FAGOR AUTOMATION

CNC 101/102(S)

New Features (Version 0110 in)

FAGOR

ERRORS DETECTED IN THE INSTALLATION MANUAL (REF. 9703)

Comparison table (page x). General characteristics.

In the "Axes" section" where it says "Axes X + Y + Auxiliary handwheel"
It should say "X Axis + Auxiliary Y axis (not dro) + Auxiliary handwheel"

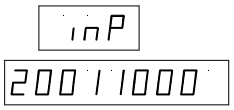
Comparison table (page xii). Programming.

The programming function G34 is missing:

G34 X axis as an infinite follower of another axis (only for the 101S)

Section 2.3.4 (chapter 2 page 8). Table below.

Digits 7 and 8 are backwards. They should be like this:



Digit	*Corresponding Input*	*Pin*
8	External feedrate override 1	10 (I/O1)
7	External feedrate override 2	11 (I/O1)
6	X axis feedback error	
5	Y axis feedback error	
4	X axis sine-wave feedback alarm	
3	Y axis sine-wave feedback alarm	
2	Over-temperature	
1	Not being used at this time	

Section 3.5 (chapter 3 page 8). Feedback alarm parameter P22(7), P62(7)

The last paragraph is wrong, it should read:

"If the feedback system ..... with a value of "0" (feedback alarm OFF)".

Section 4.4.2 (chapter 4 page 13). Open positioning loop

The first paragraph is wrong, it should say:

It is necessary to set P23(4)=0.

Appendix "F" (page 9). I/O related parameters

The first line is wrong, it should read:

P22(7), P62(7) Feedback alarm ON (1) or OFF (0) on the X, Y axis (respectively).
P63(6) The probe is active high, P63(6)=0, or low, P63(6)=1.

Appendix "G" (page 12). P22(7)

It is wrong, it should read:

P22(7) Feedback alarm ON (1) or OFF (0) on the X axis.

Appendix "G" (page 13). P62(7)

It is wrong, it should read:

P62(7) Feedback alarm ON (1) or OFF (0) on the Y axis.
P63(6) The probe is active high, P63(6)=0, or low, P63(6)=1.

MODIFICATIONS TO THE INSTALLATION MANUAL (REF. 9703)

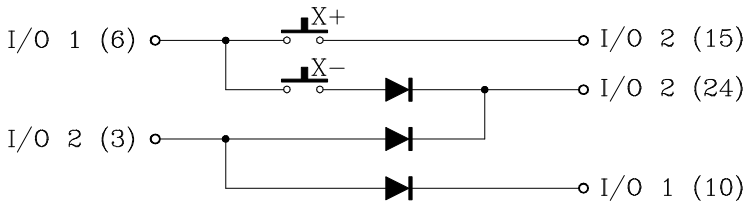
Section 1.6.1 (chapter 1 page 11). RESET

The last paragraph should read:

When setting machine parameter "P30" with a value other than "0", the CNC behaves as follows: A leading edge (up flank) interrupts the execution and it is redirected to a HOME block, but the HOME function is not executed until a trailing edge (down flank) is detected.

Section 1.8.1 (chapter 1 page 22). External keys without the "JOG 100" keypad (jog box)

Connection example using only the external control keys "X+", "X-"



Section 4.1.1.1 (chapter 4 page 11). P63(1) Acceleration/deceleration in all G01 movements

It should read:

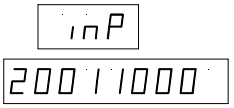
P63(1) Acceleration/deceleration also on linear interpolations (G01)

It defines if the CNC, besides applying acc/dec ramps (P16, P17, P91, P92) on all rapid movements at F0, it also applies them on linear interpolations (G01).

0 = Only on rapid movements (G00) and at F0.
1 = On rapid movements and on all linear interpolations (G01).

MODIFICATIONS TO THE OPERATION MANUAL (REF. 9703)

Section 2.3.4 (chapter 2 page 8). Table below.
Digits 7 and 8 are backwards. They should be like this:



Digit	*Corresponding Input*	*Pin*
8	External feedrate override 1	10 (I/O1)
7	External feedrate override 2	11 (I/O1)
6	X axis feedback error	
5	Y axis feedback error	
4	X axis sine-wave feedback alarm	
3	Y axis sine-wave feedback alarm	
2	Over-temperature	
1	Not being used at this time	

Section 6.5.4 (chapter 6 page 17). Synchronism (G33)

In the printing example.

* If the turning of the roller is controlled with an external device, it is not necessary to program the " N0 S1000 M3" block, but machine parameter P36 must be set to the approximate rpm of the roller.
* If the roller does not have an encoder, because no controlled synchronism is needed, pin 5 of connector A2 must be connected to 5V.

Software Version 2.02 (May 1998)

1. ASSUME X1 OF THE HANDWHEEL WITH THE "JOG 100" JOG BOX

Machine parameter P102(7) indicates whether the axes can be jogged or not with the handwheel when the Feedrate Override Switch is positioned out of the handwheel markings while using the "JOG 100" jog box and the JOG mode is selected.

P102(7) = 0 It is not possible. The handwheel is active in the handwheel positions only.
P102(7) = 1 The handwheel is active in any position of the Feedrate Override Switch.

When machine parameter P102(7) = 1, the CNC applies the "x1" factor when the switch is positioned out of the handwheel positions.

2. THE CNC101 ALSO HAS ARITHMETIC PROGRAMMING.

From this version on, the CNC101 model also has arithmetic programming with conditional jumps (G26, G27, G28, G29).

			101	**101S**	**102**	**102S**
Arithmetic programming			**x**	**x**	**x**	**x**
Arithmetic parameters			100	100	100	100
PROGRAMMING FUNCTIONS	G26	Jump if zero	**x**	**x**	**x**	**x**
	G27	Jump if not zero	**x**	**x**	**x**	**x**
	G28	Jump if less than zero	**x**	**x**	**x**	**x**
	G29	Jump if equal or greater than zero	**x**	**x**	**x**	**x**

3. AXES NOMENCLATURE.

With bits 1 and 2 of parameter P102, the axes nomenclature may be defined.

P102(2)	P102(1)	Axes Nomenclature
0	0	X Y
0	1	Y C
1	0	X Z
1	1	Y Z

The new denomination selected only affects the display, they will keep being X and Y internally. Therefore, when accessing the CNC via DNC 100, the axes will always be X Y.

4. MOVEMENTS IN G75

In previous versions, when a movement programmed in G75 reached position and the CNC had not yet received the probe signal, the CNC would issue error 21.

From this version on, parameter P102(5) indicates whether the CNC issues error 21 or not.

P102(5) = 0 It issues error 21. Like until now.
P102(5) = 1 It does not issue error 21. It goes on executing the next block.

5. DISPLAY OF THE AXIS IN EXECUTION

In previous versions, while in Automatic mode, the CNC could change the axis being displayed depending on the movement programmed:

If both axes move => it keeps displaying the axis selected with A+ ,A-
If only the X axis moves => it displays the X axis
If only the Y axis moves => it displays the Y axis

From this version on, parameter P102(6) determines whether the CNC behaves like before or it does not change the axis being displayed.

P102(6)=0 Like before
P102(6)=1 The CNC does not change the axis. It keeps displaying the axis selected with A+ ,A-

Software Version 2.03 (January 1999)

1. ADDITIONAL MOVEMENT WITH G75

When probing at high speed, it could stop abruptly making the axis overshoot the programmed position and having to move back into position.

In previous versions of the CNC 101 S, machine parameter P82 could be used to minimize this sometimes undesirable effect.

This parameter indicates to the CNC the distance the axis must move after receiving the probe signal, thus stopping smoothly.

From this version on, this feature will also be available on the "102 S" CNC model and parameter P83 indicates the distance the Y axis must move after receiving the probe signal.

Therefore: P82 indicates the distance the X axis must move after receiving the probe signal.
P83 indicates the distance the Y axis must move after receiving the probe signal.
Possible values: From 1 to 65535 microns.
From 1 to 25801 tenth-thousandths of an inch.

Software Version 2.05 (October 2001)

1. OPERATION WITH 100-LINE HANDWHEELS (U.F.O.)

Until now, the CNC 101/102 was ready to operate with 25-line handwheels. It internally multiplies by 4 in order to obtain 100 pulses per each turn of the handwheel.
From this version on, it is also possible to use 100-line handwheels (Fagor UFO model handwheels)
Set machine parameter P103(2)=1 so its pulses are not multiplied by 4.

This feature is only available when connecting the handwheel to the CNC's feedback input.
The auxiliary handwheel, connected to the digital inputs of the CNC must always have 25 lines per turn.

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FAGOR 101 / 101S CNC
FAGOR 102 / 102S CNC

INSTALLATION MANUAL

Ref. 9703 (ing)

The information described in this manual may be subject to variations due to technical modifications.

FAGOR AUTOMATION, S. Coop. Ltda. reserves the right to modify the contents of this manual without prior notice.

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COMPARISON TABLE FOR FAGOR CNC MODELS: 101/101S/102/102S

GENERAL CARACTERISTICS

		101	101S	102	102S
Feedback inputs	Connector A1 (X axis)	x	x	x	x
	Connector A2 (Y axis)		x	x	x
	x5 multiplier circuit for sine-wave signals		x	x	x
	Feedback correction factor	x	x	x	x
Analog outputs	X axis	x	x	x	x
	Y axis			x	x
	Spindle (S)	x	x	x	x
Axes	X axis	x	x	x	x
	X + Y axis			x	x
	X axis + electronic handwheel		x	x	x
	Axes X + Y + auxiliary handwheel		x	x	x
	Double feedback for X axis		x		
Axis control	Closed Loop	x	x	x	x
	Open Loop	x		x	
	Rigid Tapping				x
Interface with external devices	External operator panel "JOG 100"		x		x
	RS232C Interface		x	x	x
	Fagor Local Area Network (LAN)		x	x	x
	DNC 100		x		x
Operating options	Overtemperature alarm		x	x	x
	Operation in radius or diameter		x	x	x
	Operation with a probe		x	x	x
	Zero offsets		x	x	x
	Tool length compensation		x	x	x
	Acceleration / deceleration	x	x	x	x

INPUTS AND OUTPUTS

		101	101S	102	102S
INPUTS	X axis home switch	x	x	x	x
	Y axis home switch		x	x	x
	External emergency stop	x	x	x	x
	Feedhold	x	x	x	x
	External Cycle Start	x	x	x	x
	External Cycle Stop	x	x	x	x
	Conditional input (block skip)	x	x	x	x
	Manual input (DRO mode)	x	x	x	x
	External Reset (initial CNC conditions)	x	x	x	x
	2 inputs as Handwheel multiplying factor		JOG100	x	JOG100
	2 inputs for Feedrate override		JOG100	x	JOG100
	5 inputs for parametric programming		x	x	x
	2 inputs for handling the auxiliary handwheel		x	x	x
OUTPUTS	8 outputs for M, S or T in BCD or decoded	x	x	x	x
	M Strobe	x	x	x	x
	S Strobe		x	x	x
	T Strobe		x	x	x
	JOG mode selected at the CNC	x	x	x	x
	Automatic mode selected at the CNC		x	x	x
	Internal CNC emergency	x	x	x	x
	X axis brake	x	x	x	x
	Y axis brake			x	x
	X axis in position	x	x	x	x
	Y axis in position			x	x
	X axis Fast (Non-servocontrolled open loop)	x	JOG 100	x	JOG 100
	X axis Slow (Non-servocontrolled open loop)	x	JOG 100	x	JOG 100
	X direction (Non-servocontrolled open loop)	x	JOG 100	x	JOG 100
	Y axis Fast (Non-servocontrolled open loop)		JOG 100	x	JOG 100
	Y axis Slow (Non-servocontrolled open loop)			x	
	Y direction (Non-servocontrolled open loop)			x	

PROGRAMMING

	101	101S	102	102S
Number of blocks	900	900	900	900
Conditional blocks (block skip)	x	x	x	x
Parts counter	x	x	x	x
Arithmetic programming		x	x	x
Arithmetic parameters		100	100	100

PROGRAMMI FUNCTIONS	G00	Rapid positioning	x	x	x	x
	G01	Linear interpolation	x	x	x	x
	G02	Clockwise circular interpolation			x	x
	G03	Counter-clockwise circular interpolation			x	x
	G04	Dwell	x	x	x	x
	G05	Round corner	x	x	x	x
	G07	Square corner	x	x	x	x
	G25	Unconditional jump	x	x	x	x
	G26	Jump if zero		x	x	x
	G27	Jump if not zero		x	x	x
	G28	Jump if less than zero		x	x	x
	G29	Jump if equal or greater than zero		x	x	x
	G33	Synchronization		x		
	G45	Increment part-counter's count	x	x	x	x
	G47	Pulse inhibit		x	x	x
	G48	Cancel function G47		x	x	x
	G51 to G60	Load zero offset		x	x	x
	G61	F not affected by "P18"	x	x	x	x
	G62	Cancel function G61	x	x	x	x
	G70	Inch programming	x	x	x	x
	G71	Metric programming	x	x	x	x
	G74	Machine Reference (home) search	x	x	x	x
	G75	Probing		x	x	x
	G81	Batch programming		x		x
	G84, G80	Rigid tapping				x
	G90	Absolute coordinate programming	x	x	x	x
	G91	Incremental coordinate programming	x	x	x	x
	G92	Coordinate presetting	x	x	x	x
	G93	Modification of acceleration ramp		x	x	x

NEW FEATURES AND MODIFICATIONS

Date: **March 1997**	*Software Version:* **2.1 and newer**	
FEATURE	**AFFECTED MANUAL AND SECTION**	
Synchronization of movements (G33)	Operating Manual	Section 6.5.4
Axis X as infinite slave of another axis (G34)	Installation Manual Operating Manual	Section 5.5 Section 6.5.5
G47, G48 as axis loop opener	Installation Manual Operating Manual	Section 5.7 Section 6.7.2
G75 special function	Installation Manual	Section 5.6
Travel limit control taking into account the the punch radius	Installation Manual Operating Manual	Section 5.8 Section 6.8.4
Selection of the Arithmetical Parameters which are required for display.	Installation Manual Operating Manual	Section 3.7 Section 6.9.3
Play-Back, as reading points.	Installation Manual Operating Manual	Section 3.6 Section 4.3.1
Parametrical programming takes the S sign into account	Installation Manual	Sect. 5.1 and 6.7
The axes can be denominated Y, C	Installation Manual	Section 3.4
Auxiliary Handwheel handling by means of 2 digital inputs	Installation Manual Operating Manual	Sect. 1.7, 3.4 and Section 3.1
Braking Control in open loop	Installation Manual	Section 4.4.2
Reading / Writing of machine parameters from the DNC100		
Error elimination by external Reset.		

INTRODUCTION

Attention:

Before starting up the CNC, carefully read the instructions of Chapter 2 in the Installation Manual.

The CNC must not be powered-on until verifying that the machine complies with the "89/392/CEE" Directive.

DECLARATION OF CONFORMITY

Manufacturer: Fagor Automation, S. Coop.

Barrio de San Andrés s/n, C.P. 20500, Mondragón -Guipúzcoa- (ESPAÑA)

We hereby declare, under our responsibility that the product:

Fagor 101/101S / 102/102S CNC

meets the following directives:

SAFETY:

EN 60204-1 Machine safety. Electrical equipment of the machines.

ELECTROMAGNETIC COMPATIBILITY:

EN 50081-2 Emission
- EN 55011 Radiated. Class A, Group 1.
- EN 55011 Conducted. Class A, Group 1.
- EN 61000-3-2 Current Harmonics
- EN 61000-3-3 Voltage fluctuations and flickers

EN 50082-2 Immunity
- EN 61000-4-2 Electrostatic Discharges.
- EN 61000-4-3 Radiofrequency Radiated Electromagnetic Fields.
- EN 61000-4-4 Bursts and fast transients.
- EN 61000-4-5 Conducted high voltage pulses in mains (Surges)
- EN 61000-4-6 Conducted disturbance induced by radio frequency fields.
- EN 61000-4-8 Magnetic fields at mains frequency
- EN 61000-4-11 Voltage fluctuations and Outages.
- ENV 50204 Fields generated by digital radio-telephones

As instructed by the European Community Directives: on Low Voltage 73/23/CEE, on Machine Safety 89/392/EEC, 89/336/EEC on Electromagnetic Compatibility and its upgrades.

In Mondragón, on October 1st, 2001

Fagor Automation, S. Coop. Ltda.
Director Gerente

Fdo.: Julen Busturia

SAFETY CONDITIONS

Read the following safety measures in order to prevent damage to personnel, to this product and to those products connected to it.

This unit must only be repaired by personnel authorized by Fagor Automation.

Fagor Automation shall not be held responsible for any physical or material damage derived from the violation of these basic safety regulations.

Precautions against personal damage

Use proper Mains AC power cables

To avoid risks, use only the Mains AC cables recommended for this unit.

Avoid electrical overloads

In order to avoid electrical discharges and fire hazards, do not apply electrical voltage outside the range selected on the rear panel of the Central Unit.

Ground connection

In order to avoid electrical discharges, connect the ground terminals of all the modules to the main ground terminal. Before connecting the inputs and outputs of this unit, make sure that all the grounding connections are properly made.

Before powering the unit up, make sure that it is connected to ground

In order to avoid electrical discharges, make sure that all the grounding connections are properly made.

Do not work in humid environments

In order to avoid electrical discharges, always work under 90% of relative humidity (non-condensing) and 45º C (113º F).

Do not work in explosive environments

In order to avoid risks, damage, do not work in explosive environments.

Precautions against product damage

Working environment

This unit is ready to be used in Industrial Environments complying with the directives and regulations effective in the European Community

Fagor Automation shall not be held responsible for any damage suffered or caused when installed in other environments (residential or homes).

Install the unit in the right place

It is recommended, whenever possible, to instal the CNC away from coolants, chemical product, blows, etc. that could damage it.

This unit complies with the European directives on electromagnetic compatibility. Nevertheless, it is recommended to keep it away from sources of electromagnetic disturbance such as.

- Powerful loads connected to the same AC power line as this equipment.
- Nearby portable transmitters (Radio-telephones, Ham radio transmitters).
- Nearby radio / TC transmitters.
- Nearby arc welding machines
- Nearby High Voltage power lines
- Etc.

Enclosures

The manufacturer is responsible of assuring that the enclosure involving the equipment meets all the currently effective directives of the European Community.

Avoid disturbances coming from the machine tool

The machine-tool must have all the interference generating elements (relay coils, contactors, motors, etc.) uncoupled.

Use the proper power supply

Use an external regulated 24 Vdc power supply for the inputs and outputs.

Grounding of the power supply

The zero volt point of the external power supply must be connected to the main ground point of the machine.

Analog inputs and outputs connection

It is recommended to connect them using shielded cables and connecting their shields (mesh) to the corresponding pin (See chapter 2).

Ambient conditions

The working temperature must be between +5° C and +45° C (41ºF and 113º F)
The storage temperature must be between -25° C and 70° C. (-13º F and 158º F)

Monitor enclosure

Assure that the Monitor is installed at the distances indicated in chapter 1 from the walls of the enclosure.

Use a DC fan to improve enclosure ventilation.

Main AC Power Switch

This switch must be easy to access and at a distance between 0.7 m (27.5 inches) and 1.7 m (5.6 ft) off the floor.

Protections of the unit itself

It carries two fast fuses of 3.15 Amp./ 250V. to protect the mains AC input.

All the digital inputs and outputs have galvanic isolation via optocouplers between the CNC circuitry and the outside.

They are protected by an external fast fuse (F) of 3.15 Amp./ 250V. against over voltage and reverse connection of the power supply.

The type of fuse depends on the type of monitor. See the identification label of the unit.

Precautions during repair

Do not manipulate the inside of the unit

Only personnel authorized by Fagor Automation may manipulate the inside of this unit.

Do not manipulate the connectors with the unit connected to AC power.

Before manipulating the connectors (inputs/outputs, feedback, etc.) make sure that the unit is not connected to AC power.

Safety symbols

Symbols which may appear on the manual

WARNING. symbol
It has an associated text indicating those actions or operations may hurt people or damage products.

Symbols that may be carried on the product

WARNING. symbol
It has an associated text indicating those actions or operations may hurt people or damage products.

"Electrical Shock" symbol
It indicates that point may be under electrical voltage

"Ground Protection" symbol
It indicates that point must be connected to the main ground point of the machine as protection for people and units.

WARRANTY TERMS

WARRANTY

All products manufactured or marketed by Fagor Automation has a warranty period of 12 months from the day they are shipped out of our warehouses.

The mentioned warranty covers repair material and labor costs, at FAGOR facilities, incurred in the repair of the products.

Within the warranty period, Fagor will repair or replace the products verified as being defective.

FAGOR is committed to repairing or replacing its products from the time when the first such product was launched up to 8 years after such product has disappeared from the product catalog.

It is entirely up to FAGOR to determine whether a repair is to be considered under warranty.

EXCLUDING CLAUSES

The repair will take place at our facilities. Therefore, all shipping expenses as well as travelling expenses incurred by technical personnel are NOT under warranty even when the unit is under warranty.

This warranty will be applied so long as the equipment has been installed according to the instructions, it has not been mistreated or damaged by accident or negligence and has been manipulated by personnel authorized by FAGOR.

If once the service call or repair has been completed, the cause of the failure is not to be blamed the FAGOR product, the customer must cover all generated expenses according to current fees.

No other implicit or explicit warranty is covered and FAGOR AUTOMATION shall not be held responsible, under any circumstances, of the damage which could be originated.

SERVICE CONTRACTS

Service and Maintenance Contracts are available for the customer within the warranty period as well as outside of it.

MATERIAL RETURNING TERMS

When returning the CNC, pack it in its original package and with its original packaging material. If not available, pack it as follows:

1.- Get a cardboard box whose three inside dimensions are at least 15 cm (6 inches) larger than those of the unit. The cardboard being used to make the box must have a resistance of 170 Kg (375 lb.).

2.- When sending it to a Fagor Automation office for repair, attach a label indicating the owner of the unit, person to contact, type of unit, serial number, symptom and a brief description of the problem.

3.- Wrap the unit in a polyethylene roll or similar material to protect it.

When sending the monitor, especially protect the CRT glass.

4.- Pad the unit inside the cardboard box with poly-utherane foam on all sides.

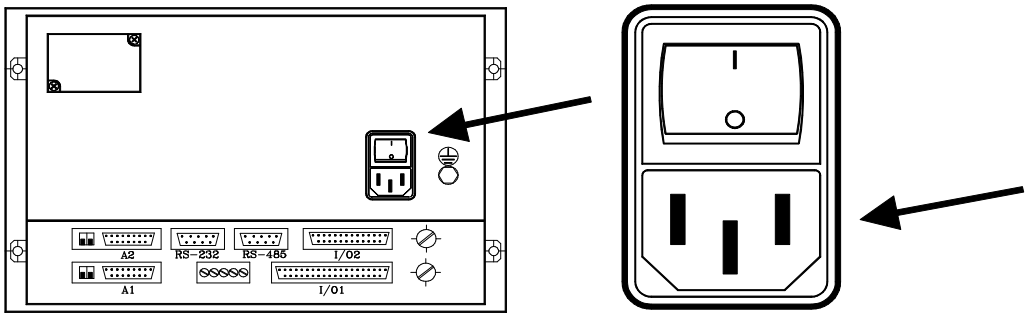
5.- Seal the cardboard box with packing tape or industrial staples.

ADDITIONAL REMARKS

* Mount the CNC away from coolants, chemical products, blows, etc. which could damage it.

* Before turning the unit on, verify that the ground connections have been properly made. See Section 2.2 of this manual.

* To prevent electrical shock use the proper mains AC connector at the Power Supply Module. Use 3-wire power cables (one for ground connection)



* In case of a malfunction or failure, disconnect it and call the technical service. Do not manipulate inside the unit.

FAGOR DOCUMENTATION
FOR THE 101/101S / 102/102S CNC

101/101S / 102/102S CNC OEM Manual

Is directed to the machine builder or person in charge of installing and starting up the CNC.

It has the Installation manual inside. Sometimes, it may contain an additional manual describing New Software Features recently implemented.

101/101S / 102/102S CNC USER Manual

Is directed to the end user or CNC operator.

It contains the Operating manual.
Sometimes, it may contain an additional manual describing New Software Features recently implemented.

MANUAL CONTENTS

The installation manual consists of the following sections:

Index

Comparative Table for Fagor 101/101S / 102/102S CNC models

Introduction
- Warning sheet prior to start-up
- Declaration of Conformity
- Safety Conditions
- Warranty terms
- Shipping conditions
- Additional remarks
- Fagor documents for the 101/101S / 102/102S CNC
- Manual Contents

Chapter 1 CNC configuration
- Indicates the Central Unit dimensions
- Detailed description of all the connectors.

Chapter 2 Power and machine connection.
- Indicates how to connect it to Main AC power.
- Ground connection.
- Characteristics of the digital inputs and outputs.
- Characteristics of the analog output.
- Characteristics of the feedback inputs
- CNC setup and start-up
- System I/O testing
- Connection of the Emergency input and output.

Chapter 3, 4, 5 Machine parameters.
- How to operate with machine parameters.
- How to set the machine parameters.
- Detailed description of the general machine parameters.

Chapter 6 Concepts.
- Feedback systems, resolution
- Adjustment of the axes and their gains.
- Reference Systems: Reference systems, search and setting
- Acceleration / deceleration.
- Spindle: speed control and range change.
- Tools and tool magazine
- Auxiliary M, S, T function transfer

Chapter 7 Local Area Network
- Indicates how to connect an operate the Fagor LAN

Chapter 8 DNC communications protocol

Appendix
- A CNC technical characteristics.
- B Enclosures.
- C Circuits recommended for probe connection
- D CNC inputs and outputs.
- E 2-digit BCD coded spindle "S" output
- F Machine parameter summary chart
- G Sequential machine parameter listing
- H Machine parameter setting chart
- I Key codes
- J Maintenance

Error Codes

1. CNC CONFIGURATION

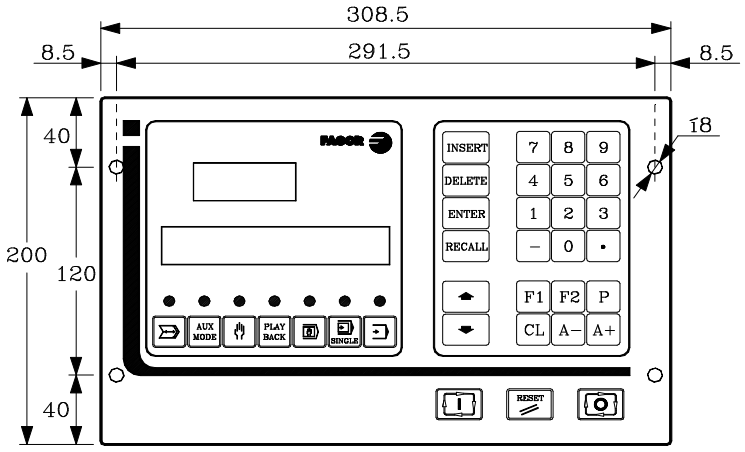
Attention:

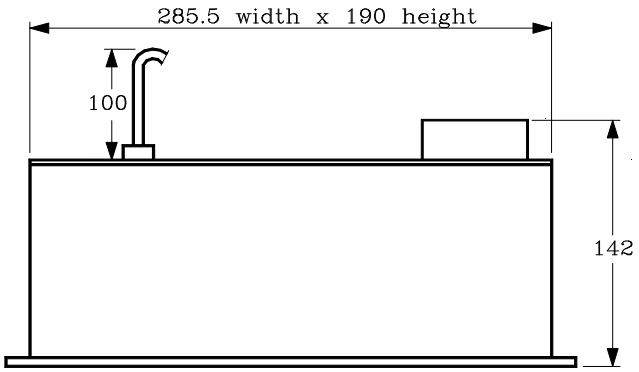
The CNC is prepared to be used in Industrial Environments, especially on milling machines, lathes, etc. It can control machine movements and devices.

It can control machine movements and devices.

1.1 DIMENSIONS AND INSTALLATION

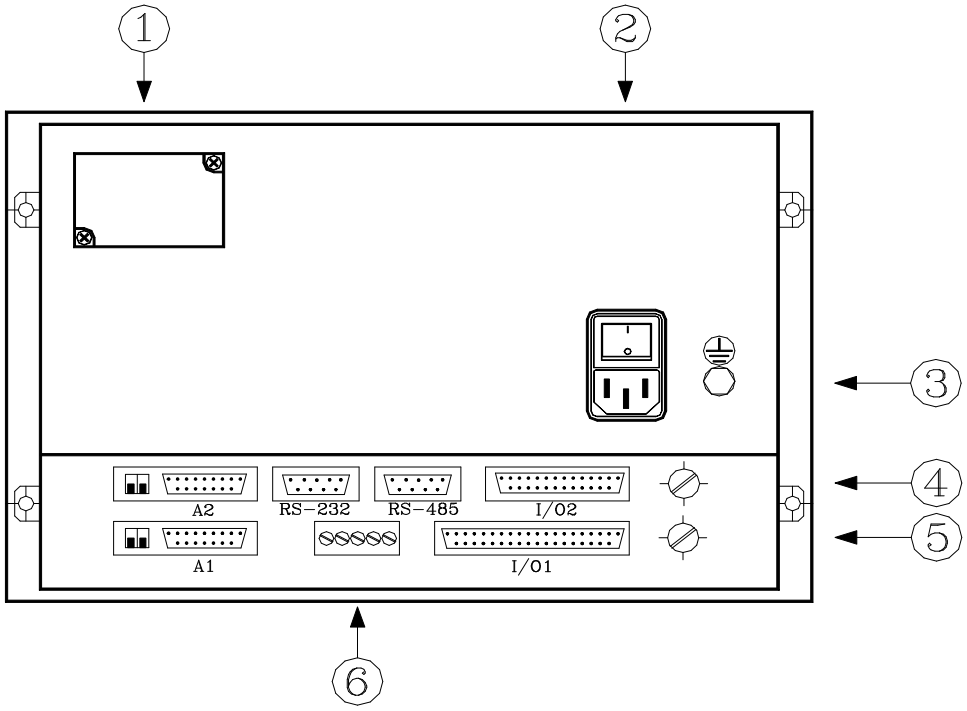
This FAGOR CNC is usually mounted on the operator panel of the machine by means of the 4 mounting holes provided on the front panel of the CNC.





The appendix at the end of this manual shows the necessary dimensions of the enclosure where this CNC will be installed guaranteeing its proper ambient conditions.

1.2 CONNECTORS AND INTERFACE



A1 **15-pin SUB-D type female connector** for X axis feedback connection. It admits sine-wave signals.

A2 **15-pin SUB-D type female connector** for Y axis feedback connection. It admits sine-wave signals.

RS232C **9-pin SUB-D type female connector** for RS-232C serial line connection.

RS485 **9-pin SUB-D type female connector** for RS-485 serial line connection.

I/O1 **37-pin SUB-D type female connector** to interface with the electrical cabinet.

I/O2 **25-pin SUB-D type female connector** to interface with the electrical cabinet.

1 **Lithium battery.** See appendix in this manual.

2 **Mains, A.C. power plug and switch.** To power the CNC by connecting it through a transformer and ground.

3 **Ground terminal. Metric 6mm**. Where the general machine ground must be connected.

4, 5 **Fuses.** 3.15Amp./250V fast fuses (F) to protect the internal I/O circuitry of the CNC.

6 **Potentiometers for analog output adjustment. ONLY** to be used by the Technical Service Department at FAGOR AUTOMATION.
SM (symmetry), G (gain), OF1 (X axis offset), OF2 (Y axis offset), OF3 (spindle offset).

Attention:

Do not manipulate inside this unit

Only personnel authorized by Fagor Automation may manipulate inside this module.

Do not manipulate the connectors with the unit connected to main AC power

Before manipulating these connectors, make sure that the unit is not connected to main AC power.

1.3 CONNECTORS A1, A2

They are 15-pin SUB-D type female connectors used to connect feedback devices.
The feedback system must be metric. Which means that each feedback pulse must be assigned a non-decimal distance value in microns. For example, when a 0.0001 inch/pulse resolution is desired, its equivalent metric value of 2.54µm/pulse **cannot** be set. This problem may be solved by using inch-pitch encoders (635 lines/rev., 1270 lines/rev. etc.) or the feedback correcting factor described later on in this manual.

* Connector A1 is used for the X axis feedback signals.
* Connector A2 is used for the feedback signals from the Y axis or from the electronic handwheel.

The type of cable used must have overall shield. The rest of its characteristics such as length will depend on the type and model of the feedback device being used.

It is highly recommended to run these cables as far away as possible from the power cables of the machine.

PIN	MEANING AND FUNCTION	
1 2 3 4	$\overline{A}$ A $\overline{B}$ B	Differential square-wave feedback signals.
5 6	$\overline{Io}$ Io	Machine reference pulse (Marker)
7 8	Ac Bc	Sine-wave feedback signals.
9 10 11 12 13 14	+5V. 0V. -5V. 	Power to feedback device. Not connected. Power to feedback device. Not connected. Power to feedback device. Not connected.
15	CHASSIS	Shield.

Attention:

The output signals of square-wave rotary encoders must be TTL compatible and **no Open Collector** output signals may be used.

When using a touch probe, pin 5 of connector A2 should be used as input for the probe signal.

The appendix at the end of this manual shows a few recommended circuits for probe connection.

If this pin is also used for the Y axis marker pulse (home), an auxiliary "M" function may be used to switch the two signals.

1.3.1 DIP-SWITCHES FOR CONNECTORS A1, A2

There are 2 dip-switches next to each feedback input connector (A1, A2) to set the CNC according to the type of feedback signal being used in each case.

Dip-switch 1 indicates whether the feedback signal is sine-wave or square-wave and dip-switch 2 indicates whether the feedback signal is differential (double-ended) or not (single-ended).

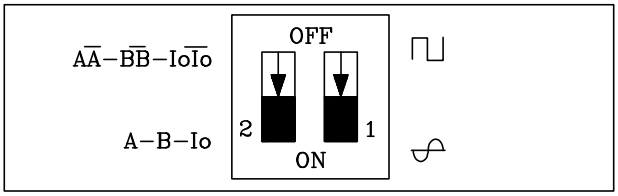
The feedback signals that can be used at connectors A1 and A2 are:

* Sine-wave feedback signals (Ac, Bc, Io)
* Square-wave feedback signals (A, B, Io)
* Differential square-wave feedback signals (A, $\overline{A}$, B, $\overline{B}$, Io, $\overline{Io}$)

The chart below shows the dip-switch combinations for the particular type of feedback signal used at each feedback input:

Dip-switch 1	Dip-switch 2	MEANING AND FUNCTION
ON	ON	Sine-wave signal (Ac, Bc, Io)
ON	OFF	Differential sine-wave signal **"Not allowed"**
OFF	ON	Square-wave signal (A, B, Io)
OFF	OFF	Differential square-wave signal (A, $\overline{A}$, B, $\overline{B}$, Io, $\overline{Io}$)

There is a label next to each pair of switches indicating their meaning.



1.4 RS232C CONNECTOR

It is a 9-pin SUB-D type female connector used to connect the RS-232C serial line.

The shield of the cable being used must be connected to pin 1 of the connector at the CNC end and to the metal housing of the connector at the PERIPHERAL end.

PIN	SIGNAL	FUNCTION
1	FG	Shield.
2	TxD	Transmit Data
3	RxD	Receive Data
4	RTS	Request To Send
5	CTS	Clear To Send
6	DSR	Data Send Ready
7	GND	Ground
8	—-	Not connected
9	DTR	Data Pin Ready

SUGGESTIONS FOR RS232C INTERFACE

* **Connecting and disconnecting the peripheral device**.

The DRO must be powered off when connecting or disconnecting any peripheral device via connector X6 (RS232C interface connector).

* **Cable length**. The EIA RS232C standards specify that the capacity of the cable must not exceed 2500pF, thus, since the cables usually have a capacity between 130 and 170 pF, their maximum length will be limited to **15 meters** (50 feet).

  For greater distances, it is recommended to insert "RS232C<-->RS422A" converters (contact the pertinent distributor).

  It is suggested to use shielded cables and/or twisted-pair wires in order to minimize interference between cables thus avoiding faulty communications over lengthy cables.

  It is recommended to use 7-conductor cables with a minimum section of 0.14 mm^2 and overall shielding.

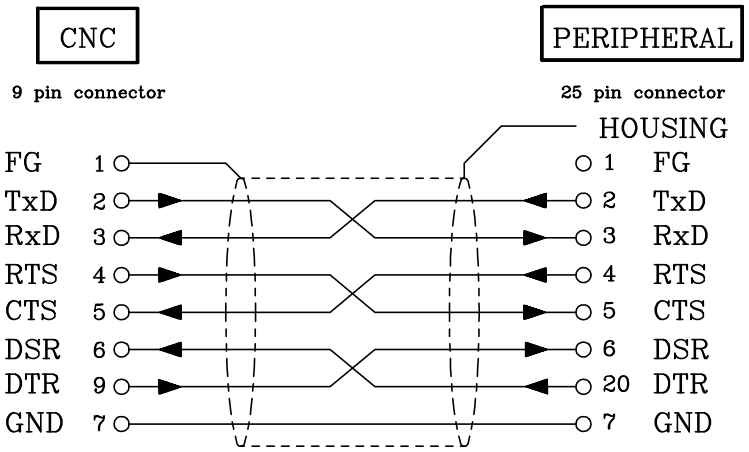
* **Transmission speed (baudrate)**. The most common baudrate used between a peripheral and this CNC is 9600 baud.

  All unused wires should be grounded to avoid erroneous control and data signals.

* **Ground connection**. It is suggested to reference all control and data signals to the same ground wire (pin 7 -GND-) thus avoiding reference points at different voltage levels since there could be different voltages between both ends of long cables.

RECOMMENDED RS232C INTERFACE CONNECTIONS

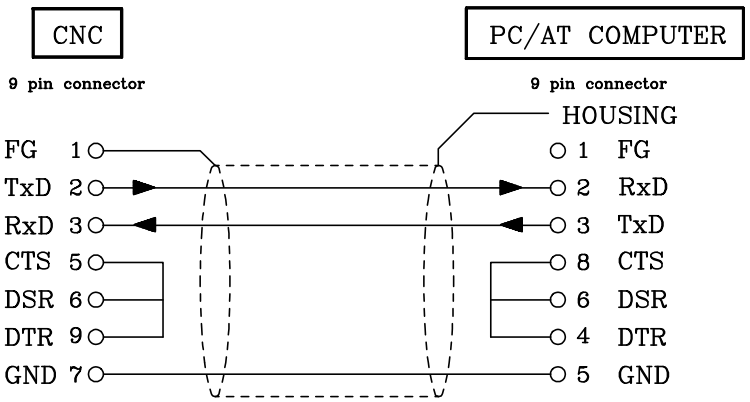
* Complete connection

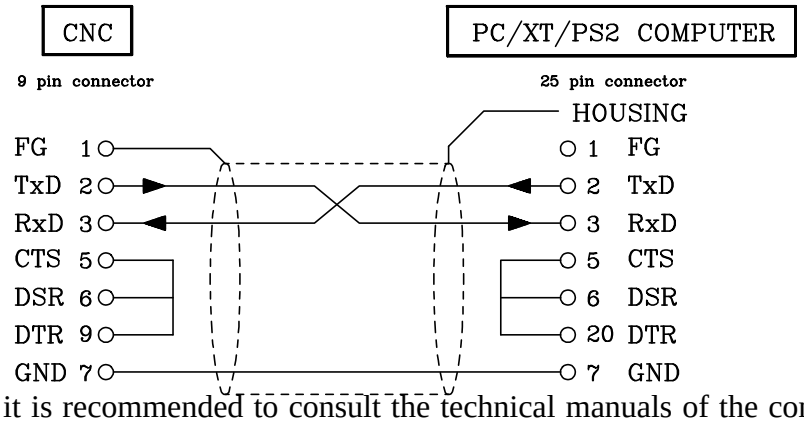


* Simplified connection

To be used when the computer or peripheral device meets one of the following requirements:

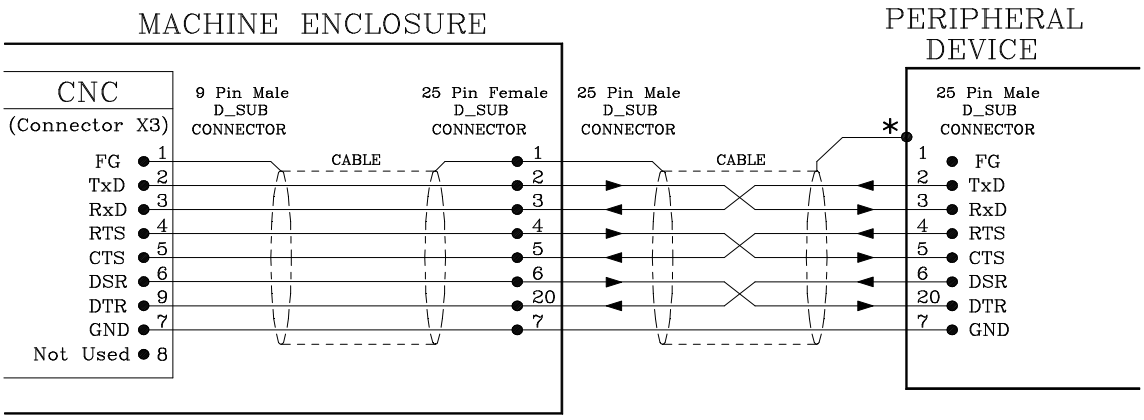
- It does not have the RTS signal.
- DNC is being used.
- The receiving unit can receive data at the selected baudrate.



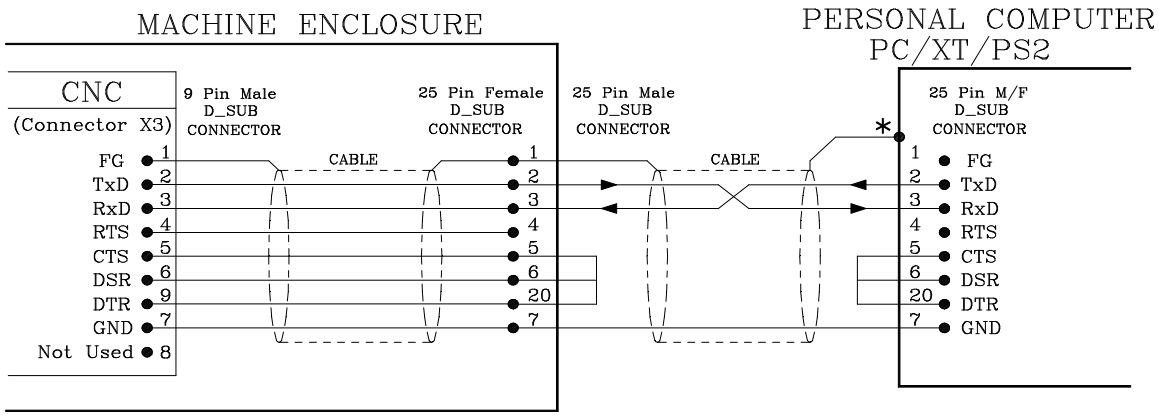


However, it is recommended to consult the technical manuals of the computer or peripheral device in case there are any discrepancies.

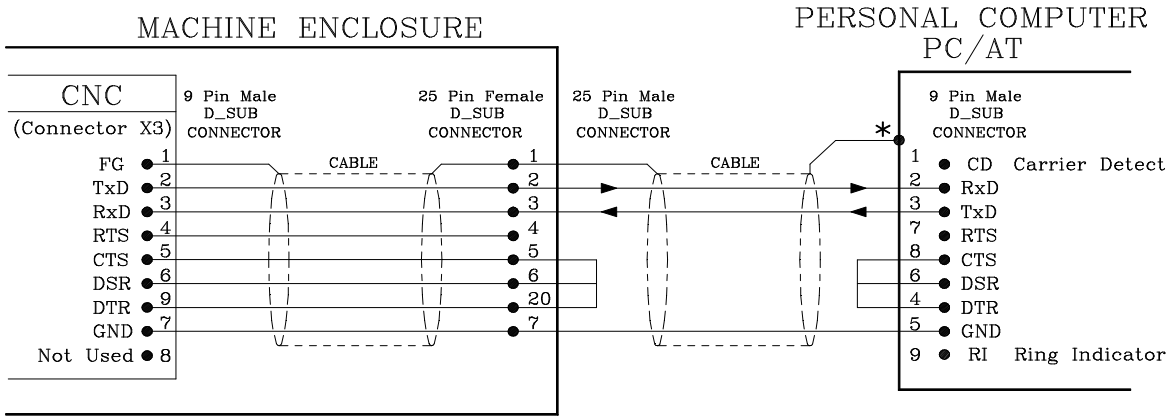
RS232C CONNECTION



NOTE: VERIFY THE GENDER OF THE SERIAL PORT CONNECTOR USED ON YOUR PERIPHERAL DEVICE BEFORE MAKING THE CABLE ASSEMBLY



NOTE: VERIFY THE GENDER OF THE SERIAL PORT CONNECTOR USED ON YOUR PERSONAL COMPUTER BEFORE MAKING THE CABLE ASSEMBLY



* It is recommended to connect the cable shield to the Peripheral device or Personal Computer chassis in order to improve transmissions

1.5 RS485 CONNECTOR

It is a 9-pin SUB-D type female connector used to connect the RS485 serial line.

This serial line is used to integrate this CNC into the FAGOR Local Area Network (LAN) so it can communicate with other FAGOR CNCs and PLCs (FAGOR PLC64).

PIN	SIGNAL	FUNCTION
1	---	*Not connected*
2	---	*Not connected*
3	TxD	Transmit Data
4	---	*Not connected*
5	---	*Not connected*
6	---	*Not connected*
7	---	*Not connected*
8	TxD	Transmit Data
9	---	*Not connected*

Attention: Do not manipulate the connectors with the unit connected to main AC power

Before manipulating these connectors, make sure that the unit is not connected to main AC power.

For better immunity of the RS485 serial line against conducted electromagnetic disturbances, it is recommended to solder the cable mesh to the metal hood of the connector.

1.5.1 RECOMMENDED CABLE FOR THE RS485

TECHNICAL CHARACTERISTICS

"TWINAXIAL" CABLE

SPECIFICATIONS		
Conductor	Type: Material: Resistance:	02 AWG twisted 7x28 Copper (only one stained wire) Max 11 L per every 305m. (1000 ft)
Insulator	Material:	Teflon
Shields	Material Type Cover Resistance	Stained copper Braid 34 AWG. 8 ends / 16 carriers Minimum 95% Maximum 3L per every 305m. (1000 ft)
Covering	Material: Outside diameter	Teflon Nominal 7mm. (0.257inches)
Capacitance		Maximum 53,1 pF/m (16.2 pF/ft)
Impedance		107± 5% Ohm at 1 MHz.

1.6 CONNECTOR I/O 1

It is a 37-pin SUB-D type female connector to interface with the electrical cabinet.

Pin	SIGNAL AND FUNCTION	
1	0V.	External power input.
2	Jog Output	Output. Active in JOG and Play-Back modes.
3	Brake (X)	Output.
4	M Strobe	Output. The BCD coded outputs correspond to an M code.
5	Emergency	Output.
6	Fast (X) / JOG	Output. Fast feedrate for X. Open loop without servo systems.
7	Slow (X) / JOG	Output. Slow feedrate for X. Open loop without servo systems.
8	Direction (X) /JOG	Output. Moving direction for X. Open loop without servo systems.
9	In Position (X)	Output.
10	Feed Over. 1 / JOG	Input. For external axis feedrate override
11	Feed Over. 2 /JOG	Input. For external axis feedrate override
12	Reset	Input.
13	Home switch (X)	Input from the Machine Reference (home) switch.
14	Emergency Stop	Input.
15	Feed Hold	Input.
16	Cycle stop	Input.
17	Cycle start	Input.
18	Block skip	Conditional Input.
19	Manual Input	Input. The CNC behaves as a DRO.
20	MST80	BCD coded Output, weight 80
21	MST40	BCD coded Output, weight 40
22	MST20	BCD coded Output, weight 20
23	MST10	BCD coded Output, weight 10
24	MST08	BCD coded Output, weight 8
25	MST04	BCD coded Output, weight 4
26	MST02	BCD coded Output, weight 2
27	MST01	BCD coded Output, weight 1
28	CHASSIS	Connect all cable shields to this pin.
29	24V.	External power Input.
30	±10V	Analog output for X axis servo drive.
31	0V.	Analog output for X axis servo drive.
32	±10V	Analog output for Y axis servo drive.
33	0V.	Analog output for Y axis servo drive.
34	±10V	Analog output for the spindle drive.
35	0V.	Analog output for the spindle drive.
36		Not being used at this time.
37		Not being used at this time.

Attention:

The machine manufacturer must comply with the EN 60204-1 (IEC-204-1) regulation regarding the protection against electrical shock derived from defective input/output connection with the external power supply when this connector is not connected before turning the power supply on.

Do not manipulate the connectors with the unit connected to main AC power

Before manipulating these connectors, make sure that the unit is not connected to main AC power.

1.6.1 INPUTS OF CONNECTOR I/O 1

FEEDRATE OVERRIDE / JOG *Pins 10 and 11*

By means of these 2 inputs, it is possible to change the feedrate of the axes in JOG, Play-back, Execution and Single-Block modes.

Depending on the type of axis, the CNC acts as follows:

Pin		***Servocontrolled axes***		***Non-servocontrolled axes***
10	11	(G01/G02/G03)	(G00)	Range
1	1	25%	25%	Slow range
1	0	50%	50%	Ignored
0	0	100%	100%	Ignored
0	1	If "P101(8)=0" 200% If "P101(8)=1" 0%	100%	Slow range

Pin OFF = 0, ON = 1

When using the external operator panel "JOG 100", these inputs are treated differently as described in its corresponding section later on in this chapter.

Attention:

When operating in open loop with servo drives, the feedrate override goes into effect on the next movement and not on the current one.

RESET *Pin 12*

This input must be normally low (0V).

When set high, the CNC assumes the pre-established initial conditions. It acts as if the **[RESET]** were pressed.

When machine parameter "P30" is set to a value other than "0", the CNC **HOMES** the axes whenever a leading edge (transition from low to high) is detected at this input.

X AXIS HOME SWITCH *Pin 13*

This input must be high (24V) as long as the X axis home switch is pressed.

EMERGENCY STOP *Pin 14*

This input must be normally high (24V).

When set low, the CNC cancels the analog outputs for the axes, sets the brake signal low to prevent the axes from moving, interrupts the execution of the part-program and displays error 17 at the lower window. **It does not activate the external Emergency Output (pin 5 of this connector).**

See connection diagram in the chapter on "Power and Machine interface" in this manual.

FEED HOLD *Pin 15*

This input must be normally high and its meaning depends on the type of block or function being executed.

* If while moving the axes, this signal (FEED HOLD) is set low (0V), the CNC maintains the spindle turning and stops the axes by bringing their analog voltages to 0V while maintaining the brake signals high (24V = brake off).

  When this signal returns high, the CNC will resume the movement of the axes.

* When machine parameter "P22(5) = 1", the CNC waits for the electrical cabinet to process the requested M function and set the FEED HOLD signal high.

  See the section on "Transfer of auxiliary functions M, S, T" in the chapter on "Concepts" later on in this manual.

CYCLE STOP *Pin 16*

This input must be normally high (24V).

When setting this input low, the CNC stops program execution. Its treatment is identical to that of the key.

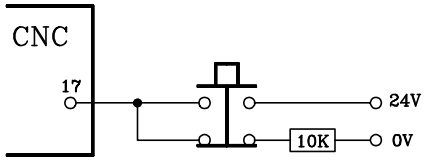
To resume program execution, this input must be set high again and, then, the key must be pressed.

CYCLE START *Pin 17*

This input must be normally low (0V).

If a leading edge (low-to-high transition) is detected at this input while in Automatic or Single-Block mode, the CNC behaves as if the key were pressed.

When inactive, this input must be connected to 0V through a 10KOhm resistor.



BLOCK SKIP (CONDITIONAL) INPUT *Pin 18*

Every time the CNC executes the miscellaneous function M01 (conditional stop), it analyzes the status of this input. If high (24V), the CNC will interrupt the execution of the program.

By the same token, every time the CNC must execute a conditional block, it will analyze the status of this input and it will execute the block if this input is high (24V) or skip it if low (0V).

MANUAL INPUT (DRO Mode) *Pin 19*

If while in the JOG mode, this input is set high, the CNC will behave as a DRO.

However, although the CNC has "freed" the axes, the electrical cabinet must disable the axes so they can be moved manually.

1.6.2 OUTPUTS OF CONNECTOR I/O 1

JOG OUTPUT *Pin 2*

This output is set high (24V) whenever the CNC is either in JOG or Play-Back mode.

X AXIS BRAKE *Pin 3*

This output is set high (24V) to indicate that the axis may be moved (brake off). When low (0V), the axis must be braked.

M Strobe *Pin 4*

This output is set high when the activated BCD outputs (pins 20 through 27) correspond to an auxiliary "M" function.

EMERGENCY *Pin 5*

This output is normally high (24V).

This output is set low whenever an internal alarm or emergency occurs.

FAST (X) / JOG *Pin 6*
SLOW (X) / JOG *Pin 7*
DIRECTION (X) / JOG *Pin 8*

When operating in Open Loop without servo systems, these outputs indicate the feedrate to be selected (fast or slow) as well as the moving direction for the X axis.

When using the external operator panel "JOG 100", these inputs are treated differently as described in its corresponding section later on in this chapter.

IN POSITION (X) *Pin 9*

The CNC sets this output high (24V) to indicate that the X axis has reached its programmed position.

There are several machine parameters to indicate the length of this signal, when to be activated, etc. as described in the section on "Concepts" later on in this manual.

MST80 *Pin 20*
MST40 *Pin 21*
MST20 *Pin 22*
MST10 *Pin 23*
MST08 *Pin 24*
MST04 *Pin 25*
MST02 *Pin 26*
MST01 *Pin 27*

The CNC uses these outputs to indicate to the electrical cabinet that an M, S or T function has been selected.

This information is BCD coded and the significance (weight) of each output is expressed by the corresponding mnemonic.

For example, to select the first spindle speed range, the CNC sends the M41 code out to the electrical cabinet.

MST80	**MST40**	MST20	MST10	MST08	MST04	MST02	**MST01**
0	**1**	0	0	0	0	0	**1**

Together with these signals, the CNC will activate the "M Strobe", "T Strobe" or "S Strobe" output to indicate the type of function being selected.

X axis analog output ±10V. *Pin 30*
X axis analog output 0V. *Pin 31*

These outputs provide the analog voltage for the X axis servo drive. The cable used for this connection must be shielded.

Y axis analog output ±10V. *Pin 32*
Y axis analog output 0V. *Pin 33*

These outputs provide the analog voltage for the Y axis servo drive. The cable used for this connection must be shielded.

Spindle analog output ±10V. *Pin 34*
Spindle analog output 0V. *Pin 35*

These outputs provide the analog voltage for the spindle drive. The cable used for this connection must be shielded.

1.7 CONNECTOR I/O 2

It is a 25-pin SUB-D type female connector to interface with the electrical cabinet.

Pin	SIGNAL AND FUNCTION	
1	0V.	External power supply input.
2		*Not being used at this time.*
3	Fast (Y) / JOG	Output. Y axis fast feedrate. Open Loop without servo systems.
4	T Strobe	Output. The BCD outputs (I/O1) correspond to a tool Number.
5	Slow (Y)	Output. Y axis slow feedrate. Open Loop without servo systems.
6	S Strobe	Output. The BCD outputs (I/O1) correspond to a spindle speed
7	Brake (Y)	Output.
8	Direction (Y)	Output. Y axis moving direction. Open Loop without servo systems.
9	In Position (Y)	Output. Y axis currently in position.
10	Automatic	Output. Automatic mode selected.
11		*Not being used at this time.*
12		*Not being used at this time.*
13		*Not being used at this time.*
14		*Not being used at this time.*
15	Mul. Factor. Handw.	Input. Handwheel multiplying Factor or JOG type positioning
16	CHASSIS	Connect all cable shields to this pin.
17	Input E5	Input assignable to a parameter, Double feedback input or auxiliary handwheel input.
18	Home switch (Y)	Input. Y axis Machine Reference (home) switch.
19		*Not being used at this time.*
20	24V.	External power supply input.
21	Input E1	Input which may be assigned to an arithmetic parameter.
22	Input E3	Input which may be assigned to an arithmetic parameter.
23	Input E2	Input which may be assigned to an arithmetic parameter.
24	Mul. Factor. Handw.	Input. Handwheel multiplying Factor or JOG type positioning
25	Input E4	Input assignable to a parameter or auxiliary handwheel input.

Attention:

The machine manufacturer must comply with the EN 60204-1 (IEC-204-1) regulation regarding the protection against electrical shock derived from defective input/output connection with the external power supply when this connector is not connected before turning the power supply on.

Do not manipulate the connectors with the unit connected to main AC power

Before manipulating these connectors, make sure that the unit is not connected to main AC power.

1.7.1 INPUTS OF CONNECTOR I/O 2

Multipl. Factor / Handwheel *Pin 15*
Multipl. Factor / Handwheel *Pin 24*

When using an electronic handwheel, machine parameter "P60(4)=1", These 2 inputs indicate the multiplying factor that the CNC applies to the pulses coming from the electronic handwheel.

The axis moving distance is a result of multiplying the handwheel pulses by this factor.

Pin		***Multiplying Factor***	***Example: 250 lines/turn***
24	15		Distance per turn
0	0	x 1	0.250 mm or 0.0250"
0	1	x 10	2.500 mm or 0.2500"
1	0	x 50	12.50 mm or 1.2500"
1	1	x 100	25.00 mm or 2.500"

Pin activated = 1
deactivated = 0

When not using an electronic handwheel, machine parameter "P60(4)=0", These 2 inputs indicate the type of jogging movement obtained.

Pin		JOG type	Moving distance
24	15		
0	0	Continuous	
0	1	Incremental	0.001 mm or 0.0001"
1	0	Incremental	0.010 mm or 0.0010"
1	1	Incremental	0.100 mm or 0.0100"

Pin activated = 1
deactivated = 0

When using the external operator panel "JOG 100", these inputs are treated differently as described in the corresponding section of this chapter.

Y AXIS HOME SWITCH *Pin 18*

This input must be high (24V) as long as the Y axis Machine Reference (home) switch is pressed.

INPUT E1	*Pin 21*	**INPUT E2**	*Pin 23*
INPUT E3	*Pin 22*	**INPUT E4**	*Pin 25*
INPUT E5	*Pin 17*		

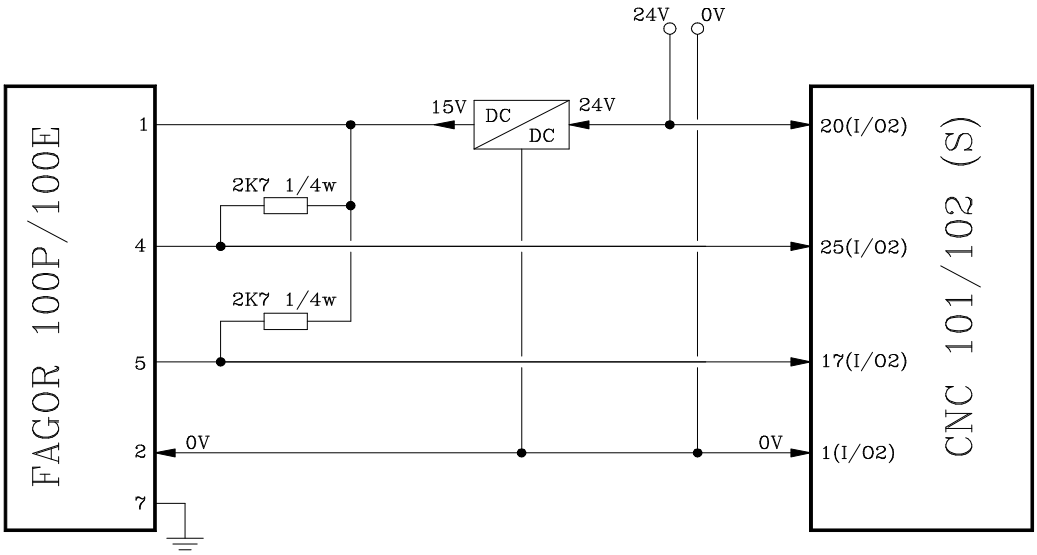
By means of parametric programming, it is possible to assign the status of each one of these inputs to any arithmetic parameters.

When the input status is high, the value assigned to the parameter will be "1" and "0" when the input status is low.

When using one axis with double feedback, input E5 determines whether the CNC uses feedback connector A1 or A2 to close the position loop of the axis. See section "Parameters related to Double Feedback" of this manual.

When an auxiliary electronic handwheel is available, machine parameter "P102(8)=1", inputs E4 and E5 must be connected to signals A and B of handwheel feedback.

Diagram for adapting Fagor handwheel 100P/100E signals.



1.7.2 OUTPUTS OF CONNECTOR I/0 2

T Strobe *Pin 4*

This output is set high when the activated BCD outputs (pins 20 through 27 of connector I/O1) correspond to a tool number (T function).

S Strobe *Pin 6*

This output is set high when the activated BCD outputs (pins 20 through 27 of connector I/O1) correspond to a spindle speed (S function).

Y AXIS BRAKE *Pin 7*

This output is set high (24V) to indicate that the axis may be moved (brake off). When low (0V), the axis must be braked.

FAST (Y) / JOG *Pin 3*
SLOW (Y) *Pin 5*
DIRECTION (Y) *Pin 8*

When operating in Open Loop without servo systems, these outputs indicate the feedrate to be selected (fast or slow) as well as the moving direction for the X axis.

When using the external operator panel "JOG 100", the "fast Y / JOG" input (pin 3) is treated differently as described in its corresponding section later on in this chapter.

IN POSITION (Y) *Pin 9*

The CNC sets this output high (24V) to indicate that the Y axis has reached its programmed position.

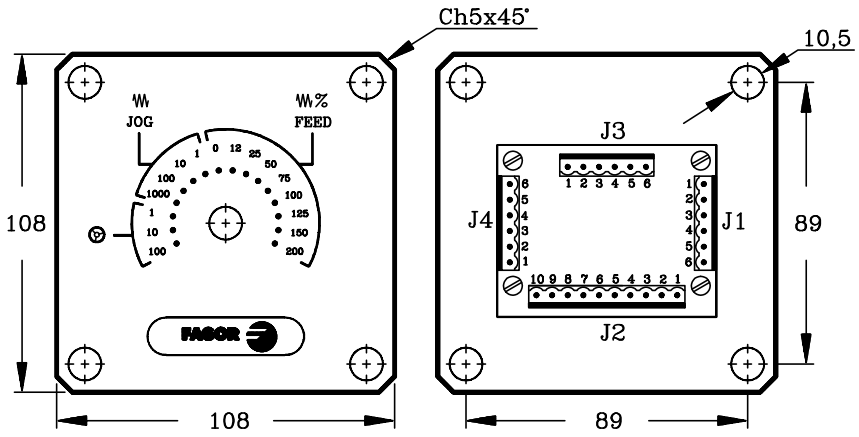
There are several machine parameters to indicate the length of this signal, when to be activated, etc. as described in the section on "Concepts" later on in this manual.

AUTOMATIC *Pin 10*

This output is set high whenever the Automatic operating mode is selected.

1.8 EXTERNAL OPERATOR PANEL "JOG 100"

It is an optional device that permits overriding the feedrate of the axes (%FEED), set the incremental jogging distance for them and select the multiplying factor for the handwheel pulses.



When the "JOG 100" external operator panel is used, one has to:

- Set machine parameter "P101(1)=1".
- Supply connector I/O1 and connector I/O2 (both) with 24 Vdc.

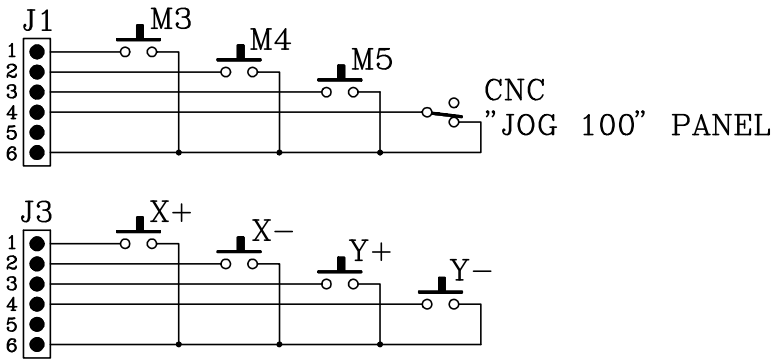
The "JOG 100" must be connected to the CNC via connector "J2" as shown here.

CNC		**Operator panel**
Connector I/O1	*Connector I/O2*	*Connector J2*
	15	1
	24	2
11		3
10		4
		5
	3	6
6		7
7		8
8		9
		10

It is also possible to use connectors "J1" and "J3" to utilize external control keys. Connector "J4" is not being used at this time.

Connector J1	
Pin	*Function*
1	M3 (Spindle clockwise)
2	M4 (Spindle counter-clockwise)
3	M5 (Spindle stop)
4	JOG/CNC Selector
5	Not being used
6	Common

Connector J3	
Pin	*Function*
1	X+ Key
2	X- Key
3	Y+ Key
4	Y- Key
5	Not being used
6	Common



When the switch is at the "JOG 100 PANEL" position, the CNC selects the JOG mode and does not let the operator select any other mode from the CNC keyboard.

When the switch is at the CNC position, it recovers its normal operation enabling the whole CNC keyboard.

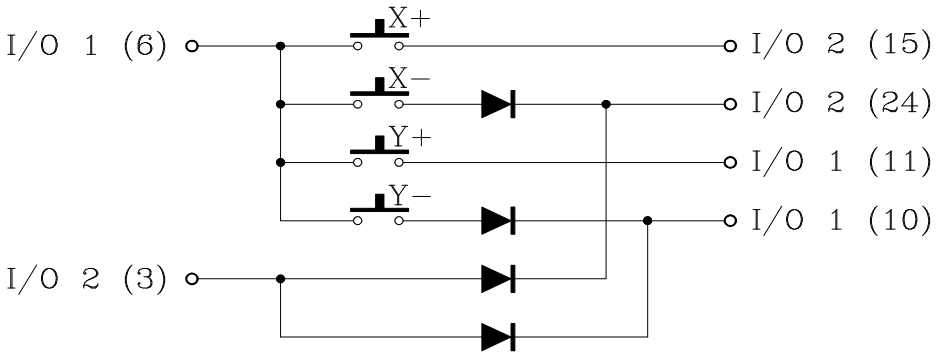
Regardless of the selected switch position, each one of the external keys allow governing the machine at all times as follows:

KEY	***COMMAND***
M3	Start the spindle clockwise
M4	Start the spindle counter-clockwise
M5	Stop the spindle
X+	Jog the X axis in the positive direction
X-	Jog the X axis in the negative direction
Y+	Jog the Y axis in the positive direction
Y-	Jog the Y axis in the negative direction

1.8.1 EXTERNAL KEYS WITHOUT "JOG 100" OPERATOR PANEL

The CNC allows external control keys "X+", "X-", "Y+", "Y-" to be used without making use of the "JOG 100" external operator panel.

For this purpose machine parameter "P101(1)=1" must be used as well as making the following connections:



Notes: The feedrate of the axes, FEED, is 100% fixed and it is not possible to operate in incremental mode (JOG) nor use an electronic handwheel.

The nomenclature "I/O 1 (6)" means that pin 6 of I/O 1 connector must be connected.

The diodes must be of the 1N4148 type or equivalent.

2. *POWER AND MACHINE INTERFACE*

Attention:

Power switch

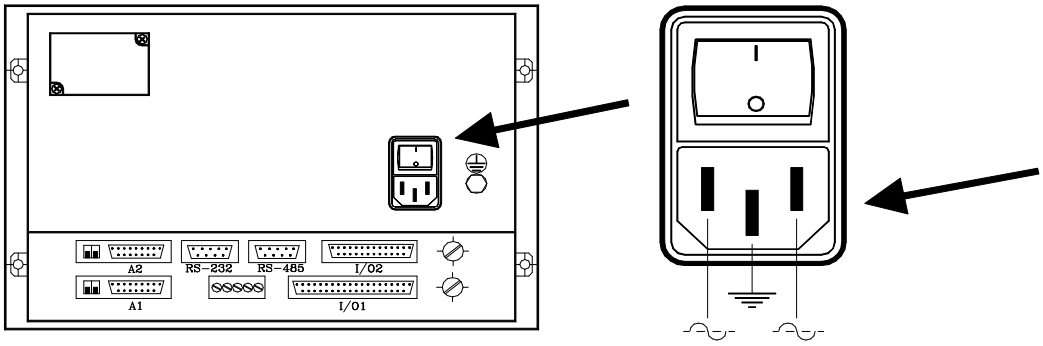
This power switch must be mounted in such a way that it is easily accessed and at a distance between 0.7 meters (27.5 inches) and 1.7 meters (5.5 ft) off the floor.

Install this unit in the proper place

It is recommended to install the CNC away from coolants, chemical products, possible blows etc. which could damage it.

2.1 POWER INTERFACE

The rear of the CNC has a three-prong connector for AC and ground connection.



This connection must be done through an independent shielded 110VA transformer with an AC output voltage between 100V and 240V +10% -15%.

The power outlet to connect the equipment must be near it and easily accessible.

In case of overload or overvoltage, it is recommended to wait for 3 minutes before powering the unit back up in order to prevent any possible damage to the power supply.

2.2 MACHINE INTERFACE

2.2.1 GENERAL CONSIDERATIONS

All those elements of the machine capable of generating interference (relay coils, contactors, motors, etc.) must be decoupled.

* D.C. Relay coils.

  Diode type 1N4000.

* A.C. relay coils

  RC connected as close as possible to the coils. Their approximate values should be:

  R 220 Ohms/1W
  C 0,2 µF/600V

* A.C. motors.

  RC connected between phases with values:

  R 300 Ohms/6W
  C 0,47µF/600V

Ground connection.

It is imperative to carry out a proper ground connection in order to achieve:

* Protection of anybody against electrical shocks caused by a malfunction.

* Protection of the electronic equipment against interference generated by the proper machine or by other electronic equipment near by which could cause erratic equipment behaviour.

Therefore, it is crucial to install one or two ground points where the above mentioned elements must be connected.

Use large section cables for this purpose in order to obtain low impedance and efficiently avoid any interference. This way, all parts of the installation will have the same voltage reference.

Even when a proper **ground** connection reduces the effects of electrical interference (noise), the signal cables require additional protection.

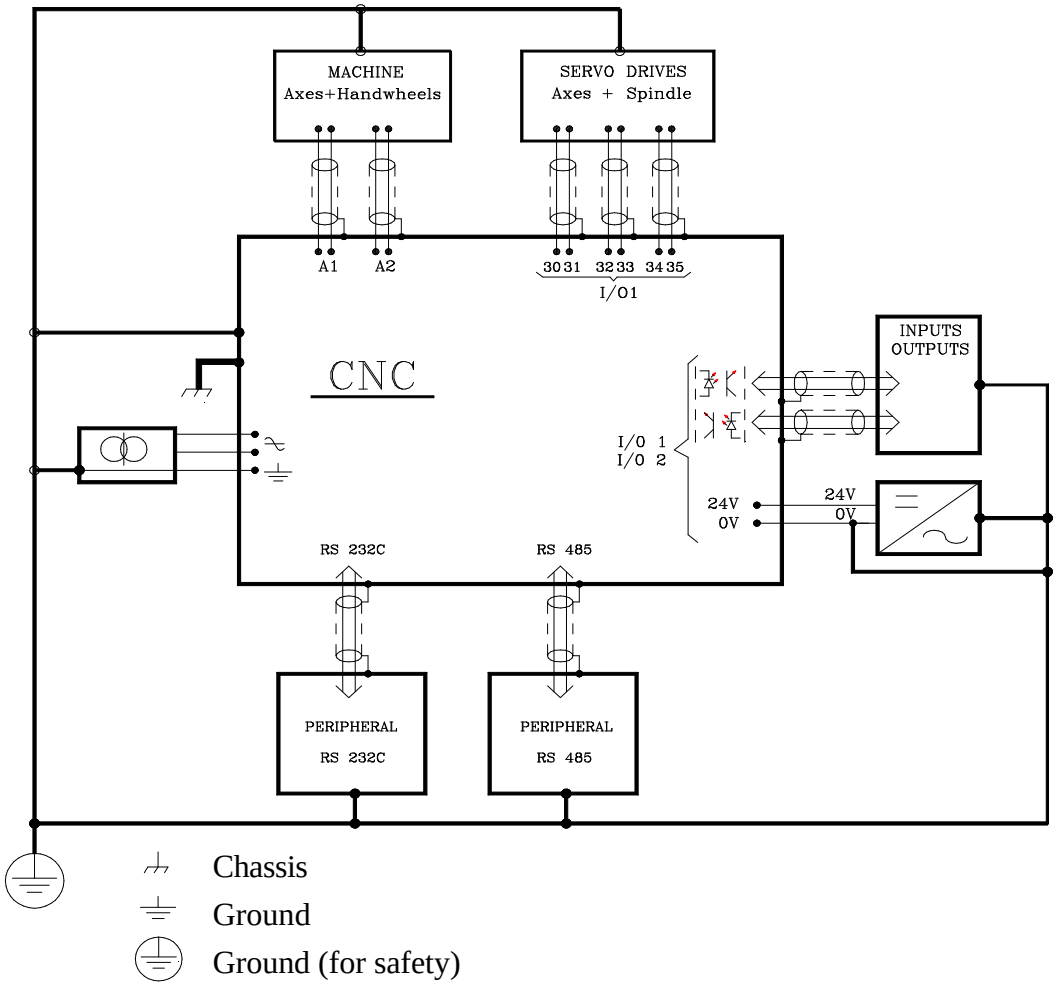
This is generally achieved by using twisted-pair cables which are also covered with anti-static shielding mesh-wire. This shield must be connected to a specific point avoiding **ground loops** that could cause undesired effects. This connection is usually done at one of the CNC's ground points.

Each element of the whole system must be connected to ground via the established main points. These points will be conveniently set close to the machine-tool and properly connected to the general ground (of the building).

When a second point is necessary, it is recommended to join both points with a cable whose section is not smaller than 8 mm² (or 2 cables of 4 mm²).

Verify that the impedance between the central point of each connector housing and the main ground point is less than 1 Ohm.

Ground connection diagram



2.2.2 DIGITAL OUTPUTS.

The CNC has several optocoupled digital outputs which may be used to activate relays, deacons, etc.

These digital outputs, with galvanic isolation by optocouplers, can commutate D.C. voltages supplied by the electrical cabinet of the machine.

The external D.C. power supply used to power the digital outputs must be regulated.

Nominal voltage: +24 Vdc Voltage range: +18 Vdc to +30 Vdc.

The electrical characteristics of the outputs are:

Output voltage	Vcc.- 2V
Maximum output current	100 mA.

All outputs are protected by means of:

Galvanic isolation by optocouplers.
External 3A fuse for protection against output overload (greater than 125mA), external power supply overvoltage (over 33V DC) and against reverse connection of the external power supply.

2.2.3 DIGITAL INPUTS.

The digital inputs of the CNC are to used to "read" external devices.

All of them are galvanically isolated from the outside world by optocouplers.

The electrical characteristics of these inputs are:

Nominal voltage value	+24 V DC
Maximum voltage value	+30 V.
Minimum voltage value	+18 V.
High threshold voltage (logic state 1) over	+18V.
Low threshold voltage (logic state 0) under	+5V.
Typical input consumption	5 mA.
Maximum consumption per input	7 mA.

All inputs are protected by means of:

Galvanic isolation by optocouplers.
Protection against reverse connection of the power supply up to -30V.

Attention:

The external 24V power supply used for the digital inputs and outputs must be regulated.

The 0V point of this power supply must be connected to the main ground point of the electrical cabinet.

2.2.4 ANALOG OUTPUTS.

The CNC has 3 analog outputs which could be used to command servo drives and the spindle drive.

The electrical characteristics of these outputs are:

Analog voltage range:	±10V.
Minimum impedance of the connected drive:	10 KOhm.
Maximum cable length without shield:	75 mm.

It is highly recommended to use the shielded cable connecting the shield to the corresponding pin of the connector.

Attention:

It is recommended to adjust the servo drives so their maximum feedrate (G00) is obtained at ±9.5 V.

2.2.5 FEEDBACK INPUTS

The feedback inputs are used to receive sine-wave, single-ended and double-ended square-wave signals coming from linear or rotary transducers (encoders).

Connector A1 is used for the X axis feedback signals and it accepts sine-wave and double-ended (differential) square-wave signals.

Connector A2 is used for the feedback signals from the Y axis or from the handwheel and it accepts sine-wave and double-ended (differential) square-wave signals.

The electrical characteristics of these inputs are:

Sine-wave signals	Supply voltage	±5V. ±5%
	Maximum counting frequency	50KHz.
Square-wave signals	Supply voltage	±5V.±5%
	Maximum counting frequency	200KHz.

It is recommended to use shielded cables for their connection connecting the shield to the corresponding pin of the connector (at the CNC side).

2.3 SET-UP

2.3.1 GENERAL CONSIDERATIONS

Inspect the whole electrical cabinet verifying the ground connections BEFORE powering it up.

This ground connection must be done at a single machine point (Main Ground Point) and all other ground points must be connected to this point.

Verify that the 24V external power supply used for the digital inputs and outputs is REGULATED and that its 0V are connected to the Main Ground Point.

Verify the connection of the feedback system cables to the CNC.

DO NOT connect or disconnect these cables to/from the CNC when the CNC is on.

Look for short-circuits in all connectors (inputs, outputs, axes, feedback, etc.) BEFORE supplying power to them.

2.3.2 PRECAUTIONS

It is recommended to reduce the axis travel installing the limit switches closer to each other or detaching the motor from the axis until they are under control.

Verify that there is no power going from the servo drives to the motors.

Verify that the connectors for the digital inputs and outputs are disconnected.

Verify that the feedback dip-switches for each axis are set according to the type of feedback signal being used.

Verify that the E-STOP button is pressed.

2.3.3 CONNECTION

Verify that the AC power is correct.

Being the CNC disconnected, power the electrical cabinet and verify that it responds properly.

Verify that there is proper voltage between the pins corresponding to 0V and 24V of the connectors for the digital inputs and outputs.

Apply 24V to each one of the terminals of the electrical cabinet being used that correspond to the digital outputs of the CNC and verify their correct performance.

With the motors decoupled from the axes, verify that the system consisting of drive, motor and tacho is operating properly.

Connect the AC power to the CNC.

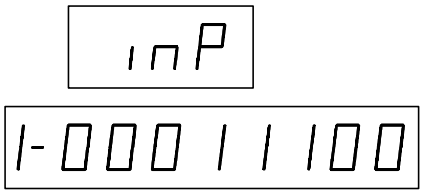
After a self-test and depending on the setting of machine parameter "P35", the CNC will get into either the automatic or the jog mode. If there is any problem, the CNC will display the corresponding error message.

2.3.4 SYSTEM I/O TEST

In this operating mode it is possible to check the status of the logic inputs and outputs of the CNC as well as activating and deactivating each one of its logic outputs.

To do this, press the following keystroke sequence: **[AUX MODE] [0]**

The bottom display shows the status of the first group of 8 inputs (INP).



Each digit corresponds to 1 input.

Bottom Display	Digit 8	Digit 7	Digit 6	Digit 5	Digit 4	Digit 3	Digit 2	Digit 1

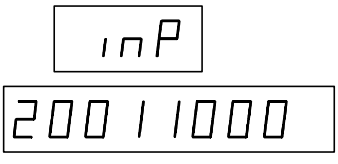
The CNC will show dynamically at all times the status of these inputs. To check a particular one, actuate its corresponding external push-button or switch and watch the status of its corresponding digit on the LED display.

A value of "1" indicates that the corresponding input is receiving 24V. If not, it will show a value of "0".

The inputs (INP) shown at the bottom display are:

Digit	***Corresponding Input***	***Pin***
8	Manual Input (DRO mode)	19 (I/O1)
7	Conditional Stop (M01) / Block Skip	18 (I/O1)
6	Cycle Start	17 (I/O1)
5	/ Cycle Stop	16 (I/O1)
4	/ Feed Hold	15 (I/O1)
3	/ Emergency Stop	14 (I/O1)
2	X axis Home switch	13 (I/O1)
1	Reset	12 (I/O1)

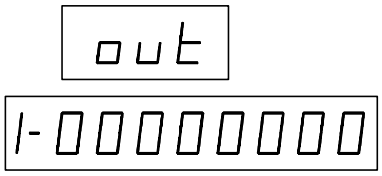
By pressing **[A+]** This display shows the next group of 8 inputs (INP).



Digit	***Corresponding Input***	***Pin***
8	External feedrate override 2	11 (I/O1)
7	External feedrate override 1	10 (I/O1)
6	X axis feedback error	
5	Y axis feedback error	
4	X axis sine-wave feedback alarm	
3	Y axis sine-wave feedback alarm	
2	Over-temperature	
1	Not being used at this time	

The information shown by digits 6, 5, 4, 3, 2 and 1 is internal CNC data.

By pressing **[A+]** again, this display shows the first group of 8 outputs (OUT).



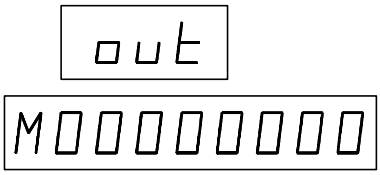
Digit	*Corresponding Output*	*Pin*
8	X axis In Position	9 (I/O1)
7	X axis Direction (Open Loop)	8 (I/O1)
6	X axis Slow (Open Loop)	7 (I/O1)
5	X axis Fast (Open Loop)	6 (I/O1)
4	/ Emergency	5 (I/O1)
3	M Strobe	4 (I/O1)
2	X axis Brake	3 (I/O1)
1	Jog mode selected	2 (I/O1)

To check a particular output, select it by means of the up and down arrow keys.

Once the desired output is selected, one may activate it by pressing **[1]** or deactivate it by pressing **[0]**.

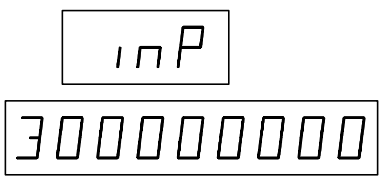
Several outputs may be ON at the same time and they will all provide 24V DC at their corresponding pins.

By pressing **[A+]**, this display shows the next group of 8 outputs (OUT).



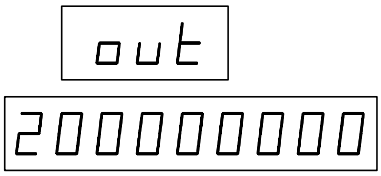
Digit	*Corresponding Output*	*Pin*
8	MST80	20 (I/O1)
7	MST40	21 (I/O1)
6	MST20	22 (I/O1)
5	MST10	23 (I/O1)
4	MST8	24 (I/O1)
3	MST4	25 (I/O1)
2	MST2	26 (I/O1)
1	MST1	27 (I/O1)

By pressing **[A+]** the display shows the **third** group of **INPUTS**.



Digit	*Corresponding Input*	*Pin*
8	E5	17 (I/O2)
7	E4	25 (!/O2)
6	E3	22 (I/O 2)
5	E2	23 (I/O 2)
4	E1	21 (I/O 2)
3	Mult. factor, handw. or JOG type posit.	24 (I/O 2)
2	Mult. factor, handw. or JOG type posit.	15 (I/O 2)
1	Y axis home switch	18 (I/O 2)

By pressing **[A+]** again, this display shows the **next** group of **OUTPUTS**.

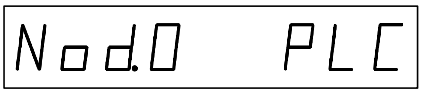


Digit	*Corresponding Output*	*Pin*
8	Y axis In Position	9 (I/O 2)
7	Y axis direction (Open Loop)	8 (I/O 2)
6	Y axis Slow (Open Loop)	5 (I/O 2)
5	Y axis Fast (Open loop)	3 (I/O 2)
4	T Strobe	4 (I/O 2)
3	S Strobe	6 (I/O 2)
2	Y axis Brake	7 (I/O 2)
1	Automatic	10 (I/O 2)

By pressing **[A+]** this display shows the CHECKSUM corresponding to the software version installed in the CNC. The example on the right shows a checksum of **08AF** for the CNC model **102S.**

By pressing **[A+]**, if the CNC is an element of the Fagor Local Area Network (LAN), it will show which other LAN elements are connected to each LAN node. Use the **[A+]** to see the next node. The displayed data looks like this:

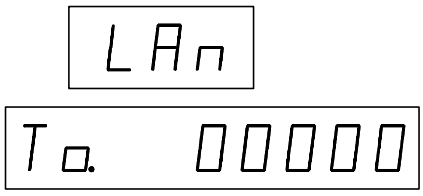
The top display reads "LAN"



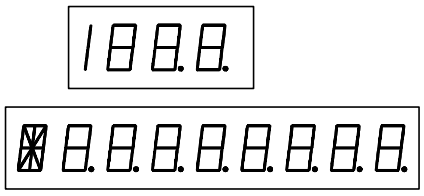
The bottom displays indicates the node number (Node 0 in this case) and the element occupying it (in this case a PLC).

The CNC models: 82, 101S, 102 and 102S are considered by the LAN as members of the same family. For this reason, it shows as "Nod.0? CN82.

By pressing **[A+]** again, if the CNC is a FAGOR LAN element, the CNC will show the number of lost tokens.
The displayed data looks like this:



By pressing **[A+]** again, all LED segments light up indicating the end of the system I/O test.



If **[A+]** is pressed again, the CNC will start the system I/O test all over.

2.4 EMERGENCY INPUT/OUTPUT CONNECTION

The Emergency Input of the CNC is called EMERGENCY STOP (E-STOP) and corresponds to pin 14 of connector I/O1. This input must normally have 24V DC.

The CNC processes this signal directly, therefore, whenever these 24V disappear, it will issue Error 17), it will deactivate the axes enables and cancel the analog voltages for all the axes and the spindle. **It does NOT imply the emergency output (pin 5).**

The electrical cabinet interface must take into account all the external elements that could cause this error.

For example, some of these elements may be:

* The E-Stop button has been pressed.

* An axis travel limit switch has been pressed.

* An axis servo drive is not ready.

On the other hand, whenever a CNC detects an internal emergency error, it will activate the EMERGENCY OUTPUT at pin 5 of connector I/O1.

Some of the internal causes which can activate this output are:

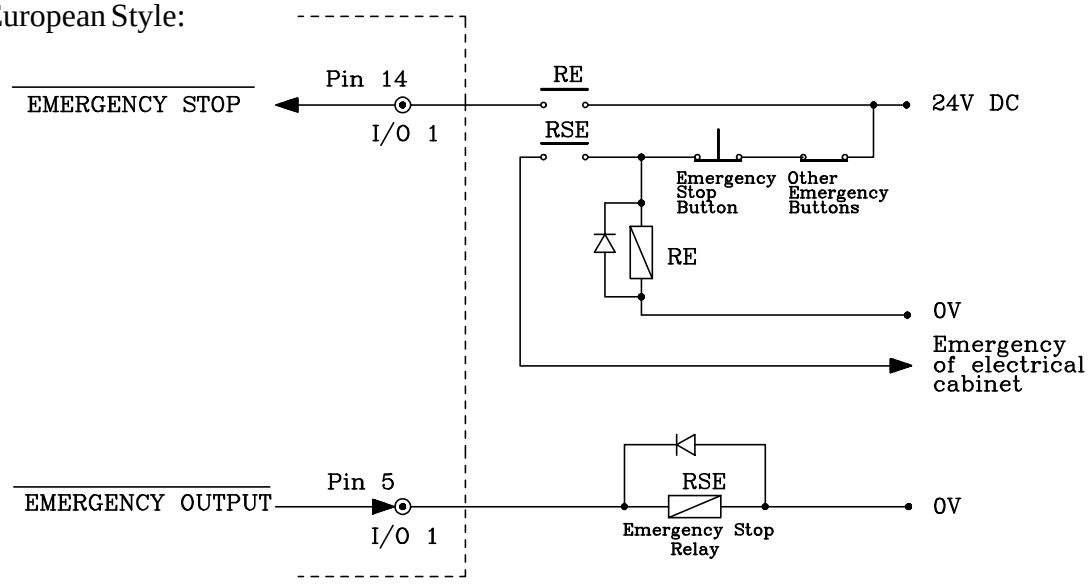
* An excessive axis following error (axis lag) has occurred.

* An axis feedback error has occurred.

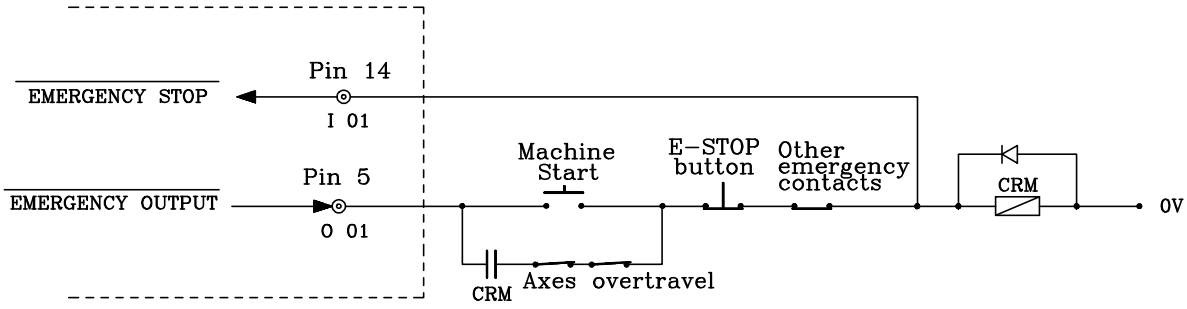
* There is erroneous data on the machine parameter table.

The recommended connection is:

European Style:



USA Style:


Pin 14
EMERGENCY STOP
I 01
Machine
Start
E-STOP
button
Other
emergency
contacts
CRM
Pin 5
EMERGENCY OUTPUT
O 01
0V
CRM
Axes overtravel

3. *MACHINE PARAMETERS*

Attention:

All unused machine parameters must be set to "0" to guarantee the proper functioning of this CNC

It is recommended to save the machine parameters of this CNC at a peripheral device or computer in order to be able to recover them after their accidental loss.

Please note that some of the machine parameters mentioned here are described in greater detail in the chapter on "CONCEPTS" in this manual.

3.1 INTRODUCTION

On power-up, the CNC performs a system hardware test. When completed, depending on the value set for machine parameter "P35", it gets either in automatic or in Jog mode. In case of any error, it displays the corresponding error number.

The CNC must "know" the specific data for the machine such as feedrates, acceleration ramps, feedback devices, etc.

This data is determined by the machine manufacturer and may be input via keyboard or via the RS232C serial line by setting the machine parameters.

To enter the machine parameter values via keyboard, press the following keystroke sequence:

[AUX MODE] [1]

The top display will show the machine parameter number (0) and the bottom one will show its contents.

To display a particular parameter, use either one of these methods:

* Use the up and down arrow keys.

* Press **[CL]** twice to clear the current display, key in the desired parameter number and, then, press **[RECALL]**.

3.2 OPERATION WITH PARAMETER TABLES

To EDIT a parameter, once selected, one must:

* Press **[CL]** to clear the bottom display.

  Pressing **[CL]** again will clear the parameter number appearing on the top display.

* Press **[A+]** to access the data entry mode.

* Key in the desired value.

  Depending on the type of machine parameter selected, it will take one of the following types of values:

  * A figure P12 = 30000
  * A group of 8 bits P19 = 00001111

* Press **[ENTER]** to "enter" this value into the table.

If the CNC does not assume this new value and it shows the previous one, instead; it means that the **machine parameter table is locked**.

To **unlock** it, press the following keystroke sequence:

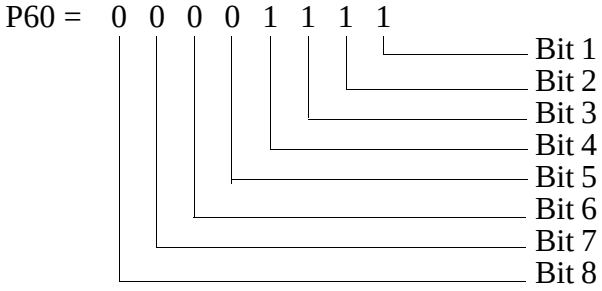
[AUX MODE] [1] [CL] [CL] [9] [9] [9] [A+] [0] [ENTER]

To **lock** it, if so desired, press the following keystroke sequence:

[AUX MODE] [1] [CL] [CL] [9] [9] [9] [A+] [1] [ENTER]

Once the machine parameters have been set, the **"RESET"** key must be pressed or the CNC must be powered down and back up in order for these new values to be assumed by the CNC.

When describing the various parameters throughout this manual, every time a parameter bit is referred to, the following nomenclature will be used:



Thus, P60(4) will refer to bit 4 of machine parameter P60.

3.3 GENERAL MACHINE PARAMETERS

P23(8) Measuring units (mm/inches)

It determines the measuring units assumed by the CNC for machine parameters, tool tables and work units at power-up and after emergency or RESET.

0 = Millimeters
1 = Inches.

P23(1) Theoretical or real display

It determines whether the CNC will display the real axis position or their theoretical position.

0 = It will display REAL position values.
1 = It will display THEORETICAL position values.

P63(4) X axis in radius or diameter

0 = Radius.
1 = Diameter.

P35 Operating mode active on power-up

It indicates whether the Automatic or the Jog mode will be selected by the CNC on power-up.

Possible values: Integers between 0 and 65535

* If set to more than 899, the Jog mode will be selected.

* If set to 899 or less, the CNC will get in Automatic mode and the block number indicated here will be selected.

  For example, if P35=10, the CNC will get in Automatic mode block 10 will be selected in such a way that if [{1}] is pressed, the CNC will start executing the program from this block on.

P60(5) Tool table or Zero Offset table

It indicates whether the CNC uses its internal table as a tool table or as Zero Offset table.

0 = Tool table.
1 = Zero Offset table.

The chapter on "The Aux mode of operation" of the operating manual describes the way to access this table and use it.

P71 Program protected from a specific block on

It indicates the block number from which the program will be write-protected.

Possible values: Integers between 0 and 899

* A value of "0" means that it is not protected, therefore, the whole program may be edited.

* If set to a value other than "0", for example P71=100, it means that block 100 and all the following ones cannot be edited.

P101(1) This CNC uses an external operator panel "JOG 100"

0 = It does **not** use an external operator panel
1 = Yes, it does.

P100(8), P100(7) Function G92 as coordinate "setting" for X and Y

When executing a G92 as coordinate **preset**, the CNC **stores** the distance from the new Part Zero to the Machine Reference Zero (home).

In certain applications such as cyclic rollers, when presetting many times, this distance may be too great and exceed the storage capacity of the CNC.

On this type of applications, it is possible to use function G92 to "set" the coordinates instead of "presetting" them without storing its distance from home.

Possible values:

0 = G92 as coordinate **preset** (**storing** its distance from home)
1 = G92 as coordinate **setting** (**not storing** its distance from home)

3.4 MACHINE PARAMETERS FOR AXIS CONFIGURATION

The feedback inputs available in the CNC are as follows:

Connector A1. Used to connect the feedback input of axis X.

Takes a sinusoidal signal and differential square-wave signal, and the machine parameter "P59(2)", section 4.1 has to be properly selected, as well as the two microswitches located beside the feedback input.

Connector A2. Used to connect the feedback input of axis Y, of the electronic handwheel or the spindle when there is rigid tapping, G33, but only for one of these devices.

Takes a sinusoidal signal and differential square-wave signal, and the machine parameter "P59(3)", section 4.1 has to be properly selected, as well as the two microswitches located beside the feedback input.

Connector I/O2, pins 17 and 25. Used to connect the feedback input of the auxiliary handwheel.

The auxiliary handwheel must be used when the feedback inputs A1 and A2 are occupied, either because the machine has 2 axes or because it has one axis and a spindle.

The possible configurations are:

CONFIGURATION					***PARAMETERS***			
X Axis	Y Axis	Rigid tapping	Handwheel	Auxiliary Handwheel	P60(8)	P63(3)	P60(4)	P102(8)
Yes	--	--	--	--	1	0	0	0
Yes	Yes	--	--	--	0	0	0	0
Yes	--	Yes	--	--	0	1	0	0
Yes	--	--	Yes	--	1	0	1	0
Yes	Yes	--	--	Yes	0	0	1	1
Yes	--	Yes	--	Yes	0	1	1	1

P60(8) The Y axis is not connected to this CNC

0 = The Y axis is connected to this CNC.
1 = The Y axis is **not** connected to this CNC.

P60(4) An electronic handwheel is being used

0 = **No** electronic handwheel is being used
1 = An electronic handwheel is being used

When using an electronic handwheel, there can be no Y axis nor rigid tapping. Consequently, machine parameter P60(8) must be set to "1" and P63(3) to "0."

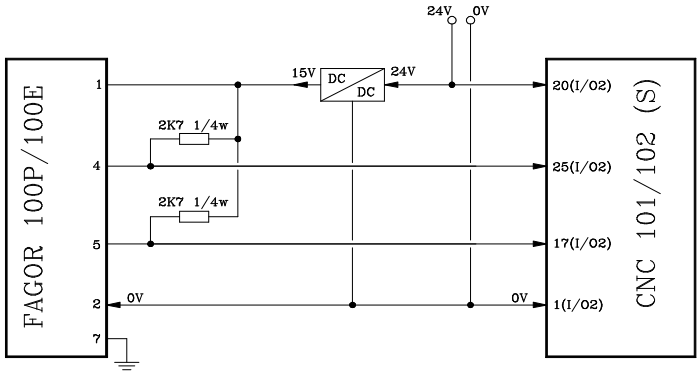
P102(8) The machine has an auxiliary handwheel

0 = The machine **may not** be used for auxiliary handwheel
1 = The machine **may be** used for auxiliary handwheel

The auxiliary handwheel must be used when feedback inputs A1 and A2 are occupied, either because the machine has 2 axes or because it has one axis and a spindle.

When the machine has an auxiliary handwheel "P102(8)=1", "P60(4)=1" must be set as well as connecting the handwheel feedback signals to pins 17 and 25 of connector I/O2

Diagram for using the Fagor 100P/100E as an auxiliary handwheel.



P63(3) The machine may be used for rigid tapping

0 = The machine **may not** be used for rigid tapping.
1 = The machine **may be** used for rigid tapping.

When the machine uses rigid tapping it cannot use an electronic handwheel, meaning that P60(8)=0 and P60(4)=0 must be set.

When using rigid tapping, the spindle feedback is connected to input A2 and the spindle analog output is provided via pins 34 and 35 of connector I/O1.

It is also necessary to set parameter P77 with the number of pulses (lines/turn) of the spindle encoder.

P77 Number of pulses (lines/turn) of the spindle encoder

This parameter must be set when controlling the spindle (as for rigid tapping, G33, etc).

It indicates the number of lines per turn of the rotary encoder of the spindle and it must be given by an integer between 0 and 9999.

P61(8), P61(7) The X, Y axis is DRO axis

It indicates whether the CNC treats the corresponding axis as a normal axis or as a DRO axis (to be moved manually).

0 = Normal CNC controlled axis.
1 = Manually moved DRO axis.

P22(6), P62(6) X, Y axis linear or rotary ROLLOVER

It indicates whether the axis is linear or rotary. When rotary, its count is set to 0º when reaching 360º (rollover).

0 = Linear.
1 = Rotary rollover.

Since a rotary rollover axis has no travel limits, their corresponding parameters (P0, P1 for X and P40, P41 for Y) must be set to "0". The home reference values (P2 for X and P42 for Y) must be between 0 and 360. The axes must operate in Closed Loop [P23(4)=1].

P21(1), P61(1) X, Y rotary axis positioning in the quickest direction

When rotary ["P22(6)=1 for X and P62(6)=1" for Y] those movements programmed in G90 may be made either in the programmed direction or in the quickest direction (via the shortest angular distance).

0 = It moves in the direction programmed with the sign.
1 = It always moves in the quickest direction not being possible to program negative position values.

P21(2), P61(2) X, Y rotary HIRTH axis

It determines whether the rotary axis has HIRTH toothing or not.

0 = It does **not** have HIRTH toothing.
1 = It has HIRTH toothing.

A HIRTH axis must be rotary ["P22(6)=1, P62(6)=1"].

It can only take whole degree (non-decimal) movements between 0º and 360º although the feedback resolution is given in thousandths of a degree

P23(6) Type of signal provided by the CNC to control the X and Y axes.

0 = Analog voltage output (for servo systems) ±10V DC.
Via pins 30, 31 (for X) and 32, 33 (for Y) of connector I/O1.
1 = Digital signals (24V DC) Fast, Slow and moving direction.
Via pins 6, 7, 8 of connector I/O1 for X and 3, 5, 8 of I/O2 for Y.

P23(4) Open or Closed Positioning Loops

0 = Open loop.
1 = Closed loop.

When using the Fast, Slow and direction signals, "P23(6)=1", this parameter must be set to "0" (Open Loop).

P102(1) The axes are denominated Y, C

0 = The axes are denominated X, Y
1 = The axes are denominated Y, C

This only affects the display, meaning that internally they are still called X, Y.
For this reason, when accessing the CNC via DNC100, the axes will always be X, Y.

3.5 I/O RELATED PARAMETERS

P22(7), P62(7) X, Y axis feedback alarm disabled.

This CNC will issue a feedback alarm on an axis when any of its corresponding feedback signals is missing or is out of its permitted range.

This parameter indicates whether this feedback alarm is active or not for the particular axis.

0 = The feedback alarm is **not** active.
1 = The feedback alarm is active.

When using only single ended feedback signals (non-differential: A, B, Io), the corresponding parameter must be set to "1" (alarm not active).

P23(7) BCD coded M function output

It indicates whether the M function output via pins 20 through 27 of connector I/O 1 will be decoded or BCD coded.

0 = Decoded M function output.
1 = BCD coded M function output.

The section on "Auxiliary functions" of the chapter on "Concepts" describes the CNC operation for both cases.

P22(4) The decoded "M" function outputs are maintained

It indicates whether the CNC maintains the decoded M function outputs ON once sent out or not (pulse).

0 = No, the M function outputs are not maintained. Only an ON/OFF pulse is sent out.
1 =Yes, they are maintained once they sent out.

P61(5) A "T" function does not generate a BCD-coded output

It indicates whether when executing a T function, the CNC activates the corresponding BCD outputs via pins 20 through 27 of connector I/O 1.

0 = Yes, it generates BCD-coded output.
1 = No, it does not generate BCD-coded output.

Attention:

When operating with maintained decoded "M" functions, it is better **NOT** to generate BCD coded T functions [P61(5)=1] since this would cancel the M function outputs.

P63(6) Touch probe pulse type

It indicates whether the touch probe supplies a positive pulse (low-to-high) or negative pulse (high-to-low) into connector A2.

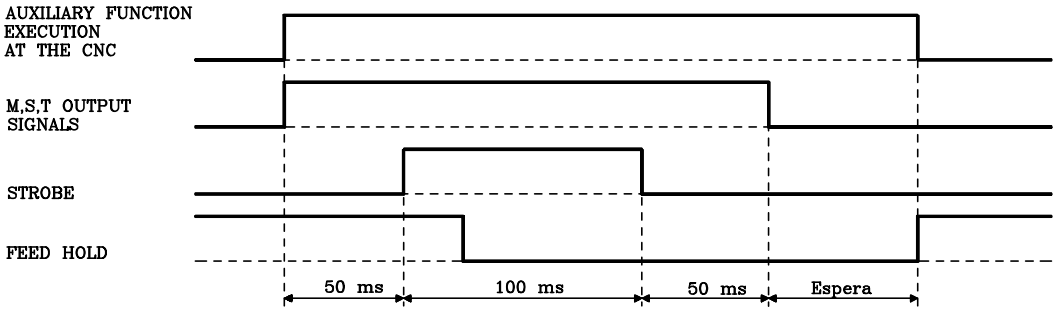
0 = Negative pulse (0V).
1 = Positive pulse (5V).

P22(5) "FEEDHOLD" input as a response to the "STROBE" signal

It indicates whether a down flank (trailing edge, high-to-low transition) of the FEEDHOLD input (pin 15 of I/O1) is required as a response to an "M STROBE", "T STROBE" or "S STROBE" signal in order for the CNC to resume the execution of these functions.

"P22(5)=0" ***The trailing edge of the Feedhold signal is not required***

The CNC will activate the BCD outputs corresponding to the "M", "S" or "T" function for 200 milliseconds. Then, if the Feedhold signal is not high (24V), it will wait for it to become high and consider the execution of the M, S, T function concluded.



If the Feedhold signal stays high (never goes low), the BCD outputs for the auxiliary functions will only be kept active for 200 milliseconds.

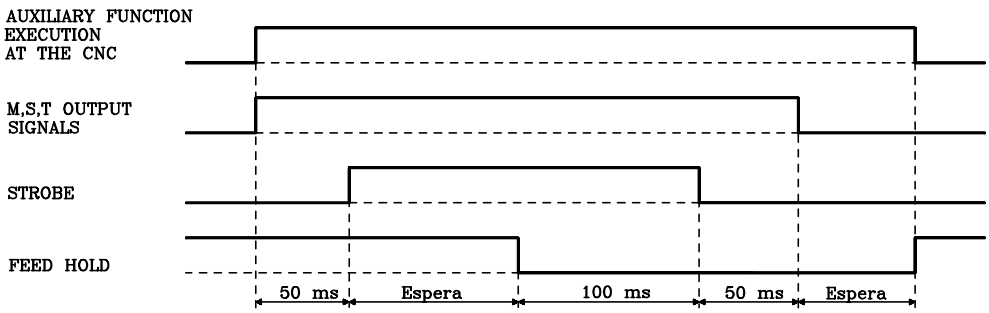
"P22(5)=1" ***The trailing edge of the Feedhold signal is required***

50 milliseconds after activating the BCD outputs corresponding to the M, S or T function, the CNC activates the corresponding "STROBE" output.

Next, if the Feedhold signal is high (24V), the CNC waits for it to go low (0V) and, once Feedhold is low, it keeps the Strobe signal high for another 100 ms.

Once the Strobe signal is off, the BCD outputs for M, S or T remain active for another 50 milliseconds.

After these 50 ms, if the Feedhold signal is not high, the CNC will wait for it to become high in order to consider the execution of the M, S, T function concluded.



P30 The RESET input activates the HOME function

With the HOME function, it is possible to make the CNC switch into Automatic mode, regardless of its current operating mode, and start executing the program from the block number indicated by this parameter (P30) whenever the RESET input is activated (pin 12 of connector I/O1).

If while executing a program, the RESET input is activated, the CNC interrupts the program and goes on to executing from the block indicated by "P30".

If "P30" is allocated a value greater than 899, the CNC ignores the HOME function and the RESET input behaves as such.

P21(8) HOME function only active during program execution

It indicates whether the HOME function is active in all operating modes or just during program execution.

0 = Active at all times regardless of the current operating mode.
1 = Active only while executing a program.

3.6 OPERATING MODE RELATED PARAMETERS

P19(8) The JOG mode not accessible

It indicates whether the JOG mode is accessible or not.

0 = Accessible.
1 = Not accessible.

P19(7) "CYCLE START", "CYCLE STOP" and "RESET" keys disabled

It indicates whether the CNC ignores these keys or not.

0 = Not ignored (Enabled).
1 = Ignored (Disabled)

P19(6) Peripheral mode not accessible

It indicates whether the Peripheral mode is accessible or not.

0 = Accessible.
1 = Not accessible.

P19(5) AUX-MODE not accessible

It indicates whether the AUX-MODE is accessible or not.

0 = Accessible.
1 = Not accessible.

Even when setting this parameter to "1", it is possible to access the AUX-MODE by holding the corresponding key pressed for about 4 seconds.

P19(4) PLAY BACK mode not accessible

It indicates whether the PLAY BACK mode is accessible or not.

0 = Accessible.
1 = Not accessible.

P100(5) General PLAY BACK or only for reading points

Indicates if the PLAY BACK operation mode allows all the functions defining a block to be defined or if it only allows the definition of blocks which contain the coordinates of axes X, Y.

0 = Allows all the functions defining a block to be edited.
1 = Only allows definition of blocks which contain the coordinates of axes X, Y

The edition mode in Play-Back is explained in section 4.3 of the Operating manual.

P19(3) Editing mode not accessible

It indicates whether the Editing mode is accessible or not.

0 = Accessible.
1 = Not accessible.

P19(2) Single block mode not accessible

It indicates whether the Single block mode is accessible or not.

0 = Accessible.
1 = Not accessible.

P19(1) Automatic mode not accessible

It indicates whether the Automatic mode is accessible or not.

0 = Accessible.
1 = Not accessible.

3.7 PROGRAMMING MODE RELATED PARAMETERS

P20(7) The E function may not be programmed

It indicates whether the E function may be programmed or not (parametric programming).

0 = Yes, it may be programmed.
1 = No, it may not.

P20(6) The P function may not be programmed

It indicates whether the P function may be programmed or not (parametric programming).

0 = Yes, it may be programmed.
1 = No, it may not.

P93 Number of arithmetic parameters which are displayed in each ten

When few arithmetic parameters are used the CNC allows only the first parameters of each ten to be displayed.

Examples:

With machine parameter "P93=0" the CNC will display all the arithmetic parameters

With machine parameter "P93=1" the CNC will display the following parameters:

P0-P1 P10-P11 P20-P21 P30-P31 ..... P90-P91

With the machine parameter "P93=2" the CNC will display the following parameters:

P0-P1-P2 P10-P11-P12 P20-P21-P22 P30-P31-P32 .... P90-P91-P92

P20(5) The K function may not be programmed

It indicates whether the K function may be programmed or not (parametric programming).

0 = Yes, it may be programmed.
1 = No, it may not.

P20(4) The M function may not be programmed

It indicates whether the M function may be programmed or not (auxiliary functions).

0 = Yes, it may be programmed.
1 = No, it may not.

P20(3) The T function may not be programmed

It indicates whether the T function may be programmed or not (Tool or Zero Offset).

0 = Yes, it may be programmed.
1 = No, it may not.

P20(2) The S function may not be programmed

It indicates whether the S function may be programmed or not (spindle speed).

0 = Yes, it may be programmed.
1 = No, it may not.

P20(1) The F function may not be programmed

It indicates whether the F function may be programmed or not (Axis feedrate).

0 = Yes, it may be programmed.
1 = No, it may not.

3.8 EXECUTION MODE RELATED PARAMETERS

P23(3) SEMI-AUTOMATIC operating mode

This parameters indicates how the CNC acts when executing a program in Automatic mode.

0 = Executes the program in a continuous cycle. Automatic mode.
1 = Executes the program in Semi-automatic mode.

In this mode, whenever a motion block has to be executed, it interrupts the program and waits for the CYCLE START key to be pressed at the operator panel or the External START input (pin 17 of I/O1) is set high before resuming the execution of the program.

P21(5) In Single block mode, the CNC displays the block to be executed

It indicates whether the CNC displays or not each block to be executed in Single block mode or the motion block to be executed in Semi-automatic mode, "P23(3)=1",

0 = No, the block contents are **not** displayed.
1 = Yes, the block contents are displayed.

P21(4) The M30 function increments the piece-counter

It indicates whether the CNC increments or not the counter for number of work-pieces (parts) every time an M30 is executed.

0 = No, it does not increment it.
1 = Yes it does.

P60(1) Vectored G00

It indicates whether the G00 movements will be interpolated (reaching the end point at the same time) or not.

0 = Non vectored G00 (each axis arrives to the end point at its own speed).
1 = Vectored G00 (all axes reach the end point at the same time).

P21(3) G90 or G91 on power-up

It indicates whether the CNC assumes G90 (absolute coordinate programming) or G91 (incremental coordinate programming) on power-up, after an M30, an EMERGENCY or RESET

0 = G90 (absolute coordinate programming)
1 = G91 (incremental coordinate programming)

P22(3) M30 when switching to Jog and Play-Back modes

It indicates whether or not an M function is generated when switching to Jog and Play-back modes.

0 = No M30 is generated
1 = An M30 is generated.

P101(2) The CNC limits the maximum Manual Feedrate Override to 100%

0 = No limit of maximum MFO value. Values greater than 100% possible.
1 = Limited maximum MFO. Values greater than 100% **not** possible.

P101(8) It is not possible to obtain 200% with feedrate override inputs

When not having an external operator panel "JOG 100", it is possible to override the feedrate through the inputs at pins 10 and 11 of connector I/O1.

This parameter indicates whether it is possible or not to apply a 200% override when using these feedrate override inputs.

Possible values with P101(8)=0	25%	50%	100%	and	200%
Possible values with P101(8)=1	25%	50%	100%	and	0%

4. *MACHINE PARAMETERS FOR THE AXES*

Atention:

Please note that some of the machine parameters mentioned here are described in greater detail in the chapters on "Power and machine interface" and on "Concepts" in this manual.

P22(1), P62(1) Sign of the analog voltage for X, Y

They define the sign of the analog voltage. If correct, leave them as they are and change them if otherwise.

P22(2), P62(2) Counting direction for X, Y

They define the counting direction for the axes. If correct, leave them as they are and change them if otherwise.

Bear in mind that when modifying this parameter, the one corresponding to the sign of the analog voltage must also be changed to prevent the axis from running away "P22(1) for X and P62(1)" for Y.

P23(2), P63(2) Jogging direction for X, Y

They define the jogging direction for the axes (in JOG mode) when using the JOG keys of the Operator Panel.

If correct, leave them as they are and change them if otherwise.

4.1 PARAMETERS RELATED TO AXIS RESOLUTION

The section on "Axis resolution" of the chapter on "Concepts" in this manual describes how to use the parameters mentioned here.

P9, P49 Feedback resolution for X, Y

They define, **always in microns**, the feedback resolution for each axis.

Possible values: 1 through 255 microns.

The feedback unit must be metric. Which means that each feedback pulse must be assigned a non-decimal distance value in microns.

For example, when a 0.0001 inch/pulse resolution is desired, its equivalent metric value of 2.54µm/pulse **cannot** be set.

This problem may be solved by using **"inch-pitch" encoders** such as 635 lines/rev., 1270 lines/rev. etc. or the **feedback correction factor** described later on in this manual.

P59(2), P59(3) Type of feedback signal for X, Y

They indicate whether the feedback signals used for each axis are square-wave or sine-wave.

0 = Square-wave feedback signals
1 = Sine-wave feedback signals.

P21(6), P61(6) Multiplying factor for X, Y feedback pulses

They indicate whether the CNC applies a x2 or x4 multiplying factor to the feedback pulses.

0 = A x4 multiplying factor is applied.
1 = A x2 multiplying factor is applied.

When using FAGOR linear transducers (scales) set these parameters to "0".

4.1.1 FEEDBACK CORRECTION FACTOR FOR THE AXES

With this CNC, it is possible to compensate the feedback error for each axis. This error may occur, for instance, in the following cases:

* When using an inch-type feedback system (versus metric) where the values required for axis resolution machine parameters P9 and P49 do not have an exact metric equivalent.

* When using an odd pitch leadscrew forcing us to set P9 or P49 to an approximate value.

P29, P69 Feedback correction factor for X, Y

They define the measuring error, in **MICRONS**, incurred every 100 millimeters of **displayed** distance.

Possible values: 0 through 49999 microns.

A value of "0" means that no feedback correction factor is to be applied.

P63(8), P63(7) Sign of the feedback correction factor for X, Y

0 (Positive) = When the actual travel exceeds the displayed distance.

1 (Negative) = When the displayed distance exceeds the actual travel.

Application examples for the X axis:

Distance displayed by the CNC	*Actual measured travel*	*Error*	*P29*	*P63(8)*
0 to 100000	0 to 98542	-1458	1458	1
0 to 100000	0 to 100684	684	684	0
0 to 200000	0 to 200246	246	123	0

Application example for inch-type X axis feedback:

To obtain 0.0001 inch resolution (2.54 microns).

Since P9 must be set to an integer value (non-decimal), P9 may be set to the closest value (P9=2) and P23(8) will be set momentarily to "0" to work in millimeters.

We move the axis until the unit **displays** a distance of **100,000 microns** (100 mm) and we observe that the **actual travelled distance** is **127,000 microns**.

Displayed distance	100,000	
Actual travel	127,000	
Error	27,000	(positive)

Therefore, P29 = 27000 and P63(8) = 0

P23(8) may now be set back to "1" to work in inches (the displayed units, that is).

Application examples for when a direct reading of the actual movement is not possible

A paper feeder uses an 80mm diameter roller. There is an 1:15 gear ratio between the motor and the roller.

Example a) The motor has a 1000 line square-wave encoder.

For every turn of the roller, the paper moves 251.327 mm.

The motor must make 15 turns for every turn of the roller. Therefore, the motor encoder will output 15 x 1,000 = 15,000 pulses.

If the CNC applies a x4 multiplier to these pulses, P21(6)=0, The number of pulses per roller turn will be 15,000 x 4 = 60,000 pulses.

Therefore, the linear paper feeding distance per encoder pulse is:

251,327 microns / 60,000 = 4.1888 microns.

Since machine parameter P9 must be set to an integer value (without decimals), it will be set to "4". That is, 4 micron resolution incurring an error of 0.1888 microns per pulse.

$$\frac{\text{Displayed distance x feedback error}}{\text{Resolution}} = \frac{100{,}000 \times 0.1888}{4} = 4720 \text{ microns}$$

Consequently, P29 = 4720 and P63(8) = 0 (positive)

Example b) The motor has a 1500 line square-wave encoder.

For every turn of the roller, the paper moves 251.327 mm.

The motor must make 15 turns for every turn of the roller. Therefore, the motor encoder will output 15 x 1,500 = 225,000 pulses.

If the CNC applies a x4 multiplier to these pulses, P21(6)=0, The number of pulses per roller turn will be 225,000 x 4 = 90,000 pulses.

Therefore, the linear paper feeding distance per encoder pulse is:

251,327 microns / 90,000 = 2.7925 microns.

Since machine parameter P9 must be set to an integer value (without decimals), it will be set to "3". That is, 3 micron resolution incurring an error of -0.2075 microns per pulse.

$$\frac{\text{Displayed distance x feedback error}}{\text{Resolution}} = \frac{100{,}000 \times (-0.2075)}{4} = -6917 \text{ microns}$$

Consequently, P29 = 6917 and P63(8) = 1 (negative)

4.2 PARAMETERS RELATED TO THE ANALOG OUTPUTS

P13, P53 Minimum analog voltage for X, Y

They define the minimum analog voltage for each axis.

It is given by an integer between 1 and 255.

Where:

Value of 1 = 2.5 mV.
Value of 10 = 25.0 mV. (10 x 2.5)
Value of 255 = 637.5 mV. (255 x 2.5)

P28, P68 In-position zone (dead band) for X, Y

They define the area, in front of the programmed coordinate and behind it, where the CNC considers the axis to be in position

Possible values: Between 1 and 65535 microns.
Between 1 and 25801 tenthousandths of an inch.

4.3 FEEDRATE RELATED PARAMETERS

P27, P67 Maximum permissible feedrate for X, Y

Possible values: Between 1 and 65535 mm./minute.
Between 1 and 25801 tenths-of-inch/minute.

P24, P64 Jogging feedrate in JOG and PLAY-BACK modes for X, Y

Possible values: Between 1 and 65535 mm./minute.
Between 1 and 25801 tenths-of-inch/minute.

These parameters cannot be set to greater values than those of P27, P67.

P12 Maximum time for uncontrolled axis.

This CNC issues error 16 (X axis out of control) or error 38 (Y axis out of control) in the following instances:

* If during the time period indicated by this parameter, the axis feedrate is out of the 50-to-200% range of the theoretical feedrate.

* If during the time period indicated by this parameter, the axis moving direction does not correspond to the sign of the analog output.

* If during the time period indicated by this parameter and while the brake signal is on, the axis drifts more than 16 times the in-position zone (P28, P68).

This machine parameter (P12) must be set to an integer value between 0 and 255.

Where:

Value of 0 = The feedrate is not monitored
Value of 1 = 12 msec.
Value of 10 = 120 msec.
Value of 255 = 3060 msec.

P20(8) Feedrate up to 655 meters/minute or 25800 inches/minute

By setting this parameter to "1", the axis feedrates will always be ten times their programmed values.

It must be used when the axis feedrates exceed 65m/min. or 2580 inches/min.

P20(8)=0 Axis feedrates as programmed and their limits as set by machine parameters P27, P67, P24, P64.

P20(8)=1 Axis feedrates ten times the programmed values.

The actual feedrate limits applied will be ten times the values set by P27, P67, P24, P64,

For example, if P27 = 10000 mm/min. The actual limit = 100000 mm/min.

Therefore, the actual maximum permissible feedrate will be:
655 meters/minute or 25800 inches/minute.

P18 Feedrates lower than 1 mm/minute or 0.1 inch/minute

With this parameter, the actual axis feedrates may be made to be **"n" times lower** than their programmed values.

This parameter is to be used on extremely slow axes.

P18=0 Axis feedrates as programmed and their limits as set by machine parameters P27, P67, P24, P64.

P18>0 The actual axis feedrates will be the results of dividing the selected feedrate by the "n" factor set in this parameter.

For example, if P18=50 and programmed F = 10 mm/min., the actual feedrate will be 0.2 mm/min.

Atention:

The value for P18 cannot exceed **256/P9** (feedback resolution for X) or **256/P49** (feedback resolution for Y).

With functions G61 and G62 it is possible to change the setting of P18 by program.

G61 Ignore P18. The actual feedrate is the one programmed.
G62 Assume P18. The actual feedrate is affected by the setting of P18.

On power-up, after an M30, Emergency or Reset, the CNC assumes G62.

4.4 PARAMETERS RELATED TO THE POSITIONING LOOP

The section on "axis positioning loop control" of the chapter on "Concepts" in this manual describes how to use the parameters indicated here.

With this CNC, it is possible to control the axes either in Closed Loop, in Open Loop with Servosystems or in Open Loop without Servosystems.

Closed Positioning Loop.

Closed Positioning Loop means that the CNC controls the actual axis position and feedrate at all times.

To operate in this mode, set P23(4)=1 (Closed loop) and P23(6)=0 for the CNC to output an analog voltage for the servo motors.

The parameters related to proportional gain and acc./dec. must also be set.

Non-servo-controlled Open Positioning Loop

When a motor does not have a servo drive, it is referred to as non-servocontrolled.

Therefore, Non-servo-controlled Open Positioning Loop means that the CNC only controls the position of the axis while carrying out the programmed movement. Once the programmed end point is reached, the CNC no longer controls the axis.

To operate in this mode, set P23(4)=0 (Open loop) and P23(6)=" for the CNC to output the "Fast", "Slow" and "moving direction" indicating signals.

The parameters determining the braking distance for each axis must also be set.

Servo-controlled Open Positioning Loop

When positioning, the CNC outputs an analog voltage proportional to the programmed F and it will be up to the servo drive to control the actual axis speed.

For example, if the maximum feedrate (set by parameter) is F10000 and F5000 is programmed, the CNC will output 5V.

When the axis enters the brake zone, the CNC switches to Closed Loop taking over the control of the axis from the servo drive until the target point is reached.

To operate in this mode, set P23(4)=0 (Open loop), P23(6)=0 (analog output and servo-motor).

The parameters defining the braking distance (for the approach stage) as well as those related to proportional gain, for the final positioning stage, must also be set.

4.4.1 CLOSED LOOP

To operate in this mode, set P23(4)=1 (Closed Loop), P23(6)=0 (analog output for the **servo motor**).

P10, P50 Proportional gain K1 for X, Y

They set the analog output corresponding to 1 micron of following error (axis lag).

It is given by an integer between 0 and 255 where a value of 64 corresponds to an analog voltage of 2.5mV

$$\text{Analog Output (mV)} = K1 \times \text{Following error (microns)} \times \frac{2.5\text{mV.}}{64}$$

P26, P66 Gain break point for X, Y

They define the following error value from where the proportional gain K2 takes over and K1 is no longer applied.

It is recommended to set these parameters to a slightly higher value the one corresponding to the maximum machining feedrate F0.

Possible values: 1 through 65535 microns
1 through 25801 tenthousandths of an inch.

P11, P51 Proportional Gain K2 for X, Y

They set the analog output corresponding to 1 micron of following error (axis lag) to be applied beyond the gain break point.

It is given by an integer between 0 and 255 where a value of 64 corresponds to an analog voltage of 2.5mV

Analog (mV) = (K1 x Ep) + [K2 x (Following error - Ep)]

Where Ep is the value of the gain break point.

It is recommended to set these parameters to a value between 50% and 70% of K1 in order to prevent jerky transitions between K1 and K2 or between machining feedrates and rapid positioning (G00).

P60(6), P60(7) The values of K1 and K2 for X, Y are in mv/ pulse

They indicate whether the values of K1 and K2 are in mV/micron or mV/pulse.

0 = In mV/micron.
1 = In mV/pulse.

4.4.1.1 PARAMETERS RELATED TO ACCELERATION/ DECELERATION

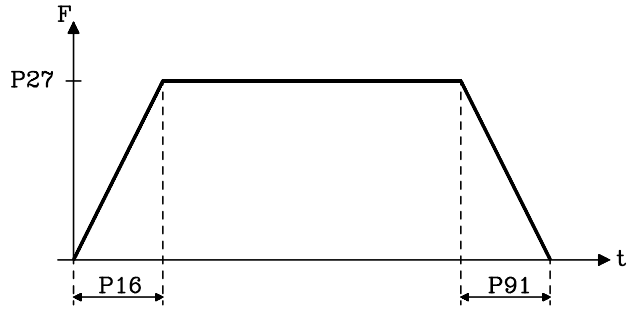
When operating in Closed Loop (P23(4)=1 and P23(6)=0), it is possible to control the acceleration and deceleration of the axes by means of the following parameters.

P16, P17 Acceleration time for X, Y
P91, P92 Deceleration time for X, Y

In order to avoid abrupt start-ups and brakes of the machine, it is possible to define some acceleration and deceleration ramps.

Parameters P16 and P17 determine the time each axis takes to reach the feedrate set by machine parameters P27, P67 (acceleration stage).

Parameters P91 and P92 determine the time each axis takes to stop (deceleration stage).



It is given by an integer between 0 and 255.

Value of 0 = No ACC./DEC ramp is applied.
Value of 1 = 0.024 seconds
Value of 10 = 0.240 seconds. (10 x 0.024)
Value of 255 = 6.120 seconds. (255 x 0.024)

When "P91=0", the acc./dec. ramp for the X axis is determined by "P16", and when "P92=0", the acc./dec. ramp for the Y axis is determined by "P17".

This type of acc./dec. is mainly applied on movements carried out in G00 or F00 although they may also be used on G01 movements. This type of acc./dec. is not applied on circular interpolations (G02, G03).

When moving in vectored G00 or in a linear interpolation G01 at F0, the CNC will apply, to the resulting path, the greatest one of the acc./dec. times set for the involved axes.

P63(1) Acceleration/deceleration on all G01 movements

It determines whether the CNC applies the acc./dec. ramps set by P16, P17, P91, P92 only when programming F0 in a G01 move or for any F values (besides G00 moves).

0 = For G01 moves at F0.
1 = For all G01 moves (at any F).

P100(2) No acc./dec. ramp when operating in G05 (round corner)

It indicates whether acc./dec. ramps are applied on G05 transitions between blocks or not.

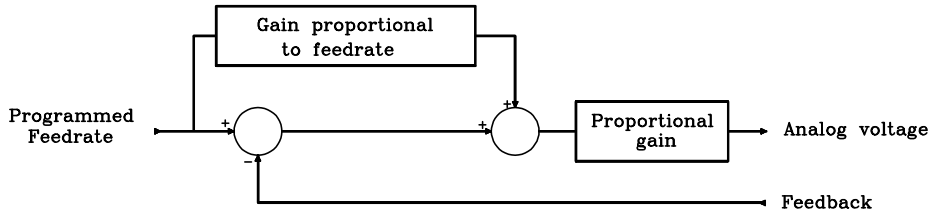
0 = Acc./dec. ramps applied in G05
1 = **No** acc./dec. ramps applied in G05

P75, P76 FEED-FORWARD gain for X, Y

This type of gain, which is proportional to the feedrate, is applied onto all rapid positioning moves (G00) and linear interpolations (G01) at F0.

It helps improve the positioning loop by minimizing the amount of following error (axis lag). It must be used when using acc./dec.

These parameters determine the percentage of the analog output based on the programmed feedrate.
It is given by an integer value between 0 and 255.



The value which will be added to the following error is (Kf x F/40), where F is the programmed feedrate and Kf is the value of this parameter P75 or P76.

The CNC will apply the proportional gain (K1 and K2) to the value resulting from the addition of the following error plus the value selected by means of the Feed-forward gain.

When the value resulting from the addition is smaller than the value assigned to the gain-break point, the CNC will apply the following formula:

Analog (mV) = K1 x [Following Error + (Kf x F/40)]

And when the value resulting from the addition is greater than the value assigned to the gain-break point:

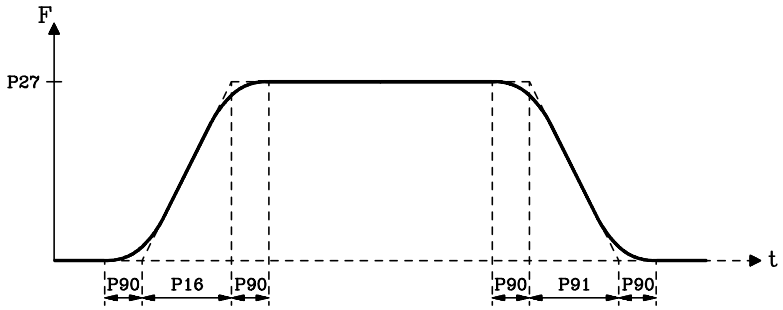
Analog (mV) = (K1 x Ep) + {K2 x [Following Error + (Kf x F/40) - Ep]}

Where “Ep” is the gain-break point value assigned to the corresponding parameter.

P90 Acceleration/Deceleration ramp with rounded corners

This parameter must be used when using acc./dec. control.

It helps improve the positioning loop of the axes by rounding the corners of the trapezoidal ramp.



It is given by an integer value.

Value of 0 = 24 milliseconds
Value of 1 = 48 milliseconds
Value of 2 = 96 milliseconds
Value of 3 = 192 milliseconds
Value > 3 = 192 milliseconds

4.4.2 OPEN LOOP

On this CNC, "Open Loop" means that the CNC monitors the position of the axis until it reaches the target point. Once in position, the CNC no longer controls the axis. "P23(4)" must be set "0".

When the motor is servo-controlled, the CNC must provide an analog output, P23(6)=0, and when the motor is not servo-controlled, the CNC must provide the FAST, SLOW and MOVING DIRECTION signals, P23(6)=1.

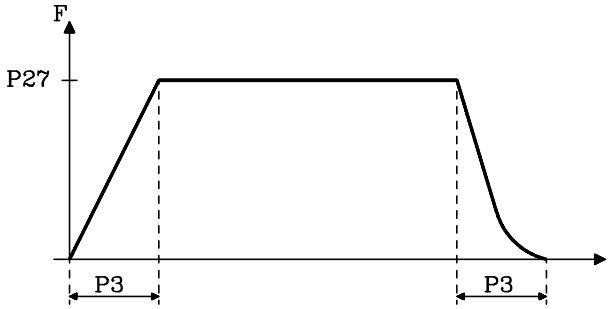
P3, P43 Braking distance for X, Y (Open Loop)

Possible values: Between 1 and 99,999.999 mm or 84,546.6 inches

It must be greater than the in-position zone: P28, P68.

When using analog output, P23(6)=0

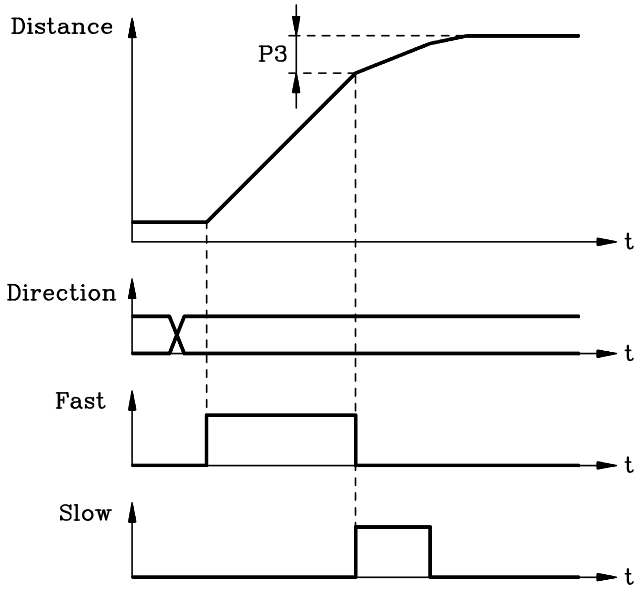
It indicates the distance required by the axis to reach its maximum feedrate, P27 and P67, as well as the braking distance from this maximum feedrate.



When the braking distance is greater than **half** the programmed distance, the block will be executed **in closed loop**.

When using the discreet signals: Fast, Slow and Moving direction, P23(6)=1

It only affects the braking stage and it indicates how far ahead of the programmed target point will the slow feed be applied.



4.5 PARAMETERS RELATED TO AXIS CONTROL

The section on "axis positioning loop control" of the chapter on "Concepts" in this manual describes how to use the parameters indicated here.

P31 T1. Delay between brake signal and analog output or Fast signal.

It indicates, in milliseconds, the delay applied from the time the brake signal is deactivated until the axes start moving.

Possible values: 0 through 65535 milliseconds.

P32, P72 T2. Delay between in-position and brake signal for X, Y

It indicates, in milliseconds, the delay applied from the time the axis enters the in-position zone until the time the brake signal is activated.

Possible values: 0 through 65535 milliseconds.

P33, P73 T3. Delay between Brake signal and In-position signal for X, Y

It indicates, in milliseconds, the delay applied from the time the brake signal is activated until the time the In-position signal for that axis is activated.

Possible values: 0 through 65535 milliseconds.

P34, P74 T4. Duration of the In-position signal for X, Y

It indicates, in milliseconds, the length of time the in-position signal of the axis stays on.

Possible values: 0 through 65535 milliseconds.

Whenever an axis is to be moved, the CNC acts as follows:

1.- Sets the corresponding axis brake signal high (pin 3 of I/O1 for X, pin 7 of I/O2 for Y).

2.- Applies the delay T1 set by P31.

3.- Outputs the analog voltage via pins 30, 31, 32, 33 of I/O1 to move the axes.

4.- When the axis enters the in-position zone, "P28, P68", the CNC---

5.- Applies the delay T2 set by P32 for X, P72 for Y.

6.- Sets the corresponding brake signal low, pin 3 of I/O1 or pin 7 of I/O2.

7.- Applies the delay T3 set by P33 for X, P73 for Y

8.- Sets the corresponding In-position signal high, pin 9 of I/O1 for X, of I/O2 for Y.

This signal stays ON for the time period T4 set by P34 for X, P74 for Y.

4.6 PARAMETERS RELATED TO MACHINE REFERENCE ZERO

The section on "Reference systems" in the chapter on "Concepts" of this manual describes how to use the parameters indicated here.

P2, P42 Coordinate of the Machine Reference point (home) for X, Y

They define the home coordinate with respect to Machine Reference Zero.

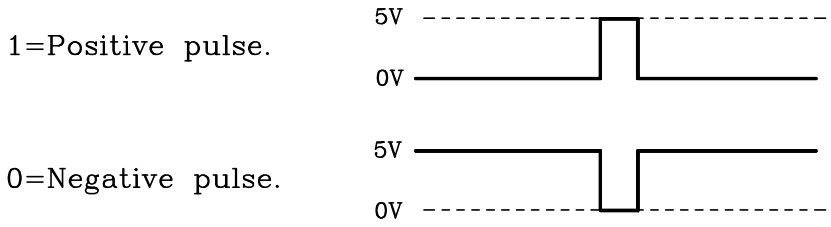
Possible values: ± 99999.999 millimeters
± 84546.600 inches.

P62(4), P62(5) Home searching direction for X, Y

0 = Positive direction.
1 = Negative direction.

P23(5), P63(5) Type of Machine Reference (marker) pulse for X, Y

They indicate the type of marker pulse (Io) provided by the feedback device.



P22(8), P62(8) Home switch for X, Y

They indicate whether a home switch is used on the axis or not.

0 = **No** home switch is used on the axis.
1 = A home switch is used on the axis.

P25, P65 Home searching feedrate X, Y

They set the homing feedrate until the home switch is pressed.

Possible values: 1 through 65535 mm./minute (degrees/minute).
1 through 25801 tenths of inch/minute.

Once the home switch is pressed, the axis will move at 100 mm/min. (3.9 inches/min.) until the marker pulse of the feedback device is detected.

P61(4) Machine Reference (Home) Search required on power-up

It determines whether it is required to reference the axes on CNC power-up or not.

0 = It is **not** required.
1 = It **is** required.

If this parameter is set to "1", when trying to execute a part-program in Automatic, Single Block or Teach-In mode without having previously referenced the axes after power-up, the CNC will issue the corresponding error message.

P21(7) Function G74 does not activate the IN-POSITION output.

It indicates whether the CNC must activate the IN-POSITION signal of the axes (pin 9 of I/O1 and pin 9 of I/O2) after executing function G74 (Home Search).

0 = It is activated.
1 = It is **not** activated.

P61(3) Axis moving sequence when executing function G74

It indicates in which order the axes will move when function G74 is executed alone in a block (without indicating the axes. For example: N20 G74).

0 = First X and then Y
1 = First Y and then X

4.7 PARAMETERS RELATED TO TRAVEL LIMITS

The section on "Reference systems" in the chapter on "Concepts" of this manual describes how to use the parameters indicated here.

P0, P40 Positive travel limit for X, Y
P1, P41 Negative travel limit for X, Y

They define the positive and negative travel limits for the axes. Each one of them indicates the distance from the Machine Reference Zero (home) to the corresponding travel limit.

Possible values: ± 99999.999 millimeters
± 84546.600 inches.

For safety reasons, in JOG mode, the actual axis travel is limited to 100 microns (0.003937 inch) short of these parameter values.

If both travel limits for an axis are set to "0", the CNC will assume that no travel limits are to be observed.

4.8 LEADSCREW RELATED PARAMETERS

P14, P54 Leadscrew backlash for X, Y

They determine the amount of leadscrew backlash to be compensated for. When using linear transducers (scales), set the pertinent parameter to "0".

Possible values: 0 through 255 feedback pulses.

P15, P55 Additional analog pulse for X, Y

This additional analog pulse may be used to make up for the possible leadscrew backlash when reversing the axis moving direction.

It is given by an integer between 0 and 255.

Value of 0 = No additional analog pulse is applied.
Value of 1 = 2.5 mV.
Value of 10 = 25.0 mV. (10 x 2.5)
Value of 255 = 637.5 mV. (255 x 2.5)

Every time the axis reverses its moving direction, the CNC will apply its corresponding analog output plus the additional analog pulse indicated here. This additional pulse will last 48 milliseconds.

When using a rotary feedback encoder, this parameter must be set to "0".

4.9 SPECIAL MACHINE PARAMETERS

P62(3) Resolution of 0.0001 millimeters (0.00001 inch)

It must be set when using 0.0001 mm (0.00001 inch) resolution.

0 = Normal resolution. 0.001 millimeter (0.0001 inch).
1 = Special resolution. 0.0001 millimeter (0.00001 inch).

When setting this parameter to "1", the following points must be observed:

* The display and programming format for axis coordinates will now be: ±3.4 in mm or ±2.5 in inches.

* The values of parameters P9 and P49 indicating the resolution of the axes will now be expressed in the new units:

  1 = Resolution of 0.0001 mm, 0.00001 inch.
  2 = Resolution of 0.0002 mm, 0.00002 inch.
  5 = Resolution of 0.0005 mm, 0.00005 inch.
  10 = Resolution of 0.0010 mm, 0.00010 inch.

* The K1, K2 and Feed-forward gains will be calculated bearing in mind that the following error is now expressed in 0.0001mm and 0.00001 inch units.

  In other words, K1 and K2 (parameters P10, P11, P50 and P51) are now in "mV/0.0001mm".

  The K1 and K2 values are **not** affected when set for mV/pulse.

* The values of machine parameters P26 and P66 indicating the gain break-point for each axis will also be given in the new units.

* The values of machine parameters P14 and P54 indicating the leadscrew backlash as well as P28 and P68 indicating the in-position zone for each axis will also be given in the new units.

  P28 = 100 indicates that the in-position zone for the X axis is 0.0100 mm

4.8 LEADSCREW RELATED PARAMETERS

P14, P54 Leadscrew backlash for X, Y

They determine the amount of leadscrew backlash to be compensated for. When using linear transducers (scales), set the pertinent parameter to "0".

Possible values: 0 through 255 feedback pulses.

P15, P55 Additional analog pulse for X, Y

This additional analog pulse may be used to make up for the possible leadscrew backlash when reversing the axis moving direction.

It is given by an integer between 0 and 255.

Value of 0 = No additional analog pulse is applied.
Value of 1 = 2.5 mV.
Value of 10 = 25.0 mV. (10 x 2.5)
Value of 255 = 637.5 mV. (255 x 2.5)

Every time the axis reverses its moving direction, the CNC will apply its corresponding analog output plus the additional analog pulse indicated here. This additional pulse will last 48 milliseconds.

When using a rotary feedback encoder, this parameter must be set to "0".

4.9 SPECIAL MACHINE PARAMETERS

P62(3) Resolution of 0.0001 millimeters (0.00001 inch)

It must be set when using 0.0001 mm (0.00001 inch) resolution.

0 = Normal resolution. 0.001 millimeter (0.0001 inch).
1 = Special resolution. 0.0001 millimeter (0.00001 inch).

When setting this parameter to "1", the following points must be observed:

* The display and programming format for axis coordinates will now be: ±3.4 in mm or ±2.5 in inches.

* The values of parameters P9 and P49 indicating the resolution of the axes will now be expressed in the new units:

  1 = Resolution of 0.0001 mm, 0.00001 inch.
  2 = Resolution of 0.0002 mm, 0.00002 inch.
  5 = Resolution of 0.0005 mm, 0.00005 inch.
  10 = Resolution of 0.0010 mm, 0.00010 inch.

* The K1, K2 and Feed-forward gains will be calculated bearing in mind that the following error is now expressed in 0.0001mm and 0.00001 inch units.

  In other words, K1 and K2 (parameters P10, P11, P50 and P51) are now in "mV/0.0001mm".

  The K1 and K2 values are**not** affected when set for mV/pulse.

* The values of machine parameters P26 and P66 indicating the gain break-point for each axis will also be given in the new units.

* The values of machine parameters P14 and P54 indicating the leadscrew backlash as well as P28 and P68 indicating the in-position zone for each axis will also be given in the new units.

  P28 = 100 indicates that the in-position zone for the X axis is 0.0100 mm

5. *OTHER MACHINE PARAMETERS*

5.1 SPINDLE MACHINE PARAMETERS

The section on "Spindle" of the chapter on "Concepts" in this manual describes how to use the machine parameters indicated here.

P36, P37, P38, P39 Maximum spindle speed for RANGE (gear) 1, 2, 3 and 4

They indicate the maximum spindle speed assigned to each range (gear).

It is given in revolutions per minute and they accept any integer value between 0 and 9999.

The value assigned to P36 must correspond to the lowest range and that of P39 to the highest range. When not using all the ranges, set P36 to the lowest range and the unused ones to the highest speed value.

Whenever a spindle speed is programmed which involves a range change, the CNC will automatically output its corresponding M code (M41, M42, M43, M44).

P101(4) In parametric programming the CNC takes into account the S signal

This parameter indicates how the CNC operates when function S is programmed by parametric assignation.

0 = Does not take into account the value assigned to the arithmetic parameter.

Example: When P20 = 100 and P21 = -100, the CNC does the following when blocks S P20 or S P21 are executed.
In both cases block S100 is executed.

1 = The value assigned to the arithmetic parameter is taken into account.
Positive values are interpreted as M3 and negative values as M4.

Example: When P20 = 100 and P21 = -100

When block S P20 is executed the CNC executes block S100 M3
When block S P21 is executed the CNC executes block S100 M4

5.1.1 PARAMETERS RELATED TO THE SPINDLE SPEED OUTPUT

The section on "Spindle" of the chapter on "Concepts" in this manual describes how to use the machine parameters indicated here.

P101(6) Single or bipolar S analog output

0 = BIPOLAR output available
The CNC generates a positive output (0 to +10V.) when "spindle clockwise (M3)" is selected and a negative output (0 to -10V.) when "spindle counter-clockwise (M4)" is selected.

1 = A SINGLE-POLE output is available.
The CNC will generate a positive output (0 a +10V.) for both moving directions.

P60(2) Analog or BCD spindle speed "S" output

It indicates whether the spindle speed output is an analog voltage via pins 34 and 35 of I/O1 or BCD-coded signals via pins 20 through 27 of I/O1.

0 = Analog output.
1 = BCD-coded output.

P60(3) 2-digit or 4-digit BCD-coded spindle speed output

P60(3) = 0 *2-digit BCD-coded spindle speed output*

If this parameter is set to "0", the CNC will output the BCD-coded value corresponding to the programmed spindle speed "S" via pins 20 through 27 of connector I/O1 plus an "S STROBE" pulse at pin 6 of connector I/O2.

The BCD value corresponding to the programmed S follows the chart below:

Programmed S	S BCD	Programmed S	S BCD	Programmed S	S BCD	Programmed S	S BCD
0	S 00	25-27	S 48	200-223	S 66	1600-1799	S 84
1	S 20	28-31	S 49	224-249	S 67	1800-1999	S 85
2	S 26	32-35	S 50	250-279	S 68	2000-2239	S 86
3	S 29	36-39	S 51	280-314	S 69	2240-2499	S 87
4	S 32	40-44	S 52	315-354	S 70	2500-2799	S 88
5	S 34	45-49	S 53	355-399	S 71	2800-3149	S 89
6	S 35	50-55	S 54	400-449	S 72	3150-3549	S 90
7	S 36	56-62	S 55	450-499	S 73	3550-3999	S 91
8	S 38	63-70	S 56	500-559	S 74	4000-4499	S 92
9	S 39	71-79	S 57	560-629	S 75	4500-4999	S 93
10-11	S 40	80-89	S 58	630-709	S 76	5000-5599	S 94
12	S 41	90-99	S 59	710-799	S 77	5600-6299	S 95
13	S 42	100-111	S 60	800-899	S 78	6300-7099	S 96
14-15	S 43	112-124	S 61	900-999	S 79	7100-7999	S 97
16-17	S 44	125-139	S 62	1000-1119	S 80	8000-8999	S 98
18-19	S 45	140-159	S 63	1120-1249	S 81	9000-9999	S 99
20-22	S 46	160-179	S 64	1250-1399	S 82		
23-24	S 47	180-199	S 65	1400-1599	S 83		

If a value greater than 9999 is programmed, the CNC will assume the spindle speed corresponding to a value of 9999.

P60(3) = 1 *4-digit BCD-coded spindle speed output.*

When selecting this type of spindle speed output, the CNC will provide the BCD value corresponding to the programmed "S" at pins 20 through 27 of connector I/O1.

This BCD-coded output will be activated in two stages with a 100 msec. delay between them. It will also send out an "S STROBE" pulse at each stage via pin 6 of connector I/O2.

For example, When programming S1234, the CNC will output the value of 12 in the first stage and the value of 34 in the second stage.

Pin	1st stage	2nd stage
20	Thousands	Tens
21		
22		
23		
24	Hundreds	Units
25		
26		
27		

Example: S1234		
Pin	1st stage	2nd stage
20	0	0
21	0	0
22	0	1
23	1	1
24	0	0
25	0	1
26	1	0
27	0	0

5.2 MACHINE PARAMETERS RELATED TO THE SERIAL LINE RS232C

P70 Communication speed (baudrate)

It indicates the communication speed (baudrate) used between the CNC and the peripheral devices.

It is given in bauds by an integer value (maximum 19200).

Typical values:

110 150 300 600 1200 2400 4800 9600

P59(7) Number of data bits per transmitted character

It indicates the number of data bits contained in each transmitted character.

Possible values:

0 = Only the 7 least significant bits (out of 8) are used. Assign this value when transmitting standard ASCII characters.

1 = All 8 bits of the transmitted character are used. Assign this value when transmitting special characters (ASCII code over 127).

P59(5) Parity

It indicates whether a parity check is performed or not in the communication.

0 = **No** parity check performed
1 = Parity check performed

P59(6) Even parity

It indicates the type of parity check performed during communication.

0 = Odd parity.
1 = Even parity.

P59(8) Stop bits

It indicates the number of stop bits used at the end of the transmitted word.

0 = 1 stop bit
1 = 2 stop bits

P100(1) This CNC uses DNC communications or not

0 = No DNC.
1 = Yes, it does.

5.3 PARAMETERS RELATED TO THE FAGOR LOCAL AREA NETWORK

The chapter on "Fagor Local Area Network (LAN)" in this manual describes how to use the machine parameters indicated here.

P59(1) Fagor Local Area Network (LAN)

It indicates whether the CNC is connected to the Fagor LAN or not.

0 = No. It is **not** connected to the Fagor LAN.
1 = Yes. It **is** connected to the Fagor LAN.

P59(4) The CNC occupies the Main Node of the LAN

It indicates whether the CNC is the main node (NODE 0) or not.

P59(4) = 0 It is **not** the main node (NODE 0).
P59(4) = 1 It **is** the main node (NODE 0).

P56 Node number occupied by the CNC in the LAN

When the CNC is the main node, this parameter indicates how many more nodes are interconnected in the LAN and when the CNC is not the main node, it indicates the node number it occupies in the LAN.

Examples:

A Fagor LAN consists of 2 PLC64 (nodes 0 and 1) and a Fagor102 CNC (node 2).

P59(4) = 0 The CNC is not the Main Node.
P56 = 2 The CNC occupies node 2

A Fagor LAN consists of a Fagor102 CNC (node 0) and 2 PLC64 (nodes 1 and 2).

P59(4) = 1 The CNC is the Main Node
P56 = 2 There are another two nodes in the LAN.

P58 Number of the node receiving the M, S, T functions

It indicates the node number of the PLC64 receiving the M, S, T functions.

If there is no PLC64 associated with the CNC, this parameter must be set to a value of 15 or greater.

P57 Register of the PLC64 receiving the M, S, T functions

It indicates the register number of the PLC64 receiving the BCD codes for the M functions.

The BCD codes for the S and T functions will be loaded into the next two registers.

This parameter must be set to an integer value greater than 10 and smaller than 253.

Example: To send the BCD codes for the M, S, T functions out to a PLC64 connected to node 3 by loading this data into registers R20, R21 and R22:

P58=3 Sends the data out to node 3

P57=20 The M code goes into register R20
The S code goes into register R21
The T code goes into R22

P80 Parameter identifying the CNC within the LAN

Any element installed in the LAN may read the contents of a machine parameter and, depending on the setting of this parameter by the manufacturer, get more information about the CNC and the machine.

Attention:

This machine parameter has no effect on the operation of the CNC.

5.4 PARAMETERS RELATED TO DOUBLE FEEDBACK

"Double feedback" means that there are two feedback devices for a single axis. Therefore, the CNC must use the Y axis as a DRO axis: P60(8)=0 and P61(7)=1.

Feedback connector A1 is used to measure the actual movement of the material (material encoder) and feedback connector A2 to connect the monitoring encoder of the feeding motor (motor encoder).

P100(6) Double Feedback is used

0 = **No** Double Feedback is used.
1 = Double Feedback **is** used.

When using this Double Feedback feature and during set-up or sheetmetal coil replacement, it may be interesting to have the CNC assume feedback input A2 as its own (which is normally used to monitor the sheetmetal slippage).

Use **input E5** (pin 17 of I/O2) to switch between A1 and A2.

E5	**= 0V**	The CNC uses **A1** to close its feedback loop **and A2 to monitor** sheetmetal slippage.
E5	= 24V	The CNC uses **A2** to close its feedback loop **and does not** monitor sheetmetal slippage.

This input must be low (0V) for normal operation and high (24V) during set-up, coil replacement, etc.

P110 Maximum slippage allowed when using "Double Feedback"

When using 2 feedbacks, it is possible to continuously control the amount of sheetmetal being fed.

When these two are not the same, it indicates that the sheetmetal is either loose or tight.

With this parameter, it is possible to set the maximum permissible difference (slippage) between the two measurements and it is expressed in microns.

When the actual difference exceeds this parameter (P110) value, the CNC will issue the corresponding error message.

If P110=0, The CNC does not monitor the slippage.

When input E5=24V, the CNC does not monitor the slippage either.

Attention:

In order to be able to monitor double feedback, P21(6) and P61(6), multiplying factor for the axis feedback pulses, must be set to the same value.

5.5 PARAMETERS RELATED TO FUNCTION G34

Function G34 allows axis X to be indefinitely synchronized with an external device.

When you wish to use this feature the following conditions must be satisfied:

- The machine cannot use a Y axis, and feedback connector A2 is used as feedback input for the external device.
- The external device must have an encoder and the machine parameter "P77" must be set with the number of pulses of said encoder.

Furthermore, in order to be able to automatically offset the variations arising in material through temperature dilation, roller tension, etc., the following requisites must be satisfied:

- The material must have reading marks in the cutting zones.
- An optical reader must be used to read these marks.
- The signal provided by this reader must be compatible with the Io signal provided by the Fagor feedback devices.
- Connect the signal provided by the optical reader to the signal provided by the optical reader terminal 6 of connector A2 and properly set machine parameter "P63(6)".

P100(4) Function G34 is available

0 = G34 feature is not available
1 = G34 feature is available

P100(3) The optical reader is available for compensating material variations

0 = An optical reader is not available
1 = An optical reader is available

P81 Maximum permitted deviation

Should be used when working with function G34 and having an optical reader available.

The optical reader measures the distance between two consecutive marks on the material and the CNC compares this distance with the pass fixed in function G34.

Machine parameter P81 fixes the maximum permitted deviation.

Possible values: From 1 through 65535 microns
From 1 through 25801 tenthousandths of an inch

After comparing the distance measured with the pass fixed in function G34, the CNC does the following:

If the difference is over 100 microns and under the value assigned to parameter P81, the CNC automatically offsets the value fixed in function G34 X????.

If the difference is greater than the value assigned to parameter P81, the CNC displays error 53.

If parameter "P81=0" has been set, the CNC does nothing.

5.6 PARAMETERS RELATED TO FUNCTION G75

Function G75 allows you to program positioning movements which will end after the CNC receives the signal from the measuring probe used.

Machine parameter P63(3) indicates if the measuring probe works normally high (positive pulse) or low (negative pulse). See section 3.5 of this manual.

The machine will move until it receives the external signal from the probe, and at this time the CNC will take the block as finished, assuming the real position the axes are in at that moment as the theoretical position of the axes.

When the probing movement is done at high speeds the stop may turn out to be rather brusque, making the axis draw back to remain in position.

Machine parameter P82 allows this effect to be minimized as it can occasionally be undesirable.

This parameter tells the CNC the distance the axis should move after the probe signal reaches it, thus making it stop smoothly.

P82 The distance the axis covers after receiving the signal from the probe.

Should be used when operating with the function G75.

Possible values: From 1 through 65535 microns
From 1 through 25801 tenthousandths of an inch.

5.7 PARAMETERS RELATED TO FUNCTION G47, G48

Depending on the value assigned to machine parameter "P101(3)" functions G47, G48 can be used in two different ways.

Functions G47, G48 as feedback inhibit.

In certain applications, after the part moves, its position has to be compensated by means of an external device which is not controlled by the CNC.

If function G47 is executed the CNC does not take into account the possible movements caused by said device, that is, the feedback pulses are inhibited.

Functions G47, G48 as opening for the axis loop.

In certain applications such as presses, folders, pipe metal formers etc., the part undergoes a movement or pull during its machining process.

When the position loop is closed, in normal working mode, the CNC controls the axis feedrate at all times.

When the position loop is open the axis operates in DRO mode, meaning that the CNC does not control the feedrate of the axes but takes into account their movements.

P101(3) Functions G47, G48 as axis loop opening

0 = Functions G47, G48 as pulse inhibition
1 = Functions G47, G48 as axis loop opening

5.8 PARAMETERS RELATED TO FUNCTION G60

Function G60 can be used in two different ways.

Function G60 as zero offset loading.

Machine parameter "P60(5)=1" must be set.

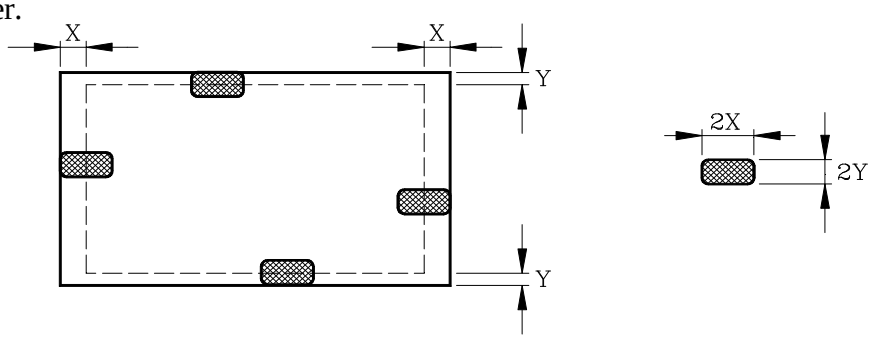
The CNC uses its internal table as zero offset table and assigns address in 10 of this table to function G60.

The programming format is G60 X Y. Values X and Y indicate at what distance from home the new part zero is required to be located.

Function G60 as punch dimension loading.

This is specially designed for punching machines. Machine parameter "P101(7)=1" must be set.

The CNC takes into account the dimensions of the punch during program execution, preventing its extreme values from exceeding the travel limits fixed by machine parameter.



The programming format is G60 X Y. Values X and Y indicate half of the punch dimensions according to axes X and Y.

When the punch is round values X and Y coincide with the punch radius.

Note: If machine parameters "P60(5)=1" and "P101(7)=1" are set, function G60 acts as loading the punch dimensions.

P60(5) Tool table or zero offset table

0 = The internal CNC table is used as tool table.
1 = The internal CNC table is used as zero offset table.

P101(7) Function G60 as punch loading dimension

0 = Functions G60 as zero offset table
1 = Functions G60 as punch dimension loading

Attention:

On power-up, after executing M30 or after an Emergency or Reset, the CNC assigns value 0 to both dimensions of the punch.

6. *CONCEPTS*

Attention:

It is recommended to save the machine parameters of this CNC at a peripheral device or computer in order to be able to recover them after their accidental loss.

6.1 FEEDBACK SYSTEMS

The feedback inputs of this CNC are:

Connector A1.

Used to connect the feedback device of the X axis.

It takes non-differential (single-ended) sine-wave signals and differential (double-ended) square-wave signal. Machine parameter "P59(2)" and the two dip-switches next to this connector must be set accordingly.

Connector A2.

Used to connect the feedback device of the Y axis, the electronic handwheel or the spindle when using rigid tapping, G33, etc.

It takes non-differential (single-ended) sine-wave signals and differential (double-ended) square-wave signal. Machine parameter "P59(3)" and the two dip-switches next to this connector must be set accordingly.

Connector I/O2, pins 17 and 25

Used to connect the feedback input of the auxiliary handwheel.

The auxiliary handwheel should be used when feedback inputs A1 and A2 are occupied either because the machine has 2 axes or because it has one axis and a spindle.

The options available are:

CONFIGURATION					*PARAMETERS*			
X Axis	Y Axis	Rigid tapping	Handwheel	Auxiliary Handwheel	P60(8)	P63(3)	P60(4)	P102(8)
Yes	--	--	--	--	1	0	0	0
Yes	Yes	--	--	--	0	0	0	0
Yes	--	Yes	--	--	0	1	0	0
Yes	--	--	Yes	--	1	0	1	0
Yes	Yes	--	--	Yes	0	0	1	1
Yes	--	Yes	--	Yes	0	1	1	1

6.1.1 COUNTING FREQUENCY LIMITATION

Sine-wave signals

The maximum counting frequency for sine-wave feedback signals is 50KHz (50,000 pulses/sec.)

The maximum feedrate for each axis will depend upon the selected resolution (machine parameters "P9, P49") and the period (pitch) of the feedback signal being used.

Example:

When using a linear scale with a 20 µm pitch, the maximum feedrate for the axis will be:

20 µm/pulse x 50,000 pulses/sec. = 1m/sec. = 60 m/min. (2362 inches/min.)

Square-wave signals

The maximum counting frequency for differential square-wave signals is 200KHz (200,000 pulses/sec.), with a 450nsec. separation between A and B flanks (that is 90º ±20º phase shift).

The maximum feedrate for each linear axis will depend upon the selected resolution (machine parameters "P9, P49") and the period (pitch) of the feedback signal being used.

When using FAGOR linear scales, the maximum feedrate is limited by its own characteristics to 60 m/min. (2362 inches/min.).

When using FAGOR rotary encoders, the limitation is set by the maximum number of pulses delivered by the encoder, which is **200KHz**.

$$\text{Maximum encoder rpm} = \frac{\textbf{6,000,000 pulses/min.}}{\text{Number of pulses/turn (encoder line count)}}$$

6.2 AXIS RESOLUTION

The CNC has a series of machine parameters to set the resolution of each axis.

The resolution used on each axis indicates the minimum variation distinguishable by the feedback device. It is given in microns or 0.0001 inch units.

The machine parameters used to define the axis resolution are the following:

P9, P49	They set the counting (feedback) resolution for each axis.
P59(2), P59(3)	They set the type of feedback signal being used (square-wave or sine-wave) for each axis.
P21(6), P61(6)	They indicate the multiplying factor, x2 or x4, to be applied to the feedback signals of each axis.
P29, P69	They indicate the feedback correction factor being applied on each axis.
P63(8), P63(7)	They indicate the sign of the feedback correction factor being applied on each axis.
P62(3)	Special machine parameter allowing resolutions of 0.0001 mm (0.00001 inch). See section on "Special Parameters" of the chapter on "Axis Machine Parameters".

Example 1: Resolution in "mm" with square-wave encoder

We want to obtain a 2µm resolution with a square-wave encoder mounted onto the X axis whose leadscrew has a 5mm/turn pitch.

Since the multiplying factor being applied by the CNC may be either x2 or x4 (depending on machine parameter setting). The resulting encoder line count will be:

$$\text{Number of pulses} = \frac{\text{Leadscrew pitch}}{\text{Multiplying Factor x Resolution}}$$

For a multiplying factor of x4:

$$\text{Number of pulses} = \frac{5000\ \mu\text{m/turn}}{4 \times 2\ \mu\text{m/pulse}} = 625\ \text{pulses/turn.}$$

P9=2 P59(2)=0 P21(6)=0 P29=0 P63(8)=0 P23(8)=0

For a multiplying factor of x2:

$$\text{Number of pulses} = \frac{5000\ \mu\text{m/turn}}{2 \times 2\ \mu\text{m/pulse}} = 1250\ \text{pulses/turn.}$$

P9=2 P59(2)=0 P21(6)=1 P29=0 P63(8)=0 P23(8)=0

If a FAGOR rotary encoder is chosen, its pulse output frequency is limited to 200KHz (the CNC admits square-wave pulses with a frequency of up to 200 KHz). Therefore, the maximum feedrate for this axis will be:

For a x4 factor:

$$\text{Max. Feed} = \frac{200{,}000\ \text{pulses/sec.}}{625\ \text{pulses/turn}} \times 5\ \text{mm/turn} = 1600\ \text{mm/sec.} = 96\ \text{m/min.}$$

For a x2 factor:

$$\text{Max. Feed} = \frac{200{,}000\ \text{pulses/sec.}}{1250\ \text{pulses/turn}} \times 5\ \text{mm/turn} = 800\ \text{mm/sec.} = 48\ \text{m/min.}$$

Example 2: Resolution in "mm" with encoder and gear reduction

A paper feeder uses an 80mm diameter roller. There is an 1:15 gear ration between the motor and the roller.

Example a) The motor has a 1000 line square-wave encoder.

For every turn of the roller, the paper moves 251.327 mm.

The motor must make 15 turns for every turn of the roller. Therefore, the motor encoder will output 15 x 1,000 = 15,000 pulses.

If the CNC applies a x4 multiplier to these pulses, (P21(6)=0, The number of pulses per roller turn will be 15,000 x 4 = 60,000 pulses.

Therefore, the linear paper feeding distance per encoder pulse is:

251,327 microns / 60,000 = 4.1888 microns.

Since machine parameter P9 must be set to an integer value (without decimals), it will be set to "4". That is, 4 micron resolution incurring an error of 0.1888 microns per pulse.

$$\frac{\text{Displayed distance x feedback error}}{\text{Resolution}} = \frac{100{,}000 \times 0.1888}{4} = 4720 \text{ microns}$$

P9=4 P59(2)=0 P21(6)=0 P29 = 4720 P63(8)=0 P23(8)=0

Example b) The motor has a 1500 line square-wave encoder.

For every turn of the roller, the paper moves 251.327 mm.

The motor must make 15 turns for every turn of the roller. Therefore, the motor encoder will output 15 x 1,500 = 225,000 pulses.

If the CNC applies a x4 multiplier to these pulses, (P21(6)=0, The number of pulses per roller turn will be 225,000 x 4 = 90,000 pulses.

Therefore, the linear paper feeding distance per encoder pulse is:

251,327 microns / 90,000 = 2.7925 microns.

Since machine parameter P9 must be set to an integer value (without decimals), it will be set to "3". That is, 3 micron resolution incurring an error of -0.2075 microns per pulse.

$$\frac{\text{Displayed distance x feedback error}}{\text{Resolution}} = \frac{100{,}000 \times (-0.2075)}{3} = -6917 \text{ microns}$$

P9=3 P59(2)=0 P21(6)=0 P29 = 6917 P63(8)=1 P23(8)=0

Example 3: Resolution in "mm" with square-wave linear scale

Considering that the CNC applies either a x2 or x4 multiplying factor (set by machine parameter), a linear scale must be chosen whose pitch is 2 or 4 times the desired resolution.

When using FAGOR linear transducers (scales) with 20 µm pitch, the following resolutions may be obtained: 5µm (20/4), 10µm (20/2).

Therefore:

Resolution	P9	P59(2)	P21(6)	P29	P63(8)	P23(8)
5 µm	5	0	0	0	0	0
10 µm	10	0	1	0	0	0

Since the counting frequency of the CNC is limited to 200 KHz for square-wave signals, the maximum feedrate obtainable with a 20µm-pitch scale is:

Max. feed = 20 µm/pulse x 200,000 pulses/sec. = 4000 mm/seg. = 240 m/min.

However, if FAGOR linear scales are used, the maximum feedrate is limited (by the scales) to 60m/min (2362 inches/min.).

Example 4: Resolution in "mm" with sine-wave linear scale

The CNC internally applies a x5 factor to sine-wave feedback signals plus another x2 or x4 (set by machine parameter).

With a 20µm-pitch FAGOR linear scale, it is possible to obtain 1µm and 2µm resolutions.

Therefore :

Resolution	P9	P59(2)	P21(6)	P29	P63(8)	P23(8)
1 µm	1	1	0	0	0	0
2 µm	2	1	1	0	0	0

The counting frequency is limited to 50KHz for sine-wave signals. Therefore, the maximum feedrate will be:

Max. feed = 20 µm/pulse x 50,000 pulses/sec. = 1000 mm/sec. = 60 m/min.

When using FAGOR linear scales, the feedrate is limited by their characteristics to 60m/min. (2362 inches/min.).

Example 5: Resolution in "inches" with square-wave encoder

We would like to obtain a 0.0001 inch resolution with a square-wave encoder mounted on to the X axis which has a 5-pitch leadscrew (5 turns per inch or 0.2 inch/turn).

Using "**feedback correction factor**":

The feedback resolution, parameter P9, must be set in millimeters. The metric equivalent for 0.0001 inch is 0.00254 mm; thus, we set P9 to "2" (since it must be an integer value) and we use the feedback correction factor, P29 and P63(8), as follows:

Displayed Distance	100,000 microns
Actual axis travel	73,000 microns
Error	27,000 microns (negative)

Therefore: P29=27000, P63(8)=1

Since the CNC applies a x2 or x4 multiplying factor, the required encoder will be:

$$\text{Number of pulses} = \frac{\text{Leadscrew pitch}}{\text{Multiplying Factor x Resolution}}$$

For a x4 factor:

$$\text{Number of pulses} = \frac{0.2 \text{ inch/turn}}{4 \times 0.0001 \text{ inch/pulse}} = 500 \text{ pulses/turn}$$

P9=2 P59(2)=0 P21(6)=0 P29=27000 P63(8)=1

For a x2 factor:

$$\text{Number of pulses} = \frac{0.2 \text{ inch/turn}}{2 \times 0.0001 \text{ inch/pulse}} = 1000 \text{ pulses/turn}$$

P9=2 P59(2)=0 P21(6)=1 P29=27000 P63(8)=1

When using FAGOR encoders, the counting frequency is limited to 100 KHz (although the CNC admits up to 200 KHz for square-wave signals). Consequently, the maximum axis feedrate will be:

$$\text{Max. feed.} = \frac{200{,}000 \text{ pulses/sec}}{\text{pulses/turn}} \times 0.2 \text{ inches/turn}$$

For a x4 factor: 4800 inches/min. For a x2 factor: 2400 inches/min.

Using an "**inch-type**" encoder instead of the feedback correction factor.

For a x4 factor:

$$\text{Number of pulses} = \frac{5.08 \text{ mm/turn (0.2 inch/turn)}}{4 \times 0.001 \text{ mm/pulse}} = \mathbf{1270} \text{ pulses/turn}$$

P9=1 P59(2)=0 P21(6)=0 P29=0 P63(8)=0

Example 6: Resolution in "inches" with square-wave encoder, gear reduction and feeback correction factor.

A paper feeder uses an 3 inch diameter roller. There is an 1:15 gear ratio between the motor and the roller.

Example a) The motor has a 1000 line square-wave encoder.

For every turn of the roller, the paper moves 9.4248 inches.

The motor must make 15 turns for every turn of the roller. Therefore, the motor encoder will output 15 x 1,000 = 15,000 pulses.

If the CNC applies a x4 multiplier to these pulses, (P21(6)=0, The number of pulses per roller turn will be 15,000 x 4 = 60,000 pulses.

Therefore, the linear paper feeding distance per encoder pulse is:

9.4248 inches / 60,000 = 0.00015708 inch = 3.9898 microns

Since machine parameter P9 must be set to an integer value (without decimals), it will be set to "4". That is, 4 micron resolution incurring an error of -0.0102 microns per pulse.

$$\frac{\text{Displayed distance x feedback error}}{\text{Resolution}} = \frac{100{,}000 \times (-0.0102)}{4} = -255 \text{ microns}$$

P9=4 P59(2)=0 P21(6)=0 P29 = 255 P63(8)=1

Example b) The motor has a 1250 line square-wave encoder.

For every turn of the roller, the paper moves 9.4248 inches.

The motor must make 15 turns for every turn of the roller. Therefore, the motor encoder will output 15 x 12500 = 18750 pulses.

If the CNC applies a x4 multiplier to these pulses, (P21(6)=0, The number of pulses per roller turn will be 18,750 x 4 = 75,000 pulses.

Therefore, the linear paper feeding distance per encoder pulse is:

9.4248 inches / 75,000 = 0.0001256663 inch = 3.1918 microns

Since machine parameter P9 must be set to an integer value (without decimals), it will be set to "3". That is, 3 micron resolution incurring an error of 0.1918 microns per pulse.

$$\frac{\text{Displayed distance x feedback error}}{\text{Resolution}} = \frac{100{,}000 \times (0.1918)}{3} = 6393 \text{ microns}$$

P9=3 P59(2)=0 P21(6)=0 P29 = 6393 P63(8)=0

Example 7: Resolution in "degrees" with sine-wave encoder

We want to obtain a 0.005º resolution with a sine-wave encoder mounted onto the X axis.

The CNC always applies a x5 multiplying factor to the sine-wave feedback pulses.

Plus, the CNC may apply an additional multiplying factor of either x2 or x4, depending on the setting of machine parameter P21(6). The resulting encoder line count will be:

$$\text{Number of pulses} = \frac{\text{Thousandths of a degree/ turn}}{\text{x5 xMultiplying Factor x Resolution}}$$

For a multiplying factor of x4:

$$\text{Number of pulses} = \frac{360{,}000}{5 \times 4 \times 5} = 3600 \text{ pulses/turn.}$$

P9=5 P59(2)=1 P21(6)=0 P29=0

For a multiplying factor of x2:

$$\text{Number of pulses} = \frac{360{,}000}{5 \times 2 \times 5} = 7200 \text{ pulses/turn.}$$

P9=5 P59(2)=0 P21(6)=1 P29=0

If a FAGOR rotary encoder is chosen, its pulse output frequency is limited to 200KHz. The CNC limits sine-wave pulse frequency to 50 KHz). Therefore, the maximum feedrate for this axis will be:

$$\text{Max. Speed} = \frac{50{,}000 \text{ pulses/sec.}}{\text{pulses/turn}}$$

Consequently, the maximum turning speed will be:
833.33 rpm for the 3600 line encoder and 416.66 rpm for the 7200 line encoder

6.3 ADJUSTMENT OF THE AXES

In order to make this adjustment it is necessary to have the feedback systems for all the axes connected to the CNC.

Before starting the adjustment of the axes, it is a good idea to move them close to the middle of their travels placing the travel-limit switches (controlled by the electrical cabinet) close to these points in order to avoid any damage to the machine.

After the machine parameters for the axes have been properly set, proceed with their adjustment by following these suggestions:

* The axes should be adjusted one at a time.

* Connect the power output of the drive corresponding to the axis being adjusted.

* In the JOG mode, move the axis being adjusted.

  In case of run-away, the CNC will display the relevant following error and the machine parameter corresponding to the SIGN OF THE ANALOG VOLTAGE will have to be changed. Machine parameters P22(1), P62(1).

* If the axis does not run away; but the direction of the move is not the desired one, the machine parameter corresponding to the COUNTING DIRECTION [P22(2), P62(2)] will have to be changed as well as that corresponding to the SIGN OF THE ANALOG VOLTAGE [P22(1), P62(1)].

* If the counting direction is correct but the axis moves in the opposite direction to the one indicated, change the axis machine parameter corresponding to the moving direction [P23(2), P63(2)].

Attention:

It may be useful to set parameter P12 with a value other than "0" while adjusting the axes.

6.3.1 ADJUSTMENT OF THE DRIFT (OFFSET) AND MAXIMUM FEEDRATE (G00)

These adjustments are performed on axis servo drives and spindle drives.

Drift adjustment (offset)

This adjustment will be made in two stages:

Pre-adjustment of the drive offset

* Disconnect the analog voltage input of the drive and short-circuit it with a wire jumper.

* Turn the offset potentiometer of the drive until the displayed axis position stops

* Remove the wire jumper mentioned above.

Fine adjustment of the drive offset

* Move the axis continuously back and forth either in JOG mode or by running a program.

  While the axis is moving, turn the offset potentiometer of the drive until the amounts of following error obtained in both directions are the same.

Adjustment of the maximum feedrate

It is recommended to adjust the drives so the maximum feedrate is obtained with an analog voltage of 9.5V.

Also, the maximum feedrate must be indicated in the corresponding machine parameter for that axis. Parameter P27, P67

The maximum feedrate can be calculated from the motor rpm, the gear ratios and the type of leadscrew being used.

Example for the X axis:

A motor can turn at 3000 rpm and it is attached to a 5-pitch leadscrew (1/5 inch/turn). Therefore, the maximum feedrate to be assigned to machine parameter P27 is:

Maximum feedrate (G00) = r.p.m. x leadscrew pitch

P27 = 3000 rev./min. x 1/5 inch/rev. = 600 inches/min.

Move the axis continuously back and forth either in JOG mode or by running a program.

While the axis is moving, measure the analog voltage coming out of the CNC towards the servo drive and adjust the gain potentiometer **at the servo drive (never at the CNC)** until this analog voltage reaches 9.5V.

6.4 CONTROL OF THE AXIS POSITIONING LOOP

With this CNC, it is possible to control the axes either in Closed Loop, in Open Loop with Servo-systems or in Open Loop without Servo-systems.

Closed Positioning Loop.

Closed Positioning Loop means that the CNC controls the actual axis position and feedrate at all times.

To operate in this mode, set P23(4)=1 (Closed loop) and P23(6)=0 for the CNC to output an analog voltage for the servo motors.

The parameters related to proportional gain and acc./dec. must also be set.

Non-servo-controlled Open Positioning Loop

When a motor does not have a servo drive, it is referred to as non-servocontrolled.

Therefore, Non-servo-controlled Open Positioning Loop means that the CNC only controls the position of the axis while carrying out the programmed movement. Once the programmed end point is reached, the CNC no longer controls the axis.

To operate in this mode, set P23(4)=0 (Open loop) and P23(6)=" for the CNC to output the "Fast", "Slow" and "moving direction" indicating signals.

The parameters determining the braking distance for each axis must also be set.

Servo-controlled Open Positioning Loop

When positioning, the CNC outputs an analog voltage proportional to the programmed F and it will be up to the servo drive to control the actual axis speed.

For example, if the maximum feedrate (set by parameter) is F10000 and F5000 is programmed, the CNC will output 5V.

When the axis enters the brake zone, the CNC switches to Closed Loop taking over the control of the axis from the servo drive until the target point is reached.

To operate in this mode, set P23(4)=0 (Open loop), P23(6)=0 (analog output and servo-motor).

The parameters defining the braking distance (for the approach stage) as well as those related to proportional gain and acc./dec. (for the final positioning stage) must also be set.

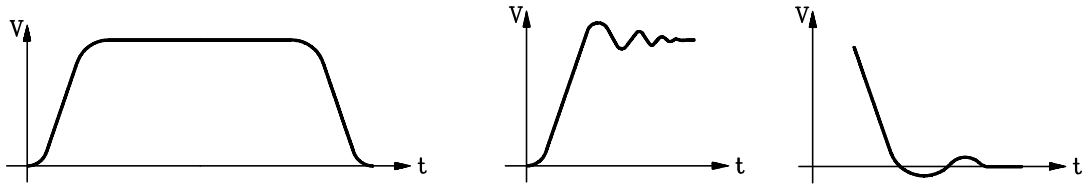
6.4.1 CLOSED POSITIONING LOOP

Closed Positioning Loop is referred to when the CNC controls, at all times, the feedrate of the axes.

P23(4) must be set to "1" (Closed Loop), and P23(6)=0 for analog voltage output and the motor must be servocontrolled.

It is necessary to properly adjust the different gains for each axis in order to optimize the response of the whole system to the programmed movements.

It is recommended to use an oscilloscope in order to obtain a finer adjustment of the axes by monitoring the signals provided by the tacho. The diagram on the left corresponds to the ideal signal shape and the other ones to an unstable start-up and brake-down.



The CNC has a series of machine parameters which permit adjusting the proportional gain for each axis. These parameters are:

PROPORTIONAL GAIN K1.

Defined by parameters: P10, P50.

PROPORTIONAL GAIN K2.

Defined by parameters: P11, P51.

Value of the **GAIN BREAK POINT**

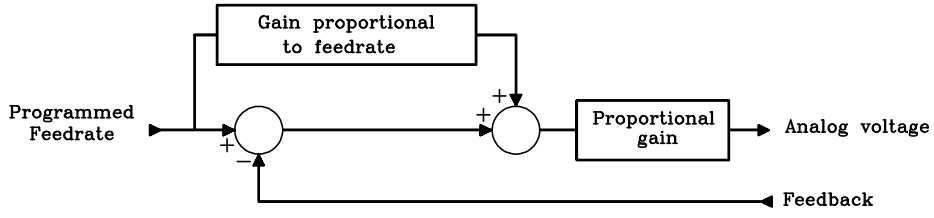
Defined by parameters: P26, P66.

FEED-FORWARD GAIN or gain proportional to the feedrate.

Defined by parameters: P75, P76

The parameters corresponding to the proportional gain K1 and K2 as well as for the gain break point allow adjusting the Proportional Gain for the axis.

The parameter for the Feed-Forward gain (proportional to feedrate) will be used when acceleration/deceleration control is being applied onto the corresponding axis.



6.4.1.1 PROPORTIONAL GAIN ADJUSTMENT

The analog voltage supplied by the CNC to control the axis is, at all times, a function of the amount of following error; that is, the difference between the theoretical position and the real (actual) position of the axis.

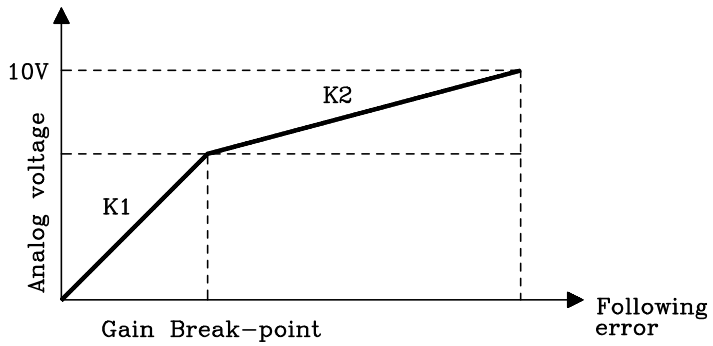
Analog output = Proportional gain “K” x Following Error

On start-up and slow-down, the following error of the axis is very small. Therefore, the proportional gain must be great in order for the axis to respond properly.

On the other hand, once the axis reaches its programmed speed, the following error is maintained practically constant and it is necessary to apply a smaller gain (K) in order to keep the system stable.

This CNC offers two proportional gains K1 and K2 to better adjust the system as well as another parameter referred to as Gain Break point which defines the active area for each one of these gains.

The CNC applies the proportional gain K1 whenever the amount of following error for the axis is smaller than the value assigned to the machine parameter corresponding to the gain break-point.



When the amount of following error exceeds the gain break-point value, the CNC applies the K2 value.

Analog = (K1 x Ep) + [K2 x (Following Error - Ep)]

Where “Ep” is the value assigned to the gain break-point and it is given in microns.

When adjusting the proportional gain, it must be borne in mind that:

* The amount of following error will decrease as the gain value increases, but the system will tend to be more unstable.

* In practice, most machines seem to respond well to what is called a unity gain (or gain of 1) which represents a following error of 1mm at a feedrate or 1m/minute or a following error of 0.001 inch at a feedrate of 1 inch/min.

  Therefore, this could be used as a practical starting point for the gain calculation described next. After analyzing the behavior of the machine for this gain, its value may be changed in order to optimize it.

6.4.1.2 CALCULATION OF K1, K2 AND GAIN BREAK-POINT

The value of K1 represents the analog voltage corresponding to 1 micron of following error. It is given by an integer between 0 and 255 in such a way that a value of 64 corresponds to an analog voltage of 2.5mV.

Therefore, the K1 value corresponding to a gain of 1 and a maximum motor speed adjusted to 9.5V servo analog input would be given by the following formulae:

$$\text{In metric (FE= 1mm for F=1m/min): } K1 = \frac{243.2}{\text{Fmax in m/min (P27 for X)}}$$

$$\text{In inches (FE= 0.001inch for F=1inch/min): } K1 = \frac{9575}{\text{Fmax in inch/min (P27 for X)}}$$

For example:

If the top feedrate for an axis is 500 inches/min (P27 for X), the K1 corresponding to a unity gain would be: K1 = 9575/500 = 19.15 and the value assigned to the corresponding parameter would be K1=19.

If the top feedrate for an axis is 20m/min, the K1 corresponding to a unity gain would be: K1 = 243.2/20 = 12.16 and the value assigned to the corresponding parameter would be K1=12.

The amount of following error corresponding to the GAIN BREAK-POINT is given in microns or 0.0001 inch units (by parameter P26 for the X axis, P215 for the Y axis, etc.). It is recommended to set it to a value slightly greater than the following error corresponding to the maximum machining feedrate F0 (P27, P67).

For example:

Let's suppose that K1 has been set for a gain of 1 (not K1=1) and that the maximum machining feedrate is 150 inches/min (P27, P67). At this feedrate, the following error should be about 0.150 inch. Thus, the gain break-point value should be slightly larger than 0.150 inch; for example: P26=0.155 inch.

Or in metric:

Let's suppose that K1 has been set for a gain of 1 (not K1=1) and that the maximum machining feedrate is 5 m/min (P27, P67). At this feedrate, the following error should be about 5 mm. Thus, the gain break-point value should be slightly larger than 5 mm; for example: P26=6 mm.

The machine parameter K2 gain sets the analog voltage for 1 micron of following error being applied from the gain break-point on.

It is also given by an integer between 0 and 255 and it is typically set to a value between 50% and 70% of K1 in order to avoid abrupt analog voltage changes when switching to slow machining feedrates.

To perform a practical axis adjustment at the machine, it is recommended:

1.- Adjust K1 optimizing the axis' response like the signal diagram shown earlier.

Set K1 =K2 or set the gain break-point to a large value (for example: 50000) and run a program moving the axis continuously back and forth.

Adjust the value of K1 until the proper response is obtained.

2.- Set the gain-break point to the correct value.

To do this, run the previous program and watch the amount of following error reached at **maximum** feedrate

Assign that value or one slightly larger to the gain break-point.

3.- Once K1 and the gain break-point have been set, change the value of K2 to one between 50% and 70% of K1.

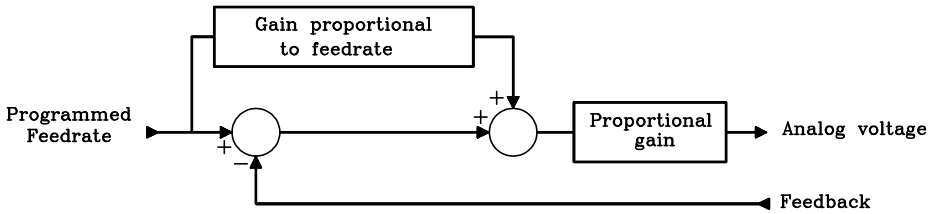
Attention:

Once each axis has been adjusted separately. All interpolating axes should be fine adjusted together in such a way that their following errors for the same feedrate are the same in order to achieve proper interpolations between those axes in the K1 area.

6.4.1.3 FEED-FORWARD GAIN ADJUSTMENT

With the Feed-Forward gain it is possible to improve the positioning loop of the axes, thus minimizing the amount of following error. **This gain must be used only when operating with acc/dec.**

The Feed-Forward gain is proportional to the feedrate and is set by machine parameters P75 for the X axis and P76 for the Y axis. They indicate the % of analog voltage that is due to the programmed feedrate.



The value added to the following error is (Kf x F/40) where Kf is the value of Feed-Forward and F is the programmed feedrate.

The CNC will apply the proportional gain (K1 and K2) to the value resulting from adding the following error of the machine plus the value selected by the Feed-Forward.

When the result of the addition is smaller than the value of the gain break-point, the CNC will apply the formula:

Analog = K1 x [Following Error + (Kf x F/40)]

And when the result of the addition is greater than the value of the gain break-point, the CNC will apply the formula:

Analog = (K1 x Ep) + {K2 x [Following Error + (Kf x F/40) - Ep]}

Where “Ep” is the value of the gain break-point.

6.4.1.4 CLOSED LOOP WITH BRAKE

When pressing the CYCLE START key or activating the START input in order to carry out the programmed movement, the CNC acts as follows:

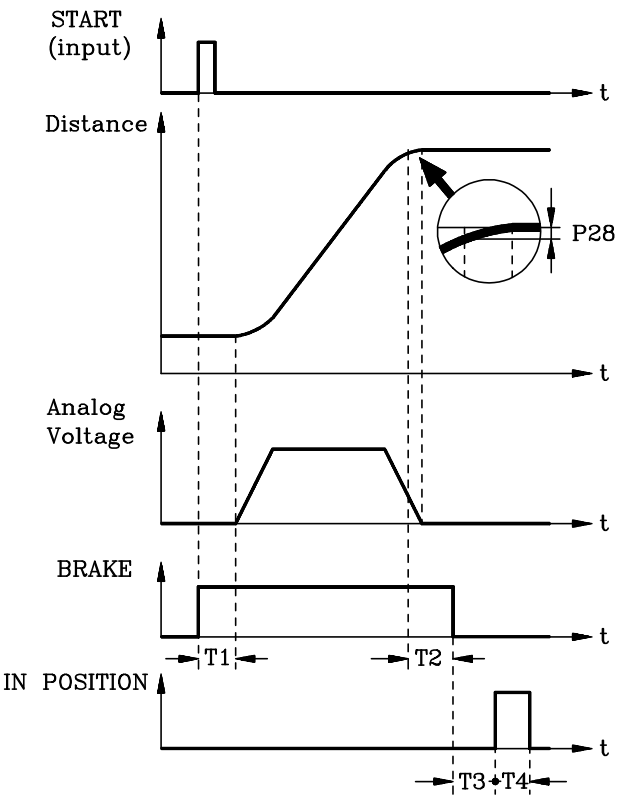
1.- Sets the Brake output high for the electrical cabinet to deactivate the brake.

2.- Because the brake is not deactivated instantaneously, machine parameter P31 may be set to establish the "T1" delay before supplying the corresponding analog voltage.

3.- Once the "T1" delay is elapsed, the CNC outputs the corresponding analog voltage.

4.- The CNC provides an analog voltage according to the programmed distance, and established gains and acceleration ramps.

5.- In order to give the axis time to reach position before activating the brake, it is possible to set a "T2" delay by means of machine parameter P32 for the X axis and P72 for the Y axis.



This parameter indicates the delay from the time the axis enters the in-position zone (at a P28 distance from target point) to the time when the brake output is set low.

6.- After the Brake output is set low, the CNC waits a "T3" period, indicated by machine parameter P33 for X and P73 for Y, before activating the In-Position output for the axis.

This In-Position output is kept high for a "T4" time period determined by machine parameter P34 for X and P74 for Y.

6.4.2 NON-SERVOCONTROLLED OPEN POSITIONING LOOP

When the motor does not use a servo drive, it is referred to as non-servocontrolled.

On a Non-servocontrolled Open Positioning Loop, the CNC controls the axis position only while carrying out the programmed movement. Once in position, the CNC no longer controls it.

P23(4) must be set "0" (Open Loop) and P23(6)=1 for the CNC to output discrete (non-analog) signals for "Fast", "Slow" and "Moving Direction".

The parameters establishing the braking distance for each axis must also be set.

The CNC outputs the "Fast" signal from the beginning of the move until entering the Brake zone where it outputs the "Slow" signal. Once in the In-Position zone (at a "P28" distance from the end point), the CNC activates the brake signal and abandons the control of the axis.

When pressing the CYCLE START key or the START input is activated for the programmed movement to be carried out, the CNC behaves as follows:

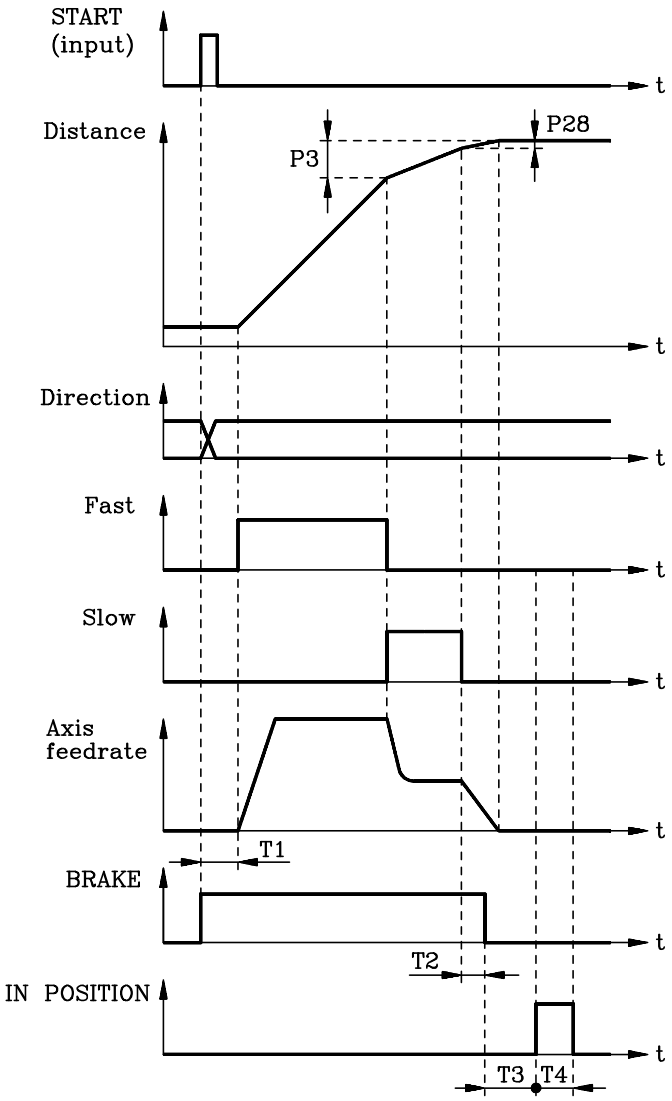
1.- Sets the Brake output high for the electrical cabinet to deactivate the axis Brake.

2.- Because the brake is not deactivated instantaneously, it is possible to set the "T1" delay by means of machine parameter P31 before activating the "Fast" signal.

3.- Once "T1" has elapsed, the CNC activates the "Fast" output so the axis can start its movement.

4.- This "Fast" output is kept high until the axis gets to a P3 or P43 distance from the end point. It then outputs the "Slow" signal.

5.- When the axis enters the In-Position zone (at a P28 distance from the end point), the CNC deactivates the "Slow" output.



6.- In order to give the axis time to reach position before activating the brake, it is possible to set the "T2" delay, by means of machine parameter P32 for X and P72 for Y.

This parameter indicates the delay from when the "Slow" signal is deactivated to the when the brake signal is set low.

7.- After setting the Brake signal low, the CNC waits a "T3" period indicated by machine parameter P33 for X and P73 for Y before activating the In-Position signal for the axis.

This In-Position output is kept high for a "T4" time period determined by machine parameter P34 for X and P74 for Y.

6.4.3 SERVO CONTROLLED OPEN POSITIONING LOOP

When positioning, the CNC outputs an analog voltage proportional to the programmed F and it will be up to the servo drive to control the actual axis speed.
For example, if the maximum feedrate (set by parameter) is F10000 and F5000 is programmed, the CNC will output 5V.

When the axis enters the brake zone, the CNC switches to Closed Loop taking over the control of the axis from the servo drive until the target point is reached.

To operate in this mode, set P23(4)=0 (Open loop), P23(6)=0 (analog output and servo-motor).

The parameters defining the braking distance (for the approach stage) as well as those related to proportional gain and acc./dec. (for the final positioning stage) must also be set.

When pressing the CYCLE START key or activating the START input for the programmed movement to be carried out, the CNC acts as follows:

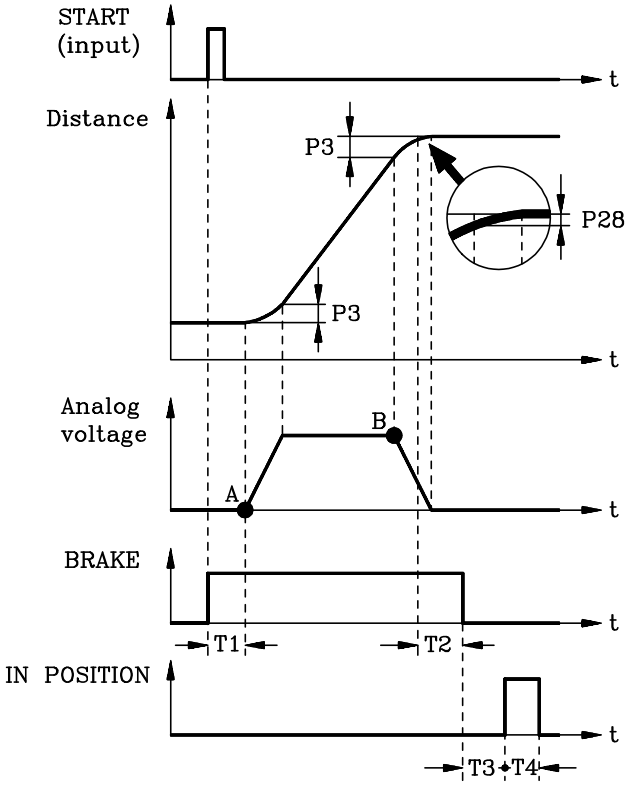
1.- Sets the Brake output high for the electrical cabinet to release the brake of the axis

2.- It applies the "T1" delay set by machine parameter P31 before supplying the corresponding analog output.

3.- Once "T1" has elapsed, the CNC outputs, in A-B section, an analog voltage proportional to the programmed F and it is up to the servo drive to control the actual speed of the motor. For example, if the maximum feedrate (set by parameter) is F10000 and F5000 is programmed, the CNC will output 5V.

4.- When the axis enters the brake zone, at a P3 or P43 distance from the target point, the CNC applies the closed loop taking over the control of the axis until it reaches position.

5.- In order to give the axis time to get in-position before activating the brake, it is possible to set a "T2" delay by means of machine parameter P32 for X and P72 for Y.



This parameter indicates the time elapsed from when the axis enters the in-position zone (at a P28 distance from the end point) to when the Brake output is set low (brake on).

6.- Once the brake output is set low, the CNC waits for "T3" period indicated by machine parameter P33 for X and P73 for Y, before turning on the In-Position output for the axis.

This In-Position output is kept high for a "T4" period of time specified by machine parameter P34 for X and P74 for Y.

Attention:

While operating in "Servo-controlled Open Positioning Loop", any variation at the Feedrate Override inputs (pins 10 and 11 of connector I/O1) will affect the **next** move and not the current one.

6.5 REFERENCE SYSTEMS

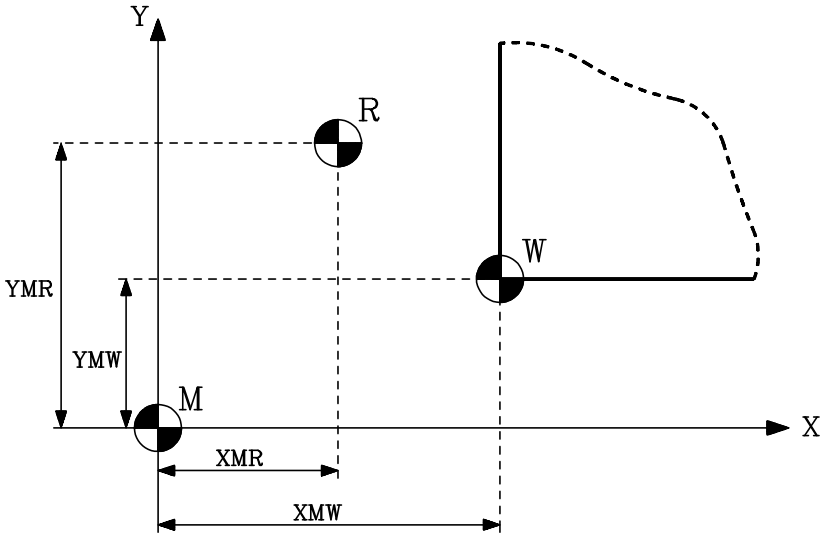
6.5.1 REFERENCE POINTS

A CNC machine must have the following reference points established:

* **Machine Reference Zero** or origin point of the machine. It is set by the machine manufacturer as the origin of the coordinate system of the machine.

* **Part Zero** or origin point for the part. It is the origin point set to program the measurements of the part. It can be chosen freely by the programmer and its reference to the machine reference zero is set by means of a zero offset.

* **Machine Reference Point**. It is the physical location of the marker pulse or reference pulse (Io) used as home to synchronize the whole machine coordinate system. The axis moves to this point when being "homed" and the CNC assumes the reference values set at machine parameter "P2, P42" accordingly.



M	Machine Reference Zero
W	Part Zero
R	Machine Reference Point
XMW, YMW	Part Zero coordinates
XMR, YMR	Machine Reference Point coordinates

6.5.2 MACHINE REFERENCE SEARCH (HOME)

With this CNC it is possible to search home in JOG mode or by program. Although it is possible to program the home search for both axes in one block, the actual home search is done on one axis at a time as follows:

The CNC starts moving the selected or programmed axis in the direction set by machine parameter P62(4) for X, P62(5) for Y at the feedrate set by machine parameter P25 for X, P65 for Y until the home switch is pressed P22(8) for X and P62(8) for Y.

Once the home switch is pressed, the CNC will continue moving the axis at a feedrate of 100 mm/min (3.9 inches/min) until the reference pulse (marker, Io) of the feedback device is found.

If the home search is performed in the JOG mode, the selected zero offset is cancelled and the CNC displays the coordinate values set by machine parameters P2 and P42.

In the other cases, it will maintain the current part zero. Therefore, the displayed coordinates are referred to this part zero

6.5.3 ADJUSTMENT OF THE MACHINE REFERENCE POINT (HOME)

The Machine Reference pint must be adjusted one axis at a time and it is recommended to follow this procedure:

* Set parameters P23(5) and P63(5) indicating the type of marker pulse used by the feedback device when searching home.

* Also, set parameters P62(4) and P62(5) to indicate the direction the axes must move when searching home.

* Besides, set parameters P25 and P65 to indicate the home switch approaching feedrate.

* Assign a value of "0" to the machine reference point. Parameters P2 and P42.

* Jog the axis to the proper area for home search and execute the home search command. When done, it will assign a value of zero to that point.

* Move the axis to the physical location where machine zero point will be (or to a position whose distance to machine zero is known), write down the position value displayed by the CNC at that point.

  The value to be assigned to parameter P2 or P42 (home coordinate) will be:

  Machine coordinate of the measured point - CNC value at that point.

  Example for the X axis:

  If the point of known dimensions is 230mm from the machine zero and the CNC shows "-123.5mm", the value to be assigned to "P2" will be:
  “P2” = 230 - (-123.5) = 353.5 mm.

* Assign this new value to the machine parameter and press **[RESET]** or power the CNC down and back up in order for the CNC to assume this new value.

* Perform a new home search in order for the CNC to assume the correct reference values.

6.5.4 SOFTWARE TRAVEL LIMITS FOR THE AXES

Once the home search has been carried out on all the axes, the soft limits for the CNC have to be established.

This is achieved one axis at a time and in the following manner:

* Jog the axis in the positive direction to a point close to the travel limit switch keeping a safety distance from it.

* Assign the position value displayed by the CNC to the machine parameter corresponding to the positive software travel limit. Parameters P0 and P40

* Repeat those steps in the negative direction assigning the displayed value to machine parameter corresponding to the negative software travel limit. Parameters P1 and P41

* Once this process is completed, press RESET or turn the CNC off and back on in order for the new values to be assumed by the CNC.

6.5.5 CONSIDERATIONS ABOUT THE MACHINE REFERENCE POINT

* If at the instant the home search is initiated, the home switch is pressed, the axis will withdraw [in the opposite direction to that set by P62(4), P62(5)] until releasing the home switch before starting the actual home search.

* If the axis is out of the soft travel limits (set by P0-P1, P40-P41), it has to be jogged into the work area (within limits) and, then, positioned at the correct side from home before starting the actual home search.

* Care must be taken when placing the home switch and when setting the home searching feedrates (P25, P65) to prevent any overshooting.

* If the selected axis does not have a home switch [P22(8), P62(8)], the CNC will consider it to be pressed and it will only make the marker pulse searching move at 100 mm/min. until the marker pulse (Io) from the feedback device is detected; thus completing the home search.

* FAGOR linear transducers (scales) have a negative marker pulse (Io) every 50 mm ["P23(5), P63(5)" = 0] and FAGOR rotary encoders output a positive marker pulse (Io) ["P23(5), P63(5)" = 1] per revolution.

6.6 AUXILIARY "M" FUNCTION

With this CNC it is possible to use up to 100 auxiliary "M" functions, M00 through M99. All of them may be programmed except M41, M42, M43 and M44 which are generated automatically by the CNC.

A program block may contain up to 4 "M" functions and they will be executed sequentially in the order they have been programmed.

Every time an "M" function is executed, the CNC sends out to the electrical cabinet, via pins 20 through 27 of connector I/O1, the number of the "M" function being executed either in BCD code or decoded depending on the setting of parameter P23(7).

Pin	***Meaning***		
	BCD Coded P23(7)=1	**Decoded P23(7)=0**	
		Activates	Deactivates
20	MST 80	M9	M19
21	MST 40	M8	M18
22	MST 20	M7	M17
23	MST 10	M6	M16
24	MST 08	M5	M15
25	MST 04	M4	M14
26	MST 02	M3	M13
27	MST 01	M2	M12

When operating with BCD-coded outputs, P23(7)=1, each output indicates its BCD weight. For example, MST80 carries a weight of 80, MST20 one of 20, etc.

Example: When executing function M35, The CNC outputs show the following:

MST80	MST40	MST20	MST10	MST08	MST04	MST02	MST01
0	0	1	1	0	1	0	1

When operating with decoded outputs, P23(7)=0, functions M2 through M9 must be executed to activate each one of these outputs.

If P22(4)=0, these decoded outputs are kept active for 100 milliseconds; but if P22(4)=1 the decoded outputs are kept active until deactivated by the corresponding "M" function.

Example: The execution of an "M3" sets pin 26 high.

This output remains high for 100 milliseconds if P22(4)=0, or until M13 is executed if P22(4)=1.

6.7 SPINDLE

Depending on the setting of machine parameters "P101(6)", "P60(2)" and "P60(3)", the CNC provides one of the following spindle speed outputs:

* Single pole analog output (0 to +10V) via pins 34 and 35 of connector I/O1.
* Bipolar analog output signal (±10V) via pins 34 and 35 of connector I/O1.
* 4-digit BCD-coded logic output via pins 20 through 27 of connector I/O1.
* 2-digit BCD-coded logic output via pins 20 through 27 of connector I/O1.

Analog voltage output

When you want the CNC to give a bipolar analog output "P60(2)=0" and "P101(6)=0" must be set.

The CNC will generate a positive output (0 a +10V.) when "spindle clockwise (M3)" is selected and a negative output (0 to -10V.) when "spindle counterclockwise (M4)" is selected.

When you want the CNC to give a single pole analog output "P60(2)=0" and "P101(6)=1" must be set.

The CNC will generate a positive output (0 to +10V.) for both turning directions.

If a spindle speed is selected the CNC generates the single or bipolar analog signal, corresponding to the programmed turning speed (S).

Whenever a new spindle speed is selected which involves a range change, the CNC will automatically generate the M function associated with the new spindle speed range: “M41, M42, M43, M44”.

4-digit BCD-coded output.

At the beginning of the execution of the programmed block, the CNC will output the value corresponding to the programmed S speed in two stages with a 100 millisecond delay between them.

It also activates the "S Strobe" output at each stage and waits for the "Feedhold" signal coming from the electrical cabinet at each one of these two stages.

The first stage outputs the values corresponding to the Thousands and Hundreds and the second stage outputs the values corresponding to the Tens and Units. The I/O1 connector pins corresponding to each of them are:

Pin	1st stage	2nd stage
20	Thousands	Tens
21		
22		
23		
24	Hundreds	Units
25		
26		
27		

Example: S1234		
Pin	1st stage	2nd stage
20	0	0
21	0	0
22	0	1
23	1	1
24	0	0
25	0	1
26	1	0
27	0	0

2-digit BCD-coded output

To use 2-digit BCD coded spindle speed output, set "P60(2)=1" and P60(3)=0".

The CNC will output the BCD code corresponding to the programmed S speed at pins 20 through 27 of connector I/O1 and activates the "S Strobe" output to indicate to the electrical cabinet to process the required auxiliary function.

These outputs are activated at the beginning of the execution of the programmed block and the CNC waits for the electrical cabinet to activate the Feedhold signal and consider the execution of the required function concluded.

The table below shows the BCD codes corresponding to the programmed "S" values.

Programmed S	S BCD	Programmed S	S BCD	Programmed S	S BCD	Programmed S	S BCD
0	S 00	25-27	S 48	200-223	S 66	1600-1799	S 84
1	S 20	28-31	S 49	224-249	S 67	1800-1999	S 85
2	S 26	32-35	S 50	250-279	S 68	2000-2239	S 86
3	S 29	36-39	S 51	280-314	S 69	2240-2499	S 87
4	S 32	40-44	S 52	315-354	S 70	2500-2799	S 88
5	S 34	45-49	S 53	355-399	S 71	2800-3149	S 89
6	S 35	50-55	S 54	400-449	S 72	3150-3549	S 90
7	S 36	56-62	S 55	450-499	S 73	3550-3999	S 91
8	S 38	63-70	S 56	500-559	S 74	4000-4499	S 92
9	S 39	71-79	S 57	560-629	S 75	4500-4999	S 93
10-11	S 40	80-89	S 58	630-709	S 76	5000-5599	S 94
12	S 41	90-99	S 59	710-799	S 77	5600-6299	S 95
13	S 42	100-111	S 60	800-899	S 78	6300-7099	S 96
14-15	S 43	112-124	S 61	900-999	S 79	7100-7999	S 97
16-17	S 44	125-139	S 62	1000-1119	S 80	8000-8999	S 98
18-19	S 45	140-159	S 63	1120-1249	S 81	9000-9999	S 99
20-22	S 46	160-179	S 64	1250-1399	S 82		
23-24	S 47	180-199	S 65	1400-1599	S 83		

When programming a value greater than 9999, the CNC will output the spindle speed code corresponding to the value of 9999.

Example: When selecting S800, the CNC will output the BCD coded value of "S78" as shown below:

	MST80	MST40	MST20	MST10	MST08	MST04	MST02	MST01
Pin	20	21	22	23	24	25	26	27
Value	0	1	1	1	1	0	0	0

6.7.1 SPINDLE SPEED RANGE CHANGE

With this CNC, the machine can have a gear box in order to adapt the speeds and torques of the spindle motor to the various machining requirements.

Up to 4 spindle ranges may be set by means of machine parameters P36, P37, P38 and P39 specifying the maximum spindle rpm value for each one of them.

The value assigned to P36 must correspond to the lowest range (RANGE 1) and the one assigned to P39 to the highest range (RANGE 4).

When not using all 4 ranges, start the speed assignment from the lowest range up and set the unused ranges to the highest speed being used.

When the new spindle speed selected requires a range change, the CNC will execute the auxiliary M function corresponding to the new range.

The CNC uses the auxiliary functions: M41, M42, M43 and M44 to indicate to the electrical cabinet which range must be selected: RANGE 1, RANGE 2, RANGE 3 or RANGE 4).

6.8 TOOLS

When working with tools, set "P60(5)=0"

If "P61(5)=0", whenever a block containing a T function is executed, the CNC outputs the BCD code corresponding to that tool via pins 20 through 27 of connector I/O1.

When working with tools, the CNC also applies tool length compensation along both axes.

To do this, the CNC uses its internal table as tool offset table.

Each one of the 10 addresses (1 through 10) of the table corresponds to the same tool table and it has two fields.

The X field indicates the tool length along the X axis and the Y field indicates the tool length along the Y axis.

The chapter on "Aux mode of operation" of the operating manual describes how to access and operate with this table.

6.9 M, S, T FUNCTION TRANSFER

Every time a block is executed, the CNC sends to the electrical cabinet the information about the M, S, T functions activated in it.

It first sends out the information about the M function, then about the S function and finally about the T function.

This transmission takes place at the beginning of the execution of the block.

Depending on the value assigned to machine parameter "P22(5)" the CNC will either wait or not for the FEEDHOLD signal to be activated in order to consider the execution of the auxiliary function completed.

M function:

When executing a programmed M function or whenever the selected S involves a spindle range change, the CNC will activate the corresponding BCD outputs (pins 20 through 27 of I/O1) and the M" Strobe" output to "tell" the electrical cabinet to execute it.

Depending on the setting of P23(7), the output value at pins 20 through 27 of I/O1 will be BCD-coded or decoded.

When executing more than one M function, the CNC will send them one by one in the programmed order as they are executed.

When the outputs are not maintained, "P22(4)=0", the CNC uses the Feedhold signal to transfer the "M" function as described later on.

S function:

When programming an S value while using BCD outputs (pins 20 through 27 of I/O1), "P60(2)=1", the CNC activates the pertinent ones and issues an "S Strobe" signal to "tell" the electrical cabinet to execute it.

T function:

If "P61(5)=0", the CNC will use the BCD outputs (pins 20 through 27 of I/O1) to indicate the T function programmed in the block and it will issue a "T Strobe" to "tell" the electrical cabinet to execute it.

6.9.1 M, S, T FUNCTION TRANSFER USING THE FEEDHOLD SIGNAL

When parameter P22(5) is set to "0", the CNC maintains the BCD outputs and the corresponding Strobe signal (M, S, T) active for 100 milliseconds.

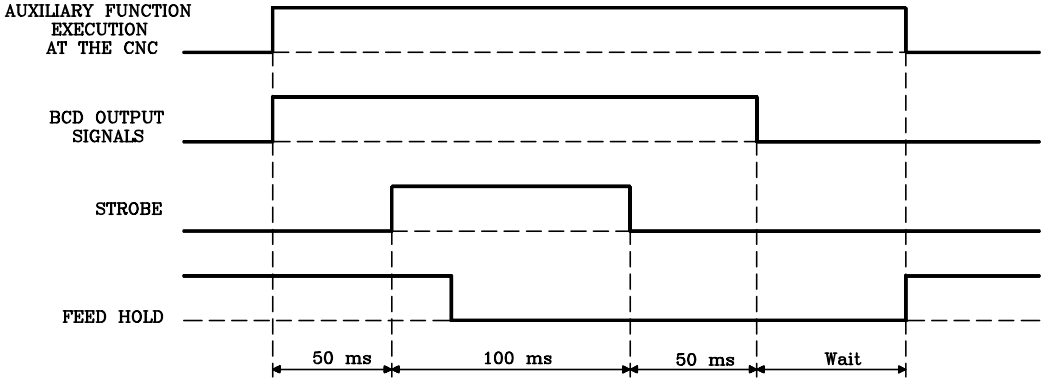
When the electrical cabinet has a device requiring the BCD signals to be active for a longer time, machine parameter P22(5) must be set to "1".

In each case, the CNC acts as follows:

"P22(5)=0"

1.- The CNC transfers the BCD value of the selected function via pins 20 to 27 of connector I/O1.

50 milliseconds later, the "M Strobe" output is activated to "tell" the electrical cabinet to execute the M function.



2.- When the electrical cabinet detects the activation of the "M Strobe" signal, it must start the execution of the corresponding function.

3.- The CNC will maintain the "M Strobe" signal for 100 milliseconds and the BCD signals for another 50 milliseconds.

After this time period, it will wait for the FEEDHOLD signal provided by the electrical cabinet indicating to the CNC that the execution of the "M" function is completed.

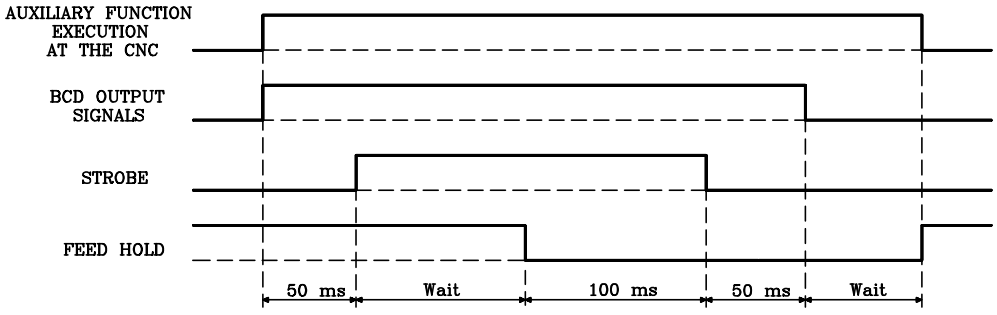
If the FEEDHOLD signal was not deactivated in point 2, the CNC will consider the M transfer completed after the BCD signals disappear (there is no wait).

“P22(5)=1”

This type of transfer is used when the electrical cabinet has a device which requires the BCD outputs from the CNC to be active for a longer period of time.

1.- The CNC sends the BCD value of the selected function via pins 20 to 27 of connector I/O 1.

50 milliseconds later, it activates the corresponding Strobe output to “tell” the electrical cabinet to execute the required auxiliary function.



2.- When the electrical cabinet detects the activation of one of the Strobe signals, it must begin the execution of the corresponding function deactivating the FEEDHOLD signal to let the CNC know that this M function execution has begun.

3.- The CNC will maintain the Strobe signal for another 100 milliseconds and the BCD outputs for another 150 milliseconds.

After this time period, it will wait for the electrical cabinet to reactivate the FEEDHOLD input “telling” the CNC that the processing of the required function has concluded.

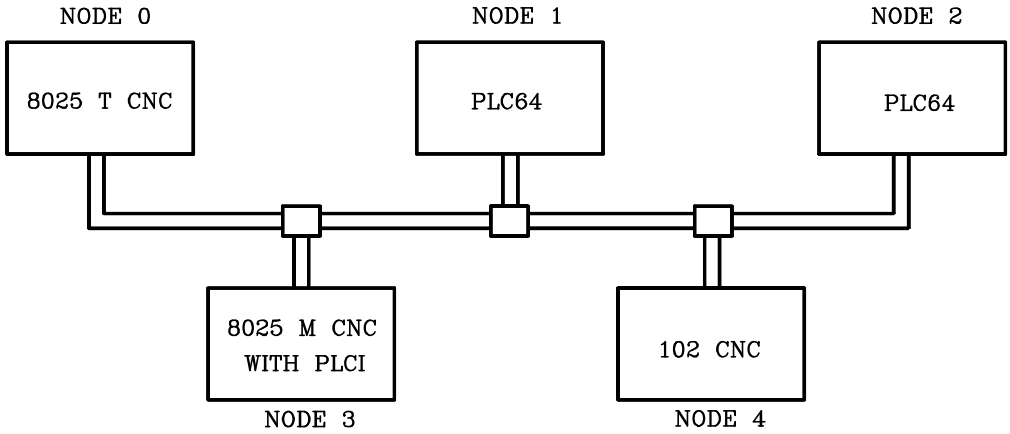
7. *FAGOR LOCAL AREA NETWORK*

7.1 INTRODUCTION

The FAGOR Local Area Network (LAN) is a Token-Passing-Bus type communication network that allows the interconnection of up to 15 elements (nodes).

The different elements that may be interconnected via the FAGOR LAN are:

CNC 82, 101S, 102, 102S
CNC 800 T, 800 M
CNC 8025 GP
CNC 8025 M, MG or MS (with or without integrated PLC)
CNC 8025 T, TG or TS (with or without integrated PLC)
CNC 8025 P, PG or PS (with or without integrated PLC)
PLC64



Each element occupies a NODE of the network and all of them have a number of machine parameters to configure the network.

The numbering of the nodes must begin by "0" and it must be sequential. Node "0" is the Main Node and the element connected to it sets or determines the total number of nodes being installed in the LAN.

This LAN utilizes the ROTARY MASTER system; that is, the different nodes temporarily assume the master function so they can communicate directly with each other.

7.2 LAN INTERFACE

The various elements must be interconnected via an RS485 serial line.

The RS485 connector for each element is a SUB-D type 9-pin female connector with the following pin-out:

PIN	SIGNAL	FUNCTION
1	---	*Not connected*
2	---	*Not connected*
3	TxD	Transmit Data
4	---	*Not connected*
5	---	*Not connected*
6	---	*Not connected*
7	---	*Not connected*
8	TxD	Transmit Data
9	---	*Not connected*

The nodes must be connected via a "TWINAXIAL" cable which must also meet the following requirements:

SPECIFICATIONS		
Conductor	Type: Material: Resistance:	02 AWG twisted 7x28 Copper (only one stained wire) Max 11 L per every 305m. (1000 ft)
Insulator	Material:	Teflon
Shields	Material Type Cover Resistance	Stained copper Braid 34 AWG. 8 ends / 16 carriers Minimum 95% Maximum 3L per every 305m. (1000 ft)
Covering	Material: Outside diameter	Teflon Nominal 7mm. (0.257inches)
Capacitance		Maximum 53,1 pF/m (16.2 pF/ft)
Impedance		107± 5% Ohm at 1 MHz.

Attention: Do not manipulate the connectors with the unit connected to main AC power

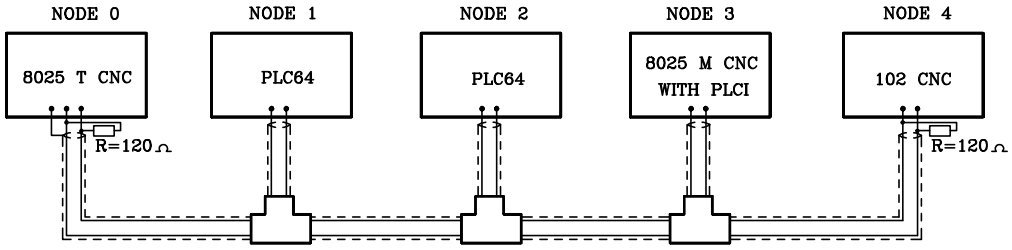
Before manipulating these connectors, make sure that the unit is not connected to main AC power.

For better immunity of the RS485 serial line against conducted electromagnetic disturbances, it is recommended to solder the cable mesh to the metal hood of the connector.

To interconnect the nodes follow these considerations:

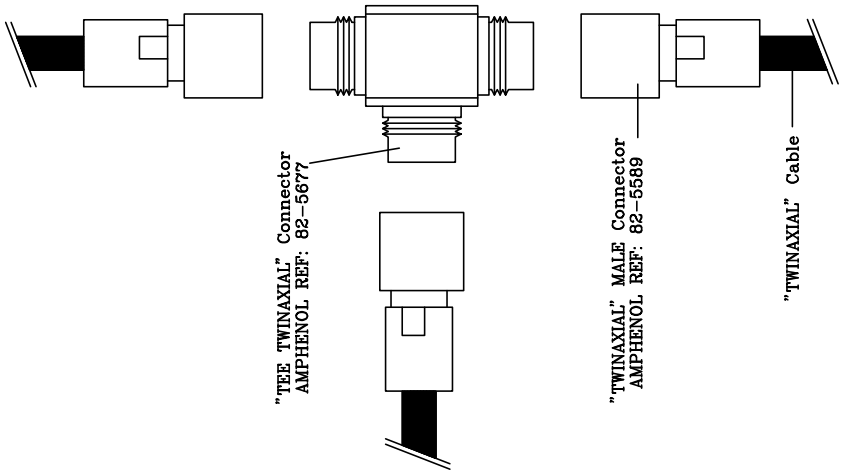
* The shield must be connected only to one of the LAN nodes using pin 1 of the corresponding connector.

* A 120-Ohm-1/4w terminating resistor must be connected between pins 3 and 8 of the nodes most distant from each other.

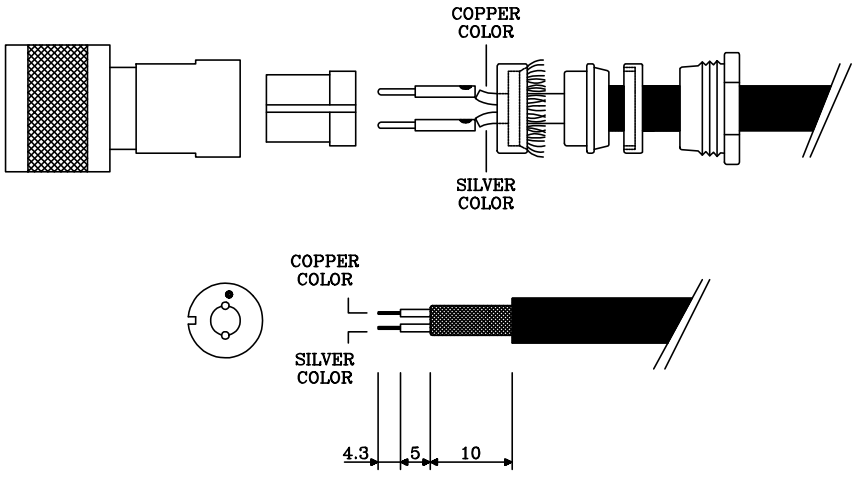


* When the FAGOR LAN consists of more than 2 nodes, "TEE TWINAXIAL" connectors must be used as indicated below.

  It must be borne in mind that the maximum cable length allowed between a "T Twinaxial" connector and the element is 80cm (31.49 inches).



MOUNTING DETAIL FOR THE "TWINAXIAL" CABLE



Before connecting or disconnecting the FAGOR LAN connectors, ALL its elements must be powered OFF.

Also, before connecting the FAGOR LAN, all the elements must be connected to ground and verified that between their 0V points:

- there is continuity (0 Ohms) (with the elements powered off).
- or there is no voltage difference (0 V) (with the elements powered on).

If this condition is not met, the internal circuitry of some elements may be damaged.

7.3 CNC CONFIGURATION IN THE FAGOR LAN

To configure a 101S, 102 or 102S CNC in the FAGOR LAN, the following machine parameters must be set:

P59(1)=1 The CNC is connected to the Fagor LAN.

P59(4) The CNC occupies the Main Node of the LAN

It indicates whether the CNC is the main node (NODE 0) or not.

P59(4) = 0 It is **not** the main node (NODE 0).
P59(4) = 1 It **is** the main node (NODE 0).

P56 Node number occupied by the CNC in the LAN

When the CNC is the main node, this parameters indicates how many more nodes are interconnected in the LAN and when the CNC is not the main node, it indicates the node number it occupies in the LAN.

Examples:

A Fagor LAN consists of 2 PLC64 (nodes 0 and 1) and a Fagor102 CNC (node 2).

P59(4) = 0 The CNC is not the Main Node.
P56 = 2 The CNC occupies node 2

A Fagor LAN consists of a Fagor102 CNC (node 0) and 2 PLC64 (nodes 1 and 2).

P59(4) = 1 The CNC is the Main Node
P56 = 2 There are another two nodes in the LAN.

P58 Number of the node receiving the M, S, T functions

It indicates the node number of the PLC64 receiving the M, S, T functions.

If there is no PLC64 associated with the CNC, this parameter must be set to a value of 15 or greater.

P57 Register of the PLC64 receiving the M, S, T functions

It indicates the register number of the PLC64 receiving the BCD codes for the M functions.

The BCD codes for the S and T functions will be loaded into the next two registers.

This parameter must be set to an integer value greater than 10 and smaller than 253.

Example: To send the BCD codes for the M, S, T functions out to a PLC64 connected to node 3 by loading this data into registers R20, R21 and R22:

P58=3 Sends the data out to node 3

P57=20 The code for M functions is deposited in register R20
The code for S functions is deposited in register R21
The code for T functions is deposited in register R22

P80 Parameter identifying the CNC within the LAN

Any element installed in the LAN may read the contents of a machine parameter and, depending on the setting of this parameter by the manufacturer, get more information about the CNC and the machine.

Attention:

This machine parameter has no effect on the operation of the CNC.

7.4 INTERNAL CNC INFORMATION

Any PLC64, 8020 CNC, 8025 CNC or 8030 CNC installed in the Fagor LAN may access the internal information of a 101S, 102 or 102S CNC also installed in the LAN being possible to:

* Know the number of the program being executed, the currently selected feedrate F, which axes are in motion, etc.

* Inhibit the axes, display messages at the CNC, simulate the CNC keyboard, etc.

The PLC64 offers a number of marks (internal relays) associated to registers that allow direct access to the various internal variables of the CNC101S, 102 or 102S.

The resources of the PLC64 for this application are:

M1901 - M1949 Each one of these marks is associated with a register (R101 - R149).

Whenever one of these marks is activated at the PLC64, the CNC puts the information corresponding to that mark into the associated register of the PLC64.

M1950 - M1964 Each one of these marks is associated to a register (R150 - R164).

Whenever one of these marks is activated, the PLC64 sends to the CNC the data stored at the associated register.

To access the arithmetic parameters of the CNC101S, 102 or 102S from a PLC64, It is required to perform system calls.

To access the internal information of the CNC101S, 102 or 102S, from an 8020 CNC, 8025 CNC or from 8030 CNC use function G52 at the CNCs requesting this data.

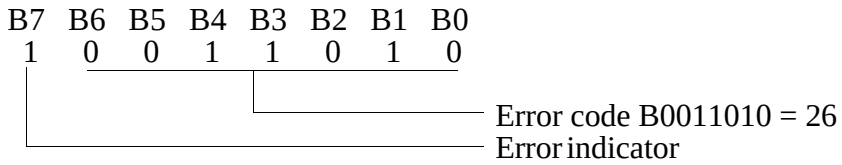
7.4.1 DIRECT READING OF THE INTERNAL CNC VARIABLES FROM A PLC64

Whenever at the PLC64 one of marks M1901 through M1949 is activated, the CNC deposits in the associated register **of the PLC64** (R101 through R149) the information corresponding to that mark.

INTERNAL CNC VARIABLES	ASSOCIATED REGISTER	Mark to be activated at the PLC64
Y axis in motion (0=No 1=Yes)	B2 R101	M1901
X axis in motion (0=No 1=Yes)	B3 R101	M1901
CNC in execution (0=No 1=Yes)	B5 R101	M1901
CNC interrupted (0=No 1=Yes)	B6 R101	M1901
Error	B7 R101	M1901
Selected operating mode	B8,9,10 R101	M1901
Movement in G00 (0=No 1=Yes)	B11 R101	M1901
Lower half of X coordinate	R102	M1902
Upper half of X coordinate	R103	M1903
Lower half of Y coordinate	R104	M1904
Upper half of Y coordinate	R105	M1905
Number of the first program block	R106	M1906
Programmed F (in mm/minute)	R107	M1907
Programmed S in rpm.	R108	M1908
Active tool number	R109	M1909
Parameter P80. CNC Id in the LAN	R110	M1910
Code of the last key pressed	R111	M1911

Error

When receiving an error indicator (B7 R101), the CNC sends its corresponding binary code to bits B0 through B6 of register R101 of the PLC64.



Operating mode

Bits 8, 9 and 10 of register R101 indicate which operating mode is currently selected at the CNC:

Operating mode	R101		
	Bit 10	Bit 9	Bit 8
Peripherals	0	0	1
Aux-Mode	0	1	0
Jog	0	1	1
Play-back	1	0	0
Editing	1	0	1
Single-Block	1	1	0
Automatic	1	1	1

Axis coordinates

When the coordinate of an axis is requested the CNC displays its value in a double register, and therefore both registers must be defined in the PLC64 program.

This value is given **IN MICRONS**, with respect to Machine Reference Zero (home) and in hexadecimal format as shown below:

If X coordinate: 123.456	Value: H1E240	R103=0001	R102=E240
If X coordinate: -30.506	Value: HFFFF88D6	R103=FFFF	R102=88D6

Number of the first program block

This number is given in BCD code. For example, if the first block is 278, register R106 will show the value of: 0000 0010 0111 1000

Axis feedrate "F" and spindle speed "S"

The F value is given in mm/min. and the S value in rpm. They are both in Hexadecimal format as shown below:

F 10000	Value: H2710	R107=2710
S 2500	Value: H9C4	R108=9C4

Active tool "T" number

The active tool number is given in BCD code. For example, T12 will appear at register R109 as 0000 0000 0001 0010

Fagor Local Area Network (LAN)

With mark M1910, it is possible to know the setting of machine parameter P80 of the CNC when it is connected to the Fagor LAN.

This parameter setting appears at the 8 least significant bits (0 through 7) of register R110 with the correspondence shown below (bits 8 through 15 are not being used at this time):

P80(8)	P80(7)	P80(6)	P80(5)	P80(4)	P80(3)	P80(2)	P80(1)
R110(7)	R110(6)	R110(5)	R110(4)	R110(3)	R110(2)	R110(1)	R110(0)

Key codes

The key codes that the CNC may return at register R111 when activating mark M1911 are described in the appendix at the end of this manual.

7.4.2 DIRECT WRITING OF THE INTERNAL CNC VARIABLES FROM A PLC64

Whenever one of marks M1950 through M1964 is activated, the PLC64 sends out to the CNC the information stored at the associated register (R150 through R164).

INTERNAL CNC INFORMATION	ASSOCIATED REGISTER	Mark to be activated at the PLC64
Inhibit Y axis (0=No 1=Yes)	B2 R150	M1950
Inhibit X axis (0=No 1=Yes)	B3 R150	M1950
Error number to be displayed	B8-15 R151	M1951
Number of the block where the execution begins	R152	M1952
Number of the block to be executed	R153	M1953
Code of the key to be simulated	B0-7 R154	M1954

Axis inhibit

The PLC64 may inhibit an axis so it cannot be moved.

When the CNC executes a block involving the movement of an inhibited axis, it interrupts the execution until that inhibition is removed.

Error display

The most significant bits (8 through 15) of register R151 indicate the binary code of the error number to be displayed at the CNC.

For example, to make the CNC display error 17, set R151 of the PLC to:
0001 0001 0000 0000 and activate mark M1951.

The CNC interrupts the execution of the program (if it was running) and displays the following information:

LAn
Error 17

Number of the block where the execution begins

It is possible to set from the PLC, the block number where the CNC will start executing the program.

To do this, set Register R152 to the BCD value of the desired initial block.

For example, to initiate the execution at block number 123, set:
R152= 0000 0001 0010 0011 and activate mark M1952.

Number of the block to be executed

It is possible to indicate to the CNC from the PLC which program block to execute.

To do this, set register R153 to the BCD code of the desired block number.

For example, to execute block number 456, set:
R153= 0000 0100 0101 0110 and activate mark M1953.

Once executed, the CNC will indicate its status in register R101 of the PLC.

Code of the key to be simulated

Whenever a key code is sent to the CNC, this behaves as if the corresponding key were pressed.

To do this, set R154 to the key code to be simulated and activate mark M1954.

When sending a keystroke sequence to the CNC, after each key code is sent and before sending the next one, it is a good idea to check whether that key has been accepted by the CNC or not by consulting the R111-M1911 combination.

The key codes to be sent to the CNC are described in the appendix at the end of this manual.

7.4.3 ACCESS TO THE ARITHMETIC PARAMETERS OF THE CNC FROM A PLC64

Each arithmetic parameter of the CNC has a double register associated with it at the CNC itself. This double register may be consulted or modified by a PLC64 installed in the LAN.

Arithmetic parameter P0 ->	Associated double register: R100 of the CNC
Arithmetic parameter P1 ->	Associated double register: R101 of the CNC
Arithmetic parameter P2 ->	Associated double register: R102 of the CNC
. .	. . . . .
. .	. . . . .
. .	. . . . .
Arithmetic parameter P97 ->	Associated double register: R197 of the CNC
Arithmetic parameter P98 ->	Associated double register: R198 of the CNC
Arithmetic parameter P99 ->	Associated double register: R199 of the CNC

To consult an arithmetic parameter of the CNC from a PLC64, a system call must be performed (see PLC64 manual).

Example of an arithmetic parameter consultation:

R5 = 15	A 32-bit register is to be consulted.
R6 = 116	Number of the CNC register to be consulted (R116)
SYS ?? R ??	System call depending on the node number occupied by the CNC.

Once the system call has concluded, register R6 and R7 indicate the arithmetic parameter value consulted (R7 will contain the upper half of the value and R6 the lower one).

Example of how to modify the value of an arithmetic parameter:

R5 = 16	A 32-bit register is to be changed.
R6 = 132	Number of the CNC register to be modified (R132)
R7 = Data	Upper half of the value to be assigned.
R8 = Data	Lower half of the value to be assigned.
SYS ?? R ??	System call depending on the node number occupied by the CNC.

Once the system call has concluded, parameter P32 will assume the value indicated at registers R7 and R8 of the PLC64.

7.4.4 ACCESS TO THE INTERNAL CNC VARIABLES FROM AN 8020, 8025 or 8030 CNC

These CNCs offer function G52 which allows access to the internal variables of a 101S, 102 or 102S model CNC as well as issuing execution commands out to a 101S, 102 or 102S model CNC.

7.4.4.1 ACCESS TO THE INTERNAL "READ" VARIABLES

The internal "read" variables of the 101S, 102 or 102S CNC are associated with a register at the CNC itself. This register may be consulted by any 8020, 8025 or 8030 CNC installed in the LAN.

INTERNAL CNC VARIABLES	Register of the CNC 102 to be consulted
Y axis in motion (0=No 1=Yes)	B2 R1
X axis in motion (0=No 1=Yes)	B3 R1
CNC in execution (0=No 1=Yes)	B5 R1
CNC interrupted (0=No 1=Yes)	B6 R1
Error	B7 R1
Selected operating mode	B8,9,10 R1
Movement in G00 (0=No 1=Yes)	B11 R1
Lower half of X coordinate	R2
Upper half of X coordinate	R3
Lower half of Y coordinate	R4
Upper half of Y coordinate	R5
Number of the first program block	R6
Programmed F (in mm/minute)	R7
Programmed S in rpm.	R8
Active tool number	R9
Parameter P80. CNC Id in the LAN	R10
Code of the last key pressed	R11

Error

When receiving the error indicator (B7 R1), The CNC will show its corresponding binary code at bits B0 through B6 of register R1.

Example, error 26: R1= 0000 0000 1001 1010

Operating mode

Bits 8, 9 and 10 of the CNC register R1 indicate the operating mode currently selected.

Operating mode	R1		
	Bit 10	Bit 9	Bit 8
Peripherals	0	0	1
Aux-Mode	0	1	0
Jog	0	1	1

Operating mode	R1		
	Bit 10	Bit 9	Bit 8
Play-back	1	0	0
Editing	1	0	1
Single-Block	1	1	0
Automatic	1	1	1

Coordinates of the axes

When requesting the coordinate of the X axis, the CNC shows the corresponding value at the double register R2-3. This value is given **in microns**, with respect to Machine Reference Zero (home) and in hexadecimal format as shown below:

If X coordinate: 123.456	Value: H1E240	R3=0001	R2=E240
If X coordinate: -30.506	Value: HFFFF88D6	R3=FFFF	R2=88D6

Number of the first program block

This number is shown in BCD code. For example: if the first block number is 278: The value of register R6 will be: 0000 0010 0111 1000

Axis feedrate "F" and spindle speed "S"

The F value is expressed in **mm/min** and the S value in rpm. both in hexadecimal format as shown below:

F 10000	Value: H2710	R7=2710
S 2500	Value: H9C4	R8=9C4

Active tool number

It is given in BCD code. For example, in the case of T12, register R9 will have the value of: 0000 0000 0001 0010

Fagor LAN

When this CNC is connected to the Fagor Local Area Network, this register shows the value allocated to the CNC machine parameter P80.

This value appears at the 8 least significant bits (0 through 7) of register R10. Bits 8 through 15 are not being used at this time. The relationship between the parameter bits and register bits is the following:

P80(8)	P80(7)	P80(6)	P80(5)	P80(4)	P80(3)	P80(2)	P80(1)
R10(7)	R10(6)	R10(5)	R10(4)	R10(3)	R10(2)	R10(1)	R10(0)

Key codes

The key codes that the CNC can return at R11 are described in the appendix at the end of this manual.

7.4.4.2 ACCESS TO THE INTERNAL "WRITE" VARIABLES

All internal variables of the 101S, 102 or 102S CNC have an associated register at the CNC itself.

In order to modify any of these internal variables of the 101S, 102 or 102S CNC from an 8020, 8025 or 8030 CNC, its associated register must be changed.

INTERNAL CNC INFORMATION	CNC register to be altered
Inhibit Y axis (0=No 1=Yes)	B2 R50
Inhibit X axis (0=No 1=Yes)	B3 R50
Error number to be displayed	B8-15 R51
Number of the block where the execution begins	R52
Number of the block to be executed	R53
Code of the key to be simulated	B0-7 R54

Axis inhibit

The axes may be inhibited so they cannot be moved.

When the CNC executes a block involving the movement of an inhibited axis, it interrupts the execution of the program (if it was running) until that inhibition is removed.

Error display

The most significant bits (8 through 15) of register R51 indicate the binary code of the error number to be displayed at the 101S, 102 or 102S CNC.

For example, to make the 102 CNC display error 17, set R51 to:
0001 0001 0000 0000 .

The CNC interrupts the execution of the program (if it was running) and displays the following information:

LAn
Error 17

Number of the block where the execution begins

It is possible to set from an 8020, 8025 or 8030 CNC, the block number where this CNC will start executing the program.

To do this, set Register R52 to the BCD value of the desired initial block.

For example, to initiate the execution at block number 123, set:
R52= 0000 0001 0010 0011.

Number of the block to be executed

An 8020, 8025 or 8030 CNC can indicate to the 101S, 102 or 102S CNC which program block to execute.

To do this, set register R53 to the binary code of the desired block number.

For example, to execute block number 456, set:
R53= 0000 0100 0101 0110.

Once executed, the 101S, 102 or 102S CNC will indicate its status in its register R1.

Code of the key to be simulated

Whenever a key code is sent to the 101S, 102 or 102S CNC, this behaves as if the corresponding key were pressed.

To do this, set R54 to the key code to be simulated.

When sending a keystroke sequence to the CNC, after each key code is sent and before sending the next one, it is a good idea to check whether that key has been accepted by the CNC or not by consulting register R11.

The key codes to be sent to the CNC are described in the appendix at the end of this manual.

7.4.4.3 ACCESS TO THE INTERNAL "READ-WRITE" VARIABLES

Each arithmetic parameter of the 101S, 102 or 102S CNC has a double register associated with it at the CNC itself. This double register may be consulted or modified by an 8020, 8025 or 8030 CNC installed in the LAN.

Arithmetic parameter P0 ->	Associated double register: R100 of the CNC
Arithmetic parameter P1 ->	Associated double register: R101 of the CNC
Arithmetic parameter P2 ->	Associated double register: R102 of the CNC
. .	. . . . .
. .	. . . . .
. .	. . . . .
Arithmetic parameter P97 ->	Associated double register: R197 of the CNC
Arithmetic parameter P98 ->	Associated double register: R198 of the CNC
Arithmetic parameter P99 ->	Associated double register: R199 of the CNC

Example for consulting an arithmetic parameter

G52 N* P12 D150

Assigns the **value of** arithmetic parameter **P50** (register R150) **of** the **101S**, 102 or 102S CNC **to** arithmetic parameter **P12 of the 8025** CNC.

Example for modifying an arithmetic parameter:

G52 N* D151 H1ABC

Sets arithmetic parameter P51 (register R151) of the 101S, 102 or 102S CNC to a hexadecimal value of H1ABC.

7.5 EXECUTION COMMANDS OF THIS CNC PROGRAMMABLE AT AN 8020, 8025 or 8030 CNC.

With function G52 of the 8020, 8025 and 8030 CNCs, it is possible, besides accessing the internal variables of the 101S, 102 or 102S CNC, to:

* Send an execution command to the 101S, 102 or 102S CNC

* Synchronize processes between the 8020, 8025 or 8030 and a 101S, 102 or 102S

8. *DNC COMMUNICATIONS PROTOCOL*

It is possible to communicate between this CNC and a PC via DNC either by generating your own communications protocol or by using the software package "FAGOR DNC 100" which may be installed at an IBM-compatible personal computer.

In order to generate your own you must follow the communications protocol described in this chapter.

With the menu driven software package "FAGOR DNC 100", it is possible to:

* Transfer a program between this CNC and a PC.
* Execute a CNC program.
* Control the machine from a PC.
* Access the internal CNC variables.
* Etc.

8.1 BASIC CONCEPTS

To set up a DNC communication, use the RS232C connector as described in the section on "RS232C connector" of the chapter on "CNC configuration" in this manual.

The machine parameters relevant to the RS232C serial line must also be set as follows:

P70	Baudrate: 110, 150, 300, 600, 1200, 2400, 4800 or 9600.
P59(7) = 8	8 Data bits per character.
P59(5) = 0	No parity check
P59(8) = 0	1 Stop bit.

The communication must always be initiated by the external device (PC). The CNC will accept commands in ASCII coded lines.

The communication is based on ECHO response by the CNC and XON-XOFF control by the PC.

All characters sent out by the PC are sent back by the CNC except the <CR> character which indicates the end of the command. The CNC acknowledges the request with the # character (23H).

Example of a request to the CNC for the active tool number:

PC:	RT	<CR>	
CNC:	RT		05 #

If the CNC detects any error on the received line or it cannot execute it because its memory is locked or it is in execution mode; it will return the "*" character followed by the "ERROR" message and its corresponding number.
For example: * ERROR 106 #

Only one command per line must be sent always ending with the <CR> character.

The command line may include the following characters:

BS	(008H)	Deletes the last characters. The CNC returns the BS-SP-BS character sequence:
DEL	(07FH)	Deletes all the characters received. For each deleted character, it returns the BS-SP-BS character sequence.
HT	(009H)	The CNC takes it as SP (020H). It returns the SP character.
CR	(00DH)	End of command. From this moment on, the CNC responds to the command and it sends a # (023H) character at the end of the response.
LF	(00AH)	The CNC takes it as a CR. End of command.

Once the command has been sent out, <CR>, the CNC analyzes it and prepares the corresponding response to send it to the PC. In this stage, the CNC only accepts the following characters:

XOFF	(011H)	Interrupts communication. The CNC no longer sends characters.
XON	(013H)	Resumes communication. The CNC continues sending characters.
ESC	(01BH)	Aborts the command being sent. The CNC returns the # character.

Any other character received will cause the CNC to return the BEL character (007H) as echo.

8.2 CODES TO READ CNC DATA

RX, RY They return the X, Y coordinate value

The coordinate may be signed or unsigned, up to 5 digits to the left of the decimal point and up to 4 decimals.

Example for requesting the X axis coordinate from the CNC

PC: RX <CR>
CNC: RX -105.345 #

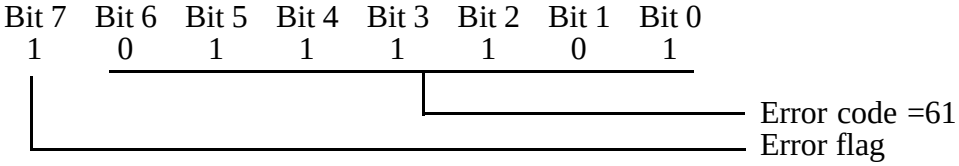
RE It returns the CNC status

It returns 4 hexadecimal-coded characters indicating the status of the CNC.

Character	Bit	Meaning	Value 0	Value 1
1st	15	Not being used	--	--
	14	Not being used	--	--
	13	Not being used	--	--
	12	Not being used	--	--
2nd	11	Movement in G00	No	Yes
	10	Operating mode		
	9			
	8			
3rd	7	Error	No	Yes
	6	Block executed	No	Yes
	5	CNC in execution	No	Yes
	4	Not being used	--	--
4th	3	X axis in motion	No	Yes
	2	Y axis in motion	No	Yes
	1	Not being used	--	--
	0	Not being used	--	--

Operating mode	Bit 10	Bit 9	Bit 8
Peripherals	0	0	1
Aux-Mode	0	1	0
Jog	0	1	1
Play-back	1	0	0
Editing	1	0	1
Single Block	1	1	0
Automatic	1	1	1

In case of error, the CNC, besides activating the error bit (bit 7 = 1), shows the corresponding error code at bits 0 through 6. For example:



Example for requesting CNC status:

PC: RE <CR>
CNC: RE 0F2C #

CNC Code	0				F				2				C			
Bit value	0	0	0	0	1	1	1	1	0	0	1	0	1	1	0	0
Bit Nr.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

The CNC indicates that the Automatic Mode is currently selected (bits 8, 9, 10), it is executing a block (bit 5), making a G00 move (bit11) and both axes are moving (bits 2, 3).

RB Reading the first block of the active program

It returns 3 characters which indicate the first block of the program being executed.

Request example:	PC:	RB <CR>	
	CNC:	RB	010 #

RF Returns the active feedrate F

It returns 5 characters which indicate the currently active feedrate F.

Request example:	PC:	RF <CR>	
	CNC:	RF	01000 #

RS Returns the theoretical spindle speed S value

It returns 4 characters which indicate the theoretical spindle speed S currently active.

Request example:	PC:	RS <CR>	
	CNC:	RS	0300 #

RT Returns the active tool number

It returns 2 characters which indicate the number of the tool currently active.

Request example:	PC:	RT <CR>	
	CNC:	RT	01 #

RP <parameter Nr.> It returns the value of the selected arithmetic parameter

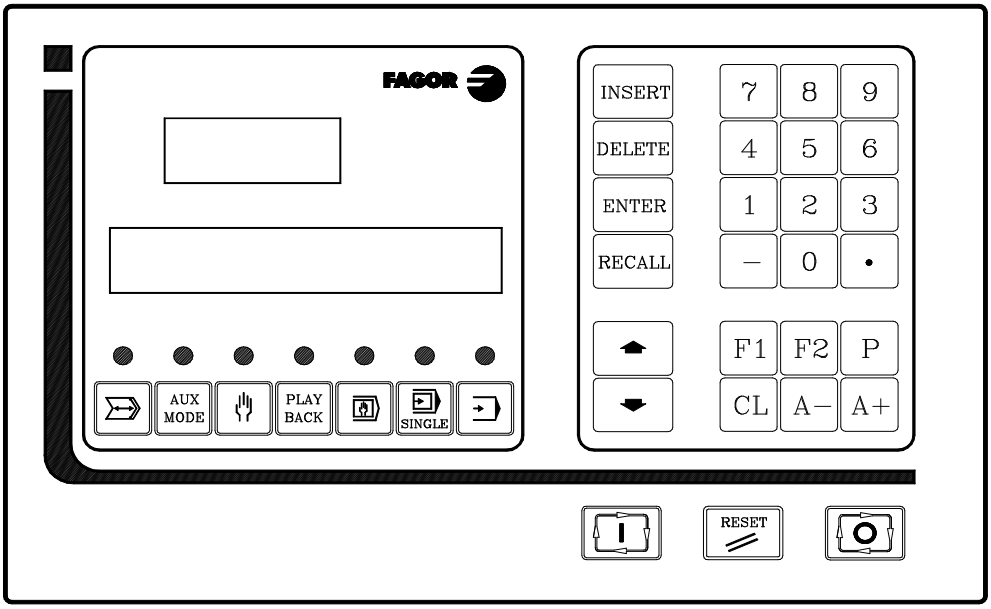
The parameter number to be read must be indicated with 2 characters. The CNC returns the value of that parameter which may have a sign, up to 5 digits to the left of the decimal point and up to 4 characters to the right (decimal).

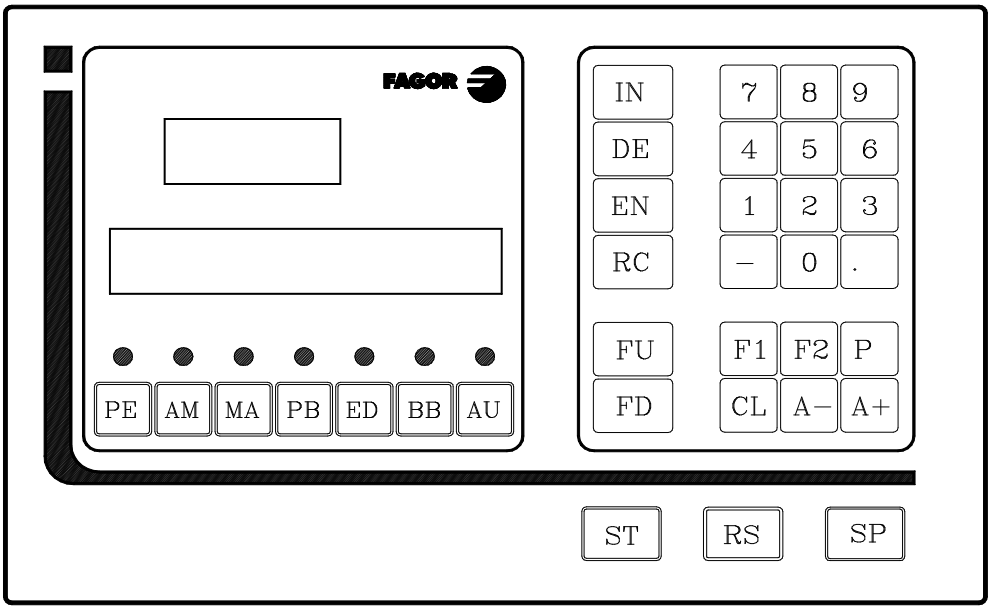
Example to request the value of arithmetic parameter P55:

PC:	RP 55 <CR>	
CNC:	RP 55	-200.3 #

RK Returns the code corresponding to the last key pressed.

It returns 2 characters indicating the code of the key that was pressed last. The code corresponding to each key is:





The codes of the control keys available at the external operator panel are:

M3 (Spindle clockwise)	Code: M3
M4 (Spindle counter-clockwise)	Code: M4
M5 (Spindle stop)	Code M5

Request example:

PC:	RK <CR>	
CNC:	RK	CL #

RI Returns the status of the CNC inputs
RO Returns the status of the CNC outputs

The RI code returns 5 characters indicating the status of the CNC inputs and the RO code returns 6 characters which indicate the status of the CNC outputs.

CNC INPUTS			
Character	**Bit**	**Meaning**	**Pin**
1st	19	Not being used	
	18	Not being used	
	17	Feedrate override 2	11 (I/O1)
	16	Feedrate override 1	10 (I/O1)
2nd	15	Input E5	17 (I/O2)
	14	Input E4	25 (I/O2)
	13	Input E3	22 (I/O2)
	12	Input E2	23 (I/O2)
3rd	11	Input E1	21 (I/O2)
	10	M.Factor / Handwheel	24 (I/O2)
	9	M.Factor / Handwheel	15 (I/O2)
	8	Y axis home switch	18 (I/O2)
4th	7	Manual input	19 (I/O1)
	6	Conditional stop	18 (I/O1)
	5	Cycle start	17 (I/O1)
	4	/ Cycle stop	16 (I/O1)
5th	3	/ Feedhold	15 (I/O1)
	2	/ Emergency Stop	14 (I/O1)
	1	X axis home switch	13 (I/O1)
	0	Reset	12 (I/O1)

CNC OUTPUTS			
Character	**Bit**	**Meaning**	**Pin**
1st	23	MST 80	20 (I/O1)
	22	MST 40	21 (I/O1)
	21	MST 20	22 (I/O1)
	20	MST 10	23 (I/O1)
2nd	19	MST 08	24 (I/O1)
	18	MST 04	25 (I/O1)
	17	MST 02	26 (I/O1)
	16	MST 01	27 (I/O1)
3rd	15	Y axis in position	9 (I/O2)
	14	OL direction for Y	8 (I/O2)
	13	OL slow for Y	5 (I/O2)
	12	OL fast for Y	3 (I/O2)
4th	11	T Strobe	4 (I/O2)
	10	S Strobe	6 (I/O2)
	9	Y axis brake	7 (I/O2)
	8	Automatic	10 (I/O2)
5th	7	X axis in position	9 (I/O1)
	6	OL direction for X	8 (I/O1)
	5	OL slow for X	7 (I/O1)
	4	OL fast for X	6 (I/O1)
6th	3	/ Emergency output	5 (I/O1)
	2	M Strobe	4 (I/O1)
	1	X axis brake	3 (I/O1)
	0	Jog output	2 (I/O1)

Example to request the status of the CNC inputs:

PC: RI <CR>
CNC: RI 23A3C #

2				3				A				3				C			
0	0	1	0	0	0	1	1	1	0	1	0	0	0	1	1	1	1	0	0

The CNC indicates that pins 11, 14, 15, 16, 17 of connector I/O1 and pins 15, 21, 22, 23 of connector I/O2 are set high (24V).

Example to request the status of the CNC outputs:

PC: RO <CR>
CNC: RO ED8412 #

E				D				8				4				1				2			
1	1	1	0	1	1	0	1	1	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0

The CNC indicates that pins 3, 6, 20, 21, 22, 24, 25, 27 of I/O1 and pins 6, 9 of I/O2 are set high (24V).

RC Returns the value of the part counter

It returns 4 characters which indicate the internal count of the CNC part-counter.

Request example:

PC:	RC <CR>	
CNC:	RC	0005 #

Rm Returns machine parameter table, tool table and tool offset table

It returns in internal CNC code, the tables for machine parameters, tools and tool offsets.

This information has more than 600 characters. To control the reception of these characters from the PC, the XON and XOFF codes must be used.

This information **must not** be manipulated and it should only be used as a safety copy (back-up) of the CNC.

Request example:

PC:	Rm <CR>	
CNC:	Rm	<internally coded data> #

RN <First block>, <Last block> Returns the contents of the requested blocks

The numbers for the first and last blocks are optional and may be expressed with 1, 2 or 3 characters. The following programming formats may be used:

RN <First block>,<Last block> Example: RN 20,110
The CNC returns the contents of the blocks between the requested ones (both included).

RN <First block> Example: RN 20
The CNC returns the contents of the all the blocks stored in memory starting from the requested one.

RN The CNC returns the contents of all the blocks stored in memory.

Each block indicates the block number and its contents. They are separated by a carriage return <CR> and when all of them are shown, the CNC returns the # character.

Request example:

PC:	RN1,3 <CR>	
CNC:	RN1,3	N001 G01.90 X0.0000 Y0.0000 F0400 <CR>
		N002 T01 <CR>
		N003 G00 X200.0000 #

8.3 CODES TO WRITE DATA INTO THE CNC

WE = <number> Causes the indicated error code at the CNC

The error code must be separated from the WE code by a blank space or "=" character and it must be defined by 1 or 2 characters.

The CNC acts as if the error itself occurred, it quits the operating mode, deactivates the brake signals, interrupts the execution of the program if necessary and it activates the emergency output. It also shows, at the top window, the message DNC and, at the bottom window, the selected error number.

Example: PC: WE 20 <CR>
CNC: WE 20 #

WK = <code> Simulates a keystroke at the CNC

The code of the key to be simulated at the CNC must be separated from the WK code by a blank space or by the "=" character.

The codes of each one of the keys are shown in an illustration in this chapter when describing the data reading code RK.

The following example shows how to interrupt the execution of the program from a PC.

PC: WK=SP <CR>
CNC: WK=SP #

WO = <value> Changes the status of the CNC outputs

The value must be defined by 6 characters separated from the WO code by a blank space or by the "=" character.

Character	Bit	Meaning	Pin
1st	23	MST 80	20 (I/O1)
	22	MST 40	21 (I/O1)
	21	MST 20	22 (I/O1)
	20	MST 10	23 (I/O1)
2nd	19	MST 08	24 (I/O1)
	18	MST 04	25 (I/O1)
	17	MST 02	26 (I/O1)
	16	MST 01	27 (I/O1)
3rd	15	Y axis in position	9 (I/O2)
	14	OL direction for Y	8 (I/O2)
	13	OL slow for Y	5 (I/O2)
	12	OL fast for Y	3 (I/O2)

Character	Bit	Meaning	Pin
4th	11	T Strobe	4 (I/O2)
	10	S Strobe	6 (I/O2)
	9	Y axis brake	7 (I/O2)
	8	Automatic	10 (I/O2)
5th	7	X axis in position	9 (I/O1)
	6	OL direction for X	8 (I/O1)
	5	OL slow for X	7 (I/O1)
	4	OL fast for X	6 (I/O1)
6th	3	/ Emergency output	5 (I/O1)
	2	M Strobe	4 (I/O1)
	1	X axis brake	3 (I/O1)
	0	JOG output	2 (I/O1)

Before changing the status of an output, it is a good idea to read all of them by using the "RO" command and then change the status of the desired output while maintaining the status of the rest.

Example: PC: WO ED8412 <CR>
CNC: WO ED8412 #

WI = <axis> Inhibits the desired axis or axes.

Indicate the axis to be inhibited after the WI code and separated by a blank space or by the "=" character.

Examples:	WI= X <CR>	WI= Y <CR>	WI= XY <CR>
	WI X <CR>	WI Y <CR>	WI XY <CR>

WH = <axis> Enables the desired axis or axes

Indicate the axis to be enabled after the WH code and separated by a blank space or by the "=" character.

Examples:	WH= X <CR>	WH= Y <CR>	WH= XY <CR>
	WH X <CR>	WH Y <CR>	WH XY <CR>

WP <number> = <value> Assigns the indicated value to the selected parameter

Following the parameter number (1 or 2 characters) and separated by a blank space or by the "=" character, indicate the value to be assigned to that parameter. The value may have a sign, up to 5 digits to the left of the decimal point and up to 4 to the right.

Example:	PC:	WP 22 = 100.2523 <CR>	
	CNC:	WP 22 = 100.2523	#

Wm Modifies the machine parameter, tool and tool offset tables

This command must be used to restore these tables.

It is absolutely necessary to have previously used the "Rm" code to read these tables and store them in memory.

This information **must not** be manipulated and it should be used as back-up of the CNC and later on, when necessary, it must be restored by means of "Wm".

Since the CNC table information has more than 600 characters, the <CR> character must be sent after the "Wm" code. The CNC will respond with the # character. Then, 80-character packages will be sent one by one. The CNC, after returning the echo for each character, will return the # character. The last package will have a variable number of characters and it will end with the <CR> character.

PC:	Wm	<CR>	<80 charac.> <80 charac.> ... <charac.> <CR>
CNC:	Wm	#	<80 charac.> # <80 charac.> ... <charac.> #

WN <block> Sends a program block to the CNC

The block must be edited following the CNC programming rules and starting with the block number (up to 3 digits).

The CNC admits up to 80 characters. If blank spaces are not used as separators, the block may not contain more than 45 characters.

Example: WN001 G01.90 X0.0000 Y0.0000 F0400 <CR>

8.4 CODES TO EXECUTE PROGRAM BLOCKS

EB <block> Executes the indicated block

The block must be edited following the CNC programming rules and it is not necessary to indicate the block number.

The CNC does not store the block, it only executes it.

The CNC admits up to maximum of 80 characters. If no blank spaces are used as separators the block may not contain more than 45 characters.

Example: EB G01.90 X0.0000 Y0.0000 F0400 <CR>

EM = <block number> Executes the indicated block number

Following the "EM" code and separated by a blank space or by a "=" character, indicate the CNC program block number to be executed with 1, 2 or 3 characters.

Examples: EM 030 EM=100

ES = <block number> Executes the CNC program starting at the indicated block number

Following the "ES" code and separated by a blank space or by the "=" character, indicate with 1, 2 or 3 characters, the number of the block from which to start the execution.

Example: ES 030

The CNC will execute block N030 and all the following ones until reading an end-of-program instruction (M00 or M30).

APPENDIX "A"

TECHNICAL CHARACTERISTICS OF THE CNC

GENERAL CHARACTERISTICS

900 blocks of part program memory capacity.
2 serial communication lines: RS232C and RS485.
2 feedback inputs.
Digital probe input (TTL)
0.001 mm. or 0.0001 inch resolution.
Feedrates between 1 mm/min and 65535 mm/min (between 0.1 and 2580 inches/min.)
Maximum axis travel : ±99999.999 mm (84546.6 inches)
18 optocoupled digital inputs.
24 optocoupled digital outputs.
3 analog outputs: ±10V (one for each axis + spindle).
Approximate weight: 6 Kg.
Maximum consumption in normal operation: 50 V.A.

PACKAGING

Meets the "EN 60068-2-32" standard.

POWER SUPPLY

High performance Switching power supply.
Universal power supply with any input between 100 V AC and 240 V AC (±10% and -15%).
AC frequency: 50 - 60 Hz ±1% and ±2% during very short periods.
Power outages. Meets the EN 61000-4-11 standard. It is capable of withstanding micro outages of up to 10 milliseconds at 50 Hz starting from 0º and 180º (two polarities: positive and negative).
Harmonic distortion: Less than 10% of the rms voltage between low voltage conductors (sum of the 2^{nd} through the 5^{th} harmonic)

ELECTRICAL CHARACTERISTICS OF FEEDBACK INPUTS

+5V power consumption: 750 mA (250 mA per connector)
-5V power consumption: 0.3A (100 mA per connector)
Operating levels for square-wave signals:
- Maximum frequency: 200KHz.
- Maximum separation between flanks: 950 nsec.
- Phase shift: 90º ±20º
- High threshold (logic state "1") 2.4V. < V_{IH} < 5V.
- Low threshold (logic state "0") -5V. < V_{IL} < 0.8V.
- Vmax. ±7 V.
- Hystheresis: 0.25 V.
- Maximum input current: 3mA.

Operating levels for sine-wave signals:
- Maximum frequency: 25KHz.
- Peak to peak voltage: 2V. < Vpp < 6V.
- Input current I_I : 1mA.

ELECTRICAL CHARACTERISTICS OF DIGITAL INPUTS

Nominal voltage: +24 Vdc.
Maximum nominal voltage: +30 Vdc.
Minimum nominal voltage: +18 Vdc.
High threshold (logic state "1") V_{IH} >+18 Vdc.
Low threshold (logic state "0") V_{IL} < +5 Vdc. or not connected.
Typical consumption per input: 5 mA.
Maximum consumption per input: 7 mA.
Protection by means of galvanic isolation by opto-couplers.
Protection against reversed connection up to -30 Vdc.

ELECTRICAL CHARACTERISTICS OF DIGITAL OUTPUTS

Nominal power supply voltage: +24 Vdc.
Maximum nominal voltage: +30 Vdc.
Minimum nominal voltage: +18 Vdc.
Output voltage Vout = Supply voltage (Vdc) - 2 V.
Maximum output current: 100 mA.
Protection by means of galvanic isolation by opto-couplers.
Protection by means of external 3 Amp. fuse against reversed connection up to -30 Vdc and over-voltage of the external power supply greater than 33 Vdc.

ELECTRIC CHARACTERISTICS OF THE PROBE INPUT

Typical value: 0.25 mA. @ Vin = 5V.
High threshold (logic state "1") V: 1.7 V.
Low threshold (logic state "0") V: 0.9 V.
Maximum nominal voltage: Vimax = +15 Vdc.

AMBIENT CONDITIONS

Relative humidity: 30-95% non condensing
Operating temperature: 5ºC - 40ºC (41º F - 104ºF) with an average lower than 35ºC (95º F)
Storage temperature : between 25º C (77ºF and 70º C (158º F).
Maximum operating altitude : Meets the "IEC 1131-2" standard.

VIBRATION

Under working conditions: 10-50 Hz. amplitude 0.2 mm.
Under transport conditions: 10-50 Hz. amplitude 1 mm, 50-300 Hz. and acceleration of 5g .
Free fall of packaged equipment: 1 m.

ELECTROMAGNETIC COMPATIBILITY

See Declaration of Conformity in the introduction of this manual.

SAFETY

See Declaration of Conformity in the introduction of this manual

DEGREE OF PROTECTION

Front panel: IP54 Rear panel: IP2X
Accessible parts inside the enclosure: IP 1X

The machine manufacturer must comply with the "EN 60204-1 (IEC-204-1)", standard regarding protection against electrical shock due to I/O contact failures with external power supply when not hooking up this connector before turning the power supply on.

Access to the inside of the unit is absolutely forbidden to non authorized personnel.

BATTERY

3.5V lithium battery.
Estimated life: 10 years
As from error indication (low battery), the information contained in memory will be kept for a maximum of 10 days with the CNC off. It must be replaced.
Caution, due to risk of explosion or combustion:

Do not attempt to recharge the battery.
Do not expose it to temperatures over 100 °C (232°F).
Do not short-circuit its leads.

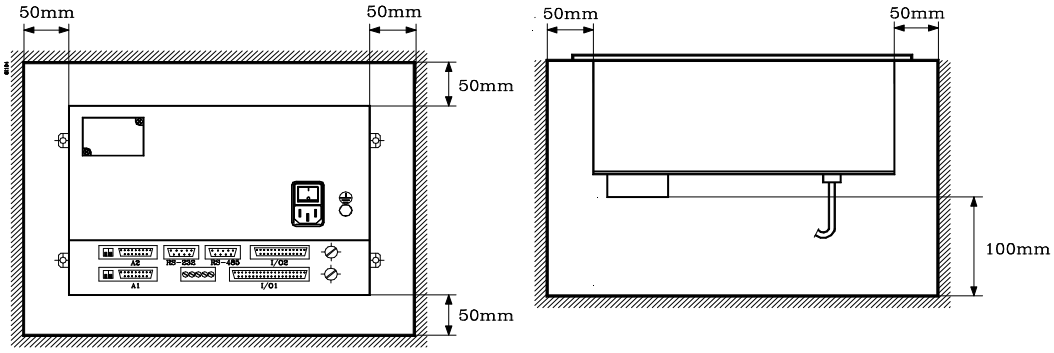
ATTENTION

To avoid overheating the internal circuits, the several ventilation slots must not be obstructed. It is also necessary to install a ventilation system which extracts hot air from the enclosure or desk supporting the CNC.

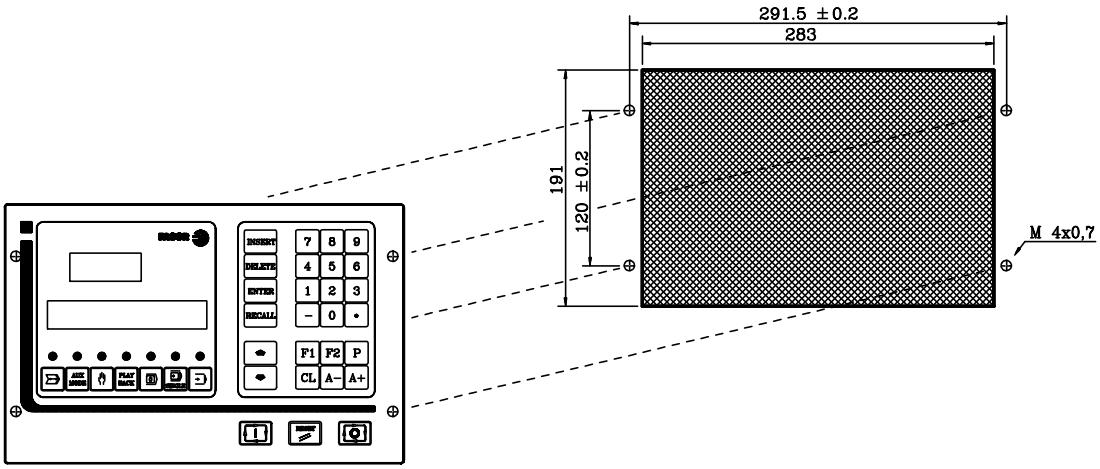
APPENDIX "B"

ENCLOSURES

The minimum distance between the sides of the CNC and its enclosure in order to meet the required ambient conditions must be the following:



The CNC must be secured as shown below: (dimensions in mm).



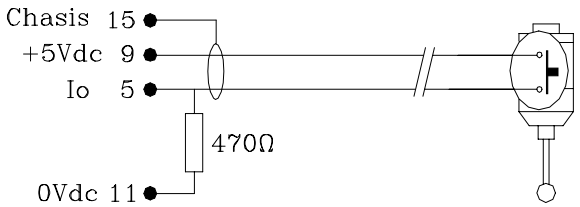
APPENDIX "C"

CIRCUITS RECOMMENDED FOR PROBE CONNECTION

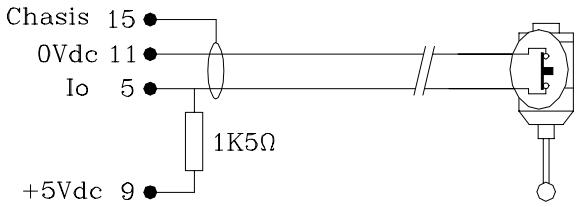
When using a touch probe, pin 5 of connector A2 should be used as input for the probe signal.

Depending on the type of connection applied machine parameter "P63(6)" must be set, indicating if operating with a high (24V) or low (0V) logic level of the signal given by the probe.

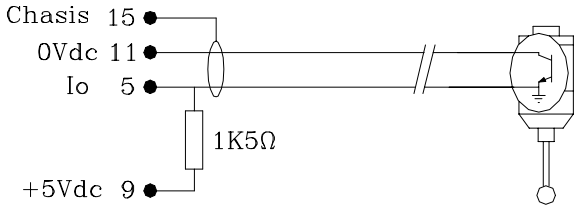
- **Probe with output per Contact normally open. "P63(6)=0"**



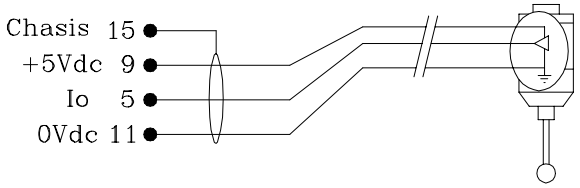
- **Probe with output per Contact normally closed. "P63(6)=1"**



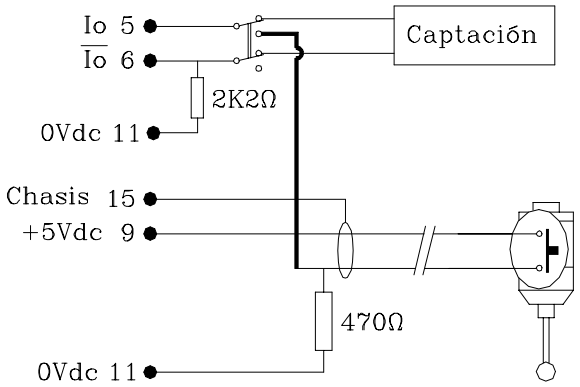
- **Interface with output in Open Collector**



- **Interface with output in PUSH-PULL**



When connecting a feedback device at connector A2, input 5 (Io) is shared by the probe and the feedback device. Switch over inputs 5 and 6.
The diagram shows the case of a probe with a normally-open-contact output.



APPENDIX "D"

CNC INPUTS AND OUTPUTS

INPUTS

Pin	Connector	Function
10	I/O 1	Feedrate override 1
11	I/O 1	Feedrate override 2
12	I/O 1	Reset
13	I/O 1	X axis home switch
14	I/O 1	/Emergency Stop
15	I/O 1	/Feed-hold
16	I/O 1	/Stop
17	I/O 1	Start
18	I/O 1	Conditional stop (block skip)
19	I/O 1	DRO mode
15	I/O 2	M. Factor, Handwheel or JOG
18	I/O 2	Y axis home switch
21	I/O 2	Input E1
22	I/O 2	Input E3
23	I/O 2	Input E2
24	I/O 2	M. Factor, Handwheel or JOG

OUTPUTS

Pin	Connector	Function
2	I/O 1	Jog mode
3	I/O 1	X axis brake
4	I/O 1	M Strobe
5	I/O 1	/Emergency
6	I/O 1	Open Loop fast for X
7	I/O 1	Open Loop slow for X
8	I/O 1	Open Loop direction for X
9	I/O 1	X axis in position
20	I/O 1	MST80
21	I/O 1	MST40
22	I/O 1	MST20
23	I/O 1	MST10
24	I/O 1	MST08
25	I/O 1	MST04
26	I/O 1	MST02
27	I/O 1	MST01
30, 31	I/O 1	X axis analog voltage
32, 33	I/O 1	Y axis analog voltage
34, 35	I/O 1	Spindle analog voltage
3	I/O 2	Open Loop fast for Y
4	I/O 2	T Strobe
5	I/O 2	Open Loop slow for Y
6	I/O 2	S Strobe
7	I/O 2	Y axis brake
8	I/O 2	Open Loop direction for Y
9	I/O 2	Y axis in position

APPENDIX "E"

2-DIGIT BCD CODED "S" OUTPUT CONVERSION TABLE

Programmed S	S BCD	Programmed S	S BCD	Programmed S	S BCD	Programmed S	S BCD
0	S 00	25-27	S 48	200-223	S 66	1600-1799	S 84
1	S 20	28-31	S 49	224-249	S 67	1800-1999	S 85
2	S 26	32-35	S 50	250-279	S 68	2000-2239	S 86
3	S 29	36-39	S 51	280-314	S 69	2240-2499	S 87
4	S 32	40-44	S 52	315-354	S 70	2500-2799	S 88
5	S 34	45-49	S 53	355-399	S 71	2800-3149	S 89
6	S 35	50-55	S 54	400-449	S 72	3150-3549	S 90
7	S 36	56-62	S 55	450-499	S 73	3550-3999	S 91
8	S 38	63-70	S 56	500-559	S 74	4000-4499	S 92
9	S 39	71-79	S 57	560-629	S 75	4500-4999	S 93
10-11	S 40	80-89	S 58	630-709	S 76	5000-5599	S 94
12	S 41	90-99	S 59	710-799	S 77	5600-6299	S 95
13	S 42	100-111	S 60	800-899	S 78	6300-7099	S 96
14-15	S 43	112-124	S 61	900-999	S 79	7100-7999	S 97
16-17	S 44	125-139	S 62	1000-1119	S 80	8000-8999	S 98
18-19	S 45	140-159	S 63	1120-1249	S 81	9000-9999	S 99
20-22	S 46	160-179	S 64	1250-1399	S 82		
23-24	S 47	180-199	S 65	1400-1599	S 83		

APPENDIX "F"

MACHINE PARAMETER SUMMARY CHART

GENERAL MACHINE PARAMETERS

P23(8)	Measuring units: mm (0), inches (1)	*Section 3.3*
P23(1)	Theoretical (1) or Real (0) display	
P63(4)	X axis in radius (0) or diameter (1)	
P35	Operating mode active on power-up: (if <900 Automatic, if > 899 Manual)	
P60(5)	Tool table (0) or zero offset table (1).	
P71	Program protected from a particular block number on.	
P101(1)	The CNC uses an external operator panel "JOG 100": (0=No, 1=Yes)	
P100(8), P100(7)	Function G92 for X, Y as coordinate setting (not preset): (0=No, 1=Yes)	

MACHINE PARAMETERS FOR AXIS CONFIGURATION

Section 3.4

P60(8)	The machine has a Y axis: (0=Yes, 1= No)
P60(4)	The machine uses an electronic handwheel: (0=No, 1=Yes)
P102(8)	The machine has an auxiliary handwheel: (0=No, 1=Yes)
P63(3)	The machine uses rigid tapping: (0=No, 1=Yes)
P77	Number of spindle encoder pulses
P61(8), P61(7)	The X, Y axis is a DRO axis: (0=No, 1=Yes)
P22(6), P62(6)	The X, Y axis is rotary ROLLOVER: (0=No, 1=Yes)
P21(1), P61(1)	The X, Y axis is rotary ROLLOVER via shortest way: (0=No, 1=Yes)
P21(2), P61(2)	The X, Y axis is rotary with HIRTH toothing: (0=No, 1=Yes)
P23(6)	Type of signal used to control the X and Y axes: (0= Analog)
P23(4)	Open (0) or Closed (1)Positioning loop for the axes
P102(1)	The axes are called Y, C (0=No, 1=Yes)

I/O RELATED MACHINE PARAMETERS

Section 3.5

P22(7), P62(7)	X, Y axis feedback alarm active (0) or cancelled (1)
P23(7)	M function output decoded (0) or in BCD (1)
P22(4)	Decoded M function outputs maintained: (0=No, 1=Yes)
P61(5)	The T function generates BCD output:: (0=Yes, 1=No)
P63(6)	Type of touch-probe signal: (0=Negative, 1= Positive)
P22(5)	"FEEDHOLD" input as response to the "STROBE" signal: (0=No, 1=Yes)
P30	The RESET input activates the HOME function:(0-899=Yes, >899=No)
P21(8)	The HOME function only during program execution: (0=No, 1=Yes)

PARAMETERS RELATED TO THE OPERATING MODES

Section 3.6

P19(8)	Access to the JOG mode: (0=Yes, 1=No)
P19(7)	The Cycle Start, Cycle Stop and Reset keys disabled: (0=No, 1=Yes)
P19(6)	Access to the Peripheral mode: (0=Yes, 1=No)
P19(5)	Access to the AUX-MODE mode: (0=Yes, 1=No)
P19(4)	Access to the PLAY BACK mode: (0=Yes, 1=No)
P100(5)	General Play-Back (0) or only for reading points (1)
P19(3)	Access to the Editing mode: (0=Yes, 1=No)
P19(2)	Access to the Single mode: (0=Yes, 1=No)
P19(1)	Access to the Automatic mode: (0=Yes, 1=No)

PARAMETERS RELATED TO THE PROGRAMMING MODE

Section 3.7

P20(7)	The E function can be programmed: (0=Yes, 1=No)
P20(6)	The P function can be programmed: (0=Yes, 1=No)
P93	Number of arithmetic parameters displayed in every ten
P20(5)	The K function can be programmed: (0=Yes, 1=No)
P20(4)	The M function can be programmed: (0=Yes, 1=No)
P20(3)	The T function can be programmed: (0=Yes, 1=No)
P20(2)	The S function can be programmed: (0=Yes, 1=No)
P20(1)	The F function can be programmed: (0=Yes, 1=No)

PARAMETERS RELATED TO THE EXECUTION MODE

Section 3.8

P23(3)	SEMI-AUTOMATIC program execution mode: (0=No, 1=Yes)
P21(5)	The Single-block mode shows the block to be executed: (0=No, 1=Yes)
P21(4)	The M30 function increments the count of the parts counter: (0=No, 1=Yes)
P60(1)	Vectored G00 (interpolated): (0=No, 1=Yes)
P21(3)	G90 (0) or G91 (1) on power-up
P22(3)	M30 when switching to JOG and Play-Back modes: (0=No, 1=Yes)
P101(2)	The CNC ignores the setting of MFO switch, always at 100%: (0=No, 1=Yes)
P101(8)	200% feedrate override possible with feedrate override inputs: (0=Yes, 1=No)

MACHINE PARAMETERS FOR THE AXES

P22(1), P62(1)	Sign of the analog output for X, Y	*Section 4.*
P22(2), P62(2)	Counting direction for X, Y	
P23(2), P63(2)	Jogging direction for X, Y	

PARAMETERS RELATED TO AXIS RESOLUTION *Section 4.1*

P9, P49	Feedback resolution for X, Y: (in microns)
P59(2), P59(3)	Type of feedback signal for X, Y : (0=Squarewave, 1=sinewave)
P21(6), P61(6)	Feedback multiplying factor for X, Y: (0=x4, 1=x2)
P29, P69	Feedback correction factor for X, Y: (in microns)
P63(8), P63(7)	Sign of the feedback correction factor for X, Y: (0=positive, 1=Negative)

PARAMETERS RELATED TO ANALOG OUTPUTS *Section 4.2*

P13, P53	Minimum analog voltage for X, Y: (1=2.5mV)
P28, P68	In-position zone for X, Y

FEEDRATE RELATED PARAMETERS *Section 4.3*

P27, P67	Maximum feedrate for X, Y
P24, P64	X, Y axis feedrate when in JOG and PLAY-BACK modes
P12	Maximum time for non-controlled axis: (1=12msec.)
P20(8)	Feedrate up to 655 meters/minute or 25,800 inches/minute: (0=No, 1=Yes)
P18	Feedrates lower than 1 mm/minute or 0.1 inches/minute: (0=No, 1=Yes)

PARAMETERS RELATED TO THE POSITIONING LOOP *Section 4.4*

P10, P50	Proportional gain K1 for X, Y
P26, P66	Gain break point for X, Y
P11, P51	Proportional gain K2 for X, Y
P60(6), P60(7)	The K1 and K2 values are in mV/ pulse for X, Y: (0=No, 1=Yes)
P16,P17	X, Y axis acceleration time: (1=24msec.)
P91,P92	X, Y axis deceleration time: (1=24msec.)
P63(1)	Acc./dec. in all G01 moves: (0=No, 1=Yes)
P100(2)	Acc./dec. in G05 (round corner): (0=Yes, 1=No)
P75, P76	FEED-FORWARD gain for X, Y
P90	Acc./dec. ramp with rounded corners: (1=48msec)
P3, P43	X, Y axis braking distance (open loop)
P94,P95	Factor by which the gain of axis X, Y is reduced in the braking stage Value of the analog output for the fast and slow signals

PARAMETERS RELATED TO AXIS CONTROL *Section 4.5*

P31	T1. Delay between brake and analog voltage or Fast signal (msec.)
P32, P72	T2. Delay between reaching position and activating the brake signal for X, Y (msec.)
P33, P73	T3. Delay between the brake signal and the in-position signal for X, Y (msec.)
P34, P74	T4. Duration of the in-position output signal for X, Y (msec.)

PARAMETERS RELATED TO MACHINE REFERENCE (HOME) *Section 4.6*

P2, P42	Home coordinate for X, Y
P62(4), P62(5)	Home searching direction for X, Y: (0=Positive, 1=Negative)
P23(5), P63(5)	Type of marker pulse (Io) signal for X, Y: (0=Negative, 1=Positive)
P22(8), P62(8)	Home switch for X, Y: (0=No, 1=Yes)
P25, P65	Home searching feedrate for X, Y
P61(4)	Mandatory home search on power-up: (0=No, 1=Yes)
P21(7)	Function G74 activates the In-Position output: (0=Yes, 1=No)
P61(3)	Axis homing order (sequence) for function G74: (0=1º X, 1=1º Y)

PARAMETERS RELATED TO TRAVEL LIMITS *Section 4.7*

P0, P40	Positive travel limit for X, Y
P1, P41	Negative travel limit for X, Y

LEADSCREW RELATED PARAMETERS *Section 4.8*

P14, P54	Leadscrew backlash for X, Y: (feedback pulses)
P15, P55	Additional analog pulse for X, Y: (1=2.5mV)

SPECIAL MACHINE PARAMETERS *Section 4.9*

P62(3)	0.0001 millimeter (0.00001 inch) resolution: (0=No, 1=Yes)

OTHER MACHINE PARAMETERS

SPINDLE MACHINE PARAMETER *Section 5.1*

P36, P37, P38, P39	Maximum speed for RANGE 1, 2, 3 and 4
P101(4)	In parametric programming the CNC takes into account the S sign (0=No, 1=Yes)
P101(6)	Analog output S is single pole (1) or bipolar (0)
P60(2)	Analog (0) or BCD-coded (1) "S" output
P60(3)	2-digit (0) or 4-digit BCD (1) coded "S" output

MACHINE PARAMETERS FOR THE RS232C SERIAL LINE *Section 5.2*

P70	Communication speed (Baudrate): (110, 150, 300, 600, 1200, 2400, 4800, 9600)
P59(7)	Number of data bits per character: (0=7, 1=8)
P59(5)	Parity: (0=No, 1=Yes)
P59(6)	Even parity: (0=No, 1=Yes)
P59(8)	Stop bits: (0=1, 1=2)
P100(1)	The CNC uses DNC communications: (0= No, 1=Yes)

FAGOR LAN RELATED PARAMETERS *Section 5.3*

P59(1)	The CNC is connected to the Fagor LAN: (0=No, 1=Yes)
P59(4)	The CNC occupies the main node (0) in the LAN: (0=No, 1=Yes)
P56	Node number occupied by the CNC or number of nodes in the LAN
P58	Number of the node receiving the M, S, T functions
P57	PLC64 register receiving the M, S, T functions
P80	CNC identification parameter in the LAN

PARAMETERS RELATED TO DOUBLE FEEDBACK *Section 5.4*

P100(6)	The "double Feedback feature" is being used: (0=No, 1=Yes)
P110	Double feedback monitoring. Maximum permissible slippage (in microns)

PARAMETERS RELATED TO FUNCTION G34 *Section 5.5*

P100(4)	Function G34 available (0=No, 1=Yes)
P100(3)	Optical reader available for compensating material variations in G34 (0=No, 1=Yes)
P81	Maximum permitted slippage with G34 and optical reader

PARAMETERS RELATED TO FUNCTION G75 *Section 5.6*

P82	Distance traveled by the axis after receiving the signal from the probe.

PARAMETERS RELATED TO FUNCTION G47, G48 *Section 5.7*

P101(3)	Functions G47, G48 as opening of axis loop (0=No, 1=Yes)

PARAMETERS RELATED TO FUNCTION G47, G48 *Section 5.8*

P101(7)	Function G60 as loading of punch dimensions (0=No, 1=Yes)

APPENDIX "G"

SEQUENTIAL MACHINE PARAMETER LIST

P0		X axis positive travel limit	*Section 4.7*
P1		X axis negative travel limit	*Section 4.7*
P2		X axis home coordinate	*Section 4.6*
P3		X axis braking distance (open loop)	*Section 4.4*
P4 thru P8		*Not being used at this time*	
P9		X axis feedback resolution (in microns)	*Section 4.1*
P10		X axis proportional gain K1	*Section 4.4*
P11		X axis proportional gain K2	*Section 4.4*
P12		Maximum time for non-controlled axis: (1=12msec)	*Section 4.3*
P13		X axis minimum analog voltage: (1=2.5mV)	*Section 4.2*
P14		X axis leadscrew backlash: (feedback pulses)	*Section 4.8*
P15		Additional analog pulse for X: (1=2.5mV)	*Section 4.8*
P16		X axis acceleration time: *(1=24msec.)*	*Section 4.4*
P17		Y axis acceleration time: (1= 24msec,)	*Section 4.4*
P18		Feedrates lower than 1 mm/min. or 0.1 inch/min.: (0=No, 1=Yes)	*Section 4.3*
P19	(8)	Access to JOG mode: (0=Yes, 1=No)	*Section 3.6*
	(7)	The Cycle Start, Cycle Stop and Reset keys disabled: (0=No, 1=Yes)	*Section 3.6*
	(6)	Access to Peripheral mode: (0=Yes, 1=No)	*Section 3.6*
	(5)	Access to AUX-MODE mode: (0=Yes, 1=No)	*Section 3.6*
	(4)	Access to PLAY-BACK mode: (0=Yes, 1=No)	*Section 3.6*
	(3)	Access to Editing mode: (0=Yes, 1=No)	*Section 3.6*
	(2)	Access to Single-Block mode: (0=Yes, 1=No)	*Section 3.6*
	(1)	Access to Automatic mode: (0=Yes, 1=No)	*Section 3.6*
P20	(8)	Feedrate up to 655 m/min. or 25.800 inch/min.: (0=No, 1=Yes)	*Section 4.3*
	(7)	The E function can be programmed: (0=Yes, 1=No)	*Section 3.7*
	(6)	The P function can be programmed: (0=Yes, 1=No)	*Section 3.7*
	(5)	The K function can be programmed: (0=Yes, 1=No)	*Section 3.7*
	(4)	The M function can be programmed: (0=Yes, 1=No)	*Section 3.7*
	(3)	The T function can be programmed: (0=Yes, 1=No)	*Section 3.7*
	(2)	The S function can be programmed: (0=Yes, 1=No)	*Section 3.7*
	(1)	The F function can be programmed: (0=Yes, 1=No)	*Section 3.7*
P21	(8)	The HOME function only during program execution: (0=No, 1=Yes)	*Section 3.5*
	(7)	Function G74 activates the In-Position output: (0=Yes, 1=No)	*Section 4.6*
	(6)	X axis feedback multiplying factor: (0=x4, 1=x2)	*Section 4.1*
	(5)	The Single-Block mode shows the block to be executed: (0=No, 1=Yes)	*Section 3.8*
	(4)	The M30 function increments the parts counter: (0=No, 1=Yes)	*Section 3.8*
	(3)	G90 (0) or G91 (1) on power-up	*Section 3.8*
	(2)	X axis rotary HIRTH: (0=No, 1=Yes)	*Section 3.4*
	(1)	X axis rotary ROLLOVER via shortest way: (0=No, 1=Yes)	*Section 3.4*
P22	(8)	X axis home switch: (0=No, 1=Yes)	*Section 4.6*
	(7)	X axis feedback alarm active (0) or cancelled (1)	*Section 3.5*
	(6)	X axis rotary ROLLOVER: (0=No, 1=Yes)	*Section 3.4*
	(5)	The "FEED HOLD" input as response to "STROBE" signal: (0=No, 1=Yes)	*Section 3.5*
	(4)	The decoded M function outputs are maintained: (0=No, 1=Yes)	*Section 3.5*
	(3)	M30 when switching to JOG and Play-Back modes: (0=No, 1=Yes)	*Section 3.8*
	(2)	X axis counting direction	*Section 4.*
	(1)	Sign of the X axis analog voltage	*Section 4.*
P23	(8)	Measuring units: (0= mm, 1=inches)	*Section 3.3*
	(7)	M function output decoded (0) or in BCD (1)	*Section 3.5*
	(6)	Type of signal used to control the X axis (0=Analog)	*Section 3.4*
	(5)	X axis home marker pulse type: (0=Negative, 1=Positive)	*Section 4.6*
	(4)	Open (0) or Closed (1)Positioning Loop.	*Section 3.4*
	(3)	SEMI-AUTOMATIC program execution mode: (0=No, 1=Yes)	*Section 3.8*
	(2)	X axis jogging feedrate	*Section 4.*
	(1)	Theoretical (1) or Real (0) display	*Section 3.3*
P24		X axis feedrate in JOG and PLAY-BACK modes	*Section 4.3*
P25		X axis home searching feedrate	*Section 4.6*
P26		X axis gain break point	*Section 4.4*
P27		X axis maximum feedrate	*Section 4.3*
P28		X axis In-Position zone	*Section 4.2*
P29		X axis feedback correction factor (in microns)	*Section 4.1*
P30		The RESET input activates the HOME function: (0-899=Yes, >899=No)	*Section 3.5*

P31 T1. Delay between brake and analog voltage or fast signal (msec.) ..... *Section 4.5*
P32 T2. Delay between reaching position and brake signal for X (msec.) ..... *Section 4.5*
P33 T3. Delay between brake signal and In-Position signal for X (msec.) ..... *Section 4.5*
P34 T4. Duration X axis In-Position output signal (msec.) ..... *Section 4.5*
P35 Operating mode selected on power-up (< 900=Auto, >899=JOG) ..... *Section 3.3*
P36 Maximum spindle speed for RANGE 1 ..... *Section 5.1*
P37 Maximum spindle speed for RANGE 2 ..... *Section 5.1*
P38 Maximum spindle speed for RANGE 3 ..... *Section 5.1*
P39 Maximum spindle speed for RANGE 4 ..... *Section 5.1*
P40 Y axis positive travel limit ..... *Section 4.7*
P41 Y axis negative travel limit ..... *Section 4.7*
P42 Y axis home coordinate ..... *Section 4.6*
P43 Y axis braking distance (open loop) ..... *Section 4.4*
P44 thru P48 *Not being used at this time*
P49 Y axis feedback resolution (in microns) ..... *Section 4.1*
P50 Y axis proportional gain K1 ..... *Section 4.4*
P51 Y axis proportional gain K2 ..... *Section 4.4*
P52 *Not being used at this time*
P53 Minimum Y axis analog voltage (1=2.5mV) ..... *Section 4.2*
P54 Y axis leadscrew backlash (feedback pulses) ..... *Section 4.8*
P55 Y axis additional analog pulse (1=2.5mV) ..... *Section 4.8*
P56 Node number of the CNC or number of nodes in the LAN ..... *Section 5.3*
P57 PLC64 register receiving the M, S, T functions ..... *Section 5.3*
P58 Number of the node receiving the M, S, T functions ..... *Section 5.3*

P59 (8) Stop bits: (0=1, 1=2) ..... *Section 5.2*
(7) Number of data bits per character: (0=7, 1=8) ..... *Section 5.2*
(6) Even parity: (0=No, 1=Yes) ..... *Section 5.2*
(5) Parity: (0=No, 1=Yes) ..... *Section 5.2*
(4) The CNC occupies the main node in the LAN: (0=No, 1=Yes) ..... *Section 5.3*
(3) Type of Y axis feedback signals: (0=Square-wave, 1=sine-wave) ..... *Section 4.1*
(2) Type of X axis feedback signals: (0=Square-wave, 1=sine-wave) ..... *Section 4.1*
(1) The CNC is connected to the Fagor LAN: (0=No, 1=Yes) ..... *Section 3.3*

P60 (8) The machine has a Y axis: (0=Yes, 1=No) ..... *Section 3.4*
(7) The Y axis K1 and K2 values are in mV/ pulse: (0=No, 1=Yes) ..... *Section 4.4*
(6) The X axis K1 and K2 values are in mV/ pulse: (0=No, 1=Yes) ..... *Section 4.4*
(5) Tool table (0) or Zero offset (1) table ..... *Section 3.3*
(4) The machine uses an electronic handwheel: (0=No, 1=Yes) ..... *Section 3.4*
(3) 2-digit (2) or 4-digit (1) BCD-coded "S" output ..... *Section 5.1*
(2) Analog (0) or BCD-coded (1) "S" output ..... *Section 5.1*
(1) Vectored G00 (interpolated): (0=No, 1=Yes) ..... *Section 3.8*

P61 (8) X axis is a DRO axis: (0=No, 1=Yes) ..... *Section 3.4*
(7) Y axis is a DRO axis: (0=No, 1=Yes) ..... *Section 3.4*
(6) Y axis feedback multiplying factor: (0=x4, 1=x2) ..... *Section 4.1*
(5) The T function generates BCD output: (0=Yes, 1=No) ..... *Section 3.5*
(4) Mandatory home search on power-up: (0=No, 1=Yes) ..... *Section 4.6*
(3) Axis homing order (sequence) in G74: (0=1º X, 1=1º Y) ..... *Section 4.6*
(2) Y axis rotary HIRTH: (0=No, 1=Yes) ..... *Section 3.4*
(1) Y axis rotary ROLLOVER via shortest way: (0=No, 1=Yes) ..... *Section 3.4*

P62 (8) Y axis home switch: (0=No, 1=Yes) ..... *Section 4.6*
(7) Y axis feedback alarm active (0) or cancelled (1) ..... *Section 3.5*
(6) Y axis rotary ROLLOVER: (0=No, 1=Yes) ..... *Section 3.4*
(5) Y axis home searching direction: (0=Positive, 1=Negative) ..... *Section 4.6*
(4) X axis home searching direction: (0=Positive, 1=Negative) ..... *Section 4.6*
(3) 0.0001 mmm (0.00001 inch) resolution: (0=No, 1=Yes) ..... *Section 4.9*
(2) Y axis counting direction ..... *Section 4.*
(1) Sign of the Y axis analog voltage ..... *Section 4.*

P63 (8) Sign of the X axis feedback correction factor: (0=Positive, 1=Negative) ..... *Section 4.1*
(7) Sign of the Y axis feedback correction factor: (0=Positive, 1=Negative) ..... *Section 4.1*
(6) Type of probe signal: (0=Negative, 1=Positive) ..... *Section 3.5*
(5) Type of Y axis reference (marker Io) pulse: (0=Negative, 1=Positive) ..... *Section 4.6*
(4) X axis in radius (0) or diameter (1) ..... *Section 3.3*
(3) The machine uses rigid tapping ..... *Section 3.4*
(2) Y axis jogging direction ..... *Section 4.*
(1) Acc./dec. in all G01 moves: (0=No, 1=Yes) ..... *Section 4.4*

P64 Y axis feedrate when in JOG and PLAY-BACK mode ..... *Section 4.3*
P65 Y axis home searching feedrate ..... *Section 4.6*
P66 Y axis gain break point ..... *Section 4.4*
P67 Maximum Y axis feedrate ..... *Section 4.3*
P68 In-Position zone for Y ..... *Section 4.2*
P69 Y axis feedback correction factor (in microns) ..... *Section 4.1*
P70 Communication speed (baudrate) (110, 150, 300, 600, 1200, 2400, 4800, 9600) ..... *Section 5.2*
P71 Program protected from a particular block on ..... *Section 3.3*
P72 T2. Delay between reaching position and brake for Y (msec.) ..... *Section 4.5*
P73 T3. Delay between brake signal and In-Position signal for Y (msec.) ..... *Section 4.5*
P74 T4. Duration of In-Position signal for Y (msec.) ..... *Section 4.5*
P75 X axis FEED-FORWARD gain ..... *Section 4.4*
P76 Y axis FEED-FORWARD gain ..... *Section 4.4*
P77 Number of spindle encoder pulses ..... *Section 3.4*
P78 thru P79 *Not being used at this time*
P80 CNC identification parameter in the LAN ..... *Section 5.3*
P81 Maximum permitted slippage with G34 and optical reader ..... *Section 5.5*
P82 Distance covered by the axis after receiving the signal from the probe ..... *Section 5.6*
P83 thru P89 *Not being used at this time*
P90 Acc./dec. ramp with rounded corners: (1=48msec.) ..... *Section 4.4*
P91 X axis acceleration time: (1=24msec.) ..... *Section 4.4*
P92 Y axis acceleration time: (1=24msec.) ..... *Section 4.4*
P93 Number of arithmetic parameters displayed in every ten ..... *Section 3.7*
P94 Factor by which the gain of axis X is reduced in the braking phase or value of the analog output corresponding to the fast signal (position loop open) ..... *Section 4.4*
P95 Factor by which the gain of axis Y is reduced in the braking phase or value of the analog output for the slow signal (position loop open) ..... *Section 4.4*
P96 thru P99 *Not being used at this time*

P100 (8) Function G92 as coordinate setting (not-preset) for X: (0=No, 1=Yes) ..... *Section 3.3*
(7) Function G92 as coordinate setting (not-preset) for Y: (0=No, 1=Yes) ..... *Section 3.3*
(6) "Double Feedback" being used: (0=No, 1=Yes) ..... *Section 5.4*
(5) General Play-Back (0) or only for reading points (1) ..... *Section 3.6*
(4) G34 being used (0=No, 1=Yes) ..... *Section 5.5*
(3) The optical reader is available for compensating material variations in G34 (0=No, 1=Yes) ..... *Section 5.5*
(2) Acc./dec. in G05 (round corner): (0=Yes, 1=No) ..... *Section 4.4*
(1) The CNC uses DNC communications: (0=No, 1=Yes) ..... *Section 5.2*

P101 (8) 200% feedrate override possible with feedrate override inputs: (0=Yes, 1=No) ..... *Section 3.8*
(7) Function G60 as loading of punch dimensions (0=No, 1=Yes) ..... *Section 5.8*
(6) Single pole S analog output (1) or bipolar (0) ..... *Section 5.1*
(5) *Not being used at this time*
(4) In Parametric programming the S sign is taken into account (0=No, 1=Yes) ..... *Section 5.1*
(3) Functions G47, G48 as opening of the axis loop (0=No, 1=Yes) ..... *Section 5.7*
(2) CNC limits MFO switch setting to 100%: (0=No, 1=Yes) ..... *Section 3.8*
(1) The CNC uses an external operator panel "JOG 100": (0=No, 1=Yes) ..... *Section 3.3*

P102 (8) The machine has an auxiliary handwheel: (0=No, 1=Yes) ..... *Section 3.4*
(7) *Not being used at this time*
(6) *Not being used at this time*
(5) *Not being used at this time*
(4) *Not being used at this time*
(3) *Not being used at this time*
(2) *Not being used at this time*
(1) The axes are called Y, C (0=No, 1=Yes) ..... *Section 3.4*

P103 thru P109 *Not being used at this time*

P110 Monitoring of "Double Feedback". Maximum slippage (in microns) ..... *Section 5.4*

P111 thru P120 *Not being used at this time*

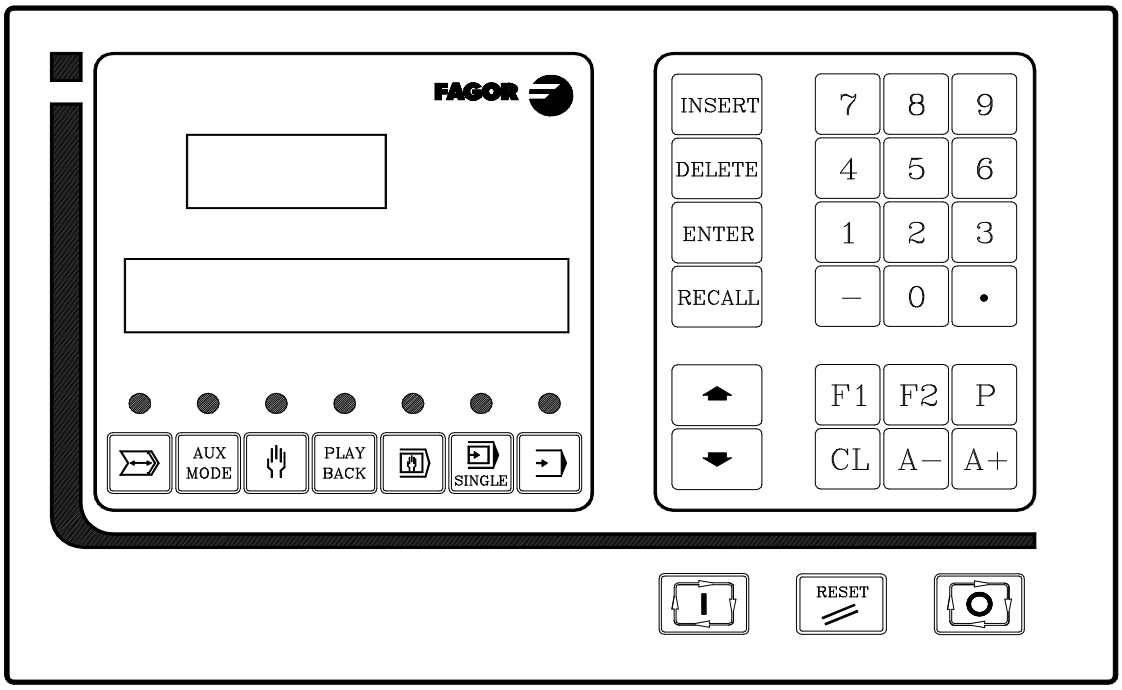
APPENDIX "H"

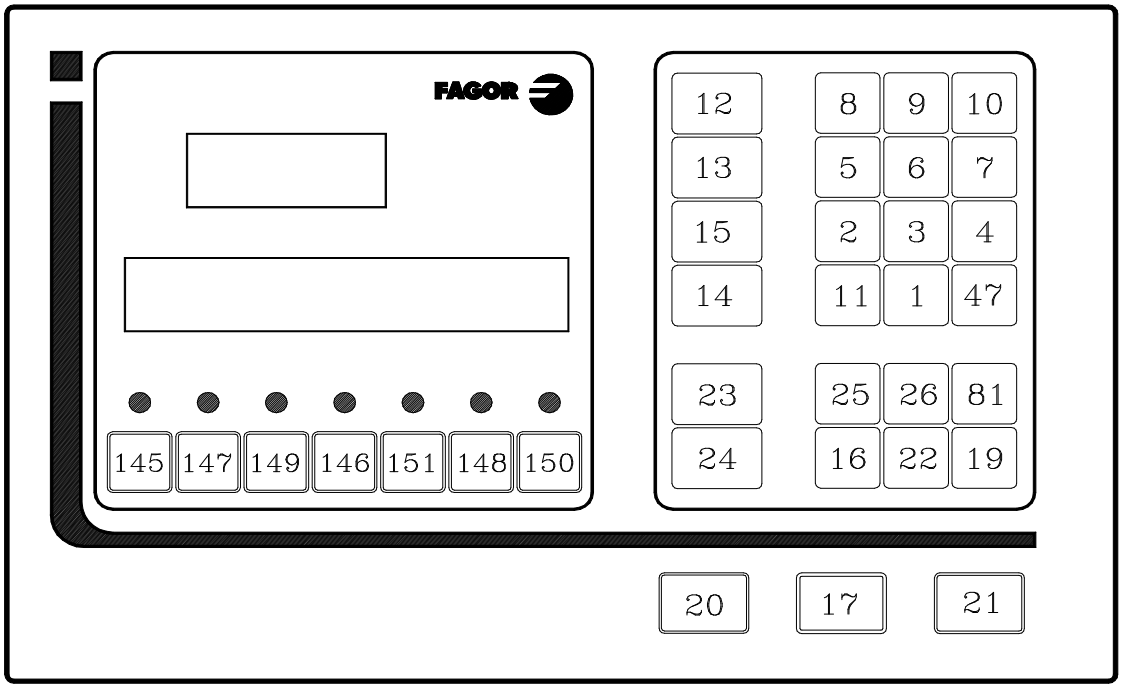
MACHINE PARAMETER SETTING CHART

Parameter	VALUE	Parameter	VALUE	Parameter	VALUE	Parameter	VALUE
P0		P31		P62		P93	
P1		P32		P63		P94	
P2		P33		P64		P95	
P3		P34		P65		P96	
P4		P35		P66		P97	
P5		P36		P67		P98	
P6		P37		P68		P99	
P7		P38		P69		P100	
P8		P39		P70		P101	
P9		P40		P71		P102	
P10		P41		P72		P103	
P11		P42		P73		P104	
P12		P43		P74		P105	
P13		P44		P75		P106	
P14		P45		P76		P107	
P15		P46		P77		P108	
P16		P47		P78		P109	
P17		P48		P79		P110	
P18		P49		P80		P111	
P19		P50		P81		P112	
P20		P51		P82		P113	
P21		P52		P83		P114	
P22		P53		P84		P115	
P23		P54		P85		P116	
P24		P55		P86		P117	
P25		P56		P87		P118	
P26		P57		P88		P119	
P27		P58		P89		p120	
P28		P59		P90			
P29		P60		P91			
P30		P61		P92			

APPENDIX "I"

KEY CODES





The codes corresponding to the control keys at the external operator panel are:

M3 (spindle clockwise)	Code 27
M4 (spindle counter-clockwise)	Code 28
M5 (spindle stop)	Code 29

APPENDIX J

MAINTENANCE

Cleaning:

The accumulated dirt inside the unit may act as a screen preventing the proper dissipation of the heat generated by the internal circuitry which could result in a harmful overheating of the CNC and, consequently, possible malfunctions.

On the other hand, accumulated dirt can sometimes act as an electrical conductor and shortcircuit the internal circuitry, especially under high humidity conditions.

To clean the operator panel and the monitor, a smooth cloth should be used which has been dipped into de-ionized water and /or non abrasive dish-washer soap (liquid, never powder) or 75º alcohol.

Do not use highly compressed air to clean the unit because it could generate electrostatic discharges.

The plastics used on the front panel of the CNC are resistant to :

1.- Grease and mineral oils
2.- Bases and bleach
3.- Dissolved detergents
4.- Alcohol

Avoid the action of solvents such as Chlorine hydrocarbons , Benzole , Esters and Ether which can damage the plastics used to make the unit's front panel.

Do not manipulate inside this unit. Only personnel authorized by Fagor Automation may manipulate inside this module.

Do not manipulate the connectors with the unit connected to main AC power. Before manipulating these connectors, make sure that the unit is not connected to main AC power.

Fagor Automation shall not be held responsible for any material or physical damage derived from the violation of these basic safety requirements.

List of materials, parts that could be replaced

Part Description		*Code*	*Manufacturer*	*Reference*
Mains cable 3x0.75		11313000	Fagor Automation	
3.15A/250V Fuse		12130015	Schurter Wickmann	FST-034-1521 Ref. 19115
English manual	OEM USER	83750030 83750024	Fagor Automation	

ERROR CODES

01 The execution of JUMP/CALL function has been attempted in the TEACH IN mode.

02 Axis feedrate F too high during execution.

03 EPROM memory error.

04 RAM memory error.

05 Parameter CHECKSUM error.

06 Strange data in memory.

07 Jump/Call programmed incorrectly.

08 Battery Error.

09 X axis machine parameter error:

> The braking distance (P3) is smaller than the In-position zone (P28).

> The P3 value, is greater than 8388.607 mm or 330.259 inches.

X axis execution error:

> The movement cannot be executed since, due to the programmed feedrate, the braking distance is smaller than the In-Position zone (Open Positioning Loop).

10 A block has been programmed which forces the X axis to overrun its travel limits.

11 A value outside the permissible limits has been programmed.

12 An invalid value has been programmed:

> The rotary ROLLOVER axis via the shortest way, does not admit negative absolute coordinates.

> An axis with HIRTH toothing does not admit decimal values.

13 A jump/call has been programmed with more than 15 nesting levels.

14 An inappropriate G function has been programmed.

15 Function M30 has not been programmed at the end of the program.

16 X axis not controlled:

> The X axis has shifted a distance 16 times the in-position zone once the brake has been activated.

> The moving direction does not correspond to the sign of the analog voltage.

> The actual X axis feedback pulses are not between 50% and 200% of the theoretical ones within the time window set by machine parameter P12.

17 Emergency.

18 X axis feedback alarm.

19 X axis travel limit overrun.

20 X axis following error.

21 Probing Error.

22 Features not available at this CNC model have been defined, such as:

> Non-servo-controlled Open Positioning Loop on 101S and 102S models.

> External operator panel "JOG 100" on 101 nd 102 models.

There is a certain incompatibility in the machine parameters such as:

> Fast and Slow signals when operating in Closed Positioning Loop.

> Rotary ROLLOVER axis when operating in Open Positioning Loop.

> Rotary HIRTH axis or following the shortest way while not being a ROLLOVER axis.

23 Too large a value assigned to an arithmetic parameter in parametric programming.

24 Arithmetic division by 0.

25 Square root of a negative figure.

26 Parametric block edited wrong.

27 A tool too large has been selected. For example, when assigning an arithmetic parameter value greater than 10 to a "T" function.

28 More than 4 "M" functions have been programmed in a block or 4 "M" functions in a block containing an "S" function which involves a gear (range) change (M41,M42,M43 or M44).

29 There are no selected spindle ranges (P36, P37, P38 and P39=0), or the "S", spindle speed, value is too high.

30 Value of machine parameter P24 or P25 greater than that of P27.

31 Value of machine parameter P64 or P65 greater than that of P67.

32 Y axis machine parameter error:

> The braking distance (P43) is smaller than the In-position zone (P68).

> The P43 value, is greater than 8388.607 mm or 330.259 inches.

Y axis execution error:

> The movement cannot be executed since, due to the programmed feedrate, the braking distance is smaller than the In-Position zone (Open Positioning Loop).

33 RS 232 C transmission error.

34 Too long a block transmitted via RS 232 C.

35 Wrong block in the RS 232 C transmission.

36 A block has been program which forces the Y axis to overrun its travel limits.

37 Internal temperature limit exceeded.

38 Y axis not controlled:

> The Y axis has shifted a distance 16 times the in-position zone once the brake has been activated.

> The moving direction does not correspond to the sign of the analog voltage.

> The actual Y axis feedback pulses are not between 50% and 200% of the theoretical ones within the time window set by machine parameter P12.

39 Y axis feedback alarm.

40 Y axis travel limit overrun.

41 Y axis following error.

42 The programmed circle does not go through the defined end point (tolerance 0.01 mm).

43 The circular interpolation is missing the I, J values or has been defined wrong.

44 A wrong block has been programmed, either in itself or with respect to the program history up to that point.

45 A function has been programmed which is not permitted by machine parameters.

46 Tool checksum error.

47 LAN error, It is not working.

48 Wrong command, the destination node cannot interpret it.

49 Misconfigured LAN, a certain node has not been accepted in the LAN.

50 The destination node cannot attend to the command (in execution).

51 The axes must be referenced (homed) after power-up.

52 While monitoring the "double feedback", the actual deviation (slippage) has exceeded its maximum value set by machine parameter P110.

101 DNC error. Wrong command.

102 DNC error. Error when reading a key code.

103 DNC error. An incorrect block has been sent.

104 DNC error. Error when reading the number of the first block of the active program.

105 DNC error. Incorrect block number.

106 DNC error. The CNC is in execution

107 DNC error. Locked key.

108 DNC error. Wrong key code.

109 DNC error. Negative coordinate for a rollover axis.

110 DNC error. Wrong arithmetic parameter number.

111 DNC error. Arithmetic parameter exponent too large.

112 DNC error. Wrong arithmetic parameter value.

113 DNC error. When requesting the contents of several blocks (RN code), the first block number is greater than the last block number. For example: RN100.50

114 DNC error. The CNC machine parameters are locked.

115 DNC error. The CNC part-program memory is protected.

116 DNC error. A block has been sent which contains too many characters. The maximum is 80 characters when using blank spaces as separators and 45 when otherwise.

117 DNC error. A program block has been sent in disagreement with the machine parameters.