Grounding cable
F. Housing
G. Mounting screw

Four LED indicators allow easy diagnosis. An attached grounding cable is sized to reach the ground terminals on all MX2 Inverter models. A feature in the housing will retain the mounting screw when the Option Board is not mounted to the Inverter. Please pay special attention to the Option Board connector: It must be properly connected with the Inverter when the Option Board is mounted.

fig. 44



LED indicators

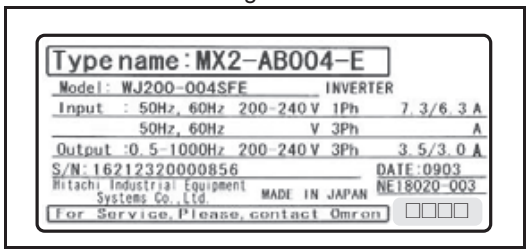
The LED indicators on the front indicate the operational mode and status of the Option Board and the network.

Indicator	Colour	Status	Meaning
RUN	Green	OFF	No power or not yet ready for operation
		Flashing	Operating in commissioning mode
		ON	Normal operation
ERR	Red	ON	Fatal error
		Flashing	Operational error
		OFF	No error
TX	Green	ON	Sending data
		OFF	Sending of data stopped, hardware reset
RX	Green	ON	Searching for receiving carrier
		OFF	No receiving carrier found, hardware reset

Inverter Support

An MX2 Inverter that supports the 3G3AX-MX2-MRT-E Option Board can be recognised from the Inverter type label. Please check that your Inverter type label displays revision characters in the bottom right corner where the □□□□ is displayed in this illustration.
If these characters are absent, your Inverter does not support the 3G3AX-MX2-MRT-E, so please contact your local OMRON representative.

fig. 45

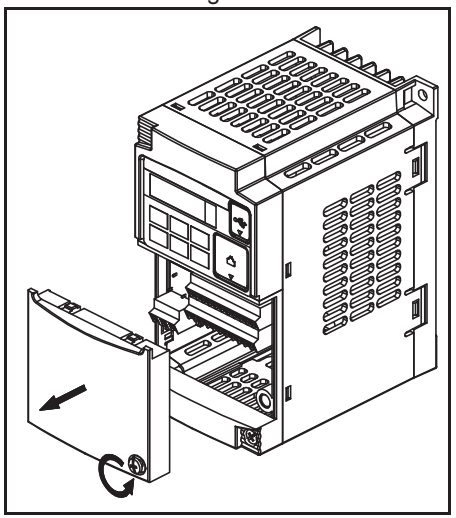


Option Board Mounting

WARNING
Always Switch OFF the mains power supply to the Inverter before removing any covers. Wait for the time specified on the Inverter front cover for the capacitors to discharge. Not doing so may result in electrical shock.

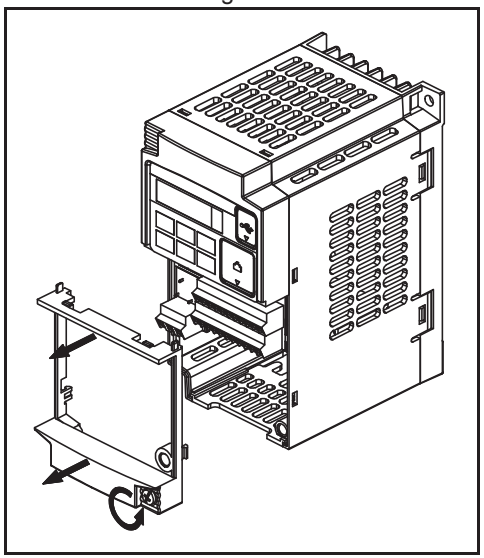
Step 1
Loosen the screw of the option board cover, remove the cover and put the cover aside.

fig. 46



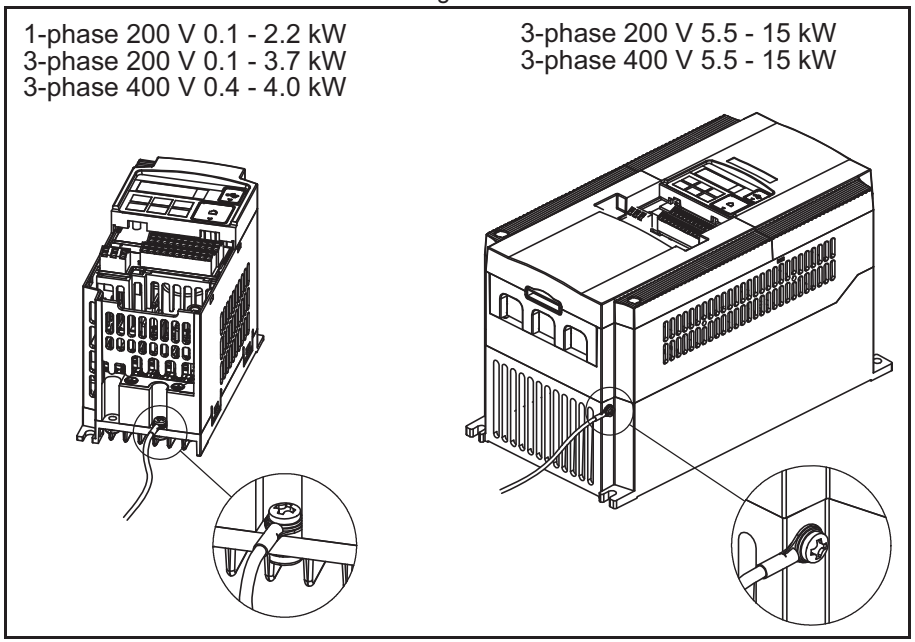
Step 2
For Inverters up to 4.0 kW only: loosen the screws of the terminal block cover and remove the cover to enable access to the chassis ground terminal screws.

fig. 47



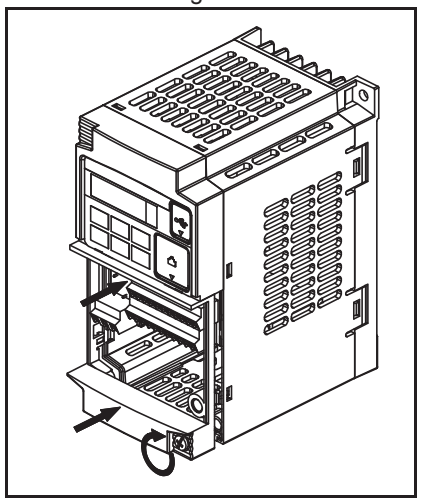
Step 3
Secure the Option Board grounding cable to the MX2 Inverter with a mounting screw.

fig. 48



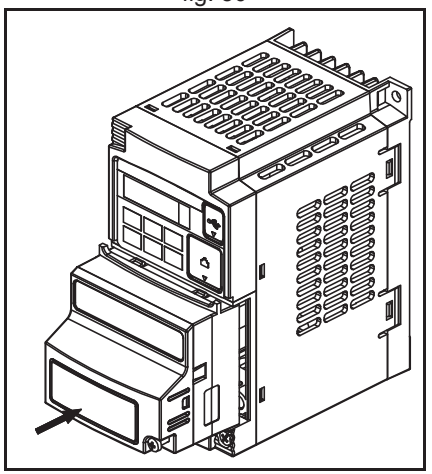
Step 4
If removed in Step 2, mount the terminal cover again and tighten the screw(s).

fig. 49



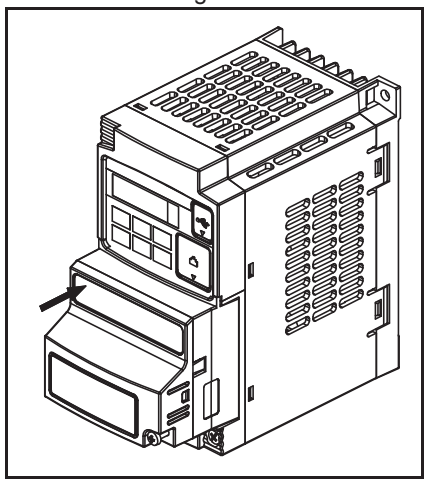
Step 5
Push the Option Board into the previous location of the option board cover until it clicks into place

fig. 50



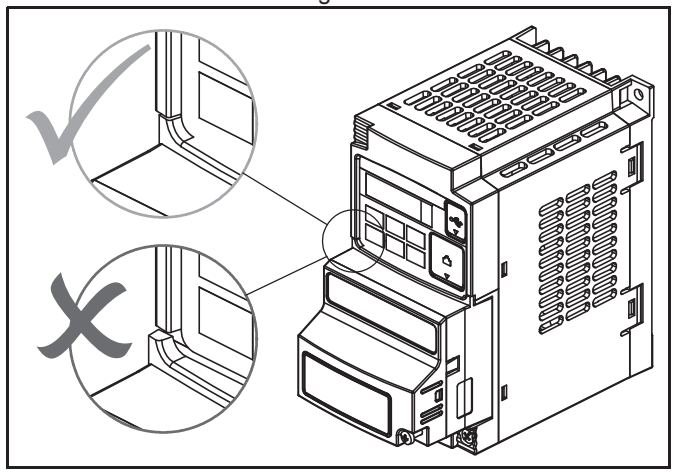
Step 6
Press down on the indicated corner of the Option Board housing to ensure proper connection of the Option Board connector

fig. 51



Step 7
Check that there is no gap between the top edges of the Option Board and the Inverter casing.

fig. 52



Step 8
Secure the Option Board in place with the mounting screw (do not overtighten).

Step 9
Select the right warning language from the warning label sheet and replace the English warning if appropriate.

Note
Refer to section 2-1-3 in the MX2 user's manual (Cat.-No. I570) for operations related to assembly and disassembly of the MX2 Inverter

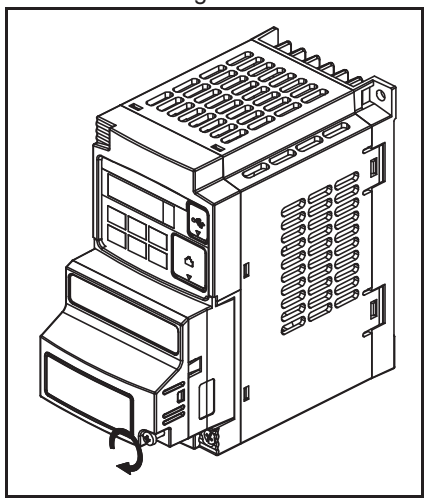
Note
Some Inverter models do not include a screw for the grounding cable. Please supply the recommended screw, lock-washer and washer to attach the grounding cable

Inverter models	Grounding Cable Attachment Screw
3-phase 200 V 5.5 – 7.5 kW	M4 x 6
3-phase 400 V 5.5 – 7.5 kW	
3-phase 200 V 11 – 15 kW	M5 x 6
3-phase 400 V 11 – 15 kW	

Note
Illustrations are only provided for one Inverter size. The instructions however are generic, and may be followed for all Inverter sizes. Make use of the MX2 Inverter manual.

WARNING
Never operate the Inverter with the terminal block cover or backing plate removed.

fig. 53



WARNING
Provide emergency stop circuits, interlock circuits, limit circuits and similar safety measures in external circuits (NOT in the Option Board). This ensures safety in the system if an abnormality occurs due to malfunction of the Option Board or another external factor affecting the Option Board operation. Not doing so may result in serious accidents.

WARNING
Always connect the grounding cable to one of the ground terminals of the MX2 Inverter. Failure to abide could lead to serious or possibly fatal injury.

Caution
Never touch the heat sink during or just after operation; it can be very hot.

Caution
Be sure that the Option Board is mounted correctly. Improper mounting may result in malfunction.

Caution
Be sure that all cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque may result in malfunction.

Installation Environment Clearance

Please adhere to the requirements of section 2-3-2 in the MX2 user's manual on “Installation Environment clearance”. In addition to this, provide sufficient clearance to allow connection and removal of the MECHATROLINK-II Connectors. No unnecessary strain should be placed on the MECHATROLINK-II cable or connector that could be transferred to the Option Board.

Option Board Dimensions

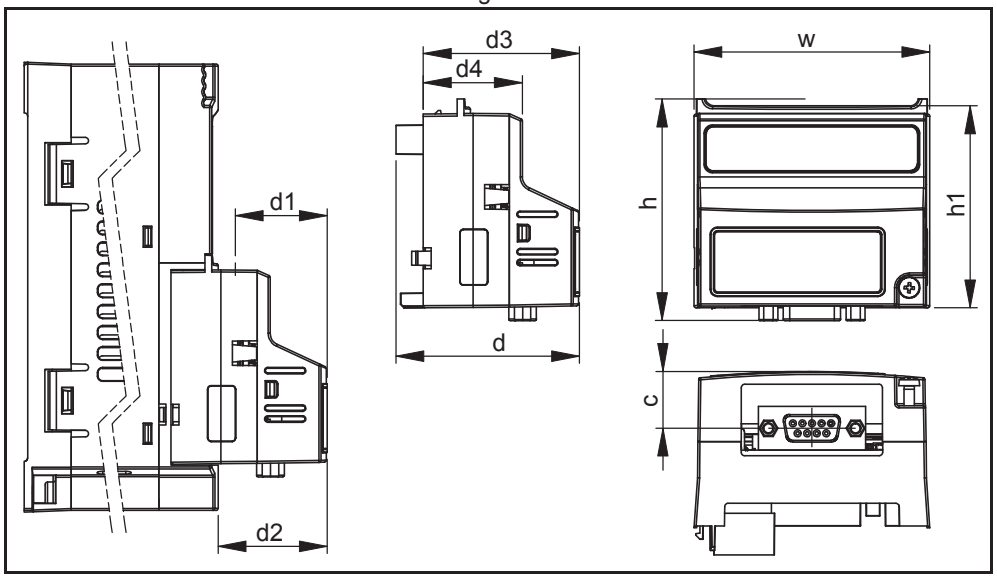
Item	Dimension
h	63.6 mm
h1	57.9 mm
w	67.6 mm

Item	Dimension
c	16.3 mm
d	52.6 mm
d1[1]	26.4 mm

Item	Dimension
d2	31.3 mm
d3	44.8 mm
d4	28.4 mm

1. Dimension d1 gives the increase in MX2 Inverter dimension D when the Option Board is fitted (Refer to section 2-3 of the Inverter user's manual).

fig. 54



Option Board Specifications

Item		Specification
Installation	Unit type	MX2 Series Option Card
	Model	3G3AX-MX2-MRT-E
	Dimensions (W × H × D)	68 x 58 x 45 mm
	Weight	170g (typical)
Environment	Ambient operating temperature[1]	−10 to 55°C (no icing or condensation)
	Ambient operating humidity	20 to 90%RH
	Storage temperature	−20 to 65°C (no icing or condensation)
	Vibration resistance	5.9m/s^2 (0.6G) at 10…55Hz
	Dielectric strength	500 VAC (between isolated circuits)
	Conformance to EMC and electrical safety standards	EN61800-3: 2004 (2004/108/EC) Second environment, Category C3
		EN61800-5-1: 2007 (2006/95/EC) SELV
	Enclosure rating	IP20
MECHATROLINK-II	Baud rate	10 Mbps (MECHATROLINK-II)
	Data length	17-byte and 32-byte data transmission

1. The derated- or ambient operating temperature of the MX2 Inverter takes precedence over that of the Option Board.

Configuring the Option Board

All Option Board parameters are stored in the MX2 Inverter. This allows for easy replacement of the Option Board without the need to re-configure. After connecting the Option Board to an MX2 Inverter for the first time however, proceed with the following steps:

Step 1

It is recommended to set C102 = 3 to prevent the Inverter reset input and Stop/reset button from interfering with Option Board during operation (Setting C102 to another value causes the Option Board to reset when a trip condition is cleared). Use the Inverter keypad to set C102 to 3.

Param	Description	Setting
C102	Reset mode selection	Recommended to set to 3 (Reset mode selection resets trip only, not Option Board)

Step 2

Inverter registers P195 and P196 configure the MECHATROLINK network-related parameters. Adjust these to configure the frame length and node address.

Param	Description	Setting
P195	MECHATROLINK frame length	0: 32 bytes (default after inverter reset) 1: 17 bytes
P196	MECHATROLINK node address	21h to 3Eh

Step 3

Change the control method for the RUN command and frequency reference to Optional Board..

Param	Description	Setting
A001	Frequency Reference Selection 1	02 (Digital Operator, default) 04 (Option board)
A002	RUN Command Selection 1	02 (Digital Operator, default) 04 (Option board)

Step 4
Restart the MX2 Inverter for the changes to take effect.

Note
When restarting the MX2 Inverter, wait for the Inverter power indicator to go out before switching on again.

Troubleshooting

The four LED indicators on the Option Board provide information on the Option Board mode and status and the network status.

When an error occurs, the Option Board indicator pattern provides troubleshooting information. For certain errors, additional information can be obtained from the trip error code given by the four-digit display of the Inverter.

In the following sections typical LED indicator and four-digit Inverter display patterns are provided to assist in troubleshooting. To show the status of the indicators, the following conventions are used:

When an error occurs

Step 1
For the MX2 Inverter, an error code is displayed on the Digital Operator Display.

Step 2
Use the error code to help troubleshoot the error.
In the following sections typical LED indicator and four-digit Inverter display patterns are provided to assist in troubleshooting. To show the status of the indicators, the following conventions are used:

MS	OFF	MS	Not important (Ignore)
MS	RED	E60.	Inverter error code
MS	GREEN	0.00	Not important (Ignore)
MS	Flashing		

Note
Do not clear the trip before you are finished troubleshooting an error. When you clear the trip, the error code is cleared from the four-digit display. The trip history can however be read back using d080 through d086. This will allow you to diagnose the error even if you accidentally cleared the trip cause.

Option board or inverter errors

During the Initialization process the RUN indicator will remain OFF. Once the initialization has been completed correctly, the RUN indicator will be ON and the ERR indicator OFF. The table below shows the indicator and display patterns caused by Option Board or Inverter Errors.

Display & Indicators	Possible Cause(s)	Corrective Action
	The Inverter does not power up.	Follow the instruction provided in the MX2-Inverter user's manual section 6-1-4 to troubleshoot.
	The Option Board is not mounted properly.	Check that the Option Board is mounted properly and restart the Inverter.
	The Option Board connector is damaged.	Replace the Option Board.
	The Inverter RS input is ON.	Switch the Inverter RS input OFF.
	The Option Board encountered a fatal error during Operation.	Check that the Option Board is mounted properly and restart the Option Board. If the problem persists, replace the Option Board.
	The user program requested a trip by setting the external trip bit of the conventional module operation command.	Check and correct all items in accordance with the user program.
	The user program requested a trip by setting the external trip bit of the conventional module operation command.	Check and correct all items in accordance with the user program.
	The Inverter detected a fatal error in the operation of the Option Board.	Check if the option is mounted properly; Restart the Option Board. If the problem persists, replace the Option Board.

Configuration Errors

If the Option Board is correctly configured, the RUN indicator will be ON and the ERR indicator OFF. The table below shows the indicator and display patterns caused by configuration errors.

Display & Indicators	Possible Cause(s)	Corrective Action
	One of the configuration parameters P160 - P179 has been rejected by the Inverter.	I/O mapping is not supported by this option board. Make sure parameters P160 - P179 are set to 0.
	Your Inverter version has not been properly verified with this version of the Option Board (The MECHATROLINK node address in the Inverter is invalid or absent).	Reset the Inverter to factory defaults. If the problem persists, contact your local OMRON representative for assistance.
	Your Inverter version has not been properly verified with this version of the Option Board (Some Option Board parameters in the Inverter are invalid or absent).	Reset the Inverter to factory defaults. If the problem persists, contact your local OMRON representative for assistance.

MECHATROLINK Errors

If the master is correctly configured and there are no wiring errors, the RX and TX indicators will be ON. The table below shows the indicator patterns caused by MECHATROLINK configuration errors.

Display & Indicators	Possible Cause(s)	Corrective Action
	The MECHATROLINK wiring is not correct.	Check (and correct) the following items: • Is the MECHATROLINK master faulty, switched off or off-line? • Are the MECHATROLINK connectors on both the Option Board and master properly connected? • Has anything changed on the MECHATROLINK network (devices, termination, connectors, etc.)? • Are there any short circuits or line interruptions?
	The MECHATROLINK network has not been terminated correctly.	Check if a terminator is present at the end of the network.
	The network error action (selected with parameter P045) was executed due to a MECHATROLINK network error.	Check (and correct) the following items: • Is the MECHATROLINK master faulty, switched off or off-line? • Are the MECHATROLINK connectors on both the Option Board and master properly connected? • Has anything changed on the MECHATROLINK network (devices, termination, connectors, etc.)? • Are there any short circuits or line interruptions?

Related BASIC commands

The following BASIC commands are related to the MECHATROLINK-II MX2 Inverters:

- **INVERTER_COMMAND**
- **INVERTER_READ**
- **INVERTER_WRITE**

For more information, refer to the Trajexia Programming Manual.

3.5.12 MECHATROLINK-II Inverter RX

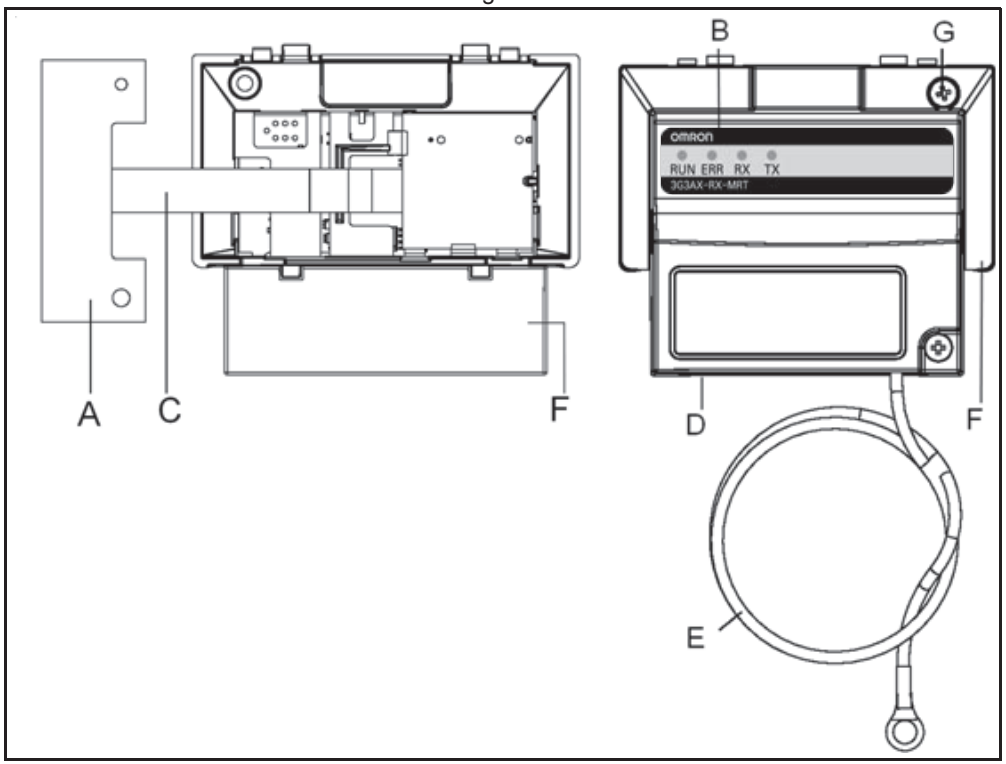
The 3G3AX-RX-MRT-E allows controlling, monitoring and parameterization of an RX Inverter via a MECHATROLINK-II network. The 3G3AX-RX-MRT-E serves as a gateway that passes communicated register values from the MECHATROLINK-II network to the RX Inverter and vice versa.

The illustration shows the external appearance of the 3G3AX-RX2-MRT-E Unit.

A. Option board Inverter connector
B. LED indicators (RUN, ERR, RX, TX)
C. Option Board Cable
D. Fieldbus connector
E. Grounding cable
F. Housing
G. Mounting screw

Four LED indicators allow easy diagnosis. An attached grounding cable is sized to reach the ground terminals on all RX Inverter models. A feature in the housing will retain the mounting screw when the Option Board is not mounted to the Inverter. Please pay special attention to the Option Board connector: It must be properly connected with the Inverter when the Option Board is mounted.

fig. 55



LED indicators

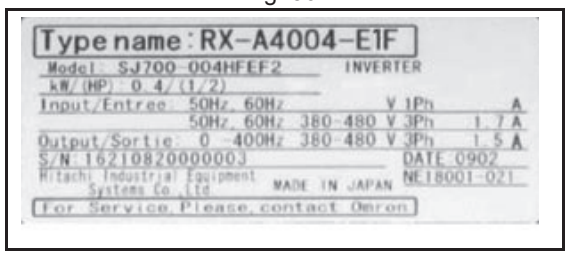
The LED indicators on the front indicate the operational mode and status of the Option Board and the network.

Indicator	Colour	Status	Meaning
RUN	Green	OFF	No power or not yet ready for operation
		Flashing	Operating in commissioning mode
		ON	Normal operation
ERR	Red	ON	Fatal error
		Flashing	Operational error
		OFF	No error
TX	Green	ON	Sending data
		OFF	Sending of data stopped, hardware reset
RX	Green	ON	Searching for receiving carrier
		OFF	No receiving carrier found, hardware reset

Inverter Support

The 3G3AX-RX-MRT-E Option Board supports the RX Inverter with minimum revision of RX-□-E1F or RX-□-V1. An RX Inverter that supports the 3G3AX-RX-MRT-E Option Board can be recognized from the Inverter type label.

fig. 56



Option Board Mounting

WARNING
Always Switch OFF the mains power supply to the Inverter before removing any covers. Wait for the time specified on the Inverter front cover for the capacitors to discharge. Not doing so may result in electrical shock.

Preparation
When the Option Board is mounted on the RX Inverter, the Digital Operator Display can not be directly connected back on the RX Inverter.

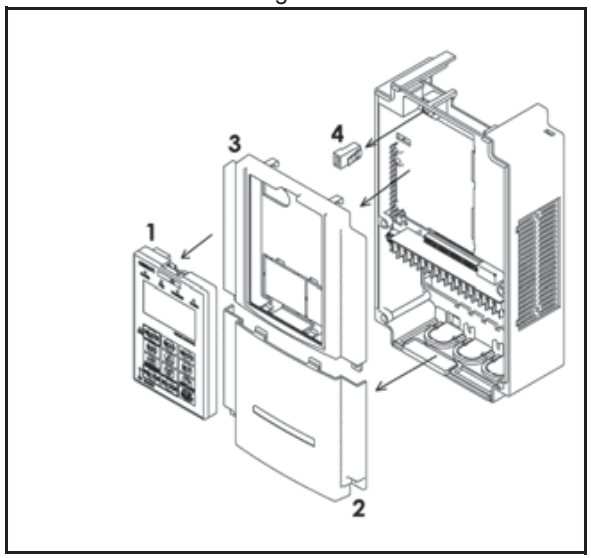
Step 1a
Mount the Option Board according the steps below.

Step 1b
Connect the Digital Operator Display using the 3G3AX CAJOP300-EE cable or straight Ethernet cable.

Step 1c
Set the desired parameters of the RX Inverter with the Digital Operator Display.

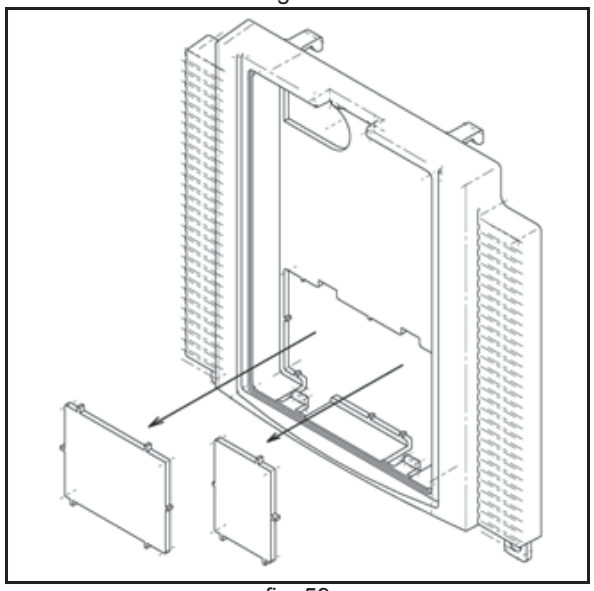
Step 2
Remove from the RX Inverter:
1. Digital Operator Display
2. Terminal cover
3. Front Cover
4. Operator connector.

fig. 57



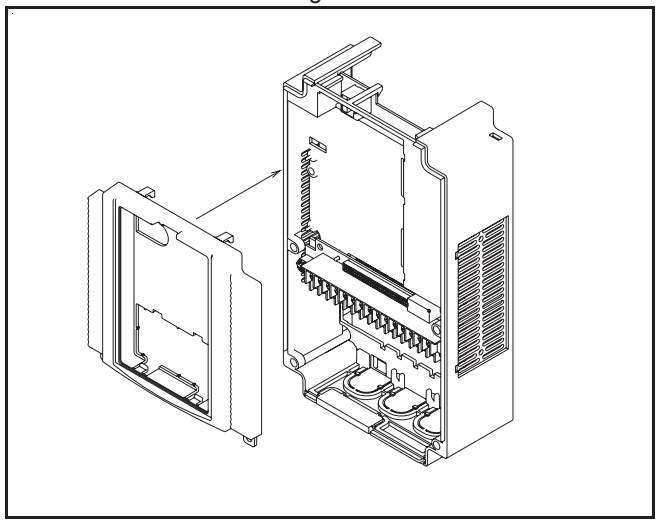
Step 3
Cut out the 2 plastic break-outs from the Front Cover.
Make sure no sharp edges remain.

fig. 58



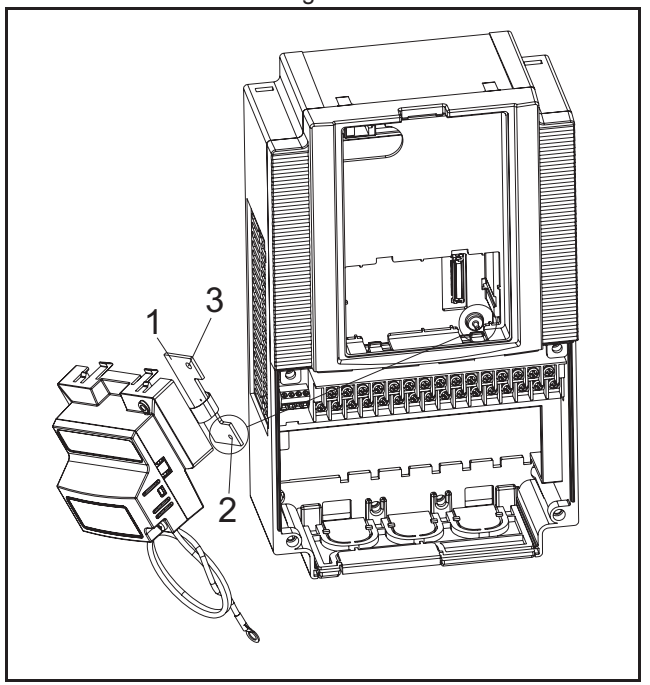
Step 4
Remount the Front Cover and tighten the screws

fig. 59



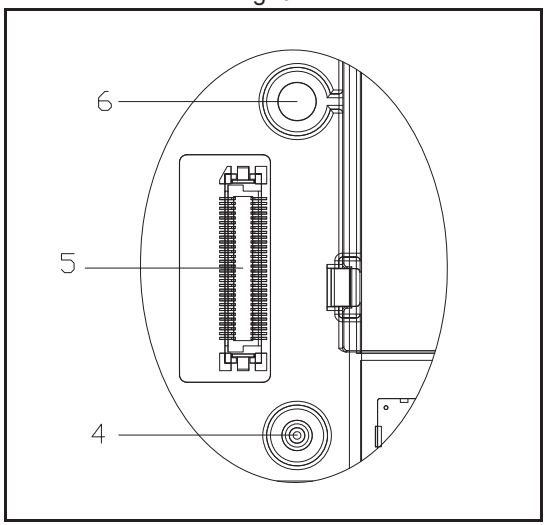
Step 5
Mount the Inverter Connector (no.1) of the Option Board onto the interface connector (no.5) of the RX Inverter.
First align the small hole of the Inverter connector (no.2) with the guide-post (no.4) in the Inverter.

fig. 60



Step 6
Then align the larger hole on the Inverter connector (no.3) with the threaded hole (no.6) in the Inverter.
Push the Inverter connector into place.

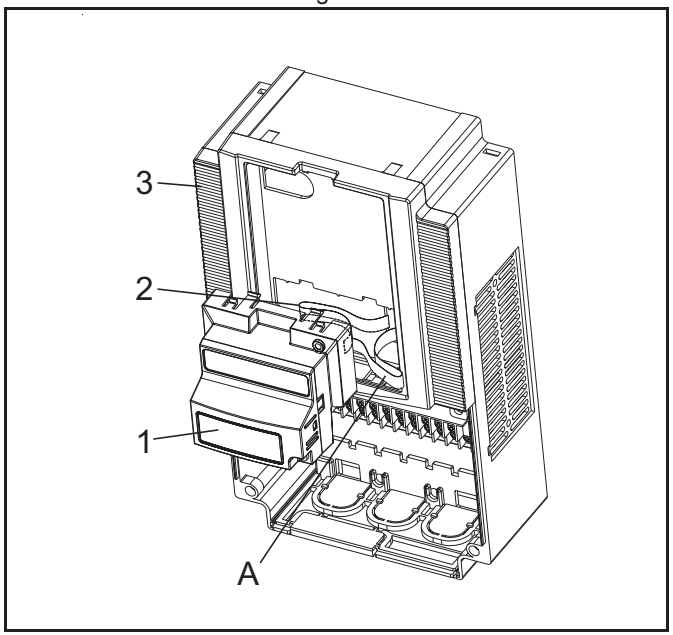
fig. 61



Step 7
Move the Option Board Cable (no.2) to the left with your finger, so the Option Board Cable is not pinched between the Option Board and the Inverter Front Cover.

Note
Prevent a pinched Option Board Cable, as shown in position A.
Do not pull on the Option Board Cable.
Do not let the Option Board hang on the Option Board Cable.

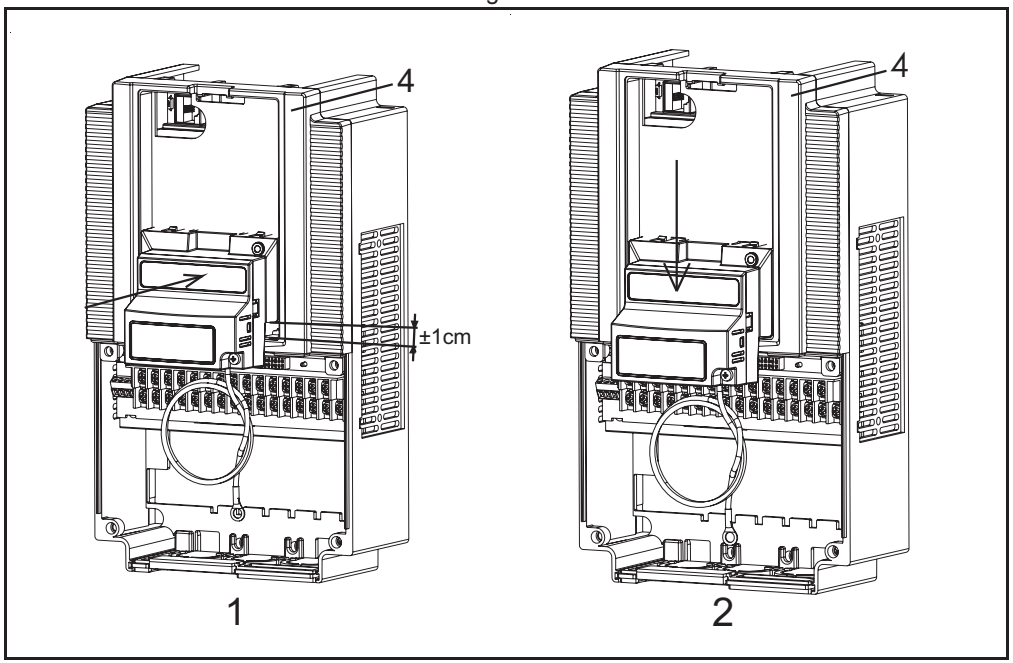
fig. 62



Step 8

Insert the Option Board approximately 1 cm above the down-position into the Front cover of the Inverter. See drawing 1 on the left.
Slide the Option Board down. See drawing 2 on the left.

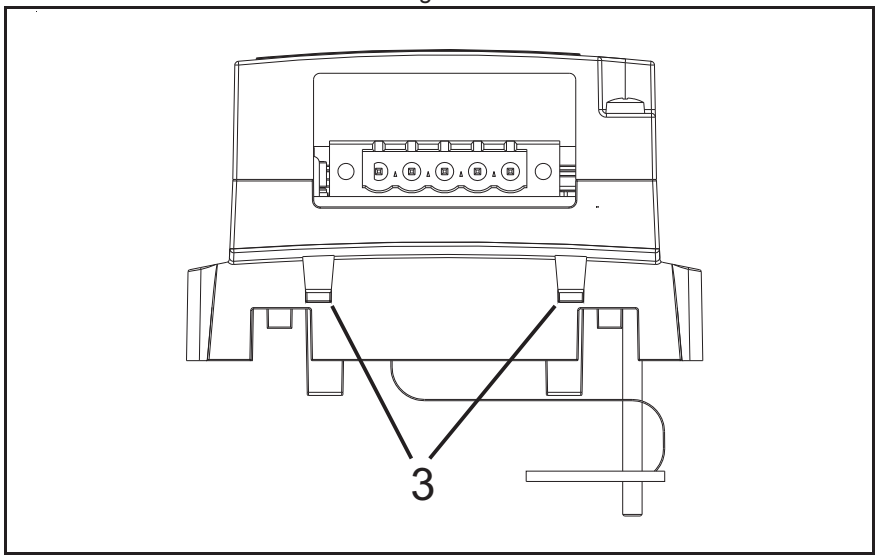
fig. 63



Step 9

The snap-fits of the Option Board (no.5) will be locked by the snap-fits in the Front cover (no.4).

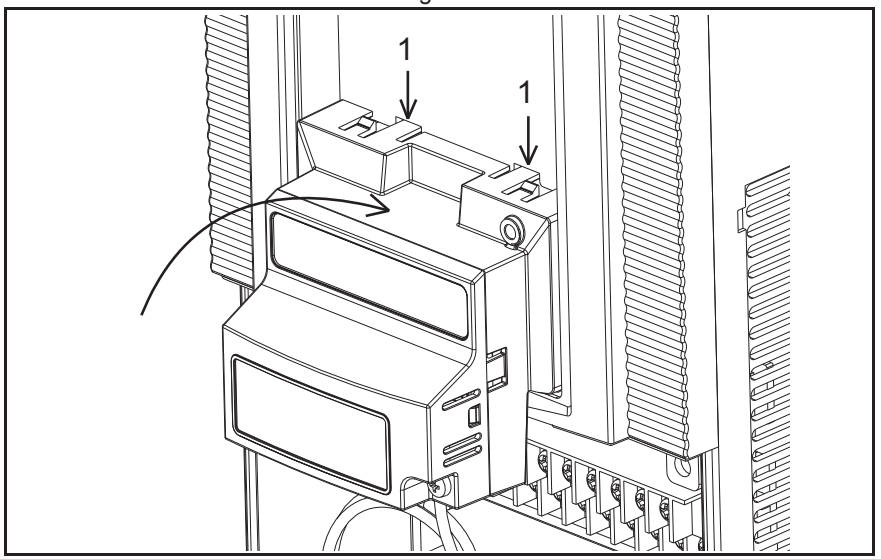
fig. 64



Step 10

Press down carefully the two locking pins (no. 1) of the Option Board.
Press carefully the top of the Option Board in the Inverter.
Check the Option Board is being locked by the locking pins (no.1).

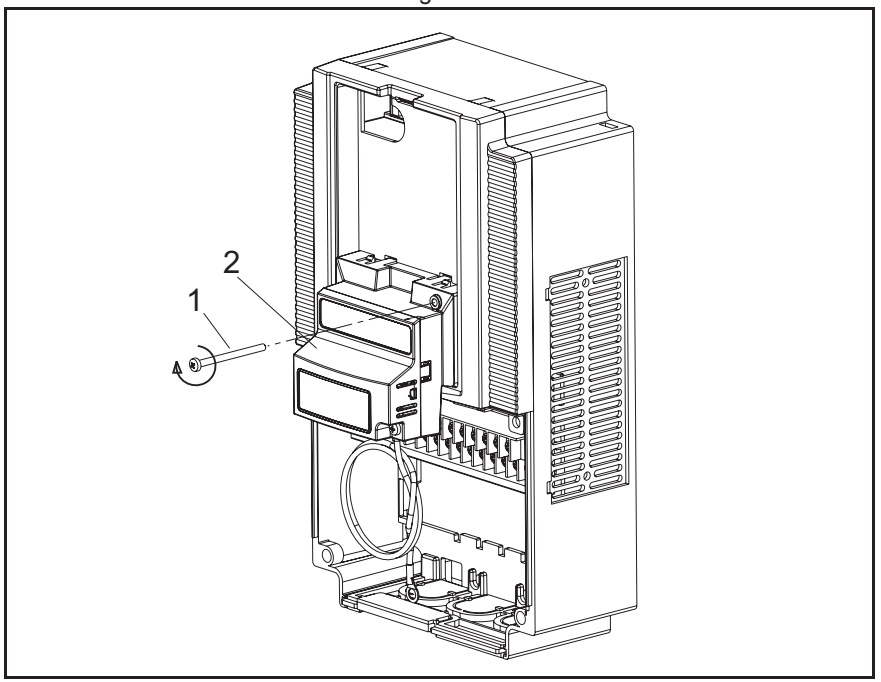
fig. 65



Step 11

Insert the screw (no. 1) into the upper right hole in the Option Board (no.2).
Tighten the screw into place (do not over tighten).

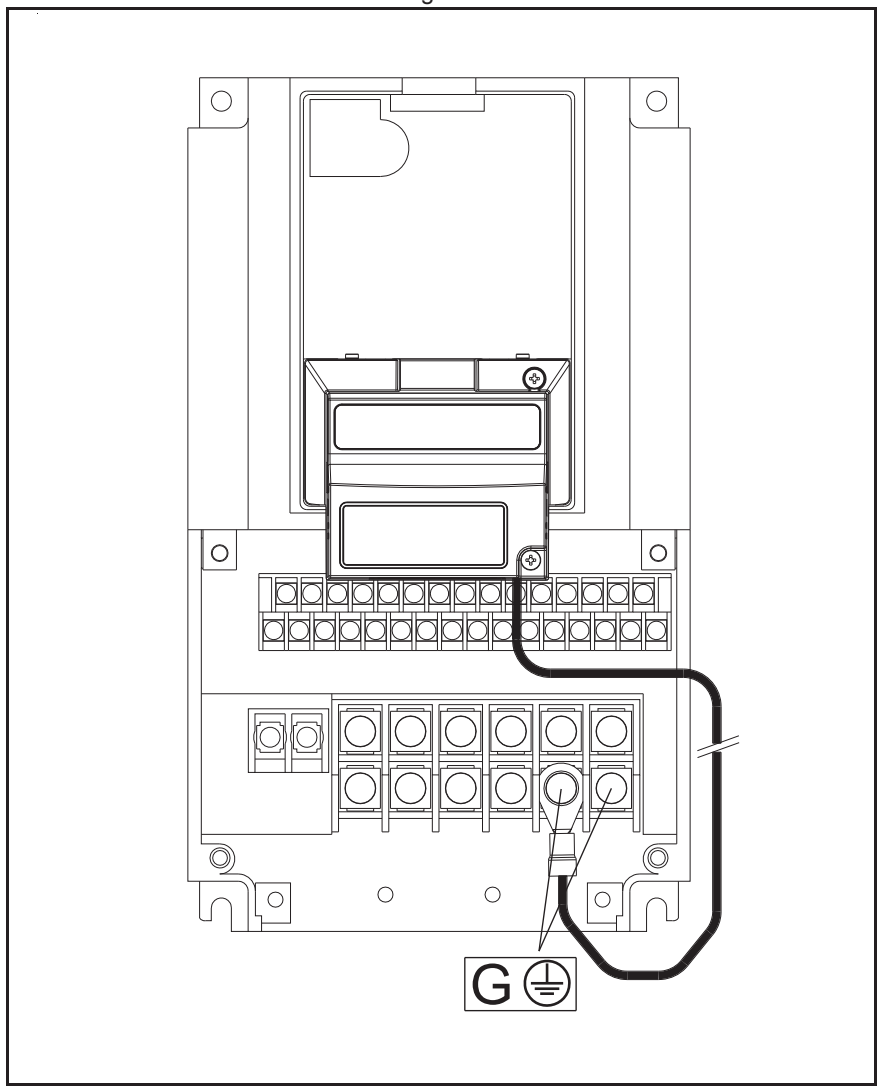
fig. 66



Step 12

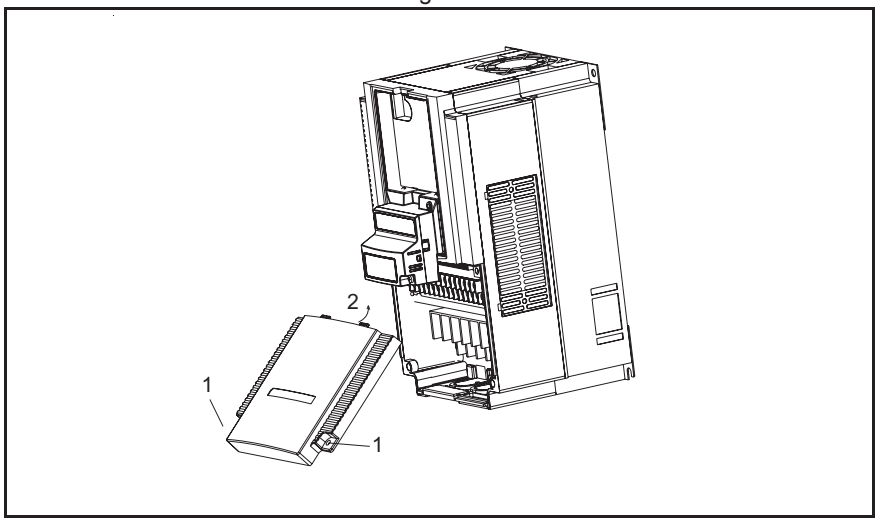
Fix the Option Board grounding cable to the chassis ground of the RX Inverter under an already fixed chassis grounding bolt.
See the bolt with the grounding figure.
The position of the chassis ground vary from inverter type. Illustrations are only provided for one Inverter size. The instructions however are generic and may be followed for all Inverter sizes.

fig. 67



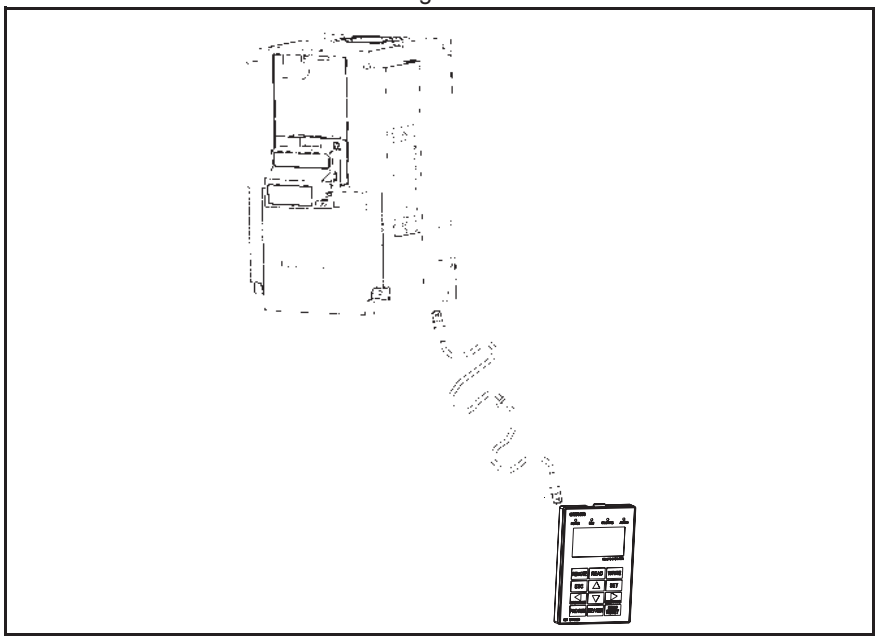
Step 13
Unscrew the mounting screws of the Terminal cover nearly completely from the plastic rings (no.1).
Remount the Terminal cover under the Option Board onto the Inverter (no.2).
Tighten the two screws (no.1).

fig. 68



Step 14
Connect the Digital Operator Display via a 3G3AX CAJOP300-EE cable or via a straight EtherNet cable with the RJ45 connector in the Inverter.

fig. 69



Step 15
If the desired parameters of the Inverter have been set successfully, disconnect the 3G3AX CAJOP300-EE cable or straight EtherNet cable from the Inverter.
Push the blind cover (no.1) into place.

Note
Refer to section 2 in the RX User's Manual (Cat. No. I560) for operations related to assembly and disassembly of the RX Inverter.

WARNING
Never operate the Inverter with the terminal block cover or backing plate removed.

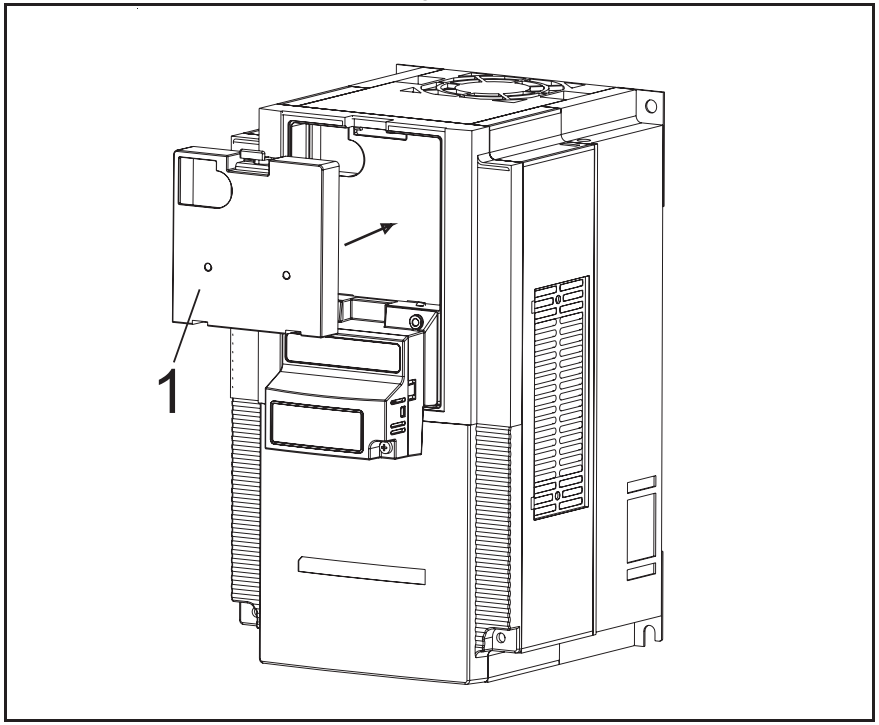
WARNING
Provide emergency stop circuits, interlock circuits, limit circuits and similar safety measures in external circuits (NOT in the Option Board). This ensures safety in the system if an abnormality occurs due to malfunction of the Option Board or another external factor affecting the Option Board operation. Not doing so may result in serious accidents.

WARNING
Always connect the grounding cable to one of the ground terminals of the RX Inverter. Failure to abide could lead to serious or possibly fatal injury.

Caution
Never touch the heat sink during or just after operation; it can be very hot.

Caution
Be sure that the Option Board is mounted correctly. Improper mounting may result in malfunction.

fig. 70



Caution
Be sure that all cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque may result in malfunction.

Installation Environment Clearance

Please refer to the RX Inverter manual (Cat. No. I560) section 2-1 Installation Environment. In addition to this, provide sufficient clearance to allow connection and removal of the MECHATROLINK-II Connectors. No unnecessary strain should be placed on the MECHATROLINK-II cable or connector that could be transferred to the Option Board.

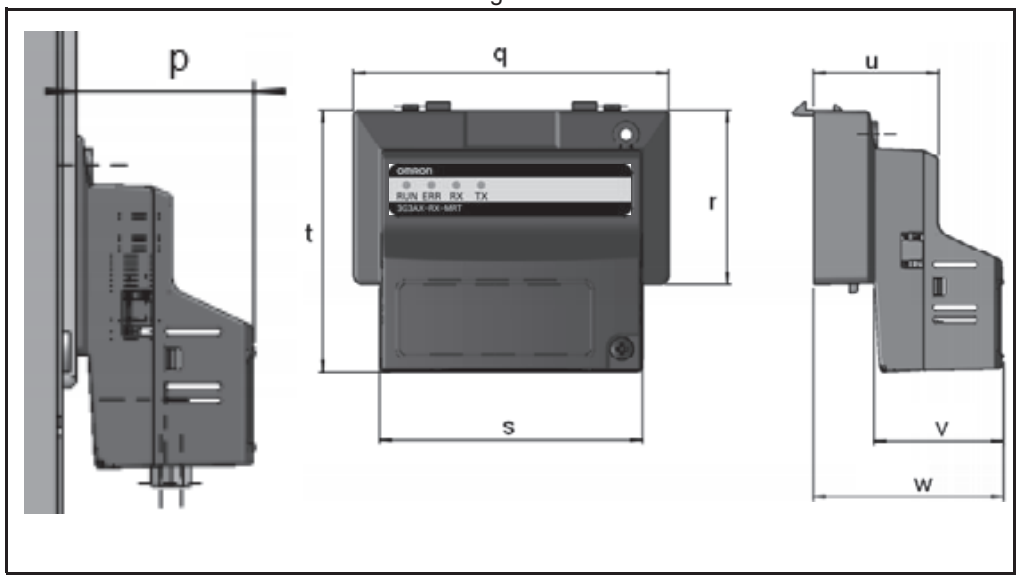
Option Board Dimensions

Item	Dimension
p	35.1 mm
q	79.8 mm

Item	Dimension
r	43.9 mm
s	66.5 mm
t	66.1 mm

Item	Dimension
u	31.7 mm
v	32.7 mm
w	48.1 mm

fig. 71



Option Board Specifications

Item		Specification
Installation	Unit type	RX Series Option Card
	Model	3G3AX-RX-MRT-E
	Dimensions (W × H × D)	68 x 58 x 45 mm
	Weight	170g (typical)
Environment	Ambient operating temperature[1]	−10 to 55°C (no icing or condensation)
	Ambient operating humidity	20 to 90%RH
	Storage temperature	−20 to 65°C (no icing or condensation)
	Vibration resistance	5.9m/s^2 (0.6G) at 10…55Hz
	Dielectric strength	500 VAC (between isolated circuits)
	Conformance to EMC and electrical safety standards	EN61800-3: 2004 (2004/108/EC) Second environment, Category C3
		EN61800-5-1: 2007 (2006/95/EC) SELV
	Enclosure rating	IP20
MECHATROLINK-II	Baud rate	10 Mbps (MECHATROLINK-II)
	Data length	17-byte and 32-byte data transmission

1. The derated- or ambient operating temperature of the RX Inverter takes precedence over that of the Option Board.

Configuring the Option Board

All Option Board parameters are stored in the RX Inverter. This allows for easy replacement of the Option Board without the need to re-configure. After connecting the Option Board to an RX Inverter for the first time however, proceed with the following steps:

Step 1

It is recommended to set C102 = 3 to prevent the Inverter reset input and Stop/reset button from interfering with Option Board during operation (Setting C102 to another value causes the Option Board to reset when a trip condition is cleared). Use the Inverter keypad to set C102 to 3.

Param	Description	Setting
C102	Reset mode selection	Recommended to set to 3 (Reset mode selection resets trip only, not Option Board)

Step 2

Inverter registers P195 and P196 configure the MECHATROLINK-II network-related parameters. Adjust these to configure the frame length and node address.

Param	Description	Setting
P195	MECHATROLINK frame length	0: 32 bytes (default after inverter reset) 1: 17 bytes
P196	MECHATROLINK node address	21h to 3Eh

Step 3
Registers A001 and A002 are used by the Inverter to adjust the frequency source and control source.

Param	Description	Setting
A001	Frequency Reference Selection 1	02 (Digital Operator, default) 05 (Option board 2)
A002	RUN Command Selection 1	02 (Digital Operator, default) 05 (Option board 2)

Step 4
Restart the Inverter for the changes to take effect.

Note
When restarting the Inverter, wait for the Inverter power indicator to go out before switching on again.

Troubleshooting

The four LED indicators on the Option Board provide information on the Option Board mode and status and the network status.

When an error occurs, the Option Board indicator pattern provides troubleshooting information. For certain errors, additional information can be obtained from the trip error code given by the four-digit display of the Inverter.

In the following sections typical LED indicator and four-digit Inverter display patterns are provided to assist in troubleshooting. To show the status of the indicators, the following conventions are used:

When an error occurs

Step 1

For the RX Inverter, you need to connect the Digital Operator Display to the Inverter with an Ethernet cable. Then you can see the error code on the display. Note: if despite the problem it is still possible to communicate with the unit, the latest error code can also be read in parameter d081.

Step 2

Use the error code to help troubleshoot the error.
In the following sections typical LED indicator and four-digit Inverter display patterns are provided to assist in troubleshooting. To show the status of the indicators, the following conventions are used:

MS (off)	OFF	MS (off)	Not important (Ignore)
MS (red)	RED	E60.	Inverter error code
MS (green)	GREEN	0.00	Not important (Ignore)
MS (flashing)	Flashing		

Note
Do not clear the trip before you are finished troubleshooting an error. When you clear the trip, the error code is cleared from the four-digit display. The trip history can however be read back using d080 through d086. This will allow you to diagnose the error even if you accidentally cleared the trip cause.

Option board or inverter errors

During the Initialization process the RUN indicator will remain OFF. Once the initialization has been completed correctly, the RUN indicator will be ON and the ERR indicator OFF. The table below shows the indicator and display patterns caused by Option Board or Inverter Errors.

Display & Indicators	Possible Cause(s)	Corrective Action
	The Inverter does not power up.	Follow the instruction provided in the RX-Inverter user's manual section 6-1 to troubleshoot.
	The Option Board is not mounted properly.	Check that the Option Board is mounted properly and restart the Inverter.
	The Option Board connector is damaged.	Replace the Option Board.
	The Inverter RS input is ON.	Switch the Inverter RS input OFF.
	The Inverter does not support an Option Board (Refer to 1-1-2 Inverter Support)	Replace the Inverter.
	The Option Board connector is damaged	Replace the Option Board.
	The Inverter encountered a fatal error during Operation.	Restart the Inverter. If the problem persists, replace the Inverter.
	The user program requested a trip by setting the external trip bit of the conventional module operation command.	Check and correct all items in accordance with the user program.
	The Inverter detected a fatal error in the operation of the Option Board.	Check if the option is mounted properly; Restart the Option Board. If the problem persists, replace the Option Board

Configuration Errors

If the Option Board is correctly configured, the RUN indicator will be ON and the ERR indicator OFF. The table below shows the indicator and display patterns caused by configuration errors.

Display & Indicators	Possible Cause(s)	Corrective Action
	One of the configuration parameters P160 - P179 has been rejected by the Inverter.	I/O mapping is not supported by this option board. Make sure parameters P160 - P179 are set to 0.
	Your Inverter version has not been properly verified with this version of the Option Board (The MECHATROLINK node address in the Inverter is invalid or absent).	Reset the Inverter to factory defaults. If the problem persists, contact your local OMRON representative for assistance.
	Your Inverter version has not been properly verified with this version of the Option Board (Some Option Board parameters in the Inverter are invalid or absent).	Reset the Inverter to factory defaults. If the problem persists, contact your local OMRON representative for assistance.

MECHATROLINK Errors

If the master is correctly configured and there are no wiring errors, the RX and TX indicators will be ON. The table below shows the indicator patterns caused by MECHATROLINK-II configuration errors.

Display & Indicators	Possible Cause(s)	Corrective Action
	The MECHATROLINK wiring is not correct.	Check (and correct) the following items: • Is the MECHATROLINK master faulty, switched off or off-line? • Are the MECHATROLINK connectors on both the Option Board and master properly connected? • Has anything changed on the MECHATROLINK network (devices, termination, connectors, etc.)? • Are there any short circuits or line interruptions?
	The MECHATROLINK network has not been terminated correctly.	Check if a terminator is present at the end of the network.
	The network error action (selected with parameter P045) was executed due to a MECHATROLINK network error.	Check (and correct) the following items: • Is the MECHATROLINK master faulty, switched off or off-line? • Are the MECHATROLINK connectors on both the Option Board and master properly connected? • Has anything changed on the MECHATROLINK network (devices, termination, connectors, etc.)? • Are there any short circuits or line interruptions?

Related BASIC commands

The following BASIC commands are related to the MECHATROLINK-II RX Inverters:

- **INVERTER_COMMAND**
- **INVERTER_READ**
- **INVERTER_WRITE**

For more information, refer to the Trajexia Programming Manual.

3.5.13 Yaskawa MECHATROLINK-II Inverters

You can also connect the following Yaskawa Inverters:

- V7 Inverter with an SI-T/V7 MECHATROLINK Communications Interface Unit.
- F7 and G7 Inverters with an SI-T MECHATROLINK Communications Interface Card.
- V1000 and A1000 Inverters with an SI-T3/V MECHATROLINK Option.

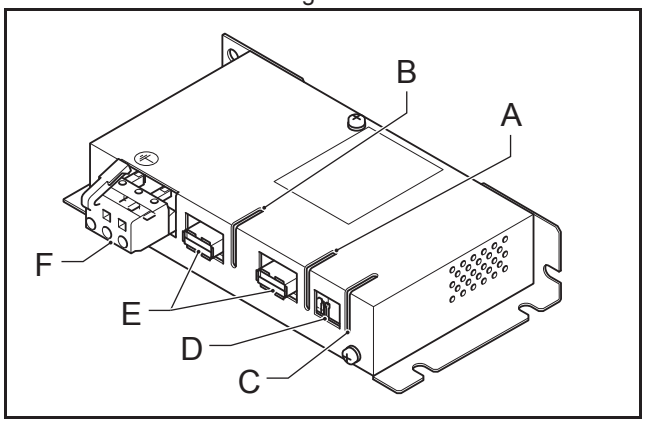
For details please refer to the manuals of these Inverters.

3.5.14 MECHATROLINK-II repeater

The FNY-REP2000 is a MECHATROLINK-II repeater. It extends the range and the maximum number of MECHATROLINK-II devices in the MECHATROLINK-II network.

Terminal/LED	Label	Description
A	TX1	CN1 communication indicator
B	TX2	CN2 communication indicator
C	POWER	Power indicator
D	SW	Dipswitch
E	CN1 & CN2	MECHATROLINK-II connectors
F	CN3	Power supply connector

fig. 72



LED indicators

LED	Description
POWER	Lit: Power on Not lit: No power
TX1	Lit: Communication via CN1 Not lit: No communication via CN1
TX2	Lit: Communication via CN2 Not lit: No communication via CN2

MECHATROLINK-II connectors

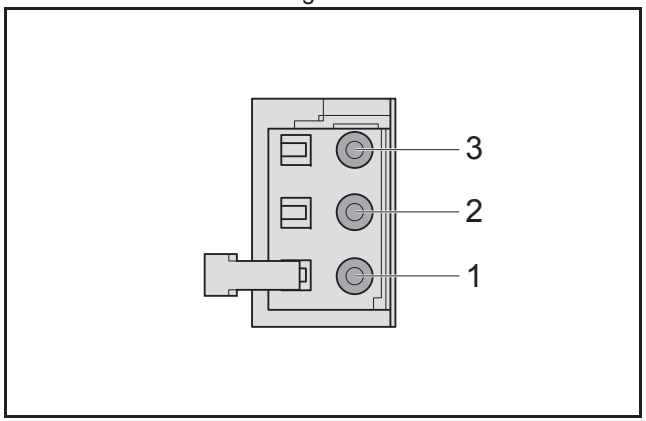
Use one MECHATROLINK-II connector (CN1 or CN2) to connect the repeater to the master-side network, i.e. the part of the network that had the TJ1-ML__. Use the other connector to connect the repeater to the network extension.
Both connectors have a built-in terminator.

Power supply connector

Connect an external 24 VDC power supply to the power supply connector (CN3).
The table below gives the pin layout for the power supply connector.

Pin	Signal	Description
1	FG	Frame ground
2	0 V	0 VDC input
3	+24 V	24 VDC input

fig. 73



Dipswitch settings (SW)

The dipswitch is for future use. Set all the pins to OFF.

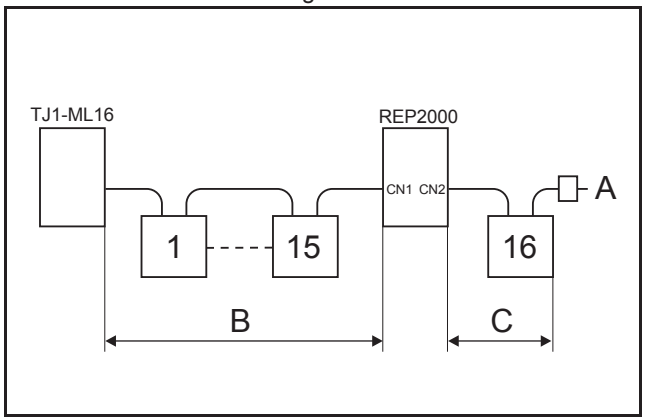
System configuration

The maximum number of MECHATROLINK-II devices that you can connect in the MECHATROLINK-II network with a repeater is set by the MECHATROLINK-II cable length.

Network part	MECHATROLINK-II cable length	Maximum number of MECHATROLINK-II devices[1]
Master-side (B)	Max. 30 m	16
	Max. 50 m	15
Extension (C)	Max. 30 m	16
	Max. 50 m	15

1. The repeater itself is included in the maximum number of MECHATROLINK-II devices.

fig. 74



The total number of MECHATROLINK-II devices is set by the TJ1-ML__:

- The TJ1-ML04 can have up to 4 MECHATROLINK-II devices.
- The TJ1-ML16 can have up to 16 MECHATROLINK-II devices.

Terminate the last MECHATROLINK-II device with a MECHATROLINK-II terminator (A).

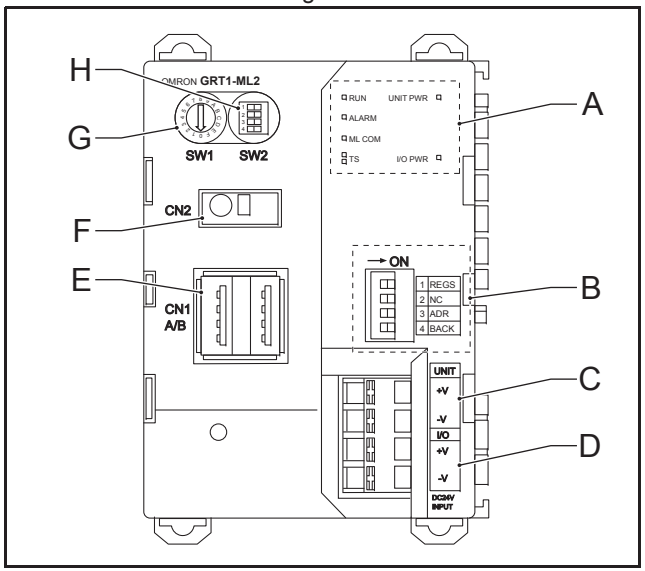
3.6 GRT1-ML2

3.6.1 Introduction

The GRT1-ML2 SmartSlice Communication Unit controls data exchange between a TJ2-MC__ Machine Controller Unit (via a connected TJ1-ML__ MECHATROLINK-II Master Unit) and SmartSlice I/O Units over a MECHATROLINK-II network. For more information on SmartSlice I/O Units, refer to the GRT1 Series SmartSlice I/O Units Operation Manual (W455).

Label	Description
A	LED indicators
B	Unit dipswitches
C	Unit power supply terminals
D	I/O power supply terminals
E	MECHATROLINK-II connectors
F	Shielding terminal
G	Rotary switch
H	Communication dipswitches

fig. 75

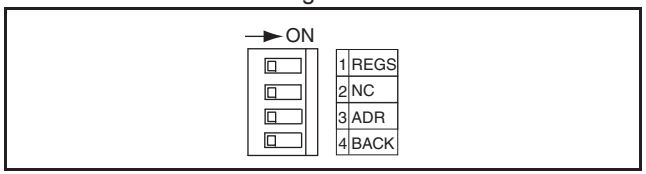


Unit dipswitches

Dipswitch	Function	Setting	Description
REGS	Create/enable registration table	ON	Registered table is enabled
		OFF	Registered table is disabled
		OFF to ON[1]	Register I/O unit table
		ON to OFF	Clear registered I/O unit table
NC	N/A	OFF	Not used, always set to OFF
ADR	Automatic restore	OFF to ON	When the SmartSlice I/O Units are replaced, the parameter data that was backed up with the BACK dipswitch is automatically restored[2]
		OFF	Automatic restore disabled
BACK	Backup trigger	ON to OFF to ON in 3 s[3]	Parameter data of all connected Smart-Slice I/O Units is backed up

1. When the unit power is on.
2. When dipswitch 1 is set to ON.
3. The setting of dipswitch 4 (BACK) is given in figure 77.

fig. 76



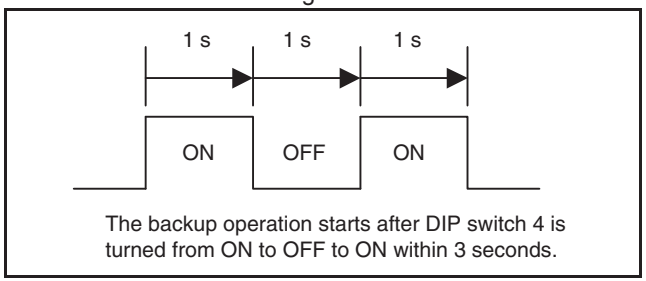
Caution
The Backup and Restore functionality is available in the GRT1-ML2. However, the backed up and restored parameters cannot be accessed via MECHATROLINK-II communication.

Note

- It is recommended to do a registration of the SmartSlice I/O Units (see the Trajexia Programming Manual).
- It is recommended to set dipswitches 1 and 3 to on and dip-switch 4 to off after this registration.

The factory setting of all dipswitches is OFF.

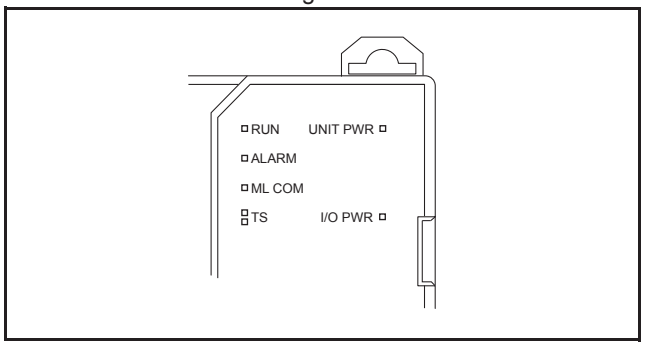
fig. 77



LED indicators

LED	Description	Color	Status	Meaning
RUN	Unit status	Green	Not lit	• Startup test failed, unit not operational • Operation stopped due to a fatal error
			Lit	Initialization successful, unit is in normal operation
ALARM	Unit error	Red	Not lit	Unit is in normal operation
			Flashing	A startup error has occurred
			Lit	Unit is in alarm state, or a fatal error has occurred
ML COM	MECHATROLINK-II communication	Green	Not lit	No MECHATROLINK-II communication
			Lit	MECHATROLINK-II communication active

fig. 78



LED	Description	Color	Status	Meaning
TS	SmartSlice I/O system communication status	N/A	Not Lit	• No power supply • Communication with SmartSlice I/O Unit has not started • Overcurrent detected
		Green	Flashing (every second)	SmartSlice I/O Unit added to the system
			Flashing (every 0.5 second)	Backup/Restore function operating: • Restoring settings to SmartSlice I/O Unit, backup function operating • Downloading SmartSlice I/O Unit settings
			Lit	Communication with SmartSlice I/O Unit established
		Red	Flashing	Non-fatal communication error occurred. • Communication timeout • Verification error occurred with registered table • Different model unit detected after SmartSlice I/O Unit replacement
			Lit	Fatal communication error occurred.
			Lit for 2 s	Failure occurred while restoring settings to I/O unit or downloading I/O unit settings
UNIT PWR		Green	Not Lit	No power supply to the unit (All LEDs are off)
			Lit	Power supply to the unit
I/O PWR		Green	Not Lit	No power supply to the SmartSlice I/O (No output from the SmartSlice I/O Units, even when they are in operation)
			Lit	Power supply to the SmartSlice I/O

Note

- When the power of the Trajexia system is turned on, the TJ2-MC__ executes its startup sequence before it initializes the MECHATROLINK-II bus. During this startup sequence, the ML COM LED is off.
- When the TJ2-MC__ initializes the MECHATROLINK-II bus with the command **MECHATROLINK(unit,0)**, the ML COM LED goes on.
- When the GRT1-ML2 loses the MECHATROLINK-II communication with the master, or when the command **MECHATROLINK(unit,1)** is executed, the ML COM LED goes off.

Communication dipswitches

Dipswitch	Function	Setting	Description
1	MECHATROLINK-II address range	ON	70 hex – 7F hex
		OFF	60 hex – 6F hex
2	MECHATROLINK-II bus speed	OFF	10 Mbps[1]
3	Frame size	OFF	32 bytes[2]
4	HOLD/CLEAR	ON	HOLD: All outputs hold their values when communication is lost
		OFF	CLEAR: All outputs become 0 when communication is lost

1. Trajexia only supports 10 Mbps bus speed. Therefore always set dip-switch 2 to OFF.
2. Trajexia only supports 32-byte communication. Therefore always set dip-switch 3 to OFF.

Rotary switch

The rotary switch (SW1) sets the MECHATROLINK-II address that identifies the GRT1-ML2 in the MECHATROLINK-II network. The settings range is from 0 hex to F hex.

To set the MECHATROLINK-II address of the GRT1-ML2, do these steps:

1. Turn off the Unit power supply of the GRT1-ML2.

Note
The address of the GRT1-ML2 is read only at power on. Setting the new address when the power is on has no effect.

2. To set the address of the unit, set communication dipswitch 1 and the rotary switch as given in the table below.

Dipswitch 1	Rotary switch	Address	Dipswitch 1	Rotary switch	Address
OFF	0	60 hex	ON	0	70
OFF	1	61 hex	ON	1	71
OFF	2	62 hex	ON	2	72
OFF	3	63 hex	ON	3	73
OFF	4	64 hex	ON	4	74
OFF	5	65 hex	ON	5	75
OFF	6	66 hex	ON	6	76
OFF	7	67 hex	ON	7	77
OFF	8	68 hex	ON	8	78
OFF	9	69 hex	ON	9	79
OFF	A	6A hex	ON	A	7A
OFF	B	6B hex	ON	B	7B
OFF	C	6C hex	ON	C	7C
OFF	D	6D hex	ON	D	7D
OFF	E	6E hex	ON	E	7E
OFF	F	6F hex	ON	F	7F

Note
Make sure that the address is unique in the MECHATROLINK-II network. If two or more units have the same MECHATROLINK-II address, they cannot be initialized properly.

3. Turn the power on.

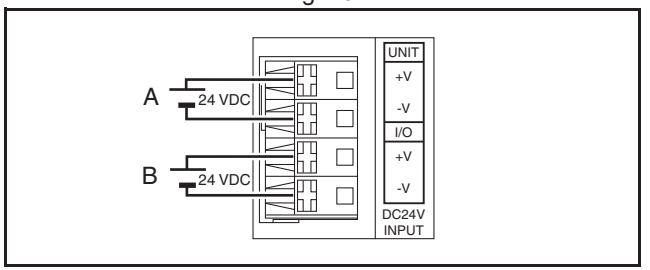
Note
To make the MECHATROLINK-II address of the unit valid, do one of these steps:
- Restart the TJ2-MC__.
- Execute the command **MECHATROLINK(unit,0)**.

Power supply connector

The GRT1-ML2 has 2 24 VDC power supply terminals:

Label	Power supply terminal	Description
A	Unit power supply terminal	Power supply to the internal circuits of the GRT1-ML2 and to the internal circuits of the connected SmartSlice I/O Units (through the SmartSlice bus)
B	External I/O power supply terminal	Power supply to the external I/Os connected to the SmartSlice I/O Units

fig. 79



Note
The unit power supply and the external I/O power supply are not transferred through the GCN2-100 Turnback cable. The GRT1-TBR units have the same power supply terminals as the GRT1-ML2.

Note
The unit power supply is isolated from the external I/O power supply. Please use 2 separate power-supplies to keep this isolation.

3.6.2 Specifications

Item		Specification
Installation	Unit type	SmartSlice GRT1 series
	Model	GRT1-ML2
	Installation position	On a DIN rail
	Power supply	24 VDC +10% −15% (20.4 to 26.4 VDC)
	Current consumption	110 mA typical at 24 VDC
	Dimensions (W × H × D)	58 × 80 × 70 mm
	Weight	130 g
Environment	Ambient operating temperature	−10 to 55°C (no icing or condensation)
	Ambient operating humidity	25% to 85% Relative humidity
	Storage temperature	−20 to 65°C (no icing or condensation)
	Vibration resistance	10 to 57 Hz, 0.7 mm amplitude 57 to 150 Hz, acceleration: 49 m/s^2
	Shock resistance	150 m/s^2
	Dielectric strength	500 VAC (between isolated circuits)
	Conformance to EMC and electrical safety standards	EN61131-2:2003
	Enclosure rating	IP20

Item		Specification
SmartSlice I/O	Number of connectable SmartSlice I/O Units	64 Units max. Connected directly to the GRT1-ML2 or via Turnback extension units
	Baud rate	3 Mbps
	Communication signal level	RS485
	Communication distance	SmartSlice I/O Units: 64 Units coupled (about 2 m max.) Turnback cable: 2 m max. (2 cables, 1 m each)
	Turnback cable	Length 1 m max., up to 2 cables can be connected
	SmartSlice I/O Unit connections	Building-block style configuration with slide connectors (Units connect with Turnback cables).
	Baseblock power supply	Voltage: 24 VDC Current: 4 A max.
	Event messaging	Supported
MECHATROLINK-II	Baud rate	10 Mbps (MECHATROLINK-II)
	Data length	17-byte and 32-byte data transmission

Supported SmartSlice I/O Units

The GRT1-ML2, in combination with the Trajexia system, supports these SmartSlice I/O Units.

Function	Specification	Model
4 NPN inputs	24 VDC, 6 mA, 3-wire connection	GRT1-ID4
4 PNP inputs	24 VDC, 6 mA, 3-wire connection	GRT1-ID4-1
8 NPN inputs	24 VDC, 4 mA, 1-wire connection + 4xG	GRT1-ID8
8 PNP inputs	24 VDC, 4 mA, 1-wire connection + 4xV	GRT1-ID8-1
4 NPN outputs	24 VDC, 500 mA, 2-wire connection	GRT1-OD4
4 PNP outputs	24 VDC, 500 mA, 2-wire connection	GRT1-OD4-1
4 PNP outputs with short-circuit protection	24 VDC, 500 mA, 3-wire connection	GRT1-OD4G-1
4 PNP outputs with short-circuit protection	from 4 x 2.0 A at 30°C to 4 x 1.0 A at 55°C	GRT1-OD4G-3
8 NPN outputs	24 VDC, 500 mA, 1-wire connection + 4xV	GRT1-OD8
8 PNP outputs	24 VDC, 500 mA, 1-wire connection + 4xG	GRT1-OD8-1
8 PNP outputs with short-circuit protection	24 VDC, 500 mA, 1-wire connection + 4xG	GRT1-OD8G-1
2 relay outputs	240 VAC, 2A, normally-open contacts	GRT1-ROS2
2 analog inputs, current/ voltage	10 V, 0-10 V, 0-5 V, 1-5 V, 0-20 mA, 4-20 mA	GRT1-AD2
2 analog outputs, voltage	10 V, 0-10 V, 0-5 V, 1-5 V	GRT1-DA2V
2 analog outputs, current	0-20 mA, 4-20 mA	GRT1-DA2C
Four-point AC Input Unit	100 to 120 VAC 50/60 Hz	GRT1-IA4-1
Four-point AC Input Unit	200 to 240 VAC 50/60 Hz	GRT1-IA4-2
Two-point Temperature Input Unit	Resistance thermometer input, Input type: PT100 (−200 to 850°C) or PT100 (−200 to 200°C)	GRT1-TS2P

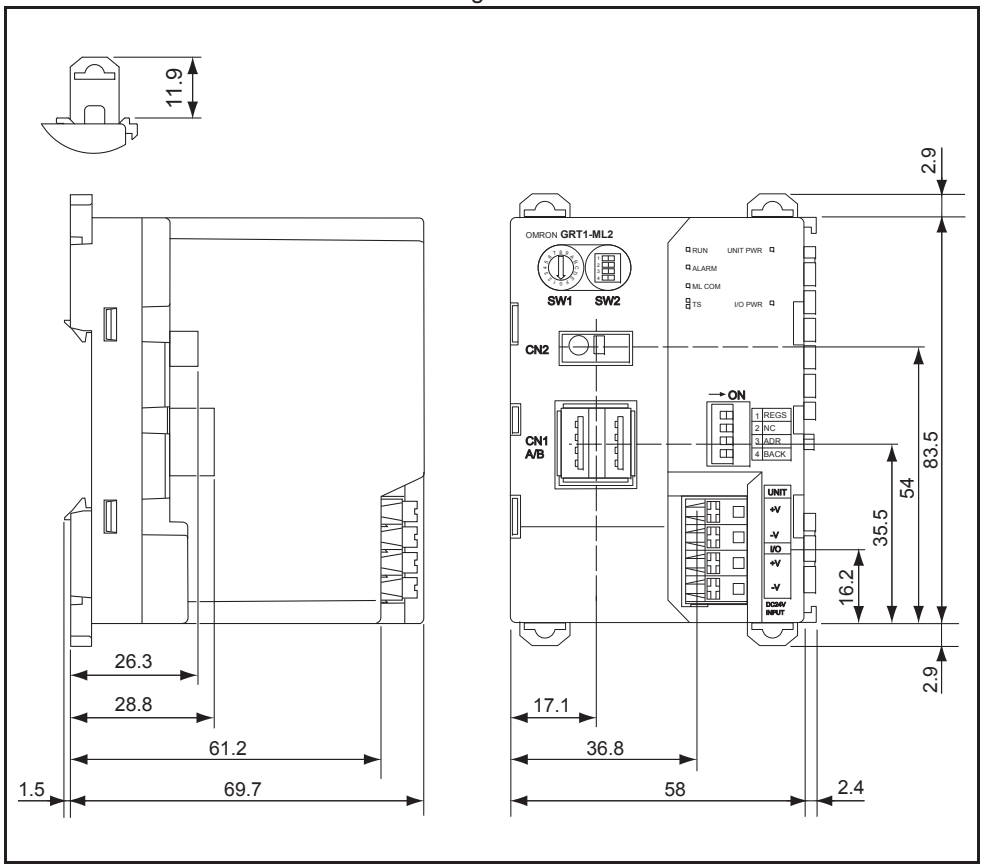
Function	Specification	Model
Two-point Temperature Input Unit	Resistance thermometer input, Input type: PT1000 (−200 to 850°C) or PT1000 (−200 to 200°C)	GRT1-TS2PK
Two-point Temperature Input Unit	Thermocouple input, Input type: R, S, K J, T, E, B, N, L, U, W, or PL2	GRT1-TS2T

Function	Model
I/O power feed unit, separates power supply between groups of I/O units	GRT1-PD2
I/O power feed unit with electronic overload protection, separates power supply between groups of I/O units	GRT1-PD2G
I/O power feed and distribution unit, separates power supply between groups of I/O units, 8xV + 4xG	GRT1-PD8
I/O power feed and distribution unit, separates power supply between groups of I/O units, 4xV + 8xG	GRT1-PD8-1
I/O power connection unit, 8xV + 4xG	GRT1-PC8
I/O power connection unit, 4xV + 8xG	GRT1-PC8-1
Turnback Unit, right-hand side	GRT1-TBR
Turnback Unit, left-hand side	GRT1-TBL
Turnback cable, one meter	GCN2-100

Dimensions

The external dimensions are in mm.

fig. 80



3.6.3 Installation

Follow these rules when installing the GRT1-ML2:

- Before installing the GRT1-ML2 or connect or disconnect cables, switch off the power of the Trajexia system, the SmartSlice I/O Units and the external I/Os.
- Make sure that the power supplies of the GRT1-ML2, the SmartSlice I/O Units and the external I/Os are correctly connected.
- Provide separate conduits or ducts for the I/O lines to prevent noise from high-tension lines or power lines.
- It is possible to connect up to 64 SmartSlice I/O Units to 1 GRT1-ML2.
- Install the GRT1-ML2 and the SmartSlice I/O Units on a DIN rail. To install a GRT1-ML2 on the DIN rail, press it onto the DIN track from the front, and press the unit firmly until it clicks. Check that all DIN rail sliders of the unit are locked onto the DIN rail.
- To remove the GRT1-ML2 from the DIN rail, release the sliders from the DIN rail with a screwdriver, and pull the unit straight from the DIN rail.

Connections

Connect the first SmartSlice I/O Unit to the GRT1-ML2:

- Align the sides of the GRT1-ML2 and the SmartSlice I/O Unit.
- Slide the SmartSlice I/O Unit to the rear until it clicks onto the DIN rail.

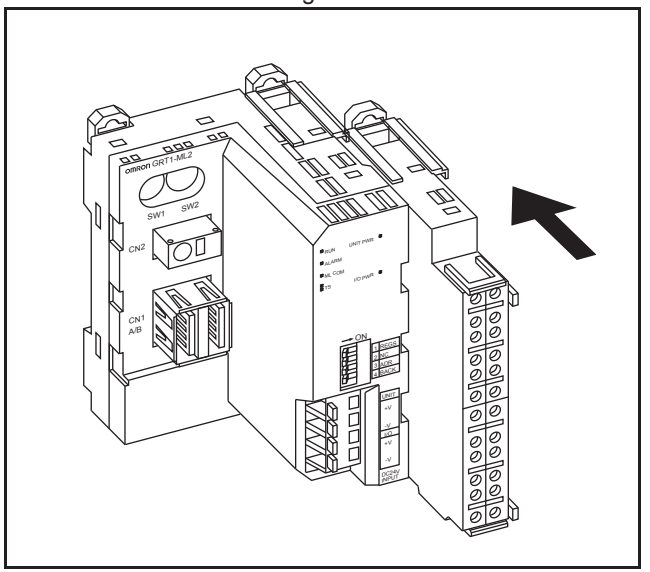
Caution
Do not touch the connectors on the side of GRT1-ML2 and the SmartSlice I/O Units.

See the GRT1 Series SmartSlice I/O Units Operation Manual for more information on connecting additional SmartSlice I/O Units, Turnback Units, End Units and end plates.

Wiring

The GRT1-ML2 has 2 power supply terminals. Both power supply terminals have screwless clamping-type connections.
To determine the power supply requirements, do the steps below.

fig. 81



The maximum power consumption for SmartSlice I/O Units is 80 W per block.

1. Calculate the power consumption of all SmartSlice I/O Units connected to the GRT1-ML2. Refer to the GRT1 Series SmartSlice I/O Units Operation Manual (W455) for the power value for each SmartSlice I/O Unit.
2. If the power consumption exceeds 80 W, mount a Right Turnback Unit (GRT1-TBR) on the SmartSlice I/O Unit at the point where the power consumption is less than 80 W.
3. Connect the 24 VDC unit power supply to the Left Turnback Unit (GRT1-TBL).

The maximum I/O current consumption is 4 A.

1. Calculate the total current consumption used by all external I/Os of the connected SmartSlice I/O Units (including other units like Turnback Units). Refer to the GRT1 Series SmartSlice I/O Units Operation Manual (W455) for the current value for each SmartSlice I/O Unit.
2. If the current consumption exceeds 4 A or if you want to provide separate systems for inputs and outputs, divide the SmartSlice I/O Units at the desired point with a GRT1-PD_(-1) I/O Power Supply Unit and provide a separate external I/O power supply.

Note
It is also possible to provide a separate external I/O power supply at a Left Turnback Unit (GRT1-TBL).

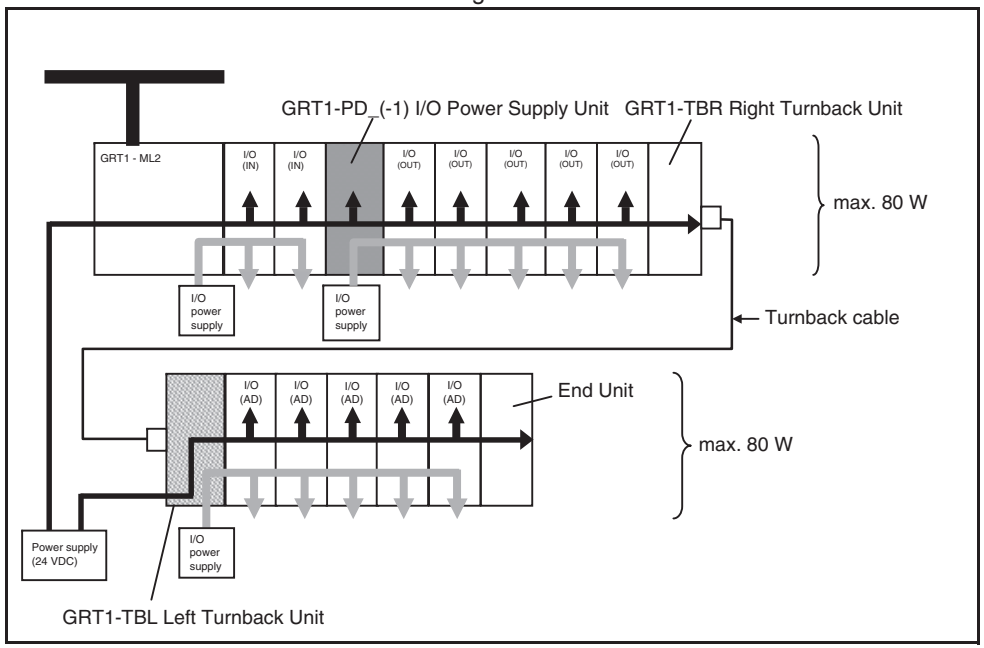
Note
Make sure the power supply is isolated.

Note
The GCN2-100 Turnback cable does not supply power.

The figure gives a wiring example.

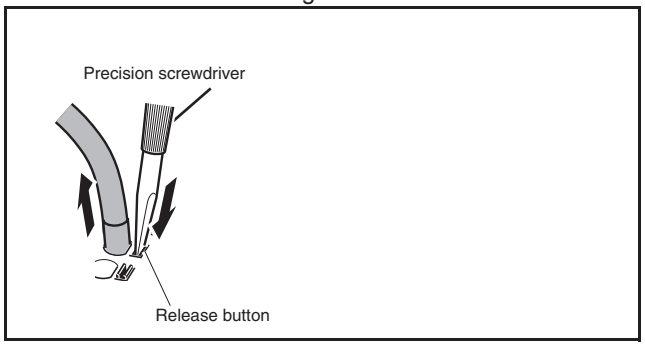
To supply power to the units and the I/O devices, connect the power supply wires to the power supply terminals of the GRT1-ML2. If the wire ends have pin terminals, just insert the pin terminals in the power supply terminals.

fig. 82



To remove the wires, press the release button above the terminal hole with a precision screwdriver, and pull out the wire.

fig. 83



It is recommended to use a SELV (Safety Extra Low Voltage) power supply with over-current protection. A SELV power supply has redundant or increased insulation between the I/O, an output voltage of 30 V rms and a 42.4 V peak or maximum of 60 VDC.
Recommended power supplies are:

- S82K-01524 (OMRON)
- S8TS-06024 (OMRON).

It is recommended to use wires with a gauge of 20 AWG to 16 AWG (0.5 to 1.25 mm^2).
Strip the wire between 7 and 10 mm of insulation at the ends of the wires (stranded or solid wire), or use pin terminals with a pin (conductor) length of 8 to 10 mm.

Replace

Caution
The GRT1-ML2 is a unit that is part of a network. If the GRT1-ML2 is damaged, it effects the whole network. Make sure that a damaged GRT1-ML2 is repaired immediately.

To replace the unit, follow these rules:

- Turn off the power before replacing the unit. This includes the power to all master and slave units in the network.
- Make sure that the new unit is not damaged.
- If a poor connection is the probable cause of any malfunctioning, do these steps:
  - Clean the connectors with a clean, soft cloth and industrial-grade alcohol.
  - Remove any lint or threads left from the cloth.
  - Install the unit again.
- When returning a damaged unit to the OMRON dealer, include a detailed damage report with the unit.
- Before reconnecting the new unit, do these steps:
  - Set the MECHATROLINK-II station address to the same address as the old unit.
  - If the table registration function was used for the old unit, create a new registration table for the new unit. See the Trajexia Programming Manual.

3.6.4 Online replacement

It is possible to replace SmartSlice I/O Units connected to a GRT1-ML2 when the power is on. The I/O communication continues while a SmartSlice I/O Unit is removed and replaced.
To replace a SmartSlice I/O Unit online, do these steps:

1. Turn off all power supplies of the SmartSlice I/O Unit. This is the I/O power supply, plus possible external power supplies to the terminal block (for example, a Relay Output Unit).
2. Release the locks on the front of the unit and remove the terminal block. Do not remove the wiring.

3. Remove the main block of the unit. Replace it with a new SmartSlice I/O Unit of the same type.
4. Attach the new unit to the system. Close the locks on the front of the unit.
5. Turn on the power supplies to the unit.

When replacing a SmartSlice I/O Unit online, note the following things:
- When a unit is removed from the I/O communication, the withdrawn flag of the unit is set on and the TS LED on the GRT1-ML2 flashes red.
- If I/O power supply of the unit is not turned off, there can be false output signals, false input signals and electrical shocks.
- Only replace one SmartSlice I/O Unit at a time.
- If a unit is replaced with a different type of unit, there can be unexpected outputs and the restore operation can be incomplete.
- If the base block has faults or damage, turn off the power supply and replace the entire unit.

When an online replacement is performed, the status word of the GRT1-ML2 reports an error (missing I/O Unit). When the I/O Unit is replaced or put back, the status word changes to 8000 hex, but the error has already been detected by the TJ2-MC__. To avoid this, it is necessary to mask the errors before the online replacement is performed. To perform the online replacement do the following:
1. Execute **MECHATROLINK(unit,37,station_addr, 0)**. This masks all bits, including errors, in the GRT1-ML2 status word.
2. Replace the I/O Unit.
3. Execute **MECHATROLINK(unit,37,station_addr, $4000)**. This sets the error mask to its default value.

3.6.5 Related BASIC commands

The following BASIC commands are related to the MECHATROLINK-II GRT1-ML2 module:
- **MECHATROLINK**

For more information, refer to the Trajexia Programming Manual.

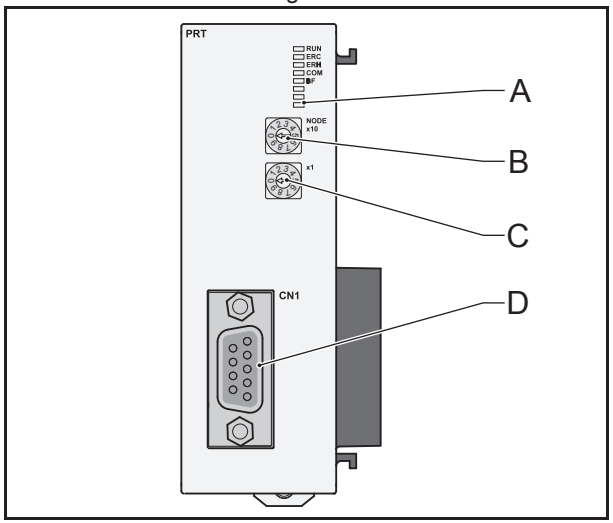
3.7 TJ1-PRT

3.7.1 Introduction

The TJ1-PRT is an interface between the Trajexia system and a PROFIBUS network.
The TJ1-PRT has these visible parts.

Part	Description
A	LEDs
B and C	Node number selectors
D	PROFIBUS connector

fig. 84



3.7.2 LEDs description

Label	Status	Description
run	off	Start-up test failed. Unit not operational Operation stopped. Fatal error
	on	Start-up test successful. Normal operation
ERC	off	Normal operation
	flashing	Start-up error
	on	Fatal error in program Error occurred while Reading or Writing error log
ERH	off	Normal operation
	flashing	I/O-size not configured
	on	Error detected in communication with controller
COM	off	No PROFIBUS data exchange communication
	on	I/O data exchange on PROFIBUS is active
BF	off	No PROFIBUS bus communication errors
	flashing	Parameter values sent by the PROFIBUS master unit are invalid. I/O data exchange is not possible.
	on	No PROFIBUS communication is detected by the unit

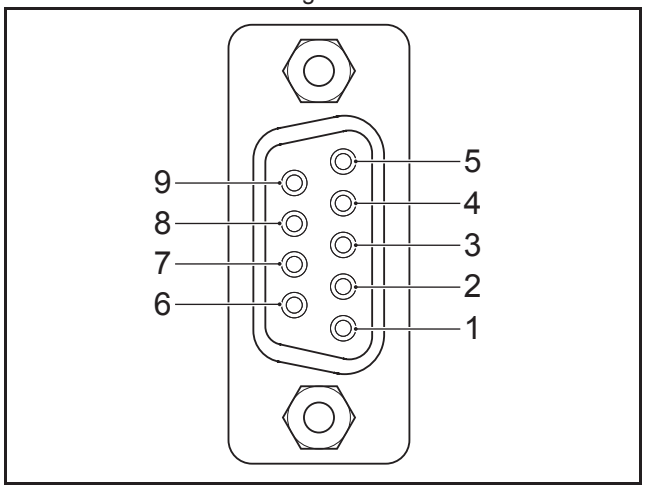
3.7.3 Node number selectors

You can use the node number selectors to assign a node number to the TJ1-PRT. This node number identifies the TJ1-PRT in the PROFIBUS network.
The upper node number selector sets the tens of the node number. The lower node number selector sets the units of the node number. Both selectors range from 0 to 9. To set a selector to *n*, turn the arrow to point to the label *n*. Refer to the chapter, Communication Protocols in the Programming Manual.

3.7.4 TJ1-PRT Connections

Pin	Signal	Description
1	Shield	Connected to the metal shell
2	N/A	N/A
3	B-line	Data signal
4	RTS	Direction control signal for repeaters
5	DGND	Data 0 Volts
6	VP	Power output for the termination, 5 V, 10 mA
7	N/A	N/A
8	A-line	Data signal
9	N/A	N/A

fig. 85



3.7.5 TJ1-PRT Specifications

Item	Specification
Power supply	5 VDC (supplied by the TJ2-MC__)
Power consumption	0.8 W
Current consumption	150 mA at 5 VDC
Approximate weight	100 g
Electrical characteristics	Conforms to PROFIBUS-DP standard EN50170 (DP-V0)
Communication connector	1 PROFIBUS-DP slave connector
Transmission speed	9.6, 19.2, 45.45, 93.75, 187.5, 500, 1500, 3000, 6000 and 12000 Kbps
Node numbers	0 to 99
I/O size	0 to 122 words (16-bit), configurable, for both directions
Galvanic isolation	Yes

3.7.6 TJ1-PRT unit box contents

TJ1-PRT box:
- Safety sheet.
- TJ1-PRT.
- Protection label attached to the top surface of the unit.

3.7.7 Applicable BASIC commands

The following BASIC commands are applicable for the TJ1-PRT:
- **PROFIBUS**

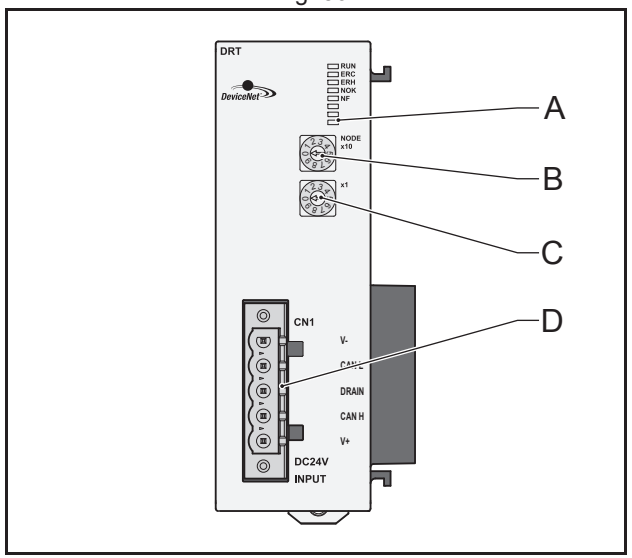
For more information, refer to the Trajexia Programming Manual.

3.8 TJ1-DRT

3.8.1 Introduction

The TJ1-DRT is an interface between the Trajexia system and a DeviceNet network.

fig. 86



Part	Description
A	LEDs
B and C	Node number selectors
D	DeviceNet connector

3.8.2 LEDs description

Label	Status	Description
RUN	off	Start-up test failed. Unit not operational Operation stopped. Fatal error
	on	Start-up test successful. Normal operation
ERC	off	Normal operation
	flashing	Start-up error
	on	Fatal error in program Error occurred while Reading or Writing error log
ERH	off	Normal operation
	flashing	I/O-size not configured
	on	Error detected in communication with controller
NOK	off	Baud rate not detected or node address duplication check not completed.
	flashing	Slave not allocated to a DeviceNet master.
	on	Slave is on-line and allocated to a DeviceNet master.

Label	Status	Description
NF	off	No network error detected.
	flashing	Connection time-out detected for I/O connection with the DeviceNet master.
	on	Other device detected with the same node number or severe network error detected.

3.8.3 Node number selectors

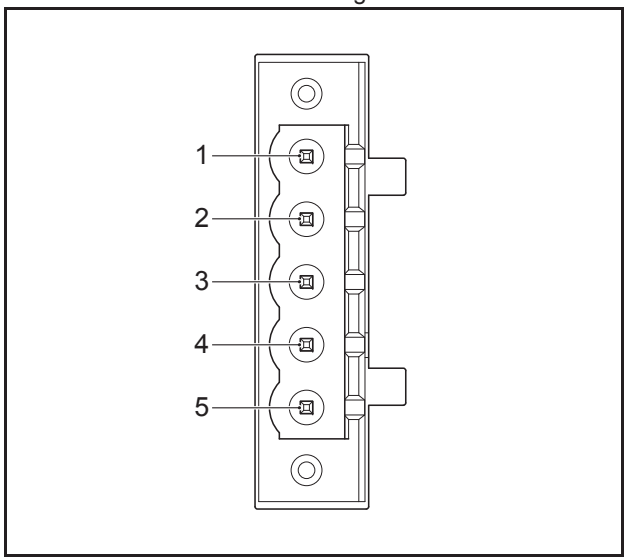
You can use the node number selectors to assign a node number to the TJ1-DRT. This node number identifies the TJ1-DRT in the DeviceNet network.
The upper node number selector sets the tens of the node number. The lower node number selector sets the units of the node number. Both selectors range from 0 to 9. To set a selector to *n*, turn the arrow to point to the label *n*. Refer to the chapter, Communication Protocols in the Programming Manual.

The DeviceNet node numbers range from 0 to 63. If you select a node number with the node number selectors that exceeds this range, you will select the node number that is set by software. The nodes that enable software settings are 64 to 99.

3.8.4 TJ1-DRT Connections

Pin	Signal	Description
1	V-	Power supply input, negative voltage
2	CAN L	Communication line, low
3	DRAIN	Shield
4	CAN H	Communication line, high
5	V+	Power supply input, positive voltage

fig. 87



3.8.5 TJ1-DRT Specifications

Item	Specification
Power supply	5 VDC (supplied by the TJ2-MC__)
Power consumption	120 mA at 5 VDC
Network power supply	24 VDC
Network current consumption	15 mA at 24 VDC
Power dissipation	0.6 W
Approximate weight	100 g
Electrical characteristics	Conforms to DeviceNet standard of CIP edition 1.
Communication connector	1 DeviceNet slave connector
Transmission speed	125, 250 and 500 Kbps, auto-detected
Node numbers	0 to 63
I/O size	0 to 32 words (16-bit), configurable, for both directions
Galvanic isolation	Yes

3.8.6 TJ1-DRT unit box contents

TJ1-DRT box:
- Safety sheet.
- TJ1-DRT.
- DeviceNet connector.
- Protection label attached to the top surface of the unit.

3.8.7 Applicable BASIC commands

The following BASIC commands are applicable for the TJ1-DRT:
- **DEVICENET**

For more information, refer to the Trajexia Programming Manual.

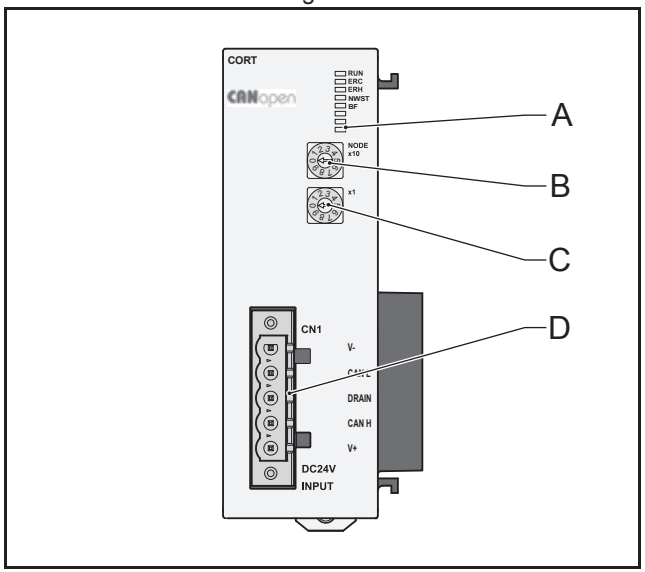
3.9 TJ1-CORT

3.9.1 Introduction

The CANopen Master Unit (TJ1-CORT) is an interface between the Trajexia system and a CANopen network.

Part	Description
A	LED indicators
B and C	Node number selectors
D	CANopen port

fig. 88



3.9.2 LEDs description

Label	Status	Description
RUN	off	Start-up test failed. Unit not operational. Operation stopped. Fatal error.
	on	Start-up test successful. Normal operation.
ERC	off	Normal operation
	flashing	Start-up error
	on	Fatal error in program. Error occurred while Reading or Writing error log.
ERH	off	Normal operation.
	flashing	I/O size not configured.
	on	Error detected in communication with controller.
NWST	off	Start-up error or fatal error detected.
	single flash	TJ1-CORT in stopped state.
	flashing	TJ1-CORT in pre-operational state.
	on	TJ1-CORT in operational state.
BF	off	No network error detected.
	single flash[1]	Warning limit reached. At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many errors).
	double flash[2]	A remote error or a heartbeat event has occurred.
	flashing[3]	Invalid configuration.
	on	A duplicate node address has been detected, or the unit is in Bus OFF state.

1. Single flash: one 200ms pulse, followed by 1 second off.
2. Double flash: two 200ms pulses, followed by 1 second off.
3. LED flashing frequency: 2.5 Hz.

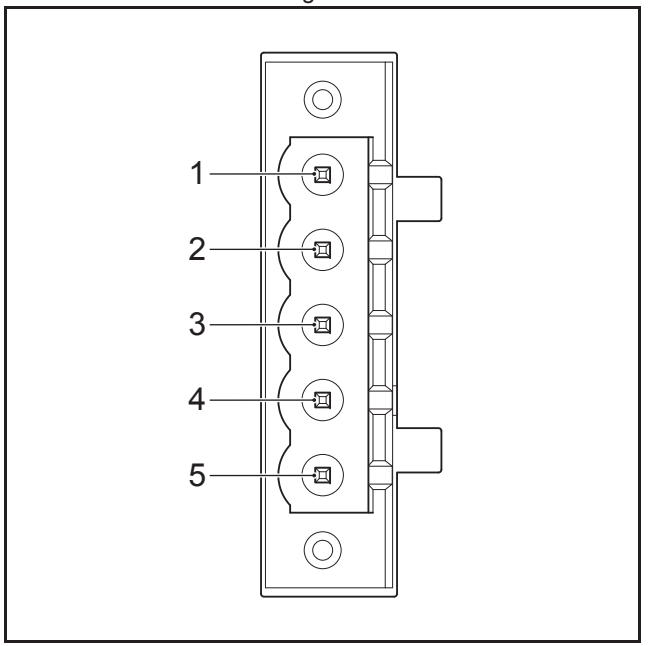
3.9.3 Node number selectors

You can use the node number selectors to assign a node number to the TJ1-CORT. This node number identifies the TJ1-CORT in the CANopen network.
The upper node number selector sets the tens of the node number. The lower node number selector sets the units of the node number. Both selectors range from 0 to 9. To set a selector to *n*, turn the arrow to point to the label *n*.
The CANopen node number can range from 0 to 127. But the TJ1-CORT only supports node numbers from 1 to 99. The default node number, 0, is invalid. Therefore, the default node number must be changed before the TJ1-CORT is used.

3.9.4 TJ1-CORT connections

Pin	Signal	Description
1	V-	Power supply input, negative voltage
2	CAN L	Communication line, low
3	DRAIN	Shield
4	CAN H	Communication line, high
5	V+	Power supply input, positive voltage

fig. 89



3.9.5 TJ1-CORT specifications

Item	Specification
Power supply	5 VDC (supplied by the TJ2-MC__)
Power consumption	120 mA at 5 VDC
Network power supply	24 VDC
Network current consumption	15 mA at 24 VDC
Power dissipation	0.6 W
Approximate weight	100 g
Electrical characteristics	Conforms to ISO 11898-1
Communication ports	1 CAN port
Transmission speed	20, 50, 125 and 500 Kbps
Node numbers	1 to 99
I/O size	8 RPDO and 8 TPDO
Galvanic isolation	Yes
Device profile	DS302: CANopen manager profile Note: This CANopen master does not support motion control features of slaves with the DS401 profile

3.9.6 TJ1-CORT unit box contents

CANopen Master Unit box:
- Safety sheet.
- CANopen Master Unit.
- DeviceNet connector.
- Protection label attached to the top surface of the unit.

3.9.7 Applicable BASIC commands

The following BASIC commands are applicable for the TJ1-CORT:

- **CAN_CORT**

For more information, refer to the Trajexia Programming Manual.

3.10 TJ1-FL02

3.10.1 Introduction

WARNING
Do not start the system until you check that the axes are present and of the correct type.
The numbers of the Flexible axes will change if MECHATROLINK-II network errors occur during start-up or if the MECHATROLINK-II network configuration changes.

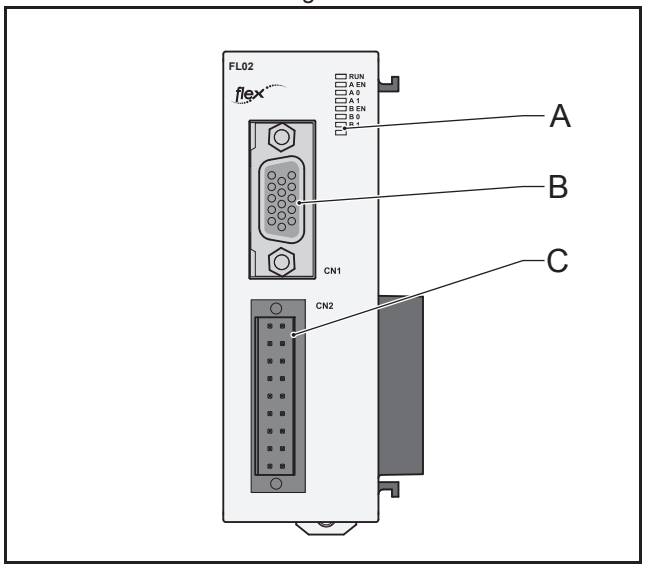
The TJ1-FL02 is an analogue control unit. It controls up to two axes A and B in these modes:

- Analogue speed reference plus encoder feedback.
- Incremental or absolute encoder input.
- Pulse output.

At start up the TJ2-MC__ assigns the TJ1-FL02 to the first 2 free axes in sequence, starting from the **AXIS_OFFSET** parameter for that unit. When multiple TJ1-FL02 units are connected they are assigned in unit sequence 0...6. Any MECHATROLINK-II axes that are assigned (using the Drive switches) will not change. The TJ2-MC__ assigns the next free axis.
The TJ1-FL02 has these visible parts:

Part	Description
A	LEDs
B	15-pin connector
C	18-pin connector

fig. 90



3.10.2 LED description

The function of the LEDs is defined by the BASIC command **AXIS_DISPLAY**. For more information, refer to the Programming Manual.

Axis	Label	Status	AXIS_DISPLAY parameter			
			0	**1**	**2**	**3**
All	run	on	The TJ2-MC__ recognises the TJ1-FL02			
A	A EN	on	Axis enabled.			
		flashing	Axis error			
		off	Axis disabled			
	A 0	on	REG 0	AUX	OUT 0	Encoder A
	A 1	on	REG 1	Encoder Z[1]	OUT 1	Encoder B
B	B EN	on	Axis enabled			
		flashing	Axis error			
		off	Axis disabled			
	B 0	on	REG 0	AUX	OUT 0	Encoder A
	B 1	on	REG 1	Encoder Z	OUT 1	Encoder B

1. In case of incremental encoder, it reflects the status of the Z-input.
   In case of absolute encoder, it reflects the status of the clock output.

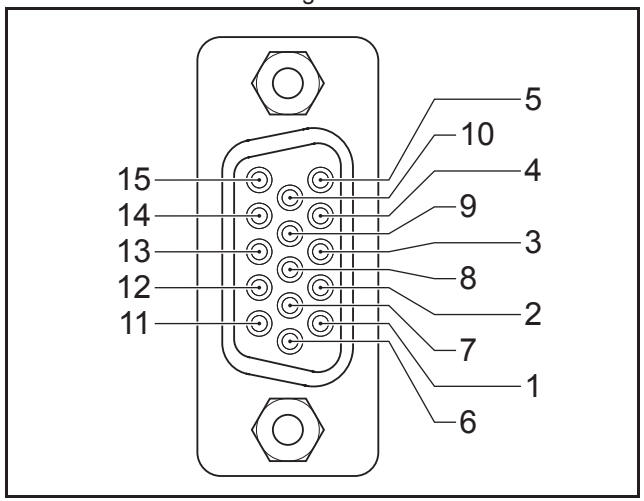
3.10.3 TJ1-FL02 connections

The signals of the 15-pin connector depend on the type of interface selected:

15-pin connector

Pin	Axis	Encoder input	Stepper input	Encoder output	Stepper output	SSI/EnDat	Tamagawa
1	A	A+	Step+	A+	Step+	Clock+	
2	A	A-	Step-	A-	Step-	Clock-	
3	A	B+	Dir+	B+	Dir+		
4	A	B-	Dir-	B-	Dir-		
5		GND	GND	GND	GND	GND	GND
6	A	Z+	Z+	Enable+	Enable+	Data+	SD+
7	A	Z-	Z-	Enable-	Enable-	Data-	SD-
8	B	Z+	Z+	Enable+	Enable+	Data+	SD+
9	B	Z-	Z-	Enable-	Enable-	Data-	SD-
10		+5V out	+5V out	Do not use	Do not use	Do not use	Do not use
11	B	A+	Step+	A+	Step+	Clock+	
12	B	A-	Step-	A-	Step-	Clock-	
13	B	B+	Dir+	B+	Dir+		
14	B	B-	Dir-	B-	Dir-		
15		GND	GND	GND	GND	GND	GND

fig. 91

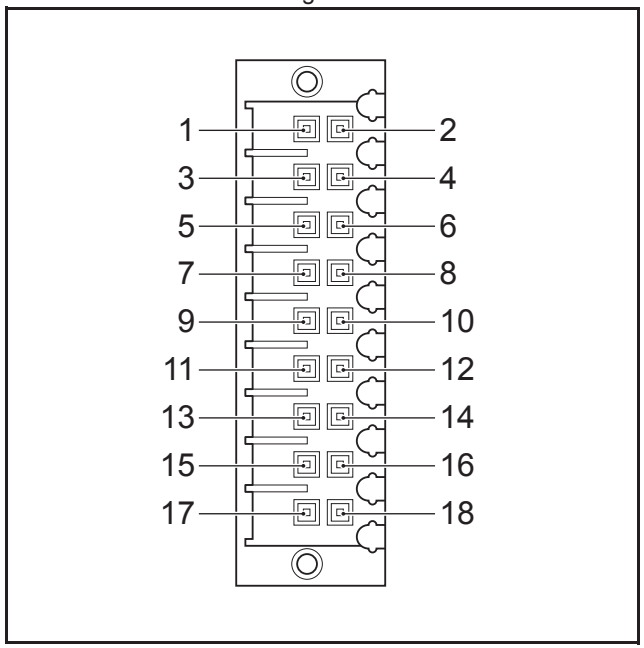


18-pin connector

The 18 pin connector is a Weidmuller connector designation: B2L 3.5/18 LH.

Pin	Axis	Signal	Pin	Axis	Signal	Description
1	A	Vout	2	B	Vout	Analog output
3	A	0V	4	B	0V	0V Reference for Vout
5		Wdog-	6		Wdog+	Enable relay contacts
7	A	Reg 0	8	B	Reg 0	24V registration inputs
9	A	Reg 1	10	B	Reg 1	24V registration inputs
11	A	AUX	12	B	AUX	24V auxiliary inputs
13	A	OUT 0	14	B	OUT 0	position switch outputs (HW_PSWITCH)
15	A	OUT 1	16	B	OUT 1	OUT1 Auxiliary outputs
17		I/O 0V Common	18		I/O +24 V	24V Power supply Input for the Outputs.

fig. 92

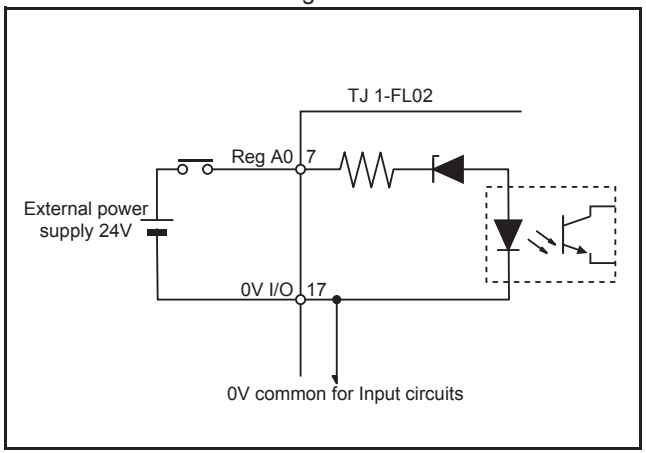


Digital inputs

The following table and illustration details the digital input specifications:

Item	Specification
Type	PNP
Maximum voltage	24 VDC + 10%
Input current	8 mA at 24 VDC
on voltage	18.5 VDC min
off voltage	5.0 VDC max

fig. 93



Input response time (registration):

- without noise filter: 0.5µs maximum.
- with noise filter 3.5µs maximum.

Note
In the case of an incorrect registration due to slow edges or noise, a digital noise filter can be enabled with the **REGIST** command. Refer to the BASIC Commands in the Programming Manual.

Note
A maximum of 4 inputs on is allowed simultaneously.

Digital outputs

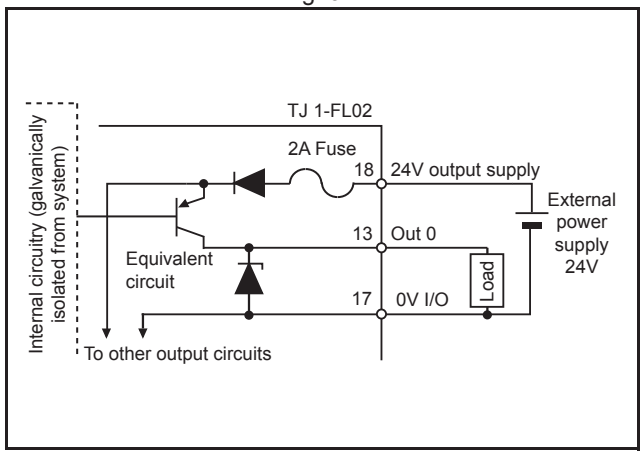
The following table and illustration details the digital output specifications:

Item	Specification
Type	PNP
Maximum voltage	24 VDC + 10%
Current capacity	100 mA each output (400 mA for a group of 4)
Max. Voltage	24 VDC + 10%
Protection	Over current, Over temperature and 2A fuse on Common

Output response time (PSwitch):

- 140 µs maximum

fig. 94

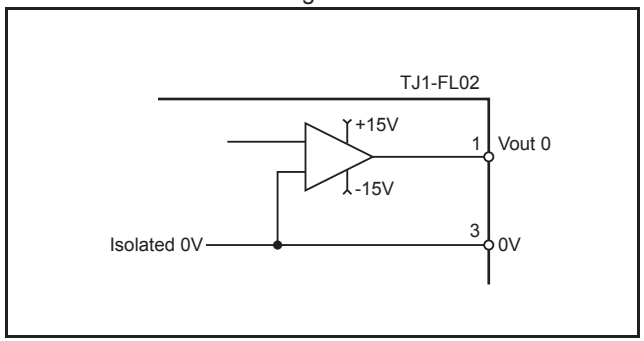


Analog outputs

The following table and illustration details the analog output specifications:

Item	Specification
Output voltage	-10 to +10 V
Resolution	16 bit
Output impedance	100 Ω
Load impedance	10 k Ω min

fig. 95



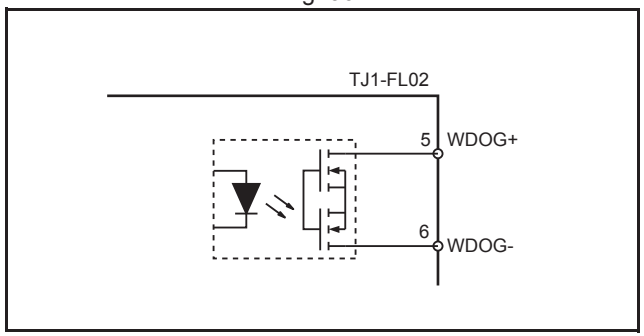
Note
The analogue output of one flexible axis is always 0V unless both axes in the TJ1-FL02, axis A & B are enabled, that is:
WDOG=ON
AXIS_ENABLE AXIS(A)=1
AXIS_ENABLE AXIS(B)=1

Wdog relay

The following table and illustration details the Wdog relay:

Item	Specification
Type	Solid state relay
Current capacity	50 mA
on resistance	25 Ω max.
Maximum voltage	24 VDC + 10%

fig. 96

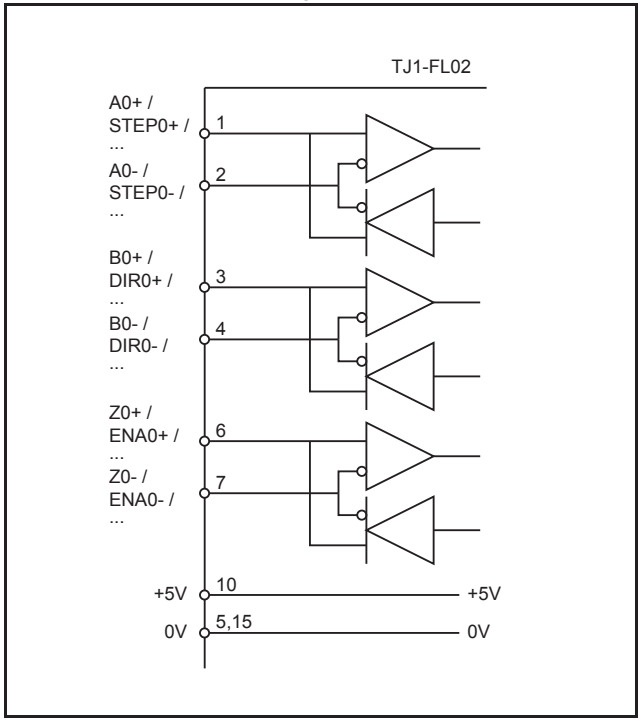


Encoder interface

The following table and illustration details the encoder interface:

Item	Specification
Type	Phase differential incremental encoder
Signal level	EIA RS-422-A Standards (line-Drive)
Input impedance	48 kΩ min
Load impedance	220 Ω min
Termination	None

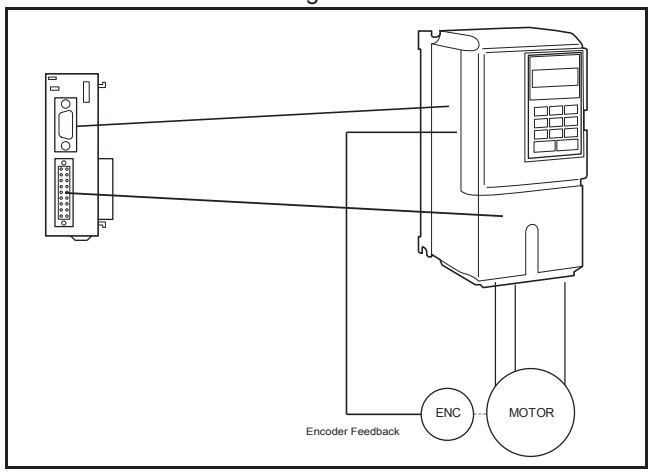
fig. 97



Connection example

The example shows the connections for the TJ1-FL02 to a F7 Inverter for position control.
The encoder from the motor must be connected to the encoder interface (PG-X2) in the Inverter (connector TA1). The encoder signal is forwarded in the connector TA2 of the (PG-X2).
Make the connections for the 18 pin connector on the TJ1-FL02 to the terminal board on the F7 Inverter as follows:

fig. 98



TJ1-FL02 pin number	F7 Inverter TA1	Signal	Description
1	A1	Vout	Analog output
3	AC	0V	0V Reference for Vout
5	S1	Wdog-	Enable relay contacts
6	SP	Wdog+	Enable relay contacts

The cable for pins 1 and 3 must be shielded twisted pair.
The cables for pins 5 and 6 are two single strand cables.

Make the connections for the 15 pin connector on the TJ1-FL02 to the PG-X2 option board on the F7 Inverter as follows:

TJ1-FL02 pin number	F7 Inverter TA2	Signal	Description
1	1	A+	Pulse monitor input phase A+
2	2	A-	Pulse monitor input phase A-
3	3	B+	Pulse monitor input phase B+
4	4	B-	Pulse monitor input phase B-
5	7	GND	Isolated controller circuit GND

Note
The cables are twisted pair (A+,A- and B+,B-) and shielded with the shield connected to the shell of the TJ1-FL02 15 pin connector.

3.10.4 TJ1-FL02 specifications

Item	Specification
Power supply	5 VDC and 24 VDC (supplied by the TJ2-MC__)
Total power consumption	3.35 W
Current consumption	190 mA at 5 VDC and 100 mA at 24 VDC
Approximate weight	110 g
Galvanic isolation	• Encoder interface • Analogue outputs • Digital interface
Output power supply	5 VDC, 150 mA Maximum
Number of axes	2
Control method	• +/- 10 V analogue output in Closed Loop • Pulse Train output in Open Loop
Encoder position/speed feedback	Incremental and absolute
Absolute encoder standards supported	• SSI 200 kHz Up to 25 bit Gray and binary encoding • EnDat 1 MHz • Tamagawa
EnDAT specification	Compatible with version 2.1 and 2.2 Maximum supported number of bits: 32
Servo period	0.25 ms, 0.5 ms, 1 ms, 2ms Note: 0.25 ms not supported by absolute encoder interfaces.
Encoder input maximum frequency	6 MHz
Encoder/pulse output maximum frequency	2 MHz
Maximum cable length:	• SSI 200 kHz, 100 m • EnDat 1 MHz, 40 m • Tamagawa, 50 m • Encoder/stepper input, 100 m • Encoder/stepper output, 100 m

Item	Specification
Auxiliary I/Os	• Two fast registration inputs per axis • Two definable inputs • Two hardware position switch outputs • One enable output • Two definable outputs

Note
The 5 VDC power supply can only be used when both axes are in **SERVO_AXIS** mode (**ATYPE=44**).

3.10.5 Applicable BASIC commands

The following BASIC commands are applicable for the TJ1-FL02:
- **ATYPE**
- **AXIS_OFFSET**
- **AXIS_DISPLAY**
- **DRIVE_CONTROL**
- **DRIVE_STATUS**

BASIC commands applicable for specific encoder types, are listed with the corresponding explanations in the next chapters. For more information of BASIC commands, refer to the Trajexia Programming Manual.

3.10.6 Incremental encoder

An incremental encoder has this phase definition:
- An advanced phase A for forward rotation.
- An advanced phase B for reverse rotation.

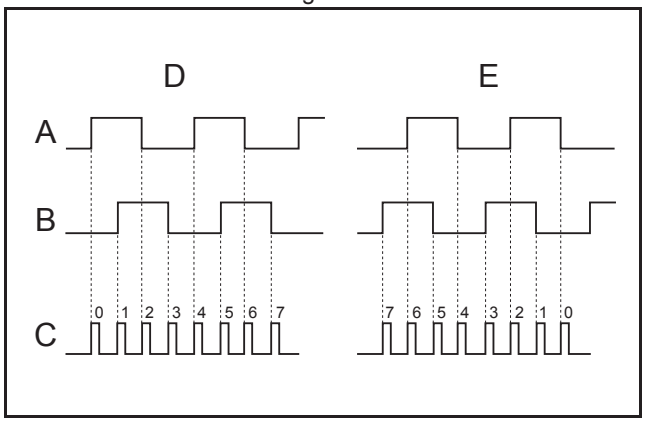
By monitoring the relative phase of the 2 signals, you can easily detect the rotation direction. If signal A leads signal B, the movement is clockwise and the counter increments. If channel B leads channel A, the movement is counterclockwise and the counter decrements.

Most rotary encodes also provide an additional Z marker. This Z marker is a reference pulse within each revolution. With these 3 signals, you can determine the direction, the speed and the relative position.

Encoder input

The pulse ratio of the TJ2-MC__ is 1: every encoder edge (i.e., a pulse edge for either phase A or B) is equal to one internal count.
The figure shows phase A (A), phase B (B) and the number of counts (C) for forward or clockwise rotation (D) and reverse or counterclockwise rotation (E).
The signals A, B and Z appear physically as A+ and A-, B+ and B- and Z+ and Z-. They appear as differential signals on twisted-pair wire inputs. This makes sure that common mode noise is rejected.
When you use an encoder from other manufacturers, check the encoder specification for the phase advancement carefully. If the phase definition is different from the phase definition of the standard OMRON equipment, reverse the B-phase wiring between the TJ2-MC__ and the encoder.

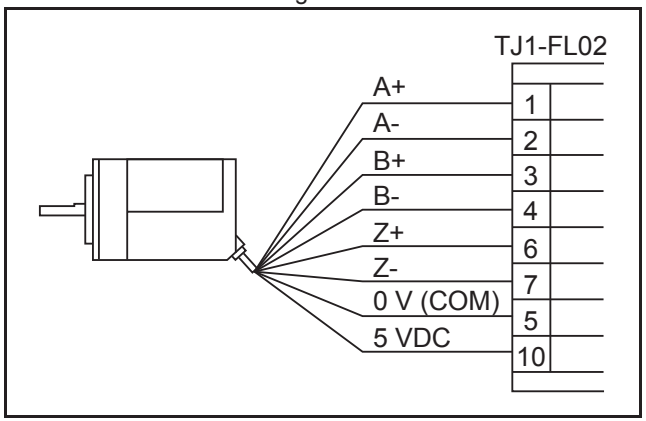
fig. 99



Note
The TJ1-FL02 does not have a termination inside. In case of long distances or disturbed communication, add an external termination to the TJ1-FL02.

The table below and the figure give an example of how to connect the OMRON E6B2-CWZ1Z encoder to the TJ1-FL02.

fig. 100

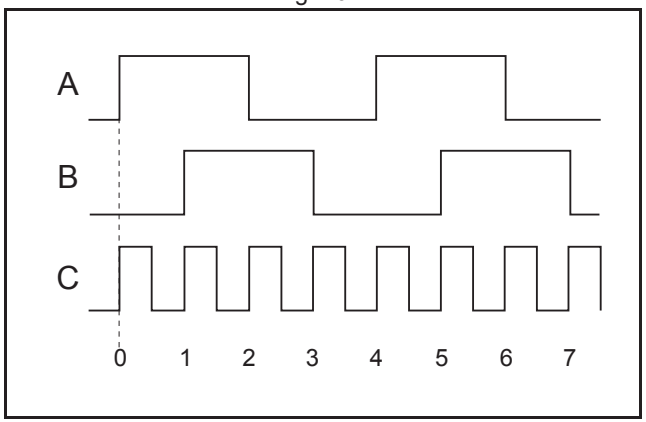


Encoder		TJ1-FL02	
Signal	**Wire color**	**Pin**	**Signal**
A+	Black	1	A+
A-	Black/red	2	A-
B+	White	3	B+
B-	White/red	4	B-
Z+	Orange	6	Z+
Z-	Orange/red	7	Z-
0 V (COM)	Blue	5	GND
5 VDC	Brown	10	+ 5V

Encoder output

The TJ1-FL02 can generate encoder type pulses. For each internal count (C), the TJ1-FL02 produces one encoder edge for phase A (A) or phase B (B).

fig. 101



Related BASIC commands

The following BASIC commands are related to incremental encoders:

- **ATYPE (ATYPE=44 and ATYPE=45)**
- **ENCODER_RATIO**

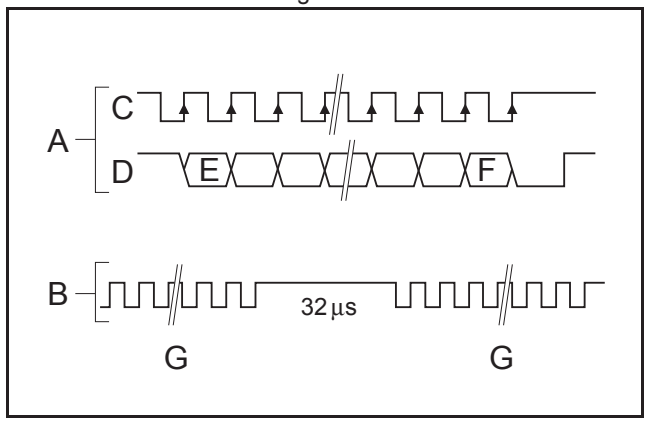
For more information, refer to the Trajexia Programming Manual.

3.10.7 Absolute encoder

SSI

SSI (Synchronous Serial Interface) is a digital system for transferring data in serial form. SSI is the most widely used serial interface between absolute sensors and controllers. SSI uses a pulse train from the controller to clock out the data from the sensor.
The SSI interface of the TJ1-FL02 accepts absolute values from an encoder if the data is in Gray Code format or in binary format and if the resolution is 25 bits or less. The number of bits, and therefore the number of clock pulses sent to the encoder in each frame, is programmable. You set this number with the BASIC command **ENCODER_BITS = n**.
When you have initialized the TJ1-FL02 with the **ENCODER_BITS** command, the TJ1-FL02 continuously sends clock pulses to the encoder. These clock pulses are sent in frames of *n*+2 pulses, where *n* is the bit count set. The clock rate is fixed at 200 kHz. The clock interval between frames is 32 µs. The resulting maximum cable length between the controller and the sensor is 200 m.
The labels in the figure are:
A. Timing diagram.
B. Clock sequence.
C. Clock.
D. Data.
E. MSB (Most Significant Bit).
F. LSB (Least Significant Bit).
G. Clock frame.

fig. 102



When the data is clocked into the TJ2-MC__, the position value is interpreted. With this position value, it produces a value for **MPOS** and a position error that is used to close the control loop.

The connections for SSI are:

Encoder signal	Axis A	Axis B
DATA+	6	8
DATA-	7	9
CLOCK+	1	11
CLOCK-	2	12
GND	5 / 15	5 / 15

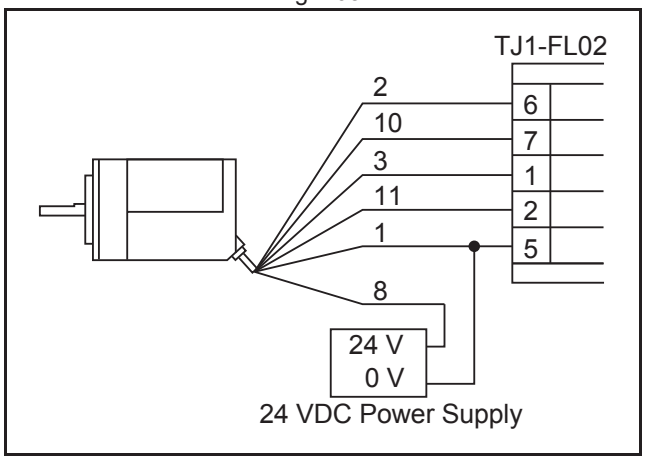
Note
The TJ1-FL02 does not have a termination inside. In case of long distances or disturbed communication, add an external termination to the TJ1-FL02.

The table below and the figure give an example of how to connect the Stegmann ATM 60-A encoder to the TJ1-FL02.

Encoder			TJ1-FL02	
Pin	**Signal**	**Wire color**	**Pin**	**Signal**
2	DATA+	White	6	DATA+
10	DATA-	Brown	7	DATA-
3	CLOCK+	Yellow	1	CLOCK+
11	CLOCK-	Lilac	2	CLOCK-
1	GND	Blue	5	GND
8	Us	Red	See footnote [1]	

1. Use an external power supply

fig. 103



Related BASIC commands
The following BASIC commands are related to SSI absolute encoders:

- **ATYPE (ATYPE=48)**
- **ENCODER_BITS**

For more information, refer to the Trajexia Programming Manual.

EnDat

You can configure the TJ1-FL02 to interface directly to EnDat absolute encoders. EnDat absolute encoders respond on a dedicated Clock and Data 1 MHz RS485 serial interface when their position is requested by the controller. When you set the encoder to the relevant encoder mode, the axis transmits an information request to the encoder on a fixed 250 µs cycle. The connections for EnDat are:

Encoder signal	Axis A	Axis B
DATA	6	8
/DATA	7	9
CLOCK	1	11
/CLOCK	2	12
GND	5 / 15	5 / 15

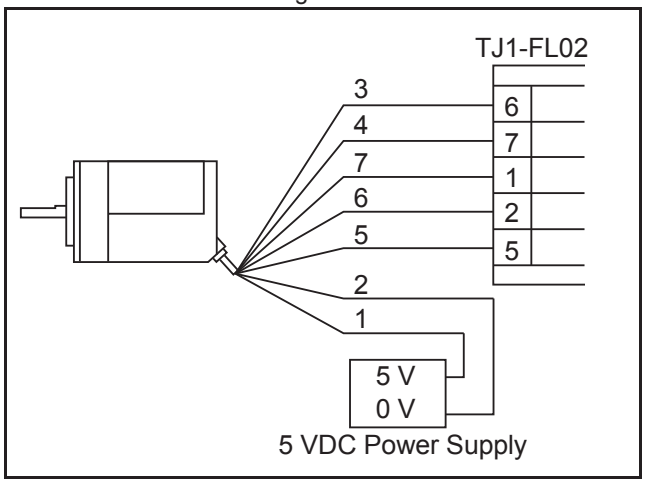
Note
The TJ1-FL02 does not have a termination inside. In case of long distances or disturbed communication, add an external termination to the TJ1-FL02.

The table below and the figure give an example of how to connect the Heidenhain ROC 425 2048 5XS08-C4 encoder to the TJ1-FL02.

Encoder			TJ1-FL02	
Pin	**Signal**	**Wire color**	**Pin**	**Signal**
3	DATA	Grey	6	DATA
4	/DATA	Pink	7	/DATA
7	CLOCK	Violet	1	CLOCK
6	/CLOCK	Yellow	2	/CLOCK
5	GND	White/Green	5	GND
2	0 V	White	See footnote [1]	
1	Up	Blue		

1. Use an external power supply

fig. 104



Related BASIC commands
The following BASIC commands are related to EnDat absolute encoders:

- **ATYPE (ATYPE=47)**
- **ENCODER_BITS**
- **ENCODER_CONTROL**
- **ENCODER_READ**
- **ENCODER_TURNS**
- **ENCODER_WRITE**

For more information, refer to the Trajexia Programming Manual.

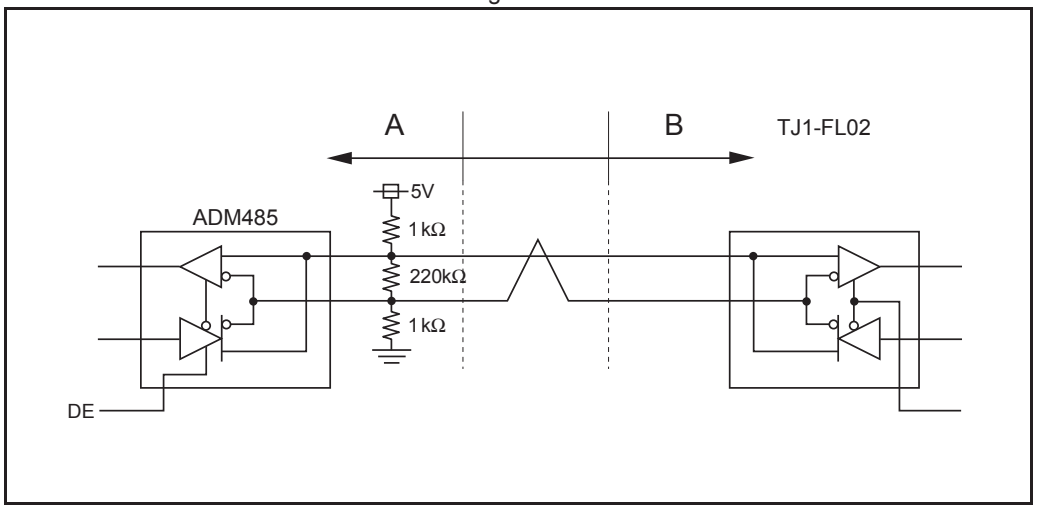
Tamagawa

The TJ1-FL02 can interface directly to Tamagawa “SmartAbs” absolute encoders. Tamagawa encoders respond on a dedicated 2.5 MHz RS485 serial interface when their position is requested by the controller. When you set the encoder to the relevant encoder mode, the axis transmits an information request to the encoder on a fixed 250 µs cycle. The data returned is available to BASIC and you can use it to drive a servo motor.
In the figure, A is the encoder side, and B is the receiving side.
The connections for Tamagawa are:

Encoder signal	Axis A	Axis B
SD	6	8
/SD	7	9
GND	5 / 15	5 / 15

Note
The TJ1-FL02 does not have a termination inside. In case of long distances or disturbed communication, add an external termination to the TJ1-FL02.

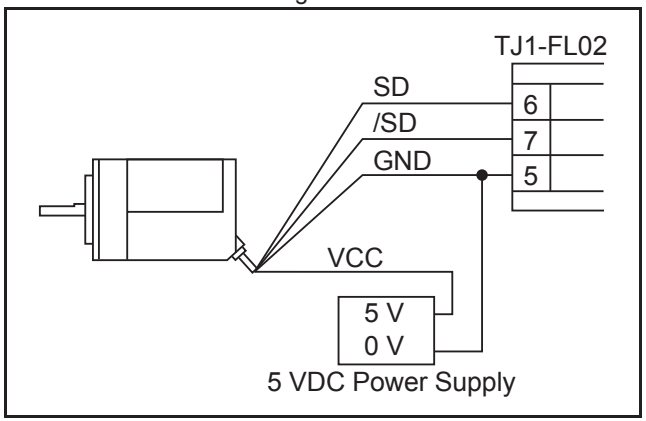
fig. 105



The table below and the figure give an example of how to connect the Tamagawa TS5667N420 encoder to the TJ1-FL02.

Encoder		TJ1-FL02	
Signal	**Wire color**	**Pin**	**Signal**
SD	Blue	6	SD
/SD	Blue/Black	7	/SD
GND	Black	5	GND
Vcc	Red	Use an external power supply	

fig. 106



Related BASIC commands
The following BASIC commands are related to Tamagawa absolute encoders:

- **ATYPE (ATYPE=46)**
- **ENCODER_ID**
- **ENCODER_STATUS**
- **ENCODER_TURNS**

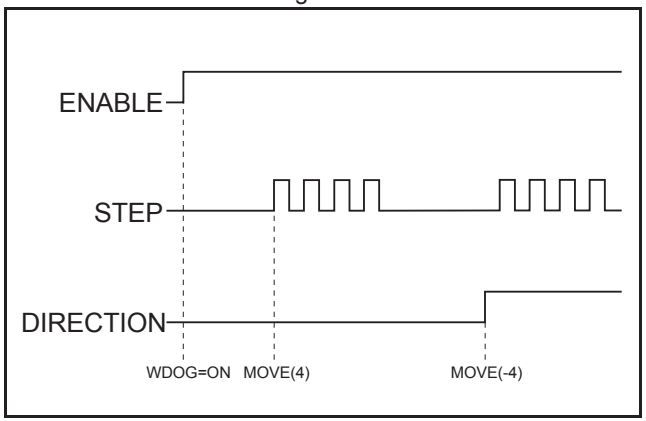
For more information, refer to the Trajexia Programming Manual.

3.10.8 Stepper

The TJ1-FL02 can generate pulses to drive an external stepper motor amplifier. You can use single step, half step and micro-stepping Drives with this interface. Applicable signals:

- Enable
- Step
- Direction.

fig. 107



Related BASIC commands

The following BASIC commands are related to stepper outputs:

- **ATYPE (ATYPE=43)**
- **INVERT_STEP**

For more information, refer to the Trajexia Programming Manual.

3.10.9 Registration

The TJ1-FL02 can capture the position of an axis in a register when an event occurs. The event is called the print registration input. On the rising or falling edge of an input signal (either the Z marker or an input), the TJ1-FL02 captures the position of an axis in hardware. You can use this position to correct possible errors between the actual position and the desired position. You set up the print registration with the **REGIST** command.
The position is captured in hardware and therefore there is no software overhead. This eliminates the need to deal with timing issues.
Because the registration inputs are very fast, they are susceptible to noise in combination with slow rising and falling edges. To counter this problem, you can use a digital noise filter. Use of the noise filter increases the response time from 0.5 μs to 3.5 μs.
We refer to the **REGIST** command in the Trajexia Programming Manual for more information on using the registration inputs.

3.10.10 Hardware PSWITCH

The TJ1-FL02 has 2 outputs that you can use as hardware position switches. These outputs go on when the measured position of the predefined axis is reached. They go off when another measured position is reached.
The outputs are driven by hardware only. This means that the response times do not have software delays.
We refer to the **HW_PSWITCH** command in the Trajexia Programming Manual for more information on using the position switches.

3.10.11 TJ1-FL02 box contents

- Safety sheet.
- TJ1-FL02.
- Protection label attached to the top surface of the unit.
- Parts for a 15-pin connector.
- Parts for an 18-pin connector.

3.11 TJ2-ECT__

3.11.1 Introduction

EtherCAT is an open high-speed industrial network system that conforms to Ethernet (IEEE 802.3). Each node achieves a short cycle time by transmitting Ethernet frames at high speed.
A mechanism that allows sharing clock information enables high-precision synchronization control with low communications jitter.
The TJ2-ECT__ controls EtherCAT devices in a cyclic and deterministic way.
EtherCAT devices can be:

- Servo Drives.
- Inverters.
- I/Os.

Note
Only specific EtherCAT devices are supported. This depends on the firmware version of the connected TJ2-MC__.
Only master to slave communication is supported. Master to master communication is not supported.

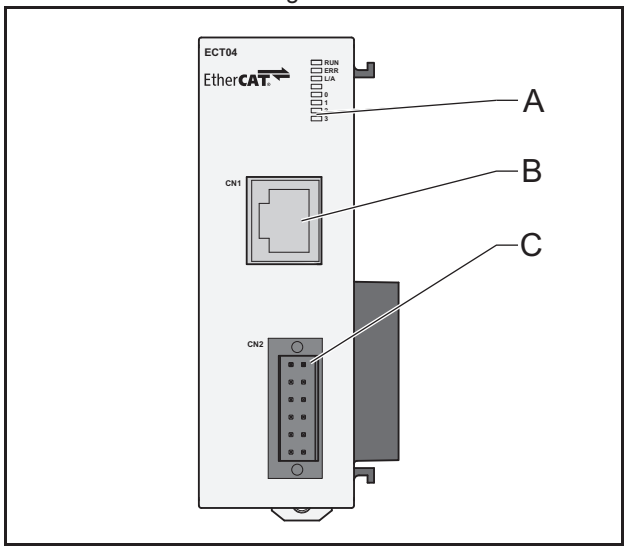
The TJ2-ECT__ has these visible parts:

Part	Description
A	LED indicators
B	CN1 EtherCAT connector
C	CN2 Registration connector

Together the TJ2-ECT__ and its devices form a serial network. The first unit in the network is the TJ2-ECT__.

- One TJ2-ECT04 can control up to 4 Servo axes.
- One TJ2-ECT16 can control up to 16 Servo axes.
- One TJ2-ECT64 can control up to 64 Servo axes.

fig. 108



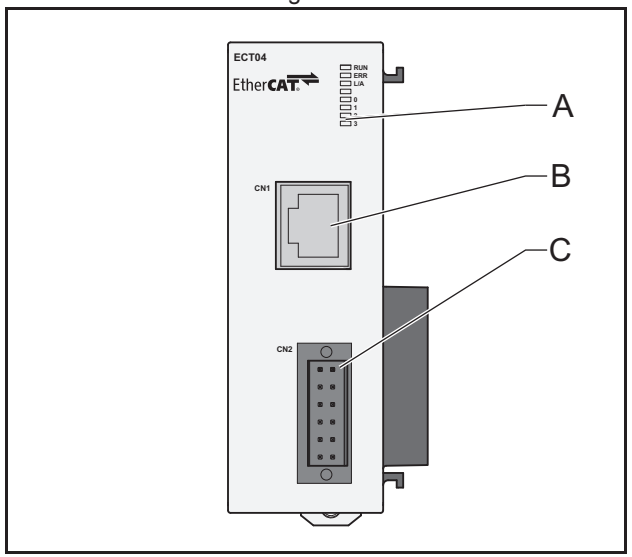
3.11.2 LEDs description

Label	Status	Description
RUN	off	Start-up test failed. Unit not operational Operation stopped. Fatal error
	on	Start-up test successful. Normal operation
ERR	off	Normal operation
	blinking	EtherCAT network error
	on	Unit failure
L/A	off	No link
	on	Link
	blinking	Link and activity
-		Reserved
0...3	off	Assigned input off
	on	Assigned input on

3.11.3 TJ2-ECT__ connections

To communicate with the EtherCAT network a RJ45 8-pin modular connector is provided. A 12-pin connector is supplied to perform registration on EtherCAT axes.

fig. 109



EtherCAT Communications Connector

This connector is used to connect the EtherCAT twisted-pair cable.

Pin	Signal name	Abbreviation	Signal direction
1	Transmission data +	TD+	Output
2	Transmission data -	TD-	Output
3	Reception data +	RD+	Input
4	Not used.	---	---
5	Not used.	---	---
6	Reception data -	RD-	Input
7	Not used.	---	---
8	Not used.	---	---
Hood	Shield	---	---

WARNING
Always connect the EtherCAT master port to the IN port of the first slave. Not doing so can result in unreliable communication and changes to address and axes assignment of EtherCAT slaves.

WARNING
Do not swap connections between the IN and OUT port of EtherCAT slaves. This can result in changes of address and axes assignment of EtherCAT slaves.

WARNING
Do not connect or disconnect EtherCAT slaves while the system is operational. Doing so can result in unreliable communication.

Note
Do not connect the EtherCAT network to any other Ethernet network, for example of office use. Doing so can result in unreliable communication.

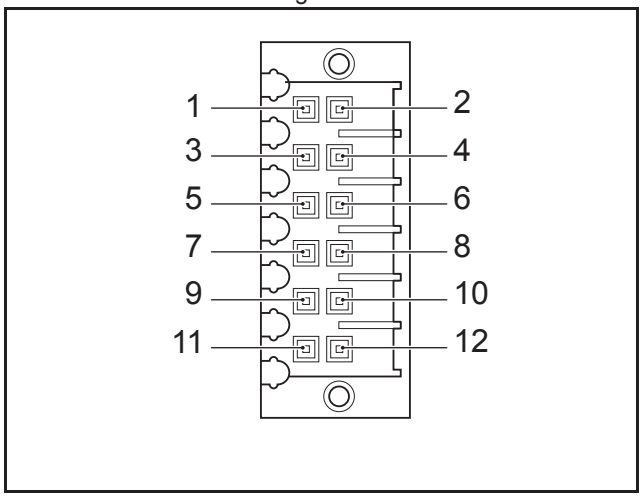
Note
Do not use Ethernet Switches in the EtherCAT network. Doing so can result in unreliable communication.

12-pin connector

The 12 pin connector is a Weidmuller connector designation: B2L 3.5/12 LH

Pin	Connection	Pin	Connection
1	Registration input 0	2	Registration input 1
3	Registration input 2	4	Registration input 3
5	Registration input 4	6	Registration input 5
7	Registration input 6	8	Registration input 7
9	0V common	10	0V common
11	0V common	12	0V common

fig. 110



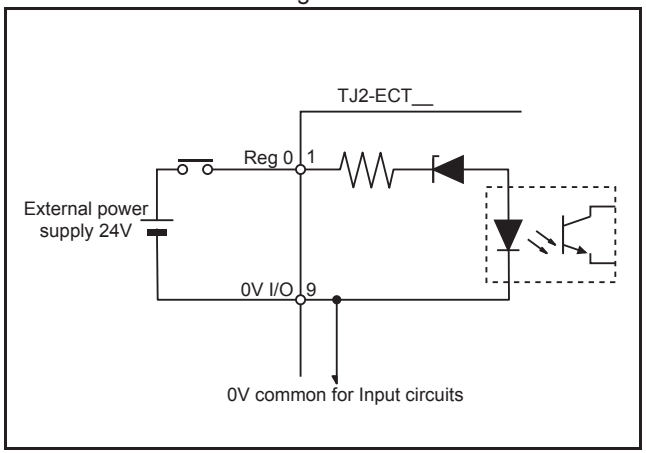
Digital inputs

The digital inputs can both be used as registration inputs (through the **R_REGIST** command) and as general purpose inputs. The inputs are available in the **IN** array, starting after the TJ2-MC__ build-in IO.

The following table and illustration details the digital input specifications:

Item	Specification
Type	PNP
Maximum voltage	24 VDC + 10%
Input current	8 mA at 24 VDC
on voltage	18.5 VDC min
off voltage	5.0 VDC max

fig. 111



3.11.4 TJ2-ECT__ specifications

Item	Specification		
	TJ2-ECT04	TJ2-ECT16	TJ2-ECT64
Power supply	5 VDC (supplied by the TJ2-MC__)		
Total power consumption	1.1 W		
Current consumption	250 mA at 5 VDC		
Approximate weight	80 g		
Communications protocol	EtherCAT		
Baud rate	100 Mbps		
Physical layer	100Base-TX		
Communications control functions	Auto Negotiation: Only for 100Base-TX full-duplex communications		
Topology	Daisy chain, line, or drop line		
Communications media	STP Category 5		
Maximum cable length	100 m max. between nodes		
Number of Servo axes	4	16	64
Servo period	0.25 ms, 0.5 ms, 1 ms, 2ms		
Supported devices	• Accurax G5 Servo Drives • MX2 Inverters with MX2-ECT • GRT1-ECT SmartSlice Communication Unit • GX-series Slave Units • FZM1 and FQ-M Vision Sensors Support for additional devices depend on the firmware of the TJ2-MC__ controller.		
Interface data	Process data (PDOs) and mailbox data (SDOs)		
Device profile	CANopen over EtherCAT (CoE)		
Applicable addressing modes	Position Addressing (Auto Increment) Node Addressing (Configured Station Addresses)		
Auxiliary I/Os	8 fast registration inputs		

3.11.5 TJ2-ECT__ box contents

EtherCAT Master Unit box:
- Safety sheet.
- TJ2-ECT__.
- Parts for an I/O connector.
- Protection label attached to the top surface of the unit.

3.11.6 Related BASIC commands

The following BASIC commands are related to the TJ2-ECT__:
- **ETHERCAT**
  To initialise the EtherCAT network
- **CO_READ(_AXIS)**, **CO_WRITE(_AXIS)**
  To read and write CANopen objects in EtherCAT slaves
- **R_REGIST**
  To configure the registration inputs of the EtherCAT master

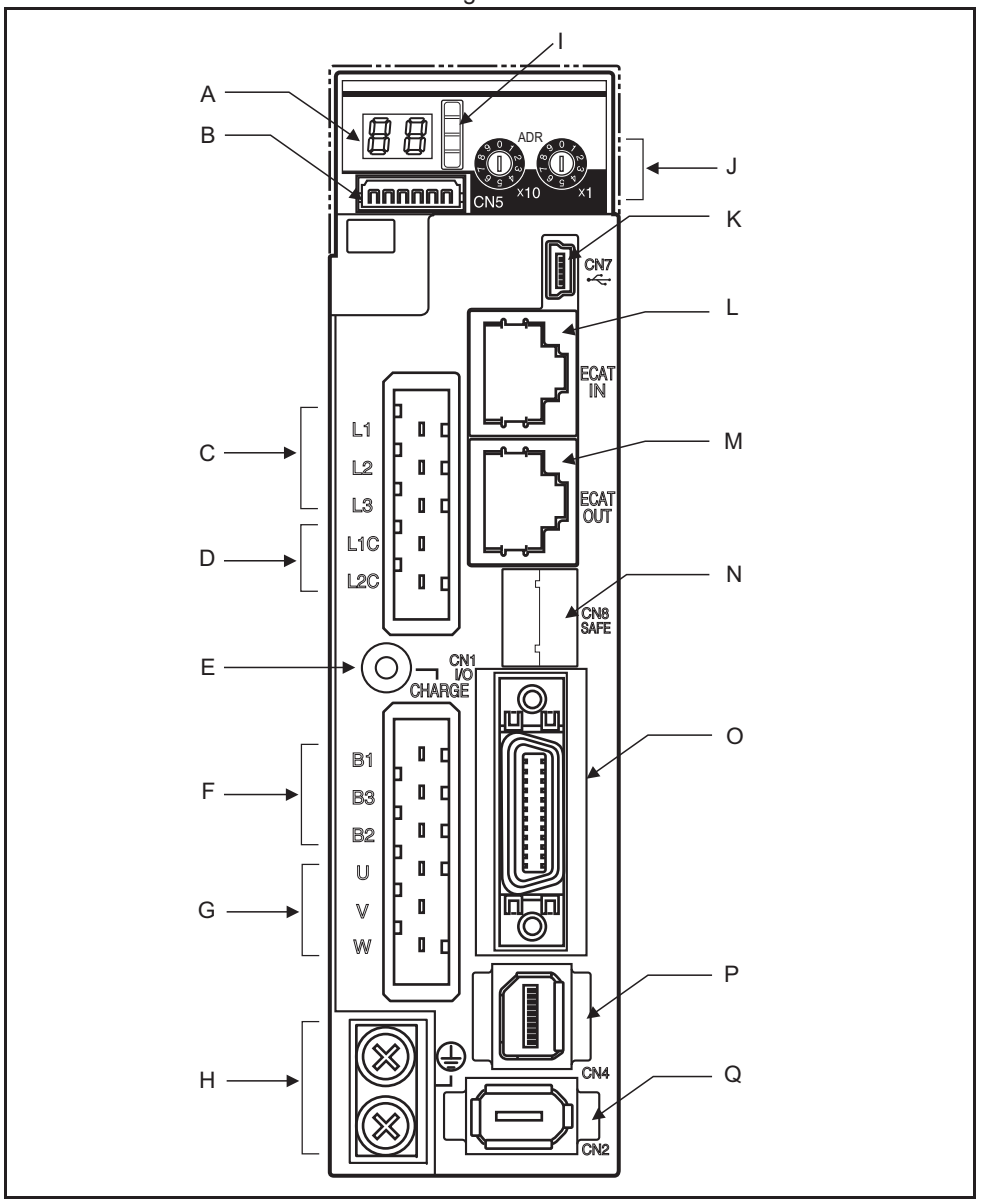
For more information, refer to the Trajexia Programming Manual.

3.11.7 EtherCAT Accurax G5 Servo Drives

You can also connect an Accurax G5 Servo Drive to a Trajexia system.

Label	Terminal/LED	Description
A	---	Display area
B	CN5	Analog monitor check pins
C	L1, L2, L3	Main-circuit power terminals
D	L1C, L2C	Control-circuit power terminals
E	CHARGE	Charge lamp
F	B1, B2, B3	External Regeneration Resistor connection terminals
G	U, V, W	Servomotor connection terminals
H	---	Protective ground terminals
I	---	EtherCAT status indicators
J	---	Rotary switches for node address setting
K	CN7	USB connector
L	ECAT IN	EtherCAT communications connector
M	ECAT OUT	EtherCAT communications connector
N	CN8	Connector for safety function devices
O	CN1	Control I/O connector
P	CN4	Full-closed encoder connector
Q	CN2	Encoder connector

fig. 112



EtherCAT Communications Status Indicators

The table below shows the LED indication status and the corresponding conditions of the communications.

Name	Colour	Status	Description
RUN	Green	OFF	Init state
		Blinking	Pre-Operational state
		Single flash	Safe-Operational state
		ON	Operational state
ERR	Red	OFF	No error
		Blinking	Communications setting error
		Single flash	Synchronization error or communications data error
		Double flash	Application WDT timeout
		Flickering	Boot error
		ON	PDI WDT timeout
L/A IN	Green	OFF	Link not established in physical layer
		ON	Link established in physical layer
		Flickering	In operation after establishing link
L/A OUT	Green	OFF	Link not established in physical layer
		ON	Link established in physical layer
		Flickering	In operation after establishing link

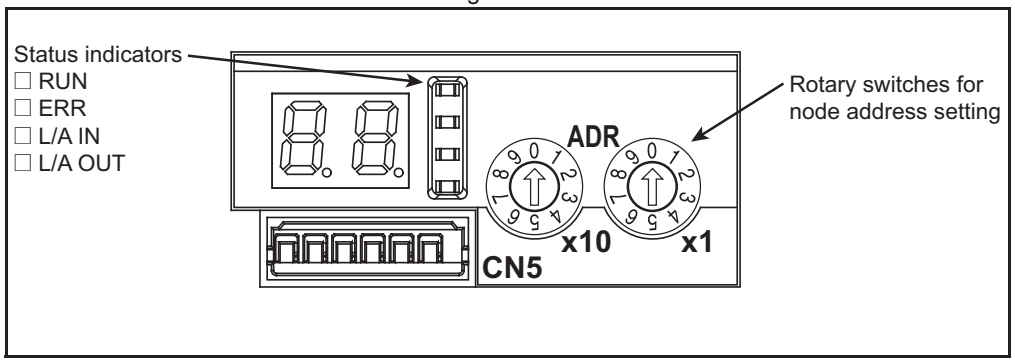
Node Address settings

Set the address selector of the Accurax G5 Servo Drive to the required node address by using the X1 (right) and X10 (left) rotary switches.
The setting range for the node address setting rotary switch is 00 to 99.
When the rotary switches are set to 00, the node address will be assigned automatically, depending on the position in the network, starting from 1 sequentially.
The axis assigned depends on the node address setting and the **AXIS_OFFSET** parameter, using the following rule:
Axis No. = (Node Address -1) + **AXIS_OFFSET**
This offset (**AXIS_OFFSET**) needs to be specified per TJ2-ECT__. Please note that the node address per TJ2-ECT__ needs to be unique.

Example:
TJ2-MC64 + TJ2-ECT16 + 6 Drives

- Node address range: 01 to 07
- **AXIS_OFFSET SLOT(0) = 0**
- Assigned axis numbers: 0 to 6

fig. 113



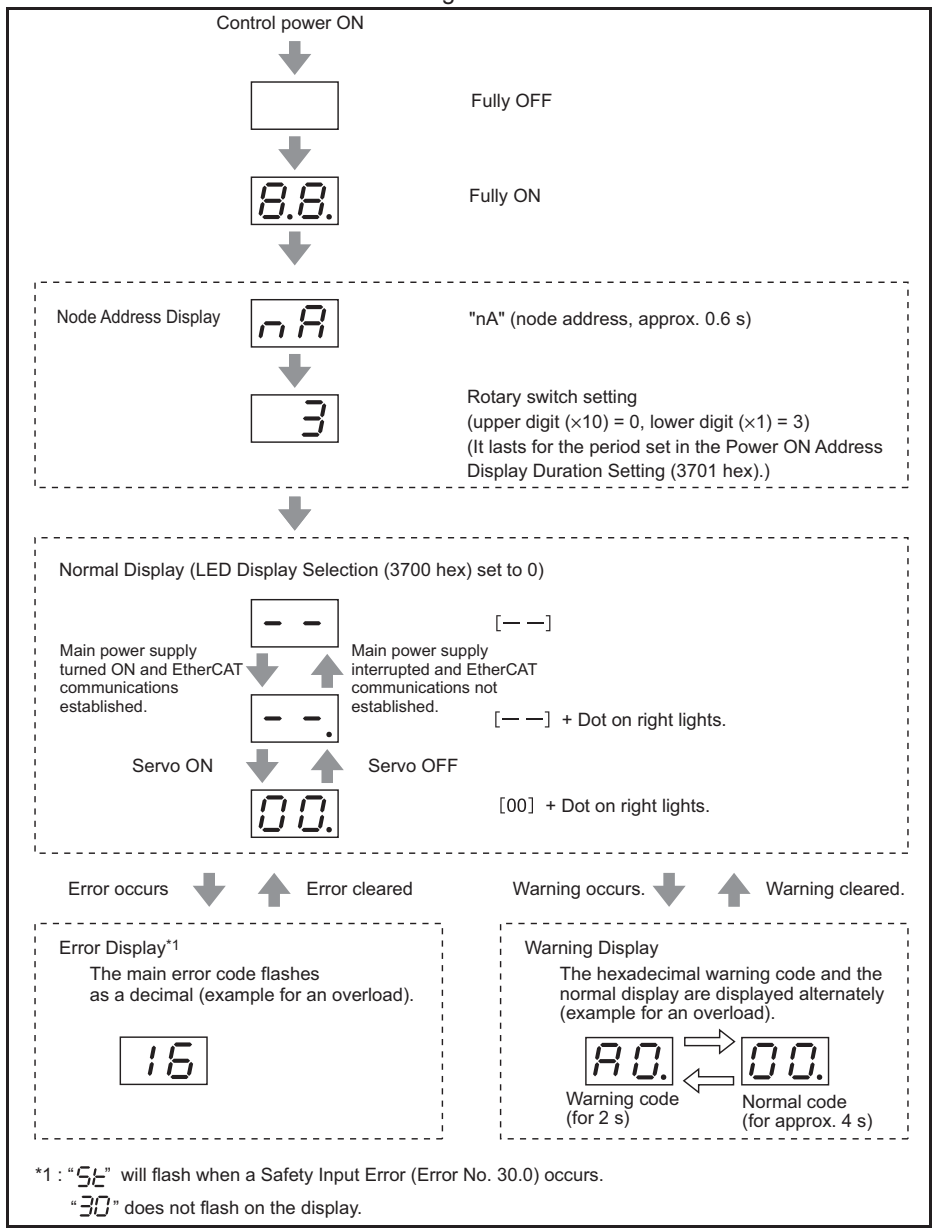
Note
The node address set on the rotary switches is read only once when the control power supply is turned ON. Any changes made to the rotary switches after the power is turned ON are ignored. Such changes are enabled only after the power supply is turned ON again. Do not change the rotary switch setting after the turning ON the power supply.

Note
When node address are assigned automatically (rotary switch set to 00), make sure the resulting axis numbers do not conflict with axes already assigned to other drives. This will result in a configuration error.

7-segment LED

The 7-segment display is on the front panel. When the power is turned ON, it shows the node address that is set by the rotary switches. Then the display changes according to the setting of the LED Display Selection (3700 hex). An error code is displayed if an error occurs. A warning code is displayed if a warning occurs.

fig. 114

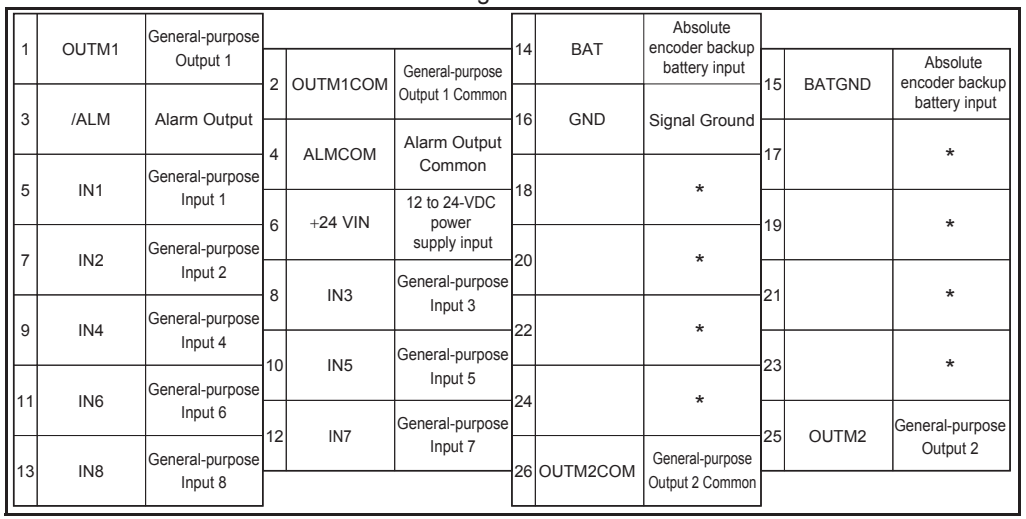


CN1 I/O Signal connector

The table below shows the pin layout for the I/O signal connector (CN1).

Pin	I/O	Code	Signal name
6	Input	+24 VIN	12 to 24-VDC Power Supply Input
5	Input	IN1	General-purpose Input 1
7	Input	IN2	General-purpose Input 2
8	Input	IN3	General-purpose Input 3
9	Input	IN4	General-purpose Input 4
10	Input	IN5	General-purpose Input 5
11	Input	IN6	General-purpose Input 6
12	Input	IN7	General-purpose Input 7
13	Input	IN8	General-purpose Input 8
3	Output	/ALM	Alarm output
4	Output	ALMCOM	
1	Output	OUTM1	General-purpose Output 1
2	Output	OUTM1COM	
25	Output	OUTM2	General-purpose Output 2
26	Output	OUTM2COM	
14	---	BAT	Backup Battery Input
15	---	BATGND	
16	---	GND	Signal ground
17 to 24	Input	---	Spare inputs. Do not connect anything to these inputs.
Shell	---	---	FG

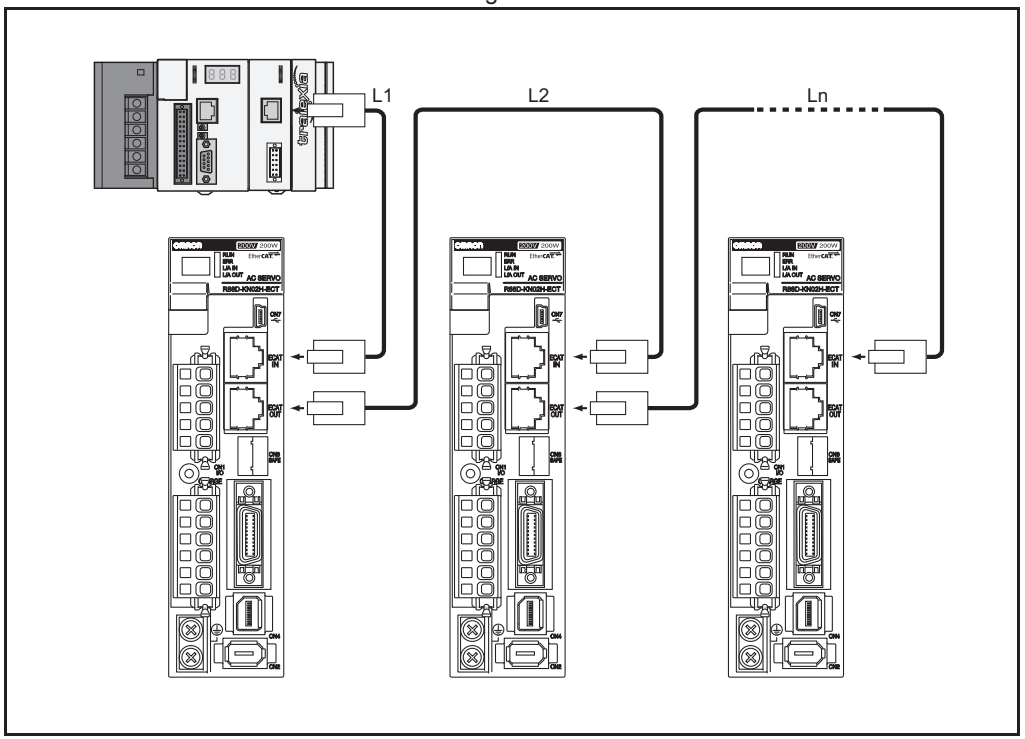
fig. 115



EtherCAT connectors (ECAT IN & OUT)

Connect the EtherCAT master to the ECAT IN connector on the first Servo Drive. Connect the ECAT OUT connector on the first Servo Drive to the ECAT IN connector on the next Servo Drive. Do not connect the ECAT OUT connector on the last Servo Drive.

fig. 116



Note

Always turn OFF the power supply to the Machine Control Unit and Servo Drives before connecting or disconnecting the EtherCAT Communications Cables.

The cable between two nodes (L1, L2 ... Ln) must be 100 m or less.

CN2 Encoder input connector

The table below shows the pin layout for the encoder connector.

Pin	Signal	Name
1	E5V	Encoder power supply +5 V
2	E0V	Encoder power supply GND
3	BAT+	Battery +
4	BAT-	Battery -
5	PS+	Encoder +phase S input
6	PS-	Encoder -phase S input
Shell	FG	Shield ground

CN4 External encoder connector

The table below shows the pin layout for the external encoder connector.

Pin	Signal	Name
1	E5V	Encoder power supply +5 V
2	E0V	Encoder power supply GND
3	PS+	Encoder +phase S input
4	PS-	Encoder -phase S input
5	EXA+	Encoder +phase A input
6	EXA-	Encoder -phase A input
7	EXB+	Encoder +phase B input
8	EXB-	Encoder -phase B input
9	EXZ+	Encoder +phase Z input
10	EXZ-	Encoder -phase Z input
Shell	FG	Shield ground

CN5 Monitor connector

The table below shows the pin layout for the CN5 monitor connector.

Pin	Signal#	Name
1	AM1	Analog monitor output 1
2	AM2	Analog monitor output 2
3	GND	Analog monitor ground
4	---	Reserved: do not connect.
5	---	Reserved: do not connect.
6	---	Reserved: do not connect.

CN7 USB Connector

The table below shows the pin layout for the CN7 USB connector.

Pin	Signal	Name
1	VBUS	USB signal terminal
2	D+	
3	D-	
4	---	Reserved: do not connect.
5	SENGND	Signal ground

CN8 Safety connector

The table below shows the pin layout for the CN8 safety connector.

Pin	Signal	Name
1	---	Reserved: do not connect.
2	---	Reserved: do not connect.
3	SF1-	Safety input 1
4	SF1+	
5	SF2-	Safety input 2
6	SF2+	
7	EDM-	EDM output
8	EDM+	
Shell	FG	Shield ground

CNA Power supply connector

The table below shows the pin layout for the CNA power supply connector.

Pin	Signal	Name
1	L1	Main circuit power supply input
2	L2	
3	L3	
4	L1C	Control circuit power supply input
5	L2C	

CNB Servo motor connector

The table below shows the pin layout for the CNB servo motor connector.

Pin	Signal	Name
1	B1	External Regeneration Resistor connection terminals
2	B2	
3	B3	
4	U	Servomotor connection terminals
5	V	
6	W	

Related BASIC commands

The following BASIC commands are related to the EtherCAT Accurax G5 Servo Drives:

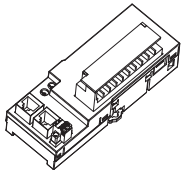
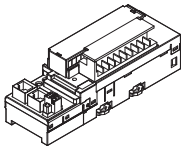
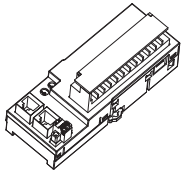
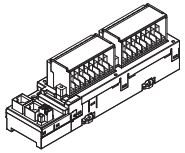
- **ATYPE**
- **AXIS**
- **AXIS_ENABLE**
- **AXISSTATUS**
- **DRIVE_ALARM**
- **DRIVE_CLEAR**
- **DRIVE_CONTROL**
- **DRIVE_INPUTS**
- **DRIVE_MONITOR**
- **DRIVE_READ**
- **DRIVE_RESET**
- **DRIVE_STATUS**
- **DRIVE_WRITE**

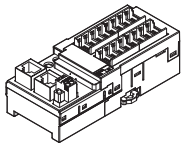
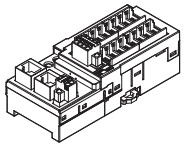
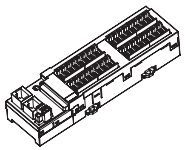
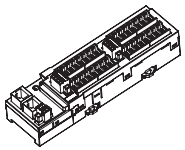
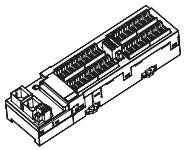
For more information, refer to the Trajexia Programming Manual.

3.11.8 GX-series EtherCAT Slave Units

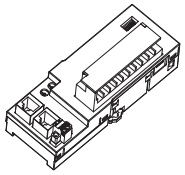
The TJ2-MC__ supports the following GX-series EtherCAT Slave Units:

Digital I/O Slave Units

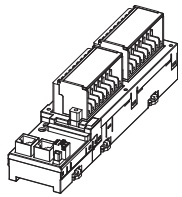
Type	Appearance	I/O points	Model
Models with 2-tier terminal block		16 inputs (NPN)	GX-ID1611
		16 inputs (PNP)	GX-ID1621
		16 outputs (NPN)	GX-OD1611
		16 outputs (PNP)	GX-OD1621
		Relay 16 outputs	GX-OC1601
		8 inputs and 8 outputs (NPN)	GX-MD1611
		8 inputs and 8 outputs (PNP)	GX-MD1621
Models with 3-tier terminal block		16 inputs (NPN)	GX-ID1612
		16 inputs (PNP)	GX -ID1622
		16 outputs (NPN)	GX-OD1612
		16 outputs (PNP)	GX-OD1622
		8 inputs and 8 outputs (NPN)	GX-MD1612
		8 inputs and 8 outputs (PNP)	GX-MD1622

Type	Appearance	I/O points	Model
e-CON Connectors		16 inputs (NPN)	GX-ID1618
		16 inputs (PNP)	GX-ID1628
		16 outputs (NPN)	GX-OD1618
		16 outputs (PNP)	GX-OD1628
		8 inputs and 8 outputs (NPN)	GX-MD1618
		8 inputs and 8 outputs (PNP)	GX-MD1628
		32 inputs (NPN)	GX-ID3218
		32 inputs (PNP)	GX-ID3228
		32 outputs (NPN)	GX-OD3218
		32 outputs (PNP)	GX-OD3228
		16 inputs and 16 outputs (NPN)	GX-MD3218
		16 inputs and 16 outputs (PNP)	GX-MD3228

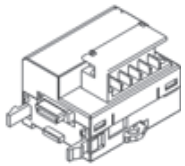
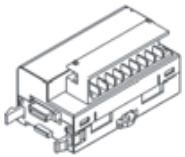
Analog I/O Slave Units

Type	Appearance	I/O points	Model
Models with screw terminal blocks		4 inputs	GX-AD0471
		2 outputs	GX-DA0271

Encoder Input Slave Units

Type	Appearance	I/O points	Model
Models with screw terminal blocks		2 inputs (5 V and 24 V voltage input)	GX-EC0211
		2 inputs (Line driver input)	GX-EC0241

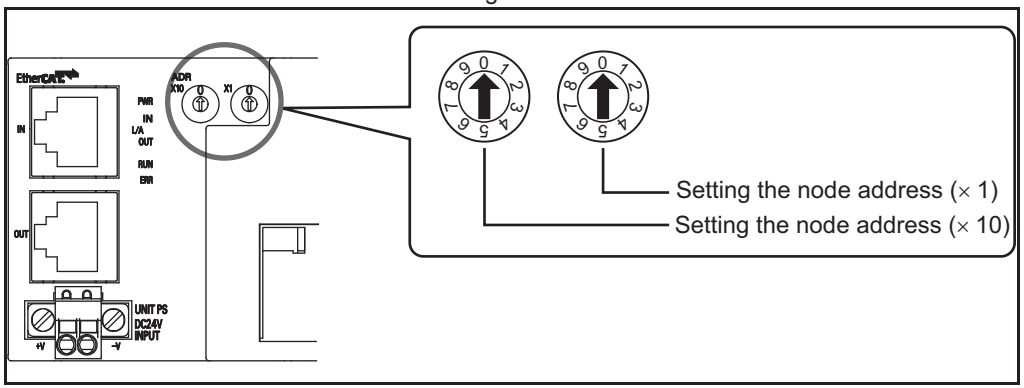
Expansion Units

Type	Appearance	I/O points	Model
Models with 2-tier terminal block		8 inputs (NPN)	XWT-ID08
		8 inputs (PNP)	XWT-ID08-1
		8 outputs (NPN)	XWT-OD08
		8 outputs (PNP)	XWT-OD08-1
		16 inputs (NPN)	XWT-ID16
		16 inputs (PNP)	XWT-ID16-1
		16 outputs (NPN)	XWT-OD16
		16 outputs (PNP)	XWT-OD16-1

Rotary switches

Set the address selector of the slave units to the required node address by using the X1 (right) and X10 (left) rotary switches.
The setting range for the node address switches is 00 to 99.
When the rotary switches are set to 00, the node address will be assigned automatically, depending on the position in the network.
The node address of digital and analog I/O slaves start from 1000.
The node address of the encoder input slaves start from 1.

fig. 117



To set the EtherCAT node address of the slave units, do these steps:
1. Turn off the Unit power supply of the slave units.

Note
The address of the slave units is read only at power on. Setting the new address when the power is on has no effect.

2. To set the address of the unit, either use auto-addressing by setting the rotary switches to 00, or set the desired address with the rotary switches.

Note
Make sure that the address is unique in the EtherCAT network. If two or more IO units have the same node address, a configuration error will occur.

3. Turn the power on.

Note
To make the EtherCAT address of the unit valid, do one of these steps:
- Restart the TJ2-MC__.
- Execute the command **ETHERCAT(0,unit)**.

Axes assignment

The GX-EC0211 and GX-EC0241 encoder input slaves will introduce 2 axes (**ATYPE**=69) to the Trajexia system. The axis numbers assigned depend on the node address setting and the **AXIS_OFFSET** parameter, using the following rule:

Axis No. 1 = (Node Address -1) + **AXIS_OFFSET**

Axis No. 2 = (Node Address - 1) + **AXIS_OFFSET** + 1

This offset (**AXIS_OFFSET**) needs to be specified per TJ2-ECT__. Please note that the node addresses per TJ2-ECT__ need to be unique and the resulting axis numbers must be unique in the system.

Example:

TJ2-MC__ + TJ2-ECT16 + GX-EC0241

- Node address: 02
- **AXIS_OFFSET SLOT(0) = 0**
- Assigned node addresses: 2 and 3
- Assigned axis numbers: 1 and 2

Note

An Encoder Input Slave Unit will get 2 axes assigned. These will always be sequential and should not conflict with other axes in the system.

Registration

The GX-EC0211 and GX-EC0241 encoder input slaves support 2 registration inputs per axis. These can be enabled and configured using the **REGIST** command.

Bit	Function (EtherCAT encoder)
1, 0	Primary registration occurs for: • 00: Latch A
2	Set this bit to use primary registration event
3	Not used
5, 4	Secondary registration occurs for: • 00: Latch B
6	Set this bit to use secondary registration event
7	Not used
9, 8	Windowing function choice: • 00: No windowing • 01: Inclusive windowing • 11: Exclusive windowing
10	Not used

Related BASIC commands

The following BASIC commands are related to the GX-series EtherCAT Slave Units:

- **ATYPE**
- **AXIS**
- **REGIST**

For more information, refer to the Trajexia Programming Manual

3.11.9 FZM1 Vision Sensor

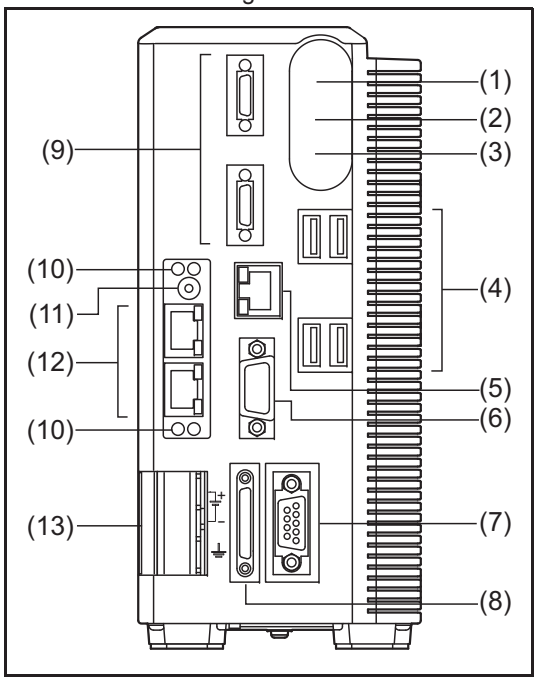
The OMRON Vision Sensor FZM1 can also be connected through EtherCAT to detect at high speed and high accuracy the position and orientation of any object inside a machine.

The following types are supported:

Item	Description			Model
Controllers with EtherCAT interface	Box-type Controllers	Two-camera controllers	NPN	FZM1-350-ECT
			PNP	FZM1-355-ECT

Label	Terminal/LED	Description
(1)	[POWER] LED	Lights when the power is supplied.
(2)	[RUN] LED	Lights during the measurement mode.
(3)	[ERROR] LED	Lights when an error occurs.
(4)	USB connectors	Connected to a trackball, mouse, and/or USB memory.
(5)	Ethernet connector	Connects the Ethernet communication cable.
(6)	Monitor connector	Connects the monitor.
(7)	Connector for RS-232C/422	Connects to an external device such as a PC and a PLC.
(8)	I/O connector	Connects to an external device such as a sync sensor and a PLC.
(9)	Camera connectors	Connects a camera.
(10)	Status LED	Displays the current EtherCAT network communication status.
(11)	Node address setting switch	Sets the node address of the slave. Node addresses from 1 to 9 can be set. When this is set to 0, the node address is automatically assigned.
(12)	EtherCAT connectors	Connects the EtherCAT communication cables.
(13)	Power supply and grounding terminal	Connects the DC power supply and the grounding wire.

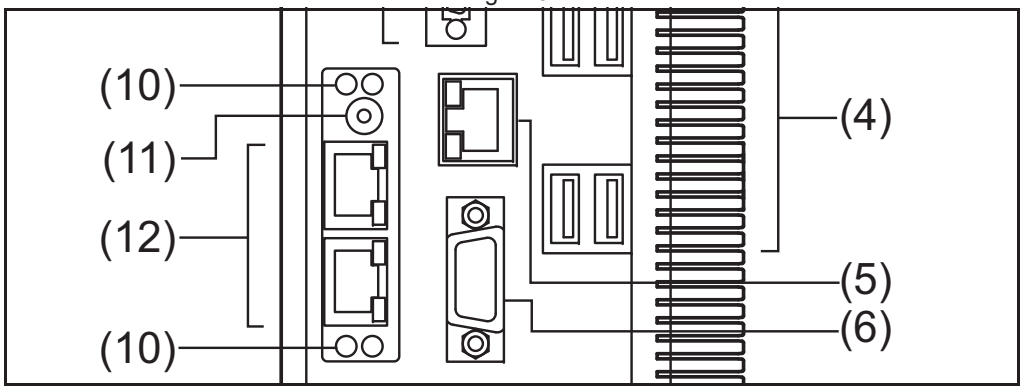
fig. 118



Rotary switches

Set the address selector of the slave unit to the required node address by using the rotary switch (11).
The setting range for the node address switch is 1 to 9 and will result in node address 1001 to 1009.
When the rotary switch is set to 0, the node address will be assigned automatically, starting from 1000, depending on the position in the network.

fig. 119



PDO Mapping

The TJ2-MC__ will communicate to the FZM1 Vision Sensor by mapping the Command, Response and Output areas in VR memory. The VR locations to be used need to be configured after initializing the EtherCAT network, by using a function of the ETHERCAT command.

Type	System command
Syntax	**ETHERCAT(function, unit_number, address, VR_start_RxPDO, VR_length_RxPDO, VR_start_TxPDO, VR_length_TxPDO)**
Description	Command to control and access the EtherCAT network and its functions. Notes: • This command waits for the response of the device so, its execution is slow and the time variable. Do not use this command together with other commands that require quick execution. • The **ETHERCAT** command returns -1 (**TRUE**) on success and 0 (**FALSE**) on failure.

Arguments
- **function**
  $66 to configure the mapping
- **unit_number**
  Unit number of the EtherCAT master to which the slave is attached.
- **address**
  Configured address of the EtherCAT slave
- **VR_start_RxPDO**
  The starting address in VR memory of the controller where the data to the device (RxPDO) is mapped (default = 0)
- **VR_length_RxPDO**
  The number of VR locations to allocate data to the device (RxPDO) (one object per VR, default = 0)
- **VR_start_TxPDO**
  The starting address in VR memory of the controller where the data from the device (TxPDO) is mapped (default = 0)
- **VR_length_TxPDO**
  The number of VR locations to allocate data from the device (TxPDO) (one object per VR, default = 0)

Example
The following example maps the FZM1 (address 1001) Command area to VR locations 100 to 104 and the Response and Output area to VR locations 200 to 211 and checks if the command was successful.

```
IF ETHERCAT($66,0,1001,100,5,200,12) THEN
   PRINT "Mapping: OK"
ELSE
   PRINT "Mapping: FAIL"
ENDIF
```

See also
N/A

The FZM1 PDO contains the following areas:
Command area (controller to FZM1)

Item	31 - 17	16	15 - 2	1	0
Control	Reserved	DSA	Reserved	STEP	EXE
Command	UDINT (32 bits)				
Parameter 1	DINT (32 bits)				
Parameter 2	DINT (32 bits)				
Parameter 3	DINT (32 bits)				

Response area (FZM1 to controller)

Item	31 - 17	16	15	14 - 5	4	3	2	1	0
Control	Reserved	GATE	ERR	Reserved	RUN	OR	READY	BUSY	FLG
Command	UDINT (32 bits)								
Response code	UDINT (32 bits)								
Response data	DINT (32 bits)								

Output area (FZM1 to controller)

Item	31 - 0
Data 1	DINT (32 bits)
Data 2	DINT (32 bits)
...	
Data 7	DINT (32 bits)
Data 8	DINT (32 bits)

The data is mapped in VR using function $66 of the **ETHERCAT** command in the following way:

Area	VR location start	VR location end
Command	VR_start_RxPDO	VR_start_RxPDO + 4
Response	VR_start_TxPDO	VR_start_TxPDO + 3
Output	VR_start_TxPDO + 4	VR_start_TxPDO + 11

Example

The following example maps the FZM1 (address 1001) Command area to VR locations 100 to 104 and the Response and Output area to VR locations 200 to 211:

ETHERCAT($66,0,1001,100,5,200,12)

As a result the Control word is mapped to VR(100), the Command word to VR(101), etc..

The status of the FZM1 can be read from VR(200).

To read the ERR flag, use **READ_BIT(15,200)**

Note
Please refer to the FZM1 EtherCAT Communication manual (Q179-E1) to configure the Fieldbus Data Output.
Please set the output format of the data to Fixed point: Integer portion of the value 1,000 times the data (decimal number) is output.

Command Specifications

The following commands can be sent to the FZM1 to control its functions.

Function	Command code
Start continuous measurement	$00101020
End continuous measurement	$00101030
Clear measurement value	$00102010
Save to unit	$00103010
Restart	$0010F010
Get scene number	$00201000
Get scene group number	$00202000
Switch scene	$00301000
Switch scene group number	$00302000
Get unit data	$00401000
Set unit data	$00501000

The required command code must be written to the VR location mapped to the Command word in the Command area. The command is executed by setting the EXE flag in the Control word in the Command area.

Example The following example sends the “Switch scene” command to the FZM1.

```
VR(101)=$00301000 ‘Command
VR(102)=3 ‘Scene number
SET_BIT(0,100) ‘Execute command: bit 0 of VR(100)
WAIT UNTIL READ_BIT(0,200)=ON ‘Wait for FLG bit to be set
CLEAR_BIT(0,100)
WAIT UNTIL READ_BIT(0,200)=OFF ‘Wait for FLG bit to be cleared
```

If successful VR(202) (Response code) contains 0. When the command failed VR(202) contains -1.

Related BASIC commands

The following BASIC commands are related to the FZM1:

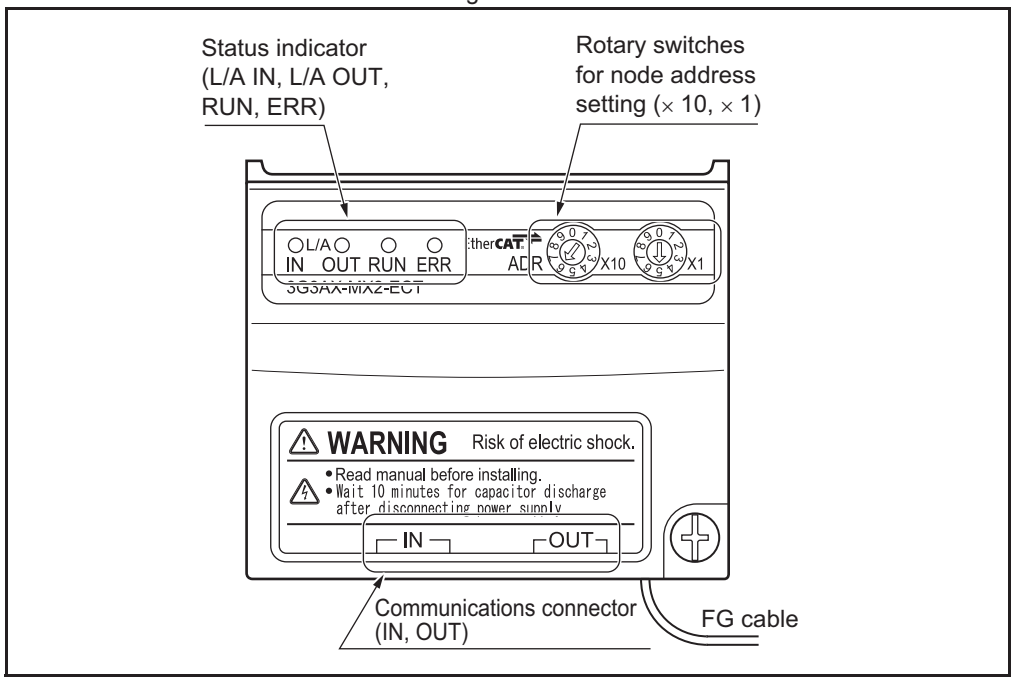
- **ETHERCAT**

For more information, refer to the Trajexia Programming Manual

3.11.10 3G3AX-MX2-ECT

The EtherCAT Communication Unit is an interface unit. When installed to a SYSDRIVE MX2-series multi-function compact inverter, it provides support for 100-Mbps EtherCAT.
For detailed information about installation and operation, please refer to the 3G3AX-MX2-ECT user's manual (I574-E1).

fig. 120

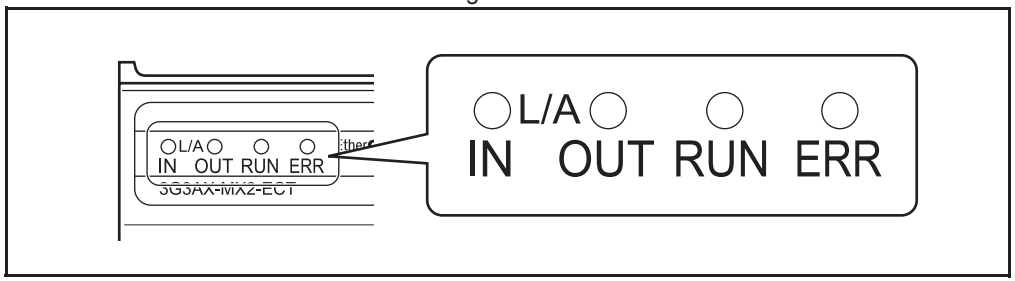


EtherCAT Communications Status Indicators

The table below shows the LED indication status and the corresponding conditions of the communications.

Name	Colour	Status	Description
L/A IN	Green	OFF	Link not established in physical layer
		ON	Link established in physical layer
		Flickering	In operation after establishing link
L/A OUT	Green	OFF	Link not established in physical layer
		ON	Link established in physical layer
		Flickering	In operation after establishing link
RUN	Green	OFF	Init state
		Blinking	Pre-Operational state
		Single flash	Safe-Operational state
		ON	Operational state
ERR	Red	OFF	No error
		Blinking	Communications setting error
		Single flash	Synchronization error or communications data error
		Double flash	Application WDT timeout
		Flickering	Boot error
		ON	PDI WDT timeout

fig. 121



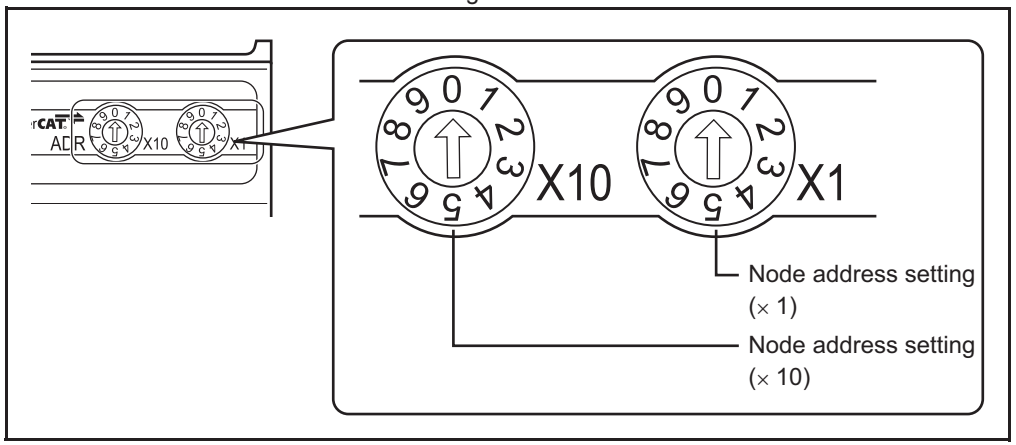
Node Address settings

Set the address selector of the 3G3AX-MX2-ECT to the required node address by using the X1 (right) and X10 (left) rotary switches.
The setting range for the node address setting rotary switch is 00 to 99.
When the rotary switches are set to 00, the node address will be assigned automatically, depending on the position in the network, starting from 1 sequentially.
The axis assigned depends on the node address setting and the **AXIS_OFFSET** parameter, using the following rule:
Axis No. = (Node Address -1) + **AXIS_OFFSET**
This offset (**AXIS_OFFSET**) needs to be specified per TJ2-ECT__. Please note that the node address per TJ2-ECT__ needs to be unique.
Example:
TJ2-MC__ + TJ2-ECT16 + 3 MX2 Inverters

- Node address setting: 01, 04 and 07
- **AXIS_OFFSET SLOT(0) = 4**

Assigned axis numbers: 4, 7 and 10.

fig. 122



Note
The set node address is read only once when the inverter power supply is turned ON. If the setting is changed after the power supply is turned ON, the new setting will not be used until the next time that the power is turned ON.
Do not change the setting on the rotary switches after the power supply has been turned ON.

Note
When using an MX2 Inverter through the EtherCAT interface it will get assigned an axis number and is controlled through axis commands and parameters. The Inverter commands like **INVERTER_READ** and **INVERTER_WRITE** are not applicable. This is different compared to interfacing an Inverter through the MECHATROLINK-II network.

Note
When node address are assigned automatically (rotary switch set to 00), make sure the resulting axis numbers do not conflict with axes already assigned to other drives. This will result in a configuration error.

Configuring the Option Board

All Option Board parameters are stored in the MX2 Inverter. This allows for easy replacement of the Option Board without the need to re-configure. After connecting the Option Board to an MX2 Inverter for the first time however, proceed with the following steps:

Step 1

It is recommended to set C102 = 3 to prevent the Inverter reset input and Stop/reset button from interfering with Option Board during operation (Setting C102 to another value causes the Option Board to reset when a trip condition is cleared). Use the Inverter keypad to set C102 to 3.

Param	Description	Setting
C102	Reset mode selection	Recommended to set to 3 (Reset mode selection resets trip only, not Option Board)

Step 2

Change the control method for the RUN command and frequency reference to Optional Board.

Param	Description	Setting
A001	Frequency Reference Selection 1	02 (Digital Operator, default) 04 (Option board)
A002	RUN Command Selection 1	02 (Digital Operator, default) 04 (Option board)

Step 3
Restart the MX2 Inverter for the changes to take effect.

Note
When restarting the MX2 Inverter, wait for the Inverter power indicator to go out before switching on again.

Related BASIC commands

The following BASIC commands are related to the MX2 Inverter with EtherCAT option:

- **ATYPE**
- **AXIS**
- **AXIS_ENABLE**
- **S_REF**
- **AXISSTATUS**
- **DRIVE_ALARM**
- **DRIVE_CLEAR**
- **DRIVE_READ**
- **DRIVE_STATUS**
- **DRIVE_WRITE**

For more information, refer to the Trajexia Programming Manual.

3.11.11 GX-JC03/JC06 EtherCAT Junction Slave

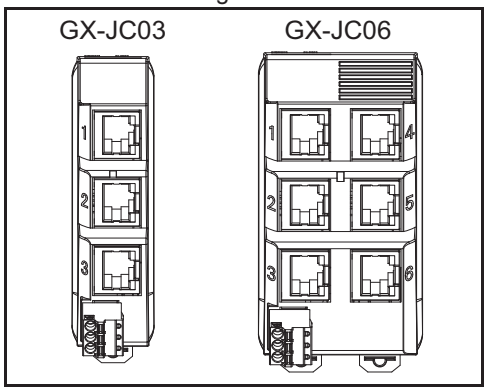
This is a special unit for branching EtherCAT network wiring.
Each Junction Slave has one input port and two or five output ports. The output ports on each Junction Slave can be connected to another Junction Slave or other EtherCAT slaves.

The following types are supported:

Slave type/name	Number of ports	Model
EtherCAT Junction Slave	3	GX-JC03
	6	GX-JC06

Please refer to the Instruction Manual (supplied with each slave) for mounting and connection instructions.

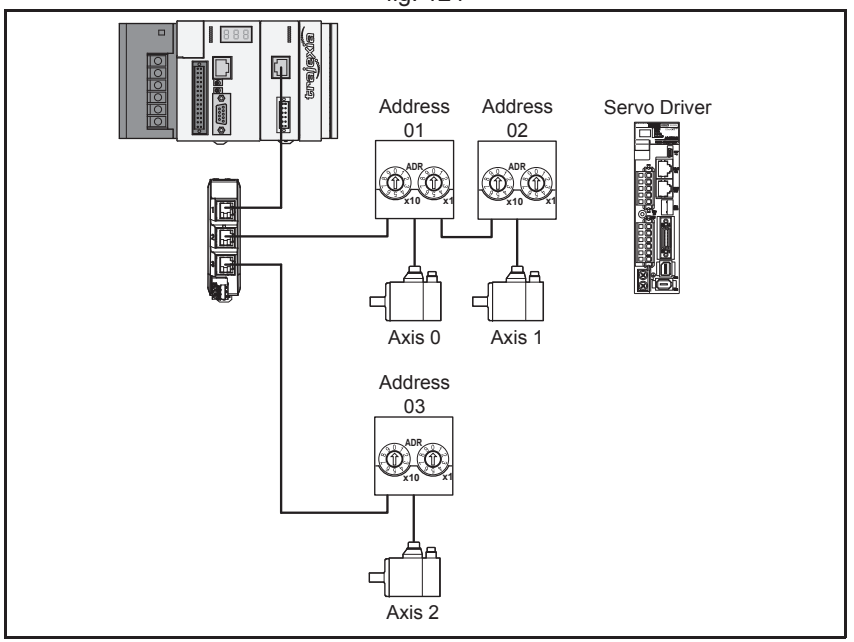
fig. 123



Node address assignment

The node address is assigned to the Junction slave automatically, starting from 2000. Because of the internal structure of the GX-JC06, it will get assigned 2 node addresses: first node address for the 3 ports on the left, second node address for the 3 ports on the right. The master or previous slave must always be connected to the IN port: top or top-left connector. The network is scanned in order of the port numbering. Ports can be left unconnected.

fig. 124



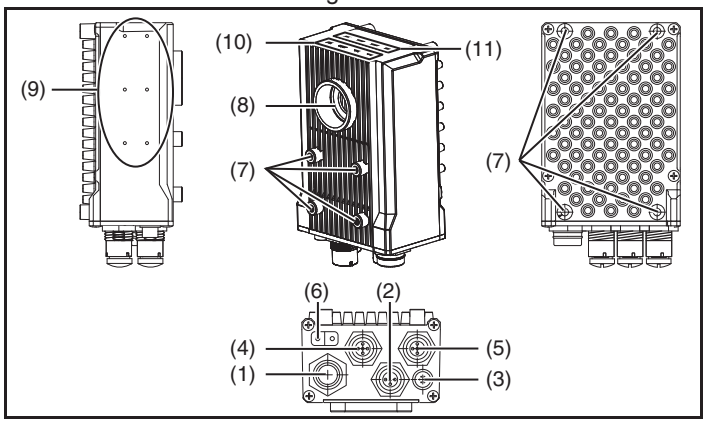
3.11.12 FQ-M-series Vision Sensors

The FQ-M Series is a series of Vision Sensors that are designed to be integrated with high-speed positioning equipment.

The following types are supported:

Item	Type	Model
FQ-M-series Vision Sensors	Monochrome	FQ-MS□□□-M-ECT
	Color	FQ-MS□□□-ECT

fig. 125



Label	Terminal/LED	Description
(1)	I/O connector	An I/O Cable is used to connect the Sensor to the power supply and external devices.
(2)	Ethernet connector	An Ethernet cable is used to connect the Sensor to external devices such as PLCs, the Touch Finder, or computers.
(3)	Lighting connector	This connector is used to connect to external lighting (a Strobe Controller).
(4)	EtherCAT input connector	This connector is used to connect to EtherCAT-compatible devices.
(5)	EtherCAT output connector	This connector is used to connect to EtherCAT-compatible devices.
(6)	Node address setting switches*	These switches are used to set the node address as an EtherCAT communications device. The setting range is 00 to 99.
(7)	Mounting holes	These mounting holes are used to mount the camera.
(8)	C-mount lens fitting	The C-mount lens is attached here. Determine the appropriate CCTV lens (C-mount lens) to use based on the field of view required for the size of the measurement object.
(9)	Strobe Controller mounting holes	The Strobe Controller is attached here. The Vision Sensor is compatible with the FL-TCC1.

Label	Terminal/LED	Description
(10)	Measurement process operation indicators	OR: this indicator lights orange when the OR output signal turns ON.
		ETN: this indicator lights orange when Ethernet communications are performed.
		ERROR: this indicator lights red when an error occurs.
(11)	EtherCAT operation indicators	Displays the current EtherCAT network communication status.

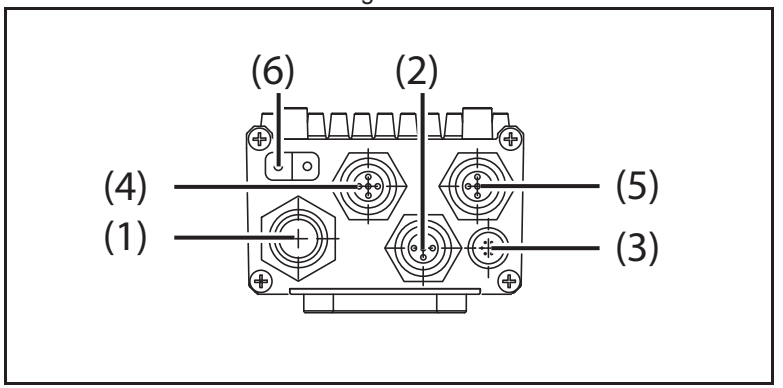
Rotary switches

Set the address selector of the slave unit to the required node address by using the rotary switch (6).
The setting range for the node address switch is 01 to 99 and will result in node address 1001 to 1099.
When the rotary switch is set to 0, the node address will be assigned automatically, starting from 1000, depending on the position in the network.

PDO Mapping

The TJ2-MC__ will communicate to the FQ-M Vision Sensor by mapping the Command, Response and Output areas in VR memory. The VR locations to be used need to be configured after initializing the EtherCAT network, by using a function of the ETHERCAT command.

fig. 126



Type System command

Syntax **ETHERCAT(function, unit_number, address, VR_start_RxPDO, VR_length_RxPDO, VR_start_TxPDO, VR_length_TxPDO)**

Description Command to control and access the EtherCAT network and its functions.
Notes:
- This command waits for the response of the device so, its execution is slow and the time variable. Do not use this command together with other commands that require quick execution.
- The **ETHERCAT** command returns -1 (**TRUE**) on success and 0 (**FALSE**) on failure.

Arguments
- **function**
  $66 to configure the mapping
- **unit_number**
  Unit number of the EtherCAT master to which the slave is attached.
- **address**
  Configured address of the EtherCAT slave
- **VR_start_RxPDO**
  The starting address in VR memory of the controller where the data to the device (RxPDO) is mapped (default = 0)
- **VR_length_RxPDO**
  The number of VR locations to allocate data to the device (RxPDO) (one object per VR, default = 0)
- **VR_start_TxPDO**
  The starting address in VR memory of the controller where the data from the device (TxPDO) is mapped (default = 0)
- **VR_length_TxPDO**
  The number of VR locations to allocate data from the device (TxPDO) (one object per VR, default = 0)

Example The following example maps the FQ-M (address 1002) Command area to VR locations 100 to 104 and the Response and Output area to VR locations 200 to 212 and checks if the command was successful.

```
IF ETHERCAT($66,0,1002,100,5,200,13) THEN
   PRINT "Mapping: OK"
ELSE
   PRINT "Mapping: FAIL"
ENDIF
```

See also N/A

The FQ-M PDO contains the following areas:
Command area (controller to FQ-M)

Item	31 - 17	16	15	14 - 2	1	0
Control	Reserved	DSA	ERCLR	Reserved	TRIG	EXE
Command	UDINT (32 bits)					
Parameter 1	DINT (32 bits)					
Parameter 2	DINT (32 bits)					
Parameter 3	DINT (32 bits)					

Response area (FQ-M to controller)

Item	31 - 17	16	15	14 - 5	4	3	2	1	0
Control	Reserved	GATE	ERR	Reserved	RUN	OR	READY	BUSY	FLG
Command	UDINT (32 bits)								
Response code	UDINT (32 bits)								
Response data	DINT (32 bits)								
Extended region	DINT (32 bits)								

Output area (FQ-M to controller)

Item	31 - 0
Data 1	DINT (32 bits)
Data 2	DINT (32 bits)
...	
Data 7	DINT (32 bits)
Data 8	DINT (32 bits)

The data is mapped in VR using function $66 of the **ETHERCAT** command in the following way:

Area	VR location start	VR location end
Command	VR_start_RxPDO	VR_start_RxPDO + 4
Response	VR_start_TxPDO	VR_start_TxPDO + 4
Output	VR_start_TxPDO + 5	VR_start_TxPDO + 12

Example The following example maps the FQ-M (address 1002) Command area to VR locations 100 to 104 and the Response and Output area to VR locations 200 to 212:
ETHERCAT($66,0,1002,100,5,200,13)
As a result the Control word is mapped to VR(100), the Command word to VR(101), etc..
The status of the FQ-M can be read from VR(200).
To read the ERR flag, use **READ_BIT(15,200)**

Note
Please refer to the FQ-M User's manual (Z314-E1) to configure the Fieldbus Data Output.

Command Specifications

The following commands can be sent to the FQ-M to control its functions.

Function	Command code
Start continuous measurement	$00101020
End continuous measurement	$00101030
Clear measurement values	$00102010
Clear Data Output Buffer	$00102020
Reset Encoder Counter	$00102030
Save Data in Sensor	$00103010
Re-register Model	$00104010
Reset	$0010F010
Get Scene Number	$00201000
Select Scene	$00301000
Get Inspection Item Data	$00401020
Set Inspection Item Data	$00501020
Get Software Version Information	$00403000
Get Encoder Counter	$00206000
Set Encoder Counter	$00306000

The required command code must be written to the VR location mapped to the Command word in the Command area. The command is executed by setting the EXE flag in the Control word in the Command area.

Example

The following example sends the “Switch scene” command to the FQ-M.

```
VR(101)=$00301000 ‘Command
VR(102)=3 ‘Scene number
SET_BIT(0,100) ‘Execute command: bit 0 of VR(100)
WAIT UNTIL READ_BIT(0,200)=ON ‘Wait for FLG bit to be set
CLEAR_BIT(0,100)
WAIT UNTIL READ_BIT(0,200)=OFF ‘Wait for FLG bit to be cleared
```

If successful VR(202) (Response code) contains 0. When the command failed VR(202) contains -1.

Related BASIC commands

The following BASIC commands are related to the FQ-M:

- **ETHERCAT**

For more information, refer to the Trajexia Programming Manual

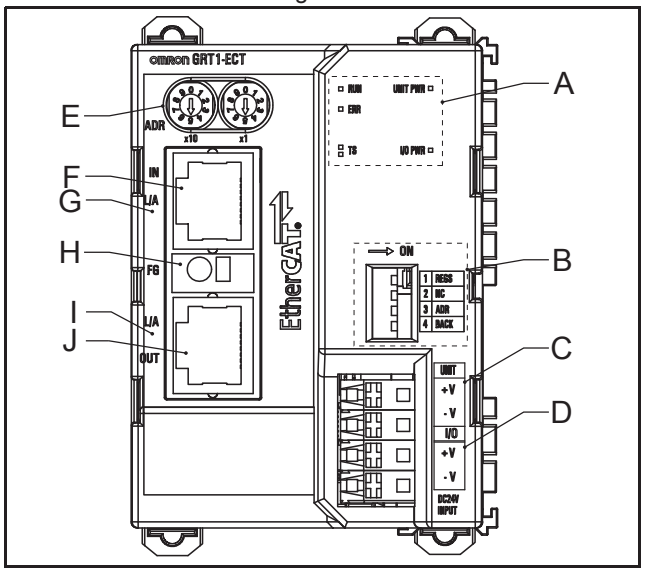
3.12 GRT1-ECT

3.12.1 Introduction

The GRT1-ECT SmartSlice Communication Unit controls data exchange between a TJ2-MC__ Machine Controller Unit (via a connected TJ2-ECT__ EtherCAT Master Unit) and SmartSlice I/O Units over an EtherCAT network. For more information on SmartSlice I/O Units, refer to the GRT1 Series SmartSlice I/O Units Operation Manual (W455).

Label	Description
A	LED indicators
B	Unit dipswitches
C	Unit power supply terminals
D	I/O power supply terminals
E	Node address switches
F	EtherCAT connector IN port
G	Link/activity LED IN port
H	Shielding terminal
I	Link/activity LED OUT port
J	EtherCAT connector OUT port

fig. 127

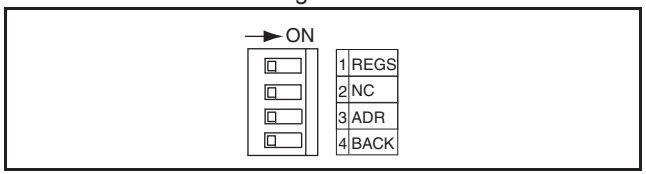


Unit dipswitches

Dipswitch	Function	Setting	Description
REGS	Create/enable registration table	ON	Registered table is enabled
		OFF	Registered table is disabled
		OFF to ON[1]	Register I/O unit table
		ON to OFF	Clear registered I/O unit table
NC	N/A	OFF	Not used, always set to OFF
ADR	Automatic restore	OFF to ON	When the SmartSlice I/O Units are replaced, the parameter data that was backed up with the BACK dipswitch is automatically restored[2]
		OFF	Automatic restore disabled
BACK	Backup trigger	ON to OFF to ON in 3 s[3]	Parameter data of all connected Smart-Slice I/O Units is backed up

1. When the unit power is on.
2. When dipswitch 1 is set to ON.
3. The setting of dipswitch 4 (BACK) is given in figure 125.

fig. 128



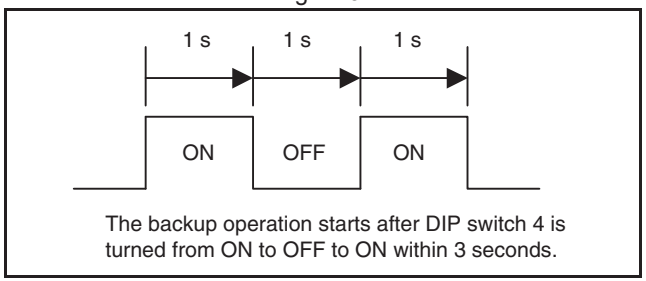
Caution
The Backup and Restore functionality is available in the GRT1-ECT. However, the backed up and restored parameters cannot be accessed via EtherCAT communication.

Note

- It is recommended to do a registration of the SmartSlice I/O Units (see the Trajexia Programming Manual).
- It is recommended to set dipswitches 1 and 3 to on and dip-switch 4 to off after this registration.

The factory setting of all dipswitches is OFF.

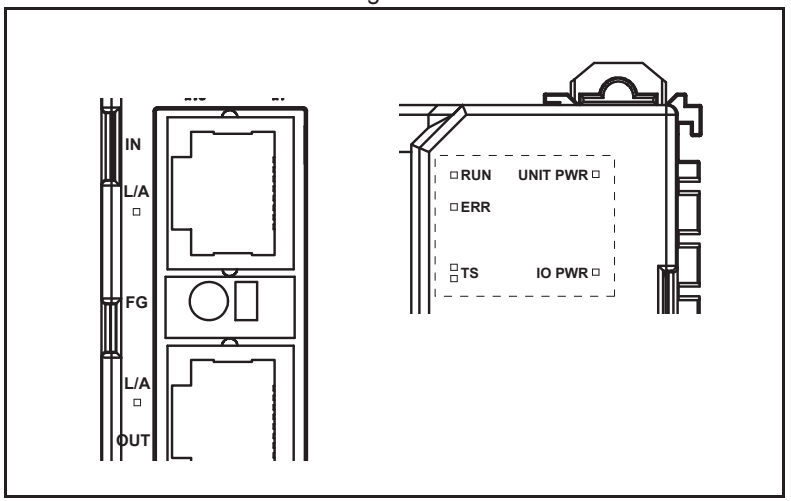
fig. 129



LED indicators

LED	Description	Color	Status	Meaning
RUN	Unit status	Green	OFF	Init state
			Blinking	Pre-Operational state
			Single flash	Safe-Operational state
			ON	Operational state
ERR	Unit error	Red	OFF	No error
			Double flash	An application watchdog timeout has occurred
			Single flash	Unit has changed its state autonomously, due to local error. Error indicator bit is set to 1 in AL status register.
			Blinking	General configuration error.
			ON	A critical communication or application error has occurred.
L/A IN	Link/activity IN port	Green	OFF	Link not established in physical layer
			ON	Link established in physical layer
			Flickering	In operation after establishing link
L/A OUT	Link/activity OUT port	Green	OFF	Link not established in physical layer
			ON	Link established in physical layer
			Flickering	In operation after establishing link

fig. 130



LED	Description	Color	Status	Meaning
TS	SmartSlice I/O system communication status	N/A	Not Lit	• No power supply • Communication with SmartSlice I/O Unit has not started • Overcurrent detected
		Green	Flashing (every second)	SmartSlice I/O Unit added to the system
			Flashing (every 0.5 second)	Backup/Restore function operating: • Restoring settings to SmartSlice I/O Unit, backup function operating • Downloading SmartSlice I/O Unit settings
			Lit	Communication with SmartSlice I/O Unit established
		Red	Flashing	Non-fatal communication error occurred. • Communication timeout • Verification error occurred with registered table • Different model unit detected after SmartSlice I/O Unit replacement
			Lit	Fatal communication error occurred.
			Lit for 2 s	Failure occurred while restoring settings to I/O unit or downloading I/O unit settings
UNIT PWR		Green	Not Lit	No power supply to the unit (All LEDs are off)
			Lit	Power supply to the unit
I/O PWR		Green	Not Lit	No power supply to the SmartSlice I/O (No output from the SmartSlice I/O Units, even when they are in operation)
			Lit	Power supply to the SmartSlice I/O

Rotary switches

Set the address selector of the GRT1-ECT to the required node address by using the X1 (right) and X10 (left) rotary switches.
The setting range for the node address switches is 00 to 99.
When the rotary switches are set to 00, the node address will be assigned automatically, depending on the position in the network, starting from 1000.
When set from 01 to 99, the node address assigned will 1000 plus the switch setting.
To set the EtherCAT node address of the GRT1-ECT, do these steps:

1. Turn off the Unit power supply of the GRT1-ECT.

Note
The address of the GRT1-ECT is read only at power on. Setting the new address when the power is on has no effect.

2. To set the address of the unit, either use auto-addressing by setting the rotary switches to 00, or set the desired address with the rotary switches.

Note
Make sure that the address is unique in the EtherCAT network. If two or more IO units have the same node address, a configuration error will occur.

3. Turn the power on.

Note
To make the EtherCAT address of the unit valid, do one of these steps:

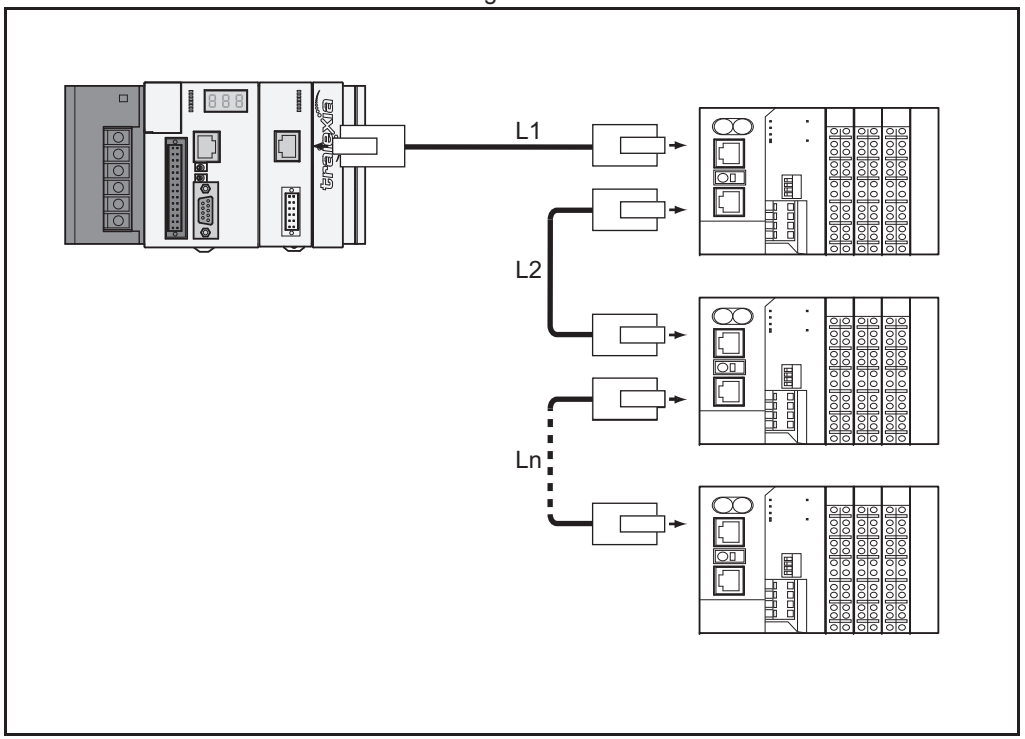
- Restart the TJ2-MC__.
- Execute the command **ETHERCAT(0,unit)**.

EtherCAT connectors (IN & OUT)

Connect the EtherCAT master to the IN connector of the first slave. Connect the OUT connector on the first slave to the IN connector on the next slave. Do not connect the OUT connector on the last slave.

Note
Always turn OFF the power supply to the Machine Control Unit and slaves before connecting or disconnecting the EtherCAT Communications Cables.
The cable between two nodes (L1, L2 ... Ln) must be 100 m or less.

fig. 131



Field Ground Terminal

The GRT1-ECT provides a Field Ground Terminal (FG) between the EtherCAT connectors. If noise is a significant source of errors, ground the Field Ground Terminal (recommended wire 20 AWG to 14 AWG or 0.5 to 2.0 mm^2). Strip the wire between 8 mm and 10 mm of insulation at the ends of the wires (stranded or solid wire) or use pin terminals with a pin (conductor) length of 8 mm to 10 mm.

Power supply connector

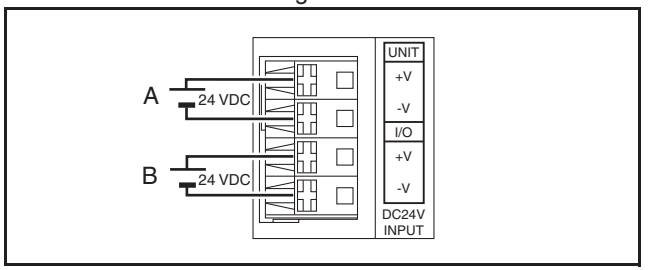
The GRT1-ECT has 2 24 VDC power supply terminals:

Label	Power supply terminal	Description
A	Unit power supply terminal	Power supply to the internal circuits of the GRT1-ECT and to the internal circuits of the connected SmartSlice I/O Units (through the SmartSlice bus)
B	External I/O power supply terminal	Power supply to the external I/Os connected to the SmartSlice I/O Units

Note
The unit power supply is isolated from the external I/O power supply. Please use 2 separate power-supplies to keep this isolation.

Note
The unit power supply and the external I/O power supply are not transferred through the GCN2-100 Turnback cable. The GRT1-TBR units have the same power supply terminals as the GRT1-ECT.

fig. 132



3.12.2 Specifications

Item		Specification
Installation	Unit type	SmartSlice GRT1 series
	Model	GRT1-ECT
	Installation position	On a DIN rail
	Power supply	24 VDC +10% −15% (20.4 to 26.4 VDC)
	Current consumption	130 mA typical at 24 VDC
	Dimensions (W × H × D)	58 × 80 × 70 mm
	Weight	130 g
Environment	Ambient operating temperature	−10 to 55°C (no icing or condensation)
	Ambient operating humidity	25% to 85% Relative humidity
	Storage temperature	−20 to 65°C (no icing or condensation)
	Vibration resistance	10 to 57 Hz, 0.7 mm amplitude 57 to 150 Hz, acceleration: 49 m/s^2
	Shock resistance	150 m/s^2
	Dielectric strength	500 VAC (between isolated circuits)
	Conformance to EMC and electrical safety standards	EN61131-2:2003
	Enclosure rating	IP20

Item		Specification
SmartSlice I/O	Number of connectable SmartSlice I/O Units	64 Units max. Connected directly to the GRT1-ECT or via Turnback extension units
	Baud rate	3 Mbps
	Communication signal level	RS485
	Communication distance	SmartSlice I/O Units: 64 Units coupled (about 2 m max.) Turnback cable: 2 m max. (2 cables, 1 m each)
	Turnback cable	Length 1 m max., up to 2 cables can be connected
	SmartSlice I/O Unit connections	Building-block style configuration with slide connectors (Units connect with Turnback cables).
	Baseblock power supply	Voltage: 24 VDC Current: 4 A max.
	Event messaging	Supported
EtherCAT	Communications protocol	EtherCAT
	Baud rate	100 Mbps
	Physical layer	100Base-TX
	Communications control functions	Auto Negotiation: Only for 100Base-TX full-duplex communications
	Topology	Daisy chain, line, or drop line
	Communications media	STP Category 5
	Maximum cable length	100 m max. between nodes

Supported SmartSlice I/O Units

The GRT1-ECT supports the following SmartSlice I/O Units.

Function	Specification	Model
4 NPN inputs	24 VDC, 6 mA, 3-wire connection	GRT1-ID4
4 PNP inputs	24 VDC, 6 mA, 3-wire connection	GRT1-ID4-1
8 NPN inputs	24 VDC, 4 mA, 1-wire connection + 4xG	GRT1-ID8
8 PNP inputs	24 VDC, 4 mA, 1-wire connection + 4xV	GRT1-ID8-1
4 NPN outputs	24 VDC, 500 mA, 2-wire connection	GRT1-OD4
4 PNP outputs	24 VDC, 500 mA, 2-wire connection	GRT1-OD4-1
4 PNP outputs with short-circuit protection	24 VDC, 500 mA, 3-wire connection	GRT1-OD4G-1
4 PNP outputs with short-circuit protection	from 4 x 2.0 A at 30°C to 4 x 1.0 A at 55°C	GRT1-OD4G-3
8 NPN outputs	24 VDC, 500 mA, 1-wire connection + 4xV	GRT1-OD8
8 PNP outputs	24 VDC, 500 mA, 1-wire connection + 4xG	GRT1-OD8-1
8 PNP outputs with short-circuit protection	24 VDC, 500 mA, 1-wire connection + 4xG	GRT1-OD8G-1
2 relay outputs	240 VAC, 2A, normally-open contacts	GRT1-ROS2
2 analog inputs, current/ voltage	10 V, 0-10 V, 0-5 V, 1-5 V, 0-20 mA, 4-20 mA	GRT1-AD2
2 analog outputs, voltage	10 V, 0-10 V, 0-5 V, 1-5 V	GRT1-DA2V
2 analog outputs, current	0-20 mA, 4-20 mA	GRT1-DA2C
Four-point AC Input Unit	100 to 120 VAC 50/60 Hz	GRT1-IA4-1
Four-point AC Input Unit	200 to 240 VAC 50/60 Hz	GRT1-IA4-2
Two-point Temperature Input Unit	Resistance thermometer input, Input type: PT100 (−200 to 850°C) or PT100 (−200 to 200°C)	GRT1-TS2P

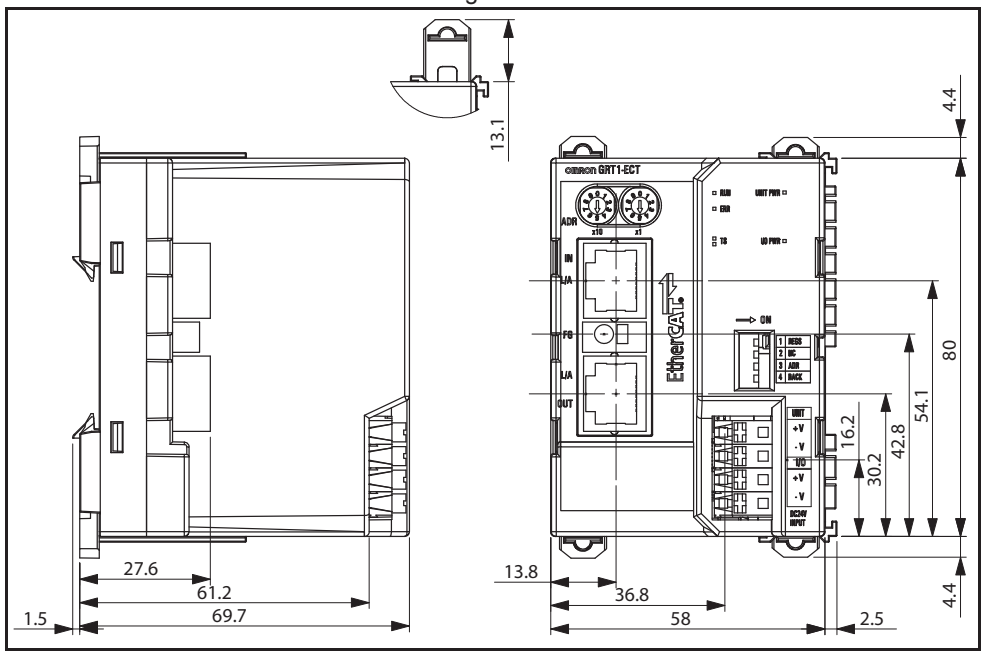
Function	Specification	Model
Two-point Temperature Input Unit	Resistance thermometer input, Input type: PT1000 (−200 to 850°C) or PT1000 (−200 to 200°C)	GRT1-TS2PK
Two-point Temperature Input Unit	Thermocouple input, Input type: R, S, K J, T, E, B, N, L, U, W, or PL2	GRT1-TS2T

Function	Model
I/O power feed unit, separates power supply between groups of I/O units	GRT1-PD2
I/O power feed unit with electronic overload protection, separates power supply between groups of I/O units	GRT1-PD2G
I/O power feed and distribution unit, separates power supply between groups of I/O units, 8xV + 4xG	GRT1-PD8
I/O power feed and distribution unit, separates power supply between groups of I/O units, 4xV + 8xG	GRT1-PD8-1
I/O power connection unit, 8xV + 4xG	GRT1-PC8
I/O power connection unit, 4xV + 8xG	GRT1-PC8-1
Turnback Unit, right-hand side	GRT1-TBR
Turnback Unit, left-hand side	GRT1-TBL
Turnback cable, one meter	GCN2-100

Dimensions

The external dimensions are in mm.

fig. 133



3.12.3 Installation

Follow these rules when installing the GRT1-ECT:

- Before installing the GRT1-ECT or connect or disconnect cables, switch off the power of the Trajexia system, the SmartSlice I/O Units and the external I/Os.
- Make sure that the power supplies of the GRT1-ECT, the SmartSlice I/O Units and the external I/Os are correctly connected.
- Provide separate conduits or ducts for the I/O lines to prevent noise from high-tension lines or power lines.
- It is possible to connect up to 64 SmartSlice I/O Units to 1 GRT1-ECT.

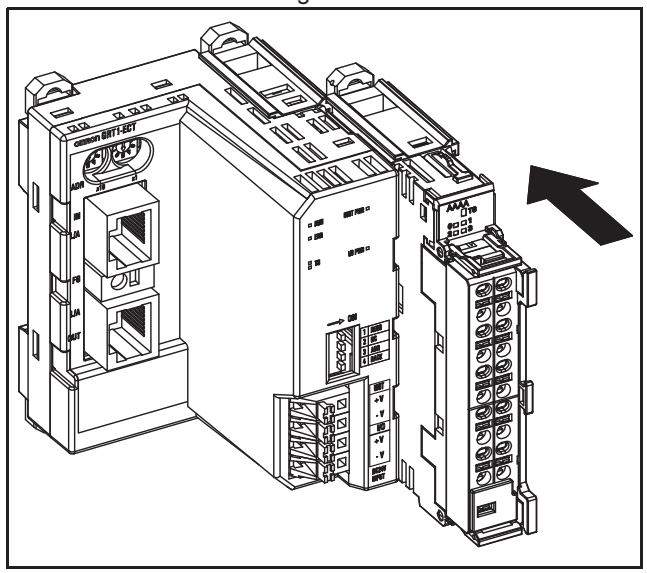
- Install the GRT1-ECT and the SmartSlice I/O Units on a DIN rail. To install a GRT1-ECT on the DIN rail, press it onto the DIN track from the front, and press the unit firmly until it clicks. Check that all DIN rail sliders of the unit are locked onto the DIN rail.
- To remove the GRT1-ECT from the DIN rail, release the sliders from the DIN rail with a screwdriver, and pull the unit straight from the DIN rail.

Connections

Connect the first SmartSlice I/O Unit to the GRT1-ECT:

- Align the sides of the GRT1-ECT and the SmartSlice I/O Unit.
- Slide the SmartSlice I/O Unit to the rear until it clicks onto the DIN rail.

fig. 134



Caution
Do not touch the connectors on the side of GRT1-ECT and the SmartSlice I/O Units.

See the GRT1 Series SmartSlice I/O Units Operation Manual for more information on connecting additional SmartSlice I/O Units, Turnback Units, End Units and end plates.

Wiring

The GRT1-ECT has 2 power supply terminals. Both power supply terminals have screwless clamping-type connections.
To determine the power supply requirements, do the steps below.
The maximum power consumption for SmartSlice I/O Units is 80 W per block.

1. Calculate the power consumption of all SmartSlice I/O Units connected to the GRT1-ECT. Refer to the GRT1 Series SmartSlice I/O Units Operation Manual (W455) for the power value for each SmartSlice I/O Unit.
2. If the power consumption exceeds 80 W, mount a Right Turnback Unit (GRT1-TBR) on the SmartSlice I/O Unit at the point where the power consumption is less than 80 W.
3. Connect the 24 VDC unit power supply to the Left Turnback Unit (GRT1-TBL).

The maximum I/O current consumption is 4 A.

1. Calculate the total current consumption used by all external I/Os of the connected SmartSlice I/O Units (including other units like Turnback Units). Refer to the GRT1 Series SmartSlice I/O Units Operation Manual (W455) for the current value for each SmartSlice I/O Unit.
2. If the current consumption exceeds 4 A or if you want to provide separate systems for inputs and outputs, divide the SmartSlice I/O Units at the desired point with a GRT1-PD_(-1) I/O Power Supply Unit and provide a separate external I/O power supply.

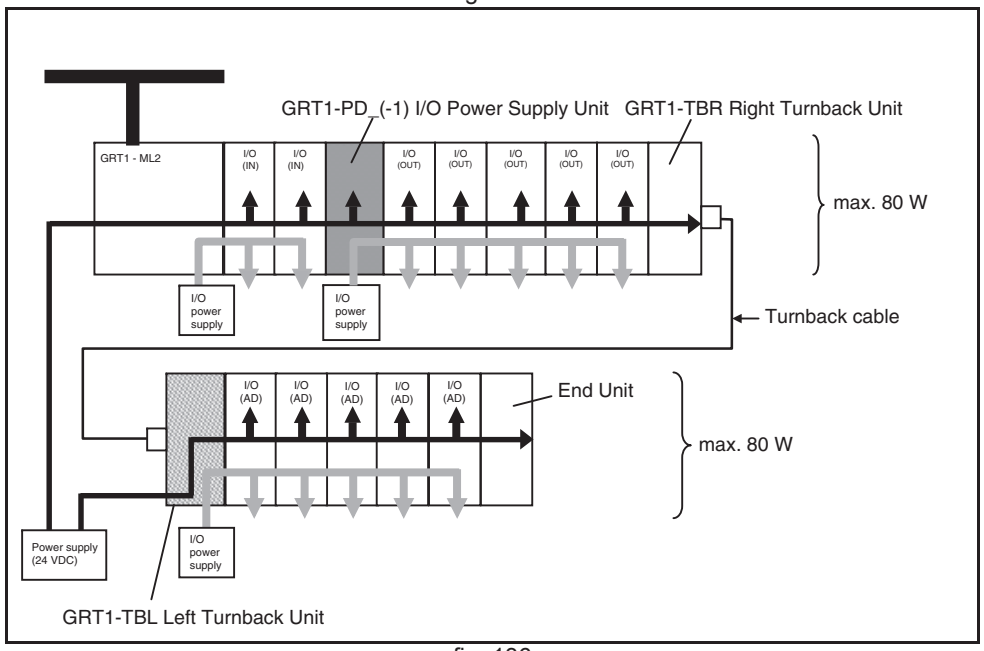
Note
It is also possible to provide a separate external I/O power supply at a Left Turnback Unit (GRT1-TBL).

Note
Make sure the power supply is isolated.

Note
The GCN2-100 Turnback cable does not supply power.

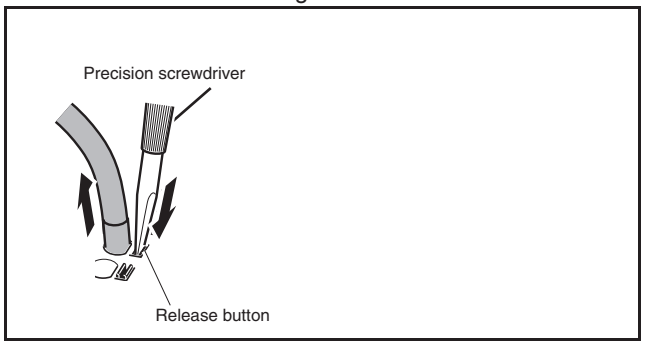
The figure gives a wiring example.
To supply power to the units and the I/O devices, connect the power supply wires to the power supply terminals of the GRT1-ECT. If the wire ends have pin terminals, just insert the pin terminals in the power supply terminals.

fig. 135



To remove the wires, press the release button above the terminal hole with a precision screwdriver, and pull out the wire.

fig. 136



It is recommended to use a SELV (Safety Extra Low Voltage) power supply with over-current protection. A SELV power supply has redundant or increased insulation between the I/O, an output voltage of 30 V rms and a 42.4 V peak or maximum of 60 VDC.
Recommended power supplies are:

- S82K-01524 (OMRON)
- S8TS-06024 (OMRON).

It is recommended to use wires with a gauge of 20 AWG to 16 AWG (0.5 to 1.25 mm^2).
Strip the wire between 7 and 10 mm of insulation at the ends of the wires (stranded or solid wire), or use pin terminals with a pin (conductor) length of 8 to 10 mm.

Replace

Caution
The GRT1-ECT is a unit that is part of a network. If the GRT1-ECT is damaged, it effects the whole network. Make sure that a damaged GRT1-ECT is repaired immediately.

To replace the unit, follow these rules:

- Turn off the power before replacing the unit. This includes the power to all master and slave units in the network.
- Make sure that the new unit is not damaged.
- If a poor connection is the probable cause of any malfunctioning, do these steps:
  - Clean the connectors with a clean, soft cloth and industrial-grade alcohol.
  - Remove any lint or threads left from the cloth.
  - Install the unit again.
- When returning a damaged unit to the OMRON dealer, include a detailed damage report with the unit.
- Before reconnecting the new unit, do these steps:
  - Set the EtherCAT node address to the same address as the old unit.
  - If the table registration function was used for the old unit, create a new registration table for the new unit. See the Trajexia Programming Manual.

3.12.4 Online replacement

It is possible to replace SmartSlice I/O Units connected to a GRT1-ECT when the power is on. The I/O communication continues while a SmartSlice I/O Unit is removed and replaced.
To replace a SmartSlice I/O Unit online, do these steps:

1. Turn off all power supplies of the SmartSlice I/O Unit. This is the I/O power supply, plus possible external power supplies to the terminal block (for example, a Relay Output Unit).
2. Release the locks on the front of the unit and remove the terminal block. Do not remove the wiring.
3. Remove the main block of the unit. Replace it with a new SmartSlice I/O Unit of the same type.
4. Attach the new unit to the system. Close the locks on the front of the unit.
5. Turn on the power supplies to the unit.

When replacing a SmartSlice I/O Unit online, note the following things:

- When a unit is removed from the I/O communication, the withdrawn flag of the unit is set on and the TS LED on the GRT1-ECT flashes red.
- If I/O power supply of the unit is not turned off, there can be false output signals, false input signals and electrical shocks.
- Only replace one SmartSlice I/O Unit at a time.
- If a unit is replaced with a different type of unit, there can be unexpected outputs and the restore operation can be incomplete.
- If the base block has faults or damage, turn off the power supply and replace the entire unit.

When an online replacement is performed, the status word of the GRT1-ECT reports an error (missing I/O Unit). When the I/O Unit is replaced or put back, the status word changes to 8000 hex, but the error has already been detected by the TJ2-MC__. To avoid this, it is necessary to mask the errors before the online replacement is performed. To perform the online replacement do the following:

1. Execute **IO_STATUSMASK(unit, address, 1, 0)**. This masks all bits, including errors, in the GRT1-ECT status word.
2. Replace the I/O Unit.
3. Execute **IO_STATUSMASK(unit, address, 1, $4000)**. This sets the error mask to its default value.

3.12.5 Related BASIC commands

The following BASIC commands are related to the GRT1-ECT module:

- **ETHERCAT**
- **CO_READ**
- **CO_WRITE**
- **IO_STATUS**
- **IO_STATUSMASK**

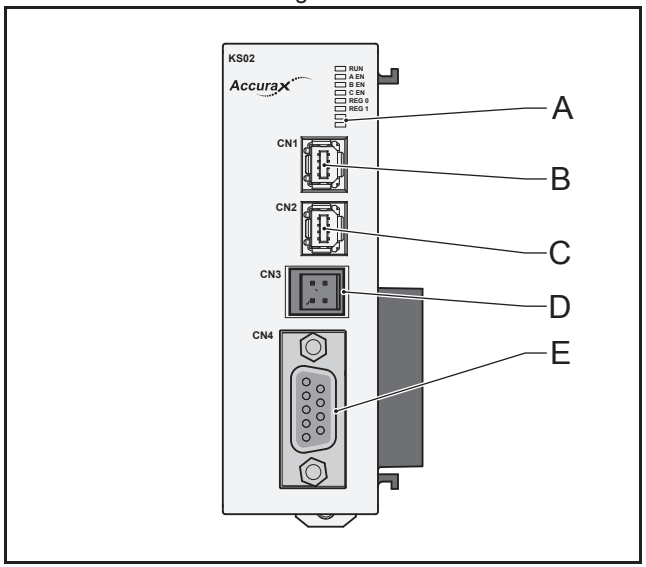
For more information, refer to the Trajexia Programming Manual.

3.13 TJ2-KS02

3.13.1 Introduction

The TJ2-KS02 can control up to two Accurax G5-A/P Servo Drives and is also equipped with an encoder interface. The Servo Drives can be controlled in position, speed and torque mode. The encoder interface supports incremental (phase differential or stepper) and absolute (SSI and EnDat) encoders, and can also generate pulses (phase differential and stepper). Furthermore, the unit is equipped with two 24V registration inputs, which can be used to register positions for the encoder interface, both with incremental and absolute encoders.

fig. 137



The TJ2-KS02 has these visible parts:

Part	Description
A	LEDs
B	First G5-A/P Servo Drive connection (CN1)
C	Second G5-A/P Servo Drive connection (CN2)
D	Registration inputs (CN3)
E	Encoder interface (CN4)

3.13.2 LED description

Label	Status	Description
RUN	off	Start-up test failed. Unit not operational Operation stopped. Fatal error
	on	Start-up test successful. Normal operation
A EN	on	Axis enabled.
	flashing	Axis error
	off	Axis disabled
B EN	on	Axis enabled
	flashing	Axis error
	off	Axis disabled
C EN	on	Axis enabled
	flashing	Axis error
	off	Axis disabled
REG 0	off	Registration input 0 off
	on	Registration input 0 on
REG 1	off	Registration input 1 off
	on	Registration input 1 on

3.13.3 TJ2-KS02 connections

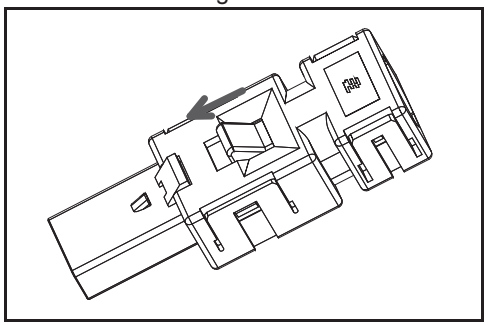
CN1, CN2 Accurax G5-A/P connectors

These connectors are used to connect to one or two Accurax G5-A/P Servo Drives to the TJ2-KS02.

Disconnection

To disconnect, push the lock on the connector towards the TJ2-KS02 or Servo Drive and pull-out the cable.

fig. 138

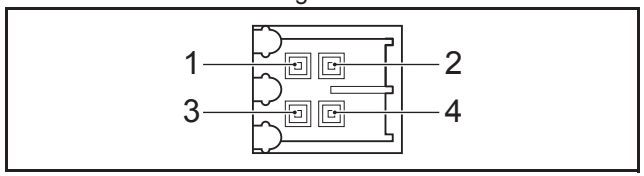


CN2 Registration inputs

The 4 pin connector is a Weidmuller connector designation: B2L 3.5/4 LH.

Pin	Signal	Pin	Signal	Description
1	REG 0	2	REG 1	24V registration inputs
3	0V	4	0V	0V Reference for inputs

fig. 139



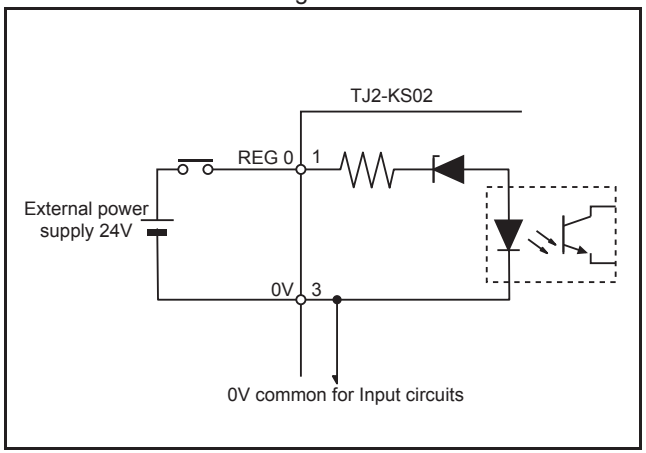
The registration inputs can be used to capture the position of the encoder interface for both incremental and absolute encoders. In case of absolute encoders, the registration position will be estimated using interpolation. This is because the encoder position is only read every servo cycle.

Registration inputs specifications

The following table and illustration details the digital input specifications:

Item	Specification
Type	PNP
Maximum voltage	24 VDC + 10%
Input current	8 mA at 24 VDC
on voltage	18.5 VDC min
off voltage	5.0 VDC max

fig. 140



Input response time (registration):
- without noise filter: 0.5µs maximum.
- with noise filter 3.5µs maximum.

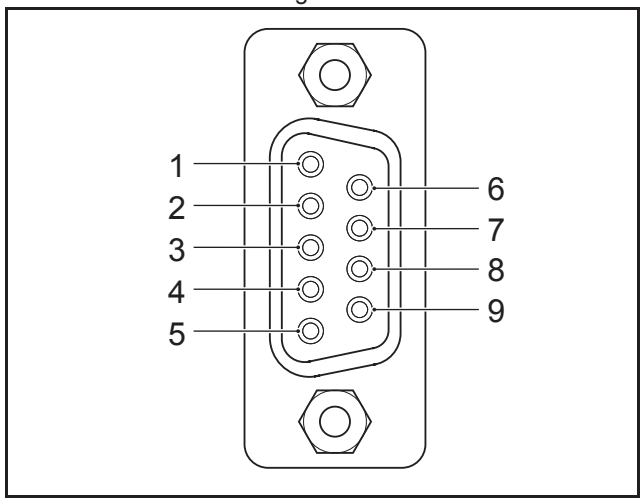
Note
In the case of an incorrect registration due to slow edges or noise, a digital noise filter can be enabled with the **REGIST** command. Refer to the BASIC Commands in the Programming Manual.

CN3 Encoder connector

The signals of the 9-pin connector depend on the type of interface selected:

Pin	Encoder input	Encoder output	Stepper input	Stepper output	SSI/EnDat
1	NC				
2	A+		Step+		Clock+
3	A-		Step-		Clock-
4	B+		Dir+		
5	B-		Dir-		
6	5V power supply output				
7	Z+	Enable+	Z+	Enable+	Data+
8	Z-	Enable-	Z-	Enable-	Data-
9	0V power supply				
Shell					

fig. 141

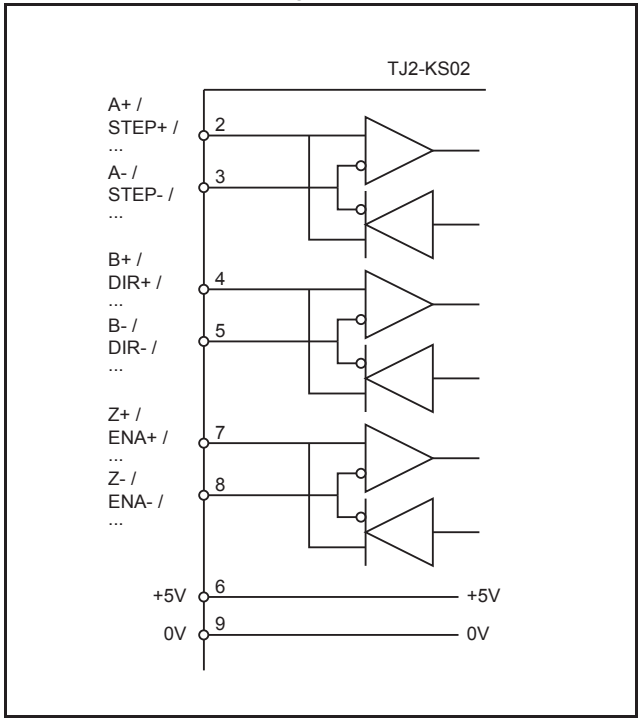


Encoder interface specifications

The following table and illustration details the encoder interface:

Item	Specification
Type	Phase differential incremental encoder
Signal level	EIA RS-422-A Standards (line-Drive)
Input impedance	48 kΩ min
Load impedance	220 Ω min
Termination	None

fig. 142



3.13.4 Initial setup

To be able to control the Accurax G5-A/P through its serial interface, please follow the following steps:

A. Make sure the Servo Drive has the correct software version.
   The software version can be checked on the front panel or with the CX-Drive.
   Minimum software version required: 1.20
B. Enable the serial interface of the Servo Drive by setting the following parameters:
   Pn628: set to 1
   Pn629: set to 5000 (advised value)
   These changes can be made using the front panel or with CX-Drive.
C. Make sure the parameters are written to EEPROM and power cycle the Servo Drive.
D. Make sure the servo-period of the TJ2-MC__ controller is set to 500us.
   This can be done using Trajexia Studio.
E. Connect the Servo Drive to the TJ2-KS02 using the serial cable.
F. Clear the settings of Pn400 to Pn415.
   This can be done using the front panel, through Trajexia Studio or CX-Drive.

3.13.5 TJ2-KS02 specifications

Item	Specification
Power supply	5 VDC and 24 VDC (supplied by the TJ2-MC__)
Total power consumption	1.5 W to 3.7 W (Output PS maximum load)
Current consumption	5 VDC: 110 mA 24 VDC: 20 mA to 110 mA (Output PS maximum load)
Approximate weight	83 g
Galvanic isolation	• Encoder interface • Digital interface
Output power supply	5 VDC, 250 mA Maximum
Number of axes	3
Control method	• Position, speed and torque • Pulse Train output in Open Loop
Encoder position/speed feedback	Incremental and absolute
Absolute encoder standards supported	• SSI • EnDat
SSI specification	• Maximum supported number of bits: 25 • Gray and binary encoding • Multiples of 2^n • Clock frequency: 200 kHz
EnDAT specification	• Compatible with version 2.1 and 2.2 • Maximum supported number of bits: 32 • Clock frequency: 1 MHz
Servo period	• 0.5 ms when using Accurax G5-A/P Servo Drives • 0.25 ms, 0.5 ms, 1 ms, 2ms Note: 0.25 ms not supported by the absolute encoder interfaces.
Encoder input maximum frequency	6 MHz

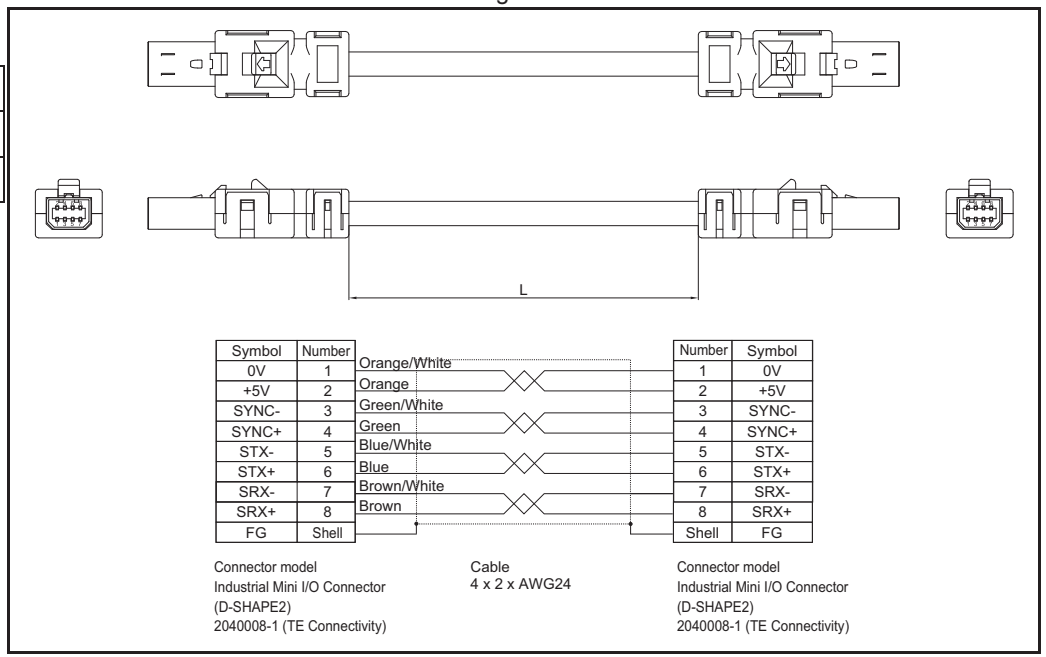
Item	Specification
Encoder/pulse output maximum frequency	2 MHz
Maximum cable length:	• Accurax G5 interface, 3 m • SSI, 100 m • EnDat, 40 m • Encoder/stepper input, 100 m • Encoder/stepper output, 100 m
Auxiliary I/Os	• Two fast registration inputs

Accessories

The following accessories are available:

Name	Length (L)	Model
Interface cable	1 m	TJ2-KC01M
Interface cable	3 m	TJ2-KC03M

fig. 143



3.13.6 Applicable BASIC commands

The following BASIC commands are applicable for the TJ2-KS02:

- **ATYPE**
- **AXIS_OFFSET**
- **UNIT_INIT**
- **DRIVE_READ**
- **DRIVE_WRITE**
- **DRIVE_CONTROL**
- **DRIVE_MONITOR**
- **DRIVE_STATUS**
- **DRIVE_ALARM**
- **REGIST**

BASIC commands applicable for specific encoder types, are listed with the corresponding explanations in the next chapters. For more information of BASIC commands, refer to the Trajexia Programming Manual.

3.13.7 Axes allocation

The axis numbers for the (up to) 3 axes will be assigned automatically, according the following rules:

- Upper G5 interface (CN1): **AXIS_OFFSET**
- Lower G5 interface (CN2): **AXIS_OFFSET**+1
- Encoder interface (CN4): **AXIS_OFFSET**+2

In case no Servo drive is attached or the Servo Drive is not powered, then the axis will be a virtual axis (**ATYPE**=0). When a Servo Drive is attached or powered on after startup of the TJ2-MC__, the communication with the Servo Drive can be (re-)started using the **UNIT_INIT**(unit_number). The virtual axis will then be changed to the default ATYPE for this type of axis (**ATYPE**=80).
Axis numbers of additional TJ2-KS02 units will continue with the next available axis number or from **AXIS_OFFSET** if bigger.

3.13.8 Incremental encoder

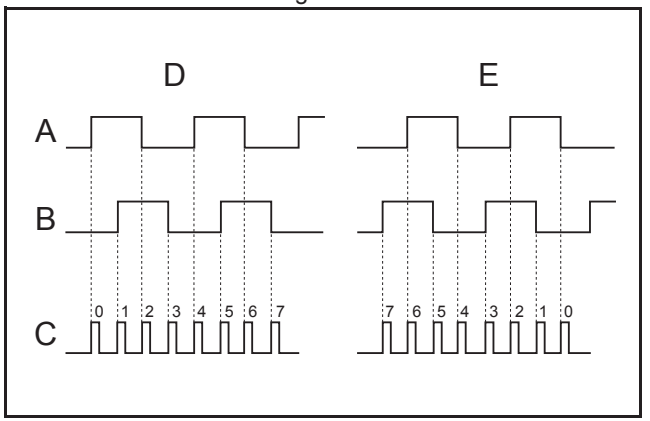
An incremental encoder has this phase definition:
- An advanced phase A for forward rotation.
- An advanced phase B for reverse rotation.

By monitoring the relative phase of the 2 signals, you can easily detect the rotation direction. If signal A leads signal B, the movement is clockwise and the counter increments. If channel B leads channel A, the movement is counterclockwise and the counter decrements.
Most rotary encodes also provide an additional Z marker. This Z marker is a reference pulse within each revolution. With these 3 signals, you can determine the direction, the speed and the relative position.

Encoder input

The pulse ratio of the TJ2-MC__ is 1: every encoder edge (i.e., a pulse edge for either phase A or B) is equal to one internal count.
The figure shows phase A (A), phase B (B) and the number of counts (C) for forward or clockwise rotation (D) and reverse or counterclockwise rotation (E).
The signals A, B and Z appear physically as A+ and A-, B+ and B- and Z+ and Z-. They appear as differential signals on twisted-pair wire inputs. This makes sure that common mode noise is rejected.
When you use an encoder from other manufacturers, check the encoder specification for the phase advancement carefully. If the phase definition is different from the phase definition of the standard OMRON equipment, reverse the B-phase wiring between the TJ2-MC__ and the encoder.

fig. 144

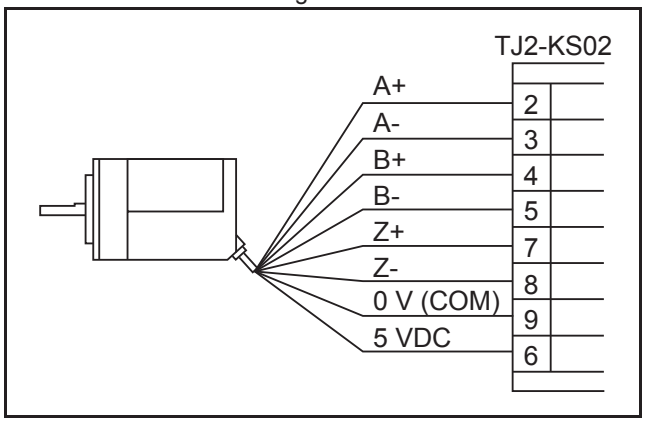


Note
The TJ2-KS02 does not have a termination inside. In case of long distances or disturbed communication, add an external termination to the TJ2-KS02.

The table below and the figure give an example of how to connect the OMRON E6B2-CWZ1Z encoder to the TJ2-KS02.

Encoder		TJ2-KS02	
Signal	**Wire color**	**Pin**	**Signal**
A+	Black	2	A+
A-	Black/red	3	A-
B+	White	4	B+
B-	White/red	5	B-
Z+	Orange	7	Z+
Z-	Orange/red	8	Z-
0 V (COM)	Blue	9	0V
5 VDC	Brown	6	+ 5V

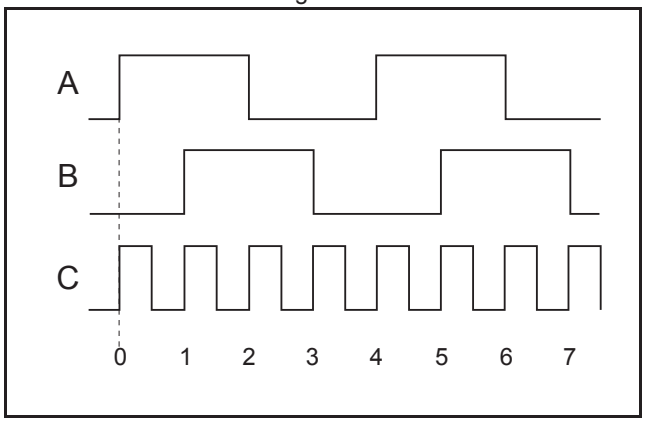
fig. 145



Encoder output

The TJ2-KS02 can generate encoder type pulses. For each internal count (C), the TJ2-KS02 produces one encoder edge for phase A (A) or phase B (B).

fig. 146



Related BASIC commands

The following BASIC commands are related to incremental encoders:

- **ATYPE (ATYPE=44** and **ATYPE=45)**
- **ENCODER_RATIO**

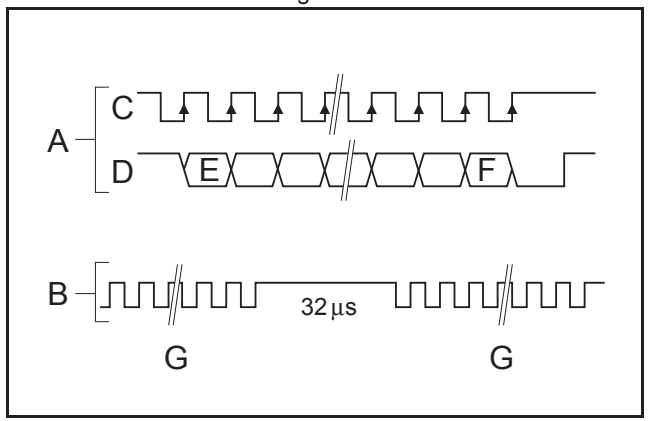
For more information, refer to the Trajexia Programming Manual.

3.13.9 Absolute encoder

SSI

SSI (Synchronous Serial Interface) is a digital system for transferring data in serial form. SSI is the most widely used serial interface between absolute sensors and controllers. SSI uses a pulse train from the controller to clock out the data from the sensor.
The SSI interface of the TJ2-KS02 accepts absolute values from an encoder if the data is in Gray Code format or in binary format and if the resolution is 25 bits or less. The number of bits, and therefore the number of clock pulses sent to the encoder in each frame, is programmable. You set this number with the BASIC command **ENCODER_BITS = n**.
When you have initialized the TJ2-KS02 with the **ENCODER_BITS** command, the TJ2-KS02 continuously sends clock pulses to the encoder. These clock pulses are sent in frames of *n*+2 pulses, where *n* is the bit count set. The clock rate is fixed at 200 kHz. The clock interval between frames is 32 µs. The resulting maximum cable length between the controller and the sensor is 200 m.
The labels in the figure are:
A. Timing diagram.
B. Clock sequence.
C. Clock.
D. Data.
E. MSB (Most Significant Bit).
F. LSB (Least Significant Bit).
G. Clock frame.

fig. 147



When the data is clocked into the TJ2-MC__, the position value is interpreted. With this position value, it produces a value for **MPOS** and a position error that is used to close the control loop.

The connections for SSI are:

Encoder signal	Pin
DATA+	7
DATA-	8
CLOCK+	2
CLOCK-	3
+5V	6
0V	9

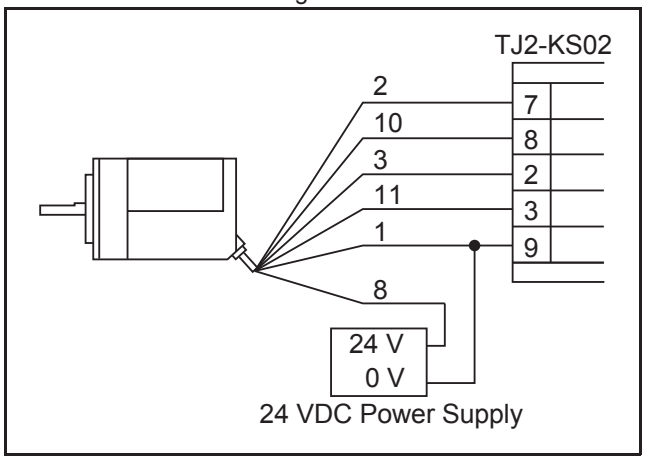
Note
The TJ2-KS02 does not have a termination inside. In case of long distances or disturbed communication, add an external termination to the TJ2-KS02.

The table below and the figure give an example of how to connect the Stegmann ATM 60-A encoder to the TJ2-KS02.

Encoder			TJ2-KS02	
Pin	**Signal**	**Wire color**	**Pin**	**Signal**
2	DATA+	White	7	DATA+
10	DATA-	Brown	8	DATA-
3	CLOCK+	Yellow	2	CLOCK+
11	CLOCK-	Lilac	3	CLOCK-
1	GND	Blue	9	GND
8	Us	Red	See footnote [1]	

1. Use an external power supply

fig. 148



Related BASIC commands
The following BASIC commands are related to SSI absolute encoders:
- **ATYPE (ATYPE=48)**
- **ENCODER_BITS**

For more information, refer to the Trajexia Programming Manual.

EnDat

You can configure the TJ2-KS02 to interface directly to EnDat absolute encoders. EnDat absolute encoders respond on a dedicated Clock and Data 1 MHz RS485 serial interface when their position is requested by the controller. When you set the encoder to the relevant encoder mode, the axis transmits an information request to the encoder on a fixed 250 µs cycle.
The connections for EnDat are:

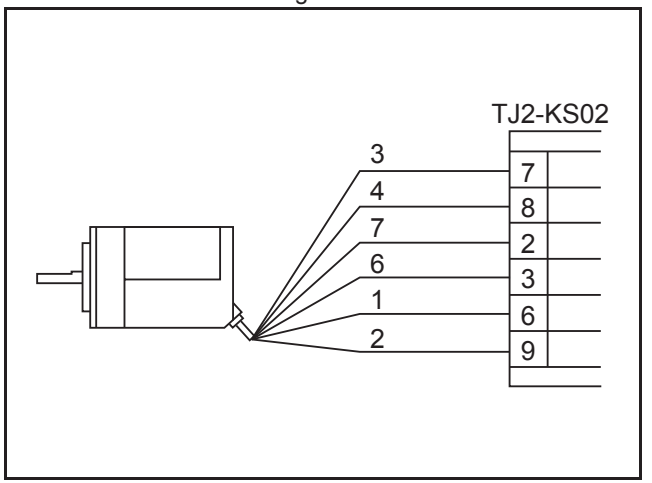
Encoder signal	Pin
DATA	7
/DATA	8
CLOCK	2
/CLOCK	3
+5V	6
0V	9

Note
The TJ2-KS02 does not have a termination inside. In case of long distances or disturbed communication, add an external termination to the TJ2-KS02.

The table below and the figure give an example of how to connect the Heidenhain ROC 425 2048 5XS08-C4 encoder to the TJ2-KS02.

Encoder			TJ2-KS02	
Pin	**Signal**	**Wire color**	**Pin**	**Signal**
3	DATA	Grey	7	DATA
4	/DATA	Pink	8	/DATA
7	CLOCK	Violet	2	CLOCK
6	/CLOCK	Yellow	3	/CLOCK
2	0 V	White	9	0V
1	Up	Blue	6	+5V

fig. 149



Related BASIC commands
The following BASIC commands are related to EnDat absolute encoders:

- **ATYPE (ATYPE=47)**
- **ENCODER_BITS**
- **ENCODER_CONTROL**
- **ENCODER_READ**
- **ENCODER_TURNS**
- **ENCODER_WRITE**

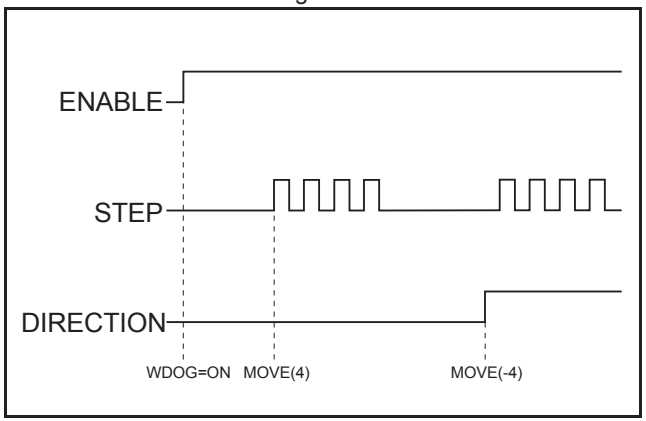
For more information, refer to the Trajexia Programming Manual.

3.13.10 Stepper

The TJ2-KS02 can generate pulses to drive an external stepper motor amplifier. You can use single step, half step and micro-stepping Drives with this interface. Applicable signals:

- Enable
- Step
- Direction.

fig. 150



Related BASIC commands

The following BASIC commands are related to stepper outputs:

- **ATYPE (ATYPE=43** and **ATYPE=60)**
- **INVERT_STEP**

For more information, refer to the Trajexia Programming Manual.

3.13.11 Registration

The TJ2-KS02 can capture the position of an axis in a register when an event occurs. The event is called the print registration input. On the rising or falling edge of an input signal (either the Z marker or one of the inputs), the TJ2-KS02 captures the position of the encoder axis in hardware. You can use this position to correct possible errors between the actual position and the desired position. You set up the print registration with the **REGIST** command.

Note
The TJ2-KS02 supports registration with both incremental and absolute encoders. In case of registration with an absolute encoder, the captured position (**REG_POS** or **REG_POSB**) is interpolated, using a time based counter which has a resolution of 100 ns.

The position is captured in hardware and therefore there is no software overhead. This eliminates the need to deal with timing issues.
Because the registration inputs are very fast, they are susceptible to noise in combination with slow rising and falling edges. To counter this problem, you can use a digital noise filter. Use of the noise filter increases the response time from 0.5 μs to 3.5 μs.
We refer to the **REGIST** command in the Trajexia Programming Manual for more information on using the registration inputs.

3.13.12 TJ2-KS02 box contents

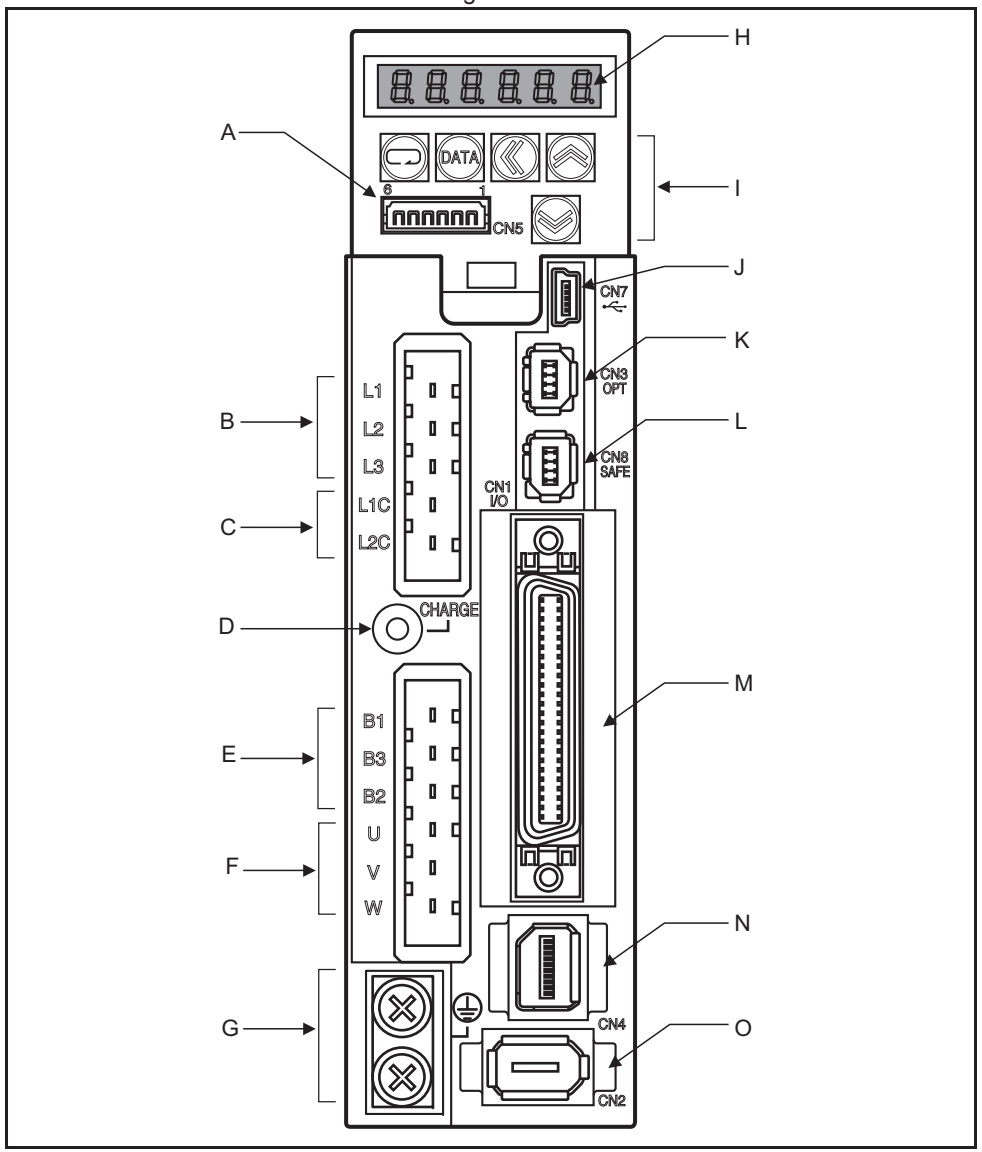
- Safety sheet.
- TJ2-KS02.
- Protection label attached to the top surface of the unit.
- Parts for a 4-pin connector.
- Parts for a 9-pin connector.

3.13.13 Accurax G5-A/P Servo Drives

An Accurax G5-A/P Servo Drive can be connected to a Trajexia system through the TJ2-KS02.

Label	Terminal/LED	Description
A	CN5	Analog monitor check pins
B	L1, L2, L3	Main-circuit power terminals
C	L1C, L2C	Control-circuit power terminals
D	CHARGE	Charge lamp
E	B1, B2, B3	External Regeneration Resistor connection terminals
F	U, V, W	Servomotor connection terminals
G	---	Protective ground terminals
H	---	Display
I	---	Operation area
J	CN7	USB connector
K	CN3	Expansion connector
L	CN8	Connector for safety function devices
M	CN1	Control I/O connector
N	CN4	Full-closed encoder connector
O	CN2	Encoder connector

fig. 151



CN1 I/O Signal connector

The table below shows the pin layout for the I/O signal connector (CN1).

Pin	I/O	Code	Signal name
7	Input	+24 VIN	12 to 24-VDC Power Supply Input
8	Input	SI1	General-purpose Input 1
9	Input	SI2	General-purpose Input 2
26	Input	SI3	General-purpose Input 3
27	Input	SI4	General-purpose Input 4
28	Input	SI5	General-purpose Input 5
29	Input	SI6	General-purpose Input 6
30	Input	SI7	General-purpose Input 7
31	Input	SI8	General-purpose Input 8
32	Input	SI9	General-purpose Input 9
33	Input	SI10	General-purpose Input 10
11	Output	SO1	General-purpose Output 1
10	Output	SO1COM	
35	Output	SO2	General-purpose Output 2
34	Output	SO2COM	
37	Output	/ALM (SO3)	Alarm output (general-purpose output 3)
36	Output	ALMCOM (SO3COM)	
39	Output	SO4	General-purpose Output 4
38	Output	SO4COM	
12	Output	SO5	General-purpose Output 5
40	Output	SO6	General-purpose Output 6
41	Output	SO5&6COM	General-purpose Outputs 5 & 6 common
42	---	BAT	Backup Battery Input
43	---	BATGND	
Shell	---	---	FG

fig. 152

2	PCOM	24-V open-collector input for command pulse	1	PCOM	24-V open-collector input for command pulse	27	SI4 (GSEL)	General-purpose input 4 (gain switching)	26	SI3*2	General-purpose input 3*2
4	-CW/ -PULS/-FA	Reverse pulses, feed pulses, or 90º phase difference signal (phase A)	3	+CW/ +PULS/+FA	Reverse pulses, feed pulses, or 90° phase difference signal (phase A)	29	SI6 (RUN)	General-purpose input 6 (operation command)	28	SI5*2	General-purpose input 5*2
6	-CCW/ -SIGN/-FB	Forward pulse, direction signal, or 90º phase difference signal (phase B)	5	+CCW/ +SIGN/+FB	Forward pulse, direction signal, or 90°phase difference signal (phase B)	31	SI8 (RESET)	General-purpose input 8 (alarm reset input)	30	SI7*2	General-purpose input 7*2
8	SI1 (NOT)	General-purpose input 1 (reverse drive prohibition input)	7	+24VIN	12 to 24-VDC power supply input	33	SI10*2	General-purpose input10*2	32	SI9 (TVSEL)	General-purpose input 9 (control mode switching)
10	SO1COM	General-purpose output 1 common	9	SI2 (POT)	General-purpose input 2 (forward drive prohibition input)	35	SO2 (READY)	General-purpose output 2 (servo ready completed output)	34	SO2COM	General-purpose output 2 common
12	SO5	General-purpose output 5*2	11	SO1 (BKIR)	General-purpose input 1 (brake interlock output)	37	/ALM [SO3]	Alarm output [general-purpose output 3]	36	ALMCOM [SO3COM]	Alarm output common [general-purpose output 3 common]
14	REF/TREF1/ VLIM	Speed command input, torque command input 1, speed limit input	13	SENGND	Signal ground	39	SO4*2	General-purpose output 4*2	38	SO4COM	General-purpose output 4 common
16	PCL/TREF2	Forward torque limit input, torque command input 2	15	AGND1	Analog ground 1	41	SO5&6COM	General-purpose output 5&6 common	40	SO6	General-purpose output 6*2
18	NCL	Reverse torque limit input	17	AGND2	Analog ground 2	43	BATGND	Absolute encoder backup battery input	42	BAT	Absolute encoder backup battery input
20	SEN	Sensor ON undefined	19	Z	Phase-Z output (open collector)	45	-CWLD	Reverse pulse (input for line driver only)	44	+CWLD	Reverse pulse (input for line driver only)
22	-A	Encoder phase A-output	21	+A	Encoder phase A+output	47	-CCWLD	Forward pulse (input for line driver only)	46	+CCWLD	Forward pulse (input for line driver only)
24	-Z	Encoder phase Z-output	23	+Z	Encoder phase Z+output	49	+B	Encoder phase B+output	48	-B	Encoder phase B-output
			25	ZGND	Phase-Z (open collector) common				50		*1

CN2 Encoder input connector

The table below shows the pin layout for the encoder connector.

Pin	Signal	Name
1	E5V	Encoder power supply +5 V
2	E0V	Encoder power supply GND
3	BAT+	Battery +
4	BAT-	Battery -
5	PS+	Encoder +phase S input
6	PS-	Encoder -phase S input
Shell	FG	Shield ground

CN3 Expansion connector

This connector is used to control the Servo drive through its synchronous serial interface.

CN4 External encoder connector

The table below shows the pin layout for the external encoder connector.

Pin	Signal	Name
1	E5V	Encoder power supply +5 V
2	E0V	Encoder power supply GND
3	PS+	Encoder +phase S input
4	PS-	Encoder -phase S input
5	EXA+	Encoder +phase A input
6	EXA-	Encoder -phase A input
7	EXB+	Encoder +phase B input
8	EXB-	Encoder -phase B input
9	EXZ+	Encoder +phase Z input
10	EXZ-	Encoder -phase Z input
Shell	FG	Shield ground

CN5 Monitor connector

The table below shows the pin layout for the CN5 monitor connector.

Pin	Signal	Name
1	AM1	Analog monitor output 1
2	AM2	Analog monitor output 2
3	GND	Analog monitor ground
4	---	Reserved: do not connect.
5	---	Reserved: do not connect.
6	---	Reserved: do not connect.

CN7 USB Connector

The table below shows the pin layout for the CN7 USB connector.

Pin	Signal	Name
1	VBUS	USB signal terminal
2	D+	
3	D-	
4	---	Reserved: do not connect.
5	SENGND	Signal ground

CN8 Safety connector

The table below shows the pin layout for the CN8 safety connector.

Pin	Signal	Name
1	---	Reserved: do not connect.
2	---	Reserved: do not connect.
3	SF1-	Safety input 1
4	SF1+	
5	SF2-	Safety input 2
6	SF2+	
7	EDM-	EDM output
8	EDM+	
Shell	FG	Shield ground

CNA Power supply connector

The table below shows the pin layout for the CNA power supply connector.

Pin	Signal	Name
1	L1	Main circuit power supply input
2	L2	
3	L3	
4	L1C	Control circuit power supply input
5	L2C	

CNB Servo motor connector

The table below shows the pin layout for the CNB servo motor connector.

Pin	Signal	Name
1	B1	External Regeneration Resistor connection terminals
2	B2	
3	B3	
4	U	Servomotor connection terminals
5	V	
6	W	

Restrictions

When using the G5-A/P Servo Drive with the serial interface enabled, the following limitations apply:

- Block programming operation is disabled
- Electric gear function is disabled
- Analog/pulse interface can only be used for monitoring
- Test run and FFT function via USB communication and Jog function via front panel cannot be used. If these functions are required, temporarily disable the option unit interface (Pn628=0).
- Set Pn616 (absolute I/F function setting) to 0 to disable the absolute I/F function. Do not use the pulse regeneration output function.
- The following functions are not allowed to assign to the multi-function inputs (SI1 to SI10):

Signal name	Symbol
Control mode switching input	TVSEL
Error counter reset input	ECRST
Pulse prohibition input	IPG
Electronic gear switching input 1	GESEL1
Electronic gear switching input 2	GESEL2
Internally set speed selection 1	VSEL1
Internally set speed selection 2	VSEL2
Internally set speed selection 3	VSEL3
Zero speed designation input	VZERO
Speed command sign input	VSIGN
Torque command sign input	TSIGN

  In case these functions are allocated, alarm 33.2 or 33.3 will occur.
- When the operation command (RUN), latch input 1 (EXT1) or latch input 2 (EXT2) are allocated, they need to be allocated to all control modes. Otherwise Alarm 33.8 (EXT input function allocation error) will occur.

Initial Drive configuration

To be able to connect the Servo Drive through CN3 to the TJ2-KS02, this interface has to be enabled. To do so, parameters Pn628 and Pn629 need to be changed.

Pn number	Parameter name	Description	Default setting	Unit	Setting range	Power supply OFF to ON
628	Special function selection	Set to 1 to enable the option unit interface	0	-	0 or 1	Yes
629	Option unit timeout	Time to wait for response from the option unit.	100	ms	100 – 10000	Yes

Sequence I/O Signal

Input Signals

When the option unit interface is enabled, the following additional functions can be allocated to the multi-function inputs (SI1 to SI10):

Signal name	Symbol	Set value		Input terminal that can be allocated
		NO	NC	
Latch input 1	EXT1	20h	Alarm 33	SI4 only
Latch input 2	EXT2	21h	Alarm 33	SI5 only
Homing input	HOME	22h	A2h	SI1-SI10

3.13.14 Output Signals

When the option unit interface is enabled, two additional outputs are available:

Pn number	Parameter name	Description	Default setting	Unit	Setting range	Power supply OFFto ON
414	Output Signal Selection 5	Set the output signal 5 function allocation.	460551	-	0 to 00FFFFFFh	Yes
415	Output Signal Selection 6	Set the output signal 6 function allocation.	394758	-	0 to 00FFFFFFh	Yes

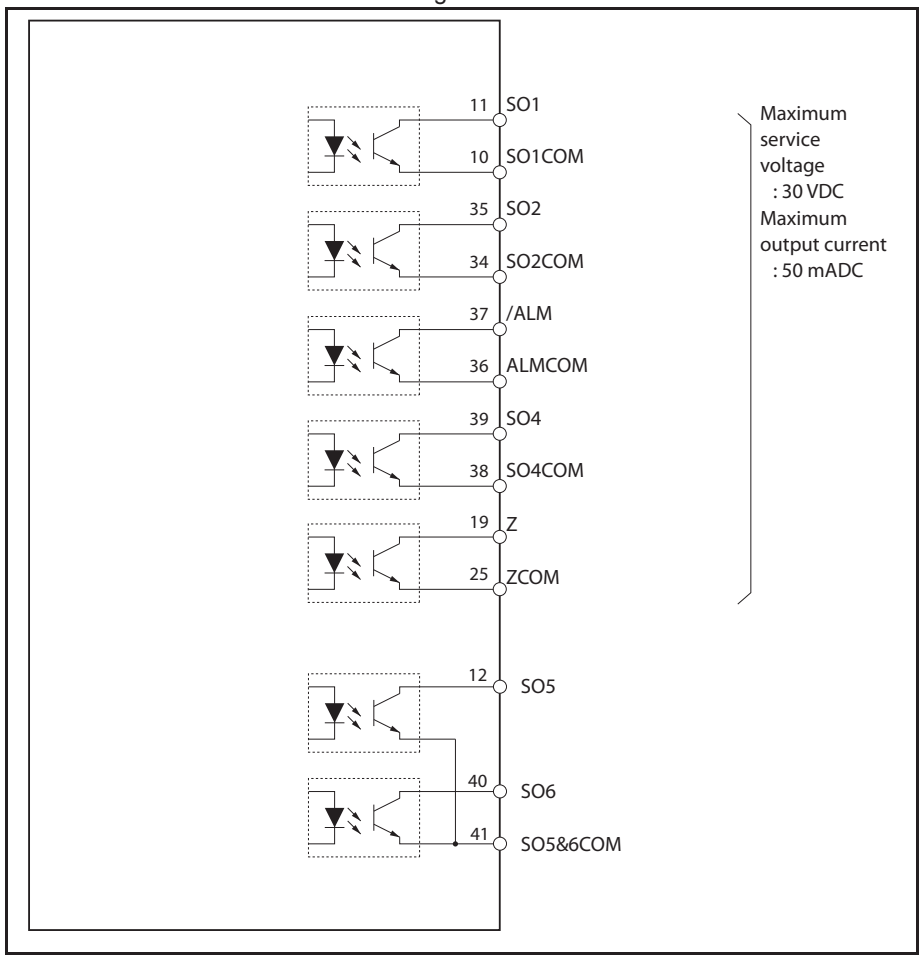
When the option unit interface is enabled, the following additional functions can be allocated to the multi-function outputs (SO1 to SO6):

Signal name	Symbol	Set value	Output terminal that can be allocated
Serial control output 1	S-CTRL1	20h	SO1, SO2, SO4, SO5, SO6
Serial control output 2	S-CTRL2	21h	SO1, SO2, SO4, SO5, SO6
Serial control output 3	S-CTRL3	22h	SO1, SO2, SO4, SO5, SO6

S-CTRL1 to S-CTRL3 can be controlled by using the **DRIVE_OUTPUTS** parameter in the TJ2-MC__:

Bit no.	Signal	Description
0	S-CTRL1	Serial control output 1
1	S-CTRL2	Serial control output 2
2	S-CTRL3	Serial control output 3

fig. 153



Warning list

When the option unit interface is enabled, the following additional warnings can occur:

Warning number	Warning name	Latch*1	Warning condition	Warning Output Selection (Pn440, Pn441)	Countermeasure
AAh	Serial bus communication warning	Always fixed with no time limit	Communication Error occurred 1 time.	Not available	• Check the routing of the communication cable and the FG wiring. • Mount ferrite cores on the communication cable. • Replace the servo drive or TJ2-KS02
ABh	Serial bus processing warning	Always fixed with no time limit	The command has been accepted and task processed but had any problem to cause abnormal termination.	Not available	• Check the power supply condition of the servo drive. • Replace the servo drive or TJ2-KS02

Alarm list

When the option unit interface is enabled, the following additional alarms can occur:

Alarm number		Error detection function	Detection details and probable cause	Countermeasure	Attribute		
Main	Sub				History	Can be cleared	Immediate stop
27	1	Absolute encoder clear error protection	A reset of the multi-rotation data of the absolute encoder has been executed over USB communications.	• Check whether a reset of the multi-rotation data of the absolute encoder has been executed over USB communications. Note: This is not a fault recovery procedure but a safety measure. Although no alarm is generated in case a reset of the multi-rotation data is executed over serial bus communications, reset the control power supply in such a case also.	√	–	–
27	4	Command error protection	Amount of change in the position command has exceeded a prespecified value.	• Check whether the amount of change in the position command is excessive, for example in interpolation.	√	–	–

Alarm number		Error detection function	Detection details and probable cause	Countermeasure	Attribute		
Main	Sub				History	Can be cleared	Immediate stop
29	2	Counter overflow error protection 2	The value of position deviation in the unit of pulse has exceeded $\pm 2^{29}$ (536870912), or the value of position deviation in the unit of command has exceeded $\pm 2^{30}$ (1073741824).	• Check whether the motor rotates in accordance with the position command. • Check on the torque monitor that the output torque is not saturated. • Perform gain adjustment. • Maximize Pn013 “First torque limit setting” and Pn524 “Second torque limit setting”. • Perform encoder connection as per the wiring diagram.	√	–	–
33	8	EXT input function allocation error	• While EXT1 or EXT2 is allocated to a general-purpose input, EXT1 input or EXT2 input is not allocated to all control modes. • EXT1 input is allocated elsewhere than SI4. • EXT2 input is allocated elsewhere than SI5. • EXT1 input or EX2 input is allocated via break contact.	• Allocate EXT1 input or EXT2 input to all control modes. • Check the EXT1 input allocation port and logic. • Check the EXT2 input allocation port and logic.	√	–	–
83	0	Serial bus communication error protection	Communication error occurred 4 consecutive times.	• Check if the communication cable is still connected to both the Servo Drive and the TJ2-KS02 • Check the routing of the communication cable and the FG wiring. • Mount ferrite cores on the communication cable. • Replace the servo drive or TJ2-KS02	√	√	–
84	0	Serial bus timeout error protection	SYNC signal is disconnected for 2 ms.	• Check if the communication cable is still connected to both the Servo Drive and the TJ2-KS02 • Check the routing of the communication cable and the FG wiring. • Mount ferrite cores on the communication cable. • Replace the servo drive or TJ2-KS02	√	√	–
	1	Serial bus SYNC signal error protection 1	Communication and servo cycle out of synchronization (SYNC signal is connected but cycle is abnormal).		√	√	–
	2	Serial bus SYNC signal error protection 2	SYNC signal was input 4 times or more for the communication cycle.		√	–	–
	3	Synchronization error protection	An error occurred in the synchronization processing.		√	–	–
86	0	Cyclic command error protection	Cyclic command is undefined.	• Check the processing by the option unit for any wrong cyclic command setting.	√	√	–

Alarm number		Error detection function	Detection details and probable cause	Countermeasure	Attribute		
Main	Sub				History	Can be cleared	Immediate stop
92	0	Encoder data recovery error protection	Initialization of internal position information was unsuccessful under semi-closed control in the absolute mode.	• Check if the power supply voltage of encoder is 5VDC±5% (4.75 to 5.25V). Take special care when the encoder cable is long. • Separate motor cables from encoder cables if they are tied together. • Connect a shielded wire to FG.	√	–	–
	1	External scale data recovery error protection	Initialization of internal position information was unsuccessful under full-closed control in the absolute mode.	• Check if the power supply voltage of encoder is 5VDC±5% (4.75 to 5.25V). Take special care when the encoder cable is long. • Separate motor cables from external scale connection cables if they are tied together. • Connect a shielded wire to FG. Refer to the external scale connection diagram. • Check the parameter set value.	√	–	–
93	2	Parameter setting error protection 2	External scale ratio has exceeded the permissible range.	Use the external scale ratio within the range of 1/40 to 160 times.	√	–	–

Parameter list

Below is the list of all parameters with their sizes in bytes. These sizes are necessary when accessing these parameters through **DRIVE_READ** and **DRIVE_WRITE**.

Pn number	Parameter name	Size
000	Rotation Direction Switching	2
001	CONTROL mode Selection	2
002	REALTIME AUTOTUNING mode selection	2
003	Realtime Autotuning Machine Rigidity Setting	2
004	Inertia Ratio	2
005	Command Pulse Input Selection	2
006	Command Pulse Rotation Direction Switching Selection	2
007	COMMAND PULSE mode Selection	2
008	Electronic Gear Integer Setting	4
009	Electronic Gear Ratio Numerator 1	4
010	Electronic Gear Ratio Denominator	4
011	Encoder Dividing Numerator	4
012	Encoder Output Direction Switching Selection	2
013	No. 1 Torque Limit	2
014	Error Counter Overflow Level Set the range of the error counter overflow	4
015	Operation Switch when Using Absolute Encoder	2
016	Regeneration Resistor Selection	2
017	External Regeneration Resistor Setting	2
100	Position Loop Gain	2
101	Speed Loop Gain	2
102	Speed Loop Integral Time Constant	2
103	Speed Feedback Filter Time Constant	2
104	Torque Command Filter Time Constant	2
105	Position Loop Gain 2	2
106	Speed Loop Gain 2	2
107	Speed Loop Integration Time Constant 2	2
108	Speed Feedback Filter Time Constant 2	2
109	Torque Command Filter Time Constant 2	2
110	Speed Feedforward Amount	2
111	Speed Feedforward Command Filter	2
112	Torque Feedforward Amount	2
113	Torque Feedforward Command Filter	2
114	GAIN SWITCHING INPUT OPERATING mode Selection	2
115	SWITCHING mode in Position Control	2
116	Gain Switching Delay Time in Position Control	2
117	Gain Switching Level in Position Control	2
118	Gain Switching Hysteresis in Position Control	2
119	Position Gain Switching Time	2
120	Switching Mode in Speed Control	2
121	Gain Switching Delay Time in Speed Control	2
122	Gain Switching Level in Speed Control	2
123	Gain Switching Hysteresis in Speed Control	2
124	Switching Mode in Torque Control	2
125	Gain Switching Delay Time in Torque Control	2
126	Gain Switching Level in Torque Control	2
127	Gain Switching Hysteresis in Torque Control	2
200	Adaptive Filter Selection	2
201	Notch 1 Frequency Setting	2
202	Notch 1 Width Setting	2
203	Notch 1 Depth Setting	2
204	Notch 2 Frequency Setting	2
205	Notch 2 Width Setting	2
206	Notch 2 Depth Setting	2
207	Notch 3 Frequency Setting	2
208	Notch 3 Width Setting	2
209	Notch 3 Depth Setting	2

Pn number	Parameter name	Size
210	Notch 4 Frequency Setting	2
211	Notch 4 Width Setting	2
212	Notch 4 Depth Setting	2
213	Damping Filter Selection	2
214	Damping Frequency 1	2
215	Damping Filter 1 Setting	2
216	Damping Frequency 2	2
217	Damping Filter 2 Setting	2
218	Damping Frequency 3	2
219	Damping Filter 3 Setting	2
220	Damping Frequency 4	2
221	Damping Filter 4 Setting	2
222	Position Command Filter Time Constant	2
223	Smoothing Filter Time Constant	2
300	Command Speed Selection	2
301	Speed Command Direction Selection	2
302	Speed Command Scale	2
303	Analog Speed Command Rotation Direction Switching	2
304	No. 1 Internally Set Speed	2
305	No. 2 Internally Set Speed	2
306	No. 3 Internally Set Speed	2
307	No. 4 Internally Set Speed	2
308	No. 5 Internally Set Speed	2
309	No. 6 Internally Set Speed	2
310	No. 7 Internally Set Speed	2
311	No. 8 Internally Set Speed	2
312	Soft Start Acceleration Time	2
313	Soft Start Deceleration Time	2
314	S-curve Acceleration/Deceleration Time Setting	2
315	Zero Speed Designation Selection	2
316	Position Lock Level Setting	2

Pn number	Parameter name	Size
317	Torque Command/Speed Limit Selection	2
318	Torque Command Direction Selection	2
319	Torque Command Scale	2
320	Analog Torque Command Rotation Direction Switching	2
321	Speed Limit Value Setting	2
322	Reverse Direction Speed Limit Value Setting	2
323	External Feedback Pulse Type Selection	2
324	External Feedback Pulse Dividing Numerator	4
325	External Feedback Pulse Dividing Denominator	4
326	External Feedback Pulse Direction Switching	2
327	External Feedback Pulse Phase-Z Setting	2
328	Internal/External Feedback Pulse Error Counter Overflow Level	4
329	Internal/External Feedback Pulse Error Counter Reset	2
400	Input Signal Selection 1	4
401	Input Signal Selection 2	4
402	Input Signal Selection 3	4
403	Input Signal Selection 4	4
404	Input Signal Selection 5	4
405	Input Signal Selection 6	4
406	Input Signal Selection 7	4
407	Input Signal Selection 8	4
408	Input Signal Selection 9	4
409	Input Signal Selection 10	4
410	Output Signal Selection 1	4
411	Output Signal Selection 2	4
412	Not used	4
413	Output Signal Selection 4	4
414	Output Signal Selection 5	4
415	Output Signal Selection 6	4
416	Analog Monitor 1 Selection	2
417	Analog Monitor 1 Scale Setting	4

Pn number	Parameter name	Size
418	Analog Monitor 2 Selection	2
419	Analog Monitor 2 Scale Setting	4
421	Analog Monitor Output Setting	2
422	Analog Input 1 Offset	2
423	Analog Input 1 Filter Time Constant	2
424	Excessive Analog Input 1	2
425	Analog Input 2 Offset	2
426	Analog Input 2 Filter Time Constant	2
427	Excessive Analog Input 2	2
428	Analog Input 3 Offset	2
429	Analog Input 3 Filter Time Constant	2
430	Excessive Analog Input 3	2
431	Positioning Completion Range 1	4
432	Positioning Completion Condition Selection	2
433	Positioning Completion Hold Time	2
434	Zero Speed Detection	2
435	Speed Conformity Detection Range	2
436	Rotation Speed for Motor Rotation Detection	2
437	Brake Timing when Stopped	2
438	Brake Timing During Operation	2
439	Brake Release Speed Setting	2
440	Warning Output Selection 1	2
441	Warning Output Selection 2	2
442	Positioning Completion Range 2	4
500	Electronic Gear Ratio Numerator 2	4
501	Electronic Gear Ratio Numerator 3	4
502	Electronic Gear Ratio Numerator 4	4
503	Encoder Dividing Denominator	4
504	Drive Prohibition Input Selection	2
505	Stop Selection for Drive Prohibition Input	2
506	Stop Selection with Servo OFF	2

Pn number	Parameter name	Size
507	Stop Selection with Main Power Supply OFF	2
508	Undervoltage Alarm Selection	2
509	Momentary Hold Time	2
510	Stop Selection for Alarm Detection	2
511	Immediate Stop Torque	2
512	Overload Detection Level Setting	2
513	Overspeed Detection Level Setting	2
514	Overrun Limit Setting	2
515	Control Input Signal Read Setting	2
516	Alarm Reset Condition Setting	2
517	Error Counter Reset Condition Selection	2
518	Command Pulse Prohibition Input Setting	2
519	Command Pulse Prohibition Input Read Setting	2
520	Position Setting Unit Selection	2
521	Torque Limit Selection	2
522	No. 2 Torque Limit	2
523	Torque Limit Switching Setting 1	2
524	Torque Limit Switching Setting 2	2
525	Forward External Torque Limit	2
526	Reverse External Torque Limit	2
527	Analog Torque Limit Scale	2
528	Default Display	2
531	Axis Number	2
532	Command Pulse Input Maximum Setting	2
533	Pulse Regeneration Limit Output Setting	2
535	Front Key Protection Setting	2
600	Analog Torque Feed-forward Gain Setting	2
602	Excessive Speed Error Setting	2
604	Jog Speed	2
605	Gain 3 Effective Time	2
606	Gain 3 Ratio Setting	2

Pn number	Parameter name	Size
607	Torque Command Value Offset	2
608	Forward Direction Torque Offset	2
609	Reverse Direction Torque Offset	2
610	Function Expansion Setting	2
611	Electric Current Response Setting	2
613	Inertia Ratio 2	2
614	Alarm Detection Allowable Time Setting	2
615	Overspeed Detection Level Setting at Immediate Stop	2
616	Absolute Interface Function Selection	2
617	Front Panel Parameter Write Selection	2
618	Power Supply ON Initialization Time	2
619	Encoder Phase-Z Setting	2
620	External Encoder Phase-Z Expansion Setting	2
621	Serial Absolute External Encoder Phase-Z Setting	4
622	Phase-AB Regeneration Method Selection for External Encoder of Phase-AB Output Type	2
623	Disturbance Torque Compensation Gain	2
624	Disturbance Observer Filter Setting	2
627	Warning Latch Hold Time Selection	2
628	Special function selection	2
629	Option unit timeout	2
631	Realtime Autotuning Estimated Speed Selection	2
632	Realtime Autotuning Customization Mode Setting	2
633	Absolute Encoder Initial Pulse Regeneration Speed	2
634	Hybrid Vibration Suppression Gain	2
635	Hybrid Vibration Suppression Filter	2
637	Vibration Detection Threshold	2
638	Warning Mask Setting	2

Related BASIC commands

The following BASIC commands are related to the Accurax G5-A/P Servo Drives:

- **ATYPE**
- **AXIS**
- **AXIS_ENABLE**
- **AXISSTATUS**
- **DRIVE_ALARM**
- **DRIVE_CLEAR**
- **DRIVE_CONTROL**
- **DRIVE_MONITOR**
- **DRIVE_INPUTS**
- **DRIVE_OUTPUTS**
- **DRIVE_READ**
- **DRIVE_STATUS**
- **DRIVE_WRITE**

For more information, refer to the Trajexia Programming Manual.

Revision history

A manual revision code shows as a suffix to the catalogue number on the front cover of the manual.

Revision code	Date	Revised content
01	February 2010	First version
02	January 2011	TJ2-ECT__ EtherCAT master added GRT1-ECT EtherCAT SmartSlice coupler added
03	July 2011	GX-series and FZM1-ECT added
04	February 2012	GX-JC03 and -JC06 added FQ-M-series Vision Sensors added RX-MRT added
05	June 2012	TJ2-MC02 and TJ2-KS02 added

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