



DS60-M Series
DIGITAL READOUTS

Operation Manual

(Version 1.0)

Dear Users:

Thank you for purchasing DS60-M series digital readouts. The digital readout is applicable for the machines such as millers, lathes, boring machines, grinding machines and EDM, etc.. Read all the instructions in the manual carefully before used and strictly follow them. Keep the manual for future references.

Safety attention:

To prevent electric shock or fire, moisture or directly sprayed cooling liquid must be avoid. In case of any smoke or peculiar smell from the digital readout, please unplug the power plug immediately, otherwise, fire or electric shock may be caused. In such a case, do not try to repair it, please contact your distributors.

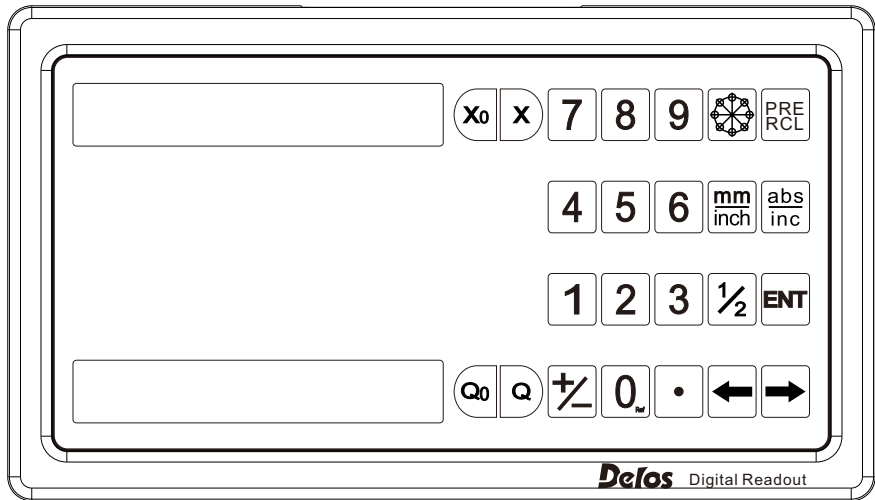
Digital readout is a precise measuring device used with an optical Linear Scale. When it is in use, if the connection between the Linear Scale and the digital readout is broken or damaged externally, incorrect measuring values may be resulted. Therefore, the user should be careful.

Do not try to repair or modify the digital readout, otherwise, failure, fault or injury may occur. In case of any abnormal condition, please contact your distributor.

If the optical Linear Scale used with the digital readout is damaged, do not use a Linear Scale of other brand. Because the performance, specification and connection of the products of different and can not be connected without the instruction of specialized technical personnel, otherwise, trouble will be caused to the digital readout.

Illustration of Panel and keyboard

DRO_1V Readout Panel and Keyboard



DRO_2V Readout Panel and Keyboard

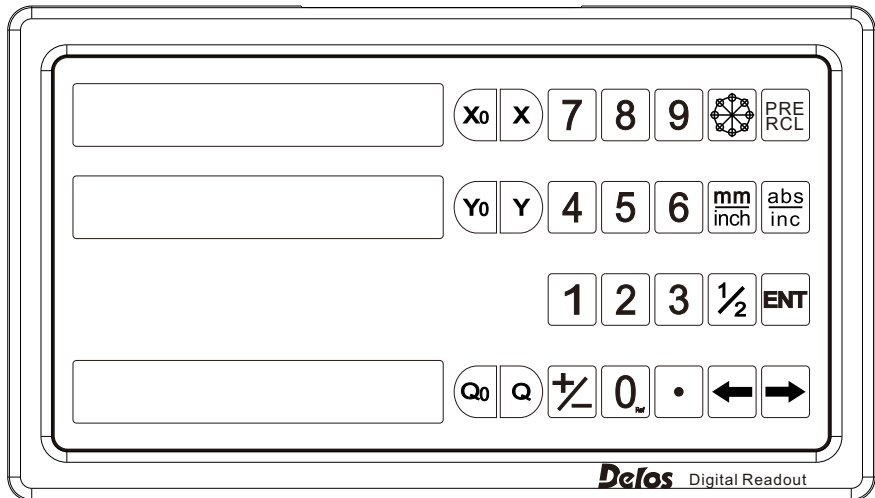
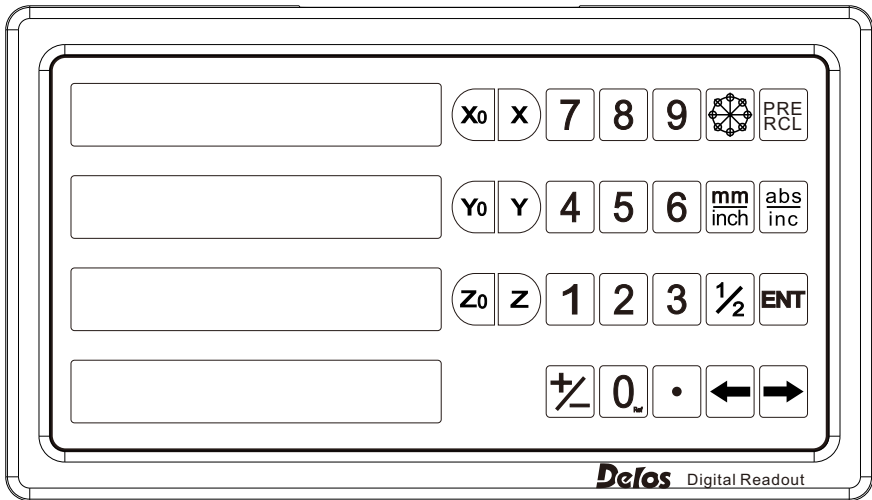
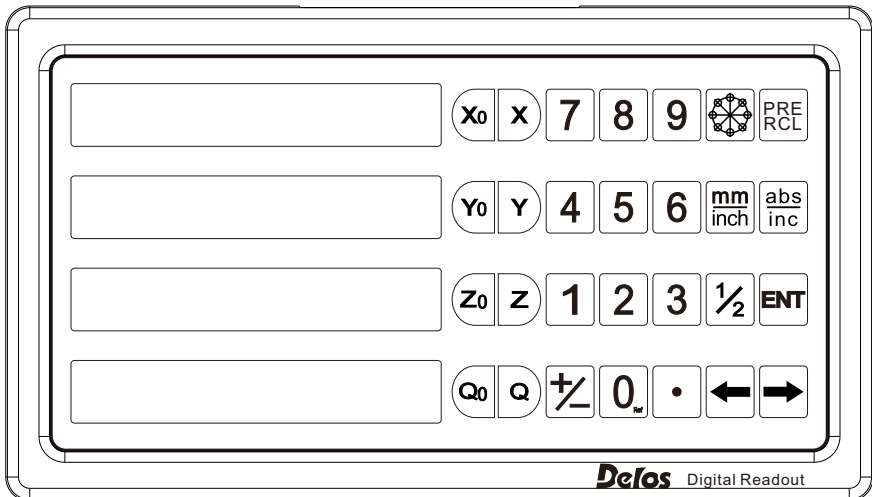


Illustration of Panel and keyboard

DRO_3V Readout Panel and Keyboard

















DRO_4V Readout Panel and Keyboard



Caption of the Keyboard

    _____ Keys for Axis selection


    _____ Clear Key

    
     _____ Enter Key for digits

 _____ Enter Key for decimal point

 _____ Enter Key Plus or minus symbol

 _____ Key for entering data

 _____ Function key for getting one half
(Press X, Y or Z, then press this key)
Key fo radius (for Lathe)

 _____ Key for the conversion the
Meter System / British System

 _____ Reference Function Key

 _____ Function key for circle equally
Dividing (PCD Function)

 _____ Key for the conversion of
relative / absolute display

Caption of the Keyboard



————— Key for the selection of upper / lower term or plane procession



————— When the input is a number , Enter key is a confirmation Key. In the ABS state, when there is no digital input, the number of SDM coordinates can be selected by the ENT key.

Contents

1. General description

1.1 Illustration of panel and keyboard	1
1.2 Caption of the Keyboard	3
1.3 Contents	6

2. Parameters settings

2.1 Encode type setting	9
2.2 Resolution setting	9
2.3 Direction setting	9
2.4 Compensation Type (Linear or Non-Linear) setting	10
2.5 Set decimal number for INCH	10
2.6 Select functions for the special Machine	10

3. Basic Functions

3.1 Reset	12
3.2 MM / INCH Mode	12
3.3 Enter dimensions	12
3.4 1 / 2 function	13
3.5 ABS / INC Mode	14
3.6 Clear 200 sets Sdm datum	14
3.7 NON-VOLATILE MEMORY	14
3.8 Sleeping Mode	14
3.9 Ref datum memory function	15
3.9.1 Find Ref (Find the ref mark position)	16
3.9.2 Recall the work datum zero (FD ORG)	17
3.10 Linear Compensation	18
3.11 Non-linear Error Compensation	18
3.12 200 sets SubDatum function	20

Contents

4. Special Functions

4.1 Linear Drilling.....	26
4.2 PCD Function.....	27
4.3 R Function.....	28
4.3.1 SMOOTH R Function.....	29
4.3.2 SIMPLE R Function.....	33
4.4 Chambering.....	36
4.5 Tool Compensation Function.....	37
4.6 Machining of oblique plane.....	38

5. Appendix..... 41

5.1 Mechanical and Electrical Features.....	41
5.2 Dimensions.....	41
5.3 Troubleshooting	42

2. Parameters Setting

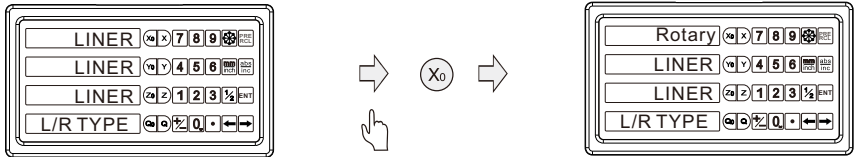
2. Parameters setting

2. Parameters setting

Set the power switch to ON, the DRO enters to the self-check and init state. The resolution will be display on the X, Y, Z LED window, and the type of the DRO will be display on the left window. Mill 2for 2 axes Milling Machine, Mill 3 for 3 axes Milling machine, GRIND 2 for 2 axes Grind, Lathe 2 for 2 axes Lathe, etc.

In the course of self-check, press the key \square to access the System settings. In the System settings, the following system item will be set. 1) encode type, 2) Resolution, 3) direction, 4)compensation Mode Selection; 5) No. Decimal Selection @INCH unit. 6) The (Linear or Un-Linear) settings.

Step 1: select the encode type: LINER encode or Rotary encode.



Press the key X_0 to toggle the X axis encode type between LINER encode or Rotary encode. Press the key Y_0 for the Y axis and press the key Z_0 for the Z axis..

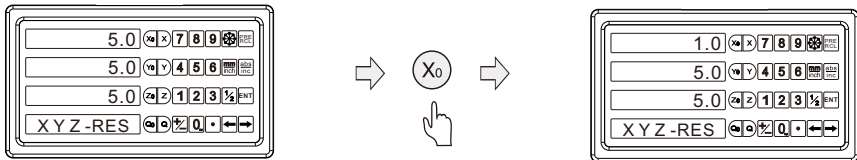
Press \blacktriangleright or ENT key to enter the Step 2.

Step 2: set the resolution for encode

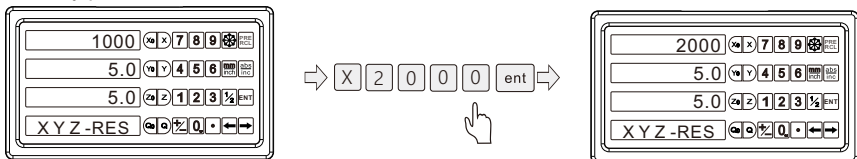
When selecting the LINER encode, the resolution will be set as follow:

There are 7 types of Resolution : 0.1um;0.2um;0.5um;1um;2um;2.5um;5um;10um

Press X_0 for the X axis, the key Y_0 for the Y axis and the key Z_0 for the Z axis.



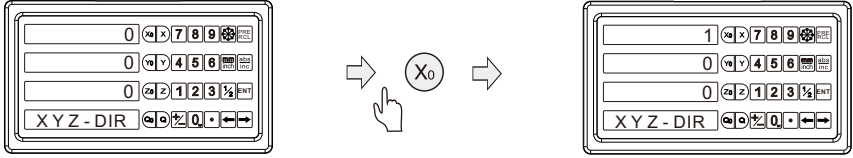
When selecting the Rotary encode, the resolution will be set as follow: input the rotary parameters.



Press \blacktriangleright or ENT key to enter the Step 3.

2. Parameters setting

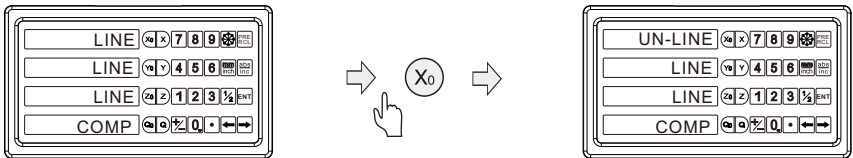
Step 3: set the direction.



Press X_0 for the X axis, the key Y_0 for the Y axis and the key Z_0 for the Z axis.

Press \blacktriangleright or ENT key to enter the Step 4.

Step 4: set the compensation Type (Linear or Non-Linear).



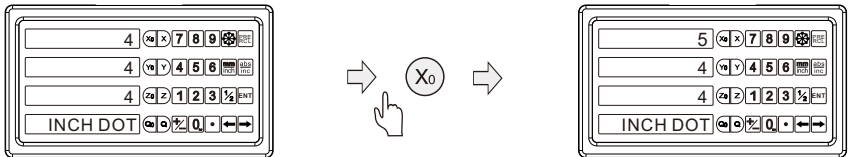
LINE : the Linear compensation ; (Ref to Linear compensation settings)

UN-LINE : the Non-Linear compensation (Ref to Non-Linear Error compensation)

Press X_0 for the X axis, the key Y_0 for the Y axis and the key Z_0 for the Z axis.

Press \blacktriangleright or ENT key to enter the Step 5.

Step 5: The position of the decimal point (only useful @ INCH unit).



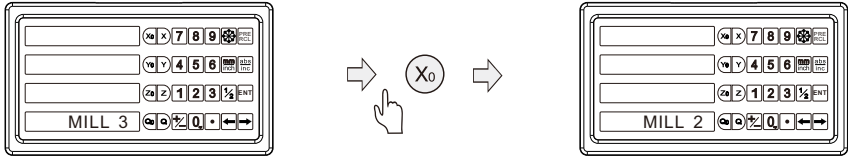
At INCH unit , the operator can use through this can alter the decimal point.

Press X_0 for the X axis, the key Y_0 for the Y axis and the key Z_0 for the Z axis.

Press \blacktriangleright or ENT key to enter the Step 6.

2. Parameters setting

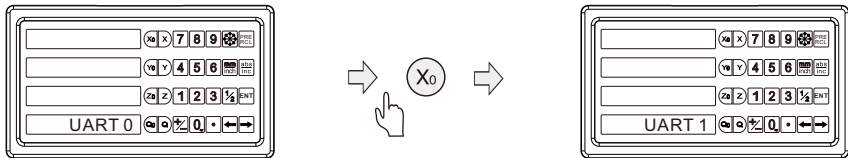
Step 6: Select the special functions for machine



Press the X_0 key, the operator can select the special functions for the machine. There are MILL 2; MILL 3; Lathe 2; Lathe 3; Grind 2 and EDM Functions for MILL Machine, Lathe machine, Grind machine and EDM machine.

Press \blacktriangleright or ENT key to enter the Step 7.

Step 7: Select the data format for RS232 serial communication



Press the X_0 key, the operator can select the data format for RS232 serial communication, UART 0 for ASCII data and UART 1 for Hex Data;

Press \square to quit the Parameters setting.

3. Basic Functions

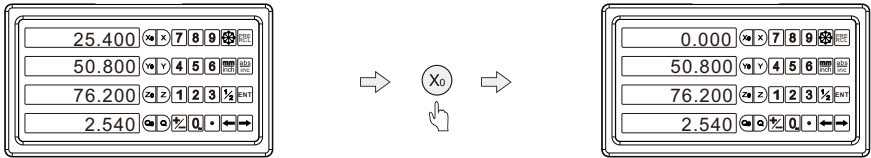
3. Basic Functions

3. Basic Functions:

3.1 Reset:

Function: Reset the current position for that axis by pressing the key X_0 or Y_0 or Z_0 .

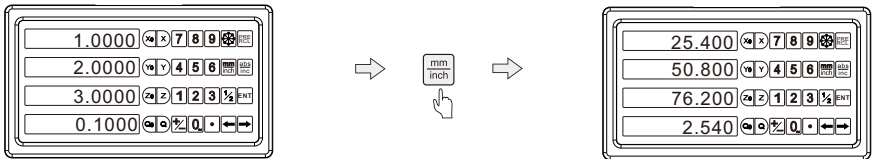
Example: to Reset the current X position.



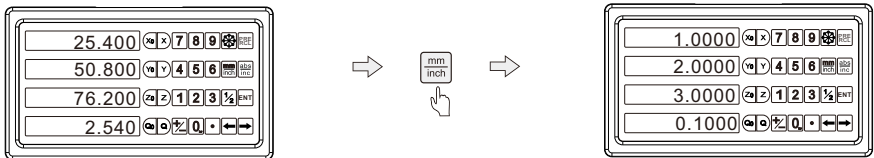
3.2 MM/INCH MODE

Function: Toggle the display unit between inch and metric by pressing $\frac{mm}{inch}$.

Example 1: currently in inch display MODE, to toggle to metric display MODE.



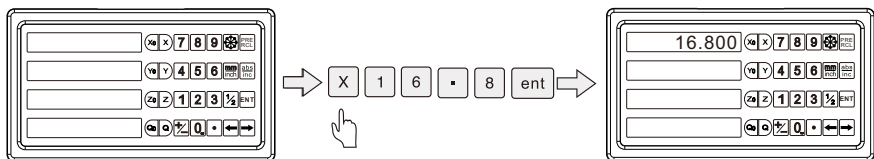
Example2: currently in metric display MODE, to toggle to inch display MODE.



3.3 Enter Dimensions

Function: set the current position for that axis to an entered Dimension.

Example: To set the current X-Axis position to 16.8mm.



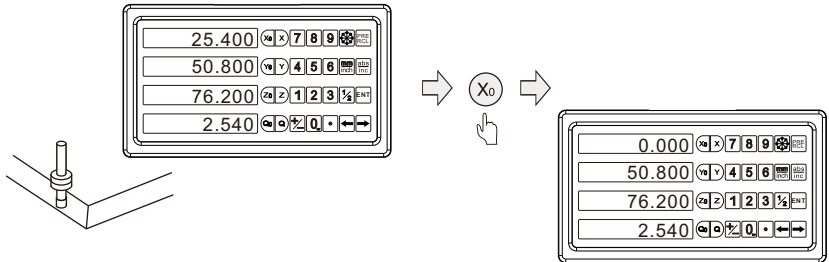
3. Basic Functions

3.4 1 / 2 Function

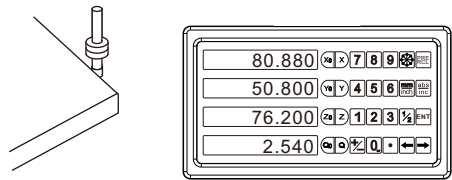
Function: to find the centre of the workpiece

Example: To find the centre of the workpiece of X-Axis.

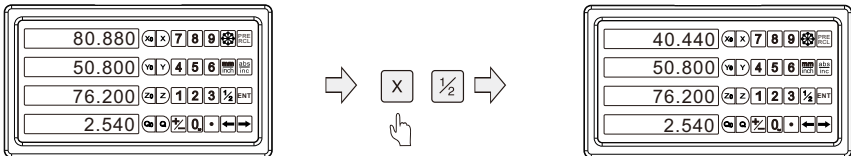
Step 1: Touch one side of the workpiece with th TOOL, then zero the X-Axis.



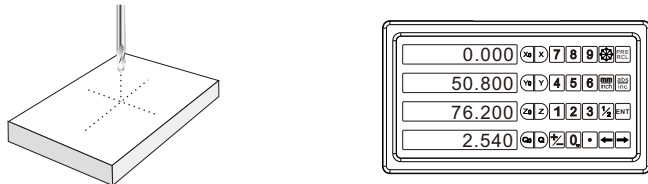
Step 2: Take the TOOL to the opposite side of the workpiece and touch it.



Step 3: Execute the workpiece centering of the X axis as per follow





Step 4: Retract the axes until the displays read 0.000, the TOOL can be placed exactly at the center of the workpiece.

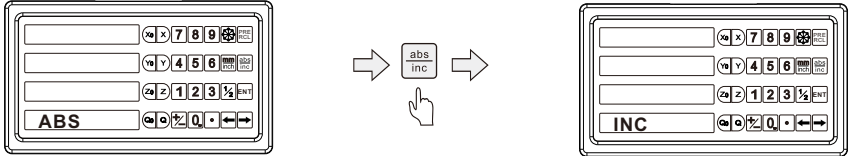



3. Basic Functions

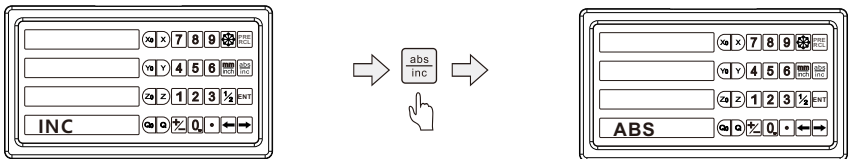
3.5 ABS/INC Mode

Description: There are two set of basic coordinates display, ABS (absolute) and INC (incremental) displays. During machining operations, operator can store the workpiece datum (zero position) in ABS coordinate, then switch to INC coordinate for continue machining operations. ABS and INC can be simply toggle by pressing 


Example: currently in ABS mode. To toggle to INC mode by pressing 



Example: currently in INC mode. To toggle to ABS mode by pressing 



3.6 Clear 200 sets Sdm datum

In ABS Mode, To continuously press the key  ten times will cause to clear all the datum for 200 sets Sdm.

3.7 NON-VOLATILE MEMORY

The memory is used to store the settings of the DRO and machine reference values when power is turn off.

3. Basic Functions

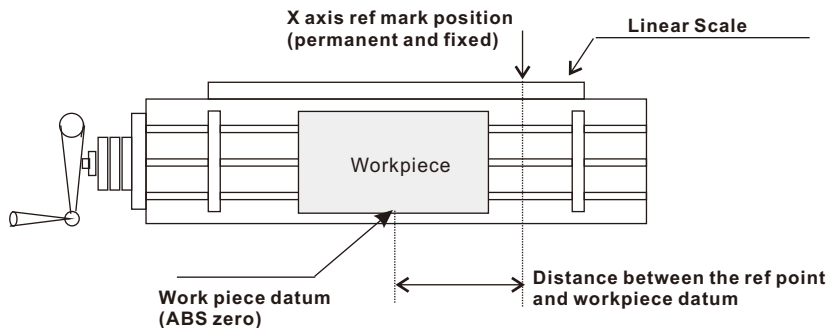
3.9 Ref datum memory function:

During the daily machining process, it is very common that the machining cannot be completed within one work shift, and hence the DRO have to be switched off after work, or power failure happen during the machining process which is leading to lost of the workpiece datum (workpiece zero position), the re-establishment of workpiece datum using edge finder or other method is inevitably induce higher machining in accuracy because it is not possible to re-establish the workpiece datum exactly at the previous position. To allow the recovery of workpiece datum very accurately and no need to re-establish the workpiece datum using edge finder or other methods, every Linear scale have a ref point location which is equipped with ref position to provide datum point memory function.

The working principal of the ref datum memory function are as follows.

Since the ref point of Linear scale is permanent and fixed, it will never change or disappear when the DRO system is switched off. Therefore, we simply need to store the distance between the ref point and the workpiece datum(zero position) in NON-Volatile memory. Then in case of the power failure or DRO being switched off, we can recover the workpiece datum (zero position) by presetting the display zero position as the stored distance from the ref point.

Example: to store the X axis work datum.



After power failure, the workpiece datum can be recover by presetting this distance from the ref mark position.

Operation: DRO provides one of the most easy to used ref datum memory function. There is no need to store the relative distance between the ref mark and your work datum zero into DRO, when ever you alter the zero position of ABS coordinate, such as by zeroing, center find, coordinate preset or etc..., DRO will automatically store the relative distance between ABS zero and the ref mark location into the memory of DRO.

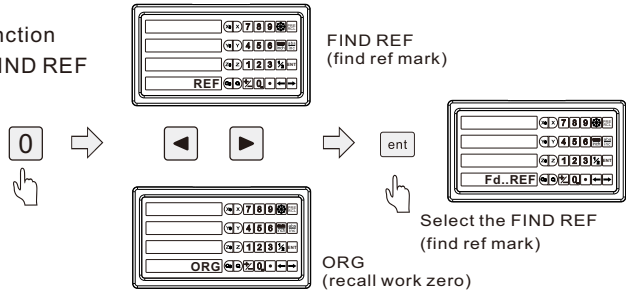
In daily operation, operator simply need to find the ref mark position whenever they switch on the DRO to let DRO know where the ref mark position is, then DRO will automatically do the work datum storage on its own whenever you alter the ABS zero position. In case power failure or the DRO switched off, the operator can recover the workpiece datum easily by the RECALL 0 procedure.

3. Basic Functions

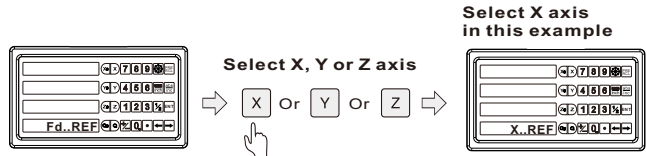
3.9.1 Find Ref: the DRO can automatically store the relative distance between the ref mark position and the ABS datum (zero position) whenever the operator alter the ABS zero position, such as zeroing, centra find, coordinate preset or etc...

Therefore, DRO need to know where the ref position in prior to machining operation. In order to avoid the lost of work piece datum (zero position) during any accidental or unexpected events, such as power failure or etc..., It is highly recommend that operator find the ref mark position using the (FIND REF) function whenever they switch on the DRO.

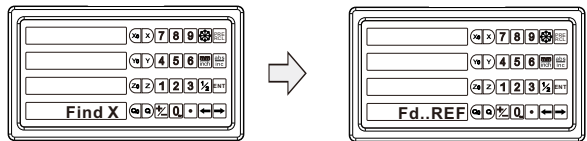
Step 1: enter the Ref function and select the FIND REF (find ref mark)



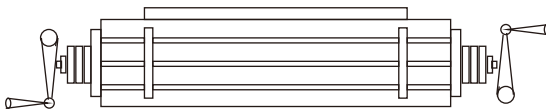
Step 2: select the axis of which ref mark needed to be found



Step 3: move the machine across the centra or the left or the right of the Linear scale until the right window flashes FIND X, then display FD...REF. Press **[Y]** for FIND REF Y and the key **[Z]** for FIND REF Z.



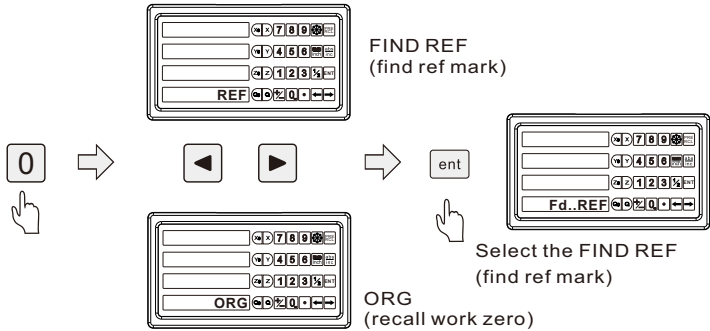
Move the machine across the ref mark point



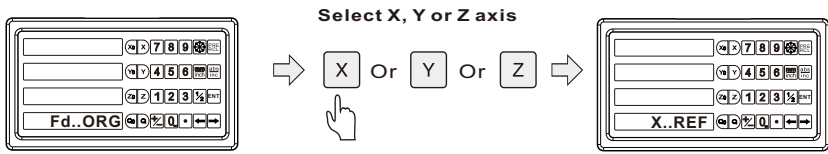
Step 4: press **[ref]** to quit Ref function.

3.9.2 Recall work zero

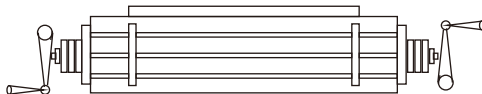
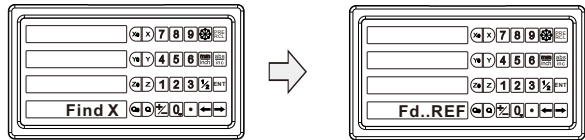
Step 1: enter the ref function and select the FD ORG (recall workpiece zero)



Step 2: select the axis of which work datum(zero position) needed to be recovered



Step 3: move the machine across the centre or the left or the right of the Linear scale until the right window flashes FIND X, then display FD...ORG. Press **[Y]** for FIND ORG Y and the key **[Z]** for FIND ORG Z.



Move the machine across the ref mark point

Step 4: After find ORG X, Y and Z; move the machine to display value=(0.000), the TOOL is exactly located at the ABS zero.

3. Basic Functions

3.10 Linear Compensation

Setting Linear compensation to rectify the system error of the digital readouts system.

$$\text{Rectifying coefficient } S = (L - L1) / (L - 1000) \text{ mm/m}$$

L : the actual length value , unit: mm

L1 : the display value , unit: mm

S: Rectifying coefficient. Unit: mm/m

Regarding the polarity, select a positive(+) compensation when displayed value is smaller than the actual length and negative(-) compensation when the display value is greater.

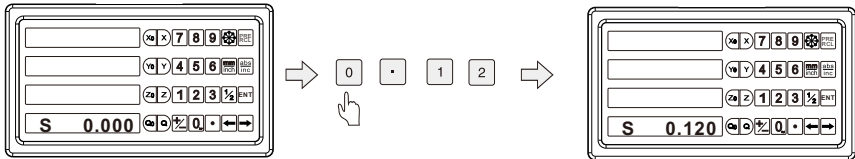
Compensation range: -1.500mm/m to +1.500mm/m

Example: the actual value is 1000mm and the display value is 999.98mm

$$S = (1000.000 - 999.980) \div (1000.000 - 1000.000) = 0.120$$

Step 1: Press \boxed{X} to select the x axis and press $\boxed{\frac{\text{mm}}{\text{inch}}}$ to access the setting Linear compensation.

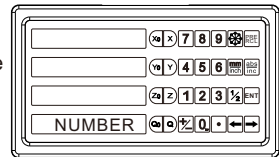
Step 2: Input rectifying coefficient 0.12 as follow



3.11 Non-Linear Error Compensation

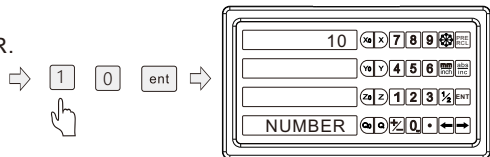
First compensation Type (Linear or Non-Linear) in parameter setting must be set Non-Linear.

Step 1: Move the worktable to the left ,
and press the key $\boxed{\frac{\text{abs}}{\text{inc}}}$ to enter ABS display Mode



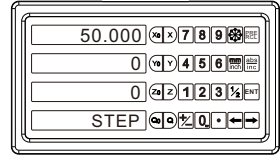
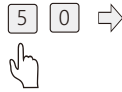
Step 2: Press the Key \boxed{X} , then press $\boxed{\frac{\text{mm}}{\text{inch}}}$ to enter
parameter setting for Non-Linear compensation.

Step 3: Input the parameter NUMBER.

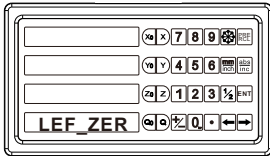


3. Basic Functions

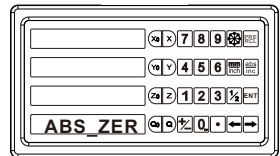
Step 4: Input the parameter STEP.
(For example : STEP = 50)



Step 5: select the start point (There are two kinds of start point a. LEFT ZERO;
b. ABS Ref ZERO and can be selected by pressing key ◀ ▶)



Mode A: LEF_ZERO



Mode B: ABS_ZERO

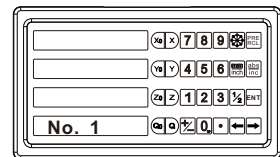
In Mode A (LEF_ZERO), the start point is find by pressing the key **ent**

In Mode B (ABS_ZERO), the start point is find by moving the worktable.

The start point is the start point for calculation of Non- Linear compensation.

Step 5: Input compensation value.

X -axis display the value of the Digital Readout
Y-axis display the real value (input by the operator)
the error must be less than 10%.



Step 6: after input all parameter, the DRO automatically exit .

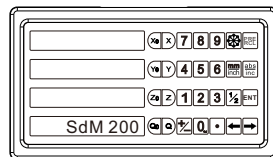
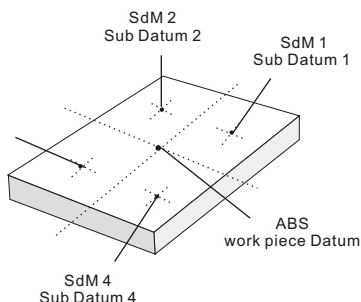
3.12 200 sets Sub Datum Function:

There are three kinds of coordinate systems. ABS Mode (1 set), INC Mode(1set) and SdM Mode (200 sets). It is a good way to store the datum of workpiece in ABS Mode and to machine in INC or SdM Mode. INC is independent of ABS, it is not relative to ABS datum. However, all Sdm coordinate are relative to ABS coordinate, the SdM position will shift together with the ABS zero position change.

ABS Mode , INC Mode and SdM Mode are specially designed to provide much more convenience features to the operator to cope with the batch machining of repetitive works and the machining of the workpiece machining dimensions from more than one datums.

Application to the workpiece that have more than one datums

Store all the subdatums of workpiece as per follow.

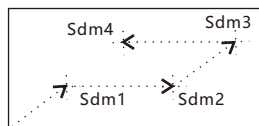


Go to the SdM directly by pressing the Number of SdM in SdM state or pressing

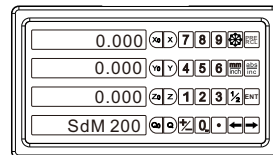
Application to the batch machining of repetitive works

Because all SdM subdatums(0.000) are relative to ABS datum, therefore, for any repetitive works, the operator just need to set up the first workpiece datum at ABS and store the machining position in SdMs.

For anymore repetitive parts, just set up the 2nd, 3rd... Workpiece zero at ABS, then all the machining positions will reappear.



ABS zero
Workpiece Datum(0.000)



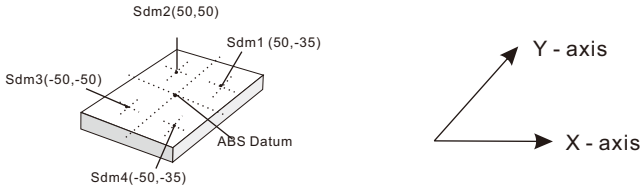
Go to the SdM directly by pressing the Number of SdM in SdM state or pressing the key

Move the TOOL to display= 0.000, then machining location reached.

3. Basic Functions

Example:

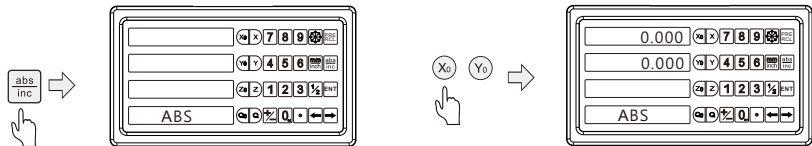
There are four auxiliary zeros (sdm1 to sdm4), There are two methods to set the auxiliary zeros. One is zeroing when reaching position and the other is directly input sdm zero. The example, as follow, the sdm coordinates are all related to ABS zero.



Method 1: Zeroing when reaching Position

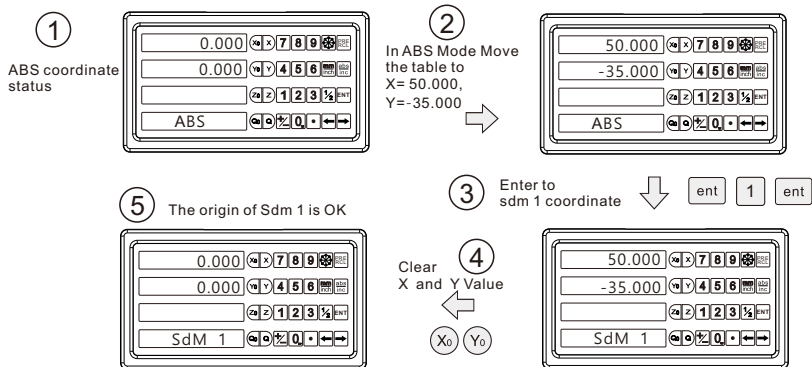
Move worktable to place the TOOL at the central point fo the workpiece, then enter display way of ABS. Zeroing, set ABS zero in the main reference point of parts.

Step 1: set the origin of ABS (the reference of the workpiece)




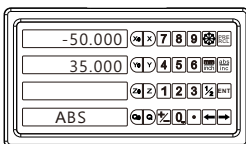
Step 2: set the origin of sdm 1

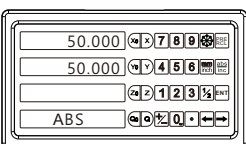
In ABS Mode, Move the machine worktable to X=50.000, Y=-35.000




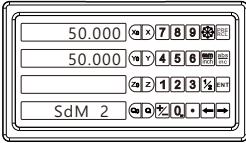
3. Basic Functions

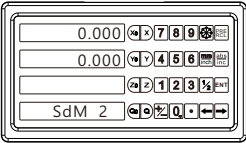
Step 3: set the origin of Sdm 2 (continue)

① Enter to ABS coordinate




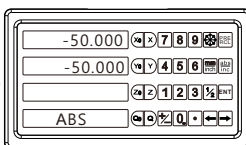
② In ABS Mode Move the table to X=-50.000, Y=50.000


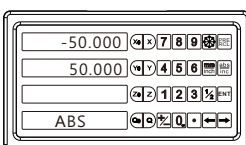
③ Enter to sdm 2 coordinate



④ Clear X and Y Value


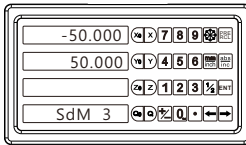
⑤ The origin of Sdm 2 is OK


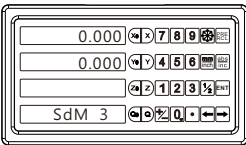
Step 4: set the origin of Sdm 3 (continue)

① Enter to ABS coordinate




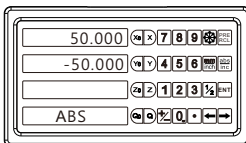
② In ABS Mode Move the table to X=-50.000, Y=50.000


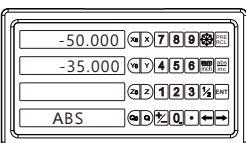
③ Enter to sdm 3 coordinate



④ Clear X and Y Value


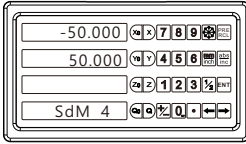
⑤ The origin of Sdm 3 is OK


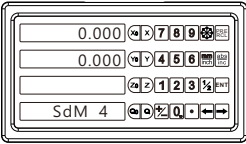
Step 5: set the origin of Sdm 4 (continue)

① Enter to ABS coordinate



② In ABS Mode Move the table to X=-50.000, Y=-35.000


③ Enter to sdm 4 coordinate


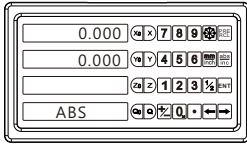
④ Clear X and Y Value


⑤ The origin of Sdm 4 is OK


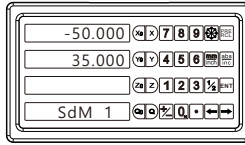
3. Basic Functions

To ACK the origin of Sdm

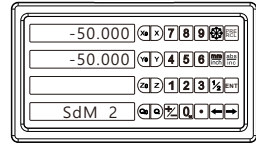
Press to the sdm coordinates done and ACK the value.



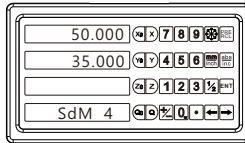
① ABS



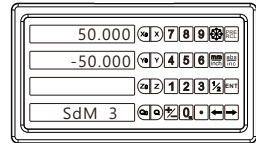
② SdM 1



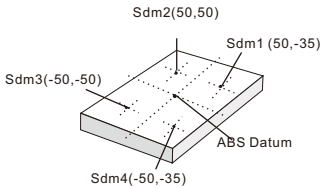
③ SdM 2



⑤ SdM 4



④ SdM 3



The dimension on the drawing, and all the dimensions are relative to the coordinates of the ABS zero.

The upper dimension is the ABS zero coordinates which are relative to the coordinate of the Sdm.

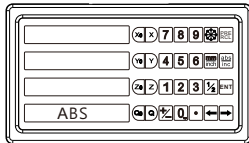
So the coordinates values are positive and negative.

Method 2: Directly input

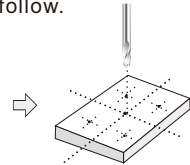
There are the same sample as Method 1. First Move the worktable to place the TOOL exactly at the origin of ABS, secondly Enter the ABS Mode as follow.

Step 1: set the origin of ABS

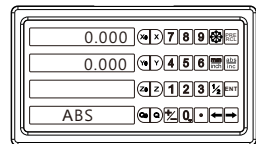
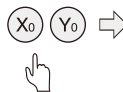
① Enter the ABS Mode



② Move the worktable to place the TOOL at the origin of ABS



③ Clear ABS



3. Basic Functions

Step 2: set the origin of Sdm 1 coordinate.

① Enter the Sdm 1 ② Input the contrary value (-50,35) of the coordinate Value as follow

The origin of Sdm 1 is done.

Note : the input value and the coordinate value is contrary.
Reason: the TOOL is at the origin of ABS Mode. AS the input value is contrary to the coordinate, Retract the axes until the displays read 0.000, the TOOL can be placed exactly at the origin of the Sdm.

Step 3: Set the origin of Sdm 2

① Enter the Sdm 2 ② Input the contrary value(-50,-50) of the coordinate value as follow

The origin of Sdm 2 is done.

Step 4: Set the origin of Sdm 3

① Enter the Sdm 3 ② Input the contrary value(50,-50) of the coordinate value as follow

The origin of Sdm 3 is done.

Step 5: Set the origin of Sdm 4

① Enter the Sdm 4 Input the contrary value(50,35) of the coordinate value as follow

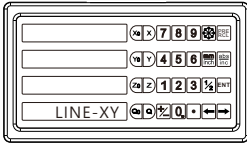
The origin of Sdm 4 is done.

4. Special Functions

4. Special Functions

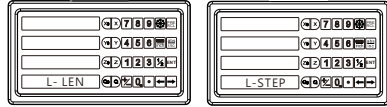
4.1 Linear Drilling

Press the **PRE RCL** **1** key accesses the function "Linear Drilling".



LINE-XY for XY plane, LINE-XZ for XZ plane and LINE-YZ for YZ plane;
Pressing the key **←→** repeatedly displays the various available options.
Pressing **ENT** key assumes the selected option.

There are two modes to carry out the Linear bolt-hole Drilling
L-LEN mode and L-STEP mode
Pressing the key **←→** to displays
Pressing the ENT key to assum



To input the following data

L-Mode: LENGTH--Length of oblique line--the distance of the centers of the starting hole to the ending hole

ANGLE -- It indicates the direction of oblique line on the coordinate plane.

AS the Fig(), the intersection angle A is 30. The intersection angle B is -30.

No.Hole

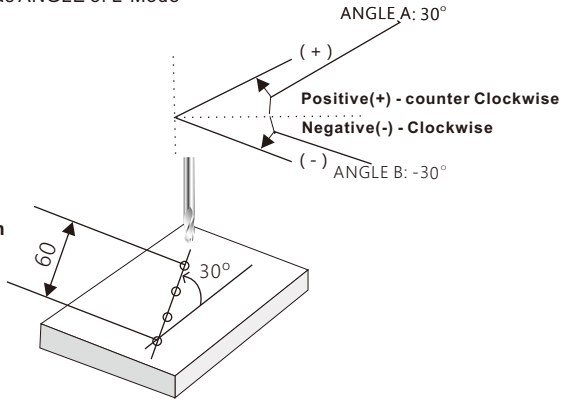
S-Mode: STEP -- the distance of two adjacent holes.

ANGLE -- the same as ANGLE of L-Mode

No.Hole

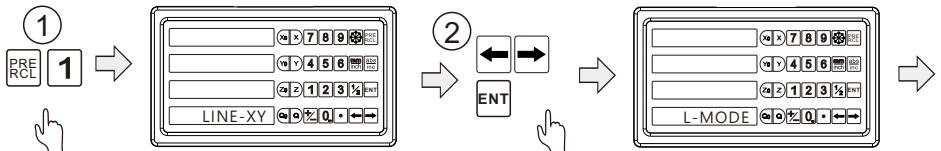
Example: As the left Fig.

XY Plane
The Length :60mm
The angle: 30
Hole Number: 4





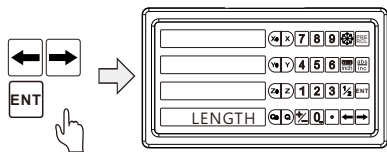
① Press **PRE RCL** **1** accesses the function "Linear Drilling"

② Pressing **←→** to select.
Pressing **ENT** assumes LINE-XY.

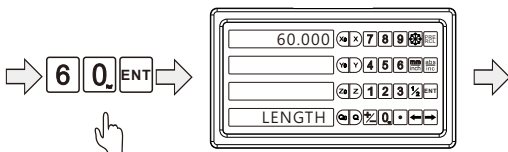


4. Special Functions

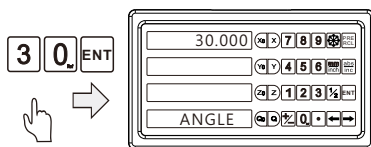
③ Pressing   to select .
Pressing  assumes L-MODE.



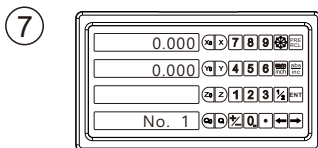
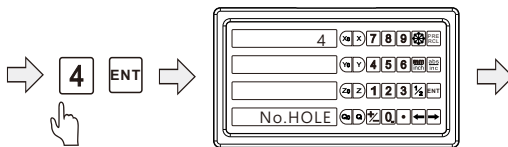
④ Input the LENGTH (60),
then pressing  to next step :







⑤ Input the ANGLE (30),
then pressing  to next step :



⑥ Input the No.Hole (4),
then pressing  to next step :



the display reading is
the coordinate of the First Hole

Press the key   to display the position of the hole.
Retract the axes until the displays read 0.000,
the tool can be placed exactly at the position of the hole.
Press   to quit the Function at any time.

4.2 PCD Function

The Function of PCD positioning on Circumference is used to distribute arc equally, such as boring hole on flange. The right window will show the parameter to be defined when selecting PCD Function. The Parameters to be defined are:

CT POS -- the central coordinate of arc

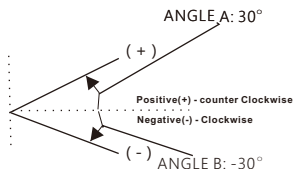
DIA -- Arc diameter

No.Hole -- Number of equipartition points


AT ANGLE -- Starting angle of arc to be distributed equally.

ED ANGLE -- Ending angle of arc to be distributed equally.

Note: the direction of starting angle and ending angle is shown as the right Fig



Take the machining of the work-piece in Figure as an example

Press  to enter PCD Function and select the processing plane X-Y for 3 axes

(when using DRO for 2 axes, goto the next parameter without selecting processing plane)

4. Special Functions

The Parameters of the example:

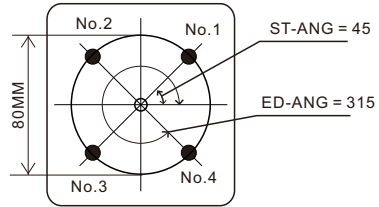
CT POS-----X=0.000, Y=0.000

DIA-----80mm

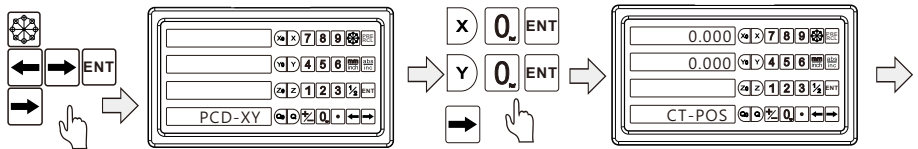
No.HOLE---4

ST ANG-----45

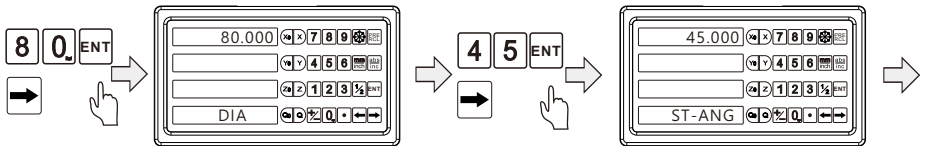
ED ANG----315



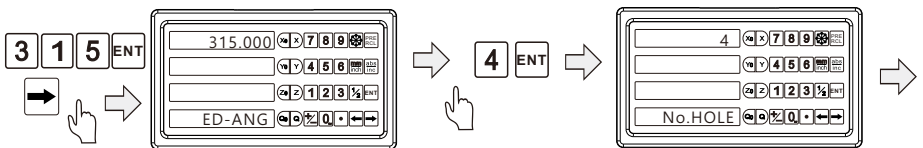
- ① Press accesses "PCD function"
Press to select, Press assumes .
Press to the next step .
- ② Input the 1st parameter : CT-POS:
Press to the next step .



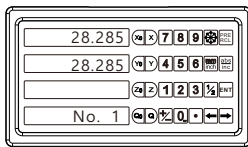
- ③ Input the 2nd parameter : DIA:
- ④ Input the 3rd Parameter ST-ANGLE, then pressing to next step :



- ⑤ Input the 4th parameter ED-ANG, then pressing to next step :
- ⑥ Input the 5th parameter No.Hole (4), then pressing to next step :



⑦



the display reading is
the coordinate of the First Hole

Press the key to display the position of the hole.
Retract the axes until the displays read 0.000,
the tool can be placed exactly at the position of the hole.
Press to quit the Function at any time.

4. Special Functions

4.3 R Function (applicable to: milling machine, Boring machine)

Two functions are available for the R function: the simple R Function and the smooth R function. Their advantages and limitations are as per follows.

Smooth R function: provides maximum flexibility in R machining, the R sector to be machined by the coordinates of R

- 1) R centre; 2) R Radius; 3) R start angle; 4) R end angle..





Advantage: Very flexible, R function can machine virtually all kinds of R, ever the intersected R.

Limitation: Relatively a bit complicated to operate, operator need to calculate and enter the coordinates of R centre, start angle and end angle.

Simple R function: is aimed to machine only simple R or round corners, DRO provides the eight type of most frequently used R machining process.

Advantage: Very easy to use, operator does not even need to calculate the R parameters, just posit the TOOL at the start point and the type of machining, and then can start the R machining right away..

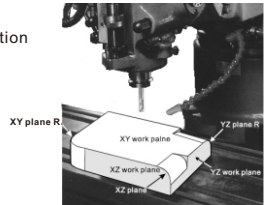
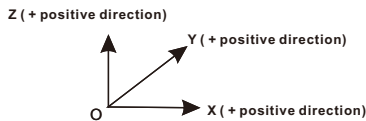
Limitation: Restricted to eight type of preset R only, cannot machine more complicated R such as intersected R.

Press   **2** to enter R function, then press   for selecting Smooth R Function or Simple R Function.

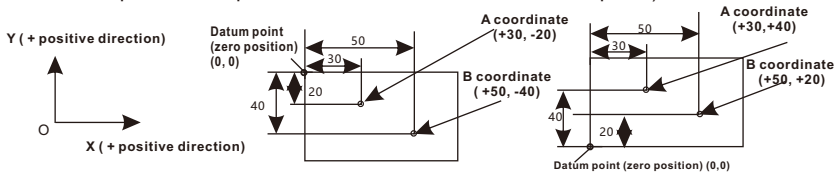
Before using the R Function, operators shall understand as follows.

- 1) the coordinate system and the direction of X, Y and Z axis of the machine ..
- 2) the angle and the polarity of angle.

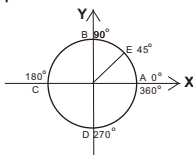
During installation, normally the coordinate of the machine and the direction of X, Y, Z are as per follow. The work plane is shown as the right Figure.



Example: Understand coordinate system. (On any of plate XY, XZ or YZ the coordinate of a point is the position relative to the zero one the plate)



Example: understand the Angle. (On any of plate XY, XZ or YZ both the start angle and end angle of R is calculated in counter-clockwise)



Arc AB (from A to B; the start angle A is 0, the end angle B is 90.)

(From B to A: the start angle B is 90, and the end angle A is 0.)

Arc ED(from E to D; the start angle E is 45, and the end angle D is 270.)

(from D to E: the start angle D is 270, and the end angle E is 45.)

4. Special Functions

4.3.1 SMOOTH R Function

Procedure for using the SMOOTH R function:

Install and fix the workpiece in accordance with figures(A, B, C) and set the TOOL.

1. Move the TOOL to the start point and Clear every axis.
(make the TOOL setting position to the zero).
2. Press $\left[\begin{smallmatrix} \text{PRE} \\ \text{RCL} \end{smallmatrix} \right] \left[2 \right]$ to enter R function and press $\left[\leftarrow \right] \left[\rightarrow \right]$ to select the SMOOTH R function:
3. Select work plan -XY, XZ or YZ plane R
(ARC-XY, ARC-XZ, ARC-YZ)
4. Input the parameter CT POS :
CT POS is refer to the position of the centre of an arc relative to that of the TOOL at TOOL setting and clearing.

When plane XZ or YZ is machined

As shown in figure (b). It refers to the position of point O at the centre of the arc relative to point B of the TOOL when a planar milling TOOL is used.

AS shown if figure (c), it refers to the position of point O at the centre of the arc relative to point C of the TOOL when an arc milling TOOL is used.

When plane XY is machined

As shown in figure (a), it refers to the position of point O at the centre of the arc relative to the central spindle of the TOOL

5. Input the parameter of R (the radius of the Arc)
6. Input the parameter of TL DIA (the diameter of the TOOL)

Note: when Arc on plane XZ or YZ are machined: as shown in figure (b), a planar milling TOOL shall be used to machine R with point B as the machining point, and the diameter of the TOOL has no impact on the machining, so please input the TL DIA = 0.

7. Input the parameter of MAX CUT

Note: For XY plane Arc, MaxCUT = max distance between interplotted points.

For XZ / YZ plane R:

- 1) MAX CUT = max distance between interplotted points in SMOOTH R function
- 2) MAX CUT = Z STEP (fixed increment per step) in SIMPLE R function.

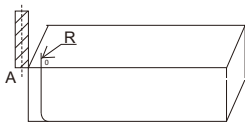


Figure A

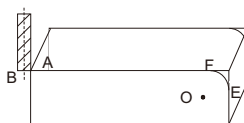


Figure B

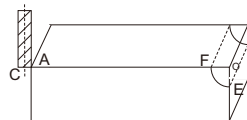


Figure C

8. Input the parameter of ST ANG (the angle of the start point of the Arc)
9. Input the parameter of ED ANG (the angle of the end point of the Arc)

4. Special Functions

10. Press to Select R+TOOL(for outer Arc) or R-TOOL (for inner Arc)
 As shown the right figure: R + TOOL for outer arc and R - TOOL for inner arc

11. After all parameters are input, Press the Key for machining.
 The DRO will display the position for machining. Retract the axes until the displays read 0.000, Machine the Arc point by point in accordance with the display.

Press to quit the Function at any time.

	R + TOOL	R - TOOL
XZ/YZ plane R		
XY plane R		

Example: (for SMOOTH R FUNCTION)

To machine an XY plane R, machining parameters as per follow.

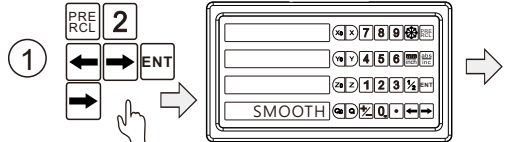
1. Move the TOOL to the start point and clear every axis.
 (Make the TOOL setting position to the zero).
2. Select XY plane R
3. CT POS = (20, -20)
4. R = 20.000
5. TL DIA = 6.000
6. MAX CUT = 0.3
7. STANG = 0
8. EDANG = 90
9. R + TOOL (outer arc machining)

① Press accesses " R function "

Press to select SMOOTH or SIMPLE R Function ,

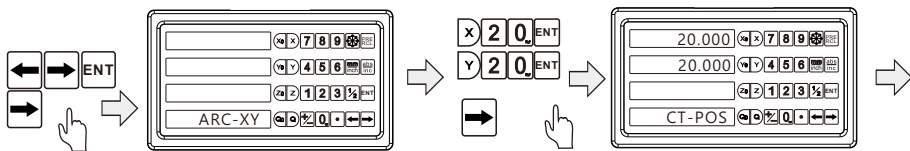
Press assumes .

Press to the next step .

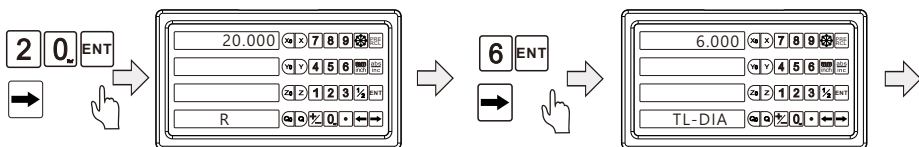


4. Special Functions

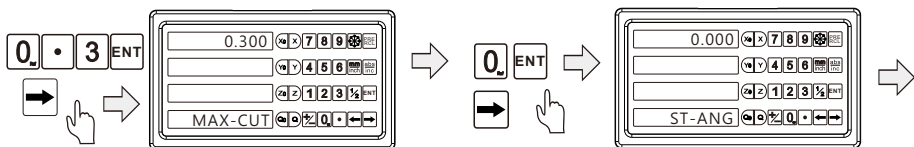
- ② Select work plane XY, YZ, XZ
 Press to select, Press assumes. Press to the next step.
 Press to the next step.



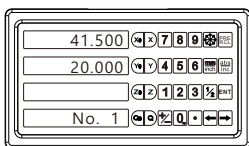
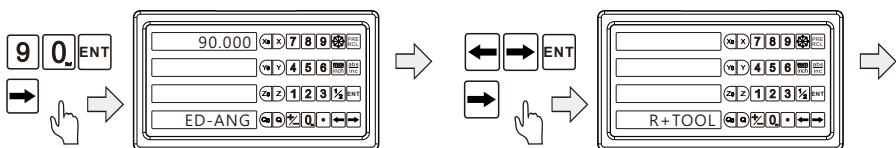
- ④ Input the 2nd parameter R:
 ⑤ Input the 3rd Parameter TL-DIA, then pressing to next step:



- ⑥ Input the 4th parameter MAX CUT, then pressing to next step:
 ⑦ Input the 5th parameter ST-ANG, then pressing to next step:



- ⑧ Input the 6th parameter ED-ANG, then pressing to next step:
 ⑨ Select the machining mode, then pressing to next step:



After inputting all parameters, Press the key for machining. The DRO will display the position of the first point. Move the table until the axis is displayed as zero to get R starting point. Press to quit the Function at any time.

4. Special Functions

4.3.2 The SIMPLE R function

When the smoothness is not highly demanded, the SIMPLE R function is normally used for machining Arc. In the SIMPLE function there are only eight type of ARC used to machine. The operator just select the type of R and input the parameters of the radius of Arc , MAX CUT and outer Arc or inner Arc. In general, an arc may be machined by a planar slot TOOL or arc TOOL , the different between them in different work plane as shown as per follows.

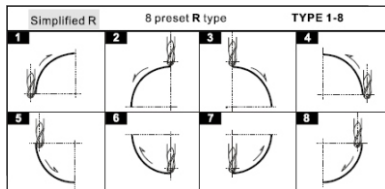


Figure 1: Using a arc lot TOOL for XZ/YZ plane Arc

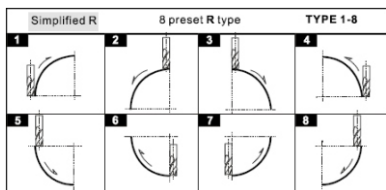


Figure 2: using a planar TOOL for XZ/YZ plane Arc

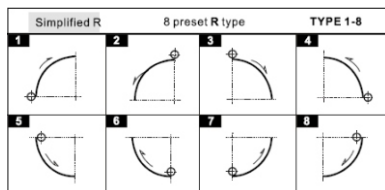


Figure 3: Using two Flute for XY plane Arc

Procedure for using the SIMPLE R function:

1. Make the TOOL over against the arc starting point (refer to the left figure) and clear every axis to make the TOOL setting position to the zero
2. Press $\boxed{\text{PRE}} \boxed{\text{RCE}} \boxed{2}$ to enter R function and press the key $\boxed{\leftarrow} \boxed{\rightarrow}$ to select Simple R function.
3. Select R machining Mode which has been preset as type 1 to type 8.
4. Select XY, YZ or XZ as the machining plane. (ARC-XY, ARC-XZ, ARC-YZ)
5. Input the parameter of A . (the radius of the Arc)
6. Input the parameter of TL DIA. (the diameter of the TOOL)

Note: (refer to step 6 of SMOOTH R Function)
use a planar TOOL to machine arcs on plane XZ or YZ and input TL DIA = 0;

7. Input the parameter of MAX-CUT .

Note: For XY plane Arc, MaxCUT = max distance between interpolated points.

For XZ / YZ plane R:

- 1) MAX CUT = max distance between interpolated points in SMOOTH R function
- 2) MAX CUT = Z STEP (fixed increment per step) in SIMPLE R function

8. Press $\boxed{\leftarrow} \boxed{\rightarrow}$ to select R+TOOL (for outer Arc) or R- TOOL (for inner Arc) (Refer to step 10 of SMOOTH Function for outer arc and inner arc)
9. After all parameters are input, Press the Key $\boxed{\text{ENT}}$ for machining..

The DRO will display the position for machining. Retract the axes until the displays read 0.000, Machine the Arc point by point in accordance with the display.

Press $\boxed{\text{PRE}} \boxed{\text{RCE}}$ to quit the Function at any time..

4. Special Functions

Example: To machine the workpiece as shown Figure

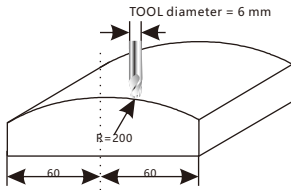
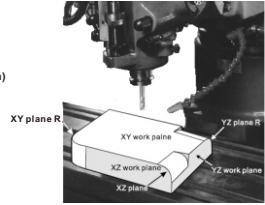
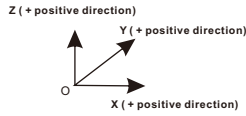


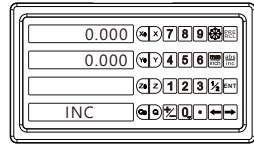
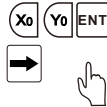
Figure 1:



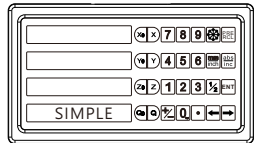
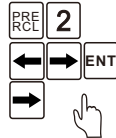
Divide the machining into two parts for using the SIMPLE R function



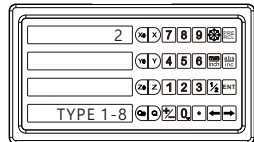
1. Make the TOOL over against the arc starting point (refer to the figure) and clear every axis to make the TOOL setting position to the zero .



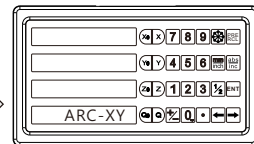
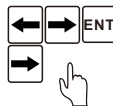
- 2 Press **PRE RCL** **2** accesses " R function " .
 Press **←** **→** to select SIMPLE R Function ,
 Press **ENT** assumes .
 Press **→** to the next step .



- 3 Select preset R type.
 (TYPE 2 for 1st part of workpiece)
 (TYPE 3 for 2nd part of workpiece)

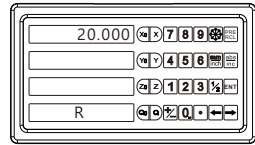
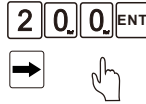


- 4 Select the work plane (ARC_XZ)

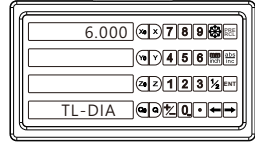


4. Special Functions

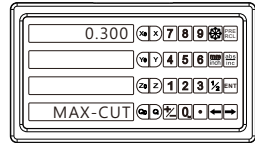
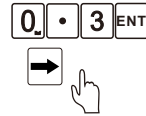
⑤ Input R = 200.



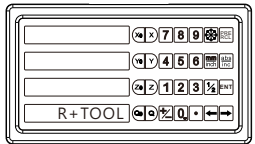
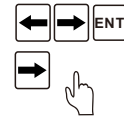
⑥ Input the TL DIA = 6



⑦ Input the MAX CUT = 0.3.



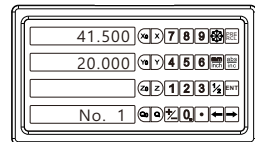
⑧ Select the machining mode of the inner or outer arc.



⑨ After inputting all parameters, Press the key for machining.

The DRO will display the position of the first point. Move the table until the axis is displayed as zero to get R starting point.

Press to quit the Function at any time.

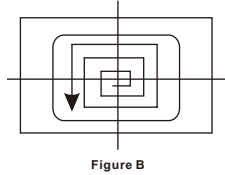
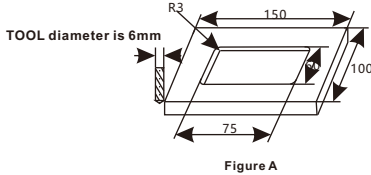


4. Special Functions

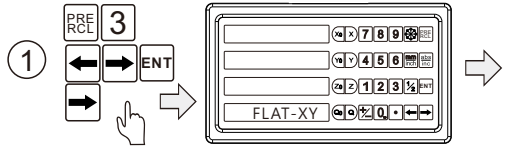
4.4 Chambering (applicable to: Milling machine, Boring Machine)

Enter chambering function. Input parameters: center coordinate, chamber length, chamber width, TOOL diameter.

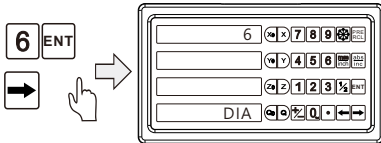
Example: Machining the part chamber shown in Figure A, Align TOOL as Figure A.



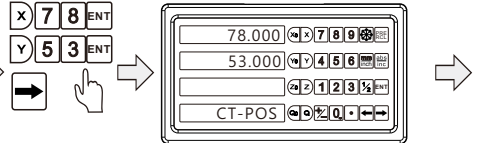
- Press **PRE** **RCE** **3** accesses "Chambering"
 Press **←** **→** to select FLAT-XY, YZ, XZ work plane,
 Press **ENT** assumes.
 Press **→** to the next step.



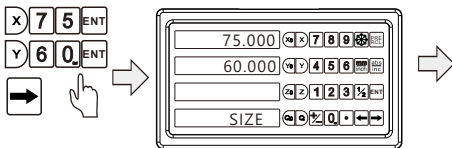
- Input the TOOL diameter
 Press **→** to the next step.



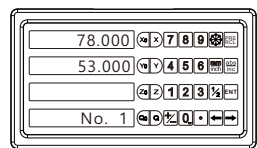
- Input the center coordinate,
 then pressing **→** to next step:



- Input the size,
 then pressing **→** to next step:



- After all parameters are input,
 pressing **ENT** to next step:



Move the machine until the display of the axis is zero, ie, the position of the first point. Machine the first point. Display the next machining point by pressing **→**.

On the completion of machining, the right window shows OVER.

Press **PRE** **RCE** to quit the Chambering Function.

4. Special Functions

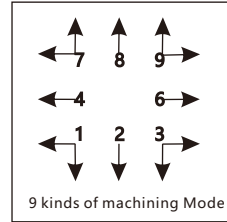
4.5 TOOL compensation Function (Applicable to : Milling machine)

Without TOOL compensation, the operator has to move the TOOL for an additional distance of the diameter of the TOOL along each side when machining the four 150 and 100 sides of a workpiece to finish machining the whole brim. The digital readouts shall automatically compensate when the TOOL compensation function is enable.

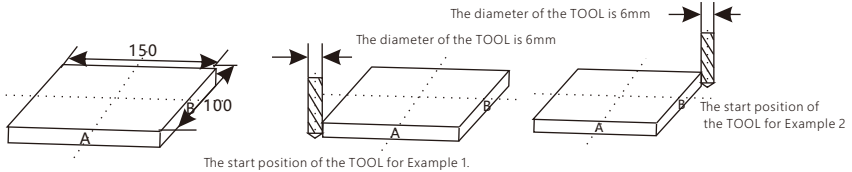
Note: the TOOL compensation is made in the direction of X-axis and Y-axis.

Procedures:

- 1). Enter the function of compensating the diameter of the TOOL.
- 2). Select one of the(four) preset machining modes.
- 3). Input the diameter of the TOOL.
- 4). Enter machining.



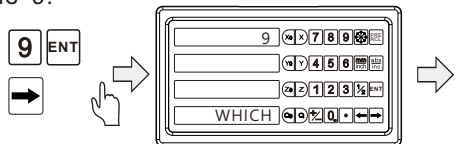
Example: As shown below. Machining the plane A & B of workpiece shown in Figure.



① Press **PRE** **4** accesses "TOOL compensation function"

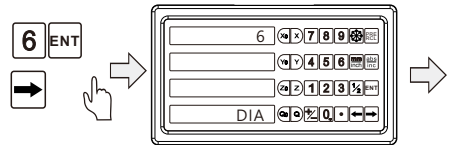
Input the machine Mode , For example 9:

Press **→** to the next step .



② Input the diameter of the TOOL:

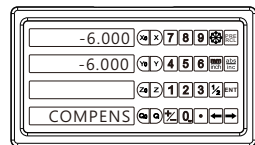
Press **→** to the next step .



Step 4: Press **ENT** to the machining Mode.

Machining of 2 side planes can be done by moving the TOOL until X-Axis is 150.000 and Y-Axis is 100.000.

Press the Key **PRE** to quit the Function.



Enter the machining with the TOOL compensation Function (Example 2 ; WHICH = 9)

4. Special Functions

4.6 Machining of oblique plane (applicable to: Milling Machine)

There are 2 ways available for machining oblique plane:

- a) on the plane XY ; b) on the plane YZ, or XZ.

4.6.1. XY plane

When the machining plane is on plane XY as the part shown in Figure 1, the angle of obliquity of the workpiece should be calibrated before the oblique plane is machined. Therefore, at this point the machining of oblique plane plays the role of calibrating the obliquity.

Procedure for calibrating the obliquity

First place the workpiece on the worktable as per the required angle of obliquity.

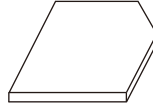


Figure 1

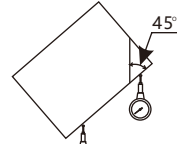


Figure 2

1) Enter the function of oblique plane.

2) Select the function of plane XY .

3) Input the angle of obliquity.

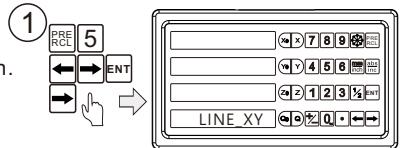
4) Move the worktable until the measuring tool (such as a dial gauge) installed on the milling machine touches the obliquity-calibrating plane, adjust it to zero, and move the worktable for any distance in the direction of X-axis.

5) Move the worktable in the distance of Y-Axis until the display turns to zero.

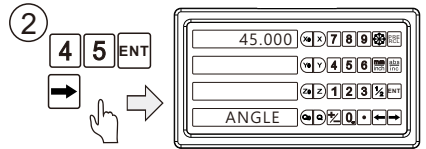
6) Change the angle of the work piece to make the workpiece touch the measuring tool and adjust it to zero.

For example: calibrate the obliquity of the workpiece to 45 degree shown in Figure 2.

- ① Place the work piece on the worktable at the obliquity of about 45 degree. Press **PRE RCL** **5** to enter the Machining of Oblique Plane Function. Press **←** **→** **ENT** to select X Y plane



- ② Input the angle of obliquity.

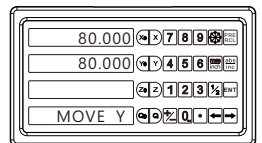
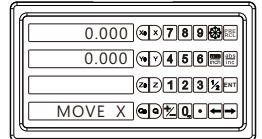


- ③ Move the workpiece along the X-Axis until the measuring tool touches the workpiece adjust it to zero, and move the worktable for any distance along the X-Axis.

Step 4: Press **Y**, display the value of Y-Axis. Move the workpiece along the Y-Axis, change the angle of workpiece to make the obliquity-calibrating plane touch the measuring tool until it turns to zero.

Move the worktable until Y-Axis is displayed as zero.

Press **PRE RCL** to quit at any time.



4. Special Functions

4.6.2 XZ or YZ plane

When the machining plane is on plane XZ or YZ, the function of TOOL inclination can instruct the operator to machine the oblique plane step by step.

Procedures for using the function of cutter inclination:

When the machining plane is on plane XZ or YZ, first please calibrate the obliquity of the primary spindle nose and set the TOOL

- 1) Select the machining function
- 2) Input the starting point (ST POS)
- 3) Input the end point (ED POS).
- 4) Input the diameter of the TOOL (DIA).
- 5) machining the oblique plane.

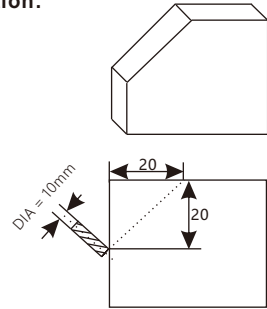
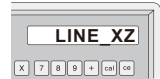


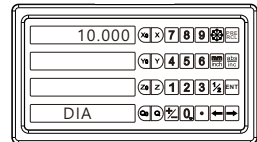
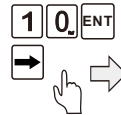
Figure 1

For example: machining the obliquity of the workpiece to 45 degree on XZ plane shown in Figure 1.

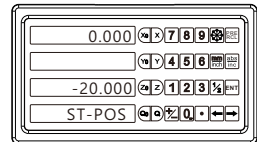
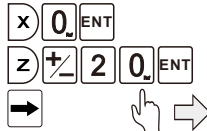
Step 1: Press **PRE RCL** **5** to enter the Machining of Oblique Plane Function.
Press **←** **→** **ENT** to select XZ plane



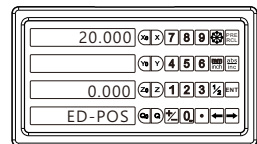
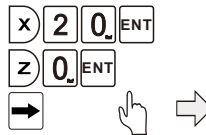
Step 2: Input the parameter DIA (the diameter of the TOOL)



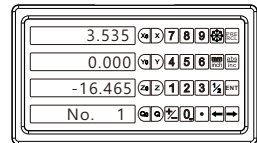
Step 3: Input ST POS (the starting coordinate)



Step 4: Input ED POS (the end coordinate)



Step 5: After input all parameters, press **ENT** to enter the machining state. AS shown right The displayed value is the coordinate of the first point. Move the Machine TOOL until X-Axis and Z-Axis are all displayed as zero. Repeat it until over.
Press **PRE RCL** to quit this function at anytime.

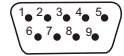


5. Appendix

5. Appendix

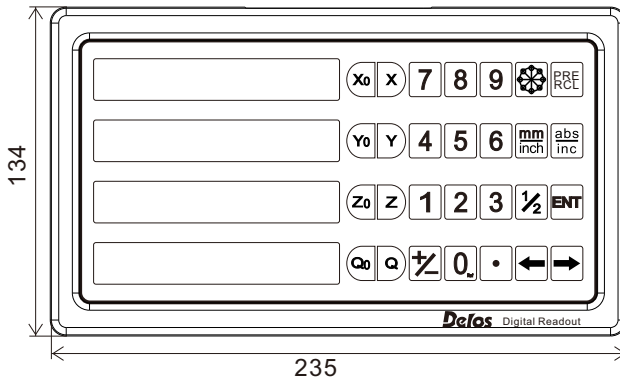
5.1 Mechanical and Electrical Features

DSUB-9



Resolutions for Linear Scale	10--0.1um	pin	PP signal	EIA422 signal
Resolutions for Rotary Encoder	0.001--1"	1	—	\bar{A}
Power Supply	100VAC--230VAC±10% /15 VA	2	OV	OV
Axis Display	7 Segment LED H = 17mm	3	—	\bar{B}
Signal input per axis	A / B quadrature signals	4	GND	GND
Maximum input frequency	500KHz	5	—	\bar{R}
Operating Temperature	0° – 50°	6	A	A
Storage Temperature	-20° – 70°	7	5V	5V
Relative Humidity	95% (not condensed)	8	B	B
Vibration Resistance	25 m/s ² (55 – 2000Hz)	9	R	R
Protection Class(EN60529)	IP42			
Weight	2.1 Kg			

5.2 DIMENSIONS



5. Appendix

5.3 Troubleshooting:

The following are the preliminary solvents for troubleshooting.

If there is still trouble, Please contact out company or agents for help.

Troubles	Possible reasons	Solvents
No display	<ol style="list-style-type: none"> 1. Power isn't connected 2. Power switch is off. 3. The range of power voltage is not right. 4. The inner power of Linear Scale is short. 	<ol style="list-style-type: none"> 1. Check power wire and connect the power 2. Turn on the power switch. 3. The range of voltage is in 80--260V 4. Unplug the connector of linear scale
One axis is not counting	<ol style="list-style-type: none"> 1. Replace the linear scale of the other axis. 2. DRO is in special function 	<ol style="list-style-type: none"> 1. If count is normal, the linear scale has trouble; If abnormal, the DRO readouts has trouble. 2. Quit the special function.
Linear scale is not counting	<ol style="list-style-type: none"> 1. Reading head is bad for using range exceeds. 2. Aluminum chips is in reading head of linear scale. 3. The span between the reading head and metal part of linear scale is large. 4. The metal parts of linear scale is damage. 	<ol style="list-style-type: none"> 1. Repair the linear scale 2. Repair the linear scale 3. Repair the linear scale 4. Repair the linear scale
Counting is error	<ol style="list-style-type: none"> 1. Shell is poor grounding. 2. Low precision of machine . 3. Speed of machine is too rapid. 4. Precision of linear scale is low. 5. The resolution of DRO readouts and the linear scale is not match. 6. The unit (mm/inch) is not match. 7. Setting the linear compensating is not arrest. 8. Reading head of the linear scale is damaged. 	<ol style="list-style-type: none"> 1. Shell is good grounding. 2. Repair the machine. 3. Reduce the speed of machine. 4. Mount the linear scale again. 5. Set the resolution of the DRO again. 6. Cover the unit of display mm/inch. 7. Reset the linear compensation. 8. Repair the linear scale.
The counting of the linear scale is not accurate	<ol style="list-style-type: none"> 1. The mounting of linear scale does not demand the requirement, and the prcision is not adequate. 2. The screw is loosen. 3. Precision of machine is low. 4. The resolution of digital readouts and the linear scale is not match. 	<ol style="list-style-type: none"> 1. Mount the linear scale again and level it. 2. Lock all fixing screws. 3. Repair the machine. 4. Reset the resolution of digital readouts.
Sometimes the linear scale is not counting	<ol style="list-style-type: none"> 1. The small car and steel ball is separated. 2. The glass of reading head is wearied. 3. The glass of reading head of the linear scale has dirt. 4. The elasticity of the steel wire is not adequate. 	<ol style="list-style-type: none"> 1. Repair the linear scale 2. Repair the linear scale 3. Repair the linear scale. 4. Repair the linear scale.

