STERLING

SDS6

DIGITAL READOUT

Operation Manual

Dear User:

Thank you for purchasing digital readout from Sterling. You have made an excellent choice and we would like to draw your attention to a few points below to ensure you enjoy trouble free operation.

Please read the following safety instructions and precautions for safe operation of your new digital readout.

When using the manual:

- Chapters and sections are listed in the table of contents (see P5).
- This manual includes some instructions for panel keys of SDS6 digital readout and other series, including.

SDS6-2V	the readout used for 2 axis milling machine and grinding machine and lathe machine
SDS6-3V	the readout used for 3 axis milling machine and lathe machine and EDM machine

---

Safety Precautions:

Caution:

- Do not splash coolant directly onto the unit to avoid risk of electric shock or fire.

Warning:

- Do not open the enclosure, there is no element repairable by the user inside. Please return unit to your dealer / service department for repair.
- If the unit is not used for a long time, the chargeable lithium batteries for data retention may be damaged. Please contact agent or professional technicians for battery replacement when required.

Notes:

- Disconnect power plug promptly if the digital display meter emits smoke or peculiar smells, an electric shock or fire may be caused if continuing to use it. Please contact you dealer and never attempt to repair by yourself.
- The digital readout constitutes a precision detection device with an optical electronic scale. Once the connecting wires between the two parts are broken or damaged during use, error in signal data may caused, to which the user should pay special attention.

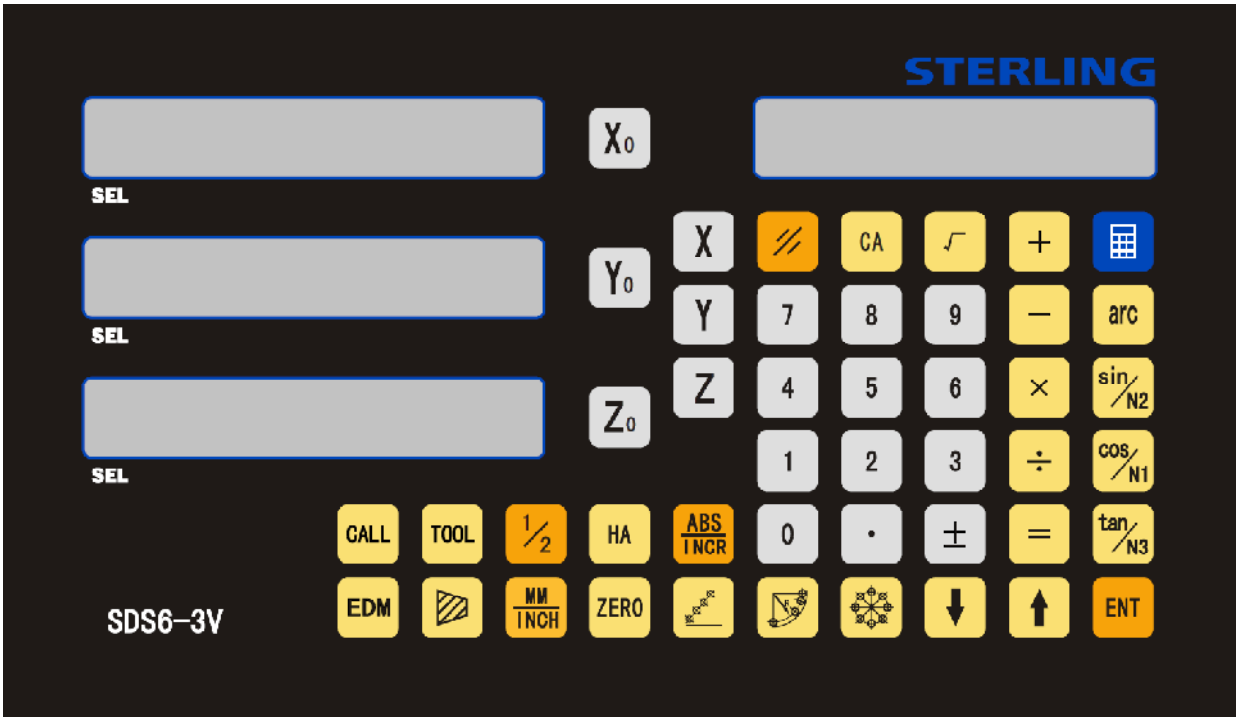
- Do not repair or refit the digital display by yourself, damage might be caused. In case of abnormality, please contact your dealer.
- If the optical scale used with the digital counter is damaged, do not replace it with other brand of scale as different companies have their respective characteristics and wiring. Never make wiring without the guide of professional technicians or the digital counter / scale may be damaged.

CE The displacement sensor complies with 2006/95/EC directive for low-voltage electric apparatus and 2004/108/EC directive for EMC.

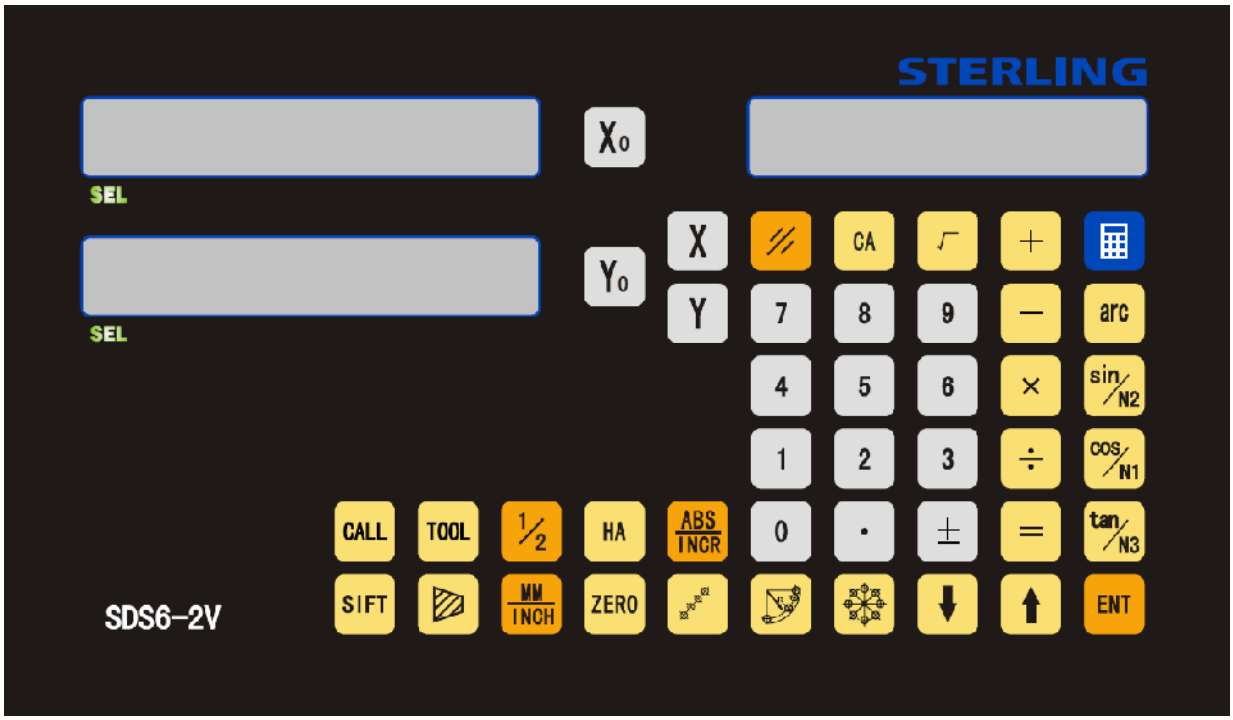
Our manufacturing company has passed the authorization and the audit of ISO9001 Quality System, ISO14001 Environmental System, OHSAS18001 Occupational Health and Safety System.

Notice: We reserve the right to make continual upgrades which may change operation or specification slightly without prior notice.

SDS6-3V READOUT PANEL AND KEYBOARD



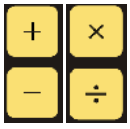
SDS6-2V READOUT PANEL AND KEYBOARD



Quick Function Key Guide.

Keys for Axis selection

Entry keys for digits



Operation Key (in Calculation function key)

Calculation function key (Calculator mode)

Input (calculation result) canceling key(in Calculation mode)

Key for “Inverting” TrigonometricFunctions (in Calculation mode)

Square root calculating key (in Calculation mode)

Entry key for decimal point

Entry key plus or minus symbol

Key for entering data

Key for clearing the displayed value to zero

Function key for halving

Key for metric / imperial conversion

Function key for Sleep

Function key for 200 zero Position memory

R angular ARC function key (ARC Function key)

PCD Function key (for equally dividing bolt circle)

Function key for drilling holes along an oblique line

Angular surface processing function key; In calculation mode as sine trigonometric function key

Progressive inner chamber processing function key; In calculation mode as cosine trigonometric function key

Tool compensation function key; In calculation mode as tangent trigonometric function key

Key for the conversion of Incremental /absolute display

Keys for the selection of Upper / lower term or plane processing

Key for taper measure function

Key for calling 200 tool storeroom

Key for input 200 tool storeroom

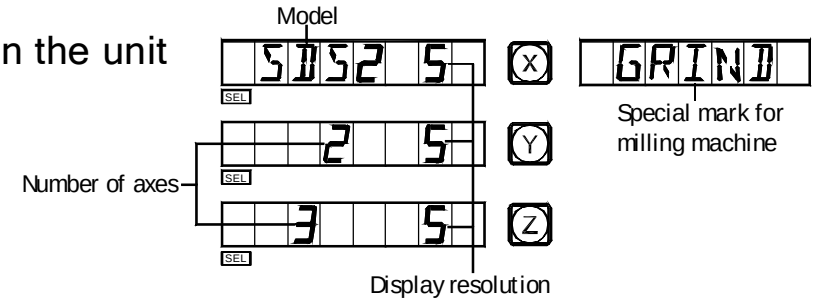
Function key for machine output (EDM)
（only SDS6-3V readout）

Function key for data filtration
（only SDS6-2V readout）

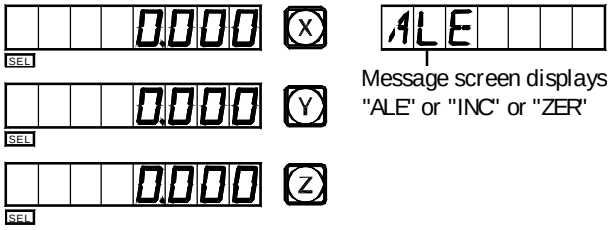
I. Settings

1. Start, Self check

1) When power is turned on the unit will start a self check.



2) When self check completes, DRO enters working mode



Note: Two axis readout only has X-axis and Y-axis, three axis readout has X-axis, Y-axis and Z-axis. Lathe readout will display “LATHE”; grinding machine readout displays “GRIND”; multifunctional milling machine readout displays “MILL_MS”; universal milling machine readout displays “MILL_M”; the EDM discharging readout displays “EDM”.

2. Setting of System

In process of self check, key ⊙, then the system enter setting mode after self check finished.

1) Setting axis X resolution.

Set different resolutions according to different numbers.

Number key	0	1	2	5	7	8	9
Resolution(um)	10	1	2	5	0.1	0.2	0.5

Key ENT ⇩ next step

2) Setting axis Y resolution.

Repeat same procedure as X axis.

Key ENT ⇩, next step

3) Setting axis Z resolution.

Repeat same procedure as X axis.

Key [ENT] → [⇩], next step

4) Setting count direction of axis X linear encoder.

Key [0] as positive count direction.

Key [1] as negative count direction.

Key [ENT] → [⇩], next step

5) Setting count direction of Y axis encoder.

Repeat same procedure as X axis.

Key [ENT] → [⇩], next step

6) Setting count direction of axis Z encoder.

Repeat same procedure as X axis.

Key [ENT] → [⇩], next step

7) Choose machine type

[0] multifunctional milling machine readout
[1] universal milling machine readout
[2] discharging processing readout
[3] lathe machine readout

key [ENT] [⇩], next step

8) Choose whether to integrate Y-axis with Z-axis (axis summing)

press [0] or [1] activate the function.

“NONE” means no integration

"INGREAT" means integration and the integrated value will be displays in Y-axis.

Press [ENT] → [⇩] next step

Note: only 3 axis lathe DRO has this function.

9) Choose compensation type

[0] choose linear error compensation "LINEAR";

[1] choose segmented error compensation "SEGMENT";

Press [ENT] → [⇩] next step

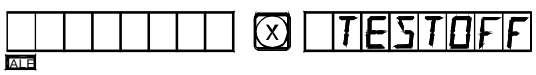
10) Choosing the precision of calculation

[3] decimal fraction of calculation is 3;

[4] decimal fraction of calculation is 4;

[5] decimal fraction of calculation is 5;

11) Self test.

Key [⇩] twice, to start Self-test program 

then [·] key to quit.

(Note: Setting of axis Z only applies to three axis digital readout.)

Index

A.

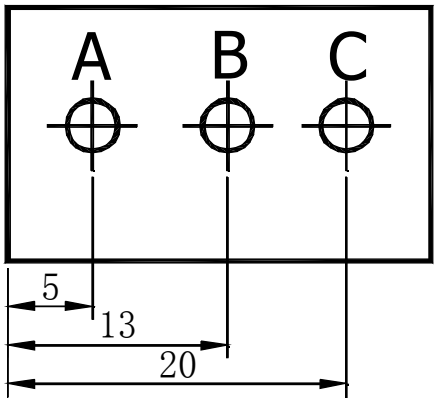
Basic Functions

1. Resetting axis value to zero

1) It is possible to reset to zero at any point by pressing [X0]

2) Or Key [X] → [⁄]

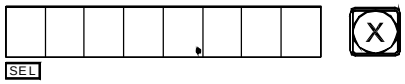
2. Axis Presetting



1) As shown in the figure, after drilling hole A, if the position of the working piece has moved and hole A is used as a datum.

2) Align the Tool with Hole A.

3) Select the key for axis, key [X].

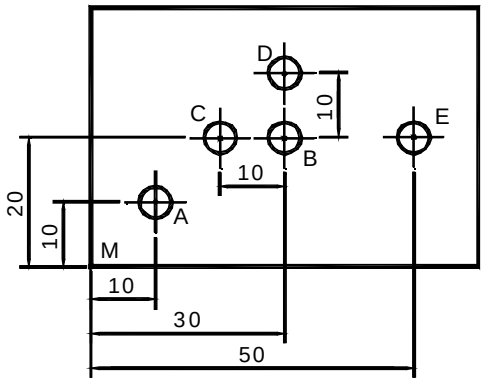


4) Key [5],to enter value (If entered value is wrong, key [X] and enter correct value

5) Key [ENT], (If any mistake, repeat 3 - 5).

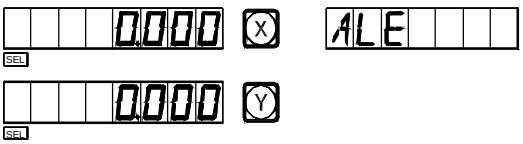
6) Move the machine table to the position of 13, and the hole B can be drilled.

5. Absolute/incremental coordinate display mode.

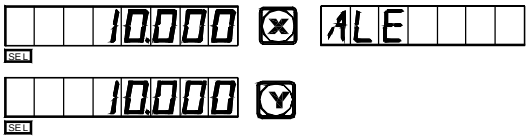


Key [⇧] [⇩] absolute/relative display mode will convert automatically, see following example.

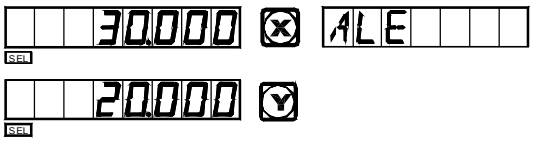
1) Reference datum point M and reset under the absolute mode.
Key ⇧ or ⇩
Key X → ⁄⁄
Y → ⁄⁄



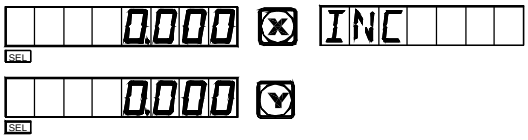
2) Move the machine tool to Position A.



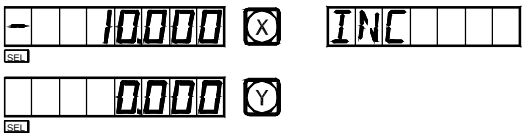
3) Move the machine tool to Position. B.



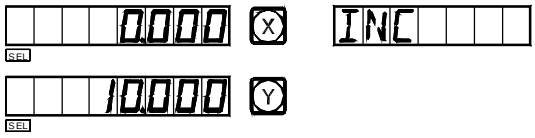
4) Key ⇧ → X → ⁄⁄
Y → ⁄⁄



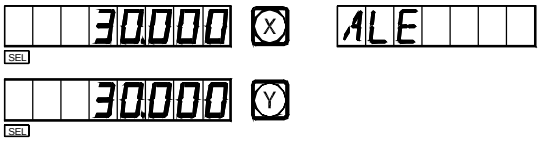
5) Move the machine tool to Position C.



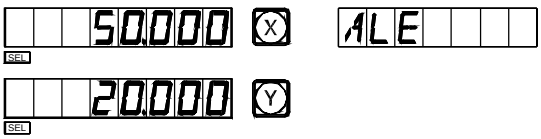
6) Move the machine tool to Position D.



7) Return to the absolute mode ⇩

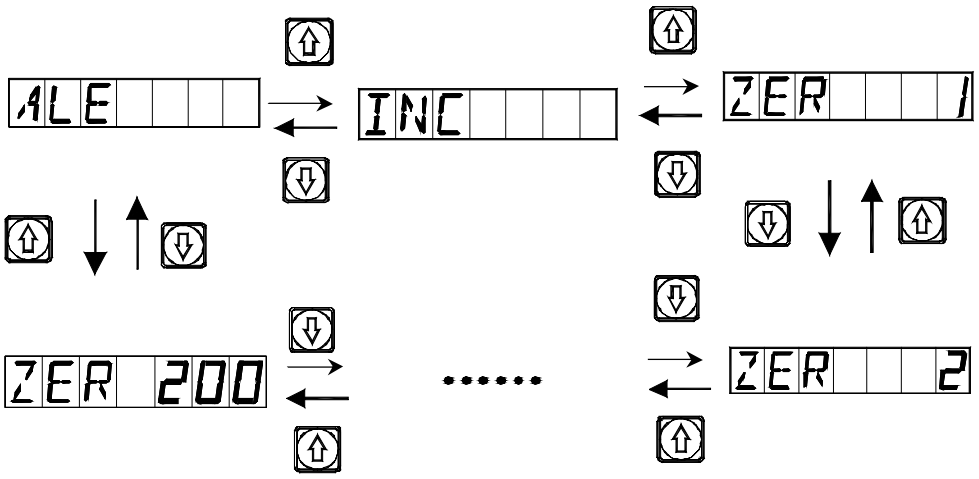


8) Move the machine tool to Position E.



Note: Resetting absolute and incremental display mode must be done separately. In absolute display mode, "ALE" is displayed on Message Screen and "INC" is displayed for incremental mode.

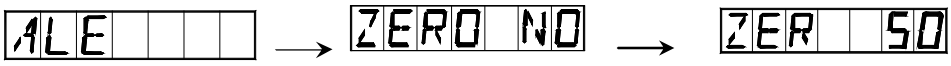
Keying ⇧, ⇩ can also activate conversion between the two display modes. It is also possible to enter the display mode of 200 sets of user coordinates as shown in the following diagram.



Or

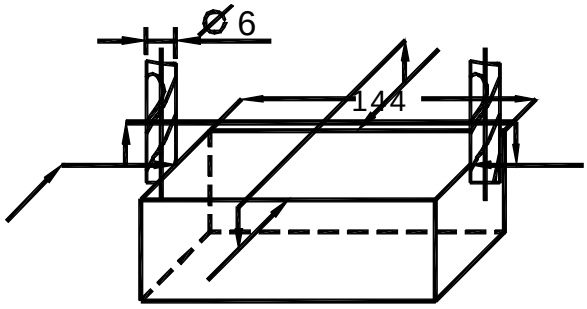
Key ZERO and enter the coordinate number directly.

Enter the number



⇩ Key digit keys, such as 5 0 ENT

6. ½ Centering Function



As shown in the figure, the center between two points can be found.

1) Touch the tool on one edge of the workpiece and reset X-axis display value to zero, move tool along direction of arrow and touch other edge of workpiece, follow steps below to determine center position.

2) Key axis key X

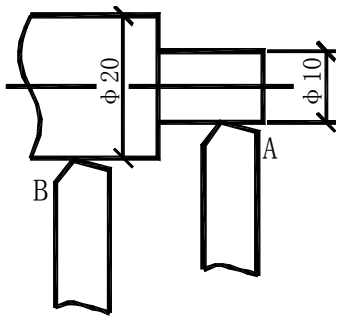
3) Key ½

4) Move the machine tool until axis display value is zero; the center position is reached. (Same method can apply to Y and Z-axis).

Note: Lathe DRO does not have this function.

7. Radius/Diameter mode on lathes.

X axis datum on the center line.



1) Cutting tool in position A.

2) Key [X] → [½]

3) Move tool to position B.

4) Key [X] → [½]

Note: only lathe mode has this function; The "SEL" indicator means diameter display - applies to X axis only.

8. Switching between summing axis display mode.

In Y/ Z axis summing mode, pressing [arc] can switch the display mode.

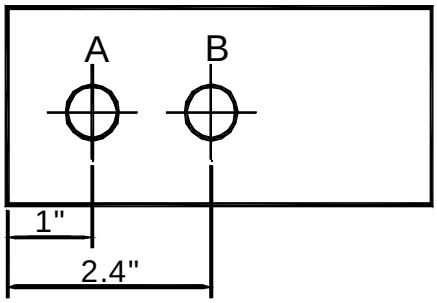
1) if the former display mode is summing, press [arc] switch to separate mode.

2) if the former display mode is separated, press [arc] switch to summing mode.

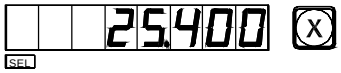
Note: only lathe DRO has this function, summing option parameter must be set; only Z axis displays value and cannot be preset or cleared.

9. "MM/INCH" Metric / Imperial Conversion Display.

Key [MM/INCH], the value displayed will toggle between mm and inch mode with automatic conversion.



1) Standard display is in the mm mode,
if display in inch is required:



2) Key [MM/INCH]

3) Key [⇩] or [⇧] to select decimal places;
（4 bits or 5 digits）
Key [ENT]

4) Enter processing mode of Hole B

5) Key [MM/INCH] can convert directly to mm System

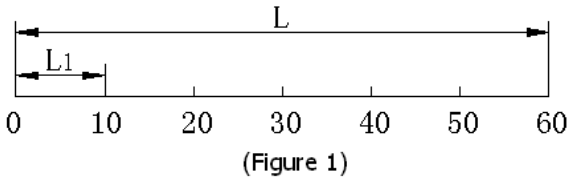
10. Segmented error compensation

Note: Segmented error compensation can only be applied in metric mode. After segmented error compensation, the display can be converted freely between metric system and imperial systems.

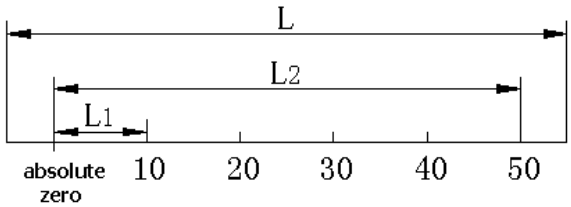
There are two methods for segmented error compensation of the digital display meter:

1. To carry out error compensation taking the start point as the mechanical origin. (Figure 1)

2. To carry out error compensation taking the first absolute zero of the linear scale as the mechanical origin. (Figure 2)



(Figure 1)



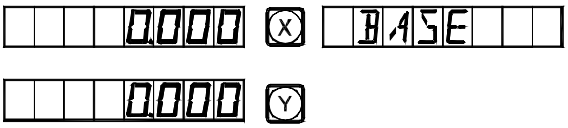
(Figure 2)

L: The distance of effective range of linear scale

L1: Length of the compensation segment

L2: Effective distance of the compensation segment

1. Set up according to the sketch map 1. The parameter set-up method is as follows:



1) Move the linear scale to the smallest end of the coordinate data, enter into the ALE right-angle coordinate system.

2) Press X → MAN TMCH , enter into the input function of multi-segment compensation of X axis (set-up method for Y and Z axis is the same).

3) Input the quantity of compensation segments

(Figuer 1):

Press

(Figuer 2):

Press X 5 ENT

Press ⇩ next step

Remarks: The quantity of compensation segments of any axis is input in X axis.

4) Input the length of compensation segments

Press X → input compensation length value → ENT

Press ⇩, next step

5）Find the mechanical origin

There are two methods for setting the compensation origin.

1、directly press ENT to choose the current position as origin.

2、Press HA → ENT to choose the 1st absolute zero of the linear scale as the mechanical origin.

Move towards the positive direction of X axis of the machine tool and search for the 1st absolute zero of the linear scale as the mechanical origin. After finding the origin, then auto enter the next step for data input. This time the X-axis displays the linear scale fact value, and Y-axis displays the former compensation value (if first time for compensation, the Y-axis displays an uncertain value).

6) Input compensation setup of the 1st segment

At this time, first move the

X-axis linear scale towards the positive direction. When the linear scale is moved around the length of the compensation value（the compensation length in Step 4 is ±0.5mm）, the display of Y axis is dimmed and enters into status value setting mode, at this time input the exact value measured (this method is implemented in every set-up point)

Press 1

（When press ENT ,Y-axis will display the X-axis's value, and that means the compensation value has been setup. If the value input is wrong, don't move the linear scale and press ⇧ then press ⇩ this time the display of Y-axis will be in input state, and input the right value again.）

Press ⇩ and enter into the next set-up point

coordinate value

Remarks: In this function, the display of X axis is the coordinate value, while Y axis displays the standard value or the actual real measurement value.

The standard value or the measurement value by laser

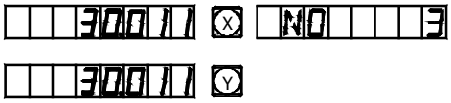
7) Input the compensation setup of the 2nd segment

Press 2 → 0 → ENT

Press ⇩, enter into the next set-up point

8) Input the compensation setup of the 3rd segment

Press 3 → 0 → ENT



Press ⇩, and enter into the next set-up point

9) Input the compensation setup of the 4th segment

Press

Press ⇩, and enter into the next set-up point

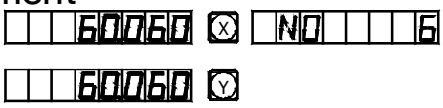
10) Input the compensation setup of the 5th segment

Press

Press ⇩, and enter into the next set-up point

11) Input the compensation setup of the 6th segment

Press 6 → 0 → ENT



After the setup is finished, press MM/INCH key to exit.

Remarks: The input zone for compensation value of Y and Z axis is the coordinate display of X axis.

2. Cancellation of segmented compensation value

Segmented compensation is valid only for a set of DRO, linear scales and machine tool together. If a linear scale or DRO is moved to another machine tool, it needs to be reset. If segmented compensation function is not needed, it can be cancelled as follows:

According to the set-up method of segmented compensation indicated above, when entering the quantity of compensation points, input 0. At this time, all previous compensation values are cancelled automatically.

3. Finding the function of the mechanical origin

If the linear scale is moved without power to the DRO the mechanical origin needs to be found again. Because of movement without power the coordinate origin of the machine tool won't match the value in the DRO. If the mechanical origin is not found, the misplaced relationship is brought into the coordinate system.

The method of finding mechanical origin is as follows:

1.Move the linear scale to the position which is initially set up as the mechanical origin, and then set up segmented compensation. When inputting the quantity of compensation segments and the compensation length, do not make any change, and press ⇩ to skip. Enter into the interface for choosing compensation method, press ENT. At this time,

directly press MM/INCH to quit compensation setup and finish finding the mechanical origin.

2. First move the linear scale to the smallest value, and then set up segmented compensation. When inputting the quantity of compensation segments and the compensation length, do not make any change, and press ⇩ .directly to skip. Enter into the interface for choosing compensation method, press HA → ENT to enter X axis to find the status of absolute zero. Move the linear scale towards the positive direction. When the absolute zero is found, it is the mechanical origin. The DRO processes automatically. At this time, press MM/INCH key to quit the compensation setup and finish finding the mechanical origin. (Remarks: It is applicable to setting up parameters according to sketch map 2)

Note: After finding the mechanical origin, the user-coordinate will resume.

Advise: find the mechanical origin before starting to work after power on to ensure coordinate origin of the machine tool matches the value in the DRO.

11. Linear Error Compensation

Linear error compensation function is used to make linear correction of errors.

Correction factor S =(L-L')/(L/1000) mm/m

L---the actual measured length (mm)

L'---the displayed value on DRO (mm)

S---the actual factor (mm/m), "+" means actual length is larger, and "-" means actual length is smaller.

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

Example: The actual measured length of the machine table is 1000 mm, and the display value on the DRO is 999.98 mm.

S=(1000-999.98)/(1000/1000)=0.02 mm/m

1) Select the axis (X)

2) Key (MM/INCH)

coefficient used last time

3) Key in the new correction factor:

(0) → (.) → (0) → (2)

4) Key (ENT)

Note: Linear error compensation can only be carried in absolute display mode (ALE) and in metric system.

12. Power Interruption Memory

During processing of a work piece, you may temporarily turn off power and the DRO will automatically store the working state (such as working mode in each axis, displayed position, and linear error compensation factor). When power is resumed, after self checking, the DRO will recover to its working state and previous displayed position values will be restored.

13. Hibernate Axis, HA, "sleep mode" (not applicable to 3 axis DRO)

Pressing (HA) will enter put the DRO in a sleep mode. Press (HA) again to restore axis display. The DRO must be in incremental mode, INC, to activate sleep. While in Hibernate Axis mode, the DRO will still track linear scale positions, so the table can be moved without losing position. Note the DRO remains in a power on state in this mode.

B.

Smooth R Function

Smooth R Arc Calculation function (ARC Function)

The advanced smooth R arc calculation function makes it possible to machine a radius quickly and easily with a universal milling machine. The function makes it possible to control smoothness of the arc by setting the distance between two adjoining working points.

① The message window display prompts the operator to enter all the parameters, so it is very easy to operate.

②The arc can based on the input maximum cut (MAX CUT) and calculates the proper depth of cut / step, so arc smoothness is under operator's control.

1) An operator without experience must first gain a clear understanding of the coordinate system as shown in Fig 1 below.

Note: The arrow direction indicates positive direction of coordinate axes.

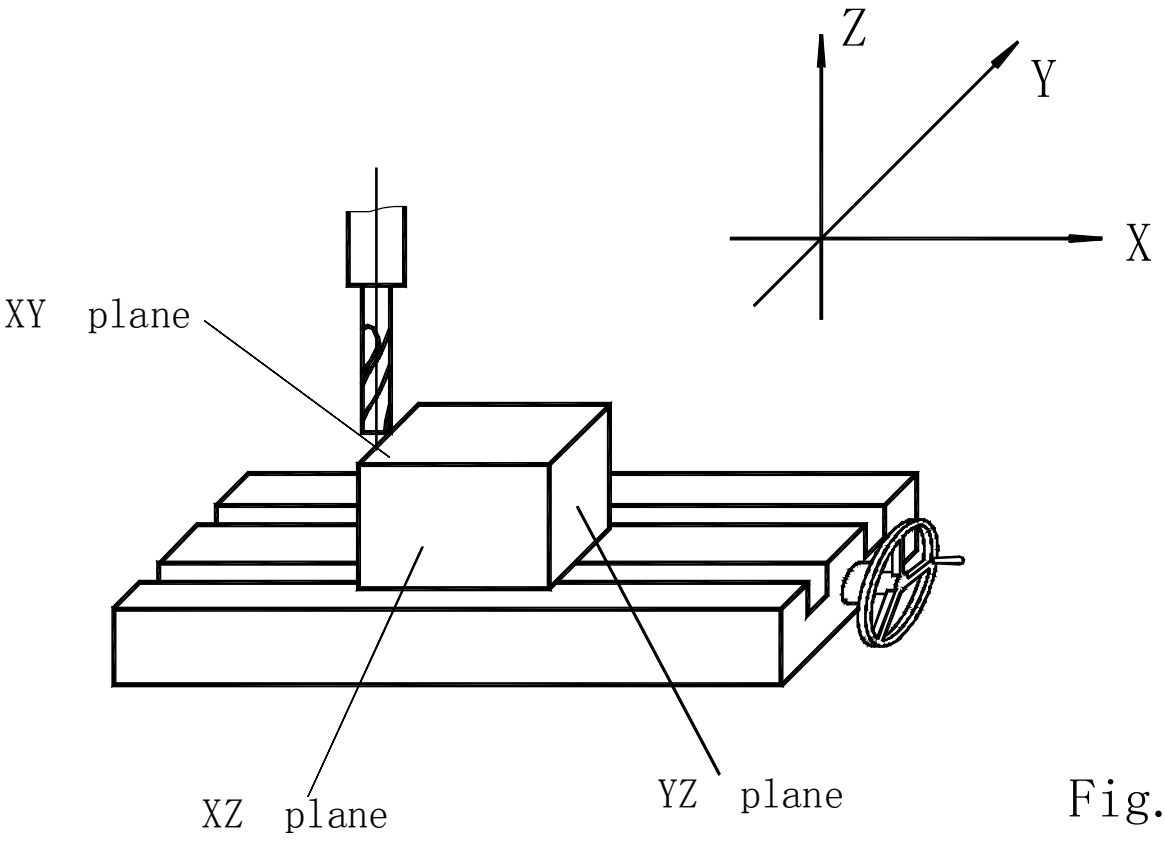


Fig. 1

2) First, review the plane, coordinates and the start / end angles of a an arc.

In Plane XY、XZ or YZ, the coordinate of a point is its position with respect to the zero point on that plane.

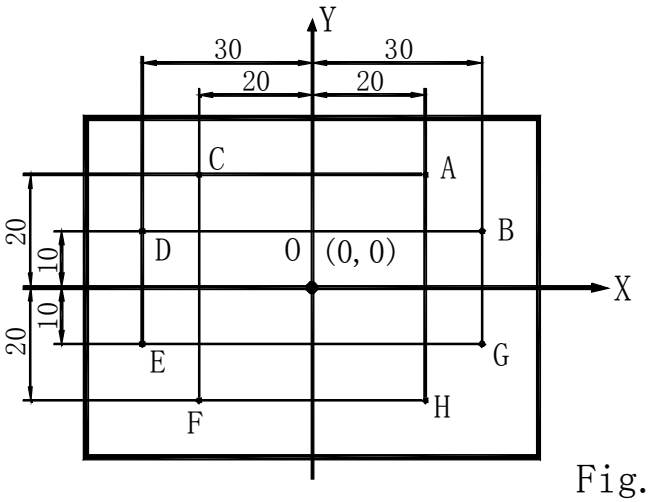


Fig. 2

The coordinate of zero point O:(0,0)
The coordinate of Point A:(20,20)
The coordinate of Point B:(30,10)
The coordinate of Point C:(-20,20)
The coordinate of Point D:(-30,10)
The coordinate of Point E:(-30,-10)
The coordinate of Point F:(-20,-20)
The coordinate of Point G:(30,-10)
The coordinate of Point H:(20,-20)

In Plane XY、XZ or YZ, the start and end angle of a circular arc is counted in anti clockwise. As shown in Fig. 3:

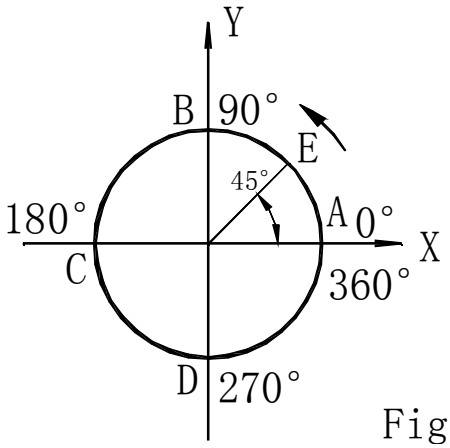


Fig. 3

Arc AB
- From A to B 0° 90°
- Form B to A 90° 0°

Arc BC
- From B to C 90° 180°
- From C to B 180° 90°

Arc CD
- From C to D 180° 270°
- From D to C 270° 180°

Arc DA
- From A to D 360° 270°
- From D to A 270° 360°

Arc BE
- From E to B 45° 90°
- From B to E 90° 45°

3) As shown in figures (a) (b)and (c) below, reset all axes after finishing the installation of tool and related tool setting (assign the position of tool after tool setting as the zero point).

Key , to enter the Arc R Calculation function.

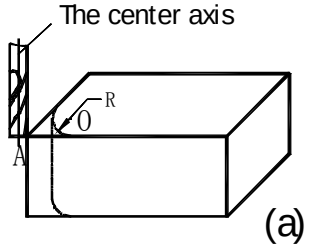
1. Select the smooth R function (SMOOTH).

2. Select the processing plane XY, XZ, or, YZ.

(ARC-XY)

(ARC-XZ)

(ARC-YZ)



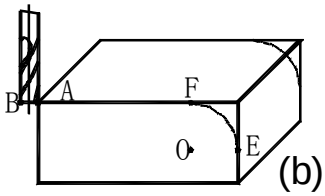
(a)

3. Enter the center position of the arc:(CT POS)

The center position of the circular arc is the position of the circle with respect to the position of the tool just after tool setting and reset.

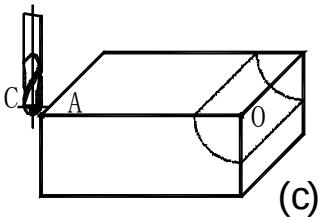
In the processing the arc in XZ or YZ plane:

As shown in Fig. (b) when a flat end milling tool is used, the circle center position is the position of Point O with respect to Point B on the tool.



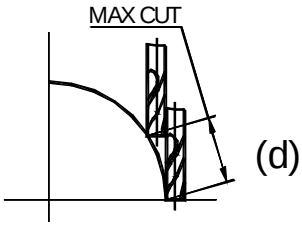
(b)

As shown in Fig. (c) when a circular arc milling tool is used, the circle center position is the positio of Point O with respect to Point C on the tool.



(c)

In the processing of the arc in Plane XY, as sho in Fig. (a), the circle center position is the position of the center axis of the tool.



(d)

4. Enter the radius of the circle (RADIUS)

5. Enter the diameter of the tool (TL DIA)

Note: In the processing of the arc in Plane XZ or YZ, as show in Fig. (b) an end mill is used and the working point is Point B, the diameter of the

tool does not factor in the processing, enter (TL DIA) =0.

6. Enter the maximum cut (MAX CUT)

When this function is used the step of every cutting feed is uniform, as shown in Fig. (d).

7. Enter the start angle of the circular arc (ST ANG)

This determines the position of the first cut feed in the processing of circular arc. As show in Fig.(b), the start angle is 0° if the arc is to be processed from Point E to Point F, and 90° when from F to E.

8. Enter the end angle of the arc (ED ANG)

This determines the position of the last cut feed in the processing of circular arc. As shown in Fig. (b), the end angle is 90° if the arc is to be processed from Point E to Point F, but 0 when from F to E.

9. Determine inner/outer circle mode:

For outer circular arc, as shown in Fig. (b), RAD+TL.

For inner circular arc, as shown in Fig. (c), RAD -TL.

10. Move the machine tool to the start point of the processing in following with the display on axes, and then start the point by point processing.

11. You can quit the Arc R Calculation function by pressing  **.**

(Ⅰ) *Taking the the arc shown in the figure in page 22 as an example.

1) At first, finish tool setting, reset, key  ,
and enter ARC function.

2) choose smooth function

press ⇩ SIMPLE

press ⇩ SMOOTH

press ENT SMOOTH

（only 2V readout has this setting; 3V model readout has only smooth R function and therefore go directly to next step）

3) Select processing plane

ARC-XY

Key ⇧ or ⇩

ARC-XZ

ARC-YZ

4) Select Plane XY

Key ENT ARC-XY

5) Enter the position of the circle center.

CT POS

If finish the tool setting as shown in Fig. (a).

Key X → 4 → 2 → · → 5 → ENT 42.500 X CT POS

Y → 2 → 2 → · → 5 → ENT 22.500 Y

Key ⇩

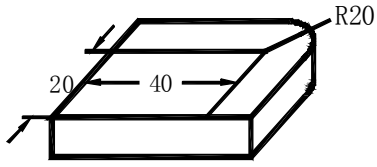
If finish the tool setting as shown in Fig. (b).

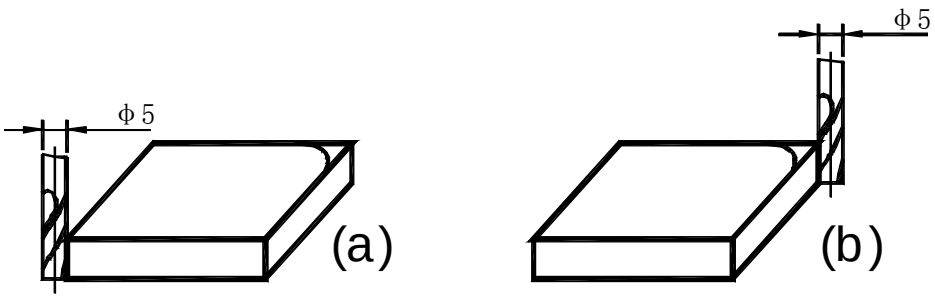
Key X → 2 → 2 → · → 5 → ± → ENT

Y → 2 → 2 → · → 5 → ± → ENT

Key ⇩ -22.500 X CT POS

-22.500 Y

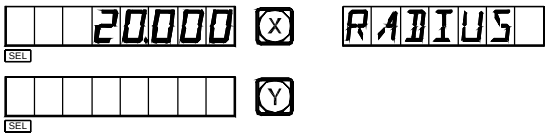




6) Enter the radius of the circle.

Key 2 → 0 → ENT

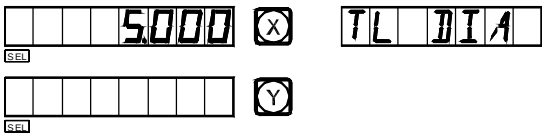
Key ⇩



7) Enter the diameter of the tool.

Key 5 → ENT

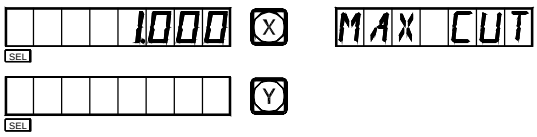
Key ⇩



8) Enter the maximum cut.

Key 1 → ENT

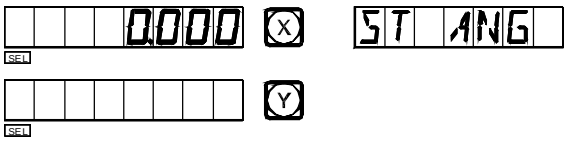
Key ⇩



9) Enter the start angle of the arc.

Key 0 → ENT

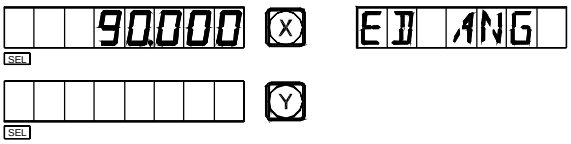
Key ⇩



10) Enter the end angle of the arc.

Key 9 → 0 → ENT

Key ⇩

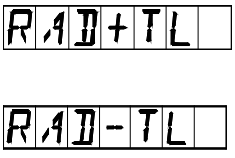


11) Determine inner/outer circle mode.

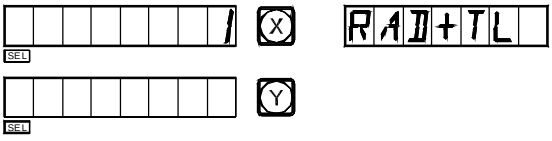
Key ⇧ or ⇩

Key ENT

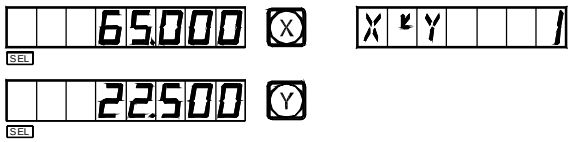
Key ⇩



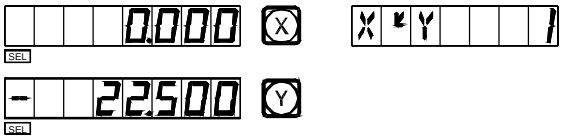
12) It is display that the processing start at the first point.



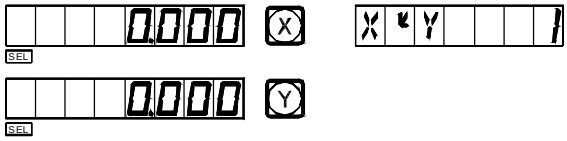
Tool setting as Fig. (a)



Tool setting as Fig. (b)



13) Move the machine tool to bring the display value on X- and Y-axes to zero, reach the start point of R.



14) Key ⇩ or ⇧ and the position of any processing point may be displayed and you can move the machine tool to until both axes display zero ~ reaching the corresponding position of the R circular arc.

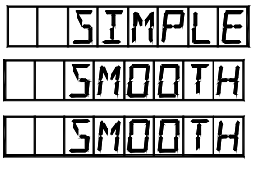
(Ⅱ) *Example as shown in figure on page 24.

1) At first, finish tool setting, reset, key , and enter ARC function.

2)choose smooth function

press ⇩

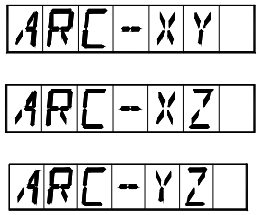
press ENT



（only 2V readout has this setting; 3V model readout has only smooth R function and therefore go directly to next step）

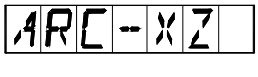
3) Select processing plane

Key ⇧ or ⇩

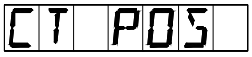


4) Select Plane XZ.

Key ENT



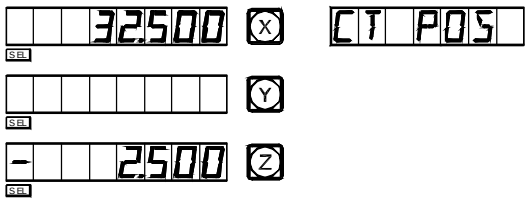
5) Enter the position of the circle center.



If you use a circular arc milling tool,
finish tool setting as shown in Fig. (a).

Key X → 3 → 2 → . → 5 → ENT

Z → ± → 2 → . → 5 → ENT

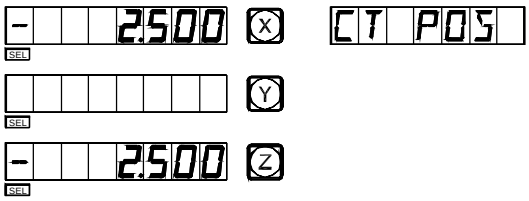


Key ⇩

If you use a circular arc milling tool,
finish tool setting as shown in Fig. (b)

Key X → ± → 2 → . → 5 → ENT

Z → ± → 2 → . → 5 → ENT

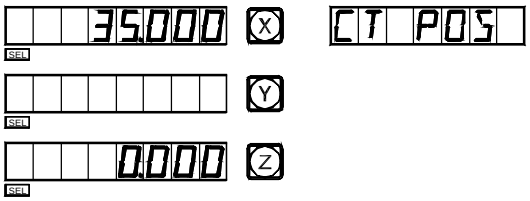


Key ⇩

If you use a flat end milling tool,
finish tool setting as shown in Fig. (a)

Key X → 3 → 5 → ENT

Z → 0 → ENT

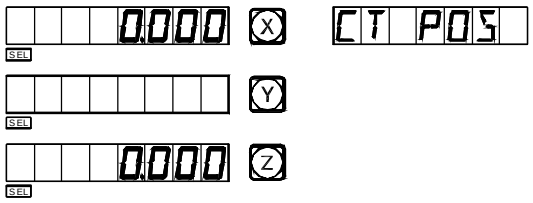


Key ⇩

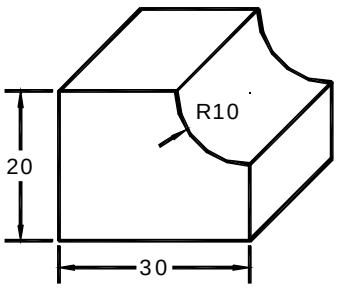
If you use a flat end milling tool,
finish tool setting as shown in Fig (b)

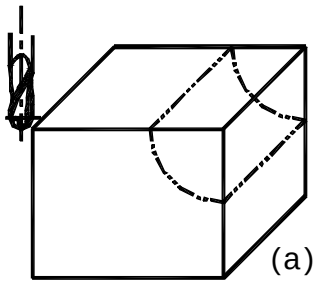
Key X 0 ENT

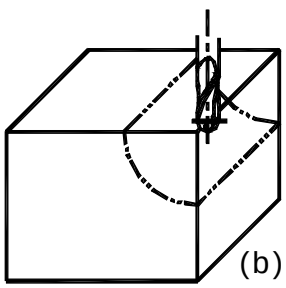
Z 0 ENT



Key ⇩



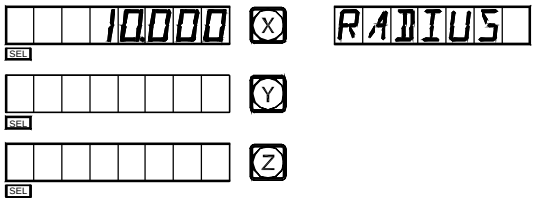




6) Enter the radius of the circle.

Key 1 → 0 → ENT

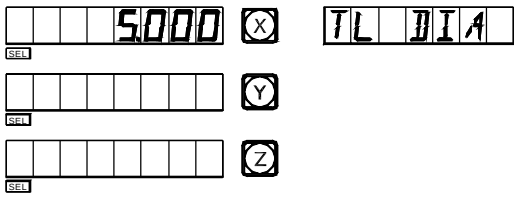
Key ⇩



7) Enter the diameter of the tool.

Use a circular arc milling tool

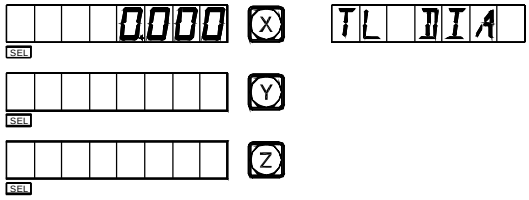
Key 5 → ENT



Use a flat end milling tool

Key 0 → ENT

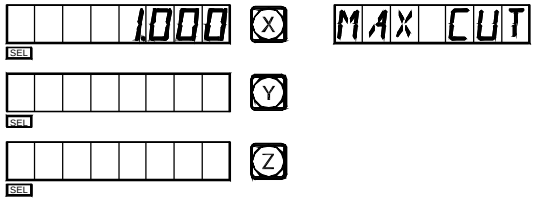
Key ⇩



8) Enter the maximum cut.

Key 1 → ENT

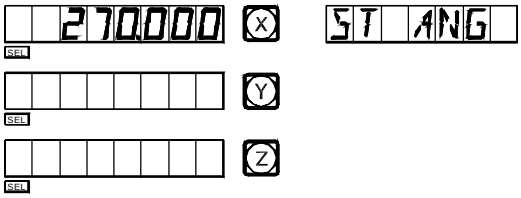
Key ⇩



9) Enter the start angle of the arc.

Key 2 → 7 → 0 → ENT

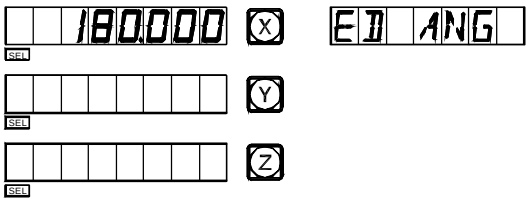
Key ⇩



10) Enter the end angle of the arc.

Key 1 8 0 ENT

Key ⇩

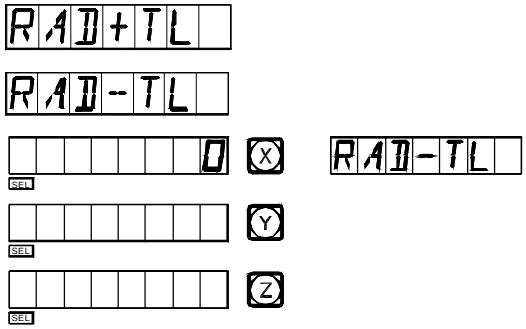


11) Determine inner/outer circle mode.

Key ⇧ or ⇩

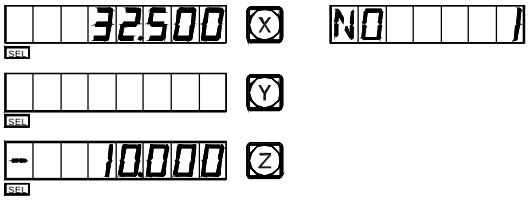
Key ENT

Key ⇩

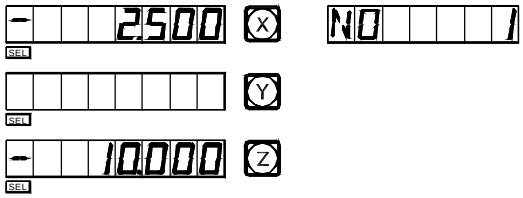


12) It is display that the processing start at the first point.

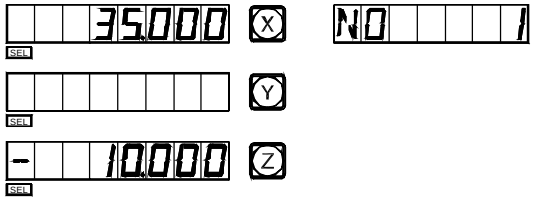
Use a circular arc milling tool setting as Fig. (a)



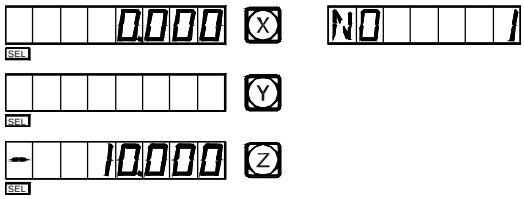
Use a circular arc milling tool setting as Fig. (b)



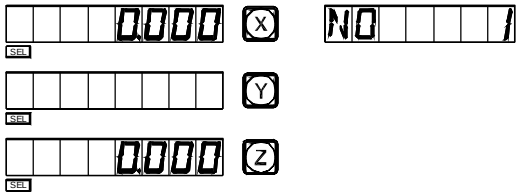
Use a flat end milling tool setting as Fig. (a)



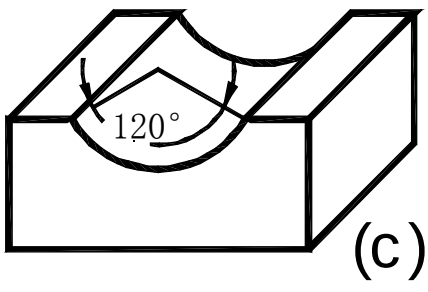
Use a flat end milling tool setting as Fig. (b)

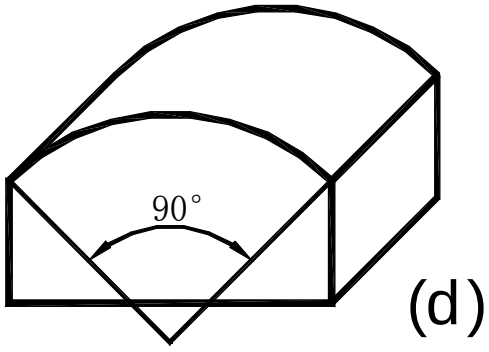


13) Move the machine tool to bring the display value on X- and Y-axes into zero, reach the start point of R.



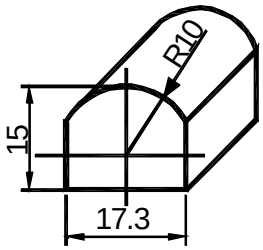
14) Key ⇩ or ⇧ and the position of any processing point may be displayed and you can move the machine tool to until both axes display zero ~ reaching the corresponding position of the R circular arc.





Note: When the arc to be processed in Planes XZ and YZ covers the 90° or the 270° position, for example, the one from 210° to 330° covers 270° in Fig.(c), and the other from 135° to 45° covers 90° in Fig. (d),end mill shall not be used.

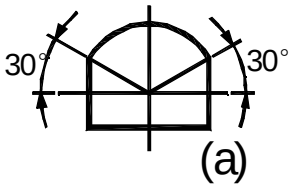
(Ⅲ) *Further example as shown in figure on the right



1. For the processing of this working piece, it is necessary to calculate out the start and end angles of the arc at first.

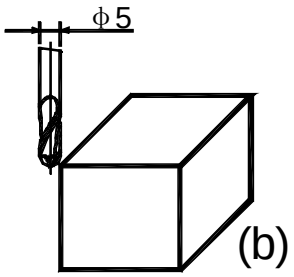
Refer to the figure.

α=arc cos(17.3/2)/10≈30°



(a)

The start angle (ST ANG)of the arc is 30°,
and the end angle (ED ANG) is 150°.



(b)

2. At first, finish tool setting and return the boring ring scales on X- and Z- axes to zero.

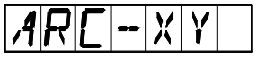
1) Key  , enter ARC function.

2)choose smooth function

press 

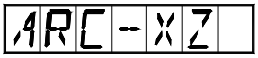
press 

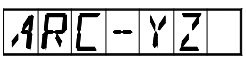
（only 2V readout has this set item，3V readout has only smooth R function, so directly go to next step）



3) Select processing plane.

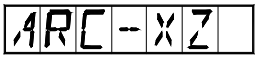
Key  or 

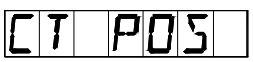




4) Select Plane XZ.

Key 

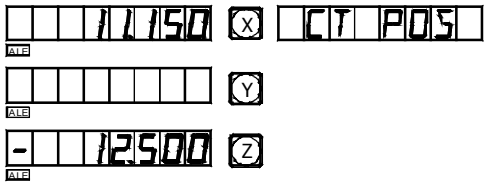




5) Enter the position of the circle center

Key [X] → [1] → [1] → [.] → [1] → [5] → [ENT]

[Z] → [1] → [2] → [.] → [5] → [±] → [ENT]



Key [⇩]

6) Enter the radius of the circle.

Key [1] → [0] → [ENT]

Key [⇩]

***Now a circular arc mill is used, finish the tool setting as shown in Fig. (b)**

7) Enter the diameter of the tool.

Key [5] → [ENT]

Key [⇩]

8) Enter the maximum cut.

Key [1] → [ENT]

Key [⇩]

9) Enter the start angle of the arc.

Key [1] [5] [0] [ENT]

Key [⇩]

10) Enter the end angle of the arc.

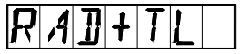
Key [3] [0] [ENT]

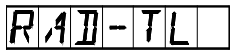
Key [⇩]

11) Determine inner/outer circle mode.

Key ⇧ or ⇩

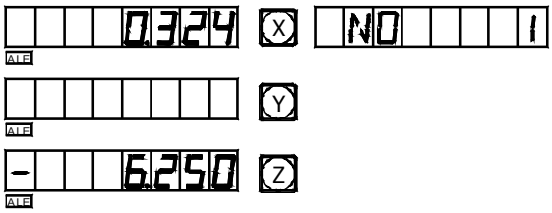
Key ENT





Key ⇩

12) It is display that the processing start at the first point.



13) enter processing and display the first point.

14) Press ⇩ or ⇧ to display every processing position, move the machine tool to bring the display value on X- and Y-axes to zero, being each point of R.

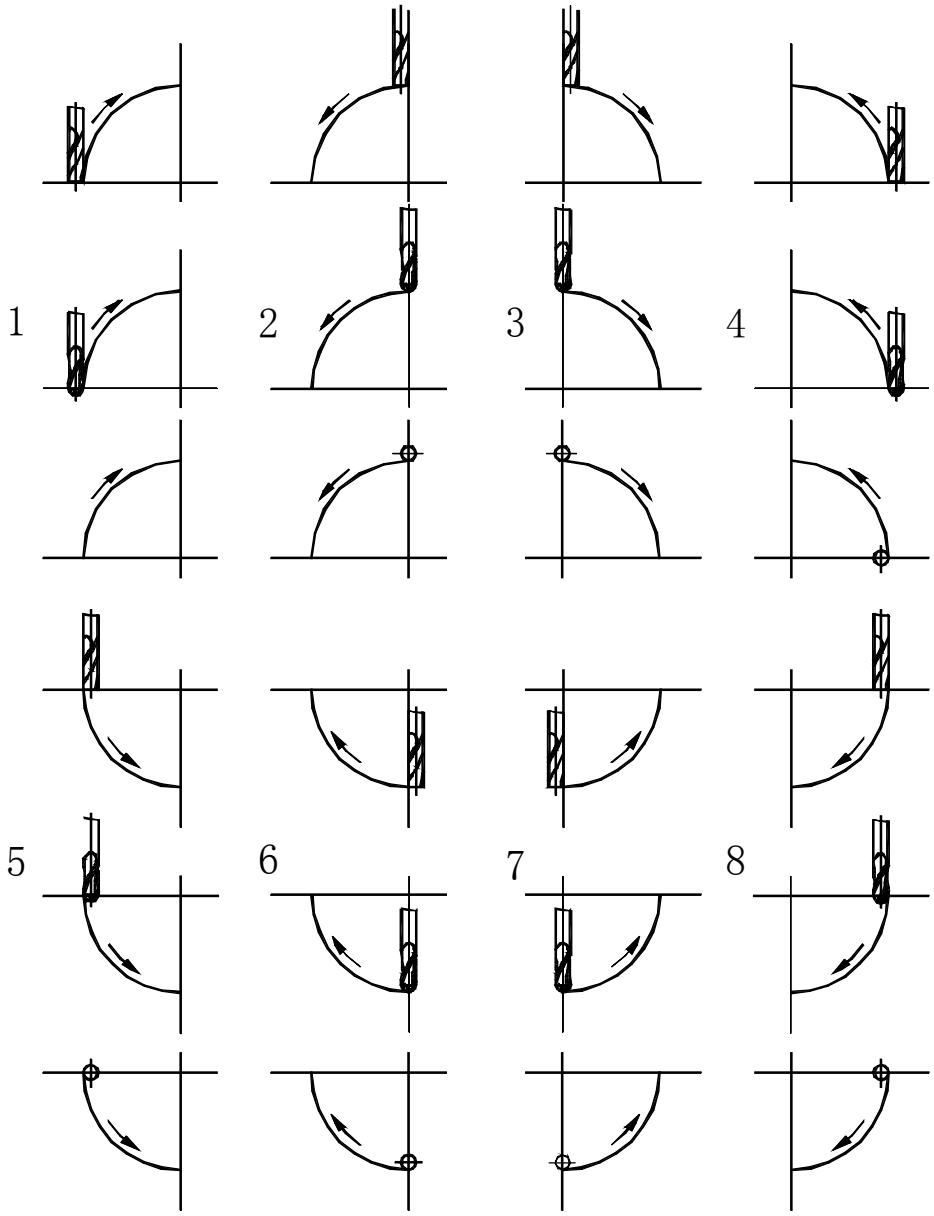
You may quit ARC function at will, by pressing ⏻ .

C.

Simple R

Simple Arc R Calculation function:

If not familiar with the concept of plane coordinates, the simple arc function offers an easier alternative. In general, the processing of a circular arc will be realized in one of the eight ways shown below, using an end mill or circular arc mill.



***The operation procedure of the simple arc R function.**

Let the tool face just at the arc, and key [M], enter arc R Calculating function. As to how to let the tool face just at the start point, just refer to (1) in page 30.

1. Select the simple R function (SIMPLE).

2. Select the processing way among the preset 1 to 8 ways, the prompt: “WHICH”.
3. Select the processing plane, XY、XZ or YZ.

(ARC-XY)

(ARC-XZ)

(ARC-YZ)

4. Enter the of the circular arc (RDDIUS)

5. Enter the diameter of the tool (TL DLA): When processing the arc in Planes XZ and YZ, end mill is used and the processing in carried by the end edge of the tool, so the diameter valve to be entered should be zero.(refer to step 5 in the operation procedure of the smooth R function).

6. Enter the maximum cut (MAX CUT):

When processing an arc in Planes XZ and YZ, “MAX CUT” in the simple R function is defined as the depth of cut in each cut feed in Z axis direction (see Fig. a) the maximum, cut can be changed during the processing.

When processing an arc in plane XY, “MAX CUT” is the cut of each cut feed and is uniform (refer to Fig. b).

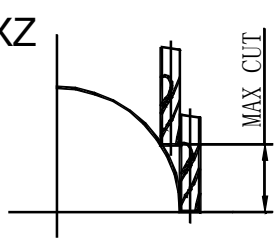


Fig. (a)

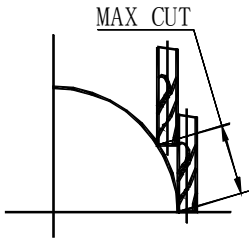
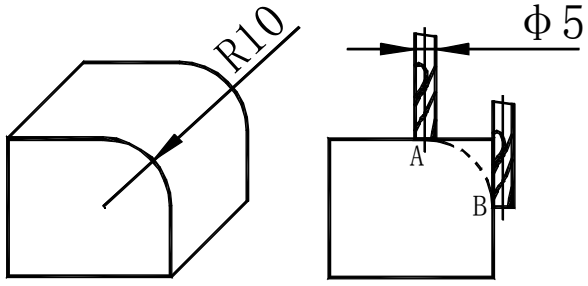


Fig. (b)

7. Implement the processing point by point following the display.

8. You may quit the arc R Calculating function at will, just key M.



***Take the processing of the arc on right as an example.**

1) At first, let the tool face just at the start point of the arc (point A or Point B), key M ,

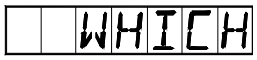
enter ARC function.

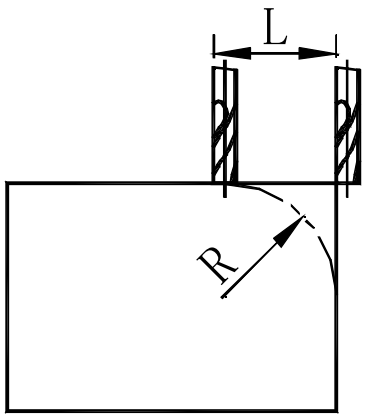
Select the simple function key ENT .

2) Select R processing mode.

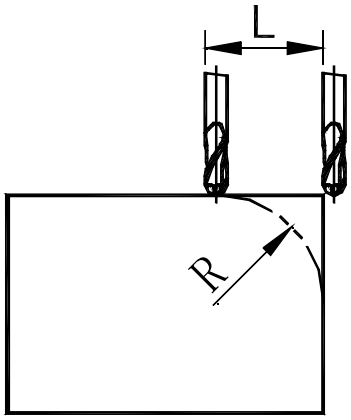
Start point is A, key 3 → ENT

End point is B, key 4 → ENT

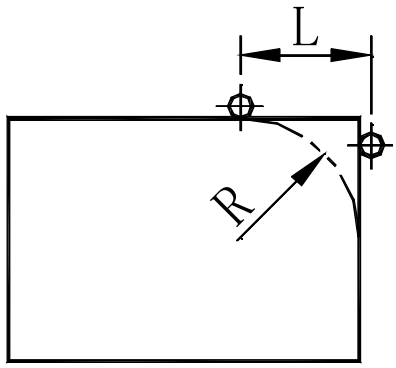




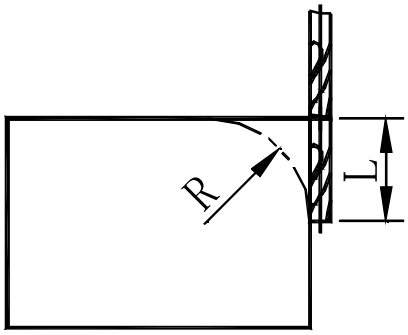
L= R



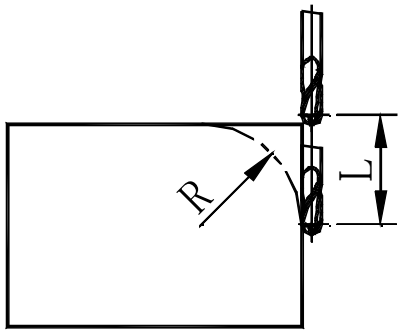
L= R+ the radius of the tool



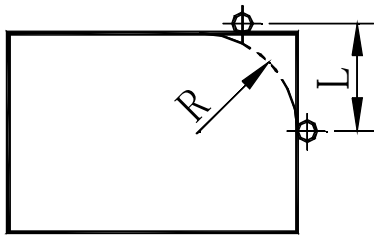
L= R+ the radius of the tool



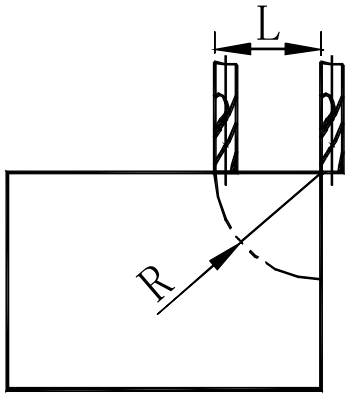
L= R



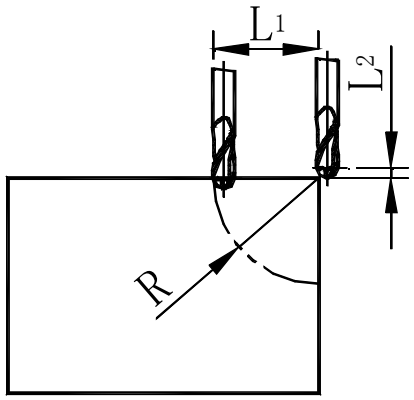
L= R+ the radius of the tool



L= R+ the radius of the tool

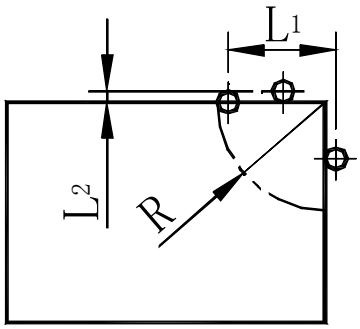


L=R



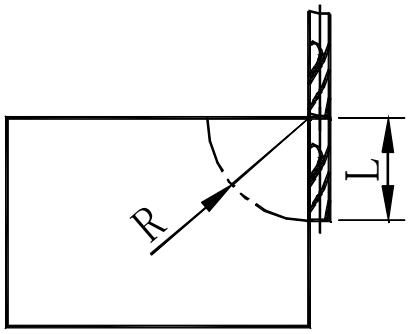
L1= R

L2= the radius of the tool

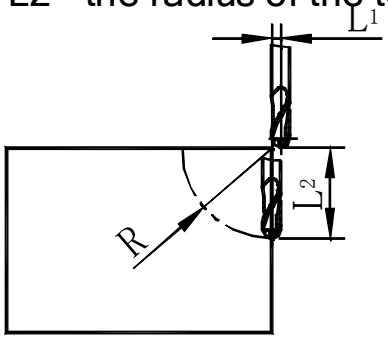


L1= R

L2= the radius of the tool

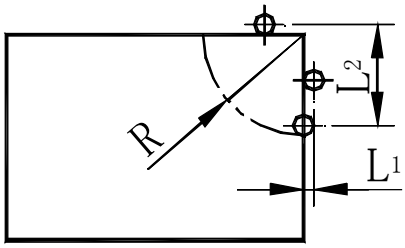


L=R



L1= the radius of the tool

L2= R



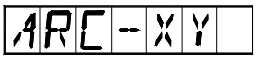
L1= the radius of the tool

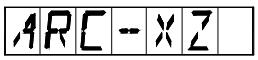
L2= R

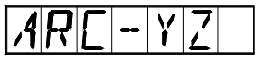
End mill | Circular arc mill | Plane XY

3) Select the processing plane

Key ⇧ or ⇩

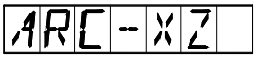






4) Select Plane XZ

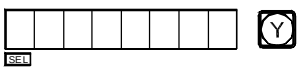
Key ENT



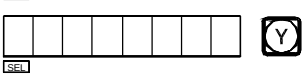
5) Enter the radius of the circular arc

Key 1 0 ENT

Key ⇩



6) Enter the radius of the tool

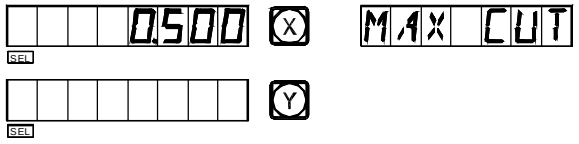


Key 0 → ENT

Key ⇩

7) Enter the maximum cut

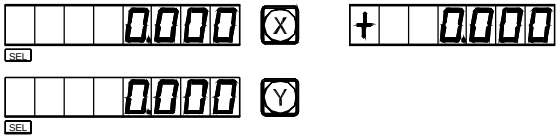
Key 0 → . → 5 → ENT



Key ⇩

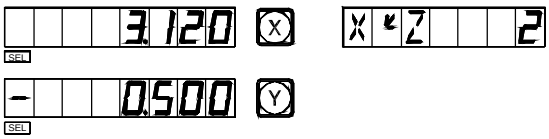
8) Start processing

Key ⇩



Point A as the start point(0,0)

Key ⇩



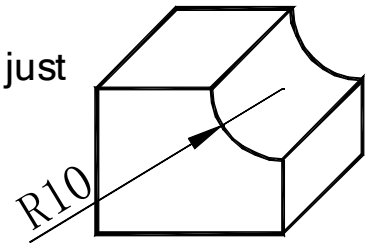
Point B as the start point(0,0)

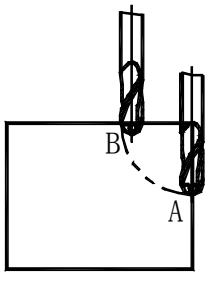
Key ⇩

9) Refer to the display, move the machine tool to bring the displayed value on X axis to zero, then turn the Z axis handwheel to let the machine table rise or drop by the display value in Y axis.

10) Key ⇩ or ⇧ and the position of next/last point will displayed.

You can quit ARC function at will, just key M





***Take the processing of an inner circular arc as example:**

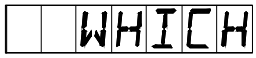
1) At first, align the tool to face just the start point(Point A or Point B), key M to enter ARC function.

Select the simple function, key ENT

2) Select the way of the R processing

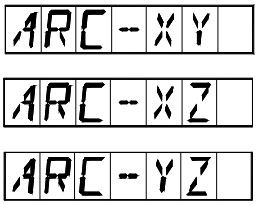
Point A is the start point, key 6 → ENT

Point A is the start point, key 5 → ENT



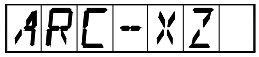
3) Select the processing plane

Key ↑ or ↓



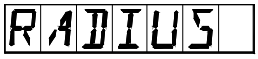
4) Select Plane XZ

Key ENT



5) Enter the radius of the circular arc

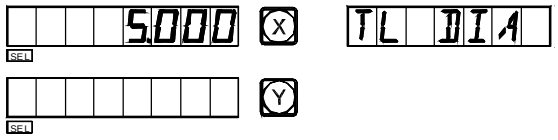
Key 1 → 0 → ENT



Key ↓

6) Enter the diameter of the tool

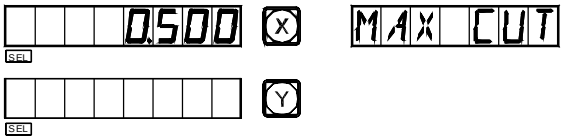
Key 5 → ENT



Key ↓

7) Enter the maximal cut

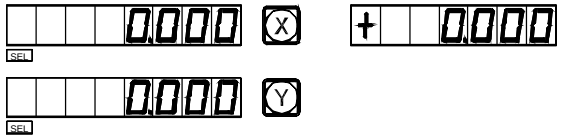
Key 0 . 5 ENT



Key ↓

8) Enter processing mode

Key ↓



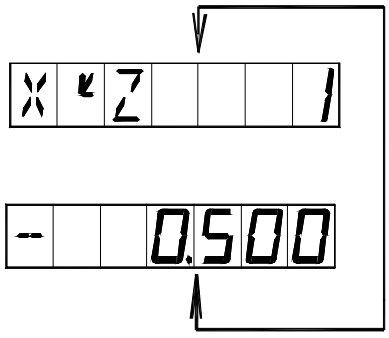
Point A is the start point(0,0), key ↓

Point A is the start point(0,0), key ⇩

9) Refer to the display, move the machine tool to bring the displayed valve on X axis into zero, then turn the Z axis hand wheel to let the machine table rise or drop by the displayed value in Y axis.

10) Key ⇩ or ⇧ and the position of next/last point will display. You may quit ARC function, by pressing ↵ .

Note: After entering processing mode, the number of the processing point and the accumulated value in Z axis direction will alternately displayed on the message window.



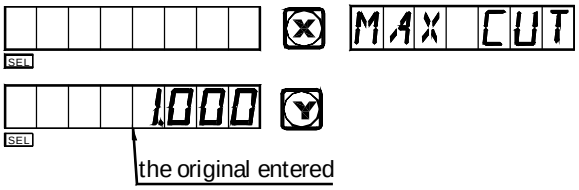
***Changing the maximum cut**

When processing an arc in Plane XZ and YZ, “MAX CUT” is the depth of cut in Z axis. If the depth of cut in Z axis is uniform, the surface quality of the arc may not be uniform. To improve the surface quality of the arc in plane XZ and YZ, the operator may change the maximum cut during processing to bring a uniform surface quality. When processing an arc in Plane XY, “MAX CUT” is the cut of each cut feed. As each cut feed is uniform, the surface quality of the calculated arc will be uniform, so “changing the maximim cut” function is not required when processing an arc in Plane XY.

For changing the maximum cut, the operator may follow the following operations.

1) Change the maximum cut under processing mode.

Key [½]

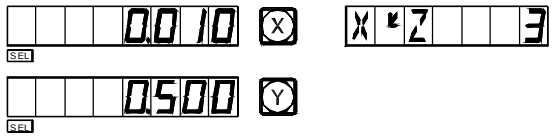


2) Enter the changed value of the maximal cut, for example, “0.5”.

Key [0] → [.] → [5] → [ENT]

3) Return to processing mode, Continue the processing.

Key [½]



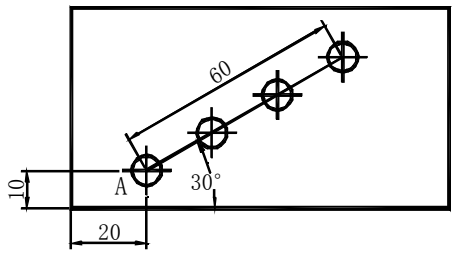
D.

Hole Drilling Along An Oblique Line

(

Hole drilling along an oblique line

Normally, for processing the work piece shown on the right the operator must calculate the X and Y coordinates an easy and quick resolution is provided through the function of hole drilling along an oblique line.

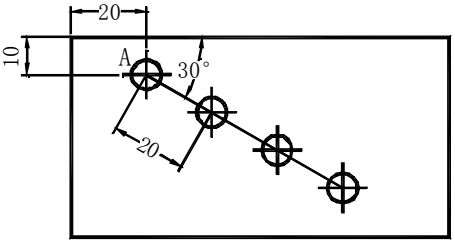


(a)

All the operator needs to do is enter the following data:

The length of the oblique line (LENGTH)

This is the real distance from the center of the start hole to the center of the end hole, enter this data when “MODE L” (length mode) is selected.



(b)

The step length (STEP)

This is the distance between two adjacent holes.

This data shall be entered when “MODE S” (step length mode) is selected.

Angle (ANGLE)

This is the direction of the oblique line in the plane coordinate. The angle is 30° in (a), so, the plane angle to be entered is 30; the angle is -30 in (b), so the plane angle to be entered is -30.

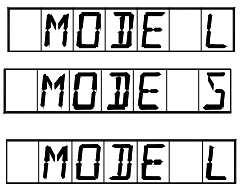
Number of holes (NUMBER)

Taking processing of (a) as example

1) At first move the tool to the position of the start hole A.
   Key [⇗] to enter the function.

2) Choosing the processing plane
   Press [⇧] or [⇩]
   Choose “processing plan”, press [ENT]
   （only 3V model has this set item，2V model has only XY plane，therefore go directly get into next step）

3) Select Mode
   Key [⇧] or [⇩]
   Select “MODE L”
   Key [ENT]



4) Enter the length of the oblique line

Key 6 → 0 → ENT

Key ⇩

5) Enter the angle

Key 3 → 0 → ENT

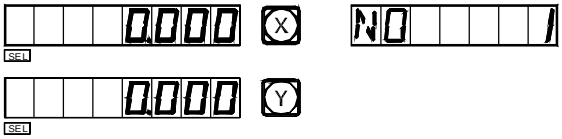
Key ⇩

6) Enter the number of holes

Key 4 → ENT

Key ⇩

7) The position of the first hole is displayed, enter processing state.



8) Key ⇩ to display the position of next processing point, and then move the machine tool until both X- and Y-axes read zero. You can quit the function at will, by pressing ↩

For the working piece in (a), it is more convenient to select “MODE L”. In the following, we take working piece in (b) as another example to show how to operate when “MODE S” is selected.

1) At first move the tool to the position of the start hole A.

Key ↩ to enter the function

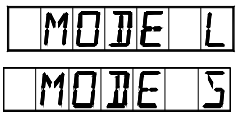
2) Choosing the processing plane

Press ⇧ or ⇩

Choose “processing plane”, press ENT

（only 3V model has this set item，2V model has only XY plane therefore go directly get to next step）

3) Select Mode



Key ⇧ or ⇩

Select “MODE S”

Key ENT

4) Enter the step length

Key [2] → [0] → [ENT]

Key [⇩]

5) Enter the angle

Key [3] → [0] → [ENT]

Key [⇩]

6) Enter the number of holes

Key [4] → [ENT]

Key [⇩]

7) Enter processing state

8) Key [⇩] to display the position of next processing point, then move the machine tool until both X- and Y-axes read zero. You can quit the function at will, by pressing [⇦]

E_1

200 Point Subsidiary Zero Positions

200 zero position memory function:

200 zero position function: also called 200 user Coordinate System (UCS) function.

ALE: Absolute Coordinate System.

ALE is the “reference” system. All 200 UCS positions are defined relative to the ALE. ALE is confirmed in the initialization of the work piece, which doesn’t change if the work piece is not changed.

UCS: User Coordinate System.

Certain large parts / drawings of complicated drilling/milling fittings have multiple zero reference points. In such cases the ability to set multiple zero datums increases work efficiency.

Ⅰ. The operator must know the following two key points before making use of this function:

1. Every subsidiary zero position is the origin datum point of one UCS. Once entering the display mode of a UCS, the display of every point will take the subsidiary zero position as the original datum point.

2. Each subsidiary zero position is relative to the zero position in absolute mode (ALE). After a subsidiary zero position is set, the DRO will keep the position relation between with zero position in the absolute mode in memory, if zero position in the absolute mode changes, the subsidiary zero position will also change by the same distance and angle.

Ⅱ. The operator may use this function as follows:

1. Set the zero position in absolute mode (ALE lamp on) at the main reference point of the working piece, for example, Point O in Fig. (1) in next page. Set subsidiary zero positions at subsidiary reference points of the working piece, for example, Points 1, 2 and 3 in Fig. (1). It is possible to enter the display mode of every UCS taking a subsidiary zero position

as its original points to perform the processing when need.

2. In the display mode of every UCS, working with various DRO function can be performed.

Ⅲ. Setting of subsidiary zero positions.

There are two methods of setting subsidiary zero positions: one is entering the position of the subsidiary zero position directly, the other is resetting once a subsidiary zero position is reached.

Method 1: Directly entering, under the UCS display mode, key (X) (Y) (Z) ⟶ Number keys ⟶ (ZERO) .

Using Fig. (1) as example: move the machine tool to the center point O, enter the absolute display mode.

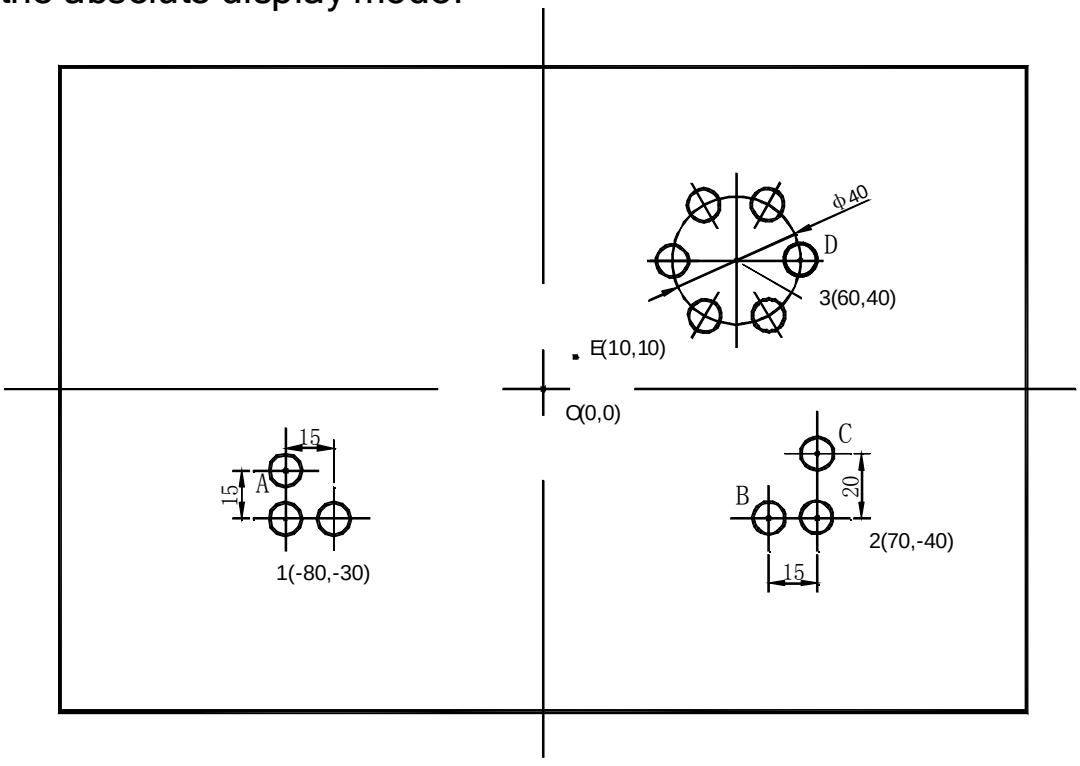
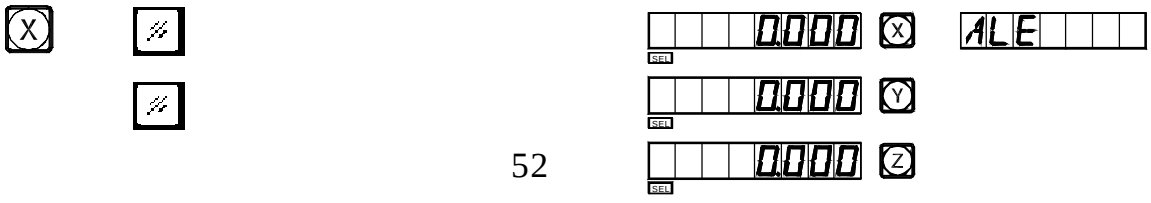


Fig. (1)

Set the zero position in absolute mode at the main reference of the work piece.



Y →

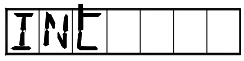
Z → ⁄

1) After setting zero position in absolute mode, the DRO automatically stores position in memory, in case of power interruption the zero position may be recalled.

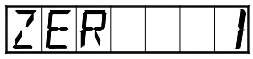
2) Second method. Enter the UCS display mode.

Method 1:

Key ⇧



Key ⇧



Method 2:

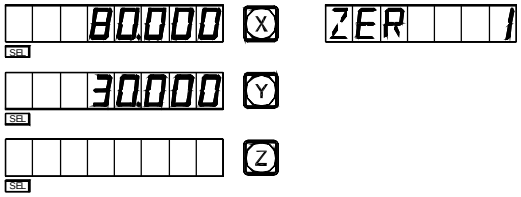
Key ZERO

Key 1 → ENT

3) Enter the first subsidiary zero position coordinates.

Key X → ± → 8 → 0 → ENT

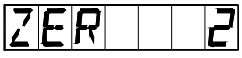
Y → ± → 3 → 0 → ENT



4) Enter the position of the second UCS.

Key ⇧ or ZERO

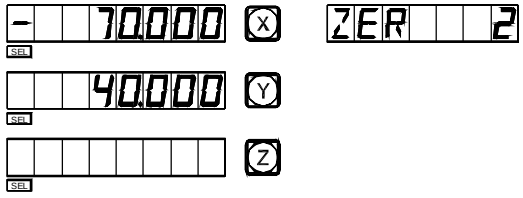
Key 2 ENT



5) Enter coordinates of the second zero position.

Key X 7 0 ENT

Y ± 4 0 ENT



6) Enter the display mode of the third UCS.

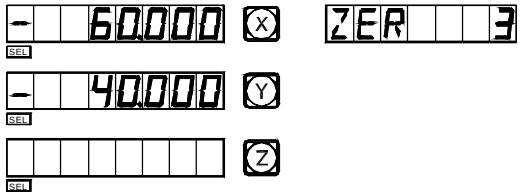
Key ⇧ or ZERO

Key 3 → ENT

7) Enter the coordinates of third zero position.

Key X → 6 → 0 → ENT

Y → 4 → 0 → ENT



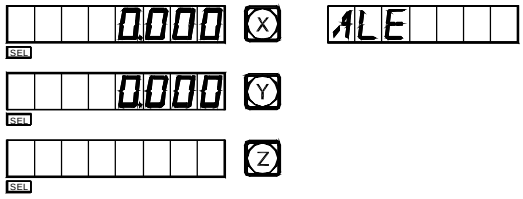
Setting of all the subsidiary zero positions of the working piece shown in Fig. (1) is now complete.

Why the enter position coordinates of every subsidiary zero position are just in the opposite direction of the displayed values? Let us explain this with the above example. Under the UCS mode, when the coordinates of the subsidiary zero position are entered at the position of the zero position in the absolute mode, the displayed data will be the position of the zero position in the absolute mode in the corresponding UCS. This is because the subsidiary zero position is taken as the original point of the UCS under the relative display mode. In Fig. (1), we can see that Point O is at the position(-80, -30) with respect to Point 1, (-70, -40) with respect to Point 2, and (-60, -40)with respect to Point 3. If the operator enter the coordinates of a subsidiary zero point other than the zero position in the absolute mode, the displayed data will be the position with respect to subsidiary zero point in the corresponding UCS. For example, when the position of the third subsidiary zero position is entered at Point E, the resulted display will be (-50, -30).

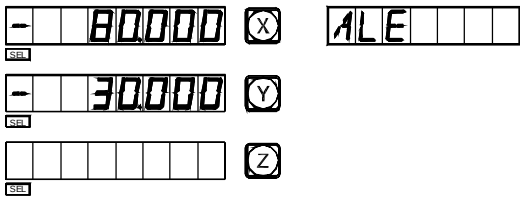
Method 2: Clearing when the position is reached. When the tool is at the position of the subsidiary zero point, key [X] [Y] [Z] [⁄⁄]

We take the working piece shown in Fig. (1) as example again: Move the machine table to the center point O shown in Fig. (1).

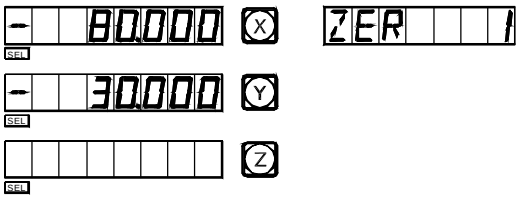
1) Enter the absolute display mode, reset the zero position in absolute mode at the main reference point.



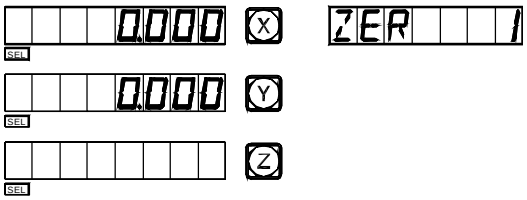
2) Move the tool to Point 1.
X axis display -80,
Y axis display -30,



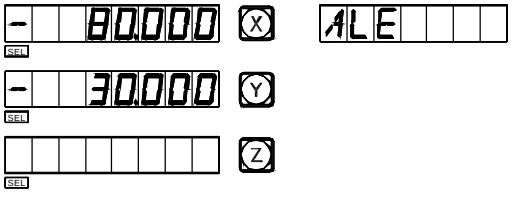
3) Enter display mode of the first UCS.
Key [⇧] or [ZERO]
Key [1] → [ENT]



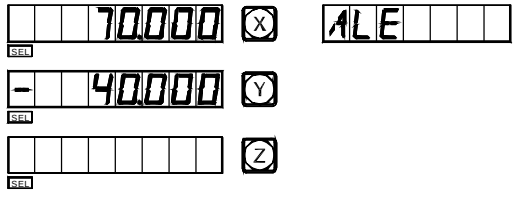
4) Set the subsidiary zero position.
Key [X] → [⁄⁄]
[Y] → [⁄⁄]



5) Return to absolute state display mode
Key [⇩]

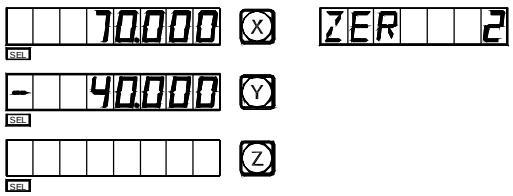


6) Move the tool to Point 2.
X axis display 70,
Y axis display-40.



7) Enter display mode of the second UCS.

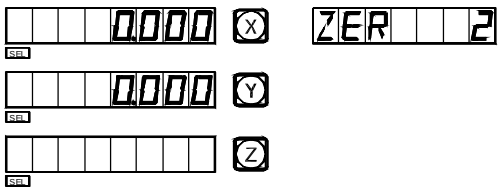
Key ZERO → 2 → ENT



8) Clear the second subsidiary zero point.

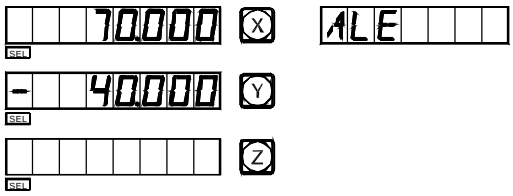
Key X → CE

Y → CE



9) Return to absolute display mode.

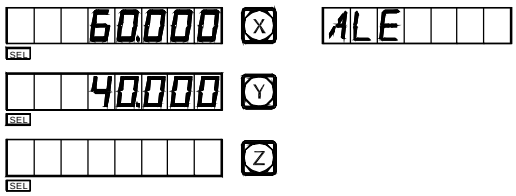
Press key ⇩ three times



10) Move the tool to Point 3.

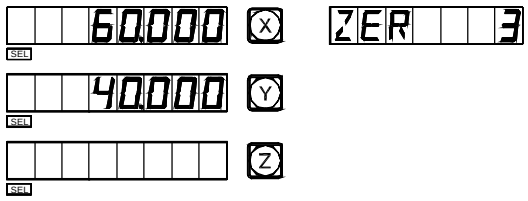
X axis display 60,

Y axis display 40.



11) Enter display mode of the third UCS.

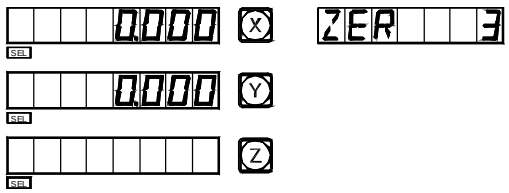
Key ZERO → 3 → ENT



12) Clear the third subsidiary zero point.

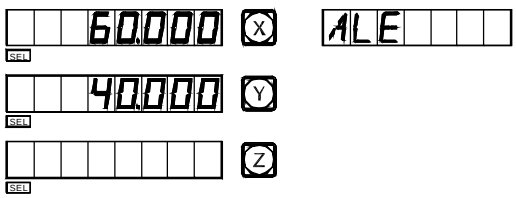
Key X → CE

Y CE



13) Return to absolute display mode.

Press key ⇩ four times



Setting of all subsidiary zero positions of example shown in Fig. (1) is now complete.

Ⅳ. Usage of subsidiary zero positions.

It is possible to enter a UCS display mode using key [⇧] 、[⇩] or [ZERO] .

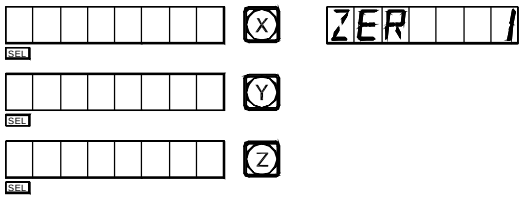
When using keys [⇧] and [⇩] , you may press continuously until reaching the desired UCS number.

When using key [ZERO] just key [ZERO] and at the prompt “ZERO No” enter the number of the desired UCS. For related operations, refer to “5 Absolute/relative/user coordinate display mode” under “Ⅰ.Usage” of “A. Basic Function”.

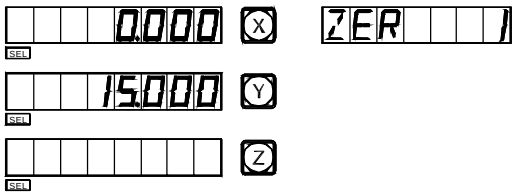
Using work piece shown in Fig. (1) as an example.

1) Enter the display mode of the first UCS.
   Key [ZERO]

2) Enter the number.
   Key [1] → [ENT]

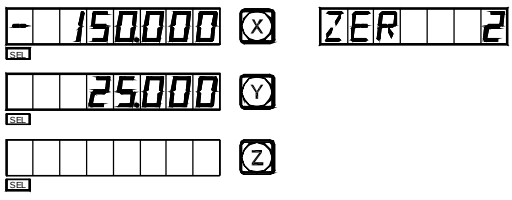


3) Move the tool to Point A.
   X axis display 0,
   Y axis display 15.

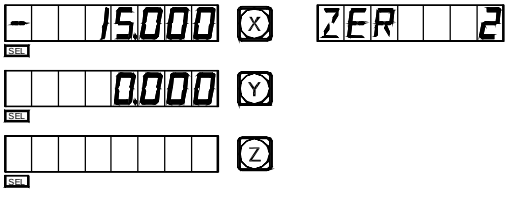


4) Process Hole A.

5) Enter display mode of second UCS.
   Key [⇧]



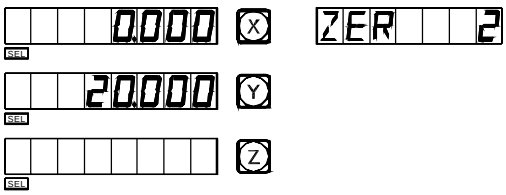
6) Move the tool to Point B



X axis display -15,
Y axis display 0.

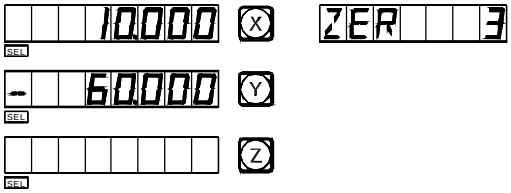
7) Process Hole B

8) Move the tool to Point C.
X axis display 0,
Y axis display 20.

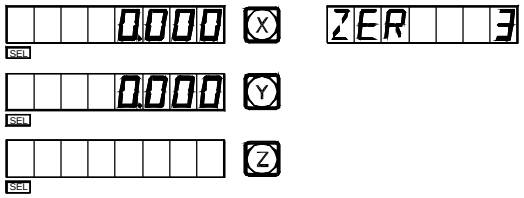


9) Process Hole C

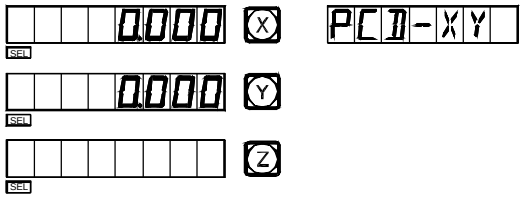
10) Enter display mode of the third UCS.
Key ⇧



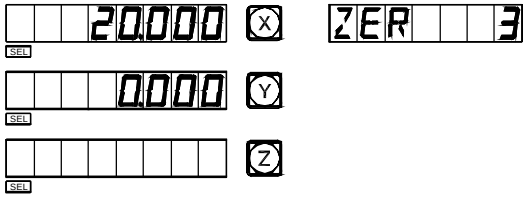
11) Move the tool to point 3.
X axis display 0,
Y axis display 0.



12) Enter PCD function, process the six holes on circle center at Point 3.
Key ❄



13) After processing of six small holes return to Point D, the display should be:



For PCD function, please refer to the related sections.

Ⅴ. Clearing of Subsidiary Zero Positions and Other Related Problems.

1. Clearing of Subsidiary zero positions

In absolute state (ALE state), key ⊙ 10 times continuously, the memory of all subsidiary zero positions will be cleared.

2. Reset during a subsidiary zero position while in use

When a subsidiary zero position is being used (UCS #), resetting in this state will set a new subsidiary zero position. The point at which resetting is performed will become the new subsidiary zero position replacing the original.

3. Halving (centering) during use of a subsidiary zero position.

“1/2” function may be used under UCS display mode. Centering under UCS display mode will actually set a new subsidiary zero position. After centering, the original subsidiary zero position will be replaced by the new subsidiary zero, centered between the original subsidiary zero position and the point at which centering was performed.

E_2

200 Point Subsidiary Zero Positions

(LATHE)

Setting of subsidiary zero position

There are two methods of setting subsidiary zero positions: one is entering the position of the subsidiary zero position directly, the other is resetting once a subsidiary zero position is reached.

Method 1: Directly Entering, under the UCS display mode, key [X] [Y] Number keys → [ZERO] .

Take Fig. (1) as example: Move the machine tool to the center point O in Fig.(1), Enter the absolute display mode.

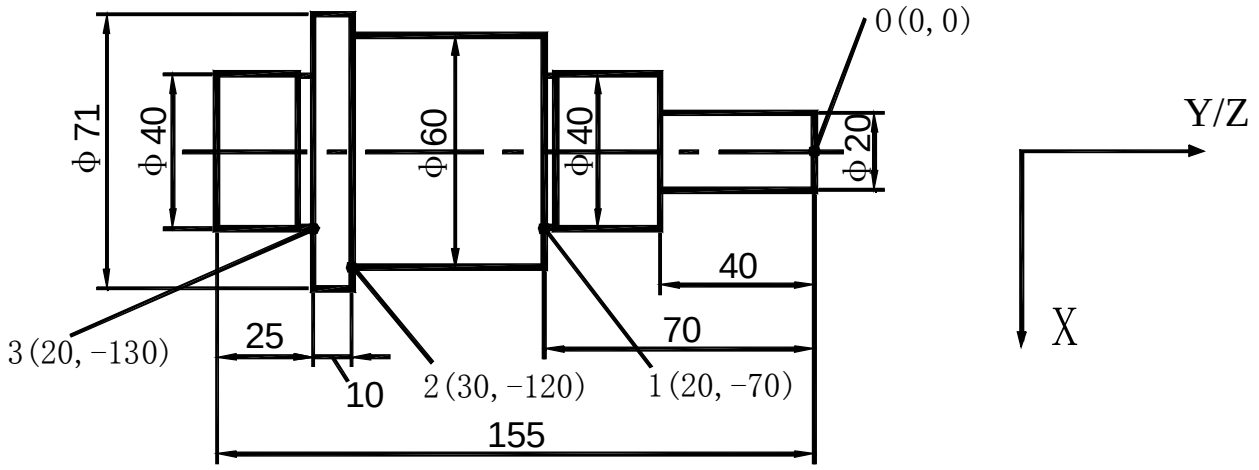
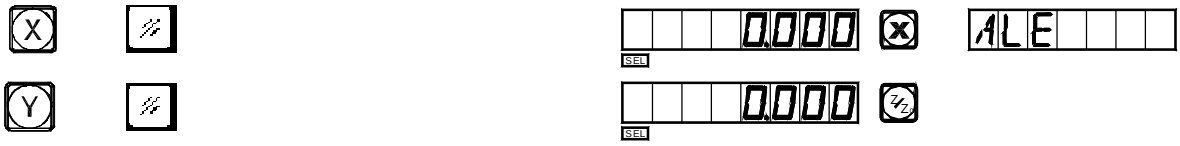


Fig. (1)

In the following content take Y axis as an example

Reset the zero position in absolute mode at the main reference of the work piece.

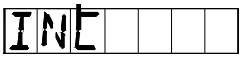


1) After setting the zero position in absolute mode (ALE), the DRO automatically stores the position in memory, in the event of power failure the zero position may be recalled.

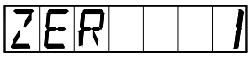
2) Enter the UCS display mode.

Method 1:

Key ⇧

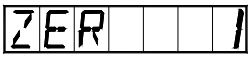


Key ⇧



Method 2:

Key ZERO

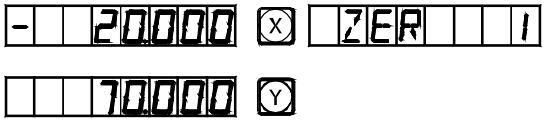


Key 1 → ENT

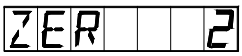
3) Enter the position of the first subsidiary zero position.

Key X → 2 → 0 → ENT

Y → ± → 7 → 0 → ENT



4) Enter the position of the second UCS.



Key ⇧ or ZERO

Key 2 → ENT

5) Enter the position of the second zero position.

Key X 3 0 ENT

Y ± 1 2 0 ENT

6) Enter the display mode of the third UCS.

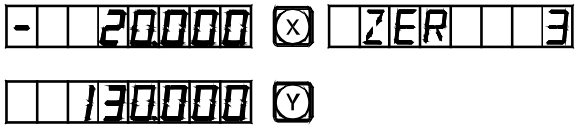
Key ⇧ or ZERO

Key 3 ENT

7) Enter the display mode of the third zero position.

Key [X] → [2] → [0] → [ENT]

[Y] → [±] → [1] → [3] → [0] → [ENT]



The setting of all subsidiary zero positions of the work piece shown in Fig. (1) is now complete.

Why the direction of each coordinate of your input auxiliary zero position opposite to that of the display result? As the above example illustrates, under the user coordinate display mode, if your enter the coordinate of auxiliary zero position on the position of the zero position under absolute state, the display result will be the position of absolute state zero position in this user coordinate. Because the user coordinate display mode uses each auxiliary zero position as the origin of user coordinate. Seeing from Fig. 1, Point O is exactly located at the position of Point 1(-20, 70), the position of Point 2 (-30, 120) and that of to Point 3 (-20, 130). If the operator enters the coordinate of auxiliary zero point at any other point than the zero point under absolute state, the display result will be the position of this point in this user coordinate.

Method 2: Clearing when the position is reached. When the machine tool is at the position of the subsidiary zero point, key [X] [Y] [⌿]

Method 2 is not suited to operations on a lathe.

Ⅳ. Usage of subsidiary zero positions.

It is possible to enter a UCS display mode using key [⇧]、[⇩] or [ZERO].
When using keys [⇧] nd [⇩] ou may press continuously until reaching the desired UCS number.
When using key [ZERO] just ke [ZERO] and at the prompt “ZERO No” enter the desired UCS number. For related operations please refer to “5 Absolute/relative/user coordinate display mode” under “Ⅰ.Usage” of “A. Basic Function”.

Using Fig. (2) as an example.

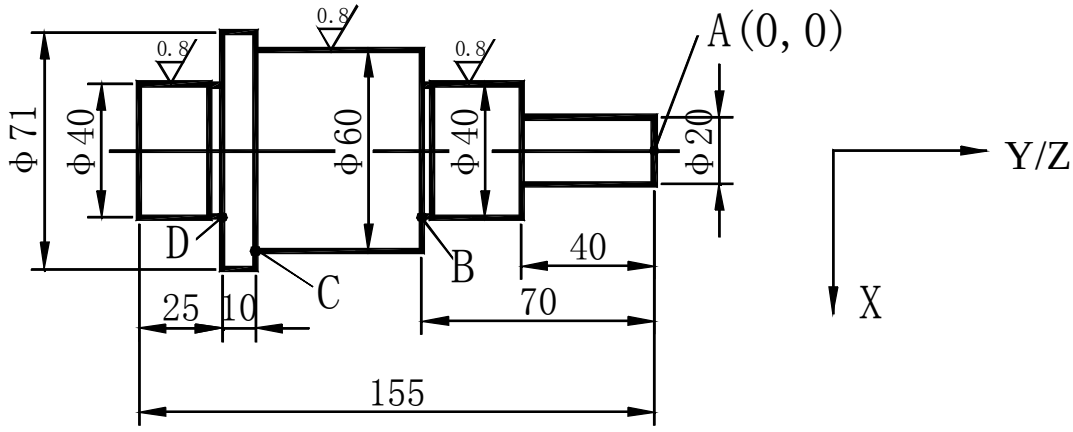


Fig.(2)

Assuming work piece has been rough turned and will now be finish cut with a 0.05 depth of cut.

First set absolute coordinate origin at Point A, then directly set positions of the auxiliary zero point. We have to set the first auxiliary zero point at point (10, -40), the second at point (20.05, -70) and point (30.05, -120).

1) After checking the cutting tool, enter the first user coordinate system.

Key ZERO

2) Enter the code

Key 1 → ENT

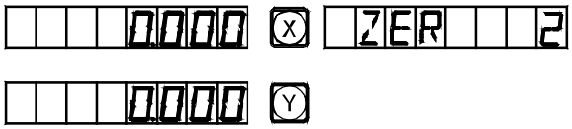
3) Process Φ20

Start cutting until the displays on both X axis and Y read 0.

4) Enter the second user coordinate system.

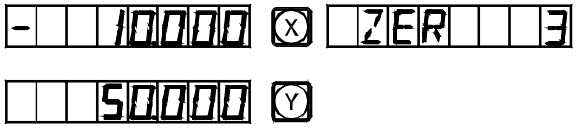
Key ⇧

5) Process Φ40
start cutting until the displays on
X axis and Y read 0.



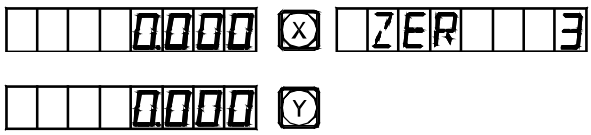
6) Enter the third user coordinate system.

Key ⇧

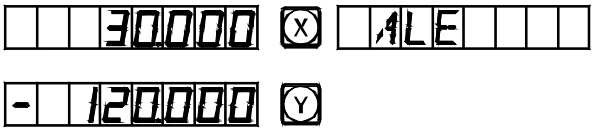


7) Process Φ60

Start cutting until the displays on
X axis and Y read zero.



8) Return to absolute state
Keep pressing ⇩ until “ALE” is
displayed.



9) Rotate work piece for turning of other end Φ40.

Ⅴ. Clearing of Subsidiary Zero Positions.

1. Clearing of Subsidiary zero positions

In absolute state (ALE state), key ⊙ 10 times continuously, all 200 subsidiary zero positions will be cleared.

For other functions refer to page 60

E_3

200 Point Subsidiary Zero Positions

(Grinding)

Ⅲ. The setting of subsidiary zero position

There are two methods of setting subsidiary zero position: the one is entering the position of the subsidiary zero position directly, the other is resetting once a subsidiary zero position is reached.

Method 1: Directly Entering, under the UCS display mode, key (X) (Y) Number keys → (ZERO) .

Take Fig. (1) as example: After turning the machine on, move the machine tool to the center point O in Fig.(1), Enter the absolute display mode.

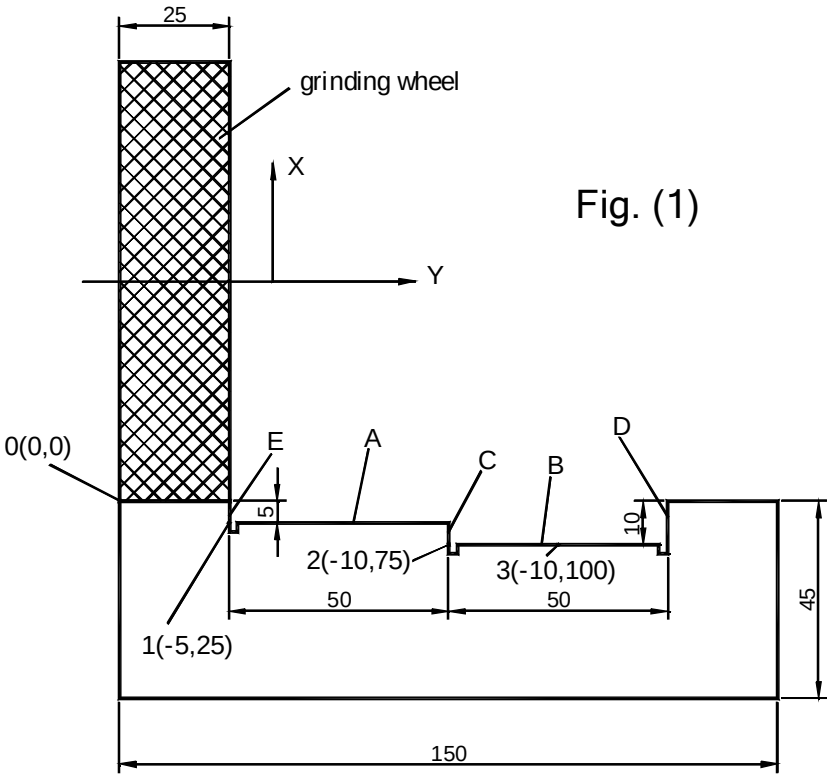
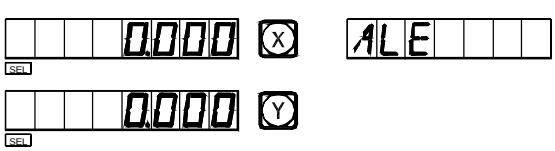


Fig. (1)

Reset, set the zero position in the absolute mode at the main reference of the working piece.

(X) (⁄)

(Y) (⁄)

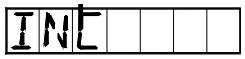


1) After setting the zero position in the absolute mode, the system automatically perform a keeping in memory operation, in order that once a power interruption happen in the course the zero position may be tracked back.

2) Enter the UCS display mode. (Two Method)

Method 1:

Key ⇧

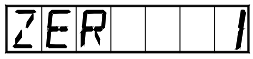


Key ⇧

Method 2:

Key ZERO

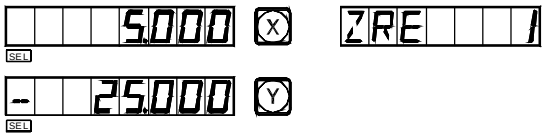
Key 1 → ENT



3) Enter the position of the first subsidiary zero position.

Key X → ± → 5 → ENT

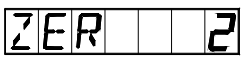
Y → 2 → 5 → ENT



4) Enter the position of the second UCS.

Key ⇧ or ZERO

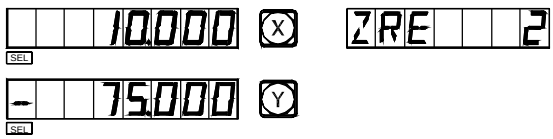
Key 2 ENT



5) Enter the position of the second zero position.

Key X ± 1 0 ENT

Y 7 5 ENT



6) Enter the display mode of the third UCS.

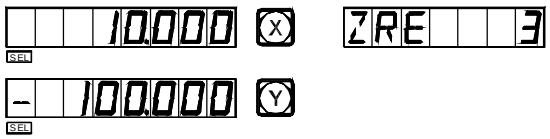
Key ⇧ or ZERO

Key 3 → ENT

7) Enter the display mode of the third zero position.

Key X → ± → 1 → 0 → ENT

Y → 1 → 0 → 0 → ENT



The setting of all the subsidiary zero positions of the working piece shown in Fig. (1) has been finished.

Method 2: Clearing when the position is reached. When the machine tool is at the position of the subsidiary zero point, key X Y ⁄ .

Method 2 is not suited to operations on grinding machine. The instructions for lathe are not given in details in this manual.

Ⅳ. The usage of subsidiary zero positions

After entering the display mode of the UCS, the corresponding subsidiary zero positions may be used to help in the processing.

It is possible to enter a UCS display mode using ke⇧ ⇩ oZERO .

When using keys ⇧ and ⇩ you may key ⇧ ⇩ntinuously until entering the desired UCS.

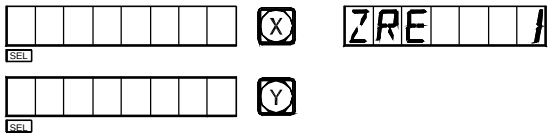
When using key ZERO just key ZERO and under the prompt “ZERO No” enter the number of the desired UCS. For the related operations, the operator may refer to “5 Absolute/relative/user coordinate display mode” under “Ⅰ.Usage” of “A. Basic Function”.

We take the working piece shown in Fig. (1) as example again: Move the machine table to the center point O shown in Fig. (1).

1) Enter the display mode of the first UCS. ZERO NO

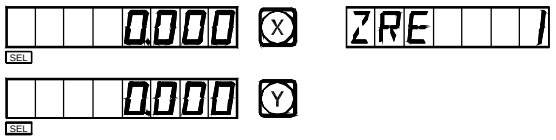
Key ZERO

2) Enter the number.
Key 1 → ENT

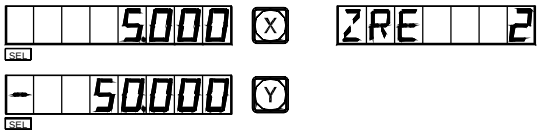


3) Process the plane A, E

Start grinding until the displays on both X axis and Y turn out 0.

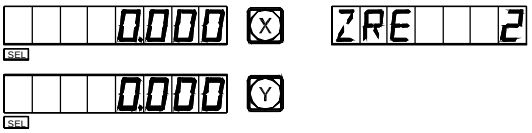


4) Enter the second user coordinate system.
Key ⇧

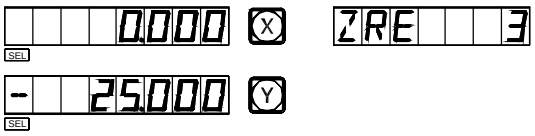


5) Process the plane B, C

Start grinding until the displays on both X axis and Y turn out 0.

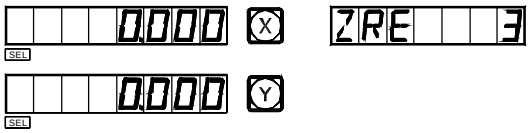


6) Enter the third user coordinate system.
Key ⇧

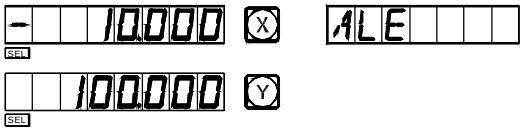


7) Process the plane B、D

Start grinding until the displays on both X axis and Y turn out 0.



8) Return to absolute state
Keep pressing ⇩ until “ALE” is displayed.



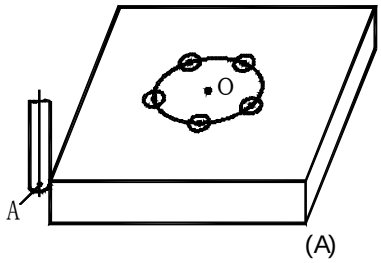
F.

PCD Bolt Circle Function

(Equally dividing holes on bolt flange)

Bolt circle (PCD) Function.

This function may be used to equally divide a circular arc, like drilling holes distributed uniformly on a flange for example.
After selecting this function, the message window will prompt for various parameters to be defined.

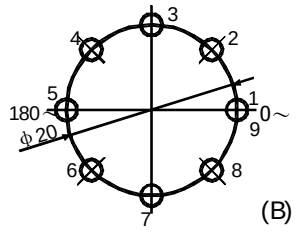


(A)

The following are parameter to be defined.

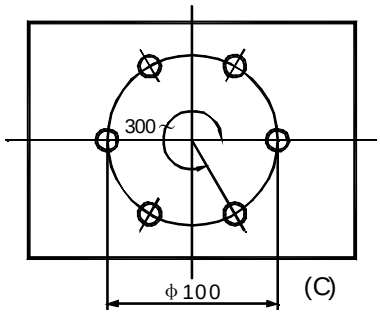
1. Position of the circle center.

The position of the circle center (CT POS) with respect to the center of the tool relative to the part zero datum such as position of Point O relative to Point A in Fig. (A).



(B)

2. The Diameter (DIA) of the circle to be divided equally.



(C)

3. Number of holes (NUMBER):

The number of holes equally divided on circle diameter.
For the example shown in Fig. (B), 9 points must be used to divide the whole circle into 8 equal sections, and Point 9 will coincide with Point 1. Or in the case of a half circle, 5 points from point 1 to Point 5 must used to divide the arc from 0° to 180° into 4 equal sections.

4. Start angle (ST ANG): The angle of the start point of circular arc

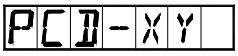
5. End angle (ED ANG): The angle of the end point of circular arc

Note: For definition of start angle (ST ANG) and end angle (ED ANG), refer to section “To recognize the start and end angle of a circular arc”, page 19.

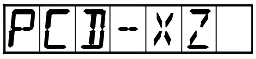
Using Fig. (c) as an example:

1) First, find part center position.

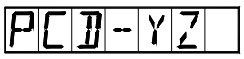
Key ❄ to enter PCD function.



2) Key ⇧ or ⇩ select processing plane.

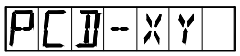


or



Enter the parameter

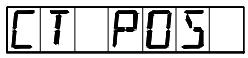
Select Plane XY.



Key ENT , next step.

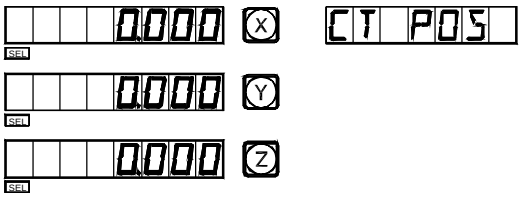
（only 3V readout has multiple planes, 2V model has only XY plane and this step does not appear）

3) Enter the center position of the circular arc.



Key X → 0 → ENT

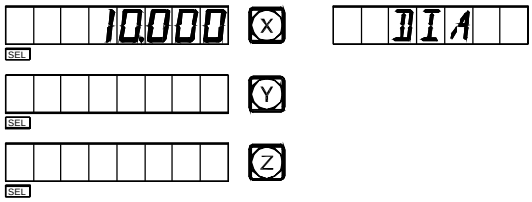
Y → 0 → ENT



Key ⇩ , next step.

4) Enter the diameter of the circular arc.

Key 1 → 0 → 0 → ENT



Key ⇩, next step.

5) Enter the number of points equally dividing the arc.

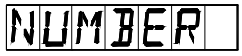
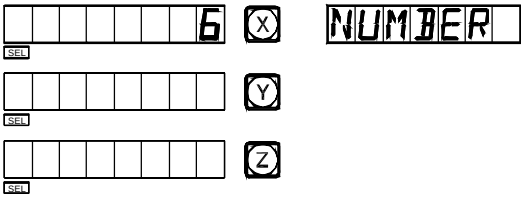


Fig. (c),we can consider it as 6 points is used to divide the arc from 0 to 300° into 5° equal section.

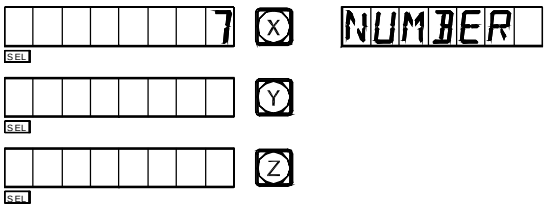
Key 6 ENT



Key ⇩ , next step.

It is also possible to consider as 7 points in points in used to divide the whole circle into 6 equal sections.

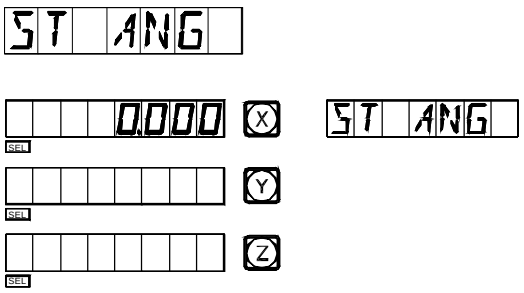
Key 7 → ENT



Key ⇩ , next step.

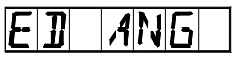
6) Enter the start angle.

Key 0 → ENT



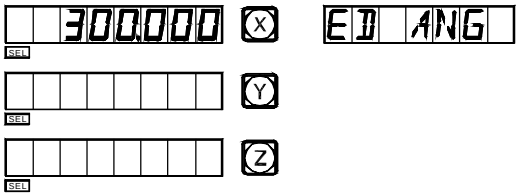
Key ⇩ , next step.

7) Enter the end angle.



If the arc is dividing by 6 points.

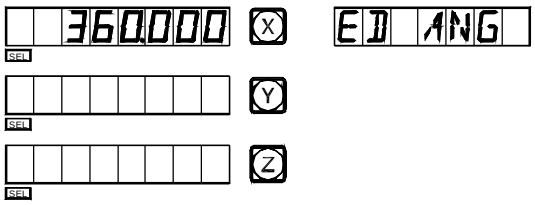
Key 3 → 0 → 0 → ENT



Key ⇩ , next step.

If the whole circle is divided by 7 point.

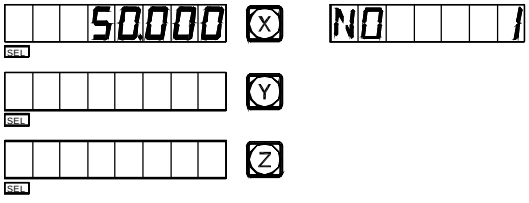
Key 3 6 0 ENT



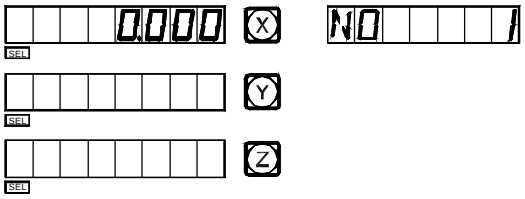
Key ⇩ , next step.

8) Enter processing

The display result for dividing the arc into 5 equal sections.



The display result for dividing the arc into 6 equal sections.



9) Key ⇩ and the position of next processing point will be displayed, move tool to bring the displayed values on both axes to zero to reach the corresponding position.

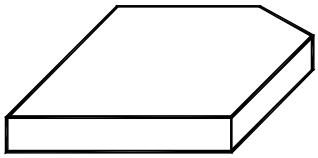
10) You may quit PCD function at will, by pressing ❄ .

G.

Angular Surface Processing

Angular Surface Processing

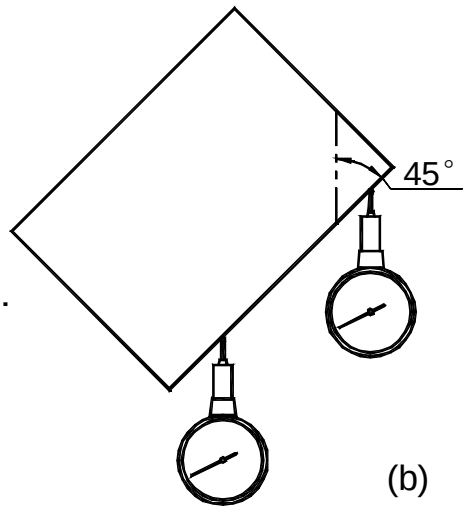
This function allows easy alignment of work piece for milling of angles.



(a)

Ⅰ. Aligning for the specific angles:

When the surface to be machined is in the XY plane, as shown in Fig. (a), it is necessary to align the work piece to the angle before milling. In this case, the angular surface function is very useful in aligning the reference angle.



(b)

Procedure for aligning reference angle:

First, set the work piece on the table with an oblique angle roughly equal to the desired angle.

1. Key [G17 N2] to enter the angular surface processing function.

2. Select the processing plane-Plane XY.

3. Enter the angle of the angular surface (ANGLE).

4. Move the machine table to let the tool (or dial indicator) come in contact with the reference plane being aligned, adjust the scale reading to zero, and move the machine table an arbitrary distance along X axis.

5. Key [Y], refer to the display and move along Y axis until the displayed value become zero.

6. Adjust the angle of the work piece and bring the scale reading to zero.

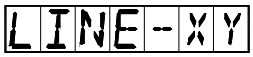
For example: Align the angle of work piece to 45° as shown in Fig. (b).

1) Set the work piece on the machine table with an angle equal roughly 45°

Key [sin/N2]

2) Select Plane XY.

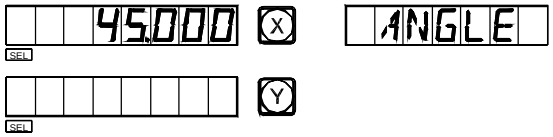
Key [ENT]



3) Enter the required angle of surface

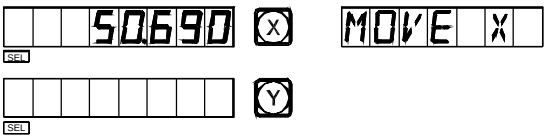
Key [4] → [5] → [ENT]

Key [⇩]



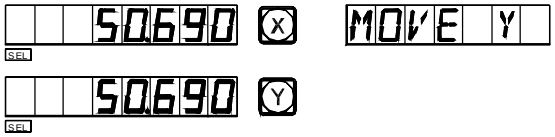
4) Move the machine table along X axis.

Let the metering tool touch the work piece, and adjust the scale reading to zero, then move machine table an arbitrary distance along X axis.



5) The moving distance on Y axis is displayed.

Key [Y]



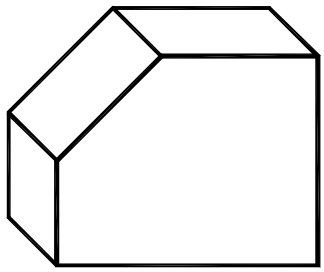
6) Move the machine tool along Y axis.

Adjust the angle of work piece, let the reference plane being aligned come just in contact with the metering tool and the scale reading be zero.

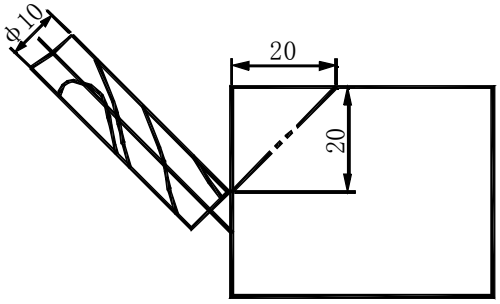
7) Move the machine table to bring the displayed value on Y axis into zero.

You may quit the angular surface processing function by pressing [sin/N2]

Ⅱ. Processing angular surface



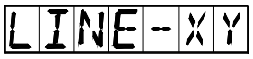
When the processing plane is Plane XZ or YZ. At first align the spindle of the machine tool for the bank angle, finish tool setting, and key [Sin/N2] to enter the angular processing function.



1. Select Plane XZ or YZ.
2. Enter the diameter of the tool (DIA).
3. Enter the start point (ST POS).
4. Enter the end point (ED POS).
5. You may quit the angular surface processing function by pressing [Sin/N2]

Refer to the example:

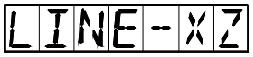
1) Align for the bank angle, finish tool setting, and key [Sin/N2].



2) Select the processing plane

Key [⇩]

Select Plane XZ



Key [ENT]

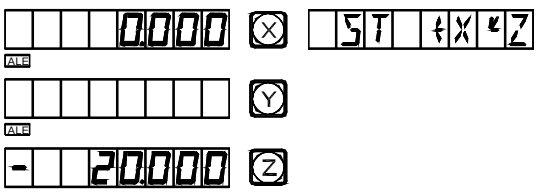
3) Enter the tool diameter

Key [1] [0] [ENT]

Key [⇩]

4) Enter the start point

Key [X] [0] [ENT]



[Z] [±] [2] [0] [ENT]

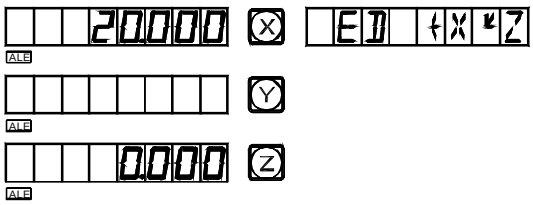
Key [⇩]

5) Enter coordinates of the end point.

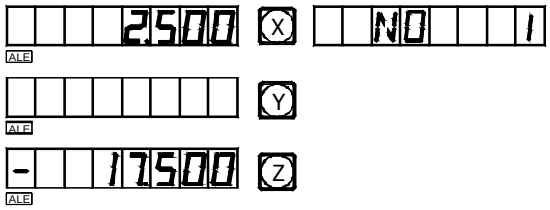
Key [X] → [2] → [0] → [ENT]

[Z] → [0] → [ENT]

Key [⇩]



6)Enter processing state



Key [⇧] or [⇩] and respectively the position of last/next processing point will be displayed.

You may quit the angular processing function by pressing [sin N2]

H.

Calculator Function

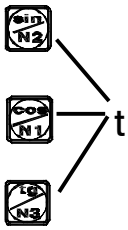
Calculator function

It is often necessary to calculate out some values during work, so we have provided a handy built in calculator function. All calculated values will be displayed on the X axis.

Is the Calculation function key, press it to enter calculator mode. You can exit calculator mode at any time by pressing the same key again.

For calculating the square root.

Key for “inverting” trigonometric functions, key it and then key a trigonometric function key for calculating the inverse trigonometric function.



trigonometric function key.

Key for canceling last input and result of last calculation.

→ Data to axis transfer, use in succession to transfer calculated value into axis position.

, quit data axis transferring.

Example: Key to enter calculator mode.

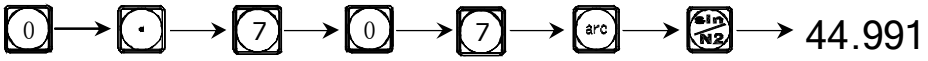
Perform the following calculation: 10+10÷2×5＝35

1 0 + 1 0 ÷ 2 % 5 =

Calculate: sin 45°= 0.707

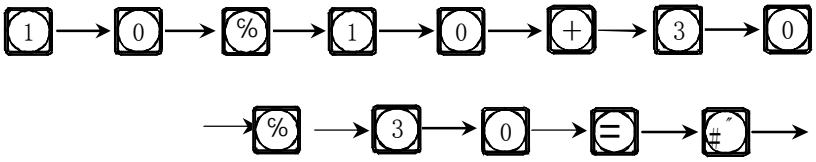
4 5 sin N2 0.707

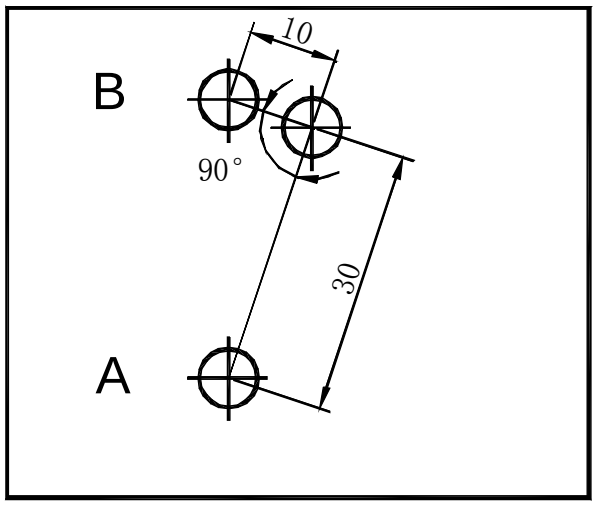
Calculate: arc sin 0.707=44.991



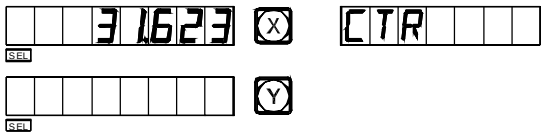
Make the following calculation:

The distance AB in the figure $=\sqrt{10^2+30^2}=31.623$



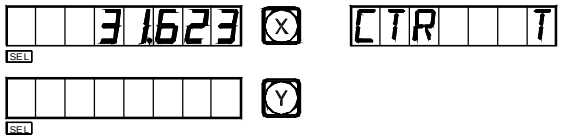


Display for the result:



Transfer the value 31.623 to Y axis.

Key ⇧



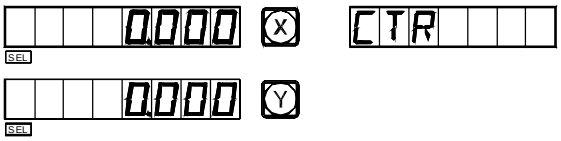
Key Y

As shown in the figure, the distance AB=31.623, the tool is at Point A, move the machine table to bring the displayed value into zero, the position

of Point B is reached, the processing of Hole B may start.

Quit the resulted value axis transferring function, enter the calculation function again.

Key CA → ⇧



Key ▦ to quit the calculation function.

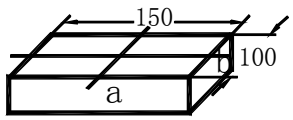
Note: When the value of input or calculation runs over, the information window will display "CTR E", meaning the result of calculation is wrong, pressing CA will clear the error

I.

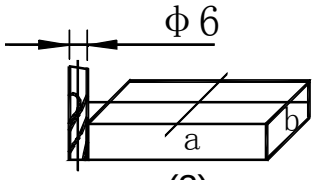
Tool Diameter Compensation

Tool Diameter Compensation Function

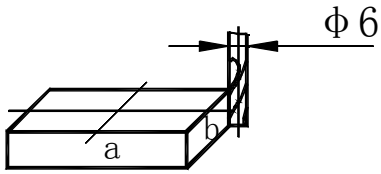
In the processing of the four sides of the part shown in (1), the operator has to run for an additional feeding distance equal the diameter of the tool in every side to complete the processing of the whole length, if the tool diameter compensation function is not used. The tool diameter compensation function provided in the digital display box can make the related compensation automatically.



(1)



(2)

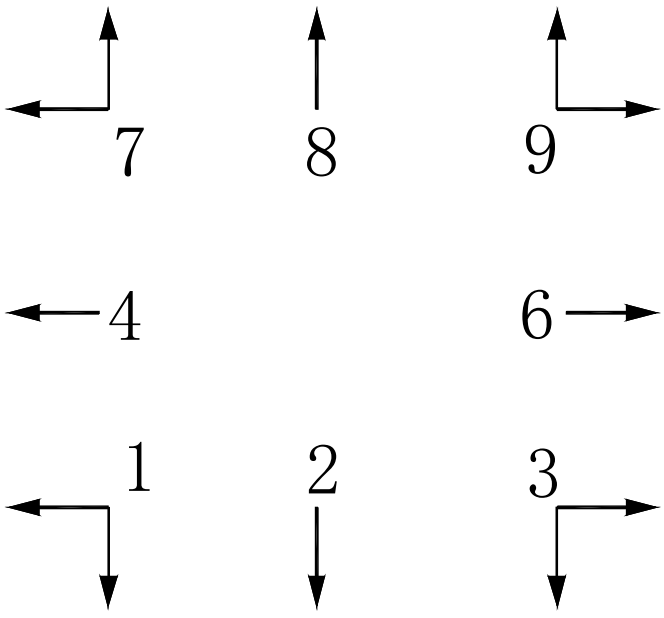


(3)

Note: The tool diameter can be made only in X- or Y- direction.

Operation Procedure:

1. Key to enter the tool compensation function.
2. Select a processing way among the preset 8 ways (prompt: WHICH).

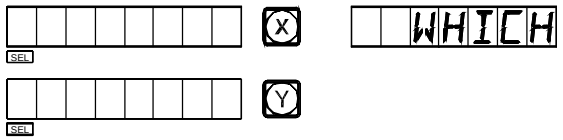


3. Enter the diameter of the tool. (DIA)
4. Enter processing state.

Refer to the operation procedure in a particular example:

The processing of Plane a and of the fitting shown in Fig. (1).

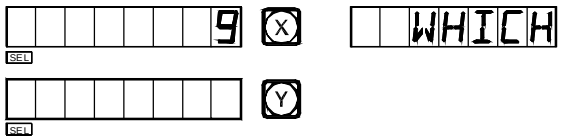
1) Key (G90 N3) to enter the tool compensation function.



2) Select a processing mode preset.

Start the processing at the position shown in Fig. (2)

Key 9 → ENT



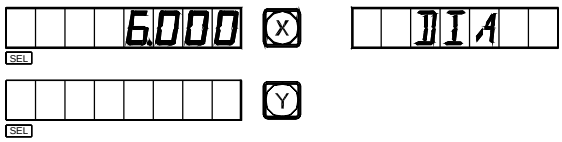
Start the processing at the position shown in Fig. (3)

Key 1 → ENT

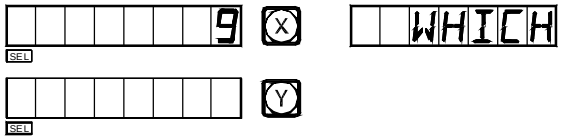
3) Enter the diameter of the tool

Key 6 → ENT

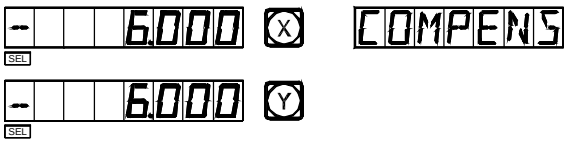
Key ⇩



4) Enter processing state

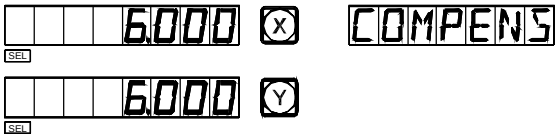


① Start the processing at the position shown in Fig. (2)



Move the machine tool to bring the X-axis displayed value into 150.000, and then move to bring the Y-axis displayed value into 100.000, so, the processing of two peripheral sides finishes.

② Start the processing at the position shown in Fig. (3)



Move the machine tool to bring the X-axis displayed value into -150.000 and then move to bring the Y-axis displayed value into -100.000, so, the processing of two peripheral sides finishes.

5) You may key to quit the tool compensation at will.

J.

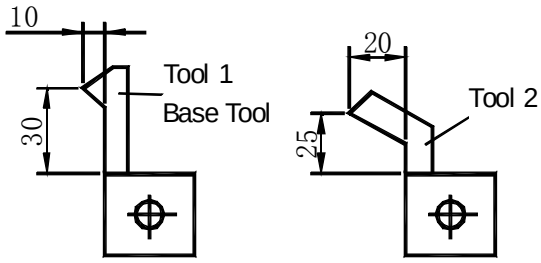
200 Tool Storeroom

200 tool storeroom:

It will need to use different tools when turning different work pieces or different surface of work pieces, so it is necessary to uninstall and adjust the tools, SDS6 digital readout has the function of 200 tools storeroom, which makes the operation simple.

Notice: The function of 200 tools storeroom can't be used unless the lathe has tool post.

1. Set a base tool. In the state of "ALE", to clear the display value of the X axis or the Y axis when moving the base tool to touch the frame of adjusting tool.

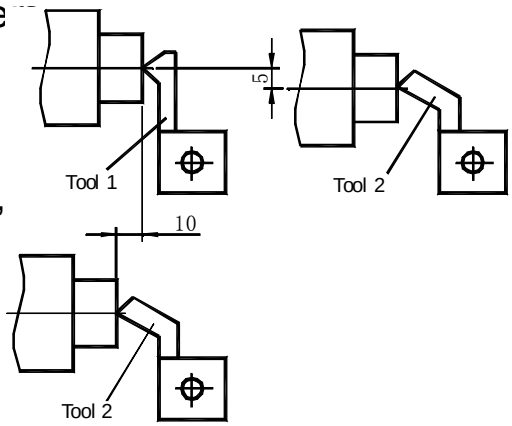


(a)

2. Ensure the other tool position relative to the base tool position, which is also the zero point of "ALE" coordinate system, as the figure (a) shows, the relative position of the second tool is:
   X-axis 25-30=-5, Y-axis 20-10=10.

3. Number the tool, and store the relative position to the base tool into the digital readout.

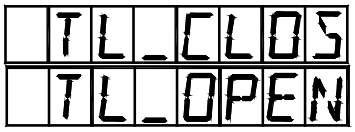
4. In process, the operator can input the numbe of using tool, the digital readout will display the relative position dimension of using tool to the zero point of "ALE" coordinate system, moving the lathe platform to make the display of X axis and Y axis become zero.



5. The tool storeroom can store datum of 200 tools.

6. If the function of 200 tools storeroom is opened, you can lock this function after you continue to touch the key ± 10 times.

If the function of 200 tools is locked, you can unlock this function after you continue touch the key ± 10 times. In the state of “ALE”.

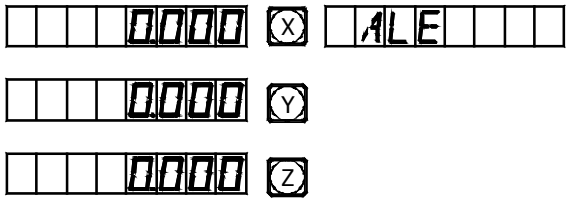


Means close tool storeroom;
Means open tool storeroom。

Notes: the Y-axis value mentioned above is the integrated value of Y-axis with Z-axis, namely the Z/Z0-axis in the former lathe machine readout.

The operation of inputting the datum of tools and calling tool:

1) Please input the datum of tools, in the “ALE” coordinate system, clear the display value when moving the base tool to touch the frame of adjusting tool, set the first tool to the base tool.



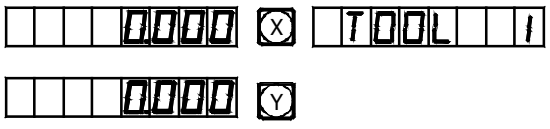
2) Enter the inputting stare.

Key TOOL

3) Input the datum of next tool.

Key X → 0 → ENT

Y 0 ENT



Key ⇩

4) Input the numbers of tool

Key 2 ENT

Key ⇩

5) Input the datum of tool.

Key X → ± → 5 → ENT

Y → 1 → 0 → ENT

6) Key ⇩ continue to input the datum of next tool.

Key TOOL quit the inputting state.

You can operate the tool storeroom as below after you input the datum of tools, first install the second tool.

1) Enter the using state.

Key CALL

2) Ensure the base tool.

Key ⇧

Default the first tool as the base tool, you can also set the other tool as the base tool, key number ENT is OK. Key ⇩ can call other tools.

3) Call the second tool.

Key 2 → ENT

4) Exit

Key CALL

Move the flat-from to make the display value of X axis and Z/Z_0 axis become zero.

The second tool has reached the datum mark, in like manner, the

operator can input and call 200 tools.

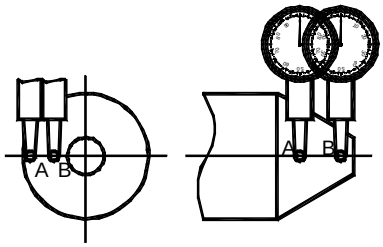
Notice: You can clear the display value to zero in “ALE” coordinate system only when using the base tool, you can clear the display value to zero in “INC” coordinate system when using other tools.

K.

Taper measure Function

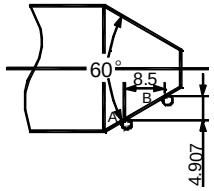
Taper measurement function:

The taper of work piece can be measured when turning the taper work piece.



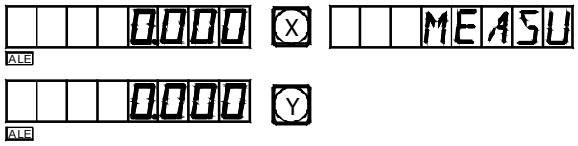
Operation:

As figure shows, the nod of lever meter is touched the position A of work piece surface. Pressing it to make the lever meter point to zero.



1) Then entering the function of measure for taper.

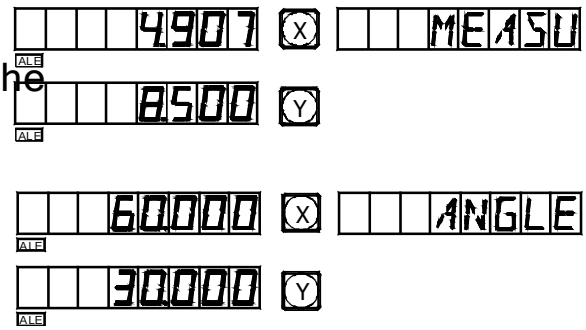
Key 



2) Move the lever meter to position B of work piece surface, press it to make the lever meter point to zero.

3) Compute.

Key 



The display value of X axis is taper.
The display value of Y axis is angle.

4) Quit

Key 

L.

EDM Matching Output Function

(3V-EDM only)

New type matching output function:

1. Function

This function is used especially for processing by use of discharging processing machine. When the set target valve on Z axis of spark machine is equal to the current value, the digital display case exports switching signals to control the spark machine tool to stop the in depth processing.

Model SDS6-3V digital display case has its direction setup in the Z axis as shown in Fig. 1. Namely, the deeper the depth goes, the bigger the coordinate value displayed on Z axis. The depth goes further ever since the processing is stared, and the displayed value on Z axis increases gradually.

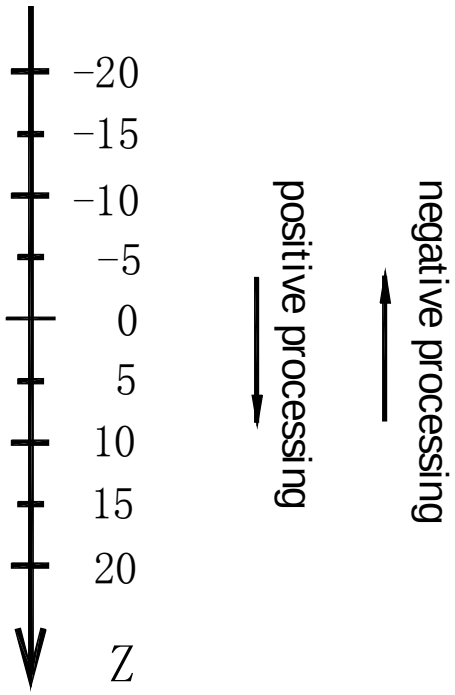


Fig. 1

According the set direction on Z axis, the processing directions are divided into positive and negative. When the electrode goes down and processing goes from upper to lower, the value displayed on digital display meter increases, and the processing direction now is “positive”. This direction is then set as normal setup.

When the electrode goes up and processing goes from lower to upper, the displayed value on the digital display meter is reduced, and the processing direction now is “negative”, namely, the “negative processing”

as shown is Fig. 1.

Model SDS6-3V digital display case also possesses the “negative anti fire height” function that other cases of similar kinds cannot offer. This function is delivered by a kind of intellectual location tracing, testing and protecting device. In the positive processing, the electrode surface will be covered by a kind of intellectual location tracing protecting device. In the positive processing, the electrode surface will be covered by accumulative carbon; in case of long time processing and overtime processing not under control by anybody, such accumulated carbon is not cleaned by anyone; then the electrode will increase along the negative direction; and once the electrode exceeds the liquid surface, it may cause a fire accident and incur losses. This function is designed to exactly resolve this problem in setup. Once you set “negative anti fire height”, when the increased height of electrode exceeds its height above the depth of processed surface (i. e. the negative anti fire height), the digital display case will flash alarm signal; meanwhile, its exported signal will automatically shut down the discharging processing machine to avoid any possibility of fire accident (as shown in Fig. 2).

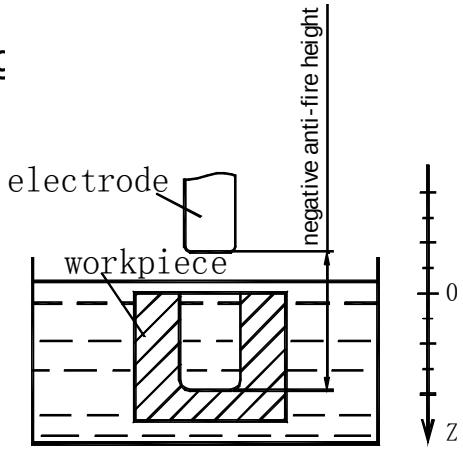


Fig. 2

2. Concrete operating methods:

See the concrete processing examples 1, 2 and 3.

1) Before processing, first set the parameters “negative anti-fir height”, “exit mode”, and “processing direction”.

2) First, move the main axis electrode on Z axis to make it touch work piece datum. Reset Z → or enter a figure.

3) Press EDM button, enter your desired depth value (to be displayed on X axis to). Such as 10. Then press ENT button to confirm the input value. Afterwards, press the button to exit from “Depth” status. At the same time, enter the “EDM” status to conduct processing.

4) X-axis will display “target value of personal location”

Y-axis will display “value of depth reached”. Note: Values on Y-axis means the depths reached on the work piece by processing.

Z-axis will display “real time value of personal location”. Note: Values on Z-axis mean the values of locations of main axis electrode on Z-axis.

5) Start processing. The displayed value on Z-axis gradually gets close to the target value. The displayed value on Y-axis also gets close to the target value. If the electrode is repeated raised and lowered at this time, the displayed value on Z-axis will change accordingly. But the displayed

value on Y-axis will not change, and always refer to the value of depth reached by processing.

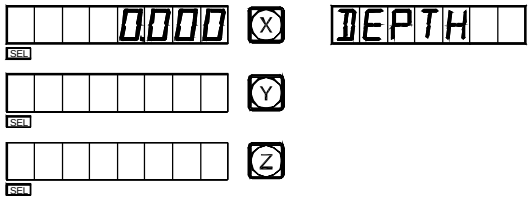
6) When the displayed value on Z-axis is equal to the set target value, the matching switch is shut off, EDM discharging machine will stop processing, and message screen will display “EDM. E”. According to the setup of operators, there are 2 kinds of exit modes:①automatic mode: means automatically exit from the processing status of spark machine, and return to the display status before such processing;②pause mode: “EDM. E” is always displayed, you have to press the EDM button once to exit and return to the original display status.

3. Set “ERRHIGH”, exit mode and processing direction:

Before processing, you can first set “ERRHIGH”, “exit mode” and “processing direction”.

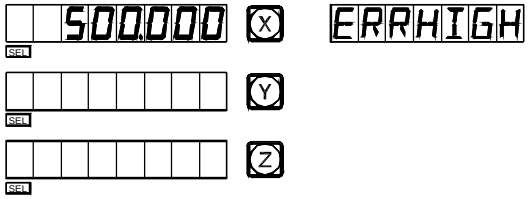
1) Enter “EDM”

Key EDM

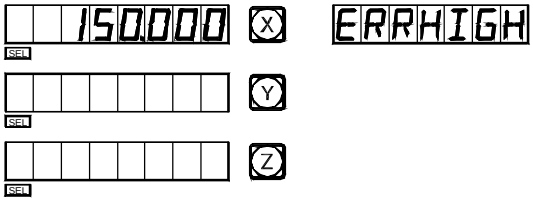


2) Enter Setup Mode

Key ⇩



3) Set “negative anti-fire height:
Enter a height, i. e. “150”.
Key 1 5 0 ENT



Key ⇩

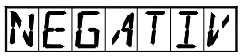
4) Enter the “Exit Mode” Setup. 

Key 1 → ENT Set at “pause mode”.

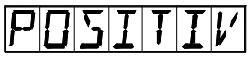
Key ⇩

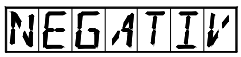
“AUTO” means automatic mode, “STOP” refers to pause mode. If the original exit mode is pause mode, and “STOP” mark appears, press O to display “Automatic mode” to replace the “AUTO ” mark. You can use 1 or 0 to change.

5) Select positive or negative processing direction.



Key 0 → ENT , set at “negative processing”

Positive, Key 1 

Negative, Key 0 

6）choose the EDM process mode

there’s two alterative choice 0 and 1 of EDM MODE:

Press 0 ENT to choose mode 0.

the relay act as list below:

A power off, relay OFF

B CPU resetting, relay OFF

C CPU start-up, relay ON

D Running function EDM , relay ON

E Reach the depth of function EDM setting, relay OFF

Press (1) → (ENT) to choose mode 1. 

the relay act as list below:

A power off, relay OFF

B CPU resetting, relay OFF

C CPU start-up, relay OFF

D Running function EDM , relay OFF

E Reach the depth of function EDM setting, relay ON

You shall first make sure the mode is positive processing: in negative processing, for the work piece as shown in Fig. (f), be sure to set at negative processing mode and lead to exit from processing.

6) Exit from setup mode

Key (EDM)

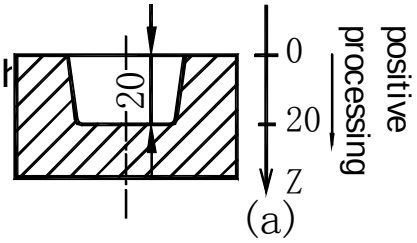
You can also set various parameters during processing. When electronic spark processing started, if you find it is necessary to change the originally set “DEPTH”, “ERRHIGH” or “EXIT MODE” and “PROCESSING DIRECTION”, the operator can press (⇧) button to enter the setup mode. When the message screen displays “DEPTH”, you can re-ser the depth value; continue to press (⇧) button, the screen will display “ERRHIGH”, “AUTO” (or “STOP”) and “POSITIVE” (or “NEGATIVE”) in succession, then you can re-set any item as you choose. Press down the (⇩) button until “EDM” is shown, you can return to the processing mode again.

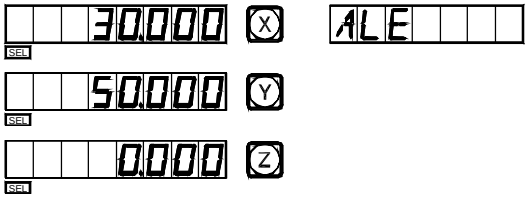
4. Example of Positive Processing:

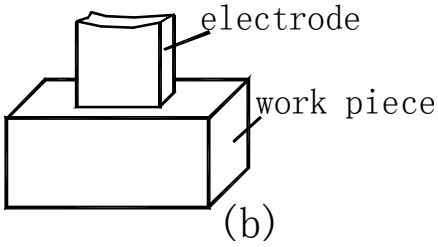
Example 1: Model Chamber as shown in the processing Fig. (a)

Please make sure the processing direction is positive.

1) First move the main axis electrode to make it touch the work piece, as shown in Fig. (b), then press Z → CLS to clear the display.

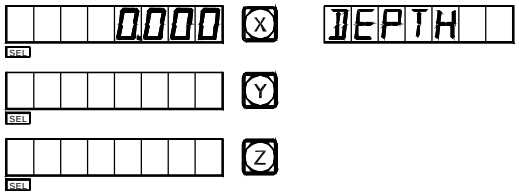






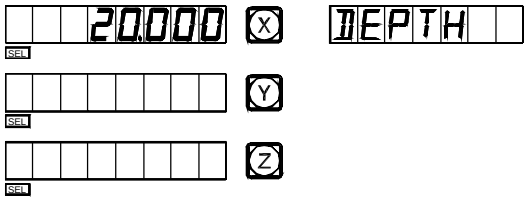
2) Put in depth of processing.

Key EDM



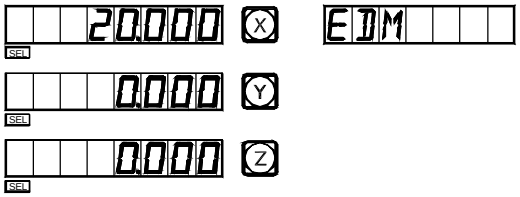
3) Enter the depth value.

Key 2 → 0 → ENT



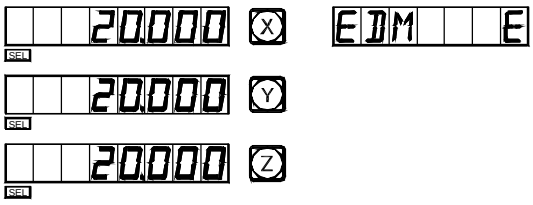
Key ⇩

4) Start processing.

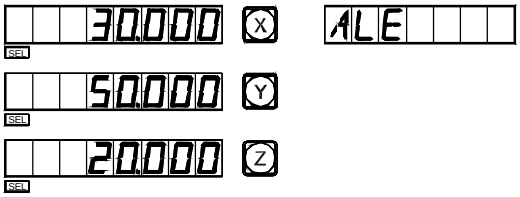


5) "EDM E" display lasts for 3 seconds long.

Return to the state before processing.

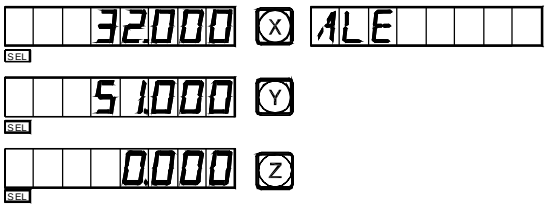


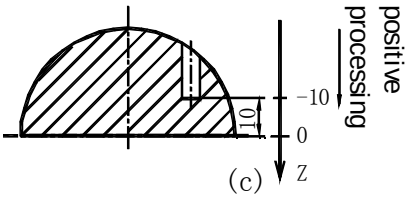
Example 2: Work piece shown in the processing drawing (c).



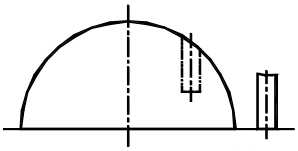
Please make sure the processing direction is positive.

1) First move the main axis electrode to make it touch the work piece datum, as shown in Fig. (d), then press Z → reset.

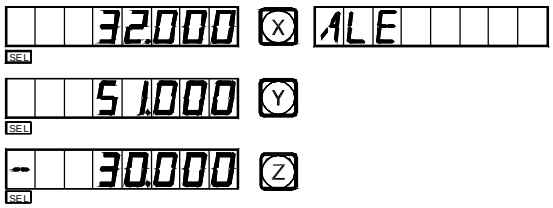


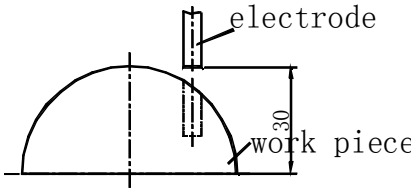


(c)


(d)

Move the electrode to the shown place in drawing (e).

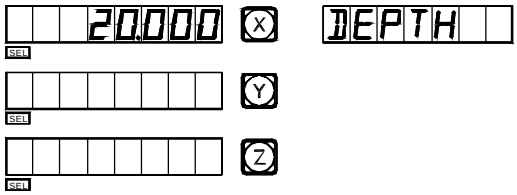




(e)

2) Enter "EDM"

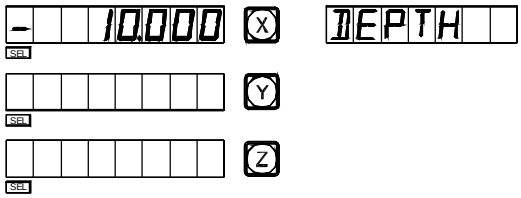
Key EDM



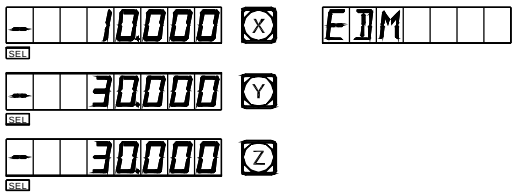
3) Enter the depth value.

Key ± 1 0 ENT

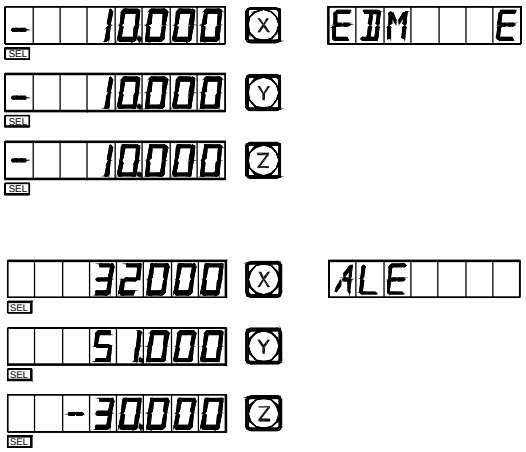
Key ⇩



4) Start processing



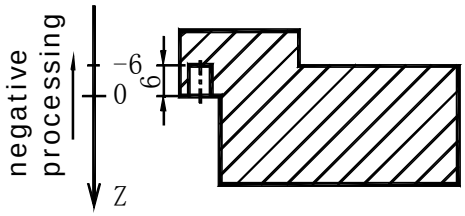
5) Reach the target value. “EDM E” display lasts for 3 seconds and then exits automatically.



5. Example of Negative Processing.

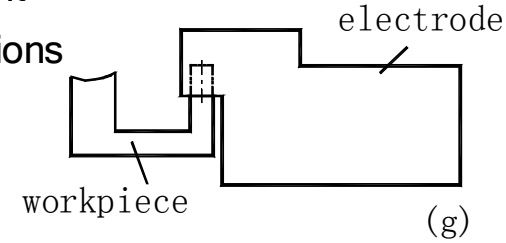
Example 3: Work piece as shown in the processing drawing (f).

Before processing, please make sure the processing is negative.

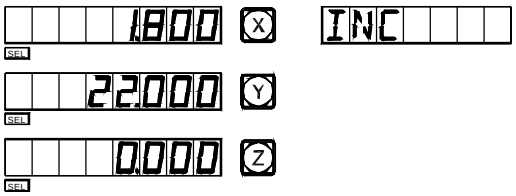


(f)

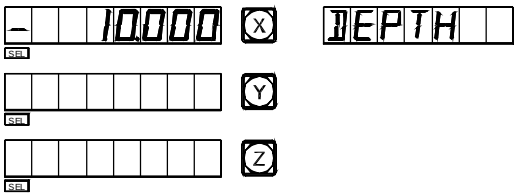
1) First, move the main axis electrode to make it touch datum place for processing specifications of the work piece as shown in Fig. (g). Then press Z → ⌀ to clear the display.



(g)



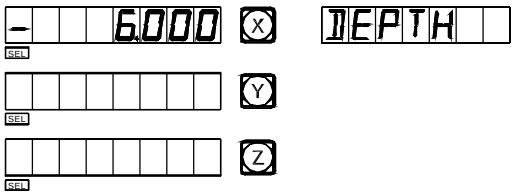
2) Put in depth of processing.
Key EDM



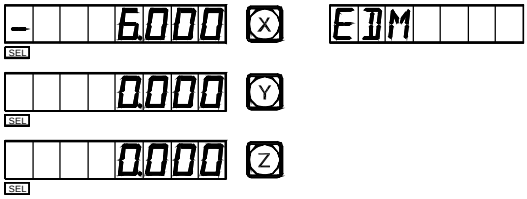
3) Enter the depth value.

Key ± → 6 → ENT

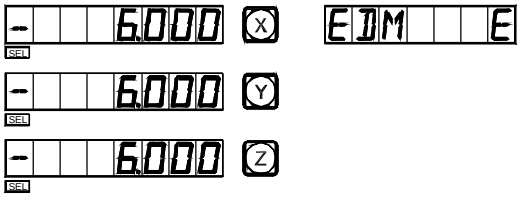
Key ⇩

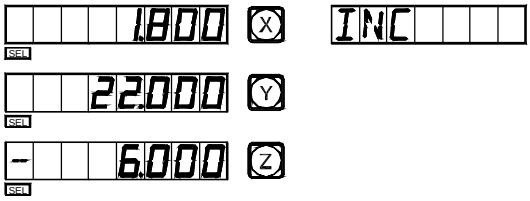


4) Start processing



5) Reach the target value. “EDM E” display lasts for 3 seconds and then exits automatically.





6. A Combined Use of PCD function and EDM function.

PCD and EDM functions can be used in a combination. The operator can first use the PCD function, under the working condition, press ❄ button to exit from PCD; then you can press EDM to enter EDM function to process the work piece; after exiting from EDM, press ½ button to return to the status when you exited from PCD just now, then you can continue to use PCD function. In such a cycle, you can use the discharging processing machine to process evenly the hole around the circumference.

7. Switch Display Mode Function

In EDM spark processing, if the operator wants to know the XY plane coordinates in the exterior, he can press ⊙ button, then the message screen displays “EDM. P”; and X axis and Y axis will display the exterior XY planes. Press the button again to return the original EDM display mode. This function only switches between display modes, and does not affect the spark processing.

8. back panel EQUAL OUT port

EQUAL OUT port is connected to the output of relay,
1.0A30DC 0.5A125VAC 0.3A60VDC

PIN	SIGNAL	COLOR OF WIRE
1	NC(Normal Close)	Brown
3	COM(Common)	Blue
5	NO(Normal Open)	Yellow-green

M.

Digital Filter Function

Digital filter function:

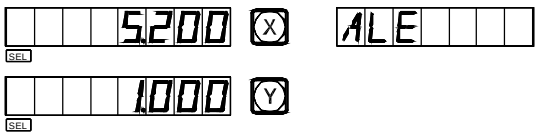
In grinding process, the readout display value may change quickly due to vibration of the grinding machine. SDS6-2V special readout for grinding machine has the digital filter function, it delays the readout display value when the grinding machine is vibrating.

The operator can use the digital filter function as follow:

1) Enter the digital filter function.

Key (SIFT)

2) Key (SIFT) quit the digital filter function.



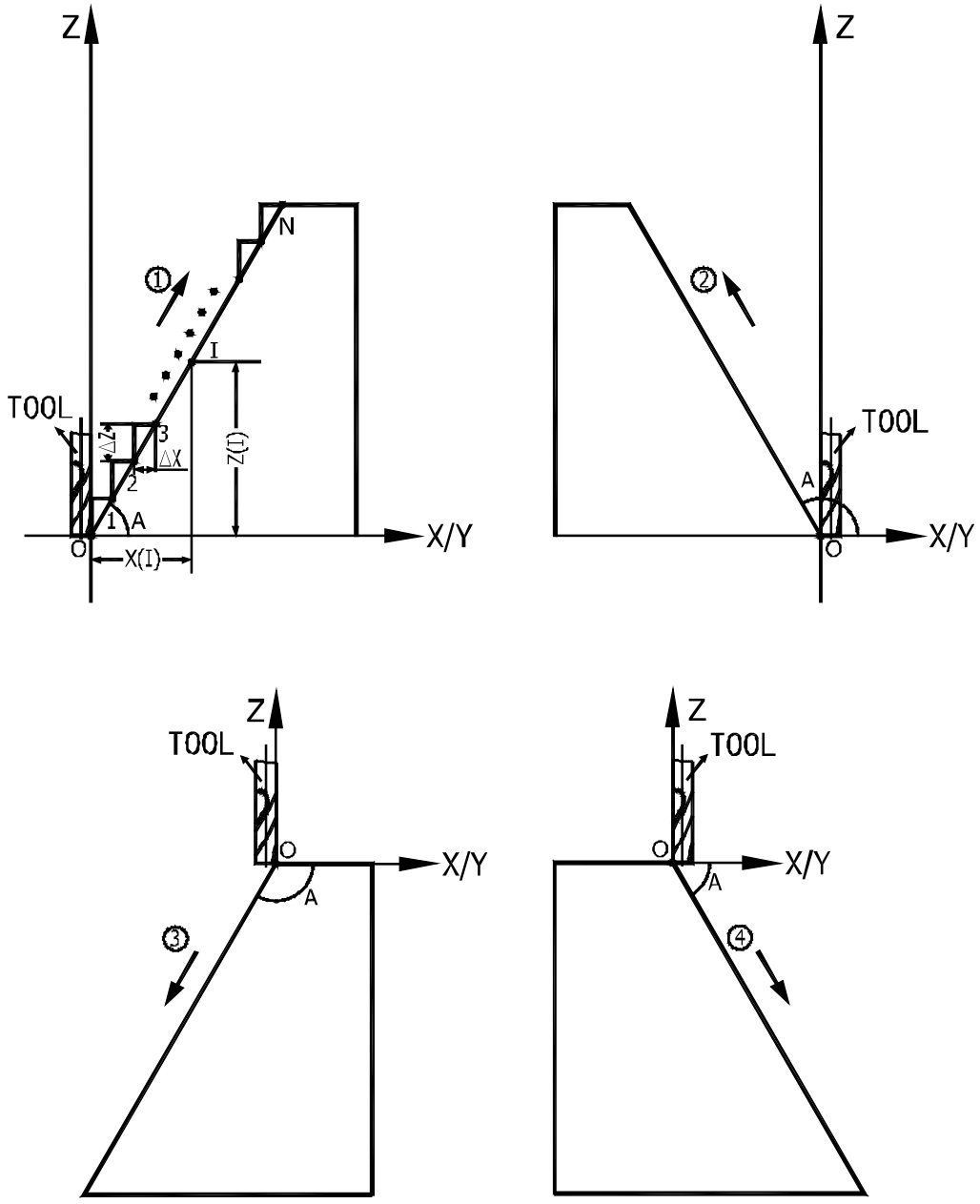
Note: The digital filter function can only be used in "INC" or "ALE" mode.

N.

Vertical Slope Milling
“N3” Function

The function is suit for Z axis vertical slope machining.

There are four machining mode, as following example:



① ΔZ=0.1

A=60°

② ΔZ=0.1

A=120°

③ ΔZ=-0.1

A=-120°

④ ΔZ=-0.1

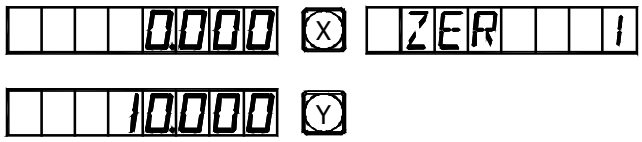
A=-60°

Operation steps was show as fallow: (Take the processing plane XZ as an example)

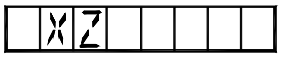
1) Move the tool to the start point,

Key (X) → (⁄⁄)

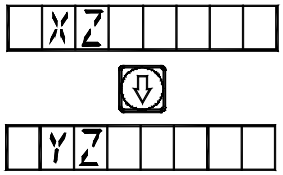
(Y) → (⁄⁄) (plane YZ).



2) Key (tg/N3) enter N3 function.

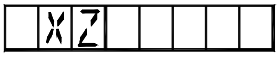


3) Key (⇩) select the processing plane.



4) Select plane XZ，

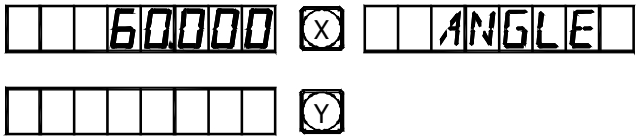
Key (ENT) to ensure



5) Enter the angle.

Key (6) → (0) → (ENT)

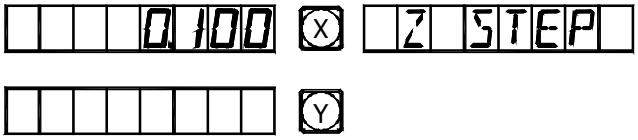
Key (⇩)， next step



6) Enter the feeding of Z(delta Z)

Key (0) → (·) → (1) → (ENT)

Key (⇩)， start processing.

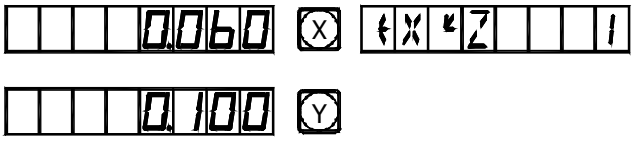


(Note: When processing, delta Z of each step is equal.)

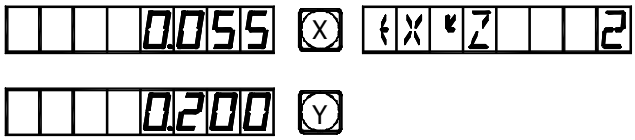
7) Point 1, move axis X to 0,

move axis Z 0.1mm forward.

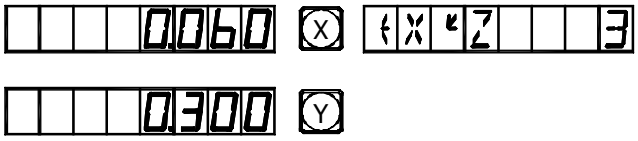
Key (⇩)， next point.



8) Point 2, move axis X to 0,
move axis Z 0.1mm forward.
Key ⇩, next point.

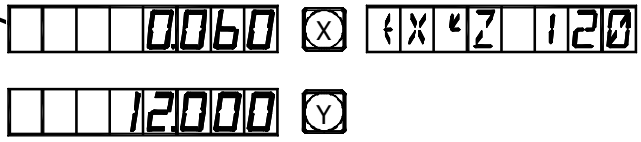


9) Point 3, move axis X to 0,
move axis Z 0.1mm forward.
Key ⇩, next point.

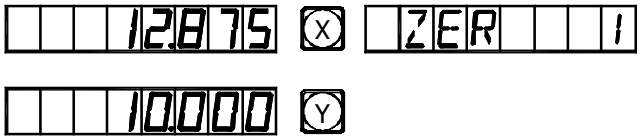


The last point

10) The last point, move axis X to 0,
move axis Z 0.1mm forward.



11) Key tg/N3, quit N3 function, digital readout show the current XY value.



12) Validate the value using the equation bellow:

$$X_{(I)} = \frac{\Delta Z}{tgA} \times I \qquad \Delta X = \frac{\Delta Z}{tgA}$$

$$Z_{(I)} = \Delta Z \times I$$

I Step number.

Delta X: feed of axis X between each step.

Delta Z: feed of axis Z between each step.

XI: displacement of axis X in the Ith point.

ZI: displacement of axis Z in the Ith point.

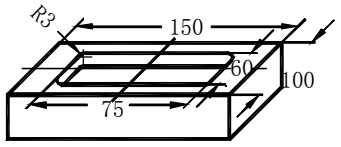
(Note: the processing on plane YZ is the same with plane XZ.)

O.

Rectangular pocket milling.

Rectangular pocket milling.

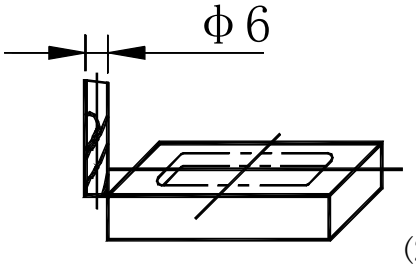
When the part requires rectangular pocket milling as shown in Fig. (1), the pocket milling function may be used easily by referring to the prompts in the message window. As shown in Fig. (3), the processing starts from the center of the inner chamber and goes on along the arrow direction.



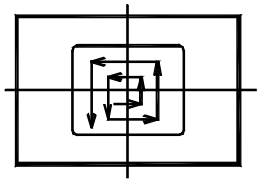
(1)

Operation procedure:

1. Key [Cos N1] to enter the pocket milling function.
2. Enter the diameter of the tool (DIA).
3. Enter the position of the inner chamber (CT POS) (the position with respect to center of the tool).
4. Enter the size of the pocket.
5. Enter processing state.



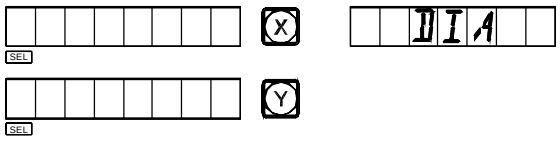
(2)


(3)

The operation procedure in an example:

Fig. (1).

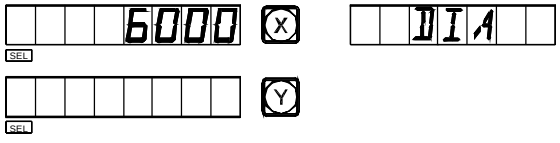
1) Finish tool setting as shown in Fig. (2), reset, and key [Cos N1] to enter the function.



2) Enter the diameter of the tool

Key [6] [ENT]

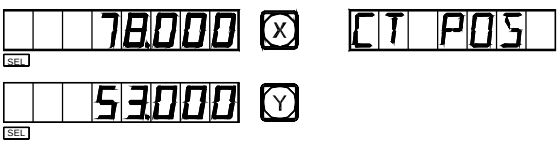
Key [⇩]



3) Enter the position of the center of the inner chamber.

Key [X] [7] [8] [ENT]

[Y] [5] [3] [ENT]



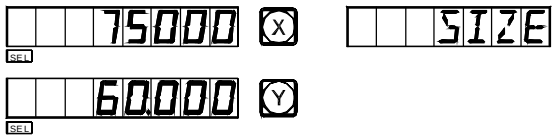
Key [⇩]

4) Enter the size of the inner chamber

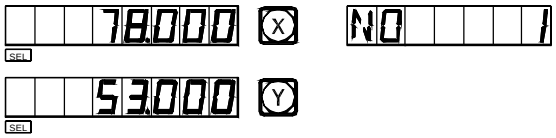
Key X → 7 → 5 → ENT

Key Y → 6 → 0 → ENT

Key ⇩



5) Enter processing state.



6) Move the machine table to bring the displayed values on both X- and Y-axes into zero.

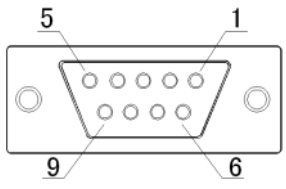
7) Key ⇩ to display the processing position of next step, refer to the prompts and move the machine to bring the displayed values on both X- and Y- axes into zero.

You may quit the pocketing function at will by pressing COS N1

Additional data sheet:

1. The digital display box must be handled carefully.
2. The box must be grounded properly.
3. Power voltage selection: AC 80V~260V ±15%
   50 Hz~60 Hz
4. Power consumption: 25VA
5. Working temperature: 0℃~45℃
6. Storage temperature: -30℃~70℃
7. Relative humidity: <90%(20±5℃)
8. Weight: ≈3.2 kg
9. There must not obviously be corrosive gases around the box.
10. Number of coordinates: 2 coordinates, 3 coordinates.
11. Display: 7 digit with plus and minus symbol display (2 axes or 3 axes), the message window displays by means of 8 star character display device.
12. Frequency multiplication: 4X
13. Allowable input signal: TTL square wave.
14. Allowable input signal frequency: ≤5M Hz
15. Length resolution: 5μm, 1μm,10μm, 0.1μm, 0.2μm, 0.5μm.
16. Operation keyboard: Sealed diaphragm touch keys.
17. Linear scale connections: (9_pin socket)

Pin	1	2	3	4	5	6	7	8	9
Signal	Null	0V	Null	Null	Null	A	+5V	B	Z

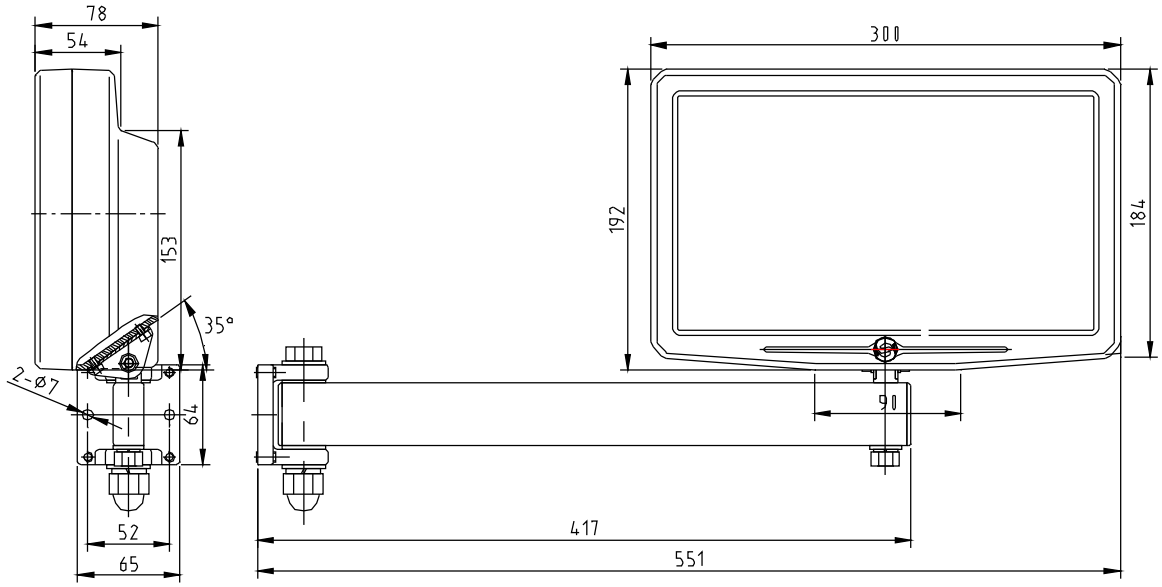


Ⅱ. Trouble shooting and handling:

The following troubleshooting allows basic fault finding. If there are still problems, do not attempt repair by yourself, seek assistance from us or our agents.

Symptom of failure	Source of failure	Troubleshooting
Digital display meter does not display	1. Is it connected to power supply? 2. Is power switch closed? 3. Is appropriate mains voltage used? 4. Shorting of power supply inside reading head.	1. Check power wire, then switch on power supply. 2. Close the power switch. 3. Mains voltage should be within 60~260V. 4. Disconnect plug of linear scale.
Enclosure of digital display meter is charged.	1. Is enclosure of machine tool and digital display meter well grounded? 2. Is there electric leakage from 220V power supply to the ground?	1. Well ground enclosure of machine tool and digital display meter 2. Check 220V power supply.
One axis of DRO does not count.	1. Exchange with the linear scale on other axis, and then operate to see if it no longer counts. 2. Is digital display meter in some special function mode?	1. If counting is normal the linear scale is faulty. If counting is abnormal the DRO counter is faulty. 2. Exit special function.

Ⅳ. Installation figure



Note:

1. Clip the power and signal wire to avoid tripping or catching.
2. Installation height is suggested at 1350mm from floor.

Sterling.
8F-2, No. 97 Taichung Kang Rd, Sec,3., Taichung 40755, Taiwan.
Tel: 04 2358 8535 | Fax: 04 2358 8530 | info@dro.com.tw
www.dro.com.tw