METROLOGY
DRO
FAGOR
NVP-200 QC

INSTALLATION MANUAL

Man: 0009 Soft: 1.xx

New features V01.01:

1. **More memory for measured elements.**

   This version increases to 100 the number of measured elements stored in memory and they are not lost when the DRO is turned off. The elements are numbered from 0 to 99 and the element measured after number 99 overwrites the first element.

   To clear this memory completely, press: [CLEAR] [8]

2. **More memory for statistics. Now up to 300 elements may be stored.**

3. **Automatic "Q" axis calibration.**

   Rotate the screen a known angle to "teach it" to the DRO.

   - Within the calibration menu select "Q axis".
   - Enter the desired angle.
   - Rotate the screen the desired angle or press [Y] and enter the number of pulses corresponding to the indicated angle.
   - Press [ENTER] to finish.

4. **New option for SKEW.**

   It is now possible to force the axis to be aligned with a line by pressing the desired axis key [X] or [Y] after measuring or recalling a line.

New parameters:

PAR51 STORE memory data as either measured or statistical elements

Bit 3 = 0 The STORE memory data is used as measured elements istead of statistical elements.

Bit 3 = 1 The STORE memory data is for statistics only.

PAR92 Selection of point capturing method with the optical fiber.

= 0 Normal

= 1 Capture a point when moving from dark to light.

= 2 Capture a point when moving from light to dark.

SYSTEM CALIBRATION

A gage of known thickness will be used to calibrate the system. The gage must be placed parallel to one of the cross-lines on the screen; but first, make sure that the table moves perfectly parallel to the horizontal line of the cross on the screen.

Steps:

1. Adjust the focus until a dust particle may be clearly seen on the screen.
2. Take this particle to one end of the screen by moving the axes and place it exactly on the horizontal line of the cross on the screen.
3. By moving the axis, take this particle to the other end and check its deviation on the vertical axis of the screen.
4. Rotate the projector screen until the horizontal line of the cross is perfectly parallel to the path followed by the dust particle.
5. Repeat the movement of the particle to verify that the horizontal line of the cross moves parallel to the path of the particle.

Then, place the calibrated gage parallel to the vertical line of the cross on the screen (this can also be done with the horizontal line).

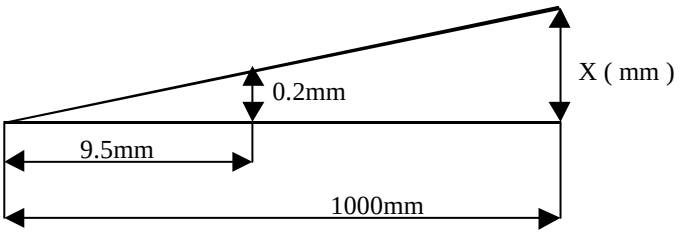
CALIBRATION OF THE LINEAR ENCODERS

The linear encoders must be calibrated before adjusting the optical fiber. This is done because the projector table may sag affecting the reading. This table sag must be compensated.

Steps:

1. Use the screen cross to measure a gage of known value. The larger the value of the gage, the more accurate the adjustment will be.
2. Calculate as follows. For example. A gage 9.5 mm thick is measured and the dro shows 9.3 mm. Since PAR09 must be assigned the value in mm per meter of table sag, calculate as follows:

$$\frac{0.2\ \text{mm}}{9.5\ \text{mm}} = \frac{X\ \text{mm}}{1000\ \text{mm}}$$



3. Assign the calculated value to PAR09.
4. Measure again using the cross. If the reading is not properly adjusted, change PAR09 in small amounts until the required accuracy is achieved.

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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-200 QC

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

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.

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.

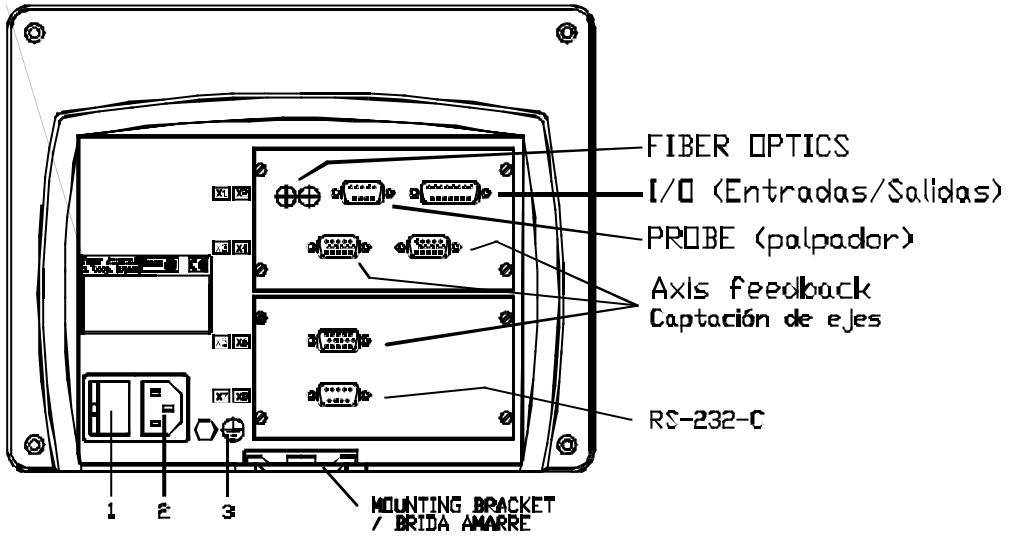
1. UNIT DESCRIPTION

This DRO has been designed to be used for measuring parts with an optical profile projector or a microscope.

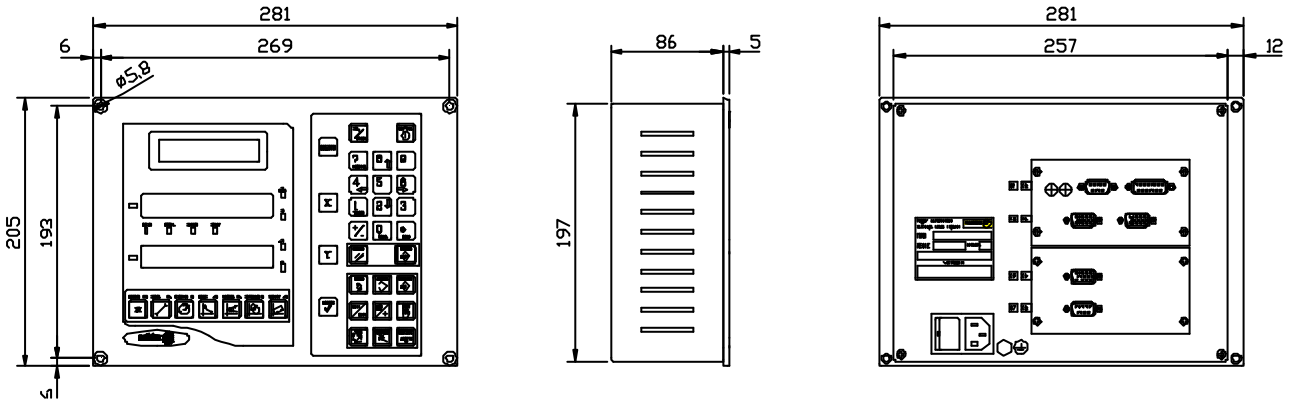
It can display the position of linear axes X and Y as well as an auxiliary "Q" axis that could be either linear or rotary.

1.1 FRONT PANEL (SEE OPERATION MANUAL)

1.2 REAR PANEL



Dimensions of the Built-in model:



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

1.- Power switch. When the unit is turned off by this switch, the DRO no longer reads axis position. Therefore, it is recommended to use the 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.

Optic Fiber: Two connectors to connect the fiber optic cables from the projector.

X1.- SUB-D type 9-pin male connector for the footswitch.

X2.- SUB-D type 15 pin female connector to connect up to three digital inputs and four digital outputs.

X3.- SUB-D HD type 15-pin female connector for the X axis feedback device.

X4.- SUB-D HD type 15-pin female connector for the Y axis feedback device.

X5.- SUB-D HD type 15-pin female connector for the Q axis feedback device.

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

WARNING

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

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

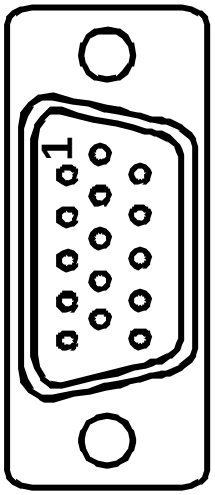
It is NOT enough to turn the display off by using the  key at the keyboard.

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** (for the X axis), **X4** (for the Y axis) and **X5** (for the auxiliary axis Q) .

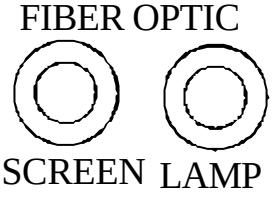


Pin	Signal	Function
1	A	Feedback signals
2	/A *	
3	B	
4	/B *	
5	Io	Reference signal
6	/Io *	
7	Not connected	Not being used at this time
8	Not connected	
9	+5V	Power for feedback
10	Not connected	Not being used at this time
11	0V	Power for feedback
12	Not connected	Not being used at this time
13	Not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

* Available only at the NVP-201QC

2.2 FIBER OPTIC CONNECTION

This connection is carried out by connecting the fiber optic cable for the reference light (lamp under the table supporting the part to be measured) to the connector on the right and the cable for the screen light to the connector on the left.



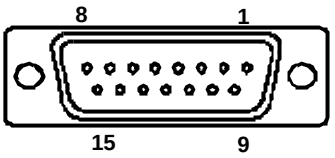
This fiber optic cable must have a diameter of at least 1 mm.

2.3 INPUT / OUTPUT CONNECTION (X2)

It has three digital inputs (IN) and four digital ouputs (OUT) that could be activated either at 5 V or 24 V.

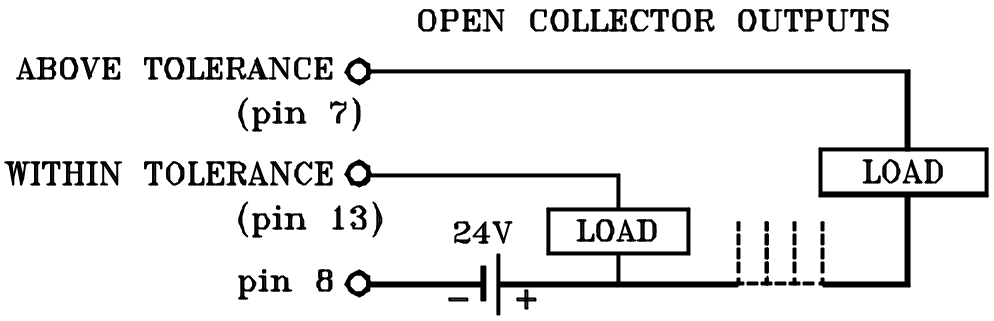
Characteristics of the signals at connector "X2":

Four general purpose opto-isolated inputs. The operating voltage for these inputs may be chosen between 5V and 24V with an on/off threshold is around +6V. The +24V power supply voltage must be between 0 and 24V (±25%). The on/off threshold is around +2.4V.

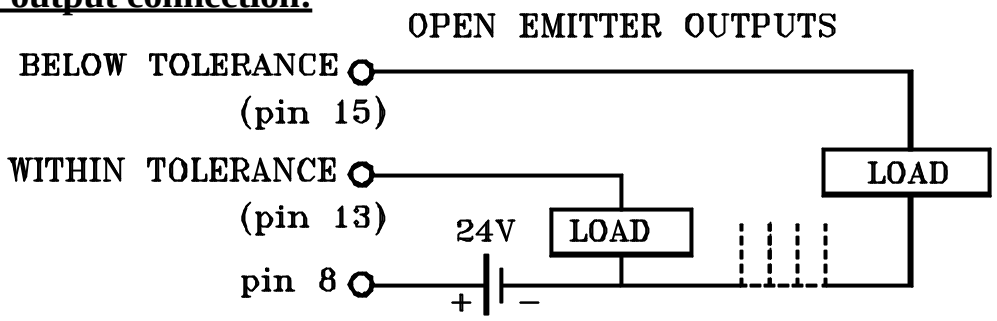


PIN	SIGNAL	FUNCTION
1	ZERO_X_IN	Input to set the X axis reading to zero
2	ZERO_Q_IN	Input to set the Q axis reading to zero
3	GND24V	Ground for the 24V inputs
4	(not connected)	(not being used at this time)
5	(not connected)	(not being used at this time)
6	NO_GO (OUT)	Output. Measurement out of tolerance
7	NO_GO+ (OUT)	Output. Measurement above tolerance
8	OUTPUT_COMMON	Output common
9	ZERO_Y_IN	Input to set the Y axis reading to zero
10	(not connected)	(not being used at this time)
11	GND5V	Ground for the 5V inputs
12	(not connected)	(not being used at this time)
13	(not connected)	(not being used at this time)
14	GO (OUT)	Output. Measurement within tolerance
15	NO_GO- (OUT)	Output. Measurement below tolerance

Open collector output connection:

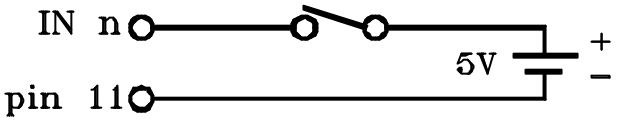


Open emitter output connection:

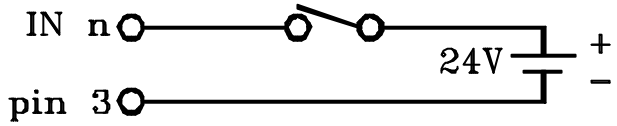


Note .- If any of the outputs is going to be connected to an inductive device, a 1N4000 type diode must be placed in anti-parallel.

Input connection at 5 Volts :



Input connection at 24 Volts :

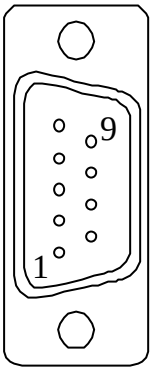


2.4 RS-232-C CONNECTION (CONNECTOR X7)

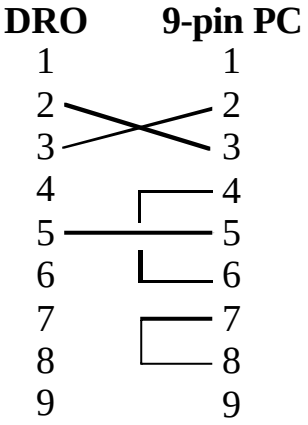
The RS-232-C serial communications line uses a 9-pin male SUB-D type connector.

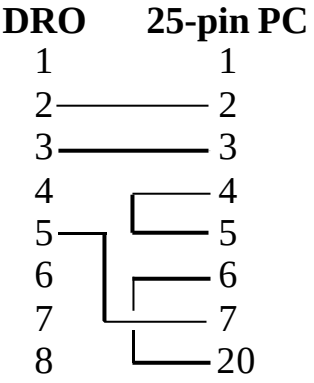
The installation parameters for this feature are described in section 3.3 of this manual.

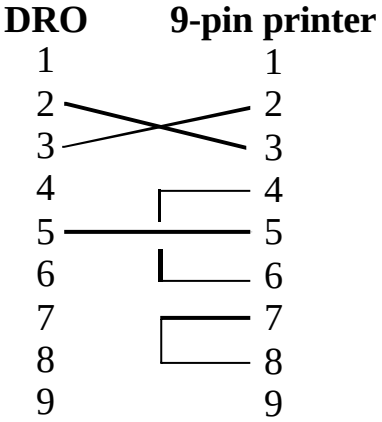
The operating mode for this feature is described in chapter 5 of the Operating Manual.

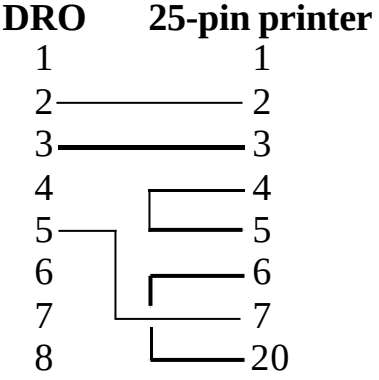


Pin	Signal	Function
1	NC	Not connected
2	RxD	Receive Data
3	TxD	Transmit Data
4	NC	Not connected
5	GND	Ground
6	NC	Not connected
7	NC	Not connected
8	NC	Not connected
9	NC	Not connected



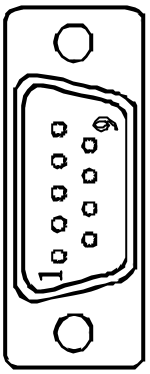






2.5 FOOTSWITCH CONNECTION (CONNECTOR X1)

Up to 2 footswitches may be connected to validate the measurements (capture points) carried out at the profile projector

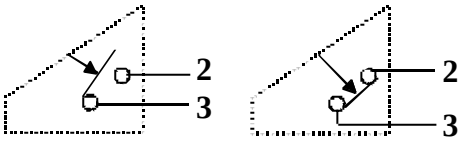


PIN	SIGNAL	FUNCTION
1	CHASSIS	Ground connection
2	+5VOUT	+5V output.
3	FOOT-1_5	+5V input for footswitch 1.
4	FOOT-1_24	+24V input for footswitch 1.
5	GNDVOUT	Output ground.
6	+5VOUT	+5V output.
7	FOOT-2_5	+5V input for footswitch 2.
8	FOOT-2_24	+24V input for footswitch
9	GNDVOUT	Output ground.

Footswitch connection:

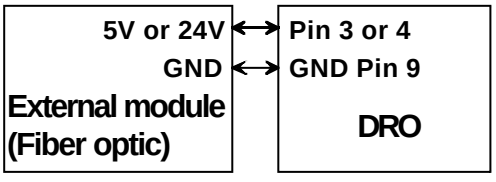
Each of the two footswitches may be connected either to 5 Vdc or 24Vdc as shown in the pinout table above.

Depending on whether the footswitch contact is normally open or closed, parameter PAR91 must be set accordingly to "1" or "2".



PAR91=2 PAR91=1

An external module (fiber optic, for example) can also be used to validate the detected point. In that case, it must be connected as follows:



PAR91=3

2.6 POWER AND MACHINE CONNECTION

These DROs can be connected to an AC voltage anywhere between 100V AC and 264 V AC ±10% with a frequency between 45 Hz and 400 Hz and between 120Vdc and 300Vdc 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).

2.7 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 message display the text: “Testing..." After the test, the message display shows "NVP-200 QC" and the X and Y displays show "Fagor dro". if everything is OK and the error number if otherwise. See the appendix at the end of this manual. Press 

When working with the edge detector, the dro will always turn on with the configuration of the last calibration used.

The default values for startup, such as millimeters or inches, Cartesian or Polar coordinate system, etc. may be set with parameter PAR60.

If any machine error compensation (be it linear or point to point) must be applied , the machine reference zero point (home) must be searched on the scales in order to apply it properly and, consequently, obtain more accurate measurements.

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 Message 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

To access the parameters:

· Press:  

. The Message display requests the password (**060496)**. If it is not entered, it is still possible to edit those general parameters not affecting the axes.

The auxiliary axis "Q" only admits parameters PAR00, PAR01, PAR02, PAR03, PAR10 and PAR14.

Once in parameter mode, to access a particular parameter, press  **[Nº de parámetro]** 

The Message 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 Y**) or  for the Q axis and key in its new value.

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

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

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

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

From the count modes, it is also possible to access all the parameters not affecting the count (user), such as: parameter **PAR50** (language) with the keystroke sequence:  5  . 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 PAR51 (memory lock), PAR90 through PAR93 (RS-232-C serial line).

3.2 PARAMETERS TO CONFIGURE AXIS COUNT AND DISPLAY

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

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

PARA-METER	**FUNCTION**
PAR00	Feedback configuration, different per axis. Binary type. This parameter sets the specific characteristics of the feedback device (rotary or linear encoder) used to read the axis position.
Digit	
8	Direction of the distance-coded Io (**0 = Increasing**, 1 = Decreasing) Fagor offers two types of linear encoders depending on the type of reference marks they use (Io): the standard one with several reference marks every 50 mm and the one with distance-coded reference marks (models with "O", e.g.: MOVX, FOP, etc.). When using a rotary encoder or a **standard Fagor linear encoder** (without "O") for this axis, **this bit must be set to "0".** When using an "**M**" or "**F**" series **Fagor linear encoders with distance-coded reference marks** (e.g.: MOVX, FOP) for this axis, **this bit** must be set to "**0**". When using a "**C**" type linear encoder **with distance-coded reference marks**, (e.g.: COX, COVP) for this axis, this bit must be set to "**1**".
7	Pitch of the distance-coded Io (**0 = 20 mm**, 1 = 100 mm) This bit is ignored if bit 6 has been set to "0". When using Fagor M or C series linear encoders, this bit must be "0". When using Fagor F series linear encoders, this bit must be "1".

6 Type of linear scale's Io (**0 = Fix**, 1 = Coded)

Fagor offers two types of linear encoders depending on the type of reference marks they use (Io): the standard one with several reference marks every 50 mm and the one with distance-coded reference marks (models with "O" e.g.: M**O**VC, C**O**S, etc.).

When using a rotary encoder or a standard Fagor linear encoder, this bit must be set to "0".

5 Axis units:

If linear: **0 = mm**, 1 = inches

If rotary: 0 = decimal degrees, 1= degrees, minutes and seconds.

These units refer to the feedback and not to the display which may be changed with the [0 Inch] key. Obviously, this key does not affect the display of the rotary axis.

4 Type of axis (**0 = Linear**, 1 = Rotary)

3 Differential feedback signals (**0 = No**, 1 = Yes)

This bit indicates whether the feedback system outputs differential signals (A, /A, B, /B, Io, /Io) or not (only A, B, Io).

See the electrical characteristics of the device used for this axis.

2 Type of feedback signals (**0 = TTL**, 1 = 1 Vpp)

This bit indicates whether the feedback signals are square TTL (rotary encoders and Fagor linear encoders without "P", e.g.: CX, MX, CT, etc.) or 1 Volt peak to peak sinewave (without P, e.g.: MVP, CVP, etc.).

1 Counting direction (**0 = normal**, 1 = reverse)

If an axis count increases or decreases in the opposite direction to the one desired, change the value of this digit.

PAR01 Feedback resolution, independent for each axis,

If linear axis. Possible values: from 0.0001 mm to 1 mm.
From 0.000001 to 0.03937 inch
These values are set as any other number depending on the setting of PAR00 (units).
If rotary axis:
In ten-thousandth of a degree (0.0001º): 1, 2, 5, 10, 20, 25, 50, 100, 180, 200, 250 and 300.
In seconds 1, 2, 3, 5, 9, 10, 15, 18, 20, 25, 30 and 36.

PAR02 TTL multiplying factor (subdivision). Independent for each axis.

Options: x4, x2, x1 and x0.5.

The selection of these values rotates by pressing [+/-]
The factory setting is: **x4** and it is the one used for FAGOR scales.

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

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

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

PAR03 Internal multiplying factor when using sinewave feedback signals or external multiplying factor when using semi-absolute feedback devices (coded Io) and TTL feedback signals. Independent for each axis. **Options: 1, 5, 10, 20, 25, 50. Factory setting: 1**

For example:

For standard Fagor linear encoders with squarewave signals (without "**O**" or "P") e.g.: MX, CT, CX, etc. it must be set to "**1**".

For **Fagor linear encoders with squarewave signals and distance-coded reference marks** (models with "**O**"), eg.: MOX, COX, etc. it must be set to "**5**".

For **Fagor linear encoders with squarewave signals and distance-coded reference marks** (models with "**O**") and 0.5µm resolution, eg.: MOY, COY, etc. it must be set to "**10**".

For Fagor sinewave linear encoders (with "**P**"), e.g..: MVP-5, COVP-3), this parameter must be set to "**5**".

PAR08 Depending on the type of feedback device being used, this DRO sends out a feedback alarm when any of the feedback signals is too weak or when overrunning any of the travel limits set by PAR12 or PAR13 or when exceeding the maximum axis feedrate allowed.

Digits This parameter indicates whether these alarms will be used or not.

8, 7, 6	Not being used at this time. Must be set to "0".
5	The NVP-201QC 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 Linear axis 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 Offset of the reference point with respect to the reference zero of the scale, independent for each axis.

When selecting a reference point as the absolute zero, the reference mark of the feedback device usually does not coincide with the same physical point on the axis.

Therefore, when using standard Io's, this parameter must be assigned the value of the distance from the machine zero point to the feedback reference point.

When using Fagor linear encoders with distance-coded reference marks (models names with the letter "O", e.g.: FOX, MOVP-5), this parameter must be assigned the OFFSET value indicated on the label of the linear encoder itself.

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.
Refer to the operating manual for reference zero (home) searching.

PAR12 To set the negative axis travel limit.

Possible values: between -99999.999 and 0.

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

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

PAR13 To set the positive axis travel limit.

Possible values: between 0 and 99999.999

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

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

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".**

Refer to the operating manual for reference zero (home) searching.

PAR 15 It contains the point-to-point axis compensation.

Besides the linear compensation of PAR09, with this DRO it is possible to define a point-to-point compensation of up to 40 points per axis.

A value of "0", indicates that no compensation is applied.

The procedure is as follows:

- Press the key of the axis to be compensated (X or Y) .
- Key in the number of points to compensate at the corresponding display..

- When pressing [ENTER], the DRO shows the position value (X axis display) and the amount of error to be compensated (Y axis display). It is possible to move between points using the arrow keys and [ENTER]

- When pressing the axis keys ([X] or [Y]), it goes on to editing the position or the error with the resolution and units of the axis (PAR00 and PAR01).

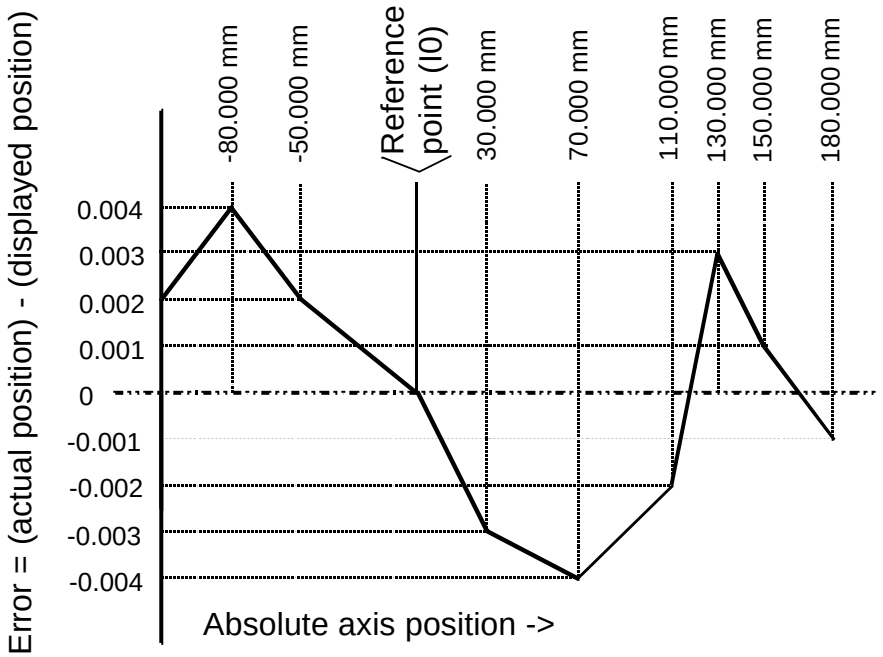
- When pressing [PROG], the X axis display shows the home coordinate of the selected axis. By pressing [ENTER] or [Y] it assumes the displayed value as the position and it goes on to requesting the error.

The amount of error to be enter is the "actual position" minus the "displayed position".

For example: Actual position = 12.025, Displayed position = 12.028

Value to be entered at this point: **-0.003**

The reference point must be assigned an error value of "0".



- The preset is canceled by pressing [CLR] before pressing [ENTER].

- To exit, press [CLR] while no axis is blinking.

3.3 INPUT/OUTPUT RELATED PARAMETERS

PAR21 Indicates the active level for the inputs. Only the first four digits are used where the first one corresponds to "E1" and the third one to "E3". A "0" indicates that the input is active low (0V).

E1, E2 and E3 are used to zero the reading of the X, Y and Q axes respectively.

PAR23 This parameter only makes sense when bit 3 of PAR64 is set to "1".

Indicates the active level for the outputs. Only the first four digits are used. A "1" means that the output is active high (5 V or 24V).

Digits

8 to 5 Not being used at this time. They must be set to "0".

4 GO (within tolerance, pin 14)

3 NO_GO (out of tolerance, pin 6)

2 NO_GO- (below tolerance, pin 15)

1 NO_GO+ (above tolerance, pin 7)

3.4 MESSAGES AND PROGRAMMING RELATED PARAMETERS

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

These values are selected in a rotary fashion by pressing 

PAR51

(8 to 3) Not being used at this time. They all must be set to "0".

(2) Cancel the beep (=1). If =0, the DRO beeps when pressing a key and when the measurement just made is within tolerance.

(1) Program memory lock, 0 = unlocked; 1 = locked.
When the memory is locked, the operator cannot modify its contents.

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 PARAMETERS FOR PART MEASURING

PAR60 It indicates the configuration assumed by the DRO when turned on:

Digit

8	If =1, the tolerance outputs will be used.
7	If =1, the reference points of the axes will have to be searched when the unit is turned on.
6	It sets either a fixed number of points to create a point, a line or a circle or the maximum number of points possible (value of 0 = 50 points). If this bit is set to "1", the fixed number is set by PAR65, PAR66 and PAR67.
5	Without edge detector (0) or with edge detector (1).
4	Manual point capture validation (=1).
3	Decimal degrees (0) or degrees-minutes-seconds (1).
2	Cartesian (0) or polar (1) coordinate system
1	Millimeters (0) or inches (1).

PAR61 It indicates the configuration of the function to "print" the data measured or created ([1]):

Digit

8	Not being used at this time. It must be "0"
7	Print a PC type report (1)
6	Print an 80-column report (1)
5	Print a 20-column report (1). Simple format.
4	Print also the header (1)
3	Only print the tolerances (1)
2	Only print the last one (1)
1	Print all (1)

Note: Although this parameter sets the default way to print reports, it may be changed by going into the print menu pressing [MENU] as described in chapter 8.2 of the operating manual.

Print all:
When selecting this option, it will print all the measurement as they are carried out.

Print tolerances:
When selecting this option, it will print all the results having a tolerance associated to them as they are being measured.

Print last:

If this option has been selected, pressing [1 PRINT] will only print the value measured last.

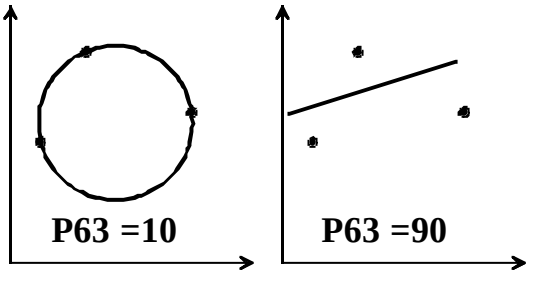
Print header:
It indicates whether the header will also be printed at the top of each new page. This header is only printed on full 80-column reports.

Print 20, 80, CSV:
It selects the print format for the report, the 20 or 80-column format or the Comma-Separated-Values format (CSV). The latter is ideal to send measurement data over to a PC and then import it into a spreadsheet or data base.

PAR62 Number o lines per page of the printed measurement report ([1 PRINT]). Possible values between 1 and 255. Factory set to "70" (A4).

PAR63 Factor that indicates the degree of dispersion of the captured points for the automatic recognition of a line or a circle. Possible values from 1 to 255. Factory set to "50".

For example, when capturing 3 points, this DRO may consider them either to be part of a line or of a circle depending on the value given to this parameter (PAR63).



PAR64

Digits

8 to 4 Not being used at this time. They must be set to "0".

3 If equal to "1" it enables the tolerance indicating outputs (pins 6, 7, 14 and 15 of connector X2). Factory set to "1".

2 It indicates whether a VFD display (=1) or an LCD display (=0) is being used. It is factory set to "1".

1 If equal to "1", it indicates that a second fiber optic cable is being used for the reference light. It is factory set to "0".

PAR65
PAR66
PAR67

It indicates the number of points required to measure or create a point, a line or a circle.
Once the number of points indicated by this parameter has been captured, the DRO will automatically create (or considered measured) the selected element without having to press the [FINISH] key.

PAR71
PAR72

They indicate the maximum and minimum position tolerance respectively. Possible values within ±3,2 mm (always in mm).
In mm or inches depending on whether the INCH led is OFF or ON.

When the measurement exceeds one of these values, the DRO activates the relevant output OUT-UP or OUT-DOWN respectively. Otherwise, if the measured value is within the tolerance range, it will activate the OK-OUT output.

PAR73
PAR74

They indicate the maximum and minimum radius measuring tolerance. Possible values within ±3,2 mm (always in mm).
In mm or inches depending on whether the INCH led is OFF or ON.

When the measurement exceeds one of these values, the DRO activates the relevant output [NO_GO+] or [NO_GO-] respectively. Otherwise, if the measured value is within the tolerance range, it will activate the [GO] output.

PAR75
PAR76

They indicate the maximum and minimum distance measuring tolerance. Possible values within ±3,2 mm (always in mm).
In mm or inches depending on whether the INCH led is OFF or ON.

When the measurement exceeds one of these values, the DRO activates the relevant output [NO_GO+] or [NO_GO-] respectively. Otherwise, if the measured value is within the tolerance range, it will activate the [GO] output.

PAR77
PAR78

They indicate the maximum and minimum angle measuring tolerance. Possible values within ±3.000º.
When the measurement exceeds one of these values, the DRO activates the relevant output [NO_GO+] or [NO_GO-] respectively. Otherwise, if the measured value is within the tolerance range, it will activate the [GO] output.

3.6 RS-232-C RELATED PARAMETERS

PAR90 Indicates the transmission speed of the RS 232 line.

Options: 75, 150, 300, 600, 1200, 2400, 4800 & 9600 baud.

3.7 FOOT-SWITCH RELATED PARAMETERS

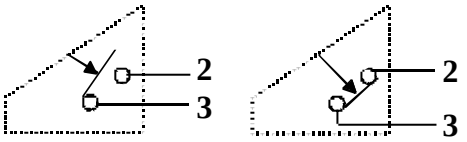
PAR91 It indicates the existence of a foot-switch and its active level.

Options: 0 = There is no foot-switch,

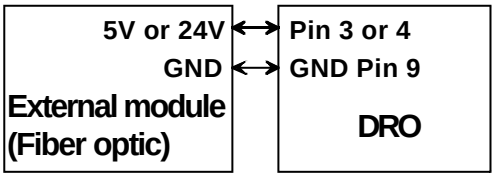
1 = There is a normally-closed foot-switch.

2 = There is a normally-open foot-switch.

3 = An external (fiber optic) module is used.



PAR91=2 PAR91=1



PAR91=3

PAR93 Position display mode when activating the foot-switch:

Options: 0 = It keeps displaying the axis position.

1 = It freezes the display until it quits touching.

2 = It freezes the display until it touches again.

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

4.1. SAVING AND RESTORING DATA

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

This data is sent out in the following format:

Baudrate as set by PAR90, 8 data bits, 1 stop bit and no parity.

To access this mode:

- Press [MENU]
- Select the "Com" option (communications) of the message display by means of the [4] [6] keys until that word appears between < > "**<Com>" and** press [ENTER]
- Select: <**Send**> and press [ENTER] to send the data out to a PC or peripheral device or select <**Receive**> and press [ENTER] to receive data from a PC or peripheral device.
- Select the type of data to transmit: a **Progr**am or the **Param**eter table by means of the [4] [6] keys and press [ENTER] .

4.2 PARAMETER TRANSMITTING FORMAT

The format of the transmitted parameters are:

For value parameters: **P?? 123.123**
For binary parameters: **P?? 10101010**
For option parameters: **P?? 0**
For axis parameters: **P?? X 123.123 Y 123.123 Q 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
 Y03
        N00 P-1000.000 E-1.500
        N01 P0.000 E0.000
        N02 P1000.000 E1.500
```

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

4.3 REMOTE KEYBOARD MODE ("PC" OPTION)

When selecting this option, the DRO may be operated remotely from a PC by sending the codes for the desired keystroke sequences through the serial line RS-232-C using a communications program such as the Hyperterminal from Windows.

See section 8.5 of the operating manual for further detail.

5. PROJECTOR CALIBRATION (SEE CHAPTER 8.1 OF THE OPERATING MANUAL)

APPENDIX

GENERAL TECHNICAL CHARACTERISTICS

Universal Power Supply between 100V AC and 240V AC ±10% with a frequency between and beteen 45 Hz and 400 Hz and between 120Vdc and 300Vdc.

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.

CHARACTERISTICS OF FEEDBACK INPUTS: X3, X4 X5:

They are SUB-D HD female 15-pin connectors.

- +5V input consumption: 250 mA
- Admits square-wave signal (TTL). (A, B, Io)
- 1Vpp voltage modulated sinewave signals (NVP-X01M model)
- Maximum frequency: 250 KHz, minimum separation between flanks: 950nsec.
- Phase shift 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) $0.0V \leq V_{IL} \leq 0.55V$

CHARACTERISTICS OF DIGITAL INPUTS AND OUTPUTS

Characteristics of the inputs at 24V :

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

Characteristics of the inputs at 5V :

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

Characteristics of the digital outputs

They are optocoupled with a solid state relay with a normally open contact.

Their main characteristics are:

- Maximum AC or DC voltage: 40V
- Maximum load current: 225mA
- Maximum internal resistance: 5Ohms
- Maximum peak current: 2.5A for 100ms at 25ºC
- Through current when open: ≤ 1µA
- Galvanic isolation voltage: 1500V for 1 minute
- Activation time: ≤ 3ms
- Deactivation time: ≤ 3ms

ERROR CODES

Message	Description
FAGOR dro	Power outage or turned off by main switch after saving the data.
Error 02	Power outage or turned off by main switch without having saved the data. The unit has been turned off without previously pushing the [ON/OFF] key. It will only lose the position count (will be reset to zero) and the status of the operating modes (inch, abs, etc.).
Error 04	Wrong parameter values
Error 05	Wrong internal configuration
Error 06	Errors in data backup memory (Service Dept.)
Error 07	Emergency input active. Press [C] or cancel emergency signal.
Error 08	Wrong software memory or the software has been changed
Error 09	Errors in work memory (Service Dept.)
Error 12	Error while searching a coded marker pulse (Io)
Error 31	Internal malfunction (Service Dept.)
Error 32	Internal malfunction (Service Dept.)
Error 99	Internal malfunction (Service Dept.)
.....	Feedback alarm 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 nonabrasive dish-washing detergents are recommended (in liquid, never powder form) or 75% isotropic alcohol with a clean cloth. DO NOT USE aggressive solvents, (benzol, acetones, etc.) which could damage the materials the equipment is made with.

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

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

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

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

Preventive Inspection

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

METROLOGY
DRO
FAGOR
NVP-200 QC

OPERATING MANUAL

Man: 0009 Soft: 1.xx

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INTRODUCTION

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

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

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

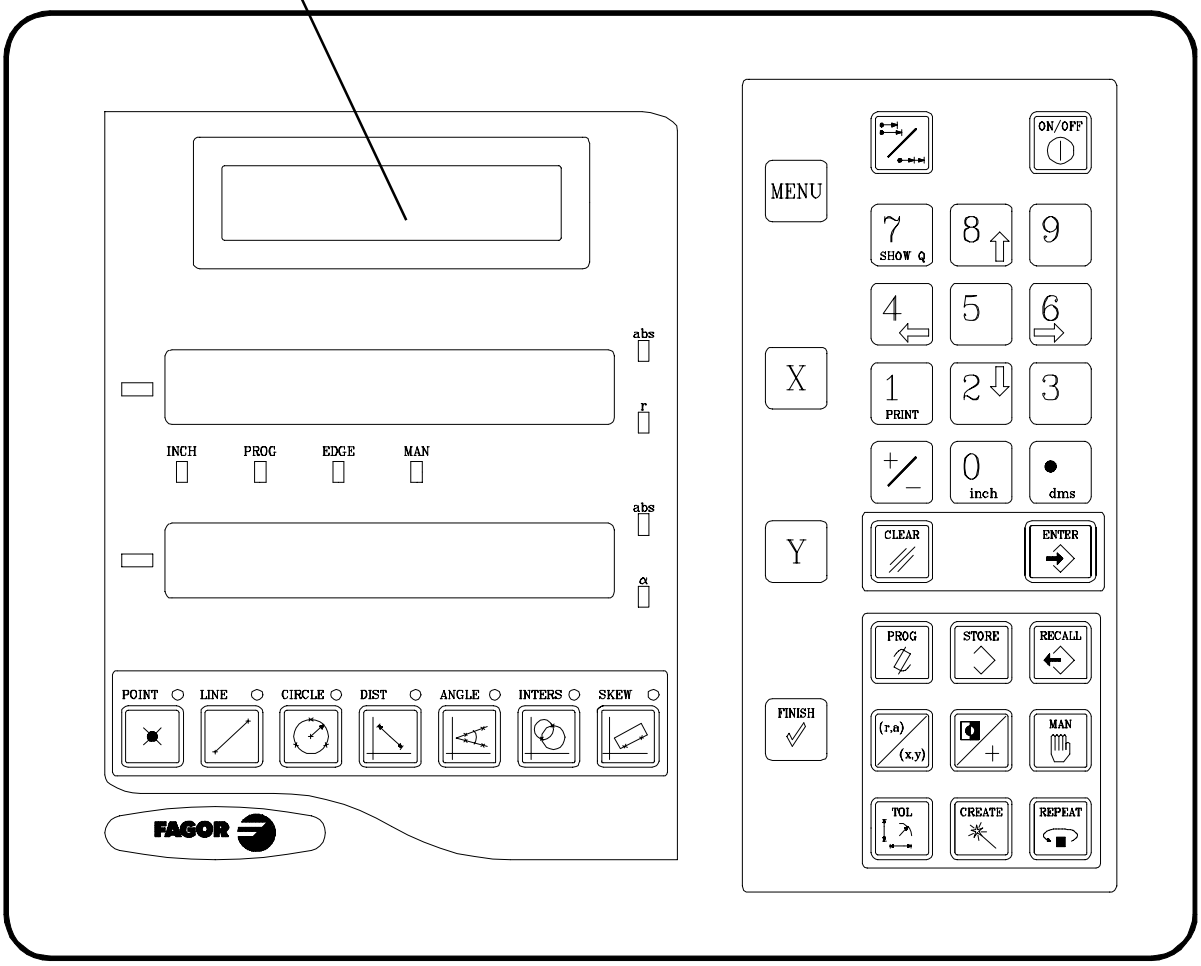
1. UNIT DESCRIPTION

This DRO has been designed for part measuring using an optical profile projector or a microscope.

It can display the position of linear axes X and Y as well as that of a third auxiliary axis "Q" which may be either linear or rotary.

1.1 FRONT PANEL

Message display



The message display offers assistance for the various operations possible with this unit.

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

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

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

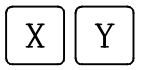
PROG-This LED turns on when selecting the "Execution" option of the "program" mode or when pressing 

EDGE-This LED turns on when selecting the edge detection mode and it turns off when selecting the "crosshairs" mode by pressing 

MAN- This LED turns on when being the edge detector active, the manual point capturing mode is selectedand and it turns off when deselecting the edge detector mode or selecting the automatic mode by pressing 

r -
α - These LEDs turn on when selecting the Polar coordinate display move and they turn off when selecting the Cartesian coordinate mode using the  key.

Key to access special functions such as calibration, printing, PC communications, statistics and home (reference zero) search.



To select the first and second axis respectively.

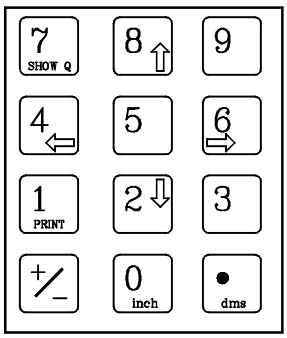
To finish the measurement or creation of an element (line, circle, etc.)


To toggle between absolute and incremental modes.

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.

To validate an operation.

To cancel or abort an operation already initiated.



These keys have a dual function and they are used to enter values, select the various menu options (4 6) to increase or decrease values; (8 2) select the data of the temporary memory; display the auxiliary Q axis (7 SHOW Q); print data (1 PRINT); change the sign of a value (+/-); change the display of the rotary axis in degrees, minutes and seconds (• dms).

To access the program menu, to edit or delete a program.

To save the measurement just made into permanent memory.

To recall a value previously stored in memory.

To toggle between polar coordinate mode (degrees and radius) and Cartesian mode (mm or inches).

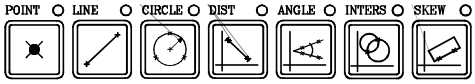
To toggle between edge detection mode and crosshairs mode of point capturing.

To select the manual point capturing mode.

To indicate the tolerance to be applied to a measurement.

To create an element: Point, line, circle, parallel line, perpendicular, bisector or distance.

To activate the repetition mode, if pressed after measuring an element or repeat the point capture if pressed while measuring an element.



To select the type of element to measure: Point, line, circle, distance, angle, intersection and skew respectively.

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

The DRO runs a self-test and shows on the message display the text: “Testing..." After the test, the message display shows "NVP-200 QC" and the X and Y displays show "Fagor dro". If everything is OK and the error number if otherwise. See the appendix at the end of this manual. Press 

When working with the edge detector, the dro will always turn on with the configuration of the last calibration used.

The default values for start-up, such as millimeters or inches, Cartesian or Polar coordinate system, etc. may be set with parameter PAR60.

If any machine error compensation (be it linear or point to point) must be applied , the machine reference zero point (home) must be searched on the scales in order to apply it properly and, consequently, obtain more accurate measurements.

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 

.

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 instead of ENTER to quit the language selection mode.

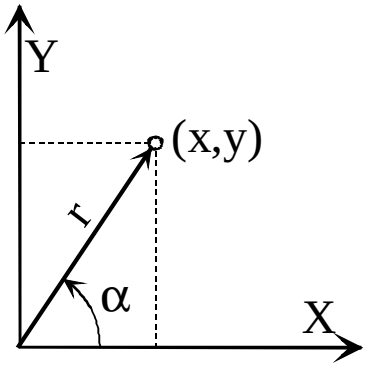
* "Custom" may be any user defined language. (See section 3.2 PAR52 of the installation manual).

Conversion mm into inches

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

Position in Cartesian or Polar coordinates

To toggle the display of the axis position between the Cartesian system (x, y) and the polar system (α, r), simply press (r,a)/(x,y)

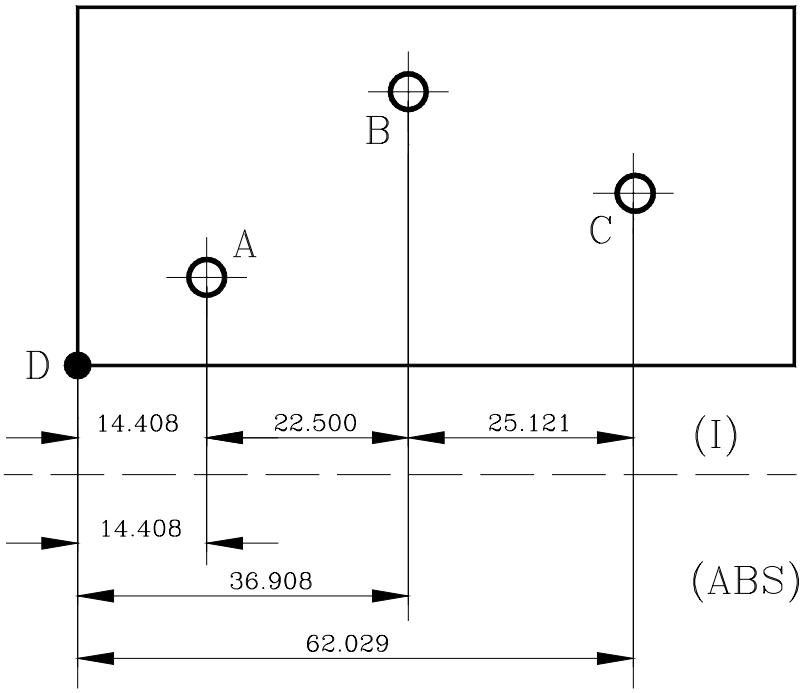


2.2 INCREMENTAL AND ABSOLUTE MODES

These DROs can display the position of the axes in incremental or absolute mode using the key. The ABS led will be off or on respectively depending on the selected mode.

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

- In **Incremental** (I), when the **ABS** led is off the distance from the present position of the axis to the previous position.
- In **Absolute** (**ABS**), when the **ABS** led is on, the distance from the present position of the axis to part zero (**D**) is displayed.



2.3 AXIS COORDINATE PRESET

The axis position may be preset to any value both in incremental (ABS led off) and in absolute mode (ABS led on).

-To set the axis reading to zero, press:

CLEAR X for "X", CLEAR Y for "Y" and CLEAR 7 SHOW Q for the auxiliary axis "Q".

-To preset any other value (for example for the X axis), press: X [key in the desired value] ENTER .

Note: If the Skew is active (SKEW led on), the axis position cannot be preset or zeroed. The same thing happens when the polar coordinate system is active using

2.4 MACHINE REFERENCE SELECTION AND SEARCH (REFS)

When installing the system, a reference point (home) should be established in order to be able compensate for any inaccuracies of the machine axes using the reference marks (Io) of each axis be it a linear or rotary encoder. See PAR09 (linear feedback compensation) and PAR15 (point-to-point compensation) on section 3.2 of the installation manual.

It is also possible to force the operator to carry a reference search on each axis every time the DRO is turned on in order to recover all the compensations set when installing the system.

The standard FAGOR linear encoders (scales) have one reference mark (Io) every 50 mm along its travel. The model names of these linear scales do not have an "O" (for example: MX, CVX, FP).

In these cases, one must choose an area of the linear encoder which will be marked as the "**reference zone**" with a marker or sticker on the linear encoder or on the machine the first time the axis reference is searched for in order to use the same reference point on later home searches (**REF**).

FAGOR also offers linear encoders with distance-coded reference marks. With this method, homing only requires moving the axis a maximum of 20 mm or 100 mm (models MO-/CO- and FO- respectively) from the current position in order to find the exact position with respect to the reference zero point (home) without having to establish any "**reference zone**" as in the previous case.

The names of these models have the letter "O". For example: MOV, COVP, FOP, etc.

2.4.1 HOME SEARCH PROCEDURE

To access the machine reference zero (home) search mode:

- Press [MENU]
- Select the <**REFS**> option using [4 ⇦] and [6 ⇨]
- When using a standard Fagor linear encoder (without an "**O**" on its name):

  Move the axis to the **reference zone.**
- Select the axis to be homed by pressing its key [X] or [Y]

  The axis position reading starts blinking.
- Move the selected axis until the reference mark (Io) of the feedback device (linear or rotary encoder) is detected.

  Then, the axis display stops blinking and it shows the exact current position with respect to machine reference zero (home).
- To exit the home search mode, press [MENU] again.

NOTE: If installation parameter PAR14=1 (feedback without reference mark; Fagor scales: MKT), the zero position may be preset.

3. *MEASURING*

With this DRO, it is extremely easy to **measure** points 

, lines 

and circles 

and calculate distances 

, angles 

and intersections 

between elements (points, lines or circles).

There are two ways to measure elements:

- In **EDGE DETECTION** mode  (**EDGE** led on) when having a fiber optic cable. In this mode, the points are captured automatically when going from light to shadow or vice versa.

  If while being in this mode, the 

key is pressed, **(MAN** led on**)**. Every time a light < - >shadow change is detected, the message display will show the word **"POINT"**. That point will be validated manually by pressing 

- In CROSSHAIRS mode (**EDGE** led off). In this mode, the points may be selected by pressing 

or the foot-switch if it has been previously installed, obviously.

On the other hand, the elements may be measured using two methods:

- With a **FIXED** number of points to be captured for each element (set by parameter).
- Or with a **MAXIMUM** number of points to be captured for all each element (50). If the message display shows that the total number of points to be captured for a particular element is 50 (so set by installation parameter), it means that one can entered up to 50 points (maximum) to complete an element.

Name of the element

```
Element      Circle
Point         02/50
```

Number of points measured

Maximum number of points

To change from **FIXED** (a) mode to **MAXIMUM** mode (b) and vice versa, press 

a)
```
Point = 1
```

b)
```
Point = 50
```

- Once one has chosen to measure an element and depending on how the corresponding installation parameter has been set, the message display will request a particular number of points to capture (from 1 to 50).
  For example: **POINT 01/05** indicates the first point of the five required to complete the selected element (line or circle).

  If one wishes to capture less or more points than the total shown on the display (5 in this example). The total number of points for a particular element may be increased or decreased using the [6 ⇨] and [4 ⇦] keys.

- To complete the measurement of an element, capture all the points requested or press [FINISH ✓]

- If, by mistake, an undesired point has been entered, this last point may be **canceled** by pressing [REPEAT]. This key "undoes" the last element and one may keep undoing the last points captured by pressing it again and again.

- To **cancel the measurement** of an element, press [CLEAR]

- To change from radius mode (r) to diameter mode (Φ) and vice versa: press [CLEAR] [CIRCLE]

NOTES: If the number of points is not sufficient to calculate the element, an error message will be displayed. For example when capturing only 2 points for a circle (which requires at least 3 points).

When measuring an element using more than the minimum number of points required (1 for a point, 2 for a line, 3 for a circle), the result will be a theoretical element that best matches those points. It will also calculate an error indicating the dispersion of those points with respect to the calculated theoretical element.

For the point, the standard deviation of the distances of the theoretical point to the measured points.

For a line, the standard deviation of the distances to the theoretical points used to create it.

For a circle. It will give the form (rounding) error of the circle that represents the difference between the maximum and minimum radii of the measured element.

3.1 MEASURING EXAMPLES

In order to make these examples simple, we will assume the CROSSHAIRS mode ("**EDGE**" led off,).

Remember that in Edge detection mode, ("**EDGE**" led on), the operator does not need to press unless the "**MAN**" led is on (on). It will be enough to go from light to shadow or vice versa.

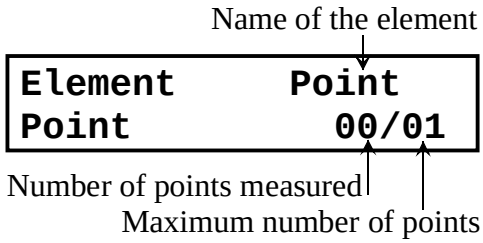
To repeat a measurement, press after it and the "**PROG**" led will turn on. To quit this "repeat" mode, press and the "**PROG**" led will turn off.

3.1.1 POINT MEASUREMENT EXAMPLES

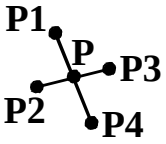
When measuring or capturing a single point, two situations may occur:

a) With a single pint (maximum set by installation parameter). To do this:

1- Press
2- Move the axes to the point to be captured
3- Press (or the foot-switch).



b) With a maximum number of points greater than one, set by parameter. In this case (4)



Element	Point
Point	00/04

Maximum number of points

1- Press POINT 

This maximum number of points to be captured may be changed any time while measuring by means of the 4 ⇦ and 6 ⇨ keys.

2- Move the axes to the first point to be captured

3- Press ENTER or the foot-switch.

Element	Point
Point	01/04

4- Move the axes to the second point to be captured

5- Press ENTER or the foot-switch.

Element	Point
Point	02/04

6- And so on, until the last point has been captured (in this case the 4th one).

Element	Point
Point	03/04

To end the point capture after having taken two or three points without having to get the last one, simply press FINISH ✓ .

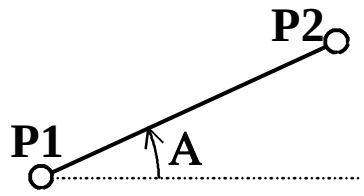
Point	►

X = X coord. of the point
Y = Y coord. of the point

Pressing 6 ⇨ the message display will show the error of the average point (P) resulting from measuring all of them.

	◄
e = 0.002	

3.1.2 LINE MEASUREMENT EXAMPLES



Measuring a line requires at least 2 points .

When measuring a line, several situations may occur:

a) With two points (set by parameter).

To do this:

1- Press 

2- Move the axes to the first axis

3- Press 

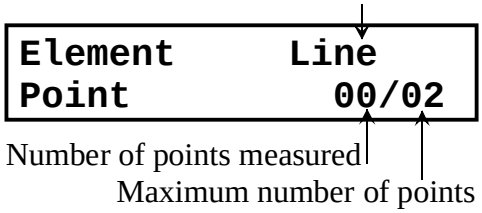
or the foot-switch

4- Move the axes to the second point

5- Press 

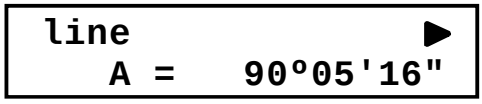
or the foot-switch

Name of the element

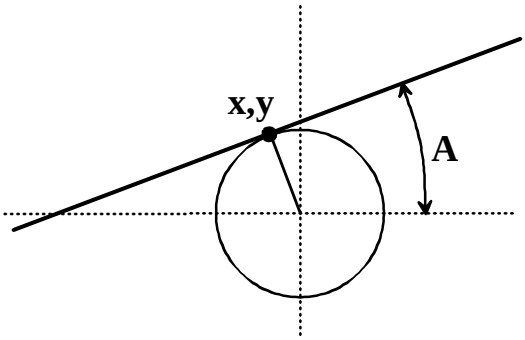


Number of points measured

Maximum number of points



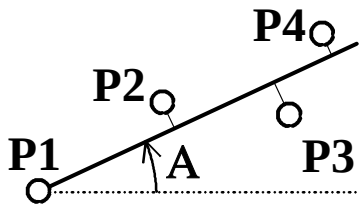
The message display will show the angle (A) and the X/Y displays will show the coordinates of the point (x,y) closest to the origin point.



Pressing 

the message display will show the measuring error. Measuring a line with two points results in an error "e = 0".

b) With a maximum number of points greater than two, set by parameter. In this case (4).



1- Press 

The maximum number of points may be changed any time while measuring using 

2- Move the axes to the first point.

3- Press 

or the foot-switch.

```
Element      Line
Point          01/04
```

4- Move the axes to the second point.

5- Press 

or the foot-switch.

```
Element      Line
Point          02/04
```

6- And so on until reaching the last point (in this case the 4th one).

3- Press 

to capture it and end the measurement.

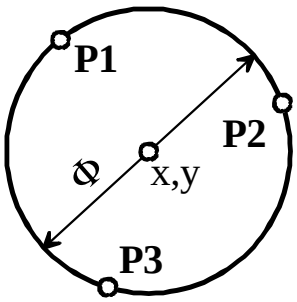
The message display will show the angle "A" (with respect to the X axis) of the line that best matches the measured points.

```
Line                    ▶
   A =   90º05'16"
```

Pressing 

the message display will show the measurement error.

3.1.3 CIRCLE MEASUREMENT EXAMPLES



Measuring a circle requires at least 3 points.

When measuring a circle two situations may occur:

a) With three points (set by parameter).

To do that:

1- Press CIRCLE

Element	Circle
Point	00/03

2- Move the axes to the first point

3- Press ENTER or the foot-switch

Element	Circle
Point	01/03

4- Move the axes to the second point

5- Press ENTER or the foot-switch

Element	Circle
Point	02/03

6- Move the axes to the third point

7- Press ENTER or the foot-switch

Circle ▶
Φ = 150.000

X = center coord.
Y = center coord.

Circle ◀▶
r = 75.000

◀
e = 0.002

X = maximum radius
Y = minimum radius

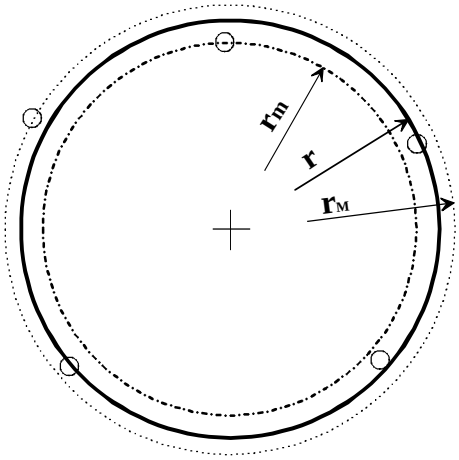
The message display will show the circle diameter (Φ) and the X/Y displays will show the center coordinates.

If the radius mode is selected (with CLEAR CIRCLE), it will first show the radius (r) and then the diameter (Φ).

Pressing 6 ⇨ the message display will show the radius and the form error.

The form error (e) is the difference between the maximum and minimum radii. In the case of a three-point circle, "e = 0".

b) With more than 3 points (5 in this example).



To do that:

1- Press CIRCLE

Element	**Circle**
Point	**00/05**

The maximum number of points may be changed any time while measuring using 4 6

2- Measure the points by positioning on them and pressing ENTER

The message display will show the diameter (Φ) of the circle and the X/ Y displays will show the center coordinates.

Pressing 6 the message display will show the circle radius (r) and the form error which is the difference between the maximum and minimum radii ($e = r_M - r_m$) . On the other hand, the X axis display will show the maximum radius (r_M) and the Y the minimum (r_m).

4 CALCULATIONS

Remember that, same as with measurements, the REPEAT key may be used after calculating an angle, distance or intersection to repeat the same operation without having to select again the element to be calculated (angle, distance or intersection).

To exit the repeat mode, press PROG

The message screen will request confirmation of this command.

The elements used in the calculations may be obtained by measuring them or by recalling them from memory if they have been previously stored (see chapter 5).

4.1 MIDPOINT CALCULATION

To calculate the midpoint between two elements, press POINT

Element Point	Point ►
Point 00/02	

Note: The message display must **not** show "00/**01**", otherwise, it will not allow capturing more than one point. If it does show "00/**01**", press 6 to change the display to "00/**02**".

The elements used in the calculations may be obtained by measuring them or by recalling them from memory (see chapter 5).

Once those elements have been entered, the X and Y displays will show the coordinates of the midpoint between both elements.

4.2 DISTANCE CALCULATION

To calculate the distance between two elements, press 

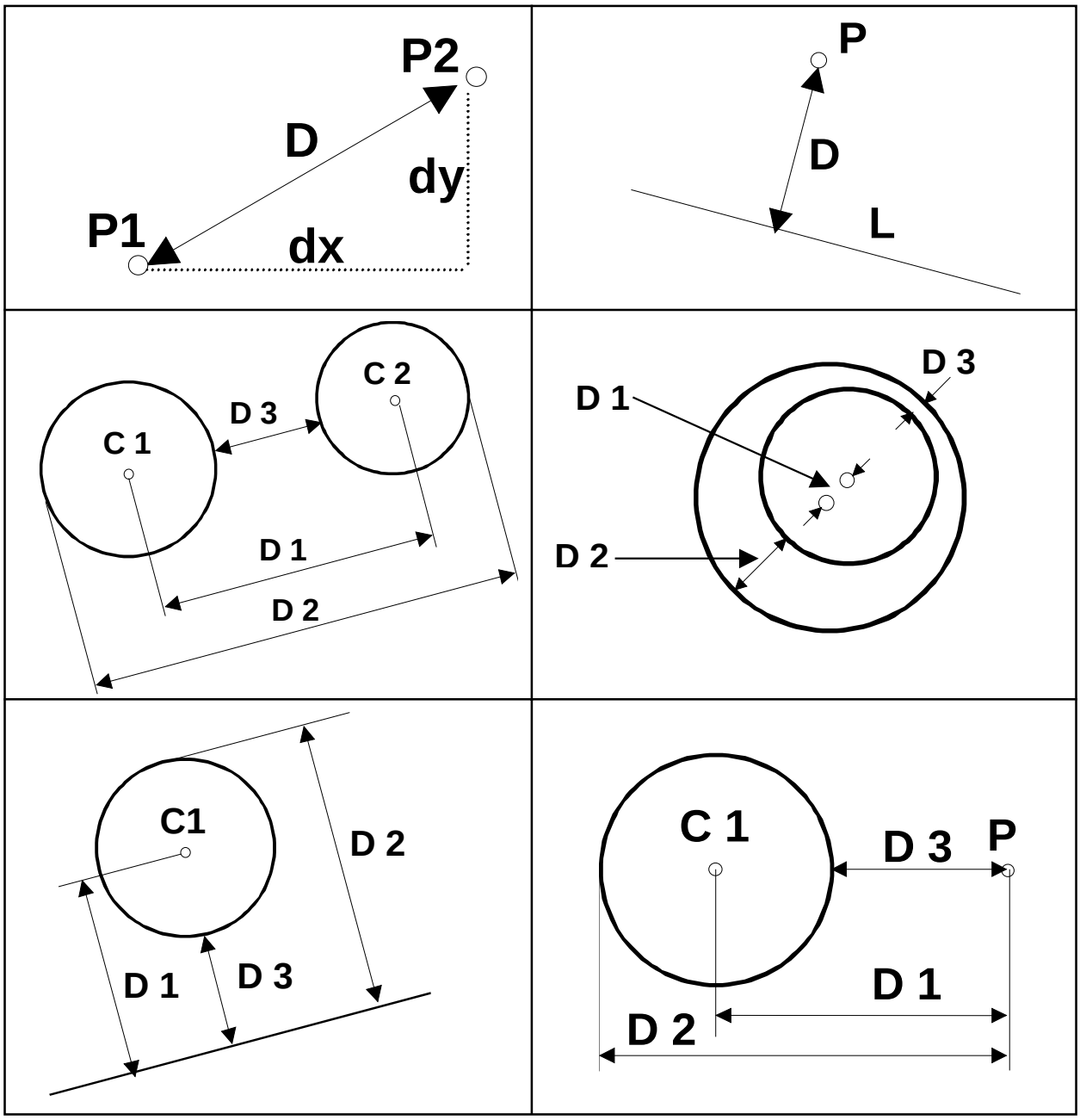
It is possible to calculate the distance between two points, between a point and a line, between a point and a circle, between two circles, between circle and a line.

```
Distance
Element      1
```

The elements used in the calculations may be obtained by measuring them or by recalling them from memory (see chapter 5).

Once those elements have been entered, the X/Y displays will show the distances in X and Y (dx, dy) between them.

As can be observed in the following drawings, there is only one distance between two points and between a point and a line.

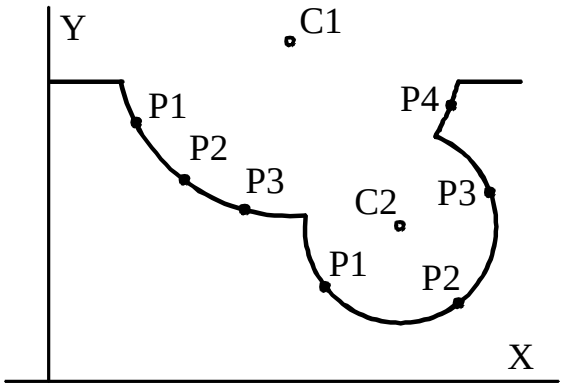


However, when measuring (or calculating) the distance between a circle and a line or between two circles, there may be several cases that will be displayed on the message display as distances **1, 2** and **3**. "1" indicates the distance from the center to the line or to the center of the other circle, "2" the maximum distance and "3" the minimum distance between both elements.

When distance "1" is shown, press [6 ⇨] to display the maximum distance (2) on the X axis display and the minimum distance (3) on the Y axis display.

4.2.1 DISTANCE CALCULATION EXAMPLE

To calculate the distance between circles C1 and C2 of the figure.



Method 1

ACTION	MESSAGE
Press [DIST]	Element 1
Press [CIRCLE]	Circle Point 0
Measure C1	Circle Point 1
Measure C1	Circle Point 2
Measure C1	Circle Point 3
Measure C1	Circle Point 4
Press [FINISH]	Element 2
Press [CIRCLE]	Circle Point 0
Measure C2	Circle Point 1
Measure C2	Circle Point 2
Measure C2	Circle Point 3
Press [FINISH]	

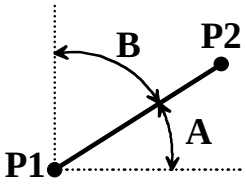
Method 2

ACTION	MESSAGE
Press [DIST]	Element 1
Press [CIRCLE] [CIRCLE]	Circle Point 0
Measure C1	Circle Point 1
Measure C1	Circle Point 2
Measure C1	Circle Point 3
Measure C1	Circle Point 4
Press [FINISH]	Element 2
Measure C2	Circle Point 1
Measure C2	Circle Point 2
Measure C2	Circle Point 3
Press [FINISH]	

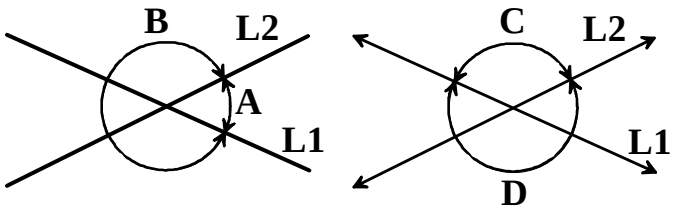
4.3 ANGLE CALCULATION

To calculate the angle between two elements, press 

Between 2 points



Between 2 lines



The message display will request the points for the first element and then for the second element.

```
Angle
Element      1
```

These elements may be measured directly or recalled from memory (see chapter 5).

Once these elements have been entered, the X axis display will show the angle A and the Y display will show the angle B.

In the case of two lines, when pressing  , the X display will show the angle C and the Y display will show the angle D.

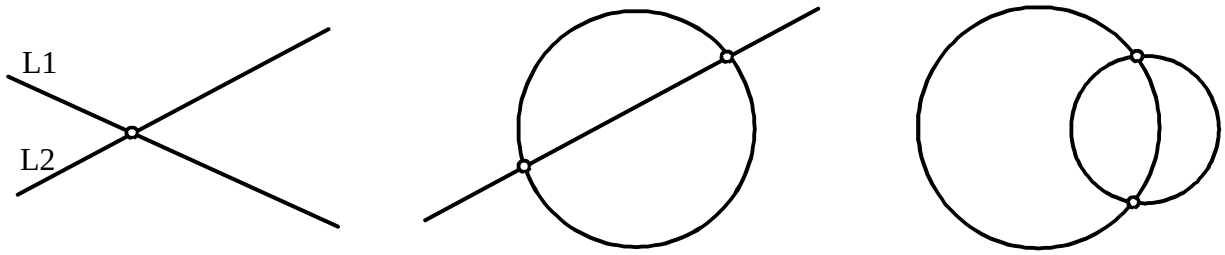
```
Angle                ▶
```

Note: In those cases where no angle can be calculated, an error message will be displayed.

4.4 CALCULATION OF INTERSECTIONS

To calculate the intersection between two elements, press INTERS

```
Intersection
Element     1
```



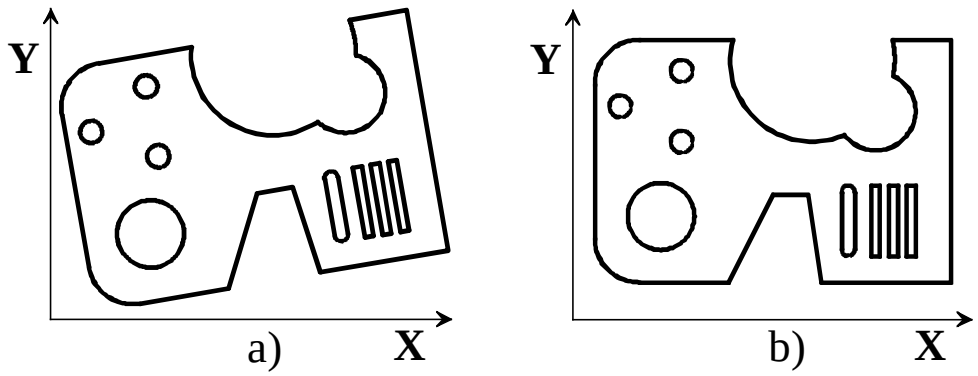
These elements may be measured directly or recalled from memory (see chapter 5).

Once the elements have been entered, the X/Y displays will show the coordinates of **one** of the intersection points (which will be stored in position "01" of the temporary memory).

If there are two intersection points, the other one will stored in memory position "02". Press CLEAR and then 8 ⇧ to display the other point.

If the elements do not intersect each other, the message display will show the corresponding error message.

4.5 PART ALIGNMENT (SKEW)

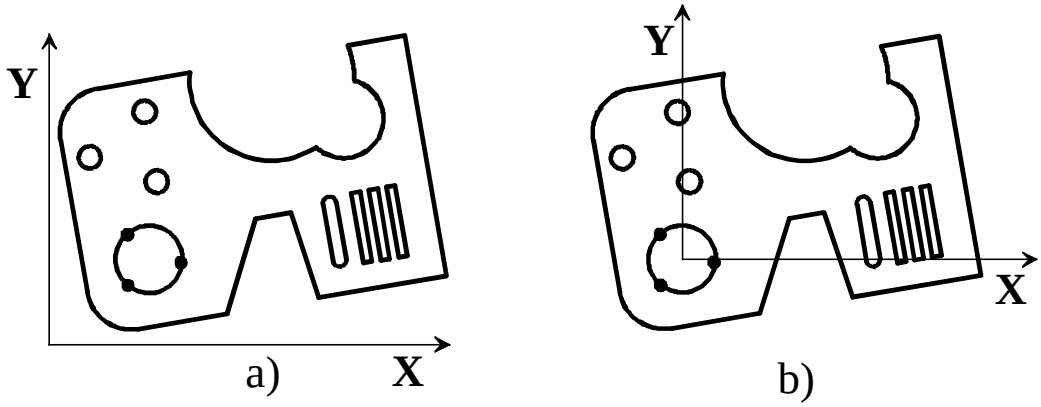


When placing the part on the projector table, more than likely, it will not be aligned (skewed) with the X and Y axes (a). Therefore, if the elements were measured directly, their measured values would not match their blueprint values. Consequently, the part must be aligned (unskewed) with respect to one or both axes (b).

4.5.1 SKEW TYPES

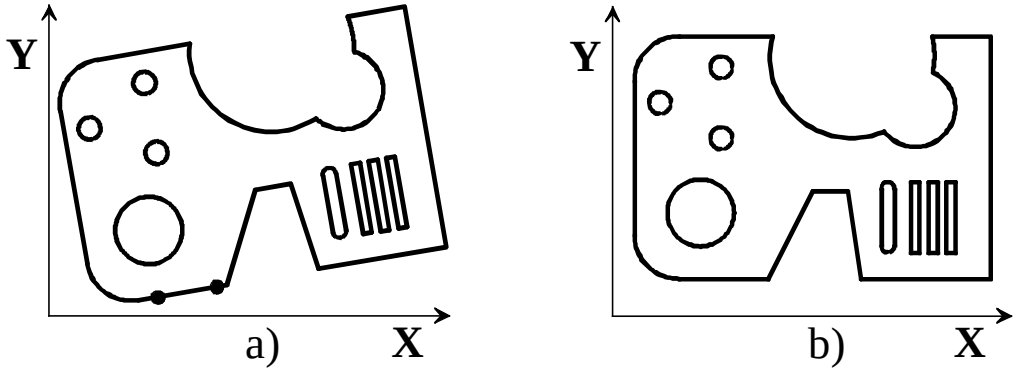
Depending on the type of part, there could be the following types of skewing:

Using a **circle or point** (a). The center becomes the new X,Y origin point (b).

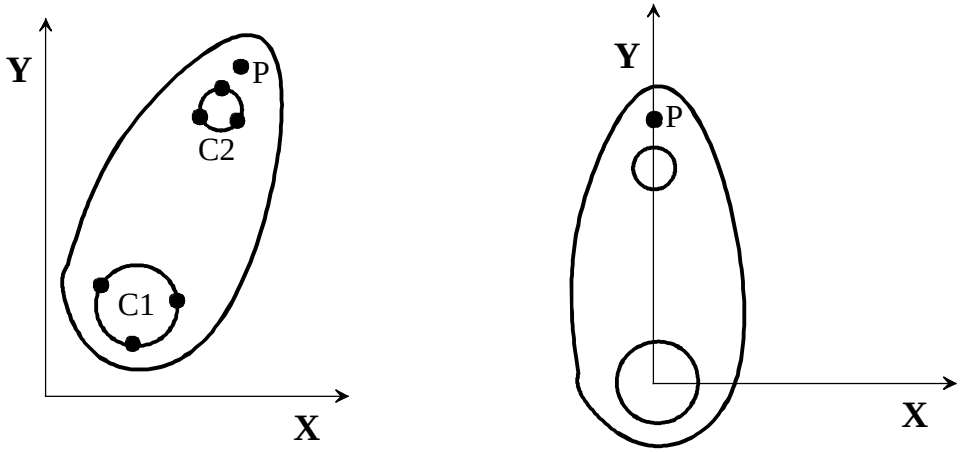


Using a **line or two points** (a).

That **line is aligned with the nearest axis.** In this case with the X axis (b).

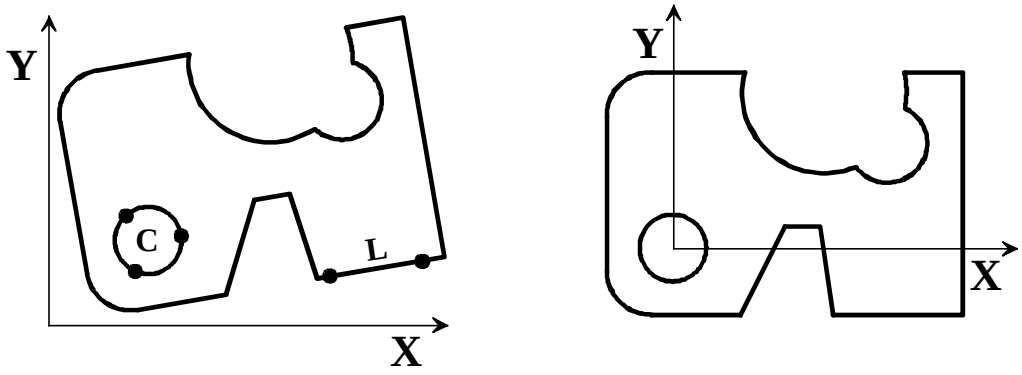


Using **two circles**. The **centers are aligned with the nearest axis** (in this case the Y axis) and the **center of the first** one becomes the **coordinate origin point**.

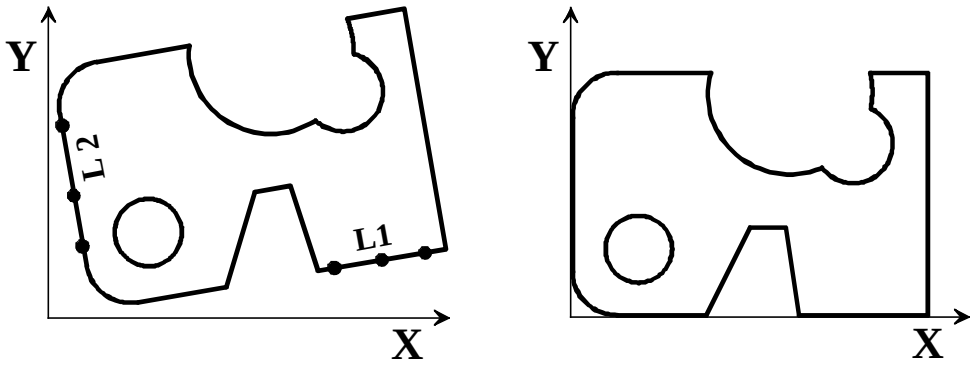


The same type of alignment is obtained with a circle (1) and a point (P).

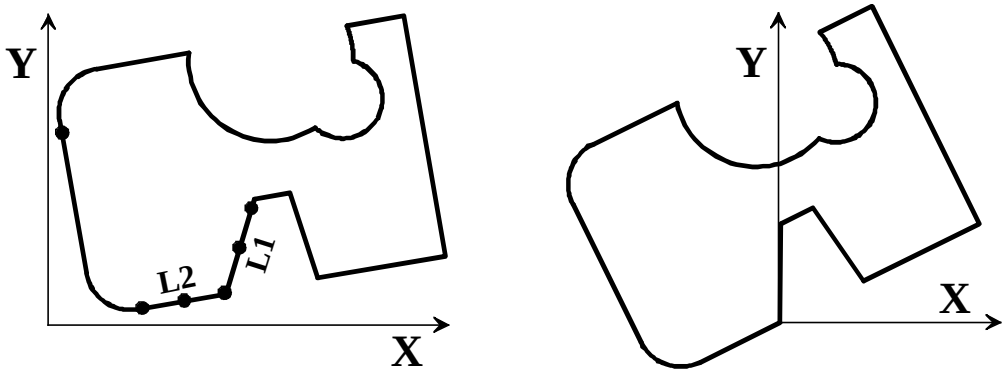
Using **a circle or point and a line**. The **line is aligned with the nearest axis** and the **point** or **center of the circle** becomes **the origin point**



Using **two lines**. The **intersection** of the two lines becomes the **origin point** and the **first line is aligned with the nearest axis**.



If the angle of the first line (L1) is greater than 45º, it will be aligned with the Y axis.



Section 6.8 in this manual contains an example of SKEW.

4.5.2 ALIGNMENT PROCEDURE (SKEW)

To access this mode, press 

and the "**SKEW**" led will turn on.

The message screen will request the elements to be used for the alignment and will be selected according to the desired type among the ones described in the previous section.

```
Skew
Element      1
```

After the initial screen:

· Press the key of the first element to be aligned 

, 

or 

One may also use an element previously stored in memory (see chapter 5).

```
Skew          Line
Point         00/02
```

· Capture (measure) the points of that element.

Remember that if the maximum number of elements is greater than the number desired for the element, 

must be pressed after having measured the last point of that element.

```
Skew          Line
Point         00/50
```

For example, if only 3 points are needed for a line ---

- After positioning at point 3, press 

to capture it and then ---
- press 

to indicate that it is the last point to be captured for that line.
- To skew the second element, if there isn't one, press 

. If there is, repeat the previous steps.

· The "**SKEW**" led will stay on and the X/Y displays will show the current position with respect to the new coordinate origin point.

To quit this mode, press 

. The "**SKEW**" led will turn off.

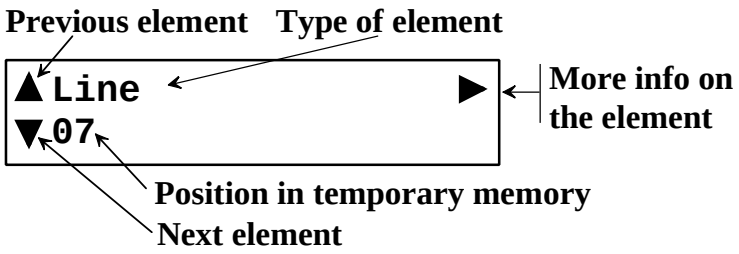
Section 6.8 of this manual contains an example of SKEW.

5. USING THE MEMORIES OF THE DRO

5.1 USING THE TEMPORARY MEMORY

When measuring, calculating or creating elements, the results of the last 10 operations are stored in a temporary memory and they are lost when the DRO is turned off. These results may be used at any time for any calculations between them.

If an element is recovered while measuring another one, its data will be used for calculating another element. For example, it is possible to measure a line by recovering two points from memory.



To recover an element from the temporary memory, use the 8 ⇧ and 2 ⇩ arrow keys and then press ENTER to use it or CLEAR to exit the memory data recovery mode without using any of its data.

With this feature, it is possible, for example, to measure a line from two points that were just measured or are the result of the intersection of two circles.

5.1.1 EXAMPLE. MEASURE THE DISTANCE BETWEEN TWO CIRCLES

To calculate the distance between two circles previously measured and stored in the temporary memory:

Let us assume that the data for these two circles have been stored in positions "01" and "03" of the temporary memory.

```
Distance
Element     1
```

- Press 


```
▲Circle          ▶
 01
```

- Press [8 ⇧] or [2 ⇩] until the message display and the X/Y displays show the data of the first circle.

```
▲Circle          ▶
 01 r = 23.4320
```

- Press, if so wished, [6 ⇨] to verify that it is the desired element.

```
Distance
Element     2
```

- Press 

to use it.

```
▲Circle          ▶
 03
```

- Press [8 ⇧] or [2 ⇩] until the message display and the X/Y displays show the data of the second circle.

```
▲Circle          ▶
 03 r = 18.500
```

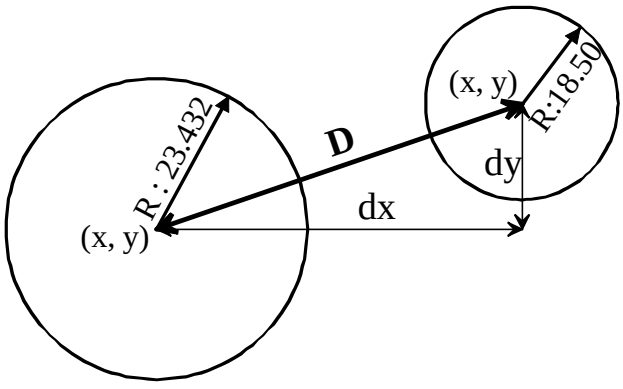
- Press, if so wished, [6 ⇨] to verify that it is the desired element.

- Press 

to use it.

The message screen shows the distance between centers (d) and the X and Y displays show the distances (dx) and (dy) respectively.

This distance data will now occupy temporary memory position "01" and will push the other ones back on position.



5.1.2 EXAMPLE. MEASURE A CIRCLE GOING THROUGH THE CENTERS OF OTHER THREE CIRCLES

- Measure the three circles as described in section 3.1.3 of this manual. The data of these circles will occupy positions "01", "02" and "03" of the temporary memory.

- Press CIRCLE.

```
Element      Circle
Point          00/03
```

- Press 8 ⇧ or 2 ⇩ until the message display and the X/Y displays show the data of the first circle.

```
▲Circle          ▶
 01
```

- Press ENTER to use it.

```
Element      Circle
Point          01/03
```

- Press 8 ⇧ or 2 ⇩ until the message display and the X/Y displays show the data of the second circle.

```
▲Circle          ▶
 02
```

- Press ENTER to use it.

```
Element      Circle
Point          02/03
```

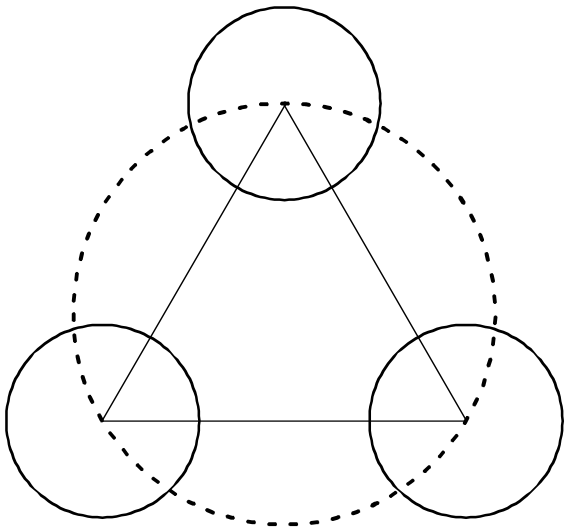
- Press 8 ⇧ or 2 ⇩ until the message display and the X/Y displays show the data of the third circle.

```
▲Circle          ▶
 03
```

- Press ENTER to use it.

```
Circle
   Φ = 150.000
```

Remember that if the number of points to be measured is greater than 3 (00/**50**, for example) one must press FINISH to finish the measurement.



5.2 USING THE PERMANENT MEMORY

Besides the temporary memory mentioned in the previous section, this DRO offers a permanent memory of up to 100 positions whose data **is not lost** when turning the unit off.

When recalling an element while another one **is not** being measured, its data may be viewed and this element will then occupy the first position of the temporary memory as if it were just measured.

To store an element (that has just been measured or displayed on the message display) in permanent memory:

- Press 

.

STORE

If this data is to be used for statistical reports, the 

key must be pressed again.

The X axis display will blink the memory position following the last one used.

- Key in the desired number and press 

or just 

if the position shown is the desired one.

After measuring or calculating an element and pressing 

, those steps may be repeated by pressing 

. The data will be stored in consecutive positions.

In **repeat** mode, the **"PRG"** will stay on.
To exit this mode, press 

To recall an element stored in permanent memory:

- Press 

RECALL

The X axis display will blink a two-digit number indicating the number of the block to be recalled.

- Key in the desired number
- Press 

The 

key can only be used for elements that have NOT been stored for statistics.

6. CREATING ELEMENTS [CREATE]

When pressing [CREATE], the message display will show the following menu:

```
CREATE
<Automatic> Bisec →
```

```
CREATE
<←>Perp Paral
```

To move around the various menu options, use the arrow keys [4] [6] and [ENTER] to select the desired ones.

When pressing [CREATE], the leds of Point, Line, Circle and Distance will turn on to indicate that any of those elements may be selected [POINT] [LINE] [CIRCLE] or [DIST].

6.1 AUTO CREATE <AUTO>

The advantage of this option is that it is the DRO itself who recognizes the element being measured, Point, Line or Circle.

```
Element      Automat
Point          00/50
```

- After entering the points, press [FINISH]
  The maximum number of points is 50.

This option will stay active until [CLEAR] is pressed.

6.2 CREATING A POINT

```
CREATE Point
```

1· Press [POINT]. The digits of the X axis display will start blinking indicating that a value must be entered.

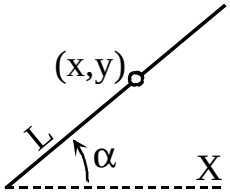
2· Key in the X value

3· Press [Y] to key in the Y value or [ENTER] if the value is zero.

4· Key in the Y value if [ENTER] was not pressed in the previous step.

5· Press [ENTER] to finish (it was not pressed in step 3).

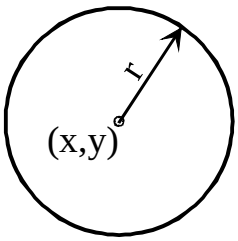
6.3 CREATING A LINE



The message display will request a point (x,y) that the line (L) is going through and the angle (α) of that line with respect to the X axis.

The data is entered by keying the values and pressing ENTER

6.4 CREATING A CIRCLE

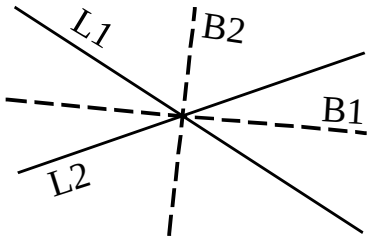


The message display will request a point (x,y) that will be taken as the center and then the radius (r) or diameter (Φ) of that circle depending on the selected mode.

To change from radius mode to diameter mode and vice versa, press CLEAR to get out of the "CREATE" mode and press CLEAR CIRCLE .

The data is entered by keying the values and pressing ENTER

6.5 CREATING A BISECTOR



To create a line bisecting two given lines (L1, L2), the message display will request the first line and then the second one.

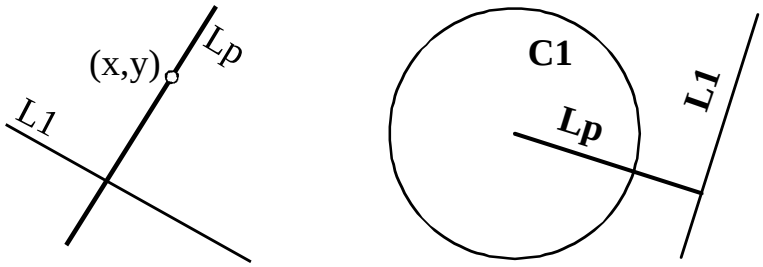
These lines may be measured at the time (by selecting LINE) or recovered from either the temporary or the permanent memory (see section 5).

The solutions will be two lines (B1 and B2) and will be stored in positions "01" and "02" of the temporary memory.

To show the data of the other bisector, press CLEAR and then 8 ⇧ 8 ⇧

6.6 CREATING A PERPENDICULAR LINE

To create a line perpendicular to another line and going through a particular point or circle. The DRO will request an element (L1) and then the second one: point (x,y) or circle (C1) the line has to go through. The solution will be a single line (Lp).



These elements may be measured at the time (by selecting 

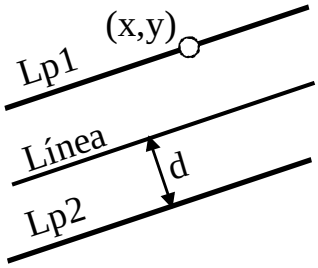
or 

) or recovered from either the temporary or the permanent memory (see section 5).

The message display will show the angle of the line Lp and the X/Y displays will show the point closest to the coordinate origin point.

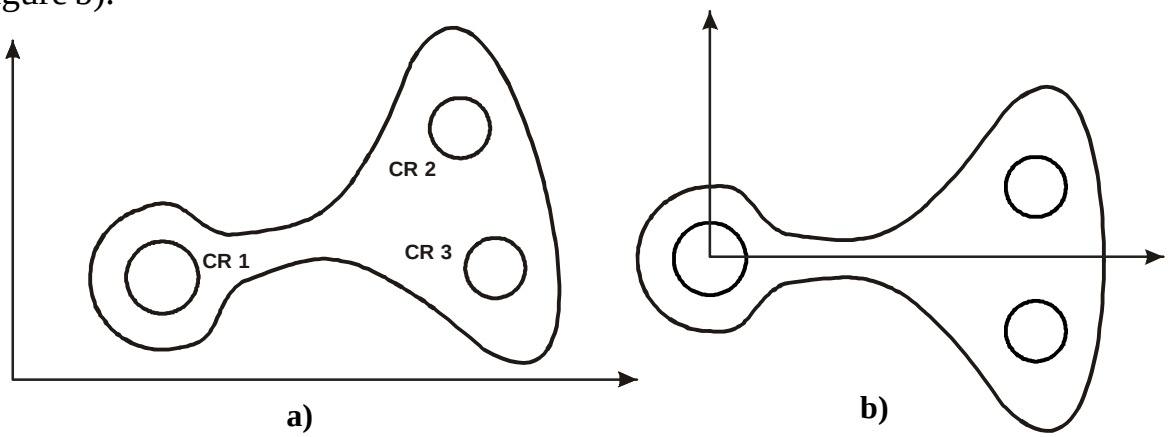
6.7 CREATING A PARALLEL LINE

To create a line parallel to another one and going through a point (lp1) or at a particular distance (Lp2). The DRO will request the first element (line) and then the second element (xy point or circle) it has to go through. Instead of a point, a distance (d) may also be entered or recovered from memory.



6.8 EXAMPLE OF ALIGNMENT (SKEW)

Having positioned the part as shown in figure a), we will align it as shown in figure b).

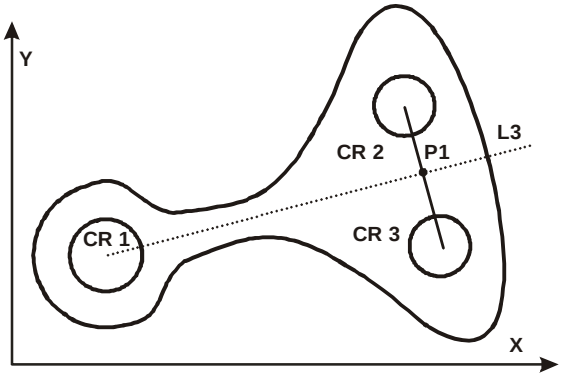


There are 2 methods.

Method 1:

1. Measure circles CR3 and CR2

If they are measured in this order, they will be stored in positions "02" and "01" of the temporary memory respectively.



2. Measure the midpoint between the centers of CR2 and CR3 (P1)

To do this:

· Press POINT

```
Element      Point
Point          00/50
```

Note: The message display must **not** show "00/**01",** otherwise, it will not let capturing more than one point. If that is the case, press 6 ⇨ to change it to "00/**02**".

· Press 8 ⇧ to look for circle CR3 stored in position "01"

. Press ENTER to select it.

```
▲ Circle      ▶
  01
```

· Press 8 ⇧ to look for circle CR2 stored in position "02"

. Press ENTER to select it.

```
▲ Circle      ▶
  02
```

This point is P1 and it now occupies the temporary memory position "01 pushing CR3 to position "03" and CR2 to "02".

3. Measure circle CR1

It will be stored in position "01" and P1 will be pushed to "02".

4· Align the part using CR1 (center) and the point P1 (line L3).

To do this:

· Press SKEW

```
Skew
Element      1
```

· Press 8 ⇧ to look for circle CR1 stored in position "01"

```
▲ Circle          ▶
  01
```

. Press ENTER to select it.

```
Skew
Element      2
```

· Press 8 ⇧ to look for point P1 stored in position "02"

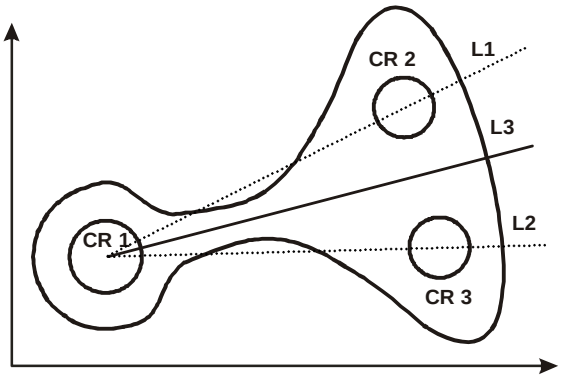
```
▲ Point           ▶
▼ 02
```

. Press ENTER to select it.

The center of CR1 will be the new coordinate origin point and the imaginary line (since it was not actually measured) L3 will become the X axis.

Method 2:

1. Measure circles CR3, CR2 and CR1
2. Calculate the line (L1) joining the centers of CR1 and CR2.
3· Calculate the line (L2) joining the centers of CR1 and CR3
4· Create the line (L3) bisecting lines L1 and L2.
5. Align the part using CR1 and L3.



The center of CR1 will be the new coordinate origin and L3 will become the X axis.

Note: Since this method is less practical than the previous one, the steps will not be detailed here.

7. PROGRAMMING

With this DRO, it is possible to create, edit (modify), delete and execute up to 100 programs with a total of 416 steps to follow when measuring or calculating elements repeatedly.

This mode is accessed by pressing PROG. After which, the message display will show the following menu:

```
Programs
<Exec> Edit  Delete
```

7.1 EDITING A PROGRAM

To create a new program, enter the desired program number and press ENTER. All measurements will be registered in the program.

```
Programs
Exec <Edit> Delete
```

If the program number already exists, it can now be edited (modified).

To do this, press PROG and the message display will show the following menu:

```
Edit Programa
Number .......:00
```

```
P00  000:POINT
     001:ENTER    ▼
```

```
P00  004:POINT    ▲
<End>Insert Delete
```

Insert: The X axis display will show the word "insert" to indicate that it is in insert mode. If a key is pressed, it will be automatically inserted behind the selected command and it will push the next ones back one position.

To quit the insert mode, press PROG

Delete: The X axis display will show the word "delete" to indicate that it is in "line delete" mode. Press ENTER to delete the selected line.

End: To finish editing the program.

7.2 EXECUTING A PROGRAM

Once in the "**Program**" menu (after having pressed PROG) , to execute a program:

```
Programs
<Exec> Edit  Delete
```

· Select the "**Exec**" option.

By default, the program edited last.

```
Execute Program
Number .......:00
```

· Key in the number of the desired program or press RECALL to find the next one.

```
Nr. of repetitions
Number .......:01
```

To find the number of the next edited program, press it again.

· Press ENTER .

· Key in the number of times the program will be repeated (up to 99).

· Press ENTER . The message display will show the first step to follow.

To abort the execution, press PROG and select the "**End**" option.

The message display will request confirmation of the command.

7.3 DELETE A PROGRAM

Once in the "**Program**" menu (after having pressed PROG), to delete a program, select the "**Delete**" option, key in the desired program number and press ENTER . The message display will request confirmation of the command.

7.4 DELETE ALL THE PROGRAMS

Once in the "**Delete**" option of the " "**Programs**" menu (after having pressed PROG) , to delete all the programs from memory, press the keystroke sequence: PROG ENTER PROG

```
Programs
 Exec  Edit <Delete>
```

```
Delete Program
Number .......:00
```

The X axis display will show dots as each key of this sequence is pressed.

The message display will request confirmation of the command.

7.5. USING TOLERANCES WHEN MEASURING [TOL]

After a measurement, the operator may indicate the nominal value and the maximum and minimum tolerance values allowed. If the measured value is out of these limits, the DRO will issue a message error.

The tolerance will be applied to the last measured element.

To use it, simply press [TOL] after measuring an element.

```
Tolerance          ▶
  Φ
```

· Select the data on to which to apply the tolerance using [4] [6]

```
Tolerance          ◀
Position
```

The table below shows which values may be applied the tolerance.

POINT	X Coordinate	Y Coordinate		
LINE	Angle			
CIRCLE	Radius/Diameter	X Coordinate	Y Coordinate	
ANGLE	A1	A2	B1	B2
DISTANCE	X or Max. Dist.	Y or Min.Dist.	Distance	

· Key in the nominal value onto which the tolerance is to be applied and press [ENTER]

```
   Φ
Nominal Value
```

```
Tolerance
Select Axis & Value
```

· Enter the maximum and minimum tolerance values by pressing:

[X] [value] [Y] [value] [ENTER]

```
Tolerance
Upper tolerance
```

The display will show the values set by installation parameters PAR71 through PAR78.

```
Tolerance
Lower tolerance
```

· Press [ENTER] again and the message display will show the deviation of the measurement with respect to the nominal value:

```
    Deviation      ▶
<----------*---->
```

Measurement within tolerance indicated by the position of the "*"

```
    Deviation      ▶
<<< 003º17'05"
```

(Below tolerance)

```
    Deviation      ▶
    005º10'18" >>>
```

(Above tolerance)

Pressing [6 ⇨], the X axis display will show the nominal value and the Y the average value.

Pressing [6 ⇨] again, the X axis display will show the maximum and minimum tolerance values entered.

The next example shows the operation of the tolerance outputs of this DRO.

Nominal value = 100 mm

Upper tolerance = 0.1

Lower tolerance = -0.3

Measured value	Activated outputs
100	OK_OUT
100.050	OK_OUT
100.1	OK_OUT
100.150	OUT_UP
99.90	OK_OUT
99.2	OUT_DOWN

8. SPECIAL FUNCTIONS [MENU]

This menu is accessed by pressing MENU

```
MENU
<Cal>Print Com →
```

8.1. CALIBRATION MENU

The calibration has four aspects: Light/Dark calibration, distance calibration and second-fiber-optic-cable calibration.

The edge detector needs not be calibrated every time the DRO is turned on, because the calibration data is kept in memory and it can be simply recalled. Up to 3 calibrations may be stored in memory. This is useful when using different lenses.

This menu is accessed by pressing MENU and it allows calibrating the Edge detector.

```
Calibration
<Read>Calibrate
```

<Read> To activate a previously set calibration so it does not have to be calibrated again. It is selected among the three possible calibrations by keying its number and pressing ENTER

<**Calibrate**> It offers the following menu:

```
Calibration
<Light-Dark>Offset →
```

```
Calibration
<↔>Distance  F.O.2
```

8.1.1 LIGHT/SHADE CALIBRATION

Up to three different calibrations are possible depending on the types of lenses or the opacity of the parts to be measured.

```
Calibration
 Read<Calibrate>
```

This calibration should be done in the following cases:

- During installation.
- When changing lenses.
- When changing the projector lamp.

In general, in all cases affecting the variations of luminosity of the levels of light and shadow.

When also using the second fiber optic cable (F.O.2 reference light), it must be calibrated before the F.O.1

To carry out this calibration:

```
Calibration
Number:
```

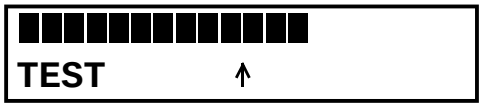
· Key in the desired calibration number and press ENTER

·Place the detector in a light area of the table and press ENTER .

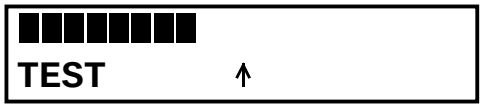
· Place the detector in a shaded area of the part and press ENTER .

This sets the two light levels.

When the adjustment is done, the screen will show a Test bar to verify that the calibration is correct. When switching from the dark area to the light area and vice versa, the bars must go beyond the vertical arrow.



Dark level



Light level

8.1.2 OFFSET CALIBRATION

This calibration must be done in the following cases:

· During installation.

· When changing lenses.

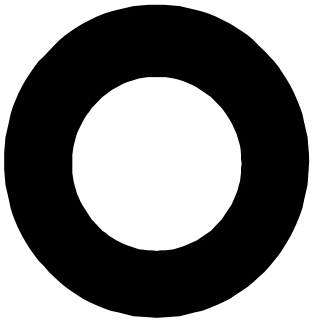
· When replacing or shifting the position of fiber optic detector.

· When changing axis resolution or reading parameters.

Its purpose is to establish the offset on X and Y between the crosshairs of the screen and the fiber optic edge detector in order to be able to switch from one to the other while measuring a part.

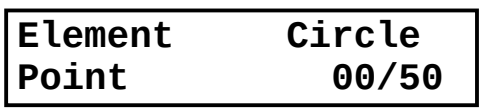
This calibration is not necessary if one does not wished to do it.

To do this, a circle must be measured. It is recommended to use a master ring or machined part with the least form error possible for proper calibration. The diameter of the circle needs not be known.



· First, measure the circle with the crosshairs.

· Then, without moving the ring or master part, repeat the measurement with the edge detector.

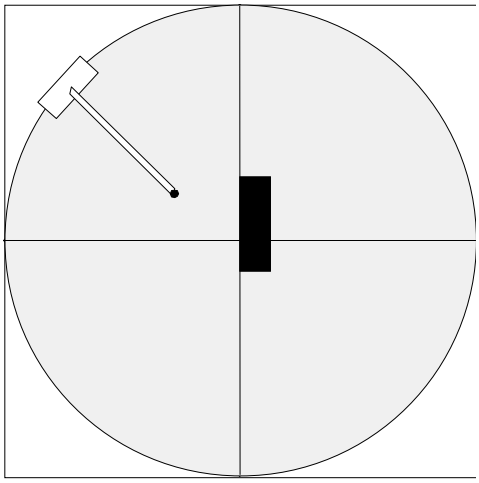


This will calibrate the position offset of one with respect to the other.

8.1.3 DISTANCE CALIBRATION

```
Calibration
←<Distance> F.O.2
```

This calibration is optional and is used to correct accuracy problems when the dark-to-light area is not clearly defined either due to the type of part or inadequate lighting conditions.



It is carried out for better defining the light change area and prevent measuring errors.

To do this, place a gage or a part of known dimensions perpendicular to axis that is going to move (on the drawing, if the axis is horizontal, the gage goes vertically).

Enter the exact measurement of the gage to be measured ([nominal value] ENTER) and then move the axis for taking the measurement.

```
Nominal value
```

The DRO will show the measurement obtained. If this data is too far from the actual one, repeat the measurement so it adjusts automatically the light change value between light and dark and, consequently obtain a value closer to the real one.

```
Point          00/02
```

This measurement must be repeated until the measurement is correct or is within the permitted tolerance levels.

8.1.4 CALIBRATION OF THE 2ND FIBER OPTIC CABLE

If your model has a second fiber optic cable used as a light reference [it must be activated by setting PAR64(1)=1], simply, press ENTER and the test bars will line up with vertical arrow of the message display indicating the it has been adjusted automatically.

```
Calibration
← Distance <F.O.2>
```

```
TEST          ↑
```

8.2 PRINTING MEASUREMENT RESULTS (PRINT)

This option is accessed by selecting "**Print**".

```
MENU
 Cal<Print>Com ➔
```

In this menu, one can configure how the [1 PRINT] key is going to work . With this key, it is possible to print results and information out to printer having a series communications port or sending them directly to a PC for printing them later on at any printer.

The factory set values for this data is set by parameter (**PAR61**), but the print options may be changed through this menu.

Print all:

When selecting this option, it will print all the measurements as they are being taken.

```
Print
<All> Last  Tol
```

Print Last:

If this option is selected, only the last measurement will be printed when pressing [1 PRINT].

```
Print
 All <Last> Tol
```

Print Tolerances:

When selecting this option, only the results associated with a tolerance will be printed.

```
Print
 All  Last <Tol>
```

Print 20, 80, CSV:

This selects the printing format for the report: in 20 or 80 columns or in Comma Separated Values (CSV). The latter is ideal for sending the data out to a PC and then import it into a spreadsheet or data base.

```
Type of report
 20<80>CSV
```

Print Header:

When entering into a full report type (at 80 columns), it displays the Header options. It indicates whether or not this header is to be printed on every page.

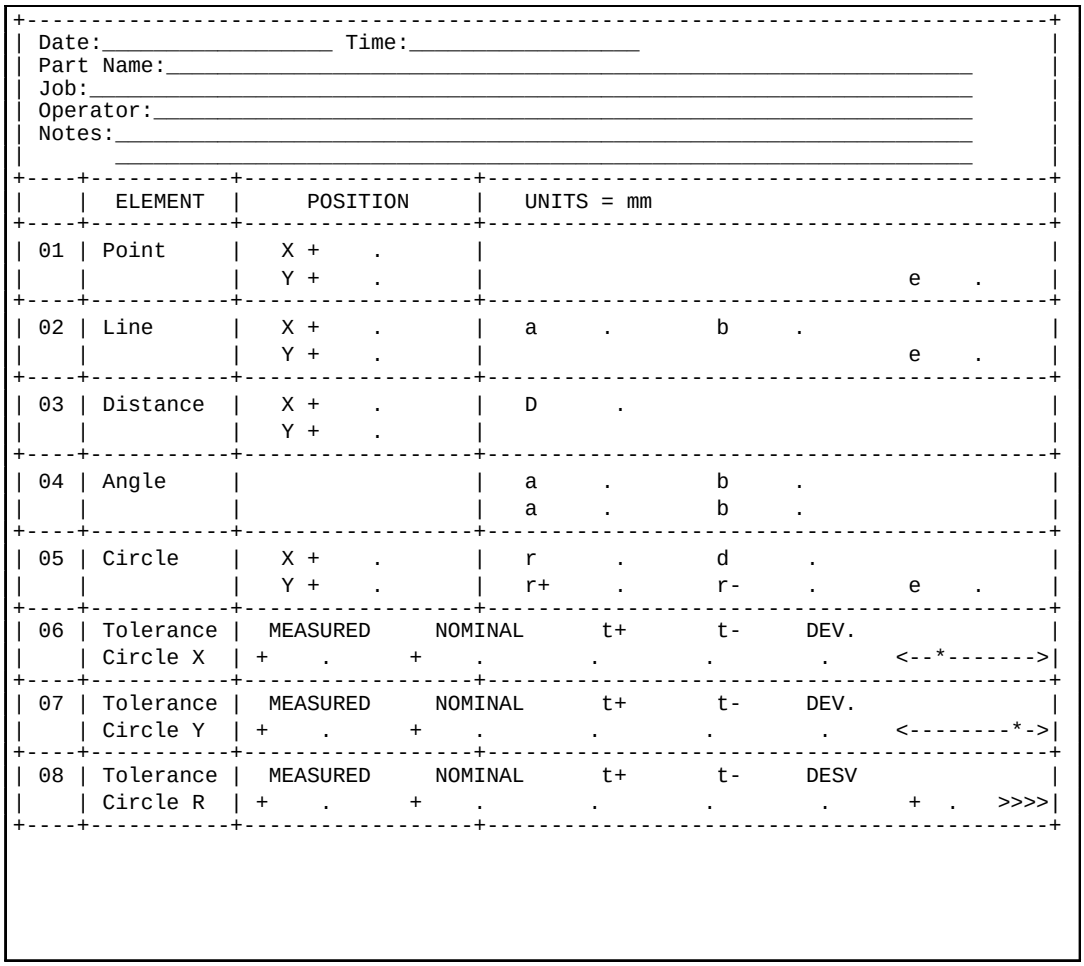
```
Print Header
<Yes> No
```

CVS format

The output values in this format are:

ID	X	Y	D1	D2	D3	D4	D5
P	X Coord	Y Coord			Error		
L	X Point	Y Point	Angle		Error		
C	Center X	Y Center	Radius	Diameter	Error	Rmax	Rmin
D	X Dist.	Y Dist.	Module	Max. dist.	Min. dist.		
A	A1	A2	B1	B2			
T	X Coord	Y Coord	Measured	Nominal	Diff.	Tol +	Tol -

8.3 EXAMPLE OF FULL REPORT (IN 80 COLUMNS)



8.4 COMMUNICATION WITH A PC (COM)

After pressing [MENU] and selecting the "**Com**" option, the message display shows the options to "**Send**" and "**Receive**" which, in turn, offer the possibility to transmit all the **Programs** or installation **Parameters** from and to a PC in order to even edit them and modify them at the PC.

```
MENU
 Cal Print<Com>→
```

```
Communications
<Send> Receive  PC
```

After selecting "**Prog**" or "**Param**" The message display shows whether it is sending or receiving the selected data.

```
<Prog>Param
```

```
Communications
Send
```

```
Communications
Receive
```

The format used to send programs is:

$	Program header (beginning)
15	Program number
CIRCLE CIRCLE LINE	Program contents
....	
$ $	End of all programs

The program used to send installation parameters is described in section 4.2 of the installation manual.

Note: When sending programs out to a PC, all of them are sent out, they cannot be sent separately.

EXAMPLE:

Send measurements out to a PC, for statistics or to generate reports.

Procedure: Select the CSV format

At the PC, use a terminal program and set in text capturing mode to store it in a file.

Make the measurements, and press [1 PRINT] to send the desired data if the PRINT LAST mode has been selected.

Import the text file generated by the terminal program into a spread sheet or data base.

8.5 REMOTE KEYBOARD (PC OPTION)

Selecting this option, the DRO may be operated remotely from a PC by sending the codes corresponding to keystroke sequences through the serial line RS-232-C using a communications program such as Hyperterminal from Windows.

To access this option (<**PC**>),

- Enter the options menu pressing [MENU]
- Select <**Com**> with [4 ⇦] [6 ⇨] and pressing [ENTER]
- Select <**PC**> with [4 ⇦] [6 ⇨] and pressing [ENTER].

The following key codes may be sent out:

Code	Function		Code	Function
POINT	Point		LINE	Line
CIRCLE	Circle		DIST	Distance
ANGLE	Angle		INTERS	Intersection
SKEW	Alignment		PROG	Program
STORE	In permanent memory		RECALL	From permanent memory
POL	Polar/Cartesian		EDGE	Edge/Crosshairs
MAN	Manual/Automatic		TOL	Tolerance
CREATE	Create		REPEAT	Repeat
CLEAR	Delete		ENTER	Enter
FINISH	Finish elemento		X	X
Y	Y		MENU	Menu
1	1, print		2	2, down arrow
3	3		4	4, left arrow
5	5		6	6, right arrow
7	7, show Q axis		8	8, up arrow
9	9		0	0, inch/mm
-	±		.	decimal point
INC	Incremental/absolute		ON	ON/OFF

By means of the letter "**P**", the DRO will send the X and Y position coordinates when receiving this string of characters.

The coordinates will be sent in the following format:

X = 234.2215

Y = 42.4565

8.6 STATISTICS

MENU <Cal>Print Com →

MENU ←<Statistics>Refs

This menu offers the options for statistical calculations.

First of all, one must indicate which data will be used for the calculations.

The data to be used must be previously stored in permanent memory by **pressing** STORE **twice in a row** and they must have consecutive number. By default, the X axis display shows memory position 00 as the first data.

- Key in the number of the first block (shown on the X axis display) and press ENTER

Starting from Number :

- Key in the last block (shown on the Y axis display) and press ENTER

To... Number :

- Select the type of calculation desired.

Statistics <Mean>Deviation →

Statistics <↔>Maximum Minimum

In order to calculate properly, the element must be of the same type (points, lines, circles, etc.); otherwise, an error message will be issued.

8.6.1 CALCULATING MEAN VALUES AND DEVIATIONS

Point:

It generates a POINT (X = mean X Y = mean Y)

Line:

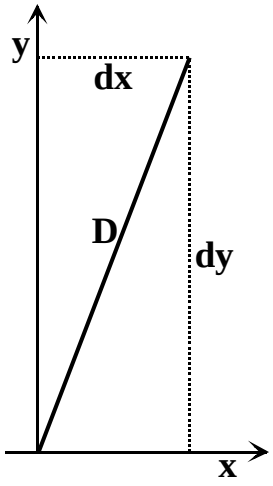
It generates an angle. α = mean angle of the set of lines, $\beta = 90 - \alpha$
If it is a deviation, it calculates the deviation of α.

Circle:

It generates a circle with the data (X = mean X , Y = mean Y, R = mean R)
If it is a deviation, (X = Dev X , Y = Dev Y , R = Dev R).

Distances between points, points and lines:

It generates a distance: D = mean distance.
It will show the mean Dx and Dy.



If it is a deviation: D = Distance deviation.

Distances between point-circle, line-circle, circle-circle:

It generates a distance: D = mean distance.
It will show the mean Dx and Dy.

D max to the circle = Mean value of all maximum D's.

D min to the circle = Mean value of all minimum D's.

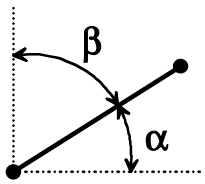
If it is a deviation: D = Distance deviation.

D max to the circle = Deviation of all maximum D's.

D min to the circle = Deviation of all minimum D's.

Angle between two points or circles:

It generates an angle. α = Mean angle of the set of lines.
$\beta = 90 - \alpha$



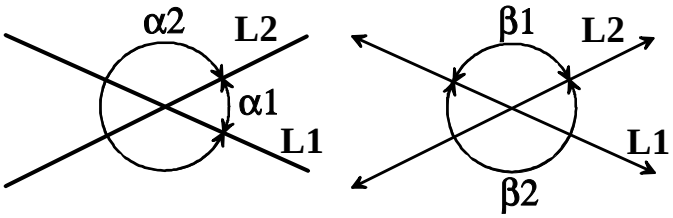
If it is a deviation: α = Angle deviation.

Angle between two lines:

It generates an angle.

$\alpha 1$= Mean angle of the set of lines. $\alpha 2 = 360 - \alpha 1$
$\beta 1$= Mean angle of the set of lines. $\beta 2 = 360 - \beta 1$

If it is a deviation: α = Angle deviation.



8.6.2 CALCULATING THE MAXIMUM/MINIMUM VALUES

Point:

It generates a POINT (X = Max/min X, Y = Max/min Y)

Line:

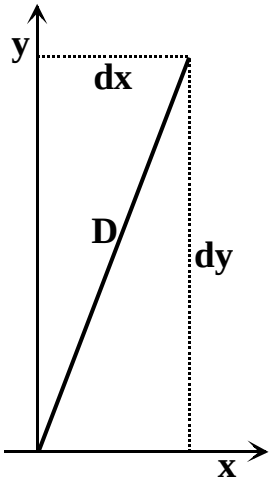
It generates an angle.
X = Max/min angle of the set of lines.
Y = 90 - α

Circle:

It generates a circle with the data
(X = Max/min X, Y = Max/min Y, R = Max/min Radius)

Distances between points, points and lines:

It generates a distance: D = max/min distance. It will show the Dx and Dy components of that distance.



Distances between point-circle, line-circle, circle-circle:

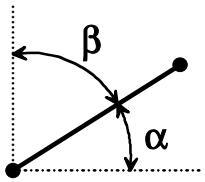
It generates a distance: D = max/min distance. It will show the Dx and Dy components of that distance.

D max/min to the circle = Max/min of all maximum D values.

D max/min to the circle = Max/min of all minimum D values.

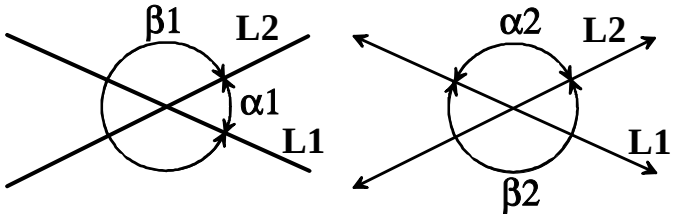
Angle between two points or circles:

It generates an angle. X = Max/min angle of the set of lines.
Y = 90 - α



Angle between two lines:

It generates an angle.
α1 = Ángulo máx/min de serie de rectas. α2= 360 - α1
β1 = Ángulo máx/min de serie de rectas. β2= 360 - β1



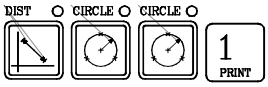
APPENDIX

PRACTICAL EXAMPLES

·Measure the maximum distance between two circles and only print the result of the calculated distance.

Procedure:

Select the "Last" type of report format

Sequence: 

. It only prints the result of the distance calculation.

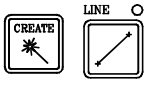
·Measure circles and store then in consecutive memory positions (1, 2, 3, 4…)

Procedure: 

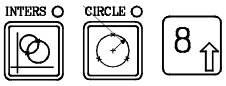
. It repeats the measuring and storing sequence.

·Measure the width of round hole at a position given by the blueprint.

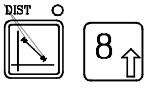
Procedure:



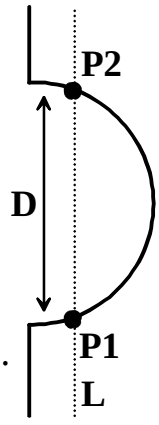
(vertical line "L" going through the desired point).



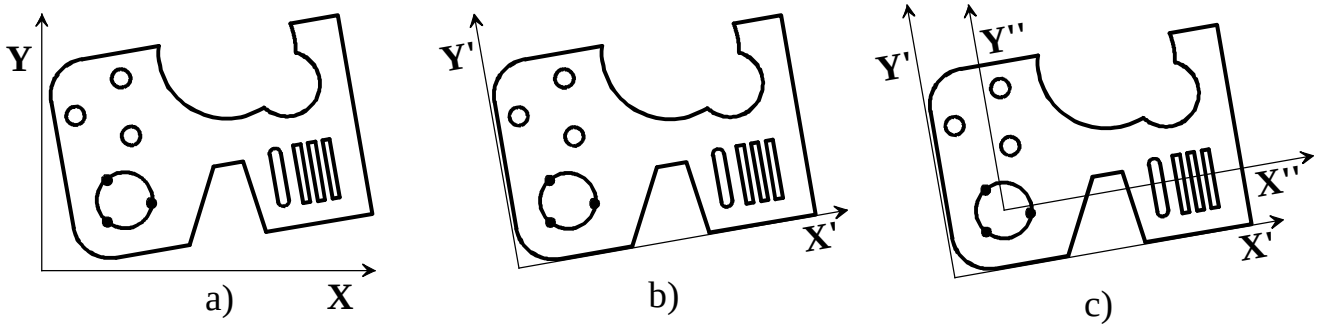
(Recover the created line "L" from memory).



(Recover the intersection points from memory P1 and P2).



· **Shift part datum point, even with SKEW on, without losing axis rotation.**



· **Procedure:**

Once the part has been skewed as per X' Y' , to shift the datum point to the center of the circle (new coordinate axes X" Y"): 

, select the circle.

ERROR CODES

Message	Description
FAGOR dro	Power outage or turned off by main switch after saving the data.
Error 02	Power outage or turned off by main switch without having saved the data. The unit has been turned off without previously pushing the [ON/OFF] key. It will only lose the position count (will be reset to zero) and the status of the operating modes (inch, abs, etc.).
Error 04	Wrong parameter values
Error 05	Wrong internal configuration
Error 06	Errors in data backup memory (Service Dept.)
Error 07	Emergency input active. Press [C] or cancel emergency signal.
Error 08	Wrong software memory or the software has been changed
Error 09	Errors in work memory (Service Dept.)
Error 12	Error while searching a coded marker pulse (Io)
Error 31	Internal malfunction (Service Dept.)
Error 32	Internal malfunction (Service Dept.)
Error 99	Internal malfunction (Service Dept.)
. . . . . .	Feedback alarm 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 nonabrasive dish-washing detergents are recommended (in liquid, never powder form) or 75% isotropic alcohol with a clean cloth. DO NOT USE aggressive solvents, (benzol, acetones, etc.) which could damage the materials the equipment is made with.

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

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

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

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

Preventive Inspection

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

- QUICK REFERENCE - NVP-200QC - (QR VERSION: 0009-E)

Display ON/OFF

Language selection [CLEAR] [5] [0 inch] --> press [+/-] until language appears, [ENTER]

[MENU] **Calibration Print Com →** [6] **← Statistics Refs**

Read Calibrate **Send Receive PC**

Zero axis reading (X) [CLEAR] [X]

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

Cancel [CLEAR]

MM/Inches: [0 inch]

Radius/diameter mode: [CLEAR] [CIRCLE]

Incremental/absolute

Polar/Cartesian: [(r,a)/(x,y)]

See auxiliary Q: [7 SHOW Q]

Select **edge detection** or **crosshairs**: .

If edge detector, "EDGE" led ON.

Select **MANUAL** mode to capture points [MAN]

Recover elements from temporary memory: [8 ⇧] [2 ⇩]

"Store in" / "Recall from" permanent memory: [STORE] / [RECALL]

Repeat measuring or program steps: [REPEAT]

Apply tolerances: After measuring an element, press [TOL]

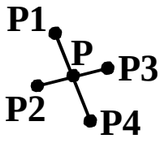
Program (Exec, abort, edit, delete): [PROG]

Delete ALL the programs: Once in PROG, [PROG] [ENTER] [PROG]

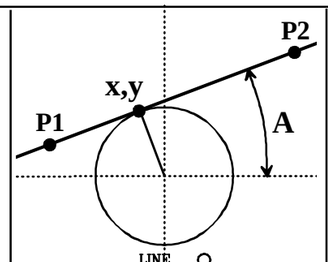
Print measurement reports: [1 PRINT]

MEASUREMENT:

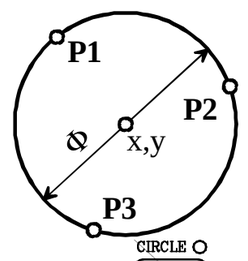
Measuring mode with fixed maximum number of points or 50 points: [CLEAR] [POINT]



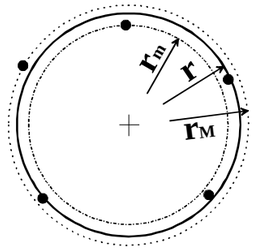
Point: [POINT]



Line: [LINE]



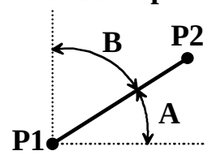
Circle: [CIRCLE]



X = r_M, Y = r_m

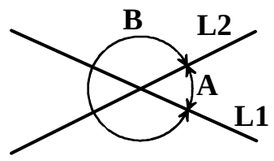
Angle: [ANGLE]

Between 2 points

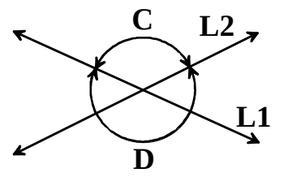


X = A, Y= B

Between 2 lines

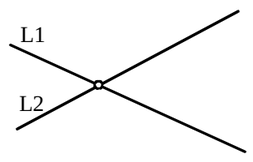


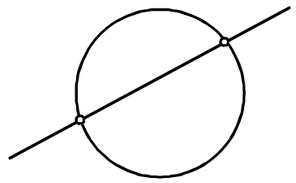
X =A, Y =B

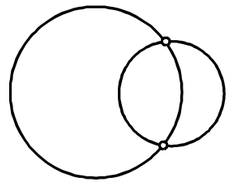


[6] **X = C, Y =D**

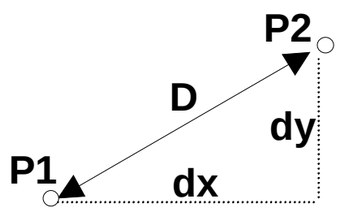
Intersection: [INTERS]

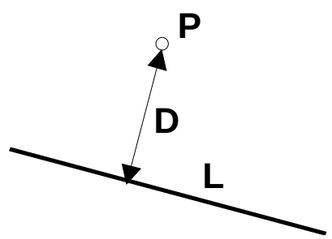


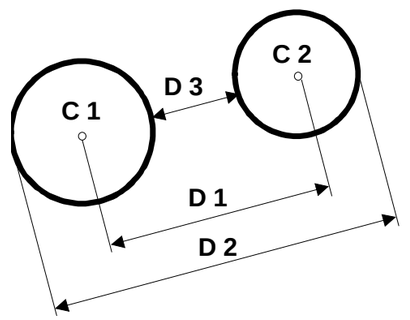


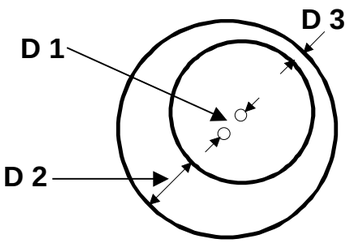


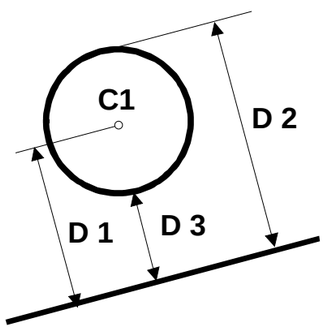
Distance calculation: [DIST]

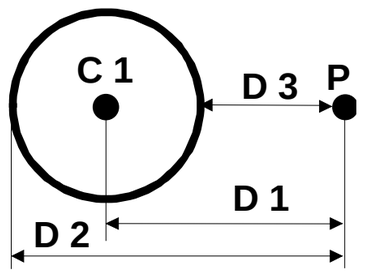










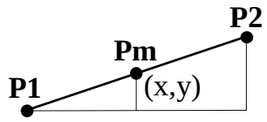


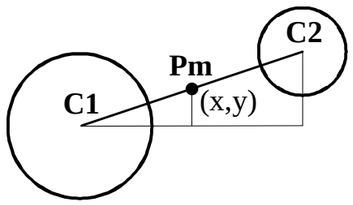
- QUICK REFERENCE - NVP-200QC - (QR VERSION: 0009-E)

FAGOR

Create elements: CREATE

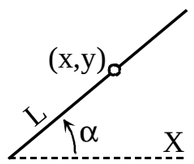
Midpoint (Pm):



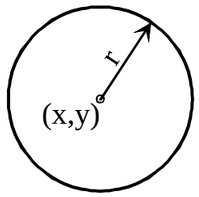


POINT 8 2 (find P1 or C1) ENTER ; 8 2 (find P2 or C2) ENTER

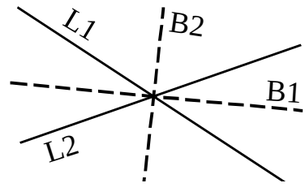
Line with point and angle



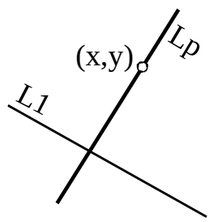
Circle with center & radius



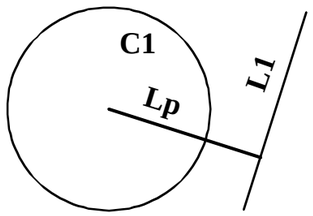
Bisector to two lines



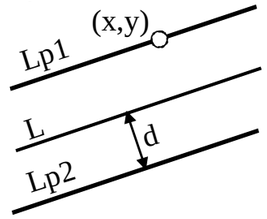
Perpendicular thru point



Perpendicular thru circle



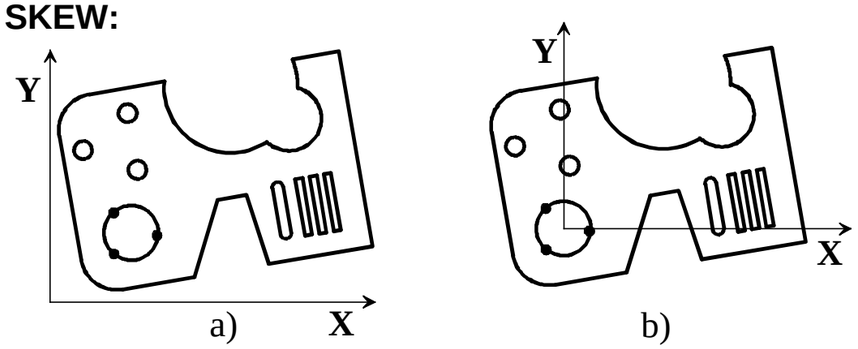
Parallel at a distance or thru a point



Skew SKEW **TYPES OF SKEW:**

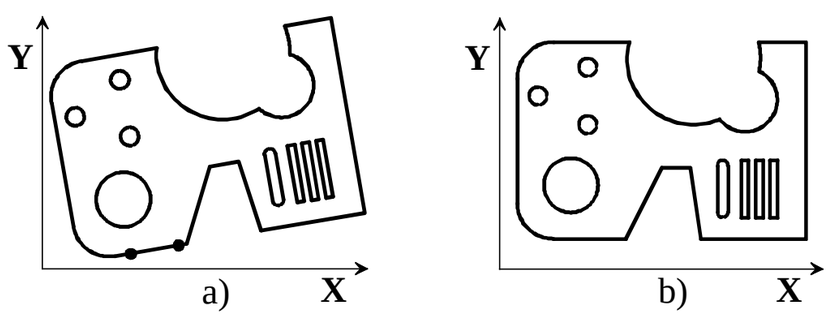
Using a **circle** or a **point** (a).

Center becomes new origin X,Y (b).



Using **a line or two points** (a).

Line aligned with nearest axis. In this case with the X axis (b).

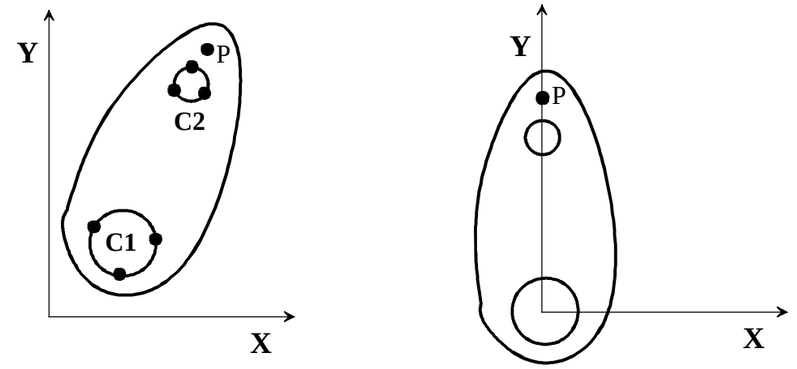


TYPES OF SKEW:

Using **two circles**.

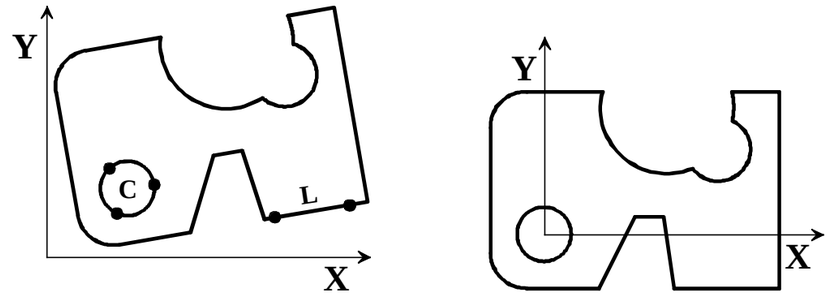
Centers aligned with nearest axis (in this case Y) and **first center (C1) becomes origin point.**

Same type of alignment obtained with a circle (C1) and a point (P).



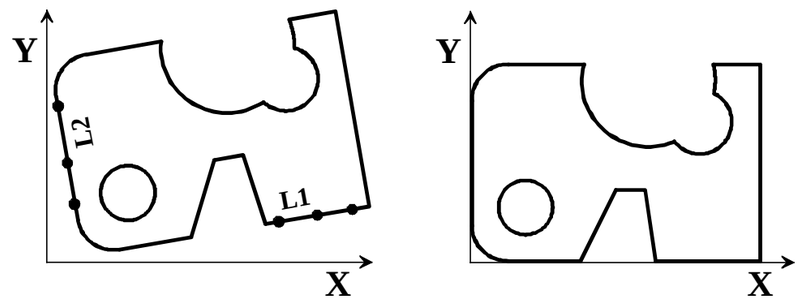
Using **a circle or point and a line**.

Line aligned with nearest axis and **the point or circle center becomes origin point**



Using **two lines**.

Intersection of two lines becomes origin point and **first line (L1) aligned with nearest axis**.



If the angle of the first line (L1) is greater than 45º, it will be aligned with the Y axis.