EL 700

Operational Manual

Digital Readout System

For

Machine Tool

electronica

Table of Contents

1. Introduction

Congratulations on purchasing EL700 series Digital Readout System (DRO) from Electronica Mechatronic Systems. Our DRO incorporates the latest state of the art technology; giving you world class features which help in improving productivity, reducing rejection and at the same time giving ease of operation to user with its ergonomic design.

Some of the key features of EL700 series DRO are:

- ➢ Adaptability to various types of machines, old and new, simple and complex.
- ➢ Ease of installation.
- ➢ Optional fourth axis gives addition encoder combination possibilities for milling machines.
- ➢ User friendly operations.

- ✓ **Note: Please familiarize yourself with the contents of this Operators manual to benefit from all features provided by EL700 DRO.**
- ✓ **Electronica Mechatronic Systems (I) Pvt. Ltd. Reserves the right to change specifications without prior notice.**

2. DRO Specifications

Electrical:

Mains Supply:	90 VAC to 265 VAC (50 / 60 Hz)
Fuse Rating:	800mASlow Blow 20mm
Power Consumption:	15W SMPS
Standard Compliance:	EMC and Low Voltage Compliance BS EN61326RoHS

Environmental:

Storage Temperature:	-20° C to +70° C
Operating Temperature:	0°c to 50°c
Relative Humidity:	20% To 85% Non-Condensing

Mechanical:

Dimensions (mm)	192 mm X 290 mm X 76 mm Height X Width X Depth
Net Weight:	Approx1.5 Kg
Display:	5.7" Colour TFT Display with LED backlight

Connections

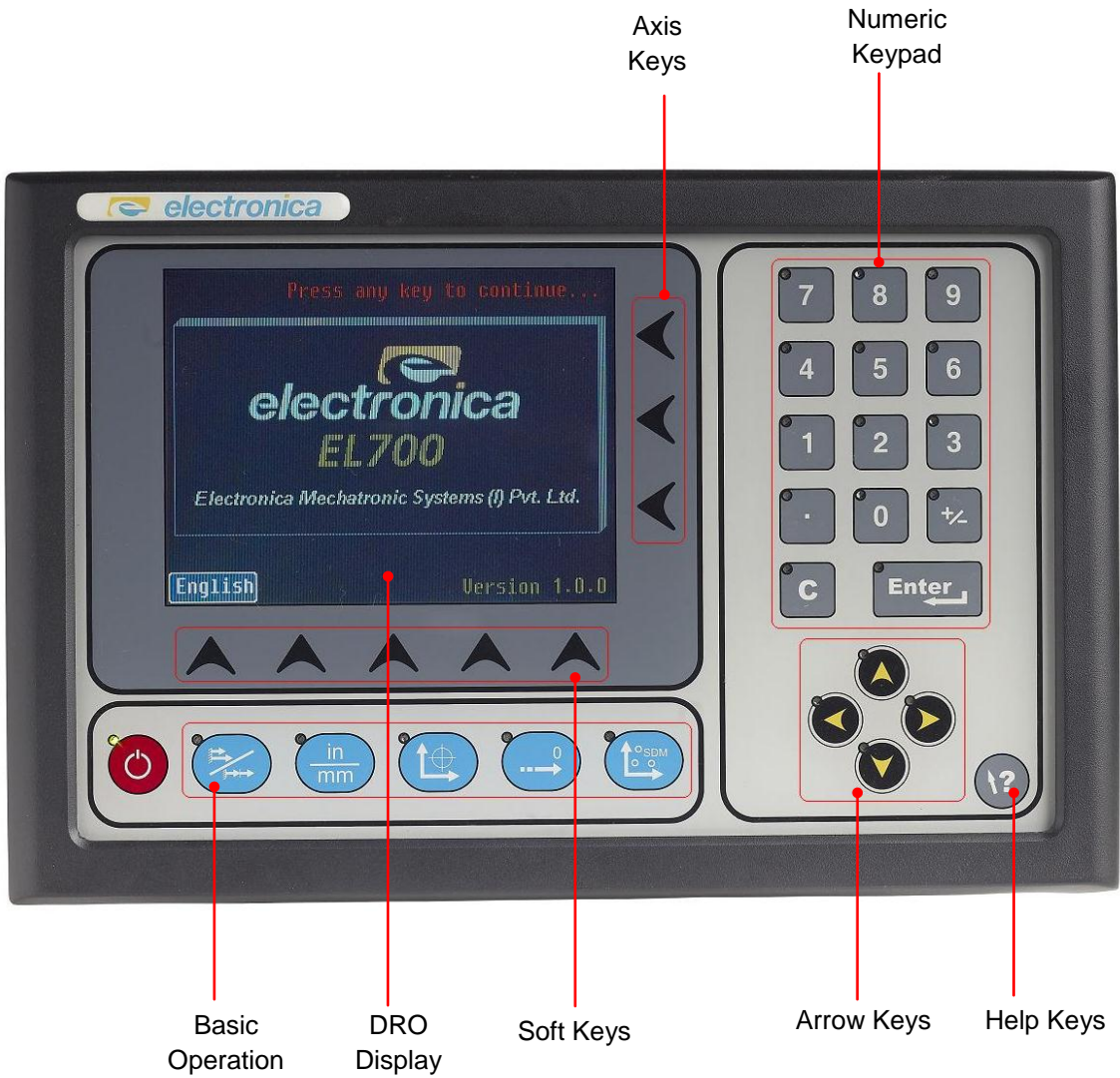|	
Encoder Input:	RS422
Encoder Connector Type:	9-Pin D-Type Female
Encoder Resolution Supported:	0.1/0.2/0.5/1/2/5/10/20/50 Micron
Auxiliary Connectors:	15-Pin D-Type Female for Auxiliary Output Optional) Encoder Jack Plug connector for Probe input (Optional) USB B type Connector (for service only)

CE   ISO 9001:2008 COMPANY

3. Read Before Proceeding

- The EL700 DRO is sophisticated electronic equipment and should be carefully handled to avoid any damage.
- The rated supply to DRO should be within specified limits and should not be exceeded under any circumstances. Doing so may cause irreversible damage to DRO.
- DRO should be opened by authorized person only. Otherwise it will invalidate the warranty of the unit.
- Equipotential Point (Ground) should be provided to avoid erratic operations of DRO.
- Cable routing of DRO and encoders should not be routed through or nearby high capacity switching/inductive load or where it can cause danger.
- EL700 DRO is standard compliant with
  - EMC Directive EN61326 Standard 61326-4-2, 61326-4-4, 61326-4-11, 61326-4-5, CISPR 16-1 and 16-2.
  - RoHS compliant.

- **Warranty will be considered void if and not limited to**
  - Failing to meet manufacturers specified supply conditions.
  - Abusive handling.
  - Environmental conditions outside of Manufacturers specifications.
  - Manipulation, tampering of electronics.
  - Replacement of original parts with other parts than specified by manufacturer.
  - Used with encoders other than those supplied by the manufacturer.
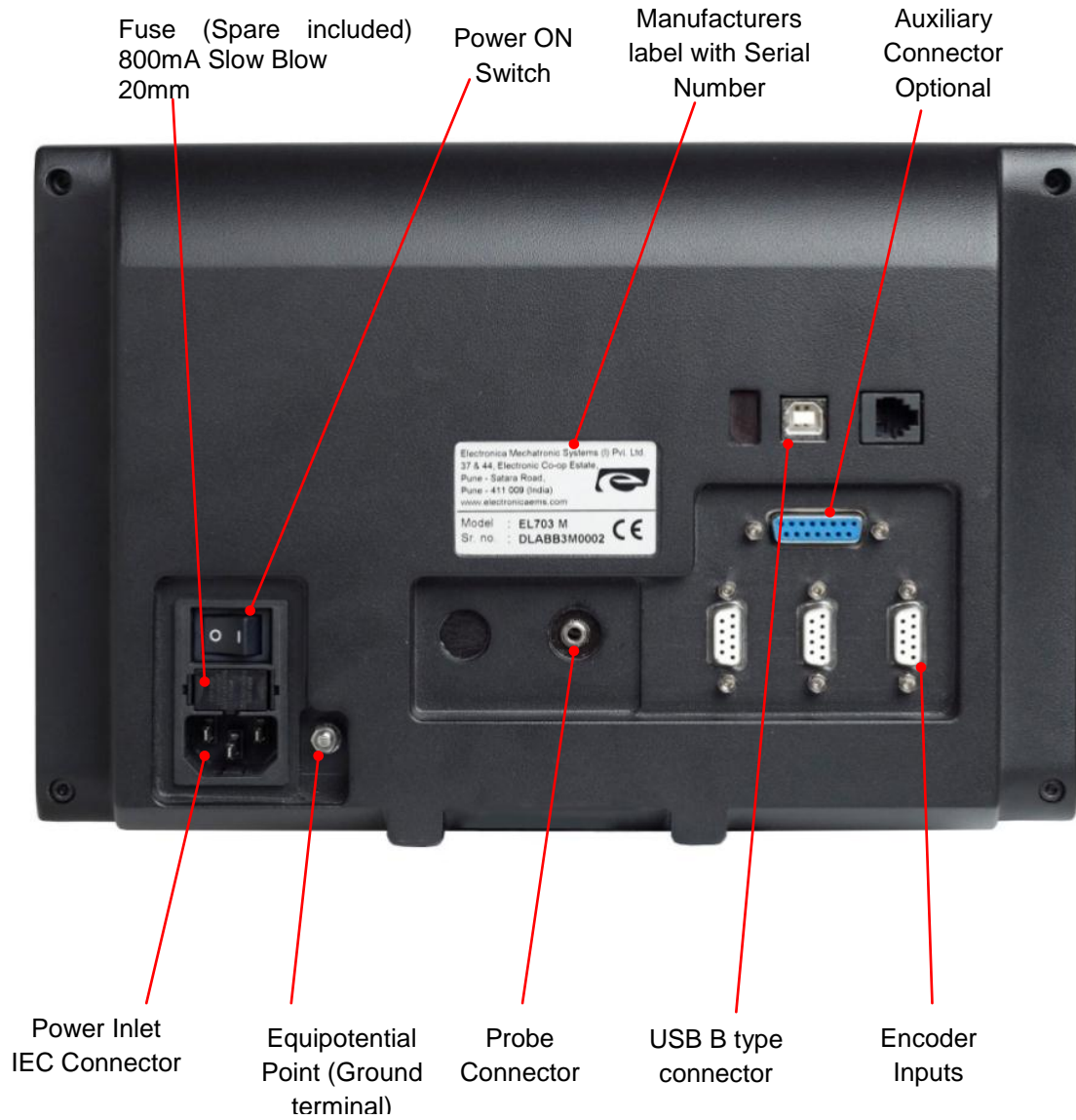
- **Disposal**
  At the end of its life the EL700 DRO systems should be disposed of in a safe an environmentally sympathetic manner as applicable to local legislation. The casework and other components may be suitable for recycling. DO NOT BURN.

4. Getting Started

4.1 Front View

Axis Keys

Numeric Keypad

Basic Operation

DRO Display

Soft Keys

Arrow Keys

Help Keys

4.2 Rear View

Fuse (Spare included) 800mA Slow Blow 20mm

Power ON Switch

Manufacturers label with Serial Number

Auxiliary Connector Optional

Electronica Mechatronic Systems (I) Pvt. Ltd.
37 & 44, Electronic Co-op Estate,
Pune - Satara Road,
Pune - 411 009 (India)
www.electronicaems.com

Model : EL703 M
Sr. no : DLABB3M0002

CE

Power Inlet IEC Connector

Equipotential Point (Ground terminal)

Probe Connector

USB B type connector

Encoder Inputs

4.3   Keyboard layout

Symbols	Description	
ABS / INC symbol	ABS / INC	FUNCTION KEYS
Inch / mm symbol	Inch / mm	
Reference symbol	Reference	
Preset symbol	Preset	
SDM symbol	SDM Function	
0 ... 9 keys	Numeric Keys	NUMERIC KEYBOARD
+/- key	Toggle Sign	
. key	Decimal Entry	
Enter key	Enter	
C key	Cancel	
Navigation keys	Navigation Keys	
Soft key symbols	Soft key Selection / Axis Selection	COMMON OPERATIONS
LCD standby symbol	LCD standby Key	
Help symbol	Help Key	

4.4   Power Supply

The EL700 DRO series uses a Switch mode power supply inside which covers the universal power input range i.e. 90VAC to 265VAC / 50 to 60 Hz. Ensure the input power is within the specifications before powering the unit.

The power supply to the DRO should not be given from the same source as that of any high capacity switching / inductive loads to avoid interference. Ensure proper equipotential point (Ground) connection is provided to the DRO to avoid any erratic operations.

4.5 Encoder Connections

	Pin Number	Output Signal
	1	ABS^{*1}
	2	/ABS
	3	VCC (+5V)
	4	Shield^{*2}
	5	GND (0V)
	6	Phase A
	7	Phase /A
	8	Phase /B
	9	Phase B

> **Note:**

*1 **-** ABS is Reference Mark.

*2 – Ensure proper shielding of the encoder cables for proper functioning of the encoder and the DRO.

Encoder Cable should be properly routed as per manufacturers' guidelines. Cable should not be routed near any inductive loads to avoid electrical noise interference. It should be routed away from the machine moving parts to avoid any damage.

4.6 Power UP

Switch ON the power switch located on the back of the DRO. The DRO will display the power UP message momentarily as shown below

*Owing to continuous Research & Development software version may be different than displayed.
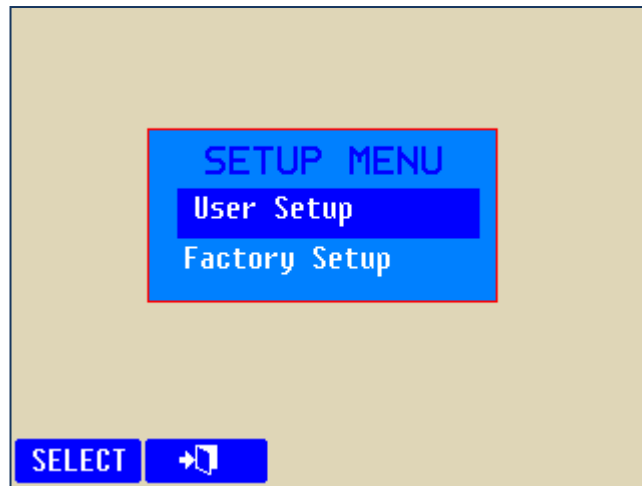
4.7 Screen Layout

Sample screen of EL700 DRO, Labels description is as below.
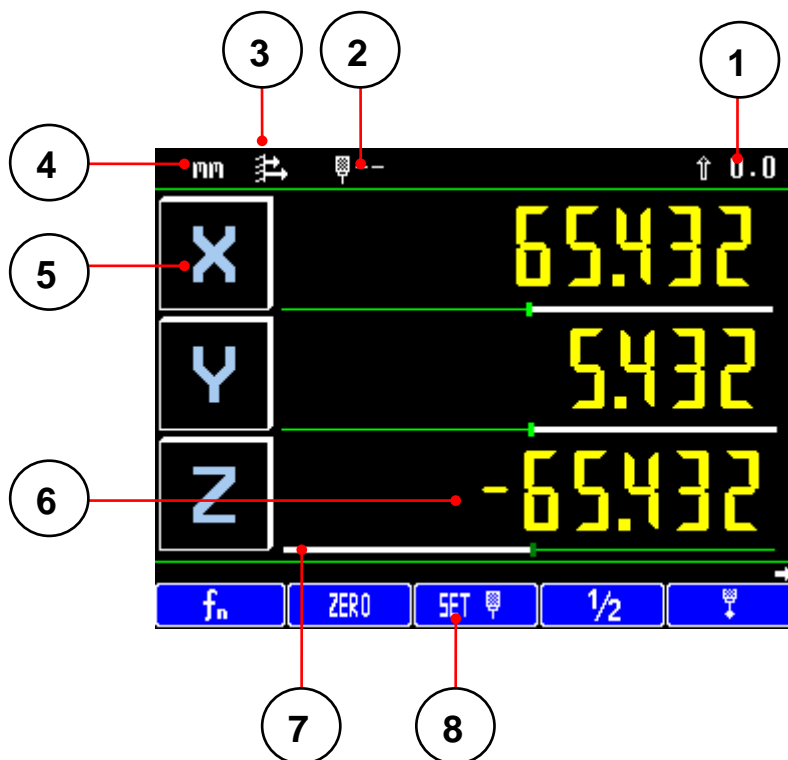
Labels	Description
1	Feed rate
2	Tool No.
3	ABS/ Inc mode
4	Measurement unit
5	Axis Label
6	Display Area
7	Zero approach Bar
8	Soft keys

5. Setup

The EL-700 setup can be accessed by pressing [ ] key followed by SOFT KEY { }. The SETUP mode screen is as shown below

- Different fields can be navigated using [ ][ ]keys.
- Options for each field to be selected are displayed at the SOFT Key labels. A particular option can be selected using the SOFT key.

✓ **Note**: In this manual, following notations will be used
  - [name] denotes a dedicated key name
  - {name} denotes a Soft key name

5.1 General Settings:

Sr. no.	User Setup Parameters	Description
1	**Sleep Mode Time (min)**	Defines Sleep Time Interval in minutes (5 to 120).
2	**Key Beep Enable**	To enable or disable keyboard beep ON or OFF.
3	**Zero App. Beep En**	To enable or disable Zero Approach Beep ON or OFF.
4	**Zero App. Tolerance**	This sets a tolerance value for Zero Value in Zero approach modes.
5	**Diagnostics**	This can be used checking the Keyboard, Encoder, Probe, and Display as diagnostic tool.
6	**Select Axis**	This is used for setting axis specific parameters. (Axis parameters are given below in 5.2 & 5.3)
7	**Serial communication**	Enables the user to set the Serial communications parameters.
8	**Recall OEM setting**	Recalling OEM settings will reset all the users settings related to Axis and Auxiliary I/O to Standard OEM setting.
9	**Save & Exit**	To save the changes and exit from setup.
10	**Exit without saving**	Exit from setup without saving changes.

5.2 Axis Specific Settings (Linear Type):

1. **Scale Resolution**: This option is available for all axes if configured as linear type. The options available are 0.1 µm, 0.2 µm, 0.5 µm, 1 µm, 2 µm, 5 µm, 10 µm, 20 µm, 50 µm and 100 µm. The default value is 1µm.

2. **Display Resolution:** Option available for all axis, resolution settings available are 0.1 µm, 0.2 µm, 0.5 µm, 1 µm, 2 µm, 5 µm, 10 µm, 20 µm, 50 µm and 100 µm if the axis is configured as linear type.

3. **Axis Direction:** The counting direction can be set either Left or Right for each individual axis. The default value is left direction.

4. **Axis Mode:** The Axis mode can be set either Radius or Diametric for each individual axis. This is valid only if the DRO is configured as Lathe model. In Mill model, all axes are forced to RAD mode.

5. **Reference mode:** This defines which reference mode to select, Single or DCR. For Single mode, the DRO uses the encoder reference mark for referencing. DCR mode of referencing required special encoders & kept for future developments.

6. **Machine Reference:** Keep the encoder position near to the desired reference on the encoder. Refer section 5.5 for setting machine reference.
   Procedure:-

   1) Press { ⬅ } key in "Machine Ref." in axis settings. "Homing" Message is shown on the screen.

   2) Pass the reference mark on the encoder. Here the DRO will reset the axis on the reference mark.

   3) Go to the machine reference position and press { SET }.

7. **Zero App. Distance:** Zero Approach Distance is the distance band for zero approach beep which is used to get operators attention when the axis count is within the band. There is also a proportional bar graph display that is shown below the axis display. The default value is "1.000 mm".

8. **Calibrate Axis:** Axis calibration is required to compensate for errors arising due to wear and tear, encoder misalignment etc. each axis can be calibrated for Linear Errors or Segmented errors as applicable. The detailed procedure for calibration is explained in the later section 5.4.

9. **Apply Compensation:** The type of compensation applied to selected axis is programmed here. Three options are possible NONE, LEC and SLEC. The default compensation type is set "none".

5.3 Axis Specific Settings (Angular Type):

1. Counts per Revolution. (CPR): This parameter defines the Encoder counts per rotation. Either the operator can enter this value if this is known or there is an automatic calibration process for finding the CPR value. In the automatic process, the user is prompted to pass two reference marks in the same direction. The DRO counts within them, and sets the CPR value. The default value is 4096.

2. **Resolution (Deg.):** This parameter defines the Display resolution in degrees. The default value is 0.1 degrees.

3. **Reference Mode**: This defines which reference mode to select, internal or external. For internal mode, the DRO uses the encoder reference mark for referencing. For external mode, the DRO senses an external input (Input 4) first and then references the DRO on encoder internal reference mark. This mode can be used where sometimes one machine rotation corresponds to more encoder rotations due to gear coupling. The default is set to internal.

4. **Axis Direction**: This defines the counting direction of the encoder, clockwise (CW) or counter-clockwise (CCW). The default is set to CW.

5. **Count Mode**: Under this parameter there are two options:
   - ➢ Rollover: The angle rolls back to zero after 360°.
   - ➢ Continuous: The angle continues accumulating after 360°.

   The default is set to Continuous mode.

6. **Machine reference**: There are two types of reference mode, as described In section 5.3.3
   a. Internal reference: -This is similar to that in linear. Only thing the value is set in degrees.
   b. External mode: - The DRO senses an external input first and then references the DRO on encoder internal reference mark.

7. **Display Mode**: The angular axis is configurable for two possible options.
   a. DDMMSS – Degrees: Minutes: Seconds (00.00.00).
   b. DDDEC – Decimal Degrees (0.0000).

   The default mode is DDMMSS.

8. **Axis Lock**: Two options are possible for this parameter.
   a. Axis Lock ON
   b. Axis Lock OFF.

   Axis Lock ON prevents the operator from axis setting in absolute mode. Only the operator can perform referencing. The default value is Axis Lock OFF.

9. **Zero App. Angle**: This is similar to the Zero Approach distance in linear mode. Only the setting is in angular mode. The default value is 10.00.00.

10. **Zero App. Tolerance**: This is similar to the Zero approach tolerance in linear mode. Only the setting is in angular mode. The default value is 0.00.00.

✓ **Note**
   - ➢ The changes made in the setup mode should be saved by using "Save and Exit".
   - ➢ Note that the options for each Menu item are displayed on the Soft key label. User has to press the correct soft key for required settings.

5.4 Error compensation

- **Error compensation should be done only in case job accuracies are not as per expectations.**
- **If job accuracies are acceptable, the error compensation should not be performed.**

These deviations in job accuracies could be the errors in screw pitch of machine or result of deflection / tilting of axes or encoder installation.

These can be linear or non-linear and can be determined with the help of Standard measuring system or a high accuracy slip gauge / gauge block.

5.4.1   Error compensation for linear Axis

5.4.1.1   Linear Error Compensation (LEC)

Linear error compensation can be applied, if the results of the comparison with a reference standard show a linear deviation over the whole measuring length. In this case the error can be compensated by the calculation of a single correction factor.

Procedure:-

Scroll to 'SELECT AXIS' in user setup mode, select the required axis to calibrate using 'X, Y, Z, U' soft keys. Following screen will be displayed in axis settings.
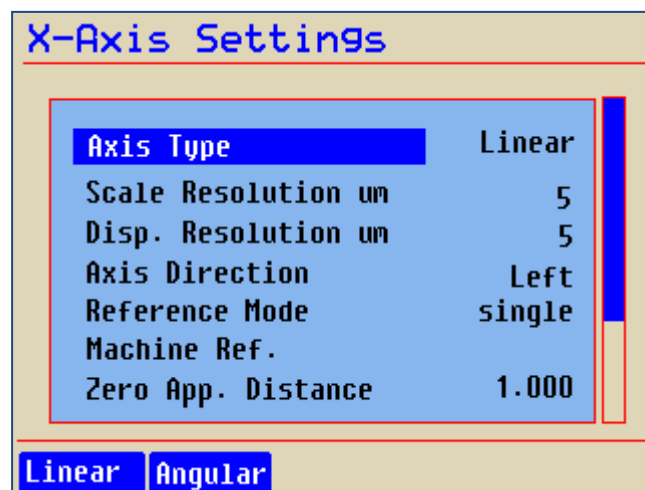
Navigate to Calibration Menu in axis setting
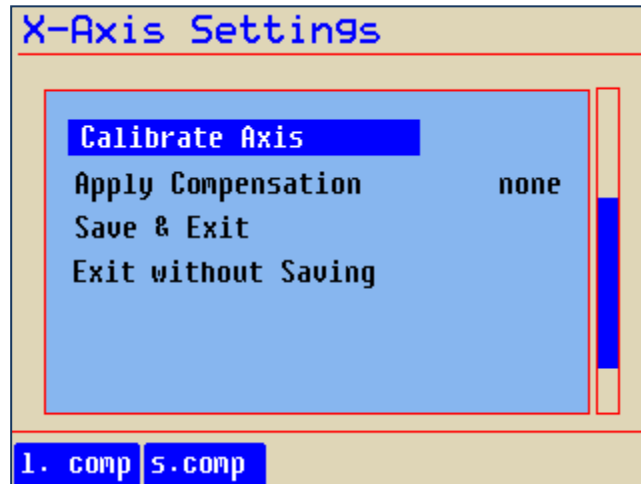
Select Linear Error Compensation { **l. comp** }menu.

1. Move to the start position.
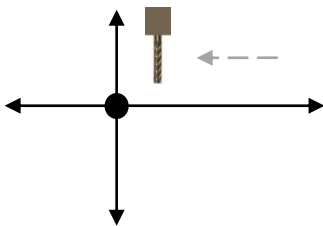
2. Zero the display value by pressing { **reset** }.
3. Move a known distance (use a laser interferometer, slip gauge or standard).
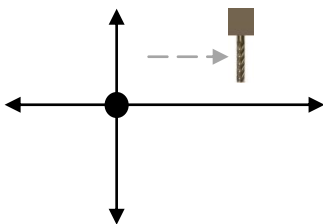
4. Move the axis to touch the slip gauge. Select 'Slip Value' and enter this known distance using the numeric keypad.
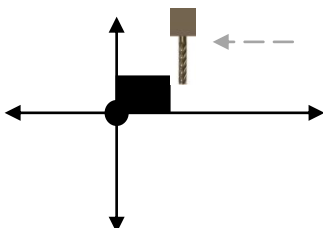
5. Select 'Cal Factor' and press { **Calc** }.
6. Save & exit the menu.

Now the linear error compensation is stored and applied. Following is sample screen shown

```
X-Axis LEC

   Display Value        99.055
   Slip Value          100.000
   Cal Factor            1.009
   Save & Exit
   Exit without Saving

reset
```
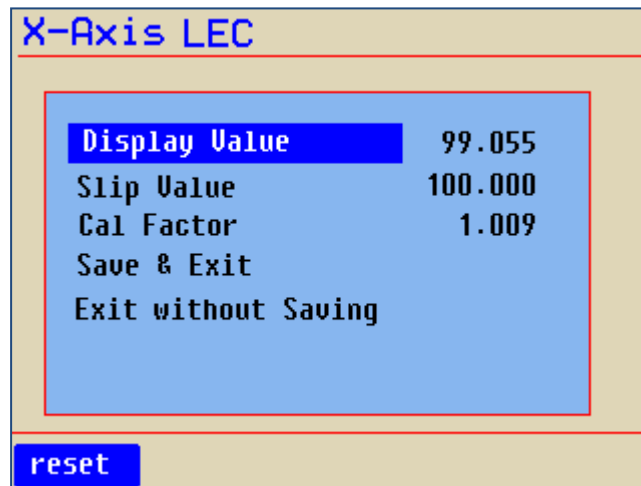
5.4.1.2   Segmented Error Compensation (SLEC)

Segmented Linear Error Compensation (SLEC) is used when the results of the comparison with a reference standard shows non-linear error. In SLEC the entire axis travel is divided into as many as 99 user defined segments. The error in each segment is compensated with a single correction factor. Each correction point is measured with respect to the starting point. This starting point is usually set close to the end of the scale. This starting point can coincide with the absolute datum point.

Procedure:-

Scroll to 'SELECT AXIS' in user setup mode, select the required axis to calibrate using 'X, Y, Z, U' soft keys. Following screen will be displayed in axis settings.

```
X-Axis Settings

   Axis Type            Linear
   Scale Resolution um       5
   Disp. Resolution um       5
   Axis Direction         Left
   Reference Mode       single
   Machine Ref.
   Zero App. Distance    1.000

Linear  Angular
```
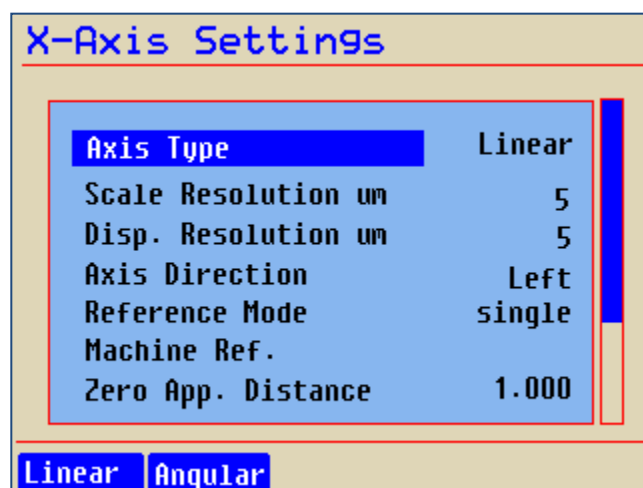
Navigate to Calibration Menu in axis setting

Select Linear Error Compensation { **s.comp** } menu.

1. Perform Machine reference in the axis settings. Refer to Section 5.5. After performing machine reference do not set or reset the axis till the complete SLEC calibration is complete.
2. Divide the travel into user defined segments.
3. Enter into standard measurement mode (DRO mode).
4. Note down all the standard values and the observed values for each segment.
5. Enter the setup mode and select { **s.comp** } for the respective axis.
6. Start entering the Slip values and observed values one by one.
7. Press { **→** }to move to the next segment, Repeat the procedure for each segment.
8. Save & exit the menu.

Now the Nonlinear error compensation is stored and applied.Following is sample screen shown
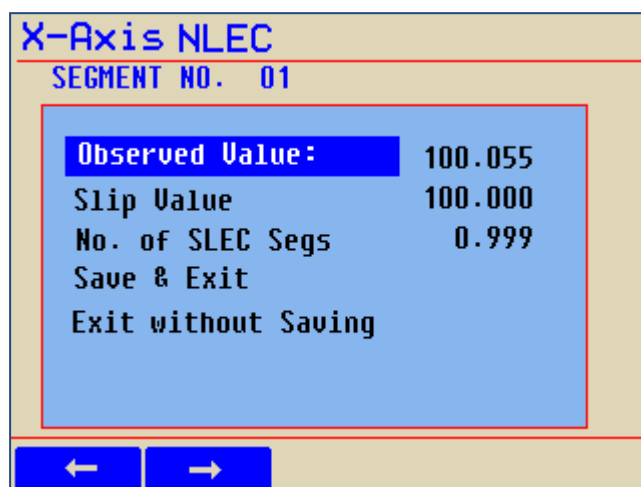
5.5 Machine reference

Machine referencing is used when datum is not at the reference mark on encoder but at a fixed distance from reference mark.

Setting the machine reference

Scroll to 'Select Axis' in user setup, select axis 'X.Y, Z, U' from the soft keys. In axis setting keys Select machine Ref. & follow the steps below.

1. Press { } when 'Machine Ref.' is highlighted.
   The screen displays the message '**homing...**' Move the slider to the reference point on encoder.
   Mark this reference position for future use.
2. Once the reference mark is sensed screen will display **'Set MC Ref**.' Message.
3. Now travel to the desired position on the machine till machine reference point is achieved.
4. Press the { } key.

The axis machine reference is now saved in DRO. To use this reference as your absolute zero in operations, you will have to recall machine reference by pressing [ ] key.

This is very important when you use segmented axis compensation.

6. Primary functions

6.1 Absolute / Incremental mode (ABS / INC)

The [ ] key toggles between the Absolute / Incremental position display.
Absolute mode displays the positions of all axes from a fixed datum.
The Incremental mode displays each position relative to the last position. This is also known as point to point use.
After switching to incremental mode, the user can reset the axis without changing the absolute datum. When switched back to Absolute Mode the original datum is intact.
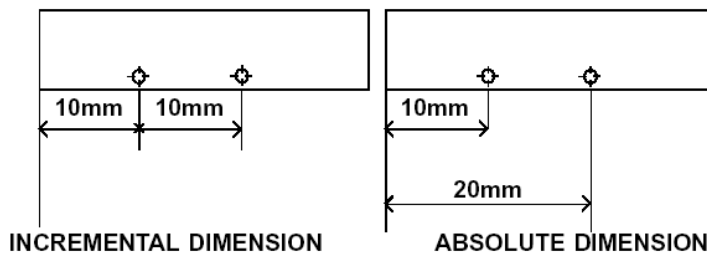
✓ **Note**: At the beginning of each working session, set the datum in Absolute Mode, and then switch the DRO to Incremental Mode. By using the DRO in this way, you can return the machine to its absolute datum at anytime, simply by switching back to Absolute Mode**.**

6.2 Inch Metric Display (In / mm)

The [ ] key toggles between the Inch units (in) or the millimeter units (mm).
The unit is displayed at top on left side of the display.

6.3 Axis Set/Reset

This function is used to set the axis with a known value or to Zero the axis.

6.3.1 Axis Set: -

This function is used to set the axis with a known value.

Press { SET } key to switch DRO in set mode, Select the axis to set be pressing the

[◀]. Enter the numeric value to be set using numeric keypad and press[Enter] to

confirm. Incorrect numeric entries can be cancelled one by one using [C] key.

6.3.2 Axis Reset: -

This function is used to Zero the axis.

Press { ZERO } key to switch DRO in reset mode, Press the [◀] key to be reset.

When axis Set/Reset function is activated in ABS mode, it will redefine the datum of the travel, and then it is not possible to restore the old datum.

6.4 Half Function

This function is used to find the center of a work piece by halving the displayed distance on the selected axis.

Press { ½ } key followed by [◀]key will half the value of axis display.

It is recommended to use this function in INC mode. If you press this key in ABS mode, it will change the datum point of the axis.

6.5 Probe Measurement

The probe function { [icon] } allows the operator to set an axis value or measure a work-piece feature. There are different modes of operation for this.
The basic modes of operation are:

 a. Datum Axis. [icon]
 b. Linear Measurement mode [icons]
 c. Angle Measurement mode [icon]
 d. Diameter Measurement mode [icon]

➢ **Datum Axis: This is the most basic operation of the probe. Here an axis can be loaded with a datum position as determined by a probe touch.**

Operation:
 a. Press { [icon] } key to enter in axis datum mode.

 b. Select the required Axis by pressing [[icon]] key.
   o Message windows shows [Probe – Datum]
   o Probe message window shows [Move to datum]
   o The axis display shows '---'
 c. Move the axis to the desired datum point. When probe is sensed the datum for the selected axis sets at the probe point.

 d. The Operator needs to press { [icon] } to go the basic probe window.

Following display will be seen
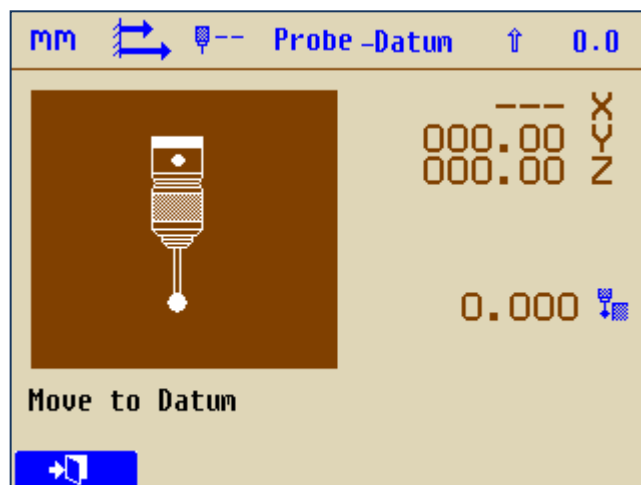
✓ **Note**: This operation functions in both Incremental and Absolute modes depending on the DRO operating status.
✓ **Note**: All other axes continue to display as normal. If multiple axes require being datumed then they must be done one at a time using the procedure above.

➢ **Linear Measurement mode: This is performed using the { 🔲 🔲 } soft key and can be used for Height and length both inside and outside measurements. Under this mode, there are different options:**

Height & Depth

Step Length

External Feature
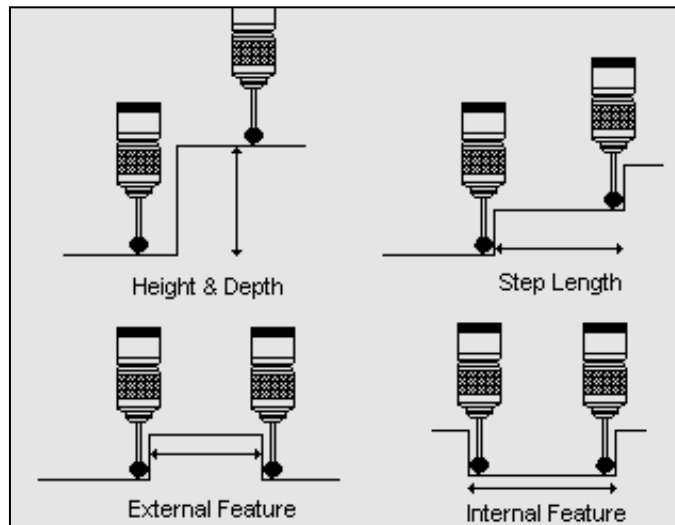
Internal Feature

Operation:

- Select Measure mode

  Press { 🔲 } key to measure height or depth.

  Press { 🔲 } key to measure step length.

  Press { 🔲 } key to measure external feature.

  Press { 🔲 } key to measure internal feature

- Select the required Axis by pressing relevant {axis} key.
- Move to start position and touch.
- Move to end position and touch.
- As per the measurement option, the results are shown.

- The Operator needs to select {. 🔲 } to go the basic probe window.

  ✓ **Note**: This operation functions in both Incremental and Absolute modes depending on the DRO operating status.

Sample Screens of Height & depth measurement
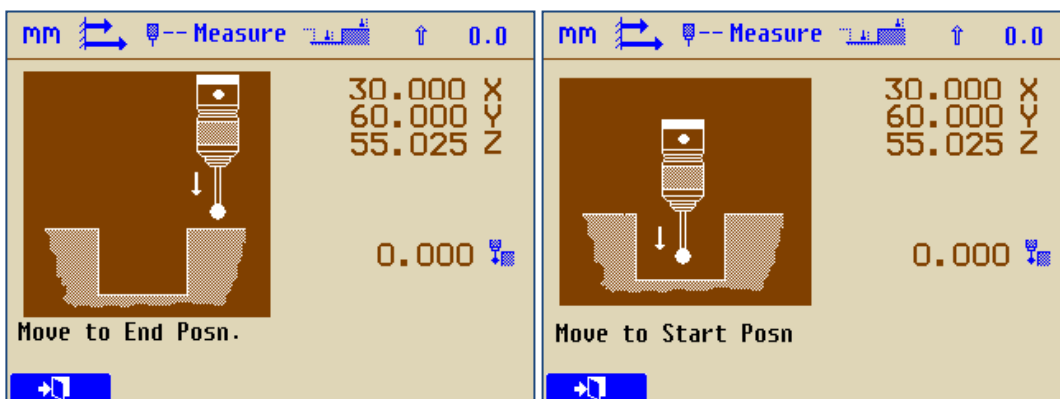
➢ **Angle Measurement mode: This function can be used to measure angles on the work-piece. It can also be used to calculate work-piece skew angles. Under this, there are different options:**

   ➢ Skew Operation:

Skew Operation
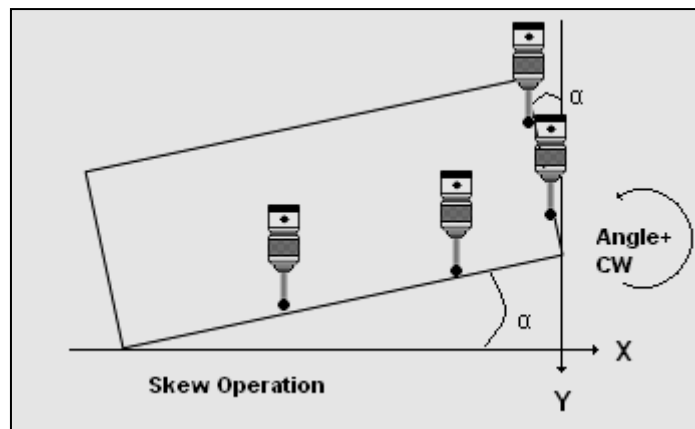
- Press{ }
- Select { }
- The probe display shows 'Move to Position 1'.

- Move to the starting position and press [Enter]
- The probe display shows 'Move to Position 2'.

- Move to the next position and press [Enter]
- The probe display shows 'Move to Position 3'

- Move to the next position and press [Enter]
- Skew Angle of the work-piece with respect to the selected axis is   displayed on the screen

Sample Screens of Angle measurement
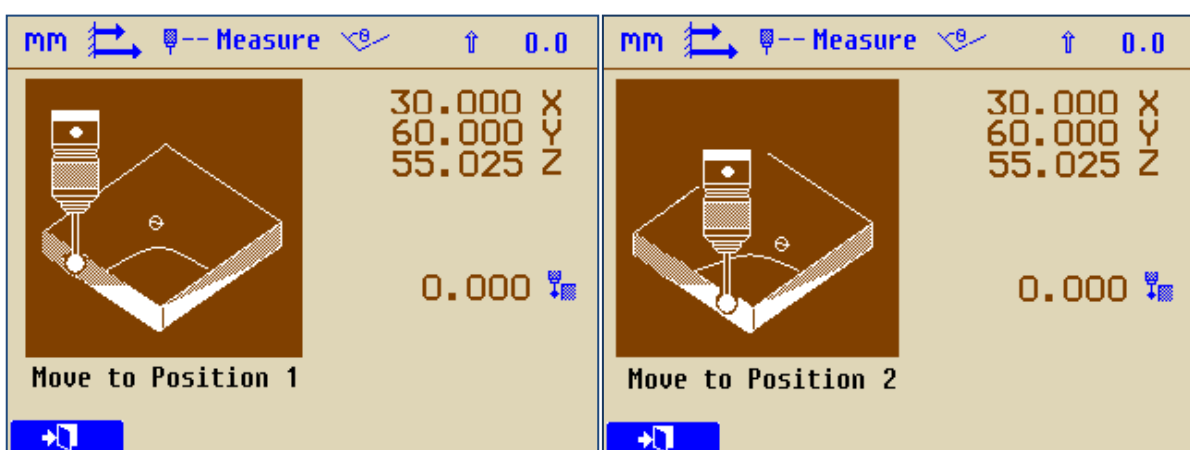
➢ Corner Angle Operation:
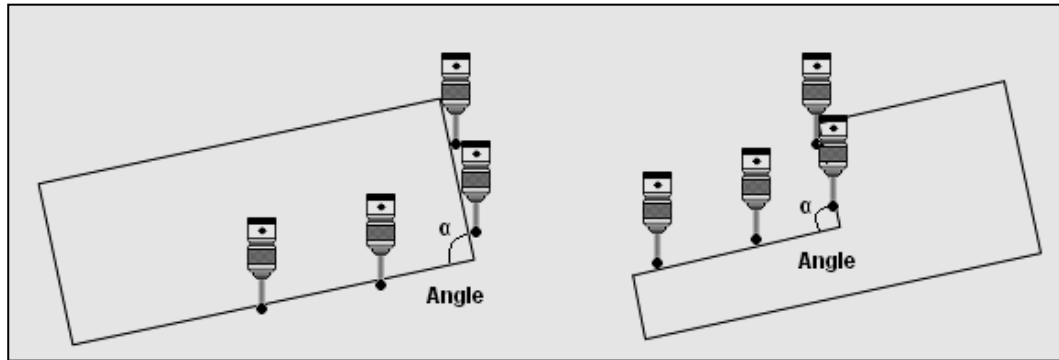
- Press { }
- Select{ }
- Select the required axis key.

- Move to start position press [Enter].The DRO beeps.

- Move to new position press [Enter]. The DRO beeps.

- The result is displayed on the screen.

➢ **Diameter Measurement mode: This function allows for the diameter of a circular feature to be calculated from three points. Under this there are different measurement options.**
  - Internal Diameter Measurement.
  - External Diameter Measurement.

For both the measurement modes use following sequence:

- Press { } key to enter in diameter measurement mode.
- Select mode of operation { , }
- Move to first point and touch
- DRO makes a 'Beep'
- Move to second point and touch
- DRO makes a 'Beep'
- Move to third point and touch
- DRO makes a 'Beep'
- The result is displayed after probing the third point.

Sample Screens of Diameter measurement
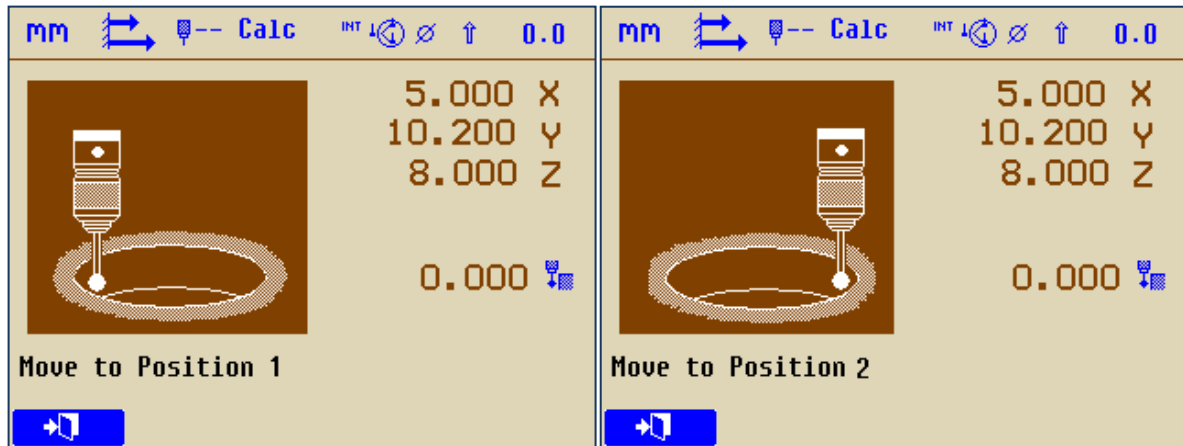
- ✓ **Note**: For every probe function, after displaying the results, two more soft keys are enabled:
- ▪ Repeat Soft Key [⟳] : This key can be used to execute the current function again from the beginning.
- ▪ Center Soft Key
    - ➢ {[⊕]}: centre key in diameter mode
    - ➢ {[½]}:- Linear and Angle measurement.

This key can be used to set the center of the measurement as an origin. This forces the DRO in the Incremental mode, and sets the center as origin in Incremental mode.

6.6 Calculator

Calculator function enables the operator to do Basic/Trigonometric calculations. Following screen is displayed when { [⊞] } is pressed in Normal mode of operation. As shown in the above screen, the big square on the LCD contains all the results and the small

rectangle is for the present number entry. The results are displayed when [Enter] key is pressed.

We can perform following functions on calculator
- a. Addition
- b. Subtraction
- c. Multiplication
- d. Division
- e. Percentage
- f. Modular division
- g. Exponential
- h. Trigonometric function (sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$)
- i. Square
- j. Squareroot

CALCULATOR

0.000	X
0.000	Y
0.000	Z

→

| + | − | X | ÷ | →] |
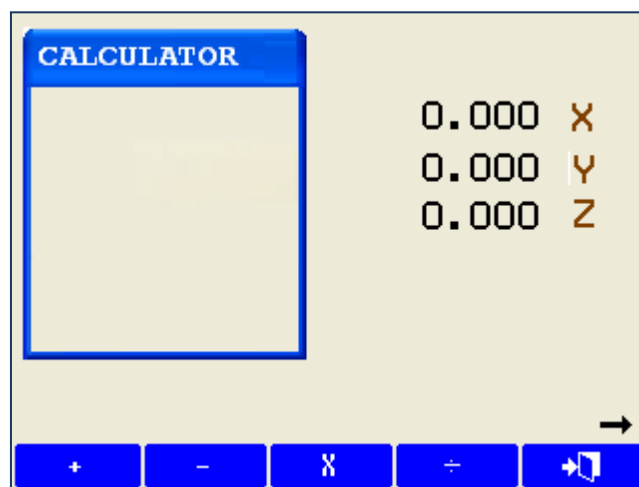
6.7   Setting Reference

This function allows user to set a machine zero point. With this machine zero point users can restore the work coordinates even if the machine is moved when the DRO is in OFF condition. Generally each encoder has reference marks present at every specified interval. One of these reference marks is used to recall the same datum point every time.

This function works only in ABS mode. It will not be executed in INC mode.

6.7.1   Homing reference

In this function, the Datum is set at the reference mark on the encoder. Follow the procedure for the homing reference.

1. Press [ ] key.
2. The soft key menu displays { **homing** } and { **M/C ref** }.
3. Press { **homing** } The Information Bar message window displays 'SELECT AXIS'
4. Axis will display 'Homing....' Message. Move the slider to the reference point
5. After crossing reference mark DRO will start counting. Your reference is now set.

   ✓ **Note:** It is highly recommended to mark an indicator on the encoder so as to use the same reference mark while finding the datum point.

6.7.2   Recalling machine reference

In this function, the Machine reference is recalled as set in the user setup. Follow the procedure for the Machine reference.

1. Press the [ ] key.
2. The soft key menu displays { **homing** } and { **M/C ref** }.
3. Select { **M/C ref** }. The Information Bar message window displays 'SELECT AXIS'
4. Press the required axis [ ] key. The selected axis displays 'M/C REF.'.
5. Move the axis to the reference point on encoder which was used for setting machine reference.
6. Now the DRO will not display 0.000 but it will display the distance of the encoder reference mark from the machine reference position.
7. Now if you will move the slide to make the DRO reading zero, you will achieve the machine reference position.

7. Secondary Functions

7.1 Preset

The Preset function provides a simple mechanism for stepping through repeat positions using the work-to-zero principle. It also takes into account positioning errors for repeated points. The first time that you enter the function, the previous move error is set to zero. In this way pressing only { } recalls any previous axis preset value.

Axis preset values are not maintained after a power cycle. The setting of the axis preset value does take into account the error of any previous move. The value that you enter is the step move value.

Pressing { } again recalls the axis preset value and takes into account the error of any previous movement. Pressing { } after a power cycle results in a zero value.

The value of the axis Preset value that you enter is maintained until power-off. In this way pressing after returning to the Preset function after exiting it previously, recalls the previous axis-preset, without error adjustment as the error is set to zero on initial entry.

The values displayed do not affect the axis positions and the axis datum is restored when you exit the Preset mode function.

7.2 Sub Datum Memory (SDM)

This function allows the DRO to store upto1000 sub datum points. Each Sub-Datum stores coordinates for all 3 axes (X, Y, and Z). In operation, the datum of the machine is replaced by each Sub-Datum in turn, allowing the operator to work to zero for each Sub-Datum instead of having to constantly refer to printed list of coordinates. SDM no. is displayed on the main screen during working in this function
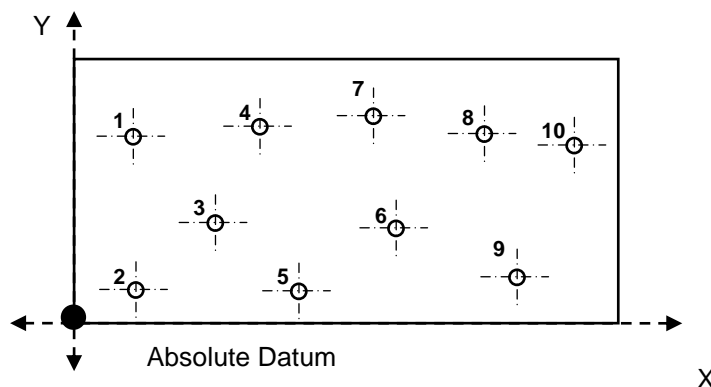
Sub-Datums are different machining steps that you may need. In operation, the absolute datum of the machine is replaced by each Sub-Datum in turn, so you can work to zero for each step instead of having to constantly refer to a printed list of coordinates.

Using this function, you can create as many as 50 jobs each containing up to 20Sub-Datum. Here, a job is a group of Sub-Datums for a particular job. You can give each job a 20-character name which is stored in the permanent memory.

There are three options under SDMs.

Creating a job

1. Press [ ].
2. From the Sub-Datum selection screen press { }. This opens a new Sub-Datum job.
3. Press { }.
4. You can either enter the axis co-ordinates using the axis load or move the axes to the required position.
   To use axis load:
   Press the [ ] key to load. Enter the coordinate value using numeric keypad and then press [ ].
5. Press { } key to save the coordinates and move to the next step.
   The information bar shows the current step / total of saved steps.
6. If you make a mistake or decide you do not want the point you have created, press { } key.

7. Once you have entered all the Sub-Datum points, press { } twice. The job is automatically named 'LAST JOB'. You do not have to rename the job at this point you can leave it as 'LAST JOB' until you decide whether you want to keep it. You can then rename it later if you want to keep it. Press { } to enter a name for that job. Once you have named the Sub-Datum, press { }.

Editing a job
Occasionally, you may need to edit a Sub-Datum job as specifications change.

Adding or deleting steps from a sub datum

1. When in normal mode, press [ ]. A list of existing jobs is displayed. The numbers on the right indicate the number of Sub-Datum for each job.
2. Select the SDM job to be edit using [ ] [ ] keys.
3. Press{ } key. The information bars shows 'SDM'. It also shows (current step) / (total number of steps). The EL700 is in SDM graphical edit mode. The Sub-Datum number and name are displayed.
4. Use [ ] [ ] keys to go to required step.
5. Use { } key to add a step.
6. Use { } to delete a step.
7. To exit Sub-Datum edit mode, press { } twice**.**

Editing sub datum coordinates

1. When in normal mode, press [ ]. A list of existing jobs is displayed. The numbers on the right indicate the number of Sub-Datum for each job.

2. Use the [ ] [ ] navigation to select a job.

3. Press { } key. The information bar shows 'SDM'. It also shows (current step) / (total number of steps). The EL700 is now in SDM graphical mode.

4. Use { } to go to the next step. Use to back up a step.

5. You can either enter the axis coordinates using axis load or move the axis to the required position.

   To use axis load, Press the [ ] key to load. Enter the coordinate value using numeric keypad and then press [Enter].

6. To exit Sub-Datum from graphical mode, press { } twice.
Any changes that you make are automatically saved.

Using sub datums

1. When in normal mode, press [ ]. A list of existing jobs is displayed. The numbers on the right indicate that number of Sub-Datums for each job.

2. Use the [ ] [ ] navigation keys to select a job.

3. Press { } key. The information bar shows 'SDM'. It also shows (current step) / (total number of steps). The EL700 is now in SDM graphical mode.

4. If you prefer to use Sub-Datum in normal display mode instead of graphical mode. Press { }. While in normal display mode, you can move from point to point using the [ ] [ ] navigation keys. The EL700displays 'SDM - (Current Step) / (total steps)' below axis display in the lower left hand corner. Press [ ] to return to graphical mode.

5. Move each axis until it reaches zero. Perform the machining step.

6. Use the [ ] key to go to the next step. To back up a step, press [ ]. To exit Sub-Datum from graphical mode, press { } key twice.

8. Machine Specific Functions

8.1 Milling Machine Specific Functions:-

If the DRO is of Mill type, following functions are available on { **fn** } key:

- ➢ Bolt Hole (Circular and Arc)
- ➢ Line Hole
- ➢ Grid
- ➢ Frame
- ➢ Arc Contouring
- ➢ R-Function
- ➢ Pocket
- ➢ Slot
- ➢ Polar Coordinates
- ➢ Axis Summing
- ➢ Zero approach
- ➢ Job timer
- ➢ Shrinkage factor

All these functions have following soft keys

Sr .No	Soft Keys		Function
1	Recall		Shows previously saved list for the selected function
2	Exit		Exits from the Function List.
3	New		Shows the parameter list for the selected function.
4	Run		Key executes the function on the set parameters.
5	Save		Key saves the pattern in permanent memory. If the operator has opted for a new pattern, this key opens a data entry screen enabling the operator to select a name for the pattern. If a previously saved pattern is recalled, then this key saves the changes for that pattern.
6	Copy		Copy the data to new job
7	Delete		Delete the data stored
8	Rename		Rename the saved Job

8.1.1   Circular Bolt Hole Function (PCD)

This function is used to calculate the locations of Holes in a circular pattern. This is also known as Pitch Circle Diameter (PCD). The following Parameters are required:

- ➢ Co-ord. 1 of center.
- ➢ Co-ord. 2 of center.
- ➢ Circle radius
- ➢ Starting Angle
- ➢ No. of Holes(0 - 99)
- ➢ Depth
- ➢ Select Plane (X-Y, Y-Z, X-Z)

When you have entered the above parameters follow the procedure below for execution.

1. Press { 💾 }
2. This opens the Data Entry screen. Enter a name for your pattern, and press { 💾 }
3. You return to the parameters screen.
4. Press { ⬅ }

This opens a graphical display showing the arrangement of the holes.
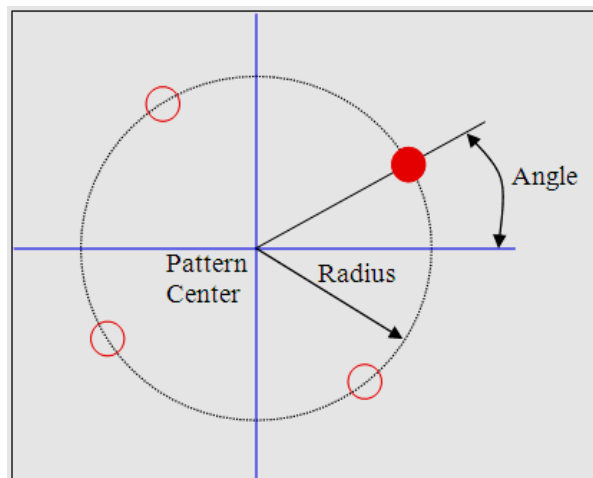
You can use [🔙] and [▶] to move around the holes. { ⊙→ } is used to switch between graphic mode and normal counting mode. You can edit the saved parameter by entering in edit menu by pressing { 📂 } key. Press { ↦ } key to exit this function.

8.1.2   Arc Bolt Hole Function

Arc Bolt Hole function is very similar to Circular Bolt Hole function, except in arc hole function user can enter the starting and ending angle of an arc. This angle is always with respect to positive X-axis and is calculated in anti-clockwise direction. The following Parameters are required:

- ➢ Co-ord. 1 of center.
- ➢ Co-ord. 2 of center.
- ➢ Arc radius
- ➢ Starting Angle
- ➢ End Angle
- ➢ No. of Holes(0 - 99)
- ➢ Depth
- ➢ Select Plane (X-Y, Y-Z, X-Z)

When you have entered the above parameters follow the procedure below for execution.

1. Press{ 🖫 }
2. This opens the Data Entry screen. Enter a name for your pattern, and press { 🖫 }
3. You return to the parameters screen.
4. Press { ⬅ }

This opens a graphical display showing the arrangement of the holes.
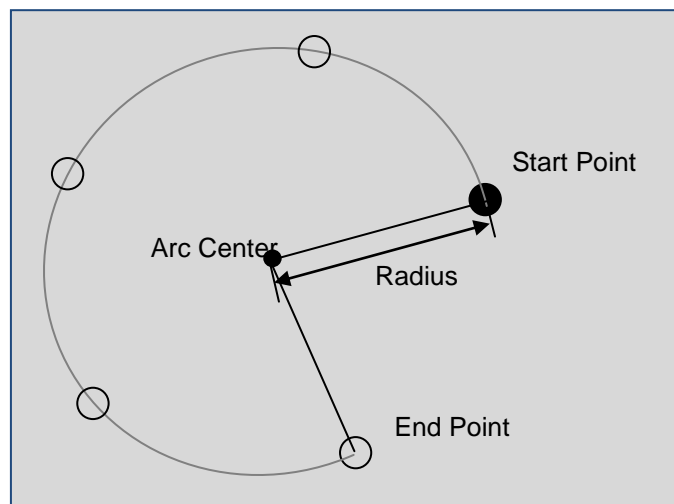
You can use [◀] and [▶] to move around the holes. { ⚙➜ } is used to switch between graphic mode and normal counting mode. You can edit the saved parameter by entering in edit menu by pressing { 📂 } key. Press { ➜❑ } key to exit this function.

8.1.3   Line Hole

This function is used to calculate the locations of Holes in a linear pattern. It is also known as Linear Bolt Hole.). The following Parameters are required:

- ➢ Co-ord. 1 of center.
- ➢ Co-ord. 2 of center.
- ➢ Pitch Distance.
- ➢ Angle.
- ➢ No. of Holes. (0 - 99)
- ➢ Depth.
- ➢ Sel. Plane (X-Y, X-Z or Y-Z).

When you have entered the above parameters follow the procedure below for execution.

1. Press { 💾 }
2. This opens the Data Entry screen. Enter a name for your pattern, and press { 💾 }
3. You return to the parameters screen.
4. Press { ⬅ }

This opens a graphical display showing the arrangement of the holes.

You can use[◀] and [▶] to move around the holes. { ⚙➡ } is used to switch between graphic mode and normal counting mode. You can edit the saved parameter by entering in edit menu by pressing { 📂 } key. Press { ➡ } key to exit this function.

EL700
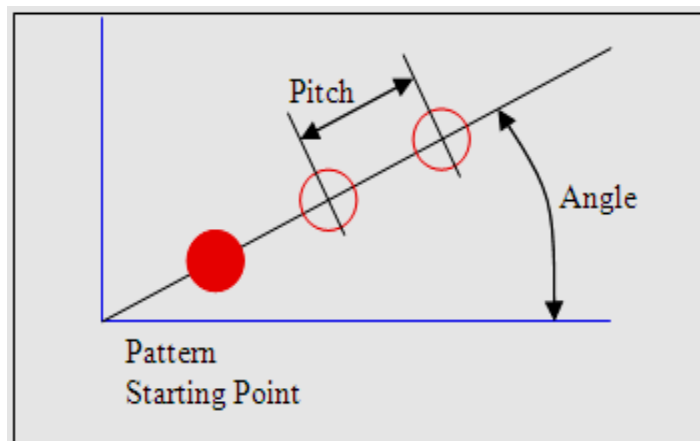
8.1.4 Grid

This function is used to calculate the location of holes in Grid pattern. The following parameters are required for this function:

➢ Start Co-ord. 1
➢ Start Co-ord. 2
➢ Angle.
➢ Pitch Distance in Axis '1'.
➢ Pitch Distance in Axis '2'
➢ No. of Holes in Axis '1'. (Max. 99)
➢ No. of Holes in Axis '2'. (Max. 99)
➢ Depth of the Hole.
➢ Sel. Plane (X-Y, X-Z or Y-Z).

When you have entered the above parameters follow the procedure below for execution.

1. Press { 💾 }.
2. This opens the Data Entry screen. Enter a name for your pattern, and press { 💾 }
3. You return to the parameters screen.
4. Press { ← }

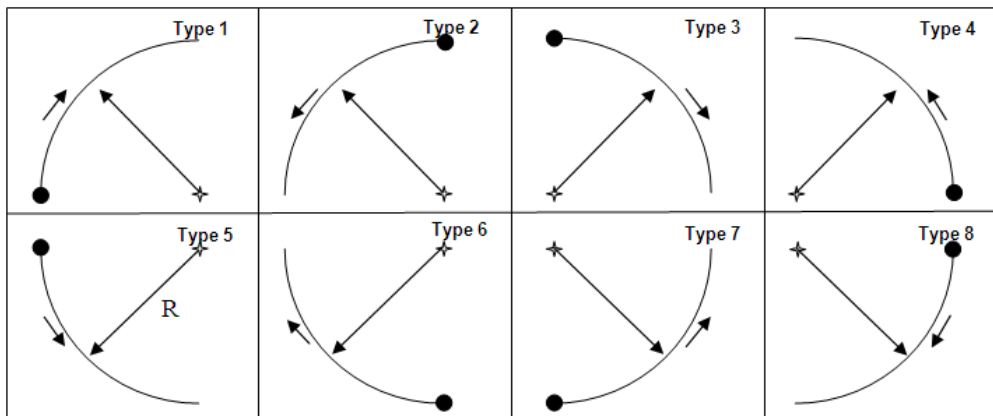This opens a graphical display showing the arrangement of the holes.
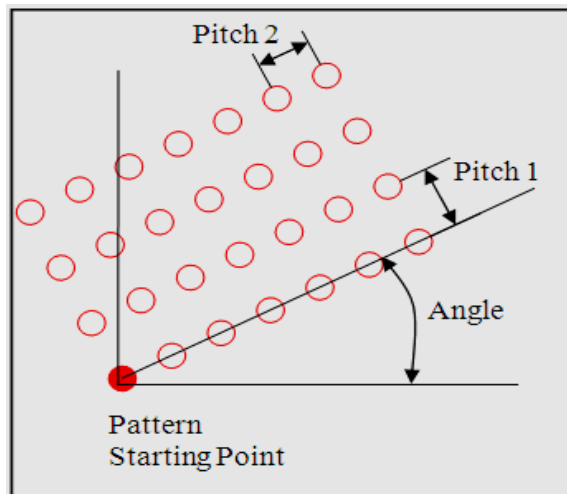
You can use [◀] and [▶] to move around the holes. { ⊙→ } is used to switch between graphic mode and normal counting mode. You can edit the saved parameter by entering in edit menu by pressing { 📂 } key. Press { →🚪 } key to exit this function.

8.1.5   Frame: -

This function is used to calculate the locations of points along the line of a Rectangle. This will enable the operator to mill a rectangular Frame. The following parameters are required for this function:

> Start Co-ord. 1
> Start Co-ord. 2
> Angle.
> Pitch Distance in Axis '1'.
> Pitch Distance in Axis '2'
> Tool Diameter
> Maximum Cut
> Machined To
> Depth
> Sel. Plane. (X-Y, X-Z or Y-Z).

When you have entered the above parameters follow the procedure below for execution.

1. Press{ 💾 }
2. This opens the Data Entry screen. Enter a name for your pattern, and press { 💾 }
3. You return to the parameters screen.
4. Press { ⬅ }

This opens a graphical display showing the arrangement of the holes.
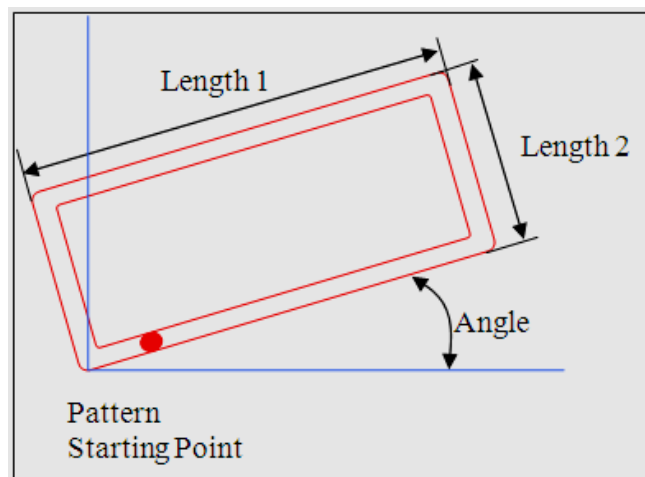
You can use[◀] and [▶] to move around the holes.{ ⚙➜ } is used to switch between graphic mode and normal counting mode. You can edit the saved parameter by entering in edit menu by pressing { 📂 } key. Press { ➡ } key to exit this function.

8.1.6 Arc Contouring: -

This function is used to calculate the location of points along the line of the ARC. The following parameters are required for this function:

- ➢ Co-ord. 1 of center.
- ➢ Co-ord. 2 of center.
- ➢ Radius
- ➢ Starting Angle.
- ➢ End Angle
- ➢ Maximum cut
- ➢ Tool Diameter
- ➢ Machined To
- ➢ Sel. Plane (X-Y, X-Z or Y-Z).

When you have entered the above parameters follow the procedure below for execution.

1. Press{ [💾] }
2. This opens the Data Entry screen. Enter a name for your pattern, and press { [💾] }
3. You return to the parameters screen.
4. Press { [⬅] }

This opens a graphical display showing the arrangement of the holes.
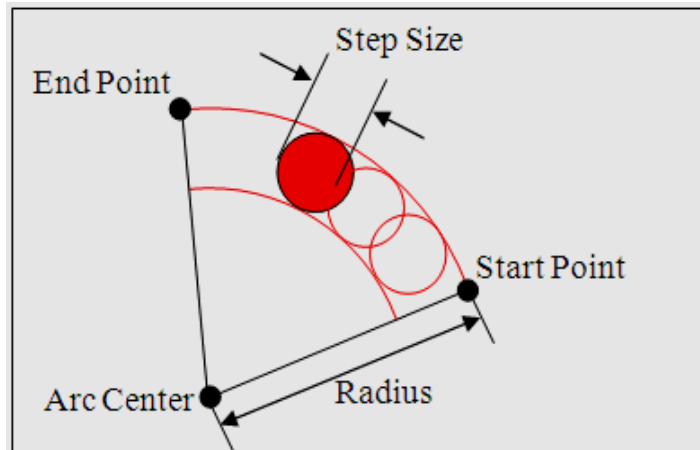
You can use [◀] and [▶] to move around the holes { [⊙→] } is used to switch between graphic mode and normal counting mode. You can edit the saved parameter by entering in edit menu by pressing { [📂] } key. Press { [→🚪] } key to exit this function..

8.1.7   R- Function

The R-Functions is basically a pre defined ARC function. The following Parameters are required:

> ➢ Arc Type.
> ➢ Radius
> ➢ Tool Diameter
> ➢ Maximum cut
> ➢ Machined To
> ➢ Depth
> ➢ Sel. Plane (X-Y, X-Z or Y-Z).

There are 8 types of arc as below:

This function assumes the current tool position as the start point for all the ARC type. Depending on the ARC type it decides the other parameters of ARC. The following diagram describes the 8 ARC types:
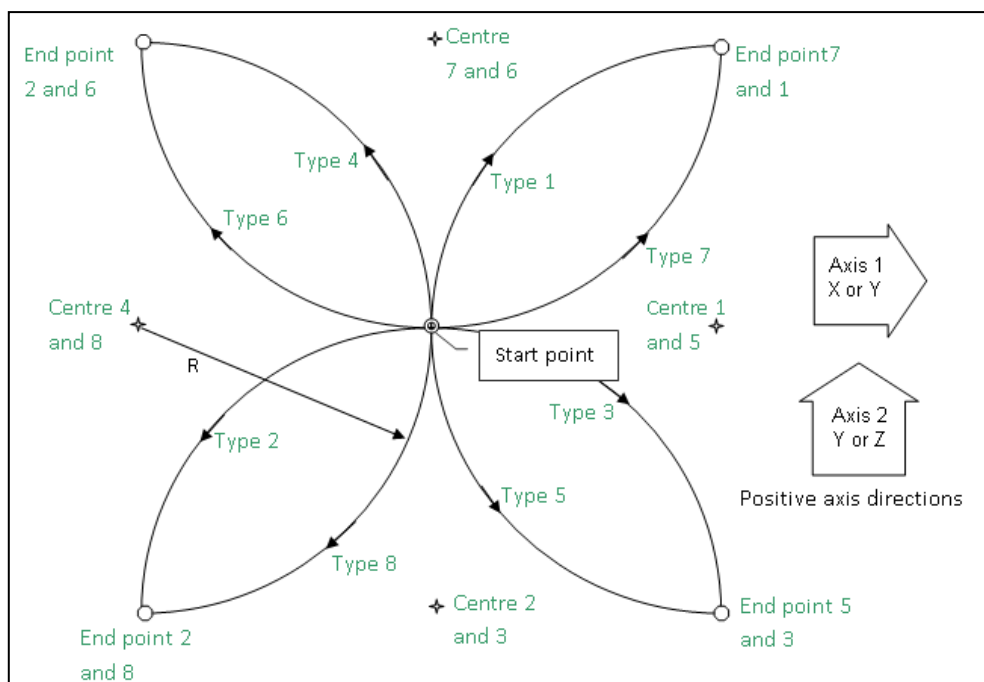
When you have entered the above parameters follow the procedure below for execution.

1. Press { [icon] }

2. This opens the Data Entry screen. Enter a name for your pattern, and press { [icon] }

3. You return to the parameters screen.

4. Press { [icon] }

You can use [[icon]] and [[icon]] to move around the holes. { [icon] } is used to switch between graphic mode and normal counting mode. You can edit the saved parameter by entering in edit menu by pressing { [icon] } key. Press { [icon] } key to exit this function.

8.1.8   Pocket: -

This function is similar to Frame function, only the middle portion of the Frame is also milled. The following parameters are required for this function:

- ➤ Start Co-ord. 1
- ➤ Start Co-ord. 2
- ➤ Angle.
- ➤ Side 1 Length.
- ➤ Side 2 Length.
- ➤ Tool Diameter
- ➤ Maximum Cut
- ➤ Machined To
- ➤ Depth
- ➤ Sel. Plane. (X-Y, X-Z or Y-Z).

When you have entered the above parameters follow the procedure below for execution.

1. Press { 💾 }
2. This opens the Data Entry screen. Enter a name for your pattern, and press { 💾 }
3. You return to the parameters screen.
4. Press { ⬅ }

This opens a graphical display showing the arrangement of the holes.
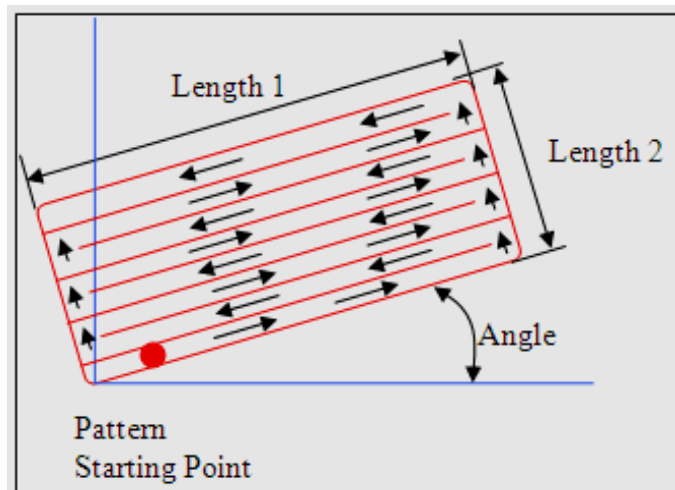
You can use [◀] and [▶] to move around the holes. { ⟳→ } is used to switch between graphic mode and normal counting mode. You can edit the saved parameter by entering in edit menu by pressing { 📂 } key. Press { →🚪 } key to exit this function.

8.1.9 Slot

Slotting is a simple milling function similar to the Arc functions only in a straight line. The following parameters are required for this function:

> Start Co-ord. 1
> Start Co-ord. 2
> Angle.
> Slot Length.
> Tool Diameter
> Maximum Cut
> Depth
> Sel. Plane. (X-Y, X-Z or Y-Z).

When you have entered the above parameters follow the procedure below for execution.

1. Press { 🖫 }
2. This opens the Data Entry screen. Enter a name for your pattern, and press { 🖫 }
3. You return to the parameters screen.
4. Press { ⬅ }

This opens a graphical display showing the arrangement of the holes.
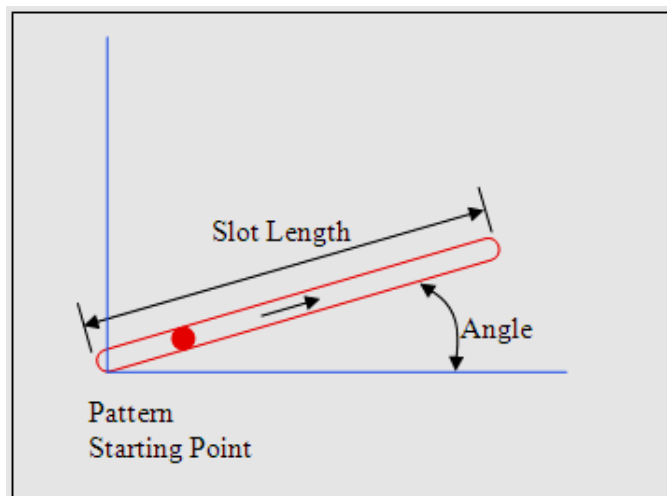
You can use ◀ and ▶ to move around the holes. { ⊙→⇄ } is used to switch between graphic mode and normal counting mode. You can edit the saved parameter by entering in edit menu by pressing { 📂 } key. Press { →🚪 } key to exit this function.

✓ **Note**: - For All the functions Co-ord1 refers to the first axis coordinate and Co-ord2 refers to second axis coordinate in the selected plane.

8.1.10 Polar Coordinates

This function will convert the position of the two selected axes in to Polar coordinates. To activate this function, first select the plane (X-Y or X-Z or Y-Z) and then press { ⬅ }. The following screen will be displayed.
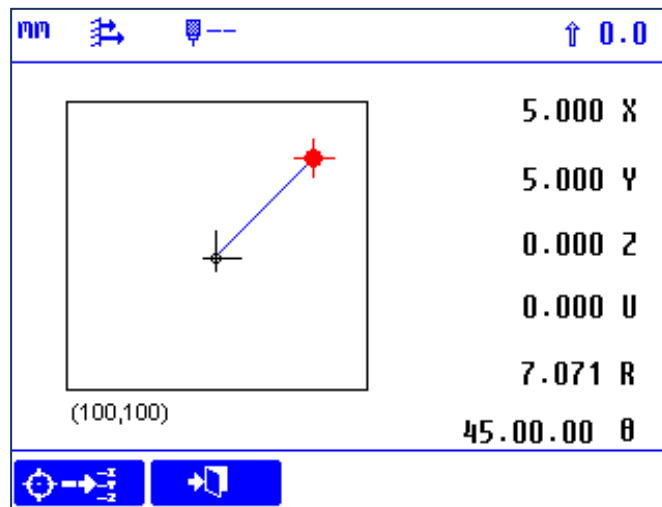
- ❯ { ⊙→⋮ } is used to switch between graphic mode and normal counting mode.
- ❯ { →⬚ } is used to exit from the function.

8.1.11 Axis Summing

The summing is to allow for the position of the Mill table relative to the Tool to be shown for machines fitted with both a Knee (U) and Quill (Z) axis-scale. Essentially the axes are added to form a single compound axes S. This option is only visible in case of a 4 axis DRO. Following options are available for this mode:

- ❯ { ON } Turns this mode ON. This will switch the DRO to 3 Axes display and the third axis will show addition of 'Z' axis and 'U' axis.
- ❯ { OFF } Turns this mode OFF. This switches the DRO back to the 4 Axes display.
- ❯ { →⬚ } Applies the selected option and exits from the function list.

8.1.12 Zero Approach

This function Enables or Disable the zero approach beep sound while performing the machine functions. Select { ON } to turns this mode ON. Or select { OFF } to turns this mode OFF.

8.1.13   Job Timer

This is a Timer utility and can be used by the operator to get the Time / Rate for completing a particular Job. This has following Soft Keys:

- ➢ { ✓ } Starts the Job Timer.
- ➢ { ✗ } Stops the Job Timer.
- ➢ { 0 ➜ } Resets the Job Timer.
- ➢ { ➜ } Exits from the function list.
- ➢ { $ } This enables the operator to enter the machining rate in units per hour for the machine on which the DRO is operating. If this is set to zero, the main DRO screen shows the Job Timer; otherwise it shows the machining cost which is denoted by "#".

8.1.14   Shrinkage Factor

This function is useful when manufacturing moulds/ Dies. While designing/manufacturing the moulds the material shrinkage has to be considered. EL700 has a facility to enter this shrinkage factor. Once this function is enabled the axis readings are multiplied by this factor to compensate the material Shrinkage.

Follow the steps to apply shrinkage factor.
- ➢ Navigate to Shrinkage Factor in Mill functions
- ➢ Select { SET } to enter shrinkage factor value using keypad.
- ➢ Select { YES , No } to apply the shrinkage factor.
- ➢ Press [Enter] to save the changes.

L
L+ Shrinkage Factor
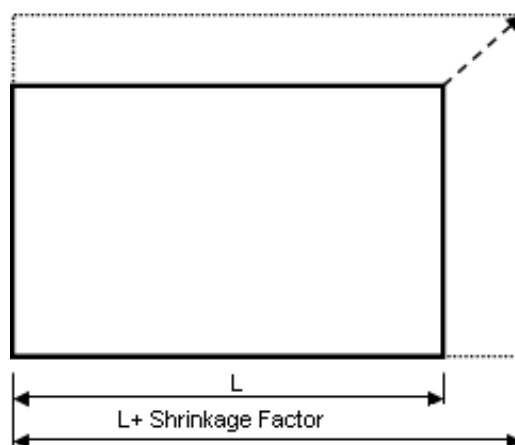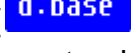
8.1.15 Tools

Mill mode

In Mill mode, you use this function to program the different tool parameters, such as Diameter, Length, RPM (max) and Speed (max).These parameters can then be referred to in different machining functions, such as Arc contouring and Grid.

When you press { [SET] }, the DRO shows the list of previously saved tools. It has the following soft keys:

- ➢ { [📄] } creates a new tool setup. Maximum 99 new tools can be created. The Data Entry screen is displayed so you can enter a tool name. A maximum of 20 characters is allowed for a tool name.
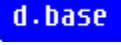- ➢ { [ON] } Applies the selected tool. The information stored under that tool can then be used by the other functions. When you apply a specific tool, its tool number is displayed on the main screen, for example T01.This number also appears next to the tool name.
- ➢ { [OFF] } Exits from the tool list to the main screen.
- ➢ { [× 🔧] } Deletes the selected tool from the list. You are prompted to confirm this before the tool is deleted.
- ➢ { [📂] } Edits the tool parameters under the selected tool.
- ➢ { [ABC 📄] } Renames the tool.
- ➢ { [d.base] } you access the Tool Database or Tap/Drill Library. It is a reference for standard tools. You can also retrieve the required information for a particular tool from the database. The tool databases provide the required information on tap sizes and clearance drills in both imperial and metric formats. You navigate around the database using the [⬇] [⬆] navigation keys. Pressing the [Enter] key transfers the highlighted database tool diameter and sets this as the current Tool diameter.

Database screen is shown below

METRIC THREAD		
Thread Size	Tap Drill	Clearence Drill
M2 x 0.4	1.60	2.40
M2.2 x 0.45	1.75	2.50
M2.5 x 0.45	2.0	2.90
M3 x 0.5	2.50	3.40
M3.5 x 0.6	2.90	3.90
M4 x 0.7	3.30	4.50
M4 x 0.5	3.50	4.50

[SET] [→] [mm] [inch]

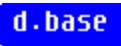**Creating a new tool**

- ➢ Press { } to create a new empty tool.
- ➢ Enter a name using the alpha-numeric keypad.

- ➢ Select the parameter that you want to set using the [ ] [ ] navigation keys.

- ➢ Enter the required value using the numeric keys, or press { d.base } to select a value from the database.

- ➢ Press { } key to apply the parameters of this new tool and save the tool settings against the tool name.

Editing a tool

Here you can edit an existing tool or view its settings.

- ➢ Press { } to enter the desired parameter values.

- ➢ Select the parameter that you want to set using the [ ] [ ] navigation keys.

- ➢ Enter the required value using the numeric keys, or press { d.base } to select a value from the database.

- ➢ Press { } key to apply the parameters of this new tool and save the tool settings against the tool name.

8.2 Lathe Machine Specific Functions:-

The following functions are available on { **fn** } when you select Lathe Machine:

- ➢ Summing
- ➢ Vectoring
- ➢ Taper
- ➢ Tools
- ➢ Zero Approach (Refer section 8.1.12 From Mill Functions)
- ➢ Job Timer (Refer section 8.1.13 From Mill Functions)
- ➢ Shrinkage Factor (Refer section 8.1.14 From Mill Functions)

8.2.1 Summing

Axes Summing function is used to display combined movement of either X – Z' axes pair or Z – Z' axes pair. The summing axis pair can be displayed either on X axis or Z axis. Summing pair axis configuration setting is available in {function} menu.
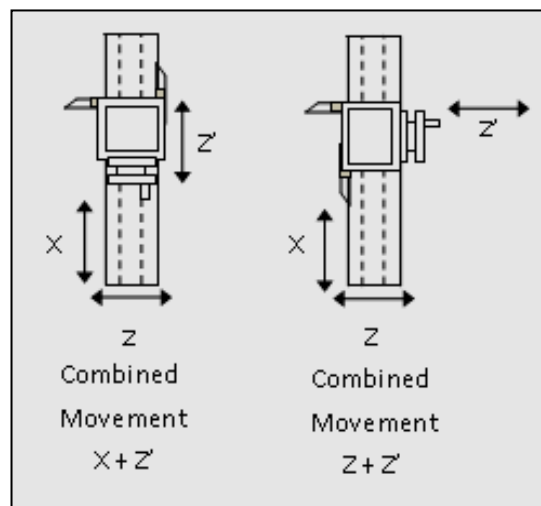

To access Lathe functions go to { **fn** } scroll to 'summing' press enter.

- ➢ This will show selection of axis
- ➢ { **X+Z'** } You can select this option for the X-axis
- ➢ { **Z+Z'** } You can select this option for the Z-axis
- ➢ { **⏎** } Exits to the main screen without saving the changes

When you set a particular axis to sum mode, its axis legend changes to 'S' and the summing pair is shown below the axis legend.

8.2.2   **Vectoring**

Vectoring function is used for displaying combined movement of either X – Z' axis pair or Z – Z' axis pair taking into consideration angle between Z and Z' i.e. α. The resulting combined movement is displayed on X and Z axis.

Combined Movement $X = X + Z'$ (Sin α)

Combined Movement $Z = Z + Z'$ (Cos α)
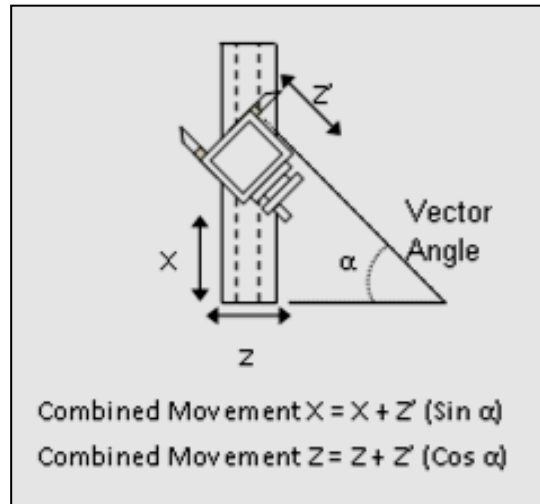
➢ { ⬛ } Turns the function on. When you apply the function, 'Vect' is shown below the axis legends to show the vectoring angle. The DRO switches back to normal counting mode and the X and Z axes show the combined vectored position. You can perform other functions on these new vectored positions.

➢ { ⬛ } Turns the function off.

➢ { ⬛ } Changes the vector angle if required.

➢ { ⬛ } Sets the changes done and exits to the main screen.

➢ { ⬛ } Exits from the vector angle screen to the functions list.

➢ { ⬛ } Exits from the function list to the main screen.

8.2.3   Taper

Taper function allows user to calculate taper of the job. Measurements carried out in Taper function are Radius of taper and Angle θ° of taper. Taper on axis setting is available in DRO setup menu. This will select where to display taper angle.
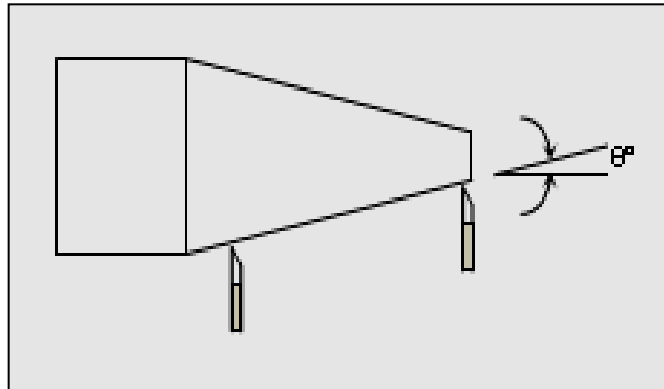
Following soft keys are available:

➢ {⬅} This key can be used to start the Taper function. The operator can select the datum by pressing {⊥} key. The display shows taper distance (R) and taper angle (θ) with reference to the selected datum position.

➢ {OFF} Exits from the function list to the main screen.

8.2.4   Tools

Lathe mode

In Lathe mode, you use this function to program the different tool parameters, such as Diameter, Length, RPM (max) and Speed (max).These parameters can then be referred to in different machining functions, such as Arc contouring and Grid.

When you press { SET }, the DRO shows the list of previously saved tools. It has the following soft keys:

➢ { 📄 } creates a new tool setup. Maximum 99 new tools can be created. The Data Entry screen is displayed so you can enter a tool name. A maximum of 20 characters is allowed for a tool name.

➢ { ON } Applies the selected tool. The information stored under that tool can then be used by the other functions. When you apply a specific tool, its tool number is displayed on the main screen, for example T01.This number also appears next to the tool name.

➢ { OFF } Exits from the tool list to the main screen.

➢ { ✕ } Deletes the selected tool from the list. You are prompted to confirm this before the tool is deleted.

> { [icon] } Edits the tool parameters under the selected tool.
> { [icon] } Renames the tool.

Creating a new tool

> Press { [icon] } to create a new empty tool.
> Enter a name using the alpha-numeric keypad.
> Select the parameter that you want to set using the [▼] [▲] navigation keys.
> Enter the required value using the numeric keys,
> Press { [icon] } key to apply the parameters of this new tool and save the tool settings against the tool name.

Editing a tool

Here you can edit an existing tool or view its settings.

> Press { [icon] } to enter the desired parameter values.
> Select the parameter that you want to set using the [▼] [▲] navigation keys.
> Enter the required value using the numeric keys,
> Press { [icon] } key to apply the parameters of this new tool and save the tool settings against the tool name.

9. Troubleshooting

9.1 Self Diagnostics Mode

EL700 DRO features self diagnostics mode which checks for following areas.

➢ Keyboard functioning
➢ Encoder diagnostics
➢ Probe Function

Self diagnostics mode is enabled by pressing Selection of Diagnostic option in User Setup Mode.

In Keyboard functioning relevant keys will be highlighted one by one as per the sequence entered by the user. Highlighting of key ensures working of the key.
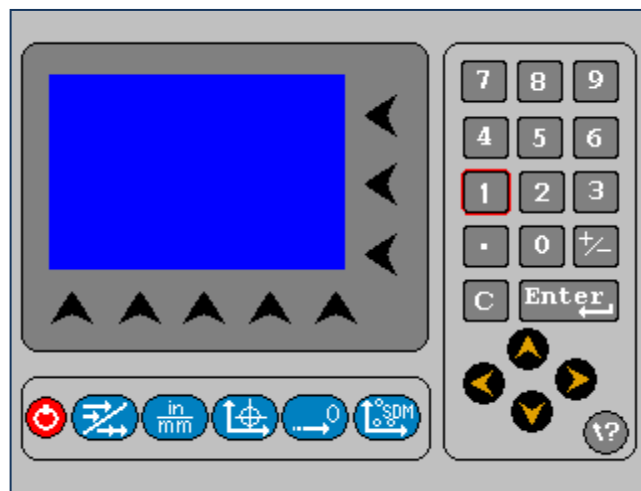
Press probe button for probe diagnostic, Probe will touch the surface after pressing the probe button.

Before   After

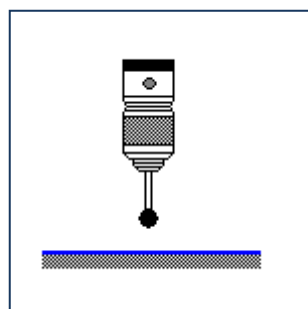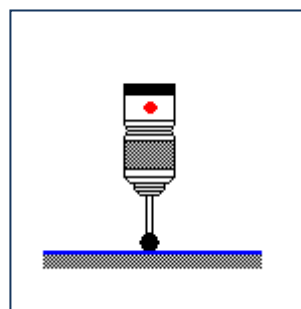Encoder diagnostics will display the axis count, Ref. Pitch & type of encoder. Ref will glow RED when Reference is passed by the counter.

10. DRO Models

Sr. No.	CODE	Product Description	NO. OF AXIS				Interface	Machine Model			Options		
			1	2	3	4	RS422	SIMPLE	LATHE	MILL	RS232	Aux I/O 6	PROBE
1	EL7P-11-0000	EL701-S	X				X	X					
2	EL7L-21-0000	EL702-L		X			X		X				
3	EL7L-31-0000	EL703-L			X		X		X				
4	EL7M-21-0000	EL702-M		X			X			X			
5	EL7M-31-0000	EL703-M			X		X			X			
6	EL7M-41-0000	EL704-M				X	X			X			
7	EL7P-11-1110	EL711-S	X				X	X			X	X	X
8	EL7L-21-1110	EL712-L		X			X		X		X	X	X
9	EL7L-31-1110	EL713-L			X		X		X		X	X	X
10	EL7M-21-1110	EL712-M		X			X			X	X	X	X
11	EL7M-31-1110	EL713-M			X		X			X	X	X	X
12	EL7M-41-1110	EL714-M				X	X			X	X	X	X

EL700

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Electronica Mechatronic Systems (India) Pvt. Ltd.,
Unit No. 37&44, Electronic Co-operative Estate,
Pune-Satara road, Pune – 411009
Maharashtra, India
Phone: +91 (020) 2422 4440, 2422 9398,
Fax: +91 (020) 2422 1881
Email: **info@electronicaems.com**
Web: **www.electronicaems.com**

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