

Easson

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ES-2 DRO Counter Operation Manual

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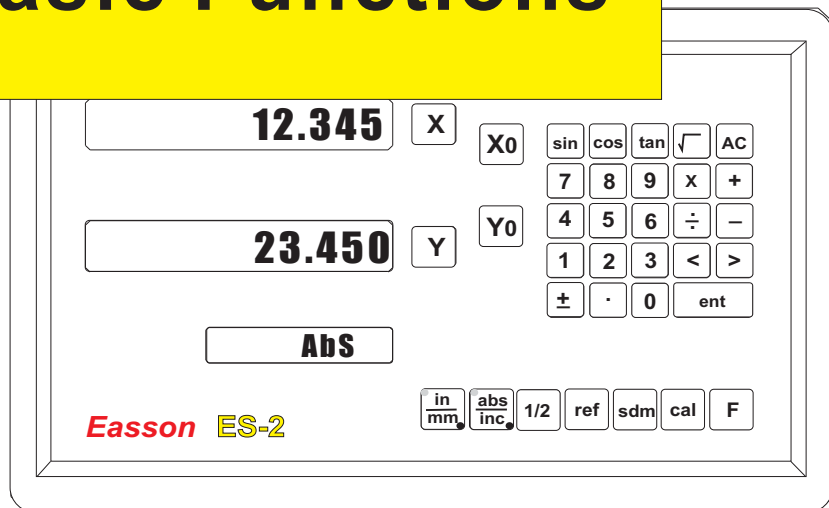
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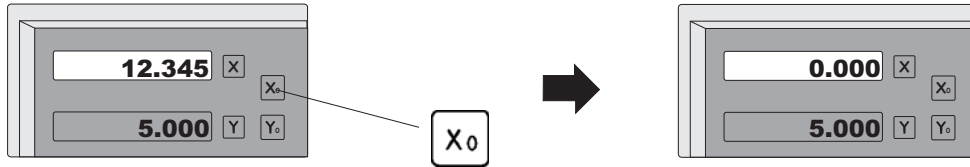
Basic Functions



Set Display to Zero

Purpose : Set the current position for that axis to zero

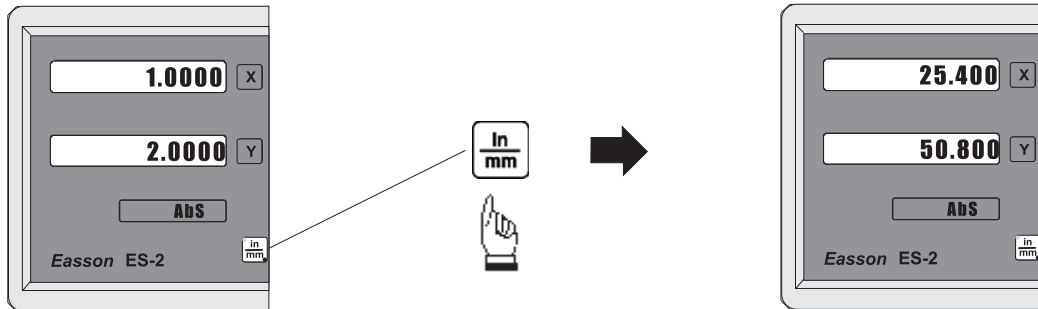
Example : To set the current **X Axis** position to zero



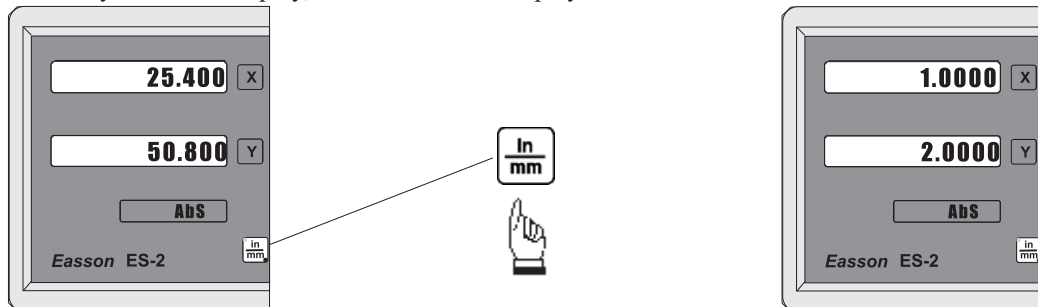
Inch / Metric Display Conversion

Purpose : Switches between inch and metric display

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



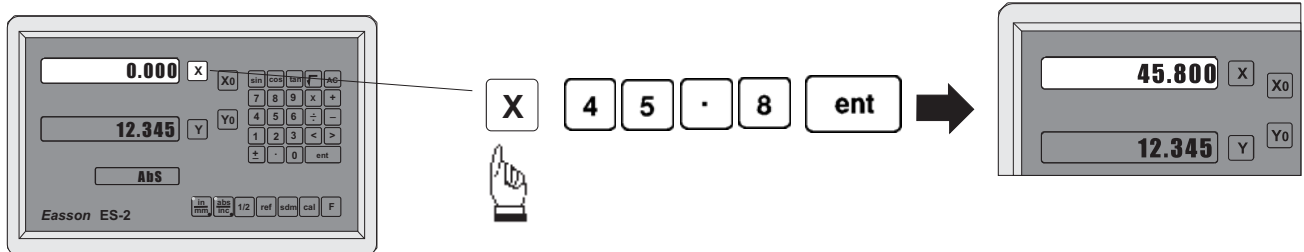
Example 2 : Currently in **metric** display, to switch to **inch** display



Enter Dimensions

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

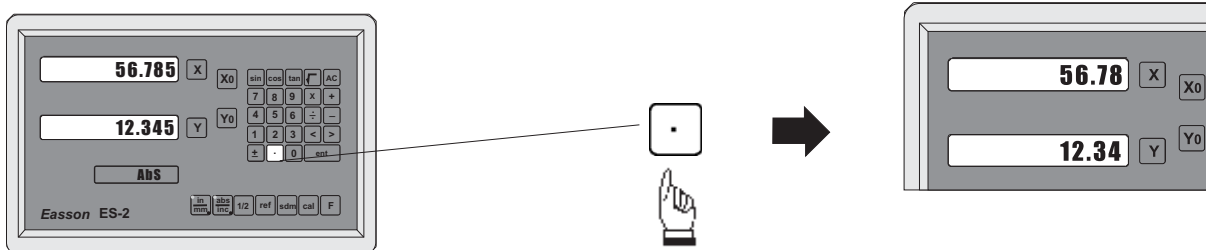
Example : To set the current **X Axis** position to **45.800 mm**



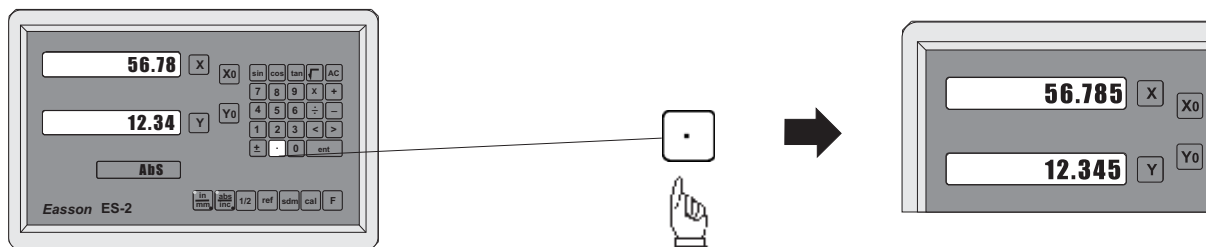
0.005 / 0.01 resolution display switches

Purpose : Switches between 0.005mm/(0.0002") and 0.01mm(0.0004") resolution display

Example 1 : Currently in 0.005mm display resolution, to switch to 0.01mm display resolution



Example 2 : Currently in 0.01mm display resolution, to switch to 0.005mm display resolution



ABS / INC Coordinates display switches

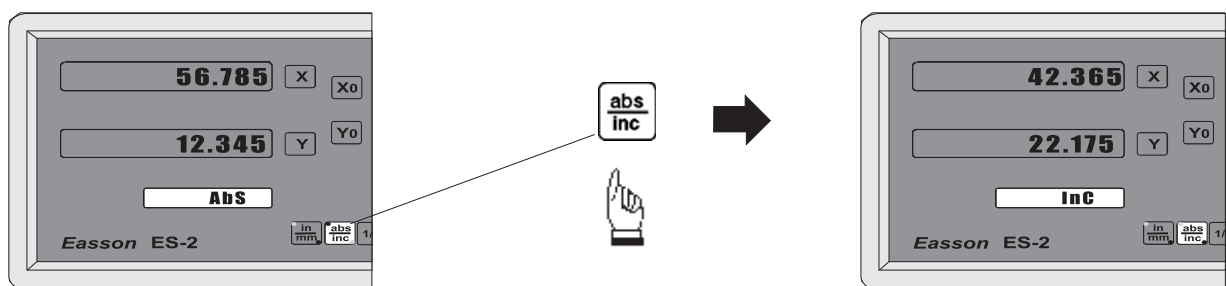
Purpose : ES-2 provides two sets of basic coordinate display, they are **ABS** (absolute) and **INC** (incremental) displays.

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.*

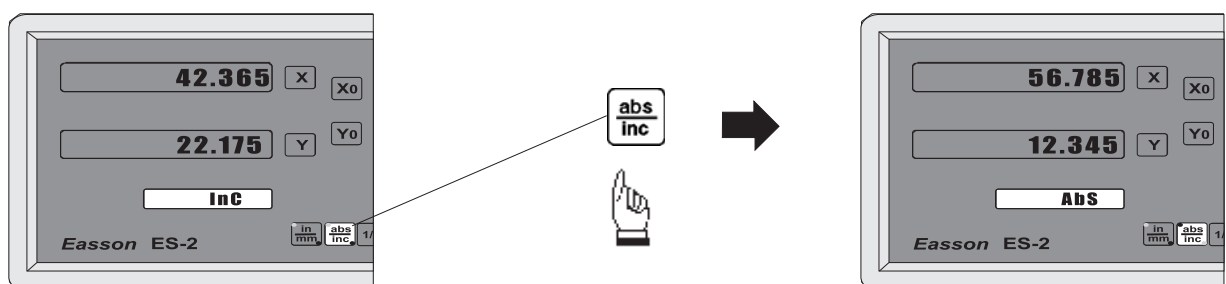
The operator is then free to zero the axes or preset any dimensions into any axis in INC coordinate for relative position machining. The work piece datum (work piece zero position) is still retained in ABS coordinate by the ES-2.

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

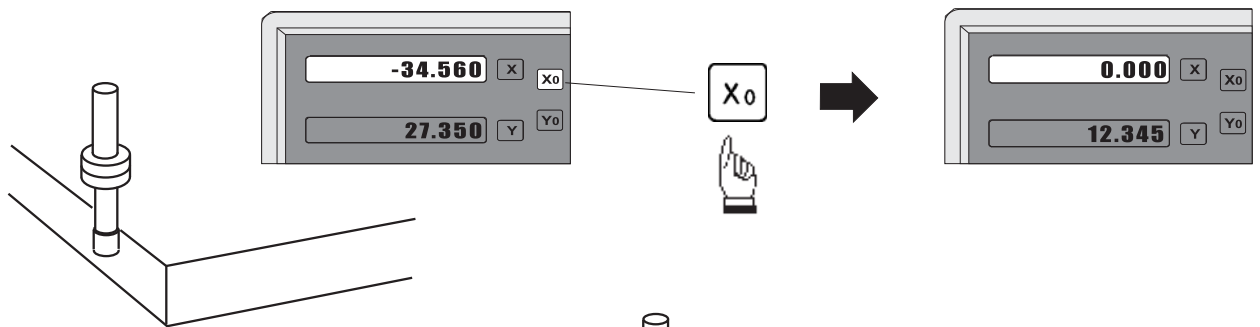


Centre-find

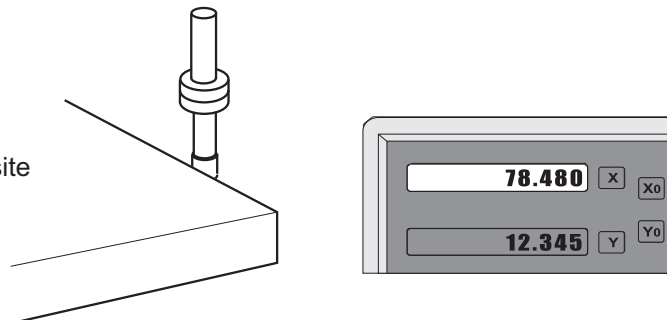
Purpose : ES-2 provides the centre-find function by halving the current display coordinate, so that the zero point of the work piece is located at the centre of the work piece.

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

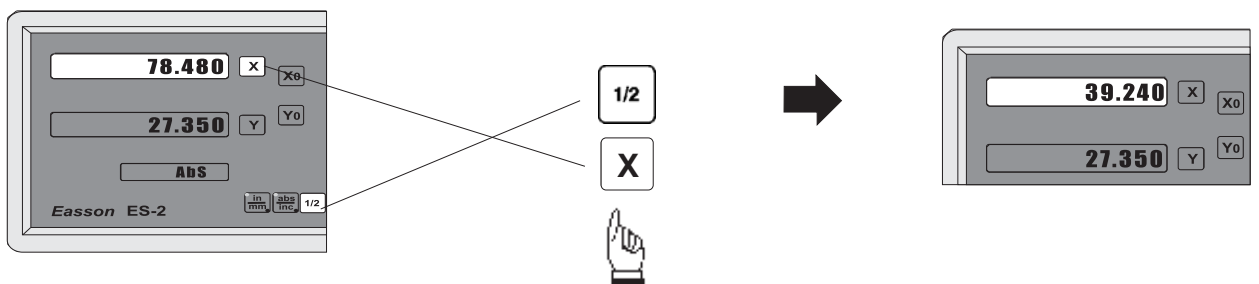
Step 1 : Locate the edge finder at one end of the work piece, then zero the X Axis.



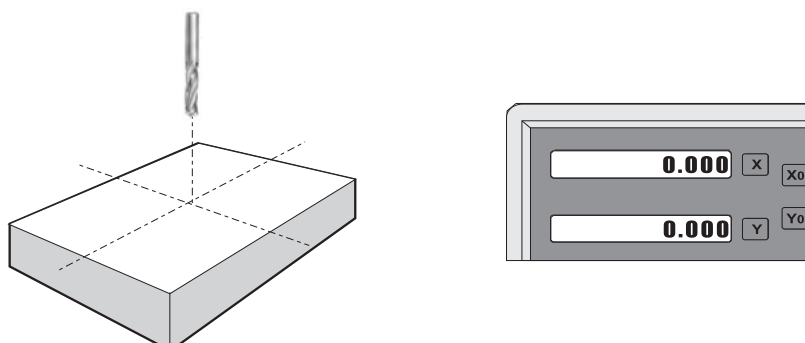
Step 2 : Locate the edge finder at the opposite end of the work piece.



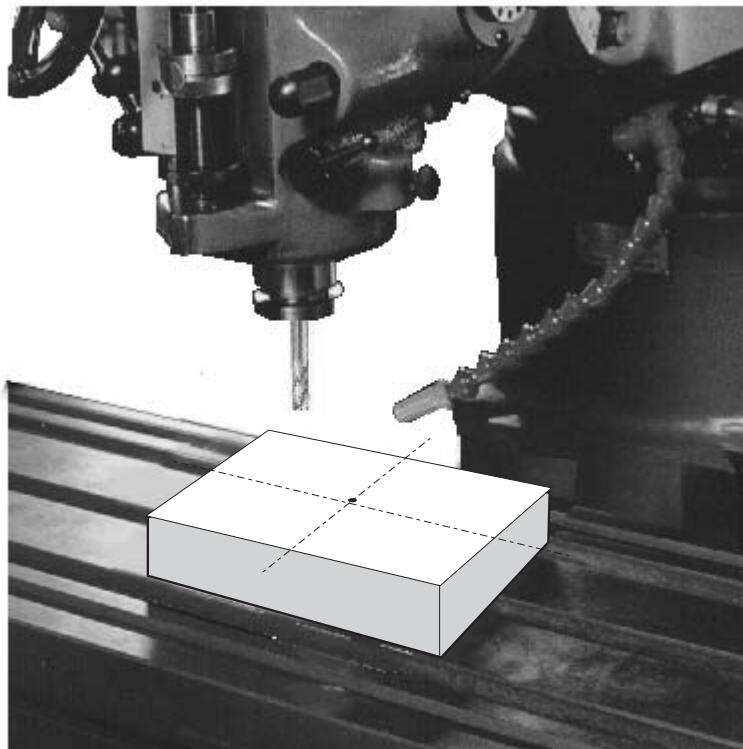
Step 3 : Then half the display coordinate using centre-find function as per follows:



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



ref datum memory



ref datum memory function

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.

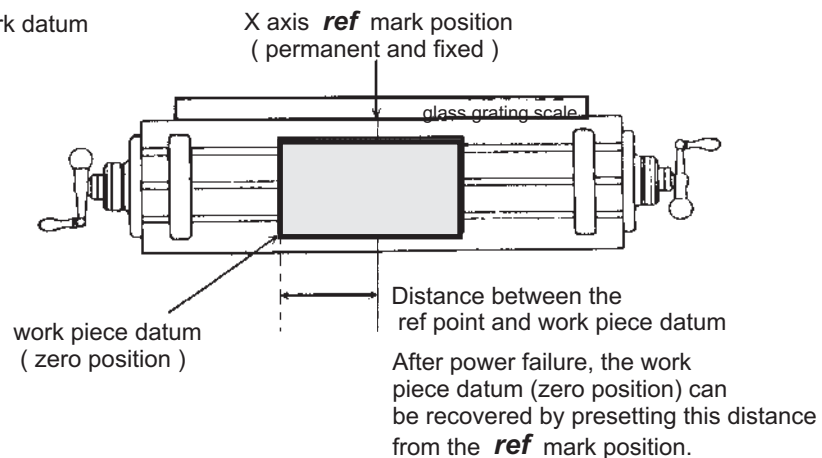
To allow the recovery of work piece datum very accurately, with no need to re-establish the work piece datum using an edge finder or other methods, every transducer has a reference point location to provide a datum point memory function.

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 ES-2 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 : ES-2 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 ES-2, whenever you alter the zero position of ABS coordinate, such as by zeroing, centre find, coordinate preset or etc., ES-2 will automatically store the relative distance between ABS zero and the *ref* mark location into ES-2's memory.

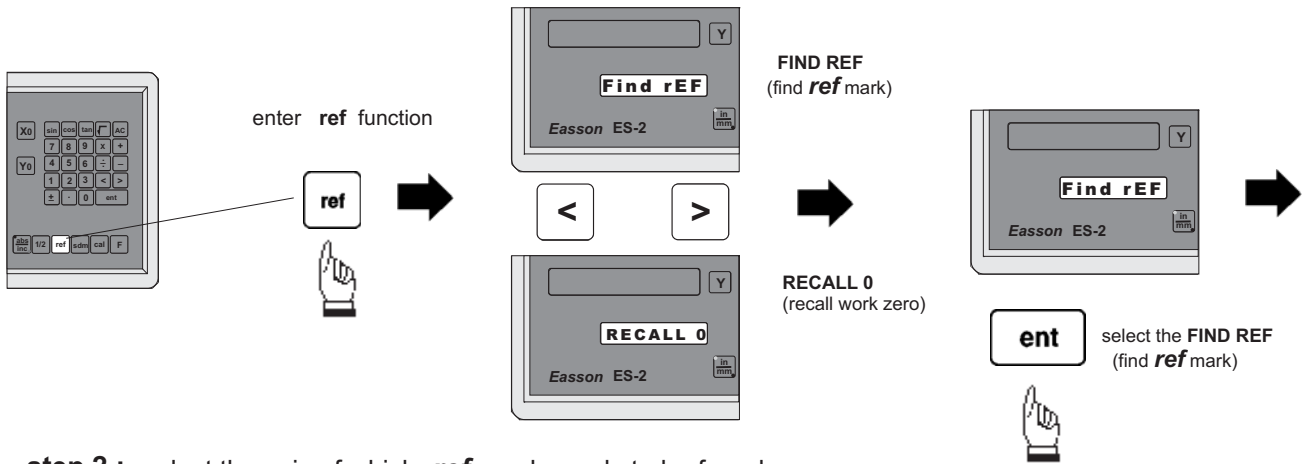
In daily operation, operator simply needs to locate the *ref* mark position whenever they switch on the ES-2 to let it know where the *ref* mark position is, then ES-2 will automatically do the work datum storage on its' own . In the case of a power failure or the ES-2 being switched off, the operator can recover the work piece datum easily by using the **RECALL 0** procedure.

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

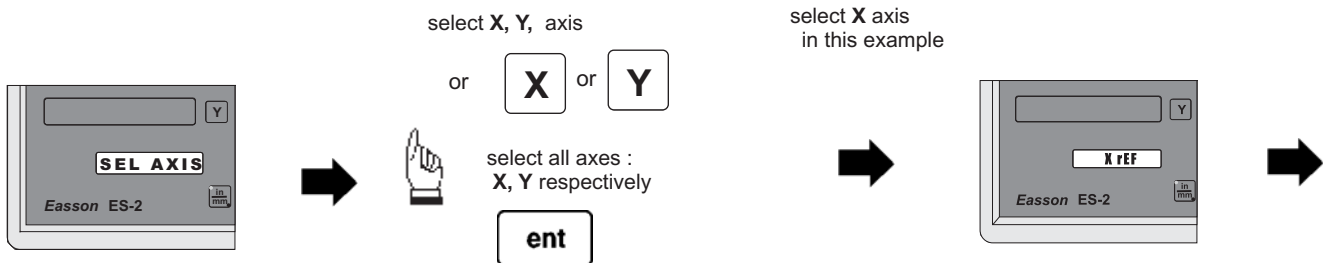
function : In ref datum memory function, the **ES-2** will automatically store the relative distance between the *ref* mark position and the work piece datum (zero position) whenever the operator alter the **ABS** zero position, such as zeroing, centre find, co-ordinate preset or etc...

Therefore, the **ES-2** 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 **ES-2**.

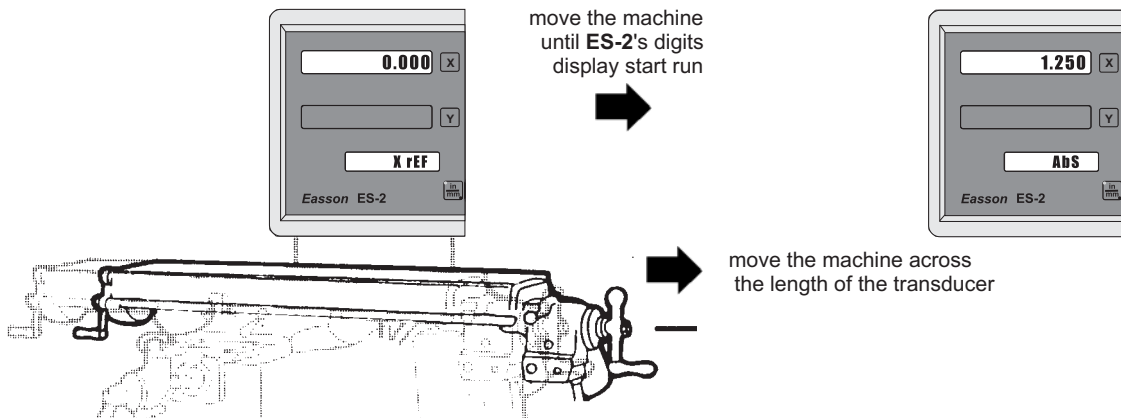
step 1 : To enter the ref function, select the **FIND REF** (find *ref* mark)



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



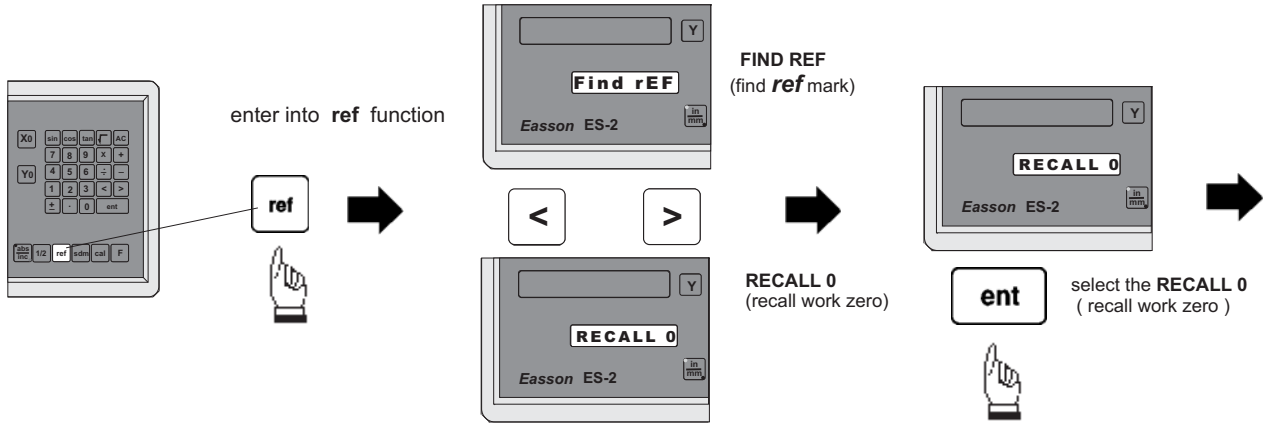
step 3 : move the machine reader head across the length of the transducer until digits display in ES-2 start to count.



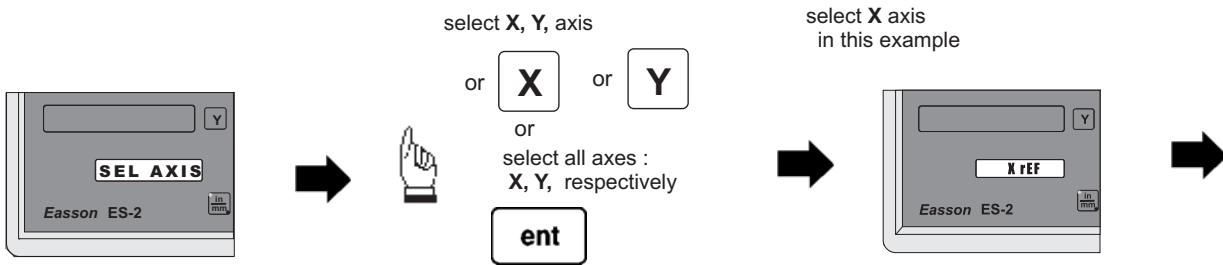
Recall the work datum zero (**RECALL 0**)

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

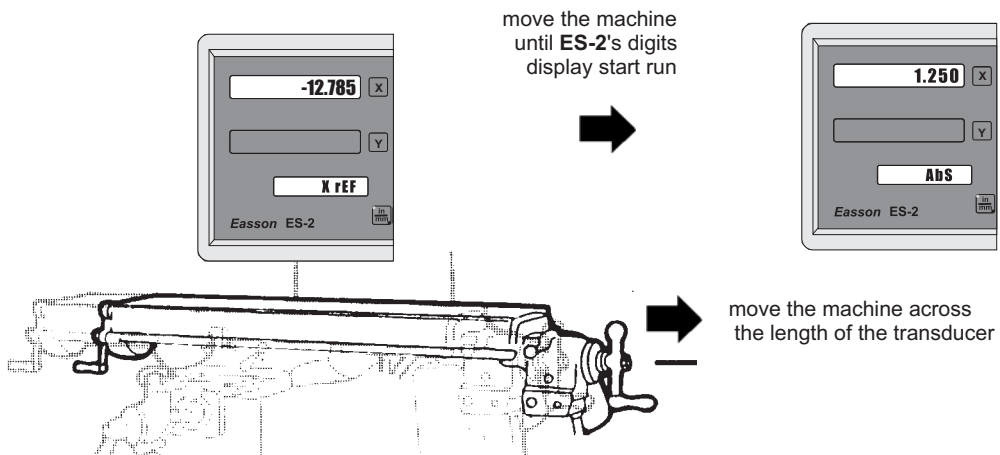
step 1 : enter into the **ref** function, select the **RECALL 0** (recall work piece zero)



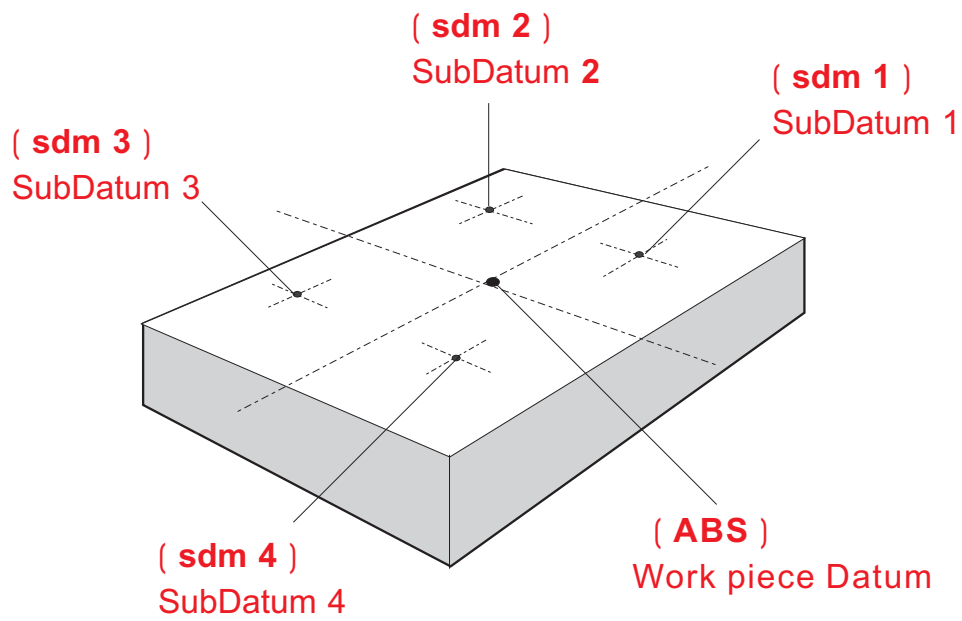
step 2 : select the axis of which work datum (zero position) needed to be recovered



step 3 : move the machine across the length of the transducer until the **ES-2** display starts to count, then the work piece datum is recovered



199 SubDatum Function



199 SubDatum function

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

ABS / INC operation has the following shortfalls :

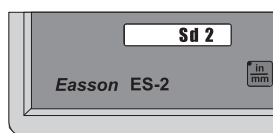
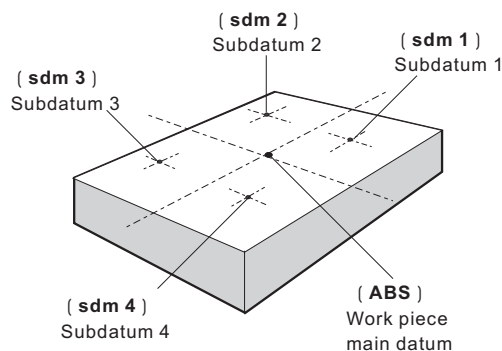
- In much machining work, the work-piece machining dimensions are derived from more than two datums, therefore, the operator has to switch between ABS and INC to set up the machining datums time after time. This process is very time consuming and prone to error.
- In the case of batch machining of repetitive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

ES-2 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 ES-2 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 ES-2's memory as per follows.



or

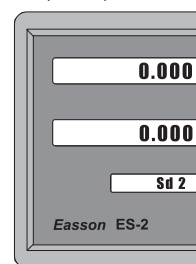
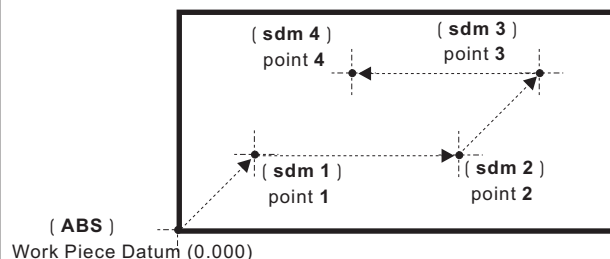


Operator then can switch between the subdatums directly by pressing key
No need to refer back to ABS coordinate and set up the subdatums from their relative distance from ABS point

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



or



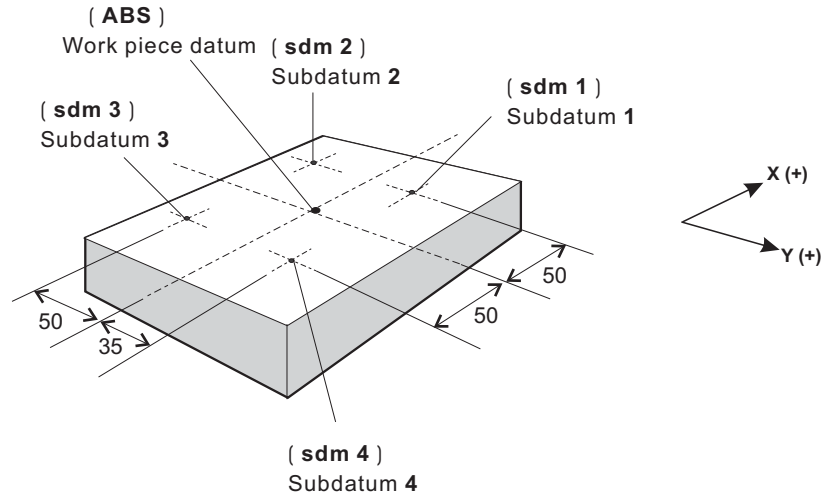
Press Up/Down key to go to machining points
move the machine to display = 0.000, then machining location reached

199 SubDatum function

Application example:

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

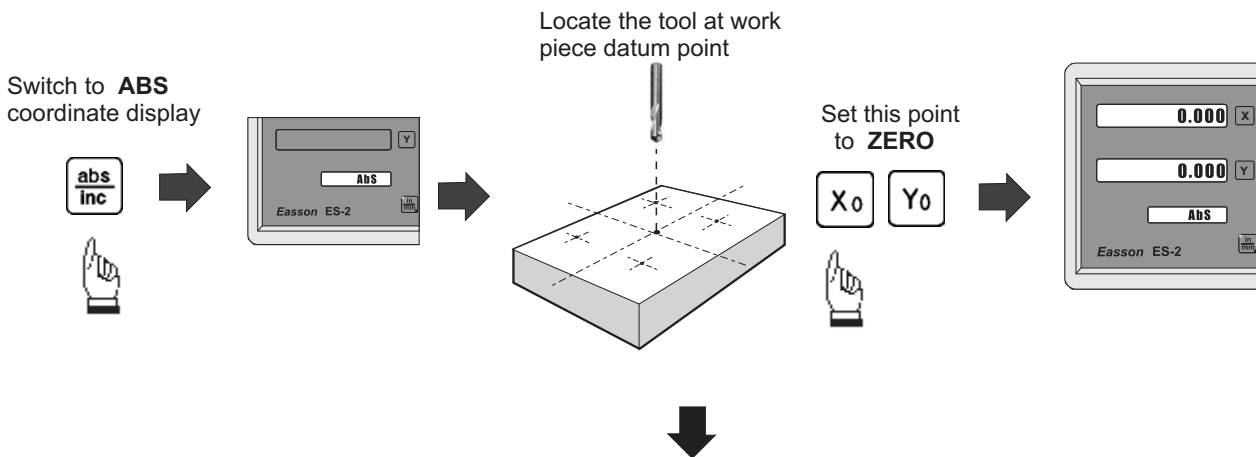
- Either 1. Move machine to required subdatum position, then zero SdM display coordinates
 Or 2. Directly key in the sdm zero position co-ordinates (co-ordinate relative to ABS zero)



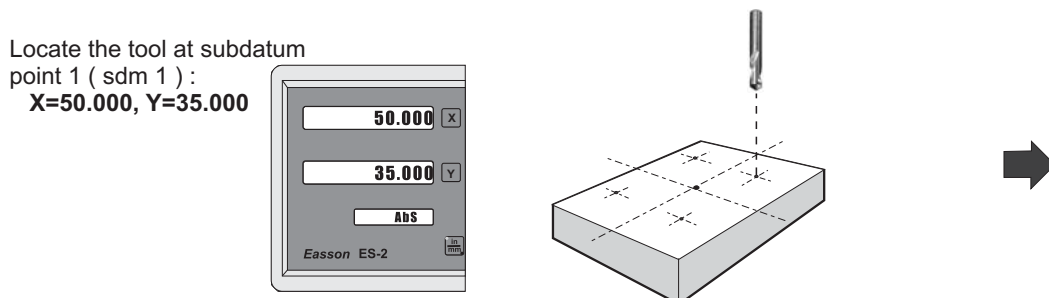
Method 1 : Move machine to required subdatum position, then zero SdM display coordinate

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

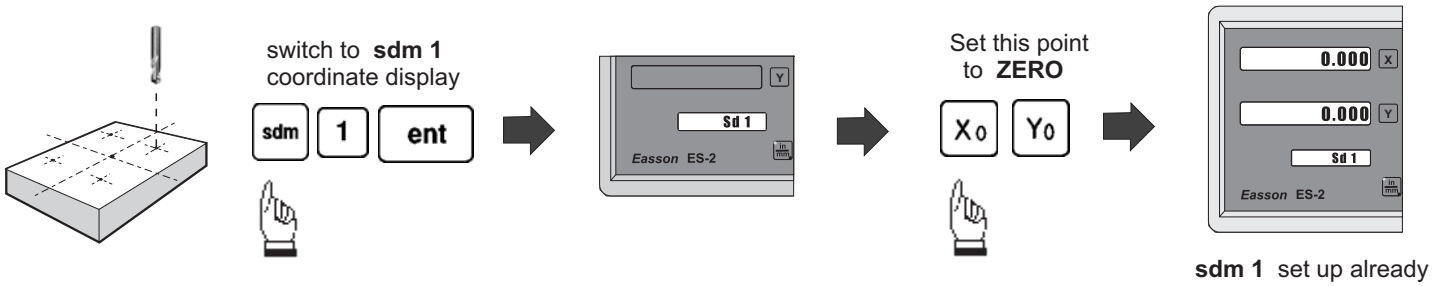
Step 1 : Set up the work piece datum in ABS co-ordinate



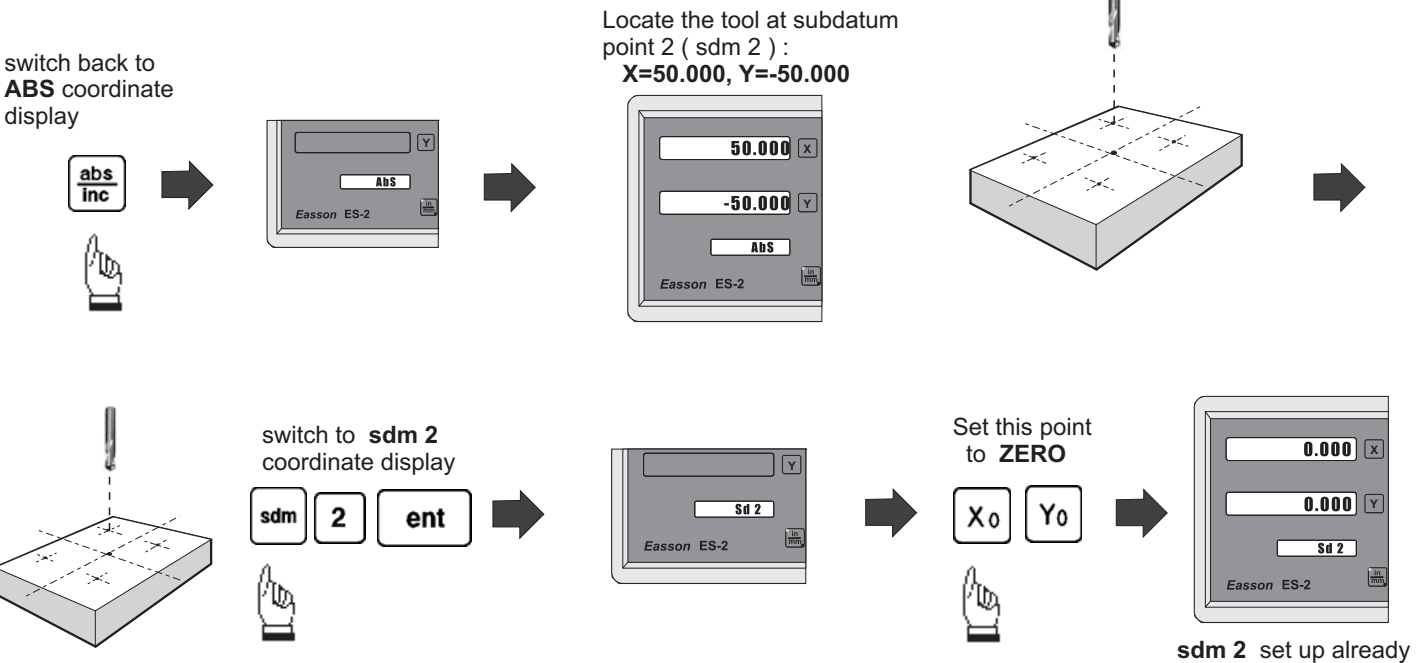
Step 2 : Set up the subdatum point 1 (sdm1)



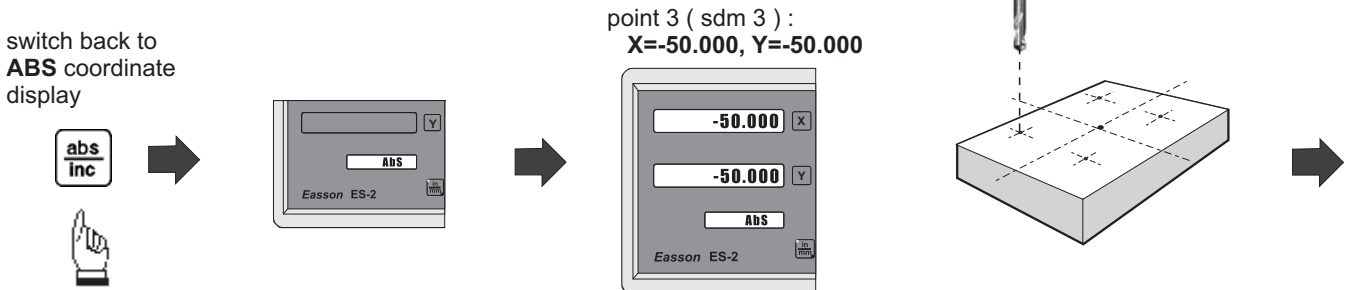
199 SubDatum function



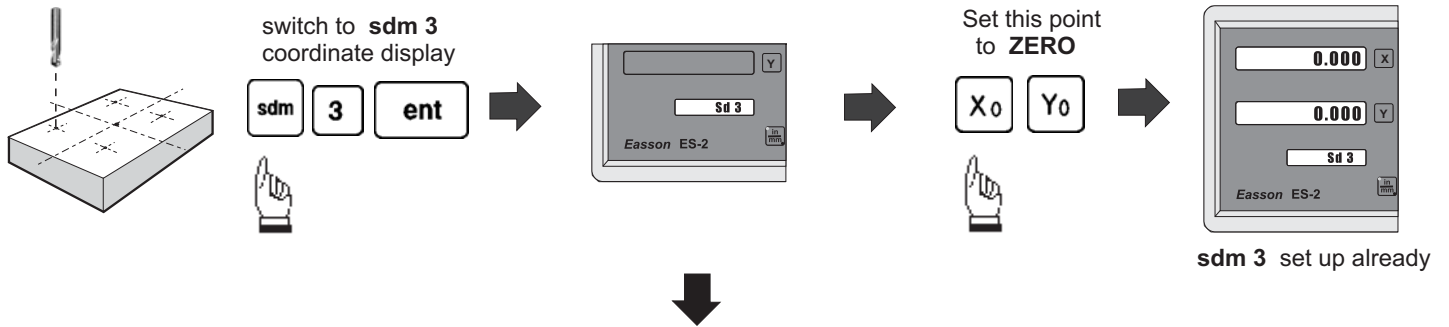
Step 3 : Set up the subdatum point 2 (sdm 2)



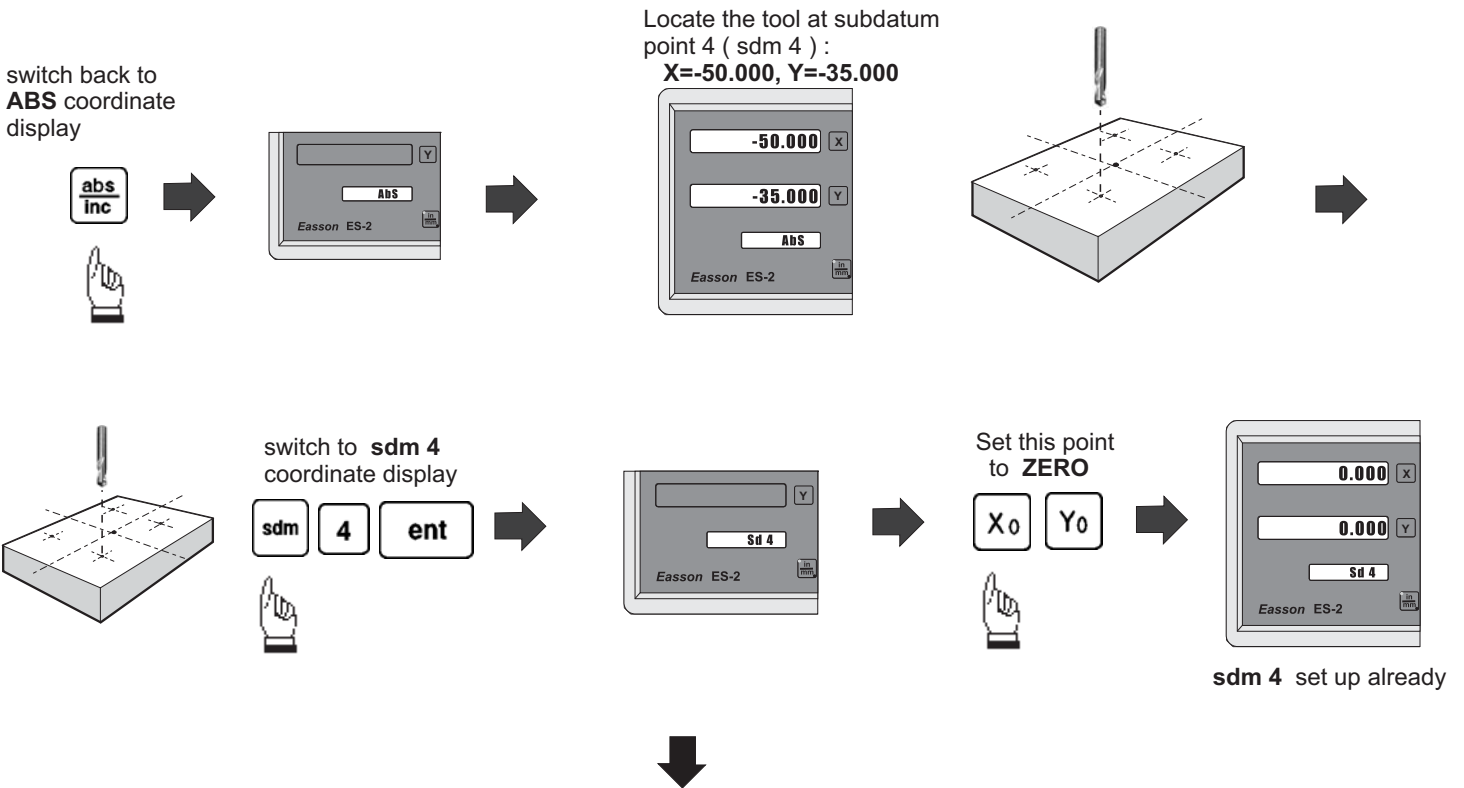
Step 4 : Set up the subdatum point 3 (sdm 3)



199 SubDatum function



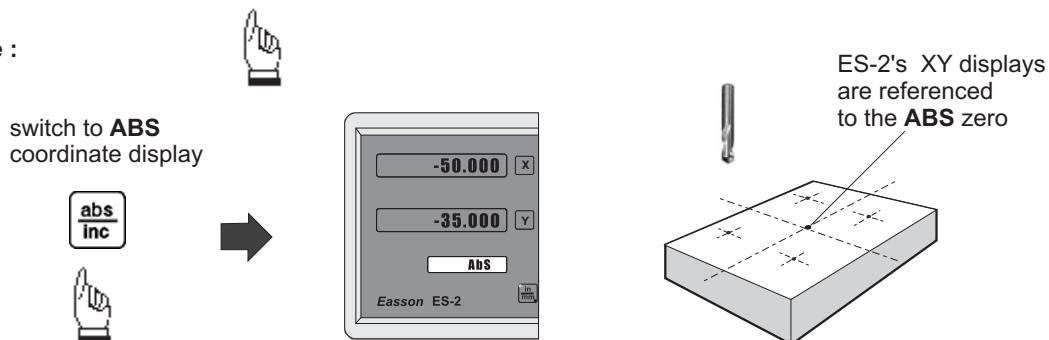
Step 5 : Set up the subdatum point 4 (sdm 4)



All the four subdatum points have already been set up

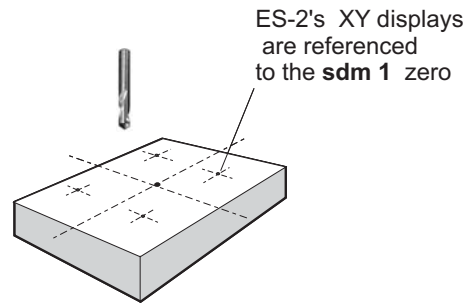
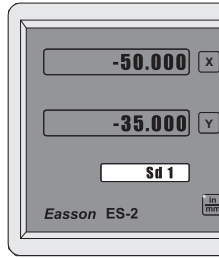
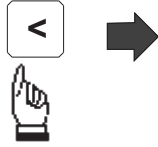
Operator can < or > to directly switch to the required subdatum (sdm) coordinate

Example :

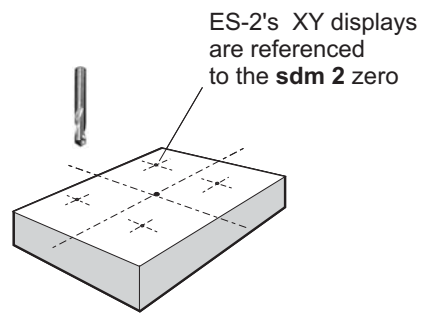
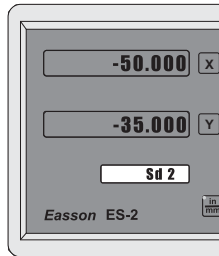
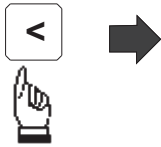


199 SubDatum function

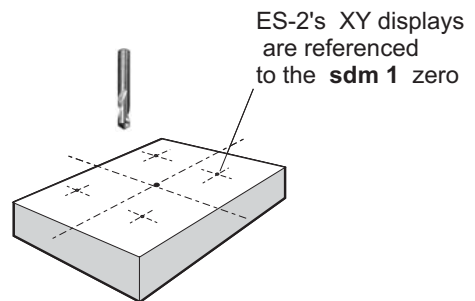
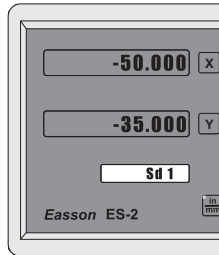
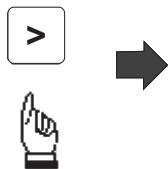
switch to next (up)
sdm coordinate display



switch to next (up)
sdm coordinate display



switch to previous (down)
sdm coordinate display



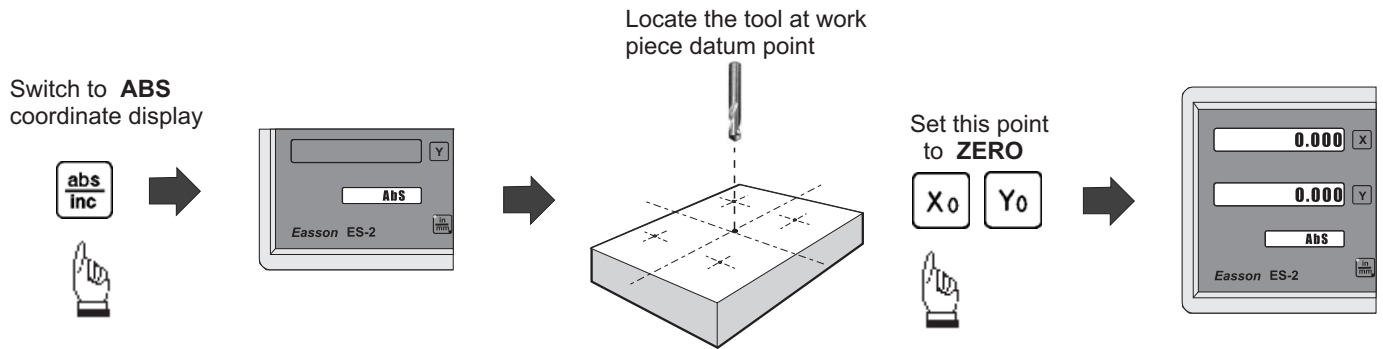
199 SubDatum function

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.

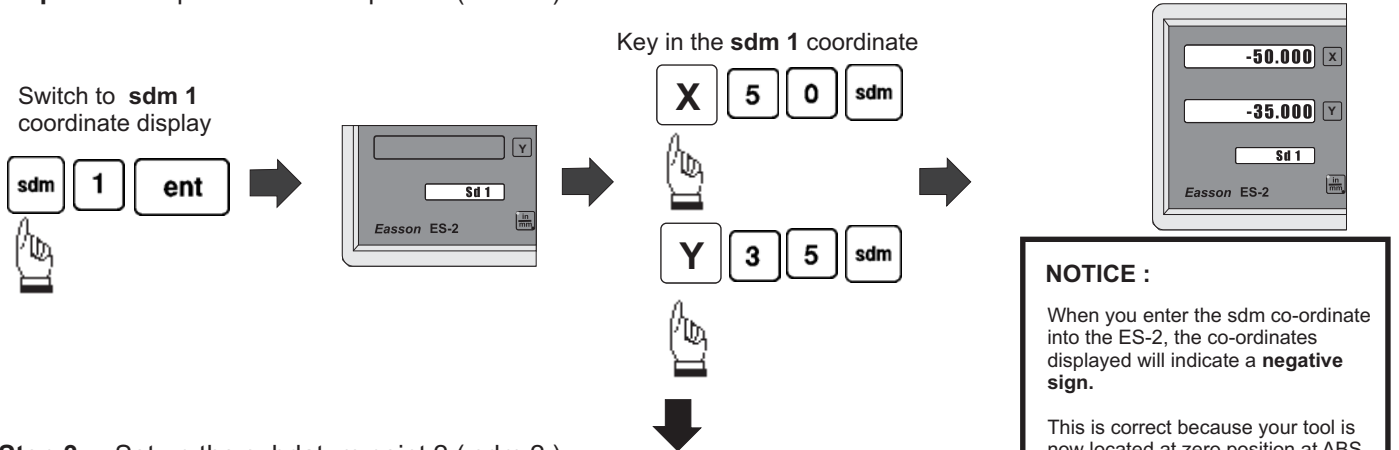
Mthod 2 : Direct keying in the of SdM zero position co-ordinate (co-ordinate relative to ABS zero)

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.

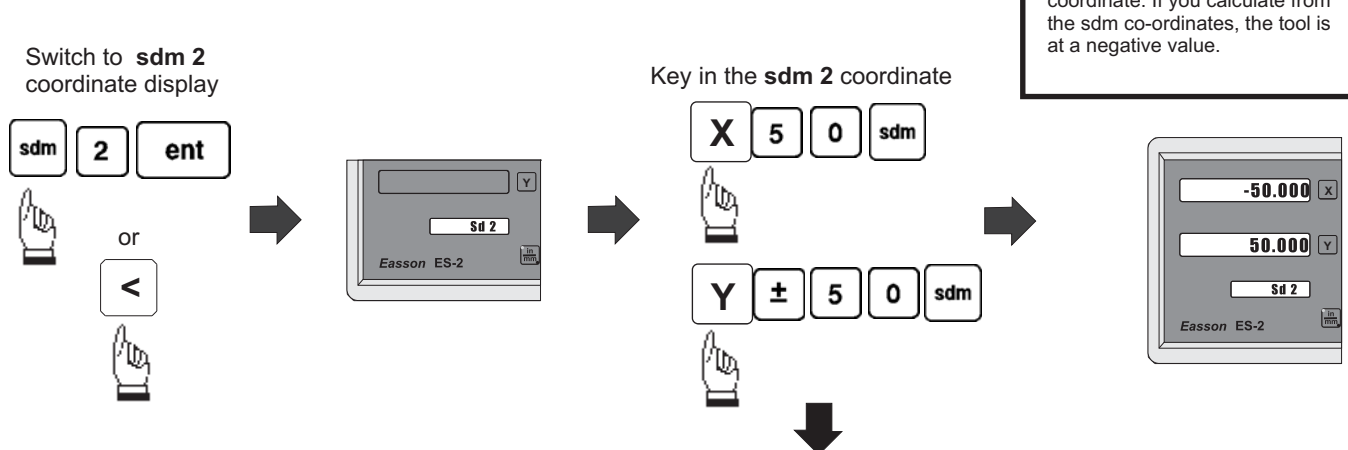
Step 1 : Set up the work piece datum in ABS coordinate



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



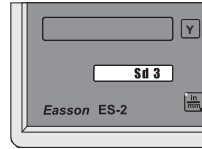
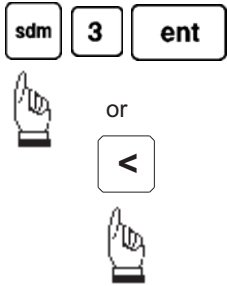
Step 3 : Set up the subdatum point 2 (sdm 2)



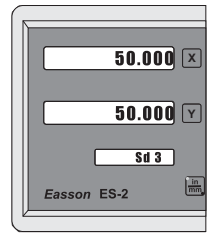
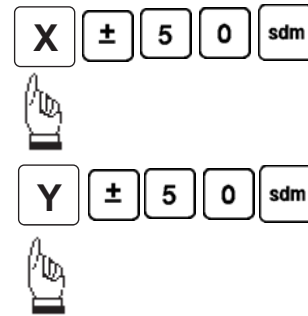
199 SubDatum function

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

Switch to **sdm 3** coordinate display

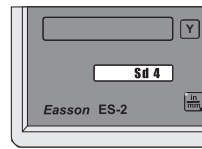
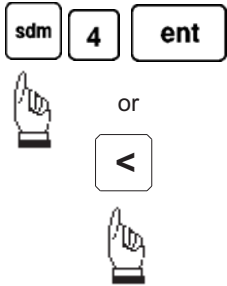


Key in the **sdm 3** coordinate

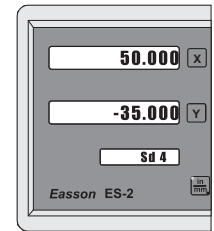
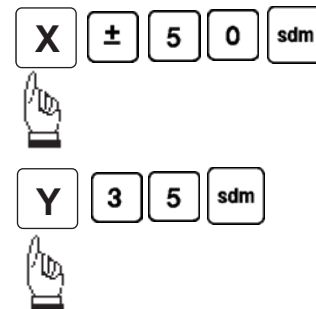


Step 5 : Set up the subdatum point 4 (sdm 4)


Switch to **sdm 4** coordinate display



Key in the **sdm 4** coordinate

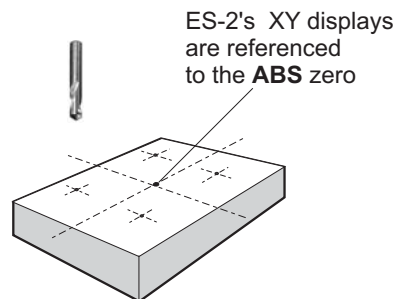
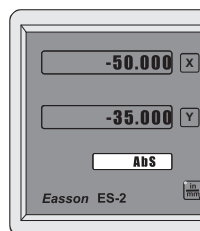


All the four subdatum points have already been set up

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

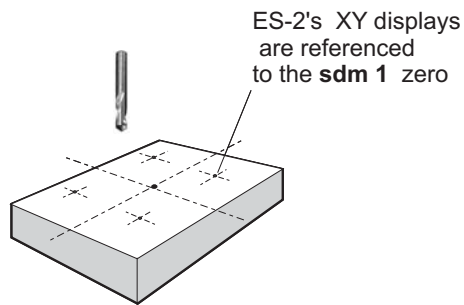
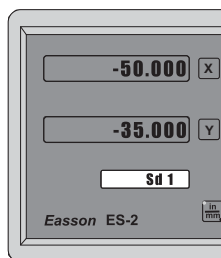
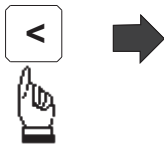
Example :

switch to **ABS** coordinate display

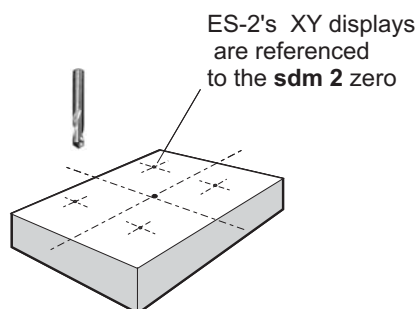
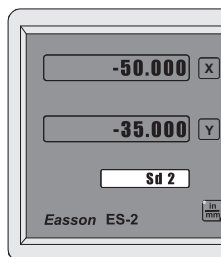
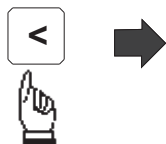


199 SubDatum function

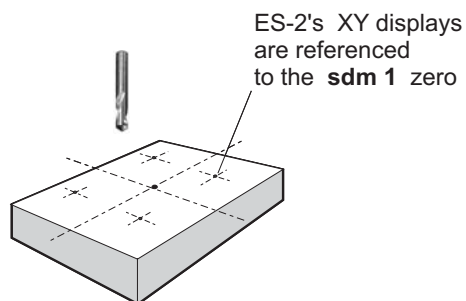
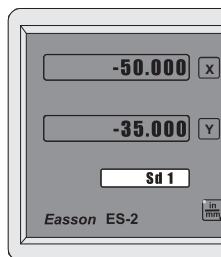
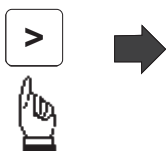
switch to next (**up**)
sdm coordinate display



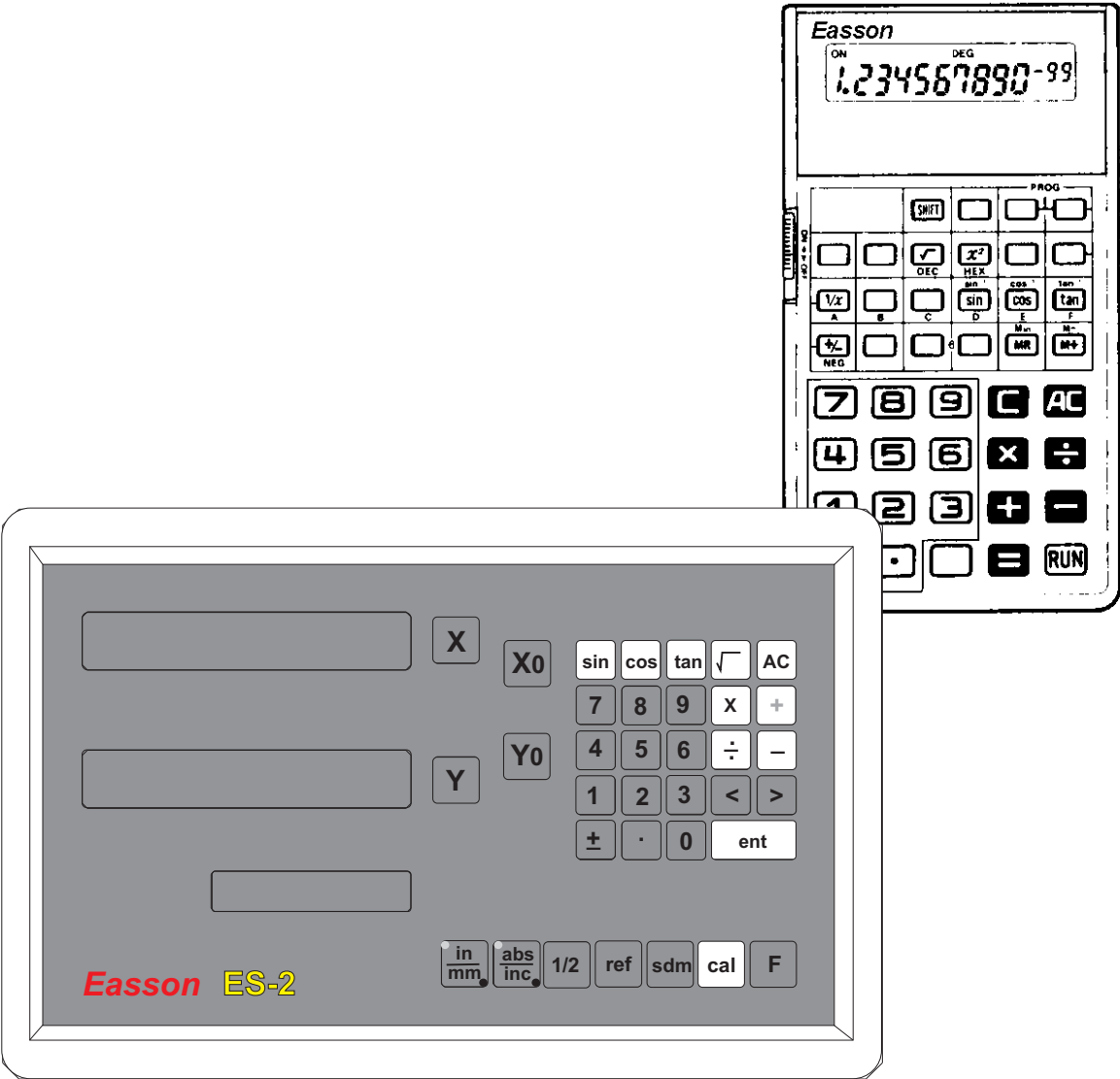
switch to next (**up**)
sdm coordinate display



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



Built-in Calculator



Built in Calculator

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

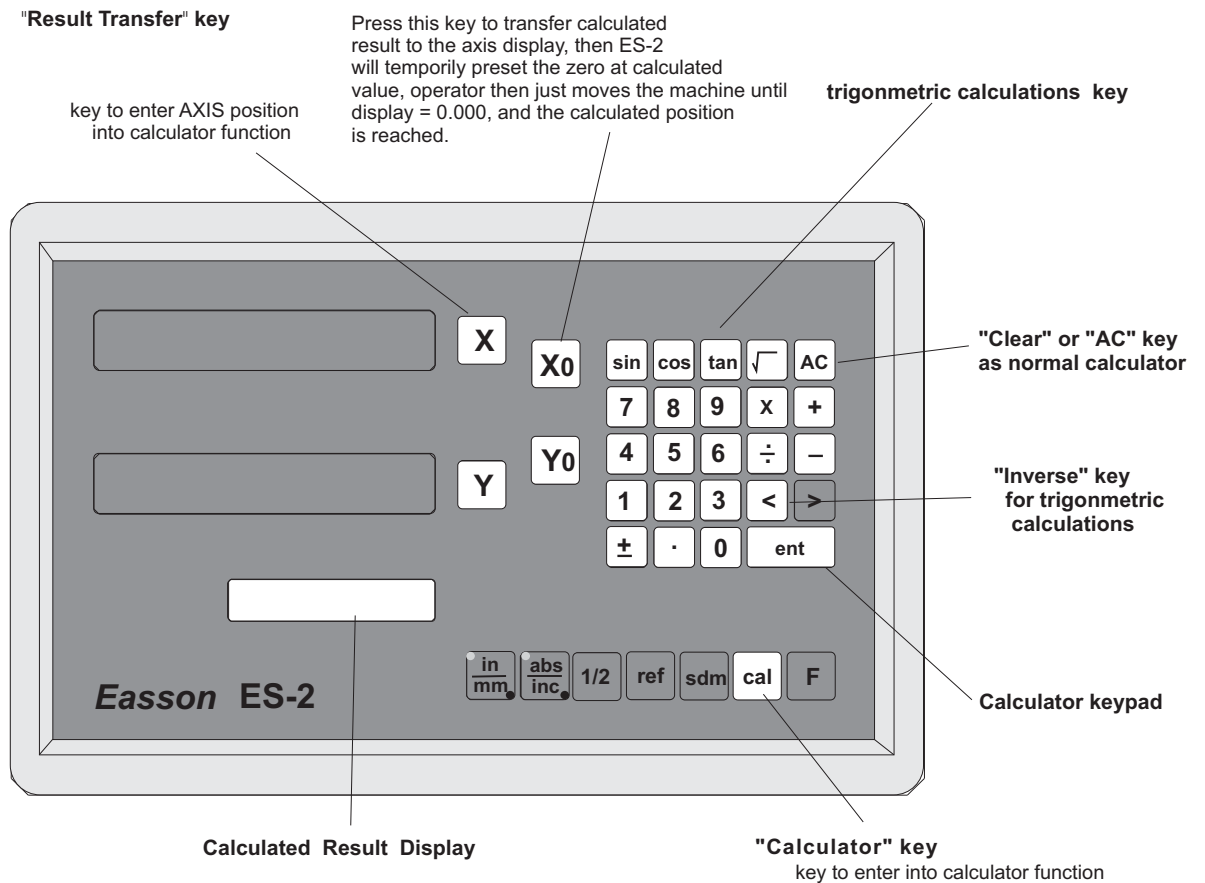
ES-2 is the first DRO that has a built-in calculator

The built-in calculator of the ES-2 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 ES-2 is "**Result Transfer**", in that all calculated results from the calculator of ES-2 can be "transferred" to any axis to enable you to position the tool. After the result has been transferred to an axis, the ES-2 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.



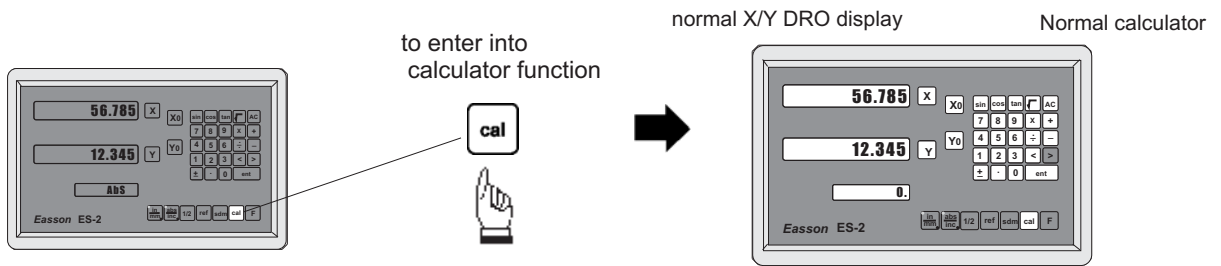
Key layout of the built-in calculator

Built in Calculator

Example :

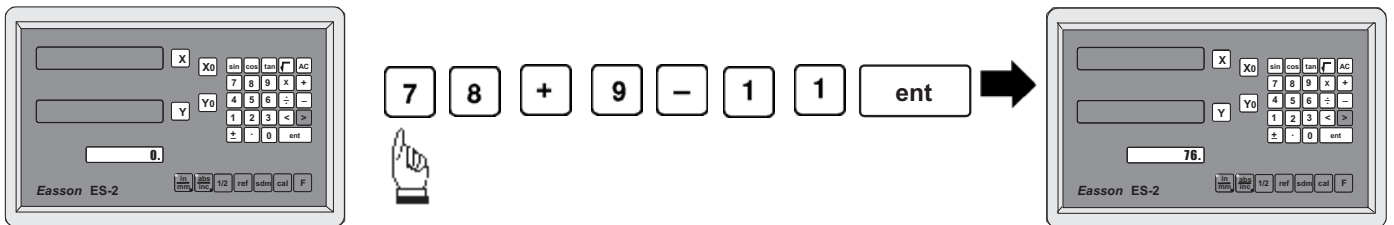
Working principle of ES-2's calculator function

when the ES-2 is put in calculator mode, the operation of ES-2 actually divided into two parts as follows

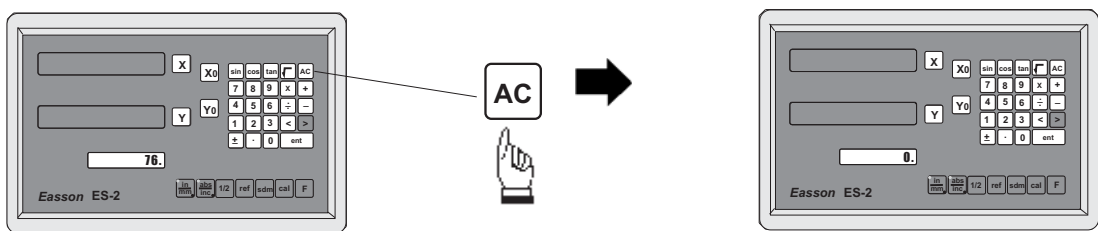


The operations of ES-2's built-in calculator is the same as other ordinary calculators

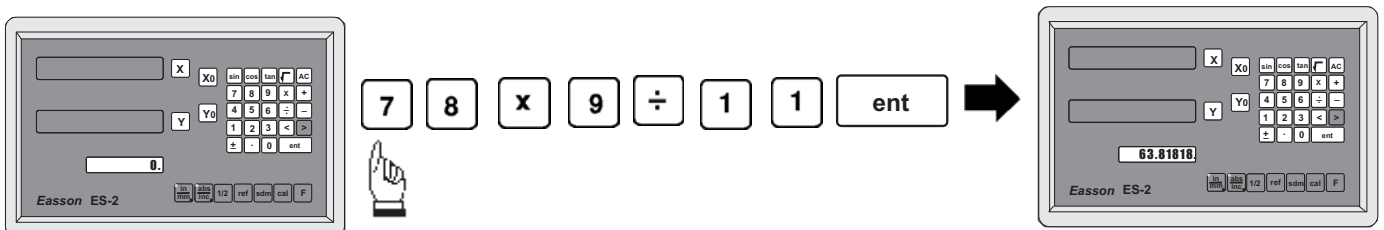
i.e. Basic mathematics - **add ; subtract** : $78 + 9 - 11 = 76$



Clear - Restart the calculation

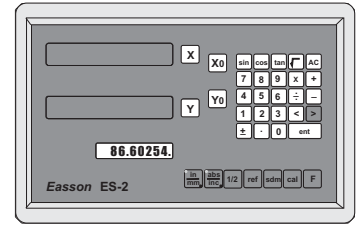
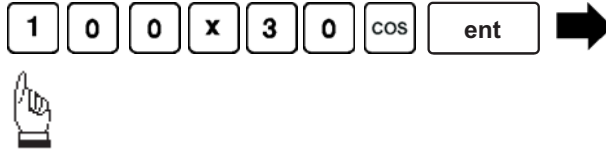
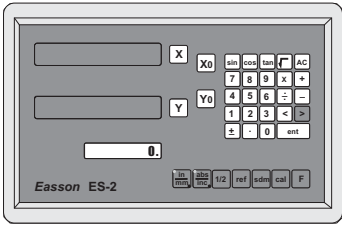


i.e. Basic mathematics - **multiply, division** : $78 \times 9 / 11 = 63.81818$

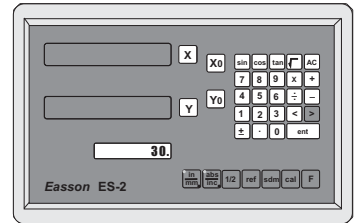
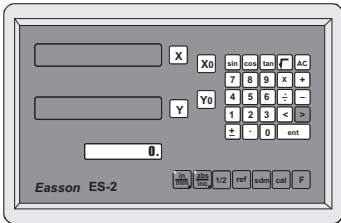


Built-in Calculator

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

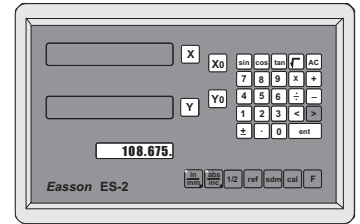
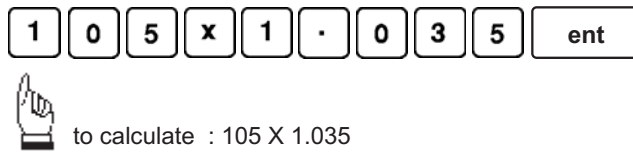
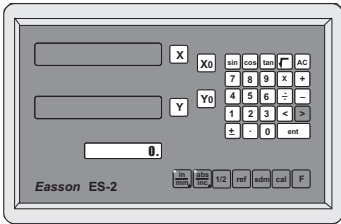


i.e. Trigonometric calculation - **inverse SIN** : $\sin^{-1} 0.5 = 30^\circ$



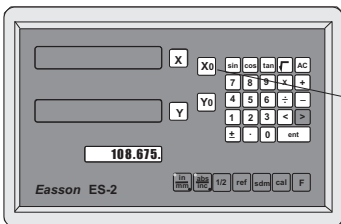
Result Transfer

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

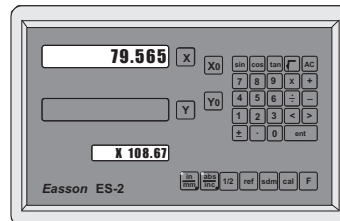


transfer the calculated result : 108.675 onto the X axis for tool positioning

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

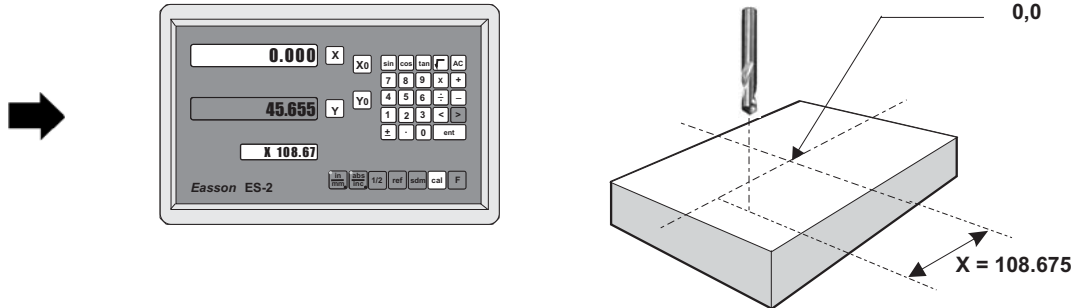


to transfer calculated result to X axis

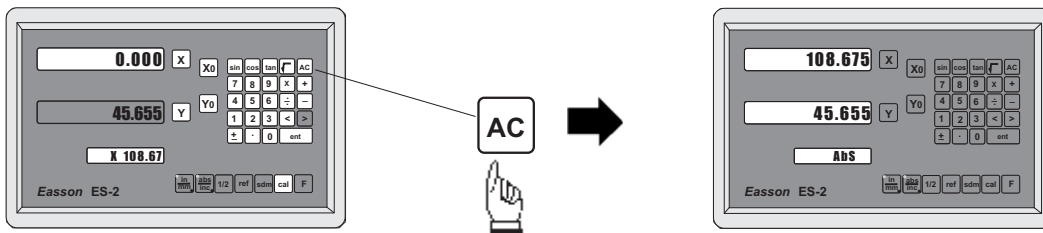
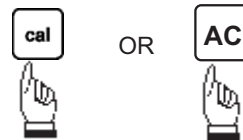


Built-in Calculator

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



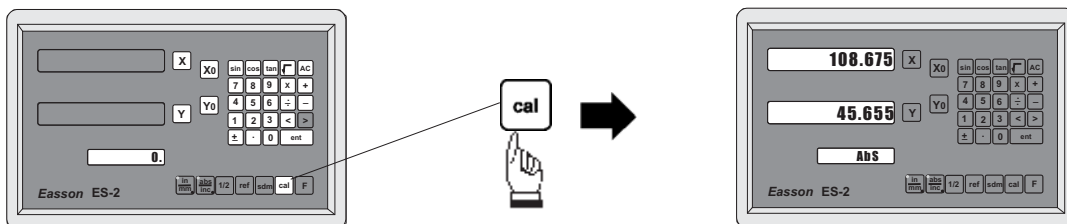
The tool is now at the position of the calculated result
(X = 108.675 in the above example)
To get back to normal coordinate display to continue
the machining



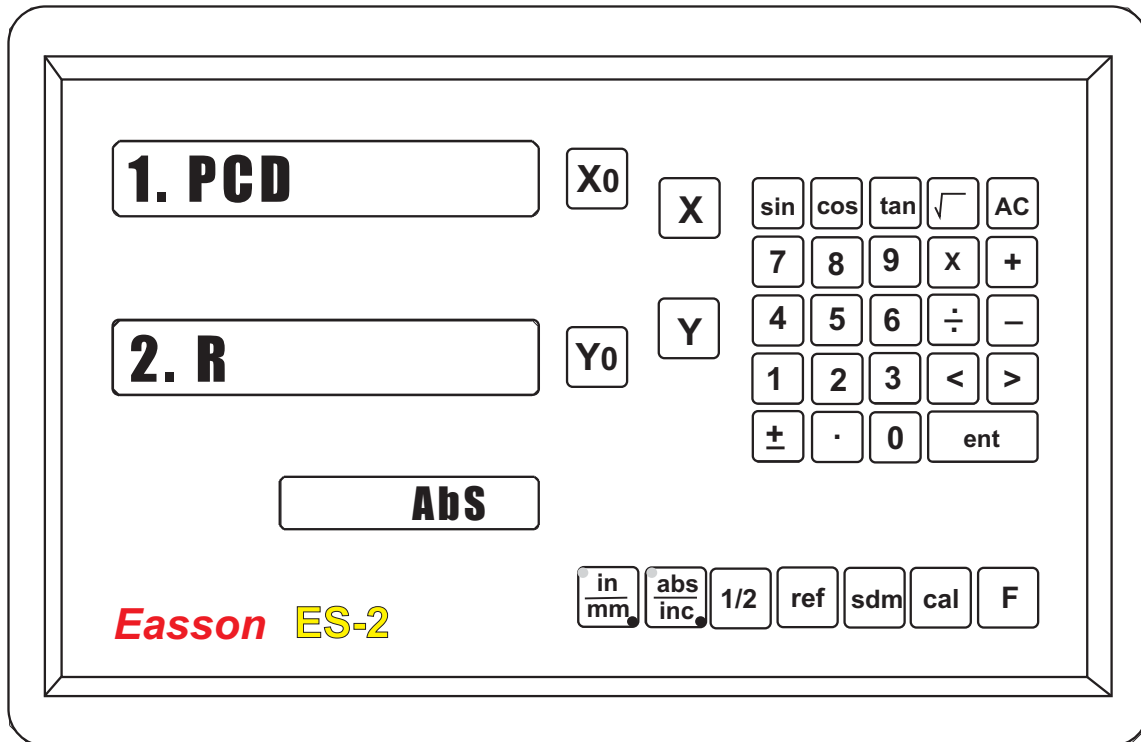
When you are in calculator mode, you can



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



F Functions



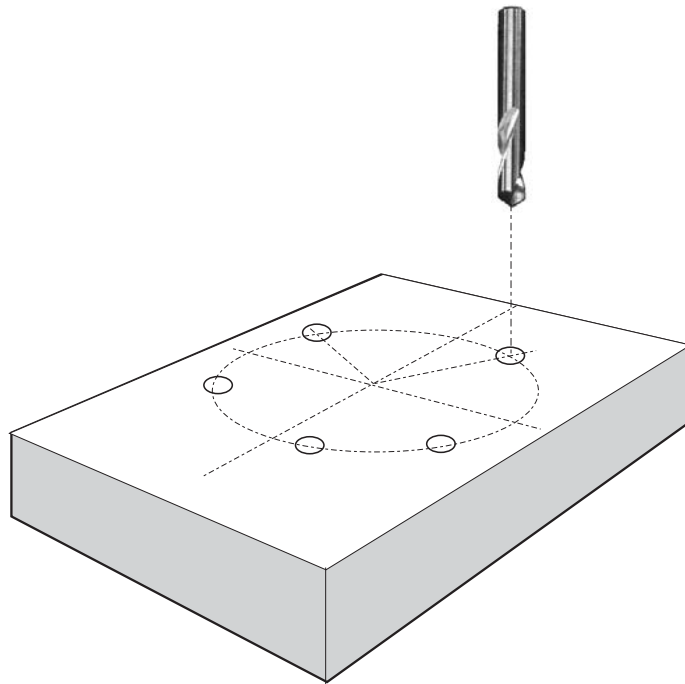
Directions:

1. The button F of ES-2 DRO provides the functions of PCD and Simplified R.
2. When you press the button F ,the window X will show " 1.PCD " ,and window Y will show " 2 R " .
3. Then you can press the button "1"into the function of PCD ,and the Button"2" into that of R.

Reference:

Referring to P.31~ P.37,The operation of PCD
 Referring to P.39 ~ P.56,The operation of Simplified R.

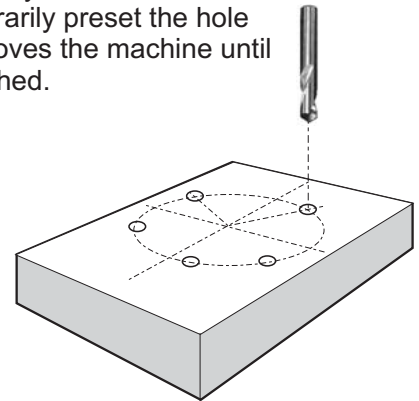
PCD - Tool positioning for Pitch Circle Diameter



PCD - Tool positioning for Pitch Circle Diameter

Function : ES-2 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 ES-2's message display,. The ES-2 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.

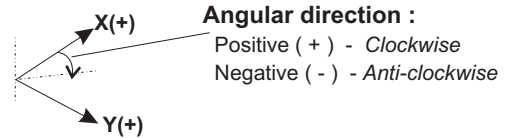
- Centre (**CENTRE**)
- Diameter (**DIA**)
- No. of Holes (**NO. HOLE**)
- Start Angle (**ST. ANG**)
- End Angle (**ENd. ANG**)



After the above machining parameters are entered into ES-1, it presets all the pitch hole positions to 0.000

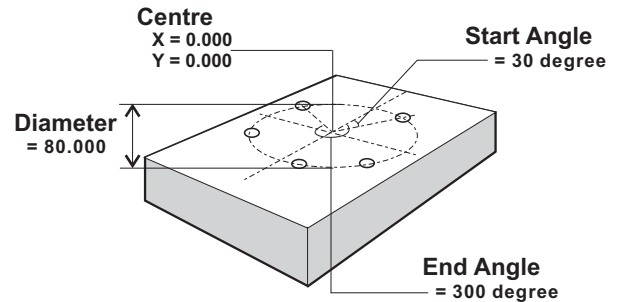
Operator can press **<** or **>** to select

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

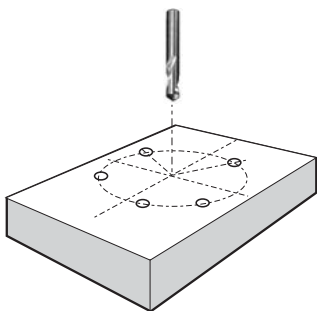


Example

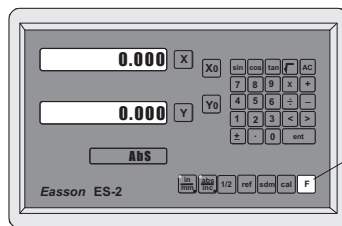
Centre Coordinate (**CENTRE**) **X= 0.000, Y=0.000**
 Diameter (**DIA**) **80.000mm**
 No. of Holes (**NO. HOLE**) **5 holes**
 Start Angle (**ST. ANG**) **30 degree** (clockwise)
 End Angle (**ENd. ANG**)..... **300 degree** (clockwise)



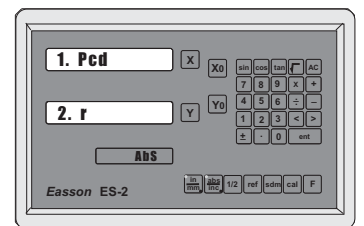
step 1 : Set up the work piece datum (work piece zero) **F** **1** to enter the **PCD** function



set up work piece datum



Enter **F** into F function



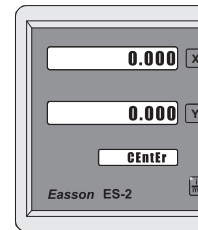
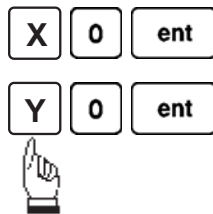
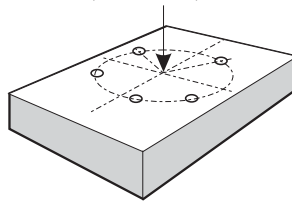
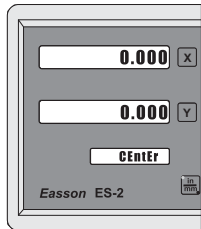
Enter **1** into PCD function

PCD - Tool positioning for Pitch Circle Diameter

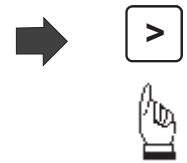
step 2 : Enter Centre Coordinate (CENTRE)

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

enter Centre Coordinate (CENTRE)



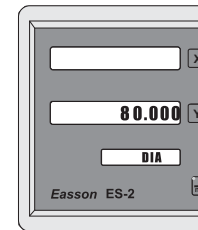
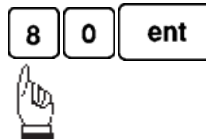
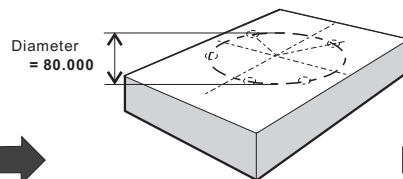
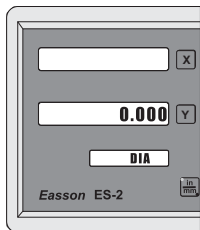
next step



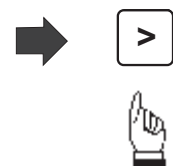
step 3 : Enter Diameter (DIA)

Diameter (DIA) = 80 mm

enter Diameter (DIA)



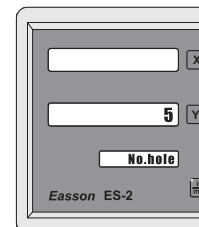
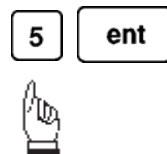
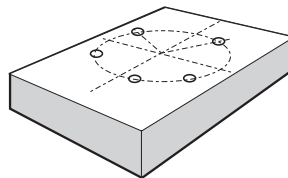
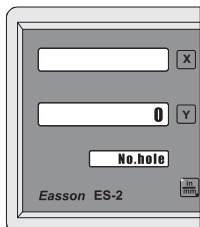
next step



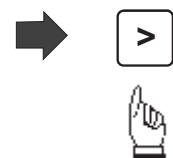
step 4 : Enter No. of Holes (NO. HOLE)

No. of Holes (NO. HOLE) = 5

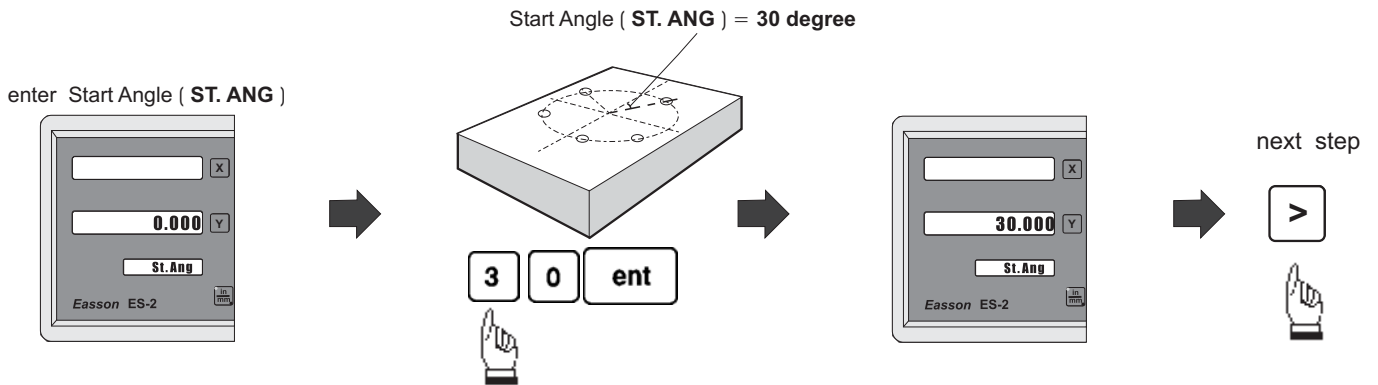
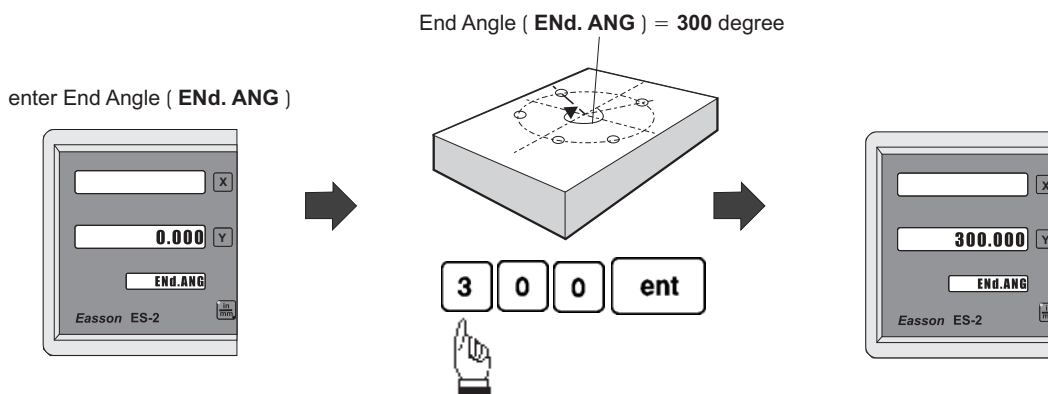
enter No. of Holes (NO. HOLE)





next step



PCD - Tool positioning for Pitch Circle Diameter

step 5 : Enter the Start Angle (ST. ANG)**step 6 : Enter the End Angle (ENd. ANG)**

All PCD machining parameters are already entered into ES-2  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

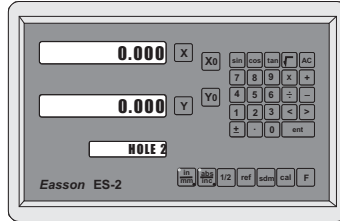


PCD - Tool positioning for Pitch Circle Diameter

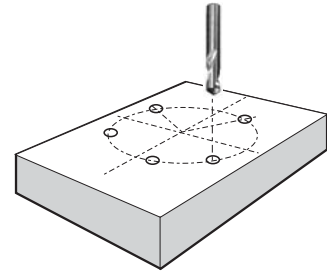
Next Pitch hole



move the machine to display = 0.000



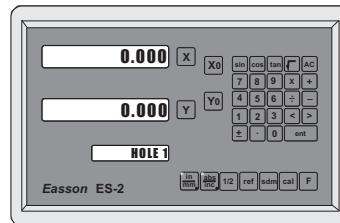
HOLE 2 = pitch hole no. 2



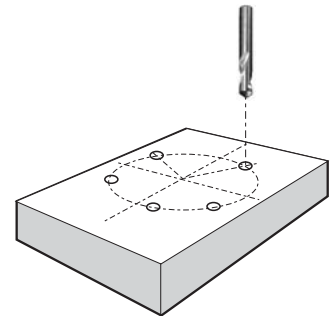
Last Pitch hole



move the machine to display = 0.000

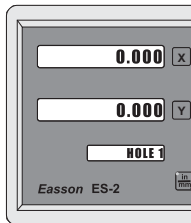


HOLE 1 = pitch hole no. 1



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

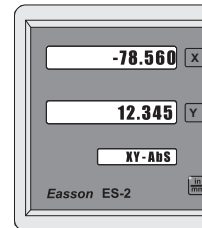
presently in **PCD** cycle



temporarily **swap** to normal XY coordinate display

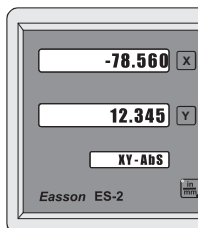


temporarily return to XY coordinate display



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

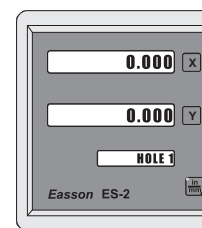
presently in the temporarily XYZ coordinate display



swap back to **PCD** function cycle



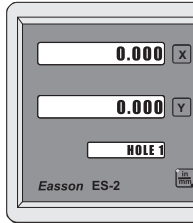
return to **PCD** function cycle



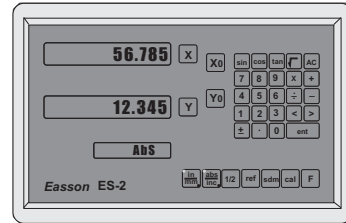
PCD - Tool positioning for Pitch Circle Diameter

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

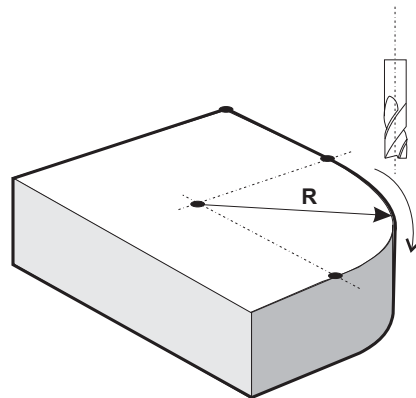
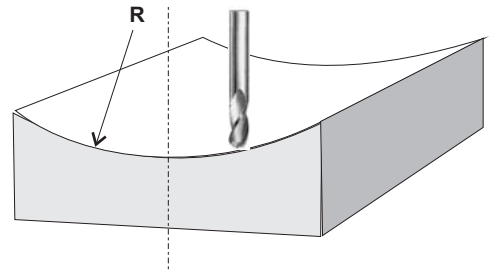
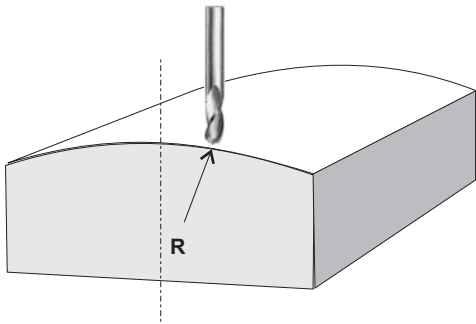
presently in **PCD** function cycle



returns to normal
XY coordinate display



Simplified R function

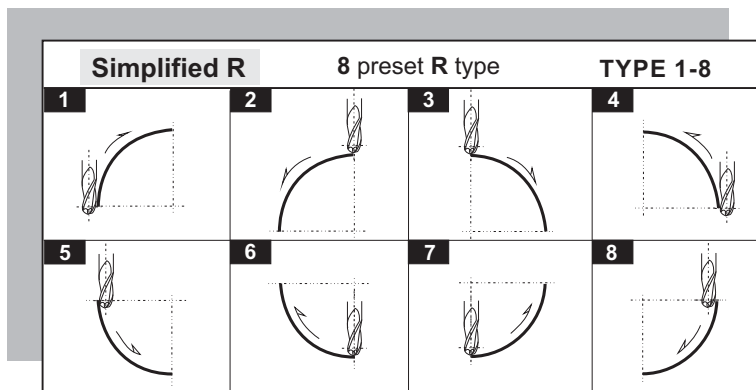


Simplified R function

function : The R function of ES-2 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 ES-2 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 ES-2 provides a very easy-to-use R function to enable the operator to machine simple R in a very short time.

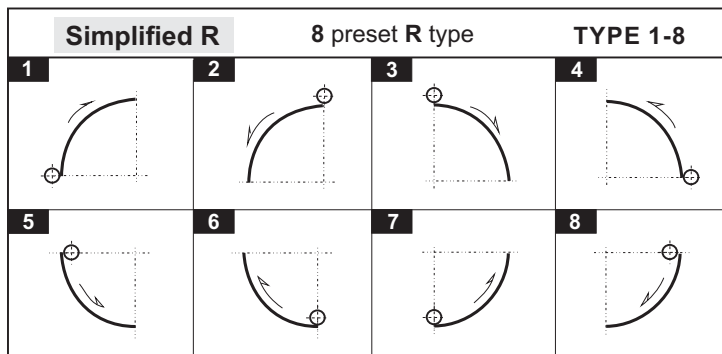
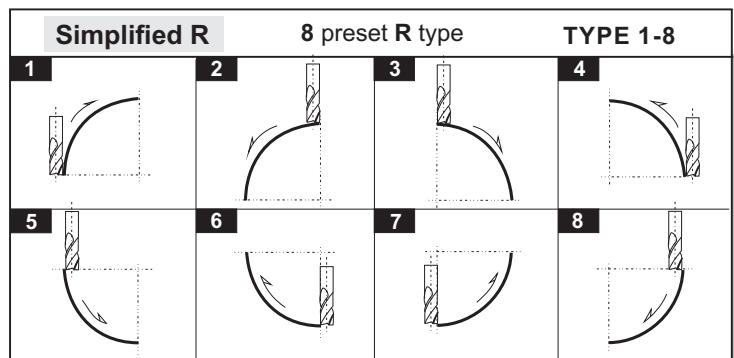
In majority of cases, only eight types of ARC are used for machining. The ES-2 has therefore incorporated those 8 type of R, and the operator must just select the type of R they need to machine their part, and input the Radius, tool compensation and increment per machining step. Then they can immediately 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

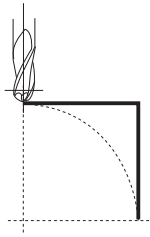


Using two Flute(SLOT DRILL) for XY plane R

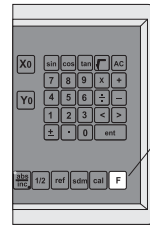
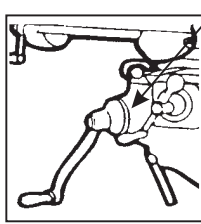
Simplified R function

The operation procedures of Simplified R are as follows

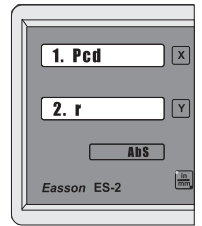
positions the tool at the ARC starting point



set the Z dial to zero



Enter **F** into F function

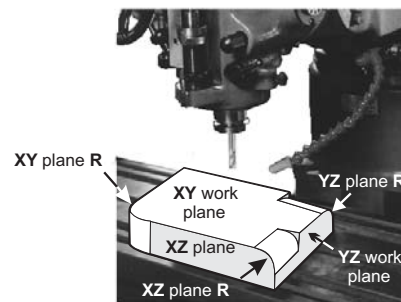


Enter **2** into

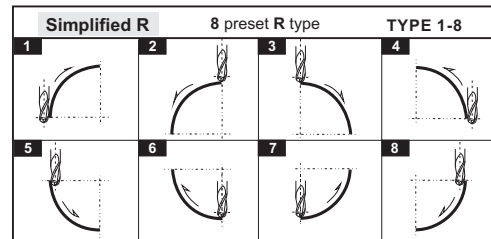
Simplified R function

Following parameters needed to enter into ES-2 for ARC machining :

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

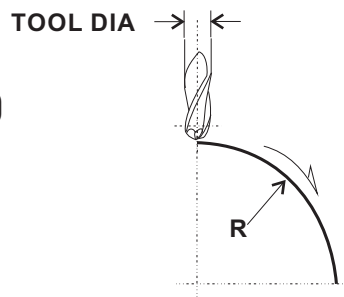


2. Select the R type (**R TYPE**) - Type 1 to 8



3. Radius (**R**)

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



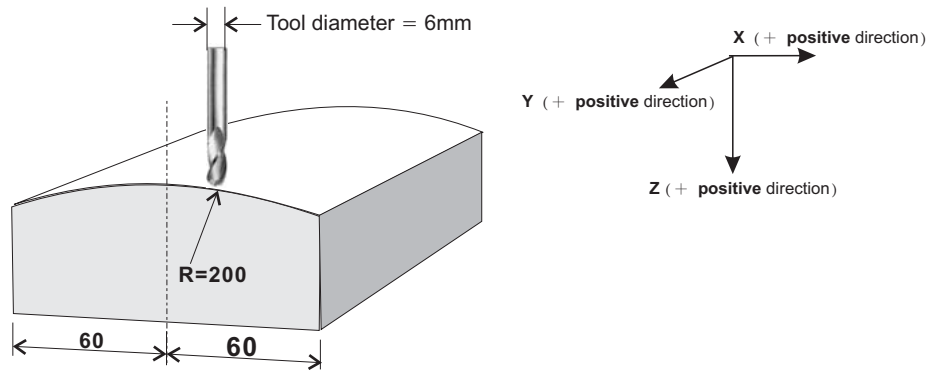
5. Machining step Increment

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>MAX CUT = 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>Z STEP = fixed increment per step</p>	<p>For XZ/YZ plane R, under smooth R option selected. ES-1 will calculate the Z step increment so that the Max. distance between each machining point approximately the same.</p> <p>MAX CUT = max. distance between interpolated points.</p>

Simplified R function

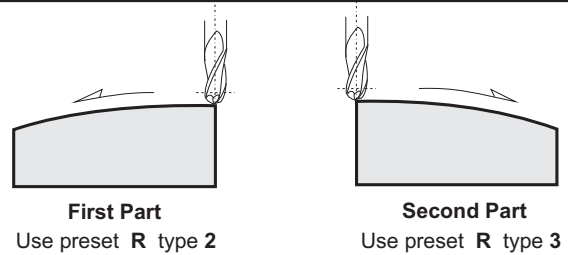
Example :

To machine the copper electrode as shown which has an ARCoF $R = 200$ mm using a Two Axis ES-2

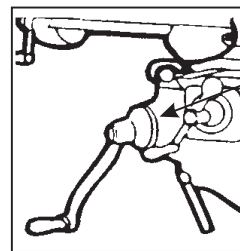
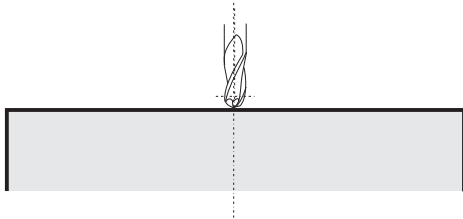


Operation procedures

Because ES-2'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.

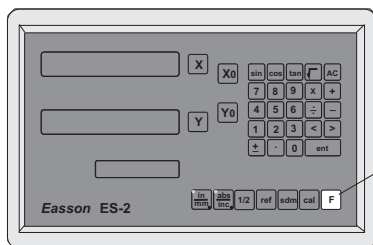


position the tool at the ARC starting point (surface of the work piece centre in this case)

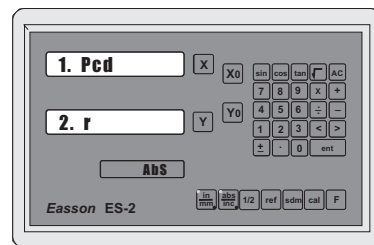


set the Z dial to zero

Step 1: Simple Radius function



enter **F** into function Select

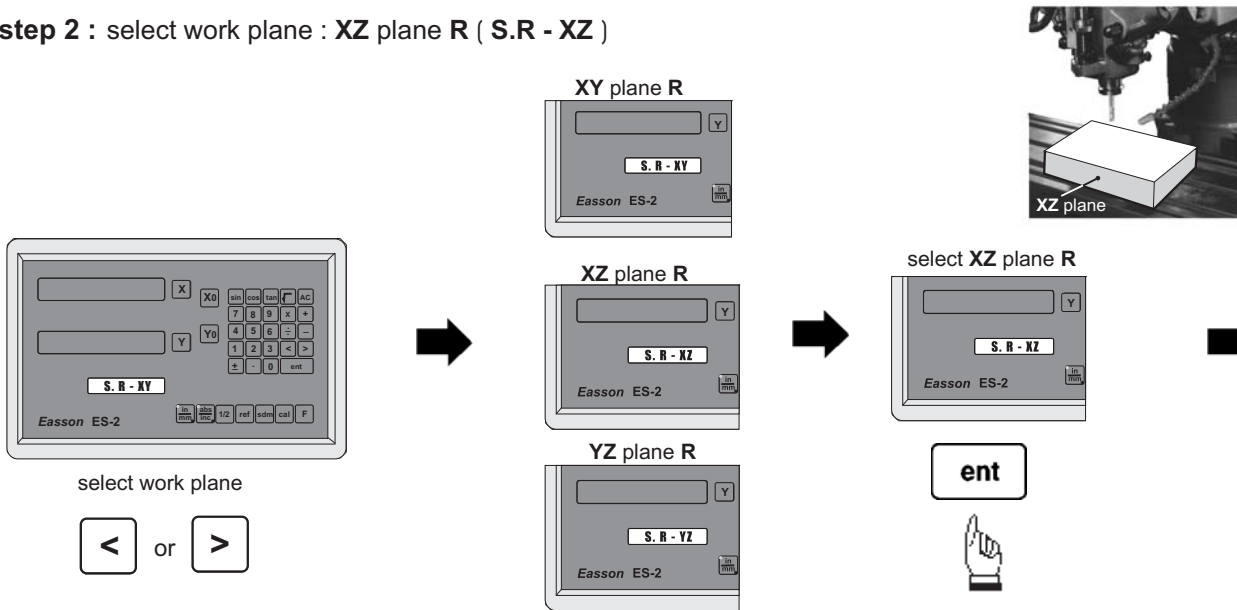


enter **2** into R(Radius) function

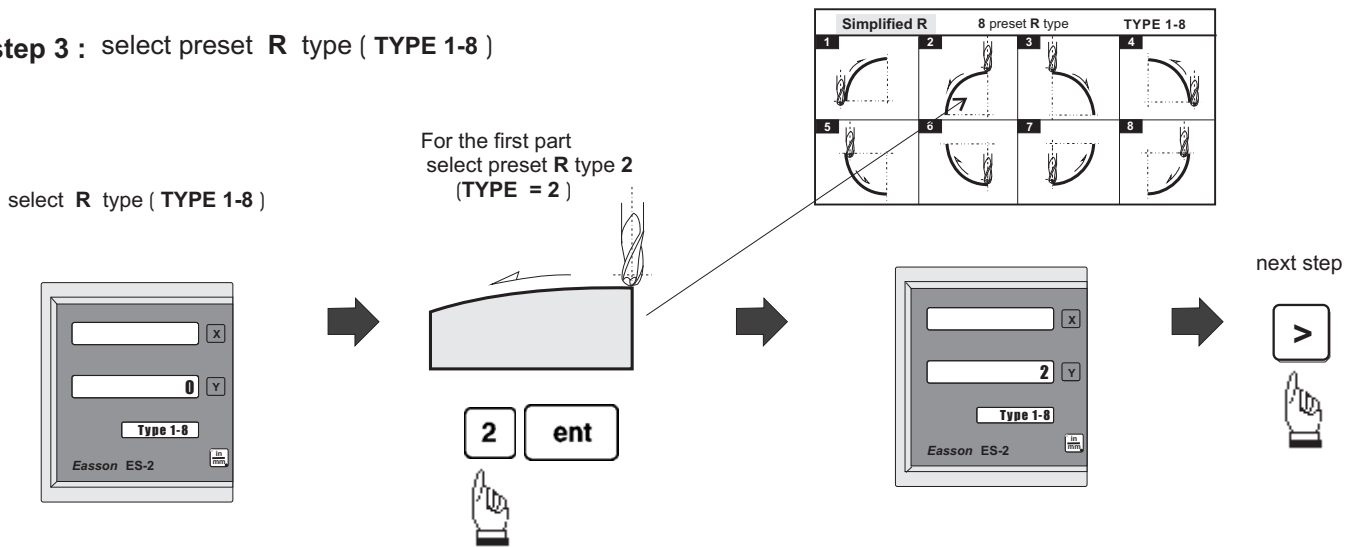


Simplified R function

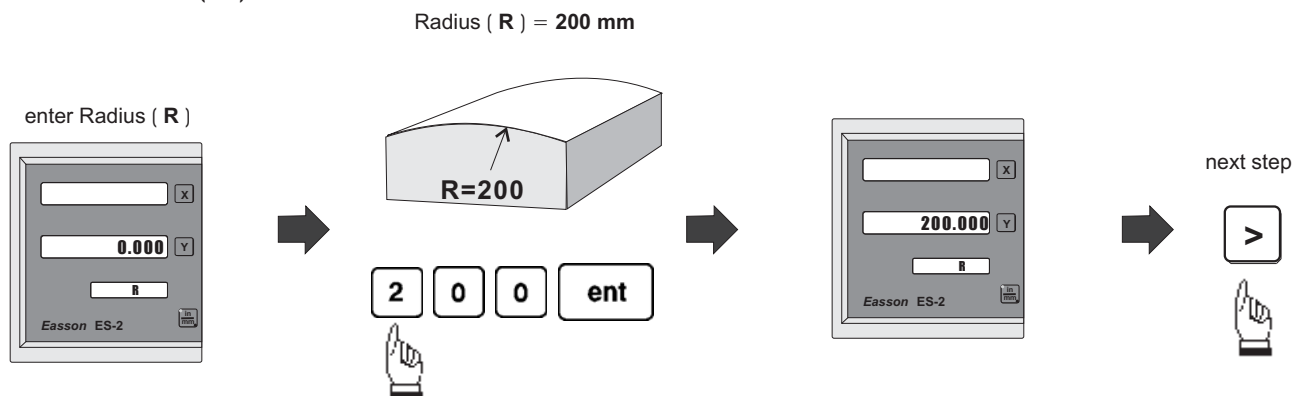
step 2 : select work plane : XZ plane R (S.R - XZ)



step 3 : select preset R type (TYPE 1-8)



Step 4 : Enter Radius (R)

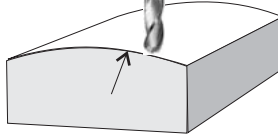
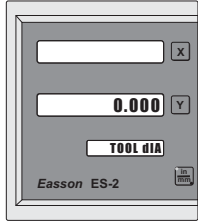


Simplified R function

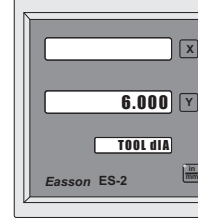
step 4 : enter Tool diameter (**TOOL DIA**)

← Tool diameter = 6mm

enter Tool diameter (**TOOL DIA**)



6 ent



next step



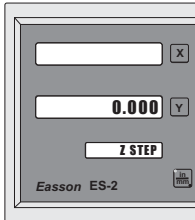
step 5 : enter Z increment per step machining

ES-1 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

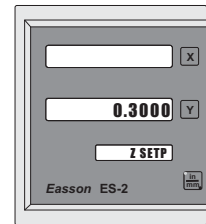
enter Z step increment (**Z STEP**)



Z Axis increment per step machining is fixed

Z STEP = 0.3 mm

. 3 ent



All simplified R function machining parameters have already entered into ES-2

to enter into ARC machining mode

The two Axis **ES-2** does not have a Z Axis, so the **ES-2** uses the



and



to simulate the Z axis movement



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





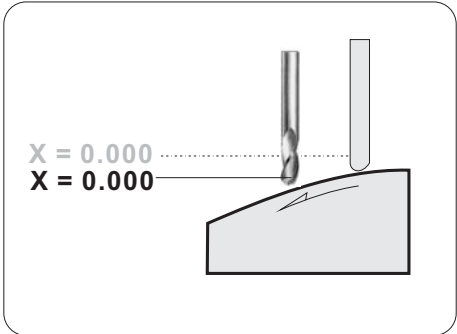
— simulate Z axis move **down** one step

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

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 ES-2, and, in order that the operator can easily guide and position the Z axis during the ARC machining, the ES-2 uses the unused axis display to display the **Z dial turn number** and **Z dial reading**.

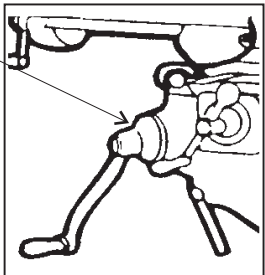
At the beginning of the ARC machining, the ES-2 will assume the Z axis dial at zero position with the tool positioned at the starting point of the ARC. Press the  and  once to simulate Z axis move up or down for one step - the corresponding Z dial turn number and Z dial reading will display on the unused 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

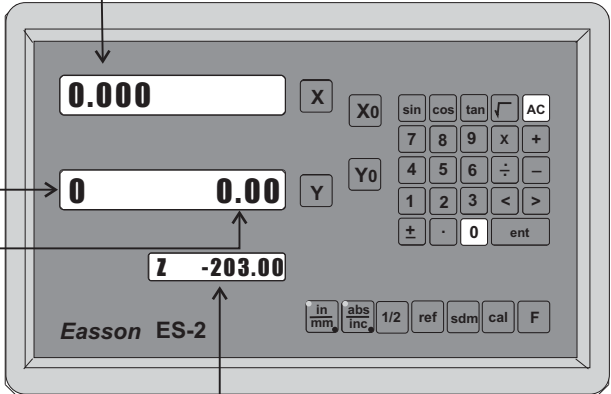
The display will **shift left** to signify it is not normal co-ordinate display.

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



Z dial turn number

Z dial reading



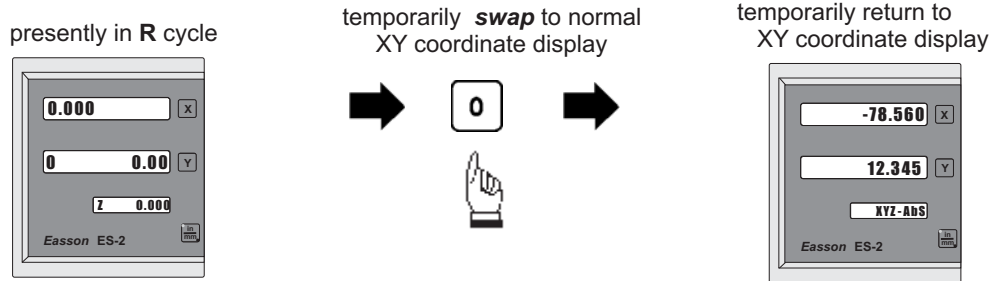
Z axis simulated height

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

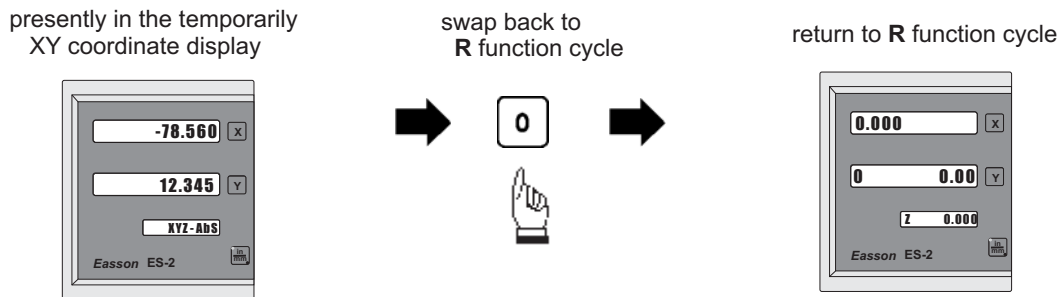
If the **Z** axis is positioned outside the **R** curvature, **ES-2** will display "**Z OU LI**" (**Z OUT LIMIT**)

Simplified R function

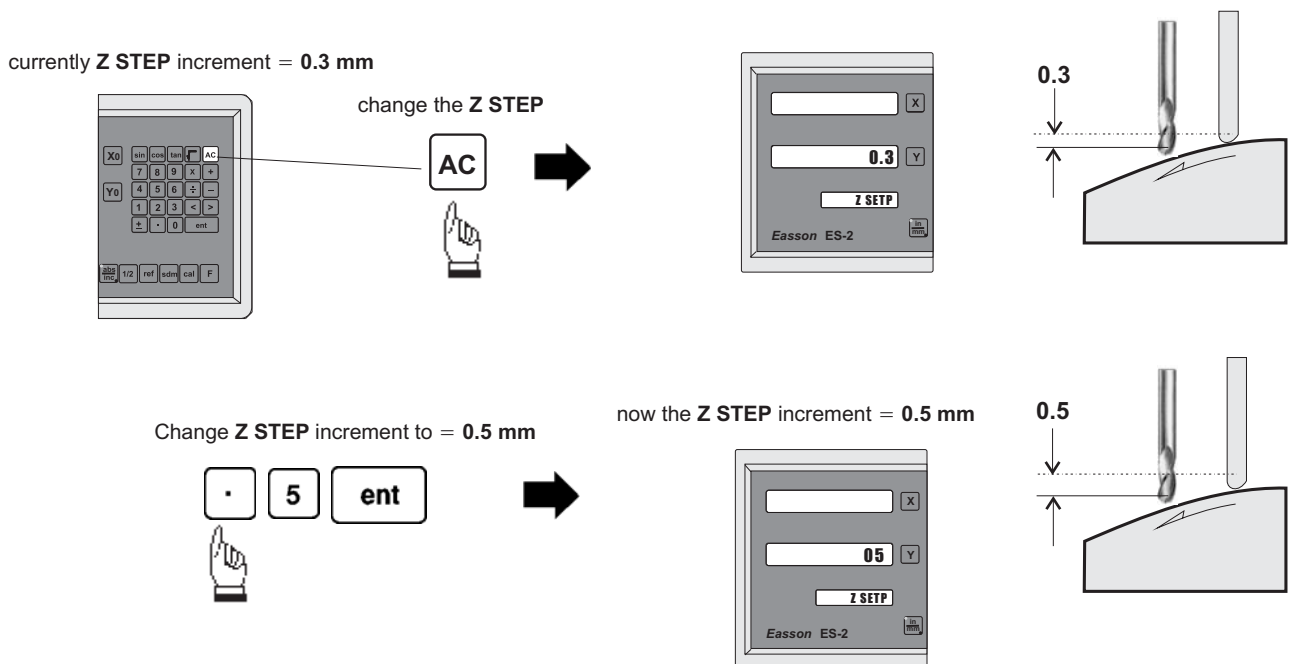
If the operator wants to verify if ES-2's **Simplified R** calculation is correct, or wants to temporarily exit the **R** function cycle (swap to normal XY display), The procedure is as follows :



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



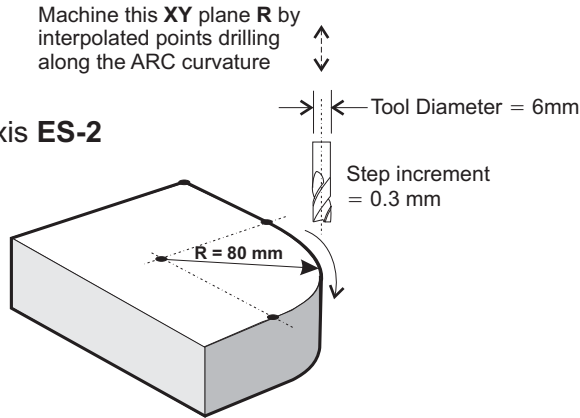
If fixed **Z STEP** option chosen, the **Z STEP** increment can be changed at any time during the ARC machining



Simplified R function

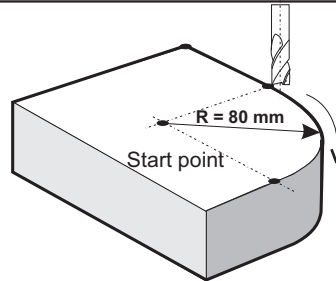
Example :

To machine an XY plane R using 2 Axis ES-2

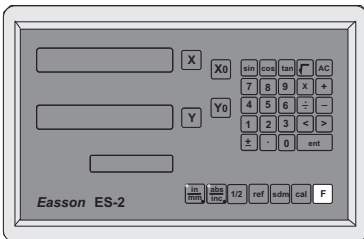


Operation procedures

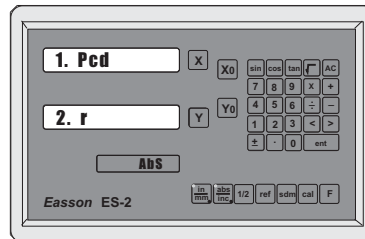
position the tool at the start point of the ARC



Step 1: Simple Radius function

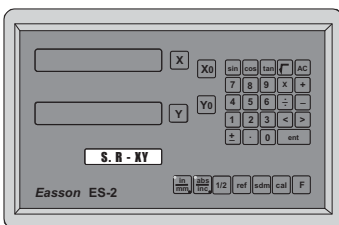


enter **F** into function Select

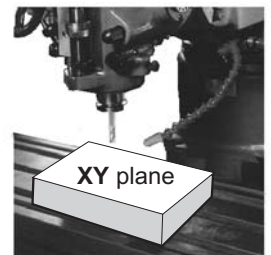
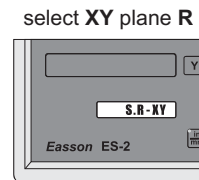
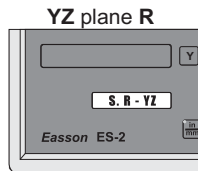
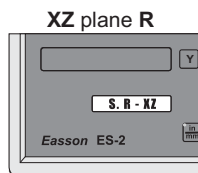
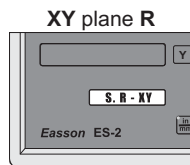
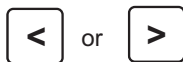


enter **2** into R(Radius) function

step 2 : select XY plane R (R. - XY)

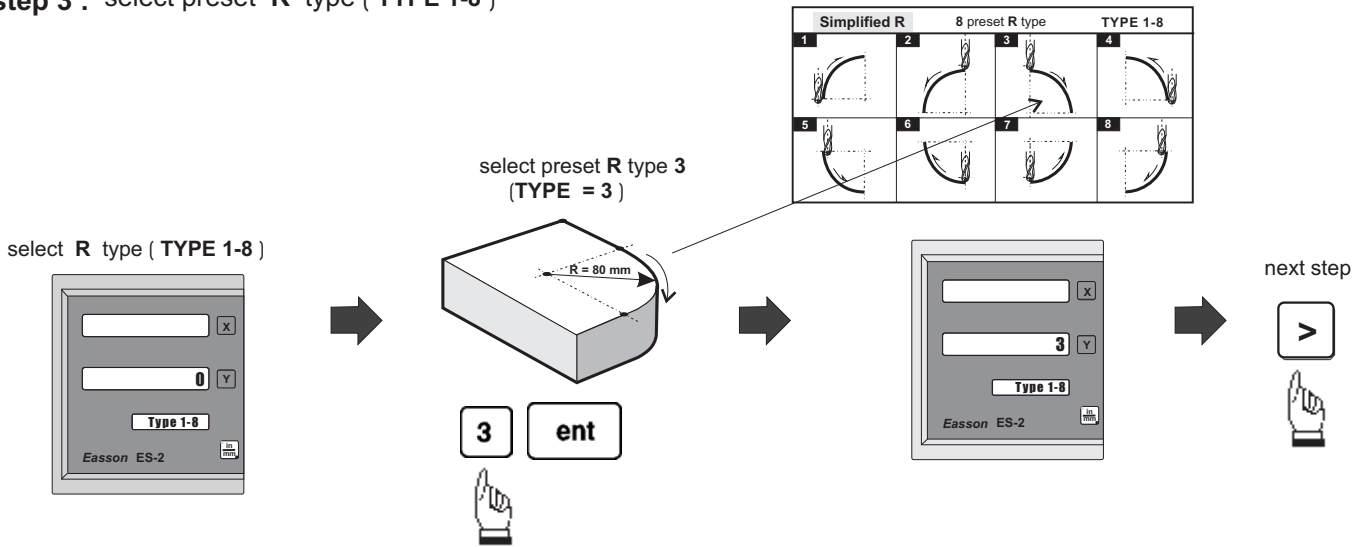


select work plane

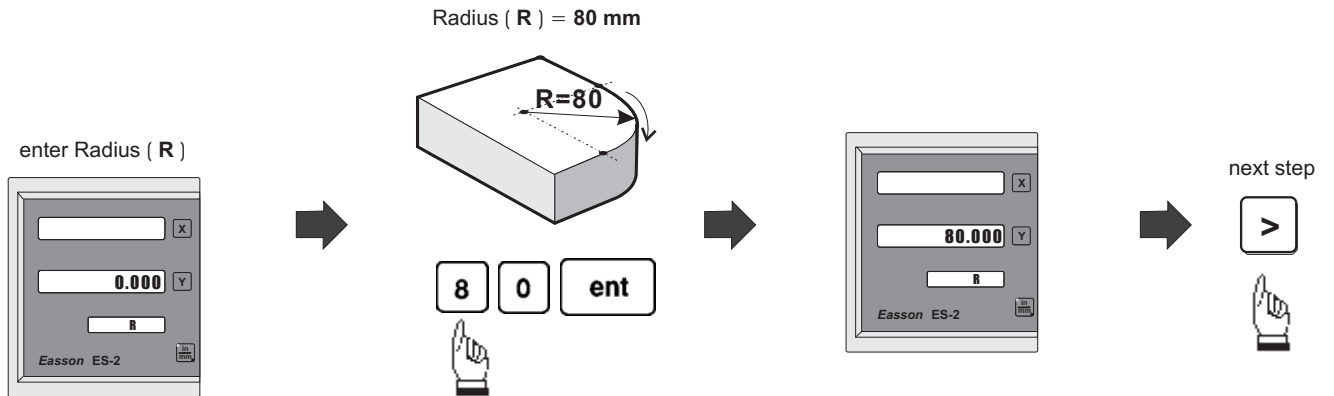


Simplified R function

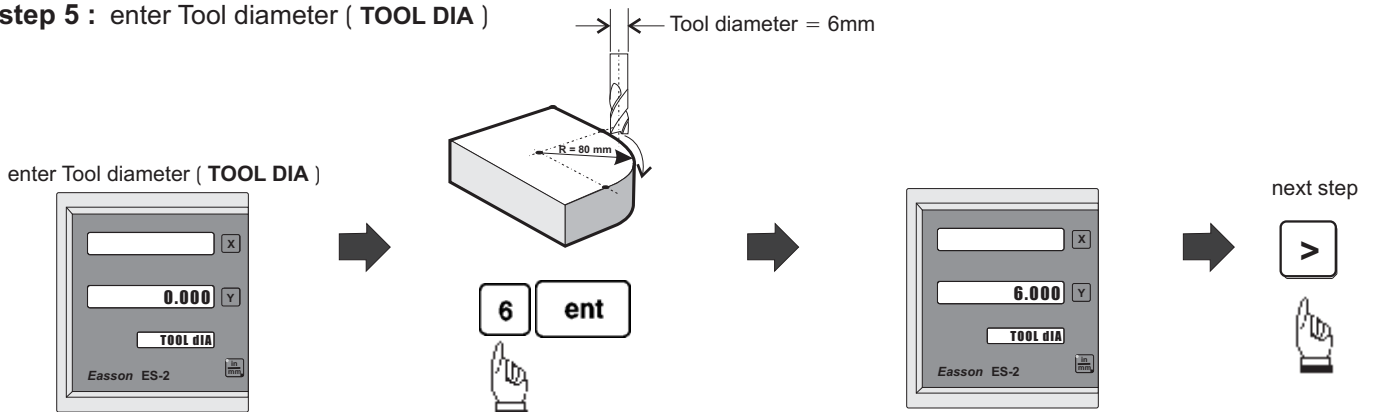
step 3 : select preset R type (TYPE 1-8)



step 4 : enter Radius (R)

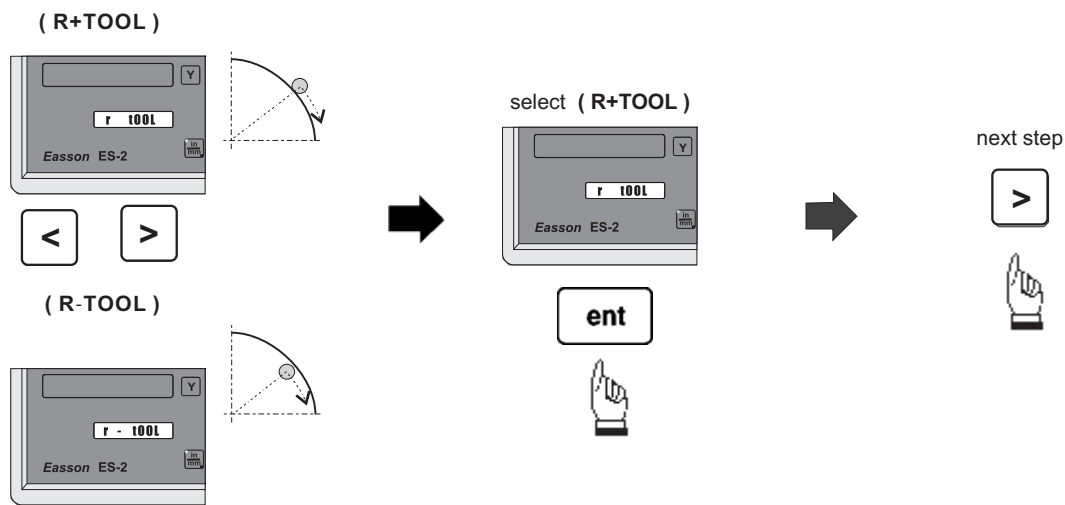


step 5 : enter Tool diameter (TOOL DIA)

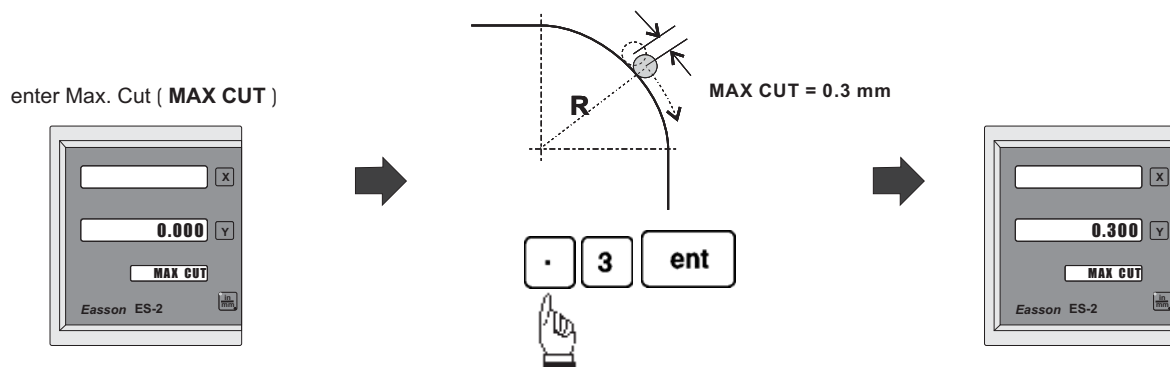


Simplified R function

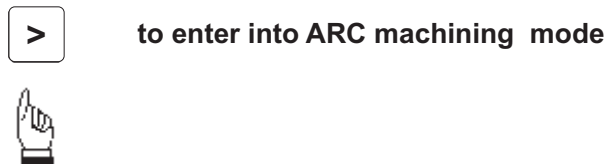
step 6 : select tool compensation direction



step 7 : enter Max. Cut between interpolated points (MAX CUT)



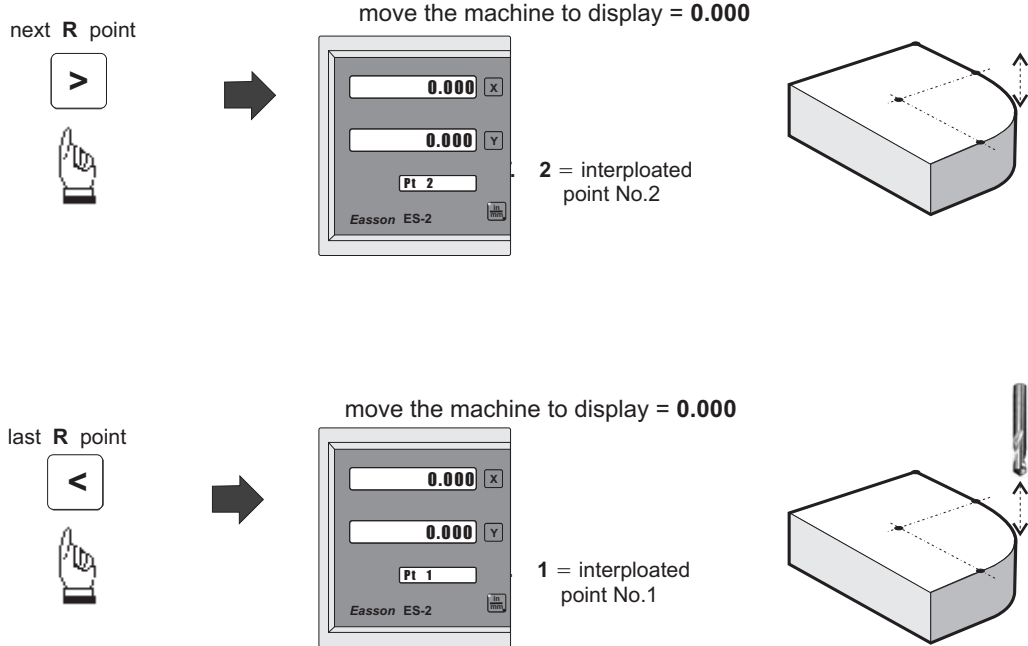
All simplified R function machining parameters have already entered into ES-2



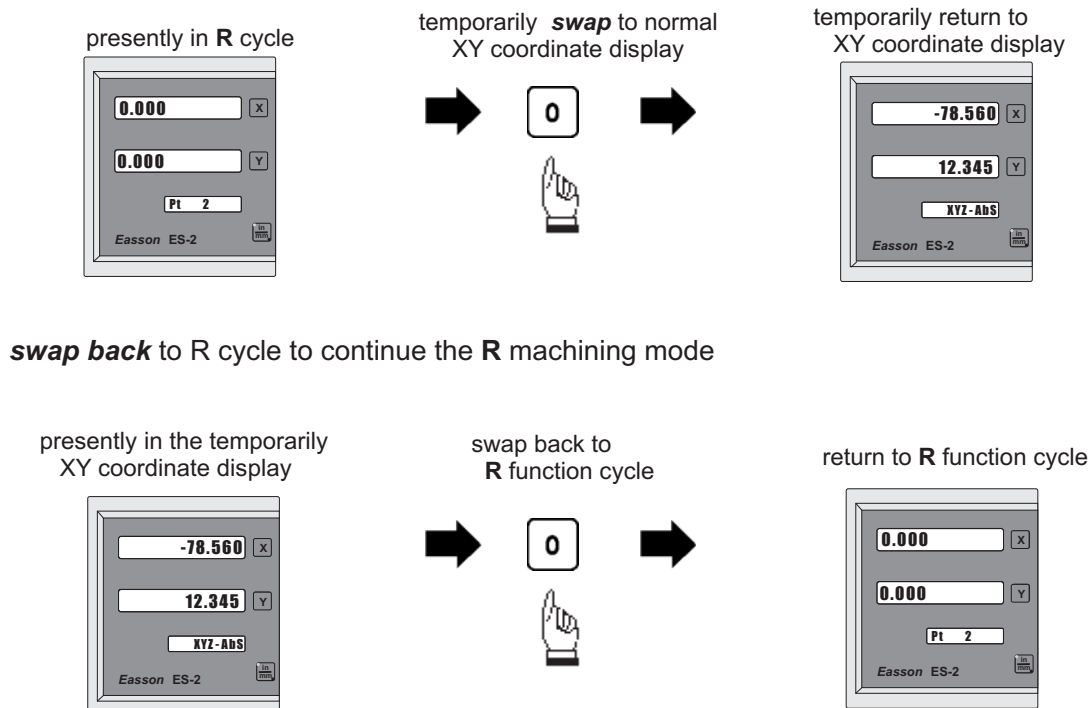
Operator can < or > to select the interpolated points along the ARC curvature, then move the machine to display = 0.000, then the ARC curvature position is reached.



Simplified R function



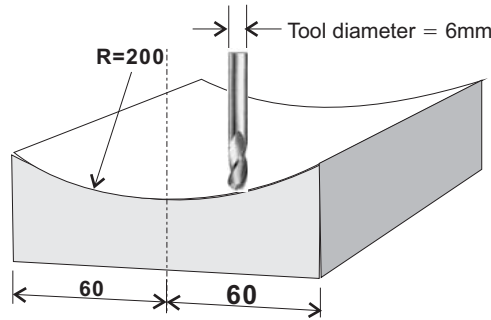
If the operator wants to verify if ES-2's R calculation is correct, or wants to temporarily exit the R function cycle (swap to normal XY display). The procedure is as follows :



Simplified R function

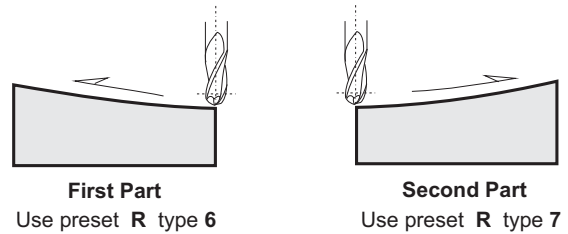
Example :

To machine the copper electrode as shown which has an ARCoF $R = 200$ mm using a Two Axis ES-2

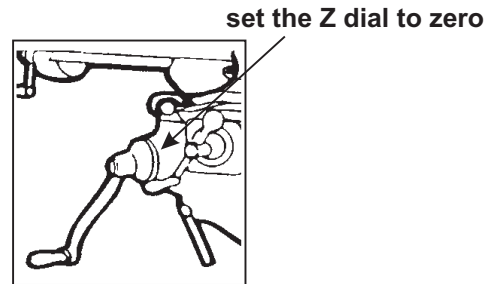
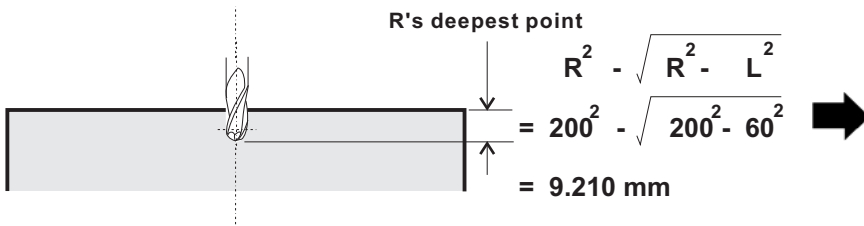


操作實例

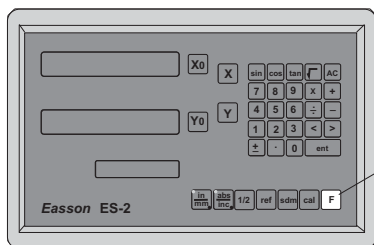
Because ES-2's XZ/YZ can only machine an arc which is less than 90 degrees, it is necessary to divide this arc machining into two parts.



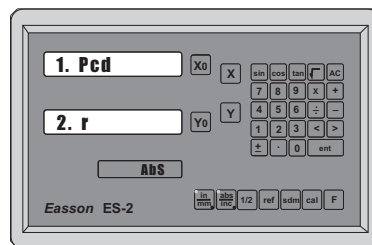
posit the tool at the ARC starting point



Step 1: Simple Radius function



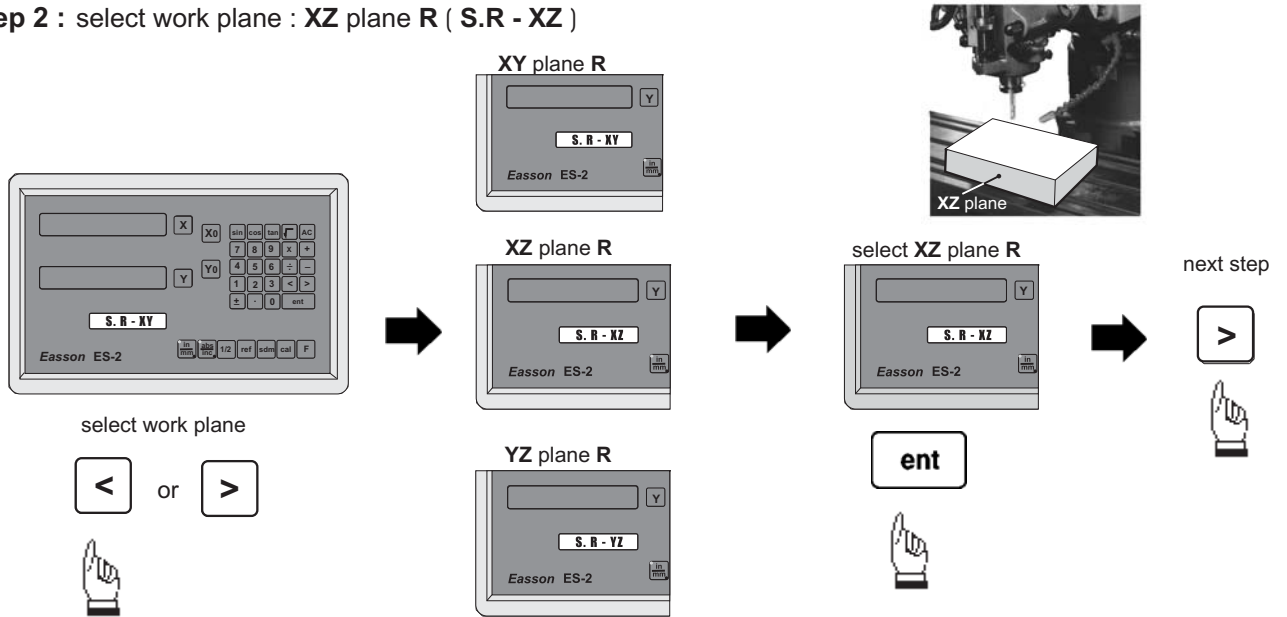
enter **F** into function Select



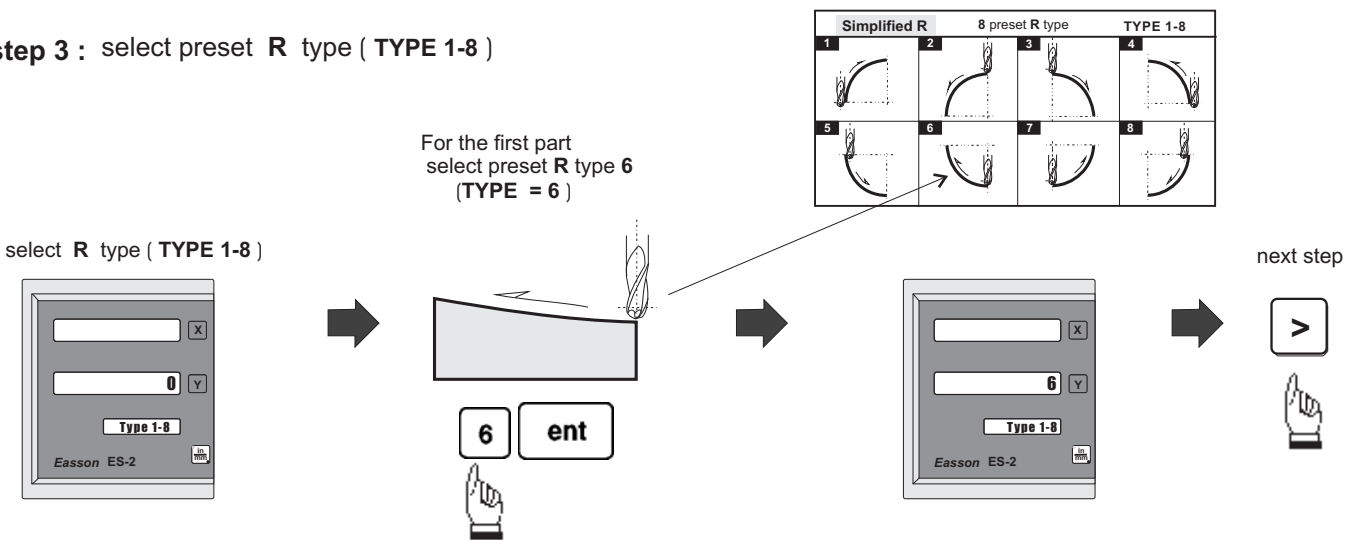
enter **2** into R(Radius) function

Simplified R function

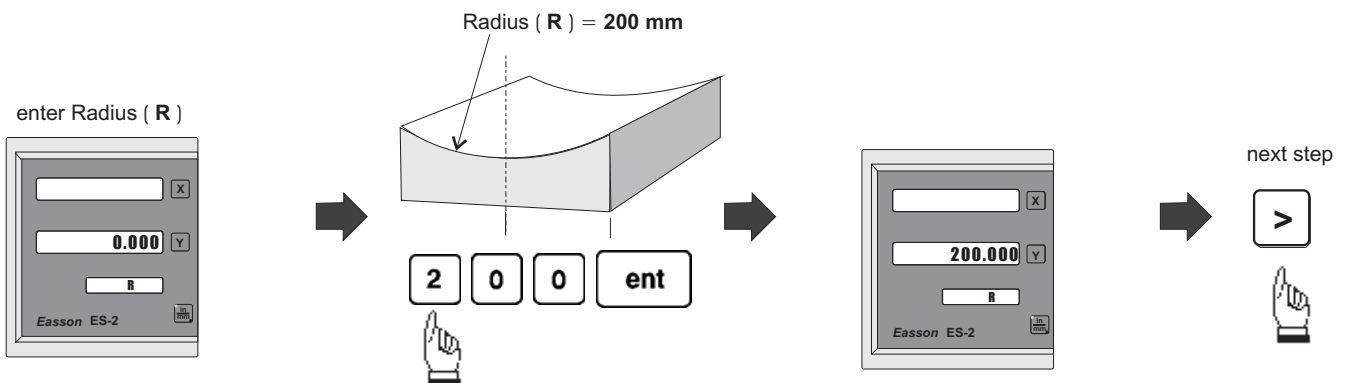
step 2 : select work plane : XZ plane R (S.R - XZ)



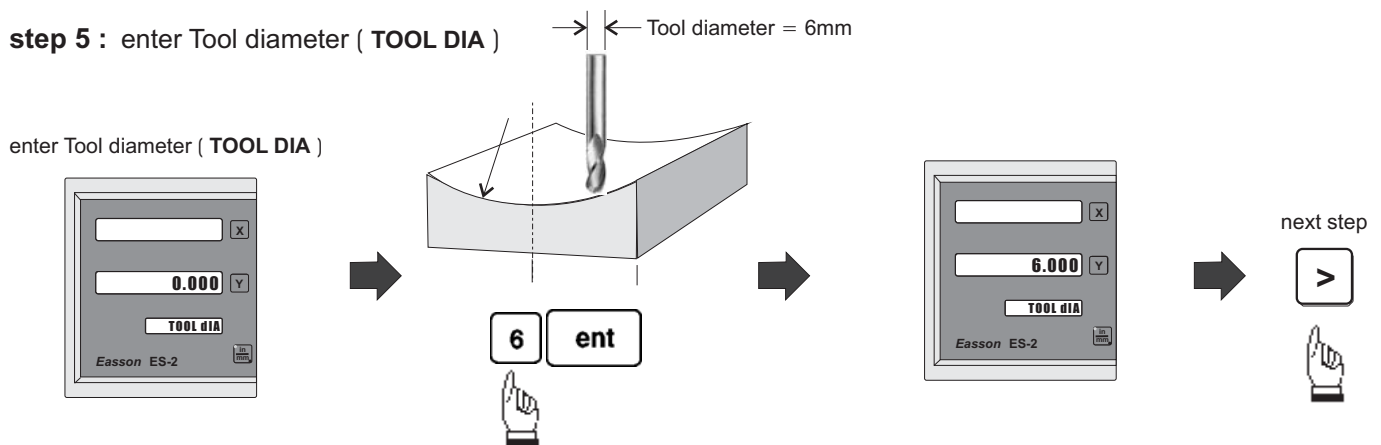
step 3 : select preset R type (TYPE 1-8)



step 4 : enter Radius (R)



step 5 : enter Tool diameter (TOOL DIA)

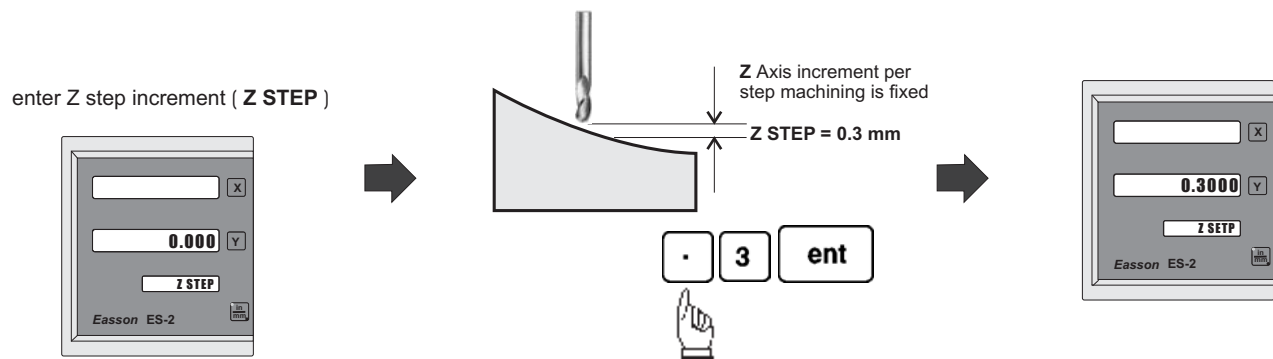


step 6 : enter Z increment per step machining

ES-2 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




All simplified R function machining parameters have already entered into ES-2




to enter into ARC machining mode



|The two Axis **ES-2** does not have a Z Axis, so the **ES-2** uses the  and  to simulate the Z axis movement



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

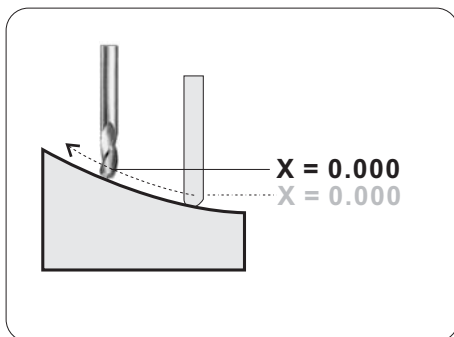
 — simulate Z axis move **down** one step

before the start of ARC machining, please make sure the tool is posited 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 ES-2, and, in order that the operator can easily guide and position the Z axis during the ARC machining, the ES-2 uses the unused axis display to display the **Z dial turn number** and **Z dial reading**.

At the beginning of the ARC machining, the ES-2 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..



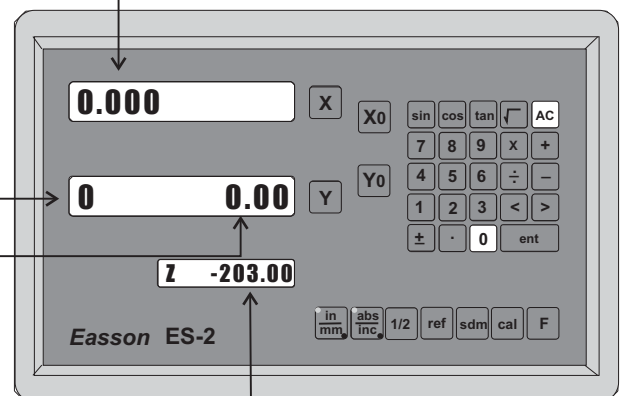
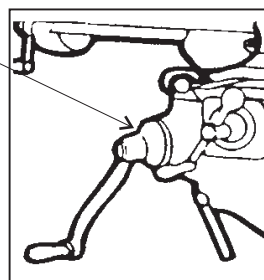
Move the X axis until display = 0.000, then the tool is positioned on the ARC curve

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

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

Z dial turn number

Z dial reading



Z axis simulated height

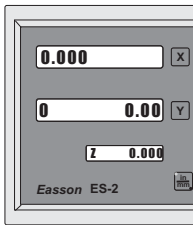
Display data in XZ plane R machining mode

If the Z axis is positioned outside the R curvature, ES-2 will display "Z OU LI" (Z OUT LIMIT)

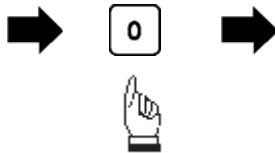
Simplified R function

If the operator wants to verify if the ES-2's **Simplified R** calculation is correct, or wants to temporarily exit the **R** function cycle (swap to normal XY display). The procedure is as follows :

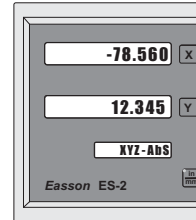
presently in **R** cycle



temporarily **swap** to normal XY coordinate display

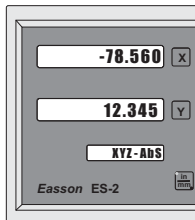


temporarily return to XY coordinate display

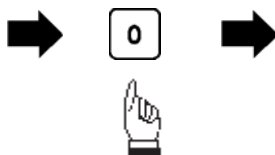


swap back to R cycle to continue the **R** machining mode

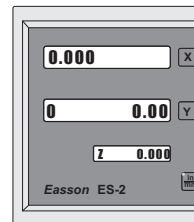
presently in the temporarily XY coordinate display



swap back to R function cycle

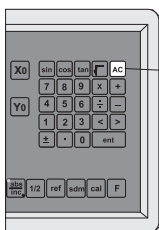


return to R function cycle

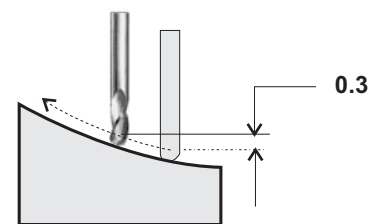
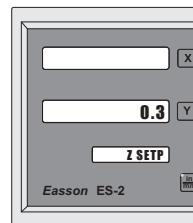
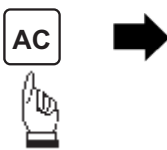


If fixed **Z STEP** option is chosen, the **Z STEP** increment can be change anytime during the ARC machining

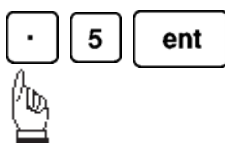
currently **Z STEP** increment = 0.3 mm



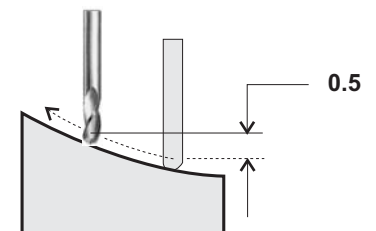
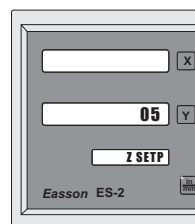
change the **Z STEP**



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

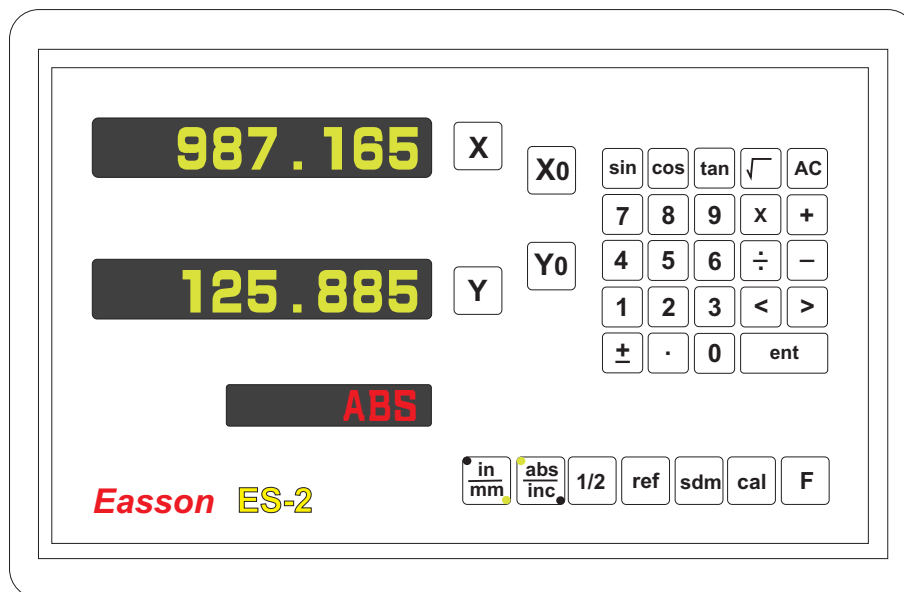


now the **Z STEP** increment = 0.5 mm

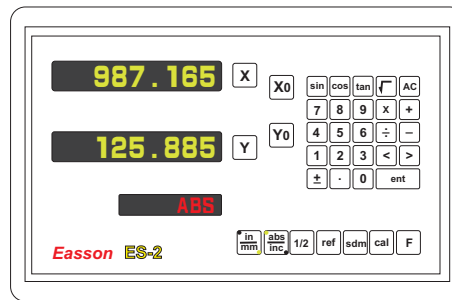


ES-2

Digital Readout Setup Function



ES-2 ORIGINAL PARAMETER RESET FUNCTION

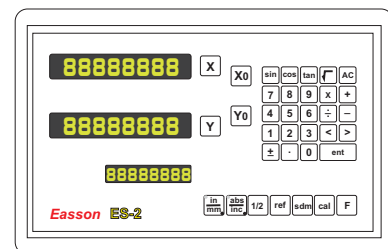


Some inscrutable cases or improper operations cause the chaos of parameter, then you need to initialize the parameter to reset the system.

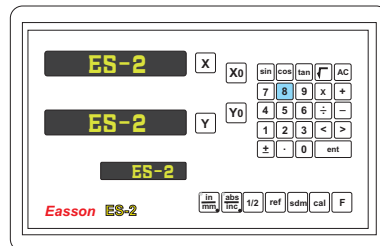
Operational procedure :

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

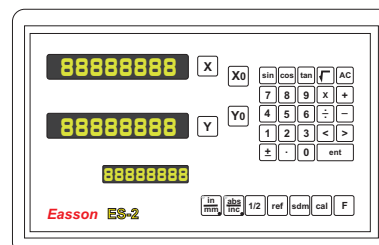
power on the DRO, then DRO starts the self-test function



when "ES-2" appears in display window, please press " **8** " key.

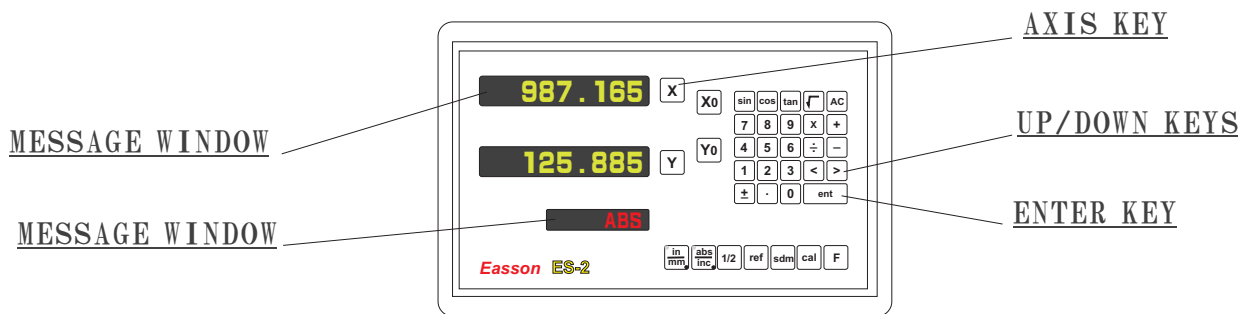


after press " **8** " key, the word "8" can appear and continuously move in display window.



- (3). When enter into the RESET function, the word "8" appears and continuously moves in display window. After the word "8" moves 2~3 trips, the DRO will complete the reset.
- (4). Turn off the DRO after complete the reset, then power on DRO once again.

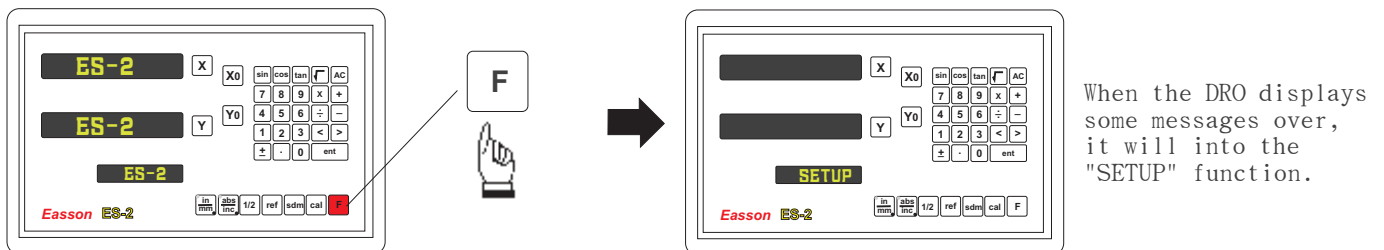
ES-2 SETUP FUNCTION



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

Procedure :

- 1). Turn off the ES-2.
- 2). Power on the ES-2 once again, when the message "ES-2" showing in the MESSAGE WINDOW, please **F** key immediately then the DRO ES-2 starts entering into the SETUP function.

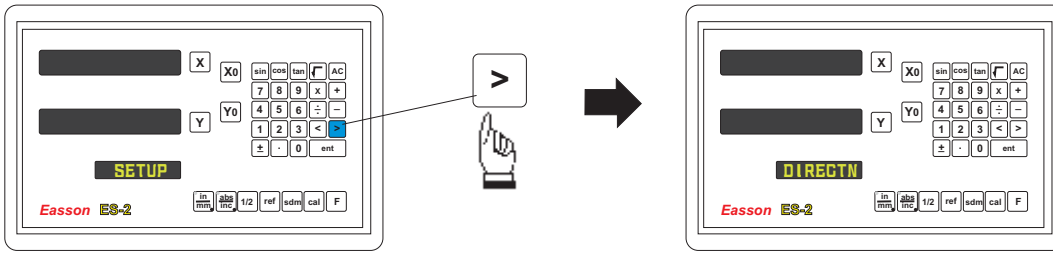


The SETUP procedure is written in a menu mode which enables you to scroll through the top level options and enter, configure and exit the sub-functions as they arise.

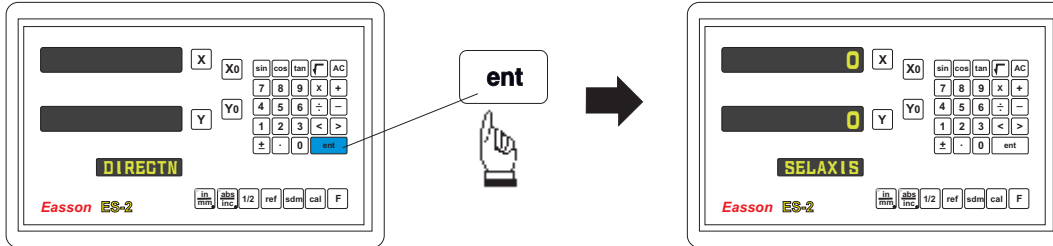
The top level menu headers in order are as follows :

DIRECTIN	specifies the direction of count for each axis
LIN COMP	permits linear error compensation to be input
REF SIGN	specifies the signal of the reference point for each axis
Z DIAL	forms part of the dial parameters for a milling machine, and specifies one turn of Z dial travel.
DIAL INC	enters the Z increment for ARC machining
Z MOVE	forms second part of the dial parameters for milling machine, specifying the direction of the Z axis positioning.
AXIS NO	configures the DRO axis number
R MODE	set up "Z STEP" or "MAX CUT" for Radius (R)
NORMAL	returns the DRO settings to the factory preset values
QUIT	exits the SETUP function to proceed to normal working

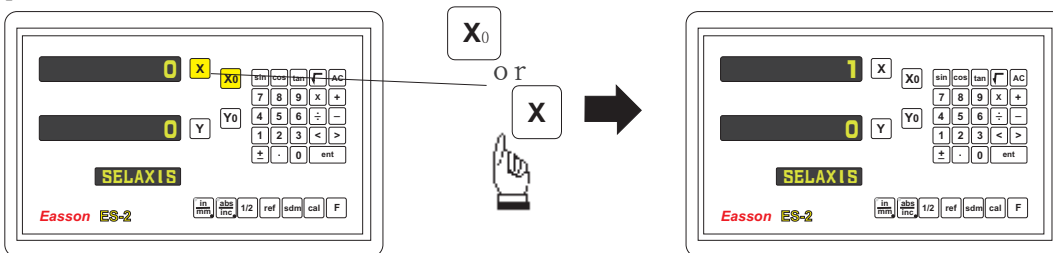
3.) Press **>** key to select the "DIRECTN" (counting direction) function. Press **<** key to return to the last function.



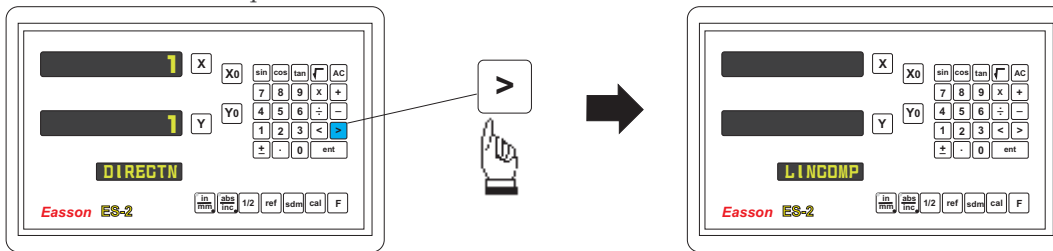
Press **ent** key into the direction setting function, the 0 represents a positive, 1 represents a negative.



Press **X0** or **X** key to set up a negative direction "1" for X Axis, make a same procedure for Y Axis.



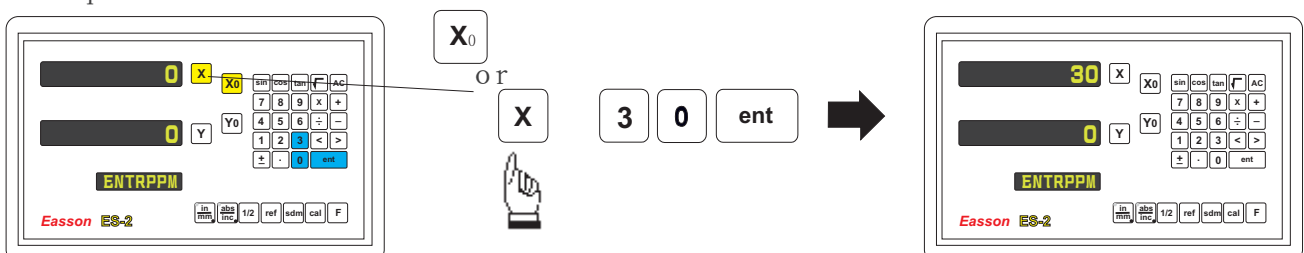
4.) Press **ent** key to make your setting, then press **>** key to select the "LIN COMP" (linear compensation) function.



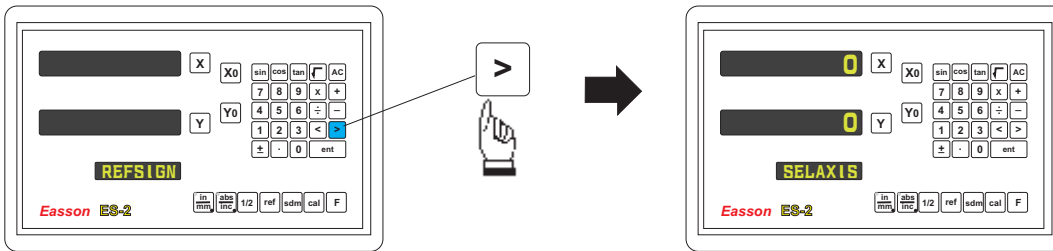
Press **ent** key into the linear error compensation function, the formula as below:
 error value X $-(1000/\text{measuring length}) = \text{compensation value}$
 (ML) measuring length unit = mm, error unit = μm

Example : ML=500mm Error = $-15 \mu\text{m}$
 $-15 \mu \times -(1000/500) = 30 \mu\text{m}$
 the compensation value is $30 \mu\text{m}$

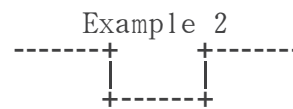
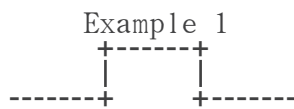
If set up the linear compensation value of X Axis = 30, through the AXIS key make a same procedure for Y Axis.



5.) Press **ent** key to make youn setting, then press **>** key to select the "REF SIGN" function.



Press the UP/DOWN keys until the word "REF SIGH" is shown in the MEASSAGE WINDOW, Press the ENTER key to access the next menu level. Press the DOWN key once and the message "SEL AXIS" appears in the MESSAGE WINDOW. Press the individual axis key and enter a 0 or 1 in accordance with the instructions below. Press the ENTER key to store the value. Press the UP/DOWN keys to move to the next menu item. In the market there are many gratings using a 20 μm pitch. There are two types of electronic signal which generate the reference point. The first associates the signal with a rise in voltage, the second with a drop.



REF SIGN = 0
Normal Voltage = 0V
At ref point = 5V

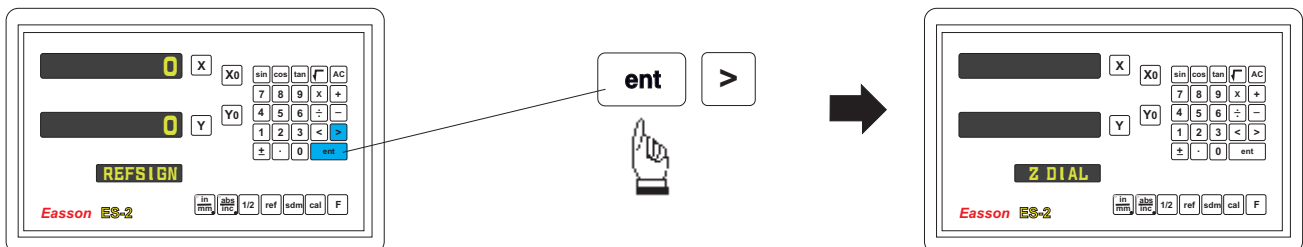
REF SIGN = 1
Normal Voltage = 5V
At ref point = 0V

Suppliers-Easson, Mitutoyo, Futaba

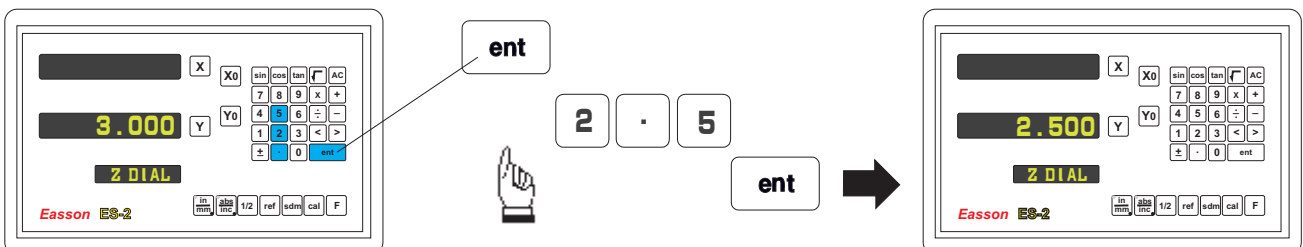
Suppliers-Fagor

When fitting an EASSON scale always set to 0

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



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

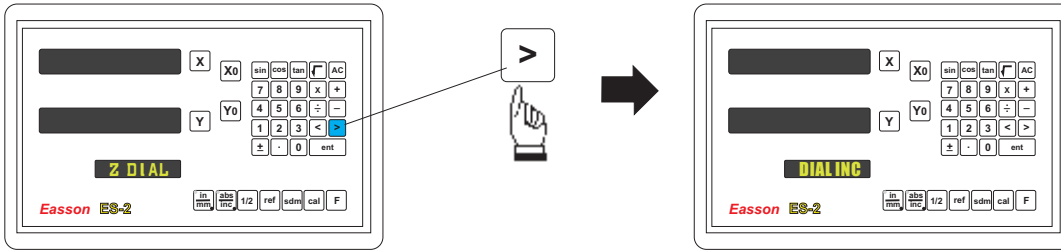


Z DIAL INSTRUCTIONS :

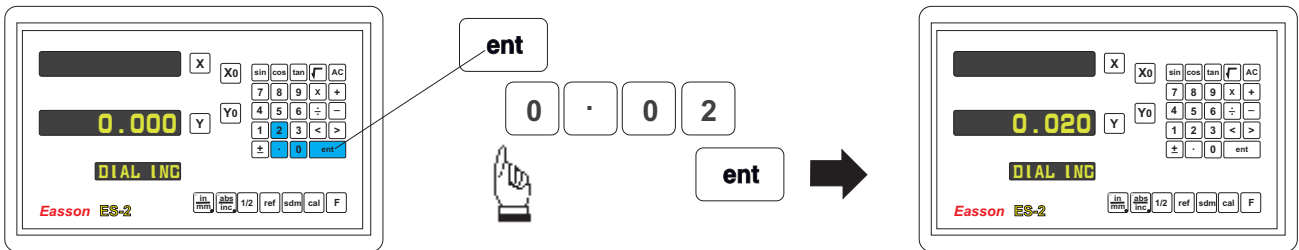
After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "Z DIAL" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level, Press the DOWN key once and the message "0.00" appears in the Y AXIS WINDOW. Press the individual axis key and enter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

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

7.) Press **>** key to select the "DIAL INC" (dial increment) function.



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

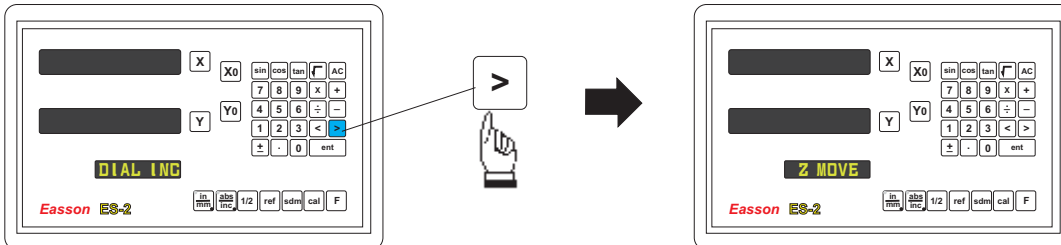


DIAL INC INSTRUCTIONS :

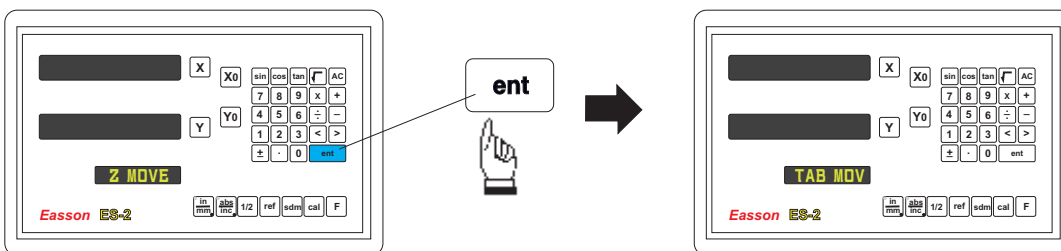
After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "DIAL INC" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level. Press the DOWN key once and the message "0.000" appears in the Y AXIS WINDOW. Press the individual Y axis key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

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

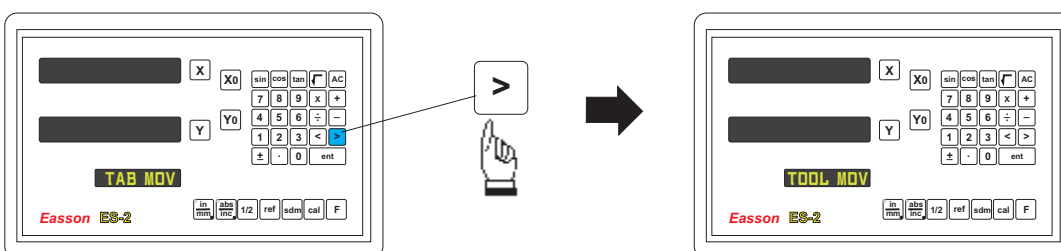
8.) Press **>** key to select the "Z MOVE" function.



Press **ent** key into the setting function, the message "TAB MOV" is shown in the MESSAGE WINDOW.



Press **>** key to select the "TOOL MOV" function, then press the ENTER key to make your selection.

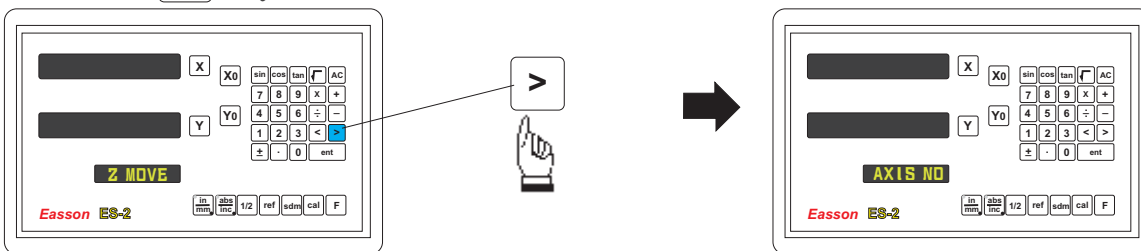


Z MOVE INSTRUCTIONS :

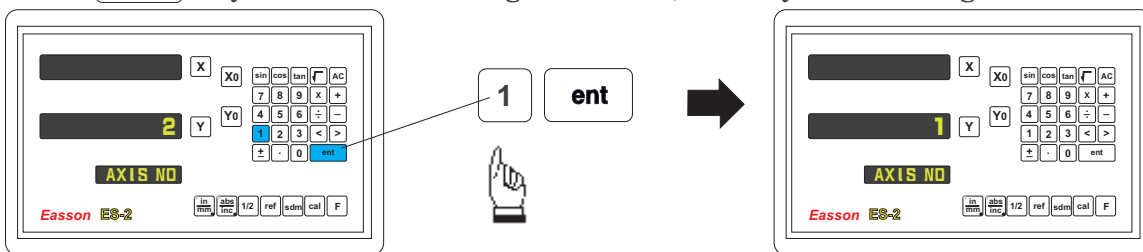
After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "Z MOVE" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level. Press the DOWN key once and the message "TAB MOV" appears in the MESSAGE WINDOW. Press the DOWN key again and the message "TOOL MOV" appears. You can toggle between these options until making your choice. Press the ENTER key to accept the displayed type of your choice. Press the UP/DOWN keys to move to the next menu item.

The NORMAL setting for the machine is the TAB MOV, indicating that the table moves during the machining process. Some machines need to have the opposite directional setting facilitated by the TOOL MOV setting. It facilitates the direction of the increment in a similar manner to the DIRECTIN command setting described earlier. As already described the DEFAULT for the Z DIAL, DIAL INC and Z MOV is a normal Taiwanese kenn-type milling machine. Only in the case of the DRO system being installed on another different style machine do these parameters need changing.

9.) Press **>** key to select the "AXIS NO" function.

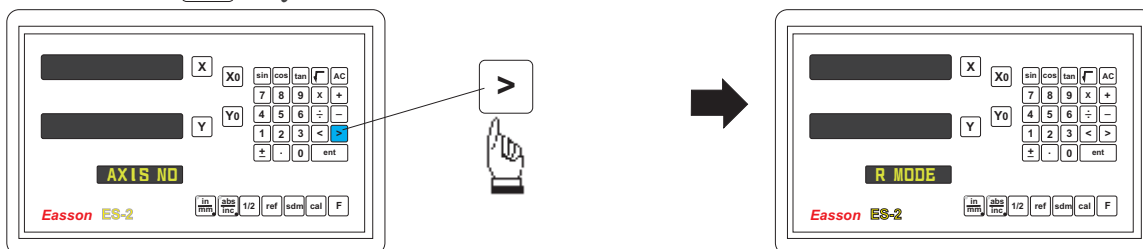


Press **ent** key into the setting function, i.e. your setting axis number is "1".

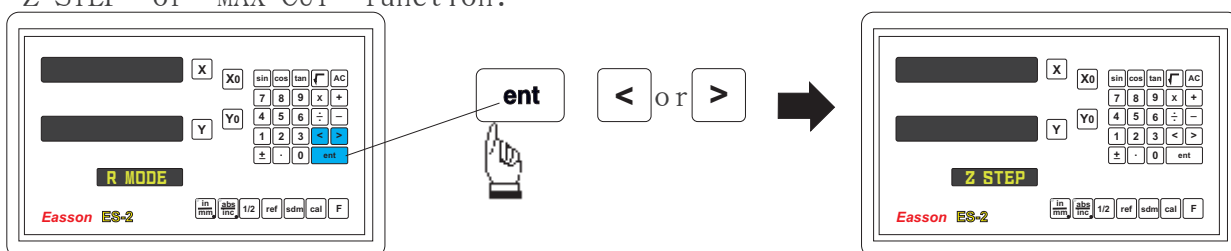


After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "AXIS NO" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level. Press the DOWN key once and the message "2" (for a 2 axis etc) appears in the Y AXIS WINDOW. Press the individual axis key and enter a number to specify the axis number. Press the ENTER key to store the information. Press the UP/DOWN keys to move to the next menu item.

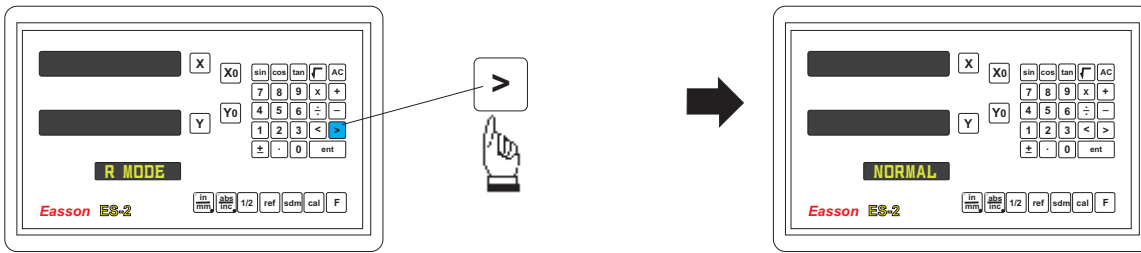
10.) Press **>** key to select the "R MODE" function.



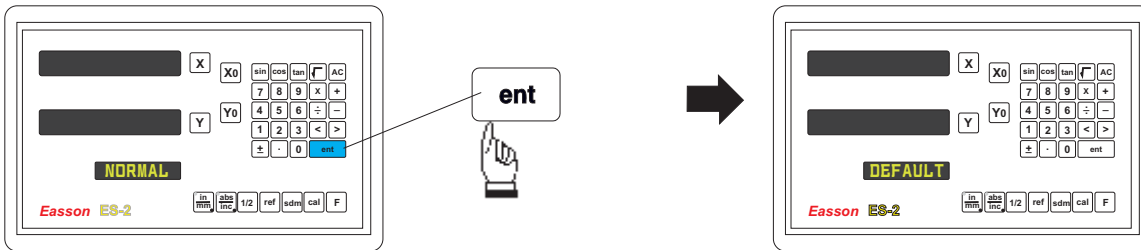
Press **ent** key to make your setting, then press **<** key or **>** key to select the "Z STEP" or "MAX CUT" function.



11.) Press **ent** key to make your setting, then press **>** key to select the "NORMAL" function.

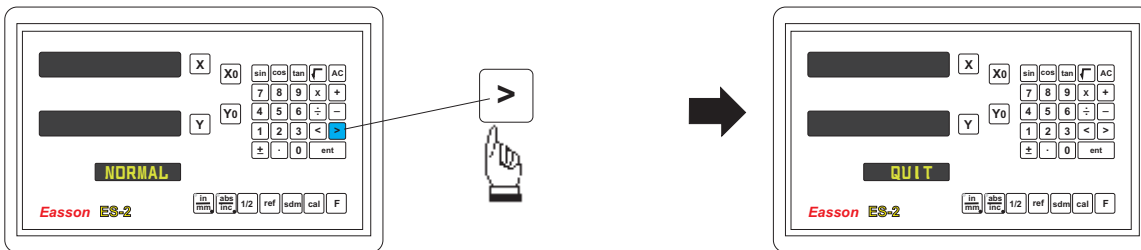


Press **ent** key into the setting function, the message "DEFAULT" is shown in the MESSAGE WINDOW.

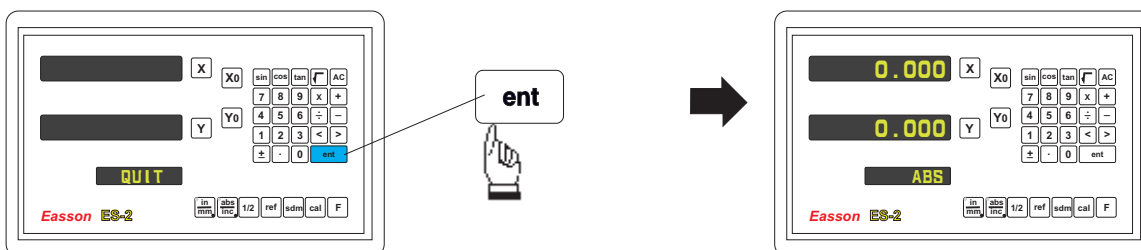


After entering the SETUP mode shown overleaf, push the UP/DOWN keys on the keypad until the word "NORMAL" is shown in the MESSAGE WINDOW. Press the ENTER key to access the next menu level. Press the DOWN key once and the message "DEFAULT" appears in the MESSAGE WINDOW. By pressing the ENTER key the software is restored to default level. Press the UP/DOWN keys to move to the next menu item.

12.) Press **ent** key to make your setting, then press **>** key to select the "QUIT" function.



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



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