DIGITAL READOUTS

Operation Manual

DRO for 2 axes

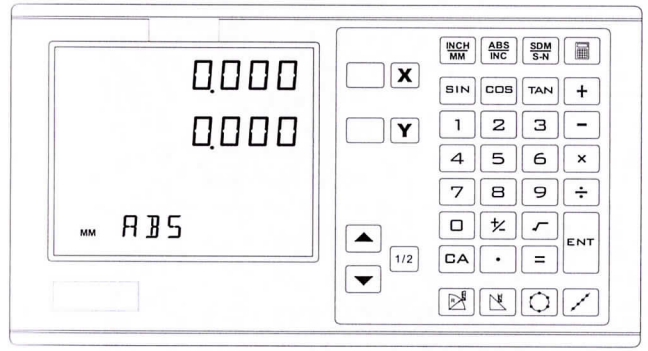
DRO for 3 axes

VER1.00

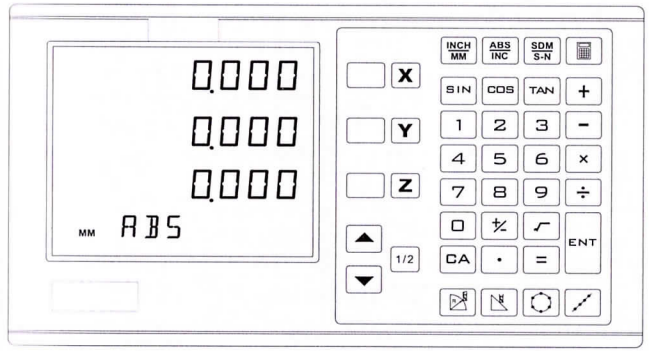
Contents

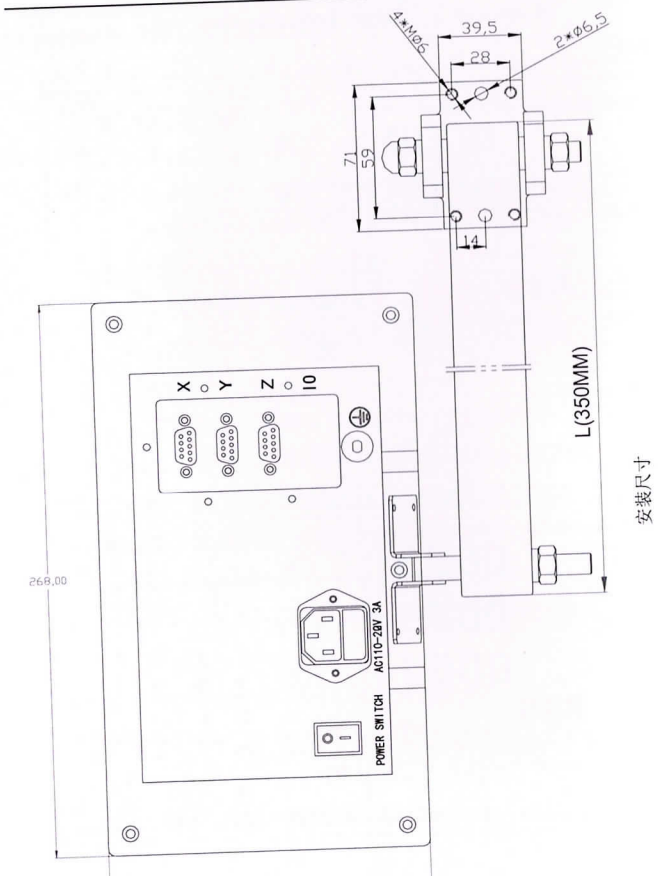
Chapter 1 Brief Introduction

2 axes



3 axes





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Description of Key Function

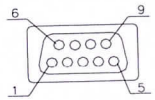
KEY MARK	FUNCTION
[ ]	Zero selected axis.
X Y Z	Select axis to operate.
INCH MM	Inch/Metric Switch
1/2	Center Finding
ABS INC	ABS/IINC Switch
SDM S-N	1: Calculate inverse trigonometric unction in calculating function. 2 :Enter No. of SDM coordinate.
0 9	Numeric Key
•	Decimal Point
+/-	+/- Sign
ENT	Enter
CA	Clearing
[ ]	Calculator
SIN COS TAN	Trigonometric Function
+ − × ÷ =	Add: Decrease: Multiple: Divide

	Square root or square.
	Process holes displayed equally on a circle.
	Process holes displayed equally on a line.
	Simple R cutting function
	Process a slope.
	Stroll up or down to select.

1.1 Interface

Linear Scale Interface

1) 9PD Connector 1



PIN	NAME
1	+5V
2	0V
3	A
4	B
6-9	NC

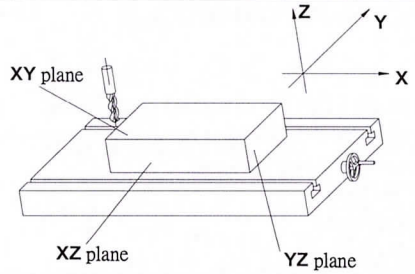
2) 9PD Connector 2

PIN	NAME
1	NC
2	0V
3-5	NC
6	A
7	+5V
8	B
9	NC

Please contact the agent to confirm which connection method to use.

1.2 Coordinate System

DRO is an instrument which can measure position of work piece when processing. Coordinate system must be definite first for more efficiency and accuracy.



In horizontal plane, the X axis is parallel with the operator; Y axis is perpendicular to X axis. Z-axis is perpendicular to horizontal plane. Positive direction of axis is set as the figure. It also can be changed as customer.

The value of one point position is the distance relative to the origin of coordinate.

For a work-piece as Figure A, the value of each point position is as the Figure B when point O is the origin of coordinate.

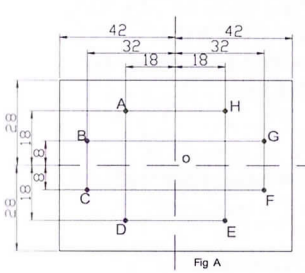


Fig A

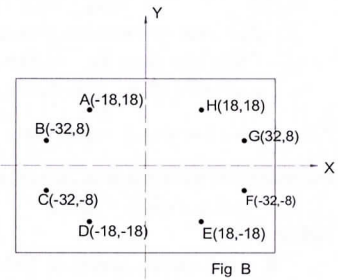


Fig B

Chapter 2 BASIC OPERATION

2.1 Power on

Function: Power on then DRO enter normal display state.
It can memorize the following parameter after power on.

A. The scale position where power off;
B. ABS/INC/SDM mode;
C. Metric/Imperial mode;

NOTE: ***Normal display state***

In normal display state, X window, Y window,Z window displays the current value of X axis, Y axis and Z axis separately. The message window displays "ABS", "INC" or "SDM XXX" (indicate the Number of SDM coordinate, with a range of 000—499).When user switch among ABS/INC/SDM, MM/INCH

2.2 Zeroing

Function: Zero the designated axis in normal display state. Zeroing is used to set the current point as datum point.

NOTE:

1. ***The axes can be zeroed in ABS/INC/SDM states;***
2. ***Press the zero key of the same axis will cancel above zero operation if the scale kept still after zero.***

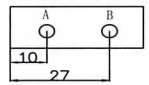
2.3 Preset Data to designed axis

Function: Preset a value to current position for a designed axis in normal display state.

NOTE:

1. ***Axis can be preset in ABS/INC/SDM state.***
2. ***In SDM state, input mode "0" means that the display value is equal to the enter value; input mode "1" means that the display value is equal to the negative of enter value.***

Example: Machine the work-piece from the A to B



STEPS:

1. Move the machine table, and align the lathe tool to A.
2. Return normal display state;
3. Pres[X]→[1]→[.]→[ENT], which means the preset data is "10";

   NOTE: ***If in SDM state and SDM input mode is "1", [±] needn't be inputted. Otherwise [±] must be inputted.***
4. Moving the machine table until "27.000" is displayed in X window. Now it is the position of B.

2.4 Toggle display unit between mm and inch

Function: Length can be displayed either in "mm" (metric) or "inch" (imperial). Display unit can be toggled between mm and inch.

Example: Display value toggle from mm to inch

STEPS:

1. DRO returns normal display state.

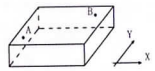
Press [INCH/MM], the display unit is inch now.

NOTE: ***It is invalid to toggle between mm and inch while axis is encoder.***

2.5 Mid-point Calculation

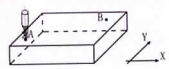
Function: Set the center of work piece as datum by halving the displayed value.

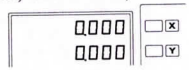
Example: Set the center of rectangle as datum as the right figure.



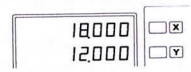
STEPS:

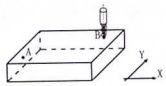
1. Place the work piece on the machine table
2. DRO returns normal display state, move machine table and align the lathe tool with point A; Press key to zero X axis, and Y axis;

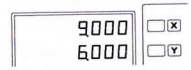




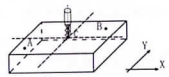
3. Align lathe tool with point B by moving machine table;
   Press 1/2→X
   Press 1/2→Y

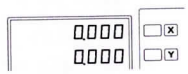






4. Move the machine table until "0.000" is displayed in X window and Y window. The position (where the lathe tool is) is the work-piece's center.





NOTE: ***1. It is invalid to mid-point calculation while axis is encoder.***

2.6 Absolute / Incremental / 500 groups SDM

Function: DRO has 3 display modes: the absolute mode (ABS); the incremental mode (INC) and 500 groups Second Data Memory (SDM) with the range of 000 to499.

1. Zero point of work-piece is set at the origin point of ABS coordinate;
2. The relative distance between datum of ABS and SDM remains unchanged when ABS datum is changed.

I. toggle among ABS/INC/SDM coordinate

These three display modes can be changed only in normal display state.

Press key ABS INC SDM S-N or ▲▼, the display modes can be changed between ABS、INC and SDM

II. Set the new number of SDM in SDM mode

STEPS:

1. Enter SDM mode;
2. Press key SDM S-N, message window flashes, waiting for inputting a new number of SDM;
3. Enter a new number. for example, enter 8→6
   SDM 86
4. Press ENT , then the message window stops flashing and the number of SDM is changed to 86.

III: Increase/Decrease the SDM number

DRO return normal display state with the display mode SDM, press ▲ to decrease the number of SDM by 1; press ▼ to increase the number of SDM by 1.

2.7 Lathe Function

As the right figure, if two scales are installed in one axis, the position of the work-piece should be the sum of these two values (X+Y) in this direction. It is called lathe function.

lathe mode 0: normal display (the lathe function is disabled).

A. lathe mode 1:
   X window value = X + Y.

B. lathe mode 2:

X window value = X + Z

C. lathe mode 3:

Y window value = Y + Z.

When the lathe mode is not 0, in the normal display state, pressing [+] can open or close the lathe function.

2.8 Filter display value

When machine a work-piece by grinder, the display value varies quickly due to the vibration of grinder. User can't see display value clearly. DRO provides display value filter function to disable the quake change of display value.

STEP:

1. Enter display value filter function.
   In normal display state, Press and hold [SIN], then press [ENT], enter display value filter function.
   SMOOTH
2. Exit display value filter function.
   Press [SIN], exit display value filter function.
   EXIT SH

Chapter3 500groups SDM coordinate

DRO has three display modes: the absolute mode (ABS), the incremental mode (INC) and the 500 groups second data memory (SDM 0—SDM499).

ABS datum of the work-piece is set at the beginning of the processing and the 500 group SDM is set relative to ABS coordinate.

500 group SDM coordinate can be divided into several segments, and every segment stores data of one work-piece. If one segment has 20 groups SDM coordinate, DRO can be divided into 25 segments and can store data of 25 work-pieces.

SDM 000 ------ SDM 019 data of the first work-piece

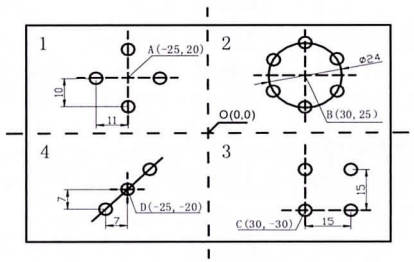
SDM 020 ------ SDM 039 data of the second work-piece

……

SDM 460 ------ SDM479 data of 24th work-piece

SDM480 ------ SDM499 data of 25th work-piece

Example: The ABS datum is the center point O, the pointA, B, C, D needed processing are set as datum of SDM 000 —SDM 003.



Two ways to set SDM coordinates:

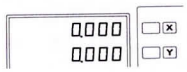
1) Zeroing at the current point.
2) Presetting datum of SDM coordinate.

3.1 Zeroing at the Current Point

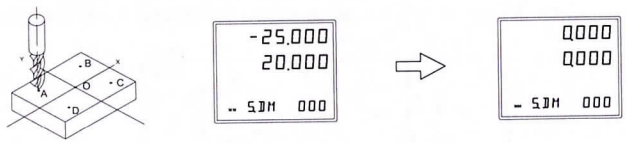
At first set the center point of the work-piece as the origin of the ABS, then align the lathe tool with point A, B, C, D by moving the machine table and zero them. It is the position to process where the "0.00" appears in X window, Y window by moving the machine table whether in ABS or in SDM coordinate.

STEPS:

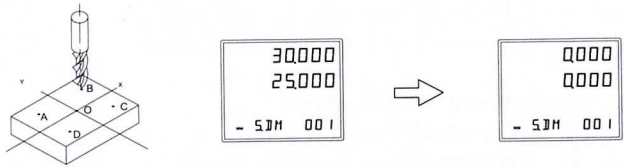
1. Set the center of rectangular point O as the datum of ABS
   Make line L1 parallel with X axis: line L2 parallel with Y axis.
   When position lathe tool to point O
   Zero X axis and Y axis in SDM 000;
   Zero X axis and Y axis in SDM 001;
   Zero X axis and Y axis in SDM 002;
   Zero X axis and Y axis in SDM 003;



2. Set the point A as the datum of SDM 000.
   SDM 000: align the lathe tool with point A and zero X axis, Y axis.



3. Set the point B as the datum of SDM 001.
   SDM 001: align the lathe tool with point B and zero X axis, Y axis.



4. Similarly, the auxiliary zero positions of C and D can be set according to the above steps.
5. Machine the work-piece according to the preset SDM coordinate;
6. Machine another work-piece according to the same blueprint. You only need set the center point as the datum of ABS. It is not necessary to set SDM coordinate again, as SDM can be set automatically. Point A, B, C, and D is the zero point of SDM 000, SDM 001, SDM 002, and SDM 003 respectively. Point can be machined when enter corresponding SDM coordinate and "0.000" appears in screen by moving machine table. This function can save great plenty of time in production.

3.2 Preset datum of SDM Coordinate

Compared with the way of zeroing at current point, the another way (presetting datum of SDM coordinate) can set zero point of SDM more accurately and quickly without moving the machine table.

As the figure showed right, center point is the datum of ABS, the position of point A, B,C, D is (-25, 20), (25, 20), (25, -20), (-25, -20) in ABS coordinate.

A Enter SDM 000 preset the position of point O as (25, -20), which means the point A is the datum of SDM 000;

B Enter SDM 001, preset the position of point O as (-25, -20), which means the point B is the datum of SDM 001;

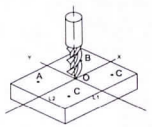
C Enter SDM 002 and set the position of point O as (-25, 20), which means the point C is the datum of SDM 002;

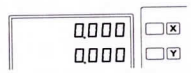
D Enter SDM 003, preset the position of point O as (25, 20), witch means the point D is the datum of SDM 003;

Pay attention that the preset value is negative to the actual value of position in ABS. If set "SDM DIR" as "1" in initial system settings, the caution is not necessary. The value DRO accepts is equal to the negative of the enter value.

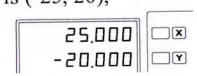
STEPS:

1. Set "SDM DIR" as "1" in initial system settings;
2. Set the center point of the work-piece as the datum of ABS;
   Line L1 is parallel to X axis, line L2 is parallel to Y axis.
   Move machine table; align the milling cutter with point O.
   The machine table remain still while presetting;
   Clear the X, Y axis data to determine the absolute coordinate zero position

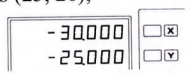




3. Set point A as the datum of SDM 000;
   Enter SDM 000.The position of point A is (-25, 20),
   press. [X]→[2]→[5]→[+/-]→[ENT]
   press. [Y]→[2]→[0]→[ENT]



4. Set point B as the datum of SDM 001;
   Enter SDM 001.The position of point B is (25, 20),
   press [X]→[3]→[0]→[ENT]
   press [Y]→[2]→[5]→[ENT]



5. Similarly, the auxiliary zero positions of C and D can be set according to the above steps.

NOTE:Clear All SDM Datum

Return normal display state,Press and hold [SDM S-N], then press [CA], and the message window displays "CLS SDM" and flashes, which means it is clearing now. About four seconds later, the clearing is completed and "CLS OK" is displayed in message window temporary and DRO return normal display state.

Chapter 4 SPECIAL FUNCTIONS

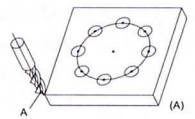
DRO has special function as the following except measuring and positioning:

Bolt Hole Circle (BHC);
Bolt Holt Line (BHL);
ARC Processing ;
Slope Processing ;

Please refer **Coordinate System** (in Chapter 1) before reading this section.

4.1 Bolt Hole Circle

Function description:

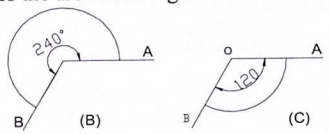


DRO has the function of BOLT HOLE CIRCLE (BHC) .This function can simplify the pressing of multiple holes which are attributed equally around the circumference of a circle. The DRO will guide operator to enter the following parameters:

RADIUS	Radius of circle
ST.ANGLE	Starting angle that the center of the first hole on the circle
END.ANGLE	Ending angle that the center of the last hole on the circle
HOLE NUM	Hole number
DIRECT	Angle direction.

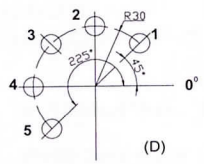
Angle has two directions: counterclockwise and clockwise. "0" indicates that it is counterclockwise from ST.ANGLE to END.ANGLE; "1" indicates it is clockwise from ST.ANGLE to END.ANGLE. As the following figure, the ST.ANGLE is 0º, END.ANG is 240º. The figure (B) illustrates the arc while angle direction is counterclockwise; figure (C)

illustrates the arc while angle direction is clockwise.



As figure (D) illustrates, machine a hole every 45 deg from 0° ~ 225°. Parameters are as the following:

RADIUS	20
ST.ANGLE	45
END.ANGLE	225
HOL NUM	5
DIRECT	0

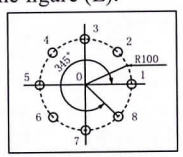


NOTE: If ST.ANGLE equals END.ANGLE, the holes are attributed equally around the whole circumference.

The positions of the hole center are calculated automatically after input all parameters. Press [▲][▼] to choose the hole No. and move the machine table until the "0.000" appears in X window, Y window. It is the position to process a hole.

Example: Machine holes on circumference as the figure (E).

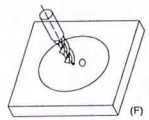
RADIUS	100mm
ST.ANGLE	0°
END.ANGLE	315°
HOLE NUM	8
DIRECT	0



Note: If the end angle is 360°, then the number of holes should be set to 9, because the last hole is coincident with the first hole

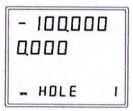
STEPS:

1. Set display unit to metric in normal state;
   Move the machine table until the machine tool is aligned with the center of the circle, then

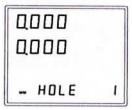


zero X axis, Y axis.

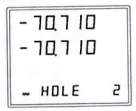
2. Press [◌] to enter Bolt Hole Circle function.
   If all parameters have been set, press [ENT] to process directly.
3. Input radius
   Y window displays the formerly preset radius; message window displays "RADIUS".
   Press [1]→[0]→[0]→[ENT] in turn. RADIUS
4. Input ST.ANGLE
   Message window displays "ST.ANGLE"; Y window displays the former preset starting angle.
   Press [0]→[ENT] in turn; ST. ANGLE
5. Input ending angle
   Message window displays "END.ANGLE"; Y window displays the former angle
   Press [3]→[1]→[5]→[ENT] in turn. END ANGLE
6. Input the number of hole.
   Message window displays "HOLE NUM"; Y window displays the former number.
   Press [8]→[ENT] in turn. HOLE NUM
7. Input angle direction.
   Message window displays "DIRECT", Y window displays the former preset direction;
   Press [0]→[ENT] in turn; DIRECT
8. Message window displays "HOLE 1";
   It is the position of the first hole to punch where the "0.000" is displayed in X window and Y window by moving the machine table.



9. After finishing the first hole, press [▼]
   Message window displays "HOLE 2";
   Move the machine table, the "0.000" is

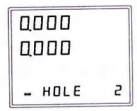


displayed in X window and Y window. It is the position of the second hole.



NOTE: ***Press*** ▲ **or** ▼ ***to change holes number.***

10. Process the holes 3rd –6th in the same way.
11. After processing all holes, press ⊕ to return normal display state.



4.2 Bolt Hole Line

Function:

DRO provide BOLT HOLE LINE (BHL) function. This function can simplify the processing multiple holes whose centers are attributed equally on one line.

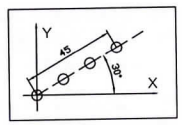
The following parameters are needed to be input:

LINE DIS	Line distance (distance between the center of first hole and the center of the last hole)
LINE ANG	Line angle (angle between the line and the positive X axis)
HOLE NUM	Number of holes

DRO will calculate the positions of the hole after all the parameters have been entered. Press ▼ or ▲ to select the No. of hole and move the machine until "0.000" is displayed in X window and Y window. It is the position of hole to machine.

Example:

LINE DIS	45mm
LINE ANG	30°
HOLE NUM	4

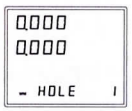


STEPS:

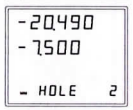
1. Set display unit to metric
   Move the machine table until the machine tool is aligned with the

center point of the first hole, and zero X axis, Y axis.

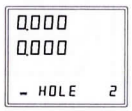
2. Press ⟋ to enter BOLT HOLE LINE function;
   If all parameters have been entered, press ENT to start processing directly.
3. Input line distance.
   Y window displays the former preset line distance, and the message window displays "LINE DIS". LINE DIS
   Press 4→5→ENT in turn;
4. Input line angle.
   The message window displays "LINE ANG"; Y window displays the former preset line angle. LINE ANG
   Press 3→0→ENT in turn.
5. Input the number of hole.
   Message window displays "HOLE NUM", Y window displays the former preset hole number. HOLE NUM
   Press 4→ENT in turn, processing begins.
6. Message window displays "HOLE 1";
   Move the machine table until "0.000"appears in X window and Y window, it is the center of the first hole to punch.



7. After finishing the first hole, press ▼, and the message window displays "HOLE 2";
   Move the machine table until "0.000" appears in X and Y window, and then you can punch the second hole at this point.



   NOTE: Press ▼ ***or*** ▲ ***to transform among holes.***



8. Process the holes 3rd –6th in the same way.
9. Press ⟋ to return normal display state when finishing processing.

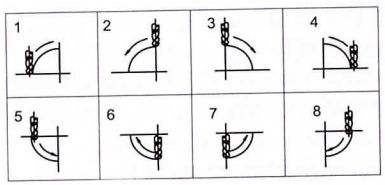
4.3 ARC Processing

This function is only for DRO of 2 axes, DRO of 3 axes.

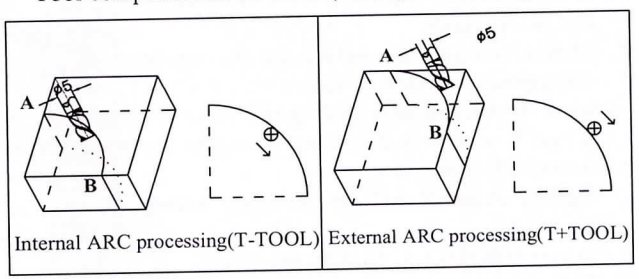
It is waste to using numerical control lathe to process arc in the simple product or small production. This function makes it convenient to process arc with normal lathe. Parameter "MAX CUT" is the arc length each process. The smaller the MAX CUT, the more smooth the arc plane and the longer processing time.

A. Process XZ, YZ plane

There are 8 modes as the following when processing arc in XZ or YZ plane:



Tool compensation direction(when process XY plane)



Internal ARC processing(T-TOOL) External ARC processing(T+TOOL)

Milling cutter may be flat-bottomed or arc-bottomed. If flat-bottomed, set the tool diameter as 0;

B. Process XY plane

DRO provides the above 8 modes in processing XY plane. The milling cutter is perpendicular to the machine plane. DRO has internal ARC processing and external ARC processing for each type:

External T +TOOL:

Internal T - TOOL.

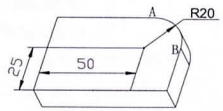
Set the tool radius according to the actual milling cutter when process XY plane.

Enter the following data for ARC processing:

TYPE 1 - 8	Mode of the ARC processing
T+TOOL / T-TOOL	Selection between T + TOOL / T - TOOL (This parameter is only for XY plane)
RADIUS	The radius of ARC that is to be processed
TOOL DIA	Tool diameter
MAX CUT	Feed step

Example 1:

Process an arc AB of 90° from point A to point B as the figure.



Parameters are as the following:

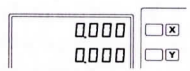
Machine plane	XY
ARC mode type	3
T + TOOL	
RADIUS	

20mm

TOOL DIA	5mm
MAX CUT	1mm

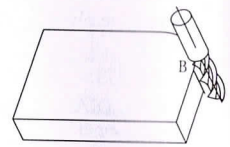
STEPS:

1. Set display unit is metric
2. Move the machine table until the lathe tool is aligned with point A, then zero X axis and Y axis;



3. Enter ARC processing state;
   Press [▷8] to enter ARC processing state.
   If all parameters have been set: press [ENT] to process directly.
4. Select machine plane;
   Press [X]→[ENT] to select XY.
   SIMP XY
   NOTE: [X] ***indicates XY plane;***
   [Y] ***indicates YZ plane;***
   [Z] ***indicates ZX plane;***
5. Select processing mode:
   Message window displays "TYPE 1-8", and Y window displays the former processing mode;
   TYPE 1-8
   Press [3]→[ENT] in turn to select mode 3,
   and then enter ARC type;
6. Select T + TOOL mode:
   Press [+]→[ENT] to select the external arc processing;
   T + TOOL
   NOTE:
   [+] ***indicates T + TOOL mode (external arc processing);***
   [−] ***indicates T – TOOL mode (internal arc processing);***
7. Set ARC radius
   Message window displays "RADIUS", and Y window displays the former arc radius;
   RADIUS
   Press [2]→[0]→[ENT] in turn to input the arc radius.
8. Set Tool diameter.
   Message window displays "TOOL DIA";
   TOOL DIA
   Y window displays the former preset diameter
   Press [5]→[ENT]in turn to enter the tool diameter.
9. Set the feed step.
   Message window displays "MAX CUT";
   MAX CUT
   Y window displays the former feed step.
   Press [1]→[ENT] in turn to input the feed step.

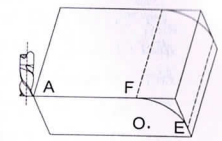
10. Process ARC
    Message window displays "POIN 1".
    Process when the "0.000" appears in X window and Y window. Then you have finished the first point. Press [▼] to switch to the second point and repeat the same step. Process in this way until the message window displays "POIN 74". Pressing [▲]or[▼] can select processing point.



10. Press [▷8] to exit ARC processing after machining is over.

Example 2:

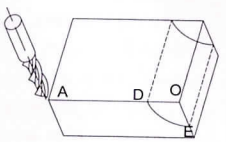
Process the ARC EF as the figure from point E to point F.
Parameters are set as following:



Machine plane:	XZ
TYPE:	4
RADIUS:	Actual radius of the arc
TOOL DIA:	0 (flat-bottomed tool)
MAX CUT:	preset as the costumer

Example 3:

Process the ARC DE as the figure from point D to point E. Parameters are as the following:



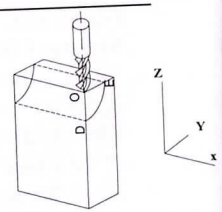
Machine plane:	XZ
TYPE:	6
RADIUS:	Actual radius of the arc
TOOL DIA:	Actual value (actual tool)
MAX CUT:	preset as the costumer

Example 4:

Process the ARC DE as the figure from point D to point E.

Parameters are as the following:

Machine plane:	YZ
TYPE:	7
RADIUS:	Actual radius of the arc
TOOL DIA:	Actual value (actual tool)
MAX CUT:	preset as the costumer



NOTE: ***For DRO of 2 axes, it is not installed with Z-axis, please press ▲or▼ to simulate position of Z-axis, ▲ simulate moving to the former process point, and ▼ simulate moving to the next process point.***

Steps:

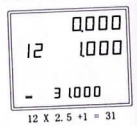
1: ***set "STEP MODE" as "Z STEP" in setup mode, and set Z-axis dial (default value is 2.5mm);***

2: ***Before machining, at first, align lathe with the beginning point Z of R, zero Z axis;***

3: ***In machining process, message window displays simulate height of Z axis, which indicates simulate height of Z axis while machining;***

As right figure, while machining XZ plane, X window display position of X axis, X axis is finished when displaying "0.000" in X window; In Y window, the former 2 number indicates number of dial, and the following 5 number indicates scale number of dial, which means that machining to this scale for current point.

While machining YZ plane, Y window display position of Y axis, and when this window displays "0.000", which indicates the machining is finished in Y direction; In X window, the former 2 number indicates number of dial, and the following 5 number indicates scale number of dial, which means that machining to this scale for current point.



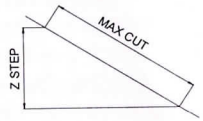
4.4 Slope Processing

Function: This function can calculate the position of every processing point automatically in processing slope. Only the following parameters need to be inputted:

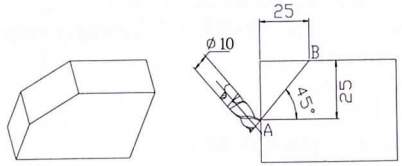
INCLE:	Set machine plane XY, YZ or XZ plane
INCL.ANG:	the inclination angle of the slope
MAX CUT:	the slope length each time processing

NOTE:

Z STEP and MAX.CUT are defined as the figure.



DRO will calculate the position of each processing on the slope automatically when all parameters have been input. Press ▲or▼ to select the processing point and process until "0.000" appears in the window.



Example 1:

Process the slope AB as the figure. The parameters are as ollowing:

INCLE:	XZ
INCL.ANG	45°
MAX.CUT	1mm

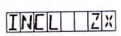
STEPS:

1. Set display unit to metric;
   Set the SLOP.MODE 1 in initial system settings.

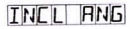
NOTE: ***If the third parameter isn't Z STEP, set the SLOP.MODE 0.***

Move the machine table until the lathe tool is aligned with the starting point A, then zero X axis and Z axis.

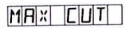
2. Press [↖] to enter slop processing
   Press [ENT] to start processing directly if all parameter have been set.
3. Select machine plane.
   Press [Z]→[ENT] in turn to select the ZX plane.
   NOTE: Press [X] indicates XY plane;
   Press [Y] indicates YZ plane;
   Press [Z] indicates ZX plane;



4. Enter INCL.ANG.
   Message window displays "INCL ANG"; Y window displays the former INCL.ANG.
   Press [4]→[5]→[ENT] in turn.



5. Enter MAX.CUT.
   Message window displays "MAX CUT"; Y window displays the former MAX.CUT.
   Press [1]→[ENT] in turn;



6. Processing
   Message window displays "POIN 1";
   Processes slop when the "0.000" appears; then press [▼] to process the next point.
7. Press [▲] or [▼] to select point.
8. Press [↖] to return normal display state after processing is over.

NOTE:

For DRO of 2 axes, it is not installed with Z-axis, please press [▲] or [▼] to simulate position of Z-axis, [▲] simulate moving to the former process point, and [▼] simulate moving to the next process point.

Steps:

1: Set Z axis dial in internal system setup;

2: Before machining, align the start point Z point with lathe, then set Z axis as "0.000";

3. While machining XZ plane, X window display position of X axis, X axis is finished when"0.000" appears in X window; In Y window, the former 2 number indicates number of dial, and the following 5 number indicates scale number of dial, which means that machining to this scale for current point.While machining YZ plane, Y window display position of Y axis, and when this window displays "0.000", which indicates the machining is finished in Y direction; In X window, the former 2 number indicates number of dial, and the following 5 number indicates scale
number of dial, which means that machining to this scale for current point.

Chapter 5 CALCULATOR FUNCTION

DRO provides arithmetic operation such as plus, minus, multiply and divide, which convenient for operator to processing work piece according to the drawing.

In normal display state: press [▦] to enter calculator function

In calculator state: press [▦] to exit calculator function

- **Calculating Example**

Example 1: 2+30×2-6/2= 59

[2]→[+]→[3]→[0]→[×]→[2]→[−]→[6]→[÷]→[2]→[=]

Example 2: 345 + 2 × $\sin^{-1}$(-0.5) = 285

[3]→[4]→[5]→[+]→[2]→[×]→[0]→[•]→[5]→[+/−]→[SDM SN]→[SIN]→[=]

NOTE:

1. ***Error would occur when calculating incorrectly, such as "0" is used as divisor or proceeding arcsine when absolute value is more than 1. In this case, the message window will display "ERR..." You can cancel this error message by pressing [CA] and input data again.***
2. ***The absolute value of inputted data and calculated result should be in the range of 0.000001 to 9999999, otherwise it can't be displayed.***

- **Transferring the Calculated Results**

In calculator state: Press the X-axis, Y-axis, Z-axis reset button to transfer the calculated result to X,Y,Z,axis, then the window will display this value.

In calculator state:Press [X]、[Y]、[Z]to transfer the display value in X,Y,Z,window to calculator.

Chapter 6 INITIAL SYSTEM

Function: Set various parameters according to actual operation.

SEL SYS	Setting the number of linear scale
DIRECT	Setting positive direction for counter
LIN COMP	Setting linear compensation
R OR D	Radius/Diameter Mode
Z DIAL	Setting Z axis Dial
RESOLUTE	Setting the resolution of scale
SDM DIR	Setting the input mode of SDM
SLOP.MODE	Setting the slope machining mode
STEP.MODE	Select the step mode in ARC processing
LATH.MODE	Setting the lathe mode
AXIS.TYPE	Setting the type of axis
ANGE.MODE	Select the angle display mode
ANGE.TYPE	Select the angle display type
ALL CLS	Clearing all customer setting and return default setting
EXIT	Exit setup

NOTE: what you have changed (except "ALL.CLS") would not been saved if you quit "SETUP" (initial system settings) without selecting "EXIT" item.

6.1 Enter/Exit Initial System Settings

Press [ENT] or [•] to enter initial system setting after DRO powers on in 1 second: then "SETUP" displays in message window. Press [▼] or [▲] to select the item you want to change.

If you want to quit initial settings: press [▼] or [▲] until "EXIT" appears in message window and press [ENT].

6.2 Setting the type of DRO（SEL SYS）

Because DROs (two axes or three axes DRO) share the same software and their functions have some differences. DRO type must be set before use. ALL CLS has no effect on type of DRO.

"2" means the DRO type is 2 axes;

"3" means the DRO type is 3 axes;

6.3 Setting Positive Direction for Counter

The counting direction of the scale is set by the erector, and the operator had better not change it.

Default: 0

6.4 Setting Linear Compensation (LIN COMP)

Definition

Linear error: There is always an error between actual measure value and standard value. If it is distributed around the scale travel linearly, the error is defined as linear error. For example, the scale valid length is 400mm.if the measure value is 400mm and the standard value is 400.040mm: There is a △L of 40μm. If 40μm is distributed around the scale linearly, there is a △L of 10μm when the scale travels 100mm; a △L of 20μm when the scale travels 200mm; a △L of 30μm when the scale travels 300mm.

Linear compensation: Compensate the linear error to make display value equals to standard value.

NOTE: ***The linear compensation is set by erector. Operator had better not change it, or the accuracy of linear scale will be worse.***

Default coefficient: 0

6.4.1 Manually compensate

The calculation of compensation coefficient:

$$\text{Coefficient} = \frac{(\text{measurement} - \text{standard value}) \times 1000\,000}{\text{standard value}}$$

Example:

Measurement 400.040mm

Standard value 400.000mm

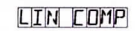
Compensation value (400.040 - 400.000) X 1000 000 / 400 = 100

Unit: μm/m;

Set linear error compensation: X axis is 100;

STEPS:

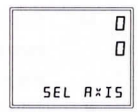
1. Enter "SETUP", then press [▼] or [▲] until message window displays "LIN COMP".



2. Press [ENT],

   X window, Y window, Z window displays the former linear error compensation coefficient separately.

   Message window displays "SEL AXIS" which indicates that the next step is to select axis.



3. Select axis

   Press [X] to select X axis.

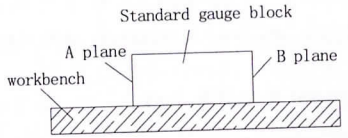
   Message window displays "ENTR.COMP", indicating it is waiting for a data to be inputted.

4. Press [1] [0] [0] [ENT] in turn;
5. Press [ENT] to confirm your setting and exit linear error compensation setup.

6.4.2 Automatic compensation

Operating steps (Take the X axis as example)

1. Touch-hold "X" button for 3 seconds, enter into the mode of X axis automatic compensation, the X axis blinks.
2. As shown in the figure, put the standard gauge blocks on top of the workbench, move X axis to align with the A plane, then zero the x-axis



3. Move X axis to align with the B plane, press the "ENT" key, deputy window will show "SET OK", then the linear compensation of X axis finished

NOTE:

- ***Standard gauge block must be integer times of 10 mm (for example: 10 mm, 20 mm, 30 mm...). If not, please manually compensate.***
- ***During automatic compensation, pressing the AC key can exit automatic compensation function, and the previous compensation value will not change.***
- ***INC and SDM coordinates cannot automatically compensate, inch system cannot automatically compensate, only under the ABS and metric system, can enter into automatic compensation function.***
- ***After compensation, values can be checked in internal parameter set.***

6.4.3 Encoder compensation

Under the condition of number axis types are encoder:

After the encoder rotating a circle, if the angle is not 360 °, but larger or smaller than 360 °, you will need to compensate the encoder.

Operating steps (Take the X axis as example)

1. After the encoder rotating a circle, got a value of 359.8°.
2. Directly input 359.8 °, compensation finished.

NOTE: Please refer to section 6.12 before setting encoder compensation value, set the number axis type into the right mode: the encoder

6.5 Toggle Between R/D Display Mode(R – D MODE)

In common case, the display value is the distance between lathe tools and the coordinate origin. This display mode is called MODE R. When process cylinder given diameter measurement, diameter is the double distance between lathe tool and coordinate datum. The DRO will display the diameter in MODE D

"0": mode R.
"1": mode D.

Default mode: mode R.

6.6 Setting Z axis Dial(Z DIAL)

Z axis Dial should be set if Z axis is emulated for DRO of 2axes and only install linear scale for X, Y axis.

Z axis Dial means the distance the Z axis travels when screw runs a revolution.

Default value: 2.5mm

6.7 Setting the Resolution of Scale(RESOLUTE)

Different scale has different resolution. DRO can connect with 10 kinds of scale, and these resolutions are 0.05μm, 0.1μm, 0.2μm, 0.5μm, 1μm, 2μm, 5μm, 10μm, 20μm, 50μm. The resolution must be set to match the linear scale. This parameter is set by erector,

operator had better not change it.

Default resolution: 5μm

Set the resolution of X axis as 1um.

STEPS:

1. Enter "SETUP" and press ▼ or ▲until "RESOLUTE" appears in message window; RESOLUTE
2. Press ENT X window displays the former resolution of each axis separately. Message window displays "SEL AXIS", which indicates the next step is to select axis.
3. Select axis.
   Press X to change the resolution of X axis, then data in X windows flashes.
4. Press ▼ or ▲to scroll through 0.05, 0.10, 0.20, 0.50, 1.00, 2.00, 5.00, 10.00, 20.00, 5 0.00. Press ENT to select "1.00" when it appears and return "SEL.RXIS" state. Press CA to cancel your selection.
5. Set the resolution of Y axis: Z axis by repeating step 3-4.
6. Press ENT to exit "RESOLUTE" setup.

6.8 Setting the Input Mode in SDM Coordinate (SDM DIR)

DRO provides two inputting data mode in SDM coordinate:

MODE 0 (Normal inputting mode):

the data the DRO accept equals the inputted data;

MODE 1 (Special inputting mode):

the data the DRO accept equals the negative of the inputted number.

Default mode: MODE 0.

6.9 Setting the Slope Machining Parameter (SLOP.MODE)

Parameter can be set in two ways in slope machining :

Set the step of second axis (Z STEP) in one plane: for XY plane,

setthe step of Y axis; for YZ plane and XZ plane set the step of Z axis.

MODE 1: MAX CUT;

MODE 0: Z STEP ,

Default setting: the step of the second axis (Z STEP).

6.10 Step Mode of ARC(STEP.MODE)

In ARC function, if the plane is not XY, you can setup the step mode. There are two modes. Mode 0 is Z STEP mode and Mode 1 is MAX CUT mode.

Default setting: Z STEP.

6.11 Setting Lathe Mode (LATH.MODE)

Lathe mode 0: Disable lathe function;

Lathe mode 1: X window display value = X + Y.

Lathe mode 2: X window display value =X + Z

Lathe mode 3: Y window display value =Y + Z

Default mode: disable lathe mode(mode 0).

6.12 Toggle between Linear Scale and Rotary Encoder (AXIS.TYPE)

Both linear scale and rotary encoder can be installed in any axis. The linear scale is used to measure distance; the rotary encoder is used to measure angle.

Default: linear scale.

Set rotary encoder in X axis.

STEPS:

1. Enter "SETUP" and press ▼ or ▲until the message window displays "AXIS.TYPE"; AXISTYPE
2. Press ENT:
   X, Y, Z window displays the former type.
   "LINEA" means linear scale.
   "ENCODE" means rotary encoder.

Message window displays "SEL AXIS", which means the next step is to select axis.

3. SetX axis are installed with rotary

Press [X] until display in X window is "ENCODE";

4. Press [ENT] to confirm your new set and exit.
   Press [CA] to cancel your new set and exit.

6.13 Angle Display Mode (ANGL.MODE)

DRO provides 3 angle display modes.
Mode 1, the angle is in the range of 0° to 360°;
Mode 2, the angle is in the range of -360° to 360°;
Mode 3, the angle is in the range of -180° to 180°.
Default mode: MODE 1.

6.14 Angle display type(ANGL.TYPE)

There are two angle display types for DRO.
TYPE 0: indicate angle display is DD.
TYPE 1: indicate angle display is DMS.
Default value: TYPE 0 ◦

6.15 Load default setup (ALL CLS)

Function: Clear all data except the linear compensation and DRO type. DRO will load default setup for all parameters.

STEPS:

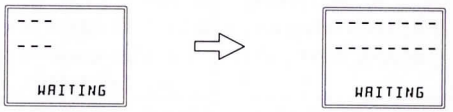
1. Enter "SETUP", then press [▼] or [▲] until the message window displays "ALL CLS";

2. Press [ENT] and message windows display "PASSWORD" indicating the operator to input password. At this moment, there are two selections:

   A Press [CA] to quit "ALL.CLS";
   B Enter the correct password to clear all parameters and load

default setup;

3. Input the password;
   Input the Correct password to load default value.
   The message window displays "WAITING", which means the clearing is going on.



4. Return normal display state after loading default setup is finished.

The default setup for all parameters is as following:

- Counting direction is mode 0;
- The R/D is mode R ;
- Z DIAL = 2.5mm;
- Resolution = 5μm;
- Input mode in SDM as 0, display value = input value;
- Lathe function is disabled;
- Slope machining parameter is Z step;
- Linear scale is installed for any axis;
- Angle display mode is mode 1: 0~360;
- Angle display type is 0: DD;
- ARC machining parameter is Z step.

Chapter 7 TROUBLE SHOOTING

The following are the easy solvent for troubleshooting. If they can not work: please contact with distributor for more service.

Trouble	Possible Reason	Solvent
No display	A:The DRO isn't powered. B:AC power voltage is not in the range of 100V to 240V.	A:Check the fuse is OK or not. B:Check the socket is loose. C:Check the input power voltage is in the range of 100V to 240V.
Cover is charged	A:Poor grounding is float B:Leakage of electricity	Check the lathe and DRO are well grounded.
Display value is doubled	A:Improper resolution B:Display mode D	A :Set proper resolution. B: Set display mode R.
No counting	A:Poor contact of scale B:No scale signal output C:Useless of counting function	Exchange scale and check again.
Display value is in disorder	Memory is disorder	A:Clear system. B: Check compensation is proper.
Erroneous counting	A:Poor precision of lathe B:Too fast run speed of the lathe C:Proper scale precision D:Improper resolution is set E:Improper linear error compensation F:Useless of scale	A: Repair lathe. B: Reduce the move speed of scale. C :Reinstall scale. D: Set proper resolution. E: Set proper linear error compensation. F: Repair or exchange linear scale.