

**FAGOR DRO**  
**NVP-300T/301T**

**INSTALLATION MANUAL**

**Man: 9910 Soft: 1.xx**



# INDEX

Declaration of conformity .....	1
Safety conditions .....	2
Warranty terms .....	4
Material returning terms .....	5
<b>1. Unit description .....</b>	<b>6</b>
1.1 Front panel (See operation manual) .....	6
1.2 Rear panel .....	6
1.3 General technical characteristics .....	7
<b>2. Connections .....</b>	<b>8</b>
2.1 connection of the feedback systems .....	8
2.2 Input / output connection (X2) .....	9
2.3 RS-232-C connection (connector X7) .....	10
2.4 Power and machine connection .....	11
2.5 Turning the unit on and off .....	11
<b>3. Installation Parameters .....</b>	<b>12</b>
3.1 Parameter setting .....	13
3.2 Parameters to configure axis count and display .....	14
3.3 Input/output related parameters .....	18
3.3.1. Operation with the inputs and outputs .....	19
3.4 Messages and programming related parameters .....	20
3.5 RS-232-C related parameters .....	20
<b>4. Operation with the RS-232-C serial line .....</b>	<b>21</b>
4.1. Saving and restoring data .....	21
4.2 Parameter transmitting format .....	22
4.3 Tool table transmitting format .....	22
<b>Appendix .....</b>	<b>23</b>
Error codes .....	23
Maintenance .....	24

## **Attention:**



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

The DRO 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:

**Digital Readout (DRO) Fagor  
NVP-300T / NVP-301T**

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 50082-2	Immunity
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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	Power surges
EN 61000-4-6	Conducted disturbance induced by radio frequency fields.
EN 61000-4-11	Voltage fluctuations and Outages.

ENV 50204 Electromagnetic fields radiated by wireless telephones.

As instructed by the European Community Directives on Low Voltage: 73/23/EEC, (and the 93/68/EEC amendment) on Machine Safety 89/392/EEC and 89/336/EEC on Electromagnetic Compatibility.

In Mondragón, on April 1st, 1996

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.

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



### **Do not open this unit**

Only personnel authorized by Fagor Automation may open this unit.



### **Do not handle the connectors with the unit connected to AC power.**

Before handling the connectors (mains, feedback, etc.) make sure that the unit is not connected to AC power.

### **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 indicated in chapter 2 of this manual

### **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.

### **Ambient conditions**

Respect the temperature and humidity ranges specified on the chapter about technical characteristics in this manual (1.3).

### **Do not work in explosive environments**

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

## Working environment

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

## Install the unit in the right place

It is recommended, whenever possible, to instal the DRO so its power switch of the back panel is at a distance between 0.7 m (27.5 inches) and 1.7 m (5.6 ft) off the floor and away from direct sunlight, hot air, coolants, chemical products, blows as well as from relays, or high electromagnetic fields (about 0.5m or 20 inches) 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.
- Disturbance generating elements of the machine.
- Etc.

## 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 DRO, 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.
- 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.

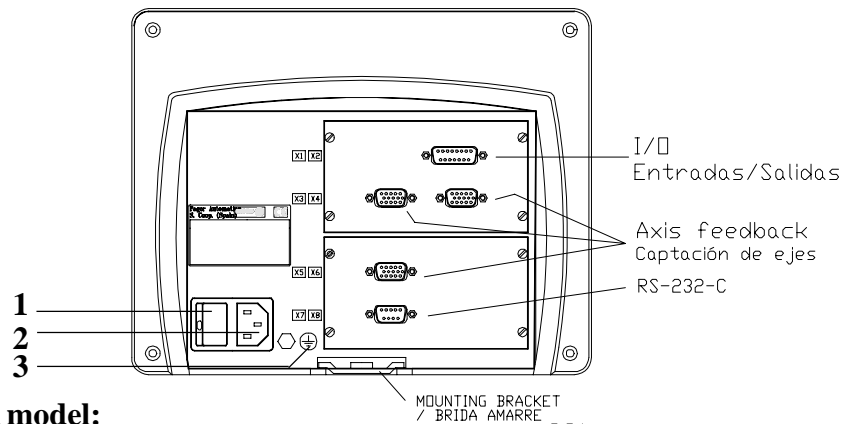
## 1. UNIT DESCRIPTION

This DRO is designed for industrial environments, especially for machine tools and measuring machines.

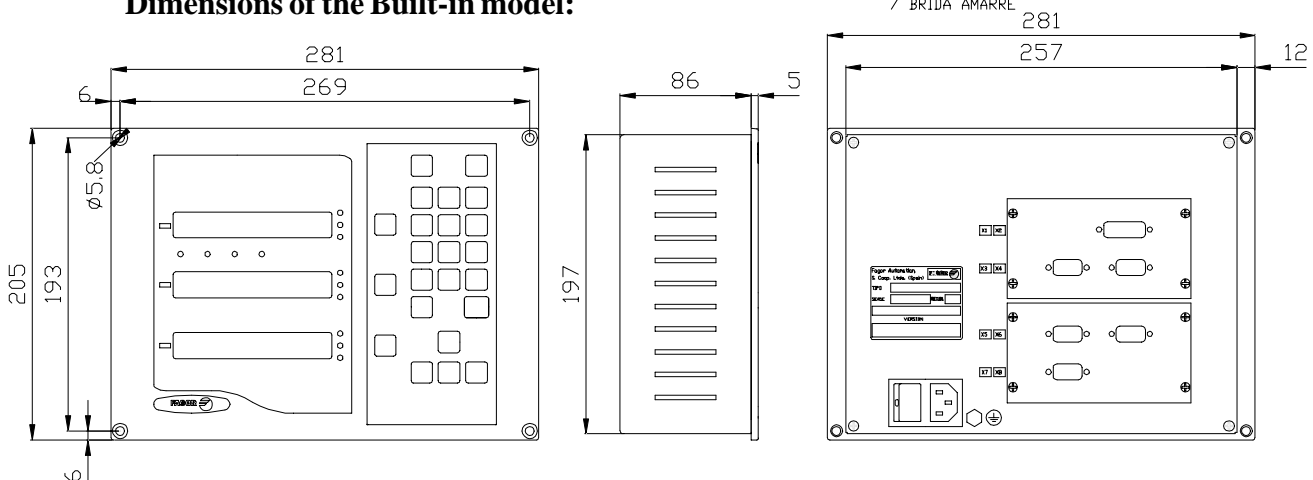
It can display the position of two, three or four axes of the machine and repetitive parts can be programmed

### 1.1 FRONT PANEL (SEE OPERATION MANUAL)


### 1.2 REAR PANEL



#### Dimensions of the Built-in model:



On the back of the unit, the following items may be found:

- 1.- Power switch. When the unit is turned off by this switch, the DRO no longer reads axis position. Therefore, it is recommended to use the  key at the front panel to turn the display off so the DRO continues keeping track of the axes position when they are moved.
- 2.- Three-prong power connector for AC and ground connection.
- 3.- M6 mm terminal for general machine ground connection.




- X2.-** SUB-D type 15 pin female connector to connect up to four digital inputs and outputs.
- X3.-** SUB-D HD type 15-pin female connector for 1st axis feedback device.
- X4.-** SUB-D HD type 15-pin female connector for 2nd axis feedback device.
- X5.-** SUB-D HD type 15-pin female connector for 3rd axis feedback device.
- X7.-** SUB-D type 9 pin male connector for the RS-232-C serial line connection.

## **WARNING**



**Do not handle the connectors while the unit is under power.**

Before handling the connectors (mains, feedback, etc.) make sure that the unit is not under power.

It is NOT enough to turn the display off by using the  key at the keyboard.

## ***1.3 GENERAL TECHNICAL CHARACTERISTICS***

Universal Power Supply between 100V AC and 240V AC +10% -15%

Mains frequency of 0 Hz (DC) and from 45 Hz to 400 Hz.

Power outages of up to 20 milliseconds.

10-year memory backup of installation parameter even when the unit is off.

The operating temperature inside the DRO enclosure must be between 5° C and 45° C (41°F and 113°F).

The storage temperature inside the DRO enclosure must be -25° C and +70° C (-13° F and 158° F).

Maximum relative humidity: 95% non condensing at 45°C (113°F).

Front Panel Sealing: IP54 (DIN 40050), Rear panel: IP54 (DIN40050) except for built-in models in which case is: IP20.

## 2. CONNECTIONS

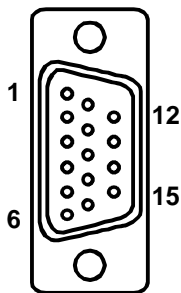
The connection for the RS-232 serial line (optional X1 connector) is not described in this manual; but in a supplement for it.

### 2.1 CONNECTION OF THE FEEDBACK SYSTEMS

The feedback systems (scales or encoders) are connected via SUB-D HD type 15-pin female connectors: **X3, X4, X5** and **X6**.

#### Characteristics of feedback inputs: X3, X4, X5 and X6:

- +5V input consumption: 250 mA
- Admits square-wave signal (TTL). (A, B, Io)
- 1Vpp voltage modulated sinewave signals.
- Maximum frequency: 250 KHz, minimum separation between flanks: 950nsec.
- Phase shift  $90^\circ \pm 20^\circ$ , hysteresis 0.25 V,  $V_{max}$  7V, maximum input current: 3 mA.
- High threshold (logic state 1)  $2.4V \leq V_{IH} \leq 5V$
- Low threshold (logic state 0)  $0.0V \leq V_{IL} \leq 0.8V$



Pin	Signal	Function
1	A	Feedback signals
2	/A *	
3	B	
4	/B *	
5	Io	Reference signal
6	/Io *	
7	Not connected	Not being used at this time
8	Not connected	
9	+5V	Power for feedback
10	Not connected	Not being used at this time
11	0V	Power for feedback
12	Not connected	Not being used at this time
13	Not connected	Not being used at this time
14	Not connected	Not being used at this time
15	Chassis	Shield

\* Available only at the NVP-301T

## 2.2 INPUT / OUTPUT CONNECTION (X2)

Each position may be independently associated with each one of the display axis.

If the machine does not control all the positions, the unused ones can be cancelled as to not being able to change its position or activate its corresponding output.

It also has four digital inputs, activated at 5 V or 24 V. They can be used as Emergency Input (E4) or to reset the reading of the axes (E1 for the X axis, E2 for the Z axis). When the Emergency Signal (E4) is activated, the output signals are deactivated.

**Refer to section 3.3.1 in this manual to see how to use these inputs and outputs.**

### **Characteristics of the signals at connector "X2":**

Four general purpose opto-isolated inputs. The operating voltage for these inputs may be chosen between 5V and 24V with an on/off threshold is around +6V. The +24V power supply voltage must be between 0 and 24V ( $\pm 25\%$ ). The on/off threshold is around +2.4V.

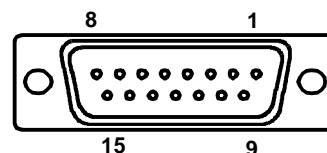
### **Characteristics of the inputs at 24V :**

- Maximum load current: 100mA
- Minimum DC voltage: 18V
- Maximum DC voltage: 30V

Pin	Signal	Pin	Signal
1	Input 1	9	Input 2
2	Input 3	10	Input 4
3	GND for inputs at 24V	11	GND for inputs at 5V
4	Not connected	12	Not connected
5	Output 5	13	Output 6
6	Output 3	14	Output 4
7	Output 1	15	Output 2
8	Common output contact		

### **Characteristics of the inputs at 5V :**

- Maximum load current: 100mA
- Minimum DC voltage: 3.75V
- Maximum DC voltage: 6.25V

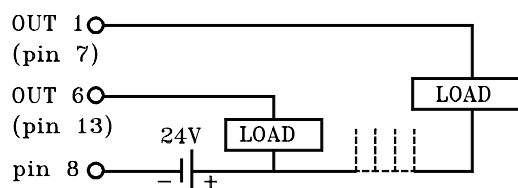


**Six outputs,** opto-isolated with solid state relay with a normally open contact.

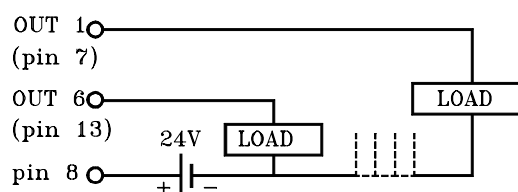
**The main characteristics of these outputs are:**

- Maximum AC or DC voltage: 40V
- Maximum load current: 225mA
- Maximum internal resistance: 5ê
- Maximum peak current: 2.5A for 100ms at 25°C
- Through current when open: ≤ 1µA
- Galvanic isolation voltage: 1500V for 1 minute
- Activation time: ≤ 3ms
- Deactivation time: ≤ 3ms

**Open collector output connection:**

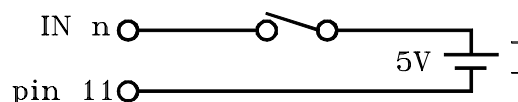


**Open emitter output connection:**

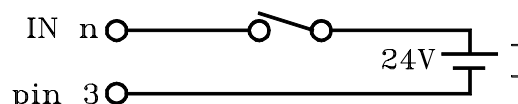


Note .- If any of the outputs is going to be connected to an inductive device, a 1N4000 type diode must be placed in parallel.

**Input connection at 5 Volts :**



**Input connection at 24 Volts :**

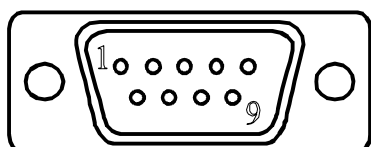


**2.3 RS-232-C CONNECTION (CONNECTOR X7)**

The RS-232-C serial communications line uses a 9-pin male SUB-D type connector.

The installation parameters for this feature are described in section 3.3 of this manual.

The operating mode for this feature is described in chapter 5 of the Operating Manual.



<b>Pin</b>	<b>Signal</b>	<b>Function</b>
1	NC	Not connected
2	RxD	Receive Data
3	TxD	Transmit Data
4	NC	Not connected
5	GND	Ground
6-9	NC	Not connected

## 2.4 **POWER AND MACHINE CONNECTION**

These DROs can be connected to an AC voltage anywhere between 100V AC and 264 V AC +10% -15% with a frequency between 45 Hz and 400 Hz without having to select it depending on the country where they are installed thanks to their universal power supply.

Always mount it vertically so its keyboard is within operator's reach and its digits are easily visible (at operator's eye level).


**Do not connect or disconnect the DRO connectors while it is under power.**

Connect all metallic parts to a common point on the machine tool and it to the general ground point. Use cables of enough gage (no thinner than 8 mm<sup>2</sup>).


## 2.5 **TURNING THE UNIT ON AND OFF**

### **Turning the unit ON**

The unit is turned on by actuating on the power switch of the rear panel



The DRO runs a self-test and shows on the LCD display the text: "Fagor NVPxxx T, Press  " (where xxx indicates the model) and the X and Z displays show "Fagor dro" if everything is OK and the error number if otherwise. See the appendix at the end of this manual.

### **Turning the unit OFF**

If you press  the DRO turns off the displays while maintaining the power supply to the feedback systems and goes on reading the position of the axes at all times. This is not the case when the equipment is switched off by means of the switch on its rear panel.

To reset the displays, just press this key again, on condition that the DRO is getting voltage (plugged in and with the switch on the rear panel on).

### **Notes:**

- Before powering the DRO down with the switch on the rear panel or disconnecting it from mains, it is a good idea to press the  key in order to store the current position of the axes permanently.
- If the unit is powered down with its rear panel switch or there is a power outage without previously having pressed , the DRO will keep the last position of the axes for at least 30 minutes.
- The unit will display ERROR 2 when powered back up if the position reading was lost when turned off while the axes were moving or after the accidental backup period has expired without having saved the current position by previously pressing



### 3. *INSTALLATION PARAMETERS*

These DROs have a number of installation parameters to configure it for a particular application.

These parameters may be saved into a peripheral or uploaded from it through the RS-232-C serial communications line.

The format for these parameters depends on whether they are general or particular for each axis.





- If it affects the axes, press the corresponding axis key to modify it.
- If it is a general parameter, the **X** display will show its current value.
- The LCD display will show the description of the parameter and its number.

There are several kinds of parameters depending on how to set them:






- With binary values. The value of each digit toggles between "0" and "1" when pressing its corresponding key from  to  where  corresponds to the rightmost digit and  to the leftmost one.
- Numeric values, usually with the corresponding axis resolution, they are entered as regular preset.
- Options, the value is changed by pressing  which will make the various options appear in a cyclic way.







### 3.1 PARAMETER SETTING

The DRO display must be on and in counting mode in order to be able to edit the parameters.

- Press . The LCD display will show the menu:  
**SPECIAL**  
**UTILIT. / PARAM / COMM**
- Select "**PARAM**" using the   keys.
- When the word "**PARAM**" appears between < >, press 
- The LCD display requests the password ( **060496**). If it is not entered, it is still possible to edit those general parameters not affecting the axes.

The LCD display will show the parameter number and a brief description.

- If it is a general parameter (not affecting the axis reading), the display will show its current value.
- If it is an axis parameter, each axis display will show its current value. In this case, press the axis key (**X** or **Z**) and key in its new value.
- To go from one parameter to another **and save the changes**:  
Press  or  to go to the next one. To go to the previous one, press   
or 
- Pressing another axis key, (**X** or **Z**), the DRO saves the value of the previous axis and shows the new axis to be edited.
- To quit the parameter editing mode, press  and the DRO will recover the previous values ignoring the changes just made.

From the count modes, it is also possible to access all the parameters not affecting the count (user), such as: parameter **PAR50** (language) with the keystroke sequence:    and **PAR05** (scaling factor) with the keystroke sequence:   . This way, it is possible to change operating modes without having to go through all the parameters preceding the ones we would like to edit. This is also possible for parameters PAR40 through PAR45 (I/O), PAR51(memory lock), PAR90 (RS-232-C serial line).

### 3.2 PARAMETERS TO CONFIGURE AXIS COUNT AND DISPLAY

The digits of digital parameters refer to the digits on the axis displays so digit "1" corresponds to the rightmost digit and "8" to the leftmost digit.


X	X	X	X	X	X	X	X
8	7	6	5	4	3	2	1

<b>PARA-METER</b>	<b>FUNCTION</b>
<b>PAR00</b>	Feedback configuration, different for each axis. Binary type.
Digit	
8	Direction of the coded Io ( <b>0 = Increasing</b> , 1 = Decreasing)
7	Pitch of the coded Io ( <b>0 = 20 mm</b> , 1 = 100mm)
6	Type of linear scale's Io ( <b>0 = Fix</b> , 1 = Coded)
5	Feedback resolution units: <b>0 = microns</b> , 1 = inches
4	Not being used at this time. It must be set to "0".
3	Differential feedback signals ( <b>0 = No</b> , 1 = Yes) <b>The NVP-300T cannot be set to "1" (Yes)</b>
2	Type of feedback signals ( <b>0 = TTL</b> , 1 = 1 Vpp) <b>The NVP-300T cannot be set to "1" (1 Vpp)</b>
1	Counting direction ( <b>0 = normal</b> , 1 = reverse)
	If an axis count increases or decreases in the opposite direction to the one desired, change the value of this digit.



**PAR01** Feedback resolution, independent for each axis,  
Possible values: from 0.1µm to 1mm (0.000005" to 0.03937").  
Factory setting: **5** (µm).

**PAR02** TTL multiplying factor (subdivision). Independent for each axis.  
Options: x4, x2, x1 and x0.5.

The selection of these values rotates by pressing .

The factory setting is: **x4** and it is the one used for FAGOR scales.

When using an encoder, its number of pulses should be calculated according to the leadscrew pitch, the desired resolution and the multiplying factor to be applied as per the formula:


$$\text{Encoder (lines/turn)} = \frac{\text{Leadscrew pitch (mm/turn)}}{\text{Resolution (mm/pulse)} \times F}$$

Where "xF" would be the multiplying factor to be applied.

**PAR03** Internal multiplying factor when using sinewave feedback signals or external multiplying factor when using semi-absolute feedback devices (coded Io) and TTL feedback signals. Independent for each axis.  
Options: 1, 5, 10, 20, 25, 50. **Factory setting: 1**

For example, for FAGOR scales: MOX, COX or FOT, set this parameter to 5.

**PAR05** Scaling or shrink factor. Independent for each axis, numeric value within ±9,999.

A "0" value means that no factor is to be applied. It is applied onto the coordinates to be displayed after compensating for table sag. It is **not** applied when reading with respect to machine reference zero ( led on).

The factory setting is: "0".

**PAR08** Indicates whether the feedback alarms will be used or not.

Digit

- 8, 7, 6 Not being used at this time. Must be set to "0".
- 5 The NVP-301T detects the amplitude of the feedback signals.
- 4 Feedback alarm contact active level (0=low, 1=high)
- 3 Detect the feedback alarm supplied by the transducer.
- 2 Detect software travel limits (PAR12 and PAR13).
- 1 Detect speed alarms.

Possible values 0 (alarm OFF) and "1" (alarms ON).

Factory setting: **0**

Refer also to the error codes in the appendix of this manual.

**PAR09** Axis sag compensation, per linear axis.

Numeric value within  $\pm 99.999$  millimeters per meter.

Factory setting: **0**.

**Notes:**

- Even when selecting the display in inches, this value **MUST ALWAYS BE IN MILLIMETERS**.
- Remember that 1 inch = 25.4 mm

**PAR10** Offset of the reference point with respect to the reference zero of the scale, independent for each axis.

Numeric value in resolution units for each axis.


Factory setting: **0**.

This value will be in mm or inches depending on whether the INCH LED is off or on.

**PAR11** Miscellaneous, binary.

Digit

8, 7, 6, 5, 4, 3, 2 Not being used. Must be set to "0".

- 1 The  key affects one axis ( = 0) or all of them ( = 1).

It may toggle from absolute reading mode to incremental. This parameter determines whether this toggle affects one axis or all of them.

If it affects by axis, after pressing  one must press the axis key. **Factory setting: "1"**

**PAR12** To set the negative axis travel limit.  
Possible values: between -99999.999 and 0.

This value will be in mm or inches depending on whether the INCH LED is off or on.

If PAR08=1(limit alarms ON), when the axis exceeds this distance, the corresponding axis display starts blinking until it is moved back into the work zone.

**PAR13** To set the positive axis travel limit.  
Possible values: between 0 and 99999.999

This value will be in mm or inches depending on whether the INCH LED is off or on.

If PAR08=1(limit alarms ON), when the axis exceeds this distance, the corresponding axis display starts blinking until it is moved back into the work zone.

**PAR 14** To carry out the home search when the feedback device does NOT have reference marks "Io" (for example, FAGOR MKT scales), this parameter must be set to "1". **Factory setting = "0"**.

**PAR 15** Contains the leadscrew error compensation.  
Enter the number of points to be compensated (up to 40). "0" means that no compensation is to be applied.

- When pressing  , the X axis display shows the position value and the Z axis display shows the error to be compensated. Use the  and  to move from point to point.
- Use the axes keys to edit the position or the error with the resolution and units of the axis (PAR00 and PAR01).
- When pressing  , the X axis, shows the home coordinate of the selected axis. When pressing  or  the dro assumes the displayed coordinate as the error position and it then requests the amount of error to be compensated.

**This error amount is the "Actual position - Displayed position".  
The Home point (Io) must be assigned an error of "0"**

- The preset is canceled by pressing  before pressing .
- To exit, press  when none of the axes is blinking.

### 3.3 INPUT/OUTPUT RELATED PARAMETERS

**PAR21** Indicates the active level for the inputs. Only the first four digits are used where the first one corresponds to "E1" and the last one to "E4". A "0" indicates that the input is active low (0V).

E1 and E2 are used to zero the reading of the X and Z axes respectively and E4 as Emergency signal.

**PAR23** Indicates the active level for the outputs. Only the first six digits are used where the first one corresponds to output "S1" and the last one to "S6". A "1" indicates that the output is active high (5V or 24V).

It must be borne in mind that the outputs are activated when the axis position is equal to or more negative than the preset value and they go high "1" or low "0" depending on the setting of machine parameter PAR23.

**PAR26** Contains the anticipated activation distance (up to 0.9999 mm or 0.03937 inch) before reaching the established coordinate. This value will be in mm or inches depending on whether the "INCH" LED is ON or OFF. The axis will be considered to be at the target position when it is positioned at a distance smaller than PAR26 from it.

**PAR30** These parameters set the axis number controlling its corresponding signal. PAR30 corresponds to S1 ... PAR35 to S6.

**PAR35** It admits values of 0, 1 or 2, where "0" means that the signal is not being used, 1 = X, 2 = Z.

**PAR40** They set the signal activating positions (levels) of the axes indicated to by PAR30 through PAR35. The PAR40 coordinate is used to

**PAR45** activate signal "S1", ... and the PAR45 coordinate to activate "S6".









This value will be in mm or inches depending on whether the "INCH" LED is off or on.

### 3.3.1. OPERATION WITH THE INPUTS AND OUTPUTS

With this DRO up to 4 digital inputs (E1 to E4) and 6 outputs (S1 to S6).

Inputs E1 and E2 are used to zero the reading of the X and Z axis respectively. E4 may be used as an Emergency input.

Outputs S1 to S6 (PAR30 ... PAR 35) are activated when the reading of the selected axis reaches, in the negative direction, the coordinate set either by parameter (PAR40 for S1 ... PAR45 for S6) or ...

by pressing    [coordinate for S1]  and so on up to     
[coordinate for S6] 

**NOTE: When working in execution mode, PAR40 through PAR45 must be set to "0".**

### **3.4 MESSAGES AND PROGRAMMING RELATED PARAMETERS**

**PAR50** Language selection for the messages appearing on the LCD display.

0 = English; 1 = Spanish; 2 = French; 3 = German; 4 = Italian;  
5 = Portuguese; 6 = User defined.

**PAR51**  
**digits**

**8 to 3** Not being used at this time. They all must be set to "0".

2 To turn on (=0) or off (=1) the confirmation beep when pressing the keys.

1 Program memory lock, 0 = unlocked; 1 = locked.

**PAR52** Loading of the user defined language.

When accessing this parameter, the DRO requests the password.  
After keying 5564, the DRO is ready to receive the file containing the user defined language.

### **3.5 RS-232-C RELATED PARAMETERS**

**PAR90** Indicates the transmission speed of the RS 232 line.

Options: 75, 150, 300, 600, 1200, 2400, 4800 & 9600 baud.

## 4. OPERATION WITH THE RS-232-C SERIAL LINE










### 4.1. SAVING AND RESTORING DATA

With this DRO, it is possible to save data into a PC or peripheral device and later restore it by using the RS-232-C serial communications line.

This data is sent out in the following format:

Baudrate as set by PAR90, 8 data bits, 1 stop bit and no parity.

To access this mode:

- Press 
- Select the "Comm" option (communications) of the LCD display by means of the   keys until that word appears between < > and press .
- Select: <**Send**> and press  to send the data out to a PC or peripheral device or select <**Receive**> and press  to receive data from a PC or peripheral device.
- Select the type of data to transmit **Parameters**, **Program** or **Tool** table by means of the   keys and press .

## **4.2 PARAMETER TRANSMITTING FORMAT**

The format of the transmitted parameters are:

For value parameters: **P?? 123.123**

For binary parameters: **P?? 10101010**

For option parameters: **P?? 0**

For axis parameters: **P?? X 123.123 Z' 123.123 Z'' 123.123**

The number of decimals depends on the selected resolution.

The format for the "PAR15" regarding leadscrew error compensation is:

P15 X05

N00 P-1000.000 E-1.000

N01 P-500.000 E-0.500

N02 P0.000 E0.000

N03 P500.000 E0.500

N04 P1000.000 E1.000

Z' 03

N00 P-1000.000 E-1.500

N01 P0.000 E0.000

N02 P1000.000 E1.500

Where "P" corresponds to the axis position referred to home and "E" is the amount of error to be compensated for that point.

## **4.3 TOOL TABLE TRANSMITTING FORMAT**

The format is:

**In mm: T?? X 1234.1234 Z 1234.1234**

**In inches: T?? X 123.12345 Z 123.12345**




# APPENDIX

## *ERROR CODES*


Message	Description
<b>FAGOR dro</b>	Power outage or turned off by main switch after saving the data.
<b>Error 02</b>	Power outage or turned off by main switch without having saved the data. The unit has been turned off without previously pushing the [ON/OFF] key. It will only lose the position count (will be reset to zero) and the status of the operating modes (inch, abs, etc.).
<b>Error 04</b>	Wrong parameter values
<b>Error 05</b>	Wrong internal configuration
<b>Error 06</b>	Errors in data backup memory (Service Dept.)
<b>Error 07</b>	Emergency input active. Press [C] or cancel emergency signal.
<b>Error 08</b>	Wrong software memory or the software has been changed
<b>Error 09</b>	Errors in work memory (Service Dept.)
<b>Error 12</b>	Error while searching a coded marker pulse (Io)
<b>Error 31</b>	Internal malfunction (Service Dept.)
<b>Error 32</b>	Internal malfunction (Service Dept.)
<b>Error 99</b>	Internal malfunction (Service Dept.)
.....	Feedback alarm supplied by the feedback device (scale, encoder, etc).
<b>1.4.3.6.5.7.2.5</b>	Feedback speed too high.
<b>EEEEEEEE</b>	Maximum position reading or speed exceeded when searching Home

If any message other than the first two from the table were to come up, the equipment should be switched off and on again until one of the first two are seen.

After pressing  to access the counting mode, check the parameters.

If any of the errors shown as (Service Department) are often repeated, ask Fagor Automation's Customer Services Department about this.

The feedback alarm error will appear if the bit of the corresponding alarm activating parameter for the axis has been set to "1" **PAR08(1) = 1**.

In either case, to clear the display, press .

If the axis value is flashing, this means that one of the travel limits established by machine parameter has been exceeded. This error will be displayed if the alarm activation parameter for the axis **PAR08(2) = 1**

If the DRO does not come on or goes out while running, check that the voltage and ground outlets are as they should be. If an axis does not count, disconnect the feedback connectors one by one. If the DRO comes on, it indicates a fault in the feedback device. If the fault persists get in touch with Fagor Automation's Customer Services Department about it.

## ***MAINTENANCE***

### **Cleaning:**

An accumulation of dirt in the equipment can act as a screen preventing proper dissipation of the heat generated by the internal electronic circuits with the consequent danger of overheating and DRO fault.

Accumulated dirt can also, in some cases, provide a conductive path for electricity which could give rise to faults in the internal circuits of the equipment, especially in high humidity conditions.

To clean the equipment non-abrasive dish-washing detergents are recommended (in liquid, never powder form) or 75% isotropic alcohol with a clean cloth. DO NOT USE aggressive solvents, (benzol, acetones, etc.) which could damage the materials the equipment is made with.

Do not use high pressure compressed air to clean the item as this could give rise to an accumulation of charges which in turn lead to electrostatic discharges.

The plastics used in the front panel of the DRO stand up to:

1. Grease and mineral oils.
2. Alkalis and bleaches.
3. Dissolved Detergents.
4. Alcohol

Avoid the effect of solvents such as Chlorohydrocarbons, Benzol, Esters and Ethers because these could damage the plastics with which the front of the equipment is made.

### **Preventive Inspection**

If the DRO does not come on press the rear switch for starting, make sure it is properly connected and being supplied with the proper mains voltage.

**FAGOR DRO**  
**NVP-300T/301T**

**OPERATION MANUAL**

**Man: 9910 Soft: 1.xx**



# INDEX

<b>Introduction</b> .....	<b>1</b>
<b>1. Unit description</b> .....	<b>1</b>
1.1 Front panel .....	1
1.2 Rear panel (See installation manual) .....	3
<b>2. Coordinate display</b> .....	<b>4</b>
2.1 Display modes .....	4
2.2 Incremental, absolute and with respect to machine zero .....	6
2.3 Machine reference selection and search .....	7
2.4 Axis coordinate preset .....	9
<b>3. Special operations</b> .....	<b>12</b>
3.1 Scaling factor .....	12
3.2 Operation Utilities .....	12
3.2.1 Feedrate .....	12
3.2.2 Calculation of the cutting speed .....	13
3.2.3 Taper (cone) calculation .....	13
3.3 Tool Preset .....	14
3.3.1 Deleting all tool offsets .....	15
3.4 Coordinate freeze (Hold) .....	15
<b>4 Programming</b> .....	<b>16</b>
4.1 Deleting blocks .....	16
4.2 Editing blocks .....	16
4.2.1 Editing a new block (empty) .....	17
4.2.2. Teach-in mode .....	18
4.2.3 Special functions .....	18
4.2.3.1 Scaling factor (programming) .....	18
4.2.3.2 Jump to another block .....	19
4.2.4 Cycles .....	19
4.2.4.1 Positioning (see section 4.2.1) .....	19
4.2.4.2 Turning/facing cycle .....	20
4.2.4.3 Taper turning / facing cycle (taper 1) .....	20
4.2.4.4 Taper turning / facing cycle (taper 2) .....	21
4.2.4.5 Corner rounding cycle .....	22
4.3 Execution .....	22
4.3.1 program execution .....	22
4.3.2 Cycle execution .....	23
4.3.3 Execution errors .....	24
<b>5. Operation with the RS-232-C serial line</b> .....	<b>25</b>
5.1. Saving and restoring data .....	25
5.2 Parameter transmitting format .....	25
5.3 Tool table transmitting format .....	25
5.4 Programs transmission Format .....	26
5.5 Operation with the inputs and outputs.....	27
<b>Appendix</b> .....	<b>28</b>
Error codes .....	28
Maintenance .....	29

# INTRODUCTION

Throughout this manual, certain installation parameters are referred to which affect the description of certain DRO functions.

These parameters have been set by the installer and may be modified by the operator.

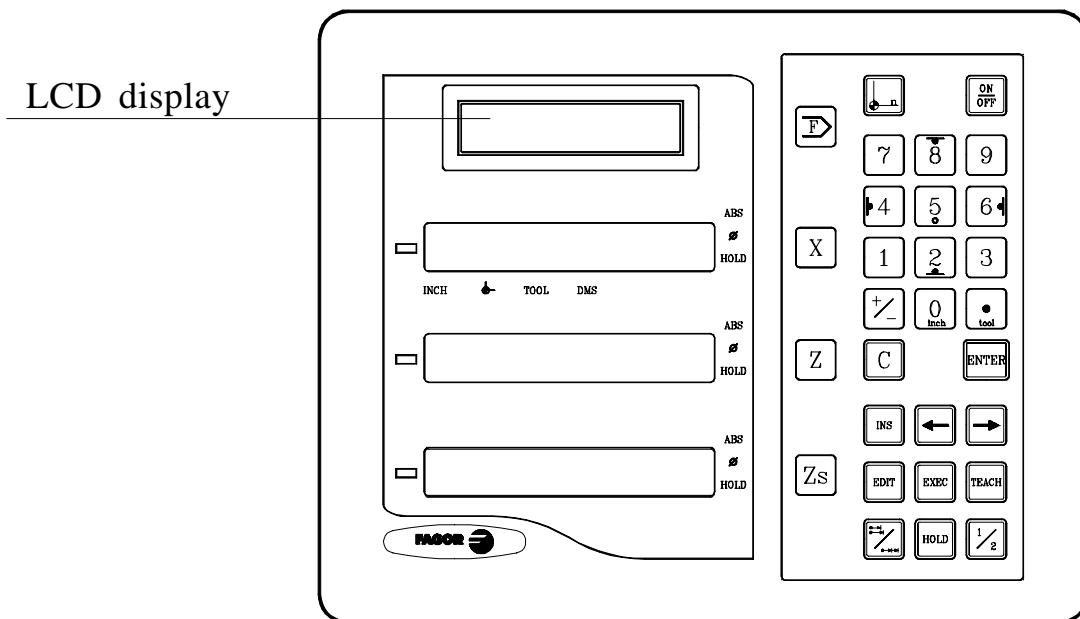
These parameters are described in the installation manual supplied with this unit.

## 1. UNIT DESCRIPTION

This DRO is designed for industrial environments, especially for machine tools.


It can display the position of two, three or four axes of the machine and run repetitive parts.


### 1.1 FRONT PANEL





The LCD display offers assistance for the various operations possible with this unit.

Each axis display has eight 14.1mm high LEDs and another one for the minus sign (-).

**ABS**-This lamp stays on when operating in absolute mode and off when in incremental mode. To access or quit this mode, use the  key.

**φ** - This lamp stays on when operating in diameter mode. In this mode, the DRO displays twice the actual axis movement. To access it or quit it, use the  key (if allowed by PAR04)


**HOLD**- This lamp comes on when "freezing" the axis position by pressing  and the axis key.

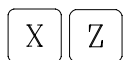
**INCH**- This lamp stays on when working in inches and off when doing it in millimeters. To access it or quit it, press 



This lamp stays on during machine reference search . See the section on references.

**3rd display** The rightmost digit shows a "1", a "2" or is off to indicate that the Z axis display (2nd one) corresponds to "Z<sub>1</sub>", "Z<sub>2</sub>" or to the combination of "Z<sub>1</sub>+Z<sub>2</sub>" respectively.

This selection rotates by pressing  . It also shows the text "tool" followed by the number of the active tool corresponding to the XZ coordinates shown on the other displays.



Keys to select the first the second and third axis respectively.



Is used for changing the part zero or home reference.



Is used for rotating from the incremental to the absolute mode and vice versa



Is used to turn the display off while keeping track of the axes position at all times. This key must be pressed before turning the unit's power off by the main switch on the back of the unit.



Is used to validate an operation.



Is used to insert blocks or delete memory blocks and tools.



Is used to cancel or abort an operation already initiated.



Is used to toggle the display of double the actual axis movement.



These are used for entering values.



Is used to change the sign of the entered value or change from fine to coarse resolution and vice versa.



Is used for “freezing” the display of the feedback even though the axis moves.



This key is also used to toggle between metric and inch display.



Is used to access the special operation modes, parameter setting, communications via RS-232-C, etc.



Are used to select the previous or next option in a menu or in a mode.



Is used to access the program editing mode.



Is used for programming a part in teach-in mode by inserting blocks after moving the axes to the desired position.




Is used to access the execution of a cycle or part program previously stored.

## ***1.2 REAR PANEL (SEE INSTALLATION MANUAL)***


## 2. COORDINATE DISPLAY

### 2.1 DISPLAY MODES

#### Turning the unit ON




The unit is turned on by actuating on the power switch of the rear panel. This DRO runs a self-test and its LCD screen shows the text: "Fagor NVPxxxT, Press ". Where xxx indicates the model and the X and Z displays show "Fagor dro" if everything is OK and the error number if otherwise. See the appendix at the end of this manual.

#### Turning the unit OFF

If you press  key the DRO switches off the displays while maintaining the power supply to the feedback systems and goes on reading the position of the axes at all times. This is not the case when the equipment is switched off by means of the switch on the rear panel of the same.

To reset the displays, just press this key again, on condition that the DRO is getting voltage (plugged in and with the switch on the rear panel on).







#### Notes:

- Before powering the DRO down with the switch on the rear panel or disconnecting it from mains, it is a good idea to press the  key in order to store the current position of the axes permanently.
- If the unit is powered down with its rear panel switch or there is a power outage without previously having pressed , the DRO will keep the last position of the axes for at least 30 minutes.
- The unit will display ERROR 2 when powered back up if the position reading was lost when turned off while the axes were moving or after the accidental backup period has expired without having saved the current position by previously pressing .




## **Language selection**

On this DRO, it is possible to select the language used for displaying the help on the LCD screen. To do this:


- Access parameter PAR50 (language) directly by pressing   
- Press  repeatedly until the desired language appears (English, Spanish, French, German, Italian, Portuguese, custom\*) and press . Press  to quit the language selection mode.

"Custom" may be any user defined language. (See section 3.2 PAR52 of the installation manual).


## **Conversion mm into inches**

This DRO can displayed the position of the axes in millimeters or inches by pressing  key depending on whether the **INCH** led is off or on respectively.

## **Fine / coarse resolution**

This DRO allows a decimal digit to be switched off (coarse resolution) when the resolution is excessive, simply by pressing . For example 0.01 instead of 0.012.

## **Radius / Diameter:**

When these models are used for measuring radius or diameter, one can display twice the real displacement of the axis (diameter) by pressing . Led  $\Phi$  will go on or off to indicate the double or real counting mode respectively.

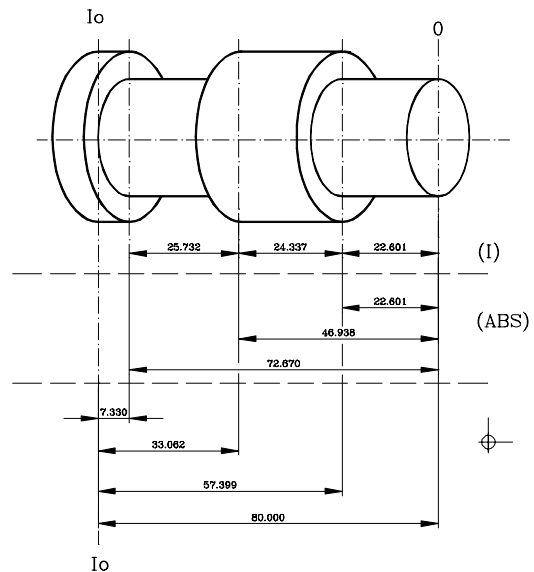
## 2.2 INCREMENTAL, ABSOLUTE AND WITH RESPECT TO MACHINE ZERO










A coordinate DRO displays the present coordinate of one or several axes.

Coordinate means the distance from one point or position with respect to another chosen as reference.


These DROs can display the position of the axes in incremental or absolute mode or referring to home.






The figure shows the coordinates of an axis which would appear in the different modes:



- In **Incremental (I)**, when the **ABS** and  leds are off the distance from the present position of the axis to the previous position is displayed.
- In **Absolute (ABS)**, when the **ABS** led is on and the  is off, the distance from the present position of the axis to part zero (**D**) is displayed.
- In **reference zero** (), when  led is on, the distance from the present position of the axis to home (**Io**) chosen in the feedback system (scale or encoder) is displayed. To access this mode use  key.
- To select another reference point, just press its corresponding key [0] to [9] or the   keys. Once it is selected, press  to activate it or  to cancel the operation and quit this mode leaving the previous part zero.
- The home reference "0" cannot be preset and it will be assumed when the DRO detects the reference pulse coming from the feedback device as described later on.

**Note:** If parameter PAR14 = 1, it will be possible to preset the home position when using feedback devices not having a reference mark (pulse). For example FAGOR MKT series scales.

To change from one of these display modes to another, press  until the relevant led goes on or off as described earlier.

It could occur that the installation parameter **PAR11(1)** has been set to "0" for  key to independently affect each axis so that one axis can display its position in incremental mode whilst the other does this in absolute. In this case, to change the display mode for a particular axis, press sequence:   for "X",   for "Z".

## 2.3 MACHINE REFERENCE SELECTION AND SEARCH


Though it is not absolutely necessary for a large number of applications we recommend fixing a reference point (home) for each axis using the reference marks (Io) of its feedback system, whether this is a scale or an encoder in order to be able to keep the respective zeros (part and incremental) and recover these after having disconnected the equipment or for any other reason.

Standard FAGOR scales have a fixed reference mark (Io) every 50 mm along their travel.


When starting the home search and pressing an axis key (X, for example) the current axis position starts blinking with zeros to the left.

FAGOR also offers scales with a coded Io with which all you have to do is move the axis at most 20 mm or 100 mm (depending on the model) from the present position in order to “find” the exact position of the axis with respect to home.

When this mode is selected, the DRO waits to receive this pulse (Io) to re-establish all its previous absolute and incremental references (part zero and incremental zero).








For this reason when fixed Io (not coded) scales are used, one first has to choose an approximate reference zone, for example about half way along the axis travel, take the axis up to said zone and carry out the search for the Io () reference mark of the scale (or encoder).

After said (Io) mark has been “found”, following the steps described below, this axis zone is marked with a pen or sticker in order to go back to this in later searches, recommended after having disconnected (not “switched off” the machine, as will be shown later on).

These DROs keep the relative distance from home () to part zero (**ABS** on) and incremental zero (**ABS** off) for each axis in their internal memory for about 10 years even after cutting off their mains power supply, for example, by means of the switch on the rear panel. This means that when it is necessary to reference the axes again, when the Io (home) mark is “found” said absolute and incremental zero values are recovered.

**Note:** In Machine Reference mode, the X, Z<sub>1</sub> and Z<sub>2</sub> axes are displayed.

The home search sequence is as follows:




- Move the axis to the approximate reference zone (roughly).  
**This step is only for fixed I<sub>o</sub> scales (not coded)**
- Get the DRO in home reference mode by pressing the sequence:  
   . If the  LED is on, it is already in that mode.
- Select the axis to be referenced by pressing  for X,  for Z<sub>1</sub> and  for Z<sub>2</sub> .

Zeros to the left of the axis display will appear.

- Move the axis until the DRO detects the reference mark of the feedback device. This happens when the zeros to the left of the corresponding display disappear.

When the reference pulse is received, the DRO presets this point with the value assigned to the installation parameter **PAR10** for this axis. This value is (factory set) default “0”. At the same time it recovers the relative distance from this home to the previously set part zeros (ABS) and the incremental value.

When using reference-coded scales (coded I<sub>o</sub>), the value assumed is the position with respect to scale zero plus the offset.

- Press  [Reference Number]  to turn off the  led and thus quit the home mode. Bear in mind that in reference mode, no other operation besides home searching and axis position display are possible.

**NOTE**.- If PAR14=1 (feedback without reference mark -I<sub>0</sub>-), The home position may be preset in Machine Reference mode. See the next section for coordinate preset.

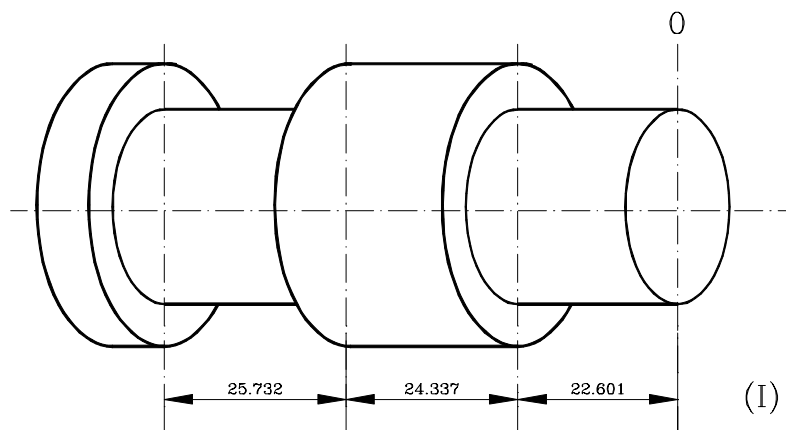
## 2.4 AXIS COORDINATE PRESET




To reset the axis display, just press: sequence: **C** **X** for "X", and **C** **Z** for "Z".

Using the lower figure, let us imagine we wish to make a part in which three holes have to be drilled with the coordinates stated. It is clear that the blueprint will only reflect the incremental coordinates (I) or the absolute ones (ABS) referring to the part zero (point "0" in the figure) although the DRO also shows them with respect to home (Io).

After referencing the axes, as was described in the previous section, we can make this part in incremental or absolute mode according to whether we chose a type of dimensions (I) or (ABS) of the blueprint.

### In incremental mode:



- Press  until the **ABS** led go out and the key  for switching off the  led.
- Move the axis up to corner "D" to set this as part zero.
- At this point, one can proceed in two ways.
  - Preset the axis with zero value by pressing **C** **X**
  - Move the axis to the face of the part until the DRO reads: **022.601**

- After drilling this hole, one can go to the next position, after having preset or...

- Preset the axis with value **22.601** by pressing:   **22.601**  to validate it.

In case of a mistake, press  to cancel it and leave it as it was.

When pressing , the previously preset value is displayed.

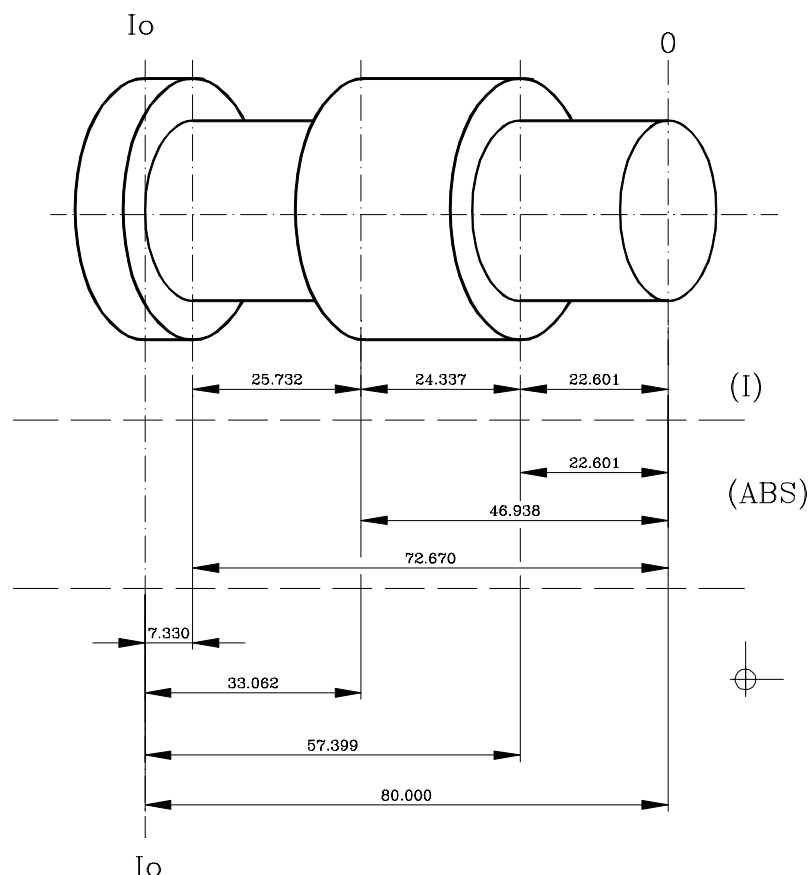
- Move the axis towards the first position until the DRO reads: **0.000**.

This last method turns out to be more practical as after selecting the destination coordinate one only has to remember to move the axis until the DRO reads zero.


- Once this turning operation has concluded, one can go to the next position, after having preset the next coordinate (**24.337**), by moving the axis until the display reads **0.000**.




- And so on until all the turning operations are concluded.

**Note:** By pressing  until the "ABS" LED lights up, the DRO will show the axis real position with respect to part zero "O"

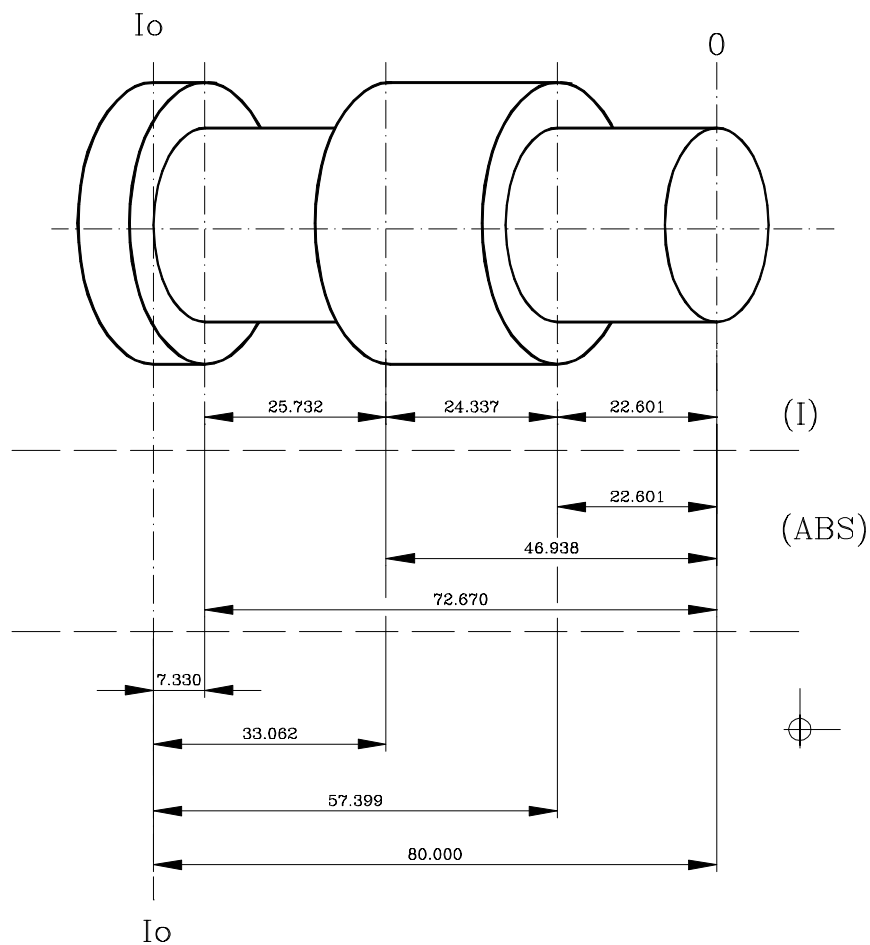


### In absolute mode:

- Press  until the **ABS** led comes on.
- To preset part zero:
  - Place the axis exactly over “0” and press: **C** **X**

At any time, by pressing key , the DRO will display the present position with respect to the previous zero (**ABS** and  led off), to part zero (**ABS** led on) or with respect to home ( led on).






The next section describes how preset up to 16 tools.



### 3. SPECIAL OPERATIONS


#### 3.1 SCALING FACTOR

With this DRO, it is possible to apply a scaling factor between 0 and  $\pm 9.999$  for applications such as mold making by simply keying in (for the X axis, for example):





    'value' .

The DRO will then show the axis position resulting from multiplying its real position by the 'value' of the scaling factor.

#### 3.2 OPERATION UTILITIES



After pressing , this DRO shows a menu with the first options:



##### 3.2.1 FEEDRATE

Once the <Feed> option has been selected by means of the    keys, the axis displays start blinking waiting to be selected by pressing their corresponding key (  for example). To deselect it, get back into this mode and press the same keystroke sequence used to activate that axis.

The LCD display will show:




- The current feedrate of the selected axis F0000000 in mm/min. or tenth-of-an-inch/min.
- The maximum feedrate reached by the axis until then since the this mode was activated: Fm000000 in mm/min. or tenth-of-an-inch/min.

To select another axis, select <Feed> again, press  and then the key for that axis (  for example).

To deselect it, press   or get back into this mode and press the same keystroke sequence used to activate that axis.






### 3.2.2 CALCULATION OF THE CUTTING SPEED

Once the <Cut.speed> option has been selected by means of the    keys (the LEDs start blinking).




With this utility, it is possible to calculate the cutting speed or the rpm given a radius or diameter (depending on selected mode).

- To calculate the cutting speed (mm/min or feet/min): enter the radius value at the X axis display and the rpm at the Zs display. The display will calculate their corresponding cutting speed and it will show it at the Z axis display.
- To calculate the rpm: Enter the radius or diameter value (depending on selected mode) at the X axis display and the cutting speed at the Z axis display. The DRO will calculate the corresponding rpm and will show them at the Zs axis display.

### 3.2.3 TAPER (CONE) CALCULATION

Once the <Taper> option has been selected by means of the    keys. (the LEDs start blinking). This DRO calculates the taper angle (cone) of a part by simply touching two of its points.

To do this, follow this procedure:

- Move the tool until it touches the part at any point of the taper.
- Press .
- Touch the part with the tool at any other point of the taper.
- Press  so the DRO calculates the angle or  to cancel the operation. (The displays stop blinking).




The "X" axis display will show the angle **in ten-thousandths of a degree** (0.0001°) and the "Z" axis display will do so in **degrees, minutes and seconds**.

### 3.3 TOOL PRESET




Up to 16 tools may be preset on this DRO model (from "tool 00" to "tool 15"). The unit stores in its internal memory the relative offsets of all the tools with respect to that of "T0".

Therefore, if "T0" has been preset in ABSolute mode (on X and Z) and, then, the rest of the tools, it will suffice to just preset "T0" again (on Z) to make a new part. The DRO will then automatically recalculate all the offsets of the rest of the tools without having to preset them for each part.

To preset a tool, just follow this procedure:

- Place a part of known diameter in the chuck in **ABS**olute mode.
- Move the tool to be preset until it touches the part at the known diameter.
- Press  and the 3rd display will show the word "**tool**" followed by the number of the active tool. The LCD screen will show "tool number: XX".
- Press the desired number key from "**00**" to "**15**".
- Press  to validate this operation or  to cancel it.
- Preset the axes with the contact position of the tool and the known part.

The tools can also be preset using the TEACH-IN mode. To do that:

1. Press  , The "0" tool will be shown selected.
2. Move the tool to a reference point (previously established).
3. Press . The display will show the next tool.

Repeat steps 2 and 3 for the rest of the tools.


These tool presets are kept in memory even when the unit is powered off up to a maximum of 10 years.

#### Notes:







In incremental mode, tools are not used, it is considered as just another tool, independent from T00.

If the offset of a tool has been preset in either  $Z_1$ ,  $Z_2$  or  $Z_S$  mode, the same mode ( $Z_1$ ,  $Z_2$  or  $Z_S$ ) must be selected to make the part with it.

### 3.3.1 DELETING ALL TOOL OFFSETS

To delete the offsets of ALL the tools: The  LED must be off.






Press . The text: "Tool = ??" will appear.

   The dro will request confirmation. Press  to ignore it and   
 to confirm it.

### 3.4 COORDINATE FREEZE (HOLD)

It enables “freezing” the display of the counter whilst inside it goes on reading the real position of the axis. This comes about when it is necessary to change the tool and preset the dimension of the new one.

For example, to change a tool at any known point of the part:

- Press key   and the display counting said axis “freezes” at the present value.
  - Press key of other axis if you wish to also “freeze” the display of this axis.
  - The tool to be replaced withdraws and the new one takes its position.
  - The new tool is led to the “freezing” point and the part is touched at said point.
  - Press  and the counting “defreezes” starting to count from the previously “frozen” value.
- If  is pressed, instead, the DRO will assume half the distance travelled since  was pressed.







## 4 PROGRAMMING

On this DRO, up to 100 blocks can be programmed (00 to 99) indicating axis positions at random or following a particular path (cycle) and some special functions such as tool change, jump to another block, scaling factor, etc. to be carried out later on in a repetitive way.

**Note:** If the memory is locked, the program blocks can be neither edited nor deleted.

### 4.1 DELETING BLOCKS


To delete all the program blocks, after pressing , press the sequence:

   The DRO will request confirmation. If **not** wished to proceed, press  (to select <Yes>, **otherwise**, press:   (to select <NO>).




### 4.2 EDITING BLOCKS

In a program, it is possible to "Edit" new blocks (empty) and the data already in them, "Modify" the contents of the blocks completely or "Delete" their contents leaving them empty.

The destination coordinates may be entered in the blocks by keying the values or after moving the axes to the desired destination point as described in the section on "Teach In".

When pressing  to access the block editing mode, the LCD display shows:

Program Edit  
Block: 00



After this, select the block number to be edited either by keying its two digits or using the   and then pressing 

## 4.2.1 EDITING A NEW BLOCK (EMPTY)

Once in the desired block as described earlier, the LCD display shows:

Program Edit
<Posit> Change Cycle




The option between < > (<Posit>) is the one selected.

To select any other option, use the   keys.

Then press  to access it.


### **Selecting the POSITION option:**


This menu option can be used to move the axes to specific coordinates using the indicated tool. It requests the following data:

- X coordinate of the target point: Press  and key in the value.
- Z coordinate of the target point: Press  and key in the value.
- The number of the tool to be used:  
Press  and key in the value.


If any of the coordinates is left out, its display will show: "-----" indicating that axis must not be moved.

To enter the target coordinate for another axis, press its corresponding key.

-Once the values have been entered for all the desired axes, press  to validate the block.

-To cancel the changes, press .

### **Selecting the CHANGE option:**

If while this option is selected,  is pressed, it is possible to change the scaling factor or edit a jump to another block or subroutine as described in section 4.2.3


### **Selecting the CYCLE option:**

While this is option is selected, it is possible to edit any of the cycles described in section 4.2.4

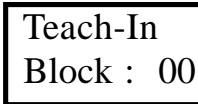
## 4.2.2. TEACH-IN MODE



In this mode, it is possible to enter the target coordinates after moving the axes to the desired position instead of keying its numeric value.


To edit a block in this mode:

- Press  to access this mode.

The LCD display will show:  
and the current axis position.



- Select the block to be edited by keying its number or by using the:    
keys

and then pressing  to validate the selection.




- Move the axes to the desired position and press 

When receiving a probe pulse, the current position is also entered and it goes on to the next block.




- To quit the TEACH-IN mode, press 

When programming incremental coordinates, "ABS" led off, the DRO will display the distance traveled from the previous block.

## 4.2.3 SPECIAL FUNCTIONS




Once in block editing mode and after selecting <Change> using the   keys and pressing , it is possible to program a scaling factor, a jump to another block or a tool change to be applied in the following blocks as described next.

### 4.2.3.1 SCALING FACTOR (PROGRAMMING)

After selecting this option using the   keys and pressing , it is possible to enter a scaling factor different for each axis, thus being possible to generate a mirror image (negative factor). This factor will affect the following blocks and may have a value within  $\pm 9.999$

If a scaling factor has been programmed, it will only be applied on to the programmed coordinates during the execution of the program, **but not on to the axis count or the regular dro mode.** To do that, it would have to be set by installation parameter PAR05 (section 3.1).

### 4.2.3.2 JUMP TO ANOTHER BLOCK

After selecting this option using the   keys and pressing , it is possible to program this function in order to change the order the blocks will be executed in or jump to subroutines from any block of the program.

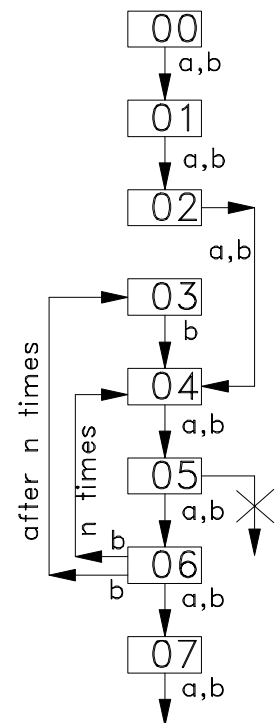
This type of block contains a jump destination block number and a return block number.

When programming the return block, the blocks contained between them will be considered a subroutine and one can program the number of times they will be executed before returning to the block after the one it jumped from.

For example:

- Block "02" of the figure contains a jump to block "04".
- If no return block is programmed in this block "02" (a), the DRO will execute blocks: 01, 02, 04, 05, 06, 07.
- If a return block "06" is programmed in this block "02" (b), the number of times (n) blocks "04, 05 and 06" will be executed. After that, blocks 03, 04, 05, 06 and 07 will be executed.

Note: No nesting is possible. This means that no jumps can be programmed from inside a group out to another, as from block 05 of the figure in case (b).



### 4.2.4 CYCLES

With this DRO, typical cycles may be programmed in an interactive way without having to program the exact position of each point.

#### 4.2.4.1 POSITIONING (SEE SECTION 4.2.1)

#### 4.2.4.2 TURNING/FACING CYCLE

After selecting these option with: and pressing

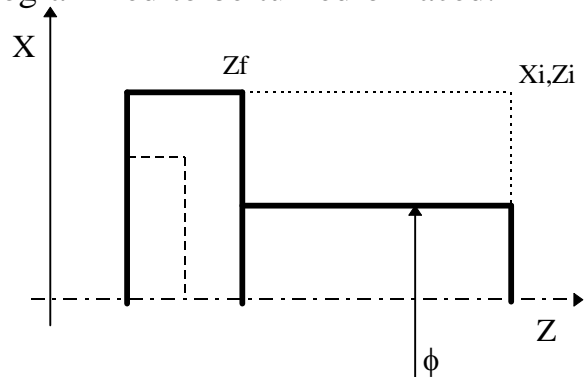
The desired section of the part can be programmed to be turned or faced.

To do this, indicate:

- The initial position ( $X_i, Z_i$ )

Press: [value]

- The final position ( $Z_f$ ):[value]
- The final diameter ( $\phi$ ):[value]
- The cutting pass: [value]



When executing this cycle, the dro will show the current position with respect to the target position for each machining movement (step) so the axes have to be moved until the dro displays read 0.000

**Notes:** To go from one step to the next, use either or .

to go back to the previous step, press

#### 4.2.4.3 TAPER TURNING / FACING CYCLE (TAPER 1)

After selecting these options with and pressing

The desired section can be programmed to be turned or faced.

To do this, indicate:

- The initial position ( $X_i, Z_i$ )

[value]

- The final position ( $X_f, Z_f$ ):

[value]

- The cutting pass:

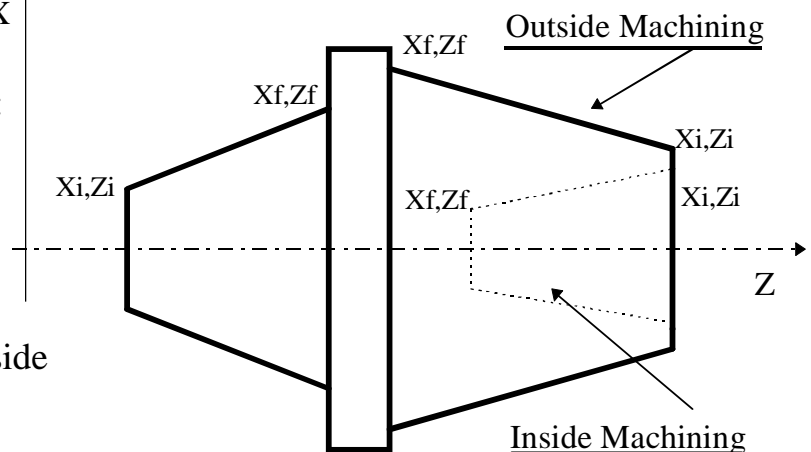
[value]

- Select either inside or outside machining with:

and or

- Select facing or turning with: and or

- Press to end this operation.



When executing this cycle, the dro will show the current position with respect to the target position for each machining movement (step) so the axes have to be moved until the dro displays read 0.000




**Notes:** To go from one step to the next, use either or .

to go back to the previous step, press



#### 4.2.4.4 TAPER TURNING / FACING CYCLE (TAPER 2)



In this cycle, a taper machining operation is programmed for a known taper angle:

After selecting these option with:   and pressing 

The desired section of the part can be programmed to be turned or faced.

To do this, indicate:

- The initial position ( $X_i, Z_i$ )

 [value]  

- The taper angle ( $\alpha$ ):

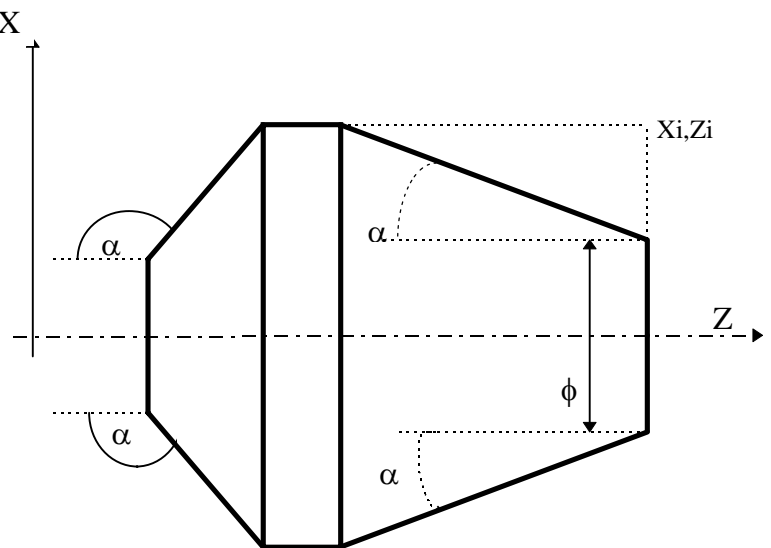
[value] 




- The diameter ( $\phi$ ):


[value] 

- The cutting pass:



[value] 



- Select facing or turning with:  and  or 

- Press  to end this operation.

When executing this cycle, the dro will show the current position with respect to the target position for each machining movement (step) so the axes have to be moved until the dro displays read 0.000

**Notes:** To go from one step to the next, use either  or .

to go back to the previous step, press .

#### 4.2.4.5 CORNER ROUNDING CYCLE

In this cycle the rounding of a section is programmed from the following data requested by the dro:

- The initial position ( $X_i, Z_i$ ):

[value]

- The final position ( $X_f, Z_f$ ):

[value]

- Rounding radius (negative = inside)

[value]

- The cutting pass:

[value]

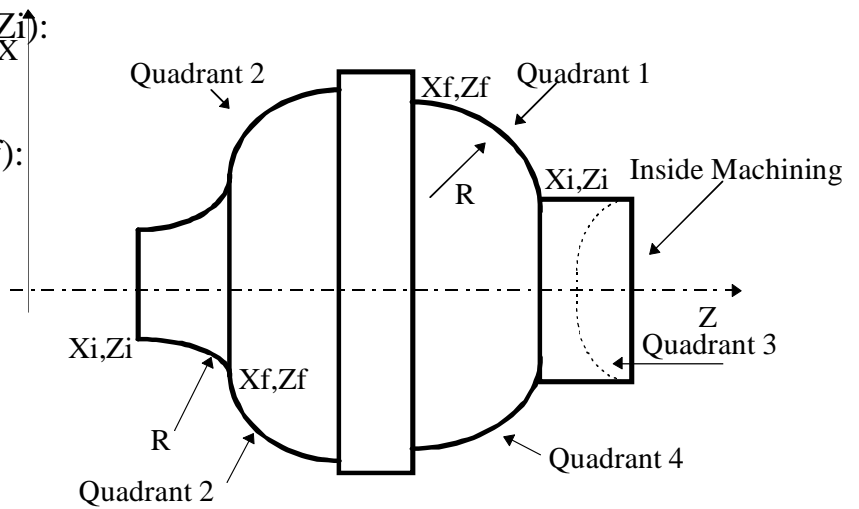
- Select the quadrant with

- Select facing or turning with  and  or

- Press  to end this operation.

**Notes:** To go from one step to the next, use either  or .

to go back to the previous step, press .



### 4.3 EXECUTION

To access the program execution mode, press  and the LCD display will show:

```

EXECUTION
<PROGRAM> CYCLE
    
```

#### 4.3.1 PROGRAM EXECUTION










This option is selected using the   keys and pressing



- In incremental mode, the currently shown reading is the distance to the target point with the opposite sign. Therefore, the axes must be moved until their displays read 0.000.
- In absolute mode, the DRO shows the difference between the programmed coordinate and the current one with the opposite sign (distance to go).

### Notes:

- If a tool has been programmed to carry out the cycle and when executing it, it does not match the current one, the LCD screen will show a message requesting a tool change.
- If a scaling format has been programmed, it will only be applied during the execution of the program and not in the regular dro mode. To do that it has to be set by installation parameter PAR05 (see chapter 3.1)

## 4.3.2 CYCLE EXECUTION

Once the tool to be used in the cycle has been selected by the keystroke sequence:  [tool number]  or keying     and the option for <cycle> execution has been selected by pressing   , any type of cycle may be executed directly. To do that, enter the data requested by the LCD display and go directly into execution. The DRO will automatically calculate the value and the sign of the compensation to be applied on each move.

Notes: To go to the next block in the cycle, press  or .

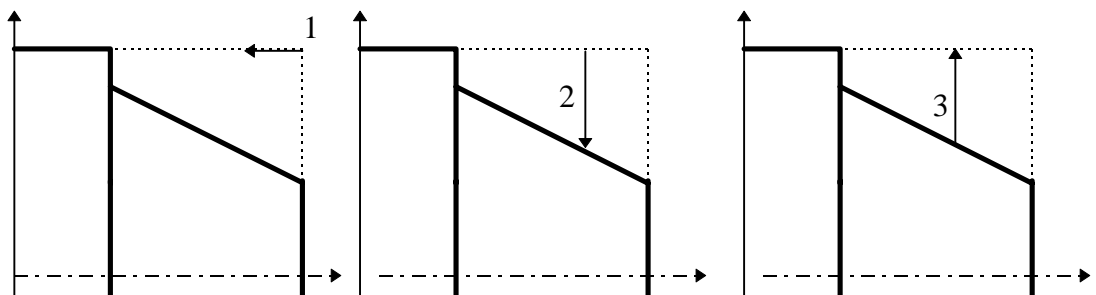
To go back to the previous step, press .

After this cycle is executed, the entered data is lost.

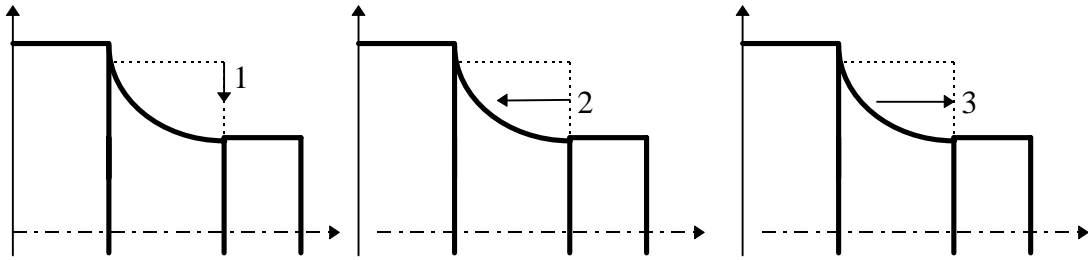
The machining operation is divided into several steps. These steps are further divided into three sub-steps.

- 1.-Increment the position in the stepping axis.
- 2.-Machine up to the calculated position.
- 3.-Withdraw up to the starting point.

Facing example.



Turning example:



These illustrations show a full step. The machining will consist of consecutive steps until finishing the operation. The LCD screen shows the step and substep numbers of the machining process (000.0)

When executing a block, the LCD display shows the distance to move. When the "Zero" position is reached on each axis, when pressing  or  the substep being executed is considered to be completed.

Use the  key to go back one full step.

Example: Execution of program number 00 that corresponds to a "taper 1" machining cycle.

The machining is at step 3 and substep 2.

N00	- Taper 1
003.2	Move to zero

### 4.3.3 EXECUTION ERRORS

When executing a block or program, the following error messages may come up:

**Error in axes:** A wrong axis has been programmed (it does not exist).

**Error empty block:** An attempt has been made to execute an empty block.

**Error in data:** Some necessary data for block execution is missing or...

In rounding: - The total angle of the arc is greater than 90°.










In Jump: - A jump to an empty block has been programmed.

## 5. OPERATION WITH THE RS-232-C SERIAL LINE

### 5.1. SAVING AND RESTORING DATA

With this DRO, it is possible to save data into a PC or peripheral device and later restore it by using the RS-232-C serial communications line.

To access this mode:

- Press 
- Select the "Comm" option (communications) of the LCD display by means of the   keys until that word appears between < > and press .
- Select: <Send> and press  to send the data out to a PC or peripheral device or select <Receive> and press  to receive data from a PC or peripheral device.
- Select the type of data to transmit **Parameters**, **Program** or **Tool** table by means of the   keys and press .

### 5.2 PARAMETER TRANSMITTING FORMAT

The format of the transmitted parameters are:

For value parameters:           **P00 123.123**  
For binary parameters:           **P00 10101010**  
For option parameters:           **P00 0**  
For axis parameters:           **P?? X 123.123 Z' 123.123 Z''123.123**

The number of decimals depends on the selected resolution.

### 5.3 TOOL TABLE TRANSMITTING FORMAT

The format is:

**In mm:    T?? X 1234.1234   Z 1234.1234**  
**In inches: T?? X 123.12345   Z 123.12345**

## 5.4 PROGRAMS TRANSMISSION FORMAT

The format is "Nxx Gxx X Z" where Nxx indicates the block number and Gxx the type of programmed cycle followed by its parameters.

The values sent out by block may be one or several of the following:

<u>Cycle</u>	<u>Code</u>	<u>Parameters</u>
<b>Go to a position</b>		X__ Z__ T__
<b>Jump to a subroutine</b>	G25	N begin.end.repetitions
<b>Scaling Factor</b>	G72	X__Z__
<b>Turning Facing</b>	G81 G82	X__ Z__ M__ C__ D X Z = Initial coordinate M = Final Z coordinate C = Increment (pass) D = Final diameter
<b>Turning. Taper 1 Facing. Taper 1</b>	G83 G84	X__ Z__ L__ M__ C__ I__ X Z = Initial coordinate L M = Final coordinate C = Increment (pass) I = Inside machining (blank) = Outside machining
<b>Turning. Taper 2 Facing. Taper 2</b>	G85 G86	X__ Z__ C__ D__ A__ X Z = Initial coordinate C = Increment (pass) D = Final diameter A = Taper angle
<b>Rounding while turning Rounding while facing</b>	G87 G88	X__ Z__ L__ M__ C__ R__ K__ X Z = Initial coordinate L M = Final coordinate C = Increment (pass) R = Radius (negative = inside machining) K = quadrant

**Note:** If the memory is locked, no program can be read.

## 5.5. OPERATION WITH THE INPUTS AND OUTPUTS

With this DRO up to 4 digital inputs (E1 to E4) and 6 outputs (S1 to S6).

Inputs E1 and E2 are used to zero the reading of the X, Y, and Z axis respectively. E4 may be used as an Emergency input.

Outputs S1 to S6 (PAR30 ... PAR 35) are activated when the reading of the selected axis reaches, in the negative direction, the coordinate set either by parameter (PAR40 for S1 ... PAR45 for S6) or ...


by pressing **C** **F4** **0** [coordinate for S1] **ENTER** and so on up to **C** **F4** **5**  
[coordinate for S6] **ENTER**

# APPENDIX

## *ERROR CODES*


Message	Description
<b>FAGOR dro</b>	Power outage or turned off by main switch after saving the data.
<b>Error 02</b>	Power outage or turned off by main switch without having saved the data. The unit has been turned off without previously pushing the [ON/OFF] key. It will only lose the position count (will be reset to zero) and the status of the operating modes (inch, abs, etc.).
<b>Error 04</b>	Wrong parameter values
<b>Error 05</b>	Wrong internal configuration
<b>Error 06</b>	Errors in data backup memory (Service Dept.)
<b>Error 07</b>	Emergency input active. Press [C] or cancel emergency signal.
<b>Error 08</b>	Wrong software memory or the software has been changed
<b>Error 09</b>	Errors in work memory (Service Dept.)
<b>Error 12</b>	Error while searching a coded marker pulse (Io)
<b>Error 31</b>	Internal malfunction (Service Dept.)
<b>Error 32</b>	Internal malfunction (Service Dept.)
<b>Error 99</b>	Internal malfunction (Service Dept.)
.....	Feedback alarm supplied by the feedback device (scale, encoder, etc).
<b>1.4.3.6.5.7.2.5</b>	Feedback speed too high.
<b>EEEEEEEE</b>	Maximum position reading or speed exceeded when searching Home

If any message other than the first two from the table were to come up, the equipment should be switched off and on again until one of the first two are seen.

After pressing  to access the counting mode, check the parameters.

If any of the errors shown as (Service Department) are often repeated, ask Fagor Automation's Customer Services Department about this.

The feedback alarm error will appear if the bit of the corresponding alarm activating parameter for the axis has been set to "1". **PAR08(1) = 1**.

In either case, to clear the display, press .

If the axis value is flashing, this means that one of the travel limits established by machine parameter has been exceeded. This error will be displayed if the alarm activation parameter for the axis **PAR08(2) = 1**

If the DRO does not come on or goes out while running, check that the voltage and ground outlets are as they should be. If an axis does not count, disconnect the feedback connectors one by one. If the DRO comes on, it indicates a fault in the feedback device. If the fault persists get in touch with Fagor Automation's Customer Services Department about it.



## ***MAINTENANCE***

### **Cleaning:**

An accumulation of dirt in the equipment can act as a screen preventing proper dissipation of the heat generated by the internal electronic circuits with the consequent danger of overheating and DRO fault.

Accumulated dirt can also, in some cases, provide a conductive path for electricity which could give rise to faults in the internal circuits of the equipment, especially in high humidity conditions.

To clean the equipment nonabrasive dish-washing detergents are recommended (in liquid, never powder form) or 75% isotropic alcohol with a clean cloth. **DO NOT USE** aggressive solvents, (benzol, acetones, etc.) which could damage the materials the equipment is made with.

Do not use high pressure compressed air to clean the item as this could give rise to an accumulation of charges which in turn lead to electrostatic discharges.

The plastics used in the front panel of the DRO stand up to:

1. Grease and mineral oils.
2. Alkalis and bleaches.
3. Dissolved Detergents.
4. Alcohol

Avoid the effect of solvents such as Chlorohydrocarbons, Benzol, Esters and Ethers because these could damage the plastics with which the front of the equipment is made.

### **Preventive Inspection**

If the DRO does not come on press the rear switch for starting, make sure it is properly connected and being supplied with the proper mains voltage.