

FAGOR DRO NVP-M

INSTALLATION MANUAL

Man: 9910 Soft: 1.xx



This feature is only available for software version 2.0 and newer.

Installation parameter **PAR 08** has been completed to better handle feedback alarms.

PAR08 Indicates whether the alarms for feedrate, travel limits and feedback will be activated or not.

Digit

- 8, 7, 6 Not being used at this time. Must be set to "0".
- 5 Detect feedback signal weakness on NVPxx1M models (1 Vpp)
- 4 Value for the feedback alarm contact (0=low, 1=high)
- 3 Detect feedback alarm provided by the scale.
- 2 Detect travel limits (PAR12 and PAR13).
- 1 Detect feedback speed alarm when the feedrate exceeds 200 Khz (60m/min with 1 µm resolution..
- Possible values: 0 (alarms off) and "1" (alarms on).
- Factory values: 0
- The feedback (.) and travel limit overrun alarms (axis display blinking) will be displayed if the corresponding bit of PAR08 = "1".

The blinking axis error is cleared by returning the axis within its limits

The speed alarm is cleared by pressing [C] .

This feature is only available for software version 2.1 and newer.

PAR64 (bit 2). Type of message display.

If = 0 → LCD type message display

If = 1 → VFD (bright blue characters).

Features available for software version 2.4 and newer.

- **The 4th axis can now be rotary.**
- **The probe signal can now send the 4th axis data via RS232C**
- **It is now possible to clear the axes and preset a coordinate when the axes are rotated.**
- **New feature for bolt-hole drilling.**

Arc center

Set the XY coordinates of the arc going through the holes. This data is not required. When not used, the dro will assume the current machine position (when executing this cycle) as the arc center.

It is even possible to indicate only one coordinate X or Y. This way, one of the coordinates of the arc will be the axis coordinate set for the cycle and the other one will be the current coordinate of the axis when executing the cycle.

PAR 16 To compensate for leadscrew backlash. It indicates the value in millimeters or inches, according to PAR00(5), to compensate for in each reversal of movement.

Notes: This parameter makes no sense when using linear feedback devices (scales).

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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-200M / NVP-300M / NVP-400M
NVP-201M / NVP-301M / NVP-401M**

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
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-etherane foam on all sides.
- 5.- Seal the cardboard box with packing tape or industrial staples.

User notes

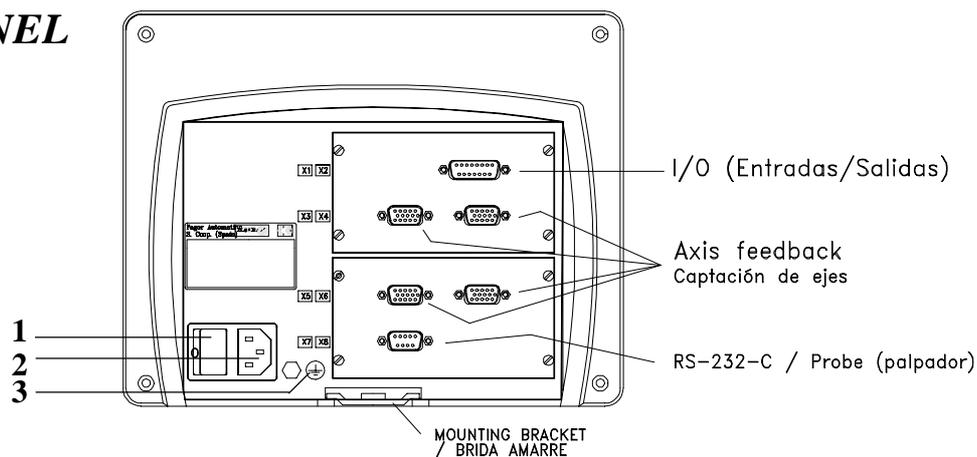
1. UNIT DESCRIPTION

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

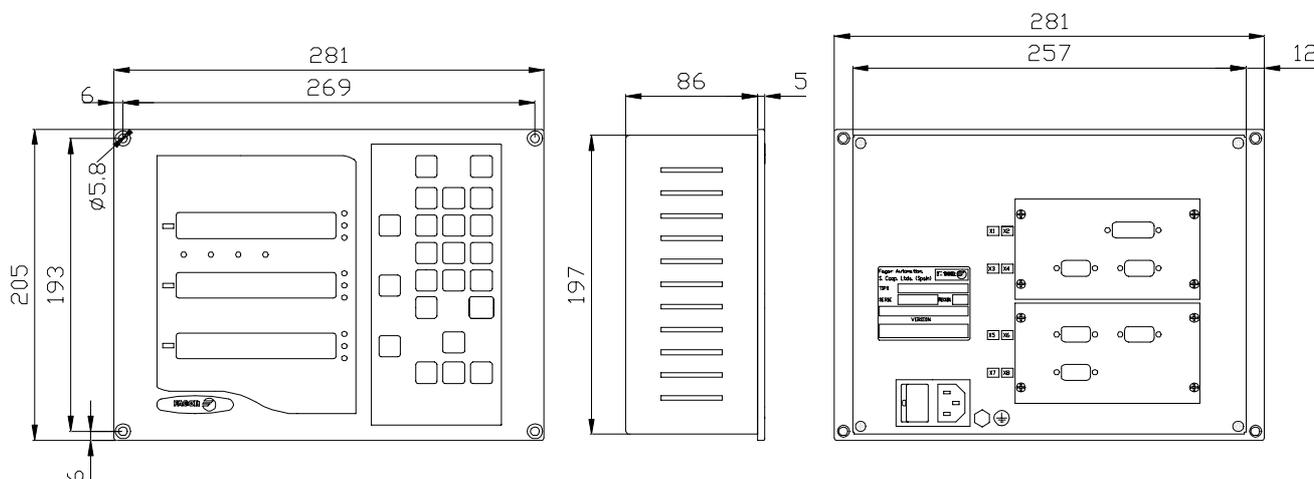
It can display the position of two, three or four axes of the machine and repetitive parts can be programmed

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.

X6.- SUB-D HD type 15 pin female connector for the 4th 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 between 45 Hz and 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: IP4X (DIN40050) except for built-in models in which case is: IP20.

2. CONNECTIONS

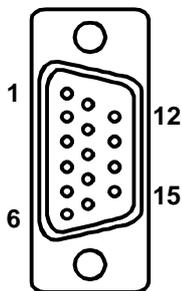
The connection for the RS-232 serial line (optional X1 connector) is not described in this manual; but in a supplement for it.

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 (NVP-X01M model)
- 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-201, NVP-301, NVP-401 models

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 Y axis and E3 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.

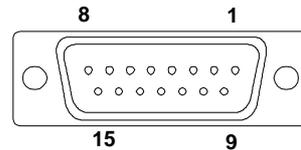
Characteristics of the signals at connector "X2":

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 :

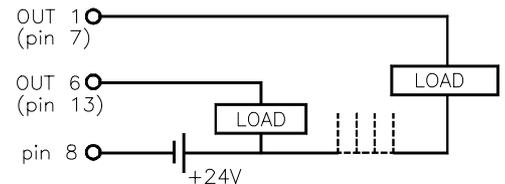
- Maximum load current: 100mA
- Minimum DC voltage: 3.75V
- Maximum DC voltage: 6.25V

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

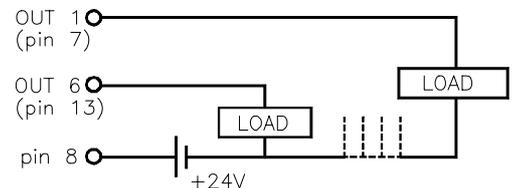
The main characteristics are:

- | | |
|--------------------------------|------------------------|
| - Maximum AC or DC voltage: | 40V |
| - Maximum load current: | 225mA |
| - Maximum internal resistance: | 24 Ohm |
| - 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:

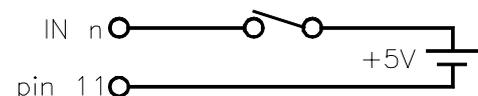


Open emitter output connection:

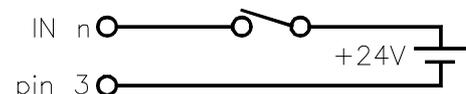


Note .- If any of the outputs is going to be connected to an inductive device, a 1N4000 type diode must be placed in anti-parallel.

Input connection at 5 Volts :



Input connection at 24 Volts :

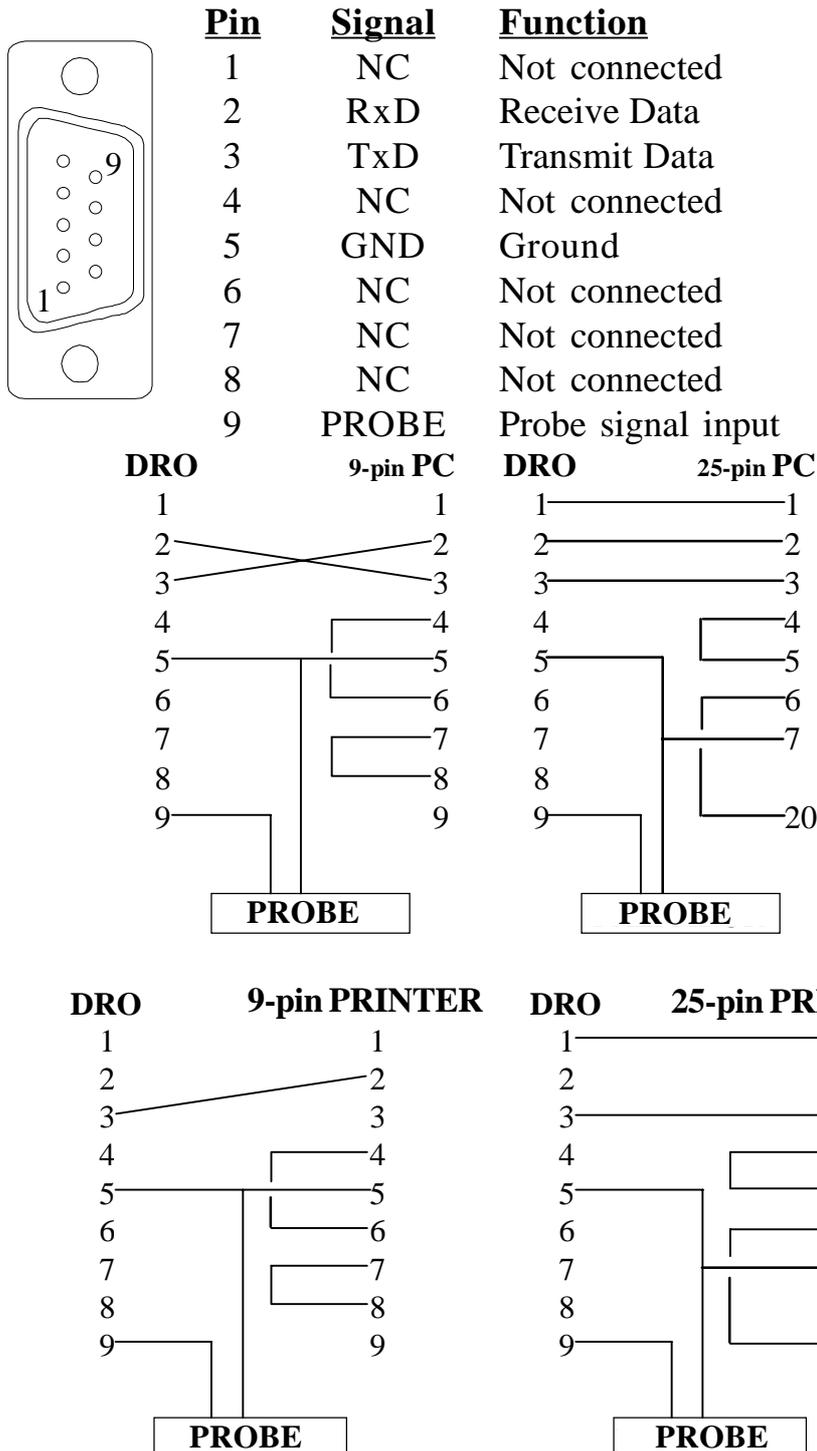


2.3 RS-232-C CONNECTION (CONNECTOR X7)

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.

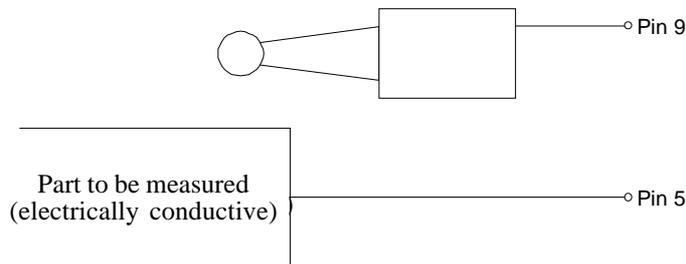
The operating mode for this feature is described in chapter 5 of the Operating Manual.



2.4 PROBE CONNECTION

Touch probe connection:

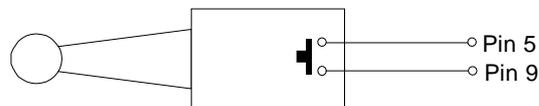
Simple connection. "PAM-10" type probe from Renishaw :



This type of connection uses the active-low level (< 0.8 Vdc).

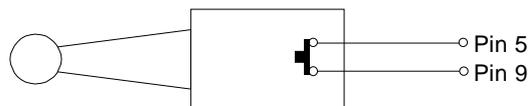
Connection of a probe with an internal contact:

Probe with a normally-open contact:



This type of connection uses the active-low level (< 0.8 Vdc).

Probe with a normally-closed contact:



This type of connection uses the active-high level (> 2.4 Vdc).

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

2.5 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 mm²).

2.6 **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 M, Press  " (where xxx indicates the model) and the X and Y 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.

Note: On "NVP400M" and "NVP401M" models, parameters 00, 01, 02, 03, 04 and 14 of the 4th axis may be edited by pressing while editing the corresponding PAR??.

Its value will appear at the X axis display. These values are ignored if the axis is coupled with another one since those of the main axis will be taken.

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**, **Y** 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**, **Y** 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 through PAR93 (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

PARA-METER	FUNCTION
PAR00	Feedback configuration, different for each axis. Binary type.
Digit	
8	Direction of the coded Io (0 = Increasing , 1 = Decreasing)
7	Pitch of the coded Io (0 = 20 mm , 1 = 100mm)
6	Type of linear scale's Io (0 = Fix , 1 = Coded)
5	Axis units: If linear: 0 = mm , 1 = inches If rotary: 0 = 0.0001°, 1= seconds
4	Type of axis (0 = Linear , 1 = Rotary)
3	Differential feedback signals (0 = No , 1 = Yes)
2	Type of feedback signals (0 = TTL , 1 = 1 Vpp)
1	Counting direction (0 = normal , 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,
If linear axis. Possible values: from 0.0001mm to 1 mm.
from 0.000001 to 0.03937 inch
These values are set as any other number depending on the setting
of PAR00 (units).

If rotary axis:

In ten-thousandth of a degree (0.0001°): 1, 2, 5, 10, 20, 25, 50, 100,
180, 200, 250 and 300.

In seconds 1, 2, 3, 5, 9, 10, 15, 18, 20, 25, 30 and 36.

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.

PAR04 Radius or Diameter. Independent for each axis. Possible values: 0
(**Gamma**Radius), 1 (**dIAmeter**) and 2 (**COPI**mutated). The first case is
regular count, the second one is double count and the third one is
toggle between radius and diameter by pressing .

The selection of these values rotates by pressing 

Note: When a rotary axis, the setting of this parameter will be
ignored.

PAR05 Scaling or shrink factor. Independent for each axis, numeric value within $\pm 9,999$.

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) or onto the tool when applying tool compensation (**TOOL** led on).

The factory setting is: "0".

Note: When a rotary axis, the setting of this parameter will be ignored.

PAR06 Display the axis or not.. Independent for each axis:
Possible values: "0 = Yes" and "1=No".

It is possible to "turn off" the display of an axis which is not being used.

The selection of these values rotates by pressing 

The factory setting is: "0".

PAR07 Combine the reading of an axis. Independent for each axis.
Possible values: -4 a 4. Factory setting: "0".

Indicates the number of the axis to be combined; **0** means not to combine any other axis, 1 = X axis, 2 = Y, 3 = Z, 4 = W. With the negative sign, the other axis' count will be subtracted. **Factory setting = 0.**

The selection of these values rotate by pressing 

With this model, the **X** axis display may combine the reading of another axis. In that case the other axis display may be turned off by setting installation parameter **PAR06 = "0"**. When not turned off, the **Y** axis display will show the actual position of that axis (not combined).

The parameters of the axis to be combined will be considered the same as those of the combination of the axes.

Note: When a rotary axis, the setting of this parameter will be ignored.

PAR08 Indicates whether the alarms for feedrate, travel limits will be activated or not.

Possible values: "0" (alarms off) and "1" (alarms on).

The selection of these values rotates by pressing 

Factory setting: **0**

PAR09 Table sag compensation, per linear axis.
Numeric value within ± 99.999 millimeters per meter.
Factory setting: **0**.

Notes: Even when selecting the display in inches, this value **MUST ALWAYS BE IN MILLIMETERS.**

When a rotary axis, the setting of this parameter will be ignored.

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.

Note: When a rotary axis, the setting of this parameter will be ignored.

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

Note: When a rotary axis, the setting of this parameter will be ignored.

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

Note: When a rotary axis, the setting of this parameter will be ignored.

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 Y 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, E2 and E3 are used to zero the reading of the X, Y 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.

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

PAR35 It admits values from "0" to "3" where "0" means that the signal is not being used, 1 = X, 2 = Y, 3 = Z.

PAR40 They set the signal activating positions (levels) of the axes indicated 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.

3.4 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

(8 to 2) Not being used at this time. They all must be set to "0".

(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.

PAR91 Indicates the existence and active level of the probe.

Options: 0 = There is no probe.

1 = There is a probe and it is active high (> 2.4Vdc).

2 = There is a probe and it is active low (< 0.8Vdc).

The probe signals must be within ± 24 Vdc.

PAR93 Position display mode when activating the probe:

Options: 0 = It keeps displaying the axis position.

1 = It freezes the display until it quits touching.

2 = It freezes the display until it touches again.

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 Y 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
Y00
Z03
  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? D 1234.1234 L 1234.1234
In inches: T? D 123.12345 L 123.12345

APPENDIX

ERROR CODES

Message	Description
FAGOR dro	Power outage or turned off by main switch after saving the data.
Error 02	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.).
Error 04	Wrong parameter values
Error 05	Wrong internal configuration
Error 06	Errors in data backup memory (Service Dept.)
Error 07	Emergency input active. Press [C] or cancel emergency signal.
Error 08	Wrong software memory or the software has been changed
Error 09	Errors in work memory (Service Dept.)
Error 12	Error while searching a coded marker pulse (Io)
Error 31	Internal malfunction (Service Dept.)
Error 32	Internal malfunction (Service Dept.)
Error 99	Internal malfunction (Service Dept.)
.....	Feedback alarm from the feedback device (scale, encoder, etc) or weak signal.
1.4.3.6.5.7.2.5	Feedback speed too high.
EEEEEEEE	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.

If the display of some axis shows all its decimal points; for example: **1.4.3.6.5.7.2.5**. this means that the axis has moved at a greater speed than what is required for its reading (>200 KHz or 60 m/min. with 1µm resolution). This error is displayed if the alarm activation parameter for the axis **PAR08 = 1**. 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 = 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 no anomalies are found in them, disconnect the feedback connectors one by one. If the DRO comes on this indicates a fault in the feedback device. If the fault persists get in touch with Fagor Automation's Customer Services Department about this.

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.

FAGOR DRO NVP-M

OPERATION MANUAL

Man: 9910 Soft: 1.xx



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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.

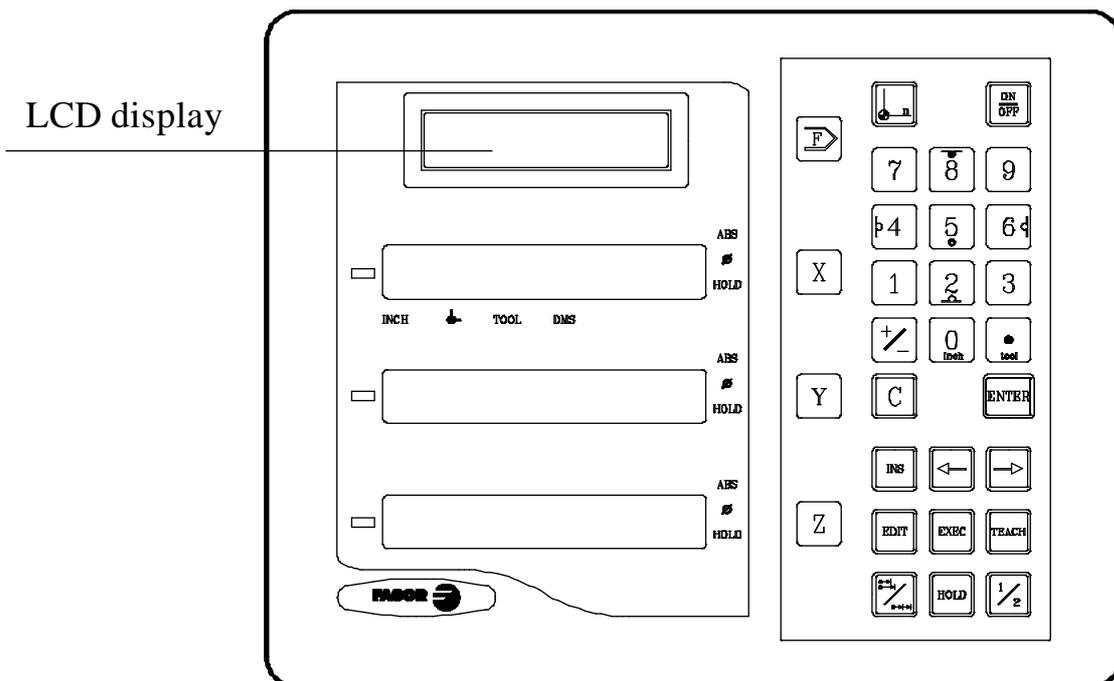
These parameters are described in the installation manual supplied with this unit.

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.

TOOL- This lamp stays on when working with tool compensation.

"PROBE" This lamp goes on when selecting the "probe" mode.



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 cancel or abort an operation already initiated.

 Is used to display half the actual axis movement.

      These are dual purpose keys and are used for entering values and applying tool compensation

 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.

 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 editing mode for the tool table or program blocks.

 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 NVPxxx M, Press ". Where xxx indicates the model and the X and Y 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 Φ will go on or off to indicate the double or real counting mode respectively.

Notes:

- This key works in this way if the installation parameter **PAR04** of the axis has been preset as “**2**” (**commutated**).
- If this parameter is preset as “**0**” (**radius**), this key will not affect the DRO reading and will always show the real displacement of the axis.
- If this parameter is preset as “**1**” (**diameter**), this key will not affect the DRO reading and **twice** the real displacement of the axis will always be shown.

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 on the next page 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.

This DRO offers up to 9 reference points (from 1 to 9 part zeros) which can be preset with different absolute values ("ABS" LED ON) and an incremental value ("ABS" LED OFF) common to all of them.

Plus, reference "0" which is the home reference. In this mode ( on) the DRO shows the current position of the axis with respect to home (reference mark of the feedback device).

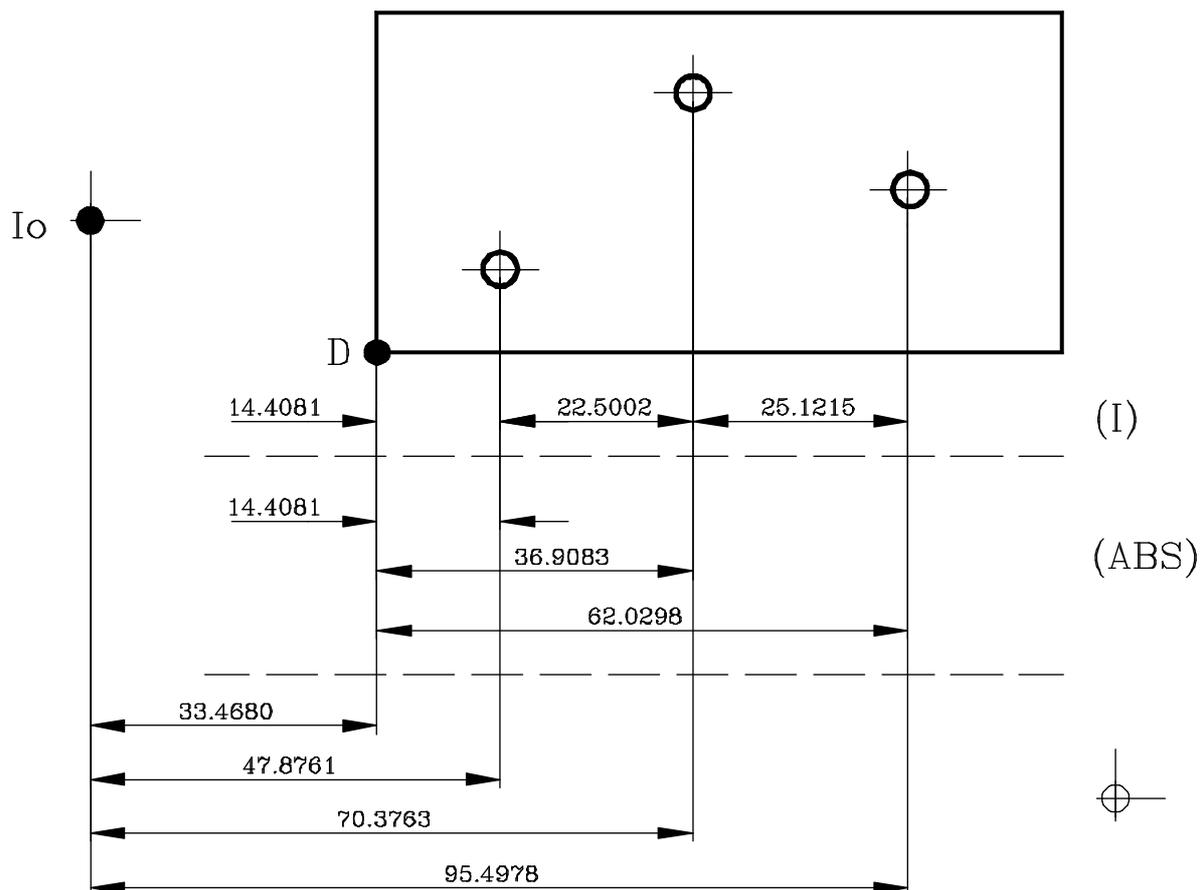
- To get into this mode, press  and the LCD shows "Reference Number: 1" or part zero from 1 to 9) indicating that the position of the axes are referred to that reference point or part zero.-

- 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:  X for "X",  Y for "Y" and  Z 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.

The home search sequence is as follows:

- Move the axis to the approximate reference zone (roughly).
This step is only for fixed I_o 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.
- Press the axis of the axis to be homed: , ,  (or  if the 4th axis is displayed)
- 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.

- 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 -I₀-), The home position may be preset in "Ref 0" mode. See the next section for coordinate preset.

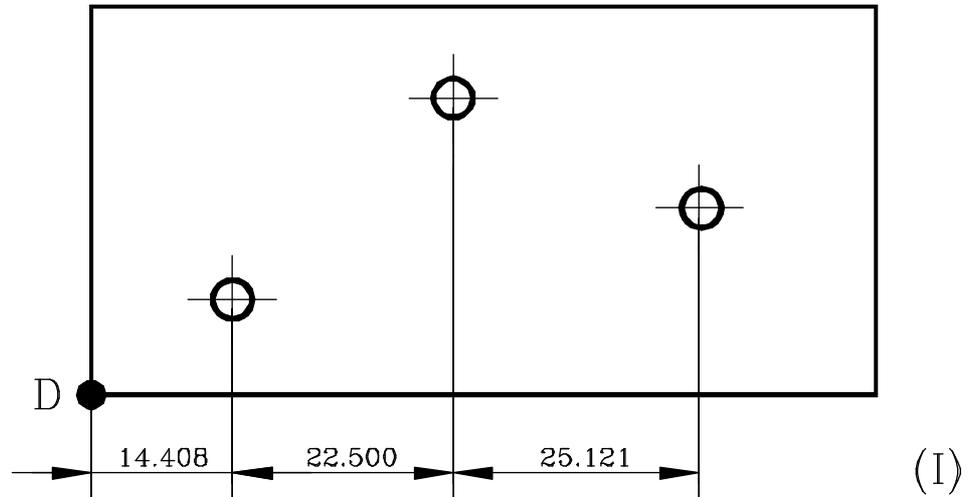
2.4 AXIS COORDINATE PRESET

To reset the axis display, just press: sequence:   for "X",   for "Y" and   for "Z" (  If the 4th axis is displayed).

Using the next figure, let us imagine we wish to make a part in which three holes have to be made 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 D in the figure) although the DRO also shows them with respect to home (I₀).

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:



It must be borne in mind that the preset value preset in this mode is the same for all part zeros (from 1 to 9).

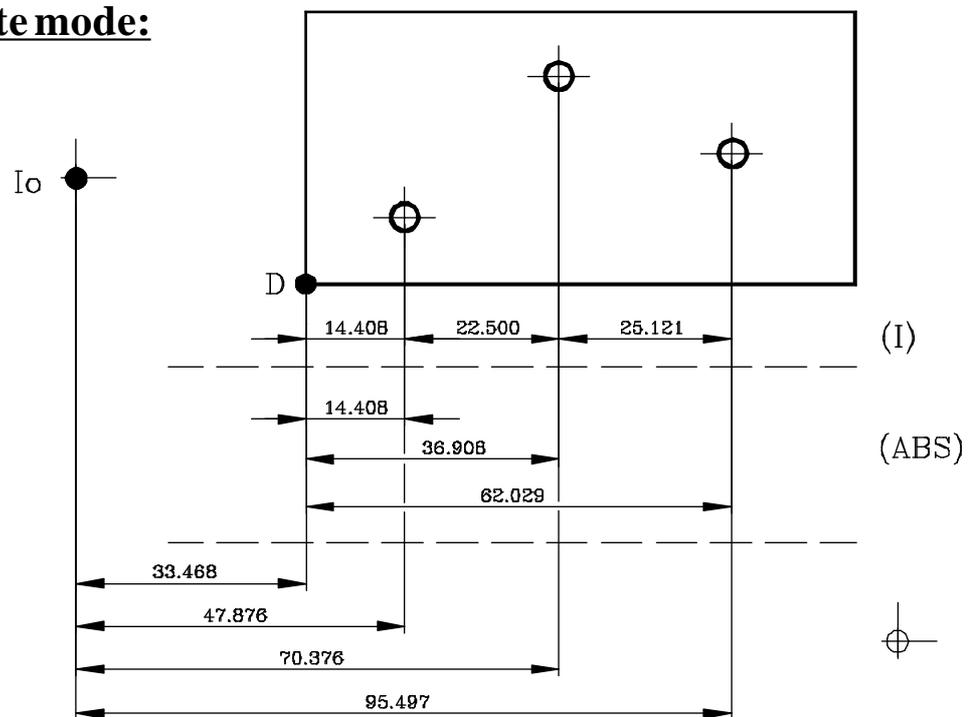
- Press   (for X, for example) to turn on the ABS led if this function is independent for each axis. If this function affects all the axes at the same time, just press 
- Move the axis up to corner "D" to set this as part zero.
- **At this point, one can proceed in two ways.**
 - Preset the axis with zero value by pressing  
 - Move the axis towards the first hole until the DRO reads: **14.408**.
 - Move the axis towards the second hole until the DRO reads: **22.500**
 - And so on up to the third hole.or...
 - Preset the axis with value **-14.408** by pressing:   **14.408**  to validate it
 - In case of a mistake, press  to cancel this and leave it as it was.
- Move the axis towards the first hole 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.

- After drilling this hole, one can go to the next position, after having preset the next coordinate (-22.500), by moving the axis until the display reads **0.000**.
- And so on successively until all the holes are drilled .

Note: By pressing  until the "ABS" LED lights up, the DRO will show the axis real position with respect to part zero "D". To find the current position with respect to another part zero, select after pressing  by means of its numeric key or using   

In absolute mode:



Once the desired part zero has been selected ("2" for example) by pressing



- Press   (for X, for example) to turn on the ABS led if this function is independent for each axis. If this function affects all the axes at the same time, just press 

- To preset part zero, one of these methods can be used:

- Place the axis (tool center) exactly over “D” and press:  

or

- Touch one of the sides of the part with a tool of known diameter (for example 25.076) and press:   (to enter this with the opposite sign)

25.076 

The DRO will thus indicate that the tool center is: **-12.538** mm from Part zero. By moving the axis until the DRO reads 000.000, the center of the tool will be placed exactly over point “D” or Part zero.

In this mode one can also work from coordinate to zero as in the incremental mode, thus having two parallel incremental counting systems, but this IS NOT RECOMMENDED as it is more practical to use absolute counting with respect to a fixed part zero “D” and another incremental one with respect to a mobile zero (previous position).

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).

3. SPECIAL OPERATIONS

3.1 SCALING FACTOR

With this DRO, it is possible to apply a scaling factor between 0 and 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 inches/min.
- The maximum feedrate reached by the axis until then since the this mode was activated: Fm000000 in mm/min. or inches/min.

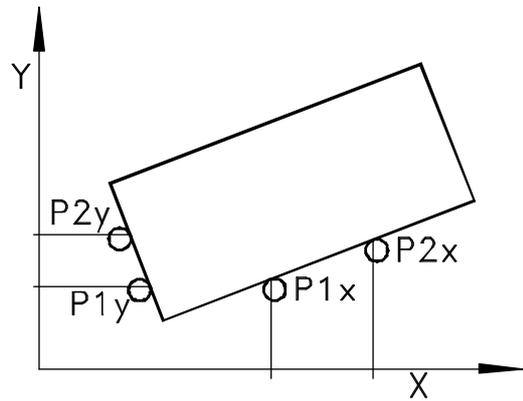
Note: The maximum feedrate (feedback pulse frequency) is 250 KHz.

For example, with a "Fagor MX" type scale with 1µm resolution: 60 m/min.

To select another axis, select <Feed> again, press  and then the key for that axis (, for example). To deselect it, get back into this mode and press the same keystroke sequence used to activate that axis.

3.2.2 PART ALIGNMENT

While drilling, not machining, when the part is not aligned with the X and Y axes, it is possible to compensate automatically for the part's rotation.



To do this, once the part is properly secured, just touch in two points of the same axis.

. Press **[F]**, "UTILIT." and select "ALIGN"

by using the **[←]** **[→]** keys.

The word "<ALIGN>" will appear between < >.

. Press **[ENTER]**

The inclination of the part is defined:

- . By touching on the right-hand side of the part (P1x) and pressing **[X]**
 - . and then touching at another point on the same side (P2x) and pressing **[ENTER]**
- or:
- . By touching on the left-hand side of the part (P1y) and pressing **[X]**
 - . and then touching at another point on the same side (P2y) and pressing **[ENTER]**

3.2.3 FOURTH AXIS

On 4-axis models, the fourth axis can be displayed by selecting the <4th Axis> option on the <Utilit.> menu.

This permits:

- To display its position.
- Zero it (not preset it) in the absolute, incremental and home reference modes (the latter if PAR14=1) by pressing **[C]** **[F]**
- If PAR14=0 (feedback device without reference mark), it is possible to set home by pressing **[F]** while in "REFERENCE 0" mode.

3.3 PART CENTERING

This feature is available when none of the axes have installation parameter PAR04 set to “2” (commutable). This limitation applies only to method 1 described next.

Part centering can be done in two ways:

Method 1:

- Set the DRO in incremental mode by pressing key  until the **ABS** and  LEDs go out.
If this LED does not light up, press key 
- Touch one side of the part with the tool.
- Reset the counting by pressing   for the "X" axis
- Take the tool to the other side of the part and touch this with it.
- Press   for "X" axis (for example) The DRO will display **half** of the distance covered by the tool.

Consequently, as the axes withdraw until the displays read **0.0000**, the tool can be placed exactly at the center of the part.

To cancel this operation after starting, press  or 

Method 2 Coordinate freeze "HOLD"

- Set the DRO in incremental mode by pressing key  until the **ABS** and  LEDs go out.
If this LED does not light up, press key 
- Touch one side of the part with the tool.
- Freeze the counting for the axis by pressing   for the "X" axis.
- Take the tool to the other side of the part and touch this with it.
- Press   for the "X" axis. The DRO will display **half** of the distance covered by the tool.

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. This is possible when "freezing" only one axis.

3.5 OPERATION WITH TOOL COMPENSATION

3.5.1 EDITING THE TOOL TABLE

The tool table can hold up to 10 offsets (from 0 to 9). When offset "0" is used, it is assumed that no compensation is to be applied.

To edit the tool table: Press , the LCD display will show the text:

Tool Edit
Number: 0

For each tool, the "X" axis display shows its diameter and the "Y" its length.

Their diameter and length values may be entered in two ways:

- By keying the data for each tool.
- By calibrating each tool with respect to tool "0".

To get to a particular tool:

Use the   keys or... press [tool digit (0-9)]

To enter tool data

- Press .
- Press  (for diameter) or  (for length) to change the corresponding value.
- Press  to store the change and go to the next tool.

To calibrate the tools with respect to the first one "0":

1. Mount a tool of known dimensions (tool "0").
2. Press  , the LCD shows "Tool Calibration 0".
3. Move until touching the calibration point with that tool.
4. Press . The master tool "0" is now calibrated (to zero, no compensation).
5. Mount another tool to be calibrated (for example "1").
6. Select it with the  key
7. Move it until touching the calibration point with it and press .
8. Repeat steps 5 through 7 for the other tools.
9. Press  twice to exit the tool editing mode.

To delete all the tool offsets: Press the keystroke sequence:    while in tool editing mode. The DRO will display a confirmation message: "Are you sure?: Yes <No>". Select <Yes> and press .

3.5.2 EXAMPLE OF TOOL RADIUS COMPENSATION (REGULAR DRO MODE WITHOUT PROGRAMMING A CYCLE)

The drawing shows a typical application of tool compensation for making an outside pocket. **For making an inside pocket, it is much easier to use the pocket cycle (see section 4.3.2).**

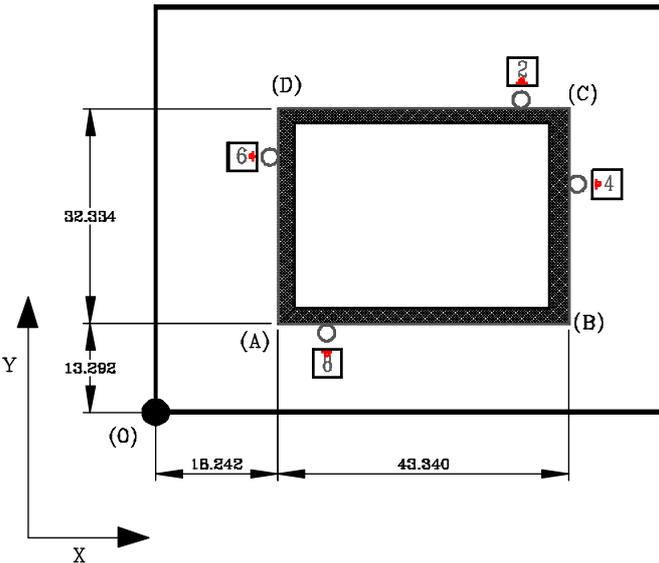
Once the tool has been selected, by keying $\boxed{\bullet}$ [tool number] $\boxed{\text{ENTER}}$ or $\boxed{\bullet}$ $\boxed{\leftarrow}$ $\boxed{\rightarrow}$ $\boxed{\text{ENTER}}$, the operator should know how to apply the compensation before making each move.

Tool compensation is applied when pressing any of these keys:

$\boxed{8}$ $\boxed{4}$ $\boxed{6}$ or $\boxed{2}$ and it is canceled when pressing $\boxed{5}$

After selecting the part zero (0) by keying:

$\boxed{\text{G}} \boxed{0}$ [Reference Number] $\boxed{\text{ENTER}}$ or using $\boxed{\text{G}} \boxed{\leftarrow} \boxed{\rightarrow} \boxed{\text{ENTER}}$ and before making the next movement, there has to be analysis of which side the tool is to “attack” from.



In the figure, let us suppose that there is an 8 mm diameter mill working in incremental mode (**ABS** and $\boxed{\text{G}} \boxed{0}$ leds off).

- With the mill at point (0); to go to point (A):
 preset value $\boxed{X} \boxed{-18.242} \boxed{\text{ENTER}}$ and $\boxed{Y} \boxed{-13.292} \boxed{\text{ENTER}}$
- By pressing $\boxed{6}$ and $\boxed{8}$ the DRO will display value **-14.242** for **X** and **-9.292** for **Y** and due to the compensation of the tool radius. By moving both axes to “**0.000**”, the mill will take position at point “A”.
- After reaching point “A”, to go to point “B” preset the value:
-43.340 for X.
 By pressing $\boxed{4}$ the DRO will display values: **-51.340** for X.
- And so on successively for the remaining points of the figure using the symbolic keys shown on it.

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:

A destination (target) point may be entered for the first axis.

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 tool, 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

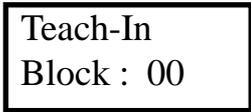
4.2.2. TEACH-IN MODE

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.



Teach-In
Block : 00

- 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 \leftarrow \rightarrow keys and pressing ENTER , 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 \leftarrow \rightarrow keys and pressing ENTER , it is possible to enter a scaling factor different for each axis (except for the 4th axis), thus being possible to generate a mirror image (negative factor). This factor will affect the following blocks and may have a value within ± 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).

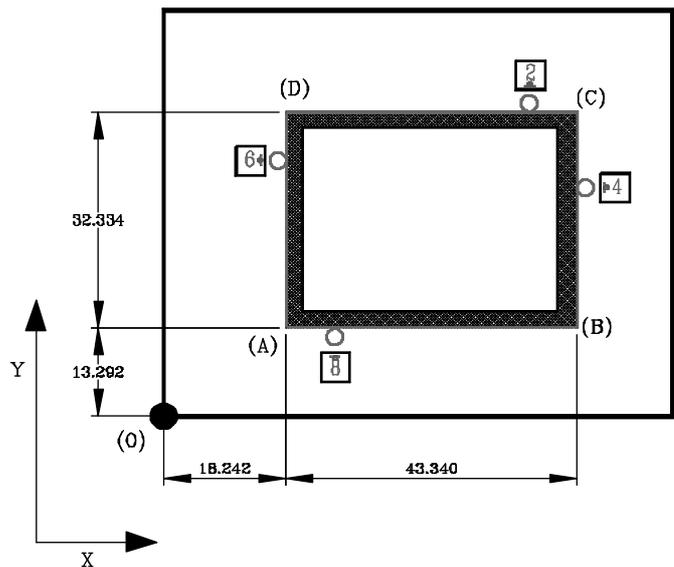
4.2.3.2 TOOL CHANGE

After selecting this option using the \leftarrow \rightarrow keys and pressing ENTER , it is possible to program the tool to be used on the following blocks as well as the type of compensation (radius "X" or length "Y") and how it affects each axis in the next move (sign).

To do this:

- Key in the desired tool number and press ENTER .
- Select the axis affected by the compensation by pressing the corresponding axis key (X for example). The axis display will show the radius of the selected tool.

- Press $\leftarrow 4$ or $\leftarrow 6$ for the "X" axis, $\leftarrow 2$ or $\leftarrow 8$ for the "Y" axis as required to indicate how that tool is going to approach the part (sign of compensation).



Negative compensation can also be indicated by pressing $\leftarrow \frac{+}{-}$ when the actual movement of the tool is greater than the distance on the blueprint (for example to go from the "A" corner to the "B" corner in the drawing).

4.2.3.3 JUMP TO ANOTHER BLOCK

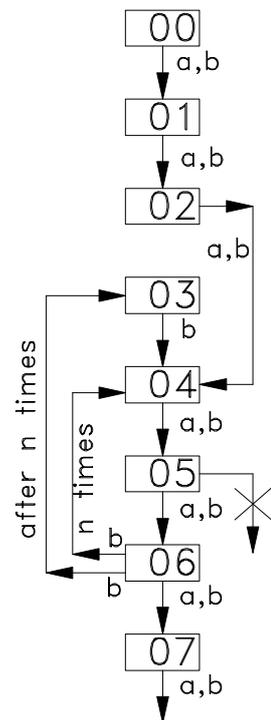
After selecting this option using the   keys and pressing , it is possible to program this function in order to change the order the blocks will be executed in or jump to subroutines from any block of the program.

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.

If while this option is selected and **before pressing**  any digit between "1" and "8" is pressed, the corresponding cycle is directly selected according to the table on the right:

CODE	CYCLE
1	Positioning
2	Bolt-hole drilling
3	Linear drilling
4	Grid drilling
5	Parallelogram drilling
6	Rectangular pocket
7	Rounding
8	Tool change
9	Scaling factor

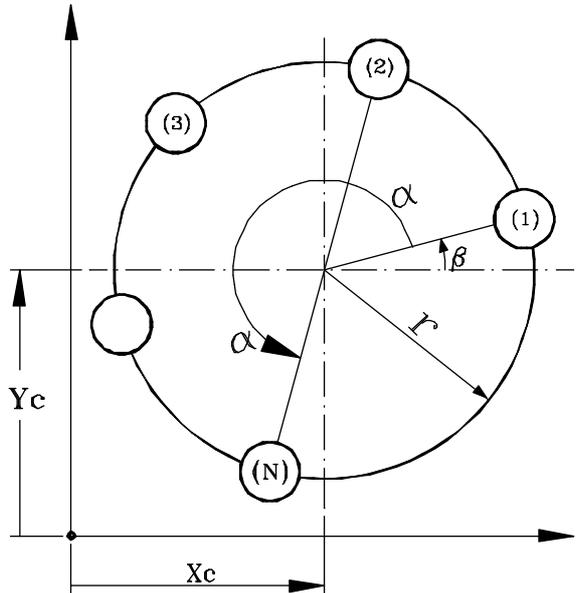
4.2.4.1 POSITIONING (SEE SECTION 4.2.1)

4.2.4.2 BOLT-HOLE DRILLING

It is used to program a series of points in arc. The work plane may be formed by any two linear axes.

After selecting this option using the \leftarrow \rightarrow keys and pressing ENTER , the LCD display requests the necessary data. This data is entered by keying the values and then pressing ENTER . This data is:

- Number of holes. In the figure: $N=5$
Maximum value: 99.
- Radius of the arc. in the figure: r .
- Total angle from the first hole to the last one. In the figure: α .
 $\alpha = 0$ means 360°
- Angle of the 1st hole. In the figure: β



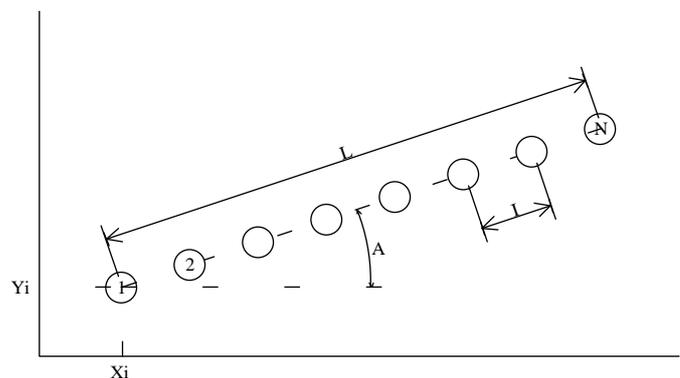
The DRO assumes the current position as the arc center. Therefore, one must program a positioning move to that point in the previous block.

4.2.4.3 LINEAR DRILLING

It is used to program a series of points (N) in line at any angle (A) with respect to the abscissa axis and separated by a fixed distance (I).

After selecting this option using the \leftarrow \rightarrow keys and pressing ENTER , the LCD display requests the necessary data. This data is entered by keying the values and then pressing ENTER . This data is:

- Number of holes (N)*
Maximum value: 99.
 - Angle of the line (A)
 - Step between holes (I)*
 - Length of the line (L)*
- * Only the two values not being zero are taken.



The DRO assumes the current position as the position of the 1st hole (X_i, Y_i). Therefore, one must program a positioning move to that point in the previous block.

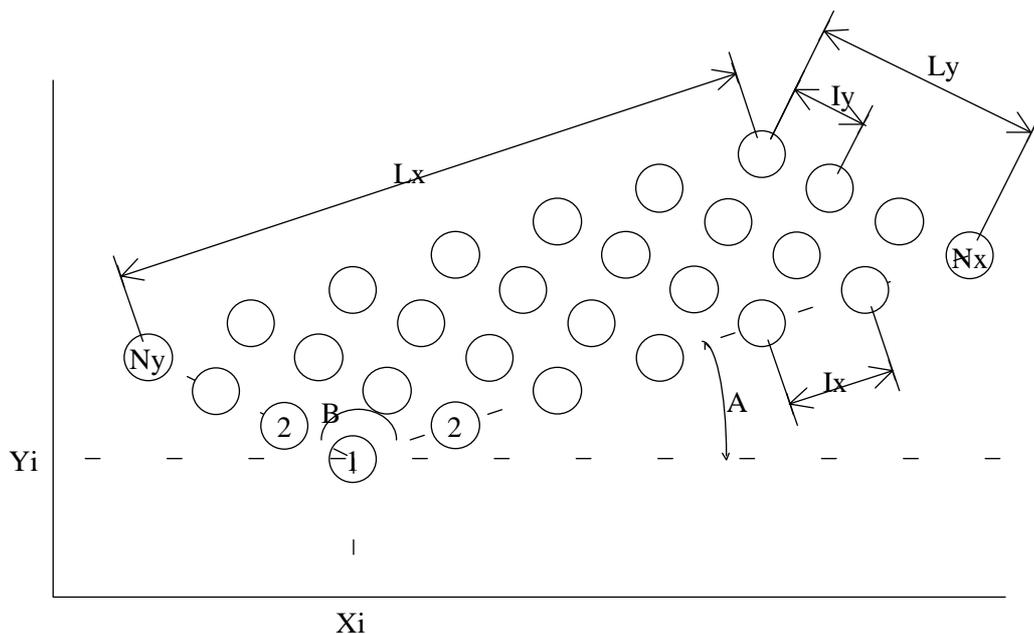
4.2.4.4 GRID PATTERN DRILLING

It is used for programming a number of points (N) in a grid pattern at any angle "A" with respect to the abscissa axis and separated from each other by a set distance (I). In turn, the sides of the grid can form any angle (B) with each other. After selecting this option with the   keys and pressing , the LCD screen requests the necessary data.

The data is entered by keying their values and pressing . They are:

- Angle of the abscissa axis (A).
- Number of holes on the abscissa axis (N_x).
- Gap between holes on the abscissa axis (I_x).
- Distance between the first and last holes along the abscissa axis (L_x).
- Angle between the two sides of the grid (B).
- Number of holes on the ordinate axis (N_y).
- Gap between holes on the ordinate axis (I_y).
- Distance between the first and last holes along the ordinate axis (L_y).

The dro assumes the current position as the coordinate of the first hole (X_i , Y_i). Therefore, one must program a positioning move to that point in the previous block.



4.2.4.5 PARALLELOGRAM PATTERN DRILLING

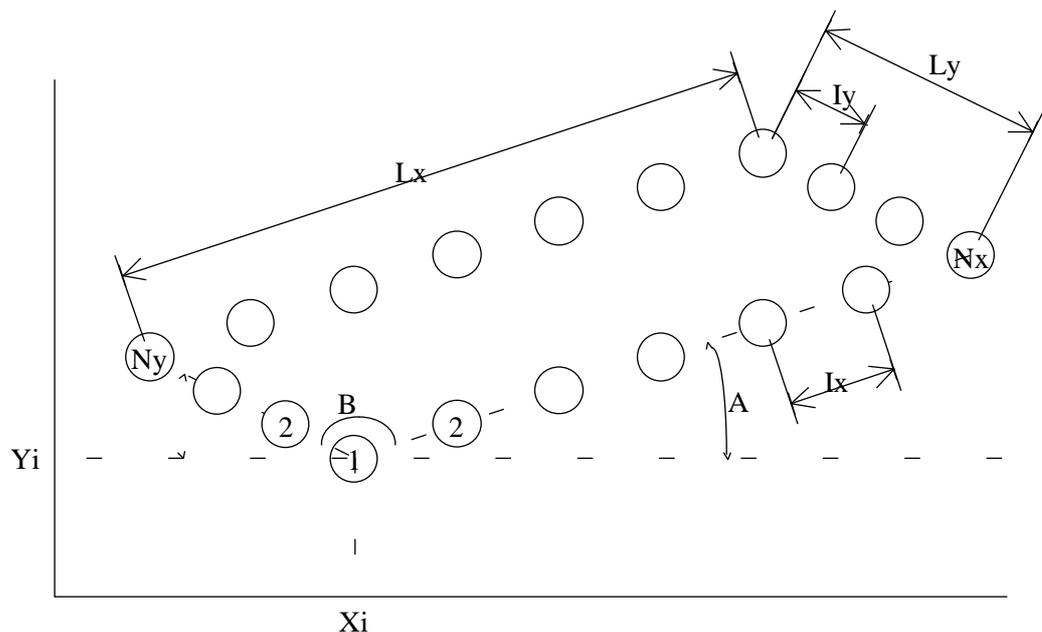
It is used for programming a number of points (N) in a grid pattern at any angle "A" with respect to the abscissa axis and separated from each other by a set distance (I). In turn, the sides of the parallelogram can form any angle (B) with each other.

After selecting this option with the   keys and pressing , the LCD screen requests the necessary data.

The data is entered by keying their values and pressing . They are:

- Angle of the abscissa axis (A).
- Number of holes on the abscissa axis (N_x).
- Gap between holes on the abscissa axis (I_x).
- Distance between the first and last holes along the abscissa axis (L_x).
- Angle between the two sides of the parallelogram (B).
- Number of holes on the ordinate axis (N_y).
- Gap between holes on the ordinate axis (I_y).
- Distance between the first and last holes along the ordinate axis (L_y).

The dro assumes the current position as the coordinate of the first hole (X_i, Y_i). Therefore, one must program a positioning move to that point in the previous block.



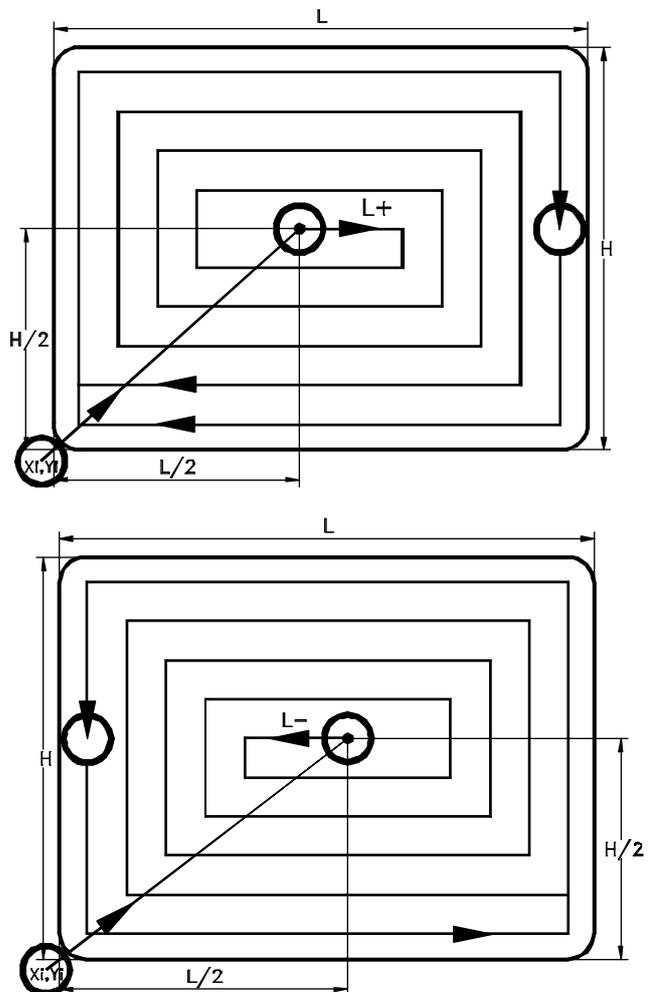
4.2.4.6 MACHINING RECTANGULAR POCKETS

It is used to program the machining of a rectangular pocket in any plane defined by two linear axes. A tool with a diameter other than zero must be active in order for this cycle to be executed.

After selecting this option using the   keys and pressing , the LCD display requests the necessary data. This data is entered by keying the values and then pressing . This data is:

- Pocket width (H)
- Pocket length (L)
With a positive "L" the pocket will be machined clockwise and with negative "L" counter-clockwise.
- Number of passes in "Z".
- Depth of each cut.

The DRO assumes the current position as the position of the lower left-hand corner (X_i, Y_i). Therefore, one must program a positioning move to that point in the previous block. When executing this cycle, the DRO will make you move the axes to the center of the pocket.



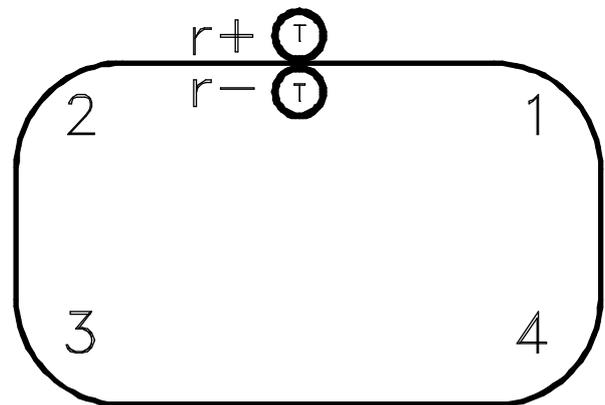
4.2.4.7 CORNER ROUNDING

It is used to program a circular roughing operation in any plane defined by two linear axes. A tool with a diameter other than zero must be active in order for this cycle to be executed.

After selecting this option using the   keys and pressing , the LCD display requests the necessary data. This data is entered by keying the values and then pressing . This data is:

- Preset the target point in X and Y.
- Enter the radius value and its sign depending on the type of rounding to carry out, concave (r-) or convex (r+).

The DRO assumes the current position as the starting point. Therefore, one must program a positioning move to that point in the previous block.



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).

Note: 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.

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

After executing the cycle, all the entered data will be lost.

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 (either it does not exist or it is rotary)

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 pockets:

- No tool has been selected.
- The diameter of the tool is larger than the pocket.

In rounding:

- No tool has been selected.
- The tool is larger than the radius of the block
- A certain end coordinate is the same as the initial one.
- In incremental, end coordinate = 0.
- The initial and end coordinates do not correspond to the quadrant.
- The total angle of the arc is greater than 90°.

In Drilling:

- Less than two holes have been programmed.

In Jump:

- A jump to an empty block has been programmed.
- There is an empty block in the subroutine (repetitive block group).

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: **P00 X 123.123 Y 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: T0 D 1234.1234 L 1234.1234**
- In inches: T0 D 123.12345 L 123.12345**

5.4 PROGRAMS TRANSMISSION FORMAT

The format is "Nxx Gxx X Y 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>
Go to a position		X__ Y__ Z__
Jump to a subroutine Corner rounding	G25 G36	N begin.end.repetitions X End coordinate Y End coordinate R radius K quadrant
Tool compensation:		T__ X+ Y+Z+ X- Y- Z-
Linear drilling:	G60	A Line angle X* Length of the line I* Step between holes K* Number of holes (* XI , KX or KI)
Parallelogram: and Grid pattern: drilling	G61 G62	A angle along X B angle between sides X length along X I gap between holes along X K number of holes along X Y length along Y J gap between holes along Y D number of holes along Y
Bolt-hole drilling:	G64	A Total arc angle B Angle of 1st hole R Arc radius K number of holes
Scaling factor: One or more axes	G72	X ... Z value of the scaling factor
Pocket machining	G87	J Pocket width K Pocket length I Number of passes Z Depth of each pass

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

5.5 OPERATION WITH A PROBE

Once the probe has been installed, follow these steps to measure a part:

1. Mount the probe on the machine and connect it to the DRO and the peripheral both being turned OFF.
2. Turn the DRO and the peripheral receiving the data ON and set the latter in receive mode. Both the DRO and the peripheral must be set to the same transmission values.
3. Press  . The text "**PROBE**" will be display and its corresponding LED will light up. If not, check the probe configuration parameters for the proper setting (PAR91 = 1 or 2).
4. Make the part measurements. If the axes data does not reach the peripheral or it gets strange characters, check the parameter settings on the DRO as well as on the peripheral and check the cable connection.
5. To end the measuring process, press   again. The "**PROBE**" LED will turn OFF.

The data format is:

X = -12345.678 Y = -12345.678 Z = - 12345.678<cr><lf>

Notes : Only the data for the axes being displayed is sent. The leading zeros are eliminated. A blank space is sent in front of positive numbers (no + sign). The decimal point corresponds to each axis resolution, millimeters or inches, fine or coarse resolution. In case of a rotary axis, its position will be sent in its own format (ddd°mm'ss" or ddd.mmmmm).
<cr> means carriage return.
<lf> means line feed.

A home search (Io) cannot be carried out while in this mode. The rest of the operations may be performed.

If while being in this mode, the parameter editing mode is accessed, the probe mode will be canceled.

Fagor Automation supplies the PAM-10 probe with its connection cable for these DROs.

APPENDIX

ERROR CODES

Message	Description
FAGOR dro	Power outage or turned off by main switch after saving the data.
Error 02	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.).
Error 04	Wrong parameter values
Error 05	Wrong internal configuration
Error 06	Errors in data backup memory (Service Dept.)
Error 07	Emergency input active. Cancel emergency signal.
Error 08	Wrong software memory or the software has been changed
Error 09	Errors in work memory (Service Dept.)
Error 12	Error while searching a coded marker pulse (lo)
Error 31	Internal malfunction (Service Dept.)
Error 32	Internal malfunction (Service Dept.)
Error 99	Internal malfunction (Service Dept.)
EEEEEEEE	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 **C** 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.

If the display of some axis shows all its decimal points; for example: **1.4.3.6.5.7.2.5**. this means that the axis has moved at a greater speed than what is required for its reading (>200 KHz or 60 m/min. with 1µm resolution). This error is displayed if the alarm activation parameter for the axis **PAR08 = 1**. To clear the display, press **C**.

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 = 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 no anomalies are found in them, disconnect the feedback connectors one by one. If the DRO comes on this indicates a fault in the feedback device. If the fault persists get in touch with Fagor Automation's Customer Services Department about this.

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.

Display ON/OFF **[ON/OFF]**

Language selection: **[C]** **[5]** **[0]**
 press **[+/-]** repeatedly until language is displayed
[ENTER]

MM/Inches **[0]**
inch

Fine/Coarse resolution **[+/-]**

Radius/Diameter **[1/2]**

Scaling factor (X) **[C]** **[0]** **[5]** **[X]** **[Value]** **[ENTER]**

Incremental/Absolute mode **[+/-]**

Home reference mode **[Home]**

Home search (X) **[X]** move (X) axis

Axis preset (X) **[X]** **[+/-]** **[Value]** **[ENTER]**

1/2 axis preset (X) **[X]** **[+/-]** **[Value]** **[1/2]**

Cancel **[C]**

Zero setting (X) **[C]** **[X]**

Part centering (X) **[1/2]** **[X]**

Coordinate freeze (X) **[HOLD]** **[X]** ... **[HOLD]**

Middle point (X) **[HOLD]** **[X]** ... **[1/2]**

Display (or hide) Speed (X): **[F]** **[←]** **[→]** **<Speed>** **[ENTER]** **[X]**

Display another axis: **<Speed>** **[ENTER]** **[Y]**

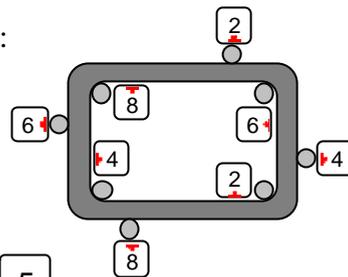
Tool editing: **[Tool]** **[Tool number]** (or **[←]** **[→]**)
[EDIT] **[X]** **[Value]** (or **[Y]** **[Value]**) **[ENTER]**

Tool calibration:

[Tool] **[TEACH]** (select tool with **[→]**) (move axes) **[ENTER]**

Delete ALL tools:
 (Once in **[EDIT]** mode): **[INS]** **[ENTER]** **[INS]**

Tool Radius Compensation:



Cancel Tool Radius comp. **[5]**

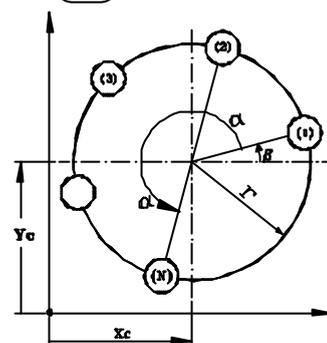
Teach-in **[TEACH]**

- Select block by keying Nr. (or **[←]** **[→]**) **[ENTER]**
- Move axes **[ENTER]**

Cycle and/or program execution: **[EXEC]**

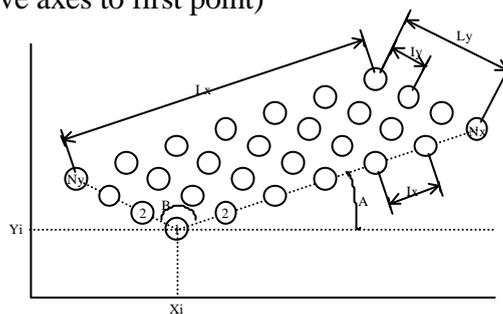
Bolt-hole drilling

(move axes to center)



Grid pattern drilling

(move axes to first point)



Message	Description
FAGOR dro	Power outage or turned off by main switch after saving the data.
Error 02	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.).
Error 04	Wrong parameter values
Error 05	Wrong internal configuration
Error 07	Emergency input active. Press [C] or cancel emergency signal.
Error 08	Wrong software memory or the software has been changed
Error 12	Error while searching a coded marker pulse (Io)
Errors 06, 09, 31, 32, 99	Internal malfunction (Service Dept.)
.....	Feedback alarm from the feedback device (scale, encoder, etc) or weak signal.
1.4.3.6.5.7.2.5	Feedback speed too high.
EEEEEEEE	Maximum position reading or speed exceeded when searching Home