



**SC-200**



**SC-100**



**SC-300**



**SC-400**



**SC-500**



**SC-600**



# SC-100

Digital Readout System  
- Digital Counter -  
Operation Manual  
(Milling Multi-function Option)

# VERIFICATION

## OF COMPLIANCE With Low Voltage Directive



**Verification No.: 16TW0856-LVD**

**Applicable Standard: IEC 61010-1:2010;**

**EN 61010-1:2010**

This Verification of Compliance is hereby issued to the below named company.  
The test results of this report relate only to the tested sample identified in this report.

### *General Information*

**Document holder** :Resson Technologies Co., Ltd.  
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TAIWAN(R.O.C)

**Product Description** : Digital Readout System - Digital Counter

**Model Number** SC-102, SC-103, SC-202, SC-203, SC-204, SC-302,  
SC-303, SC-402, SC-502, SC-503, SC-603, SC-613

**Trademark**



This device has been tested and found to comply with the stated standard(s), which is(are) required by the Council Directive of 2006/95/EC. The test results are indicated in the test report and are applicable only to the tested sample identified in the report

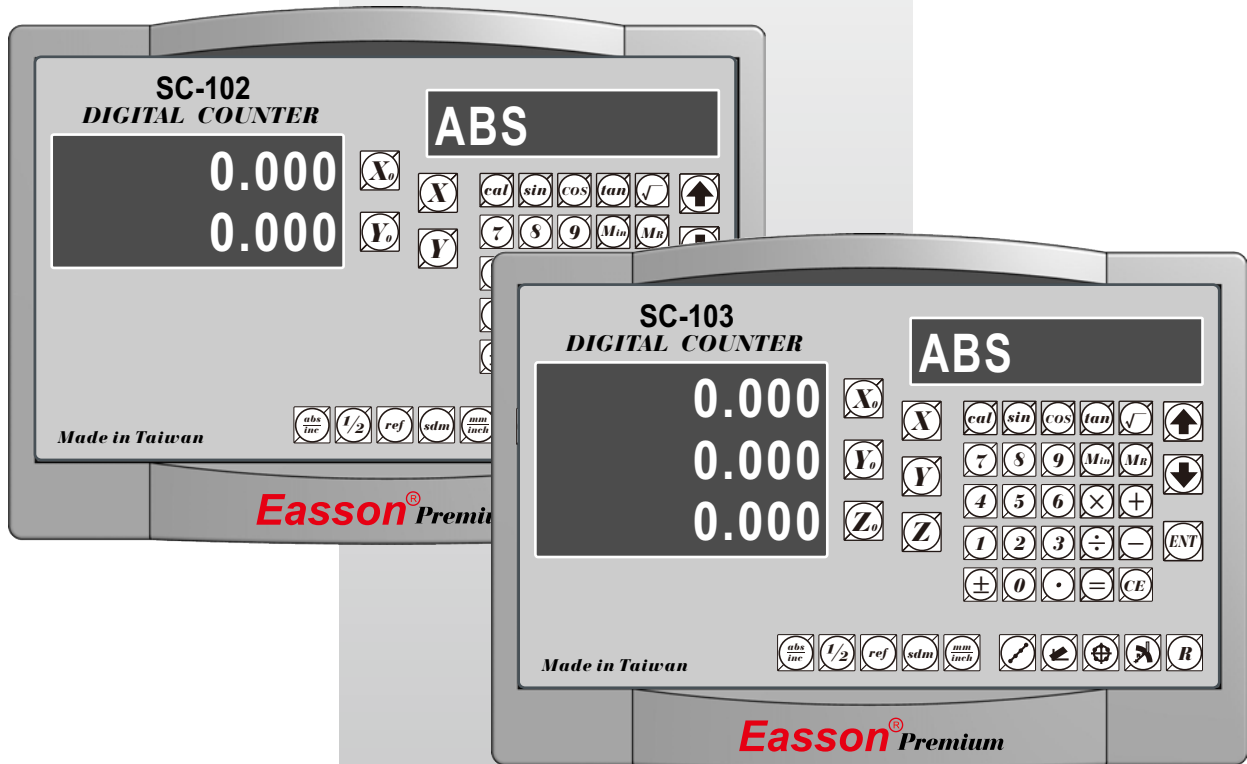
**Winnie Chiu/ Reviewer**

Date: Oct.28, 2016

**Global Compliance Co., Ltd.**

# **Easson<sup>®</sup> Premium**

*Made in Taiwan*



## **SC-100**

**Digital Readout System  
- Digital Counter -  
Operation Manual  
(Multi-function)**

**Resson Technologies Co., Ltd.**

### **Note before using this display !**

● Use the defined voltage

The rated power voltage supplied to this display should be 100V~230V, select correct voltage supply and try best supplying the power from lighting power line!

Since the power circuit would become unstable under frequent power on/off and cause instant strong interference or even power shutdown; take special note on it!

● Ground the display!

To guaranty user safety and stable & reliable system work, we strongly request user connecting the attached ground line (3-m yellow-green cable packed in the packaged box to the FC terminal at back of display to make good grounding connection!

● Insert each axis optic rule into correct position before turning on display; if doing the turn inversely, it might burn out the electronic devices in the optic ruler!

● Do not operate this display in elevated ambient temperature or under high humidity!

● Do not operate this display in strong electric field, magnetic field or noisy environment, or by electric machine that would be the main reason making system act in error!

● Use dry, soft cloth to wipe cleaning display surface!

● For stain hard to remove, use soft cloth wet by neutral detergent to clean it up!

● Do not use gasoline, diesel fuel, kerosene or alcohol to wipe cleaning the display surface!

● Do not use compressing air gun to blow display and optic scale assembly since it would blow oil, moisture, dust or chips into them from seam and cause system unstable and damage!

### **Elaborate maintenance, correct operation;**

### **Extend operation lifetime and stabilize work performed**

**Thanks for buying our product! To use it correctly,  
read this Operation Manual carefully and in details.**

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**SC-100 Specification****SC-100 Specification :**

Number of axes : 2Axes (SC-102) 、 3Axes (SC-103)

Resolution : 0.05/0.02/0.01/0.005/0.002/0.001/0.0005/0.0002/0.0001mm

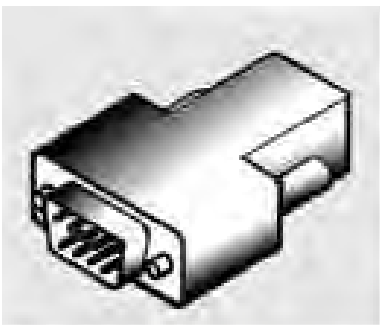
Display function : 8-digit LED

Response speed : 60m (198.6feet)/min

Quantizing error :  $\pm 1$  count

Power source : AC100V~240V / 50~60Hz / 20VA

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

**Linear Encoter (Scales) Electrical connector :**

**D-sub 9 pins connector**

**TTL**

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

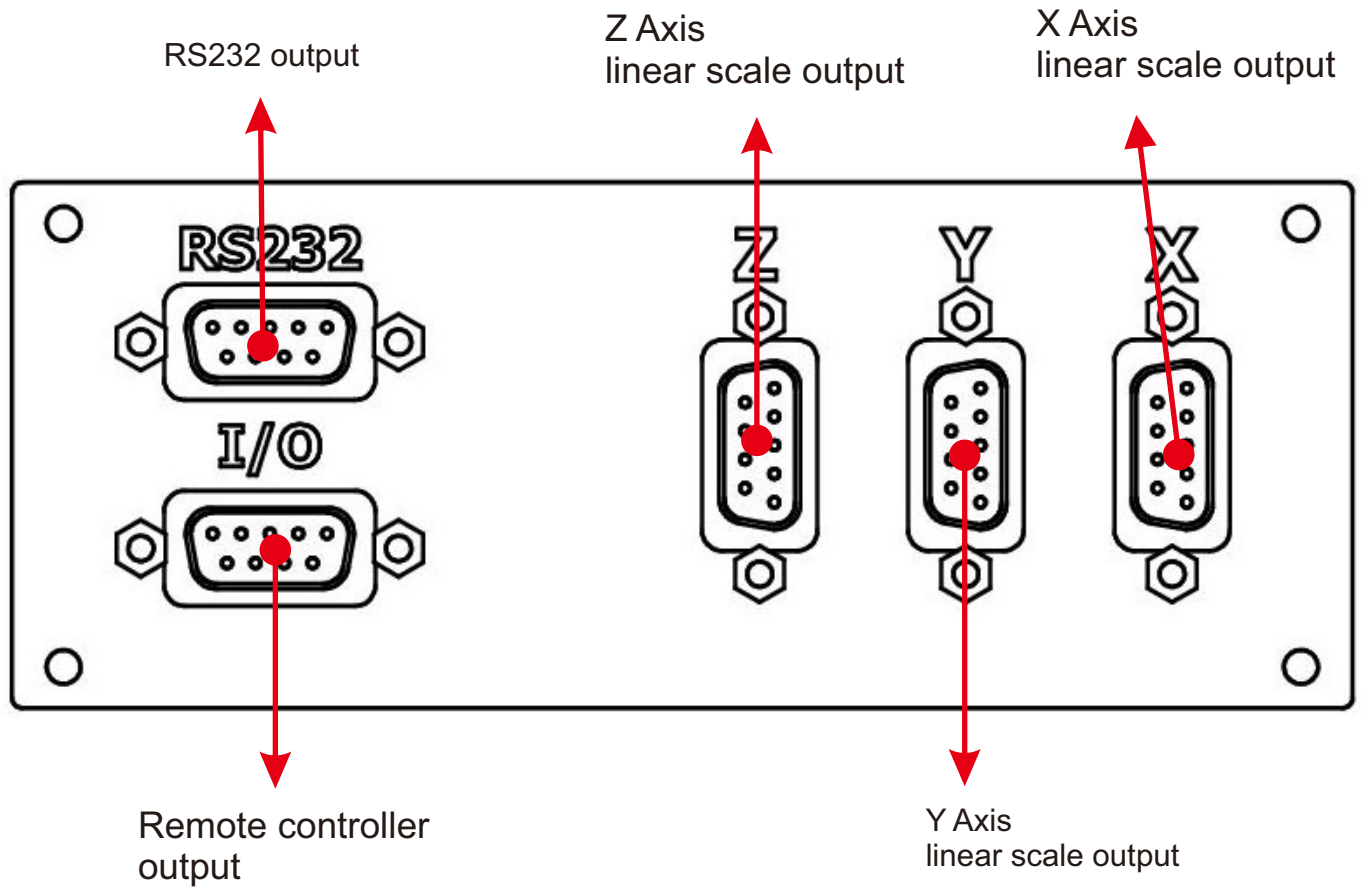
N/C : No Connection

**RS422**

PIN	SIGNALS
1	A-
2	0V
3	B-
4	Inner shield
5	R-
6	A+
7	5V
8	B+
9	R+

**The back shell plug seat of DRO.**

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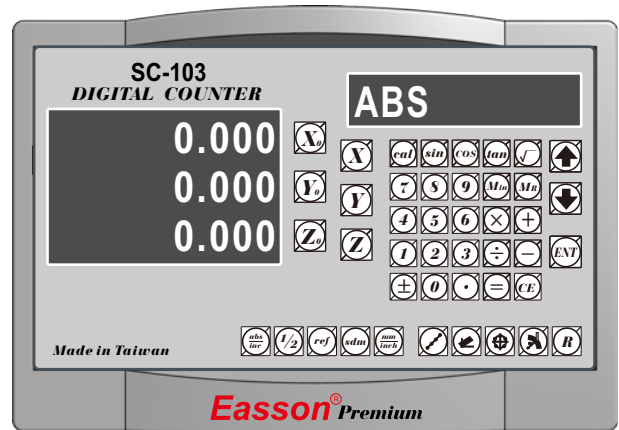
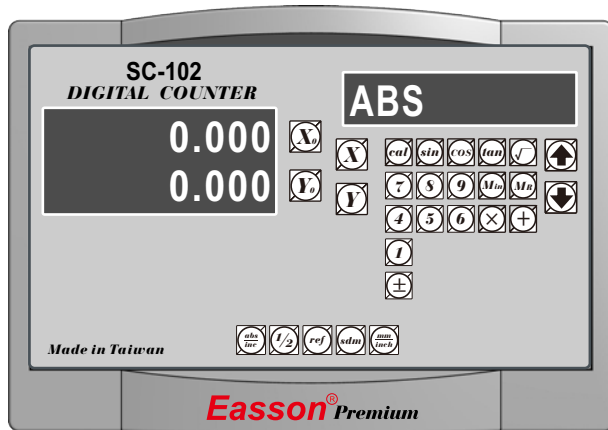
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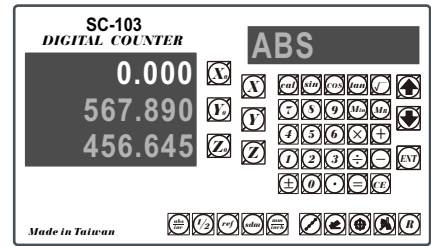
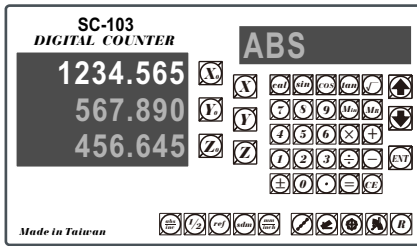
# Basic Functions



## Set Display to Zero

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

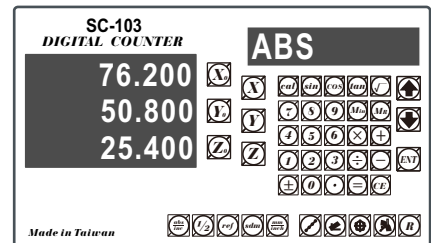
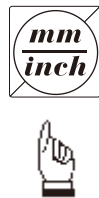
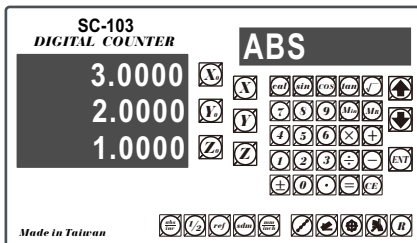
**Example :** To set the current **X Axis** position to zero



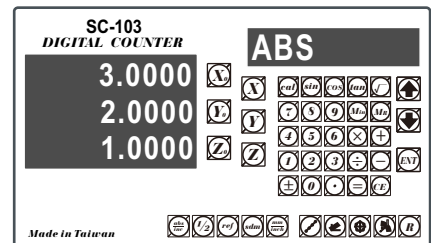
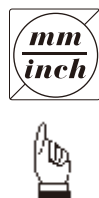
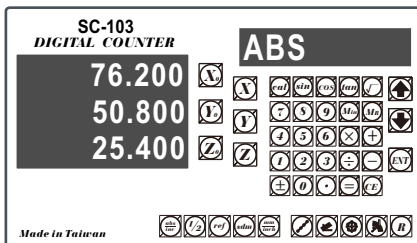
## Inch / Metric Display Conversion

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

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



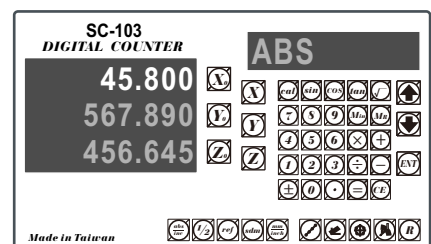
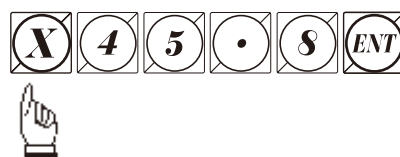
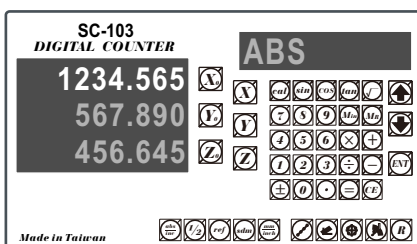
**Example 2 :** Currently in **metric** display, to switch to **inch** display



## 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

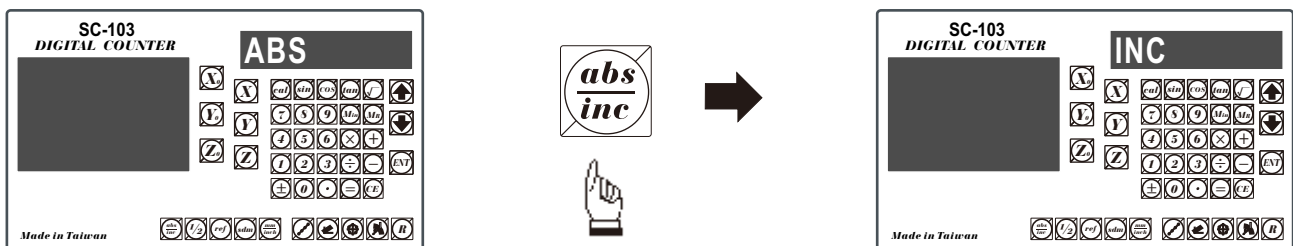
**Purpose :** **SC-100** provides two sets of basic coordinate display, they are **ABS** (absolute) and **INC** (incremental) displays.

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.

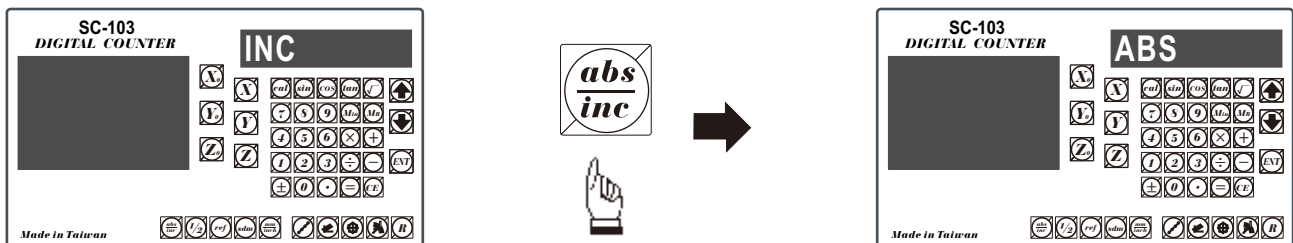
The operator is then free to zero the axes or preset any dimensions into any axis in **INC** coordinate for relative position machining. The work piece datum ( work piece zero position ) is still retained in **ABS** coordinate by the **SC-100**.

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

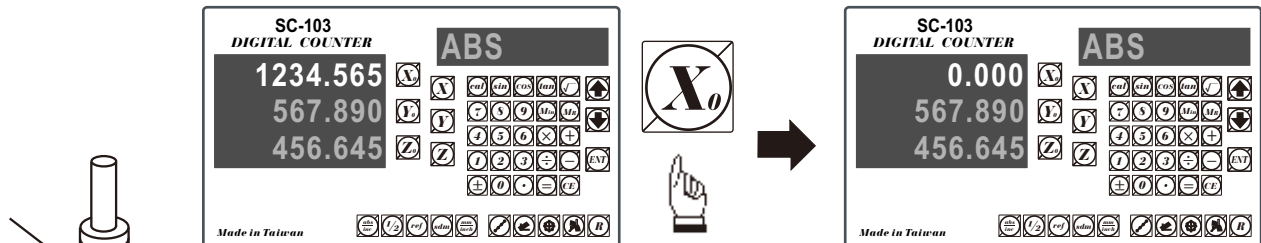


## Centre-find

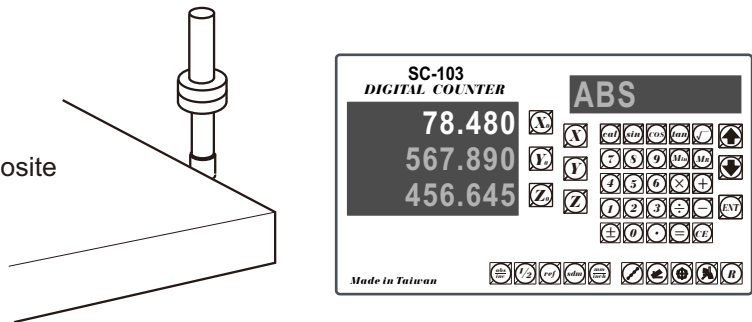
**Purpose :** SC-100 provides the centre-find function by halving the current display coordinate, so that the zero point of the work piece is located at the centre of the work piece.

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

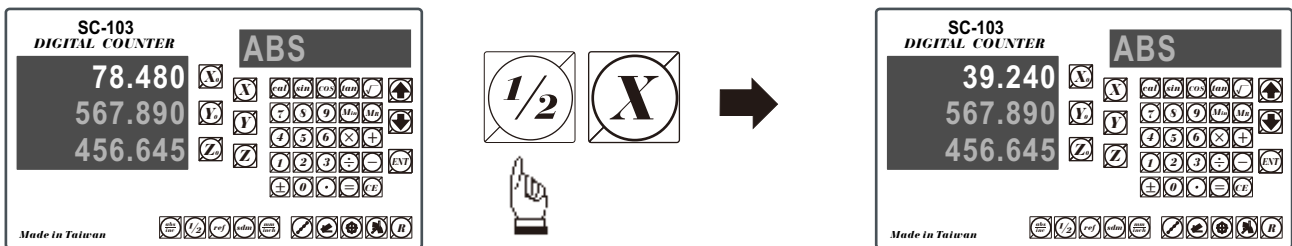
**Step 1 :** Locate the edge finder at one end of the work piece, then zero the X Axis.



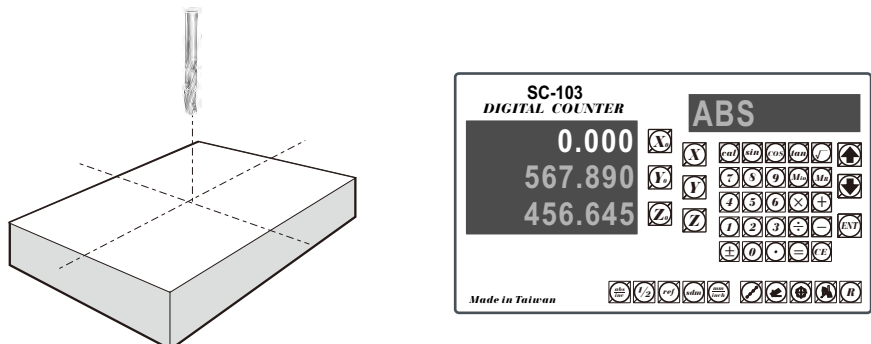
**Step 2 :** Locate the edge finder at the opposite end of the work piece.



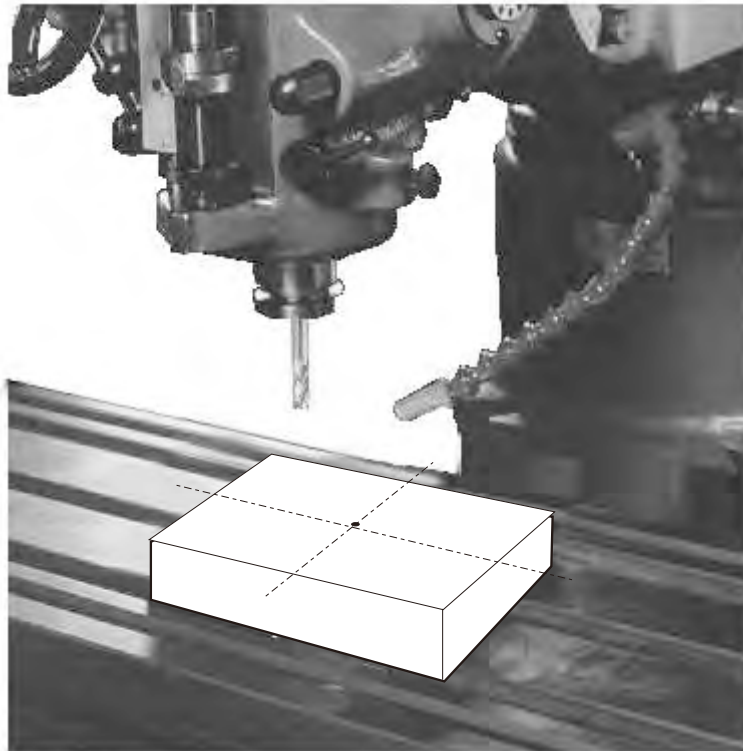
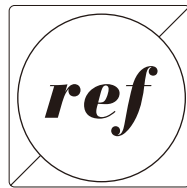
**Step 3 :** Then half the display coordinate using centre-find function as per follows:



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.

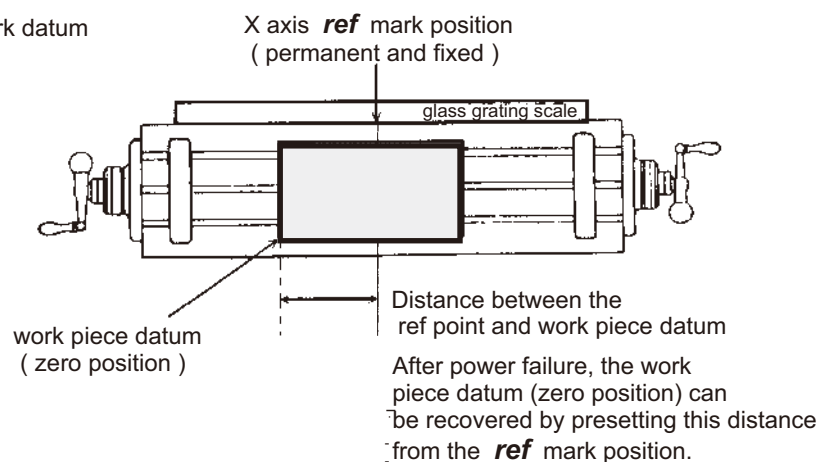
To allow the recovery of work piece datum very accurately, with no need to re-establish the work piece datum using an edge finder or other methods, every transducer has a reference point location to provide a datum point memory function.

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 SC-100 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 :** **SC-100** 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 **SC-100**, whenever you alter the zero position of **ABS** coordinate, such as by zeroing, centre find, coordinate preset or etc., **SC-100** will automatically store the relative distance between **ABS** zero and the **ref** mark location into **SC-100**'s memory.

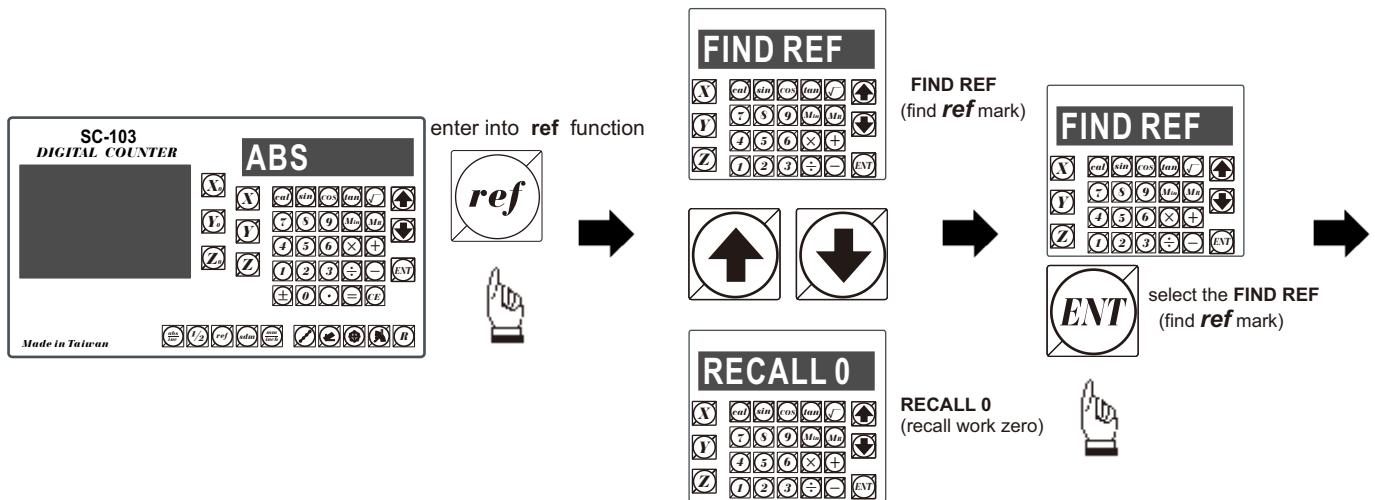
In daily operation, operator simply needs to locate the **ref** mark position whenever they switch on the **SC-100** to let it know where the **ref** mark position is, then **SC-100** will automatically do the work datum storage on its' own . In the case of a power failure or the **SC-100** being switched off, the operator can recover the work piece datum easily by using the **RECALL 0** procedure.

## Find the scale's *ref* mark position ( FIND REF )

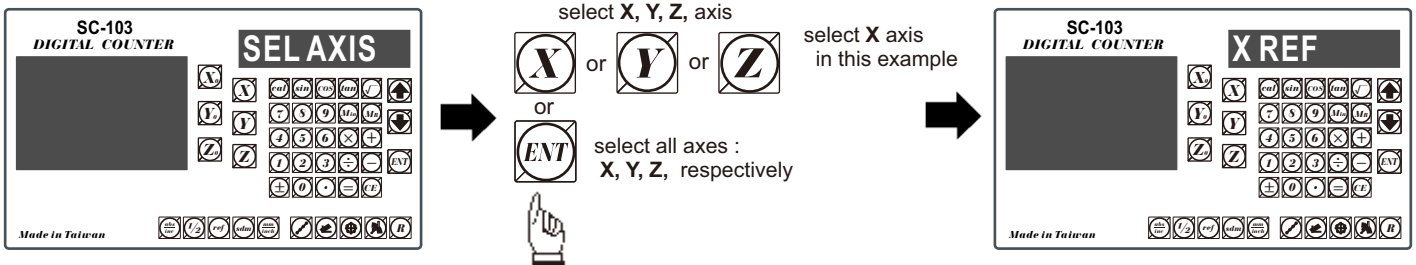
**function :** In *ref* datum memory function, the **SC-100** will automatically store the relative distance between the *ref* mark position and the work piece datum ( zero position ) whenever the operator alter the **ABS** zero position, such as zeroing, centre find, co-ordinate preset or etc...

Therefore, the **SC-100** 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 accidental 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 **SC-100**.

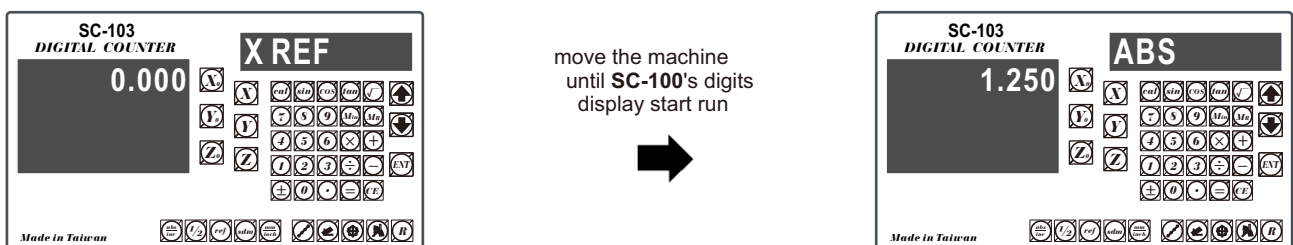
**step 1 :** To enter the *ref* function, select the **FIND REF** ( find *ref* mark )



**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 **SC-100** start to count.

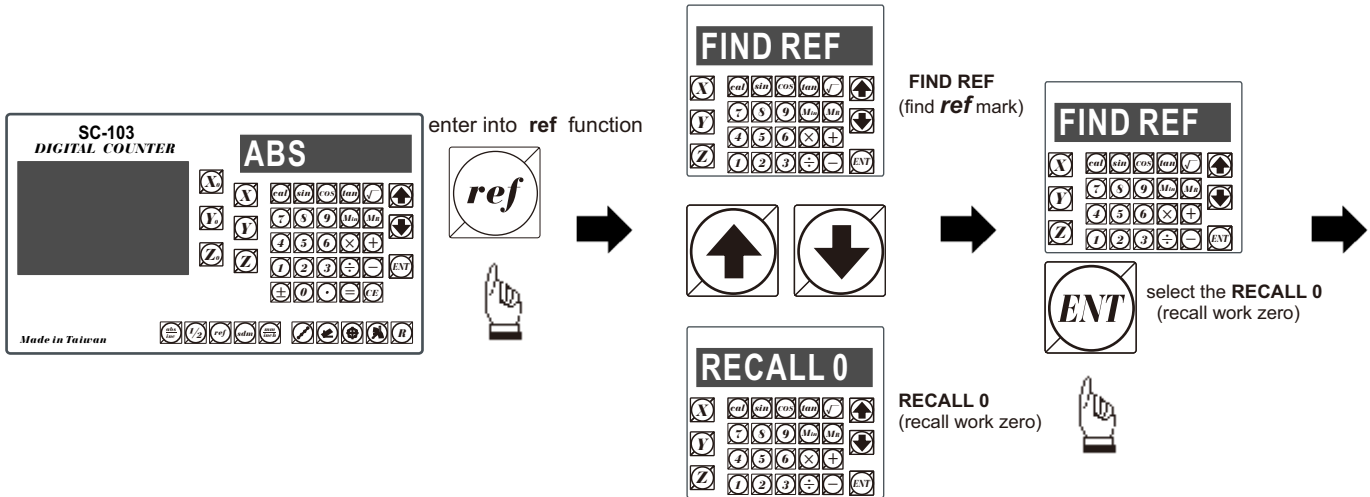


move the machine across the length of the transducer

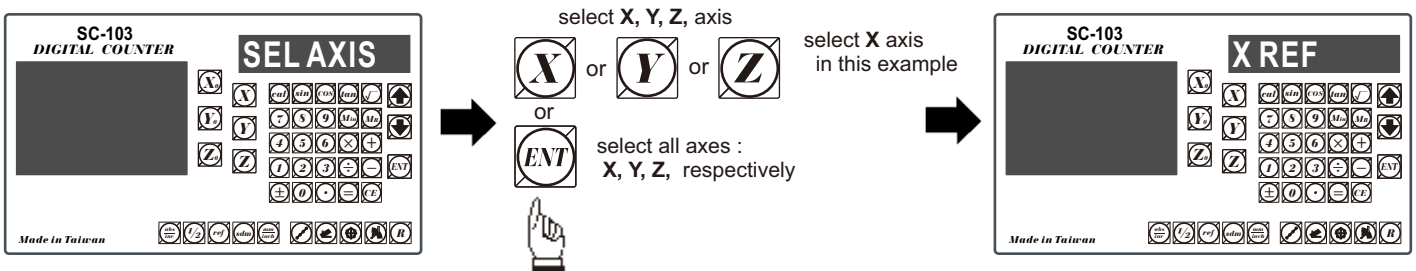
## Recall the work datum zero ( **RECALL 0** )

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

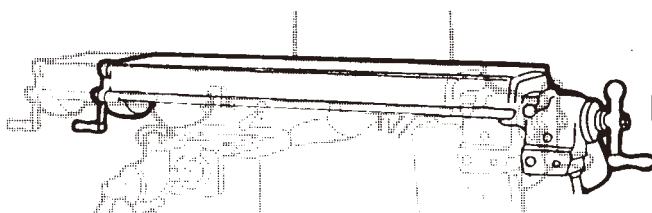
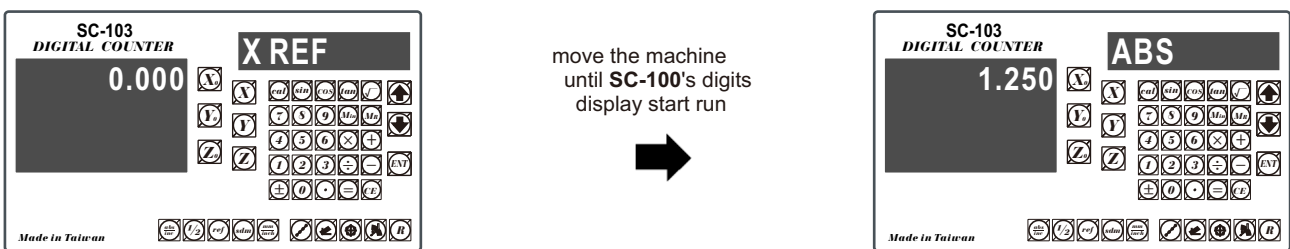
**step 1 :** enter into the **ref** function, select the **RECALL 0** ( recall work piece zero )



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



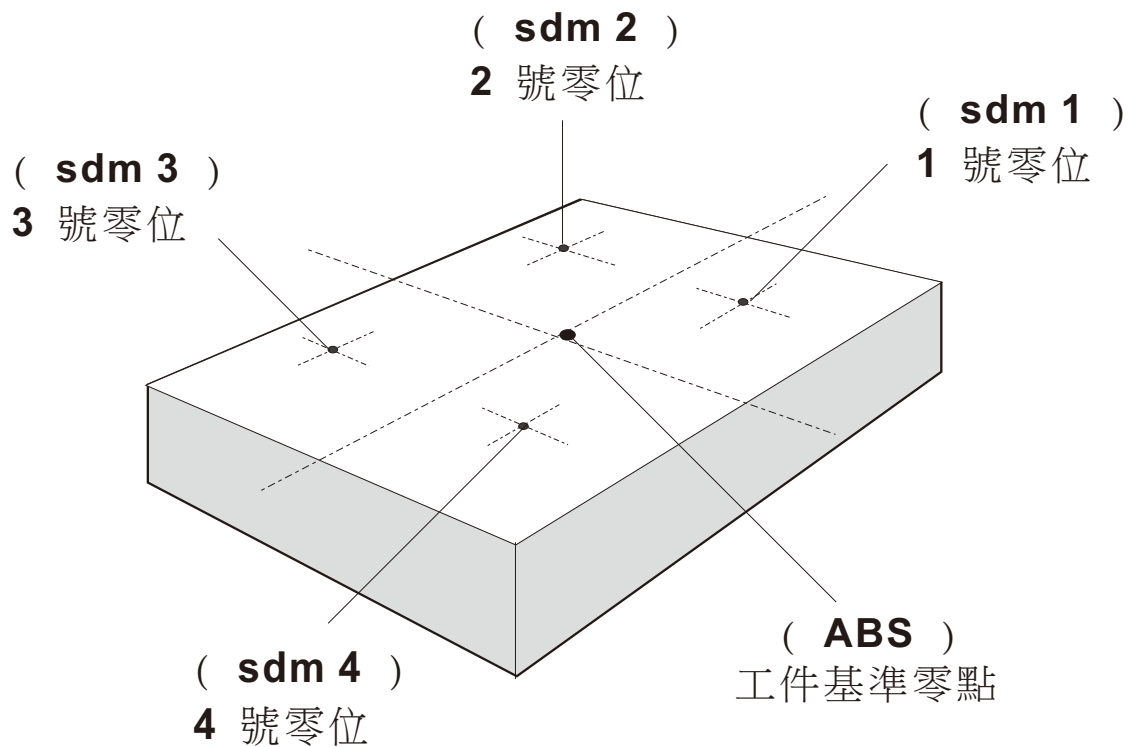
**step 3 :** move the machine across the length of the transducer until the **SC-100** display starts to count, then the work piece datum is recovered



move the machine across the length of the transducer



# 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 :

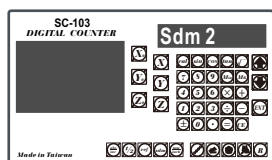
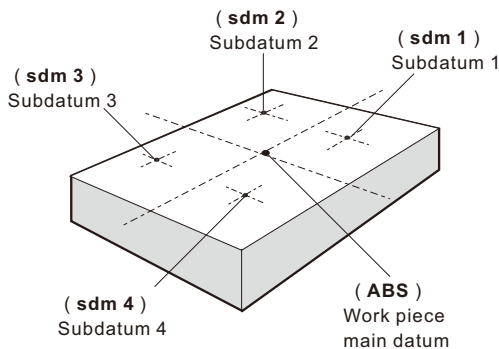
- In much machining work, the work-piece machining dimensions are derived from more than two datums, therefore, the operator has to switch between **ABS** and **INC** to set up the machining datums time after time. This process is very time consuming and prone to error.
- In the case of batch machining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

**SC-100** 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 **SC-100** memory using the keypad. No need for any additional calculations.

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

Operator can store all the work subdatums in SC-100's memory as per follows.



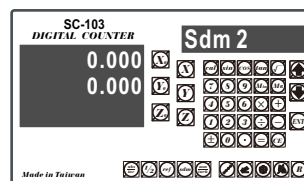
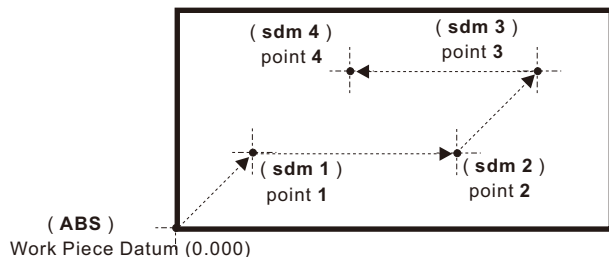
Operator then can switch between the subdatums directly by pressing key

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 repetitive 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 repetitive 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

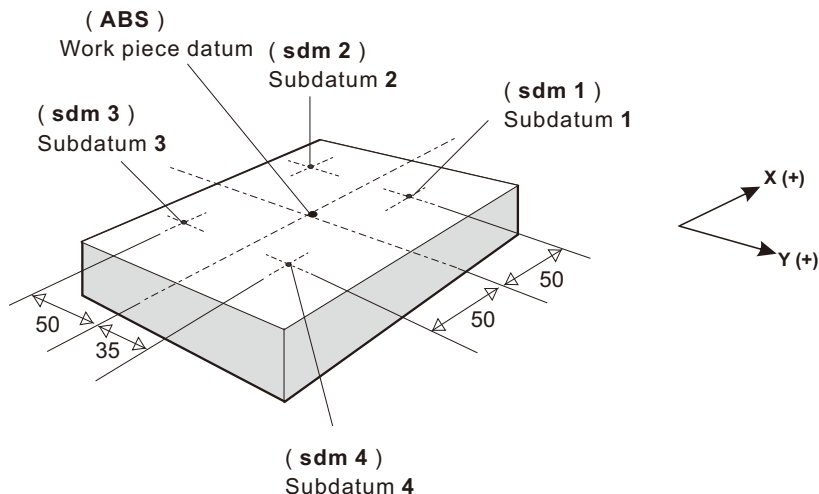
or  
move the machine to display = 0.000, then machining location reached

## 199 SubDatum function

### Application example:

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

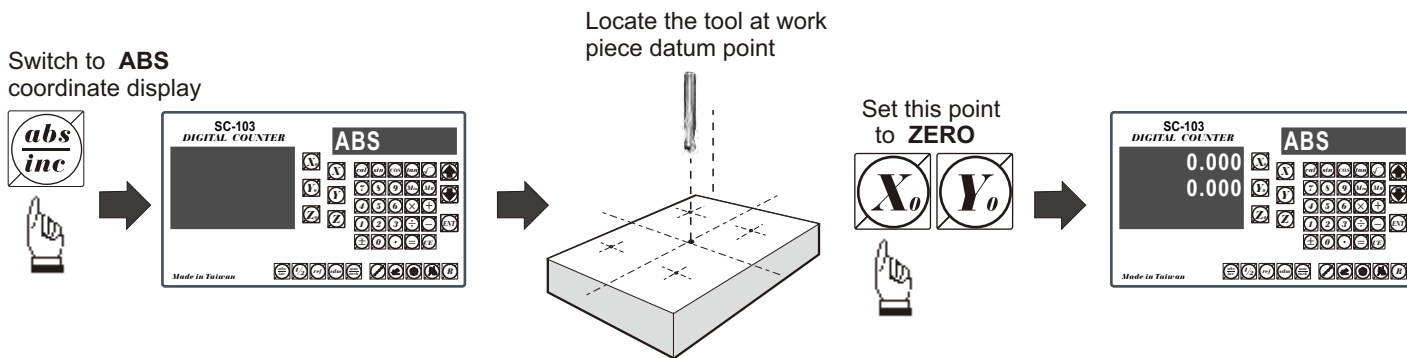
- Either 1. Move machine to required subdatum position, then zero **SdM** display coordinates
- Or 2. Directly key in the **SdM** zero position co-ordinates ( co-ordinate relative to **ABS** zero )



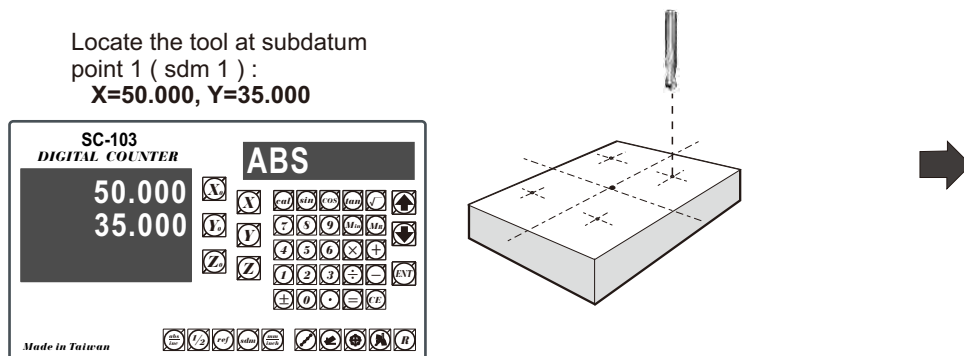
### Method 1 : Move machine to required subdatum position, then zero SdM display coordinate

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

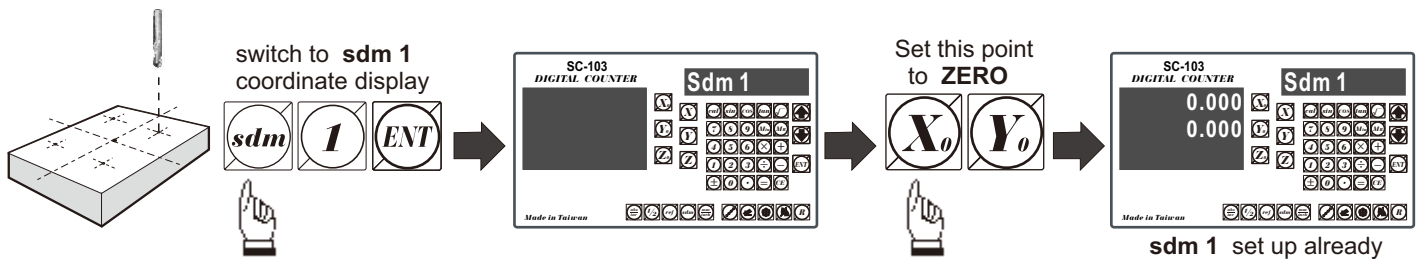
#### Step 1 : Set up the work piece datum in **ABS** co-ordinate



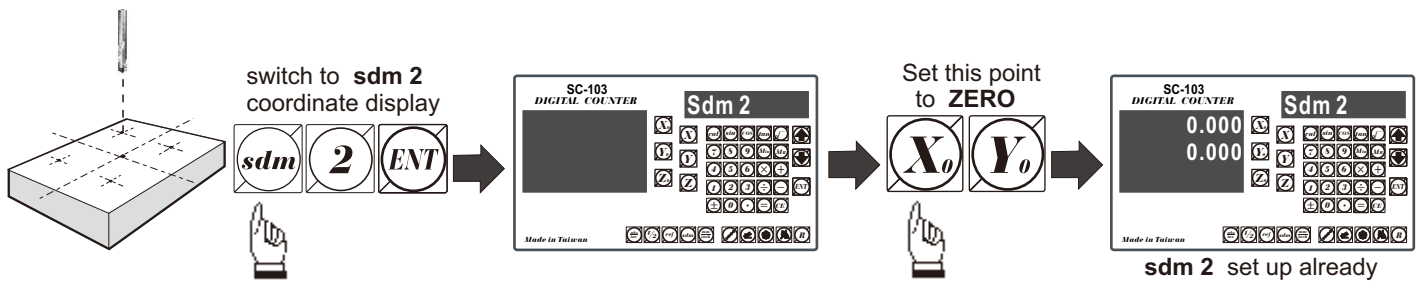
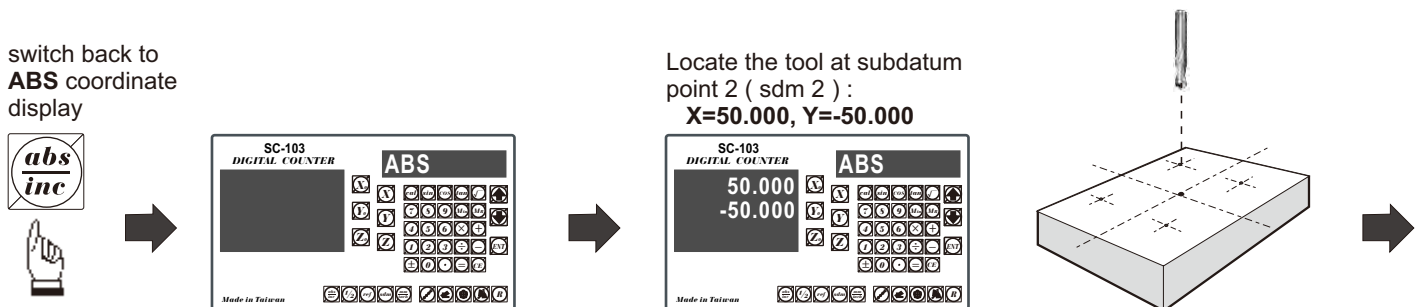
#### Step 2 : Set up the subdatum point 1 ( **sdm 1** )



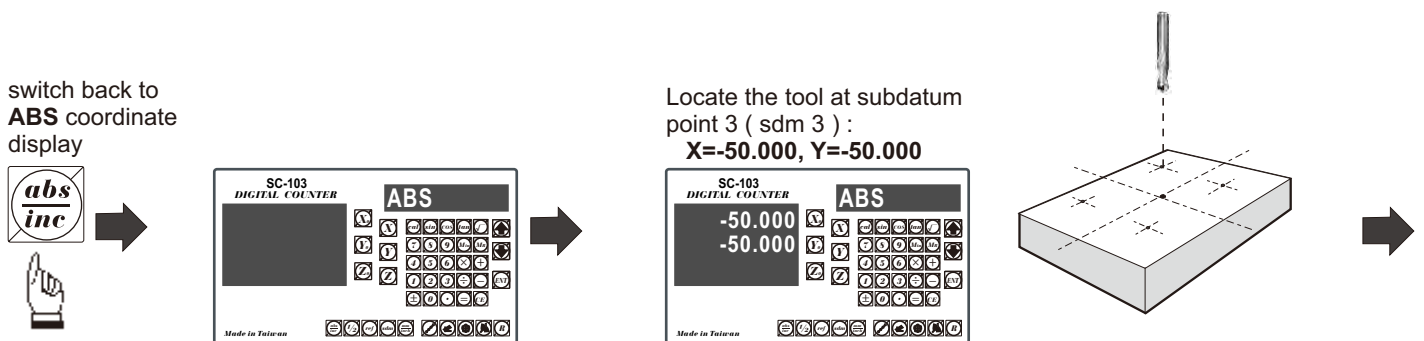
## 199 SubDatum function



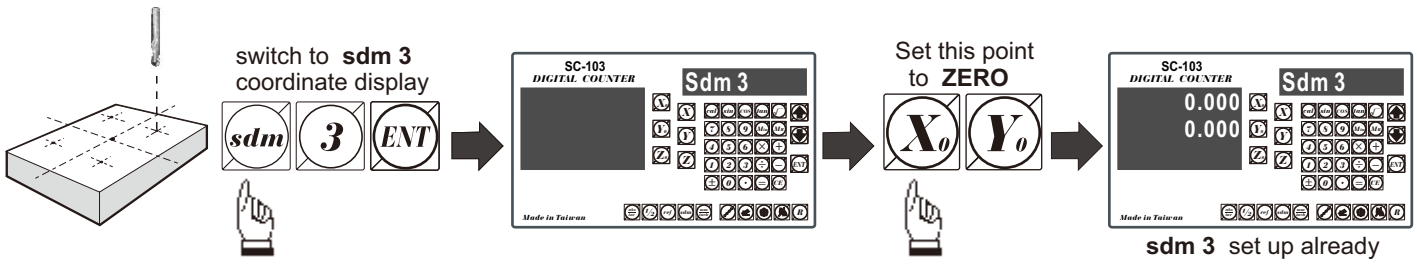
### Step 3 : Set up the subdatum point 2 ( sdm 2 )



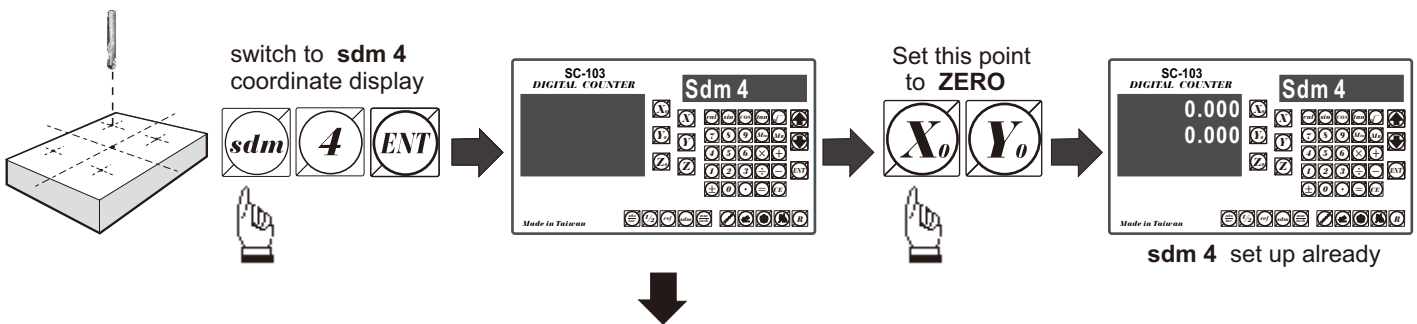
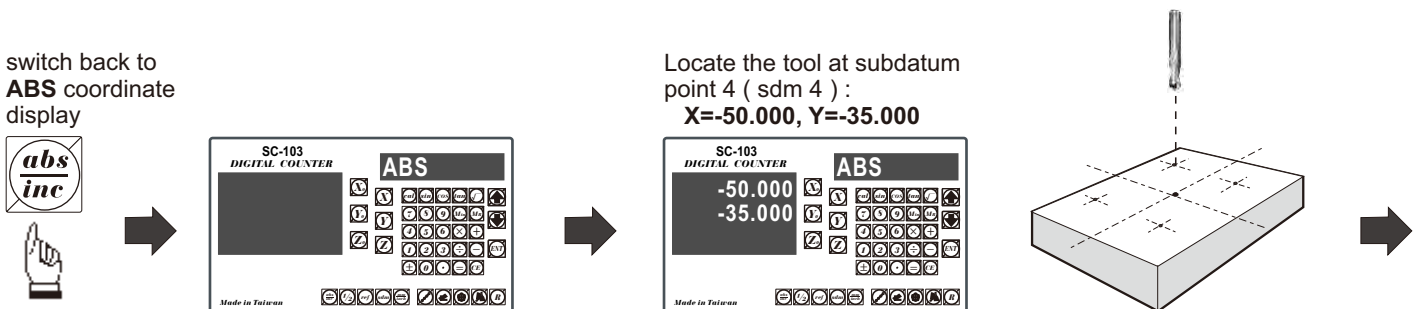
### Step 4 : Set up the subdatum point 3 ( sdm 3 )





## 199 SubDatum function



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

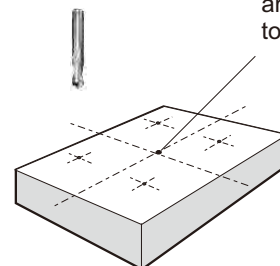
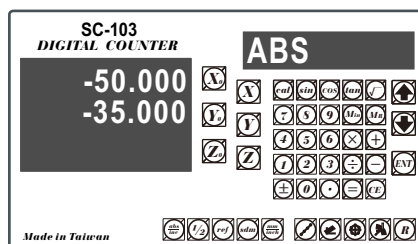


**All the four subdatum points have already been set up**

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

Example :

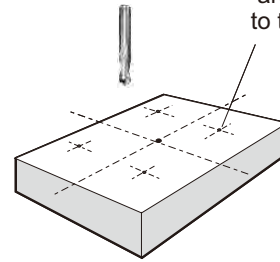
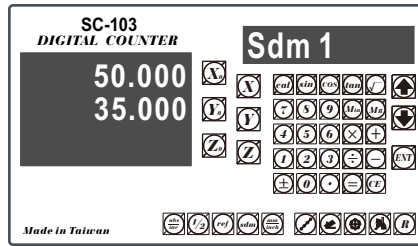
switch to **ABS** coordinate display



SC-100's XY displays are referenced to the **ABS** zero

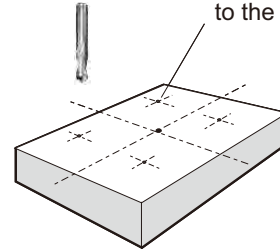
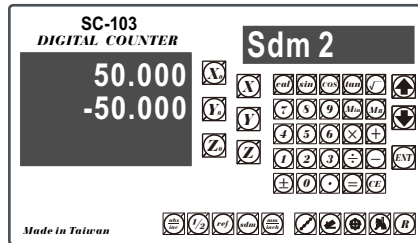
## 199 SubDatum function

switch to next ( up )  
sdm coordinate display



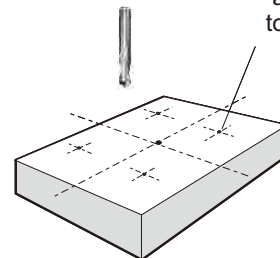
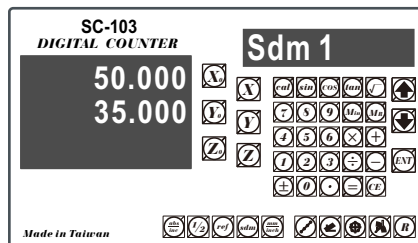
SC-100's XY displays  
are referenced  
to the **sdm 1** zero

switch to next ( up )  
sdm coordinate display



SC-100's XY displays  
are referenced  
to the **sdm 2** zero

switch to previous ( down )  
sdm coordinate display



SC-100's XY displays  
are referenced  
to the **sdm 1** zero

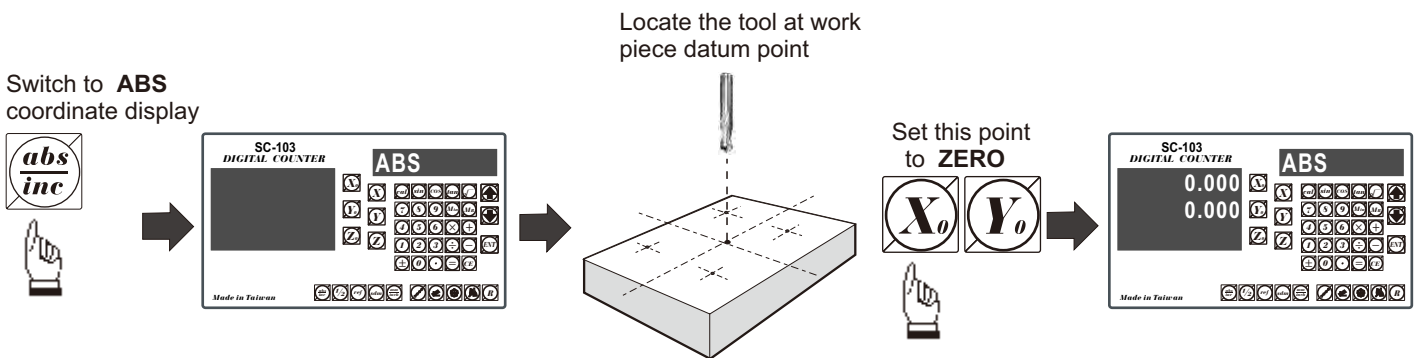
## 199 SubDatum function

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.

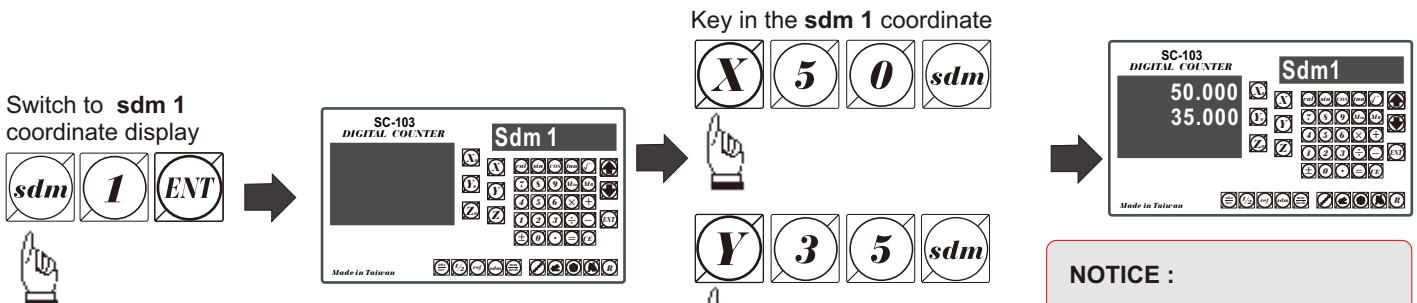
### Method 2 : Direct keying in the of SdM zero position co-ordinate ( co-ordinate relative to ABS zero )

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.

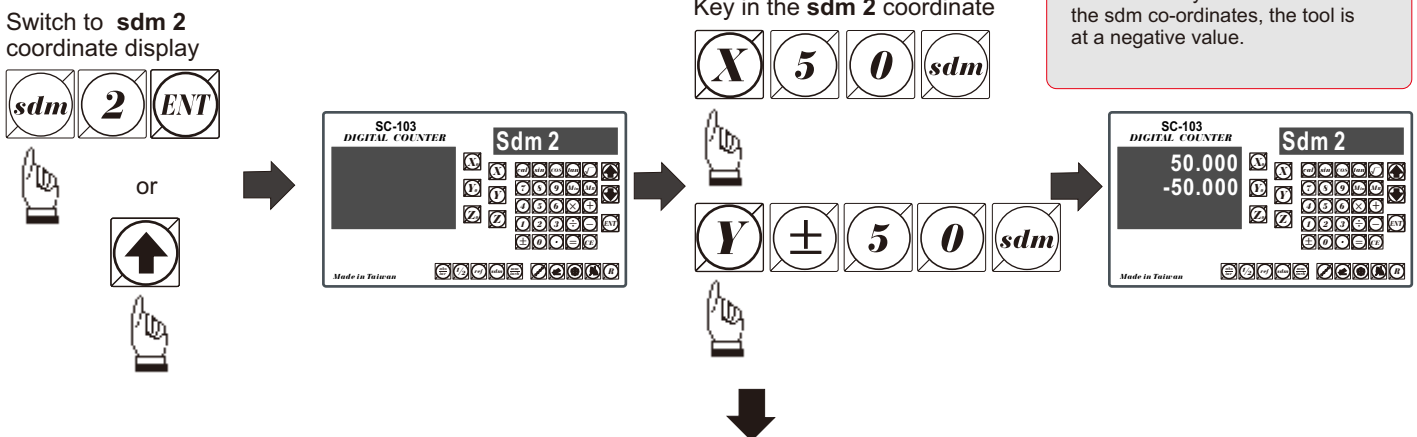
**Step 1 :** Set up the work piece datum in ABS coordinate



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



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

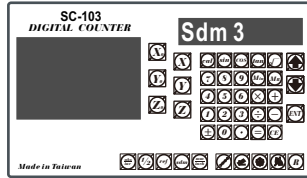
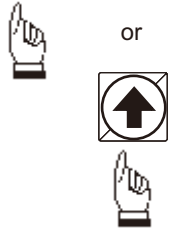


**NOTICE :**  
When you enter the sdm co-ordinate into the SC-100, the co-ordinates displayed will indicate a **negative sign**.  
  
This is correct because your tool is now located at zero position at ABS coordinate. If you calculate from the sdm co-ordinates, the tool is at a negative value.

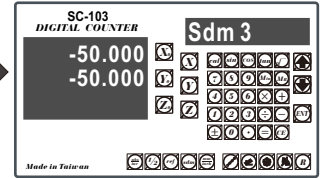
## 199 SubDatum function

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

Switch to **sdm 3** coordinate display

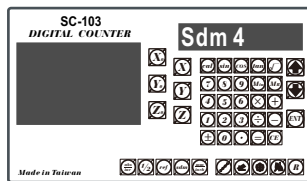
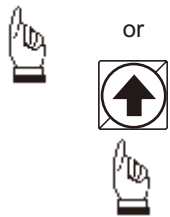


Key in the **sdm 3** coordinate

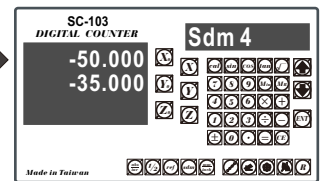


**Step 5 :** Set up the subdatum point 4 ( sdm 4 )



Switch to **sdm 4** coordinate display



Key in the **sdm 4** coordinate



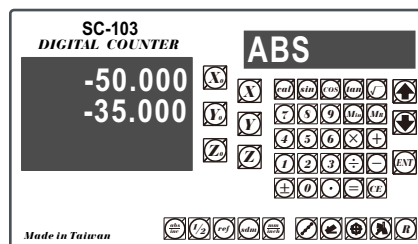
**All the four subdatum points have already been set up**

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

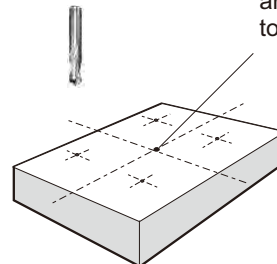


**Example :**

switch to **ABS** coordinate display



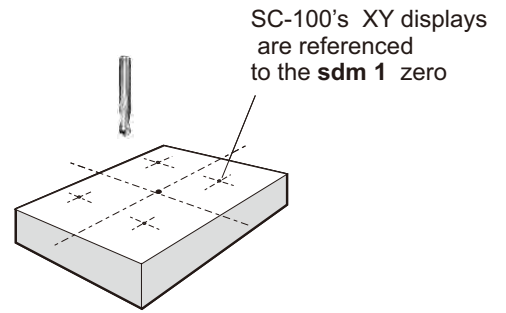
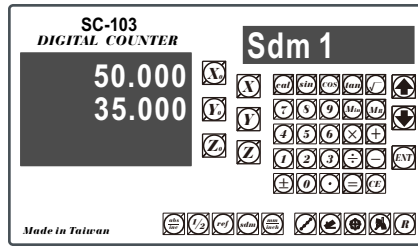
SC-100's XY displays are referenced to the **ABS** zero



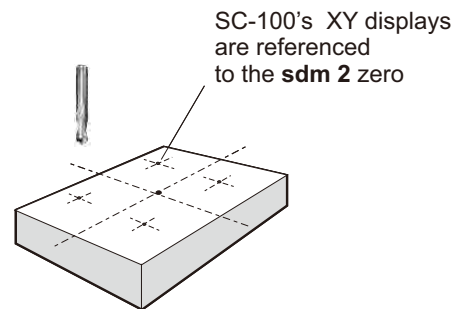
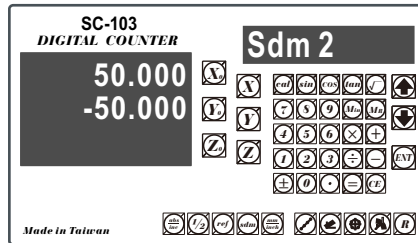


**199 SubDatum function**

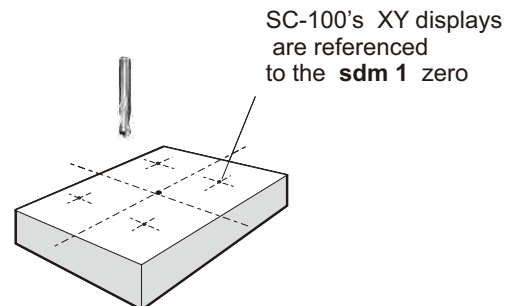
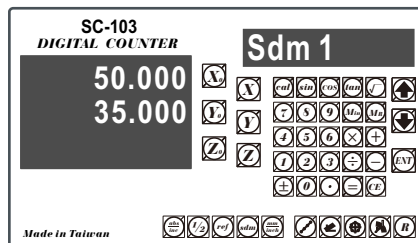
switch to next ( up )  
sdm coordinate display



switch to next ( up )  
sdm coordinate display



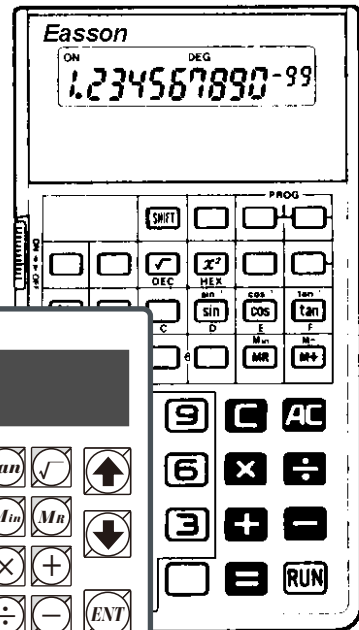
switch to previous ( down )  
sdm coordinate display





**Built in Calculator**

**Built-in Calculator**



**SC-103**  
**DIGITAL COUNTER**

**1234.565**  
**567.890**  
**456.645**

**ABS**

X <sub>0</sub>	X	cal	sin	cos	tan	√	↑
Y <sub>0</sub>	Y	7	8	9	M <sub>+</sub>	M <sub>-</sub>	↓
Z <sub>0</sub>	Z	4	5	6	×	+	ENT
		1	2	3	÷	-	
		±	0	.	=	CE	

*abs inc* *1/2* *ref* *sdm* *mm inch* *↗* *↖* *⊕* *⊖* *R*

*Made in Taiwan*



**Built in Calculator**

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

**SC-100 is the first DRO that has a built-in calculator**

The built-in calculator of the SC-100 not only provides normal mathematical calculations such as add, subtract, 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...**

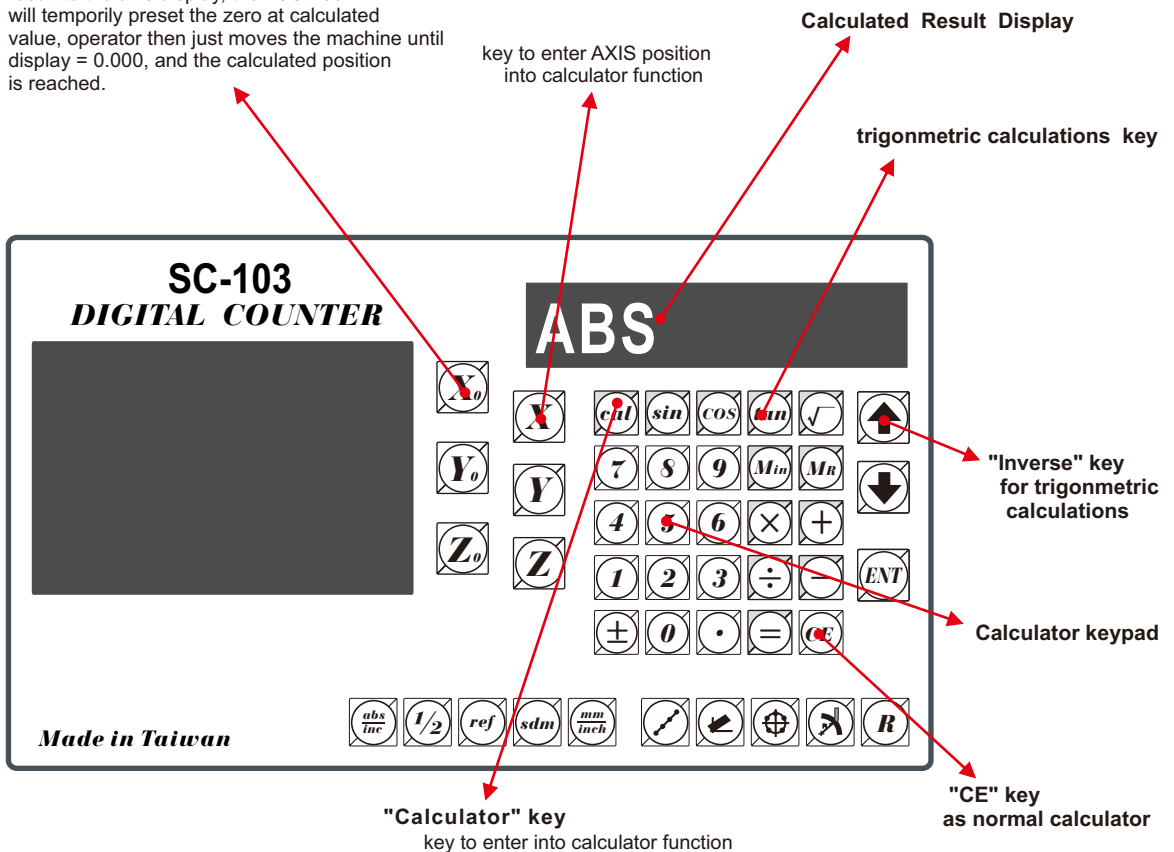
In addition a major feature of the calculator of the SC-100 is "**Result Transfer**", in that all calculated results from the calculator of SC-100 can be "transferred" to any axis to enable you to position the tool. After the result has been transferred to an axis, the SC-100 will **temporarily** preset 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 commercially available calculators and it is easy to use ;
2. The calculated result can be directly transferred 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.

**"Result Transfer" key**

Press this key to transfer calculated result to the axis display, then SC-100 will temporarily preset the zero at calculated value, operator then just moves the machine until display = 0.000, and the calculated position is reached.

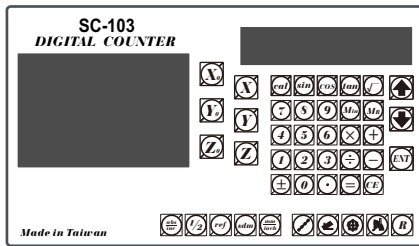


**Key layout of the built-in calculator**

## Built in Calculator

Example :

**Working principle of SC-100's calculator function**  
 when the SC-100 is put in calculator mode, the operation of RD-15M actually divided into two parts as follows

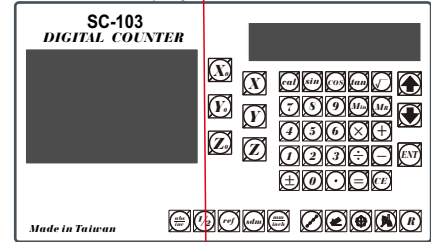


to enter into calculator function



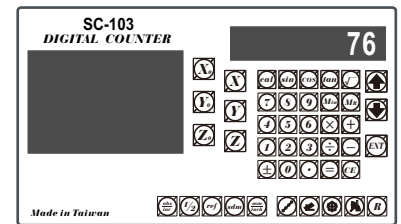
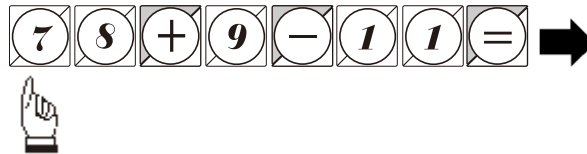
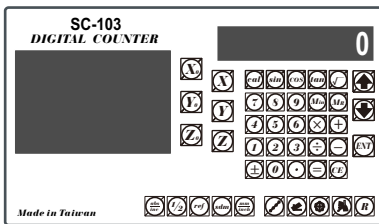
normal X/Y/Z DRO display

Normal calculator

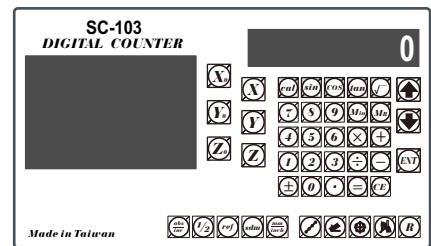
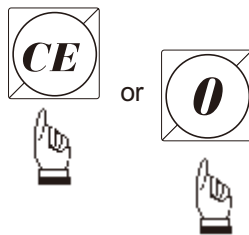
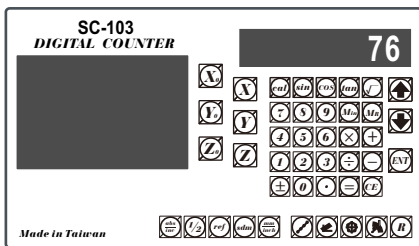


The operations of SC-100's built-in calculator is the same as other ordinary calculators

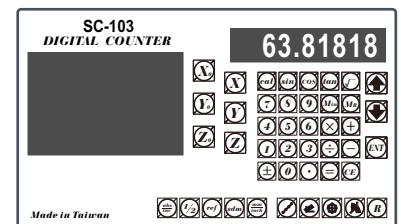
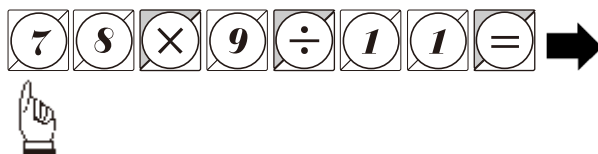
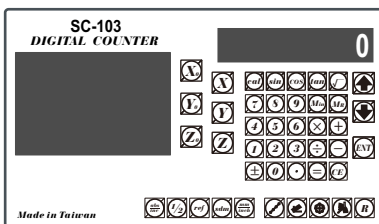
i.e. Basic mathematics - add ; subtract :  $78 + 9 - 11 = 76$



Clear - Restart the calculation

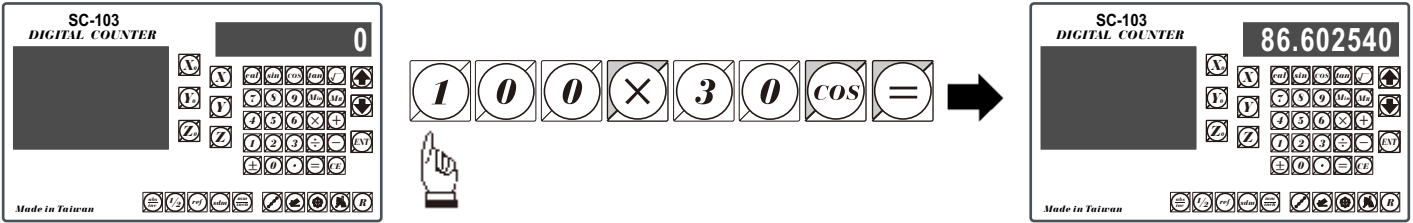


i.e. Basic mathematics - multiply, division :  $78 \times 9 \div 11 = 63.81818$

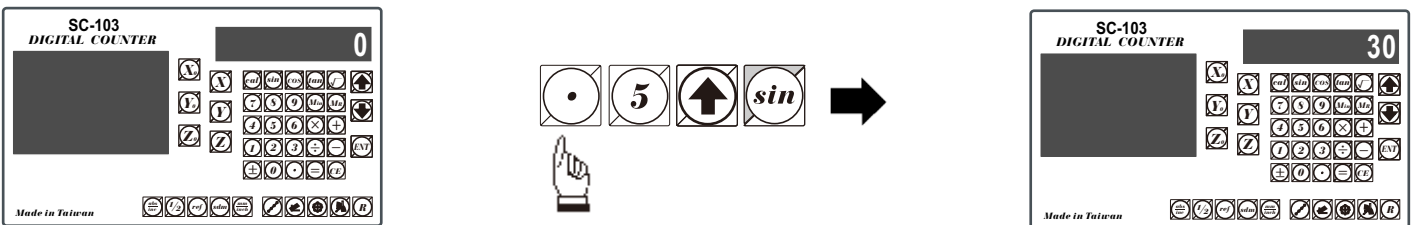


## Built in Calculator

i.e. Trigonometric calculation - **COS** :  $100 \times \cos 30^\circ = 86.602540$

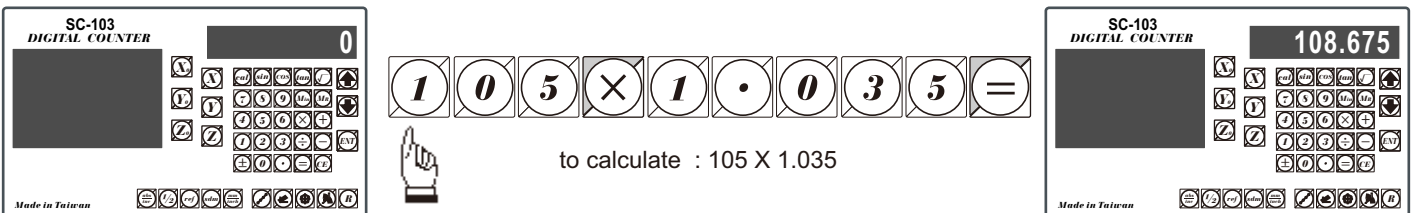


i.e. Trigonometric calculation - **inverse SIN** :  $\sin^{-1} 0.5 = 30^\circ$

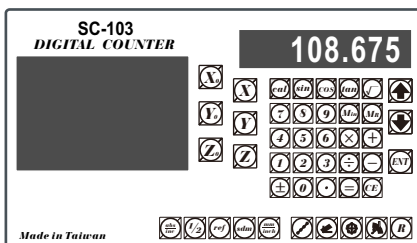


## Result Transfer

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



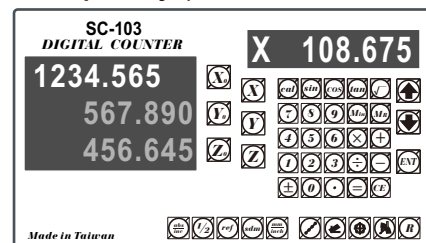
transfer the calculated result : 108.675 onto the X axis for tool positioning



to transfer calculated result to X axis

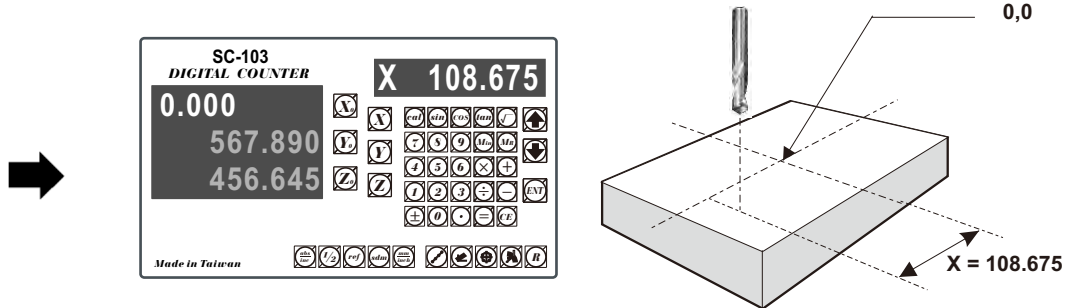


X axis zero position is now **temporarily** preset at X = 108.675

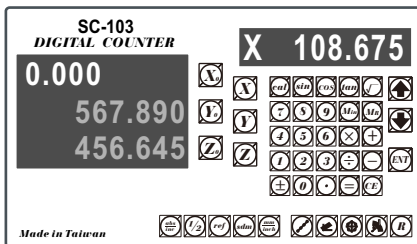


## Built in Calculator

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



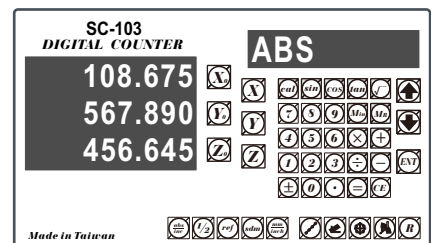
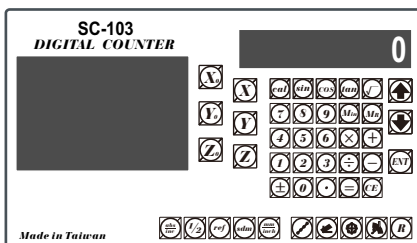
The tool is now at the position of the calculated result  
( X = 108.675 in the above example )  
To get back to normal coordinate display to continue  
the machining



When you are in calculator mode, you can

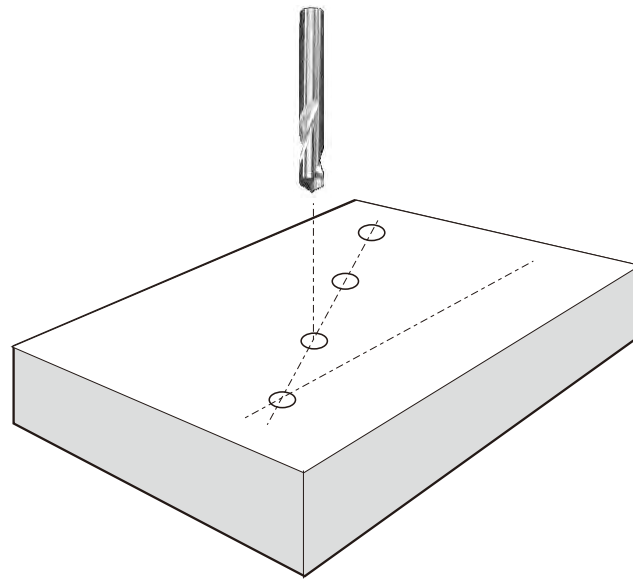
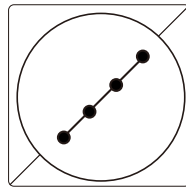


to exit the calculator mode, to return to normal coordinate  
display to continue the machining.





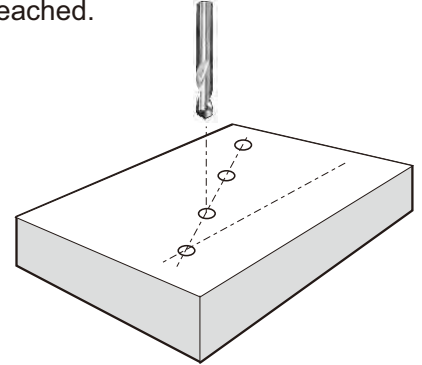
**LHOLE - Tool positioning for a Line of Holes**



## LHOLE - Tool positioning for a Line of Holes

**Function :** SC-100 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 SC-100's message screens), and the SC-100 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.

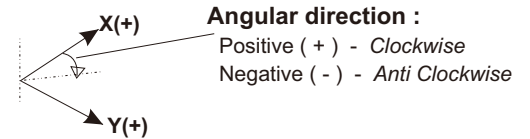
- Line Angle ( **LIN ANG** )
- Line Distance ( **LIN DIST** )
- No.of Holes ( **NO. HOLE** )



After the above machining parameters are entered into SC-100, it presets all the Line Hole positions to 0.000

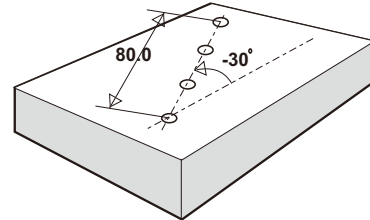
Operator can press  or  to select


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

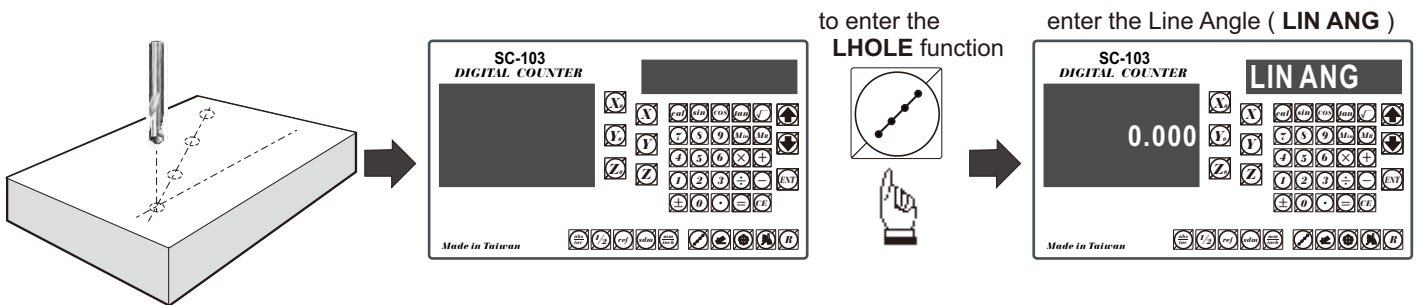


### Example

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



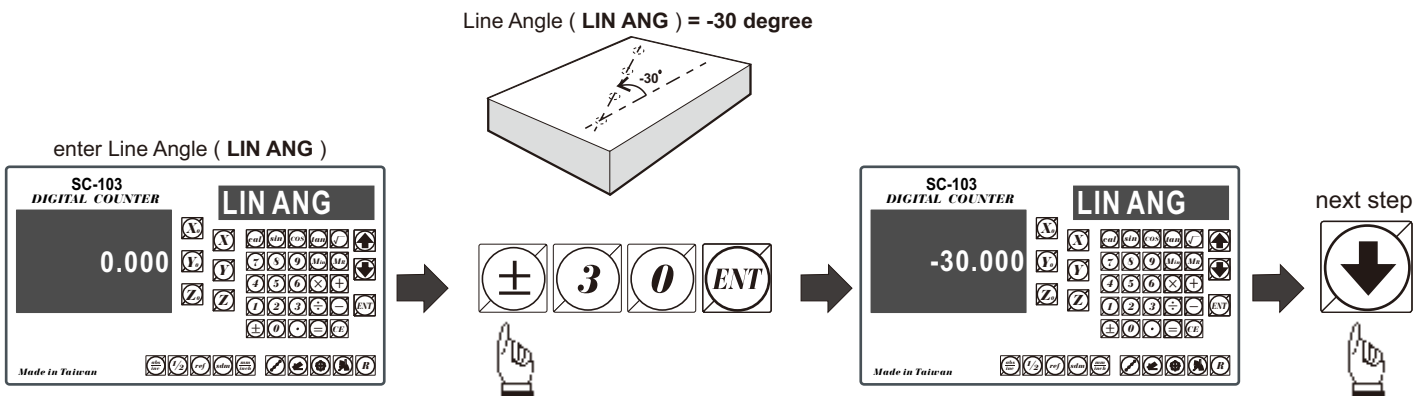
**step 1 :** The LHOLE function starts by using the current tool position as the starting point, therefore, locate the tool at the **first** LINE HOLE position  to enter the **LHOLE** function



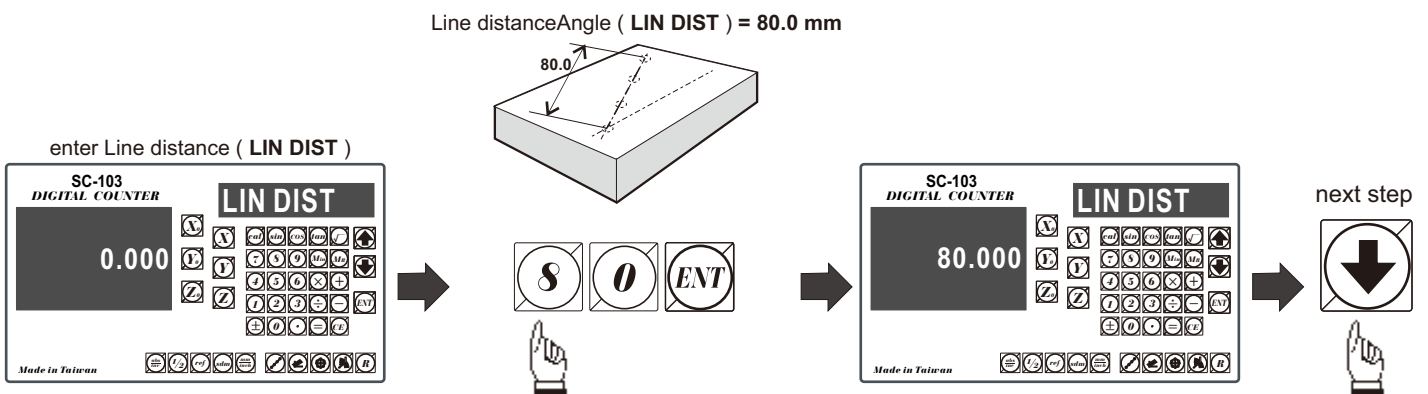
locate the tool at the **first** Line Hole position

## LHOLE - Tool positioning for a Line of Holes

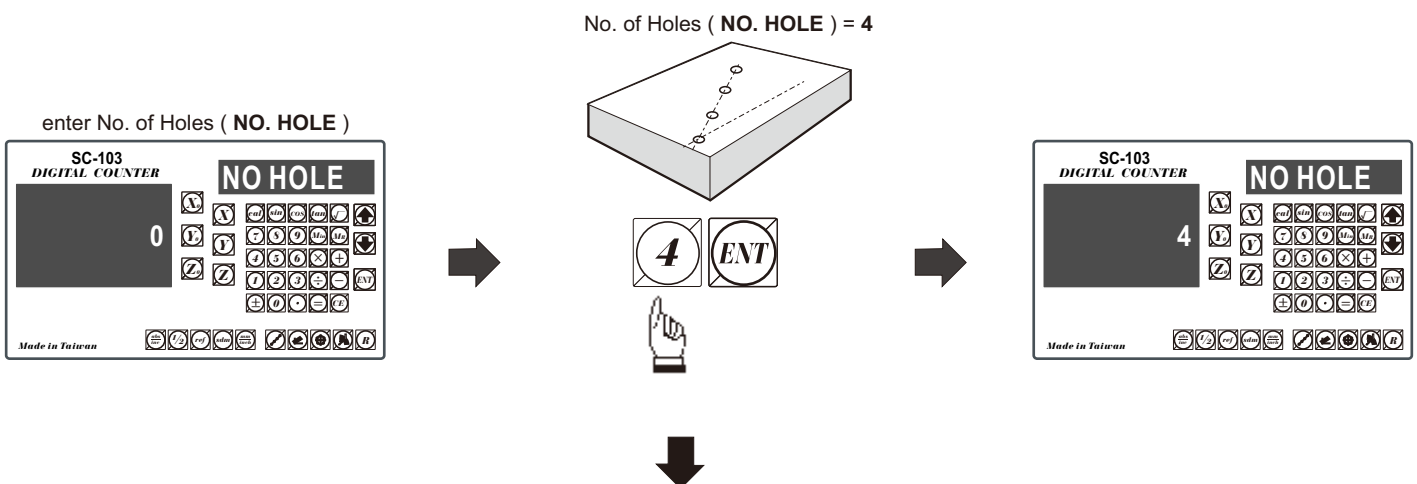
step 2 : Enter Line Angle ( LIN ANG )



step 3 : Enter Line distance ( LIN DIST )





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



## LHOLE - Tool positioning for a Line of Holes

➔ All LHOLE machining parameters are already entered into SC-100  to enter into LHOLE drilling mode



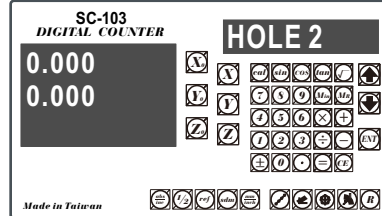
Operator can  or  to select the Line Hole, then move the machine to display = 0.000, then the Line Hole position is reached.



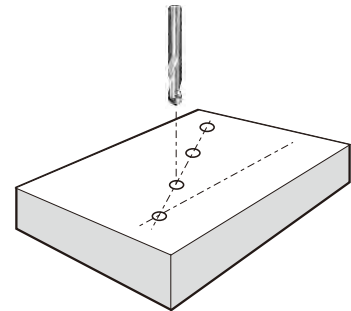
Next Line Hole



move the machine to display = 0.000



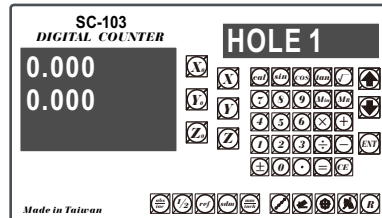
HOLE 2 = Line Hole no. 2



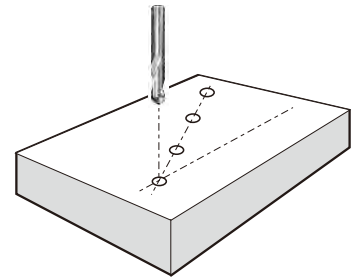
Last Line Hole



move the machine to display = 0.000

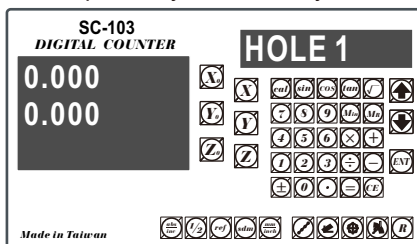


HOLE 1 = Line Hole no. 1

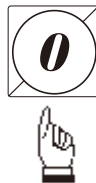


If the operator wants to check or verify that the SC-100's LHOLE calculation is correct, or wants to temporarily exit the LHOLE function cycle (ie swap to normal XYZ display). The operation is as follows .:

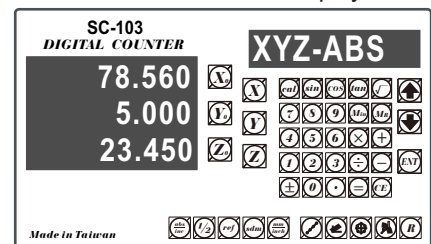
presently in LHOLE cycle



temporarily *swap* to normal XYZ coordinate display

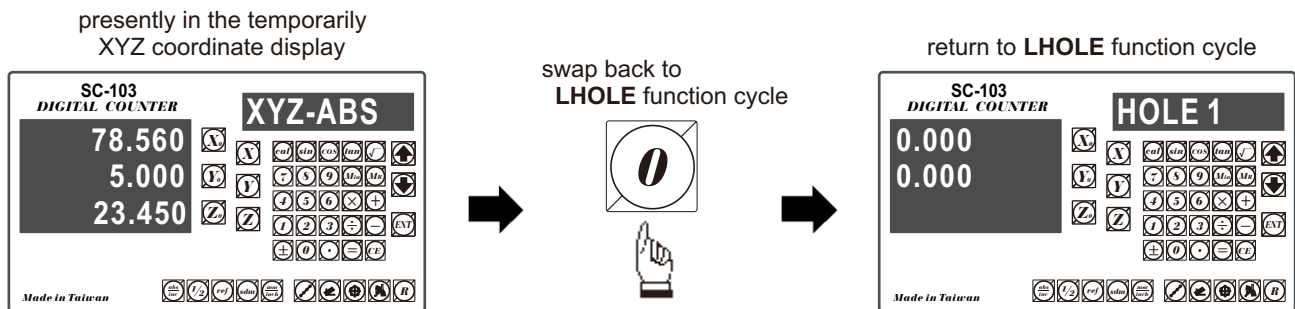


temporarily return to XYZ coordinate display

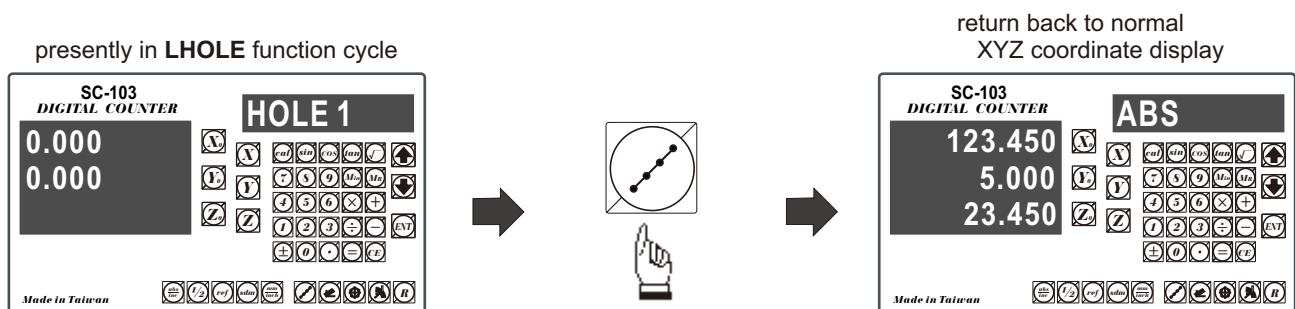


## LHOLE - Tool positioning for a Line of Holes

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

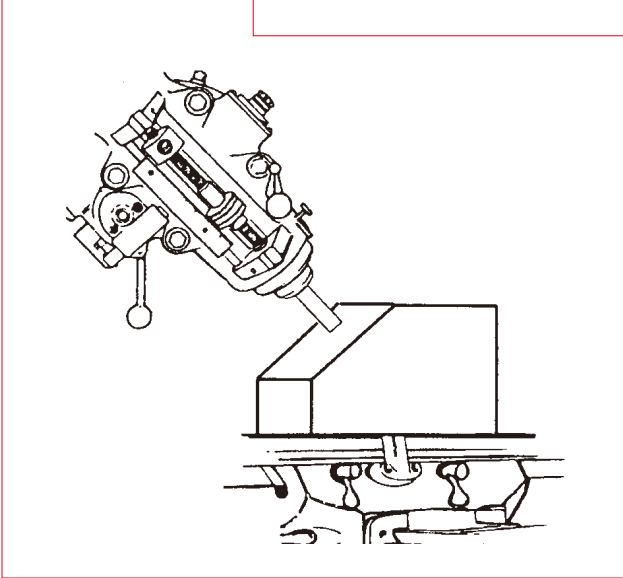
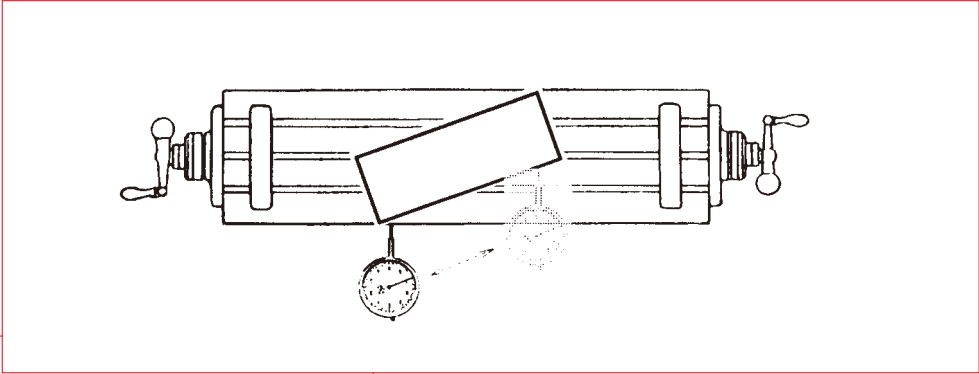
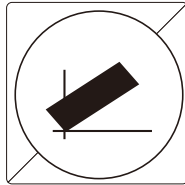


After the Line Holes drilling operation is completed, and to leave the LHOLE function cycle, follow the procedure below





**INCL - Inclined surface datum tool positioning**



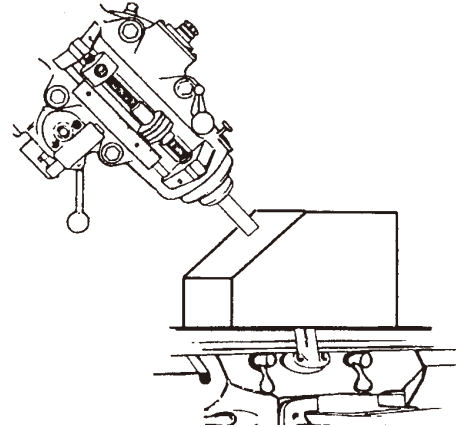
## INCL - Inclined surface datum tool positioning

**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.

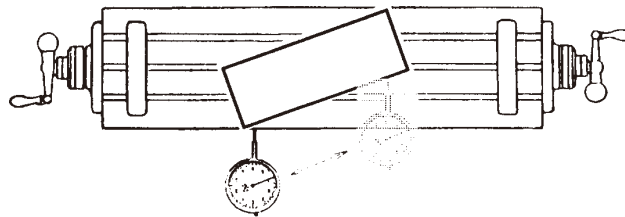
However, when the **work piece is too big** to be installed onto the incline table, or the **accuracy requirement is high**, the only solution is to calculate the machining points or datuming points using the mathematical method. This is generally very time consuming.

The SC-100 provides easy-to-use **INCL** function to help the operator for precision inclined surface datuming and machining.

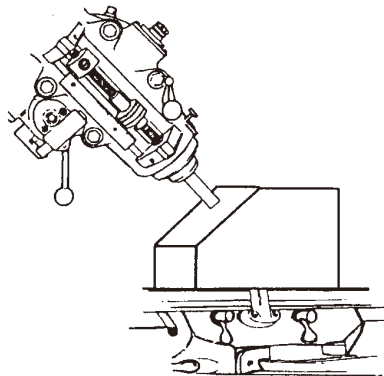


**Application of the INCL function are as follows :**

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



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

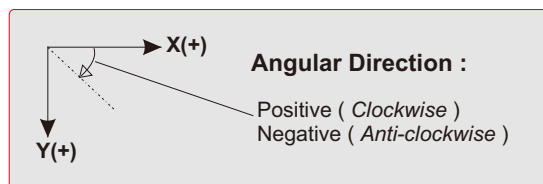




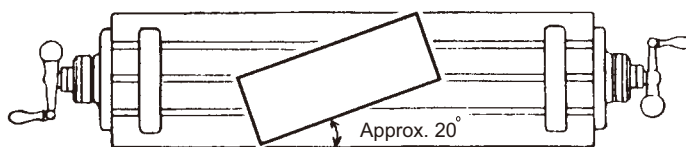
## INCL - Inclined surface datum tool positioning

### Example :

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

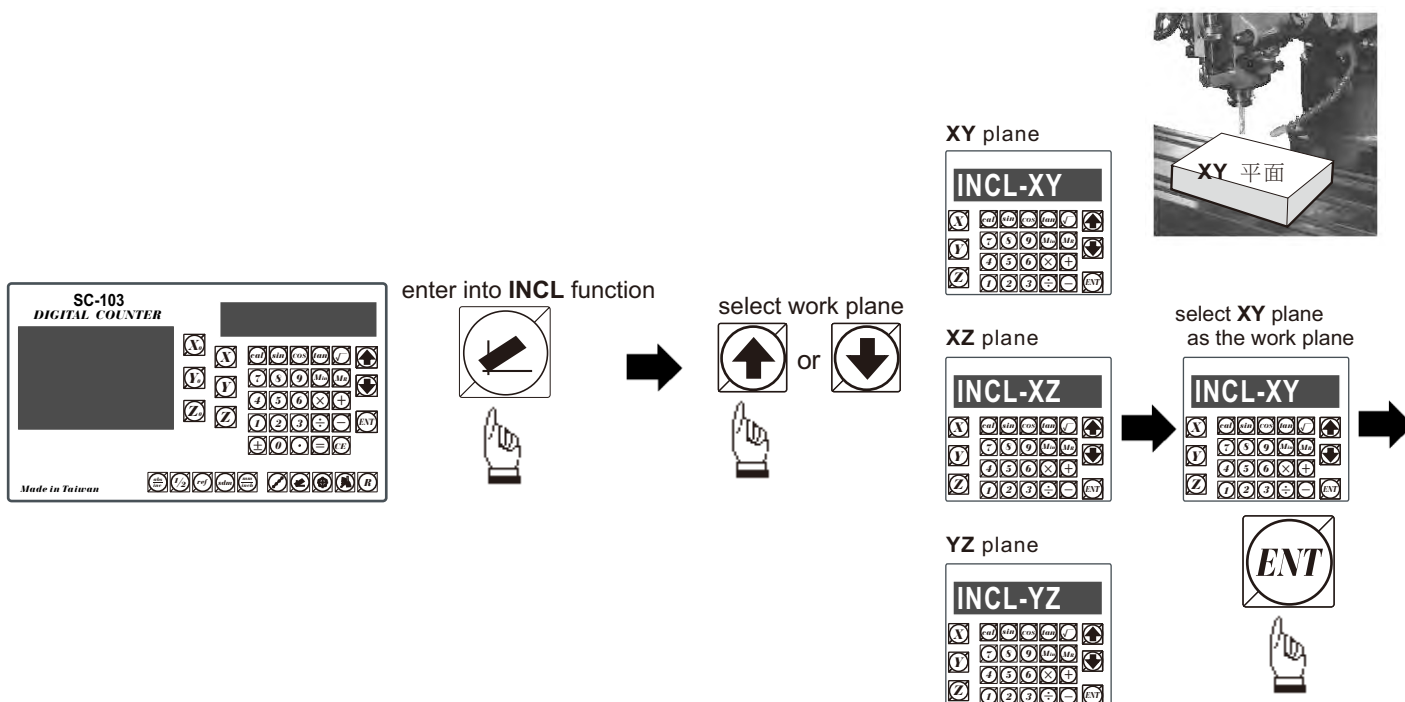


### Operational procedure



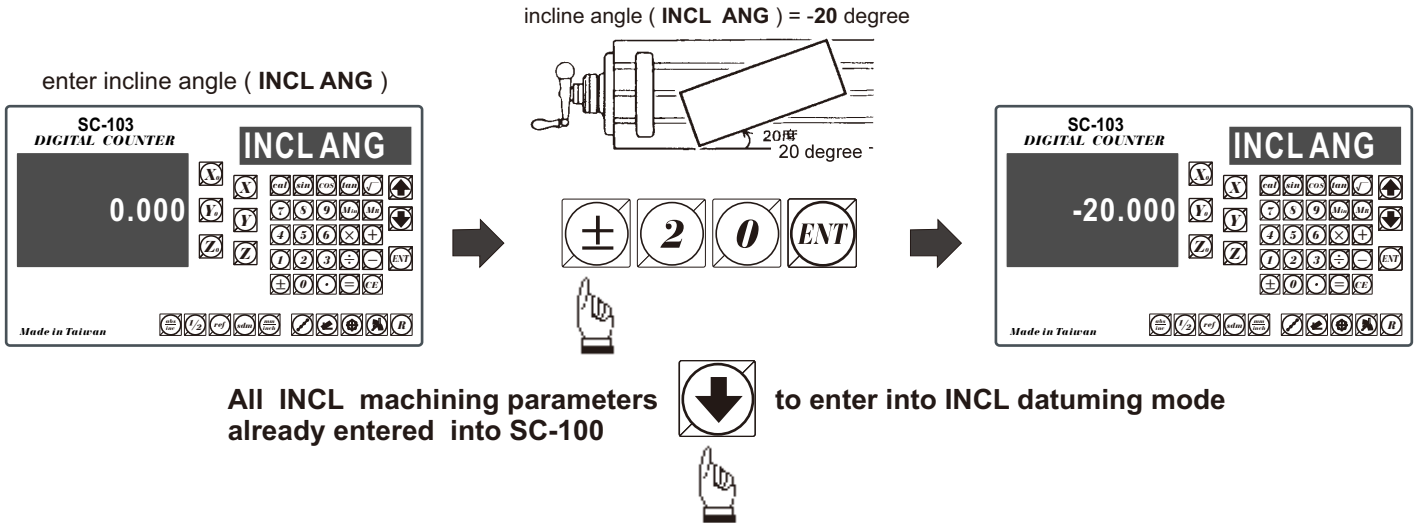
Install the work piece onto an rotary table at approximately 20 degree.

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

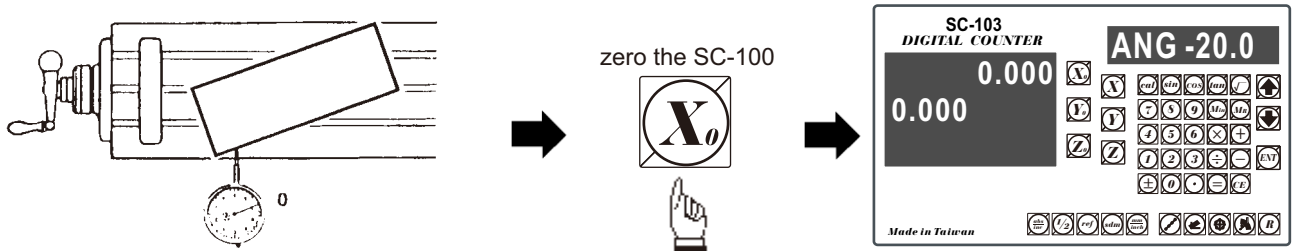


## INCL - Inclined surface datum tool positioning

step 2 : enter incline angle ( INCL ANG )

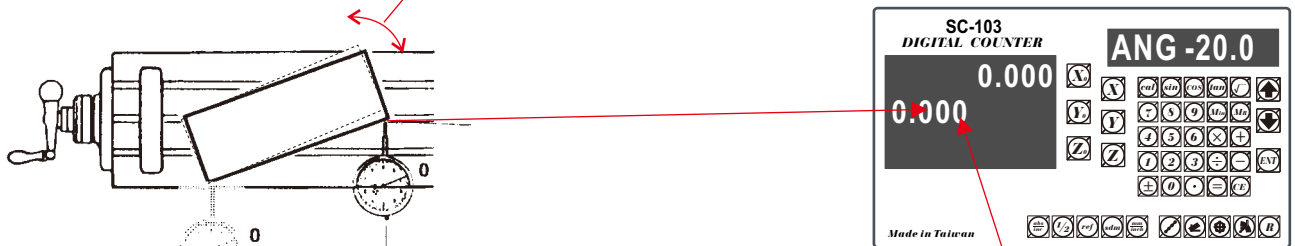


A) zero the dial indicator on one end of the work piece



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.

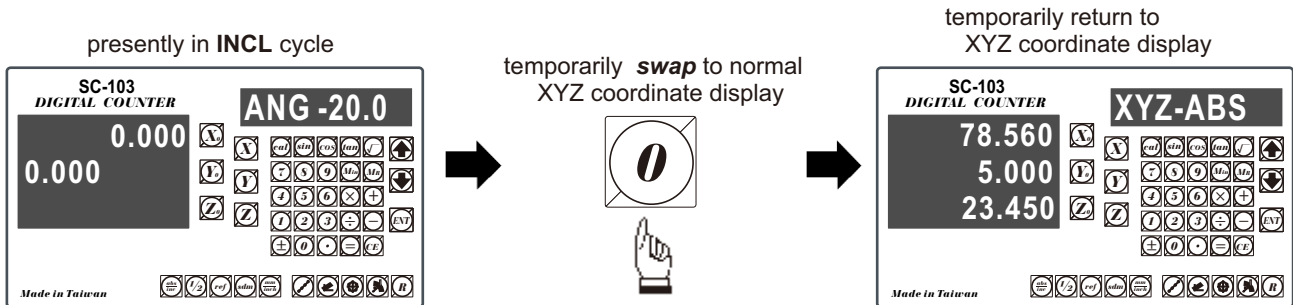


Y axis zero position will follow the X axis position at the angle of ANG ( -20 degree in this example ) operator just move the Y axis to display = 0.000 - it is then at an accurate 20 degree position

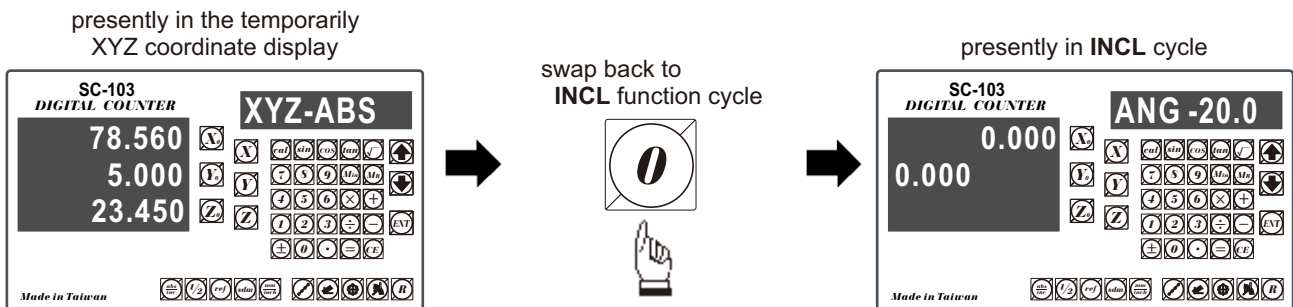
During the incline angle alignment, angular adjustment of any one end of the work piece will affect the the position on the other end, the above angular alignment procedure A) & B) has to be carried out iteratively until operator is satisfied with the angular alignment achieved.

## INCL - Inclined surface datum tool positioning

If the operator wants to check or verify if SC-100's INCL calculation is correct, or wants to temporarily exit the INCL function cycle ( swap to normal XYZ display ). The operation are as follows .:



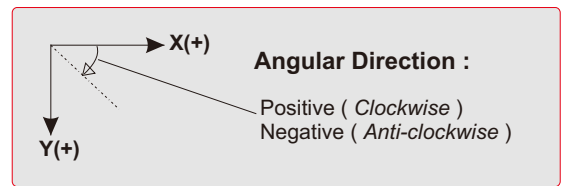
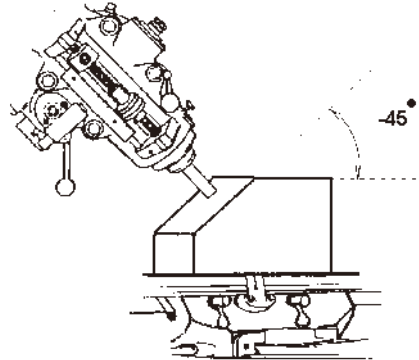
**swap back** to INCL cycle to continue the **INCL** incline angle alignment



## INCL - Inclined surface datum tool positioning

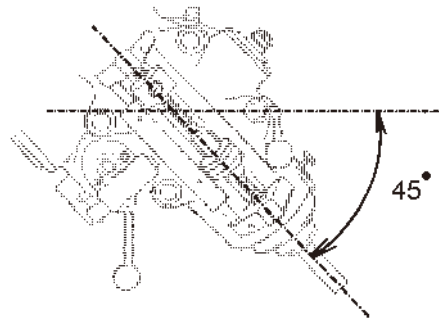
### Example :

To machine a 45 degree inclined surface on XZ plane using a two axis SC-100

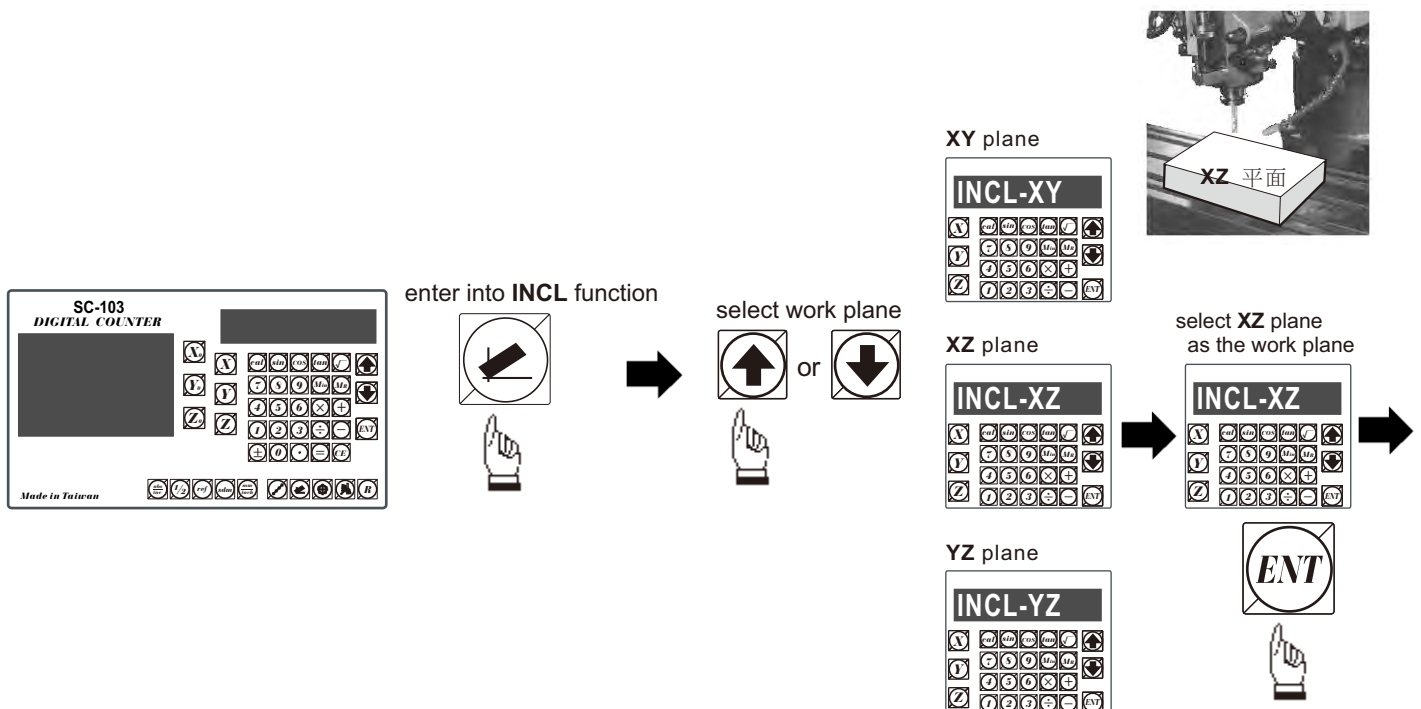


### Operation procedure

Inclines the mill head by 45 degree

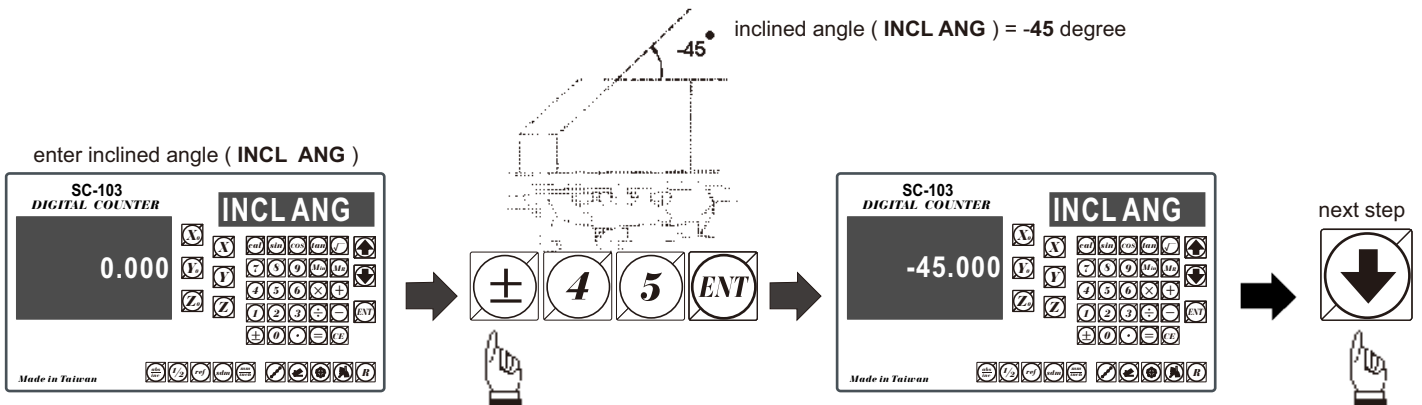


**step 1 :** select XZ plane as the work plane ( INCL - XZ )

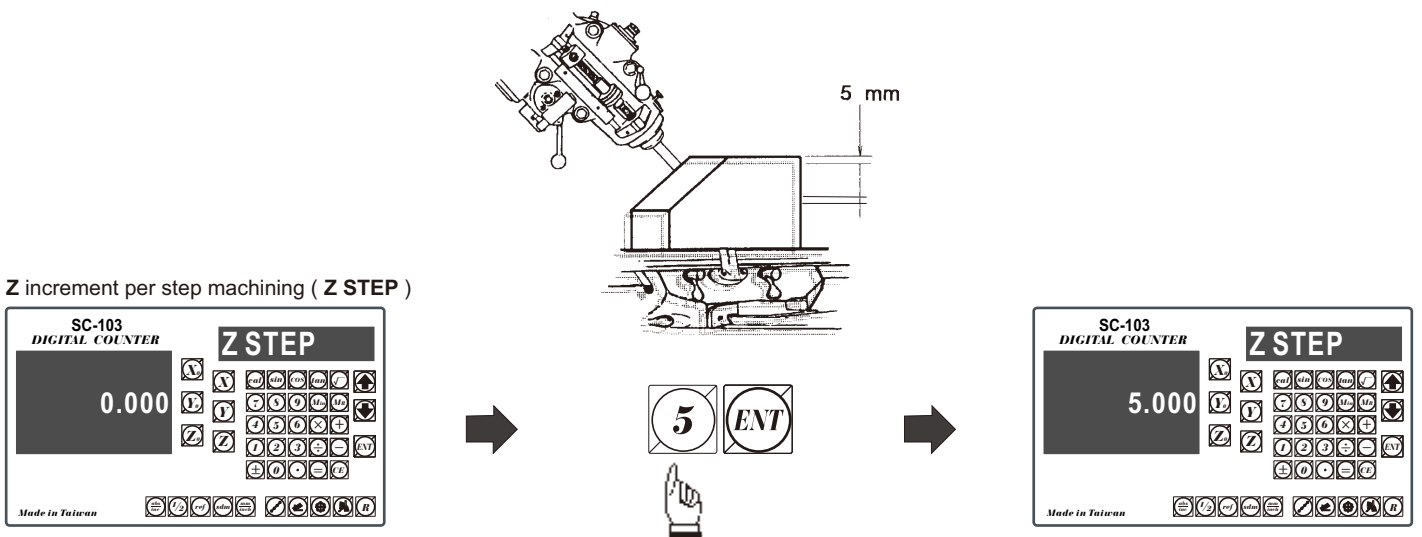


## INCL - Inclined surface datum tool positioning

step 2 : enter inclined angle ( INCL ANG )



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



All INCL machining parameters already entered into SC-100

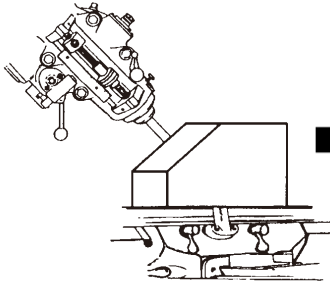


to enter into INCL datuming mode

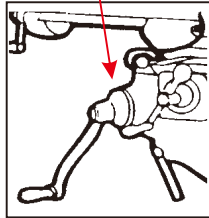


## INCL - Inclined surface datum tool positioning

Position the tool on any point on the inclined surface



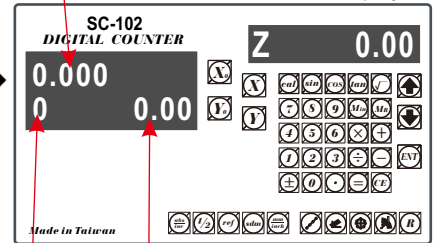
set the Z dial to zero



reset XZ axis



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



two axis SC-102 incline display

Z dial turn number

Z dial reading

As a 2-Axis SC-102 does not have Z Axis, the SC-102 uses the



to simulate the Z axis movement



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

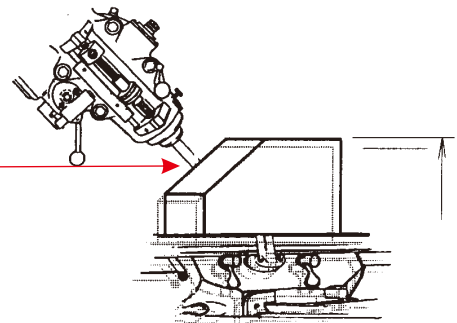
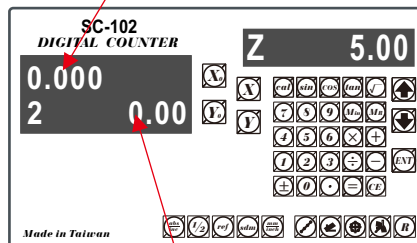


— simulate Z axis move **down** one step

simulate Z axis move **up** one step



move the X axis of SC-102 to display = 0.000, then the tool is positioned on the inclined surface

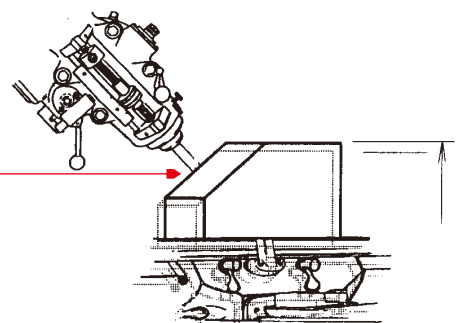
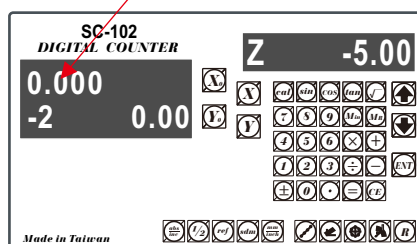


position the Z axis according to the Z dial turns and Z dial reading

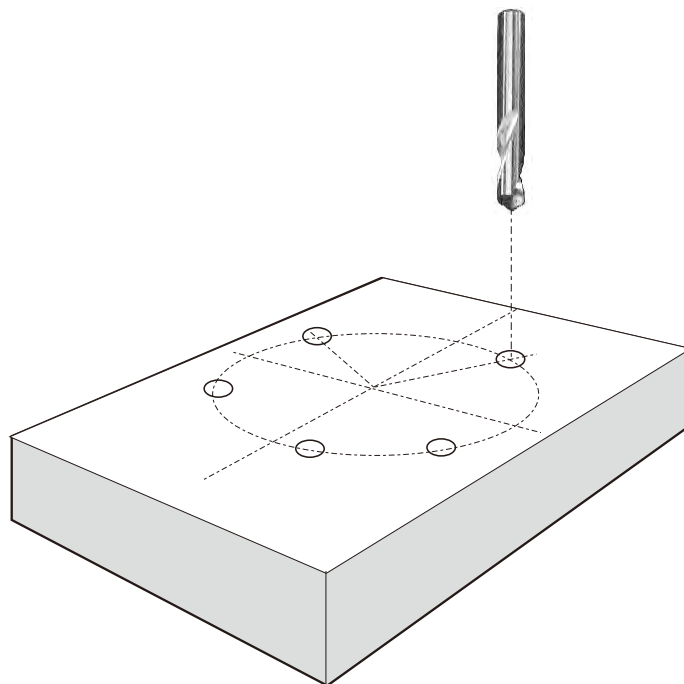
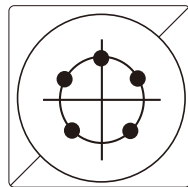
simulate Z axis move **down** one step



move the X axis of SC-102 to display = 0.000, then the tool is positioned on the inclined surface



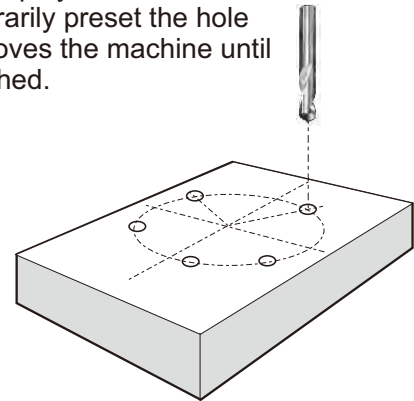
# PCD - Tool positioning for Pitch Circle Diameter



## PCD - Tool positioning for Pitch Circle Diameter

**Function :** SC-100 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 SC-100's message display,. The SC-100 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.

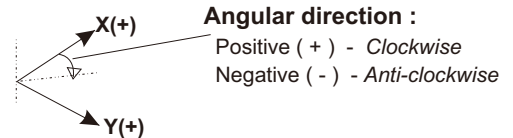
- Centre ( **CENTRE** )
- Diameter ( **DIA** )
- No. of Holes ( **NO. HOLE** )
- Start Angle ( **ST. ANG** )
- End Angle ( **END. ANG** )



After the above machining parameters are entered into SC-100, it presets all the pitch hole positions to 0.000

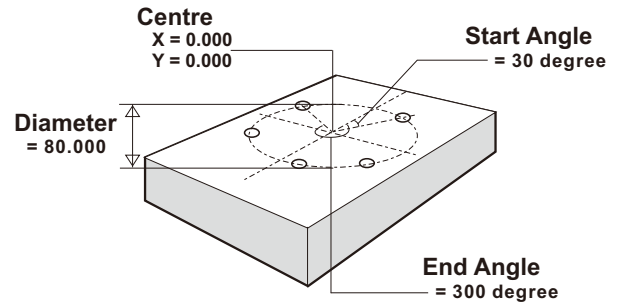
Operator can press  or  to select


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

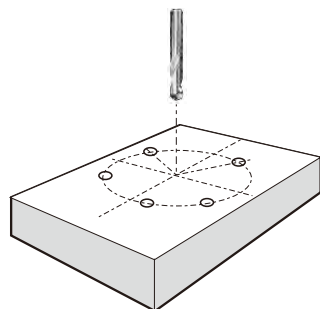


### Example

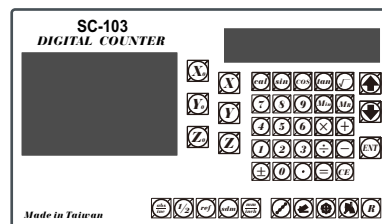
Centre Coordinate ( **CENTRE** ) ..... **X= 0.000, Y=0.000**  
 Diameter ( **DIA** ) ..... **80.000mm**  
 No. of Holes ( **NO. HOLE** ) ..... **5 holes**  
 Start Angle ( **ST. ANG** ) ..... **30 degree** ( clockwise )  
 End Angle ( **END. ANG** ) ..... **300 degree** ( clockwise )



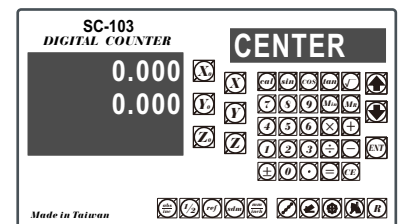
**step 1 :** Set up the work piece datum ( work piece zero )  to enter the **PCD** function



set up work piece datum



to enter the **PCD** function



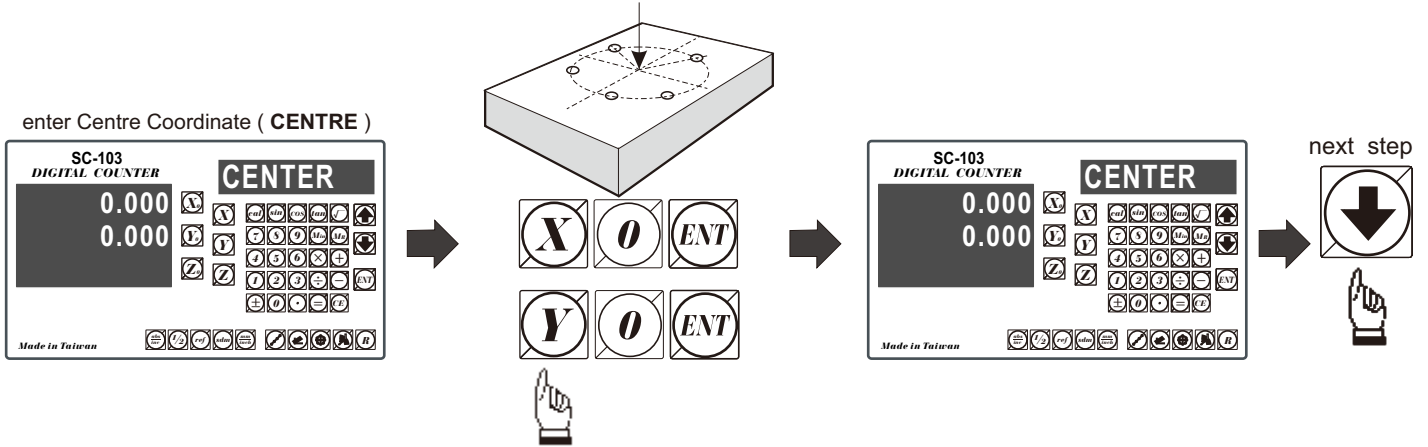
enter the **CENTRE** coordinate



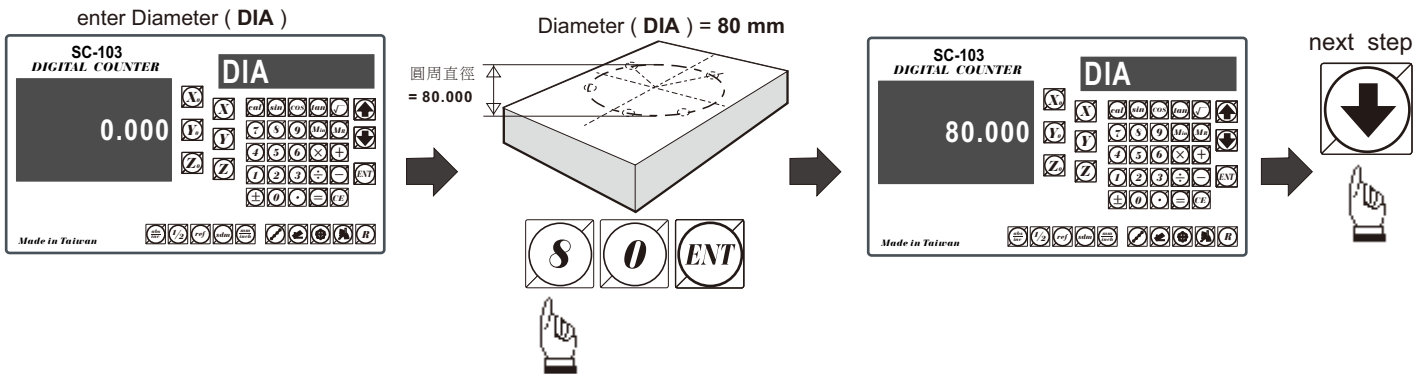
## PCD - Tool positioning for Pitch Circle Diameter

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

Centre Coordinate ( CENTRE ) : X=0.000, Y=0.000

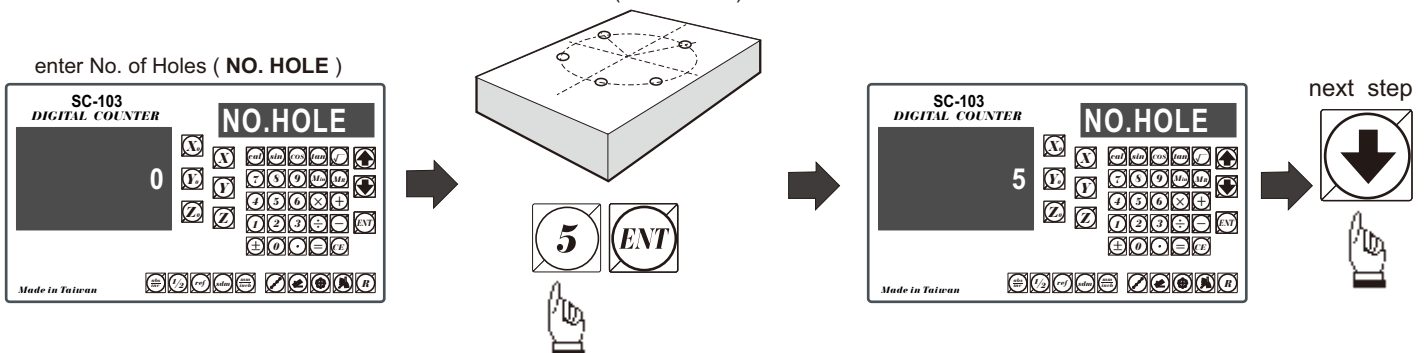


### step 3 : Enter Diameter ( DIA )

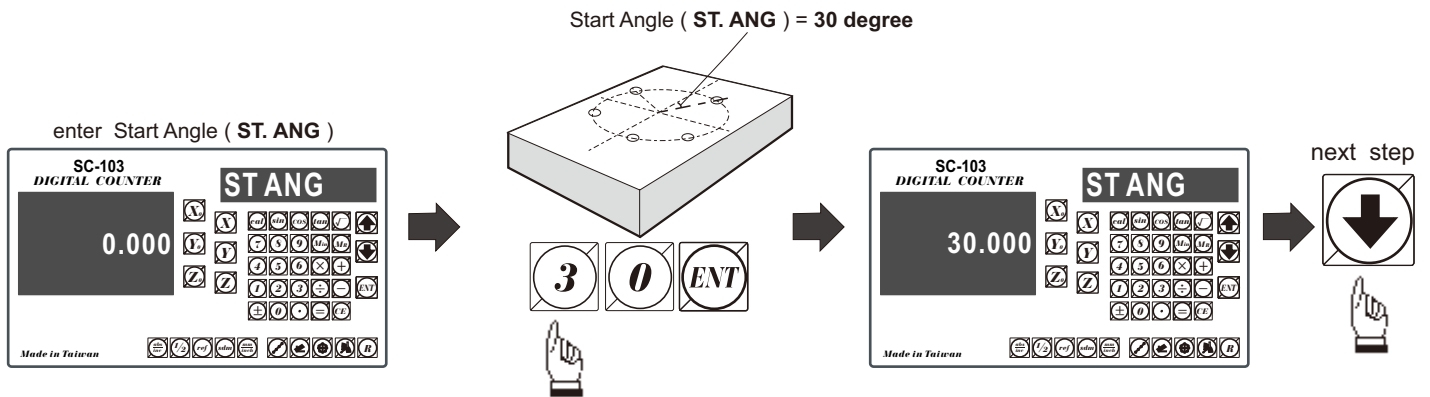


### step 4 : Enter No. of Holes ( NO. HOLE )

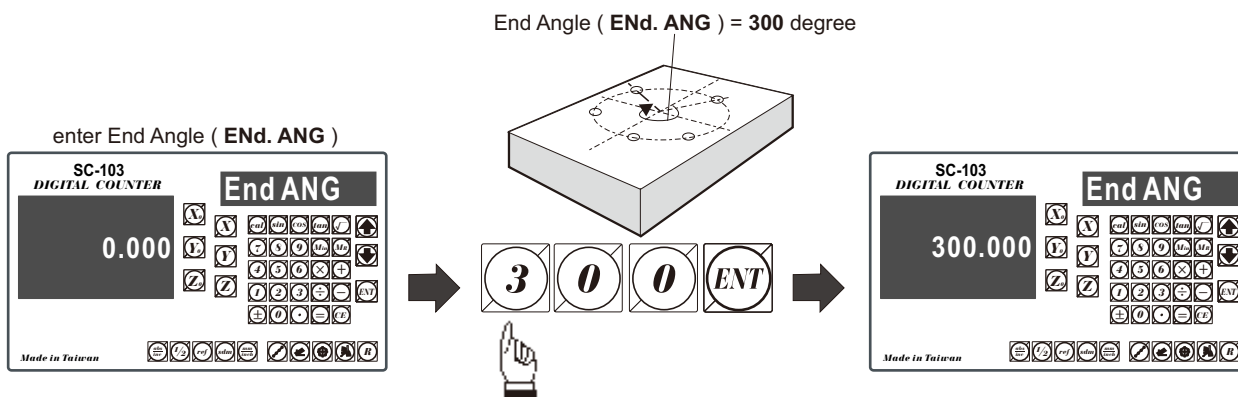
No. of Holes ( NO. HOLE ) = 5



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





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



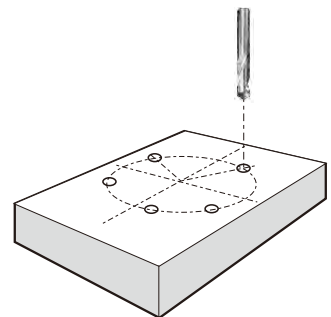
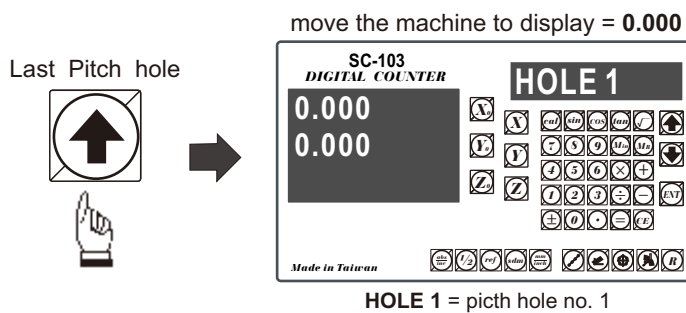
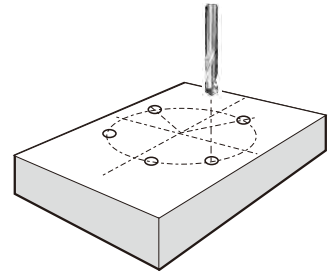
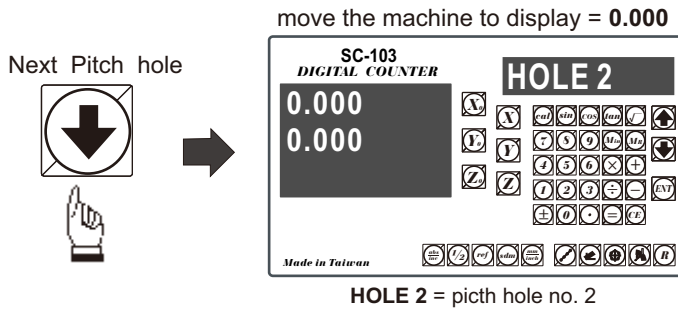
All PCD machining parameters are already entered into SC-100  to enter into PCD drilling mode



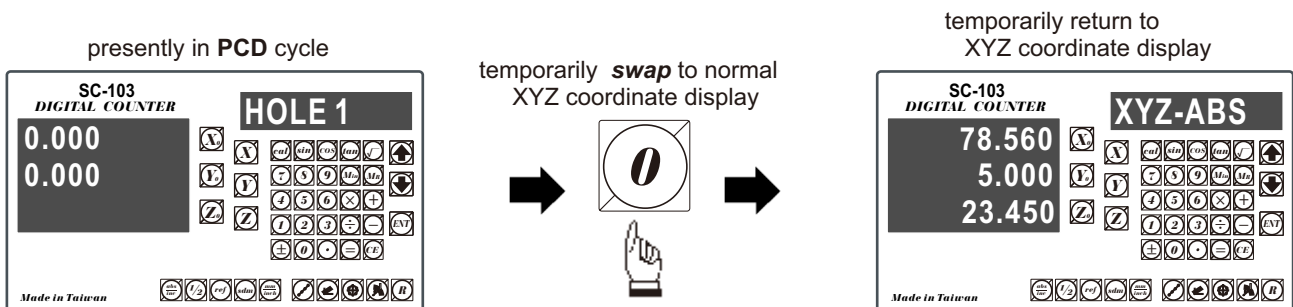
Operator can  or  to select the pitch hole, then move the machine to display = 0.000, to reach the pitch hole position



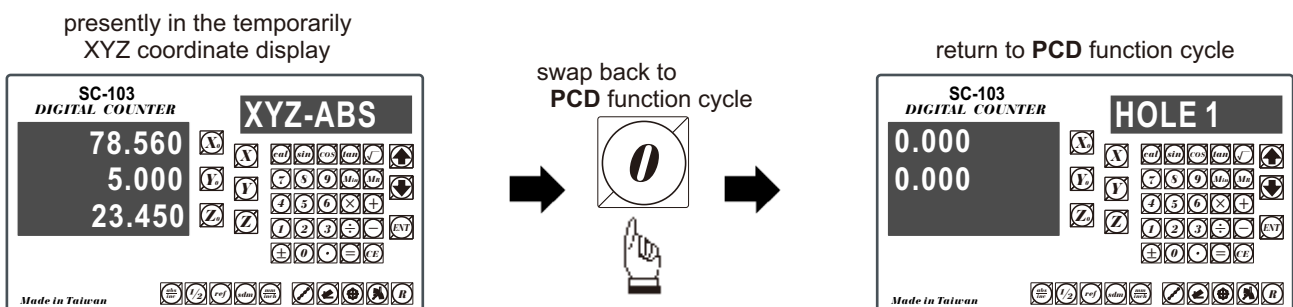
## PCD - Tool positioning for Pitch Circle Diameter



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 :

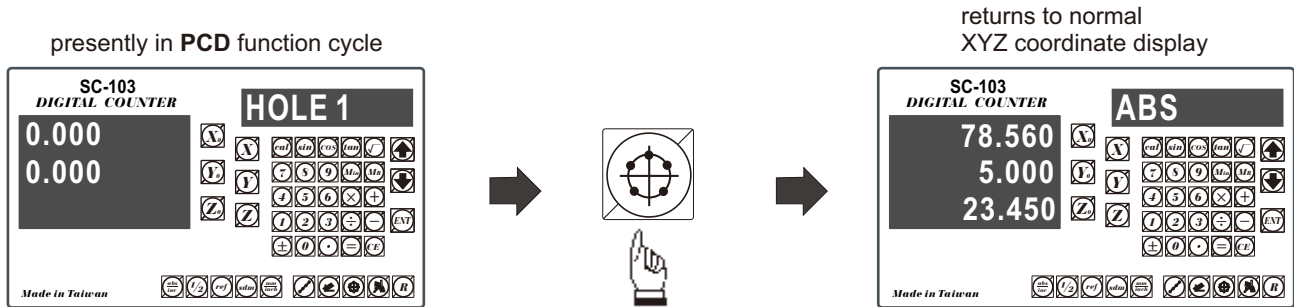


**swap back** to PCD cycle to continue the **PCD** hole drilling

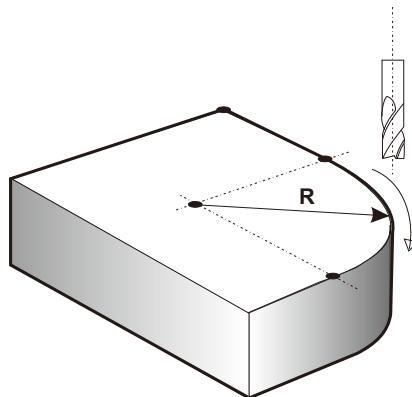
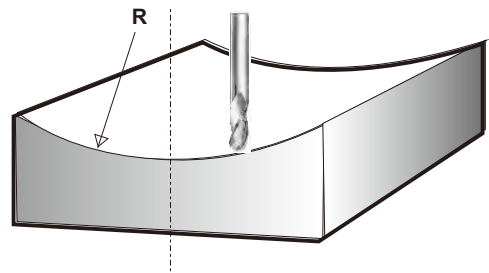
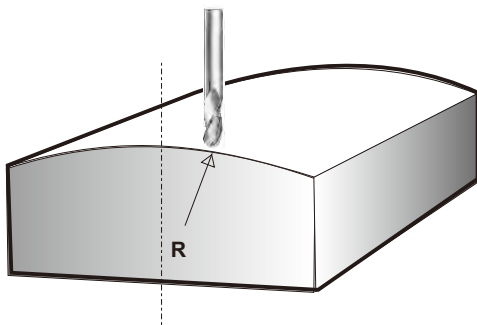
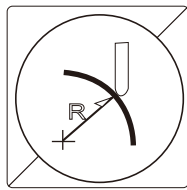


## PCD - Tool positioning for Pitch Circle Diameter

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



# Tool positioning for ARC machining



## 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.

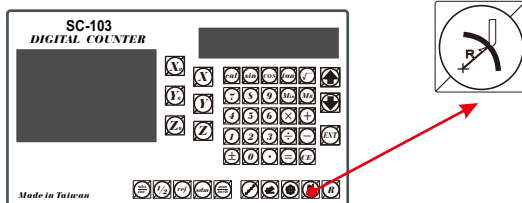
SC-100 features has a very easy-to-use tool positioning function for ARC machining which enables mould makers to machine simple ARC in the shortest possible time. But before you make your decision to use the ARC function or to have your work piece to be machined in a CNC machine, please bear in mind 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.

## ARC functions groups

In SC-100, 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

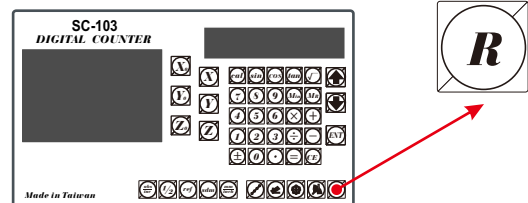
Advantage :

- 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 SC-100.

### Simplified R function



The SC-100'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 SC-100 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.

## R function

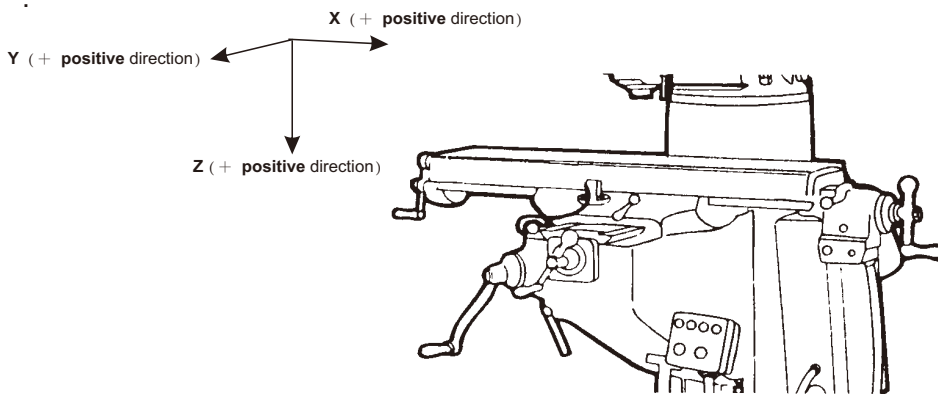
### Understanding the Co-ordinate System :

For those operator who do not have experience in CNC programming, or the first time user of SC-100'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 SC-100's R function, it is necessary to enter the co-ordinates of ARC center, start point, end point and etc. to let SC-100 know the geometry of the ARC to be machined.

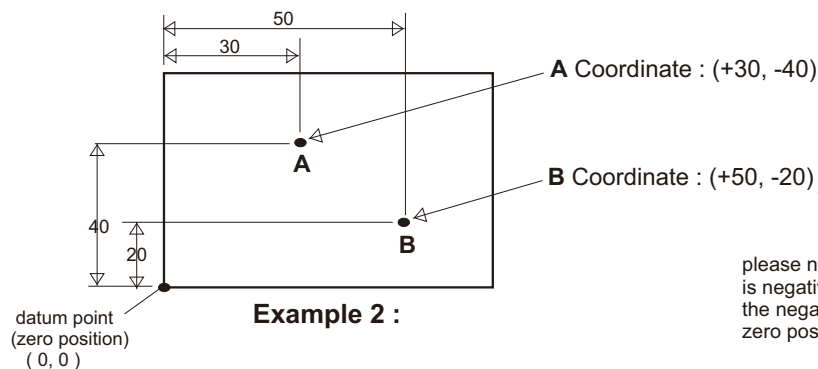
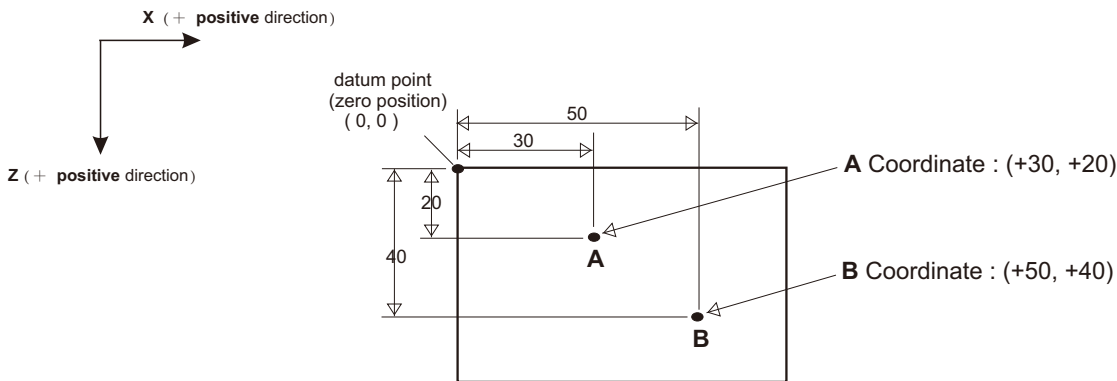
During installation, the engineer will set the display direction same the the dial of the machine. For a Taiwanese made knee-type machine, because of the lead screw dial direction, the SC-100 display directions are also be normally set as follows



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

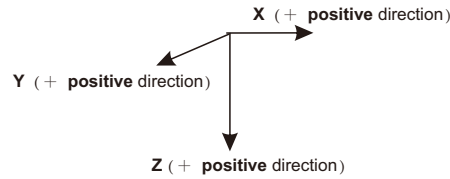
### Co-ordinate Example

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

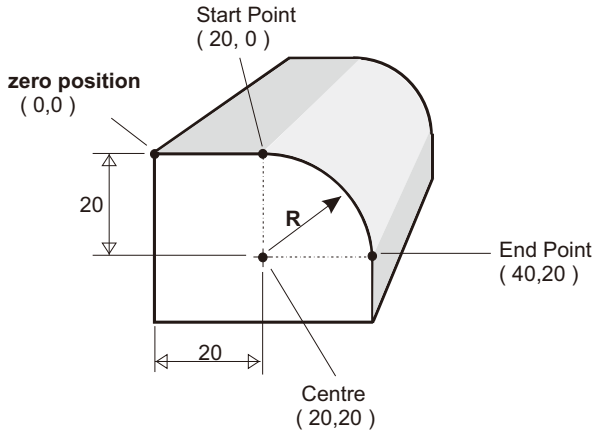


please notice that the Y coordinate is negative because it located at the negative direction from the zero position.

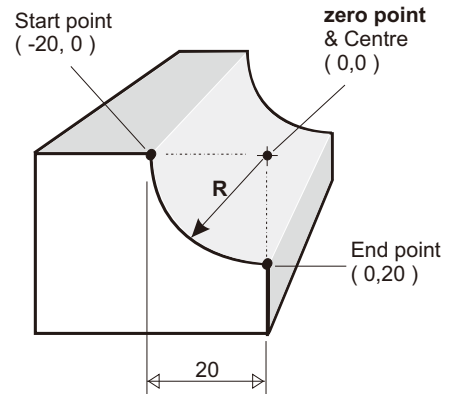
## R function



**Example 3 :**

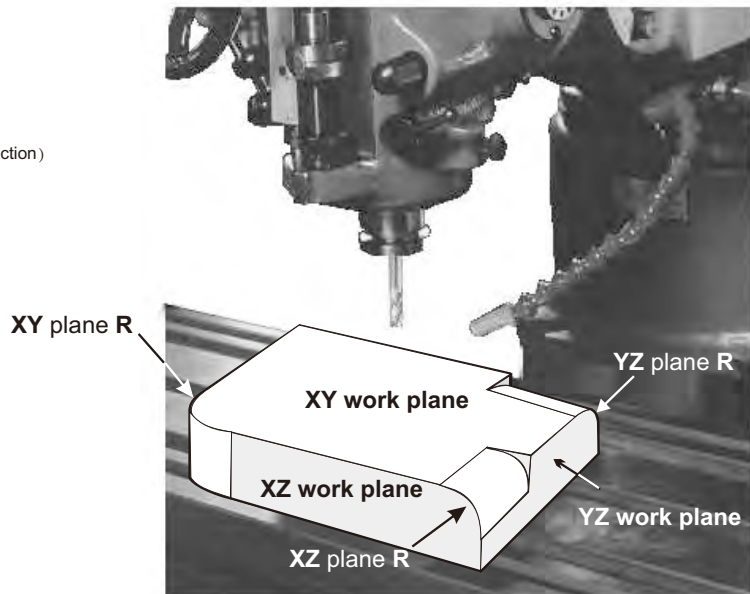
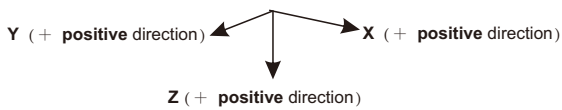


**Example 4 :**



### Work plane :

The R function of SC-100 allows the operator to machine R in XY, XZ & YZ plane as the illustration shows. Even for 2 axis DRO, SC-100 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 SC-100 during in R function data entry.

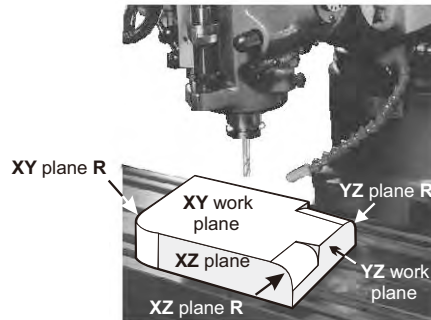




## R function

Following parameters need to be entered into SC-100 for ARC machining :

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



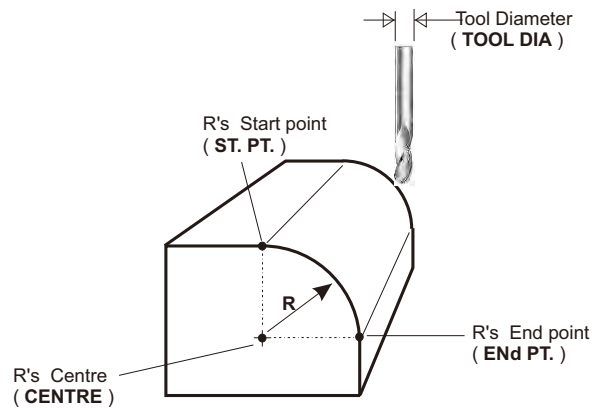
2. R's Centre ( **CENTRE** )

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 )
<b>XZ / YZ</b> plane R		
<b>XY</b> plane R		

8. machining step Increment

<b>XY plane R</b>	<b>XZ / YZ plane R</b>	
<p>For XY plane R, Max. distance between interpolated points is to be specified as the machining step increment.</p> <p><b>MAX CUT</b> = max. distance between interpolated points.</p>	<p>For XZ/YZ plane R, under normal condition, the Z step increment is fixed and to be specified as the machining step increment.</p> <p><b>Z STEP</b> = fixed increment per step</p>	<p>For XZ/YZ plane R, under smooth R option selected. SC-100 will calculate the Z step increment so that the Max. distance between each machining point is approximately the same.</p> <p><b>MAX CUT</b> = max. distance between interpolated points.</p>

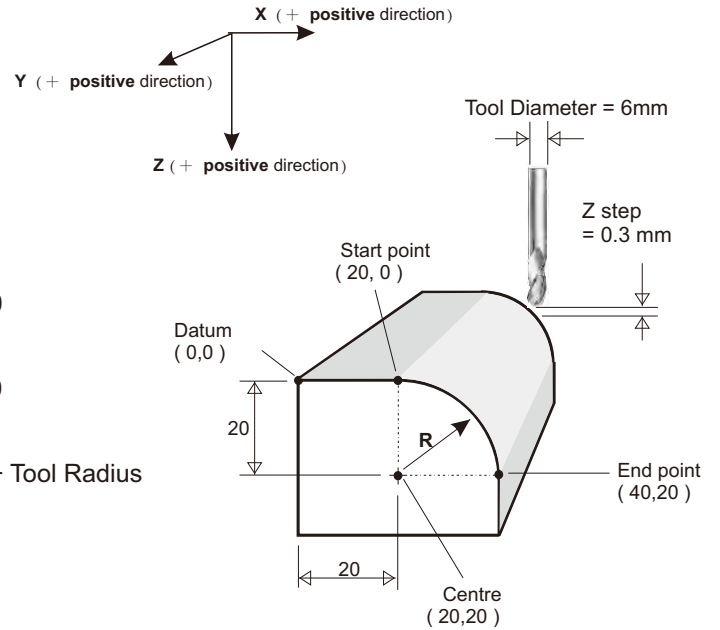
## R function

### Example :

To machine an **XZ plane R** using a 2 Axis **SC-100**

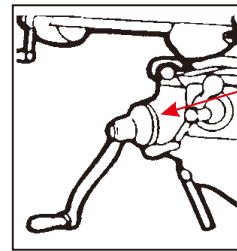
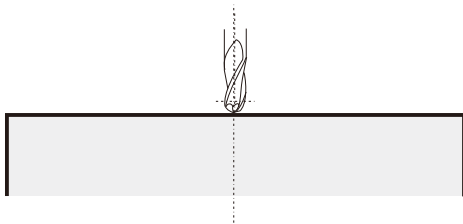
The following machining parameters have to be entered into the **SC-100** :

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**



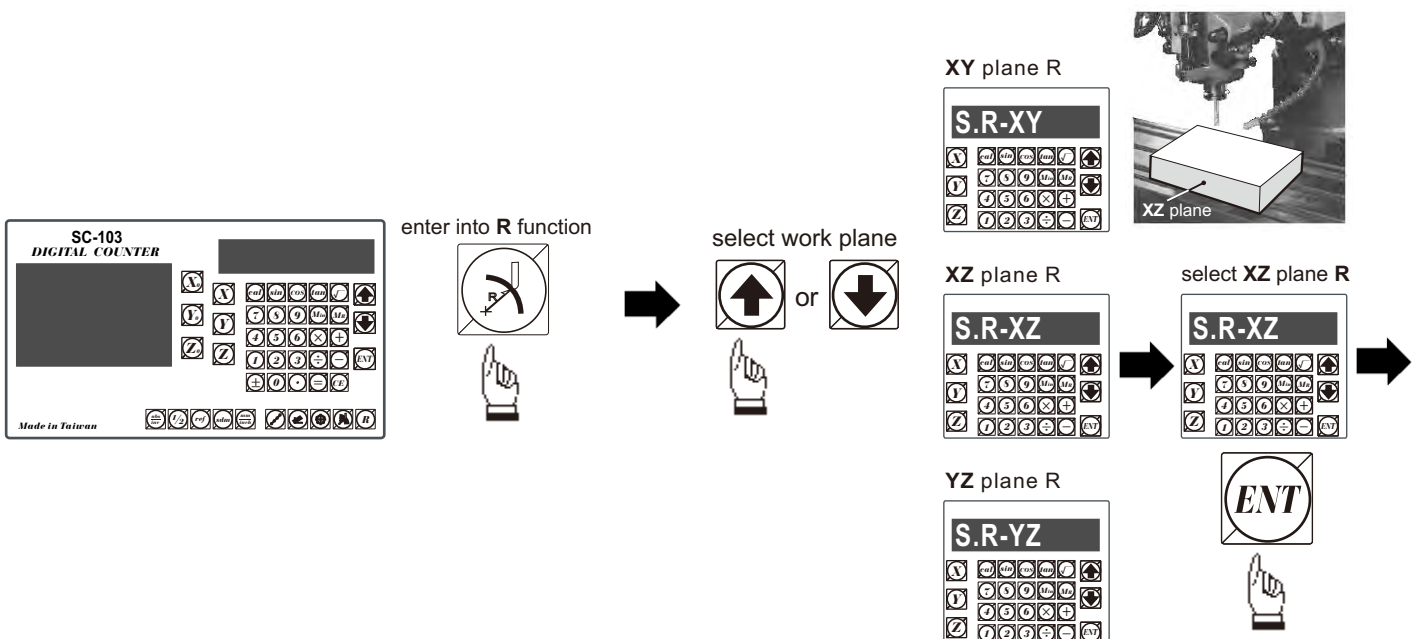
### Operation Example

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** )

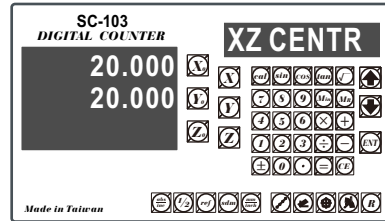
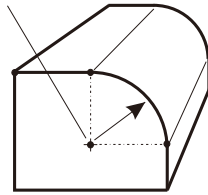
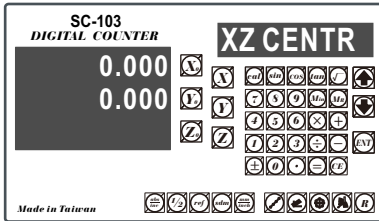


## R function

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

centre coordinate ( XZ CENTR ) : X=20.000, Z=20.000

enter centre's coordinate ( XZ CENTR )



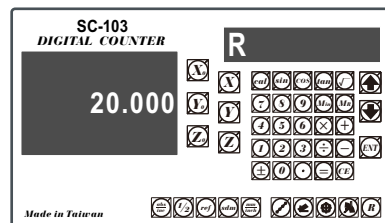
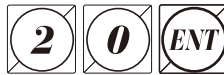
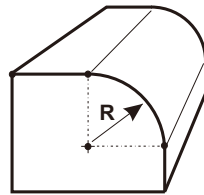
next step



since two axis SC-102 do not have Z axis  
use Y axis to enter Z coordinate

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

Radius ( R ) = 20 mm



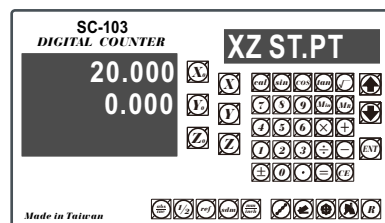
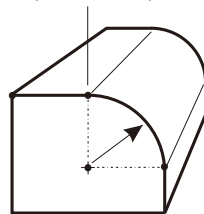
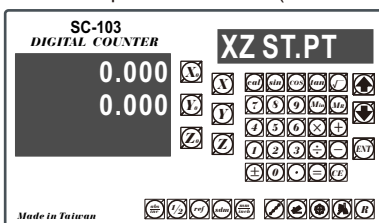
next step



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

start point coordinate ( XZ ST. PT ) : X=20.000, Z=0.000

enter Start point's coordinate( XZ ST. PT )



next step



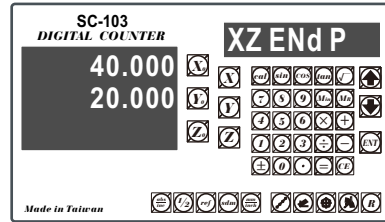
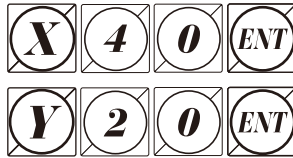
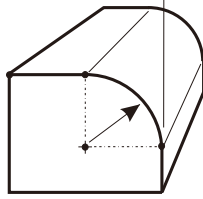
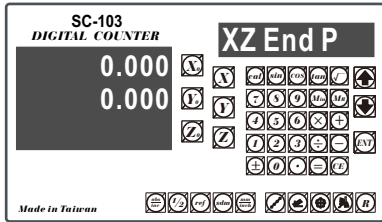
The two axis SC-102 does not have Z axis  
Use Y axis to enter Z coordinate

## R function

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

end point coordinate ( XZ End P ) : X=40.000, Z=20.000

enter End point's coordinate ( XZ End P )



next step

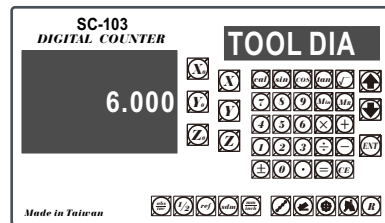
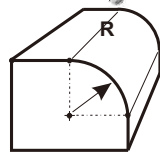
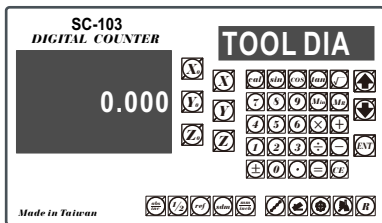


The two axis SC-102 does not have Z axis  
Use Y axis to enter Z coordinate

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

Tool Diameter = 6mm

enter Tool diameter ( TOOL DIA )

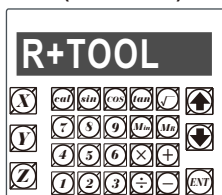


next step

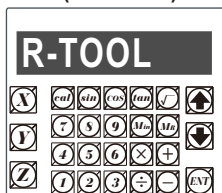


**step 7 : select tool compensation direction**

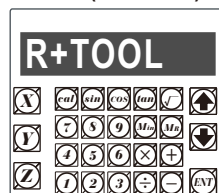
( R+TOOL )



( R-TOOL )



select ( R+TOOL )



next step



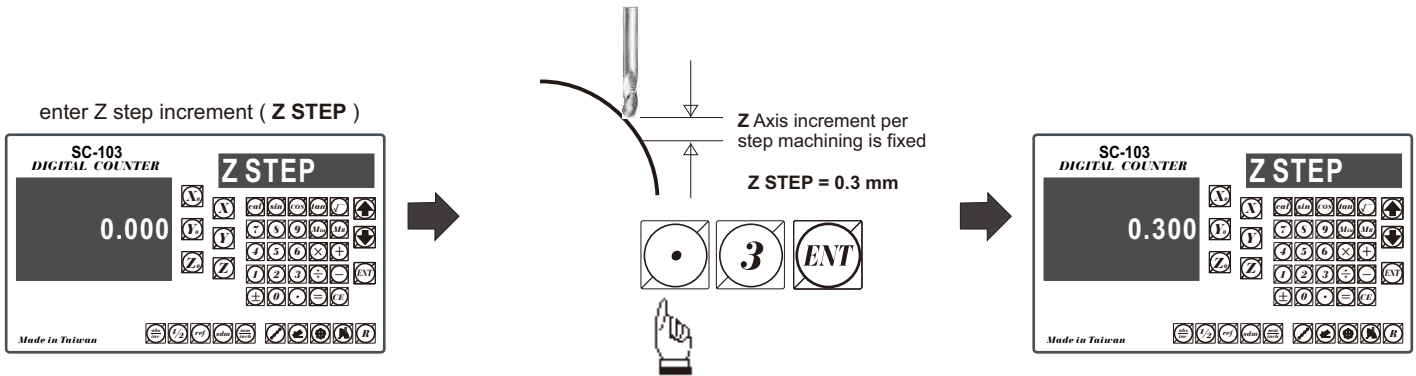
## R function

### step 8 : enter Z incremental step machining

SC-100 provides two options on the Z incremental step machining. The Operator can enter select the smooth R function which best suits the job.

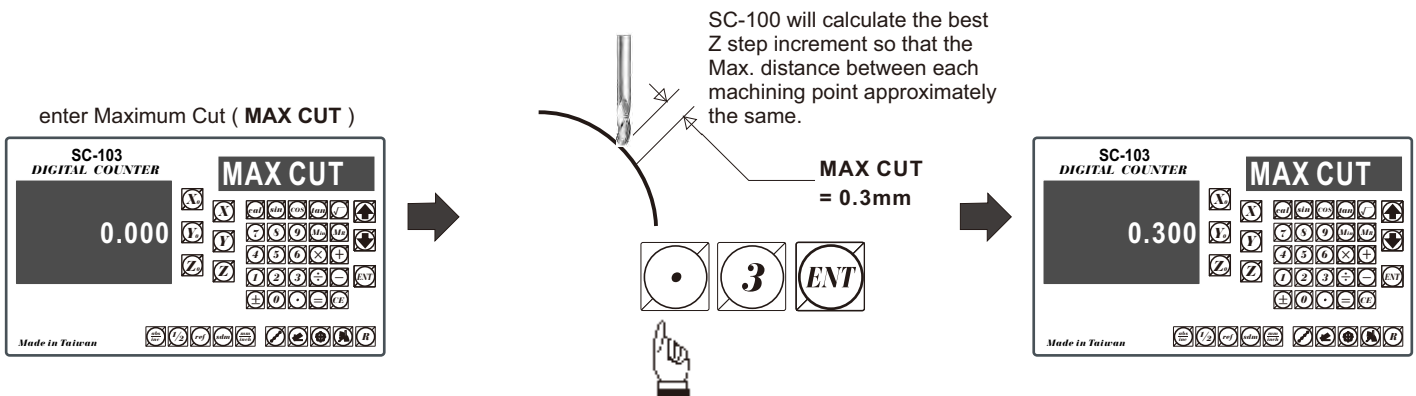
#### Option 1 : Fixed Z step ( Z STEP )

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, SC-100 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 function machining parameters have already entered into SC-100



to enter into ARC machining mode



The two Axis **SC-102** does not have a Z Axis, therefore, **SC-102** 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 the tool is positioned at the ARC starting point and Z axis dial is set to zero ( 0.000 )

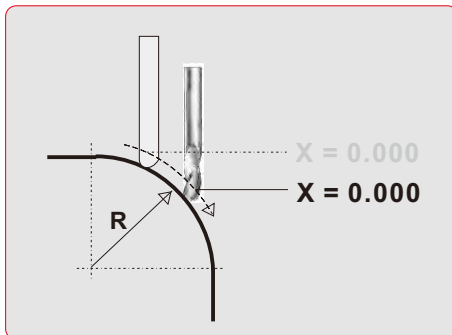
## R function

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 SC-102, and guide the operator easily to position the Z axis during the ARC machining, SC-102 uses the unused axis display to show the **Z dial turn number** and **Z dial reading**.

At the beginning of the ARC machining, the SC-102 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 dial 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..



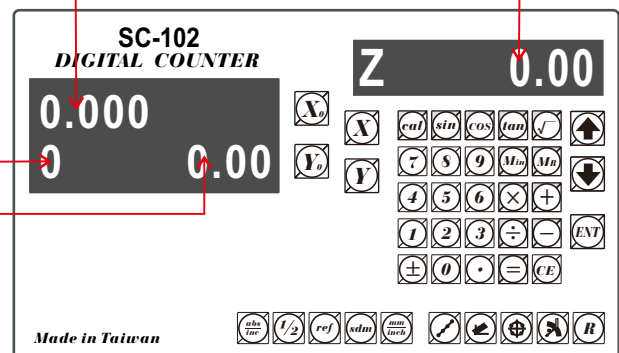
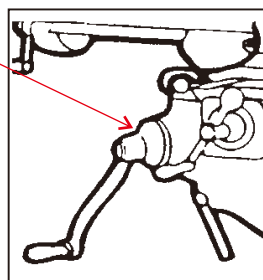
Move the X axis until display = 0.000, then the tool is positioned on the ARC curve

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

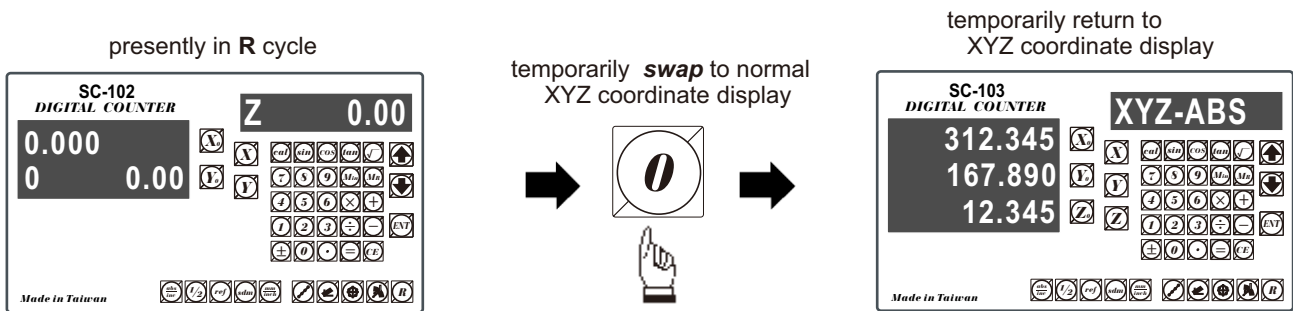


Display data in XZ plane R machining mode

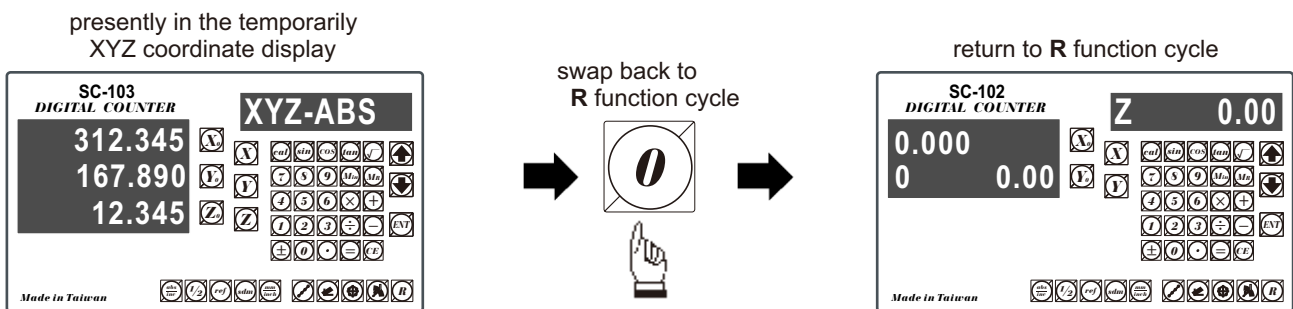
If the Z axis is positioned outside the R curvature, the SC-102 will display "Z OU LI" ( Z OUT LIMIT )

## R function

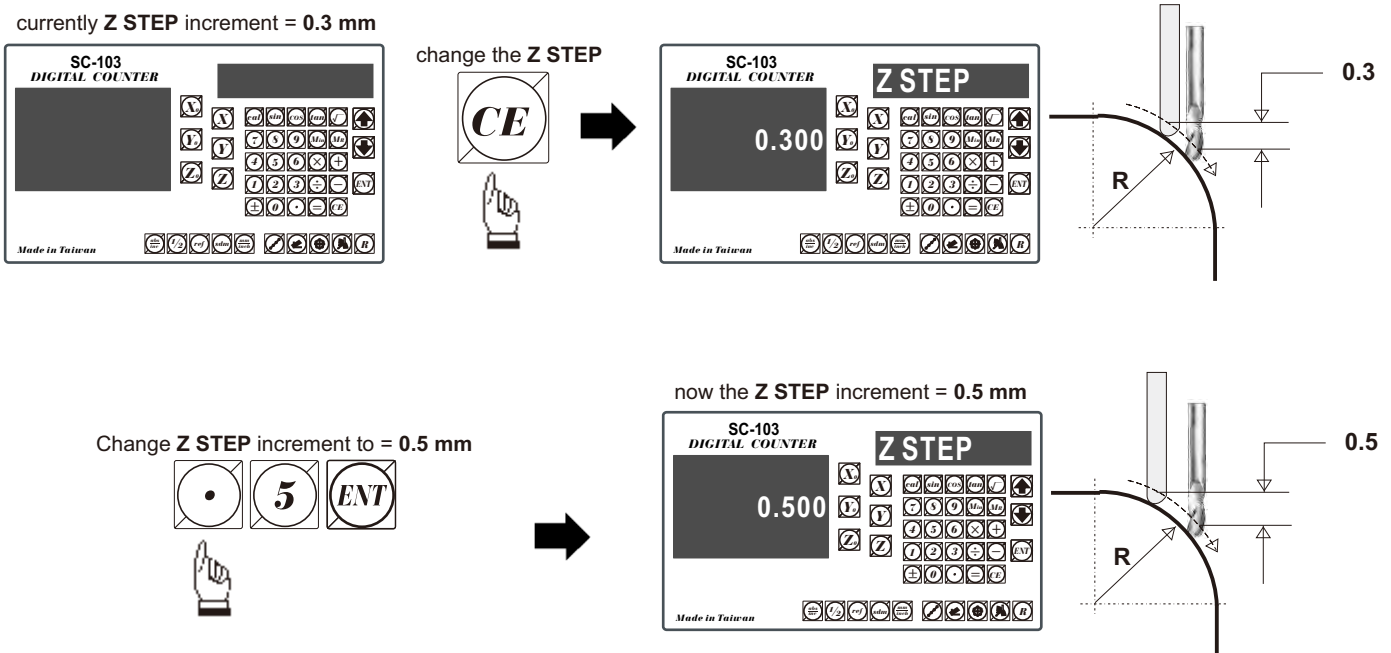
If the operator wants to verify if the SC-100's **R** calculation is correct, or wants to temporarily exit the **R** function cycle ( swap to normal XYZ display ). The procedure is as follows :



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



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



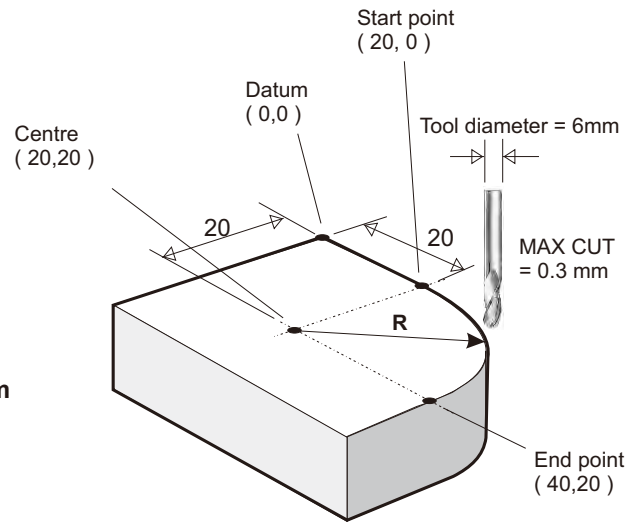
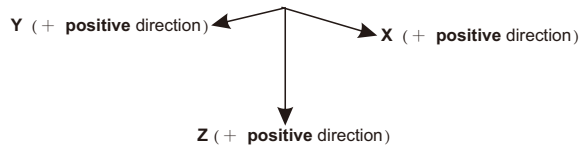
## R function

### Example :

To machine an **XY plane R** using a 2 Axis **SC-100**

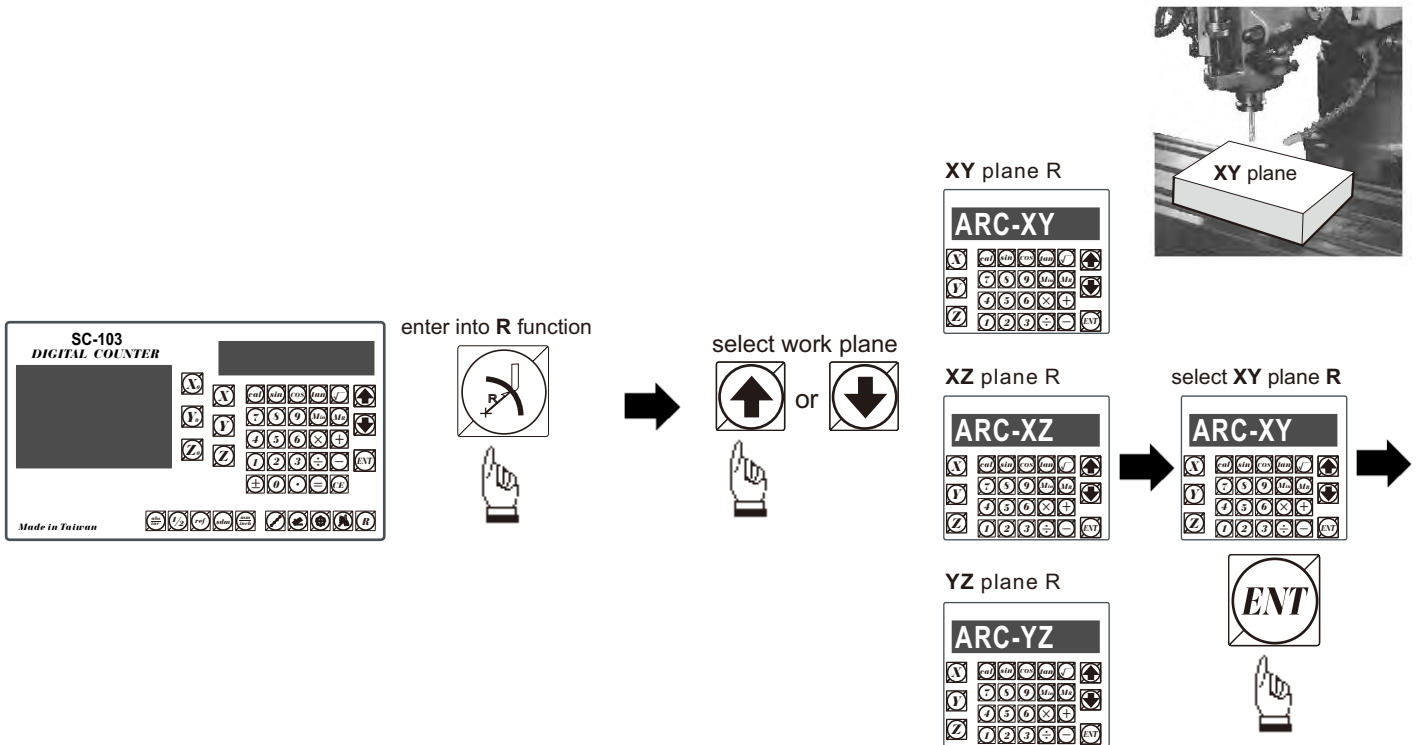
Following machining parameters have to be entered into the **SC-100** :

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** )



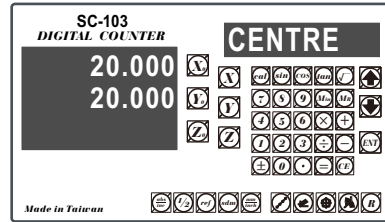
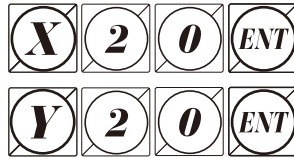
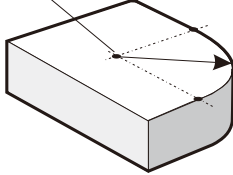
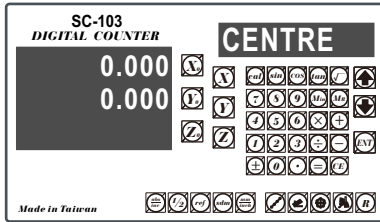


## R function

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

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

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



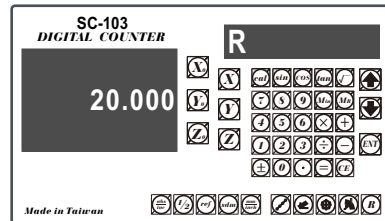
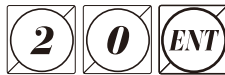
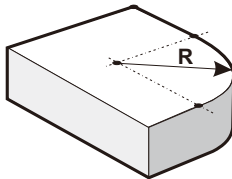
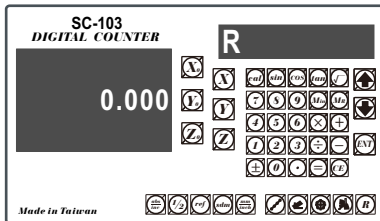
next step



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

Radius ( **R** ) = 20 mm

enter Radius ( **R** )



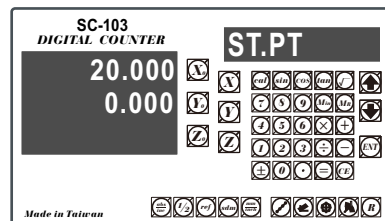
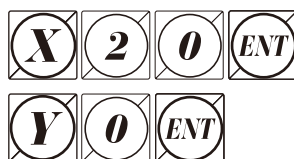
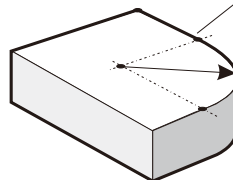
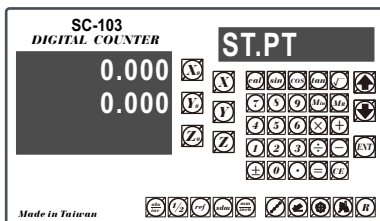
next step



**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** )



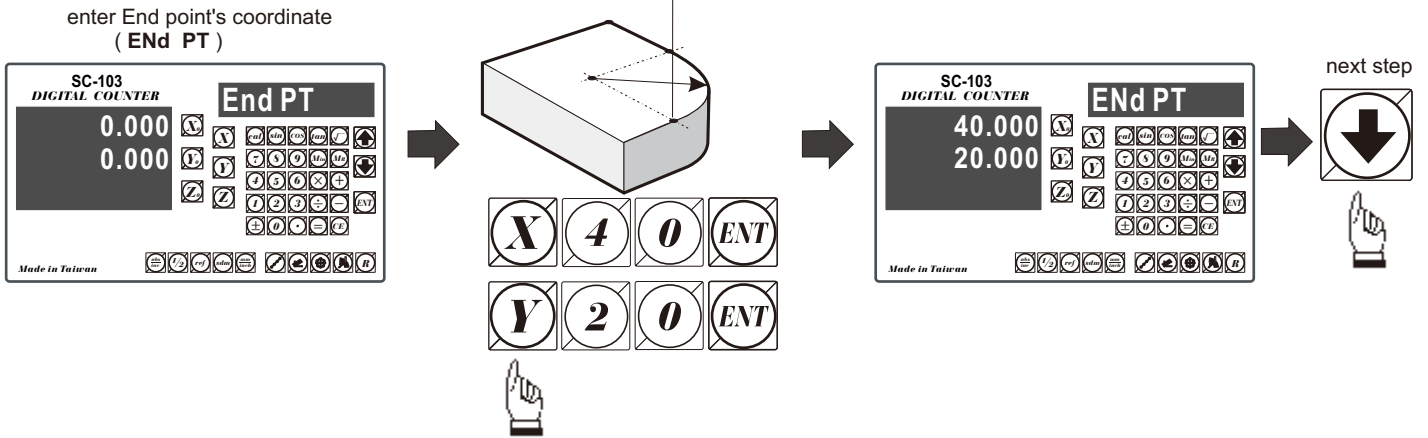
next step



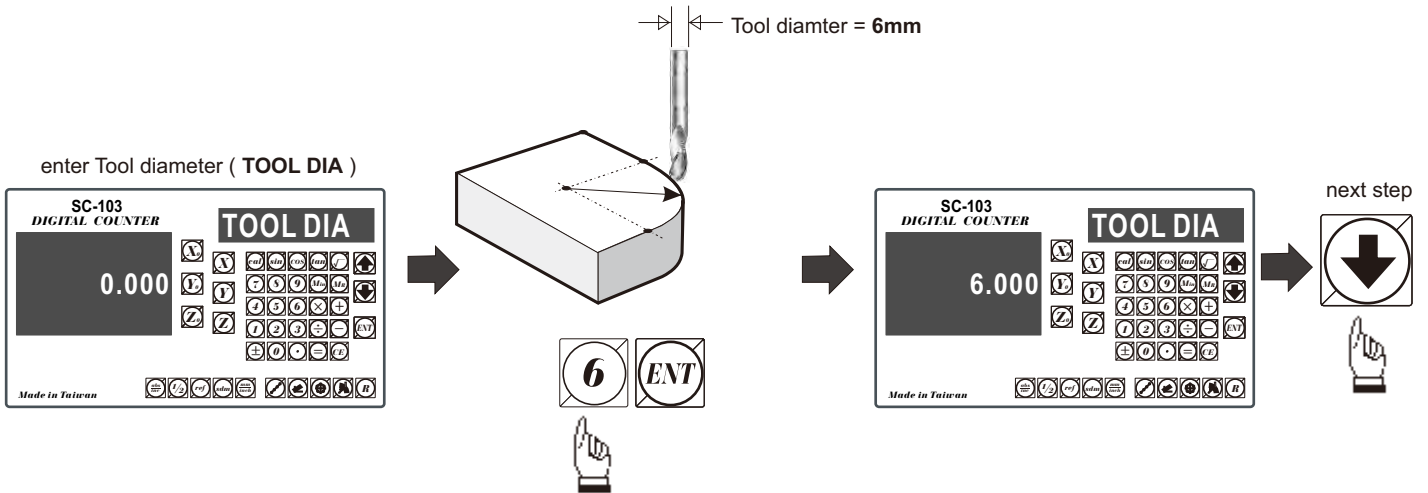
## R function

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

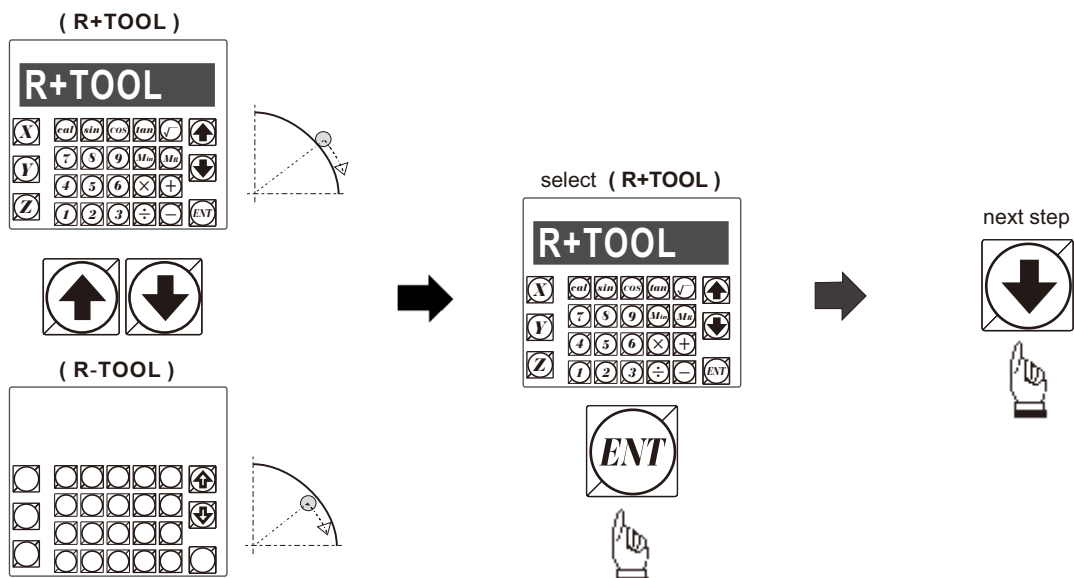
end point coordinates ( ENd PT ) : X=40.000, Y=20.000



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

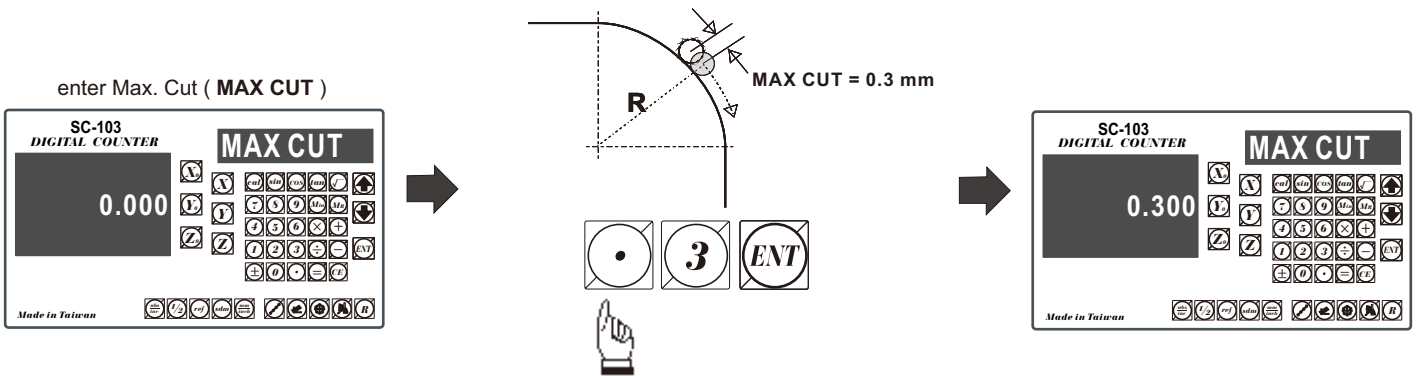


**step 7 : select tool compensation direction**



## R function



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

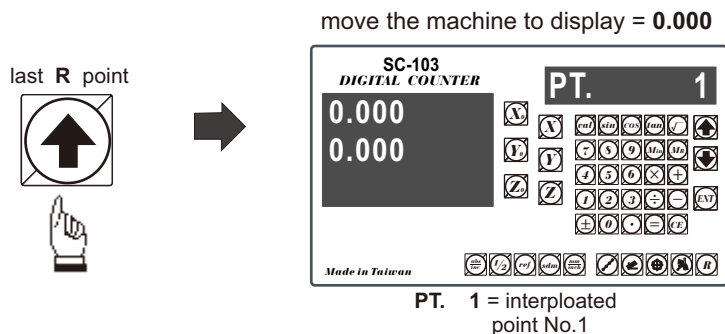
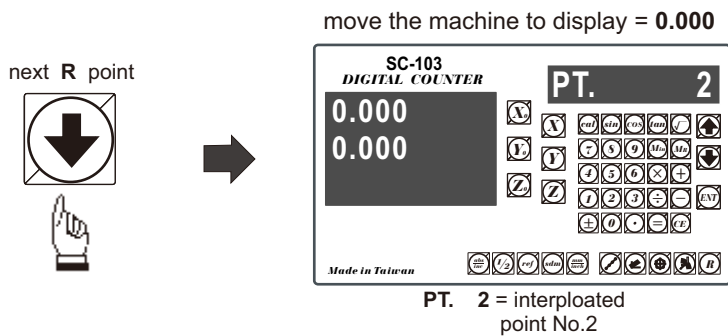


All R function machining parameters have already been entered into the SC-100



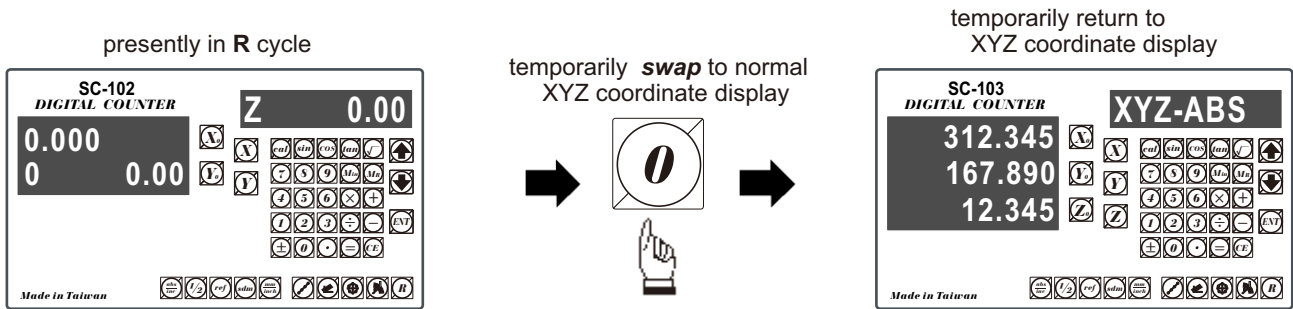
to enter into ARC machining mode

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.

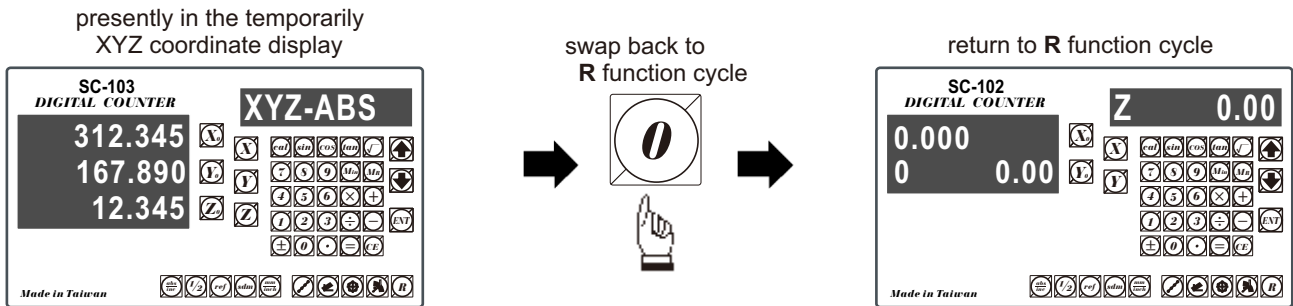


## R function

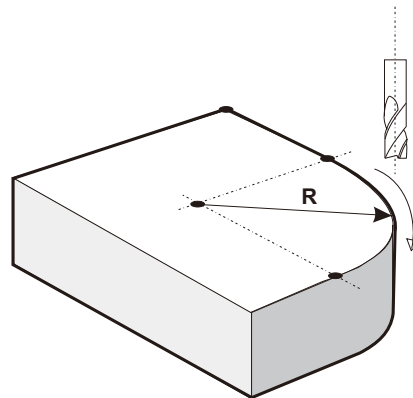
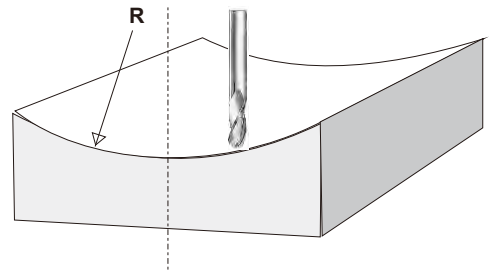
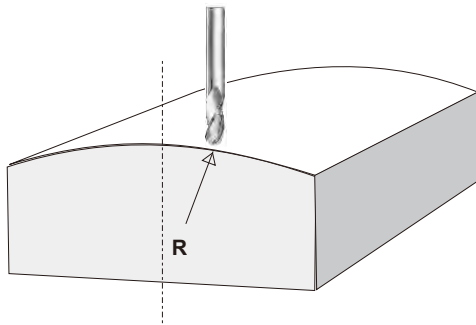
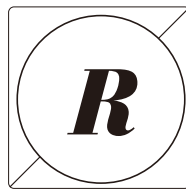
If the operator wants to verify if the SC-100's **R** calculation is correct , or wants to temporarily exit the **R** function cycle ( swap to normal XYZ display ). The procedure is as follows :



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



**Simplified R function**

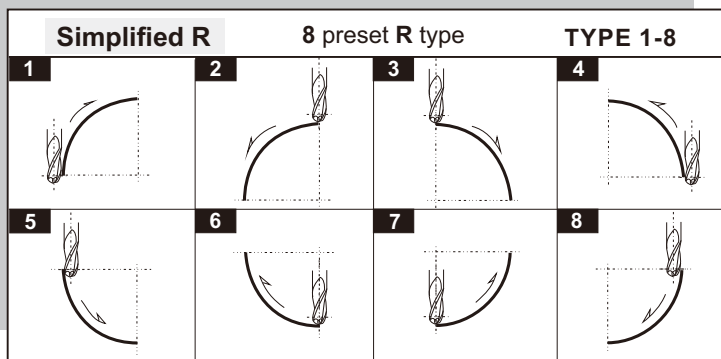


## Simplified R function

**function :** The R function of SC-100 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 SC-100 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 SC-100 provides a very easy-to-use R function to enable the operator to machine simple R in a very short time.

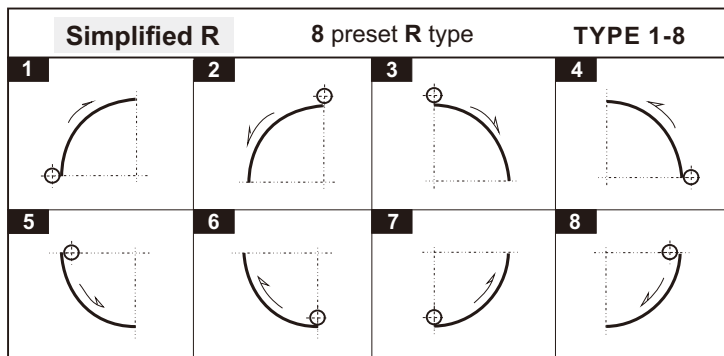
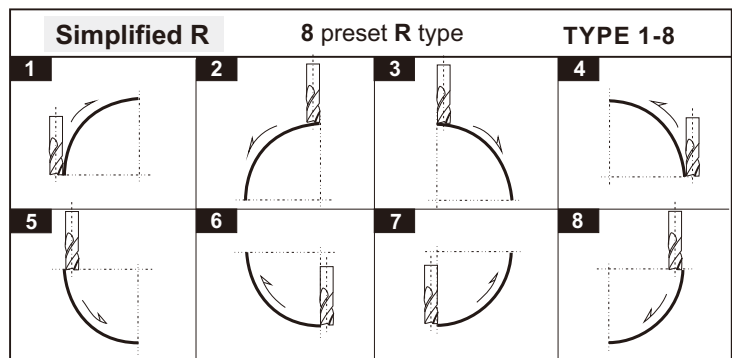
In majority of cases, only eight types of ARC are used for machining. The SC-100 has therefore incorporated those 8 type of R, and the operator must just select the type of R they need to machine their part, and input the Radius, tool compensation and increment per machining step. Then they can immediately 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

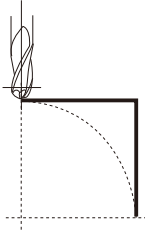


Using two Flute( SLOT DRILL ) for XY plane R

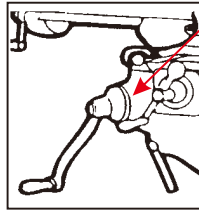
## Simplified R function

The operation procedures of Simplified R are as follows

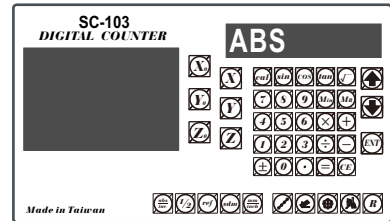
positions the tool at the ARC starting point



set the Z dial to zero

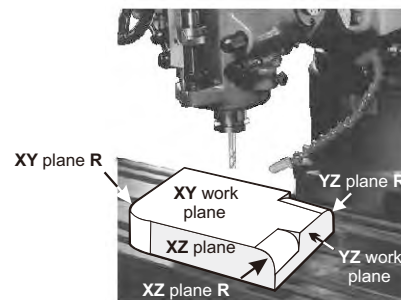


enter into Simplified R function

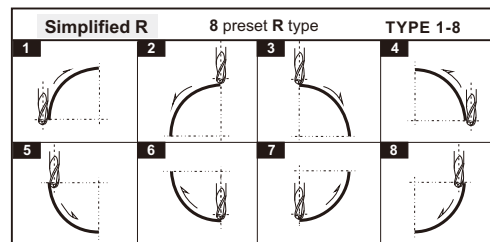


Following parameters needed to enter into SC-100 for ARC machining :

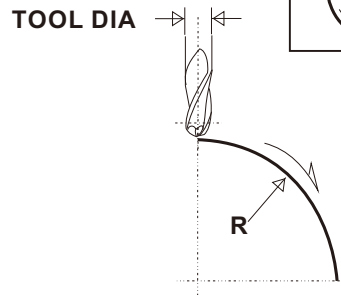
1. Select work plane - XY, XZ or YZ plane R



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

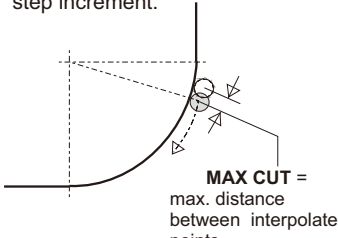
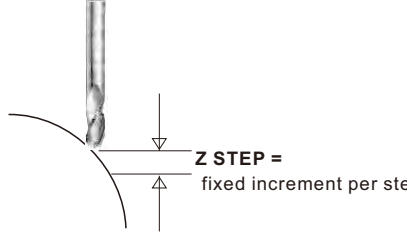
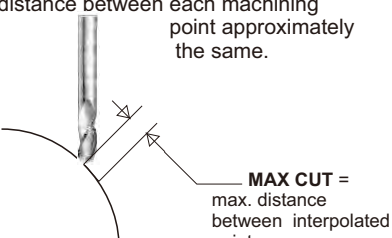


3. Radius ( R )



4. Tool diameter ( TOOL DIA )

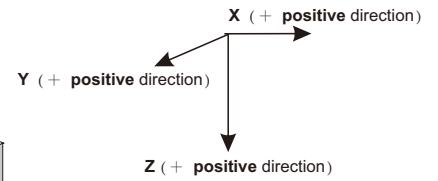
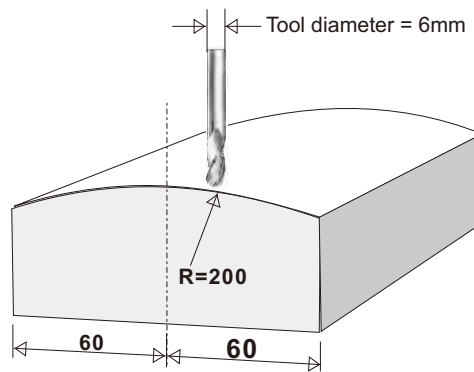
5. Machining step Increment

XY plane R	XZ / YZ plane R	
<p>For XY plane R, Max. distance between interpolated points is to be specified as the machining step increment.</p>  <p><b>MAX CUT =</b> max. distance between interpolated points.</p>	<p>For XZ/YZ plane R, under normal condition, the Z step increment is fixed and to be specified as the machining step increment.</p>  <p><b>Z STEP =</b> fixed increment per step</p>	<p>For XZ/YZ plane R, under smooth R option selected. SC-100 will calculate the Z step increment so that the Max. distance between each machining point approximately the same.</p>  <p><b>MAX CUT =</b> max. distance between interpolated points.</p>

## Simplified R function

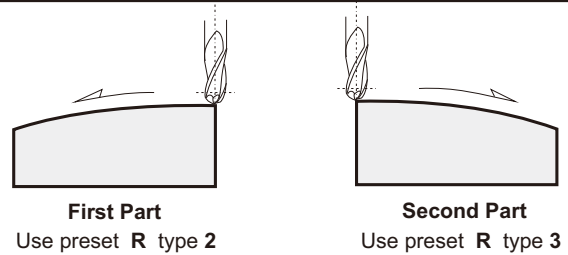
**Example :**

To machine the copper electrode as shown which has an ARCoF  $R = 200$  mm using a Two Axis SC-100

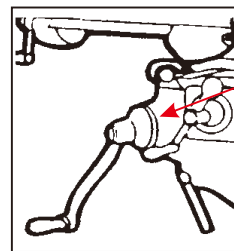
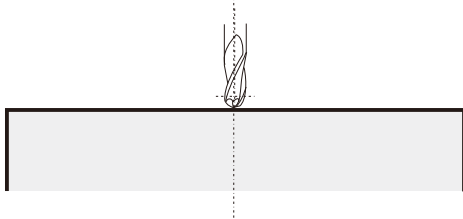


## Operation procedures

Because SC-100'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.

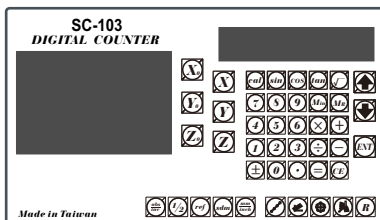


position the tool at the ARC starting point  
( surface of the work piece centre in this case )



set the Z dial to zero

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



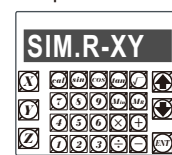
enter into  
Simplified R  
function



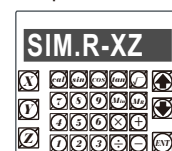
select work plane



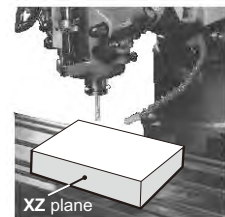
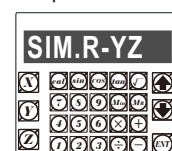
XY plane R



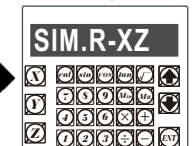
XZ plane R



YZ plane R



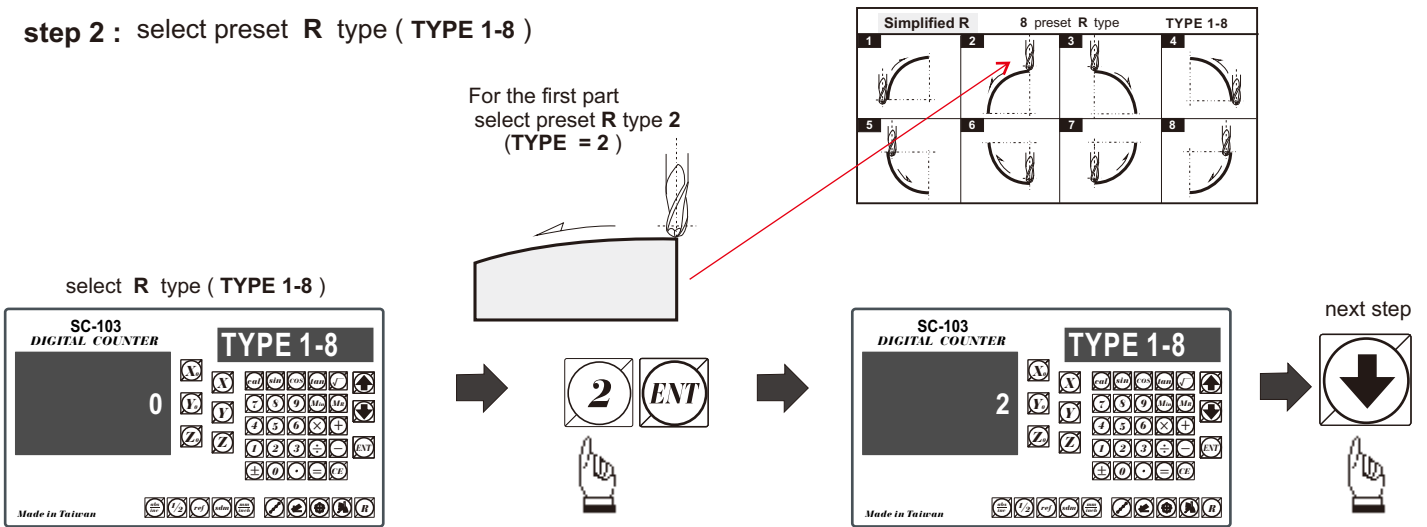
select XZ plane R



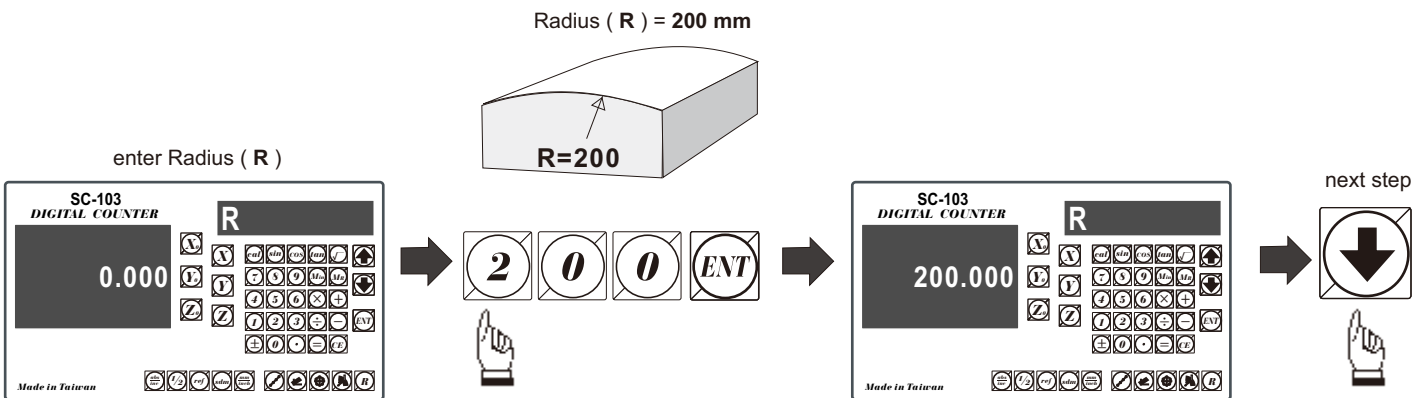


## Simplified R function

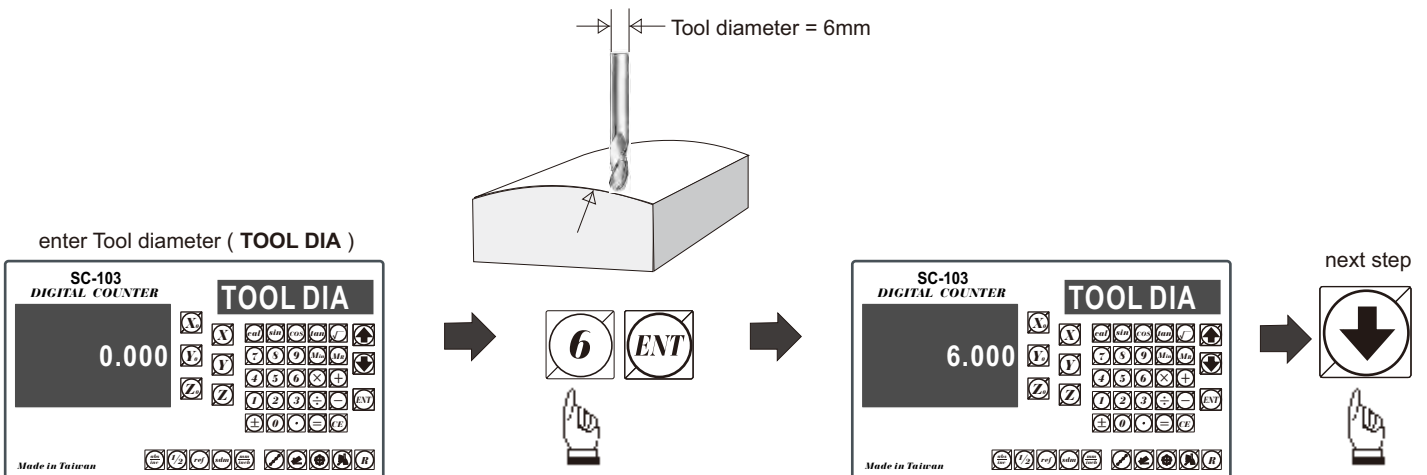
**step 2 : select preset R type ( TYPE 1-8 )**



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



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



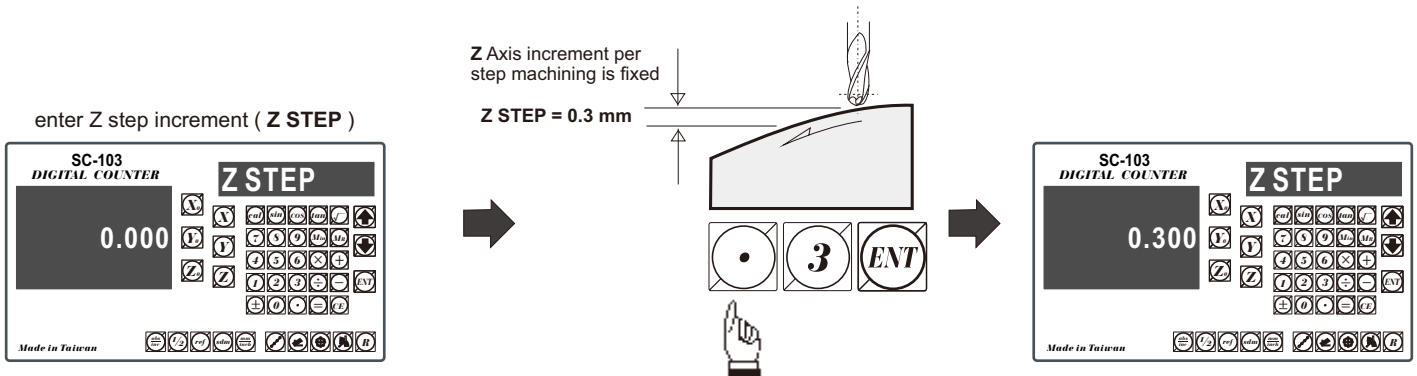
## Simplified R function

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

SC-100 provides two options on the Z increment per step machining. The operator can enter their selection on the smooth R function.

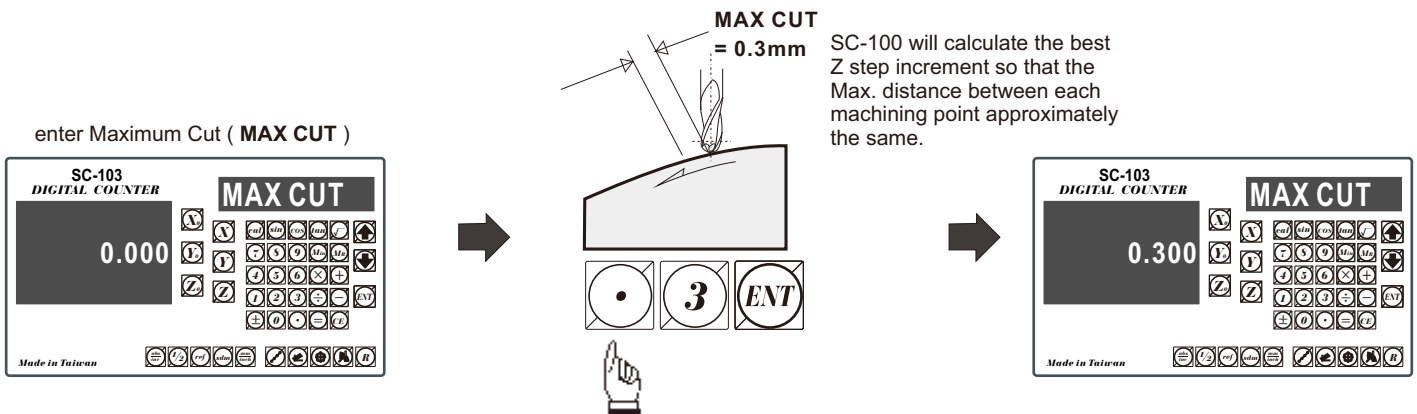
#### Option 1 : Fixed Z step ( Z STEP )

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, SC-100 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 function machining parameters have already entered into SC-100



to enter into ARC machining mode



The two Axis **SC-102** does not have a Z Axis, therefore, **SC-102** uses the  and  to simulate the Z axis movement



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





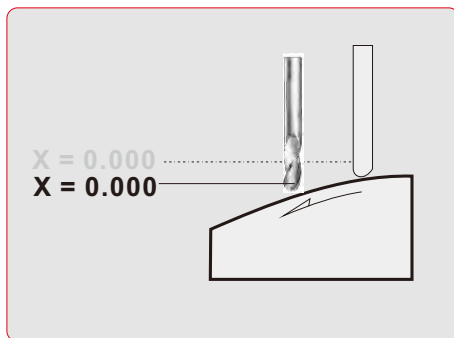
— simulate Z axis move **down** one step

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

## Simplified R function

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 SC-102, and, in order that the operator can easily guide and position the Z axis during the ARC machining, the SC-102 uses the unused axis display to display the **Z dial turn number** and **Z dial reading**.

At the beginning of the ARC machining, the SC-102 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 dial 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

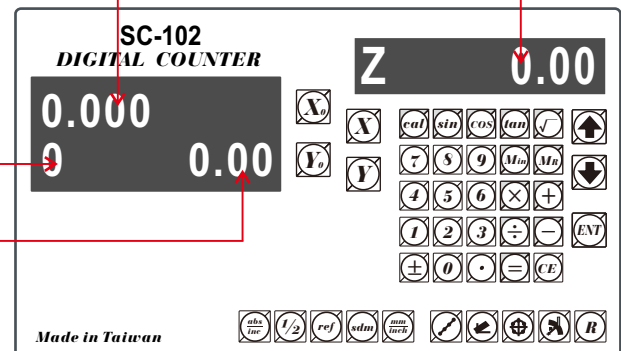
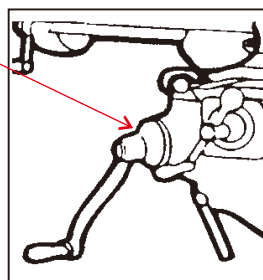
The display will **shift left** to signify it is not normal co-ordinate display.

Z axis simulated height

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

Z dial turn number

Z dial reading

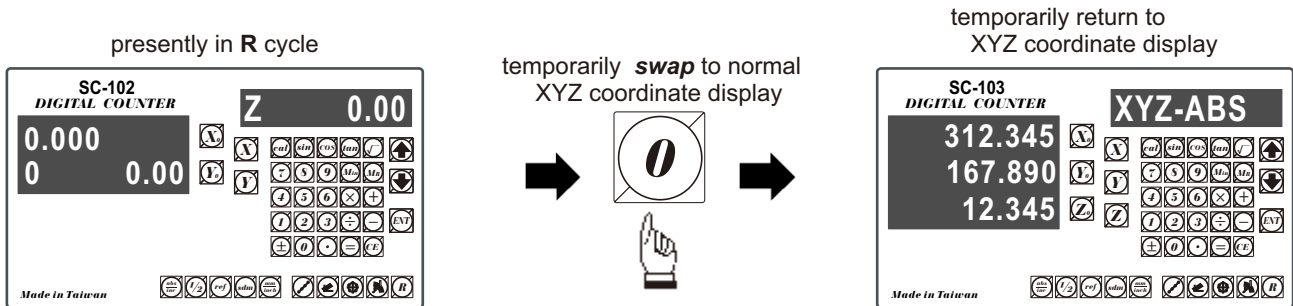


Display data in XZ plane R machining mode

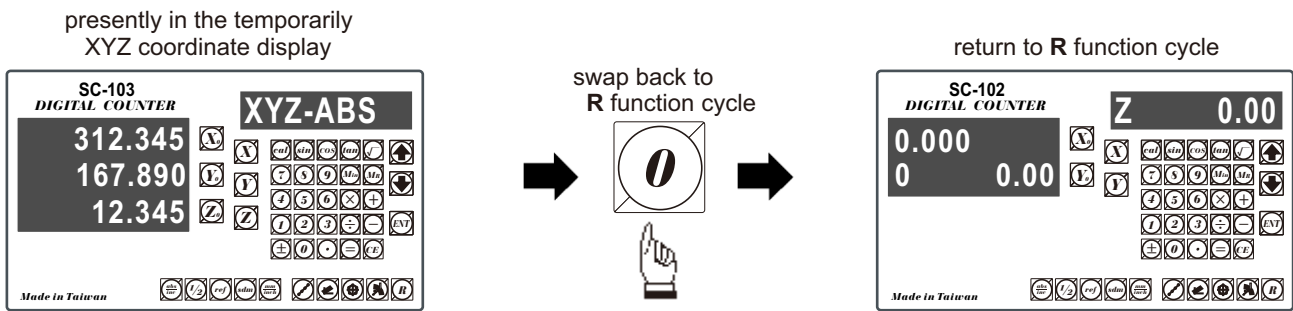
If the Z axis is positioned outside the R curvature, SC-102 will display "Z OU LI" ( Z OUT LIMIT )

## Simplified R function

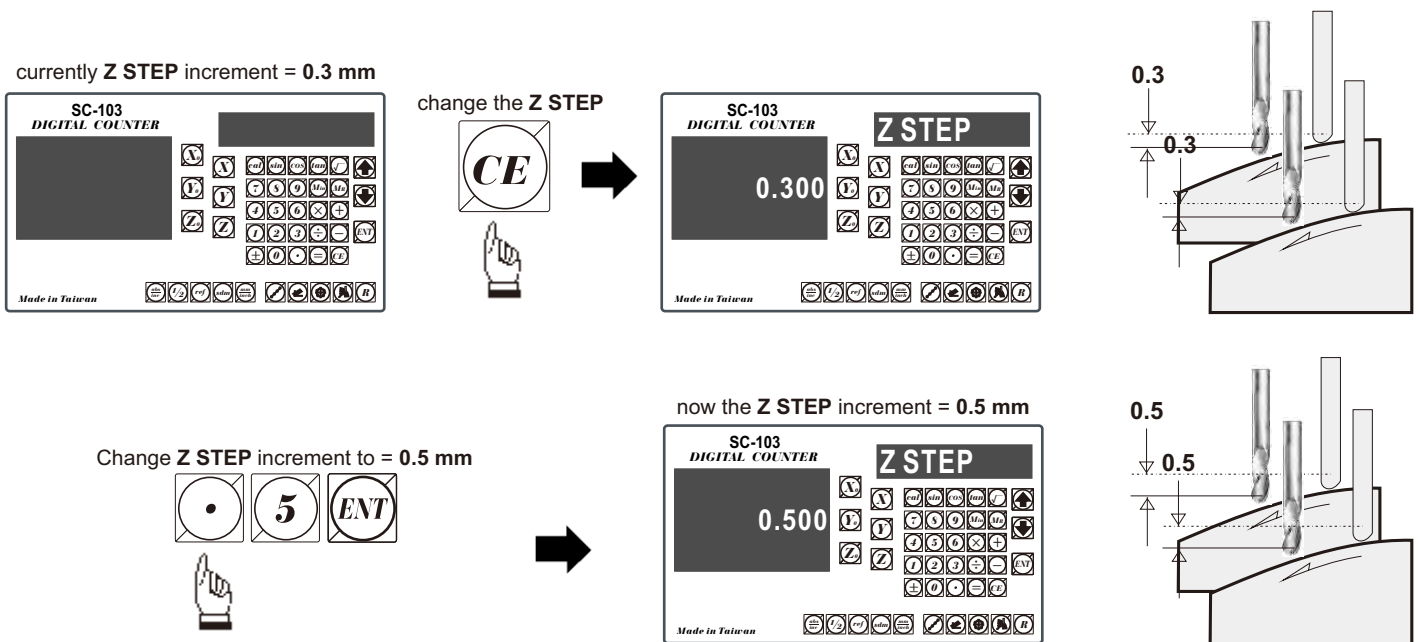
If the operator wants to verify if SC-100's **Simplified R** calculation is correct, or wants to temporarily exit the **R** function cycle ( swap to normal XYZ display ), The procedure is as follows :



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



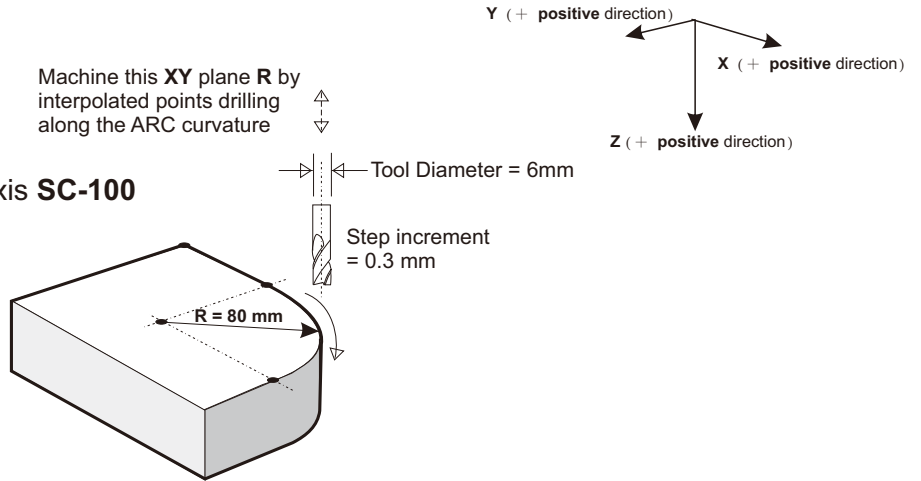
If fixed **Z STEP** option choosed, the **Z STEP** increment can be changed at any time during the ARC machining



## Simplified R function

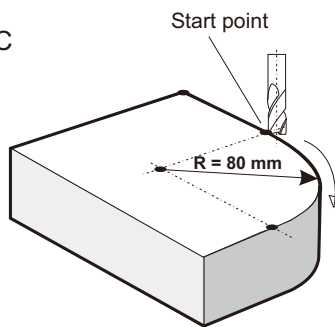
### Example :

To machine an **XY plane R** using 2 Axis **SC-100**

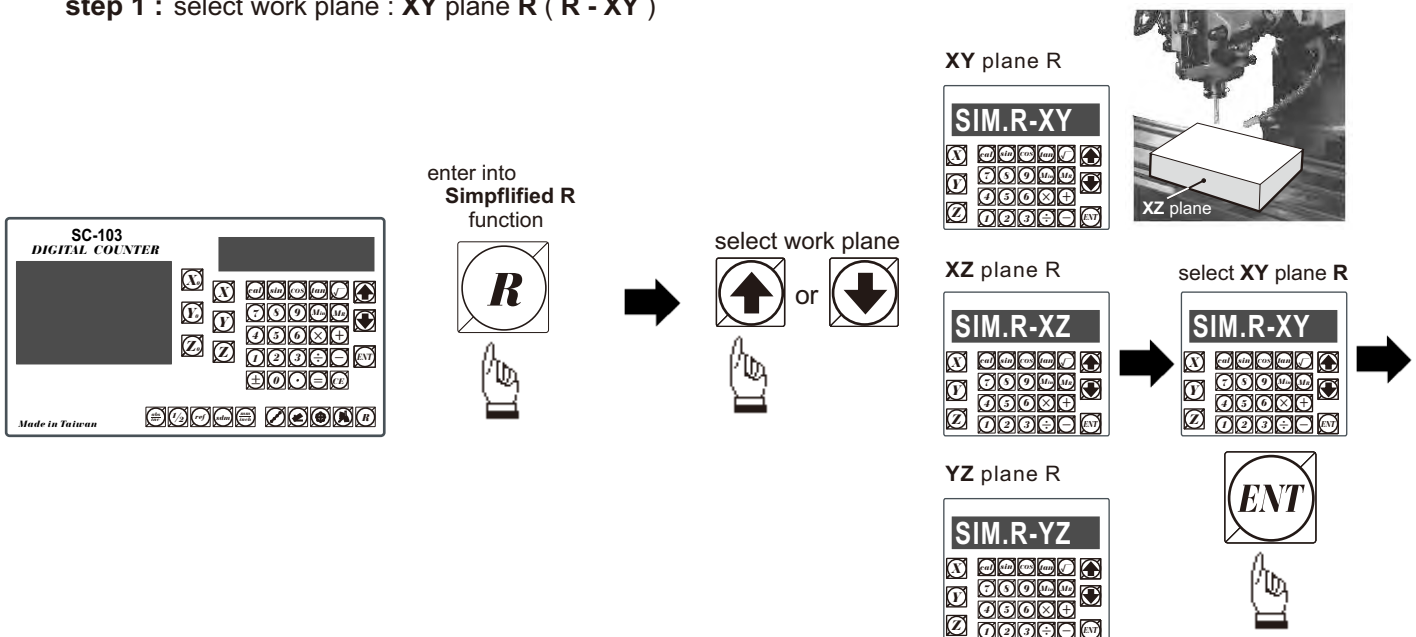


## Operation procedures

position the tool at the start point of the ARC

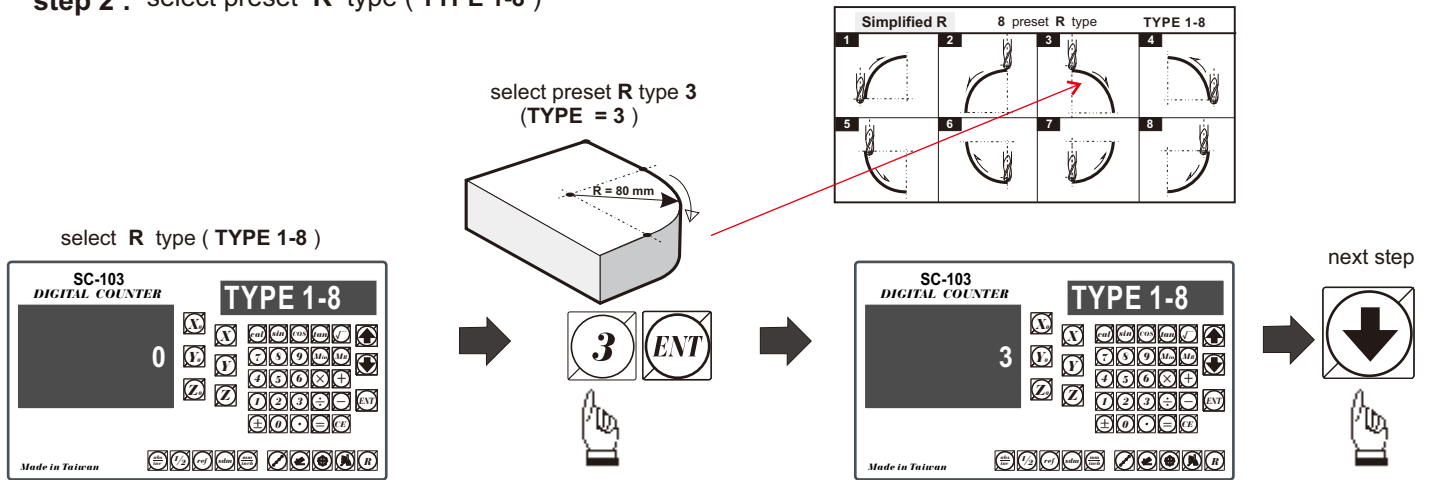


**step 1 :** select work plane : **XY plane R ( R - XY )**

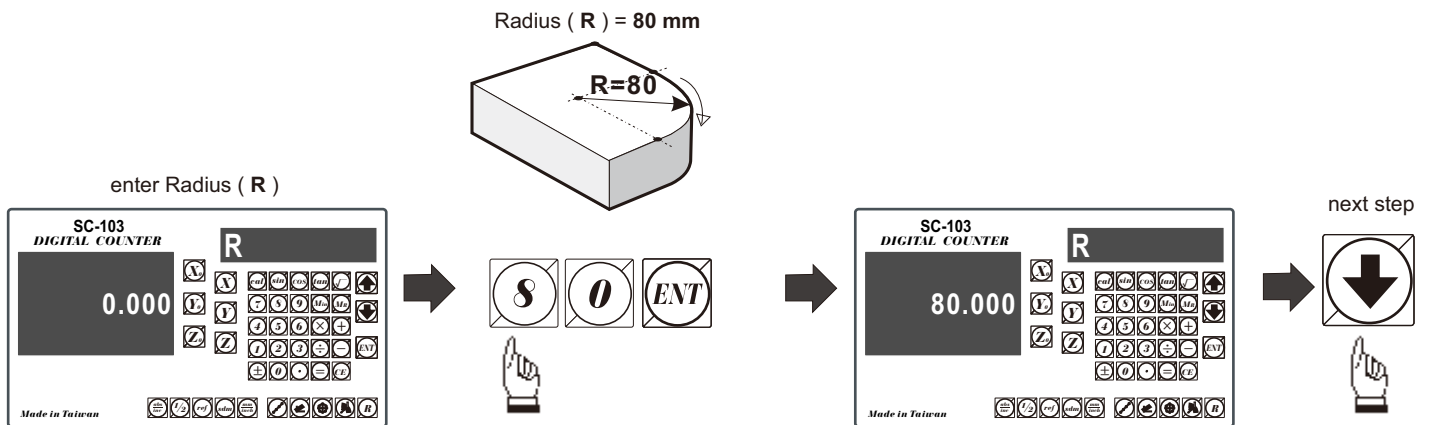


## Simplified R function

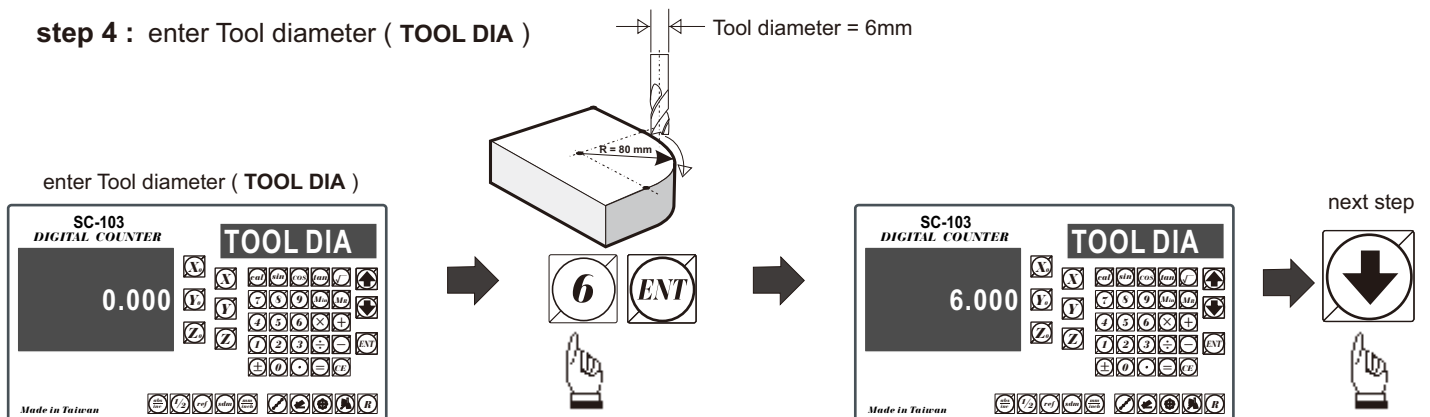
**step 2 : select preset R type ( TYPE 1-8 )**



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

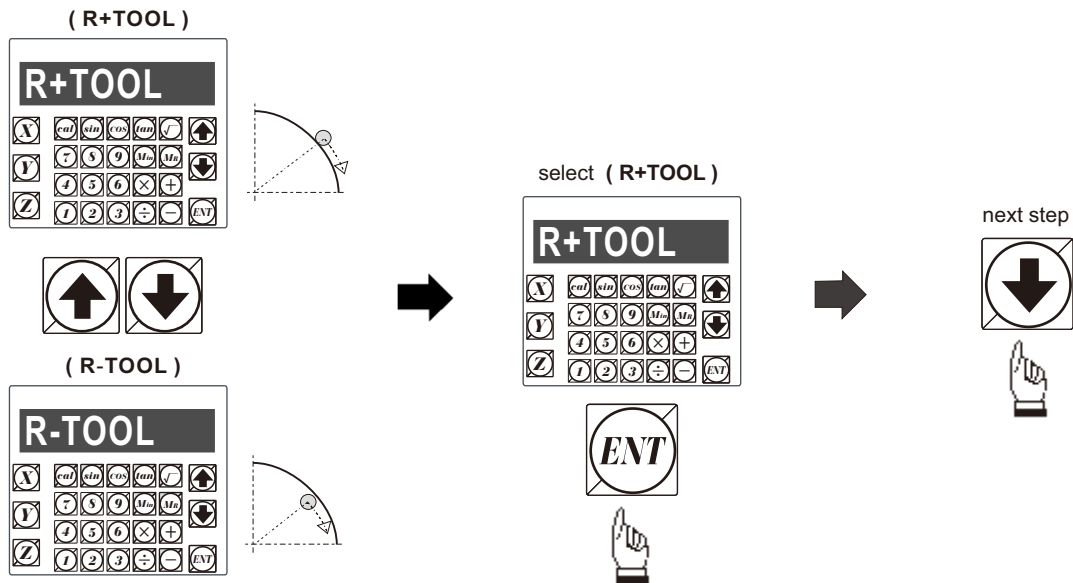


**step 4 : enter Tool diameter ( TOOL DIA )**

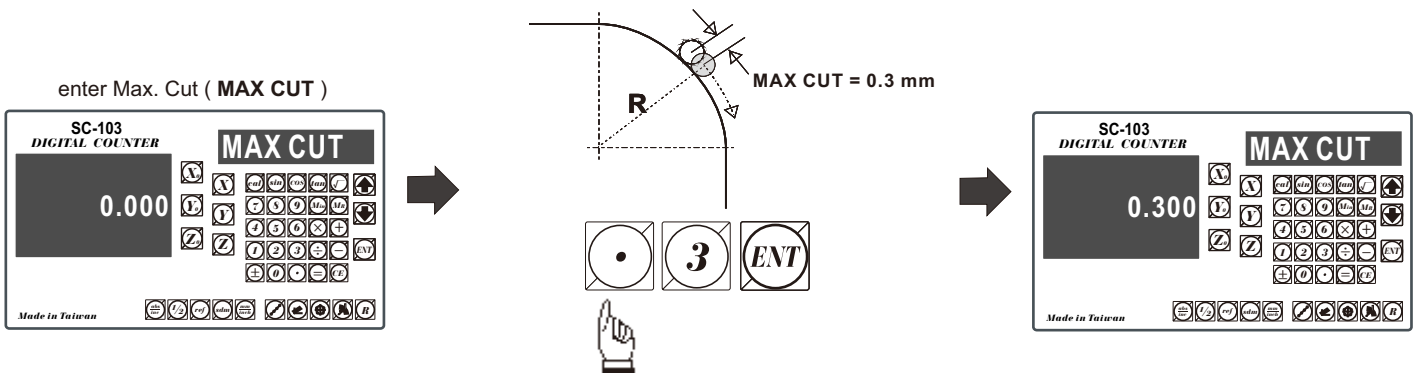


## Simplified R function

**step 5 :** select tool compensation direction





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



All simplified R function machining parameters have already entered into SC-100

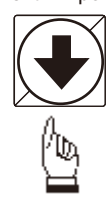


to enter into ARC machining mode

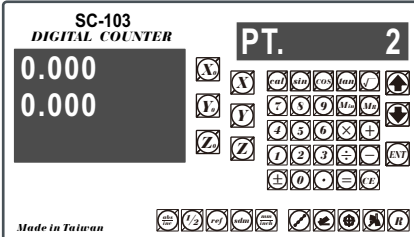
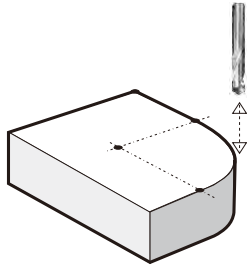
Operator can  or  to select the interpolated points along the ARC curvature, then move the machine to display = 0.000, to arrive at the ARC curvature position.

## Simplified R function

next R point

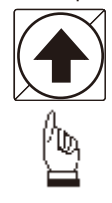


move the machine to display = 0.000

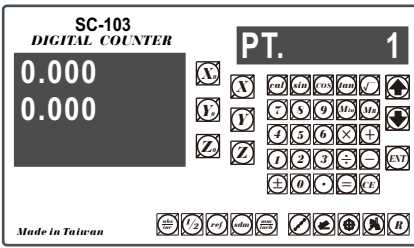
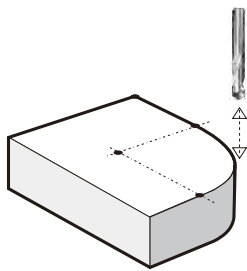



PT. 2 = interpolated point No.2

last R point



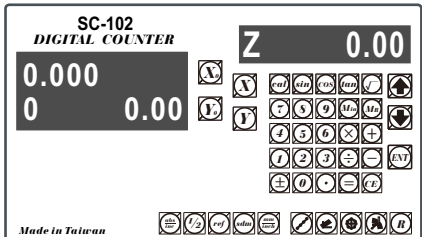
move the machine to display = 0.000

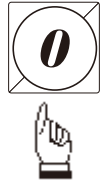
PT. 1 = interpolated point No.1

If the operator wants to verify if SC-100's R calculation is correct, or wants to temporarily exit the R function cycle ( swap to normal XYZ display ). The procedure is as follows :

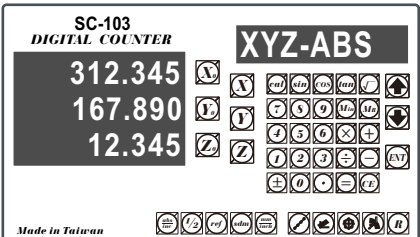
presently in R cycle



temporarily swap to normal XYZ coordinate display

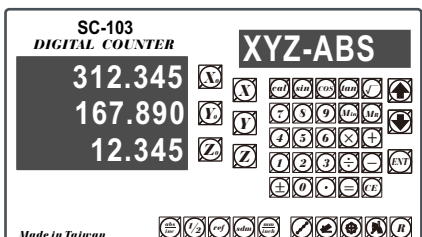


temporarily return to XYZ coordinate display

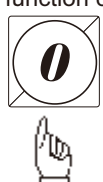


swap back to R cycle to continue the R machining mode

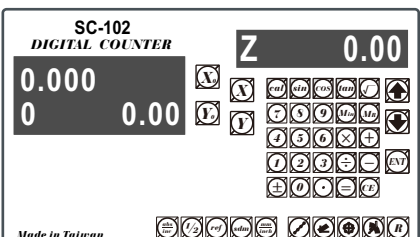
presently in the temporarily XYZ coordinate display



swap back to R function cycle



return to R function cycle

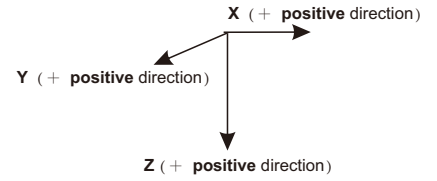
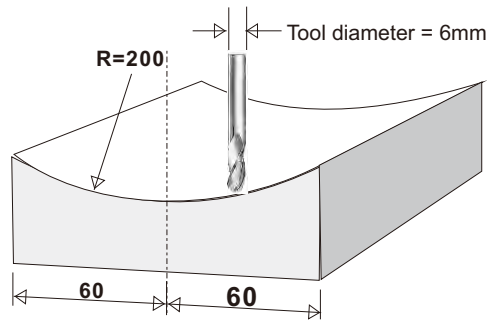




## Simplified R function

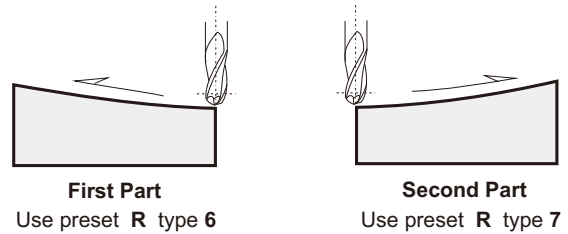
### Example :

To machine the copper electrode as shown which has an ARC of  $R = 200$  mm using a Two Axis SC-102

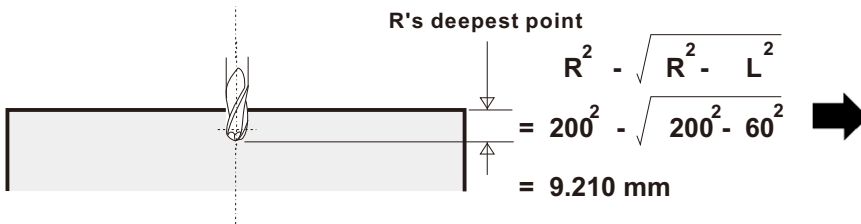


## Operation procedures

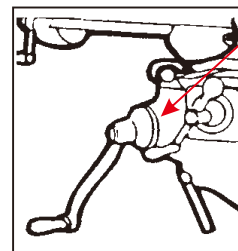
Because SC-102's XZ/YZ can only machine an arc which is less than 90 degrees, it is necessary to divide this arc machining into two parts.



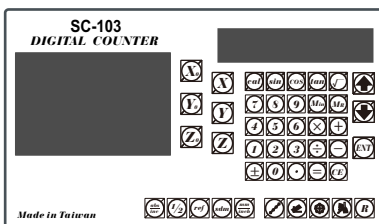
posit the tool at the ARC starting point



set the Z dial to zero



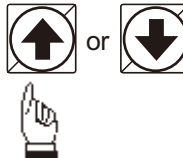
step 1 : select work plane : XZ plane R ( S.R - XZ )



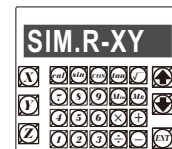
enter into R function



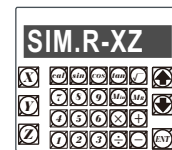
select work plane



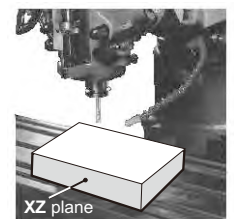
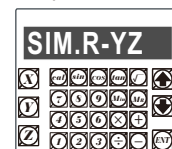
XY plane R



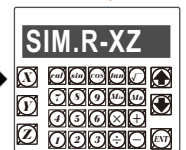
XZ plane R



YZ plane R

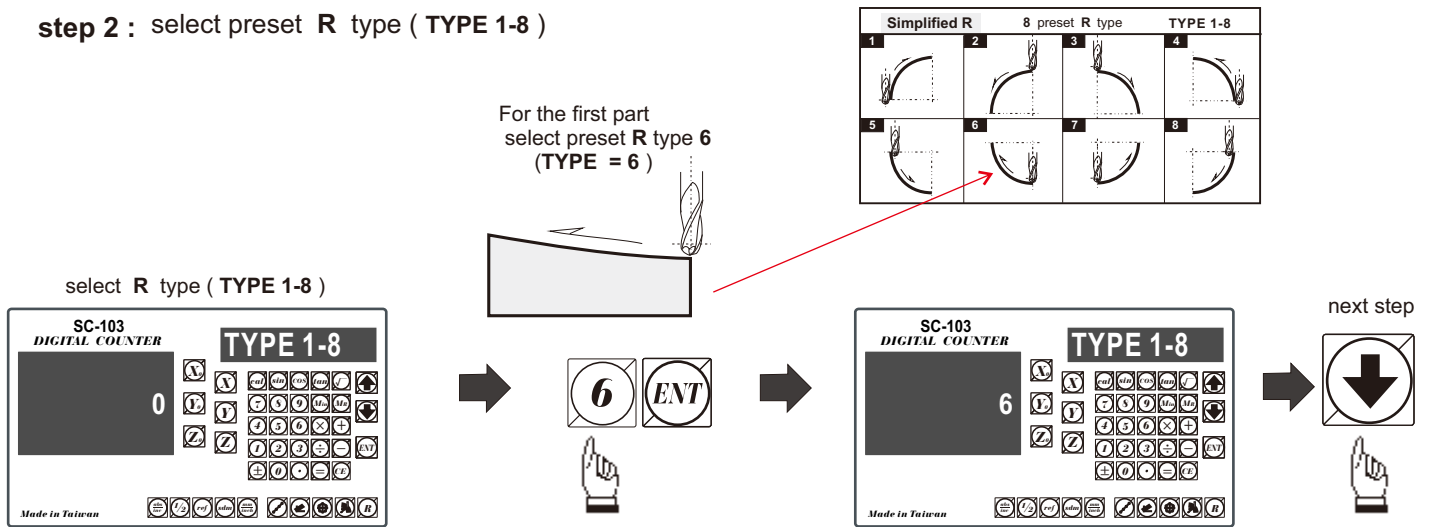


select XZ plane R

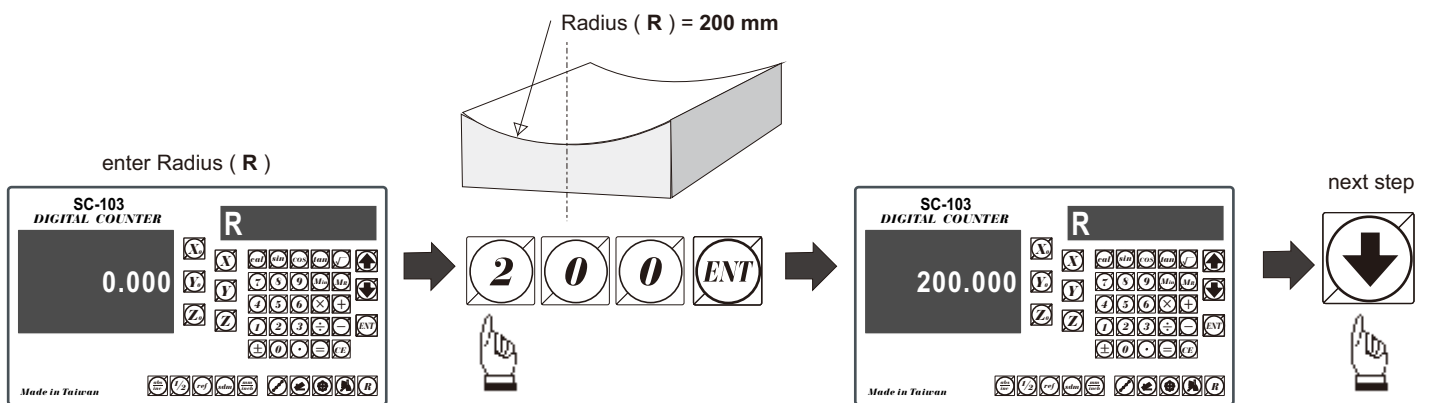


## Simplified R function

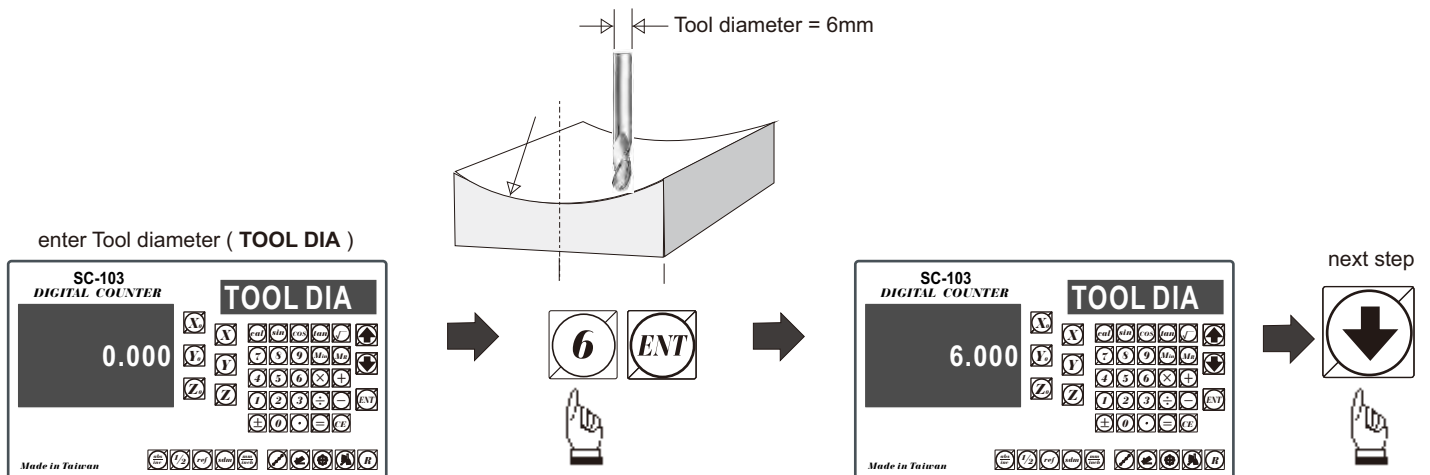
**step 2 : select preset R type ( TYPE 1-8 )**



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



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



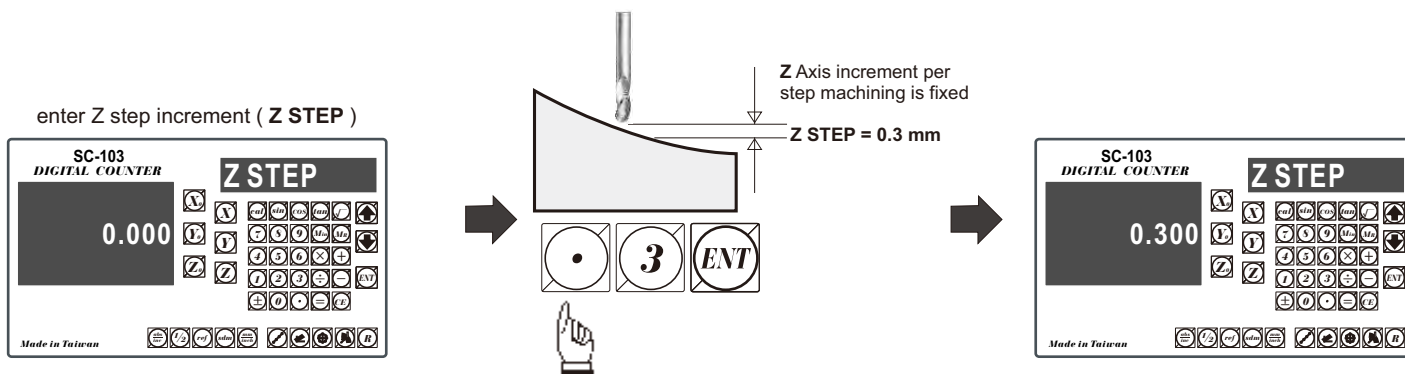
## Simplified R function

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

SC-100 provides two options on the Z increment per step machining. Operator can make their selection on the smooth R function.

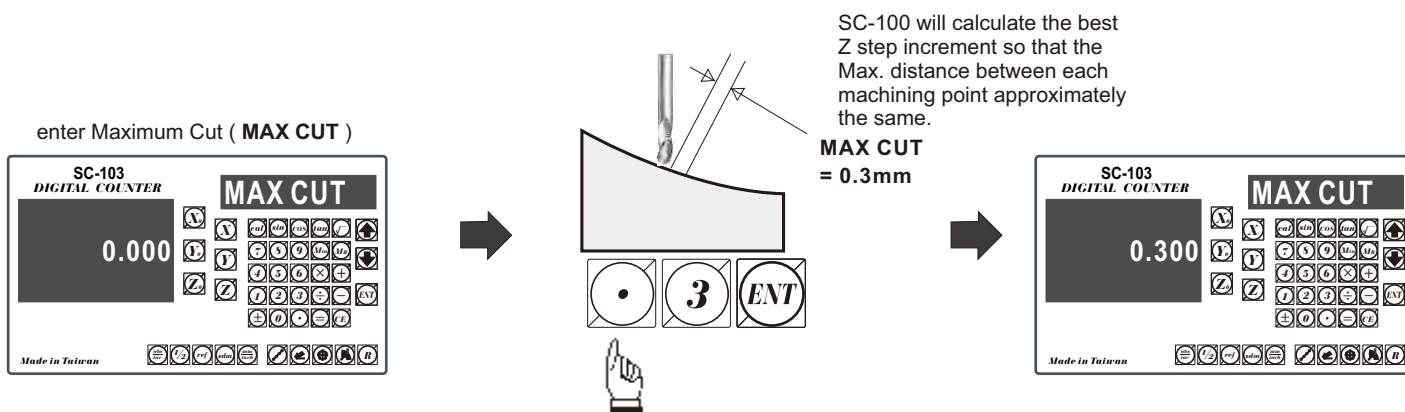
#### Option 1 : Fixed Z step ( Z STEP )

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, SC-100 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 function machining parameters have already entered into SC-100



to enter into ARC machining mode



The two Axis **SC-102** does not have a Z Axis, so the **SC-102** uses the



and



to simulate the Z axis movement



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





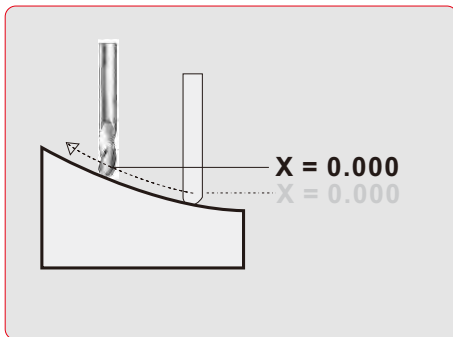
— simulate Z axis move **down** one step

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

## Simplified R function

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 SC-102, and, in order that the operator can easily guide and position the Z axis during the ARC machining, the SC-102 uses the unused axis display to display the **Z dial turn number** and **Z dial reading**.

At the beginning of the ARC machining, the SC-102 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 dial turn number and Z dial reading will display on the unused axis. The operator must move the Z axis according to 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

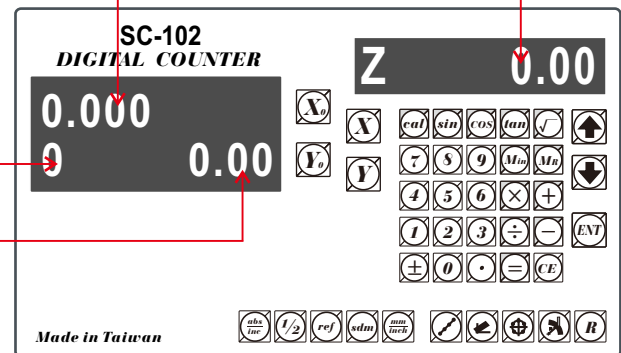
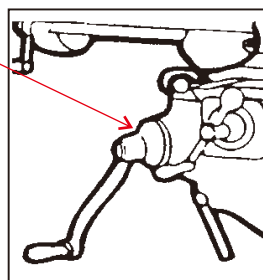
The display will **shift left** to signify it is not normal co-ordinate display.

Z axis simulated height

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

Z dial turn number

Z dial reading

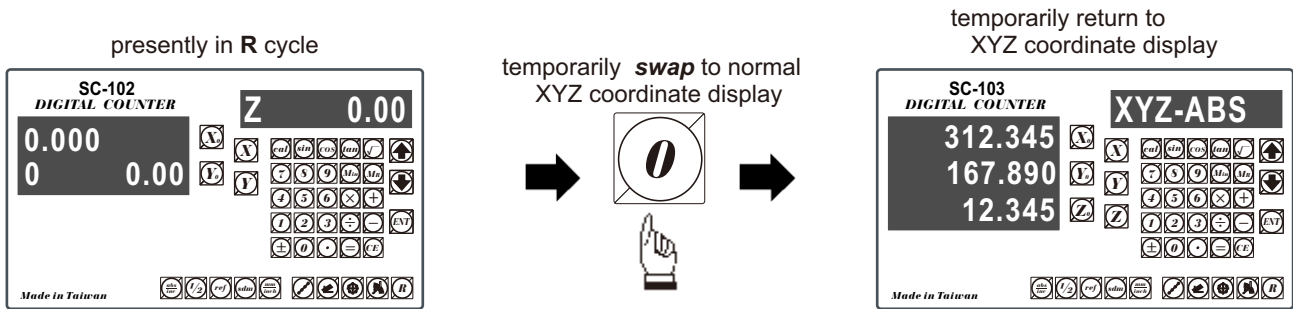


Display data in XZ plane R machining mode

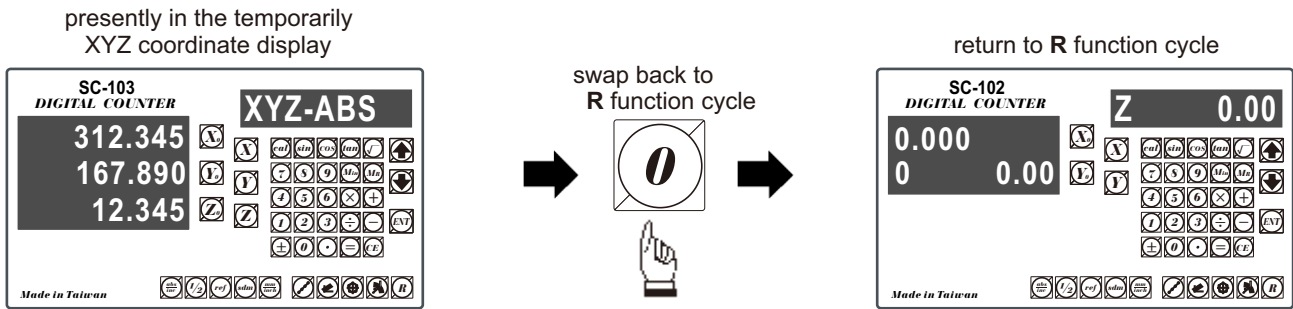
If the Z axis is positioned outside the R curvature, SC-102 will display "Z OU LI" ( Z OUT LIMIT )

## Simplified R function

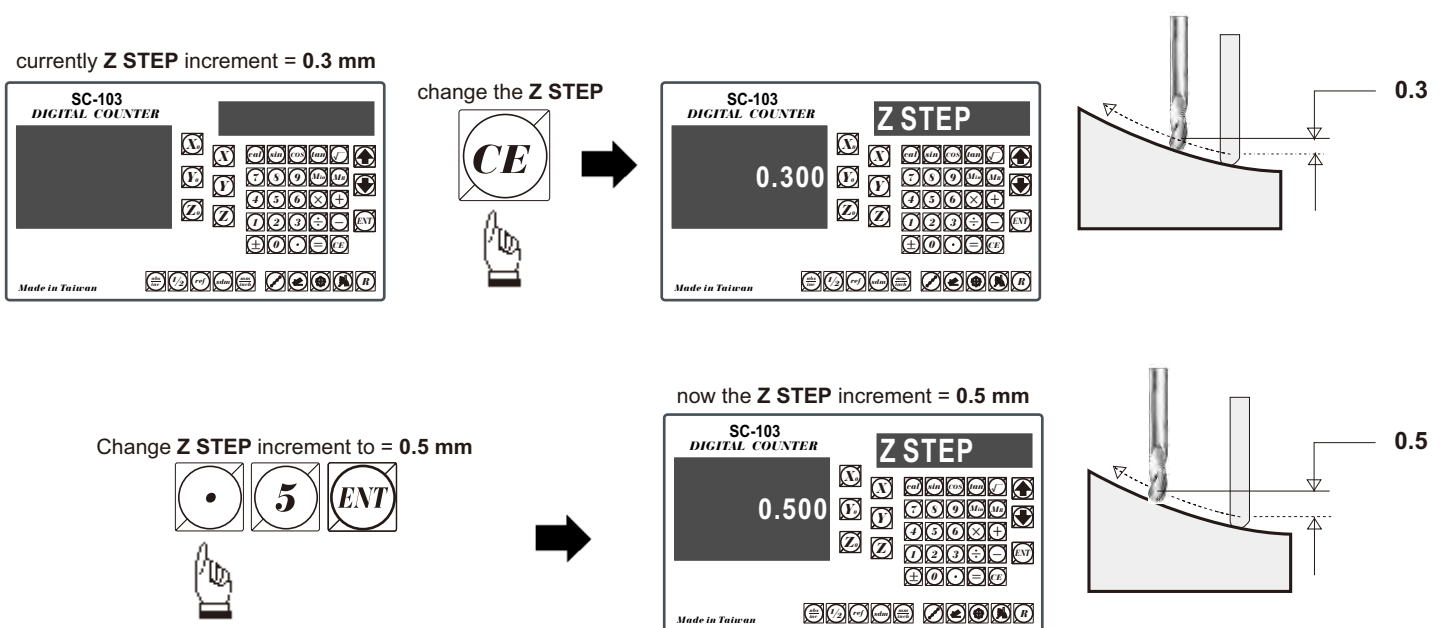
If the operator wants to verify if the SC-100's **Simplified R** calculation is correct, or wants to temporarily exit the **R** function cycle ( swap to normal XYZ display ). The procedure is as follows :



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

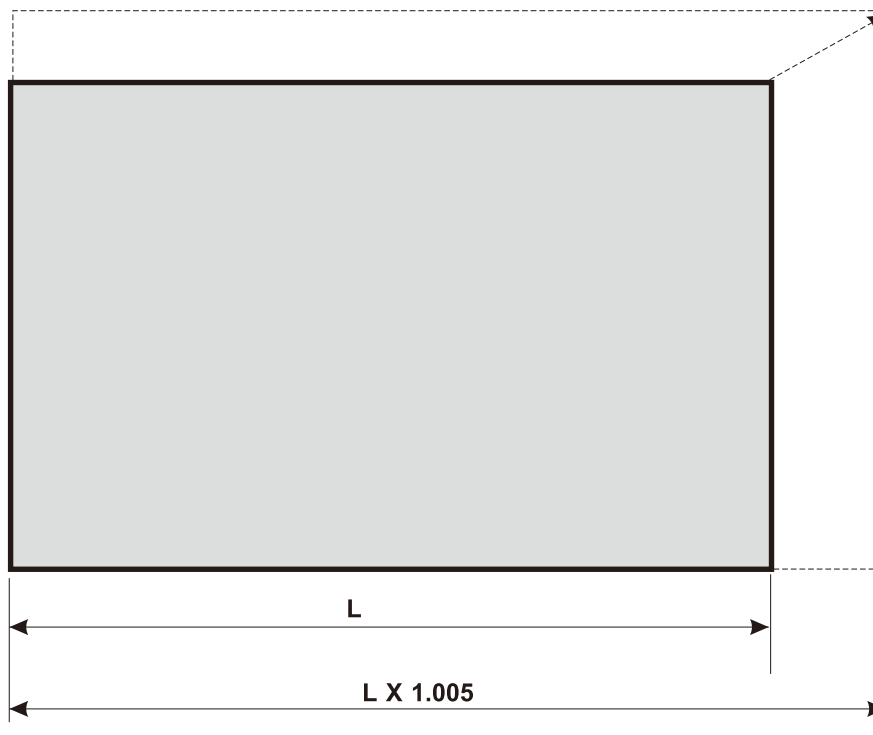


If fixed **Z STEP** option is chosen, the **Z STEP** increment can be change anytime during the ARC machining





# Shrinkage Calculation





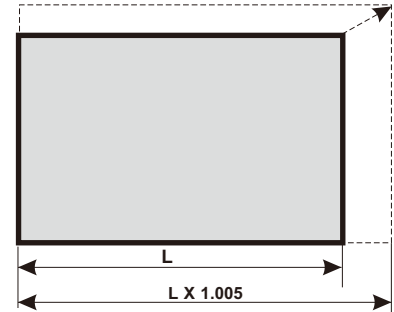


## Shrinkage calculation

**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.



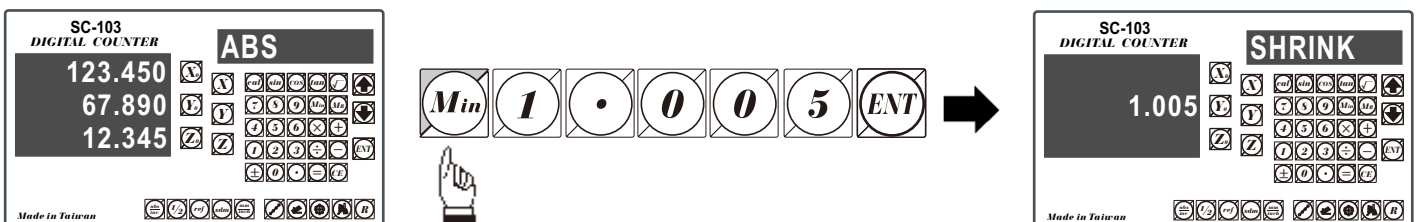
**SC-100 provides the world's first practical "SHRINKAGE CALCULATION" function to help the mould maker calculate the shrinkage and verify the calculated expanded/ reduced dimension.**

## 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 **SC-100**.

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





## Shrinkage calculation

### 2. Shrinkage Calculations

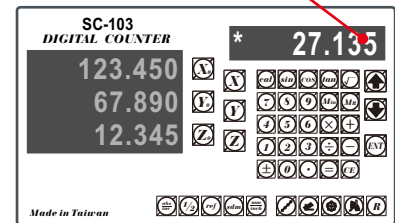
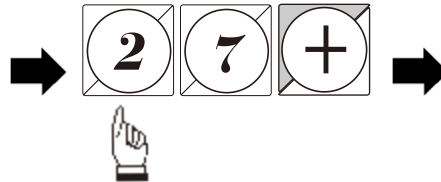
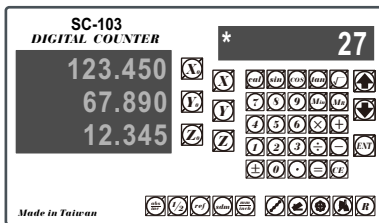
SC-100 provides a very easy-to-use shrinkage function, and allows the operator to easily calculate the expanded or reduced dimensions.

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 SC-100 during the machining process, the operator can calculate the shrinkage dimensions directly with the readout. SC-100 also provides an easy method of verifying the calculated dimension marked on the drawings.

SC-100 uses  for expand calculation  for shrink calculation

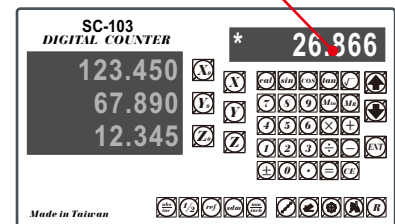
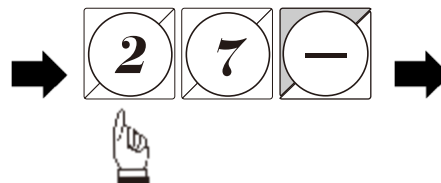
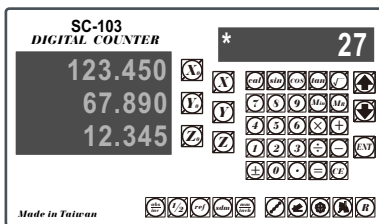
**Example :** To calculate the expanded dimension of 27mm

27mm expand =  $27 \times 1.005 = 27.135$   
Calculation result will display in the message window



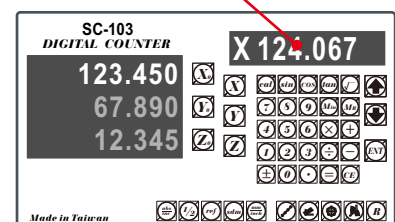
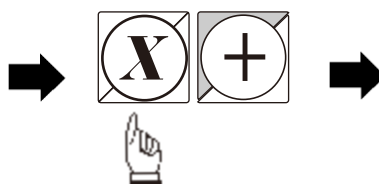
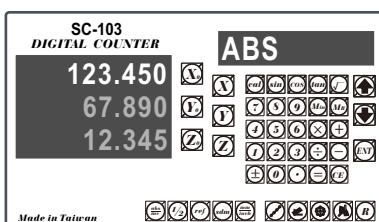
**Example :** To calculate the shrunk dimension of 27mm

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,  
 $123.45 \text{ mm expands} = 123.45 \times 1.005 = 124.067$   
Calculation result will display in the message window





## Shrinkage calculation

### 3. Shrinkage Compensation

When the operator is familiar with the shrinkage function of SC-100, instead of calculating all the shrink dimensions and marking them onto the drawing, the operator can use the shrinkage compensation features of the SC-100 which actually expand or reduce all display dimension according to the multiples of the shrink factor, thereby, the need to calculate all the working dimensions one by one.

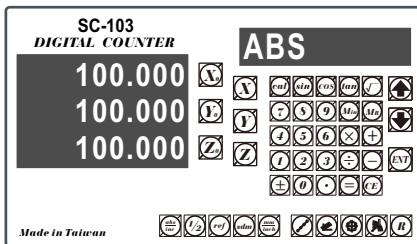
If the operator still insists that they have more confidence by calculating all shrink dimensions prior to the actual machining process and marking them on the drawing, the SC-100 shrinkage compensation function can still be used to provide a very efficient way of verifying the operator's calculated dimensions, marked on the drawing by using the "Expand" and "Shrink" toggle-function to switch between real-dimension display and shrinkage-compensated-dimension display.

SC-100 uses  for expand calculation  for shrink calculation

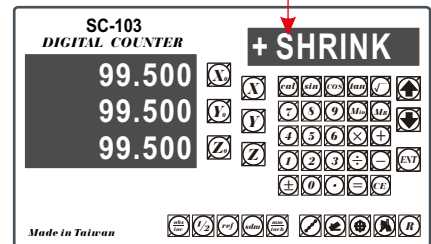
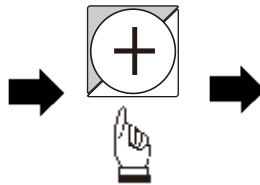
**Example :** To compensate by "Expand", so that the actual dimensions are the expanded dimension of the SC-100's display dimensions.

Because the display dimension has compensated by the shrink factor, in order to remind operator that SC-100 is currently in shrink compensation mode to avoid operation mistake, SC-100 will display

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



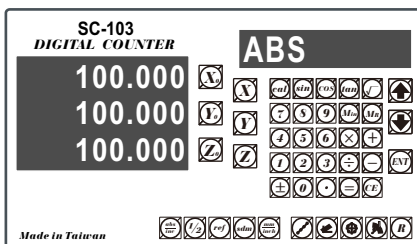
**Real Dimension**



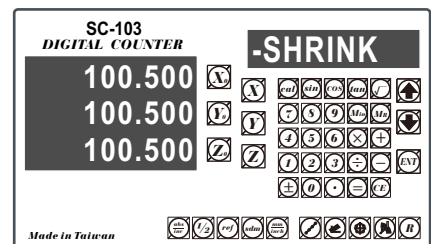
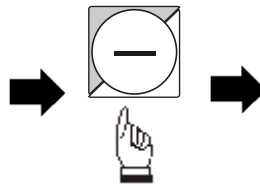
**Compensated dimensions :**

The actual dimension are now X 1.005 of the displayed dimensions

**Example :** To compensate by "Shrink", so that the actual dimensions are the shrunk dimension of the SC-100's display dimensions.



**Real Dimension**



**Compensated dimensions :**

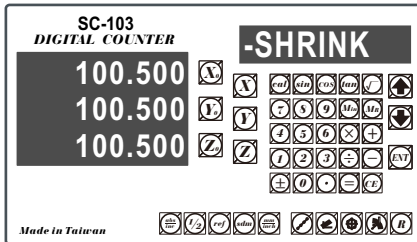
The actual dimension are now / 1.005 of the displayed dimensions

## Shrinkage calculation

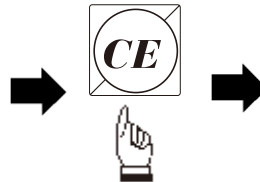
When the SC-103 is in shrink compensation mode, if the operator wants to return to normal real dimension display.

press  or 

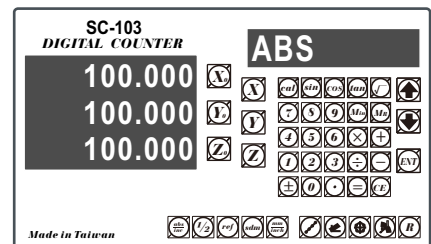
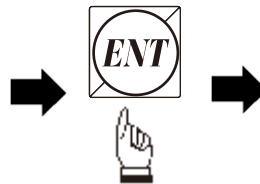
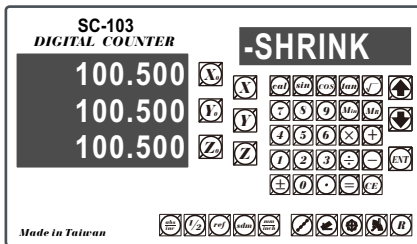
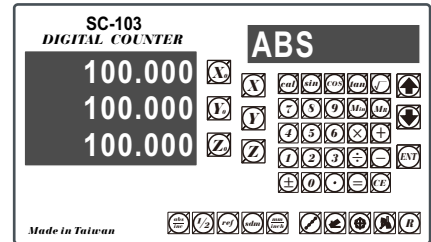
Currently in "shrink" compensation mode



return to normal display

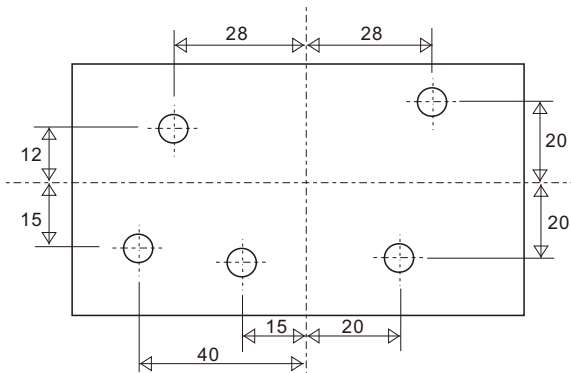


normal real dimension display



## Shrinkage calculation

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



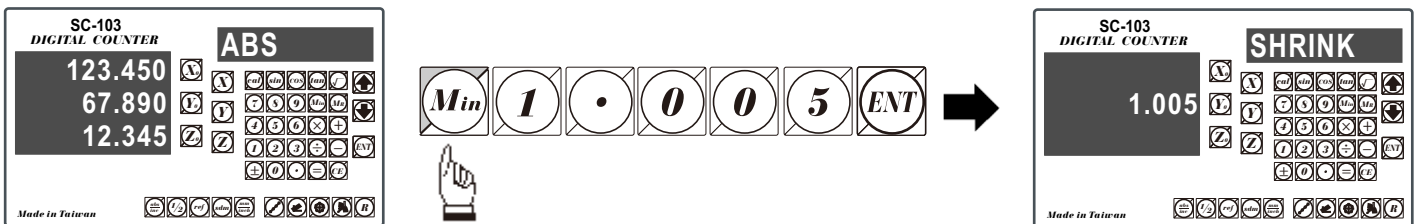
Because the plastic material shrinks when it cools down after the plastic injection process, the dimensions of the holes in the mould have to be expanded according to the shrink factor.

Normally, the operator has to calculate all the expanded dimensions prior to the machining, but with SC-100, the operator can use SC-100'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 the drawing, obviating the need to calculate the reduced dimensions one by one.

## Operation procedure

### 1. Entering the "SHRINK FACTOR"

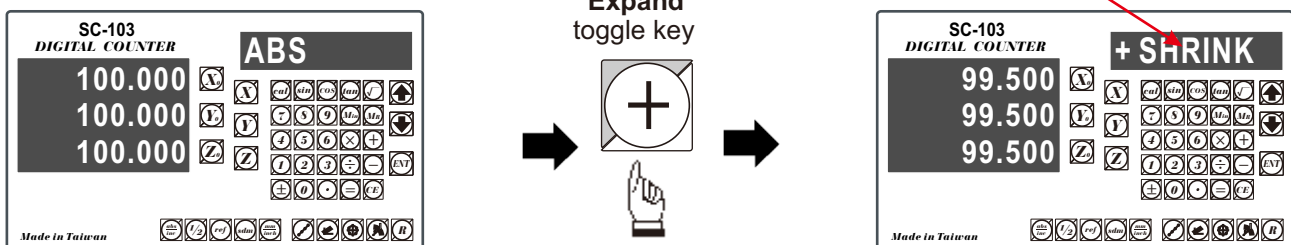
i.e : For plastic material ( ABS ), it's shrink factor is 1.005.



### 2. Set the SC-100 to "Expand Compensation"

Because the display dimension has compensated by the shrink factor, in order to remind operator that SC-100 is currently in shrink compensation mode to avoid operation mistake, SC-100 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

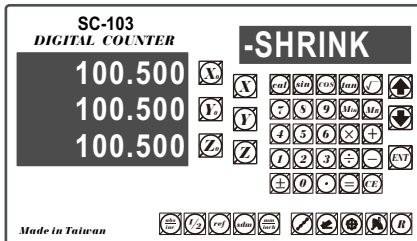
Operator can drill the holes as above in this mode without the need of calculation

## Shrinkage calculation

When the SC-100 is in shrink compensation mode, if the operator wants to return to normal real dimension display.

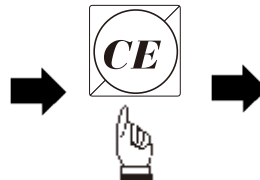
press  or 

Currently in "shrink" compensation mode

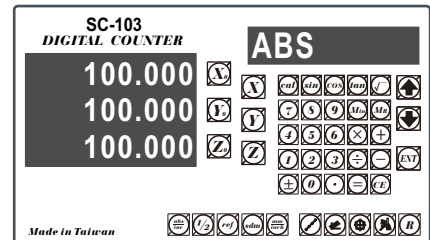


**Compensated dimensions :**  
The actual dimension are now X 1.005 of the displayed dimensions

return to normal display

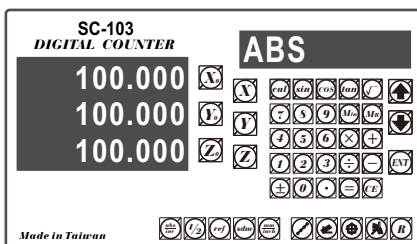


normal real dimension display



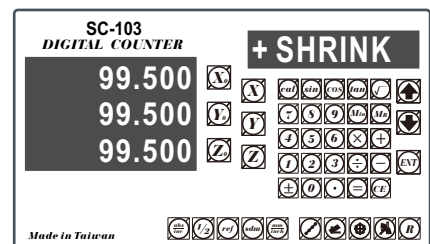
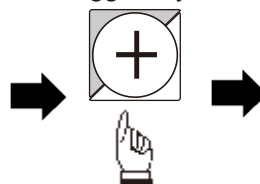
**Real Dimension**

After verifying and need further machining in shrink compensated mode



**Real Dimension**

Expand toggle key

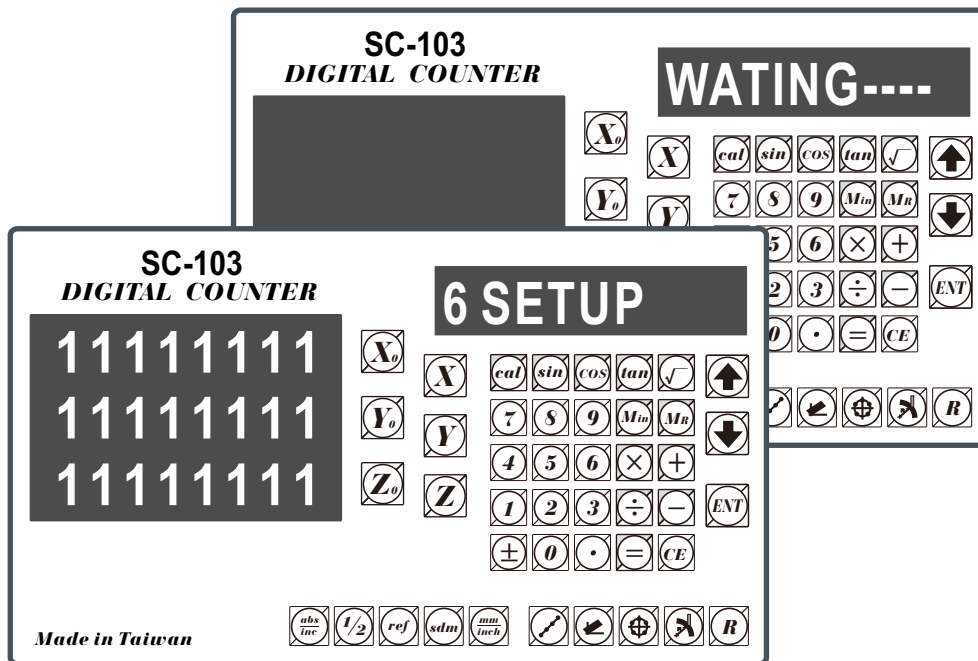


**Compensated dimensions :**

The actual dimension are now X 1.005 of the displayed dimensions

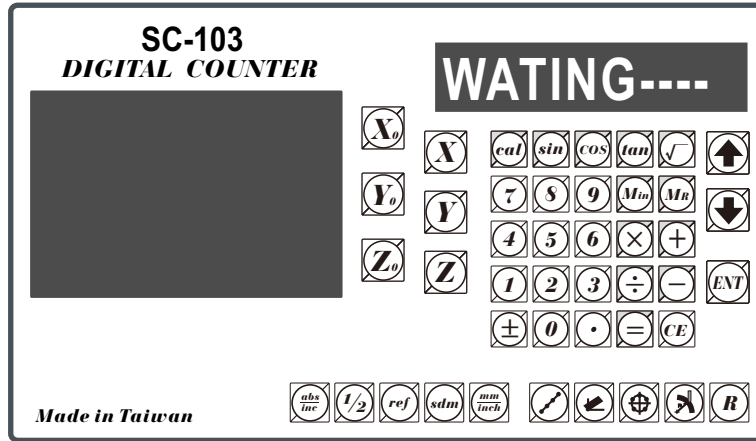
Operator can drill the holes as above in this mode without the need of calculation

# SC-100 Parameters Setup



- Z DIAL ..... regarding the milling process, set up the dialing ring parameter and define the turning route of axis Z dialing ring.
- DIAL INC ..... regarding the arc machining, input z-increment value.
- BAUD SET ..... set up RS232 transmission baud.
- BEEP ON/OFF ..... turn on/off printer.
- BEEP ON/OFF ..... turn on/off beeper.
- RESOLUTE ..... set up Linear scale resolution.
- CP ERROR ..... compensate Linear scale error
  - LINEAR P ..... compensate linear error.
  - NL ERROR ..... compensate nonlinear error (point compensation)
- DIRECT ..... set up direction.
- EXIT ..... end and exit.

**Reset display's original parameter (RESET)**

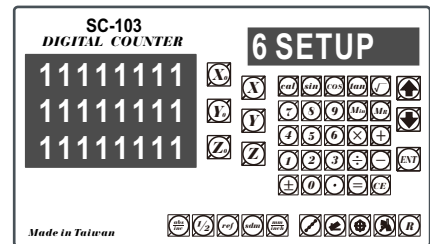


When the DRO is under the impact of abnormal voltage, or user's improper operation that cause parameter setting in error, it needs to default simple working parameters by resetting them to default value from memory. Yet, before parameter reset, check if there is any parameter value set in already; if so, write down the setting data and set it up after reset.

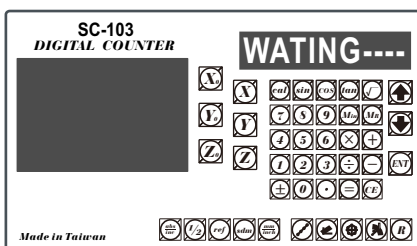
**Operation steps:**

- 1) . Turn off the DRO power.
- 2) . Turn on the DRO; when “1111111” test signal is shown in the display window, press “0” and the display start performing “reset”.

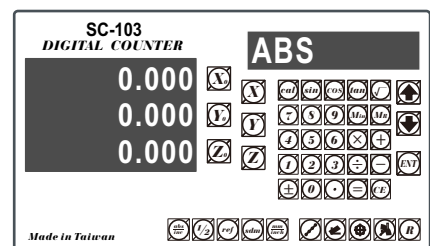
While turning on the display,  
it will perform self diagnosis  
and test; press 



- 3). 1. When parameters reset, “WATING” will show on the display.



“WAITING --” is shown as  
parameter reset is underway.



After coming backing to normal mode,  
the parameter reset process is complete.

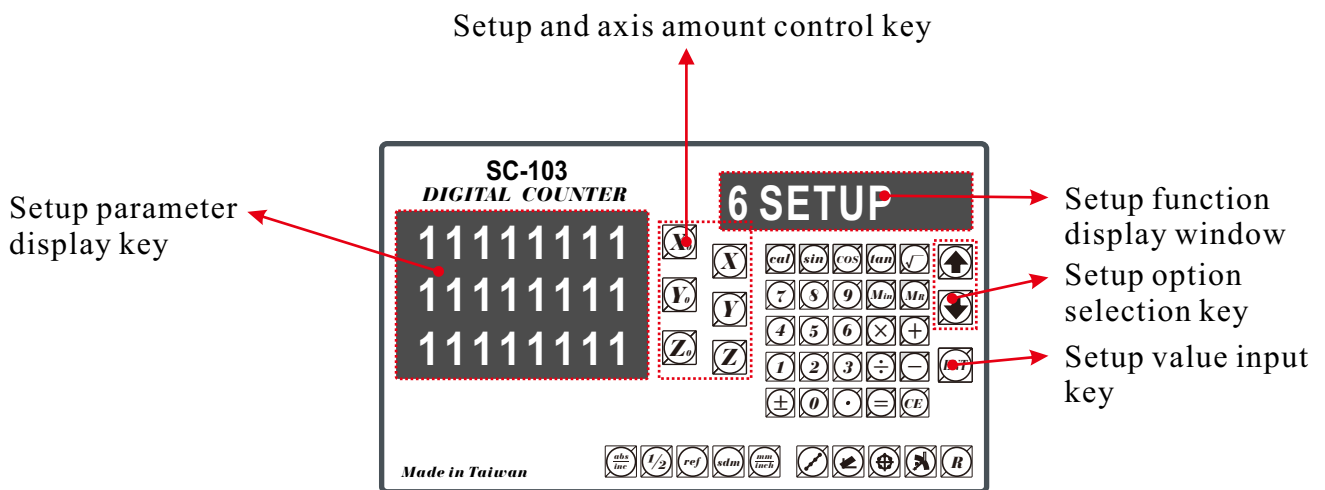


**Parameters Setup**

**Set up new parameters in display (SETUP)**

When DRO-change IC is under the impact of abnormal voltage or improper operation, which cause the default disturbed; or user wants to change production process and needs to modify the default value, it needs to set up DRO and reset function values in memory.

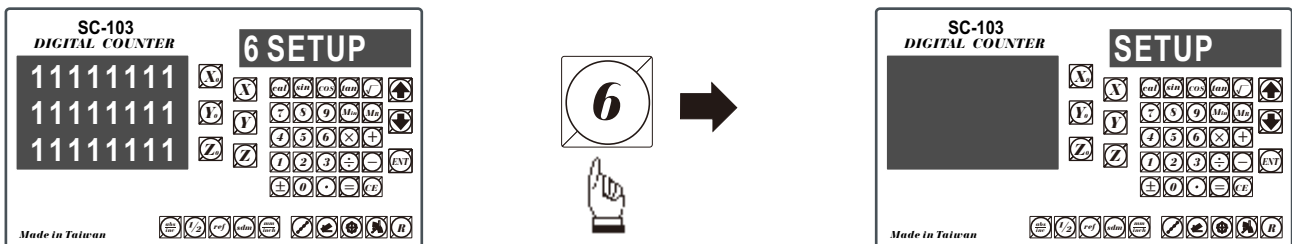
DRO in the display and related key locations in the SETUP process:



**Operation steps:**

- 1) 1. Turn off the DRO power.
- 2) Turn on the DRO; when self-diagnosis test signal is shown in the display window, press **6** and the display start performing “setup”

When messages are all displayed, it comes into the “setup” function.




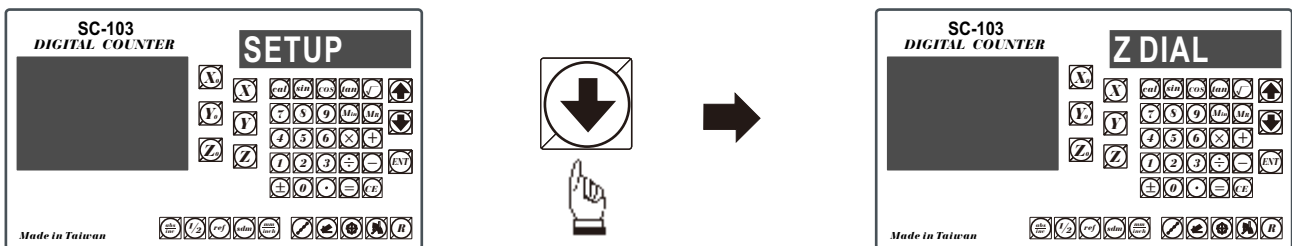
The setup procedure is designed to option menu mode; the Definition List facilitates user to apply the following options.


## Parameters Setup

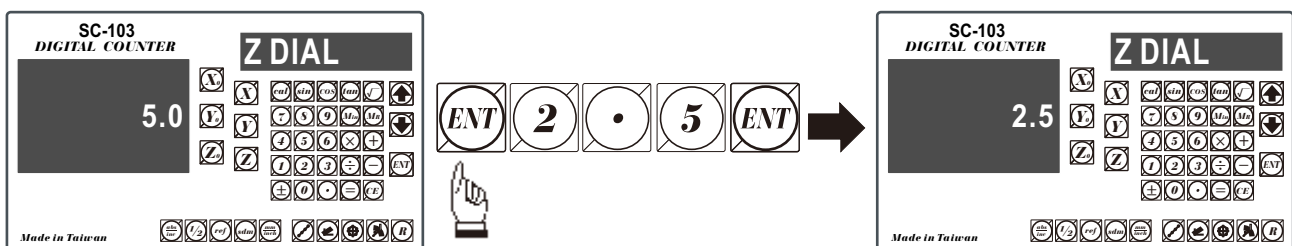
### The first layer functions are, in turn, defined as below:

- Z DIAL ..... regarding the milling process, set up the dialing ring parameter and define the turning route of axis Z dialing ring.
- DIAL INC ..... regarding the arc machining, input z-increment value.
- BAUD SET ..... set up RS232 transmission baud.
- PRINTER ON/OFF ..... turn on/off printer.
- BEEP ON/OFF ..... turn on/off beeper.
- RESOLUTE ..... set up Linear scale resolution.
- CP ERROR ..... compensate Linear scale error
- LINEAR P ..... compensate linear error.
- NL ERROR ..... compensate nonlinear error (point compensation)
- DIRECT ..... set up direction.
- EXIT ..... end and exit.

3) Press  to enter the “Z DIAL” function.




Then, press  (ent) to enter the setup function; assume the setup is “2.5”

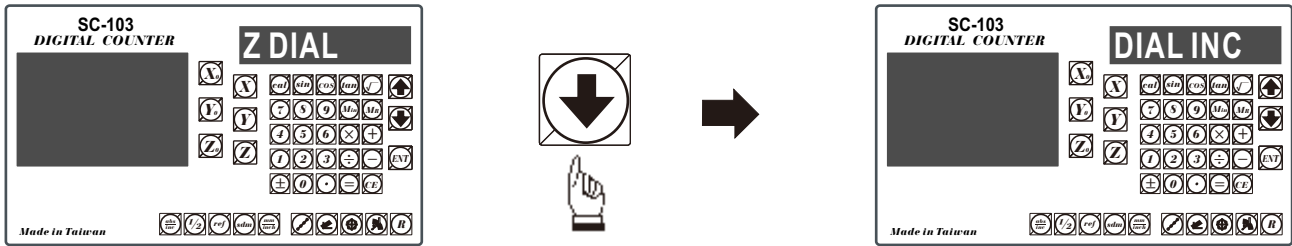



Z-axis dialing ring- after entering into the SETUP mode, press up/down key till “Z DIAL” is displayed; then, press input key to confirm it and turn to next step. When “0.00” is displayed in Y-axis displaying window, key in your data input to set up the “Z DIAL” pitch distance; press input key to save the data inputted, then, the up/down key to exit and turn to next item.

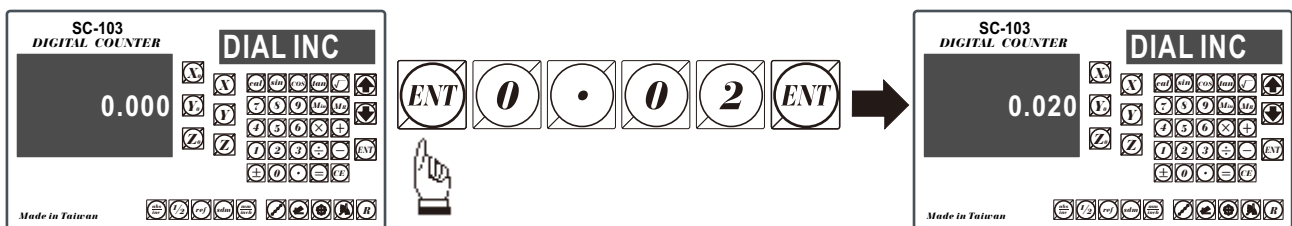
The pitch distance of milling machine made in Taiwan is 2.5mm.

## Parameters Setup

4) Press  to enter into the dialing ring increment.



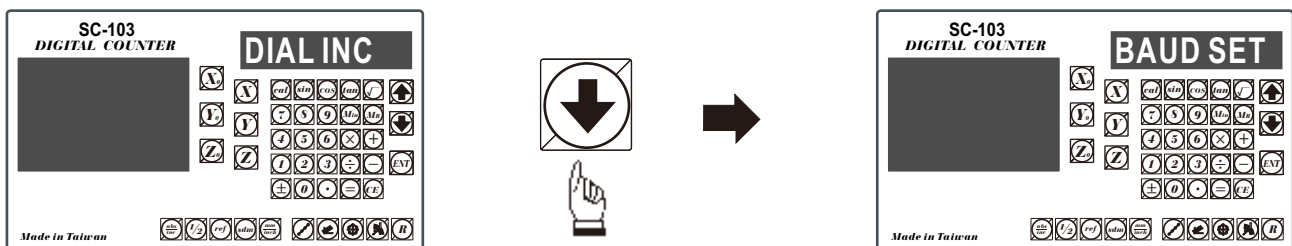
Press  to enter the setup function; assume the setup is “0.02”.




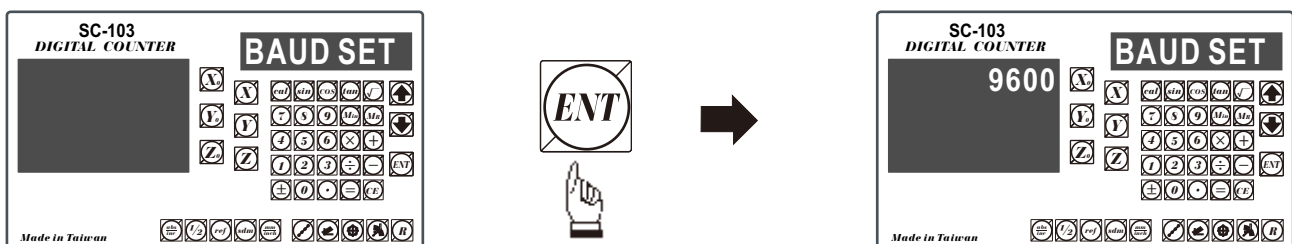
Dialing ring increment- after entering into the SETUP mode, press up/down key till “DIAL INC” is displayed; then, press input key to confirm it and turn to next step. When “0.00” is displayed in Y-axis displaying window, key in the minimum increment; press input key to save it and up/down key to exit and turn to next item.

The minimum dialing increment of knees-bended type milling machine made in Taiwan is 0.02 mm.



5) Press  to “BAUD SET”.

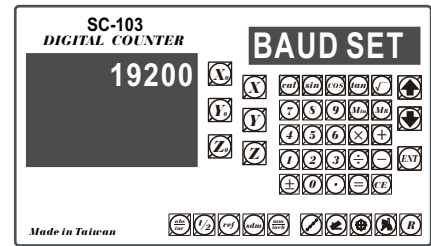
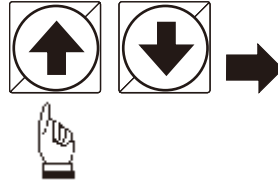
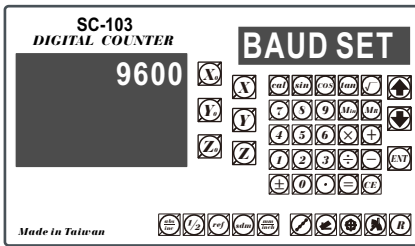


Press  to enter the setting of RS232 transmission baud.





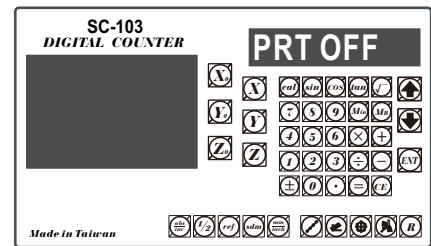
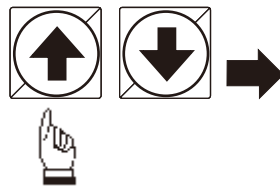
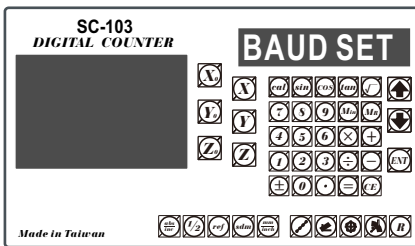
## Parameters Setup


Press  or  to select the correct baud speed from 1200/2400/4800/9600/19200/57600.

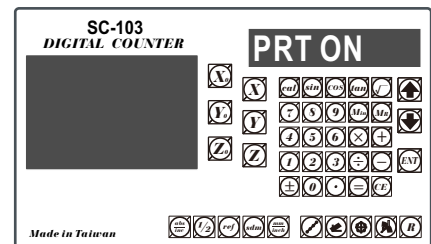
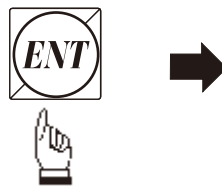
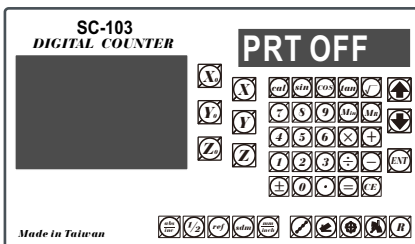




After baud speed is selected, press  to end up this setting function.

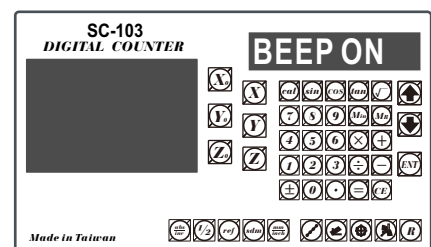
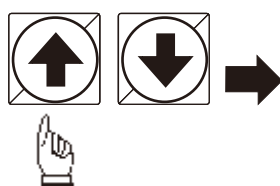
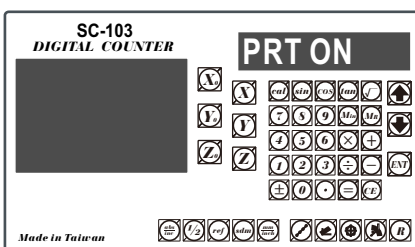
6) Press  or  and move to “PRT ON/OFF”.




Directly press  to change over OFF & ON.

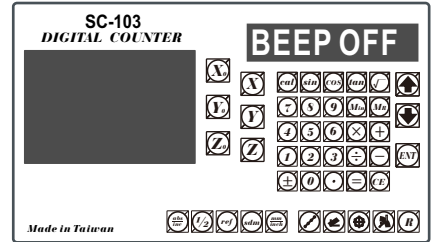
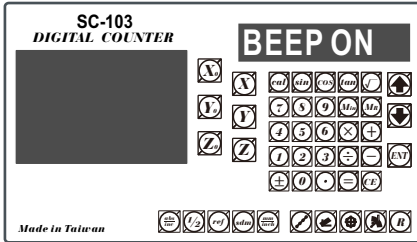




7) Press  or  and move to “BEEP ON/OFF”.

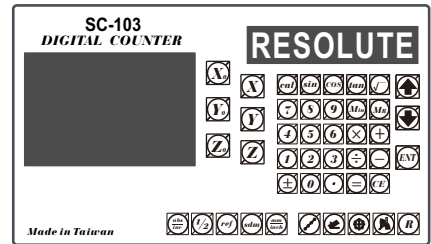
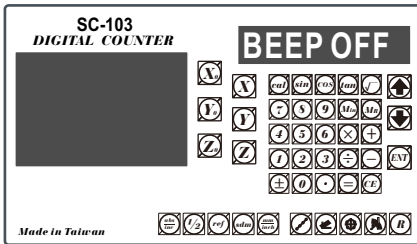



## Parameters Setup

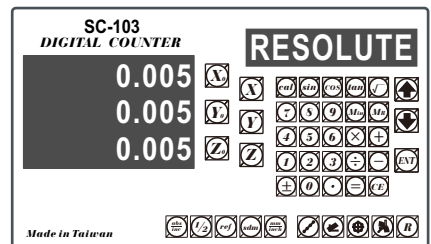
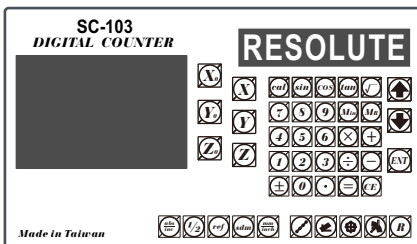
Directly press  to change over OFF or ON.






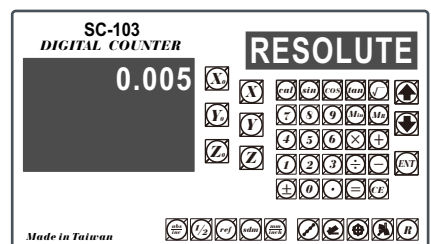
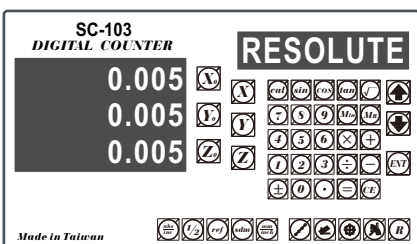
8) Press  or  and move to "RESOLUTE".





Press  to enter the linear scale resolute setup.

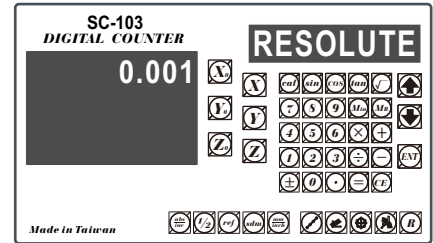
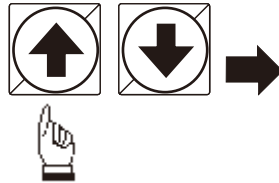
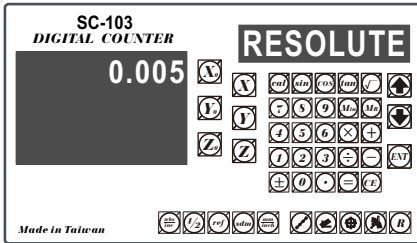



Press the axis going to be changed:  ,  , 

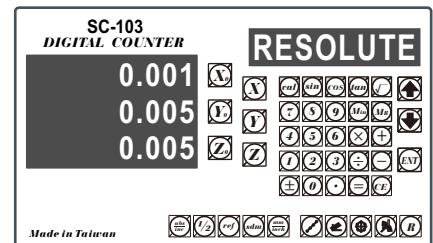
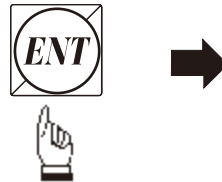
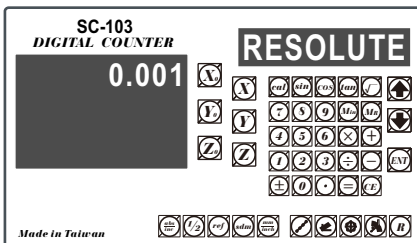



## Parameters Setup

Press  or  to switch to the correct resolution value from 0.01/0.005/0.002/0.001/0.0005/0.0002/0.0001.

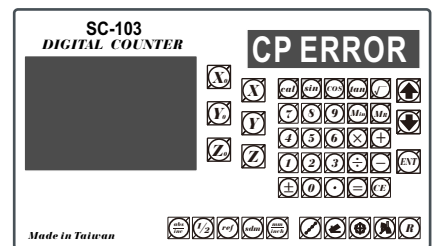
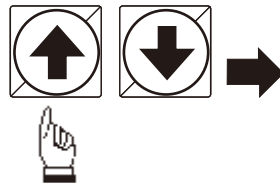
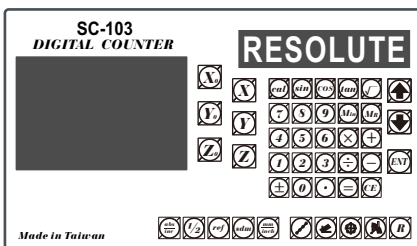





Press  to end up this axis's setup

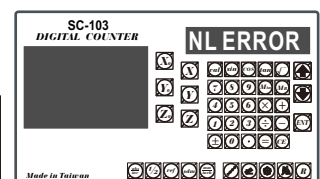
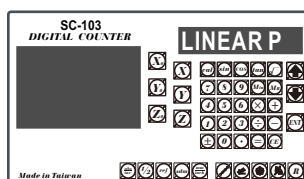
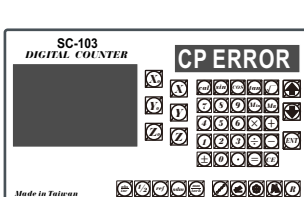


Then, press  to end up the linear scale resolute setup procedure.

9) Press  or  to "CP ERROR" (error compensation).

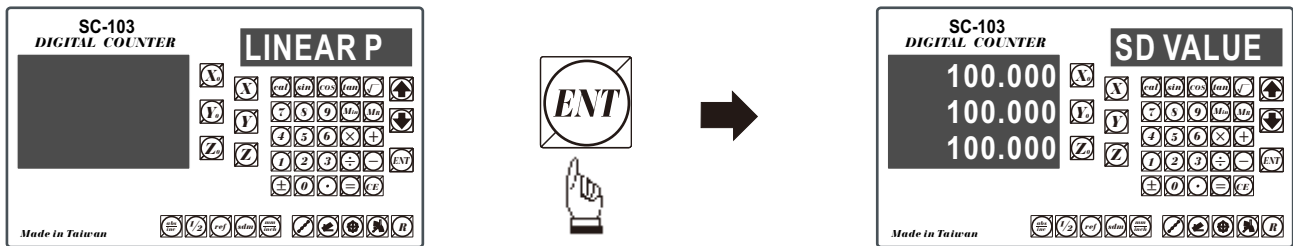





Press  to enter the compensation setup; you can press  or  to switch between the "LINEAR P" (linear compensation) mode and "NL ERROR" (nonlinear compensation) mode; choose one alternatively.

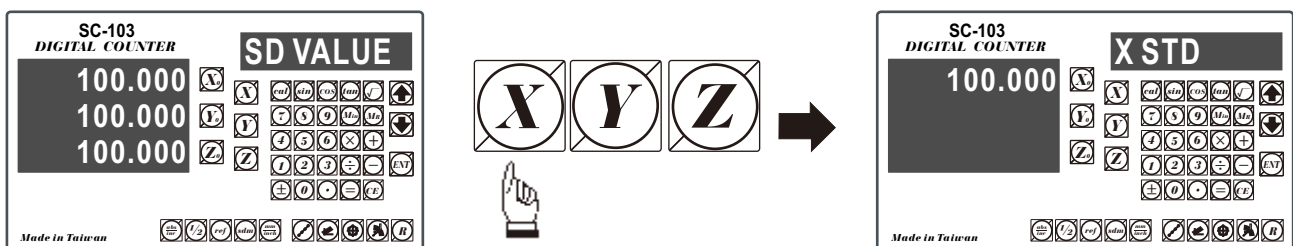



## Parameters Setup

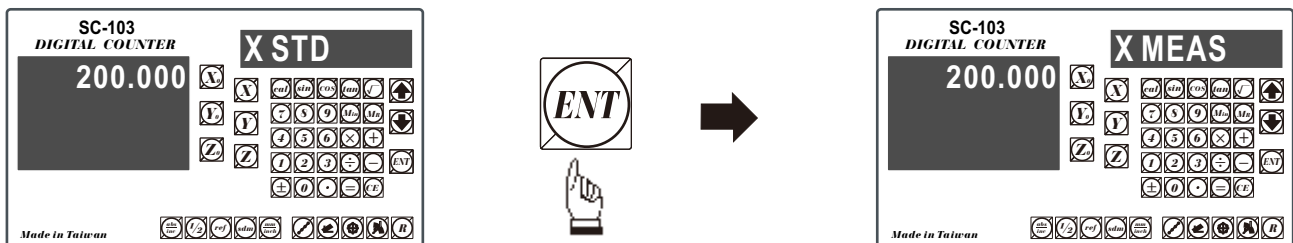
While selecting “**LINEAR P**”, press  to enter the linear compensation process.




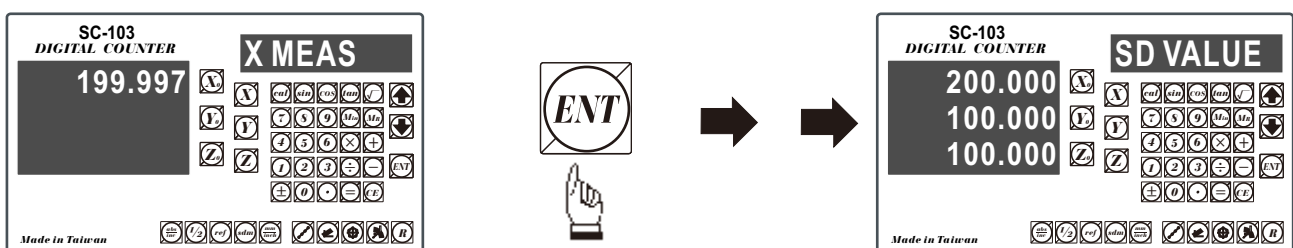
Press the axis ,  or  under compensation.




Input the length measured and press .



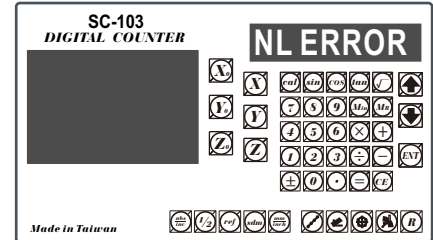
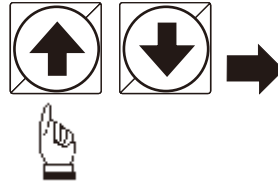
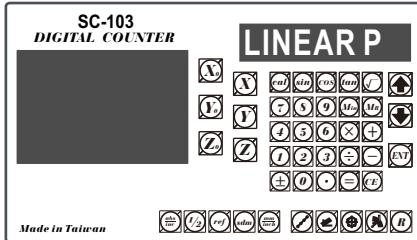
Input the actual length and press .




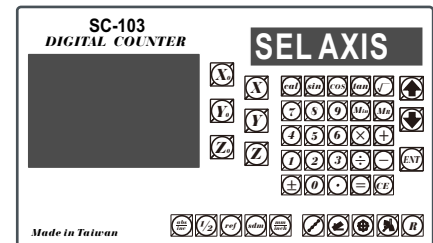
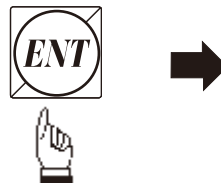
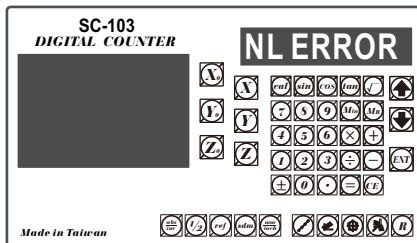
Press other axis  or  under change and follow the above procedure to operate;  
after the compensation procedure is done, press  to end up the compensation of linear scale.




## Parameters Setup

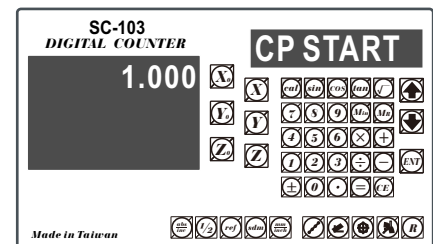
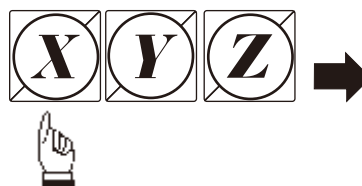
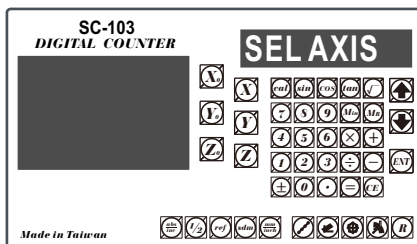
Press  or  to switch to “NL ERROR” (nonlinear compensation).



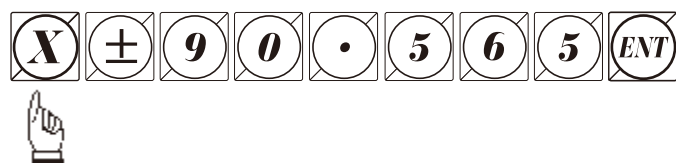
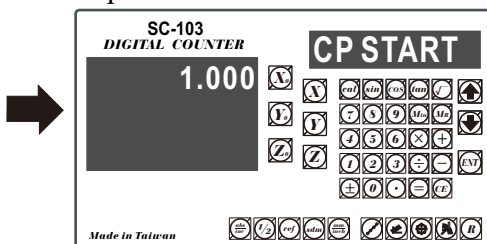
Press  to enter the nonlinear compensation setup.



Press the axis ,  or  under compensation.



Input CP START

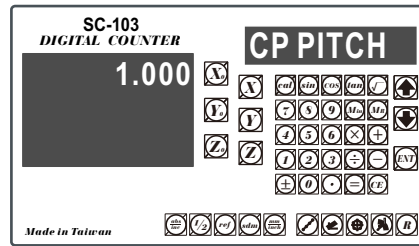




## Parameters Setup

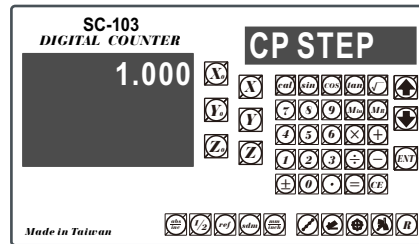
### Input CP START

Next step



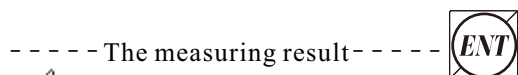
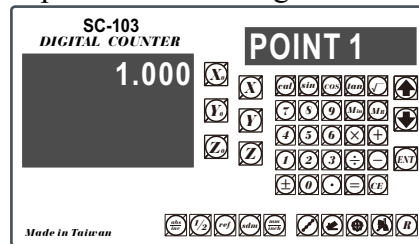
### Input CP STEP

Next step

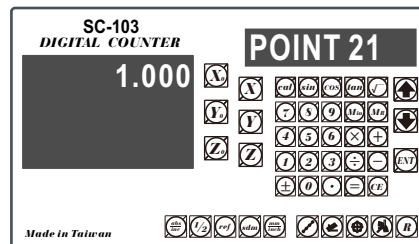


After entering the “Point 1” status, press the up/down key to select the measuring result at the point selected.

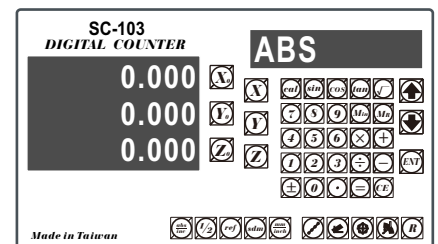
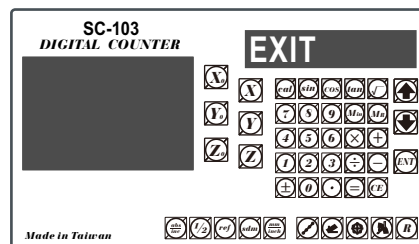
### Input the measuring result.



After all data inputs are done, press CE to exit.





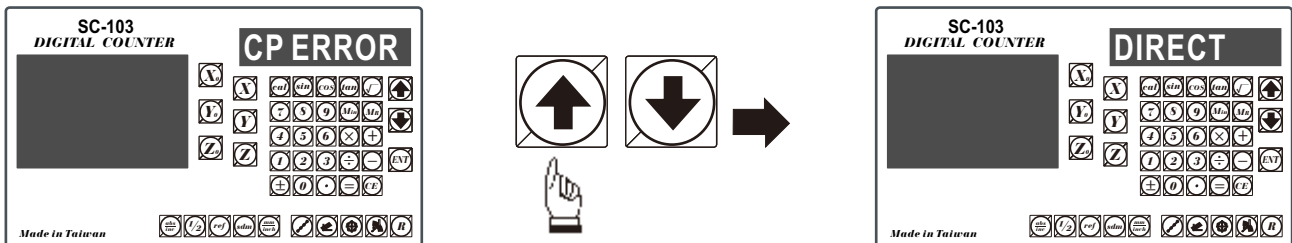
Press up/down key till EXIT appears.




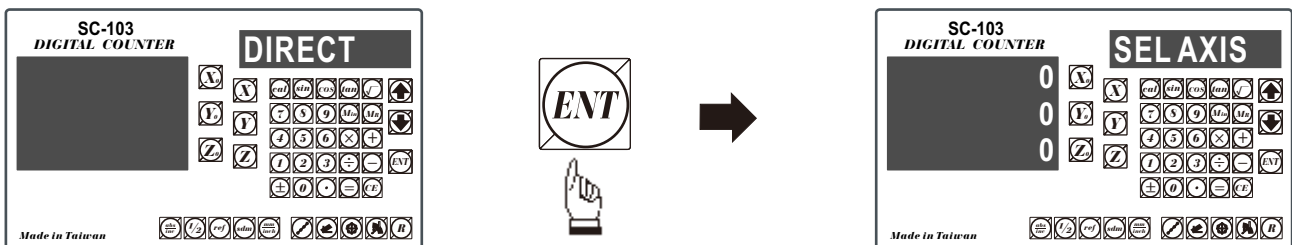
If use the error compensation function, you must turn off the DRO then power on the DRO again, otherwise your compensated value will invalid.



## Parameters Setup

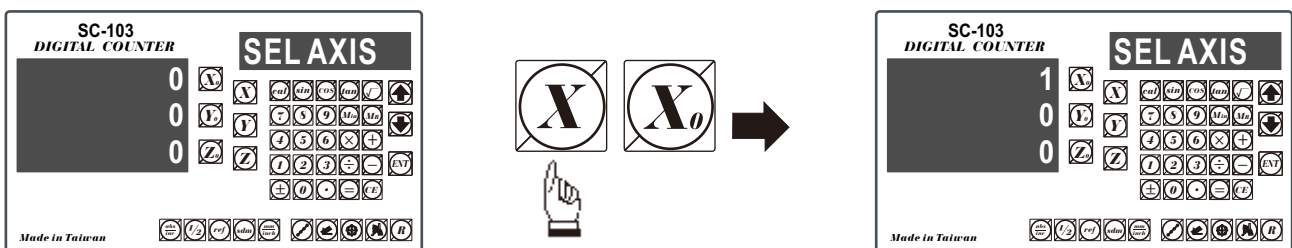
10) Press  or  to move the “DIRECT” (direction setup).



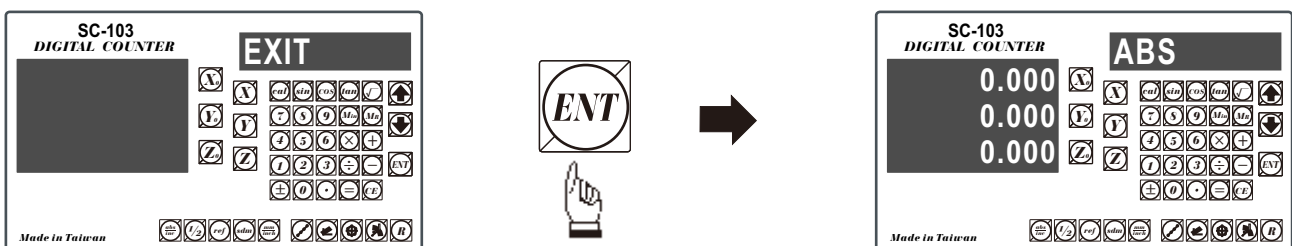
Press  to enter direction setup mode. “0” means in positive direction whereas “1” means the negative direction.



Press  or  to set up X-axis to “1” (negative direction); and do it to Y- & Z-axis similarly.



11) Press  to exit; and  or  to “EXIT” and end up the parameter setup.



## **Easson SC-100** Milling Multi-function

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## **Easson SC-200** Standard

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## **Easson SC-300** Lathe

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## **Easson SC-400** Grinding

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## **Easson SC-500** 2D Measuring

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## **Easson SC-600** EDM

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