HEIDENHAIN

Operating Instructions

ND 1400 QUADRA-CHEK

(QC 330)

English (en)
2/2010

QC-330 Series
User's Guide

Touch Probe Systems
QC-330 and QC-331

QC-330 Series Touch Probe Systems
User's Guide

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Conventions & Terms

QC-330 refers to any of the QC-330 series of instruments. System refers to the QC-330 and the measuring devices connected to it.

Icons

This guide uses the following icons to highlight information:

WARNINGS

The raised hand icon warns of a situation or condition that can lead to personal injury or death. Do not proceed until the warning is read and thoroughly understood.

DANGEROUS VOLTAGE

The lightning icon warns of the presence of a dangerous voltage within the product enclosure that might be of sufficient magnitude to cause serious shocks or death. Do not open the enclosure unless you are a qualified service person approved by Metronics, Inc., and never open the enclosure while power is connected.

CAUTIONS & IMPORTANT INFORMATION

The exclamation point icon indicates important information regarding equipment operation or maintenance, or a situation or condition that can lead to equipment malfunction or damage. Do not proceed until the information is read and thoroughly understood.

NOTE

The note icon indicates additional or supplementary information about an activity or concept.

Safety & Maintenance Considerations

General safety precautions must be followed when operating the system. Failure to observe these precautions could result in damage to the equipment, or injury to personnel.

It is understood that safety rules within individual companies vary. If a conflict exists between the material contained in this guide and the rules of a company using this system, the more stringent rules should take precedence.

Additional safety information is included on the next page and in Chapter 2: Installation.

WARNINGS

Disconnect the QC-330 from power before cleaning.

The QC-330 is equipped with a 3-wire power plug that includes a separate ground connection. Always connect the power plug to a 3-wire grounded outlet. The use of accessories that remove the third grounded connection such as a 2-wire power plug adapter create a safety hazard and should not be permitted. If a 3-wire grounded outlet is not available, ask your electrician to provide one.

DANGEROUS VOLTAGE

Do not open the enclosure unless you are a qualified service person approved by Metronics, Inc., and never open the enclosure while power is connected. There are no user-serviceable components or assemblies inside. Refer servicing to qualified service personnel.

General Maintenance

Disconnect the QC-330 from power and seek the assistance of a qualified service technician if:

- The power cord is frayed or damaged or the power plug is damaged
- Liquid is spilled or splashed onto the enclosure
- The QC-330 has been dropped or the exterior has been damaged
- The QC-330 exhibits degraded performance or indicates a need for service some other way

Cleaning the enclosure

Use only a cloth dampened with water and a mild detergent for cleaning the exterior surfaces. Never use abrasive cleaners, and never use strong detergents or solvents. Only dampen the cloth, do not use a cleaning cloth that is dripping wet. Instructions for cleaning the touch screen are different and are given below.

Cleaning the touch screen

The touch screen should be cleaned as described below to prevent scratching or wearing the screen surface and to prevent liquids from leaking into the enclosure.

Use only a soft, lint-free cloth dampened with water for cleaning the touch screen. Never use abrasive cloths or paper towels. Never use abrasive cleaners, and never use detergents or solvents. Only dampen the cloth, do not use a cleaning cloth that is dripping wet. Never spray the screen.

If the screen is badly soiled, the cloth can be dampened with a 50:50 mixture of isopropyl alcohol and water. Remember, only dampen the cloth, do not use a cleaning cloth that is dripping wet, and never spray the screen.

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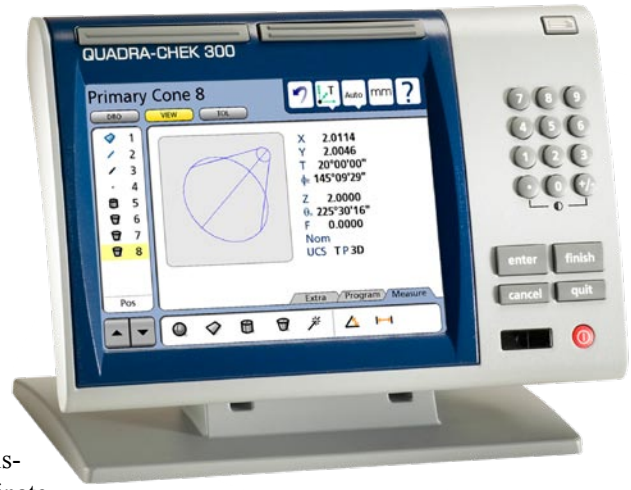
Chapter 1: Overview

The Quadra-Chek 330 series is a family of advanced digital readout systems for performing 2, 3 and 4 axis measurements at very high levels of precision and accuracy. Dimensional inspection of components can be made using CMM touch probe systems as part of in-line production activities or final quality inspection.



Feature points are entered using fixed, indexing or friction touch probes. Feature type can automatically be determined by the system using Measure Magic technology. Level and skew compensation can be performed on misaligned parts prior to measurements to eliminate the need for time-consuming fixturing.

The intuitive interface will be familiar to users of the QC-200 and other Metronics digital readouts. Operators will find the QC-330 easy to understand and use thanks to the large color touch screen LCD display.

The color LCD displays alphanumeric and graphic information for the current measurement, part features and measurement data clearly on one screen, eliminating the need to page or scroll or navigate for information.

Touch screen controls select the feature to be measured, change operating and display modes, zero axes, and configure setup parameters. Touch screen controls change to support measurement-specific functions displayed on the LCD screen.

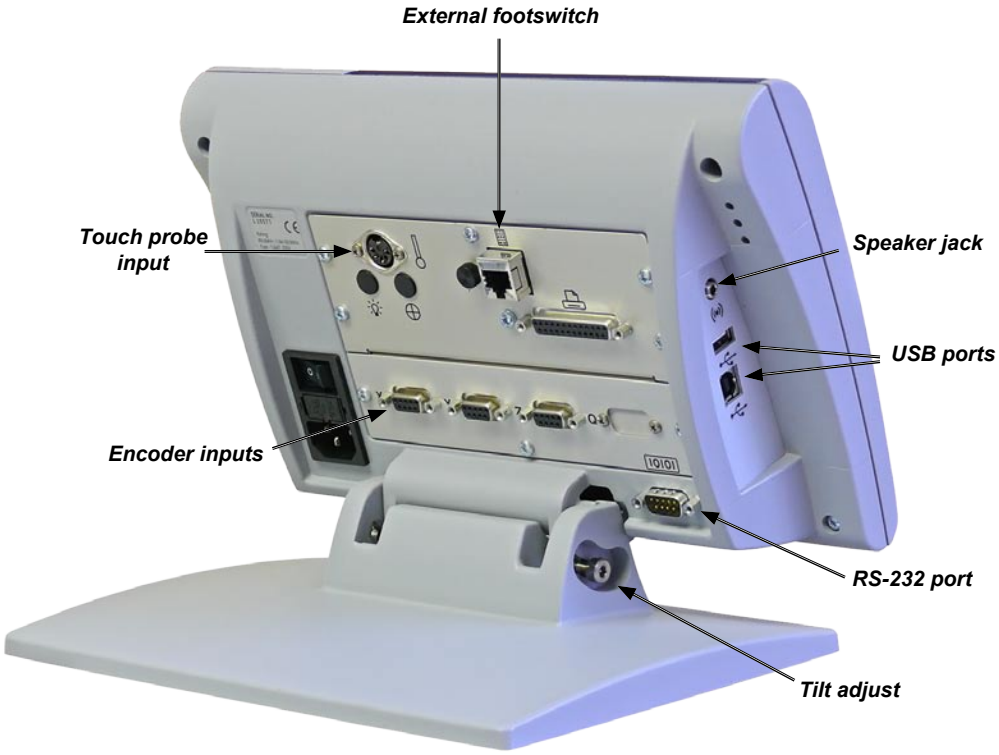
Front panel keys enter numeric data, turn the LCD on or off and send data to a printer or computer. Two wide keys located over the LCD can quickly be pressed without looking at the front panel to initiate frequently used functions programmed by the user. All front panel keys provide tactile sensory feedback, and key-press operations can be configured to generate an audible sound.

Speaker and external speaker jack outputs are provided that can be adjusted for quiet or noisy environments. Ear phones can be plugged into the external speaker jack to facilitate silent operation in quiet environments.

Sequences of key-presses and touch probe contacts used to perform measurements can be recorded and stored as programs. These programs can be replayed later to perform complete measurement sequences. Sequences can be as simple as measuring a line, or can be expanded to include skew adjustment, datuming, the measurement of multiple features, tolerancing and printing reports of measurement results.

Measurement results can be saved to a USB flash drive, transmitted to a PC over the RS-232 port or printed on a USB printer.

Description of QC-330 Features



The compact ergonomic design and adjustable-tilt front panel of the QC-330 allow users to locate and mount the instrument in a wide variety of environments that accommodate nearly any viewing requirement. The tilt front panel can be adjusted and secured in any convenient position. Rubber feet on the bottom prevent slipping when the system is not permanently bolted to a work surface using the bolt holes provided in the bottom of the mounting stand.

Jacks are provided for an optional foot switch or hand switch. All the optional accessories for the QC-330 are shown in detail at the rear of this guide in Chapter 13: Options.

Chapter 2: Installation

The QC-330 is easy to install in a variety of basic and advanced measurement applications. This chapter describes how to unpack and install the QC-330. Repackaging instructions are also included for return shipments and for distributors and OEM customers that are configuring a QC-330 and shipping it to an end-user.

Unpacking the QC-330

Carefully remove the contents of the shipping carton.

NOTE
Save the carton and packaging materials in case future return shipment becomes necessary.

Inspect the components listed below for shipping damage. The contents of the carton includes:

- QC-330 instrument
- Power cord
- Mounting stand and hardware
- Warranty registration card

Shipments of other optional equipment in separate cartons might include:

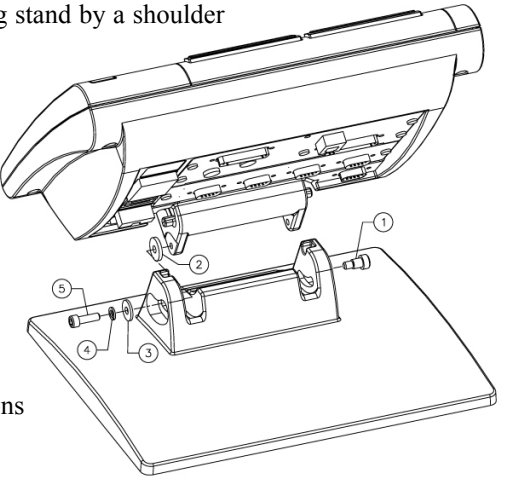
- RS-232 serial cable
- Foot switch or hand switch
- QC-Wedge software

If any components were damaged in shipment, save the packaging materials for inspection and contact your shipping agent for mediation. Contact your Metronics distributor for replacement parts.

Assembling the mounting stand

The QC-330 is secured to the swivel slots of the mounting stand by a shoulder screw, a cap screw and associated washers.

Assemble the QC-330 to the mounting stand as shown. Tighten the shoulder screw (1), and then tighten the cap screw (5) and washers (3 & 4) so that the QC-330 will be secure when adjusted to the desired tilt position.



Safety considerations

The QC-330 is completely enclosed and no hazardous outputs can come in contact with the user. Safety considerations are related to power connections and physical mounting.

WARNING
If the QC-330 falls from its mounting location, serious personal injury or damage to the equipment can result.

Power cord and plug

Do not locate the power cord where it can be walked on or will create a tripping hazard. Connect the 3-wire power plug to only a 3-wire grounded outlet. Never connect 2-wire to 3-wire adapters to the power cord or remove the third ground wire to fit the plug into a 2-wire electrical outlet. Modifying or overriding the third-wire ground creates a safety hazard and should not be permitted.

DANGEROUS VOLTAGE
Always disconnect the power cord from the source of AC power before unplugging it from the QC-330 power connector. The AC voltage available at electrical outlets is extremely dangerous and can cause serious injury or death.

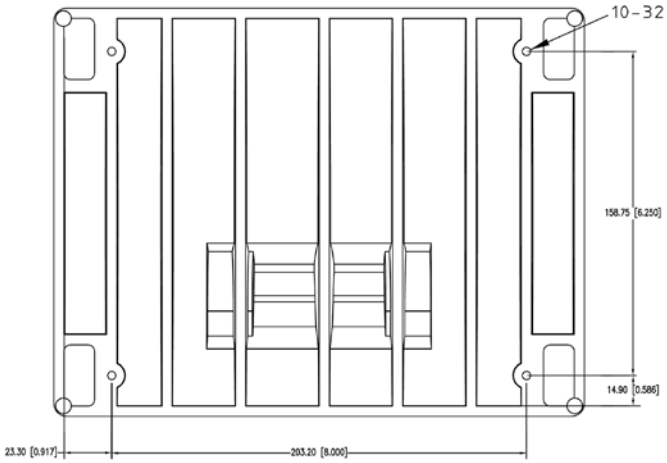
Electrical wiring and connections

Perform regular inspections of all connections to the QC-330. Keep connections clean and tight. Locate cables away from moving objects. Do not create tripping hazards with power cords, input/output cables or other electrical wiring.

Use shielded cables to connect to the serial RS-232 port. Make certain that cables are properly terminated and firmly connected on both ends.

Location and mounting

Rest the QC-330 on a flat, stable surface, or bolt it to a stable surface from the bottom using four 10/32 screws fastened in the pattern shown at the right.



Mounting holes tapped for 10-32 screws
Dimensions in millimeters/inches

Power surge suppressor

Connect the QC-330 to power through a high-quality power surge suppressor. Surge suppressors limit the amplitude of potentially damaging power line transients caused by electrical machinery or lightning. When a surge suppressor is not used, power line transients can corrupt system memory or damage circuits.

Connecting axis encoders

Axis encoders are attached to interface connectors on the rear of the QC-330. Many encoder interfaces are available to match the wide variety of encoders that can be used with the QC-330. The type of axis encoder connectors will vary depending on the application. Encoder inputs are specified as analog or TTL at the time of purchase and cannot be changed in the field.

1 Verify that the QC-330 is off.

2 Connect the axis encoders tightly to their connectors. An axis label is provided near each connector. Do not overtighten the connector screws.

Encoder input parameters must be configured later using the Encoder setup screen. Please refer to Chapter 10: Setup for details regarding encoder setup.

Connecting the touch probe input

The fixed or manually indexed touch probe is connected to the Renishaw® connector on the rear of the QC-330.

1 Verify that the QC-330 is off.

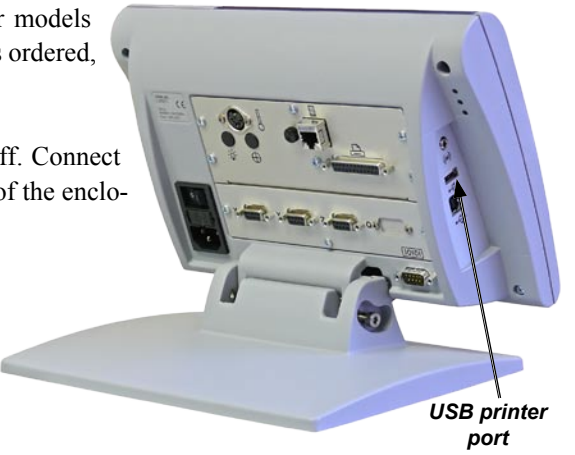
2 Connect the touch probe to the Renishaw connector on the rear panel.

Connecting a printer

The QC-330 supports certain USB printers. Printer models should be specified by Metronics when the QC-330 is ordered, or approved by Metronics later.

1 Verify that the QC-330 and printer power are off. Connect the USB printer to the USB Type A port on the side of the enclosure.

2 Make sure the USB cable plug is fully inserted.

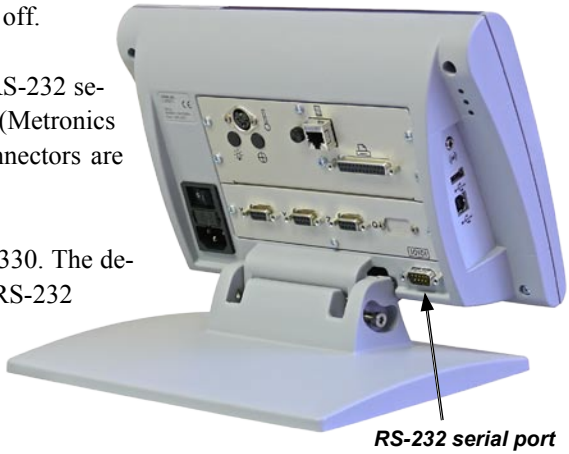


Connecting a computer

1 Verify that the QC-330 and computer power are off.

2 Connect a computer COM port to the QC-330 RS-232 serial port using a standard straight-through serial cable (Metronics part number 11B12176). Make sure the cable connectors are tight, but do not overtighten the connector screws.

3 Apply power to the computer, and then the QC-330. The default QC-330 settings for communication over the RS-232 serial port are shown here.



- Baud rate: 1200
- Parity: None
- Data bits: 7
- Stop bits: 1
- Flow control: Hardware

4 Launch the computer application that will be used to communicate with the QC-330, and configure the communication properties of the COM port to match those of the QC-330.

Connecting an optional footswitch

The optional foot switch is connected to the RJ-45 connector on the rear of the QC-330.

1 Verify that the QC-330 is off.

2 Connect the foot switch to the RJ-45 connector on the rear connector panel.

Warranty registration form

The warranty registration form included in the shipping carton should be completed and mailed as soon as possible. Also record the purchase and warranty information here so that it will be readily available later to support any necessary interactions with distributor or factory technical support personnel.

QC-300 model number	QC-300 serial number
Purchased from	Date received
Software version number	

The software version can be found in the Hardware setup screen. Refer to Chapter 10: Setup for screen descriptions.

Repackaging for shipment

Repackage the QC-330 in the original packaging as received from the factory, or equivalent. It is not necessary to ship the base when shipping the QC-330 for repair.

CAUTION
The original packaging must be duplicated and the LCD must be inserted face-up to prevent damage to the LCD screen.

Pay special attention to the following instructions:

1 Connect any loose mounting hardware to the QC-330 instrument

2 Repackage the foam and cardboard carton inserts as originally shipped from the factory.

3 Place the QC-330 into shipping carton with the LCD facing up.

4 Replace the warranty card and slip sheets found at the top of the carton. The "Before you begin" slip sheet should be inserted last.

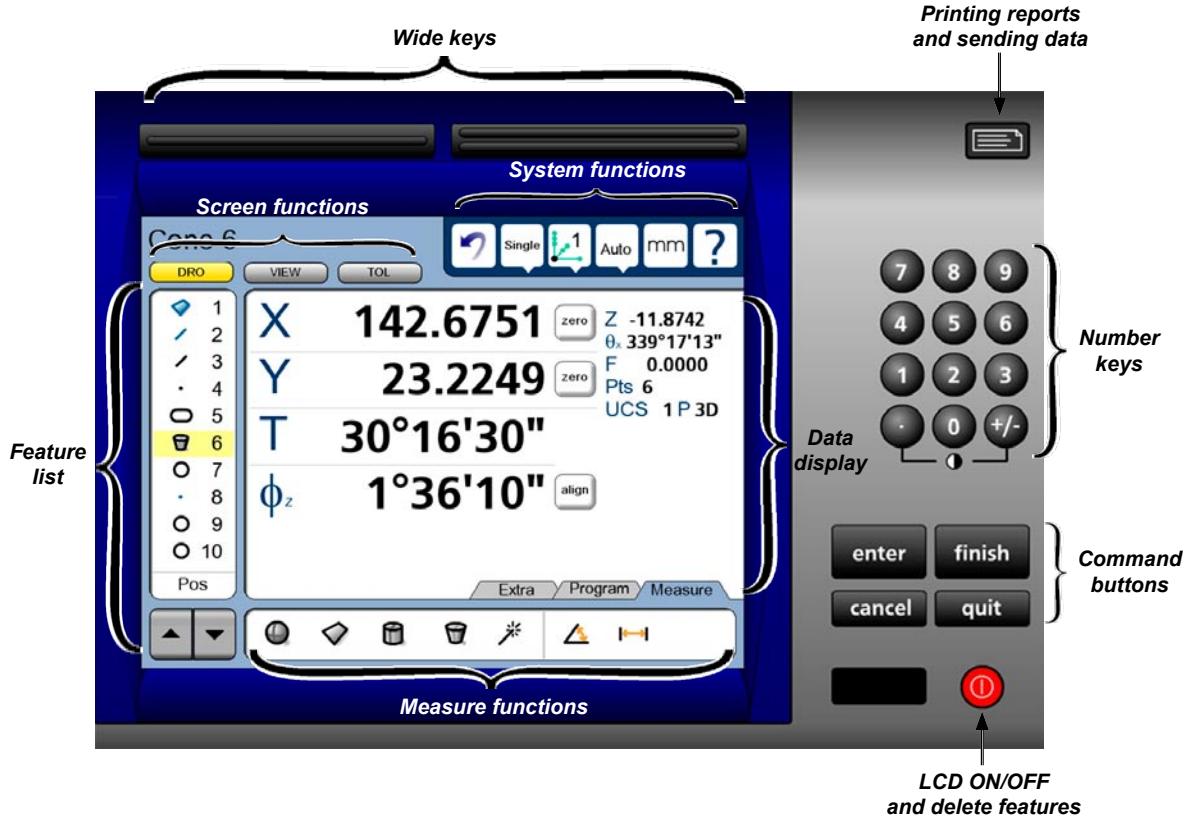
What's next?

Proceed to Chapter 10: Setup to configure your QC-330 for use. Follow the instructions for *Minimum Setup* requirements.

Chapter 3: User Interface

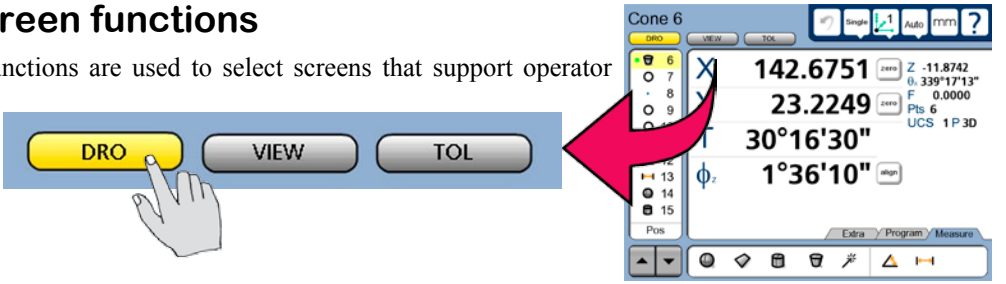
The QC-330 user interface consists of hardware front panel buttons and number keys that work in cooperation with software menus, buttons, and data fields shown on the color LCD touch screen. The hardware/software interface is divided into the function areas listed and shown below.

- Screen functions
- Data display
- Measurement functions
- Feature list
- System functions
- Command buttons and wide keys
- Number keys
- LCD ON/OFF or delete features
- Printing reports and sending data



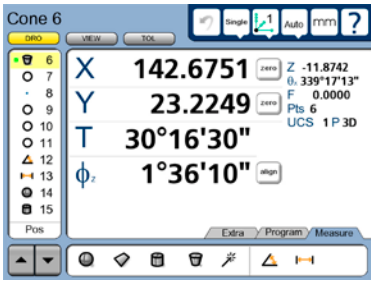
LCD Screen functions

The LCD functions are used to select screens that support operator activities.

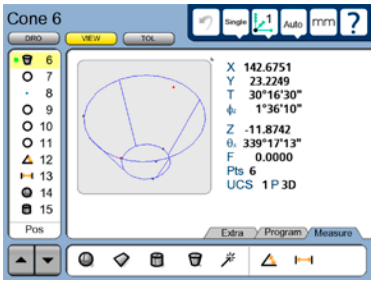


Touch a button to select the desired screen.

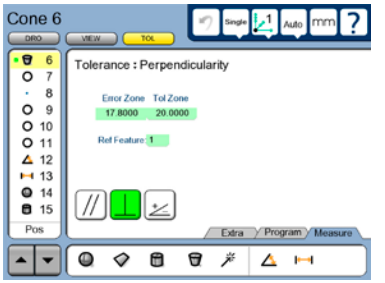
- DRO Displays the digital readout
- VIEW Displays the selected feature's data cloud and physical geometry
- TOL Displays the tolerance screens for entering and editing tolerances



DRO screen



VIEW screen



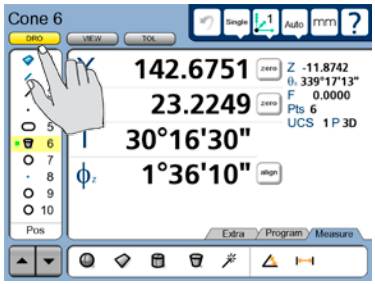
TOL screen

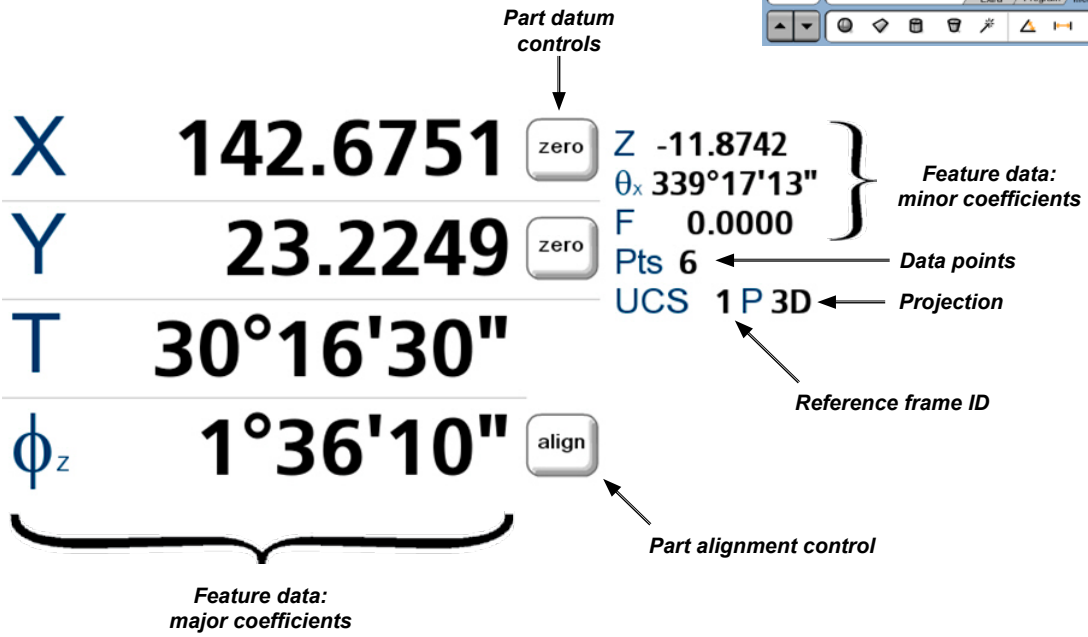
Data display

Data is displayed on the DRO, View and Tol screens.

DRO screen

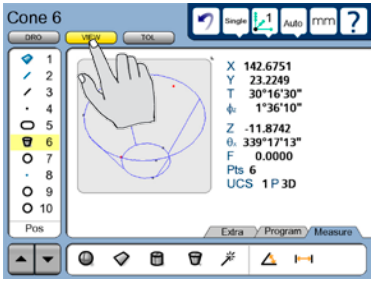
Press the DRO button to display the DRO screen. Measurement data, reference frame, projection, part alignment controls and part datum controls are shown on the DRO screen.

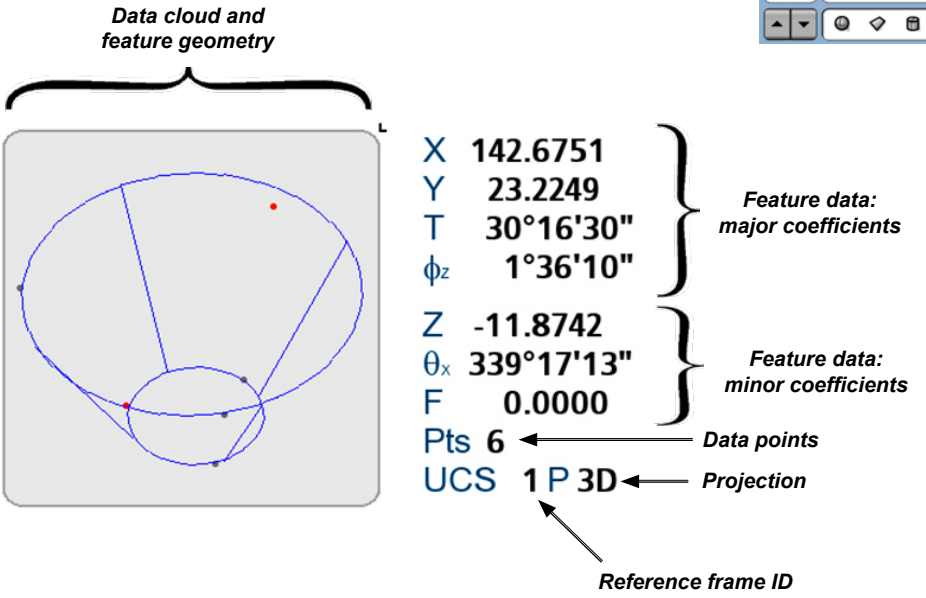




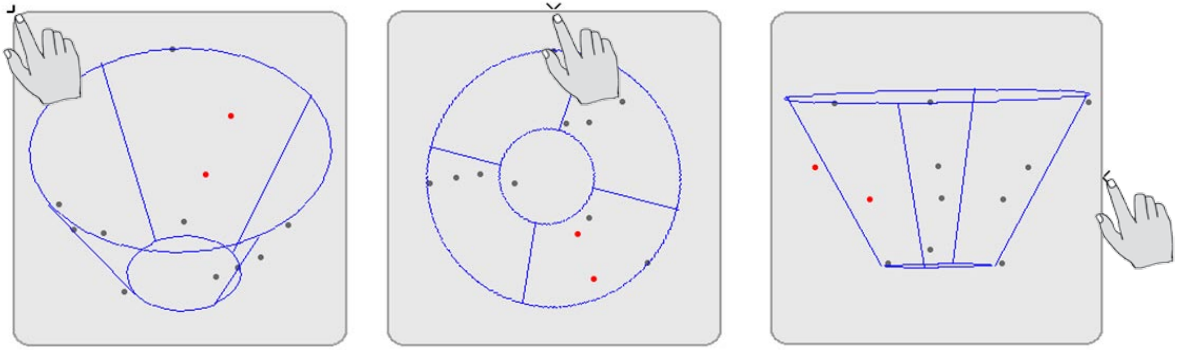
View screen

Press the VIEW button to display the VIEW screen. Measurement data, reference frame, projection and an image of the data cloud and resulting feature geometry are shown on the View screen.



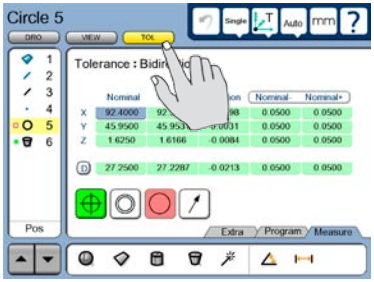


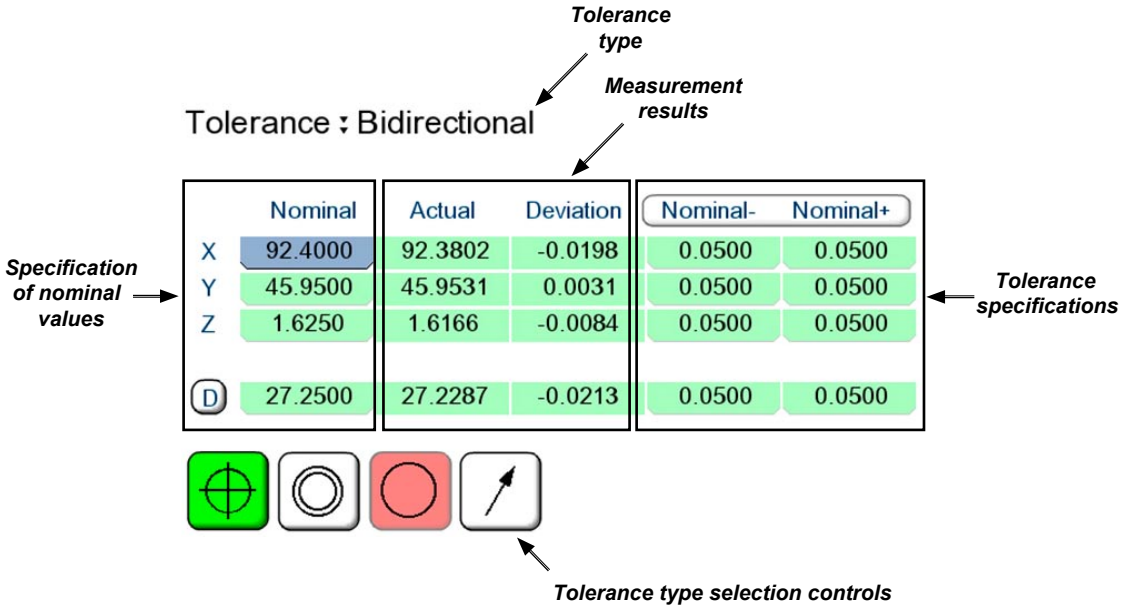
The view of the feature geometry is rotated by touching center or corner points at the edge of the image or by touching and dragging across the screen.



TOL screen

Press the TOL button to display the Tolerance screen. Tolerance data, tolerance type selections and tolerance specification fields are shown on the TOL screen.





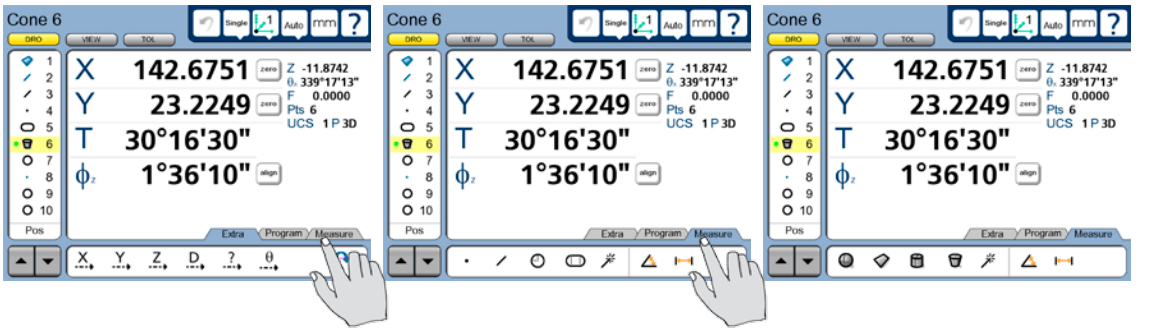
Measurement functions

The measurement functions are divided into three tabbed areas:

- Measure — Select a measurement type, such as circle, line or sphere
- Program — Record, edit or play back a program of measurement steps
- Extra — Send data to the RS-232 port

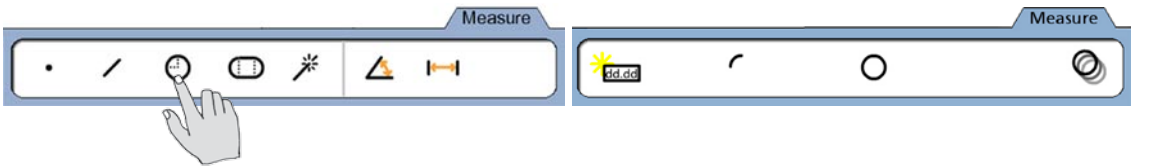
Selecting a measurement type

Measurement types are selected from the Measure tab. Touch the Measure tab repeatedly to display icons in the measure tab for the different 2D and 3D measurement types.



Touch the Measure tab to display measurement types... ***then touch the Measure tab repeatedly to alternately display 2D and 3D measurement types***

Touch a measure icon to select the desired measurement type. In some cases, such as when selecting circles and slots, related measurement types will also be presented as shown in this example of touching the circle icon to display the arc measure type.

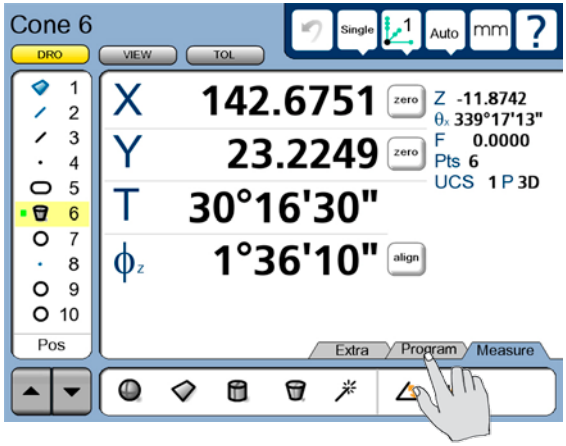


Touching the circle measure icon... ***displays circle and arc measurement types***

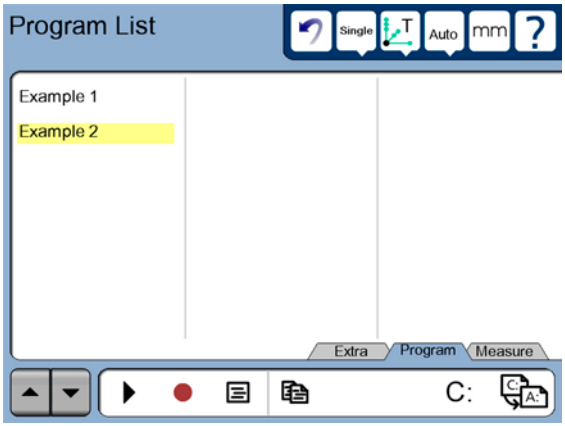
NOTE
Details regarding performing measurements and the use of measurement tools are provided in Chapter 6: Measuring.

Accessing programs

Programming functions are accessed from the Program tab. Touch the Program tab to display a list of programs and show programming tools. Details regarding programming and the use of programming tools are provided in Chapter 8: Programming.



Touch the Program tab...



to display programs and programming tools

Touch a program tool icon to play, record, edit, copy, stop or add a user message to a measurement program. In the Edit mode, completed program steps are shown in the feature list.

Programming tools shown before recording

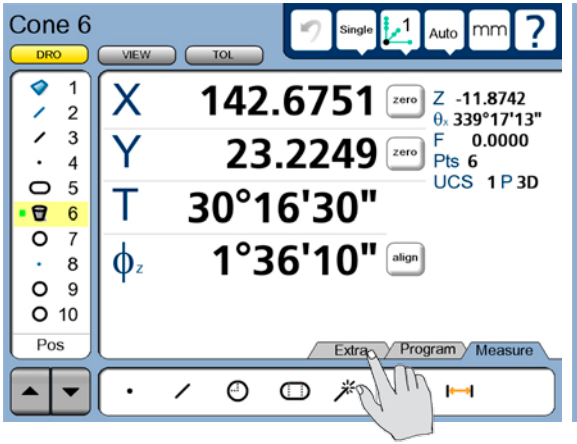
Programming tools shown during recording

- Run a program
- Record a program
- Open edit mode
- Copy a program
- C: Select a drive
- Copy to drive

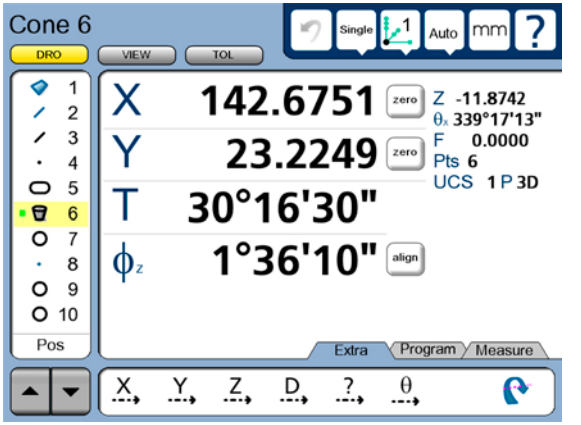
- Run a program
- Stop recording
- Open edit mode
- Include user message

Sending data to a computer from the Extra tab

Touch a data icon shown in the Extra tab to send the corresponding data element for the current position or selected feature to a computer over the RS-232 serial port. Touch the Extra tab again to display more data choices.



Touch the Extra tab...



to display the data choice icons

NOTE
The Extra tab sends data only to the RS-232 port and is configured in the Display setup screen. Please refer to Chapter 10: Setup for details.

The data sent to the RS-232 serial port always correspond to the information displayed in the DRO screen. The information types are shown in the upper-left corner of the screen and are:

- Current position (no feature selected)
- Feature measurement (feature selected)

NOTE
Touching an icon for an inappropriate data type produces no result. For example, touching the diameter icon when a circle feature is selected in the feature list sends diameter data to the serial port, however, touching the diameter icon when a line is selected produces no result.

The Extra tab is typically used to send abbreviated data to the RS-232 serial port since complete reports or screens of data can be sent using the Print function described in Chapter 10: Setup. However, a complete data set can be sent for a feature from the Extra tab by touching the required series of icons in succession. The transmission of data to the serial port from the Extra tab can be included in programs, like any other measurement, tolerancing or reporting activity.

Extra tab functions

Space menu insert

The space insert is included in the Extra tab to separate control functions into groups on the tab.

Divider line menu insert

The divider line insert is included in the Extra tab to separate control functions into groups on the tab without using a space insert.

Transmit feature data

X Y Z r D L W θ When the user touches any transmit data icon, the corresponding measurement data will be transmitted to the RS-232 serial port for the feature highlighted in the feature list.

Data prompt function

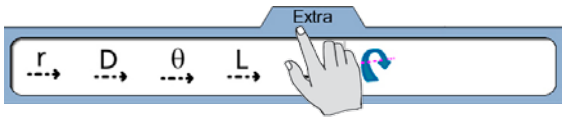
? The data prompt function is included in the Extra tab to send a user-defined measurement such as X position, Y position, radius or angle to the RS-232 serial port. When the user touches the data prompt function, a prompt message is displayed and the user selects the desired piece of measurement data to be transmitted.

Rotate about axis function

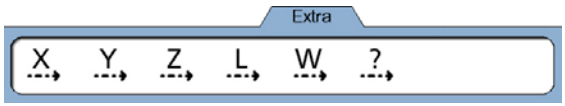
When the user touches the rotate about axis function, an axis dialog box is displayed for axis selection and rotation angle entry.

Multiple Extra tabs

Multiple Extra tabs might be necessary to display all the Extra tab functions available. Touch the Extra tab repeatedly to access multiple tabs.



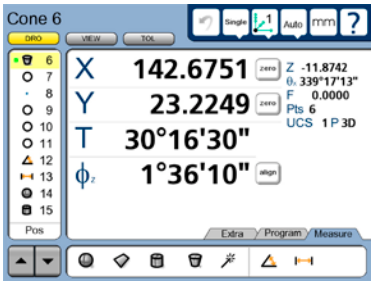
Touch the Extra tab...



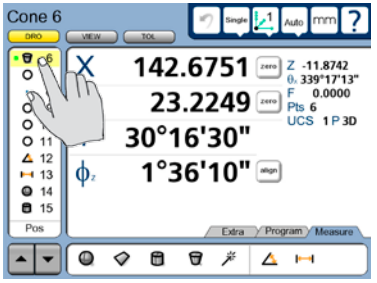
to show alternate functions

Feature list

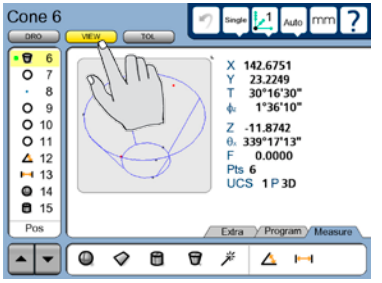
The feature list provides access to all features that have been measured, constructed or created. Features are selected by touching them in the feature list, and are then viewed or toleranced in other screens.



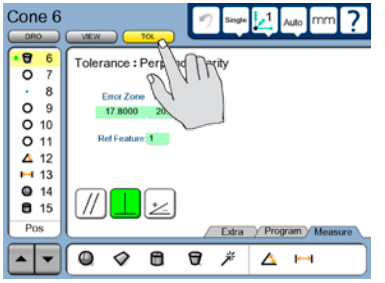
When the feature list contains too many entries to be displayed on a single screen, the arrow keys at the bottom of the list are used to scroll up or down through all features.



Selected features...

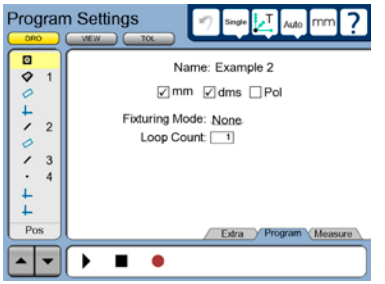


can be viewed...



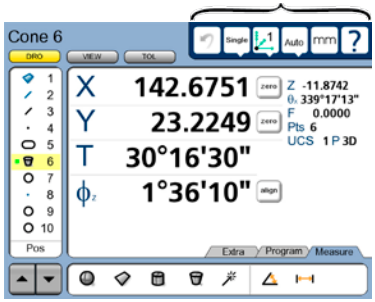
or toleranced in other screens

When editing programs, program steps are also shown in the feature list.



System functions

System functions



System functions support a wide variety of measurement and setup activities. System functions include:

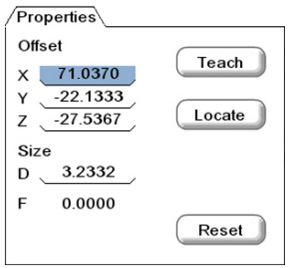
- Undo
- Probe holder
- Reference frame
- Projection
- Unit of measure (mm/Inch)
- Setup

Undo

The undo function is very similar to the Windows® undo function and erases the last measurement or feature list activity. The Undo function only erases the last step, sequences of steps cannot be erased using undo.

Probe holder

The probe holder button shows which of the touch probes has been selected. Touching the probe holder button displays the probe Properties dialog box which shows probe size, offsets and controls for probe qualification and data reset.

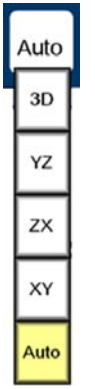


Reference frame

The reference frame button shows the active reference frame. Touching the reference frame button displays a drop down menu of previously saved reference frames. Any of the previously saved reference frames can be selected.

Projection

The projection button shows the active 2D or 3D projection plane or coordinate system. Touching the projection button displays a drop down menu of available 2D projection planes or 3D coordinate systems that can be selected. Auto instructs the system to choose the projection plane or coordinate system that best matches the current measurement activities.

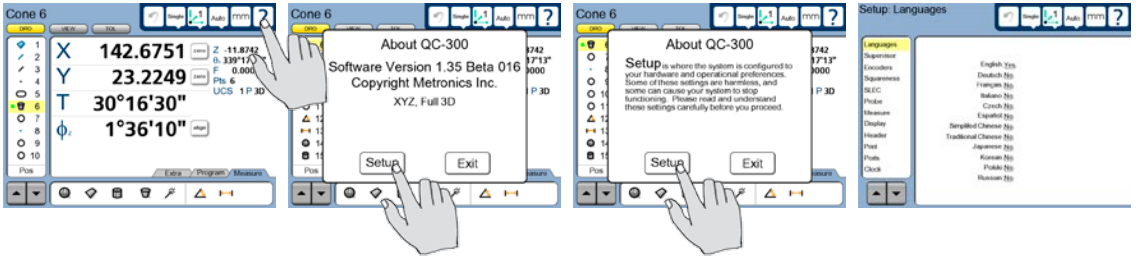


Unit of measure

The unit of measure button toggles the linear unit of measure between metric and English. Touch the mm/in button to toggle the units of measure.

Setup

The setup button provides access to the system setup screens required for configuring QC-330 measurement and operation. Touch the setup button to display the setup screens. Access to the setup menu is given through two introductory screens that show the software version, the system options and a caution regarding the use of setup functions.



Setup screen tools will be made available to those who can provide a valid supervisor password.

NOTE
Detailed descriptions of all setup functions and tools are contained in Chapter 10: Setup.

Command buttons and wide keys

The command buttons and wide keys are primarily used to support measurement and setup activities. The command wide keys are duplicates of the Enter and Finish functions which are the most frequently used command buttons, and can be located and pressed easily by the operator without looking at the front panel.

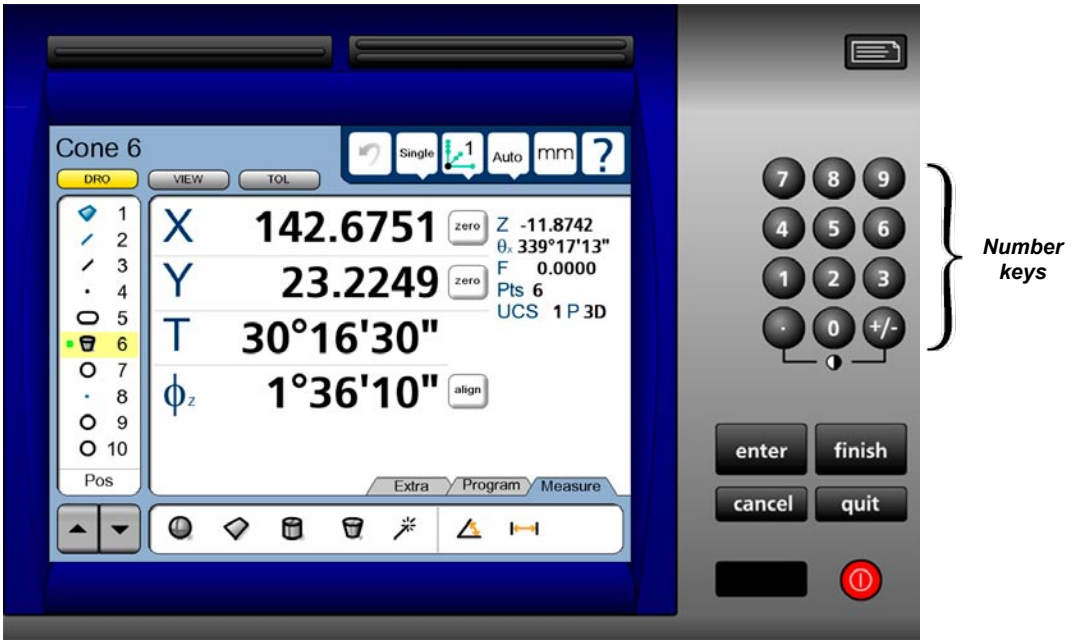
- Enter — Enters a point (or points) into a measurement, or enters a value into a measurement data field, tolerance data field, communication data field or a setup data field
- Finish — Completes a measurement, tolerancing or setup session
- Cancel — Removes the last point from a measurement, deletes a feature from the feature list, or removes the last character from a data or text field
- Quit — Cancels a measurement in progress, ends a setup session without saving new settings or ends a programming session

NOTE
Details regarding the use of the command keys are provided in Chapter 6: Measuring, and are distributed throughout the remainder of this user guide.

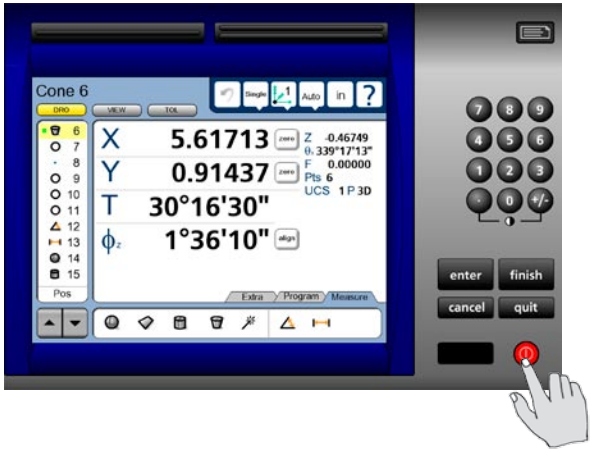
Number keys

The number keys are used to enter data into feature constructions and creations, tolerances, programs, and setup data fields.

Numbers are entered into data fields in the conventional manner, and can be erased when necessary by backspacing over them using the Cancel button.

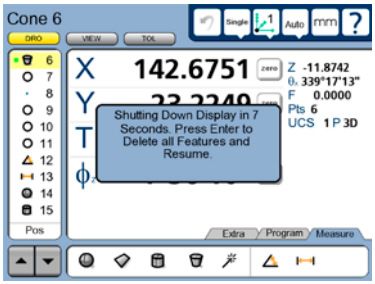


LCD ON/OFF and deleting feature data

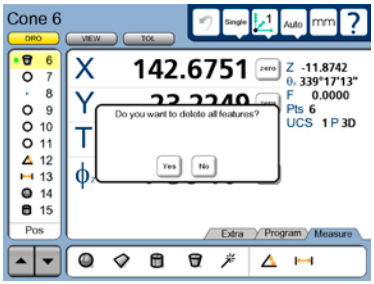


The LCD screen can be turned off without cycling power when the QC-330 will be idle for an extended period and it is desirable to retain the original machine zero encoder references. Press the red LCD ON/OFF button to toggle the LCD on and off.

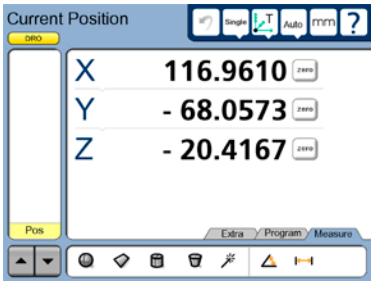
When the LCD ON/OFF button is pressed, the operator is given the opportunity to turn the LCD off or to erase all feature data and resume operation without turning the LCD off. If the operator presses the Enter key to delete feature data, the system will ask for confirmation. If confirmation is given, the feature data and datums will be permanently deleted.



You will be asked to press Enter...



and to confirm the delete...



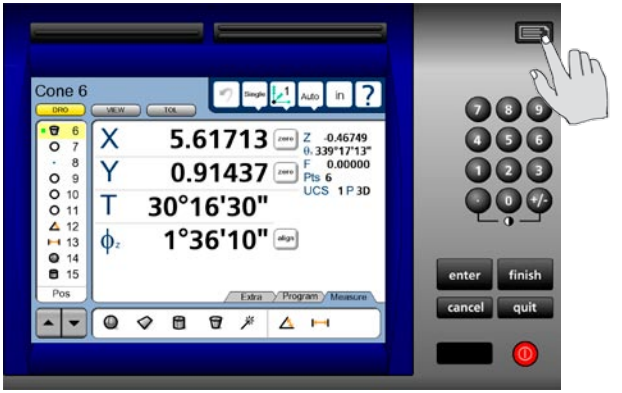
then the features will be deleted

CAUTION

Delete feature data only when you have saved the data in a report, transmitted it to a computer file or are sure that you no longer need them. Once the data are deleted, they cannot be restored.

Printing reports and sending data

Feature data shown on the DRO screen or contained in the feature list can be printed in reports using the USB port or sent to a computer over the RS232 serial port. In either case, the printing of reports and the transmission of measurement data is initiated by pressing the Print button.



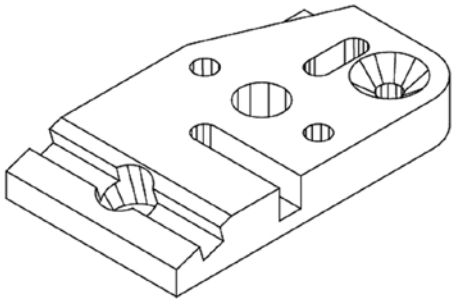
NOTE

Report printing and data transmission are configured in the Print setup screen described in Chapter 10: Setup. Printing and data transmission are described in Chapter 9: Communication.

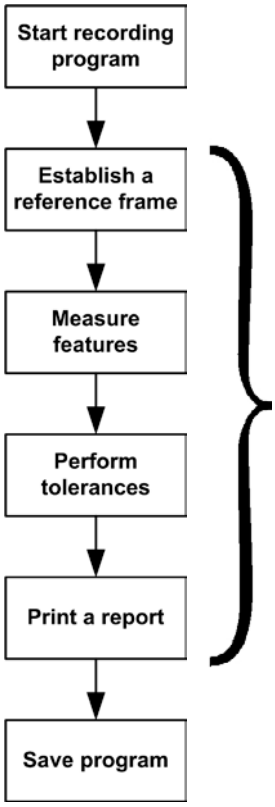
Chapter 4:
Quick Start Demonstration

This chapter demonstrates the operation of the QC-330 system. The demonstration is provided as a means of quickly helping experienced operators to use the system. This demonstration will be most helpful if you perform the measurements and other activities as you follow along.

The demonstration will use the Metronics 3D Demo part to establish a measurement reference frame, measure a part feature, apply a tolerance, print a tolerance report and save all these activities as a program that can be recalled and run again later.



A 3D Demo part is shipped with each system



When the program is run, the series of required points will be indicated by a green arrow that moves over the part outline in the View screen. The user need only probe locations indicated by the arrow to complete measurements.

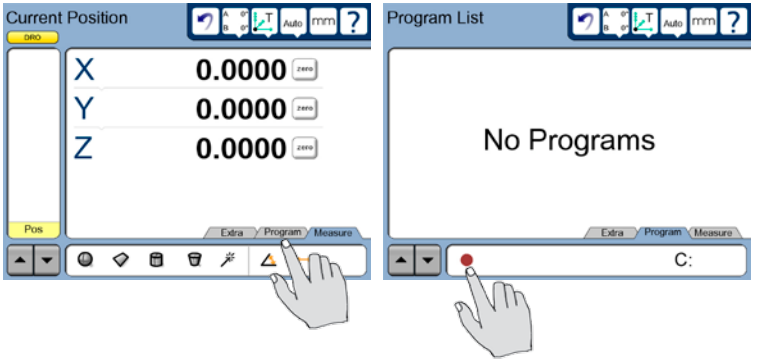
The demonstration will be performed using an indexable probe qualified in the A=0, B=0 position. However, the same measurements could be performed using any supported touch probe.

Detailed information regarding reference frames is contained in Chapter 6: Measuring. Information regarding tolerancing is contained in Chapter 7: Tolerancing. Report printing is discussed in Chapter 9: Communication. Information regarding programming is contained in Chapter 8: Programming.

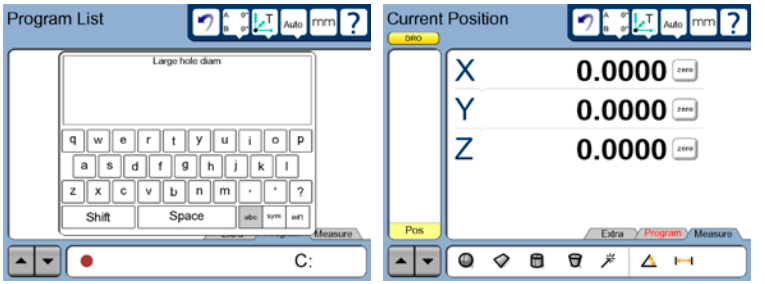
Start recording a program

To record the following activities as a program:

1 Touch the Program tab to display the program screen and then touch the Record icon. The text entry screen will be displayed.



2 Enter a program title and press the Finish key. The DRO will be displayed. The measure icons will also be displayed and the Program tab will be shown in red to indicate that programming is in progress.



Establish a reference frame

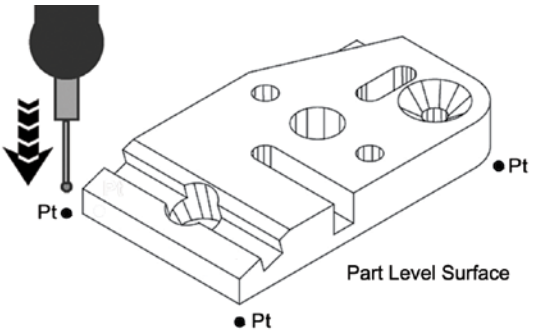
Perform a level, skew and datum as described in Chapter 6: Measuring. In this example, the resting surface for the part is leveled, the X-axis edge of the part is skewed, and a datum point is constructed from the Y-axis edge of the part and the skew line.

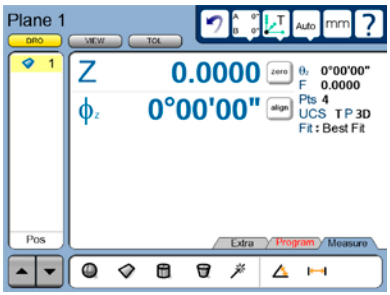
To level:
Measure the desired part plane and zero the angle and Z values. This will be the projection plane for the skew measurement and datum point construction. In this example, the X-Y plane is leveled.

To skew:
Measure a line on the X (skew) axis, in the X-Y projection plane, and zero the angle.

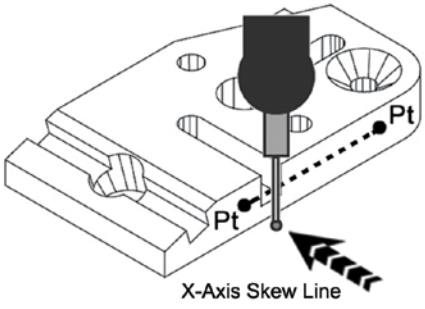
To construct a zero datum point:
Measure a line on the Y-axis, in the X-Y projection plane, and construct an intersection point.

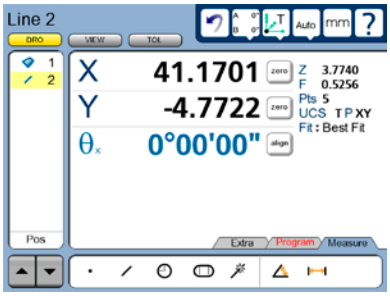
These steps and the resulting screen images are shown on the facing page.



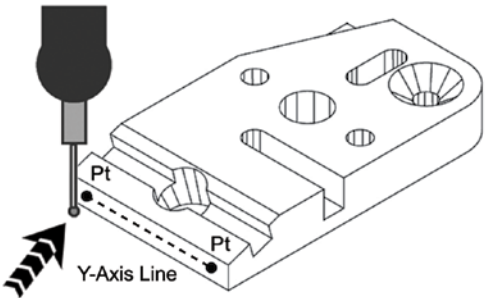


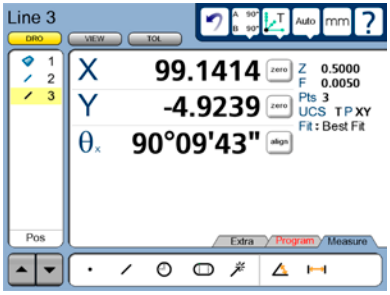
The part reference plane is leveled...



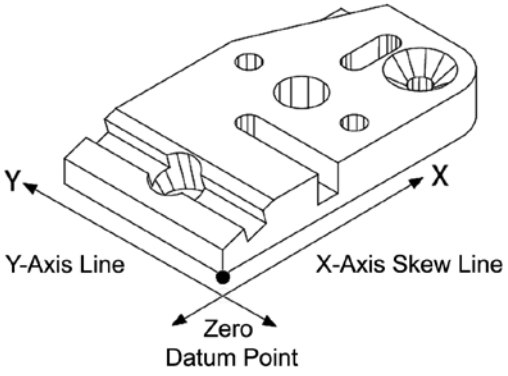


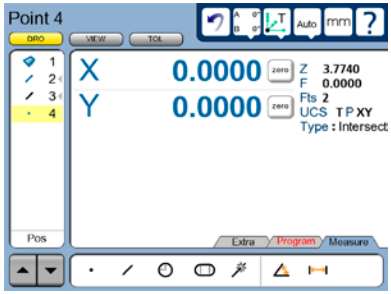
the X-axis edge is skewed...





the Y-axis edge is measured ...

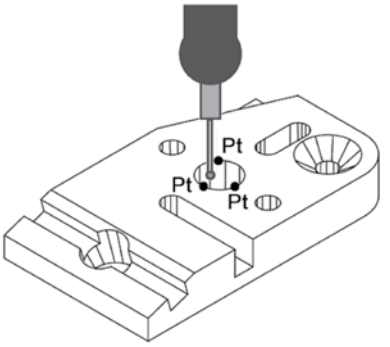


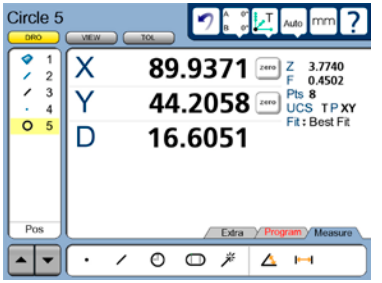


and a datum is constructed

Measure a feature

In this example, the largest hole in the 3D demo part will be measured. Feature measurements are described in Chapter 6: Measuring.





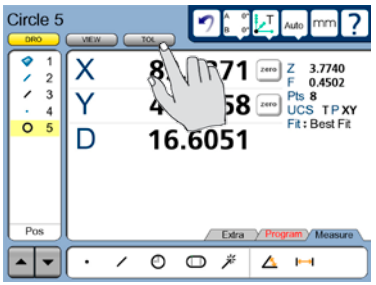
Measurement data are displayed

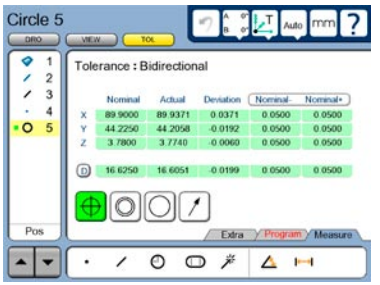
Apply tolerances to a feature measurement

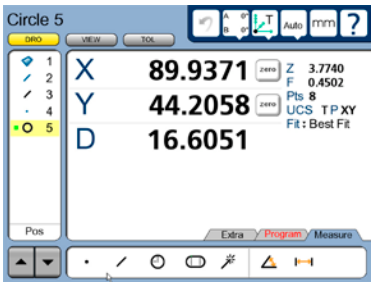
In this example, a true position tolerance will be applied to the circle measurement. More information regarding tolerances is contained in Chapter 7: Tolerancing.

To apply a true position tolerance:

With the circle feature highlighted, touch the Tol screen button, touch the position tolerance icon, select true position and enter nominal, limit or tolerance values. Error and Deviation values are generated as soon as the Nominal and Tol Dia values are entered.







Pass/fail results are indicated by green and red colors in the tolerance screen and in the feature list. Pass is indicated by green, fail is indicated by red in the tolerance screen. Any tolerance failure will be indicated by a red mark next to the feature in the feature list. A green mark will be displayed in the feature list when all tolerance tests pass.

Print a report

To print a report of the current position (Display), the feature list (Report) or tolerances (Tol Report):

1 Verify that the QC-330 is attached to a USB printer as described in Chapter 9: Communication.

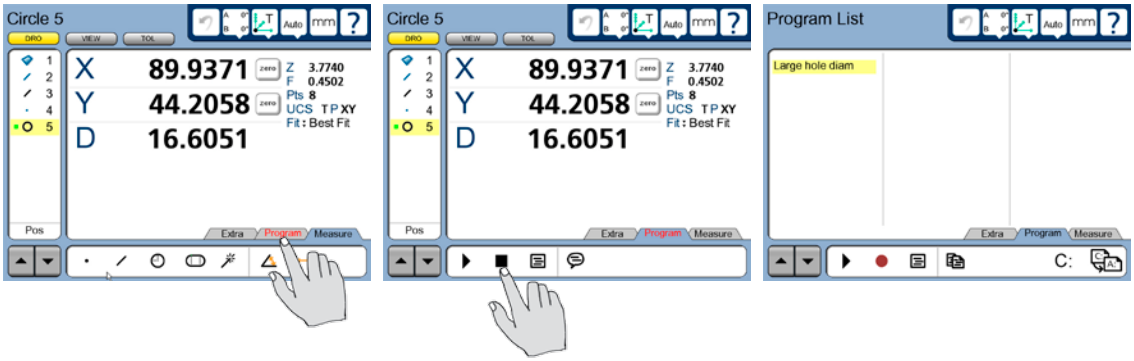
2 Verify that the report content and printer formatting are specified correctly in the Print setup screen described in Chapter 9: Communication and Chapter 10: Setup.

3 Press the Print key while displaying the Current Position in the DRO screen.

More information regarding reports of feature measurement data and QC-330 system settings are contained in Chapter 9: Communication and Chapter 10: Setup.

Stop program recording

To end a recording session, touch the Program tab to display the programming tools, and then touch the Stop icon to stop recording the program. The program title will be shown on the left side of the screen.



The program is now saved and can be edited or run on new parts. Touch the Measure tab to return to the measure mode of operation and display the DRO.

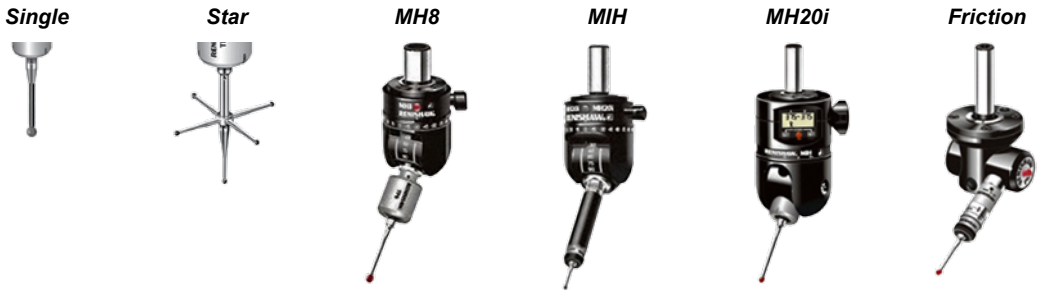
Running the program

To run a program, touch the Program tab to display the program screen, select the desired program and then touch the Run (play) icon to run the selected program.

Chapter 5: Probes

Probe holders supported by the QC-330 include:

- Single
- Star
- MH8 indexable
- MIH indexable
- MH20i indexable
- Friction



Probes can be touch probes or hard probes. The choices of probe holder and probe type are made in the probe setup screen described in Chapter 10: Setup.

Probe qualification

Unqualified probes are indicated by a red probe icon at the top right of the screen. The icon becomes white when a qualification is performed. Probes must be qualified before use to determine tips sizes and offsets.

Red icon for unqualified probes *White icon for qualified probes*

Probes must be qualified upon startup if:

- There is no repeatable machine zero
- The qualification sphere has been moved
- A friction probe is used

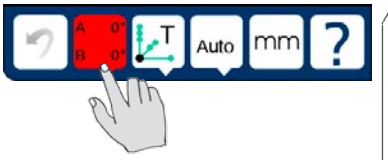
The QC-330 can be configured to initiate a probe qualification automatically upon startup in the probe setup screen described in Chapter 10: Setup.

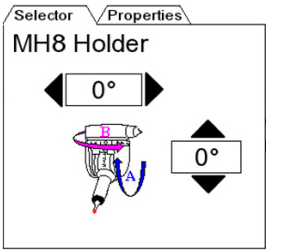
Friction probes must be qualified each time the probe position is changed.

Probe qualification can be performed at any time. A measurement sequence can be interrupted to qualify a new probe tip or position without invalidating the measurement.

To qualify a probe:

1 Touch the probe icon to display the Selector and Property tabs. The Selector tab is displayed only for the star and indexable probes.





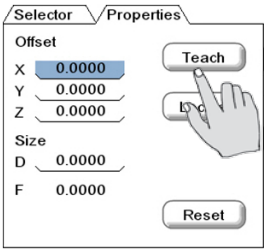
2 Select the appropriate indexable probe angles or a star probe tip if a star or indexable probe is being qualified.

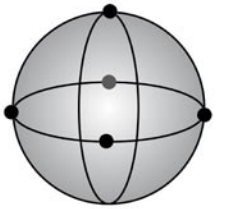
NOTE
Qualify the straight-down (0°, 0°) probe position of star and indexable probes first. All subsequent probe positions will be referred to this (0°, 0°) position.

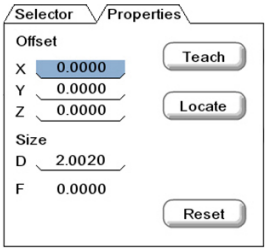
3 Touch the Properties tab to display the probe offset and size fields.

4 Touch the Teach button to initiate a probe qualification. Collect 5 points on the qualification sphere; 4 around the equator and 1 at the top. Press the Finish key to complete the qualification session.

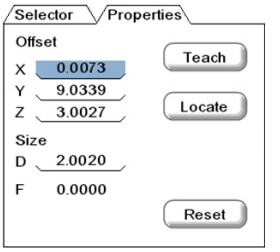
The tip size will be shown in the Size field. The X, Y and Z offsets are also shown, and will be zero for the straight-down (0°, 0°) reference position. When other star probe or indexable probe positions are qualified, X, Y and Z offsets will also be shown.







Only probe tip size is shown for 0, 0 position

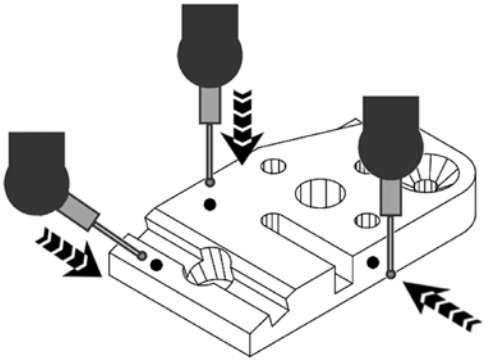


X, Y and Z offsets are shown for other positions

Probing technique

Probing technique refers to the method of moving CMM axes and entering point data with a *touch probe*. Good probing technique includes the following:

- Approach the surface at a 90° angle
- Approach the surface without direction changes from a distance of at least 5 mm
- Do not drag the probe across the surface
- Do not probe on a sharp edge or drop the probe off an edge of the part



Orthogonal approach without changing direction

Auto change/teach function

Star and indexable probe tips or positions can be changed or qualified at the CMM work surface without touching front panel controls when the Auto change/teach function is enabled in the Probe setup screen as described in Chapter 10: Setup.

To change or qualify a new star probe tip or indexable probe position:

1 Touch the qualification sphere once with the current (qualified) tip.

2 Touch the qualification sphere a second time with the new star probe tip or the new indexable probe position. If the new tip or position was previously qualified, the QC-330 will acknowledge the change and continue gathering feature data. If the new tip or position was not previously qualified, measurements will be temporarily suspended and a probe qualification will be initiated. When the qualification is complete, the measurements will be resumed.

Chapter 6: Measuring

Measurements can be performed using single-fixed, star, indexable or friction hard probes or touch probes. Activities can be limited to probing features, or can include the construction or creation of new features in addition to probing. However measurements are conducted, the fundamental measurement process and the tools required to perform measurements remain unchanged. Here's what you'll find in this chapter:

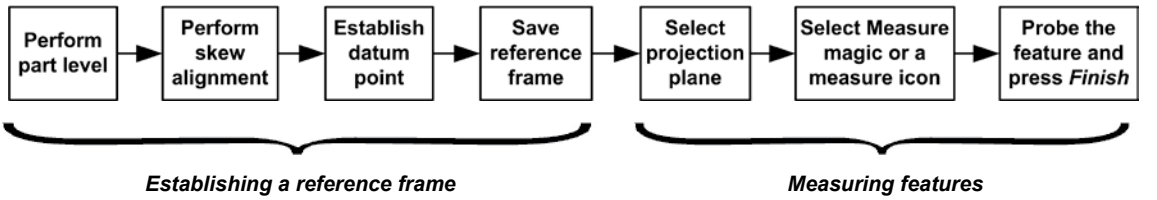
Measurement activities

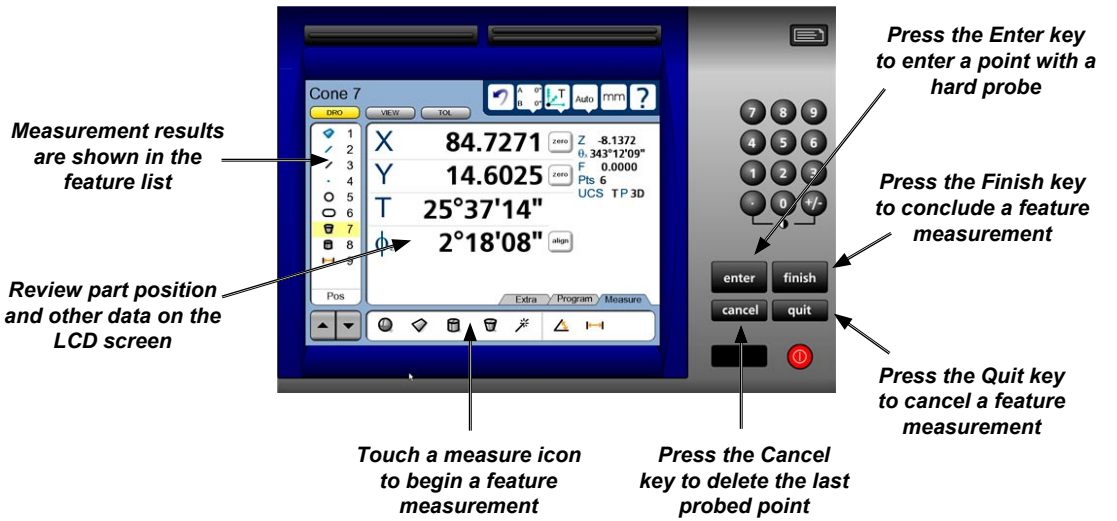
QC-330 measurement sessions can include two or more of the following activities:

- Establishing a measurement reference
- Probing and measuring features
- Constructing features
- Creating features

The measurement process

The basic measurement process shown here is identical for all feature types. The details of individual measurement steps are described in the remaining pages of this section.





NOTE

Tools and controls for probing features and conducting measurements are discussed in Chapter 3: User Interface, and Chapter 5: Probes.

Establishing a reference frame

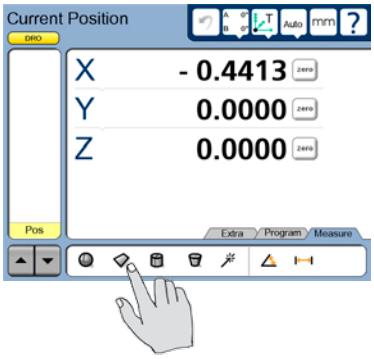
A reliable measurement reference must be established before part features can be probed and measured. This reference frame is created by the user to ensure a level part surface, precise part alignment and accurate datum zero. Reference features are presented in the feature list in blue, other features are presented in black. Reference frames can be established in any projection plane. The examples included in this chapter are in the X-Y plane.

Part leveling

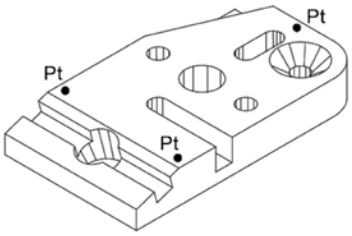
When the surface plane of the part is not orthogonal to the measurement axis, small cosine errors can be generated during the measuring process. These errors are minimized or eliminated by leveling the part.

To level the part:

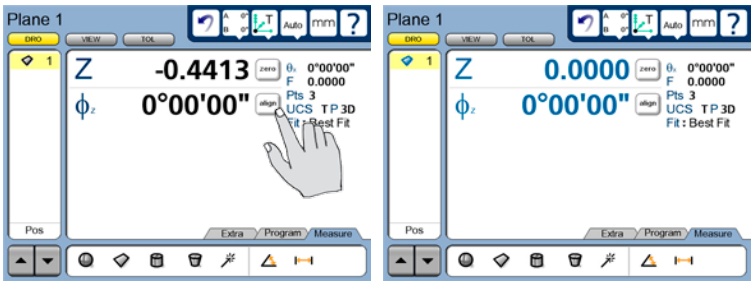
1 Touch the Measure tab to display the 3D feature measure icons, and then touch the measure plane icon.



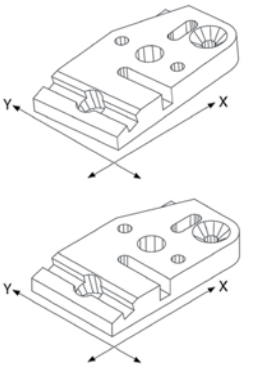
2 Perform the leveling measurement by probing three or more points distributed across the surface of the desired part plane. Press the Finish key to complete the level measurement.



3 Touch the Align and Zero buttons to level the plane at the Z = 0 elevation. The reference plane feature will be shown in blue and the Z-axis value will be zero.



Part skew alignment

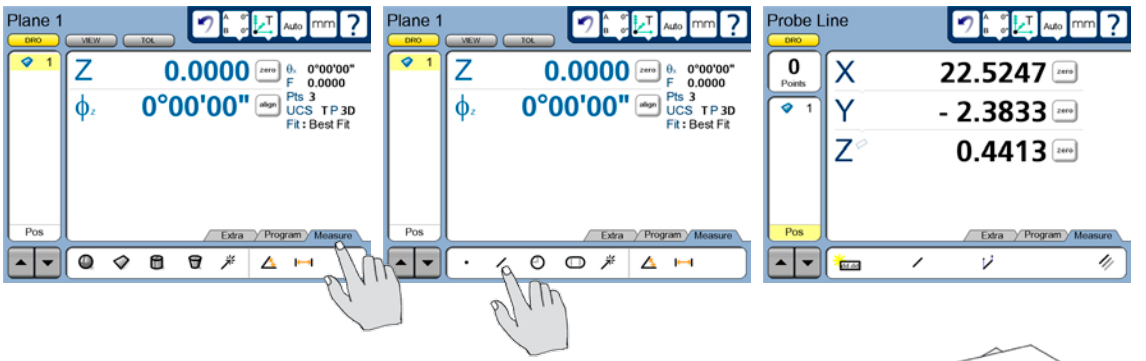


When the part is misaligned (twisted) in the X-Y plane, errors can be generated during the measurement process. These errors can be eliminated by performing a skew alignment on the part.

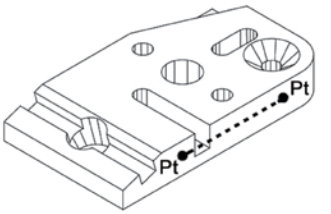
The skew alignment includes a precise measurement of the part misalignment. Once the misalignment is known to the system, subsequent feature measurements are automatically compensated to eliminate misalignment errors. Measurement data in the DRO will reflect measurements of a perfectly aligned part.

To skew the part:

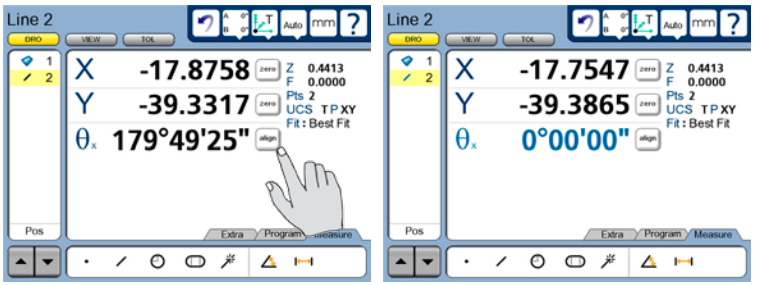
1 Touch the Measure tab and then touch the measure line icon.



2 Measure a line along the reference edge of the part. The X-axis edge is used in this example.



3 Touch the Align button to perform a skew on the reference edge.



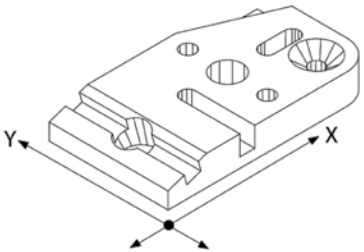
The skew line feature will now be shown in blue and the reference angle will be zero degrees.

Establishing a datum zero point

The datum zero point is used as the origin of the reference frame. The datum zero point can be positioned in any location that satisfies the measurement requirements of the user and can be created by probing a point, but is probably better created by constructing a point from parent features.

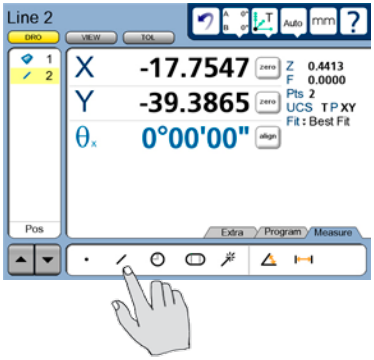
It would not be possible to provide a single description of this process for all measurement applications. However, the concept is illustrated by this example and by the construction techniques described later in this chapter.

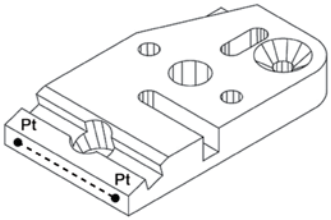
After the part level and part skew are performed, a datum zero point is constructed at the intersection points of the X-axis (skew axis), and the Y-axis of the part.



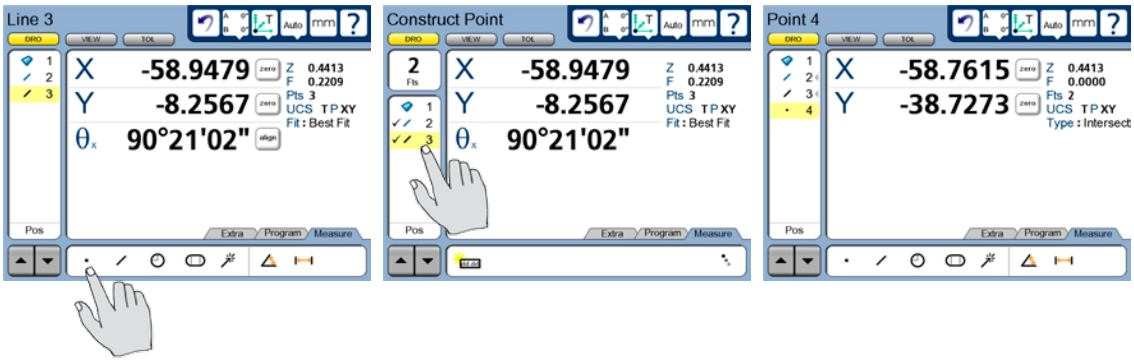
To construct the datum zero point:

1 Touch the Measure Line icon and then measure a line along the Y-axis edge of the part.





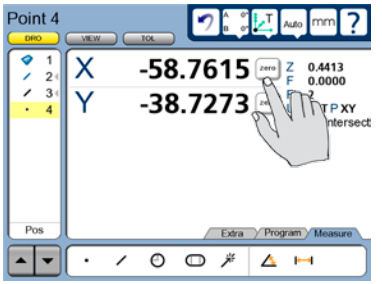
2 Touch the measure point icon and then construct a point at the intersection of the skew and Y-axis lines by touching (selecting) them in the feature list and pressing the Finish button.

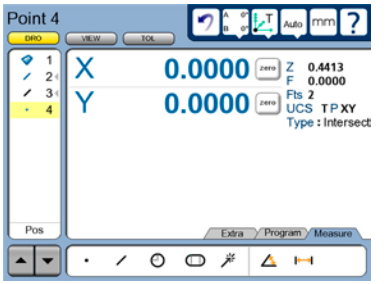


Construct a point for the datum by selecting the skew and Y-axis lines and pressing the Finish key

3 Establish the zero datum point by touching the Zero buttons for the X and Y axes.

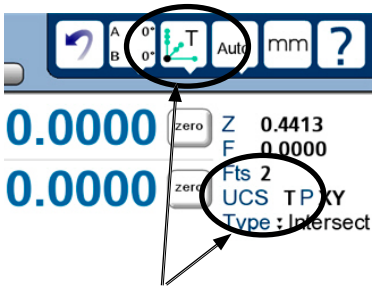
The datum point will be shown in blue in the feature list and the X-Y values will be zero.





Saving the reference frame

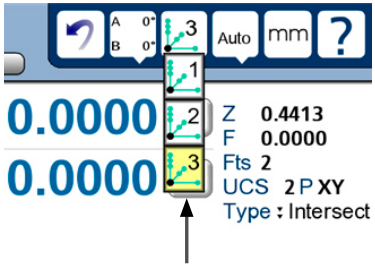
Measurements are referred to a temporary reference frame until a new reference frame is saved. Temporary reference frames are indicated by a T in the reference frame icon in the upper-right corner of the screen, and by a T in the UCS (user coordinate system) field of the DRO.



Reference frame indications

Reference frames must be saved to maintain measurement integrity. When multiple reference frames are created but not saved, all references are temporary and all measurements are referred to the last temporary reference frame.

When a new reference frame is saved, the reference frame indications are given the next number in a sequence that begins at 1. As new reference frames are created and saved, additional indicator numbers are assigned and made available to the drop-down menu of reference frames.



Drop-down menu of reference frames

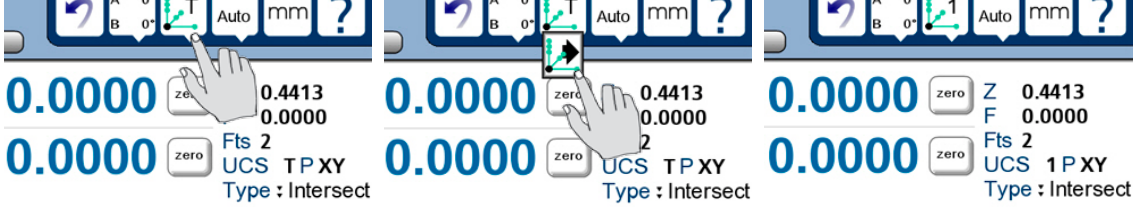
Reference frames can be saved manually or automatically. In either case, the entire reference frame must be completed before conducting any measurements.

Saving reference frames manually

When reference frames are saved manually, they must be saved immediately after their creation. To save a reference frame manually:

1 Verify that the reference frame is complete and correct

2 Touch the reference frame icon and then touch the Save icon.



A new reference frame number will be displayed in the reference frame icon.

Saving reference frames automatically

The QC-330 can be configured to save reference frames automatically in the Measure setup screen, as described in Chapter 10: Setup.

When configured to auto-save reference frames, the current reference frame is saved each time a new datum operation is initiated. A new reference frame number is added to the drop-down menu each time a reference frame is saved.

Measuring features

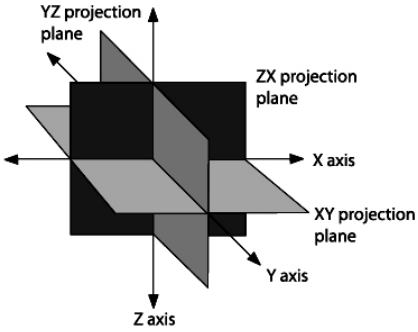
Part features are measured after creating a reference frame by selecting a projection plane (if required) and then probing points that define the feature's shape and location.

Selecting a projection plane

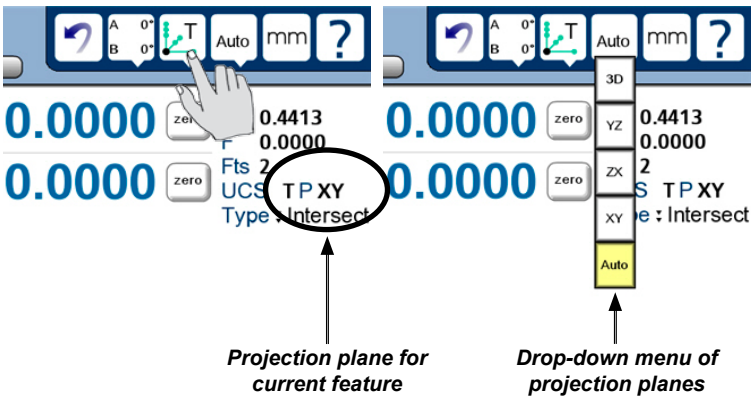
Projection planes can be selected by the user or selected automatically by the system and include:

- 3D: No plane is selected
- YZ • ZX • XY
- Auto: The system selects a plane based on measurement activities

The default projection plane for measurements and constructions is the level plane used to establish a reference frame. If the level was performed in the X-Y plane, it is likely that most measurements will be shown in the X-Y projection plane. However, when Auto is chosen, a projection plane is selected by the system that best fits the measurement. When 3D is selected, no projection plane is shown. When a specific projection plane is selected, measurements and constructions are forced into the selected plane.

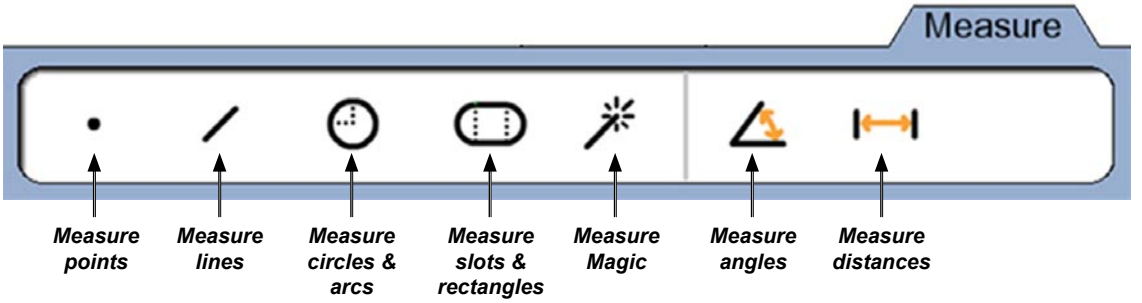


Projection planes are selected from the drop-down menu and shown with the measurement data on the DRO screen.

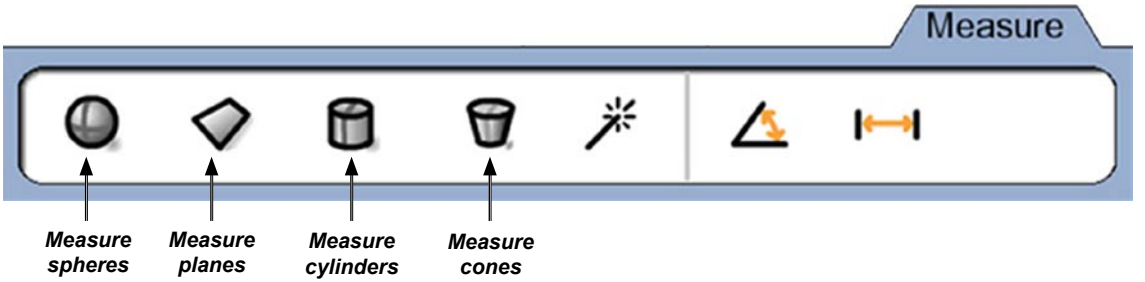


Probing features

Feature points can be probed using Measure Magic or by choosing a specific feature type such as the line or circle. Measure Magic or measure functions are selected by touching icons in the measure toolbar. Repeatedly touching the measure tab toggles the measure toolbar between 2D and 3D functions. Measurement results are shown in the Feature list, DRO screen and View screen.



The measure toolbar icons for 2D measurement functions and measure magic



The measure toolbar icons for 3D measurement functions and measure magic

Probing with Measure Magic

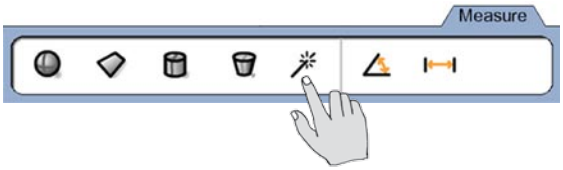
Measure Magic analyzes feature data collected by part probing and automatically determines the feature type. Measure Magic supports the following feature types in the QC-330:

- Points
- Lines
- Circles
- Arcs
- Planes
- Cylinders
- Cones

When Measure Magic is used, and more than the minimum number of points required to define a feature type are collected, the feature type can be changed manually by the user if the wrong feature type is assigned.

Measure can be configured to start automatically on the first probe hit in the Measure setup screen as explained in Chapter 10: Setup.

To probe a feature using Measure Magic, touch the Measure Magic measure icon (if not configured to auto-start), probe points on the desired feature and then press the Finish key.



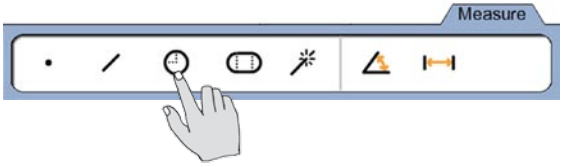
Probing specific feature types without Measure Magic

When Measure Magic is not used, a measure icon must be touched before a feature type is probed. However, a series of features of the same type can be probed by touching the desired measure icon and then touching the multiple measurement icon.

Probing a single specific feature type

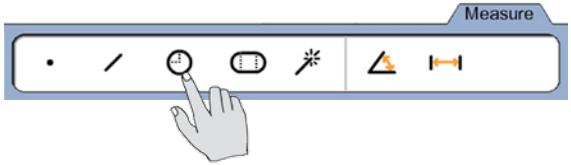
To probe a single feature without Measure Magic, touch the desired measure icon, probe points on the feature and then press the Finish key. A measure icon must be touched again to measure the next feature. In this example a single circle is probed.

When a specific measure function is used to probe the feature, the feature type cannot be changed once it is added to the feature list.

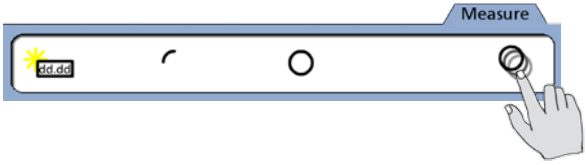


Probing multiple specific feature types

To probe a series of features without Measure Magic, touch the desired measure icon, touch the multiple measurement icon, probe points on each feature pressing the Finish key to conclude each feature measurement. In this example multiple circles are probed.



Touch the circle icon for circle measurements...

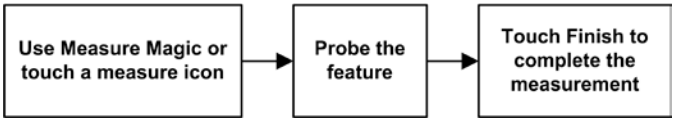


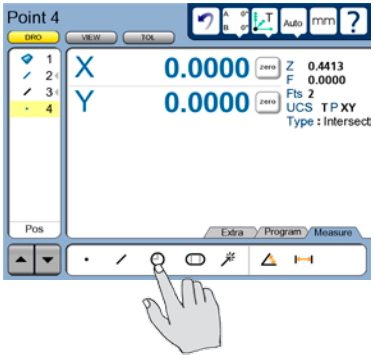
and then touch the multiple measurement icon to measure a series of circle features

When a measure icon is touched to probe a series of similar features, the feature type cannot be changed once features have been added to the feature list.

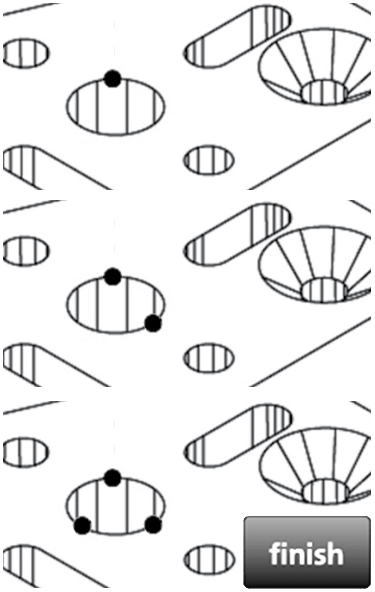
Probing process

The feature probing process is essentially the same for all feature types.

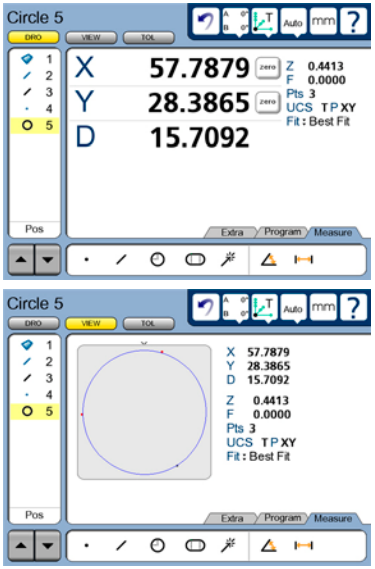




Touch the desired measure icon



Probe the feature, then press Finish to complete measurements



Results are displayed in the DRO and View screens

Supported feature types

The following feature measurements are supported by the QC-330:

- Points
- Lines
- Arcs
- Circles
- Slots
- Rectangles
- Distances
- Angles
- Planes
- Cylinders
- Cones

Features can be probed manually or semi-automatically as part of a program.

NOTE

Manual probing is discussed in Chapter 5: Probes. Semi-automatic probing is discussed in Chapter 8: Programming.

Backward/forward annotation

Forward annotation is used to specify a required number of probed points for each feature type. Backward annotation allows the user to probe any number of points beyond the minimum requirement for any feature type except slots and rectangles.

When using forward annotation, the number of remaining required points is shown at the top left of the screen. As points are probed this number counts down. Backward annotation simply displays the number of points as they are entered. Some users prefer forward annotation because it establishes a uniform number of points for feature measurements. For example, forward annotation can be set to require 4 points when measuring a circle instead of the minimum three.

When forward annotation is used, the system automatically displays the feature after the last required point is entered. It is not necessary to press the Finish key to conclude forward annotation measurements.

NOTE

Users can toggle between backward and forward annotation and specify the required points for forward annotation in the Measure setup screen. Please refer to Chapter 10: Setup for more information regarding backward and forward annotation.

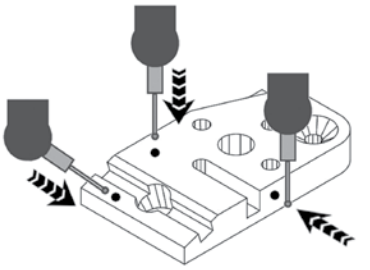
Probing specific feature types

While the probing process is essentially the same for all feature types, the minimum number of points required and the geometric placement of these points are different. The unique requirements for probing each feature type are described in the remainder of this section.

Probing points

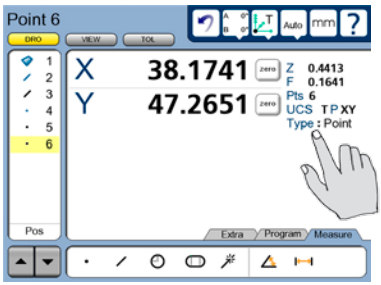
A minimum of one probed point is required to measure a point. Multiple points can be probed and it is considered a benefit to use the geometric average of many probed locations.

When a single point is probed, Measure Magic will correctly recognize a point and assign the correct feature. However, when multiple points are probed, it is possible that the wrong feature type will be assigned. If the wrong feature type is assigned, it can easily be changed by selecting the correct feature from a menu of alternatives in the DRO screen.

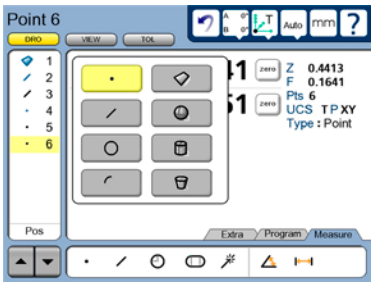


Points must be probed orthogonal to the contact surface

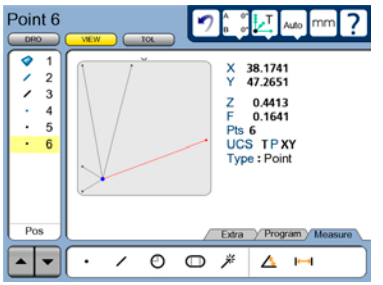
NOTE
Points must be probed orthogonal to the contact surface for the system to correctly apply probe tip compensation.



Touch the feature type...



to display the menu of alternative types



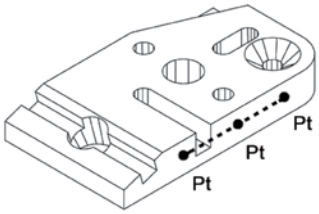
Probed points are shown in the View window

Measurement results are shown in the Feature list, View screen and DRO screen. The feature graphic in the View screen shows the feature and the points used to define it. Errors are shown as whiskers connecting the probed points to the feature. The maximum errors are shown in red and are used in the calculation of form. The DRO screen shows the feature type, feature position, form error, number of points used, reference frame and the projection plane. When the minimum required points are probed, the form error is zero. When more than the minimum are probed, the form error is the sum of the two greatest opposing error magnitudes.

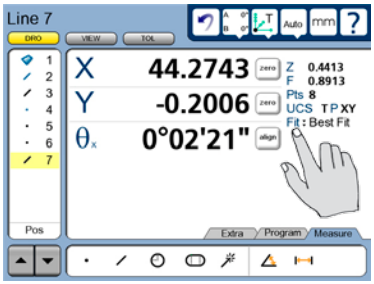
Probing lines

A minimum of two points are required to measure a line. There is no practical limit to the number of points that can be probed, and in general accuracy is increased by probing more points.

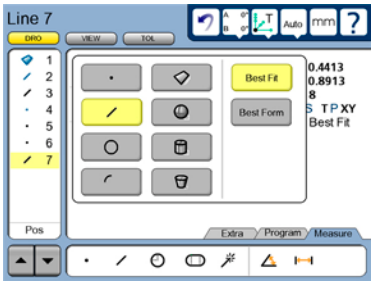
When only two points are probed, Measure Magic will correctly recognize a line and assign the correct feature. However, when more than two points are probed, it is possible that the wrong feature type will be assigned. If the wrong feature type is assigned, it can easily be changed by selecting the correct feature from a menu of alternatives in the DRO screen.



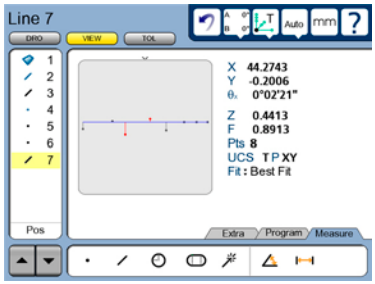
In this example, three points are probed to measure a line



Touch the feature Fit menu...



to display the menu of alternative types



Probed points are shown in the View window

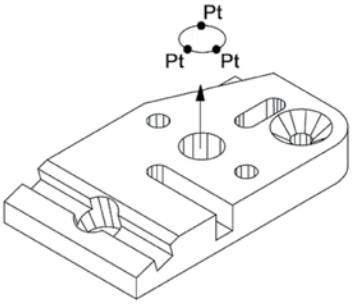
A best fit algorithm is used to define lines when more than two points are probed. The line fit to the probed data can also be changed by selecting the desired fitting algorithm from the Fit menu in the DRO screen. Please refer to Chapter 12: Reference Materials for details regarding the fitting algorithms.

Measurement results are shown in the Feature list, View screen and DRO screen. The feature graphic in the View screen shows the feature and the points used to define it. Errors are shown as whiskers connecting the probed points to the feature. The maximum errors are shown in red and are used in the calculation of form. The DRO screen shows the feature type, feature position, angular orientation of the line, form error, number of points used, reference frame and the projection plane. When only two points are probed, the form error is zero. When more than two points are probed, the form error is the sum of the two greatest opposing error magnitudes.

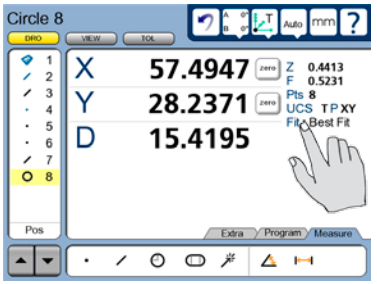
Probing circles

A minimum of three probed points are required to measure a circle. There is no practical limit to the number of points that can be probed, and in general accuracy is increased by probing more points.

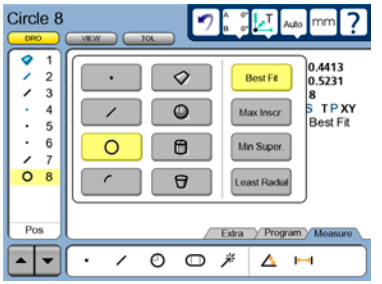
When 185 degrees or more of the circle is probed, Measure Magic will correctly recognize the circle and assign the correct feature. However, when less than 185 degrees is probed, it is likely that Measure Magic will assign the arc feature to the data. If the wrong feature type is assigned, it can be changed by selecting the correct feature from a menu of alternatives in the DRO screen.



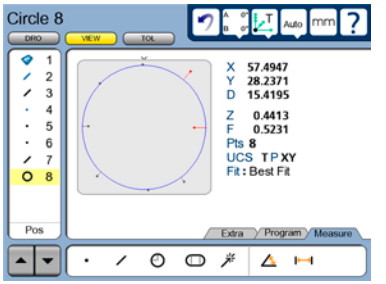
In this example, three points are probed to measure a circle



Touch the feature type...



to display the menu of alternative types



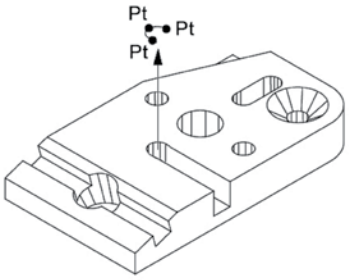
Probed points are shown in the View window

A best fit algorithm is used to define the circle when more than three points are probed. The circle fit to the probed data can also be changed by selecting the desired fitting algorithm from a menu in the DRO screen. Please refer to Chapter 12: Reference Materials for details regarding the fitting algorithms.

Measurement results are shown in the Feature list, View screen and DRO screen. The feature graphic in the View screen shows the feature and the points used to define it. Errors are shown as whiskers connecting the probed points to the feature. The maximum errors are shown in red and are used in the calculation of form. The DRO screen shows the number of points used, the radius, diameter, coordinate location of the center of the circle, form error reference frame and the projection plane. When only three points are probed, the form error is zero. When more than three points are probed, the form error is the sum of the two greatest opposing error magnitudes.

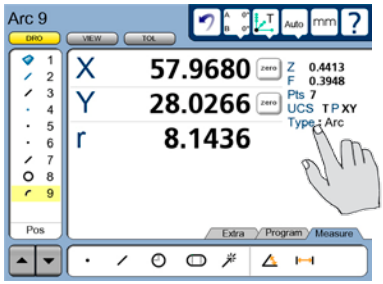
Probing arcs

A minimum of three probed points is required to measure an arc. There is no practical limit to the number of points that can be probed, and in general accuracy is increased by probing more points.

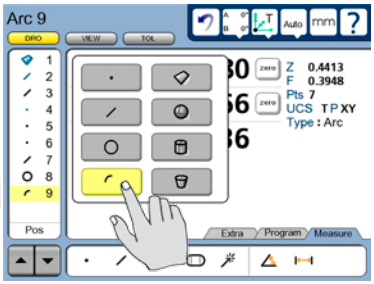


In this example, three points are probed to measure an arc

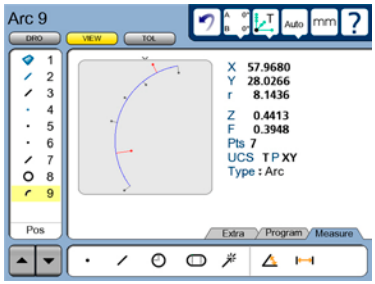
When the arc is less than 185 degrees, Measure Magic will correctly recognize the arc and assign the correct feature. However, when the arc is 185 degrees or more, it is likely that Measure Magic will assign the circle feature type to the data. If the arc is shallow, Measure Magic might mistakenly assign a line feature. If the wrong feature type is assigned, it can easily be changed by selecting the correct feature from a menu of alternatives in the DRO screen.



Touch the feature type...



to display the menu of alternative types



Probed points are shown in the View window

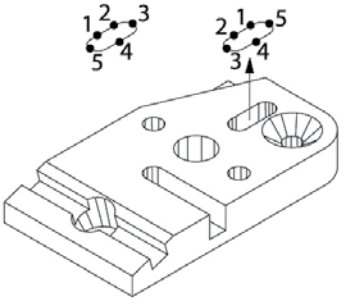
A best fit algorithm is used to define the arc when more than three points are probed. The arc fit to the data can also be changed by selecting the desired fitting algorithm from a menu in the DRO screen. Please refer to Chapter 12: Reference Materials for details regarding the fitting algorithms.

Measurement results are shown in the Feature list, View screen and DRO screen. The DRO screen shows the number of points used, the radius and diameter of the arc, the coordinate location of the center of the arc, form error, reference frame and the projection plane. The feature graphic in the View screen shows the feature and the points used to define it. Errors are shown as whiskers connecting the probed points to the feature. The maximum errors are shown in red and are used in the calculation of form. When only three points are probed, the form error is zero. When more than three points are probed, the form error is the sum of the two greatest opposing error magnitudes.

Probing slots and rectangles

Five probed points are required to measure a slot or rectangle. The five points must be probed in a clockwise or counterclockwise sequence. As shown here, the correct pattern of points probed is:

- Two points well distributed along one long side, followed by
- One point on the closest end, followed by
- One point on the approximate center of the second long side, followed by
- The last point on the remaining end

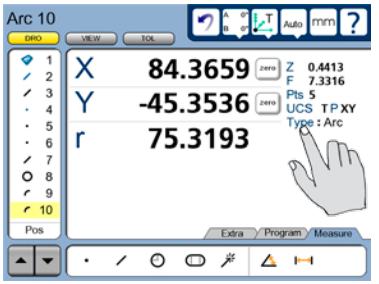


The required five points can be probed in either direction

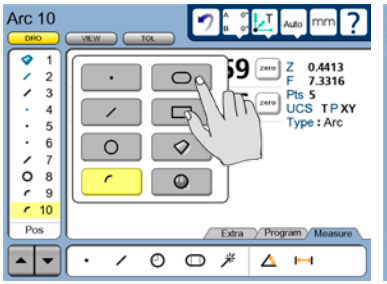
CAUTION

Probing a different sequence of points, or probing out of either clockwise or counter-clockwise order will result in erroneous slot measurements.

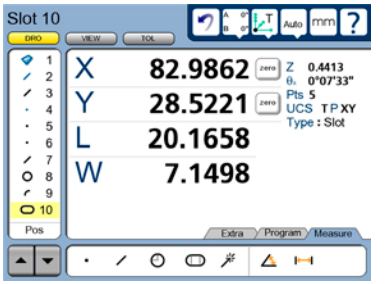
Measure Magic does not recognize slots or rectangles and will assign the wrong feature type to the data. The feature must be changed by selecting a slot or rectangle from a menu of alternatives in the DRO screen.



Touch the feature type...

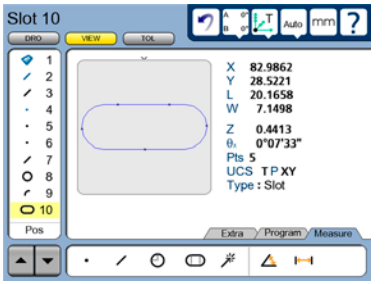


and change the feature...



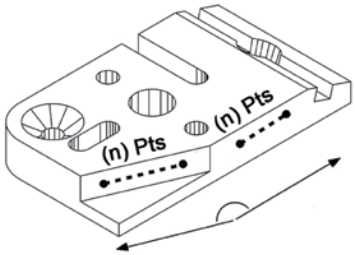
to a slot (or rectangle)

Measurement results are shown in the Feature list, View screen and DRO screen. The View screen shows the feature and the points used to define it, the number of points probed, the coordinate location of the center of the slot or rectangle, the length, the width, the angle of the center line with respect to the skew axis, the reference frame and the projection plane.



Probing angles

A minimum of four probed points are required to measure an angle. The points must be probed as two lines that form an angle. The number of points on the first leg of the angle must equal the number on the second leg. There is no practical limit to the number of points that can be probed, and in general accuracy is increased by probing more points.

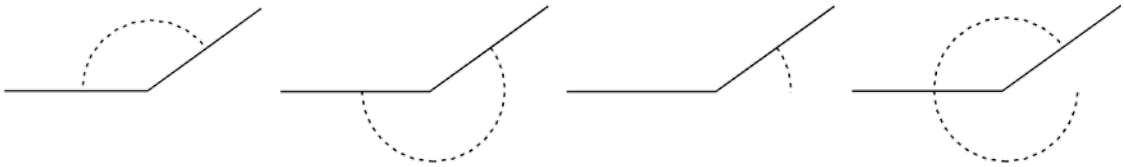


The number of points must be the same for both legs

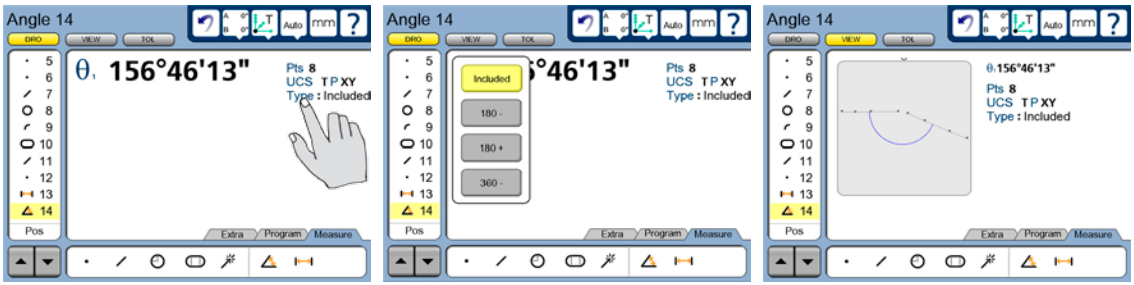
To probe an angle:

1 Probe (n) points on the first leg
2 Press the Finish key
3 Probe (n) points on the second leg
4 Press the Finish key

The included angle is shown as the default measurement result, however, the angle type can be changed by selecting the desired angle type from a menu of alternatives in the DRO screen



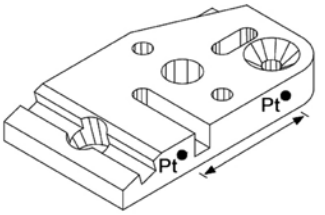
Included angle ***360 - angle*** ***180 - angle*** ***180 + angle***



The View screen shows the feature and the points used to define it, the coordinate location of the angle, the angle orientation to the skew axis, the reference frame and the projection plane.

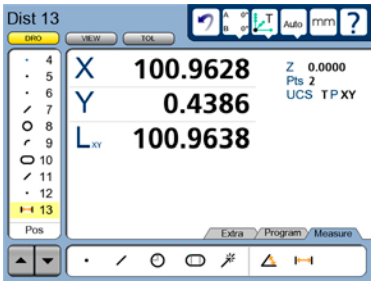
Probing distances

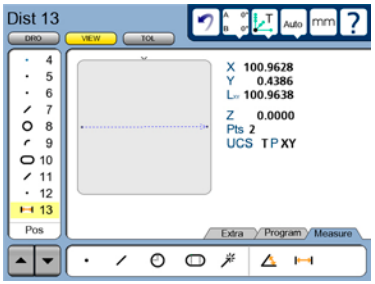
Two probed points are required to measure a distance. Measure Magic can not be used to measure a distance.



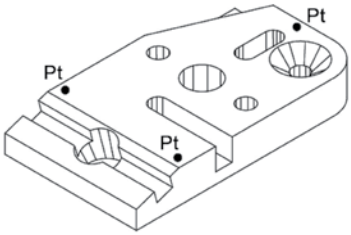
Measurement results are shown in the Feature list, View screen, and the DRO screen.

The View screen shows the feature and the points used to define it, the X and Y axis displacements the distance vector between features, the reference frame and the projection plane.



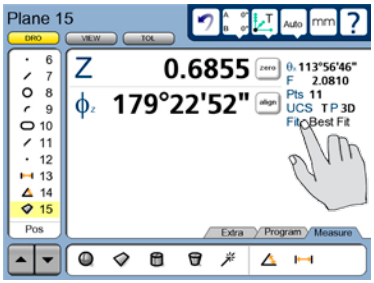


Probing planes

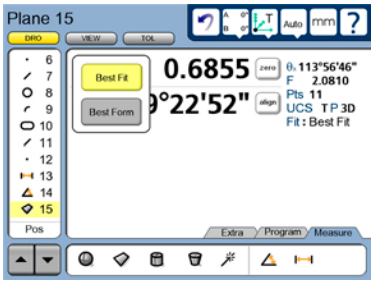


A minimum of three probed points are required to measure a plane. There is no practical limit to the number of points that can be probed, and in general accuracy is increased by probing more points.

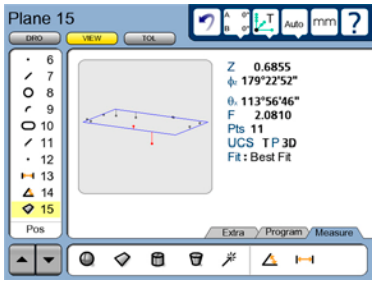
A best fit algorithm is used to define the plane when more than three points are probed. The plane fit to the probed data can also be changed by selecting the desired fitting algorithm from a menu in the DRO screen. Please refer to Chapter 12: Reference Materials for details regarding the fitting algorithms.



Touch the feature type...

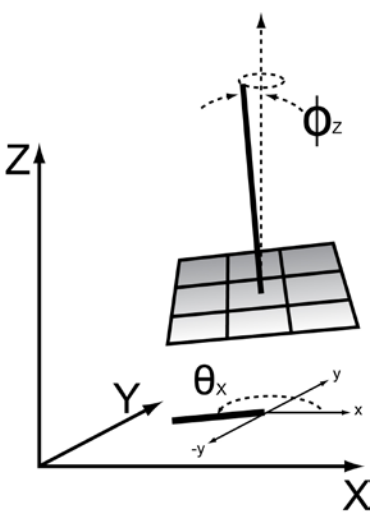


to display the menu of alternative fit algorithms



Probed points are shown in the View window

Measurement results are shown in the Feature list, View screen and DRO screen. The feature graphic in the View screen shows the feature and the points used to define it. Errors are shown as whiskers connecting the probed points to the feature. The maximum errors are shown in red and are used in the calculation of form. The View screen shows location and angular displacement (shown below), form error, the number of points used, reference frame and the projection plane (3D). When only three points are probed, the form error is zero. When more than three points are probed, the form error is the sum of the two greatest opposing error magnitudes.

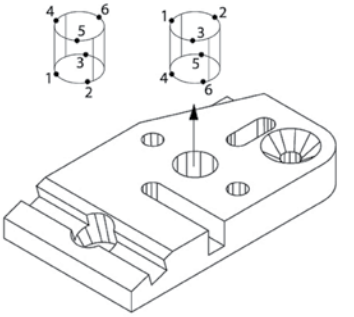


The angular displacements in the coordinate system orientation shown here for a plane are designated as:

- Phi(Z) ϕ_z The angular displacement of the plane's axis from the reference frame's Z-axis
- Theta(X) θ_x The angular displacement of the X-Y projection of the plane's axis from the reference frame's X-axis

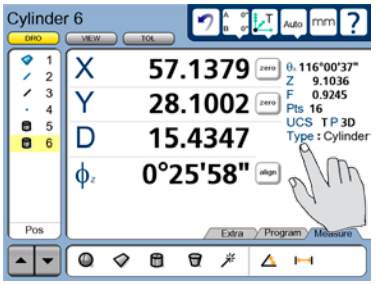
Probing cylinders

A minimum of six probed points are required to measure a cylinder. The points must be probed beginning with two sets of three points; one set of three at the top and another at the bottom of the cylinder. After the initial six points, there is no practical limit to the additional number of points that can be probed, and in general accuracy is increased by probing more points. The first six points can be probed: three at the top, then three at the bottom, or in the reverse order. Additional points can be probed anywhere on the cylinder surface.

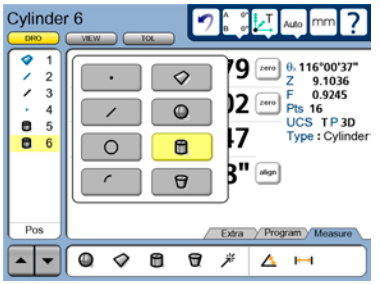


Points can be probed starting at the top or at the bottom

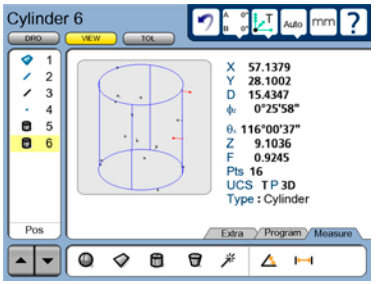
If the feature type is not interpreted correctly by Measure Magic, it can be changed to a cylinder when more than six points are probed.



Touch the feature type...

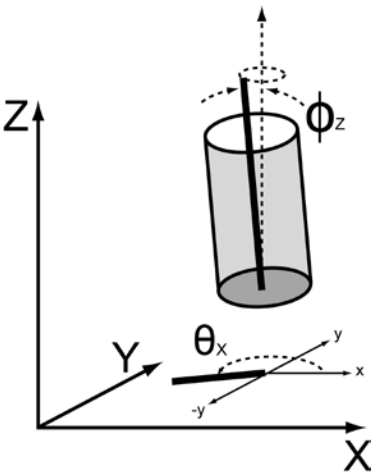


to display the menu of alternative feature types



Probed points are shown in the View screen

Measurement results are shown in the Feature list, View screen and DRO screen. The feature graphic in the View screen shows the feature and the points used to define it. Errors are shown as whiskers connecting the probed points to the feature. The maximum errors are shown in red and are used in the calculation of form. The View screen shows location and angular displacement (shown below), form error, the number of points used, reference frame and the projection plane (3D). When only six points are probed, the form error is zero. When more than six points are probed, the form error is the sum of the two greatest opposing error magnitudes.

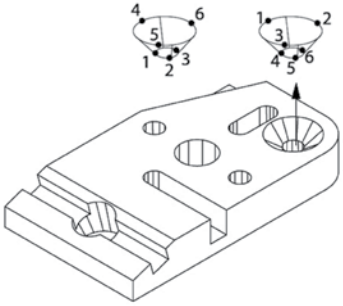


The angular displacements in the coordinate system orientation shown here for a plane are designated as:

- Phi(Z) ϕ_z The angular displacement of the cylinder's axis from the reference frame's Z-axis
- Theta(X) θ_x The angular displacement of the X-Y projection of the cylinder's axis from the reference frame's X-axis

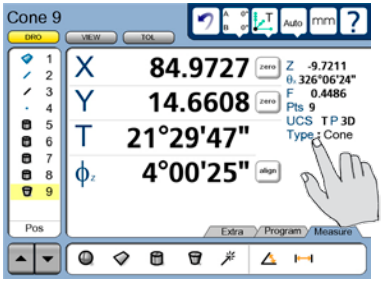
Probing cones

A minimum of six probed points are required to measure a cone. The points must be probed beginning with two sets of three points; one set of three at the top and another at the bottom of the cone. After the initial six points, there is no practical limit to the additional number of points that can be probed, and in general accuracy is increased by probing more points. The first six points can be probed: three at the top, then three at the bottom, or in the reverse order. Additional points can be probed anywhere on the cone surface.

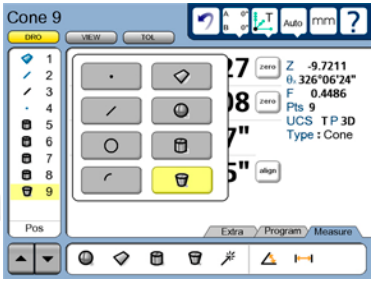


Points can be probed starting at the top or at the bottom

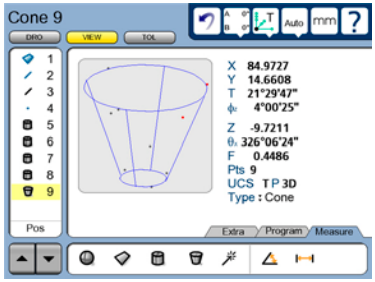
If the feature type is not interpreted correctly by Measure Magic, it can be changed to a cone when more than six points are probed.



Touch the feature type...



to display the menu of alternative feature types

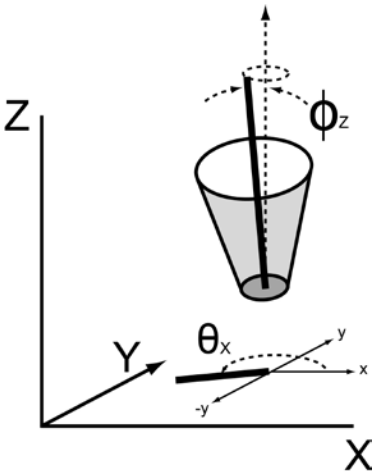


Probed points are shown in the View screen

Measurement results are shown in the Feature list, View screen and DRO screen. The feature graphic in the View screen shows the feature and the points used to define it. Errors are shown as whiskers connecting the probed points to the feature. The maximum errors are shown in red and are used in the calculation of form. The View screen shows location and angular displacement (shown below), form error, the number of points used, reference frame and the projection plane (3D). When only six points are probed, the form error is zero. When more than six points are probed, the form error is the sum of the two greatest opposing error magnitudes.

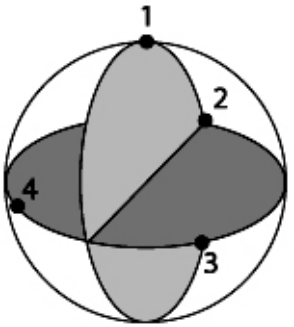
The angular displacements in the coordinate system orientation shown here for a plane are designated as:

- Phi(Z) ϕ_z The angular displacement of the cone's axis from the reference frame's Z-axis
- Theta(X) θ_x The angular displacement of the X-Y projection of the cone's axis from the reference frame's X-axis



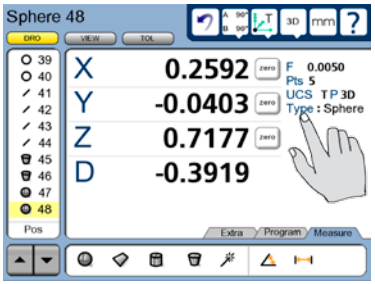
Probing spheres

A minimum of four probed points are required to measure a sphere. The points can be probed in any order. After the initial four points, there is no practical limit to the additional number of points that can be probed, and in general accuracy is increased by probing more points. The first three points should be probed around the equator, and the last point at the top. Additional points can be probed anywhere on the sphere surface.

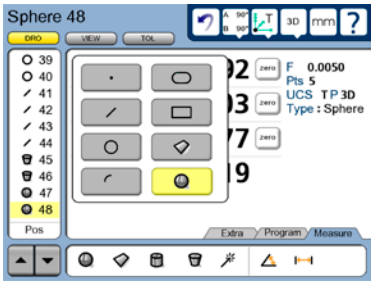


Points can be probed in any order

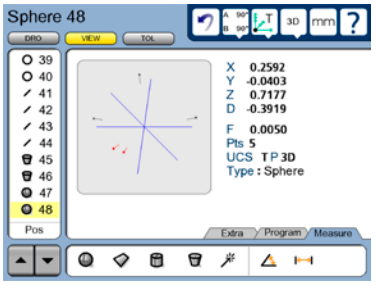
If the feature type is not interpreted correctly by Measure Magic, it can be changed to a sphere when more than four points are probed.



Touch the feature type...



to display the menu of alternative feature types



Probed points are shown in the View screen

Measurement results are shown in the Feature list, View screen and DRO screen. The feature graphic in the View screen shows the feature and the points used to define it. Errors are shown as whiskers connecting the probed points to the feature. The maximum errors are shown in red and are used in the calculation of form. The View screen shows location and angular displacement (shown below), form error, the number of points used, reference frame and the projection plane (3D). When only four points are probed, the form error is zero. When more than four points are probed, the form error is the sum of the two greatest opposing error magnitudes.

Constructing features

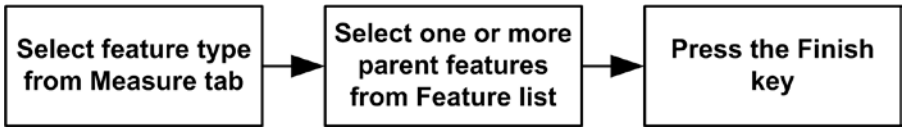
Features can be constructed from one or more existing features. Existing features used to construct new features are called parent features, and can be features that were measured, constructed or created. Existing features are shown in black, and constructed features are shown in blue in the View screen. Feature constructions are divided into seven categories:

- Duplicate features
- Extractions
- Intersections
- Relations
- Multipoint features
- Perpendicular/parallel/tangents
- Gage lines and circles

Parent features used to construct other features include:

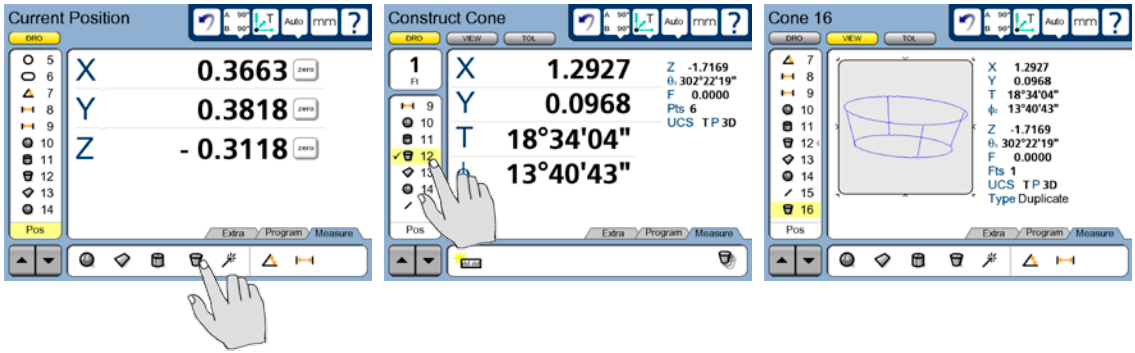
- Positional features
  Points, circles, parks, slots, rectangles, and spheres
- Linear features
  Cylinders, cones, lines
- Planes
- Angles
- Distances

The feature construction process is identical for all feature types:



Duplicate features

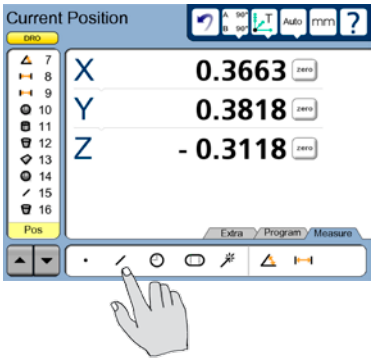
Any feature can be duplicated. In this example a cone is duplicated.



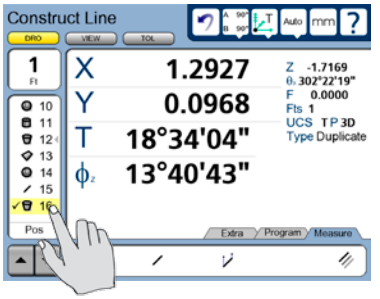
Select the cone feature type... *select the parent cone feature...* *then press the Finish key*

Extracted features

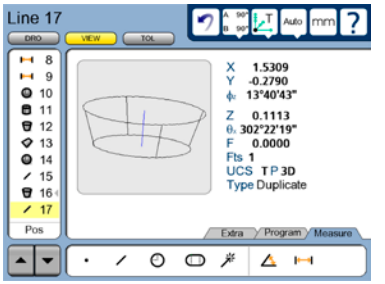
Features such as points and lines can be extracted from parent features. In this example, an axis line is extracted from a cone.



Select the line feature type...



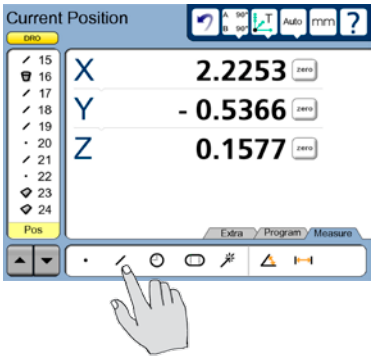
select the parent cone feature...



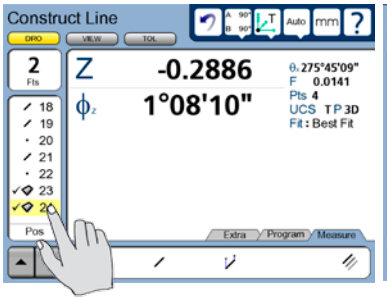
then press the Finish key

Intersection features

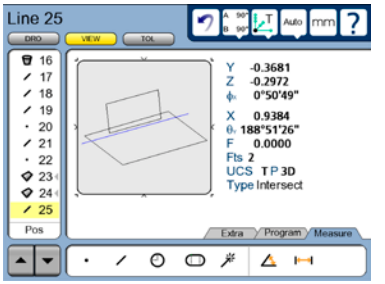
Features such as points, lines and circles can be constructed from the intersections of positional, linear and plain features. In this example, a line is constructed from two planes.



Select the line feature type...



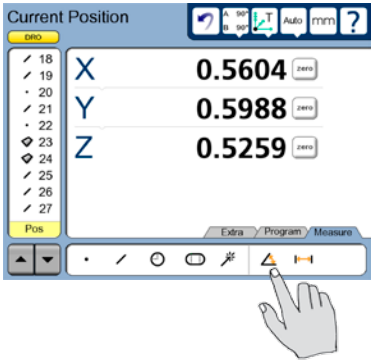
select the two plane features...



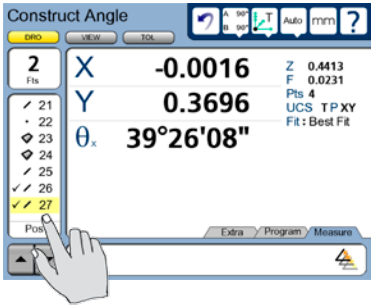
then press the Finish key

Relation features

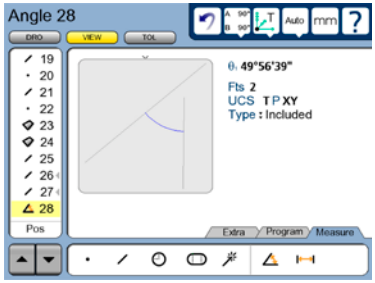
Features such as angles and distances can be constructed by relating one linear feature to another or one positional feature to another. In this example, an angle is constructed between two lines.



Select the line feature type...



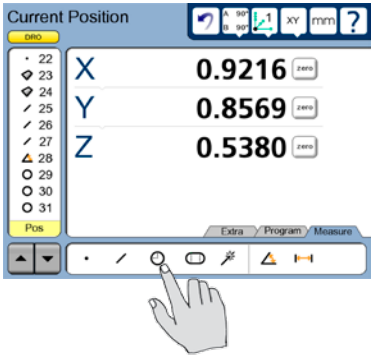
select the two plane features...



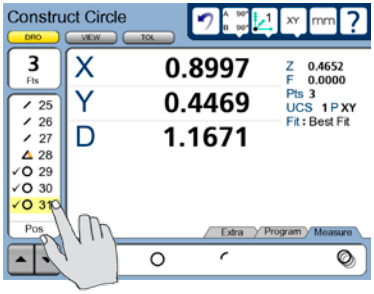
then press the Finish key

Multipoint features

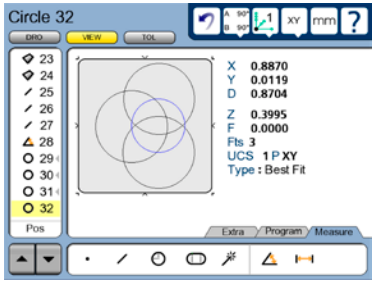
Features such as circles can be constructed from multiple positional features. In this example, a bolt hole pattern circle is constructed from three bolt hole circles.



Select the circle feature type...



select the three circle features...

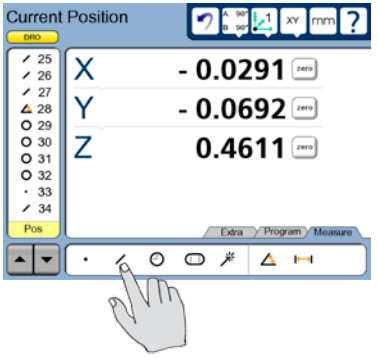


then press the Finish key

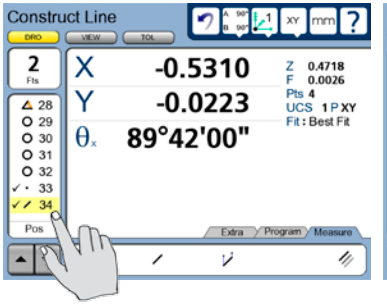
Perpendicular/parallel/tangent features

Line features can be constructed that are perpendicular, parallel or tangent to other linear or positional features. In these examples, a line is constructed through a point that is perpendicular to another line and a line is constructed that is tangent to two circles.\

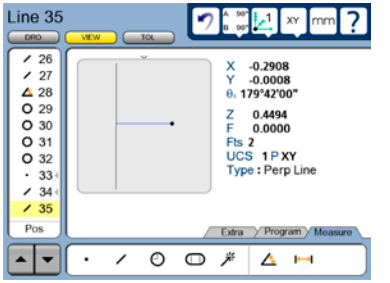
Perpendicular line example



Select the line feature type...

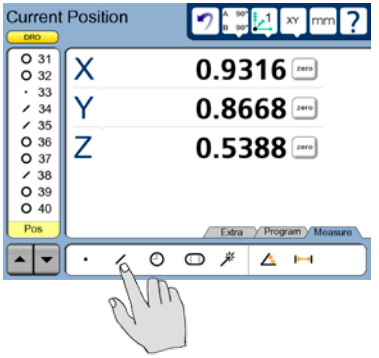


select the two parent features...

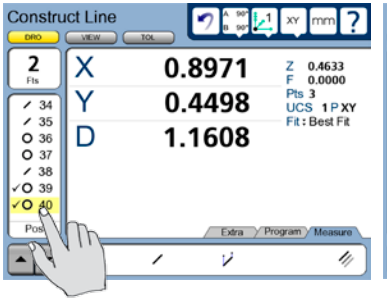


then press the Finish key

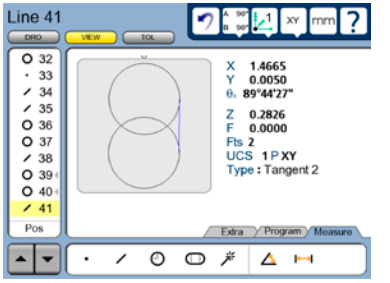
Tangent line example



Select the line feature type...



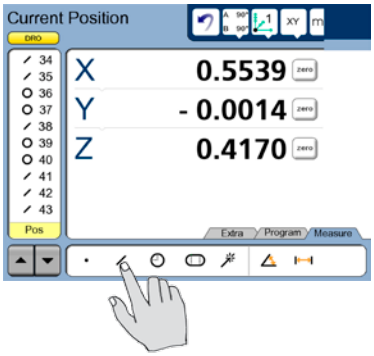
select the two parent features...



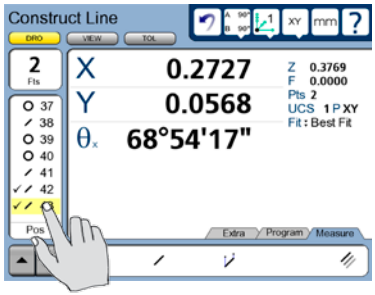
then press the Finish key

Gage line and circle features

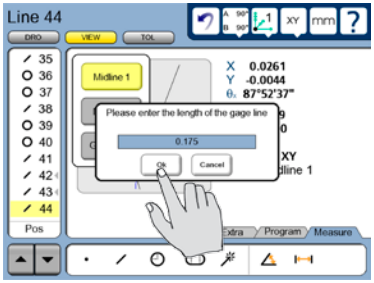
Gage lines and circles can be constructed between to linear features. In this example, a gage line is constructed between two lines. When gage lines and gage circles are constructed, an extra step is required. The user must enter a gage line length or gage circle diameter.



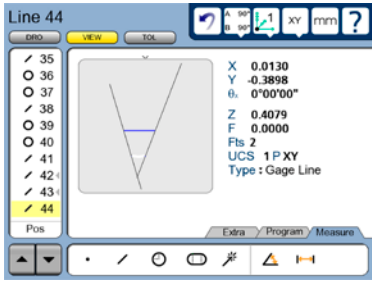
Select the line feature type...



select the two parent features...



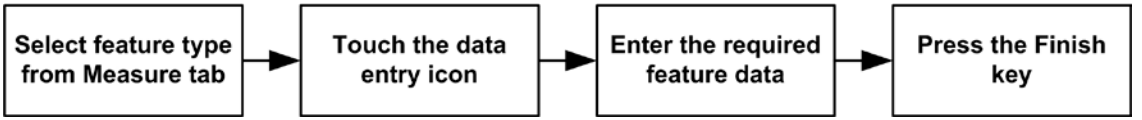
enter the gage value, touch OK...



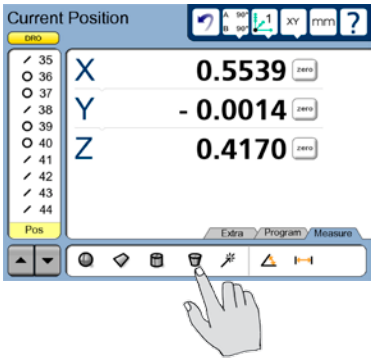
then press the Finish key

Creating features

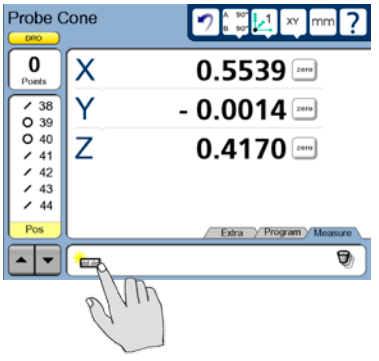
Features can be created for any feature type by entering position, size and other parameters into feature data fields. The process for creating feature is identical for all feature types:



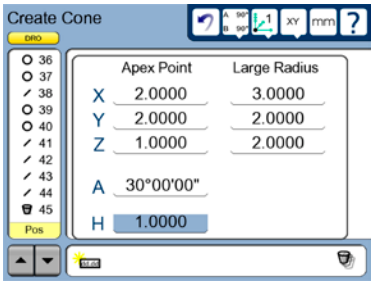
Feature data fields are self-explanatory. In this example, a cone is created.



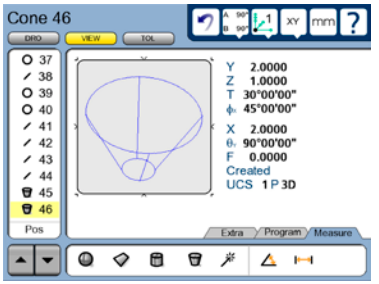
Select the cone feature type...



touch the data entry icon...



enter the cone feature data...



then press the Finish key

Chapter 7: Tolerancing

Tolerances can easily be applied to position, form, orientation, runout and size measurements using the tools found in the tolerance screens.

CAUTION

Discrete point measuring machines estimate the size, position, orientation, and form of geometric features based on points probed. When parts are designed with critical tolerances, be sure that you have probed sufficient points to calculate a reliable estimate. For example, if you probe a circle with only three points, the circularity will be perfect and the circle will always pass a form tolerance test.

CAUTION

The QC-330 initially uses a best fit algorithm to estimate the size, position, orientation and form of geometric features. While the best fit yields very useful information, the results do not necessarily reflect how well the parts will fit together and perform their function. For example, a hole diameter could be calculated as 10.000 mm but have poor form. In this case, a 9.9 mm pin might not fit in the 10.000 mm hole.

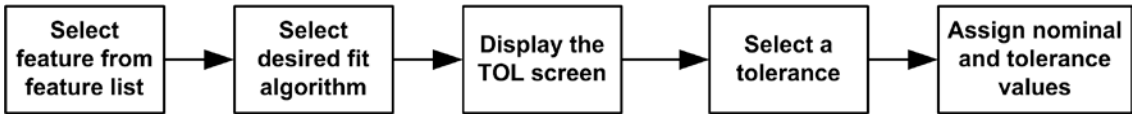
NOTE

Tolerance calculations comply with the ASME Y14.5M-1994 standard except as noted in the tolerance section of Chapter 12: Reference Materials.

This chapter includes the following tolerance information:

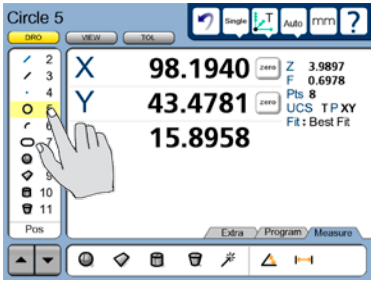
Applying tolerances to features

Tolerances are applied to feature measurements using tolerance screens. The method of applying tolerances to features is diagrammed below and is nearly identical for all tolerance types. In the following example, a true position tolerance is applied to a circle feature.



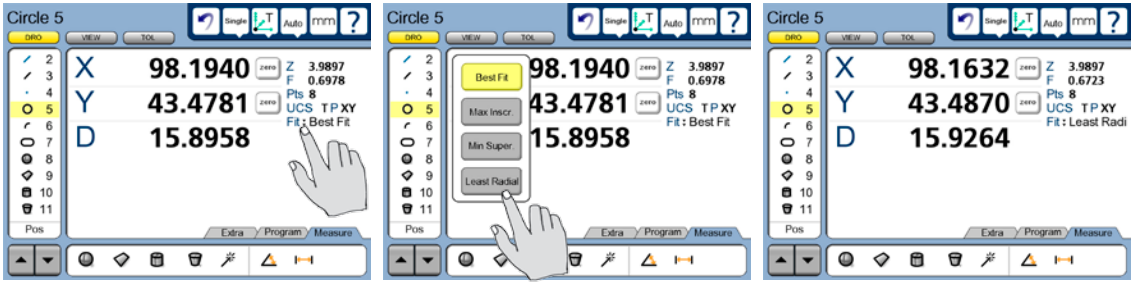
Select a feature from the feature list

Touch the desired feature in the feature list to select it. In this example a circle is selected.



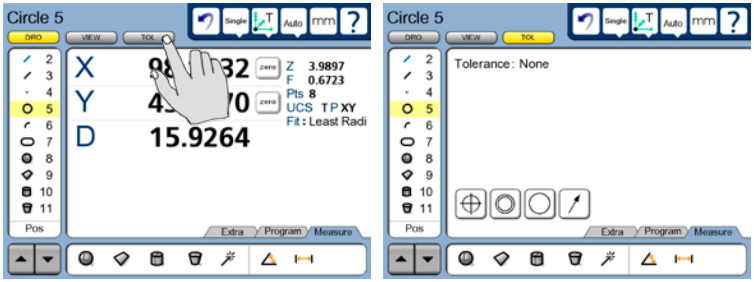
Select the desired fit algorithm

Touch the Fit choice field to display a menu of available fit algorithms, then touch the desired fit algorithm button. In this example, the fit algorithm is changed from Best Fit to Least Radial.



Display the TOL screen

Touch the Tol screen button to display the tolerance screen.



Select a tolerance

Tolerance categories and the feature types that fit into each tolerance category are outlined below:

Position

Bidirectional	*True position*	*MMC*	*LMC*	*Concentricity*
Point	Point	Circle	Circle	Circle
Line	Line	Arc	Arc	Arc
Circle	Circle	Cylinder	Cylinder	
Arc	Arc			
Slot	Sphere			
Rectangle	Cylinder			
Sphere				

Form

Straightness	*Roundness*	*Cylindricity*	*Flatness*
Line	Circle	Cylinder	Plane
	Arc		
	Sphere		

Orientation

Perpendicularity	*Parallelism*	*Angle*	*Co-planarity*
Line	Line	Angle	Plane
Cylinder	Cylinder	Cone	
Cone	Cone		
Plane			

Runout

Circular runout
Circle
Arc

Size

Diam/radius	*Length/width*	*Width*
Circle	Slot	Distance
Arc	Rectangle	
Sphere		
Cylinder		

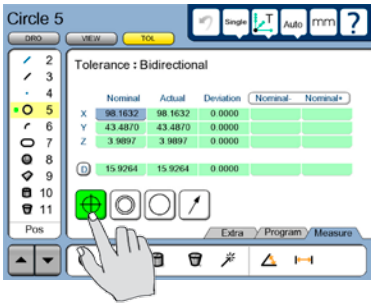
Position tolerances

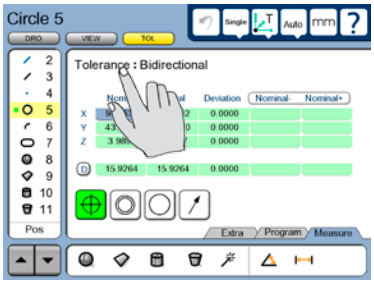
To select a position tolerance:

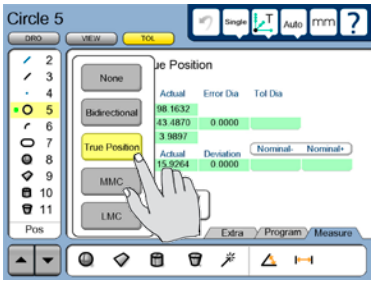
1 Touch the position icon. 

2 Touch the Tolerance title to display the menu of position tolerance alternatives.

3 Touch the desired position tolerance menu item.







Bidirectional	***True position***	***MMC***	***LMC***	***Concentricity***
Point	Point	Circle	Circle	Circle
Line	Line	Arc	Arc	Arc
Circle	Circle	Cylinder	Cylinder	
Arc	Arc			
Slot	Sphere			
Rectangle	Cylinder			
Sphere				

Form tolerances

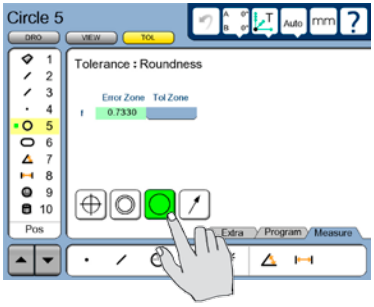
To select a form tolerance, touch a form icon. Form icons include:

Straightness 

Roundness 

Cylindricity 

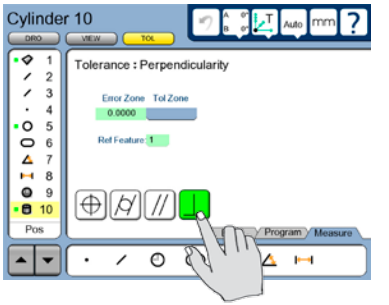
Flatness 



Straightness	***Roundness***	***Cylindricity***	***Flatness***
Line	Circle	Cylinder	Plane
	Arc		
	Sphere		

Orientation tolerances

To select an orientation tolerance, touch an orientation icon. Orientation icons include:

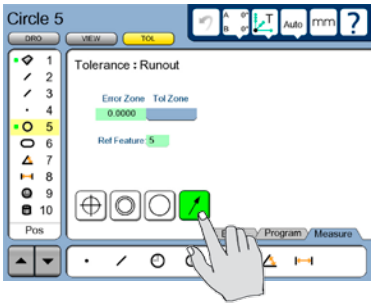


Perpendicularity	Parallelism and Co-planarity	Angle
		

Perpendicularity	***Parallelism***	***Angle***	***Co-planarity***
Line	Line	Angle	Plane
Cylinder	Cylinder	Cone	
Cone	Cone		
Plane			

Runout tolerances

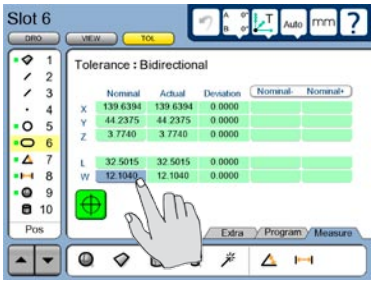
To select a runout tolerance, touch the runout icon. 



Circular runout
- Circle
- Arc

Size tolerances

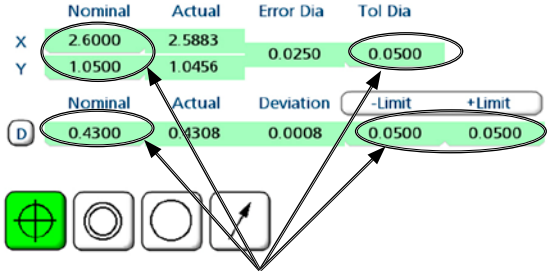
To select a size tolerance, touch the length, width, radius or diameter field within a tolerance screen.



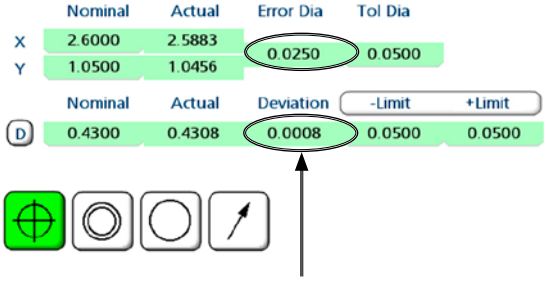
Diam/radius	***Length/width***	***Width***
Circle	Slot	Distance
Arc	Rectangle	
Sphere		
Cylinder		

Enter nominal, limit or tolerance values

To enter nominal, limit or tolerance values touch the desired data field and enter the value. In this example, the Nominal and Tol Dia (Tolerance diameter around the nominal position) values are entered by touching data fields and entering a new values. Error and Deviation values are generated as soon as the Nominal and Tol Dia values are entered.



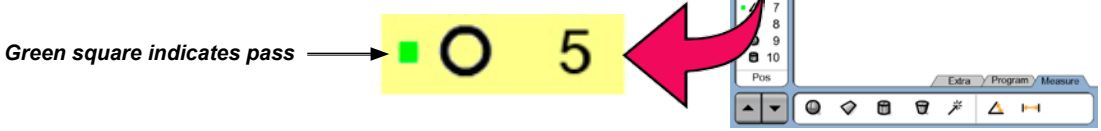
The Nominal, Tol Dia and Limit values are entered...



resulting in new error and deviation values

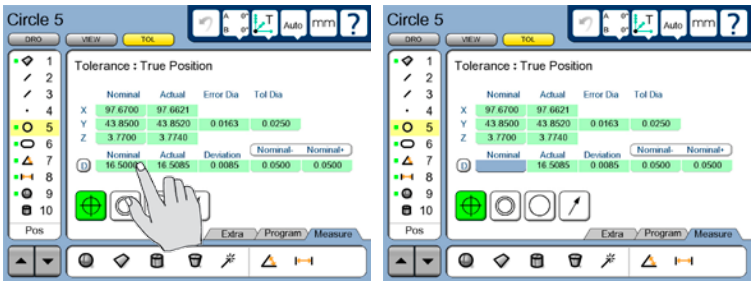
Pass/fail results are indicated by green and red colors in the tolerance screen and in the feature list. Pass is indicated by green, fail is indicated by red in the tolerance screen.

Any tolerance failure will be indicated by a red square next to the feature in the feature list. A green square will be displayed in the feature list when all tolerance tests pass.



Omitting a tolerance category

When a tolerance category is unnecessary, it can be omitted. To omit a category, select the Nominal data field, remove any data by repeatedly pressing the Cancel key and press the Enter key. In this example, the Diameter category is omitted.



Tolerance types

As mentioned earlier, the method of applying tolerances to features is nearly identical for all tolerances. This section describes tolerances for each feature type. The following tolerance descriptions are included:

Position:	Bidirectional, true position, MMC, LMC, concentricity
Form:	Straightness, roundness, cylindricity, flatness
Orientation:	Perpendicularity, parallelism , angle, co-planarity
Runout:	Circular runout
Size:	Diam/radius, length, width

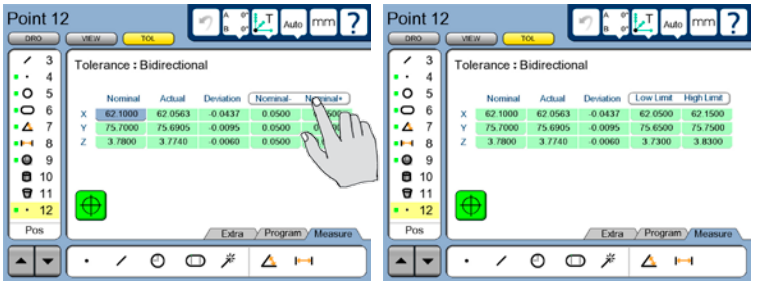
Position/Bidirectional

Bidirectional tolerances can be applied to points, lines, circles, arcs, slots, rectangles and spheres.

Points

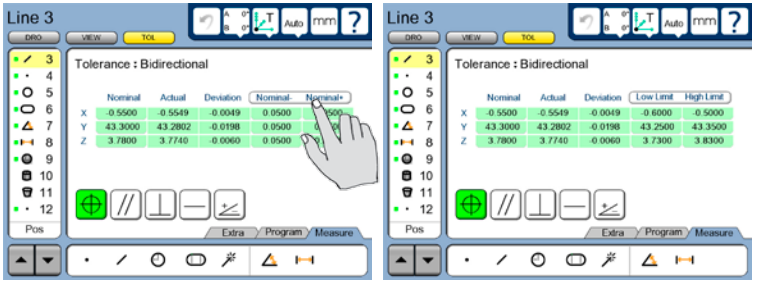
The tolerance screen for points is used to specify the acceptable deviation from a nominal position in the X, Y and Z axes. The bidirectional tolerance compares the measured location of a point to the nominal location of the feature's center or mid point.

Enter the nominal values into the X, Y and Z axis data fields provided. Enter the allowed limits into the Limit data fields as +/- ranges or as absolute limits. Touch the Limit data fields to toggle between +/- ranges or absolute limits.



Lines

The tolerance screen for lines is used to specify the acceptable deviation from nominal positions in X, Y and Z axes. The bidirectional tolerance compares the measured location of the mid point of a line to the nominal location of the line's mid point.

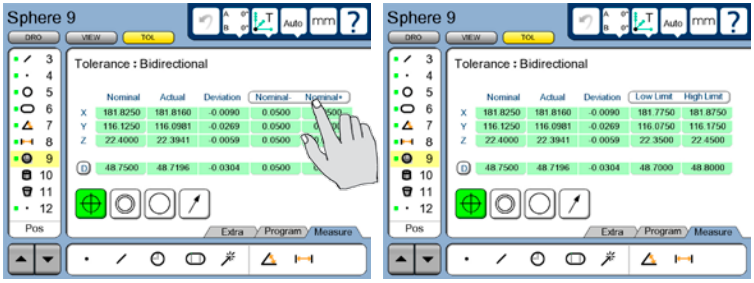


Enter the nominal values into the appropriate axis data fields. Enter the allowed limits into the Limit data fields as +/- ranges or as absolute limits. Touch the Limit data fields to toggle between +/- ranges or absolute limits.

Circles, arcs and spheres

The tolerance screens for circles, arcs and spheres are identical, and are used to specify the acceptable deviation from nominal positions in X, Y and Z axes, and from the nominal diameter or radius. The bidirectional tolerance compares the measured location of the center point of the arc, circle or sphere to the nominal center point and compares the measured diameter or radius to the nominal. Touch the D (diameter) or r (radius) choice field in the DRO screen to toggle between the display of diameter and radius if desired.

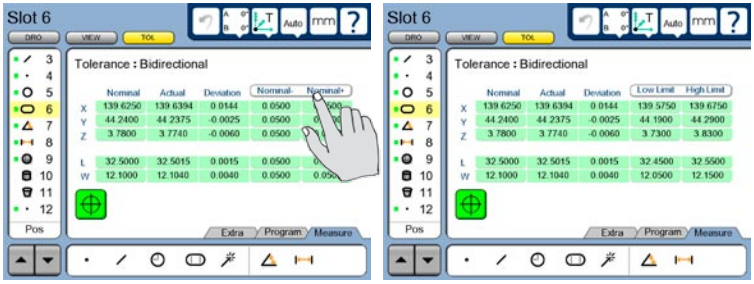
Enter the nominal values into the X, Y and Z axis and D (diameter) data fields provided. Enter the allowed limits into the Limit data fields as +/- ranges or as absolute limits. Touch the Limit data fields to toggle between +/- ranges or absolute limits.



Slots and rectangles

The tolerance screens for slots and rectangles are identical and are used to specify the acceptable deviation from nominal positions in the X and Y axes, and from the nominal length and width. The bidirectional tolerance compares the measured location of the center point of the slot or rectangle to the nominal center point and compares the measured size to the nominal size.

Enter the nominal values into the X, Y and Z axis and L and W data fields provided. Enter the allowed limits into the Limit data fields as +/- ranges or as absolute limits. Touch the Limit data fields to toggle between +/- ranges or absolute limits.

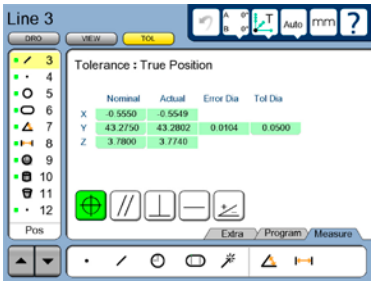


Position/True position

True position tolerances can be applied to points, lines, circles, arcs, spheres and cylinders.

Points and lines

The tolerance screens for points and lines are identical, and are used to specify the acceptable deviation from the nominal feature position. The true position tolerance compares the measured location of the center point to the nominal center point.

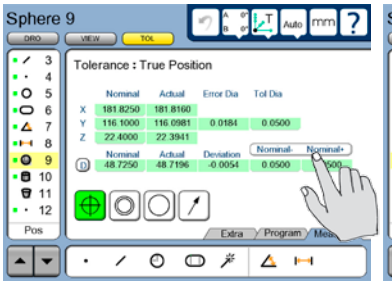


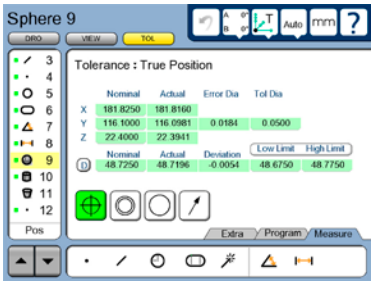
Enter the nominal values into the X, Y and Z axis data fields. Enter the allowed tolerance diameter into the Tol Dia field.

Circles, arcs, spheres and cylinders

The tolerance screens for circles, arcs, spheres and cylinders are identical, and are used to specify the acceptable deviation from the nominal feature position, and from the nominal diameter. The true position tolerance compares the measured location of the center point of the circle, arc, sphere or cylinder to the nominal center point and compares the measured diameter to the nominal diameter. Touch the D (diameter) or r (radius) choice field in the DRO screen to toggle between the display of diameter and radius if desired.

Enter the nominal values into the X, Y and Z axis and D (diameter) data fields provided. Enter the allowed Tol Dia (Tolerance diameter) and feature diameter limits into the Limit data fields as +/- ranges or as absolute limits. Touch the Limit data fields to toggle between +/- ranges or absolute limits.



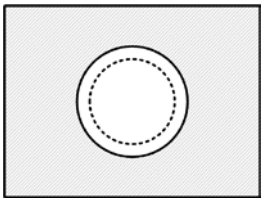


Position/MMC and LMC (Material conditions)

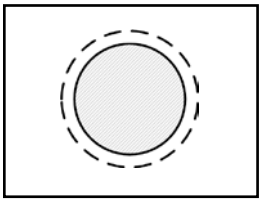
MMC and LMC tolerances can be applied to bosses or to bores, compare measured center locations to the nominal centers and compare measured diameters to nominal diameters. MMC and LMC tolerances can be applied to circles, arcs and cylinders.

MMC Circles, arcs and cylinders

The MMC tolerance screens for circles, arcs and cylinders are identical, and are used to specify the maximum material that can exist within a bore or on the surface of a boss.



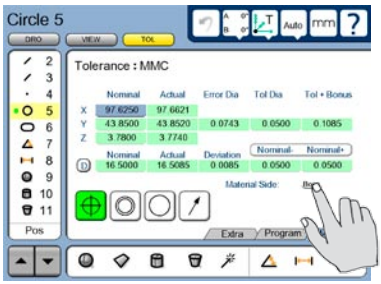
Maximum material within a bore

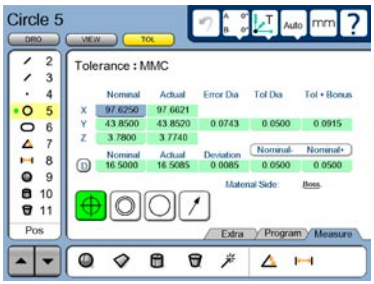


Maximum material on a boss

MMC tolerances generate position bonuses as a result of size tolerance surpluses. For example, when the size of a bore is larger than MMC, but within the acceptable tolerance range, a position tolerance bonus is generated for the bore and its acceptable location is given more flexibility. However, if a bore is within the position tolerance diameter, no position bonus is generated and the bore must be located exactly as specified.

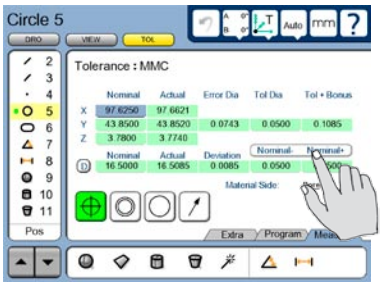
Touch the Boss or Bore choice field to specify the feature type as a Boss or a Bore.

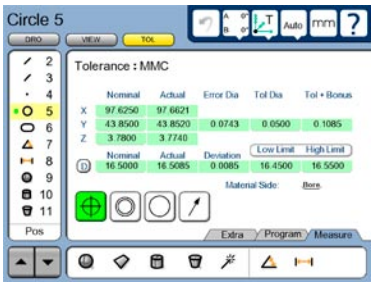




Enter the nominal values into the X, Y and Z axis and D (diameter) data fields provided. Enter the allowed Tol Dia (Tolerance diameter) and feature diameter limits into the Limit data fields as +/- ranges or as absolute limits.

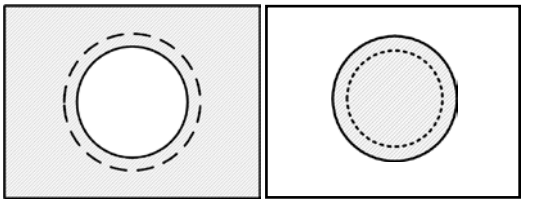
Touch the Limit data fields to toggle between +/- ranges or absolute limits.





LMC Circles, arcs and cylinders

The LMC tolerance screens for circles, arcs and cylinders are identical, and are used to specify the minimum material that can exist within a bore or on the surface of a boss.

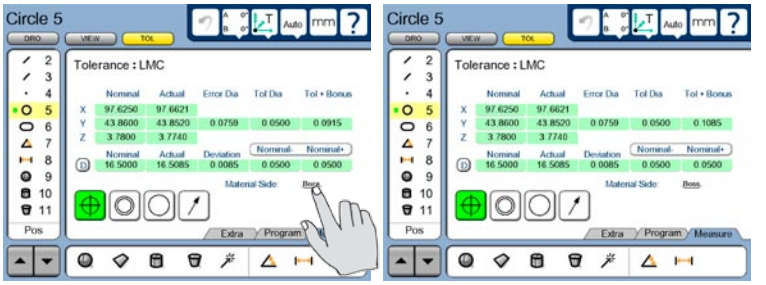


Minimum material within a bore *Minimum material on a boss*

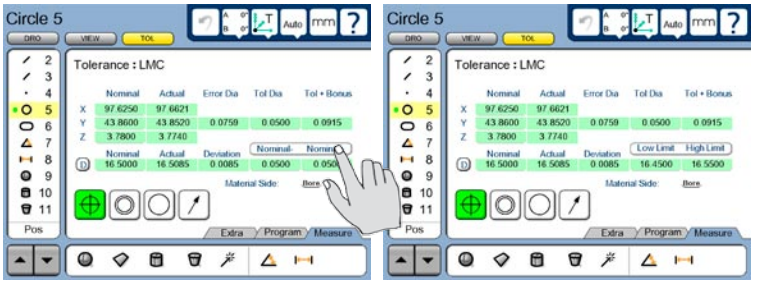
LMC tolerances can generate position bonuses as a result of size tolerance surpluses. For example, when the size of a bore is smaller than LMC, but within the acceptable tolerance range, a position tolerance bonus is generated for the bore and its acceptable location is given more flexibility. However, if a bore is within the position tolerance diameter, no position bonus is generated and the bore must be located exactly as specified.

Touch the Boss or Bore choice field to specify the feature type as a Boss or a Bore.

Enter the nominal values into the X, Y and Z axis and D (diameter) data fields provided. Enter the allowed Tol Dia (Tolerance diameter) and feature diameter limits into the Limit data fields as +/- ranges or as absolute limits.

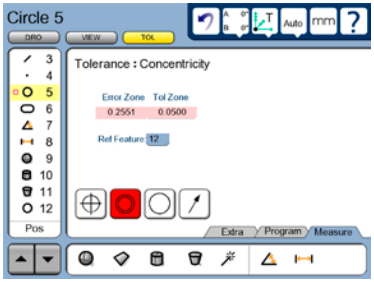


Touch the Limit data fields to toggle between +/- ranges or absolute limits.



Position/Concentricity circles and arcs

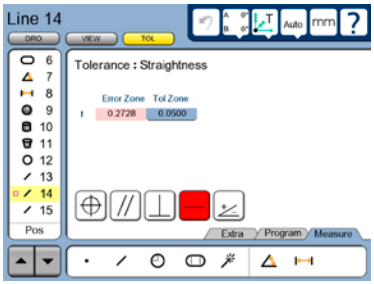
Concentricity tolerances can be applied to circles and arcs. The tolerance entry screens are identical, and are used to specify the acceptable position deviation from a circle or arc concentric to a reference feature.



Enter the acceptable position deviation into the Tol Zone data field and then enter the number of the reference feature for the concentricity tolerance into the Ref Feature data field.

Form/Straightness lines

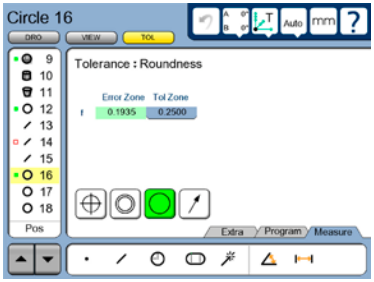
The straightness tolerance can be applied to lines and is used to specify the acceptable deviation from a perfect line.



Enter the acceptable form deviation into the Tol Zone data field .

Form/Roundness circles, arcs and spheres

Roundness tolerances can be applied to circles, arcs and spheres. The tolerance screens are identical, and are used to specify the acceptable deviation from a perfect circle or circle segment.

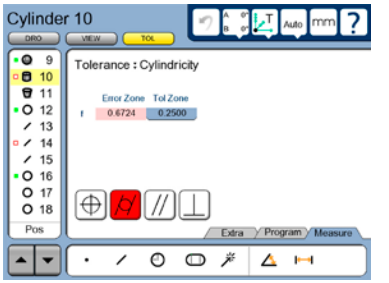


Enter the acceptable form deviation into the Tol Zone data field.

Form/Cylindricity cylinders

Cylindricity tolerances can be applied to cylinders. The tolerance screen is used to specify the acceptable deviation from a perfect cylinder.

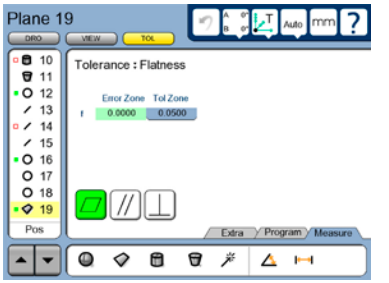
Enter the acceptable form deviation into the Tol Zone data field.



Form/Flatness planes

Flatness tolerances can be applied to planes. The tolerance screen is used to specify the acceptable deviation from a perfect plane.

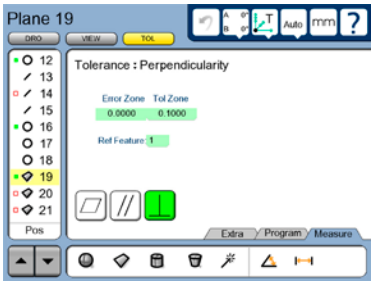
Enter the acceptable form deviation into the Tol Zone data field.



Orientation/Perpendicularity lines, cylinders, cones, planes

Perpendicularity tolerances can be applied to lines, cylinders, cones and planes. Perpendicularity tolerances are used to specify the acceptable deviation from a line, axis or plane perfectly perpendicular to a Reference feature.

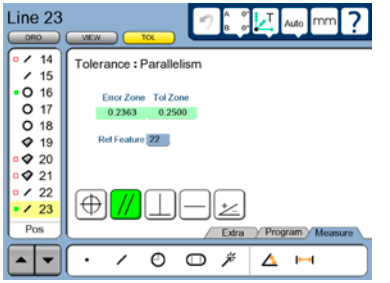
Enter the acceptable perpendicularity deviation value into the Tol Zone data field, and then enter the number of the reference feature for the Perpendicularity tolerance into the Ref Feature data field.



Orientation/Parallelism lines, cylinders, cones

Parallelism tolerances can be applied to lines, cylinders and cones. Parallelism tolerances are used to specify the acceptable deviation from a line or axis perfectly parallel to a reference feature.

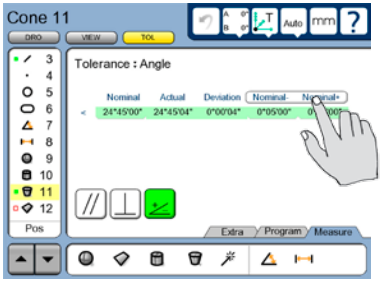
Enter the acceptable parallelism deviation into the Tol Zone data field, and then enter the number of the reference feature for the parallelism tolerance into the Ref Feature data field.

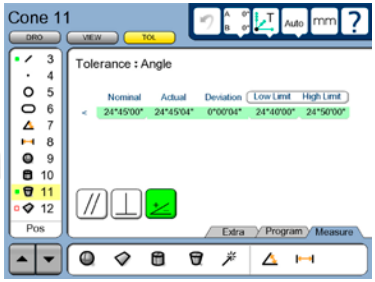


Orientation/Angle angles, cones

Angle tolerances can be applied to angles and cones. The tolerance screens are identical, and are used to specify the acceptable deviation from a nominal angle.

Enter the allowed angle limits into the Limit data fields as +/- ranges or as absolute limits. Touch the Limit data fields to toggle between +/- ranges or absolute limits.

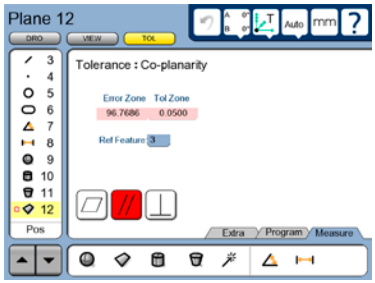




Orientation/Co-planarity planes

Co-planarity tolerances can be applied to planes and are used to specify the acceptable deviation from a plane perfectly parallel to a reference plane.

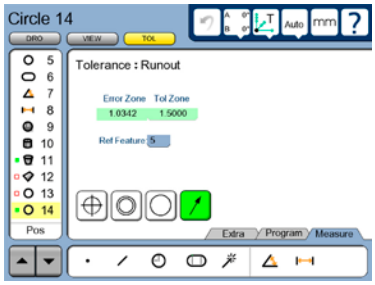
Touch the Parallelism icon for co-planarity tolerances. Enter the acceptable co-planarity deviation into the Tol Zone data field, and then enter the number of the reference feature for the parallelism tolerance into the Ref Feature data field.



Runout/Circular runout circles, arcs

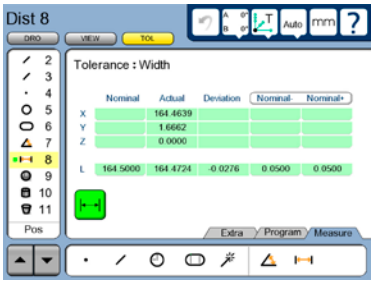
Circular runout tolerances can be applied to circles and arcs. The tolerance screens are identical, and are used to specify the acceptable deviation from a circle or arc around the center of the reference feature axis.

Enter the acceptable runout deviation into the Tol Zone data field and then enter the number of the reference feature for the tolerance into the Ref Feature data field.

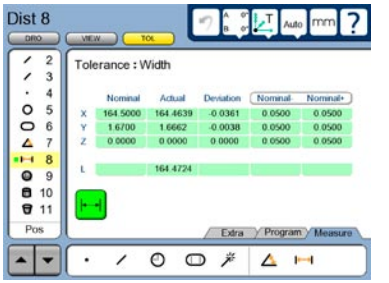


Size/Width distances

Width tolerances can be applied to distances and are used to specify the acceptable deviation from a nominal distance. The distance can be specified as a vector length (L) or as separate X, Y and Z lengths.

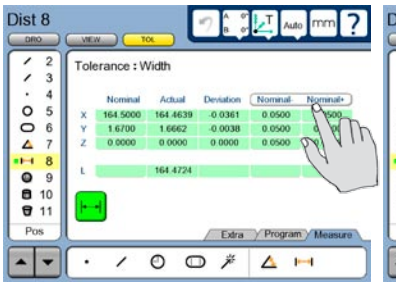


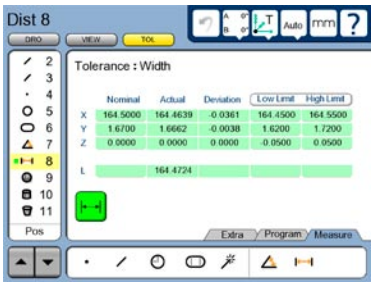
X, Y and Z nominal values deleted to tolerance L value



L nominal value deleted to tolerance X, Y and Z values

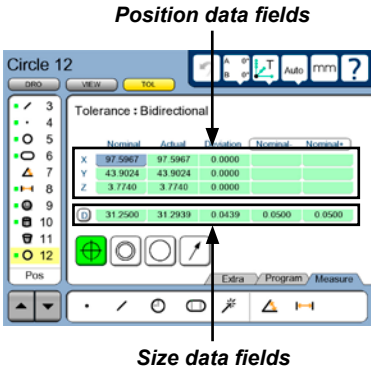
Enter the allowed width limits into the Limit data fields as +/- ranges or as absolute limits. Touch the Limit data fields to toggle between +/- ranges or absolute limits.

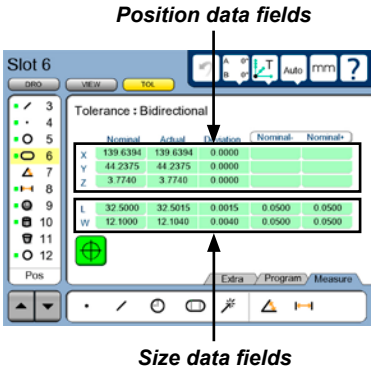


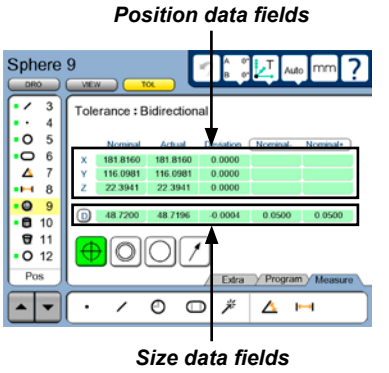


Size/Radius, diameter, length, width

Size tolerances can be applied to circles, arcs, slots, rectangles, cylinders, and spheres and are used to specify the acceptable deviation from a nominal radius, diameter, length or width. The tolerance is specified in size data fields on the bottom of position tolerance screens. Three examples are shown below.







Chapter 8: Programming

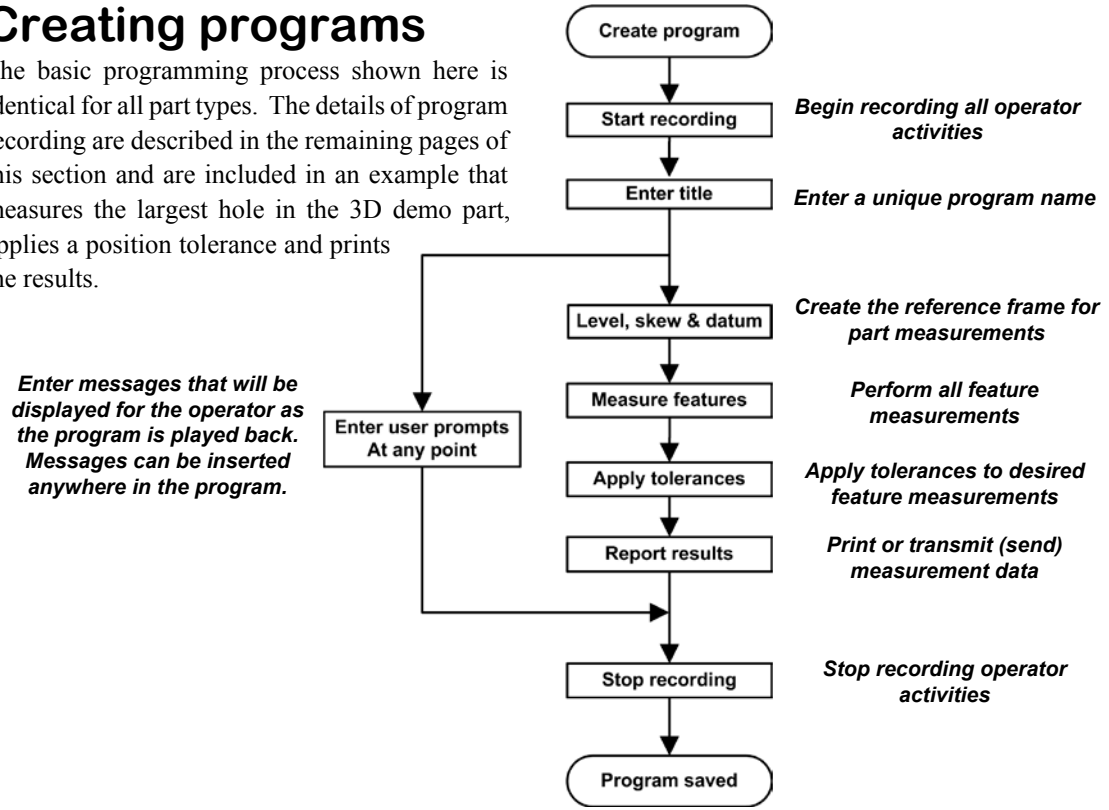
QC-330 programs are sequences of measurement steps performed on a part by the operator and stored by the system for playback later on other identical parts. Using the programming capabilities of the QC-330 greatly increases productivity by compressing the many manual steps required to measure, tolerance and report part dimensions into a few guided steps which are little more than operator responses to system prompts.

Programs can be:

- Created (recorded)
- Edited
- Run on new parts
- Archived
- Deleted

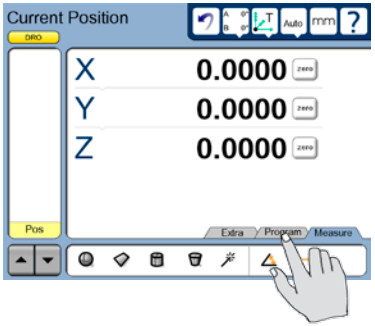
Creating programs

The basic programming process shown here is identical for all part types. The details of program recording are described in the remaining pages of this section and are included in an example that measures the largest hole in the 3D demo part, applies a position tolerance and prints the results.

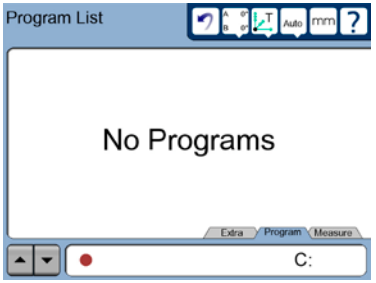


Start program recording

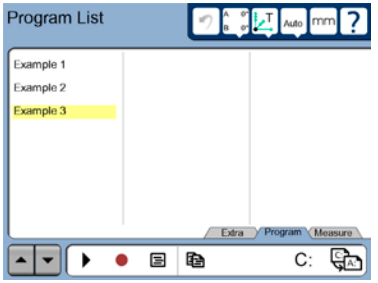
Touch the Program tab to display the programming tools. When no previous programs have been recorded, only the record icon will be shown. When other programs already exist, all the program tool icons will be shown.



Touch the Program tab...

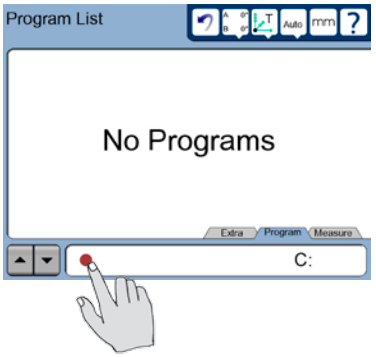


to display the record icon when no other programs exist, or...

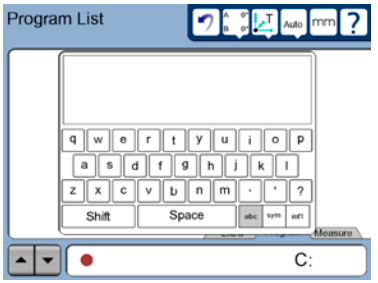


to display all the programming icons when other programs do exist

Touch the record icon to begin recording a program. The program title entry screen will be displayed.



Touch the record icon...



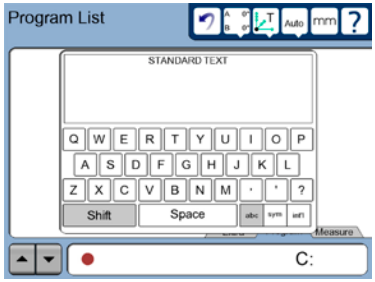
to display the title entry screen

Enter a program title (or user message)

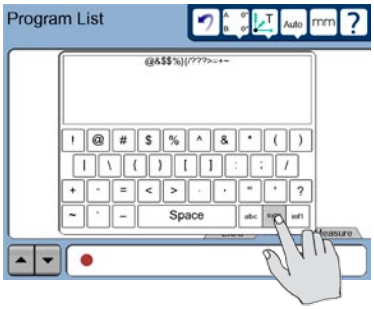
The method used to enter a program title is also used to enter any text message that will be played back during program execution as a user prompt.

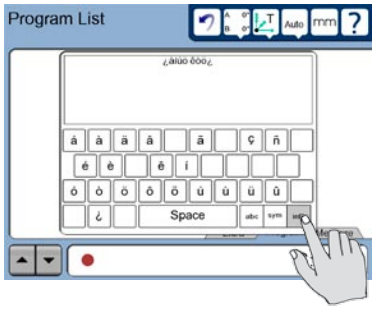
To enter a program title:

Touch the character and control keys on the text entry screen to enter a unique name for your new program. The number keys on the front panel can also be used to enter numeric characters. Characters can be upper or lower case and can be separated by spaces.

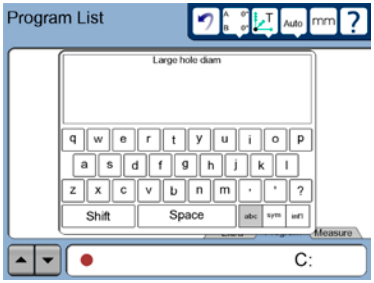


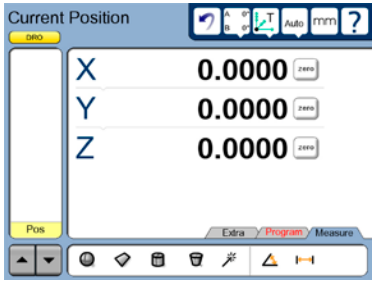
Touch the sym or int'l control keys to enter symbol or international characters.





Press the Finish key to enter the new program name and begin recording the program. The DRO screen will be displayed.

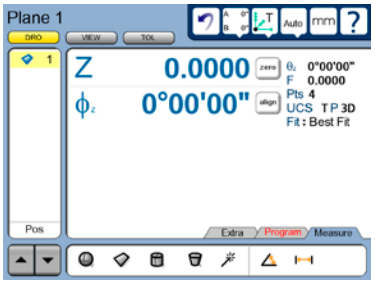




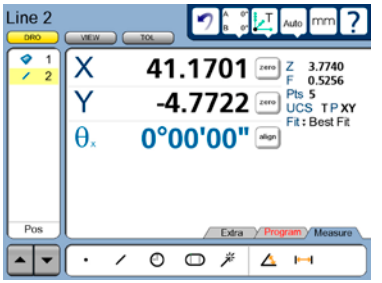
The system is now ready to record all datum, measurement, tolerance and reporting activities. Perform all the datum, measurement, tolerance and reporting activities just as you would if a program were not being recorded. Program recording is conducted by the system in the background and is invisible to the operator.

Create a reference frame for measurements

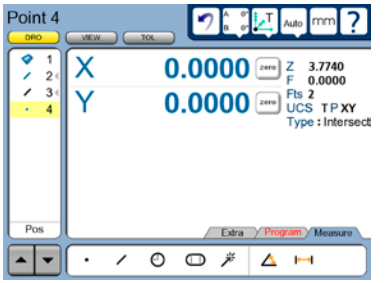
Perform a level, skew and datum as described in Chapter 6: Measuring. In this example, the resting surface for the part is leveled, the bottom edge of the part is skewed, and a datum point is constructed from the left edge of the part and the skew line.



The resting surface is leveled...



the bottom edge is skewed...

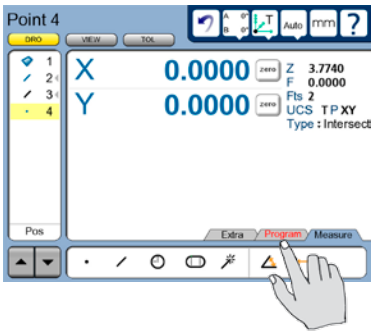


and a datum is created

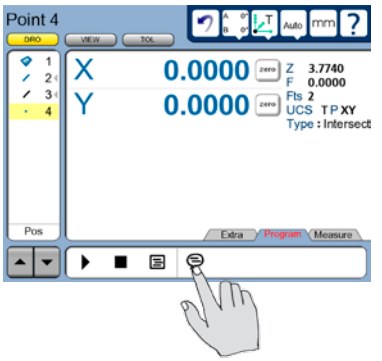
Measure a feature (include a message)

Feature measurements are described in Chapter 6: Measuring. In this example, the largest hole in the 3D demo part is measured.

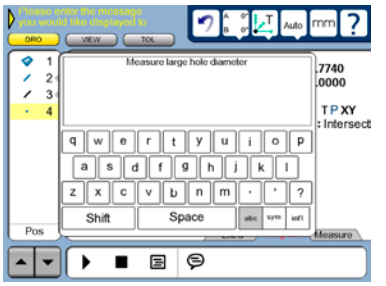
First, create a message that prompts the user to measure the hole. Press the Finish key to complete the message.



Display the Program tools...

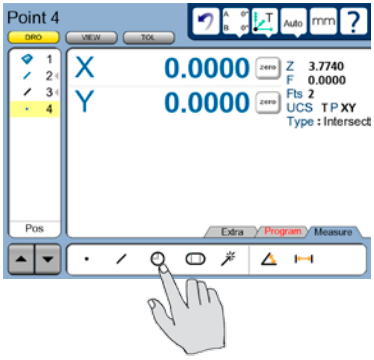


Touch the message icon...



include a user prompt message and press Finish

Then measure the largest hole in the 3D demo part. Details of performing circle measurements are described in Chapter 6: Measuring.

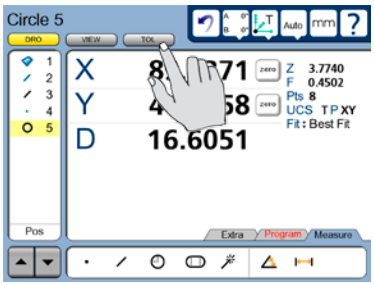


Measurement data are displayed

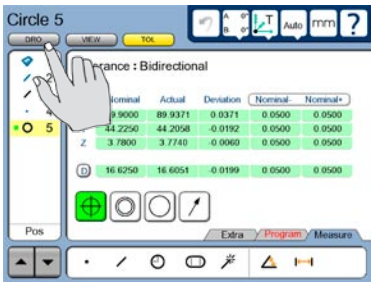
Apply a tolerance

Tolerance operations are described in Chapter 7: Tolerancing. In this example, a position tolerance is applied to the hole feature measured in the last step.

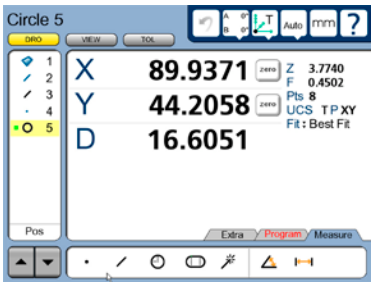
Touch the Tol button to display the Tolerance screen, apply the position tolerance and touch the DRO button to return to the DRO screen.



Touch the Tol button...



apply the tolerance and touch the DRO button...



to return to the DRO screen

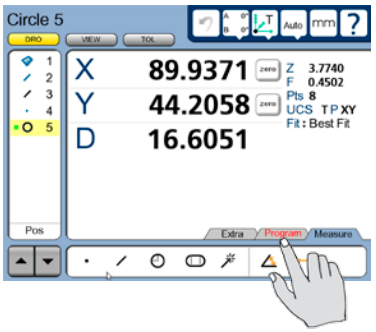
Report results

Measurement results can be printed over the USB port or transmitted to a computer over the RS-232 serial port. Parameters governing reports and data transmissions are configured in the Print setup screen described in Chapter 9: Communication, and in Chapter 10: Setup.

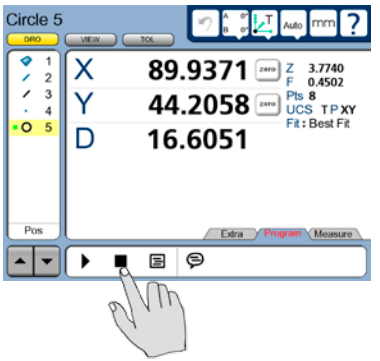
Reporting is included in a program by simply pressing the Print key while in recording a program.

Stop the program recording

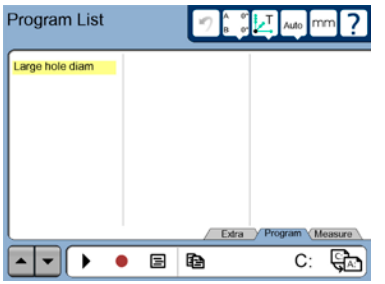
Touch the Program tab to display the programming icons, and then touch the Stop program icon to stop recording the program. The program title will be shown.



Touch the Program tab...



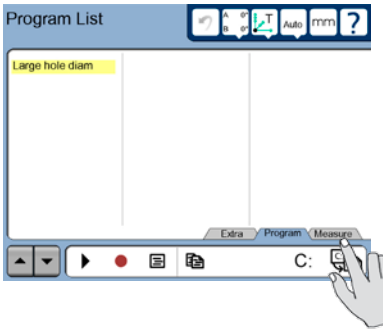
touch the Stop icon...



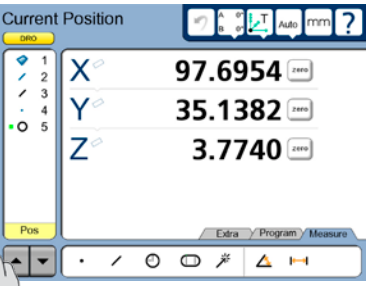
and then new program name will be shown

The program is now saved and can be edited or run on new parts.

Touch the Measure tab to return to the measure mode of operation.



Touch the Measure tab...



to return to the DRO

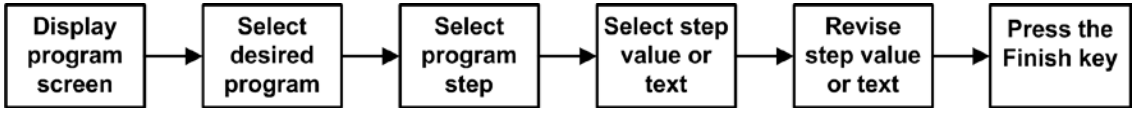
Editing Programs

Programs can be edited to:

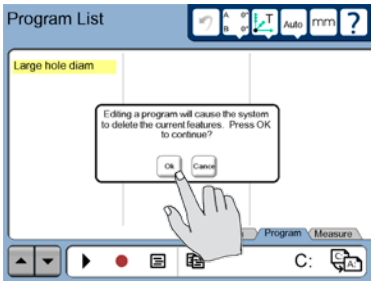
- Revise units of measure
- Revise user prompt messages
- Revise tolerances
- Insert or append program steps

Editing existing steps

The process for editing existing steps is diagrammed below and is identical for all types of revisions.



A message will be displayed at the beginning of an edit session warning the user that the current feature list will be cleared and asking for confirmation before continuing. Touch OK to clear the current feature list and begin editing the selected program.

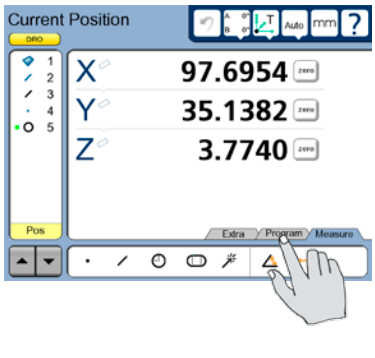


Editing program settings

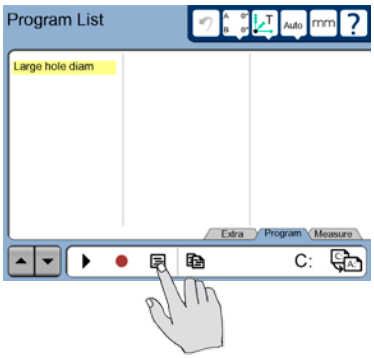
Program settings are contained in the initial program step and include units of measure and program loop count. Loop counter determines the number of program executions.

To edit program settings:

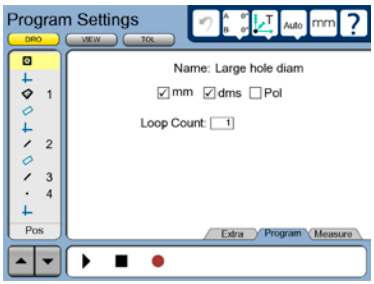
1 Touch the Program tab, the program title and the Edit program icon. Program steps will be displayed.



Touch the Program tab...



select a program and touch the Edit icon, settings will be displayed



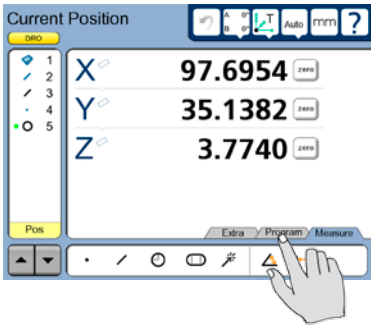
2 Touch the units or loop count fields and perform the desired edits, then press the Finish key to save the changes and return to the program list.

Editing tolerances

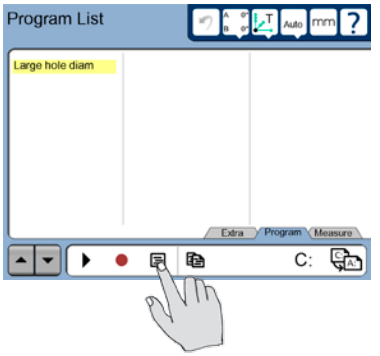
Tolerances are contained in the feature measurement data associated with each feature in the feature list. Tolerances are initially assigned in tolerance screens when features are measured, as described in Chapter 7: Tolerancing.

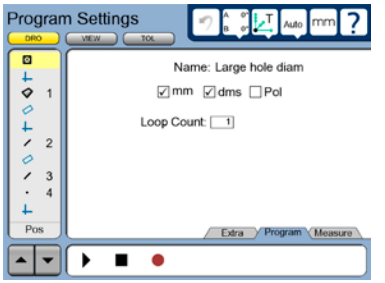
To edit tolerances:

1 Touch the Program tab, the program title and the Edit icon. Program steps will be displayed.



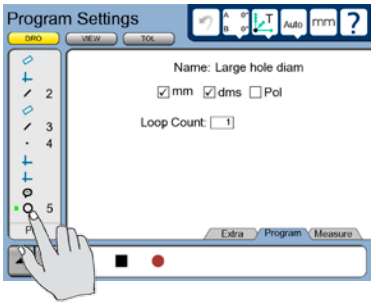
Touch the Program tab...



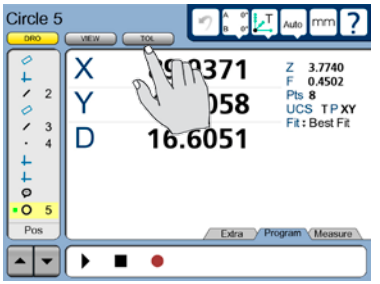


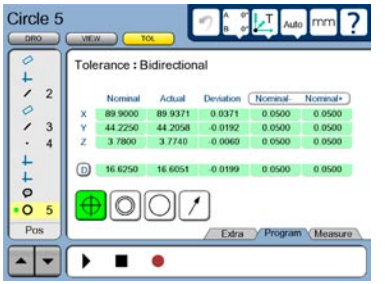
select a program and touch the Edit icon, settings will be displayed

2 Scroll to the desired feature if necessary, then touch the feature and touch the Tol button to display the tolerance screen.



Touch the desired feature...





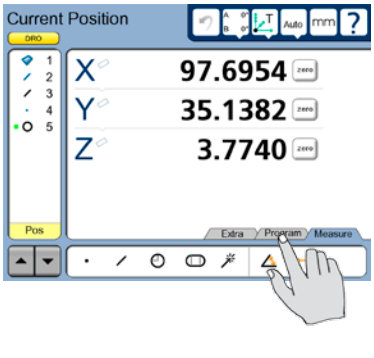
then touch the Tol button to display the feature tolerances

3 Edit tolerances and then press the Finish key to save the changes and return to the program list.

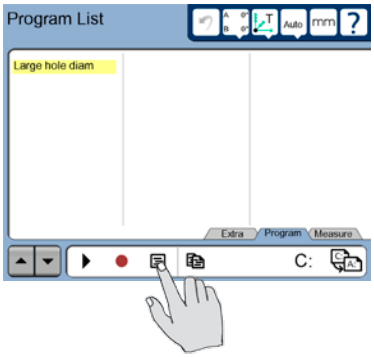
Editing user prompt messages

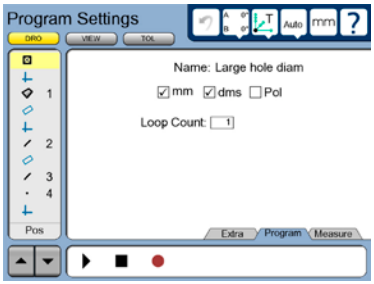
To revise message text:

1 Touch the Program tab, the program title and the Edit icon. Program steps will be displayed.



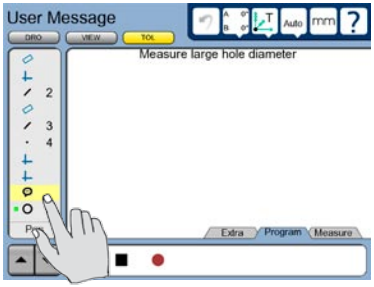
Touch the Program tab...

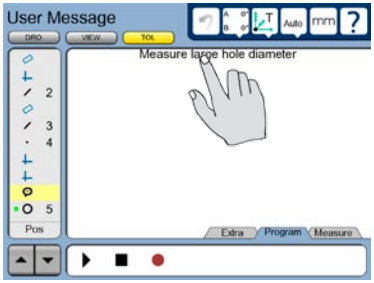


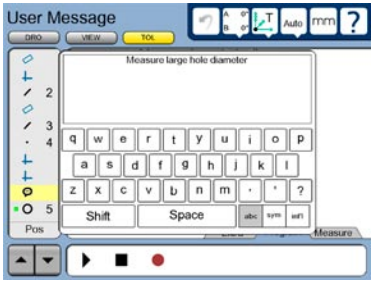


select a program and touch the Edit icon, settings will be displayed

2 Touch the desired message icon and then touch the message text to display the text entry screen.





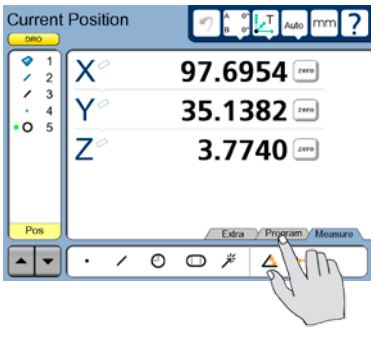


3 Edit the message and then press the Finish key to save the changes and return to the program list.

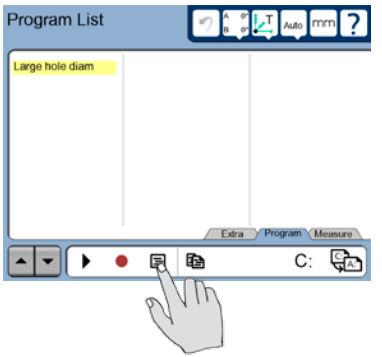
Inserting or appending new program steps

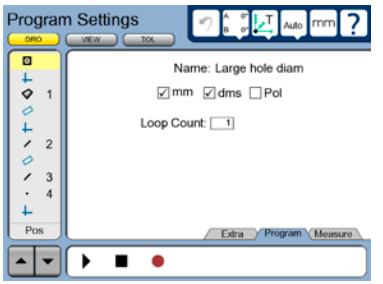
To insert or append new steps into an existing program:

1 Touch the Program tab, the program title and the Edit icon. Program steps will be displayed.



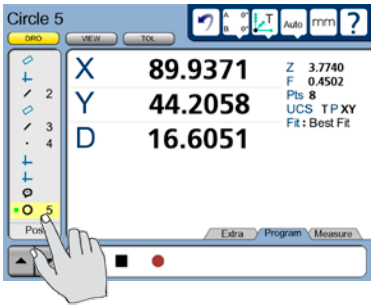
Touch the Program tab...

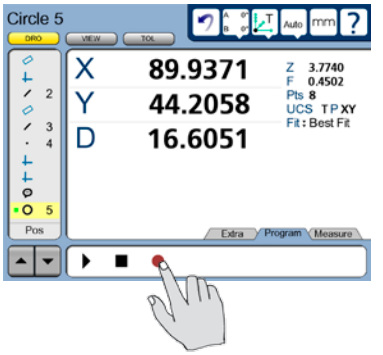




select a program and touch the Edit icon, settings will be displayed

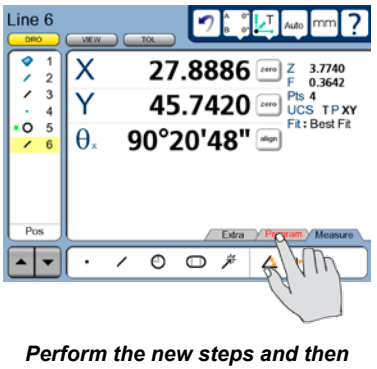
2 To insert steps, touch the program step before the insertion point for the new program steps. To append steps, touch the last step. Then touch the Record icon. A message will ask you to confirm your intention. To continue, touch Yes. In this example steps will be inserted after the circle measurement.



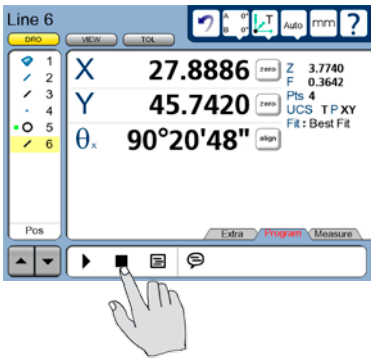


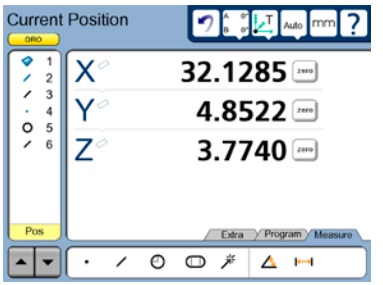
Touch an insertion point... *and begin recording*

3 The QC-330 will begin recording and the DRO will be displayed. Perform the new measurement steps. In this example a line is measured. When the measurement is complete, touch the Program tab and then touch the Stop icon and the Finish button to complete the program.



Perform the new steps and then touch the Program tab...





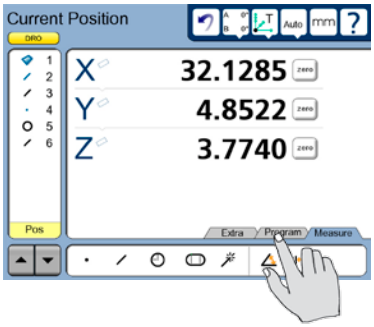
touch the Stop icon and press Finish to complete the addition

Running programs

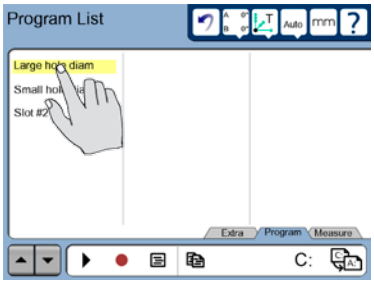
The operator will position the part and collect measurement data points in response to the program text and green runtime arrow displayed on the screen. When the program has successfully completed executing, feature data will be shown in the feature list and the screen will leave the program execution mode and display the current position.

To run a program:

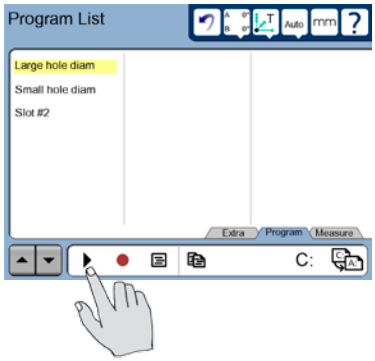
1 Touch the Program tab to display the program screen, touch a program title to select the desired program and then touch the Run icon to run the selected program



Touch the program tab...



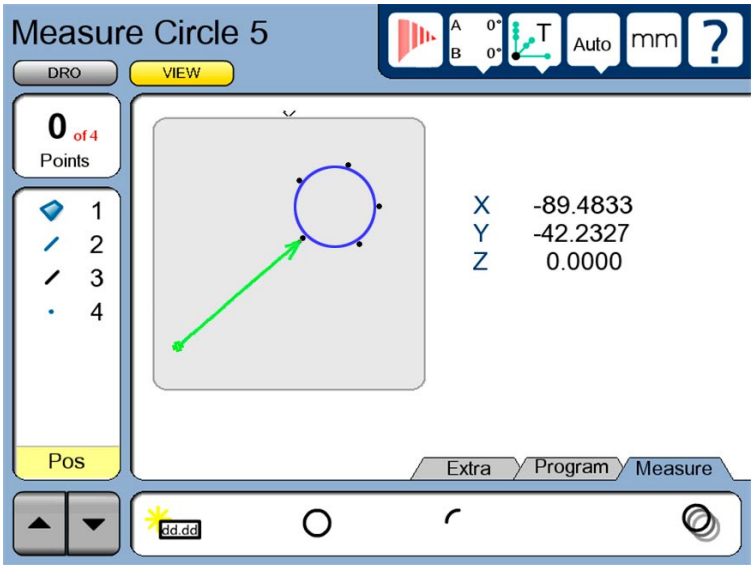
select a program...



and touch the Run icon

During execution, after the datum is established, text and the green run-time arrow will guide the operator through the program measurement steps.

When the program is finished, the feature data will be shown in the Feature list and the current position will be shown.



A green runtime arrow will guide the user through measurement steps

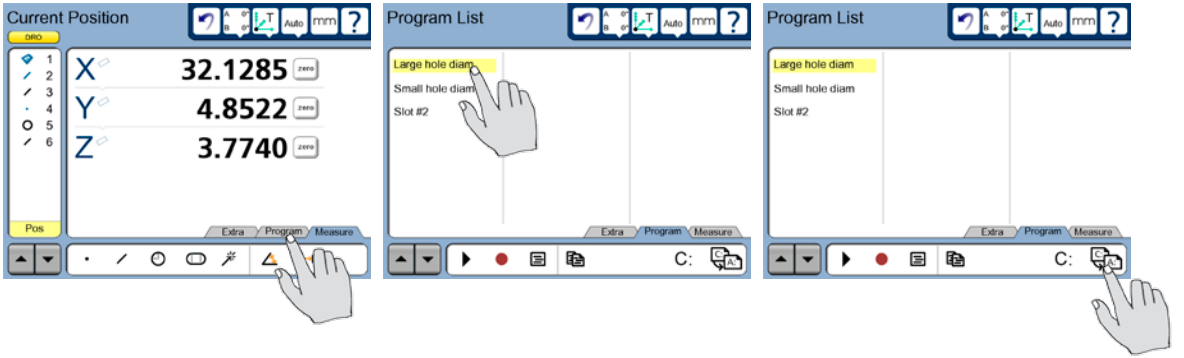
Saving and retrieving programs

Programs can be saved by themselves, or included in settings files and saved as part of the complete collection of all QC-330 system settings. In either case, the files can be retrieved later and used again. Refer to Chapter 10: Setup for details regarding saving system settings files.

Saving programs

To save programs:

1 Touch the Program tab to display the program screen, touch a program title to select the desired program and then touch the Copy icon to save the selected program to the USB drive (A:).

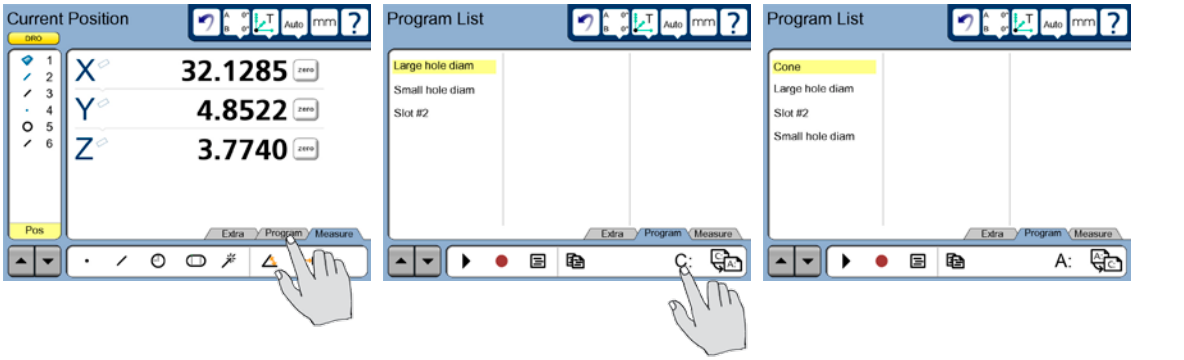


Touch the program tab... *select a program...* *and touch the Copy icon*

Retrieving programs

To retrieve programs:

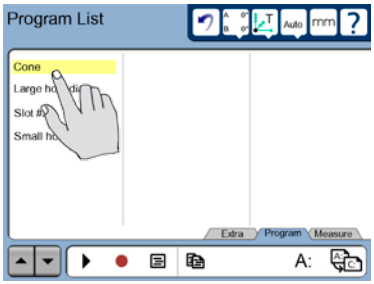
1 Touch the Program tab to display the program screen, touch drive letter icon to toggle to the USB drive (A:). The list of programs on the USB drive will be shown.



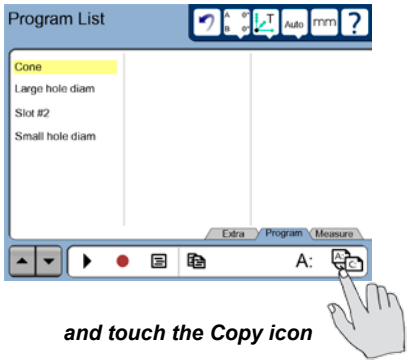
Touch the program tab... *touch the drive letter icon...* *to toggle to the USB drive*

2 Select the desired program and touch the Copy icon.

The selected program will be copied from the USB drive (A:) to the local drive (C:).

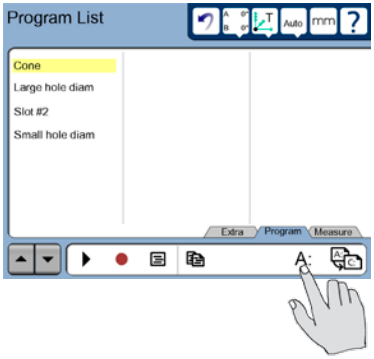


Select a program...

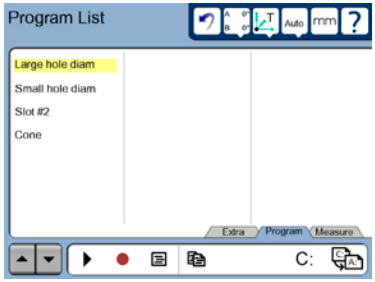


and touch the Copy icon

3 Touch the drive letter icon again to toggle to the local drive (C:). The retrieved program will be shown.



Touch the drive letter icon...



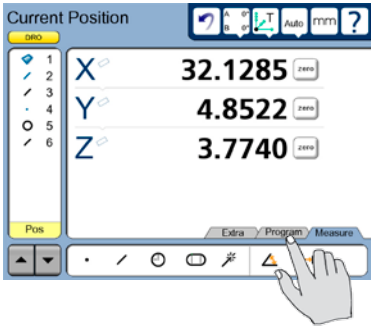
to toggle to the local drive

Deleting programs

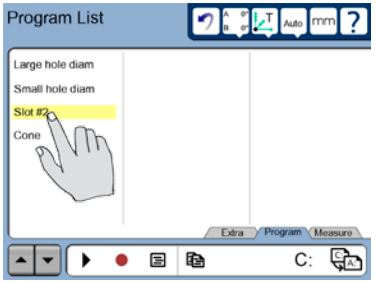
Programs are deleted by selecting the desired program and pressing the Cancel key. You will be asked to confirm your intention to delete the program. Programs can be deleted on the local (C:) and USB (A:) drives.

To delete a program:

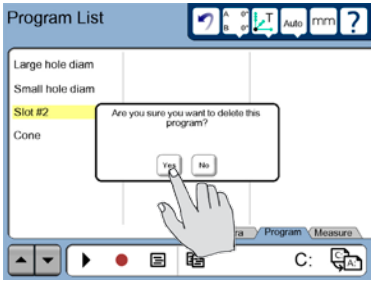
1 Touch the Program tab to display the program screen, touch a program title to select the desired program and press the Cancel key to delete the program. Then touch the Yes button to confirm your intention.



Touch the program tab...



select a program and press the Cancel button...



then touch Yes to delete the selected program

Chapter 9: Communication

The QC-330 communicates with computers over the RS-232 serial port and with printers over the USB port.

Connecting to a computer

1 Verify that the QC-330 and computer power are off.

2 Connect a computer COM port to the QC-330 RS-232 serial port using a standard straight-through serial cable (Metronics part number 11B12176). Make sure the cable connectors are tight, but do not overtighten the connector screws.

RS-232 serial port connector

3 Apply power to the computer, and then the QC-330. The default QC-330 settings for communication over the RS-232 serial port are shown here.

- Baud rate: 2400
- Parity: None
- Data bits: 8
- Stop bits: 1
- EOC Delay: 0
- EOL Delay: 0

Current settings for your QC-330 are shown on the Ports setup screen discussed in detail in Chapter 10: Setup.

4 Launch the computer application that will be used to communicate with the QC-330, and configure the communication properties of the COM port to match those of the QC-330.

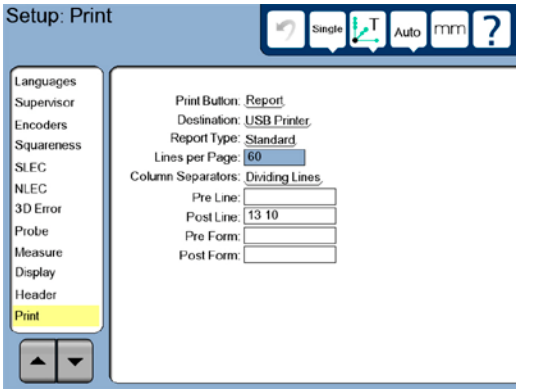
Sending data to a computer

Measurement data can be sent to a computer over the RS-232 serial port in the following formats:

- None — No data will be sent to the computer
- Select — User will be prompted to select the data that will be sent
- Report — A standard report of all feature data or a tolerance report of only features that have tolerances applied will be sent

To send data to a computer:

1 Touch the question mark Icon and display the setup menu, then touch Print to display the Print setup screen.



2 Verify that the desired data is specified in the Print Button choice field. None, Select or Report can be specified. In this example, the Report is specified.

Print Button: Report

3 Verify that the Serial Device is specified in the Destination field. In this example, the communication will be with a computer, so the Serial port is specified.

Destination: Serial Device

4 Verify that the desired report is specified in the Report Type setup choice field. Standard, Export or Tolerance can be specified. In this example, a Tolerance report is specified.

Report Type: Tolerance

5 Specify other settings that are consistent with the computer application's requirements.

6 Press the Finish key to exit the setup mode, and then press the Print key to send the data to a computer.

NOTE

A Windows® data communication program such as QC-Wedge might be necessary to format data for your PC application. Refer to Chapter 13: Options for more information regarding QC-Wedge.

Sending data to a printer

The QC-330 supports certain USB printers. The printer must be approved for use by Metronics. The current printer is shown in the Print setup screen discussed in Chapter 10: Setup.

1 Verify that the QC-330 and printer power are off. Connect the USB printer to the USB Type A port on the side of the enclosure.

2 Make sure the USB cable plug is fully inserted.

USB printer port

Printer format strings

The formatting strings listed below include one or more ASCII codes listed at the end of this chapter. This formatting is configured in the Print setup screen discussed in Chapter 10: Setup.

- Pre Line: ASCII control character (or string) for printer control before printing a line.
- Post Line: ASCII control character (or string) for printer control after printing a line.
- Pre Form: ASCII control character (or string) for printer control before printing a form.
- Post Form: ASCII control character (or string) for printer control after printing a form.

Report formats

Reports of feature measurement data can be printed with the formats discussed in the Print setup screen portion of Chapter 10: Setup. These can include:

- Number of lines per page
- Form
- Pre/Post line formats
- Pre/Post formats
- Axis labels
- Units of measure

QC-300 Feature Print Out

Date _____ Time _____ Operator _____
Job _____ Part _____

NO.	FEATURE	ID	UNITS	POSITION	DIMENSION	FORM
001	Point	1	mm A DMS	X = -0.876 Y = -0.175		
002	Line	2	mm A DMS	X = -0.120 Y = -0.152	< = 82.41.16	+T = 0.000 -T = 0.000
003	Circle	3	mm A DMS	X = 0.464 Y = -0.073	r = 0.073 d = 0.145	+T = 0.000 -T = 0.000
004	Distance	4	mm A DMS		X = 2.273 Y = 0.711	
005	Line	5	mm A DMS	X = 0.116 Y = 0.174	< = 30.15.23	+T = 0.000 -T = 0.000
006	Line	6	mm A DMS	X = -0.116 Y = -0.174	< = 77.44.45	+T = 0.000 -T = 0.000
007	Angle	7	mm A DMS	X = -0.063 Y = 0.070	<1= 132.30.37 <2= 227.29.22	
008	Line	8	mm A DMS	X = 0.000 Y = 0.000	< = 270.00.00	+T = -T =

Printing a report

Feature measurement data or records of QC-330 system settings can be printed at the USB port.

Printing feature measurement data

Feature measurement data can be printed in the following formats:

- None — No data will be printed
- Select — User will be prompted to select the data that will be printed
- Report — A standard report of all feature data or a tolerance report of only features that have tolerances applied will be printed

To print feature measurement data:

1 Touch the question mark Icon and display the setup menu, then display the Print setup screen.

2 Verify that the desired data is specified in the Print Button choice field. None, Select or Report can be specified. In this example, the Report is specified.

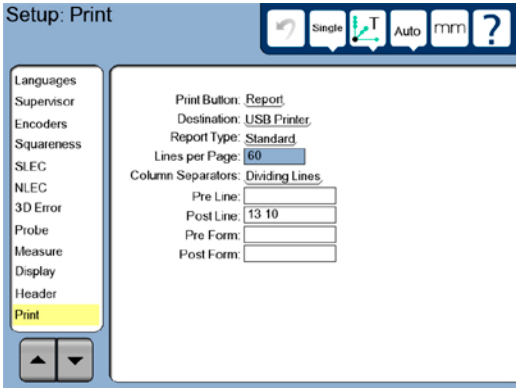
Print Button: Report

3 Verify that the Serial Device is specified in the Destination field. In this example, the file will be printed to a USB printer, so the USB Printer is specified.

Destination: USB Printer

4 Verify that the desired report is specified in the Report Type setup choice field. Standard or Tolerance can be specified. In this example, a Standard report is specified.

Report Type: Standard



5 Specify other settings that are consistent with the computer application's requirements.

6 Press the Finish key to exit the setup mode, and then press the Print key to send the data to the printer.

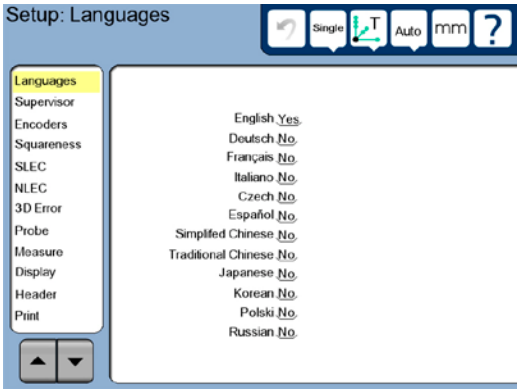
NOTE
Refer to the description of the Print setup screen in Chapter 10: Setup for more details regarding the Print screen.

Printing QC-330 system settings

To print a report of the QC-330 setup parameters:

1 Touch the question mark Icon and display the setup menu.

2 Press the Print key.



RS-232 connector pin designations

Pin No.	Description	Direction
2	Data in	Input
3	Data out	Output
7	Signal ground	Reference
8	Power on	Output (always high)

ASCII Code table

ASCII Codes

8	backspace	46	.	84	T
9	horizontal tab	47	/	85	U
10	line feed	48	0	86	V
11	vertical tab	49	1	87	W
12	form feed	50	2	88	X
13	carriage return	51	3	89	Y
14	so	52	4	90	Z
15	si	53	5	91	[
16	dle	54	6	92	\
17	dcl	55	7	93	]
18	dc2	56	8	94	^
19	dc3	57	9	95	_
20	dc4	58	:	96	`
21	nak	59	;	97	a
22	syn	60	<	98	b
23	etb	61	=	99	c
24	can	62	>	100	d
25	em	63	?	101	e
26	sub	64	@	102	f
27	esc	65	A	103	g
28	fs	66	B	104	h
29	gs	67	C	105	i
30	rs	68	D	106	j
31	us	69	E	107	k
32	space	70	F	108	l
33	!	71	G	109	m
34	"	72	H	110	n
35	#	73	I	111	o
36	$	74	J	112	p
37	%	75	K	113	q
38	&	76	L	114	r
39	'	77	M	115	s
40	(	78	N	116	t
41	)	79	O	117	u
42	*	80	P	118	v
43	+	81	Q	119	w
44	comma (,)	82	R	120	x
45	-	83	S	121	y
				122	z

Chapter 10: Setup

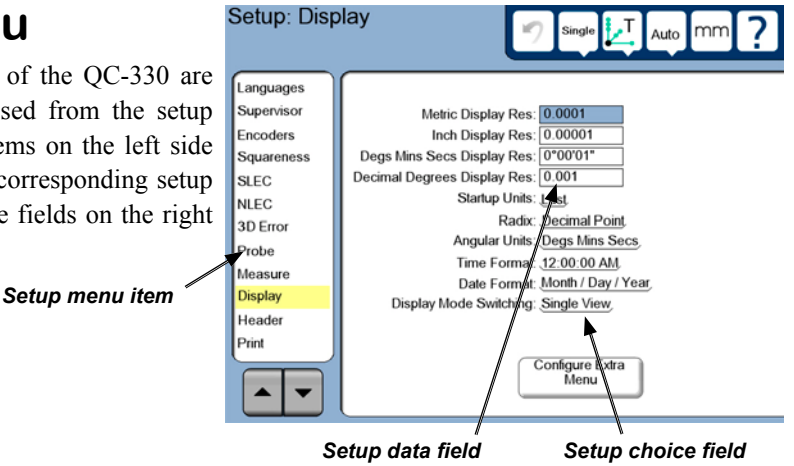
The operating parameters of the QC-330 must be configured prior to using the system for the first time, and any time part measurement, reporting or communication requirements change. Day to day use of the QC-330 does not require reconfiguration of the system settings.

CAUTION

Parameter changes made in any of the setup screens affect the operation of the QC-330. For this reason setup screens should be password-protected. Only qualified supervisory personnel should be given password access to setup screens.

The Setup Menu

All setup operating parameters of the QC-330 are configured using screens accessed from the setup menu. Touching setup menu items on the left side of the setup screen display the corresponding setup parameter data fields and choice fields on the right side of the screen.



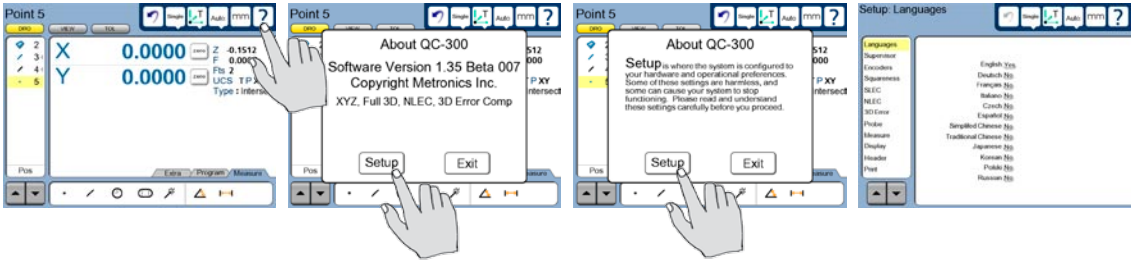
Parameters configured in setup screens will be retained by the QC-330 until:

- The data-backup battery is changed
- The system data and settings are cleared by maintenance personnel
- They are changed using the setup menu screens
- Certain software upgrades are performed

Accessing and using the Setup Menu

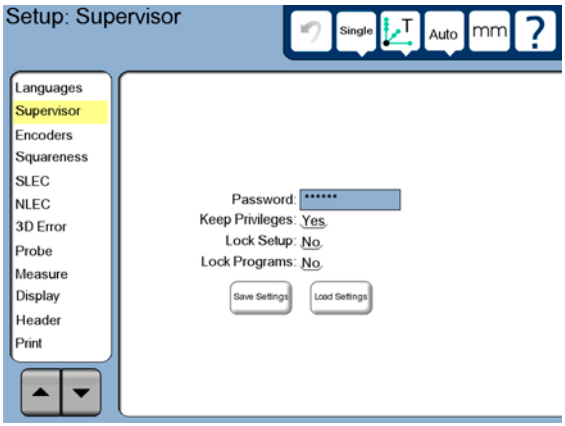
QC-330 operating parameters are entered into the system using touch screen selections and keys located on the front panel. The configuration process is facilitated by a simple menu structure of setup functions that can be quickly navigated on the large color LCD display.

The setup screens and functions are accessed from other screens by touching the Help (?) button, and then pressing the Setup button twice. Access to most setup parameter fields is restricted to users that can provide the supervisor password.



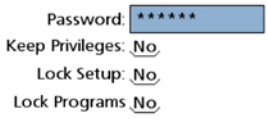
Entering the supervisor password

The supervisor password must be entered into the Supervisor setup screen to access most setup fields. To enter the supervisor password:

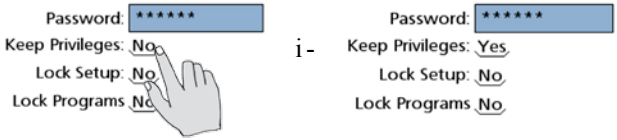


1 Access the setup menu as described on the previous page.

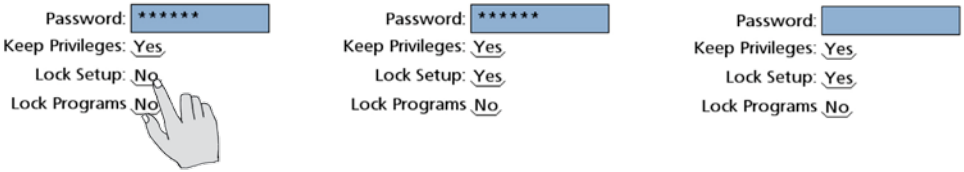
2 Touch the Supervisor menu item, enter the supervisor password using the number keys on the front panel and press the Enter key.



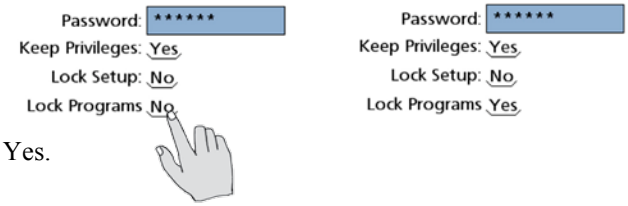
3 Setup editing privileges can be retained until the QC-330 power is cycled, eliminating the need to reenter the password if another setup editing session is required. Touch the Keep Privileges choice field to toggle the Keep Privileges parameter from No to Yes.



4 Views of the Setup can be locked so that the supervisor password is required to see the setup parameter settings. Touch the Lock Setup choice field to toggle the Lock Setup parameter from No to Yes, then delete the password from the Password field and press the Finish key.

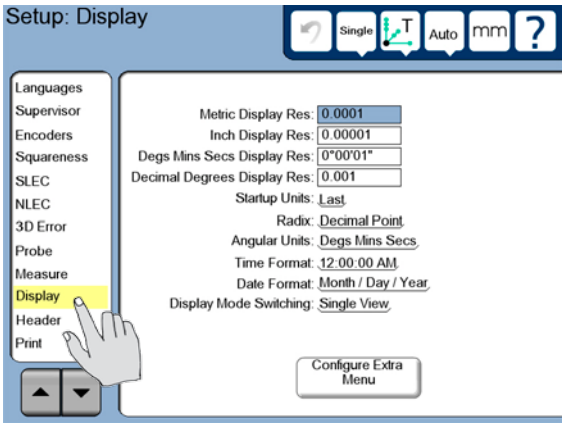


5 Operator access to program functions can be limited to running existing programs by toggling the Lock Programs choice field to Yes. Touch the Lock Programs choice field to toggle the setup parameter from No to Yes.



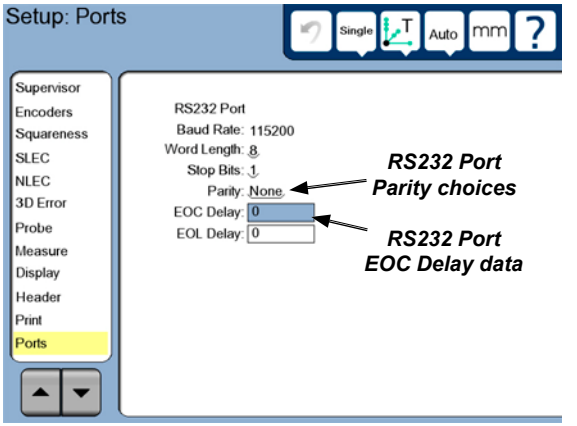
Selecting items from the Setup Menu

Setup menu items are selected by touching the item on the left side of the screen. Menu items will become highlighted to indicate that the selection is complete and the corresponding setup parameter choice and data fields will be shown on the right side of the screen. Touch the up or down scroll arrow to scroll to the desired menu item.

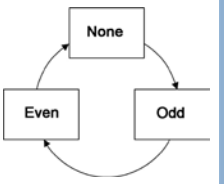


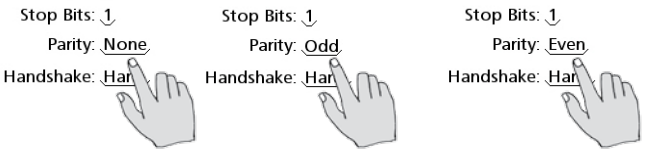
Selecting setup parameter choices

Many setup parameters are selected from two choices: Yes or No. Other setup parameters offer more choices to the user. In all cases, selections are made by repeatedly touching the choice field to cycle through all the available parameter setting choices.



In this example, the RS-232 Port Parity choices are shown by repeatedly touching the Parity choice field.





Entering and deleting setup data

Some setup parameters must be entered as numeric values into setup data fields. To enter setup data, touch the desired data field and enter the data using the number keys. In this example, the RS-232 Port EOC Delay data field is selected and data is entered using the number keys. Obsolete or erroneous setup data is deleted from a highlighted data field by pressing the Cancel key.

Storing a parameter and advancing to the next step

Press the Enter key to store the highlighted value and advance to the next setup field.

Leaving the setup menu

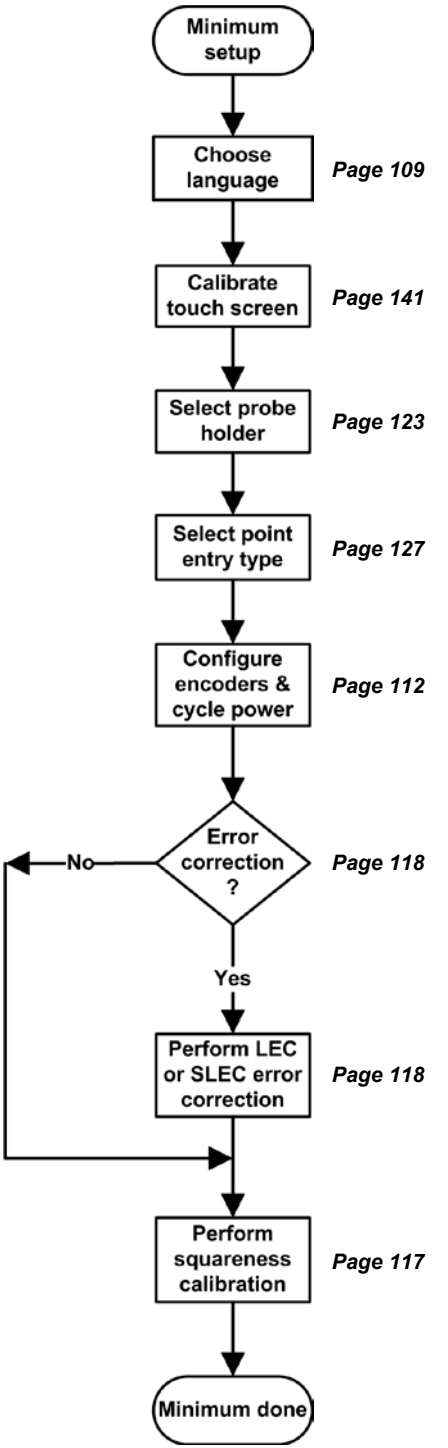
Press the Finish key to conclude the setup session.

Minimum setup

In most cases, the QC-330 will be provided by a Metronics distributor or an OEM and will be configured and ready to use. Setup by the end-user will be unnecessary. However, if some setup is required, a minimum sequence of steps should be performed in the order shown by this diagram. Each block describes a setup task and refers to pages where detailed instructions are presented.

A variety of optional setup steps can be performed after the minimum setup to specify display, reporting and other parameters. These optional and all other setup parameters and screens are described in detail in the remainder of this chapter.

Familiarize yourself with the methods of accessing and using the Setup menu described on earlier pages before performing these minimum or additional optional setup steps.



Setup screen descriptions

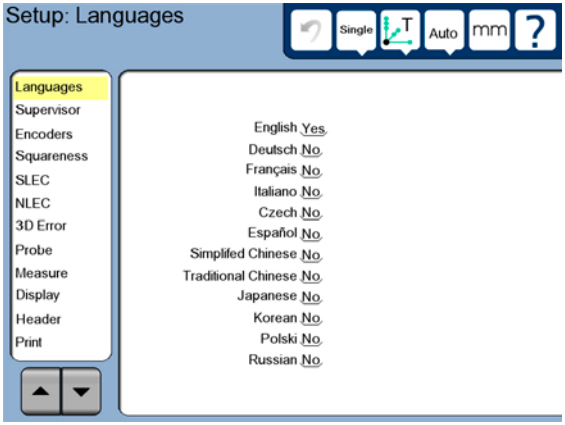
The setup screen descriptions are presented in the order of their appearance in the setup menu. However, the first time the QC-330 is configured, the order of setup screen use should follow the minimum setup diagram, and then continue in the order that best satisfies the application or the user's preferences. The subsequent use of setup screens will probably be infrequent and will address part requirement or hardware changes.

Language screen

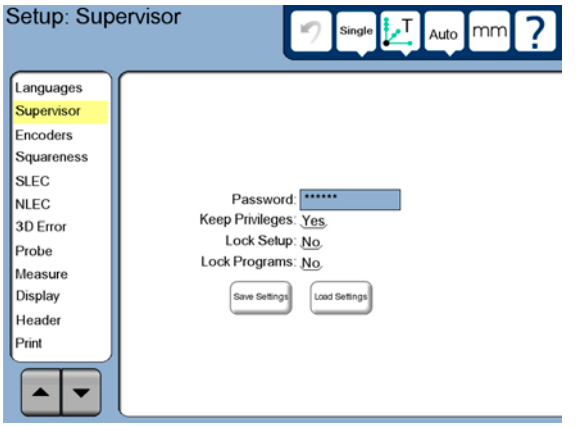
The Language screen contains selections for changing the language of text displayed on the LCD, included in transmitted data and printed on reports.

Specifying the displayed language

Touch the desired language to toggle the language choice to Yes.



Supervisor screen



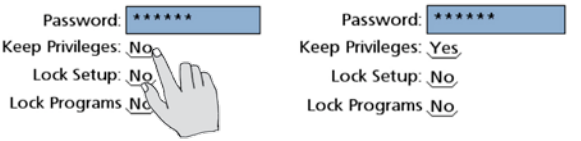
The Supervisor screen contains fields for entering the supervisor password, choosing to keep privileges until the power is cycled and locking the setup menu so that setup parameters cannot be viewed. Button controls are also provided for saving system settings to, or loading setting from the USB port.

Entering the supervisor password

The supervisor password must be entered into the Supervisor setup screen to access most setup fields. To enter the supervisor password, touch the Supervisor menu item, enter the supervisor password using the number keys on the front panel and press the Enter key. Asterisks will be shown in the Password field.

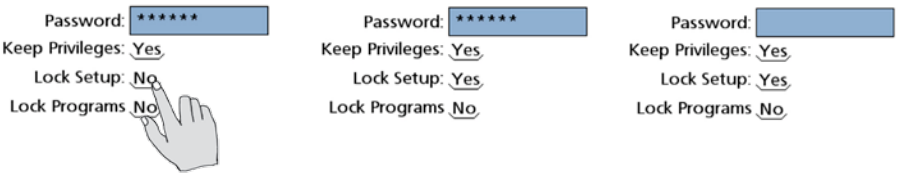
Keeping setup privileges until the power is cycled

Setup editing privileges can be retained until the QC-330 power is cycled, eliminating the need to reenter the password if another setup editing session is required. To retain setup privileges, touch the Keep Privileges to toggle the Keep Privileges parameter from No to Yes.



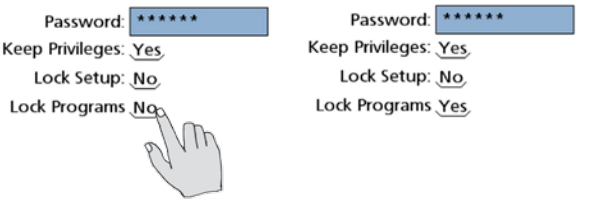
Hiding setup parameters from unauthorized personnel

Views of the setup can be locked so that the supervisor password is required to see the setup parameter settings. Touch the Lock Setup choice field to toggle the Lock Setup parameter from No to Yes, then delete the password from the Password field and press the Finish key.



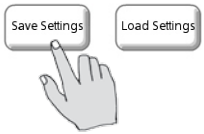
Limiting access to program functions

Operator access to program functions can be limited to running existing programs by toggling the Lock Programs choice field to Yes. Touch the Lock Programs choice field to toggle the setup parameter from No to Yes.



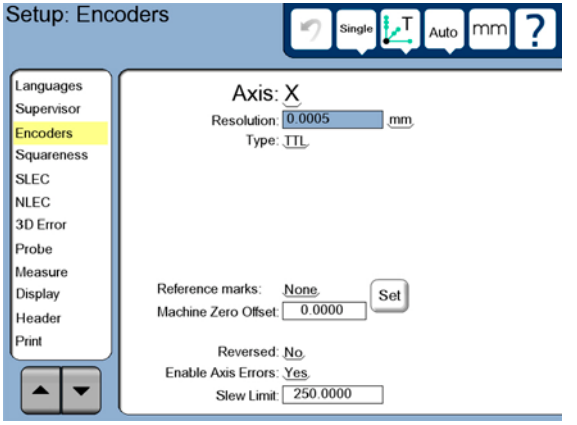
Saving and loading settings

System settings can be saved to storage devices, or loaded from storage devices attached to the USB port by connecting the USB storage device and touching the Save Settings or Load Settings button.



Encoders screen

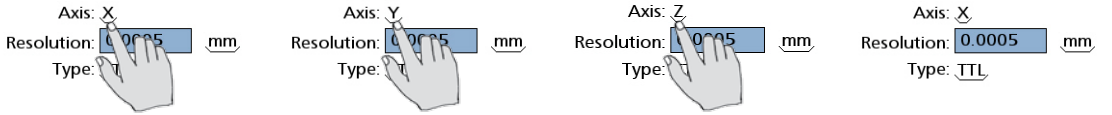
The Encoders screen contains data and choice fields for specifying encoder resolution, units of measure, encoder type, reference marks and other critical encoder parameters for each measurement axis.



Selecting an axis to configure

Selections are made by repeatedly touching the Axis choice field to cycle through all the available measurement axes.

In this example, the measurement axis choices (X, Y and Z) are cycled by repeatedly touching the Axis choice field.

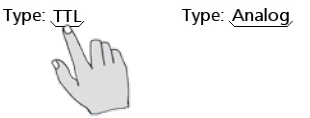


Specifying encoder resolution

Encoder resolution is entered into the Resolution data field using the numeric keys on the front panel.

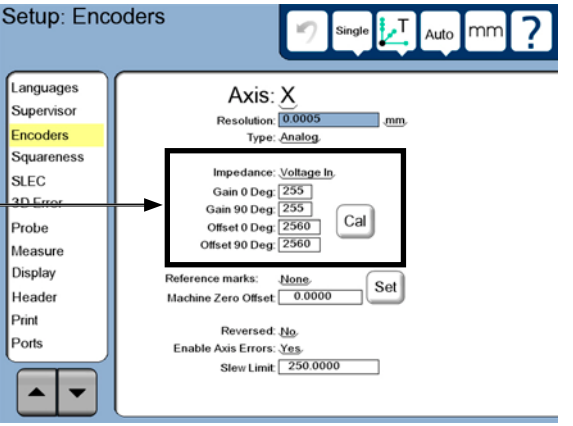
Specifying encoder type

Encoder type is toggled between TTL and Analog by touching the Type choice field.



TTL encoders do not require calibration. However, analog encoders must be calibrated and when the analog encoder type is selected, tools are automatically displayed for analog encoder calibration.

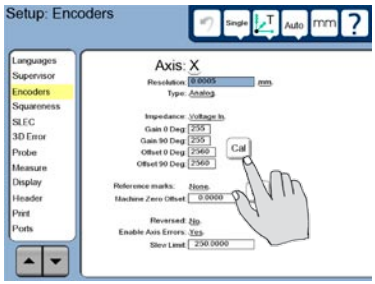
Analog encoder calibration tools



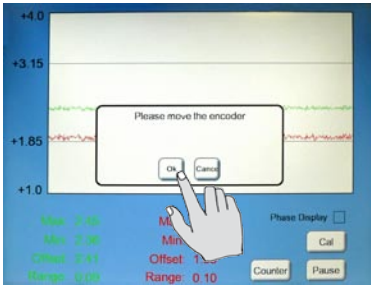
Calibrating analog encoders

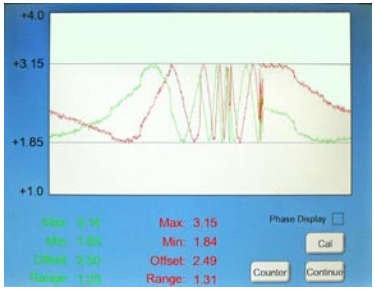
The process of calibrating analog encoders is identical for current and voltage output devices. To calibrate an analog encoder:

1 Select the desired axis and touch the Cal button. The calibration screen will be displayed and you will be instructed to move the axis.



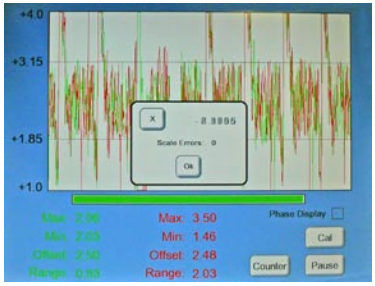
2 Touch OK and begin moving the axis in slow, gradual back and forth or up and down motions. The sine wave output of the analog encoder will be displayed as the axis is moved. The display is shown as two sine waves that are 90 degrees out of phase. The real-time display changes as the encoder is moved, however, still images can be captured for evaluation at any time by clicking the Pause button.





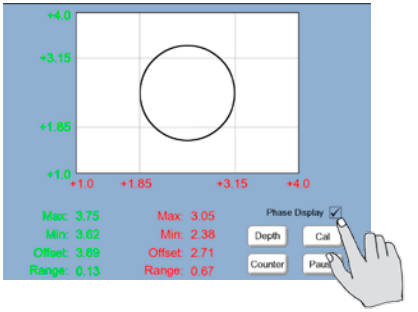
NOTE
The wave shape can include imperfections that won't affect the accuracy of measurements. However, erratic frequency or amplitude variations or high noise content can cause inaccuracies. If any continuing erratic output is noted, or if scale errors appear, check the encoder head mounting, alignment and wiring for problems.

3 Continue moving the encoder slowly between the limits of motion until scale errors are encountered or the process completes without scale errors. The system will fit the wave shape between the two horizontal lines as the calibration is performed. A dialog box will appear upon completion that shows encoder position and scale errors. When calibration has been completed without scale errors, click OK.



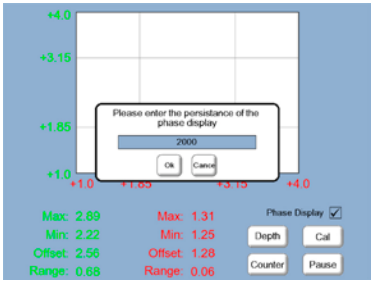
NOTE
The display of scale position and error counts can be recalled at any time by clicking the Counter button.

4 Check the Phase Display box to display the combined phases of the encoder output as an ellipsoidal pattern when the encoder is moved slowly between the limits of motion. Move the encoder and evaluate the resulting pattern. The combined-phase pattern will form a circle when the encoder output phase amplitudes are equal. Generally when the pattern displayed is not circular, the reader head will need to be realigned, and the encoder recalibrated from the beginning.



The contrast of the pattern can be changed to facilitate the evaluation of phase. Touch the Depth button to display the Persistence data field. Enter higher values for higher-contrast images.

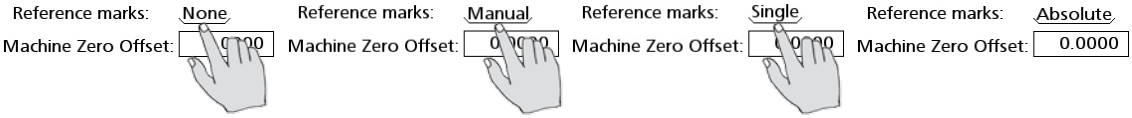
5 Repeat the process described in steps 1 through 4 to calibrate analog encoders on the remaining axes.



Selecting reference marks

Selections are made by repeatedly touching the Reference marks choice field to cycle through all the available encoder reference mark types.

In this example, the reference mark choices (None, Manual, Single and Absolute) are cycled by repeatedly touching the Axis choice field.



None

No encoder reference marks are used. Machine zero will be established at the encoder locations encountered when the system is powered on. The machine zero location can be changed at any time using the Machine Zero Set function described later in this chapter.

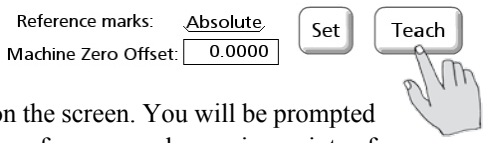
Manual

You will be prompted to move the stage to position the encoders at a point that you wish to use as machine zero each time the system is powered. The manual reference mark selection is commonly used with "hard stop" machine references. The machine zero location can be changed at any time using the Machine Zero Set function described later in this chapter.

Single

You will be prompted to move the stage to cross encoder reference marks on each axis each time the system is powered. The reference mark crossing points of each encoder are used to determine the machine zero position. The machine zero location can be changed at any time using the Machine Zero Set function described later in this chapter.

Absolute

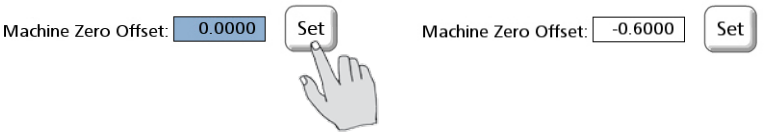


Selecting Absolute reference marks causes a Teach button to be displayed. Touch the Teach button to initiate a process that will guide you through the steps required to cross encoder reference marks. Follow the instructions provided on the screen. You will be prompted to move the stage to cross reference marks on each axis. The reference mark crossing points of each encoder are used to determine the machine zero position. Sometimes the resulting machine zero position for absolute reference marks can be located outside the stage boundaries. In these cases, this machine zero location can be changed by the user to a more convenient "home" position for measurements using the Machine Zero Set function described on the next page.

Setting a new machine zero reference

A machine zero is established each time the QC-330 is powered. However, it might be necessary or convenient to change the location of the machine zero position to a new "home" position for measurements. To set a new machine zero position:

Select the Machine Zero Offset data field, move the stage to the desired new machine zero position and touch the Set button. The new machine zero for the current axis will be established and the offset displacement from the original machine zero to the new machine zero will be shown in the Machine Zero Offset data field. Repeat this process for each axis.

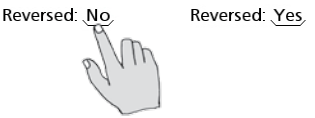


CAUTION

SLEC encoder error correction and probe qualification values are referred to a repeatable machine zero location. If the machine zero location is set to a different position, SLEC and probe qualification values will no longer be valid.

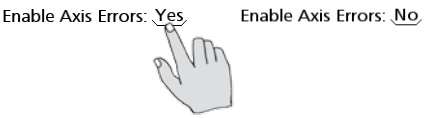
Reversing the encoder count direction

Encoder count direction for each axis is toggled between normal and reversed by repeatedly touching the Reversed choice field.



Enabling axis error messages

Encoder error messages for each axis can be displayed on the LCD. These messages are enabled or disabled by toggling the Enable Axis Errors choice field between Yes and No.



Specifying slew limit

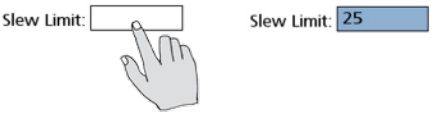
The encoder data rate limit of the system is 500,000 counts per second. An encoder error message is displayed when the encoder rate of travel exceeds the encoder velocity shown in the Slew Limit data field. The Slew Limit velocity is calculated using the formula:

Slew Limit = (500,000 counts/second) X (encoder resolution distance/count)

For example, a 0.0005 mm/count encoder would have a Slew Limit of 25 mm/sec

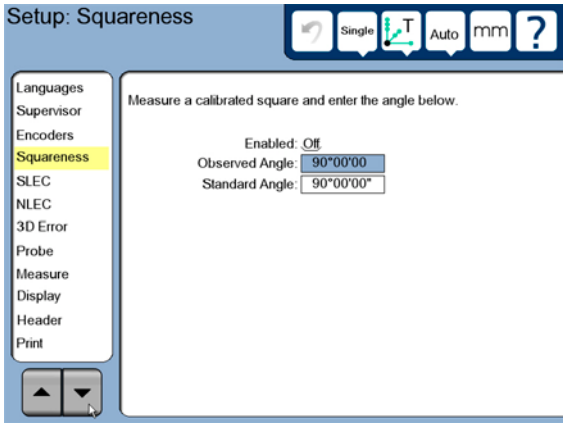
Slew Limit = (500,000 counts/second) X (0.0005 mm/count) = 25 mm/sec

To change the velocity limit value, touch the Slew Limit data field and enter a new velocity.



Squareness screen

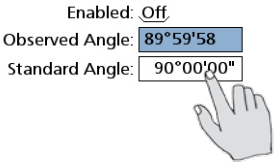
The Squareness screen contains data and choice fields for calibrating the squareness of the measuring system. The calibration of stage squareness requires the use of a certified square artifact. To calibrate squareness:



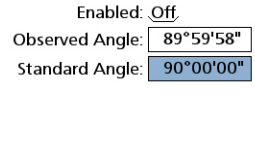
1 Place the square calibration artifact on the stage with one edge along the X-axis.

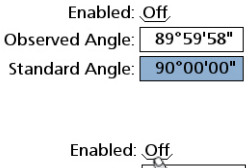
2 Measure the angle of the square calibration artifact (ideally 90 degrees).

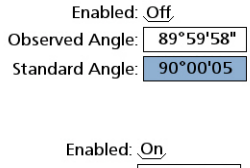
3 Select the Observed Angle data field, enter the measured angle using the number keys and press the Enter key to highlight the Standard Angle field.



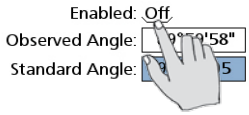
4 Enter the actual angle of the square calibration artifact obtained from the artifact's certification document into the Standard Angle data field.

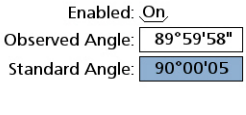




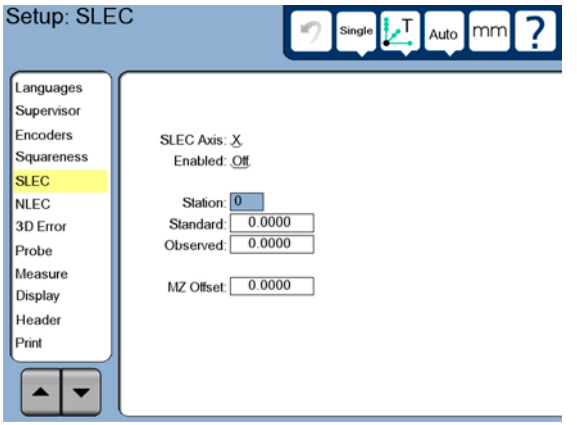


5 Touch the Enabled choice field to toggle the field to ON.





SLEC screen



The SLEC screen contains fields for enabling and configuring linear error correction (LEC) or segmented linear error correction (SLEC) for each encoder axis.

LEC or SLEC, which is right for my application?

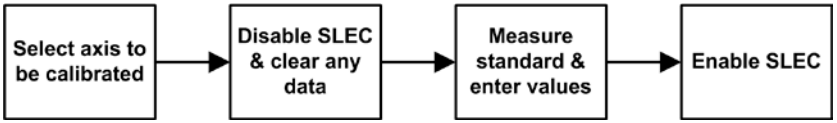
Any channel input device can include slight nonlinearities over its measurement range. LEC compensates for nonlinearities by applying a single linear correction value to the entire range of measurement. SLEC compensates for nonlinearities by applying correction values to the individual nonlinear segments of the measurement range.

LEC is the easiest error correction to set up, but does not provide correction for individual nonlinearities that could be present over small portions of the entire range. SLEC error correction can result in more accurate measurements, but requires more time and effort to set up.

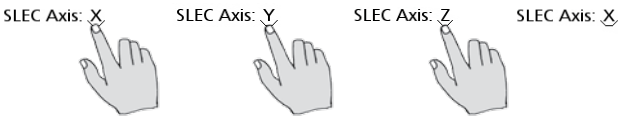
If an overall nonlinearity exists without significant individual errors across the scale, LEC can be applied as an overall correction method. However, if an encoder is thought to have significant individual nonlinearities across the range of measurement, SLEC should be applied as the correction method.

LEC (Linear error correction)

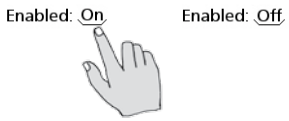
LEC compensates for encoder nonlinearities by applying a single linear correction value to the entire range of measurement. The procedure for configuring the LEC error correction is diagrammed and explained below.

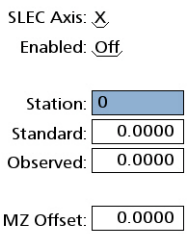


1 Touch the SLEC menu item and then touch the Axis choice field repeatedly to cycle to the desired axis.



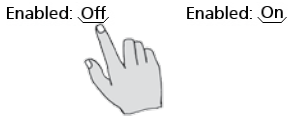
2 Make sure the Enabled choice field is toggled to Off, and erase any existing data in all the data fields using the methods described earlier in this chapter. Station 0 should be displayed with zeros in the Standard, Observed and MZ Offset fields when this step is complete.

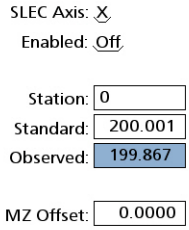




3 The length of the calibration standard should cover as much of the axis range of motion as possible. Measure the standard and enter the Standard (certified) and Observed (measured) values into the corresponding data fields.

4 Touch the Enabled choice field to toggle error correction On.





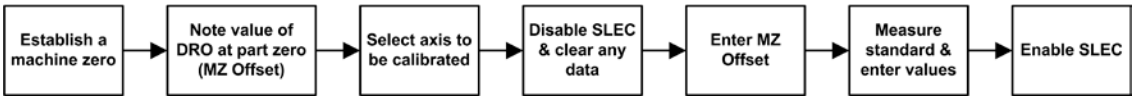
SLEC (Segmented linear error correction)

SLEC compensates for encoder non-linearities by applying correction values to individual nonlinear segments. These SLEC correction values are created by the QC-330 system using data provided by the user in the SLEC Setup screen. The SLEC setup data provided by the user consists of Standard (certified) and Observed (measured) values of a standard, or standards that cover the entire range of axis motion.

The SLEC measurements can divide the axis range of motion into up to 150 segments. The example diagrammed on the next page shows standard values compared to observed values for 6 segments. The deviation (difference between standard and observed) is also shown. Segments are defined as any straight line on the graph of deviations, beginning with segment zero.

The standard and observed values at the end of each segment are entered as data for a station in the SLEC Setup screen. For example, the standard and observed values at the end of segment 0 on the diagram are 40 and 40, and are entered into the Standard and Observed data fields for station 1.

When the procedure is complete and setup data are entered, correction values will be calculated for the encoder based on the standard and observed values at the end of the segments. The procedure for configuring the SLEC error correction is diagrammed and explained below.

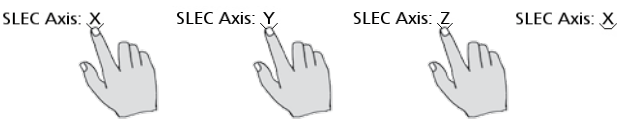


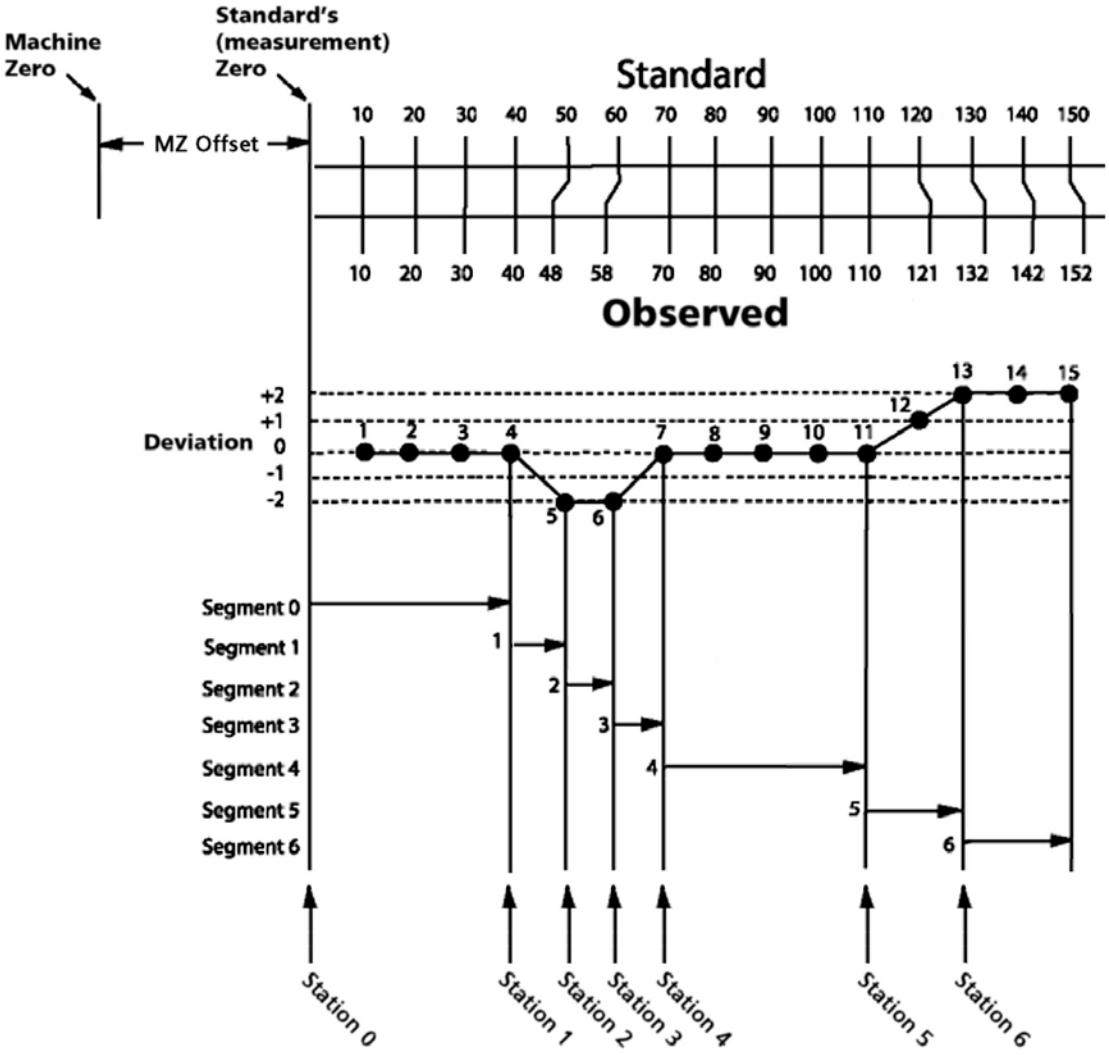
1 Cycle the power to establish a repeatable machine zero. You will be prompted to move the encoders to cross reference marks or perform a hard stop to the establish machine zero. Perform the machine zero operation.

NOTE
If a hard stop zero is performed, the same stop will be required each time the QC-330 is started.

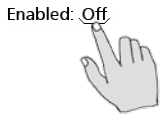
2 The length of the calibration standard should cover as much of the range of axis motion as possible. Move the stage to position the encoder of the axis being calibrated at the beginning (part zero position) of the calibration standard. Make a note of this calibration axis value shown in the DRO; this will be entered later as the machine zero (MZ) Offset.

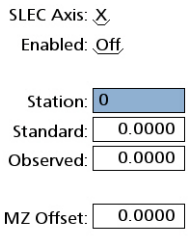
3 Access the setup menu, touch the SLEC menu item and then touch the Axis choice field repeatedly to cycle to the axis that will be calibrated.



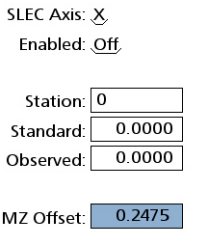


4 Make sure the Enabled choice field is toggled to Off, and erase any existing data in all the data fields using the methods described earlier in this chapter. Station 0 should be displayed with zeros in the Standard, Observed and MZ Offset fields when this step is complete.





5 Enter the MZ Offset value noted earlier in step 2.



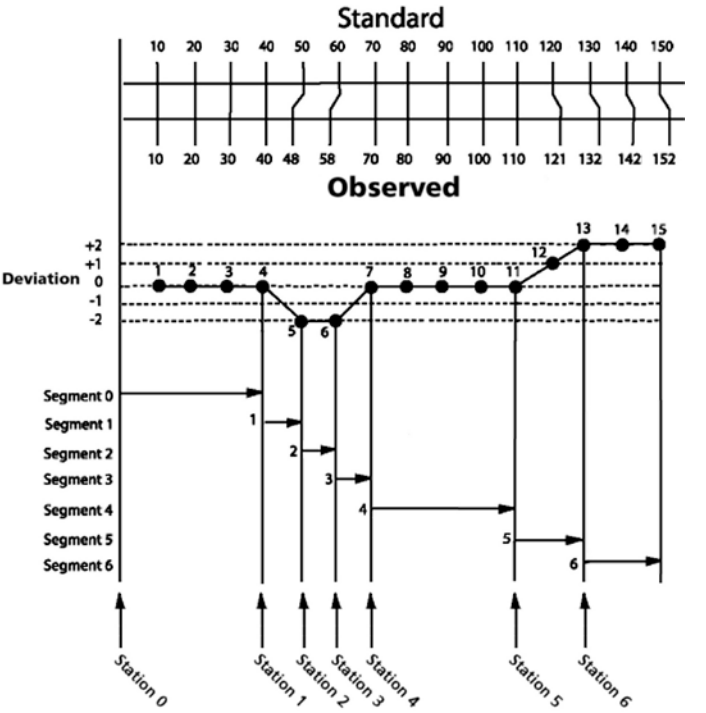
6 Zero the DRO for the axis being calibrated at the part zero position of the standard and enter zeros into the Standard and Observed data fields for Station zero.

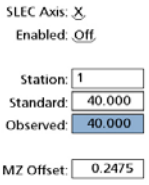
7 Measure the standard, incrementing the Station number and entering the Standard (certified) and Observed (measured) values into the corresponding data fields for each segment.

This example shows measurements across 150 mm on the X-axis, and the SLEC screens for entering the six segments of standard and observed data to provide error correction.

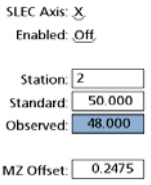
Reminder

Segments are straight lines on the deviation graph. Only the beginning and end points of each straight line segments must be entered into SLEC data fields.

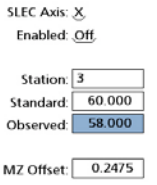




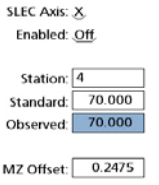
Station 1 of 6



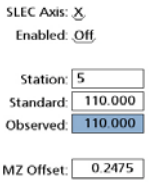
Station 2 of 6



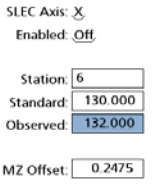
Station 3 of 6



Station 4 of 6

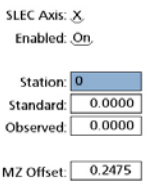


Station 5 of 6



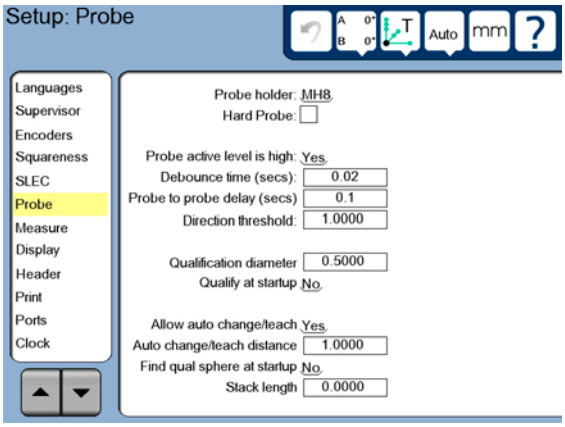
Station 6 of 6

8 Touch the Enabled choice field to toggle it On.



Probe screen

The Probe screen contains fields for specifying and configuring the touch probe input.



Probe holder

Touch the Probe holder choice field repeatedly to cycle through the available probe types. Probe type include:

- Single
- Star
- Friction
- MH8 indexable
- MH20i indexable
- MIH indexable

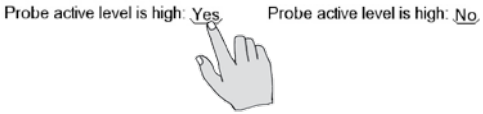
Touch Probe holder repeatedly to cycle through the available probe types

Hard probe

Probes are defined as touch probes or hard probes by clearing or checking the Hard Probe box. Check the box if the probe selected in the Probe holder field is a hard probe.

Probe active level is high

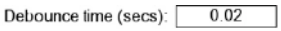
The probe logic is either active high or active low. Configure the logic to match the touch probe input requirement by toggling the Probe active level is high box to Yes for positive logic, or No for negative logic.



Touch Probe active level is high to toggle between Yes and No

Debounce time

Probe debounce time is the duration of uninterrupted probe contact with a surface required for a valid probe input. Debounce time eliminates measurement inaccuracies caused by CMM machine vibration and mechanical switch noise. The default 0.02 seconds of debounce time is adequate for most applications. Increase the debounce time in 0.02 second increments to accommodate noisy environments. Enter the debounce time into the Debounce time data field in seconds.



Probe to probe delay

Probe to probe delay is the minimum quiet time between valid probe hits. Probe to probe delay eliminates the possibility of unintended multiple probe inputs due to probe vibration against a surface or mechanical switch noise. The default of 0.10 seconds of delay is adequate for most applications. Increase the delay in 0.10 second increments if multiple probe hits occur. Enter the delay into the Probe to probe delay field in seconds.

Probe to probe delay (secs) 0.1

Direction threshold

Probe direction threshold is the distance the probe must travel in the same direction prior to making contact with a surface for a valid touch probe input. The Direction threshold distance determines which side of the probe compensation is applied to. Enter the distance into the Direction threshold data field in the current unit of measure.

Direction threshold: 1.0000

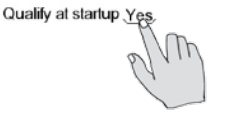
Qualification diameter

A qualification sphere standard is used to teach the QC-330 the dimensions and offsets of all touch probes. The sphere diameter is entered into the Qualification diameter data field in the current unit of measure.

Qualification diameter 0.0000

Qualify at startup

Probe qualification is performed using a qualification sphere to determine the location and dimensions of the touch probe. The probe should be qualified at startup if the system does not have a repeatable machine zero (encoder reference marks), or if a friction probe is used. Toggle Qualify at startup to Yes to perform probe qualifications upon startup.



Allow auto change/teach

The probe auto change/teach function allows the user to change probes from the CMM work surface without touching the QC-330 front panel controls or navigating through menus. The change/teach function is initiated by touching the qualification sphere with the current probe, and then touching the sphere again with the new probe. If the new probe is already qualified, the user can simply begin measuring with it. If the new probe is not qualified, the system begins a probe teach to qualify the probe. Toggle Allow auto change/teach to Yes to enable the auto change/teach function.

Auto change/teach distance

The auto change/teach function is initiated by probing the qualification sphere. Probe contacts must occur within a minimum distance from the surface of the sphere to be considered valid and trigger the function. This minimum distance is entered into the Auto change/teach distance data field in the current unit of measure.

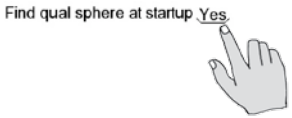
Auto change/teach distance 1.0000

Find qual sphere at startup

Once probe qualification is performed, the precise location of the qualification sphere is stored by the system and used to perform probe qualifications and probe changes using the auto change/teach function. However, if the system power is cycled off and back on, the location of the qualification sphere can be lost if:

- The encoders do not include reference marks
- A friction probe is used
- The qualification sphere has been moved

Under the conditions sited above, the qualification sphere must be probed upon startup to reestablish the precise location of the sphere. Toggle Find qual sphere at startup to Yes to automatically initiate a sphere probing sequence upon system startup.



Stack length

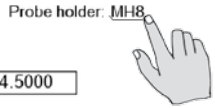
The configuration of indexable probes must include a definition of probe stack length when using the auto change/teach function.

NOTE

Stack length is important only when the auto change/teach function is used with indexable probes. Stack length can be disregarded when non-indexable probes are used or when indexable probes are used without the auto change/teach function.

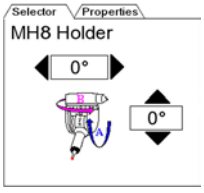
The probe qualification (teach) procedure must be performed once at the A = 0, B 0 position to find the approximate stack length of your probe. Then the teach procedure is performed again for multiple probe positions to find the exact stack length. Please refer to Chapter 5: Probes for details regarding the teach procedure. To find the stack length of your indexable probe:

1 Select the desired indexable probe in the Probe Holder choice field.

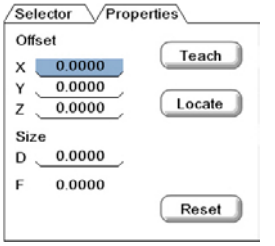


2 Enter the qualifications sphere diameter into the qualification diameter data field.

3 Press the Finish button to return to the DRO, and then touch the probe icon to display the probe selector and property tabs. Set the A and B probe angles to 0°, and then adjust the indexable probe position to A = 0° and B = 0°.

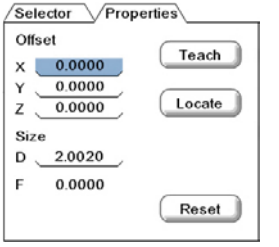


4 Touch the properties tab, and then touch Reset to clear any offset or size values.

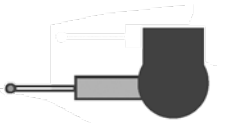


5 Touch the Teach button to begin a probe qualification session. Perform the probe qualification by collecting 5 points on the qualification sphere; 4 around the center and 1 at the top. Press the Finish key to complete the qualification.

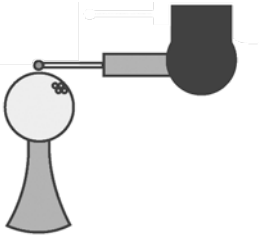
The properties tab will show the probe tip size and all offset values will be zero.



6 Adjust the indexable probe position to A = 90° and B = 0°. *Do not change the probe position values in the Selector tab.*



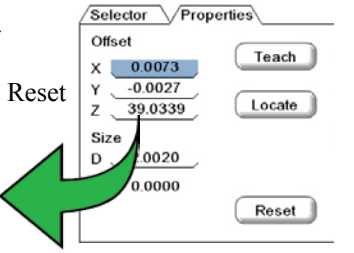
7 Touch the Teach button to initiate a second probe qualification session. *Do not reset values in the Properties tab data fields.*



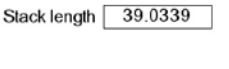
8 Perform a new probe qualification with the indexable probe oriented in the 90° position, and then press the Finish button.

9 The Z -offset value shown in the Properties tab is the stack length of the indexable probe. Other offset values are not important in this procedure.

Enter the Z -offset value into the Stack Length value field and touch the Reset button to clear all offset and size values.



10 Now that the approximate stack length is known to the system, additional probe qualifications must be performed for:



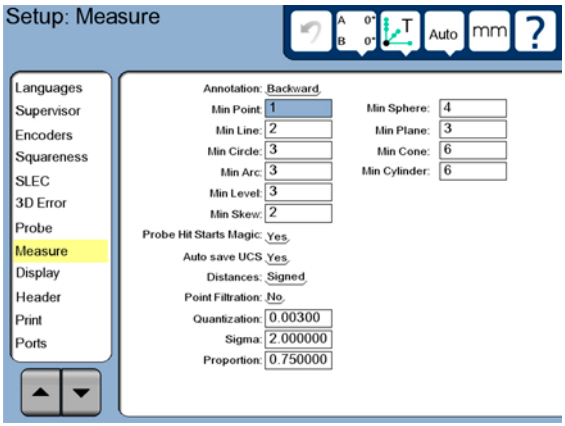
A = 0 B = 0
A = 90 B = 90
A = 90 B = 0
A = 90 B = - 90
A = 90 B = 180

11 Upon completion of all probe qualifications, restart the QC-330 by cycling the power from on to off and back to on.

The final precise stack length will be shown in the Probe setup screen.

Measure screen

The Measure screen contains fields for specifying the method of data point collection, specifying the minimum number of points required to measure different geometries, locking the reference frame, selecting distance presentations and configuring point filtration.



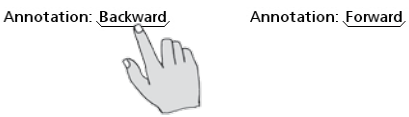
Annotation

The annotation type defines the method of data point collection. The annotation choice field can be toggled between Backward and Forward annotation types.

Backward annotation imposes no limit on the number of data points that can be collected by the user when measuring a feature. For example, when backward annotation is used, a circle can be measured with as few as the minimum number of points shown in the Min Circle data field, or as many as the user wishes to collect up to a maximum of 99 points. When backward annotation is used, the user must press the Finish key to complete the measurement and store measurement data in the feature list.

Forward annotation limits the number of data points collected in a feature measurement to the minimum shown in the corresponding Min data field. For example, when forward annotation is used and the Min Circle value is 3, the circle measurement will automatically be completed when 3 points have been collected. No user interaction will be required to store the measurement data in the feature list.

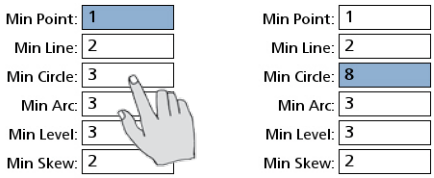
Touch the Annotation choice field to toggle the choice between Backward and Forward annotation.



Minimum points required for a feature measurement

Each feature type is given a minimum data point requirement. The default minimums are the geometric minimums necessary to define the corresponding feature type. For example, a minimum of 3 points is required to define a circle, 2 for a line and 1 for a point. The minimum number required by the system can be increased (up to 99) to improve the accuracy of measurements. This is most useful when Forward annotation is used and the measurement data are automatically limited to the specified minimum.

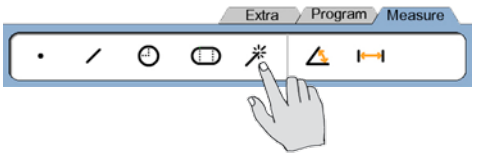
To define the minimum data points required by the system to complete a feature measurement, touch the corresponding Min data field and enter the desired minimum number using the number keys.



The minimum points for a circle are changed from 3 to 8

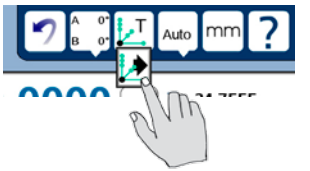
Probe hit starts measure magic

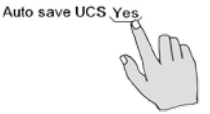
Measure magic automatically selects a feature type, such as line or circle, based on the geometric orientation of probed data points. Measure magic can be started manually by touching the measure magic icon prior to a measurement, or started automatically when the first new probe contact of a measurement occurs, thereby saving the user the time required to press a panel button. Enable this automatic function by toggling the Probe Hit Starts Magic choice field to Yes.



Auto save UCS

A new user coordinate system (UCS) is the measurement reference frame established each time the user creates a new datum. The new UCS is temporary until it is saved or replaced by another new UCS. The UCS can be saved manually by touching the UCS icon in the top right corner of the screen, or can be saved automatically each time a new datum operation is performed by the operator. Enable this automatic function by toggling the Auto save UCS choice field to Yes.





Distances

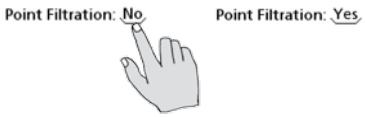
Distance measurements result in X, Y and L (vector) displacements. The Y-axis displacements can be shown as signed or absolute (positive only) values. When signed values are specified, axis displacements from right to left and from top to bottom are negative. Specify signed distances by toggling the Distances choice field to Signed.

Enabling and configuring point filtration

Point filtration extracts aberrant data points from the total population of data during the least squares best fit calculations of arc, circle and line features. Points are extracted when they exceed the specified error limit (quantization factor) and fall outside the specified standard deviation range (Sigma factor). The filtration process ends when all remaining data points satisfy the quantization or standard deviation requirement, or when the minimum percentage of retained data points (proportion factor) is reached. Extracted data points are highlighted in yellow in the View window. The last points retained are highlighted in red.

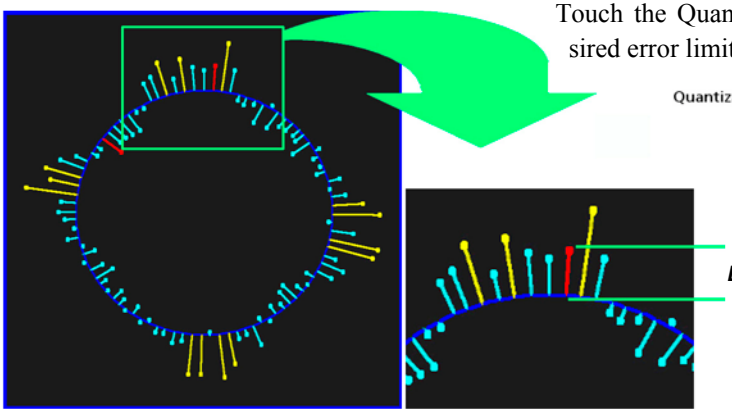
Enabling point filtration

Touch the Point Filtration choice field and toggle the choice to Yes to enable point filtration.

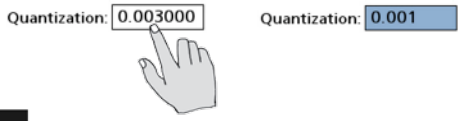


Specifying a filtration error limit

The quantization factor is the maximum acceptable error. For most measurements, a quantization factor of 3 microns or less can be applied. However, measurements that contain larger numbers of aberrant points might benefit from higher quantization factors.

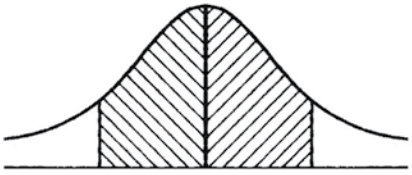


Touch the Quantization data field and enter the desired error limit.



Specifying a filtration standard deviation range

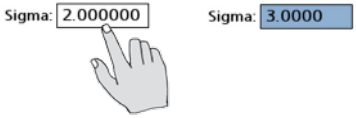
The acceptable standard deviation range is determined by the value of Sigma. For example, a Sigma of 2.0 produces a Standard deviation range that includes 95.5% of the total population.

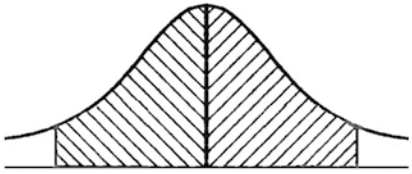


± 1 Sigma

For most measurements, a Sigma of 2 or more can be applied. However, measurements that include a large number of aberrant points might benefit from a lower Sigma.

Touch the Sigma data field and enter the desired value.

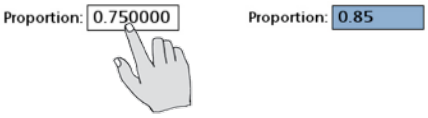




± 2 Sigma

Specifying the minimum percentage of retained points

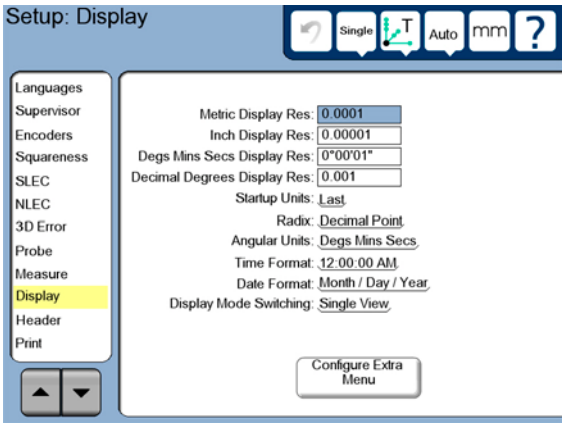
The Proportion value determines the minimum percentage of data points that will be retained. For example, a Proportion value of 0.75 will cause the system to retain a minimum of 75% of all data points collected for a feature.



Touch the Proportion data field and enter the desired value.

Display screen

The Display screen contains fields for configuring display resolution and other LCD display parameters.



Display resolution

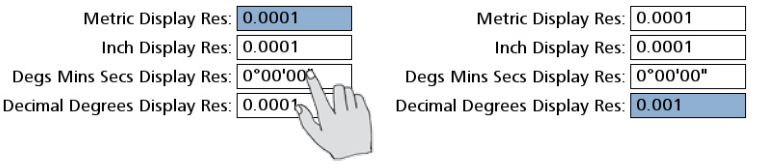
The display resolution fields are used to specify the resolution of measurements shown on the DRO and other screens. Displayed numbers will be rounded as the display resolution is decreased below that of the input. The table below illustrates how the display is governed by the display resolution setting.

Encoder input	Display resolution	Displayed value
1.567	0.0001	1.5670
1.567	0.001	1.567
1.567	0.01	1.57
1.567	0.1	1.6
1.567	1	2

NOTE

Display resolution should never be higher than the encoder resolution. Specifying display resolutions that are higher than encoder resolutions can lead to misleading displays of values.

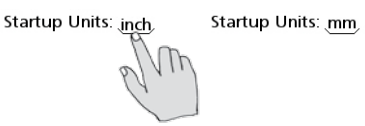
To specify display resolution, touch the data field of the desired Display category and enter the desired resolution using the number keys.



Default units of linear measure

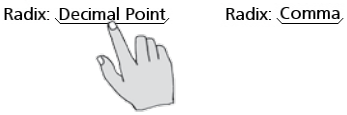
The Startup Units field is used to specify the default display of linear measurements when power is applied to the system. These display settings can be changed temporarily but will revert to the startup defaults when the power is cycled.

To select startup units of linear measure, touch the Startup Units choice field to toggle between Inch and mm.



Radix for numeric displays

The Radix choice field is used to specify the radix displayed in numeric fields. Touch the Radix choice field to toggle between Decimal Point (1.0) and Comma (1,0).



Angular units of measure

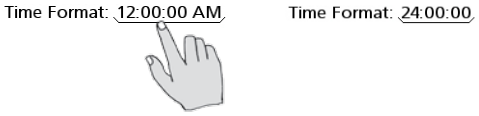
The Angular Units choice field is used to specify the display of angular units of measurement. The display choice can be toggled between degrees, minutes and seconds or in decimal degrees and will be retained across power cycles.

Touch the Angular Units choice field to toggle between degrees, minutes and seconds and decimal degrees.

Time formats

The Time Format choice field is used to specify the display of time. The display choice can be toggled between 12 hour and 24 hour formats and will be retained across power cycles.

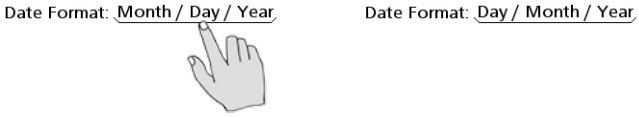
Touch the Time Format choice field to toggle between 12 hour and 24 hour formats.



Date formats

The Date Format choice field is used to specify the display of date. The display choice can be toggled between Month/Day/Year and Day/Month/Year formats and will be retained across power cycles.

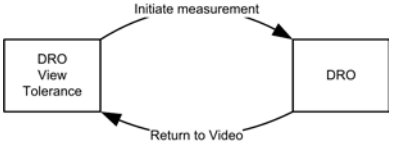
Touch the Date Format choice field to toggle between Month/Day/Year and Day/Month/Year formats.

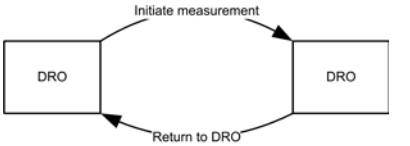


Display mode switching

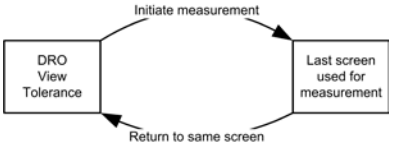
The QC-330 provides two display modes for measurements, Single View and Dual View.

In the Single View mode, the screen used for a measurement will be displayed again when the measurement is complete.





In the Dual View mode, the last screen used for a measurement will be used again for the current measurement. When the measurement is complete, the screen displayed before the measurement was initiated will be displayed again.



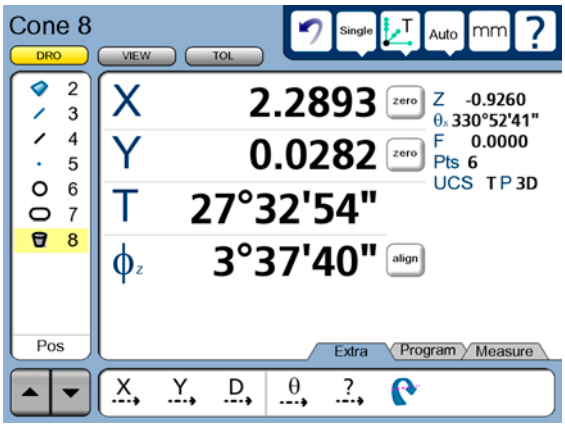
Touch the Display Mode Switching choice field to toggle the display mode between Single View and Dual View.

Display Mode Switching: Single View

Display Mode Switching: Dual View

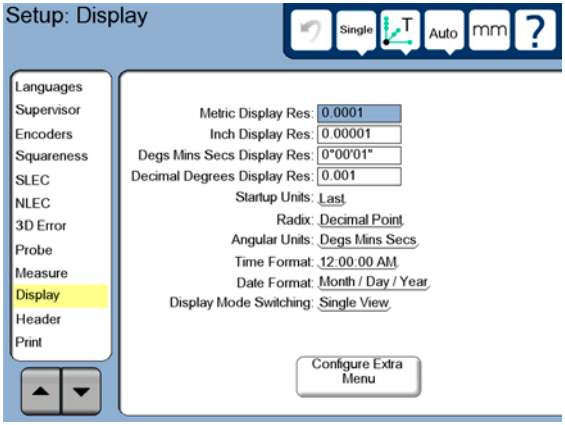
Configuring the Extra tab

The Extra tab can be configured to contain controls for transmitting measurement data, performing datum operations and a variety of other functions. Up to 99 Extra tabs can be configured to be available on each system. Repeatedly touching the Extra tab cycles through the available configurations. This is especially useful when the user would like to use a large number of data transmission and other functions, or would like to group similar functions on separate Extra tabs.

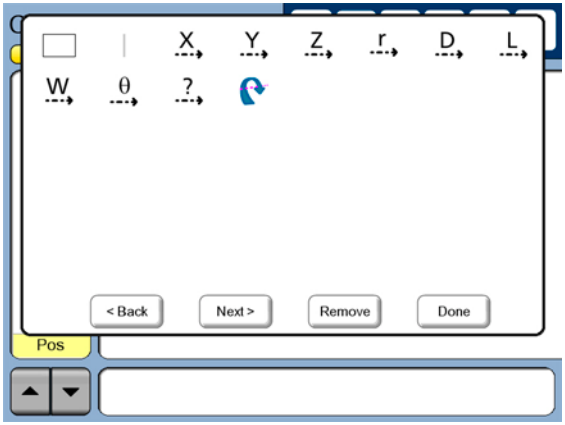


Extra tab at bottom of screen configured to contain controls for transmitting measurement data

Touch the Configure Extra Menu button to display the configuration window.



Touch the Configure Extra Menu button...



to display available Extra tab functions

Available Extra tab functions for your system and Extra tab editing controls are shown in the configuration window.

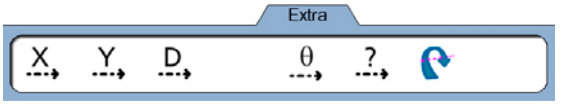
NOTE

Extra tab functions are different for different QC-330 systems. For example, Extra tab functions for a touch probe or video edge detection system will be slightly different than those for an optical edge detection system. Optional Extra tab functions also appear only in systems that include the corresponding options, such as laser pointers.

Extra tab functions

Space menu insert

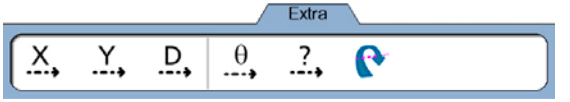
The space insert is included in the Extra tab to separate control functions into groups on the tab.



Extra tab divided by space into data and CNC groups

Divider line menu insert

The divider line insert is included in the Extra tab to separate control functions into groups on the tab without using a space insert.



Extra tab divided by line into data and CNC groups

Data prompt function

Touch the data prompt function icon to send a user-defined measurement such as X position, Y position, radius or angle to the serial port, USB printer or USB drive as a file. When the user touches the data prompt function icon, a prompt message is displayed and the user selects the desired piece of measurement data to be transmitted.

Axis position

Touch the axis position function icon to send X position, Y position or Z position data to the serial port, USB printer or USB drive as a file.

Angle

Touch the angle function icon to send angle data to the serial port, USB printer or USB drive as a file.

Diameter

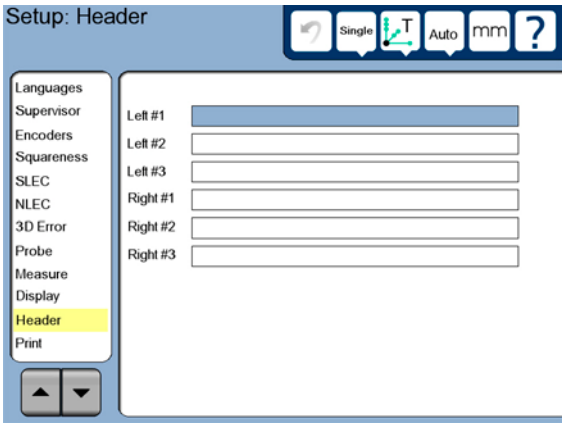
Touch the diameter (or radius) function icon to send diameter (or radius) data to the serial port, USB printer or USB drive as a file.

Rotate coordinate system

Touch the rotate coordinate system icon to rotate the 3D coordinate system around an axis. When the user touches the rotate coordinate system icon, a prompt message is displayed and the user selects the desired axis of rotation.

Header screen

The Header screen contains fields for formatting text headers for printed and exported reports.

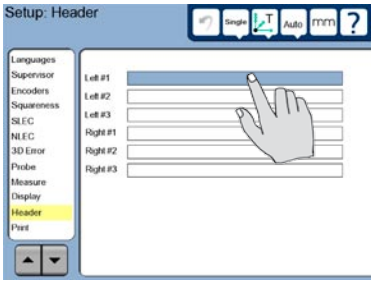


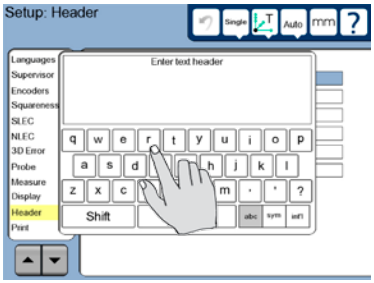
Creating report headers

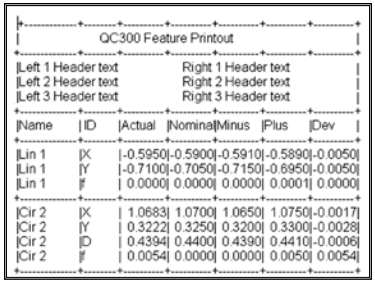
Two columns of three text headers can be created for the top left and right sides of reports, as shown in this example. To create a header:

1 Touch the desired header field. The text entry window will be displayed.

2 Enter the text header and press the Enter button when finished.





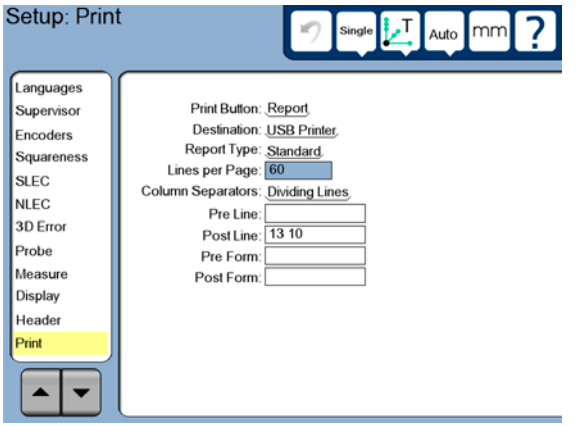


QC300 Feature Printout

Left 1 Header text				Right 1 Header text		
Left 2 Header text				Right 2 Header text		
Left 3 Header text				Right 3 Header text		
Name	ID	Actual	Nomina	Minus	Plus	Dev
Lin 1	X	-0.5950	-0.5900	-0.5910	-0.5890	-0.0050
Lin 1	Y	-0.7100	-0.7050	-0.7150	-0.6950	-0.0050
Lin 1	F	0.0000	0.0000	0.0000	0.0001	0.0000
Cir 2	X	1.0683	1.0700	1.0650	1.0750	-0.0017
Cir 2	Y	0.3222	0.3250	0.3200	0.3300	-0.0028
Cir 2	D	0.4394	0.4400	0.4390	0.4410	-0.0006
Cir 2	F	0.0054	0.0000	0.0000	0.0050	0.0054

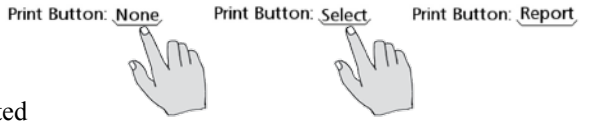
Print screen

The Print screen contains fields for formatting printed reports and RS-232 data streams of feature measurement data.



Specifying a data type

The Print button initiates the transfer of data to the USB port for printing, or to the RS-232 serial port for communication with a computer. Specify the type of data to be transmitted by repeatedly touching the Print Button choice field.

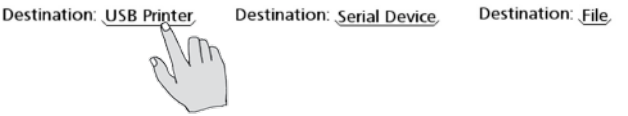


Data choices include:

- None — No data will be printed or transmitted
- Select — User will be prompted to select the data that will be printed or transmitted
- Report — A standard report of all feature data or a tolerance report of only features that have tolerances applied will be printed or transmitted

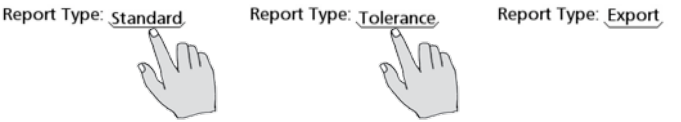
Specifying a data destination

Feature measurement data can be sent to the USB port for printing, to the RS-232 serial port for transmission to a computer or to the USB drive as a text file. Touch the Destination choice field to cycle through the destination choices.



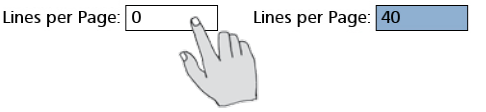
Report Type

Report types are selected to send standard or tolerance reports to printers or a comma separated variable data file to a computer. Touch the Report Type choice field to cycle through the choices.



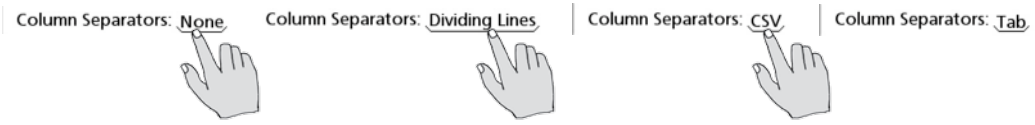
Lines per page

Specify the length of printed report pages by touching the Lines per Page data field and entering the desired number of character lines using the number keys.



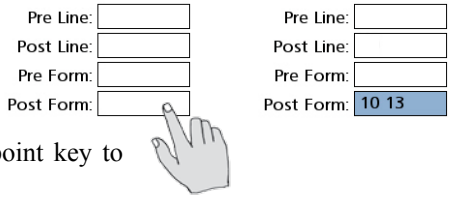
Specifying column separators

Columns of feature measurement data in printed reports and in transmitted data can be contiguous or can be separated by dividing lines, commas or Tabs. Touch the Column Separator choice field to cycle through the choices.



RS-232 control characters

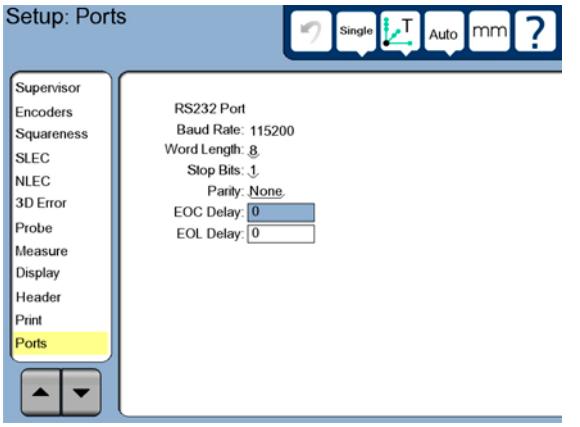
Control characters can be added to the beginning and end of line and form data streams to accommodate the requirements of receiving systems and programs. To add RS-232 control characters, touch the desired data field and enter the ASCII character number using the number keys. Use the decimal point key to separate ASCII characters.



NOTE
An ASCII character chart is provided in Chapter 9: Communication.

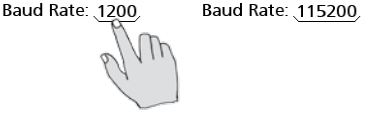
Ports screen

The Ports screen contains fields for configuring the RS-232 serial communication port. The RS-232 communication port is used to send data to computers. RS-232 port settings can be changed to match those of the receiving system.



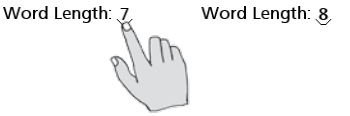
Baud rate

Touch the Baud Rate choice field repeatedly to cycle to the desired serial data rate. Baud rates from 1,200 to 115,200 are available.



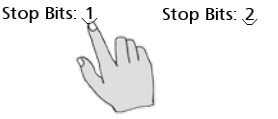
Word length

Touch the Word Length choice field to toggle between data word lengths of 7 bits and 8 bits.



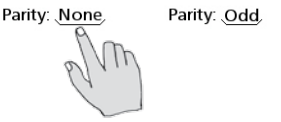
Stop bits

Touch the Stop Bits choice field to toggle between 1 and 2 stop bits at the end of the data word.



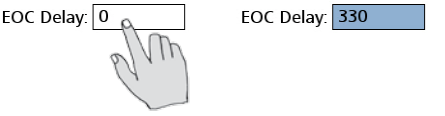
Parity

Touch the Parity choice field repeatedly to cycle to the desired parity error checking. Choices include None, Odd and Even.



EOC delay

A delay can be inserted at the end of each character to satisfy the communication requirements of receiving systems. Touch the EOC data field and enter the desired delay in milliseconds using the number keys.



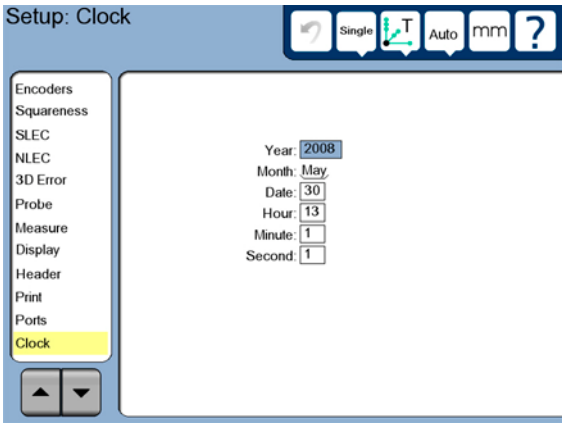
EOL delay

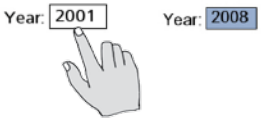
A delay can be inserted at the end of each line of characters to satisfy the communication requirements of receiving systems. Touch the EOL data field and enter the desired delay in milliseconds using the number keys.

Clock screen

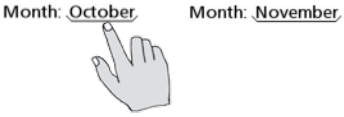
The Clock screen contains fields for setting the date and time included in data transmissions and printed on reports.

To change a date or time value, touch the desired choice or data field and enter the desired value.





Touch and enter numbers

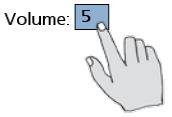


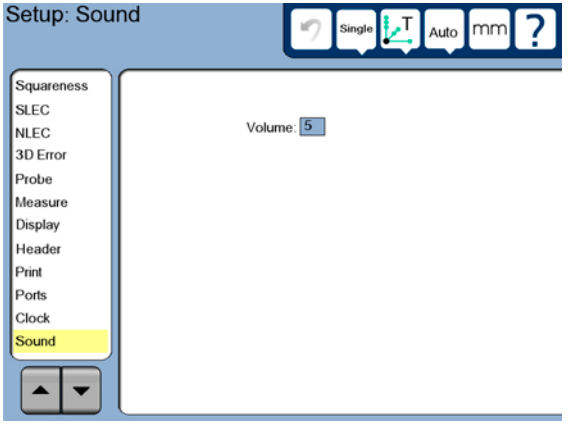
Touch and cycle through choices

Sound screen

A sound can be generated by the system to call attention to point entries. The sound is generated each time the Enter button is pressed to enter a point as part of a measurement.

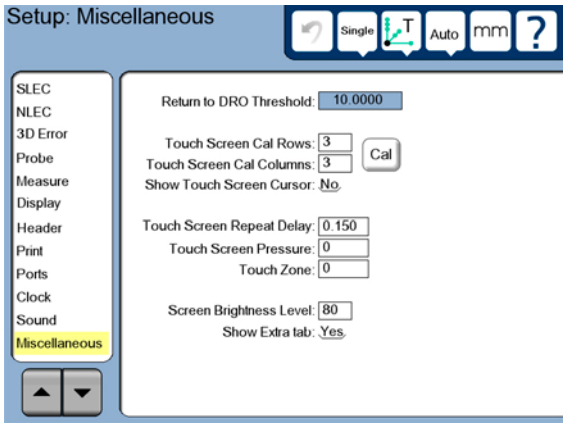
Touch the Volume data field and enter a number to adjust the loudness of all sounds from 1 (very soft) to 10 (loud). Enter a zero to mute all sounds.





Miscellaneous screen

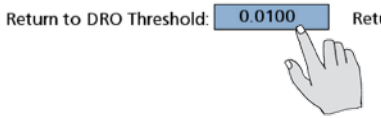
The Miscellaneous screen contains fields for calibrating and configuring the LCD touchscreen.



Return to DRO threshold

The display automatically switches to display current position on the DRO from the View, Tolerance or DRO screens when the stage movement reaches or exceeds the DRO threshold value.

Touch the Return to DRO Threshold data field and enter the desired stage threshold motion using the number keys.



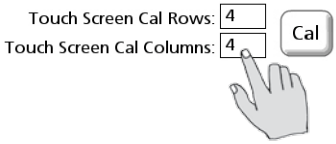
NOTE
Entering a zero disables this function.

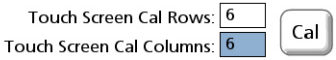
Touchscreen calibration rows and columns

Touchscreen calibration measures touch-pressure at points displayed on a matrix of rows and columns. The number of touch-points included in the calibration is defined by specifying the number of rows and columns in the matrix. An example of a 4-row, 4-column matrix is shown at the right.

Example of a 4 X 4 calibration matrix

Touch the Touchscreen Cal Rows or Touchscreen Cal Columns data field and enter the desired value using the number keys.



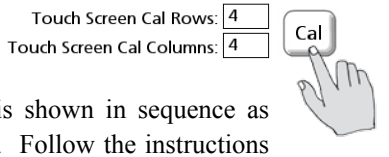


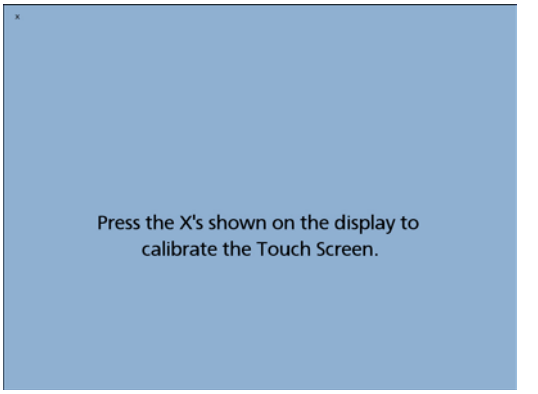
Calibrating the touchscreen

The touch-pressure of the touchscreen should be calibrated as part of the initial setup and when a new operator begins using the system. To calibrate the touchscreen:

1 Confirm that the number of calibration rows and columns provide adequate touch-points to satisfy typical use requirements. Increase or decrease them if desired as described above.

2 Touch the Cal button. The first point of the calibration matrix will be displayed.



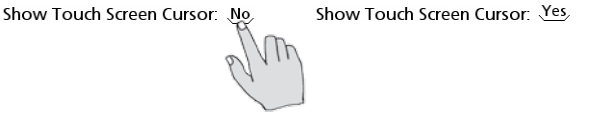


Each touch-point is shown in sequence as an x on the screen. Follow the instructions provided on the screen and then press the Finish key to complete the calibration. The touchscreen pressure calibration value will be shown in the Touchscreen Pressure data field.

Touch screen cursor

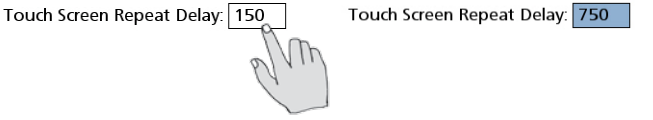
A green cross mark cursor can be displayed on the touchscreen briefly to indicate the touch-point as visual feedback for the user.

Touch the Show Touch Screen Cursor choice field to toggle the choice between Yes and No.



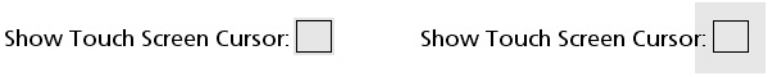
Touch screen repeat delay

The feature list can be scrolled by touching and continuously pressing the scroll arrows at the bottom of the list. The scroll rate is inversely proportional to the touch screen repeat delay. Small delays result in rapid scrolling, large delays result in slow scrolling. Adjust the scroll rate by touching the Touch Screen Repeat Delay data field and entering the desired delay in milliseconds.



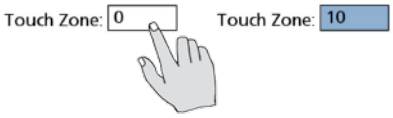
Touch zone size

The size of the touch zone can be changed to accommodate different users. When the touch zone size value is zero, the touch zone extends only to the limits of the choice or data field. As the touch zone value is increased, the touch zone is increased beyond the perimeter of the field on all sides. The touch zone value is expressed in screen pixels.



Default touch zone size *Enlarged touch zone size*

To change the size of the touch zone , touch the Touch Zone Size field and enter the new value using the number keys.

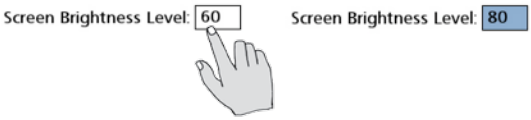


CAUTION
Increasing the touch zone size significantly might cause interference between adjacent fields.

Screen brightness

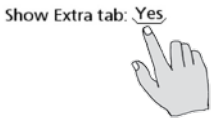
The LCD display brightness can be adjusted to accommodate different ambient lighting conditions.

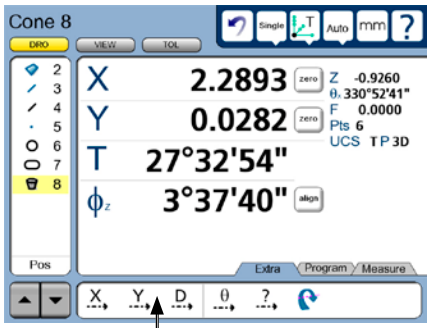
To adjust brightness, touch the Screen Brightness Level data field and enter the desired value (min = 0, max = 100).



Showing the Extra tab

The Extra tab can be hidden or displayed at the bottom of the screen. To display the Extra tab, touch the Show Extra tab choice field to toggle the choice to Yes.

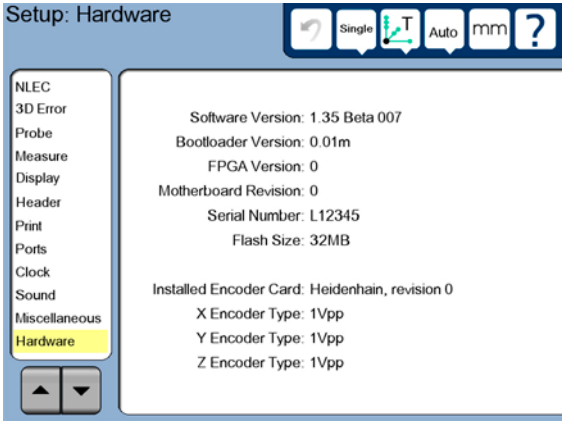




Extra tab at bottom of screen

Hardware screen

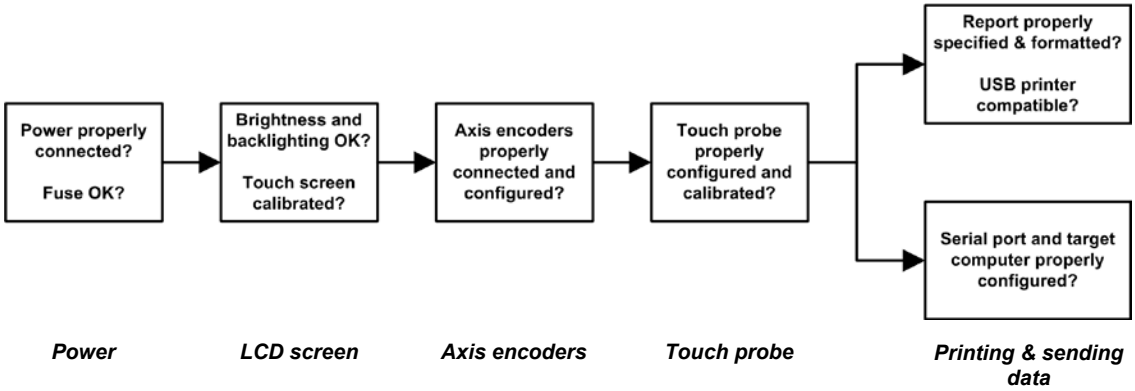
The Hardware screen contains fields that describe the software and hardware configuration of your system. This information will be essential to Metronics technical support personnel if your system is upgraded or repaired.



Chapter 11: Problem Solving

The development of the QC-330 was based on an installed base of more than 50,000 Metronics Quadra-Chek products. Years of continuous product improvement have resulted in an extremely reliable QC-330 product with few, if any problems. Problems experienced with the QC-330 are likely to be the result of printer or cable incompatibilities, instrument configuration or setup errors, encoder incompatibilities or malfunctions or setup and calibration issues.

The steps recommended for initial troubleshooting are shown below. These are typically the same initial steps that would be taken by a distributor or factory product support technician.



Since most problems experienced in the field will have simple causes, and equally simple solutions, substantial time and expense can be saved by performing some straightforward evaluations of probe calibration, configuration settings and hardware connections prior to calling the distributor for assistance.

As you're troubleshooting, list the steps that you use to identify and solve your problem. Should problems persist in spite of your efforts, gather the product information listed at the end of this chapter, and your list of troubleshooting steps, and then contact your distributor for assistance.

NOTE

Confirm that the essential setup steps described in Chapter 10: Setup have been performed before troubleshooting or requesting assistance.

Symptoms, possible causes and solutions

Some common symptoms of problems are listed in the following pages with possible causes and solutions.

No image is visible on the LCD screen

Possible cause	*Possible solutions*
Power is not applied to the QC-330	1 Activate the main power source 2 Connect the power cord or turn the power ON 3 Replace the fuse
LCD ON/OFF toggle switch is in the OFF mode	1 Press the LCD ON/OFF button to toggle the LCD ON
LCD contrast or backlighting is out of adjustment	1 Readjust the backlighting using the decimal point or +/- key 2 Adjust the brightness level in the Miscellaneous setup screen

Values displayed on the LCD screen are incorrect

Possible cause	*Possible solutions*
The axis encoder is not connected/malfunctioning	1 Connect the axis encoder cable firmly 2 Replace the axis encoder
Wrong axis encoder resolution	1 Specify the correct resolution in the Encoders setup screen
Wrong axis encoder count polarity	1 Specify the correct count polarity in the Encoders setup screen
Wrong axis encoder	1 Connect the axis encoder specified in the Encoders setup screen 2 Confirm that the each encoder is connected to the correct axis input
Wrong encoder type specified (Analog vs TTL)	1 Correct the encoder specification in the Encoders setup screen

Values displayed on the LCD screen are incorrect (continued)

Possible cause	*Possible solutions*
Wrong in/mm unit of measure	1 Specify the correct units of measure in the Encoders setup screen
Wrong encoder reference mark is specified	1 Correct the reference mark type in the Encoders setup screen
Error correction is required to compensate encoder inaccuracies	1 Perform LEC or SLEC error correction in the SLEC setup screen
Touch probe is not calibrated	1 Perform a probe teach operation as described in Chapter 5: Probes
Touch probe configuration settings are incorrect	1 Change the touch probe settings in the Probe setup screen

Reports are not printed or are incomplete

Possible cause	*Possible solutions*
Printer is not supported	1 Browse to www.metonics.com for a list of supported printers
USB cable is not firmly connected or is damaged	1 Connect or replace the printer cable
Printed report setup is incorrect	1 Correct the report setup in the Print setup screen

Reports are printed incorrectly

Possible cause	*Possible solutions*
Printed report setup is incorrect	1 Correct the report setup in the Print setup screen
Wrong control characters are specified	1 Correct the control character configurations in the Print setup screen

Data cannot be transmitted to a computer

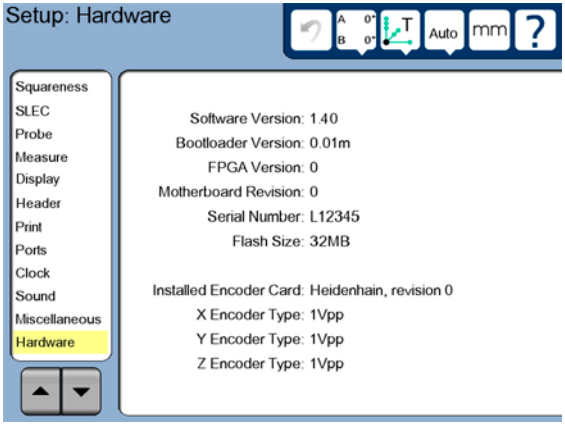
Possible cause	*Possible solutions*
Wrong serial cable is connected	1 Connect the computer to the QC-330 using an RS-232 serial cable that does not include crossed transmit and receive wires. The correct cable can be ordered from Metronics by specifying part number 11B12176
Wrong RS-232 port settings are specified	1 Change the RS-232 port settings to match the computer's serial port settings in the Port setup screen
Wrong control characters are specified	1 Correct the control characters to reflect the requirements of the receiving software in the Print setup screen

Getting help from your distributor

Performing the simple troubleshooting listed on the previous pages solves most problems experienced with the QC-330. If a problem persists after performing this troubleshooting, follow the steps listed below and contact your distributor for assistance.

1 Be prepared to discuss your troubleshooting steps.

2 Gather the following QC-330 information:
- Model number
- Serial number
- Approximate purchase date
- Software version number and hardware information from the Hardware setup screen.



Chapter 12: Reference Material

This chapter contains technical information regarding:

- QC-330 product specifications
- Footswitch wiring
- RS-232 connector wiring
- Tolerances

Product specifications

Electrical

Input Voltage Range:	85 VAC to 264 VAC. 1.0 Amp maximum (Auto switching)
Fuse:	1.6 Amp 250 VAC Slow Blow 5 x 20 mm
Input Frequency:	43 Hz to 63 Hz

Environmental

Temperature:	0 °C to 45 °C (32 °F TO 113 °F) non-condensing
Humidity:	90% rh maximum
Altitude:	2000 meters (6,562 ft) maximum
Installation:	Category: II

Dimensions

Enclosure (W x H x D):	29.2 cm x 19.1 cm x 7.0 cm	(11.5” x 7.5” x 2.75”)
Base (W x H x D):	25.4 cm x 5.1 cm x 19.8 cm	(10” x 2” x 7.8”)
Enclosure weight:	1.6 kg (3.5 lbs.)	
Base weight:	3.2 kg (7 lbs.)	

LCD

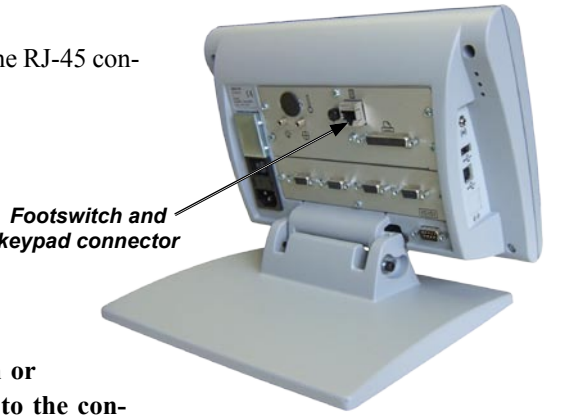
Size/color:	17.2 cm (6.8 inch) x 12.9 cm (5.1 inch) TFT color touch screen
Resolution:	800 x 600 pixels

ENC tests

EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-11, EN61000-4-2, EN61000-4-1

Footswitch/handswitch wiring

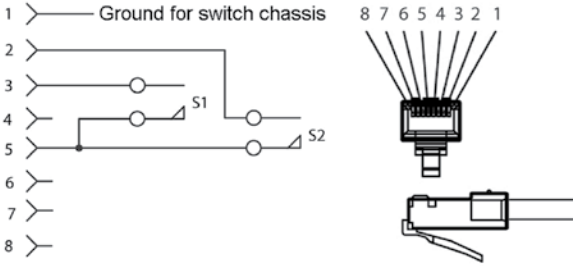
The optional foot switch/handswitch is connected to the RJ-45 connector on the left side of the QC-330.



The wiring of the switch is sometimes duplicated by other external switching devices to facilitate remote operation in conjunction with other devices in a larger semi-automated system.

CAUTION

Never apply power to the footswitch or handswitch wires. Applying power to the connector wires or wiring the switch connector in any way other than shown by this diagram can cause serious damage the QC-330 and void the product warranty.



RS-232 connector wiring

The RS-232 wiring is shown by the table below.

Pin No.	Description	Direction
2	Data in	Input
3	Data out	Output
7	Signal ground	Reference
8	Power on	Output (always high)

RS-232 connector

Tolerances

The following information is supplemental to the tolerance discussions provided earlier in Chapter 7: Tolerancing.

Concentricity tolerance

The mathematical definition of concentricity is explained in detail in the ASME Y14.5M-1994 standard and involves "the midpoints of opposing elements" in the determination of actual concentricity. This is not practical in a discrete point measuring system, so the QC-330 uses the center of the feature (determined by the best fit) to estimate the concentricity.

Reference Features

When a reference feature is called for in a tolerance definition, the reference feature will nearly always refer to a datum feature such as a skew line or datum circle. The field is required except for the MMC / LMC tolerance case.

Least squares best fit

Data is iteratively processed to position a perfect circle within the data cloud in the position that minimizes the sum of the squared form errors. Form errors are inside and outside the circle.

Maximum inscribed circle

First, a least squares best fit circle is estimated, then the data is iteratively processed to position a perfect circle through 3 points on the inside of the data cloud. The maximum inscribed circle position encloses the maximum diameter of the circle by the data cloud. Form errors are outside the circle.

Minimum superscribed circle

First, a least squares best fit circle is estimated, then the data is iteratively processed to position a perfect circle through a minimum of 2 points on the outside of the data cloud. The minimum superscribed circle position encloses the data cloud with the minimum circle diameter. Form errors are inside the circle.

ISO (least radial distance)

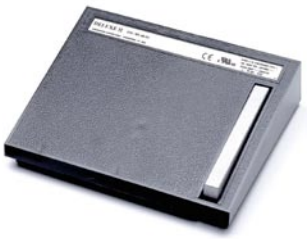
First, a least squares best fit circle is estimated, then the data is iteratively processed to position a perfect circle in the location that minimizes the inside and outside form errors. Form errors are inside and outside the circle.

Chapter 13: Options

Available options for the QC-330 are listed and shown here with Metronics part numbers:

- Foot switch for remote operation
- RS-232 cable without crossed cable wiring for communication with computers
- Arm-mounting bracket and bracket adapter for mounting the QC-330 on vertical surfaces (must be ordered together)
- QC-Wedge communication software for sending serial data directly from the QC-330 to any PC application. QC-Wedge software includes the 11B12176 serial cable option shown below.

Contact the Metronics sales group by phone at *603.622.0212* or by e-mail at *sales@metronics.com* to order QC-330 options.



Foot switch w/8 ft cable
11B12816

Serial cable
11B12176

QC arm-mounting bracket
38-22-60-101

QC arm-mounting bracket adapter
11D12764

QC-Wedge communication software
540526-08

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