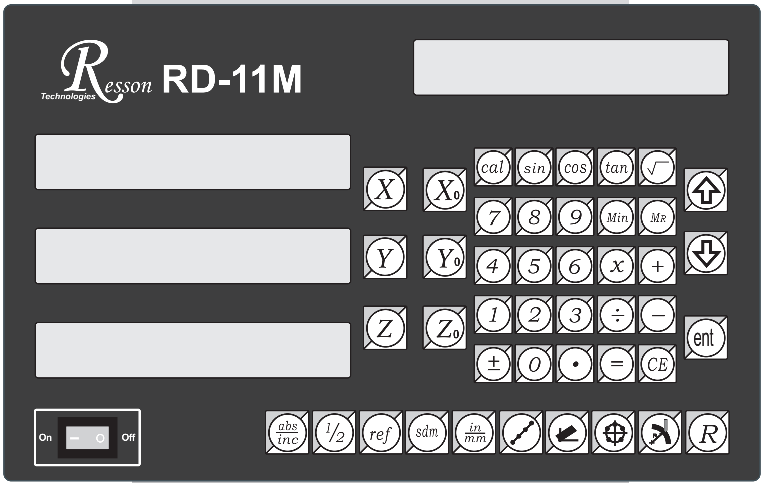
Technologies

*The People that Always Committed to Quality, Technology & Innovation*




# RD-11M

## Digital Readout System
## Operation Manual
## (Multi-function)

**Resson Technologies Co., Ltd.**

# Precautions

For your protection, please read these safety instructions completely before operating the appliance.

- Selection of mains voltage
  The Digital readout unit is supplied for 100V～230V, 50Hz/60Hz, 20W max operation.
  Instructions prior to activation of unit
  1. Please ensure that the voltage rating corresponds to the mains supply prior to activation.
  2. If this unit is to be operayed via an autotransformer from mains supply of higher voltage, it must be ensured that the low end of the transformer is connected to the neutral wire of mains.

- The mains connector may only be inserted into a socket with earthing contact. The protective effect should not be cancelled by an extension lead without an earthed conductor.
  Any interruption of the earthed conductor either inside or outside of the unit or disconnection of the earthed conductor can render the equipment potentially dangerous.
  Any intentional break is not permissible.

- Please install the Linear Encoder finish after that switch on the Digital Readout Unit. If switches on Digital Readout Unit before install the Linear Encoder not finished yet. This may cause electronic parts burnt away of the Linear Encoder.

- Do not use the instrument in an extremely hot or humid place.

- Do not use the instrument near strong magnetic or magnetic field noise place. This is the main reason that causes instrument error working.

- Wipe the Digital readout unit surface with a soft cloth to remove fingerprints, dust, etc.

- Clean the Digital readout unit surface with a soft cloth slightly moistened with Neutral purger to remove serious dirt.

- Do not use the organic solvent products such as oil, diesel fuel, kerosene, alcohol,etc clean the Digital readout unit.

- Do not use the Air guns fanned Digital readout unit and Linear Encoder accessories to let grease, dust or bits get into the Digital readout unit. This may cause the system working unstable and malfunction.

## RD-11M Specification :

Number of axes : 2、3

Reslution : 0.005mm

Display function : 8位 LED 發光管

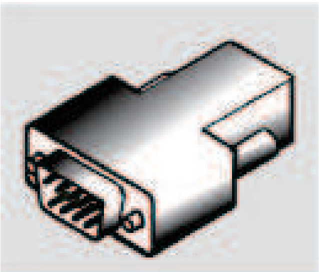
Response speed : 60m (198.6feet)/min

Quantizing error : ±1 count

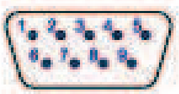
Power source : AC100V～230V / 50～60Hz / 20VA

Temperature fange : Service:0～40℃ / Storage:-20～70℃

## Linear Encoter (Scales) Electrical connector :

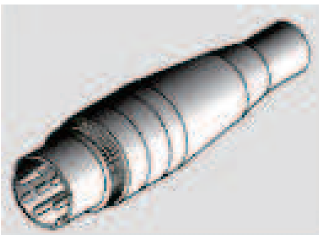


D-sub 9 pins connector

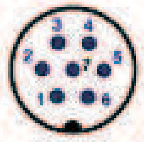


| PIN | SIGNALS |
|---|---|
| 1 | N/C |
| 2 | 0V |
| 3 | N/C |
| 4 | Inner shield |
| 5 | N/C |
| 6 | A |
| 7 | 5V |
| 8 | B |
| 9 | R |

N/C : No Connection



DIN 7 pins connector

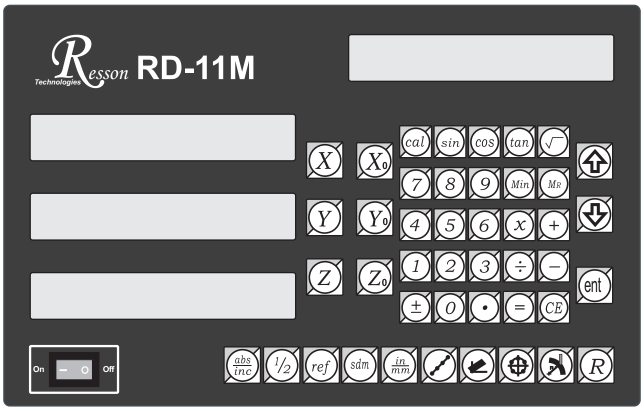


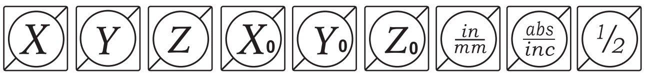
| PIN | SIGNALS |
|---|---|
| 1 | 0V |
| 2 | N/C |
| 3 | A |
| 4 | B |
| 5 | 5V |
| 6 | R |
| 7 | Inner shield |

N/C : No Connection

# Content

# Basic Functions

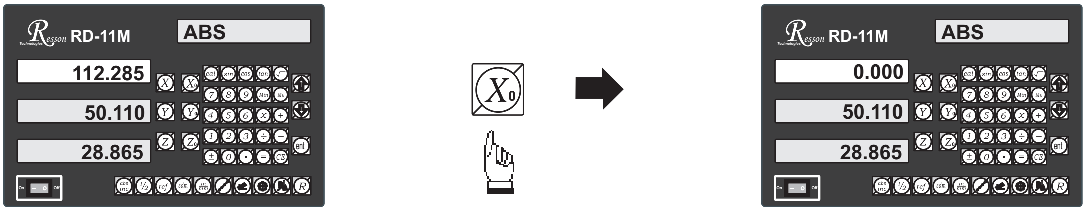


## Set Display to Zero

**Purpose :** Set the current position for that axis to zero

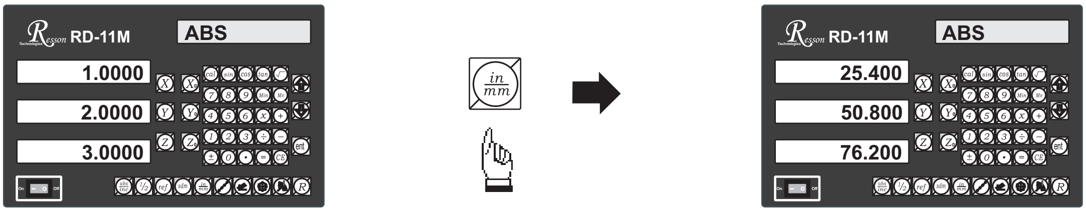
**Example :** To set the current **X Axis** position to **zero**



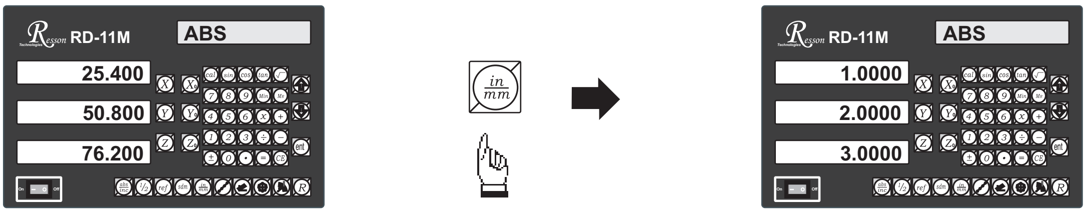

## Inch / Metric Display Conversion

**Purpose :** Switches between inch and metric display

**Example 1 :** Currently in **inch** display, to switch to **metric** display



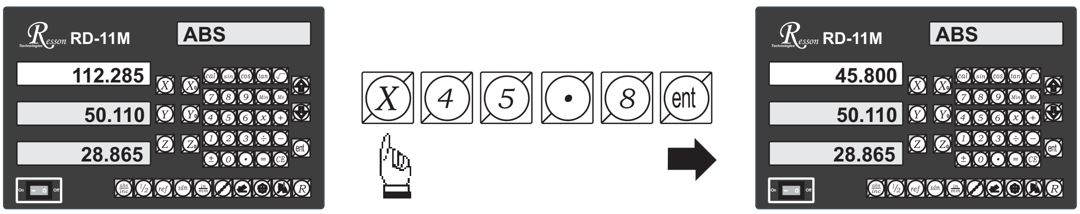

**Example 2 :** Currently in **metric** display, to switch to **inch** display




## Enter Dimensions

**Purpose :** Set the current position for that axis to an entered Dimension

**Example :** To set the current **X Axis** position to **45.800 mm**



# ABS / INC  Coordinates display switches

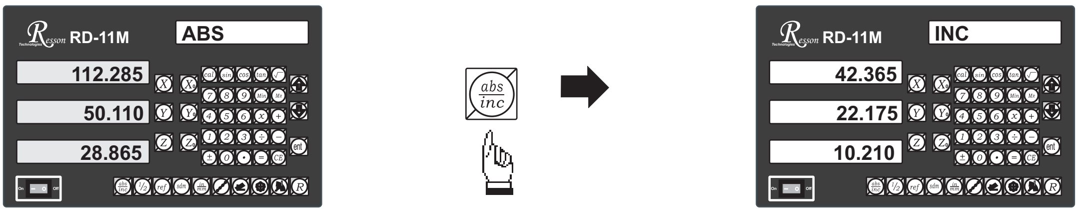
**Purpose :** **RD-11M** provides two sets of basic coordinate display, they are **ABS** (absolute) and **INC** (incremental) displays.

During machining operations, the operator can *store the work piece datum ( zero position ) in **ABS** coordinate, then switch to **INC** coordinate to continue machining operations.*

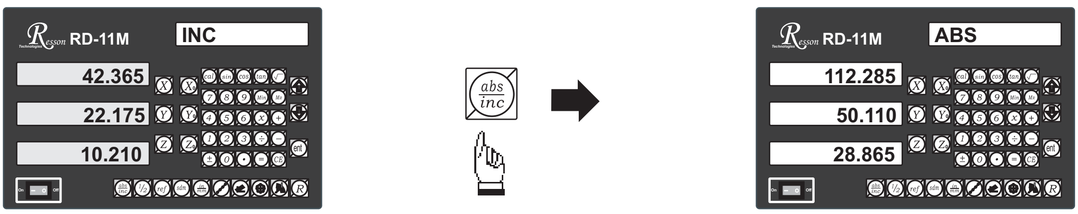
The operator is then free to zero the axes or preset any dimensions into any axis in **INC** coordinate for relative position machining. The work piece datum ( work piece zero position ) is still retained in **ABS** coordinate by the **RD-11M**.

Operator can then toggle between **ABS** (absolute) and **INC** (incremental) coordinates without losing the work piece datum ( work piece zero position ).

**Example 1 :** Currently in **ABS** display coordinate, to switch to **INC** display coordinate




**Example 2 :** Currently in **INC** display coordinate, to switch to **ABS** display coordinate

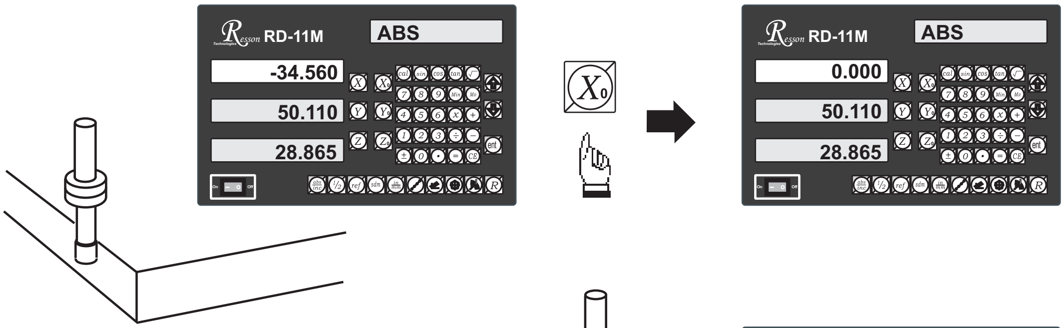


## Centre-find

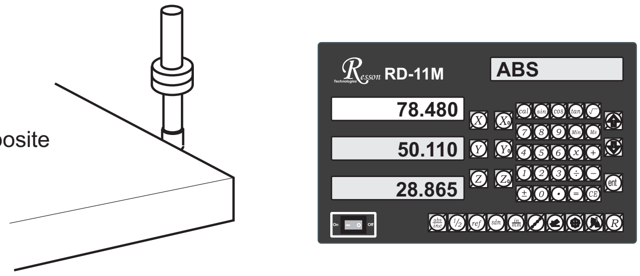
**Purpose :** **RD-11M** provides the centre-find function by halving the current display coordinate, so that the zero point of the work piece is located at the centre of the work piece.

**Example :** To set the X Axis zero point at the centre of the work piece.

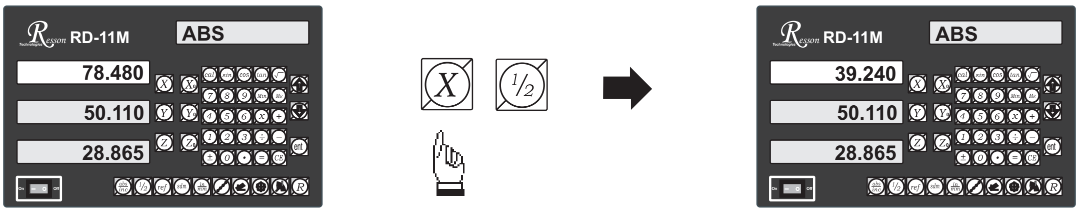
**Step 1 :** Locate the edge finder at one end of the work piece, then zero the X Axis.



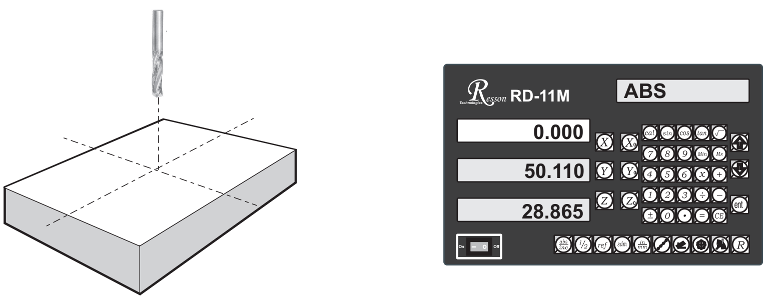

**Step 2 :** Locate the edge finder at the opposite end of the work piece.



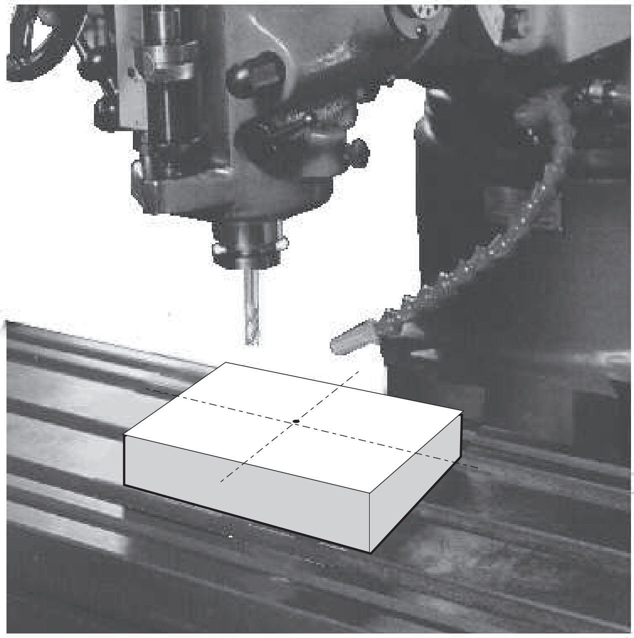

**Step 3 :** Then half the display coordinate using centre-find function as per follows:




Now the X Axis zero point ( 0.000 ) is located at the X centre of the work piece.



# ***ref*** datum memory



**function :** During the daily machining process, it is very common that the machining cannot be completed within one working shift, and hence the DRO has to be switched off, or less commonly, a power failure occurs whilst machining which leads to loss of the work piece datum ( work piece zero position ). The re-establishment of work piece datum using edge finder or other method inevitably introduces machining inaccuracies, because it is not possible to re-establish the work piece datum exactly at the previous position.

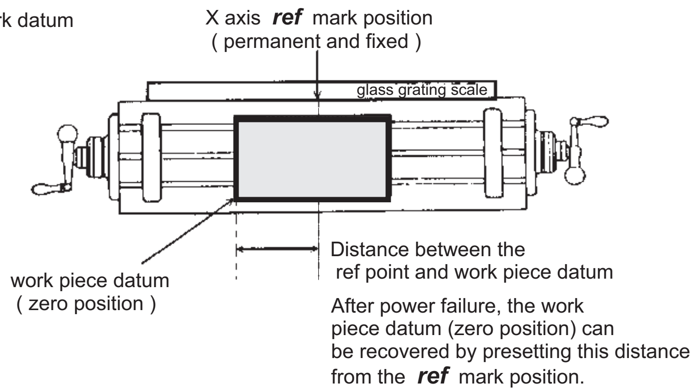
To allow the recovery of work piece datum very accurately, with no need to re-establish the work piece datum using an edge finder or other methods, every transducer has a reference point location to provide a datum point memory function.

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

- **There are a permanent and fixed mark (position) on the transducer, normally called *ref* mark or *ref* point..**

**Since this *ref* point position is permanent and fixed, it will never change or disappear when the DRO system is switched off. Therefore, we simply need to store the distance between the *ref* point and the work piece datum ( zero position ) in DRO's memory. Then, in case of the power failure or the RD-11M being switched off, we can recover the work piece datum ( zero position ) by presetting the display zero position as the stored distance from the *ref* point.**

**Example :** to store the X axis work datum




**Operation :** **RD-11M** provides one of the most easy-to-use ***ref*** datum memory function.

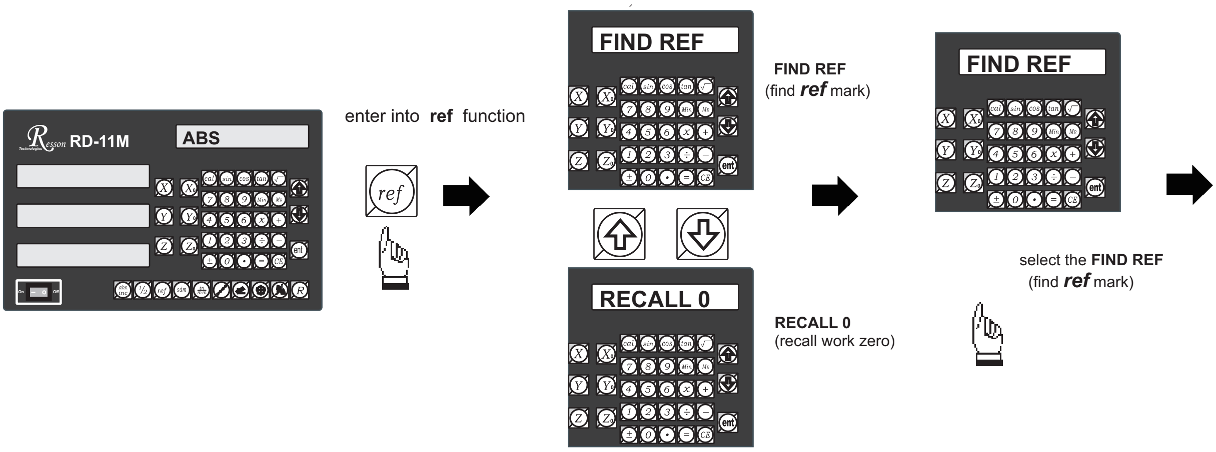
There is no need to store the relative distance between the ***ref*** mark and your work datum zero into the **RD-11M**, *whenever you alter the zero position of **ABS** coordinate, such as by zeroing, centre find, coordinate preset or etc.., **RD-11M** will automatically store the relative distance between **ABS** zero and the **ref** mark location into **RD-11M**'s memory.*

In daily operation, operator simply needs to locate the ***ref*** mark position whenever they switch on the **RD-11M** to let it know where the ***ref*** mark position is, then **RD-11M** will automatically do the work datum storage on its' own . In the case of a power failure or the **RD-11M** being switched off, the operator can recover the work piece datum easily by using the **RECALL 0** procedure.

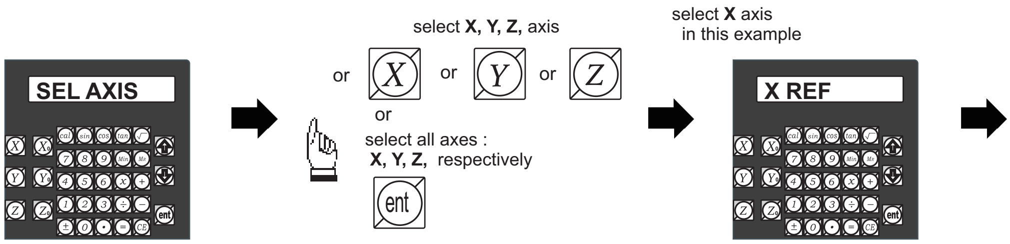
**function :** In ref datum memory function, the **RD-11M** will automatically store the relative distance between the ***ref*** mark position and the work piece datum ( zero position ) whenever the operator alter the **ABS** zero position, such as zeroing, centre find, co-ordinate preset or etc...

Therefore, the **RD-11M** needs to store the ***ref*** mark position prior to any machining operation. So that the loss of the work piece datum ( zero position ) is avoided during any accidential or unexpected events, such as power failure or etc.. it is recommend that the operator finds the ref mark position using the ( **FIND REF** ) function whenever he switches on the **RD-11M**.

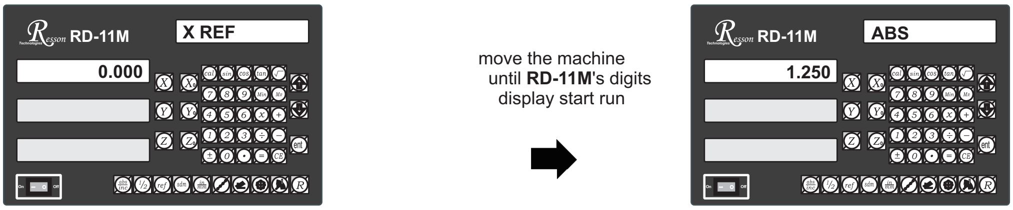
**step 1 :** To enter the ref function, select the **FIND REF** ( find ***ref*** mark )

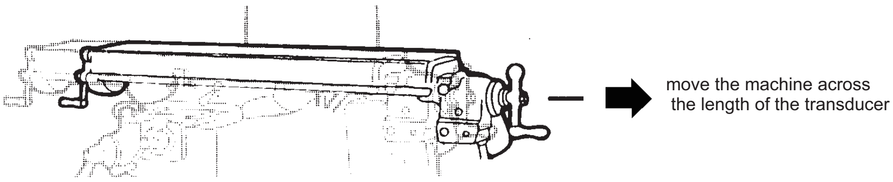



**step 2 :** select the axis of which ***ref*** mark needs to be found



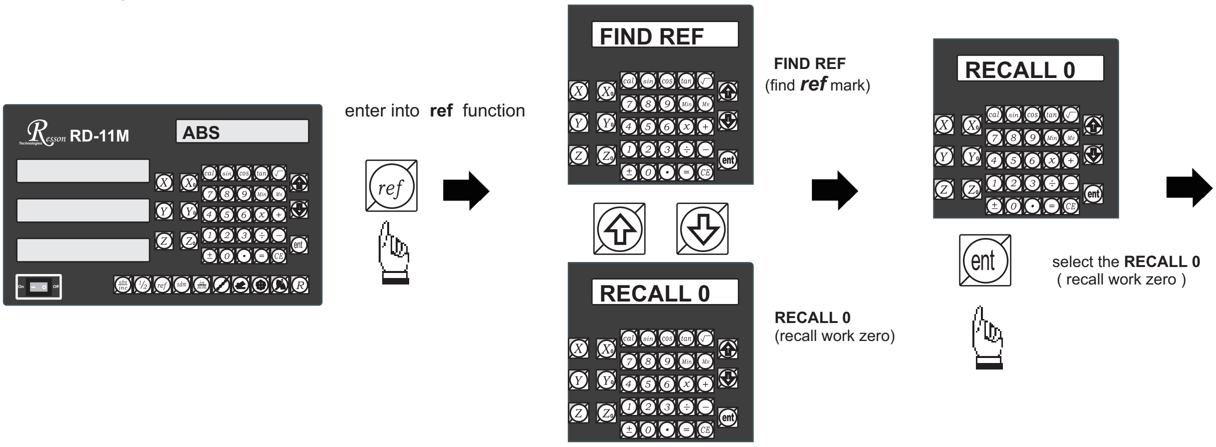

**step 3 :** move the machine reader head across the length of the transducer until digits display in **RD-11M** start to count.



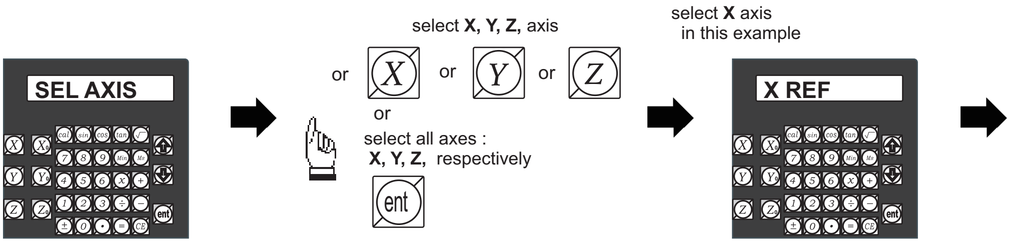



**function :** If the ref point is lost for any reason, the work piece datum can be recovered by **RECALL 0** function as follows:.

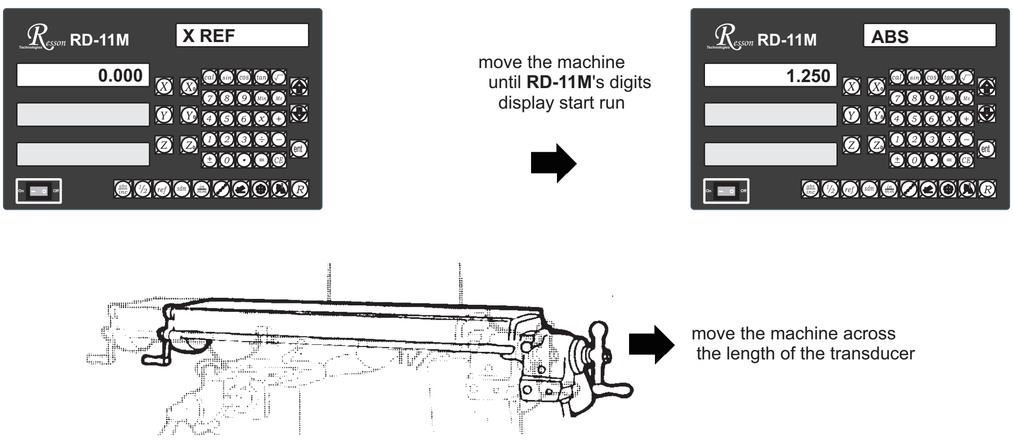
**step 1 :** enter into the **ref** function, select the **RECALL 0** ( recall work piece zero )



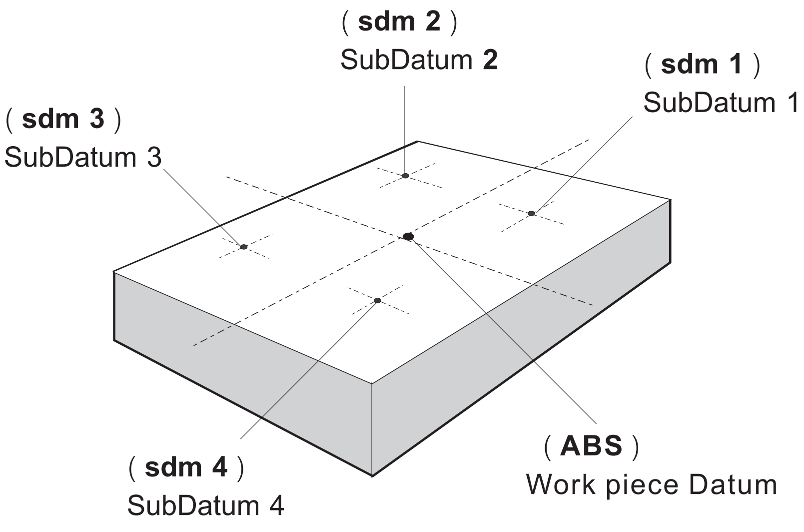

**step 2 :** select the axis of which work datum (zero position) needed to be recovered




**step 3 :** move the machine across the length of the transducer until the **RD-11M** display starts to count, then the work piece datum is recovered



# 199 SubDatum Function



# 199 SubDatum function

**Purpose :** Most **DRO** cabinet on the market provide just two set of work co-ordinates - **ABS/INC**. It was found that **ABS/INC** was inadequate and inconvenient to use, and, particularly in the case of complex machining or repetitive work, which needed more than just two sets of working co-ordinates.

**ABS / INC** operation has the following shortfalls :

- In much machining work, the work-piece machining dimensions are derived from more than two datums, therefore, the operator has to switch between **ABS** and **INC** to set up the machining datums time after time. This process is very time consuming and prone to error.

- In the case of batch machining of repetitive work, the operator has to set up and calculate all the machining positions time after time.

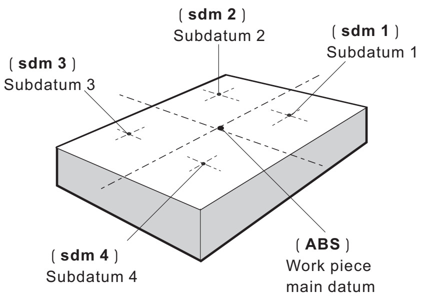
**RD-11M** provides a **199** subdatum ( **sdm** ) memory to cope with the shortfalls of **ABS/INC**. **SdM** function does not just simply provide **199** sets of **INC** co-ordinates, it is specially designed to provide much more convenient features for the operator to cope with repetitive work.
The difference between **INC** and **SdM** is as follows:.

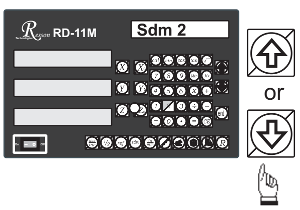
1. **INC** is independent of **ABS** and will not follow any change in **ABS** zero point. All **sdm** co-ordinates are relative to the **ABS** coordinates, so, all **SDM** positions will move together when the **ABS** zero position changes.

2. All **SdM** relative distance data to **ABS** can be entered directly into **RD-11M** memory using the keypad. No need for any additional calculations.

**SdM application in a work piece that has more that one datum.**

Operator can store all the work subdatums in RD-11M's memory as per follows.



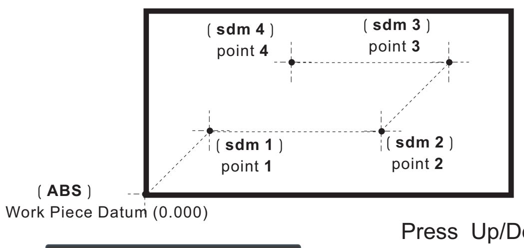

Operator then can switch between the subdatums directly by pressing key

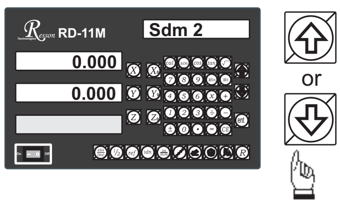
No need to refer back to ABS coordinate and set up the subdatums from their relative distance from ABS point

**SdM application on the repetitive batch machining of parts**

Because all sdm subdatums (0.000) are relative to ABS zero, so, for any repeative work, the operator just needs to set up the first work piece zero at ABS and store the machining position in subdatum zero.

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




Press Up/Down key to go to machining points

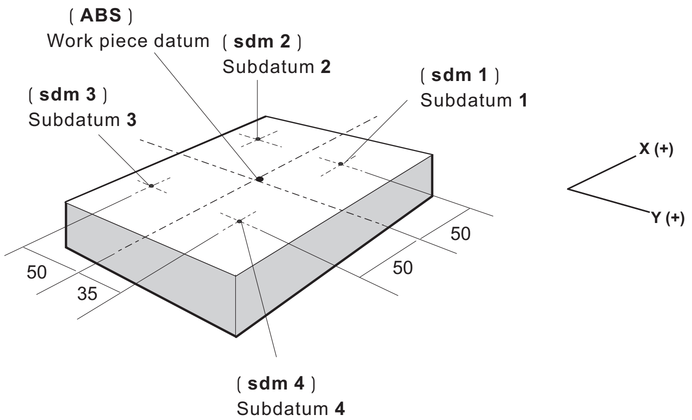
move the machine to display = 0.000, then machining location reached

# 199 SubDatum function

**Application example:**

To set up four subdatum zero ( **SdM 1** to **SdM 4** ) the following two methods can be used

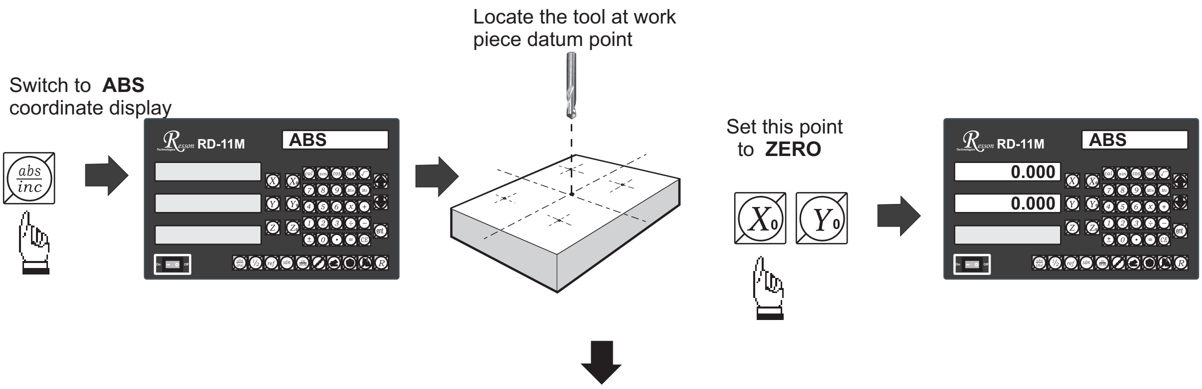
Either 1. Move machine to required subdatum position, then zero **SdM** display coordinates
Or 2. Directly key in the **sdm** zero position co-ordinates ( co-ordinate relative to **ABS** zero )



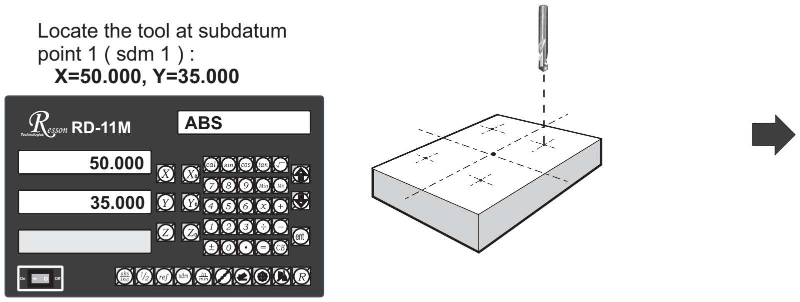

## Method 1 : Move machine to required subdatum position, then zero SdM display coordinate

Set up the work piece datum in **ABS** co-ordinate, move the machine to the required subdatum position, then zero **SdM** display co-ordinate.

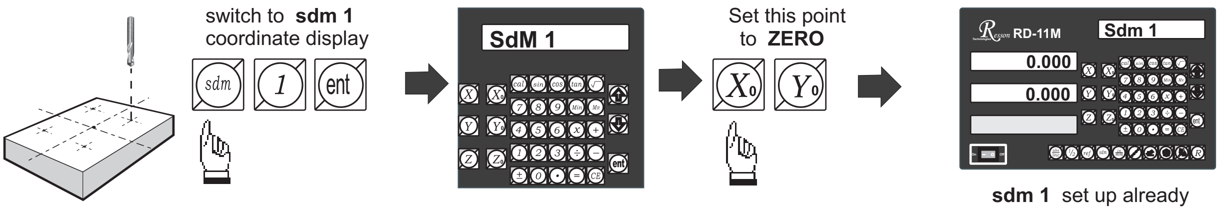
**Step 1 :** Set up the work piece datum in **ABS** co-ordinate



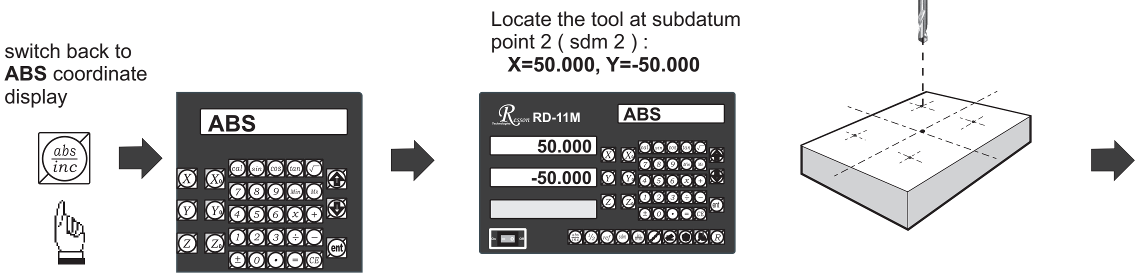

**Step 2 :** Set up the subdatum point **1** ( **sdm1** )

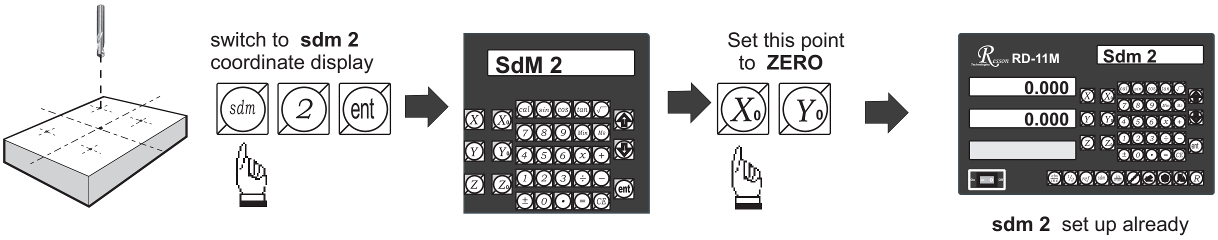


# 199 SubDatum function

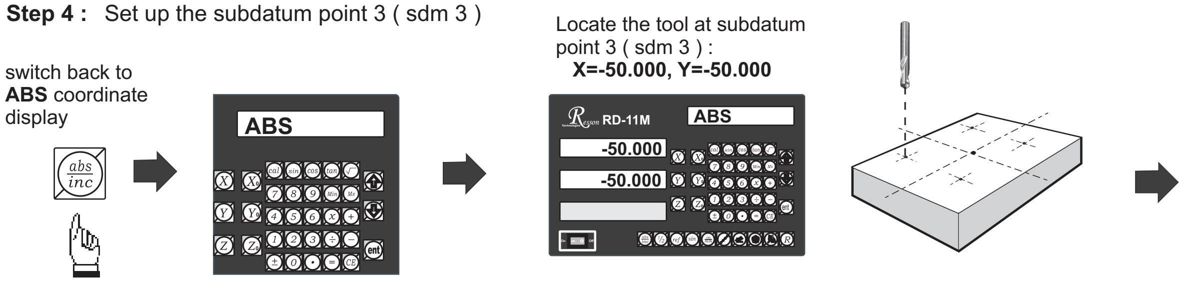


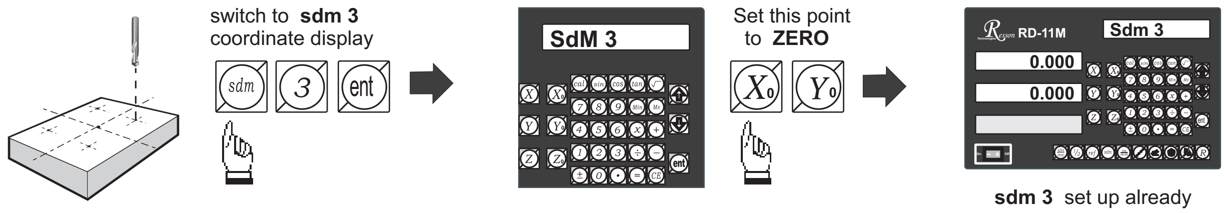

**Step 3 :** Set up the subdatum point 2 ( sdm 2 )



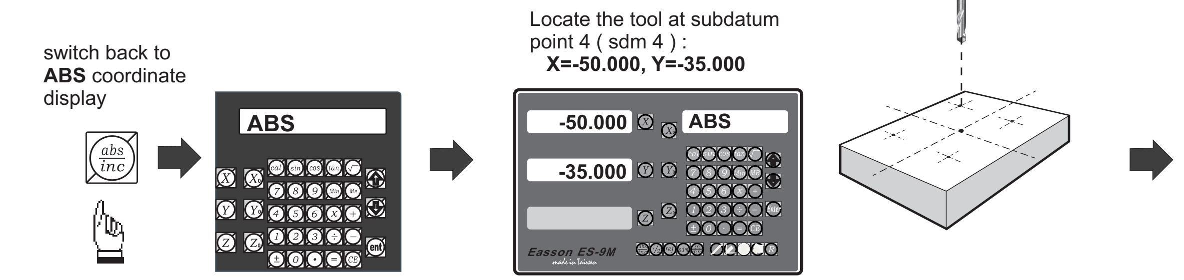



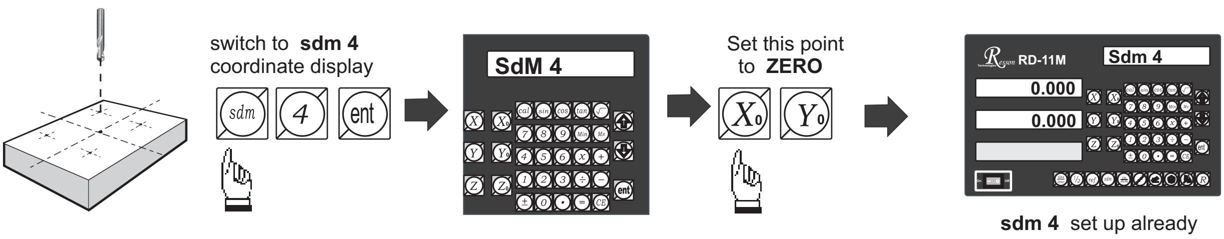

**Step 4 :** Set up the subdatum point 3 ( sdm 3 )






**Step 5 :** Set up the subdatum point 4 ( sdm 4 )

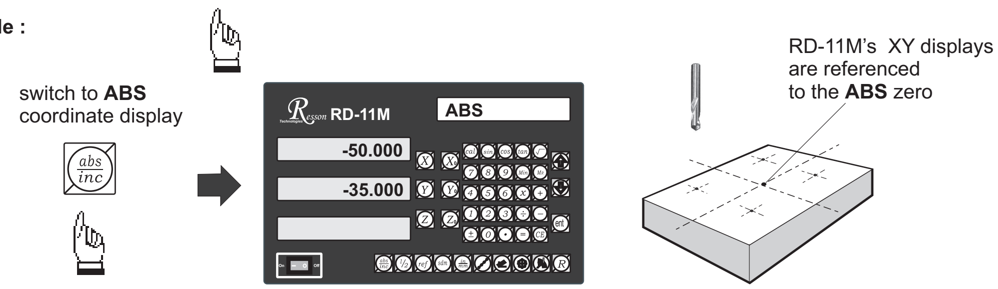



## All the four subdatum points have already been set up

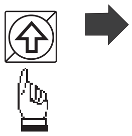
Operator can ⇧ or ⇩ to directly switch to the required subdatum ( **sdm** ) coordinate

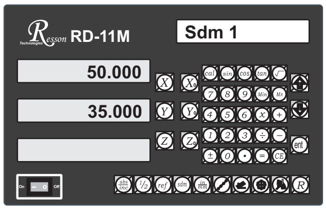
**Example :**

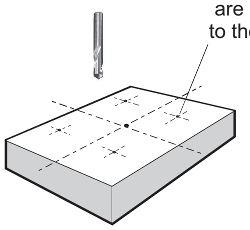


# 199 SubDatum function

switch to next ( **up** )
**sdm** coordinate display

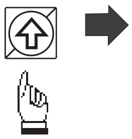


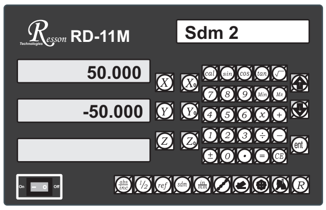


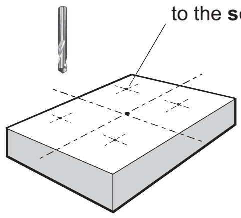



RD-11M's XY displays are referenced to the **sdm 1** zero

switch to next ( **up** )
**sdm** coordinate display

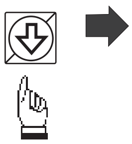


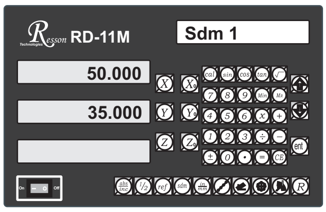


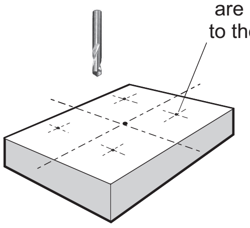



RD-11M's XY displays are referenced to the **sdm 2** zero

switch to previous ( **down** )
**sdm** coordinate display





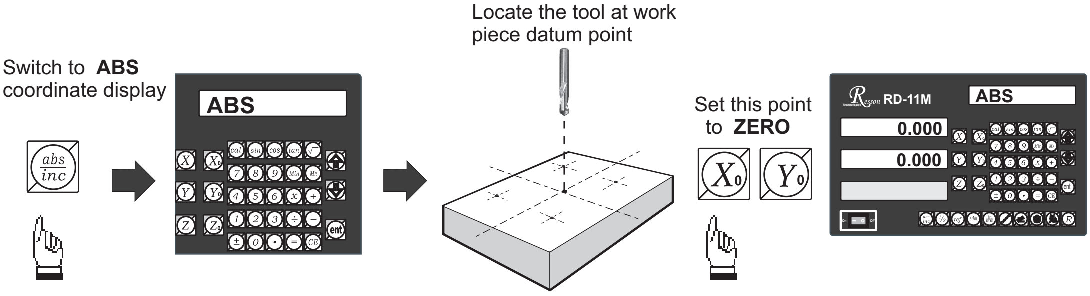
RD-11M's XY displays are referenced to the **sdm 1** zero

In a case where many subdatum ( sdm ) points need to be set up,the operator will find that the method of **direct keying in the of SdM zero position co-ordinates ( co-ordinate relative to ABS zero )** is much quicker and less prone to error.

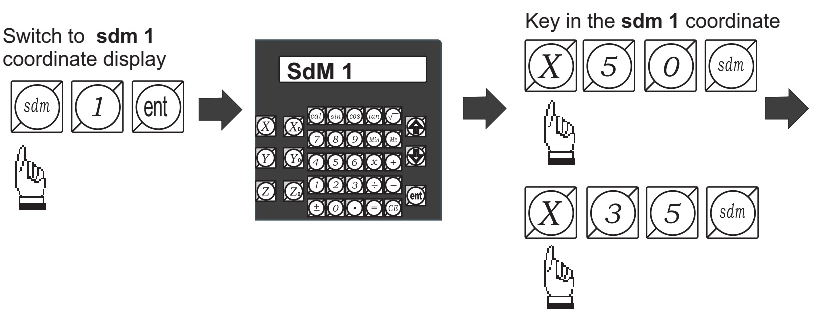
## Mtheod 2 : Direct keying in the of SdM zero position co-ordinate ( co-ordinate relative to ABS zero )

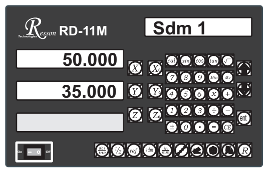
Set up the work piece datum ( ZERO) at ABS co-ordinate, then move the tool located at the work piece datum ( ABS zero point )and directly key in all subdatum point co-ordinates ( the relative position to ABS zero ) using the keypad.

**Step 1 :** Set up the work piece datum in ABS coordinate




**Step 2 :** Set up the subdatum point 1 ( sdm 1 )



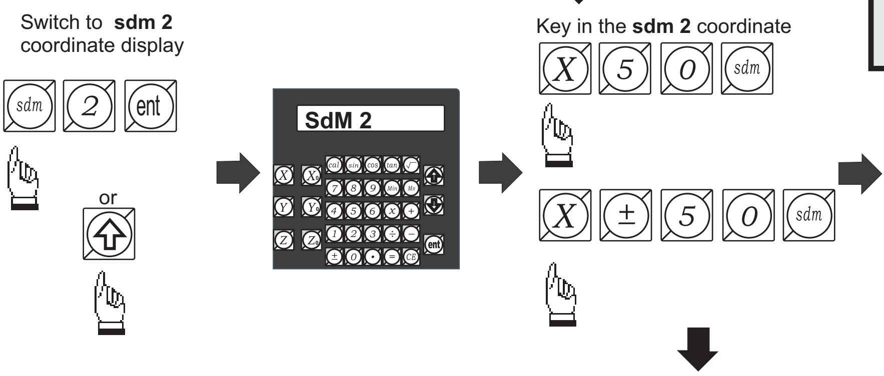



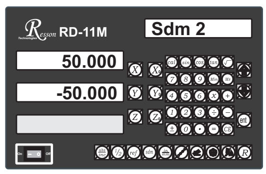

**NOTICE :**

When you enter the sdm co-ordinate into the RD-11M, the co-ordinates displayed will indicate a **negative sign.**

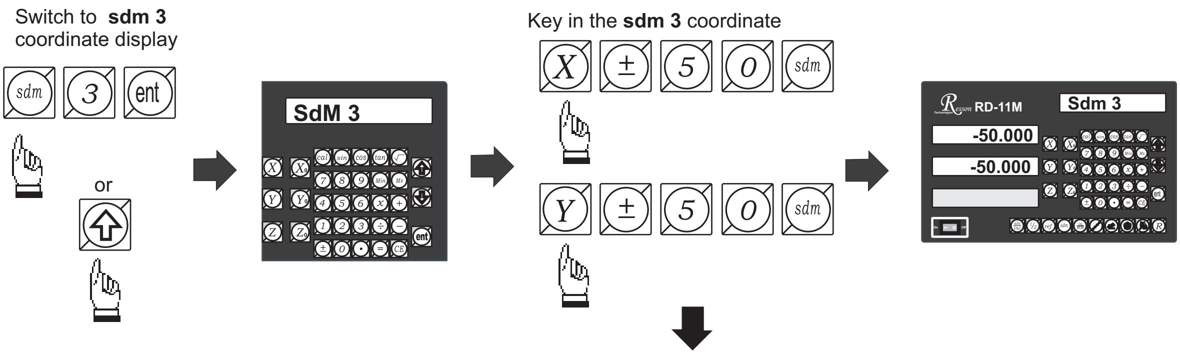
This is correct because your tool is now located at zero position at ABS coordinate. If you calculate from the sdm co-ordinates, the tool is at a negative value.

**Step 3 :** Set up the subdatum point 2 ( sdm 2 )

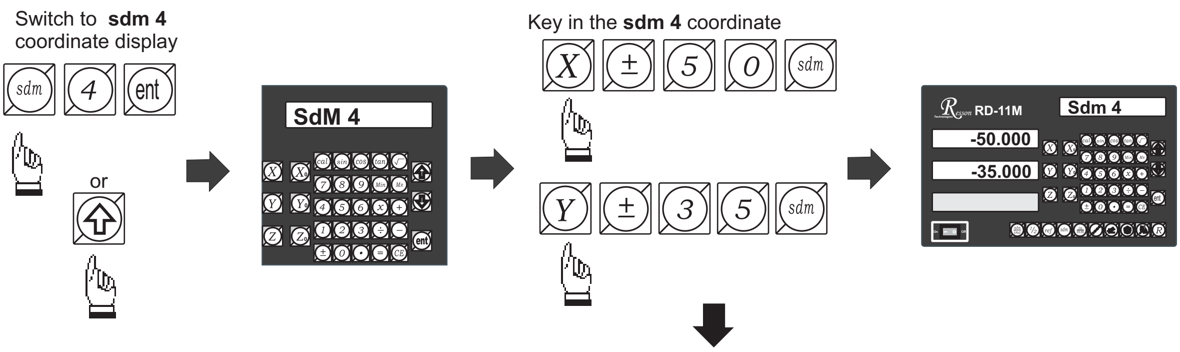


**Step 4 :** Set up the subdatum point 3 ( sdm 3 )

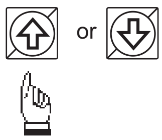



**Step 5 :** Set up the subdatum point 4 ( sdm 4 )

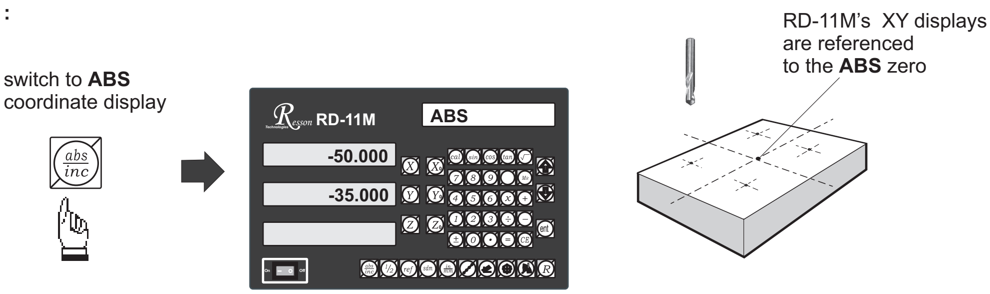



## All the four subdatum points have already been set up

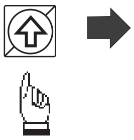
Operator can or to directly switch to the required subdatum ( **sdm** ) coordinate

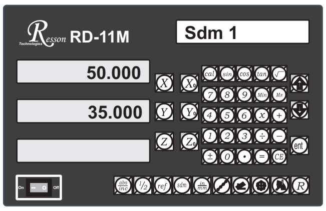


**Example :**

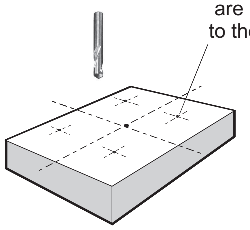


switch to next ( **up** )
**sdm** coordinate display

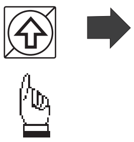


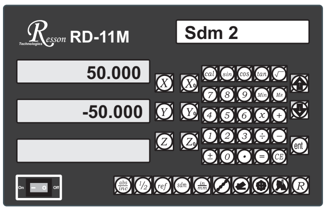



RD-11M's XY displays are referenced to the **sdm 1** zero

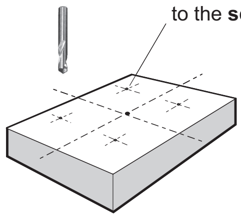


switch to next ( **up** )
**sdm** coordinate display

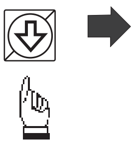


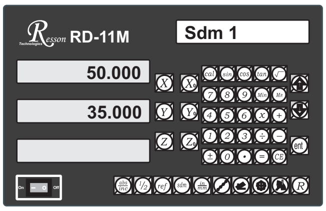



RD-11M's XY displays are referenced to the **sdm 2** zero

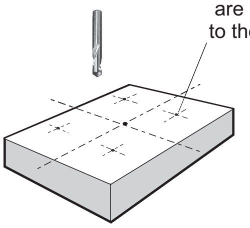


switch to previous ( **down** )
**sdm** coordinate display

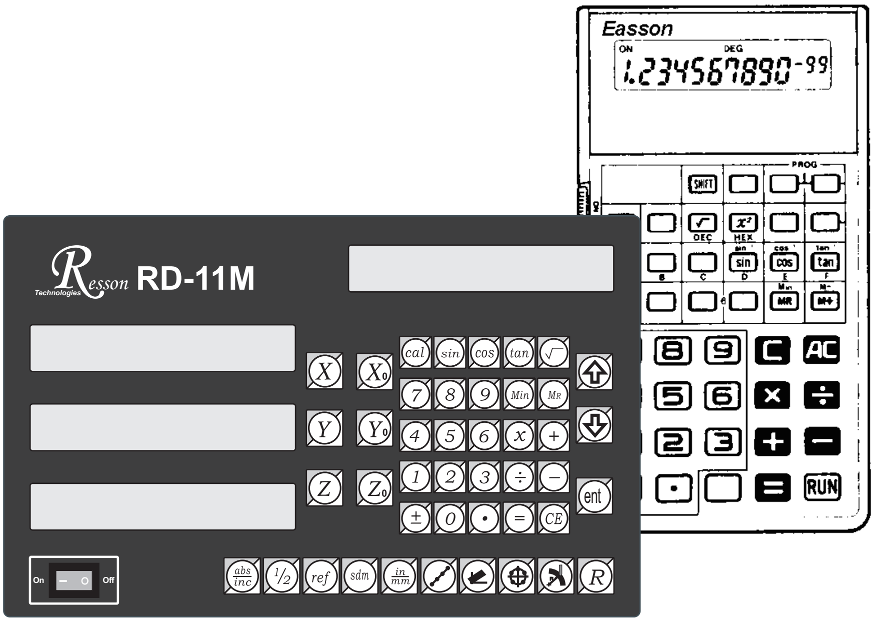





RD-11M's XY displays are referenced to the **sdm 1** zero



# Built- in  Calculator



# Built in Calculator

**Function :** A calculator is used frequently during a manual machining process..

***RD-11M is the first DRO that has a built-in calculator***

The built-in calculator of the RD-11M not only provides normal mathematical calculations such as add, substract, multiply & divide, it also provides useful trigonometric calculations that are frequently required during a machining process such as **SIN, COS, TAN, SQRT** and also ***inv*** **SIN,** ***inv*** **COS,** ***inv*** **TAN, SQUARE...**

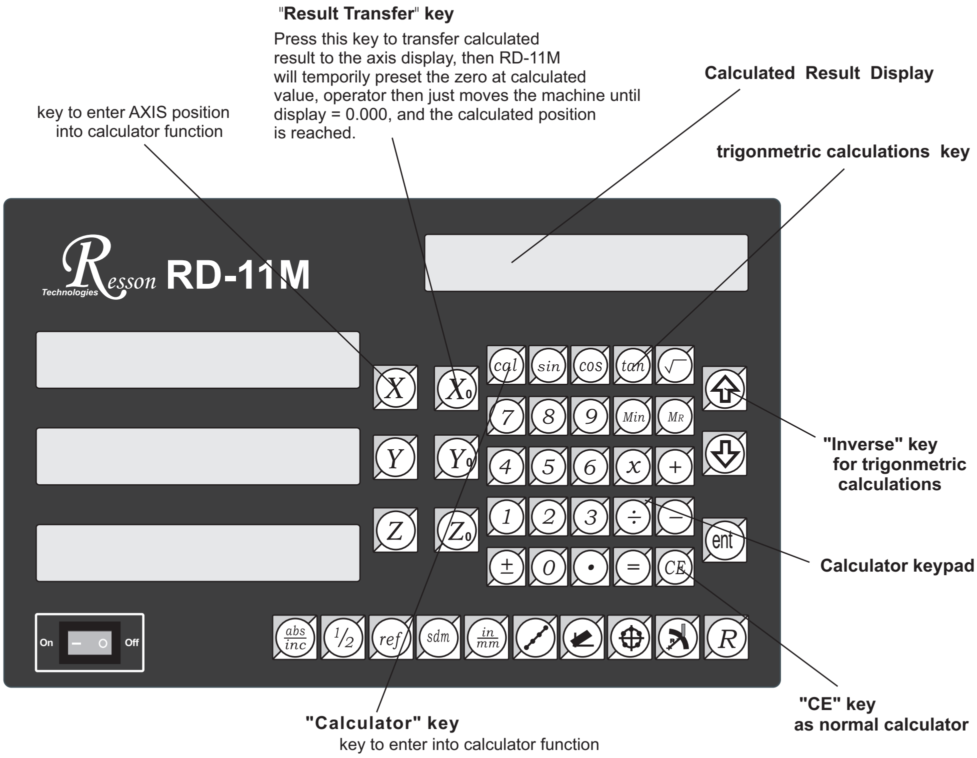
In addition a major feature of the calculator of the RD-11M is "***Result Transfer***", in that all calculated results from the calculator of RD-11M can be "transferred" to any axis to enable you to position the tool. After the result has been transferred to an axis, the RD-11M will ***temporarily*** preset the zero position at the calculated value, enabling the operator to simply move the machine back to axis display = 0.000, leaving the tool positioned at the calculated coordinate .

The built-in calculator offers the following advantages :

1. Operations are the same as commerically availiable calculators and it is easy to use ;

2. The calculated result can be directly transfered to any axis, eliminating the need to make notes of a calculation on paper, thus saving time and avoiding errors;

3. No unnecessary down-time in finding or sharing calculators whenever you need one to make calculations.

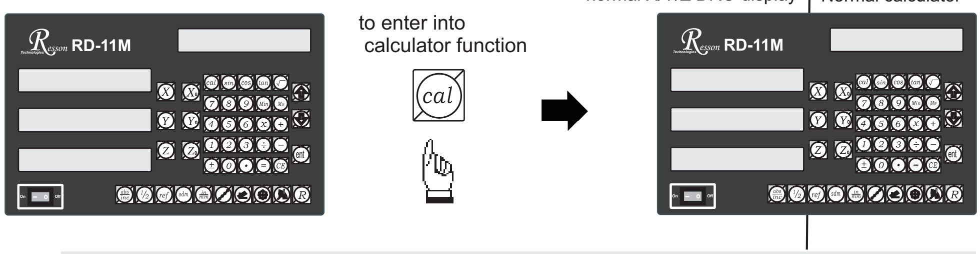



***Key layout of the built-in calculator***

Example :

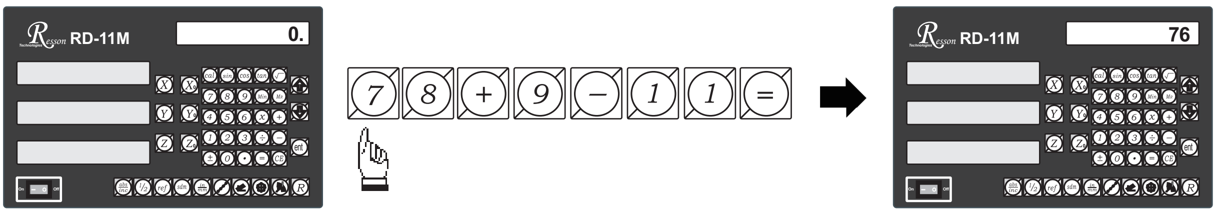
**Working principle of RD-11M's calculator function**
when the RD-11M is put in calculator mode, the operation of RD-11M actually divided into two parts as follows

normal X/Y/Z DRO display | Normal calculator

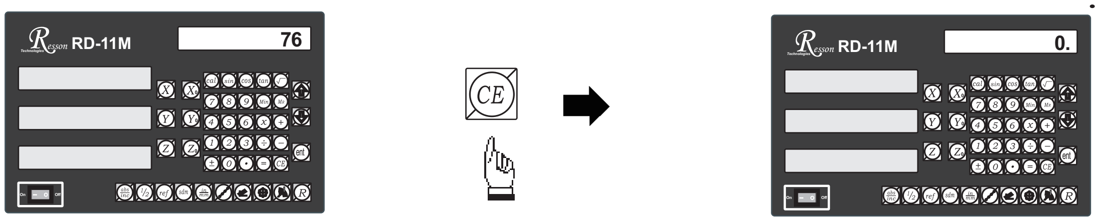



**The operations of RD-11M's built-in calculator is the same as other ordinary calculators**

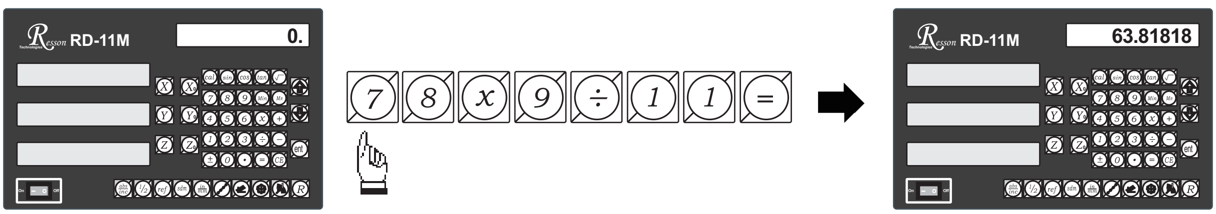
**i.e.** Basic mathematics **- add ; substract :** 78 + 9 - 11 = 76



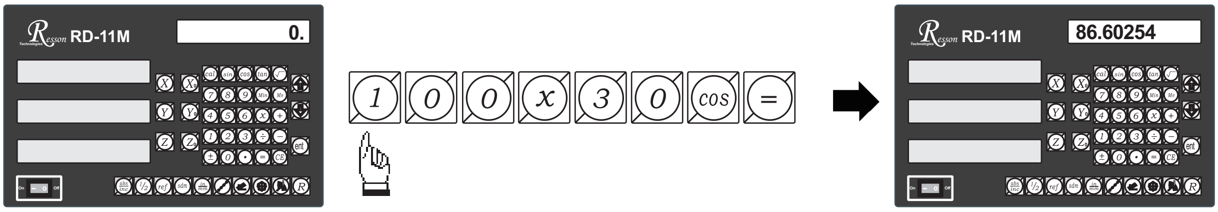

**Clear - Restart the calculation**



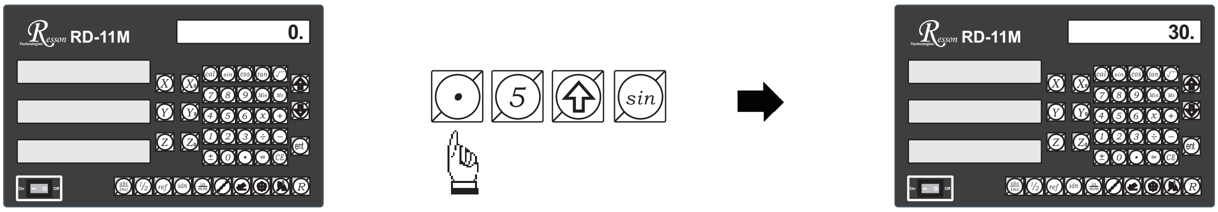

**i.e.** Basic mathematics **- multiply, division :** 78 X 9 / 11 = 63.81818



**i.e.** Trigonometric calculation **- COS :** 100 X COS 30° = 86.602540

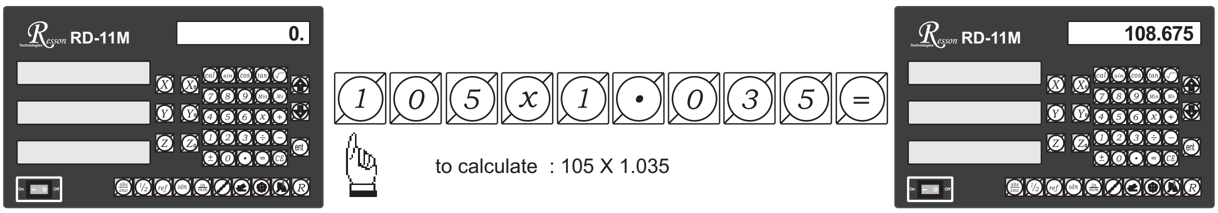



**i.e.** Trigonometric calculation **- inverse SIN :** $SIN^{-1}0.5 = 30°$



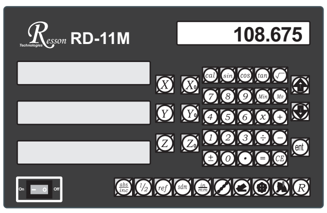

## *Result Transfer*

i.e. : **To move the tool at the position of X axis coordinate :** 105 X 1.035 = 108.675

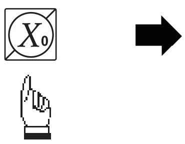



to calculate : 105 X 1.035

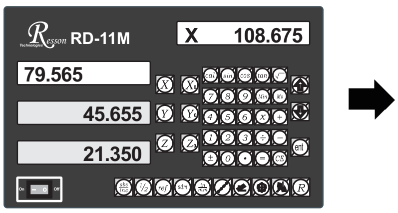
transfer the calculated result : 108.675
onto the X axis for tool positioning




to transfer calculated
result to X axis

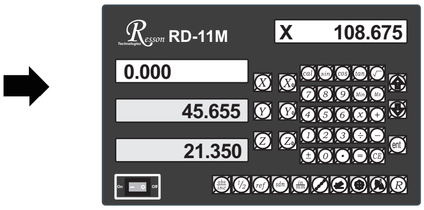


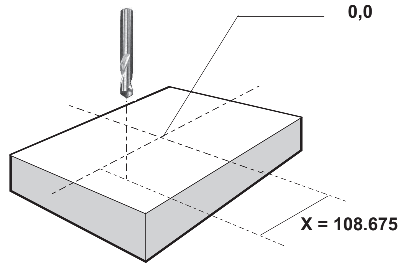

X axis zero position is now
***temporarily*** preset at X = 108.675



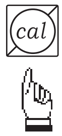
## Built in Calculator

Move the machine to X display = 0.000
then it is at the position of X = 108.675

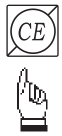


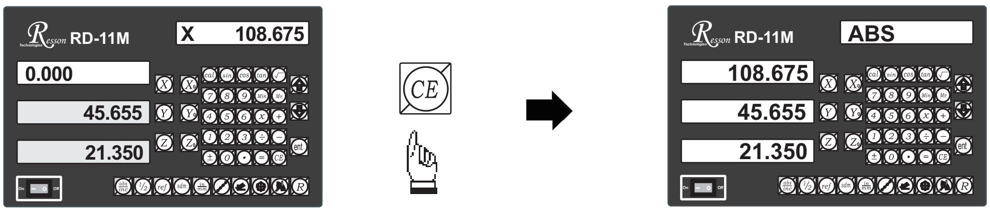




The tool is now at the position of the calculated result
( X = 108.675 in the above example )
To get back to normal coordinate display to continue
the machining

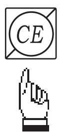



OR

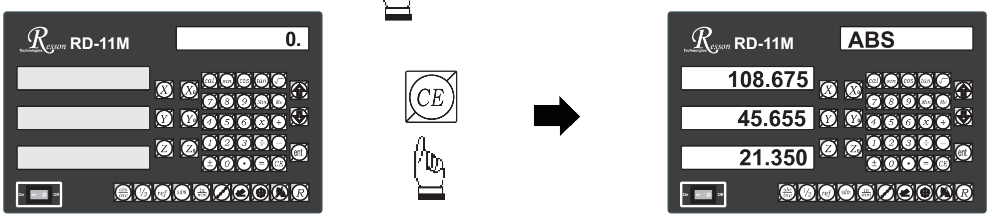


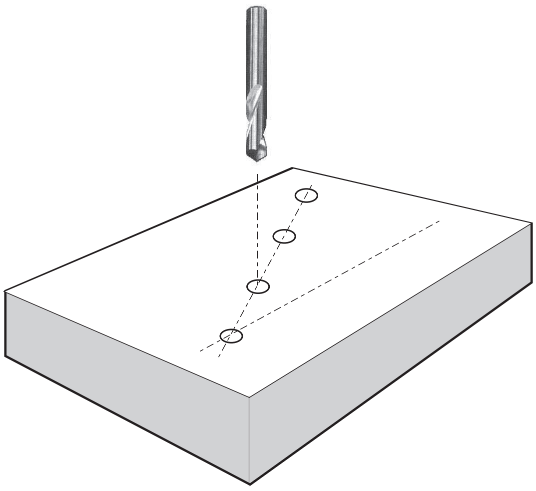

When you are in calculator mode, you can



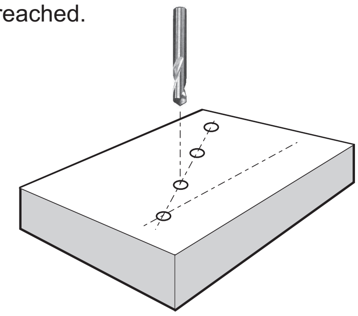

to exit the calculator mode, to return to normal coordinate display to continue the machining.



# **LHOLE** - Tool positioning for a Line of Holes



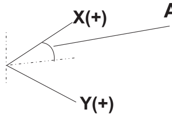
**Function :** RD-11M provides LHOLE function for drilling a line of holes. Simply enter the machining parameters below (following the step by step guides that are displayed on the RD-11M's message screens), and the RD-11M will calculate all the hole position co-ordinates and temporarily preset the hole position coordinates to zero ( 0.000 ). The operator then moves the machine until the display axes = 0.000, then the Line of Holes start-position is reached.



- Line Angle **( LIN ANG )**
- Line Distance **( LIN DIST )**
- No.of Holes **( NO. HOLE )**

After the above machining parameters are entered into RD-11M, it presets all the Line Hole positions to 0.000

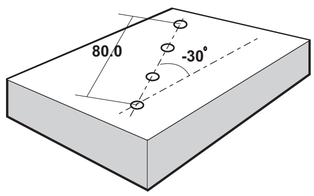
Operator can press ⇧ or ⇩ to select the Line Hole, and then move the machine to display = 0.000, then the Line Hole position is reached




**Angular direction :**
Positive ( + ) - *Clockwise*
Negative ( - ) - *Anti Clockwise*

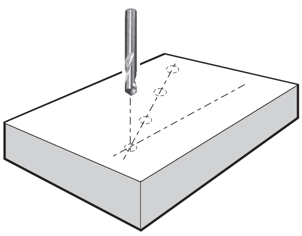
## Example

Line Angle **( LIN ANG )................ - 30** degree ( Anti-clockwise)
Line Distance **( LIN DIST )................ 80.00 mm**
No. of Holes **( NO. HOLE )............. 4**

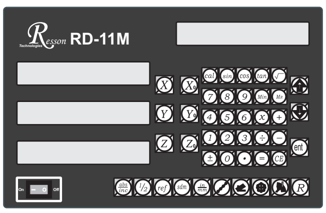



**step 1 :** The LHOLE function starts by using the current tool position as the starting point, therefore, locate the tool at the ***first*** LINE HOLE position

to enter the **LHOLE** function

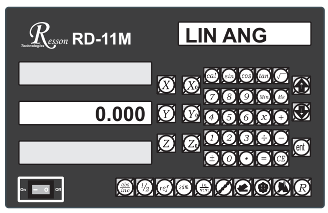


locate the tool at the ***first*** Line Hole position




to enter the **LHOLE** function

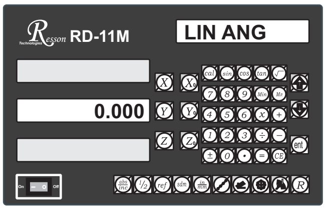
enter the Line Angle ( **LIN ANG** )

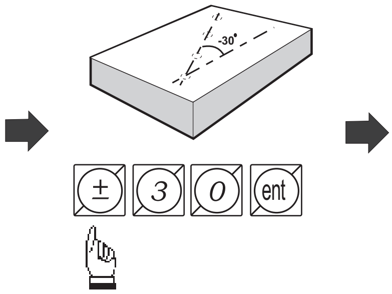


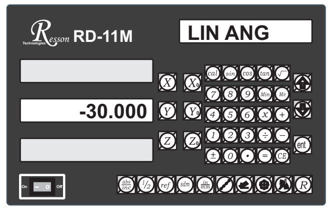
**step 2 :** Enter Line Angle ( **LIN ANG** )

Line Angle ( **LIN ANG** ) = **-30 degree**

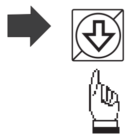
enter Line Angle ( **LIN ANG** )



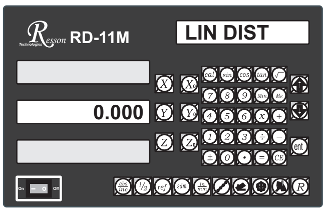

next step

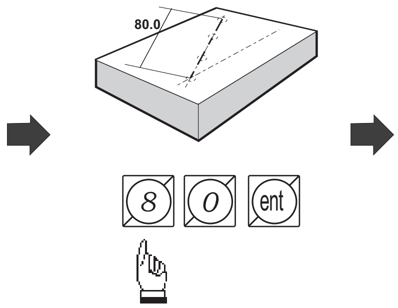


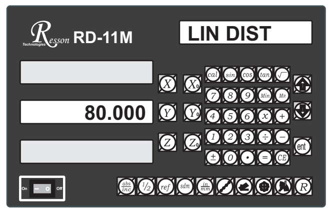
**step 3 :** Enter Line distance ( **LIN DIST** )

Line distanceAngle ( **LIN DIST** ) = **80.0 mm**

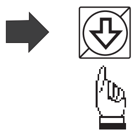
enter Line distance ( **LIN DIST** )



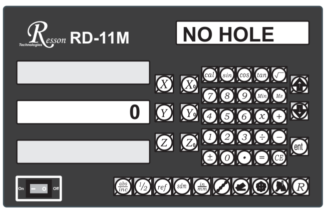

next step

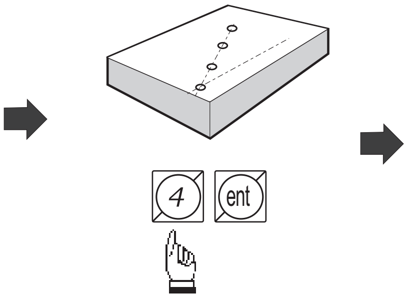


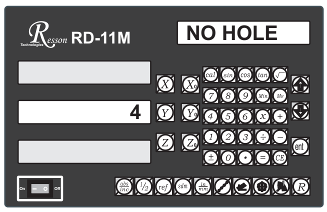
**step 4 :** Enter No. of Holes ( **NO. HOLE** )

No. of Holes ( **NO. HOLE** ) = **4**

enter No. of Holes ( **NO. HOLE** )



**All LHOLE machining parameters are already entered into RD-11M**

**to enter into LHOLE drilling mode**

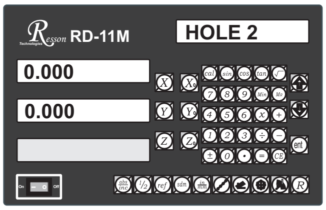
Operator can

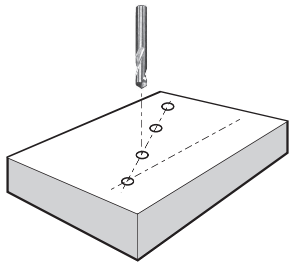
or

to select the Line Hole, then move the machine to display = 0.000, then the Line Hole position is reached.

Next Line Hole

move the machine to display = **0.000**

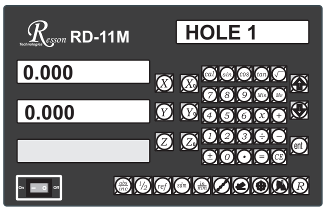


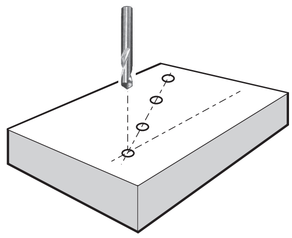



**HOLE 2** = Line Hole no. 2

Last Line Hole

move the machine to display = **0.000**

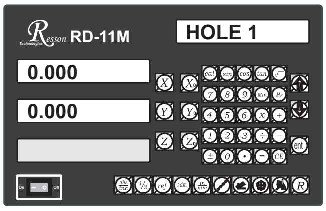


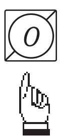
**HOLE 1** = Line Hole no. 1

If the operator wants to check or verify that the RD-11M's LHOLE calculation is correct, or wants to temporarily exit the LHOLE function cycle ( ie swap to normal XYZ display ).
The operation is as follows :.

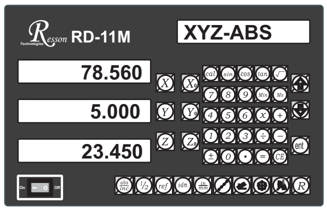
presently in **LHOLE** cycle




temporarily ***swap*** to normal XYZ coordinate display

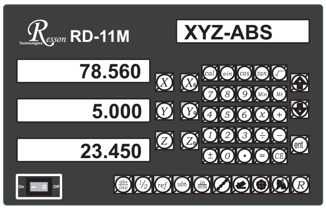


temporarily return to XYZ coordinate display

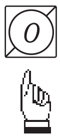


***swap back*** to LHOLE cycle to continue the Line Holes drilling operation

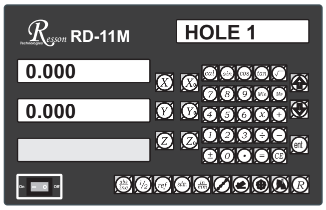
presently in the temporarily
XYZ coordinate display




swap back to
**LHOLE** function cycle

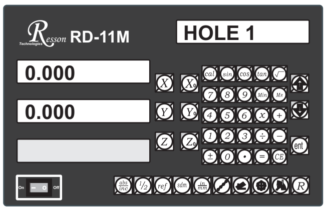


return to **LHOLE** function cycle

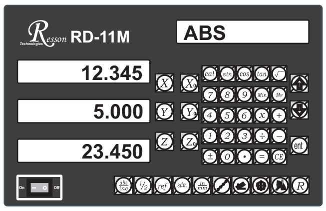



After the Line Holes drilling operation is completed, and to leave the LHOLE function cycle,
follow the procedure below

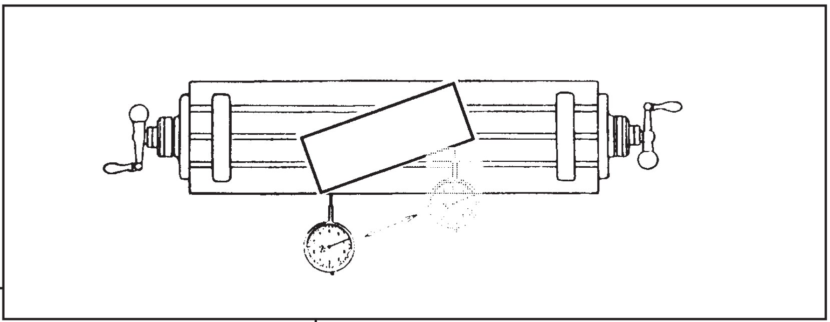
presently in **LHOLE** function cycle

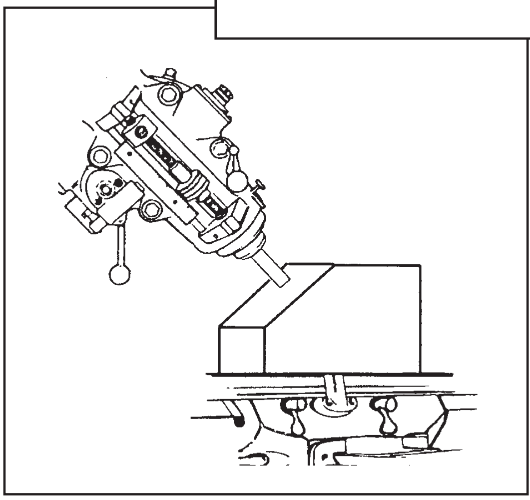



return back to normal
XYZ coordinate display



# **INCL** - Inclined surface datum tool positioning



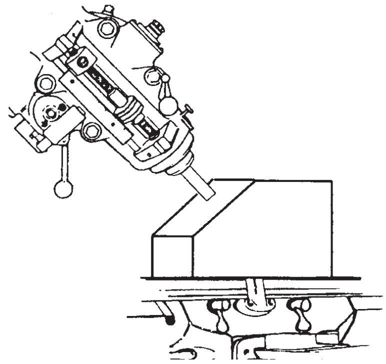


**Function :** During a machining process, it is quite common to machine an inclined surface.

If the work piece is small or the accuracy requirement is quite low, the operator can simply work on an incline or rotary table to machine the inclined working surface easily.

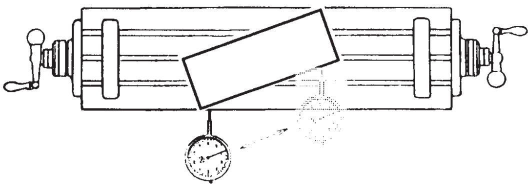
However, when the **work piece is too big** to be installed onto the incline table, or the **accuracy requirement is high,** the only solution is to calculate the machining points or datuming points using the mathematical method. This is generally very time consuming.

The RD-11M provides easy-to-use **INCL** function to help the operator for precision inclined surface datuming and machining.

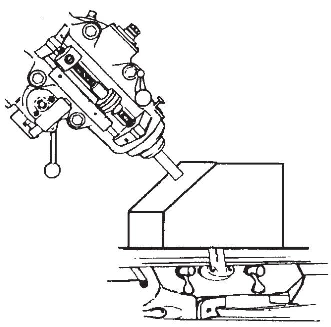


### Application of the INCL function are as follows :

**A**) **XY** plane - to accurately datum the work piece at an inclined angle

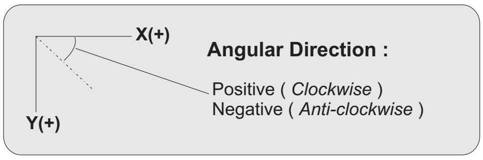


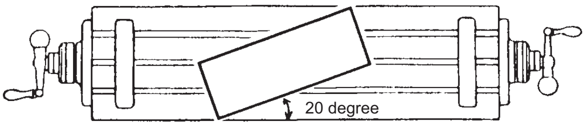
**B**) **XZ/YZ** plane - Machine an inclined surface



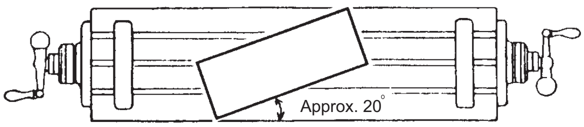
**Example :**

To accurately datum the
work piece at a 20 degree angle
on the XY plane



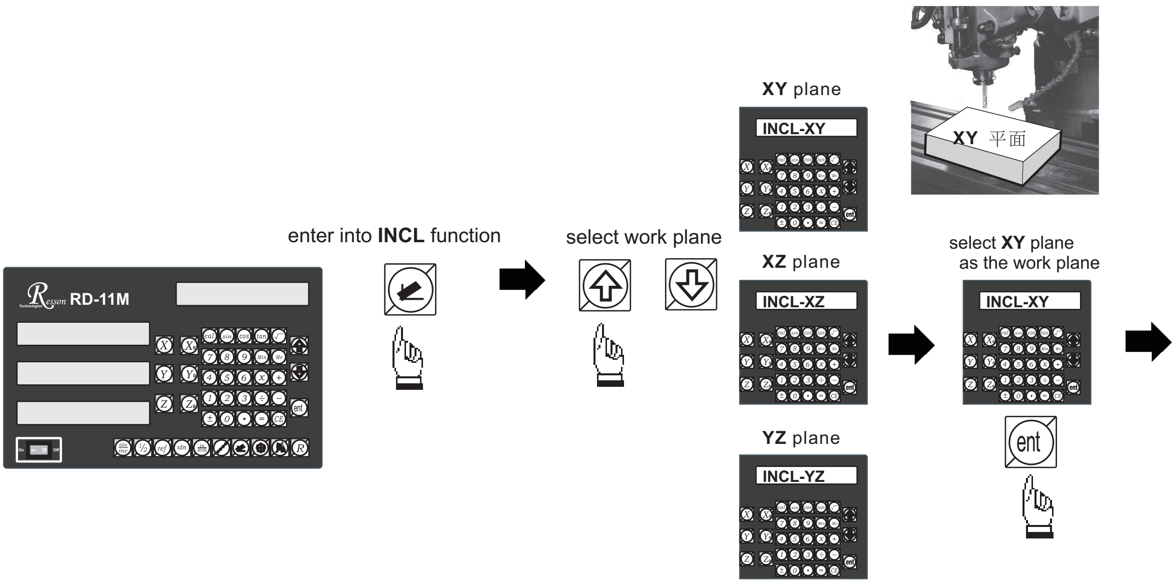




## Operational procedure



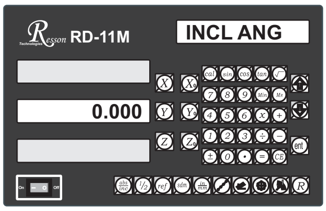

Install the work piece onto an rotary table at approxiately 20 degree.

**step 1 :** select XY plane as the work plane ( INCL - XY )

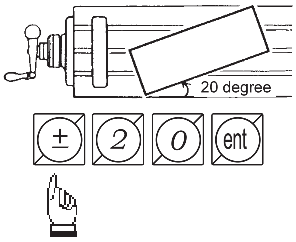


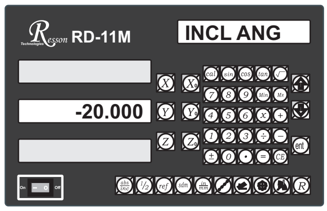
step 2 : enter incline angle ( **INCL ANG** )

enter incline angle ( **INCL ANG** )




incline angle ( **INCL ANG** ) = -**20** degree

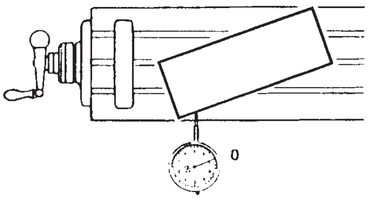


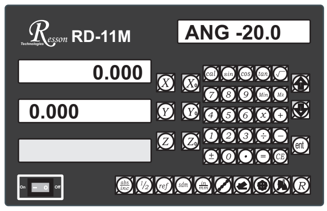

**All INCL machining parameters already entered into RD-11M**

**to enter into INCL datuming mode**

**A**) zero the dial indicator on one end of the work piece

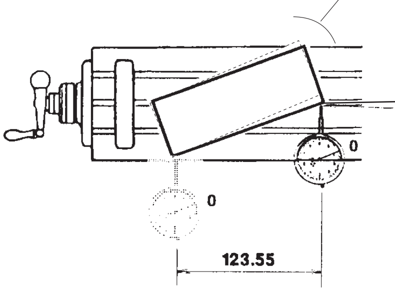


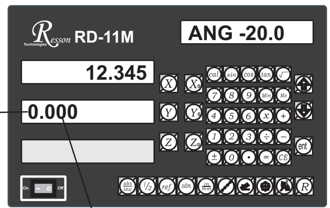

zero the RD-11M


since in INCL mode, the Y display is set according to X * tan ( ANG ), therefore, zeroing the X axis also clear the Y axis.

**B** ) After move the machine to Y axis display = 0.000, then the Y axis position is accurately posited at 20 degree. operator can fine tune the work piece incline angle until the dial indicator at zero.



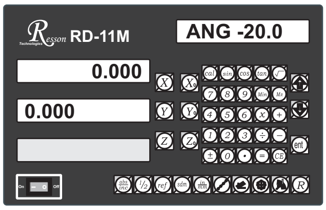




**Y** axis zero position will follow the X axis position at the angle of ANG ( -20 degree in this example ) operator just move the Y axis to display = 0.000 - it is then at an accurate 20 degree position

During the incline angle alignment, angular adjustment of any one end of the work piece will affect the the position on the other end, the above angular alignment procedure A) & B) has to be carried out iteratively until operator is satisfied with the angular alignment achieved.

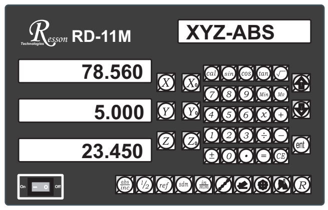
If the operator wants to check or verify if RD-11M's INCL calculation is correct, or wants to temporarily exit the INCL function cycle ( swap to normal XYZ display ). The operation are as follows :.

presently in **INCL** cycle



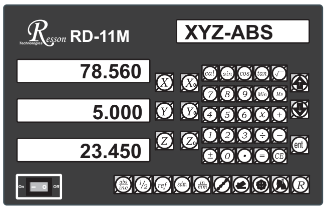

temporarily ***swap*** to normal XYZ coordinate display


temporarily return to XYZ coordinate display

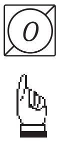



***swap back*** to INCL cycle to continue the **INCL** incline angle alignment

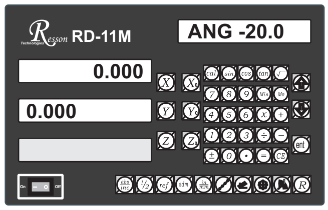
presently in the temporarily XYZ coordinate display




swap back to **INCL** function cycle

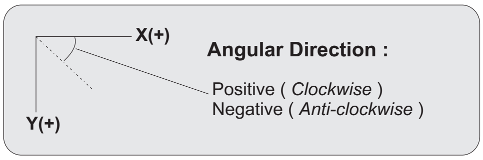


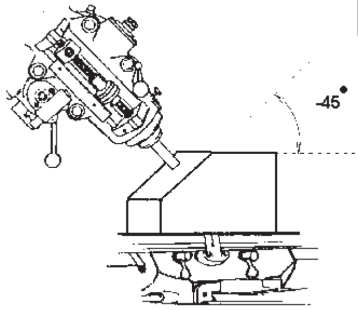

presently in **INCL** cycle



**Example :**

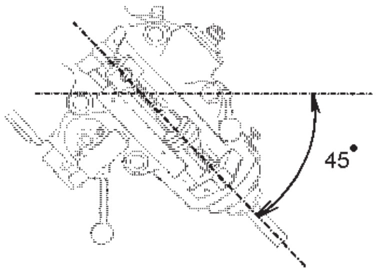
To machine a 45 degree inclined surface
on XZ plane using a two axis ES-9



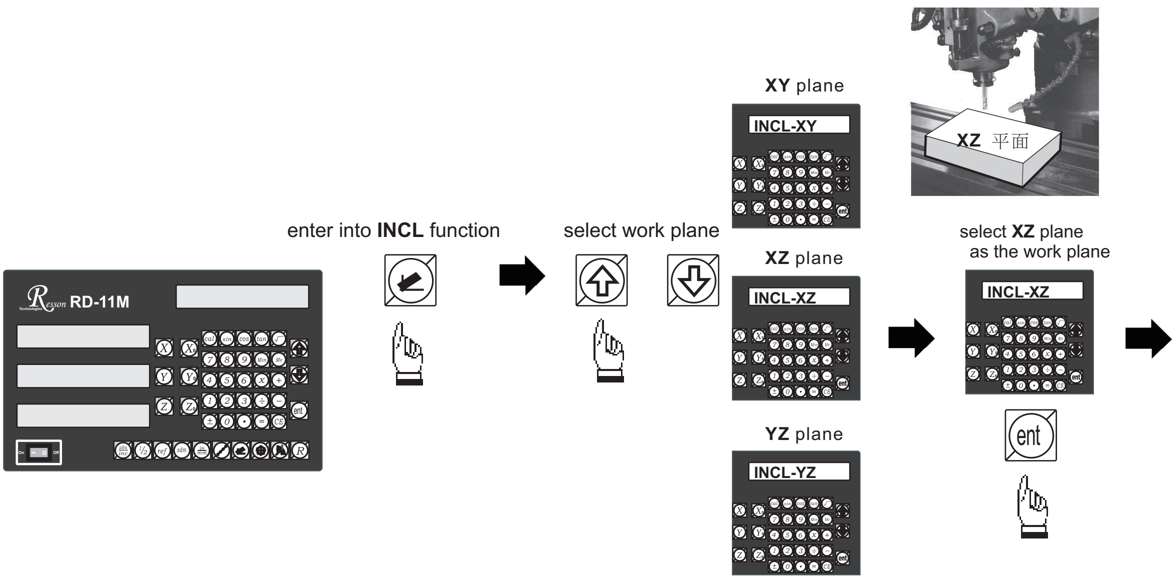




## Operation procedure

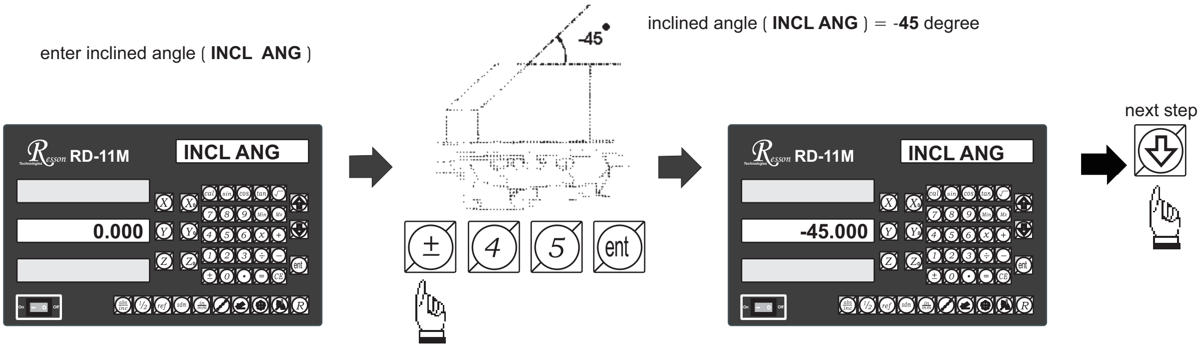
Inclines the mill head by 45 degree



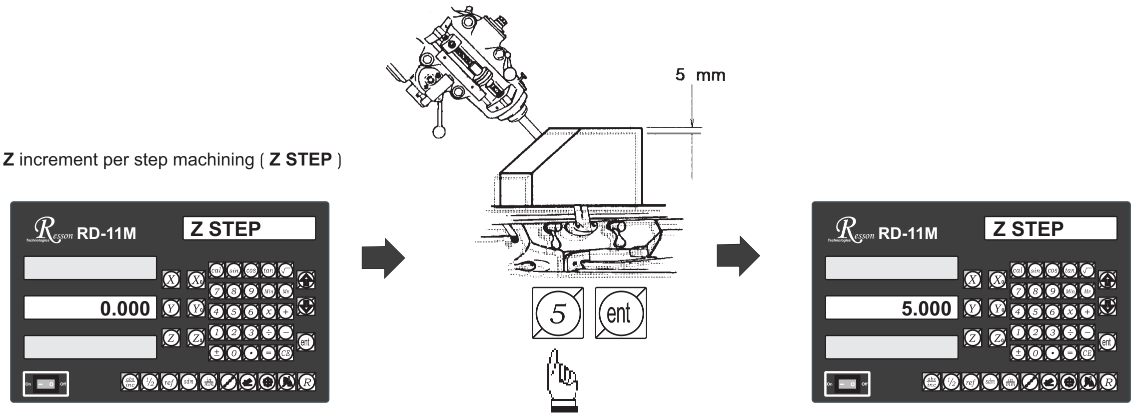

**step 1 :** select XZ plane as the work plane ( INCL - XZ )



**step 2 :** enter inclined angle ( **INCL ANG** )




**step 3 :** Z increment per step machining ( **Z STEP** )




**All INCL machining parameters already entered into RD-11M**  **to enter into INCL datuming mode**

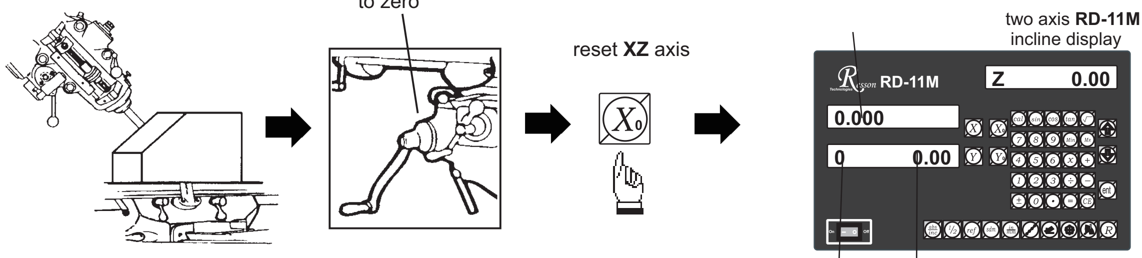
Position the tool on any point on the inclined surface

set the Z dial to zero

reset **XZ** axis

move the machine to display = 0.000 - then the tool is positioned at the inclined surface

two axis **RD-11M** incline display




Z dial turn number

Z dial reading

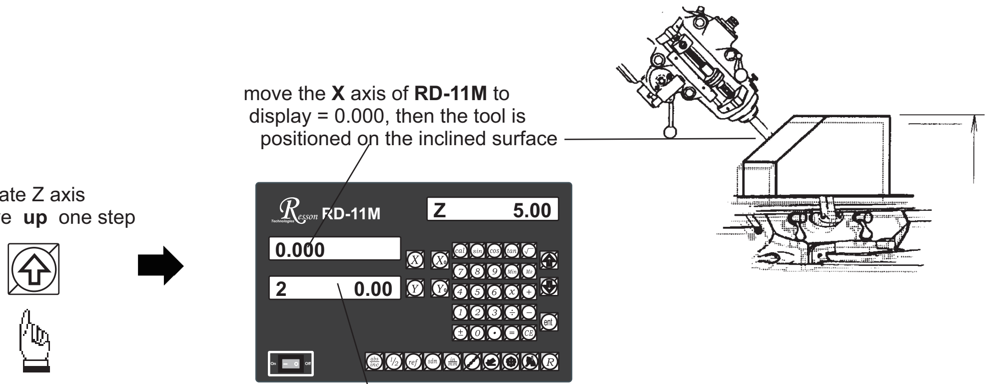
As a 2- Axis **RD-11M** does not have Z Axis, the **RD-11M** uses the [up] and [down] to simiulate the Z axis movement

[up] — simulate Z axis move **up** one step

[down] — simulate Z axis move **down** one step

move the **X** axis of **RD-11M** to display = 0.000, then the tool is positioned on the inclined surface

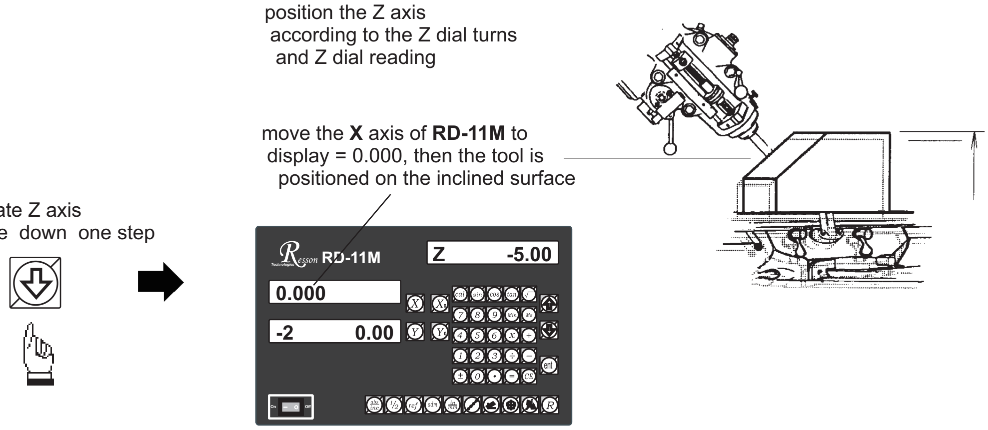
simulate Z axis move **up** one step



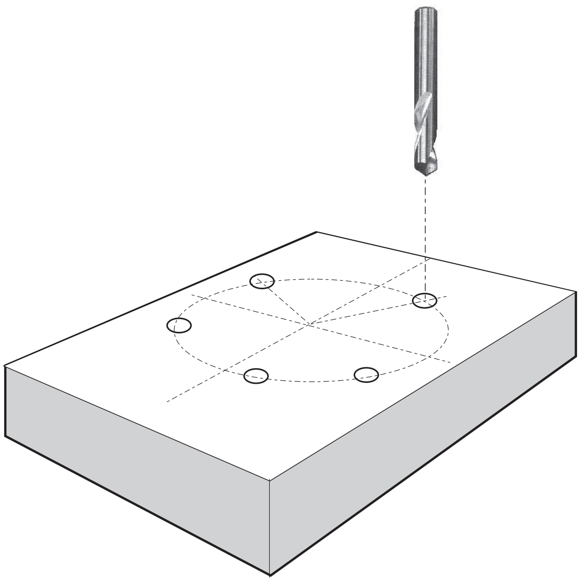

position the Z axis according to the Z dial turns and Z dial reading

move the **X** axis of **RD-11M** to display = 0.000, then the tool is positioned on the inclined surface

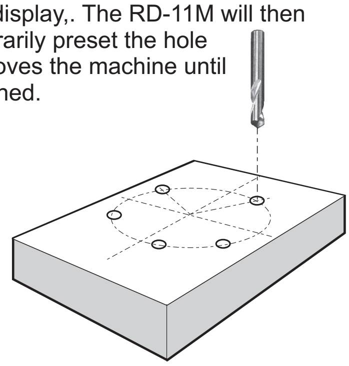
simulate Z axis move down one step



# **PCD** - Tool positioning for Pitch Circle Diameter



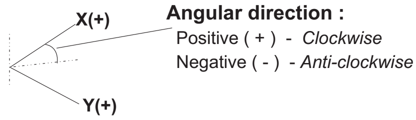
**Function :** RD-11M provides a PCD function to for drilling holes around a Pitch Circle Diameter. The operator simply enters the following machining parameters in accordance with the step by step guides shown on the RD-11M's message display,. The RD-11M will then calculate all the pitch hole position coordinates and temporarily preset the hole position coordinates to zero ( 0.000 ). The operator then moves the machine until the display axes = 0.000 and the pitch hole position is reached.



- Centre ( **CENTRE )**
- Diameter ( **DIA** )
- No. of Holes ( **NO. HOLE** )
- Start Angle ( **ST. ANG** )
- End Angle ( **ENd. ANG** )

After the above machining parameters are entered into RD-11M, it presets all the pitch hole positions to 0.000

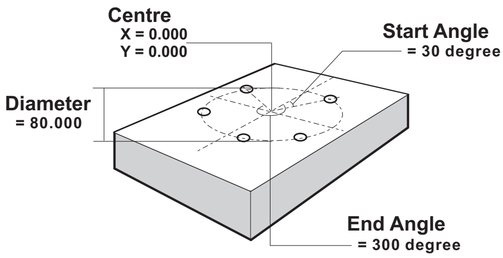
Operator can press or to select



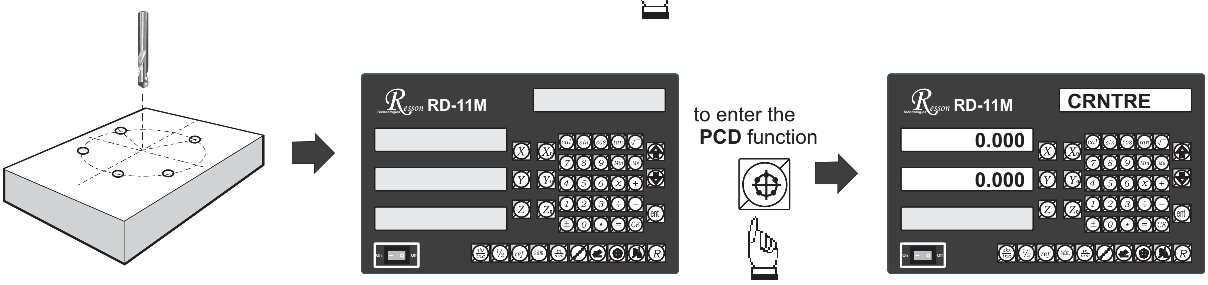

the pitch hole, and then move the machine to display = 0.000 - the pitch hole position is then reached

## Example

Centre Coordinate **( CENTRE )** ......... **X= 0.000, Y=0.000**
Diameter **( DIA )** .............................. **80.000mm**
No. of Holes **( NO. HOLE )** ................ **5 holes**
Start Angle **( ST. ANG )** ..................... **30 degree** ( clockwise )
End Angle **( ENd. ANG )**.................... **300 degree** ( clockwise )



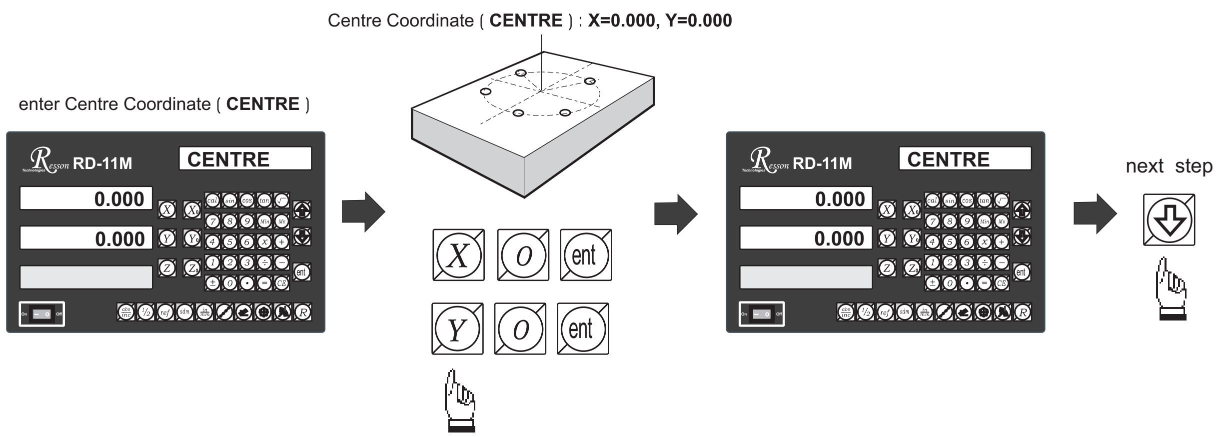

**step 1 :** Set up the work piece datum ( work piece zero ) to enter the **PCD** function



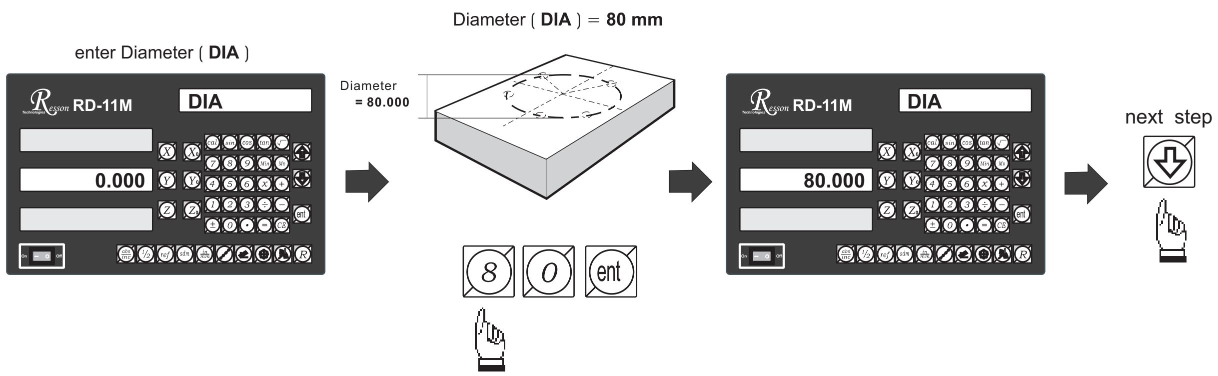

set up work piece datum

enter the **CENTRE** coordinate

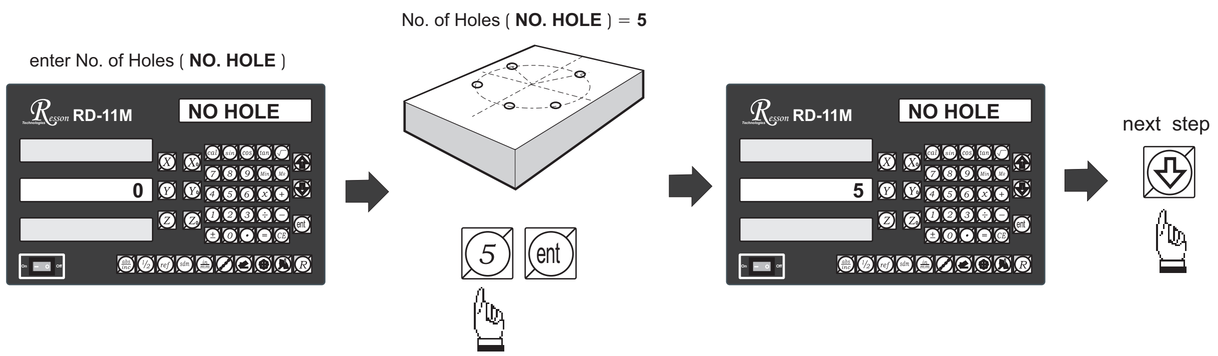
**step 2 :** Enter Centre Coordinate ( **CENTRE** )



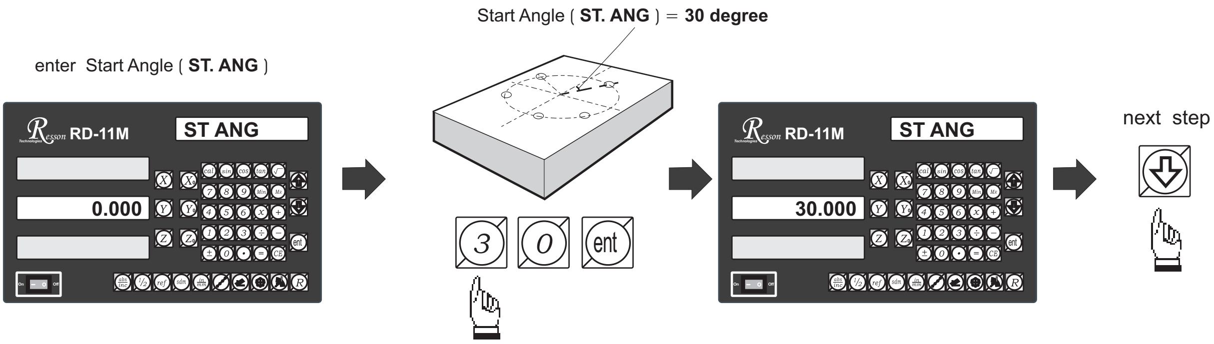

**step 3 :** Enter Diameter ( **DIA** )



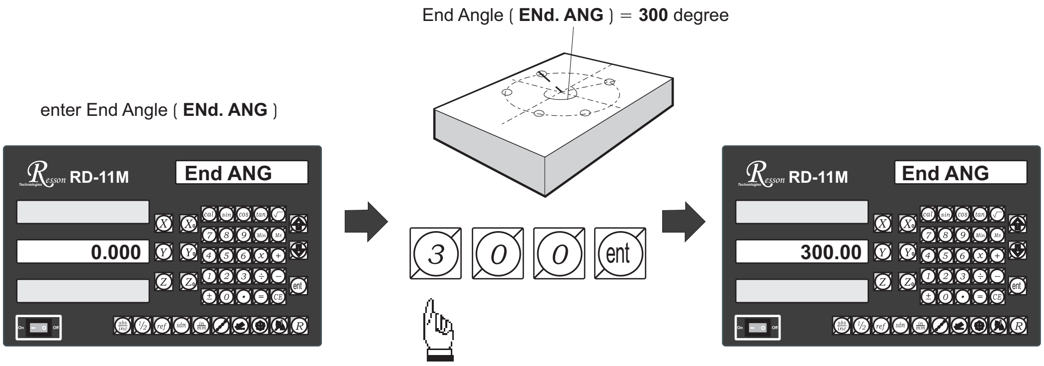

**step 4 :** Enter No. of Holes ( **NO. HOLE** )



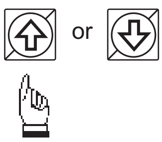
**step 5 :** Enter the Start Angle ( **ST. ANG** )




**step 6 :** Enter the End Angle ( **ENd. ANG** )

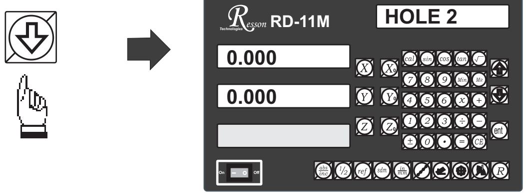


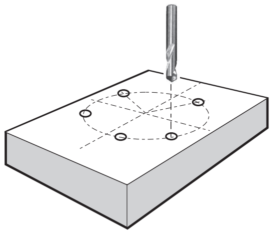

**All PCD machining parameters are already entered into RD-11M**  **to enter into PCD drilling mode**

Operator can  to select the pitch hole, then move the machine to display = 0.000, to reach the pitch hole position

Next Pitch hole

move the machine to display = **0.000**

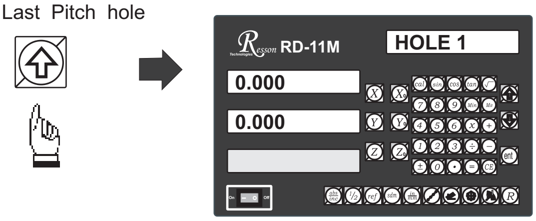


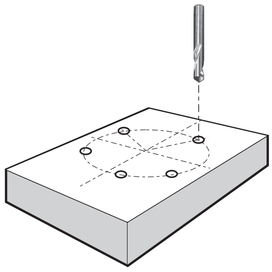



**HOLE 2** = picth hole no. 2

Last Pitch hole

move the machine to display = **0.000**

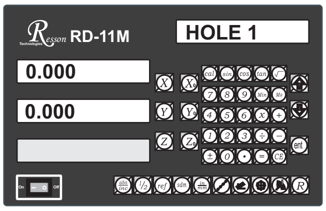


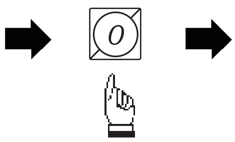
**HOLE 1** = picth hole no. 1

Anytime the operator wants to check or verify that the **PCD** calculation is correct, or wants to temporarily exit the **PCD** function cycle ( swap to normal XYZ display ).
The operations are as follows :.

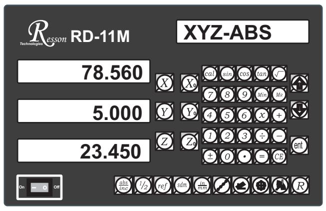
presently in **PCD** cycle




temporarily ***swap*** to normal XYZ coordinate display

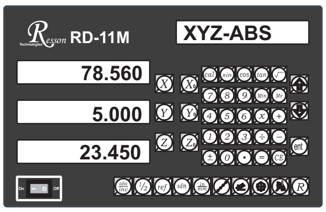


temporarily return to XYZ coordinate display

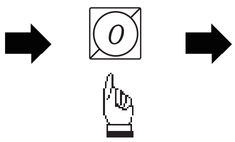



***swap back*** to PCD cycle to continue the **PCD** hole drilling

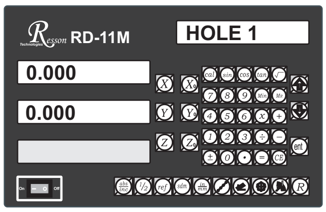
presently in the temporarily XYZ coordinate display




swap back to **PCD** function cycle



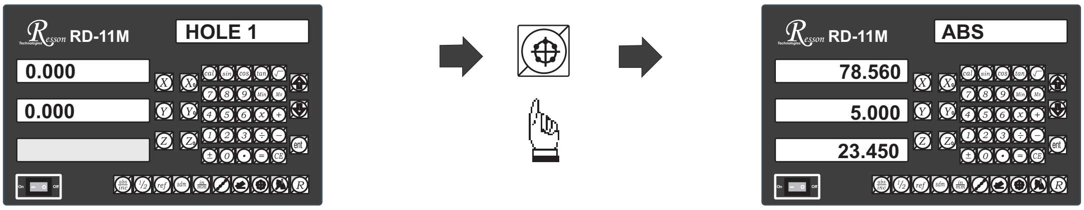
return to **PCD** function cycle



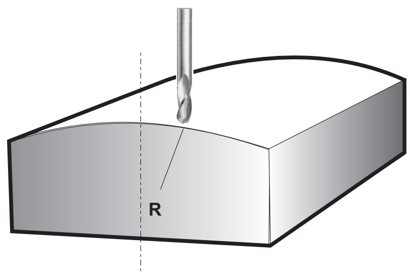
To leavet the PCD function, after the PCD hole drilling operation is completed follow the under-mentioned procedure:

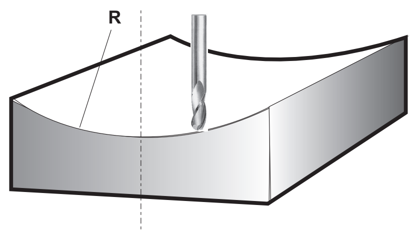
presently in **PCD** function cycle

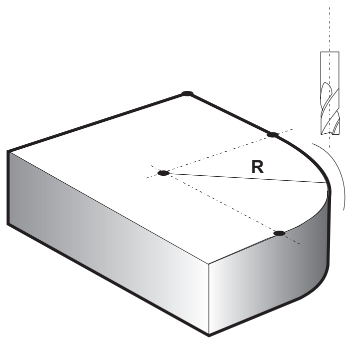
returns to normal
XYZ coordinate display



# Tool positioning for ARC machining



**function :** It is quite common to need to machine round a corner or an arc surface in the course of a day's work, especially in mould making.

If the arc surfaces are complicated or a number of round corners have to be precisely machined, or arc or round corners are to be machined, then CNC milling machine should be used.

There are still a lot of the cases, however, that only a simple arc surface or one or two round corners need to be machined and the precision of those arc or round corners machining are not demanding ( especially in mould making ). If we do not have a CNC machine in house, it is then more cost effective and time saving to carry out simple arc or round corners machining on your manual milling machine in-house rather than sub-contract it as CNC machining externally.

In the past, many mould makers made their tool positioning calculations for ARC machining with a scientific calculator. But the process is time consuming and easily prone to mistakes.

RD-11M features has a very easy-to-use tool positioning function for ARC machining which enables mould makers to machine simple ARC in the shortest possible time. But before you make your decision to use the ARC function or to have your work piece to be machined in a CNC machine, please bear in mind that ARC function is only cost effective and time saving under following conditions

1) **One off job**
2) **Only simple ARC surface or round corners to be machined.**

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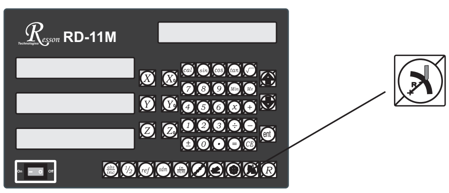
## **ARC** functions groups

In RD-11M, the ARC function group consists of two functions as follows

### **R** function



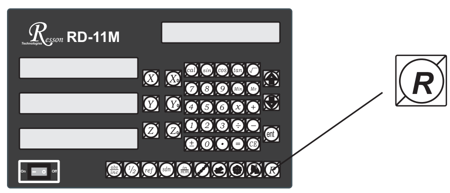

R function provides maximum flexibility in ARC machining, the ARC sector to be machined is defined by the co-ordinates of :

1) ARC centre ; 2) ARC Radius ; 3) ARC start point
4) ARC end point

Advantage :
- Very flexible, R function can machine virtually all kinds of ARC, even the intersected ARCs.

Limitation :
- Relatively complicated to operate, operator needs to calculate and enter the co-ordinates of ARC centre, start point and end point into RD-11M.

### **Simplified R** function




The RD-11M's ARC function is aimed at machining only simple ARC or round corners, and to make the operation really very easy for the operator, the RD-11M presets the eight type of most frequently-used ARC machining processes.

Advantage :
- Very easy to use, operator doesn't need to calculate the ARC parameters, just position the tool at the start point, and then he can start the ARC machining immediately.

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

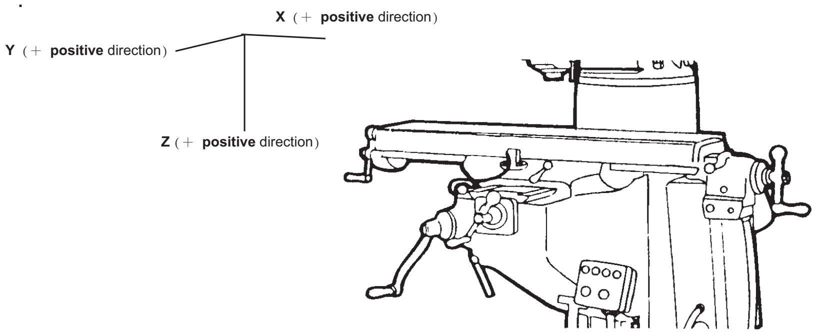
**Understanding the Co-ordinate System :**

For those operator who do not have experience in CNC programming, or the first time user of RD-11M's R functions, they may find that it is difficult to understand what is meant by "co-ordinate".

The co-ordinate is a pair of numbers which specify a position on a surface.

When using RD-11M's R function, it is necessary to enter the co-ordinates of ARC center, start point, end point and etc. to let RD-11M know the geometry of the ARC to be machined.

During installation, the engineer will set the display direction same the the dial of the machine. For a Taiwanese made knee-type machine, because of the lead screw dial direction, the RD-11M display directions are also be normally set as follows
.

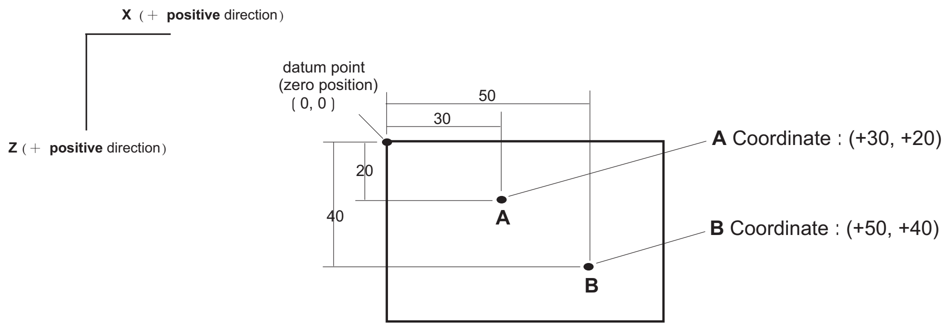



**-- NOTICE --**

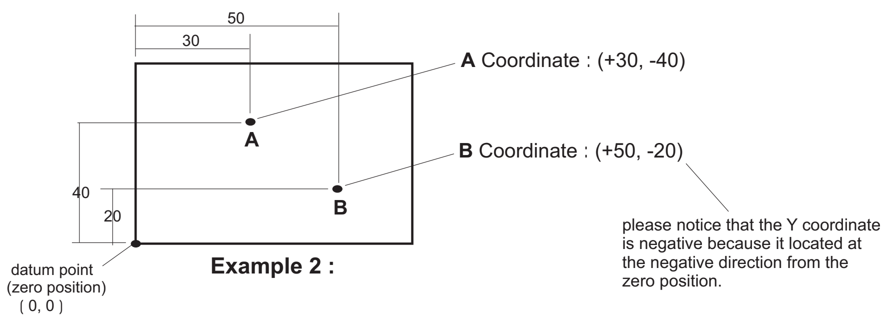
Co-ordinate have signs to specify its' relative location from zero.

## Co-ordinate Example

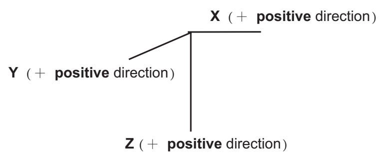
Co-ordinate is a pair of number which specify the distance from the datum point ( zero position ), the number can be either be positive or negative and depends on the direction relative to the zero position



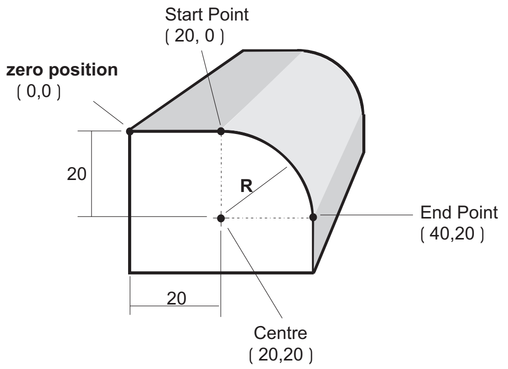

**Example 1 :**



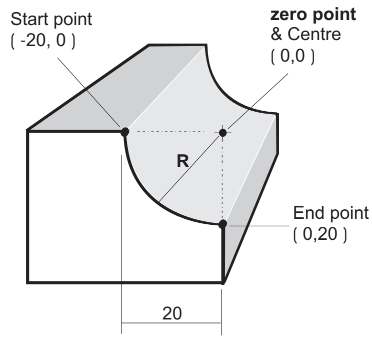

**Example 2 :**




**Example 3 :**

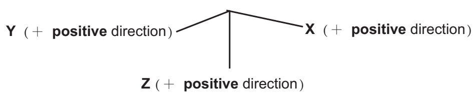


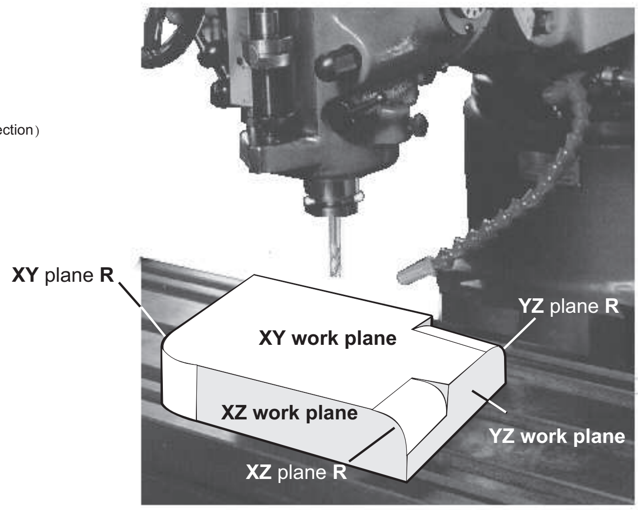

**Example 4 :**




## Work plane :

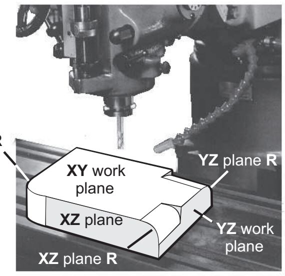
The R function of RD-11M allows the operator to machine R in XY, XZ & YZ plane as the illustration shows. Even for 2 axis DRO, RD-11M can calculate all the ARC machining positions on XZ & YZ work-planes. It is necessary, therefore, to select the work-plane required as one of the machining parameters entered into the RD-11M during in R function data entry.



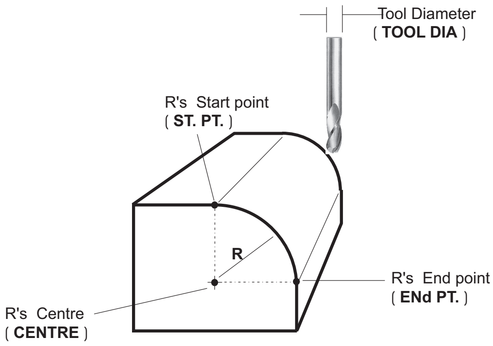



**Following parameters need to be entered into RD-11M for ARC machining :**

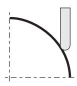
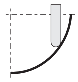
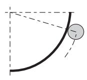
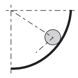
1. Select work plane - **XY, XZ** or **YZ** plane **R**



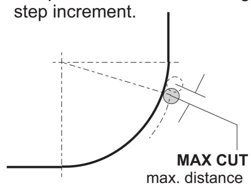
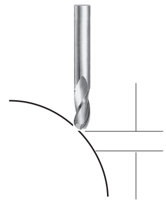
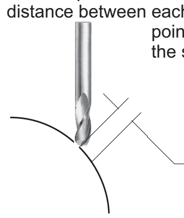

2. R's Centre ( **CENTRE** )
3. R's Radius ( **R** )
4. R's start point ( **ST. PT.** )
5. R's end point ( **ENd PT.** )
6. Tool Diameter ( **TOOL DIA** )




7. Select Tool radius compensation ( **R+TOOL** ) or ( **R-TOOL** )

| | **( R+TOOL )** | **( R-TOOL )** |
|---|---|---|
| **XZ / YZ** plane **R** |  |  |
| **XY** plane **R** |  |  |

8. machining step Increment

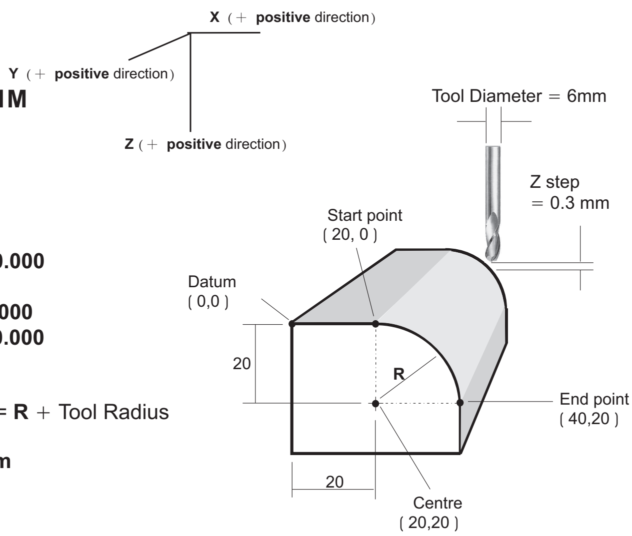
| **XY** plane **R** | **XZ / YZ** plane **R** | |
|---|---|---|
| For XY plane R, Max. distance between interploated points is to be specified as the machining step increment.  **MAX CUT** = max. distance between interpolated points. | For XZ/YZ plane R, under normal condition, the Z step increment is fixed and to be specified as the machining step increment.  **Z STEP** = fixed increment per step | For XZ/YZ plane R, under smooth R option selected. RD-11M will calculate the Z step increment so that the Max. distance between each machining point is approximately the same.  **MAX CUT** = max. distance between interpolated points. |

## Example :

To machine an **XZ** plane **R** using a 2 Axis **RD-11M**

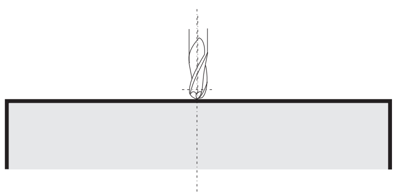
The following machining parameters have to be entered into the **RD-11M** :

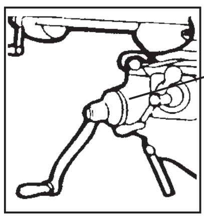
1. select **XZ** plane **R** **( S.R - XZ )**
2. Centre **( XZ CENTR )** .................... **X = 20.000, Z = 20.000**
3. Radius **( R )** .................................. **20.000**
4. Start point **( XZ ST. PT )** ................ **X = 20.000, Z = 0.000**
5. End Point **( XZ ENd P )** ................. **X = 40.000, Z = 20.000**
6. Tool diameter **( TOOL DIA )** .......... **6.000 mm**
7. Tool Compensation-**( R+TOOL )**, Actual ARC Radius = **R** + Tool Radius
8. **Z** incremental step machining **( Z STEP )** ........ **0.3 mm**




## Operation Example

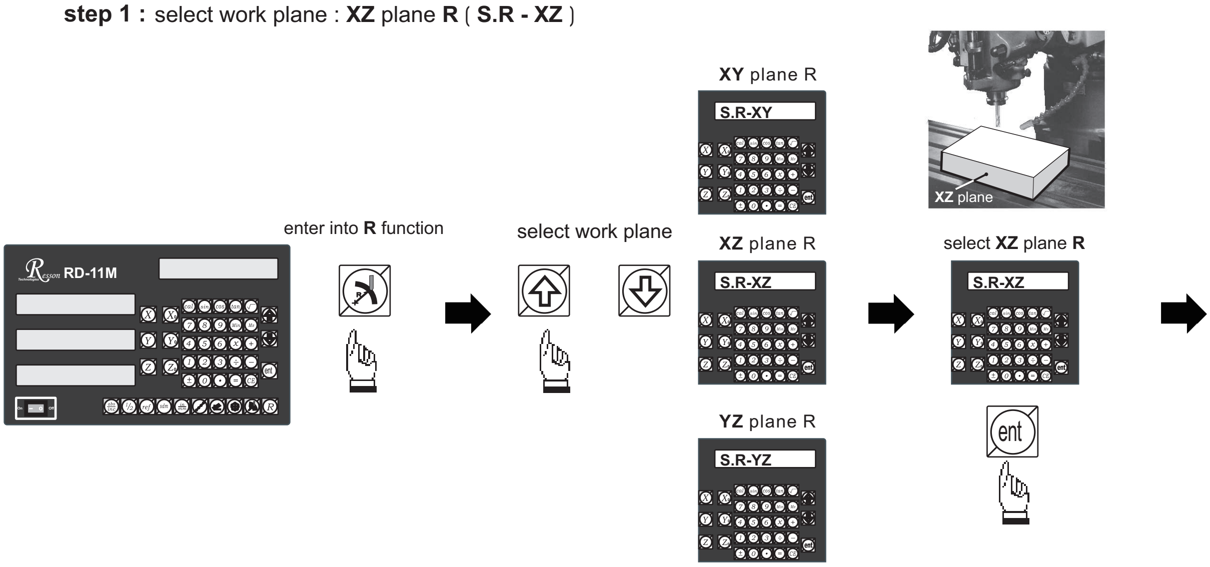
**Position the tool at the start point of the ARC**



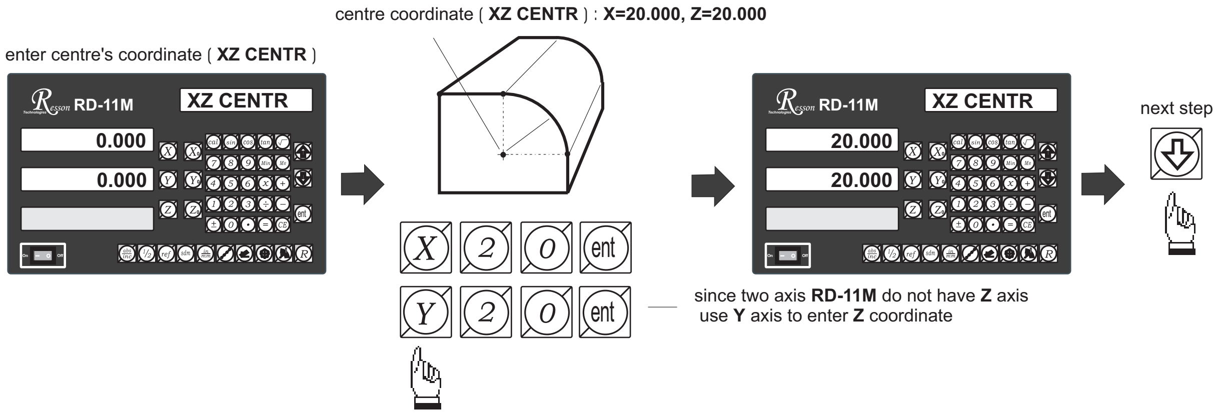


**Set the Z axis dial to Zero (0.000)**

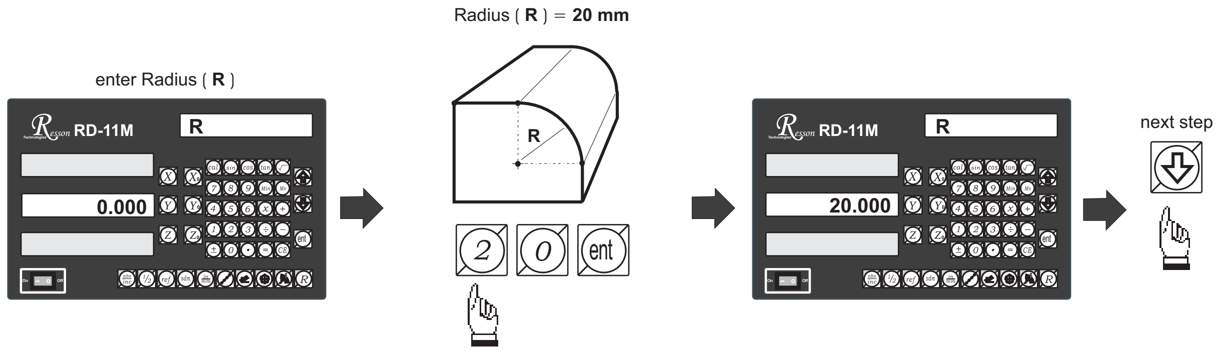
**step 1 :** select work plane : **XZ** plane **R** ( **S.R - XZ** )



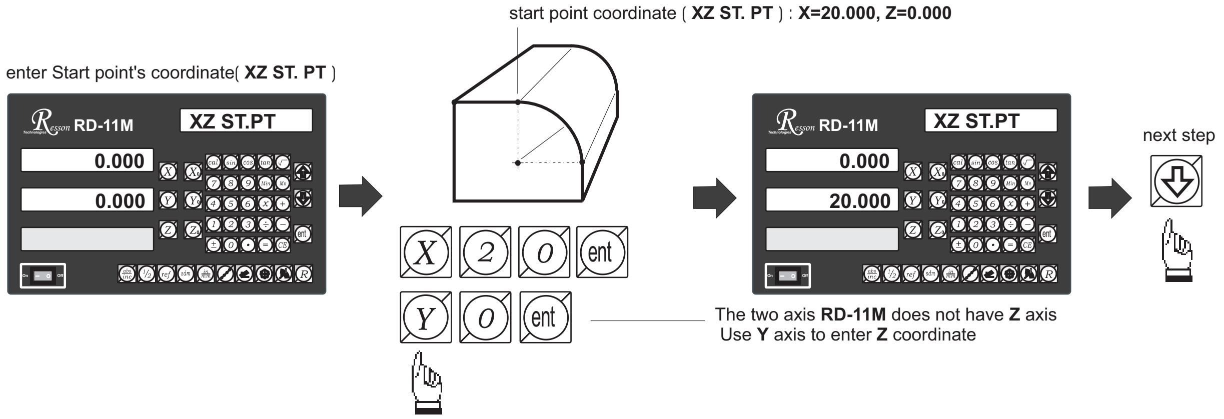
**step 2 :** enter the Centre's co-ordinate ( **XZ CENTR** )



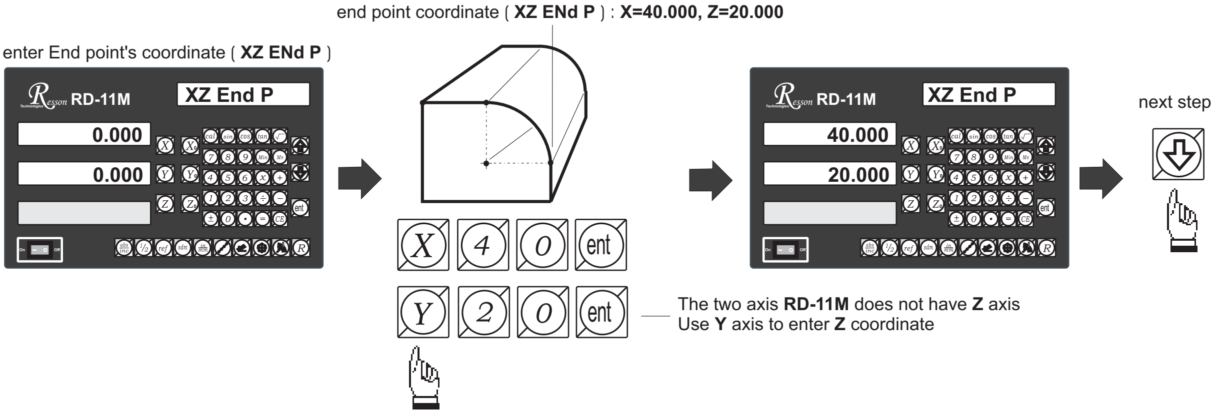

**step 3 :** enter the Radius ( R )



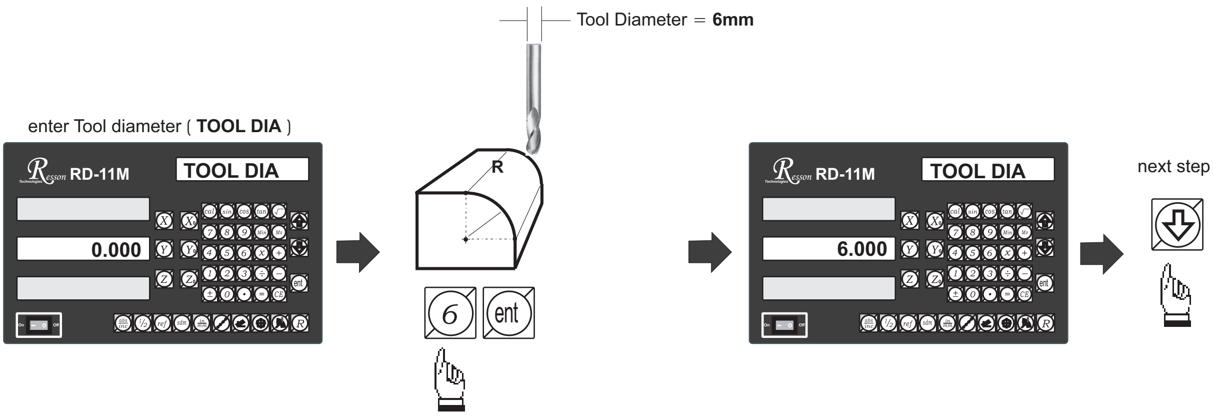

**step 4 :** enter the Start point co-ordinate ( **XZ ST.PT** )



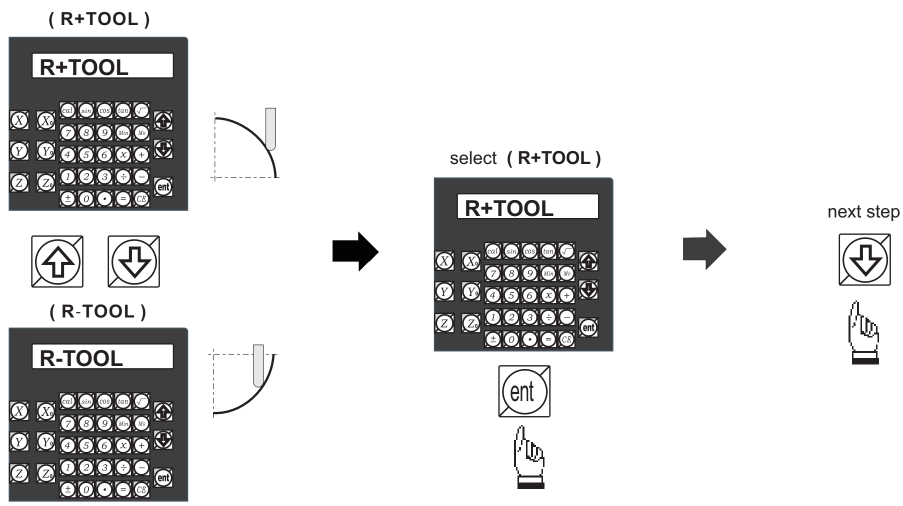
**step 5 :** enter the End point's coordinate ( **XZ End P** )




**step 6 :** enter the Tool diameter ( **TOOL DIA** )



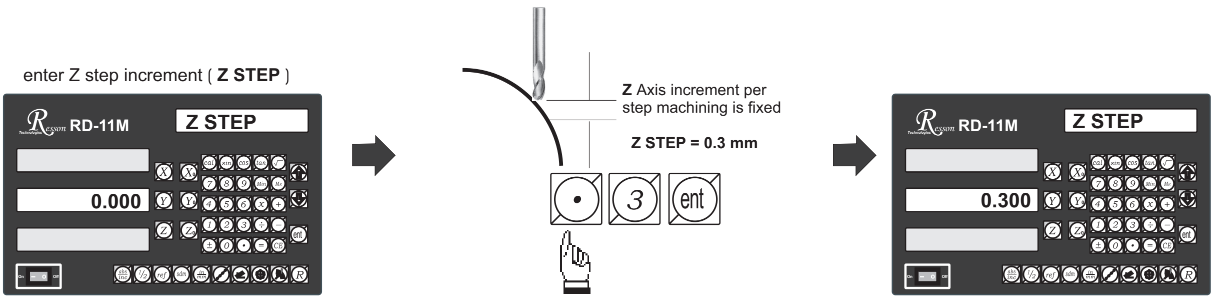

**step 7 :** select tool compensation direction



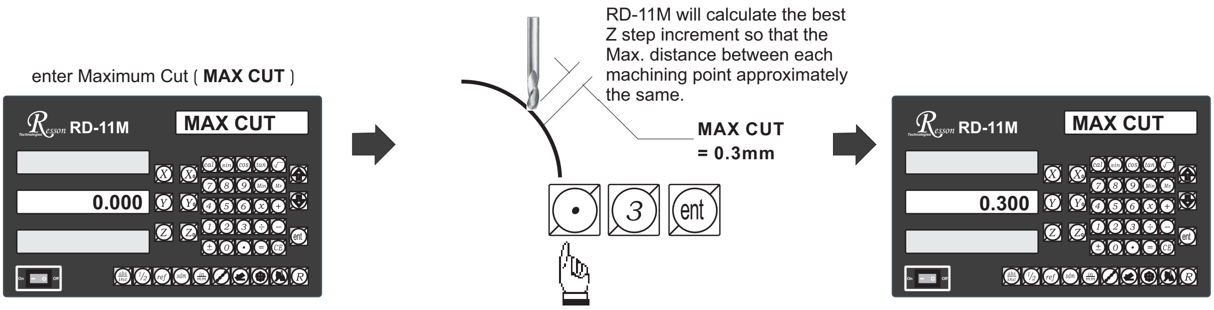
**step 8 :** enter Z incremental step machining

RD-11M provides two options on the Z incremental step machining. The Operator can enter select the smooth R function which best suits the job.

Option 1 : Fixed Z step ( **Z STEP** )
The Z increment per step machining is fixed, and as the ARc's curvature varies with their Z position, the operator has to use their experience to select different Z STEP increments during the ARC machining to get the optimal, fast machining




Option 2 : Maximum Cut ( **MAX CUT** )
Under this option, RD-11M will calculate the best possible Z increment per step machining according to the curvature of ARC, to make the interpolated point approximately equal to the MAX CUT entered.




**All R funtion machining parameters have already entered into RD-11M**

**to enter into ARC machining mode**

The two Axis **RD-11M** does not have a Z Axis, therefore, **RD-11M** uses the [up] and [down] to simulate the Z axis movement

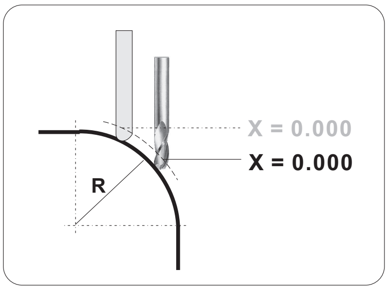
[up] — simulate Z axis move **up** one step

[down] — simulate Z axis move **down** one step

before the start of ARC machining, please ensure the tool is positioned at the ARC starting point and Z axis dial is set to zero ( 0.000 )

During the XZ or YZ plane R machining, it is necessary to accurately position the Z axis. However, as there is no Z axis in a two axis RD-11M, and guide the operator easily to position the Z axis during the ARC machining, RD-11M uses the unused axis display to show the **Z dial turn number** and **Z dial reading.**.

At the begining of the ARC machining, the RD-11M will assume the Z axis dial is at zero position with the tool positioned at the starting point of the ARC. then press the and once to simulate Z axis move up or down one step, the corresponding Z dail turn number and Z dial reading will display on the unused axis. The operator then moves the Z axis according the dial reading displayed on this axis, until the correct Z axis height is reached..




**Move the X axis until display = 0.000, then the tool is positioned on the ARC curve**

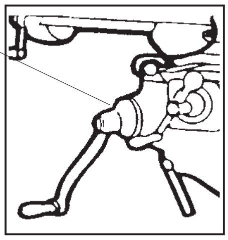
The display will **shift left** to signify it is not normal coordinate display.

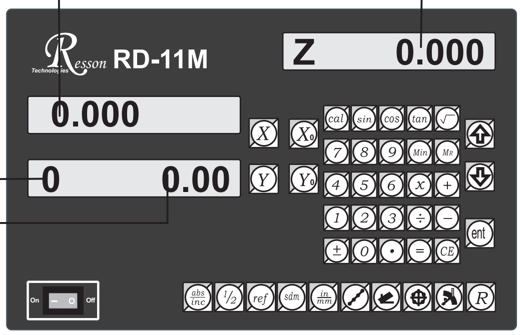
Z axis simulated height

move the Z axis according to the dial settings displayed on Y axis

**Z dial turn number**

**Z dial reading**

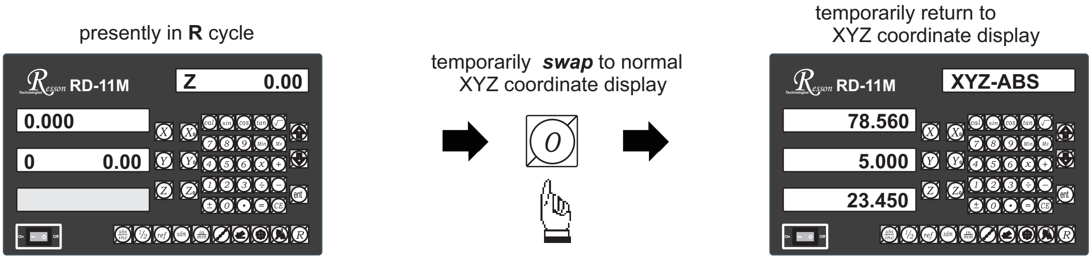




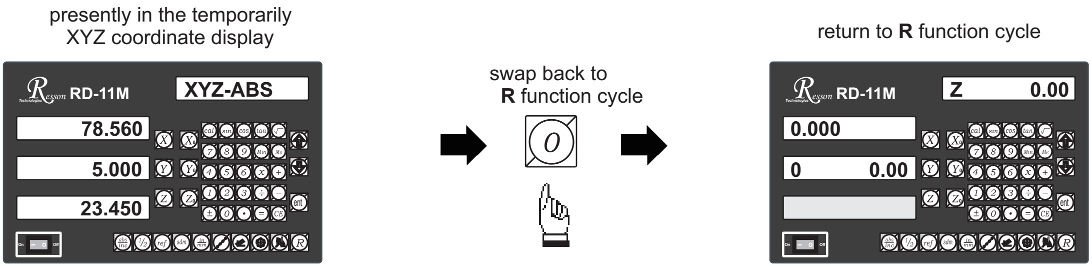

Display data in **XZ** plane **R** machining mode

If the **Z** axis is positioned outside the **R** curvature, the **RD-11M** will display "**Z OU LI**" ( **Z OUT LIMIT )**

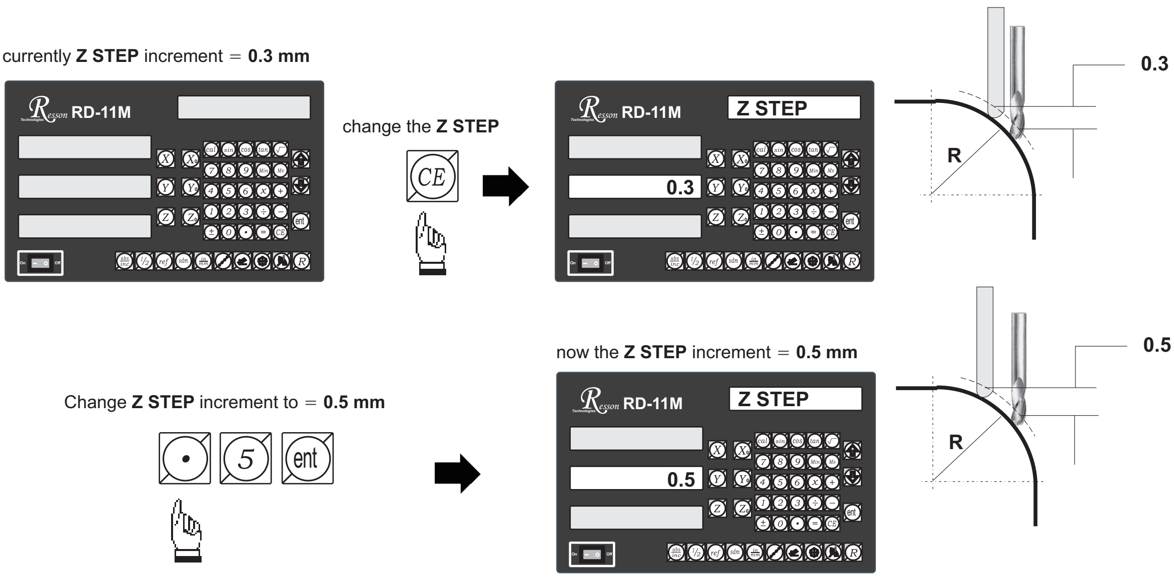
If the operator wants to verify if the RD-11M's **R** calculation is correct , or wants to temporarily exit the **R** function cycle ( swap to normal XYZ display ). The procedure is as follows :.




***swap back*** to R cycle to continue the **R** machining mode



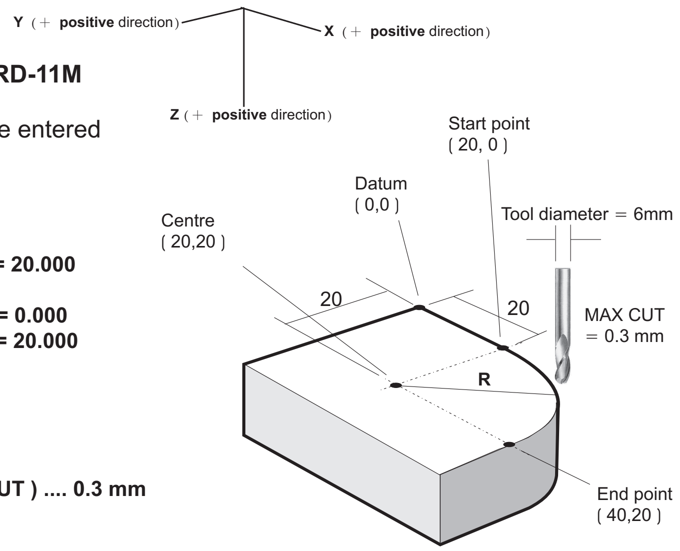

If fixed **Z STEP** option choosed, the **Z STEP** increment can be change anytime during the ARC machining



## Example :

To machine an **XY** plane **R** using a 2 Axis **RD-11M**

Following machining parameters have to be entered into the **RD-11M** :




1. select **XY** plane **R** **( R. - XY )**

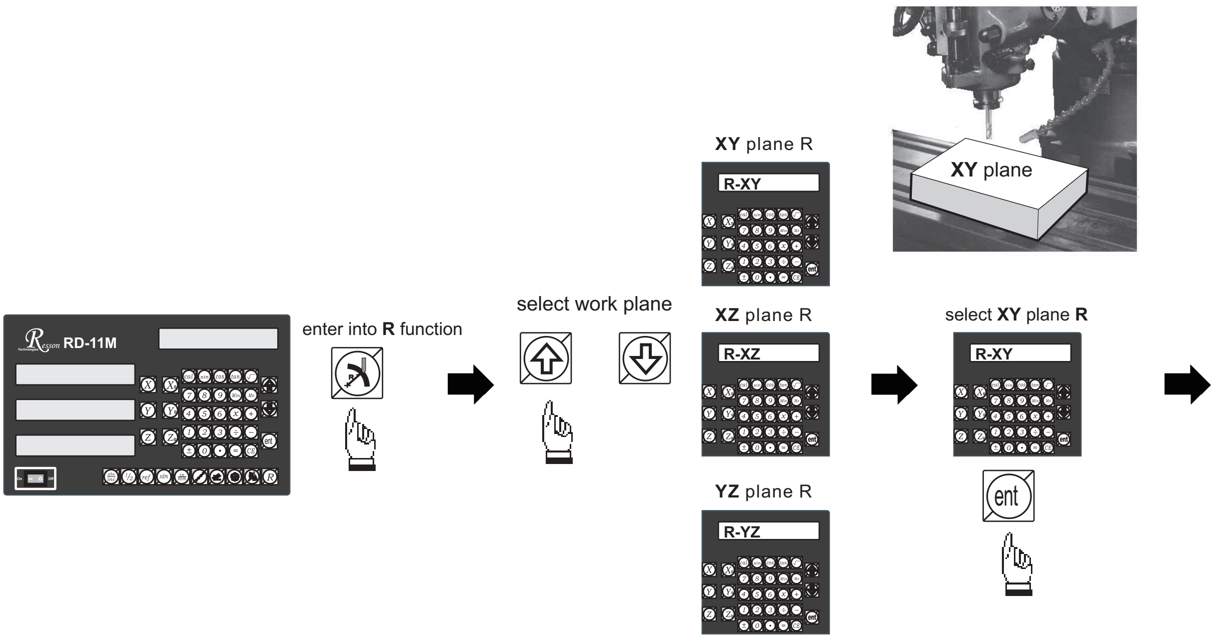
2. Centre **( CENTER ) .................. X = 20.000, Y = 20.000**
3. Radius **( R ) .............................. 20.000**
4. Start point **( ST. PT ) ................. X = 20.000, Y = 0.000**
5. End point **( ENd PT ) ................ X = 40.000, Y = 20.000**
6. Tool diameter **( TOOL DIA ) ...... 6.000 mm**

7. Tool Compensation - **( R+TOOL ) :**
   Actual ARC Radius = **R** + Tool Radius

8. Max. Cut between Interpolated points **( MAX CUT ) .... 0.3 mm**

## Operation Example

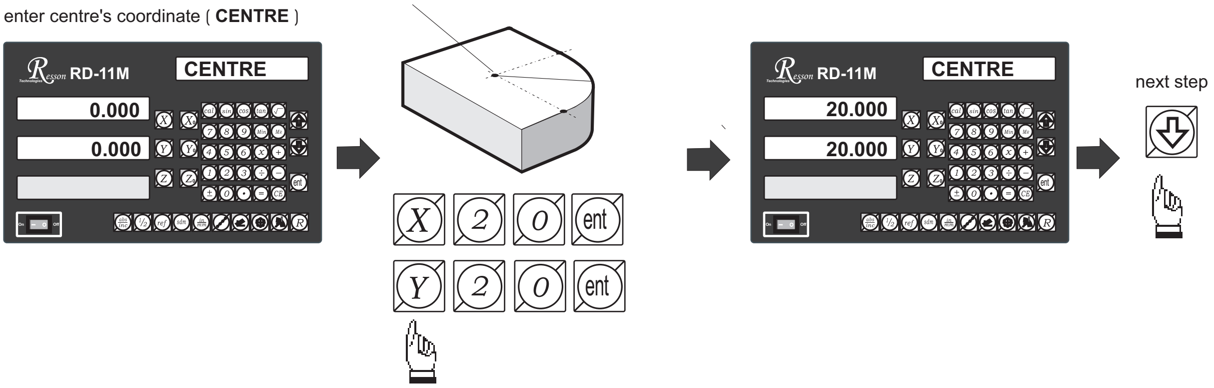
**step 1 :** select **XY** plane **R** ( **R. - XY** )



**step 2 :** enter the Centre's coordinate ( **CENTRE** )

centre coordinate ( **CENTRE** ) : **X=20.000, Y=20.000**

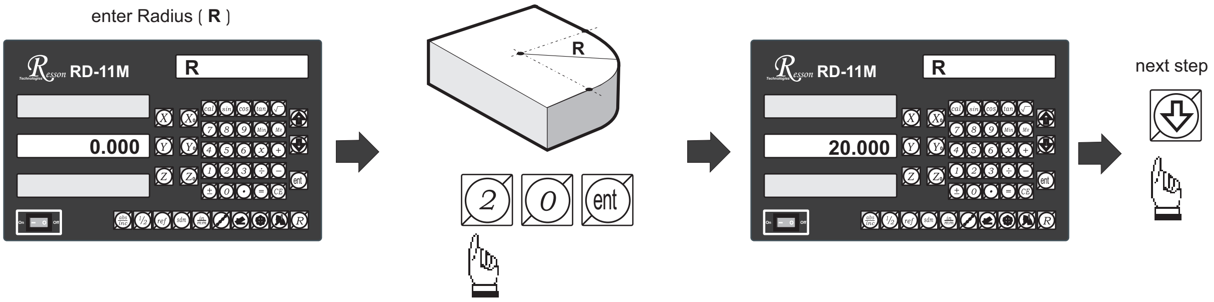
enter centre's coordinate ( **CENTRE** )




**step 3 :** enter the Radius ( **R** )

Radius ( **R** ) = **20 mm**

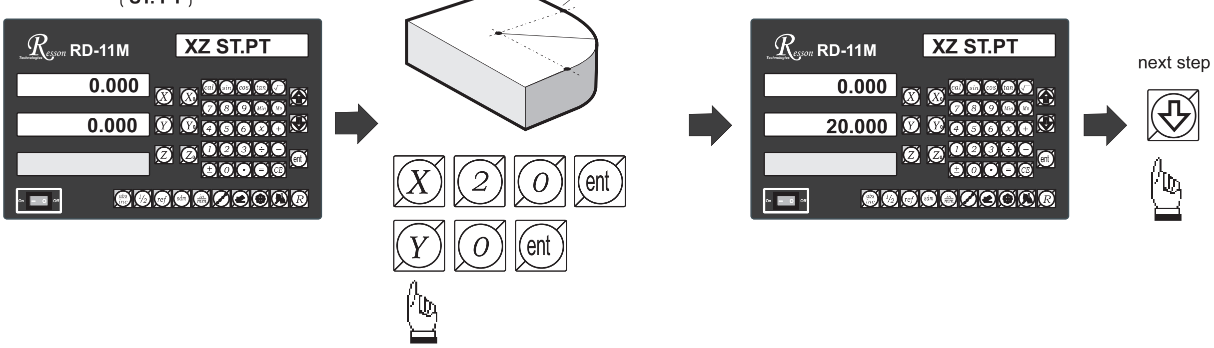
enter Radius ( **R** )



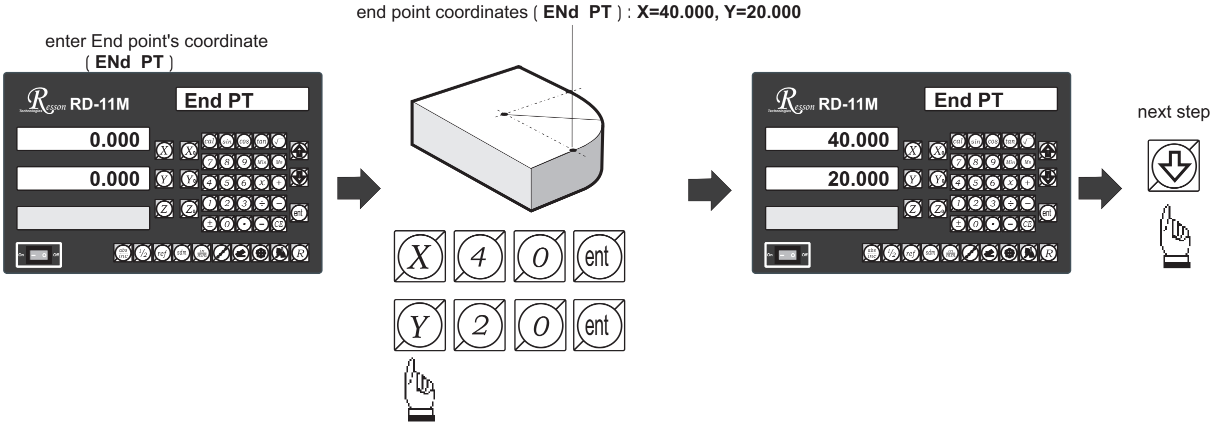

**step 4 :** enter the Start point coordinates ( **ST. PT** )

start point coordinates ( **ST. PT** ) : **X=20.000, Y=0.000**

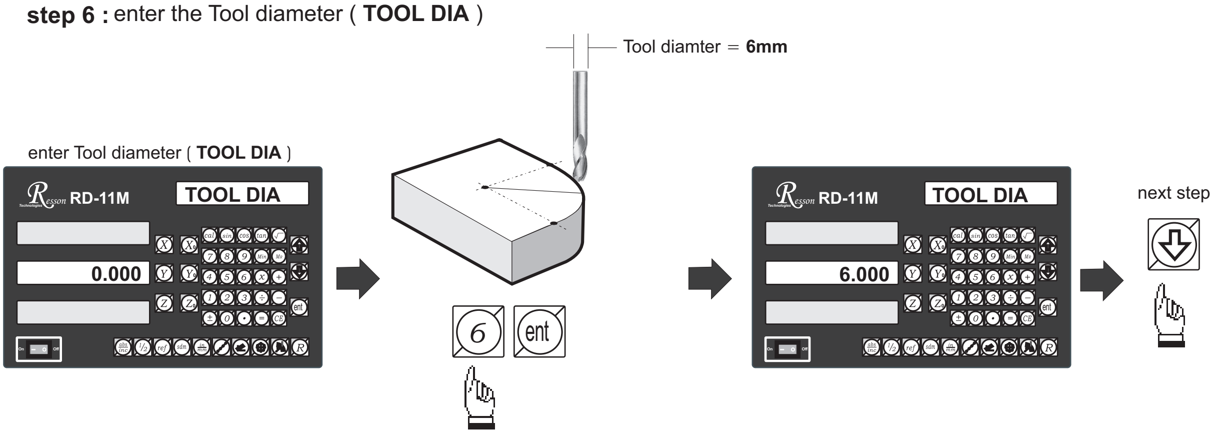
enter the start point coordinates
( **ST. PT** )



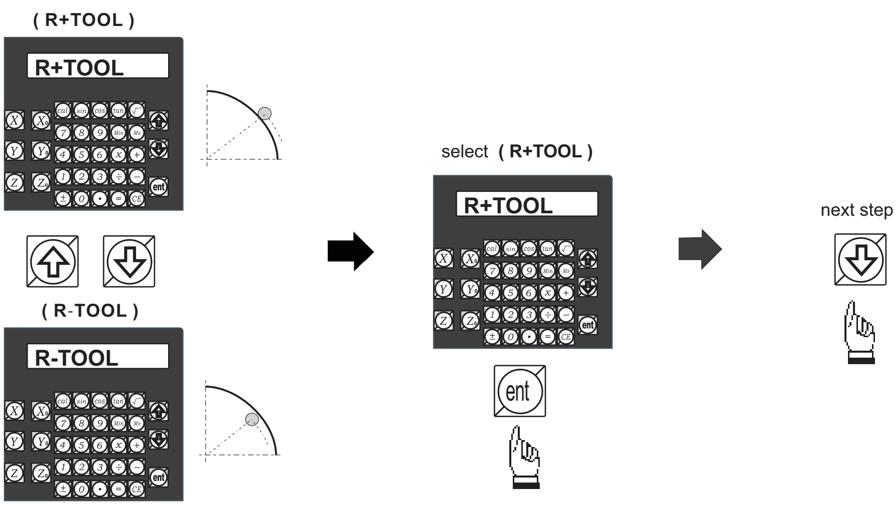
**step 5 :** enter the End point coordinates ( **ENd PT** )




**step 6 :** enter the Tool diameter ( **TOOL DIA** )

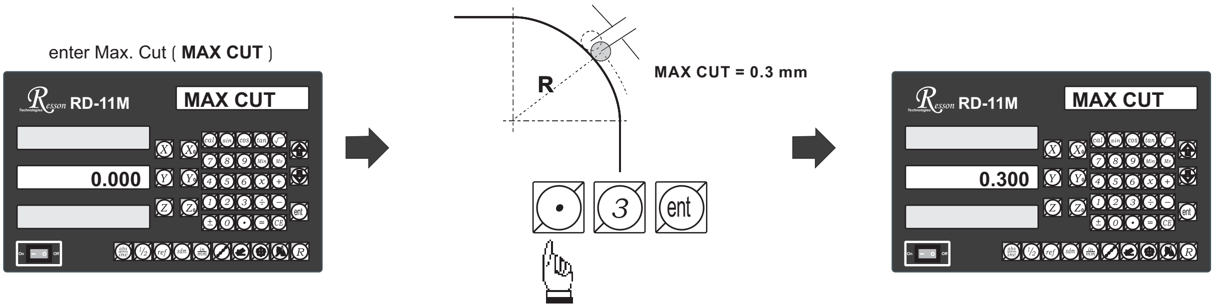



**step 7 :** select tool compensation direction



**step 8 :** enter Max. Cut between interpolated points ( **MAX CUT** )

enter Max. Cut ( **MAX CUT** )




**All R funtion machining parameters have already been entered into the RD-11M**

**to enter into ARC machining mode**

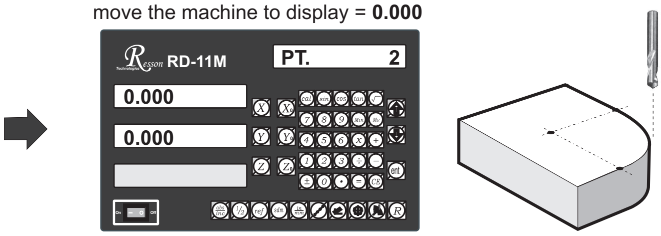
Operator can

or

to select the interpolated points along the ARC curvature, then move the machine to display = 0.000, to arrive at the ARC curvature position.

move the machine to display = **0.000**

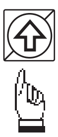
next **R** point

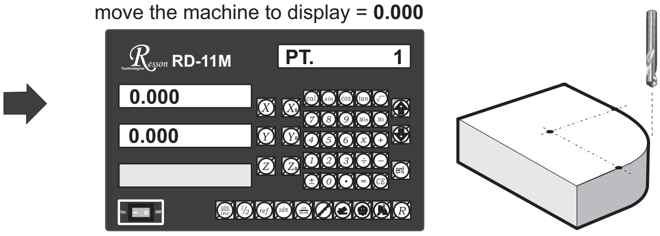



**PT. 2** = interploated point No.2

move the machine to display = **0.000**

last **R** point

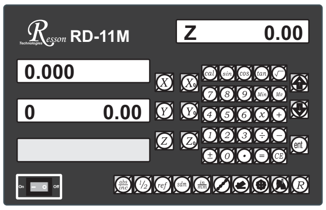




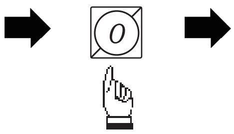

**PT. 1** = interploated point No.1

If the operator wants to verify if the RD-11M's **R** calculation is correct , or wants to temporarily exit the **R** function cycle ( swap to normal XYZ display ). The procedure is as follows :.

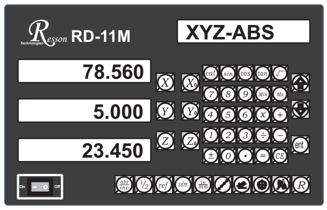
presently in **R** cycle




temporarily ***swap*** to normal XYZ coordinate display

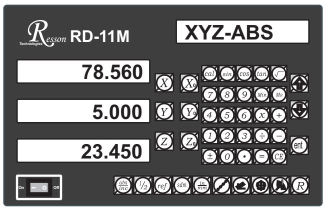



temporarily return to XYZ coordinate display

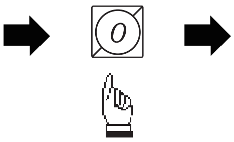



***swap back*** to R cycle to continue the **R** machining mode

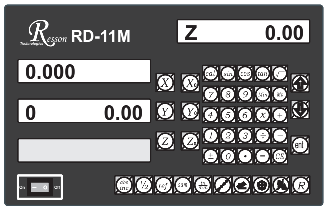
presently in the temporarily XYZ coordinate display



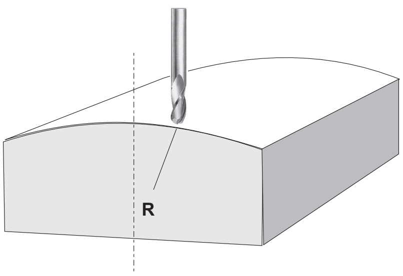

swap back to **R** function cycle

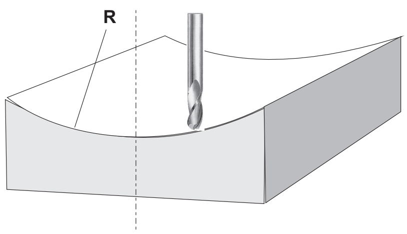


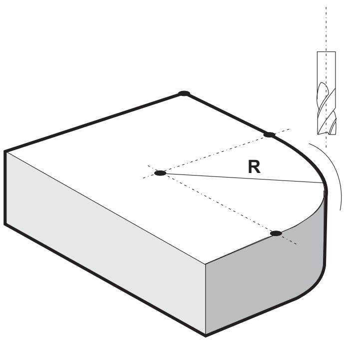

return to **R** function cycle



# Simplifiied R function



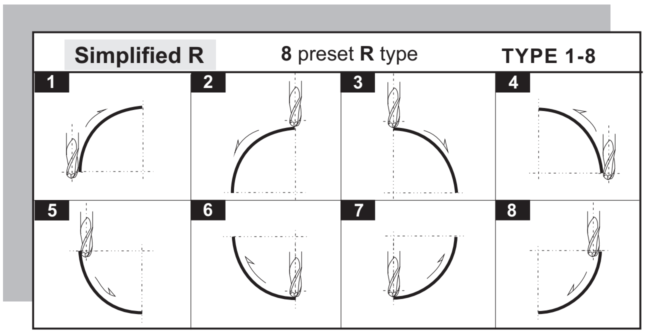



**function :** The R function of RD-11M has been designed to machine simple ARC, We have discovered and concluded from our years of experience in DRO, that in over 95% of cases, our customer only use the RD-11M to machine extremely simple ARC. This is because they found that the parameters entry of an R function was too complicated for them.

The new-design RD-11M provides a very easy-to-use R function to enable the operator to machine simple R in a very short time.

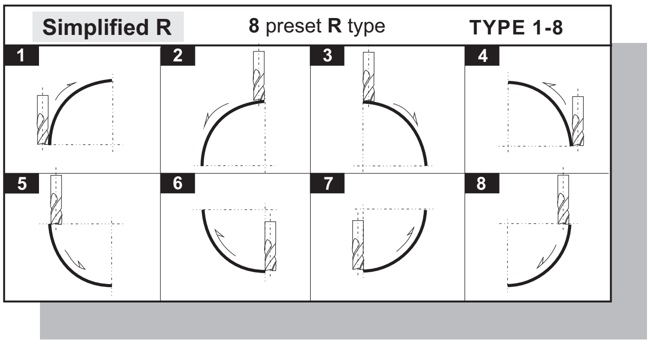
In majority of cases, only eight types of ARC are used for machining. The RD-11M has therefore incorporated those 8 type of R, and the operator must just select the type of R they need to machine their part, and input the Radius, tool compensation and increment per machining step. Then they can immediately begin ARC machining.

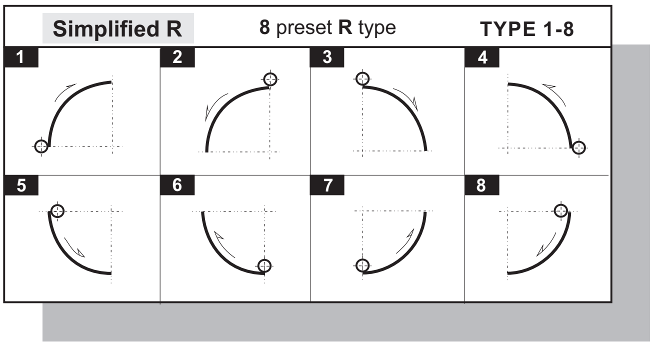



Using Ball Nose slot drill
to machine **XZ/YZ** plane **R**

Using 4 Flute End Mill
to machine **XZ/YZ** plane **R**

please notice that when using flat end end mill to machine R, as we are actually using the sharp corner for cutting, therefore the TOOL DIA must be set to 0.000

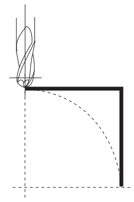


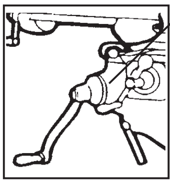

Using two Flute( **SLOT DRILL** )
for **XY** plane **R**

## The operation procedures of Simplified R are as follows

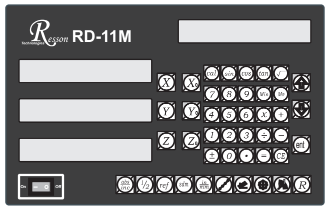
positions the tool at the ARC starting point



set the Z dial to zero



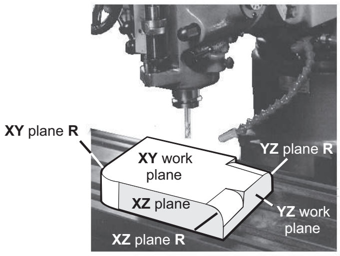
enter into Simplified R function



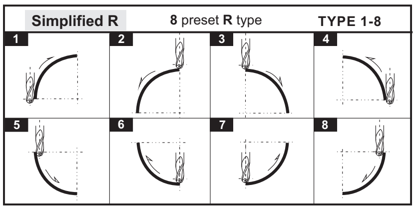


**Following parameters needed to enter into RD-11M for ARC machining :**

1. Select work plane - **XY, XZ** or **YZ** plane **R**



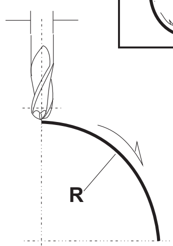

2. Select the R type ( **R TYPE** ) - Type 1 to 8



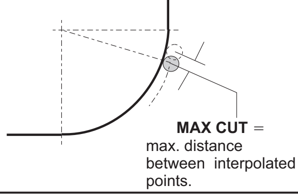
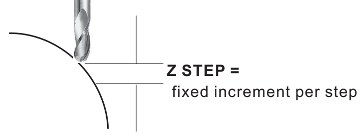
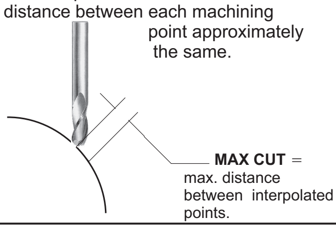

3. Radius ( **R** )

4. Tool diameter ( **TOOL DIA** )

**TOOL DIA**

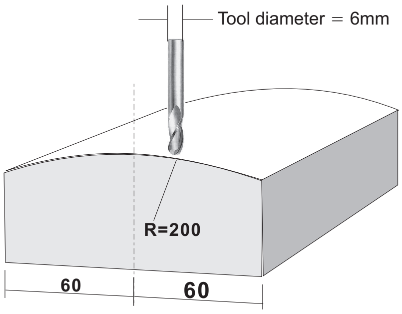


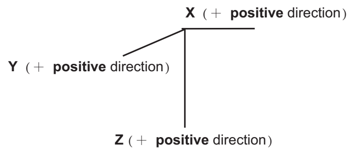

5. Machining step Increment

| **XY** plane **R** | **XZ / YZ** plane **R** | |
|---|---|---|
| For XY plane R, Max. distance between interpolated points is to be specified as the machining step increment.   | For XZ/YZ plane R, under normal condition, the Z step increment is fixed and to be specified as the machining step increment.   | For XZ/YZ plane R, under smooth R option selected. RD-11M will calculate the Z step increment so that the Max. distance between each machining point approximately the same.   |

**Example :**

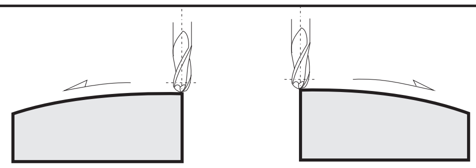
To machine the copper electrode
as shown which has an ARCof
**R = 200 mm** using a Two Axis **RD-11M**




## Operation procedures

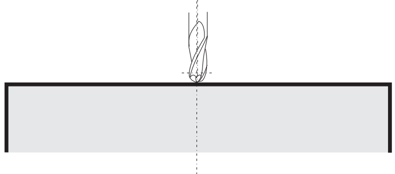
Because RD-11M's XZ/YZ can only machine
an arc which is less than 90 degrees,
it is necessary to divide this arc
machining into two parts.

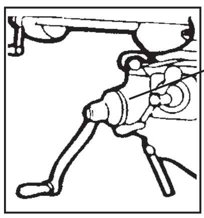


**First Part**
Use preset **R** type **2**

**Second Part**
Use preset **R** type **3**

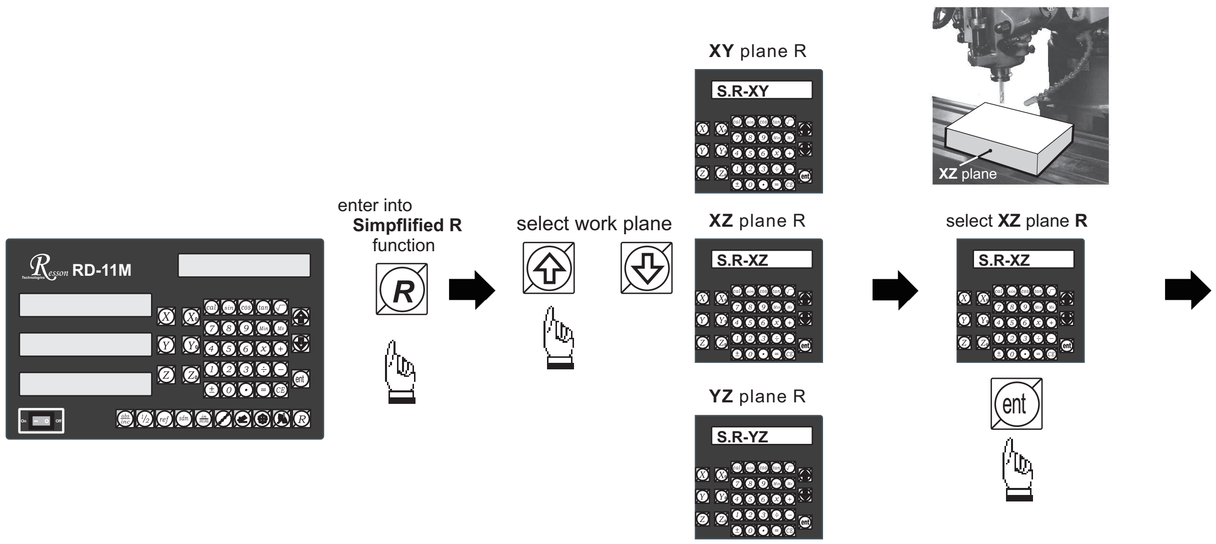
**position the tool at the ARC starting point**
( surface of the work piece centre in this case )



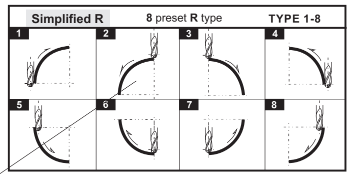


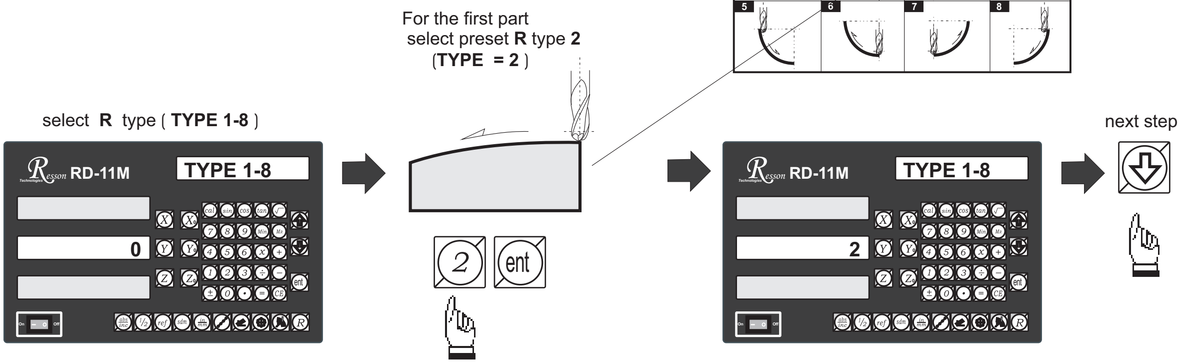
**set the Z dial to zero**

**step 1 :** select work plane : **XZ** plane **R** ( **S.R - XZ** )

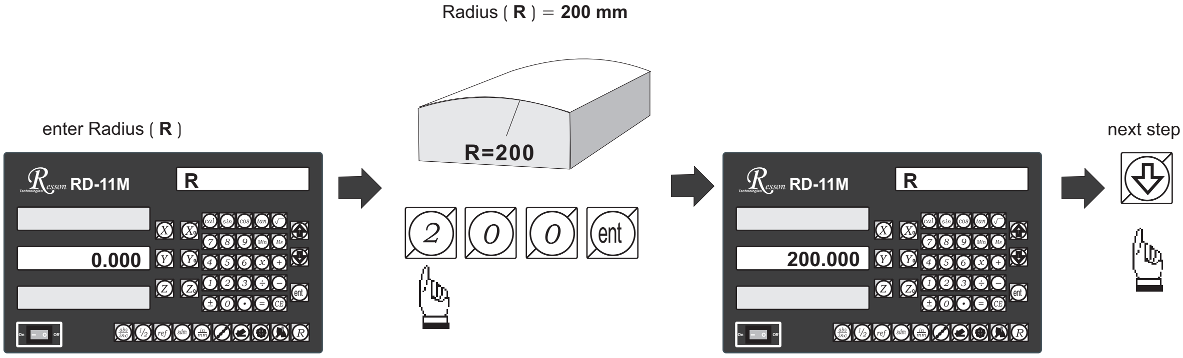


**step 2 :** select preset **R** type ( **TYPE 1-8** )

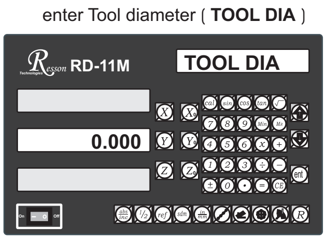


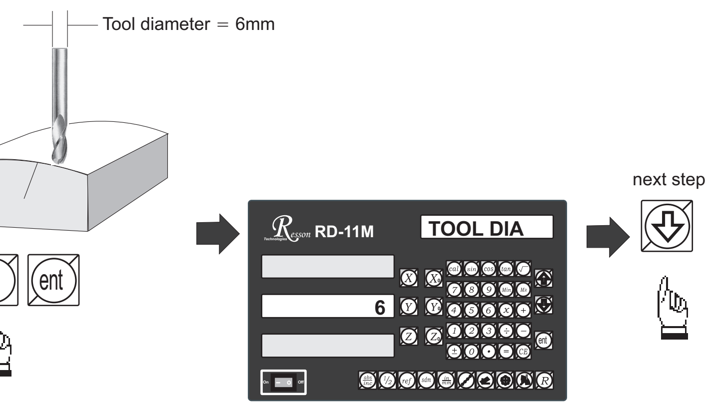




**step 3 :** enter Radius ( **R** )




**step 4 :** enter Tool diameter ( **TOOL DIA** )



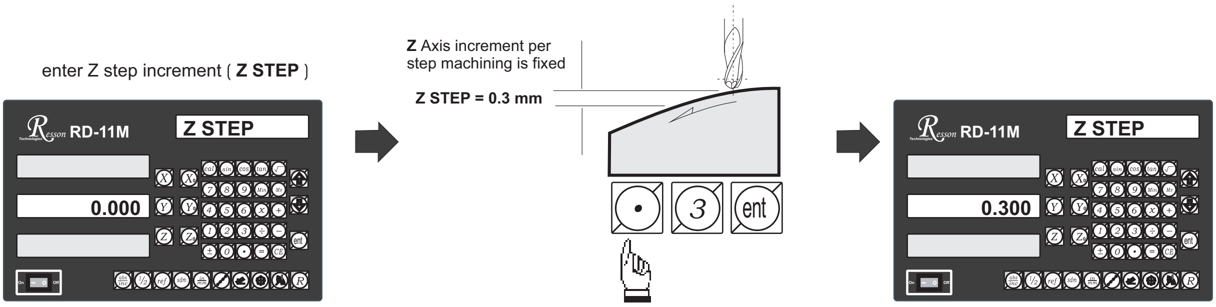



**step 5 :** enter Z increment per step machining

RD-11M provides two options on the Z increment per step machining. The operator can enter their selection on the smooth R function.

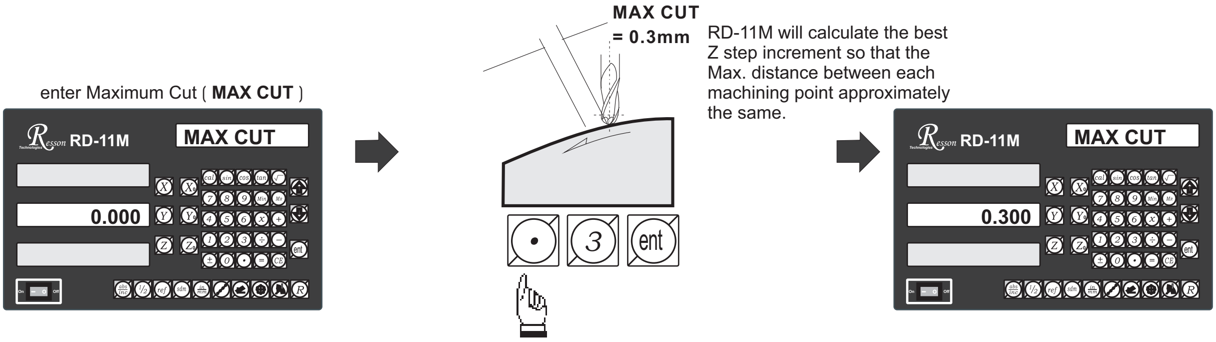
Option 1 : Fixed Z step ( **Z STEP** )

Under this option, the Z increment per step machining is fixed, since the ARc's curvature varies with their Z position, the operator has to use their experience to select different Z STEP increment during the ARC machining to get the optimal, fastest machining




Option 2 : Maximum Cut ( **MAX CUT** )

Under this option, RD-11M will calculate the best possible Z increment per step machining according to the curvature of ARC, to make the interpolated point approximately equal to the MAX CUT entered.




**All simplified R funtion machining parameters have already entered into RD-11M**

**to enter into ARC machining mode**

The two Axis **RD-11M** does not have a Z Axis, so the **RD-11M** uses the  and  to simulate the Z axis movement

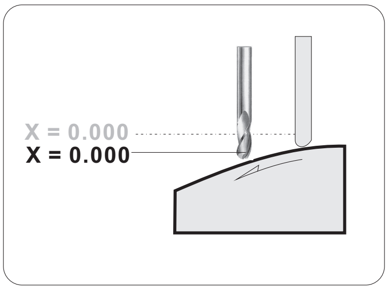
 — simulate Z axis move **up** one step

 — simulate Z axis move **down** one step

before the start of ARC machining, please ensure that the tool is positioned at the ARC starting point and Z axis dial is set to zero ( 0.000 )

During the XZ or YZ plane R machining, it is necessary to carefully position the Z axis to obtain a precise Z position. As, there is no Z axis in the two axis RD-11M, and, in order that the operator can easily guide and position the Z axis during the ARC machining, the RD-11M uses the unused axis display to display the **Z dial turn number** and **Z dial reading.**

At the beginning of the ARC machining, the RD-11M will assume the Z axis dial at zero position with the tool positioned at the starting point of the ARC. Press the  and  once to simulate Z axis move up or down for one step - the corresponding Z dail turn number and Z dial reading will display on the unused axis. The operator must move the Z axis according the dial reading display on this axis, then the correct Z axis height is reached..




**Move the X axis until display = 0.000, then the tool is positioned on the ARC curve**

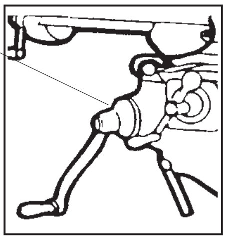
The display will **shift left** to signify it is not normal co-ordinate display.

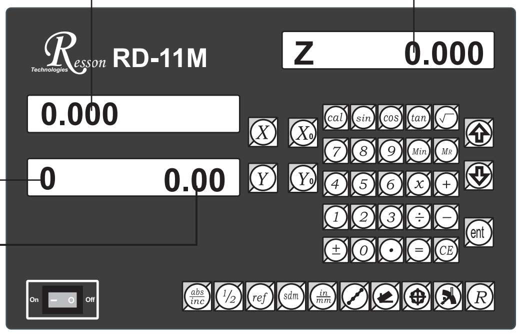
Z axis simulated height

**Z dial turn number**

**Z dial reading**

move the Z axis according to the dial settings displayed on Y axis



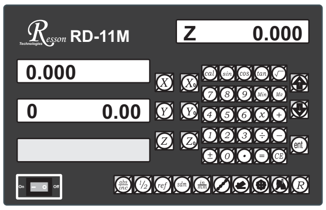



Display data in **XZ** plane **R** machining mode

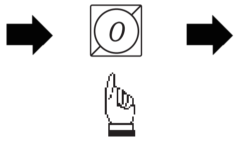
If the **Z** axis is positioned outside the **R** curvature, **RD-11M** will display "**Z OU LI**" ( **Z OUT LIMIT )**

If the operator wants to verify if RD-11M's **Simplified R** calculation is correct, or wants to temporarily exit the **R** function cycle ( swap to normal XYZ display ), The procedure is as follows :

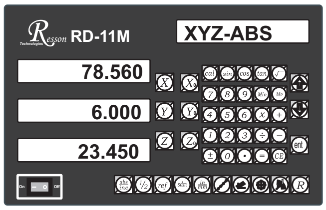
presently in **R** cycle




temporarily ***swap*** to normal XYZ coordinate display

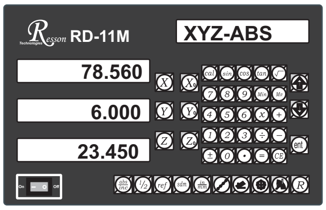



temporarily return to XYZ coordinate display

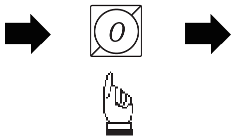



***swap back*** to R cycle to continue the **R** machining mode

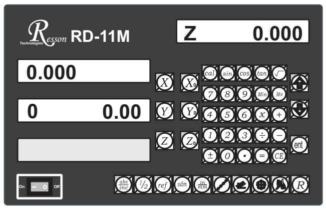
presently in the temporarily XYZ coordinate display




swap back to **R** function cycle

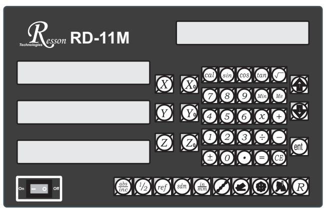



return to **R** function cycle

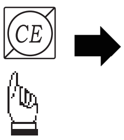


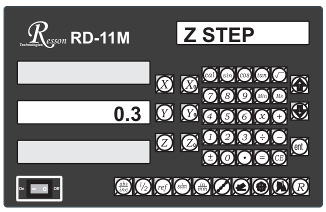

If fixed **Z STEP** option choosed, the **Z STEP** increment can be changed at any time during the ARC machining

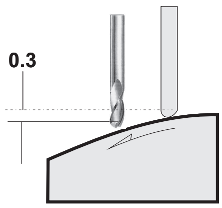
currently **Z STEP** increment = **0.3 mm**



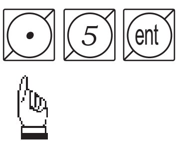

change the **Z STEP**



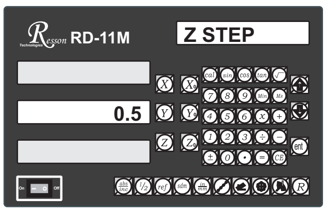



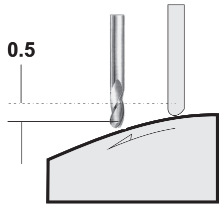




Change **Z STEP** increment to = **0.5 mm**




now the **Z STEP** increment = **0.5 mm**

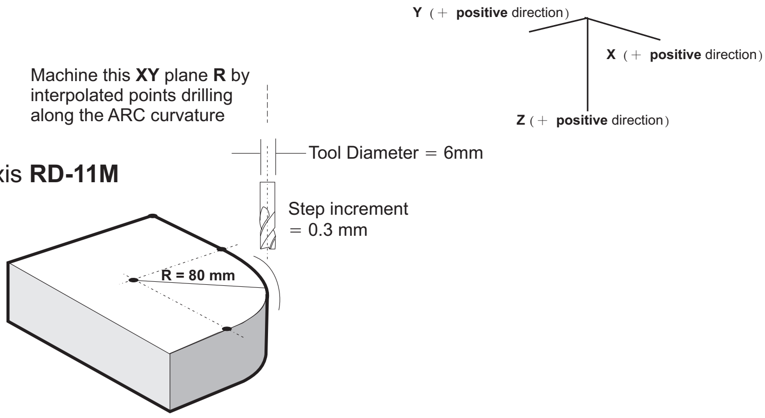


## Simplified R function

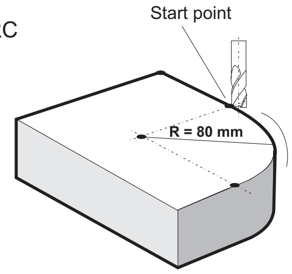
**Example :**

To machine an **XY** plane **R** using 2 Axis **RD-11M**

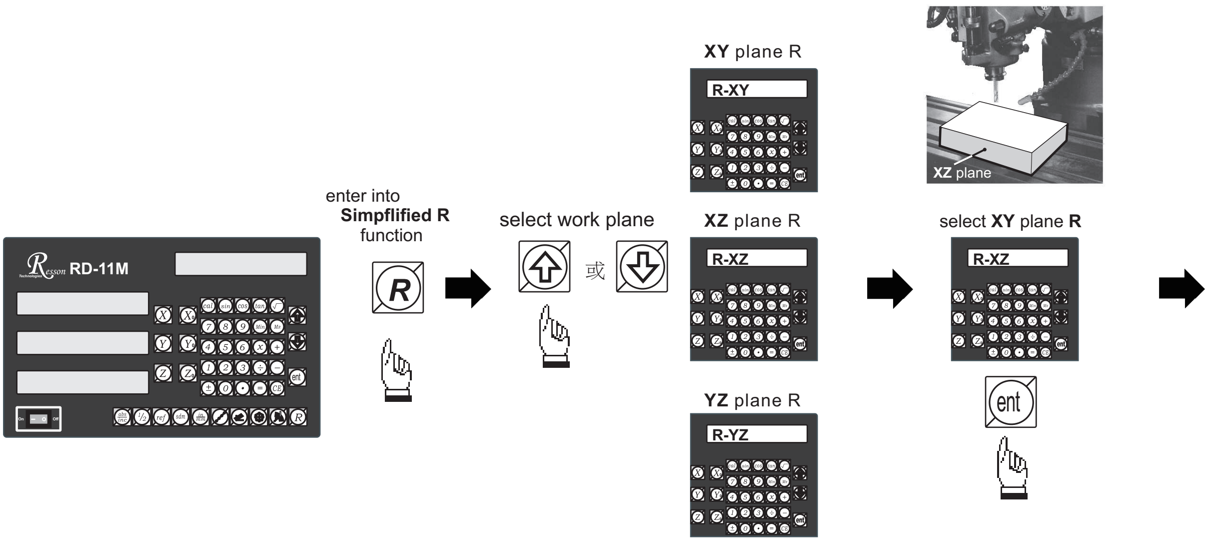



## Operation procedures

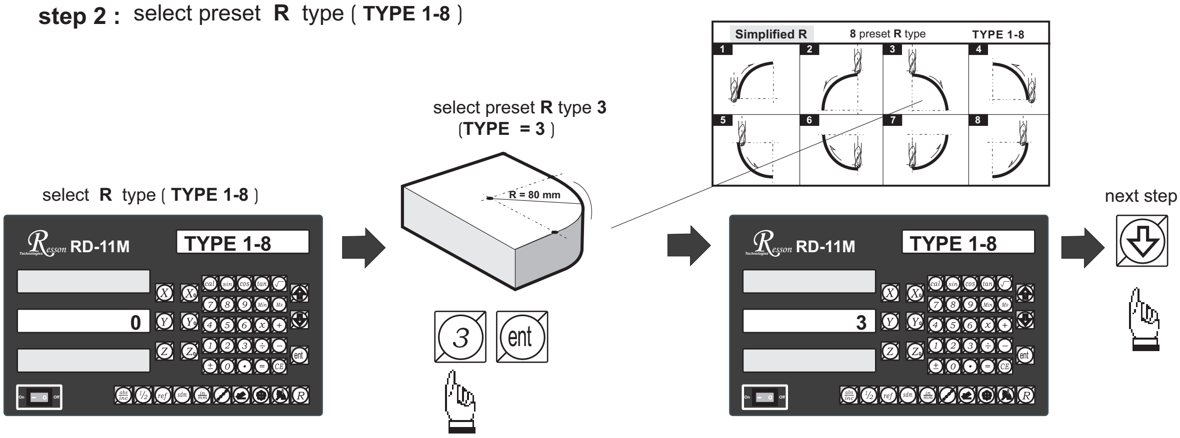
position the tool at the start point of the ARC



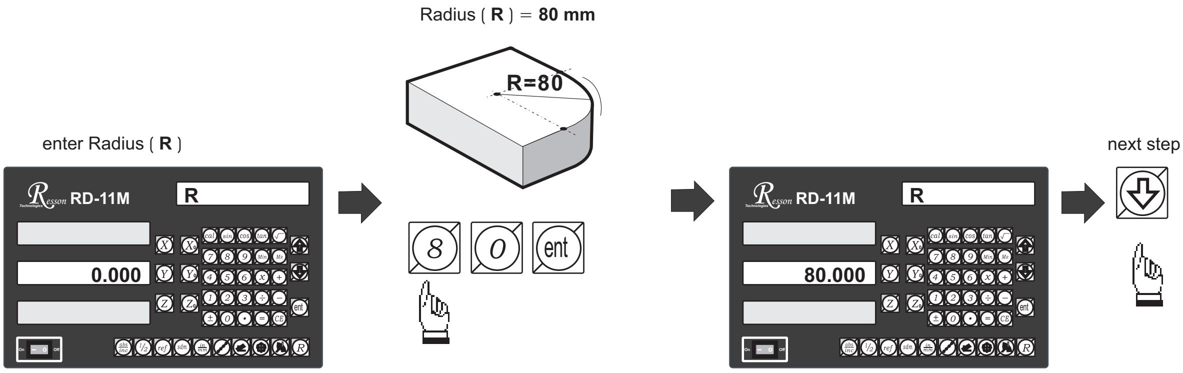

**step 1 :** select work plane : **XY** plane **R** ( **R - XY** )



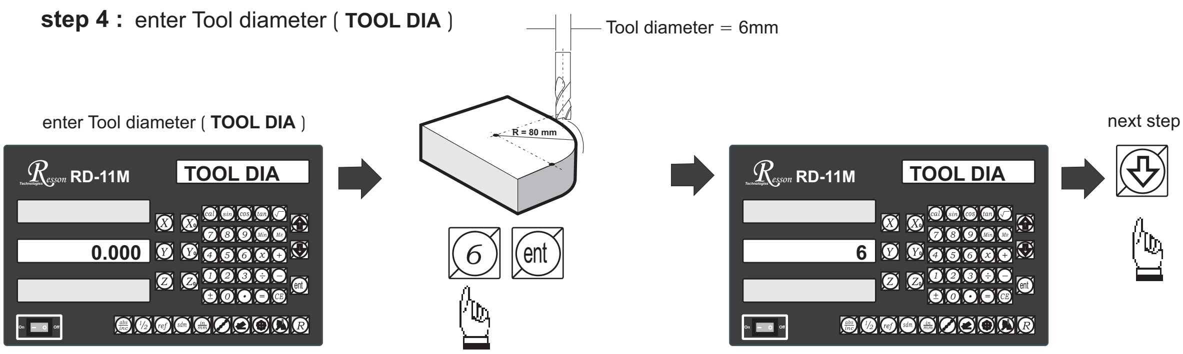
**step 2 :** select preset **R** type ( **TYPE 1-8** )




**step 3 :** enter Radius ( **R** )

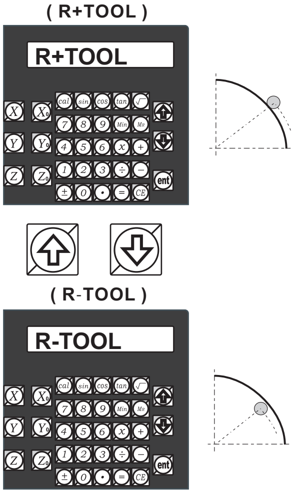



**step 4 :** enter Tool diameter ( **TOOL DIA** )



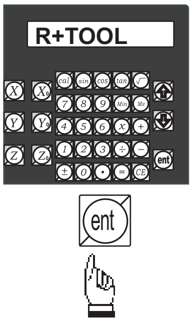
**step 5 :** select tool compensation direction

**( R+TOOL )**




**( R-TOOL )**

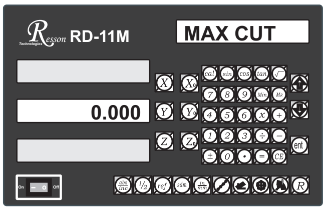
select **( R+TOOL )**

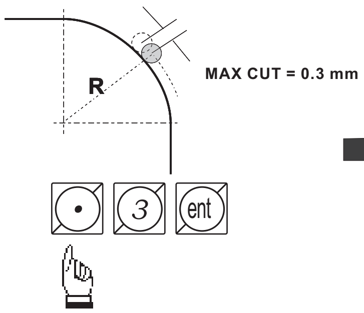


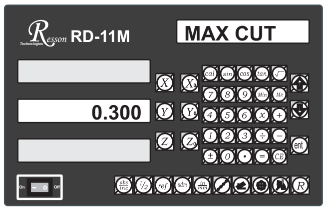

next step

**step 6 :** enter Max. Cut between interpolated points ( **MAX CUT** )

enter Max. Cut ( **MAX CUT** )



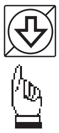




**All simplified R funtion machining parameters have already entered into RD-11M**

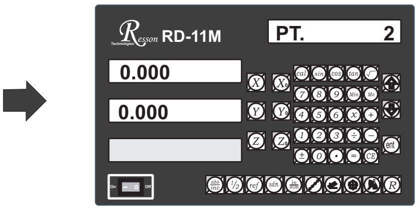
**to enter into ARC machining mode**

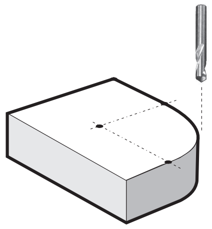
Operator can  or  to select the interpolated points along the ARC curvature, then move the machine to display = 0.000, to arrive at the ARC curvature position.

next **R** point



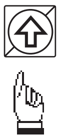
move the machine to display = **0.000**



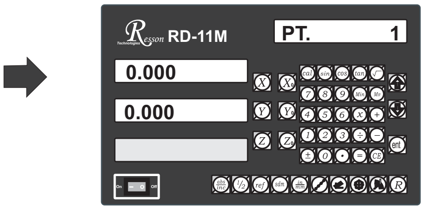



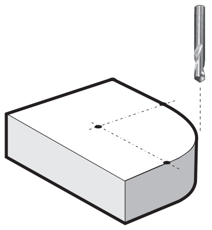
**PT. 2** = interploated point No.2

last **R** point



move the machine to display = **0.000**

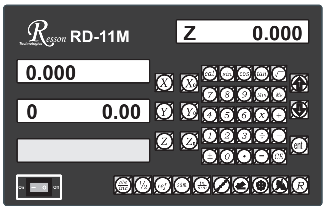


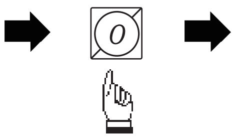
**PT. 1** = interploated point No.1

If the operator wants to verify if RD-11M's **R** calculation is correct, or wants to temporarily exit the **R** function cycle ( swap to normal XYZ display ). The procedure is as follows :

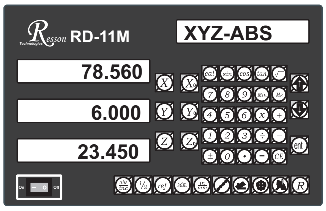
presently in **R** cycle




temporarily ***swap*** to normal XYZ coordinate display

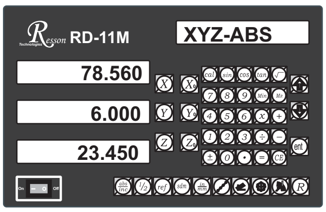


temporarily return to XYZ coordinate display

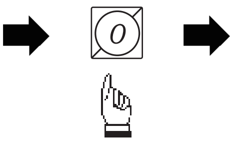



***swap back*** to R cycle to continue the **R** machining mode

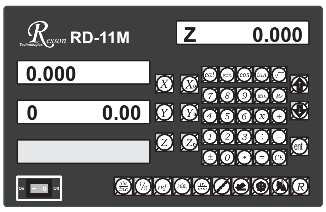
presently in the temporarily XYZ coordinate display



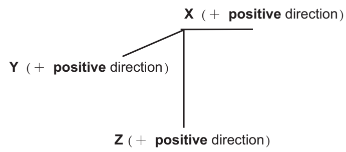

swap back to **R** function cycle



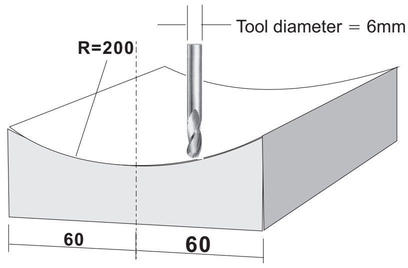
return to **R** function cycle



**Example :**

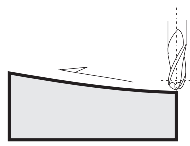



To machine the copper electrode
as shown which has an ARCof
**R = 200 mm** using a Two Axis **RD-11M**

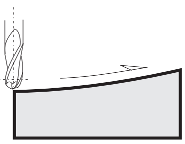



## Operation procedures

Because RD-11M's XZ/YZ can only machine
an arc which is less than 90 degrees,
it is necessary to divide this
arc machining into two parts.



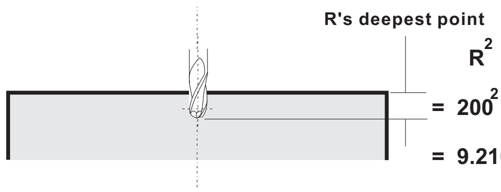
**First Part**
Use preset **R** type **6**



**Second Part**
Use preset **R** type **7**

**posit the tool at the ARC starting point**

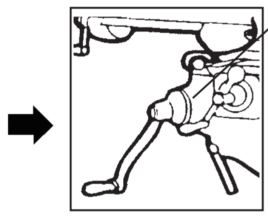
**set the Z dial to zero**



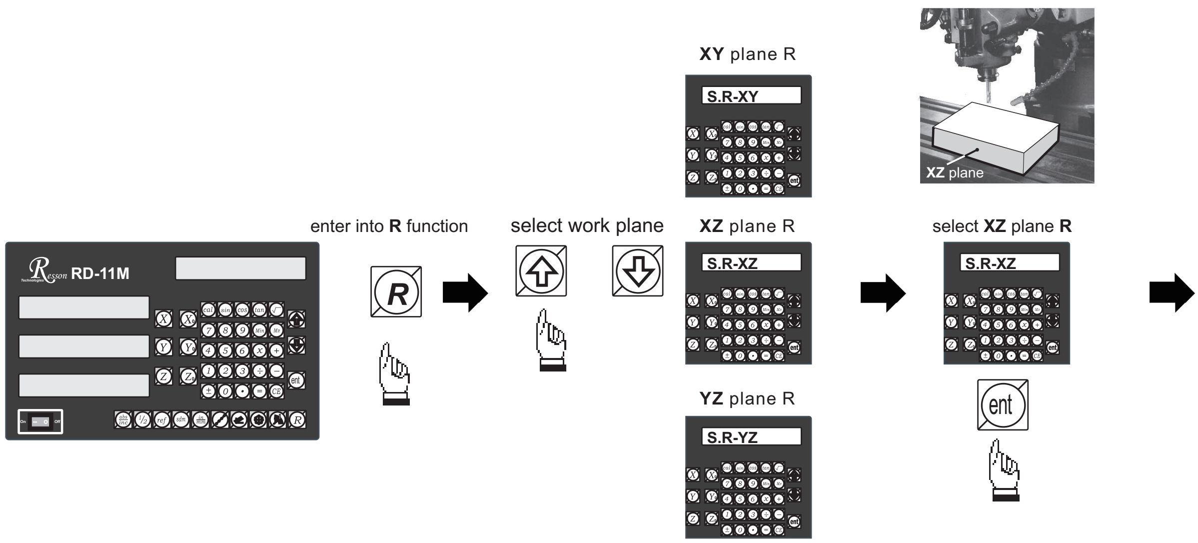

$$R^2 - \sqrt{R^2 - L^2}$$

$$= 200^2 - \sqrt{200^2 - 60^2}$$

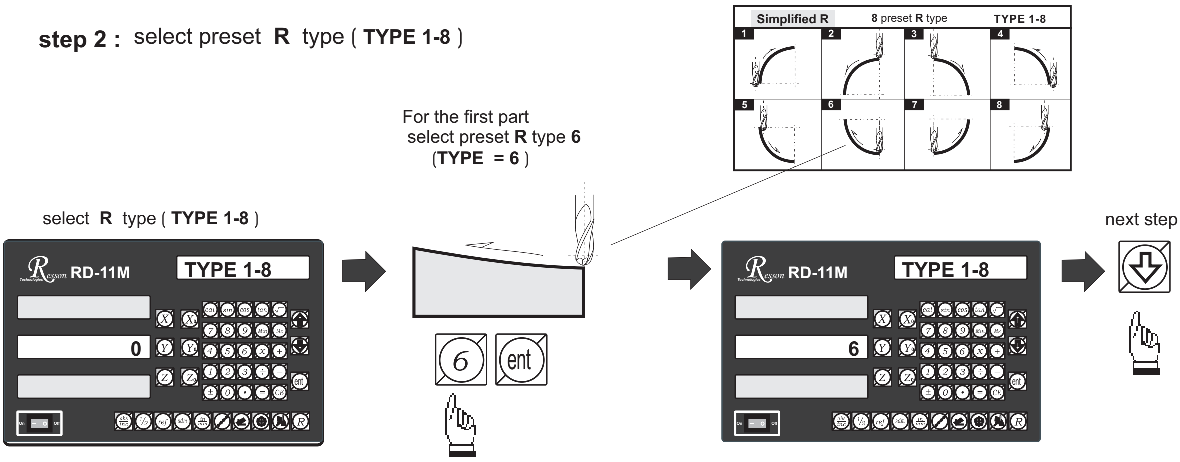
$$= 9.210 \text{ mm}$$



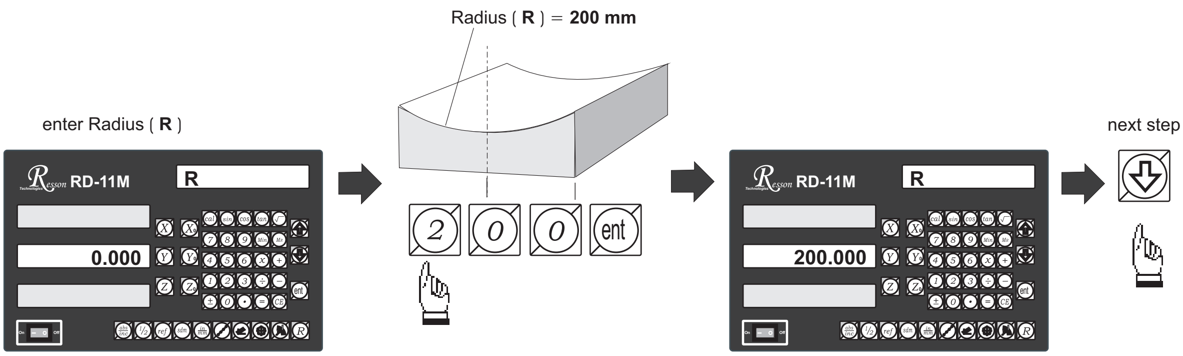
**step 1 :** select work plane : **XZ** plane **R** ( **S.R - XZ** )



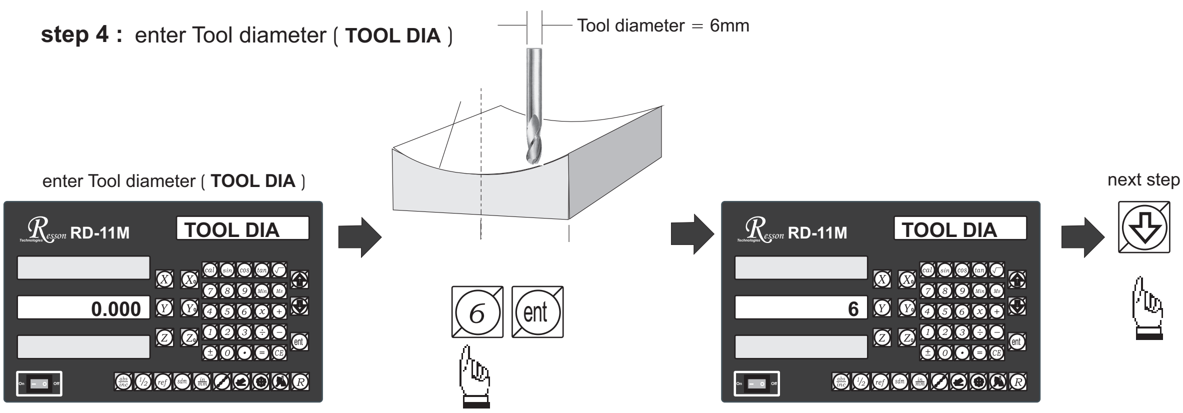
**step 2 :** select preset **R** type ( **TYPE 1-8** )




**step 3 :** enter Radius ( **R** )



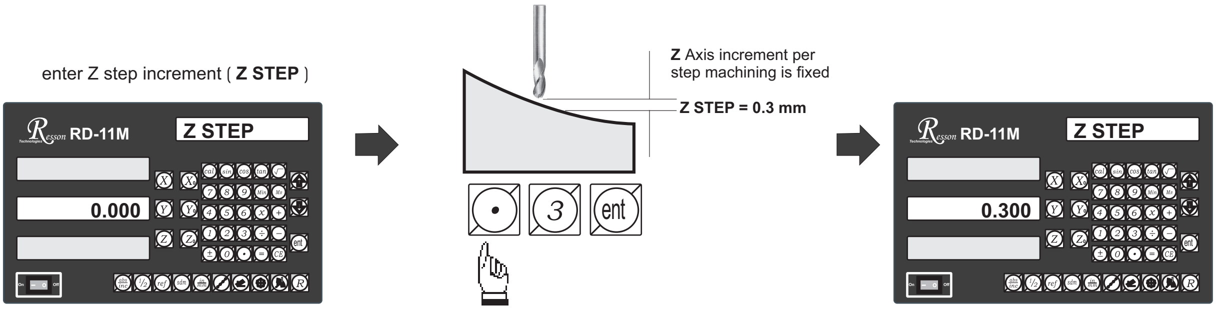

**step 4 :** enter Tool diameter ( **TOOL DIA** )



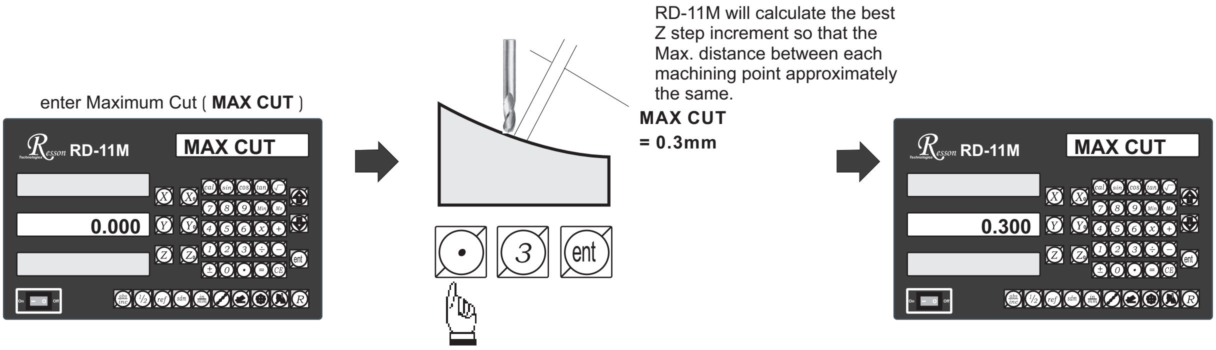
**step 5 :** enter Z increment per step machining

RD-11M provides two options on the Z increment per step machining. Operator can make their selection on the smooth R function.

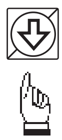
Option 1 : Fixed Z step ( **Z STEP** )
Under this option, the Z increment per step machining is fixed, since the ARC's curvature varies with the Z position, the operator has to use their experience to select different Z STEP increment during the ARC machining to get the optimal, fast machining




Option 2 : Maximum Cut ( **MAX CUT** )
Under this option, RD-11M will calculate the best possible Z increment per step machining according to the curvature of ARC, to make the interpolated point approximately equal to the MAX CUT entered.




**All simplified R funtion machining parameters have already entered into RD-11M**



**to enter into ARC machining mode**

The two Axis **RD-11M** does not have a Z Axis, so the **RD-11M** uses the  and  to simulate the Z axis movement

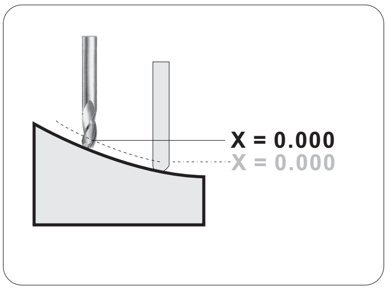
 — simulate Z axis move **up** one step

 — simulate Z axis move **down** one step

before the start of ARC machining, please ensure that the tool is positioned at the ARC starting point and Z axis dial is set to zero ( 0.000 )

During the XZ or YZ plane R machining, it is necessary to carefully position the Z axis to obtain a precise Z position. As, there is no Z axis in the two axis RD-11M, and, in order that the operator can easily guide and position the Z axis during the ARC machining, the RD-11M uses the unused axis display to display the **Z dial turn number** and **Z dial reading.**

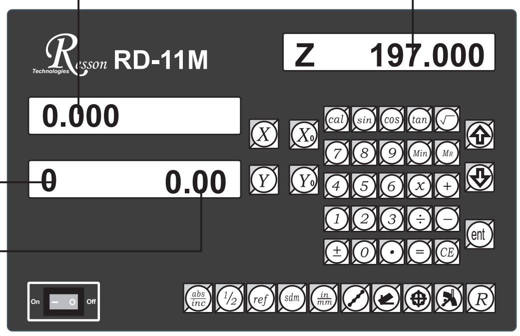
At the beginning of the ARC machining, the RD-11M will assume the Z axis dial at zero position with the tool positioned at the starting point of the ARC. Press the  and  once to simulate Z axis move up or down for one step - the corresponding Z dail turn number and Z dial reading will display on the unused axis. The operator must move the Z axis according the dial reading display on this axis, then the correct Z axis height is reached..




**Move the X axis until display = 0.000, then the tool is positioned on the ARC curve**

The display will **shift left** to signify it is not normal co-ordinate display.

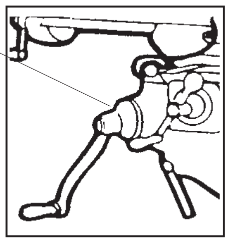
Z axis simulated height




**Z dial turn number**

**Z dial reading**

move the Z axis according to the dial settings displayed on Y axis

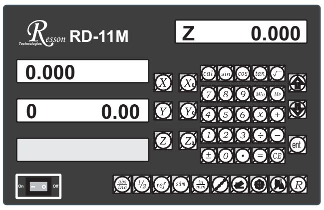


Display data in **XZ** plane **R** machining mode

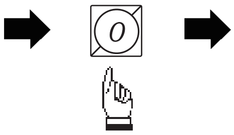
If the **Z** axis is positioned outside the **R** curvature, **RD-11M** will display "**Z OU LI**" ( **Z OUT LIMIT )**

If the operator wants to verify if the RD-11M's **Simplified R** calculation is correct, or wants to temporarily exit the **R** function cycle ( swap to normal XYZ display ). The procedure is as follows :

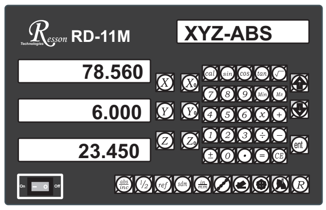
presently in **R** cycle




temporarily ***swap*** to normal XYZ coordinate display

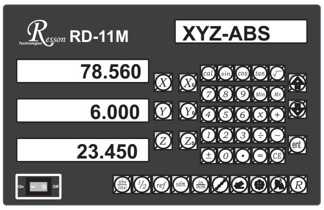



temporarily return to XYZ coordinate display

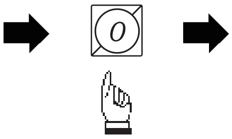



***swap back*** to R cycle to continue the **R** machining mode

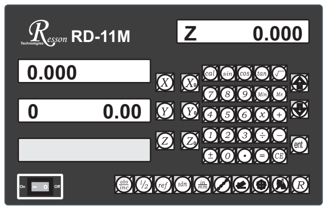
presently in the temporarily XYZ coordinate display




swap back to **R** function cycle

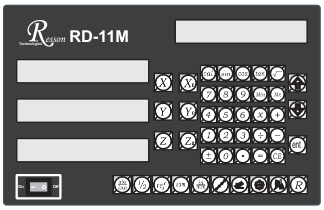



return to **R** function cycle

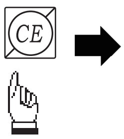


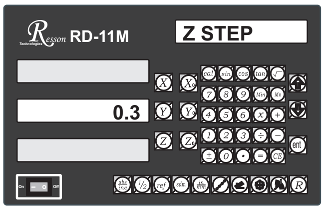

If fixed **Z STEP** option is chosen, the **Z STEP** increment can be change anytime during the ARC machining

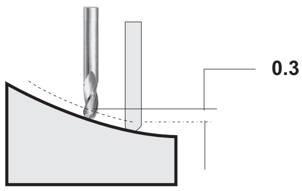
currently **Z STEP** increment = **0.3 mm**



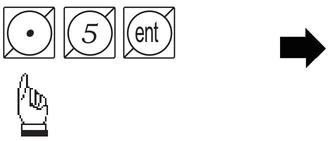

change the **Z STEP**



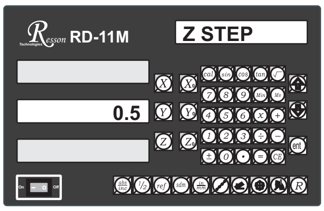



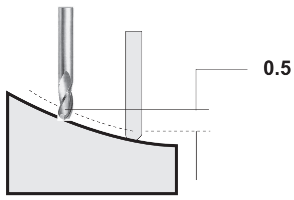




Change **Z STEP** increment to = **0.5 mm**

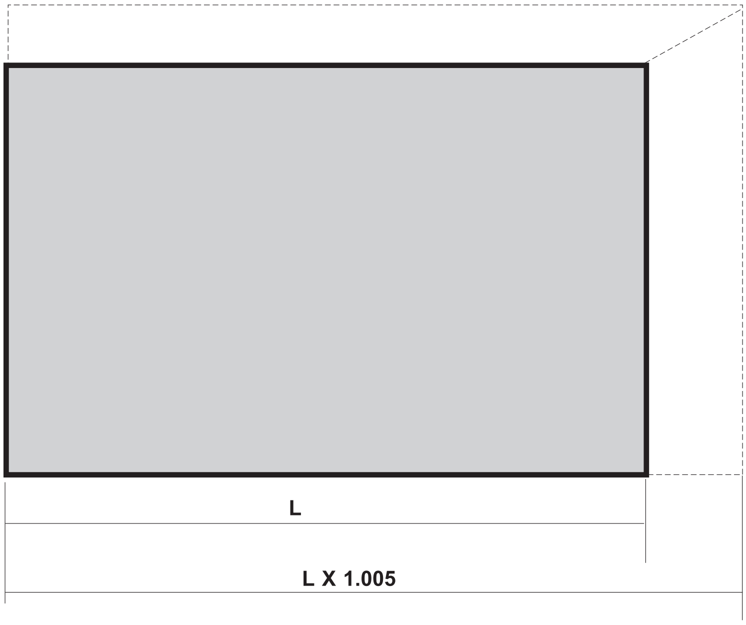



now the **Z STEP** increment = **0.5 mm**



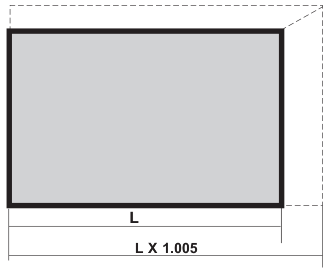



# Shrinkage Calculation



## Shrinkage calculation

**function :** Because plastic material shrinks during cooling after the the plastic injection process, therefore, when making a mould for plastic injection, the dimensions of the mould cavity have to be expanded or reduced according to a "shrink factor", ie for normal ABS material, the "shrink factor" is 1.005.




Normally, the mould maker has to calculate all the reduced or expanded dimensions prior to the actual machining, marking down the dimensions on the drawing. The pitfalls of this method areas follows:

1) It is a very time consuming process
2) Because there are a lot of calculations, it is inevitable that some calculation mistakes, or incomplete calculation ( some calculations are omitted by mistake ) occurs. There is also no easy method of verifying the calculated dimensions and it is too easy to make mistakes, subjecting the operator to heavy psychological pressure.
3) Mould work has to be correct first time, bearing in mind the cost of the product.

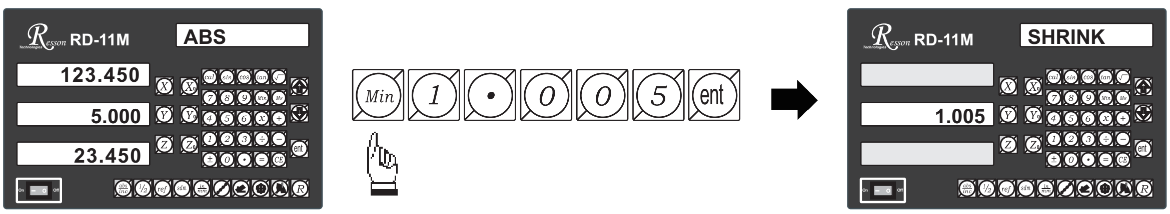
**RD-11M provides the world's first practical "SHRINKAGE CALCULATION" function to help the mould maker calculate the shrinkage and verify the calculated expanded/ reduced dimension.**

## Operation procedure

### 1. Entering the "SHRINK FACTOR"

All the shrinkage dimensions are actually the multiples or divisions of a shrinkage factor, the shrinkage factors change for different plastic material.Before machining the operator must enter the shrink factor into the **RD-11M.**

Example : For material ( ABS plastic ), the shrink factor is 1.005.



## 2. Shrinkage Calculations

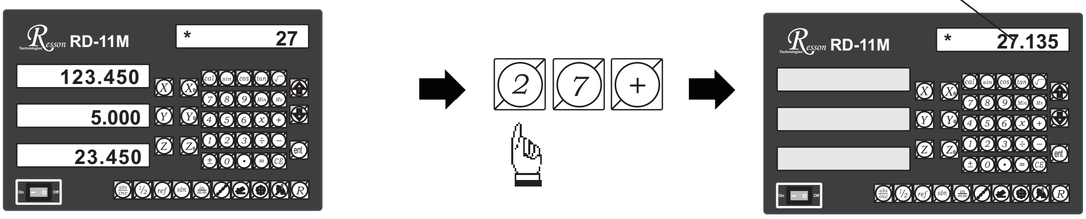
RD-11M provides a very easy-to-use shrinkage function, and allows the operator to easily calculate the expanded or reduced dimensions.

It is normally used in a case where incomplete shrinkage calculation have been made, ie some dimensions have been forgotten to be marked onto the drawing. Using the RD-11M during the machining process, the operator can calculate the shrinkage dimensions directly with the readout. RD-11M also provides an easy method of verifying the calculated dimension marked on the drawings.

**RD-11M** uses + for expand calculation − for shrink calculation

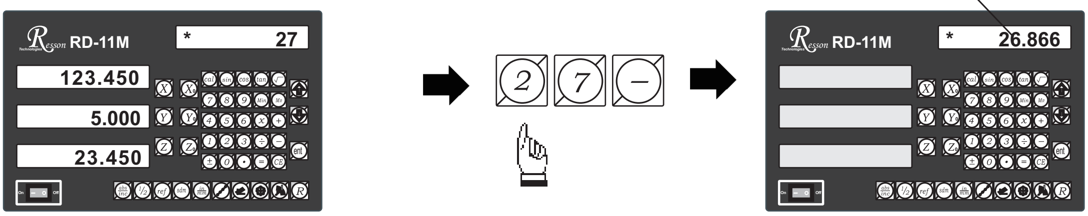
**Example :** To calculate the expanded dimension of 27mm

27mm expand = 27 x 1.005 = 27.135
Calculation result will display in the message window



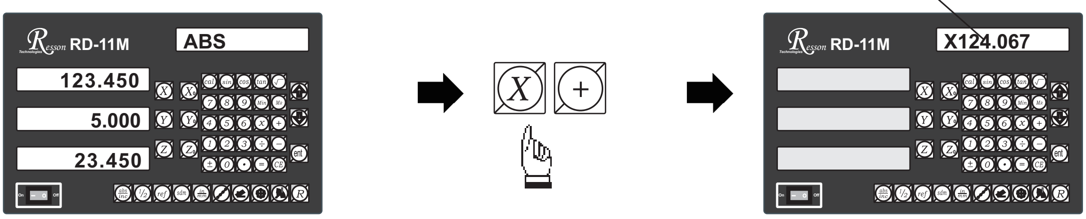

**Example :** To calculate the shrinked dimension of 27mm

27mm shrink = 27 / 1.005 = 26.866
Calculation result will display in the message window




**Example :** To calculate the expanded dimension of current X axis dimension

The current position of X axis is 123.45, therefore, 123.45 mm expands = 123.45 x 1.005 = 124.067
Calculation result will display in the message window



## 3. Shrinkage Compensation

When the operator is familiar with the shrinkage function of RD-11M, instead of calculating all the shrink dimensions and marking them onto the drawing, the operator can use the shrinkage compensation features of the RD-11M which actually expand or reduce all display dimension acccording to the multiples of the shrink factor, thereby, the need to calculate all the working dimensions one by one.

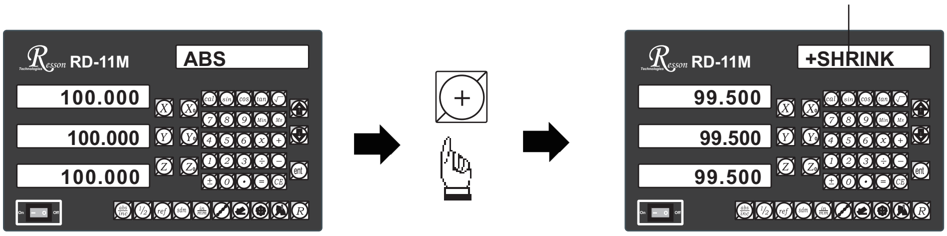
If the operator still insists that they have more confidence by calculating all shrink dimensions prior to the actual machining process and marking them on the drawing, the RD-11M shrinkage compensation function can still be used to provide a very efficient way of verifying the operator's calculated dimensions, marked on the drawing by using the "Expand" and "Shrink" toggle-function to switch between real-dimension display and shrinkage-compensated-dimension display.

**RD-11M** uses (+) for expand calculation (–) for shrink calculation

**Example :** To compensate by "Expand", so that the actual dimensions are the expanded dimension of the RD-11M's display dimensions.

Because the display dimension has compensated by the shrink factor, in order to remind operator that RD-11M is currently in shrink compensation mode to avoid operation mistake, RD-11M will display

1. flashing display of "+ SHRINK"
2. get a beep sound for every 10 SEC.
3. disable all functions and function keys

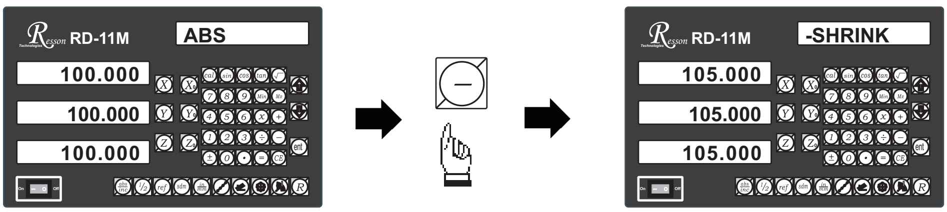



**Real Dimension**

**Compensated dimensions :**

The actual dimension are now X 1.005 of the displayed dimensions

**Example :** To compensate by "Shrink", so that the actual dimensions are the shrinked dimension of the RD-11M's display dimensions.

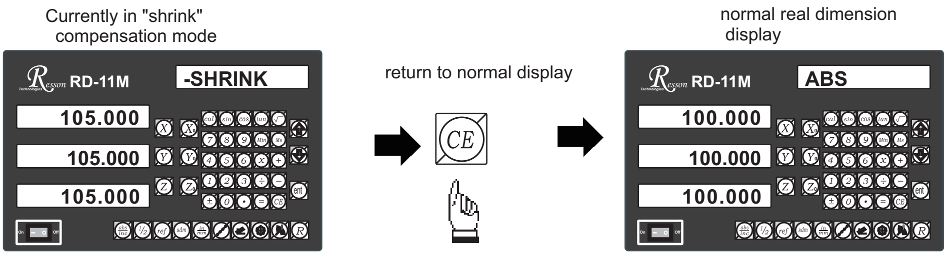


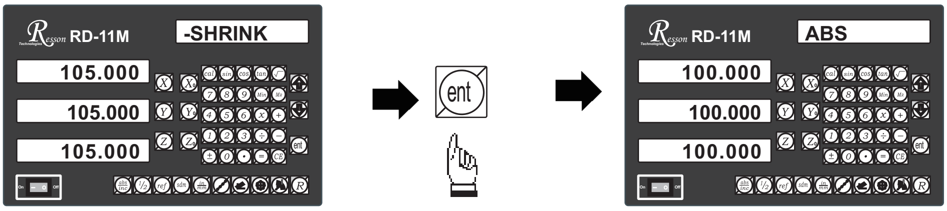

**Real Dimension**

**Compensated dimensions :**

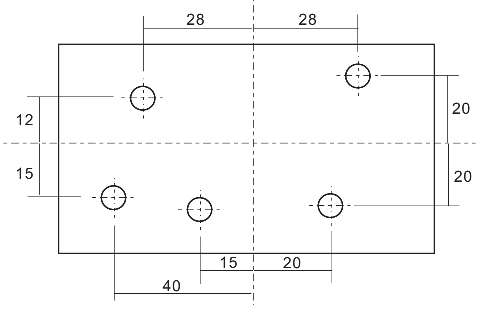
The actual dimension are now / 1.005 of the displayed dimensions

**When the RD-11M is in shrink compensation mode, if the operator wants to return to normal real dimension display.** **press** CE **or** ent



**Example :** To drill the following holes in the plastic injection mould



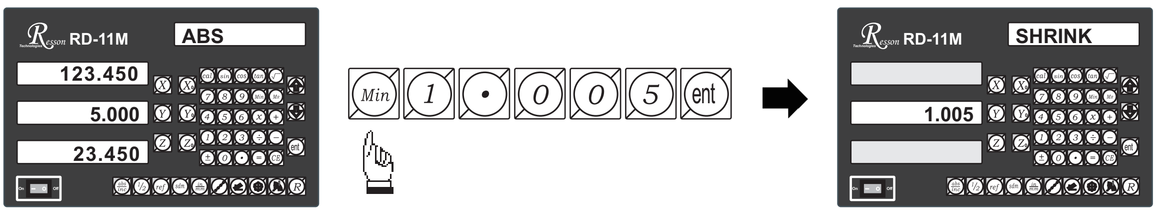

Because the plastic material shrinks when it cools down after the plastic injection process, the dimensions of the holes in the mould have to be expanded according to the shrink factor.

Normally, the operator has to calculate all the expanded dimensions prior to the machining, but with RD-11M, the operator can use RD-11M's "shrink compensation" function which actually expands the display dimension by the shrink factor, enabling , the operator to drill directly according to the dimensions specified in tjhe drawing, obviating the need to calculate the reduced dimensions one by one.

## Operation procedure

### 1. Entering the "SHRINK FACTOR"

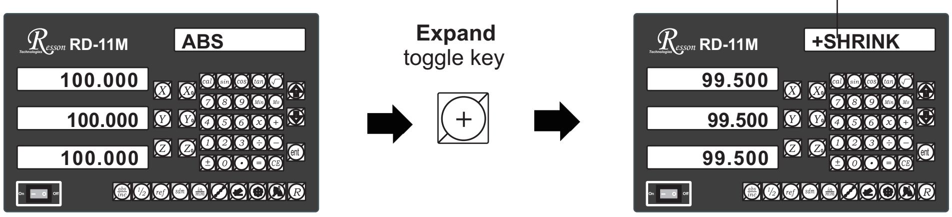
i.e : For plastic material ( ABS ), it's shrink factor is 1.005.




### 2. Set the RD-11M to "Expand Compensation"

Because the display dimension has compensated by the shrink factor, in order to remind operator that RD-11M is currently in shrink compensation mode to avoid operation mistake, RD-11M will display

1. flashing display of "+ SHRINK"
2. get a beep sound for every 10 SEC.
3. disable all functions and function keys




**Real Dimension**

**Compensated dimensions :**

The actual dimension are now X 1.005 of the displayed dimensions

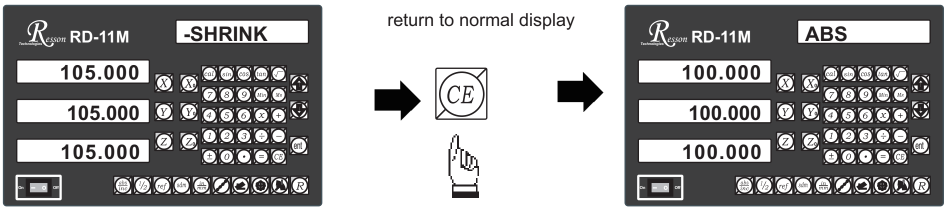
Operator can drill the holes as above in this mode without the need of calculation

**When the RD-11M is in shrink compensation mode, if the operator wants to return to normal real dimension display.** **press** CE **or** ent

Currently in "shrink" compensation mode

normal real dimension display

return to normal display

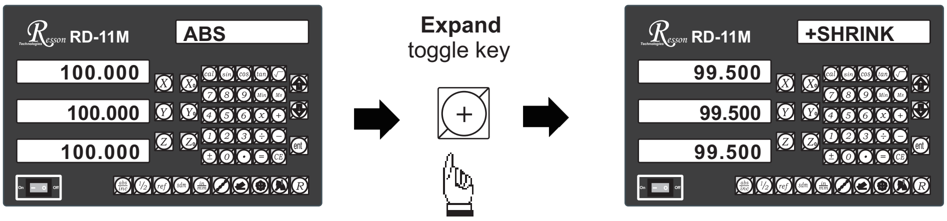



**Compensated dimensions :**
The actual dimension are now X 1.005 of the displayed dimensions

**Real Dimension**

## After verifying and need further machining in shrink compensated mode

**Expand**
toggle key



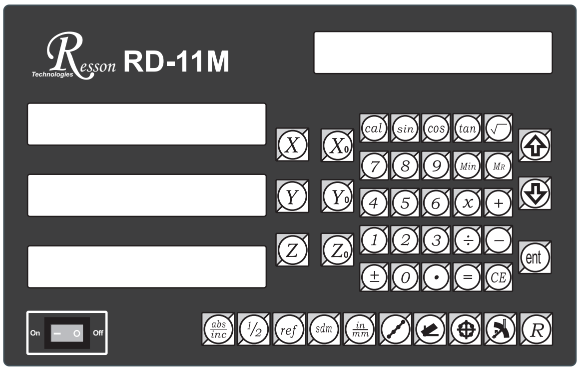

**Real Dimension**

**Compensated dimensions :**
The actual dimension are now X 1.005 of the displayed dimensions

Operator can drill the holes as above in this mode without the need of calculation

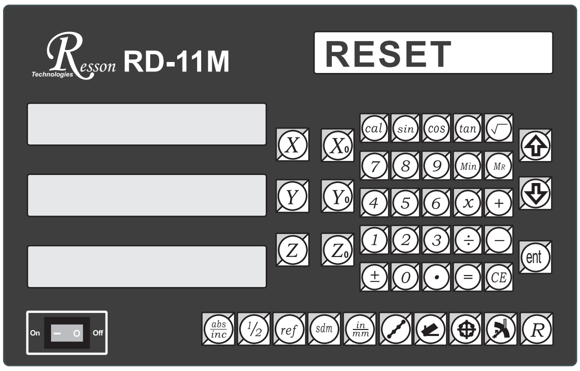
# RD-11M

## *Digital Readout Setup Function*




| | |
|---|---|
| DIRECTIN | specifies the direction of count for each axis |
| LIN COMP | permits linear error compensation to be input |
| RAD/DIA | radius and diameter setting functions |
| Z DIAL | forms part of the dial parameters for a milling machine, and specifies one turn of Z dial travel. |
| DIAL INC | enters the Z increment for ARC machining |
| R MODE | set up "Z STEP" or "MAX CUT" for Radius (R) |
| QUIT | exits the SETUP function to proceed to normal working |

# RD-11M ORIGINAL PARAMETER RESET FUNCTION

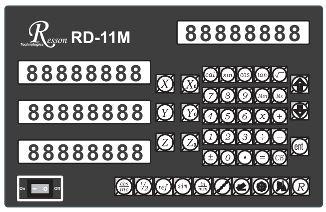



Some inscrutable cases or improper operations cause the chaos of parameter, then you need to initialize the parameter to reset the system.

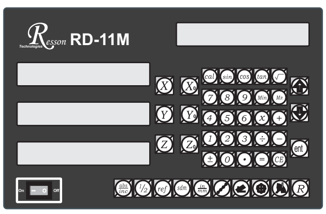
**Operational procedure：**

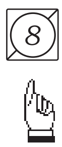
(1) Turn off the DRO.
(2) Power on DRO once again, when "VER.**" moving in display window, please press "8" key then DRO enters into the RESET function.

power on the DRO, then DRO starts the self-test function



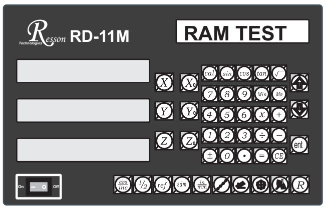

when "VER.9MA" appears in display window, please press "" key.



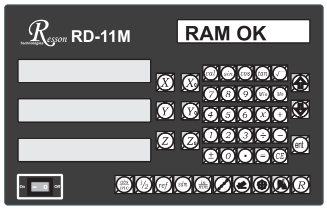




when some messages are displayed over, the DRO enters into the RESET function.

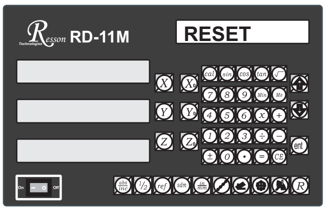
(3) When enter into the RESET function, DRO will display：




display "RAM TEST" that means the RAM is testing

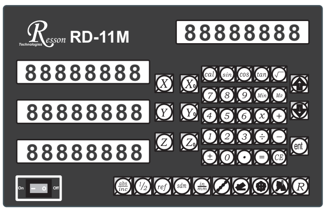



if the RAM function is normal，DRO can display "RAM OK"



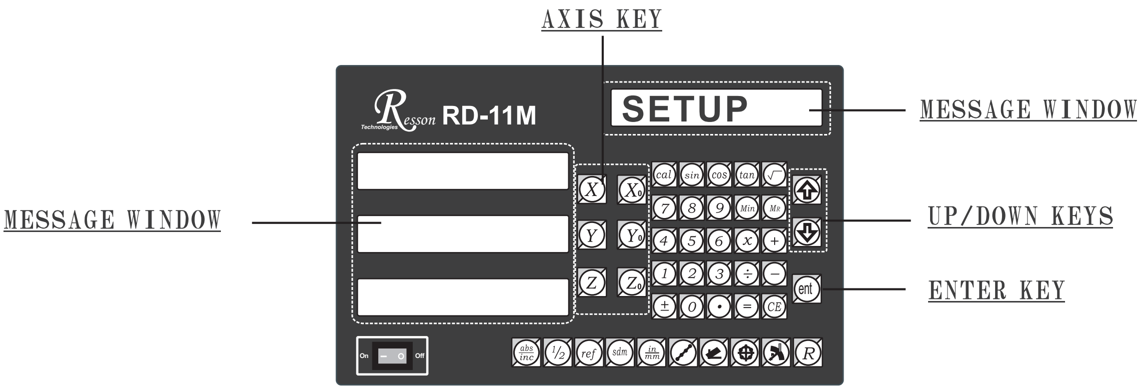

display "RESET" that means the parameter has reset

(4) The reset of parameter has completed then start to enter into the test procedure of display light.




(5) Turn off the DRO after complete the reset, then power on the DRO once again.

# RD-11M SETUP FUNCTION

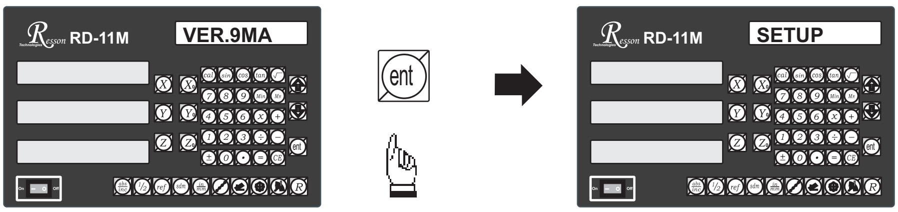



During changing the different program version IC or some abnormal voltages and operations, you need to SETUP the DRO.

## Procedure：

1). Turn off the DRO.

2). Power on the DRO once again, when the message "VER.9MA" showing in the MESSAGE WINDOW, please Enter key immediately then the DRO starts entering into the SETUP function.



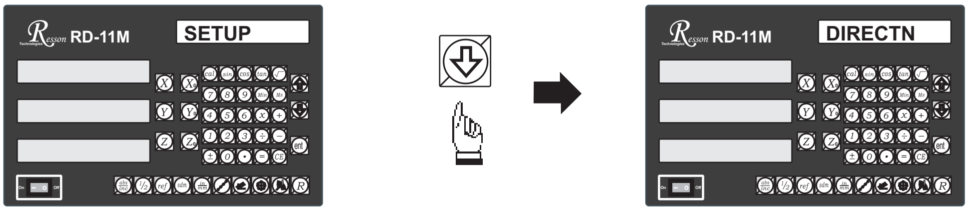

When the DRO displays some messages over, it will into the "SETUP" function.

The SETUP procedure is written in a menu mode which enables you to scroll through the top level options and enter, configure and exit the sub-functions as they arise.

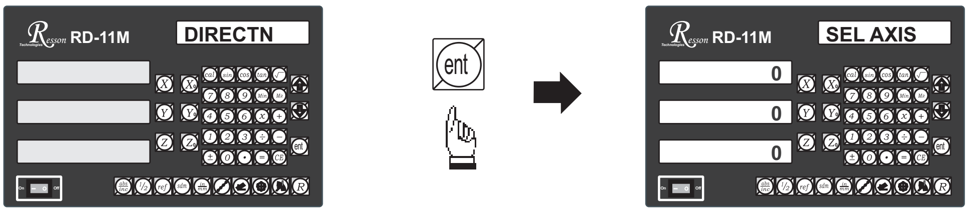
## The top level menu headers in order are as follows :

| | |
|---|---|
| DIRECTIN | specifies the direction of count for each axis |
| LIN COMP | permits linear error compensation to be input |
| RAD/DIA | radius and diameter setting functions |
| Z DIAL | forms part of the dial parameters for a milling machine, and specifies one turn of Z dial travel. |
| DIAL INC | enters the Z increment for ARC machining |
| R MODE | set up "Z STEP" or "MAX CUT" for Radius (R) |
| QUIT | exits the SETUP function to proceed to normal working |

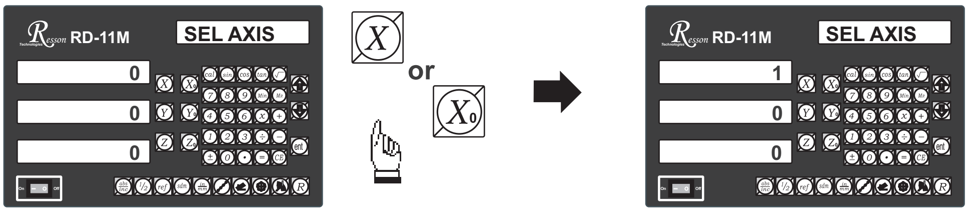
3.) Press key to select the "DIRECTN" (counting direction) function. Press key to return to the last function.



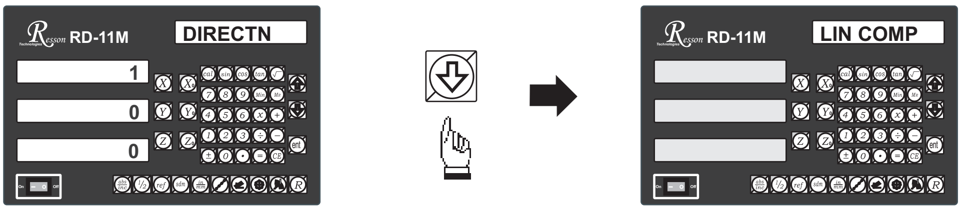

Press ent key into the direction setting function, the 0 represents a positive, 1 represents a negative.



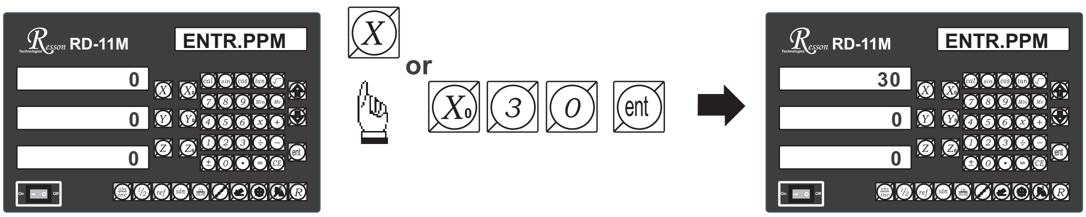

Press X or $X_0$ key to set up a negative direction "1" for X Axis, make a same procedure for Y Axis.



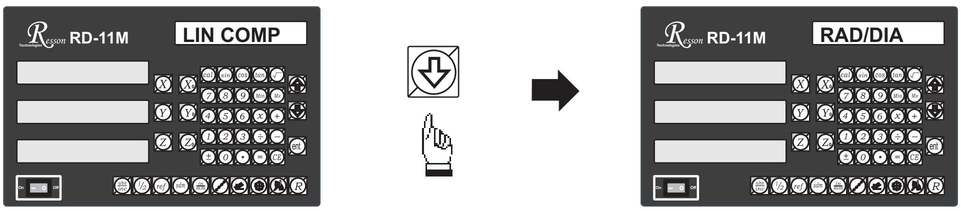
4.) Press ent key to make your setting, then press ⇩ key to select the "LIN COMP" (linear compensation) function.



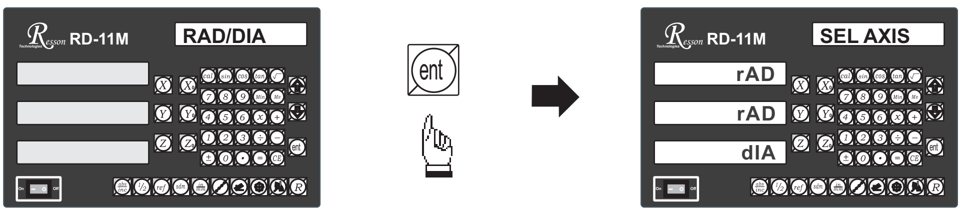

Press ent key into the linear error compensation function, the formula as below:
error value X -(1000/measuring length) = compensation value
(ML) measuring length unit = mm, error unit = μm
Example:
ML=500mm Error = -15μm
-15μ X -(1000/500) = 30μm
the compensation value is 30μm
If set up the linear compensation value of X Axis = 30, through the AXIS key make a same procedure for Y Axis.



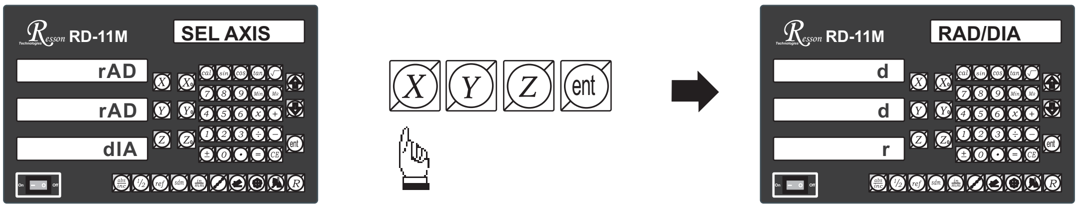

5.) Press ent key to make you setting, then press ⇩ key to select the "RAD/DIA" function.




Press ent key into the "RAD/DIA" function.



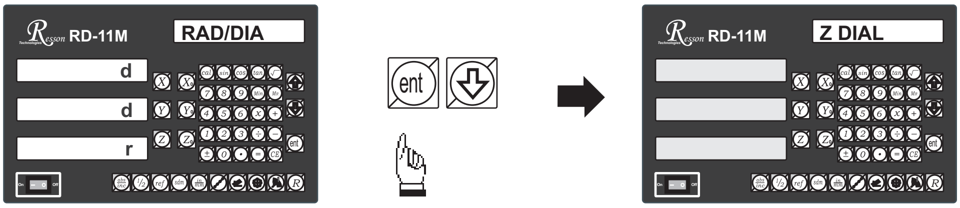
Press X Y Z key to set up X、Y or Z Axis to "RAD/DIA", then press ent key to make your setting.



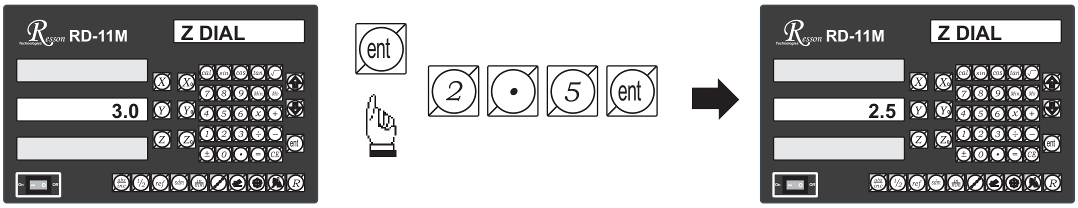

When set to "RAD", the displayed value = the measured value

When set to "DIA", the displayed value = the measured value x 2

6.) Press ent key to make you setting, then press ⇩ key to select the "Z DIAL" function.



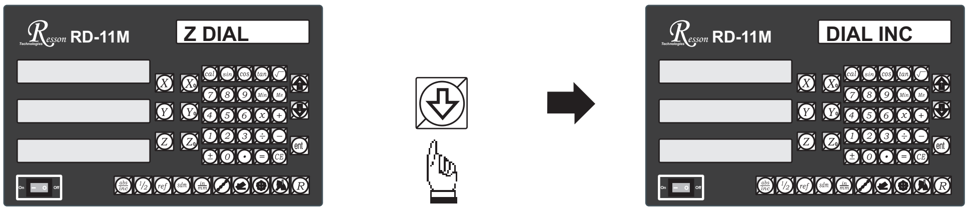

Press ent key into the setting function, i.e. your setting value is "2.500mm".



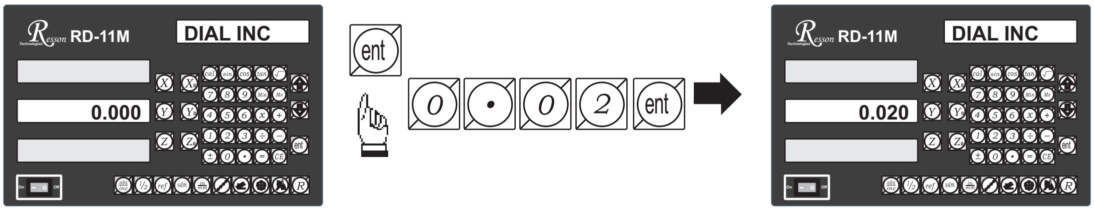

Z DIAL INSTRUCTIONS:
After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "Z DIAL" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level, Press the DOWN key once and the message "0.00" appears in the Y AXIS WINDOW. Press the individual axis key and enter a number to specify one turn of the Z DIAL. Press the ENTER key to store the value. Press the UP/DOWN keys to move to the next menu item.

For a Taiwanese type milling machine the travel is 2.5mm usually.

7.) Press  key to selsct the "DIAL INC" (dial increment) function.



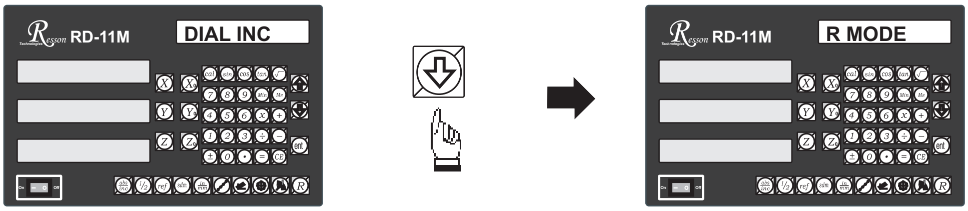

Press ent key into the setting function, i.e. your setting value is "0.020mm".



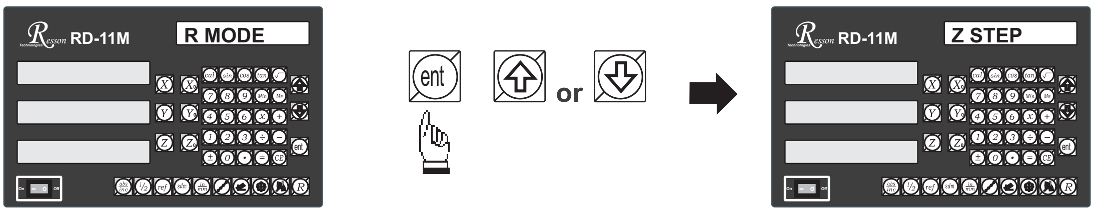

DIAL INC INSTRUCTIONS··
After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "DIAL INC" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level. Press the DOWN key once and the message "0.000" appears in the Y AXIS WINDOW. Press the individual Y axis key and enter a value for the minimum increment for positioning a Z axis. Press the ENTER key to store the value. Press the UP/DOWN keys to move to the next menu item.

For a Taiwanese knee-type milling machine the minimum increment is 0.02mm.

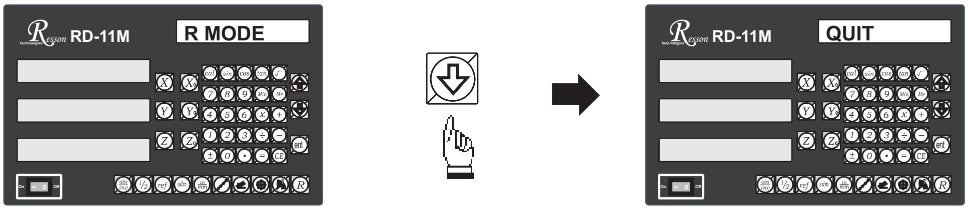
8.) Press  key to select the "R MODE" function.



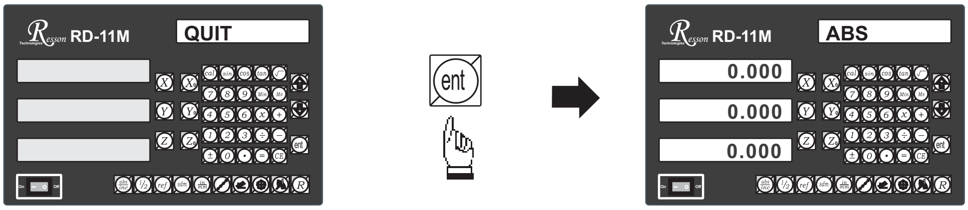

Press ent key to make your setting, then press  key or  key to select the "Z STEP" or "MAX CUT" function.



9.) Press  key to make your setting, then press  key to select the "QUIT" function.




Press  key to make your selection, then the DRO will exit the SETUP function and return to the "ABS" state.




By pressing the ENTER key the DRO exits the SETUP program and is ready for machining operations. If use the error compensation function, you must turn off the DRO then power on the DRO again, otherwise your compensated value will invalid.