FAGOR AUTOMATION

DRO 400i P
Installation / Operation Manual

INDEX

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.

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1 DRO Description

The intended use of the digital readout (DRO) display is to display the position measurement, both linear and angular, as well as other data obtained from the encoders connected to it. Perform operations such as those described in sections 2 and 3 of this manual.

1.1 Front Plate

Keys for axes

Keys for entering numeric values

7" color screen

Validate

Abort

Indicator LED cable

Keys to open the drop-down buttons of the FUNCTION BAR

Cursor keys
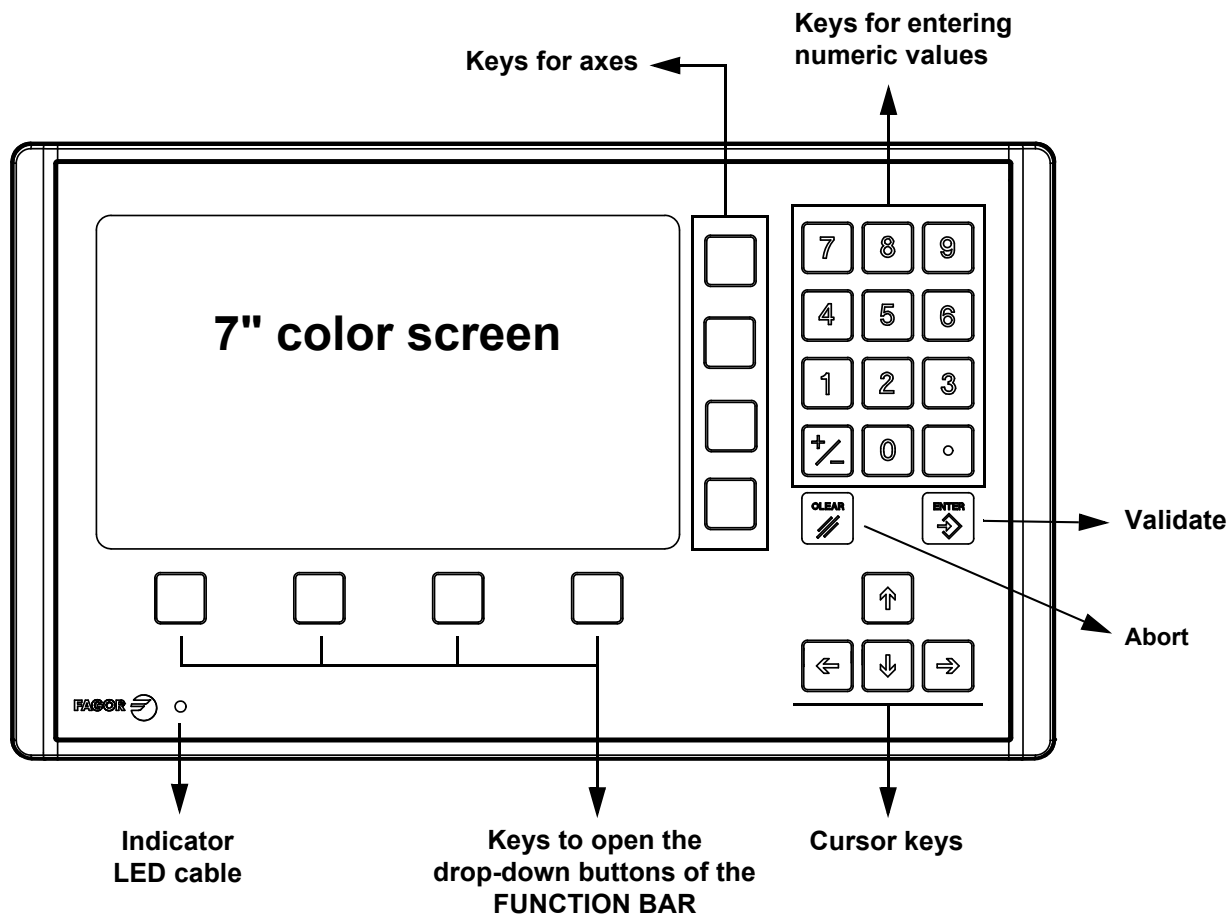
1.2 Turning the Unit On and Off

The display is switched on and off by pressing the ON|OFF Switch at the back.

When the DRO is switched on, an initial screen appears, which disappears after a few seconds and opens the work screen.

On/Off Switch

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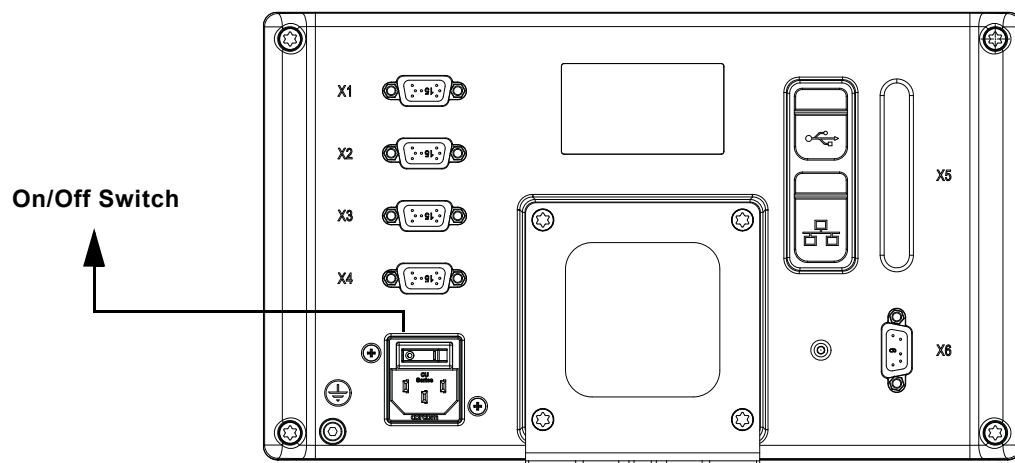
1.3 Main Screen Description

STATUS BAR   DISPLAY AREA

Set/Clear —— Set   X   120.0012

Active reference Nr —— ⌐ⁿ 2

Active tool Nr —— ▮ 1   Y   15.0012

Display units mm/inch —— ⌐ mm   Z   30.0012

Display mode: INC/ABS —— ABS

Chronometer —— 12:17   W   40.012

FUNCTION BAR ◄——   Setup   Change   Display   Function
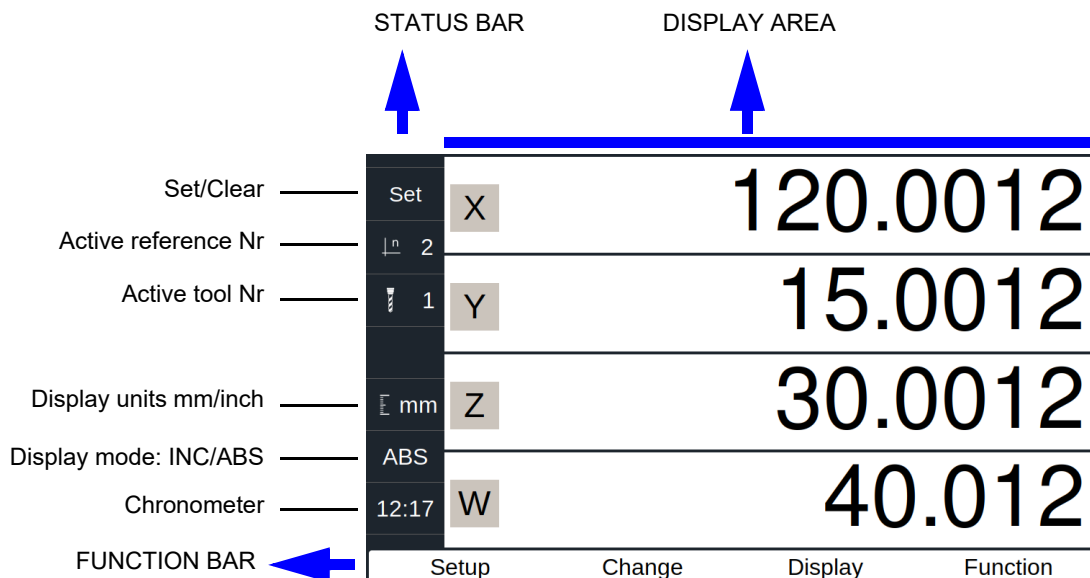
1.4 Function Bar

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

1.4.1 Access to Functions

Setup	Change		Display	Function
			Inc/Abs	Bolt-hole drilling
Home search	Reference	Tool	mm/inch	Linear drilling
Configuration	Part datum	Tool setting	Set/Clear	Grid pattern drilling
	Part center	Tool table	Deg/DMS	Go to
			Rad/Diam	Cycles
				Programs
				Calculator

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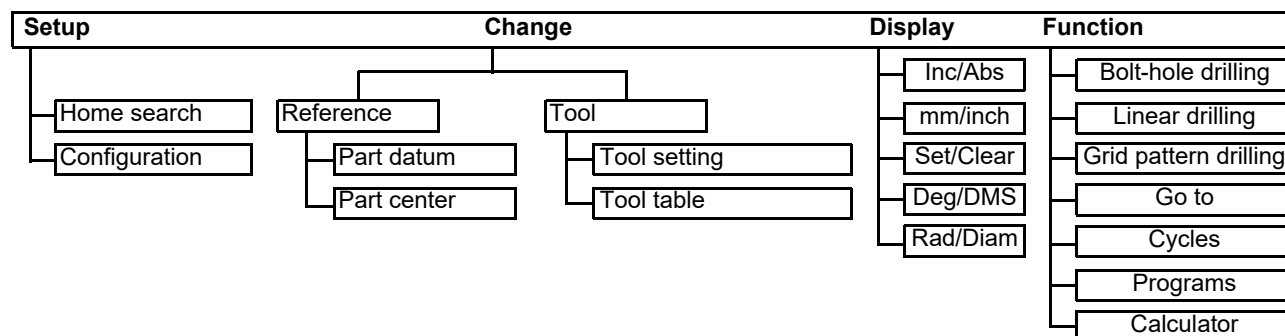
2 DRO Operation

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.
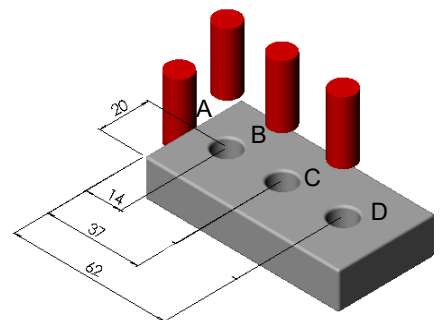
2.1.2.2 Incremental Mode

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.
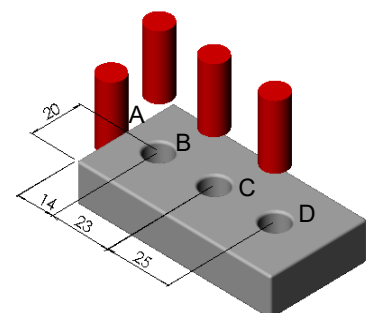
2.1.2.3 Degrees / Degrees-Minutes-Seconds

Display	Deg/DMS

| 1 | 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

| Value | ENTER | To preset a value for an axis. |

| CLEAR | | To zero the axis, either preset a 0 value using the previous keystroke sequence or use this other sequence (clear + axis). |
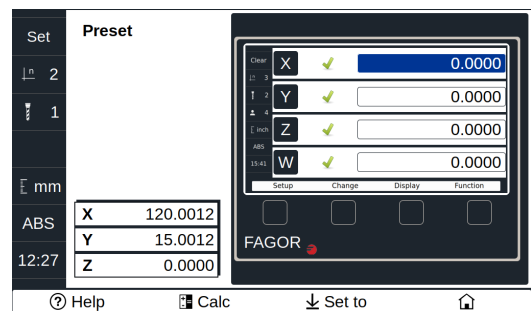
2.2.2 In "Clear" Mode

| | Set the display to zero. |

To preset a value:
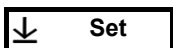
| ENTER | | Value | ENTER |

| ↓ Set | And validate the data by pressing this key. |

| ⌂ | Or ignore it by pressing this key. |

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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 or define the tool (diameter and length).

It offers a 20-tool table.

Tool	Diameter	Length
0	0.0000	0.0000
1	40.0000	10.0000
2	80.0000	25.0000
3	120.0000	50.0000
4	240.0000	0.0000
5	10.0000	0.0000
6	10.0000	0.0000

2.4.1.1 Tool Change

Tool Nr. ENTER 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 Enter the diameter of the tool. Press Enter.

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.

↑ ENTER →   Tool compensation on /off in this direction:

↓ ENTER →   Tool compensation on /off in this direction:

← ENTER →   Tool compensation on /off in this direction:

→ ENTER →   Tool compensation on /off in this direction:
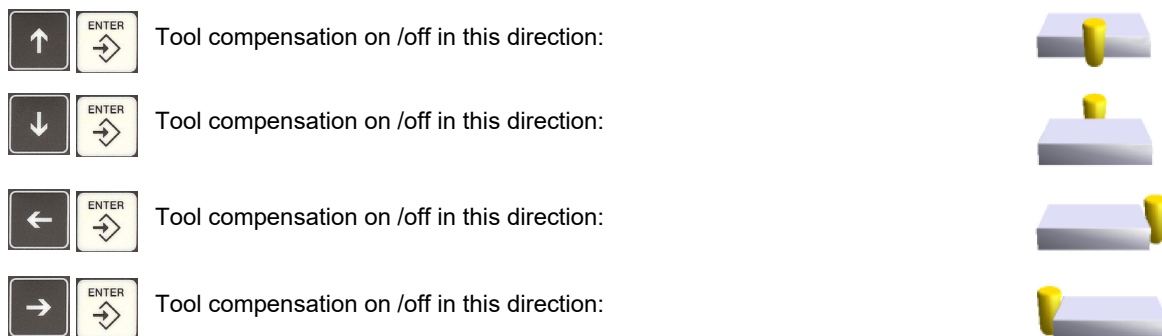
When machining pockets, tool radius compensation is activated in two axes at the same time.

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

← ↑ ENTER →   Tool compensation on /off for this corner of the pocket:

← ↓ ENTER →   Tool compensation on /off for this corner of the pocket:

→ ↓ ENTER →   Tool compensation on /off for this corner of the pocket:
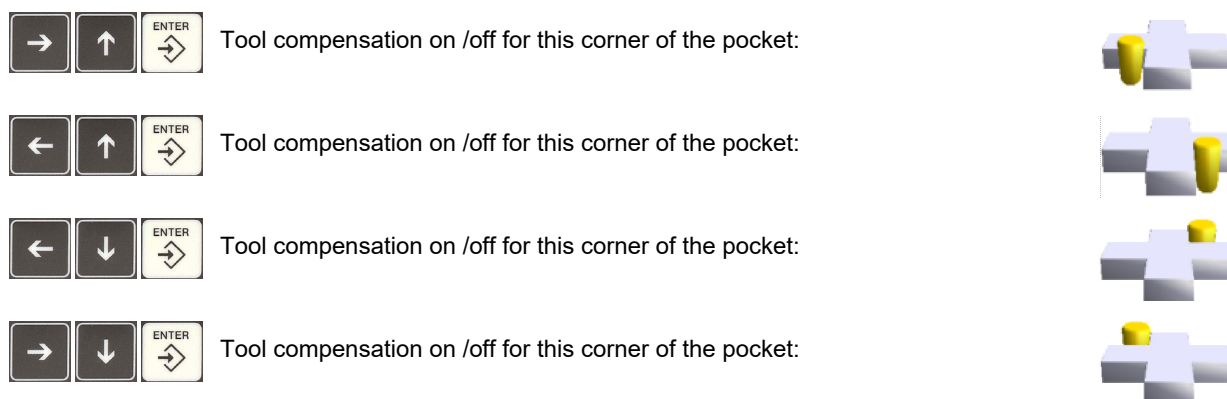
2.4.2 Reference

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.

Referencing   Assistant for setting the part zero (datum point).

Set	Reference	
⌐ 4	Number of Reference	4
⌐ 5		
⌐ mm		
ABS		
14:55		
⑦ Help	1/2 Referencing	⌂

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2.4.2.1 Changing the Reference

Change		Reference

Changing from one reference to another.

Ref. no. [ENTER →] 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.
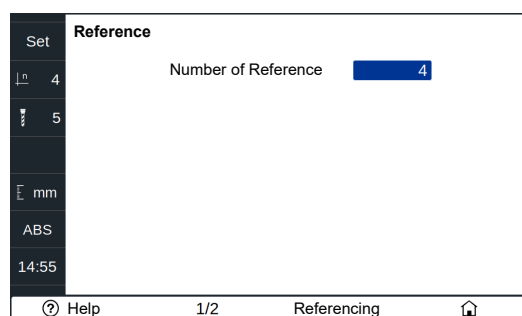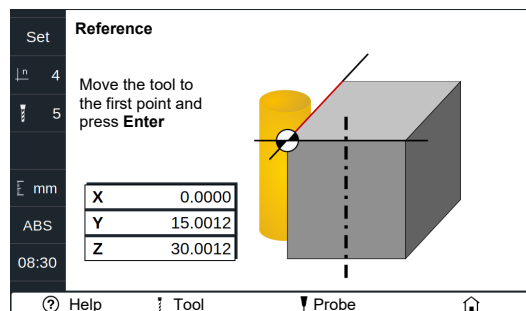
| Set | Reference |
| Move the tool to the first point and press **Enter** |
X	0.0000
Y	15.0012
Z	30.0012

? Help   ⌁ Tool   ▼ Probe   ⌂

⌁ 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:

⌁ Tool

Set or change the tool.

Move the tool to the first side until it touches the part.
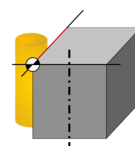
[ENTER →] Press Enter.

Move the tool to the second side until it touches the part.
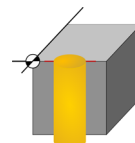
[ENTER →] Press Enter.

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

[ENTER →] Press Enter.

[1] [2]
[3] [4]
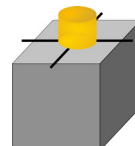
Select the corner where the part zero (datum) will be set.

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.
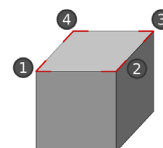
2.4.2.3 Setting Part Zero (Datum) without using the Assistant

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.
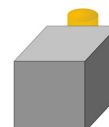
2.4.2.4 Searching the Center of a Part

Change	Reference	1/2

Tool — 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.
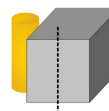
Move the tool to the second point.

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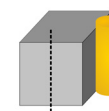
2 **Note:** This mode may be accessed directly by pressing this key.

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2.5 Special Functions

| Function | It gives access to the specific milling functions. |

2.5.1 Cycles

The DRO allows storing 99 cycles, numbered from 1 to 99. The cycles may be executed, deleted or edited at will.

The screen shows the data of the selected cycle so it can be identified easily.

Deletes the selected cycle.

To edit the values of the selected cycle.
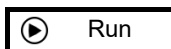
| Run | Execute (run) the cycle.

The cycles that may be programmed are:

- Bolt-hole drilling

- Linear drilling

- Grid pattern drilling

- Go to...

New functionality within the cycles:

By moving the arrow buttons (left and right) you can display the cycles that are in use or empty.

2.5.1.1 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.

2.5.1.2 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.

Set	Linear drilling			
2		Plane		
1				
		X		25.0000
mm	X	120.0012	Y	25.0000
ABS	Y	15.0012	Distance	10.0000
	Z	0.0000	Holes	96
12:44	W	40.012	Alpha	45.0000
? Help	▶ Run	▦ Application	⌂	

2.5.1.3 Grid Pattern Drilling

Function	Grid pattern drilling

It allows up to 99 holes 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.

Set	Grid drilling			
2		Plane		
1		Type	Grid	
		X		100.0000
mm	X	120.0012	Y	100.0000
	Y	15.0012	Inc 1	20.0000
ABS	Z	0.0000	Inc 2	20.0000
			Alpha	360.0000
12:47	W	40.012	N1 2	N2 2
? Help	▶ Run	▦ Application	⌂	

2.5.1.4 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.

Set	Go To			
2				
1				
		X	150.0000	✓
		Y	300.0000	✓
mm	X	120.0012	Z	0.0000	✓
ABS	Y	15.0012		
	Z	0.0000		
12:48	W	40.012		
? Help	▶ Run	▦ Application	⌂	

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

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2.5.2 Programs

Various cycles may be joined one after another making a program. The programs may be executed, deleted or edited at will.

Cycle Nr 0 indicates the end of the program.

 Deletes the selected cycle.

 Inserts an empty cycle in the current position.

Set	Programs				🗑
⌐ 2		Program number	1		
⌐ 1	n	Number	Cycles	Holes	⊕
	0	32	Linear drilling	10	
	1	73	Bolt Hole	99	
	2	24	Grid drilling	150	💾
⌐ mm	3	0	------	0	
ABS	4	0	------	0	
	5	0	------	0	
14:25	6	0	------	0	
⏵ Run		⌃		⌄	⌂
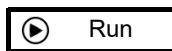
(▶) Run — Executes the current program.

New functionality within the programs:

By moving the arrow buttons (left and right) you can display the programs that are in use or empty.

2.5.2.1 Execute Programs

It will execute the various cycles up to an empty cycle or invalid cycle (with the Nr 0).

The screen shows information about the program and the current cycle:

- Current step of the program / Nr of steps.

- Cycle number and type.

(⟨) Go back one cycle.

(⟩) Advance one cycle.
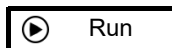
(▶) Run — Execute the current cycle.

Set	Programs	
⌐ 2		
⌐ 1		
	1 / 3	Program step
⌐ mm	C: 32	Linear drilling
ABS		
14:25		
⏵ Run	⟨	⟩	⌂

2.5.3 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.

Calculator
Set
2
1
X 120.0012
Y 15.0012
Z 0.0000
mm W 40.012
ABS
12:49
Calculator 0.0000
+
X — /
+ PI	Mode	Set to

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

| Trigonom | Trigonometric calculator. Functions: **sin**, **cos**, **tan**.

| Square | Calculator with functions: x^2, **1/x**, $\sqrt{}$.

| 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.
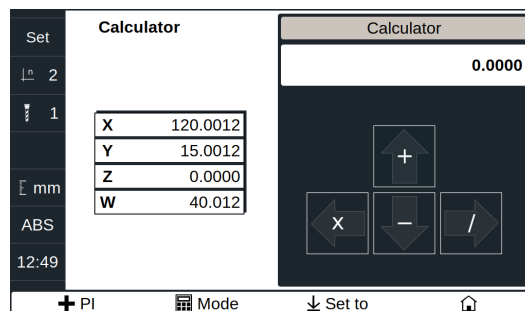
2.5.4 Simulation/Execution Special Modes

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

2.5.4.1 Cycle Simulation

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

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2.5.4.2 Cycle Execution
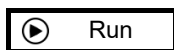
| Run |

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.

Total no. of holes programmed

Current hole no.
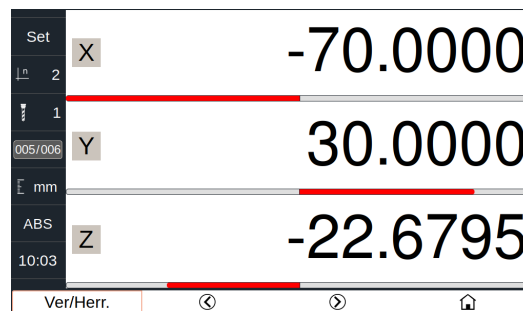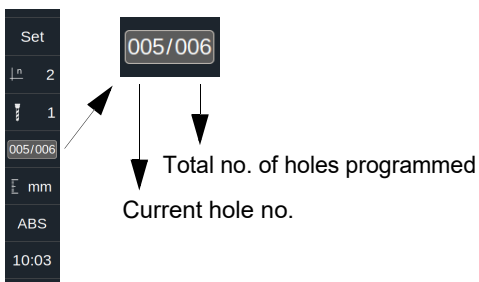
Once positioned at the drilling point, touch the surface with the tool. Press the Z axis key. The Z axis display reads zero.

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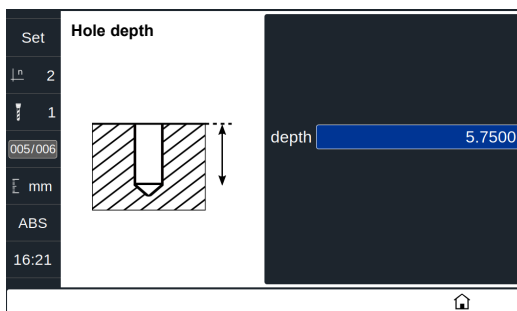
Press this key to show the coordinates of the next drilling position (hole).

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.

2.5.5 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:	115 200 Bd
Number of bits:	8
Stop bits:	1
Parity:	none

From the left column to the right, the values correspond to the 1st, 2nd, 3rd and 4th axis respectively:

For example:

> 100.000 , 132.035 , 0.435 , -124.500
> 133.005 , 132.035 , 0.435 , -140.005
> 870.020 , 132.435 , 0.435 , -145.755
> 133.870 , 132.035 , 0.435 , -140.500
> 191.890 , 205.545 , 10.540 , 40.500

2.5.5.1 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.
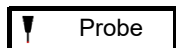
The icon shows that the probe mode is ON. The data captured by the probe is saved in the file.

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.

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3 DRO Installation

There are two ways to mount the DRO 400i P:

1- Mounted on the support arm.

Each support arm is available upon request and comes with its own specific assembly manual ·*man_dro_innova_support_arm*· for the horizontal arm and ·*man_dro_innova_support_arm_vertical* · for the vertical arm detailing the elements required for installation.

2- Built-in model.

3.1 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.

Mounting with support
ARM-300/500

Mounting with support
ARM-300/500

Mounting with rear stand

Mounting with support
ARM-V-500
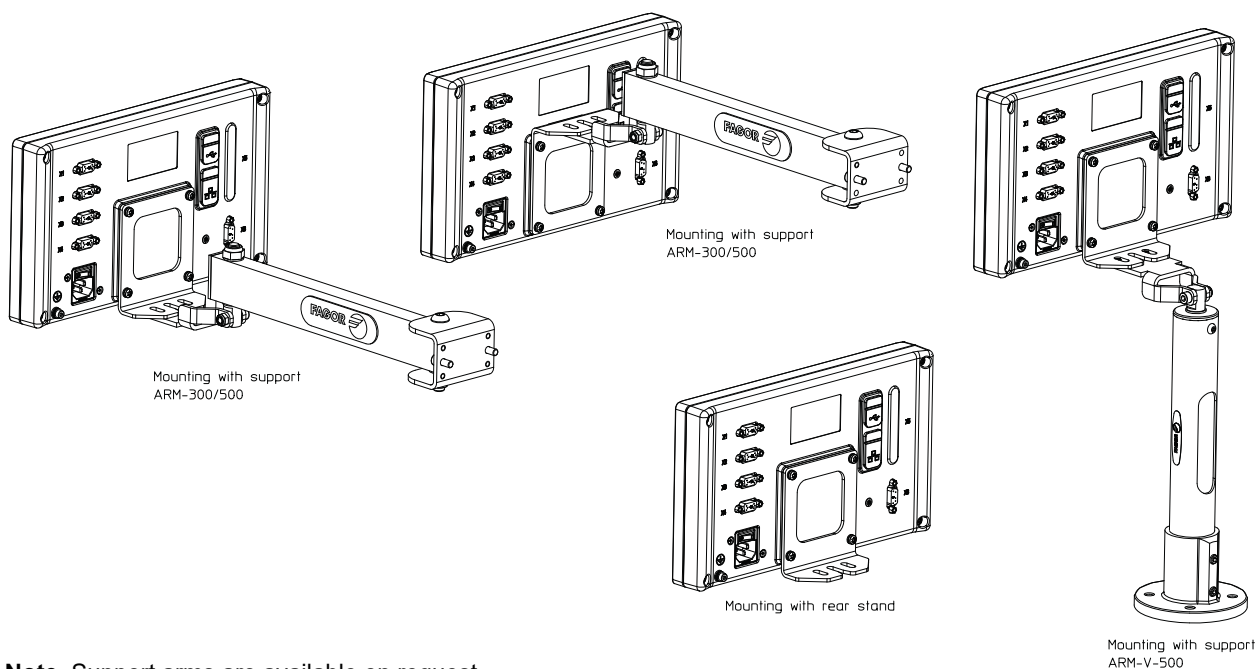
Note. Support arms are available on request.

3.2 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.
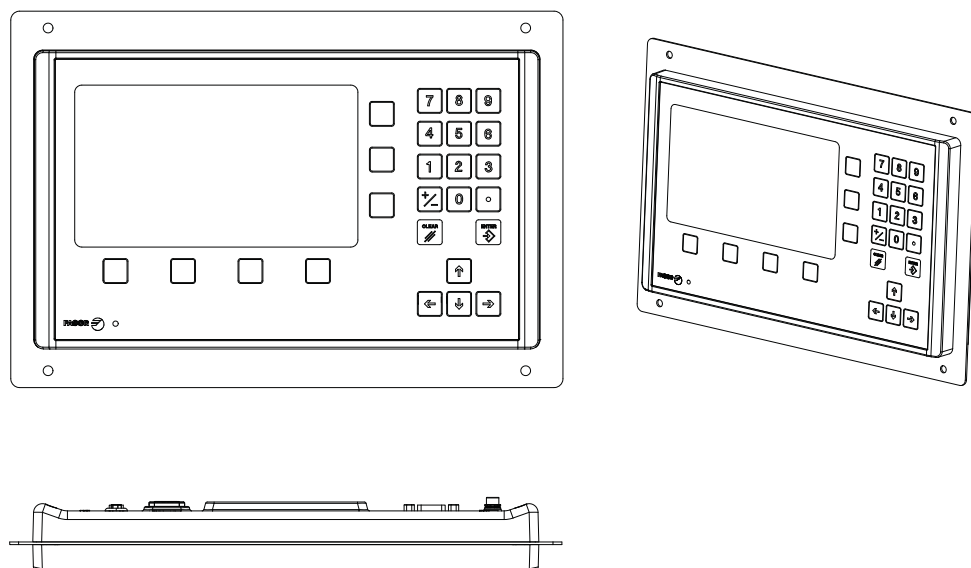
3.3   Dimensions of the Display, the Bracket and of the Window to Insert it Into

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. The dimensions of the bracket where the arm is mounted are shown in the third figure.

Dimensions of the display
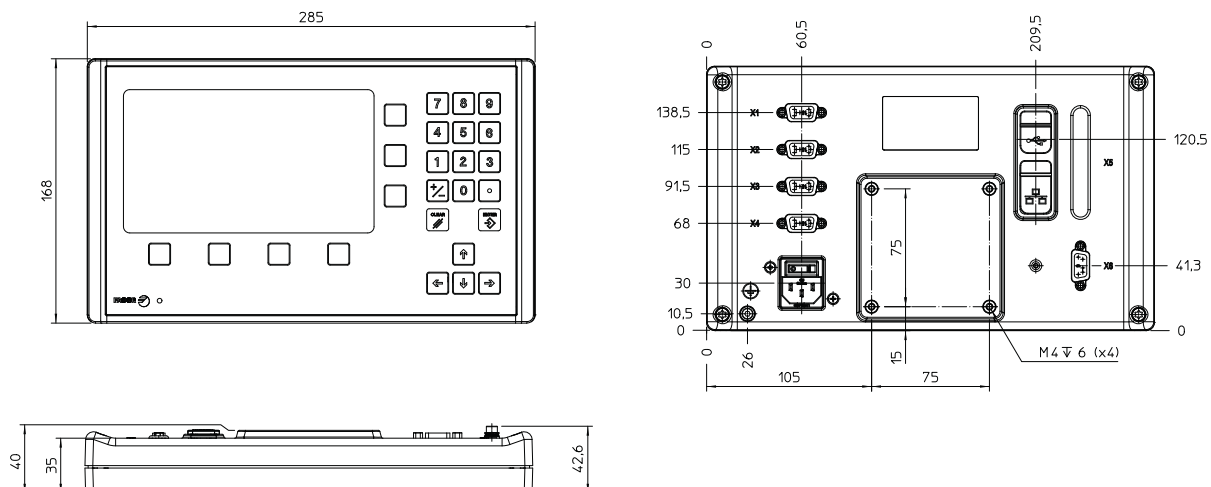
Dimensions of the window for recessed installation
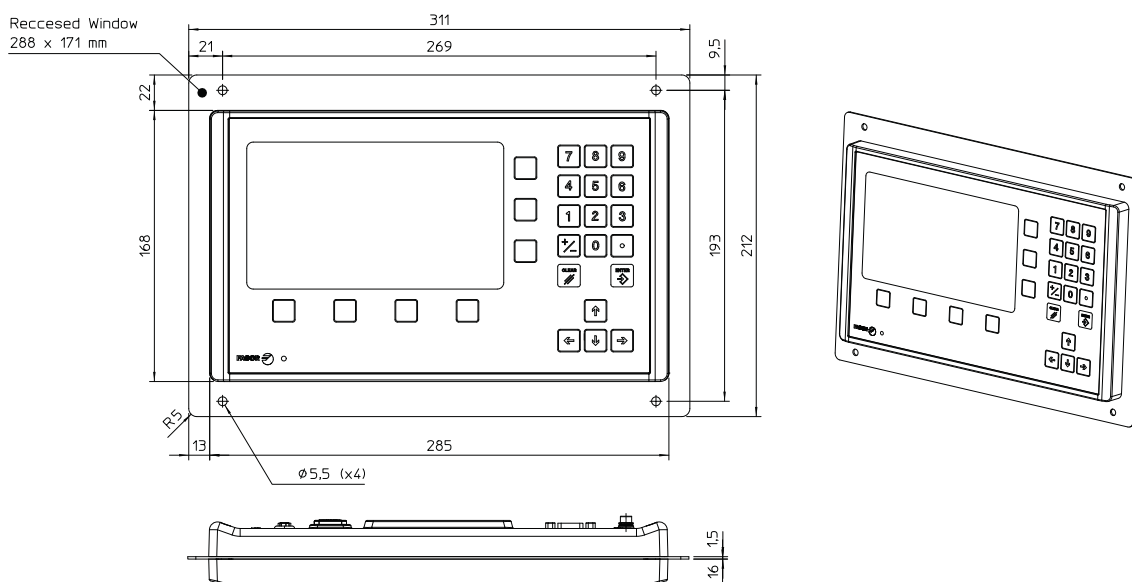
Dimensions of the arm bracket

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3.4 Rear Panel

Axis feedback input
X1-X4
(D-Sub HD 15F)

Ethernet connection

USB 2.0 connection

Touch-trigger probe input
X6 (D-Sub 9F)

Power supply input
(IEC C14 M)
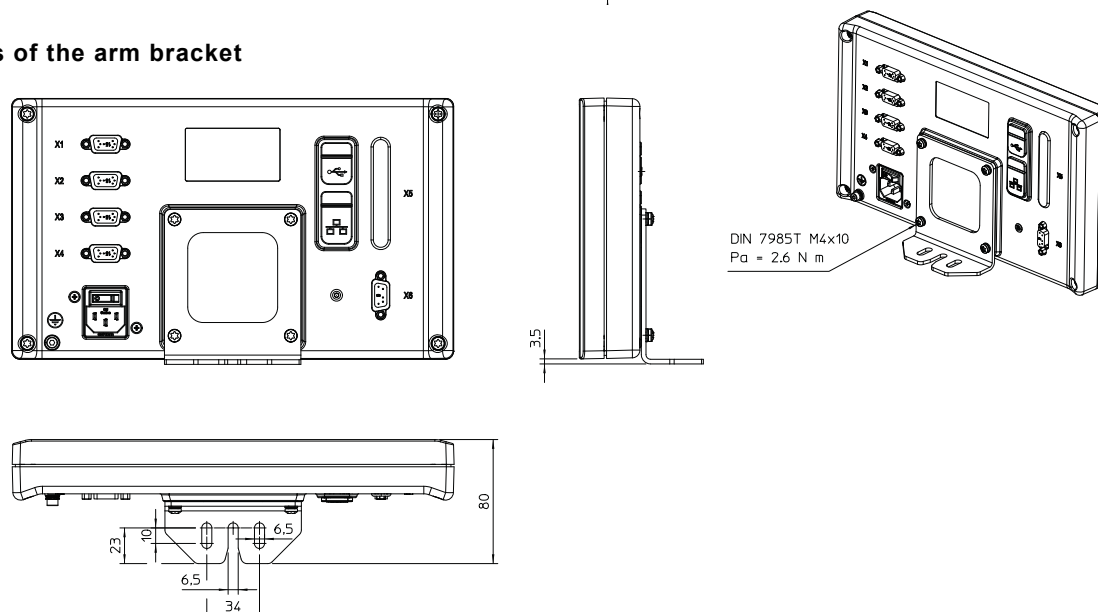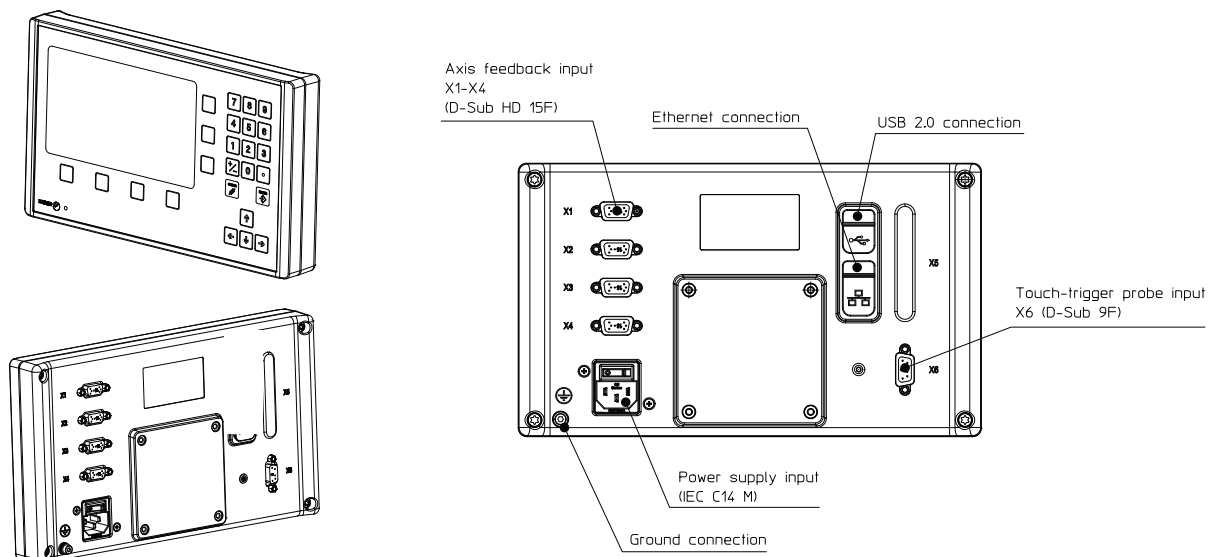
Ground connection

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

- Three-prong power connector for AC and ground connection.
- ON/OFF Switch.
- M6 terminal, for general machine ground connection.
- Mounting bracket.
- USB connector.
- Ethernet connector. *Not being used at this time*.
- Feedback connectors:

    X1.- D-Sub HD type 15-pin female connector for 1st axis feedback device.

    X2.- D-Sub HD type 15-pin female connector for 2nd axis feedback device.

    X3.- D-Sub HD type 15-pin female connector for 3rd axis feedback device.

    X4.- D-Sub HD type 15-pin female connector for 4th axis feedback device.

    X6.- D-Sub type 9-pin female connector for the probe.

3.4.1 UL/CSA Standard Marking

In order to comply with the "UL/CSA" standard, this equipment must be connected to the end application using an approved detachable cordset (ELBZ) consisting of SJT cables or equivalent for a minimum voltage of 300 Vac with a molded Nema 5-15 or Nema 6-15 plug and IEC C13 connector. Otherwise, FAGOR accepts no liability for any damage caused.

DO NOT REPLACE the removable power cord with one of inadequate capacity.

ETL file number:

Cert. to CSA
STD C22.2 # 61010-2-201

Conforms to
UL STD 61010-2-201

INTERTEK
ETL
LISTED
C   US
3168680

⚠ **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.

3.5 General Technical Characteristics

- For indoor use.

- Universal power supply from 100 (1 - 10 %) Vac to 240 (1 + 10 %) Vac and mains frequencies between 50-60 Hz. Maximum power consumed 25 VA. Resistant to mains outages of up to 10 ms.

- The machine parameters are stored for up to 10 years with the display turned off.

- Permissible ambient temperature during operation inside the display housing between 5 °C and 45 °C (41 °F and 113 °F).

- Permissible ambient temperature when NOT in operation inside the display housing between -40 °C and +70 °C (-40 °F and +158 °F)..

- Maximum **R**elative **H**umidity 95 % non condensing at 45 ºC (113 ºF).

- Degrees of protection provided by enclosures (according to DIN 40050): front panel IP 54, rear panel IP 4X, except for built-in models in which case is IP 20.

- Maximum altitude without loss of features: 2 000 m (6 561.6 ft) above mean sea level.

- Pollution Level: Degree 2.

3.6 Connections

3.6.1 Connection of the Feedback Systems

The feedback systems (linear or rotary encoders) are connected via D-Sub HD type 15-pin female connectors: X1 through X4.

Characteristics of feedback inputs: X1, X2, X3 and X4
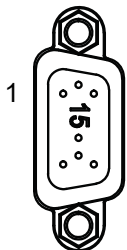
- Maximum feedback consumption: 250 mA at the +5 V input.

- It admits square-wave signal TTL.

- It admits voltage modulated 1 Vpp sinusoidal signal.

- It admits SSI communication for absolute encoders

- Maximum frequency: 250 kHz, minimum gap between flanks: 950 ns.

- Phase difference: 90º ± 20º, hysteresis: 0.25 V, Vmax: 7 V, maximum input current: 3 mA

- High threshold (logic state 1): 2.4 V < VIH < 5.0 V

- Low threshold (logic state 0): 0.0 V < VIL < 0.55 V

Feedback connection. Connectors X1, X2, X3 and X4

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

3.6.2 Probe Connection (X6 Connector)

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

Characteristics of probe inputs X6
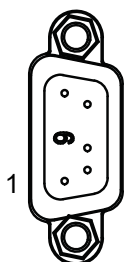
5 V probe input

Typical value 0.25 mA ➔ Vin = 5 V.

High threshold (logic level "1") VIH: From +2.4 Vdc on.

Low threshold (logic level "0") VIL: Below +0.9 Vdc.

Rated voltage Vimax = +15 Vdc.

24 V probe input

Typical value 0,30 mA ➔ Vin = 24 V.

High threshold (logic level "1") VIH: From +12.5 Vdc on.

Low threshold (logic level "0") VIL: Below +4 Vdc.

Rated voltage Vimax = +35 Vdc.

Probe connection. X6 connector

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

The unit has two probe inputs (5 Vdc and 24 Vdc) at connector X6.

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 DRO).

Probe with "normally open contact" output.

Acts with the up-flank.
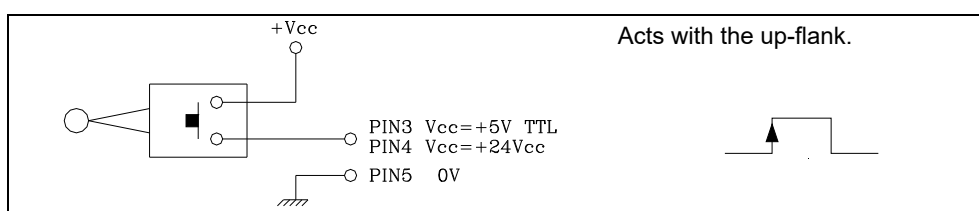
Probe with "normally closed contact" output.
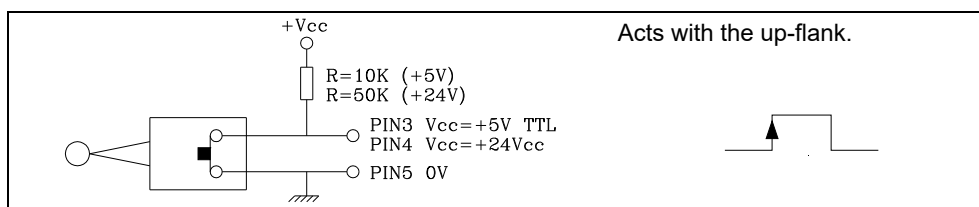
Acts with the up-flank.

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

Acts with a down flank.

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

```
                        +24V
                         ○
                         ┃ 12K
                         ┃ ○  PIN4  Vcc=+24V
  ○━◁▨▨▨▨━┃┫
         ┃        ┃      ○  PIN5  0V
         ⏚
```

Acts with a down flank.
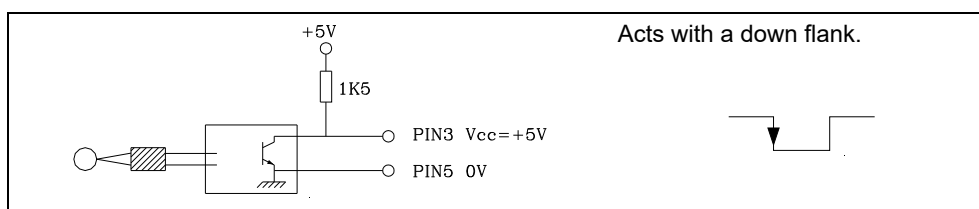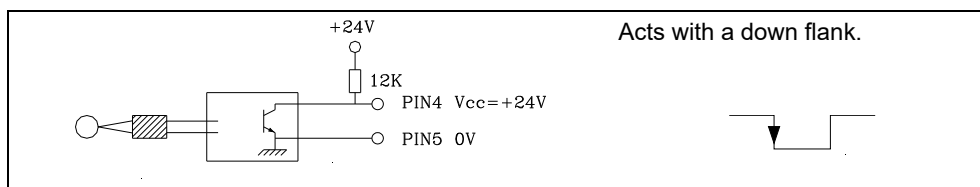
Interface with a PUSH-PULL output

```
                        +Vcc
                         ○
                         ┃        ○  PIN3  Vcc=+5V  TTL
  ○━◁▨▨▨▨━┃▷            ○  PIN4  Vcc=+24Vcc
         ┃              ○  PIN5  0V)
         ⏚
```

The active flank depends on the interface used.
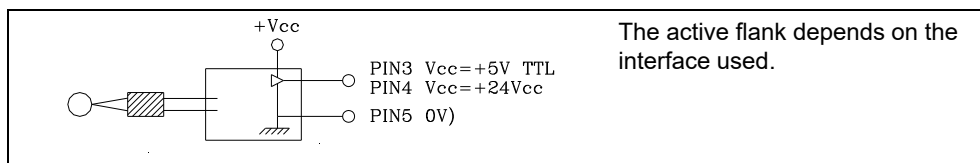
3.6.3 Power and Machine Connection

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.

Connect the external earth terminal of the display to a **P**rotective **E**arth connection.

WARNING

To avoid the risk of electric shock, the equipment must only be connected to a supply mains with a **P**rotective **E**arth connection.

3.7 Installation Parameters

3.7.1 Accessing Installation Parameters

```
                              ┌──────────────┐
                              │    Setup     │
                              └──────┬───────┘
                     ┌───────────────┴───────────────┐
              ┌──────┴───────┐              ┌─────────┴─────────┐
              │ Home search  │              │  Configuration    │
              └──────────────┘              └─────────┬─────────┘
                          ┌───────────────┬───────────┴──────────┐
                   ┌──────┴──────┐  ┌──────┴──────┐        ┌──────┴──────┐
                   │    User     │  │    Test     │        │  Installer  │
                   └──────┬──────┘  └─────────────┘        └──────┬──────┘
              ┌───────────┴──────────┐                    ┌───────┴────────┐
       ┌──────┴──────┐        ┌──────┴──────┐             │    Password    │
       │  Language   │        │    Color    │             │    231202      │
       └─────────────┘        └─────────────┘             └───────┬────────┘
                                        ┌───────────────┬──────────┴─────────────┐
                                 ┌──────┴──────┐  ┌──────┴──────┐        ┌────────┴────────┐
                                 │     DRO     │  │  Feedback   │        │  Compensation   │
                                 │(type, axes, │  │ (encoders)  │        │(linear, multi-  │
                                 │   alarms)   │  │             │        │    point)       │
                                 └─────────────┘  └─────────────┘        └─────────────────┘
```

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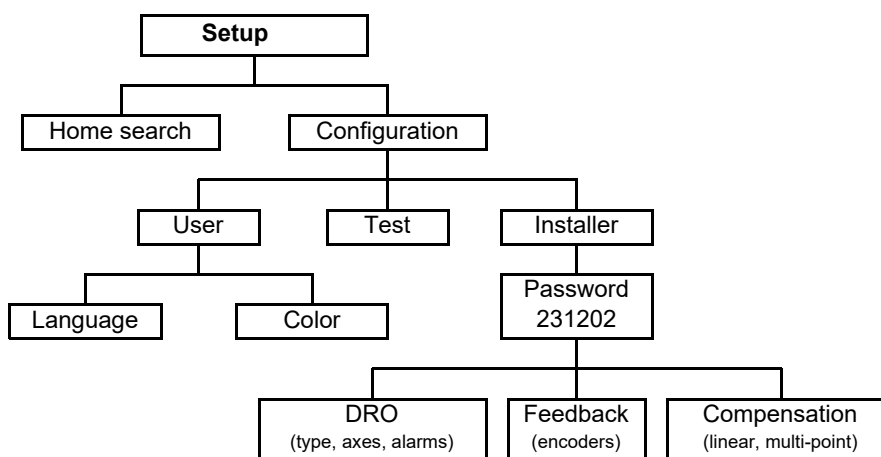
Gives access to setting installation and user parameters and to the test mode.

The parameter setup is divided into three parts:
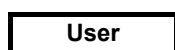
User

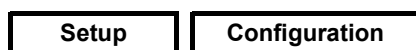**1- USER PARAMETERS:** Parameters that may be modified by the user: *change the language, set the chronometer* and *set the screen color*.

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.
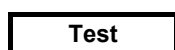
Test

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**
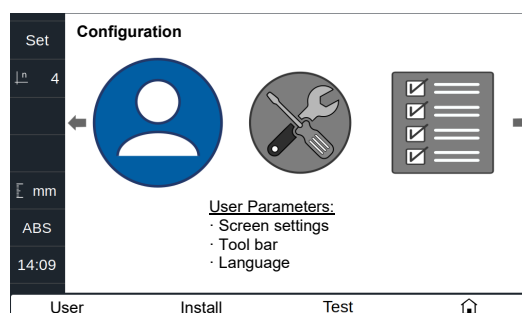
3.7.2 User Parameters

Setup		Configuration		User

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

3.7.2.1 Language
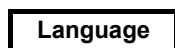
Language Use the cursor keys to select the language.

[ENTER] Press Enter.

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3.7.2.2 Screen Color

| ColorSet | The colors of the background and numbers on the main screen can be changed. There is also the option to restore the original colors.

3.7.2.3 Chronometer

| Chronometer | It is possible to turn the stopwatch on or off. As well as to restart your account or set a number.

3.7.2.4 Sound

| Sound | It is possible to turn the keystroke sound on or off.

3.7.2.5 Screen Brightness

| Brightness | It is possible to adjust the brightness value of the screen by levels: Low, Medium, High.

3.7.3   Installer Parameters

| Setup | | Configuration | | 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**
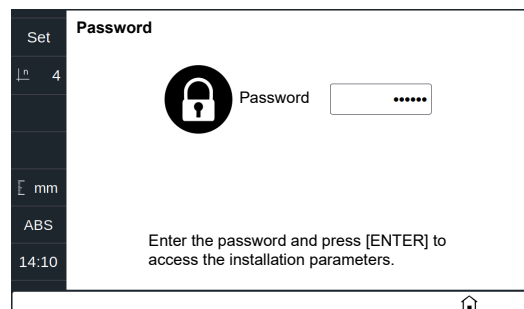
3.7.3.1 Parameter Backup into USB Memory

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

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

3.7.3.2 DRO

Setup	Configuration	Install	DRO

It configures the DRO for each machine type: Nr of Axes, machine type (milling machine).

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

1- Machine Type: Milling machine.

2- Number of Axes to Display: 1, 2, 3 or 4.

3- Default Units: mm or inches.

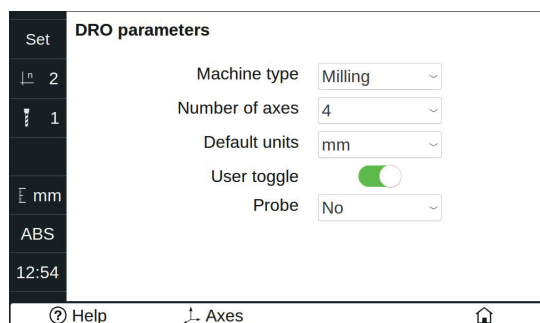**4- Toggled by the User:** Yes or NO. If set to "YES", to change the units, select the **mm/inch** option from the **Display** drop list while the DRO is showing the main screen.

Set	DRO parameters	
2	Machine type	Milling
1	Number of axes	4
	Default units	mm
mm	User toggle	(on)
ABS	Probe	No
12:54		
⑦ Help	⌐ Axes	⌂

5- Configure the Probe. It may be configured as inactive, active low (0 V) or active high (5 V or 24 V depending on type of connection).

Axes Option

Setup	Configuration	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 DRO resolution. 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.

Set	Axis configuration		X
2	Combine axes	None	
1	Display resolution	0.0001 mm	Y
	Reverse counting	(off)	
	Show feedrate (m/min)	(off)	
mm	Hide axis	(off)	Z
ABS	Default value	Radius	
12:56			W
⑦ Help	✎ Name	⚠ Alarms	⌂
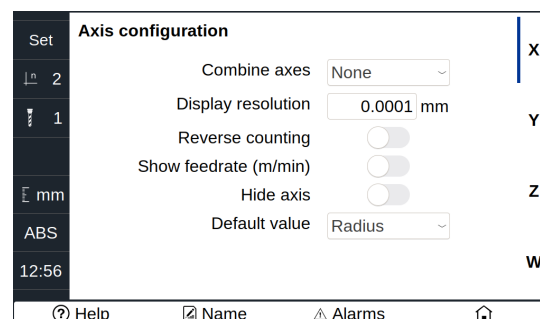
3- Reverse the feedback reading (pulse counting) direction: Yes or NO. Factory setting: NO.

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.

Name

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

Alarms Option

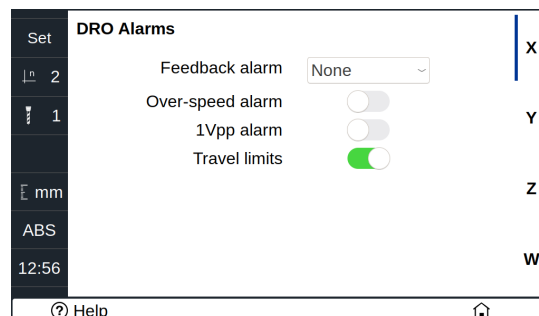| Setup	Configuration	Install	DRO	Alarms

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).

Set	**DRO Alarms**		X
2	Feedback alarm	None	
1	Over-speed alarm	⬜	Y
	1Vpp alarm	⬜	
mm	Travel limits	🟢	Z
ABS			
12:56			W
⑦ Help			⌂

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.

3.7.3.3 Feedback

Setup	Configuration	Install	Feedback	FAGOR

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

Select axis.

Select linear encoder type, signal type and reference pulse type.
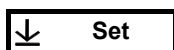
↓ **Set** — To validate the data for that axis.

Set	**Fagor Feedback properties**		None	X
2				
1			SX	Y
	Series	G ▾		
	Signals	Y ▾	GSW	Z
mm	RefMark	GSY ▾		
ABS				
12:58			None	W
⑦ Help	⊗ Clear	↓ Set to	⌂	
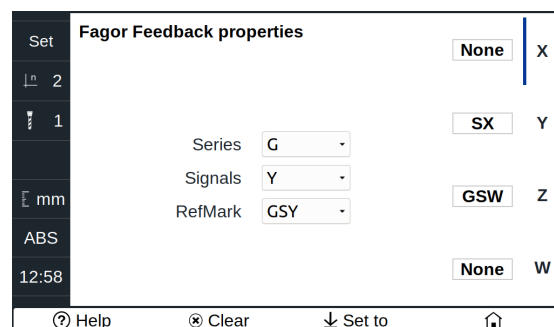
Custom feedback selection

Setup	Configuration	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 360º movement (mechanical gear ratio).For SSI, the number of bits per turn (maximum number of bits = 23).

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- 1 Vpp: 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 **1 Vpp** 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:

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

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

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.

* Nr 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.

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Reference

Setup	Configuration	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 "in".

* **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.

* **Inverted Ref.** Reverses the polarity of the reference signal, required for models with FT, CT, MT and MKT encoders.

* **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).

⌂

Exit and save data.

3.7.3.4 Compensation

Setup	Configuration	Install	Comp.

Choose the type of compensation to be used.

1- NONE.

2- LINEAR.

ENTER →

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 →

Enter the linear compensation value and press Enter.

3- MULTI POINT.

[ENTER] 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 ± 3 mm/m.

Set	Error compensation			X
⌐ 2	Select compensation type	Multi Point ⌄		
⚡ 1	**Multi Point Error Compensation**			Y
	Point	Position	Error	
	1	0.0000	0.0000	
	2	10.0000	0.0200	
⌐ mm	3	30.0000	0.0100	Z
	4	40.0000	-0.0100	
ABS	5	50.0000	-0.0300	
	6	0.0000	0.0000	W
13:05				
⑦ Help	⌃	⌄	View / ⌂	

Edit

Pressing the Edit button displays a table with 108 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:
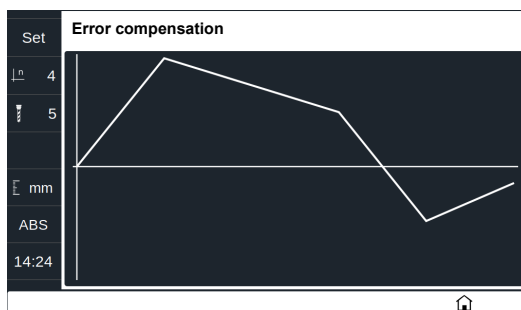
- Exit:

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.

3.7.4 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**

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4 Appendix

4.1 UL/CSA Seal

See ' UL/CSA Standard Marking ' on page 21.

4.2 CE Seal

WARNING

Before starting up the DRO, carefully read the instructions of chapter 2 in this manual.

The DRO must not be powered-on until verifying that the machine complies with the 2006/42/EC Directive.

4.2.1 Declaration of Conformity

The declaration of conformity for the DRO is available in the downloads section of FAGOR'S corporate website at http://www.fagorautomation.com. (Type of file: Declaration of conformity).

4.2.2 Safety Conditions

Read the following safety measures in order to prevent harming people or damage to this product and those products connected to it.

Fagor Automation shall not be held responsible of any physical or material damage originated from not complying with these basic safety rules.

Remember that if the appliance is used in a manner not specified by the manufacturer, the protection provided by the equipment may be compromised.

Do not manipulate the inside of the unit

Only personnel authorized by Fagor Automation may access the interior of this unit.

Do not handle the connectors with the unit connected to main AC 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 electric shocks

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. Also, before connecting the inputs and outputs of this product, make sure that the ground connection has been done.

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

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

Ambient conditions

Respect the temperature and relative humidity ranges indicated in chapter.

Do not work in explosive environments

In order to avoid risks, harm or damages, do not work in explosive environments.

Working environment

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

It is recommended to mount the DRO vertically

so its power switch of the back panel is at a distance between 0.7 m (2.3 ft) 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 1.6 ft).

This unit meets 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 mains as the unit.

- Nearby portable transmitters (radio-telephones, Ham radio transmitters).

- Nearby radio / TC transmitters.

- Nearby arc welding machines.

- Nearby high voltage lines.

- Disturbance generating elements of the machine.

- Etc.

Safety Symbols

Symbols that may appear in the manual:

WARNING Symbol.

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

Symbols that the product may carry:

WARNING Symbol.

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

ELECTRICAL SHOCK Symbol.

It indicates that that point must be under voltage.

PROTECTIVE EARTH Symbol.

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

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4.2.3 Warranty Terms

The warranty conditions for the DRO are available in the downloads section of FAGOR's corporate website at http://www.fagorautomation.com. (Type of file: General sales-warranty conditions.

4.2.4 Returning Conditions

When returning the DRO, pack it in its original package and with its original packaging material. If you do not have the original packaging material, pack it as follows:

Get a cardboard box whose 3 inside dimensions are at least 15 cm (6 in) larger than those of the unit itself. 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.

Protect the unit wrapping it up with a roll of polyethylene or with similar material.

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

Seal the cardboard box with packaging tape or with industrial staples.

4.3 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.

On the other hand, accumulated dirt can sometimes act as an electrical conductor and shortcircuit the internal circuitry, especially under high humidity conditions.

It is recommended to clean the device using a clean cloth soaked in 70 % isopropyl alcohol. **DO NOT USE** aggressive solvents, (benzol, acetones, etc.) which could damage the materials used to make the equipment.

Never use air compressed at high pressure to clean the unit because it could cause the accumulation of electrostatic charges that could result in electrostatic shocks.

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.

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.