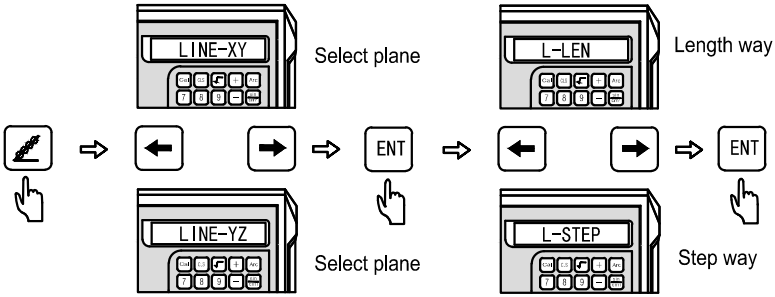
4.1 PLD Function

(Applicable to the machine tools: 2M, 3M milling machines and Electric Discharge Machines)

We have two ways to realize the PLD function.

Way 1: Length way (L-LEN, the distance from the starting hole center to the ending hole center)
Way 2: Step way (L-STEP, the distance between two adjacent holes)



PLD input parameters:
L-LEN:

LENGTH - - oblique line overall length (the distance from the starting hole to the ending hole, as shown in figure B)
ANGLE - - oblique line angle (as shown in figure A)
No HOLE - hole number (as shown in figure B)

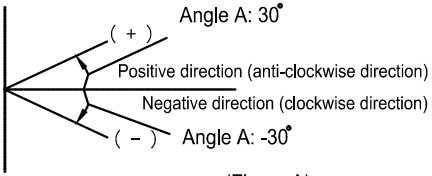
L-STEP:

STEP - - - - pitch-row length (the distance between two adjacent hole centers, as shown in figure B)
ANGLE - - oblique line angle (as shown in figure A)
No HOLE - hole number (as shown in figure B)

Example: as shown in the right figure

Figure A:

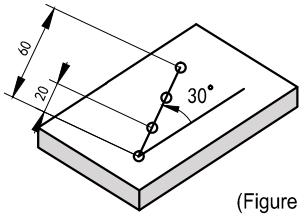
The angle refers to the position direction of the oblique line on the coordinate plane. The anti-clockwise direction is the positive direction, and the clockwise direction is the negative direction.



(Figure A)

Figure B:

oblique line: 60mm
oblique line angle: 30mm
pitch-row: 20mm
holes: 4

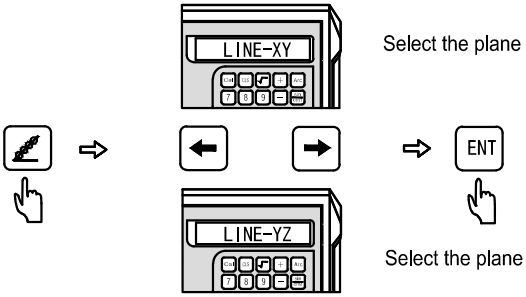


(Figure B)

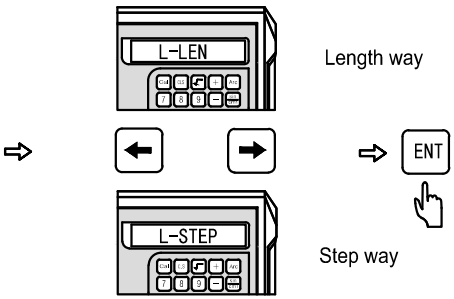
Example 1: L-LEN

Step 1: Firstly, move the tool to the position of the starting hole. (L-LEN)
Press the key to enter the function of punching on an oblique line.

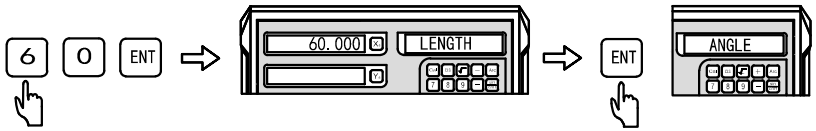
Step 2: Select the machining plane
Press the ← and → keys to select the "machining plane" and press the ENT key for confirmation (This setting is only available for 3 M and EDM DRO. Because 2M DRO only contains XY plane, it can jump into the next step directly without selection).



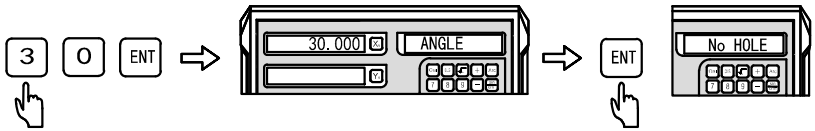
Step 3: Machining way selection
Press the ← and → keys to select "the machining way" and press the ENT key for confirmation. Here, we select the L-LEN.



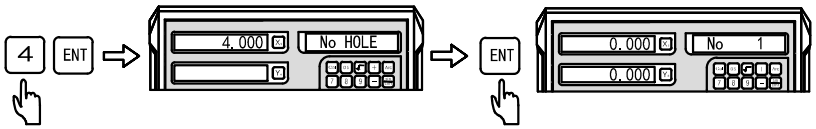
Step 4: Input length



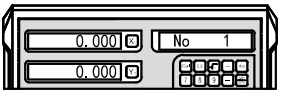
Step 5: Input angle



Step 6: Input hole number



Step 7: Enter the machining state, and display the position of the first hole



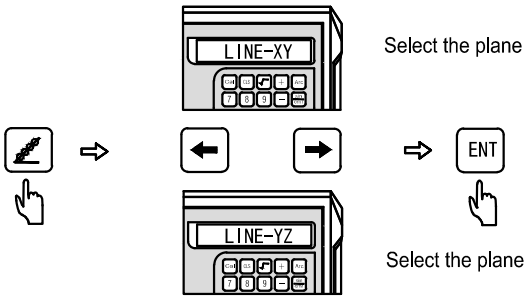
Step 8: Press the ← key to display the position of the next machining point, then move the machine tool until the axis displays zero, indicating the position of the second machining point, and press the ✎ key to exit the function of punching on an oblique line anytime.

Example 2: L-STEP

Step 1: Firstly, move the tool to the position of the starting hole. (L-STEP)
Press the ✎ key to enter the function of punching on an oblique line.

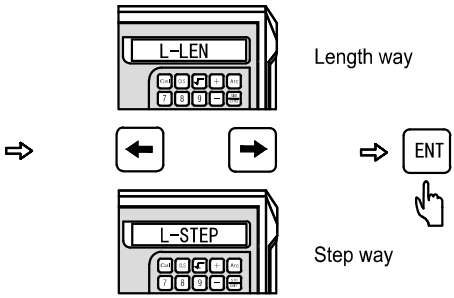
Step 2: Select the machining plane

Press the ← and → keys to select the "machining plane" and press the ENT key for confirmation (This setting is only available for 3 M and EDM DRO. Because 2M DRO only contains XY plane, it can jump into the next step directly without selection).

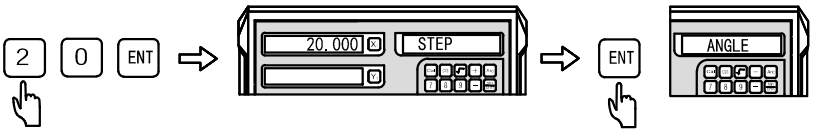


Step 3: Machining way selection

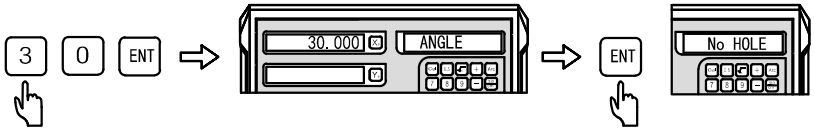
Press the ← and → keys to select “the machining way” and press the ENT key for confirmation. Here, we select the L-STEP.



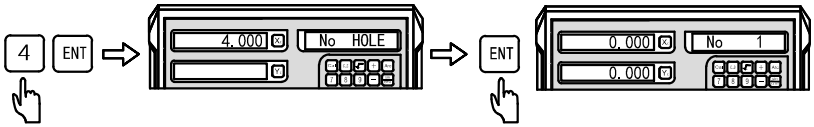
Step 4: Input step length



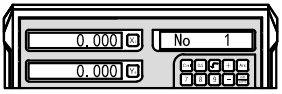
Step 5: Input angle



Step 6: Input hole number



Step 7: Enter the machining state, and display the position of the first hole



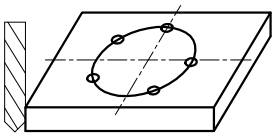
Step 8: Press the ← key to display the position of the next machining point, then move the machine tool until the axis displays zero, indicating the position of the second machining point, and press the ✎ key to exit the function of punching on an oblique line anytime.

PCD Function

4.2: PCD Function

(Applicable to machine tools: 2M and 3M milling machines and EDM)

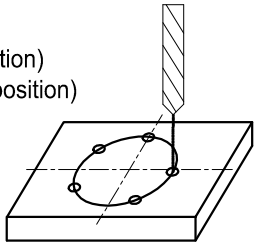
This function is used for dividing the arc equally, such as the equally distributed holes on the drilling flange.



Function:

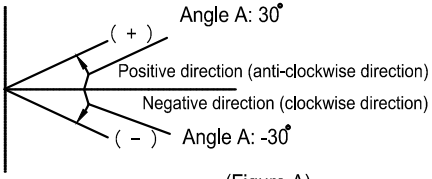
The DRO offers the tool positioning function of drilling equally divided holes on the circumference. Operators only need to input the relevant machining parameters according to the provided information, then the system will calculate the position coordinates of holes immediately and set the hole position to zero point (0.000, 0.000) temporarily. Operators only need to input the following six parameters.

PCD-XY	plane selection
CT-POS	circle center coordinate
DIA	arc diameter
ST-ANG	starting angle (angle of 1st hole position)
ED-ANG	ending angle (angle of the last hole position)
No HOLE	hole number



The DRO automatically calculates the position of every equally divided hole on the circumference and sets position of every hole to zero point. Operators only need to press the ⬅ and ➡ keys to select which hole to be reached on the circumference, then move the machine tool until the DRO displays (0.000), i.e. the hole position is reached.

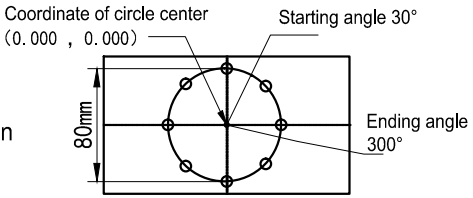
Note: The angle direction is shown in the right figure.



(Figure A)

Example: Machining for the Work Pieces as shown in the Figure

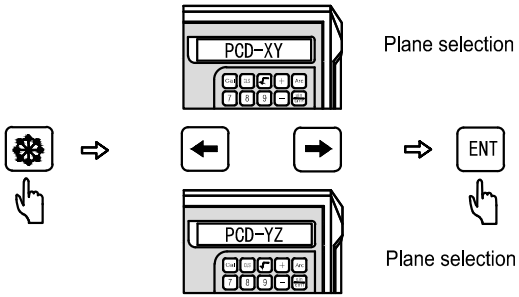
PCD-XY - - plane XY
CT-POS - - - coordinate of circle center X=0.000 Y=0.000
DIA - - - - - - 80mm arc diameter
ST-ANG - - - starting angle 0°
ED-ANG - - - ending angle 360°
No HOLE - - 9 holes
Note:the 1st hole will be superposition with the 9th hole.



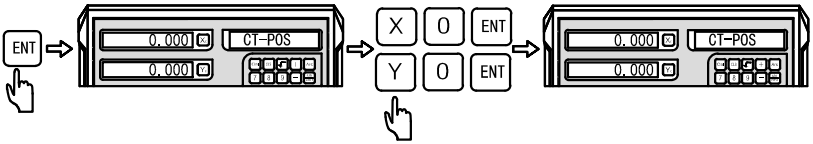
4.2 PCD Function

Step 1: Find the central position of the work piece, and Set the tool.
Press the ❁ key to enter the PCD function.

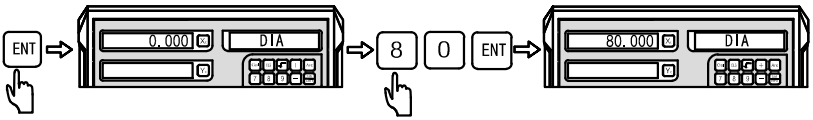
Step 2: Plane selection
Press the ← and → keys to select the machining plane to select XY plane and then press the ENT key to confirm the next step.
This setting is only available for 3M and EDM DRO. Because 2M DRO only contains XY plane, it can jump into the next step directly without selection.



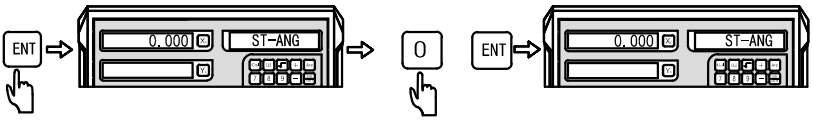
Step 3: Enter coordinate of circle center



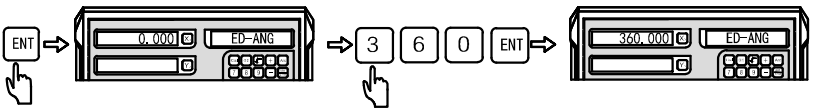
Step 4: Input diameter



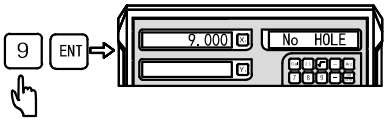
Step 5: Input starting angle



Step 6: Input ending angle

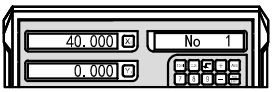


Step 7: Input hole number



Step 8: Enter the machining state

Enter the machining state, and display the position of the first hole.



Step 9: Move the machine tool until the axis displays zero, i.e. the first point position is reached. Press the ← key to display next machining point position, and move the machine tool until the axis displays zero.

Step 10: Press the ❄ key to exit the PCD function anytime.

Smooth R Function

4.3 Smooth R function

(For 2M and 3M Digital Readout (DRO)

Function:

When a milling machine is used, especially in the process of machining a mold, arc often needs to be machined on a work piece. If the arc surface is complex, or a lot of round angles need to be machined, or the arc or round angle needs to be accurately machined, a CNC milling machine should be utilized.

But in the daily machining process, only a simple arc surface or a round angle is needed with no requirements for the precision of the arc or round angle (particularly in the process of machining molds). If there is no CNC milling machine in the production line, the best way is to machine it with a manual milling machine as it saves time and efforts, compared to outsourcing it. In the past, an operator used to calculate the tool positioning in arc machining with a scientific calculator, but this method was time-consuming and liable for errors.

DRO provides a simple and easy positioning function for arc cutting tool, so the operator can perform arc machining in the shortest time. But before you decide to use smooth R function or CNC machining, please bear the following points in mind to make sure smooth R yields the best performance.

The R function group in DRO contains two R functions: smooth R function and simple R function.

Smooth R function:

Smooth R function is a function for full-functional arc machining. The operator can use the smooth R function to machine all types of most complex arc, even an arc to be connected to another arc (commonly known as R-to-R).

Advantages of smooth R function:

Smooth R function can be used to machine the most complex arc or even for complex machining in R-to-R.

Disadvantages of smooth R function:

Operation is complex and the operator needs to know the basic coordinate system in order to calculate the start point, the end point and the center.

Simple R function:

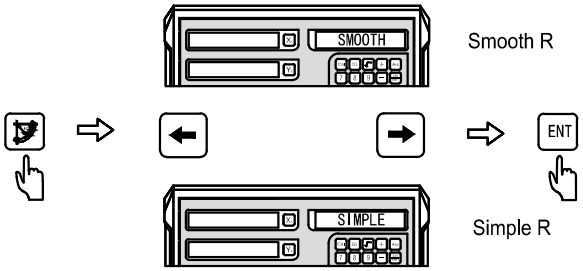
As most arcs machined with a manual milling machine are very simple, and the operator may machine just one or two simple arcs with the manual milling machine in a month, DRO provides simple R function so that arc machining can be done in a simple and straightforward way without any calculation.

Disadvantages of simple R function:

Simple R function can only machine eight types of common arcs, and cannot machine relatively complex types of arc.

4.3 Smooth R Function

Select smooth R or simple R:

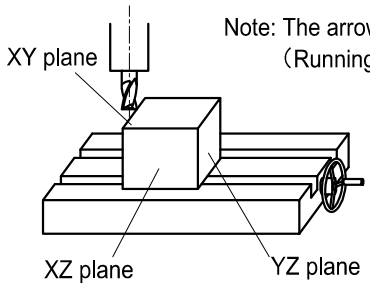


Understand the coordinate system:

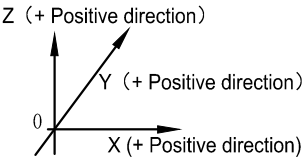
An operator who has no CNC programming experience or who has not used the DRO R function before may have difficulty in mastering the concept of coordinate system. Coordinates are a pair of numbers used to determine positions.

When using the DRO R function, the center coordinates of the arc surface, and the coordinates of the start point and those of the end point must be input to inform DRO about the geometric parameters of the arc surface to be machined.

In the process of installing a DRO, professional customer service installers will generally set the display orientation in the same direction as the machine axis. In a general milling machine, the dial direction is shown as below. Therefore, the DRO display direction will normally be set as follows.

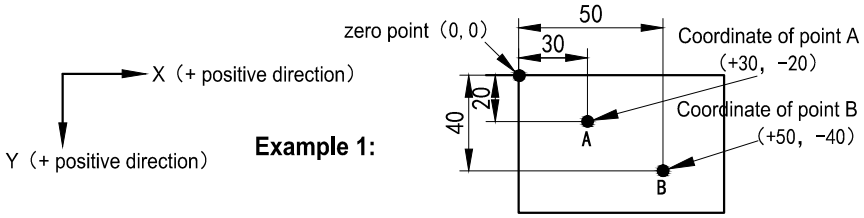


Note: The arrow indicates the positive direction of the coordinate
（Running direction of the tool relative to the table ）

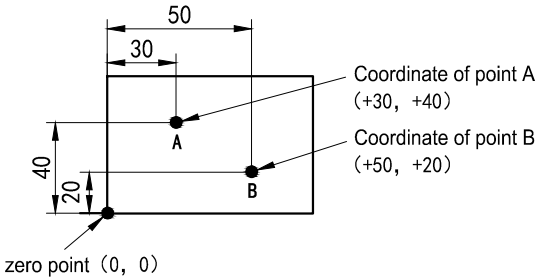


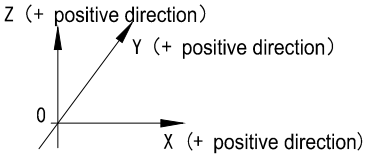
What are coordinates?

Coordinates are used to indicate positions. During plane machining, each set of coordinates contains two values, respectively corresponding to the distances from the zero point on the plane. The following is a simple example.

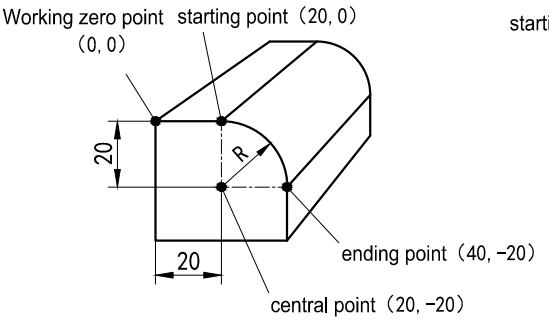


Example 2:

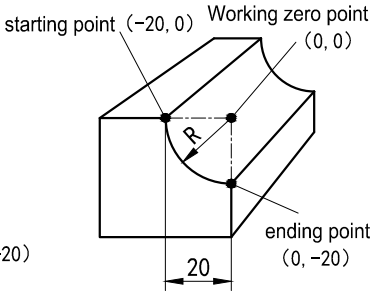




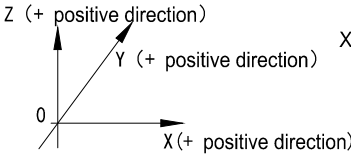
Example 3:

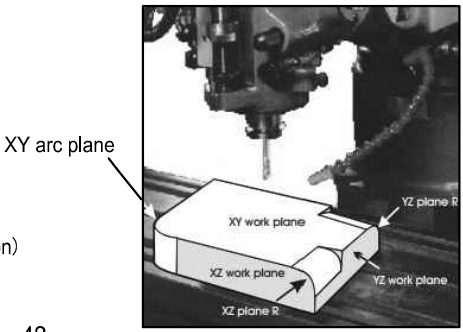


Example 4:



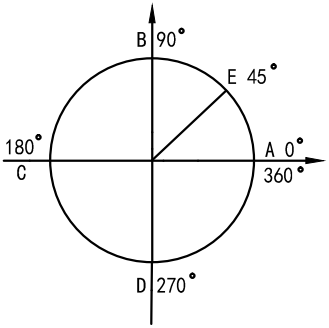
During the machining process, the coordinate of the machine tool are shown in the figure below, and the indication of the machining plane is shown in the figure.





4.3 Smooth R Function

The definition of the angle and direction:



AB arc (from A to B: the starting angle A is 0°, and the ending angle B is 90°)
(from B to A: the starting angle B is 90°, and the ending angle A is 0°)

ED arc (from E to D: the starting angle E is 45°, and the ending angle D is 270°)
(from D to E: the starting angle D is 270°, and the ending angle E is 45°)

Smooth "R" Arc Function:

Procedure for using the smooth arc machining function:

Load and clamp the work piece, tool setting as shown in figure A, figure B and figure C, and then zero every axis (set the position point of the tool setting to zero).

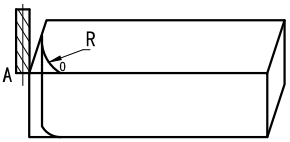


Figure A

Step 1: Press the key to enter the smooth R arc function.

Step 2: Press the and keys to select the smooth R arc function. If the information box displays SMOOTH, it indicates the smooth R function; if it displays SIMPLE, it indicates the simple R function.

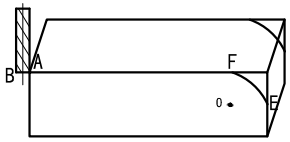


Figure B

Step 3: Select the machining plane XY, XZ, YZ where the arc surface is located （ ARC-XY, ARC-XZ,ARC-YZ）. 2-axis DRO only contains XY plane.

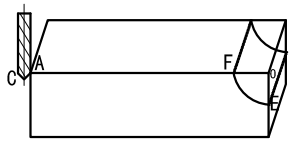


Figure C

Step 4: Input the coordinate of circle center position (CT-POS). The arc center position refers to the position of the arc center relative to the tool when zeroing the tool setting. As shown in figure B, the flat end milling cutter used in machining XZ, YZ planes refers to the position of arc center point O relative to tool point B. As shown in figure C, the used arc milling cutter refers to the position of arc center point O relative to the tool point C.

Step 5: Input the arc radius R.

Step 6: Input the TL-DIA: perform the machining for arcs on XZ and YZ planes. Note: As shown in figure B, use the flat end milling cutter to machine R. The tool machining point is point B, and the TL-DIA does not affect the machining. Please input the TL-DIA = 0.

Step 7: Input the maximum cutting amount (MAX-CUT).For this function of machining arc, the cutting amount of every tool is equal.

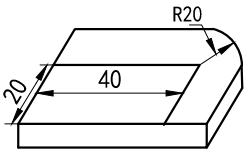
Step 8: Input the ST-ANG of the arc,The position of the first tool for machining R arc is shown in figure B. If the arc is machined from point E to point F, the starting angle is 0°; if from point F to point E, the ending angle is 90°.

Step 9: Input the ED-ANG of the arc,The position of the last tool for machining R arc is shown in figure B. If the arc is machined from point E to point F, the starting angle is 90°; if from point F to point E, the ending angle is 0°.

Step 10: Determine the machining plane of the arc (RAD-RL concave)(RAD+RL convex) The convex machining of arc plane is shown in figure B, and the concave machining of arc plane is shown in figure C. Press the ← and → keys to select the convex machining or concave machining.

Step 11: Move the machine tool to the machining staring point according to the axis display, and then machine the arc point by point.

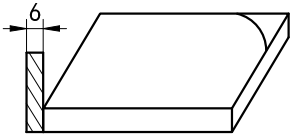
Step 12: Press the ⏎ key to exit the arc function anytime.



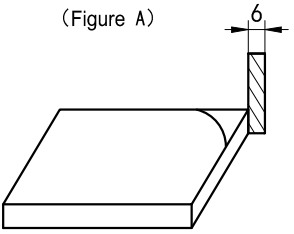
Example 1: Take the arc shown in the machining drawing as example:

The work piece size are shown in the figure below

1. Zero the tool setting
2. Select smooth R mode (SMOOTH)
3. Select XY plane for machining arc (ARC-XY)
4. Input the coordinate of circle center
   CT-POS = (X=43.Y=23)
5. Input the arc radius R = 20.000
6. Input the TL-DIA = 6.000
7. Input the MAX-CUT = 0.3
8. Input the ST-ANG= 0
9. Input the ED-ANG= 90
10. Input the arc machining plane RAD+RL
    (Select the convex to machine)



(Figure A)



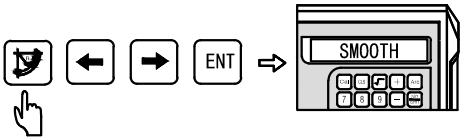
(Figure B)

4.3 Smooth R Function

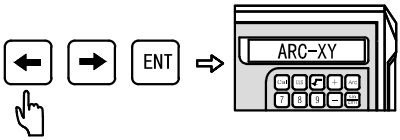
The following is the operation figure for selecting smooth R arc machining.

Step 1: Zero the tool setting

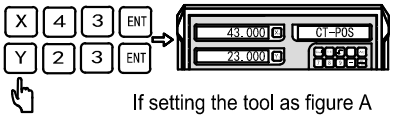
Step 2: Press the key to enter arc R function,And select smooth R arc function.



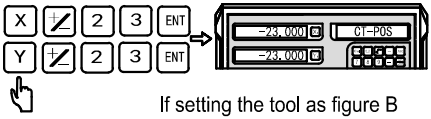
Step 3: Select XY plane for machining (ARC-XY). 2-axis DROs only contain XY plane.



Step 4: Input the coordinate of circle center

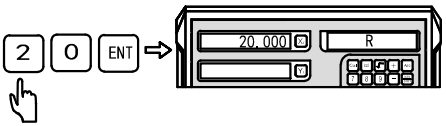


If setting the tool as figure A

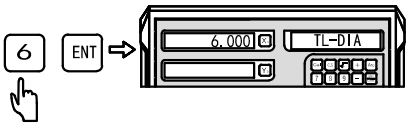


If setting the tool as figure B

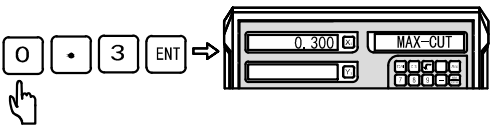
Step 5: Input the arc radius



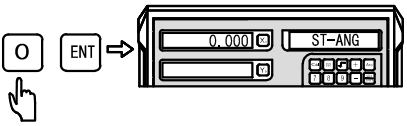
Step 6: Input the TL-DIA



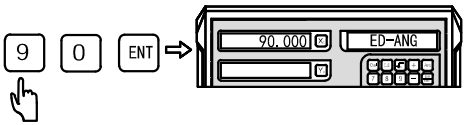
Step 7: Input the MAX-CUT



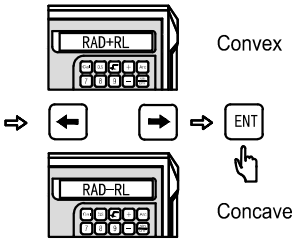
Step 8: Input the ST-ANG



Step 9: Input the ED-ANG

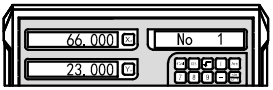


Step10: Select the convex as the machining plane

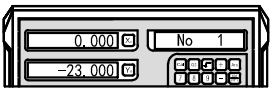


Step11: Enter machining and display the first point position

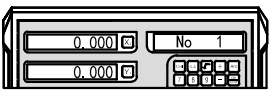
If setting the tool as figure A, the display is



If setting the tool as figure B, the display is



Step12: Move the machine tool until the axis display is zero, i.e. the R starting point



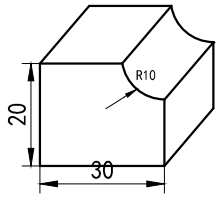
Step13: Press the ⬅ and ➡ keys to display the position of each machining point, and move the machine tool until the axis display is zero, i.e. the position of each point of R arc.

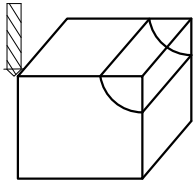
Step 14: Press the ↯ key to exit arc R function at anytime

Example 2: Take machining the following arc as example:

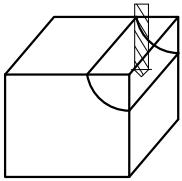
The work piece size are shown in the figure below

1. Zero the tool setting
2. Select smooth R mode (SMOOTH)
3. Select XY plane for machining arc (ARC- XZ)
4. Input the coordinate of circle center CT-POS = (X=33.Z=-3)
5. Input the arc radius R = 10.000
6. Input the TL-DIA = 6.000
7. Input the MAX-CUT = 0.3
8. Input the ST-ANG = 27 0
9. Input the ED-ANG= 180
10. Input the arc machining plane RAD-RL (Select the concave to machine)





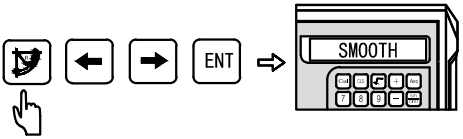
(Figure A)



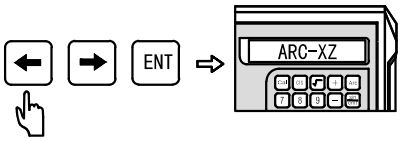
(Figure B)

Step 1: Zero the tool setting

Step 2: Press the ↯ key to enter arc R function And select smooth R arc function.

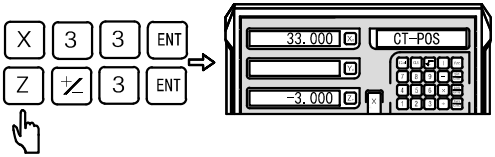


Step 3: Select XZ plane for machining (ARC- XZ),2-axis DROs only contain XY plane.

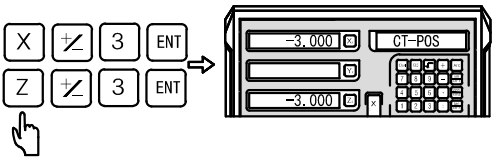


Step 4: Input the coordinate of circle center

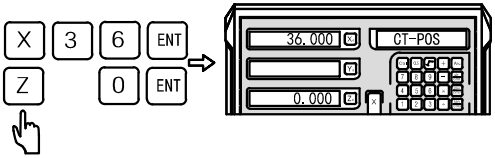
If you use the arc milling cutter, set the tool as figure A



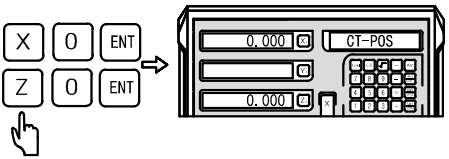
If you use the arc milling cutter, set the tool as figure B



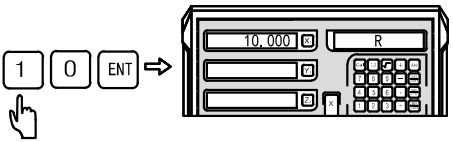
If you use the flat end milling cutter, set the tool as figure A



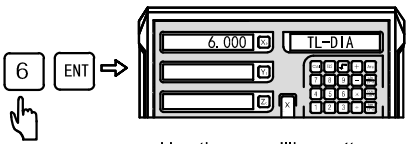
If you use the flat end milling cutter, set the tool as figure B



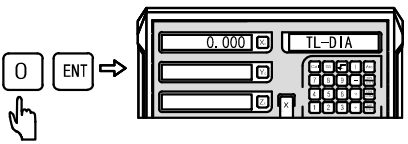
Step 5: Input the arc radius



Step 6: Input the TL-DIA

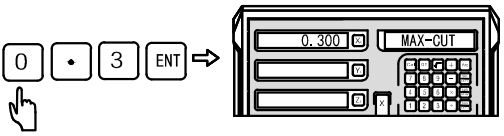


Use the arc milling cutter

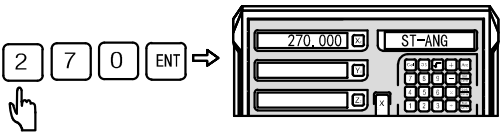


Use the flat end milling cutter

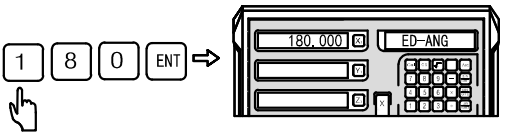
Step 7: Input the MAX-CUT



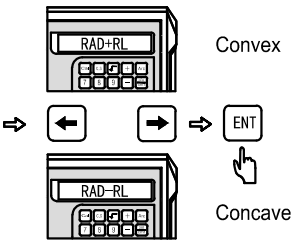
Step 8: Input the ST-ANG



Step 9: Input the ED-ANG

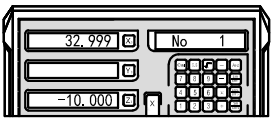


Step10: Select the concave as the machining plane

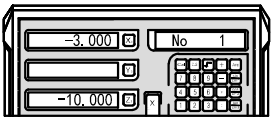


Step11: Enter machining and display the first point position

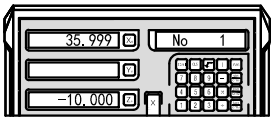
If you use the arc milling cutter and set the tool as figure (A), it will display:



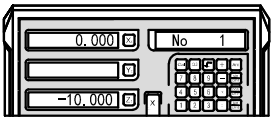
If you use the arc milling cutter and set the tool as figure (B), it will display:



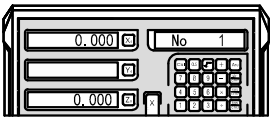
If you use the flat end milling cutter and set the tool as figure (A) , it will display:



If you use the flat end milling cutter and set the tool as figure (B), it will display:

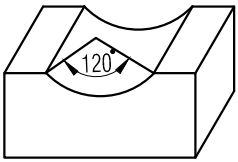


Step12: Move the machine tool until the axis display is zero, i.e. the R starting point

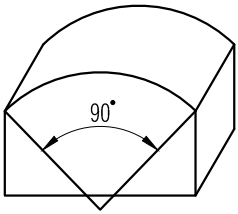


Step13: Press the ← and → keys to display the position of each machining point, and move the machine tool until the axis display is zero, i.e. the position of each point of R arc.

Step 14: Press the ESC key to exit arc R function at anytime



(C)



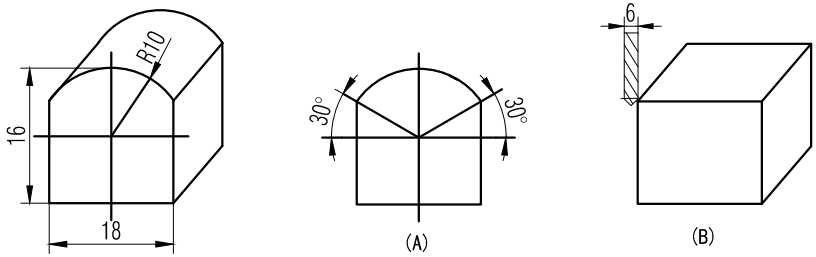
(D)

Note: On XZ and YZ planes, machining passing the arc at 90 °and 270°positions is shown in figure (C); the machining for the arc from 210°to 330° (passing 270°) is shown in figure (D); when the arc passes from 135°to 45°(passing 90°), do not use the flat end milling cutter for the machining.

Example 3: Take machining the following arc as example:

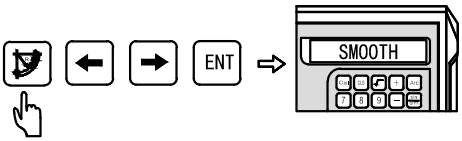
The work piece size is shown in the figure below

1. Zero the tool setting
2. Select smooth R mode (SMOOTH)
3. Select XY plane for machining arc (ARC- XZ)
4. Input the coordinate of circle center CT-POS = (X=14.Z=11)
5. Input the arc radius R = 10.000
6. Input the TL-DIA = 6.000
7. Input the MAX-CUT = 0.3
8. Input the ST-ANG= 30
9. Input the ED-ANG= 150
10. Input the arc machining plane RAD+RL (Select the convex to machine)

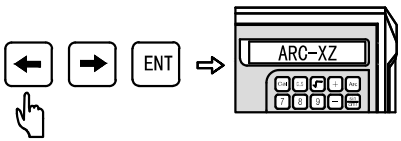


Step 1: Zero the tool setting

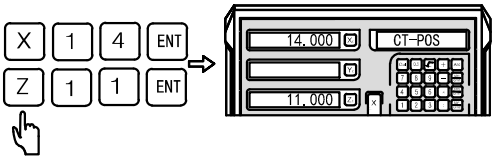
Step 2: Press the key to enter arc R function And select smooth R arc function



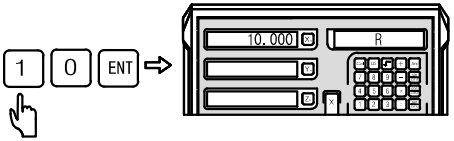
Step 3: Select XZ plane for machining (ARC- XZ)
2-axis DROs only contain XY plane.



Step 4: Input the coordinate of circle center

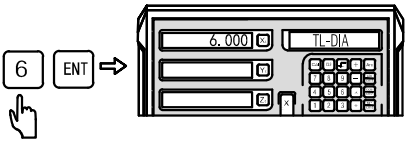


Step 5: Input the arc radius

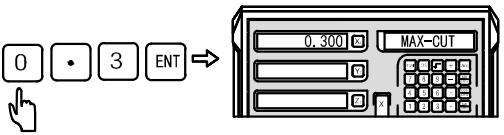


Step 6: Input the TL-DIA

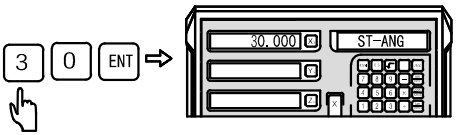
Now use the arc milling cutter, set the tool as figure (B).



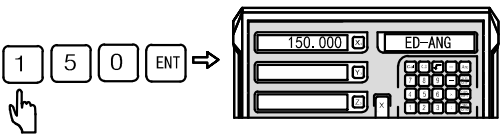
Step 7: Input the MAX-CUT



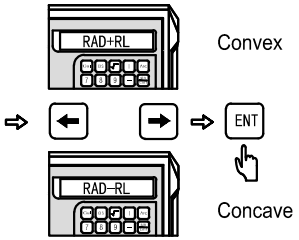
Step 8: Input the ST-ANG



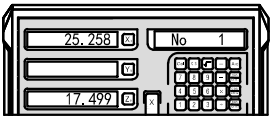
Step 9: Input the ED-ANG



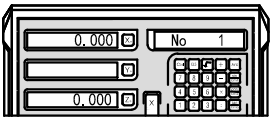
Step10: Select the convex as the machining plane



Step11: Enter machining and display the first point position



Step12: Move the machine tool until the axis display is zero, i.e. the R starting point



Step13: Press the ⬅ and ➡ keys to display the position of each machining point, and move the machine tool until the axis display is zero, i.e. the position of each point of R arc.

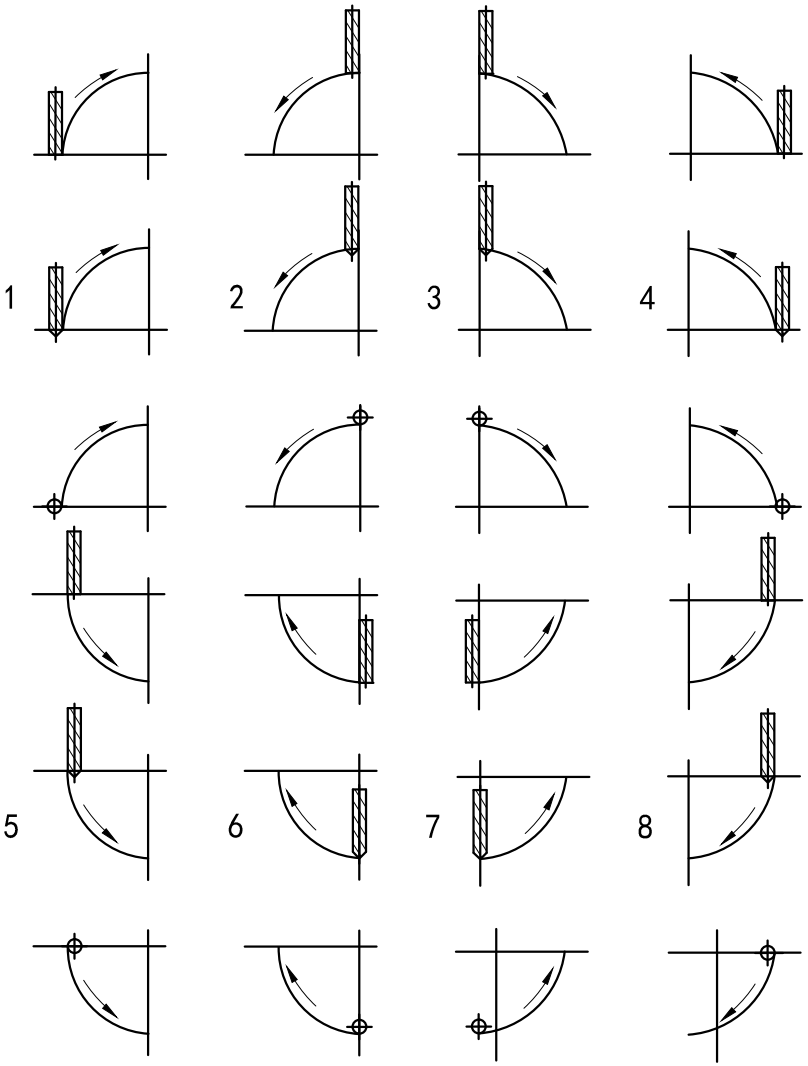
Step 14: Press the ESC key to exit arc R function at anytime

Simple R function

4.4: Procedures for using simple R function
(Applicable to: 2M and 3M DROs)

Function:

If you are not familiar with the concept of plane coordinate, you may have difficulty of using the smooth R arc function. If very simple arcs are needed for machining and there is no high requirement for the smoothness, the simple R arc calculation function can be used at this moment. Generally, the arc machining mainly includes the following 8 types, and the flat end milling cutter or arc milling cutter is used for the machining.



4.4 Simple R function

Procedure for using simple R function:

Place the tool directly opposite to the starting point of the arc, and press the key to enter R arc calculation function. Please refer to figure (1) for the method to place the tool directly opposite to the starting point of the arc.

Step 1: Select the simple R function (SIMPLE).

Step 2: Select R machining type which is one of the pre-set type 1-8, and the indicated type is type 1-8.

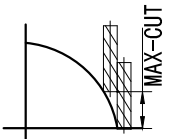
Step 3: Select XY, XZ and YZ plane for machining (ARC-XY, ARC-XZ, ARC-YZ).

Step 4: Input the arc radius

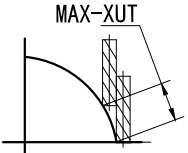
Step 5: Input the TL-DIA: when machining the arc on XZ and YZ planes, please machine with the tool angle end of flat end milling cutter and set the TL-DIA to 0. (You may refer to step 6 in the procedures for using the smooth R function).

Step 6: Input the MAX-CUT:

In machining the arcs on XZ and YZ planes, "MAX-CUT" in the simple R function refers to the amount of feed for every step as shown in figure (A).The MAX-CUT can be changed during the machining process. When machining the arc on XY plane, "MAX-CUT" refers to the cutting amount of every tool. As shown in figure (B), the cutting amount for every tool is equal.



(Figure A)



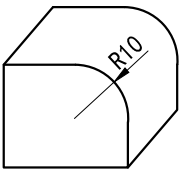
(Figure B)

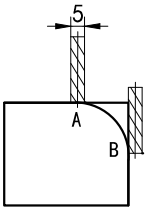
Step 7: Select the convex or concave as the machining plane.

Step 8: Machine the arc according to the display point by point.

Step 9: Press the key to exit R arc calculation function anytime.

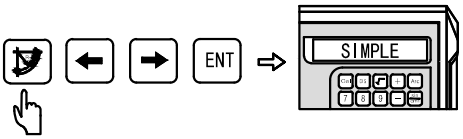
Example 1: Take machining the arc shown in the figure as example:





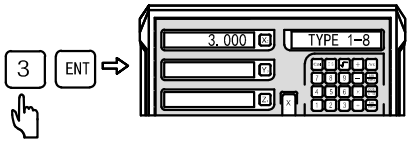
4.4 Simple R function

Step 1: Place the tool directly opposite to the starting point (A or B) of the arc, then press the key to enter ARC function. Select the simple R function, and press the ENT key for confirmation.

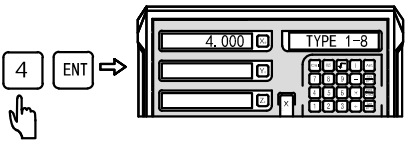


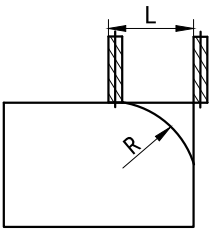
Step 2: Select R machining type

The starting point is A

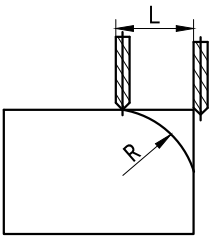


The starting point is B

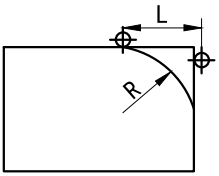




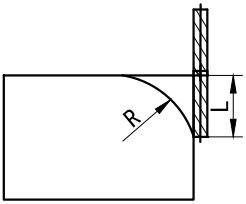
L = R



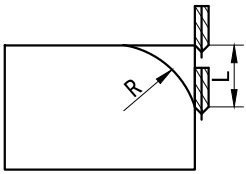
L = R + tool radius



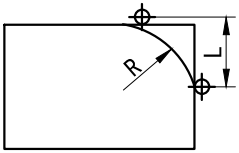
L = R + tool radius



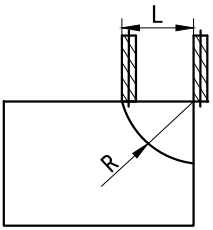
L = R



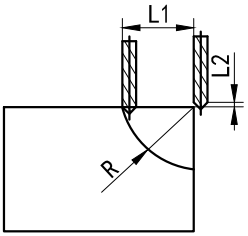
L1 = R + tool radius



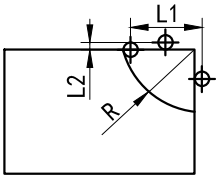
L1 = R + tool radius



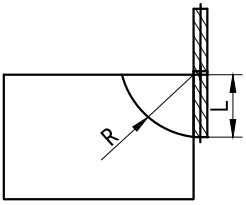
L=R



L1=R
L2 = R + tool radius

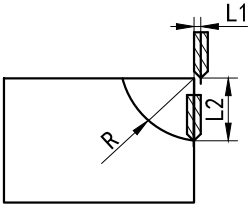


L1=R
L2 = R + tool radius

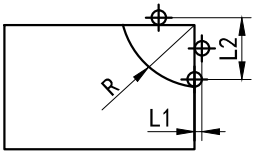


L = R

Flat end milling cutter

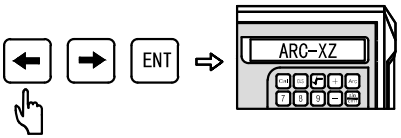


L1 = R + tool radius
L2=R
Arc milling cutter

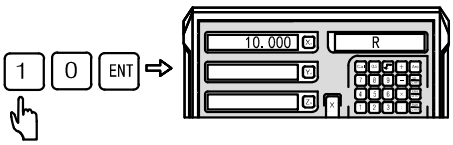


L1 = R + tool radius
L2=R
XY plane

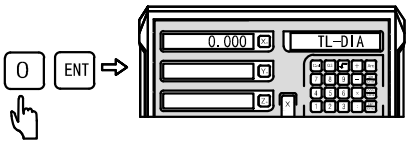
Step 3: Select XZ plane for machining



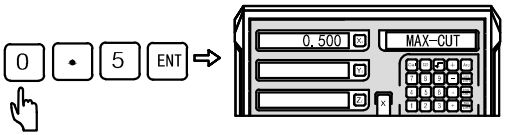
Step 4: Input the arc radius R



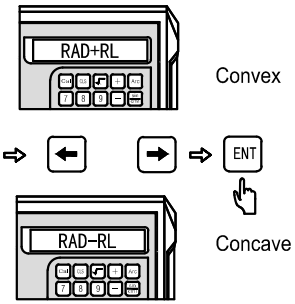
Step 5: Input the TL-DIA



Step 6: Input the MAX-CUT

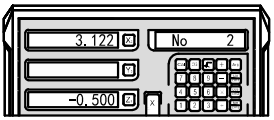


Step 7: Select the convex as the machining plane

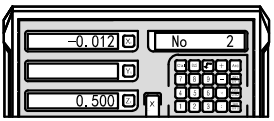


Step 8: Enter machining point

Take A as the starting point（0, 0）



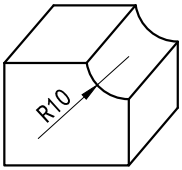
Take B as the starting point（0, 0）

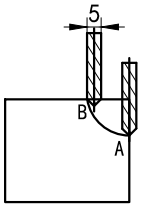


Step 9: Press the ← and → keys to display the position of the next point or the last point.Turn the machine tool until displaying zero.

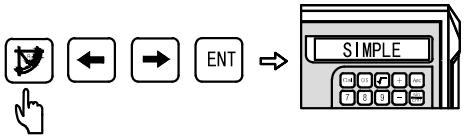
Step 10: Press the ESC key to exit ARC function at anytime.

Example 2: Take machining the arc shown in the figure as example:



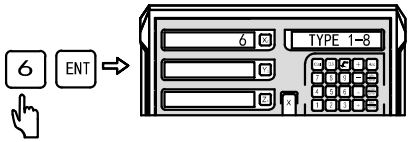


Step 1: Place the tool directly opposite to the starting point (A or B) of the arc, then press the key to enter ARC function.Select the simple R function, and press the ENT key for confirmation.

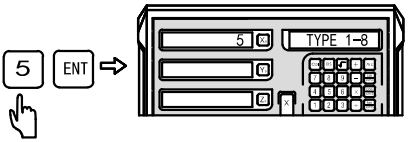


Step 2: Select R machining type

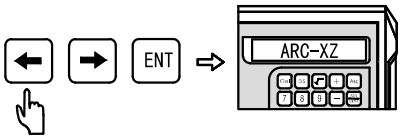
The starting point is A



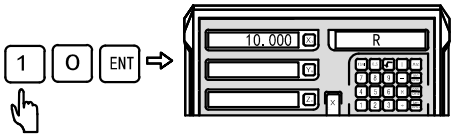
The starting point is B



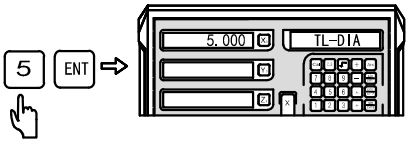
Step 3: Select XZ plane for machining



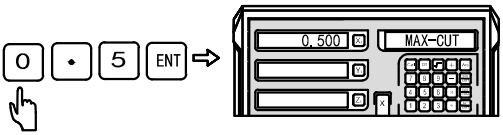
Step 4: Input the arc radius R



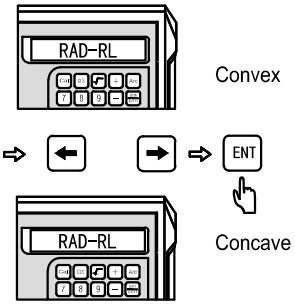
Step 5: Input the TL-DIA



Step 6: Input the MAX-CUT

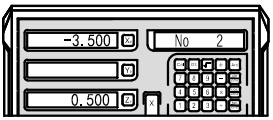


Step 7: Select the convex as the machining plane

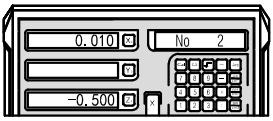


Step 8: Enter machining point

Take A as the starting point（0，0）



Take B as the starting point（0，0）



Step 9: Press the ← and → keys to display the position of the next point or the last point. Turn the machine tool until displaying zero.

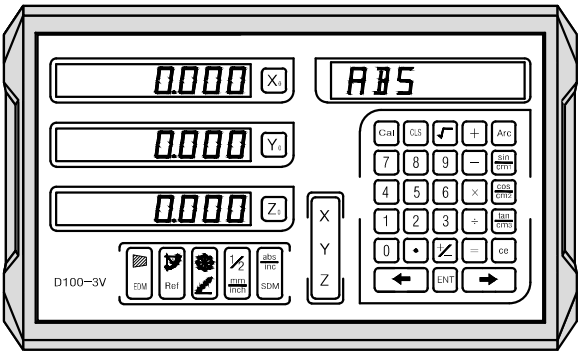
Step 10: Press the ESC key to exit ARC function at anytime.

Calculator

4.5 Calculator Function

You may encounter with the situation that some numerical value needs to be calculated in working. The DRO has the built-in calculator function which includes the simple arithmetical operations such as addition, subtraction, multiplication and division and the calculation such as trigonometric function, anti-trigonometric function and square root, etc.

The key layout on the calculator panel:



Introduction about the function keys:

All calculation is performed on the menu window

[Cal] Calculation function key: Press this key to enter the calculation function. While, you could exit the calculation function by pressing this key.

[√] Calculate the square root.

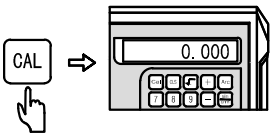
[Arc] Anti-trigonometric function calculation: Press this key and then press the trigonometric function key to restore the trigonometric function.

[sin/cmT] [cos/cm2] [tan/cm3] Trigonometric function key.

[Ce] Delete the input and delete the last calculation result; [CLS] can be used to delete the current digit.

[X], [Y] and [Z] Data axis transferring: you may transfer the calculated value to X axis, Y axis and Z axis.

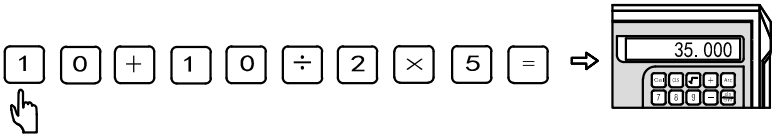
Example 1: Press the [Cal] key to enter the calculation function



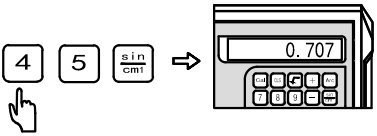
4.5 Calculator

Perform the following calculation after entering the calculation function:

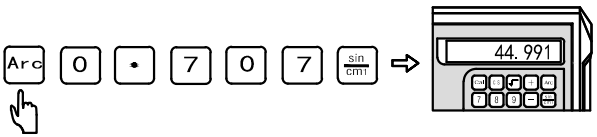
10+10÷2×5=35



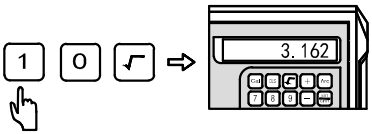
Example 2: Calculate sin 45 = 0.707



Example 3: Restore the trigonometric function ARC sin 0.707 = 44.991

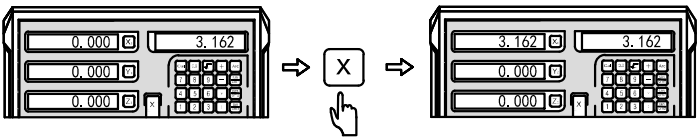


Example 4: Calculation $\sqrt{10}$ = 3. 162

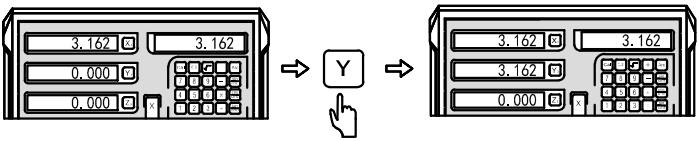


Example 5: Transfer the calculated results to X axis, Y axis and Y axis for displaying respectively,Transfer the calculated result 3.162 in example 4 to X axis, Y axis and Y axis respectively

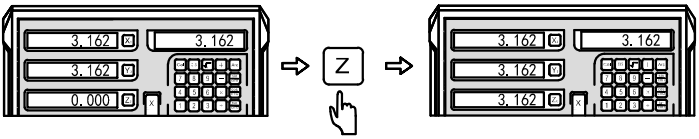
Move to X axis



Move to Y axis

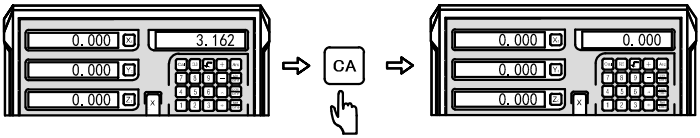


Move to Z axis

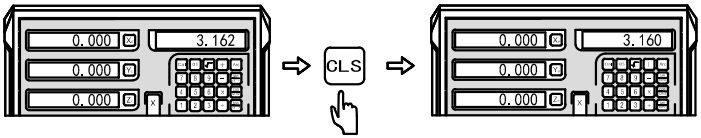


Example 6: Zero the calculated value

Full zeroing



Single step zeroing: The single step zeroing only applies to D60-3V or D60-2V DROs and does not apply to D60-3M or D60-2M DROs.

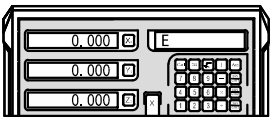


Example 7: Exit the calculator function

Press the Cal key to exit the calculator function

Note: When the input value or the calculated results exceed the displaying scope, the displayed value is in error and the calculator column displays “E”. At this moment, press the CA key to restore the normality.

The calculated results exceed the displaying scope



Digital filtering function

5.1 Digital filtering function
(Applicable to D100-2G DRO)

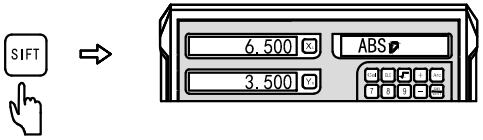
Function introduction:

The vibration of the grinding machine in grinding process causes the display on the DRO changing repeatedly and fast, which leads to visual discomfort of operator. Special function of grinding machine in the DRO has digital filtering function known as “Debouncing function”. During the vibration of the grinding machine, the function could prevent the DRO from changing fast to avoid visual confusion.

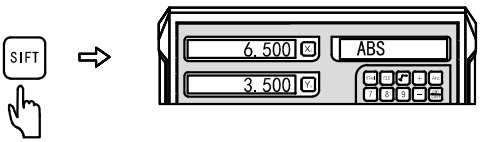
The operator could adopt digital filtering function according to the following procedures during grinding process.

Step 1: Press SIFT key to enter the digital filtering function

Enter the digital filtering function The right window will display mark “D”



Step 2: Exit the digital filtering function
The mark “D” on right window will disappear.



Note: The digital filtering function could be used only under ABS, INC and SDM states. Once the digital filtering function is used, other functions could not be used simultaneously.

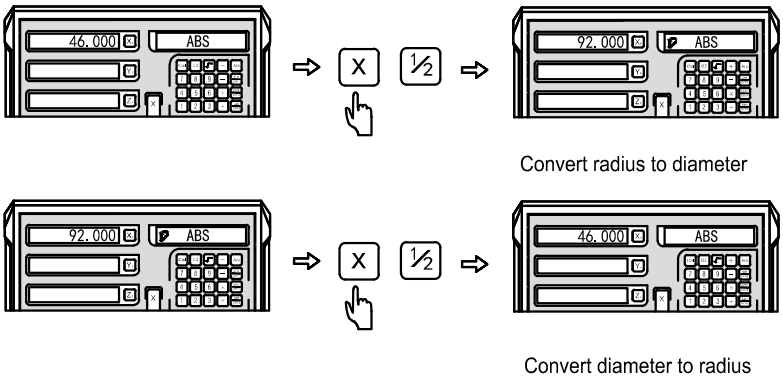
Diameter/radiusConversion

6.1 Diamete/radius Conversion
(Applicable to D100-2L and D100-3L DROs)

Function introduction:

When the DRO is set as lathe meter, [½] key has specific functions. Press [X] key firstly and then [½] key, display of the X axis will convert to radius and the right menu window will display mark "⌀". Press [X] key firstly and then [½] key, display of the X axis will convert to diameter and the mark "⌀" on the right menu window will disappear.

Example: Radius/diameter



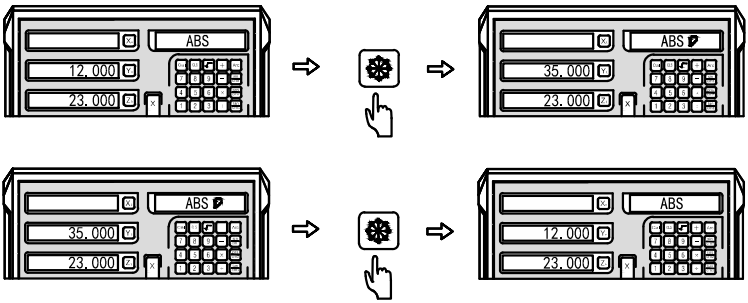
Note：When the DRO is used as a lathe meter, only the X axis has radius/diameter conversion and Y and Z axis don't have this function.

6.2 Y + Z function
(Applicable to D100-3L DRO)

Function introduction:

When the DRO is used as a 3-axis lathe meter, the calculated value of Y and Z axis could be combined and displayed on Y axis. Press key, the value of Y and Z axis will be combined and displayed on Y axis and the right menu window will display a "" mark. Press key again , the mark "" on the right menu window will disappear and the display will back to normal.

Example: Y + Z function



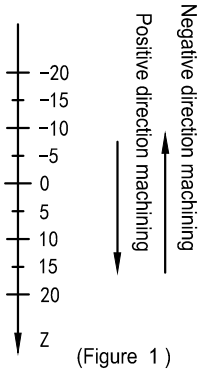
Congruous Output Function of EDM

7.1 Congruous Output Function of EDM (Applicable to D100-3E DRO)

1. Function introduction:

This function is used for the specialized machining by the electric discharge machine (i.e. EDM). When the target value on Z axis of the EDM equals the current value, the DRO will output a switch signal to control the EDM to stop the depth machining.

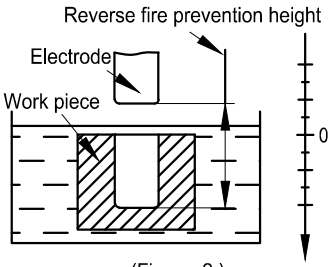
The setting for Z axis direction of D100-3E type DRO is shown in figure 1, i.e., the depth is larger, the coordinate value displayed by Z axis is larger. Since the machining is started, as the depth increases gradually, the value displayed by Z axis increases gradually.



(Figure 1)

According to the set direction on the Z axis, the machining direction includes the positive direction and negative direction. When the electrode drops, the machining direction is from upper to lower part, and the DRO value will increase. We call the machining direction as "positive direction machining" which is the normal direction. When the electrode rises, the machining direction is from lower to upper part, and the DRO value will decrease. We call the machining direction as "Negative", namely, "negative direction machining" (as shown in figure1).

The D100-3E DRO with EDM function also has the function of "reverse fire prevention height" which is not offered by other similar DROs. This function is one kind of intelligent safety protection device of position following and detecting. When the carbon deposition occurs on the electrode surface in the process of positive direction machining, especially in the long-time machining or round-the-clock machining without supervision by people, the carbon deposition will increase gradually along the reverse direction without being cleared up by people. Once the electrode exceeds the liquid level, the fire may tend to break out to cause the damage. This “reverse fire prevention height” function is set for this problem. If the “reverse fire prevention height” is set, the DRO will give a warning and an alarm when the height enhanced by the electrode exceeds the height (i.e., the reverse fire prevention height) between electrode and the machined plane depth. Meanwhile, the output signal will shut down the EDM automatically to completely eradicate the chance of fire breaking out. (See figure 2)



(Figure 2)

2. Specific Operations:

1: Before machining, set the parameters of "reverse fire prevention height", "exit mode", "machining direction" and "EDM mode".

2: Firstly move the main axis electrode of Z axis to make it touch the work piece reference, and then zero Z axis or set the number.

3: Press the [EDM] key, and input the depth value for machining (the depth value will be displayed on X axis), such as 10.00, then press the [ENT] key to confirm. After the confirmation, press the [EDM] again to exit "DEPTH" and enter "EDM" state for machining.

4: "The target value of the machining depth" will be displayed on X axis. will be displayed on Y axis. The value on Y axis is the machined depth value of the work piece.will be displayed on Z axis. Note: The value on Z axis is the value of position where the main axis electrode of Z axis is located.

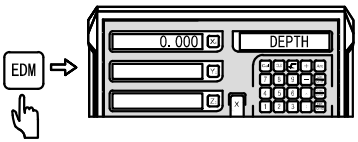
5: After the machining is started, the value displayed on Z axis will get on for the target value gradually. If the electrode rises and drops repeatedly at this moment, the value displayed on Z axis will change accordingly. However, the value displayed on Y axis will not change and always indicate the machined depth value.

6: When the value displayed on Z axis equals the target value, the limit switch will close, and the EDM will stop machining, also, the information screen will display "EDM END". According to the setting made by the operators, there have two exit modes: I. Automatic mode. Exit the EDM machining state automatically and restore the displaying state before machining. II. Pause mode. The screen always shows "EDM END", and it need to press the [EDM] key to exit and restore the original displaying state.

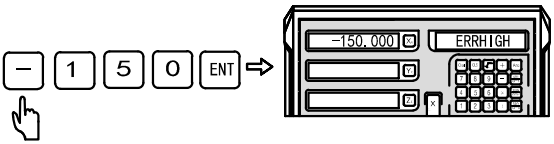
3. Set the "reverse fire prevention height (ERRHIGH)", exit mode and machining direction:

Before machining, set the "reverse fire prevention height (ERRHIGH)", "exit mode" and "machining direction" at first:

Step 1: Zero the coordinate of every axis and then press the [EDM] key to enter into the "EDM" function. Press the [←] and [→] keys to enter the "EDM" menu setting.

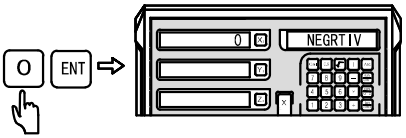


Step 2: press the [→] key to enter the setting mode, and set the "reverse fire prevention height" and input the height value "-150".

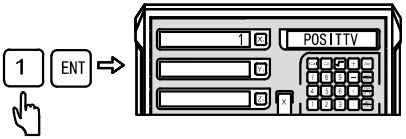


Step 3: Set the positive, negative directions and the current setting is the positive direction machining.

Negative machining direction (NEGRTIV)
Press the [0] key to select

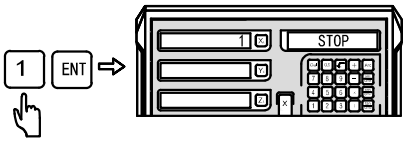


Positive machining direction (POSITIV)
Press the [1] key to select

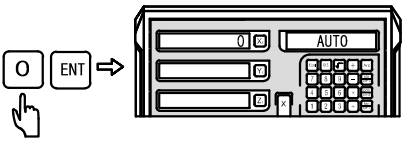


Step 4: Enter the setting of "exit mode", and the current setting is "automatic mode".

Pause mode

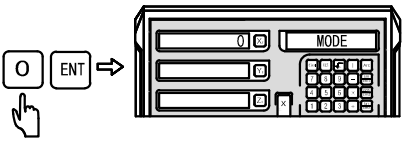


Automatic mode



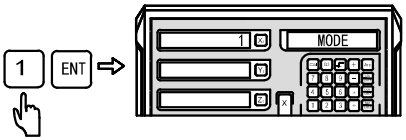
"AUTO" refers to the automatic mode and "STOP" refers to the pause mode. If the original exit mode is "pause mode", the word "STOP" will appear. Press the [0] key, the mode could be switched to the "automatic mode", and the word "AUTO" will appear. For mode selection, you can press the [0] or [1] keys to switch.

Step 5: Select the EDM machining mode, and the current setting is MODE 0.



Press the [0] key to select MODE 0. The output states of the relay in MODE 0 are as follows:

a. When the power is off, the relay coil is OFF.
b. When the CPU is not initialized, the relay coil is OFF.
c. When the normal state output of booting is 1, the relay coil is ON.
d. When EDM function outputs 0 in operation, the relay coil is ON.
e. When EDM outputs 0 in depth, the relay coil is OFF.



Press the [1] key to select MODE 1. The output states of the relay in MODE 1 are as follows:

a. When the power is off, the relay coil is OFF.
b. When the CPU is not initialized, the relay coil is OFF.
c. When the normal state output of booting is 0, the relay coil is OFF.
d. When EDM function outputs 1 in operation, the relay coil is ON.
e. When EDM outputs 0 in depth, the relay coil is OFF.

The machining defaulted by the DRO is the positive direction machining. As in example 1 and example 2, you should set the positive direction machining as the machining at first in the positive direction machining; as the work piece shown in the machining figure (F), you should set the negative direction machining as the machining direction before machining in the negative direction machining. Otherwise, after entering the machining, the DRO will identify that the machining has been completed and exit the machining.

Step 6: Press the [EDM] key to exit the setting to restore the original state.

4. Examples of Positive Direction Machining

Example 1: Machining the work piece as shown in Figure (A) , The work piece and electrode are shown in figure (B). Please set the positive direction machining as the machining direction at first.

7.1 Congruous Output Function of EDM

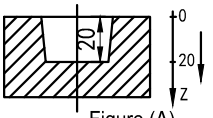


Figure (A)

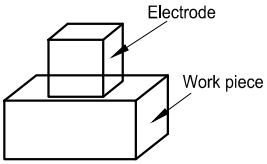
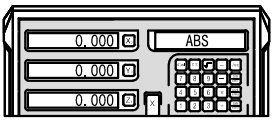
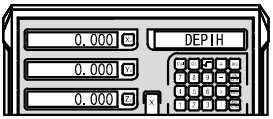


Figure (B)

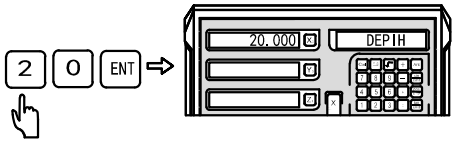
Step 1: As shown in figure (B), move the main axis electrode to make it touch the work piece and then press the [X], [Y] and [Z] keys to zero.



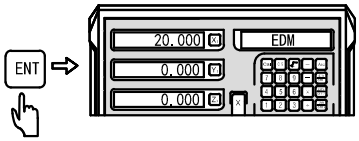
Step 2: Press the [EDM] key to enter the machining.



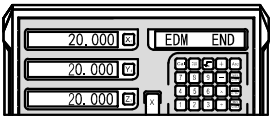
Step 3: Set the machining depth.



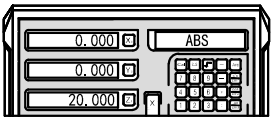
Step 4: Start to machine.



Step 5: When the value displayed on Z axis equals the target value, the limit switch will close; the information window on the right will display “EDM END” for 3 seconds, then back to the state before machining.



Three seconds later, the information window will exit the EDM machining state and back to the ABS displaying state.



Example 2: Machining the work pieces as shown in Figure (C)

Please set the positive direction machining as the machining direction at first.

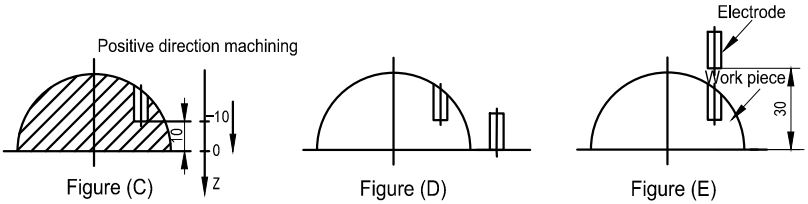
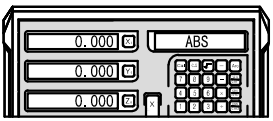
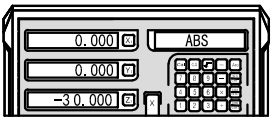


Figure (C) Figure (D) Figure (E)

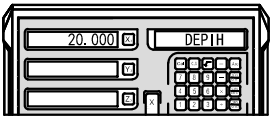
Step 1: As shown in figure (D), move the main axis electrode to make it touch the machining size reference position of the work pieces and press the [Z] key to zero.



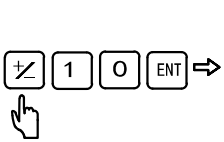
Move the electrode to the position shown in figure (E)

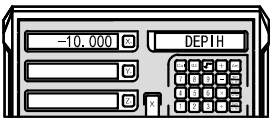


Step 2: Press the [EDM] key to enter the machining

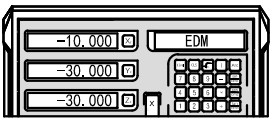


Step 3: Set the machining depth

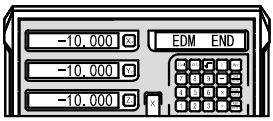




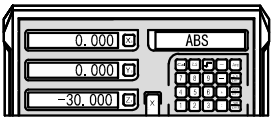
Step 4: Start to machine



Step 5: When the value displayed on Z axis equals the target value, the limit switch will close; the information window on the right will display “EDM END” for 3 seconds, then back to the state before machining.



Three seconds later, the information window will exit the EDM machining state and back to the ABS displaying state.



5. Examples of Negative Direction Machining

Example 3: Machining the work pieces as shown in Figure (F) ,Please set the negative direction machining as the machining direction.

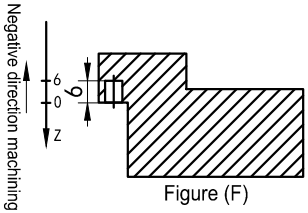


Figure (F)

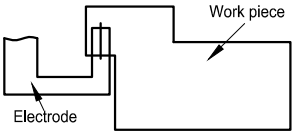
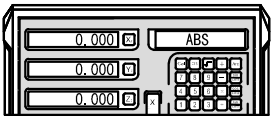
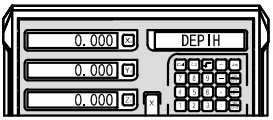


Figure (G)

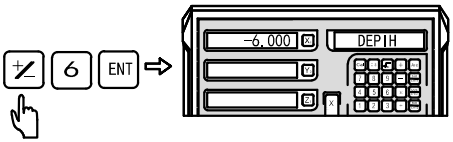
Step 1: As shown in figure (G), move the main axis electrode to make it touch the machining size reference position of the work piece and press the [Z] key to zero.



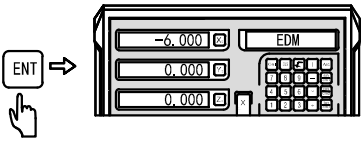
Step 2: Press the [EDM] key to enter the machining.



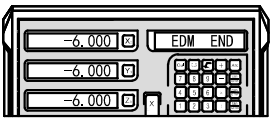
Step 3: Set the machining depth.



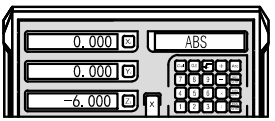
Step 4: Start to machine.



Step 5: When the value displayed on Z axis equals the target value, the limit switch will close; the information window on the right will display "EDM END" for 3 seconds, then back to the state before machining.



Three seconds later, the information window will exit the EDM machining state and back to the ABS displaying state.



6. Use PCD Function together with EDM Function

In PCD function, the DRO can call the EDM function to complete the EDM machining for the PCD. The specific operation procedures are as follows:

1) Press the ❁ key to enter the PCD function to set parameters (please refer to the PCD function setting). After setting all parameters, press the ENT key to enter the PCD machining. When displaying the position coordinate of the first machining, move the table to make the electrode aligning the first machining hole.

2） Press the EDM key to input the EDM parameter setting and machining state (refer to the EDM parameter setting for the EDM parameter setting method), and input the machining depth for EDM machining. After the machining is completed, press the EDM key to exit EDM machining and enter the PCD machining. Press the ← key to display the position coordinate of the second hole. Move the table to make the electrode aligning the next machining hole.

7. Use PLD Function and EDM Function Cooperatively

In PLD function, the DRO can call the EDM function to complete the EDM machining for the PLD. The specific operation procedures are as follows:

1) Press the [✎] key to enter the PLD function to set parameters (please refer to the PLD function setting). After setting all parameters, press the [ENT] key to confirm entering the PCD machining. The position of first machining hole is displayed in coordinate. Then move the table to make the electrode aligning the first machining hole.

2) Press the [EDM] key to enter the EDM parameter setting and machining state (refer to the EDM parameter setting for the EDM parameter setting method), and input the machining depth for EDM machining. After the machining is completed, press the [EDM] key to exit EDM machining and enter the PLD machining. Press the [←] key to display the position coordinate of the second hole. Move the table to make the electrode aligning the next machining hole.

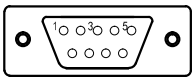
8. Function of Switching Displaying Mode

In the EDM machining, the operators may press the [•] key if they want to know the coordinate condition of external XY plane. If the information window displays "EDM-P", the values displayed on X axis and Y axis are the values of the external XY plane. Press the [•] key again to restore the EDM displaying mode. This function is only limited to switching the displaying mode and does not affect the EDM machining.

9. EQUAL OUT port of rear base plate

The output of EQUAL OUT is the relay output and the contact capacity is: 1.0A30VC, 0.5A125VAC, 0.3A60VDC.

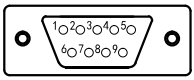
9-pins Socket Pin Number	Signal type	9-pins lead
1	OFF (NC Port)	Black
3	COM (Common Port)	Yellow
5	NO (NO Port)	Red



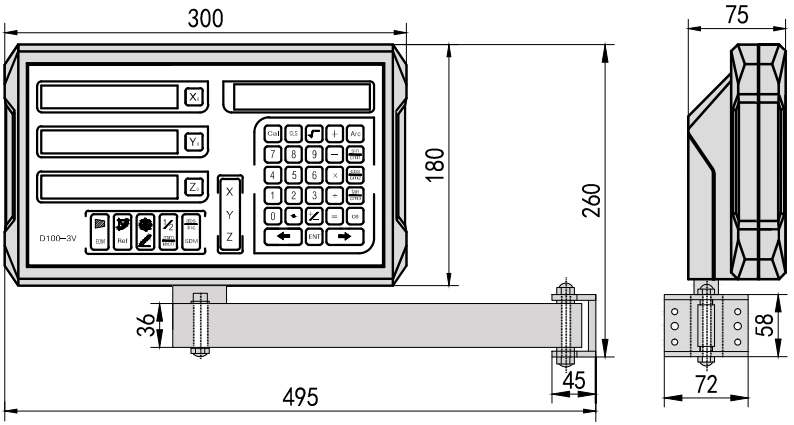
8.1 Notices for Usage:

1. Supply voltage: AC 80 V - - 260 V, 50 - - 60 Hz
2. Power: 15 W
3. Operating temperature: -10℃- - 60℃
4. Storage temperature: -30℃- - 70℃
5. Relative humidity (RH): <90% (25)>
6. Axis to be displayed : 1 axis, 2-axis , 3-axis
7. Input signal allowed by the DRO: TTL square wave
8. Allowable input signal frequency: < 2 MHz
9. Length resolution: 0.1 um, 0.2 um, 0.5 um, 1 um, 2 um, 2.5 um, 5 um and 10 um
10. Minimum resolution of angle display: 0.0001/ pulse
11. Weight: 0.8 KG
12. Volume size: 300 x 180 x 75 (mm)
13. Interface definition of the grating ruler: (DB 9-pins socket)

Pin	1	2	3	4	5	6	7	8	9
signal	NA	0V	NA	NA	NA	A	+5V	B	R



8.2 Installation Figure



8.3 Troubleshooting

The following troubleshootings are just the preliminary methods. If the problems still exist, please do not dismantle the DRO by yourself, but contact our company or the dealers for help in time.

Faults	Fault Causes	Solutions
The DRO doesn't display anything	1. The power is not on ? 2. The power switch is not closed ? 3. The supply voltage is not appropriate 4. The internal supply of the grating ruler is in short circuit.	1. Check whether the power line and power plug are plugged in. 2. Close the power switch. 3. Make sure the supply voltage between 85V-265V. 4. Pull out the connector of the grating ruler.
One axis of the DRO doesn't count	1. Operate the machine after swapping with the grating ruler of another axis. 2. Some special functions of the DRO are being used.	1. If counting, it's the fault of the grating ruler; if not, it's the fault of the DRO. 2. Exit the special function
The counting of DRO is not accurate (it can't zero)	1. The grating ruler isn't installed according to the requirements or the accuracy is not enough. 2. After being used for a long time, the vibration of the machine tool makes the fixed reading head or the screws loosen. 3. The accuracy of the machine tool is not good. 4. The DRO resolution isn't consistent with the grating ruler.	1. Reinstall the grating ruler and adjust the level. 2. Tighten all the fixed screws. 3. Overhaul the machine tool. 4. Reset the DRO resolution.
The counting of DRO is in error,The displayed operation distance isn't consistent with the actual distance	1. The machine tool and the DRO shell are not connected to earth. 2. The accuracy of the machine tool is not good. 3. The running speed of the machine tool is too fast. 4. The grating ruler isn't installed according to the requirements and the accuracy is not enough. 5. The DRO resolution isn't consistent with the grating ruler. 6. The operating size unit is not consistent with the displayed Metric/British units. 7. The linear error compensation setting of the DRO is not appropriate. 8. The grating ruler exceeds the operating range of length or the read head is broken.	1. Connect the machine tool and the DRO shell to earth. 2. Overhaul the machine tool. 3. Reduce the running speed of the machine tool. 4. Reinstall the grating ruler and adjust the level. 5. Reset the DRO resolution. 6. Switch the displayed Metric/British units. 7. Reset the linear error compensation of the DRO. 8. Repair the grating ruler.

Faults	Fault Causes	Solutions
The grating ruler doesn't count	1. The grating ruler exceeds the operating range of length or the read head is broken. 2. The read head of grating ruler rubs the ruler shell leading to the aluminum scraps accumulated. 3. The gap between the read head of grating ruler and the ruler body is too wide. 4. The metal tubes of the grating ruler are damaged, which causing the short circuit or disconnection in internal wiring.	1. Repair the grating ruler 2. Repair the grating ruler 3. Repair the grating ruler 4. Repair the grating ruler
The grating ruler doesn't count sometimes	1. The small box of the grating ruler is separated from the steel ball. 2. The grating glass in the read head of the grating ruler is abraded. 3. There is dirt on the grating glass in the shell of the grating ruler. 4. The elasticity of small box spring in the read head of the grating ruler is not enough.	1. Repair the grating ruler 2. Repair the grating ruler 3. Repair the grating ruler 4. Repair the grating ruler