

Installation / Operation Manual

Manual code: 14460086

Manual version: 1501

Software version: 2.50

The enclosed instructions for the Fagor Model 40i display are applicable for usage with the Kentucky Gauge MMT/MMTV single and multi-axis measuring machines.

For the purpose of usage with the Kentucky Gauge MMT/MMTV systems, please refer to section 4.6 (page 28) Accessing Installation Parameters. Your machine display should be preloaded with parameters for allowing of operation from start / power up. However, Multi Point Error Compensation Entry (if needed) will need to be applied post receipt / installation of machine.



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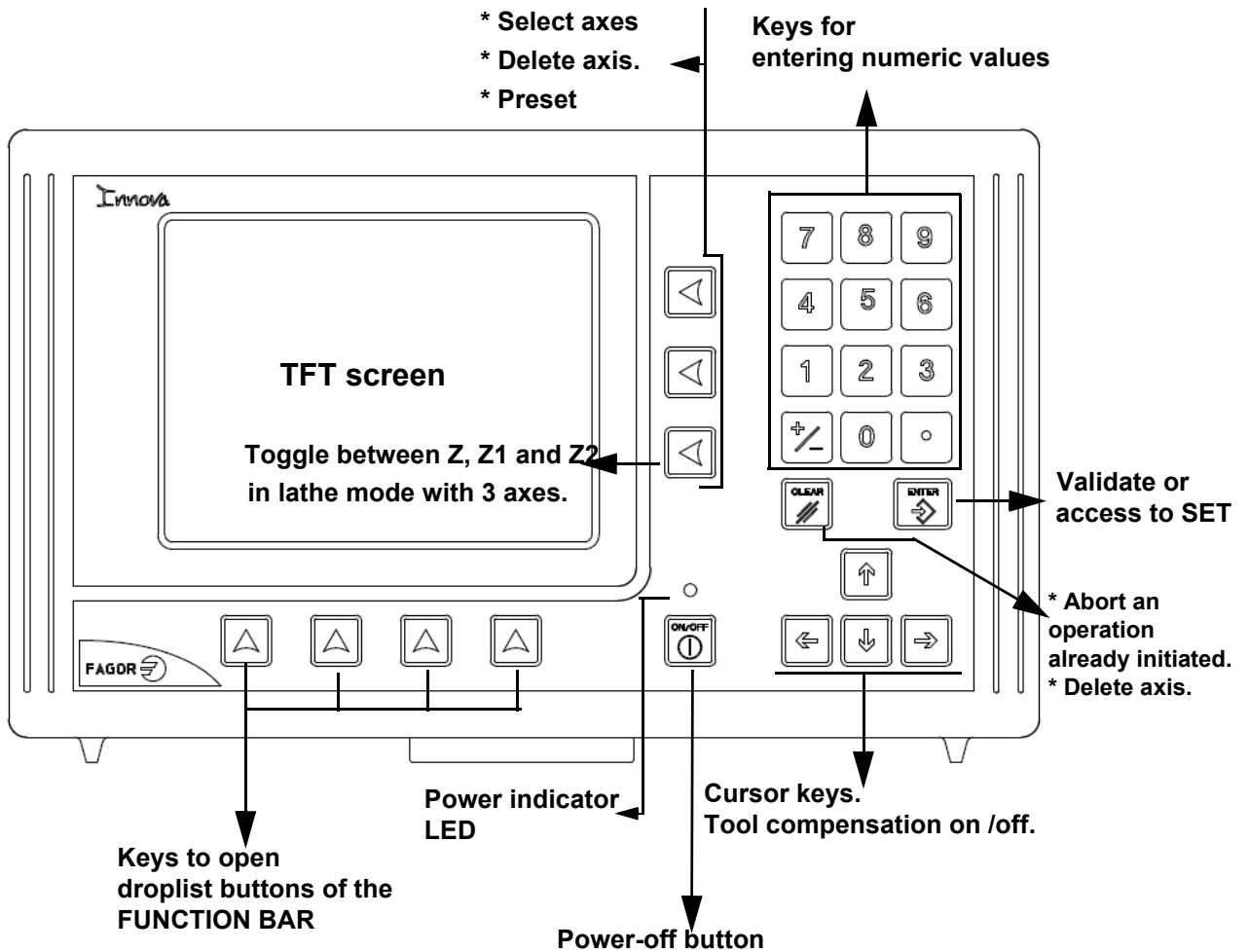
IMPORTANT NOTE

Some of the features described in this manual may not be available in this version.

Consult with the Fagor Automation branch office nearest you.

1 DRO description

1.1 Front plate:



1.2 Turning the unit on and off

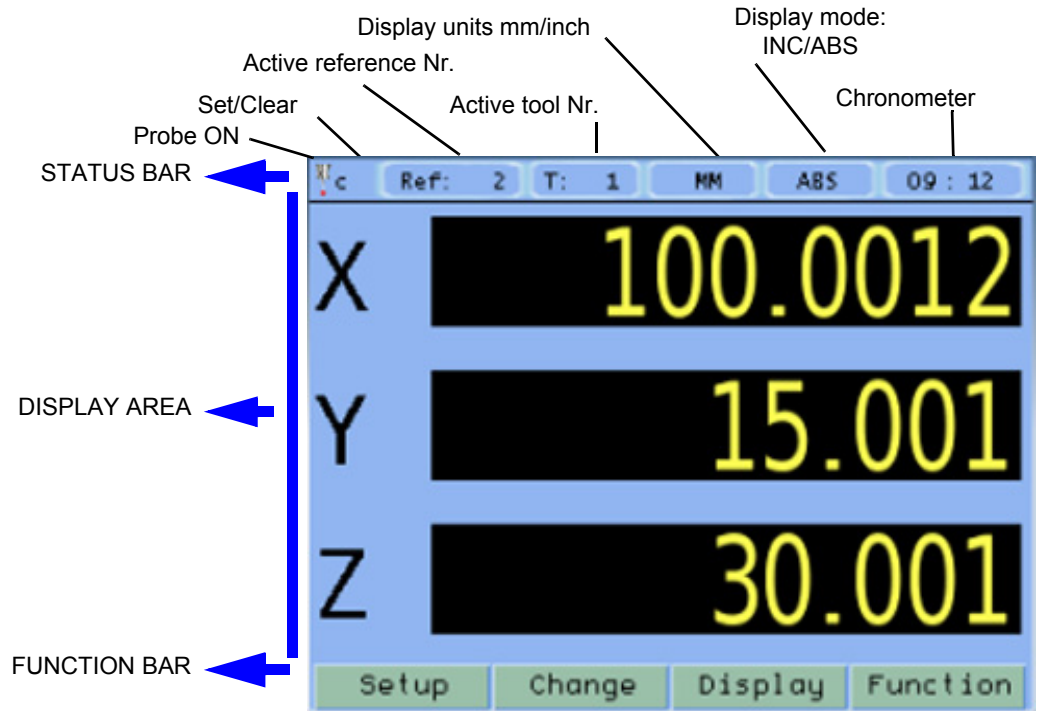
It turns on automatically when applying voltage or after pressing the on/off key.

On power-up, an initial screen comes up for a few seconds and then the work screen is displayed.



Turns the DRO on or off.

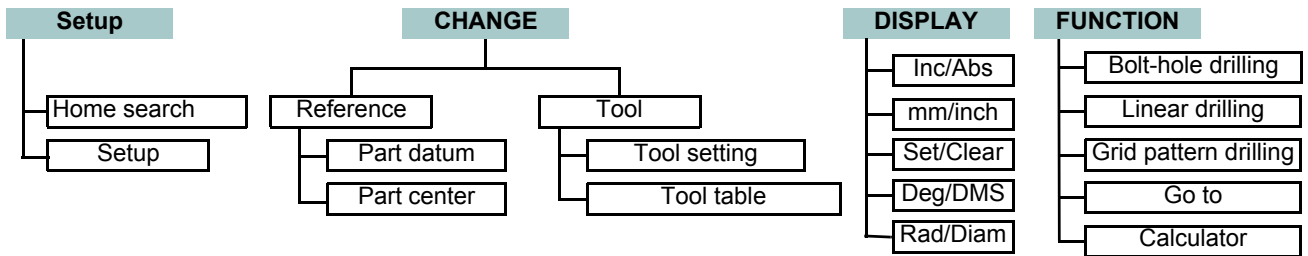
1.3 Main screen description



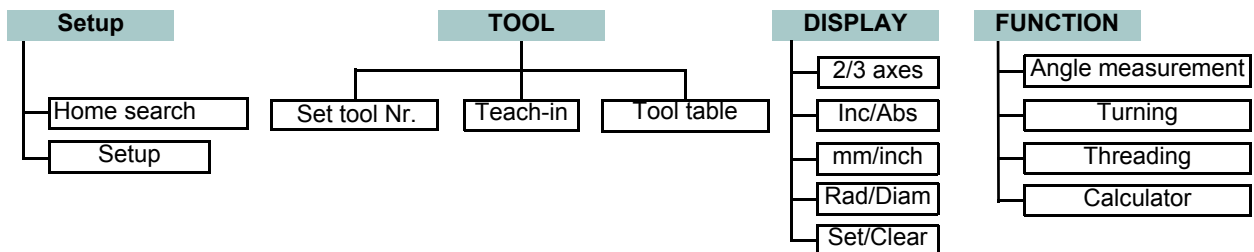
1.4 Function bar

The function bar gives access to the various functions offered by the DRO.

1.4.1 Accessing functions in MILL mode



1.4.2 Accessing functions in LATHE mode



2 DRO operation in MILL mode

2.1 Display modes

Display

2.1.1 mm / inch

Display mm / inch

Toggle units between mm and inches.

This toggle is possible if the installer parameters have been set as toggle .

2.1.2 inc / abs

Display inc / abs



Toggle between incremental and absolute feedback reading (counting).

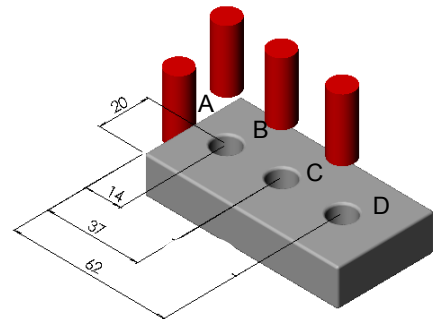
The status bar shows the currently active feedback reading mode.

2.1.2.1 Absolute mode

The coordinates (position values) are referred to part zero.

The example on the right would be carried out as follows:

- (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.

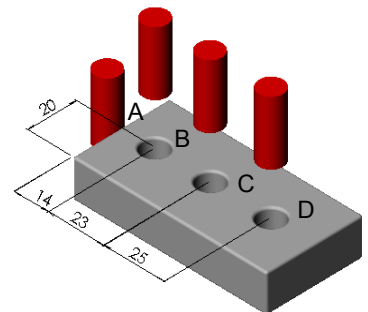


2.1.2.2 Incremental mode

The coordinate is referred to the previous point where the axis display has been set to zero.

The example on the right would be carried out as follows 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.
- (C)[23.000] Move the axis until the display reads [23,000] (C position) and drill the hole.
Sets the X axis to zero.
- (D) [25.000] Move the axis until the display reads [25,000] (D position) and drill the hole.



2.1.2.3 Degrees / Degrees-Minutes-Seconds

Display

Deg / DMS



Toggles the axis display units between degrees and degrees, minutes, seconds.

2.1.3 Rad / Diam

Display

Rad / Diam

Toggles the X axis display between radius and diameter

2.2 Set/Clear

Display

Set/Clear

There are two ways (modes) to set a value (Set) on the display or zero it (Clear).

2.2.1 In "Set" mode (indicated with an "S" on the upper status bar)



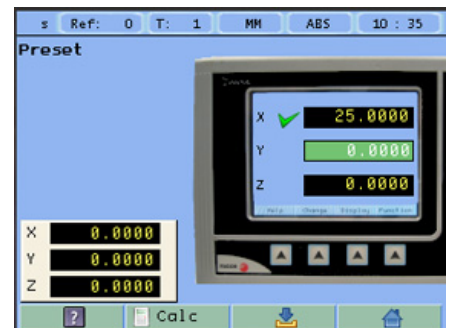
Value



To preset a value for an axis.



To zero the axis, either preset a 0 value using the previous keystroke sequence or use this other sequence (clear + axis).



2.2.2 In "Clear" mode (indicated with a "C" on the upper status bar)



Set the display to zero.

To preset a value:



Value



And validate the data by pressing this key.



Or ignore it by pressing this key.

2.3 Machine reference (home) search

Setup

Home search



Select axis. A red bar appears on that axis display indicating that it is waiting for a reference pulse.

Move the selected axis until the DRO detects the reference mark.



A green checkmark appears next to the axis display when the reference mark is properly detected (homed) and the axis display will show the position value preset in parameter "user offset", (see [Reference](#)).



This icon indicates that the axis must be homed.



Note:When all the required axes are homed, the DRO automatically leaves the home search mode.

2.4 Tools and references

Change

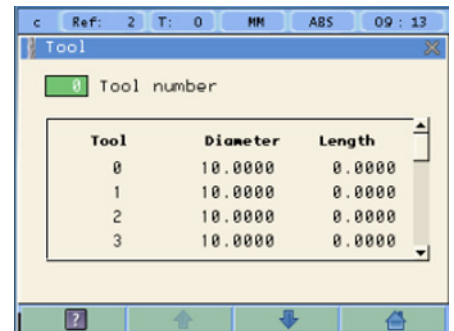
2.4.1 Tools:

Change


Tool

Change to or set tool (diameter and length).

It offers a 15-tool table.



2.4.1.1 Tool change

Tool Nr.  It becomes the current tool.

2.4.1.2 Set a new tool in the table



Select the tool number you wish to set.



Enter the diameter of the tool. Press Enter.



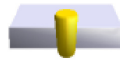
Enter the length of the tool. Press Enter.

2.4.1.3 Tool compensation

This DRO offers a function for compensating tool radius depending on the machining direction.



Tool compensation on /off in this direction:



Tool compensation on /off in this direction:



Tool compensation on /off in this direction:



Tool compensation on /off in this direction:



When machining pockets, tool radius compensation is activated in two axes at the same time.



Tool compensation on /off for this corner of the pocket:



Tool compensation on /off for this corner of the pocket:



Tool compensation on /off for this corner of the pocket:



Tool compensation on /off for this corner of the pocket:



2.4.2 Reference

Change

Reference

Change part reference (datum), set a new one or search the center of the part.

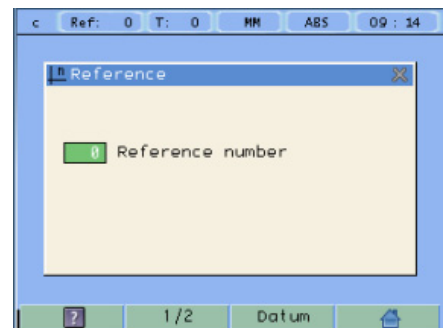
There are 100 references or datum points that may be set for the part when using absolute coordinates (0-99).

1/2

Assistant for searching the center of the part by touching on two sides.

Origin

Assistant for setting the part zero (datum point).



2.4.2.1 Changing the reference

Change

Reference

Changing from one reference to another.

Tool Nr.



It changes to the selected reference.

2.4.2.2 Setting part zero (datum) as instructed by the assistant:

Change

Reference

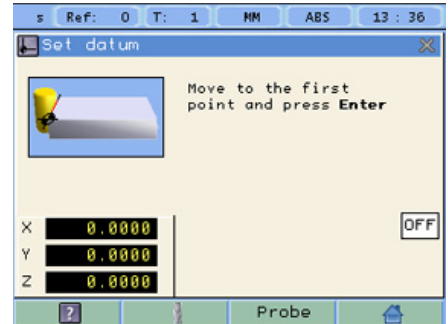
Origin

Setting part zero requires measuring at least 2 points. One point on each of the sides to be homed. The third point is optional and is used for setting the datum point (origin) of the vertical axis.

Probe

It activates the probe mode. If the probe has been set, it may be used to touch the desired sides of the part. Probe dimensions, length and diameter, must be entered as if they were those of a tool.

Set or change the tool. It will compensate for the radius of the tool being used.



[Z axis]

Activate Z axis homing.

Optional:

- Activate the probe mode if the probe has been configured and it is being used.
- Select the Z axis to set the datum point on the vertical axis.

Sequence to follow:

Set or change the tool.

Move the tool to the first side until it touches the part.



Press Enter.

Move the tool to the second side until it touches the part.



Press Enter.

If the vertical axis is activated, move the tool to the top side until it touches it.



Press Enter.

1

2

Select the corner where the part zero (datum) will be set.

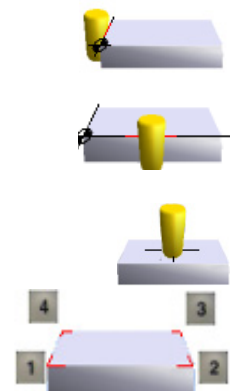
3

4

Notes:

When using a probe, there is no need to press Enter, just touch a point on the desired side.

In order to ensure that tool or probe radius compensation is done correctly, the sides of the part to be referenced, must be aligned with the axes of the machine as much as possible.



2.4.2.3 Setting part zero (datum) without using the assistant

Change

Reference

Set a datum point at a corner other than the 3rd quadrant.



Compensate for tool radius on the X axis.

Touch with the tool on the side indicated in the figure.



Set the X axis to zero.

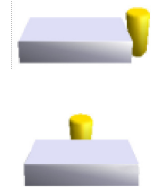


Compensate for tool radius on the Y axis.

Touch with the tool on the side indicated in the figure.



Set the Y axis to zero.



2.4.2.4 Searching the center of a part

Change

Reference

1/2



Set or change the tool.

Probe

It activates the probe mode. If the probe has been set, it may be used to touch the desired sides of the part.

Move the tool to the first point.



Press ENTER.

Move the tool to the second point.

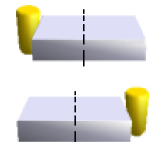


Press the key of the axis whose center you're trying to find.

The display of the axis whose center you're searching shows a value that is half the distance moved in that axis. Move this axis to zero. The tool is now located at the center.



Note: This mode may be accessed directly by pressing this key.



2.5 Special functions

Function It gives access to the specific milling functions.

2.5.1 Bolt-hole drilling

Function **Bolt-hole drilling**

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



Select **plane**.

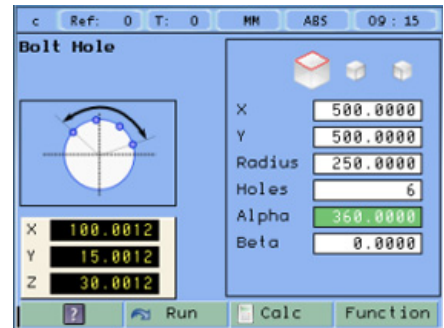
X, Y: Coordinates of the center of the circle where the holes will be drilled referred to the active reference zero.

Radius of the circle where the holes will be drilled.

Number of holes.

Alpha: Total angle between the first and last hole of the circle.

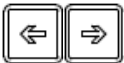
Beta: Position of the first hole.



2.5.2 Linear drilling

Function **Linear drilling**

It allows up to 99 holes to be drilled in line in different planes (XY, XZ, YZ) without having to calculate the coordinates (X Y) of each hole, by simply keying in some basic data.



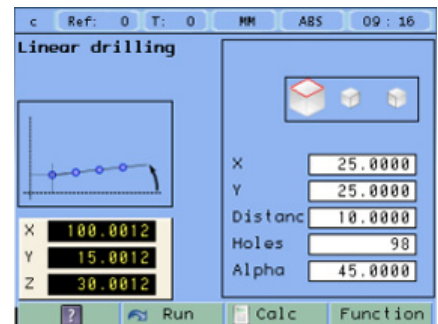
Select **plane**.

X, Y: Position of the first hole.

Distance between holes.

Number of holes.

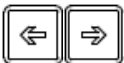
Alpha: Inclination of the line of holes.



2.5.3 Grid pattern drilling

Function **Grid pattern drilling.**

It allows up to 99holes to be drilled in grid or frame pattern in different planes (XY, XZ, YZ) without having to calculate the coordinates (X Y) of each hole, by simply keying in some basic data.



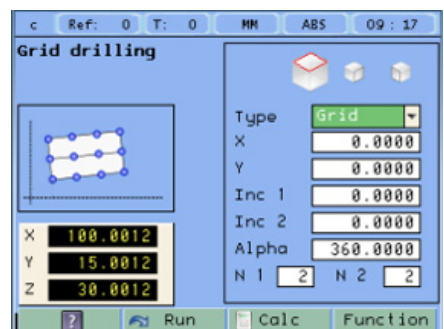
Select **plane**.

Type: *Grid* (a matrix of holes) or *frame* (holes in the perimeter of a frame).

X, Y:Position of the first hole.

Inc 1: Gap between the holes of the grid along the X axis.

Inc 2: Gap between the holes of the grid along the Y axis.



Alpha: Inclination of the matrix of holes.

N 1: Nr of holes along the X axis.

N 2: Nr of holes along the Y axis.

2.5.4 Go to

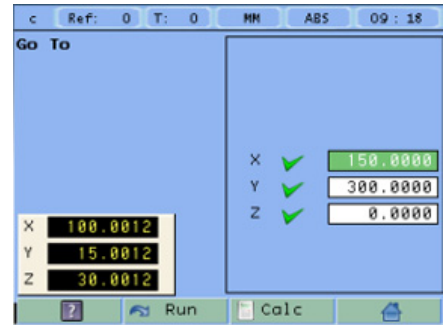
Function

Go to

This function is the alternative to the most commonly used positioning method consisting in presetting an incremental zero at a point and moving the axis until the display shows the desired coordinate. The **Go to** function may be used to do the same in the opposite direction, you enter the coordinates of the target point and the DRO screen shows these values with the negative sign. The operator must move the axes to zero. The advantage of using this method is that the operator does not have to memorize the target coordinates, he simply has to move the axes to zero.



When presetting a value on an axis, press **ENTER** to go on to the next axis and validate the data just entered.



2.5.5 Calculator function

Function

Calculator

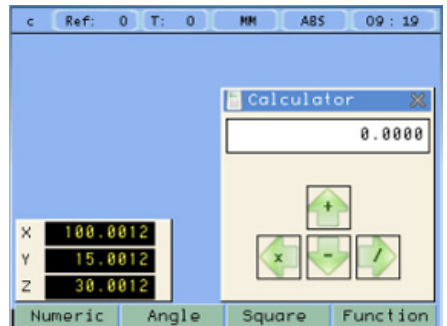
It may be used to carry out mathematical and trigonometric operations as well as preset the desired axis with the result of the calculation or import the displayed coordinate values into the calculator to carry out math operations.

Different types of calculators may be selected at the function bar: Arithmetic, trigonometric and for square functions.

Numeric Numeric calculator. Functions: **+** **-** **x** **/**

Trigonom Trigonometric calculator. Functions: **Sin**, **Cos**, **Tan**.

Square Functions: x^2 $1/x$ $\sqrt{\quad}$



Function To **Exit** the calculator, **Set** an axis with the result or **Insert** a value into the calculator.

Exit Exit the calculator.

Set Set one of the axis with the result of the calculator. To do this, access the calculator by pressing the Calc button of the function bar on the **Preset** screen.

Insert Enter the value of an axis, PI or 2PI into the calculator.

2.5.6 Simulation / execution special modes

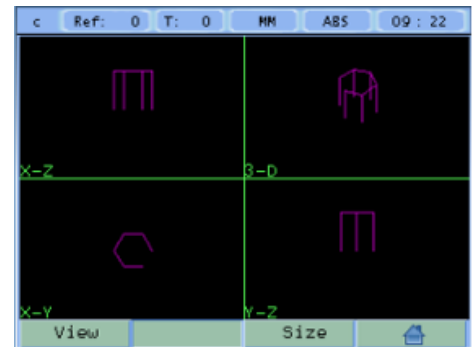
After completing the data that define a drilling cycle, you can execute the cycle or simulate it to verify that data entered is correct.

2.5.6.1 Cycle simulation

Function	Bolt-hole drilling	Function	Show Graph
	Linear drilling		
	Grid pattern drilling		

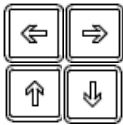
The simulation may be seen in the following modes: *tool movement*, *views and sections* or *3D*.

View	Tool movement
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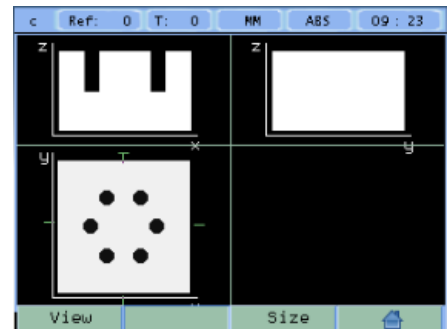


Tool movement

View	Engineering Drawing
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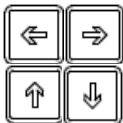


Consists of a top view and two sections with a mobile partition by pressing the arrow keys.



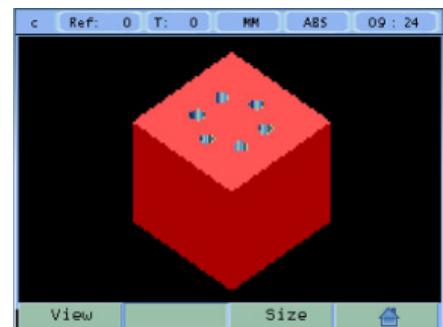
2D views

View	3D
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The 3D graphic may be rotated using the arrow keys.

Size	Opens the window for entering the actual (real) part dimensions. Viewing the simulation in real mode requires entering the real X, Y, Z dimensions of the part.
-------------	---



3D solid

2.5.6.2 Cycle execution

Run

Pressing the **Run** key, the DRO shows the distance the axes must move to position at the first hole. Move the axes to zero. .

The status bar indicates the number of the current hole and the total number of holes programmed in the cycle.



Current hole Nr. Total number of holes programmed.



Once positioned at the drilling point, touch the surface with the tool. Press the Z axis key. The Z axis display reads zero.



Press Enter. A window opens for entering the hole depth. Press Enter to validate. The entered depth value is shown on the Z axis display.

Move the Z axis until its display reads zero. This way, the hole is drilled with the indicated depth.



Press this key to show the coordinates of the next drilling position (hole).

Repeat these steps until all the holes of the circle are drilled.

The following keys may also be used:



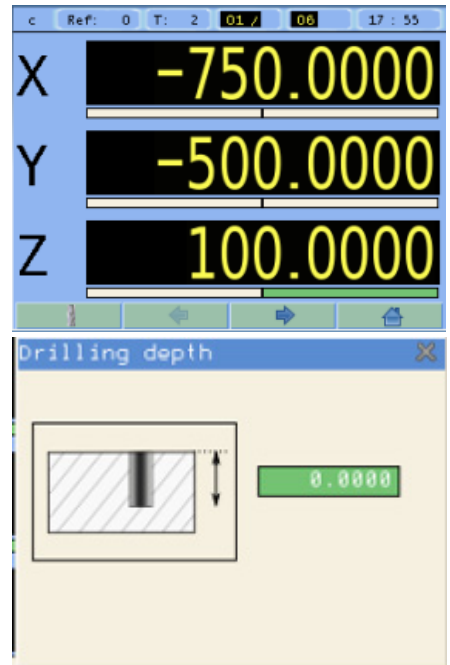
Go to the last hole



Go to the first hole



Select particular hole.



2.5.7 Probe

The probe stores the data about the probed points in a USB memory. The probing data may be read and processed at a PC.

The file containing the probed points is: **FAGOR/DRO/PROBE/probe.csv**

The format of the generated file is “**csv**” (comma separated values) and may be easily imported into a spreadsheet.

When using the USB-RS232 adapter, the probe data will be sent to the PC in the same format.

RS232 communication parameters:

Baudrate: 9600 Baud
Number of bits: 8
Stop bits: 1
Parity: none

From the left column to the right, the values correspond to the 1st, 2nd and 3rd axis respectively:

For example:

100.000 , 132.035 , 0.435
133.005 , 132.035 , 0.435
870.020 , 132.435 , 0.435
133.870 , 132.035 , 0.435
191.890 , 205.545 , 10.540

2.5.7.1 Turn the probe ON and OFF

Connect a USB memory to the DRO and wait for 4 seconds for the DRO to configure the memory.



To turn the probe mode ON.

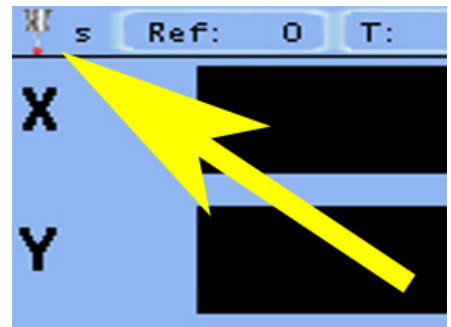


The icon shows that the probe mode is ON. The data captured by the probe is saved in the file.

The probe **MUST** be turned OFF properly before extracting the USB memory so as not to lose any probing data.



To turn the probe mode OFF.



Note: Do not unplug the USB memory until the DRO completes the safe extraction sequence.

3 DRO operation in LATHE mode

3.1 Display modes

3.1.1 2/3 axes

Display

2/3 axes

3rd



Toggle the reading of the second axis between Z (Z1 + Z2), Z1 or Z2, when the DRO has been set for 3-axis lathe.

When it has been set by parameter to only display the Z axis, this key toggles between displaying 2 axes (X, Z) and displaying 3 axes (X, Z1, Z2).

3.1.2 mm / inch

Display

mm/inch

Toggle units between mm and inches.

This toggle is possible if the installer parameters have been set as toggle .

3.1.3 rad/diam

Display

rad/diam

Toggle between radius mode and diameter mode. It only affects the X axis.

In **diameter mode**, the X axis display shows twice the actual distance traveled by the tool. When this mode is active, the X axis display shows the \varnothing sign.

In radius mode, the X axis display shows the actual distance traveled.

3.1.4 inc / abs

Display

inc/abs



Toggle between incremental and absolute feedback reading (counting). The status bar shows the currently active mode.

3.1.4.1 Absolute mode

In this mode, the coordinates (position values) are referred to part zero.

Example on the right:

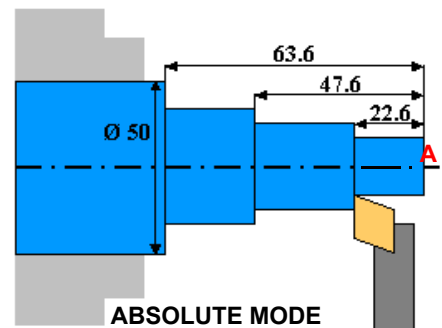
Set the DRO in absolute mode.

Set part zero (datum).

Run several passes moving the Z axis from “0” to “63.6” until obtaining the desired diameter.

Run several passes moving the Z axis from “0” to “47.6” until obtaining the desired diameter.

Run several passes moving the Z axis from “0” to “22.6” until obtaining the desired diameter.



3.1.4.2 Incremental mode

The coordinate is referred to the previous point where the axis display has been set to zero.

Set the dro in incremental mode.

Set a floating zero (Z=0) at point A.

Preset the value "22.6" for the Z axis. Run several passes moving the Z axis from "0" to "63.6" until obtaining the desired diameter.



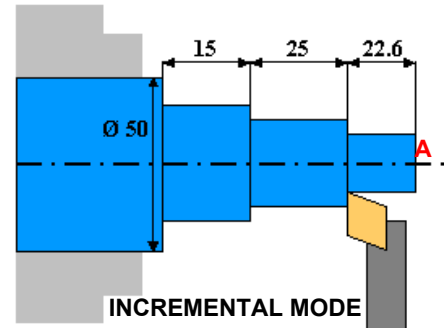
Clear Z axis.

Preset the value "25" for the Z axis. Run several passes moving the Z axis from "0" to "63.6" until obtaining the desired diameter.



Clear Z axis.

Preset the value "15" for the Z axis. Run several passes moving the Z axis from "0" to "63.6" until obtaining the desired diameter.



3.2 Tool

Change

Tool

Set or change the tool.

Up to 100 tool offsets may be defined at this DRO, from *tool 0* to tool 99. The unit stores in its internal memory the relative offsets of all the tools with respect to that of tool "0". (master tool).

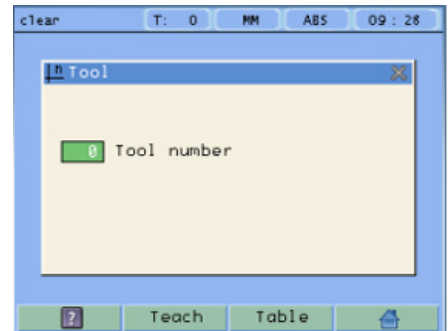
Therefore, if *tool 0* has been preset in ABS mode (on X and Z) and, then, the rest of the tools, it will suffice to just preset the *master tool* (tool 0) again (on Z) for the new part. The DRO will then automatically recalculate all the offsets of the rest of the tools without having to preset them for each part.

Teach

Assistant for setting new tool offsets.

Table

Access to the tool table.



3.2.1 Tool setting

Change

Tool

Teach

When going into Teach mode, if the DRO was in INC mode, it switches to ABS mode.

3.2.1.1 Setting the tool by touching a part of known diameter



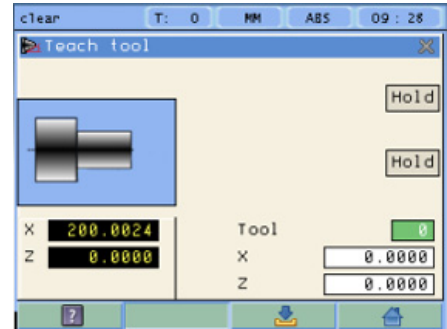
Enter tool number. Press Enter.

Move the X axis until the tool touches the part. Preset the part diameter.

Move the Z axis until the tool touches the part. Preset the value for the Z axis.



Press button to validate.



3.2.1.2 Setting the tool by touching a part of unknown diameter

When the part must be removed to measure its dimensions, use the **HOLD** function.



Enter tool number. Press Enter.

Move the X axis until the tool touches the part.

Move the Z axis until the tool touches the part.

Hold

Press **HOLD** for both axes.

Remove the part and measure it.

Preset the X axis with the measured diameter value.

Preset the value for the Z axis.



Press button to validate.

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

Notes: The presets done with any tool in incremental mode change the part zero for all the tools.

If a tool offset has been preset in Z_1 , Z_2 or Z ($Z_1 + Z_2$) mode, that tool must be used in the same mode (Z_1 , Z_2 or Z) when using it to machine the part.

The tool offsets are referred to the machine zero found at the time. When turning the DRO on, it is necessary to find the same reference mark.

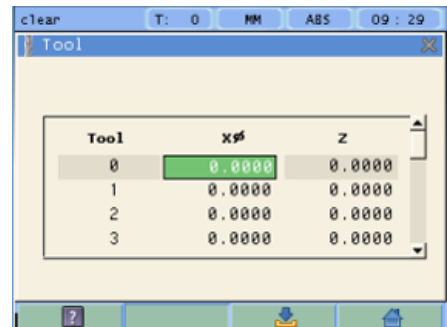
3.2.2 View tool table

Change

Tool

Table

View tool offset table.



3.3 Special functions

Function

It gives access to the specific lathe functions.

3.3.1 Angle measurement

Function

Angle measurement

It may be used to calculate the angle or taper of a part by touching two points.

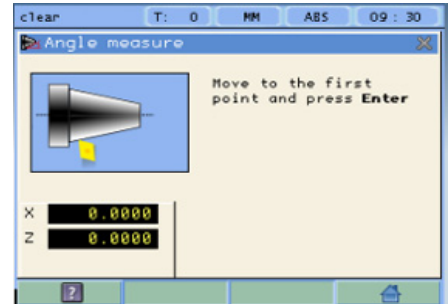


Touch the first point and press Enter.



Touch the second point and press Enter.

It shows the calculated angle in *degrees* and *degrees - minutes - seconds*.



3.3.2 Turning function

Function

Turning

Assistant for defining a turning cycle after having entered the following data:



X: Starting diameter. Move the X axis until the tool touches the part. Press X axis button to enter the position value on the X axis. If the part diameter is known, its value may be entered directly. Press Enter. The next field (box) is activated.



Z: Initial Z axis value. Place the tool touching the part on the Z axis. Preset a value and press the button for the Z axis to enter the value of the Z axis display. Press Enter. The next field (box) is activated.

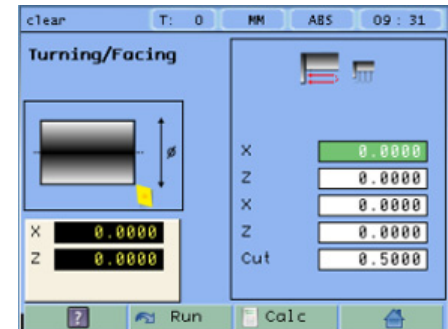


X: Enter **final diameter**. Press Enter.



Z: Enter Z axis final value. Press Enter. Press Enter.

Cut: Enter cutting pass in mm. The DRO will use this value also as the safety distance to withdraw after each pass.



Run

Execute turning cycle. Move the axes until both axis displays read zero.



Go on to the next execution step.



Current step Nr. Total number of steps.




3.3.3 Threading function

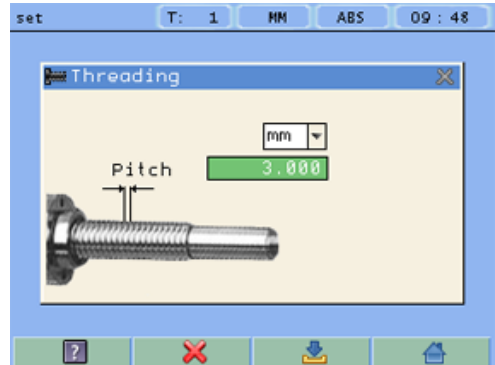
Function	Threading
----------	-----------

This function helps you making threads of various pitches on a lathe. This function is only available on machines that have an encoder on the leadscrew. Refer to section 4.6.5 "Threading" on page 35 to see how to install the encoder and set the relevant parameters.

3.3.3.1 Threading Procedure

Pitch It is the thread pitch in mm or threads per inch (tpi).

-  Cancel threading
-  Execute Threading cycle It will display the threading screen.
-  Home



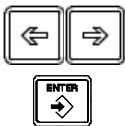
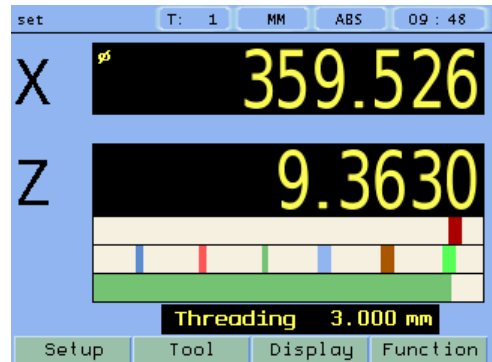
Main screen

3 bars will now appear on the screen.

The top LED bar is for the linear scale feedback that's attached to Z axis. The middle LED bars are for the encoder feedback that's attached to the leadscrew. The bottom bar shows the distance to go.

Setup

When beginning to work, depending on the encoder position, sometimes it is impossible to engage the axis. So, with the machine stopped, move the Z axis position just to get one rectangle close to the other (one of the colored rectangle on the right side of the red one) and engage the machine.



Now using the DRO keys [<-] [->], move the red rectangle just to see it over the other colored rectangle and then press Enter.



IMPORTANT

The LED bars need to move from right to left.

If they are not, reverse polarity as described on page: 36

-
- The operator has the chance to clutch the axis every time the rectangles are aligned one of top of the other. If the operation has been properly done, the green bar will be at 100 %.
 - For finishing the thread, we do recommend engaging the machine in the same color as the previous cycle, to improve the final result of the thread.

Distance-to-go bar (DTG): As the Z axis feedback and the encoder feedback LED bars approach each other, the white bar will increase size. When the DTG turns fully green, the LED bars should be aligned and ready to engage lever.

3.3.4 Calculator function

Function

Calculator

See section: [2.5.5 "Calculator function" on page 12](#)

4 DRO installation

There are two ways to mount the Innova 40i:

- 1- Mounted on the support arm.
- 2- Built-in model.

4.1 Mounting on the support arm

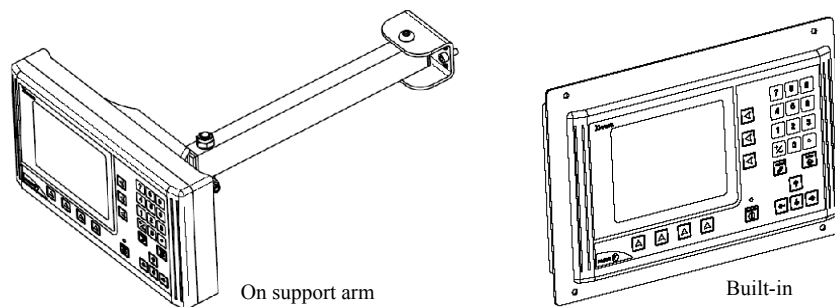
The DRO may be mounted at the desired height and may be oriented at will.

The DRO is mounted on to the support arm using two set-screws.

4.2 Mounting of the built-in model

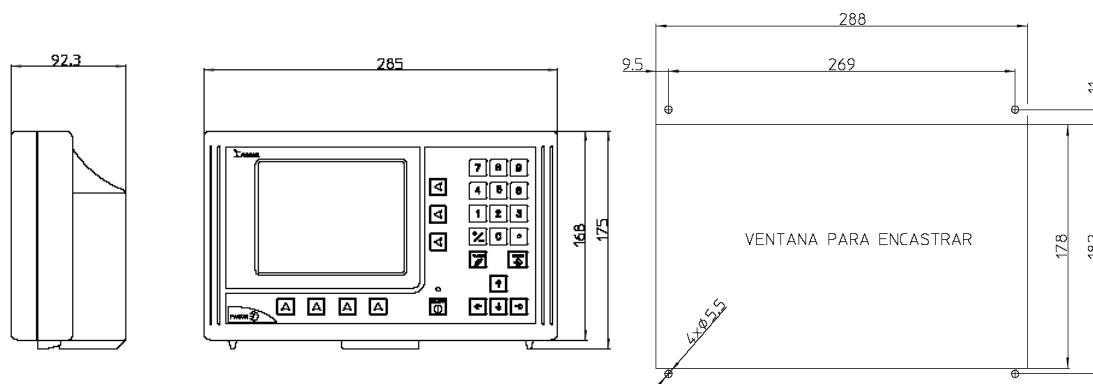
The DRO is ready to be built into an operator panel or pendant. The name of this model is special, a **B** has been added at the end of the product name.

Example: INNOVA 40i -**B**

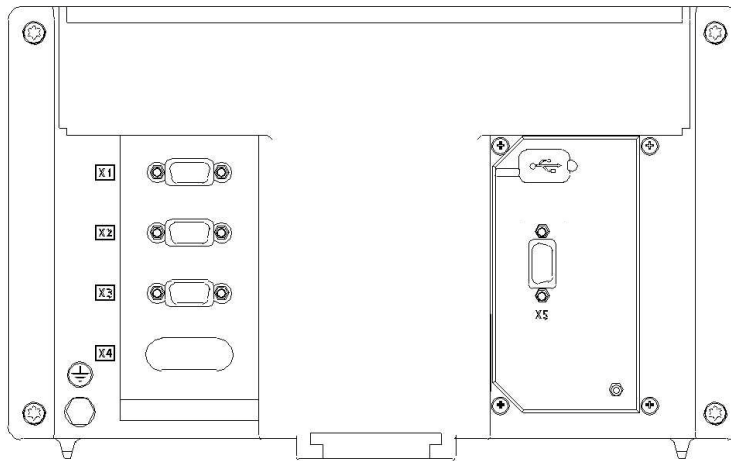


Dimensions of the DRO and the window to insert it into

The first figure shows the DRO dimensions. The second figure shows the dimensions of the hole needed in the enclosure of the machine to built this model into.



4.3 Rear panel



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

- * Three-prong power connector for AC and ground connection.
- * M6 mm terminal, for general machine ground connection.
- * Mounting bracket.
- * Feedback connectors:

X1.-SUB-D HD type 15-pin female connector for 1st axis feedback device (scale or encoder).



X2.-SUB-D HD type 15-pin female connector for 2nd axis feedback device (scale or encoder).

X3.-SUB-D HD type 15-pin female connector for 3rd axis feedback device (scale or encoder).

X5.-SUB-D type 9-pin female connector for the probe.



*USB connector.



In order to comply with UL standards, this unit must be connected in the final application using a listed detachable cord set (BLEZ) with a molded three-prong plug and a suitable fitting to be connected to the equipment, rated minimum 300 V AC. The cord type shall be SO, SJO or STO. Suitable Strain Relief means must be provided in the cord set to assure the connection of the plug and the fitting.

ETL file number:



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 [on/off] key at the keyboard

4.4 General technical characteristics

- Universal Power Supply between 100V AC and 240V AC $\pm 10\%$ at Mains frequency between 45 Hz and 400 Hz. Between 120 V DC and 300 V DC. Maximum power consumed 25 VA. It withstands power outages of up to 20 milliseconds.
- 10-year memory backup of installation parameters 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.

4.5 Connections

4.5.1 Connection of the feedback systems

The feedback systems (linear or rotary encoders) are connected via SUB-D HD type 15-pin female connectors: X1 through X3.

Characteristics of feedback inputs: X1, X2 and X3:



-Maximum feedback consumption: 250 mA at the +5V input.

-Admits square-wave signal (TTL).

-It admits voltage modulated 1 V_{pp} sinusoidal signal.

-It admits SSI communication for absolute encoders.

-Maximum frequency: 250 KHZ, minimum gap between flanks: 950 nsec.

-Phase shift: 90° ±20°, hysteresis: 0.25 V, V_{max}: 7V, maximum input current: 3mA

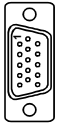
- High threshold (logic state 1): 2.4 V < V_{IH} < 5 V

- Low threshold (logic state 0): 0.0 V < V_{IL} < 0.55 V

Feedback connection. Connectors X1, X2 and X3

Pin	Signal 1V _{pp} / TTL	Signal SSI	Function
1	A	-	Input for feedback signals
2	/A	-	
3	B	-	
4	/B	-	
5	I0	Data	
6	/I0	/Data	
7	Alarm	Clock	
8	/Alarm*	/Clock	
9	+5V		Power supply to feedback devices
10	Not connected		
11	0V		Power supply to feedback devices
12, 13, 14	Not connected		
15	Chassis		Shield

4.5.2 Probe connection (connector X5)



Either a 5 V or a 24 V probe may be connected.

Characteristics of probe inputs X5:

5V probe input

Typical value 0,25 mA. ? Vin = 5 V.

High threshold (logic state 1) VIH: From +2.4 V DC on.

Low threshold (logic state 0) VIL: Below +0.9 V DC.

Maximum nominal voltage Vimax = +15 V DC.

24 V probe input

Typical value 0,30 mA. ? Vin = 24 V.

High threshold (logic state 1) VIH: From +12.5 V DC on.

Low threshold (logic state 0) VIL: Below +4 V DC.

Maximum nominal voltage Vimax = +35 V DC.

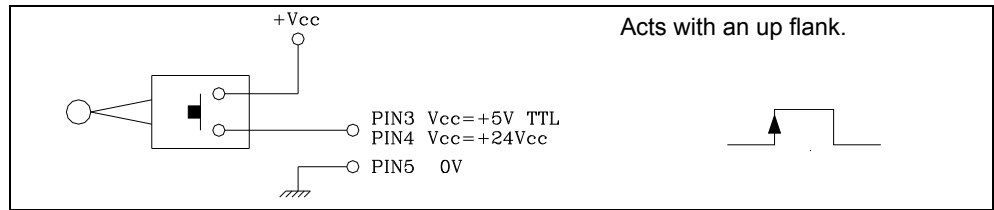
Probe connection. Connector X5

PIN	SIGNAL	DESCRIPTION
1	CHASSIS	Ground connection
2	+5Vout	+5V output
3	PROBE_5	+5V Probe input
4	PROBE_24	+24V Probe input
5	GNDVOUT	GND output.
6	5Vout	5V output
7	---	---
8	---	---
9	GNDVOUT	GND output.

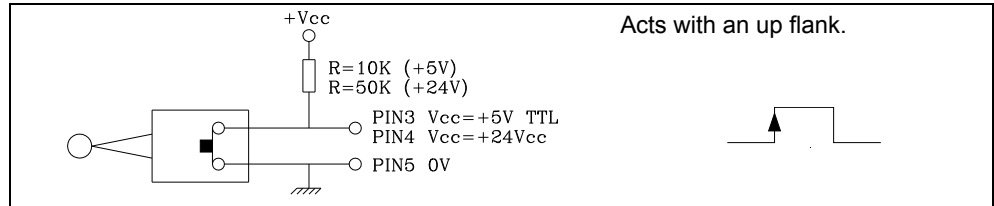
The unit has two probe inputs (5 V DC and 24 V DC) at connector X5.

Depending on the connection being used, it is possible to choose whether it is activated by the up flank or by the down flank of the probe (see section [4.6.3.2 DRO en la página 29](#)).

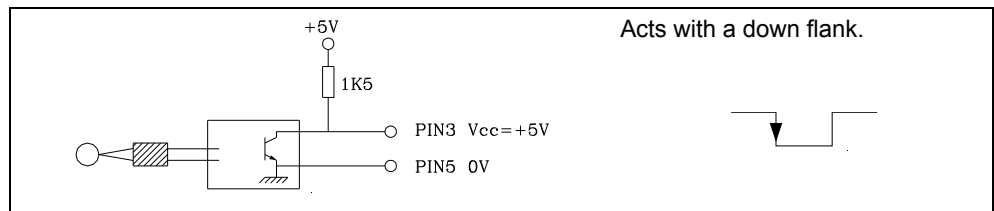
Probe with a normally-open-contact output.



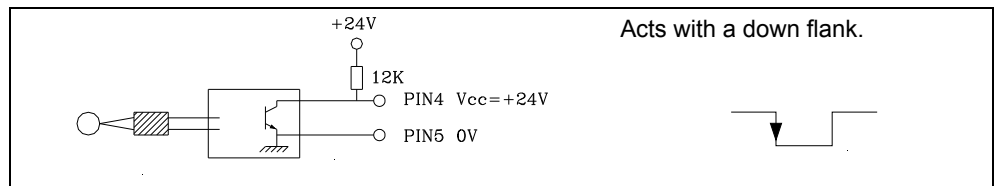
Probe with a normally-closed-contact output.



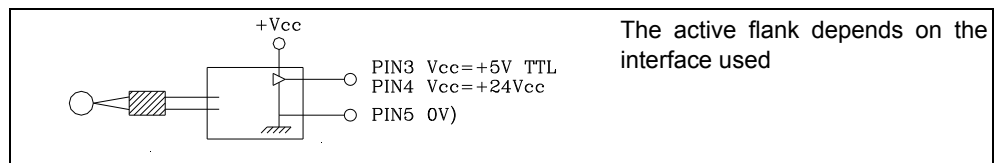
Interface with an open-collector output. Connection to +5 V.



Interface with an open-collector output. Connection to +24 V.



Interface with a PUSH-PULL output.



4.5.3 Power and machine connection

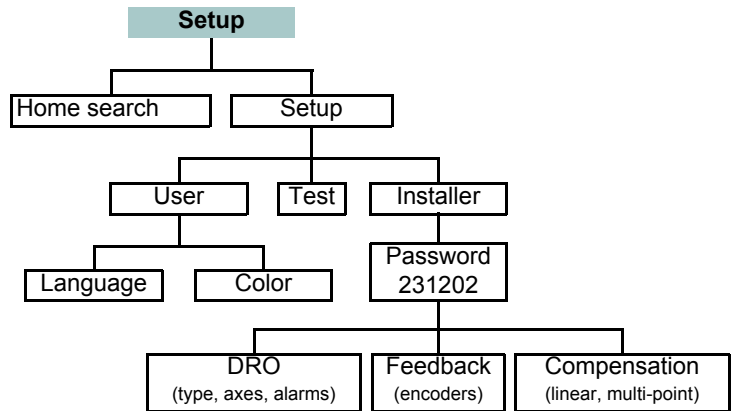
Always mount it vertically so its keyboard is within operator's reach and its digits are easily visible (at operator's eye level).

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) for this connection.

4.6 Installation parameters

4.6.1 Accessing installation parameters



Setup

Setup

Gives access to setting installation and user parameters and to the test mode.

The parameter setup is divided into three parts:

User

1- USER PARAMETERS: Parameters that may be modified by the user: *change the language, set the chronometer and set the screen color.*

Install

2- INSTALLER PARAMETERS: Parameters that must be set when installing the DRO for the first time, when replacing an encoder or when doing a repair. They are parameters related to the machine, feedback and to the DRO itself.

Test

3- TEST MODE: To check the various status of different elements of the DRO, such as screen, keyboard, etc.

For the installer only. Accessing the test mode requires a password:

Password: **231202**



4.6.2 User parameters

Setup

Setup

User

Parameters that may be modified by the user: *change the language, set the chronograph and set the screen color.*

4.6.2.1 Language



Use the cursor keys to select the language.



Press Enter.

4.6.2.2 Screen color

ColorSet

Use the cursor keys to change the colors for the background, for the numbers, for the box, etc.

The *default* box shows the three preset options:

- 1- **Default:** Blue background with yellow numbers.
- 2- **Color 1:** Black background with yellow numbers.
- 3- **Color 2:** Green background, white box and green numbers.

4.6.3 Installer parameters

Setup

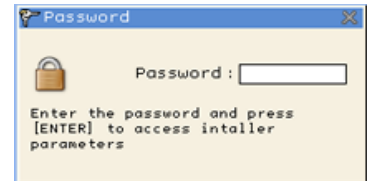
Setup

Install

Parameters that must be set when installing the DRO for the first time, when replacing an encoder or when doing a repair. They are parameters related to the machine, feedback and to the DRO itself.

Enter the password: **231202**

Note: Password "050672" allows for reset to factory parameters and removal of compensation table



4.6.3.1 Parameter backup into USB memory

If a USB memory is connected, it is possible to save and recover:

- DRO parameters
- Multi-point compensation tables
- User programs

4.6.3.2 DRO

Setup

Setup

Install

DRO

It configures the DRO for each type of machine: Number of axes, type of machine (mill, lathe, etc.).

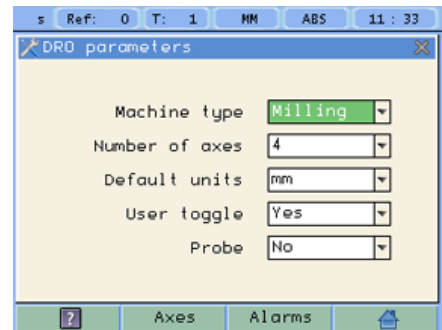
Pressing this button opens the window shown on the right. The following items are set in it:

- 1- **Type of machine:** Mill or lathe.
- 2- **Number of axes to display:** 1, 2 or 3.
- 3- **Default units:** mm or inches.
- 4- **Toggled by the user:** Yes or NO. If set to "YES", to change the units, select the **mm/inch** option from the **Display** drop list while the DRO is showing the main screen.
- 5- **Configure the probe.** It may be configured as inactive, active low (0V) or active high (5V or 24V depending on type of connection).

3rd



6- **Display Z only.** The main window will only show the X and Z axes. Pressing the third axis selection key, the display will toggle between displaying 2 axes and displaying 3 axes.



Axes option:

Setup

Setup

Install

DRO

Axes

These parameters must be set for each axis.

1- Combine axes: It is possible to add/subtract any axis to/from another axis. The factory setting is NO.

Rotary axes cannot be combined.

2- Display resolution: It is the resolution of the DRO. It makes it possible to display the position with a coarser resolution than that of the feedback device, although the actual internal calculation is done with the finest resolution.

Factory setting: 0.0000. It means that the display resolution is the encoder resolution.

3- Reverse the feedback reading (pulse counting) direction: Yes or NO. Factory setting: NO.

4-Display Feedrate: Axis feed rate, both in mill and lathe modes. When activating this option ("YES"), the screens shows a window indicating the feed rate of each axis.

The units will be m/min or inches/min depending on whether MM or INCH is active.

Axis	Combine axes	Display resolution	Reverse counting	Show feedrate
X	None	0.0000	No	No
Z1				
Z2				

Name

The names of the axes may also be changed instead of calling them X, Y or Z.

Alarms option:

Setup

Setup

Install

DRO

Alarms

Turn on/off the various types of alarms.

These alarms must be set for each axis. The following screen is displayed:

1- 1 Vpp alarm: The DRO checks the amplitude and phase shift of 1 Vpp signals. An alarm is displayed when any of the signals gets out of the set limits.

2- Feedback alarm: Feedback alarm provided by TTL angular encoders. It may be active low (TTL 0) or active high (TTL 1).

3- Feed rate overrun alarm: When set to YES, an alarm is issued over 200 kHz.

4- Travel limits: Setting it to YES activates two more fields (boxes) for entering the travel limits. A warning appears on the screen when overrunning these limits.

Axis	1Vpp alarm	Feedback alarm	Over-speed alarm	Travel limits	Lower limit	Upper limit
X	Yes	None	No	Yes	0.0000	0.0000
Z1						
Z2						

4.6.3.3 Feedback

Setup

Setup

Install

Feedback

FAGOR

Selecting Fagor feedback knowing the name or model of the linear encoder.



Select axis.

Select type of linear encoder, type of signal and type of reference pulse.



To validate the data for that axis.

s Ref: 0 T: 1 MM ABS 10 : 43

Axis	Series	Signals	RefMark
X	S	P	SOP
Y		none	
Z		none	

? [Download] [Home]

Custom feedback selection:

Setup

Setup

Install

Feedback

Use this screen to set the characteristics of the encoder.

They are parameters for each axis.

The sections to be set are:

1- Type of axis: Linear or rotary.

1.1- LINEAR: It requests the *resolution of the linear encoder*.

1.2- ROTARY: It requests the number of pulses/turn of the encoder and the number of turns the encoder must make for the machine to consider a 360° movement (mechanical gear ratio). For SSI, the number of bits per turn (maximum number of bits = 23)

s Ref: 0 T: 1 MM ABS 10 : 36

Feedback properties

Axis	Axis type	Encoder signals	Resolution	TTL multiply	SIN multiply
X	Linear	1 Vpp	0.0001	4	50
Y					
Z					

? Ref Fagor [Home]

s Ref: 0 T: 1 MM ABS 09 : 53

Feedback properties

Axis	Axis type	Encoder signals	Pulses, turns
X	Rotary	TTL	3600 1
Y			
Z			

? Ref Fagor [Home]

2- Type of encoder signal: TTL, 1 Vpp or SSI.

2.1- TTL: It requests the resolution of the linear encoder or Nr of pulses of the encoder.

The following table shows the resolutions of FAGOR TTL linear encoders.

Model	Resolution
MT/MKT, MTD, CT & FT	0,005 mm
MX/MKX, CX, SX, GX, FX, LX, MOX, COX, SOX, GOX, FOX & LOX	0,001 mm
SY, SOY, SSY, GY, GOY & GSY	0.0005 mm
SW, SOW, SSW, GW, GOW & GSW	0.0001 mm

2.2- 1Vpp: The **TTL MULTIPLICATION** and **SINUSOIDAL MULTIPLICATION** boxes are activated.

* **TTL multiplication.** Options: 0.5, 1, 2, 4. The factory setting is 4 and it is the one normally used with FAGOR linear encoders.

* **Sinusoidal multiplication.** Options: 1, 5, 10, 20, 25, 50. One or the other is used depending on the resolution to be obtained if the feedback signal is **1Vpp** or **TTL** with **distance-coded** reference marks.

Example: We wish to install a FAGOR GP linear encoder (1 Vpp and 20-micron-pitch graduated glass) with **1 micron** resolution:

$$\text{Resolution} = \frac{\text{Graduation pitch (20, 40 or 100 } \mu\text{m)}}{\text{TTL multiplier} * \text{Sinusoidal multiplier}}$$

$$1 \mu\text{m} = \frac{20 \mu\text{m}}{4 * 5}$$

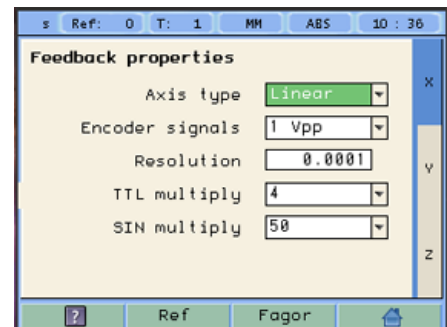
Therefore, a **1-micron resolution**, would require a **sinusoidal multiplying factor of 5**.

If the feedback signal is TTL with NO distance-coded reference marks, like GX, FT, SY etc. the value for this parameter will be "1".

2.3- SSI: It is the protocol used to communicate with absolute encoders. This protocol is configured with the following parameters:

* **Resolution:** Only requested if the axis is linear. The resolution to be used with FAGOR absolute linear encoders is 0.0001 mm.

* **Number of bits:** It sets the digital communication between the encoder and the DRO. The factory setting and the one used with absolute linear encoders are 32 bits.



Reference

Setup

Setup

Install

Feedback

Reference

This window sets the parameters related to home search and the type of reference mark of the encoder. This configuration must be set for each axis.

* **User offset:** Offset of the reference point with respect to the reference zero of the feedback device, independent for each axis.

Usually, the machine reference zero (reference mark of the linear encoder) does not coincide with the absolute zero to be used. Therefore, this parameter must be assigned the value of the distance from the machine zero point to the feedback reference point.

Factory setting: 0.

This value will be in mm or inches depending on whether the DRO units have been set in "mm" or "INCH".

* **Mandatory Home search.** When set to **YES**, every time the DRO is turned on, it forces a home search. It is recommended to set it to **YES** when the DRO uses positioning error compensation because if the compensated axis is not homed, the compensation will not be applied.

* **Type:** It sets the homing system of the linear encoder: NONE, NORMAL (INCREMENTAL) or DISTANCE-CODED.

When selecting DISTANCE-CODED, you must set the engraving pitch of the linear encoder (20 µm, 40 µm or 100 µm) and the external multiplying factor (1, 5, 10, 25 or 50).

Reference marks

User Offset: 0.0000

Homing on start up: No

Type: Normal

Reference marks

User Offset: 0.0000

Homing on start up: No

Type: Coded

Extern. Multiply: 1

Engraving pitch options: 20, 40, 100

External multiplying factor options: 1, 5, 10, 20, 25, 50



Exit and save data.

4.6.3.4 Compensation

Setup

Setup

Install

Comp.

Choose the type of compensation to be used.

1- NONE.



2- LINEAR.

Choose LINEAR from the list, press Enter to validate it.

Edit

Press Edit to enter the compensation value. The following window is opened:

Even when working in inches, this value must always be in mm.



Enter the linear compensation value and press Enter.

3- MULTI POINT.



Choose MULTI-POINT from the list and press Enter to validate it.

Important Before capturing data for an accuracy graph, a home search must be carried out because the compensation will not be applied until the home search is done. To use this compensation, it is recommended to force a home search on power-up.

The maximum amount of error that may be compensated corresponds to a slope of $\pm 3\text{mm/m}$.

Point	Position	Error
1	0.0000	0.0000
2	0.0000	0.0000
3	0.0000	0.0000
4	0.0000	0.0000
5	0.0000	0.0000
6	0.0000	0.0000
7	0.0000	0.0000
8	0.0000	0.0000

Edit

Pressing the Edit button displays a table with 105 points and their corresponding error values.

Error to be compensated = Master's actual position - displayed position

There is no need to use all the points. The compensation point must have at least one point with no error (error 0).

Different options are offered when the Function button is pressed:

* **Exit:**

Function

Exit

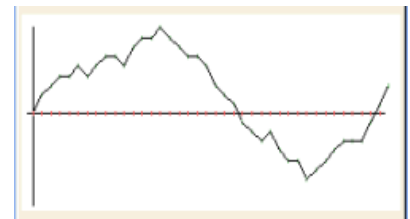
To exit the screen saving the data.

* **Draw Graph:**

Function

Draw Graph

Draws a graph with the points and errors entered. It is recommended to check the graph to detect possible mistakes made when entering data.



4.6.4 Test mode

Test

It may be used to know system information such as software version, hardware version, software burning date, etc.



Pressing the **Test** key displays the software and hardware versions, software recording date, checksum, error history, etc.

Pressing **Test** again offers the chance to run different tests that are very useful for troubleshooting the DRO itself or the encoder.

The Test mode is for the installer only and the access is protected with a password.

Password: 231202

Note: Password "050672" allows for reset to factory parameters and removal of compensation table

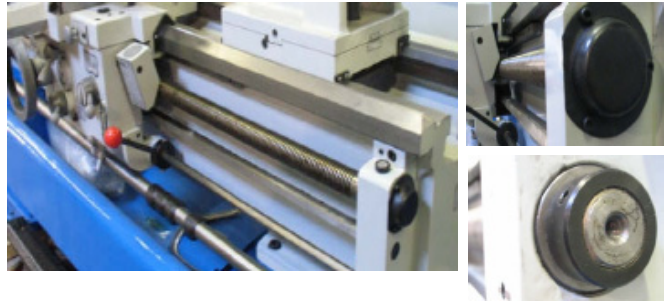
4.6.5 Threading

4.6.5.1 Installation Instructions

To install the threading feature onto a lathe you will first have to attach an encoder to the end of the ballscrew/leadscrew.

First off you will need to locate the end of the ballscrew/leadscrew.

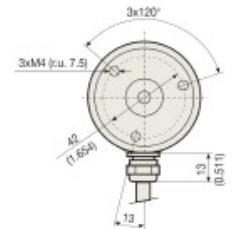
You will need to expose the end of the ballscrew/leadscrew so that you can attach the encoder to it.



Encoder hole pattern

To attach the encoder to the ballscrew/leadscrew you will need some sort of shaft extruding off of it.

Here is an example of a shaft that was made to connect to the encoder.

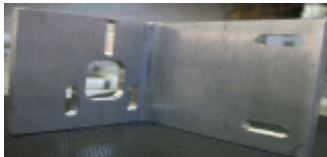


Note: AF Coupling will be connecting the shaft to the encoder.)



You will have to make up a bracket to secure the encoder onto the machine.

Here is an example of a bracket made up to mount to the machine.



Accessories included with encoder

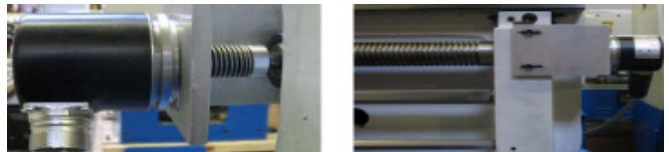


The encoder and AF Coupling are attached to the bracket as another example.



Connect the shaft to the AF Coupling.

Align and mount the encoder bracket onto the machine.



Make sure everything is tight, aligned and secure.

Attach the cable to the encoder and the DRO.



After mounting all of the hardware correctly, the next step is set the software parameters.

4.6.5.2 Parameters for the threading function

In Feedback properties set Z2 as Rotary axis type (Z2 reads the pulses of the encoder connected to the leadscrew in the lathe). Then, follow the instructions on the screen to complete the configuration of Z2: number of pulses of the encoder and the leadscrew pitch of the lathe in millimeters or inches.

Access the DRO, AXIS and FEEDBACK parameters as described in the previous sections and set them as follows:

Machine type: Lathe

Number of axes: 3

Default units: mm or inches.

Type of axis: Rotary.

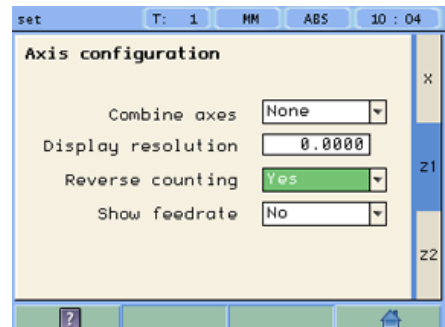
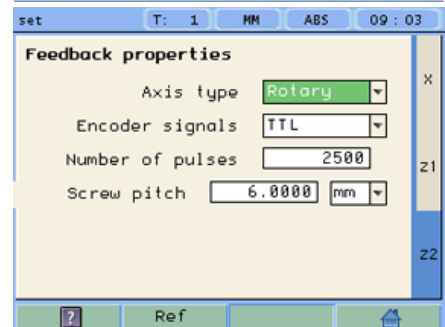
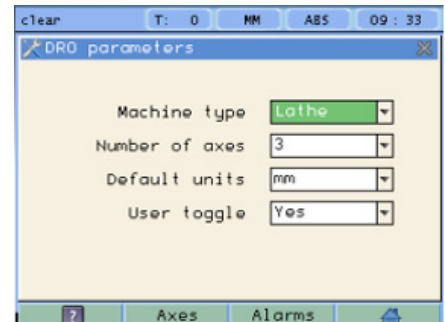
Number of pulses: Depends on encoder.

Pitch: Depends on leadscrew/ballscrew. In millimeters (mm) or threads per inch (tpi).

Note: If the polarity of the Z axis linear encoder needs to be reversed, follow steps below for Z1.

Change Reverse Counting to Yes.

It will ask you if you want to save parameters. Press Yes.



5 Appendix

5.1 UL seal

see "Rear panel" (page 23).

5.2 CE seal



Warning

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.

5.2.1 Declaration of conformity

Manufacturer: Fagor Automation, S. Coop.
Barrio de San Andrés 19,
20500, Mondragón -Guipúzcoa- (SPAIN)

We hereby declare, under our responsibility that the product this manual refers to

Note. Some additional characters may follow the references to the models indicated in this manual. All of them comply with the following regulations:

5.2.1.1 Electromagnetic compatibility:


EN 61000-6-2:2005 Standard on immunity in industrial environments

EN 61000-6-4:2007 Standard on emission in industrial environments

According to the European Directive: 2004/108/CE on electromagnetic compatibility.

In Mondragón, September 1st, 2009

Fagor Automation, S. Coop.


Director Gerente
Pedro Ruiz de Aguirre

5.2.2 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 manipulate the inside of the unit



Only personnel authorized by Fagor Automation may open this unit.

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.

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 limits for temperature and relative humidity indicated in chapter

Do not work in explosive environments

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

Work environment

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

Install this DRO vertically 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 coolants, chemical products, blows etc that could damage it. Keep it away from direct sunlight, extremely hot air, high voltage and high current sources as well as from relays, or high electromagnetic fields (about 0.5 m or 20 inches).

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.

5.2.3 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.

5.2.4 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:

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.).

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.

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

Pad the unit inside the cardboard box with polyurethane foam on all sides.

Seal the cardboard box with packing tape or industrial staples.

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 oil, alkalis and bleaches, dissolved detergents and 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.

Web: www.fagorautomation.com
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Rolling Meadows, IL 60008
847-981-1500



Fagor Automation S. Coop.

Fagor shall not be held responsible for any printing or transcribing errors in this manual and reserves the right to make any modifications to the characteristics of their products without prior notice.