

# **DIGITAL READOUTS**

## **Operation Manual**

*Pro Ver1.0*

*GUIYANG XINTIAN OETECH CO.,LTD*

*www.chfoic.com*

☞ The digital counter devices comply with the provisions of the Directive of the European Union:Low Voltage Directive ( 73/23/EEC) and EMC Directive (89/336/EEC ).

The company has acquired ISO9001: 2000 International Standard Quality System Certificate issued by the Quality Certification Body of China.

Respected user:

The digital readout is a kind of displaying and locating device for machine tools. Please read the safety attention before operating .

Please read the explanations before using the manual.

- ◆ The manual is suit for some explanations about the DRO series digital readouts. It includes:
  - DS-DRO-2M** Digital readouts used for milling machine of multi-function 2 coordinates.
  - DS-DRO-2G** Digital readouts used for grinding machine of general function 2 coordinates.
  - DS-DRO-2L** Digital readouts used for lathe of general function 2 coordinates.
  - DS-DRO-3M** Digital readouts used for milling machine of multi-function 3 coordinates.
  - DS-DRO-3E** Digital readouts used for electric spark machine tool of general function 3 coordinates.
- ◆ The chapter 1 is mainly some explanations about the panels and keys of DRO Series digital readouts.
- ◆ Please read the following safety items carefully, which is about your safe.

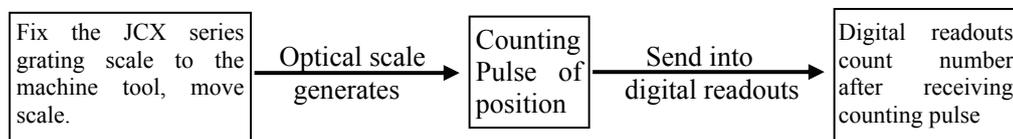


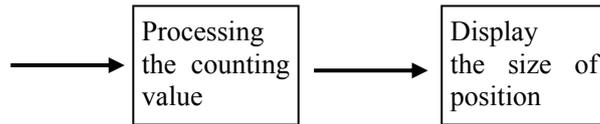
**Safety attention**

- ◆Do not use the device in an atmosphere charged with flammable gases because it does not have an explosion-proof structure.
- ◆Please turn off the power if the device has not been used for a long time.
- ◆To prevent the electric shock or fire, the device should not be moist or splashed with cool liquid directly.
- ◆Try to unplug the power plug in rainy or thunderstorm weather.
- ◆Do not open the device shell or connected or unplug the plug of grating scale before turning off the power.
- ◆Ensure the digital readout is connected to the ground.
- ◆If smog or peculiar smell scatters from the digital readouts, please unplug the power plug immediately. If continue using the device, it may result in fire or electric shock. Contact the agent; do not repair it by yourself.
- ◆If the device has not been used for a long time, the lithium charged battery which is used to save data inside the readouts will be damaged. Please contact our company agents to change the battery when it does not save data.
- ◆If the connecting wire of grating scale and digital readouts is broken off or the surface is damaged, it will cause the error of inspecting data. So user should be careful.

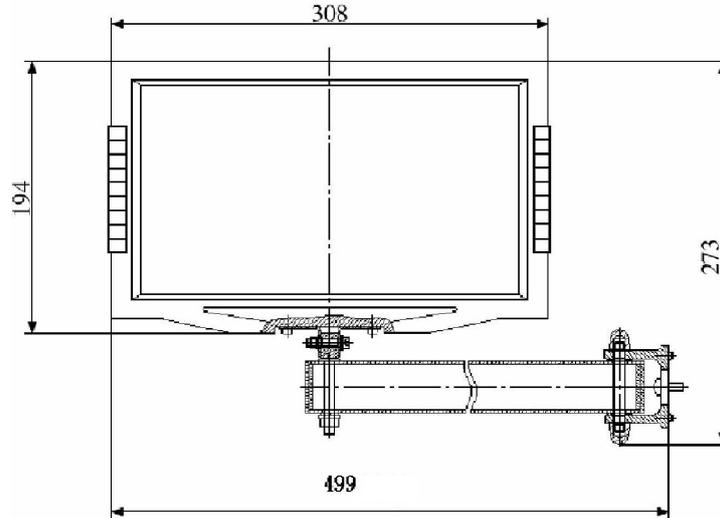
**Operating principle**

The optical scale displayer of our company belongs to high technology product integrated with the photoelectric techniques, precision mechanism techniques, micro-electric analog techniques and computer processing techniques and so on. If the user has not been professionally trained should not repair the system alone. The block diagram of operating principle is as follows:





### Dimensions for installation



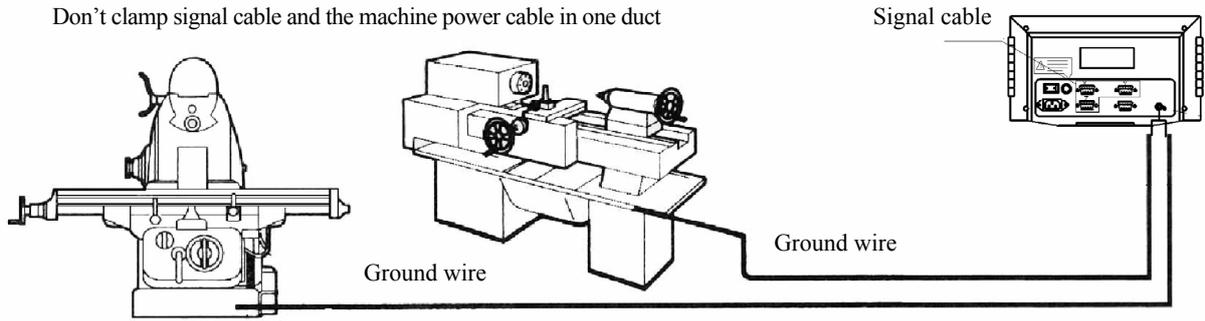
- NOTE:** ①Clamp the power cord and signal cord to avoid tripping person.  
 ②Height of installation is absolute 1350mm height of operator.

### Specifications of Digital Readouts

- 1) Input power voltage: **AC 100V~240V; 50 HZ/60 HZ**
- 2) Power consumption: **7-14VA**  
Fuse: **F 2A/250V**
- 3) Operating temperature: **0°C~45°C**
- 4) Storage temperature: **-30°C~70°C**
- 5) Relative humidity: **<90% (20±5°C)**
- 6) Weight: **≈2.7kg**
- 7) Dimensions: **308×194×80** (Unit: **mm**)
- 8) Number of axes displayed: **2 coordinates, 3coordinates**
- 9) Display:**7** bits display with sign (**2** or **3** axis) and information window outputs **8** bit “米” sign.
- 10)Frequency doubling: **4X**
- 11)Scale Signal: TTL square wave or EIA-422-A wave or~1Vpp sine wave.
- 12)Frequency of input signal: **<100kHz**
- 13)Resolution of length: **10μm、5μm、1μm、0.5μm .**
- 14)Keyboard: contact key slightly.
- 15)Grating scale:Pitch is **0.02mm or 0.01mm**, supply voltage is **+5v**. Output signals are two **TTL** square waves which are phase-shifted by 90 degree (with zeroing signal). Current is **50mA** .

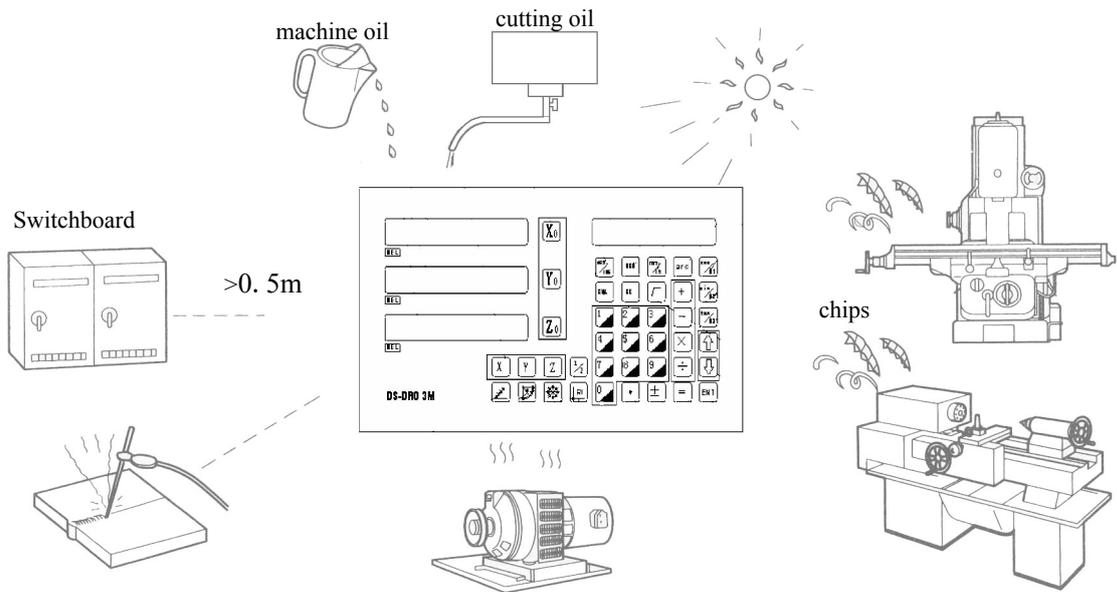
## Environment for operation

Don't clamp signal cable and the machine power cable in one duct



Remove paint or rust completely before connecting the ground wire

- ◆ The ambient temperature should be in the range from 0°C to 45°C. Avoid exposing to direct sunlight or hot air currents.
- ◆ Leave distance from devices of high voltage, large current and strong magnetism, and keep the signal cable of the grating scale away from the power cord.
- ◆ Avoid metal cutting, water and oil. Pay attention to dust and humidity protection. The device should not be fixed to greater shock or insecure worktables.



## Packing List

- 1、 DRO digital readout one set.
- 2、 Power and ground wire one piece.
- 3、 Operating manual one copy.
- 4、 Traversing arm groups one set.
- 5、 Protecting glue case one piece.
- 6、 Certificate one copy.

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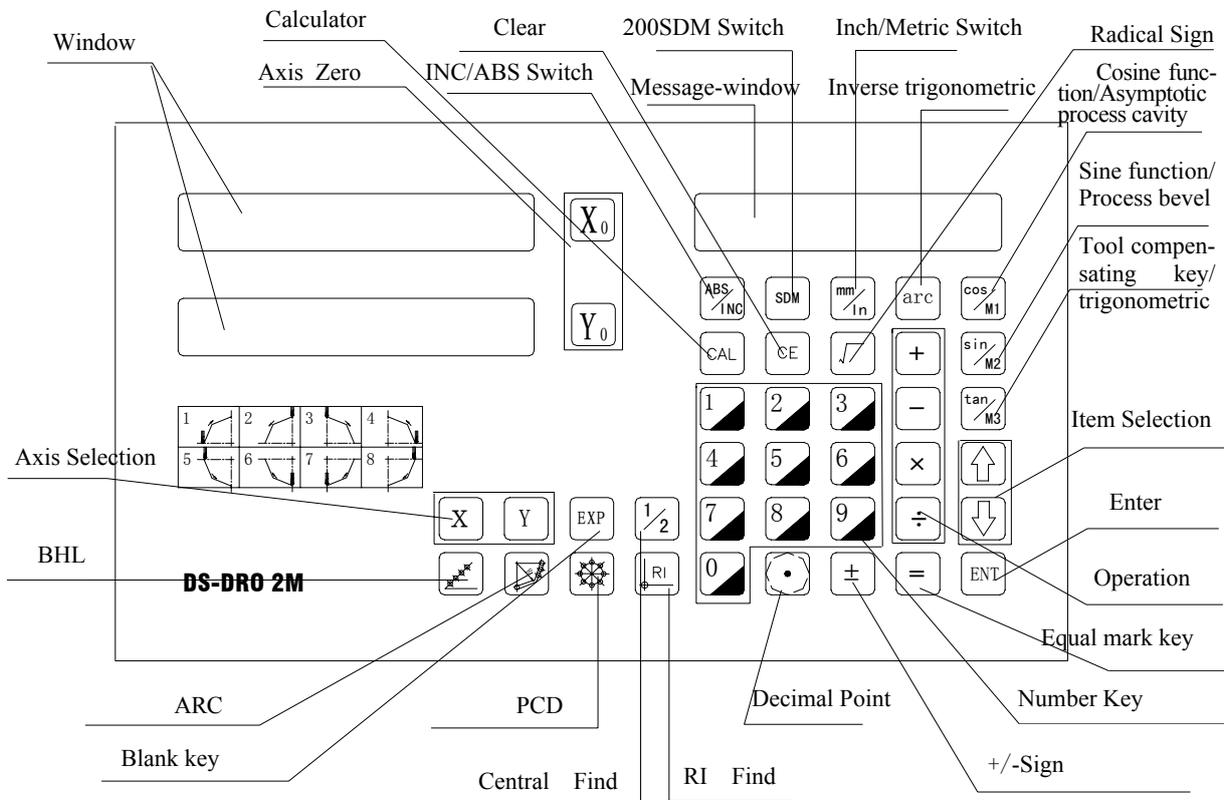
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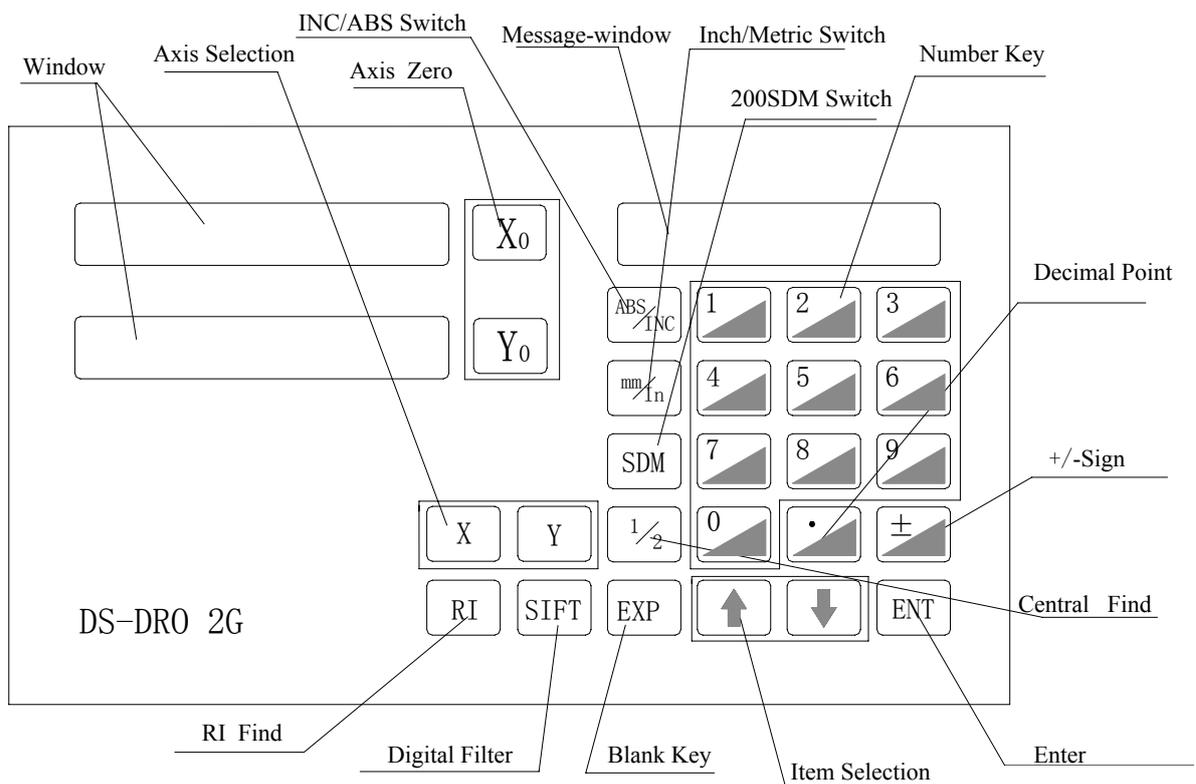
## Chapter 1 Introduction

### 1.1 Front Panel

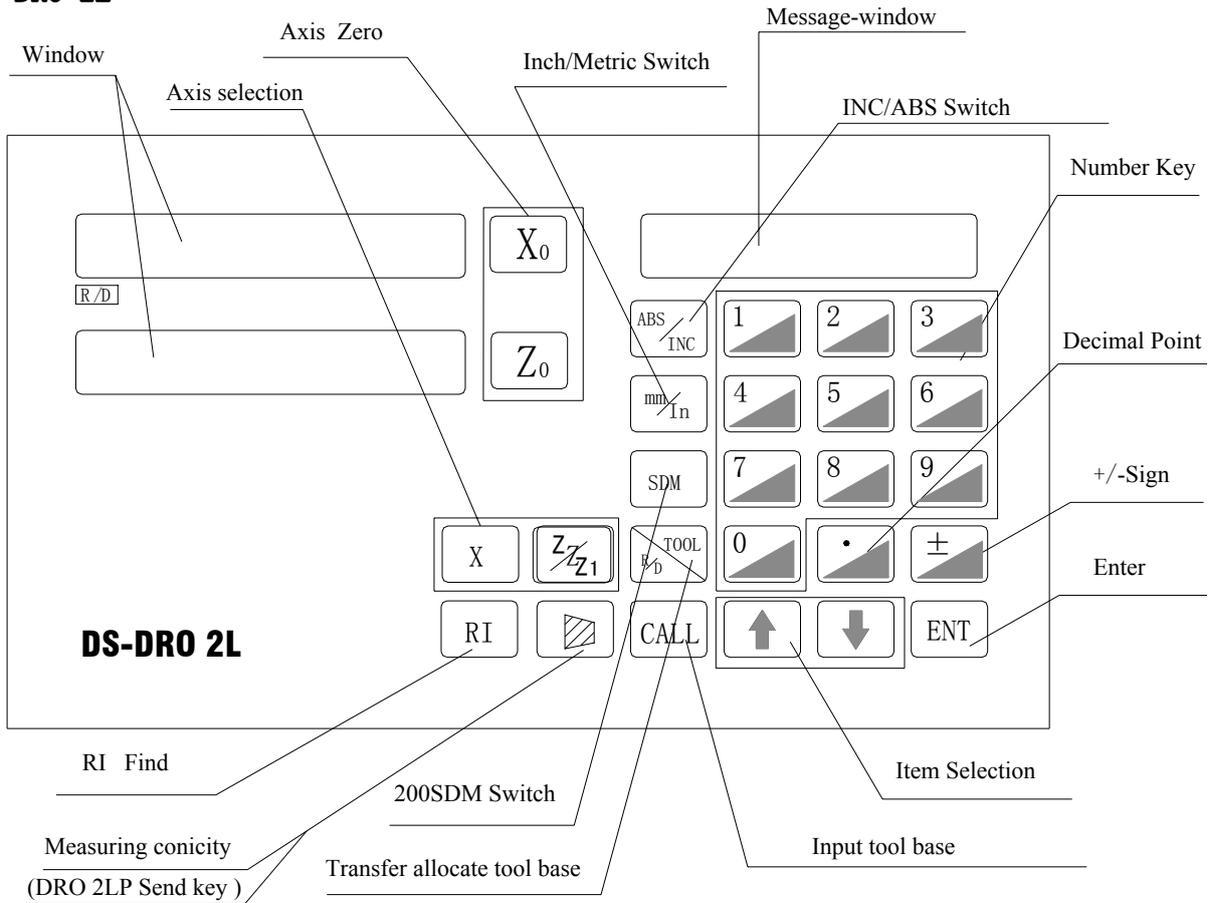
#### DRO-2M



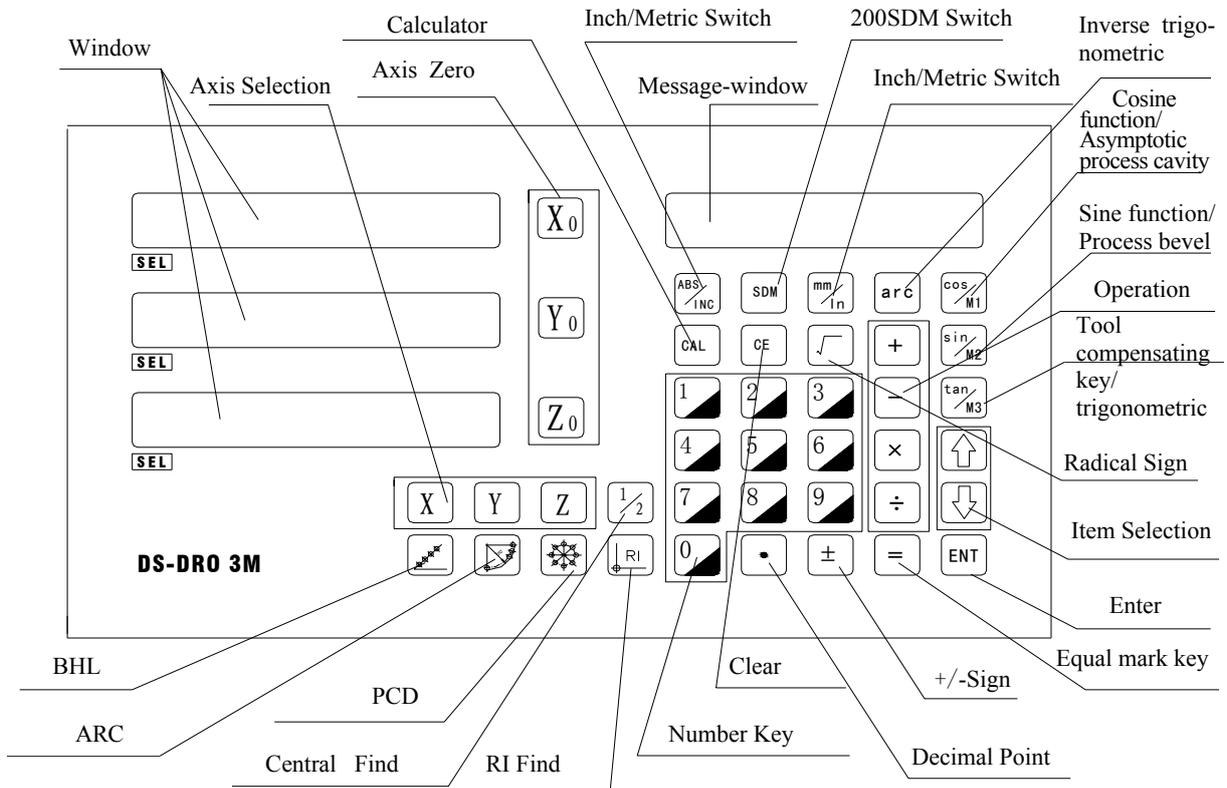
#### DRO-2G



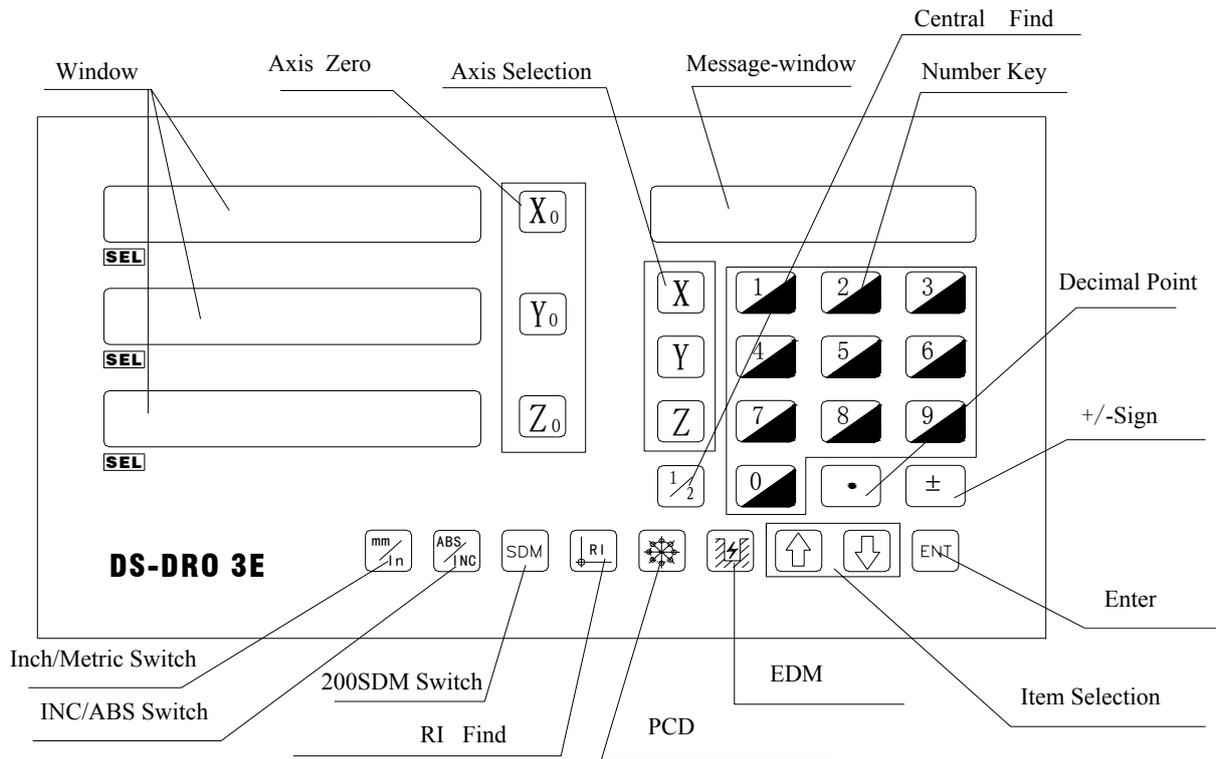
**DRO-2L**



**DRO-3M**



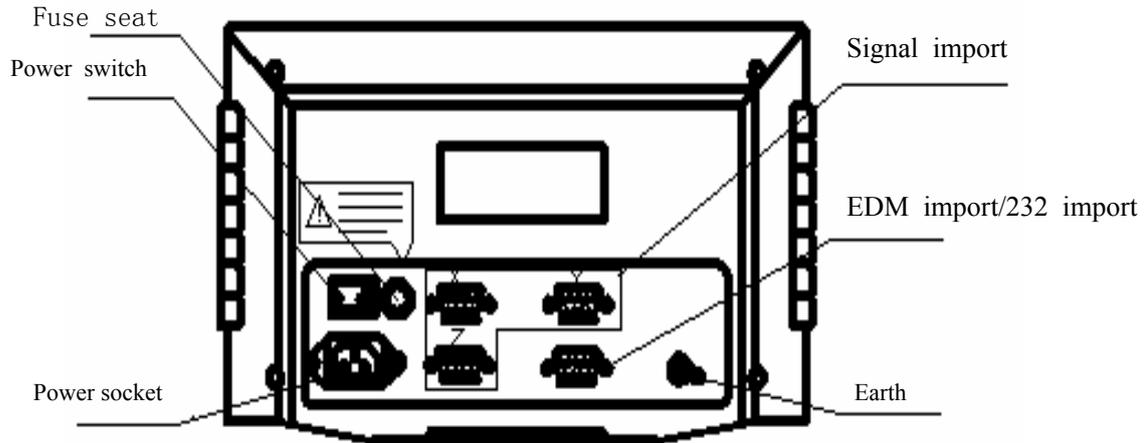
### DRO-3E



## 1.2 Description of Key Function

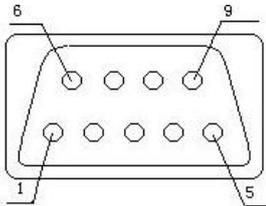
	KEY MARK	KEY NAME	FUNCTION
1		Axis Selection	Select axis to operate
2		Axis Zero	Clear the display value of designated axis to zero
3		Trigonometric Function	Inverse trigonometric
4		ABS/INC Switch	Toggle between ABS/INC coordinate
5		200 SDM Switch	Second data memory
6		Inch/Metric Switch	Toggle display unit between metric and inch
7		Item Selection	Stroll up or down to select
8		Calculator	Enter/quit calculator state.
9		Clear	Cancel incorrect operation
10		Radical Sign	Square root or square
11		Add, Decrease, Multiple, Divide	Operate adding, decreasing, multiplying, dividing
12		Number Key	Enter number
13		Decimal Point	Enter decimal point
14		+/-Sign	Enter +/-Sign
15		Equality Sign	Make calculating result
16		BHL	Process holes displayed equally on a circle
17		ARC	Simple R cutting function
18		PBC	Process holes displayed equally on a line
19		Slope/sin	Process a slope/
20		Asymptotic process inner cavity key	Process cavity on workpiece (is cosine function key)
21		Tool compensating key	Preset tool diareadouts (Is the tang function key)
22		RI Find	Automatically find zero function
25		Central Find	Halve a display value of a axis
26		Enter	Confirm operation
27		Digital filter	Digital filter
28		EDM	EDM output function
29		Measuring conicity	Measuring conicity function.
30		Input tool base	Input tool base to readouts.
31		Transfer allocate tool	Transfer allocate tool base

### 1.3 Back Panel



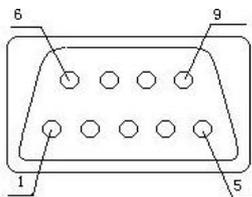
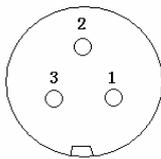
### 1.4 Interface

#### 1) DB9 Connector



Pin	TTL wave	EIA-422-A wave	~1Vpp
1	-	A-	A-
2	0V	0V	0V
3	-	B-	B-
4	Earth Wire	Earth Wire	Earth Wire
5	-	R-	R-
6	A+	A+	A+
7	+5V	+5V	+5V
8	B+	B+	B+
9	R+	R+	R+

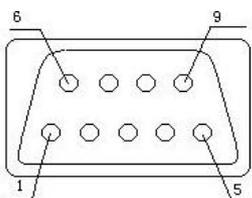
#### 2) EDM OUT Connector



PIN	Color	Signal
1	Green	NC
2	Red	COM
3	Green/Yellow	NO

PIN	Color	Signal
2	Red	COM
3	Green	NC
6	Green/Yellow	NO

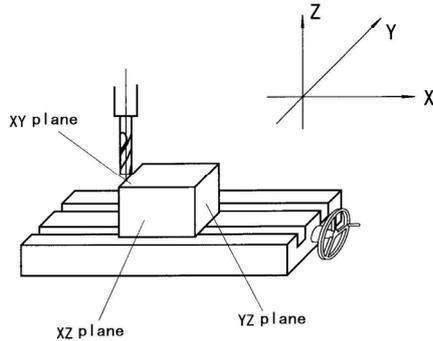
#### 2) 232 Signal Connector



PIN	Color	Signal
2	Red	sink
3	Green	RTS
5	Green/Yellow	Ground wire

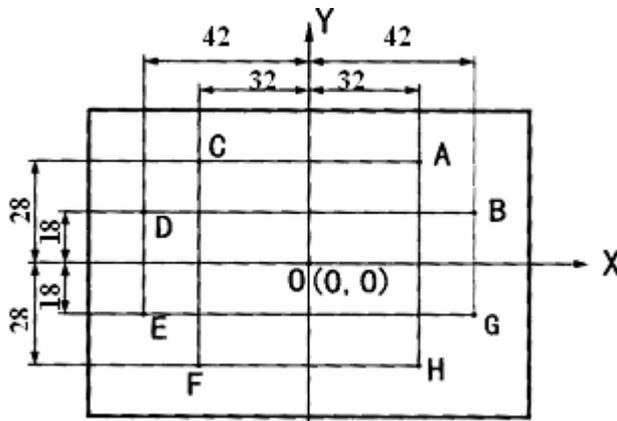
### 1.5 Coordinate System

1) To less experienced operators, recognize the coordinate system to acquire accurate and efficient operation when using the device.



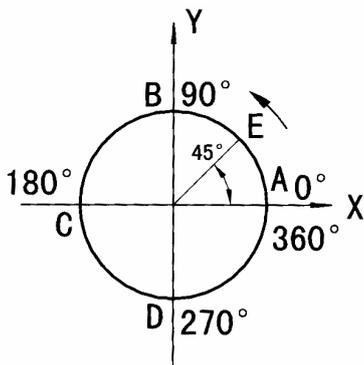
NOTE : Positive direction of axis is set as the figure (moving of tool relative to the worktable)

2) For a workpiece as figure , the value of each point position is as the figure when point 0 is the origin of coordinate.



- O: (0, 0)
- A: (32, 28)
- B: (42, 18)
- C: (-32, 28)
- D: (-42, 18)
- E: (-42, -18)
- F: (-32, -28)
- G: (42, -18)
- H: (32, -28)

In any plane of **XY**, **XZ** and **YZ**, the starting angle and ending angle of arc are calculated by anticlockwise direction.

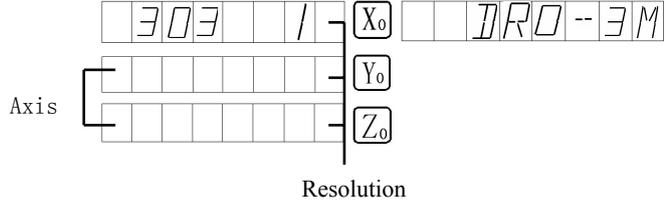


- AB arc
  - From A to B  $0^\circ - 90^\circ$
  - From B to A  $90^\circ - 0^\circ$
- BC arc
  - From B to C  $90^\circ - 180^\circ$
  - From C to B  $180^\circ - 90^\circ$
- CD arc
  - From C to D  $180^\circ - 270^\circ$
  - From D to C  $270^\circ - 180^\circ$
- DA arc
  - From A to D  $360^\circ - 270^\circ$
  - From D to A  $270^\circ - 360^\circ$
- BE arc
  - From E to B  $45^\circ - 90^\circ$
  - From B to E  $90^\circ - 45^\circ$

## Chapter 2 Basic operation (For:DRO-2M、DRO-2G DRO-2L、DRO-3M、DRO-3E)

### 2.1 Start, self-checking

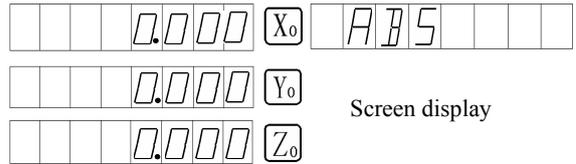
1) Power on



2) Instrument self-check.

3) Enter working state.

**NOTE:** The **2** axes have X,Y axis only, Z is only for 3 axes. The lathe shows “DRO-2L”、grinding machine shows “DRO-2G”、milling machine shows “DRO-2M” or “DRO-3M”、spark machine shows “DRO-3E” .



### 2.2 System Settings

In the course of self-checking, press  in three seconds to enter system setting.

1) Set resolution of **X** as figure



The number is:

Number Key	9	1	2	5	0
Resolution (um)	0.5	1	2	5	10

Press  Next step



2) Set resolution of **Y** , like **X**.

Press  Press  Next step

3) Set resolution of **Z**, like **X**.

Press  Press  Next step



4) Set counting direction of **X**.

Press  is positive count.

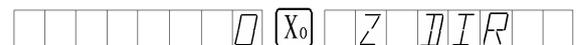
Press  is negative count.

Press  Press  Next step



5) Set counting direction of **Y**, like **X**

Press  Press  Next step



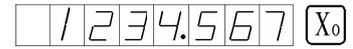
6) Set counting direction of **Z**, like **X**

Press  Press  to quit the system setting.

**(NOTE:** Set counting direction of **Z** is only suit for **3** axes)

**2.3 Zeroing**

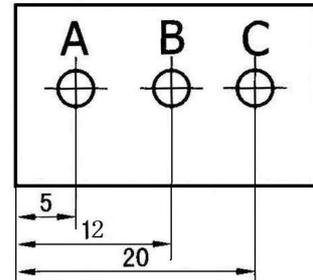
- 1) The axis can be zeroed at any point, take **X** axis displays as an example.



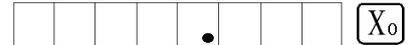
- 2) Press **X0**

**2.4 Presetting**

- 1) As figure: Adjust position of part after processing hole **A**. To process point **B**.
- 2) Align the lathe tool with hole **A**.
- 3) Select **X**, press **X**



- 4) Press **5** (If incorrect value is input, Press **X** to cancel and input again.)



- 5) Press **ENT**

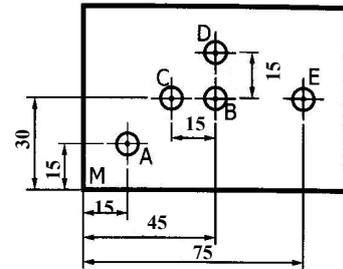


- 6) Move the machine table until "12" is displayed in the window. Now it is position of point **B**.



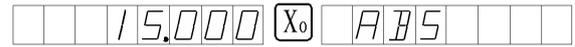
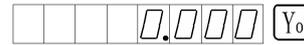
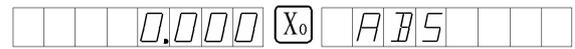
**2.5 Absolute/Incremental/200 groups user coordinate display way**

Press **↑** or **↓** to change between "Absolute" and "Incremental".



- 1) Tool point to M, zeroing at absolute state.

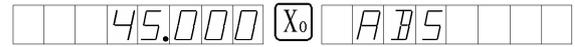
Press **↑** or **↓** → **X0**  
**Y0**



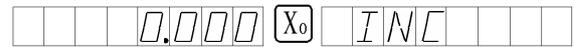
- 2) Move the machine table onto **A**



- 3) Move the machine table onto **B**



- 4) Press **↑** or **↓** → **X0**  
**Y0**



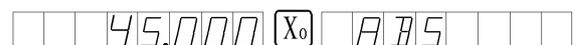
- 5) Move the machine table onto **C**



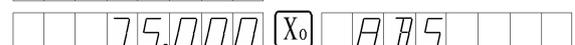
- 6) Move the machine table onto **D**



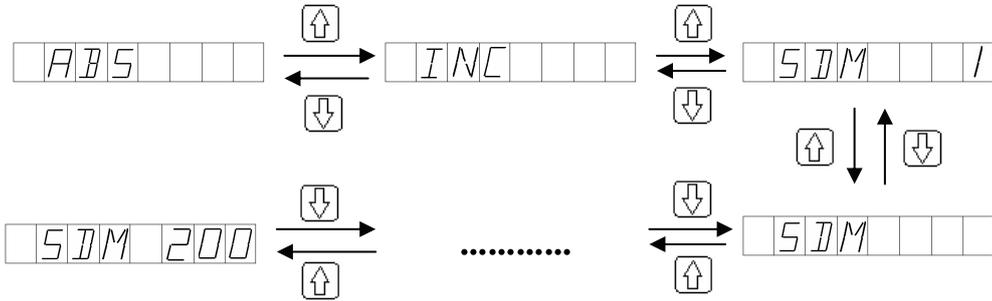
- 7) Return to absolute state by pressing **↓**



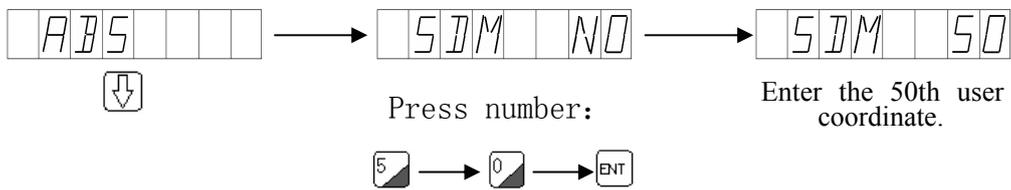
- 8) Move the machine table onto **E**



**NOTE:** Zeroing in absolute/incremental state is separated. When the window displays “ABS”, it is absolute coordinate display way. The “INC” indicates incremental coordinate display way. We can also switch among absolute/incremental/200 groups user coordinate by pressing  $\uparrow$  or  $\downarrow$ . The circle figure is as follows:



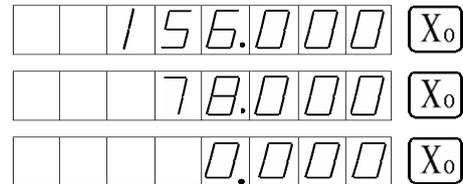
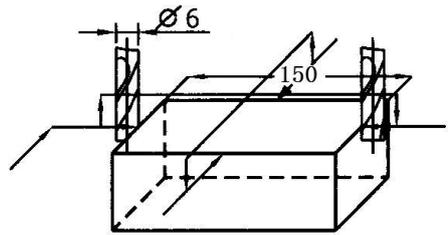
Press  $\downarrow$  to enter 200 groups user coordinate directly.



### 2.6 Mid-point Calculation

As figure, we need to find the center of two points. Move the tool by arrow direction, determine central position after contacting two sides.

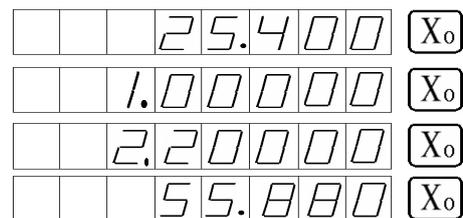
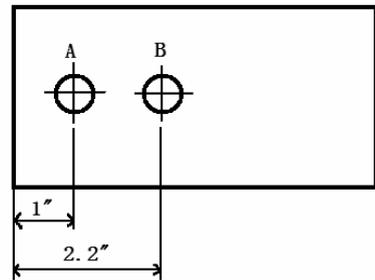
- 1) Press  $X$
- 2) Press  $\frac{1}{2}$
- 3) Move the machine table until “0” is displayed in **X** window, now it is the center.



### 2.7 Toggle Display Unit Between mm And inch

Press  $\frac{mm}{in}$  to change between “mm” and “inch”.

- 1) The former is metric, now change it into inch.
- 2) Press  $\frac{mm}{in}$
- 3) Move the machine table until **B**
- 4) Process **B**
- 5) Press  $\frac{mm}{in}$



### 2.8 Linear Compensation Settings

The linear error compensating is to rectify the system error of grating measuring system.

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

**L** ——Measured length, unit is: **mm**

**L'** ——Display value, unit is: **mm**

**S** ——Rectifying coefficient. **mm / m**, “+” indicates increasing, “-” indicates decreasing.

Compensating range : **-1.500mm / m — 1.500mm / m**

Example:The actual measured length of machine table is 1000, the display value is **999.98**.

$$S: (1000 - 999.98) / (1000 / 1000) = 0.02 \text{ mm / m}$$

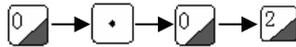
1) Press **X** to select axis.

2) Press **mm/m**



3) Input rectifying coefficient by pressing

Coefficient used last time



4) Press **ENT**

**NOTE :** In absolute and incremental coordinates, user can input the coefficient of linear error.

### 2.9 Outage memory

In the course of machining, if the power is off ,the digital readout will save the working state of outage automatically. (Including working way ,display data and rectify coefficient) .Reopen the readout, it will return to working state of outage and memory the value of outage and continue working.

### 2.10 Sleeping switch(DRO-3E digital readout does not have the function)

In the course of machining, if turn off the rear switch, the processing data will not be disappeared. Because the DRO digital readout has the memory outage. If the machine tool is moved after the power of the digital readout being cut off, when open the instrument again, the display may not identical with the real result. Operator can use the function in rest time to avoid the happening of this case.

In not ABS state, pressing **RL** can close all display, pressing **RL** can open all displays when working again. After closing display, the digital display device will reflect the state after moving machine tool. After opening the display, the working state displaying is the actual state.

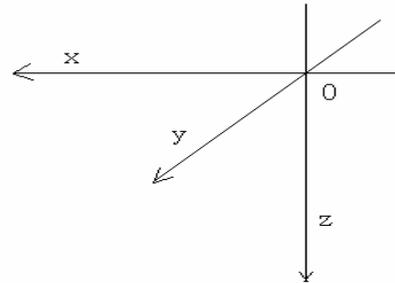
**NOTE:**The sleep switch is not real in closing state. If turn off the power, it is impossible to use sleep switch. For DRO-3M、DRO-3E,when using the functions of arc R and distributing arc, user can use the sleeping function. Press any key to quit. (Besides the **RL** and **UP** and **DN** the function key.)

### Chapter 3 Smooth arc R function(FOR:DRO-2M、DRO-3M)

In machining mould, it usually has the case of machining arc. For single and simple arcs, it will waste time and money for using numerically-controlled machine tool. **DRO** readouts provide advanced function of calculating smooth arc **R**. The function is used to machine arc .①Operator can input all parameters defined in information window. It is very convenient.②It can calculate optimum according to the maximum cutting value "**MAX CUT**" of inputting. Operator can control the smooth of arc **R**.

Firstly ,set the counting direction of grating scale as the following:

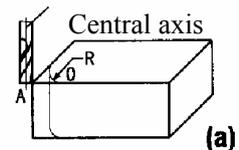
- (1) X is positive count when worktable moves left;
- (2) Y is positive count when worktable moves behind;
- (3) Z is positive count when worktable moves down.



#### 3.1 Steps of calculating arc R

As figure (a) (b) (c), mount workpiece and tool setting. Then zero each axis. Press  to enter calculating arc **R**.

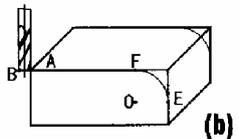
- 1、 Select smooth **R** function (**SMOOTH**) by pressing  
- 2、 Select the machine plane **XY**、 **XZ** or **YZ**.  
 (ARC-XY)  
 (ARC-XZ)  
 (ARC-YZ)



- 3、 Input central position of arc : (**CT POS**)

The central position of arc is the position of center of arc relative to the center of tool.

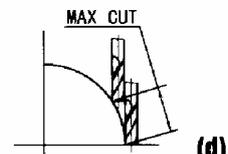
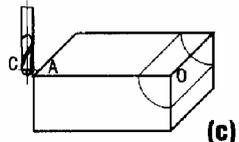
As figure (a) machining arc of **XY** plane, the point **O** of central arc is relative position of central axis.



As figure (b). It is the position that the point **O** of central arc corresponds to point **B** of tool when using flat bottom milling tool.

Machine plane  
**XY**、 **YZ**

As figure (c). It indicates the position of point **O** of central arc corresponds to point **C** of tool when using arc milling tool.



- 4、 Input arc radius (**RADIUS**).
- 5、 Input diameter of tool (**TL DIA**): For machining arcs of **XZ** and **Y** planes, note that:as fig (b) ,the function point of tool is point B as using flat bottom milling tool. The diameter of tool has no influence to machine. Please input diameter of tool (**TL DIA=0**).
- 6、 Input maximum cutting value (**MAX CUT**).  
 Now, the cutting value of each tool is the same. as figure (d).
- 7、 Input the starting angle of arc (**ST ANG**).

The position of first tool , as fig (b), if machine the arc from point E to point F, the starting angle is 0° ,if from point F to point E, starting angle is 90° .

**8、** Input ending angle (**ED ANG**)

The position of last tool , as fig (b), if machine the arc from point E to point F, the ending angle is 90° .Otherwise, from point F to E, the ending angle is 0° .

**9、** Select machining methods ( inner or outer arc).

As fig (b) is machining method of inner arc.

As fig (c) is machining method of outer arc.

**10、** Move machine tool to the point to be processed and process the arc one by one point.

**11、** Press  to return normal display state.

**3.2 Example for DRO-2M**

**1)** Tool setting, zeroing, press  to enter the **R** arc function.

**2)** Select smooth **R** arc function:

Press 

Press  to confirm.

SIMPLE

SMOOTH

SMOOTH

**3)** Select machining plane:

Press  or 

ARC--XY

ARC--XZ

ARC--YZ

**4)** Select XY plane:

Press  to confirm.

ARC--XY

**5)** Input central position of arc:

If tool setting is as fig (a)

Press      

Press 

22.5000      CT POS

12.5000 

--     12.5000      CT POS

--     12.5000 

If tool setting is as fig (b)

Press  →  →  →  →  →  → 

 →  →  →  →  →  → 

Press 

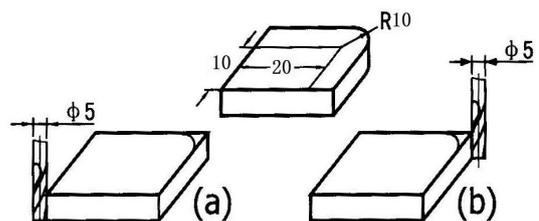
**6)** Input arc radius:

Press  →  → 

Press 

10.0000      RADIUS







5) Input central position (relative to the center of tool)

If use arc milling tool, tool setting is as fig (a):

Press  →  →  →  →  →    

→  →  →  →  →    

Press    

Use arc milling tool, tool setting is as fig (b):

Press  →  →  →  →  →    

→  →  →  →  →    

Press    

Use flat bottom milling tool, tool setting is as fig (a):

Press  →  →  →    

→  →    

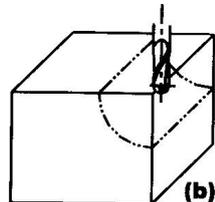
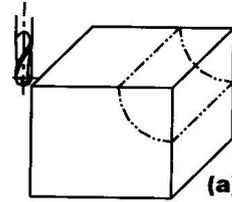
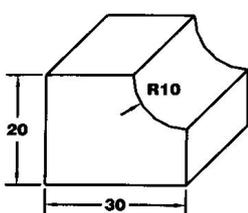
Press    

Use flat bottom milling tool, tool setting is as fig (b):

Press  →  →    

→  →    

Press    



6) Input radius:  
 Press  →  →    

Press    

7) Input tool diameter:  
 Use arc tool, Press  →    

Use flat bottom tool:  
 Press  →    

Press    

8) Input max cutting value:  
 Press  →    

Press

9) Input starting angle:       
 Press  →  →  →   
 Press

10) Input ending angle:       
 Press  →  →  →   
 Press

11) Select processing way (inner or outside arc):    
 Press  or    
 Now is inner arc processing. Press     
 Press

12) Use arc milling tool. Display position of first point. If too setting is as fig (a):

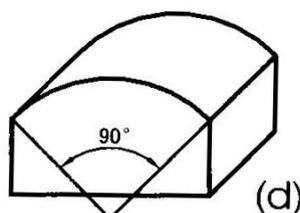
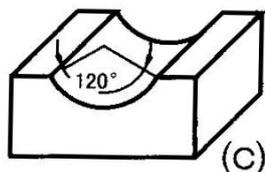
If tool setting is as fig (b):      
 Use flat bottom milling tool to process.

If tool setting is as fig (a):      
 Use flat bottom milling tool to process.

If tool setting is as fig (b):

13) Move the machine table until axis displays "0".      
 Now is start of R:

14) Press  or  to display position of each point, Move the machine table until axis displays "0", which is the position of all points.



**NOTE:** (1)On the plane of XZ and YZ, when the arc R to be processed is  $90^\circ - 270^\circ$  as fig (c). arc R is  $210^\circ - 330^\circ$  (passing  $270^\circ$  ), as fig (d), arc R is  $135^\circ - 45^\circ$  (Passing  $90^\circ$  ), now don't use flat bottom milling tool to process.

(2)For DRO readouts, processing arc R of plane XZ and YZ can be realized by simulation method. The position of each processing point on Z axis will be displayed in message-window. Rotate the handle of Z axis to make raising or lowering value of worktable be equal to display value. (If display value of Z axis is positive, lower the worktable; if it is negative, raise worktable.)

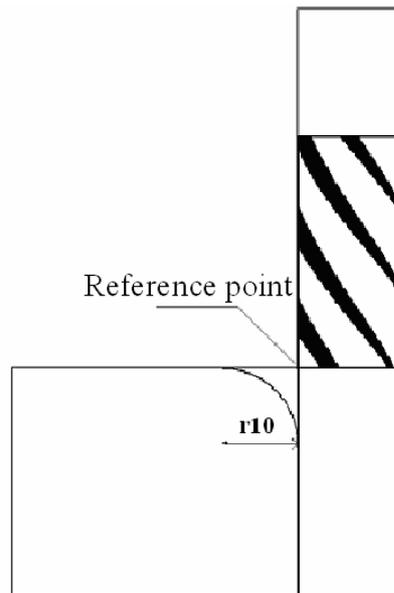
### 3.4 Example of DRO-3M with flat bottom end mill

Steps of machining inner or outer arc using flat bottom end mill:

1) Tool setting and zeroing. The method of tool setting is shown in the figure below:

- a) Move the tool to the position shown in the figure;
- b) Tool setting and zeroing of X-axis;
- c) Tool setting and zeroing of Z-axis.

The coordinates of both X and Z-axis are zero.



2) Enter the R-arc function, select the machining plane:

Press the function key .

Press  and the auxiliary window will display "ARC-XZ".

Press  to confirm the selection.

3) Input the central position of the arc:

Press  and the auxiliary window will display "CT POS":

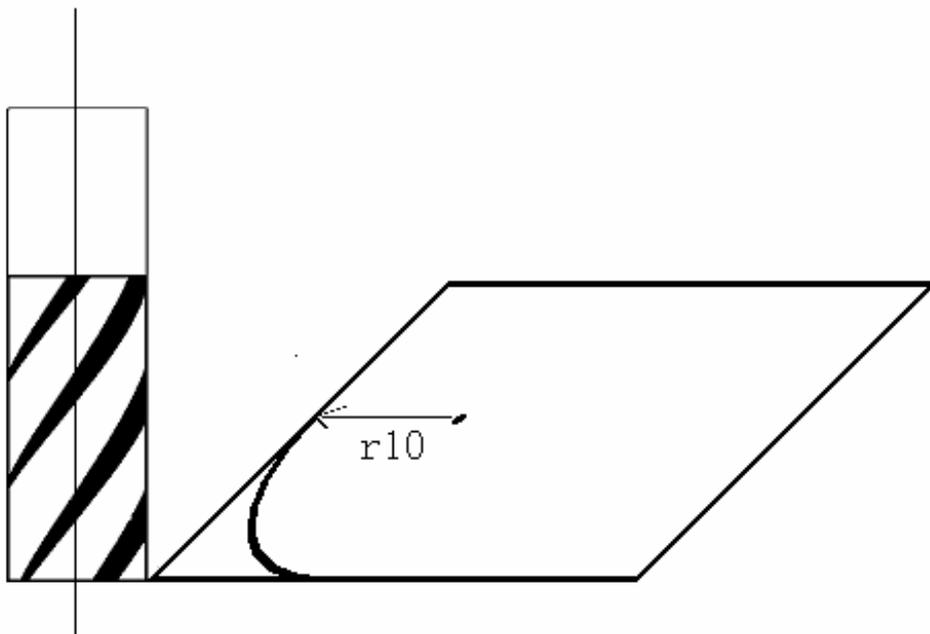
Press  →  →  →  → 

Press  →  →  →  → 

Set coordinates of X and Z-axis to "0" when machine the inner arc.

- 4) Input the arc radius:  
 Press  and the auxiliary window will display "RADIUS".  
 Press  →  → 
- 5) Input the diameter of the tool:  
 Press  and auxiliary window will display "TL DIA".  
 Press  → 
- 6) Input the maximum cutting value:  
 Press  and the auxiliary window will display "MAX CUT".  
 Press  → 
- 7) Input the starting and ending angles of the arc:  
 Press  and the auxiliary window will display "ST ANG".  
 Press  →   
 Press  and the auxiliary window will display "ED ANG".  
 Press  →  → 
- 8) Select the machining method (inner or outer arc mode):  
 Press  and the auxiliary window will display "RAD+TL" (outer arc mode).  
 Press  to confirm the selection.
- 9) Press  to start machining.

Note:When milling the XY plane, the tool diameter should be considered whether using arc or flat-bottom milling tool to machine the inner or outer arc. Take the figure below as an example. Make tool setting and zeroing first. If the diameter is 5 mm and the arc radius is 10 mm, the coordinate of the circle center should be (12.5 mm, 12.5 mm).



**3.5 Example of DRO-2M**

1、 Process the workpiece , firstly calculate the starting angle and ending angle of arc.

As fig (a).

$$a = \arccos(17.3 / 20) = 30^\circ$$

**Arc' s starting angle (ST ANG) is 30°**

**Arc' s ending angle (ED ANG) is 150°**

2、 First tool setting, zero the bore ring mark of **X** and **Z** axis.

1) Press  to enter the **ARC** function.

2) Select smooth **R** arc function:

Press 

Press  to confirm.

3) Select machining plane:

Press  or 

4) Select **XZ** plane:

Press  to confirm.

5) Input central position:

Press  →  →  →  →  →  → 

 →  →  →  →  →  → 

 19.8000   CT ← X ↗ Z

--  22.5000 

Press 

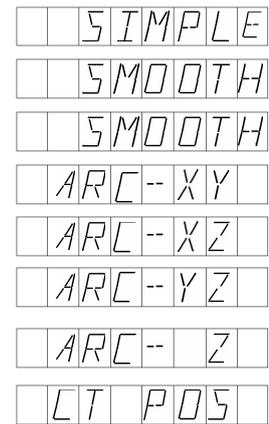
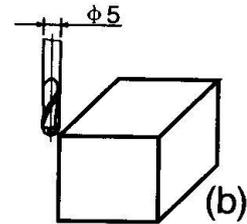
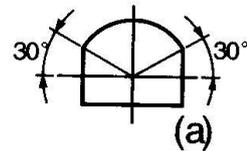
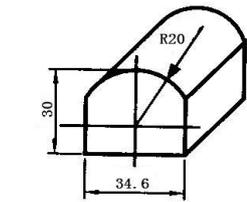
6) Input radius:

Press  →  → 

Press 

 20.0000   RADIUS



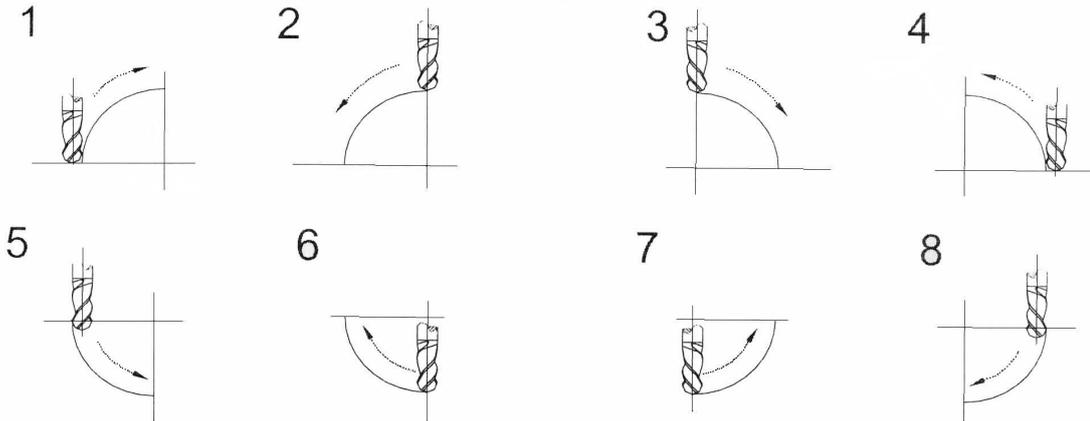


## Chapter 4: Simple and Easy R(For:DRO-2M)

### 4.1 Maculating function for simple and easy arc R

If you don't know the plane coordinate very much, you will feel difficult to use smooth arc **R**. If only process simple arc and the requirement of smooth is not high, you can use the calculating function of simple and easy arc **R**.

Generally, there are **8** cases of processing arc, adopt flat bottom milling tool or arc milling tool to machine.

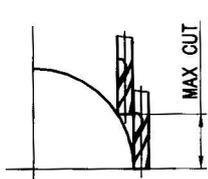


### 4.2 Steps

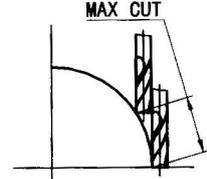
Make the tool aim at the starting point, then enter calculating function by pressing .

How to make the tool align starting point, please refer to figure 1-8.

1. Select simple **R** function. (**SIMPLE**).
2. Select the processing way, presetting arc model **1** to **8**, prompt is "**WHICH**".
3. Select processing plane. **XY**, **XZ** or **YZ**(**ARC-XY**, **ARC-XZ**, **ARC-YZ**).
4. Input radius. (**RADIUS**).
5. Input tool diameter (**TL DIA**): for arc on **XZ** and **YZ** planes ,use flat bottom milling tool, and use the end of tool to process and input value **0** of tool diameter.
6. Input maximum cutting value: (**MAX CUT**):  
 For arc on **XZ** and **YZ** planes, the "**MAXCUT**" is depth of cutting of each step on **Z** axis (as fig (a)). User can change the maximum cutting value in the course of processing. But for the arc on **XY** plane, the "**MAX CUT**" indicates the cutting value of each tool is the same.
 

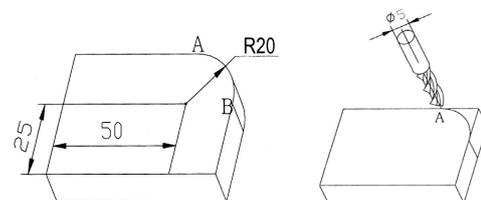


Fig(a)



Fig(b)
7. Process arc one by one point according to the display.
8. Quit from the calculating function by  
 Pressing  at any time.

### 4.3 Example for outside arc



1) Make tool aligning with starting point. (A or B)

Press  to enter **ARC** function.

Select simple R function, press  to confirm.

2) Select arc R processing way:

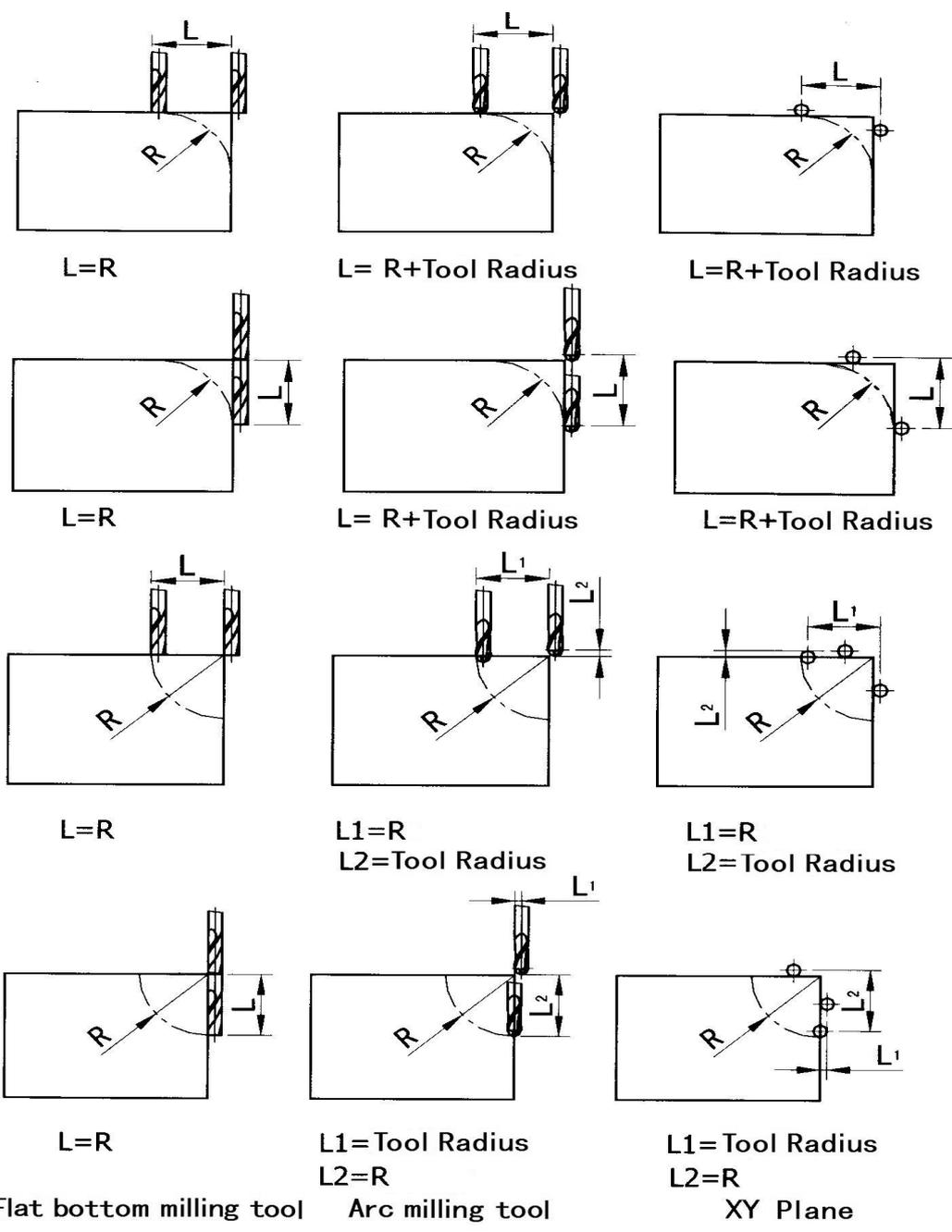
Starting point is A, press  → 

Starting point is B, press  → 

3) Select processing plane.

Press  or 

SIMPLE  
  SMOOTH  
  SIMPLE  
  WHICH  
  ARC--XY  
  ARC--XZ  
  ARC--YZ



4) Select **XZ** plane.

press

5) Input radius.

press  →  →

press

6) Input tool diameter.

press  →

press

7) Input maximum cutting value.

press  →  →  →

press

8) Process arc.

press

Start with **A(0, 0)**.

press .

Start with **B(0, 0)**.

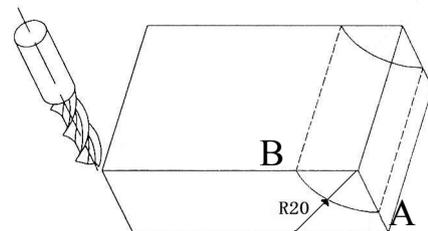
press .

--

--

9) Move machine tool until **X** axis displays "0", rotate the handle of **Z** axis to make the value of raising or lowering be equal to the display value.

10) Press  or  to display position of next or front point. Press  to quit **ARC** function at any time.



#### 4.4 Example for inner arc

1) Make the tool align with starting point (**A** or **B**)

Press  to enter **ARC** function.

Select simple **R** function, press  to confirm.

2) Select arc **R** processing way:

Starting point is **A**, press  →

Starting point is **B**, press  →

3) Select processing plane:

Press  or .

4) Select **XZ** plane:

Press .

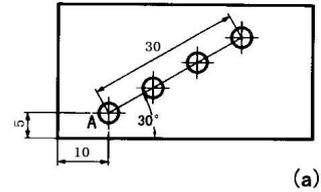
5) Input radius:



## Chapter 5 Function of boring hole in oblique line ( For:DRO-2M、 DRO-3M)

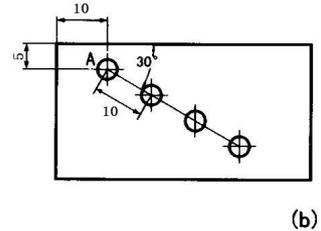
### Bore hole in oblique line

As figure, in general method, operator has to calculate the distance of two holes on the X and Y directions. If adopts function of boring hole in oblique line, it is very rapid. Operator only input the following data:



### Length of oblique line (LENGTH)

The distance of the centers of starting hole and ending hole. Input the data when selecting "MODEL" (length way).



### Step length (STEP)

The distance of two adjacent holes. Input the data when selecting "MODES" (step way).

### Angle (ANGLE)

It indicates the direction of oblique line on the coordinate plane. As fig (a), the intersection angle is  $30^\circ$ , the plane angle of inputting is  $30^\circ$ . As fig (b), the intersection angle is  $30^\circ$ , inputting plane angle is  $-30^\circ$ .

### Hole number (NUMBER)

Take the fig (a) as an example

- 1) Move tool onto position of hole **A**. Press to enter function of boring hole in oblique line.
 

  - 2) Select processing way. Press or to select "Length way":
 

  - 3) Input length oblique line: . Press . Press .
 

  - 4) Input angle . Press . Press .
 

  - 5) Input hole number . Press . Press .
 

  - 6) Display the position of first hole:
 

  - 7) Press to display the position of next point.
 

- Move machine tool until axis displays "0". Press to quit the function at any time.



**Chapter 6 200 points auxiliary zero function**

**200 point auxiliary zero function**

**200 point auxiliary zero function:** It is also called **200** users coordinate system function (**UCS**).

**ABS:Absolute Coordinate System**

**ABS** is reference coordinate system. The 200 users coordinate system is defined relative to **ABS** coordinate system. **ABS** is determined in the starting time.

**UCS: User Coordinate System**

It is a working coordinate system, which has **200** sub-coordinate systems built on **ABS**. In processing mould, one reference is not adequate, many auxiliary zeroes are needed. Therefore, **200** point auxiliary zero function is needed to solve the problem.

**6.1 About 2 problems of 200 points auxiliary zero**

- 1) Each auxiliary zero balances an origin of coordinate system that user defines. When selecting this display way, the display of each point takes the auxiliary zero as origin.
- 2) The auxiliary zero and absolute zero are related. After setting auxiliary zero, it will keep the memory relation of position between the two zeroes. when the zero in **ABS** is changed, the auxiliary zero is changed at the same distance and direction.

**6.2 How to fully use the function of 200 points auxiliary zero**

- 1) Set the zero in **ABS** as the main reference point, as point **0** in fig (1), and auxiliary zero as auxiliary reference point of workpiece.
- 2) In the display way, it can be used to process in special function.

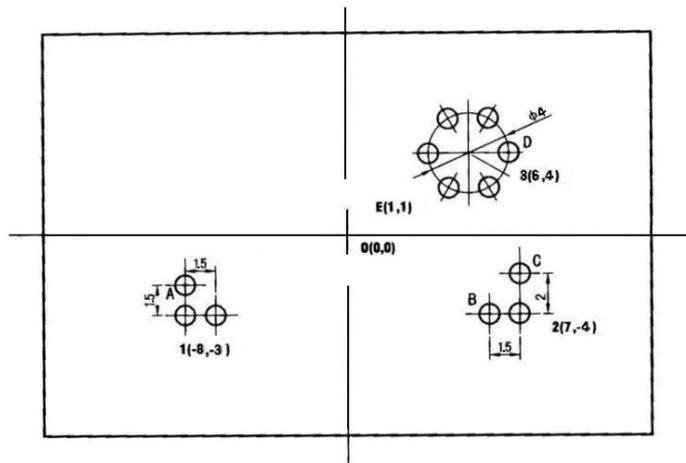
**6.3 Setting the auxiliary zero. (For:DRO-2M、DRO- 3M、DRO-3E)**

There are two methods to set auxiliary zero. One is to input the position of auxiliary zero directly, the other is zeroing after reaching auxiliary zero.

First method :Directly

input ,press **X** **Y** **Z** →  
Number key **SDM** →

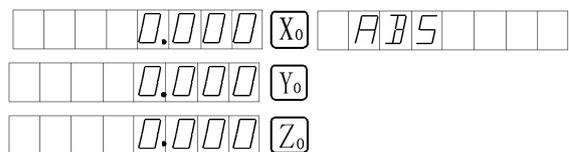
Take the right figure as an example: Move worktable of machine tool onto the central point **0**, then enter display way of **ABS**. Zeroing, set absolute zero in the main reference point of parts.



Press **X<sub>0</sub>**

Press **Y<sub>0</sub>**

Press **Z<sub>0</sub>**



- 1) Determine the zero in **ABS**, at the same time, do a memory operation of zeroing by the “recover the zero” .
- 2) Enter display way of user coordinate system (two methods):

First method:

Press

Press

Second method:

Press

Press →

- 3) Input the position of the 1st auxiliary zero:

Press → → →

→ → →

- 4) Enter the display way of the 2nd user coordinate:

Press or → →

- 5) Input the position of the 2nd auxiliary zero:

Press → →

→ → →

- 6) Enter the display way of the 3rd user coordinate:

Press or → →

- 7) Input the position of the 3rd auxiliary zero:

Press → →

→ →

The setting of auxiliary zero of part is finished.

Why does the display result and the coordinate of each auxiliary zero conflict. Take the figure above as an example. In **UCS** way, input auxiliary zero coordinate in the position of absolute coordinate zero, the result is the position of absolute coordinate in user coordinate, as the display way of user coordinate takes each auxiliary zero as the origin of point 1 **(8, 3)**, point 2 **(-7, 4)** and point 3 **(-6, 4)**. If operator input coordinate of other auxiliary zero outside absolute coordinate zero, the display value is the position of the point in user coordinate.

Second method: Zeroing when reaching position. In the position of auxiliary reference point, then press .

Take the above figure as an example: move machine table to point 0.

- 1) Enter absolute coordinate and zeroing, set the absolute zero in main reference point:

2) Move machine to point 1:  
**X** displays **-8**,  
**Y** displays **-3**.

--				8.0000	X <sub>0</sub>	ABS				
--				3.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

3) Enter the first UCS:  
 Press  or  →  → 

--				8.0000	X <sub>0</sub>	SIM				/
--				3.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

4) Set auxiliary zero:  
 Press   


				0.0000	X <sub>0</sub>	SIM				/
				0.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

5) Return absolute coordinate:  
 Press 

--				8.0000	X <sub>0</sub>	ABS				
--				3.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

6) Move machine to point 2:  
**X** displays **7**,  
**Y** displays **-4**.

				7.0000	X <sub>0</sub>	ABS				
--				4.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

7) Enter the second UCS:  
 Press  →  → 

				7.0000	X <sub>0</sub>	SIM				2
--				4.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

8) Zeroing, set the second auxiliary zero:  
 Press   


				0.0000	X <sub>0</sub>	SIM				2
				0.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

9) Return absolute coordinate:  
 Press  key for **3** times continuously.

				7.0000	X <sub>0</sub>	ABS				
--				4.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

10) Move machine to point 3:  
**X** displays **6**,  
**Y** displays **4**.

				6.0000	X <sub>0</sub>	ABS				
				4.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

11) Enter the third UCS:  
 Press  →  → 

				6.0000	X <sub>0</sub>	SIM				3
				4.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

12) Zeroing, set the third auxiliary zero:  
 Press   


				0.0000	X <sub>0</sub>	SIM				3
				0.0000	Y <sub>0</sub>					
					Z <sub>0</sub>					

- 13) Return absolute coordinate: 

				6.000	X <sub>0</sub>	A	B	S				
				4.000	Y <sub>0</sub>							
					Z <sub>0</sub>							

  
 Press  key for **4** times continuously.

**6.4 Using of auxiliary zero (For:DRO-2M、DRO-3M、DRO-3E)**

Enter the display way of user coordinate, then use the auxiliary zero to process by pressing   or .

User can press   continuously until entering the desired user coordinate. Under the  prompt of **“SDM NO”**, input the number of desired or press  user coordinate. Then press  for more operation, operator can refer to the chapter **2.5**.

Take the fig(1) as an example:

- 1) Enter the 1st **UCS**:  
 Press 

				S	D	M					N	O
--	--	--	--	---	---	---	--	--	--	--	---	---
- 2) Input the number:  
 Press   

				S	D	M						1
--	--	--	--	---	---	---	--	--	--	--	--	---
- 3) Move the machine to point **A**:  

				0.000	X <sub>0</sub>	S	D	M				1
				1.500	Y <sub>0</sub>							
					Z <sub>0</sub>							

  
**X** displays **0**,  
**Y** displays **1.5**.
- 4) Process hole **A**:
- 5) Enter the 2nd **UCS**:  
 Press 

--				15.000	X <sub>0</sub>	S	D	M				2
				2.500	Y <sub>0</sub>							
					Z <sub>0</sub>							
- 6) Move the machine to point **B**:  
**X** displays **-1.5**,  
**Y** displays **0**.

--				1.500	X <sub>0</sub>	S	D	M				2
				0.000	Y <sub>0</sub>							
					Z <sub>0</sub>							
- 7) Process hole **B**.

				0.000	X <sub>0</sub>	S	D	M				2
					Y <sub>0</sub>							
					Z <sub>0</sub>							
- 8) Move the machine to point **C**:  
**X** displays **0**,  
**Y** displays **2**.

				0.000	X <sub>0</sub>	S	D	M				2
					Y <sub>0</sub>							
					Z <sub>0</sub>							
- 9) Process hole **C**:
- 10) Enter the 3rd UCS:  
 Press 

				1.000	X <sub>0</sub>	S	D	M				3
--				6.000	Y <sub>0</sub>							
					Z <sub>0</sub>							
- 11) Move the machine to point **3**:  
**X** displays **0**,  
**Y** displays **0**.

				0.000	X <sub>0</sub>	S	D	M				3
				0.000	Y <sub>0</sub>							
					Z <sub>0</sub>							

- 12) Enter **PCD** function ,process **6** small holes distributed evenly around the circle, taking point **3** as center.  
Press  .
- |        |                |     |    |   |
|--------|----------------|-----|----|---|
| 0.0000 | X <sub>0</sub> | PCD | -- | Y |
| 0.0000 | Y <sub>0</sub> |     |    |   |
|        | Z <sub>0</sub> |     |    |   |

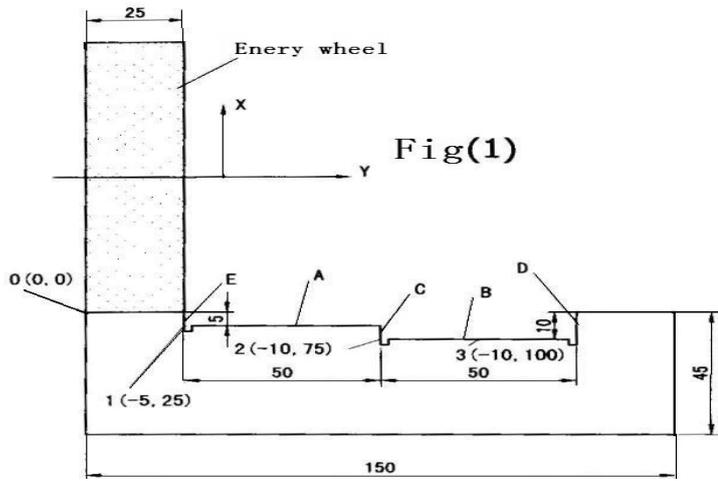
- 13) Process **6** small holes, return point **D** and display:  
**Please refer to some chapters for PCD function.**
- |        |                |     |  |  |   |
|--------|----------------|-----|--|--|---|
| 2.0000 | X <sub>0</sub> | SDM |  |  | 3 |
| 0.0000 | Y <sub>0</sub> |     |  |  |   |
|        | Z <sub>0</sub> |     |  |  |   |

### 6.5 Setting the auxiliary zero. (For:DRO-2G)

There are two methods to set auxiliary zero. One is to input the position of auxiliary zero directly, the other is to zero when reaching auxiliary zero.

First method:Directly input ,press  → Number key → 

Take the right figure for an example:Move worktable of machine tool to the central point **0**, then enter display way in **ABS**. Zeroing , set absolute zero in the main reference point of parts.



- 1) Determine the zero in **ABS**, at the same time, do a memory operation of zero by the "recover the zero" :

Press  

0.0000	X <sub>0</sub>	ABS		
0.0000	Y <sub>0</sub>			

- 2) Enter the display way of user coordinate system (two methods):

First method:  
Press   
Press 

INC			
-----	--	--	--

Second method:  
Press 

SDM			1
-----	--	--	---

  
Press  → 

SDM			NO
SDM			1

- 3) Input the position of the first auxiliary zero:

Press  →  →  →   
 →  →  → 

5.0000	X <sub>0</sub>	SDM			1
--------	----------------	-----	--	--	---

- 4) Enter the display way of the second user coordinate:

Press  or  →  → 

--	25.0000	Y <sub>0</sub>		
SDM				2

5) Input the position of the 2nd auxiliary zero:

Press  $X \rightarrow \pm \rightarrow 1 \rightarrow 0 \rightarrow \text{SDM}$  [ ] [ ] [ ] [ ] 10.0000  $X_0$  [SDM] [ ] [ ] [ ] [ ] 2  
 $Y \rightarrow 7 \rightarrow 5 \rightarrow \text{SDM}$  -- [ ] [ ] [ ] [ ] 75.0000  $Y_0$

6) Enter the display way of the 3rd user coordinate:

Press  $\uparrow$  or  $\text{SDM} \rightarrow 3 \rightarrow \text{ENT}$  [SDM] [ ] [ ] [ ] [ ] 3

7) Input the position of the 3rd auxiliary zero:

Press  $X \rightarrow \pm \rightarrow 1 \rightarrow 0 \rightarrow \text{SDM}$  [ ] [ ] [ ] [ ] 10.0000  $X_0$  [SDM] [ ] [ ] [ ] [ ] 3  
 $Y \rightarrow 1 \rightarrow 0 \rightarrow 0 \rightarrow \text{SDM}$  -- [ ] [ ] [ ] [ ] 100.0000  $Y_0$

The setting of auxiliary zero is finished:

Why does the display result and coordinate of each auxiliary zero conflict? Take the figure above for example. In **UCS** way, input auxiliary zero coordinate in the position of absolute coordinate zero, the result is the position of absolute coordinate in user coordinate, as the display way of user coordinate takes each auxiliary zero as the origin of point 1 **(5, -25)**, point 2**(10, -75)** and point 3**(10, -100)**. If operator input coordinate of other auxiliary zero outside absolute coordinate zero, the display value is the position of the point in user coordinate.

Second method: Zero after reaching position. In the position of auxiliary reference point, press  $X_0 Y_0$ .

The second method is not suit for DRO-2G.

**6.6 Using of auxiliary zero. (For: DRO-2G)**

Enter the display way of user coordinate, then use the auxiliary zero to process by pressing  $\uparrow \downarrow$  or  $\text{SDM}$ .

User can press  $\uparrow \downarrow$  continuously until entering desired user coordinate. Or press  $\text{SDM}$ , under the  $\text{SDM}$  prompt of **"SDM NO"**, input the number of desired user coordinate. Then press  $\text{ENT}$  for more operation, operator can refer to the chapter **2.5**.

Take the fig(1) as an example:

1) Enter the fist UCS:

Press  $\text{SDM}$

2) Input number.

Press  $1 \rightarrow \text{ENT}$

[SDM] [ ] [ ] [ ] [ ] NO

3) Move the machine to plane **A, E**:

Until: **X** displays **0**,  
**Y** displays **0**.

[SDM] [ ] [ ] [ ] [ ] 1

4) Enter the 2nd UCS:

Press  $\uparrow$

[ ] [ ] [ ] [ ] 0.0000  $X_0$  [SDM] [ ] [ ] [ ] [ ] 1

[ ] [ ] [ ] [ ] 0.0000  $Y_0$

[ ] [ ] [ ] [ ] 5.0000  $X_0$  [SDM] [ ] [ ] [ ] [ ] 2

-- [ ] [ ] [ ] [ ] 50.0000  $Y_0$

5) Move the machine to plane **B, C**:

Until: **X** displays **0**,  
**Y** displays **0**.

[ ] [ ] [ ] [ ] 0.0000  $X_0$  [SDM] [ ] [ ] [ ] [ ] 2

6) Enter the 3rd UCS:

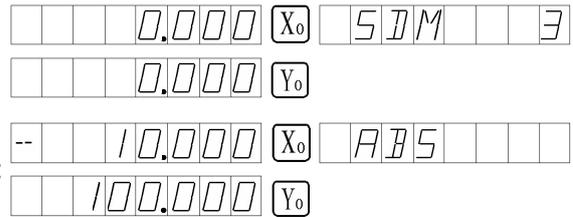
Press  $\uparrow$

[ ] [ ] [ ] [ ] 0.0000  $Y_0$

[ ] [ ] [ ] [ ] 0.0000  $X_0$  [SDM] [ ] [ ] [ ] [ ] 3

-- [ ] [ ] [ ] [ ] 25.0000  $Y_0$

- 7) Move the machine to plane **B, D**:  
 Until:**X** displays **0**,  
       **Y** displays **0**.  
 8) Return absolute coordinate.  
 press  $\downarrow$  key for **4** times Continuously:



### 6.7 Setting the auxiliary zero (For:DRO-2L)

There are two methods to set auxiliary zero. One is to input the position of auxiliary zero directly, the other is zeroing when reaching auxiliary zero. First method:Directly input ,press  $X$   $Z_2$  and number key and  $SDM$  .

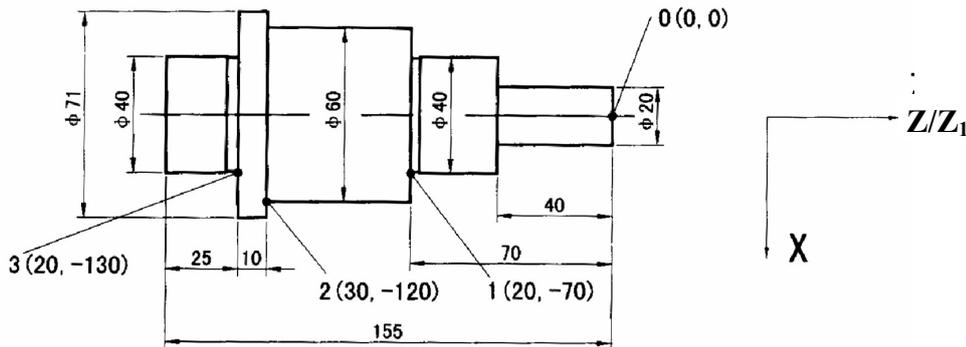


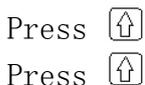
Figure (1)

Take the figure **1** as an example:Move worktable of machine tool to the central point **0**, then enter display way in **ABS**.  
 Zeroing, set absolute zero in the main reference point of parts:



- 1) Determine the zero in **ABS**, at the same time, do a memory operation of zero by the “recover the zero” .  
 2) Enter the display way of user coordinate system (two methods):

First method:



Second method:



- 3) Input the position of the **1st** auxiliary zero:



- 4) Enter the display way of the **2nd** user coordinate:



5) Input the position of the 2nd auxiliary zero:



6) Enter the display way of the 3rd user coordinate:



7) Input the position of the 3rd auxiliary zero:



The setting of auxiliary zero of part is finished.

Why does display result and coordinate of each auxiliary zero conflict? Take the figure above for example. In **UCS** way, input auxiliary zero coordinate in the position of absolute coordinate zero, the result is the position of absolute coordinate in user coordinate, as the display way of user coordinate takes each auxiliary zero as the origin of point 1(-20, 70), point 2(-30, 120) and point 3(-20, -130). If operator input coordinate of other auxiliary zero outside absolute coordinate zero, the display value is the position of the point in the user coordinate.

Second method:Zeroing when reaching position. In the position of auxiliary reference point, press  $X_0 \quad Z_0$ .

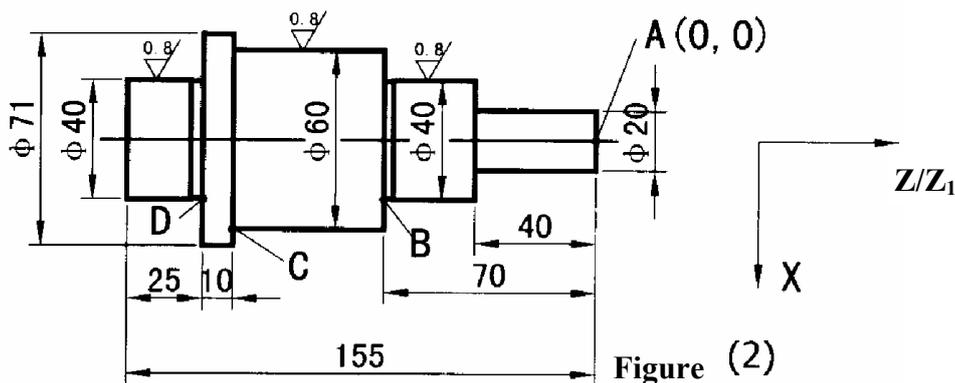
The second method is not suitable for lathe operation, therefore it is not described in the operation manual.

### 6.8 Using of auxiliary zero(For:DRO-2L)

Enter the display way of user coordinate, then use the auxiliary zero to process by pressing  $\uparrow \downarrow$  or  $\text{SDM}$ .

User can press  $\uparrow \downarrow$  continuously until entering desired user coordinate. Or press  $\text{SDM}$ , Under the  $\text{SDM}$  prompt of "SDM NO", input the number of desired user coordinate. Then press  $\text{ENT}$  for more operation, operator can refer to the chapter 2.5.

Take the fig(2) as an example:



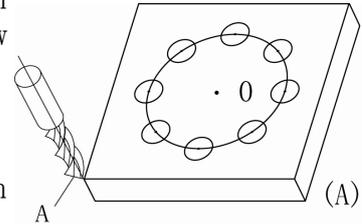
The part has been coarsely lathed. Now is semi-fine lathe. The margin of single side of coarse lathe is 0.05 and the precision should satisfy the requirements of coarsens of pares. Firstly, set point A as the origin of absolute coordinate. Then according to the first method of setting auxiliary zero to input the position of auxiliary. zero directly.



## Chapter 7 PCD Function (For:DRO-2M、DRO-3M、DRO-3E)

### Function of distributing the arc equally (PCD function)

The function is used to distribute arc equally, such as boring hole on flange. Information window will show the parameter to be defined when selecting **PCD** function. The parameter to be defined is:

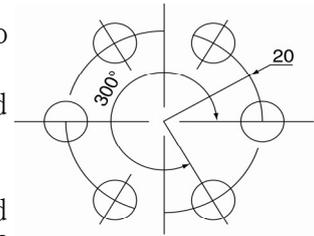


**1、 Central position (CTPOS)**

Central position is the central position of arc when the center of arc corresponds to the tool zeroing. As fig (A), the position of point O corresponding to point A .

**2、 Diameter (DIA):** The diameter of arc to be distributed equally.

**3、 Number:** Number of arc to be distributed equally. As shown in fig (B), the arc, from  $0^{\circ} \sim 180^{\circ}$  , is divided into 3 segments, for points **N01—N04** are required. If it divided into **6** segments, seven point are needed. But the point **7** and point **1** are overlapped. To bore **6** holes on circle  $\Phi 20$ , it means the arc is divided into **6** segments and the number is **7**.



(B)

**4、 Starting angle (ST ANG):**Starting angle of arc to be distributed equally.

**5、 Ending angle (ED ANG):**Ending angle of arc to be distributed equally.

**NOTE:** The definition of starting angle and ending angle refers to the chapters which are about knowing starting and ending angles.

Take fig (B) for example:

**1)**Find the central position of workpiece, tool setting, zeroing:

Press to enter **PCD** function.

P	C	D	-	X	Y
---	---	---	---	---	---

**2)**Press or to select machine plane:

P	C	D	-	X	Z
---	---	---	---	---	---

**NOTE:**Go to the next step to input parameter directly without

**or**

select “select processing plane ” when using the readouts for 2 axes .

P	C	D	-	Y	Z
---	---	---	---	---	---

P	C	D	-	X	Y
---	---	---	---	---	---

Now select **XY** plane.

C	T	P	O	S
---	---	---	---	---

Press to confirm ,next step.

**3)** Input central position of arc:

Press

				0.0000	X <sub>0</sub>	C	T	P	O	S
--	--	--	--	--------	----------------	---	---	---	---	---

				0.0000	Y <sub>0</sub>
--	--	--	--	--------	----------------

Press next step.

					Z <sub>0</sub>
--	--	--	--	--	----------------

D	I	A
---	---	---

**4)** Input arc diameter:

Press

				20.0000	X <sub>0</sub>			D	I	A
--	--	--	--	---------	----------------	--	--	---	---	---

Press next step.

					Y <sub>0</sub>
--	--	--	--	--	----------------

					Z <sub>0</sub>
--	--	--	--	--	----------------

**5)** Input the number of point of arc:

N	U	M	B	E	R
---	---	---	---	---	---



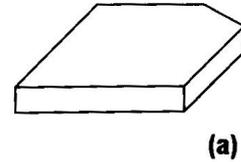
## Chapter 8 Bevel Machining (For: DRO-2M, DRO-3M)

### Bevel Machining

To process larger bevel, the function of bevel machining is very simple and easy.

#### 8.1 Bevel Rectifying

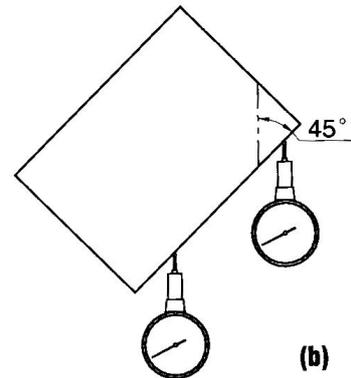
When processing in **XY** plane, as the parts in fig (a). Rectify inclination angle of workpiece before processing bevel.



#### Steps

Firstly place the workpiece on the worktable by the inclination angle.

- 1、 Enter the function of bevel machining by pressing  $\frac{\sin}{M2}$ .
- 2、 Select the processing plane of **XY**.
- 3、 Input inclination angle. **(ANGLE)**
- 4、 Move worktable, make the measuring tool mounted on the milling machine contact the bevel slightly and adjust it until the measuring tool points to zero. Move worktable any distance in X direction.



- 5、 Move worktable in Y direction until the message window displays "0" by pressing **[Y]** key.

- 6、 Adjust the angle of workpiece to make workpiece contact the measuring tool until the measuring tool points to zero.

LINE--	Z
LINE--	XY
LINE--	YZ

- 1) Place workpiece on worktable following 45° ,press  $\frac{\sin}{M2}$ .

LINE--	XY
--------	----

- 2) Select the processing plane.

Select XY plane by pressing  $\downarrow$  or  $\uparrow$   **[X0]**   
 Press **[ENT]**  **[Y0]**

- 3) Input the angle of bevel:

Press **[4]**  $\rightarrow$  **[5]**  $\rightarrow$  **[ENT]**  **[X0]**   
 Press  $\downarrow$   **[Y0]**

- 4) Move worktable in **X** direction to make measuring tool contact workpiece slightly until the measuring tool points to zero. Move any distance in **X** direction.

- 5) Display the moving distance of **Y** direction by pressing **[Y]** .

- 6) Move worktable in Y direction to adjust angle of workpiece. And make the bevel contact measuring tool until the measuring tool points to zero.

- 7) Move worktable until Y axis displays zero. Quit from the function of bevel machining by pressing  $\frac{\sin}{M2}$  at any time.

### 8.2 Bevel Machining (For:DRO-3M)

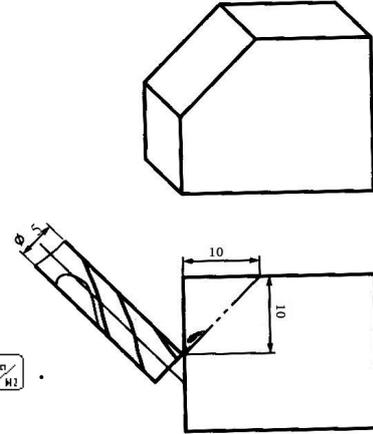
When processing in **XY** or **YZ** plane, the bevel machining function can guide operator to process bevel step by step.

#### Steps

Firstly rectify the inclination angle of main axis of machine tool and then tool setting.

Enter bevel machining by pressing .

- 1、 Select the plane of **XZ** or **YZ**.
- 2、 Input tool diameter. (**DIA**)
- 3、 Input starting position. (**ST POS**)
- 4、 Input ending position. (**ED POS**)
- 5、 At any time quit from the function by pressing .



#### Example

- 1) Correct inclination angle and tool setting:

Press 

- 2) Select processing plane by pressing  :

Press  to select **XZ** plane.

- 3) Input tool diameter:

Press  →

Press 

- 4) Input the coordinate of starting point:

Press  →  →

→  →  →  →

Press 

- 5) Input the coordinate of ending point:

Press  →  →  →

→  →

Press 

- 6) Enter processing state:

Move machine tool until **X** displays "0". Raise or lower worktable the same value according to the display. Display the processing position of the front or next point by pressing  or .

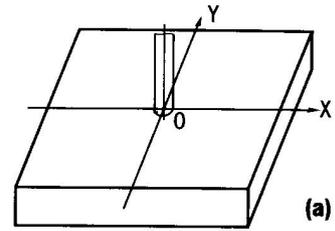
At any time quit from the function by pressing .



## Chapter 10 Function of Finding Zero Automatically

### Automatically find zero

There is a reference zero of parts in processing mould. When worktable has been moved in special case such as outage or stop processing, it is difficult to find the reference zero. The DRO readouts can solve the problem easily.



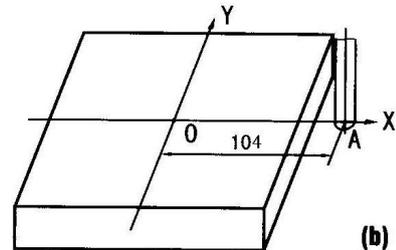
#### Example

**NOTE:** Memorizing and finding the reference point of grating scale should be in the absolute system, that means entering the function in ABS. After finding the reference point of parts and zeroing, set the reference point as origin of absolute coordinate.

#### 10.1 Steps (FOR: DRO-2M, DRO-3M, DRO-3E)

- 1、 First enter the absolute coordinate system, then find and memorize the distance of point **A** of reference point of grating scale and the reference zero by pressing .

- 2、 When need to find zero, firstly find point **A** through **O** by pressing → . Then the digital readout can automatically find reference point of grating scale.



- 1) Zeroing in absolute coordinate system:

Press or to enter absolute state, then press .

0.0000 ABS

- 2) Find reference point of axis of grating scale:

0.0000

0.0000

Press

RI

Press to confirm.

- 3) Find reference point of **X** axis of grating scale:

FUNC--RI

Press

X--ZERO

- 4) Rotate the hand wheel of machine tool and move worktable to find reference point of grating scale in **X** axis:

104.0000 FIND--X

- 5) Find the reference point:

0.0000

When information window displays     0.0000

the “**FIND-X**” (The keeping time of “**FIND-X**” is about **3** seconds), it indicates the reference point is found. As fig (b) ,if it is point **A**, the readout will write down the position of “**104.000**” of point **A**.

Finding reference point of Y axis can be dealt with in the same way. As fig (c), set position of **Y** axis as “**-20.000**” .

Press to quit.

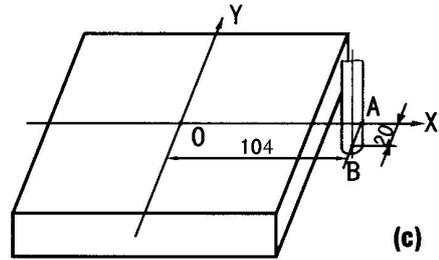
3、 Find reference point after outage.

1) In absolute coordinate system state:

press

2) Press

3) Press  to confirm.



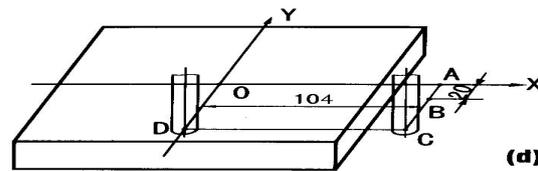
4) Find reference point of grating scale of **X**:

press

5) Move worktable in **X** direction to find the zero of absolute coordinate of **X** axis:

6) Find the point **C** of reference point as fig (d), the **DRO** readout displays "104.000".

7) Move worktable until **X** displays "0". The point **D**, As fig (d), is the absolute zero of **X** axis:



8) Find absolute zero of **Y** axis in the same way:

9) When **X** and **Y** display "0", the point **O** is the origin of absolute coordinate:

10.2 Steps (FOR:DRO-2G)

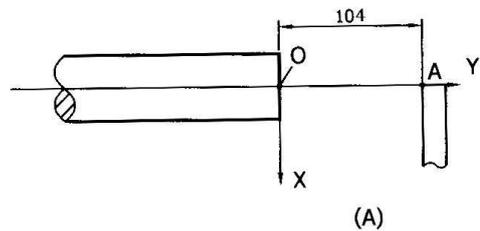
1、 First enter the absolute coordinate system, then find and memorize the distance of point **A** of reference point of grating scale and reference point **O** by pressing .

2、 When need to find zero, firstly find point **A** through **O** by pressing  → . Then the digital readout can automatically find reference point of grating scale.

1) Zeroing in absolute coordinate system:

Press  or  to return ABS state.

Press



2) Find reference point of grating scale:

Press

Press  to confirm.

- 3) Find reference point of **Y** axis of grating scale:

Press

- 4) Rotate the hand wheel of machine tool and move worktable to find reference point of grating scale in **Y** axis:

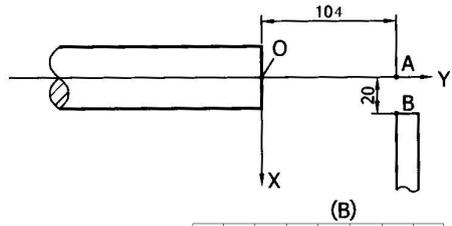
- 5) Find the reference point.

When information window displays

the "**FIND-Y**" (The keeping time of "**FIND-Y**" is about **3** seconds), it indicates the reference point is found already. As fig (B), if it is point **A**, the readout will write down the position of "**104.000**" of point **A**.

Find reference point of **Y** axis in the same way. As fig (C), set position of **X** axis as "**-20.000**".

Press  to quit.



- 3、Find reference point after outage.

- 1) In absolute coordinate system state:

press

- 2) Press

- 3) Press  to confirm:

- 4) Find reference point of grating scale of **Y**:

press

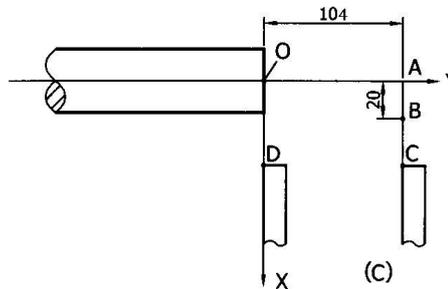
- 5) Move worktable in **Y** direction to find the zero of absolute coordinate of **Y** axis:

- 6) Find the point **C** of reference point, then the **DRO** readout will displays "**104.000**" :

- 7) Move worktable until **Y** displays "0". Point **D**, as fig (C), is the absolute zero of **Y** axis:

- 8) Find absolute zero of **X** axis in the same way:

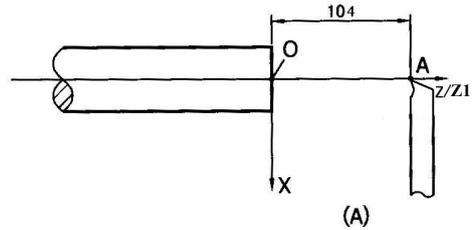
- 9) When **X** and **Y** both display "0", then the point **O** is the origin of absolute coordinate:



### 10.3 Steps (For:DRO-2L)

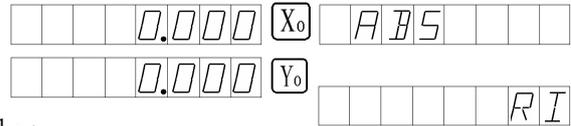
- 1、First enter the absolute coordinate system, then find and memorize the distance of point **A** of reference point of grating scale and refer zero "0" by pressing .

- 2、When you need to find zero, firstly find point **A** through **O** by pressing . Then the digital readout can automatically find reference point of grating scale.



- 1) Zeroing in absolute coordinate system:  
Press or to enter **ABS** state:

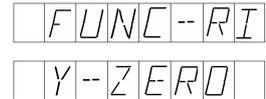
Then press .



- 2) Find reference point of grating scale:

Press

Press to confirm

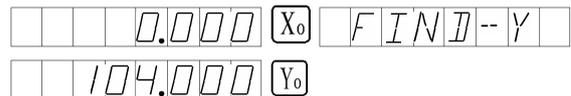


- 3) Find reference point of Z/Z1 axis of grating scale:

Press

- 4) Rotate the hand wheel of machine tool and move worktable to find reference point of grating scale in Z/Z1 axis:

- 5) Find the reference point:

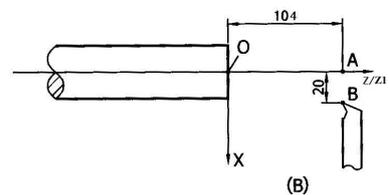


When message-window displays “FIND-Z” (The keeping time of “FIND-Z” is about **3** seconds), it indicates the reference point is found. As fig (b), if it is point **A**, the readout will write down the position of “**104.000**” of point **A**.

Find reference point of X axis in the same way.

As fig (c), set position of X axis as “**-20.000**” .

Press to quit.



- 3、Find reference point after outage.

- 1) In absolute coordinate system state:

Press

- 2) Press

- 3) Press to confirm:

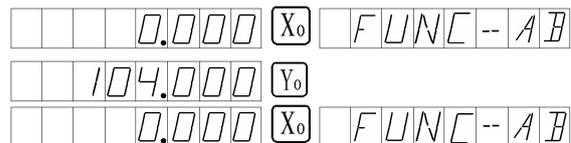


- 4) Find reference point of grating scale of Z/Z1:

press

- 5) Move worktable in Z/Z1 direction to find the zero of absolute coordinate of Z/Z1 axis:

- 6) Find the point **C** of reference point, then the **DRO** readout will display “104.000” :



- 7) Move worktable until Z/Z1 displays “0” . point **D**, As fig (C), is the absolute zero of Z/Z1 axis:



- 8) Find absolute zero of X axis in the same way.



## Chapter 11 Simple Calculating Function (For:DRO-2M、DRO-3M)

### Calculating function (CAL)

The **DRO-M** readouts supply the calculating function.

**See the introduction**

All calculating will be displayed in **X** axis.

 Function key, press it to enter calculating.

 Square root key.

 Inverse trigonometric function. Press the key then press the trigonometric function key to calculate the inverse trigonometric function.


Trigonometric function key

 Delete input data or calculating result the last time.

 →   Shift data axis. The calculated value can be shifted to **X** or **Y** or **Z** axis.

 →  Quit the shifting of data axis.

**Example:** Press  to enter calculation function:

Take the following calculations for example:  $(20+30) \div 2 \times 2 = 50$

 →  →  →  →  →  →  →  →  → 

Calculate:  $\sin 30^\circ = 0.5$

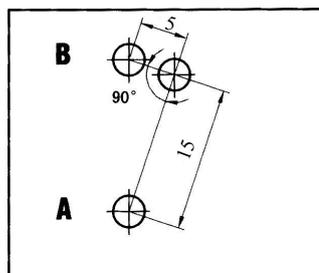
 →  →  → 0.5

Inverse trigonometric function:  $\text{arc sin } 0.5 = 30^\circ$

 →  →  →  →  → 30

Calculate distance  $AB = 5^2 + 15^2 = 15.811$

 →  →  →  →  →  →  →  →  →  →  → 15.811



Result is:

 0.0000   -- A B  
 0.0000 





## Chapter 13 Display Value Filter(For:DRO-2G)

### Function of Display Value Filter

In grinding processing, the vibrating of grinding machine makes the display of readout change repeatedly and rapidly and it causes the comfortable vision of operators. The special readout **DRO-2G** for grinding machine has the function of digital filtering , that is the “Removing shutter function” . In grinding processing, operator can use the function following the operation.

1) Press  to enter the function.

2) Press  to quit from the function.

**Note:** The digital filtering function can be only used in “INC” and “ABS” state. Once the function is used ,other functions can not be used at the same time.

## Chapter 14 EDM Output Function (For:DRO-3E)

### 14.1 Function

The function is used to process on spark machine. When the setting target value of **Z** axis of spark machine is equal to the current value, the digital readout will output switching signal to stop the spark machine from processing.

The **Z** direction of **DRO-3E** digital readout is shown as fig 1, the bigger value **Z** axis displays, the deeper depth it is. According to the display value of **Z** axis, there are positive processing way and negative processing way. When the electrode is down, the processing is positive and the value is increasing. Then the direction is regular. When the electrode is up, the processing is negative and the value is decreasing. That is “**Negative processing**”. (See fig 1)

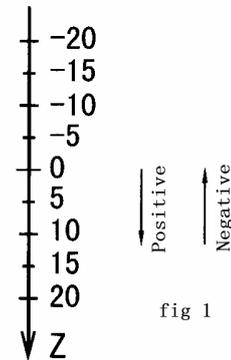


fig 1

The **DRO-3E** digital readout has the function of negative fireproof height that other readout does not have. The function is a safety protection device with intelligence position following inspection. In the course of positive processing, the electrode can be covered with carbon, the electrode will slowly increase along the negative direction. Once the electrode surpasses the liquid surface, it will cause fire. The function can solve the problems when the readout is set as the negative fireproof height, if the raising height of electrode exceeds the height of the processed surface, the digital readout will flash and alarm, and then output signal to stop the spark machine so as to prevent fire. (as fig 2)

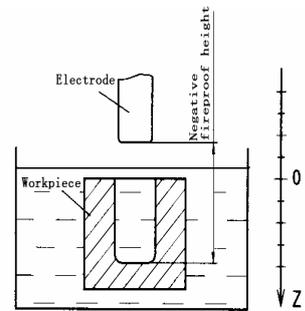


Fig 2

### 14.2 Steps

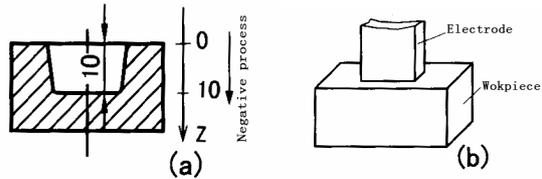
The example is shown in following example 1,2 and 3.

- 1) First set the parameters such as negative fireproof height, quit mode and processing direction before processing.
- 2) Move the main electrode of **Z** axis to contact the datum of test piece, then zero **Z** axis or set parameters.
- 3) Press  to set the depth to be processed (the depth value will be displayed in **X** axis). For example, input **10.00** and press  to confirm. Then press  to quit the “depth” state, and enter “**EDM**” state to process.
- 4) The **X** axis will display the target value of processing depth.  
The **Y** axis will display the processed depth value.  
**Note:** the value displayed in **Y** axis is the processed depth value.  
The **Z** axis will display the actual value of itself.  
**Note:** the value displayed in **Z** axis is the value of the position of main electrode of **Z** axis.
- 5) Start processing, then the display value of **Z** axis is gradually close to the target value and the display value of **Y** axis is also close to the target value. If the electrode is up or down repeatedly, the display value of **Z** will change, but the value of **Y** will not change and display the processed depth value all the time.



### 14.4 Example for positive processing

**Example 1:** To process the cavity as shown in fig (a). Select positive processing first.



1) Move electrode of main axis to contact the workpiece as fig (b).

Press  $Z_0$  to zero the axis:

$X_0$

2) Press  $\square$  to start processing:

$Y_0$

$Z_0$

$X_0$

3) Press  $\square \rightarrow 0 \rightarrow \square$  to set depth:

$Y_0$

press  $\square$

$Z_0$

$X_0$

4) Start processing:

$Y_0$

$Z_0$

$X_0$

5) If the display value of **Z** axis is equal to the target value, the switch will be turned off and "EDME" is displayed:

$Y_0$

$Z_0$

$X_0$

Press  $\square$  to return origin state.

$Y_0$

$Z_0$

$X_0$

**Example 2:** To process workpiece shown in fig (c). Select positive processing first.

$Y_0$

$Z_0$

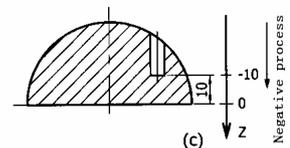
1) Move the electrode of main axis to contact workpiece as fig (d):

Press  $Z_0$  to zero the axis.

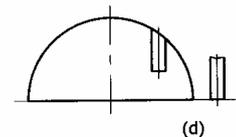
$X_0$

$Y_0$

$Z_0$



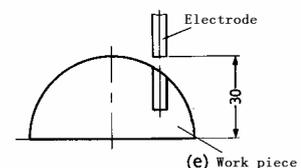
Move electrode to the position shown in fig (e):



$X_0$

$Y_0$

--   $Z_0$



2) Press  to process:

3) Press  →  →  →  →  to set processing depth:

--

4) Start processing:

--

--

--

5) If the display value of **Z** axis is equal to the target value, the switch will be turned off and “**EDME**” is displayed:

--

--

--

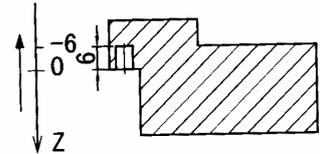
Press  to return origin state.

--

### 14.5 Example for negative processing

#### Example 3

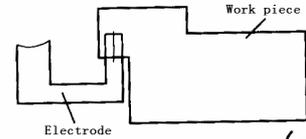
To process workpiece shown in fig (f).  
Select positive processing first.



(f)

1) Move the electrode of main axis to contact the workpiece as fig (g).

Press  to zero the axis.



(g)

2) Press  to process.

3) Press  →  →  →  to set the processing depth:

--

4) Start processing:

--

5) If the display value of **Z** axis is equal to the target value, the switch will be turned off and “**EDME**” is displayed:

--

Press  to return origin state.

--

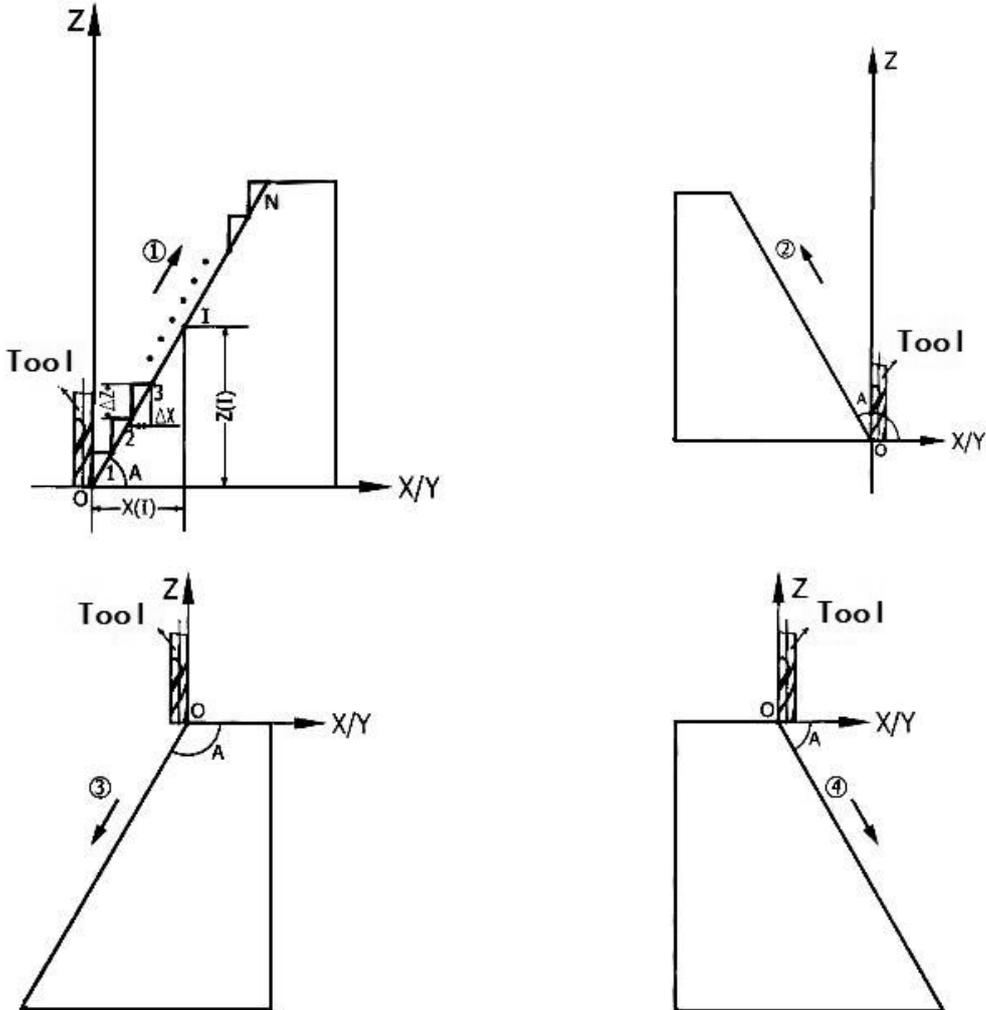
--

--



## Chapter 15 M3 Function (For: DRO-2M)

The function is used to process erect bevel of **Z** axis.  
There are **4** cases, as follows.



①  $\Delta Z=0.1$      $A=60^\circ$

②  $\Delta Z=0.1$      $A=120^\circ$

③  $\Delta Z=-0.1$      $A=-120^\circ$

④  $\Delta Z=-0.1$      $A=-60^\circ$

**Steps** (Take **XZ** as an example)

- 1) Move machine tool to make it straightly align with the starting point:

Press

(YZ plane)

- 2) Press key to enter **M3** function: [ ][ ] Z [ ][ ][ ][ ][ ]
- 3) Press key to select processing plane: [ ][ ] Z [ ][ ][ ][ ][ ]
- 4) Select **XZ** plane and press to confirm:
- 5) Input angle of bevel: [ ][ ] Y Z [ ][ ][ ][ ][ ]  
 Press → → [ ][ ] Z [ ][ ][ ][ ][ ]  
 Press next step. [ ][ ][ ][ ] 60.0000 [ ][ ][ ] ANGLE
- 6) Input step of **Z** axis: (**ΔZ**) [ ][ ][ ][ ][ ][ ][ ][ ]   
 Press → → → [ ][ ][ ][ ] 0.1000 [ ][ ] Z STEP  
 Press to enter machining state. [ ][ ][ ][ ][ ][ ][ ][ ]   
**NOTE:** The **ΔZ** value of each step is the same.
- 7) First point, move machine until **X** axis displays “0” and **Z** axis a positive distance of 0.1mm, then press next point: [ ][ ][ ][ ] 0.050 ← [ ][ ] Z [ ][ ][ ][ ] 1  
[ ][ ][ ][ ] 0.1000
- 8) Second point, move machine until **X** axis displays “0” and **Z** axis a positive distance of 0.1mm then press next point: [ ][ ][ ][ ] 0.115 ← [ ][ ] Z [ ][ ][ ][ ] 2  
[ ][ ][ ][ ] 0.2000   
[ ][ ][ ][ ] 0.175 ← [ ][ ] X [ ][ ] Z [ ][ ][ ][ ] 3
- 9) Third point, move machine until **X** axis displays “0” and **Z** axis a positive distance of 0.1mm, then press next point: [ ][ ][ ][ ] 0.3000
- Last point ← [ ][ ][ ][ ] 6.930 ← [ ][ ] X [ ][ ] Z [ ][ ][ ][ ] 120
- 10) Last point, move machine until **X** axis displays “0” and **Z** axis a positive distance of 0.1mm: [ ][ ][ ][ ] 12.0000   
[ ][ ][ ][ ] 65.0000 [ ][ ] ZER [ ][ ][ ][ ] 1
- 11) Press to quit the function: [ ][ ][ ][ ] 10.0000   
 The **DRO** displays current value of **XY**.

12) Following formula, verify the value:

$$\text{Formula: } X_{(I)} = \frac{\Delta Z}{\text{tg}A} \times I \quad \Delta X = \frac{\Delta Z}{\text{tg}A}$$

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

**I:** Step number:  $\Delta X/\Delta Z$ : Step value of each step of X/Z axis.

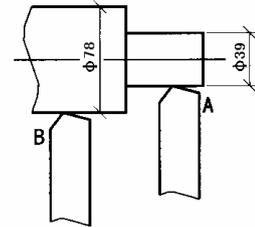
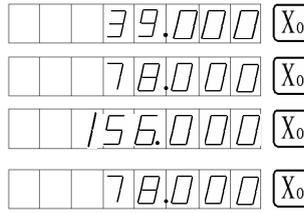
$X_{(I)}/Z_{(I)}$ : Shift of point I of X/Z axis.

**NOTE:** The operation of YZ plane can be dealt with in the same way.

## Chapter 16 Lathe Function (For:DRO-2L)

### 16.1 “R/D” function key

The **X** datum is in the central line.



1) Tool is in position **A**:

2) Press  $\boxed{X} \rightarrow \boxed{\frac{R/D}{\%}}$

3) Move the tool to position **B**:

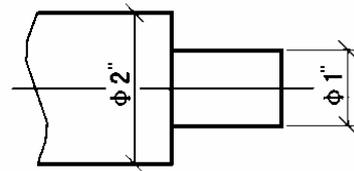
4) Press  $\boxed{X} \rightarrow \boxed{\frac{R/D}{\%}}$

When the R/D light is on, it displays the diameter. The Z doesn't have the function.

### 16.2 200 Tool base

#### 200 Tool base

Different tool is needed when processing different parts. For convenient operation, **DRO-2L** digital readout has the function of 200 tool base.

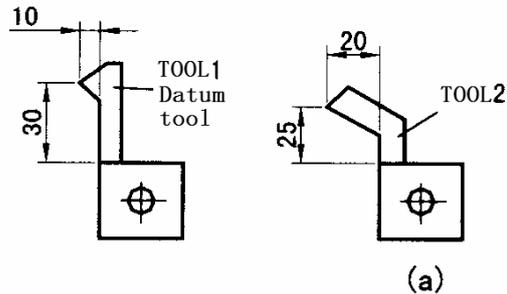


**Note:** Only when the lathe is equipped with the tool setting block, can the 200 tool base be used.

1、Set a datum tool. Tool setting, zero **X** axis and **Z** axis, then set the zero of absolute coordinate.

2、According to the size of tool and datum tool, determine the position of Tool relative to zero of absolute

Coordinate and datum tool. As fig (a), the relative size of tool **2** is as follows: **X** axis  $25-30=-5$ , **Z** axis  $20-10=10$ .

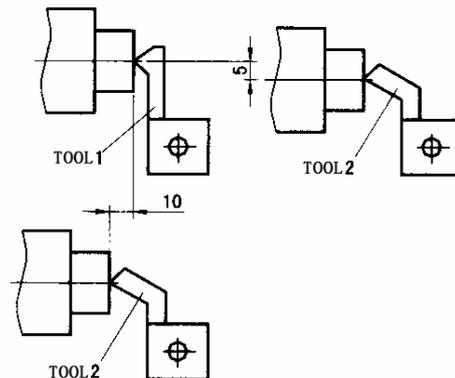


3、Save the tool number and the relative size into digital readout.

4、The number of tool can be input at random, the digital readout will display the position size of tool to absolute coordinate zero. Move lathe until **X** axis and **Z** axis display zero.

5、Tool base contains the data of **200** tools.

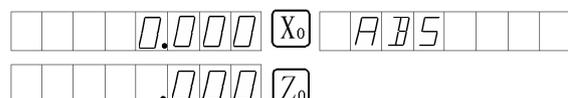
6、After open **200** tool base, **200** tool base can be closed by continuously Pressing  $\boxed{\pm}$  for ten times. If **200** tool base is not opened, it can be open by continuously pressing  $\boxed{\pm}$  for ten times.



The operations for inputting tool data and calling tool is as follows:

1) Input tool in “**ABS**” state. Then tool setting the knife **1** and zeroing.

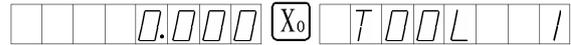
Set the knife **1** as datum tool:



2) Press to enter inputting state:

3) Input tool data:

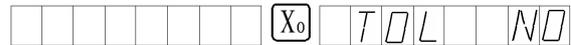
Press



Press



4) Input number of tool:

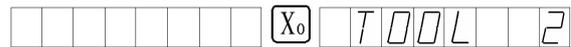


Press

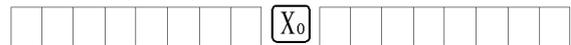


5) Input tool data:

Press



6) Press to go on inputting the data of next tool:



Press to quit input state.



7、After inputting tool data, use tool base according to the following operation. Mount the second tool.

1) Enter using state by pressing :



2) Determine the datum tool:



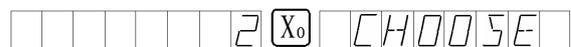
Press



The first tool is defaulted as datum tool. Press the number key and to set other tool as datum tool.



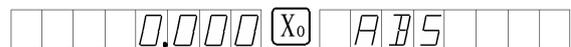
Press to use other tool.



3) Press to use the second tool:



4) Press to quit the function:



Move worktable until **X** and **Z** display “0”. Now the second tool is in the datum position. Similarly, operator can input and use the **200** tools.

**Note:** The axis can be zeroed in “ABS” state only when the datum tool is used. The axis can be zeroed in “INC” state for other tool.

## 16.3 Conicity Measuring

### Conicity Measuring

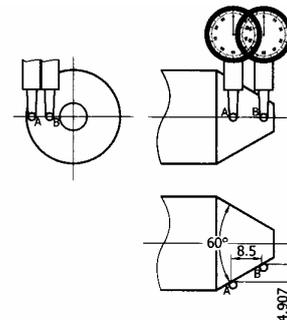
For lathing workpiece with conicity, the value of conicity in processing can be measured.

### Operations is as follows

As figure, Make the lever readout contact the workpiece surface **A** until the lever read out points to zero.

1) Enter conicity measuring by pressing :

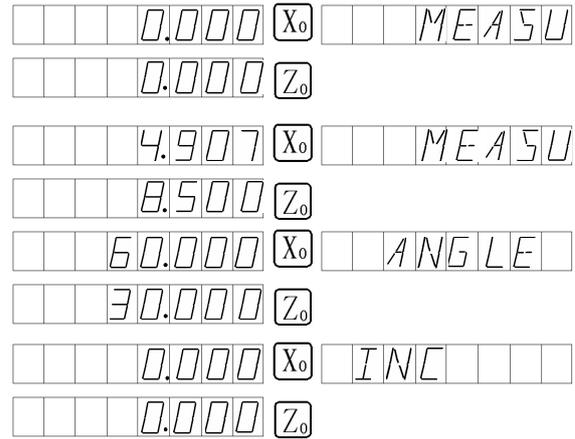
2) Move lever readout to the surface **B** until lever readout points to zero:



3) Press **ENT** to calculate:

(The display of X axis is conicity and the display of Z axis is angle.)

4) Press **ESC** to quit:

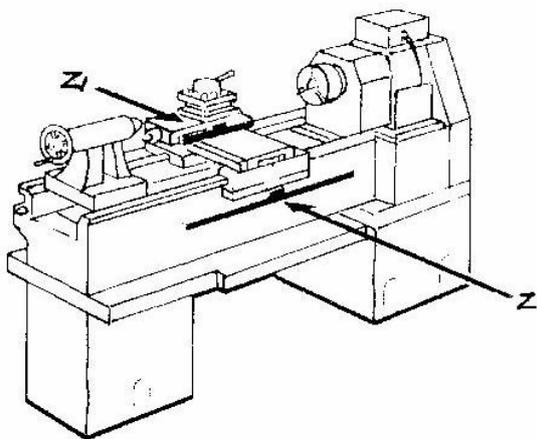


### 16.4 About the DRO-2L2

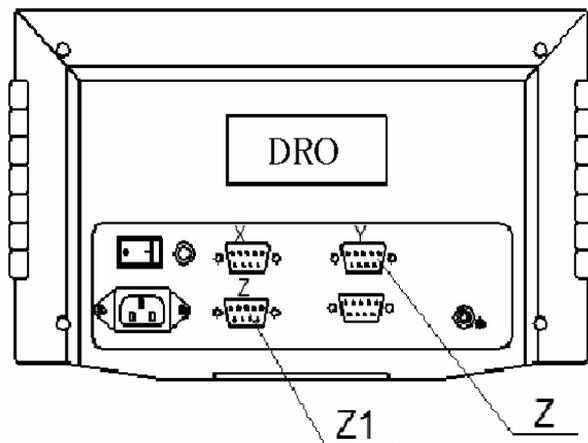
DRO-2L2 is a 3 axis digital readout specially used on lathe machines. It is the same as that of DRO-2L except that it adds a linear scale (Z1) to measure the position of the machine working stage.

See Picture I:

The lathe machine is equipped with two linear scales (Z and Z1) in the same direction, the position of the machine working stage will be decided by the displacement of the two linear scales (Z+Z1). The displacement value will be displayed in the Z axis display window. The Z1 axis of the display has no function of zero window and linear correction, the resolution will be set by Z axis and it is the same as that of Z axis. The counting direction will be set by Z1 axis. Adjust the mounting and counting direction of the reader heads and make the counting and moving direction of Z and Z1 the same, and then Z axis display window will show the moving position of the machine stage.



**Picture I**



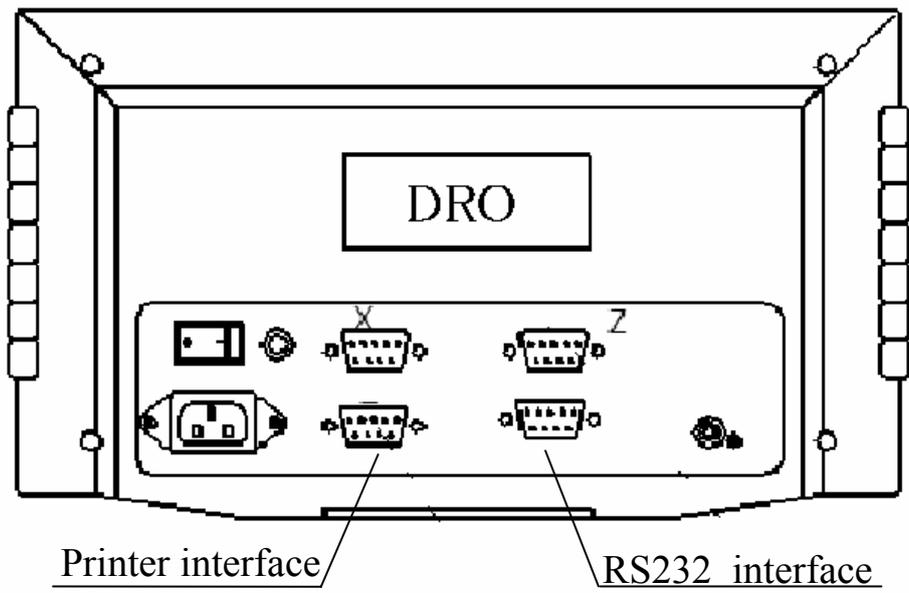
**Picture II**

Please refer to the Picture II when connecting linear scales and DRO.

**16.5 About the DRO-2LP**

The DRO-2LP is a two axis digital readout. It is the same as that of DRO-2L except that it adds a serial printer interface of TP-16 printer we provide, it can print the display value of DRO;

- Press "Send" key print: X1 Y1,X2 Y2,.....X99 Y99;
- Press "X" "Send" key print: X1, X2,X3,X4 .....X99;
- Press "Y" "Send" key print: Y1, Y2,Y3,Y4 .....Y99;



Note:The printer interface and the RS232 interface only one can be selected at the same time.

## RS-232-C Interface of DRO

### Transmission signal: 9600, 8, N, 1

Sending data singly:

the data receiver (PC) sends “R” (52H) to the DRO, and DRO sends the data singly. Upon receiving a 52H, DRO will send a group data (current displaying value in ABS or INC state).

Sending data continuously:

the data receiver (PC) sends “U” (55H) to DRO, and DRO will send data continuously. Later, DRO will send data if displaying value is changed.

Stop sending data: DRO will stop sending data when it receives data except for 55H and 52H. (For example: A9H) .

### The format of output data group( ASC II character)

X+1234.567 [sp] Y+1234.567 [sp] Z-1234.567 [LF] [SP]

X x-value[ space] Y y-value [ space ]Z z-value[ CR] [ space ]

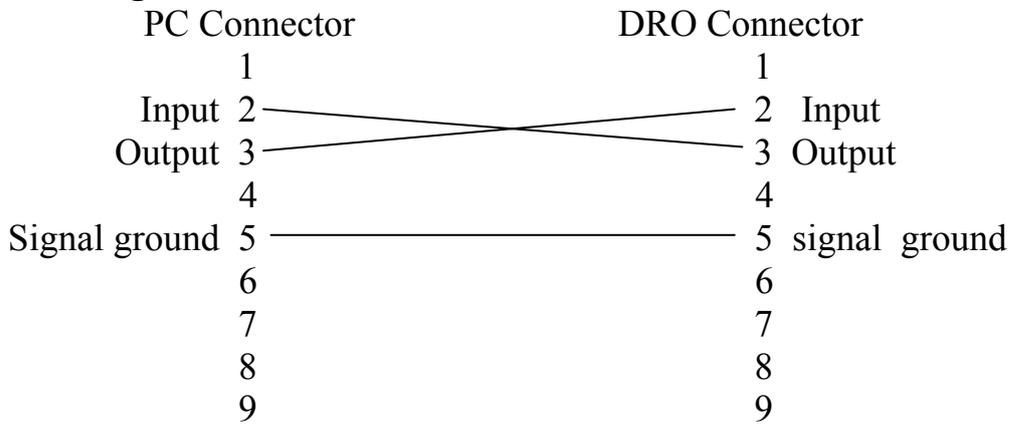
The position of decimal dot is unstable, it will change with the setup of resolution, for example:

x+1234.560 (resolution=1, 2, 5, 10)

x+123.4565 (resolution=0.5)

x+12.34567 (I/M=I ,the inch system )

### The transmission line is 1.5m filament, the connector is 9p D-type, and the connecting method is as below



## Appendix

### Troubleshooting

The following are the preliminary solvents for troubleshooting. If you still have trouble, please contact our company or agent for help.

<b>Troubles</b>	<b>Possible reasons</b>	<b>Solvents</b>
No display	<ol style="list-style-type: none"> <li>1、 Power isn' t connected.</li> <li>2、 Power switch is off.</li> <li>3、 The range of power voltage is not right.</li> <li>4、 The inner power of grating scale is short.</li> </ol>	<ol style="list-style-type: none"> <li>1、 Check power wire and connect the power.</li> <li>2、 Turn on the power switch.</li> <li>3、 The range of voltage is in 80-260v.</li> <li>4、 Unplug the connector of grating scale.</li> </ol>
Cover is charged	<ol style="list-style-type: none"> <li>1、 Shell is poor grounding.</li> <li>2、 220V power is current leakage.</li> </ol>	<ol style="list-style-type: none"> <li>1、 Check the grounding of machine.</li> <li>2、 Check the 220V power.</li> </ol>
One axis is not counting	<ol style="list-style-type: none"> <li>1、 Replace the grating scale of the other axis.</li> <li>2、 DRO is in special function.</li> </ol>	<ol style="list-style-type: none"> <li>1、 If count is normal, the grating scale has trouble; If is abnormal, the DRO readouts has trouble.</li> <li>2、 Quit the special function.</li> </ol>
Counting is error	<ol style="list-style-type: none"> <li>1、 Shell is poor grounding.</li> <li>2、 Low precision of machine tool.</li> <li>3、 Speed of machine tool is too rapid.</li> <li>4、 Precisions of grating scale is low.</li> <li>5、 The resolution of DRO readouts and grating scale is not same.</li> <li>6、 The unit is not the metric inch.</li> <li>7、 The setting of linear compensating is not correct.</li> <li>8、 Reading head is bad because grating scale exceeds the length range.</li> </ol>	<ol style="list-style-type: none"> <li>1、 Shell is good grounding.</li> <li>2、 Repair the machine tool.</li> <li>3、 Reduce the speed of machine tool.</li> <li>4、 Mount the grating scale again.</li> <li>5、 Set the resolution of DRO again.</li> <li>6、 Convert the display of metric /inch.</li> <li>7、 Reset the linear compensation.</li> <li>8、 Repair grating scale.</li> </ol>
Grating scale is not counting	<ol style="list-style-type: none"> <li>1、 Reading head is bad for using range exceeds.</li> <li>2、 Aluminum chips is in reading heading head of grating scale.</li> <li>3、 The span between the reading head of grating head and scale is large.</li> <li>4、 The metal parts of grating scale is damaged</li> </ol>	<ol style="list-style-type: none"> <li>1、 Repair grating scale.</li> <li>2、 Repair grating scale.</li> <li>3、 Repair grating scale.</li> <li>4、 Repair grating scale.</li> </ol>
Sometimes grating scale is not counting	<ol style="list-style-type: none"> <li>1、 The small car and steel ball of grating scale is separated.</li> <li>2、 The glass of reading head of grating scale is wearied.</li> <li>3、 The glass of reading head of grating scale has dirt.</li> <li>4、 The elasticity of the steel wire is not adequate.</li> </ol>	<ol style="list-style-type: none"> <li>1、 Repair grating scale.</li> <li>2、 Repair grating scale.</li> <li>3、 Repair grating scale.</li> <li>4、 Repair grating scale.</li> </ol>
The count of grating scale is not accurate	<ol style="list-style-type: none"> <li>1、 The mounting of grating scale does Not satisfy the requirement, and the precision is not adequate.</li> <li>2、 The screw is loosen.</li> <li>3、 Precision of machine tool is low.</li> <li>4、 The resolution between digital read-outs and grating scale does not match.</li> </ol>	<ol style="list-style-type: none"> <li>1、 Mount the grating scale again an level it.</li> <li>2、 Lock all fixing screws.</li> <li>3、 Repair machine tool .</li> <li>4、 Reset the resolution of digital readouts.</li> </ol>