FAGOR DRO

NVP-300TS/301TS

INSTALLATION MANUAL

Man: 0209   Soft: 2.xx

INDEX

Attention:

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

The DRO must not be powered-on until verifying that the machine complies with the "89/392/CEE" Directive.

DECLARATION OF CONFORMITY

Manufacturer: Fagor Automation, S. Coop.

Barrio de San Andrés s/n, C.P. 20500, Mondragón -Guipúzcoa (ESPAÑA)

We hereby declare, under our resposibility that the product:

Digital Readout (DRO) Fagor
NVP-300TS/NVP-301TS

meets the following directives:

SAFETY:

EN 60204-1 Machine safety. Electrical equipment of the machines.

ELECTROMAGNETIC COMPATIBILITY:

EN 50081-2	Emission
EN 55011	Radiated. Class A, Group 1.
EN 55011	Conducted. Class A, Group 1.
EN 50082-2	Immunity
EN 61000-4-2	Electrostatic Discharges.
EN 61000-4-3	Radiofrequency Radiated Electromagnetic Fields
EN 61000-4-4	Bursts and fast transients.
EN 61000-4-5	Power surges
EN 61000-4-6	Conducted disturbance induced by radio frequency fields.
EN 61000-4-11	Voltage fluctuations and Outages.

ENV 50204 Electromagnetic fields radiated by wireless telephones.

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

In Mondragón, on April 1st, 1996

Fagor Automation, S. Coop. Ltda.
Director Gerente

Fdo.: Julen Busturia

SAFETY CONDITIONS

Read the following safety measures in order to prevent damage to personnel, to this product and to those products connected to it.

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

Do not open this unit

Only personnel authorized by Fagor Automation may open this unit.

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

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

Use proper Mains AC power cables

To avoid risks, use only the Mains AC cables recommended for this unit.

Avoid electrical overloads

In order to avoid electrical discharges and fire hazards, do not apply electrical voltage outside the range indicated in chapter 2 of this manual

Ground connection

In order to avoid electrical discharges, connect the ground terminals of all the modules to the main ground terminal. Before connecting the inputs and outputs of this unit, make sure that all the grounding connections are properly made.

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

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

Ambient conditions

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

Do not work in explosive environments

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

Working environment

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

Install the unit in the right place

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

This unit complies with the European directives on electromagnetic compatibility. Nevertheless, it is recommended to keep it away from sources of electromagnetic disturbance such as.

- Powerful loads connected to the same AC power line as this equipment.
- Nearby portable transmitters (Radio-telephones, Ham radio transmitters).
- Nearby radio / TC transmitters.
- Nearby arc welding machines.
- Nearby High Voltage power lines.
- Disturbance generating elements of the machine.
- Etc.

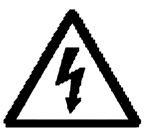
Safety symbols

Symbols which may appear on the manual

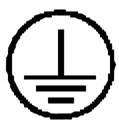
WARNING. symbol
It has an associated text indicating those actions or operations may hurt people or damage products.

Symbols that may be carried on the product

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



"ELECTRICAL SHOCK" symbol
It indicates that point may be under electrical voltage



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

WARRANTY TERMS

WARRANTY

All products manufactured or marketed by Fagor Automation has a warranty period of 12 months from the day they are shipped out of our warehouses.

The mentioned warranty covers repair material and labor costs, at FAGOR facilities, incurred in the repair of the products.

Within the warranty period, Fagor will repair or replace the products verified as being defective.

FAGOR is committed to repairing or replacing its products from the time when the first such product was launched up to 8 years after such product has disappeared from the product catalog.

It is entirely up to FAGOR to determine whether a repair is to be considered under warranty.

EXCLUDING CLAUSES

The repair will take place at our facilities. Therefore, all shipping expenses as well as travelling expenses incurred by technical personnel are NOT under warranty even when the unit is under warranty.

This warranty will be applied so long as the equipment has been installed according to the instructions, it has not been mistreated or damaged by accident or negligence and has been manipulated by personnel authorized by FAGOR.

If once the service call or repair has been completed, the cause of the failure is not to be blamed the FAGOR product, the customer must cover all generated expenses according to current fees.

No other implicit or explicit warranty is covered and FAGOR AUTOMATION shall not be held responsible, under any circumstances, of the damage which could be originated.

SERVICE CONTRACTS

Service and Maintenance Contracts are available for the customer within the warranty period as well as outside of it.

MATERIAL RETURNING TERMS

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

1.- Get a cardboard box whose three inside dimensions are at least 15 cm (6 inches) larger than those of the unit. The cardboard being used to make the box must have a resistance of 170 Kg (375 lb.).

2.- When sending it to a Fagor Automation office for repair, attach a label indicating the owner of the unit, person to contact, type of unit, serial number, symptom and a brief description of the problem.

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

4.- Pad the unit inside the cardboard box with poly-utherane foam on all sides.

5.- Seal the cardboard box with packing tape or industrial staples.

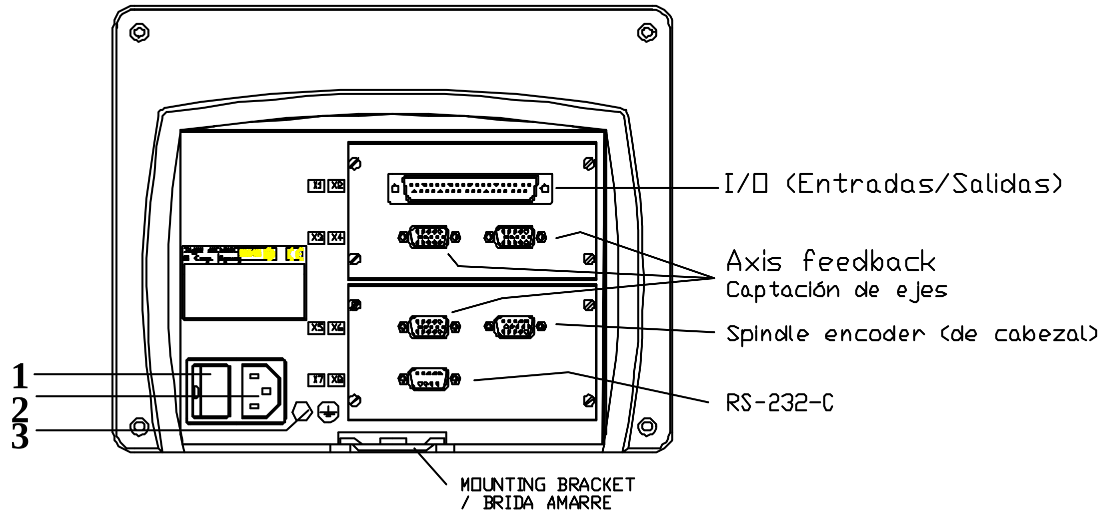
1. UNIT DESCRIPTION

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

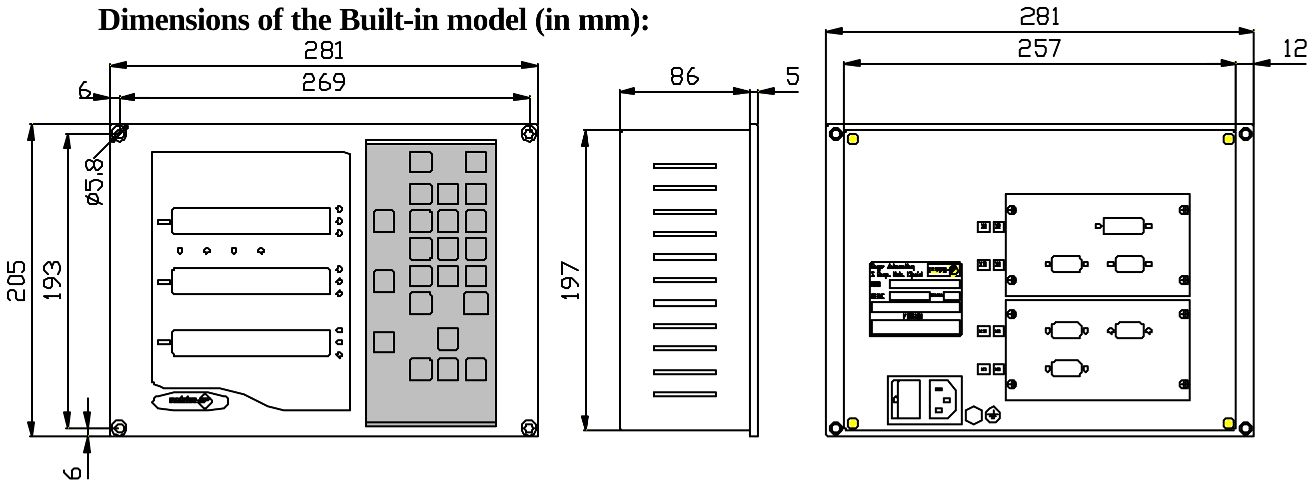
It can display the position of three axes and a spindle. Also, repetitive parts can be programmed

1.1 FRONT PANEL (SEE OPERATION MANUAL)

1.2 REAR PANEL



Dimensions of the Built-in model (in mm):



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

1.- Power switch. When the unit is turned off by this switch, the DRO no longer reads axis position. Therefore, it is recommended to use the ON/OFF key at the front panel to turn the display off so the DRO continues keeping track of the axes position when they are moved.

2.- Three-prong power connector for AC and ground connection.

3.- M6 mm terminal for general machine ground connection.

X2.- SUB-D type 37 pin female connector to connect the digital inputs and outputs as well as the analog input and output.

X3.- SUB-D HD type 15-pin female connector for 1st axis feedback device.

X4.- SUB-D HD type 15-pin female connector for 2nd axis feedback device.

X5.- SUB-D HD type 15-pin female connector for 3rd axis feedback device.

X6.- SUB-D HD type female connector for spindle encoder feedback.

X7.- SUB-D type 9 pin male connector for the RS-232-C serial line connection.

WARNING

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

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

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

1.3 GENERAL TECHNICAL CHARACTERISTICS

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

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

Power outages of up to 20 milliseconds.

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

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

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

Maximum relative humidity: 95% non condensing at 45ºC (113ºF).

Front Panel Sealing: IP54 (DIN 40050), Rear panel: IP4X (DIN40050) except for built-in models in which case is: IP20.

2. CONNECTIONS

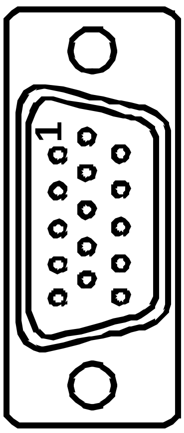
The connection for the RS-232 serial line (optional X1 connector) is not described in this manual; but in a supplement for it.

2.1 CONNECTION OF THE FEEDBACK SYSTEMS

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

<u>Characteristics of feedback inputs: X3, X4, X5 and X6:</u>

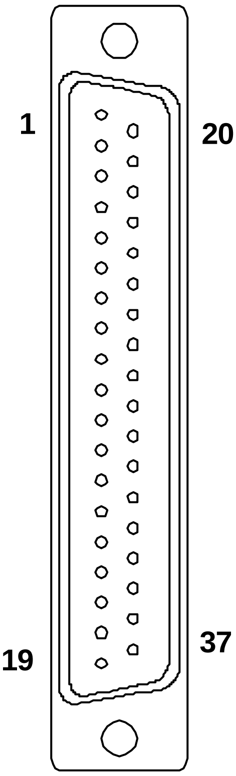
- +5V input consumption: 250 mA
- Admits square-wave signal (TTL). (A, B, Io)
- 1Vpp voltage modulated sinewave signals.
- Maximum frequency: 250 KHz, minimum separation between flanks: 950nsec.
- Phase shift 90º ±20º, hysteresis 0.25 V, Vmax 7V, maximum input current: 3 mA.
- High threshold (logic state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



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

* Available only at the NVP-301TS

2.2 *INPUT / OUTPUT CONNECTION (X2)*



Inputs and their assignments:

4 digital inputs for automatic tool change detection.
4 digital inputs for automatic spindle range detection.
4 digital inputs for external JOG. M3 and M4 which have to keep their level and correction control Jog+ and Jog- which have to provide pulses.
1 digital Emergency input.
1 digital input to "tell" the DRO that the M function has been executed (M-done).
1 digital input to indicate that an external potentiometer will be used to vary the spindle analog output.
1 analog input for that potentiometer. Between 0Vdc and 9.99Vdc

Outputs and their assignment :

2 digital outputs to indicate M3, M4 or M5 (M3=M4=0V).
4 digital outputs to indicate the spindle range (M41 through M44).
1 digital output for M-Strobe, to indicate a change of M. It is activated for a period of time set by PAR27. M3, M4 or M5 and the ranges M41...M44.
4 Digital outputs to indicate travel limits and going through "0" on the "X" and "Z" axes.
1 analog output for the spindle. Between 0Vdc through 9.99Vdc

Signal characteristics of connector "X2":

The supply voltage is at +24V (±25%), thus the threshold between a "0" and a "1" will be about +6V.

Characteristics of the inputs at 24V :

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

The main characteristics of the digital outputs are: (optocoupled with solid state relay with a normally open contact)

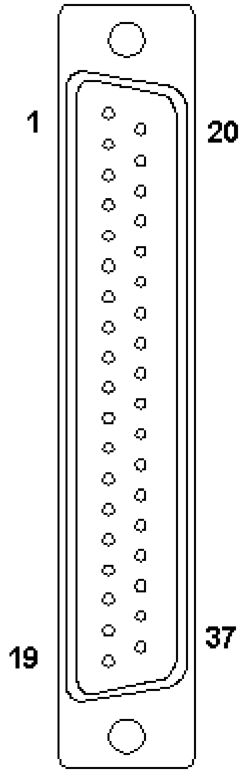
- Maximum AC or DC voltage: 48V
- Maximum load current: 150 mA
- Maximum internal resistance: 24ê
- Maximum peak current: 500mA for 100ms at 25ºC
- Through current when open: ≤ 1µA
- Leak current: 200nA (Vload=100V)
- Galvanic isolation voltage: 1500V for 1 minute
- Activation time: ≤ 3ms
- Deactivation time: ≤ 3ms

Main characteristics of the analog input

Voltage range:	±10V	Resolution:	10mV
Impedance:	>10Kê		

Main characteristics of the analog output

Voltage range:	±10V	Resolution:	4.88mV
Maximum current:	10mA	Offset:	±30mV
Impedance:	120 ê referred to GND		

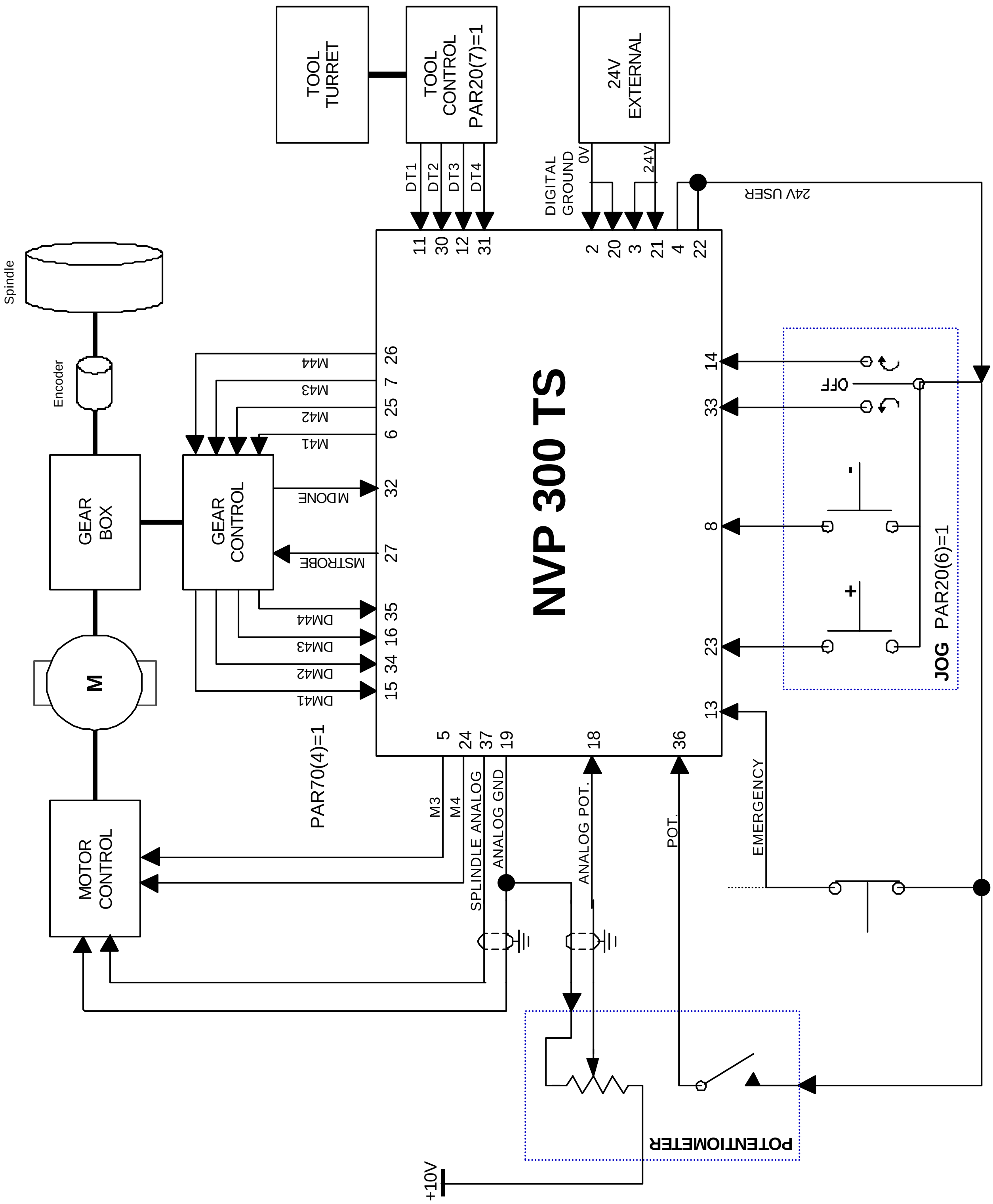


Pin	I/O	Signal		Pin	I/O	Signal
1		Chassis		20	I	External 0V
2	I	External 0V		21	I	External 24V
3	I	External 24V		22	O	User 24V
4	O	User 24V		23	I	Jog [+]
5	O	M3		24	O	M4
6	O	M41		25	O	M42
7	O	M43		26	O	M44
8	I	Jog [-]		27	O	M Strobe
9	O	X going thru "0"		28	O	X limit
10	O	Z going thru "0"		29	O	Z limit
11	I	Detect Tool 1		30	I	Detect Tool 2
12	I	Detect Tool 3		31	I	Detect Tool 4
13	I	Emergency		32	I	M done
14	I	Jog - M3		33	I	Jog - M4
15	I	Detect M41		34	I	Detect M42
16	I	Detect M43		35	I	Detect M44
17		Chasis		36	I	Potent. on/off
18	I	Analog. Potent.		37	O	Spindle analog
19	I/O	0V Analog.				

See chapter 2.2.1 (operation with inputs and outputs)

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

CONNECTION EXAMPLE



2.2.1. *OPERATION WITH INPUTS AND OUTPUTS*

This DRO is especially designed to control the spindle through the 37-pin connector X2 being possible to carry out the following operations:

Motor control

The spindle motor is controlled using **M3 (pin 5), M4 (pin 24)** and the **analog signal (pins 37, 19).**

M4 (24)	M3 (5)	Meaning
0	0	Stop
0	1	Clockwise
1	0	Counterclockwise
1	1	Stop

There are some motor controllers with a READY output. In these cases is possible to connect this READY signal to the DRO. **Pin 32 (M Done).**

The DRO will wait for the M done signal before giving the analog signal.

Potentiometer

Using the potentiometer we can select a desired spindle speed manually. This potentiometer signal must be in the range of 0 to 10 volts. The Dro uses **input pins 18 and 19** for this potentiometer analog value.

When the potentiometer switch is turned ON, the DRO commutes the potentiometer analog input directly to the motor controller through the DRO **analog output (pin 37)**. External electric relays aren't needed.

Gear control

In order to increase safety, there is an option for working with automatic range detection. Four micro switches must be installed in the range control system so that the DRO is able to read which range is selected.

These are the **input pins**

Range 1 (M41)	15
Range 2 (M42)	34
Range 3 (M43)	16
Range 4 (M44)	35

There are 2 ways for changing the range. One is the manual and the other is automatic.

When we are working in manual mode, if a range change is needed the DRO will show in the display the range we must select in the gear control.

Then we will change to this range and press [ENTER] if there is no automatic range detection. If automatic range detection is installed, the DRO will not start until we select the right range.

There is a possibility for working with a more sophisticated system, using the automatic range change feature.

This feature uses the **output pins** to indicate which range must be selected.

	Pin
Range 1 (M41)	6
Range 2 (M42)	25
Range 3 (M43)	7
Range 4 (M44)	26

Once we select the desired range there is a **STROBE** signal (**pin 27**) which initiates the change. The strobe signal is connected to the gear controller. The **M-done signal (pin 32)** from the gear controller tells the DRO when the range change has taken place.

External JOG

It is possible to use external JOG with **M3, M4 (input pins 14, 33)** and **increase, decrease spindle speed (input pins 8 and 23)**.

Tool Control

Installing 4 micro switches in the tool turret and connecting them topins 11, 12, 30 and 31 the DRO is able to read which tool is selected so that the correct tool offset will be applied.

Position Control

- Output signals are generated when the axes reach the position set by installation parameter **(pins 9 and 28 for X, 10 and 29 for Z)**.

External Emergency detection through pin 13.

These inputs and outputs must be supplied with an external regulated power supply connected between pins 2 and 3 and between 20 and 21 as shown in the following table.

Additional features for the spindle:

Apply a trapezoidal or squared sine (bell-shaped) acceleration/deceleration ram to the spindle while changing ranges.

If the spindle is already turning, the necessary ramp will be applied to adapt the spindle to the new speed.

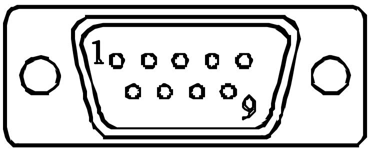
The speed variations due to radius increase or decrease will be handled without ramp thus generating directly the calculated analog voltage.

2.3 RS-232-C CONNECTION (CONNECTOR X7)

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

Parameter PAR90 sets the transmission speed through this line. See section 3.5 in this manual.

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



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

2.4 POWER AND MACHINE CONNECTION

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

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

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

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

2.5 TURNING THE UNIT ON AND OFF

Turning the unit ON

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

The DRO runs a self-test and shows on the LCD display the text: “Fagor NVP-30x TS, Press ” (where xxx indicates the model) and the X and Z displays show "Fagor dro" if everything is OK and the error number if otherwise. See the appendix at the end of this manual.

Turning the unit OFF

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

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

Notes:

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

- If the unit is powered down with its rear panel switch or there is a power outage without previously having pressed , the DRO will keep the last position of the axes for at least 30 minutes.

- The unit will display ERROR 2 when powered back up if the position reading was lost when turned off while the axes were moving or after the accidental backup period has expired without having saved the current position by previously pressing .

3. *INSTALLATION PARAMETERS*

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

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

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

. If it affects the axes, press the corresponding axis key to modify it.

. If it is a general parameter, the **X** display will show its current value.

. The LCD display will show the description of the parameter and its number.

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

· With binary values. The value of each digit toggles between "0" and "1" when pressing its corresponding key from [1] to [8] where [1] corresponds to the rightmost digit and [8] to the leftmost one.

· Numeric values, usually with the corresponding axis resolution, they are entered as regular preset.

· Options, the value is changed by pressing [+/-] which will make the various options appear in a cyclic way.

3.1 PARAMETER SETTING

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

. Press . The LCD display will show the menu:

RPM / CSS / UTILIT. ->
PARAM / COMM

. Select "**PARAM**" using the keys.

. When the word "**<u>PARAM</u>**" appears between < >, press

. The LCD display requests the password (**<u>060496)</u>**. If it is not entered, it is still possible to edit those general parameters not affecting the machine.

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

. If it is a general parameter (not affecting the axis reading), the display will show its current value.

. If it is an axis parameter, each axis display will show its current value. In this case, press the axis key (**X** or **Z**) and key in its new value.

- To go from one parameter to another **and save the changes**:

  Press or to go to the next one. To go to the previous one, press or

- Pressing another axis key, (**X** or **Z**), the DRO saves the value of the previous axis and shows the new axis to be edited.

- To quit the parameter editing mode, press and the DRO will recover the previous values ignoring the changes just made.

From the count modes, it is also possible to access the user parameters**PAR50** (language) with the keystroke sequence: and **PAR05** (scaling factor) with the keystroke sequence: . This way, it is possible to change operating modes without having to go through all the parameters preceding the ones we would like to edit. This is also possible for parameters **PAR40, PAR41, PAR51**(memory lock), **PAR90** (RS-232-C serial line).

<u>Note</u>: If there is an encoder at the spindle, parameters PAR60 through PAR86 must be set.

The following parameters must also be set: PAR00, PAR02, PAR03 and PAR10. To access these last ones, press

3.2 PARAMETERS TO CONFIGURE AXIS COUNT AND DISPLAY

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

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

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

PAR01 Feedback resolution, independent for each axis,

Possible values: from 0.1µm to 1mm (0.000005" to 0.03937").

Factory setting: **5** (µm).

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

The selection of these values rotates by pressing +/–

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

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

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

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

PAR03 Internal multiplying factor when using sinewave feedback signals or external multiplying factor when using semi-absolute feedback devices (coded Io) and TTL feedback signals. Independent for each axis.

Options: 1, 5, 10, 20, 25, 50. **Factory setting: 1**

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

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

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

The factory setting is: "**0**".

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

Digit

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

Possible values 0 (alarm OFF) and "1" (alarms ON).
Factory setting: **0**
Refer also to the error codes in the appendix of this manual.

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

Notes:

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

PAR10 This parameter allows the Io reference mark of the linear or rotary encoder to be offset so that it coincides with a physical reference point on the machine. It is independent for each axis and for the spindle.

Numeric value in resolution units for each axis.
Factory setting: **0**.

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

PAR11 Miscellaneous, binary.

Digit

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

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

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

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

PAR12, PAR13 To set the negative and positive axis travel limit.

Possible values: between -99999.999 --> 0 and "0 --> 99999.999

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

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

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

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

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

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

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

3.3 INPUT/OUTPUT AND SPINDLE RELATED PARAMETERS

PAR20

Digit	
8, 3, 2, 1	Not being used at this time
7	Indicates whether tool detection is being used or not (1 = Yes).
6	Indicates whether the RPM or CSS will be displayed (1) or not (0).
5	Indicates whether the external M3, M4 spindle keys will be used (1) or not (0). Inputs 14 and 33.
4	Indicates whether the external keys to speed up or slow down the spindle will be used (1) or not (0). Inputs 23 (+) and 8 (-)

PAR21 Indicates the level of the first 8 inputs (1= active high, 0= active low)

PAR22 Indicates the level of the next 7 inputs (1= active high, 0= active low)

Parameter	Digit	Pin	Meaning
Par21 (inputs)	8	33	M4 From External JOG keys
	7	14	M3 From External JOG keys
	6	32	**M Done (from gear change detector switch)**
	5	13	**Emergency input**
	4	31	Tool Detect. Digit 4
	3	12	Tool Detect. Digit 3
	2	30	Tool Detect. Digit 2
	1	11	Tool Detect. Digit 1
Par22 (inputs)	8	-----	-------------------
	7	23	Speed up Spindle from external JOG key
	6	8	Slow down Spindle from external JOG key
	5	36	**Potentiometer ON**
	4	35	Range 4 Detect
	3	16	Range 3 Detect
	2	34	Range 2 Detect
	1	15	Range 1 Detect

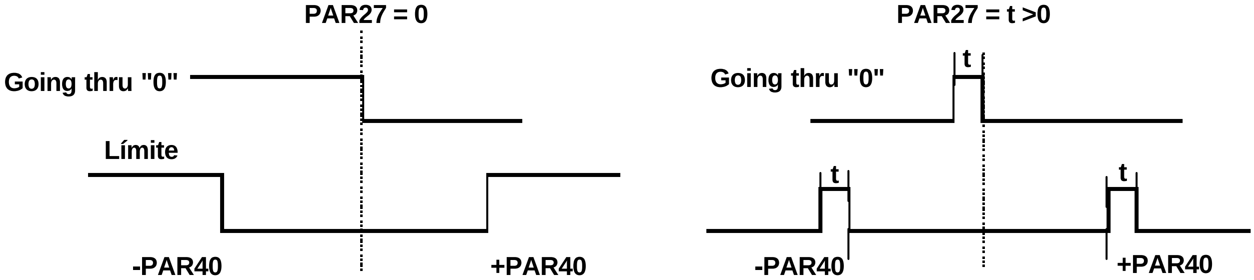
PAR23 Indicates the level of the first 8 outputs (1= active high, 0= active low)

PAR24 Indicates the level of the next 3 outputs (1= active high, 0= active low)

Parameter	Digit	Pin	Meaning
Par23 (outputs)	8	10	X “0” – Pulses when X passes zero.
	7	27	M Strobe
	6	26	M44
	5	7	M43
	4	25	M42
	3	6	M41
	2	24	M4 – output to motor control
	1	5	M3 – output to motor control
Par24 (outputs)	4-8	--	--
	3	29	Z Limit
	2	9	Z “0”- Pulses when Z passes zero.
	1	28	X Limit

PAR26 Indicates the anticipation distance for the linear axes in units of 0.0001mm or 0.00001 inch.

PAR27 Indicates the duration of the M-Strobe signal and of the travel limit signals for the corresponding axes. Possible values: 0 to 9.9 seconds.



PAR40 Sets the X axis symmetrical travel limits.

PAR41 Sets the Z axis symmetrical travel limits.

PAR60

Digit

- 8 Disable "preset" and "clear X" functions when in CSS mode.
- 7 Stop Spindle before changing the tool.
- 6 Closed loop spindle control. Digit 4 must be set to a "1" also.
- 5 Spindle orientation is used (1) or not (0). Digit 4 must be set to a "1" also.
- 4 Use spindle encoder Yes (1) No (0)
- 3 Indicates whether a linear (=0) or a smoother square-sine (=1, bell-shaped) acceleration/deceleration ramp is applied to the spindle.
- 2 Indicates the sign for the M3 when the spindle analog voltage is bipolar. 0=positive, 1=negative.
- 1 Indicates the type of spindle analog voltage, bipolar (±10V) or not (0 to +10V).

PAR61 Indicates the duration (between 0 and 9.9 seconds) of the acceleration or deceleration ramp from 0 to 10V. If the ramp is bell-shaped, it indicates the minimum acceleration time (or máximum acceleration).

PAR62 Indicates the percentage the spindle rpm increase or decrease when pressing the keys or the [jog+] and [jog-] keys respectively. Possible values: 0 to 50.

PAR64

Digit

- 8 Not being used at this time.
- 7 Stop CSS mode (1) or Not (0) if range changes. (Range M-Done signal must be used. PAR70)
- 6, 5 Not being used at this time.
- 4 Start automatically the DRO in POT mode (1) No (0).
- 3 Show (1) or Not (0) the real RPM. Useful when we are using a auxiliary RPM Display.
- 2 Type of message display. (1) for VFD, (0) for LCD
- 1 Must be set to a (1) when using an encoder which only has A signal

PAR65 Indicates the rpm to be used for spindle orientation.

PAR66 Indicates the angular anticipation distance when in spindle orientation. Possible values: Between 0º and 360º.

PAR67 Indicates the number of pulses (physical lines) of the spindle encoder. Encoder pulses / revolution. In the case of COLCHESTER only the A signal is being used. The value to be introduced is therefore (number of pulses / 4) as the multiplication between A and B signal is not possible. In that case, PAR64(1) must also be set to "1".

PAR70

Digit

8	Stop Spindle (1) or Not (0) is Range is not OK. Digit 6 must be set to a "1" also.
7	Stop CSS if the Range changes. Bit 4 must be 1.
6	Indicates whether the automatic range detection is used (1) or not (0).
5	Use (1) or Not (0) the M3, M4, M5 Done signal from motor control
4	Use (1) or Not (0) the Range M Done signal
3	Indicates whether the residual voltage is being used in a range change (1) or not (0).
2	Indicates whether the spindle must stop (1) or not (0) before changing ranges.
1	Indicates whether the range change is automatic (0) or manual (1).

PAR71 Sets the minimum rpm for range 1. Possible values: 0-9999.
PAR72 Same for range 2. Possible values: 0-9999.
PAR73 Same for range 3. Possible values: 0-9999.
PAR74 Same for range 4. Possible values: 0-9999.

PAR75 Sets the maximum rpm for range 1. Possible values: 0-9999.
PAR76 Same for range 2. Possible values: 0-9999.
PAR77 Same for range 3. Possible values: 0-9999.
PAR78 Same for range 4. Possible values: 0-9999.

Note: **The unused ranges must be set to the same value as the last one used.**

PAR81 Indicates the % of correction for range 1. Possible values: ±99
PAR82 Same for range 2. Possible values: ±99
PAR83 Same for range 3. Possible values: ±99
PAR84 Same for range 4. Possible values: ±99
PAR85 Indicates the oscillation time of the residual analog voltage during a range change. Possible values: 0 to 2.55 seconds.

PAR86 Indicates the value of the residual analog voltage to be applied during a range change. Possible values: ±9,99V.

If = 0.00V, the spindle will turn in the M3 direction at minimum speed.

If = 0.01V, the spindle will turn in the M4 direction at minimum speed.

3.4 MESSAGES AND PROGRAMMING RELATED PARAMETERS

PAR50 Language selection for the messages appearing on the LCD display.
0 = English; 1 = Spanish; 2 = German; 3 = French; 4 = Italian;
5 = Portuguese; 6 = User defined.

PAR51
digits
8 to 3 Not being used at this time. They all must be set to "0".
2 To turn on (=0) or off (=1) the confirmation beep when pressing the keys.
1 Program memory lock, 0 = unlocked; 1 = locked.

PAR52 Loading of the user defined language.
When accessing this parameter, the DRO requests the password.
After keying 5564, the DRO is ready to receive the file containing the user defined language.

3.5 RS-232-C RELATED PARAMETERS

This DRO sends and receive data at the speed set by **PAR90** and with the following configuration:

Stop bits: 1
Data bits: 8
Parity: None

PAR90 Indicates the transmission speed of the RS 232 line.
Options: 75, 150, 300, 600, 1200, 2400, 4800 & 9600 baud.

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

4.1. SAVING AND RESTORING DATA

With this DRO, it is possible to save data into a PC or peripheral device and later restore it by using the RS-232-C serial communications line.
This data is sent out in the following format:
Baudrate as set by PAR90, 8 data bits, 1 stop bit and no parity.

To access this mode:

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

4.2 PARAMETER TRANSMITTING FORMAT

The format of the transmitted parameters are:

For value parameters: **P?? 123.123**
For binary parameters: **P?? 10101010**
For option parameters: **P?? 0**
For axis parameters: **P?? X 123.123 Z' 123.123 Z'' 123.123**
The number of decimals depends on the selected resolution.

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

```
P15   X05
        N00 P-1000.000 E-1.000
        N01 P-500.000 E-0.500
        N02 P0.000 E0.000
        N03 P500.000 E0.500
        N04 P1000.000 E1.000
  Z' 03
        N00 P-1000.000 E-1.500
        N01 P0.000 E0.000
        N02 P1000.000 E1.500
```

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

CONNECTION DIAGRAM AND SPINDLE PARAMETERS

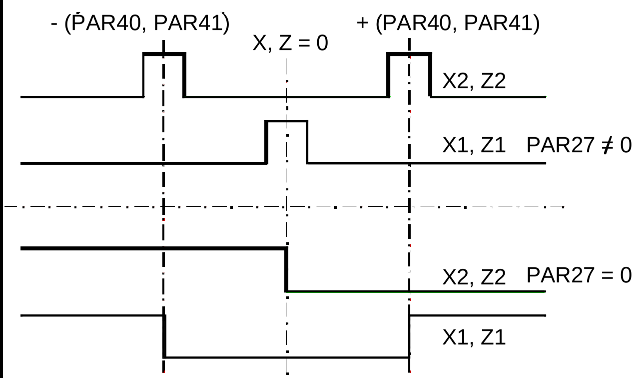
Parameter list:

SPINDLE:

PAR60 1.- Bipolar analog voltage
2.- Turning direction for M3, if bipolar
3.- Bell-shaped acc/dec.
(PAR61: Ramp duration (0-9.99 sec.)
4.- The spindle has an encoder.
(PAR67: Nr of encoder lines)
5.- Spindle orientation
(PAR65: RPM for spindle orientation 0-9999)
(PAR66: Angular positioning 0-360°)
6.- RPM follow-up.

LIMITS:

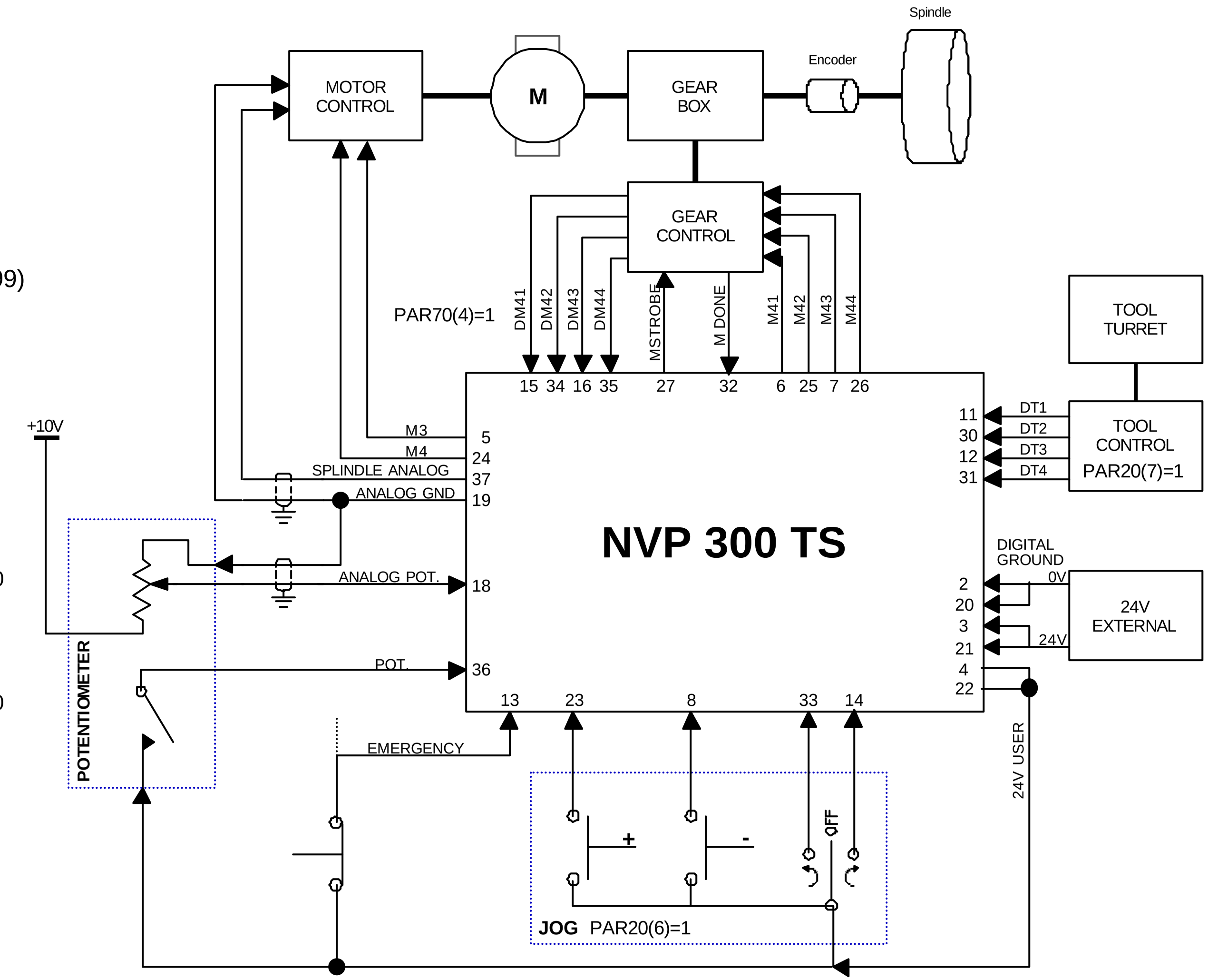
PAR40 X limit, PAR41 Z limit



Ranges	***1***	***2***	***3***	***4***
Min RPM	PAR71	PAR72	PAR73	PAR74
Max RPM	PAR75	PAR76	PAR77	PAR78
% increm.	PAR81	PAR82	PAR83	PAR84

RANGES:

PAR70 1.- Manual range change.
2.- Stop spindle before range change.
3.- Apply residual analog in range change.
(PAR85: Oscill. time residual voltage (0-2.55 sec)
(PAR86: Residual analog value 0-9.9 V)
4.- Wait for range confirmation.
5.- Waite for M-done signal.
6.- Automatic range detection.



MISCELLANEOUS:

PAR20 5.- Use external Jog.
6.- Display RPM or VCC.
7.- Use tool detection.
PAR26 Anticipation distance (for limits)
PAR27 STROBE duration, limit signal 0-9.99 sec.
PAR62 RPM % increase when pressing JOG. 0-50%

ERROR CODES

Message	Description
FAGOR dro	Power outage or turned off by main switch after saving the data.
Error 02	Power outage or turned off by main switch without having saved the data. The unit has been turned off without previously pushing the [ON/OFF] key. It will only lose the position count (will be reset to zero) and the status of the operating modes (inch, abs, etc.).
Error 04	Wrong parameter values
Error 05	Wrong internal configuration
Error 06	Errors in data backup memory (Service Dept.)
Error 07	Emergency input active. Press [C] or cancel emergency signal.
Error 08	Wrong software memory or the software has been changed
Error 09	Errors in work memory (Service Dept.)
Error 12	Error while searching a coded marker pulse (Io)
Error 20	Range detection error. The one detected does not match any valid range.
Error 31	Internal malfunction (Service Dept.)
Error 32	Internal malfunction (Service Dept.)
Error 90	Internal malfunction (Service Dept.)
Error 99	Internal malfunction (Service Dept.)
. . . .	Feedback alarm fromthe feedback device (scale, encoder, etc) or weak signal.
l.4.3.6.5.7.2.5	Feedback speed too high.
EEEEEEEE	Maximum position reading or speed exceeded when searching Home

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

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

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

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

In either case, to clear the display, press CLEAR .

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

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

MAINTENANCE

Cleaning:

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

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

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

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

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

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

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

Preventive Inspection

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

FAGOR DRO
NVP-300TS/301TS

OPERATION MANUAL

Man: 0209   Soft: 2.xx

INDEX

INTRODUCTION

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

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

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

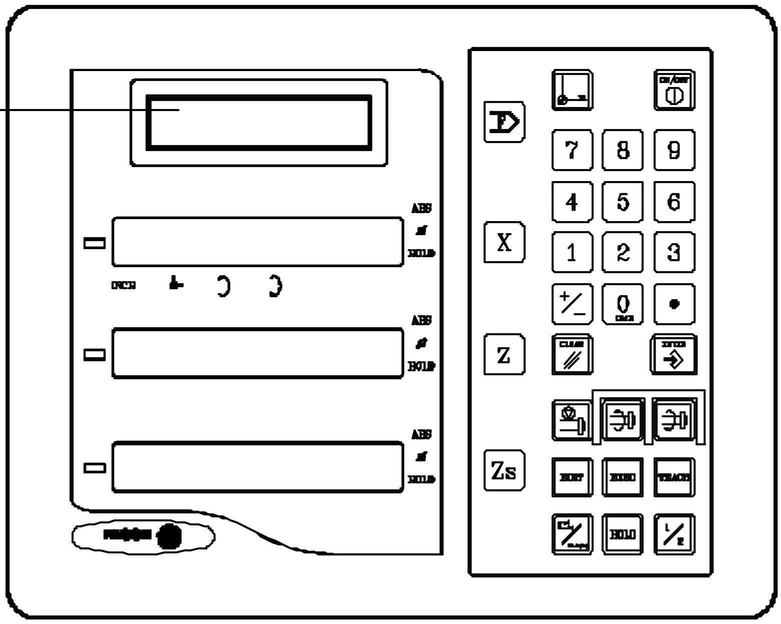
1. UNIT DESCRIPTION

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

It can display the position of three axes and a spindle and program repetitive parts.

1.1 FRONT PANEL

LCD display



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

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

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

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

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

This lamp stays on while showing the axes position in reference (home) mode.

Indicate the spindle turning direction. They blink when the spindle is accelerating or decelerating.

3rd display The rightmost digit shows a "**1**", a "**2**" or is off to indicate that the Z axis display (2nd one) corresponds to "Z_1", "Z_2" or to the combination of "Z_1+Z_2" respectively.

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

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

Is used for changing the part zero or home reference.

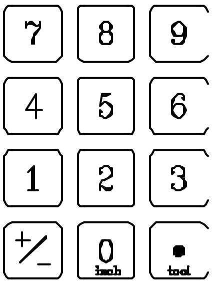
Is used for rotating from the incremental to the absolute mode and vice versa

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

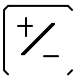
Is used to validate an operation.

Is used to cancel or abort an operation already initiated.

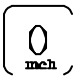
Is used to toggle the display of radius/diameter on the X axis movement.



These are used for entering values.

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

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



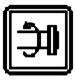
This key is also used to toggle between metric and inch display.

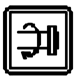
Is used to access the special operation modes, parameter setting, communications via RS-232-C, etc.

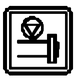
Is used to access the program editing mode.

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

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

 Is used to select the previous option in the menu or editing mode and to start the spindle counterclockwise, increase its speed if it is already turning in that direction or decrease it if it is turning in the opposite direction.

 Is used to select the previous option in the menu or editing mode and to start the spindle clockwise, increase its speed if it is already turning in that direction or decrease it if it is turning in the opposite direction.

 Is used to stop the spindle and to delete memory blocks and tools in the editing mode.

1.2 REAR PANEL (SEE INSTALLATION MANUAL)

2. *COORDINATE DISPLAY*

2.1 *DISPLAY MODES*

Turning the unit ON

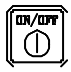
The unit is turned on by actuating on the power switch of the rear panel
This DRO runs a self-test and its LCD screen shows the text:
"Fagor NVP-30xTS , Press  " where x indicates the model and the X and Z displays show "Fagor dro" if everything is OK and the error number if otherwise. See the appendix at the end of this manual.

Turning the unit OFF

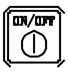
If you press  key the DRO switches off the displays while maintaining the power supply to the feedback systems and goes on reading the position of the axes at all times. This is not the case
when the equipment is switched off by means of the switch on the rear panel of the same.

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

Notes:

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

- If the unit is powered down with its rear panel switch or there is a power outage without previously having pressed , the DRO will keep the last position of the axes for at least 30 minutes.

- The unit will display ERROR 2 when powered back up if the position reading was lost when turned off while the axes were moving or after the accidental backup period has expired without having saved the current position by previously pressing  .

Language selection

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

- Access parameter PAR50 (language) directly by pressing [CLEAR] [5] [0 inch]
- Press [+/-] repeatedly until the desired language appears (English, Spanish, French, German, Italian, Portuguese, custom*) and press [ENTER].

  Press [CLEAR] to quit the language selection mode.

"Custom" may be any user defined language. (See section 3.4 PAR52 of the installation manual).

Conversion mm into inches

This DRO can displayed the position of the axes in millimeters or inches by pressing [0 inch] key depending on whether the **INCH** led is off or on respectively.

Fine / coarse resolution

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

Radius / Diameter:

When these models are used for measuring radius or diameter, one can display twice the real displacement of the axis (diameter) by pressing [1/2]. Led Φ will go on or off to indicate the double or real counting mode respectively.

RPM / CSS

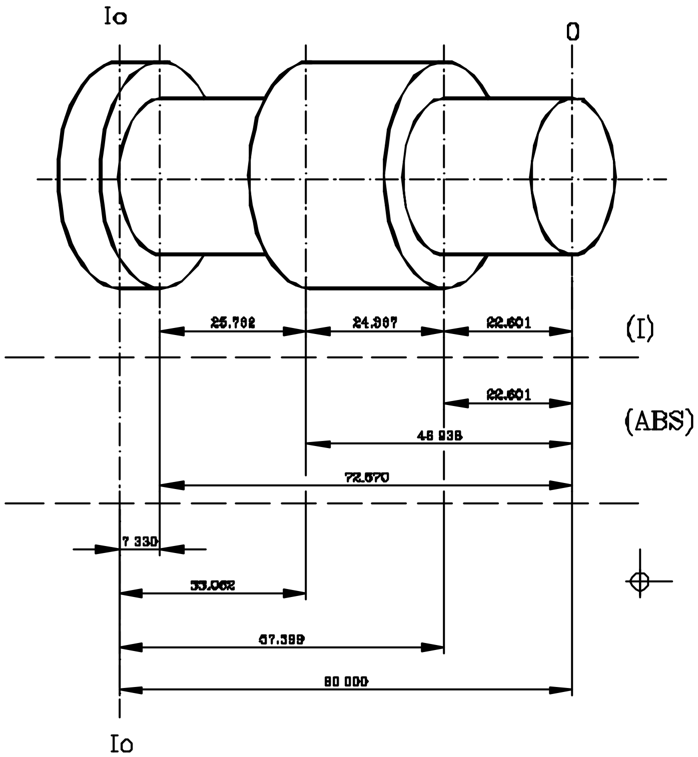
It is possible to display the preset **R**evolutions **P**er **M**inute or the **C**onstant **S**urface **S**peed of the spindle "Sp" or "Cs" as well as the actual (real) rpm "Sr" (when the spindle has an encoder) and the percentage of correction being applied.
To do that the DRO must be configured accordingly, PAR20(6)=1:

. Press [F]

. Selec the option <**RPM**> or <**CSS**>
The Sp and Sr will be in RPM and the CSS in m/min or feet/min depending on the display units being used metric or inches.

. Preset those values.

2.2 INCREMENTAL, ABSOLUTE AND WITH RESPECT TO MACHINE ZERO



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

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

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

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

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

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

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

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

2.3 MACHINE REFERENCE SELECTION AND SEARCH

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

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

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

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

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

The dro stores for 10 years in its internal memory work coordinates such as machine zero, absolute and incremental while it is turned off.

The home search sequence is as follows:

- Move the axis to the approximate reference zone (roughly).
  This step is only for fixed Io scales (not coded)

- Get the DRO in home reference mode by pressing . If the LED is on, it is already in that mode.
- Select the axis to be referenced by pressing X for X, Z for Z_1 and Zs for Z_2 (this must be done one axis at a time).

  Zeros to the left of the axis display will appear.

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

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

  When using reference-coded scales (distance-coded Io), the value assumed is the position with respect to scale zero plus the offset.

For the spindle: While in home mode:

. Press F and wait for the marker pulse. The position is displayed on the LCD screen.

NOTE.- If PAR14=1 (feedback without reference mark -I0-), The home position may be preset in Machine Reference mode. See the next section for coordinate preset.

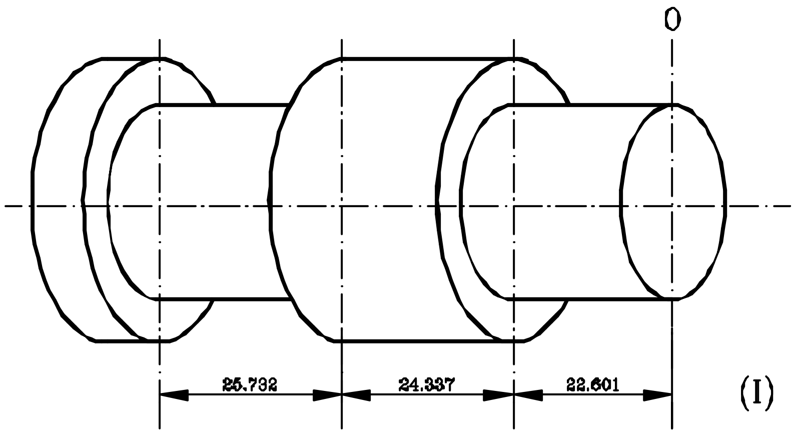
2.4 *AXIS COORDINATE PRESET*

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

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

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

__In incremental mode:__



- Press until the **ABS** led go out and the key for switching off the led.

- Move the axis up to corner "D" to set this as part zero.

- At this point, one can proceed in two ways.
  - Preset the axis with zero value by pressing CLEAR X
  - Move the axis to the face of the part until the DRO reads: **022.601**

- After drilling this hole, one can go to the next position, after having preset or...
  - Preset the axis with value **22.601** by pressing: X **22.601** ENTER to validate it.

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

    When pressing X, the previously preset value is displayed.

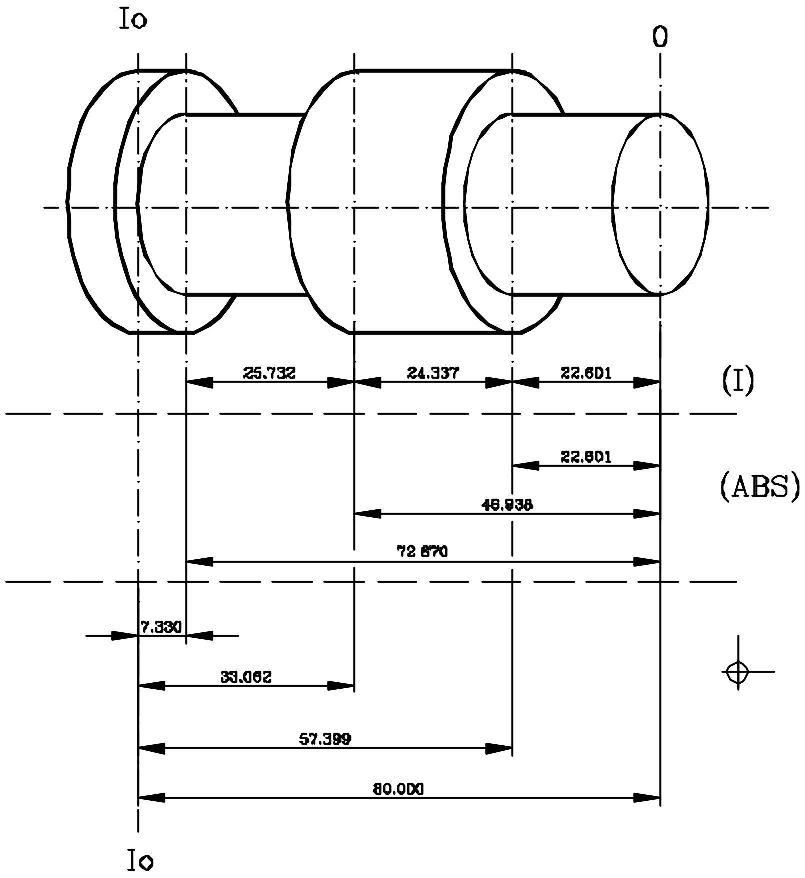
  - Move the axis towards the first position until the DRO reads: **0.000.**

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

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

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

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

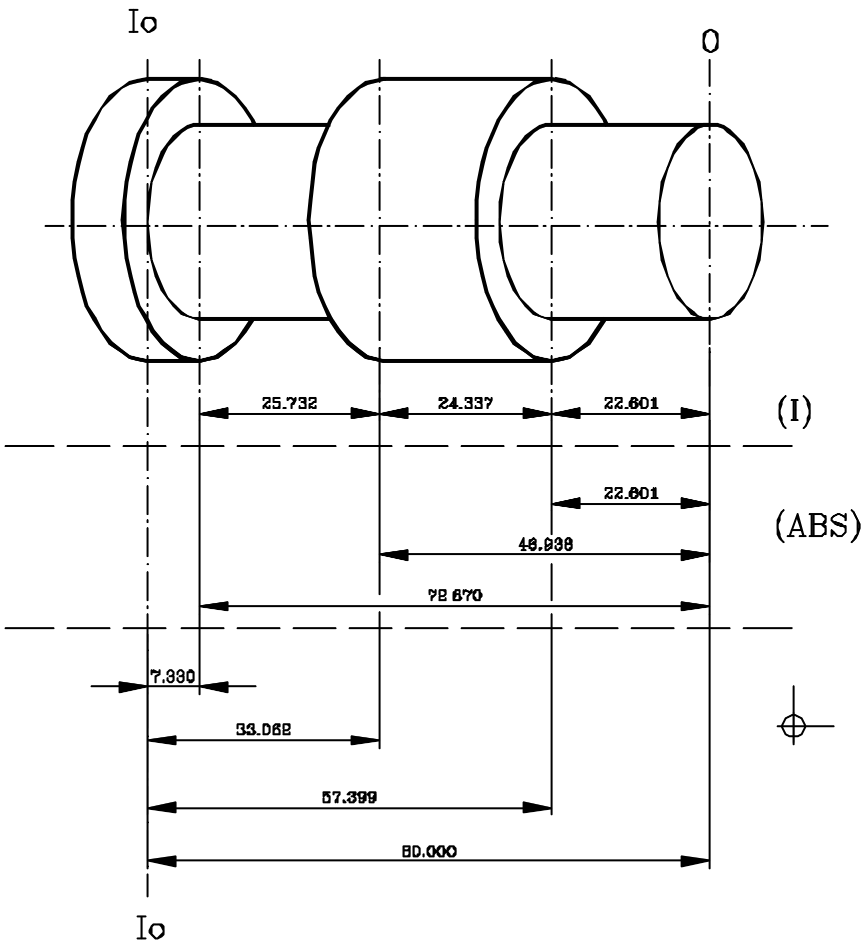


In absolute mode:

- Press [key] until the **ABS** led comes on.
- To preset part zero:
  - Place the axis exactly over "**0**" and press: [CLEAR] [X]

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

The next section describes how preset up to 13 tools.



3. SPECIAL OPERATIONS

3.1 SCALING FACTOR

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

[CLEAR] [0] [5] [X] 'value' [ENTER].

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

3.2 RPM (SPINDLE SPEED PRESET)

After pressing [F], select the < **RPM**> option to preset the spindle speed and range to be used.

Key	**Action**
[X]	Programmed RPM
[Z]	Range
[ENTER]	Validate

By default, the DRO offers the minimum range for the indicated rpm.

Once [ENTER] has been pressed, to accept the entered data, the DRO automatically checks if the programmed range matches the current one. If not, a range change is carried out.

If the spindle is already running, an acceleration ramp is applied to reach the new speed.

Note: If PAR20(6)= 0, the LCD screen does not show the programmed S , the real "Sr" or the %.

RPM presetting safety:

When using a manual gear change without detectors for selected gear, it is possible to preset an RPM value and indicate to the DRO that a gear has been selected which, actually, has not been selected at the machine. To prevent the risk of having the spindle turning faster than desired, the DRO issues ERROR 20 when the actual (real) rpm reach 120% of the programmed value.

3.2.1 MODIFY THE SPINDLE SPEED WHILE IT IS RUNNING

With this DRO, it is possible to modify the spindle speed already preset at the keyboard (using the and keys) or from an external keypad using a potentiometer and/or the [Jog+] and [Jog-] inputs.

-When the spindle is turning clockwise, every time is pressed, the spindle speed will increase and every time is pressed, it will decrease.

- On the other hand, if the spindle is turning counterclockwise, every time is pressed, the spindle speed will decrease and every time is pressed, it will increase.

<u>NOTE</u>: When the spindle speed is controlled by an external potentiometer, only the actual spindle speed "Sr" shown on the LCD screen will only make sense when there is an encoder installed on the spindle.

In potentiometer mode, The keys are operational only to start the spindle and change its turning direction, NOT to increase or decrease the speed set by the potentiometer.

(See PAR62, increase / decrease percentage of spindle RPM).

3.3 *ACTIVATING AND <u>PRESETTING</u> THE CONSTANT SURFACE SPEED (CSS)*

CSS operation may be initiated in several ways. One of them consists in accessing the DRO menu with the F key, selecting the CSS option, and entering the parameters required to set the CSS work cycle. This option is handy when the desired cutting feedrate and maximum rpm values are known.

<u>Option "A":</u>

After pressing F and <**CSS**>, the desired CSS may be preset as well as the maximum rpm allowed for a particular machining operation at Constant Surface speed and the Range to work in. After programming this data, the CSS mode is activated depending on the radius value (X axis)

<u>Key</u>	**<u>Action</u>**
X	Constant Surface Speed
Z	Maximum RPM allowed for that cutting speed
Zs	Range
+/-	Toggles ON/OFF
ENTER	Validate the data

- When working in mm, the CSS is given in m/min.
- When working in inches, the CSS is given in ft/min.

The CSS mode is only activated after entering all the pertinent data.

Once all the data has been entered and the CSS mode is activated, the DRO works in this mode until selecting F **<VCC>** to cancel it.

Option "B":

To work intuitively, one may begin working in CSS mode using TEACH-IN to set the necessary parameters.

This teach-in takes two steps, first teaching in the maximum spindle speed and then the desired cutting speed.

This teach-in operation must be carried out in this order, otherwise the CSS cycle will not be initiated

TEACHING IN the maximum spindle speed to work at CSS.

Use the potentiometer to turn the spindle at the desired rpm. After pressing [ENTER], those rpm are stored in the DRO as the maximum rpm allowed for CSS operation. The DRO screen shows the maximum rpm allowed.

These maximum rpm must be adjusted before teaching in the surface speed.

This value will be deleted when quitting the CSS mode.

TEACHING IN the surface speed.

Use the potentiometer to manually adjust the spindle rpm until it reaches the desired speed. Then, press [TEACH] and the current cutting speed will be preset as the Constant Surface Speed. Turn the potentiometer off and from then on, the DRO will work at that Constant Surface Speed.

The spindle rpm must be lower than the one set as maximum in order to be able to access the CSS mode. Otherwise, the [TEACH] will have no effect.

The current position of the X axis when pressing [TEACH] must be other than 0.000 otherwise it cannot calculate the current surface speed and save it as the desired surface speed.

Note: Accesing the potentiometer mode also cancels the CSS mode.

3.4 DISPLAYING THE AXIS FEEDRATE

After pressing F and <**UTILIT.**> select the **<Feed> option**, the axis displays start blinking waiting to be selected by pressing their corresponding key (X for example).

The LCD display will show:

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

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

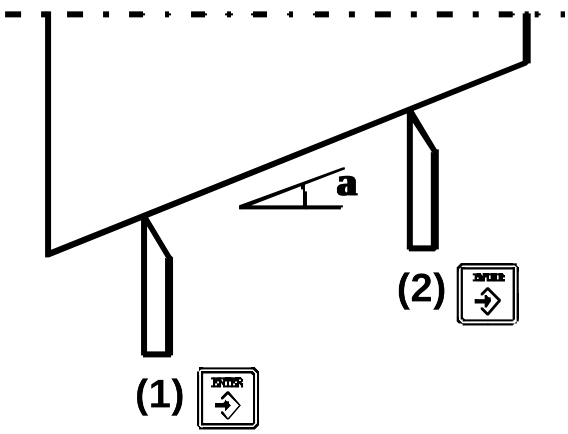
To deselect it, press CLEAR F or get back into this mode and press the same keystroke sequence used to activate that axis.

3.5 SPINDLE ORIENTATION

After pressing F, <**UTILIT.**>, <**SPIN.OR.**>, to orient the jaws towards the operator, preset the angular position (for example 120º), press EXEC or , when pressing this key again, it will advance to 240º always in the M3 direction. By pressing instead of EXEC or it will turn in the M4 direction.

3.6 TAPER (CONE) CALCULATION

After pressing [F] <**UTILIT.**> and select the <CONE> option, this DRO calculates the taper angle (cone) of a part by simply touching two of its points.



To do this, follow this procedure:

1 Move the tool until it touches the part at any point of the taper.

   - Press [ENTER].

2 Touch the part with the tool at any other point of the taper.

   - Press [ENTER] so the DRO calculates the angle or [CLEAR] to cancel the operation. (The displays stop blinking).

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

3.7 TOOL PRESET

Up to 13 tools ("00" to "12") may be preset at this dro.

In order to work with tools, the dro must be **ABS** mode**.**

Follow this procedure to preset a tool:

- Place a part with known diameter in **ABS**olute mode.
- Press tool , the 3rd display shows the active tool.
- Key in the desired tool number from "**00**" to "**12**".
- Move the tool to be preset and touch the part with it.
- Preset the known part diameter at that point.

The dro saves the relative distances (offsets) of all the tools referred to "T0".

Consequently, if "T0" is preset in ABS mode (on X and Y) and then the rest of the tools, it will suffice to preset the "T0" (on Z) for the new part. The dro will recalculate automatically the offsets of the other tools without having to preset them for each part.

When accessing the CSS menu and presetting a new constant surface speed, this speed will remain associated with the current active tool.

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

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

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

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

<u>Notes:</u>

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

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

3.7.1 DELETING ALL TOOL OFFSETS

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

Press [tool] .

[ENTER] The DRO will request confirmation to confirm this operation.

3.8 COORDINATE FREEZE (HOLD)

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

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

- Press key [HOLD] [X] and the display counting said axis "freezes" at the present value.
- Press key of other axis if you wish to also "freeze" the display of this axis.
- The tool to be replaced withdraws and the new one takes its position.
- The new tool is led to the "freezing" point and the part is touched at said point.
- Press [HOLD] and the counting "defreezes" starting to count from the previously "frozen" value.

  If [1/2] is pressed, instead, the DRO will assume half the distance travelled since [HOLD] was pressed.

4 PROGRAMMING

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

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

4.1 DELETING BLOCKS

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

The DRO will request confirmation to carry out this operation.

4.2 EDITING BLOCKS

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

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

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

```
Program Edit
Block: 00
```

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

4.2.1 EDITING A NEW BLOCK (EMPTY)

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

Program Edit
<Posit> Change Cycle

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

To select any other option, use the keys.

Then press ENTER to access it.

<u>Selecting the POSITION option:</u>

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

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

  Press Zs and key in the value.

If any of the coordinates is left out, its display will show: "-----" indicating that axis must not be moved.
To enter the target coordinate for another axis, press its corresponding key.

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

-To cancel the changes, press CLEAR

<u>Selecting the CHANGE option:</u>

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

<u>Selecting the CYCLE option:</u>

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

4.2.2. TEACH-IN MODE

In this mode, it is possible to enter the target coordinates after moving the axes to the desired position instead of keying its numeric value.
It stores the data on position and active tool.

To edit a block in this mode:

- Press TEACH to access this mode.
  The LCD display will show: and the current axis position.

Teach-In
Block : 00

- Select the block to be edited by keying its number or by using the: keys and then pressing ENTER to validate the selection.
- Move the axes to the desired position and press ENTER

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

- To quit the TEACH-IN mode, press TEACH

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

4.2.3 SPECIAL FUNCTIONS

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

4.2.3.1 CONSTANT SURFACE SPEED (CSS) OR RPM

When selecting the **RPM** option, the following is programmed in this cycle:
- The spindle speed "**S**" at the "X" axis display.
- The range at the "Z" axis display.

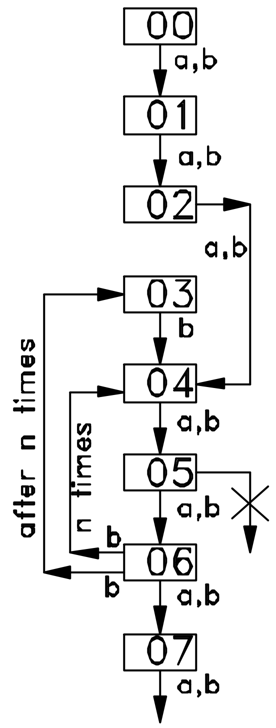
When selecting the **CSS** option, the following is programmed in this cycle:
- The Constant Surface Speed at the "X" axis display.
- Maximum rpm allowed for that CSS at the "Z" axis display.
- The clamp at the Zs display.
- The CSS mode is activated or deactivated at the "Zs" display by pressing +/−

4.2.3.2 SCALING FACTOR (PROGRAMMING)

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

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

4.2.3.3 JUMP TO ANOTHER BLOCK



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

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

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

For example:

- Block "02" of the figure contains a jump to block "04".

- If no return block is programmed in this block "02" (a), the DRO will execute blocks: 01, 02, 04, 05, 06, 07.

- If a return block "06" is programmed in this block "02" (b), the number of times (n) blocks "04, 05 and 06" will be executed. After that, blocks 03, 04, 05, 06 and 07 will be executed.

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

4.2.4 CYCLES

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

4.2.4.1 TURNING/FACING CYCLE

After selecting these option with: and pressing

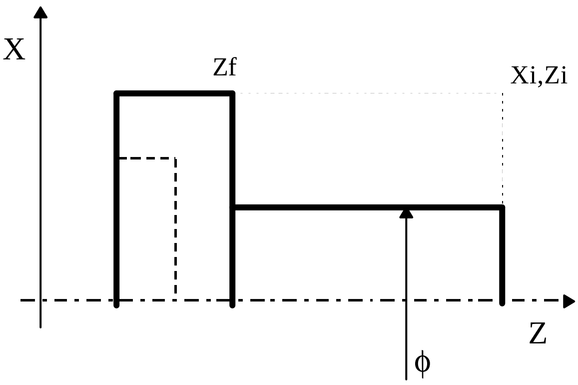
The desired section of the part can be programmed to be turned or faced.

To do this, indicate:

- The initial position (Xi, Zi)

  Press: X [value] Z

- The final position (Zf): [value]
- The final diameter (ϕ): [value]
- The cutting pass: [value]



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

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

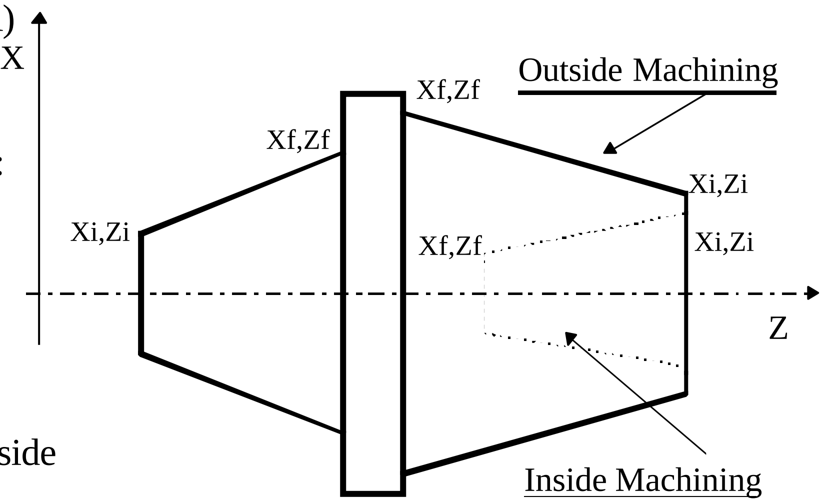
To go back to the previous step, press

In the program being edited, the cycles occupy **2 blocks**.

4.2.4.2 TAPER TURNING / FACING CYCLE (TAPER 1)

After selecting these options with and pressing ENTER

The desired section can be programmed to be turned or faced.
To do this, indicate:



- The initial position (Xi, Zi)
  X [value] Z ENTER
- The final position (Xf Zf):
  X [value] Z ENTER
- The cutting pass:
  [value] ENTER
- Select either inside or outside machining with:
  X and Z or +/-
- Select facing or turning with: X and Z or +/-
- Press ENTER to end this operation.

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

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

to go back to the previous step, press

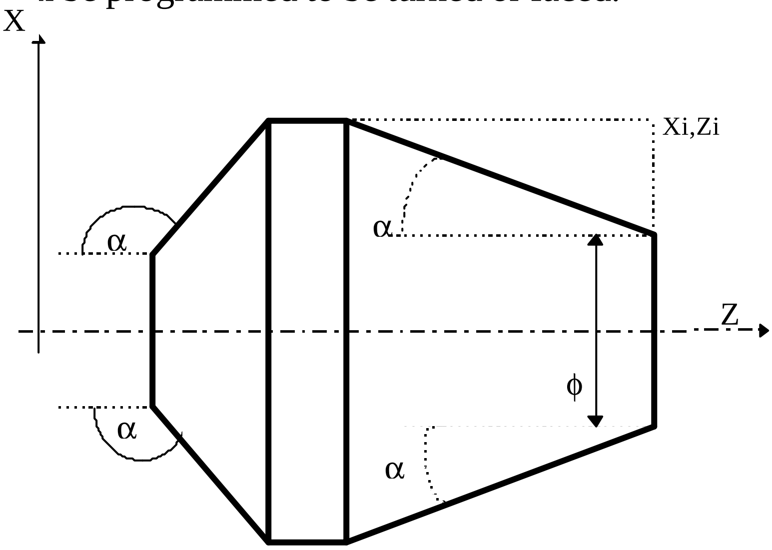
4.2.4.3 TAPER TURNING / FACING CYCLE (TAPER 2)

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

After selecting these option with: and pressing

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

To do this, indicate:



- The initial position (Xi, Zi)

  X [value] Z

- The taper angle (**a**):

  [value]

- The diameter (**f**):

  [value]

- The cutting pass:

  [value]

- Select facing or turning with: X and Z or +/–
- Press to end this operation.

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

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

to go back to the previous step, press

4.2.4.4 CORNER ROUNDING CYCLE

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

- The initial position (Xi, Zi):

  X [value] Z ENTER

- The final position (Xf Zf):

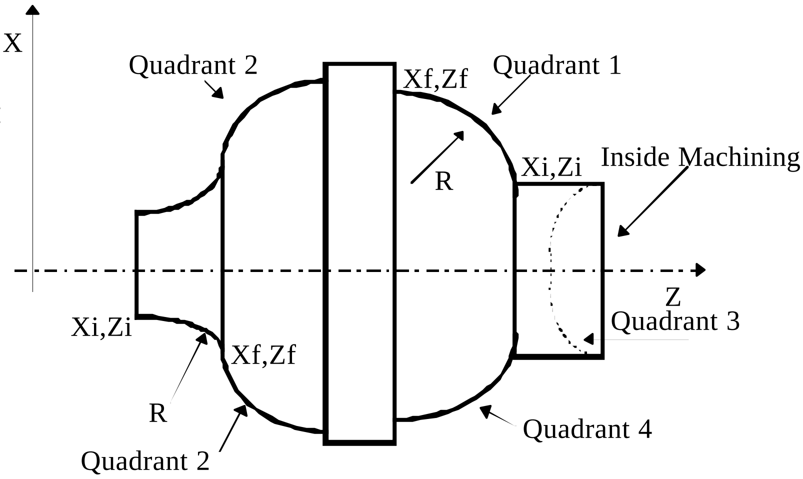
  X [value] Z ENTER

- Rounding radius (negative = inside)

  [value] ENTER

- The cutting pass:

  [value] ENTER



- Select the quadrant with +/−

- Select facing or turning with X and Z or +/−

- Press ENTER to end this operation.

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

to go back to the previous step, press

4.3 EXECUTION

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

EXECUTION
<PROGRAM> CYCLE

4.3.1 PROGRAM EXECUTION

This option is selected using the keys and pressing

- If a spindle speed change has been programmed requiring a range change, the DRO will carry it out or request the operator to do it depending on whether it has been configured for it or not.

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

Notes:

- If a tool has been programmed to carry out the cycle and when executing it, it does not match the current one, the LCD screen will show a message requesting a tool change.

- If a scaling format has been programmed, it will only be applied during the execution of the program and not in the regular dro mode. To do that it has to be set by installation parameter PAR05 (see chapter 3.1).

- If the spindle was turning when entering into execution, it stops. The turning conditions are maintained and once execution is resumed, it is possible they may be restored by pressing M3 or M4 or activating the input for turning direction.

4.3.2 CYCLE EXECUTION

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

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

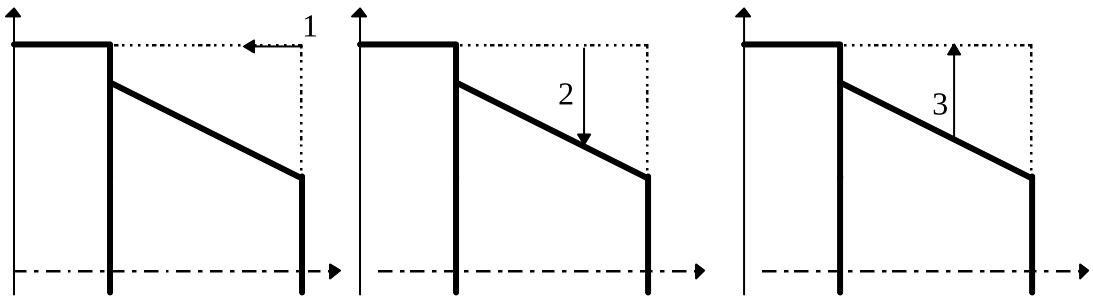
After this cycle is executed, the entered data is lost.

4.3.3 MACHINING STEPS

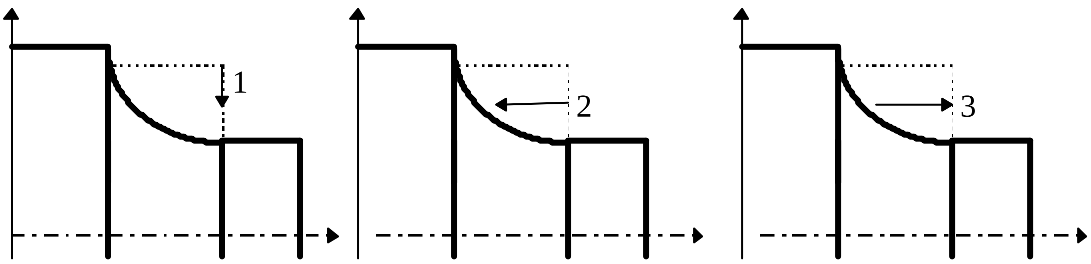
The machining operation is divided into several steps. These steps are further divided into three sub-steps.

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

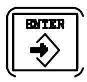
Facing example.



Turning example:



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

When executing a block, the LCD display shows the distance to move. When the "Zero" position is reached on each axis, when pressing 

the substep being executed is considered to be completed.

Example: Execution of program number 00 that corresponds to a "taper 1" machining cycle.
The machining is at step 3 and substep 2.

N00	- Taper 1
003.2	Move to zero

4.3.4 EXECUTION ERRORS

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

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

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

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

<u>In rounding:</u> - The total angle of the arc is greater than 90º.

<u>In Jump:</u> - A jump to an empty block has been programmed.
- There is an empty block in the subroutine.

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

5.1. SAVING AND RESTORING DATA

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

To access this mode:

- Press
- Press "->" and select the "**Communications**" option of the LCD display by means of the keys until that word appears between < > and press .
- Select: <**Send**> and press to send the data out to a PC or peripheral device or select <**Receive**> and press to receive data from a PC or peripheral device.
- Select the type of data to transmit **Param**eters, **Progr**am or **Tool** table by means of the keys and press .

5.2 PARAMETER TRANSMITTING FORMAT

The format of the transmitted parameters are:

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

The number of decimals depends on the selected resolution.

5.3 TOOL TABLE TRANSMITTING FORMAT

The format is:

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

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

5.4 PROGRAMS TRANSMISSION FORMAT

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

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

Cycle	Code	Parameters
Go to a position		X___ Z___ T___
Jump to a subroutine	G25	**N** beguin.end.repetitions
Scaling Factor	G72	X__Z__
Turning **Facing**	G81 G82	X__ Z__ M__ C__ D X Z = Initial coordinate M = Final Z coordinate C = Increment (pass) D = Final diameter
Turning. Taper 1 **Facing. Taper 1**	G83 G84	X__ Z__ L__ M__ C__ I__ X Z = Initial coordinate L M = Final coordinate C = Increment (pass) I = Inside machining (blank) = Outside machining
Turning. Taper 2 **Facing. Taper 2**	G85 G86	X__ Z__ C__ D__ A__ X Z = Initial coordinate C = Increment (pass) D = Final diameter A = Taper angle
Rounding while turning **Rounding while facing**	G87 G88	X__ Z__ L__ M__ C__ R__ K__ X Z = Initial coordinate L M = Final coordinate C = Increment (pass) R = Radius (negative = inside machining) K = quadrant
VCC **RPM**	G96 G97	S___ V___ M___ S___M S = Spindle speed at CSS or rpm V = Maximum rpm in CSS mode M = Range (M41, M42, M43, M44)

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

APPENDIX

ERROR CODES

Message	Description
FAGOR dro	Power outage or turned off by main switch after saving the data.
Error 02	Power outage or turned off by main switch without having saved the data. The unit has been turned off without previously pushing the [ON/OFF] key. It will only lose the position count (will be reset to zero) and the status of the operating modes (inch, abs, etc.).
Error 04	Wrong parameter values
Error 05	Wrong internal configuration
Error 06	Errors in data backup memory (Service Dept.)
Error 07	Emergency input active. Press [C] or cancel emergency signal.
Error 08	Wrong software memory or the software has been changed
Error 09	Errors in work memory (Service Dept.)
Error 12	Error while searching a coded marker pulse (Io)
Error 20	Range detection error. The one detected does not match any valid range.
Error 31	Internal malfunction (Service Dept.)
Error 32	Internal malfunction (Service Dept.)
Error 90	Internal malfunction (Service Dept.)
Error 99	Internal malfunction (Service Dept.)
. . . .	Feedback alarm fromthe feedback device (scale, encoder, etc) or weak signal.
l.4.3.6.5.7.2.5	Feedback speed too high.
EEEEEEEE	Maximum position reading or speed exceeded when searching Home

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

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

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

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

In either case, to clear the display, press  .

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

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

MAINTENANCE

Cleaning:

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

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

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

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

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

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

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

Preventive Inspection

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