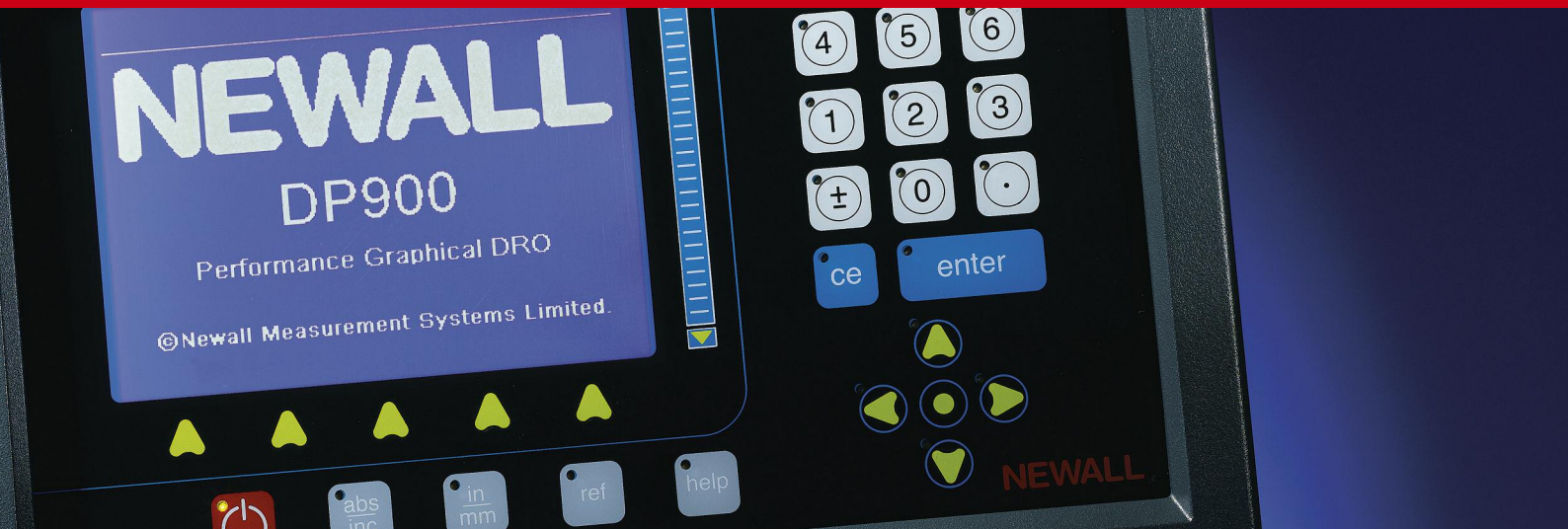


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NEWALL



Digital Readout Display

DP900 Manual

CST
CUSTOM SENSORS & TECHNOLOGIES

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Introduction

This chapter describes the basics of the DP900 DRO.

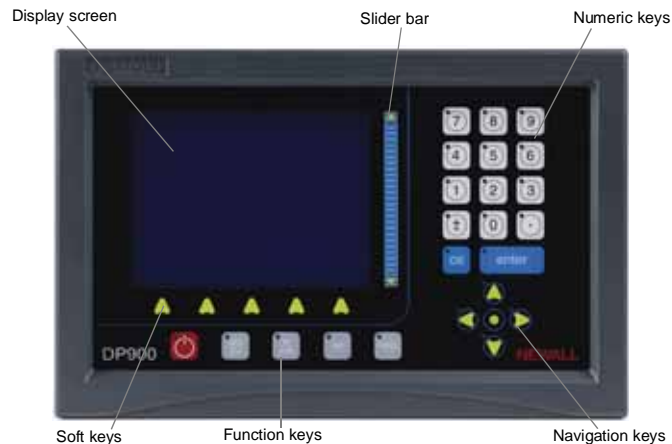
The DP900 is available with 2, 3 or 4-axes of encoders. The 4th, 'W', axis can be a Newall Spherosyn/Microsyn (analog) or an RS422 TTL differential (digital) depending on the specific unit. You can set the RS422 TTL W-axis to show linear or angular measurement.

Depending on the options that you choose, there may also be extra connections for a probe and an auxiliary input/output port.

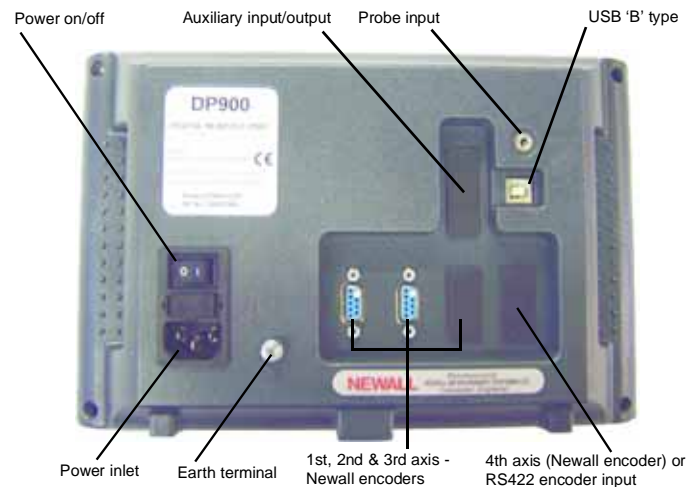
The mains on/off switch is at the rear of the unit, see the diagram on page 1.

You should always connect the equipotential terminal to the machine ground to ensure that the displays are stable.

Front

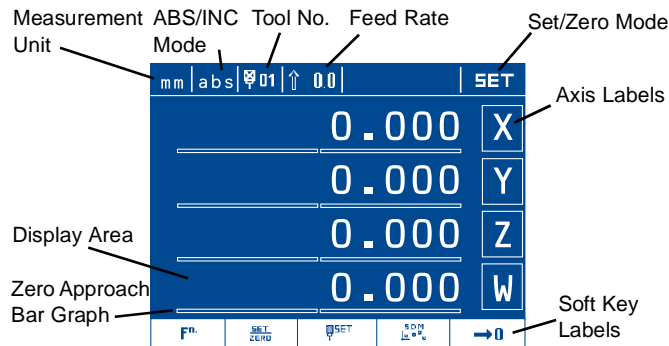


Back



Introduction

Screen layout



Using the Help system

The DP900 has a comprehensive context-sensitive help system.

The **[help]** key takes you to context-sensitive help so you can find the specific information you require quickly without the need to search through pages of information. If you press the **[help]** key while you are performing a particular operation, then you see the help screen for the function that you are currently using. You can also navigate to other topics, by pressing **[F1]** from within the Help function. This takes you to a list of contents, from where you can select the subject that you want.

The Help menus use a principle similar to HTML hyperlinks such that any item described within the Help text that is enclosed within angled brackets, **<>**, acts as a link. You can page through help pages using the up and down navigation keys and through the links using the left and right navigation keys. When you select a link, the text inverts. You press the **[enter]** key or the **[arrow-centre]** key to jump to that help page. When you

have followed links, you can press **[left arrow]** to move back through previous pages.

When you have finished with the help, press **[right arrow]** to return to the operation you were performing.

General information

- You enter numeric values using the keypad.
- You use the **[enter]** key to confirm your numeric entry and return to the previous screen while saving the parameters.
- You use the **[ce]** key to clear your numeric entries and return to the previous screen without saving the parameters.
- The **{soft key}** labels show the various functions available. You select these by pressing the corresponding key below the label. There are two levels of soft keys, which you access using the left and right navigation keys.
- You use the up and down navigation keys to move between different fields within forms or list boxes.

Slider bar

Unlike a conventional DRO there are no dedicated axis key positions. Instead, there is a slider bar that can be used in a far more flexible manner.

In normal operation, you press the region of the slider bar next to the displayed axis value for it to act in the same manner as a traditional axis key. This allows for zeroing or loading values into that axis. However, in some modes the axis position display can move to make room for graphics or additional information. When this happens, the axis active position on the slider bar moves to remain next to the axis displayed value

Introduction

on the screen. In some modes, you can use the slider bar to scroll through lists of data in much the same manner as on a PC.

The flexibility of the slider bar also means that for some complex functions, such as the calculator function, additional soft keys can be made available.

Information bar

The top of the DP900 graphical display shows the current user basic display options. It also shows the current Feed-rate, Tool selection and simple messages. For example, if you press a key with no allocated function, the display shows 'Illegal key'. The message remains for a few seconds before automatically clearing and it is accompanied by two short beeps.



Manual conventions

In this manual, the following notations are used:


[name] denotes a dedicated key name.

{name} denotes a soft key name.

Save and exit

In Setup mode, if you make changes and want these to be stored permanently you need to select 'Save and Exit'. Pressing   then saves your changes and you leave Setup mode.


Exit without saving


In Setup mode, if you have made changes but do not want them to be actioned you need to select 'Exit without Saving'. When you press  you leave Setup mode without saving or actioning any changes.



Soft keys


General operation


The order of the soft keys changes according to whether you have selected Mill or Lathe as your machine model. You press the right navigation key to scroll through all the available soft keys.

Func (). You use this to display a machine-specific functions list. This is explained in more detail in Lathe functions, Mill functions and Generic functions.

Set/Zero (). You use this to toggle between Setting and Zeroing an axis on the axis keys.


Tools ( ). You use this to enter the Tools Setup. This is explained in more detail in Tools on page 33.

Rad/Dia (Lathe mode only) (). You use this key is to toggle any axis that you have defined as diameter (dia) in Setup mode, between radius and diameter display on the screen. All axes that you defined as radius (rad) in Setup mode are unaffected. When an axis is in diameter display mode a small diameter symbol is shown against the axis value.


Preset (). You use this to enter the Preset or 'Distance to go' mode. This is explained in more detail in Preset mode on page 17.


Half Function ($1/2$). This is also known as Centerfind. You use this to reduce the value of the selected axis by half.


The reference position is lost when you use this function.


Sub Datums (). You use this to enter the Sub Datum Function. This is explained in more detail in Sub datums on page 36.


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Calculator () . You use this to enter the Calculator function. This is explained in detail in Calculator on page 20.

Contrast up () . You use this to increase the contrast.



Contrast down () . You use this to decrease the contrast.


Probe () . You use this to execute the Probe function. This is explained in detail in Probe function on page 28.



Setup () . You use this to enter the Setup function. This is a protected mode, so you need to enter a password to enter it. You use it to change the DRO settings. This is explained in detail in Setup mode.


You use the left and right navigation keys to switch between different soft key levels.


Other functions


Run () . Once you have configured the parameter values for an operation, you run the operation by pressing  .






Cancel () . You use this key to stop the current operation without saving any changes.


Done ( ) . You use this key to save and complete the data entry.





New () . You use this key to define a new job starting with the default parameters for that particular function. If you choose to save the job later then you can do so. The DP900 can save and recall up to 20 programs for each major function.



Recall () . The DP900 can save and recall up to 20 programs for each major function. For example, you can have 20 bolt hole circles, 20

grid arrays, 20 line holes, etc. This means that for repetitive jobs there is no need to re-enter the data each time. Instead you can recall the job from a list. Pressing  brings up a list of known job programs for that function. You use the up and down navigation keys to highlight the required job.


Delete () . You use this key to remove programs, jobs or tools that you no longer require. When you press  you are prompted for confirmation:  or  . If you select  , then the item is permanently deleted and cannot be retrieved.

Save () . You press  to save any changes you have made.

Copy ( ) . If you need a new program that is similar to an existing one then you can copy the original program, and then rename it. Use the up and down navigation keys to find the program or job that you want to copy. When the name of the existing program or job is highlighted, press   . This brings up the virtual keypad, so that you can enter a new alpha-numeric name.

Rename ( ) . If you need to rename a program or job, use the up and down navigation keys to find the program or job that you want to rename. When the name of the existing program or job is highlighted, press the {**rename**} key. This brings up the virtual keypad, so that you can enter a new alpha-numeric name.

D.Base. You use this key to open the DP900's databases. Here you can find information on tap sizes and clearance drills in both imperial and metric formats.

Select () . You use this key on the alpha-numeric keypad to select the highlighted character. You can also use the [**arrow-centre**] key.

Introduction

Upper (ABC). You use this key on the alpha-numeric keypad to show capital letters.

Lower (abc). You use this key on the alpha-numeric keypad to show lower case letters.

Next (←). You use this key to move to the next point or position.

Prev (→). You use this key to move to the previous point or position.

Content (≡). You use this key in Help to return to the root Help menu.

Front panel dedicated keys

Sleep mode key

This temporarily turns off the display and keyboard. All other settings are preserved. Encoder movement is still monitored while in sleep mode. Press this key again to exit sleep mode. The LED on the front panel flashes to indicate that the DRO is in sleep mode.

You can also select an integer value ranging from a minimum of 5 minutes to a maximum of 120 minutes to select the sleep mode timer. The DRO automatically goes into sleep mode if no operation is done during that elapsed time.

abs/inc key

You use this key to toggle between Absolute mode and Incremental mode.

in/mm key

You use this key to toggle the display units between inches and millimeters.

Ref key

You use the [ref] key to activate the Digifind feature, which you use to recall a previously set reference (home) position. There are two types of reference positions:

- Homing: This is the position that was most recently set in absolute mode.
- Machine Reference (M/C Ref): This is the machine's permanent home position. You set it up in Setup > Axis Settings > Machine Reference.

You should make a permanent mark on the machine when setting reference points. If the axis has been moved while the DP900 power was off, you can recall your reference positions using Digifind.

The display must be in absolute mode to use Digifind.

To use Digifind:


1. Press the [ref] key.
2. Set the axis close to the marked datum, to within:
6.3mm (0.25") for a Spherosyn encoder or
2.5mm (0.1") for a Microsyn encoder.
3. Select the {homing} or {M/C Ref} soft key.
4. The DP900 displays 'Select axis'.
Press the slider bar close to the respective axis.
The DP900 displays 'Referencing', and the axis you selected shows 'Homing' or 'M/C Reference'.

5. Press the slider bar next to the respective axis again. The current position is updated, and Digifind is complete.

Before you can use Digifind to find the Machine reference, you need to define it in Setup mode > Select axis. The procedure is explained in Setting the machine reference on page 18.

Alphanumeric keypad

You can give function programs and tools meaningful names. This means that you can give names to items that have a direct relationship to the task or tool. These could be company names, drawing numbers or customer job references. You can use any combination of numbers, alphabetical characters and some special characters, to a maximum of 12 characters.

When you need to enter an alphanumeric name the DP900 displays the Data Entry screen showing all the available characters. You navigate around these characters using the four navigation keys. Pressing  selects the highlighted character. If you enter the wrong character, you can delete it by pressing the **[ce]** key.

Press **ABC** to change the characters from a-z to A-Z and press **abc** to change the characters from A-Z to a-z.

You can enter numbers directly using the numeric keypad.

Numeric keypad

This appears on the right hand side of the DRO. You use it to enter numerical values. It also has a +/- key to enter positive and negative numbers, and a decimal point key to enter decimal values. If you enter an incorrect digit you can press the **[ce]** to delete each number in turn. If you press the **[ce]** key when no numbers remain, the DRO stops the number input operation. Press the **[enter]** key to confirm the number entry.

Navigation keys

The DP900 has four arrow keys that you use to navigate around the screen. In this manual these are referred to as the navigation keys. These keys are as follows:

- The left and right keys move you between the soft key pages when there are multiple pages.
- The up and down arrows move you through pages of on-screen information when there is more information than can be fitted on a single screen.
- In graphical run-time modes, you use the up and down keys to select the level of graphical zoom.
- When you are in conventional mode and operating a positioning function such as Sub Datums, you use the up and down keys to move between the next and previous datum or target points.
- In the middle of the four arrow keys is a circular key, this acts as an enter key. It is referred to in the text as the **[arrow-centre]** key.

Specifications

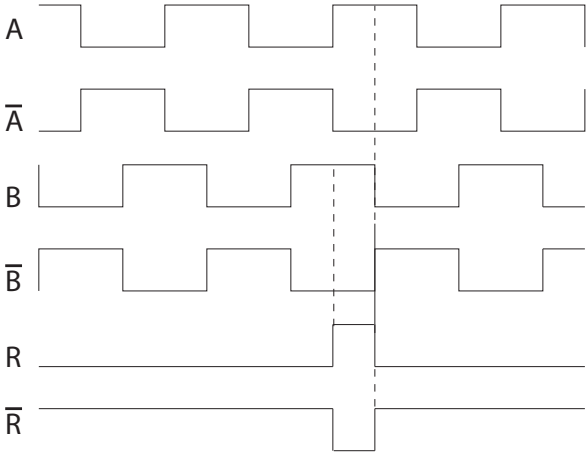
Mains supply	90...265V AC 50...60Hz
Fuse ratings	T800mA 20mm length
Power consumption	20W
Operating temperature	0°C to 45°C
Storage temperature	-20°C to 70°C
Relative humidity	Max 85% non-condensing
Dimensions	280mm x 180mm x 75mm (L x H x D)
Weight	1.9 Kg
Display	5.7" STN type monochrome LCD

Encoder inputs

Model	Spherosyn/Microsyn**	TTL*
DP900211000	X, Y	—
DP90031110 DP90031110A	X, Y, Z	—
DP90041111A	X, Y, Z, W	—

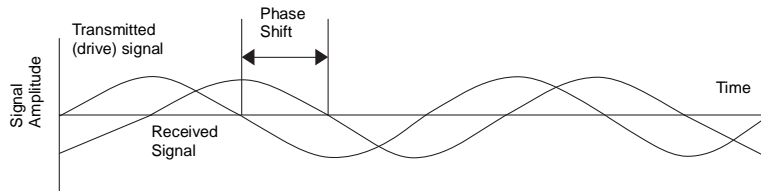
Model	Spherosyn/Microsyn**	TTL*
DP9004111DA	X, Y, Z	W

*TTL = 5V A quad B differential (RS422)



Specifications


**Spherosyn/Microsyn: 2V, 1kHz, phase analog
360 degrees per ball pitch



Phase change of 90° relating to $\frac{1}{4}$ of a pitch or $\frac{1}{8}$ inch (3.175 mm) for Spherosyn.

Setup mode

This chapter describes how to setup the DP900.

Use the right navigation key to scroll through the soft keys until the Setup soft key () appears on the screen. Press the soft key to enter Setup mode. This is a protected mode, so you need to enter a password to enter it. **PASSWORD 1 5 9 7 4** . Enter the number and then press the [enter] key.

The Setup mode screen is displayed.

You navigate to the different fields using the up and down navigation keys. The soft key labels display the options that you can select for each field. You select a particular option by pressing the appropriate soft key.

General settings

No. of axis

You use this to set the total number of axes that you need to configure. Select 2, 3 or 4 by pressing the appropriate soft key.

Sleep mode time (min)

You use this to define the Sleep Time Interval in minutes (5 to 120). Enter the required time using the numeric keypad.

Key beep enable

You use this to enable or disable the keyboard beep. Select on or off by pressing the appropriate soft key.

Zero app. beep en

You use this to enable or disable the Zero Approach Beep. Select on or off by pressing the appropriate soft key.

When you enable the Zero Approach Beep, bars appear under the axis numbers to clearly indicate the direction and relative position of the axis to zero. As the beep starts the bars start to shrink towards the centre. The bars disappear when the zero position is reached. The Zero Approach Beep only beeps when you are within the set approach distance.

The beep rate gets faster as the zero position is approached. The beep is only for the fastest moving axis.

Some functions like Preset have zero-approach always enabled.

Zero app. tolerance

You use this to set a tolerance value for the Zero Value in Zero approach modes. Enter the required tolerance using the numeric keypad.

The value that you enter corresponds to the distance from zero that the DRO considers to be close enough to zero to be counted as zero, i.e. the point at which the beep becomes continuous (if enabled and so long as the axis is moving) and when the zero-approach bars are clear.

Diagnostics

This enters a test mode where you can check the keyboard and any attached encoders. Select keyboard or encoder by pressing the appropriate soft key.

KBoard

Pressing {**k board**} shows a screen representing all the available keys. Pressing a key highlights its position on the screen. To exit this test mode press the [ce] key twice.

Encoder

Pressing {**encoder**} shows a screen with all the available axes displayed. Here you can see the Axis, Count, Pitch, Type and Reference.

Setup mode

For Newall encoders the Type is 'N' and for RS422 encoders the type is 'Q'. Newall encoders provide a count that represents the absolute position on the ball element within the scale in bits. (1-bit is 1/10000th of a ball element). To exit this test mode press [ce].

Select axis

You use this to set the axis-specific parameters. Select X, Y, Z or W by pressing the appropriate soft key. If you select W, then you first need to select whether the axis is linear or angular.

Axis-specific settings (linear type)

Scale Type. You can set the X, Y, Z and W axes to be Spherosyn, Microsyn 10 or Microsyn 5. The W-axis of a DP9004111DA model is an RS422 TTL type encoder. For the X, Y and W axes, the default value is Spherosyn and for the Z-axis, the default value is Microsyn 5. The exception is the DP9004111DA model which does not have a scale type parameter for the W-axis.

Scale Resolution. This option is available only for the W-axis of a DP9004111DA model that you have configured as a linear type. You can choose from 0.1µm, 0.2µm, 0.5µm, 1µm, 2µm, 5µm, 10µm, 20µm, and 50µm. The default value is 5µm.

Display Resolution. The resolution settings available for the X, Y, Z and W axes are as follows:

Resolution	Display	Spherosyn	Microsyn 10	Microsyn 5
1 µm (0.00005")	1	—	—	x
2 µm (0.0001")	2	—	—	x

Resolution	Display	Spherosyn	Microsyn 10	Microsyn 5
5 µm (0.0002")	5	x	x	x
10 µm (0.0004")	10	x	x	x
20 µm (0.001")	20	x	x	—
50 µm (0.002")	50	x	x	—


The exception is the W-axis of a DP9004111DA model that you have set to linear type, the resolution settings available are 0.1µm, 0.2µm, 0.5µm, 1µm, 2µm, 5µm, 10µm, 20µm and 50µm.

For the X, Y and W axes, the default value is 5µm. For the Z-axis, the default value is 1µm.


Axis Direction. This parameter defines which reader head movement direction results in a negative count. You can set the counting direction to either left or right for each individual axis. The default value is left.

Axis Mode. You can set the Axis mode to either Radius or Diameter for each individual axis. This is only valid if you have configured the DRO as a Lathe model. For the Mill model, all the axes are forced to rad mode.

Machine Reference. Here you set the Machine reference for each individual axis. Use Digifind to set the Machine reference. For the W-axis of a DP9004111DA model, the encoder reference marker output is used for referencing.

1. Press  to enter the Machine reference mode. The Homing message is shown on the display.

Setup mode

2. Set the Absolute Datum using Digifind. Press the slider bar close to the particular axis to set the datum. For the W-axis, the DRO goes to the next screen automatically once it senses the reference output from the encoder.
3. Bring the encoder near to the machine reference mark and press . The new machine reference is set.

The default value for the machine reference is zero.

Zero App. Distance. This is the bar graph that is shown below the axis display. It is available in all Distance to go modes. You can also force the bar graph on using the Functions list. The value of this setting is the limit for the bar graph. The default value is 1.000.

Calibrate Axis. You use this to compensate for errors arising due to wear and tear, encoder misalignment, etc. You can calibrate each axis for Linear Errors or Segmented Errors as applicable. The detailed procedure for calibration is explained in Calibrate axis on page 14.

Apply Compensation. You use this to program the type of compensation to be applied to the selected axis. There are three options: **{none}**, **{l. comp}** and **{s. comp}**. The none option applies a linear calibration factor of 1.0. The default compensation type is none.

Axis-specific settings (angular type)

This option is only available for the W-axis.

Counts per Revoln. This parameter defines the encoder counts per rotation. You can enter this value if it is known or there is an automatic calibration process for finding the CPR value. In the automatic process, you are prompted to pass two reference marks in the same direction. The DRO counts within them, and sets the CPR value. The default value is 4096.

Resolution (Deg.). This parameter defines the Display resolution in degrees. The default value is 0.1 degrees.

Reference Mode. This defines which reference mode to select, Internal or External. For Internal mode, the DRO uses the encoder reference mark for referencing. For External mode, the DRO senses an external input (Input 4) first and then references the DRO on the encoder internal reference mark. You use this mode where one machine rotation corresponds to more encoder rotations due to gear coupling. The default is Internal.

Axis Direction. This defines the counting direction of the encoder, clockwise (CW) or counter-clockwise (CCW). The default is CW.

Count Mode. There are two options:

Rollover: The angle rolls back to zero after 360.

Continuous: The angle continues accumulating after 360.

The default is Rollover.

Machine Reference. This is similar to the machine reference for the linear type, except that the value is set in degrees.

Display Mode. The angular axis is configurable for two possible options.

DDMMSS. Degrees:Minutes:Seconds (00:00:00).

DDDEC. Decimal Degrees (0.0000).

The default value is DDMMSS.

Axis Lock. There are two options:

Axis Lock On

Axis Lock Off.

Axis Lock On stops you axis setting in Absolute mode. Only the operator can perform referencing. The default value is Axis Lock Off.

Zero App. Angle. This is similar to the zero approach distance for the linear mode, except that the setting is in angular mode. The default value is 10.

Setup mode

Zero App. Tolerance. This is similar to the zero approach tolerance for the linear mode, except that the setting is in angular mode. The default value is 0.

You should save the changes that you make in the Setup mode using Save and Exit.

The options for each menu item are displayed on the soft key label. You have to press the correct soft key for the required settings.

Machine model

You use this to set the DRO to be Mill specific or Lathe specific, by selecting mill or lathe using the appropriate soft key.

Auxiliary setup




You use this to set the parameters required for Auxiliary Input/Output functions. See page 38 for details on using the auxiliary port.

Set factory settings

You use this to set all the DRO parameters to their factory defaults.

This option clears all the programmed data including programs, SDM jobs and segmented scale compensation.

To return to the factory defaults:

1. Press .
2. Press  to confirm that you want to return to the factory default settings.
If you decide that you don't want to return to the factory default settings, press .

The default setup settings are:

No. of Axis	4
Sleep Mode Time	5
Key Beep Enable	on
Zero App. Beep En.	on
Zero App. Tolerance	0.025mm
Machine Model	Mill
Axis Direction	left
Axis Mode	rad
Zero App. Distance	1.000mm
Apply Compensation	none

Applying compensation

You configure any compensation values in the Calibrate Axis setting.

Performing a Factory Reset clears any calculated compensation values and the unit reverts to no compensation.

When you are measuring the values for compensating an axis, you must ensure that you do not include the diameter of the probe or tool.

Error descriptions

Accuracy problems with machined parts may be caused by machine error, DRO system error, or a combination of both. The first step in determining

Setup mode

the source of error is to check the DRO system. You do this by comparing the movement of the Newall reader head to the position reading shown on the display. You need a high accuracy standard, such as a laser interferometer. You can use a dial indicator to check short distances, but a laser provides the best results. If you have to use a dial indicator, be sure it is the highest available accuracy.

To check the accuracy of the DRO system:

1. Place the target of the laser or the needle of the dial indicator directly on the Newall reader head.
It is absolutely critical that you take the readings directly from the Newall reader head.
If you have to use a dial indicator, be sure that the needle of the indicator is perpendicular to the reader head and not angled.
If you take readings anywhere else on the machine, machine errors may distort the results.
2. When the reader head moves, the movement registers on the laser / indicator and DRO display.
3. Set the laser / dial indicator and DRO display position displays to 0.
4. Make a series of movements and compare the position readings between the laser / dial indicator and the DRO display.
If the readings match within the accuracy specified, then you know that the DRO system is operating properly. If this is the case, you can proceed to the next step: evaluating the machine errors. If the readings do not match, you must repair the DRO system before proceeding with error compensation.

To evaluate machine errors:

1. Put the laser target / dial indicator on the part of the machine where the machining is done.
2. Make a series of movements and compare the position readings between the laser / dial indicator and the DRO display.

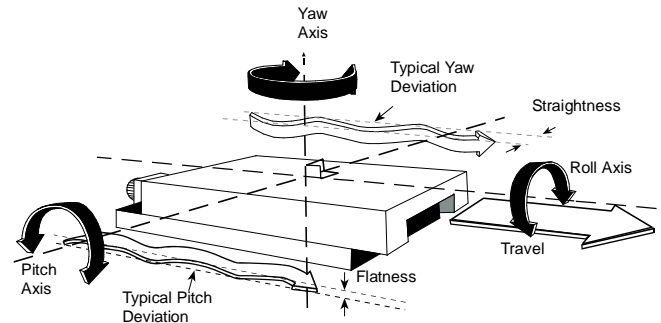
The difference between the laser / dial indicator reading and the reading on the DRO display is your machine error.

3. Plot the machine error along the entire axis of travel to determine the nature of the error.
If it is a linear error, you can use linear error compensation. If the error is not linear, you should use segmented error compensation.

When you are measuring the values for compensating an axis, you must ensure that you do not include the diameter of the probe or tool.

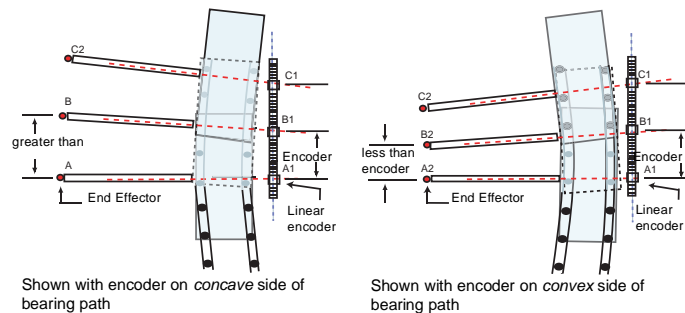
There are many types of machine error, including pitch, roll, yaw, flatness, straightness and Abbé error. The diagrams below demonstrate these errors.

Way errors



Setup mode

Abbé error



Calibrate axis

Calibration parameters are found under Setup mode > Select axis. There are two options:

- Calibrate axis
- Apply Compensation

The Calibrate axis menu offers two modes of compensation:

- Linear Compensation **{l.comp}**.
- Segmented Compensation **{s.comp}**.

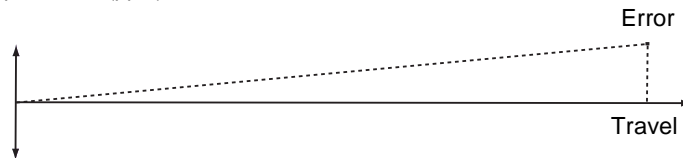
If you set the axis to Segmented Error Compensation, or Linear Error Compensation, then your next set up option is to configure the compensation for that axis.

If you apply Error Compensation, then you must ensure that it is absolutely correct. If it is not correct, then errors could be increased rather than reduced.

Once you have set up the Error Compensation, we advise you to check its effect in normal operation.

Linear compensation

A linear error occurs between the measuring device and the part to be measured, if the axis is not truly parallel with the encoder scale axis. You can overcome this by applying a scalar to the measured axis value before it is displayed. You calculate the correction factor, and specify it in parts per million (ppm). The values can be between -9999 and +9999.



The DP900 has an automatic facility to calculate the linear error correction scalar.

All displayed values are in mm, regardless of whether the DP900 is set to inch or mm mode.

1. Move to the start position.
2. Zero the display value by pressing **{reset}**.
3. Move a known distance (use a laser interferometer, slip gauge or standard).
4. Select 'Slip Value' and enter this known distance using the numeric keypad.
5. Select 'Cal Factor' and press **{calc}**.

The DP900 calculates and displays a scalar compensation value.

Setup mode

Before you can apply this compensation factor, you must enable it. Go to Setup mode > Select axis > Apply compensation, then select **{l. comp}** or **{s.comp}**.

When you are measuring the values for compensating an axis, you must ensure that you do not include the diameter of the probe or tool.

Segmented compensation

On the DP900 each axis can have up to 50 segments of compensation. Compensation is provided linearly between the segment points.

The values for segmented error compensation are calculated using a simple semi-automated procedure.

When you select segmented compensation, you can select **{auto}** or **{edit}** to set up the compensation.

If the machine has not been moved since the power was turned off, press the **[ce]** key, and the DP900 restores the last positions that were recorded.

Alternatively, you can set each axis close to the Reference Point, to within: 6.3mm (0.25") for a Spherosyn encoder or 2.5mm (0.1") for a Microsyn encoder, and press the slider bar close to the 'X', 'Y' or 'Z' axis. The DP900 re-establishes alignment with the correction parameters.

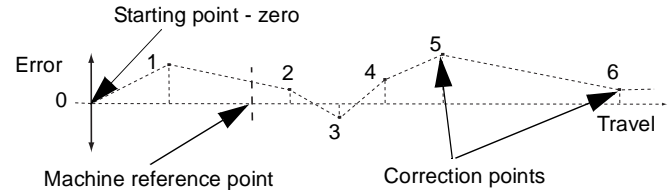
You need not apply Segmented Compensation over the entire scale length. You can apply it to a length of high importance, or to just one segment.

If you set one or more axes to Segmented Error Compensation, then you need to carry out the following procedure to configure the compensation for each of those axes.

When you are measuring the values for compensating an axis, you must ensure that you do not include the diameter of the probe or tool.

Identifying the correction parameters

The scale travel is broken down into a number of segments that you define, each with its own correction factor, measured against a high-accuracy standard. You need to identify the following parameters:



You measure each Correction Point with respect to the Starting Point, zero. You usually set this close to one end of the scale. You can set the Reference Point anywhere along the scale. It does not need to coincide with either the absolute datum or any of the correction points. However, you may find it convenient to make the absolute datum and the reference point the same.




Setting the correction points

As you follow the procedure you must ensure that you always approach the Starting Point, Correction Points and Reference Point from the same direction. If you do not, then the size of the tool or probe renders the measurement inaccurate.

Auto




1. Go to Setup > Select Axis > Apply Compensation and set this parameter to **{s. comp}**.
2. Go to Setup > Select axis > Calibrate axis and select **{s. comp}**.

Setup mode

3. Press **{auto}**.
The message 'Homing...' appears on the screen, and the DP900 automatically finds the Starting Point.
4. Press the slider bar next to the axis you are calibrating.
The message 'Set MC Ref.' appears on the screen.
5. Press **{Set}** to set the MC Ref.
The DP900 displays the Observed Value (linear encoder position) and True Value (laser interferometer position) for the first segment. Move the axis to the end of the first segment. The observed value is updated to reflect this movement.
6. Use the down navigation key to select the True Value, and enter the value shown on the laser interferometer.
7. When you press the **[enter]** key the compensation value is calculated and displayed.
8. Use **→** to move to the next segment.
9. Repeat the procedure for each segment.
10. Press  **→**  to save the values and leave the Calibrate Axis set up.
11. Press **→**  to leave the Calibrate Axis set up without saving the values.

Edit

1. Set the axis to Segmented Compensation as described in Calibrate axis on page 14.
2. Press **{edit}**.
3. Use the **←** and **→** to move to the segment number that you want to edit.

4. Press **{edit}**.
5. Enter a value for the Observed Value.
6. Enter a value for the True Value.
7. Press  or **→**  to return to the previous screen.
8. Repeat the procedure for all the segments.
9. When you have entered values for all the segments, press **→**  to save your entries and leave the Calibrate Axis setup.

You can define up to 99 segments per axis.

To use Segmented Error Compensation, you need to have a high accuracy standard, such as a laser interferometer system.

Segmented Error Compensation initially defaults to Off, with no points set.

If you set Apply Compensation to none after you have set the Correction Points, then the data is retained, but not applied. When you next set Apply Compensation to s.comp, the data is re-applied.

You must carry out this procedure in strict sequence, and in full, for it to be valid.

Do not worry about the direction of the standard measurement. For example, 678.9 and -678.9 are treated the same.

You can press the **[ce]** key to clear an entry.

Basic functions

This chapter describes the basic functions of the DP900.

The basic functions are as follows:

- Absolute mode
- Incremental mode
- Inch and mm
- Loading an axis
- Preset mode
- Referencing
- Graphical zoom
- Calculator

Absolute mode

In Absolute mode the DRO displays the positions of all the axes with respect to a fixed datum. The datum is set by entering an axis position when in Absolute mode. The current display mode is shown in the Information bar (see Information bar on page 3 for further details). You switch between Absolute mode and Incremental mode by pressing the **[abs/inc]** key.

Incremental mode

In Incremental mode the DRO displays the position relative to the last position. This is also known as point-to-point use. In this mode you can set the value for each axis, or zero it to create an Incremental datum. This does not affect the machine's Absolute datum that you configure in Absolute mode. The current display mode is shown in the Information bar (see Information bar on page 3 for further details). You switch between Absolute mode and Incremental mode by pressing the **[abs/inc]** key.

Inch and mm

The DP900 has a dedicated key (the **[inch/mm]** key) to switch the positional displays between imperial (inch) and metric (mm) measurements. The current display mode is shown at the top left of the screen as either mm or in.

Loading an axis


In normal operation, with the axis values on the screen, you can select the mode of axis data operation by pressing **$\frac{\text{SET}}{\text{ZERO}}$** . This toggles the axis mode legend between 'SET' and 'ZER'.

When you select 'ZER', pressing the slider bar next to the axis legend sets that axis value to zero.

When you select 'SET', pressing the slider bar next to the axis legend changes its value to '0'. You can then enter a number using the numeric keys. Pressing the **[enter]** key loads this value in to the axis. Pressing the **[ce]** key deletes the value that you entered and restores the original value.

Preset mode



The Preset function provides a simple mechanism for stepping through repeat positions using the work-to-zero principle. It also takes into account positioning errors for repeated points.


The first time that you enter the function, the previous move error is set to zero. In this way pressing  only recalls any previous axis preset value.

Axis preset values are not maintained after a power cycle.

The setting of the axis preset value does take into account the error of any previous move. The value that you enter is the step move value.



Basic functions

Pressing  again recalls the axis preset value and takes into account the error of any previous movement. Pressing  after a power cycle results in a zero value.


The value of the axis Preset value that you enter is maintained until power-off. In this way pressing  after returning to the Preset function after exiting it previously, recalls the previous axis-preset, without error adjustment as the error is set to zero on initial entry.

The values displayed do not affect the axis positions and the axis datum is restored when you exit the Preset mode function.

Example


1. Turn the DRO power on.
The X-axis value is 234.555.
 2. Select Preset (set error = 0).
The X-axis value = 234.555.
 3. Press  and then press the slider bar close to the X-axis.
The X-axis value = 0 (preset = 0 at power-on).
 4. Press the slider bar close to the X-axis, and then press [2] [5] [enter].
The X-axis value = 25.000.
 5. Move to 0.050 (X-axis value = 0.050).
 6. Press  and then press the slider bar close to the X-axis.
The X-axis value = 25.050 (error added to preset value of 25).
 7. Exit the function.
- You can then carry on and complete other processes.
8. The X-axis value = 34.540.
 9. Select Preset (set error = 0).

10. The X-axis value = 34.540.

11. Press  and then press the slider bar close to the X-axis..

12. The X-axis value = 25.000 (preset = 25 from last visit).

13. Move to 0.050 (X-axis value = 0.050).

14. Press  and then press the slider bar close to the X-axis.

15. The X-axis value = 25.050 (error added to preset value of 25).

Referencing

With the DP900 you can set two different reference points (home) for each axis.

Machine reference (M/C Ref). This is most often the permanent home position for the machine. You can select the approximate location for this reference (within 12.7mm for Spherosyn, or 2.5mm for Microsyn).



Homing reference. This is the last position that was set while in absolute mode. You can reset this reference point at any time by setting the position while in absolute mode. Once you have defined a reference point, you need to make a permanent mark on the machine to indicate this position. These reference points can be recalled using the Digifind feature ([Ref] key), which is explained on page 5.

Setting the machine reference

You set the Absolute machine datum in Setup > Select Axis > Machine Ref. You need to make a permanent mark on the axis. You use this mark to find your datum in the event of movement during power loss. This position can be anywhere along the travel of the axis.

Basic functions

To define the machine reference:

1. Mark the machine axis.
2. Press  when 'Machine Ref.' is highlighted.
The screen displays the message 'Homing...'.

3. Ensure the axis marks are aligned correctly by moving the axis.
4. Press the axis key slider bar.
The screen displays 'Set MC Ref.'.
5. Press the **{Set}** key.

The axis machine datum is now set so that the marked point is absolute zero. This is very important when you use segmented axis compensation.

Finding the machine reference

This does not apply to the W-axis of a DP9004111DA model. See Digital encoder reference on page 19.

1. Press the **[ref]** key.
The soft key menu displays **{homing}** and **{M/C ref}**.
2. Select **{M/C ref}**.
The Information Bar message window displays 'SELECT AXIS'.
3. Press the slider bar close to the required axis key.
The selected axis displays 'M/C REF.'.
4. Move the axis to the machine reference datum position.
You do not need to be exact as the DP900 automatically compensates for small errors of:
+/-2.5mm Microsyn encoders
+/-6.3mm Spherosyn encoders.
5. Press the slider bar close to the required axis key again.
The display now shows the distance from the absolute datum, i.e. the

displayed value is the offset to the original taught absolute axis zero datum position.

Digital encoder reference

If your DP900 is fitted with a 4th axis RS422 quadrature encoder then the reference is taken directly from the scale. These encoders can have one or more reference marks and you should be aware of this and where the reference marks are located.

1. Press the **[ref]** key.
The soft key menu displays **{homing}** and **{M/C ref}**.
2. Select either **{homing}** or **{M/C ref}**.
The Information Bar message window displays: 'SELECT AXIS'.
3. Press the slider bar close to the W-axis.
The selected axis shows 'HOMING...' or 'M/C REF...'.
4. Move the axis across the encoder reference mark.

Once the reference mark has been detected the display returns to Normal mode and displays the correct axis position relative to the zero reference marker position.

Graphical zoom

The DP900 supports graphic representations for all primary machining operations. The graphics show the current machine datum, the current tool position and the target position.

The DP900 always sets the initial graphical scaling factor to ensure that the current tool position and first target position are displayed, so that you can easily see the trajectory required to move the tool. However you may wish to expand the image to see the whole job or zoom in to to achieve a high resolution positioning display. In this case, you can use the up and down navigation keys to zoom in and zoom out.


Basic functions

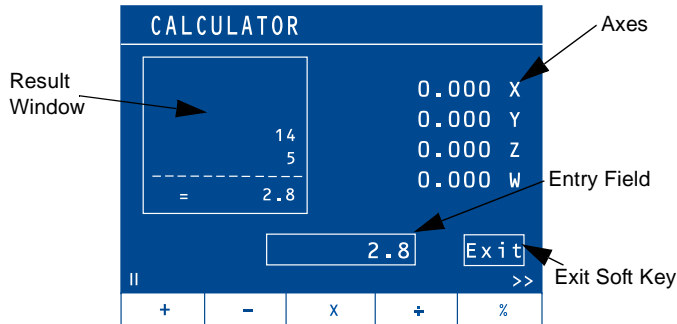
The Arc and Bolt Pattern features are not supported by the zoom in/out feature.

Calculator

You use the Calculator function to do basic and trigonometric calculations.

The current axis positions are displayed in calculator mode to save you having to remember these values if you need them for your calculations. The Calculator display screen clearly shows the calculations performed.

The following screen is displayed when you press  in Normal mode. As shown on the screen, the big square on the LCD contains all the results and the small rectangle is for the present number entry. The results are displayed when you press the **[enter]** key.



The following operators are available:

Math Functions. (+, -, ×, ÷, %). These operations are performed on two operands. The following sequence illustrates the method of operation.

If you want 23.596×131.567 then you should follow this sequence:

[2] [3] [.] [5] [9] [6] {×} [1] [3] [1] [.] [5] [6] [7] [enter]

The result displayed is '3104.4549'. You can use this result for other operations.

Trigonometric Functions. (sin, cos, tan, \sin^{-1} , \cos^{-1} and \tan^{-1}). These operate on a single operand. This operates on the number in the entry field. The result is displayed in the entry field, replacing the original number that you entered. You can perform other operations on this result. The trigonometric functions consider the operands in degrees and not in radians.

If you want $\sin(43.14)$ then you should follow this sequence:

[4] [3] [.] [1] [4] {sin}

The result displayed is '0.6837833'.

Other Functions. ($1/x$, x^2 , x^y , etc). These operate on a single operand except for xy which operates on two operands similar to the Math functions.

In addition to the above functions, you can use brackets to help order the functions. The following example shows how to use the brackets:

If you want $143 + \sin(180/23.5)$ then you should follow this sequence:

[1] [4] [3] {+} {()} [1] [8] [0] {÷} [2] [3] [.] [5] [6] {sin} [enter]

The result displayed is '143.13328'.

You can use the value of π in the calculations using the symbol.

You can use the number in the entry field to load a particular axis during any operations. You need to press the axis key to load the axis.

To exit the Calculator function, press the slider bar close to the .

Mill functions


The DP900 supports working in all three available planes for Milling operations. A plane is defined by a pair of orthogonal axes. The three available planes are X-Y, X-Z and Y-Z. By default the DP900 selects the X-Y plane as this is the most common.


For the milling machine, the following functions are available on **Fⁿ**:

- Bolt Hole (Circle and Arc)
- Line Hole
- Grid
- Frame
- Arc Contouring
- R-Function
- Pocket
- Slot
- Polar Coordinates
- Axis Summing


All these functions, except Axis Summing, have the following soft keys:


 Shows the parameter list for the selected function.

 Shows the previously saved list for the selected function.


 Exits from the Function List.

When you select a function, you see the following soft keys:


 Runs the function on the set parameters.


 Saves the pattern in permanent memory. If you chose to have a new pattern, this key opens a data entry screen so you can select a name for


the pattern. If you recalled a previously saved pattern, then this key saves the changes for that pattern.



 Exits from the Function List.

The following soft keys may appear, depending on the function that you chose.


 Use this to delete a previously saved pattern.

 Use this to copy a previously saved pattern.

 Use this to rename a previously saved pattern.

 and  Toggle between the Holes or Steps. The display shows the distance to go for the current hole. To position the tool for machining the current hole, move the axes until the display shows zero.

 Toggles between the Graphic Mode and Normal DRO Mode.

 Goes back to the parameter list.

 Exits from the function.

Bolt hole







This function is used to calculate the locations of holes in a circular pattern. It is also known as Pitch Circle Diameter (PCD). The following parameters are required:

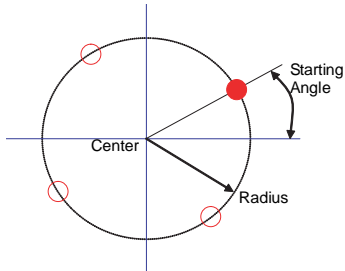
- Circle center coordinates.
- Circle radius.
- Starting angle of first hole.
- Ending angle of last hole (Only for the Arc Bolt Hole).
- No. of holes. (Max. 99)

Mill functions

- Depth (Requires 3-axis DRO).
- Plane (X-Y, X-Z or Y-Z).

When you have entered all the parameters:

1. Press .
This opens the Data Entry screen.
2. Enter a name for your pattern, and press  .
You return to the parameters screen.
3. Press .
This opens a graphical display showing the arrangement of the holes. You can use  and  to move around the holes.









This function is further sub-categorized into Circular Bolt Hole and Arc Bolt Hole. For a Circular Bolt Hole, the Ending Angle is removed from the parameter list.

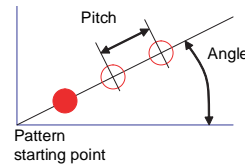
Line hole

This function is used to calculate the locations of holes in a linear pattern. It is also known as Linear Bolt Hole. The following parameters are required:

- Starting coordinates.
- Pitch distance.
- Angle.
- No. of holes. (Max. 99)
- Depth.
- Plane (X-Y, X-Z or Y-Z).

When you have entered all the parameters:

1. Press .
This opens the Data Entry screen.
2. Enter a name for your pattern, and press  .
You return to the parameters screen.
3. Press .
This opens a graphical display showing the arrangement of the holes. You can use  and  to move around the holes.









Mill functions

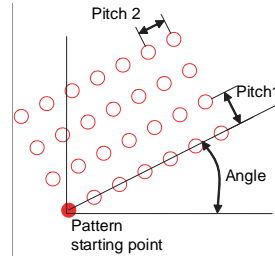
Grid

This function is used to calculate the location of holes in a grid pattern. The following parameters are required for this function:

- Pattern starting point coordinates.
- Angle.
- Pitch distance in axis '1'.
- Pitch distance in axis '2'
- No. of holes in axis '1'. (Max. 90)
- No. of holes in axis '2'. (Max. 90)
- Depth of the hole.
- Plane (X-Y, X-Z or Y-Z).

When you have entered all the parameters:

1. Press .
This opens the Data Entry screen.
2. Enter a name for your pattern, and press  .
You return to the parameters screen.
3. Press .
This opens a graphical display showing the arrangement of the holes. You can use  and  to move around the holes.




Frame






This function is used to calculate the locations of points along the line of a rectangle. You use this to mill a rectangular frame. The following parameters are required for this function:

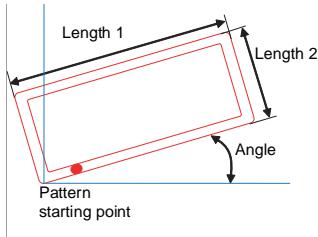
- Pattern starting point coordinates.
- Angle.
- Length of side '1'.
- Length of side '2'
- Diameter of tool. (Default value comes from the Tool Setup.)
- Maximum cut.
- Machined to. (Internal, External or Center.)
- Depth.
- Plane (X-Y, X-Z or Y-Z).

When you have entered all the parameters:

1. Press .
This opens the Data Entry screen.

Mill functions

2. Enter a name for your pattern, and press  .
You return to the parameters screen.
3. Press .
This opens a graphical display showing the arrangement of the holes. You can use  and  to move around the holes.









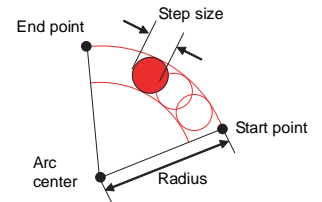
Arc contouring

This function is used to calculate the location of points along the line of the arc. The following parameters are required for this function:

- Arc center coordinates.
- Arc radius.
- Starting angle.
- Ending angle.
- Maximum cut.
- Diameter of tool. (Default value comes from the Tool Setup.)
- Machined to. (Internal, External or Center)
- Plane (X-Y, X-Z or Y-Z).

When you have entered all the parameters:

1. Press .
This opens the Data Entry screen.
2. Enter a name for your pattern, and press  .
You return to the parameters screen.
3. Press .
This opens a graphical display showing the arrangement of the holes. You can use  and  to move around the holes.









R-function

The R-Function is a pre-defined arc function. The parameters required are:

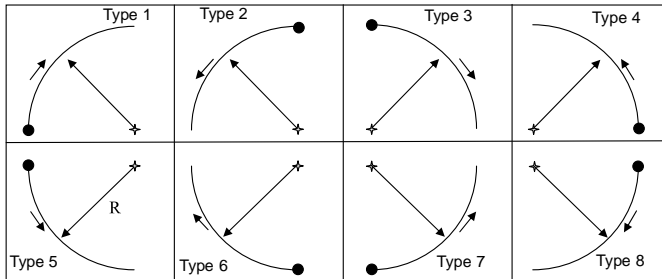
- Arc type.(1-8)
- Arc radius.
- Diameter of tool. (Default value comes from the Tool Setup.)
- Maximum cut.
- Machined to. (Internal, External or Center.)
- Depth.
- Plane (X-Y, X-Z or Y-Z).

Mill functions

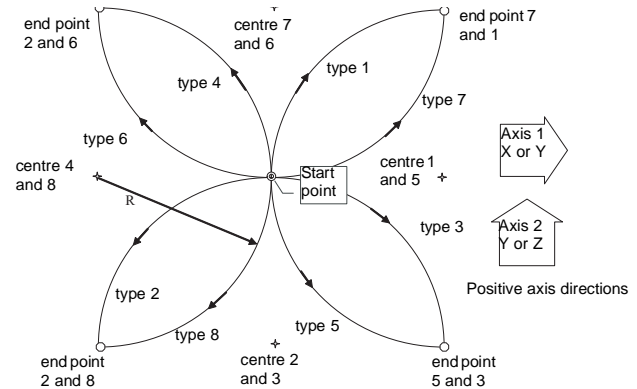
When you have entered all the parameters:

1. Press .
This opens the Data Entry screen.
2. Enter a name for your pattern, and press  .
You return to the parameters screen.
3. Press .
This opens a graphical display showing the arrangement of the holes. You can use  and  to move around the holes.

There are 8 arc types in R-Function. They are shown on the following diagram.



This function assumes the current tool position as the start point for all the arc types. Depending on the arc type, it decides the other parameters of the arc. The following diagram describes the 8 arc types:









Pocket

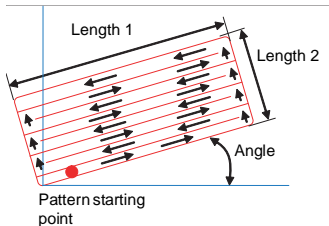
This function is similar to Frame function, except that the middle portion of the Frame is also milled. The parameters required are:

- Pattern starting point coordinates.
- Angle.
- Length of side '1'.
- Length of side '2'.
- Diameter of tool. (Default value comes from the Tool Setup.)
- Maximum cut.
- Machined to. (Internal, External or Center.)
- Depth.
- Plane (X-Y, X-Z or Y-Z).

Mill functions

When you have entered all the parameters:

1. Press .
This opens the Data Entry screen.
2. Enter a name for your pattern, and press  .
You return to the parameters screen.
3. Press .
This opens a graphical display showing the arrangement of the holes. You can use  and  to move around the holes.









Slot

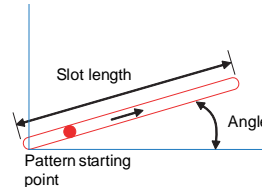
Slotting is a simple milling function similar to the arc functions, but in a straight line. The parameters required are:

- Pattern starting point coordinates.
- Angle.
- Slot length.
- Diameter of tool. (Default value comes from the Tool Setup.)
- Maximum cut.

- Depth.
- Plane (X-Y, X-Z or Y-Z).

When you have entered all the parameters:

1. Press .
This opens the Data Entry screen.
2. Enter a name for your pattern, and press  .
You return to the parameters screen.
3. Press .
This opens a graphical display showing the arrangement of the holes. You can use  and  to move around the holes.

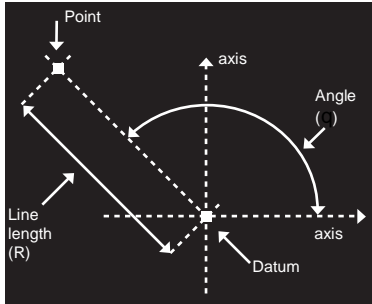


Mill functions

Polar coordinates

This function converts the position of the two selected axes into Polar coordinates. To activate this function, first select the plane and then press

←. The following screen is displayed.



It has the following soft keys

↔ Switches between graphic mode and normal counting mode.

→ Exits from the function.

Axis summing

The summing is to allow for the position of the Mill table relative to the tool to be shown for machines fitted with both a knee (W) and quill (Z) axis-scale. Essentially the axes are added to form a single compound axes S. This option is only visible for a 4-axis DRO. It has the following soft keys:

ON Turns this mode on. This switches the DRO to 3-axis display and the third axis shows the sum of the Z-axis and the W-axis.

OFF Turns this mode off. This switches the DRO back to the 4-axis display.

→ Applies the selected option and exits from the function list.

Zero approach

You use this function to turn the Zero approach bar graphs on or off in normal mode of operation. It has the following soft keys:

ON Turns the zero approach on.

OFF Turns the zero approach off.

→ Exits from the function list.

Job timer

This is a timer utility and you can use it to get the time or rate for completing a particular job. It has the following soft keys:

✓ Starts the Job Timer.

✗ Stops the Job Timer.


0 → Resets the Job Timer.

→ Exits from the function list.

\$ You use this to enter the machining rate in units per hour for the machine on which the DRO is operating. If you set this to zero, the main DRO screen shows the Job Timer; otherwise it shows the machining cost. Enter the rate using the numeric keys, then press ← to save the value.

Mill functions

Probe function


The Probe function soft key () is on the list of soft keys, not under **Fⁿ**.

You use this function to set an axis value or measure a work-piece feature. This function has different modes of operation.

The basic modes of operation are:


- Datum axis.
- Linear measurement mode.
- Angle measurement mode.
- Diameter measurement mode.

For every probe function, after displaying the results, two more soft keys are enabled:

 Executes the current function again from the beginning.



1/2 Sets the center of the measurement as an origin. This forces the DRO into the Incremental mode, and sets the center as the origin in Incremental mode.

Once the probe soft key is activated, the DP900 displays the current position for all axes. Below the position display, the probe tip (stylus) diameter is shown. It is critical that you enter this information.

1. Press the slider bar next to the probe tip diameter display ()
2. Type in the probe diameter.
3. Press [enter].

Datum axis

This is the most basic operation of the probe. With this you can load an axis loaded with a datum position as determined by a probe touch.

1. Press .
The message window shows 'Probe - Datum'.
2. Select the required axis by pressing the slider bar close to the required axis - X, Y, Z, W or S if summing.
The probe message window shows 'Move to datum'.
The axis display shows '---'.
3. Move the axis to the desired datum point. When the probe is sensed the datum for the selected axis sets at the probe point.
4. Press  to go the basic probe window.

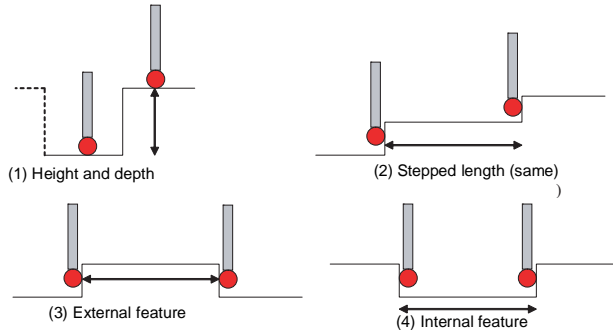
This operation functions in both Incremental and Absolute modes depending on the DRO operating status.

All the other axes continue to display as normal. If you need to set the datum for multiple axes, then you need to do them one at a time using the procedure above.

Mill functions

Linear measurement mode

This can be used for height and length both inside and outside measurements. Under this mode, there are different options:



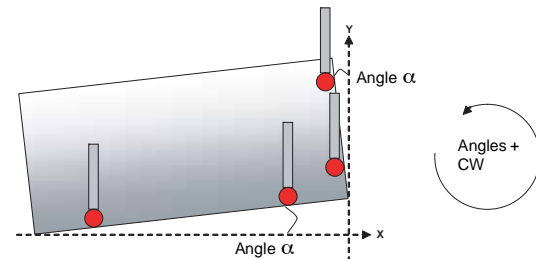
1. Press .
The message window shows 'Probe - measure'.
2. Select the measure mode by pressing the relevant soft key.
3. Select the required axis by pressing the slider bar near the required axis.
All axes revert to the showing position.
The probe message window shows 'Move to Start Posn.'.
4. Move to the start (0) position and touch.
The probe message window shows 'Move to End Posn.'.
5. Move to end position and touch.
The results are shown, as per the measurement option.
6. Press to go to the basic probe window.

This operation functions in both Incremental and Absolute modes depending on the DRO operating status.

Angle measurement mode

This function can be used to measure angles on the work-piece. It can also be used to calculate work-piece skew angles. The Angle Measurement mode has different options.

Skew operation

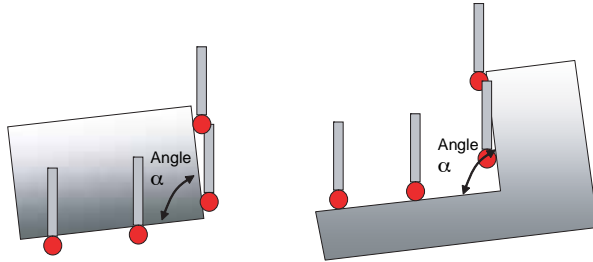


1. Press .
The message window shows 'Probe - angle'.
2. Press .
The probe message window shows 'Move to Position 1'.
3. Move to the starting position and press [enter].
The probe message window shows 'Move to Position 2'.
4. Move to the next position and press [enter].
The probe message window shows 'Move to Position 3'.

Mill functions

- Repeat step 4 for all the positions.
The probe message window displays the values for angle 1 and angle 2.

Corner angle operation



- Press .
The message window shows 'Probe - angle'.
- Press .
- Select the required axis by pressing the slider bar near the required axis
- Move to start position press **[enter]**.
The DRO beeps.
- Move to new position press **[enter]**.
The DRO beeps.
- The result is displayed on the screen.

Diameter measurement mode

This function calculates the diameter of a circular feature from three points. Under this you can choose from the following measurement options.

- Internal diameter measurement.
- External diameter measurement.

For both the measurement modes use following sequence:

- Press .
The message window shows 'Probe - diamtr'.
- Select mode of operation: internal ^{INT} or external ^{EXT} .
- The DP900 displays 'Move to Position 1'.
Move to first point and touch.
The DRO beeps.
- The DP900 displays 'Move to Position 2'.
Move to second point and touch..
The DRO beeps
- The DP900 displays 'Move to Position 3'.
Move to third point and touch.
The DRO beeps.
- The result is displayed after probing the third point.

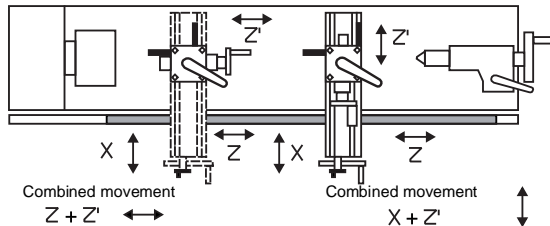
Lathe functions

The following functions are available on **Fⁿ** when you select Lathe Machine:

- Summing
- Vectoring
- Taper

Summing

You use this function to show the combined movement of the X-Z or Y-Z axes pair. The summing axis pair can be displayed on any axis to suit your requirements.



This actually acts as a DRO mode rather than a stand-alone function. It has the following soft keys:

You use this soft key to select the summing pair on each axis. When you press this key, the following options are displayed for each axis:

Acts as a normal axis.

X+Z' You can select this option for the X-axis

Z+Z' You can select this option for the Z-axis.

Exits to the main screen without saving the changes.

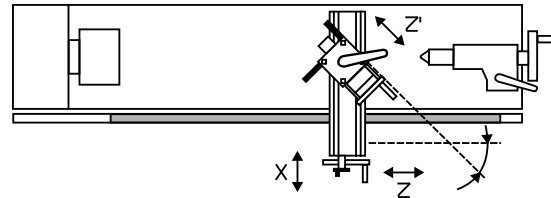
Sets the changes done and exits to the main screen.

Exits to the main screen without saving the changes.

When you set a particular axis to sum mode, its axis legend changes to 'S' and the summing pair is shown below the axis legend.

Vectoring

You use this function to combine the movement of the X and Z axes with the angle of the compound slide.



Combined X movement = $X + Z' (\sin \alpha)$

Combined Z movement = $Z + Z' (\cos \alpha)$

Where α is the vectoring angle.

It has the following soft keys:

Turns the function on. When you apply the function, 'Vect' is shown below the axis legends to show the vectoring angle. The DRO switches back to normal counting mode and the X and Z axes show the combined vectored position. You can perform other functions on these new vectored positions.

Turns the function off.

Changes the vector angle if required.

Lathe functions

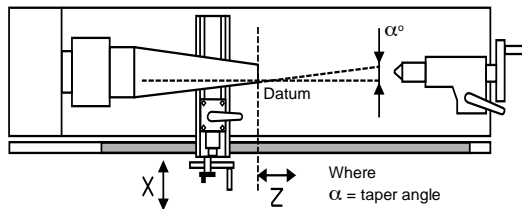
← Sets the changes done and exits to the main screen.

→ Exits from the vector angle screen to the functions list.

→ Exits from the function list to the main screen.

Taper

You use this function for turning or measuring a turned, tapered part. It displays the angle made by the tool current position and the datum position in the X-Y plane.



It has the following soft keys:

← Starts the Taper function.

{set} Selects the datum. The display shows the taper distance (R) and the taper angle (Φ) with reference to the selected datum position.

→ Exits from the function list to the main screen.

Zero approach

You use this function to turn the Zero approach bar graphs on or off in normal mode of operation. It has the following soft keys:

ON Turns the zero approach on.

OFF Turns the zero approach off.

→ Exits from the function list.

Job timer

This is a timer utility and you can use it to get the time or rate for completing a particular job. It has the following soft keys:

✓ Starts the Job Timer.

× Stops the Job Timer.

0 → Resets the Job Timer.

→ Exits from the function list.

\$ You use this to enter the machining rate in units per hour for the machine on which the DRO is operating. If you set this to zero, the main DRO screen shows the Job Timer; otherwise it shows the machining cost. Enter the rate using the numeric keys, then press ← to save the value.

Generic functions

Generic Functions are available in both Lathe and Mill machine mode.


Tools


Tool Setup is different for Mill mode and Lathe mode.



In both, Mill and Lathe modes, you can create a maximum of 99 tools.



Mill mode



In Mill mode, you use this function to program the different tool parameters, such as Diameter, Length, RPM (max) and Speed (max). These parameters can then be referred to in different machining functions, such as Arc contouring and Grid.

When you press  **SET**, the DRO shows the list of previously saved tools. It has the following soft keys:

 Creates a new tool setup. The Data Entry screen is displayed so you can enter a tool name. A maximum of 20 characters is allowed for a tool name.



 **ON**  Applies the selected tool. The information stored under that tool can then be used by the other functions. When you apply a specific tool, its tool number is displayed on the main screen, for example T01. This number also appears next to the tool name.

 **OFF**  Exits from the tool list to the main screen.




  Deletes the selected tool from the list. You are prompted to confirm this before the tool is deleted.

 Edits the tool parameters under the selected tool.

{d.base} You access the Tool Database or Tap/Drill Library using **{d.base}**. It is a reference for standard tools. You can also retrieve the required information for a particular tool from the database. The tool databases provide the required information on tap sizes and clearance drills in both imperial and metric formats. You navigate around the database using the navigation arrow keys. Pressing the **[enter]** key transfers the highlighted database tool diameter and sets this as the current Tool diameter.


 **RBC**  Renames the tool.

Creating a new tool




1. Press  to create a new empty tool.
2. Enter a name using the alpha-numeric keypad.
3. Select the parameter that you want to set using the up and down navigation keys.
4. Enter the required value using the numeric keys, or press **{d.base}** to select a value from the database.
5. Press   to apply the parameters of this new tool and save the tool settings against the tool name.

Editing a tool

Here you can edit an existing tool or view its settings.






1. Press  to enter the desired parameter values.
2. Select the parameter that you want to set using the up and down navigation keys.
3. Enter the required value using the numeric keys, or press **{d.base}** to select a value from the database.

Generic functions

4. Press   to save the tool settings against the tool name.
If you do not wish to save any changes press .

Renaming a tool

Here you can rename an existing tool or view its settings.

1. Press   to open the Data Entry screen.
2. Use the alpha-numeric keys to enter the new name.
3. Press   to save the new name.
If you do not wish to save the changes press .


Lathe mode


The DP900 can store multiple tool offsets. These are the absolute tool positions with respect to a datum (axis zero position).



Before you set up your tools you need to define the centerline of the X-axis. This is best done using a small piece of bar stock and turning it with a tool. Without moving the axis, measure the diameter of the turned part and enter this as your X-axis value. The axis now reads zero when the tip of the tool is at the centerline of the axis.



You also need to set the Z-axis datum. This could be the end of the part used to set the X-axis datum. Set the Z-axis value to zero (0.000).



You should perform the above datuming procedure with the compound 3rd-axis at 0°. If you do not, the Vectoring calculations may be incorrect.

To access the Tool Setup pages, press  **SET**. You should see a screen that lists all the previously defined tools. It has the following soft keys:



 Creates a new tool setup. The Data Entry screen is displayed so you can enter a tool name. A maximum of 20 characters is allowed for a tool name.


  Applies the selected tool. The information stored under that tool can then be used by the other functions. When you apply a specific tool, its tool number is displayed on the main screen, for example T01. This number also appears next to the tool name.



  Exits from the tool list to the main screen.

  Deletes the selected tool from the list. You are prompted to confirm this before the tool is deleted.

 Edits the tool parameters under the selected tool.

  Renames the tool.

When you create a new tool, you are prompted to enter a name for the new tool on the Data Entry screen. You navigate around this keyboard using the navigation keys. You can use  or the **[arrow-centre]** key to select characters quickly. You can enter numbers using the numeric

keypad. Select   to save the name and move to the Tool Setup page.

When you enter the Tool Setup page, the screen shows graphics and text relating to the setup of the tool. The values for RPM and speed are purely for reference and are included as an operator aid to note spindle RPM speeds and/or traverse speeds.

Generic functions

To set the X-axis tool offset:

1. Perform a skim cut with the tool or touch off on a part of known diameter.
2. Highlight the 'Job Dia' option using the up and down navigation keys.
3. Enter the known diameter using the numeric keypad.
4. Press the **{calc X}** key.
The DRO now calculates the tool offset relative to the X-axis datum that you set earlier.

For the Z-axis:

1. Touch the tool off against the defined X-axis datum reference.
2. Press the **{calc Z}** key.
The DRO now calculates the tool offset relative to the Z-axis datum that you set earlier.

You can repeat this process for all the tools in the tool-post and for multiple tool-posts if required.

All the tool offsets are relative to the axis datum. If you move the datum, all tools move relative to the new datum

If a tool is broken, you can replace it and calculate a new set of offsets using the above procedure.







Example:

To set the machine datums:

1. Place a piece of bar stock in the chuck and turn using a selected tool.
2. Measure the diameter of the bar. Do not move the axis.
3. Enter this diameter on the X-axis.
The centerline is now 0.000.
4. Move the tool to the end of the bar and touch or skim.

5. Set the Z-axis position to zero (0.000).

Creating a new tool





1. Press  SET.
2. Press .
3. Enter a name (e.g. T1).
4. Press  .
5. Skim cut a sample piece.
6. Measure the resulting diameter. Do not move the axis.
7. Enter this diameter as 'Job Dia'.
8. Press **{calc X}**.
The DP900 calculates the offset value.
9. Move the tool to the end of the part.
10. Touch the end of the part, but do not back off.
11. Press **{calc Z}**.
The DP900 calculates the offset value.
12. Add information for RPM and Speed (select using the up and down navigation keys).
13. Press  .

Editing a tool




This is the same as creating a tool offset only the tool's name and its current tool offsets are already filled in.

Generic functions




Renaming a tool

1. Highlight the tool that you wish to rename using the the up and down navigation keys.
2. Press **RBC**  to open the Data Entry screen.
3. Use the alpha-numeric keys to enter the new name.
4. Press   to save the new name.
5. If you do not wish to save the changes press .

Turning on a tool offset

1. Press .
2. Highlight a tool from the tool list using the up and down navigation keys.
3. Press  .

Turning off tool offsets

1. Select .
2. Press  .













Sub datums

Sub datums are different machining steps that you may need. In operation, the absolute datum of the machine is replaced by each sub datum in turn, so you can work to zero for each step instead of having to constantly refer to a printed list of coordinates.

Using this function, you can create as many as 50 jobs that each contains up to 20 sub datums. Here, a job is a group of sub datums for a particular

job. You can give each job a 20-character name which is stored in the permanent memory.

Creating a job







1. Press  .
2. From the Sub Datum selection screen press . This opens a new sub datum job.
3. Press .
4. You can either enter the axis co-ordinates using the axis load or move the axes to the required position.
To use axis load:
Press the slider bar close to the axis.
Enter the coordinates.
Press **[enter]**.
5. Press   to save the coordinates and move to the next step. The information bar shows the current step / total # of saved steps.
6. If you make a mistake or decide you do not want the point you have created, press  .
7. Once you have entered all the Sub Datums, press  twice.
The job is automatically named 'LAST JOB'. You do not have to rename the job at this point you can leave it as 'LAST JOB' until you decide whether you want to keep it. You can then rename it later if you want to keep it. Press **RBC**  to enter a name for that job. Once you have named the sub datum, press  .

Generic functions


Editing a job





Occasionally, you may need to edit a sub datum job as specifications change.

Adding or deleting steps from a sub datum

1. When in normal mode, press . A list of existing jobs is displayed. The numbers on the right indicate the number of sub datums for each job.
2. Press . The information bar shows 'SDM'. It also shows (current step) / (total number of steps). The DP900 is now in SDM graphical mode.
3. Press . The information bar show 'SDM'. It also shows (current step) / (total number of steps). The DP900 is in SDM graphical edit mode. The sub datum number and name are displayed. You use the up and down navigation keys to zoom in and out.
4. Use  to add a step.
5. Use  to delete a step.
6. To exit sub datums edit mode, press  twice.





Editing sub datum coordinates

1. When in normal mode, press . A list of existing jobs is displayed. The numbers on the right indicate the number of sub datums for each job.
2. Use the up and down navigation to select a job.





3. Press . The information bar shows 'SDM'. It also shows (current step) / (total number of steps). The DP900 is now in SDM graphical mode.
4. Use  to go to the next step. Use  to back up a step.
5. You can either enter the axis coordinates using axis load or move the axis to the required position.
To use axis load:
Press the slider bar close to the axis.
Enter the coordinates.
Press Enter
6. To exit sub datums from graphical mode, press  twice.

Any changes that you make are automatically saved.

Using sub datums

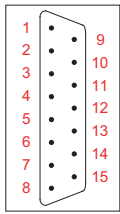
1. When in normal mode, press . A list of existing jobs is displayed. The numbers on the right indicate that number of sub datums for each job.
2. Use the up and down navigation keys to select a job.
3. Press .
The information bar shows 'SDM'. It also shows (current step) / (total number of steps). The DP900 is now in SDM graphical mode.
4. If you prefer to use Sub Datums in normal display mode instead of graphical mode:
Press  . While in normal display mode, you can move from point to point using the up and down navigation keys. The DP900

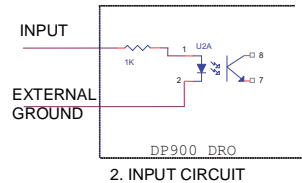
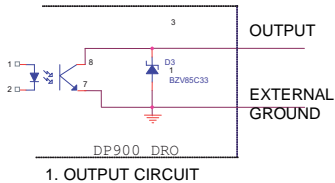
Generic functions

- displays 'SDM - (Job #) / (Coordinate #)' in the upper left hand corner. Press  to return to graphical mode.
- 5. Move each axis until it reaches zero. Perform the machining step.
 - 6. Use the  key to go to the next step. To back up a step, press .
 - 7. To exit sub datums from graphical mode, press  twice.

Auxiliary function

The following table shows the pin connection for the DP900 Auxiliary operation.

	Pin No.	Description	Pin No.	Description
	1	—	9	—
	2	—	10	—
	3	—	11	—
	4	Ext. GND	12	Output 4
	5	Input 4	13	Output 3
	6	Input 3	14	Output 2
	7	Input 2	15	Output 1
	8	Input 1		



Input and Output Specifications:

Maximum Voltage (V max) = 30V DC

Maximum Current (I max) = 150mA

Input

You need to allocate an input for each axis. You configure these as:

Axis	Input	Options Available
X	1	Off Reset X
Y	2	Off Reset Y
Z	3	Off Reset Z
W	4	Off Reset W Enter key External Angular Reference Input

Generic functions

- Off - No action is taken. This is the default option.
- Reset Axis - Sets axis value to zero or resets the output for that axis. (See Output on page 39 for more details).
- Enter key - Works as an enter key (Option available only for Input 4).
- External Angular Reference Input - Works as external angular reference input (Option available only for Input 4).

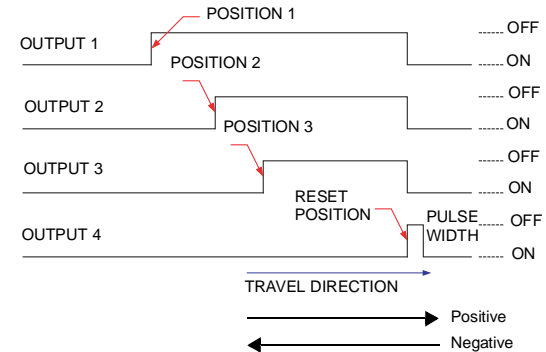
Output

You can configure the output in two modes: Single axis operation and Multiple axis operation.

If the DP900 power is disconnected during output operation, all output parameters are reset to factory defaults. This is done for safety reasons. If power disconnect happens after the reset, the output parameters are stored in memory.

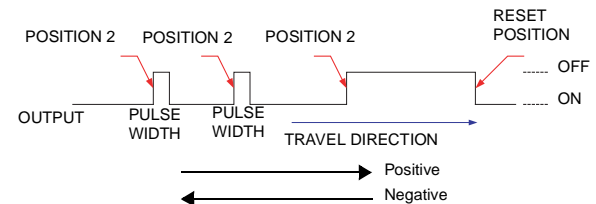
Single axis operation

In this mode, the outputs are all used by the positions set for a selected axis. So for single axis operation, any one axis can be configured for this operation. You can use {pos.} to set a particular axis to operate as a single output mode. The following diagram explains its operation in detail.



Multiple axis operation

In this mode, you assign each output line to an individual axis, so Output 1 is for the X-axis, Output 2 is for the Y-axis, etc. A pulse is issued whenever an axis passes a set position. The following diagram explains its operation in detail:



Generic functions

Reset sources

The reset is generally activated when the encoder reaches its designated position. However the reset can also occur by two further mechanisms:

- An output reset occurs if the input for that axis (see Input on page 38) has been configured for reset. To use this mode, you should set the Reset Position option to 'off' and the corresponding axis input to Reset. In this case, where the input is used to reset an active output, the axis value is not set to zero, only the Output Reset is issued.
- If you press the **[enter]** key when in normal mode, all the resettable axes reset. To use this mode, you should set the reset position option to OFF for this function to be active. Note that this does not happen when the **[enter]** key is a valid key for other functional operation. When a reset of this nature occurs, the 'Aux. Reset' message is displayed.

You can set all the Auxiliary settings in DRO setup mode.

You can set Position 1, Position 2, Position 3, Reset Position and Pulse width for individual axes using {set}. You can turn off each position status if a particular output is not required.

Aux. output example circuit

In this example the Auxiliary Connector is used to drive an external relay.

Relay:

Manufacturer : Omron Part #: MK2PNS24DC

Contact Form DPDT

Coil Voltage Rating = 24V DC, (Maximum Voltage = 26.4V, Minimum Voltage = 19.2V)

Rated Coil Current = 56mA, Coil Resistance = 440 ohms.

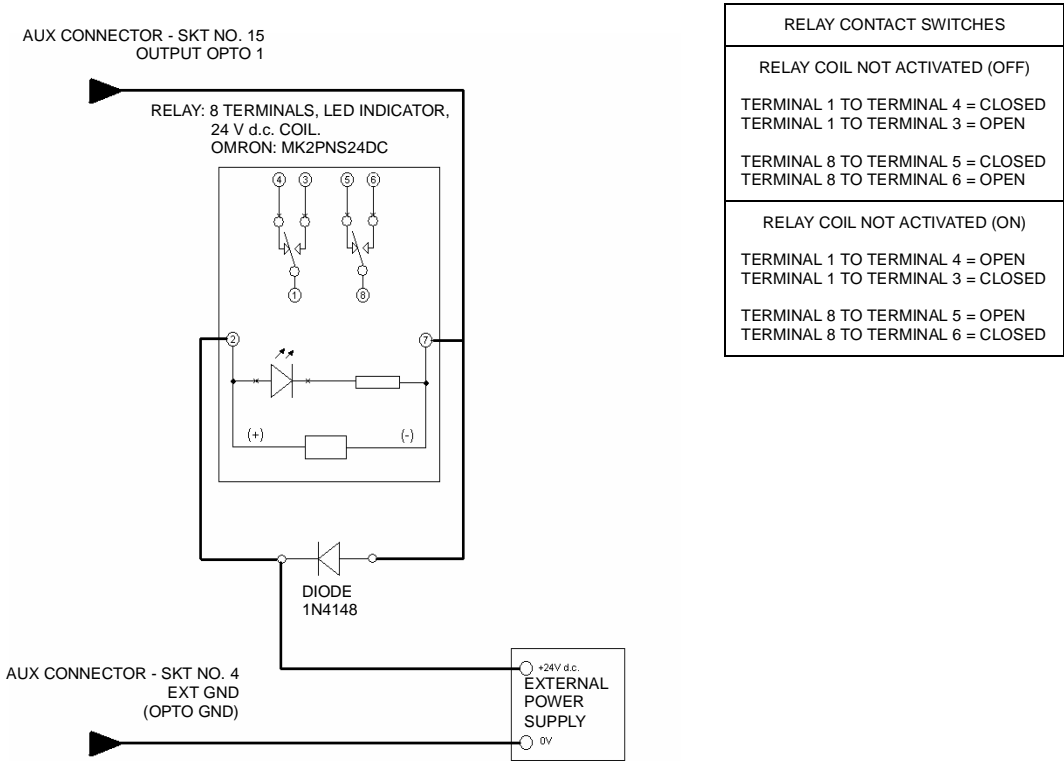
The open collector transistor output from the DP900 Auxiliary Connector allows for a maximum voltage of 30V to be switched, and it can sink up to

150mA of driving current. In this example, both the voltage of 24V DC and the current of 55mA, are within the specified limits (Max Voltage 30V DC, max current 150mA).

The current that is required to activate the relay coil is approximately 55mA (calculated by dividing the External Power Supply voltage of 24V by the Relay Coil Resistance that is 440 ohms).

The circuit diagram is shown on page 41. You need to supply the External Power Supply. A reverse biased diode connected across the coil is used to prevent damage to the Auxiliary Port from back EMF generated by the Relay Coil when the Coil is switched off.

Circuit diagram



Troubleshooting

This Troubleshooting section is intended for use in conjunction with the applicable user manuals. Please follow the troubleshooting steps below and call our Tech Support Department with the results.

Problem	Steps to take
Nothing happens when the power switch is turned on (Axis windows are blank)	<ol style="list-style-type: none">1. Unplug power to the DP900. Check the fuse.2. Test the input voltage to the display unit with a voltmeter.3. Disconnect all reader head cables. A defective reader head could prevent the display from powering up.4. Connect power and turn the display on. Did the display power up with encoders disconnected? If so, connect one encoder at a time until the failed encoder has been isolated. Be sure the unit is turned off while connecting / disconnecting encoder cables.
Display shows 'Signal Fail' or 'No Signal' in one axis	<ol style="list-style-type: none">1. Turn off the display.2. Take the reader head cable from the malfunctioning axis and plug it into the other axis of the display.3. Turn the display on.4. If the scale works properly when connected to the other axis of the display, the source of the fault is the display. The display needs to be repaired. Note: You may need to go to Setup mode and adjust the scale type, radius / diameter and error compensation parameters to get accurate readings. The main goal in this step is to identify the source of the signal fail / no signal error.5. If the malfunction followed the scale cable to the other axis of the display, the source of the fault is the reader head. Replace the reader head. <p><i>Signal Fail or No Signal errors cannot be caused by incorrect parameter settings.</i></p>

Problem	Steps to take
Inaccuracy in one axis	<ol style="list-style-type: none"> Go to Setup mode and check the following settings: <ol style="list-style-type: none"> Apply Compensation - Set to 'none' on all axes. Scale Type - Set to read the correct scale type for each axis (Spherosyn, Microsyn 5, Microsyn 10). Radius / Diameter - Diameter should display a 2:1 ratio. Radius should display a 1:1 ratio. Put a dial indicator on the edge of the reader head. Move the axis. Compare the dial indicator reading to the display reading. If there is a discrepancy that exceeds our accuracy specifications, proceed to the next step. Take the reader head cable from the malfunctioning axis and plug it into the other axis of the display. (You may need to go to Setup mode and adjust parameters to match the type of scales that are connected.) If the malfunction was corrected when the cable was moved to the other axis, the source of the fault is the display. The display needs to be repaired. If the malfunction followed the cable to the other axis, the source of the fault is the reader head and scale assembly. If this is the case, proceed to the next step. Check for any physical damage to the reader head and cable. Check the reader head for proper alignment. It must be aligned within .002" on each side. Refer to the installation manual for instructions on reader head alignment. Check the scale to make sure there is no binding on the scale. If the scale brackets are slightly loosened, you should be able to slide the scale back and forth through the brackets with minimal resistance. If you have a Spherosyn scale, ensure that the scale is not bent. Remove the scale and roll it on a flat surface. If the scale is bent at all, it will cause inaccuracies. Replace the scale if it is bent. If there is no binding on the scale, the reader head is aligned, and the scale is not bent, the malfunction must be coming from the reader head. Replace the reader head.

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