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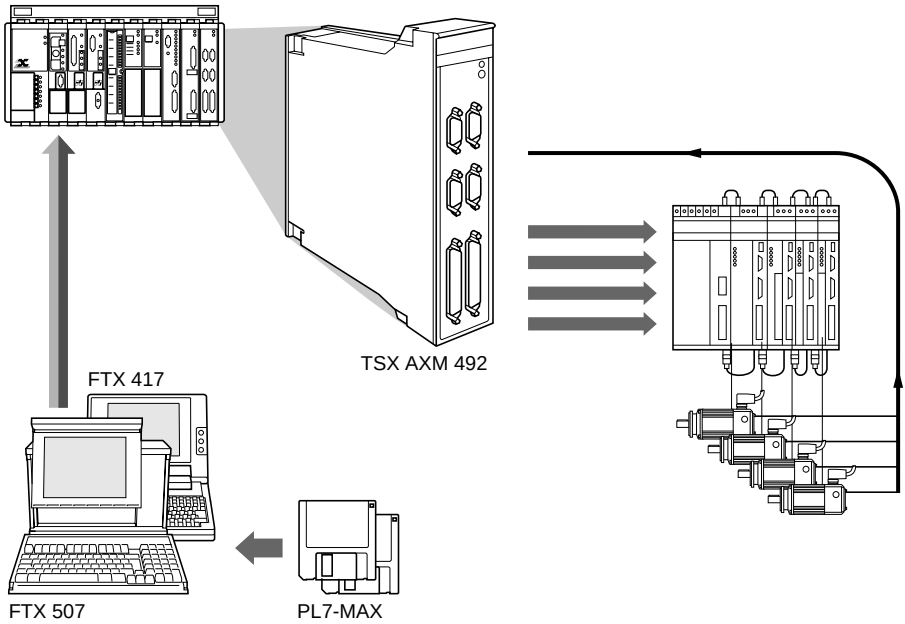
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1.1 Introduction

1.1-1 Multi-axis control range



The multi-axis control range for TSX model 40 PLCs is designed to meet the requirements of machine manufacturers.

The range covers a wide variety of requirements from the control of independent movements through to the control of 3 interpolated axes on a cartesian mechanism.

It is designed for machines which require high performance movement control together with simultaneous sequential control via a PLC.

It is not currently designed for non-cartesian mechanisms such as SCARA type robots or poly-articulated mechanisms. It cannot handle circular interpolation.

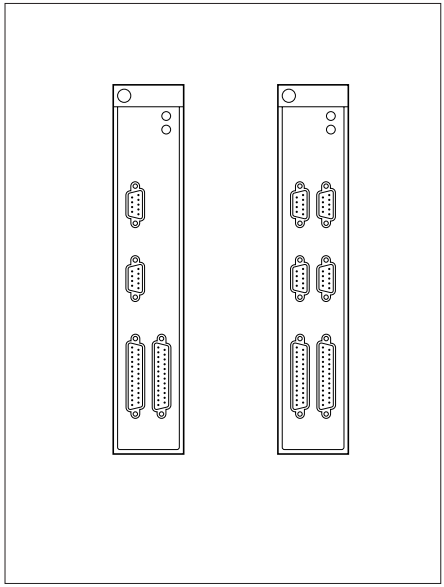
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1.1-2 Set of 2 components

Multi-axis control modules

There are 2 modules :

- 2-axis module with inputs for incremental encoder or absolute encoder with serial link :
  TSX AXM 292.
  This type of module is used for controlling a group of 2 interpolated axes or 2 independent axes.
- 4-axis module with inputs for incremental encoder or absolute encoder via serial link :
  TSX AXM 492.
  This type of module is used for controlling a group of 3 interpolated axes and one independent axis, or 2 groups of 2 interpolated (or independent) axes or 4 independent axes.
  Capacity of TSX AXM 492 module :
  - 4 axes with incremental encoder
  - 3 axes with absolute encoder

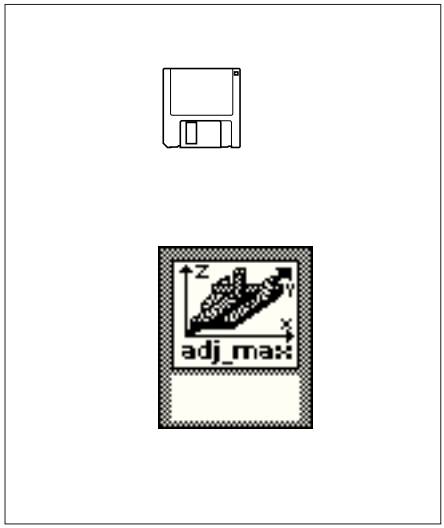


Setup software

PL7-3 language extension software, comprising 3 function blocks :

- MOVE for controlling independent axes,
- DMOVE for controlling 2 linearly interpolated axes,
- TMOVE for controlling 3 linearly interpolated axes.

This software is used for adjusting the parameters of the axes and for initiating movements. It runs under the X-TEL or MINI X-TEL software workshop (V5).



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1.2 Functions

For each of the axes, multi-axis control modules provide :

Inputs :
- An input for the acquisition of position measurements from an incremental encoder (with encoder contamination fault signal) or an SSI absolute encoder.
- An input serving as a reference point cam (if an incremental encoder is selected).
- An event input.
- A speed drive fault input.
- A speed drive present or emergency stop input.

Outputs :
- A ± 10 V analog output isolated from the logic part of the module, with a resolution of 13 bits + sign for controlling a speed drive connected to a self-starting synchronous motor, or to a self-controlled asynchronous motor.
- A relay output for speed drive validation.

Functions
TSX AXM 292/492 multi-axis control modules control the position and linear motion of moving parts (on cartesian mechanisms). Single movement commands are given by the main sequential control program of the machine, but performed and controlled by TSX AXM 292/492 modules.

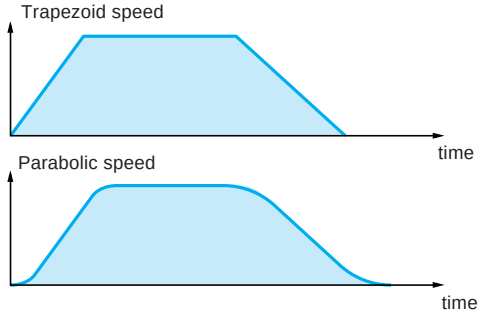
The axes on a module may be linearly interpolated in groups of 2 or 3 to control a cartesian mechanism (example : XY table or gantry).

The position is measured by :
- An RS 485 incremental encoder (maximum frequency 250 kHz). The module selects multiplication by one or by four.
- An absolute encoder, 16 to 24 data bits, with serial link, and transmission using SSI protocol.

Position control servo loop :
The equalizer is a proportional type with feedforward to reduce deviation.

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Control profile :
The user can choose between two types of profile for each group of axes :
- Trapezoid speed profile (acceleration and deceleration are separate variables which can be modified).
- Parabolic speed profile (the acceleration and deceleration derivative functions are separate variables which can be modified).



Description of movements :
Each elementary movement is defined by a movement control function block in PL7-3 language. This ensures a true symbiosis between the movement control and the actual sequential control. The standard organization of programs and data in TSX/PMX model 40 version V5 PLCs provides flexible commands suitable for the productivity demands for modern manufacturing machines.

1.3 Performance

The characteristics of the movements do not depend on the incremental or absolute nature of the encoders. The maximum characteristics depend on the resolution and unit selected.

Unit	**µm**	**10^{-5} degree**	**10^{-5} inch**	**Increment**
Resolution	1...1000 µm	1...1000 10^{-5} degrees	4...4000 10^{-5} inches	1 incr.
Max. axis length	200 m(1)	360 degrees	8000 inches	16 10^{6} inc.
Maximum speed	540 m/min	5400 degrees/min	21 600 inches/min	900000 inc/s
Maximum acceleration	450 m/s^2	4500 degrees/s^2	18 000 inches/s^2	400000 inc/s^2

(1) 16000000XR limited to 200m.

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1.4 Operation

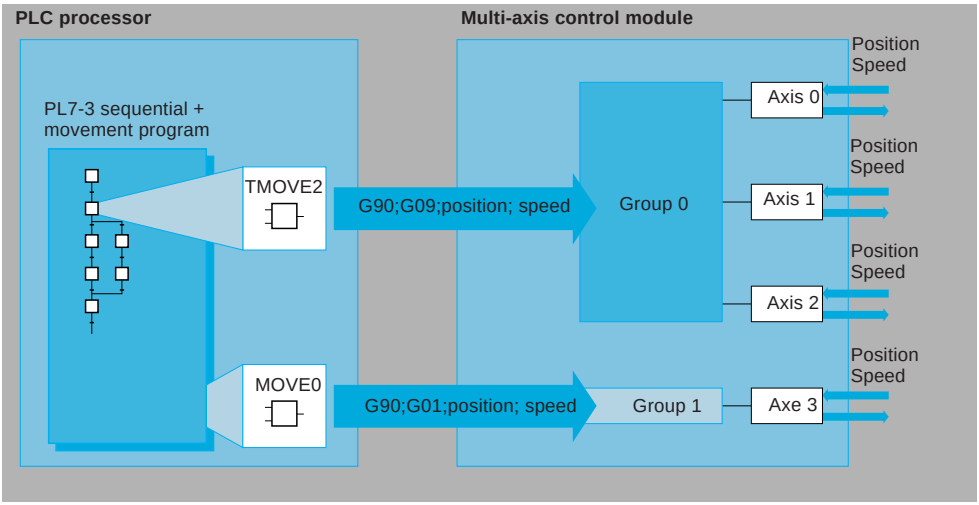
The machine axes are organized into groups of 1, 2 or 3 axes according to whether they are to operate independently or to be interpolated in twos or threes.

Each group is controlled by a function block :
- TMOVEi for 3 interpolated axes,
- DMOVEi for 2 interpolated axes,
- MOVEi for one independent axis.

Each group is identified by the number and type of function block by which it is controlled.

Example :
In the diagram below :
- Group 0 consists of axes 0, 1 and 2,
- Group 1 consists of axis 3.

Group 0 is controlled by function block TMOVE2 and group 1 by function block MOVE0.



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Each movement of the moving part is controlled by the execution of the movement control function block in the PL7-3 program.
The PLC program integrates control of the automated system involving both sequential and movement control.

These function blocks are used to define and send the characteristics of each elementary movement to the axis control module which executes the command and controls the movements.

The module performs the sequence of commands autonomously by means of a storage mechanism. The TSX AXM 292/492 module stores two successive movement commands for each group of axes : the command currently being executed and the next command. The execution time for a movement must be greater than the master task cycle time.

TSX AXM 292/492 modules perform multi-axis interpolation functions, position control functions, and send speed settings in the form of voltage signals in the range ± 10 V to the speed drives assigned respectively to each axis.

1.5 Characteristics

Encoder inputs (1)

Incremental encoder	RS 485 link (Max frequency : 250 kHz)
Absolute encoder	Serial link, SSI transmission, 16...24 data bits (Max frequency : depends on encoder)
Differential voltage	≥ 0.2 V (for state 0), ≤ -0.2 V (for state 1)
Hysteresis	[redacted]
Common mode voltage	≤ 7 V
Differential mode voltage	≤ 12 V
Line adaptation	Integrated in module
Power supply	[redacted]

Note : it is possible to power the [redacted] supply (see Section 4.2-2 or 4.2-3).

Cam and event inputs

Nominal voltage	[redacted]
Permissible voltage	[redacted]
Input impedance	3.2 kΩ at nominal voltage (current drain)
Nominal current	7.5 mA
Voltage at state 1	≥ 11 V
Current at state 1	≥ 6 mA
Voltage at state 0	< 5 V
Current at state 0	< 3 mA
Response time	22...82 µs (cam input), 32 µs (event input)

(1) See specialized catalogue on XCC rotary encoders : reference 41515.
Do not connect incremental and absolute encoders at the same time to one module.

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[redacted]

Speed drive fault input

Nominal voltage	[redacted]
Permissible voltages	[redacted]...30[redacted]
Input impedance	3.4 kΩ
Nominal current	7 mA
Voltage at state 1	≥ 11 V
Current at state 1	≥ 2 mA
Voltage at state 0	≤ 5 V
Current at state 0	≤ 1.4 mA
Response time	4.5...6.8 ms

Encoder contamination fault and speed drive present inputs

Type	TTL
Detection thresholds	Voltage < 1.4 V Current (drawn) > 1mA
Response time	1.9...2.9 ms (acknowledgment), 13...20 ms (return to normal or speed drive not present)

Analog outputs

Range	-10...+10 V
Real range	-10.24...+10.24 V
Resolution	13 bits + sign
Linearity	0.025% full scale (±2 LSB)
Precision	0.21% full scale (0°C to 60°C)
Maximum load	[redacted]
Protection	against short-circuits

Auxiliary relay outputs

Nominal operating voltage	[redacted] V
Permissible current (1)	200 mA
Response time	<10 ms (deactivation) < 5 ms (activation)
Min permissible load	1 mA at 5V

Isolation

Between inputs and the bus	1500 Vrms
Between channels (inputs or outputs)	500 Vrms

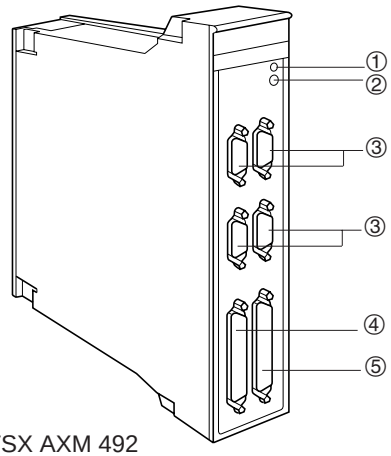
Electrical consumption

Power supply		Typical consumption
5 VL		1.8 A
5 Vexternal (2)	AXM 492	400 mA
	AXM 292	200 mA
12 VL		12 mA
12 VP	AXM 492	38 mA
	AXM 292	19 mA

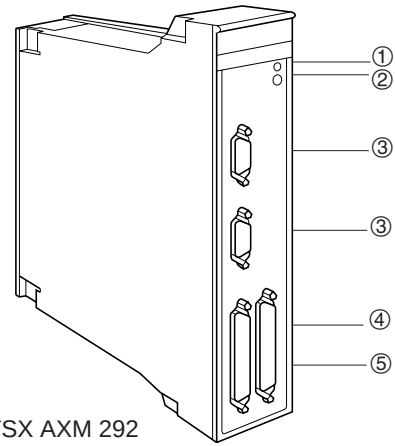
(1) Permissible current for 0.1 million operations. If there is an inductive load, a flywheel diode should be connected across the load.
(2) Consumption on 5 V external supply to the module (excluding encoder).

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1.6 Description



TSX AXM 492



TSX AXM 292

TSX AXM 292/492 multi-axis control modules comprise :

①A red indicator lamp : module fault.

②A green indicator lamp indicating that there is no module I/O fault.

③9-pin female SUB-D connectors for connecting encoders for axes 0, 1, 2 and 3 respectively.
(2 connectors for the TSX AXM 292 module)

④A 25-pin female SUB-D connector :
- ±10 V outputs for speed drive control
- speed drive fault discrete inputs
- speed drive present detection or emergency stop inputs

(there are two of each type of input or output on the TSX AXM 292 module and four on the TSX AXM 492 module)

⑤A 25-pin male SUB-D connector :
- reference point cam input,
- event input,
- sp[redacted]
(the[redacted]or output on the TSX AXM 292 module and four on the TSX AXM 492 module)
- a [redacted]
- a [redacted]

Connection accessories :

- The **TSX CAC 90** connector set comprises :
  - 4 x 9-pin male SUB-D soldering connectors for encoders ③,
  - 1 x 25-pin male SUB-D soldering connector for analog outputs ④,
  - 1 x 25-pin female SUB-D soldering connector for auxiliary I/O and power supply ⑤,
- The **TSX CAC 92** connector set also comprises, in addition to connectors ④ and ⑤, an encoder input adaptor used to connect encoders with short-circuit monitoring of the encoder inputs and of the 5 V supply. This accessory is used to monitor 2 encoder inputs (documentation is supplied with the product).

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1.7 Description of PL7-MAX software

PL7-MAX multi-axis control setup software comprises :

- Movement control function blocks which are extensions of PL7-3 software, for programming movements (OFB MAX diskette).
- A software tool which runs under the MINI X-TEL and X-TEL software workshops, for adjusting and moving the axes (ADJ MAX diskette).

Programming movements

The OFB MAX movement control software provides 3 types of function block : MOVE, DMOVE and TMOVE.

Various software workshop and PL7-3 software tools are used to set up multi-axis control.

A movement is initiated by executing the control function block in the PL7-3 program.

Example :

Go to the absolute position 10 000 000 µm, at a speed of 200 mm/min, without stopping.

Significance of each parameter :

MOVE0 : move along an axis

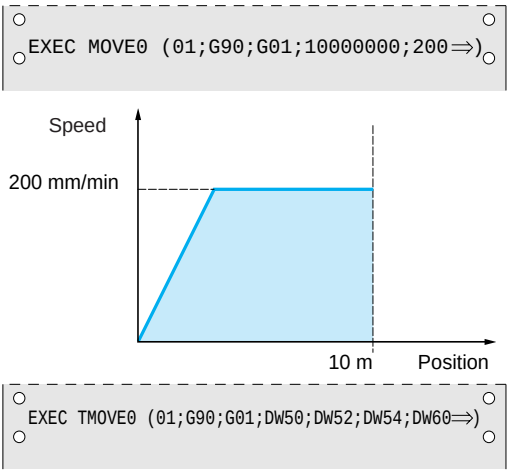
01 : movement number 1

G90 : move to an absolute position

G01 : instruction code corresponding to movement to a position without stopping.

10 000 000 : position to be reached by the moving part in µm.

200 : speed of the moving part in mm/min.



Example : Syntax for 3-axis control

In this example, the position to be reached is stored in word DW50 for the X axis, DW52 for the Y axis and DW54 for the Z axis, and the velocity in word DW60. **These words can be represented by symbols and indexed.**

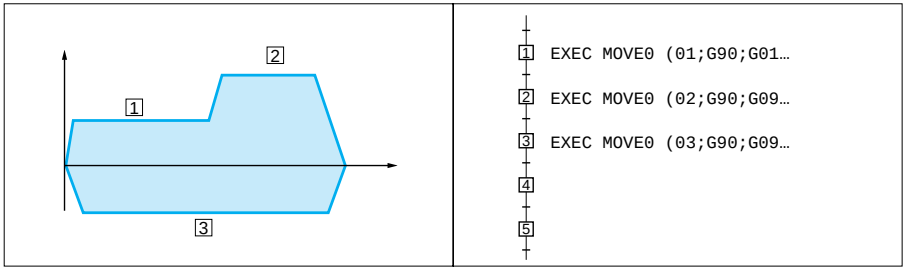
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Instructions

The characteristics of movements are described using a syntax similar to that for a numerical control program block written in ISO language.
Multi-axis control provides the following instructions :
G09 : move to the position and stop
G01/G30/G31 : move to the position without stopping (1)
G10 : move until an event is detected and stop
G11 : move until an event is detected without stopping
G14 : reference point on axis X
G15 : reference point on axis Y
G16 : reference point on axis Z
G20 : reserved for the system
G54 : validate the offset in relation to an indexed position
G53 : cancel the offset in relation to an indexed position
G05 : await an event
G07 : memorize the current position when an event occurs
Codes G90 and G91 placed before the instruction codes indicate whether the target position is absolute or relative.

Programming a trajectory

A complete trajectory can be programmed by means of a series of movement control function blocks.
Grafcet language is ideal for this type of programming. A single movement is associated with a step.



(1) Instructions G30 and G31 will be available from version V1.4 onwards.

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Once the multi-axis control application has been programmed using PL7-3, the ADJ MAX software tool is used to adjust the various axis parameters and to start up the application. The ADJ MAX software tool operates under the X-TEL or MINI X-TEL software workshop in connected mode.

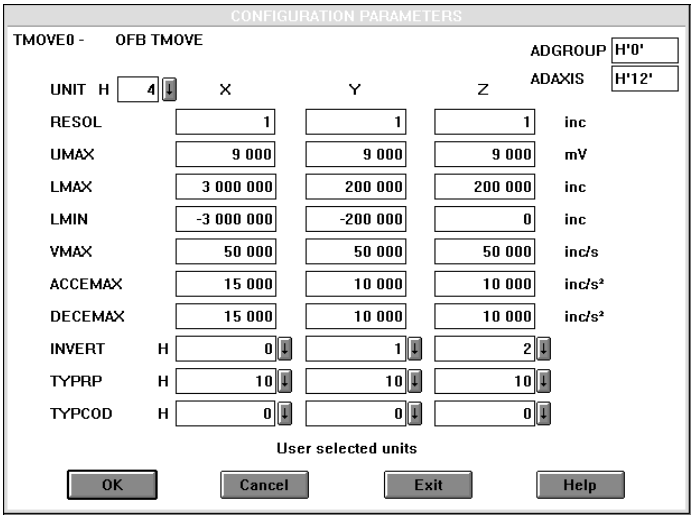
Adjusting the axes

The ADJ MAX software tool provides assistance with entering and modifying the values of the various axis parameters on site. These parameters enable the operation of the module to be adapted to the machine which is to be controlled. After validation, these parameters are transmitted to the function blocks which control the axes.

There are two types of parameter :

- Axis configuration parameters : type of encoder, encoder resolution, maximum and minimum position limits, speed, etc. These parameters are linked to the machine and cannot be modified by the program
- Axis operation parameters, of which there are three categories :
  - Command parameters : soft limits, maximum acceleration and deceleration, velocity profile, etc.
  - Servo parameters : position gain, feedforward coefficient, etc.
  - Error control parameters : deviation, etc.

  These parameters can be modified using the PL7-3 program.



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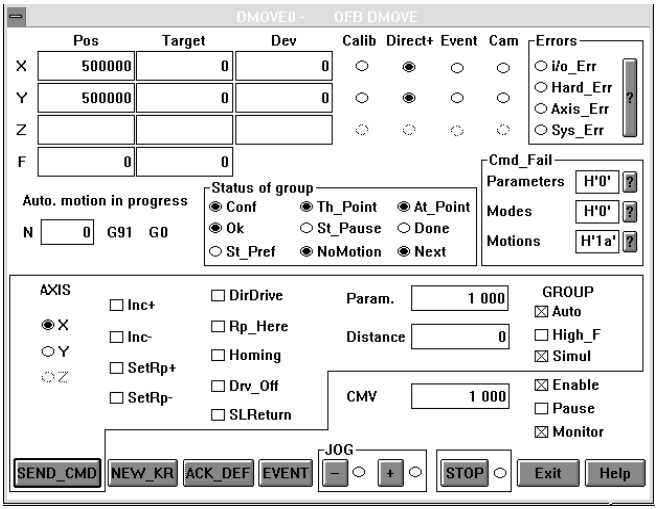
Debugging

The ADJ MAX software tool also provides the user with a control panel screen, giving him a quick visual display which he can use to control and observe the operation of a group of axes.
A simplified control panel is also available which provides a simultaneous display of 4 independent axes.

The upper area of the screen is the display part (measurement, deviations, current instruction, etc).

The lower area of the screen is the control part (selection of axis to be monitored, selection of operating modes, manual controls).

The manual and simulation operating modes are used for testing the axes and the program.



Operator dialogue and control

The user can make use of all the commands and all the axis control parameters and measurements in the CPU in the form of PL7-3 language objects. He can thus design the control dialogue for his machine and include in it all or part of the axis control data. This operator dialogue can be supported by TSX CPX 37 or CCX 57/77 terminals.

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2.1 Items required for multi-axis control

A multi-axis control application is programmed using PL7-3 software and various X-TEL and MINI X-TEL software workshop tools (XTEL-CONF, XTEL-SDBASE, XTEL-TRANSFER).

It is therefore necessary to be familiar with this software in order to be able to program a multi-axis application successfully.

Only the part which relates to setting up multi-axis modules is described in this manual.

For further information, refer to the following manuals :

- X-TEL or MINI-XTEL reference manuals and those on the basic tools.
- PL7-3 operating modes and reference manuals.

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3.1 Configuration required for PL7-MAX software

To install PL7-MAX software, an FTX terminal or an IBM PS/2 microcomputer or PC compatible is required, with :

- OS/2 operating system
- X-TEL V5 or MINI X-TEL V5 software workshop
- PL7-3 V5 software

3.2 Checking the hardware

The TXT L PL7 MAX V5 software package comprises :

- A 3" 1/2 diskette, reference TXT LF ADJ MAX V5
- A 3" 1/2 diskette, reference TXT LF FB MAX V5
- A software protection key
- A licence agreement
- This manual, reference TXT DM PL7 MAX V5E.

3.3 Terminal connections

All connections specific to the terminal (monitor, keyboard, mouse, printer, software key support, etc) are assumed to be made. Place the software key in the empty slot in the key support.

This operation must be performed with the equipment switched off.

Note
This software key contains the access rights which are needed to access PL7-MAX software. The Key Manager tool, supplied as standard with each X-TEL or MINI X-TEL software workshop, allows these rights to be transferred to the working key so that all rights are grouped on one key (the working key) in order to free a slot on the key support. For further details on using this tool, refer to the X-TEL and MINI X-TEL software workshop manuals.

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3.4 Installing PL7-MAX software

3.4-1 Preliminary operations

Before installing the PL7-MAX software on the hard disk it is advisable to :

- Read the licence agreement and warranty concerning the restrictions on copying and installing the software.
- Make duplicates of the diskettes required for installation to avoid any accidental damage to the originals, and work only on the copies.

Important

The PL7-MAX diskettes are supplied in the write-locked position. Do not alter the position of the locking tabs.

3.4-2 Installation procedure

- Switch the terminal on (if it is already switched on, close all current OS/2 sessions).
- Open an OS/2 full-screen session. To do this :
  - open the Start Programs window
  - pull down the Group menu and select the Main Group item
  - select the OS/2 full-screen session item. The prompt [C:\] is displayed on the screen.
- Insert the TXT LF ADJ MAX V5 diskette in the disk drive.
- Enter the drive identifier (a: or b:), then press <Enter>.
- From the new prompt (for example [A:\] or [B:\], type **Install** then press <Enter>.
- Follow the procedure displayed on the screen.
- When installation is complete, replace the diskette with the second diskette (reference TXT LF FB MAX V5).
- Type **Install** then press <Enter>.
- Follow the procedure displayed on the screen.
- When installation is complete and if it is the last one, check the configuration. Press <Enter>, remove the diskette from the drive and return to OS/2 using the command <Ctrl><Esc>.

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4.1 Selection of the slot and locating device

4.1-1 Possible locations for modules

TSX AXM •92 modules must be installed :
- in PLC configurations using V5 processors,
- in fan-cooled racks having a complete bus, and supplied by a TSX SUP 702.

	Processor	Rack	Slot
PLC base	All TSX/PMX V5 processors except the TSX P47 405	TSX RKN 82F	All slots 0 to 7
Local or remote extension	_	TSX RKN 8F	All slots 0 to 7

It is not possible to install a TSX AXM •92 module in a TSX RKE 8 / RKE 7 direct extension rack.

The maximum number of multi-axis control modules which can be used in a PLC configuration depends on :
- the type of processor selected
- the power consumption of each rack
- the response times (see Section 15)

The following table shows the number of axes recommended by Telemecanique :

Type of processor	P47	P67	P87	P107
Typical number of axes per configuration	8	12	16	20

These numbers are given for a master task duration of 100ms with 30% of the PLC processor capacity used for multi-axis control.

General rules
- Do not install more than 3 TSX AXM •92 modules in one rack.
- In the software configuration, the modules must be declared in the master task.
- Since TSX AXM •92 modules have a high passband, they should be kept away from all sources of electromagnetic radiation. It is therefore also advisable keep them away from devices which switch high voltages.
- They should not be connected or disconnected when switched on.
- When modules are used in remote racks, it is advisable to power these remote racks from the same 220V electrical supply as the main rack.

4.1-2 Locating devices

There are 3 female coding devices on the back of the module :
- TSX AXM 292 : code 736
- TSX AXM 492 : code 737

To ensure correct installation, set the rack coding devices to the appropriate code.

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4.2 Connection

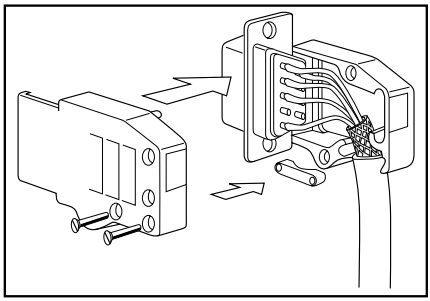
4.2-1 Principles

A TSX CAC 90 kit is used for connection. It comprises :
- Four 9-pin male SUB-D soldering connectors for connecting the encoders.
- One 25-pin male SUB-D soldering connector for connecting the analog outputs.
- One 25-pin female SUB-D soldering connector for connecting the auxiliary I/O and the power supplies.

Extreme care should be taken when connecting the encoder and auxiliary signals, and the 5 V and 24 V supplies on TSX AXM 492/292 modules.

The following should be taken into account when connecting :
- Voltage drop in the cables carrying the encoder supplies (0V and 5V). The 5V at the encoders should be within the limits given by the manufacturer (generally ± 5%).
- The encoder inputs and certain of the auxiliary inputs are very high speed. They must therefore be protected against external induced noise in serial and common mode. All connections must be made using screened cables and if possible (especially for the RS485 encoder signals) in twisted pairs.
  The screening must be grounded at both ends of the cable and it is strongly recommended that the power supply 0 V is connected to ground (at each supply output).

The screening must be tightly fastened in the clamp on the metal-coated plastic cover.



Grouping the cables in bundles :
Where the signals are of the same type, it is possible to group cables into multiple pair bundles.

Cable routing :
- Keep the measurement wires away from the discrete I/O cables (especially the relay outputs) and the power cables.
- Avoid parallel routing (the cables should be at least 20 cm apart) and make any crossings at right angles.

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4.2-2 Connecting an incremental encoder

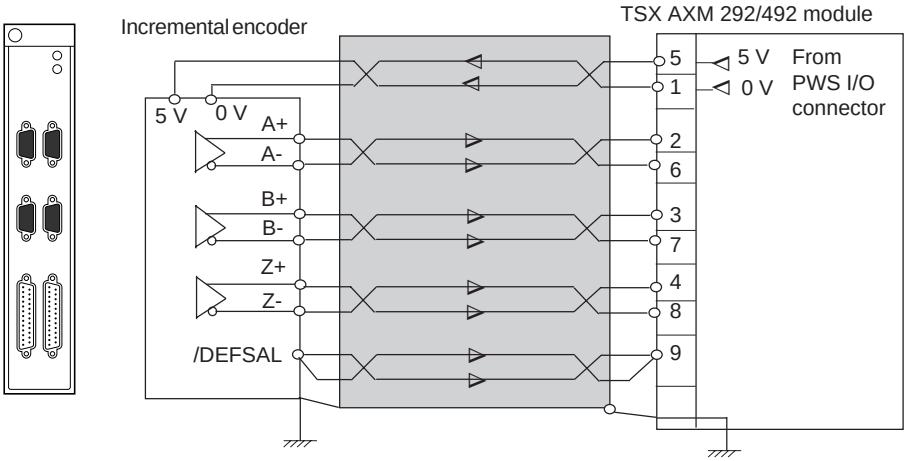
Inputs ENC0, ENC1, ENC2 and ENC3 (ENC0 and ENC1 only for the TSX AXM 292 module) will take incremental encoders with RS485 compatible outputs. Telemecanique has a complete range of XCC incremental encoders (see the general or specialized catalogues).

It is advisable to use a screened cable of 5 twisted pairs (4 twisted pairs if the contamination fault signal is not wired), with the screening correctly connected to the body of the connector at the module end and the body of the encoder at the process end.

If the encoder has a 5V power supply and the cable between the encoder and the module is 30m or less.

The following table gives the cross-sections for the 5V and 0V supply wires for distances of up to 30m between the module and the encoder.

Cross-sec. of 5V and 0V wire	1mm^2	0.34mm^2	0.22mm^2
Encoder/module distance	30m	10m	6m



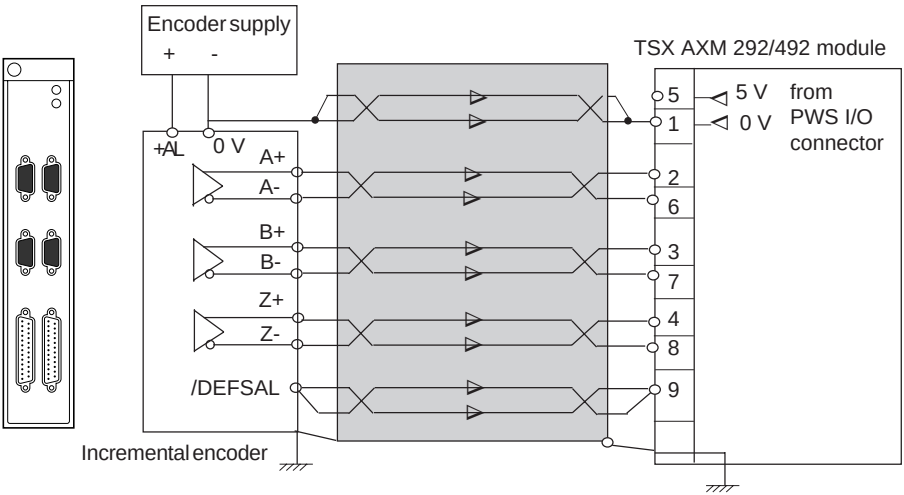
With this type of connection, the voltage drop between the 5V source and the module must be very low (wire with large a cross-section, short distance).

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Connecting an incremental encoder (continued)

If the encoder has a power supply of more than 5 V, or the cable between the encoder and the module is longer than 30m (remote encoder)

- Locate the power supply close to the encoder (and screen the cable)
- Connect the 0V of this supply to the 0V of the TSX AXM 292/492 module (pin 1)



Note :
Some types of encoder cannot be connected or disconnected while switched on. It is therefore advisable to switch off the power supply before any intervention.

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4.2-3 Connecting an absolute encoder

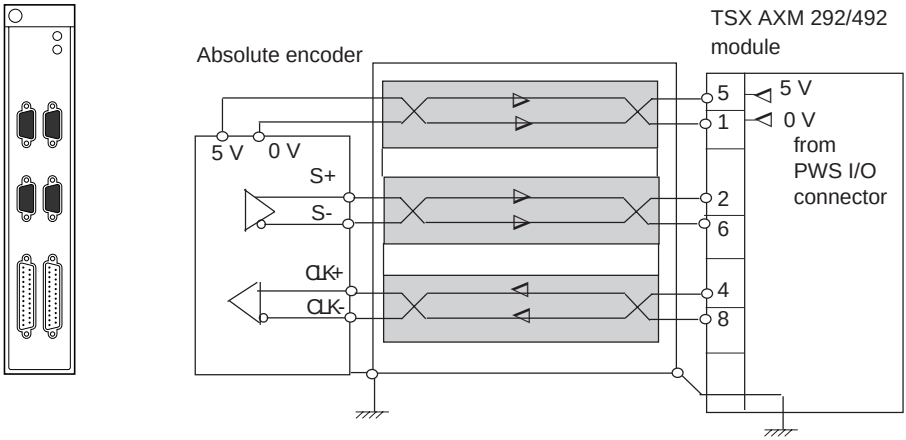
Inputs ENC0, ENC1, ENC2 and ENC3 (ENC0 and ENC1 only for the TSX AXM 292 module) will take SSI protocol absolute encoders with asynchronous serial outputs (see list of compatible absolute encoders in the Appendices).

It is advisable to use a screened cable of 3 screened twisted pairs, with the screening correctly connected to the body of the connector at the module end and the body of the encoder at the process end.

If the encoder has a 5V power supply and the cable between the encoder and the module is 30m or less.

The following table gives the cross-sections for the 5V and 0V supply wires for distances of up to 30 m between the module and the encoder.

Cross-sec. of 5V and 0V wire	1mm^2	0.34mm^2	0.22mm^2
Encoder/module distances	30m	10m	6m

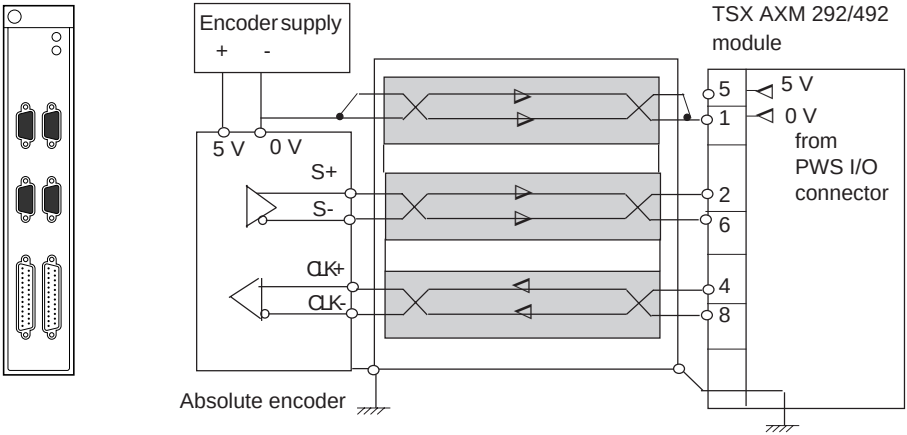


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Connecting an absolute encoder (continued)

If the encoder has a power supply of more than 5 V, or the cable between the encoder and the module is longer than 30m (remote encoder).

- Locate the power supply close to the encoder (and screen the cable)
- Connect the 0V of this supply to the 0V of the TSX AXM 292/492 module (pin 1)



Precautions :

Absolute encoders are sensitive to being connected or disconnected while switched on. To avoid the risk of damage, the following procedure should be followed.

If the encoder receives its power supply (5 V) from the module

- Disconnect the 5 V power supply
- Connect or disconnect, as appropriate
- Reconnect the power supply

If the encoder receives its power supply from an external source (5 V or 24 V)

- Disconnect the 5 V power supply from the input stage of the AXM module **then** the encoder supply
- Connect or disconnect, as appropriate
- Reconnect the encoder supply **then** the 5 V supply to the module input stage.

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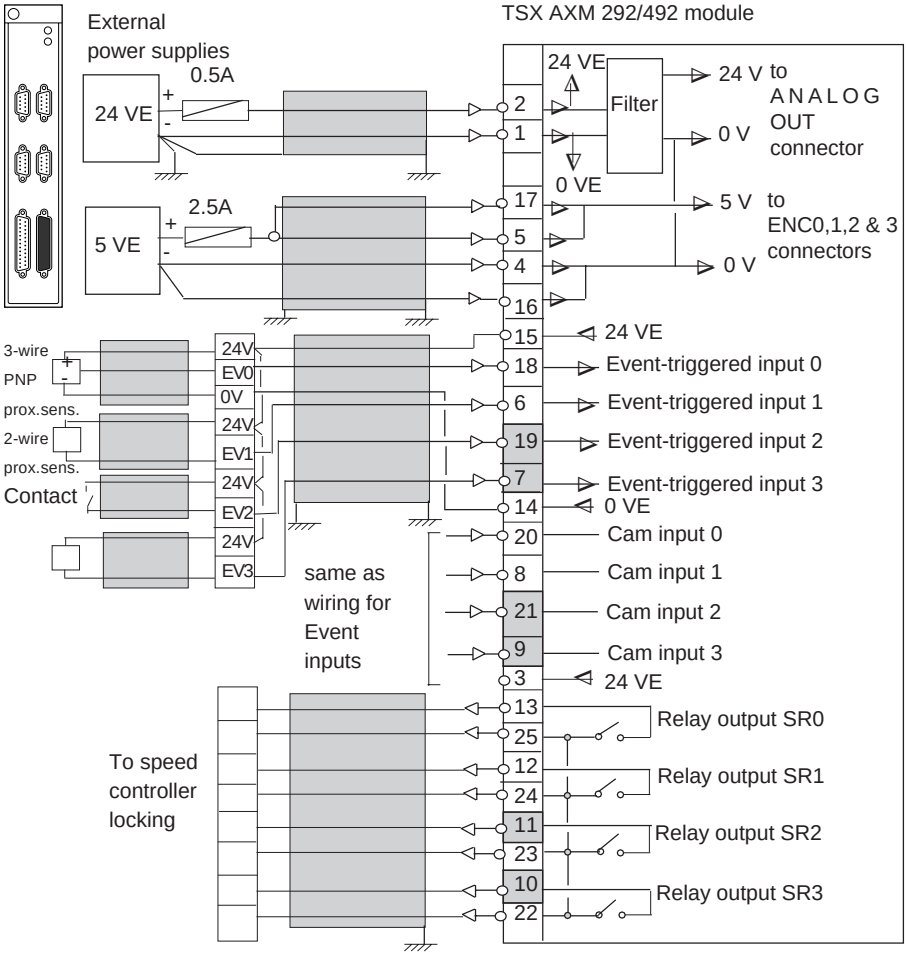
4.2-4 Connecting the auxiliary I/O

A PWS I/O connector is used to connect the power supplies, the event-triggered inputs, the reference point cams and the speed drive locking relay outputs.

Notes

- When 2-wire and 3-wire proximity sensors are used, power them from the 24 VE and 0VE.
- The wiring of the high-speed inputs must never form a loop which would create a surface sensitive to electromagnetic induction. Use screened cable.
- The 24V supply must be dedicated to the TSX AXM 292/492 module and must never supply other electromagnetic devices.
- Quick-blow fuses must be used on the 5VE and 24 VE supplies.
- If the encoders (in the case of incremental encoders) are supplied by an external source, the 5 V supply must be monitored either by the TSX CAC 92 or by an external user device which acts on the application.

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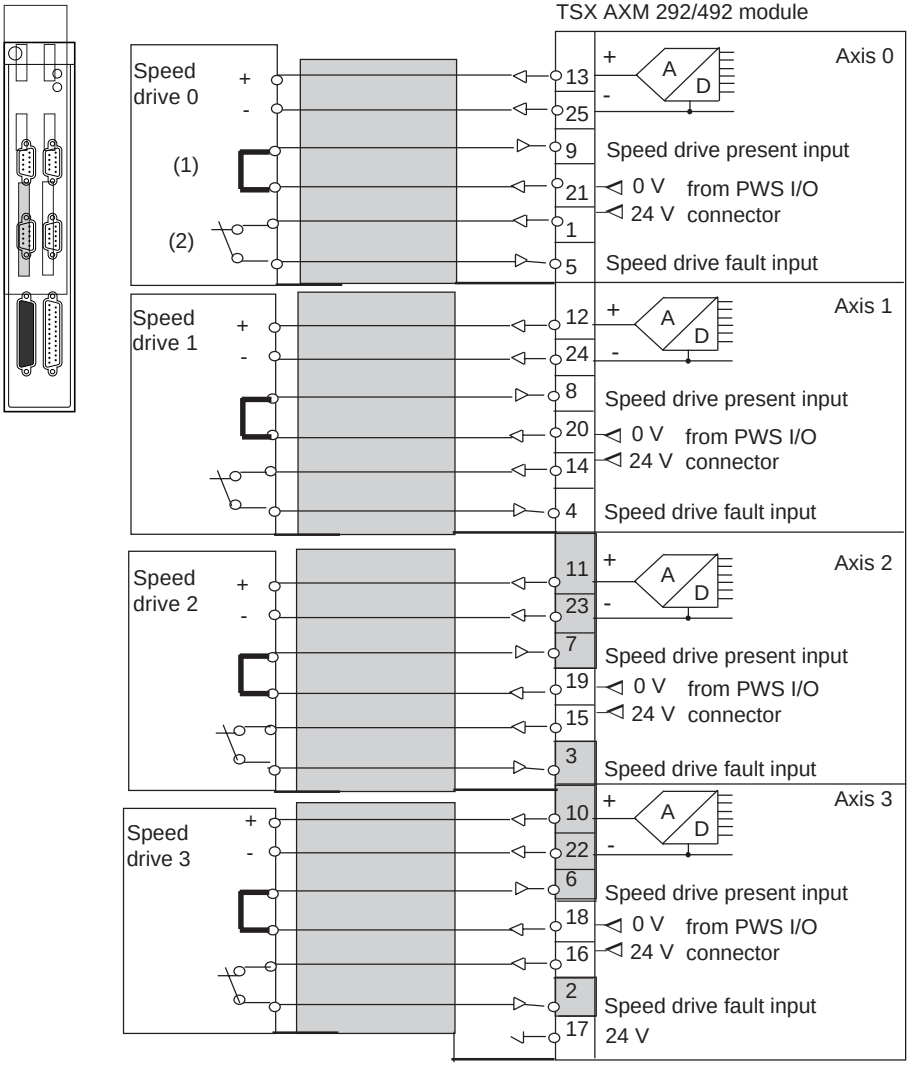
(1) External 5 V supply indispensable, even when encoders are supplied from an external source (attention : destructive polarity inversion)
(2) Must be wired at 0V if the event-triggered inputs are not used
(3) The speed drive locking outputs must be wired

The contacts outlined in grey are not connected in the TSX AXM 292 module.

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4.2-5 Connecting the speed drive I/O

The ANALOG OUT connector is used to connect the power supplies and the speed drive I/O.



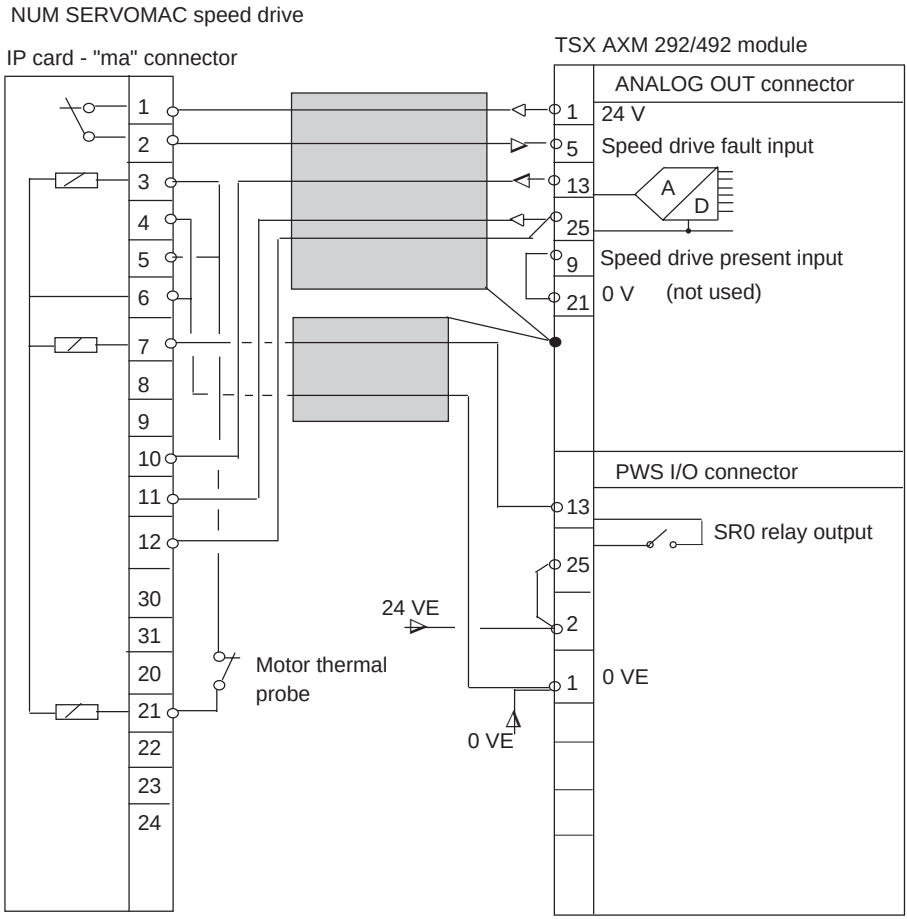
Note : It is advisable to use screened twisted pair cable with the screening correctly connected to the body of the connector at the module end, and to the speed drive body.
(1) If this is not possible, install the shunt at the output of the TSX AXM module connector.
(2) Contact closed if the speed drive is OK.

The contacts outlined in grey are not connected in the TSX AXM 292 module.

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4.2-6 Example of connection to NUM SERVOMAC speed drives

The diagram below gives an example of the wiring of one axis (axis 0) to NUM SERVOMAC variable speed drives.

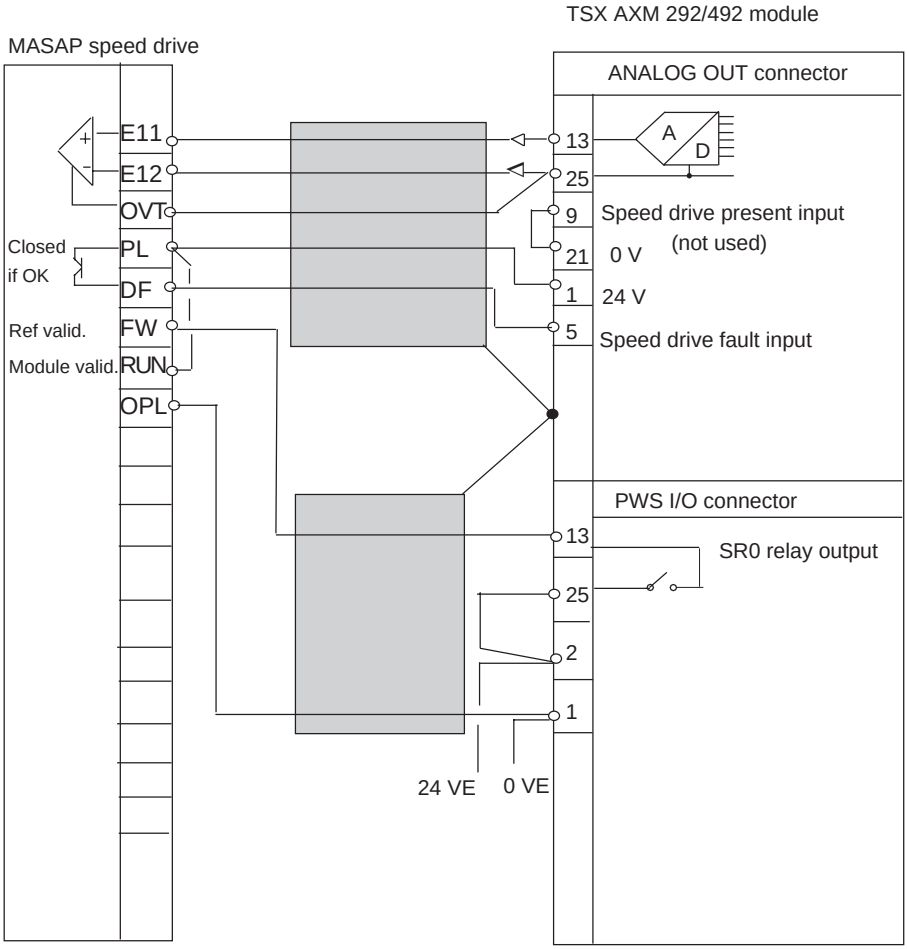


Notes :
The 24 VE can be taken from terminal 5 (if I<0.4 A) of an IP card in the speed drive rack.
Do not leave loose any wires which are not used in the twisted pairs.

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4.2-7 Example of connection to MASAP speed drives

The diagram below gives an example of the wiring of one axis (axis 0) to a Telemecanique MASAP speed drive.

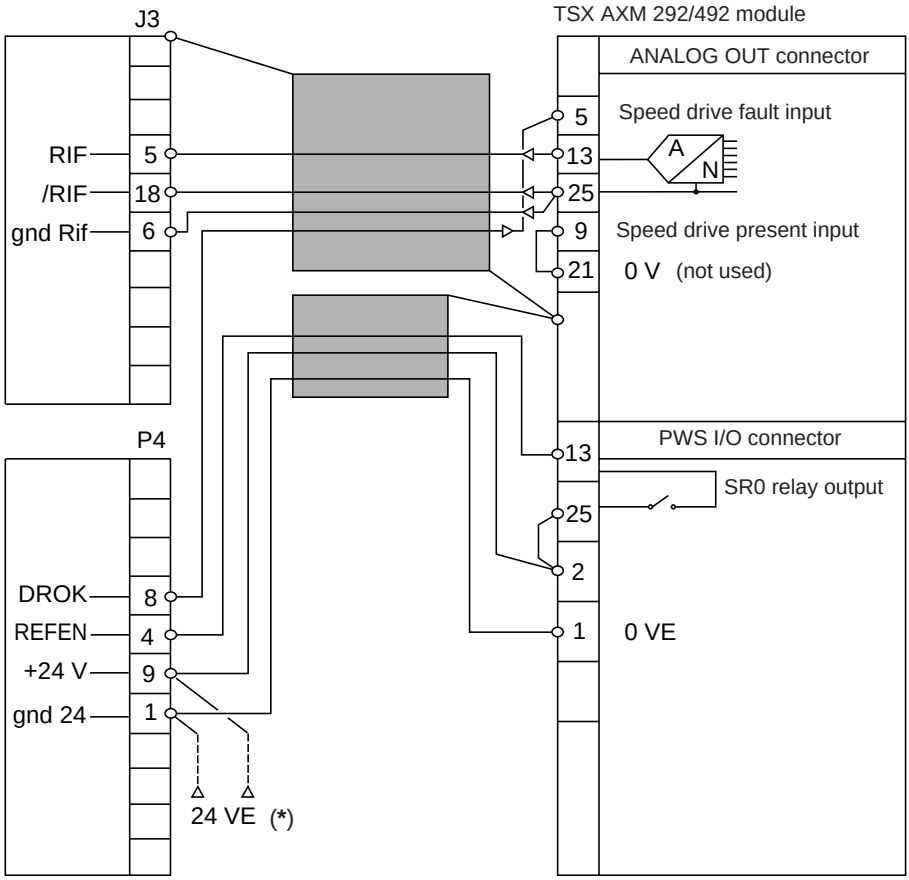


Notes :
The 24 VE (I<0.6A) can be taken from the MASAP SOURCE module, connector J1, terminals PL (+24V) and 0PL (0V).
Do not leave loose any wires which are not used in the twisted pairs.

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4.2-8 Example of connection to 400 V modular speed drives

The diagram below gives an example of the wiring of one axis (axis 0) to 400 V modular speed drives in the NUM DRIVE range.



(*) The 24 VE (I < 0.6A) can be taken from the SOURCE module of the speed drive.

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	5.2	Prerequisites	5/3
	5.3	Application design	5/4
		5.3-1 Software declaration of the PLC configuration used	5/4
		5.3-2 Integrating the instruction codes	5/4
		5.3-3 Declaring the OFB used	5/6
		5.3-4 Entering the group and axis addresses	5/7
		5.3-5 Programming	5/8
		5.3-6 Program transfer	5/12
	5.4	Adjustment and debugging	5/13
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		5.4-3 Adjusting the parameters	5/15
		5.4-4 Saving the parameters	5/16
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6	**Setup methodology**		**6/1**

Note

If the moving part is to be moved in manual mode only, the programming part is not compulsory (Section 5.3-5).
The operations described in the following sections will be performed :

- Section 5.2
- Section 5.3-1
- Section 5.3-2
- Section 5.3-3
- Section 5.3-4
- Section 5.3-6
- Section 5.4-1
- Section 5.4-2

All these operations are compulsory if a TSX AXM•92 module is to be controlled.

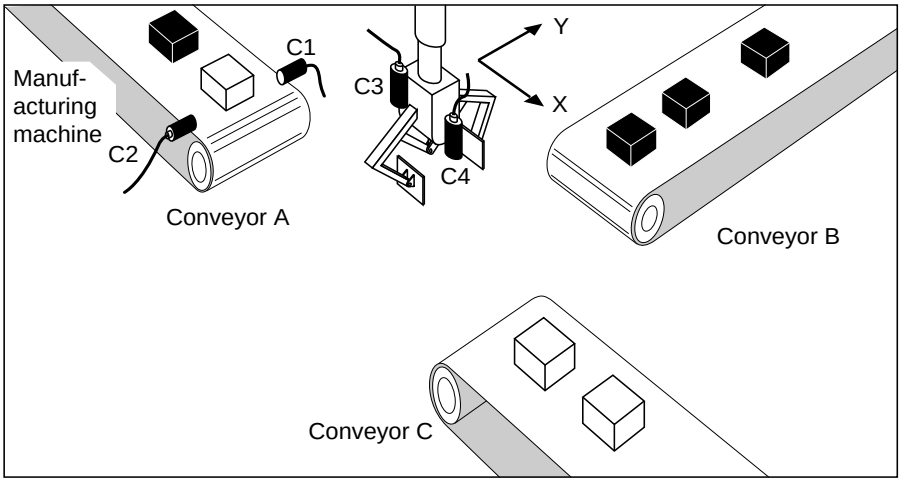
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5.1 Description of the example used

This example is given for information and learning purposes (1). It will enable you to follow all the stages involved in setting up a multi-axis control system without having to read all the documentation.

A transfer device removes all the items as they leave the manufacturing process. This device consists of a clamp which can move spatially on a plane (axis X, Y) parallel to the ground.
As soon as an item appears on exit conveyor A, the clamp will automatically pick it up and transfer it to conveyor B or conveyor C, depending on the type of item. The clamp then returns to waiting position ready to pick up another manufactured item as soon as one is detected.

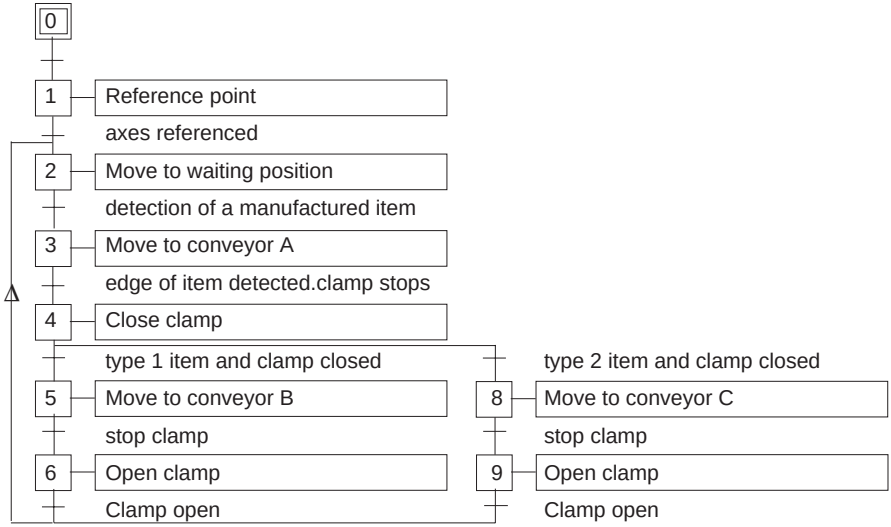


I/O :
- SENSOR1 : cell for detecting presence of manufactured item
- SENSOR2 : sensor for identifying the type of item
- SENSOR3 : sensor for detecting clamp open/clamp closed
- SENSOR4 : cell for detecting edge of item (in the clamp), connected to module event-triggered input
- ENC0 : incremental encoder for position on axis X
- ENC1 : incremental encoder for position on axis Y
- O/C clamp : open/close clamp command.

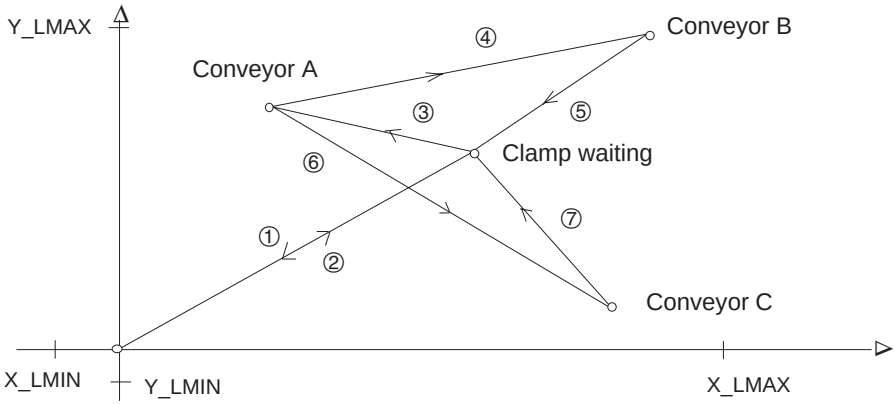
(1) **Note :** This example can also be created with two independent axes. It has been chosen for its simplicity.

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Grafcet chart for the application



Description of the trajectory



① Reference point at speed Vpo
② Move at speed Vret to waiting position (Xwait,Ywait) and stop
③ Move to conveyor A (XA,XB) at speed VA until manufactured item is detected
④ Move at speed VB to conveyor B (XB,YB) and stop
⑥ Move at speed VC to conveyor C (XC,YC) and stop
⑤ and ⑦ Move at speed Vret to waiting position (Xwait,Ywait) and stop

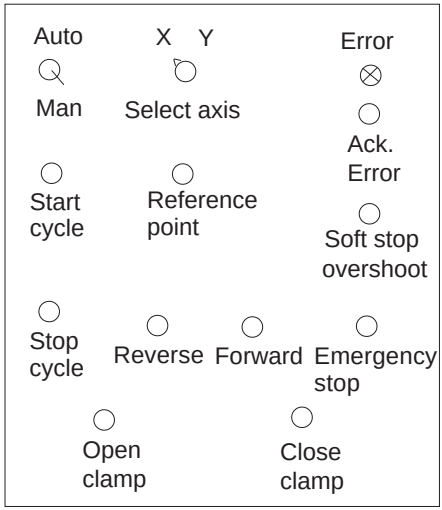
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Operator dialogue

The following controls are all on the front panel, and are used to control the moving part manually when there is a fault in the installation. The commands and the indicator lamps are controlled by an input module and a discrete output module.

Description of the commands :

- Auto/Man. : switch for selecting the operating mode
- Start Cycle : automatic execution of the cycle
- Stop Cycle : automatic cycle stop
- Select axis X/Y : selects the axis to be controlled in manual mode
- Manual reference point : reference point for the selected axis
- Forward/Reverse : manual move command in positive or negative direction, for the selected axis
- Error : indicator lamp signalling any hardware or application error
- Ack. err. : error acknowledgment command
- Soft stop overshoot : return moving part from soft stop overshoot
- Emergency stop : immediate stop of the moving part whatever mode is selected
- Open clamp : open clamp command
- Close clamp : close clamp command



5.2 Prerequisites

Only specific axis control functions will be described here. It is therefore assumed that the following operations have been performed :

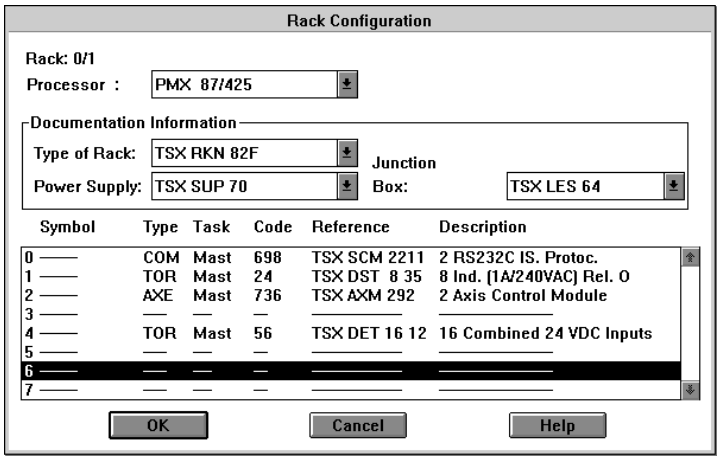
- The V5 software workshop has been installed.
- The V5 PLC station used for the application has been created.
- PL7-3 software has been installed and selected.
- ADJ MAX software has been installed (see Section 3).
- The hardware has been installed : the module, speed drives and encoders controlling the 2 axes have been wired.

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5.3 Application design

5.3-1 Software declaration of the PLC configuration used

Launch the XTEL-CONF tool and select Rack Configuration from the "Define" menu.



Then select each element of the PLC configuration. The following selections have been made in this application :

- Processor : TSX 47 425
- Rack : TSX RKN 82F
- 16-input module : TSX DET 1612 in slot n°6
- 8-output module : TSX DST 8 35 in slot n°1
- 2-axis control module : TSX AXM 292 in slot n°2

Generate the configuration.

Note : All the modules, including the axis control module, are assigned to the master task.

5.3-2 Integrating the instruction codes

This operation loads the ISO instruction codes and the symbols of all the variables used in the application.

Importing the file containing the instruction codes :

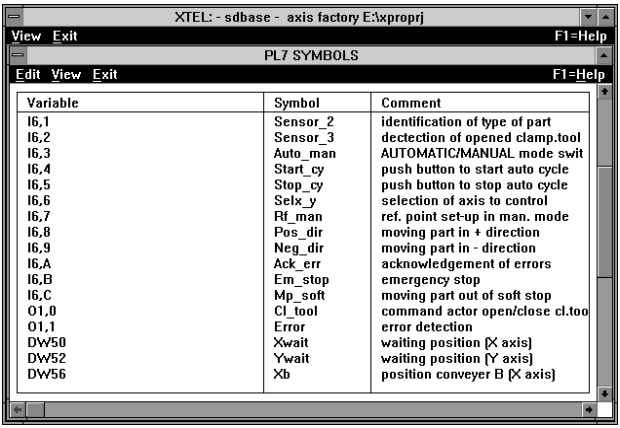
- Click on the PL7-3 icon and select the "Import" function from the menu which appears.
- Select the source : c:\XPROSYS\OFB\AXIS.
- Select the files MAX.SCY and MAX.CST.
- Select the MOD directory as the destination directory by double clicking on it, (complete path: D:\XPROPRJ\Project name\Station name\PL7_3\MOD).
- Start execution of the import.

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Merging the file containing the symbols for the instruction codes :

- Launch the XTEL-SDBASE tool.
- In the merge menu, select SCY --> Sdbase.
- Select the file MAX.SCY, then confirm the merge.
- The symbols are assigned to constants CW0 to CW13 (see screen in Section 7.2-3)

Entering the symbols for the application :

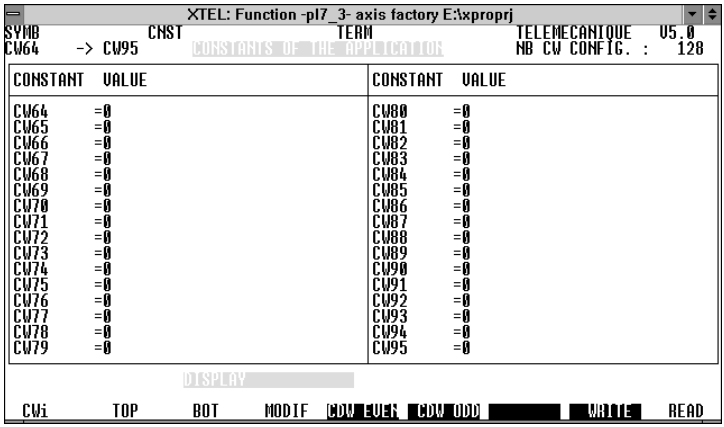


Symbol	Object	Role
Sensor1	I6,0	cell for detecting the presence of the manufactured item
Sensor2	I6,1	sensor for identifying the type of item
Sensor3	I6,2	sensor for detecting clamp open/clamp closed
Auto_man	I6,3	switch for selecting AUTOMATIC or MANUAL mode
Start_cy	I6,4	pushbutton to start automatic cycle
Stop_cy	I6,5	pushbutton to stop automatic cycle
Selx_y	I6,6	selection of axis to be controlled manually
Rf_man	I6,7	reference point setup in manual mode
Pos_dir	I6,8	move moving part in positive direction
Neg_dir	I6,9	move moving part in negative direction
Ack_err	I6,A	error acknowledgment
Mp_stop	I6,B	return moving part from soft stop overshoot
Em_stop	I6,C	emergency stop
O_clamp	I6,D	open clamp pushbutton
F_clamp	I6,E	close clamp pushbutton
Cl_tool	O1,0	open/close clamp actuating command
Error	O1,1	error detection
Xwait	DW50	waiting position (X axis)
Ywait	DW52	waiting position (Y axis)
XB	DW54	position of conveyor B (X axis)
YB	DW56	position of conveyor B (Y axis)
XC	DW58	position of conveyor C (X axis)
YC	DW60	position of conveyor C (Y axis)

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Reading the configuration and the symbols using PL7-3 :

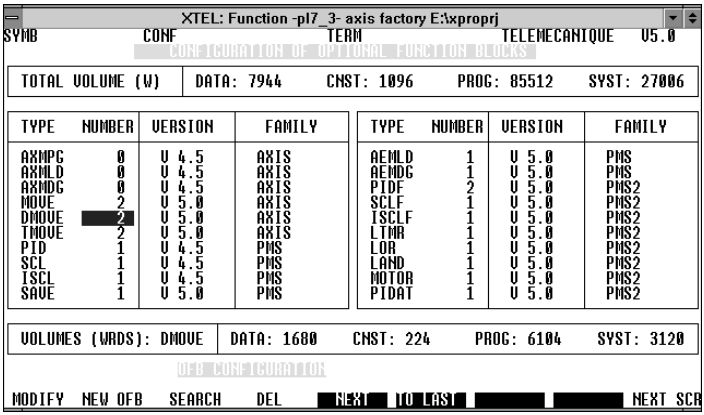
- Launch the PL7-3 software.
- Request an update, which will take into account the hardware configuration defined in XTEL-CONF and the symbols entered using XTEL-BASE.
- Select constant mode.
- Initiate the READ command and select the file MAX.CST, which assigns the values (instruction codes) to the symbols.



5.3-3 Declaring the OFB used

This operation is used to select the function block which will control the moving part.

- Select PL7-3 CONFIGURATION mode.
- Enter the parameters specific to the application, GRAFCET, task period, etc.
- Select the OPTIONAL FUNCTION BLOCKS menu and insert a DMOVE axis control OFB and declare a single use. Then confirm the configuration.



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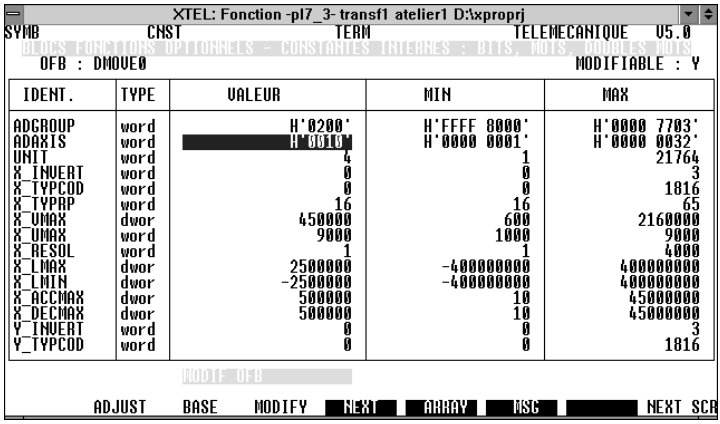
5.3-4 Entering the group and axis addresses

This operation consists of :

- Assigning the DMOVE0 function block to the axis control module using the parameter ADGROUP =
  H'0200'
  - group n° : 0 (1 single group of 2 axes)
  - slot n° occupied by the module in the rack
  - n° of the rack containing the module

- Establishing the relationship between the X and Y axes and the module physical inputs ENC0 and ENC1. The codes are set in the parameter ADAXIS =
  H'0010'
  - the X axis is assigned to input ENC0
  - the Y axis is assigned to input ENC1
  - not significant

In PL7-3 CONSTANTS mode, select the OFB constants menu, and select the DMOVE0 OFB.
Press <BASE> to select a hexadecimal base, then <MODIF> and enter the values defined above.



Note : This operation can only be performed in local mode.

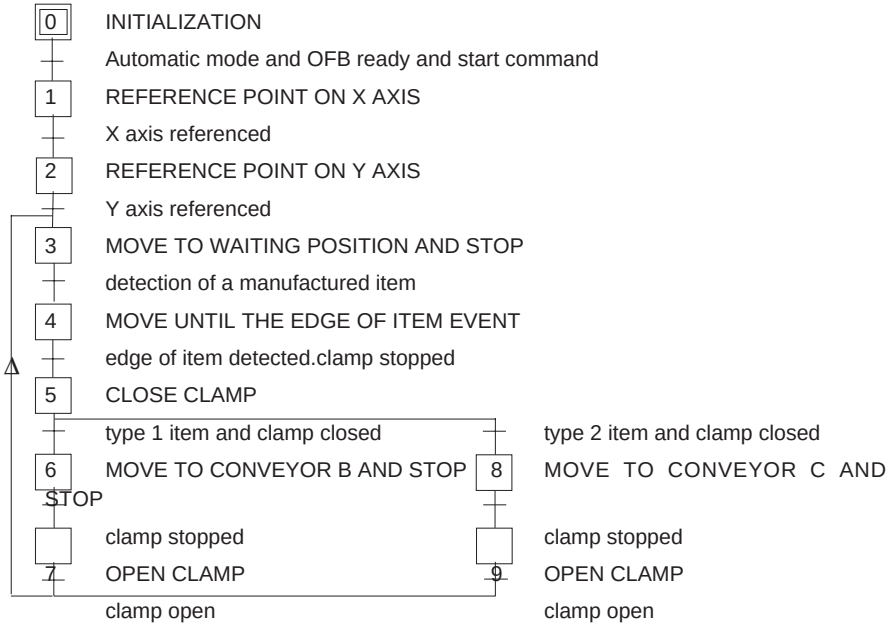
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5.3-5 Programming

The programming in this example uses Grafcet structure :

- The sequential processing for the sequential description of the application : processing of the automatic cycle.
- The pre-processing for managing the operating modes.
- The post-processing for the execution of manual mode.

Sequential processing



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```
Step 0 : Continuous action          Initialization of variables


Transition X0 > X1                  Test : auto mode, OFB ready, clamp open
DMOVE0,AUTO.DMOVE0,DONE.NOT Sensor3.RE(Start_cy)      and start cycle

Step 1 : Action on activation       Reference point on X axis at a speed of
EXEC DMOVE0 (1;G90;G14;0;0;1000=>)  1m/min

Transition X1 > X2                  Test : X axis referenced and OFB ready
DMOVE0,X_CALIB.DMOVE0,DONE

Step 2 : Action on activation       Reference point on Y axis at a speed of
EXEC DMOVE0 (2;G90;G15;0;0;1000=>)  1 m/min

Transition X2 > X3                  Test : Y axis referenced and OFB ready
DMOVE0,Y_CALIB.DMOVE0,DONE

Step 3 : Action on activation       Return at a speed of 15m/min to waiting
EXEC DMOVE0 (3;G90;G09;Xwait;Ywait;15000=>)      position (Xwait,Ywait)

Transition X3 > X4                  Test : position reached by the moving part,
DMOVE0,AT_POINT.Sensor1.B50         item detected on conveyor A and cycle running.

Step 4 : Action on activation       Move at a speed of 5m/min until the edge of the
EXEC DMOVE0 (4;G90;G10;17000;10000;5000=>)  item is detected on conveyor A


Transition X4> X5                   Test : end of execution of the instruction
DMOVE0,DONE

Step 5 : Action on activation       Close clamp
SET Clamp



Transition X5> X6                   Test : type 1 item and clamp closed
Sensor2.Sensor3

Step 6 : Action on activation       Move to conveyor B (XB, YB)
EXEC DMOVE0 (6;G90;G09;Xb;Yb;5000=>)at a speed of 5m/min

Transition X6> X7                   Test : position reached by the moving part
DMOVE0,AT_POINT
```


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```
Step 7 : Action on activation          Open clamp
RESET Clamp

Transition X7> X3                      Test : clamp open
NOT Sensor3


Transition X5> X8                      Test : type 2 item and clamp closed
NOT Sensor2.Sensor3

Step 8 : Action on activation          Move at a speed of 5m/min to
EXEC DMOVE0 (8;G90;G09;Xc;Yc;5000=>)   conveyor C (XC, YC)

Transition X8> X9                      Test : position reached by the moving part
DMOVE0,AT_POINT

Step 9 : Action on activation          Open clamp
RESET Clamp

Transition X9> X3                      Test : clamp open
NOT Sensor3
```


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Pre-processing

The pre-processing comprises the management of the operating modes.

At a blocking error :

- The chart freezes.
- The operator can then control the moving part in manual mode, and correct and acknowledge the error from the front panel.
- The chart is reinitialized when the error has disappeared and has been acknowledged.

When changing to manual mode :

- The chart freezes.
- The chart is reinitialized when AUTOMATIC mode is selected again.

```
<Initialize the positions
!           IF SY0
                  THEN 1200000->Xwait;750000->Ywait;1500000->Xb;900000-
  >Yb;
                       1440000->Xc;300000->Yc

<Close the servo loop, validate the speed drive
!           IF DMOVE0,CONF.B0
                  THEN RESET DMOVE0,DRV_OFF;SET DMOVE0,ENABLE;
                       SET DMOVE0,MONITOR

<Select automatic mode
!           IF FE(Auto_man)
                  THEN SET DMOVE0,AUTO;SET DMOVE0,SEND_CMD

<Select manual mode
!           IF RE(Auto_man)
                  THEN RESET DMOVE0,AUTO;SET DMOVE0,SEND_CMD

<Freeze chart at an error or at a change to manual mode
!           IF DMOVE0,CONF.(NOT DMOVE0,OK + NOT DMOVE0,AUTO + DMOVE0,ERROR)
                  THEN SET SY23;SET B1

<Reinitialize the chart
!           IF DMOVE0,CONF.DMOVE0,OK.DMOVE0,AUTO.B1
                  THEN RESET SY23;SET SY21;RESET B1

<Error detection
!           DMOVE0,OK --> NOT Error
```


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B

Post-processing
Manual mode is managed in post-processing.

```
<Test the selected mode
!           IF DMOVE0,AUTO.DMOVE0,CONF THEN JUMP L100
<Select the axis to control
!           IF Selx_y
                  THEN 1 --> DMOVE0,AXIS_NB
                  ELSE 0 --> DMOVE0,AXIS_NB
<Manual reference point
!           IF RE(Rf_man)
                  THEN SET DMOVE0,SETRP_M;SET DMOVE0,SEND_CMD
<Move moving part in + direction
!           Pos_dir --> DMOVE0,JOG_P
<Move moving part in - direction
!           Neg_dir --> DMOVE0,JOG_M
<Soft stop overshoot
!           IF RE(Mp_soft)
                  THEN SET DMOVE0,SLRETURN;SET DMOVE0,SEND_CMD
<Open clamp
!           IF O_clamp.Auto_man
                  THEN RESET Clamp
<Close clamp
!           IF C_clamp.Auto_man
                  THEN SET Clamp
<Acknowledge errors
            Ack_err --> DMOVE0,ACK_ERR

<End manual mode
L100
```

5.3-6 Program transfer

Once the program has been entered using PL7-3, this operation consists of transferring the configuration created under XTEL-CONF and the PL7-3 configuration and program to the PLC processor memory :

- Connect the terminal to the PLC.
- Launch the XTEL-TRANSFER tool and select Disk-->PLC station transfer from the Transfer menu and the Complete Transfer function.

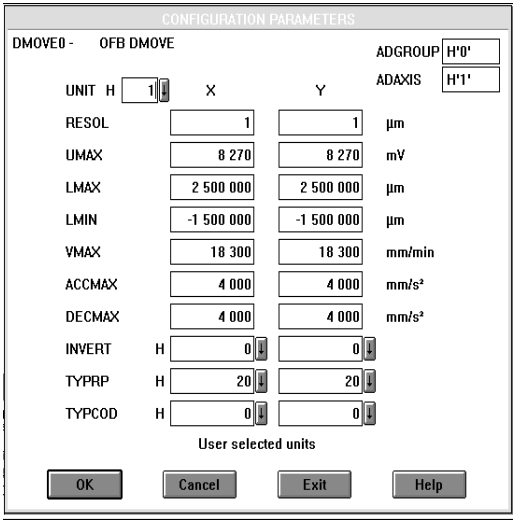
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5.4 Adjustment and debugging

5.4-1 Pre-initialization of the parameters

As a safety measure, first perform the preliminary operations described in Section 9.2. Then perform the following operations :

- Set the PLC to RUN mode using the XTEL-CONTROL tool.
- Launch the ADJ MAX tool.
- Select the Open function from the "Group" menu and select the DMOVE0 OFB in the window which appears, then confirm.
- Select the "Configuration parameters" function from the "Adjust" menu and enter the parameters given in the table below.

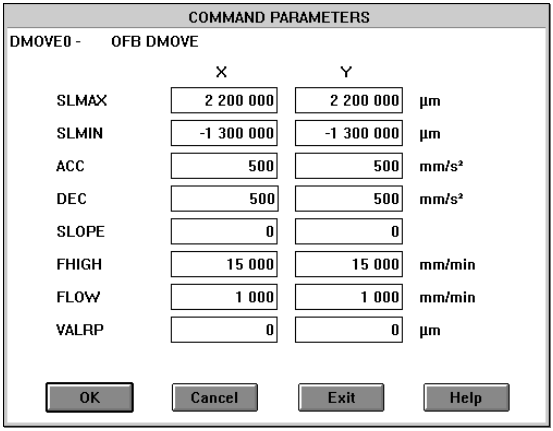


Parameter	Description	Value	Comment
UNIT	Physical units	1	corresponds to µm
RESOL	Resolution	1	encoder resolution = 1 µm
UMAX	Speed drive voltage at VMAX	8270	-
LMAX	Max. higher soft stop	2500000	-
LMIN	Min. lower soft stop	-1500000	-
VMAX	Max. speed of moving part	18300	-
ACCMAX	Max. acceleration	4000	-
DECMAX	Max. deceleration	4000	-
INVERT	Type of inversion	0	no inversion
TYPRP	Type of reference point	20	short cam + direction
TYPCOD	Type of encoder	0	incremental encoder with x 4

- Confirm the values entered, then press the Exit button.

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- Select the "Command parameters" function from the "Adjust" menu and enter the parameters in the table below.



Parameter	Description	Value	Comment
SLMAX	Upper soft stop	2200000	-
SLMIN	Lower soft stop	-1300000	-
ACC	Acceleration	500	-
DEC	Deceleration	500	-
SLOPE	Speed profile	0	trapezoid profile
FHIGH	High speed	15000	used in manual mode
FLOW	Low speed	1000	used in manual mode
VALRP	Ref. position	0	used in manual mode

- Confirm the values entered, then press the Exit button.

- Transfer these values to the module by selecting the Parameters command from the Transfer menu and pressing the SEND_CNF button.

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5.4-2 Using manual mode

If a user wishes to move a moving part without performing the programming phase, the following actions can be performed from the Mono-Group operating screen :

- Deactivate measurement mode : cancel the Drv_Off command.
- Select the ENABLE command to validate the speed drive safety relays.
- Select the MONITOR command (if it is not already selected) to update the data on the operating screen.
- Acknowledge any errors : ACK_ERR key.
- Transmit the above commands by pressing the SEND_CMD key.

- Select the X or Y axis on which the movement is to be made.
- Set a reference point :
  - either by selecting the SetRp- command (for a negative direction reference point) or SetRp+ (for a positive direction reference point) depending on the position of the moving part with respect to the cam, and start the movement by pressing the SEND_CMD key.
  - or by selecting the Rp_here command, by entering the value of the position of the moving part with respect to the reference point in the PARAM field and executing the command using the SEND_CMD key.

- Perform the positive direction movements using the JOG+ command or the negative direction movements using the JOG- command. The coordinates of the moving part are displayed in the X or Y Pos field and the speed in the F field.

5.4-3 Adjusting the parameters

Adjusting the configuration parameters
Relaunch the "Configuration parameters" function and adjust the INVERT, VMAX and UMAX parameters, see Section 11.1.

Self-adjustment of the machine characteristic KR coefficient
See procedure in Section 11.2.

Adjusting the servo parameters
See procedure in Section 11.3.

Adjusting the error control parameters
See procedure in Section 11.4.

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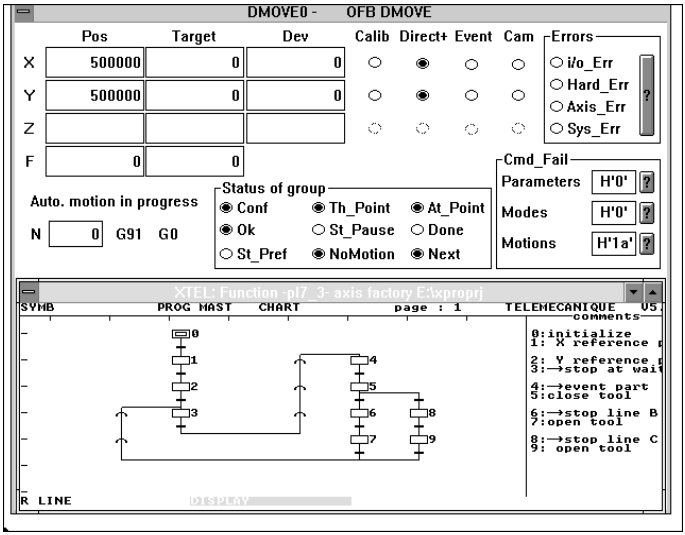
5.4-4 Saving the parameters

When the parameters have been adjusted, they should be saved. Select the **Parameters** command in the **Transfer** menu and press the **SAVE_PRM** button.

5.4-5 Debugging

To debug the program :

- Set the PLC to RUN mode.
- Display the Mono-Group operating screen, and follow the movement instructions given in the "Auto. motion in progress" field and the movements in the fields X and Y (Pos : for actual position and Target : for target position).
- At the same time display the Grafcet chart screen in a small font size to follow the evolution of the sequential processing.



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5.4-6 Archiving

When debugging of the program is completed :

- Save the parameters again if they have been modified during debugging. Select the **Parameters** command from the ADJ MAX **Transfer** menu and press the SAVE_PRM button.

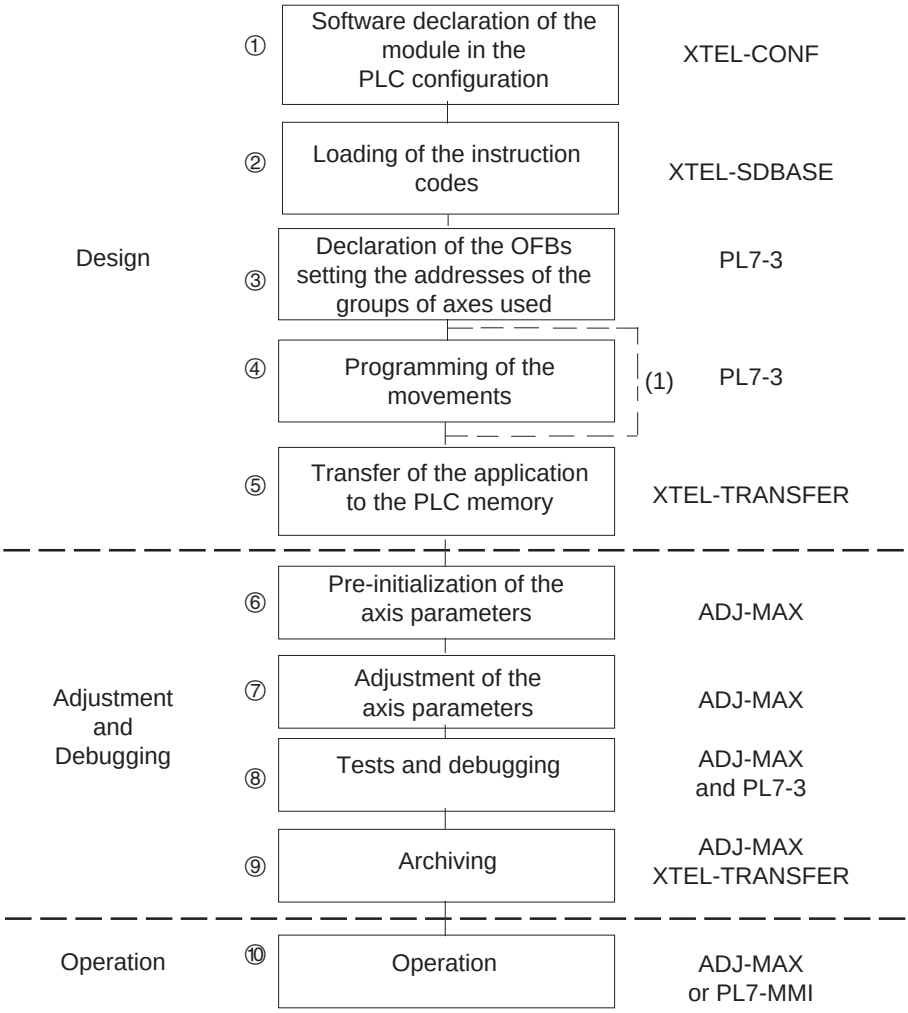
- Transfer the application from the PLC processor to the hard disk to archive it. Select the PLC Station --> Disk function and **Complete Transfer** from the XTEL-TRANSFER tool **Transfer** menu.

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6.1 Setup methodology

The tutorial has shown the various phases in setting up a multi-axis control application. The flowchart below summarizes these phases.



(1) If the user wishes, before programming, to manipulate the moving part on the various axes in Manual mode, he can leave out operation ④. However, operations ①, ②, ③, ⑤, ⑥, ⑦ and ⑧ are compulsory.

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7.1 Software declaration of the PLC configuration

This operation consists of declaring the slots occupied by the TSX AXM •92 modules in the PLC I/O configuration and fixing their use in the master task.

Define the project and the station under X-TEL or MINI-XTEL and launch the XTEL-CONF tool.

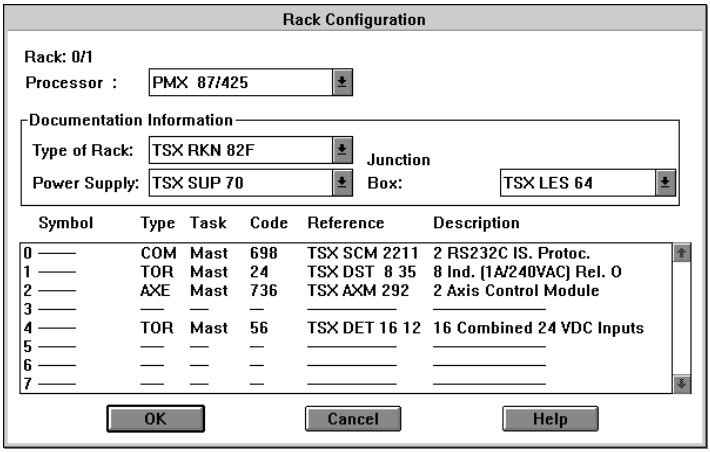
In the "CONF/X-TEL (or MINI X-TEL)" window, select the command **Rack I/O Config. point** in the **Define** menu.

The "Configuration of modules in the rack" window also provides a diagram of the hardware configuration.
Select the first rack (by double clicking on it) and define :

- The processor
- The rack (this must be a fan-cooled rack, with a reference ending in the letter F)
- The power supply
- The I/O modules.

Double click on the slot where the multi-axis control module is to be installed (if it is not installed in the main rack, confirm the main rack configuration and then double click on the rack which is to be used), and in the "Configure a module" box :

- Select the master task. The multi-axis control module must be configured in the master task.
- Click on the **Catalogue** button
- Select the "Axis control", family and confirm
- Select the TSX AXM 292 or 492 module, then confirm.



Select the **Enter Task periods...** command from the **Generate** menu and select the cycle time for each of the tasks.
Launch the **Automatic** command from the **Generate** menu and quit XTEL-CONF.

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7.2 Loading the ISO instruction codes (optional operation)

7.2-1 General

The various operations described below are optional, and make use of the ISO instruction codes for multi-axis control used for programming movements under PL7-3.

Caution : Since the instruction codes are associated with constants CW0 to CW13, it is important that these constants are not used elsewhere in the application.

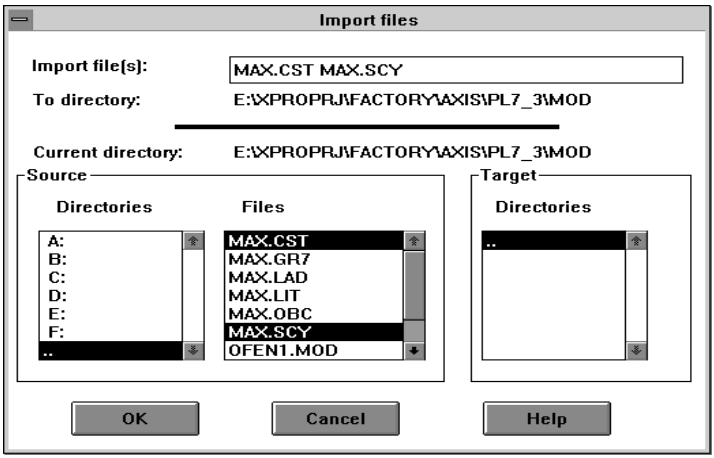
It is possible not to use these ISO codes, to define your own instruction codes, or to associate these instruction codes with other CW constant addresses. For information on this, see Section 7.2-5 "Special cases".

The multi-axis control instruction codes are contained in 2 files :
- MAX.SCY : file containing the instruction symbols (G01,G09...).
- MAX.CST : file containing the corresponding codes (1,9,...) recognized by the OFB.

C

7.2-2 Importing the files containing the instruction codes

The following operation consists of importing the 2 files MAX.SCY and MAX.CST into the PL7-3 MOD zone so that they can be used. To do this :
- Click on the station PL7-3 icon and select the **Import** command from the menu which appears when using X-TEL (under MINI X-TEL, select the PL7-3 icon and the **Import** function from the **Import/export** command in the **File** menu).
- The "Import files" dialogue box then appears.
  - Select the source :
    Directory : C:\XPROSYS\OFB\AXIS File : MAX.SCY and MAX.CST
  - Select the target :
    Directory : D:\XPROPRJ\Name_Project\Name_Station\PL7_3\MOD
- Then confirm.



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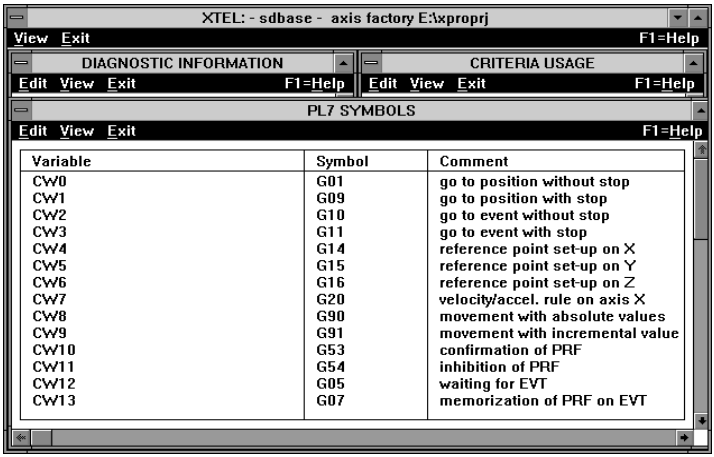
7.2-3 Merging the instruction code symbols

This operation consists of merging the instruction symbols contained in the MAX.SCY file in the station symbol database.

- Launch the XTEL-SDBASE tool, by double clicking on the icon.
- Select the **Scy-->Sdbase...** command from the **Merge** menu.

In the "Merge symbols" dialogue box which appears :
- Select the MAX.SCY file.
- Select dialogue mode to ensure that there is no conflict with other symbols in the application.
- Then confirm the merge.

Select the **Sdbase** command in the **Edit** menu and check that the symbols have been taken into account correctly.



This operation can be followed by the complete entry of the other symbols used in the application.

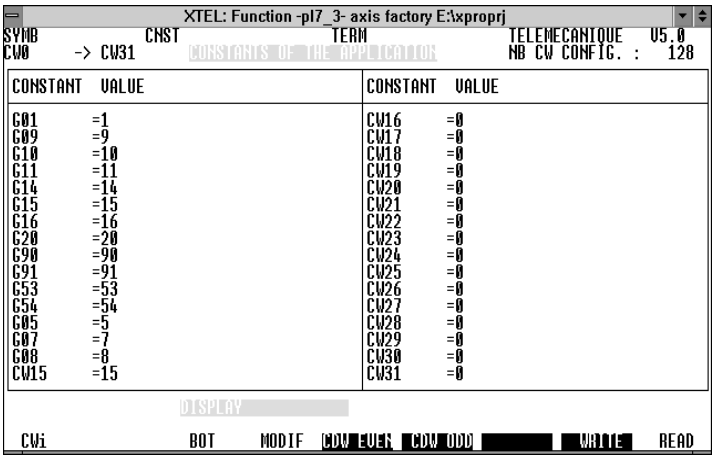
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7.2-4 Integrating the instruction codes under PL7-3

This operation consists of integrating the codes contained in the MAX.CST file under PL7-3 so that they can be associated with the instruction symbols.

- Launch PL7-3, by double clicking on the icon
- Update the PL7-3 application by pressing the **[V5 CONF.]** key. The association of the XTEL-SDBASE database symbols with the PL7-3 constants is performed automatically.
- Select PL7-3 CONSTANT mode
- Press the **[CW/DW]** soft key
- Read the MAX.CST file. To do this :
  - Press the **[READ]** soft key
  - Press the **[STR.NAME]** soft key
  - Press the **[DIR]** soft key
  - Select the MAX.CST file

  Then confirm by pressing the <ENTER> key 3 times in succession.



- Press the <CLEAR> key to exit CONSTANT mode.

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7.2-5 Special cases

You do not wish to represent your instructions with symbols :
In this case do not perform any of the operations described in Sections 7.2-2 to 7.2-4, and when programming the function blocks, do not enter the ISO instruction symbol but its code, for example enter : **EXEC DMOVE0 (1;90;1;....=>)**
in place of **EXEC DMOVE0 (1;G90;G01;....=>)**

You wish to use your own symbols :
In this case do not perform any of the operations described in Sections 7.2-2 to 7.2-4. Under XTEL-SDBASE, enter your symbols (using 8 characters maximum) and associate them with constants CWi to CWi+13.
Example :

```
GOTO_SA    CW100
....
ABSOLUTE   CW108
...
MEM_PRF    CW113
```

Under PL7-3 in CONSTANT mode, enter the codes in constants CWi (**GOTO_SA**) to CWi+13 (**MEM_PRF**).
Example :

```
GOTO_SA    1
....
ABSOLUTE   90
...
MEM_PRF    7
```

When programming the function blocks under PL7-3, do not enter the ISO instruction symbol, but the symbol defined, for example enter :
EXEC DMOVE0 (1;ABSOLUTE;GOTO_SA;....=>) in place of
EXEC DMOVE0 (1;G90;G01;....=>)

You wish to use symbols but at different constant addresses :
In this case do not perform any of the operations described in Sections 7.2-2 to 7.2-4. Under XTEL-SDBASE enter the symbols and associate them with constants CWi to CWi+13. Example :

```
G01     CW100       G15     CW105       G53     CW10
G09     CW101       G16     CW106       G54     CW11
G10     CW102       G20     CW107       G05     CW12
G11     CW103       G90     CW108       G07     CW13
G14     CW104       G91     CW109
```

Under PL7-3 in CONSTANT mode, enter the codes in constants CWi (**G01**) to CWi+1(**G07**). Example :

```
G01     1           G15     15          G53     53
G09     9           G16     16          G54     54
G10     10          G20     20          G05     5
G11     11          G90     90          G07     7
G14     14          G91     91
```


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7.3 Declaring OFBs under PL7-3

This operation is used to declare the multi-axis control function blocks which are to be used in the application.

Under PL7-3, in CONFIGURATION mode, select the OPTIONAL FUNCTION BLOCKS item.

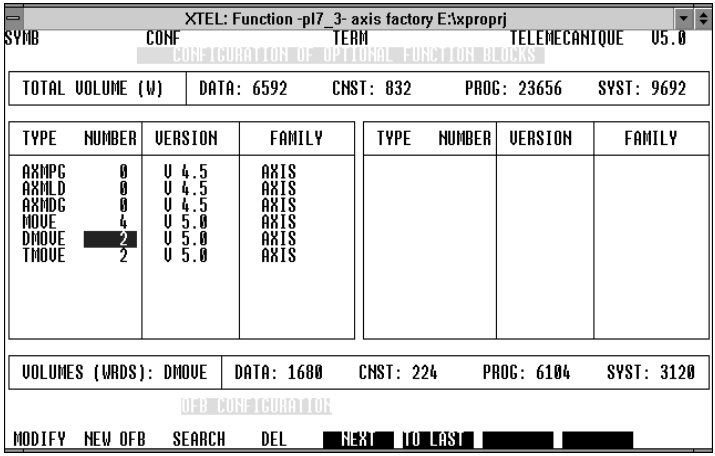
In the CONFIGURATION OF OPTIONAL FUNCTION BLOCKS window, press the soft key **[NEW OFB]** then **[NEXT FAM]** until the multi-axis control function blocks are accessed.

Select the function block to be used, MOVE (1 axis), DMOVE (2 axes) or TMOVE (3 axes), and press the **[INS]** soft key, then <ENTER>.

Repeat the operation on all the types of function block to be used.

Set the usage number for each OFB :
- Select the OFB
- Press **[MODIFY]**
- Enter the usage number

and confirm with <ENTER>.



Confirm to terminate the CONFIGURATION.

Note

Procedure when modifying versions of ●MOVE OFBs (change from V50 to V51)

Follow the procedure below :
1. Save the CONSTANTS of the OFBs which are installed (CONSTANT mode, WRITE key)
2. Insert the new versions of the OFBs in the application (CONFIGURATION mode, NEW OFB)
3. Reread the previously saved OFB constants.

This procedure can only be used for the CONFIGURATION parameters. Other parameters (COMMAND, SERVO, ERROR CONTROL) must be re-entered using the ADJ_MAX software.

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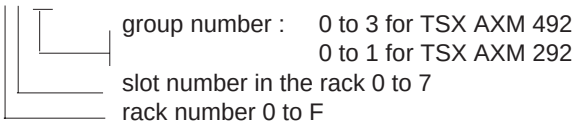
7.4 Entering the Group and Axis addresses and the Label

7.4-1 Description of the parameters

The group address ADGROUP and axis address ADAXIS configuration parameters assign the module, the axis group and the axes which are to be controlled to a multi-axis control function block.

ADGROUP : group address
Simultaneously codes the module physical address and the number of the axis group.
Coding is performed on words in hexadecimal.

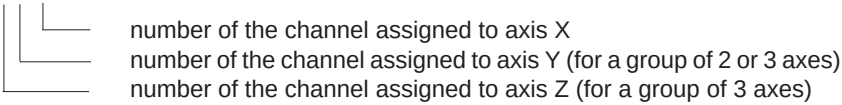
H' • • • • '



Example : TSX AXM 492 module in slot number 5 in rack number 4, the module axes are associated in pairs to 2 DMOVE optional function blocks. The coding is thus as follows :
First group of axes : ADGROUP = H'4500'
Second group of axes : ADGROUP = H'4501'

ADAXIS : axis addresses
Assignment of module channels (0 to 3) to the axes to be controlled.
Coding is performed on words in hexadecimal.

H' 0 Z Y X '



Example : in the preceding example, channels 0 (input ENC0) and 1 (input ENC1) are assigned to axes X and Y in the first group of axes. The coding is thus as follows :
ADAXIS = H'0010'
Channels 2 (input ENC2) and 3 (input ENC3) are assigned to axes X and Y in the second group of axes. The coding is thus as follows :
ADAXIS = H'0032'

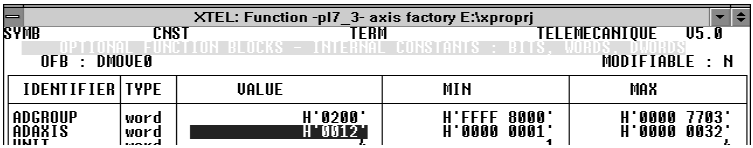
LABEL : string of 20 characters for the user to specify the name of the application.

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7.4-2 Entry under PL7-3

Entering the Group and Axis addresses (only in local mode) :

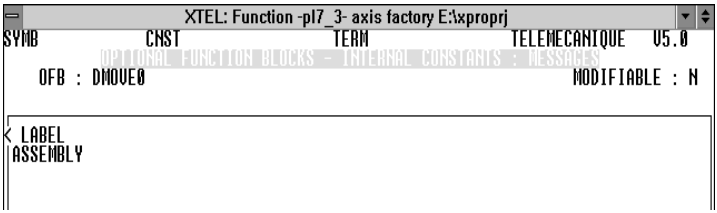
- Select PL7-3 CONSTANT mode
- Press the **[OFB]** soft key
- Select the type of OFB from the list displayed, and press <ENTER>
- Enter the OFB number, press <ENTER>
- Wait for the screen display
- Press the **[BASE]** soft key to select a hexadecimal base for the first parameter ADGROUP
- Press the **[MODIFY]** soft key and enter the parameter ADGROUP, press <ENTER>
- Select the next parameter ADAXIS
- Press the **[BASE]** soft key to select a hexadecimal base
- Press the **[MODIFY]** soft key and enter the parameter ADXIS, press <ENTER>



NB :
Other configuration parameters are entered using the ADJ-MAX software.

Entering the Label :

- Press the **[MSG]** soft key to select the Label
- Press the **[MODIFY]** soft key twice and enter the character string (20 characters maximum) corresponding to the application name, confirm by pressing <ENTER> three times.



- Press the <CLEAR> key to exit CONSTANT mode.

Note : If there is to be no programming following the configuration of the module or if you wish to adjust your axis before programming, transfer the configuration to the PLC processor (see Section 8.6) in order to access the module under ADJ-MAX.

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8.1 Module operating modes

The multi-axis control module can be used in 2 modes :

- **Automatic** : Movement commands controlled by the EXEC ●MOVEi.... instructions are controlled in this mode (1).
- **Manual** : This mode enables the user to visually control the moving part from the front panel or from an operator dialogue terminal. The commands can be accessed via OFB internal bits and apply to one axis only.

For more information on the operation of exchanges between the PLC processor and the module see Section 18.

C

The operating mode is selected using bit ●MOVEi,AUTO :

- Select automatic mode :

  SET ●MOVEi,AUTO — selects automatic mode
  SET ●MOVEi,SEND_CMD — sends the command to the module

  Conditions for changing to automatic mode :
  - no movement in progress (bit ●MOVEi,DONE at 1)
  - servo off mode (bit ●MOVEi,DIRDRIVE at 0) and measurement mode (bit ●MOVEi,DRV_OFF at 0) not selected
  - moving part stationary (bit ●MOVEi,NOWORDION at 1).
- Select manual mode :

  RESET ●MOVEi,AUTO — selects manual mode
  SET ●MOVEi,SEND_CMD — sends the command to the module

Other operating modes, which are sub-modes of Automatic and Manual mode, are also available. They can be accessed using ADJ MAX software, and are used to adjust and debug the application :

Automatic mode sub-modes :

- **Simulation** : This mode is designed to run the program without activating the outputs. It is used for local debugging of the application part.

Manual mode sub-modes :

- **Servo off** : The output acts as a digital/analog converter, and the servo-loop is not used. This mode is used to analyze the operation of the axis independently of the servo-loop.
- **Measurement** : In this mode the module only feeds back current position and speed data.
  Note : This mode is forced at start-up if the group is configured and there is no fault. To change to automatic or manual mode, this mode must be deactivated.

  Deactivating Measurement mode :
  RESET ●MOVEi,DRV_OFF
  SET ●MOVEi,SEND_CMD

(1) The ● before MOVE is replaced by D for a command addressed by a group of 2 axes, by a T for a command addressed by a group of 3 axes, and by no character for a single-axis group.

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8.2 Programming in automatic mode

8.2-1 General principle for programming movements

In the pre-configuration operations each group of axes has been assigned a movement control function block.

Each movement of the group of axes will be controlled by the execution in the PL7-3 program of the OFB assigned to it.

8.2-2 Review of programming an OFB

OFBs can be programmed in any program module (the •MOVE OFB is only programmed in the master task) in Ladder language (using an operation block) or in Literal language. The syntax is the same in both cases :

```
EXEC  OFBi(Inp1;...;Inpn=>Out1;...Outm)

OFBi    type and number of OFB
Inp     input objects
Out     output objects
=>      separator between the input and output parameters
;       separator between the parameters.
```

An OFB is programmed in PROGRAM mode.
PL7-3 software has soft keys [EXEC],[CONTENT] and [PARAM] which can be used to specify the values of the OFB constants and the I/O parameters respectively.
An instruction is entered using the following procedure :

- Press the [EXEC] key
- Enter the OFB type and number (for example DMOVE2)
- Press the [CONTENT] key to access the OFB internal constants (example : units, encoder type, etc, for a TSX AXM •92 module).

Note : For multi-axis control OFBs, the user does not need to modify these values at programming level. The ADJ-MAX software is used to adjust these parameters.

- Press the [PARAM] key to display the OFB
- Assign a variable to the OFB input and output parameters
- Confirm the screen and then the equation with <Enter>.

Comment :

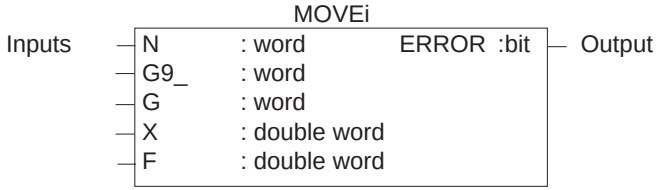
The user can, if required, enter the EXEC MOVE... instruction directly with all its parameters. Although doing this requires the meaning of each parameter to be recalled, it has the advantage of being much faster.

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8.2-3 Programming a movement command

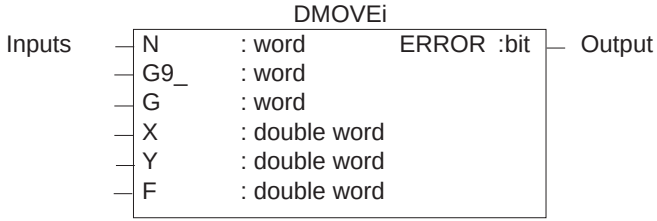
A movement command is programmed via a •MOVE function block, with the following syntax :

- **For a MOVE function block** (one axis)



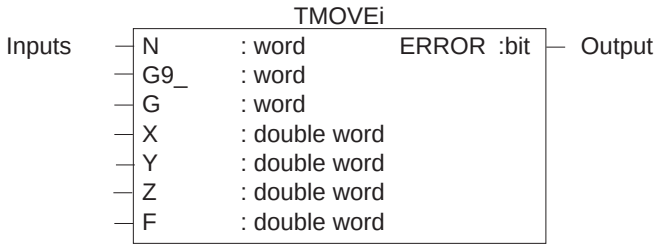
EXEC MOVEi (N;G9_;G;X;F=>)

- **For a DMOVE function block** (two axes)



EXEC DMOVEi (N;G9_;G;X;Y;F=>)

- **For a TMOVE function block** (three axes)



EXEC TMOVEi (N;G9_;G;X;Y;Z;F=>)

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where

i = OFB number from 0 to M-1, where M is the usage number declared in PL7-3 CONFIGURATION.

N = 0 to 32767, number identifying the movement performed by the OFB. In debug mode it is used to identify the current movement.

G9_ = type of movement

G90 move to an absolute position value

G91 move to a relative value in relation to the current position

G = instruction code :

G09 : move to the position and stop
G01/G30/G31 : move to the position without stopping (1)
G10 : move until an event is detected and stop
G11 : move until an event is detected without stopping
G14 : reference point on axis X
G15 : reference point on axis Y
G16 : reference point on axis Z
G20 : reserved for the system
G24 : recalibration on the fly (1)
G53 : cancel offset PREF
G54 : validate offset PREF
G62 : forced reference point (2)
G05 : await an event
G07 : memorize the current position when an event occurs

X, Y, Z= coordinates of the position to be reached or towards which the moving part is to move (in the case of moving without stopping). These positions can be :

- immediate
- coded in internal double words DWi or constant internal double words CDWi (these words can be indexed).

The unit in which these values are expressed is defined by the configuration parameter **UNIT** (this parameter is set using ADJ MAX software) :

- µm (default unit)
- 10^{-5} inch
- 10^{-5} degree
- increment

F = speed of movement of the moving part. This speed can be :

- immediate
- coded in an internal double word DWi or a constant internal double word CDWi (word can be indexed).

The speed unit depends on the selected position unit.

- µm (default unit)	-->	mm/min
- 10^{-5} inch	-->	cinch/min
- 10^{-5} degree	-->	cdeg/min
- increment	-->	increments /s

(1) G30 and G31 available from software version 1.4 onwards (2) available from software version 1.2 onwards

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8.2-4 Description of elementary movements

3 classes of movement can be programmed :

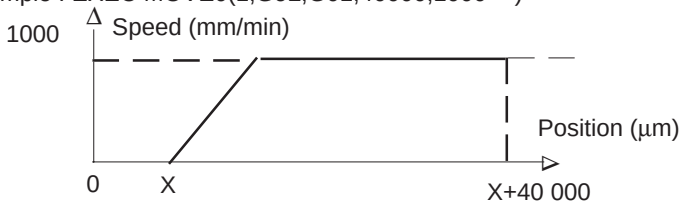
- Move to a position (G01,G09)
- Move until an event is detected (G11,G10)
- Reference points (G14,G15,G16)

When programming these movements the user defines the position to be reached and the speed. The other parameters, speed profile (trapezoid or parabolic), acceleration and deceleration, are defined either using ADJ MAX software (see Section 10.2), or under PL7-3 using the •MOVE OFB command parameters.

Movements may be :

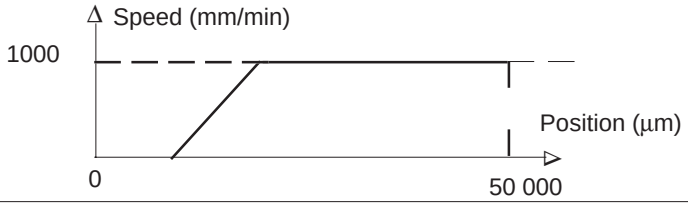
- Relative position with respect to the current position **G91**

Example : EXEC MOVE0(1;**G91**;G01;40000;1000=>)



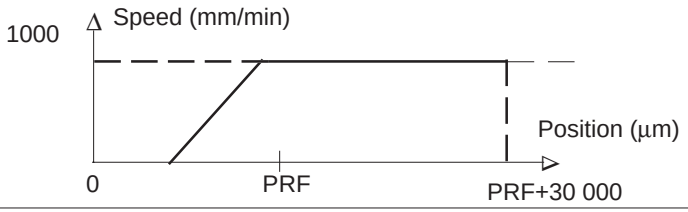
- Absolute position with respect to the machine reference **G90**

Example : EXEC MOVE0(1;**G90**;G01;50000;1000=>)



- Absolute position with respect to the indexed position PREF **G90** and instruction **G54**

Example : EXEC MOVE0(3;G90;**G54**;;=>)
EXEC MOVE0(4;G90;G01;30000;1000=>)



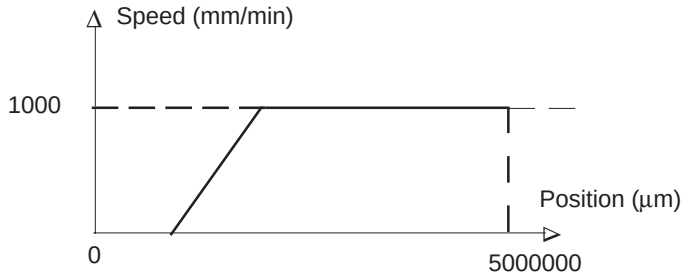
Note : For simplicity of representation, the examples are illustrated by movements on a single axis. Movements on 2 axes or 3 axes are performed in a similar way. The multi-axis control module performs the interpolation and controls each of the axes using the coordinates of the points to be reached, the speed and the parameters.

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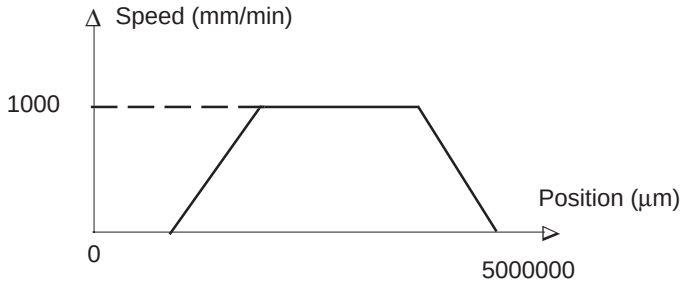
8.2-5 Description of instructions

Move to a position
without stopping : instruction code **G01/G30/G31** (1)
with stop : instruction code **G09**

Example 1 : EXEC MOVE0(1;G90;**G01**;5000000;1000=>)



Example 2 : EXEC MOVE0(1;G90;**G09**;5000000;1000=>)



Execution conditions for instructions G01 and G09 :

See general conditions for execution (Section 14.2)

(1) Codes **G30** and **G31** are described in Section 16, Part F.

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Move until an event is detected

without stopping : instruction code **G11**
with stop : instruction code **G10**

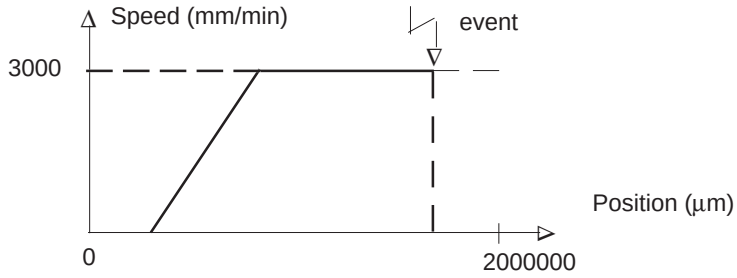
Instructions G11 and G10 are similar to G01 and G09 in that the command ends when the event is detected (or at the entered position if the event is not detected).
The event which is awaited can be the change to 1 :

- of one of the dedicated event inputs in the module associated with one of the axes of the group being controlled
- of the EVENT bit which can be programmed under PL7-3.

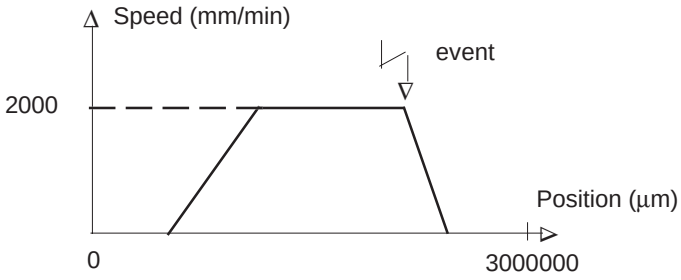
C

The position parameter must be defined. In the case of the DMOVE or TMOVE OFB, the position parameters to be reached are used to calculate the speed of each axis. Identical movements must be programmed in order to obtain equal speeds.

Example 1 : EXEC MOVE0(1;G90;**G11**;2000000;3000=>)



Example 2 : EXEC MOVE0(1;G90;**G10**;3000000;2000=>)



Execution conditions :

See general conditions for execution (Sections 14.2 and 15.1-2).

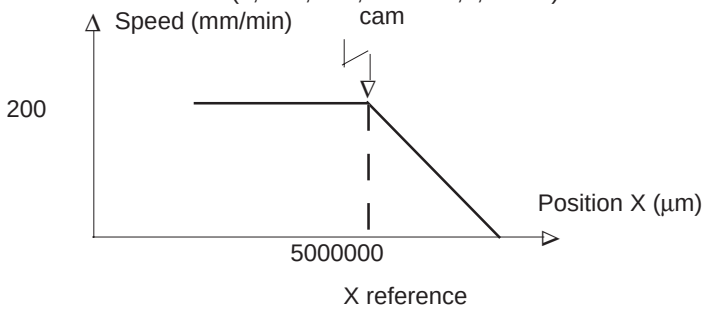
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Reference point

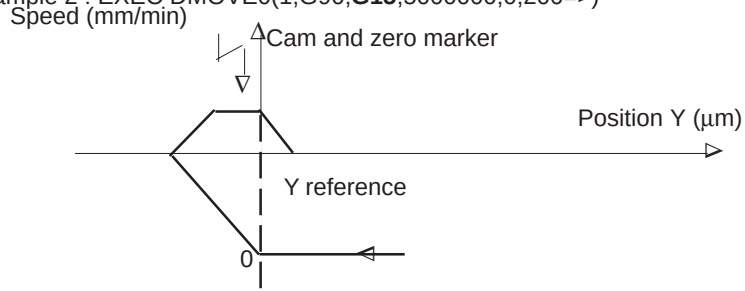
reference point on axis X : **G14**
reference point on axis Y : **G15**
reference point on axis Z : **G16**

The reference point is set on one axis at a time. The position displayed corresponds to the coordinate to be loaded in the current value when the reference is detected.
The reference point event is detected on the cam input or cam inputs and the zero marker associated with the axis being controlled, depending on the type of reference point selected.
The type of reference point and direction of movement are defined in configuration parameter x_TYPRP (for further details see Section 10.1-2).

Example 1 : EXEC DMOVE0(1;G90;**G14**;5000000;0;200=>)



Example 2 : EXEC DMOVE0(1;G90;**G15**;5000000;0;200=>)



Execution :

See general conditions for execution (Section 14.2)

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Await event : instruction code **G05**

When this instruction is used, the moving part awaits an event with a time envelope defined in parameter F in ms. If the event has not appeared during the time envelope, the following command is executed. If the parameter is defined at 0, the waiting period is not limited.

The awaited event can be the change to 1 :
- of one of the module event inputs associated with one of the axes in the group being controlled
- of the EVENT bit which can be programmed under PL7-3

Example : EXEC MOVE0(1;;G05;;500=>)
EXEC MOVE0(2;G90;G09;5000000;1000=>)

C

The 3 following instructions perform repetitive movements from the various positions : see the example on the opposite page.

Memorize the current position when an event occurs : instruction code **G07**

After the execution of this instruction, when an event occurs the coordinates of the current position are memorized in words X_PREF, Y_PREF and Z_PREF (user configurable indexed position).

The awaited event may be the change to 1 :
- of one of the dedicated event inputs in the module associated with one of the axes of the group being controlled
- of the EVENT bit which can be programmed under PL7-3

This instruction is not blocking : the program carries on immediately to the following instruction.

Validate offset PREF : instruction code **G54**

When an absolute movement (code G90) is selected, this instruction is used to define the movement not with respect to the reference, but with respect to the position of coordinates X_PREF,Y_PREF,Z_PREF (user-configurable indexed position).

Cancel offset PREF : instruction code **G53**

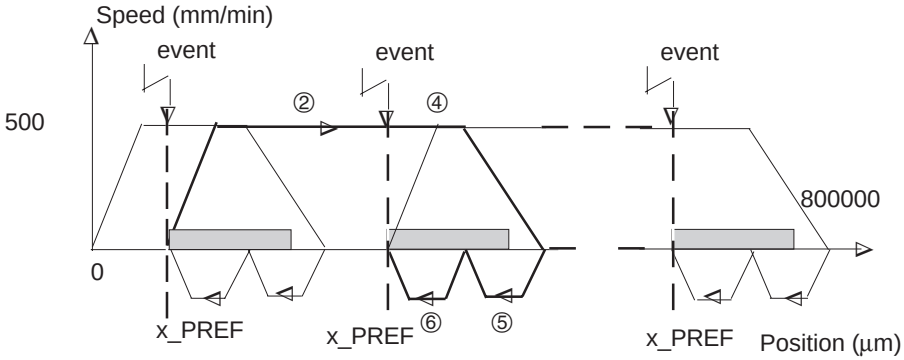
This instruction cancels instruction G54. The absolute movement is again performed with respect to the reference. By default all the absolute movements are performed with respect to the reference.

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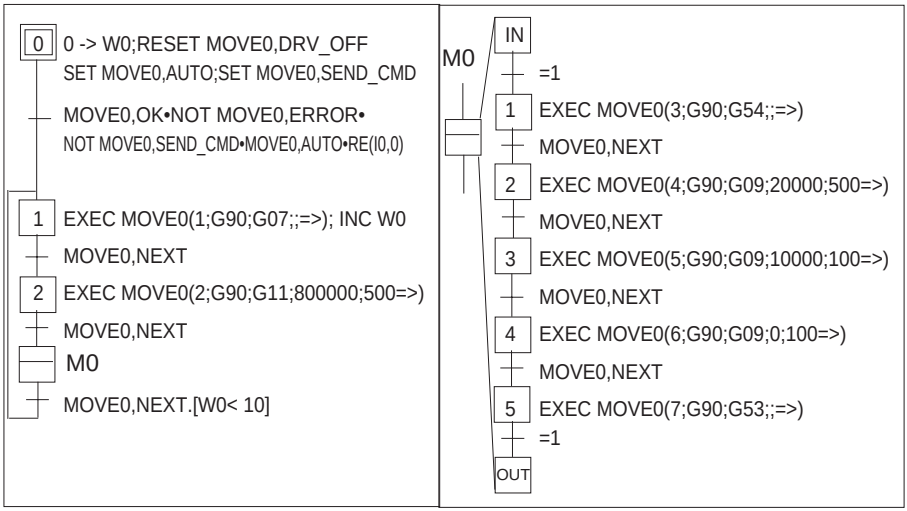
Example : The example below gives a sequence of elementary movements to be performed 9 times :

- move until edge of the item is detected ②
- move to position 2000 in relation to the edge of the item ④
- move to position 1000 in relation to the edge of the item ⑤
- move to the edge of the item ⑥

In this example it is assumed that the reference point has already been set and the moving part is in the start position.



Comment : The sequence of elementary movements is represented in bold on the above chart. The numbers shown correspond to the program step numbers in the OFB.



Note : All the actions must be programmed on activation.

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Recalibration on the fly command : instruction code **G24**

This command sets a reference point without stopping the moving part (on the fly).

It applies only to single-axis groups, that is MOVE OFBs.

Syntax : EXEC •MOVE0 (1;G90;G24;X;Y;Z;=>)

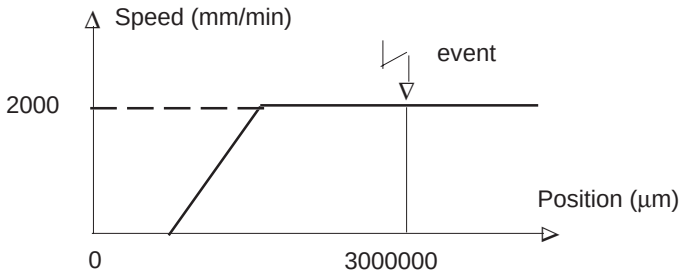
The command sets a reference point on the value X entered as control parameter and at a rising edge on the cam input of the axis concerned.
The operation is performed without stopping the movement at the required speed F if the start is from standstill, otherwise at the speed of the current command, and always in the positive direction.
The calibration events are of the short cam type, with or without zero marker and are independent of the type of reference point selected in parameter TYPRP.

Note :
- if the axis is not referenced, the initial execution of this command is accepted and at the end of execution the axis is referenced,
- if the axis is referenced, the initial execution of this command does not cancel the reference of the axis. In contrast to the other reference point commands, it can be linked with a MOVE0,NEXT command.

If command G24 is executed while movement is in the reverse direction (negative direction) there is a NON BLOCKING command failure, and CMD_FAIL will generate a message (code 1F). In this case, command G24 is ignored, and bits MOVE0,NEXT and MOVE0,DONE function normally.

Performance : the time which elapses between the event and the moment when the reference value is transferred to the measurement is 100µs, or a 100-point error at a maximum frequency of 1 MHz.

Example 2 : EXEC MOVE0(1;G90;**G24**;3000000;2000=>)



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Forced reference point command : instruction code **G62**

This command sets a forced reference point. The current value is forced to the value entered in the command (coordinates : X, Y and Z).

Syntax : EXEC ●MOVE0 (1;G90;**G62**;X;Y;Z;=>)

Note :
Whatever the state of axes X or Y or Z (referenced or not referenced), this command will be accepted and references the axes at the end of execution.

This command is accepted only if all the axes in the group are at a standstill (NO_MOTION=1).

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8.2-6 Sequence of movement commands

A trajectory is created by programming a series of elementary movement instructions.

Each elementary command to execute a function block is performed once only, the execution is thus programmed either in :
- Grafcet : in a step on activation or on deactivation of that step
- Literal or Ladder language on the rising edge of a bit

C

TSX AXM •92 modules have a mechanism for linking movement commands together into sequences.
Each group of axes of the TSX AXM module has a buffer memory which can receive a movement command while it is in the process of executing the preceding command. Thus when the current command has been executed, it goes directly to the command in the buffer memory.

The link between 2 movement commands is established in the following way :
- Immediately, if the first movement does not include a stop.
- As soon as the moving part is in the target window or at the end of the time delay TSTOP (defined using ADJ MAX) if the first movement includes a stop.

The execution time for the current instruction must be greater than the master task period so that the move from one command to another is immediate.

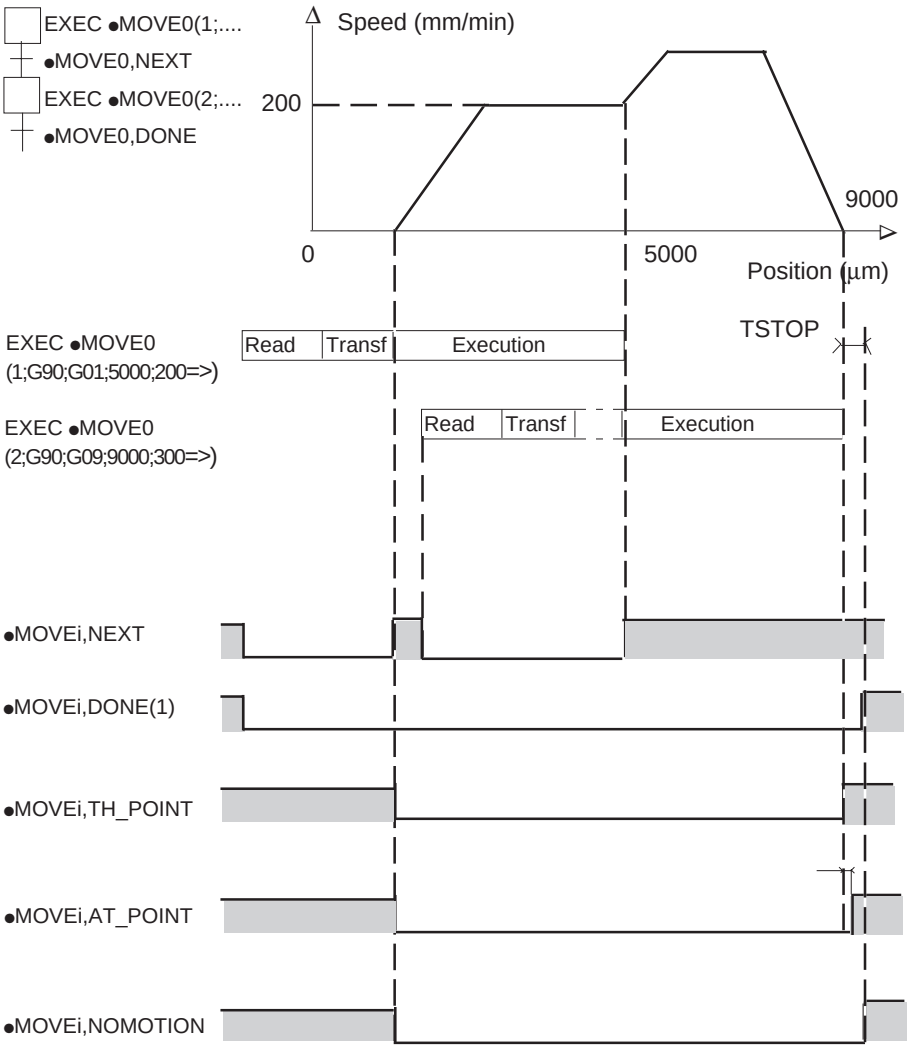
Note : A new command can only be transmitted to the module if the buffer memory assigned to the group to be controlled is empty.

Bits associated with the sequencing mechanism

Addressing	Description
•MOVEi,NEXT	Indicates to the user program that the module is ready to receive the next movement command. This command will be interpreted and executed automatically when the current commands have been executed.
•MOVEi,DONE	Indicates the end of execution of the current command and that there is no new command in the buffer memory.
•MOVEi,TH_POINT	Signals that the set value has been reached
•MOVEi,AT_POINT	Signals that the moving part has reached the intended point : • For a movement with no stop this bit changes to 1 at the same time as bit •MOVEi,TH_POINT and returns to 0 at the next movement command. • For a movement with a stop this bit changes to 1 as soon as the moving part enters the target window.
•MOVEi,NOMOTION	Indicates that the moving part is stationary

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Example :



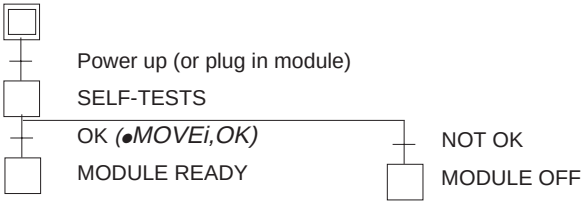
(1) For a movement with stop : ●MOVEi,DONE changes to 1 when ●MOVEi,NOMOTION changes to 1 and when the buffer memory is available.
For a movement without stop : ●MOVEi,DONE changes to 1 when ●MOVEi,TH_POINT changes to 1 and when the buffer memory is available.
Note : This diagram does not take into account the contouring error.

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8.3 Managing the operating modes

The TSX AXM •92 module operating modes can be summarized in two 2 charts :

- **Module general operating mode**

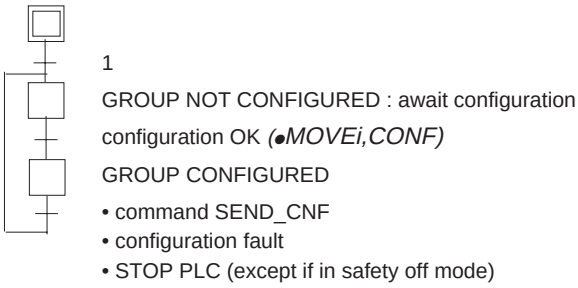


The chart is intentionally simplified, and shows that the module starts directly in ready state if no fault is detected.

Module ready state may change to module off if module faults are detected.
A power return has the same effect as powering up.

- **Operating mode of the groups of axes**

When the module is ready, each group of axes comprising the module waits to receive the configuration.



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Programming the operating modes :

To ensure that the TSX AXM •92 module can effectively deal with commands transmitted by PL7-3 (module general operating mode), it is necessary to check that the module is ready to operate. To do this test the bit : •MOVEi,OK.

To ensure that the group of axes to be controlled is ready to interpret the commands (axis group operating mode), a check must be made that the group is configured. To do this test the bit : •MOVEi,CONF.

At a cold restart (SY0) or a power return (SY1), the configuration of the groups is automatically transmitted to the module by the processor.
When the PLC changes to STOP the group is deconfigured (unless it is in safety off mode), and when it changes from STOP to RUN, the group is automatically reconfigured.

Comment : When the PLC changes to STOP a stop command is transmitted, and the group is only deconfigured when the moving part is completely stationary.

Note : At a cold restart the OFB data (servo, command and error control parameters) may be lost. To overcome this problem, the •MOVE OFB has an internal backup which automatically reloads this data. It is therefore important that once these parameters have been set, they are transferred using the ADJ MAX SAVE_PRM command or via the program using the •MOVEi,SAVE_PRM bit.

Safety off mode

This mode, which is selected by setting the •MOVEi,SAFE_OFF bit to 1, ensures that the group continues to operate even if the PLC (or the master task) changes to STOP. The execution of the movements which are in progress is completed, and the group remains configured.

This mode can be used for debugging, however it is dangerous to use it during normal operation as the PL7-3 program in the PLC processor loses control of the module.

Note : Before any transfer operation a check should be made that safety off mode is not selected and that bit •MOVEi,SAFE_OFF is at 0.

Comment : action of bit SY9

Setting bit SY9 to 1 (when bit •MOVEi,SAFE_OFF is at 0) causes the deconfiguration of all the TSX AXM 292/492 modules (Reminder : setting bit SY9 to 1 causes resetting of the discrete outputs).

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8.4 Fault management

8.4-1 Role

Checking for faults is of primary importance in the area of position control because of the inherent risks involved when moving parts are in motion.
The checks are performed internally and automatically by the module.

Three types of fault are detected :

- **Module faults.** These are internal hardware faults in the module. All the groups of axes controlled by this module are thus affected when this type of fault occurs. They may be detected during the self-tests (when the module is re-initialized) or during normal operation (I/O fault).
- **Group faults**. These faults are :
  - hardware faults external to the module (eg : encoder wiring break)
  - application faults linked to the group of axes (eg : deviation).

  Continuous checks are made for Group level faults when the group is configured.
- **Command failures**. These are faults which may occur during the execution of a movement command, the transfer of a configuration, the transfer of adjustment parameters or a change of operating mode.

Note :

- Checking for hardware faults is inhibited when the group of axes is in simulation mode.
- Checking for certain group level faults can be enabled or inhibited by the group error control parameters. These error control parameters can be adjusted using ADJ MAX software or set using the PL7-3 program.
- In servo off mode (DIRDRIVE), the application fault check is inhibited.
- In measurement mode (DRV_OFF), the application fault check, except for the soft stop fault check, is inhibited.

8.4-2 Principle

On detection of a fault, there are possible 2 consequences :

- **Fault with stop** of one (group fault) or all of the moving parts linked to a module (module fault). In this case the following occurs :
  - fault indication
  - deceleration of the moving part until D/A converter signal reduces to zero
  - deactivation of the speed drive validation relay
  - deletion of all the commands which have been memorized
  - wait for acknowledgment.

  The fault must have disappeared and been acknowledged before the application can be restarted.
- **Fault with no stopping** of the moving parts. In this case the fault is merely indicated. Any actions to be performed are the responsibility of the user and are executed in the PL7-3 program.
  The indication of the fault disappears when the fault has disappeared and been acknowledged (the acknowledgment is not memorized and only occurs if the fault has disappeared).

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8.4-3 Programming

Faults can be displayed, corrected and acknowledged using ADJ_MAX software, but it may be more convenient during operation to be able to control the moving part and correct faults from a console or using operator dialogue software (eg : PL7-MMI).

Fault indication

The module provides a large amount of data in the form of status bits and words which can be accessed via the PL7-3 program. These bits make it possible to deal with faults hierarchically :

- so that they can be used by the main program
- so that the fault is indicated.

There are 3 levels of indication :

• 1st level : general data
●MOVEi,OK : no blocking fault (with stopping of the moving part) is detected ●MOVEi,ERROR : fault (covers all faults) ●MOVEi,HARD_ERR : external hardware group fault ●MOVEi,AXIS_ERR : application group fault ●MOVEi,CMD_FAIL : command failure
• 2nd level : intermediate data
group fault status word ●MOVEi,STATUS0
• 3rd level : detailed data
axis fault status words ●MOVEi,STATUS1, ●MOVEi,STATUS2, ●MOVEi,STATUS3

Each fault is described in detail in the following sections. STATUS words are also described in detail in the quick reference guide. An example of fault processing is given in Section 5 "Tutorial".

In general it is advisable to stop the evolution of the sequential processing assigned to the axis when a blocking fault occurs, and to control the moving part in manual mode while the fault is corrected. Correction of the fault should be followed by an acknowledgment.

Acknowledging faults

When a fault occurs :

- Fault bits ●MOVEi,ERROR, ●MOVEi,HARD_ERR,●MOVEi,AXIS_ERR and bits extracted from the status word ●MOVEi,STATUSj concerned by the fault change to 1.
- If the fault is with stop, bit ●MOVEi,OK changes to 0.

When the fault disappears, the status of all the fault bits remains unchanged. The fault is memorized until it is acknowledged : bit ●MOVEi,ACK_DEF is set to 1 (or the module is reinitialized). The fault must be acknowledged after it has disappeared (except in the case of soft stop faults).

If several faults are detected, the acknowledgment command only applies to those faults which have totally disappeared. Faults which remain must be acknowledged again when they have disappeared.

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8.4-4 Summary table

The following table summarizes the various types of fault and the associated bits. The bit addresses are simplified in this table, to complete the addresses add ●MOVEj, (example ●MOVEj,HARD_ERR).

Multi-axis control fault :	*ERROR (covers all faults)* *OK (indicates that no blocking fault has been detected)*		
Module faults	Group faults		Command Failure
	External hardware *HARD_ERR STATUS0,3(4or5) (*)*	Application *AXIS_ERR STATUS0,6(7or8) (*)*	*CMD_FAIL* (double word)
• Out of Service *STATUS0, 0* • I/O interface *STATUS0,2*	• Emergency stop *STATUSi,0* • Speed drive *STATUSi,1* • Encoder wiring break *STATUSi,2* • Encoder contam. *STATUSi,3* • Analog output *STATUSi,4* short-circuit	• Soft stops SLMAX *STATUSi,5* • Soft stops SLMIN *STATUSi,6* • Overspeed *STATUSi,7* • Deviation DMAX1 *STATUSi,8* • Deviation DMAX2 *STATUSi,B* • Stop fault STOP *STATUSi,A* • Target window *STATUSi,9*	• Movement *STATUS0,B* • Chang. Mode *STATUS0,C* • Parameters *STATUS0,D* • Configuration *STATUS0,E*

(*) axis X,Y or Z, i= 1, 2 or 3 for axis X, Y or Z.

The words lMOVEj,STATUS1, 2 and 3 are only updated if bit lMOVEi,MONITOR is set to 1.

faults in shaded boxes are those which do not cause the moving part to stop (non-blocking faults) and have no effect on the OK bit.

8.4-5 Description of module faults

Fault : **Module Out of Service**

Cause	Several main functions of the module are not working
Parameter	None
Consequence	The moving parts controlled by the module have been forced to stop
Indication	• FAIL indicator lamp on module front panel is on • Bit ●MOVEi,STATUS0,0
Remedy	• Reinitialize the module • Change the module

Fault : **I/O interface**

Cause	A component controlling the I/O is not operating
Parameter	None
Consequence	The moving parts controlled by the module have been forced to stop
Indication	• OK indicator lamp on module front panel is off • Bit ●MOVEi,STATUS0,2
Remedy	• Reinitialize the module • Change the module

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8.4-6 Description of Group faults : external hardware faults

These faults are indicated by the bit •MOVEi,HARD_ERR, bits •MOVEi,STATUS0,3 4 or 5 indicate axis X,Y or Z as faulty.

Fault : **Emergency stop**

Cause	Open circuit between the 0V and speed drive validation inputs (1) on module front panel (connector ANALOG OUT) see Section 4.2-5
Parameter	None
Consequence	The moving part controlled by the group is forced to stop
Indication	Bit •MOVEi,STATUSj,0 (2)
Remedy	Reconnect the 2 inputs and acknowledge the fault

(1) As well as detecting the presence of the speed drive, these inputs can also be used by a "mushroom head" type emergency stop pushbutton or for detecting the presence of the terminal block (short-circuit wired in the connector).

Fault : **Speed drive**

Cause	Open circuit between the 24V and speed drive fault inputs on the module (connector ANALOG OUT) see Section 4.2-5
Parameter	None
Consequence	The moving part controlled by the group is forced to stop
Indication	Bit •MOVEi,STATUSj,1 (2)
Remedy	Correct and acknowledge the speed drive fault

Fault : **Encoder wiring break**

Cause	Complementarity fault in data from the encoder
Parameter	None
Consequence	The axis is dereferenced (in the case of an incremental encoder) The moving part controlled by the group is forced to stop
Indication	Bit •MOVEi,STATUSj,2 (2)
Remedy	Reconnect the offending encoder and acknowledge the fault

Fault : **Encoder contamination**

Cause	Contamination fault in an encoder. The contamination data is transmitted by the encoder using the 5V supply provided by the connector (see Section 4.2-2)
Parameter	None
Consequence	The axis is dereferenced (in the case of an incremental encoder) The moving part controlled by the group is forced to stop
Indication	Bit •MOVEi,STATUSj,3 (2)
Remedy	Check the offending encoder and acknowledge the fault

Fault : **Analog output short-circuit**

Cause	Short-circuit detected on one of the module analog outputs
Parameter	None
Consequence	The moving part controlled by the group is forced to stop
Indication	Bit •MOVEi,STATUSj,4 (2)
Remedy	Correct the short-circuit and acknowledge the fault

(2) where j =1 for axis X, 2 for axis Y and 3 for axis Z.

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8.4-7 Description of Group faults : application faults

These faults are indicated by the bit •MOVEi,AXIS_ERR. Bits •MOVEi,STATUS0,6 7 or 8 indicate axis X Y or Z as faulty.

Fault : **Soft stops**

Cause	The moving part is no longer located between the 2 limit values : upper and lower soft stop limits (this check is activated for each axis as soon as it is referenced)
Parameter	•MOVEi,x_SLMAX : upper soft stop limit •MOVEi,x_SLMIN : lower soft stop limit
Consequence	The moving part is forced to stop.
Indication	• Bit •MOVEi,STATUSj,5 upper soft stop overshoot • Bit •MOVEi,STATUSj,6 lower soft stop overshoot
Remedy	Acknowledge the fault and execute the return from soft stop overshoot command : •MOVEi,SLRETURN, which automatically repositions the moving part within the valid measurement area. To accept this command, the group checks that : • There is no movement in progress • The group is in manual mode • The function block STOP command is at zero • The axis to which this command applies is referenced • There is no other fault with stop on the axis The return from soft stop overshoot is performed at speed •MOVEi,x_FHIGH or x_FLOW depending on bit •MOVEi,HIGH_F

Fault : **Overspeed**

Cause	The speed of the moving part has exceeded maximum speed •MOVEi,x_VMAX plus the threshold on one of the axes
Parameter	•MOVEi, x_FEXCES speed threshold
Consequence	Moving part stops
Indication	Bit •MOVEi,STATUSj,7
Remedy	Acknowledge the fault

Fault : **Deviation**

Cause	The module compares (moving part stationary or in motion) the calculated position (reference) and measured position of the moving part on each axis. A fault is detected when the position error exceeds the maximum permitted deviation defined by the user.
Parameter	•MOVEi,x_DMAX 2 : non-critical abnormal position error •MOVEi,x_DMAX 1 : critical abnormal position error
Consequence	If deviation x_DMAX2 is exceeded : the fault is indicated, If deviation x_DMAX1 is exceeded : the moving part is stopped. This fault is only recognized if •MOVEi,x_DMAX1 is other than 0
Indication	• Bit •MOVEi,STATUSj,B deviation x_DMAX2 exceeded • Bit •MOVEi,STATUSj,8 deviation x_DMAX1 exceeded
Remedy	Check the servo loop and acknowledge the fault

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Fault : **Stop**

Cause	As soon as the speed reference value calculated by the group becomes 0, the group starts a time delay ●MOVEi,TSTOP : • If this parameter is set to 0, the fault check is inhibited • If this parameter is not 0 when the time delay has elapsed, the group compares the measured speed of the moving part and the stopping speed ●MOVEi,VSTOP. If the measured speed exceeds VSTOP, the group detects a stopping fault.
Parameter	●MOVEi, x_TSTOP maximum stop detection time ●MOVEi, x_VSTOP speed at which the moving part is declared to be stopped.
Consequence	A fault is indicated
Indication	• Bit ●MOVEi,STATUSj,A
Remedy	• Correct the fault or use new settings • Acknowledge the fault

Fault : **Target window**

Cause	When a move to a position with stop is requested, the group checks that the position reached corresponds to the required position with a tolerance defined by the user in parameter ●MOVEi,x_TW. (If this parameter is 0, the check is inhibited)
Parameter	●MOVEi,x_TW : target window
Consequence	If the moving part is not in the target window : the fault is indicated
Indication	Bit ●MOVEi,STATUSj,9 target window fault
Remedy	Check the servo loop and acknowledge the fault

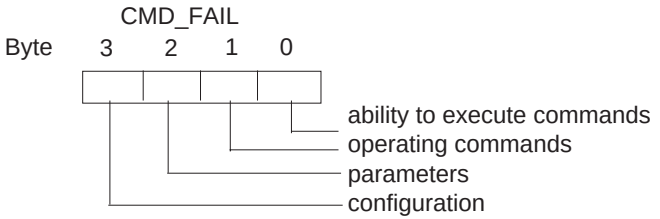
x = X,Y or Z for axes X, Y or Z and j = 1, 2 or 3 for axes X, Y or Z

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8.4-8 Description of command failure faults

These faults are indicated in double word ●MOVEi,CMD_FAIL and more generally by the bits extracted from word ●MOVEi,STATUS0.

Fault : **Command failure**

Cause	• unauthorized movement command, • unauthorized mode change, • incorrect parameter transfer, • incorrect configuration transfer, • system error.
Parameter	-
Consequence	• immediate stop of current movement, • setting to 0 of the buffer memory receiving the movement commands in automatic mode.
Indication	• bit ●MOVEi,STATUS0,B Movement command failure, • bit ●MOVEi,STATUS0,C Command failure : operating mode change, • bit ●MOVEi,STATUS0,D Command failure : parameter transfer, • bit ●MOVEi,STATUS0,E Command failure : configuration transfer, • bit ●MOVEi,STATUS0,F System error (OFB). • bit ●MOVEi,ERROR is set to 1 as soon as a command failure is detected ("Logic Or" of the ●MOVEi,STATUSi,j) Double word ●MOVEi,CMD_FAIL is other than 0 when a command failure is detected and sends back an error code.  More detailed information is provided by ADJ MAX, which displays the exact cause of the command failure (see Section 13.1-2).
Remedy	• implicit acknowledgement on reception of a new accepted command, • acknowledgement is also possible using the command ●MOVEi,ACK_DEF

Note : in the case of linked movements in automatic mode, it is advisable to make the execution of each movement conditional upon the end of execution of the previous movement, using bit ●MOVEi,ERROR. This ensures that a link is not made to the following command when the current command has failed.
See the list of error codes in the appendix.

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8.5 Management of manual mode

Manual mode can be selected and controlled from ADJ_MAX, from the front panel or from an operator dialogue or supervision console.

In this case, the dialogue is programmed in PL7-3, using the elementary commands (movements, reference point, etc) provided by the •MOVE OFB associated with the group of axes. Parameter •MOVEi,AXIS_NB is used to select the number of the axis being controlled manually (does not exist on MOVE function block).

A manual command is only addressed to one axis in the group at a time.

8.5-1 Selecting manual mode

This is performed by programming the following commands :

RESET •MOVEi,AUTO	selects the mode
SET •MOVEi,SEND_CMD	sends the mode selection command

It is only possible to change from automatic to manual mode if the moving part is stationary.
It is possible change the group to manual mode and to send a command simultaneously. The command is taken into account when the moving part is stationary and no instruction is being executed.
When the manual mode command is recognized, bit •MOVEi,SEND_CMD is automatically reset to 0 (see Section 18.1).

8.5-2 Execution of manual commands

Every manual command must be followed by the command •MOVEi,SEND_CMD so that it is taken into account (except for the direct access commands •MOVEi,JOG_P, •MOVEi,JOG_M, and •MOVEi,STOP).

There are a number of parameters associated with manual commands :

- •MOVEi,HIGH_F : select between high speed (defined in command parameter •MOVEi,x_FHIGH) and low speed (defined in command parameter •MOVEi,x_FLOW). These parameters can be adjusted using ADJ MAX software.
- •MOVEi,PARAM : value of the parameter associated with a command. This parameter may be a position, an increment or a voltage, depending on the command.

Condition for executing commands in manual mode :

- Referenced axis (except for reference point commands, JOG_P/M and DIRDRIVE)
- Target position within the soft stop limits (1)
- Axis with no blocking fault (•MOVEi,OK = 1) (1),
- No command being executed (•MOVEi,DONE = 1).

(1) Except, in the case of soft stop faults, for commands JOG_P, JOG_M, SL_RETURN, DIRDRIVE after acknowledgment of the fault.

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8.5-3 Detailed description of manual commands

Visual movement command : JOG_P and JOG_M

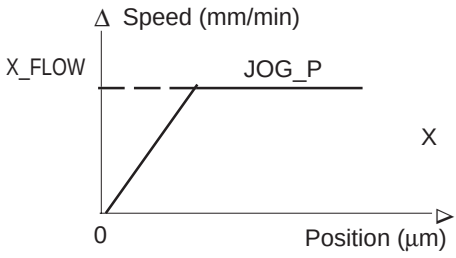
Bits •MOVEi,JOG_P and •MOVEi,JOG_M command the movement of the moving part in a positive or negative direction. The operator should visually follow the position of the moving part.
Commands JOG_P and JOG_M are active whether or not the axis is referenced.

Programming :

- Select the speed x_FHIGH or x_FLOW
- Select the axis AXIS_NB
- Acceptance command SEND_CMD
- Wait for acceptance of command SEND_CMD
- Movement command JOG_P or JOG_M.

Example : Move in a positive direction at low speed on axis 0 of a group of 2 axes.

```
Activ  RESET DMOVE0,HIGH_F
       0-->DMOVE0,AXIS_NB
       SET DMOVE0,SEND_CMD
       NOT DMOVE0,SEND_CMD
Activ  SET DMOVE0,JOG_P
```



Note : These commands are also used to release the moving part when a soft stop fault is detected and has been acknowledged.

Incremental movement command : INC_P and INC_M

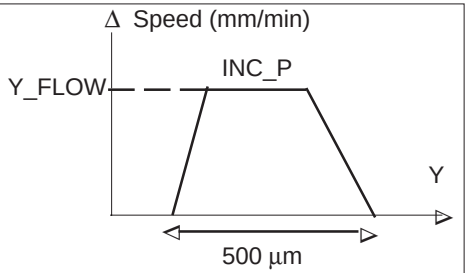
Bits •MOVEi,INC_P or •MOVEi,INC_M : command the movement of the moving part by one increment in a positive or negative direction, then stop.

Programming :

- Select the speed x_FHIGH or x_FLOW
- Select the axis AXIS_NB
- Write the value of the increment PARAM
- Incremental movement command INC_P or INC_M
- Acceptance command SEND_CMD.

Example : Move 500 µm in a + direction at low speed on axis 1 of a group of 2 axes.

```
Activ  RESET DMOVE0,HIGH_F
       1-->DMOVE0,AXIS_NB
       500-->DMOVE0,PARAM
       SET DMOVE0,INC_P
       SET DMOVE0,SEND_CMD
       NOT DMOVE0,SEND_CMD
```



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Command to move the moving part to the reference position : HOMING

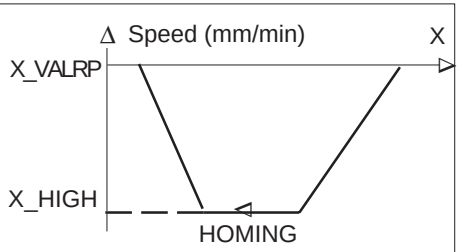
Bit •MOVEi,HOMING commands the movement of the moving part to the reference position on the selected axis. The reference position is defined in parameter x_VALRP.

Programming :
- Select the speed x_FHIGH or x_FLOW
- Select the axis AXIS_NB
- Command the movement to the reference position HOMING
- Acceptance command SEND_CMD

Example :
Move to reference at low speed on axis 0 of a group of 2 axes

```
Activ SET DMOVE0,HIGH_F
      0-->DMOVE0,AXIS_NB
      SET DMOVE0,HOMING
      SET DMOVE0,SEND_CMD

      NOT DMOVE0,SEND_CMD
```



Reference point command : SETRP_P and SETRP_M

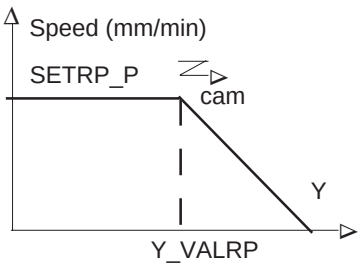
Bits •MOVEi,SETRP_P and •MOVEi,SETRP_M set a manual reference point in a positive or negative direction. In the case of a type 4 reference point, these bits automatically generate the correct direction of movement.
The type of reference point is defined in parameter x_TYPRP, and the value of the reference is defined in parameter x_VALRP.

Programming :
- Select the speed x_FHIGH or x_FLOW
- Select the axis AXIS_NB
- Reference point command SETRP_P or SETRP_M
- Acceptance command SEND_CMD

Example :
Manual reference point on axis 1 in positive direction at low speed (1)

```
Activ RESET DMOVE0,HIGH_F
      1-->DMOVE0,AXIS_NB
      SET DMOVE0,SETRP_P
      SET DMOVE0,SEND_CMD

      NOT DMOVE0,SEND_CMD
```



(1) it is assumed that the reference position VALRP has been defined using the ADJMAX software.

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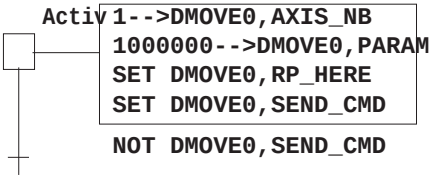
Forced reference point command : RP_HERE

Bit •MOVEi,RP_HERE forces a reference point at the value defined in parameter •MOVEi,PARAM. This command is used to reference the axis without moving the part.

Comment : command RP_HERE does not modify the value of parameter X-VALRP.

Programming :
The moving part must be stationary and no fault detected
- Select the axis AXIS_NB
- Write the position value to be loaded PARAM
- Forced reference point command RP_HERE
- Acceptance command SEND_CMD

Example : Indicate that the moving part is at the 1 meter position on axis 1.

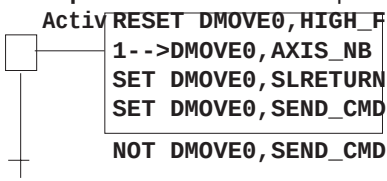


Return from soft stop overshoot command : SLRETURN

Bit •MOVEi,SLRETURN commands the return of the moving part from a soft stop overshoot on the selected axis, after this fault has appeared and been acknowledged. This command returns the moving part to position x_SLMAX - x_TW if the upper soft stop limit is crossed or x_SLMIN + x_TW if the lower soft stop limit is crossed.

Programming :
The moving part must be stationary, a soft stop fault is detected and acknowledged (command ACK_DEF)
- Select the speed HIGH_F
- Select the axis AXIS_NB
- Return from soft stop overshoot command SLRETURN
- Acceptance command SEND_CMD.

Example : Return from soft stop overshoot on axis 1.



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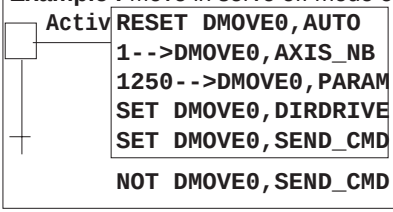
Servo off mode movement command : DIRDRIVE

Bit ●MOVEi,DIRDRIVE commands the movement of the moving part in direct drive mode. The loop is off. The voltage of the speed drive is controlled between -x_UMAX and + x_UMAX, with the sign giving the direction of movement. Nonetheless, the changes in the speed setpoint are performed while respecting the acceleration and deceleration ramps. This mode is used to analyze the behaviour of an axis independently from the loop so that it can be adjusted.

Programming :

- Select the axis AXIS_NB
- Write the voltage value to be loaded PARAM
- Servo off movement command DIRDRIVE
- Acceptance command SEND_CMD

Example : Move in servo off mode on axis 1 with a voltage of 1.25 V.



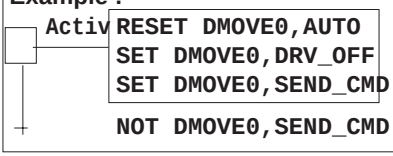
Change to group measurement mode : DRV_OFF

Bit ●MOVEi,DRV_OFF commands the change to group measurement mode. In this mode the module only sends back current position and speed data, it does not control the movement of the moving part. This command applies to all the axes in the group. The loop is off. The speed drive is not controlled, the enable relay is open. The application fault checks are masked.

Programming :

- Select measurement mode (DRV_OFF)
- Acceptance command (SEND_CMD)

Example :

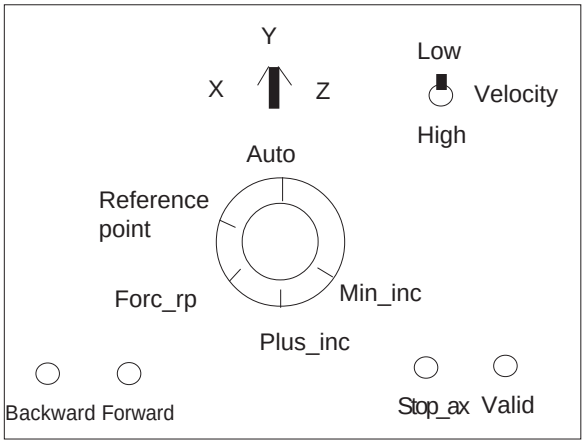


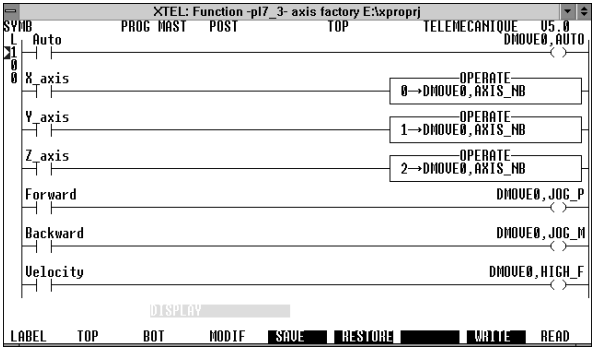
Stop moving part command : STOP

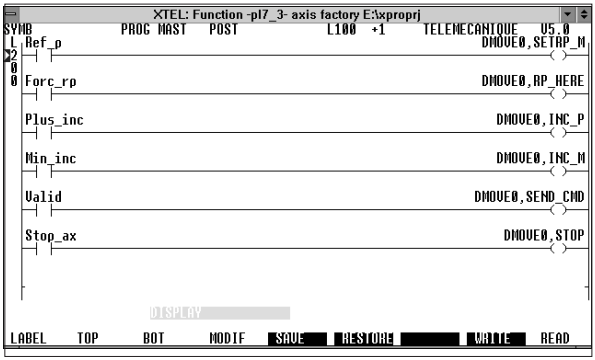
Bit ●MOVEi,STOP stops the movement of the moving part. It is a direct access command (no SEND_CMD order). It also operates in automatic mode.

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Example : The program below links the control station and the group to be controlled so that manual mode can be used.





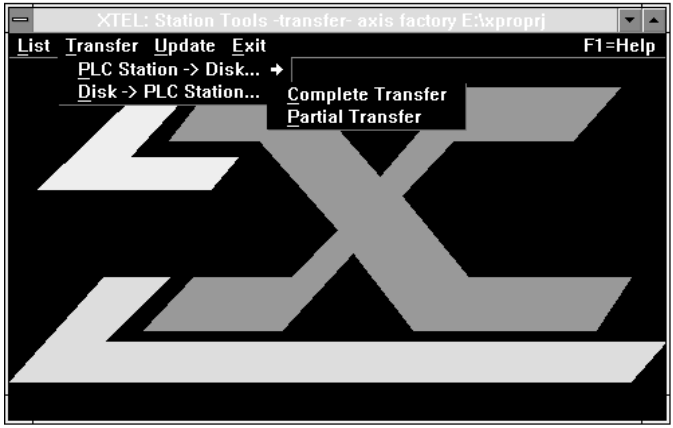


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8.6 Transfer

When the setup is complete, the PLC should be connected. The program which has been entered must be transferred to the PLC processor.

To do this, start the "XTEL-TRANSFER" tool and select the **Disk --> PLC station** command and **Complete Transfer** function from the **Transfer** menu.



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9.1 General principle for configuring and adjusting axis parameters

The axes are configured and their parameters set in a 2-stage operation using ADJ MAX adjustment software :

- **1st stage** : Initialization of parameters
  Enter configuration and operating parameters which do not require any adjustment procedure (unit, type of encoder, resolution, high and low axis limits, maximum permitted acceleration and deceleration, type of reference point).
  When they have been entered these parameters must be transferred to the module.

- **2nd stage** : Setting of the parameters
  Perform the adjustment procedures for defining the values of the configuration parameters, the machine KR coefficient and the operating parameters, and enter the values obtained (example : servo parameters KPOS, KV, etc).
  The values of the parameters will be transmitted to the module as they are set.
  Once all the parameters have been set, perform a final save.

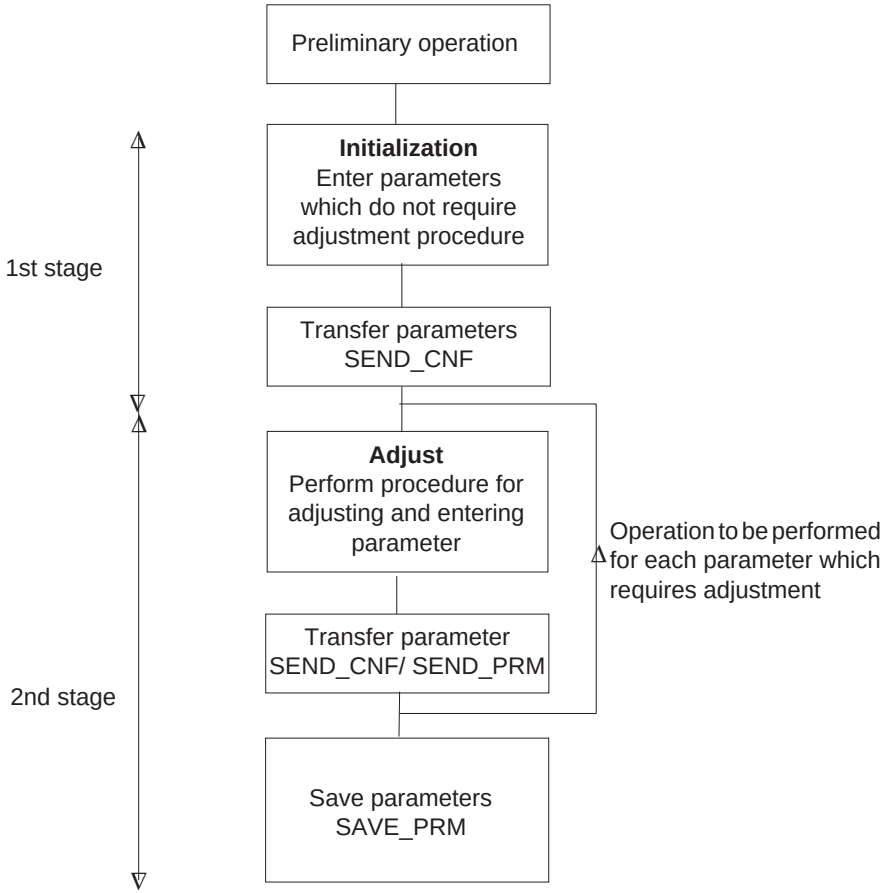
The adjustment procedures given here are for example only, none of them is compulsory. If you know the value of parameter, it can be entered directly in the appropriate adjustment screen.

All the operations described in this section require a knowledge of how to use ADJ MAX software.
Its use is described in Section 17, Appendix, "ADJ MAX software operating modes". It is also described in the on-line help which gives an explanation of the parameters and commands for each screen.

Attention
The PLC must be in RUN mode when transferring parameters and moving the moving part using ADJ MAX.
It is thus essential to check that the multi-axis control program module is not started until the PLC is set to RUN mode. Its execution must be linked to a start cycle command, or an input bit or internal bit can be used for this purpose (see example in Section 5).

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Summary of the operations



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9.2 Preliminary operations

9.2-1 Preliminary conditions

- TSX AXM module(s) installed in the PLC
- Axis control application(s) connected to the module(s)
- Terminal connected to the PLC via the terminal port or network
- ADGROUP and ADAXIS addresses entered
- Multi-axis control configuration and program created and transferred to the PLC processor
- PLC in RUN mode (multi-axis control program inhibited).

9.2-2 Preliminary checks

- Check the wiring
- Check that the movements can safely be performed
- Check that the travel limits are wired in accordance with safety regulations (generally these apply directly to the speed drive supply sequence)
- Check the connection polarity of the tachogenerator.

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9.2-3 Adjusting the speed drive

Adjust the speed drive in accordance with the manufacturer's instructions using a control station (example : MASAP MSP62 control station for MASAP speed drive) connected in place of the module.

Adjusting the current loop

- Set the maximum value for the current supplied by the speed drive to a value which is acceptable to the motor (switching dissipation) and the mechanism (accelerating torque)
- Set the stability of the current loop.

Adjusting the speed loop

- Set the Maximum working speed, give the speed drive a reference equal to the Maximum operating voltage (UMAX).
- Set the speed loop gain
- Set the offset.

Adjusting the current limit according to the speed

Reconnect the axis control module at the end of adjustment.

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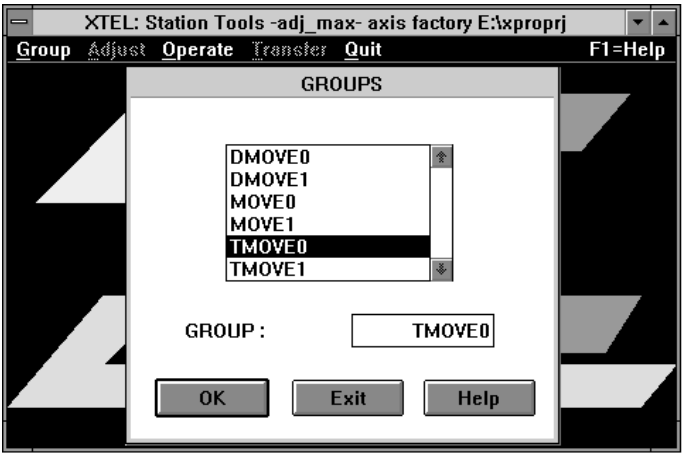
9.2-4 Executing ADJ MAX adjustment software

In the **Station_Tools** window, select the **Define** menu and the **New** command from this menu.

In the dialogue box which appears, select the **ADJ MAX** tool. The ADJ MAX icon will then appear in the **Station_Tools** window.

Start the execution of the software by double clicking on its icon.

In the ADJ MAX initial window, select the **Group** menu, the **Open** command and in the **Groups** dialogue box select the command function block (MOVE, DMOVE or TMOVE OFB) to be configured and adjusted.

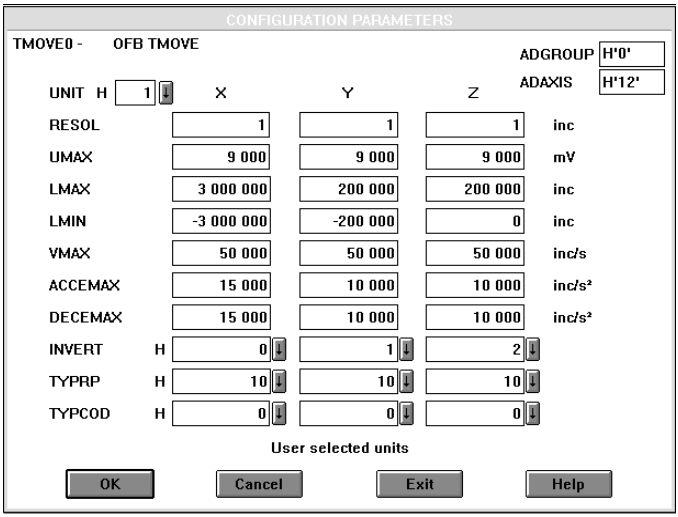


For more information on using ADJ MAX software see Section 17.

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10.1 Entering configuration parameters

Select the **Configuration Parameters** command in the **Adjust** menu. The following window accesses the various configuration a parameters.



The OK key is used to ensure that the •MOVE OFB accepts all the values entered in this screen (but not that they are sent to the group or verified, which are performed as part of the transfer operation, see Section 10.4).

Comment :
The parameters which represent the coding of data (UNIT, INVERT, TYPR, TYPCOD) can be adjusted either by clicking on the arrow to the right of the field or by directly entering the hexadecimal code.

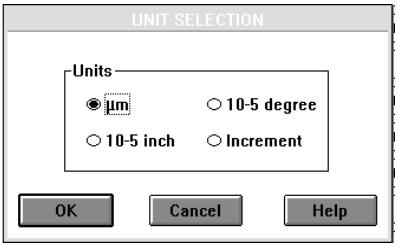
10.1-1 Group parameters

These parameters are common to all axes in the group controlled by the OFB.
The group parameters **ADGROUP**, **ADAXIS** and **LABEL** cannot be modified in this screen. They must be entered in CONSTANT mode under PL7-3.

UNIT : physical units
This is used to select the physical units in which the position measurements and thus the speed and acceleration measurements are expressed.

Position unit	Speed unit	Acceleration unit	Code
µm (default)	mm/min	mm/s^2	1
10^{-5} inch	cinch/min	$cinch/s^2$	2
10^{-5} degree	cdeg/min	$cdeg/s^2$	3
increment	inc/s (Hz)	inc/s^2	4

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Select the unit by clicking on the arrow to the right of the UNIT field and select the measurement unit in the dialogue box which appears.

Note : For 10^{-5} degree, see Section 16.2 "Angular movement".

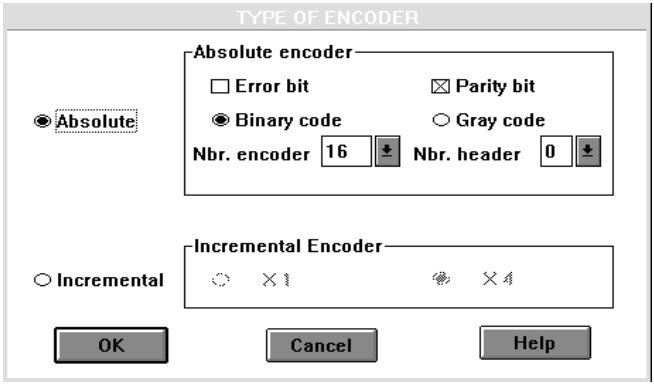
10.1-2 Parameters specific to each axis in the group

The adjustment should be performed on each axis in the group in turn.

TYPCOD : type of encoder
This gives the type and characteristics of the position encoder used.

- SSI transmission multi-turn absolute encoder
  - number of encoder bits : N min = 16, N max = 24, (default = 16)
  - number of non-significant frame header bits N min = 0, N max = 4 (default = 0)
  - Gray code or binary code (default is binary code)
  - presence of error bit (default is without error bit)
  - presence of parity bit (default is with parity bit)

- Incremental encoder (default selection)
  - with multiplication by 4 of encoder signals : default selection
  - without multiplication by 4.



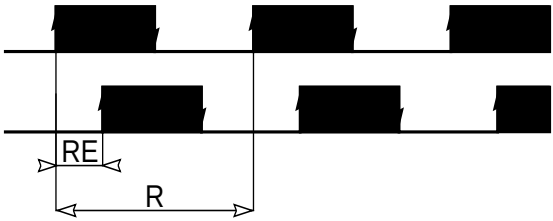
Note : Do not connect incremental and absolute encoders at the same time to one module.

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RESOL :
This parameter corresponds to the encoder resolution (R), except when the option x 4 is selected, in which case the encoder resolution R is R/4.

The encoder resolution is the distance which the moving part must travel to produce a difference of one increment in the sensor signal.

Multiplying by 4 enables the following for an incremental type encoder :
- to use a given encoder, and achieve a precision 4 times greater
- or to obtain a given resolution, using an encoder with a resolution which is 4 times lower.



RE, which corresponds to the resolution multiplied by 4, is also known as the equivalent resolution.

Calculating the resolution
where **:**
N = number of pulses or encoder points per revolution (rotary) or the length of the linear measurement.
L = useable measurement length.
With linear measurement, the calculation of R is immediate :

R = L/N

When a rotary encoder is used, ensure that an allowance is made for the position of the speed reduction gear.

R = ne . Pitch / N

ne = equivalent reduction ratio. This is the product of the reduction ratios between the encoder and the pitch.

In all cases : **Vl = F.R** and **e = I.R**

Vl : linear speed, e : distance travelled, F : frequency, I : number of increments for a given movement.

Note :
If the increment unit is selected, parameter RESOL must be set to value 1.

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LMAX and LMIN
Axis maximum upper limit and axis minimum lower limit. These correspond to the mechanical limits of the axis.

The limit values depend on the selected resolution.

Type of encoder	**Incremental encoder**	**Absolute encoder** (1)
LMAX terminal	+8000000 x RESOL	+8000000 x RESOL x 2^{n-24}
LMIN terminal	-8000000 x RESOL	-8000000 x RESOL x 2^{n-24}

(1) n = number of encoder bits
Note : In the case of angular movements, terminals LMAX and LMIN may be inverted (see Section 16.1).

ACCMAX and DECMAX
Maximum permitted acceleration and deceleration.

Position unit	**µm**	**inch**	**degree**	**increment**
Acceleration unit	mm/s^2	$cinch/s^2$	$cdeg/s^2$	inc/s^2
VMAX unit	mm/min	cinch/min	cdeg/min	inc/s
Max. terminal (2)	5/6 x VMAX	5/6 x VMAX	5/6 x VMAX	50 x VMAX
Min. terminal (3)	VMAX/120	VMAX/120	VMAX/120	VMAX/2

(2) These values correspond to the acceleration ACC (DEC) used to change from 0 to VMAX (VMAX to 0) in 20 ms and apply in the case of multiplication by 4. In the case of multiplication by 1, divide these values by 4.
(3) These values correspond to acceleration or deceleration times of less than 2s.

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The 3 parameters below are described in Section 11.1 as they require certain operations to be performed. In the first instance retain the default values.

INVERT
Defines the inversion of the reference between the output of the digital/analog converter and the speed drive, and /or the inversion of the measurement.

VMAX
Maximum speed of the moving part corresponding to applying value UMAX at the analog output.

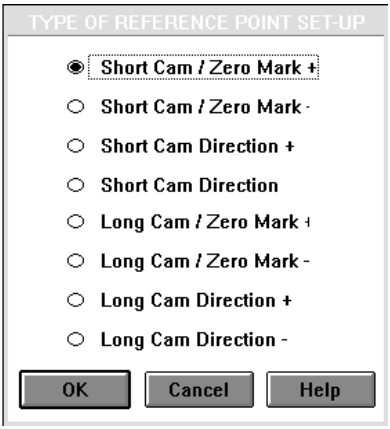
UMAX
UMAX is the voltage which must be applied to the speed drive input to obtain a speed equal to VMAX.

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TYPRP : type of reference point
Defines the type and direction of the reference point (only when the position is measured using an incremental encoder).

Select the inversion parameter by clicking on the arrow to the right of the TYPRP field and by clicking on the dialogue box which appears.

Possibilities	Code
• short cam and zero mark, + direction	H'0010'
• short cam and zero mark, - direction	H'0011'
• short cam, + direction	H'0020'
• short cam, - direction	H'0021'
• long cam as travel limit and zero mark, + direction	H'0030'
• long cam as travel limit and zero mark, - direction	H'0031'
• long cam as travel limit, + direction	H'0040'
• long cam as travel limit, - direction	H'0041'



Reminder : An incremental encoder does not provide a position measurement, only a number of pulses proportional to the distance travelled. So that this distance can be converted into a position, a known position must be assigned to a particular point on the axis (0 is generally selected). This operation is known as setting the reference point. An axis on which this has been performed is said to be referenced.
The reference point command is implemented via the following instructions :
- G14 reference point on axis X
- G15 reference point on axis Y
- G16 reference point on axis Z

or using the manual reference point command SETRP_P, SETRP_M, or RP_HERE.

The module has 2 inputs which are used to detect the reference :
- Zero marker input
- Cam input

The reference point is always set on the same edge of the cam.
The physical reference point is the same for both directions of operation. The two directions of operation are recognized by a search procedure for a different reference.

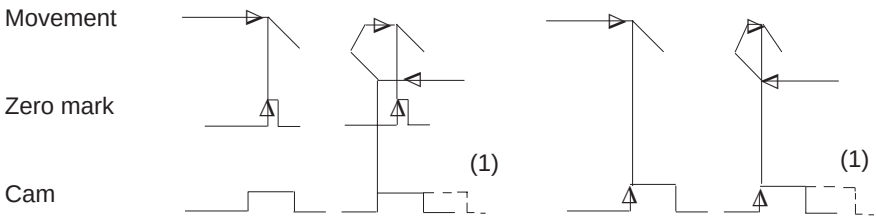
- In manual mode :
  - For types 1 and 2, the approach speed together with the reference point is the speed selected : FHIGH or FLOW, modulated by the CMV.
  - For types 3 and 4, the approach speed is the speed selected : FHIGH or FLOW, modulated by the CMV, and the reference point speed is always speed FLOW, independent of the CMV.

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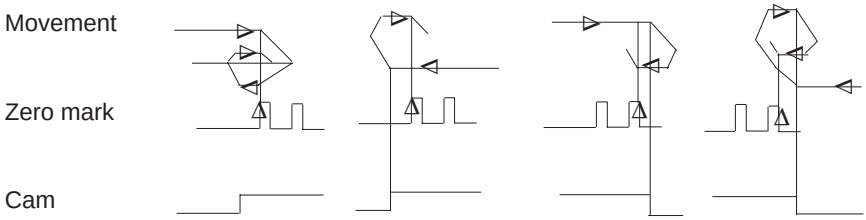
- In automatic mode :
  - For types 1 and 2, the approach speed together with the reference point speed is the speed defined in instruction G14, G15 or G16, modulated by CMV.
  - For types 3 and 4, the approach speed is the speed defined in instruction G14, G15 or G16, modulated by CMV, and the reference point speed is always speed FLOW, independent of CMV.

Detailed description of type of each reference point setup

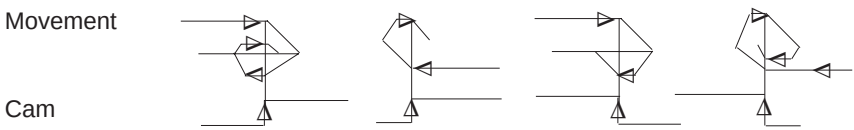
Type	Short cam/zero mark		Short cam only	
	+ direction	- direction (1)	+ direction	- direction (1)
Code	H'0010'	H'0011'	H'0020'	H'0021''



Type	Long cam as travel limit /zero mark			
	+dir. off cam	+dir. on cam	- dir. on cam	- dir. off cam
Code	H'0030'		H'0031'	



Type	Long cam as travel limit			
	+ direction		- direction	
	Start off cam	Start on cam	Start on cam	Start off cam
Code	H'0040'		H'0041'	

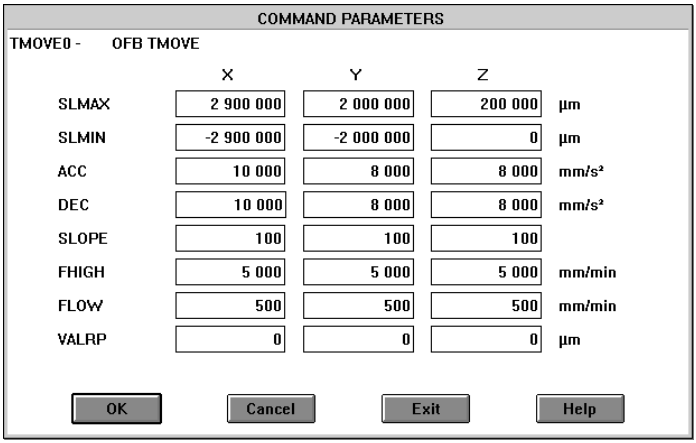


(1) or start on cam.

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10.2 Adjusting the command parameters

Select the **Command Parameters** command from the **Adjust** menu. The following window is used to access the various command parameters.



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The OK key confirms that all the values entered in this screen are accepted by the MOVE OFB.

SLMAX and SLMIN : upper and lower soft stop limits
Upper and lower limits of the position measurement which the moving part should not cross. In the event of an overshoot, the moving part stops with a soft stop fault.

SLMAX ≤ LMAX
SLMIN ≥ LMIN
SLMAX > SLMIN
Note : SLMIN may be greater than SLMAX in the case of angular movement (see Section 16.1).

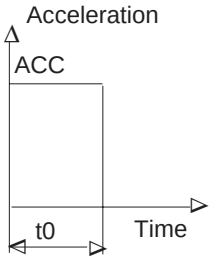
ACC and DEC : acceleration and deceleration values

Acceleration unit		mm/s²	cinch/s²	cdeg/s²	inc/s²
ACC	min limit	VMAX/120 (1)	VMAX/120 (1)	VMAX/120 (1)	VMAX/2 (2)
	max limit	ACCMAX	ACCMAX	ACCMAX	ACCMAX
DEC	min limit	VMAX/120 (1)	VMAX/120 (1)	VMAX/120 (1)	VMAX/2 (2)
	max limit	DECMAX	DECMAX	DECMAX	DECMAX

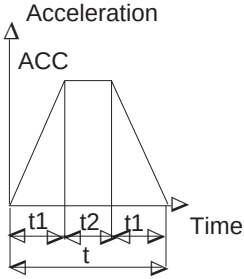
(1) if VMAX/120<10 : min terminal =10
(2) if VMAX/2<2500 : min terminal =2500

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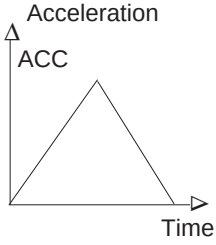
SLOPE : type of speed profile applied to the moving part : trapezoid or parabolic
0 = trapezoid profile
N = value of the peak (N minimum = 1, N maximum = 255) of the parabolic profile
where t2/t1 = (255-N)/N



SLOPE = 0



SLOPE = 100



SLOPE = 255

$$\frac{t}{t0} = \frac{SLOPE + 255}{255}$$

Definition of manual mode parameters

FHIGH : high speed of movement of the moving part in manual mode.

minimum limit : FLOW
maximum limit : VMAX

FHIGH ≥ FLOW

FLOW : low speed of movement of the moving part in manual mode.

minimum limit : 10
maximum limit : VMAX/2
FLOW≤ FHIGH

VALRP : value of the current measurement loaded at the manual reference point.

minimum limit : SLMIN
maximum limit : SLMAX

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10.3 Entering the servo and error control parameters

The servo and error control parameters are described in Sections 11.3 and 11.4 as they require certain operations to be performed.

Before being able to adjust the servo loop, specific values must be given to certain operating parameters.

To do this :

- Select the **Servo Parameters** command in the **Adjust** menu. The window is used to access the various servo parameters and enter the values given below or retain the default values.

Parameters concerned	Values
KPOS	16 (00)
CKPOS	1
LIMV	10 %
KV	0 %

- Select the **Error control Parameters** command in the **Adjust** menu. The window is used to access the various servo parameters and enter the values given below.

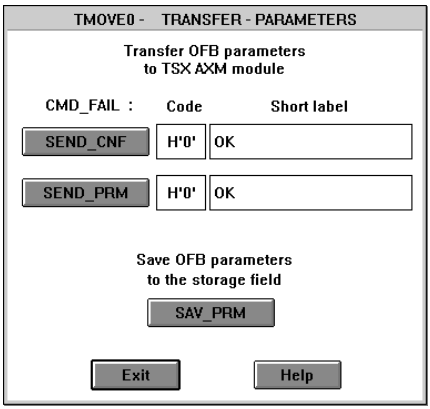
Parameters concerned	Values
VSTOP	VMAX/10
TSTOP	1 second
TW	axis length /10
DMAX1/DMAX2	axis length /10

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10.4 Transferring and saving parameters

Select the **Parameters** command in the **Transfer** menu. The following window is then displayed.



Start the sequence for accepting the configuration and the command, servo and error control parameters by executing the command SEND_CNF.

The command SEND_CNF transmits all the configuration and operating parameters to the module.

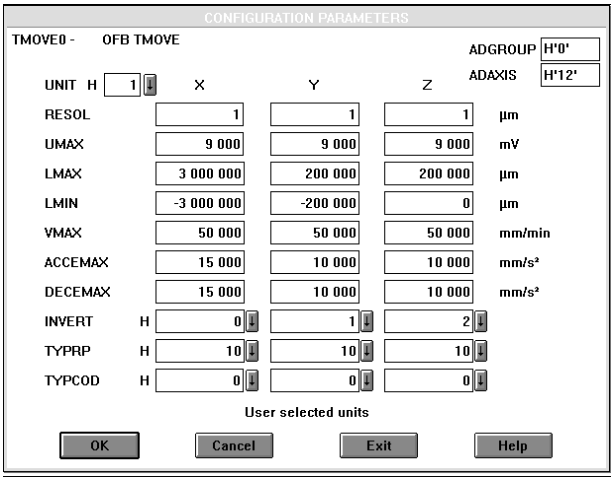
If the operating parameters are modified, execute the command SEND_PRM.

If a coherence error between the various parameters is detected during the transfer, an error code is displayed in the code zone and an error mnemonic symbol is displayed in the short label zone. To obtain more information on the error, press the Help key.
The transfer is executed all the same. Following the transfer, the parameters which failed will retain their previous values.

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11.1 Adjusting the configuration parameters

Select the **Configuration parameters** command in the **Adjust** menu. The following window accesses the various configuration parameters.



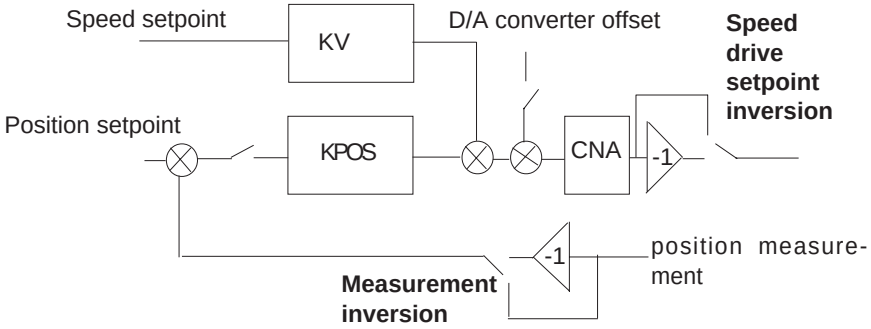
The OK key ensures that the •MOVE OFB accepts all the values entered in this screen.

Adjust the parameters which were not entered during the pre-initialization phase :

- INVERT
- VMAX
- UMAX

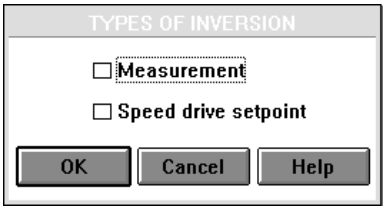
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INVERT
Defines the inversion of the setpoint between the digital/analog converter output and the speed drive and/or the measurement inversion.



Select the inversion parameter by clicking on the arrow to the right of the INVERT field and clicking on the dialogue box(es) which appear.

Possibility	**Code**
• no inversion (default value)	0
• inversion of measurement direction	1
• speed drive setpoint inversion	2
• inversion of both	3



Procedure for determining the inversion parameter
- Select the Mono-Group command from the Operate menu
- Deselect Measurement mode DRV_OFF
- Acknowledge any faults ACK_DEF
- Select servo off mode DIRDRIVE
- Then enter in succession + 100 mV (CNA output positive) and - 100 mV (CNA output negative) in the PARAM field in accordance with the table below.
  Note : if the offset is above 100mV, adjust this first, see Section 11.3-2.
- Initiate the command SEND_CMD.

D/A converter output	**Position**	**Measurement**	**Action**
Positive	increases	increases	none (connection OK)
Positive	increases	decreases	invert the measurement
Positive	decreases	decreases	invert the setpoint
Positive	decreases	increases	invert setpoint and measurement
Negative	decreases	decreases	none (connection OK)
Negative	decreases	increases	invert the measurement
Negative	increases	increases	invert the setpoint
Negative	increases	decreases	invert setpoint and measurement

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VMAX
Maximum permitted speed of the moving part.

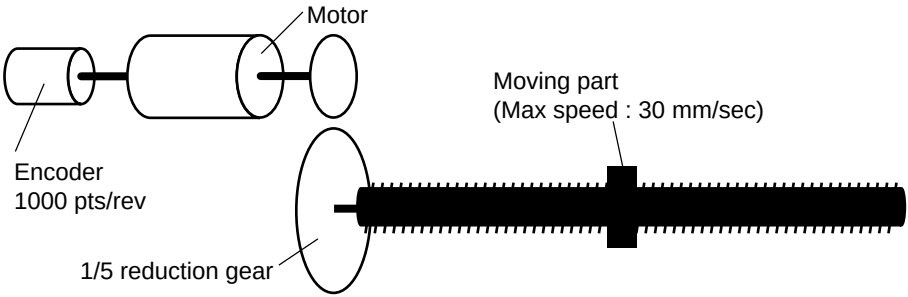
Position unit	**µm / degree**		**inch**		**Incr.**
Speed unit	mm/min / cdeg/min		cinch/min		inc/s
Resolution	R≤100	R>100	R≤100	R>100	1
Min limit without x 4	150	15000	600	6000	2 500
Min limit with x 4	60000	2400	240000	10 000	600
Max limit without x 4	13500xR (1)	13500xR (1)	13500xR (1)	13500xR (1)	22 5000
Max limit with x 4	54000xR (1)	54000xR (1)	54000xR (1)	54000xR (1)	900 000

where R = RESOL = resolution
(1) with a maximum limit of 540,000 (with x 4) and 135,000 (without x 4).
(2) respectively 6000 and 24000 with software version 1.3.
Note : for multi-axis applications (DMOVE or TMOVE), it is advisable, for each axis, to set values of the same order of magnitude for VMAX.
The min limit of VMAX corresponds to a frequency of 10 kHz, with multiplication by 4.
The max limit of VMAX corresponds to a frequency of 900 kHz, with multiplication by 4

UMAX
UMAX is the voltage which must be applied to the input of the speed drive to obtain a speed equal to VMAX.

As far as possible, the speed drive should be set to obtain maximum speed VMAX at a voltage as close as possible to (but below) 9 V.
Limiting the voltage to 9 V means that during transition periods there is sufficient reserve to allow an overvoltage. The amplitude of this overvoltage is determined by the value of LIMV (command parameter). If there are no mechanical constraints, or restrictions imposed by the maximum acceptable frequency, select the following values via the module : UMAX = 9 V LIMV = 10 %

Example : To control an axis with the following characteristics :



The maximum permitted linear speed is 30 mm / sec, or 1800 mm / min. The screw pitch is 5mm.

The axis is controlled by a motor which can run at 3000 rpm driving a ballscrew via a 1/5 reduction gear. The encoder is on the motor shaft. An incremental encoder is assumed to be used.

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The RESOLUTION parameter (distance travelled by the moving part between two encoder increments) is equal to : Ne x Pitch/N = 1/5 x 5/1000 = 1 µm

- VMAX, the maximum operating speed parameter, is 1800 mm / min.
- Parameter UMAX is the voltage value which will enable maximum speed to be obtained. Taking into account the reduction ratio (1/5) and the pitch of the screw (5 mm), the maximum linear speed (1800mm/mn) corresponds to a motor rotation speed of 1800 rpm. If the speed drive is adjusted to obtain speed 3000 rpm with an input voltage of 10 V, the voltage which will correspond to 1800 rpm (UMAX) is 6 V.
- A 10 % overvoltage during transition periods is allowed (LIMV=10).

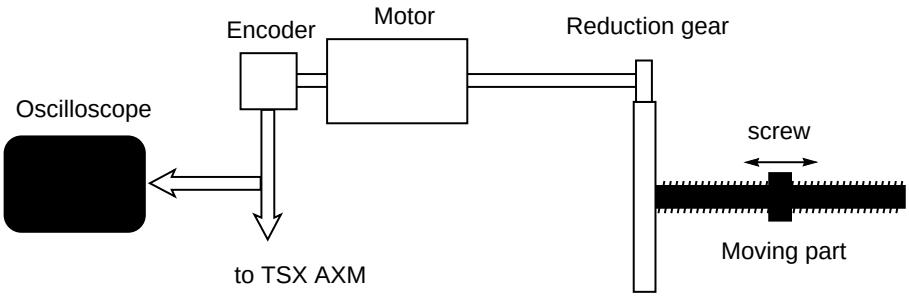
It is essential that the coherence of the RESOL, VMAX and UMAX parameters is maintained, otherwise incoherent servo loop behaviour will result.

Checking the maximum frequency

This operation, which is optional, checks that the capacities of the module have not been exceeded. It is performed in Servo off mode (DIRDRIVE).

- Apply a voltage equal to UMAX (1 + LIMV/ 100). Check the maximum frequency.
- Check that the frequency of the pulses is below 250 kHz :

Note : This check can be difficult to perform since it assumes that the axis is of sufficient length to provide the necessary observation time.
To overcome this problem a voltage can be applied which only represents a certain percentage of voltage UMAX (1+LIMV/100) and then a check made that the resulting frequency at the module input does not exceed the same percentage of the limit frequency.



Transferring the configuration parameters

Transfer the new configuration parameters which have been entered by executing the command SEND_CNF, which can be accessed via the Parameters function in the Transfer menu (see Section 10.5).

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11.2 Procedure for adjusting the machine characteristic KR coefficient

This adjustment is designed to correct errors caused by imprecise entry of configuration parameter values, and imperfections in the drive chain.

Procedure :

Perform the operations in the mono-group operation screen :

① Select MANUAL mode.
② Set a manual reference point if an incremental encoder is used (if the moving part is some distance from the cam, use servo off mode, DIRDRIVE, to bring it closer).
③ Select a value corresponding to the longest possible travel as target position : position 1 and enter this value in the PARAM field (300000µm, for example).
④ Start the movement (INC_P or INC_M according to the direction of movement, followed by the command SEND_CMD to execute the movement).
⑤ Use an external device to measure with adequate precision the distance travelled by the moving part.
⑥ Enter this value in the DISTANCE field, (for example, if the distance measured is 293000µm, this is the value which should be entered in the DISTANCE field).
⑦ Deactivate the movement command (INC_P or INC_M) and transmit the parameter to the module using the command SEND_CMD.
⑧ Press the button NEW_KR to start the automatic calculation of the coefficient by the module.

Repeat operations ②, ③, ④ and ⑤.

- If the distance measured has an error less than that required the adjustment is terminated. A SAVE_PRM command (TRANSFER screen) must then be executed to save the value of KR in the CONSTANT zone.
- If the distance measured has an error greater than that required (for example : distance measured = 299800µm), perform the following operations :
  - Enter in the DISTANCE field the same value as that contained in the PARAM field (300000µm in this example), and perform operations ⑦ and ⑧.
  - Calculate the new value of the DISTANCE parameter

    $$\text{DISTANCE} = \frac{\text{DISTANCE 1} \times \text{DISTANCE 2}}{\text{PARAM}} \quad (\text{Eg} : \frac{293000 \times 299800}{300000} = 292805)$$

    where DISTANCE 1 = distance measured the first time
    and DISTANCE 2 = distance measured the second time.
- Enter the DISTANCE value which has been calculated in this way in the DISTANCE field, and perform operations ⑦ and ⑧.

Attention

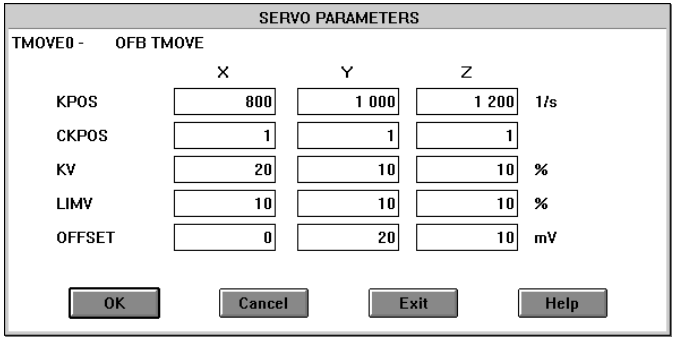
Any modification of the RESOL and VMAX parameters using ADJ MAX software will necessitate a reinitialization of the KR coefficient by the user.

To reinitialize KR select the OFB concerned in PL7-3 CONSTANT mode and enter -1 in the 3 parameters of the OFB (KR1, KR2 and KR3) and send a SEND_CNF command.

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11.3 Adjusting the servo parameters

Select the **Servo parameters** command from the **Adjust** menu. The following window is used to access the various servo parameters.

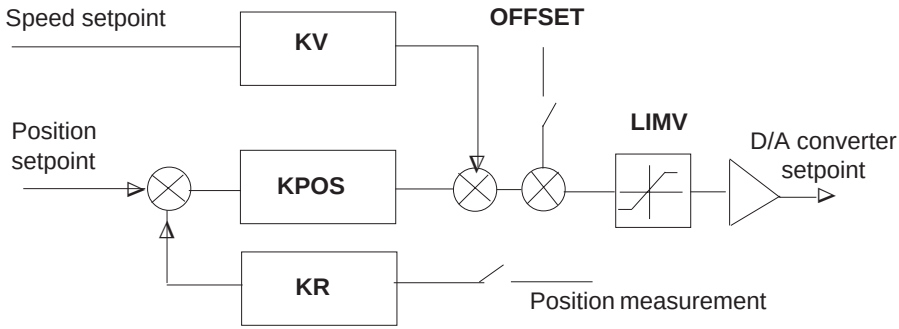


The OK key ensures that the •MOVE OFB accepts all the values entered in this screen.

D

11.3-1 Description of the servo loop

Diagram



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Defining the references

The position and speed references are defined by the user according to the required movement (speed, target position), and the acceleration and deceleration and movement profile values are given in the adjustment parameters.

11.3-2 Description of the servo parameters

KPOS : Position loop gain

The module uses two gain values. The KPOS value which is entered is for high working speeds. This value avoids overshoots and instability. The second gain value is deducted from the ratio CKPOS, it provides a gain value for low working speeds in order to obtain very low position errors.

D

The position gain applied is as follows :
if working speed ≥ VMAX/4 : KPOS
if working speed < VMAX/4 : KPOS x CKPOS

Min limit : 100 Max limit : 6400 (expressed in 1/100s)

Using the KPOS adjustment parameter, the module calculates the proportional gain coefficient KP :

KP= C x UMAX x KPOS

C : constant
UMAX : value of the speed drive setpoint VMAX (UMAX<9V).

The KPOS value to be entered corresponds to a KPOS value for high speeds (see CKPOS parameter below).

CKPOS :
Multiplication coefficient for low speed loop gain (ratio between low speed KPOS and high speed KPOS).

Min limit : 1 Max limit : 6400/KPOS

This ratio defines the position gain value for low working speeds.

Comment : generally CKPOS=1.

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KV : Feedforward gain

Min limit : 0% Max limit : 100%

This is expressed as a percentage. 100% corresponds to the value which would totally absorb the position error at constant speed for a speed drive which has no continuous error.

When KV increases, the position error decreases, but there is a resulting risk of an overshoot, including stop point overshoot. It is therefore necessary to find a compromise.

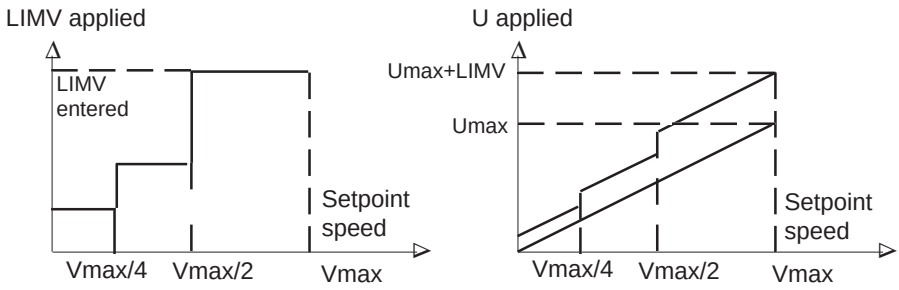
Note : In some cases, the position error passes a minimum with a possible change of sign when KV increases.

LIMV : maximum permitted overshoot of the setpoint speed.

Min limit : 2 % Max limit : 20%

This parameter is entered as a percentage of between 2 and 20. It determines the permitted overvoltage of the speed drive setpoint.
The permitted overvoltage varies with the target setpoint speed according to three levels :

- LIMV entered between VMAX and VMAX/2
- LIMV entered/2 between VMAX/2 and VMAX/4
- LIMV entered/4 between 0 and VMAX/4.



OFFSET : offset added to the value calculated by the loop.

Min limit : -150mV Max limit : +150mV

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11.3-3 Procedure for determining the servo parameters

In order to adjust the servo loop, specific values must be given to certain operating parameters, assuming that the values of the others correspond to the application. These values are given in the first phase of pre-initialization (see Section 10.3). If they are not, enter the parameters in the adjustment screens, and transfer them using the SEND_PRM command (Parameter command in the "Transfer" menu).

Initial operation

This operation consists of setting a forced reference point (RP_HERE command). Forcing the reference point means that the axis is referenced from the time the application is first started and thus that the following controls and functions are active :

• soft stops
• return of moving part from soft stop overshoot.

Note : Operation will only be correct if the direction of movement of the moving part is the same as the direction of measurement.

D

Procedure for setting a forced reference point

- Select the Mono-Group function from the Operate menu
- Deselect DRV_OFF mode
- Acknowledge the faults with the ACK_DEF command
- Using an external device, measure the position of the moving part in relation to the reference point cam (not an exact measurement)
- Set a forced reference point :
  - enter the measured value with its sign as the reference position value in the PARAM field
  - Select the RP_HERE command
  - Start execution of the command using SEND_CMD.

Adjusting the gain at high speed (value of parameter KPOS)
Since the moving part has an inertia equal to the maximum value found in the application :

- Perform movements from one position, 1, to another position, 2, and vice versa. To do this :
  - Select low speed : HIGH_F box empty
  - Enter the value of the movement in the PARAM field
  - Then select one after the other commands INC_P (position 1) and INC_M (position 2) and follow each with the SEND_CMD command, so that they are executed
- Display the position error when the moving part is stationary
- Set KPOS to produce an acceptable error while retaining suitable stability (otherwise re-check the definition of the machine). Transfer each new KPOS value entered using the SEND_PRM command in the Transfer menu.
- Select high speed : HIGH_F box selected
- Perform movements from position 1 to position 2 and vice versa, and if necessary re-adjust KPOS.

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Adjusting coefficient CKPOS

This is performed for machines which are subject to friction. If they are not, retain value 1 for the CKPOS parameter. Set CKPOS above 1 to obtain a higher gain at low speed and transfer this value using the SEND_PRM command (transfer menu) :

- Perform movements from one position, 1, to another position, 2, and vice versa. To do this :
  - Select a very low speed of movement (x_FLOW speed selected)
  - Enter a low movement value in the PARAM field
  - Then select one after the other the commands INC_P (position 1) and INC_M (position 2) and follow each with the SEND_CMD command, so that they are executed
- Display the position error when the moving part is stationary
- Set CKPOS to produce an acceptable error while retaining suitable stability. Transfer each new CKPOS value entered using the SEND_PRM command in the Transfer menu.

Adjusting feedforward gain KV

- Perform movements from position 1 to position 2 and vice versa at sped VMAX, display the position error when the moving part is moving at constant speed. To do this :
  - Select high speed of movement : HIGH_F box selected
  - Enter a movement value in the PARAM field
  - Then select one after the other commands INC_P (position 1) and INC_M (position 2) and follow each with the SEND_CMD command, so that they are executed
- Adjust KV to the required error value and sign

Note : In the event of too large an overshoot, it may be necessary to reduce KV slightly.

Adjusting the maximum permitted overshoot LIMV

See Section 11.4-2

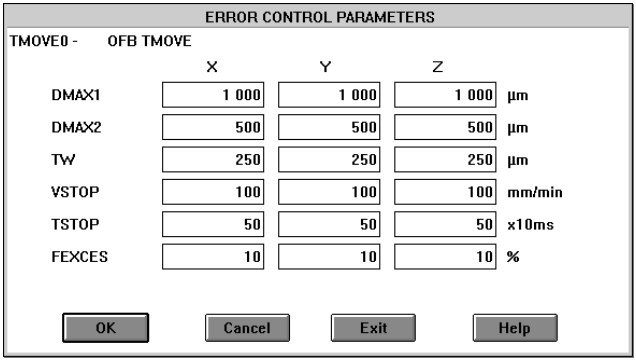
Adjusting the offset

With the moving part stationary, change to servo off mode DIRDRIVE and adjust the offset in the window -150mV and +150mV so that any slip of the moving part is eliminated.

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11.4 Adjusting the error control parameters

Select the **Error control parameters** command in the **Adjust** menu. The following window is used to access the various error control parameters.



The OK key ensures that the •MOVE OFB accepts all the values entered in this screen.

D

11.4-1 Description of the error control parameters

The error controls are described in Section 8.4-7.

DMAX1 : threshold 1, contouring error

Contouring error : 0 to (SLMAX-SLMIN)/2 (1) 0 = no control

DMAX2 : threshold 2, contouring error

Preventive error : 0 to (SLMAX-SLMIN)/2 (1) 0 = no control

TW : target window threshold error

Static error : 0 to (SLMAX-SLMIN)/10 (1) 0 = no control

VSTOP : stop speed threshold

Stop speed : 10 to VMAX/2 and limited to 32767

(1) except in the case of angular movement, see Section 16.2.

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TSTOP : value of the time delay before the stop control

Limits : 0 to 1000 (units x 10 ms) 0 = no control

FEXCES : measured overspeed error threshold expressed as a % of VMAX.

Speed overshoot : 0 to 20% 0 = no control (from version 1.3 onwards)

11.4-2 Procedure for determining the error control parameters

Principle for setting the error control parameters :

- Enter the required error control parameter values, then transfer them using the SEND_PRM command (accessed via the Parameters function in the Transfer menu).

In the Mono-Group screen :

- Select manual mode
- Select high speed of movement : HIGH_F box selected
- Perform movements from position 1 to position 2 and vice versa. To do this :
  - Enter a movement value in the PARAM field
  - Then select one after the other commands INC_P (position 1) and INC_M (position 2) and follow each with the SEND_CMD command, so that they are executed

The module should not change to error mode : Check in the "Errors" box that the fault AXIS_ERR is not showing (or for more details check words STATUS 1, 2 and 3 using PL7-3 Data mode or SYSDIAG).
If a fault is detected :

- Increase the parameter values (higher tolerances)
- or reset KR, KPOS, and KV then modify the parameters.

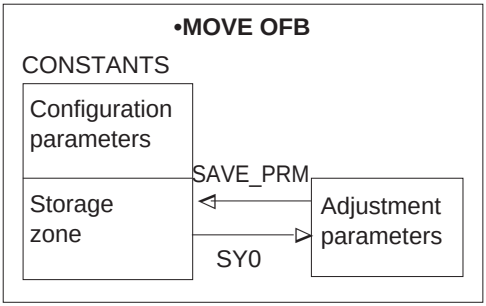
Adjust the following parameters one after the other :

- **DMAX1 and DMAX2**
- **TW**
- **VSTOP and TSTOP**
  The speed must be below VSTOP at the end of time period TSTOP.
  TSTOP is counted with respect to the moment when the position reference reaches the required position value.
- **Speed limitation LIMV**
  - Enter the desired value of parameter LIMV in the Servo Parameters screen
  - Perform movements from position 1 to position 2 and vice versa (following the same procedure as that described above). The module should not change to a DMAX error. If it does, increase LIMV or modify DMAX 2 (and DMAX 1).
- **Overspeed FEXCES**
  For this adjustment select a speed of movement FHIGH = VMAX

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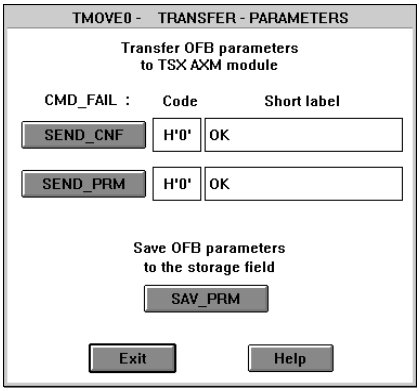
11.5 Saving the parameters

The configuration parameters are stored in the OFB constant memory and are thus saved automatically. This is not the case for adjustment parameters which are stored in the OFB data memory. A save operation for transferring the adjustment parameter values from the DATA field to the OFB CONSTANT field is therefore necessary to avoid losing adjustment values at a cold restart of the processor (SY0).



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Select the **Parameters** command in the **Transfer** menu. The following window is displayed.



Execute the command SAV_PRM to save the adjustment parameters to the PLC processor memory.

Caution : if the PL7-3 software is in CONNECTED mode during this operation, the terminal memory will not be updated with the new constant values.

The application must therefore be transferred from the PLC to the terminal using PL7-3 or the TRANSFER tool once all the adjustments have been performed. This operation ensures that all the parameters which have been set are saved to the terminal hard disk.

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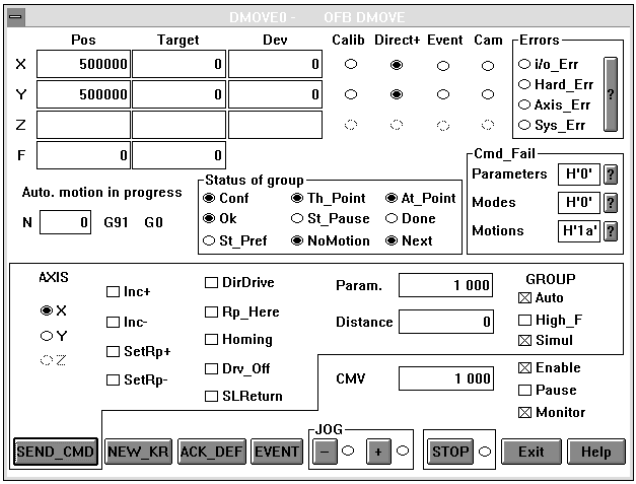
12.1 Principle of debugging a multi-axis control program

Multi-axis control, which is integrated in the PL7-3 program, uses the debugging functions of PL7-3.

Reminder of the options provided by PL7-3 :

- Real-time display and animation of the program
  - In Grafcet : as each movement is programmed in one Grafcet step, it is easy to identify the current movement.
  - In Literal or Ladder language : highlighted display of the OFB EXEC being executed
- Insertion of breakpoints and execution cycle by cycle, ladder by ladder or statement by statement.
- Access to DATA mode, which enables status bits and words to be displayed and command bits of the •MOVE OFB to be controlled. It also enables bit objects to be forced, and the Grafcet evolution to be blocked.

ADJ MAX software mono-group operation screen

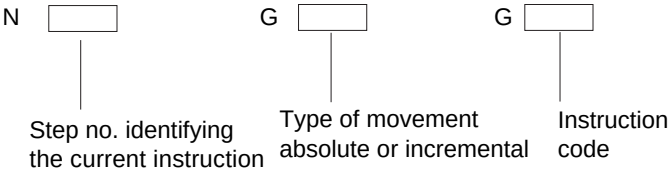


The upper part of this screen provides information used for debugging a group of axes (see detailed description of the screen in Section 17.4) :

- Following of the position and the speed of the moving part
- Status of the module inputs
- Indication of module and application faults
- Operating status of the group of axes
- Movement in progress
- Sequence of elementary movements.

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The Motion in Progress fields :



The lower part of this screen provides the commands for selecting the running modes and the manual mode movements of the axis group. These commands, which are described in Section 13, Operation, can be used to simulate the running mode management and manual control sections of the PL7-3 program.

Caution
There may be "conflicts" between the PL7-3 program which executes commands or writes variables, and the commands executed using ADJ MAX software. The last command accepted is the one which takes priority.

D

Among the data which is available, the CMD_FAIL zone gives precise information on the cause of failure to execute a command.
As soon as a command failure is detected the code associated with one of the items, Parameters, Modes or Movements, changes from 0, and by selecting the button "?" the content of the command failure is clearly displayed.

Other data which is important for debugging is contained in the STATUS words (●MOVEi,STATUS 0, 1, 2 and 3). The role of each of the bits of these words is described in the Quick Reference manual. These words can be displayed in DATA mode, PL7-3 DEBUG mode or using the SYSDIAG tool.

Servo off mode, which is described in Section 8.3 "Managing the operating modes", is used for debugging, when the PLC is in STOP mode or at a break point.

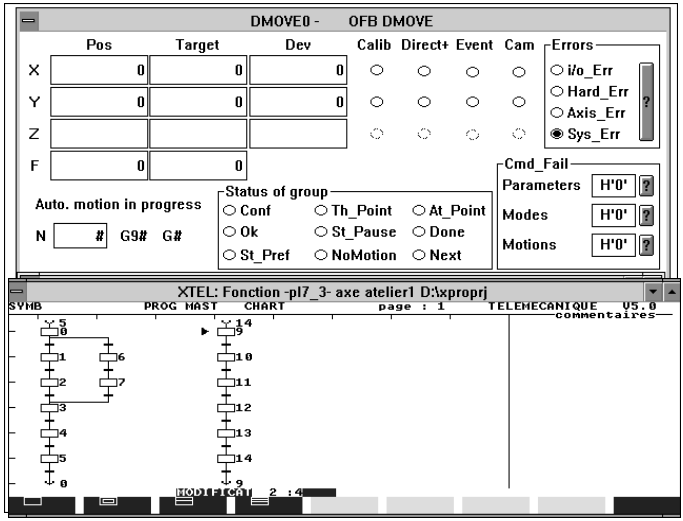
Reminder : In this mode, if the PLC stops, the group remains configured and any movement which is being executed is completed.

Modifying the program and the parameters

All modifications which are permitted under PL7-3 in RUN mode can be executed. It is also possible to modify the configuration and adjustment parameters, except for the ADGROUP and ADAXIS parameters. It is necessary to work in LOCAL mode when modifying any of these parameters.

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Simultaneous use of PL7-3 and ADJ MAX software



It is possible to use both PL7-3 debug mode (in small font size) and ADJ MAX software (Mono-Group operation function) at the same time.

12.2 Debugging in Simulation mode

This mode is used to check the sequencing of the multi-axis control instructions without moving the moving part.

This mode :
- Eliminates the need to check the wiring between the group and other equipment
- Automatically sets up the sequence of instructions,
  (automatic generation of the •MOVEi,NEXT and •MOVEi,DONE bits after 2 s).

Selecting Simulation mode

To use Simulation mode, the following commands must be executed :

- Check that the group is configured (CONF indicator lamp)
- Deselect the command DRV_OFF
- Select SIMUL mode
- Select AUTO mode

and execute the commands by pressing the SEND_CMD button.

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12.3 Archiving

When the program has been debugged in connected mode :

- Save the adjustment parameters if they have been modified, using the SAV_PRM command in the TRANSFER menu of ADJ MAX (see Section 11.5).
- Transfer the PL7-3 application to the disk, using the PL7-3 TRANSFER function (PROCESSOR ==> DISK).

12.4 Documentation

The multi-axis control application documentation is included in the complete documentation for the PL7-3 application.
It contains :

- The program part
- The constants of the ●MOVE OFBs which correspond to the CONFIGURATION parameters and the saved ADJUSTMENT parameters (1).

(1) the saved ADJUSTMENT parameters only appear in the documentation if the ●MOVE OFBs are version V5.1 or later. A list of all these parameters and their meanings is given in Section 21.1, Quick Reference Guide, Part G.

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13.2-1	Multi-Group operation	13/9
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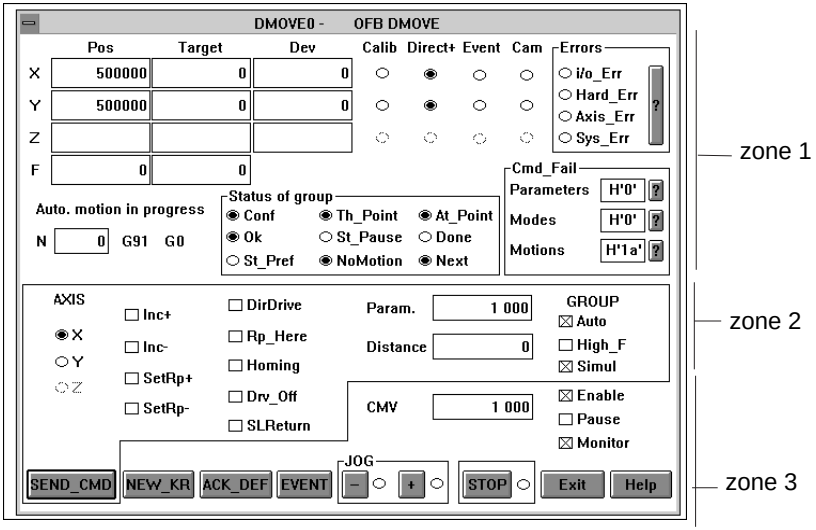
13.1 Using the ADJ MAX Mono-Group operation function

13.1-1 Mono-Group operation

The Mono-Group operation screen is used to monitor the progress of the moving part, the development of the program and to control the moving part in manual mode.

Access to the operating screen :

- Select the group of axes to operate :
  - Select the **Open** function in the ADJ MAX **Group** menu
  - and in the dialogue box which appears, select the •MOVE OFB to be controlled, then confirm the selection.
- Select the **Mono-Group** function in the **Operate** menu**.** The following screen then appears.



This screen consists of 3 zones :

- Zone 1, display zone
- Zone 2, zone for commands which are executed indirectly via the SEND_CMD button
- Zone 3, zone for commands which are executed directly

Comment :
Displays or commands which are not active are shown in grey on the screen (for example for a single axis group, the Y and Z axis data is in grey).

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13.1-2 Description of the display zone

This zone contains all the information which is necessary for monitoring the moving part, the status of the module and the development of the program. This data is located in the upper zone of the "Mono-Group Operation" screen.

Display	Description
Pos **X** ☐ **Y** ☐ **Z** ☐	For each axis in the group displays the current position of the moving part in the unit entered in the configuration parameter UNIT. This position is only significant if the group is configured, an incremental encoder is used and a reference point has been set.
Target **(1)** **X** ☐ **Y** ☐ **Z** ☐	For each axis in the group displays the target position which is to be reached in the unit entered in the configuration parameter UNIT : • In automatic mode : this target is given by the instruction (or calculated based on the instruction) • In manual mode : this target is given by the command (or calculated based on this command).
Dev **(1)** **X** ☐ **Y** ☐ **Z** ☐	For each axis in the group displays the position error in the unit entered in the configuration parameter UNIT : difference between the theoretical calculated position and the actual position of the moving part.
Pos **(1)** **F** ☐	Displays the current speed of the moving part
Target **(1)** **F** ☐	Displays the target speed of the moving part. • In automatic mode : this target is given by the instruction • In manual mode : this target is given by the command parameters x_FHIGH or x_FLOW. The choice between them is made using the command HIGH_F
(1) **Auto.motion in progress** **N** ☐ **G** ☐ **G** ☐	Displays the instruction which is being executed. **N** number identifying the instruction being executed **G** code indicating the type of movement performed : • G90 movement to an absolute position value • G91 movement to a relative position value **G** code of the instruction which is being executed

(1) **Caution** : These values are only significant if the update command is confirmed : (Monitor box selected).

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Display	Description
X ○ Y ○ Z ○ **Calib**	Indicates the axes which are referenced, that is, when incremental encoders are used and a reference point has been set.
X ○ Y ○ Z ○ **Direct+**	For each of the axes indicates that the moving part is travelling in a positive direction on the axis.
X ○ Y ○ Z ○ **Event**	Indicates that an event is detected at the event input on the module associated with the axis.
X ○ Y ○ Z ○ **Cam**	Indicates that an event is detected at the reference point cam input associated with the axis.

Error zone

Display	Description
○ **I/O_Err**	Module I/O fault
○ **Hard_Err**	Indicates that there is a hardware fault on one of the axes : emergency stop, speed drive, encoder wiring break, encoder contamination or analog output short-circuit. These are blocking faults.
○ **Axis_Err**	Indicates that there is an application fault on one of the axes : soft stop, overspeed, position error, target window or stop. DMAX1 soft stop, overspeed and position error faults are blocking.
○ **Sys_Err**	Indicates an OFB system error : initialization fault, addressing fault, communication fault. Some of these faults can be blocking.
?	Displays a screen where faults detected on each of the axes are described in detail. URGSTOP fault -> emergency stop fault VAR fault -> speed drive fault CODRUP fault -> encoder wiring break fault CODSAL fault -> encoder contamination fault CCANA fault -> analog output short-circuit fault SLMAX fault -> soft stop fault SLMIN fault -> soft stop fault F_EXES fault -> overspeed fault DMAX 1 fault -> deviation fault TW fault -> target window fault STOP fault -> stop fault DMAX2 fault -> deviation fault

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Cmd_Fail zone

This zone indicates the presence of a command failure by an error code (H'0' = no error). A message describing the cause of the failure is displayed by selecting the "?" which is to the right of the error code.

Display	Description
Parameters : [ ] [?]	Command failure caused by an incorrect parameter
Modes : [ ] [?]	Command failure caused by an incorrect operating mode
Motions : [ ] [?]	Command failure caused by inability to execute a command.

Comment : General help (Help key) accesses all the "CMD_FAIL" error codes divided into Configuration, parameter setting, operating modes and movement command families.

Group status zone

Display	Description
○ **Conf**	Indicates that the group is configured. A group which is not configured cannot be used. To configure it, use the command SEND_CONF (Transfer Parameters function).
○ **Ok**	Indicates that no blocking fault (causing the moving part to stop) has been detected.
○ **St_Pref**	Indicates in automatic mode, that the reference point is point PRF, that is, command G54 is active.
○ **Th_Point**	Indicates that the theoretical setpoint has been reached
○ **St_Pause**	Indicates that the group is in waiting status
○ **Nomotion**	Indicates that the current movement has been completed and that the moving part is really stationary.
○ **At_Point**	Indicates that the current movement has been completed and that the moving part is in the target window.
○ **Done**	Indicates in automatic mode that the group has completed the requested movement(s) (buffer memory empty).
○ **Next**	Indicates in automatic mode that the group is ready to receive a movement command.

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13.1-3 Description of the command zone

This zone contains all the commands which are used to select the operating modes and to visually control the moving part. This data is located in the lower zone of the "Mono-Group operation" screen.

Reminder : Manual mode only allows the moving part to be controlled on one axis at a time.

These commands can be executed if the following conditions are observed :

- Group configured
- Manual mode selected (except for Simul, ACK_DEF, EVENT, STOP commands).

Manual commands which are executed via SEND_CMD

The sequence of execution of these commands is as follows :

- Select the axis (for commands in the AXIS zone, except DirDrive and Drv_Off)
- Enter parameter PARAM (for commands : Inc+, Inc-, DirDrive and Rp_Here)
- Select the command
- Start execution of the command by pressing SEND_CMD.

Display	Description
X ○ **AXE** Y ○ Z ○	Selects the axis on which the command is to be executed
○ **Inc+**	Command to move incrementally in a positive direction, for a distance stated in the Param field.
○ **Inc-**	Command to move incrementally in a negative direction, for a distance stated in the Param field.
○ **Setrp+**	Command to set a manual reference point in a positive direction. The current position takes the value x_VALRP.
○ **Setrp-**	Command to set a manual reference point in a negative direction. The current position takes the value x_VALRP.
○ **Dirdrive**	Command to change the group to servo off mode. The loop is inhibited. The voltages of the speed drives are directly controlled by the digital/analog converter. The voltage value should be entered in the Param field (expressed in mV).
○ **Rp_Here**	Command to set a forced reference point. The current position is forced to the value entered in the Param field.
○ **Homing**	Command to return to the position defined as the reference.
○ **Drv_Off**	Command to change the group to measurement mode. In this mode the module only feeds back current position and speed data. The loop is inhibited and the speed drives are no longer controlled.

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Display	Description
○ **SLReturn**	Command to return to the valid measurement area. This command is only active following a soft stop fault and after the fault has been acknowledged.
Param ☐	Field for entering the parameter associated with one of the manual commands : • Inc+/Inc- : movement value • Dirdrive : voltage value • Rp_Here : position value This field is also used to adjust parameter KR : distance measured.
Distance ☐	Field for entering the DISTANCE parameter used for adjusting KR coefficient.

Group zone

Display	Description
☐ **Auto**	Selects automatic mode. When there is no cross in this box, manual mode is selected.
☐ **High_F**	Selects manual high speed defined in command parameters x_FHIGH. When there is no cross in this box, low speed x_FLOW is selected.
☐ **Simul**	Selects Simul mode. This mode is active when automatic mode is selected. It enables the program to be run without activating the outputs (with no movement).

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Manual commands with direct execution
Execution starts as soon as the command is pressed.

Display	Description
☐ **Enable**	Command to enable the speed drive fault relays of the axes in the group.
☐ **Pause**	Command to stop the moving part at the end of the current command in automatic mode.
☐ **Monitor**	Command to update the aperiodic data (target, deviation, measured and target speed, current instruction).
CMV ☐	Field for entering the factor for multiplying the speeds by a value of 0 to 2 in steps of 1/1000.

Holding down the JOG + or JOG - command executes the movement. Releasing the command stops the execution. The indicator lamp to the right indicates whether the command is being executed.

Display	Description
SEND_CMD	Command to send manual commands and to select the mode in the AXIS and GROUP zones.
NEW_KR	Command to adjust KR coefficient (see Section 11.2)
ACK_DEF	Fault acknowledgment command : all faults which have disappeared are acknowledged.
EVENT	Generates a group event (in automatic mode)
JOG + ◯	Command for unlimited movement in a positive direction on the selected axis (1).
JOG - ◯	Command for unlimited movement in a negative direction on the selected axis (1).
STOP ◯	Command to stop the moving part and the current instruction and clear the buffer memory (in automatic mode).

(1) These commands remain active at a soft stop fault.

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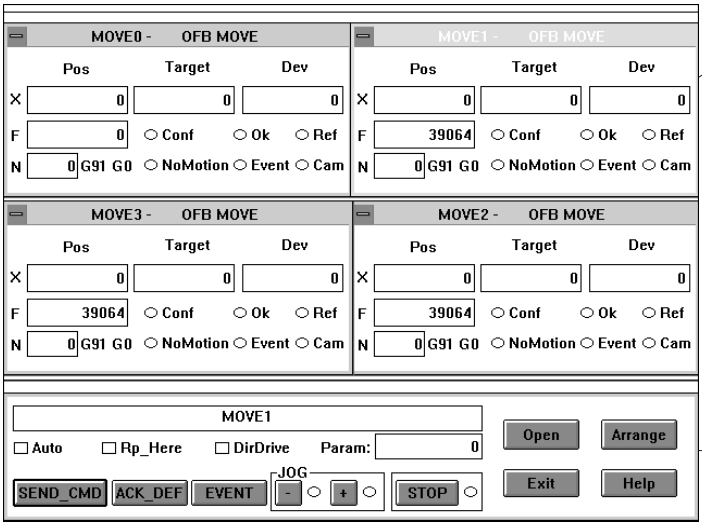
13.2 Using the ADJ MAX Multi-Group operation function

13.2-1 Multi-Group operation

The Multi-Group operation screen is used to monitor 4 single-axis groups (typically independent axes on one module). For each group it controls the progress of the moving part, the development of the program and controls the moving part in manual mode.

Access to the operating screen :

- Select the **Multi-Group** command in the **Operate** menu**.**
- If there is no single-axis group selected, this screen initially offers to open a group. If a group is already selected, it is directly positioned on the screen. Other groups are selected using the "Open" button. It is possible to reorganize groups by selecting them and moving them on the screen, using the "Arrange" button to position them exactly.



The screen consists of 2 zones :

- Zone 1, display zone

- Zone 2, command zone, comprising :
  - commands which are executed indirectly via the SEND_CMD button
  - commands which are executed directly
  These commands are specific to the group selected on the screen.

The other commands in this zone are used to select and position groups, exit the operating screen and call up the help screen.

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13.2-2 Description of the display zone

This zone contains all the data for monitoring the movement of the moving part, the status of the module and the progress of the program. This data is located in the upper zone of each window in the "Multi-Group operation" screen.

Display	Description
Pos **X**	Displays the current position of the moving part in the unit entered in the configuration parameter UNIT. This position is only significant if the group is configured, an incremental encoder is used and a reference point has been set.
Target **(1)** **X**	Displays the target position which is to be reached in the unit entered in the configuration parameter UNIT : • In automatic mode : this target is given by the instruction (or calculated based on the instruction) • In manual mode : this target is given by the manual command (or calculated).
Dev **(1)** **X**	For each axis in the group displays the position error in the unit entered in the configuration parameter UNIT : difference between the theoretical calculated position and the actual position of the moving part.
Pos **(1)** **F**	Displays the current speed of the moving part.
(1) **Motion in progress** **N** **G** **G**	Displays the instruction which is being executed. **N** number identifying the instruction being executed **G** code indicating the type of movement performed : • G90 movement to an absolute position value • G91 movement to a relative position value **G** code of the instruction which is being executed

(1) **Caution** : These values are only significant if the update command is confirmed : (Monitor box in the multi-group operation screen selected).

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Display	Description
○ **Conf**	Indicates that the group is configured
○ **Ok**	Indicates that no blocking fault (causing the moving part to stop) is detected.
○ **Calib**	Indicates that the axis is referenced, that is when incremental encoders are used and a reference point has been set.
○ **Event**	Indicates that an event is detected at the event input on the module.
○ **Nomotion**	Indicates that the moving part is stationary
○ **Cam**	Indicates that an event is detected on the reference point cam input.

13.2-3 Description of the zone containing commands executed via SEND_CMD

The sequence of execution of these commands is as follows :

- Enter parameter PARAM (for commands : Dirdrive and Rp_Here)
- Select the command
- Start execution of the command by pressing SEND_CMD.

Display	Description
☐ **Auto**	Selects automatic mode. When there is no cross in this box, manual mode is selected.
☐ **Rp_Here**	Command to set a forced reference point. The current position is forced to the value entered in the Param field.
☐ **Dirdrive**	Command to change the group to servo off mode. The loop is inhibited. The voltages of the speed drives are directly controlled by the digital/analog converter. The voltage value should be entered in the Param field (expressed in mV).
☐ **Param**	Field for entering the parameter associated with one of the manual commands : • DIR_DRIVE : voltage value in mV • RP_HERE : position value

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13.2-4 Description of the zone containing directly executed commands

These commands can be executed if the following conditions are observed :
- Group configured
- No blocking fault
- Manual mode selected for (JOG+ and JOG-) commands

Execution starts as soon as the command is pressed.

Holding down the JOG + or JOG - command executes the movement. Releasing the command stops the execution. The indicator lamp to the right indicates whether the command is being executed.

Display	Description
SEND_CMD	Command to send manual commands and to select the mode in the AXIS and GROUP zones.
NEW_KR	Command to adjust KR coefficient (see Section 11.2)
ACK_DEF	Fault acknowledgment command : all faults which have disappeared are acknowledged.
EVENT	Generates a group event (in automatic mode)
JOG + ◯	Command for unlimited movement in a positive direction on the selected axis (1).
JOG - ◯	Command for unlimited movement in a negative direction on the selected axis (1).
STOP ◯	Command to stop the moving part and the current instruction (in automatic mode) and clear the buffer memory.

(1) These commands remain active at a soft stop fault.

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13.3 Designing an operator dialogue

13.3-1 Control station

The programmer can use all the commands and elementary data in the form of command bits, and status words extracted from the •MOVE OFB to design a simple or complex control station.

Two examples are given in this manual :
- One in the tutorial in Section 5
- One in Section 8.5 "Management of manual mode"

The programming principles are given in Section 8.5, and an exhaustive list of all the bits and words extracted from the •MOVE OFB is given in the Quick Reference Guide.

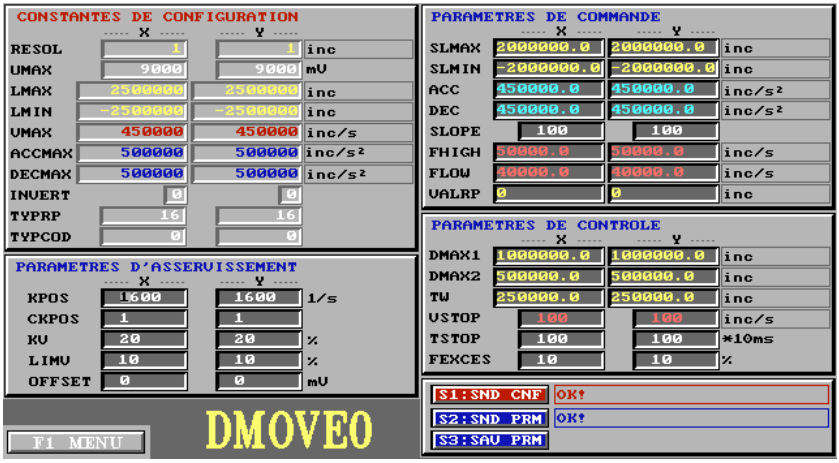
13.3-2 PL7-MMI operator dialogue software

PL7-MMI operator dialogue software is used to create a genuine control panel to control one or more axes from an MMX 7 type operator dialogue terminal.

This software uses all the data from the •MOVE OFB.

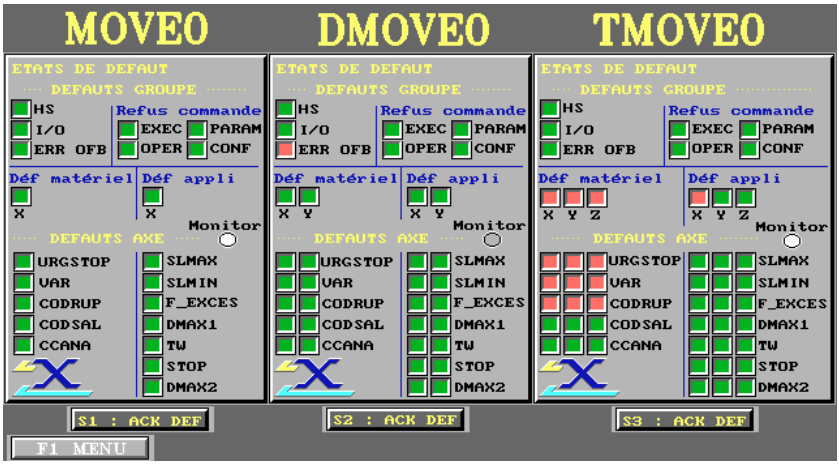
The following screens give some examples of possible operator dialogue.

Example 1 : Screen for reading and writing adjustment parameters.

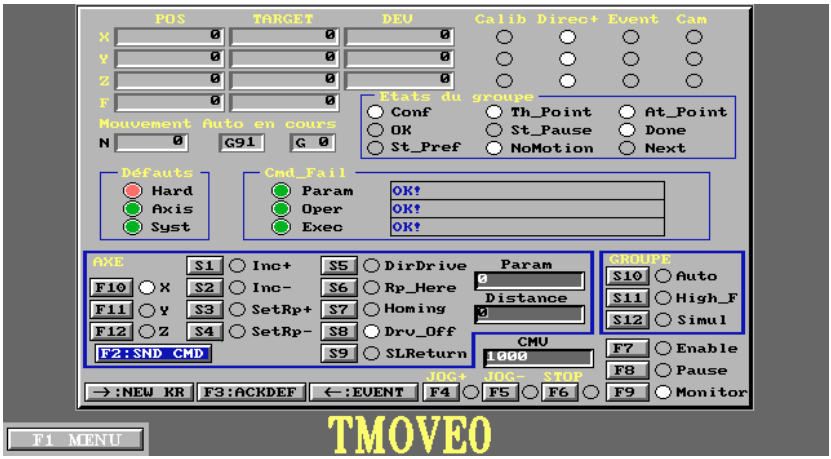


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Example 2 : Screen giving detailed fault information for 3 groups of axes.



Example 3 : Screen for operating a group of axes. It is a transposition on MMX of the ADJ MAX Mono-Group screen.



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14.1 Fault monitoring

The user has a number of means available to him for detecting faults :

- Indicator lamps on the front panel of the module :
  - red indicator lamp : general fault lamp
  - green indicator lamp : I/O fault
- Multi-Group (see Section 13.2) and Mono-Group (see Section 13.1) operation screens.
- Fault bits and status words (see Section 8.4 and Quick Reference Guide).

14.2 Conditions for executing commands

General conditions for movement control :

- Group configured and with no blocking fault
- Automatic or manual code selected
- For absolute position commands : this position should be between the limits x_SLMIN and x_SLMAX
- For relative position commands : the target calculated based on the relative position should be between limits x_SLMIN and x_SLMAX,
- The axes should be referenced except for reference point commands
- The set speed F, should be :
  - for a MOVE OFB : ≤ X_VMAX
  - for a DMOVE OFB : ≤ Min (X_VMAX, Y_VMAX)
  - for a TMOVE OFB : ≤ Min (X_VMAX, Y_VMAX, Z_VMAX)

Special case for commands with no stop (G01, G11) :

The command is refused if requested speed F cannot be reached at the intended target point with respect to the current position of the moving part.

Modifying the speed modulation parameter CMV

If the above speed conditions have not been verified, when parameter CMV is modified, the modification is not accepted.

Comment : A movement without stop which is not followed by any sequencing command continues until the soft stop limits are reached.

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14.3 Questions/answers

- **The •MOVE function block remains in system error, what action should be taken ?**

The system error is connected to an incorrect group configuration.
Modify in local mode (terminal memory) the addresses of the group ADGROUP and the addresses of the axes ADAXIS and transfer the modified application to the PLC processor (PL7-3 transfer mode).

- **Why are the X_POS positions incorrect after an SSI absolute encoder has been connected ?**

Check the DC voltage of the encoder. A voltage which is too low or incorrect causes incorrect data to be fed back.

- **Why are time lags observed between pressing the JOG commands and the commands taking effect when in visual manual mode ?**

JOG commands are managed by the master task OFB in an OS/2 window. The response therefore depends on the number of windows open and the master task cycle time.

- **What action should be taken to avoid losing the settings when there is a cold restart ?**

After setting the axes, these parameters must be saved using the SAVE_PARAM command in the ADJ-MAX TRANSFER screen.

- **What action should be taken to avoid losing the settings after a Terminal --> PLC transfer ?**

After adjusting the axes, they should be archived, as described in Section 12.3

- **What should be done to prevent the •MOVE function block being deconfigured when the PLC stops ?**

Change to Safety off mode by setting bit SAVE_OFF to 1.

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14.4 Diagnostic help

Using ADJ-MAX software

Symptom	Possible cause	Corrective action
Message H'49'('4A') :"ERR FAIL RATIO ACC(DEC) X" during a SEND_CNF or SEND_PRM command	Value of ACC(DEC) too low. Reminder : ACC(DEC)>VMAX/120 in physical units (>VMAX/2 in incremental units)	Choose a value compatible with the rule for ACC(DEC).
Mono-Group operation screen "empty" (no bit at 1, group not configured, only DRIVE_OFF present) Command modification has no effect even if SEND_ CMD seems to be accepted.	1-Axis number inconsistent in ADAXIS 2-same channel number used by several axes (eg : X and Y assigned to channel 0) of the same group or 2 different groups.	Correct ADAXIS in PL7_3 **local** mode, then transfer. NB : the TRANSFER screen often provides information on the type of problem. (Error H'6',H'2',H'3')
Mono-Group screen displays SYST ERROR	1-Group no.>max n°possible 2-address coded on ADGROUP does not correspond to an AXM •92.	Correct ADGROUP in PL7_3 **local** mode and transfer.
Clock displayed during a SEND_CMD/CNF/PRM, then command not acknowledged	Two MOVE OFBs from the same AXM have the same group number.	Correct ADGROUP in PL7_3 **local** mode and transfer.
The message "Command not acknowledged" appears on the Mono-Group screen when trying to access a group	Two groups from the same module have the same number	Correct ADGROUP and ADAXIS in PL7_3 **local** mode and transfer.
JOG command refused with error code H'14' (transient)	The axis is in DRIVE_OFF (eg : on initialization after loading of a configuration)	Deselect DRIVE_OFF mode and perform a SEND_CMD
Message H'22' during a SEND_CONF command	1-VMAX is outside limits 2-VMAX and RESOL are incompatible (VMAX too high or RESOL too low)	If there is no error, modify the drive chain.
Message H'31' ERR RANGE LMIN OR LMAX during a SEND_CONF command	LMAX/ LMIN upper and lower soft stops incompatible with the resolution	If no error has been made during entry, modify the drive chain.

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Symptom	Possible cause	Corrective action
Stop for deviation fault DMAX1, with DMAX1 very high.	Inconsistency between VMAX/RESOL	Correct the values
JOG command : Continuous movement while the command is released	Inconsistency between VMAX/RESOL (the moving part continues to advance to take up the deviation before deceleration).	Correct the values
ENABLE command refused (and operation screen generally ineffective).	Group deconfigured, either following a failed attempt to load the configuration, or because SY9 is at 1	Reset SY9 to 0, if it is at 1. Correct the parameter at the source of the refusal to load the configuration.
Error message H'47' (Group NCONF, waiting for SEND_CNF command) during an attempt to load the configuration	Bit SY9 at 1	Reset SY9 to 0

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15.1 OFB characteristics

Size of multi-axis OFB function blocks

Type of OFB	TMOVE	DMOVE	MOVE
Data memory	900	850	800
Constant memory	160	120	80
Total per occurrence	1060	970	880
Program memory	6300	6200	5800
System memory	4300	3200	2050
Total per OFB	10600	9400	7850

The approximate sizes are given in words of 16 bits.

OFB execution time in the master task

Type of Processor	P47		P67		P87		P107	
MONITOR (1)	yes	no	yes	no	yes	no	yes	no
MOVE	4	3	2.7	2.1	2	1.7	1.6	1.3
DMOVE	4.7	3.3	3	2.3	2.4	1.9	2.2	1.5
TMOVE	5.7	4.4	3.5	2.6	3	2.3	2.5	2

The times are given in ms.

(1) Remember that when the MONITOR command is active (active by default), or when bit •MOVEi,MONITOR is at 1, all aperiodic data is updated (see exhaustive list of aperiodic data in the Quick Reference Guide), otherwise only periodic data is read, which reduces the OFB execution time.

Processor capacity

The table below gives guide figures for a master task of 100ms and with 30% of the PLC processor capacity taken up by multi-axis control.

Type of Processor	P47	P67	P87	P107
MOVE	8	12	16	20
DMOVE	6	8	10	12
TMOVE	4	6	8	9

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15.2 Limitations of the TSX AXM •92 module

15.2-1 Acceleration/deceleration values

These must be between an upper and a lower limit.

The value of the upper limit corresponds to the acceleration (deceleration) necessary for changing from 0 to VMAX (VMAX to 0) in 20ms.

Limit values with multiplication by 4

• resolution expressed in µm (or in degrees)

$$ACC\ (or\ DEC) \leq \frac{VMAX}{60 \times 0.02} \qquad \text{ie. } VMAX \times 5/6$$

ACC in mm/s^2
VMAX in mm/min

• resolution expressed in increments
ACC (or DEC) ≤ VMAX x 50 as VMAX is then expressed in incr/sec.

Limit values without multiplication by 4

• resolution expressed in µm (or in degrees)

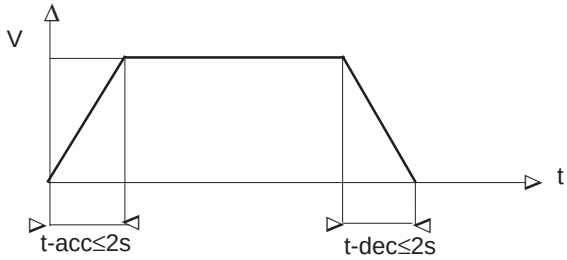
$$ACC\ (or\ DEC) \leq \frac{VMAX \times 5}{24}$$

ACC in mm/s^2
VMAX in mm/min

• resolution expressed in increments

$$ACC\ (or\ DEC) \leq \frac{VMAX}{200}$$

The value of the lower limit corresponds to a maximum duration of the acceleration / deceleration phase equal to 2 s.



which is expressed as :

$$ACC\ (or\ DEC) \geq \frac{VMAX}{60 \times 2}$$

ACC in mm/s^2
VMAX in mm/min

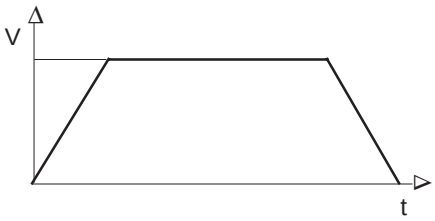
Comment : if the increment unit is selected, the formula is as follows :
ACC (or DEC) ≥ VMAX/2 as VMAX is then expressed in incr/sec.

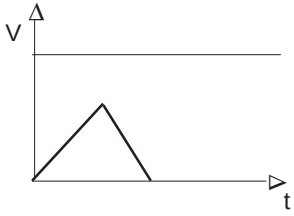
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15.2-2 Low amplitude movements

A low amplitude movement is one which does not allow the speed specified in the instruction to be reached. The speed profile is triangular rather than trapezoid.





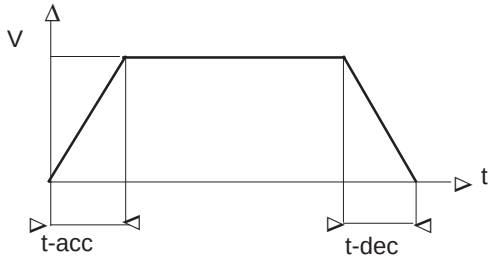
Generally, when the trajectory is being executed, the acceleration and deceleration values do not respect the values requested (except in the case of single axis control for version V1.3).

The example below describes the behaviour of the axis(axes) in the case of low amplitude movements. For simplicity, the example relates to single axis movement at constant acceleration, but it also applies to 2 and 3 axis systems and to the trapezoid acceleration profile.

The instruction is as follows :
EXEC MOVE0(1;G90;G09;X1;V==>)
X1 defines the position to be reached, V specifies the "cruise" speed at which the movement is to be performed.

X0 is the position of the moving part at the outset.

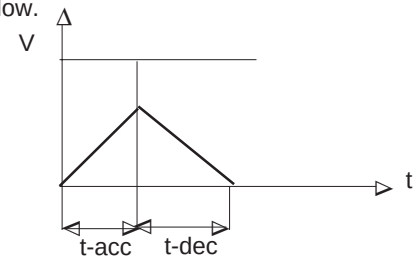
1st example :
The distance |X1-X0| to be covered is not sufficient for the specified speed V to be reached. The movement is performed in accordance with a trapezoidal speed trajectory.



This trajectory shows the duration of the acceleration/deceleration phases respectively (t-acc and t-dec).

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2nd example :
The distance |X1-X0| to be covered is not sufficient for the specified speed V to be reached. The movement is performed according to a triangular speed trajectory as shown below.



The durations of the acceleration/deceleration phases are those of the trapezoid trajectory that is, they are equal to those necessary for reaching the specified speed. The resulting acceleration/deceleration values are therefore lower than those defined by the MOVE0,X_ACC and MOVE0, X_DEC parameters.

To summarize, in the case of small movements in 2 or 3 axis systems (as well as for single axis systems for version 1.1 of the module) the movement is not performed in an optimum time, but the two- or three-dimensional trajectory is respected.

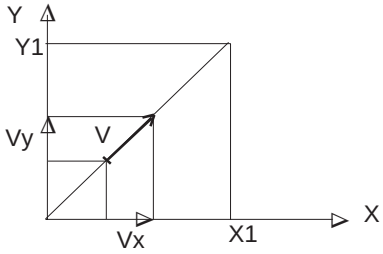
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15.2-3 Multi-axis movement : effective speed of movement

For simplicity, the explanation is given for a 2 axis system is shown, but it also applies to a 3 axis system.
The movement to be performed corresponds to the following command :

EXEC DMOVE0(1;G90;G09;X1;Y1;V=>)

The speed parameter V defines the value of the speed according to the direction of movement. It can be broken down into 2 components, Vx and Vy, on each of the axes.

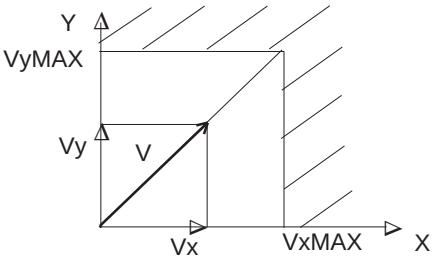


VxMAX and VyMAX are the maximum permitted speeds on each of the axes, X and Y.

The effective speed of movement will only be equal to the programmed speed V if V and its components satisfy all the following conditions :

V≤ MAX(VxMAX,VyMAX) ; Vx≤VxMAX ; Vy ≤VyMAX

Example :



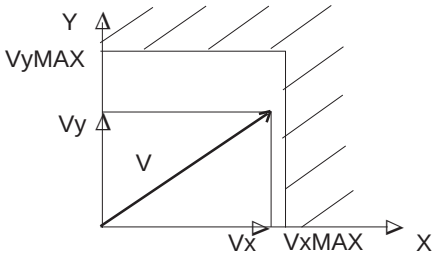
VxMAX = 2000
VyMAX = 3000
V=1500
ΔX =4000
ΔY =3000
Vx= 1200
Vy= 900

V<VxMAX, V<VyMAX, Vx<VxMAX, Vy<VyMAX

F

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If the specified speed V is greater than the maximum speed of one of the axes (but without the projection exceeding the maximum permitted limit)



Example :
VxMAX = 2000
VyMAX = 3000
V=2400
ΔX =4000
ΔY =3000
Vx= 1920
Vy= 1440

VxMAX < V < VyMAX
Vx < VxMAX

The movement is performed at the specified speed V.

If the specified speed V is greater than the maximum speed of each of the axes (whether or not the projection exceeds the maximum speed on one or both axes).

The movement will always be rejected.

15.2-4 Rules to be respected for the programmed speed to be accepted

1st example : the axes have the same VMAX.

The programmed speed must respect the condition : F≤VMAX

2nd example : the VMAX of the axes varies only slightly.

The programmed speeds must respect the condition :
F≤VxMAX and F≤VyMAX (and F≤VzMAX).

This simple rule does not lead to movements being performed in optimum times. To obtain optimum times, it is necessary to apply the rule proposed for example no. 3.

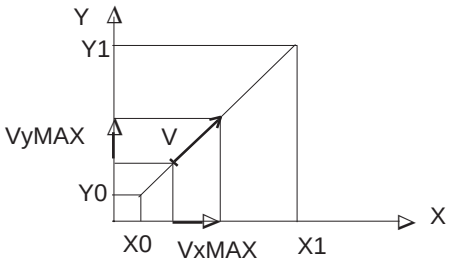
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3rd example : the axes have very different values for V_MAX.
(for example VxMAX=1m/min and VyMAX=15m/min)

The speed to be programmed in parameter F must be chosen so that the projections on axes X, Y, (Z) do not exceed the values for VMAX.

Example : moving from point (X0, Y0) to point (X1,Y1) in an optimum time



The speed V must satisfy the condition

$Vx \leq VxMAX$ and $Vy \leq VyMAX$
where $Vx = V * \frac{|X1-X0|}{D}$

$Vy = V * \frac{|Y1-Y0|}{D}$

$D = \sqrt{|X1-X0|^2+|Y1-Y0|^2}$

If the speed F to be programmed (1) does not respect this condition, the maximum acceptable value must be recalculated using the following algorithm :

If $Vx \geq VxMAX$ then $Vy * \frac{VxMAX}{Vx}$ --> Vy
and VxMAX --> Vx

If $Vy \geq VyMAX$ then $Vx * \frac{VyMAX}{Vy}$ --> Vx
and VyMAX --> Vy

Calculate $F = \sqrt{Vx^2+Vy^2}$

Note : this explanation, shown on a 2 axis system for the sake of simplicity, can easily be extended to a 3 axis system.

(1) this value can be chosen to be equal to the greater of the 2 (3) VMAX values.

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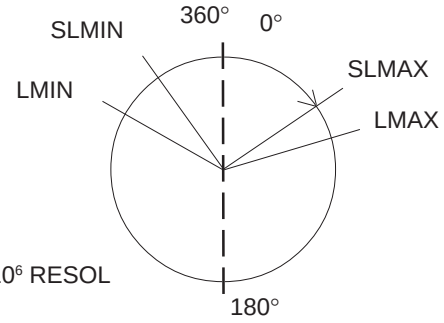
16.1 Angular movement

TSX AXM 292 and 492 modules manage angular movements of up to 360° (no management of the modulo).
To manage an angular movement, select the 10^{-5} degree measurement unit (UNIT = 3) during configuration.

Description of movements

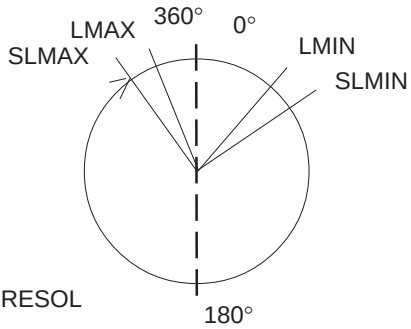
The user can select a soft stop limit X_SLMAX lower than X_SLMIN. Independently of the values SLMAX and SLMIN entered by the user (X_SLMAX ≠ X_SLMIN) a positive direction of movement is implicitly and automatically established by the module. It is always defined by the direction X_SLMIN --> X_SLMAX.

1st example : SLMIN > SLMAX



0<LMAX<LMIN<8.10^6 RESOL

2nd example : SLMIN < SLMAX



0<LMIN<LMAX≤8.10^6 RESOL

Note : Maximum values of SLMAX and SLMIN (in 10^{-5} degrees) :
- 8000 000 x RESOL for an incremental encoder
- 8000 000 x RESOL x 2^{n-24} (where n = number of encoder bits) for an absolute encoder

Comment : to have the full scale range [0...360[, it is compulsory to have a resolution RESOL≥5.

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16.2 Move to a position without stopping, code G31

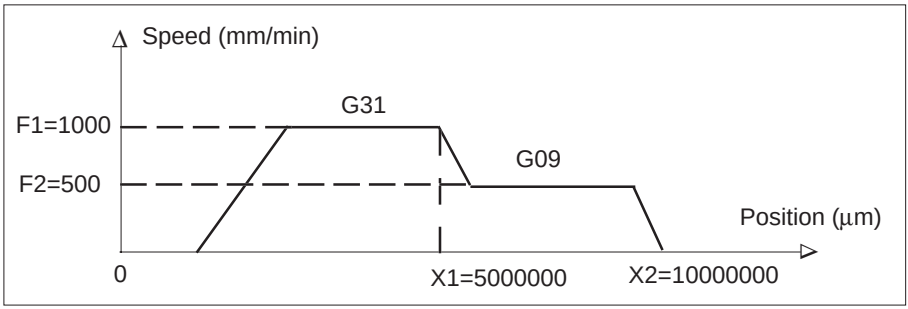
Movement instruction G31 specifies moving to a point "X" without stopping, at a specified speed "F", and without refusing the instruction if the requested speed cannot be reached at point X.

This instruction only applies to independent axes (MOVE OFB).

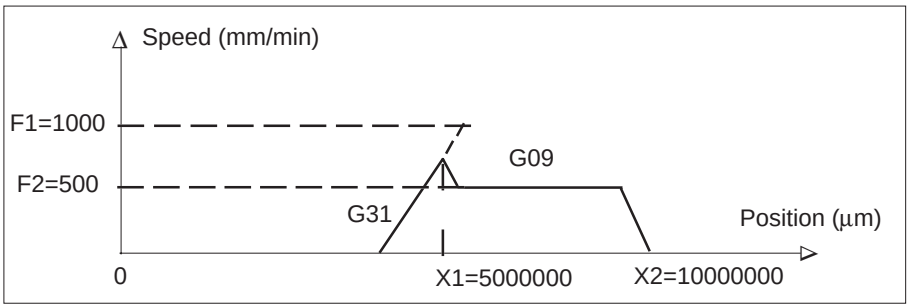
It is equivalent to instruction G01 except in the case where the distance to be travelled does not allow for the specified speed to be reached (shown in example 2 below), in which case :

- instruction G01 is refused, and the moving part is stopped,
- instruction G31 is executed "in the best way possible" : although the specified speed is not reached at the required position, the movement is executed.

Example 1 : executing a G01 and a G09 instruction in sequence. In this example the distance to be travelled by G31 is sufficient (G31 and G01 are the same).
EXEC MOVE0(1;G90;**G31**;5000000;1000=>)
EXEC MOVE0(2;G90;G09;10000000;500=>)



Example 2 : the same as example 1, but the distance to be travelled by G31 is too short to reach the required speed (in this case instruction G01 is refused).



In the example above, instruction G01 will not be executed as speed F1 (1000 mm/min) cannot be reached with the programmed acceleration. However, instruction G31 is executed.

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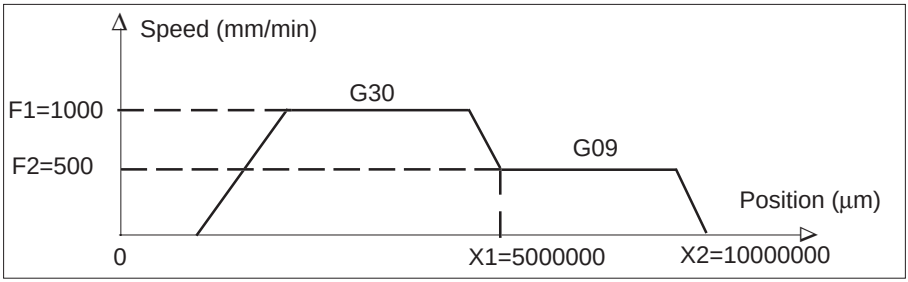
16.3 Move to a position without stopping, code G30

Movement instruction G30 is similar to instruction G31, but in addition, it offers a feedforward mechanism which enables it to reach a specific point at the speed equivalent to that specified in the instruction. It is therefore useful when executed in sequence with another movement instruction.

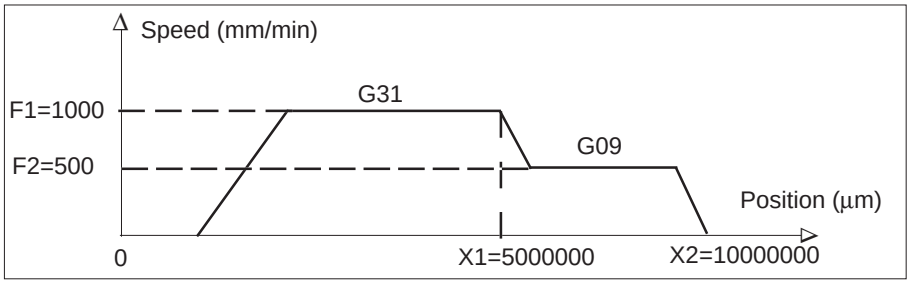
This instruction only applies to independent axes (MOVE OFB). It does not take into account acceleration and deceleration parameter modifications during execution.

Note : this instruction is used in simple machining applications.

Example : comparison between G30 and G31 instructions
EXEC MOVE0(1;G90;**G30**;5000000;1000=>)
EXEC MOVE0(2;G90;G09;10000000;500=>)



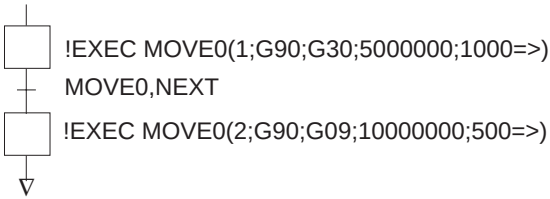
EXEC MOVE0(1;G90;G31;5000000;1000=>)
EXEC MOVE0(2;G90;G09;10000000;500=>)



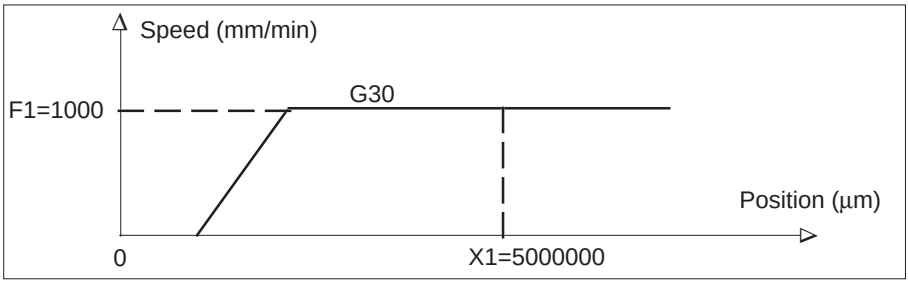
The difference between instructions G30 and G31 is the point at which the speed changes.
For G30, the speed has finished changing when the target position is reached.
For G31, the speed is starting to change when the target position is reached.

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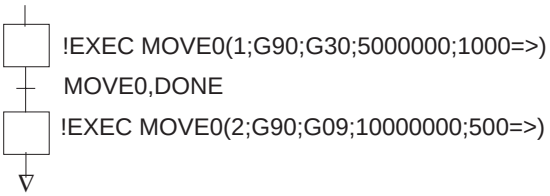
Note : the feedforward effect described on the previous page is only obtained if the 2 instructions follow the NEXT sequence mechanism.

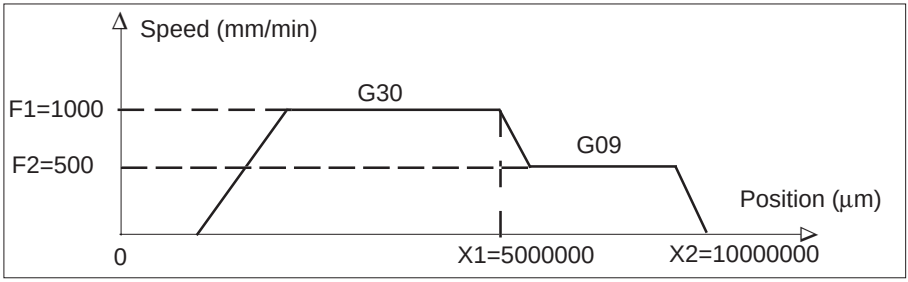


When instruction G30 is not followed by another instruction, the movement continues at the specified speed.



When instruction G30 is executed in sequence with another instruction, but by using a DONE sequence mechanism, the operation is the same as for instruction G31 (no feedforward effect).





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16.4 "PAUSE" function

This function has two possible uses :
- Step by step execution of the movement control program.
- Synchronization of the axes in a group.

Step by step execution of the movement control program

Activating the Pause instruction in the Mono-Group operation screen or setting bit •MOVEi,PAUSE to 1 causes the group to change to waiting status after the execution of the current instruction : the sequence of movements stops. Movements without stop are stopped after they have been executed.
It is therefore possible to execute movements step by step for debugging purposes by successively activating and deactivating the Pause instruction.

Synchronization of the axes in a group

Setting bit •MOVEi,PAUSE to 1 via the program for each group of axes causes the group to change to waiting status after execution of the current instruction.
When bit •MOVEi,PAUSE is reset to 0, the group of axes continues to execute the instructions.

Example
Execution of the movement of moving part 2 is stopped when moving part 1 starts to move. It is restarted as soon as the movement of moving part 1 is completed, when moving part 1 has reached position 500000.

```
IF[MOVE1,N_RUN=1] THEN SET MOVE2,PAUSE
. . . . . .
EXEC MOVE1 (3;G90;G09;W100;W200)
. . . . . .
IF[MOVE1,N_RUN=3].[MOVE1,X_POS≥500000] THEN RESET MOVE2,PAUSE
```

Note : Bit •MOVEi,ST_PAUSE indicates when it is at state 1 that the group of axes is in "PAUSE" state.

Restriction : Do not use the "Pause" function and the synchronization function at the same time, see Section 16.7.

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16.5 Immediate "PAUSE" function

This function is used to stop the moving part in automatic mode, while still ensuring that on the instruction to restart movement the programmed trajectory is followed (with no risk of the instruction being refused).

This instruction is activated :

- via the program : by assigning the value 10 to word MOVEi,CMV speed correction coefficient,
- via the ADJ MAX software operate screen : by assigning the value 10 to the speed correction coefficient parameter CMV.

It causes the moving part to stop depending on the programmed deceleration.
The pause status report is indicated via bit MOVE,ST_PAUSE.

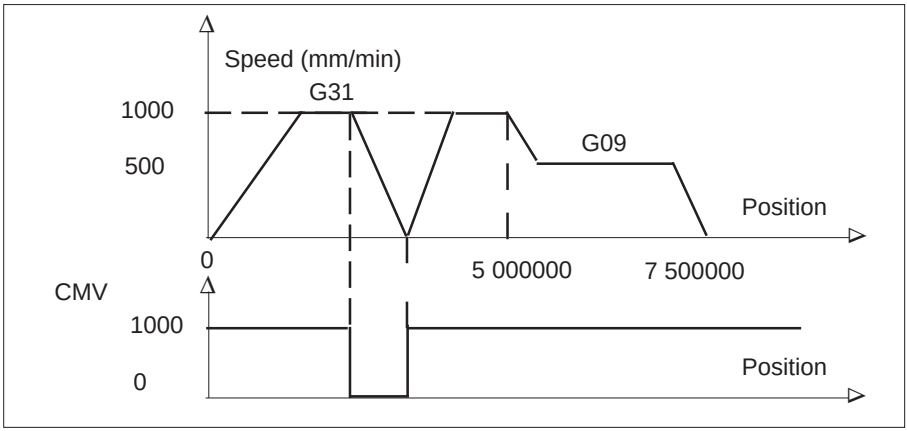
This instruction is deactivated :

- via the program : by reassigning the initial value (>10) to word •MOVEi,CMV speed correction coefficient,
- via the ADJ MAX software operate screen : by reassigning the initial value (>10) to the speed correction coefficient parameter CMV.

It causes the interrupted movement to restart at the speed corresponding to :
F*CMV/1000

Example 1 :

```
EXEC MOVE0(1;G90;G31;5000000;1000=>)
EXEC MOVE0(1;G90;G09;7500000;500=>)
.....
IF RE(B10) THEN MOVEi,CMV-->W100;0-->MOVEi,CMV
IF FE(B10)  THEN W100 --> MOVEi,CMV
```

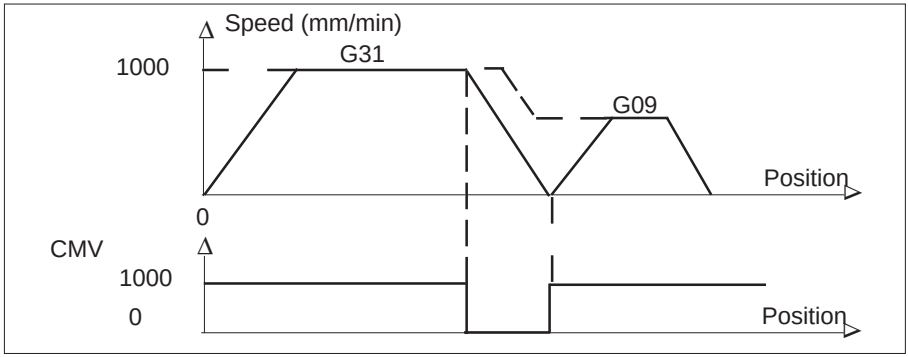


Note :

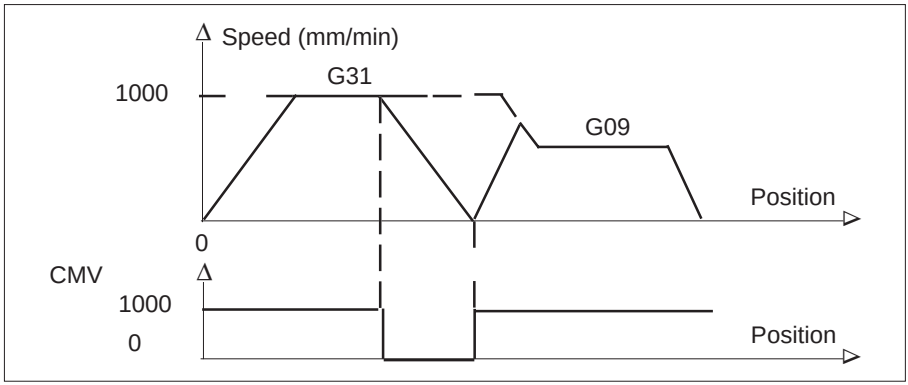
- this instruction applies to independent axes (MOVE); and instructions G09, G30 and G31,
- this instruction is deactivated on a STOP command or blocking fault.

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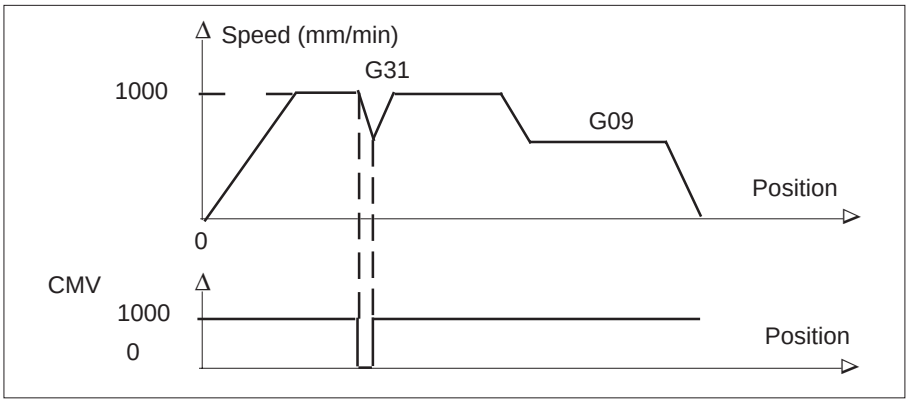
Examples of special cases



Example of restarting movement with sequencing of G09 immediately on starting



Example of restarting movement with sequencing of G09 during starting



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16.6 Synchronization of groups of axes on one module

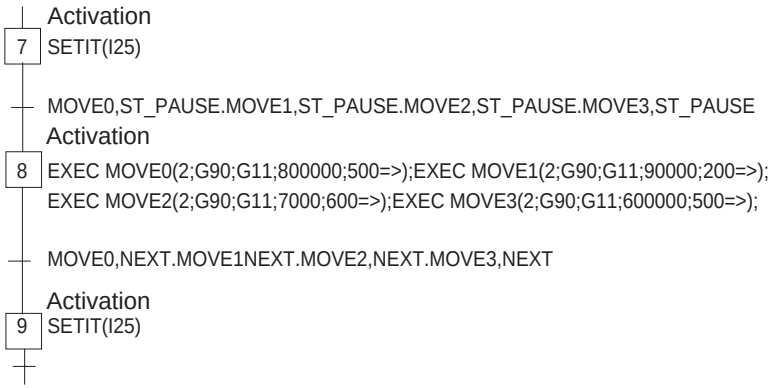
The PL7-3 language instruction SETIT synchronizes the execution of all the groups of axes on one module.

If this mechanism is not used for a instruction given during the same cycle of the master task, the groups of axes start at time intervals of up to 20 ms.

The first execution of the instruction SETIT changes all the groups of axes on the module to waiting status when they have completed the execution of the current instructions. The second execution of the instruction SETIT initiates the simultaneous execution of all the groups of axes.

Reminder of the syntax of the instruction SETIT :
SETIT(Ixy)
where x = rack number and y = module number in the rack.

Example
One TSX AXM 492 controls 4 independent axes. During a preparation phase the axes are changed to waiting status. When this phase is completed the movements on the 4 axes are then executed simultaneously.



Note : All the steps are programmed on activation.

Restriction : Do not use the synchronization function and the "Pause" function at the same time.

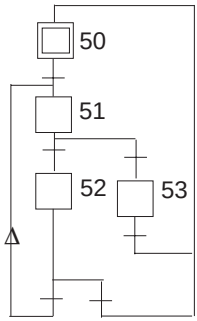
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16.7 Teaching the positions

The PL7-3 program in the following example :

- Teaches 16 positions in the first chart
- Teaches their use in the second chart

Chart for teaching positions




```
STEP 50 ACTION ON ACTIVATION
<memorize W999 in order to use it as a limit
!     W999->W998

<Initialize the index during the teaching phase
!     -1->W999

TRANSITION: X50->X51
!     RE(I46,0)

STEP 51 ACTION ON ACTIVATION
<update the index
!     W999+1->W999

<teach positions X and Y
!     DMOVE0,X_POS->DW1000(W999);
      DMOVE0,Y_POS->DW1400(W999)

TRANSITION: X51->X52
!     [W999<=16]

TRANSITION: X51->X53
!     [W999>16]

TRANSITION: X53->X50
!     RE(I46,1)

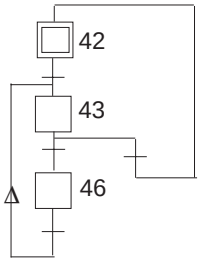
TRANSITION: X52->X51
!     RE(I46,0)

TRANSITION: X52->X50
!     RE(I46,1)
```

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Chart to teach the use of the positions




```
STEP 42 ACTION ON ACTIVATION
<initialize W997 as the execution index
!     -1->W997

TRANSITION: X42->X43
!     RE(I46,2)

STEP 51 ACTION ON ACTIVATION
<increment the execution index
!     W997+1->W997

<execute the next segment
!     EXEC DMOVE0(W997;CW8;CW1;DW1000(W997);DW1400(W997);150000=>)

      OPTIONAL FUNCTION BLOCKS: I/O PARAMETERS
                              DMOVE0
  W997                  N    :WORD    ERROR  :bit
  CW8                   G9_  :WORD
  CW1                   G    :WORD
  DW1000(W997)          X    :WORD
  DW1400(W997)          Y    :WORD
  150000                F    :WORD

CW8   : G90 movement with absolute value
CW1   : G09 go to point and stop


TRANSITION: X43->X46
!     DMOVE0,NEXT.[W997<W998].NOT DMOVE0,ERROR

TRANSITION: X43->X42
!     (DMOVE0,DONE.[W997>=998])+ DMOVE0,ERROR
```

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17.1 Introduction

ADJ MAX software is an X-TEL or MINI X-TEL station tool for adjusting and operating multi-axis control applications. **It will only operate in connected mode** :

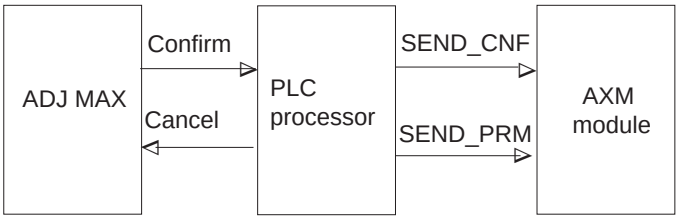
- PLC in STOP or RUN mode : for entering parameters (Adjust menu).
- PLC in RUN mode : for transferring parameters to the module and using the Mono-Group and Multi-Group operating functions.

This tool accesses ●MOVE OFB internal constants and data programmed in PL7-3 in the PLC processor.
●MOVE OFBs should have already been declared and configured (group and axis address entered) in the PL7-3 program. This program must then be transferred to the PLC processor so that the ADJ MAX software can access it.

This tool has an OS/2 Presentation Manager type user interface. It can be used with a mouse and the keyboard, or with the keyboard only.

Keyboard layout
The TAB key is used to move from one zone or button to another. The Up and Down arrows are used to move around within a zone. More detailed information on using the keyboard is provided in the help screen.

General principle



The Adjust parameters are entered in the ●MOVE OFB in the PL7-3 program in the PLC processor.

These parameters must be transferred using the parameter transfer function (SEND_CNF or SEND_PRM commands) so that they are accepted by the module.

On-line help
Contextual help can be accessed using the Help or F1 key. It lists the significance of the parameters and the keys for each screen.

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17.2 Accessing the ADJ MAX tool

The ADJ MAX tool can be accessed in two ways :

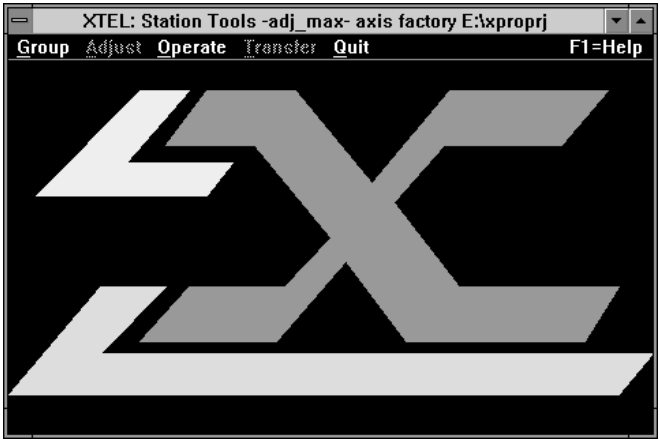
- Under the X-TEL software workshop : from the station tools for managing a TSX V5 or PMX V5 X-TEL software workshop station.
- Under the MINI X-TEL software workshop : from the primary window.

X-TEL

select a volume
→ select a project
→ select a station
→ select the ADJ MAX tool from STATION-TOOLS

MINI X-TEL

primary window
→ select the ADJ MAX tool in the primary window



The initial screen of the ADJ MAX tool is used to select the function to be performed from one of the five menus in the selection bar. When the software is started, only the **Group, Operate** and **Quit** menus can be accessed. A working ●MOVE OFB must be selected in order to access the other menus.

Software access rights

Function	Access	User	Technician	Programmer
Group	Read	yes	yes	yes
	Write	yes	yes	yes
Adjust configuration	Read	yes	yes	yes
	Write	no	no	yes
Adjust parameters	Read	yes	yes	yes
	Write	no	yes	yes
Operate	Read	yes	yes	yes
	Write	no	yes	yes
Save parameters	Write	no	yes	yes

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Summary



- Group
  - Open
  - Close
  - About...
- Adjust
  - Configuration Parameters
  - Command Parameters
  - Servo Parameters
  - Error control Parameters
- Operate
  - Mono-Group
  - Multi-Group
- Transfer
  - Parameters
- Quit
  - Quit
  - Resume

Group menu

- **Open** — Accesses the box for selecting the working ●MOVE OFB (to be adjusted or used)
- **Close** — Deselects the current ●MOVE OFB
- **About...** — Generates a message giving information on the name of the software, its software version and the Telemecanique Copyright

Adjust menu

- **Configuration Parameters** — Accesses the screen for entering the configuration parameters
- **Command Parameters** — Accesses the screen for entering the command parameters
- **Servo Parameters** — Accesses the screen for entering the servo parameters
- **Error control parameters** — Accesses the screen for entering the error control parameters

Operate menu

- **Mono-Group** — Accesses the screen for using the working ●MOVE OFB
- **Multi-Group** — Accesses the screen for using several ●MOVE OFBs

Transfer menu

- **Parameters** — Accesses the screen for transferring configuration and operating (command, servo and error control) parameters

Quit menu

- **Quit** — Quits the tool
- **Resume** — Restarts the tool

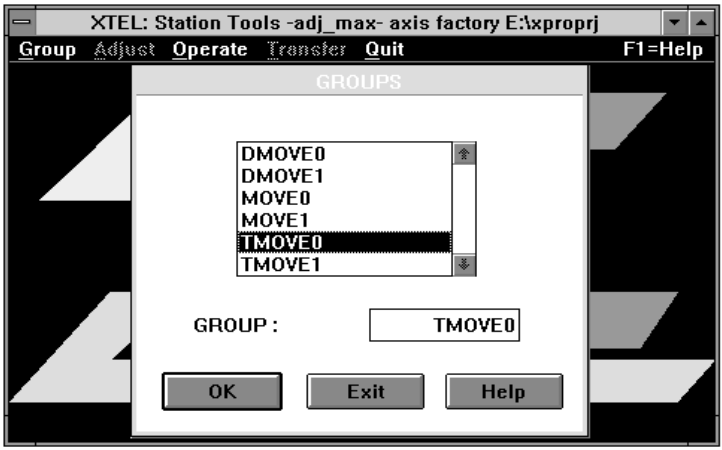
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17.3 Group menu

Open function

This function displays the dialogue box for selecting the •MOVE OFB controlling the working group of axes.



The dialogue box shows all the •MOVE OFBs contained in the PL7-3 application loaded in the PLC processor.

The working •MOVE OFB is selected by choosing the OFB from the list which is displayed or by entering its name directly in the **GROUP** field.

Role of the keys

OK Confirms the selection of the OFB from the list. The OFB which is confirmed then appears in the **Group** field

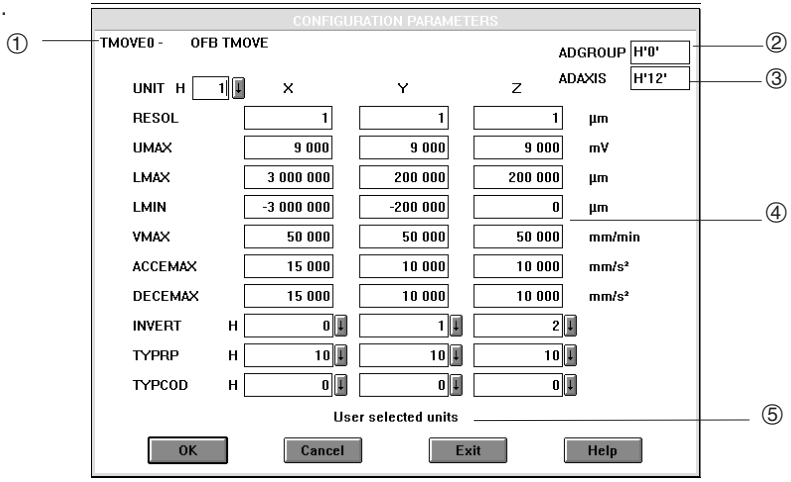
Exit Is used to abandon the opening of a group and return to the initial screen.

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17.4 Adjust menu

Each of the Adjust menu functions calls up a screen for entering the parameters of the current group of axes (●MOVE OFB).
The screens which appear are similar (the parameters are described in Sections 10 and 11).



Description of the screen

① Display of the working OFB, and the LABEL entered under PL7-3
② Display of the number of the working group of axes
③ Display of the number of the working axis
④ Fields for entering parameters
⑤ Message specific to the selected parameter

Entering parameters

Parameters are entered by selecting the field associated with the parameter and entering the value via the keyboard.
The parameters which represent the coding of data can be adjusted either using the arrow located to the right of the field or by directly entering the hexadecimal code. The arrow accesses a dialogue box which offers various choices.

Role of the keys

OK	Confirms all entries and writes these values in the working ●MOVE OFB (in the PL7-3 program in the PLC processor).
Cancel	Cancels all the entries, and reads the contents of the ●MOVE OFB.
Exit	Closes the current screen. If the user presses the exit button without confirming the entries a warning message requests confirmation of the exit.

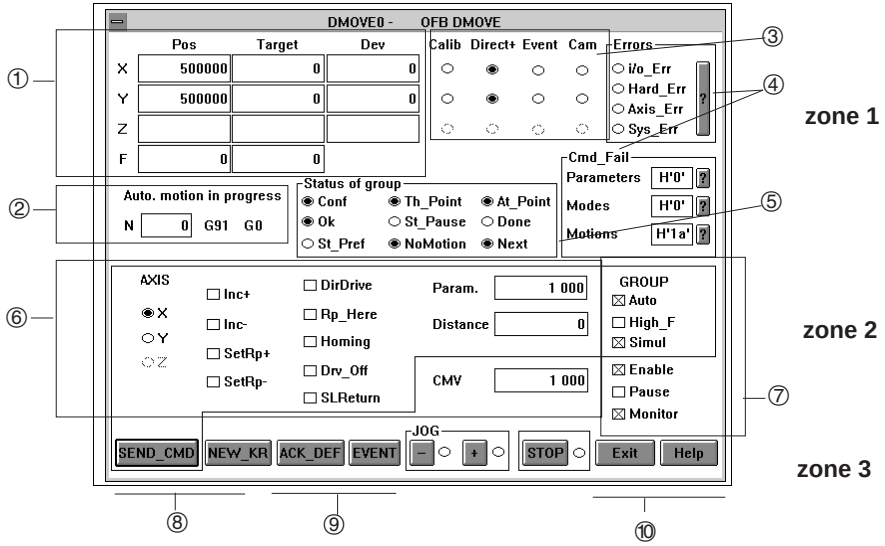
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17.5 Operate menu

Mono-Group function

The Mono-group function in the Operate menu has several displays and commands to assist with debugging and operating a group of axes.



This screen comprises :

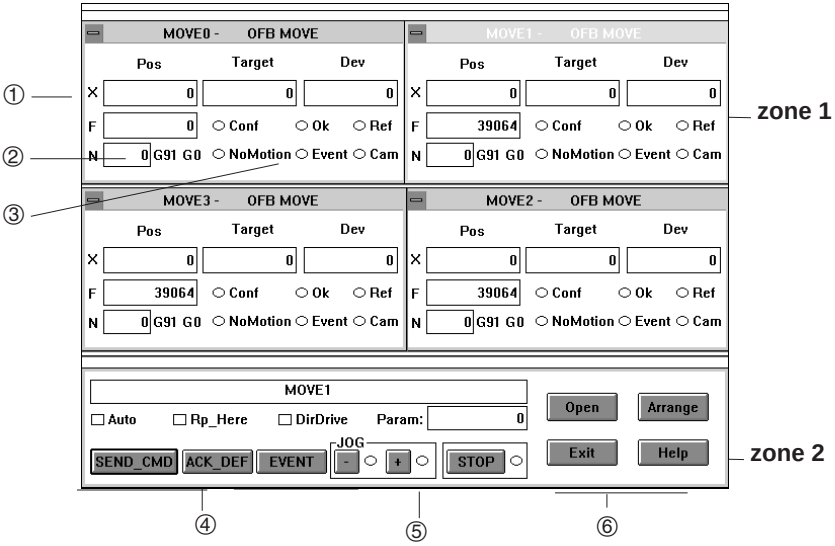
- In **zone 1**, data on the position and the status of the moving part and the module :
  - ① Measurement of the position, target position to be reached, speed and deviation for each of the axes, X, Y and Z
  - ② Instruction currently being executed
  - ③ Status : axis referenced, positive direction of movement, event detected on the dedicated input, detection of the reference point cam
  - ④ Faults : modules, application, system, commands
  - ⑤ Group status
- In **zone 2**, commands to move the moving part, with indirect execution via the SEND_CMD button :
  - ⑥ Move command in manual mode and associated entry fields
  - ⑦ Selection of operating modes
- In **zone 3**, commands with direct execution
  - ⑧ Acknowledgment of faults, generation of events, sending commands
  - ⑨ Visually move in a negative or positive direction : pressing the command activates the movement, pressing the command again deactivates the movement
  - ⑩ Exit button for exiting the screen, and on-line help button.

Note : For more details on the Mono-Group operation function see Section 13.1

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Multi-Group

The Multi-Group function in the **Operate** menu offers the option of displaying 1 to 4 sets of displays and commands for assisting with debugging and operating 1 to 4 groups of a single axis (MOVE OFB).



This screen comprises :

For each of the windows :

- In **zone 1**, data on the position and the status of the moving part and the module :
  - ① Measurement of the position, target position to be reached, speed and deviation
  - ② Instruction code currently being executed
  - ③ Status : axis configured, axis OK, axis referenced, moving part stationary, event detected on the dedicated input, detection of the reference point cam.

For the selected window :

- In **zone 2**, commands
  - ④ Sending commands, acknowledgment of faults, generation of events
  - ⑤ Visually move in a negative or positive direction : pressing the command activates the movement, pressing the command again deactivates the movement.

For the Multi-Group operation function :

- ⑥ Buttons to open groups, to re-arrange groups, to exit the screen and to call up help. The use of these buttons is described on the opposite page.

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Selecting groups

When the software is opened :

- If no single axis group is selected, a group selection window appears. This window is identical to that of the open function in the Group menu. Then select the group and confirm the selection.
- If a single axis group is already selected, the group is automatically displayed on the screen.

To display another group, use the Open button. This accesses the list of groups (MOVEi OFB). Select the required single axis group and confirm.

Re-organization of the groups in the window

Select a window associated with a group. Move it using the mouse or the arrows and press the Arrange button to position the group correctly.

Removal of groups from the window

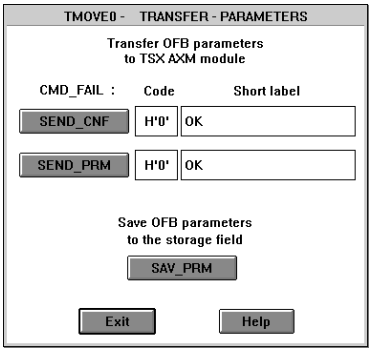
To delete the display of a group from the window, select the upper left hand corner of the corresponding window and select the "Close" option in the dialogue box which opens, or double click on the upper left hand corner of the corresponding window.

Note : For more details on the Multi-Group operation function see Section 13.2.

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17.6 Transfer menu

The **Adjust** menu writes the parameters to the ●MOVE OFB in the PL7-3 program in the PLC processor.
The **Transfer** menu transmits these parameters to the multi-axis control module (see diagram in Section 17.1).
For the transfer to be completed successfully the PLC must be in RUN mode and there must be no OFB system error.



Description of the commands

SEND_CNF Transmits all the configuration and operating (command, servo and error control) parameters to the module.

SEND_PRM Transmits the operating parameters only to the module.

SAVE_PRM Saves the operating parameters to the OFB constants zone.
The configuration parameters are automatically saved to the OFB constant zone, and the operating parameters are saved to the data memory. This operation thus ensures that there is constantly a backup in the memory, so that whenever the OFB is reinitialized the operating parameter values which have been entered are not lost.

Exit Closes the current screen.

If a coherence error between the various parameters is detected during the transfer an error code is displayed in the **Code** zone and a mnemonic error symbol is displayed in the **Short label** zone. To obtain more information on the error, press the **Help** key.

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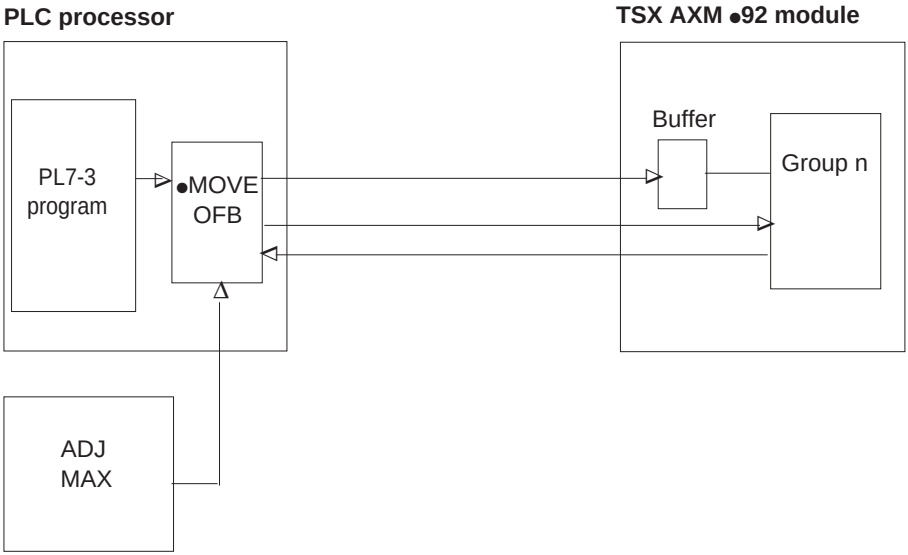
18.1 PLC processor / TSX AXM ●92 module data exchanges

18.1-1 General

The TSX AXM ●92 multi-axis control module can be accessed via the PLC program (or the ADJ MAX software) whatever operating mode is selected by the ●MOVE OFB :

- By programming the OFB inputs and by executing the OFB in automatic mode
- By writing internal data for the other operating modes.

The group sends back the operating status of the group and the axes.



In order to be able to execute commands from the program or the ADJ_MAX software, the PLC processor must be running (master task in RUN mode).

A ●MOVEi OFB controls a group j on a given module. The group/OFB relationship is established by the ADGROUP parameters. The axes which are operated by the group are defined in the ADAXIS parameter.

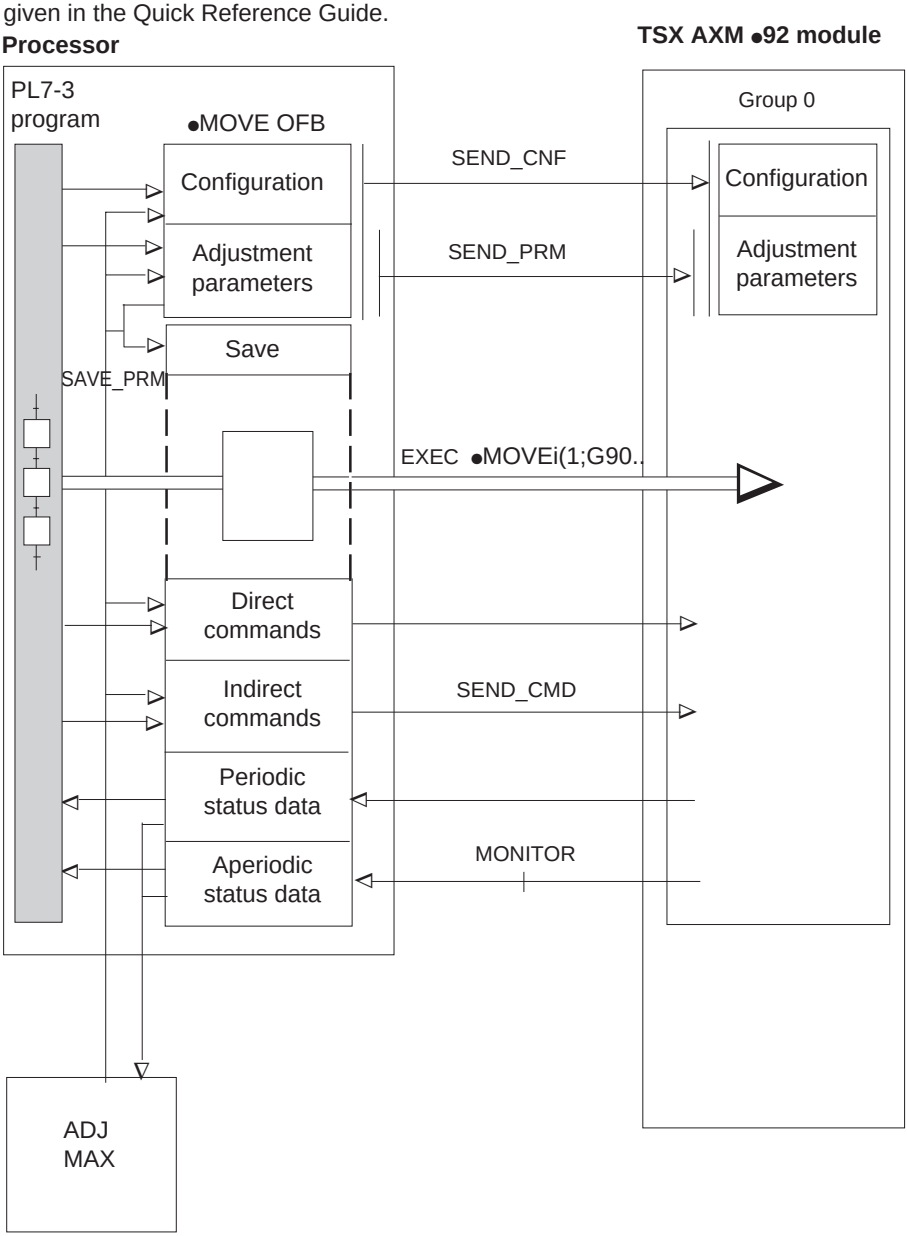
Comment : Although register words IW/OW exist, it is not advisable to use them.

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18.1-2 Diagram

The following diagram summarizes the various data exchanges between the PLC processor and the module. A complete description of the data which is exchanged is given in the Quick Reference Guide.



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18.1-3 Transmission of the configuration and adjustment parameters

The configuration and the adjustment parameters are transmitted :
- Via the ADJ MAX software using TRANSFER mode
- Automatically after a cold or warm restart
- Via the program by setting the ●MOVEi,SEND_CNF, bit to 1. The system resets the bit to 0.

It is possible to transmit the adjustment parameters only :
- Via the ADJ MAX software using TRANSFER mode
- Via the program by setting the ●MOVEi,SEND_PRM, bit to 1. The system resets the bit to 0.

The configuration is saved in the OFB constant zone. The adjustment parameters are saved in the data zone. To restore the contents after a cold restart, the OFB has a backup zone. The save command is executed :
- Via the ADJ MAX software using TRANSFER mode
- Via the program by setting the ●MOVEi,SAVE_PRM, bit to 1. The system resets the bit to 0.

At a cold restart (SY0), the contents of the backup zone are restored to the adjustment parameters data zone.

18.1-4 Transmission of movement commands in automatic mode

This is performed by executing the ●MOVEi OFBs in the PL7-3 program :

```
EXEC ●MOVEi (0;G90;G09;position;speed=>)
```

The transfer process is described in Section 8.2-6.

18.1-5 Transmission of direct access commands

This type of command can be executed :
- By the ADJ MAX software via the OPERATE menu, (manual command JOG_P, JOG_M, STOP, etc)
- Via the program by setting the command bit to 1 or 0, for example :

SET ●MOVEi,JOG_P
SET ●MOVEi,ACK_DEF.

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18.1-6 Transmission of indirect commands

This type of command can be executed :

- By the ADJ MAX software via the OPERATE menu. The commands to be executed are selected and their execution is started by the command SEND_CMD
- Via the program by setting the commands to be executed to 1 and setting the ●MOVEi,SEND_CMD, bit to 1. The system resets the bit to 0.

18.1-7 Reception of periodic status data

This data is updated at each master task cycle. It provides information on the status of the group or the axes associated with the OFB, (example ●MOVEi,AXIS_ERR, ●MOVEi,x_CALIB, etc)
This data can be tested by the program. Some of the data can be accessed by ADJ_MAX software.

18.1-8 Reception of aperiodic status data

This data is only updated at each master task cycle if the bit ●MOVEi,MONITOR is set to 1 either by the program or the ADJ MAX software. The data provides additional information on the execution of the program, monitors the movement, and application faults on each of the axes (example ●MOVEi,N_RUN, ●MOVEiSPEED, etc).
This data can be tested by the program. Some of the data can be accessed by ADJ_MAX software.

18.2 Internal operation

The internal operation is based on the execution of 2 tasks :

- A 20 ms internal master task, which performs the following functions :
  - reads the inputs
  - handles the commands and manages the operating modes
  - reads and interprets the movement commands
  - coordinates and interpolates the axes
  - generates the axis trajectories
  - checks for faults
  - processes and writes the outputs.
- A 5 ms internal fast task, which performs the following functions :
  - reads the current measurements for each axis and reads the setpoints
  - performs scaling
  - controls all the axes
  - writes the analog outputs.

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19.1 List of compatible SSI absolute encoders

The following encoders have been tested by Telemecanique.

Heidenhain encoders

- **ROC 424/235 730 24**
  24 volt, 24 bit, binary code, no parity
  TYPCOD = H'0180'

- **ROC 424/235 730 21**
  24 volt, 25 bit (of which 24 bits are used), Gray code, no parity
  TYPCOD = H'0186'

- **ROC 221/240 113 22**
  24 volt, 25 bit (of which 21 bits are used), binary code, no parity
  TYPCOD = H'3154'

Stegmann encoders

- **AG 661 01**
  24 volt, 24 bit, error bit, Gray code, no parity
  TYPCOD = H'0186'

IVO encoders

- **GM 401.140R202000**
  24 volt, 24 bit, error bit, Gray code, no parity
  TYPCOD = H'0186'

- **GM 400.020a001**
  24 volt, 24 bit, no error bit, Gray code, no parity
  TYPCOD = H'0182'

TWK encoders

- **CRE 65-4096G24E02**
  24 volt, 24 bit, Gray code
  TYPCOD = H'0182'

- **CRE 65-4096G4096XPE03**
  24 volt, 24 bit, Gray code
  TYPCOD = H'0182'

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Absolute encoder Encoder whose range of measurement is divided into a finite number of equal elementary spaces which are each given a single coded marker.

Axis Motor/speed drive/mechanism combination which controls the movement of a moving part in a given direction (axis, linear movement) or around a fixed rotation axis (rotating axis, circular movement).

Axis referenced Module status once the reference point has been set. Position measurements are only significant and movements are only permitted in this state.

Cartesian machine
Machine which can handle linear movements (two or three). The movement axes are orthogonal.

Deviation Difference between the position reference and the measurement during a movement.

Direction discriminator
A microprogrammed system which determines the direction of movement of the moving part.

Emergency stop Movement stop with maximum deceleration.

Event A change of state of the event input or the EVENT bit which is accessed by the program.

Feedforward gain (KV)
A coefficient used to adjust the speed anticipation of the position control loop (a compromise between the deviation and the stop point overshoot).

Forced reference point setting
Procedure for loading the current position measurement at a preset value. This operation references the axis.

Gray code Binary code which is said to be reflected, in which term n is changed to term n+1 without changing any digits. The code can thus be read without any ambiguity.

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Incremental encoder

Pulse generator with two 90° phase-shifted signals.

Independent multi-axis

The movement rule is applied independently to each axis. The axes start at the same time, and move at a reference speed, the duration of the movement depends on the distance to be travelled. The "axes" do not arrive at the same time. The movement in space can be of any type. The objective is to reach the target marker without the restriction of a trajectory.

Interpolation One of the roles of axis control is to coordinate the movements of the machine axes, so that the programmed trajectory is created. The interpolation function generates this trajectory while keeping to the programmed speed. It can be linear or circular, two or three-dimensional

ISO International Standard Organization. The ISO code is widely used. The formats, symbols and transmission rules are the subject of the ISO standards. AFNOR is a member of the ISO.

Lower soft stop Lower position measurement which the moving part must not pass below (set by the command parameter x_SLMIN).

Machine characteristic coefficient (KR)

Machine parameter adaptation coefficient. A self-adjustment procedure is used to add precision to the value and avoid any possible loss of precision in the definition of the machine parameters.

Machine reference point

Machine axis measurement reference point.

Mechanical cam Mechanical projection on an axis which actuates a limit switch when the moving part passes over it.

Movement A series of elementary movements.

Movement law This is the rule of variation in position, speed and acceleration references. It is often illustrated by the curve :
speed = F (time). In an increasing order of complexity there are : rectangular, triangular, trapezoid, parabolic and sine squared laws.

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Multi-axis machine (robot)

Mechanical assembly for managing the movement and orientation of a moving part in a multi-dimensional space.

Non-cartesian machine

Machine with axes, at least one of which is rotating, or with a pair of non-orthogonal linear axes. The machine may therefore have more than 3 degrees of freedom (generally 4 to 6).

Parametered indexed position (PREF)

Index value for calculating indexed positions.
Absolute position = index (PREF) + indexed position

Reference point setting

Procedure for loading the current position measurement by moving the moving part and detection of the external event (reference point input and/or cam input).

Resolution Smallest variation of input data which provides measurable information on the output data.

Return from soft stop overshoot

After a soft stop overshoot, automatic movement of the moving part at low speed in order to return to within the soft stops.

Servo control Control system function which consists of making a physical measurement conform to a fixed or variable reference (position control, speed control, etc).

Speed correction coefficient

A coefficient which multiplies all speeds by a value of 0 to 2 in steps of 1/1000.

Speed reference Theoretical speed of the moving part calculated by the module using the maximum acceleration rule and the programmed speed.

Synchronized multi-axis / free trajectory generator

The same movement law is applied to all the axes. The speed of each axis is adjusted so that all the axes arrive at the target marker at the same time. If a cartesian machine is used, the result is a linear movement, otherwise the movement can of be any type.

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Target window Positioning tolerance around the stop point.

Trajectory Series of elementary movements which pass through intermediate markers between a start marker and a target marker. The movement between the two markers is executed at an appropriate speed or in an appropriate time.

Upper soft stop Upper position measurement which the moving part must not exceed (set by the command parameter x_SLMAX).

Valid measurement area
Set of measurement points between the two soft stops.

Zero mark Pulse supplied by a rotary incremental encoder. It is detected on each complete axis revolution.

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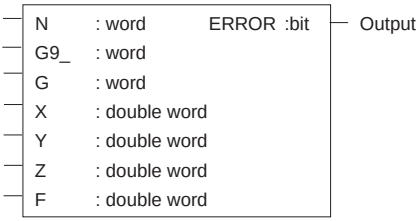
21.1 Quick Reference Guide

Programming

TMOVEi

OFB TMOVE

Inputs



EXEC TMOVEi (N;G9_;G;X;Y;Z;F=>)

where

i = OFB number from 0 to M-1 (M being the usage number declared at CONFIGURATION).

N = number identifying the movement performed by the OFB, identifies the current movement in debug mode.

G9_ = type of movement

G90 movement to an absolute position value
G91 movement to a relative value with respect to the current position.

G = instruction code

G09 : move to the position and stop
G01 : move to the position without stopping
G10 : move until an event is detected and stop
G11 : move until an event is detected without stopping
G14 : reference point on axis X
G15 : reference point on axis Y
G16 : reference point on axis Z
G20 : reserved for the system
G24 : recalibration on the fly (1)
G53 : cancel the PREF offset
G54 : validate the PREF offset
G62 : forced reference point (1)
G05 : await an event
G07 : memorize the current position in PREF when an event occurs

X, Y, Z = coordinates of the position to be reached or towards which the moving part must move.

The unit in which these values are expressed is defined by the configuration parameter UNIT (this parameter is set using ADJ MAX software) :
- µm (unit selected by default)
- 10^{-5} inch
- 10^{-5} degree
- increment

F = speed of movement of the moving part. The unit of speed depends on the selected position unit.

- µm (unit selected by default)	-->	mm/min
- 10^{-5} inch	-->	cinch/min
- 10^{-5} degree	-->	cdeg/min
- increment	-->	increments /s

(1) available from software version 1.2 onwards

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Configuration constants (transfer using SEND_CNF)

Group level constants

word **ADGROUP** = H'• • • •'



word **ADAXIS** = H'• • • •'



word **UNIT** user unit (1=µm,2=10^{-5}inch, 3=10^{-5}degree, 4=increment)

Ar_char **LABEL** application name in 20 characters

Axis level constants

word **x_INVERT** measurement and/or reference inversion : 0=none, 1= meas.inv., 2=ref. inv., 3=meas.+ref.inv.

word **x_TYPCOD** type of input encoder : incremental or absolute : 0=incr. with x4, 1=incr. with x1

H'• • • •' = absolute encoder



word **x_TYPRP** type of reference point

H'00 • •'



dword **x_VMAX** maximum speed of moving part on this axis

word **x_UMAX** maximum voltage which can be applied at the analog output

word **x_RESOL** encoder resolution

dword **x_LMAX** axis maximum upper limit

dword **x_LMIN** axis minimum lower limit

dword **x_ACCMAX** maximum acceleration value

dword **x_DECMAX** maximum deceleration value

ar_word **x_KR** KR value for axis X

Operating parameters (transfer using SEND_CNF or SEND_PRM)

Command parameters

dword **x_SLMAX** current upper soft stop limit

dword **x_SLMIN** current lower soft stop limit

dword **x_ACC** acceleration value

dword **x_DEC** deceleration value

word **x_SLOPE** slope of trapezoid acceleration profile

dword **x_FHIGH** high speed value in manual mode

dword **x_FLOW** low speed value in manual mode

dword **x_VALRP** reference point value in manual mode

Servo parameters

word **x_KPOS** position loop gain

word **x_CKPOS** ratio between KPOS1 / KPOS2

word **x_KV** feedforward gain

word **x_LIMV** limitation of the setpoint speed

word **x_OFFSET** D/A converter offset

Error control parameters

dword **x_DMAX1** position error threshold (1: safety error threshold)

dword **x_DMAX2** position error threshold (2: threshold for maintenance)

dword **x_TW** target window

word **x_VSTOP** stop speed

word **x_TSTOP** maximum time delay for detection of stop

word **x_FEXCES** overspeed threshold

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Internal command data

Commands with transmission of command SEND_CMD

Operating commands (linked to the axis number : AXIS_NB)

bit	**INC_P**	incremental positive direction movement command (PARAM)
bit	**INC_M**	incremental negative direction movement command (PARAM)
bit	**SETRP_P**	set manual reference point, on a given axis, in a positive direction (x_VALRP = reference point value)
bit	**SETRP_M**	set manual reference point, on a given axis, in a negative direction (x_VALRP = reference point value)
bit	**RP_HERE**	set forced reference point to a value defined in PARAM
bit	**HOMING**	command to move to reference position (x_VALRP = reference point value)
bit	**SLRETURN**	command to return from soft stop overshoot (linked to AXIS_NB)

Types of operation :

bit	**AUTO**	selection of Automatic / Manual mode for the execution of commands
bit	**SIMUL**	command to change to simulation of auto commands
bit	**HIGH_F**	selection of manual speed of movement (x_FHIGH or x_FLOW)
bit	**DRV_OFF**	change to measurement mode, inhibition of D/A converter output
bit	**DIRDRIVE**	command to move in servo off mode, direct control of voltage (linked to AXIS_NB),
word	**AXIS_NB (*)**	selection of the axis number for single axis commands
dword	**PARAM**	position reference value in manual mode, actual distance for adjusting KR
dword	**DISTANCE**	distance for adjusting KR

Commands without transmission of command SEND_CMD

Indirect commands :

bit	**SEND_CNF**	transmission of configuration constants and operating parameters to the module
bit	**SEND_PRM**	transmission of operating parameters to the module
bit	**SAVE_PRM**	command to save the operating parameters in the OFB internal constants
bit	**SEND_CMD**	order to accept a command
bit	**MONITOR**	command to read aperiodic status data on the group of axes.

Direct commands :

bit	**STOP**	command to stop the group immediately (stop moving part)
bit	**PAUSE**	command to stop movements at the end of the current movement
bit	**JOG_P**	unlimited movement in manual mode in a positive direction (linked to AXIS_NB)
bit	**JOG_M**	unlimited movement in manual mode in a negative direction (linked to AXIS_NB)
bit	**ACK_DEF**	acknowledgment of group faults
bit	**ENABLE**	enabling of speed drive safety relays on the axes in the group
bit	**EVENT**	command to generate an event
bit	**NEW_KR**	command to adjust KR (linked to AXIS_NB)

Local commands :

bit	**INHIB**	inhibits the ERROR output on the OFB

Types of operation :

word	**CMV**	value of the speed modulation reference from 0 to 2 in stops of 1/1000
bit	**SAFE_OFF**	operation of the group with safety off (remains in RUN mode when the PLC is in STOP mode)

(*) Does not exist on MOVE function block

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Internal status data

Aperiodic group status data (updated each cycle) :

bit	**ERROR**	ERROR output on OFB
bit	**CONF**	the group is configured
bit	**OK**	no fault causing the moving part to stop
dword	**CMD_FAIL**	contains the command failure code : (4 bytes) • configuration parameters (byte 3) • command parameters (byte 2) • operating commands (byte 1) • ability to execute commands (byte 0)
bit	**AXIS_ERR**	presence of an application fault
bit	**HARD_ERR**	presence of an external hardware fault
word	**STATUS 0**	group fault status :
	STATUS 0,0	group out of service
	STATUS 0,1	reserved
	STATUS 0,2	I/O fault
	STATUS 0,3	logic OR of hardware faults on axis X
	STATUS 0,4	logic OR of hardware faults on axis Y
	STATUS 0,5	logic OR of hardware faults on axis Z
	STATUS 0,6	logic OR of application faults on axis X
	STATUS 0,7	logic OR of application faults on axis Y
	STATUS 0,8	logic OR of application faults on axis Z
	STATUS 0,9	
	STATUS 0,A	
	STATUS 0,B	ability to execute command failure
	STATUS 0,C	operating mode command failure
	STATUS 0,D	parameter command failure
	STATUS 0,E	configuration command failure
	STATUS 0,F	OFB system error
bit	**x_CALIB**	reference point set on axis x
dword	**x_POS**	position measured on axis x
bit	**x_DIRECT**	indicates the direction of movement
bit	**x_EVENT**	copies the physical event inputs
bit	**x_CAM**	copies the CAM physical input on the module
dword	**x_PREF**	current measurement value, memorized when an event occurs
bit	**ST_PREF**	active reference point offset PREF
bit	**ABS_INC**	internal state of the interpretation of commands 1 = absolute command G90, 0 = relative command G91
bit	**ST_PAUSE**	group pause status
bit	**AT_POINT**	moving part positioned on target (in target window, on an instruction with stop)
bit	**TH_POINT**	theoretical reference point reached
bit	**NEXT**	group ready to receive a new movement command (in AUTO mode)
bit	**DONE**	all the instructions have been executed : no more instructions in the stack
bit	**NOMOTION**	moving part stationary

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Internal status data (continued)

Aperiodic status data (updated each cycle if **MONITOR** bit is at 1)

word	**N_RUN**	contains the number of the program step which is being executed
word	**COD_EXEC**	instruction code being executed
dword	**x_TARGET**	current value of the position command (target to be reached)
dword	**F_TARGET**	target movement speed

dword	**SPEED**	measured speed
dword	**x_DEV**	position error value
dword	**x_MAXDEV**	maximum position error on the whole command movement.

word	**STATUS1**	word characterizing axis X fault status
word	**STATUS2**	word characterizing axis Y fault status
word	**STATUS3**	word characterizing axis Z fault status

Hardware faults

STATUSi,0	emergency stop fault URGSTOP
STATUSi,1	speed drive fault VAR
STATUSi,2	encoder wiring break fault CODRUP
STATUSi,3	encoder contamination fault CODSAL
STATUSi,4	short-circuit fault on CCANA analog output

Application faults

STATUSi,5	soft stop fault SLMAX	Blocking faults
STATUSi,6	soft stop fault SLMIN	
STATUSi,7	overspeed fault F_EXCES	
STATUSi,8	position error fault DMAX1	
STATUSi,9	target window fault TW	
STATUSi,A	stop fault STOP	
STATUSi,B	position error fault DMAX2	
STATUSi,C		
STATUSi,D		
STATUSi,E		
STATUSi,F		

Where i = 1 to 3

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Saved adjustment parameters (saved using SAV_PRM)

The saved adjustment parameters correspond to the values of the COMMAND/SERVO/ERROR CONTROL parameters which are saved in the OFB constant memory (see Section 11.5, Part D). These are the initial values transmitted to the adjustment parameters on a cold restart of the PLC processor.
Each saved parameter has the same name as the associated adjustment parameter, with the addition of $ (except for x_OFFSET --> x_OFFSE$ and x_FEXCES --> x_FEXCE$).

Command parameters

dword	**x_SLMAX$**	current upper soft stop limit
dword	**x_SLMIN$**	current lower soft stop limit
dword	**x_ACC$**	acceleration value
dword	**x_DEC$**	deceleration value
word	**x_SLOPE$**	slope of trapezoid acceleration profile
dword	**x_FHIGH$**	high speed value in manual mode
dword	**x_FLOW$**	low speed value in manual mode
dword	**x_VALRP$**	reference point value in manual mode

Servo parameters

word	**x_KPOS$**	position loop gain
word	**x_CKPOS$**	ratio between KPOS1 / KPOS2
word	**x_KV$**	feedforward gain
word	**x_LIMV$**	limitation of the setpoint speed
word	**x_OFFSE$**	D/A converter offset

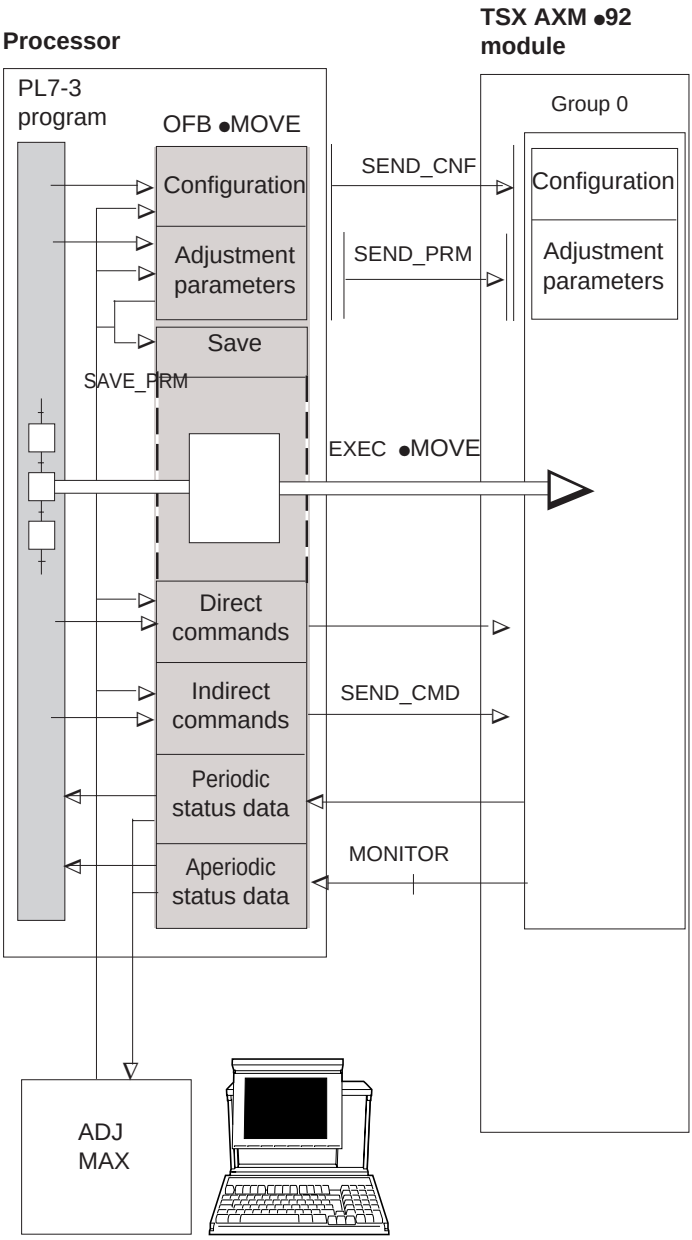
Error control parameters

dword	**x_DMAX1$**	position error threshold (1: safety error threshold)
dword	**x_DMAX2$**	position error threshold (2: threshold for maintenance)
dword	**x_TW$**	target window
word	**x_VSTOP$**	stop speed
word	**x_TSTOP$**	maximum time delay for detection of stop
word	**x_FEXCE$**	overspeed threshold

Comment : parameters SAV30 (for the MOVE OFB) and SAV88 (for the TMOVE OFB) are reserved system words.

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Summary of data exchanges



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22.1 List of CMD_FAIL error codes

A list of messages explaining the CMD_FAIL double word is given in the following pages.

The •MOVEi,CMD_FAIL double word is broken down into four bytes : O3 O2 O1 O0. This double word is :

- clearly interpreted by ADJ_MAX software (error code + online help),
- can be interpreted by PL7-3 once double word •MOVEi,CMD_FAIL->DWzz has been transferred.

Each byte corresponds to a specific class of error.

Wx	O1=Change of mode	O0=Movement command
Wx+1	O3 =Configuration	O2=Group parameters
	Most significant byte	Least significant byte

O3: error occurs during CONFIGURATION. (XX000000)
O2: error occurs during analysis of GROUP PARAMETERS. (00XX0000)
O1: error occurs during analysis of CHANGE OF MODE.(0000XX00)
O0: error in the MOVEMENT COMMAND PARAMETERS. (000000XX):

Example : **00000200**



Byte Nbr1 : Change of mode error
(code 02 =a command with order SEND_CMD has been received for a non configured group)

The meanings of other STATUS0,..3 bits and words relating to the errors are described at the end of this section.

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The text given for this family is that which will be displayed in the form of "short text" in ADJ_MAX (transfer screen). The ERR_SYSTEM text should never occur during normal operation of the module.

ERRORS DURING CONFIGURATION (XX000000)

ERR_SYSTEM **01000000**
The appearance of this message is abnormal. Error transferring configuration parameters (limits, sizes, etc).

ERR_ADAXIS **02000000**
The coding for the assignment of physical axes to the logical axes is incorrect (ADAXIS parameter).

ERR_AXE_X_BUSY **03000000**
This axis (X) has already been reserved by constituting another group (ADAXIS parameter).

ERR_AXE_Y_BUSY **04000000**
This axis (Y) has already been reserved by constituting another group (ADAXIS parameter).

ERR_AXE_Z_BUSY **05000000**
This axis (Z) has already been reserved by constituting another group (ADAXIS parameter).

ERR_NUM_AXE_X **06000000**
Illegal physical axis number specified for X (ADAXIS parameter)

ERR_NUM_AXE_Y **07000000**
Illegal physical axis number specified for Y (ADAXIS parameter)

ERR_NUM_AXE_Z **08000000L**
Illegal physical axis number specified for Z (ADAXIS parameter)

NON EXISTENT **09000000**
NON EXISTENT **0a000000**
NON EXISTENT **0b000000**
Message generated by ADJ_MAX: ERR_SYSTEM.

ERR_TYP_UNIT **0c000000**
This UNIT configuration parameter comprises an illegal value (it must be between 1 and 4).

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ERR_INVERT_X **0d000000**
The X_INVERT parameter comprises an illegal value (it must be between 0 and 3).

ERR_INVERT_Y **0e000000**
The Y_INVERT parameter comprises an illegal value (it must be between 0 and 3).

ERR_INVERT_Z **0f000000**
The Z_INVERT parameter comprises an illegal value (it must be between 0 and 3).

ERR_TYP_COD_X **10000000**
The encoder type specification is illegal for axis X.

ERR_TYP_COD_Y **11000000**
The encoder type specification is illegal for axis Y.

ERR_TYP_COD_Z **12000000**
The encoder type specification is illegal for axis Z.

ERR_RESOL_COD_X **13000000**
Parameter X_RESOL out of range.
The range for parameter X_RESOL is: 1..1000 in metric and angular units, 4..4000 in imperial units, 1 in increments.

NON EXISTENT **14000000**
NON EXISTENT **15000000**
NON EXISTENT **16000000**
Message generated by ADJ_MAX: ERR_SYSTEM.

ERR_RESOL_COD_Y **17000000**
Parameter Y_RESOL out of range.
The range for parameter Y_RESOL is: 1..1000 in metric and angular units, 4..4000 in imperial units, 1 in increments.

NON EXISTENT **18000000**
NON EXISTENT **19000000**
NON EXISTENT **1a000000**
Message generated by ADJ_MAX: ERR_SYSTEM.

ERR_RESOL_COD_Z **1b000000**
Parameter Z_RESOL out of range.
The range for parameter Z_RESOL is: 1..1000 in metric and angular units, 4..4000 in imperial units, 1 in increments.

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NON EXISTENT **1c000000**
NON EXISTENT **1d000000**
NON EXISTENT **1e000000**
Message generated by ADJ_MAX: ERR_SYSTEM.

ERR_CAM_X **1f000000**
The value of configuration parameter X_TYPRP is illegal.

ERR_CAM_Y **20000000**
The value of configuration parameter Y_TYPRP is illegal.

ERR_CAM_Z 21000000L
The value of configuration parameter Z_TYPRP is illegal.

ERR_VMAX_X **22000000**
X_VMAX out of range.
Maximum speed specified for X (X_VMAX) is incompatible with the limits: 600..540000 in metric and angular units, 2400...2160000 in imperial units and 10000..900000 in increments.

NON EXISTENT **23000000**
NON EXISTENT **24000000**
NON EXISTENT **25000000**
Message generated by ADJ_MAX: ERR_SYSTEM.

ERR_VMAX_Y **26000000**
Y_VMAX out of range.
Maximum speed specified for Y (X_VMAX) is incompatible with the limits: 600..540000 in metric and angular units, 2400...2160000 in imperial units and 10000..900000 in increments.

NON EXISTENT **27000000**
NON EXISTENT **28000000**
NON EXISTENT **29000000**
Message generated by ADJ_MAX: ERR_SYSTEM

ERR_VMAX_Z **2a000000**
Z_VMAX out of range.
Maximum speed specified for X (X_VMAX) is incompatible with the limits: 600..540000 in metric and angular units, 2400...2160000 in imperial units and 10000..900000 in increments.

NON EXISTENT **2b000000**
NON EXISTENT **2c000000**
NON EXISTENT **2d000000**
Message generated by ADJ_MAX: ERR_SYSTEM

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ERR_UMAX_VAL_X **2e000000**
The maximum voltage specified for X (X_UMAX) is out of range (1000..9000).

ERR_UMAX_VAL_Y **2f000000**
The maximum voltage specified for Y (X_UMAX) is out of range (1000..9000).

ERR_UMAX_VAL_Z **30000000**
The maximum voltage specified for X (X_UMAX) is out of range (1000..9000).

ERR_RANGE_LMIN_OR_LMAX_X**31000000**
Soft stops for X: X_LMIN or X_LMAX out of range (they depend on the type of units selected).

ERR_LMIN_SUP_LMAX_X **32000000**
Lower soft stop (X_LMIN) greater than the higher soft stop (X_LMAX) for axis X.

ERR_RANGE_LMIN_OR_LMAX_Y**33000000**
Soft stops for Y: Y_LMIN or Y_LMAX out of range (they depend on the type of units selected).

ERR_LMIN_SUP_LMAX_Y **34000000**
Lower soft stop (Y_LMIN) greater than the higher soft stop (Y_LMAX) for axis Y.

ERR_RANGE_LMIN_OR_LMAX_Z**35000000**
Soft stops for Z: Z_LMIN or Z_LMAX out of range (they depend on the type of units selected).

ERR_LMIN_SUP_LMAX_Z **36000000**
Lower soft stop (Z_LMIN) greater than the higher soft stop (Z_LMAX) for axis Z.

ERR_RANGE_DECMAX_X **37000000**
Maximum deceleration for X (X_DECMAX) is incompatible (out of range) with parameters X_VMAX and X_RESOL.

ERR_RANGE_ACCMAX_X **38000000**
Maximum acceleration for X (X_ACCMAX) is incompatible (out of range) with parameters X_VMAX and X_RESOL.

ERR_RANGE_DECMAX_Y **39000000**
Maximum deceleration for Y (Y_DECMAX) is incompatible (out of range) with parameters Y_VMAX and Y_RESOL.

ERR_RANGE_ACCMAX_Y **3a000000**
Maximum acceleration for Y (Y_ACCMAX) is incompatible (out of range) with parameters Y_VMAX and Y_RESOL.

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ERR_RANGE_DECMAX_Z **3b000000**
Maximum deceleration for Z (Z_DECMAX) is incompatible (out of range) with parameters Z_VMAX and Z_RESOL.

ERR_RANGE_ACCMAX_Z **3c000000**
Maximum acceleration for Z (Z_ACCMAX) is incompatible (out of range) with parameters Z_VMAX and Z_RESOL.

ERR_PRM_KR_X **3d000000**
The value specified for the constant X_KR is invalid.
Force X_KR to H'FF..FF'.

ERR_PRM_KR_Y **3e000000**
The value specified for the constant Y_KR is invalid.
Force Y_KR to H'FF..FF'.

ERR_PRM_KR_Z **3f000000**
The value specified for the constant Z_KR is invalid.
Force Z_KR to H'FF..FF'.

ERR_FAIL_CONF_CODABS_X **40000000**
Mixing encoder types.
Attempting to configure axis X for an absolute encoder when at least one incremental encoder was previously configured for the module.

ERR_FAIL_CONF_CODABS_Y **41000000**
Mixing encoder types.
Attempting to configure axis Y for an absolute encoder when at least one incremental encoder was previously configured for the module.

ERR_FAIL_CONF_CODABS_Z **42000000**
Mixing encoder types.
Attempting to configure axis Z for an absolute encoder when at least one incremental encoder was previously configured for the module.

ERR_FAIL_CONF_CODINC_X **43000000**
Mixing encoder types.
Attempting to configure axis X for an incremental encoder when at least one absolute encoder was previously configured for the module.

ERR_FAIL_CONF_CODINC_Y **44000000**
Mixing encoder types.
Attempting to configure axis Y for an incremental encoder when at least one absolute encoder was previously configured for the module.

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ERR_FAIL_CONF_CODINC_Z **45000000**
Mixing encoder types.
Attempting to configure axis Z for an incremental encoder when at least one absolute encoder was previously configured for the module.

ERR_FAIL_MAX_CODABS **46000000**
Too many axes with absolute encoders.
The maximum number of absolute encoders that can be configured is exceeded. A TSX AXM 492 module will accept a maximum of three absolute or four incremental encoders.

ERR_FAIL_WAIT_CONF **47000000**
Group not configured, waiting for command SEND_CONF.

The text given for this family is that which will be displayed in the form of short text in ADJ_MAX (transfer screen). The ERR_SYSTEM text should never occur during normal operation of the module.

GROUP PARAMETER ANALYSIS ERRORS (00XX0000)

ERR_SYSTEM **00010000**
The appearance of this message is abnormal. Error transferring adjustment parameters to the module (limits, sizes, etc).

ERR_SYSTEM **00020000**
The appearance of this message is abnormal. Problem sending adjustable parameters to the module, the command received is incorrect or SEND_PRM is received when the processing linked to the previous SEND_PRM is not finished.

NON EXISTENT **00030000**
Message generated by ADJ_MAX: ERR_SYSTEM

ERR_SYSTEM **00040000**
The appearance of this message is abnormal. Problem on the axis number.

ERR_FAIL_PRM_SLOPE_X **00050000**
The X_SLOPE parameter must be between 0 and 255.

ERR_FAIL_PRM_SLOPE_Y **00060000**
The Y_SLOPE parameter must be between 0 and 255.

ERR_FAIL_PRM_SLOPE_Z **00070000**
The Z_SLOPE parameter must be between 0 and 255.

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ERR_FAIL_PRM_SLMAX_X **00080000**
X_SLMAX must be between X_LMIN and X_LMAX.

ERR_FAIL_PRM_SLMAX_Y **00090000**
Y_SLMAX must be between Y_LMIN and Y_LMAX.

ERR_FAIL_PRM_SLMAX_Z **000a0000**
Z_SLMAX must be between Z_LMIN and Z_LMAX.

ERR_FAIL_PRM_SLMIN_X **000b0000**
X_SLMIN must be between X_LMIN and X_LMAX.

ERR_FAIL_PRM_SLMIN_Y **000c0000**
Y_SLMIN must be between Y_LMIN and Y_LMAX.

ERR_FAIL_PRM_SLMIN_Z **000d0000**
Z_SLMIN must be between Z_LMIN and Z_LMAX.

ERR_FAIL_PRM_SLMI_SLMA_X **000e0000**
X_SLMIN is greater than X_SLMAX.

ERR_FAIL_PRM_SLMI_SLMA_Y **000f0000**
Y_SLMIN is greater than Y_SLMAX.

ERR_FAIL_PRM_SLMI_SLMA_Z **00100000**
Z_SLMIN is greater than Z_SLMAX.

ERR_FAIL_PRM_ACC_X **00110000**
Parameter X_ACC is not between 10 (2500 in incremental units) and the configured X_ACCMAX value.

ERR_FAIL_PRM_ACC_Y **00120000**
Parameter Y_ACC is not between 10 (2500 in incremental units) and the configured Y_ACCMAX value.

ERR_FAIL_PRM_ACC_Z **00130000**
Parameter Z_ACC is not between 10 (2500 in incremental units) and the configured Z_ACCMAX value.

ERR_FAIL_PRM_DEC_X **00140000**
Parameter X_DEC is not between 10 (2500 in incremental units) and the configured X_DECMAX value.

ERR_FAIL_PRM_DEC_Y **00150000**
Parameter Y_DEC is not between 10 (2500 in incremental units) and the configured Y_DECMAX value.

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ERR_FAIL_PRM_DEC_Z **00160000**
Parameter Z_DEC is not between 10 (2500 in incremental units) and the configured Z_DECMAX value.

ERR_FAIL_PRM_VALRP_X **00170000**
X_VALRP not between X_SLMIN and X_SLMAX.

ERR_FAIL_PRM_VALRP_Y **00180000**
Y_VALRP not between Y_SLMIN and Y_SLMAX.

ERR_FAIL_PRM_VALRP_Z**00190000**
Z_VALRP not between Z_SLMIN and Z_SLMAX.

ERR_FAIL_PRM_FHIGH_X **001a0000**
Manual high speed for X out of range: X_FHIGH must be between FLOW and X_VMAX.

ERR_FAIL_PRM_FHIGH_Y **001b0000**
Manual high speed for Y out of range: Y_FHIGH must be between FLOW and Y_VMAX.

ERR_FAIL_PRM_FHIGH_Z **001c0000**
Manual high speed for Z out of range: Z_FHIGH must be between FLOW and Z_VMAX.

ERR_FAIL_PRM_FLOW_X **001d0000**
Manual low speed for X out of range: X_FLOW must be between 10 and X_VMAX/2.

ERR_FAIL_PRM_FLOW_Y **001e0000**
Manual low speed for X out of range: Y_FLOW must be between 10 and Y_VMAX/2.

ERR_FAIL_PRM_FLOW_Z **001f0000**
Manual low speed for X out of range: Z_FLOW must be between 10 and Z_VMAX/2.

NON EXISTENT **00200000**
NON EXISTENT **00210000**
NON EXISTENT **00220000**
Message generated by ADJ_MAX: ERR_SYSTEM.

ERR_FAIL_PRM_KPOS_X **00230000**
X_KPOS gain out of range.
The position gain X_KPOS for axis X was specified out of the entry range, 100 and 6400 (in decimal notation).

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ERR_FAIL_PRM_KPOS_Y **00240000**
Y_KPOS gain out of range.
The position gain Y_KPOS for axis Y was specified out of the entry range, 100 and 6400 (in decimal notation).

ERR_FAIL_PRM_KPOS_Z **00250000**
Z_KPOS gain out of range.
The position gain Z_KPOS for axis Z was specified out of the entry range, 100 and 6400 (in decimal notation).

ERR_FAIL_PRM_CKPOS_X **00260000**
X_CKPOS gain ratio out of range.
The position gain ratio X_CKPOS for axis X was specified out of range, 1 and 64 (in decimal notation).

ERR_FAIL_PRM_CKPOS_Y **00270000**
Y_CKPOS gain ratio out of range.
The position gain ratio Y_CKPOS for axis Y was specified out of range, 1 and 64 (in decimal notation).

ERR_FAIL_PRM_CKPOS_Z **00280000**
Z_CKPOS gain ratio out of range.
The position gain ratio Z_CKPOS for axis Z was specified out of range, 1 and 64 (in decimal notation).

ERR_FAIL_PRM_KV_X **00290000**
X_KV gain out of range.
The speed feed-forward percentage X_KV for axis X was specified out of range, 0 to 100 (in decimal notation).

ERR_FAIL_PRM_KV_Y **002a0000**
Y_KV gain out of range.
The speed feed-forward percentage Y_KV for axis Y was specified out of range, 0 to 100 (in decimal notation).

ERR_FAIL_PRM_KV_Z **002b0000**
Z_KV gain out of range.
The speed feed-forward percentage Z_KV for axis Z was specified out of range, 0 to 100 (in decimal notation).

ERR_FAIL_PRM_LIMV_X **002c0000**
X_LIMV limit out of range.
The speed limit X_LIMV for axis X was specified out of range, 2 to 20 (in decimal notation).

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ERR_FAIL_PRM_LIMV_Y **002d0000**
Y_LIMV limit out of range.
The speed limit Y_LIMV for axis Y was specified out of range, 2 to 20 (in decimal notation).

ERR_FAIL_PRM_LIMV_Z **002e0000**
Z_LIMV limit out of range.
The speed limit Z_LIMV for axis Z was specified out of range, 2 to 20 (in decimal notation).

ERR_FAIL_PRM_FEXCES_X **002f0000**
X_FEXCES threshold out of range.
The X_FEXCES overspeed threshold for axis X was specified out of range, 0 to 20 (in decimal notation).

ERR_FAIL_PRM_FEXCES_Y **00300000**
Y_FEXCES threshold out of range.
The Y_FEXCES overspeed threshold for axis Y was specified out of range, 0 to 20 (in decimal notation).

ERR_FAIL_PRM_FEXCES_Z **00310000**
Z_FEXCES threshold out of range.
The Z_FEXCES overspeed threshold for axis Z was specified out of range, 0 to 20 (in decimal notation).

ERR_FAIL_PRM_DMAX1_X **00320000**
X_DMAX1 threshold out of range.
The (safety) position error threshold X_DMAX1 for axis X was specified out of range, 0 to (X_SLMAX-X_SLMIN)/2.

ERR_FAIL_PRM_DMAX1_Y **00330000**
Y_DMAX1 threshold out of range.
The (safety) position error threshold Y_DMAX1 for axis Y was specified out of range, 0 to (Y_SLMAX-Y_SLMIN)/2.

ERR_FAIL_PRM_DMAX1_Z **00340000**
Z_DMAX1 threshold out of range.
The (safety) position error threshold Z_DMAX1 for axis Z was specified out of range, 0 to (Z_SLMAX-Z_SLMIN)/2.

ERR_FAIL_PRM_DMAX2_X **00350000**
X_DMAX2 threshold out of range.
The (maintenance) position error threshold X_DMAX2 for axis X was specified out of range, 0 to (X_SLMAX-X_SLMIN)/2.

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ERR_FAIL_PRM_DMAX2_Y **00360000**
Y_DMAX2 threshold out of range.
The (maintenance) position error threshold Y_DMAX2 for axis Y was specified out of range, 0 to (Y_SLMAX-Y_SLMIN)/2.

ERR_FAIL_PRM_DMAX2_Z **00370000**
Z_DMAX2 threshold out of range.
The (maintenance) position error threshold Z_DMAX2 for axis Z was specified out of range, 0 to (Z_SLMAX-Z_SLMIN)/2.

ERR_FAIL_PRM_TW_X **00380000**
Parameter X_TW out of range.
The target window parameter X_TW (distance) for axis X was specified out of range. The valid range is 0 to (X_SLMAX-X_SLMIN)/10.

ERR_FAIL_PRM_TW_Y **00390000**
Parameter Y_TW out of range.
The target window parameter Y_TW (distance) for axis Y was specified out of range. The valid range is 0 to (Y_SLMAX-Y_SLMIN)/10.

ERR_FAIL_PRM_TW_Z **003a0000**
Parameter Z_TW out of range.
The target window parameter Z_TW (distance) for axis Z was specified out of range. The valid range is 0 to (Z_SLMAX-Z_SLMIN)/10.

ERR_FAIL_PRM_VSTOP_X **003b0000**
Parameter X_VSTOP out of range.
The stopped speed parameter X_VSTOP for axis X was specified out of range. The valid range is 10 to X_VMAX/2 (limited to 32767).

ERR_FAIL_PRM_VSTOP_Y **003c0000**
Parameter Y_VSTOP out of range.
The stopped speed parameter Y_VSTOP for axis Y was specified out of range. The valid range is 10 to Y_VMAX/2 (limited to 32767).

ERR_FAIL_PRM_VSTOP_Z **003d0000**
Parameter Z_VSTOP out of range.
The stopped speed parameter Z_VSTOP for axis Z was specified out of range. The valid range is 10 to Z_VMAX/2 (limited to 32767).

ERR_FAIL_PRM_TSTOP_X **003e0000**
Parameter X_TSTOP out of range.
The maximum stop detection time X_TSTOP for axis X was specified out of range. The valid range is 0 to 1000 (in decimal notation).

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ERR_FAIL_PRM_TSTOP_Y **003f0000**
Parameter Y_TSTOP out of range.
The maximum stop detection time Y_TSTOP for axis Y was specified out of range. The valid range is 0 to 1000 (in decimal notation).

ERR_FAIL_PRM_TSTOP_Z **00400000**
Parameter Z_TSTOP out of range.
The maximum stop detection time Z_TSTOP for axis Z was specified out of range. The valid range is 0 to 1000 (in decimal notation).

ERR_FAIL_PRM_OFFSET_X **00410000**
Parameter X_OFFSET out of range.
The offset voltage parameter DAC X_OFFSET for axis X was specified out of range. The valid range is -150 to +150 (in decimal notation).

ERR_FAIL_PRM_OFFSET_Y **00420000**
Parameter Y_OFFSET out of range.
The offset voltage parameter DAC Y_OFFSET for axis Y was specified out of range. The valid range is -150 to +150 (in decimal notation).

ERR_FAIL_PRM_OFFSET_Z **00430000**
Parameter Z_OFFSET out of range.
The offset voltage parameter DAC Z_OFFSET for axis Z was specified out of range. The valid range is -150 to +150 (in decimal notation).

ERR_FAIL_PRM_KR_X **00440000**
Incorrect KR_X value sent to the module.

ERR_FAIL_PRM_KR_Y **00450000**
Incorrect KR_Y value sent to the module.

ERR_FAIL_PRM_KR_Z **00460000**
Incorrect KR_Z value sent to the module.

ERR_SYSTEM **00470000**
The appearance of this message is abnormal. Problem analyzing parameters via the module.

ERR_SYSTEM **00480000**
The appearance of this message is abnormal. Problem receiving parameters via the module (indexes, etc).

ERR_FAIL_RATIO_ACC_X **00490000**
Incorrect (X_VMAX/X_ACC) ratio.
The (X_VMAX/X_ACC) ratio must be less than 2 in incremental units, less than 120 in non-incremental units.

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ERR_FAIL_RATIO_ACC_Y **004a0000**
Incorrect (Y_VMAX/X_ACC) ratio.
The (Y_VMAX/X_ACC) ratio must be less than 2 in incremental units, less than 120 in non-incremental units.

ERR_FAIL_RATIO_ACC_Z **004b0000**
Incorrect (Z_VMAX/X_ACC) ratio.
The (Z_VMAX/X_ACC) ratio must be less than 2 in incremental units, less than 120 in non-incremental units.

ERR_FAIL_RATIO_DEC_X **004c0000**
Incorrect (X_VMAX/X_DEC) ratio.
The (X_VMAX/X_DEC) ratio must be less than 2 in incremental units, less than 120 in non-incremental units.

ERR_FAIL_RATIO_DEC_Y **004d0000**
Incorrect (Y_VMAX/Y_DEC) ratio.
The (Y_VMAX/Y_DEC) ratio must be less than 2 in incremental units, less than 120 in non-incremental units.

ERR_FAIL_RATIO_DEC_Z **004e0000**
Incorrect (Z_VMAX/Z_DEC) ratio.
The (Z_VMAX/Z_DEC) ratio must be less than 2 in incremental units, less than 120 in non-incremental units.

The ERR_SYSTEM text must in no circumstances appear during normal operation of the module.

CHANGE OF MODE ERRORS (0000XX00)

ERR_SYSTEM **00000100**
The appearance of this message is abnormal. Command received by the module is incorrect.

ERR_FAIL_STAT_NO_CONF **00000200**
Command for a non-configured group.
A command with a “SEND_CMD” order was retained for a group that is not configured (does not exist).

ERR_FAIL_STAT_NUM_AXE **00000300**
Invalid AXIS_NB parameter.
The axis number AXIS_NB used in the command received is incorrect.

ERR_FAIL_STAT_KR_DISTANCE **00000400**
Incorrect DISTANCE parameter for NEW_KR. (Out of range for internal calculations in the selected units).

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ERR_FAIL_STAT_KR_PARMAN **00000500**
Incorrect PARMAN parameter for NEW_KR. (Out of range for internal calculations in the selected units).

ERR_FAIL_STAT_CAL_KR **00000600**
KR calculation result out of range.
The result of the KR calculation (Theoretical/Measured Distance) is outside of the range [0.5, 2.0]. This may be caused by an error in the resolution parameter.

ERR_FAIL_STAT_SIMU_IMP **00000700**
SIMUL mode selection failed.
SIMUL mode (trajectory simulation) requires that the following conditions be met: a) AUTO=1, b) NOMOTION=1, c) DONE=1.

ERR_FAIL_STAT_NSIMU_IMP **00000800**
SIMUL mode exit failed.
Exit from SIMUL mode (trajectory simulation) was rejected because the group was not stopped (NOMOTION=0).

ERR_FAIL_STAT_AUTO_IMP **00000900**
Failure to changeover to AUTO mode.
The changeover to AUTO mode (automatic trajectory execution) was rejected.
a) The group was not stopped (NOMOTION=0) OR b) The mode was DIRDRIVE OR c) The mode was DRV_OFF OR d) The group was incorrectly configured.
Conditions for changeover: NOMOTION=1, DONE=1.

ERR_FAIL_STAT_NAUTO_IMP **00000a00**
Failure to exit AUTO mode.
Exit from AUTO mode (automatic trajectory execution) was rejected because the group was not stopped (NOMOTION=0).
Conditions for changeover: NOMOTION=1, DONE=1.

ERR_FAIL_STAT_DD_IMP **00000b00**
Failure to changeover to DIRDRIVE mode.
The changeover to DIRDRIVE mode (direct voltage control) requires that the following conditions be met: a) There is no blocking failure on the axis, b) The mode is not AUTO: AUTO=0. c) DONE=1. d) PARAM <= | UMAX |.

ERR_FAIL_STAT_NDD_IMP **00000c00**
Failure to Exit DIRDRIVE mode.
Exit from DIRDRIVE mode (direct voltage control) was rejected because the group was not stopped (NOMOTION=0).

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ERR_FAIL_STAT_DO_IMP **00000d00**
Failure to changeover to DRV_OFF mode.
The changeover to DRV_OFF mode (inhibit all speed drive commands) was rejected.
The execution conditions are: a) AUTO=0. b) NOMOTION=1. c) DONE=1.

ERR_FAIL_STAT_NDO_IMP **00000e00**
Failure to Exit DRV_OFF mode.
Exit from DRV_OFF (inhibit all speed drive commands) mode was rejected.
Conditions for Exit from the mode are: DONE=1 and NOMOTION=1.
Hint: An x_VSTOP parameter may be too small. Vibrations on the axis (due to external causes) may then be interpreted as a stop error. Increase x_VSTOP.

ERR_SYSTEM **00000f00**
The appearance of this message is abnormal. Problem receiving the command in the module.

ERR_FAIL_STAT_NEW_KR **00001000**
NEW_KR command rejected.
Execution of the NEW_KR command was rejected because the group was not stopped (NOMOTION=0) or because this command is irrelevant for incremental units.

ERR_SYSTEM **00001100**
The appearance of this message is abnormal. Problem analyzing the command in the context.

ERR_FAIL_STAT_WAIT_CONF **00001200**
Group not configured, waiting for command SEND_CONF.

The ERR_SYSTEM text must in no circumstances appear during normal operation of the module.

ERRORS FOLLOWING A MOVEMENT COMMAND (000000XX)

ERR_FAIL_MVT_NUM_AXE **00000001**
Invalid AXIS_NB parameter.
The command cannot be executed because the assigned axis number is invalid.

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ERR_FAIL_MVT_JOG_PLUS **00000002**
JOG_P command rejected.
The JOG_P command (“manual” motion in the axis plus direction) is only accepted if: a) There is no blocking failure on the axis, b) DONE=1.
Note: This command is allowed even if the axis is not referenced, for example after an encoder failure.

ERR_FAIL_MVT_JOG_MOINS **00000003**
JOG_M command rejected.
The JOG_M command (“manual” motion in the axis minus direction) is only accepted if: a) There is no blocking failure on the axis, b) DONE=1.
Note: This command is allowed even if the axis is not referenced, for example after an encoder failure.

ERR_FAIL_MVT_INC_PLUS **00000004**
INC_P command rejected.
The INC_P command (incremental motion in the axis plus direction) is only accepted if: a) x_CALIB=1 for the selected axis, b) There is no blocking failure on the axis, c) Target position is OK within the soft stops.

ERR_FAIL_MVT_INC_MOINS **00000005**
INC_M command rejected.
The INC_M command (incremental motion in the axis minus direction) is only accepted if: a) x_CALIB=1 for the selected axis, b) There is no blocking failure on the axis, c) Target position is OK within the soft stops.

ERR_FAIL_MVT_DIR_DRIVE **00000006**
DIRDRIVE command rejected.
The DIRDRIVE command (direct application of a voltage to the speed drive output) is only accepted if the following conditions are met: a) There is no blocking failure on the axis, b) Mode is not AUTO: AUTO=0. c) DONE=1. d) | PARAM | <= UMAX. e) Encoder failure has been acknowledged by ACKDEF.

ERR_FAIL_MVT_SET_RP_PLUS **00000007**
SETRP_P command rejected.
The SETRP_P command (manual reference point set-up in the axis plus direction) is only accepted if the following conditions are met: a) x_VALRP valid in relation to the internal maximum, b) An incremental encoder is used, c) No blocking errors are present on the axis, d) NOMOTION=1. e) DONE=1.

ERR_FAIL_MVT_SET_RP_MOINS**00000008**
SETRP_M command rejected.
The SETRP_M command (manual reference point set-up in the axis minus direction) is only accepted if the following conditions are met: a) x_VALRP valid in relation to the internal maximum, b) An incremental encoder is used, c) No blocking errors are present on the axis, d) NOMOTION=1. e) DONE=1.

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ERR_FAIL_MVT_RPH_PARAM **00000009**
Invalid forced PO parameter.
The PARAM parameter is invalid for a forced reference point set-up (RP_HERE command): it must be in the range SLMIN to SLMAX.

ERR_FAIL_MVT_RPH **0000000a**
RP_HERE command rejected.
The RP_HERE command (forced reference point set-up) is only accepted if the following conditions are met: a) No incremental encoder failure, b) AUTO=0, c) NOMOTION=1, d) DONE=1.

NON EXISTENT **0000000b**
Message generated by ADJ_MAX: ERR_SYSTEM

ERR_FAIL_MVT_HOMING **0000000c**
HOMING command rejected.
The HOMING command (move the axis to the start position) is only accepted if: a) CALIB=1 the selected axis is referenced, b) No blocking failures are present on the axis, c) NOMOTION=1, d) DONE=1, e) VALRP is within the soft stops. f) The moving part is not on position VALRP.

ERR_FAIL_MVT_SL_RETURN **0000000d**
SLRETURN command rejected.
The SLRETURN command (return from soft stops) is accepted if: a) CALIB=1 the selected axis is referenced, b) There is a BL error before starting the command. c) No other errors present after acknowledgement. (The previous BL error was actually acknowledged, controlling the speed drive safety interlock).

ERR_FAIL_MVT_NON_MANU **0000000e**
EXEC command in manual mode.
The group has received an automatic command (EXEC) when manual mode is selected.

ERR_FAIL_MVT_DIRECT **0000000f**
Command stack overflow.
The command received could not be accepted. The group command stack is not ready for it (as indicated by NEXT=0).

ERR_FAIL_MVT_STOP **00000010**
Command rejected when stopped.
The command cannot be accepted as STOP is set to 1.

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ERR_FAIL_MVT_AUTO **00000011**
Manual command rejected.
The manual command cannot be accepted by group axes as the current mode is Automatic.

NON EXISTENT **00000012**
Message generated by ADJ_MAX: ERR_SYSTEM

ERR_FAIL_MVT_M_EN_COURS **00000013**
Manual command rejected.
The manual command received cannot be accepted by group axes at present: Previous motion not yet complete. This is indicated by DONE=0.

ERR_FAIL_MVT_M_DRIV_OFF **00000014**
Command rejected in DRV_OFF state.
Two simultaneous commands with SEND_CMD, of which one was DRV_OFF, were received.

ERR_FAIL_MVT_M_DIR_DRIVE **00000015**
Command rejected in DIRDRIVE state.
Two simultaneous commands with SEND_CMD, of which one was DIRDRIVE, were received.

ERR_FAIL_MVT_M_NUM_AXE **00000016**
Invalid axis in manual control mode.
The manual command received was rejected because of an invalid axis number.

ERR_FAIL_MVT_M_DEUX_MVTS **00000017**
Two simultaneous manual commands.
Two manual commands were received simultaneously by the group.

ERR_FAIL_MVT_GRP_KO **00000018**
Command rejected by group not OK.
The command received cannot be accepted for a group not OK.

ERR_SYSTEM **00000019**
The appearance of this message is abnormal. Error in the movement command.

ERR_FAIL_MVT_NON_REF **0000001a**
Command rejected as axis not referenced.
Only commands G14, G15, or G16 are accepted in the current state of group axes: not referenced.

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ERR_FAIL_MVT_NON_EXEC **0000001b**
Automatic command rejected.
The automatic command (EXEC) received was rejected: either the EXEC code is unknown or the target is out of range (speed, positions).

ERR_SYSTEM **0000001c**
The appearance of this message is abnormal. Error in the command.

ERR_SYSTEM **0000001d**
Not attributed.
The appearance of this message is abnormal. Error in the command.

ERR_SYSTEM **0000001e**
The appearance of this message is abnormal. Error in the movement command.

ERR_FAIL_MVT_CO **0000001f**
Command rejected because of incoherent parameters.
The command received was rejected because the positioning parameters are incoherent.

ERR_SYSTEM **00000020**
The appearance of this message is abnormal. The command received in not accepted in relation to the configuration parameters.

NON EXISTENT **00000021**
Message generated by ADJ_MAX: ERR_SYSTEM

GROUP ERROR STATUS BITS

bit	OK	No fault causing the group to stop
bit	AXIS_ERR	«APPLICATION» fault detected on the group.
bit	HARD_ERR	HARDWARE fault detected on the group.

STATUS0 ERROR WORD «GROUP ERROR STATUS»

0001	STATUS0,0	«Out of service»
0002	STATUS0,1	Reserved (ex - EEPROM error)
0004	STATUS0,2	I/O error
0008	STATUS0,3	At least one HARDWARE error on axis X
0010	STATUS0,4	At least one HARDWARE error on axis Y
0020	STATUS0,5	At least one HARDWARE error on axis Z
0040	STATUS0,6	At least one «APPLICATION» error on axis X.

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0080	STATUS0,7	At least one «APPLICATION» error on axis Y.
0100	STATUS0,8	At least one «APPLICATION» error on axis Z.
0200	STATUS0,9	Not defined.
0400	STATUS0,A	Not defined.
0800	STATUS0,B	Command rejected: movement.
1000	STATUS0,C	Command rejected: operating mode.
2000	STATUS0,D	Command rejected: parameters.
4000	STATUS0,E	Command rejected: configuration.
8000	STATUS0,F	System error (OFB).

STATUS1, STATUS2, STATUS3 WORDS «AXIS ERRORS»

STATUS1: Axis X. STATUS2: Axis Y. STATUS3: Axis Z.

0001	STATUSi,0	URGSTOP	Emergency stop. «Speed drive present»
0002	STATUSi,1	VAR	Signal active speed drive «Error».
0004	STATUSi,2	CODRUP	Encoder wiring break.
0008	STATUSi,3	CODSAL	Encoder contamination.
0010	STATUSi,4	CCANA	Short-circuit on the analog output.
0020	STATUSi,5	SLMAX	Upper soft stop overshoot.
0040	STATUSi,6	SLMIN	Lower soft stop overshoot.
0080	STATUSi,7	OVER_FT	Overspeed threshold exceeded
0100	STATUSi,8	DMAX1	Overshoot of position 1 deviation threshold (safety).
0200	STATUSi,9	TW	Target window stop fault: The POSITION measured exceeds the FAP after a TSTOP delay.
0400	STATUSi,A	STOP	Stop fault: The SPEED is > VSTOP at the end of TSTOP.
0800	STATUSi,B	DMAX2	Overshoot of position 2 deviation threshold (maintenance).
1000	STATUSi,C	N. A.	
2000	STATUSi,D	N. A.	
4000	STATUSi,E	N. A.	
8000	STATUSi,F	N. A.	

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