



Fagor Automation S. Coop.

**NV-10/11**  
**NV-20/21**  
**NV-300/301M**

# Operating Manual

Manual code: 14460044

Manual version: 0410

Software version: 3.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 and measuring machines.

It can display the position of one (NV-10 / NV-11), two axes (NV-20 / NV-21) or three axes (NV-300M, NV-301M) of the machine.

### 1.1 Front panel



NV-20/21



NV-300/301M

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

## LED description:

### ABS



It stays on when operating in absolute mode and off when in incremental mode. To access it or quit it, press this key.

### Φ



It 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 this key if allowed by installation parameter PAR04.

### HOLD



It comes on when "freezing" the axis position by pressing this key and the axis key.

### INCH



It stays on when working in inches and off when doing it in millimeters. To access it or quit it, press this key.



It stays on during machine reference search. To access it or quit it, press these keys.

### TOOL

It stays on when operating in tool radius compensation mode. This feature is NOT available on the NV-10 / NV-11 model.



**2nd axis "DISPLAY"** This feature is NOT available in the NV-10 / NV-11 model.



To select the first and second axis respectively.

The [Y/Z] key is only available at the NV-20 / NV-21 model.

The [Z] key is only available at the NV-300M / NV-301M model



To turn the display off while keeping track of the axes position at all times.



To validate an operation.



To cancel or abort an operation already initiated.



Editing the tool diameter



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



(Only at the NV-10) to toggle between the following display modes: Minimum, Maximum, Difference and Normal.

## 1.2 Rear panel (see installation manual)

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## 1.3 Turning the unit on and off

### Turning the unit on

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

The dro runs an autotest and the X axis display shows the text: "FAGOR dro" if everything is OK and the error number if otherwise. See the appendix



. Press this key to access the display mode.

### 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 again, on condition that the DRO is getting voltage (plugged in and with the switch on the rear panel on).

### Precautions



Before powering the DRO down with the switch on the rear panel or disconnecting it from mains, it is a good idea to press this key in order to store the current position of the axes permanently.



If the unit is turned off using the power switch on the back or there is a power outage before having pressed this key, the dro tries to save the current position. If it does not have enough time to save all the data, it will display ERROR 2 when turned back on.

## 1.4 Display modes

### MM / INCH conversion



To display the position of the axes either in millimeters or inches by pressing this key depending on whether the INCH led is off or on respectively.

### Fine / coarse resolution



To turn off the last decimal digit (coarse resolution) for cases in which fine resolution is excessive, simply by pressing this key.

### Number of decimals



This keystroke sequence accesses parameter PAR53. The first digit corresponds to the number of decimals to be displayed in mm and the second digit in inches.

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## Radius / Diameter

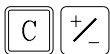


When these models are used for measuring radii or diameters, one can display twice the real displacement of the axis (diameter) by pressing this key. The  $\Phi$ led will turn on or off to indicate the double or actual reading respectively.

- Notes:**
- This works in this way if bit 2 of installation parameter PAR04 (radius/diameter) of the axis has been preset as "1" (commutated).
  - If bit 1 of PAR04 is set to "0" (radius), this key will not affect the dro reading and it will always show the actual axis movement.
  - If bit 1 of PAR04 is set to "1" (diameter), this key will not affect the dro reading and it will always show the actual axis movement.

## Hysteresis or minimum position value

When carrying out certain operations such as drilling hard material, EDM, etc. the position display may fluctuate annoyingly.



In these cases, the operator can eliminate this oscillation by selecting the "hysteresis" mode or the "minimum coordinate" mode just by pressing this keystroke sequence to toggle from one mode to the other.

- Note:** To have this option available, installation parameters PAR20 and PAR25 must be set accordingly.

## Minimum, Maximum, Difference (NV-10 only)



To toggle between the following display modes: **Min, Max, Dif and Normal.**

**Min.** It displays the minimum position reached by the axis.

**Max.** It displays the maximum position reached by the axis.

**Dif.** It displays the difference between the maximum and the minimum position.

**Normal.** It displays the current position of the axis.

## 1.5 Incremental, absolute and with respect to Machine Reference Zero

A dro displays the current position of one (NV-10 / NV-11) or several axes (NV-20 / NV-21).

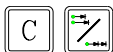
Coordinate means the distance from one point or position with respect with another chosen as reference.

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

The next figure shows the different position display modes:



- In **Home mode**, when this led is on, the distance from the present position of the axis to home chosen in the feedback system (linear or encoder) is displayed.

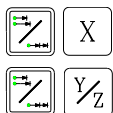


Press this sequence to access the **Home Search** mode.

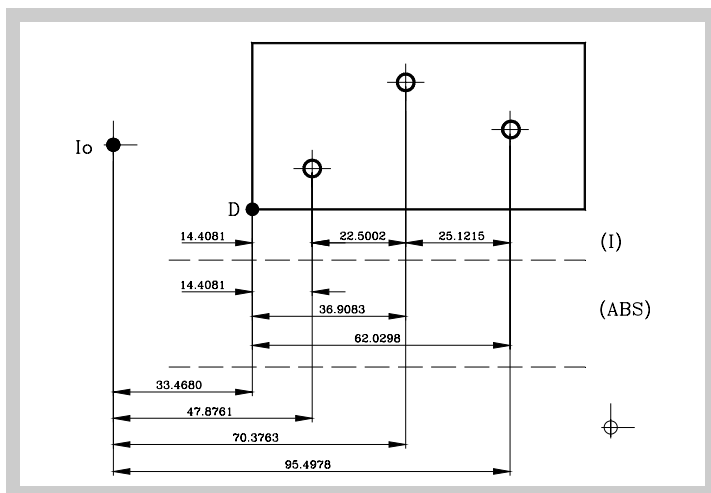
- (ABS) • In **Absolute (ABS)**, when the ABS led is on, it displays the distance from the present position of the axis to part zero (D).
- (I) • In **Incremental**, when the ABS and "home" LEDs are off the distance from the present position of the axis to the previous position is displayed.



Toggles between the ABS and incremental modes.



At the NV20 / NV21 / NV-300M / NV-301M, it could occur that the installation parameter PAR11(1) has been set to "0" for this key to independently affect each axis so that one axis can display its position in incremental mode while the other does it in absolute mode. In this case, to change the display mode for a particular axis, press one of these two sequences.



## 1.6 Machine Reference selection and search

Although it is not absolutely necessary, it is recommended to use the reference marks (lo) of the feedback system in order to set a machine zero point.

This allows the user to reference the machine axes and restore the work coordinates after having turned the dro off, moved the machine while the dro was off, for safety or for any other reason.

Fagor linear encoders have reference marks every 50 mm all along its length.

In order to use these marks properly, choose an area on the axis, for example in the middle of the measuring length or at one end. Approach this area and carry out the home search. Once the reference mark has been found, mark this area with a marker or sticker in order to carry out the home search in the same area in later occasions and make sure that you are using the same machine zero point (home).

Fagor also offers encoders with distance-coded reference marks every 20 or 100 mm. When using these distance-coded reference marks, there is no need to move to the 0 position to find the references, simply move a distance equal to the gap between marks (20 or 100 mm depending on the linear encoder)

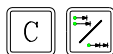
**When using an absolute encoder, there is no need to search for the reference marks (home).**

The dro stores in its internal memory work coordinates such as machine zero, absolute and incremental.

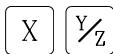
### 1.6.1 Home search sequence:

- Move the axis to the approximate reference zone (roughly).

**Note:** This step is only for linear encoders with fixed lo (not coded) every 50 mm.



- Set the dro in machine zero (home) mode pressing these keys. The **machine-zero-mode** led will turn on.

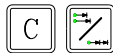


- Select the axis to be homed by pressing its key.

The display starts blinking.

- Move the axis until the reference mark is detected. The display stops blinking.

When receiving the reference pulse, the dro presets that point with the value assigned to installation parameter PAR10 (distance from the zero of the feedback device to machine zero, by default 0 mm).



- Press this keystroke sequence to quit the **Home** mode.

**Note:** Bear in mind that in **reference** mode, no other operation besides home searching and axis position display is possible. The rest of the options are not available.



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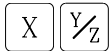
### When the feedback device does not have a reference mark.

When using feedback devices with no reference marks, bit 1 of installation parameter PAR14 for that axis must be set to "1".

To preset a **machine zero** value, proceed as when searching home:



Set the dro in machine zero (home) mode pressing these keys.



Select the axis to be referenced (homed) The display starts blinking.

Move the axis to the desired area.



To preset this point with the value that is blinking on the display (value of parameter PAR10).

## 2 Operation with the dro

### 2.1 Operate with tools (NV2x) (mill mode) and NV-30xM

It is possible to define a tool and later compensate for its dimensions while machining.

#### 2.1.1 Entering tool dimensions

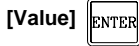


The Y axis blinks waiting for the tool value to be entered.

NV-10/11.- It requests the tool length.

NV-20/21.- It requests the tool diameter.

NV-300/301M.- It requests the diameter on the Y axis and the length on the Z axis.

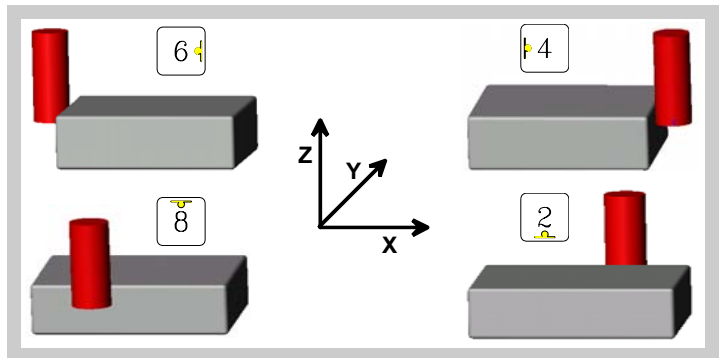


Enter this value pressing this keystroke sequence.

**Note:** Since only the diameter of a tool may be stored, when changing a tool, its dimensions must be entered again.

#### 2.1.2 Tool dimension compensation while machining

To properly machine the part, the tool diameter must be compensated depending on the machining direction.



**Tool** This led turns on when activating any of the compensations.



Cancels tool compensation and turns the Tool led off.

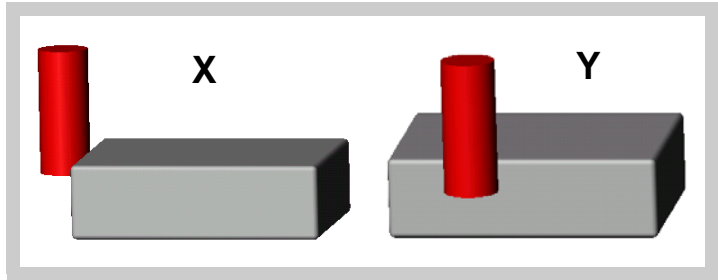
### 2.1.3 Datum point (part zero) to work with tool compensation

**ABS**



Set the dro in absolute mode.

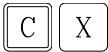
Move the tool and touch the side of the part, activate the corresponding compensation and set the axis to zero.



In the example of the figure, the sequence would be:



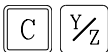
For the X axis, move the tool and touch it on the left side and press this key.



To preset this side to "0". See note.



For the Y axis, move the tool and touch it on the lower side and press this key.



To preset this side to "0". See note.

**Notes:** If installation parameter PAR11=1, just press the axis key, [X] or [Y/Z], to zero it.

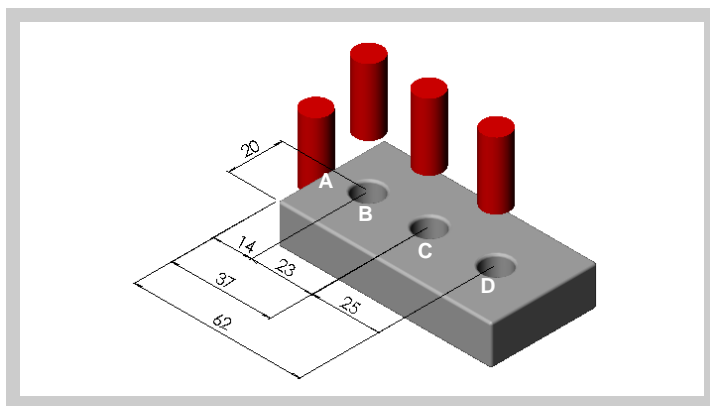
The tool diameter value must be previous entered in order to set the datum (zero) point correctly.

## 2.1.4 Absolute and incremental mode

We will drill the holes of the following part as moving examples in incremental and absolute modes.

First, set the datum point on the part to be machined as described in the section Datum point (part zero) to work with tool compensation

The axis must be positioned without tool compensation (canceled) because the hole coordinates are referred to the center and no tool radius compensation is needed.



### 2.1.4.1 Absolute mode

ABS



Set the dro in absolute mode

**(B) [14.000]** Move the axis until the display reads [14.000] (B position) and drill the hole.

**(C) [37.000]** Move the axis until the display reads [37.000] (C position) and drill the hole.

**(D) [62.000]** Move the axis until the display reads [62.000] (D position) and drill the hole.

The displayed position value is always referred to the preset part zero (datum).

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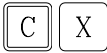
### 2.1.4.2 Incremental mode

**“ABS” off** Set the dro in incremental mode. ABS LED off

#### First method: Presetting incremental zero after each drill.

Starting at point A.

**(B) [14.000]** Move the axis until the display reads [14.000] (B position) and drill the hole.



Set the X axis to zero. See note.

**(C) [23,000]** Move the axis until the display reads [23,000] (C position) and drill the hole.



Sets the X axis to zero. See note.

**(D) [25,000]** Move the axis until the display reads [25,000] (D position) and drill the hole.

**Note:** If installation parameter PAR11=1, just press the axis key, ([X]) in this case, to zero the axis.

#### Second method: Presetting the relative distance with respect to the next hole.

Starting at point A



-14



Preset the relative distance to the next hole. See note.

**(B) [0.000]** Move the axis until the display reads [0.000] (B position) and drill the hole.



-23



Preset the relative distance to the next hole. See note.

**(C) 0.000** Move the axis until the display reads [0.000] (C position) and drill the hole.



-25



Preset the relative distance to the next hole. See note.

**(D) [0.000]** Move the axis until the display reads [0.000] (D position) and drill the hole.

**Notes:** If installation parameter PAR11=1, the presetting sequence is: [ENTER] [axis] [value] [ENTER].

Switching over to [ABS] mode, displays the distance to part zero (datum).

---

## 2.2 Special operations

### 2.2.1 Scaling factor

It is possible to apply a scaling factor within  $\pm 9.999$  for mold making applications:



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

### 2.2.2 Part centering

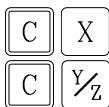
**Note:** This feature is available when none of the axes have installation parameter PAR04(2)=1 (radius/diameter commutable).

Part centering can be done as follows:



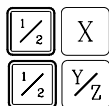
- Set the dro in absolute mode.

- Touch one side of the part with the tool.



- Reset the reading by pressing the sequence [C] [X] for one axis or [C] [Y/Z] for the other (NV-20 and NV-21 / NV-300M / NV-301M).

- Take the tool to the other side of the part and touch this with it.



- Press the sequence [1/2] [X] for one axis or [1/2] [Y] for the other (NV-20 / NV-21 / NV-300M / NV-301M). The DRO will display half of the distance covered by the tool.

- Retract the axes until the displays read 0.0000, the tool can be placed exactly at the center of the part.

## 2.2.3 Coordinate freeze (HOLD). Lathe model NV-20/21 only

**Note:** This feature is available when installation parameter PAR11(2) = 1 (lathe model).

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.

### Example: To change a tool at any known point of the part:

- Touch the part with the tool.



- Press this key. The reading for that axis freezes with the current value.

- Press this key if you wish to also “freeze” the display of the other axis (NV-20 / NV21).

- Remove the tool to be replaced and insert the new one.

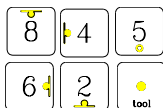
- Approach the new tool to the “freezing” point and touch the part at that point.



- Press this key. The reading “unfreezes” and starts counting from the previously “frozen” value.

If this key is pressed, instead, the DRO will assume half the distance traveled since [HOLD] was pressed. This is possible when “freezing” only one axis.

## 2.3 Examples of how to operate with tool compensation

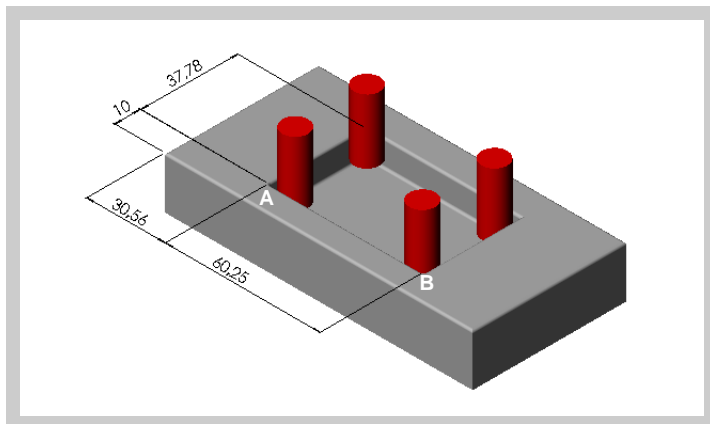


The following illustration displays the typical application of tool compensation to make both an inside and outside pocket.

Tool compensation is applied by pressing either [6] , [4] , [8] or [2] and canceled by pressing [5] .

After presetting the tool diameter, as was described in the previous section, it is advisable to know how to apply the compensation before making said movement.

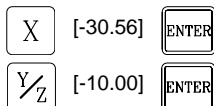
### 2.3.1 Inside pocket



- Go into incremental. "ABS" and "reference" leds off.

- Preset the part zero or datum point (see section "Datum point (part zero) to work with tool compensation" page 11)

**Go to point A. For that:**



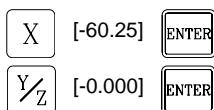
- Press these keystroke sequences.



- Compensate for the tool.

**X 0.000 Y 0.000** - Move both axes until the displays read X 0.000 and Y 0.000.

**Go to point B. For that:**



- Press these keystroke sequences.

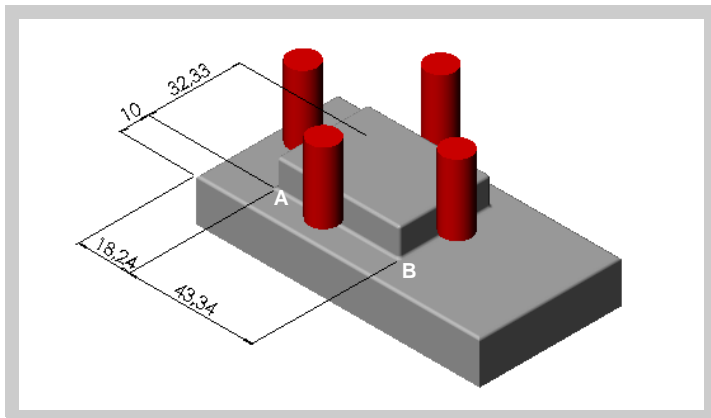


- Compensate for the tool.

**X 0.000 Y 0.000** - Move X axis until the displays read X 0.000 and Y 0.000.  
And so on for the remaining points of the figure using the icon keys shown.



## 2.3.2 Outside pocket



- Go into incremental. "ABS" and "reference" leds off.

- Preset the part zero or datum point (see section "Datum point (part zero) to work with tool compensation" page 11)

**Go to point A. For that:**

X [-18.24] ENTER

- Press these keystroke sequences.

Y/Z [-10.00] ENTER

6 8

- Compensate for the tool.

**X 0.000 Y 0.000** - Move both axes until the displays read X 0.000 and Y 0.000.

**Go to point B. For that:**

X [-43.340] ENTER

- Press these keystroke sequences.

Y/Z [-0.000] ENTER

4 8

- Compensate for the tool.

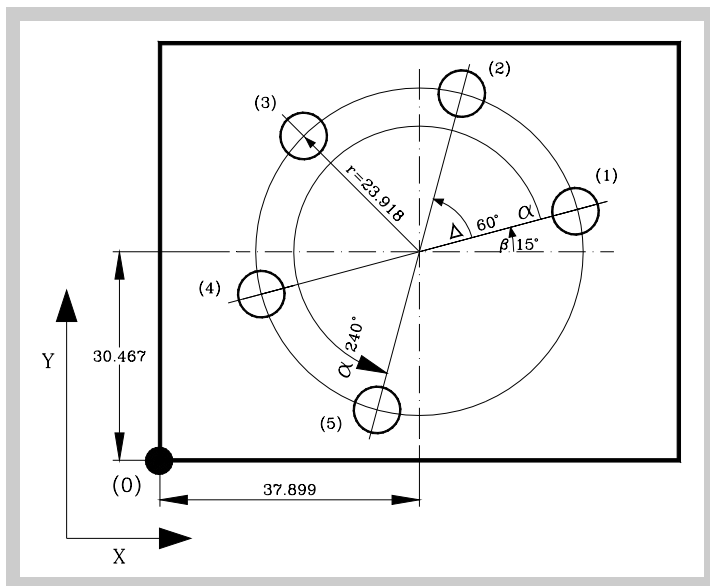
**X 0.000 Y 0.000** - Move X axis until the displays read X 0.000 and Y 0.000.

And so on for the remaining points of the figure using the icon keys shown.

### 2.3.3 Bolt-hole drilling (NV-20 / NV-21/ NV-300M / NV-301M).

**Note:** This operation requires the availability of two axes (Model NV-20 / NV-21) and for the installation parameter PAR11(2) to have been set to "0" (mill model).

It allows up to 99 holes to be drilled in a bolt-hole pattern without having to calculate the coordinates (X Y) of each hole, by simply keying in some basic data.



**Example:**

**CENTER** Coordinate of the center of the bolt-hole (X = 37.899, and Y = 30.467)

**RADIUS** RADIUS of the bolt-hole (23.918)

**HOLES N** Nr. of HOLES to be drilled (5)

**ALPHA  $\alpha$**  Total angle between the first and last hole ( $240^\circ$ ).

**DELTA  $\Delta$**  angular distance between holes ( $60^\circ$ ). Only requested when HOLES = 0.

**bEta  $\beta$**  position of the first hole ( $15^\circ$ ).

To make this part:

---

## Work plane selection:

For 3-axis dro's (NV-300M / NV-301M) it is possible to select the work plane for bolt-hole drilling. The possible work planes are: (XY, XZ, YZ).

**Note:** To enable this feature, PAR11 bit 3 must be set to "1".

## Selection sequence:



After pressing this key.

Select the two axes that form the plane by pressing their keys [X], [Y] or [Z]



Then press this key

## Entering data:



- Position the tool at the bolt-hole center (X = 37.899, Y = 30.467) and press this key.

**RADIUS** - The display of the X axis will show the word "RADIUS"

[23.918]



- Enter the radius.

**HOLES** - The display of the X axis will show the word "HOLES".



- Enter the number of holes.

**ALPHA** - The display of the X axis will show the word "ALPHA".

[240]



- Enter the angular distance between the first and last holes.

**dELTA** - The display of the X axis will show the word "dELTA".

[60]



When entering "0" holes, enter the angular distance between holes.

**bETA** - The display of the X axis will show the word "bETA".

[15]



- Enter the angle of the first hole.



If a wrong value were keyed in before pressing [ENTER], press [C] and key in the right value.

---

### 2.3.3.1 Execution of bolt-hole drilling

After entering this data, the DRO displays the text "HOLE 01" in the display "X" and turns the "Y" off.



- After pressing this key to---

**X -23,105 Y -6,190** - ... show the position of the first hole:

**X 0.000 Y 0.000** - Move the axes until the displays read X 0.000 and Y 0.000



- Press this key

**HOLE 02** - It displays this text.



- Press this key again to---

**X 16.915 Y -16.915** ... show the position of the second hole.



- Press this key to display the current position with respect to the previous hole.

**X 0.000 Y 0.000** - Move the axes until the displays read X 0.000 and Y 0.000

And so on until all the holes are completed (all 5 in the example).

## 3.1 Error codes

Error codes

Error	Description
<b>FAGOR dro</b>	<b>Power outage or turned off with main switch after saving the data.</b>
Error 02	The unit has been turned off without previously pressing [ON/OFF]. It only loses feedback reading (it resets it to zero and the status of the operating modes, inch, abs, radius, etc.).
Error 04	Wrong parameter data
Error 05	Wrong internal configuration
Error 06	Errors in data backup memory (Service Dept.)
Error 07	Emergency input active. Press [CLEAR] or cancel the 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 distance-coded reference mark (lo).
Error 31	Internal malfunction (Service Dept.).
Error 32	Internal malfunction (Service Dept.).
Error 99	Internal malfunction (Service Dept.).
.....	Feedback alarm coming from the feedback device (linear or rotary encoder).
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 this key 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 any axis shows all its dots; for example: 1.4.3.6.5.7.2.5. It means that the axis has been moved too fast (>200 KHz or 60 m/min with 1 µm resolution). This error will be displayed if the alarm activation parameter for the axis PAR08(1) = 1



To clear the display, press this key.

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 there are OK, disconnect the feedback connectors one by one. If the dro comes on, it means a feedback failure. If the fault persists get in touch with Fagor Automation's Customer Services Department about it.

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## 3.2 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:

- Grease and mineral oils.
- Alkalis and bleaches.
- Dissolved Detergents.
- 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 AUTOMATION S. COOP.**

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**Fagor Automation S. Coop.**

Display ON/OFF	
MM/Inches	
Fine/coarse resolution	
Radius/Diameter	
Scaling factor (X)	[Value]
Incremental/Absolute mode	
Home reference mode	
Home search (X)	move (X) axis
Axis preset (X)	[Value]
1/2 axis preset (X)	[Value]
Cancel	
Zero setting (X)	

Part centering (X).	
Coordinate freeze (X).	...
Middle point (X).	...
Tool diameter preset	[Value]
Tool radius compensation	
Cancel Tool Compensation	

### Bolt-hole pattern drilling

Center of the circle.  
(move the axes to the center)

Select bolt-hole operation

RADIUS: [Value]

HOLES: [Number of holes, (2-99)]

ALPHA: [Angle between 1st and last hole] (0=360°)

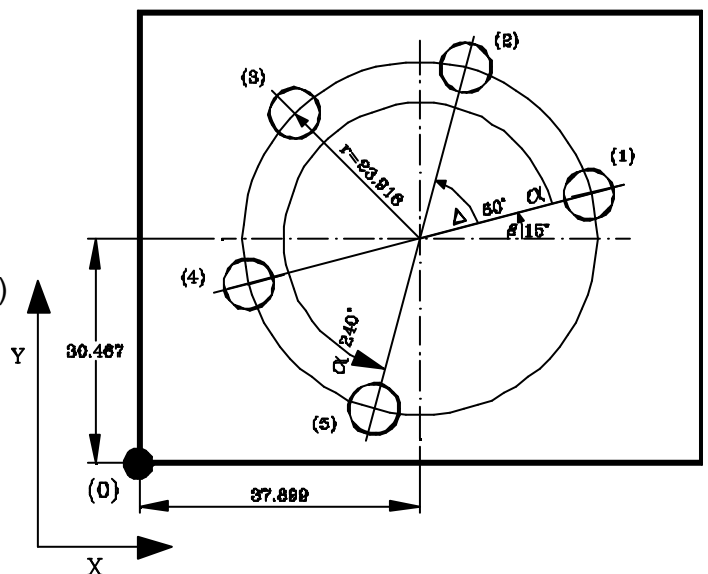
DELTA: [Angular distance between holes]

BETA: [Angular position of the 1st hole]

### Execution of the bolt-hole drilling operation:

After "HOLE 01", press and move the axis

To display the current position with respect to the previous hole, press



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.)
EEEEEEEE	Maximum position reading or speed exceeded when searching Home

Fagor Automation shall not be held responsible for any mistakes on this sheet and reserves the right to make any modifications without prior notice.

