HEIDENHAIN

Operating Instructions

ND 1300 QUADRA-CHEK

(QC 320)

Video Edge Detection and Crosshair Systems

English (en)
2/2010

QC-300 Series
User's Guide

Video Edge Detection Systems
QC-320, QC-321, QC-323, QC-324

QC-300 Series
Video Edge Detection and Crosshair Systems
User's Guide

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Conventions & Terms

QC-300 refers to any of the QC-300 series of instruments. System refers to the QC-300 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 an uninsulated dangerous voltage within the product enclosure that might be of sufficient magnetude 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 maintentance, 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.

Safety information is also included on the next page and in Chapter 2: Installation.

WARNINGS

Disconnect the QC-300 from power before cleaning.

The QC-300 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-300 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-300 has been dropped or the exterior has been damaged
- The QC-300 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.

Contents

Chapter 5 Probes

Chapter 6 Measuring

Chapter 8 Programming

Chapter 9 Image Archiving (Option)

Chapter 10 Communication

Chapter 11 Setup

Chapter 12 Problem Solving

Chapter 13 Reference Material

Chapter 14 Options

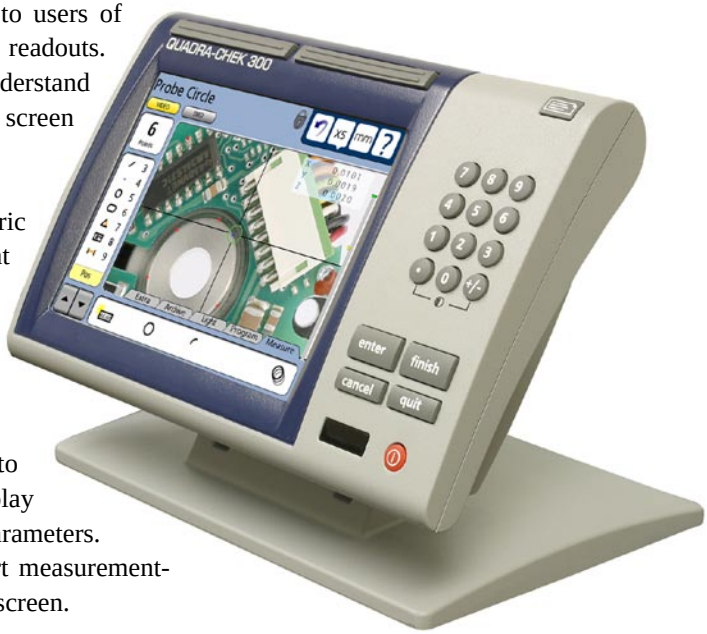
Chapter 1: Overview

The Quadra-Chek 300 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 toolmaker's microscopes and video measurement systems as part of in-line production activities or final quality inspection.

Feature points are entered manually using crosshairs or video edge detection, or automatically using the multiple video edge detection probe. Feature type can automatically be determined by the system when using Measure Magic. Part level and skew compensation can be performed on misaligned parts prior to measurements that eliminates the need for time-consuming fixturing.

Sequences of key-presses 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. Programs can include the CNC motion control option to fully automate program execution, increase thoughput and simplify operator tasks.

The intuitive interface will be familiar to users of the QC-200 and other Metronics digital readouts. Operators will find the QC-300 easy to understand and use thanks to the large color touch screen LCD display.

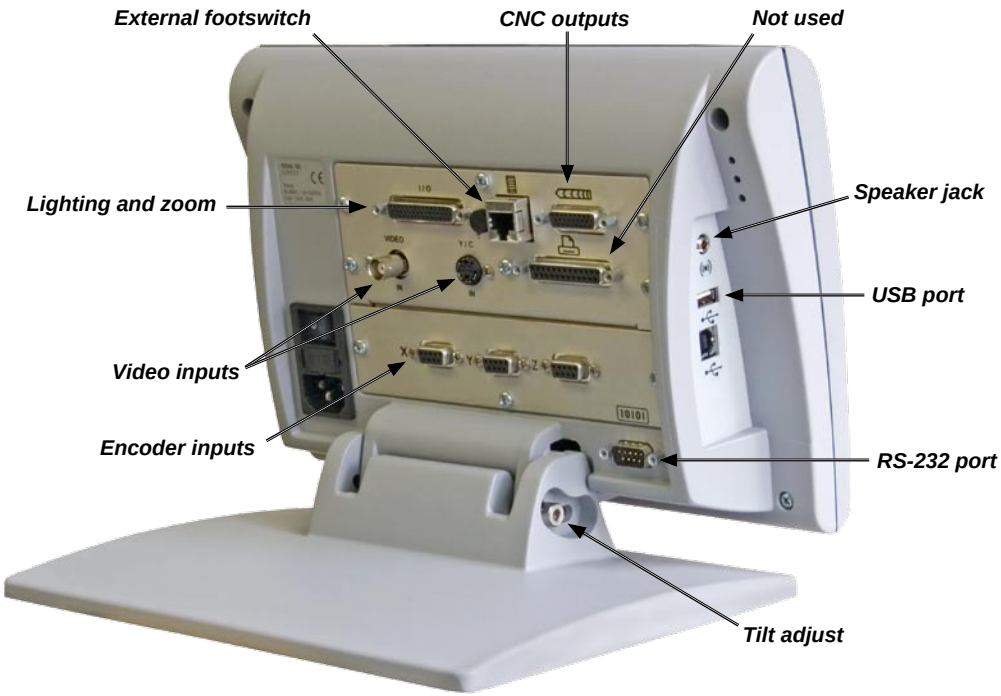


The color LCD displays alphanumeric and graphic information for the current measurement, part features and measurement data clearly on one screen, eliminating the need to page or scroll for information.

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.



Video camera inputs are displayed on the color LCD and support NTSC and Pal formats as composite video and S-video signals. Video images can be stored as JPEG snapshots using the optional image archiving functions.

Measurements viewed on the LCD can be transmitted to a PC over USB or RS-232 ports or to a printer over the USB port.

The compact ergonomic design and adjustable-tilt front panel of the QC-300 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 mounting stand.

Optional foot switch is available for operation when the user is not close to the front panel. All the optional accessories for the QC-300 are shown in detail at the rear of this guide in Chapter 14: Options.

Chapter 2: Installation

The QC-300 is easy to install in a variety of basic and advanced measurement applications. This chapter describes how to unpack and install the QC-300. Repackaging instructions are also included for return shipments and for distributors and OEM customers that are configuring a QC-300 and shipping it to an end-user.

Unpacking the QC-300

Carefully remove the contents of the shipping carton.

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

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

- QC-300 instrument
- Power cord
- Mounting stand and hardware
- Warranty registration card

Shipments of other optional equipment in separate cartons might include:

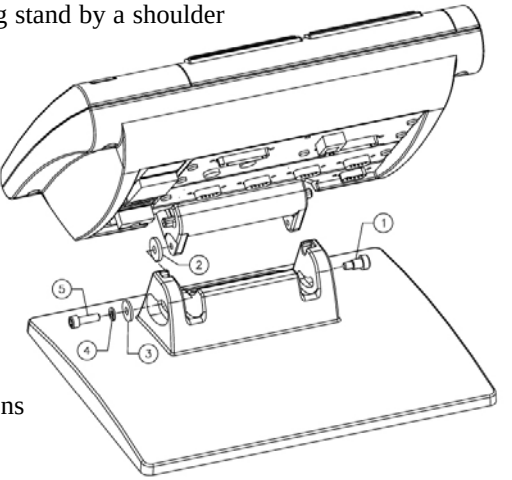
- RS-232 serial cable
- Light control cable
- Foot switch
- Video cable
- CNC output cable
- Taltech's WinWedge® software

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-300 is secured to the swivel slots of the mounting stand by a shoulder screw, a cap screw and associated washers.

Assemble the QC-300 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-300 will be secure when adjusted to the desired tilt position.



Safety considerations

The QC-300 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-300 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-300 power connector. The AC voltage available at electrical outlets is extremely dangerous and can cause serious injury or death.

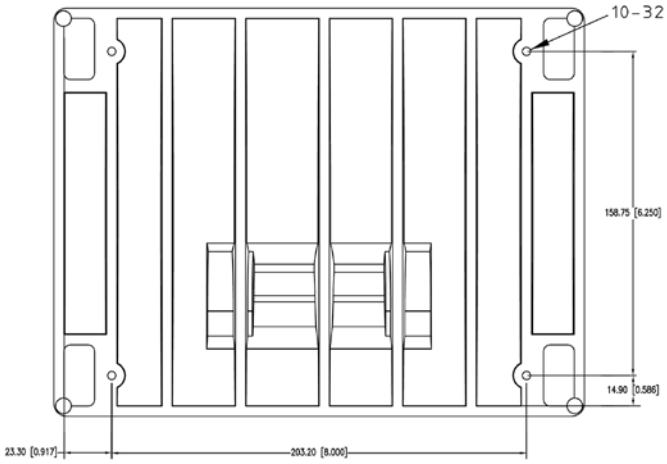
Electrical wiring and connections

Perform regular inspections of all connections to the QC-300. 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-300 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.



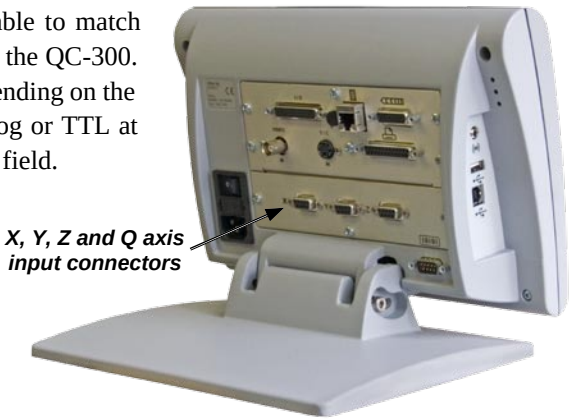
Mounting holes tapped for 10-32 screws
Dimensions in millimeters/inches

Power surge suppressor

Connect the QC-300 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-300. Many encoder interfaces are available to match the wide variety of encoders that can be used with the QC-300. 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-300 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 11: Setup for details regarding encoder setup.

Connecting an optional footswitch

The optional foot switch is connected to the RJ-45 connector on the left side of the QC-300.

1 Verify that the QC-300 is off.

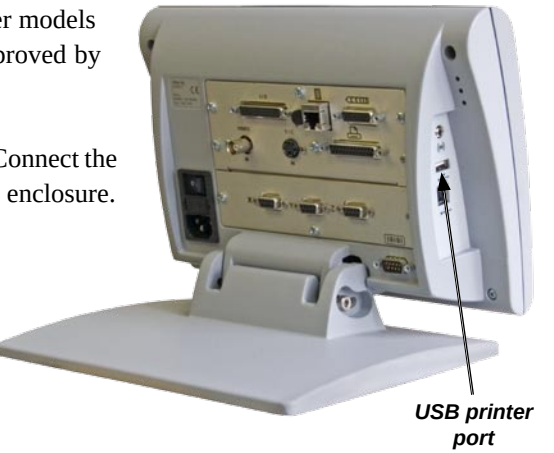
2 Connect the foot switch to the RJ-45 connector on the rear connector panel.

Connecting a printer

The QC-300 supports certain HP USB printers. Printer models must be specified when the QC-300 is ordered, or approved by Metronics later.

1 Verify that the QC-300 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.

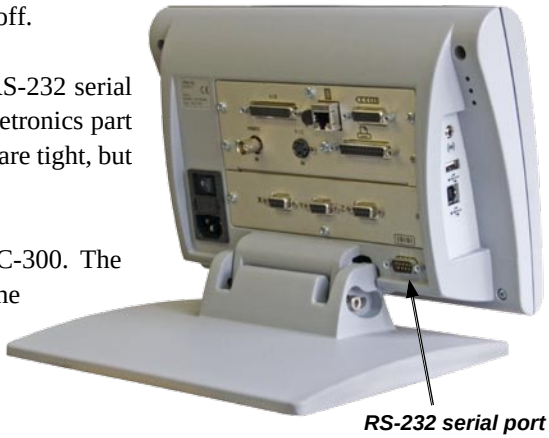


Connecting a computer

1 Verify that the QC-300 and computer power are off.

2 Connect a computer COM port to the QC-300 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-300. The default QC-300 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

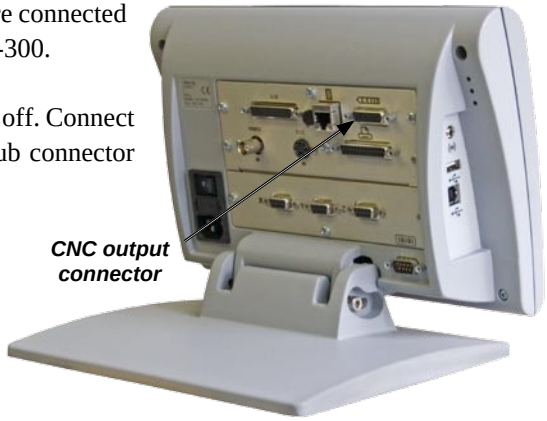
4 Launch the computer application that will be used to communicate with the QC-300, and configure the communication properties of the computer's COM port and QC-300 to match.

Connecting optional CNC outputs

The optional CNC joystick and amplifier outputs are connected at the CNC output connector on the rear of the QC-300.

1 Verify that the QC-300 and CNC amplifier are off. Connect the CNC amplifier and joystick to the 26-pin D-sub connector on the rear of the QC-300.

2 Make sure the connector is fully inserted and make sure the cable connectors are tight, but do not overtighten the connector screws.



Connecting optional camera lighting and zoom

The QC-300 supports top, back and ring lighting for image illumination. The lighting output connections are made to an external light control box through the 44 pin D-sub connector. The 0 to 5 Volt zoom control output connections to a zoom amplifier are also made through the Lighting/Zoom connector.

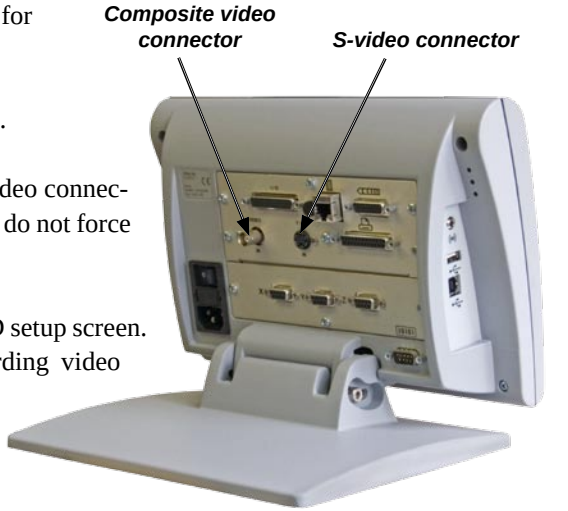
1 Verify that the QC-300, camera light control box and zoom amplifier are off.

2 Tighten the lighting/zoom cable to the lighting/zoom connector on the back panel. Do not overtighten the connector screws.

The lighting and zoom outputs must be configured using the Lighting and Magnifications setup screens. Please refer to Chapter 11: Setup for details regarding lighting and zoom setup.

Connecting a video input

The QC-300 supports composite and S-Video inputs for NTSC and PAL systems.



1 Verify that the QC-300 and video camera are off.

2 Connect the video input to the composite or S-video connector. Make sure the connector is properly oriented and do not force the connector into place.

The camera input must be configured later in the VED setup screen. Please refer to Chapter 11: Setup for details regarding video setup.

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 11: Setup for screen descriptions.

Repackaging for shipment

Repackage the QC-300 in the original packaging as received from the factory, or equivalent. It is not necessary to ship the base when shipping the QC-300 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-300 instrument

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

3 Place the QC-300 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.

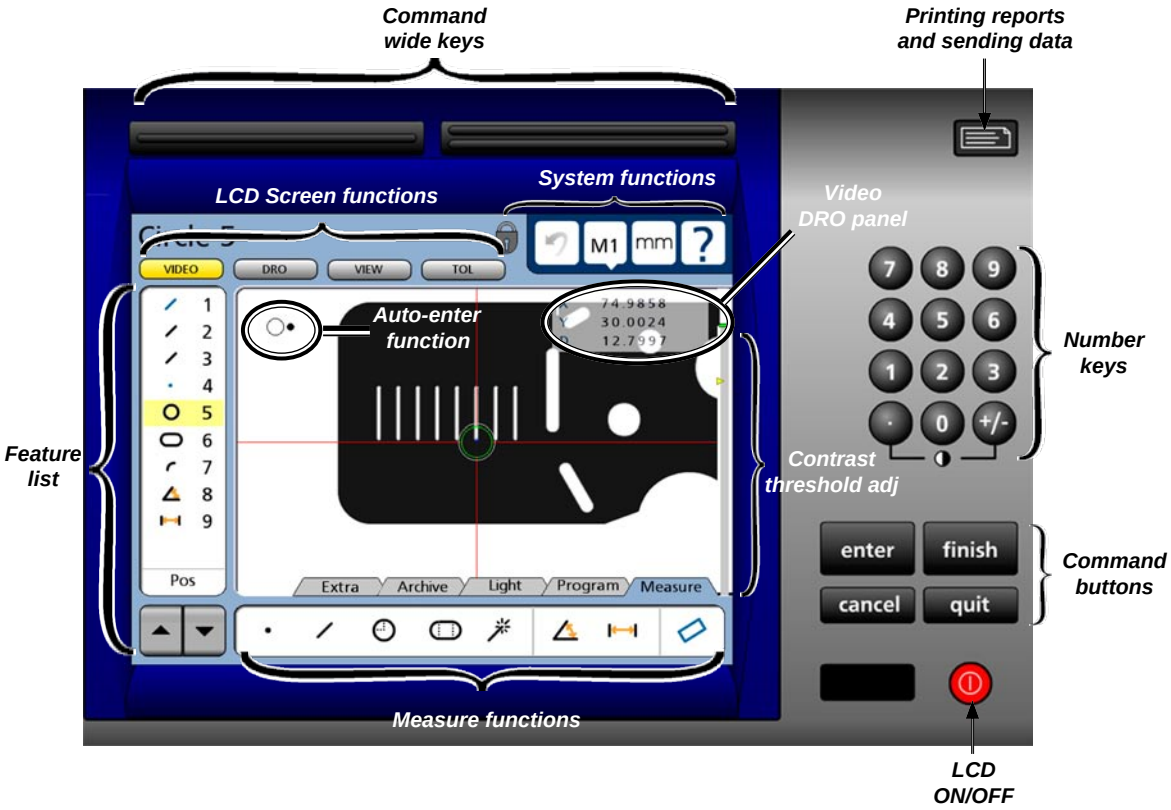
What’s next?

Proceed to Chapter 11: Setup to configure your QC-300 for use. Follow the instructions for *Essential Setup* as a minimum.

Chapter 3:
User Interface

The QC-300 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.

- Measurement functions
- Command buttons and wide keys
- Feature list
- LCD Screen functions
- Auto-enter function
- DRO screen functions
- Contrast threshold adjustment
- Number keys
- System functions
- Printing reports and sending data
- LCD ON/OFF or delete features



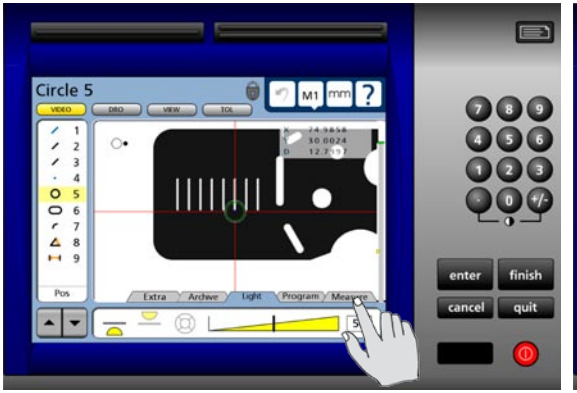
Measurement functions

The measurement functions are divided into as many as four tabbed areas:

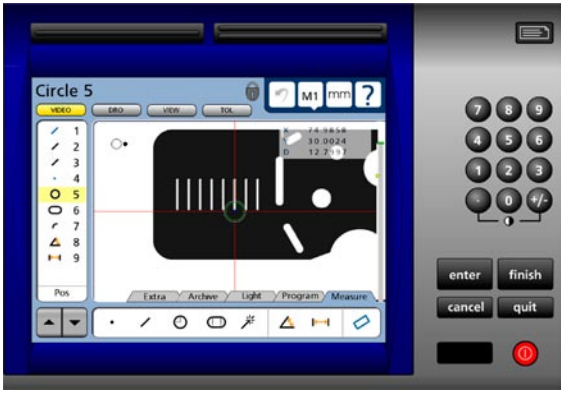
- Measure — Select a measurement type, such as circle or line
- Program — Record, edit or play back a program of measurement steps
- Light — Adjust lighting for measurements on video systems
- Archive — Store JPEG stills of video images (optional on VED systems)

Selecting a measurement type

Measurement types are selected from the Measure tab. Touch the Measure tab to display icons for the different measure types.

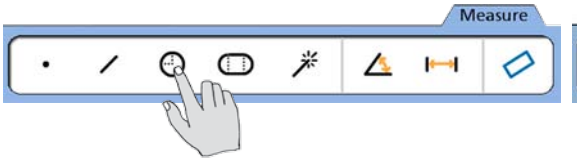


Touch the Measure tab...

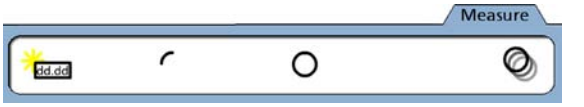


to display measure types

Touch a measure icon to select the desired measure type. In some cases, such as when selecting circles and slots, related measure 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...



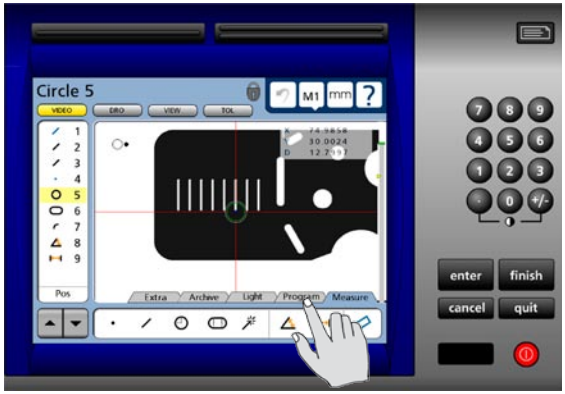
also provides access to the arc measure type

NOTE

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

Accessing programming functions

Programming functions are accessed from the Program tab. Touch the Program tab to display a list of programs and programming tools.



Touch the Program tab...

to display a list of programs and programming tools

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

Programming tools shown before recording

- Run a program
- Record a program
- Open edit mode
- Copy a program

Programming tools shown during recording

- Run a program
- Stop recording
- Open edit mode
- Include user message
- Goto here: Used to define locations for CNC program safe moves

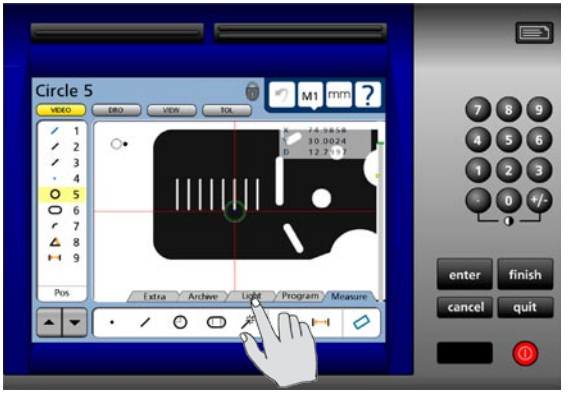
NOTES

Details regarding programming and the use of programming tools are provided in Chapter 8: Programming.

Additional CNC functions that can be included in programs are contained in the Extra tab shown later in this chapter and described in Chapter 11: Setup, in the Display screen section.

Accessing part lighting adjustment tools

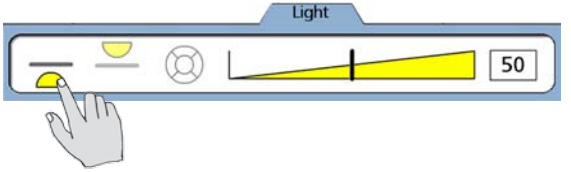
Lighting adjustment tools are accessed from the Light tab. Touch the Light tab to display the lighting adjustment tools.



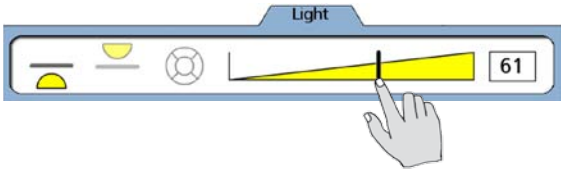
Touch the Light tab...

to display light adjustment tools

Touch an icon to select the desired light adjustment. Systems can be ordered with adjustments for back-lights, surface lights and camera ring lights. Each area of lighting is adjusted by a slider that brightens or attenuates the light intensity of the selected area from 0 to 100 % in steps of 1 %.

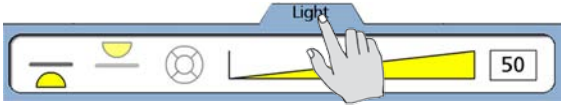


Touch the Light area icon...

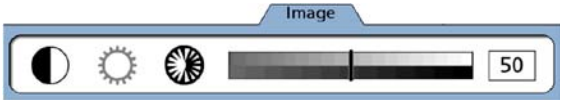


and adjust the light intensity slider

The system can be configured in the VED setup screen to include Image controls in addition to the light adjustments. Touch the Light/Image control tab repeatedly to toggle between the light and image controls.



Touch the Light tab...



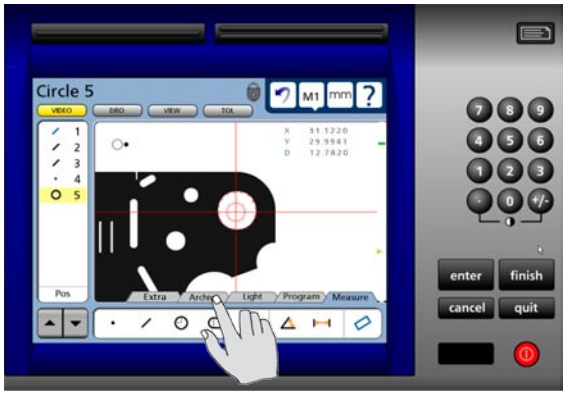
to display Image controls

NOTE

Details regarding the use of light adjustment and image control tools are provided in Chapter 6: Measuring.

Storing JPEG stills of video images

Video archiving is available as an option on systems that include video edge detection. Touch the Archive tab to display the video archiving tools.

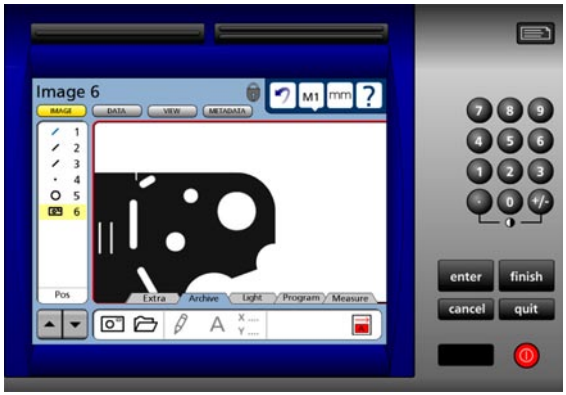


Touch the Archive tab...

to display video archiving tools

Snapshots of video images are captured as JPEG stills and then can be edited to include text, geometric shapes and file metadata.

Touch the Camera icon...



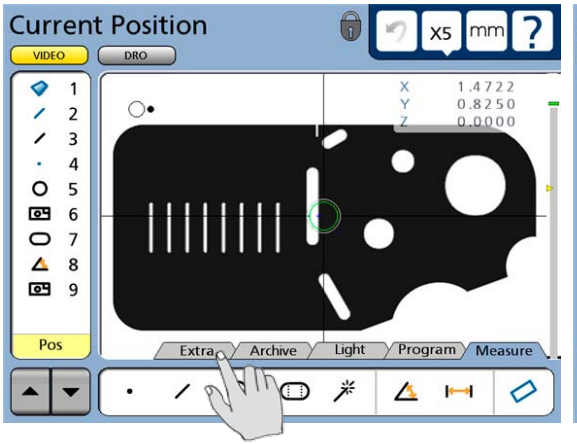
to capture a JPG snapshot of the video image

Selecting a captured image in the feature list causes additional icons to be displayed in support of text and graphic editing functions.

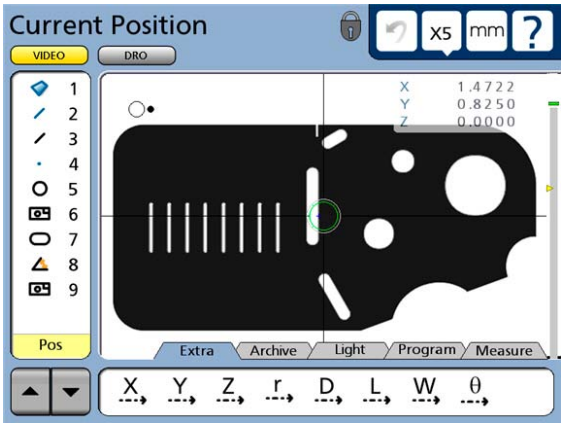
NOTE
Details regarding the image archiving and editing functions are provided in Chapter 9: Image Archiving.

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 serial port. Touch the Extra tab to display the data choices.



Touch the Extra tab...

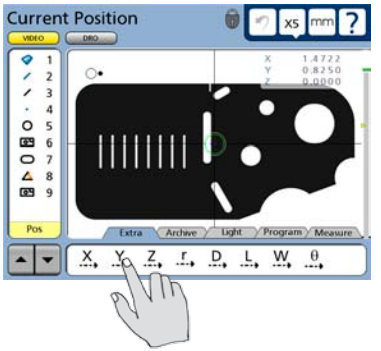


to display the data choice icons

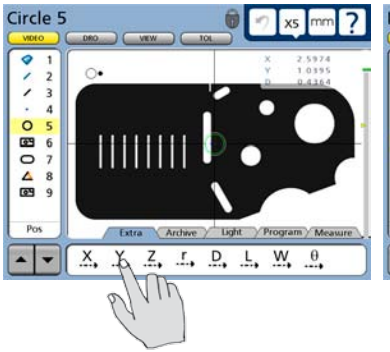
NOTE
The Extra tab is configured in the Display setup screen. Please refer to <u>Chapter 11: Setup</u> for details.

The data sent to the serial port always corresponds to the information displayed in the Video or DRO screens. The information types are shown in the upper-right corner of the screen and are:

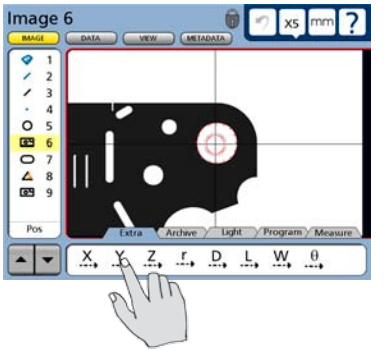
- Current position (no feature selected)
- Archived image (image file selected)
- Feature measurement (feature selected)



Send current position data...



send feature measurement data...



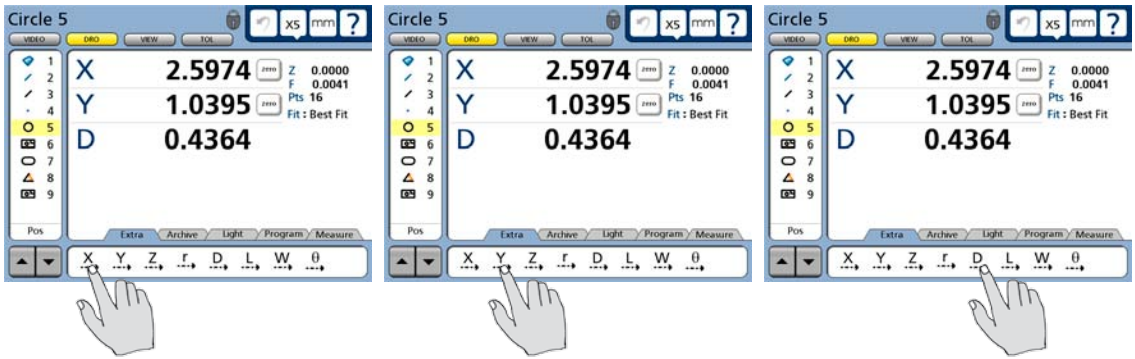
or send archived image data

NOTES

Archived image data only includes the X, Y or Z position of the image.

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 angle icon when a circle is selected produces no result.

The Extra tab is typically used to send abbreviated data to the serial port since complete reports or screens of data can be sent using the Print function described in Chapter 10: Setup for the Print screen settings. However, a complete data set can be sent for a feature by touching the required series of icons in succession.



The complete data set for the selected circle is sent to a computer by touching each data icon 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.

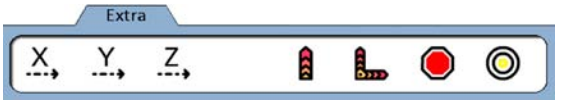
CNC and other Extra tab functions

Additional CNC functions for programming, motion control and Extra tab formatting functions can also be made available in the Extra tab as described in Chapter 11: Setup, in the Display screen section.

Extra tab functions

Space menu insert

The space insert are 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 are 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

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 serial port, USB printer or USB drive as a file. 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.

Laser pointer ON/OFF

The laser pointer ON/OFF function is included in the Extra tab to toggle the laser pointer on or off. When the user touches the laser pointer ON/OFF function, the laser is toggled on or off.

Joystick motor speed

The Joystick motor speed function is included in the Extra tab of systems with the CNC option to adjust the joystick control of motor speed. When the user touches the Joystick motor speed function, the joystick control of motor speed is toggled between fast and slow.

Fast ***Slow***

Axis lock

The Axis lock function is included in the Extra tab of systems with the CNC option to restrict stage motion to only one axis. When axis lock is on, motion is permitted only along one axis; diagonal motion is not permitted. When the user touches the Axis lock function, axis lock is toggled on or off.

Axis lock on ***Axis lock off***

Part following

The Part following function is included in the Extra tab of systems with the CNC option. Part following changes the motion reference from the machine coordinate system to the part coordinate system after a part skew has been performed. For example, if a skew is performed along the part's X-axis, when part following is enabled, subsequent X-axis motion will follow the part skew, not the machine coordinate's X-axis. When the user touches the Part following function, part following is toggled on or off.

Part following on

Part following off

Stop motion

The Stop motion function is included in the Extra tab of systems with the CNC option to stop all stage motion. When the user touches the Stop motion function, motion is toggled on or off.

Motion stopped

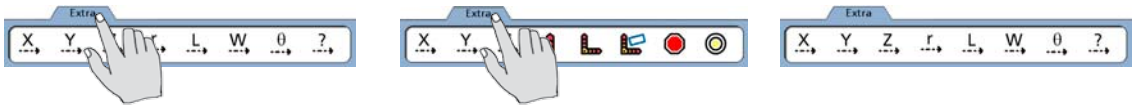
Motion enabled

Goto feature

The Goto feature function is included in the Extra tab of systems with the CNC option. When the user touches the Goto function, the stage is moved to position the probe over the feature currently selected in the feature list.

Multiple Extra tabs

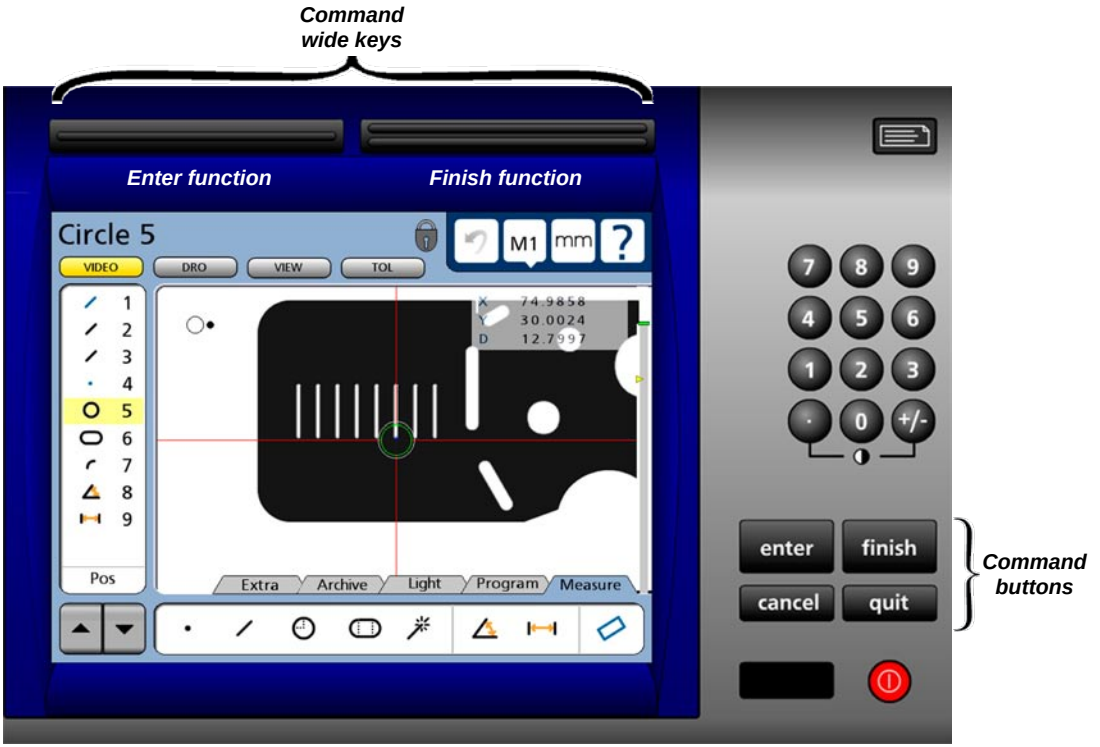
Multiple Extra tabs might be necessary to display all the Extra tab functions available. Touch the Extra tab repeatedly to access multiple tabs.



Touch the Extra tab repeatedly to cycle through available tabs

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.



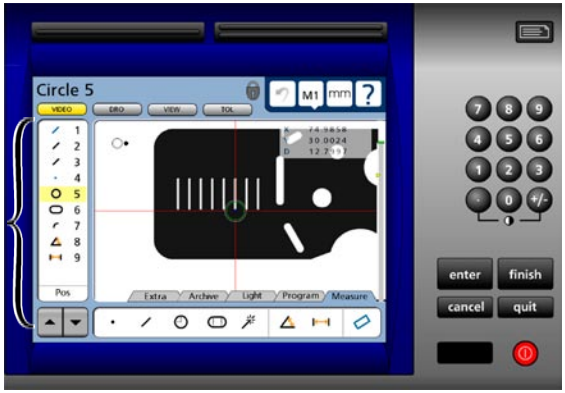
- Enter — Enters a point (or points) into a measurement, or enters a value into a measurement data field, tolerance data field, communication data field or a setup data field
- Finish — Completes a measurement, tolerancing or setup session
- Cancel — Removes the last point from a measurement, deletes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

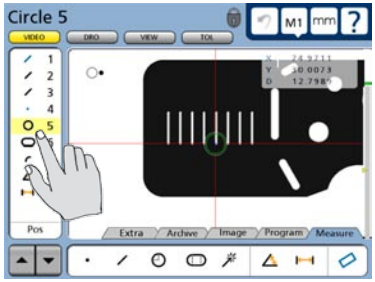
Feature list

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

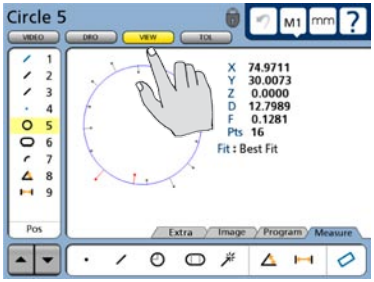
When the feature list contains too many entries to be displayed simultaneously, the arrow keys at the bottom of the list are used to scroll up or down to display all the entries.



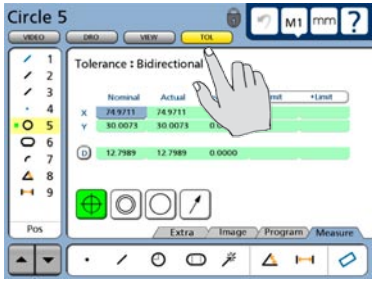
Feature list



Selected measurements can be...

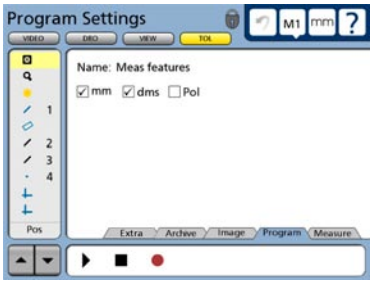


viewed...



or toleranced in other screens

When recording, playing or editing programs, the program steps are shown in the feature list.

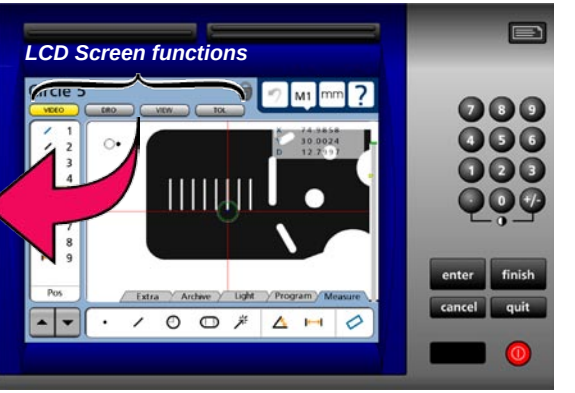


NOTE

Details regarding the use of the feature list are distributed throughout the remainder of this user guide.

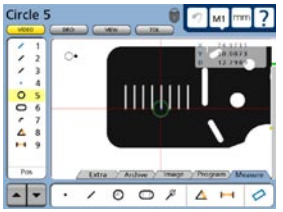
LCD Screen functions

The LCD screen functions are used to select the screen that will be presented on the color touch LCD, generally in support of the next operator activity

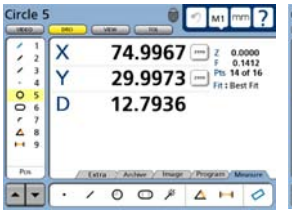


Touch a button to select the desired screen.

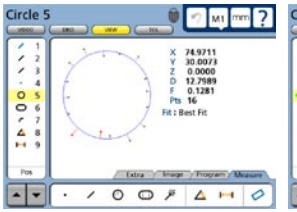
- Video Displays the camera's view
- DRO Displays the digital readout
- View Displays the selected feature's data cloud
- TOL Displays the tolerance screens for entering and editing tolerances



Video screen



DRO screen



View screen

Tol screen

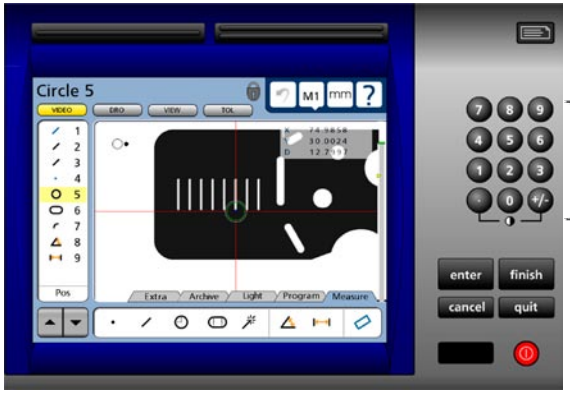
NOTE

Details regarding the use of the four basic screen types 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 back-spacing over them using the Cancel button.

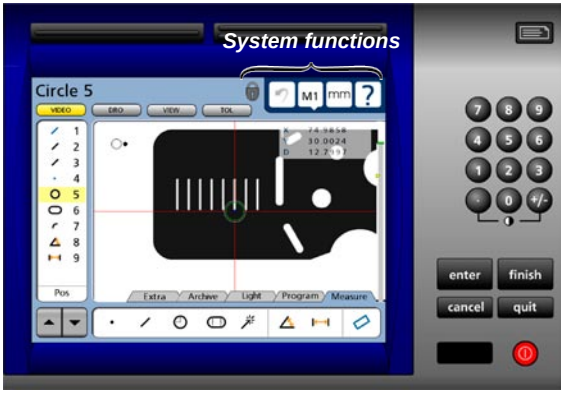


NOTE
Details regarding the use of number keys are distributed throughout the remainder of this user guide.

System functions

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

- Datum lock indication
- Undo
- Magnification (Mx)
- Unit of measure (mm/Inch)
- Setup



Datum lock indication

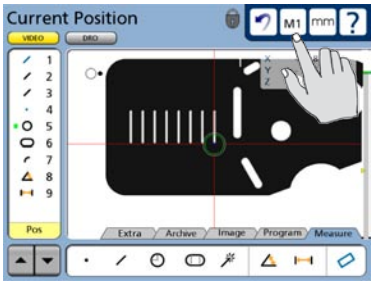
The lock icon indicates that features are locked to the datums used when they were measured. When the lock icon is not shown, new datums are applied to all features in the feature list as they are created.

Undo

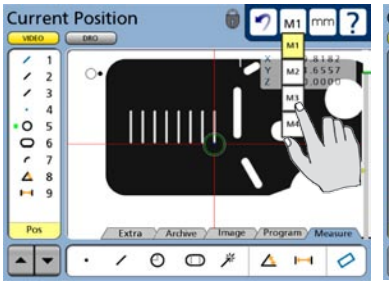
The Undo function is very similar to the Windows undo function and erases the last measurement or feature list activity step. The Undo function only erases the last step, sequences of steps cannot be erased using undo.

MX

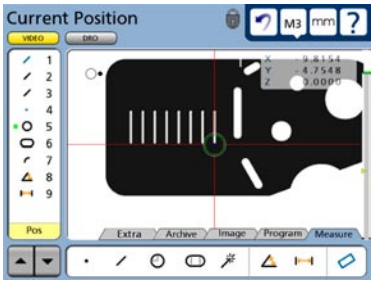
The MX (shown here as M1) function provides access to a drop down list of available video magnifications. Touching the MX button shows the list of available magnifications. Touch the desired magnification to select it.



Touch the M1 button...



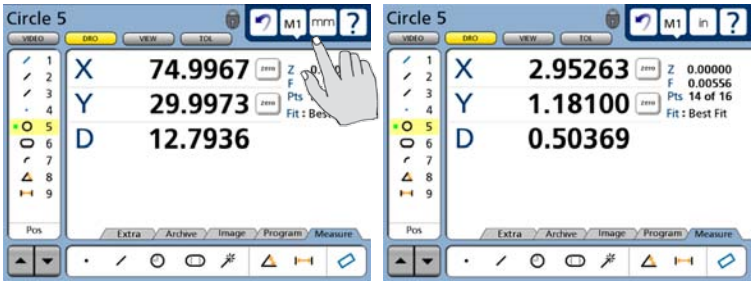
to select a video magnification...



from the drop-down list

mm/in

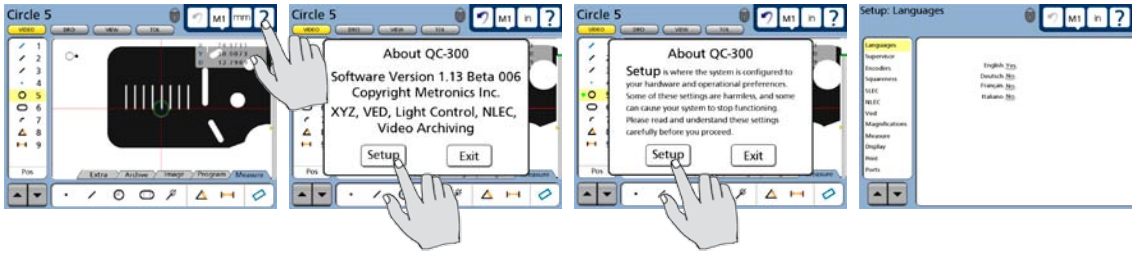
The mm/in function toggles the linear unit of measure between metric and English. Touch the mm/in button to toggle the units of measure.



Touch the mm/in button... to change the linear unit of measure

Setup

The setup function provides access to all of the system setup screens required for configuring QC-300 measurement and operation. Touch the setup button to display the setup screen and menu. 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.

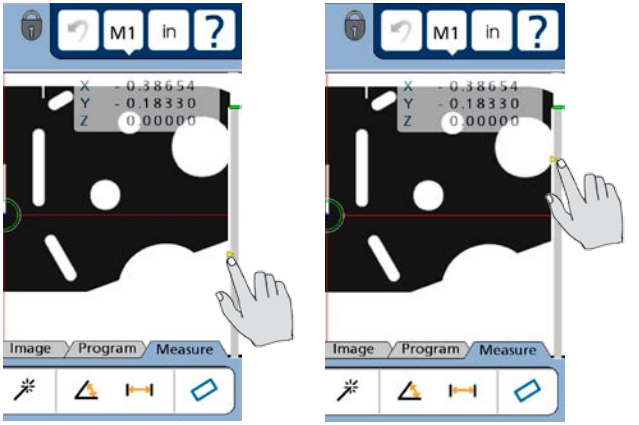


Setup screen tools will be made available to those who can provide a valid supervisor password.

NOTE
Detailed descriptions of all setup functions and tools are contained in Chapter 11: Setup.

Adjusting contrast threshold

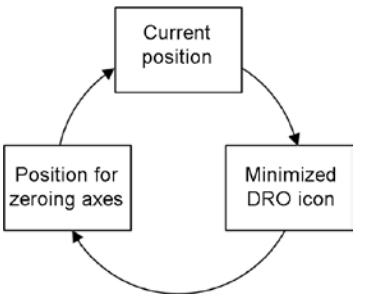
Screen contrast is a combination of the illumination difference between adjacent light and dark regions on the screen and the sharpness of the transition from light to dark. Perfect contrast could be loosely described as very light and very dark regions that meet at a very sharp transition. The contrast of an edge is shown by the height of the gray bar as the video probe moves across an edge. The contrast threshold required for edge recognition is shown by the yellow arrow and must fall within the gray bar. When the threshold adjustment is unlocked in the VED setup screen, the contrast threshold can be increased or decreased by raising or lowering the yellow arrow on a contrast bar.



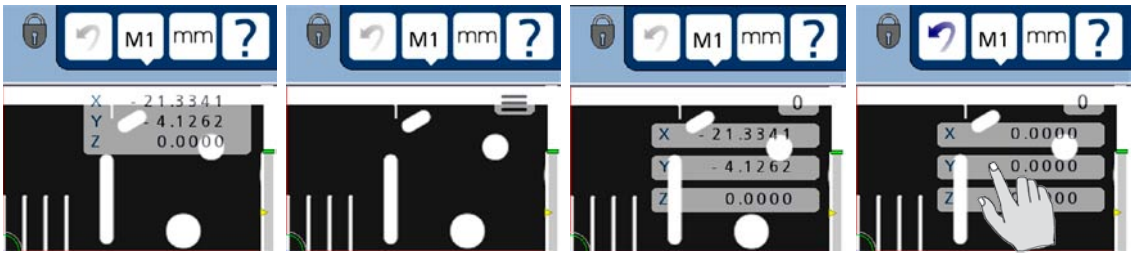
Adjust the contrast threshold by touching and sliding the yellow arrow

Video DRO panel

A small digital readout panel is shown in the upper-right corner of the video screens. Touching the panel cycles it to one of three possible display modes:



- Current position display
  The current position of each axis is shown numerically in the current unit of measure.
- Minimized DRO icon
  Icon indicating the availability and position off the DRO panel.
- Current positions for zeroing axes
  Touching an axis value zeros the axis and creates a new measurement datum.

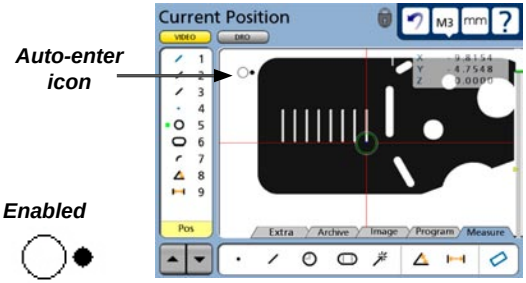


Current position ***Minimized DRO icon*** ***Current positions for...*** ***zeroing axis values***

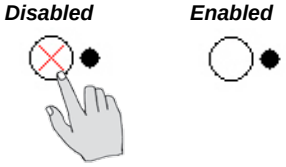
Auto-enter function

Feature data can be collected manually by positioning a probe over a part feature and pressing the Enter key, or collected automatically by enabling the auto-enter function. In crosshair systems, a single point is acquired each time the stage is moved to a new probing position. In video systems, automatic probing can acquire many points simultaneously to greatly increase productivity when edge boundaries are clear and distinct.

The auto-enter function is enabled or disabled by touching the auto-enter icon located in the upper-left corner of the video screen.



When the auto-enter function is enabled, points will be acquired automatically after the stage motion stops to position the probe over a feature or edge. Refer to the descriptions of crosshair and edge timeout delays in Chapter 5 Probes.



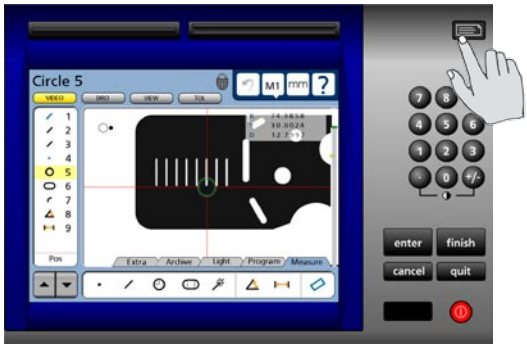
Enabling the auto-enter function

When the auto-enter function is enabled, the icon dot rotates clockwise around the icon and changes color to indicate the crosshair or edge timeout delay period prior to acquiring the point. This delay is restarted if the stage is moved an amount equal to or greater than the Motion Distance value specified in the Tool Options portion of the probe pop-up screen.

The Auto-enter icon dot rotates clockwise from 3:00 to 12:00 in the delay before a point is automatically probed

Printing reports and sending data

Measurement data shown on the DRO screen or contained in the feature list can be printed in reports on 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 11: Setup. Printing and data transmission are described in Chapter 10: Communication.

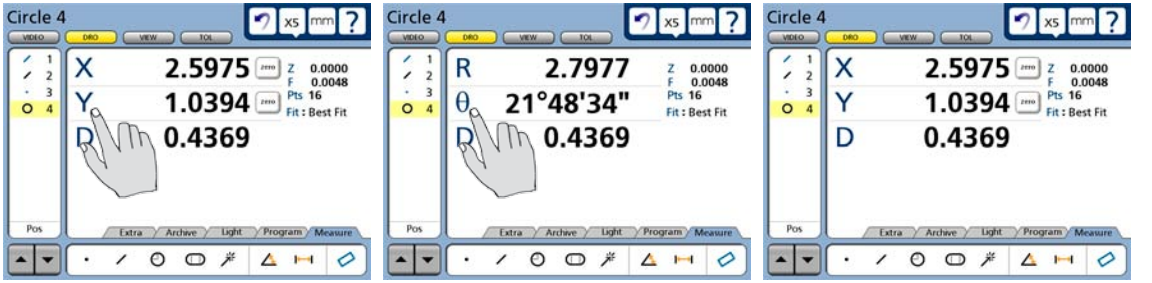
DRO screen functions

Touching certain items displayed on the DRO screen allows the user to:

- Toggle between cartesian and polar coordinate systems
- Toggle between diameter and radius displays
- Select fit algorithms

Toggling between cartesian and polar coordinate systems

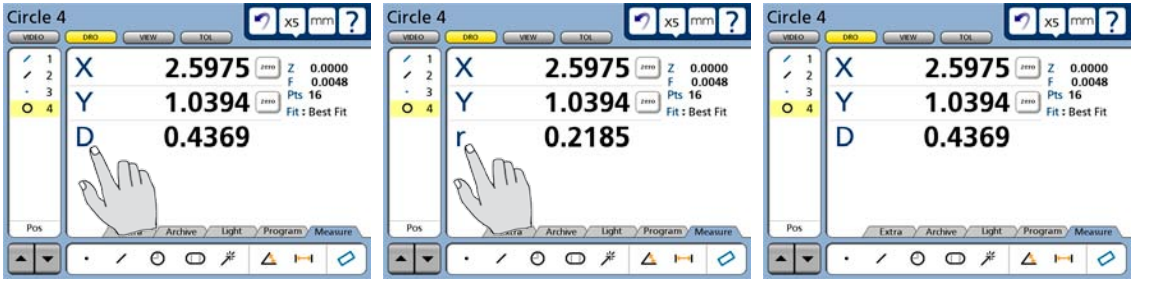
Touch one of the X, Y or the R, θ coordinate designation characters to toggle between coordinate systems.



Touch a coordinate designation character to toggle between cartesian and polar coordinates

Toggling between diameter and radius displays

Touch the D or R designation characters to toggle between diameter and radius.

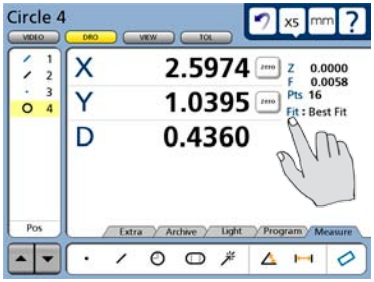


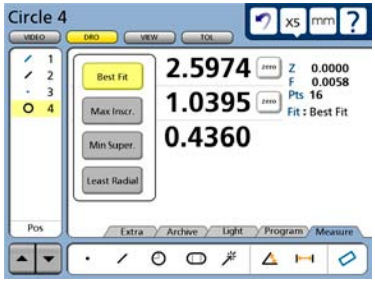
Touch the D or R designation character to toggle between diameter and radius displays

Selecting a fit algorithm

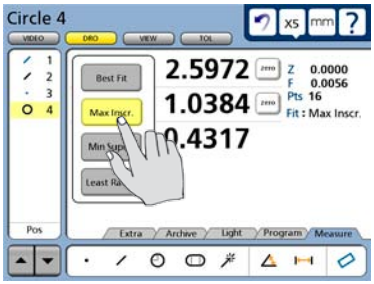
To change the fit algorithm used to determine form errors for the selected feature:

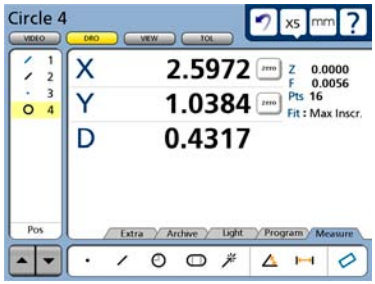
1 Touch the Fit designation on the right side of the screen to display the fit algorithm choices for the displayed feature.





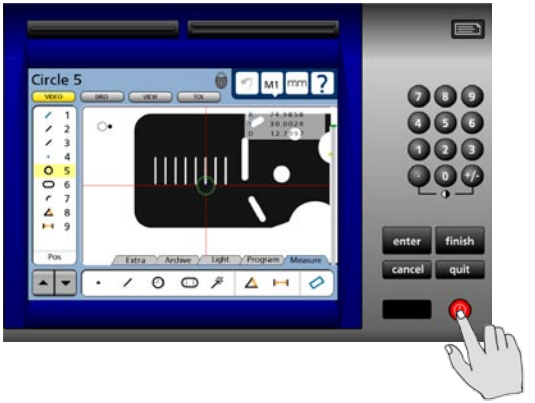
2 Touch the button icon that corresponds to the desired fit algorithm. The new fit algorithm will be applied.



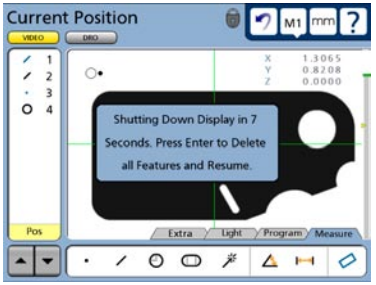


LCD ON/OFF and deleting feature data

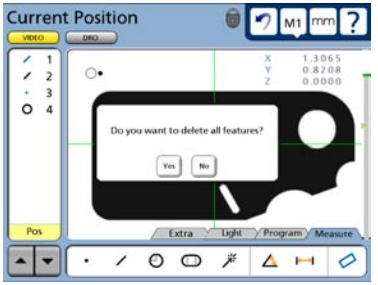
The LCD screen can be turned off without cycling power when the QC-300 will not be used for an extended period, but it is desirable to retain the original machine zero encoder references. Press the red LCD ON/OFF button to toggle the LCD on and off.



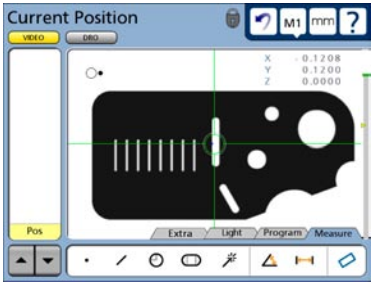
When the LCD ON/OFF button is pressed, the operator is given an opportunity to erase all feature measurement data and resume operation without turning the LCD off. If the operator presses the Enter key to delete feature data, the system will ask for confirmation. If confirmation is given, the feature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



You will be asked to press Enter...



and asked to confirm the delete...



then the feature data will be deleted

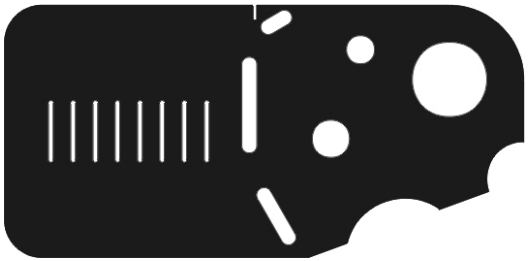
CAUTION

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.

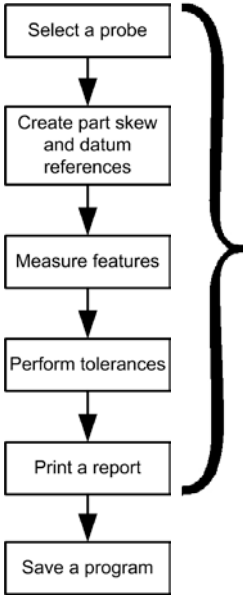
Chapter 4:
Quick Start Demonstration

This chapter demonstrates the operation of the QC-300 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 QC Quickie slide to create a part skew and datum, measure some part features, apply a few tolerances, print a tolerance report and save all these activities as a program that can be recalled and run again later.



The QC Quickie slide is shipped with each system



Summary of the Quick Start Demonstration

When the program is run on manual or CNC systems, the series of required points will be indicated by a green arrow that moves over the part outline in the Part View or Video window. For manual systems, the user need only probe locations indicated by the arrow to complete measurements. For CNC systems, the measurements are performed automatically.

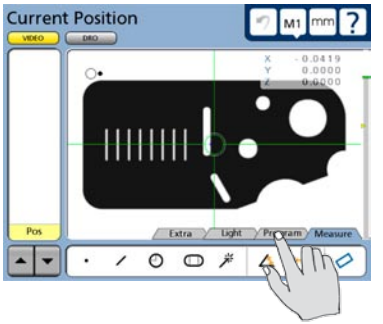
The demonstration will show measurements being performed on a video stage using a video edge detection probe. However, the same measurements could also be performed on a microscope or comparator using crosshairs.

Detailed information regarding datuming and measuring is contained in Chapter 6: Measuring. Information regarding tolerancing is contained in Chapter 7: Tolerancing. Report printing is discussed in Chapter 10: Communication. Information regarding programming is contained in Chapter 8: Programming.

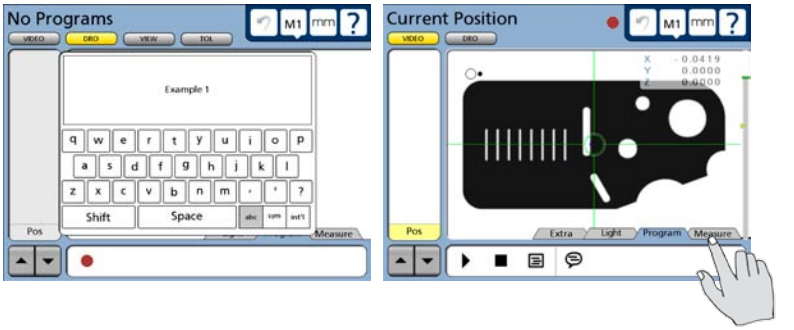
Starting program recording

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.



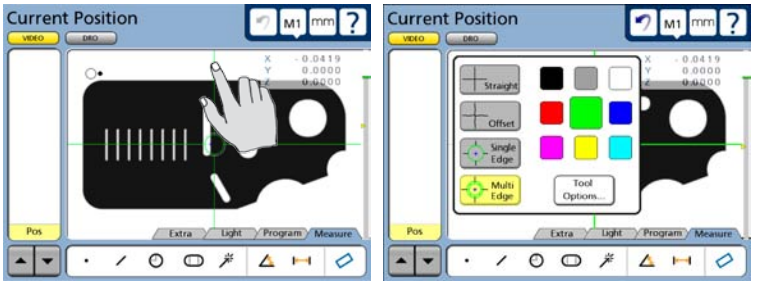
2 Enter a program title and press the Finish key. The DRO or Video screen will be displayed. Touch the Measure tab to begin measurements.



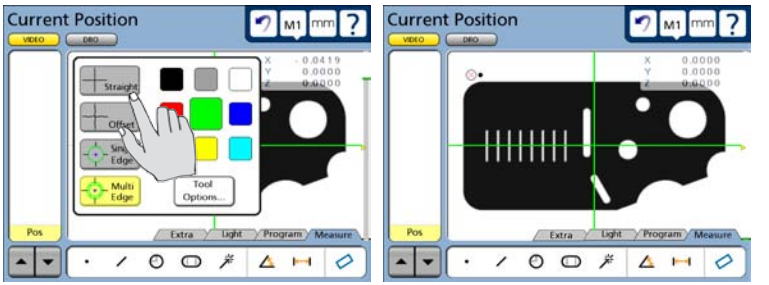
Selecting a probe

To select a new probe:

1 Select a new probe type by touching any part of the current probe on the Video window. The four probe choices will be shown on the probe pop-up screen.



2 Touch the desired probe type button. The probe pop-up screen will close and the new probe will be displayed. In this example the straight crosshair probe is selected.



NOTE

More information regarding preparing and using probes is contained in <u>Chapter 5: Probes</u>.

Creating part skew and datum references

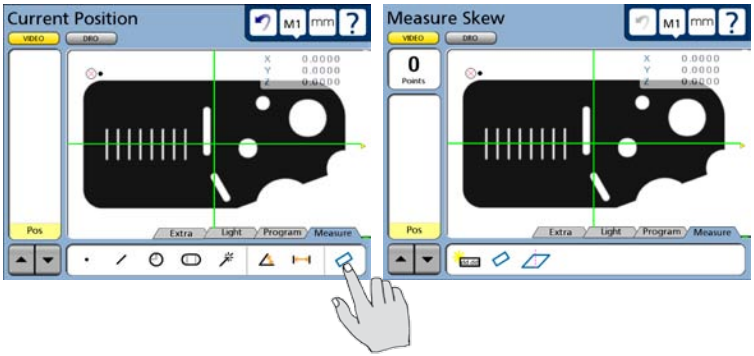
When the part is misaligned (twisted) in the X-Y plane, errors can be generated during the measurement process. These errors can be eliminated by creating a skew alignment for the part.

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.

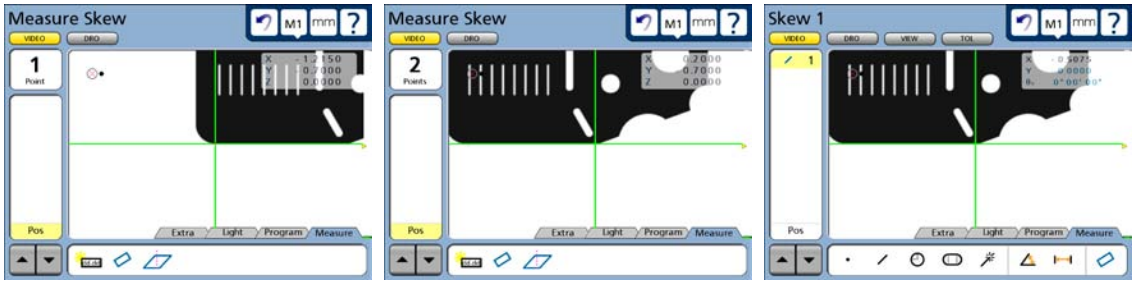
Creating a part skew

To skew the part:

1 Touch the Skew/Level Measure icon.



2 Perform the skew alignment by probing 2 or more points well distributed along the entire length of the desired part reference edge. Press the Enter key to enter each point. Press the Finish key to complete the Skew measurement. The skew line feature will be added to the Features list in blue.



Creating a datum zero point

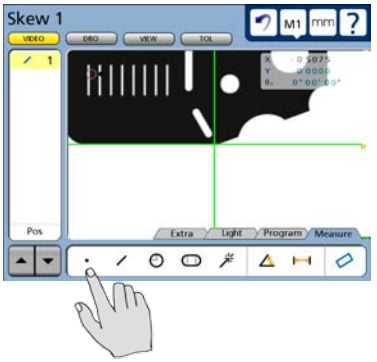
Creating the datum zero point is the final step in establishing a valid Cartesian or polar coordinate system for subsequent measurements. The datum zero point will be used as the origin of Cartesian or polar systems. The datum zero point can be positioned in any location that satisfies the measurement requirements of the user and can be created by probing a point or by constructing a point from parent features.

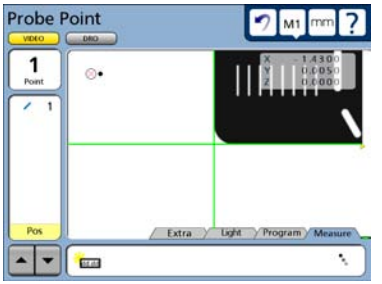
Probing a datum zero point

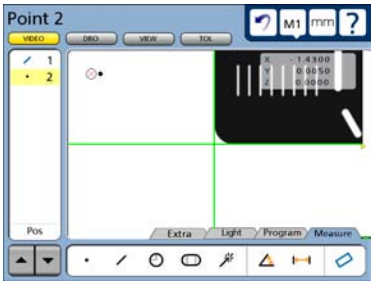
The datum zero point can sometimes be created directly by probing a point. Simple probing is more often possible when the part is precisely aligned in the stage.

To probe a datum zero point:

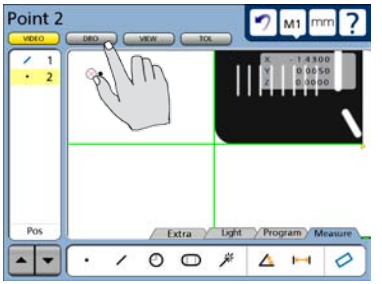
1 Touch the Point Measure icon. Probe the desired point for the datum zero, and then press the Finish key. In this example, the lower left corner of the QC Quickie slide was probed. The point will be added to the Features list in blue.

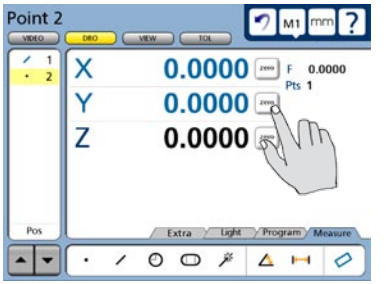






2 Select the DRO window, and while the point feature is selected touch the X and Y axis Zero buttons to zero the values and establish a datum zero at the probed point.





Constructing a datum zero point

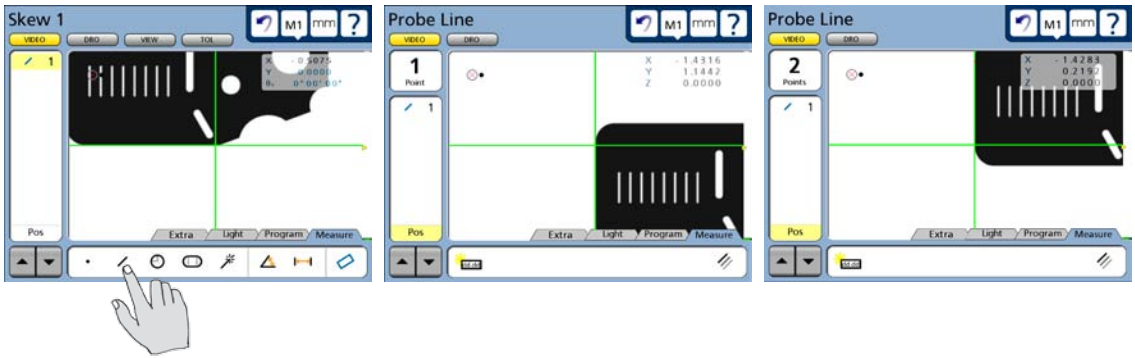
The datum zero point can be constructed from parent features when simply probing the desired point is not desirable.

It would not be possible to provide a single description of this process for all measurement applications that require feature constructions. However, the concept illustrated by the following example and the construction techniques described later in Chapter 6: Measuring can be used to construct a datum zero point for any measurement application.

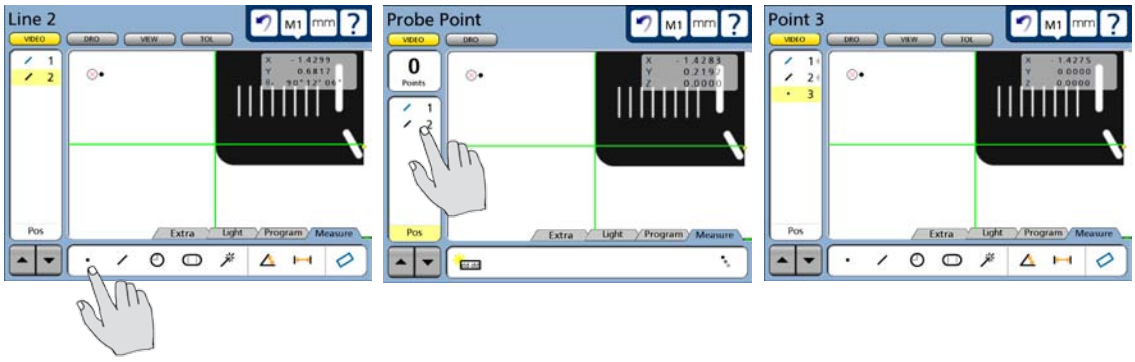
In this example, after the part skew is performed, and then a datum zero point is created at the intersection of the X-axis along the bottom of the part (skew axis), and the Y-axis along the left side of the part.

To construct the datum zero point:

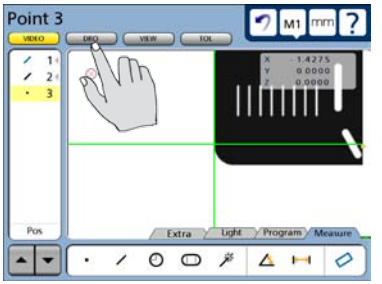
1 Touch the Measure Line icon. Probe two or more points well distributed along the left side of the part, and then press the Finish button. The line feature will be added to the Features list.

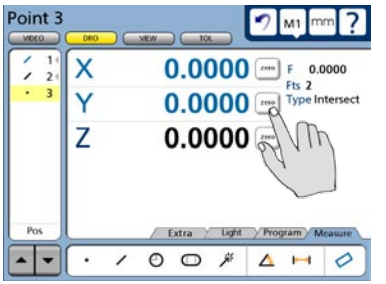


3 Touch the Measure Point icon, touch the skew line, touch the line probed on the left side of the part and then press the Enter key. A point constructed at the intersection of the two lines will be added to the Features list.



4 Select the DRO window, and while the point feature is selected touch the X and Y axis Zero buttons to zero the values and establish a datum zero at the probed point.





NOTE

More information regarding creating datums and constructions is contained in <u>Chapter 6: Measuring</u>.

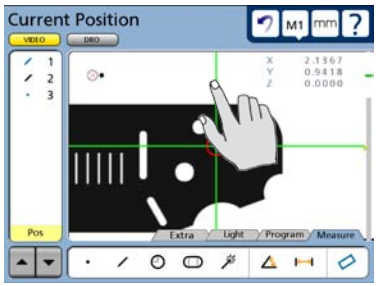
Measuring features

In this example, the largest of the three holes of the QC Quickie slide will be measured twice illustrating the use of two different probes. First the straight crosshair probe will be used, then the multiple edge probe will be used.

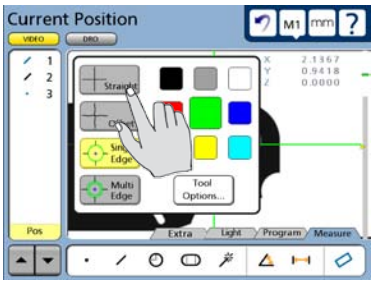
Measuring a circle with crosshairs

To measure using crosshairs:

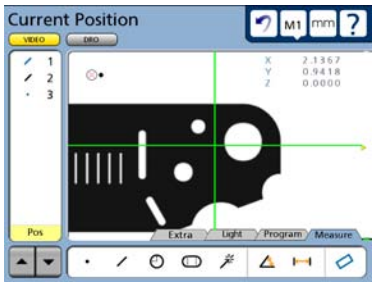
1 Select the straight crosshair probe.



Touch any part of a probe...

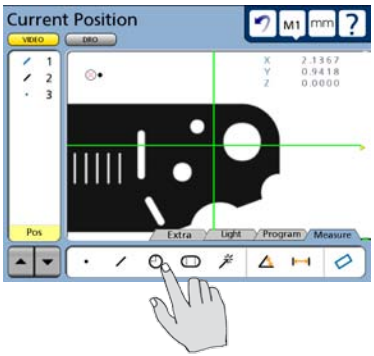


to display the probe tools...

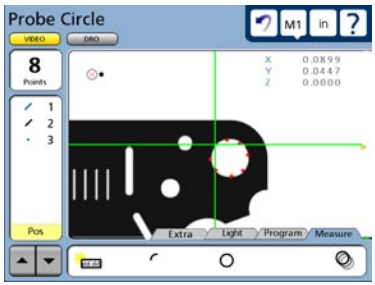


and select a new probe

2 Touch the measure circle icon and probe a minimum of three points evenly distributed around the perimeter of the circle. Eight points were probed in this example.

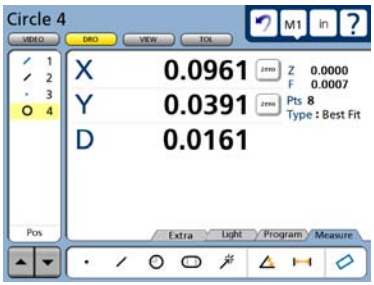


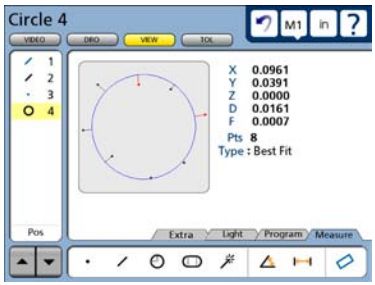
Select the circle measurement...



probe points around the circle and press Finish to complete

3 Press the Finish key to complete the feature measurement and store the feature in the feature list. The feature and probed points can be reviewed in detail by touching the DRO or View button if desired.

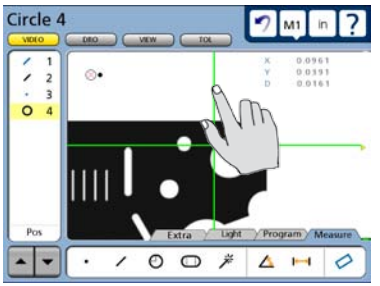




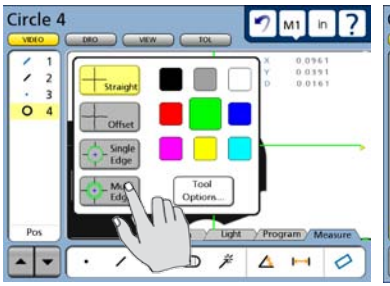
Measuring a circle with the multiple edge probe

To measure using the multiple edge probe:

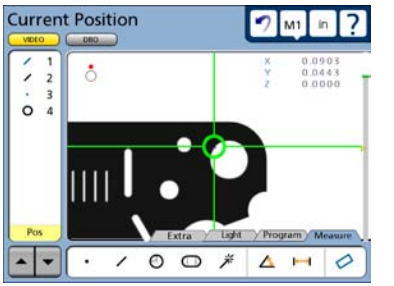
1 Select the multiple edge probe.



Touch any part of a probe...

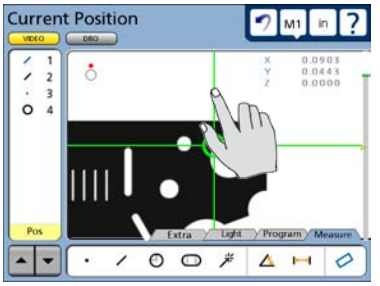


to display the probe tools...

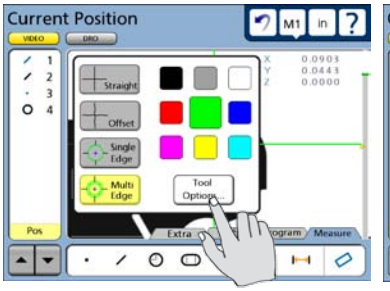


and select the multi edge probe

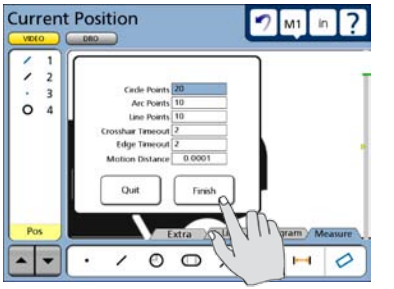
2 Touch the probe again to display the probe tools screen, and then touch the Tool Options button to display probing parameters, set the number of circle points to 20 (or any number between 3 and 99), and touch the Finish button.



Touch any part of a probe...

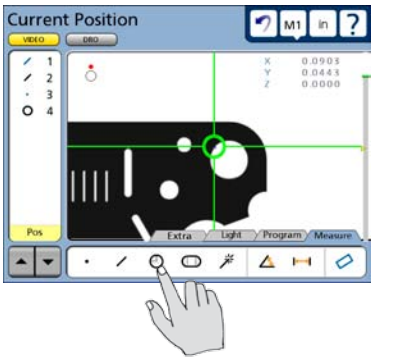


then touch Tools Options ...

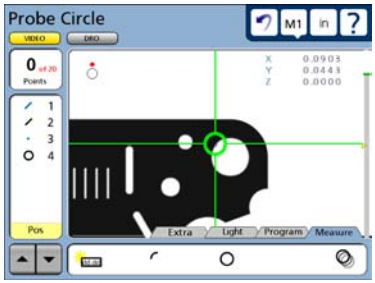


and set the number of circle points

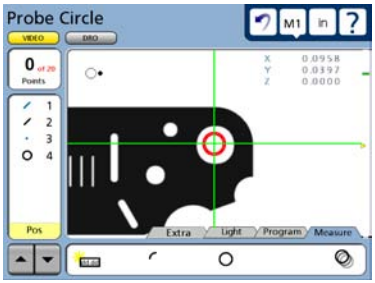
3 Touch the probe circle icon to begin the measurement.



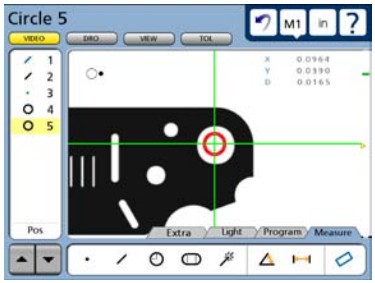
4 Move the stage to position the multiple edge tool into the center of the large circle in the QC Quickie slide and press the Enter key. The measurement will be completed and the circle data will be stored in the feature list.



Move the stage to position...

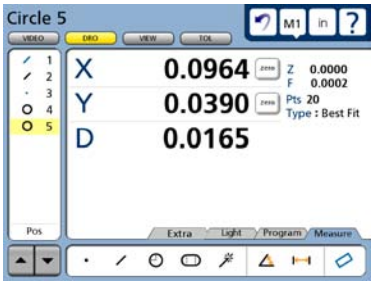


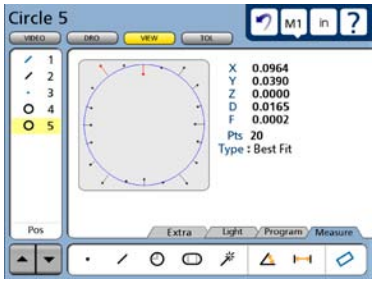
the probe inside the circle...



and press Enter to complete

The feature and probed points can be reviewed in detail by touching the DRO or View button if desired.





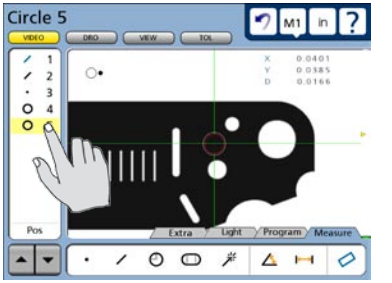
NOTE
More information regarding the use of the multiple edge probe is contained in Chapter 5: Probes. More information regarding performing measurements is contained in Chapter 6: Measuring.

Applying tolerances to feature measurements

In this example, a true position tolerance will be applied to at the last circle measurement. To apply a tolerance:

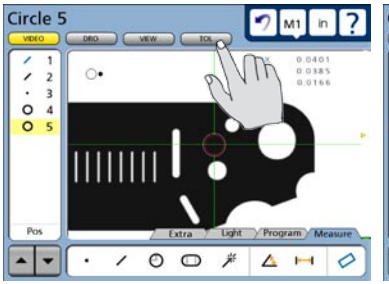
Select the feature

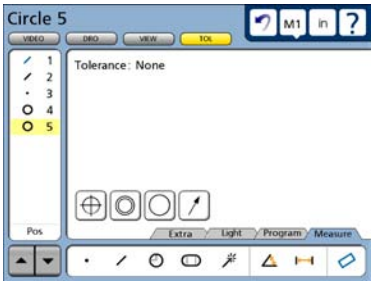
Touch the circle feature in the feature list to select it.



Display the tolerance screen

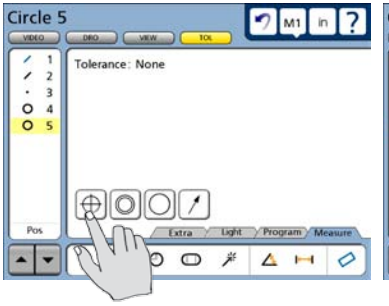
Touch the Tol screen button to display the tolerance screen.

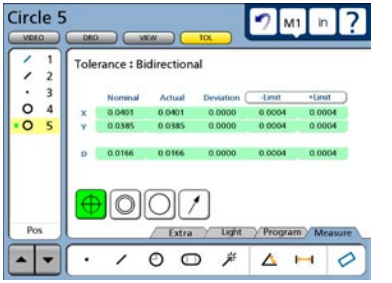




Select a tolerance type

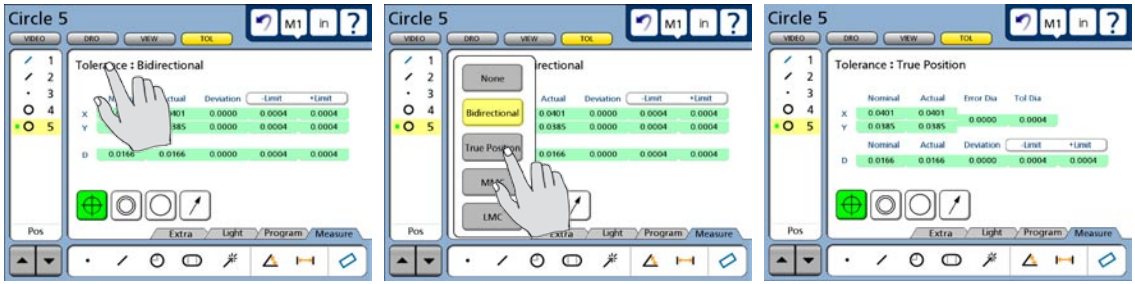
Touch the desired tolerance type button to select a tolerance type. In this example, the position tolerance type is selected.





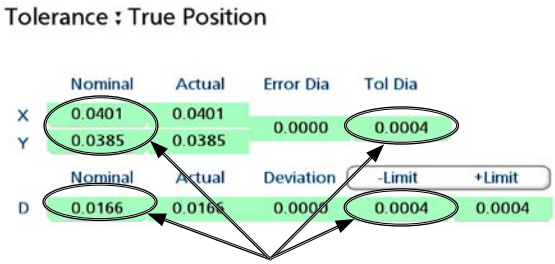
Select a specific tolerance

Touch the Tolerance menu title and then select the specific tolerance from the drop-down menu. The true position tolerance is selected in this example.

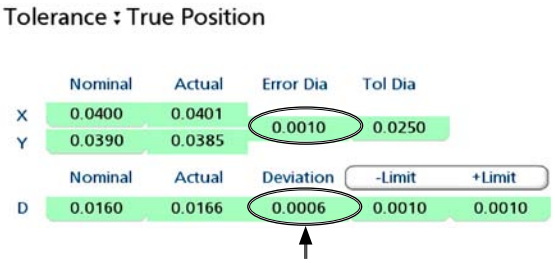


Enter nominal, limit or tolerance values

In this example, the Nominal and Tol Dia (Tolerance diameter around the nominal position) values are entered by touching the desired data field and entering a new value using the number keys. Error and Deviation values are generated as soon as the Nominal and Tol Dia values are entered.

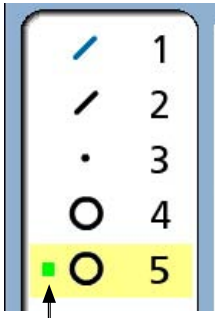


The Nominal, limit and Tol Dia values are entered...



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 mark next to the feature in the feature list. A green mark will be displayed in the feature list when all tolerance tests pass.



Pass indication is a green square

NOTE
More information regarding tolerances is contained in Chapter 7: Tolerancing.

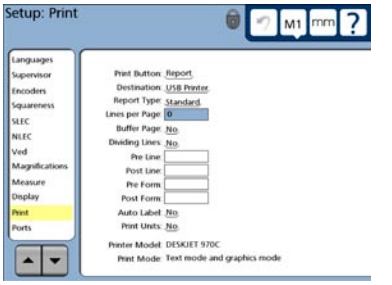
Printing a report

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

1 Verify that the QC-300 is attached to a USB printer as described in Chapter 10: Communication.

2 Verify that the report content and printer formatting are specified correctly in the Print setup screen described in Chapter 10: Communication and Chapter 11: Setup.

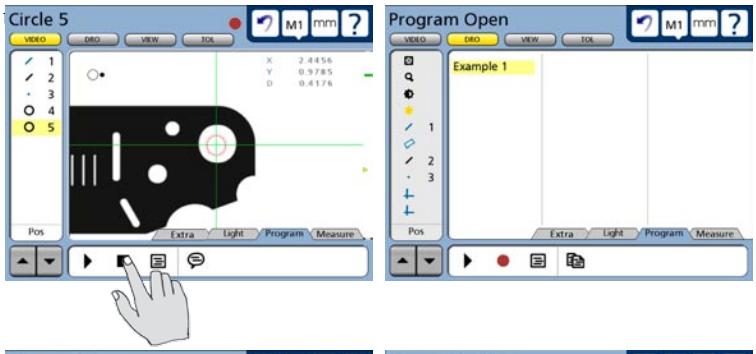
3 Press the Print key while displaying the Current Position in the Video or DRO screen.



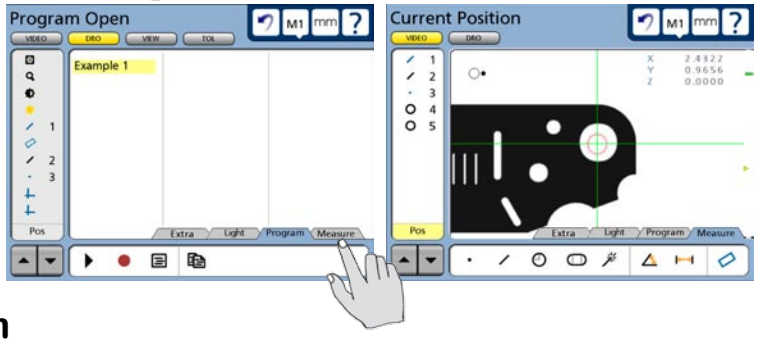
NOTE
More information regarding reports of feature measurement data and QC-300 system settings are contained in Chapter 10: Communication.

Stopping the program recording

Touch the Program tab to display touch the Stop icon to stop recording the program. The program title will be shown and program steps will be displayed in the feature list.

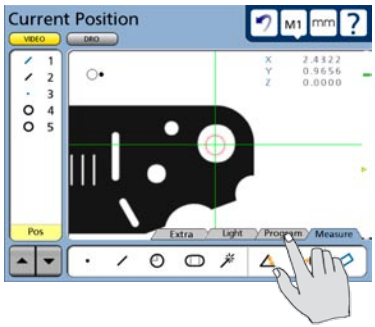


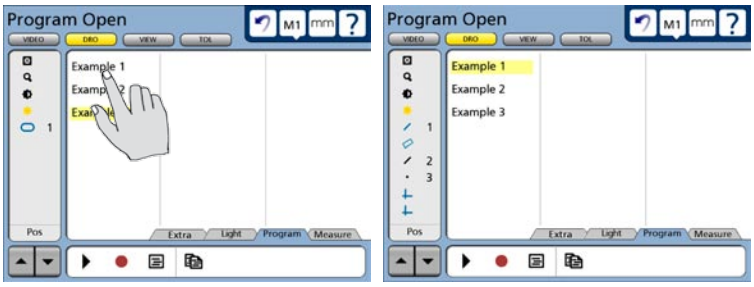
The program is now saved and can be edited or run on new parts. Touch the Measure tab to leave the record mode and return to the measure mode of operation.



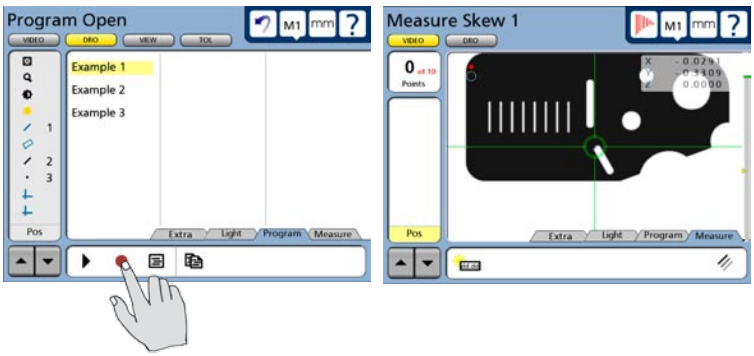
Running the program

To run a program, Touch the Program tab to display the program screen and then touch a program title to select the desired program.





Touch the Run icon to run the selected program.



Chapter 5: Probes

Measurements are conducted using manual crosshairs, video crosshairs or video edge detection on manual and CNC systems. Part features can be probed manually by the user or automatically under program control.

Video probe setup and calibration is described in Chapter 11: Setup. The measurement, construction and creation of features is explained in Chapter 6: Measuring.

Preparing to use video probes

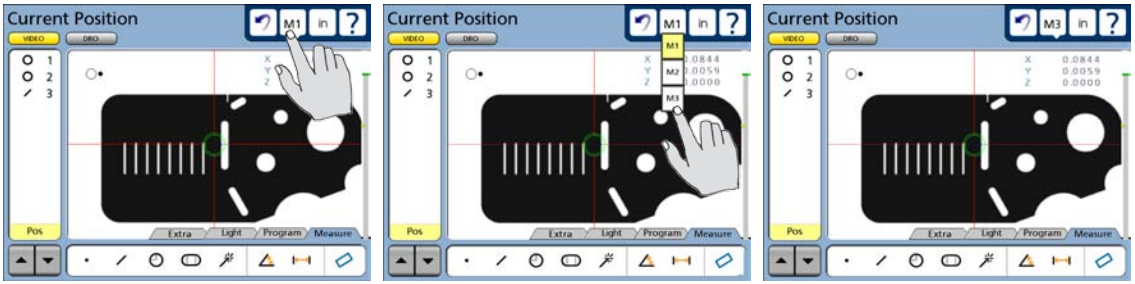
The accuracy and repeatability of video probing depends on the condition of the system, the condition of the part, video magnification, part lighting and optical focus.

System and part condition

The system is presumed to be well-maintained which implies a clean stage and optical system, free of scratches and other damage. The part to be measured is also presumed to be clean and undamaged.

Selecting video magnification

Select a different video magnification by adjusting the camera optics, touching the magnification button and then touching the desired magnification in the drop-down menu. The magnifications that appear in the drop-down menu are added and calibrated in the Magnifications setup screen by supervisors, distributors and OEMs.



Adjusting light control

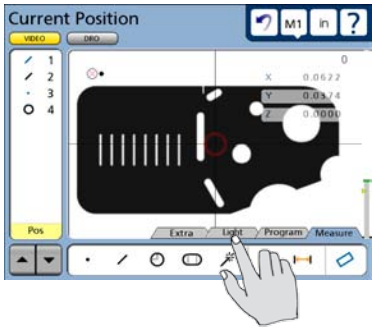
The video back light, surface light and ring lights are adjusted to optimize part illumination by selecting the desired light sources and operating the light slider controls. Light sources can be different in each system and can include:

- Back light — Single light source directly under the part that provides back lighting
- Top light — Single light source directly over the part that provides surface lighting, sometimes through the lens
- Ring lights — Four light sources are enabled or disabled individually and distributed in a ring around the camera axis. The light intensities of all enabled ring lights are controlled simultaneously as a single group. The ring lighting is often provided by one source.

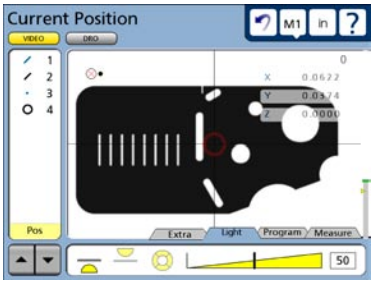
To adjust the light sources:

1 Touch the Light/Image tab at the bottom of the screen repeatedly to display the Light controls.

When the Light tab is shown in the background...

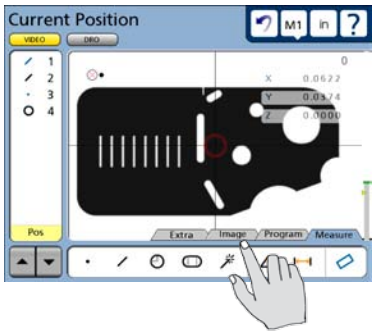


Touch the Light tab...

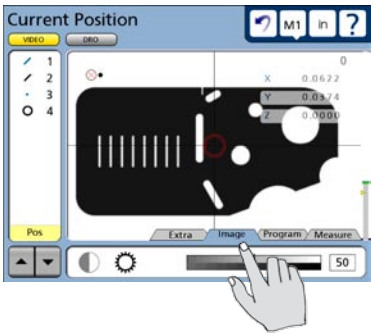


to display the light controls

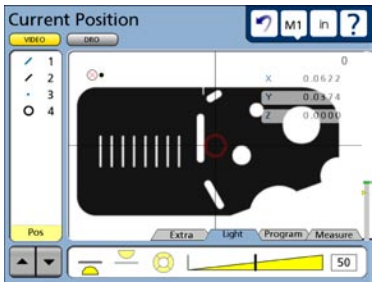
When the Image tab is shown in the background...



Touch the Image tab...

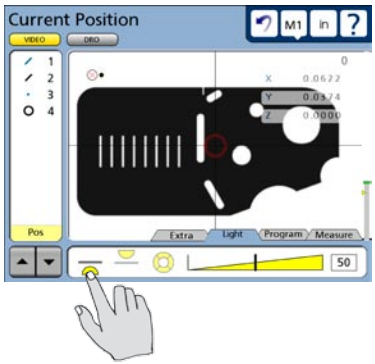


twice...

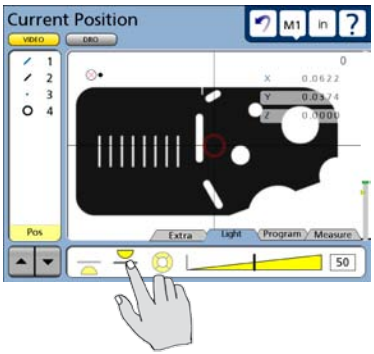


to display the light controls

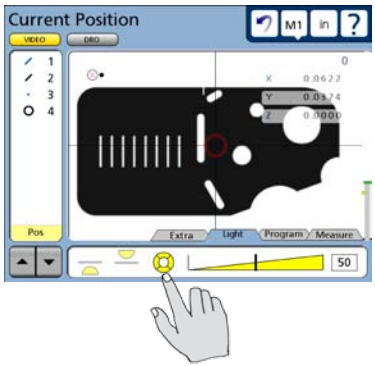
2 Touch the desired light source to select it for adjustment.



Select the back light...

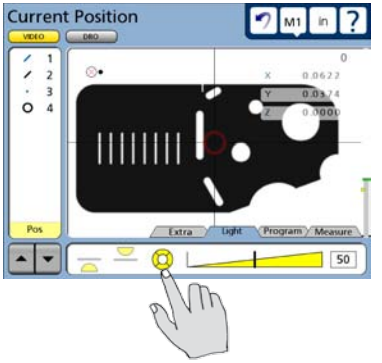


Select the top light...

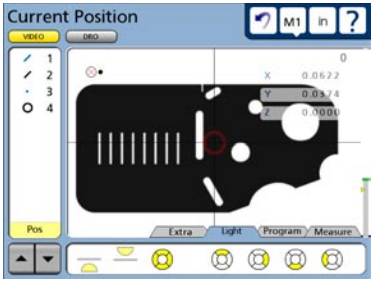


or ring lights

When ring lights are selected, touch the ring light icon again to display individual ring right segments.



Touch the ring light icon again...



to show individual segments

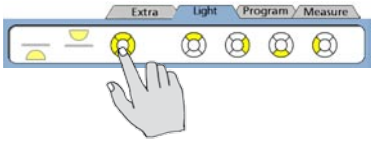
Any of the individual ring light segments can be turned on or off by touching them.

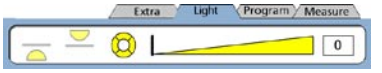
All ring light segments are off

Two ring light segments are on

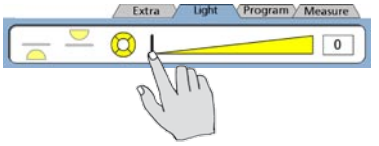
All ring light segments are on

Touch the ring light icon again to display the adjustment slider.

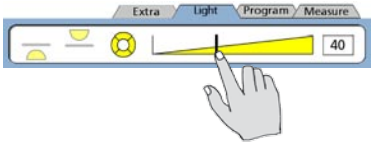




3 Touch and drag an adjustment slider to adjust the illumination of any light source. All light sources are adjusted in this manner using its own slider.



Touch and drag the slider...



to make light adjustments

Adjusting video image contrast and brightness

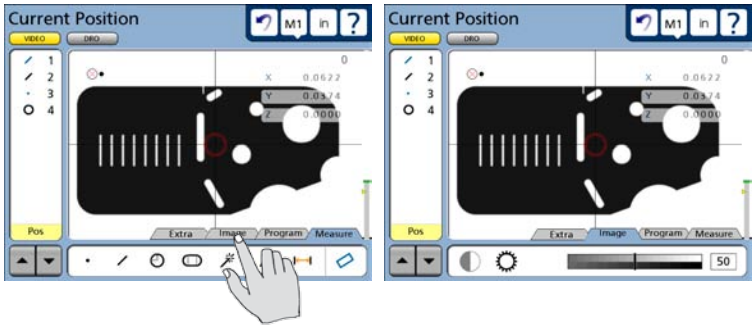
The contrast and brightness of the video camera image displayed in the video window are adjusted to optimize edge detection by selecting the Image tab and using the image contract and brightness sliders.

NOTE
The video image contrast and brightness adjustments are different than the overall screen brightness adjustment found in the Miscellaneous setup screen.

To adjust the video image contrast and brightness:

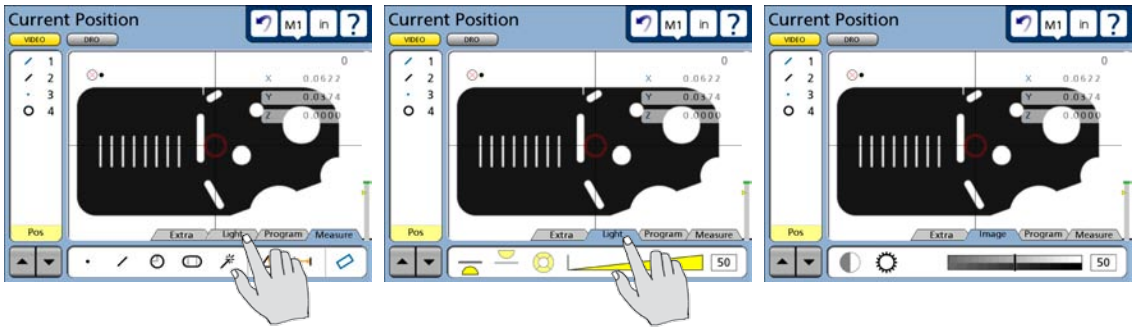
1 Touch the Light/Image tab at the bottom of the screen repeatedly if necessary to display the Image controls.

When the Image tab is shown in the background...



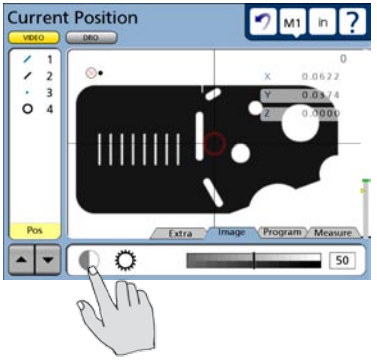
Touch the Image tab... *to display the Image controls*

When the Light tab is shown in the background...

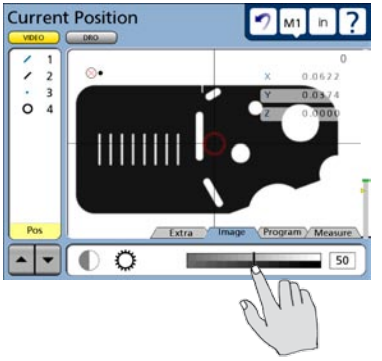


Touch the Light tab... *twice...* *to display the Image controls*

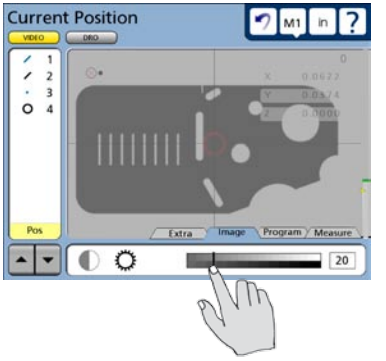
2 Touch the contrast icon and then touch and drag the contrast slider to adjust video contrast.



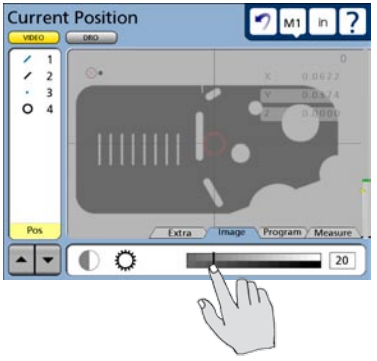
Touch the Contrast icon...



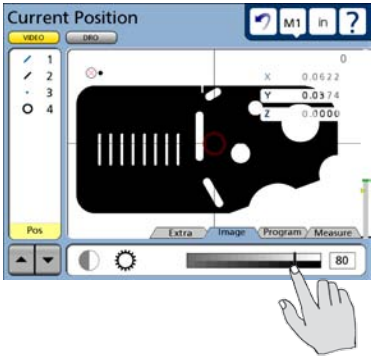
then touch and drag the slider...



to adjust contrast

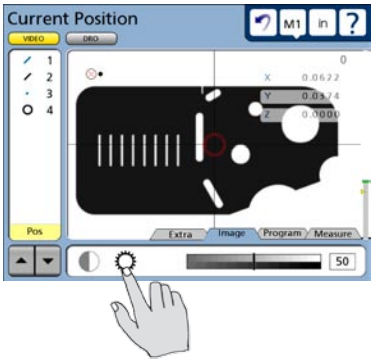


Drag left to decrease contrast...

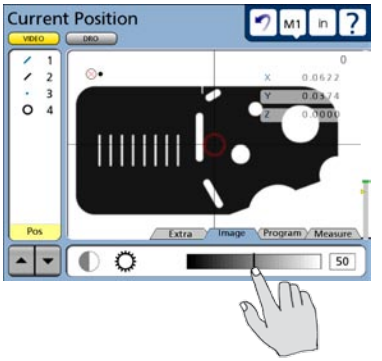


and right to increase contrast

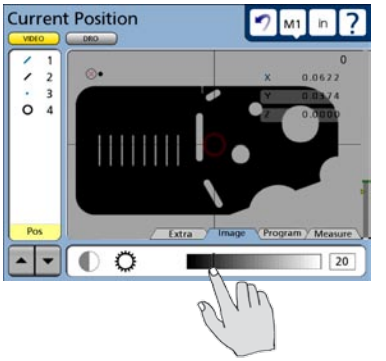
3 Touch the Brightness icon and then touch and drag the brightness slider to adjust video brightness.



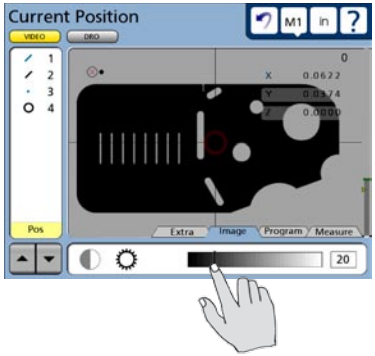
Touch the Brightness icon...



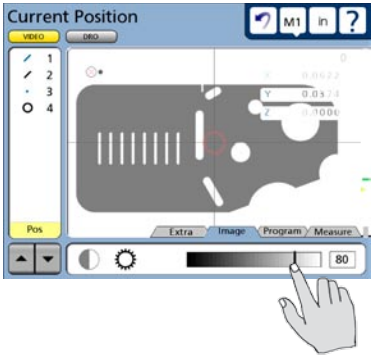
then touch and drag the slider...



to adjust brightness

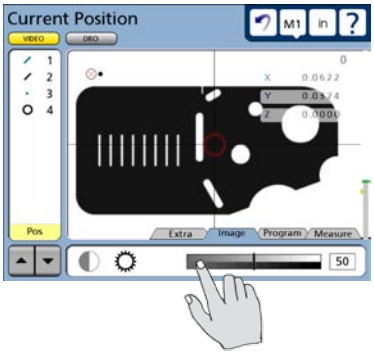


Drag left to decrease brightness...

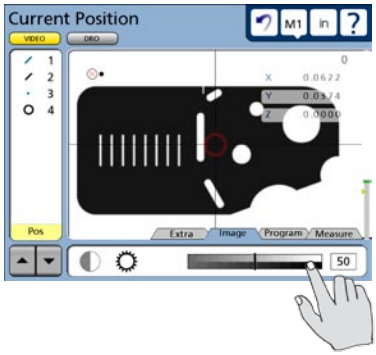


and right to increase brightness

NOTE
Contrast and brightness can be fine-adjusted by one unit of contrast or brightness by touching the slider bar on either side of the slider control.



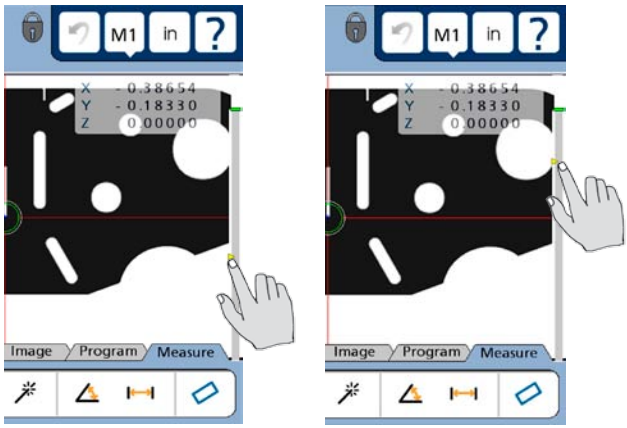
Touch left to adjust down 1 unit



Touch right to adjust up 1 unit

Adjusting video image contrast threshold

The contrast of an edge is shown by the height of the gray bar on the right side of the screen when the crosshair probe is positioned over an edge. The contrast threshold required for edge recognition is shown by the yellow arrow and must fall within the gray bar. When the threshold adjustment is unlocked in the VED setup screen, the contrast threshold is increased or decreased by raising or lowering the yellow arrow on a contrast bar.

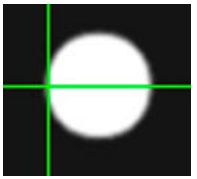


Adjust the contrast threshold by touching and sliding the yellow arrow

Using video probes

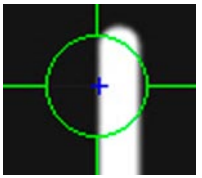
Four video probes are available for creating reference levels, skews and datums and for measuring regular geometric features including points, lines, arcs, circles, slots, rectangles, distances and angles. Probes include:

- Crosshair — Standard crosshair of two lines crossed at 90 degrees. Single points can be acquired manually or automatically.
- Offset crosshair — Crosshair of two lines with a regular pattern 3 pixel square wave offsets, crossed at 90 degrees. Single points can be acquired manually or automatically.
- Single edge — Standard crosshair with a small circle at the center for positioning the edge detector. Single points can be acquired manually or automatically.
- Multiple edge — Standard crosshair with 2 small concentric circles at the center for positioning the edge detector. Multiple points can be acquired for certain feature types automatically.

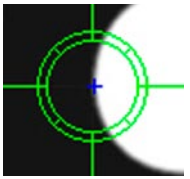


Crosshair

Offset crosshair

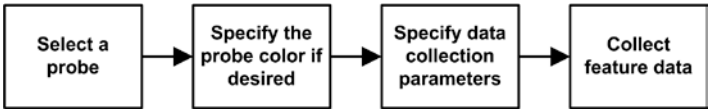


Single edge



Multiple edge

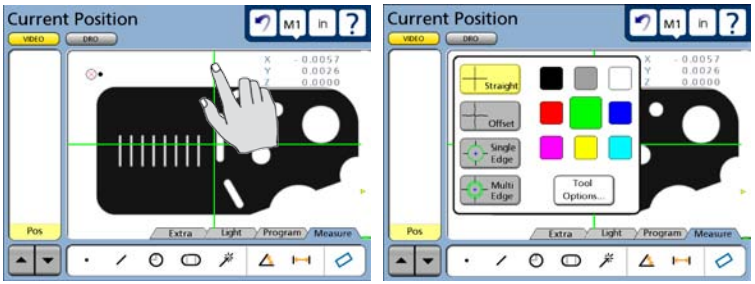
Firing a video probe generates one or more orthogonal scan lines, which acquire points as the scans cross an edge bounded by light and dark areas of the screen image. The use of these four probes is very straight-forward, as shown below.



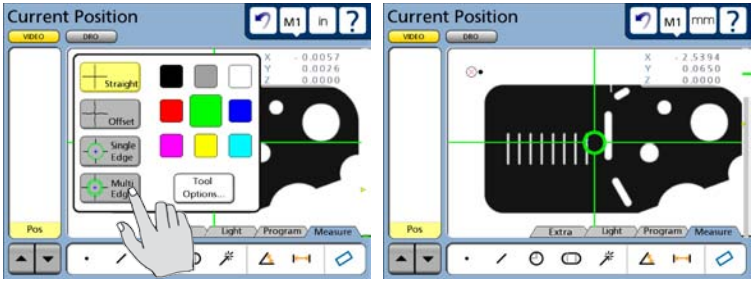
Selecting a probe

To select a new probe:

1 Select a new probe type by touching any part of the current probe on the Video window. The four probe choices will be shown on the probe pop-up screen.



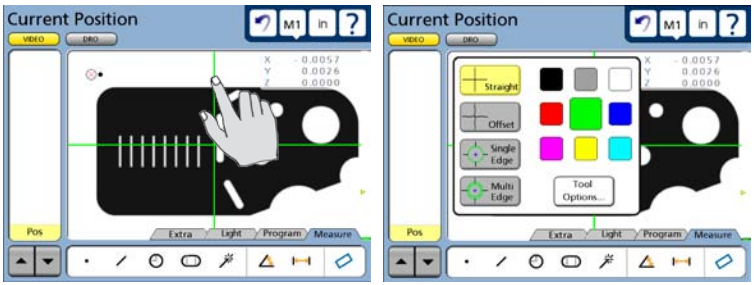
2 Touch the desired probe type button. The probe pop-up screen will close and the new probe will be displayed. In this example the Multi-edge probe is selected.



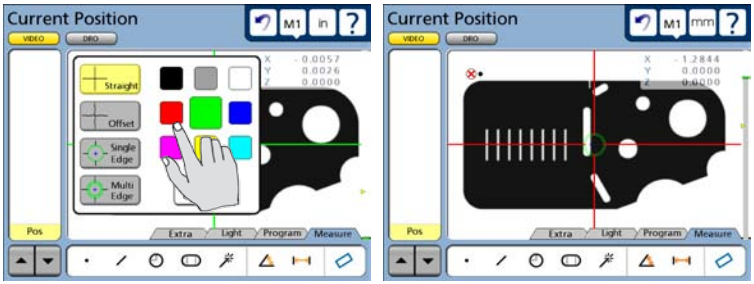
Selecting a probe color

The probe color can be selected at any time from one of nine colors that are shown on the probe pop-up screen. To select the probe color:

1 Touch any part of the current probe on the Video window. The nine color choices will be shown on the probe pop-up screen.



2 Touch the desired probe color button. The probe pop-up screen will close and the new probe color will be displayed. In this example the red probe color is selected.



NOTE

The color of the single edge and multiple edge probe circles (at the center of the probes) cannot be changed because color is used to indicate whether or not an edge has been detected. Red circles indicate that no edge has been detected. Green circles indicate that an edge has been detected. The color of the remaining straight line portions of edge probes can be changed.

Specifying probe data collection parameters

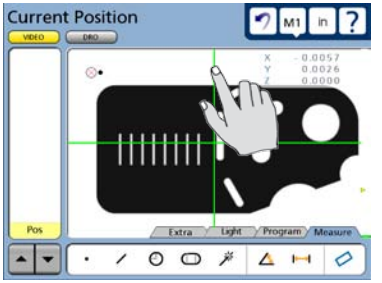
Video probe data collection parameters are specified in the Tool Options portion of the probe pop-up screen and include:

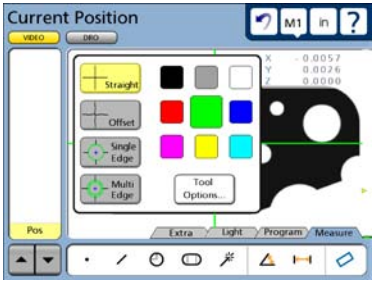
- The number of points to be collected for line, circle and arc measurement by the multiple edge probe
- Delays after the stage motion stops for auto-point entry using crosshair and edge probes
- The minimum stage motion required to restart the crosshair timeout delay for auto-point entry using crosshair probes
- The line thickness of the crosshair probe

Usually, the data collection parameters are specified for a probe and remain unchanged until significant changes are encountered in the part probing process, or the system hardware is changed.

To specify probe data collection parameters:

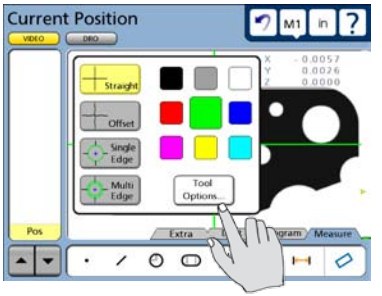
1 Touch any part of the current probe on the Video window. The probe pop-up screen will be displayed.

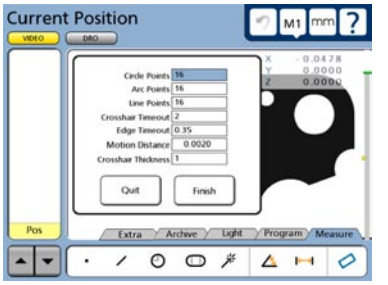




2 Touch the Tool Option button. The probe data collection parameter setup fields will be displayed.

Only a few data collection parameters are required, and they are different for crosshair and edge probes.





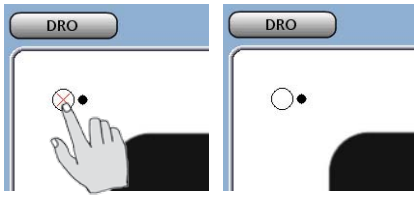
Crosshair probe data collection parameters

Data collection parameters for crosshair probes include:

- Crosshair timeout delay
- Motion distance
- Line thickness

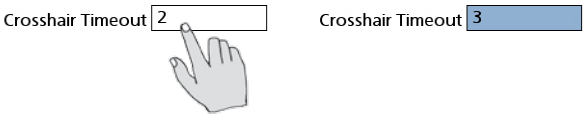
Crosshair timeout delay

When the auto-enter function is enabled during feature measurement on the LCD Video screen, a point is collected by the system each time the stage is moved to position the part under the crosshair. This automatic point entry is delayed until the stage has been motionless for a short time to ensure that the crosshair is located where the user intended. This delay is the Crosshair Timeout. This parameter is identical for the straight and offset crosshair probes. The default value will provide adequate delay for most applications, but can be increased to accommodate more relaxed probing.



The auto-enter function is enabled on the LCD video screen

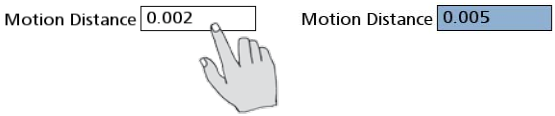
To specify Crosshair Timeout, touch the Crosshair Timeout data field and enter the desired delay in seconds using the number keys.



Motion distance

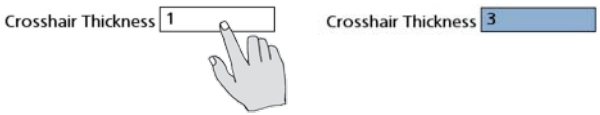
As described above, when the auto-enter function is enabled, a point is collected by the system each time the stage is moved to position the part under the crosshair at a new location. This automatic point entry is delayed until the stage has been motionless for a short time to ensure that the crosshair is located where the user intended. This delay is restarted if the stage moves again during the timeout interval to facilitate final fine adjustments of stage position.

To specify the minimum stage movement required to restart the crosshair timeout delay, touch the Motion Distance data field and enter the desired stage motion in the current unit of measure (millimeters or inches).



Line thickness

The lines of the crosshair probes can be changed in one-pixel increments from 1 to 3 pixels. To specify the line width of the crosshair probe, touch the Crosshair Thickness data field and enter 1, 2 or 3 pixels.



Edge probe data collection parameters

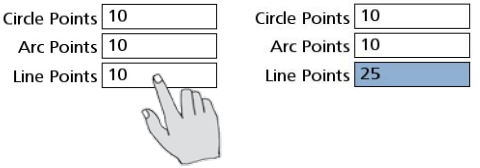
Data collection parameters for edge probes include:

- The number of points to be collected for lines, circles and arcs by the multiple edge probe
- Edge timeout delay

Number of points probed for a line, circle and arc

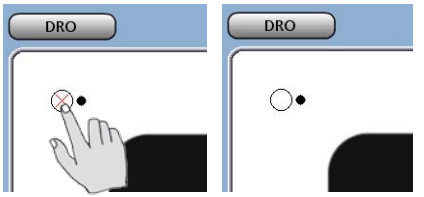
When the multiple edge probe is used, the probe is seeded with a small number of points to define the feature type, and then the remaining points are collected automatically by the system. Up to 99 points can be collected for line, circle and arc features.

To specify the number of points collected for line, circle or arc features, touch the Line, Circle or Arc Point data field and enter the desired number of points using the number keys.



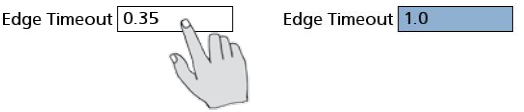
Edge timeout delay

When the auto-enter function is enabled for feature measurement on the LCD Video screen, a point is collected by the system each time the stage is moved to position the part under the edge probe. This automatic point entry is delayed until the stage has been motionless for a short time to ensure that the edge probe is located where the user intended. This delay is the Edge Timeout. This parameter is identical for the single and multiple edge probes. The default value will provide adequate delay for most applications, but can be increased to accommodate more relaxed probing.



The auto-enter function is enabled on the LCD video screen

To specify Edge Timeout, touch the Edge Timeout data field and enter the desired delay in seconds using the number keys.

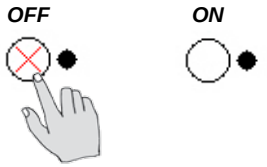


Collecting feature data

Feature data can be collected manually by positioning a probe over a part feature and pressing the Enter key, or collected automatically by enabling the auto-enter function and using the multiple edge probe. Manual probing with crosshairs is useful when part edges are indistinct and feature edge contrast is poor. Automatic probing can acquire many points simultaneously and increases productivity when feature edge boundaries are clear and automatic point entry is possible.

The auto-enter function

The auto-enter function is toggled on or off by touching the auto-enter icon in the upper-left corner of the video screen.



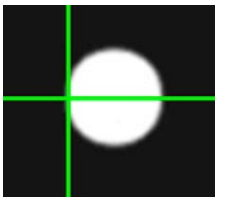
The auto-enter function is toggled on

When the auto-enter function is toggled on, the crosshair and edge probes will acquire a point automatically after the stage motion stops to position the probe over a feature or edge. Refer to the descriptions of crosshair and edge timeout delay on the previous two pages for more details regarding point acquisition timing.

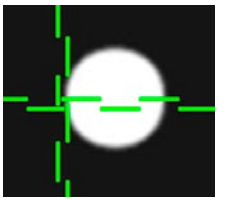
When the auto-enter function begins to acquire a point, the icon dot rotates clockwise around the icon to indicate the passage of the crosshair or edge timeout delay period. This delay is restarted if the stage is moved an amount equal to or greater than the Motion Distance value described earlier.

Crosshair probes

The crosshair probes consist of two lines crossed at 90 degrees in the video window. Probing is identical for straight and offset crosshairs. Single points can be acquired manually or automatically.



Straight crosshairs



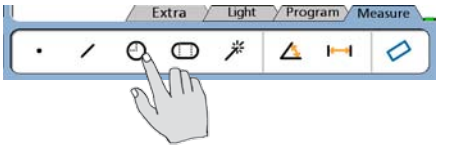
Offset crosshairs

Manual probing (crosshairs)

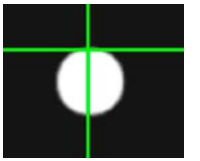
Disable auto-enter for manual probing.

To probe part features manually:

1 Select the feature to be measured. The Circle measurement is selected in this example.

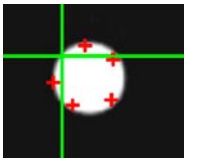


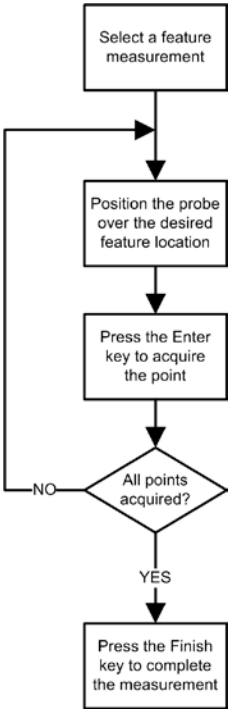
2 Position the probe over the desired feature location.



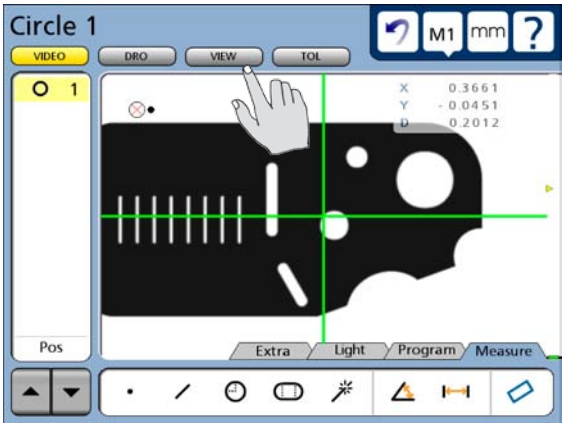
3 Press the Enter key to acquire a point.

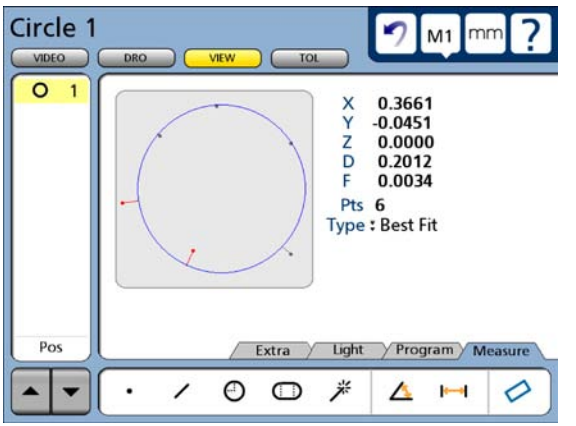
4 Repeat steps 2 and 3 until all the required points have been probed.





5 Press the Finish key to complete the feature measurement and store the feature in the feature list. The feature and probed points can be reviewed in detail by touching the View button if desired.





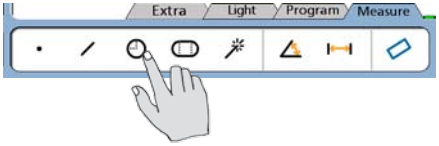
Automatic probing (crosshairs)

The process of probing automatically with crosshairs is identical to probing manually with crosshairs except that the user does not press the Enter key to enter points.

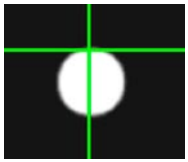
Enable auto-enter for manual probing. 

To probe part features automatically:

1 Select the feature to be measured. The Circle measurement is selected in this example.

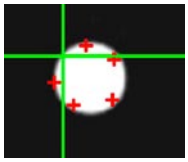


2 Position the probe over the desired feature location.

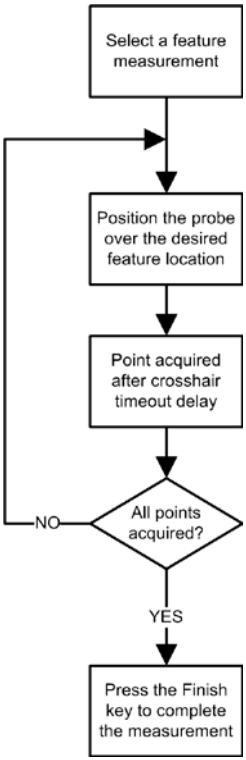


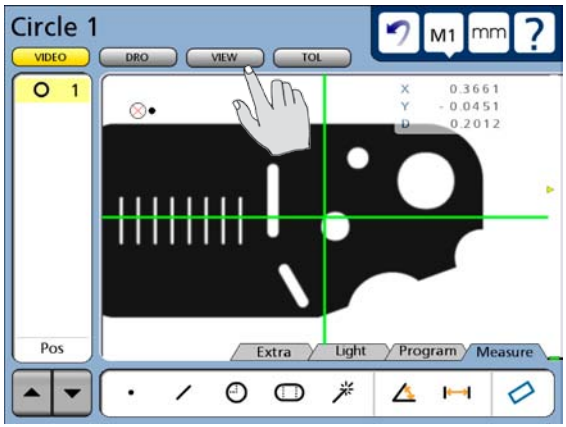
3 The point will be acquired after the crosshair timeout delay, unless the stage is moved before the delay is complete. If the stage is moved, the delay will be reinitiated.

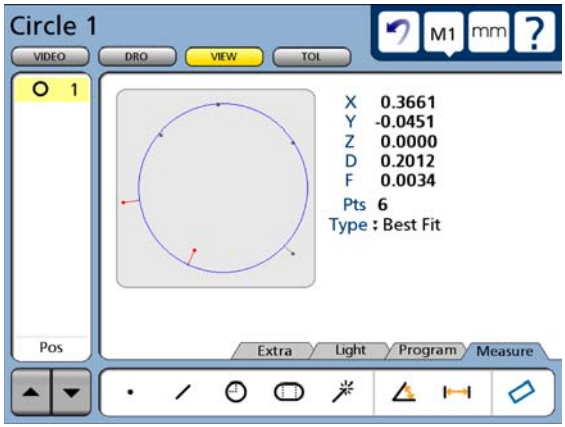
4 Repeat steps 2 and 3 until all the required points have been probed.



5 Press the Finish key to complete the feature measurement and store the feature in the feature list. The feature and probed points can be reviewed in detail by touching the View button if desired.

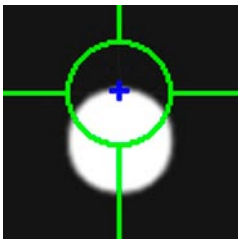




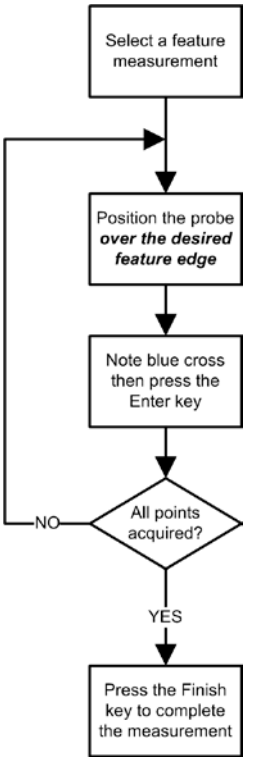


Single edge probe

The single edge probe consists of a standard crosshair with a small circle at the center for positioning the edge detector. Single points can be acquired manually or automatically.



Single edge probe

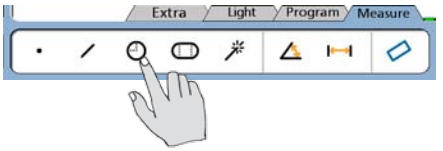


Manual probing (single edge)

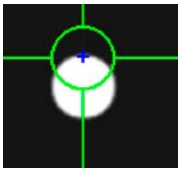
Disable auto-enter for manual probing.

To probe part features manually:

1 Select the feature to be measured. The Circle measurement is selected in this example.

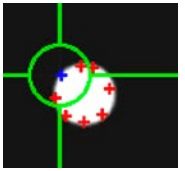


2 Position the probe over the desired feature edge. A blue cross with indicate the point that will be acquired. Reposition the probe if necessary to acquire the desired point.

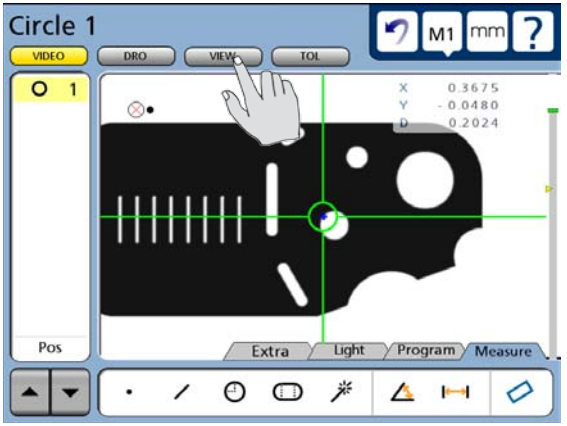


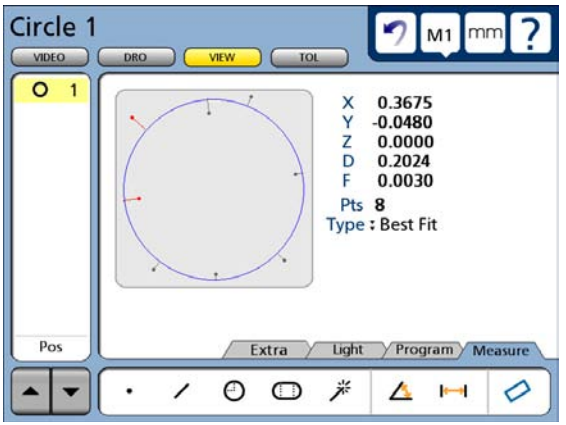
3 Press the Enter key to acquire a point.

4 Repeat steps 2 and 3 until all the required points have been probed.



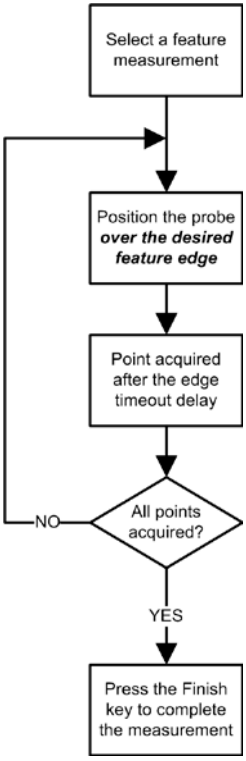
5 Press the Finish key to complete the feature measurement and store the feature in the feature list. The feature and probed points can be reviewed in detail by touching the View button if desired.





Automatic probing (single edge)

The process of probing automatically with the single edge probe is identical to probing manually with the single edge probe except that the user does not press the Enter key to enter points.

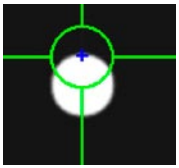


Enable auto-enter for manual probing.

To probe part features automatically:

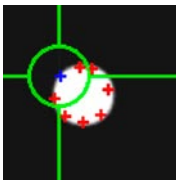
1 Select the feature to be measured. The Circle measurement is selected in this example.

2 Position the probe over the desired feature edge. A blue cross with indicate the point that will be acquired. Reposition the probe if necessary to acquire the desired point.

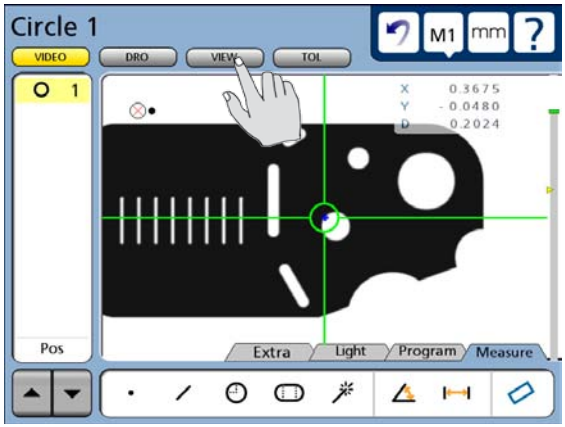


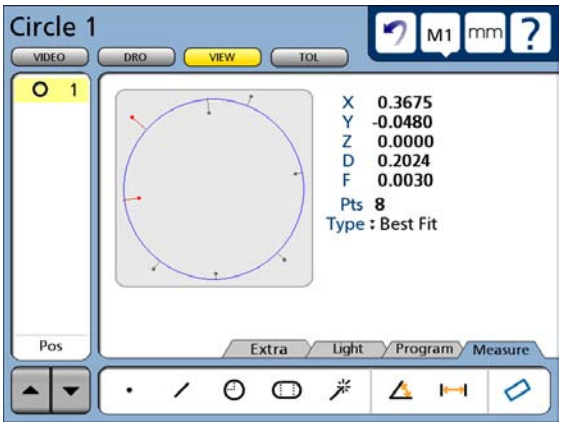
3 The point will be acquired after the edge timeout delay.

4 Repeat steps 2 and 3 until all the required points have been probed.

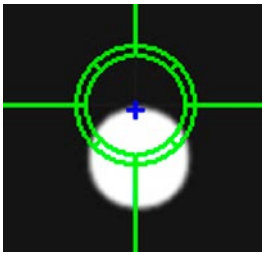


5 Press the Finish key to complete the feature measurement and store the feature in the feature list. The feature and probed points can be reviewed in detail by touching the View button if desired.





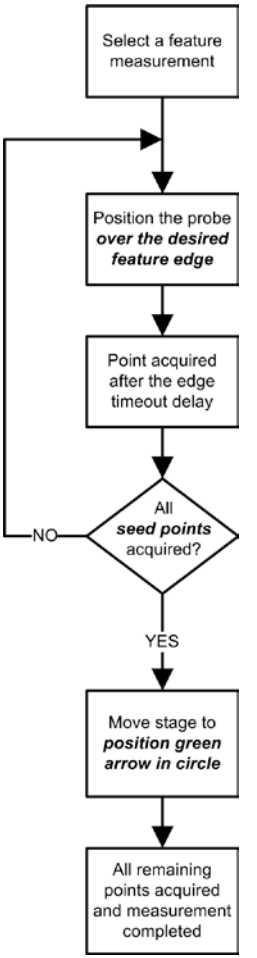
Multiple edge probe



The multiple edge probe consists of a standard crosshair with two small concentric circles at the center for positioning the edge detector. Points will be probed manually for some features as they are when the single edge probe is used, and automatically for line, circle and arc features when the probe is seeded.

Probe seeding

When points are probed automatically as diagrammed at the right, the probe must first be seeded by probing the minimum number of points required for a geometric definition of the feature type. Only lines, circles and arcs can be probed automatically.



- Line — Points probed automatically after seeding with 2 points
- Circle — Points probed automatically after seeding with 3 points
- Arc — Points probed automatically after seeding with 3 points
- Point — Points probed manually - identical to single edge probe
- Distance — Points probed manually - identical to single edge probe
- Angle — Points probed manually - identical to single edge probe
- Slot — Points probed manually - identical to single edge probe
- Rectangle — Points probed manually - identical to single edge probe

When probing lines, circles and arcs, the multiple edge probe must be seeded to provide the system with a general description of the feature location. The location of seed points is important. The order of seed points is important for arcs.

- Line — Seed by probing 2 points at the extreme ends of the line.
- Circle — Seed by probing 3 points evenly distributed around the perimeter of the circle.
- Arc — Seed by probing 3 evenly distributed points in sequence from the beginning to end of the arc.

The seed points can be entered manually by pressing the Enter key, or automatically using the auto-enter function.

Auto-enter disabled

Auto-enter enabled

When all the required points have been seeded, a green arrow and red circle are displayed. Move the stage to place the green arrow into the red circle to initiate automatic probing of the remaining points and complete the measurement.

When the probe is seeded...

move the stage to place...

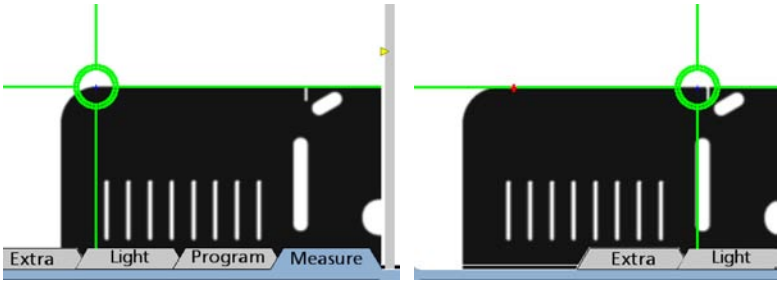
the arrow in the circle

Probing a line

The same basic technique is used to probe a line whether the line is completely within or outside the field of view. To probe a line using the multiple edge probe:

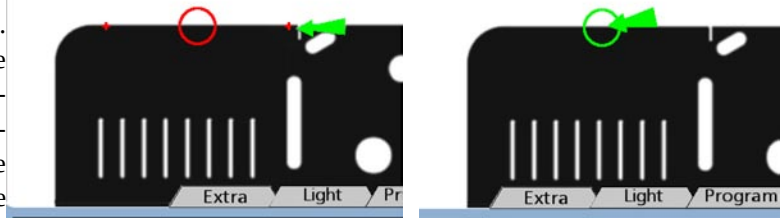
1 Select the Line feature measurement, and then select the multiple edge probe.

2 Seed the multiple edge probe at the two extreme ends of the line. The green arrow and red circle will be presented.



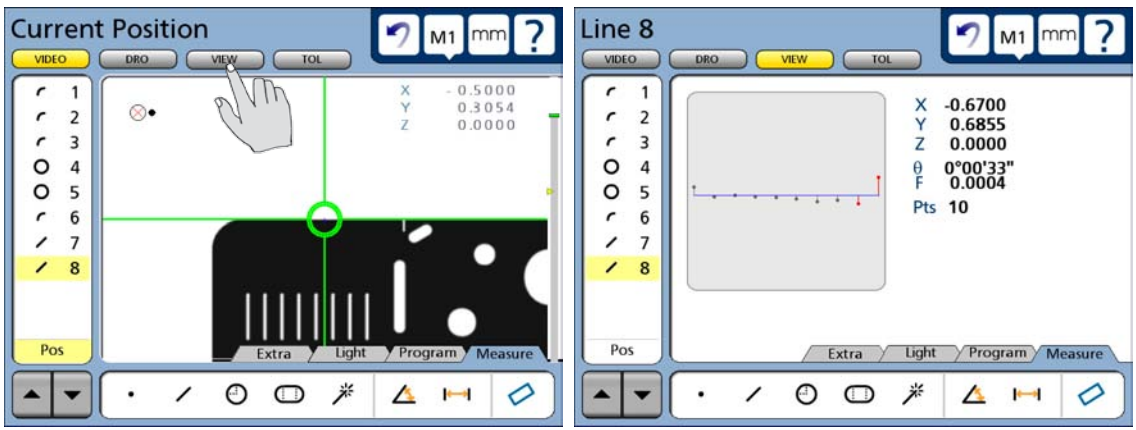
Seed the multiple edge probe at the two extreme ends of the line

3 Move the stage to place the green arrow inside the red circle. The remaining line points will be probed at roughly regular intervals along the line, the measurement will be completed and the feature data will be stored in the feature list.



Move the stage to place the arrow in the circle

4 The feature and probed points can be reviewed in detail by touching the View button if desired.

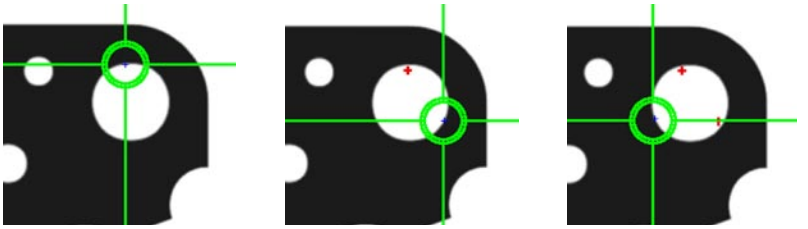


Probing a circle

Two techniques can be used to probe a circle using the Multiple edge probe. The first technique is that described earlier for probing lines and arcs and can be used to probe a circle whether the circle is completely within or outside the field of view. To probe a circle using the first technique with the multiple edge probe:

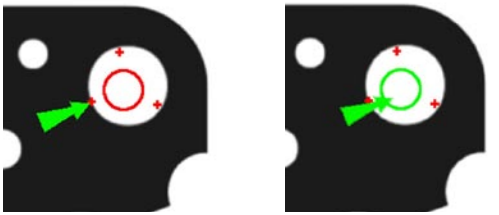
1 Select the Circle feature measurement, and then select the multiple edge probe.

2 Seed the multiple edge probe at 3 points evenly distributed around the perimeter of the circle.



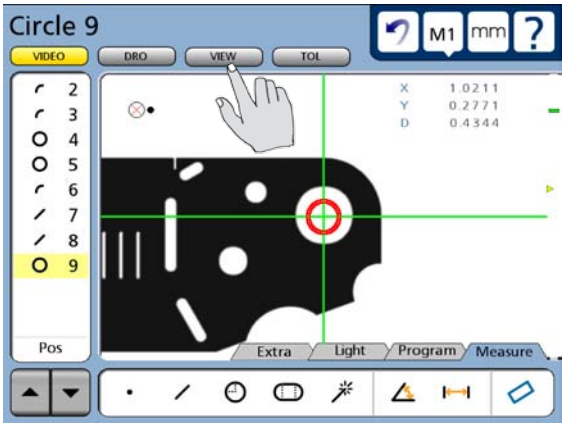
Seed the multiple edge probe at 3 points evenly distributed around the circle

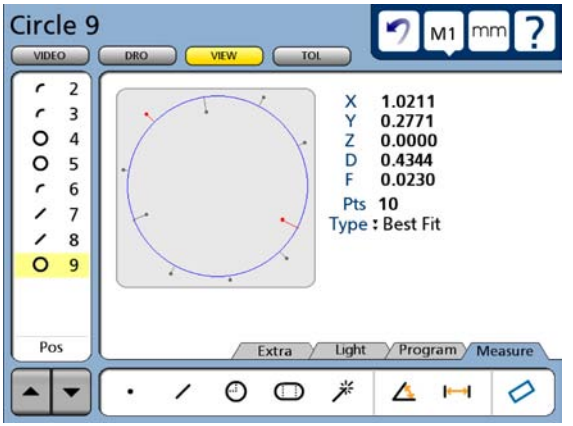
3 Move the stage to place the green arrow inside the red circle. The remaining circle points will be probed at roughly regular intervals around the perimeter of the circle, the measurement will be completed and the feature data will be stored in the feature list.



Move the stage to place the arrow in the circle

4 The feature and probed points can be reviewed in detail by touching the View button if desired.

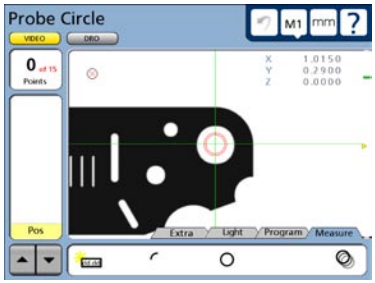




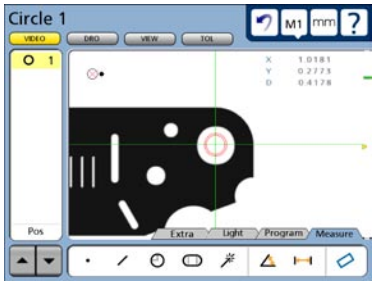
The second technique can only probe a circle located within the field of view that is large enough to enclose the center of the Multiple edge probe, but the technique is extremely simple and productive. To probe a circle using the second technique with the multiple edge probe:

1 Select the Circle feature measurement, and then select the multiple edge probe. Select a circle that will completely enclose the center of the Multiple edge probe.

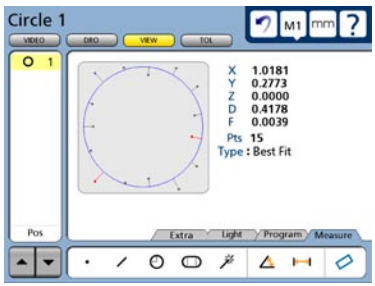
2 Move the stage to place the center of the Multiple edge probe inside the circle. The center of the Multiple edge probe should be red to indicate that no edge is detected.



3 Press the Enter key. All the circle points will be probed at roughly regular intervals around the perimeter of the circle, the measurement will be completed and the feature data will be stored in the feature list.



4 The feature and probed points can be reviewed in detail by touching the View button if desired.

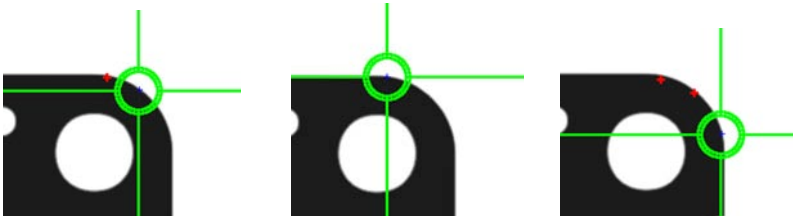


Probing an arc

The same basic technique is used to probe an arc whether the arc is completely within or outside the field of view. To probe an arc using the multiple edge probe:

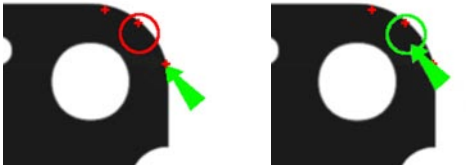
1 Select the Arc feature measurement, and then select the multiple edge probe.

2 Seed the multiple edge probe at 3 points in sequence from the beginning to the end of the arc.



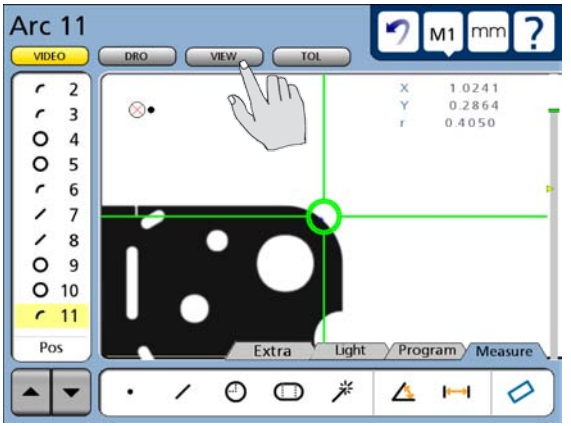
Seed the multiple edge probe at 3 points in sequence from the beginning to the end of the arc

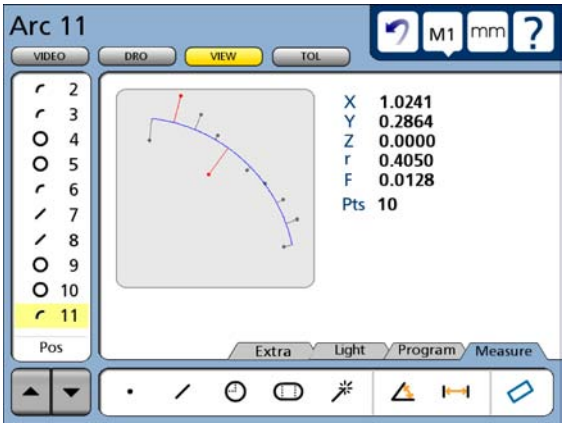
3 Move the stage to place the green arrow inside the red circle. The remaining line points will be probed at roughly regular intervals along the length of the arc, the measurement will be completed and the feature data will be stored in the feature list.



Move the stage to place the arrow in the circle

4 The feature and probed points can be reviewed in detail by touching the View button if desired.



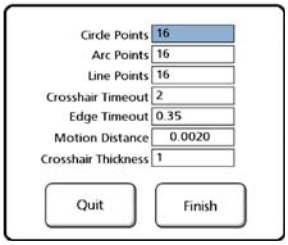


Seeding to avoid erroneous data

The multiple edge probe can be seeded manually using the single edge probe to avoid collecting data over keyways, protrusions and other feature anomalies. This is accomplished by:

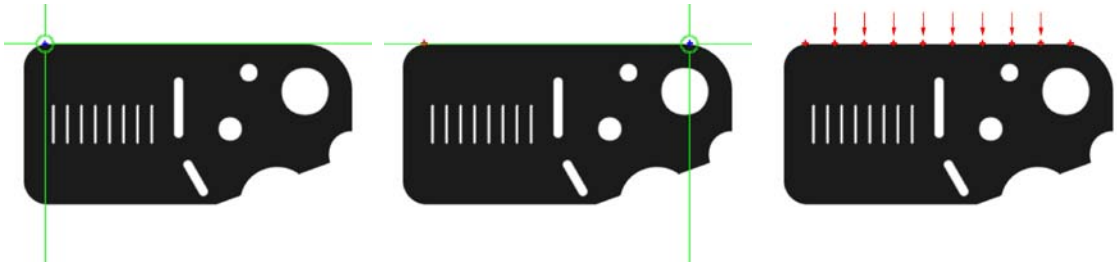
1 Seeding points very close to, and enclosing the area of anomaly using the single edge probe
2 Switching to the multiple edge probe to complete the measurement by probing the reminder of specified points automatically

Normally, the multiple edge probe attempts to collect the specified number of points from an even distribution of probed points along the feature edge, which includes the seed points.



16 Points are specified for a line

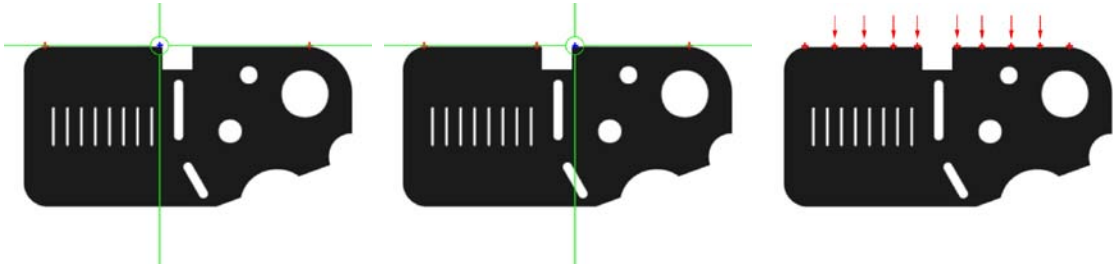
As shown in the example below, when a line without anomalies is probed, the multiple edge probe is seeded with the two endpoints, and then automatically probes the remainder of the specified points at locations distributed evenly between the endpoints.



The multiple edge probe is seeded with the endpoints of the line, and evenly distributes the remaining points

This process works well when the feature probed includes few or no edge anomalies. However, discontinuous or indistinct edges can lead to data errors if no preventive action is taken.

Since a combination of seeded locations and system-generated locations are used to distribute and probe points, tightly enclosing any edge anomaly between two seeded points greatly reduces the possibility that the multiple edge probe will probe the anomaly.



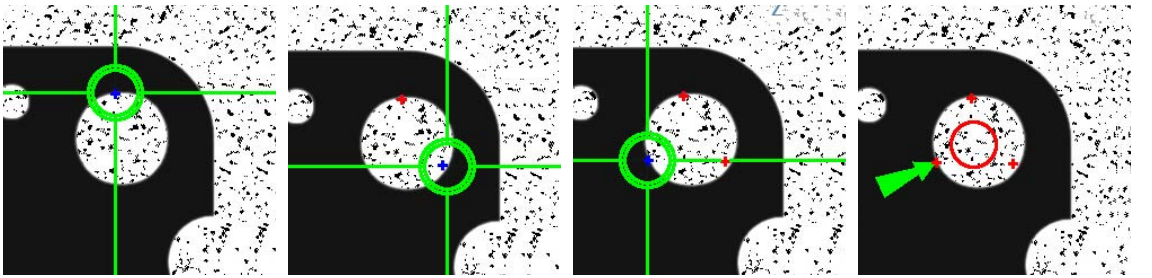
The single edge probe seeds the endpoints of the line and then probes additional seed points that enclose the line anomaly. The multiple edge probe is then selected and the remaining points are probed automatically.

Recovering from data errors

Data errors are rare when the part, stage and optical system are clean and well maintained, and the lighting, contrast and brightness are properly adjusted. In addition, the QC-300 is extremely forgiving of typical cleanliness and lighting issues. However, it is possible that an occasional data error will occur while the Multiple edge probe is attempting to collect data from feature locations calculated from the seed points and the specified number of total data points.

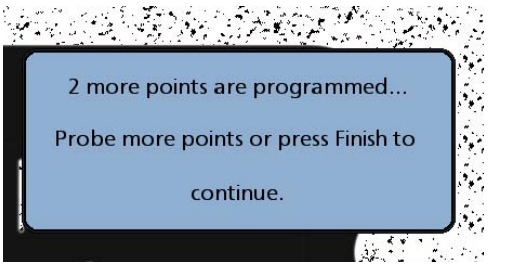
When a data error occurs, the system switches from automatic probing using the multiple edge probe to manual probing using the single edge probe, and prompts the operator to either complete the measurement with the available points, or to probe the remaining points manually. When the operator elects to continue probing, he or she is guided to the required points by the green arrow. In either case the operator must press the Finish key to complete the measurement.

While it is not expected that measurements would be conducted on a dirty stage like the one shown in this example of a circle measurement, this dirty stage was used to produce a data error and illustrate the error recovery process.

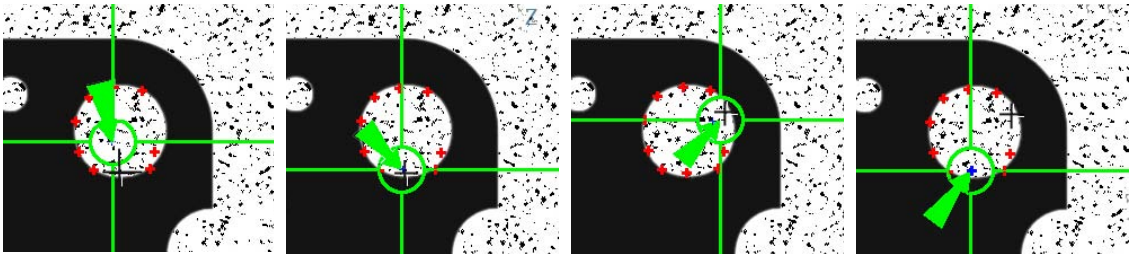


The Multiple edge probe seeds three points and user is prompted to move the green arrow into the red circle

When the seed points are probed the red target circle is displayed and the stage is positioned to place the green arrow in the target circle. The system begins to probe the remaining points automatically, however, the stage is dirty and makes the feature edge indistinct producing a data error. The operator is then asked to complete the measurement using the existing points or probe the remaining points manually using the single edge probe.

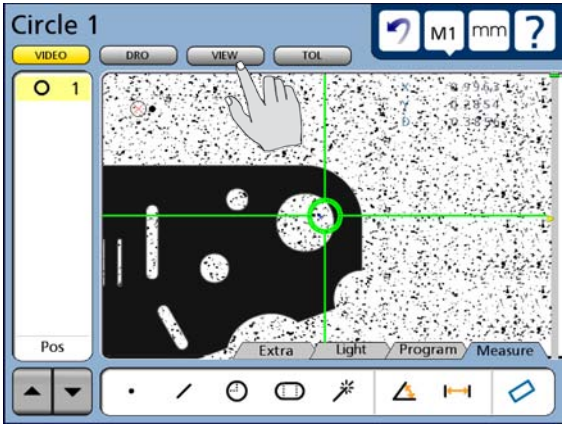


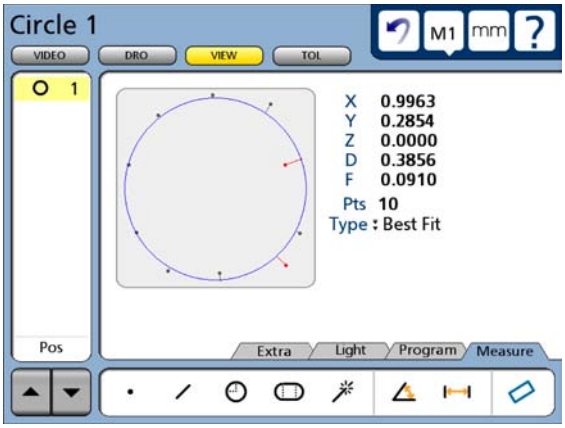
When the operator elects to continue probing the remaining points, the green arrow points to each missing point which is signified by a large X. When the stage is moved to position the single edge probe and arrow at the X and the Enter button is pressed, the next missing point is shown and the green arrow points to it. When all the remaining missing points are entered, the Finish key is pressed to complete the measurement and store the feature data in the Feature list.



The Multiple edge probe seeds three points and user is prompted to move the green arrow into the red circle

The feature and probed points can be reviewed in detail by touching the View button if desired.





Chapter 6: Measuring

Measurements can be conducted using video edge detection probes or using crosshairs. Measurements can be limited to probing feature points, 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:

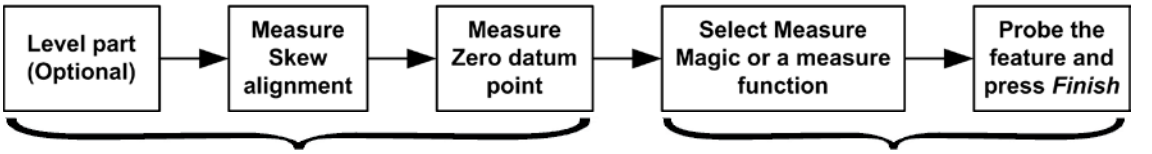
Measurement activities

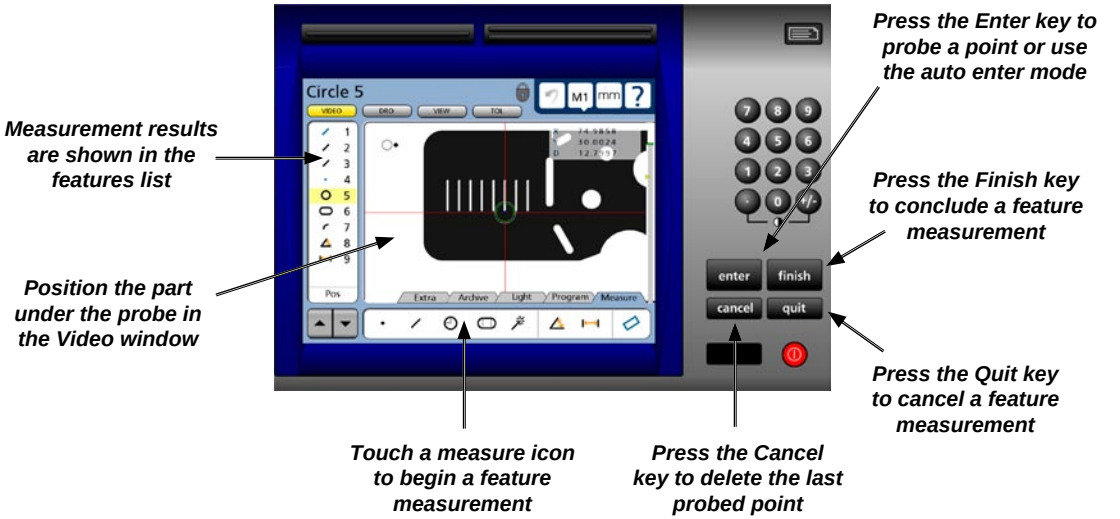
QC-300 measurement sessions can include one or all of the following activities:

- 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 detail in Chapter 3: User Interface.

NOTE
When video probes are used, the stage and optical system must be well maintained, free of scratches and other damage and clean. The optical magnification and part lighting must be prepared as described in Chapter 5: Probes.

Establishing the measurement reference

A reliable measurement reference must be established before part features can be probed and measured. This reference will be created by the user and ensures a level part surface, precise part alignment and a coordinate origin or datum zero. Reference features are presented in the feature list in blue, other features are presented in black.

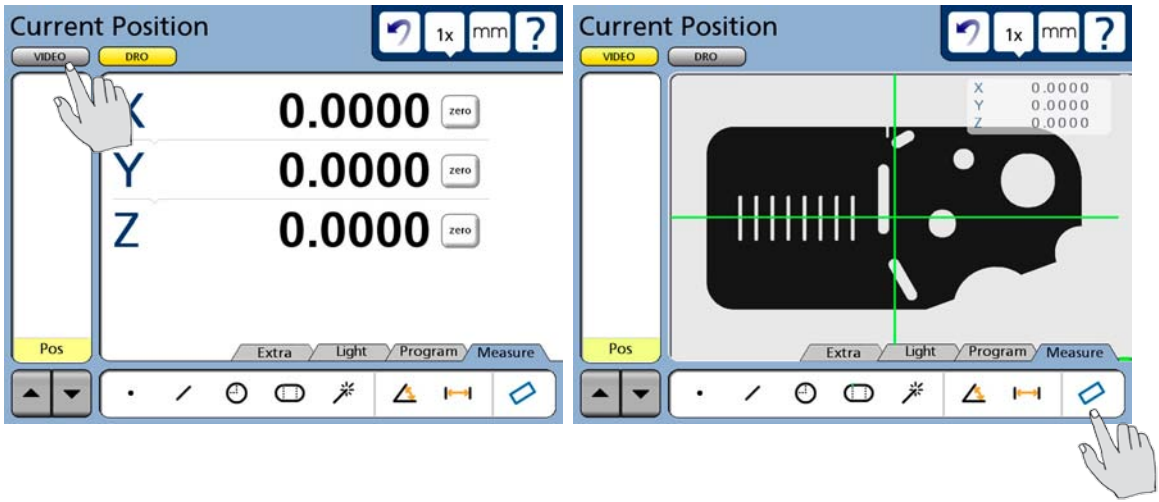
Leveling the part (optional)

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 can be minimized or eliminated by leveling the part.

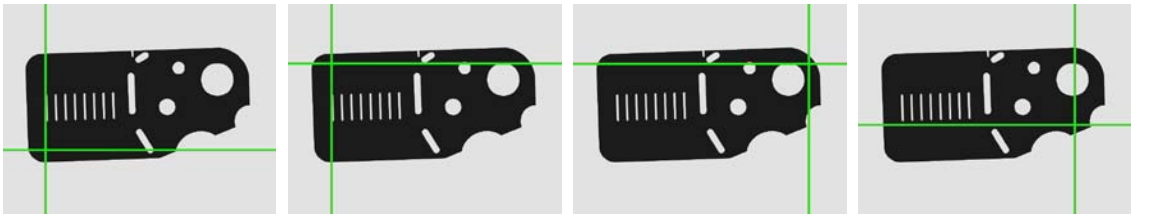
CAUTION
Leveling is optional in most well-maintained systems. Additionally, if the depth of field of the lens system is not much less than the level error, no benefit can be gained from leveling the part.

To level the part:

1 Touch the Video window button and then touch the Skew/Level Measure icon.

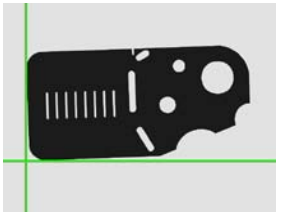


2 Touch the Level icon and perform the leveling measurement by probing three or more points that are well distributed across the surface of the desired part plane. Use the Crosshair to probe, move the Z-axis of the stage to focus the part surface under the Crosshair and then press the Enter key to enter each point. Press the Finish key to complete the level measurement. The level plane feature will be added to the Features list in blue.



The four corners of the Metronics quickie slide are probed to perform part leveling

Skewing the part

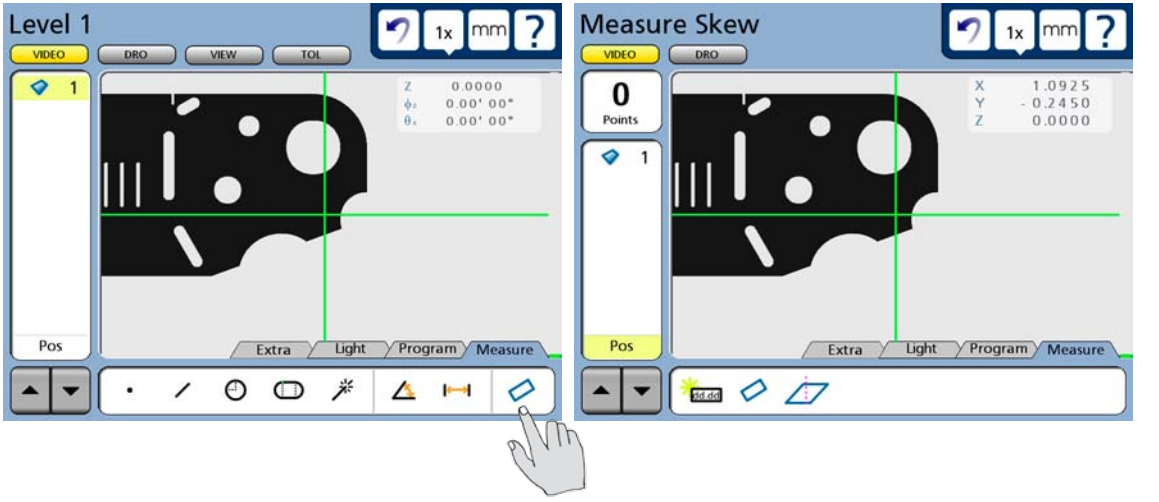


When the part is misaligned (twisted) in the X-Y plane, errors can be generated during the measurement process. These errors can be eliminated by creating a skew alignment for the part.

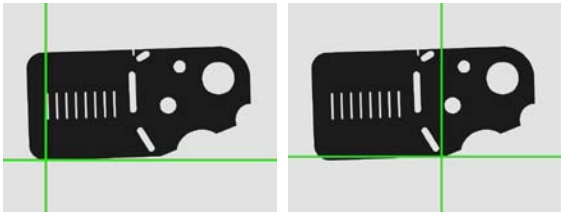
The skew alignment includes a precise measurement of the part misalignment. Once the misalignment is known to the system, subsequent feature measurements are automatically compensated to eliminate misalignment errors. Measurement data in the DRO will reflect measurements of a perfectly aligned part.

To skew the part:

1 Touch the Skew/Level Measure icon.



2 Perform the skew alignment by probing 2 or more points well distributed along the entire length of the desired part reference edge. Press the Enter key to enter each point. Press the Finish key to complete the Skew measurement. The skew line feature will be added to the Features list in blue.



Two points are probed on the bottom edge to perform a skew alignment on the X-axis

Creating a datum zero point

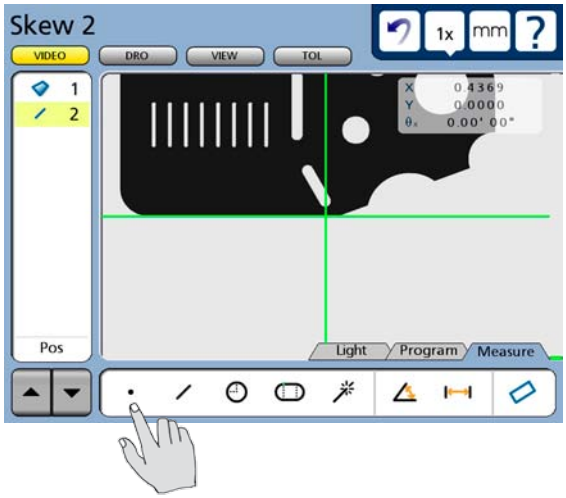
Creating the datum zero point is the final step in establishing a valid Cartesian or polar coordinate system for subsequent measurements. The datum zero point will be used as the origin of Cartesian or polar systems. The datum zero point can be positioned in any location that satisfies the measurement requirements of the user and can be created by probing a point or by constructing a point from parent features.

Probing a datum zero point

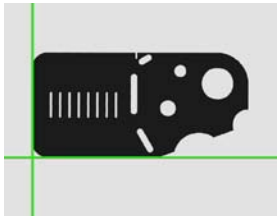
The datum zero point can sometimes be created directly by probing a point. Simple probing is more often possible when the part is precisely aligned in the stage.

To probe a datum zero point:

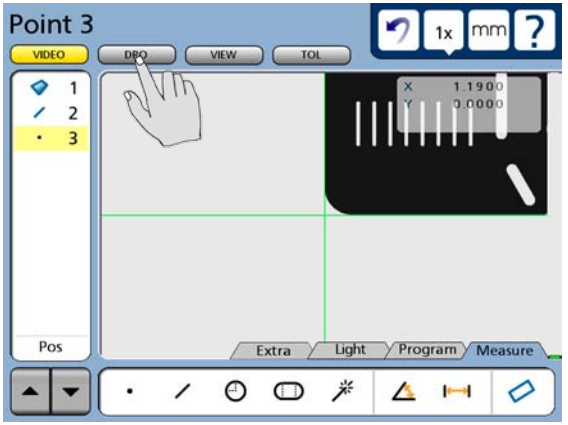
1 Touch the Point Measure icon.

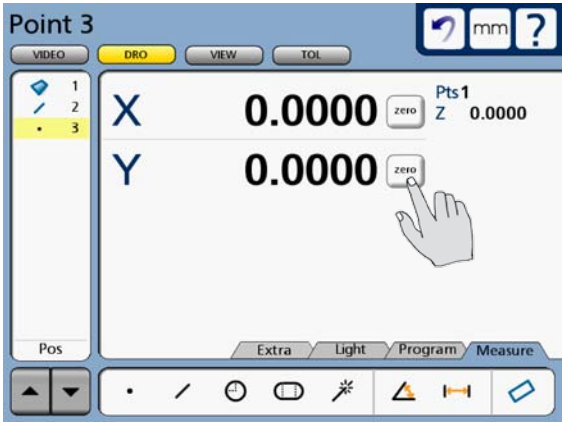


2 Use the crosshair to probe the desired point for the datum zero, and then press the Finish key. The point will be added to the Features list.



3 Select the DRO window, and while the point feature is selected touch the X and Y axis Zero buttons to establish a datum zero at the probed point. The datum point will be shown in blue.





Constructing a datum zero point

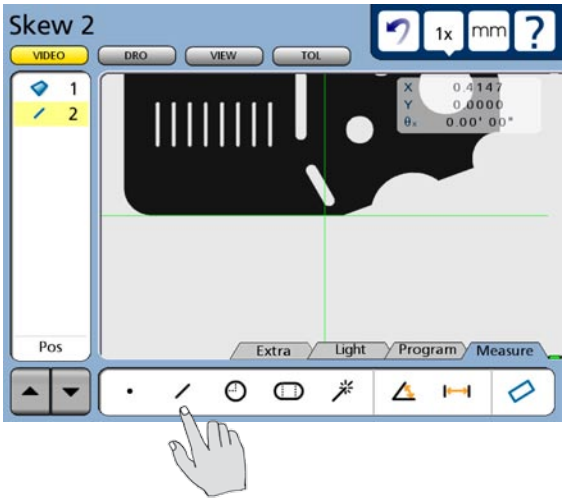
The datum zero point can be constructed from parent features when simply probing the desired point is not possible.

It would not be possible to provide a single description of this process for all measurement applications that require feature constructions to create a datum zero point. However, the concept illustrated by the following example and the construction techniques described later in this chapter can be used to construct a datum zero point for any measurement application.

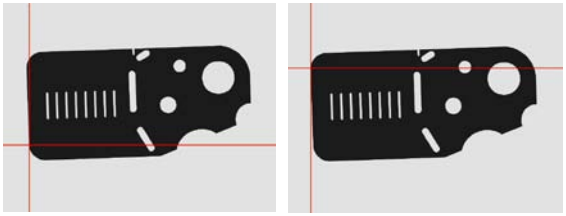
In this example, after the part skew is performed, a datum zero point is constructed at the intersection points of the X-axis along the bottom of the part (skew axis), and the Y-axis along the left side of the part.

To construct the datum zero point:

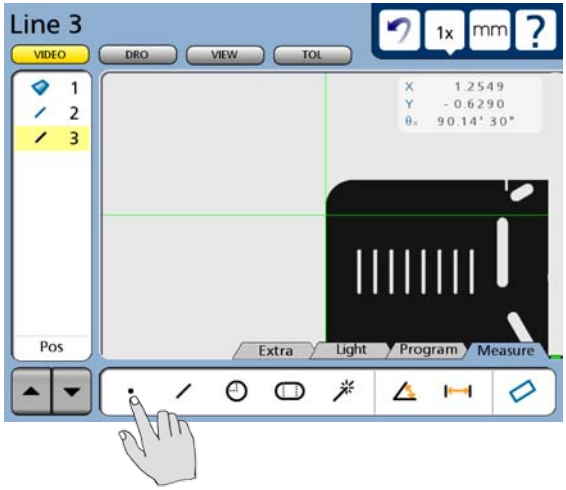
1 Touch the Measure Magic or the Measure Line icon.

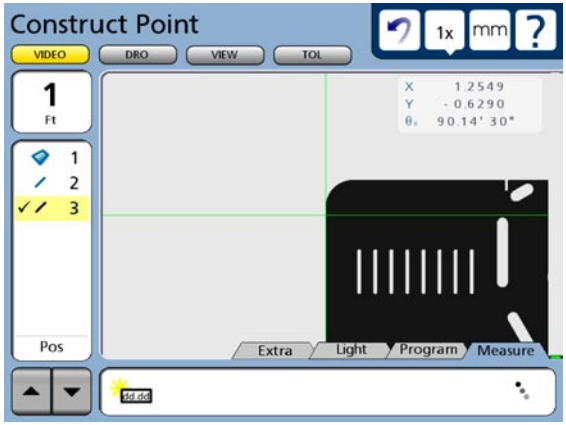


2 Probe two or more points well distributed along the left side of the part, and then press the Finish button. The line feature will be added to the Features list.

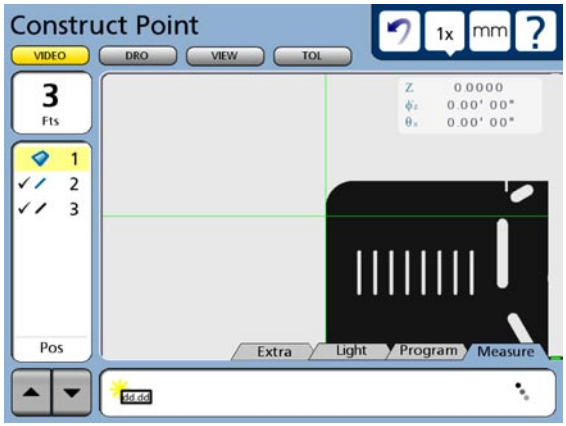


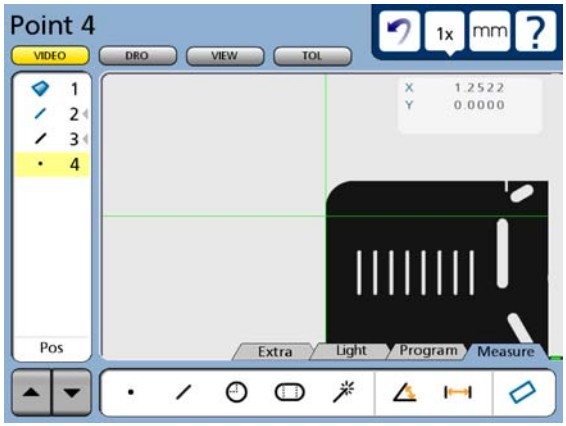
3 Touch the Measure Point icon, and the touch the line probed on the left side of the part in the Features list and then press the Enter key. A check mark will appear next to the line and the skew line will be highlighted in the Features list.



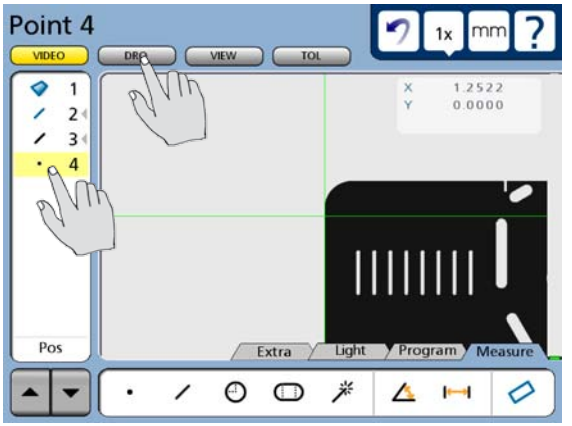


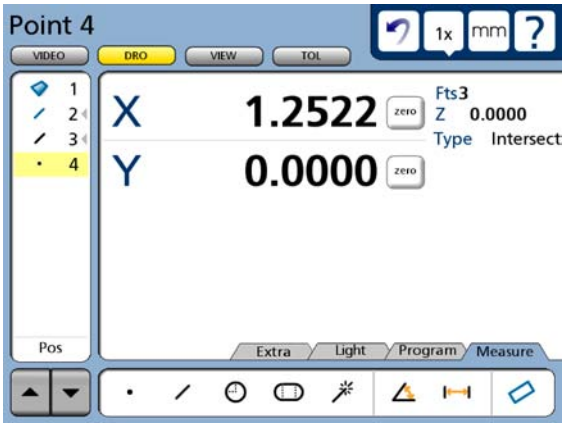
4 Press the Enter key. A check mark will appear next to the skew line. Press the Finish key to complete the point construction. The datum point will be added to the Features list.



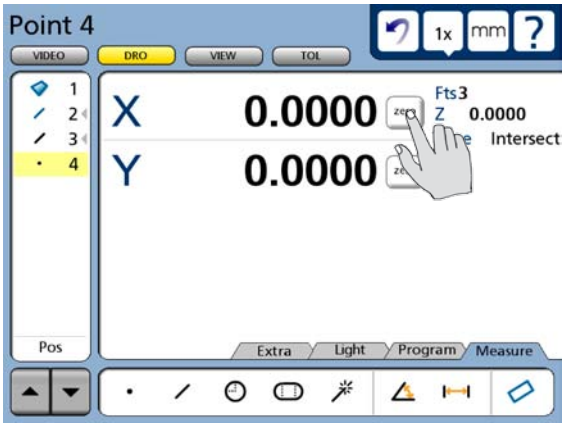


5 Touch the constructed point in the Features list and then select the DRO window.

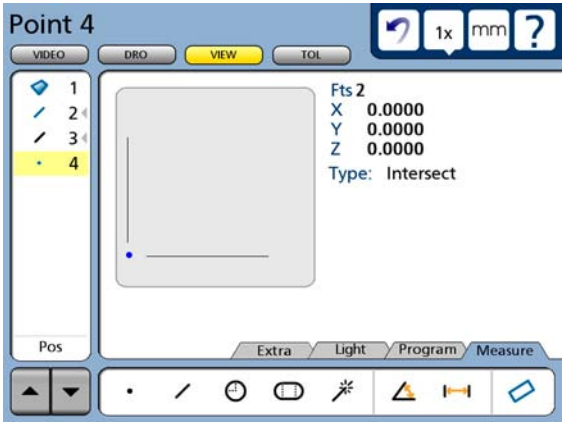




6 Touch the Zero buttons of the X and Y axes to define the point location as the zero datum. The datum point will be shown in blue.



7 Select the View window to see the zero datum at the intersection of the X and Y axes.



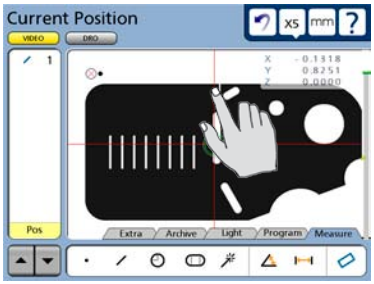
Setting a datum at the current probe position

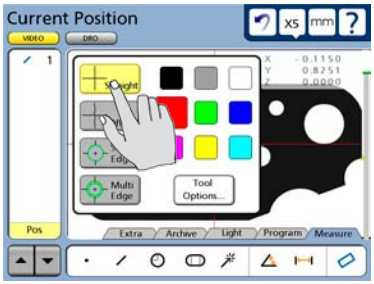
A datum can be set at the point indicated by the current crosshair probe position. The datum can be set to zero, or to a desired value.

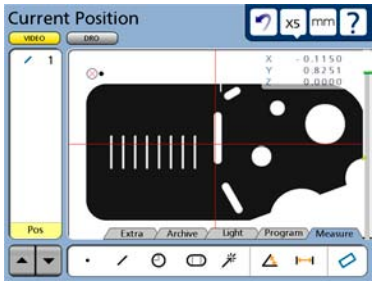
NOTE
The datum point created using this method is not shown as a feature in the features list.

To set a datum at the current position:

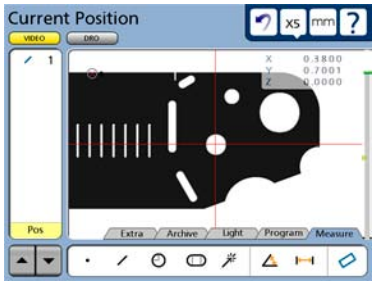
1 Select the straight or offset crosshair probe.



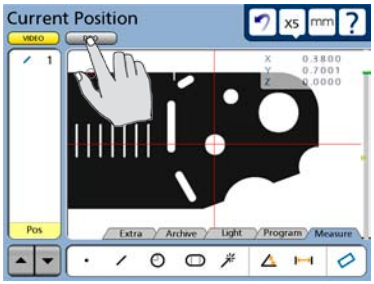


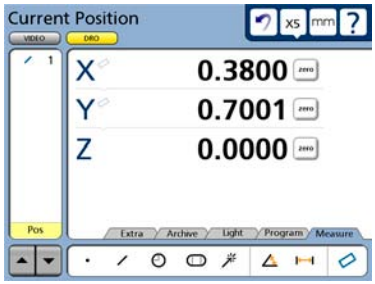


2 Position the center of the crosshair over the desired datum location. In this example, the crosshair is positioned over the center of the QC Quickie slide's medium hole.

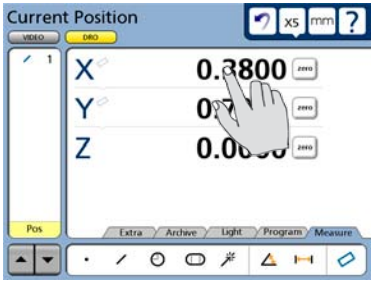


3 Touch the DRO button to display the DRO screen.

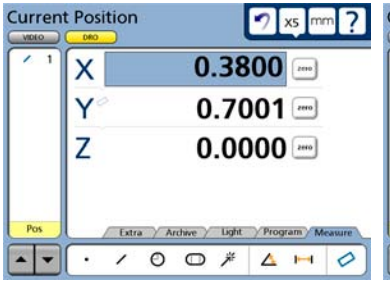




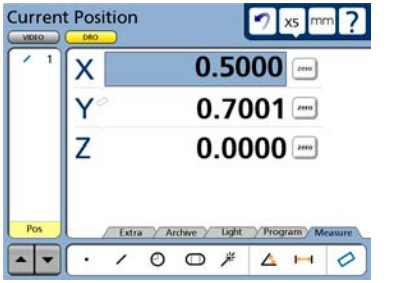
4 Touch the axis value fields and enter the zero or non-zero values to define the datum location. Press the Enter key to enter each value. In this example, a datum is specified at X=0.5, Y=0.5.



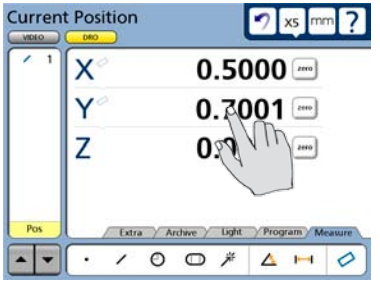
Touch the X-axis value field...



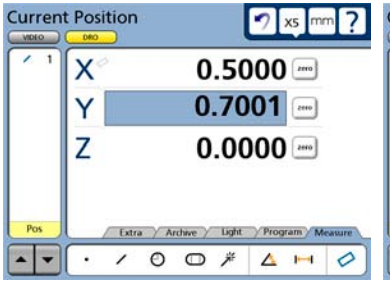
to select it for data entry...



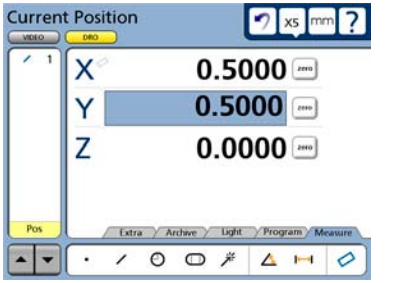
then enter a value and press Enter



Touch the Y-axis value field...

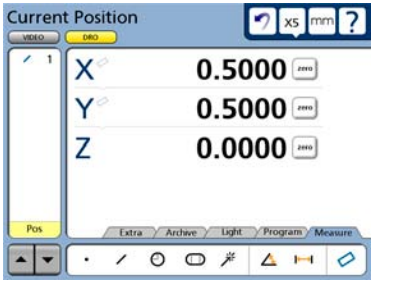


to select it for data entry...



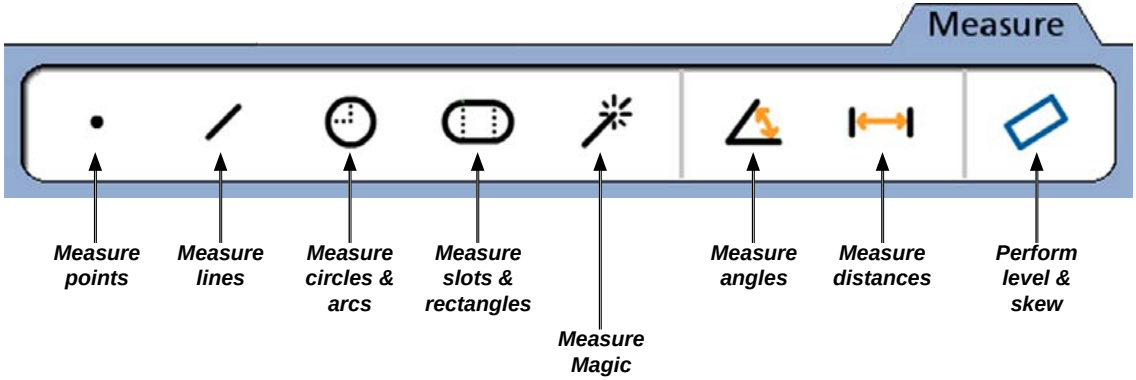
then enter a value and press Enter

The new datum will be shown at the current probe position with the values entered.



Probing and measuring features

Part features are measured by creating a part datum, and then by probing points that define the feature's shape and location. Feature points can be probed using Measure Magic or by using a specific measurement function such as the line or circle function. Measurement functions or measure magic are selected by touching a measure icon in the measure toolbar. Measurement results are shown in the Features list, DRO overlay, DRO window and View window.



The measure toolbar contains icons for 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-300:

- Points
- Lines
- Circles
- Arcs
- Slots

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.

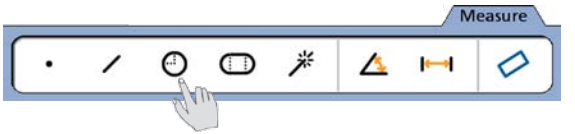
To probe a feature using measure magic, touch the measure magic measure icon, probe points on the desired feature and then press the Finish key.

Probing specific feature types

When measure magic is not used a measure icon must be touched before each specific 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 multiple measurement icon.

Probing a single specific feature type

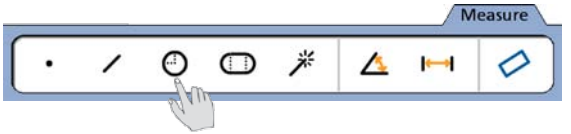
To probe a single feature of a specific type, touch the desired measure icon, probe points on the feature and then press the Finish key. A measure icon must be touched again to measure the next feature. In this example the circle icon is touched to measure a single circle.



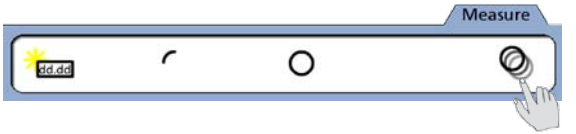
When a specific measure function is used to probe the feature, the feature type cannot be changed once it is added to the feature list.

Probing multiple specific feature type

To probe a series of features of a specific type, 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 icons are touched to probe multiple circles.



Touch the circle icon for circle measurements...

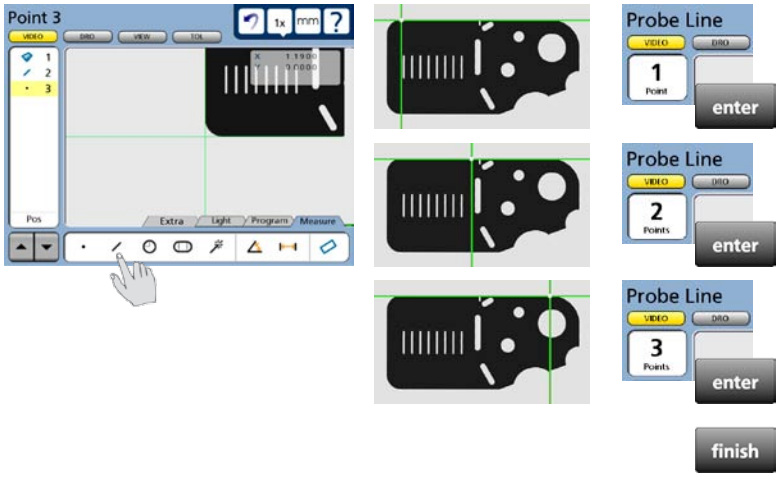


and then touch the multiple measurement icon to measure a series of circle features

When a specific measure function is used 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 and enter features, then press Finish to complete measurements

Results are displayed in the Video, DRO and View windows

Supported feature types

The following feature measurements are supported by the QC-300:

- Points
- Lines
- Arcs
- Circles
- Slots
- Rectangles
- Distances
- Angles

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

NOTE

Manual probing is discussed in Chapter 5: Probes. 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. When using forward annotation, the number of remaining required number of points is shown in 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 in the Measure setup screen. Please refer to Chapter 11: Setup for more information regarding backward and forward annotation.

Probing with crosshairs and video edge detection

Please refer to Chapter 5: Probes for details regarding probing features with crosshairs and video edge detection. Images used as examples in this chapter show crosshairs. However, the measuring concepts apply equally well to crosshair and video edge detection probes.

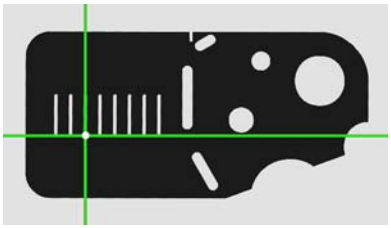
Video edge detection probes provide additional flexibility in terms of acquiring points reliably on feature edges and can probe many points automatically when lines, circles and arcs are being probed using the Multiple edge probe. Please refer to Chapter 5: Probes for more details regarding video edge detection and the Multiple edge probe.

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

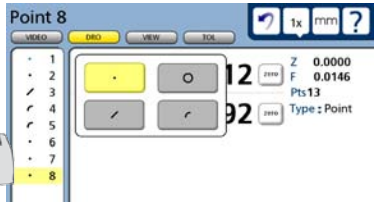
A minimum of one probed point is required to measure a point. Multiple points can be probed if the feature location is indistinct and it is considered a benefit to use the geometric average of many probed locations.



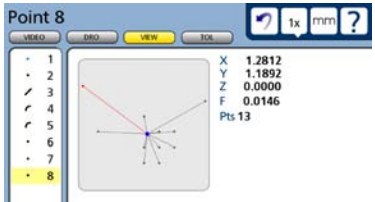
A single point is probed to measure a point

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 window.

Touch the feature type...



to display the menu of alternative types

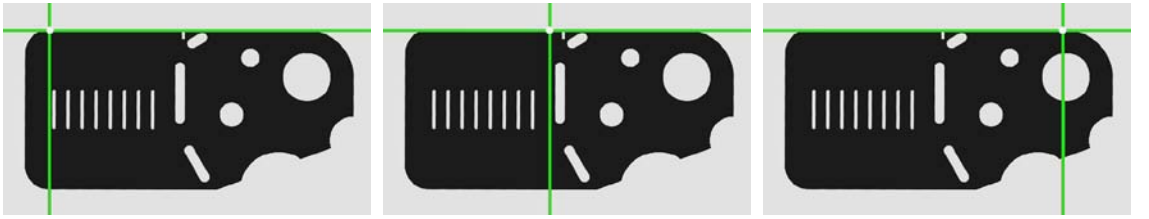


Probed points are shown in the View window

Measurement results are shown in the Features list, View window and DRO window. Results are also shown in the DRO overlay. The feature graphic in the View window 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 window shows the number of points used, the form and the coordinate location of the feature. When only one point is probed, the form error is zero. When more than one point is probed, the form error is the sum of the two greatest opposing error magnitudes.

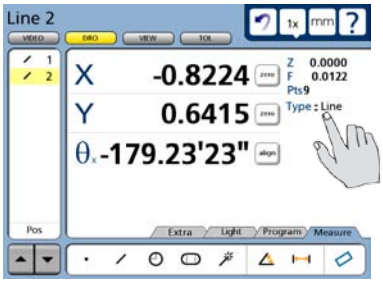
Probing lines

A minimum of two probed points is 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.

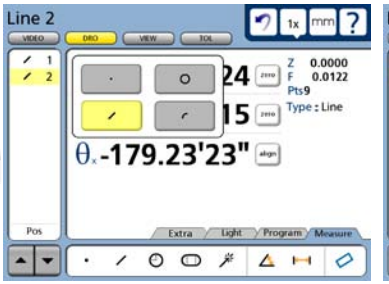


Three points are probed to measure a line

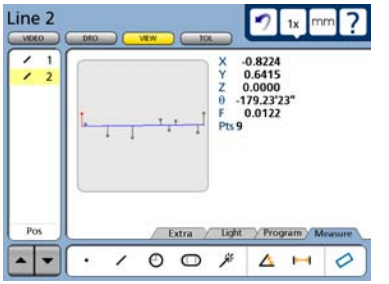
When only two points are probed, Measure Magic will correctly recognize a line and assign the correct feature. However, when more than two points are probed, it is possible that the wrong feature type will be assigned. If the wrong feature type is assigned, it can easily be changed by selecting the correct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



Touch the feature type...



to display the menu of alternative types



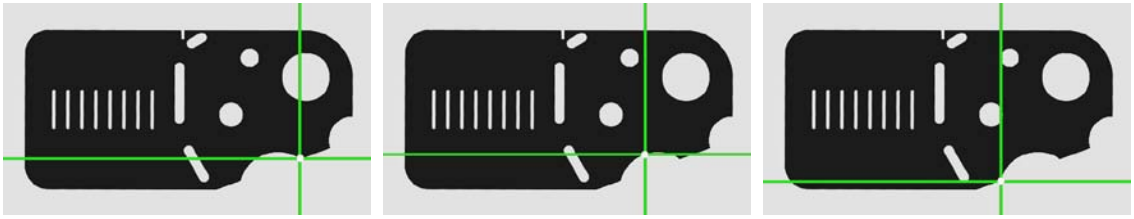
Probed points are shown in the View window

Best-fit algorithms are 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 a menu in the DRO window. Please refer to Chapter 13: Reference Materials for details regarding the fitting algorithms.

Measurement results are shown in the Features list, View window and DRO window. Results are also shown in the DRO overlay. The feature graphic in the View window 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 window shows the number of points used, the angular orientation of the line, the coordinate location of the center of the line and the form error. 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.

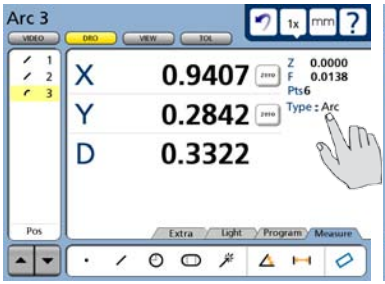
Probing arcs

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.

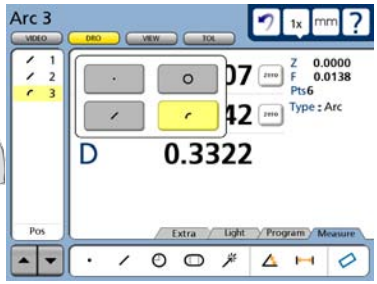


Three points are probed to measure an arc

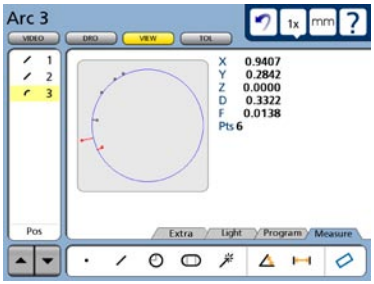
When the arc is less than 185 degrees, Measure Magic will correctly recognize the arc and assign the correct feature. However, when the arc is 185 degrees or more, it is likely that Measure Magic will assign the circle feature type to the data. If the arc is shallow, Measure Magic might mistakenly assign 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 window. Points must be gathered in sequence from the beginning to the end of the arc when the Multiple edge probe is used. More details are contained in Chapter 5: Probes.



Touch the feature type...



to display the menu of alternative types



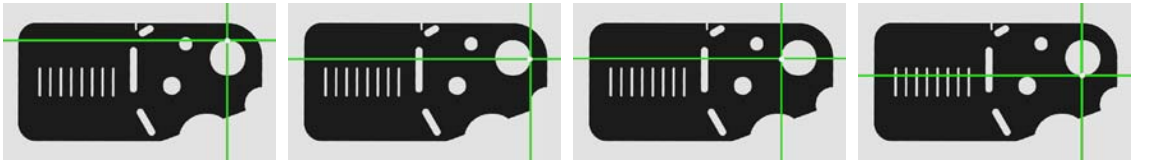
Probed points are shown in the View window

View window shows the feature and the points used to define it. Errors are shown as whiskers connecting the probed points to the feature. The arc will be shown with data point form errors in blue and the greatest two opposing form errors in red.

The DRO window shows the number of points used, the radius and diameter of the arc, the coordinate location of the center of the arc and the form error. The feature graphic in the View window 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.

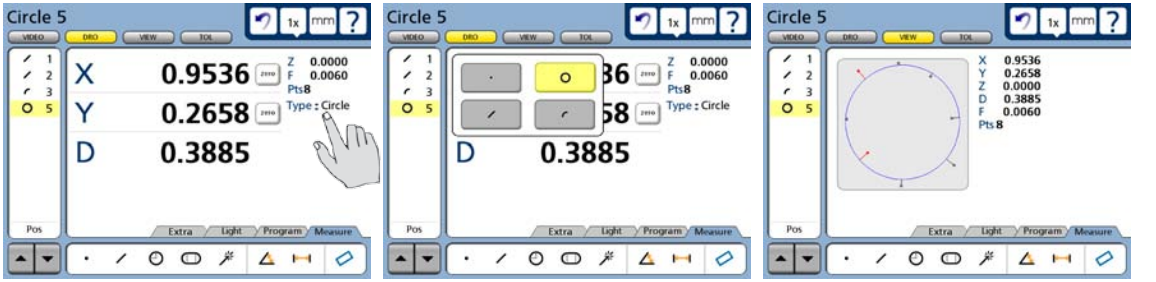
Probing circles

A minimum of three probed points is 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.



Four points are probed to measure an circle

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 type to the data. 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 window.



Touch the feature type... *to display the menu of alternative types* *Probed points are shown in the View window*

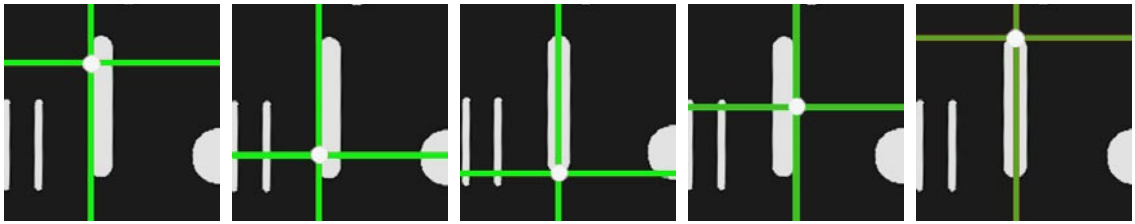
A best-fit algorithm is used to define the circle when more than three points are probed. The circle fit to the probed data can also be changed by selecting the desired fitting algorithm from a menu in the DRO window. Please refer to Chapter 13: Reference Materials for details regarding the fitting algorithms.

The View window shows the feature and the points used to define it. Errors are shown as whiskers connecting the probed points to the feature. The circle will be shown with data point form errors in blue and the greatest two opposing form errors in red.

Measurement results are shown in the Features list, View window and DRO window. Results are also shown in the DRO overlay. The feature graphic in the View window 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 window shows the number of points used, the radius, diameter, coordinate location of the center of the circle and the form error. 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

Five probed points are required to measure a slot. The five points must be probed in a prescribed pattern, and must be probed in clockwise or counterclockwise order.



As shown above, the correct pattern of points probed around the slot is:

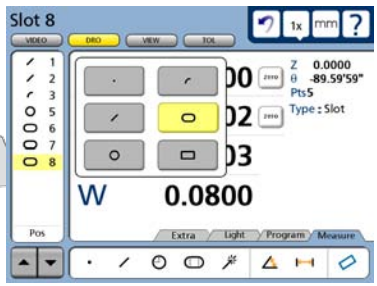
- Two points well distributed along one long side, followed by
- One point on the closest end, followed by
- One point on the approximate center of the second long side, followed by
- The last point on the remaining end

CAUTION

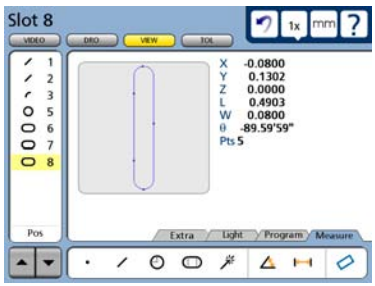
Probing a different pattern of points, or probing out of either clockwise or counter-clockwise order will result in erroneous slot measurements.

When the slot is probed as described above, Measure Magic will assign the correct feature. However, occasionally Measure Magic will assign the wrong feature type to the data. 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 window.

Touch the feature type...



to display the menu of alternative types

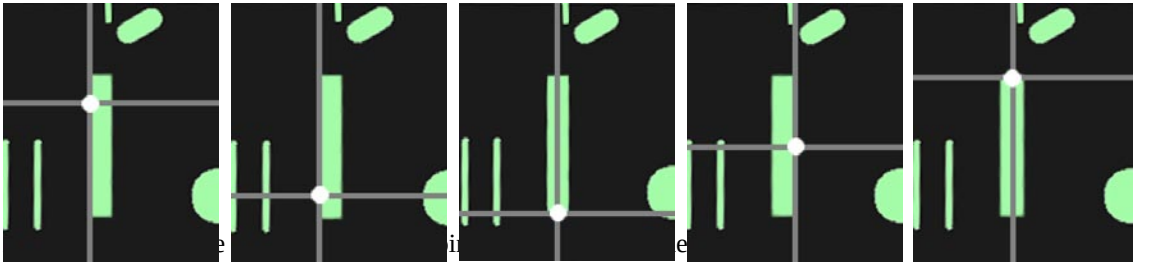


Probed points are shown in the View window

Measurement results are shown in the Features list, View window and DRO window. Results are also shown in the DRO overlay. The feature graphic in the View window shows the feature and the points used to define it. The DRO window shows the number of points probed, the coordinate location of the center of the slot, the slot length, the slot width and the angle of the slot center line with respect to the skew axis.

Probing rectangles

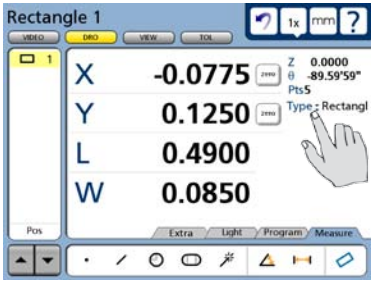
Five probed points are required to measure a rectangle. The five points must be probed in a prescribed pattern, and must be probed in clockwise or counterclockwise order.



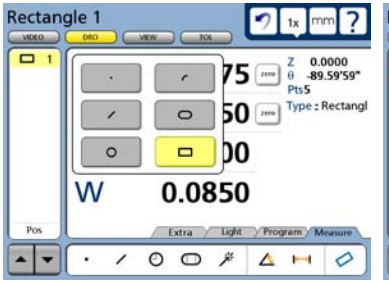
- Two points well distributed along one long side, followed by
- One point on the closest end, followed by
- One point on the approximate center of the second long side, followed by
- The last point on the remaining end

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

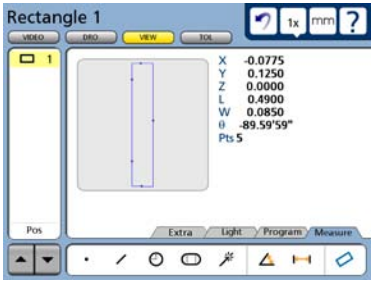
When the rectangle is probed as described above using Measure Magic, Measure Magic will assign the slot feature. However, the slot feature can easily be changed to a rectangle by selecting the rectangle feature from a menu of alternatives in the DRO window.



Touch the feature type...



to select the correct rectangle feature type

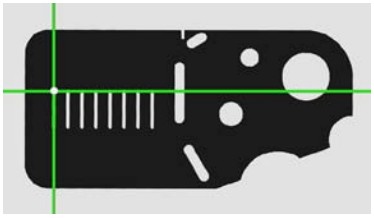


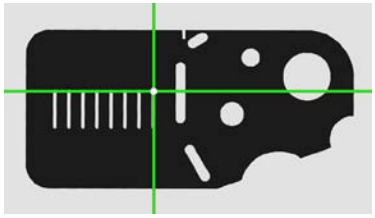
Probed points are shown in the View window

Measurement results are shown in the Features list, View window and DRO window. Results are also shown in the DRO overlay. The feature graphic in the View window shows the feature and the points used to define it. The DRO window shows the number of points probed, the coordinate location of the center of the rectangle, the rectangle length, the rectangle width and the angle of the rectangle center line with respect to the skew axis.

Probing distances

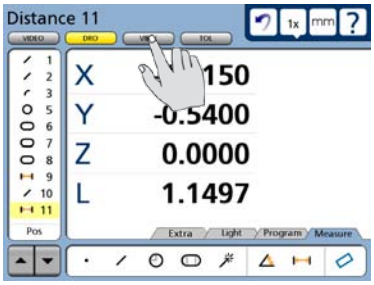
Two probed points are required to measure a distance.

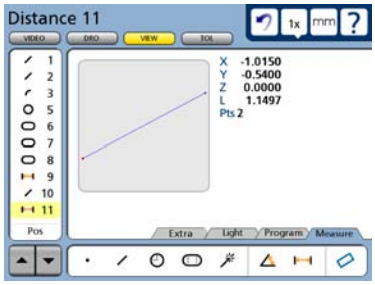




Measurement results are shown in the Features list, View window, DRO window and the DRO overlay.

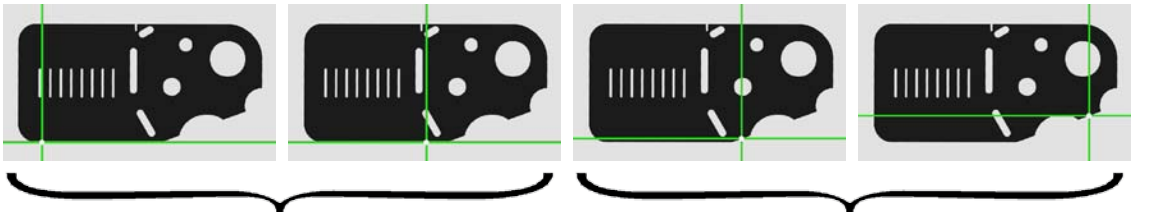
The View window shows the feature and the points used to define it. The DRO window shows the number of points used, the X and Y axis displacements and the distance vector between features.





Probing angles

Four probed points are required to measure an angle. The four points must be probed in a prescribed pattern on the two lines that form an angle. There is no practical limit to the number of points that can be probed, and in general accuracy is increased by probing more points.



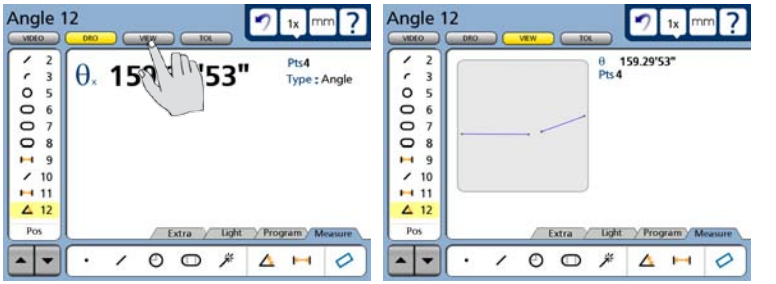
Probe the first two points on the reference side...

and then probe two points on the other side of the included angle

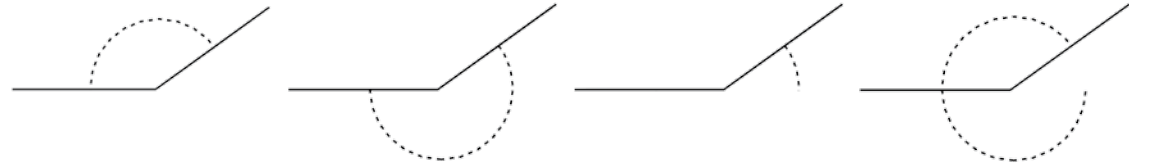
As shown here, the correct pattern of points probed for an angle is:

- A minimum of two points well distributed along the reference side, followed by
- A minimum of two points well distributed along the opposite side of the included angle
- The same number of points must be probed on each of the two sides

The View window shows the feature and the points used to define it. The DRO window shows the number of points probed, the coordinate location of the angle and the angle orientation to the skew axis.



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



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

Constructing features

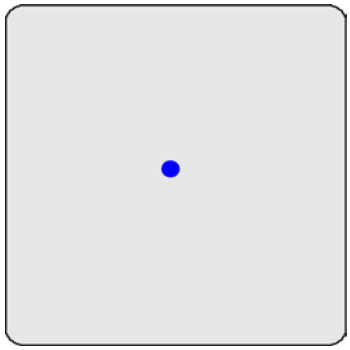
Features can be constructed from one or more existing features. Existing features used to construct new features are called parent features, and can be features that were measured, constructed or created. Existing features are shown in black, and constructed features are shown in blue in the View window.

Point constructions

Points can be constructed from:

- Points
- Lines
- Distances
- Circles
- Angles
- Arcs
- Slots
- Rectangles

Point constructed from a point

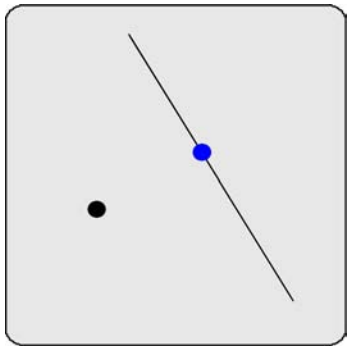


A duplicate feature can be useful when it becomes desirable to perform new operations with the original while retaining a copy. To construct a point from an existing point:

1 Touch the Measure Point icon
2 Touch the desired point in the Features list
3 Press the Enter key
4 Press the Finish key

The new point feature will be constructed over the original point.

Point constructed from a point and a line



The point will be constructed where the perpendicular from the original point intersects the line or its extension.

To construct a point from an existing point and a line:

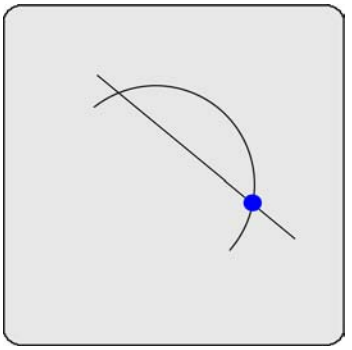
1 Touch the Measure Point icon
2 Touch the desired point feature
3 Touch the desired line feature
4 Press the Enter key
5 Press the Finish key

The new point feature will be constructed on the line.

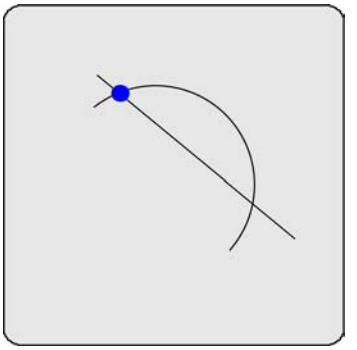
Points constructed from an arc and a line

Up to three point constructions can be made from an arc and a line:

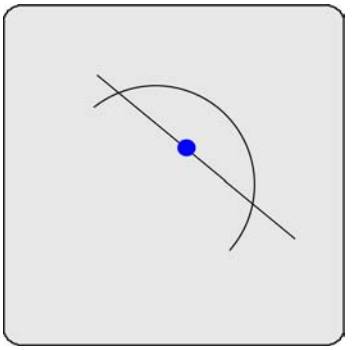
- Intersection point 1:
  The first intersection of the arc and line
- Intersection point 2:
  The second intersection of the arc and line
- Perpendicular point:
  The intersection of the line and the perpendicular from the arc center to the line



Intersection point 1



Intersection point 2



Perpendicular point

To construct a point from an arc and a line:

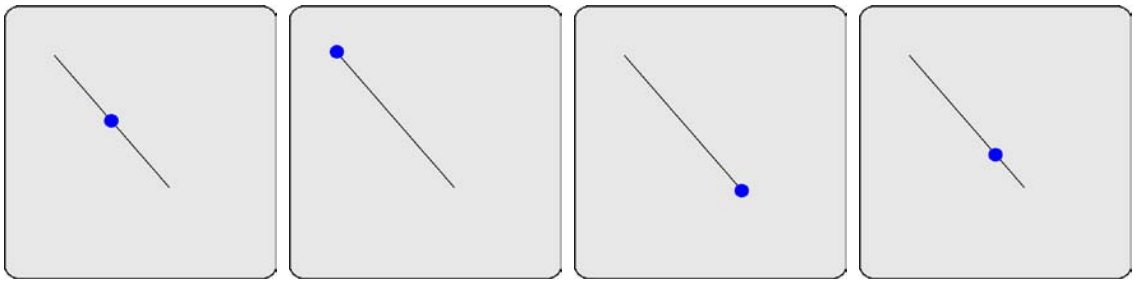
1 Touch the Measure Point icon
2 Touch the desired arc feature
3 Press the Enter key
4 Touch the desired line feature
5 Press the Enter key
6 Press the Finish key

The first intersect point or perpendicular point of the arc and line will be constructed. Alternative point constructions can be selected from the drop-down menu in the DRO window.

Points constructed from a line

Up to four point constructions can be made from a line:

- Midpoint:
  The center of the line
- End point 1:
  The first endpoint of the line
- End point 2:
  The second endpoint of the line
- Anchor point:
  The intersection of the line and the perpendicular from the datum to the line



Midpoint *End point 1* *End point 2* *Anchor point*

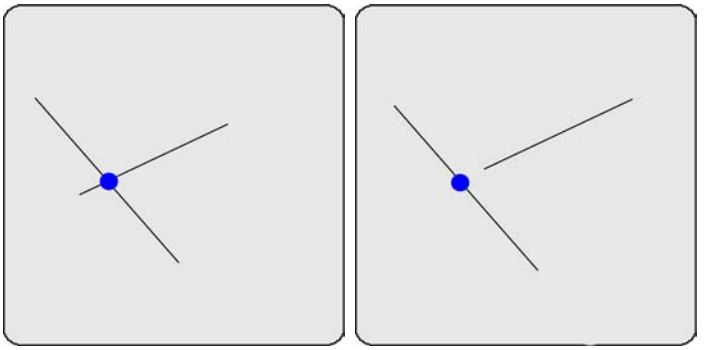
To construct a point from a line:

1 Touch the Measure Point icon
2 Touch the desired line feature
3 Press the Enter key
4 Press the Finish key

The midpoint of the line will be constructed. Alternative point constructions can be selected from the drop-down menu in the DRO window.

Point constructed from two lines

The intersection point of the lines will be constructed. The virtual intersection point will be calculated and shown if the lines do not actually cross.



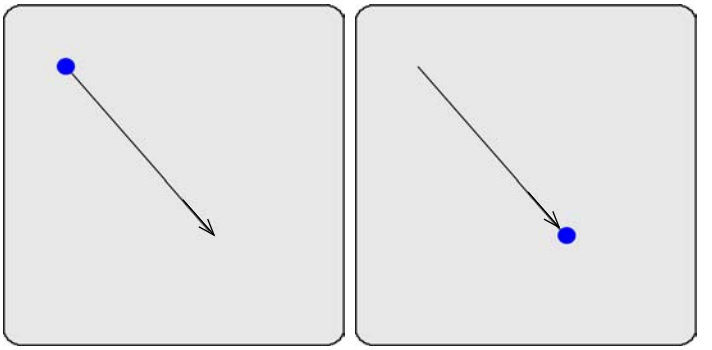
To construct a point from two lines:

1 Touch the Measure Point icon
2 Touch one desired line feature
3 Press the Enter key
4 Touch the other line feature
5 Press the Enter key
6 Press the Finish key

The intersection point or virtual intersection point of the lines will be constructed.

Points constructed from a distance

The start and end points of the distance will be constructed.



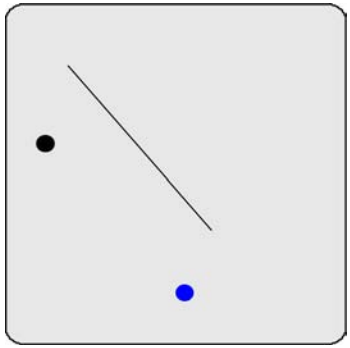
To construct points from a distance:

1 Touch the Measure Point icon
2 Touch the distance feature
3 Press the Enter key
4 Press the Finish key

The start point of the line will be constructed. The alternative end point construction can be selected from the drop-down menu in the DRO window.

Point constructed from a distance and a point

A point feature will be constructed and offset from the parent point feature by the parent distance feature.



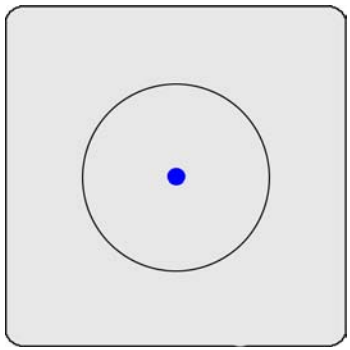
To construct a point from a point and a distance:

1 Touch the Measure Point icon
2 Touch the point feature
3 Press the Enter key
4 Touch the distance feature
5 Press the Enter key
6 Press the Finish key

An offset point feature will be constructed.

Point constructed from a circle

A point feature will be constructed at the center of a circle.



To construct a point from a circle:

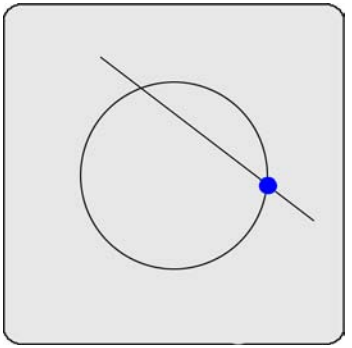
1 Touch the Measure Point icon
2 Touch the circle feature
3 Press the Enter key
4 Press the Finish key

A point feature will be constructed at the center of the circle.

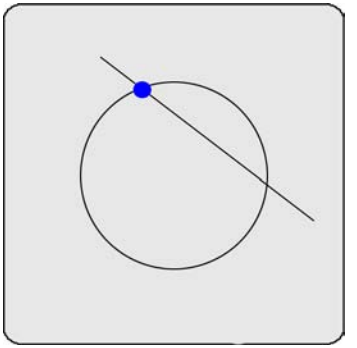
Points constructed from a circle and a line

Up to three point constructions can be made from an circle and a line:

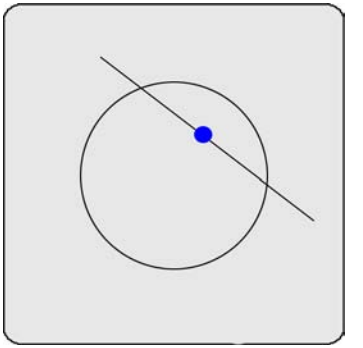
- Intersection point 1:
  The first intersection of the circle and line
- Intersection point 2:
  The second intersection of the circle and line
- Perpendicular point:
  The intersection of the line and the perpendicular from the circle center to the line



Intersection point 1



Intersection point 2



Perpendicular point

To construct a point from an circle and a line:

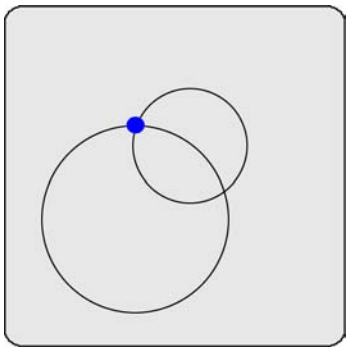
1 Touch the Measure Point icon
2 Touch the desired circle feature
3 Press the Enter key
4 Touch the desired line feature
5 Press the Enter key
6 Press the Finish key

The first intersect point or perpendicular point of the circle and line will be constructed. Alternative point constructions can be selected from the drop-down menu in the DRO window.

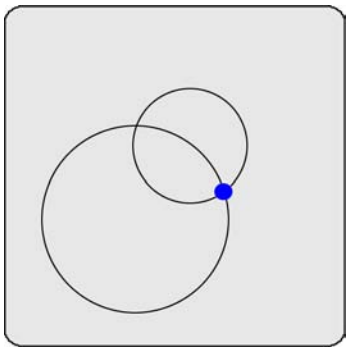
Points constructed from two circles

Up to three point constructions can be made from two circles:

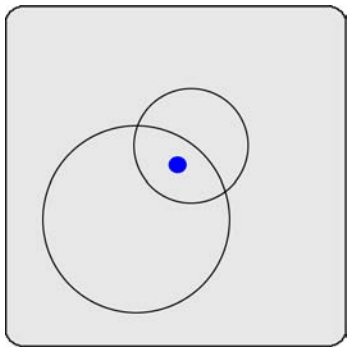
- Intersection point 1:
  The first intersection of the two circles
- Intersection point 2:
  The second intersection of the two circles
- Midpoint:
  The midpoint of the congruent portion of the two circles



Intersection point 1



Intersection point 2



Midpoint

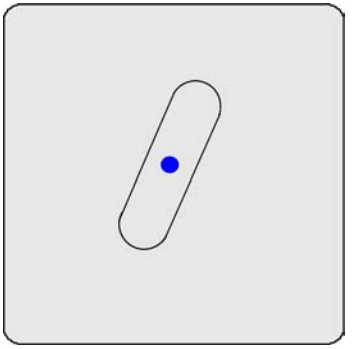
To construct a point from two circles:

1 Touch the Measure Point icon
2 Touch the first circle feature
3 Press the Enter key
4 Touch the second circle feature
5 Press the Enter key
6 Press the Finish key

The first intersect point of the two circles will be constructed. Alternative point constructions can be selected from the drop-down menu in the DRO window.

Point constructed from a slot

A point feature will be constructed at the center of a slot.



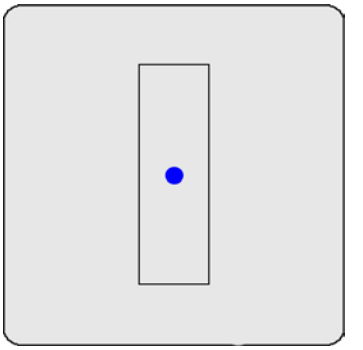
To construct a point from a slot:

1 Touch the Measure Point icon
2 Touch the slot feature
3 Press the Enter key
4 Press the Finish key

A point feature will be constructed at the center of the slot.

Point constructed from a rectangle

A point feature will be constructed at the center of a rectangle.



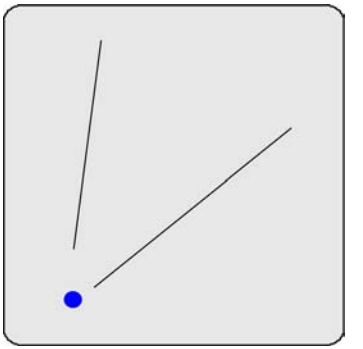
To construct a point from a slot:

1 Touch the Measure Point icon
2 Touch the rectangle feature
3 Press the Enter key
4 Press the Finish key

A point feature will be constructed at the center of the rectangle.

Point constructed from an angle

A point feature will be constructed at the apex of the angle.



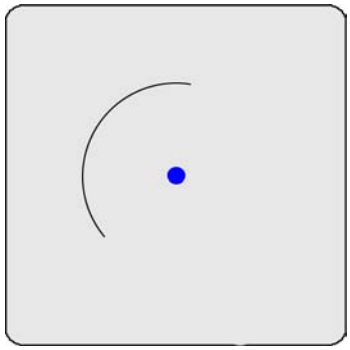
To construct a point from an angle:

1 Touch the Measure Point icon
2 Touch the angle feature
3 Press the Enter key
4 Press the Finish key

A point feature will be constructed at the apex of the angle.

Point constructed from an arc

A point feature will be constructed at the center of an arc.



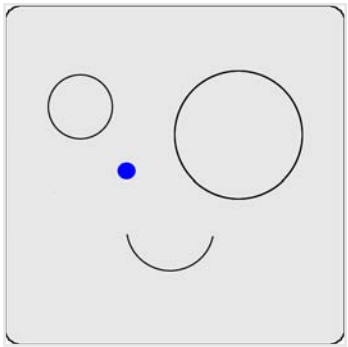
To construct a point from an arc:

1 Touch the Measure Point icon
2 Touch the arc feature
3 Press the Enter key
4 Press the Finish key

A point feature will be constructed at the center of the arc.

Point constructed from multiple features

The geometric center point of multiple features can be constructed from any combination and any number of points, slots, rectangles, circles, and arcs.



To construct a point from multiple features:

1 Touch the Measure Point icon
2 Touch a feature
3 Press the Enter key
4 Repeat steps 2 and 3 for all features
5 Press the Finish key

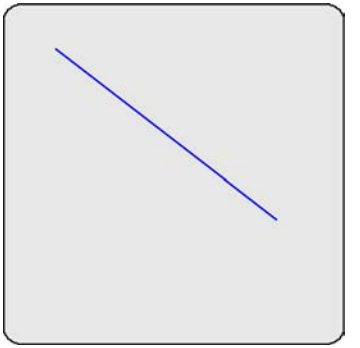
The center point (centroid) of the entire collection of features will be constructed.

Line constructions

Lines can be constructed from:

- Points
- Lines
- Distances
- Circles
- Angles
- Arcs
- Slots

Line constructed from a line

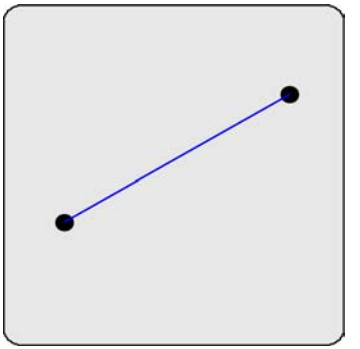


A duplicate feature can be useful when it becomes desirable to perform new operations with the original while retaining a copy. To construct a line from an existing line:

1 Touch the Measure Line icon
2 Touch the desired line in the Features list
3 Press the Enter key
4 Press the Finish key

The new line feature will be constructed over the original line.

Line constructed from two points



The line feature will be constructed between the two points.

To construct a line from two points:

1 Touch the Measure Line icon
2 Touch the first point Feature
3 Press the Enter key
4 Touch the second point Feature
5 Press the Enter key
6 Press the Finish key

The new line feature will be constructed between the two points.

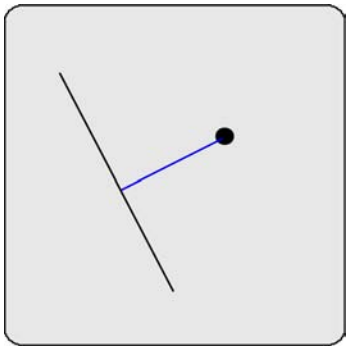
Lines constructed from a point and a line

Two line constructions can be made from a point and a line:

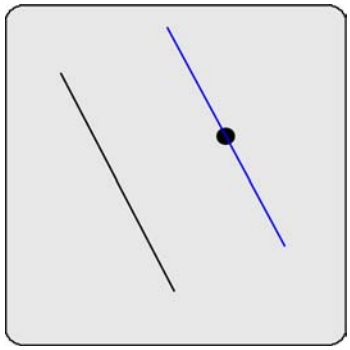
- Perpendicular line:
  The line from the point to the line, perpendicular to the line
- Parallel line:
  The line through the point parallel to the line

To construct a line from a point and a line:

1 Touch the Measure Line icon
2 Touch the point feature
3 Press the Enter key
4 Touch the line feature
5 Press the Enter key
6 Press the Finish key



Perpendicular line



Parallel line

The perpendicular line will be constructed. The alternative parallel line construction can be selected from the drop-down menu in the DRO window.

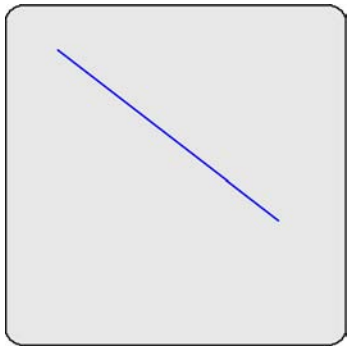
Line constructed from a distance

The line feature will be constructed over a distance feature.

To construct a line from a distance:

1 Touch the Measure Line icon
2 Touch the distance Feature
3 Press the Enter key
4 Press the Finish key

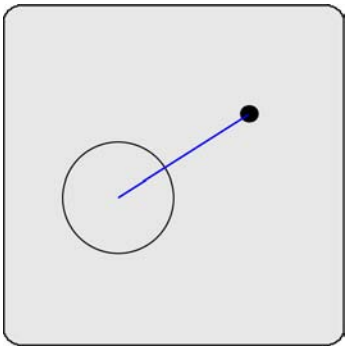
The new line feature will be constructed over the distance feature.



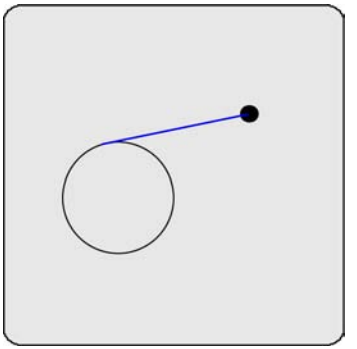
Lines constructed from a point and a circle

Up to three line constructions can be made from a point and a circle:

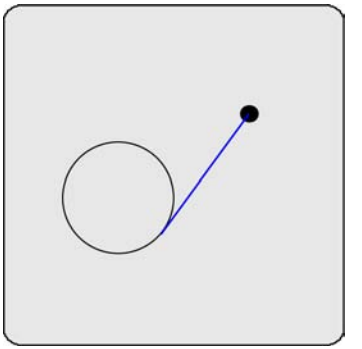
- Two point line:
  The line from the point to the center of the circle
- Tangent line 1:
  The line from the point to the first tangent of the circle
- Tangent line 2:
  The line from the point to the second tangent of the circle



Two point line



Tangent line 1



Tangent line 2

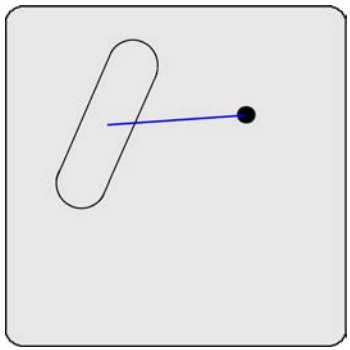
To construct a line from a point and a circle:

1 Touch the Measure line icon
2 Touch the point feature
3 Press the Enter key
4 Touch the circle feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

Line constructed from a point and a slot

The line will be constructed from the point to the center of the slot.



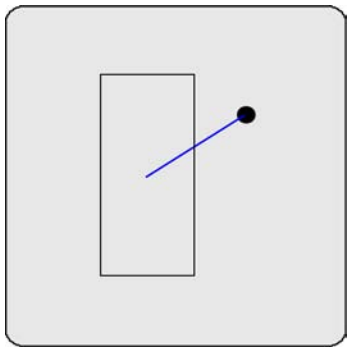
To construct a line from a point and a slot:

1 Touch the Measure line icon
2 Touch the point feature
3 Press the Enter key
4 Touch the slot feature
5 Press the Enter key
6 Press the Finish key

The line will be constructed to the center of the slot.

Line constructed from a point and a rectangle

The line will be constructed from the point to the center of the rectangle.



To construct a line from a point and a rectangle:

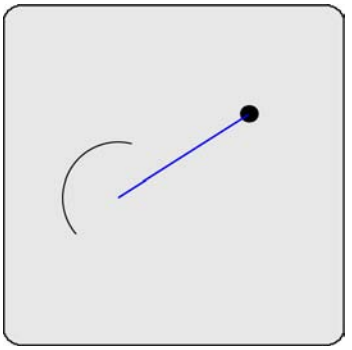
1 Touch the Measure line icon
2 Touch the point feature
3 Press the Enter key
4 Touch the rectangle feature
5 Press the Enter key
6 Press the Finish key

The line will be constructed to the center of the rectangle.

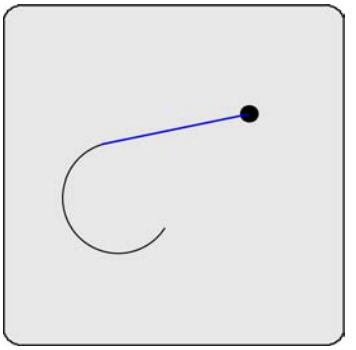
Lines constructed from a point and an arc

Up to three line constructions can be made from a point and an arc:

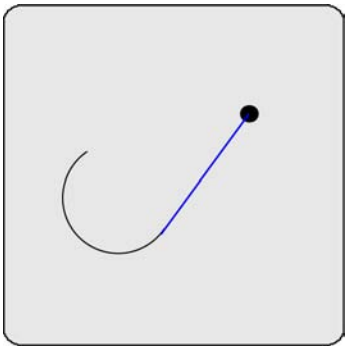
- Two point line:
  The line from the point to the center of the arc
- Tangent line 1:
  The line from the point to the first tangent of the arc
- Tangent line 2:
  The line from the point to the second tangent of the arc



Two point line



Tangent line 1



Tangent line 2

To construct a line from a point and an arc:

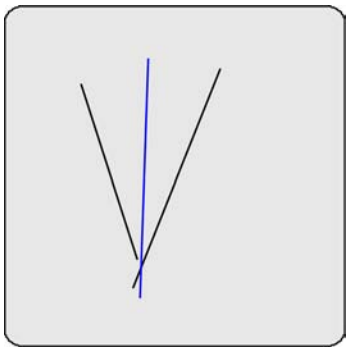
1 Touch the Measure line icon
2 Touch the point feature
3 Press the Enter key
4 Touch the arc feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

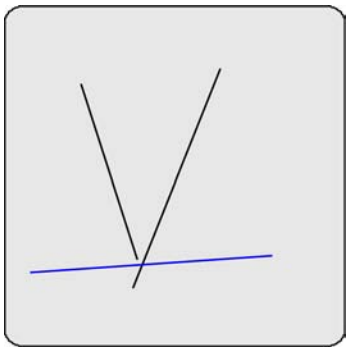
Lines constructed from two lines

Up to three line constructions can be made from two lines:

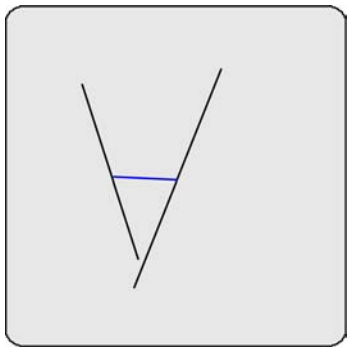
- Midline 1:
  Bisects the acute angle between the two lines
- Midline 2:
  Bisects the obtuse angle between the two lines
- Gage line:
  The line of a specified length perpendicular to bisector 1
  (The user will be prompted for the length)



Midline 1



Midline 2



Gage line

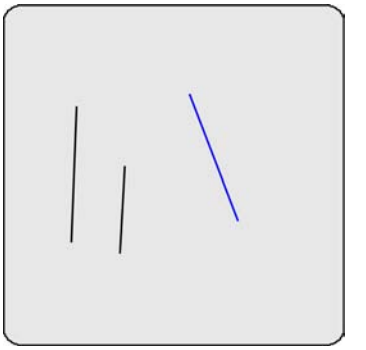
To construct a line from two lines:

1 Touch the Measure line icon
2 Touch the first line feature
3 Press the Enter key
4 Touch the second line feature
5 Press the Enter key
6 Press the Finish key

The bisector 1 line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

Line constructed from a line and a distance

A line feature will be constructed and offset from a parent line feature by a parent distance feature.



To construct a line from a line and a distance:

1 Touch the Measure Line icon
2 Touch the line feature
3 Press the Enter key
4 Touch the distance feature
5 Press the Enter key
6 Press the Finish key

An offset line feature will be constructed.

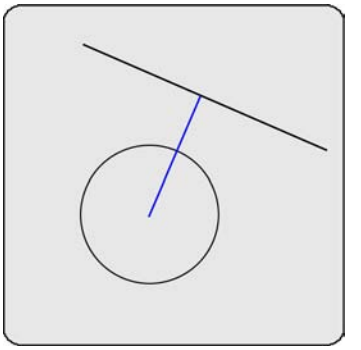
Lines constructed from a line and a circle

Two line constructions can be made from a line and a circle:

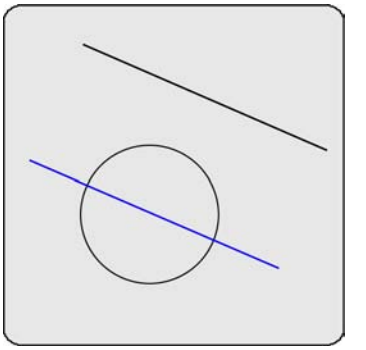
- Perpendicular line:
  The line from the center of the circle, to the line, perpendicular to the line
- Parallel line:
  The line through the center of the circle, parallel to the line

To construct a line from a line and a circle:

1 Touch the Measure Line icon
2 Touch the line feature
3 Press the Enter key
4 Touch the circle feature
5 Press the Enter key
6 Press the Finish key



Perpendicular line



Parallel line

The perpendicular line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

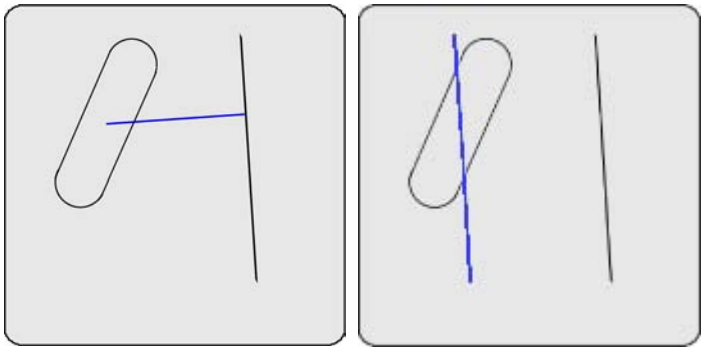
Lines constructed from a line and a slot

Two line constructions can be made from a line and a slot:

- Perpendicular line:
  The line from the center of the slot, to the line, perpendicular to the line
- Parallel line:
  The line through the center of the slot, parallel to the line

To construct a line from a line and a slot:

1 Touch the Measure Line icon
2 Touch the line feature
3 Press the Enter key
4 Touch the slot feature
5 Press the Enter key
6 Press the Finish key



The perpendicular line will be constructed. The alternative parallel line construction can be selected from the drop-down menu in the DRO window.

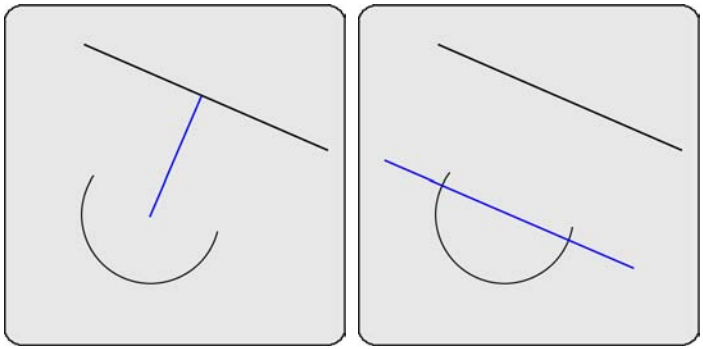
Lines constructed from a line and an arc

Two line constructions can be made from a line and an arc:

- Perpendicular line:
  The line from the center of the arc, to the line, perpendicular to the line
- Parallel line:
  The line through the center of the arc, parallel to the line

To construct a line from a line and a arc:

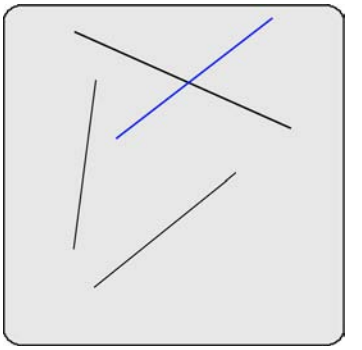
1 Touch the Measure Line icon
2 Touch the line feature
3 Press the Enter key
4 Touch the arc feature
5 Press the Enter key
6 Press the Finish key



The perpendicular line will be constructed. The alternative parallel line construction can be selected from the drop-down menu in the DRO window.

Line constructed from a line and an angle

The line will be constructed and rotated counterclockwise the amount equal to the parent angle.



To construct a line from a line and an angle:

1 Touch the Measure Line icon
2 Touch the line feature
3 Press the Enter key
4 Touch the angle feature
5 Press the Enter key
6 Press the Finish key

The rotated line will be constructed.

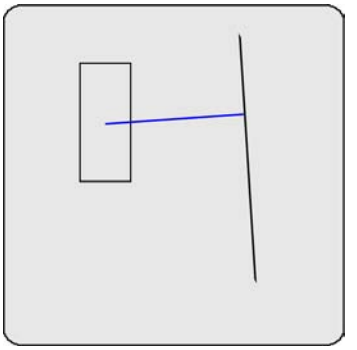
Lines constructed from a line and a rectangle

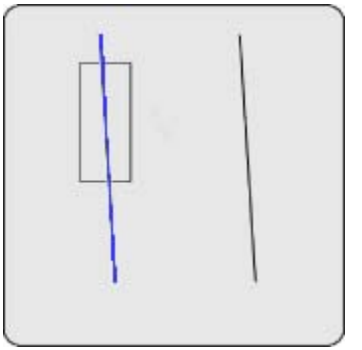
Two line constructions can be made from a line and a slot:

- Perpendicular line:
  The line from the center of the slot, to the line, perpendicular to the line
- Parallel line:
  The line through the center of the slot, parallel to the line

To construct a line from a line and a slot:

1 Touch the Measure Line icon
2 Touch the line feature
3 Press the Enter key
4 Touch the slot feature
5 Press the Enter key
6 Press the Finish key



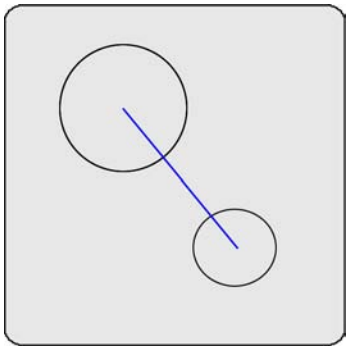


The perpendicular line will be constructed. The alternative parallel line construction can be selected from the drop-down menu in the DRO window.

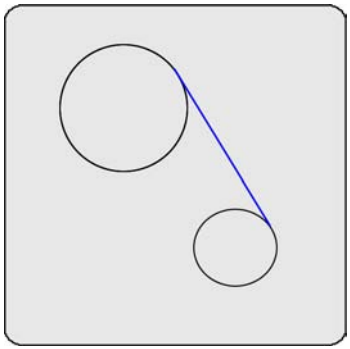
Lines constructed from two circles

Up to three line constructions can be made from two circles:

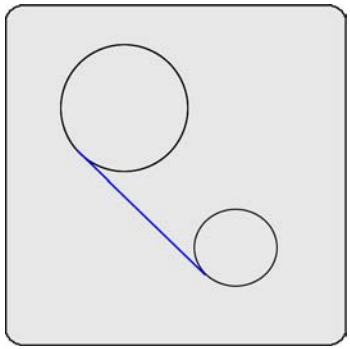
- Two point line:
  The line between the two circle centers
- Tangent line 1:
  The first line tangent to both circles on the same side
- Tangent line 2:
  The second line tangent to both circles on the opposite side



Two point line



Tangent line 1



Tangent line 2

To construct a line between two circles:

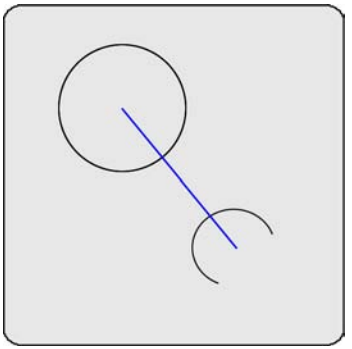
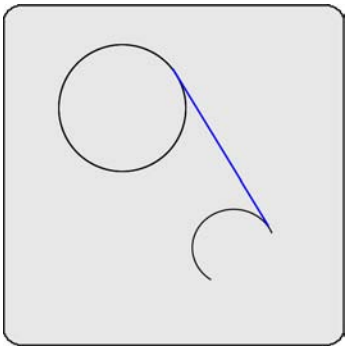
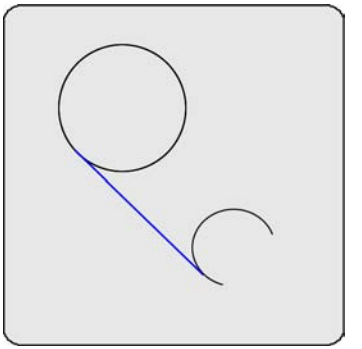
1 Touch the Measure line icon
2 Touch the first circle feature
3 Press the Enter key
4 Touch the second circle feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

Lines constructed from a circle and an arc

Up to three line constructions can be made from a circle to an arc:

- Two point line:
  The line between the circle and arc centers
- Tangent line 1:
  The first line tangent to the circle and arc on the same side
- Tangent line 2:
  The second line tangent to the circle and arc on the opposite side

To construct a line between a circle and an arc:

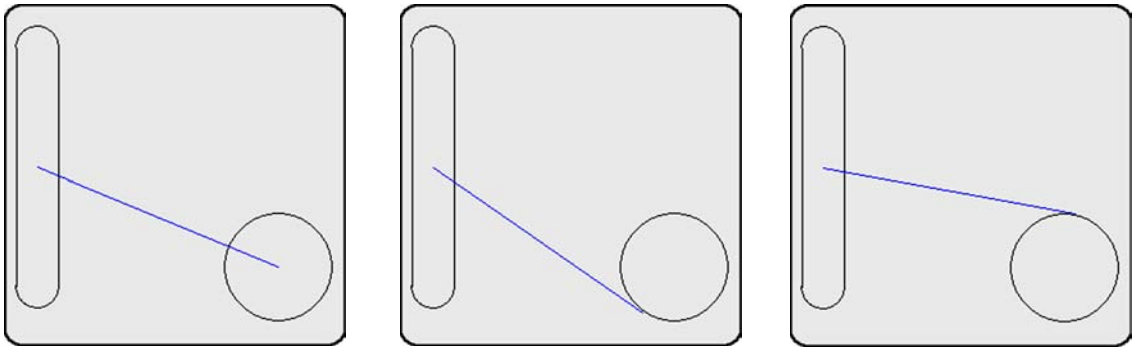
1 Touch the Measure line icon
2 Touch the circle feature
3 Press the Enter key
4 Touch the arc feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

Lines constructed from a circle and a slot

Up to three line constructions can be made from a slot to a circle:

- Two point line:
  The line between the slot and circle centers
- Tangent line 1:
  The first line tangent to the slot and circle on the same side
- Tangent line 2:
  The second line tangent to the slot and circle on the opposite side



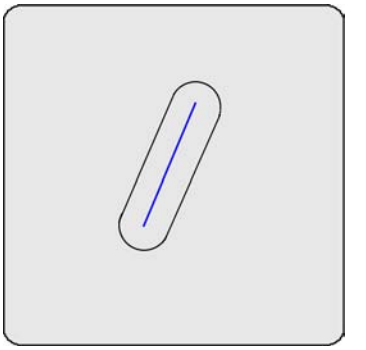
To construct a line from a slot and a circle:

1 Touch the Measure Line icon
2 Touch the circle feature
3 Press the Enter key
4 Touch the slot feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

Line constructed from a slot

The line feature will be constructed from the arc center at one end of the slot to the arc center at the other end.



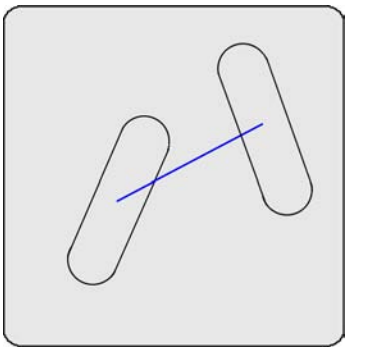
To construct a line from a slot:

1 Touch the Measure Line icon
2 Touch the slot feature
3 Press the Enter key
4 Press the Finish key

The extracted line of the slot will be constructed.

Line constructed from two slots

The line feature will be constructed from the center of one slot to the center of the other.



To construct a line from two slots:

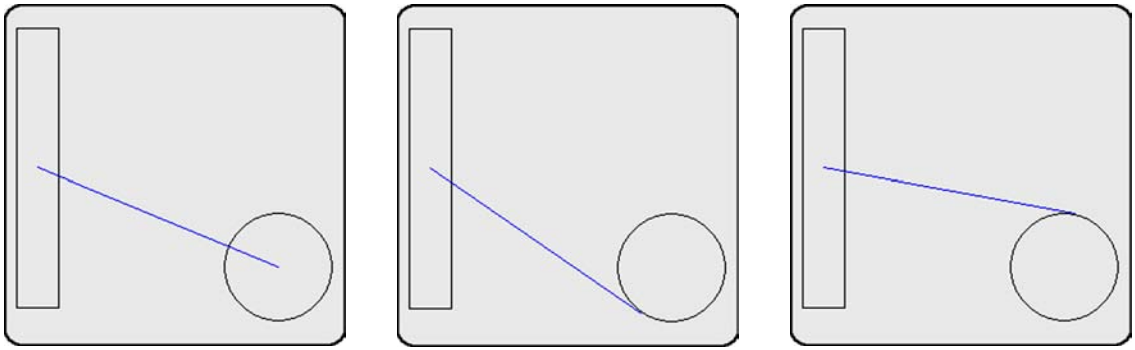
1 Touch the Measure Line icon
2 Touch the first slot feature
3 Press the Enter key
4 Touch the second slot feature
5 Press the Enter key
6 Press the Finish key

The line will be constructed between the two slots.

Lines constructed from a rectangle and a circle

Up to three line constructions can be made from a rectangle to a circle:

- Two point line:
  The line between the rectangle and circle centers
- Tangent line 1:
  The first line tangent to the rectangle and circle on the same side
- Tangent line 2:
  The second line tangent to the rectangle and circle on the opposite side



To construct a line from a rectangle and a circle:

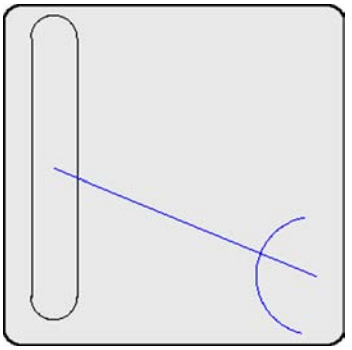
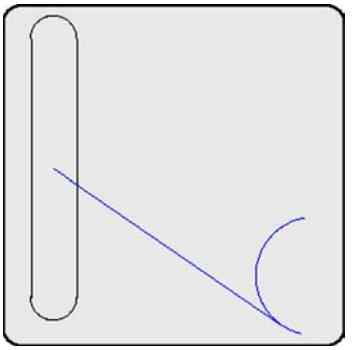
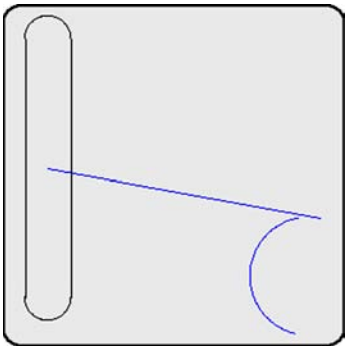
1 Touch the Measure Line icon
2 Touch the rectangle feature
3 Press the Enter key
4 Touch the circle feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

Lines constructed from a slot and an arc

Up to three line constructions can be made from a slot to an arc:

- Two point line:
  The line between the slot and arc centers
- Tangent line 1:
  The first line tangent to the slot and arc on the same side
- Tangent line 2:
  The second line tangent to the slot and arc on the opposite side

To construct a line from a slot and an arc:

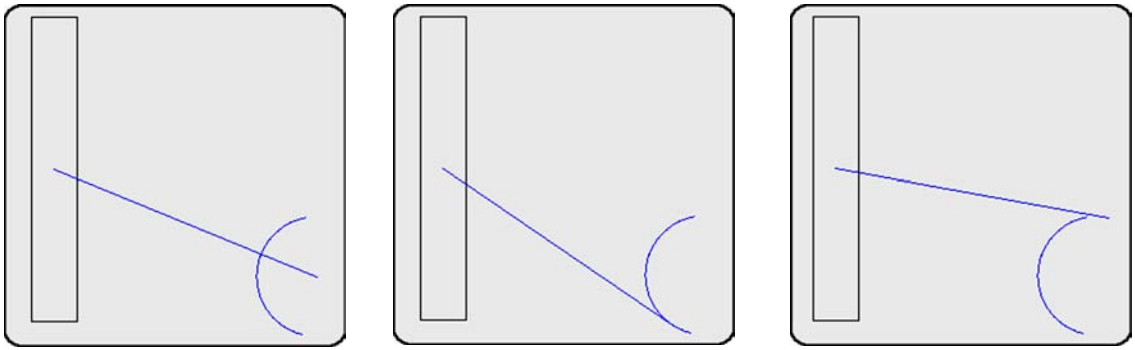
1 Touch the Measure Line icon
2 Touch the slot feature
3 Press the Enter key
4 Touch the arc feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

Lines constructed from a rectangle and an arc

Up to three line constructions can be made from a rectangle to an arc:

- Two point line:
  The line between the rectangle and arc centers
- Tangent line 1:
  The first line tangent to the rectangle and arc on the same side
- Tangent line 2:
  The second line tangent to the rectangle and arc on the opposite side

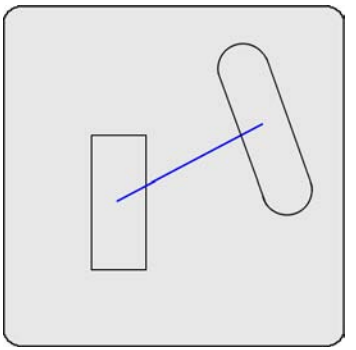


To construct a line from a rectangle and an arc:

1 Touch the Measure Line icon
2 Touch the rectangle feature
3 Press the Enter key
4 Touch the arc feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

Lines constructed from a slot and a rectangle



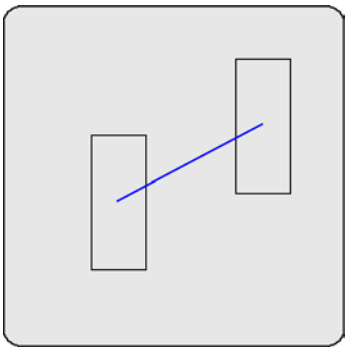
The line feature will be constructed from the center of the slot to the center of the rectangle.

To construct a line from a slot and a rectangle:

1 Touch the Measure Line icon
2 Touch the slot feature
3 Press the Enter key
4 Touch the rectangle feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed.

Lines constructed between two rectangles



The line feature will be constructed from the center of one rectangle to the center of the other.

To construct a line between two rectangles:

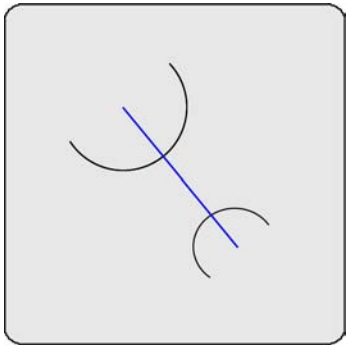
1 Touch the Measure Line icon
2 Touch the first rectangle feature
3 Press the Enter key
4 Touch the second rectangle feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed.

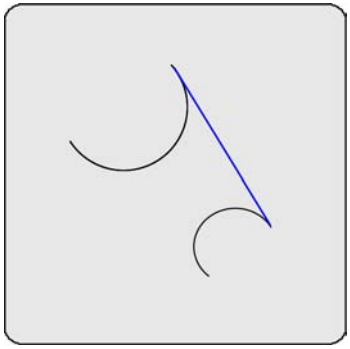
Line constructed from two arcs

Up to three line constructions can be made from two arcs:

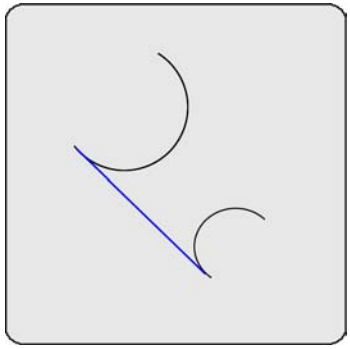
- Two point line:
  The line between the two arc centers
- Tangent line 1:
  The first line tangent to both arcs on the same side
- Tangent line 2:
  The second line tangent to both arcs on the opposite side



Two point line



Tangent line 1



Tangent line 2

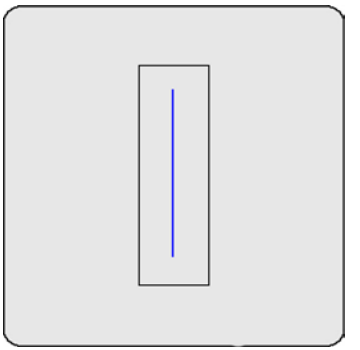
To construct a line between two arcs:

1 Touch the Measure Line icon
2 Touch the first arc feature
3 Press the Enter key
4 Touch the second arc feature
5 Press the Enter key
6 Press the Finish key

The two point line will be constructed. Alternative line constructions can be selected from the drop-down menu in the DRO window.

Line constructed from a rectangle

The line feature will be constructed from the radius center at one end of the rectangle to the radius center at the other end.



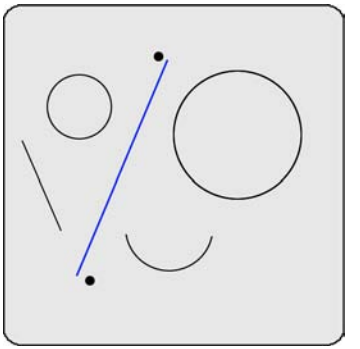
To construct a line from a slot:

1 Touch the Measure Line icon
2 Touch the rectangle feature
3 Press the Enter key
4 Press the Finish key

The center line of the rectangle will be constructed.

Line constructed from multiple features

The best fit line through the center of multiple features can be constructed from any combination and any number of points, slots, circles, and arcs.



To construct a line from multiple features:

1 Touch the Measure Line icon
2 Touch a feature
3 Press the Enter key
4 Repeat steps 2 and 3 for all features
5 Press the Finish key

The best fit line through the entire collection of features will be constructed.

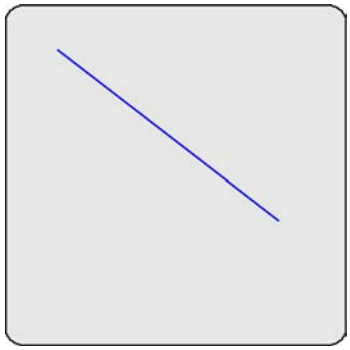
Distance constructions

Distances can be constructed from:

- Points
- Lines
- Distances
- Circles
- Arcs
- Slots

Distance constructed from a distance

A duplicate feature can be useful when it becomes desirable to perform new operations with the original while retaining a copy. To construct a distance from an existing distance:

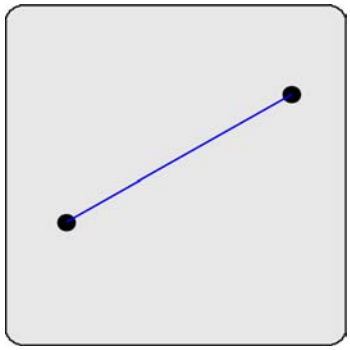


1 Touch the Measure Distance icon
2 Touch the desired distance
3 Press the Enter key
4 Press the Finish key

The new distance feature will be constructed over the original distance.

Distances constructed from two points

The distance feature will be constructed between the two points.

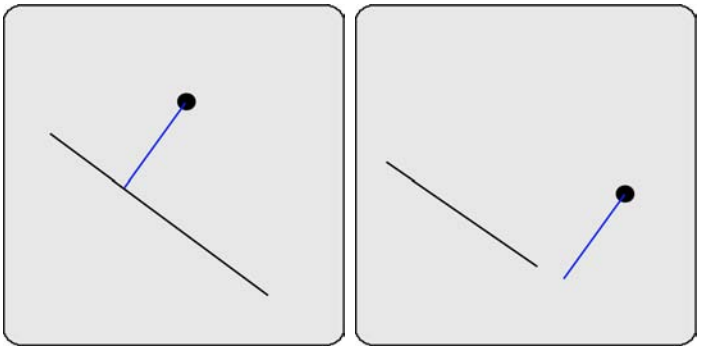


To construct a distance from two points:

1 Touch the Measure Distance icon
2 Touch the first point Feature
3 Press the Enter key
4 Touch the second point Feature
5 Press the Enter key
6 Press the Finish key

The new distance feature will be constructed between the two points.

Distances constructed from a point and a line



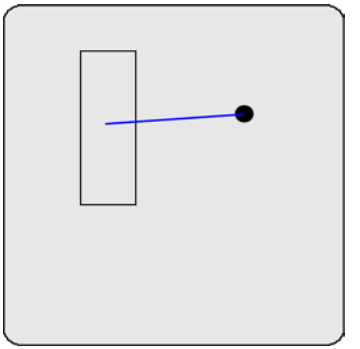
The distance feature will be constructed from the point to the line perpendicular to the line, or perpendicular to the extended virtual line if the line feature is short.

To construct a distance from a point and a line:

1 Touch the Measure Distance icon
2 Touch the point feature
3 Press the Enter key
4 Touch the line feature
5 Press the Enter key
6 Press the Finish key

The new distance feature will be constructed.

Distances constructed from a point and a rectangle



The distance feature will be constructed from the point to the center of the rectangle.

To construct a distance from a point and a rectangle:

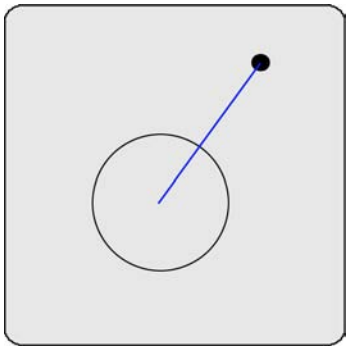
1 Touch the Measure Distance icon
2 Touch the point feature
3 Press the Enter key
4 Touch the rectangle feature
5 Press the Enter key
6 Press the Finish key

The new distance feature will be constructed.

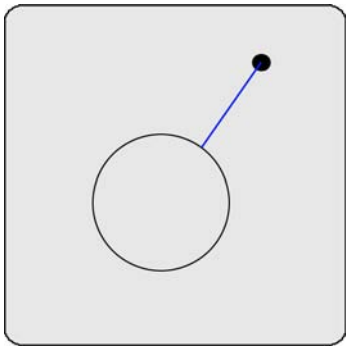
Distances constructed from a point and a circle

Up to three distance constructions can be made from a point to a circle:

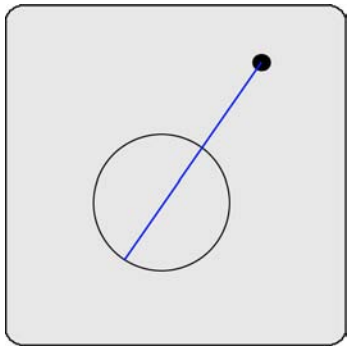
- Distance between features:
  The distance between the point and circle center
- Nearest distance:
  The distance between the point and nearest circle circumference
- Farthest distance:
  The distance between the point and farthest circle circumference



Distance between features



Nearest distance



Farthest distance

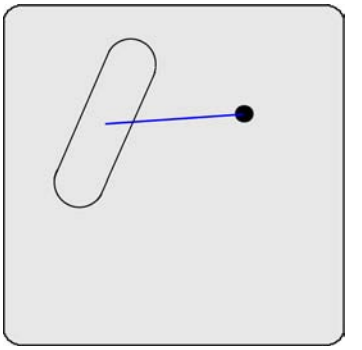
To construct a distance between a point and a circle:

1 Touch the Measure Distance icon
2 Touch the point feature
3 Press the Enter key
4 Touch the circle feature
5 Press the Enter key
6 Press the Finish key

The distance between the point and circle center will be constructed. Alternative distance constructions can be selected from the drop-down menu in the DRO window.

Distance constructed from a point and a slot

The distance feature will be constructed between the point and the center of the slot.



To construct a distance from a point to a slot:

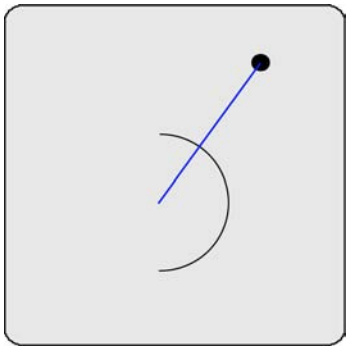
1 Touch the Measure Distance icon
2 Touch the point Feature
3 Press the Enter key
4 Touch the slot Feature
5 Press the Enter key
6 Press the Finish key

The new distance feature will be constructed between the point and the slot.

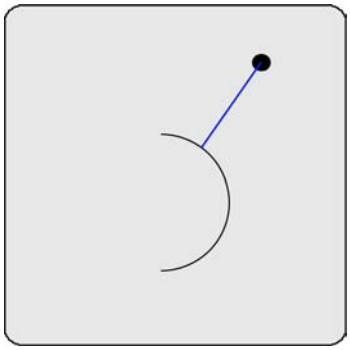
Distances constructed from a point and an arc

Up to three distance constructions can be made from a point to an arc:

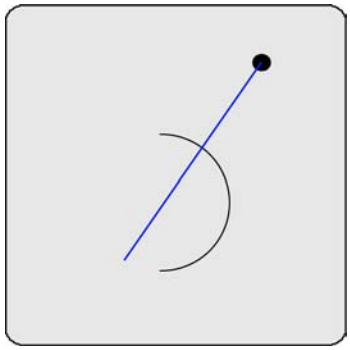
- Distance between features:
  The distance between the point and arc center
- Nearest distance:
  The distance between the point and nearest arc circumference
- Farthest distance:
  The distance between the point and farthest arc circumference



Distance between features



Nearest distance



Farthest distance

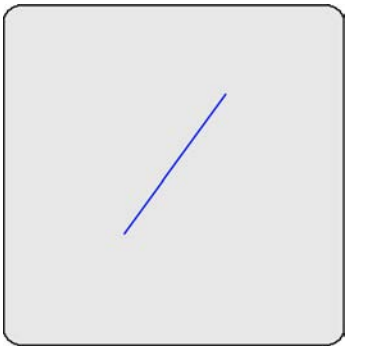
To construct a distance between a point and a arc:

1 Touch the Measure Distance icon
2 Touch the point feature
3 Press the Enter key
4 Touch the arc feature
5 Press the Enter key
6 Press the Finish key

The distance between the point and arc center will be constructed. Alternative distance constructions can be selected from the drop-down menu in the DRO window.

Distance constructed from a line

The length-of-axis distance feature will be constructed from a parent line feature.



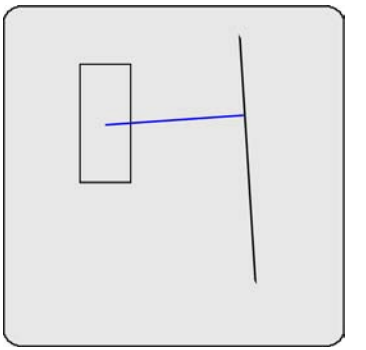
To construct a distance from a line:

1 Touch the Measure Distance icon
2 Touch the line Feature
3 Press the Enter key
4 Press the Finish key

The new distance feature will be constructed over the line.

Distance constructed from a line and a rectangle

The distance feature will be constructed between the center of the line and the center of the rectangle.



To construct a distance from a line to a rectangle:

1 Touch the Measure Distance icon
2 Touch the line Feature
3 Press the Enter key
4 Touch the rectangle Feature
5 Press the Enter key
6 Press the Finish key

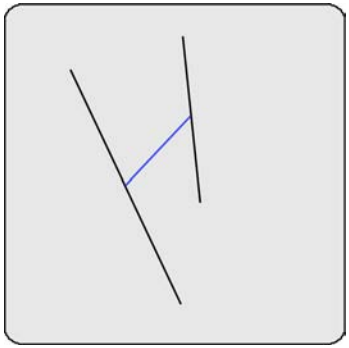
The new distance feature will be constructed between the two centers.

Distances constructed from two lines

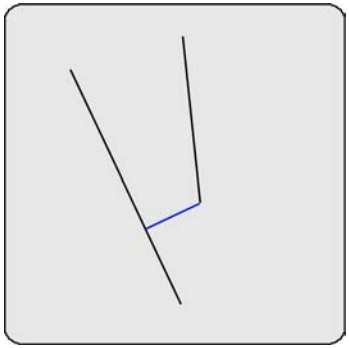
Up to three distance constructions can be made from two lines:

- Center distance:
  The perpendicular distance from the first line in the features list to the center of the second
- Min distance:
  The perpendicular distance from the first line in the features list to the nearest point of the second
- Max distance:
  The perpendicular distance from the first line in the features list to the farthest point of the second

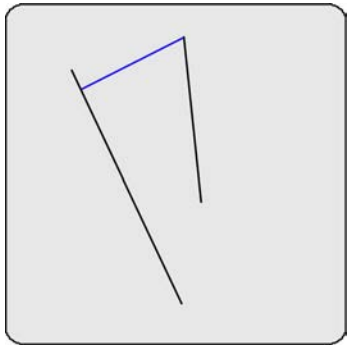
Distances from virtual line extensions will be shown if the first line in the features list is not long.



Center distance



Min distance



Max distance

To construct a distance between two lines:

1 Touch the Measure Distance icon
2 Touch the first line feature
3 Press the Enter key
4 Touch the second line feature
5 Press the Enter key
6 Press the Finish key

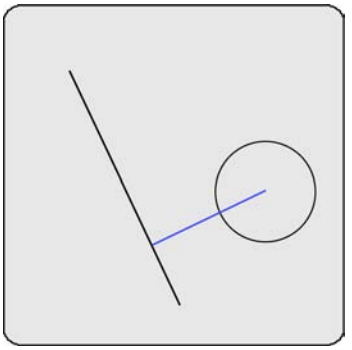
The center distance will be constructed. Alternative distance constructions can be selected from the drop-down menu in the DRO window.

Distances constructed from a line and a circle

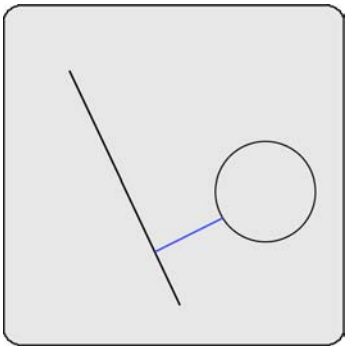
Up to three distance constructions can be made from a line and a circle:

- Center distance:
  The perpendicular distance from the line to the center of the circle
- Min distance:
  The perpendicular distance from the line to the nearest point of the circle
- Max distance:
  The perpendicular distance from the line to the farthest point of the circle

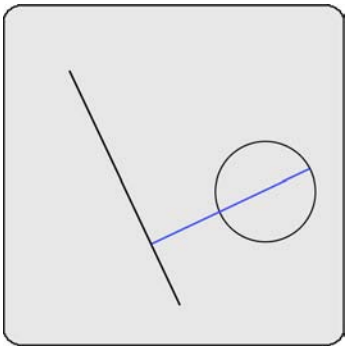
Distances from virtual line extensions will be shown if the line is not long.



Center distance



Min distance



Max distance

To construct a distance between a line and a circle:

1 Touch the Measure Distance icon
2 Touch the line feature
3 Press the Enter key
4 Touch the circle feature
5 Press the Enter key
6 Press the Finish key

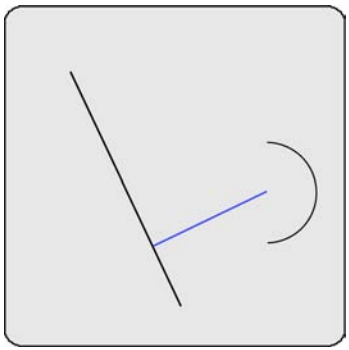
The center distance will be constructed. Alternative distance constructions can be selected from the drop-down menu in the DRO window.

Distances constructed from a line and an arc

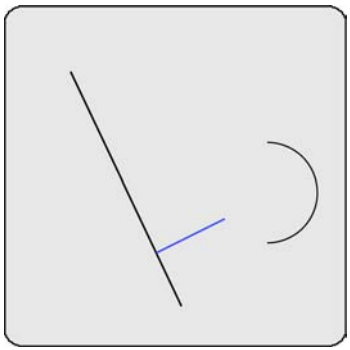
Up to three distance constructions can be made from a line and an arc:

- Center distance:
  The perpendicular distance from the line to the center of the arc
- Min distance:
  The perpendicular distance from the line to the nearest point of the arc
- Max distance:
  The perpendicular distance from the line to the farthest point of the arc

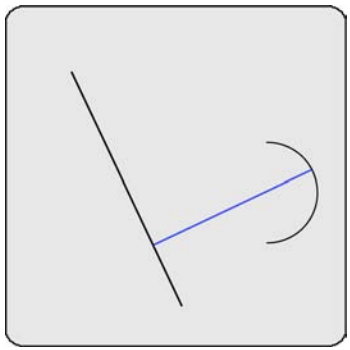
Distances from virtual line extensions will be shown if the line is not long.



Center distance



Min distance



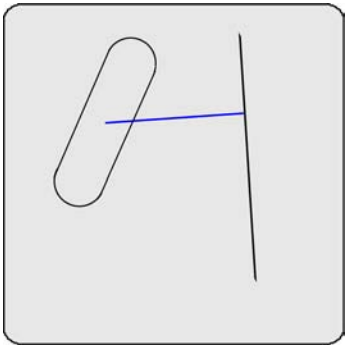
Max distance

To construct the distance between a line and an arc:

1 Touch the Measure Distance icon
2 Touch the line feature
3 Press the Enter key
4 Touch the arc feature
5 Press the Enter key
6 Press the Finish key

The center distance will be constructed. Alternative distance constructions can be selected from the drop-down menu in the DRO window.

Distance constructed from a line and a slot



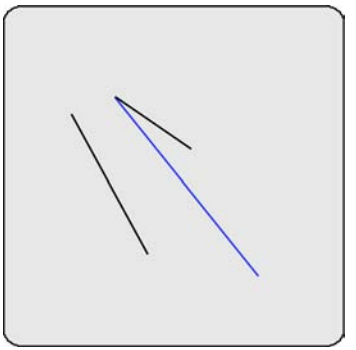
The distance feature will be constructed from the center of the slot perpendicular to the line.

To construct a distance from a line and a slot:

1 Touch the Measure Distance icon
2 Touch the line Feature
3 Press the Enter key
4 Touch the slot Feature
5 Press the Enter key
6 Press the Finish key

The distance feature will be constructed between the line and slot. Distances from virtual line extensions will be shown if the line is not long.

Distance constructed from two distances



The sum-of-distances feature will be constructed from two distance features.

To construct a distance from two distance features:

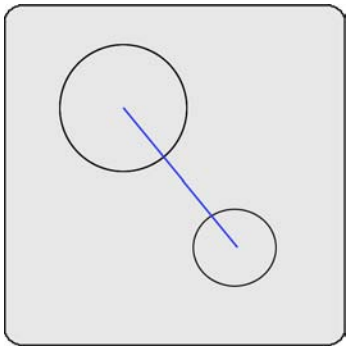
1 Touch the Measure Distance icon
2 Touch the first distance Feature
3 Press the Enter key
4 Touch the second distance Feature
5 Press the Enter key
6 Press the Finish key

The distance feature will be constructed between the two distance features.

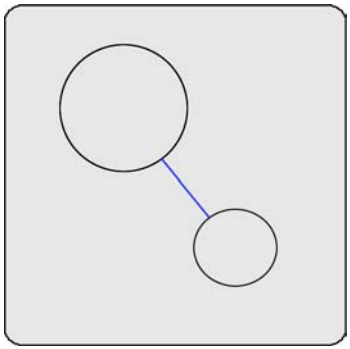
Distances constructed from two circles

Up to three distance constructions can be made from two circles:

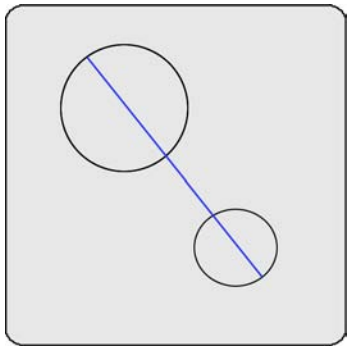
- Center distance:
  The distance from the center of one circle to the center of the other
- Min distance:
  The minimum distance between the two circle circumferences
- Max distance:
  The maximum distance between the two circle circumferences



Center distance



Min distance



Max distance

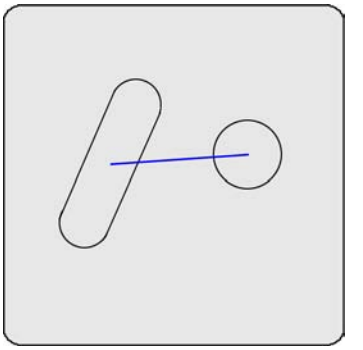
To construct the distance between two circles:

1 Touch the Measure Distance icon
2 Touch the first circle feature
3 Press the Enter key
4 Touch the second circle feature
5 Press the Enter key
6 Press the Finish key

The center distance will be constructed. Alternative distance constructions can be selected from the drop-down menu in the DRO window.

Distances constructed from a slot and a circle

The distance feature will be constructed between the centers of the slot and the circle.



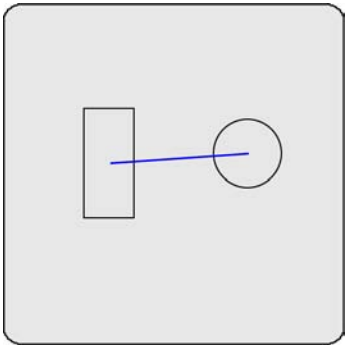
To construct a distance from a slot and a circle:

1 Touch the Measure Distance icon
2 Touch the slot Feature
3 Press the Enter key
4 Touch the circle Feature
5 Press the Enter key
6 Press the Finish key

The distance feature will be constructed between the slot and the circle.

Distances constructed from a rectangle and a circle

The distance feature will be constructed between the centers of the rectangle and the circle.



To construct a distance from a rectangle and a circle:

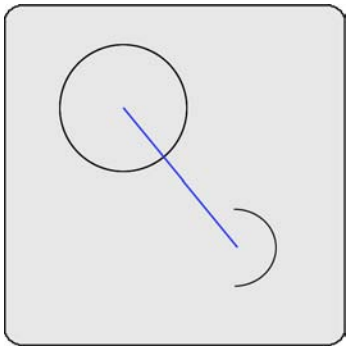
1 Touch the Measure Distance icon
2 Touch the rectangle Feature
3 Press the Enter key
4 Touch the circle Feature
5 Press the Enter key
6 Press the Finish key

The distance feature will be constructed between the rectangle and the circle.

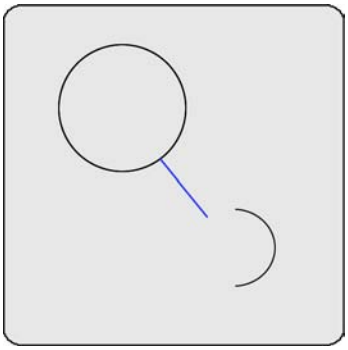
Distances constructed from an arc and a circle

Up to three distance constructions can be made from an arc and a circle:

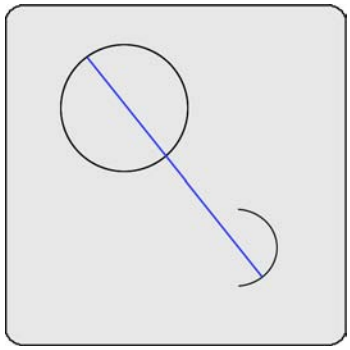
- Center distance:
  The distance from the center of the circle to the center of the arc
- Min distance:
  The minimum distance between the arc and circle circumferences
- Max distance:
  The maximum distance between the arc and circle circumferences



Center distance



Min distance



Max distance

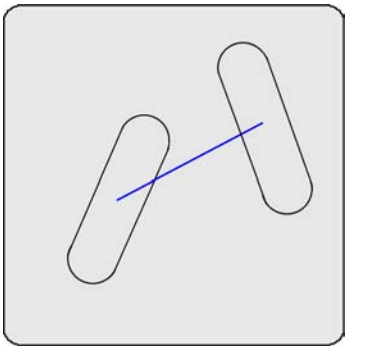
To construct the distance between an arc and a circle:

1 Touch the Measure Distance icon
2 Touch the arc feature
3 Press the Enter key
4 Touch the circle feature
5 Press the Enter key
6 Press the Finish key

The center distance will be constructed. Alternative distance constructions can be selected from the drop-down menu in the DRO window.

Distance constructed from two slots

The distance feature will be constructed between the centers of two slots.



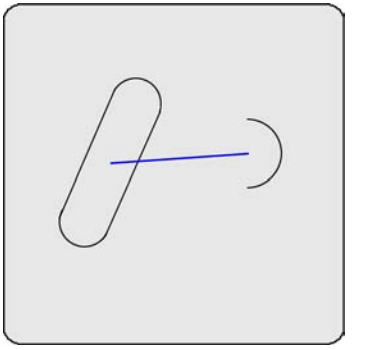
To construct a distance between two slots:

1 Touch the Measure Distance icon
2 Touch the first slot Feature
3 Press the Enter key
4 Touch the second slot Feature
5 Press the Enter key
6 Press the Finish key

The distance feature will be constructed between the two slots.

Distances constructed from a slot and an arc

The distance feature will be constructed between the centers of the slot and the arc.



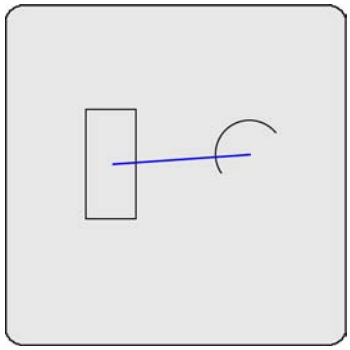
To construct a distance from a slot and an arc:

1 Touch the Measure Distance icon
2 Touch the slot Feature
3 Press the Enter key
4 Touch the arc Feature
5 Press the Enter key
6 Press the Finish key

The distance feature will be constructed between the slot and the arc.

Distances constructed from a rectangle and an arc

The distance feature will be constructed between the centers of the rectangle and the arc.



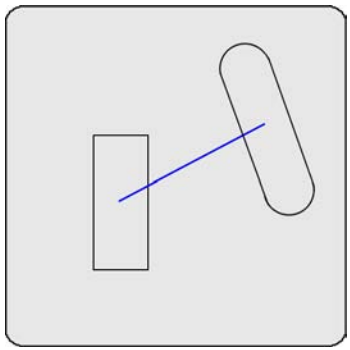
To construct a distance from a rectangle and an arc:

1 Touch the Measure Distance icon
2 Touch the rectangle Feature
3 Press the Enter key
4 Touch the arc Feature
5 Press the Enter key
6 Press the Finish key

The distance feature will be constructed between the rectangle and the arc.

Distances constructed from a slot and a rectangle

The distance feature will be constructed between the centers of a slot and a rectangle.



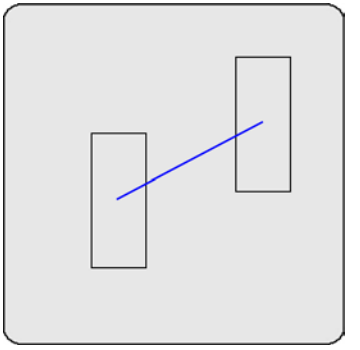
To construct a distance from a slot and a rectangle:

1 Touch the Measure Distance icon
2 Touch the slot Feature
3 Press the Enter key
4 Touch the rectangle Feature
5 Press the Enter key
6 Press the Finish key

The distance feature will be constructed between the slot and the rectangle.

Distances constructed between two rectangles

The distance feature will be constructed between the centers of two rectangles.



To construct a distance between two rectangles:

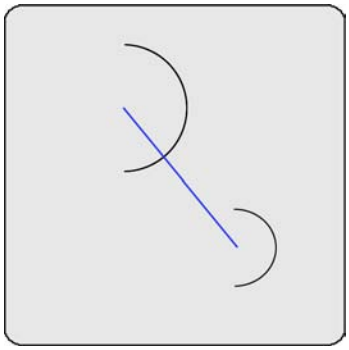
1 Touch the Measure Distance icon
2 Touch the first rectangle Feature
3 Press the Enter key
4 Touch the second rectangle Feature
5 Press the Enter key
6 Press the Finish key

The distance feature will be constructed between the two rectangles.

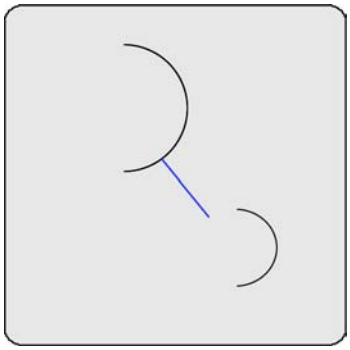
Distances constructed from two arcs

Up to three different distance constructions can be made from two arcs:

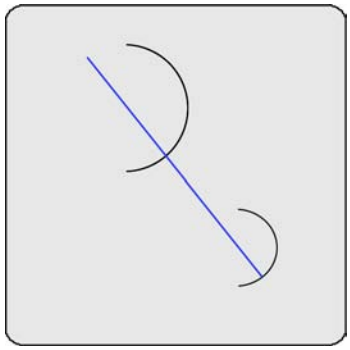
- Center distance:
  The distance from the center of one arc to the center of the other
- Min distance:
  The minimum distance between the two arc circumferences
- Max distance:
  The maximum distance between the two arc circumferences



Center distance



Min distance



Max distance

To construct the distance between two arcs:

1 Touch the Measure Distance icon
2 Touch the first arc feature
3 Press the Enter key
4 Touch the second arc feature
5 Press the Enter key
6 Press the Finish key

The center distance will be constructed. Alternative distance constructions can be selected from the drop-down menu in the DRO window.

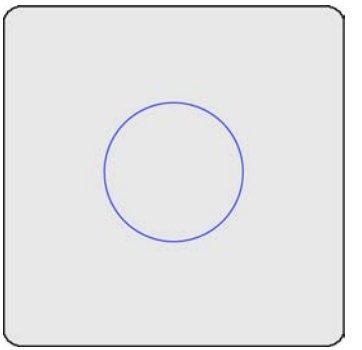
Circle constructions

Circles can be constructed from:

- Points
- Lines
- Circles
- Slots
- Distances
- Arcs

Circle constructed from a circle

A duplicate feature can be useful when it becomes desirable to perform new operations with the original while retaining a copy.



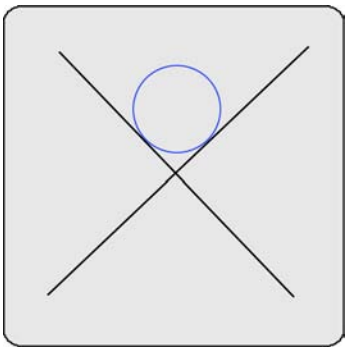
To construct a circle from an existing circle:

1 Touch the Measure Circle icon
2 Touch the desired circle
3 Press the Enter key
4 Press the Finish key

The new circle feature will be constructed over the original circle.

Circles constructed from two lines

A wire gage circle will be constructed between the two lines. The user will be prompted for the circle radius.

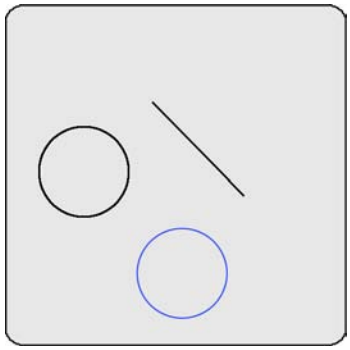


To construct a circle from two lines:

1 Touch the Measure Circle icon
2 Touch the first line feature
3 Press the Enter key
4 Touch the second line feature
5 Press the Enter key
6 Press the Finish key

The wire gage circle will be constructed.

Circle constructed from a circle and a distance



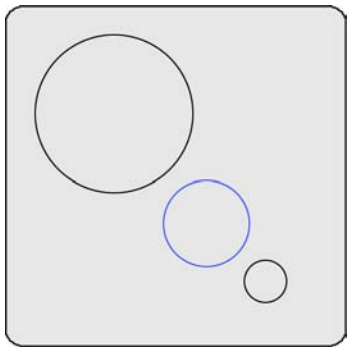
An offset circle will be constructed from circle and distance parent features. A circle equal to the parent circle will be constructed, offset the amount equal to the parent distance.

To construct a circle from a circle and a distance:

1 Touch the Measure Circle icon
2 Touch the circle feature
3 Press the Enter key
4 Touch the distance feature
5 Press the Enter key
6 Press the Finish key

The offset circle will be constructed.

Circle constructed from two circles



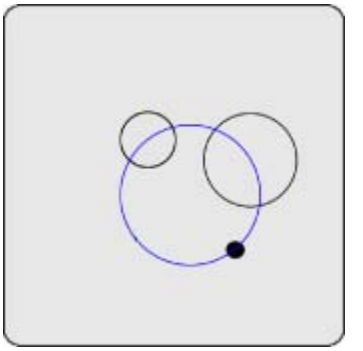
The circle will be constructed as an average of the two parent positions and sizes.

To construct a circle from two circles:

1 Touch the Measure Circle icon
2 Touch the first circle feature
3 Press the Enter key
4 Touch the second circle feature
5 Press the Enter key
6 Press the Finish key

The average circle will be constructed.

Circle constructed from multiple features



A circle feature can be constructed from any number of parent features. The parent features can be any combination of points, slots, rectangles, arcs and circles. The center points of the parent features will be used to construct the new circle feature. When more than three parent features are used, the circle can be constructed using the fitting algorithm of the user's choice.

To construct a circle from multiple features:

1 Touch the Measure Circle icon
2 Touch a feature
3 Press the Enter key
4 Repeat steps 2 and 3 for all features
5 Press the Finish key

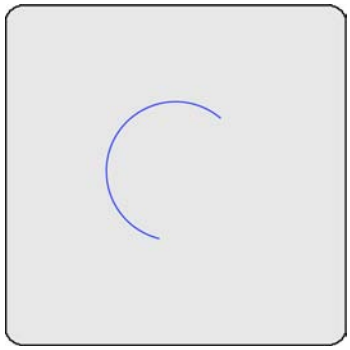
The best fit circle through the entire collection of features will be constructed.

Arc constructions

Arcs can be constructed from:

- Points
- Lines
- Circles
- Slots
- Distances
- Arcs

Arc constructed from an arc



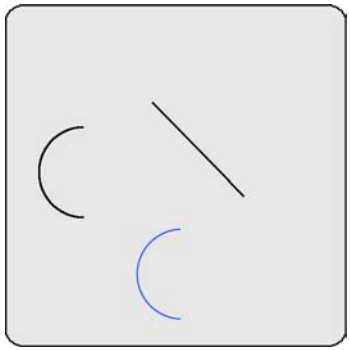
A duplicate feature can be useful when it becomes desirable to perform new operations with the original while retaining a copy.

To construct an arc from an existing arc:

1 Touch the Measure Arc icon
2 Touch the desired arc
3 Press the Enter key
4 Press the Finish key

The new arc feature will be constructed over the original arc.

Arc constructed from an arc and a distance



An offset arc will be constructed from arc and distance parent features. An arc equal to the parent arc will be constructed, offset the amount equal to the parent distance.

To construct an arc from an arc and a distance:

1 Touch the Measure Arc icon
2 Touch the arc feature
3 Press the Enter key
4 Touch the distance feature
5 Press the Enter key
6 Press the Finish key

The offset arc will be constructed.

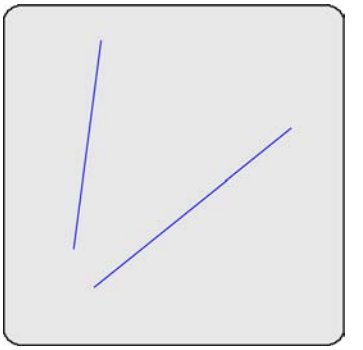
Angle constructions

Angles can be constructed from:

- An angle
- Two lines

Angle constructed from an angle

A duplicate feature can be useful when it becomes desirable to perform new operations with the original while retaining a copy.



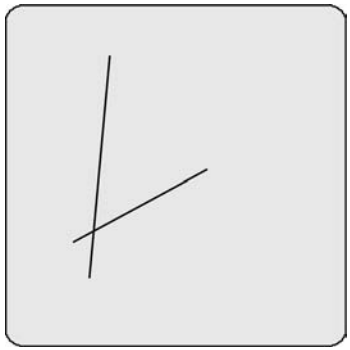
To construct an angle from an existing angle:

1 Touch the Measure Angle icon
2 Touch the desired angle
3 Press the Enter key
4 Press the Finish key

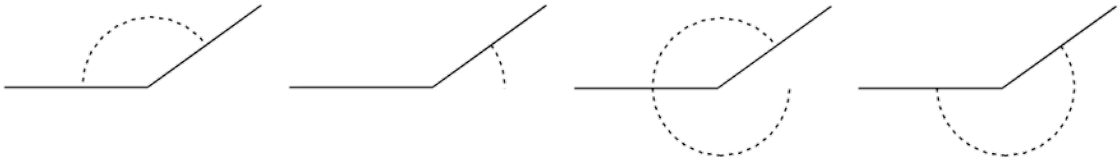
The new angle feature will be constructed over the original angle.

Angle constructed from two lines

Up to four angle constructions can be made from two lines:



- Interior angle:
  The angle included between the lines
- 180 minus:
  180 degrees minus the angle included between the lines
- 180 plus:
  180 degrees plus the angle included between the lines
- 360 minus
  360 degrees minus the angle included between the lines



Interior angle ***180 minus*** ***180 plus*** ***360 minus***

To construct angles from two lines:

1 Touch the Measure Angle icon
2 Touch the first line feature
3 Press the Enter key
4 Touch the second line feature
5 Press the Enter key
6 Press the Finish key

The interior angle will be constructed. Alternative angle constructions can be selected from the drop-down menu in the DRO window.

Creating features

Features can be created by entering information that describes feature size and position. Information can be entered in metric or English units of measure.

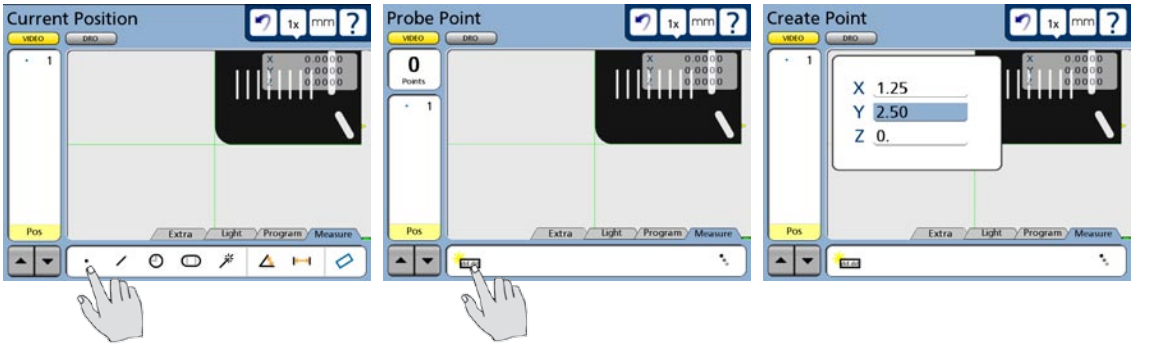
The following feature types can be created:

- Points
- Lines
- Distances
- Rectangles
- Circles
- Arcs
- Slots

Creating a point

To create a point:

1 Touch the measure point icon, and then touch the data entry icon. The data entry box will be displayed.

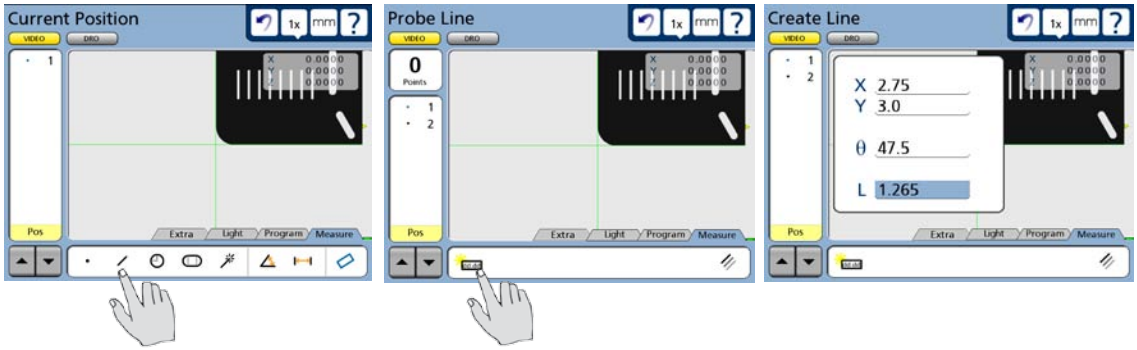


2 Enter the feature data in the fields provided and press Finish.

Creating a line

To create a line:

1 Touch the measure line icon, and then touch the data entry icon. The data entry box will be displayed.

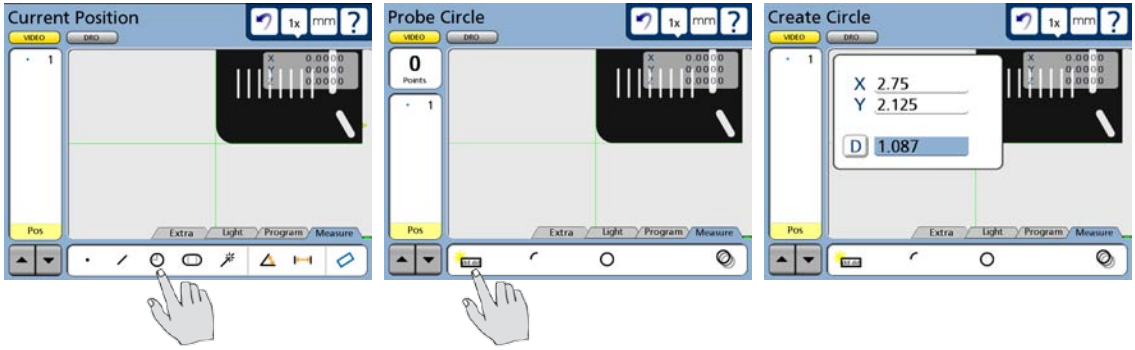


2 Enter the feature data in the fields provided and press Finish.

Creating a circle

To create a circle:

1 Touch the measure circle icon, and then touch the data entry icon. The data entry box will be displayed.

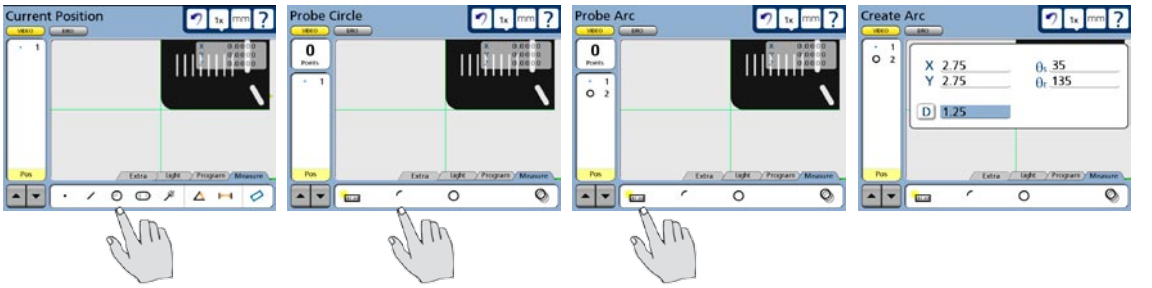


2 Enter the feature data in the fields provided and press Finish.

Creating an arc

To create an arc:

1 Touch the measure circle icon, the measure arc icon and then touch the data entry icon. The data entry box will be displayed.

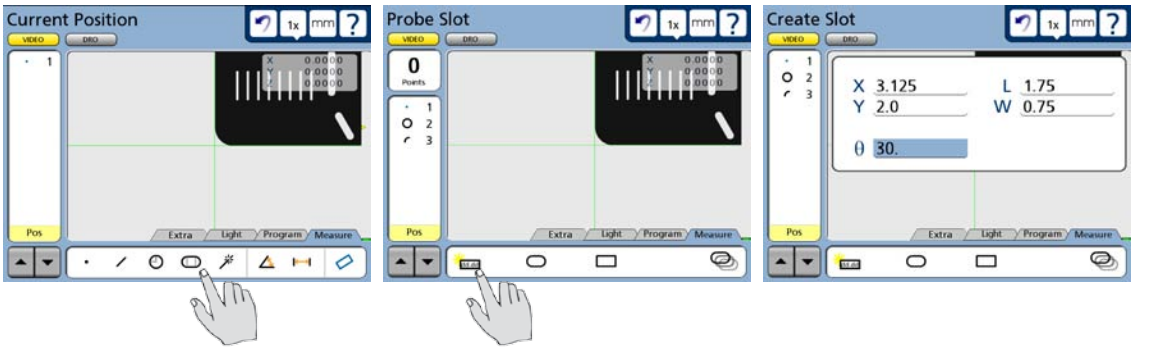


2 Enter the feature data in the fields provided and press Finish.

Creating a slot

To create a slot:

1 Touch the measure slot icon, and then touch the data entry icon. The data entry box will be displayed.

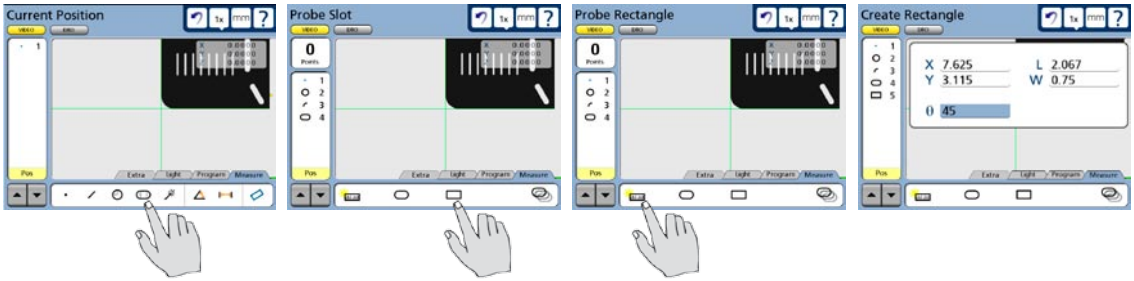


2 Enter the feature data in the fields provided and press Finish.

Creating a rectangle

To create a rectangle:

1 Touch the measure slot icon, the measure rectangle icon and then touch the data entry icon. The data entry box will be displayed.



2 Enter the feature data in the fields provided and press Finish.

Chapter 7: Tolerancing

Tolerances can easily be applied to position, size, orientation, form, runout and concentricity 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-300 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.

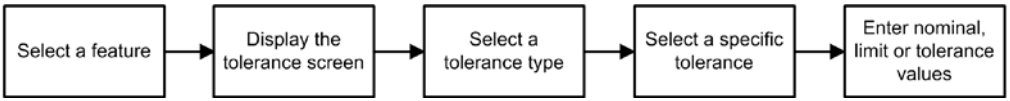
NOTE

Tolerance calculations comply with the ASME Y14.5M-1994 standard except as noted in the tolerance section of Chapter 13: Reference Materials.

This chapter includes the following tolerance information:

Applying tolerances to features

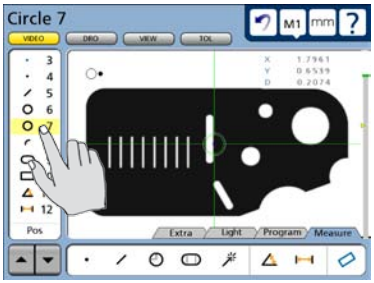
Tolerances are applied to feature measurements using tolerance screens. The method of applying tolerances to features is diagrammed below and is nearly identical for all tolerance types.



In the following example, a true position tolerance is applied to a circle feature.

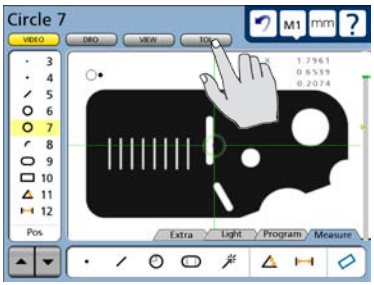
Selecting a feature

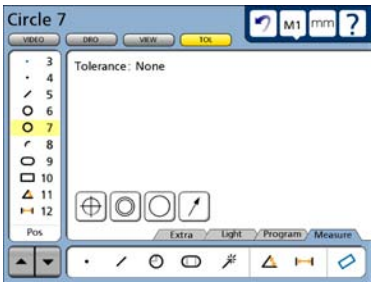
Touch the desired feature in the feature list to select it.



Displaying the tolerance screen

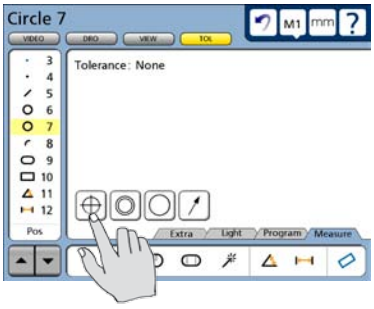
Touch the Tol screen button to display the tolerance screen.

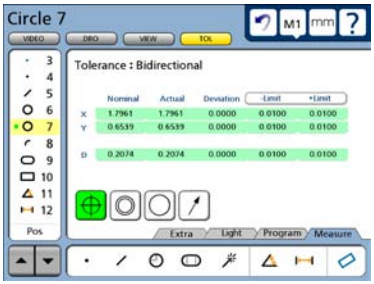




Selecting a tolerance type

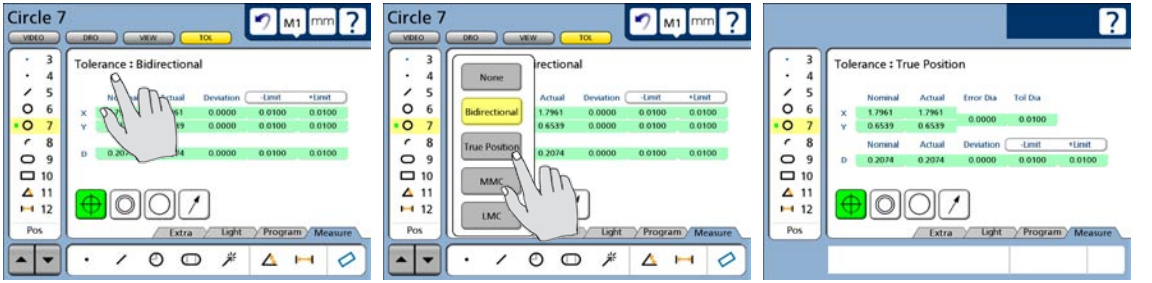
Touch the desired tolerance type button to select a tolerance type. In this example, the position tolerance type is selected.





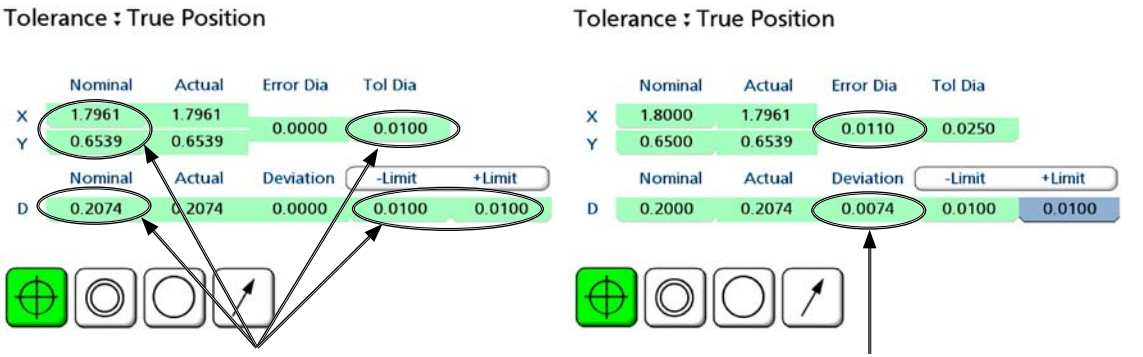
Selecting a specific tolerance

Touch the Tolerance menu title and then select the specific tolerance from the drop-down menu. The true position tolerance is selected in this example.



Entering nominal, limit or tolerance values

In this example, the Nominal and Tol Dia (Tolerance diameter around the nominal position) values are entered by touching the desired data fields and entering a new values using the number keys. Error and Deviation values are generated as soon as the Nominal and Tol Dia values are entered.

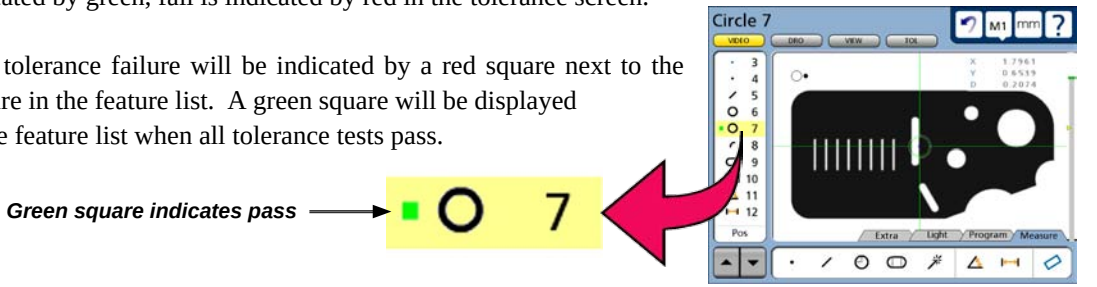


The Nominal, Tol Dia and Limit values are entered...

resulting in new error and deviation values

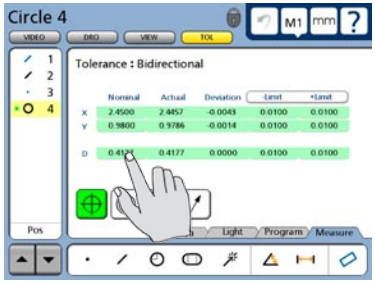
Pass/fail results are indicated by green and red colors in the tolerance screen and in the feature list. Pass is indicated by green, fail is indicated by red in the tolerance screen.

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.

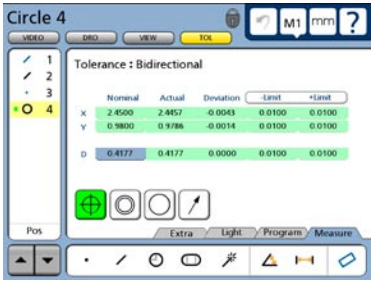


Omitting a tolerance category

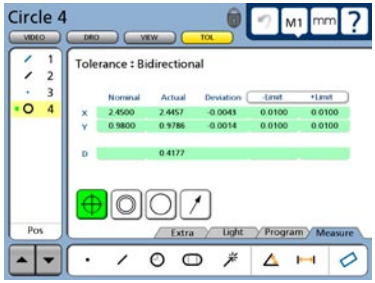
When a tolerance category is unnecessary, it can be omitted. To omit a category, select the Nominal data field, remove any data by repeatedly pressing the Cancel key and press the Enter key. In this example, the Diameter category is omitted.



Touch the category to select it...



repeatedly press the Cancel key...



and press the Enter key

Tolerance types

As mentioned earlier, the method of applying tolerances to features is nearly identical for all tolerances. This section describes the tolerance screen for each tolerance type. The following tolerances can be applied to feature measurements:

- Bidirectional
- Runout
- Parallelism
- True position
- Roundness
- Perpendicularity
- MMC
- Concentricity
- Angle
- LMC
- Straightness
- Width

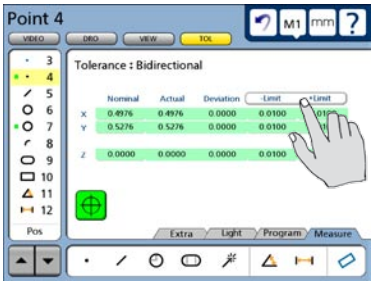
Bidirectional

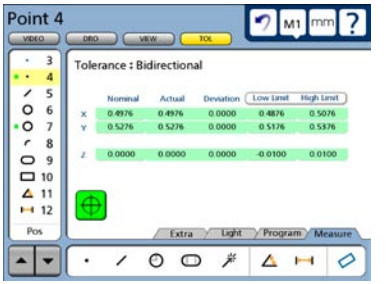
Bidirectional tolerances can be applied to points, lines, circles, arcs, slots and rectangles.

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 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.

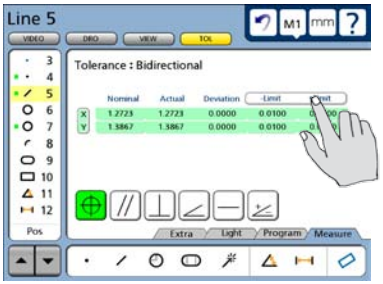


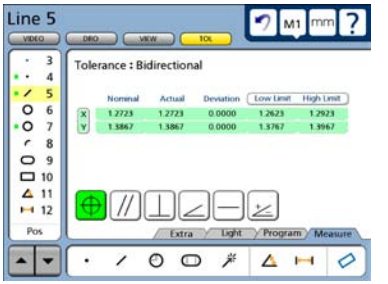


Lines

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

Enter the nominal values into the X and Y 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.

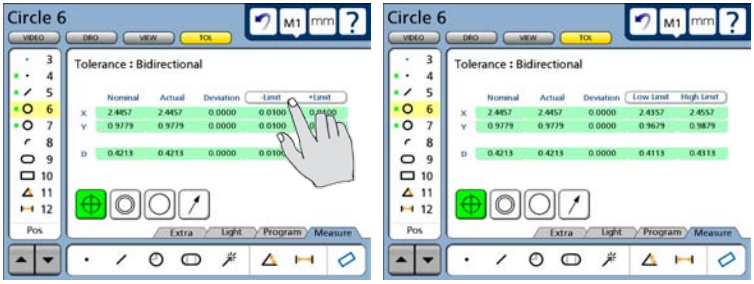




Circles and arcs

The tolerance screens for circles and arcs are identical, and are used to specify the acceptable deviation from nominal positions in the X and Y axes, and from the nominal diameter or radius. The bidirectional tolerance compares the measured location of the center point of the arc or circle 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.

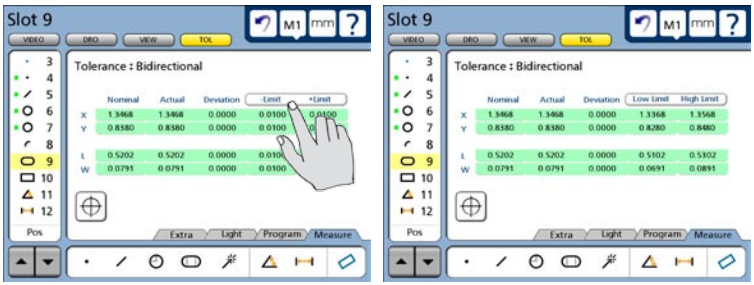
Enter the nominal values into the X and Y axis and D (diameter) data fields provided. Enter the allowed limits into the Limit data fields as +/- ranges or as absolute limits. Touch the Limit data fields to toggle between +/- ranges or absolute limits.



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 axis and L-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.

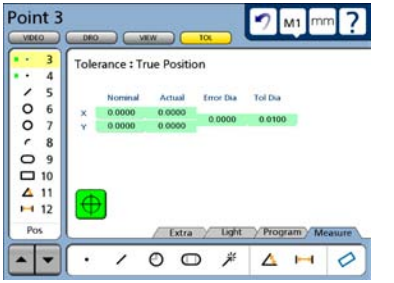


True position

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

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.

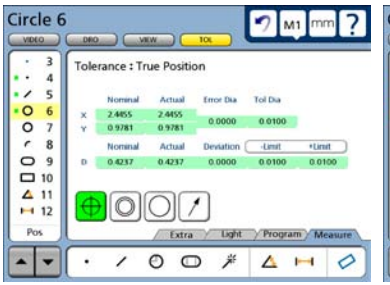


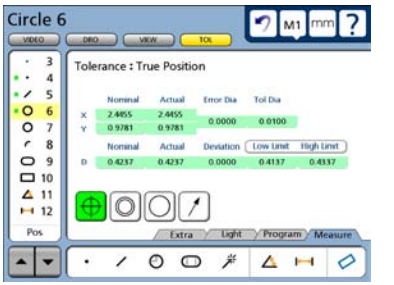
Enter the nominal values into the X and Y axis data fields. Enter the allowed tolerance diameter into the Tol Dia field.

Circles and arcs

The tolerance screens for circles and arcs 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 or arc 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 and Y 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.



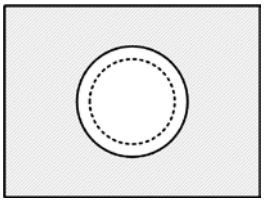


MMC/LMC (Material condition)

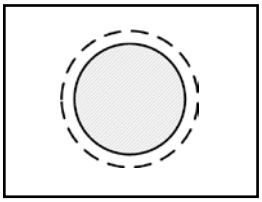
MMC and LMC tolerances can be applied to bosses or to bores, compare measured center locations to the nominal centers and compare measured diameters to nominal diameters. MMC and LMC tolerances can be applied to circles and arcs.

MMC Circles and arcs

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



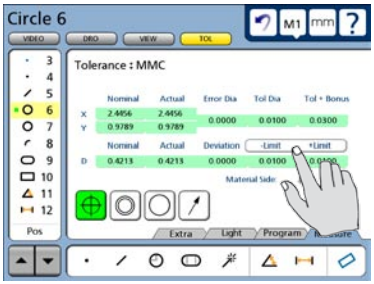
Maximum material within a bore

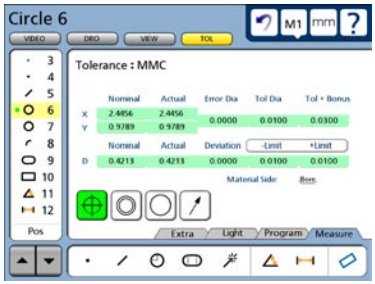


Maximum material on a boss

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.

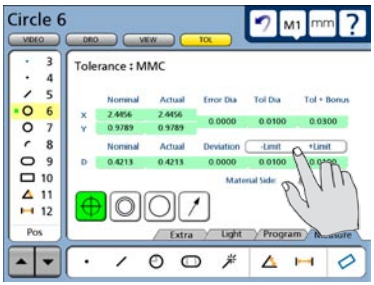
Touch the Boss or Bore choice field to specify the feature type as a Boss or a Bore.

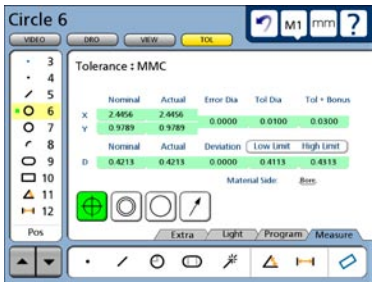




Enter the nominal values into the X and Y axis and D (diameter) data fields provided. Enter the allowed Tol Dia (Tolerance diameter) and feature diameter limits into the Limit data fields as +/- ranges or as absolute limits.

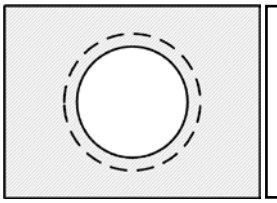
Touch the Limit data fields to toggle between +/- ranges or absolute limits.



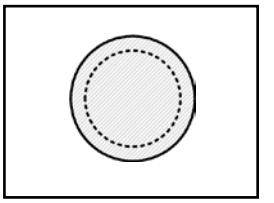


LMC Circles and arcs

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



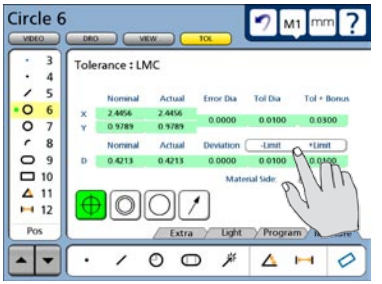
Minimum material within a bore

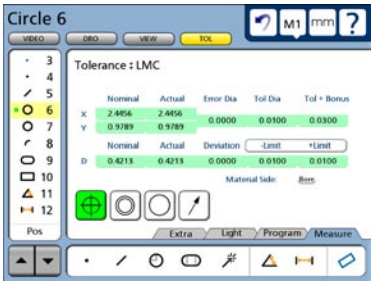


Minimum material on a boss

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.

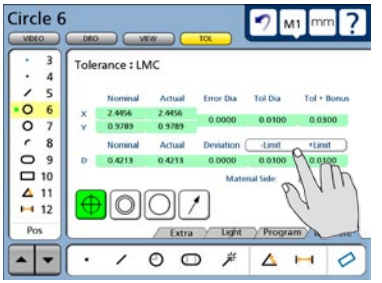
Touch the Boss or Bore choice field to specify the feature type as a Boss or a Bore.

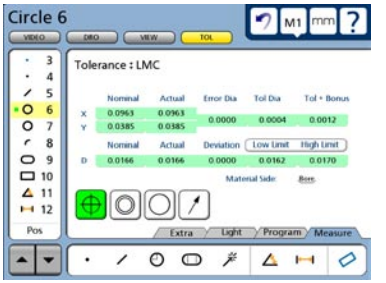




Enter the nominal values into the X and Y axis and D (diameter) data fields provided. Enter the allowed Tol Dia (Tolerance diameter) and feature diameter limits into the Limit data fields as +/- ranges or as absolute limits.

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

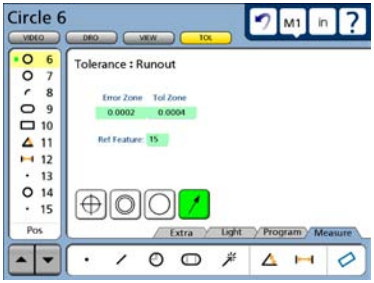




Runout

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.

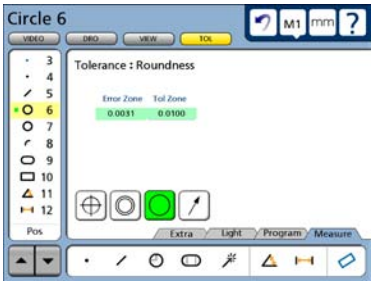
Enter the acceptable position deviation into the Tol Zone data field and then enter the number of the reference feature for the runout tolerance into the Ref Feature data field.



Roundness

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

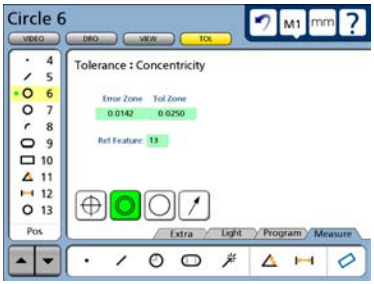
Enter the acceptable form deviation into the Tol Zone data field.



Concentricity

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.

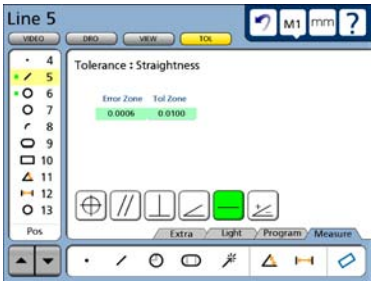
Enter the acceptable position deviation into the Tol Zone data field and then enter the number of the reference feature for the Concentricity tolerance into the Ref Feature data field.



Straightness

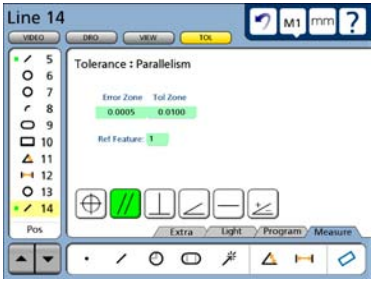
The straightness tolerance can be applied to lines and is used to specify the acceptable deviation from a perfect line.

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



Parallelism

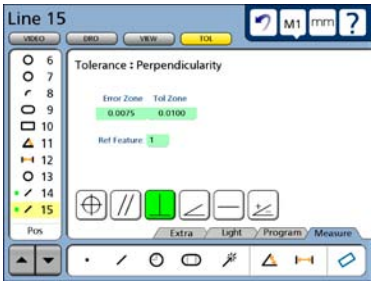
Parallelism tolerances can be applied to lines and are used to specify the acceptable deviation from a line perfectly parallel to a Reference feature.



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.

Perpendicularity

Perpendicularity tolerances can be applied to lines and are used to specify the acceptable deviation from a line perfectly perpendicular to a Reference feature.

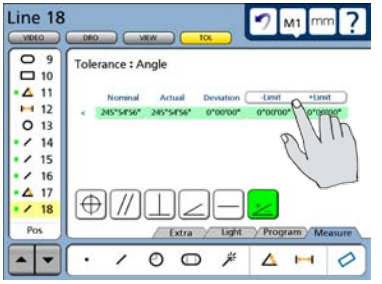


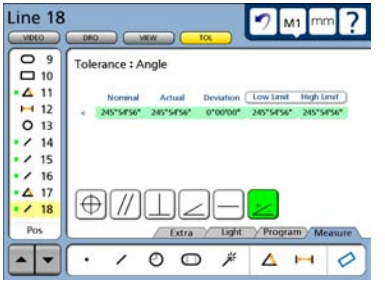
Enter the acceptable perpendicularity deviation value into the Tol Zone data field, and then enter the number of the reference feature for the Perpendicularity tolerance into the Ref Feature data field.

Angle

Angle tolerances can be applied to lines and angles. 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.

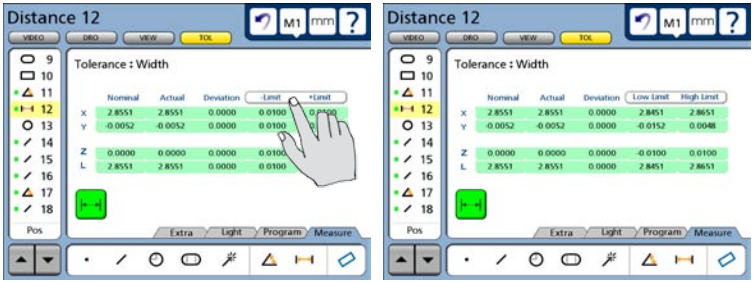




Width

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

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.



Chapter 8: Programming

QC-300 programs are sequences of measurement activities performed on a part by the operator and stored by the system for playback later on other identical parts. Programs can be run on manual or CNC systems.

Using the programming capabilities of the QC-300 greatly increases productivity by compressing the many manual steps required to measure, tolerance and report part dimensions into a few semi-automated steps which are little more than operator responses to system prompts.

When a program is run on a manual system, the series of required probe locations are indicated by a green arrow shown in the video window. The user need only probe the locations indicated by the arrow to complete a measurement session.

When a program is run on a CNC system with permanent fixturing, the user simply starts the program, then all subsequent measurement activities are completed by the system as the stage is repeatedly positioned and the required points are automatically probed. When temporary fixturing is used, the user performs the initial datum measurements, then the system completes subsequent measurements automatically.

Programs can include any combination of user-defined actions required to:

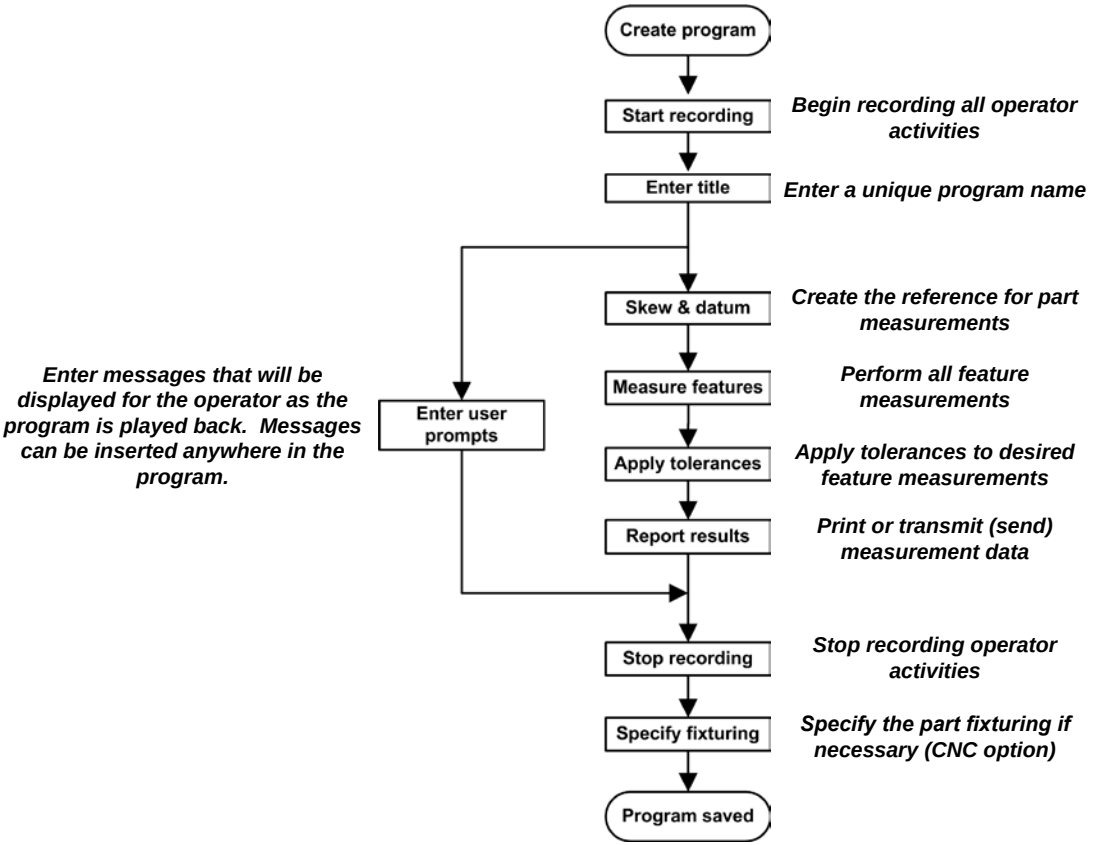
- Establish measurement references
- Measure, construct or create part features
- Capture JPEG stills of video images (optional)
- Perform tolerance measurements
- Select data for printed reports and exported files
- Print reports or export data of measurement results

Programs can be:

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

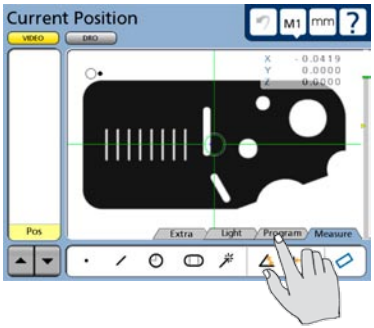
Creating programs

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 QC Quickie slide, applies a position tolerance and prints the results.

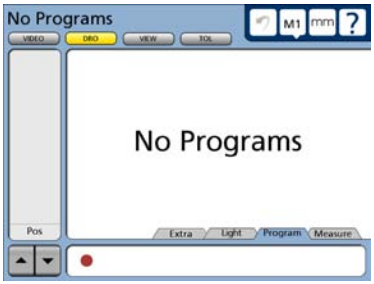


Starting program recording

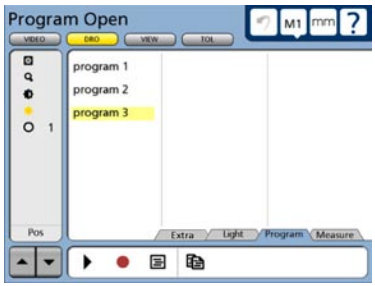
Touch the Program tab to display the programming tools. When no previous programs have been recorded, only the record icon will be shown. When other programs already exist, all the program tool icons will be shown.



Touch the Program tab...

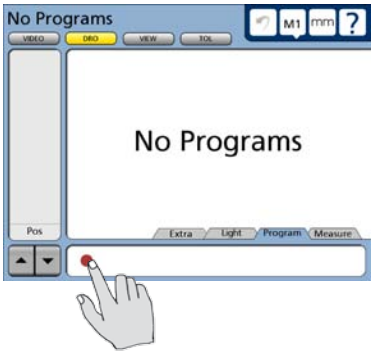


to display the record icon when no other programs exist, or...

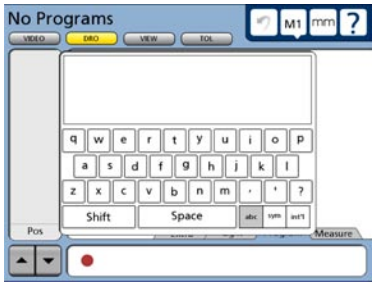


to display all the programming icons when other programs do exist

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



Touch the record icon...



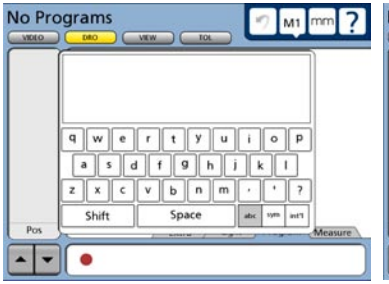
to display the title entry screen

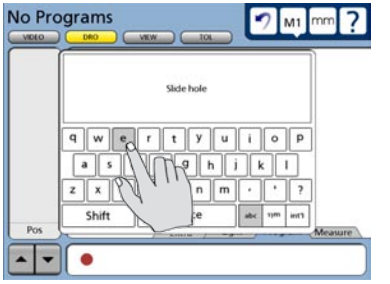
Entering a program title (or user message)

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.

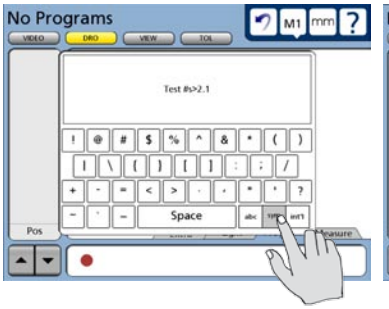
To enter a program title:

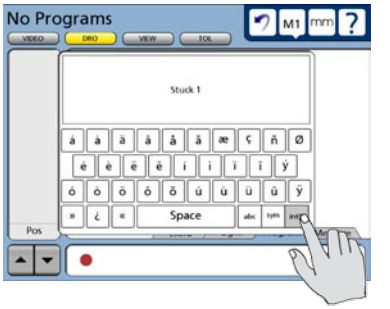
Touch the character and control keys on the text entry screen to enter a unique name for your new program. The number keys on the front panel can also be used to enter numeric characters. Characters can be upper or lower case and can be separated by spaces.



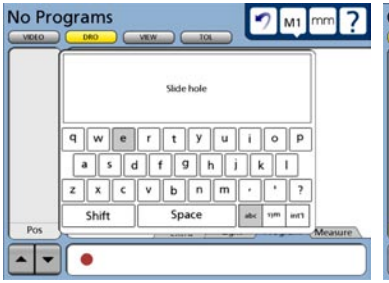


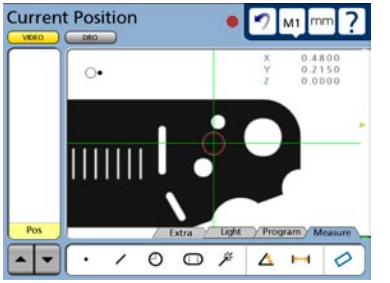
Touch the sym or int'l control keys to access symbol or international characters.





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



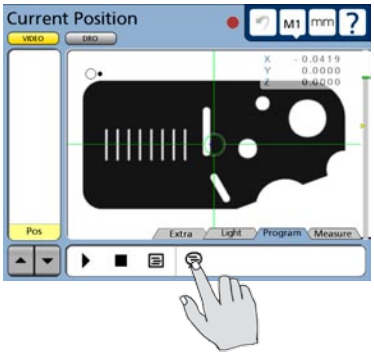


The system is now ready to record all datum, measurement, tolerance and reporting activities. Perform all the datum, measurement, tolerance and reporting activities just as you would if a program were not being recorded. Program recording is conducted by the system in the background and is invisible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

Creating a skew and datum (including a message)

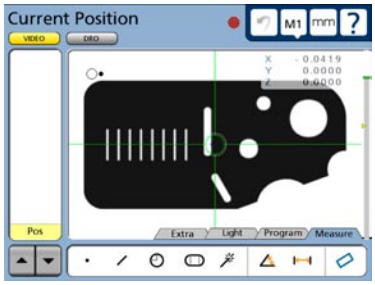
Skew and datum operations are described in Chapter 6: Measuring. In this example, the bottom edge is measured for skew compensation, the left edge is measured and the intersection point of the bottom and left edge lines is zeroed in the X, Y and Z axes and used as a datum for subsequent measurements.

First, you may optionally create a message that prompts the user to perform the operations described above. Press the Finish key to complete the message.



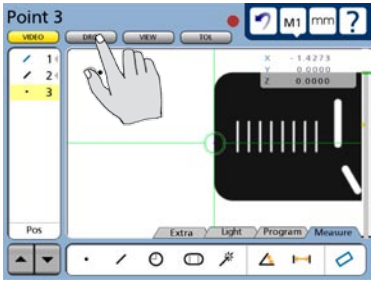
Touch the message icon...

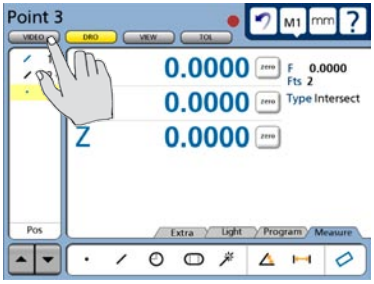
to include a user prompt message...

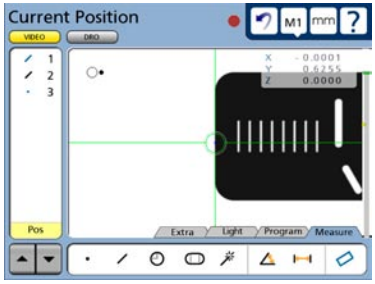


then press the Finsh key to return to a measurement screen

The details of skew and datum measurements are described in Chapter 6: Measuring. Measure the skew and left side and then construct a zero datum point at the intersection of the two lines. Press the Video key to return to the Video measure screen.





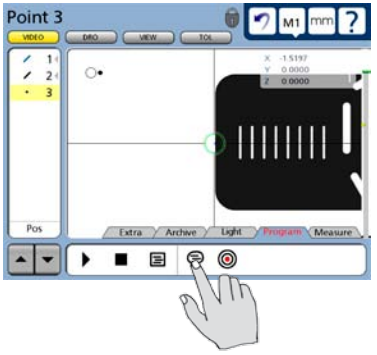


The skew and left edge are measured, then the datum is constructed. Then the Video screen is displayed

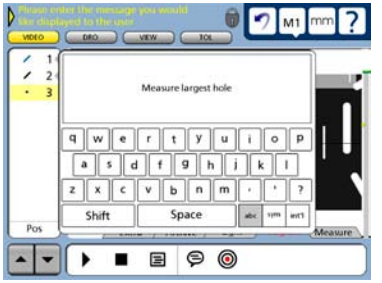
Measure a feature (including a message)

Feature measurements are described in Chapter 6: Measuring. In this example, the largest hole in the QC Quickie slide is measured.

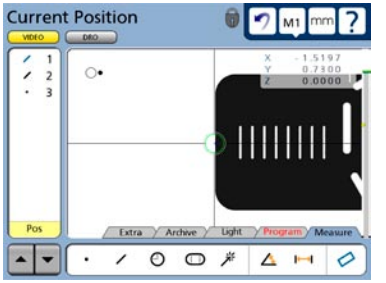
First, you may optionally create a message that prompts the user to measure the hole. Press the Finish key to complete the message.



Touch the message icon...

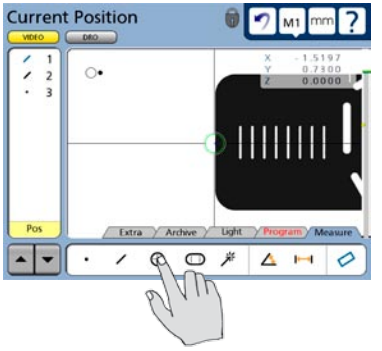


to include a user prompt message...

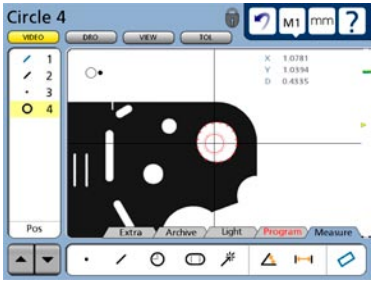


then press the Finsh key to return to a measurement screen

Perform the measurement; touch the measure icon, collect the required points and press Finish.



Touch the desired measure icon...

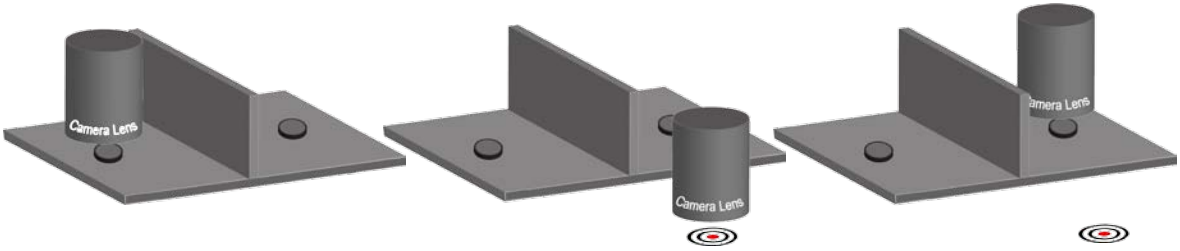


collect points and press Finish

Including safe CNC moves in programs (CNC option)

Systems equipped with optional CNC capabilities position the part under the video camera automatically as programs are played back. Sometimes it becomes necessary to add safe moves to the program to avoid collisions when mechanical obstructions are present.

A safe move is included in a program by moving the stage to an intermediate position between measurements on a path that avoids a physical obstruction, and then inserting a Goto Here instruction into the program. In the example below, a camera (represented by a cylinder) is positioned over a safe location between two part features to avoid colliding with a barrier. A Goto Here instruction is inserted into the program at this point.

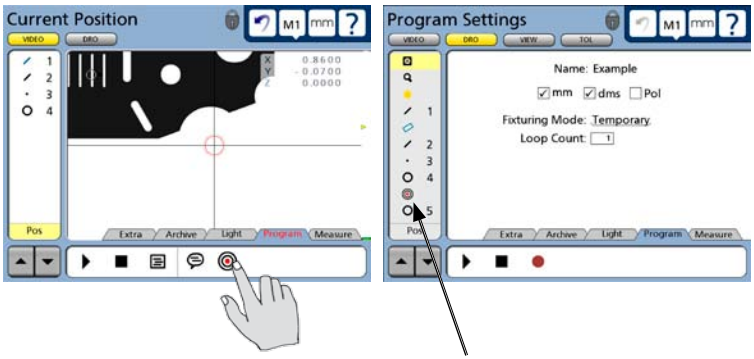


A feature is measured and the camera is positioned...

over a safe location, and a Goto Here instruction is inserted, then...

the camera is positioned over the next feature to be measured

The Goto Here instruction is inserted after positioning the camera over a safe location and by touching the Goto Here bullseye icon in the Program tab. The Goto Here bullseye icon is not shown in the video window, but is shown as a step in the completed program list.



Touch the Goto Here bullseye icon to include a safe move

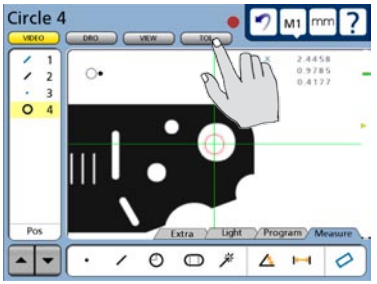
The safe move is shown in the program list

NOTE
CNC functions can be added to the Extra tab for convenient use during programming. These functions are described in detail in Chapter 3: User Interface.

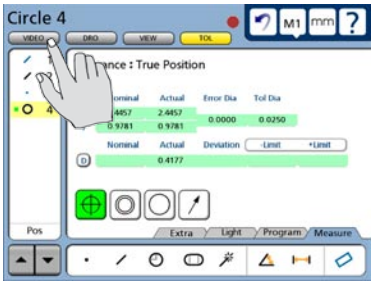
Applying a tolerance

Tolerance operations are described in Chapter 7: Tolerancing. In this example, a true position tolerance of 0.025 mm will be applied to the hole feature measured in the last step.

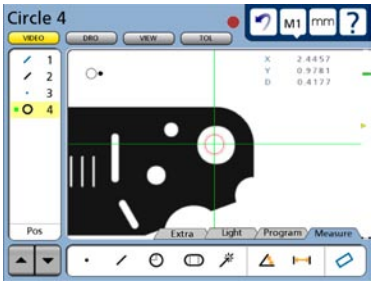
Touch the Tol button to display the Tolerance screen, apply the 0.025 mm true position tolerance and touch the Video button to return to the Video screen.



Touch the Tol button...



apply the tolerance and touch the Video button...



to return to the Video screen

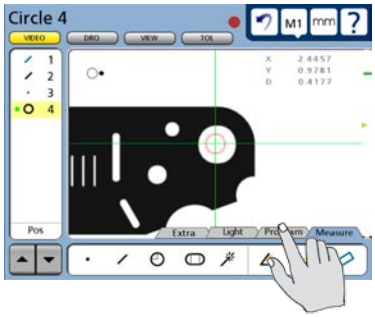
Reporting results

Measurement results can be printed on the USB port or transmitted to a computer on the RS232 serial port. Parameters governing reports and data transmissions are configured in the Print setup screen described in Chapter 10: Communication, and in Chapter 11: Setup.

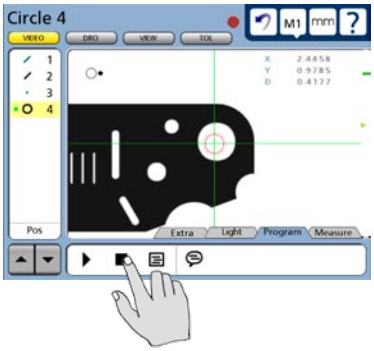
Result reporting is included in a program by simply pressing the Print key while in recording a program.

Stopping the program recording

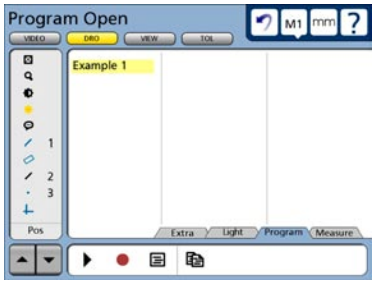
Touch the Program tab to display the programming icons, and then touch the Stop icon to stop recording the program. The program title will be shown and program steps will be displayed in the feature list.



Touch the Program tab...



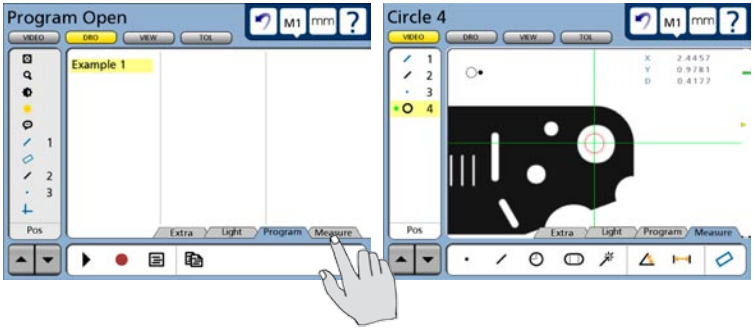
and then touch the Stop icon...



the program title is shown with program steps are in the feature list

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.



Specifying part fixturing (CNC option)

Default part fixturing is configured in the CNC General setup screen by OEMs and Distributors for CNC systems. In most cases, part fixturing will remain unchanged. However, if fixturing requirements change, the part fixture configuration can also be changed to insure that subsequent program runs will include the correct measurement reference and datum.

Any of three fixturing modes can be selected in the Program Settings screen:

None

No part fixturing is used, a measurement reference and datum must be created by the user for each part prior to measurements.

Temporary

Temporary part fixturing is used, a measurement reference and datum must be created for the first part by the user, thereafter the system will perform measurement reference and datum measurements automatically for each part.

Permanent

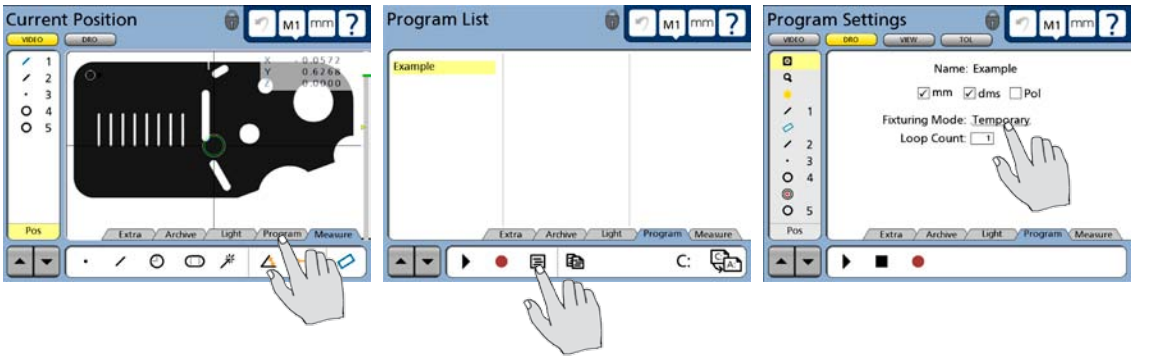
The part fixturing is permanently attached; this is a dedicated fixture. The system retains the measurement reference and datum as part of the program, no user interaction is required to create a measurement reference or datum.

To specify the desired fixturing mode in a program:

1 Touch the Program tab to display programming tools.

2 Highlight the desired program and touch the Edit icon to display its program steps.

3 Touch the Fixturing Mode choice field repeatedly to cycle through the available fixturing modes.



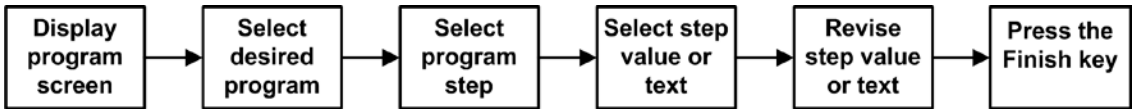
Editing Programs

Programs can be edited to:

- Revise magnifications
- Revise tolerances
- Revise brightness and contrast
- Revise lighting
- Revise user prompt messages
- Append new steps to the end of the list of program steps

Editing existing steps

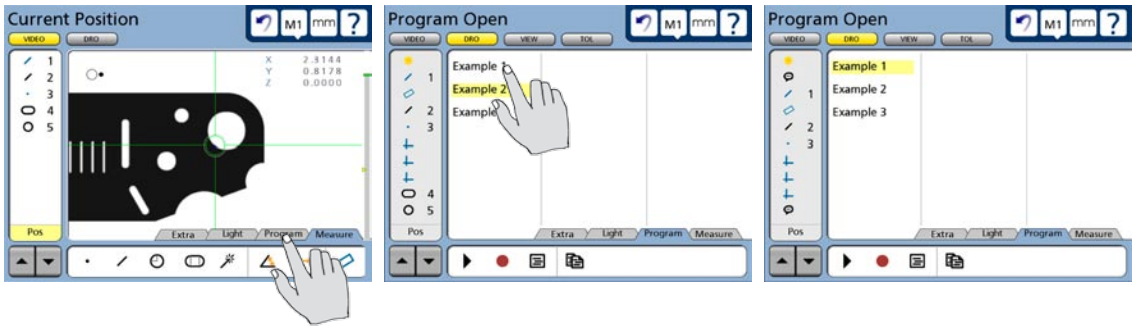
The process for editing existing steps is diagrammed below and is identical for all types of revisions.



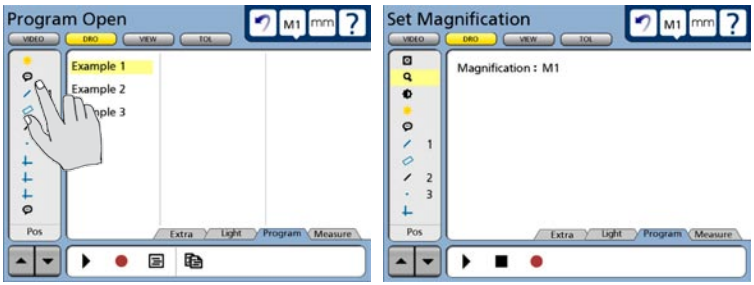
Editing magnifications

To revise a magnification:

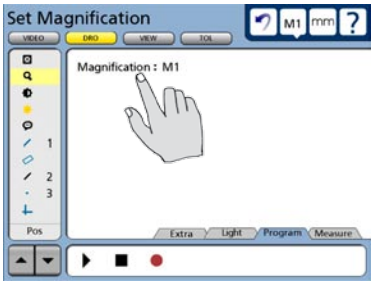
1 Touch the Program tab to display the program screen and then touch a program title to select the desired program.

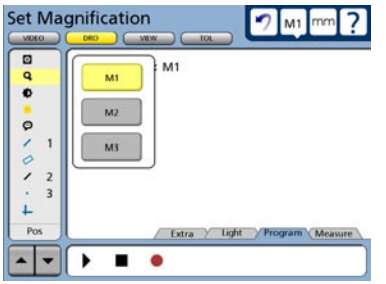


2 Touch the magnification step to display the magnification setting.

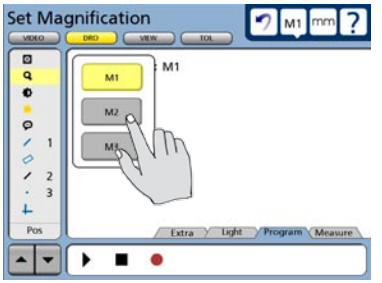


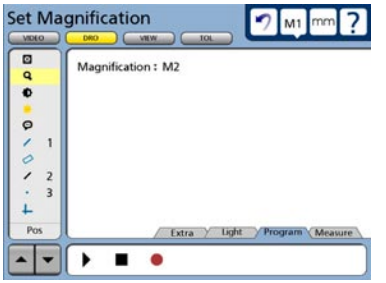
3 Touch the magnification setting to display all magnification alternatives.





4 Touch the desired magnification and then either press the Finish key to save the revision and return to the measure mode, or proceed to the next revision.

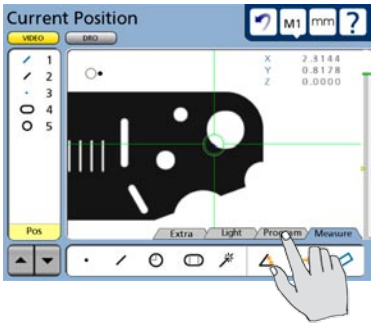


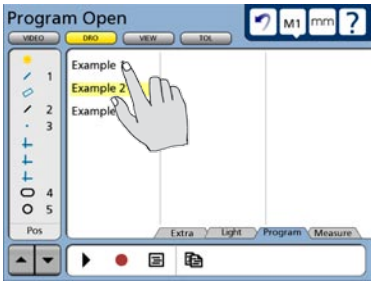


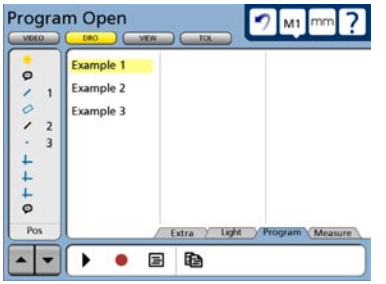
Editing tolerances

To revise or add a tolerance:

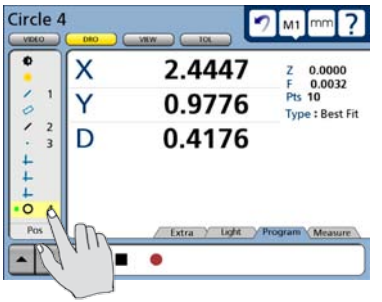
1 Touch the Program tab to display the program screen and then touch a program title to select the desired program.

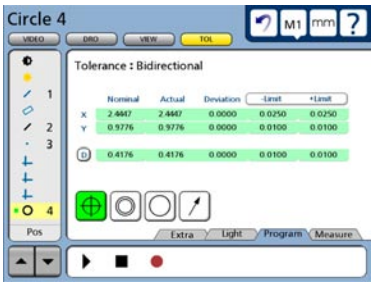






2 Touch the desired feature, touch the Tol button to display the tolerance screen and apply the new tolerances.

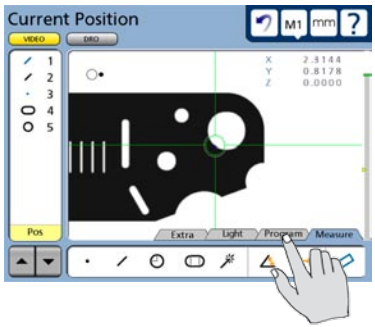


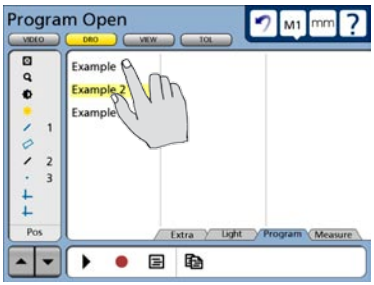


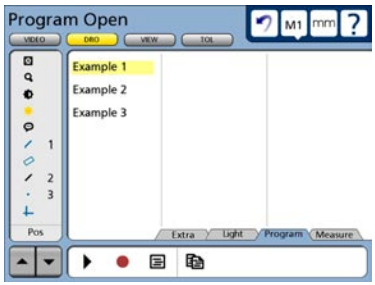
Editing brightness and contrast

To revise a brightness and contrast levels:

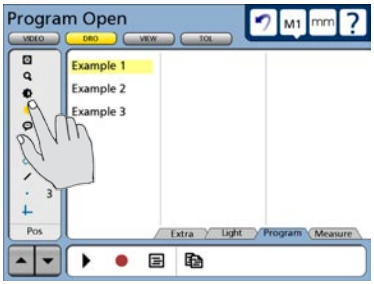
1 Touch the Program tab to display the program screen and then touch a program title to select the desired program.

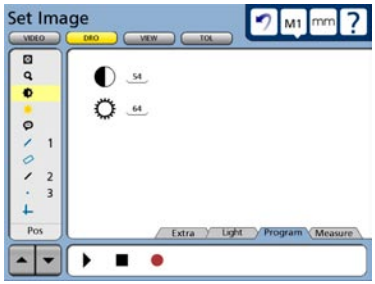




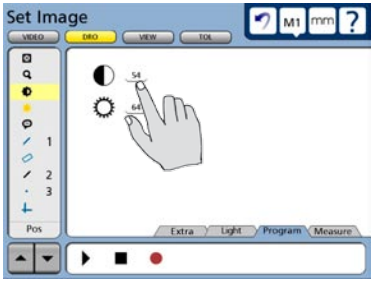


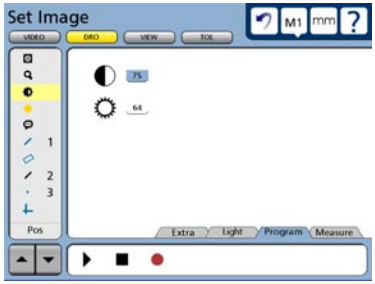
2 Touch the brightness/contrast step to display the brightness and contrast settings.





3 Touch the desired setting and enter the new value, then either press the Finish key to save the revision and return to the measure mode, or proceed to the next revision.

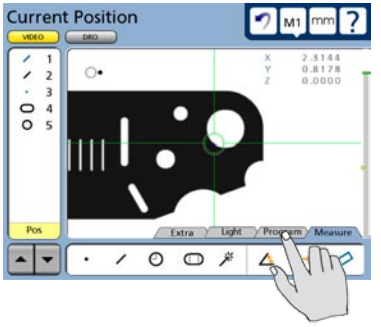


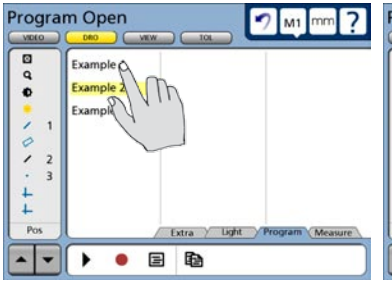


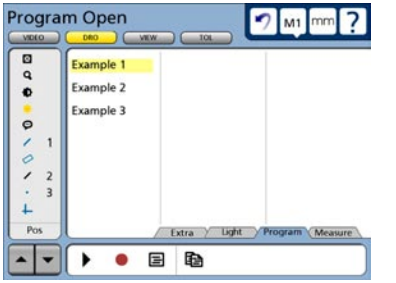
Editing light intensities

To revise light intensity levels:

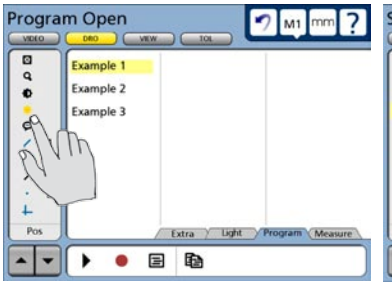
1 Touch the Program tab to display the program screen and then touch a program title to select the desired program.

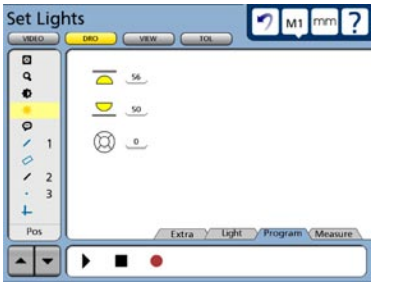




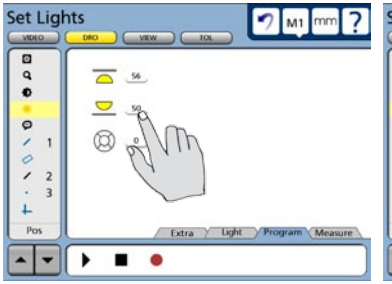


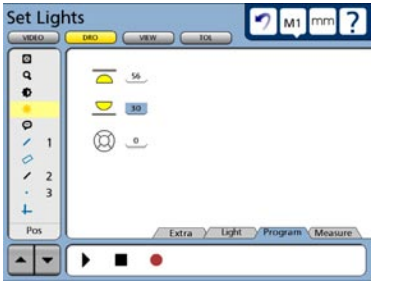
2 Touch the light intensity step to display the light intensity settings.





3 Touch the desired light setting and enter the new intensity value, then either press the Finish key to save the revision and return to the measure mode, or proceed to the next revision.

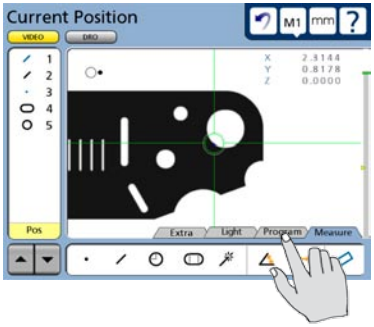


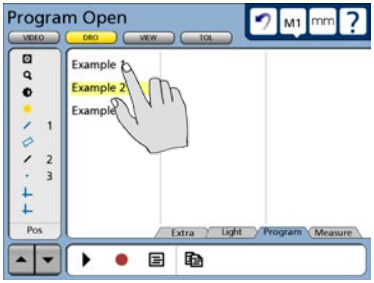


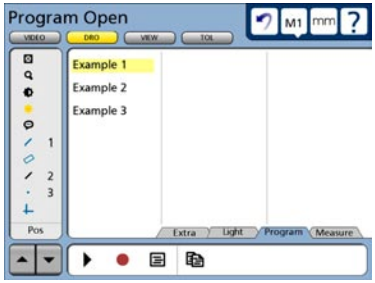
Editing user prompt messages

To revise message text:

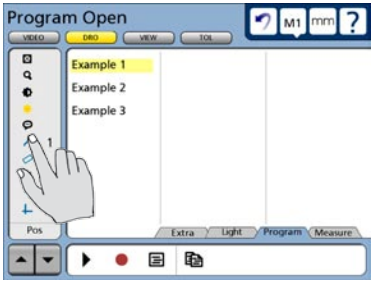
1 Touch the Program tab to display the program screen and then touch a program title to select the desired program.

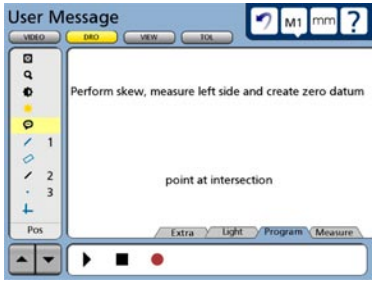




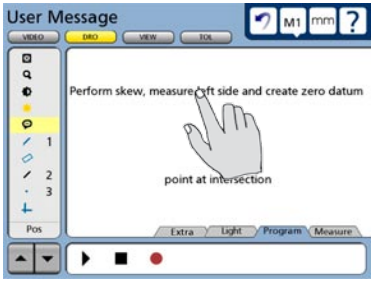


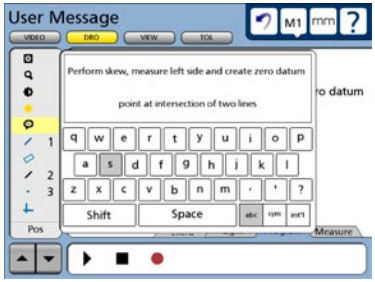
2 Touch the desired message step to display the message text.





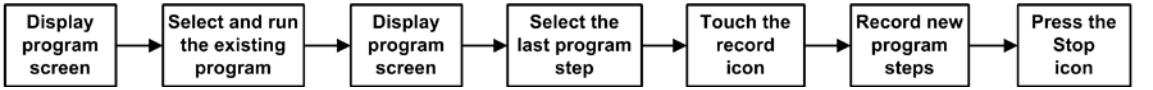
3 Touch the message text to display the text editing window and then enter the new text. The Cancel key is used to delete individual characters. When the editing is complete, either press the Finish key to save the revision and return to the measure mode, or proceed to the next revision.





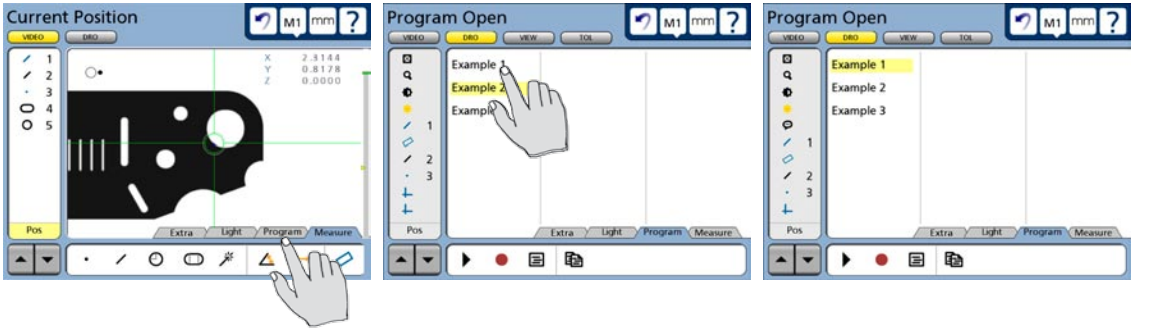
Appending new program steps to an existing program

The process for appending new steps to an existing program is diagrammed below. As shown in the diagram, it is necessary to run the existing program before appending new steps so that all the preceding conditions created by the program will be correct when the new steps are added. For example, any datums created by the program will be current and correct up to the point that new steps are added.

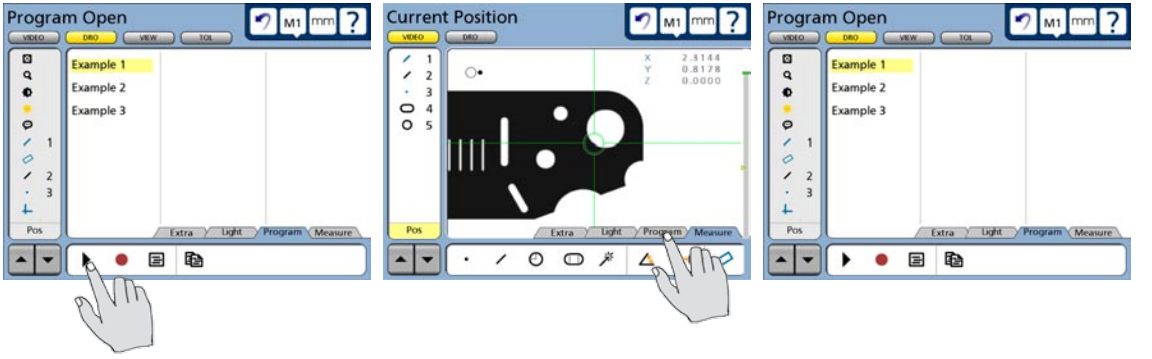


To append new steps to an existing program:

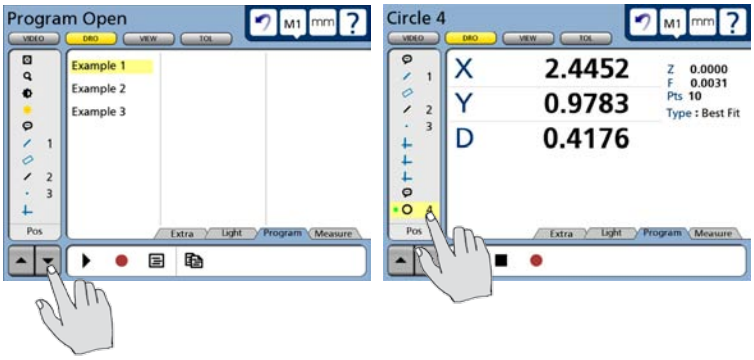
1 Touch the Program tab to display the program screen and then touch a program title to select the desired program.



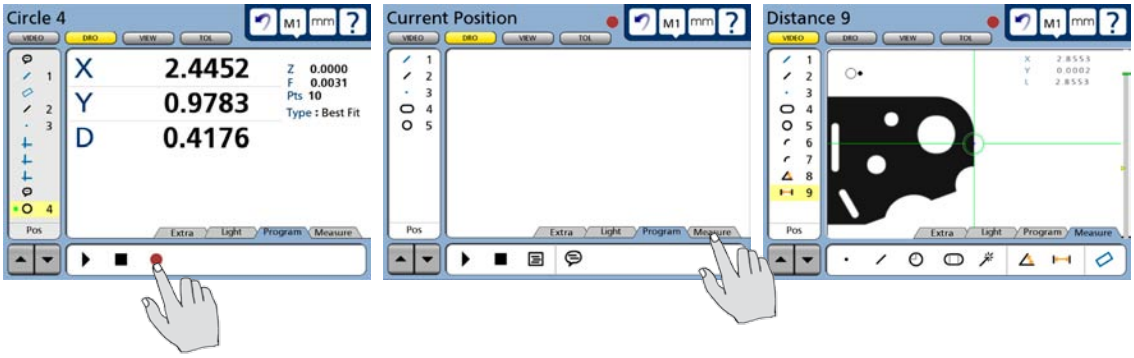
2 Touch the run icon to run the program and when execution is complete select the program screen again.



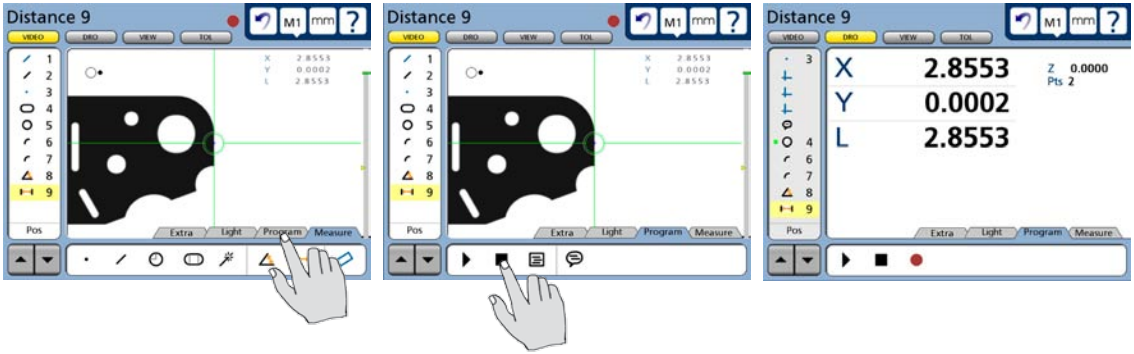
3 Scroll to the end of the program list if necessary and select the last program step.



4 Touch the Record icon, touch the Measure tab and perform all the new program steps.

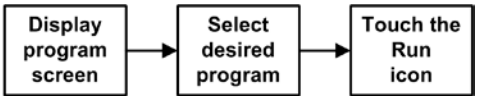


5 Touch the Program tab and touch the Stop icon to complete and save the program with its new steps.



Running programs

Programs are run by selecting the desired program and touching the Run icon as shown in this diagram.

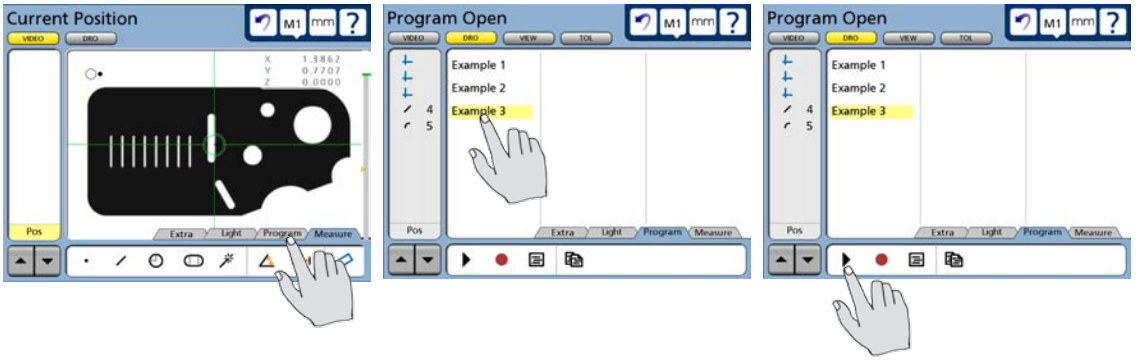


The operator will position the part and collect measurement data points in response to program text and the green run-time arrow displayed on the screen. When the program has successfully completed executing, feature data is shown in the feature list and the screen leaves the program execution mode and displays current position.

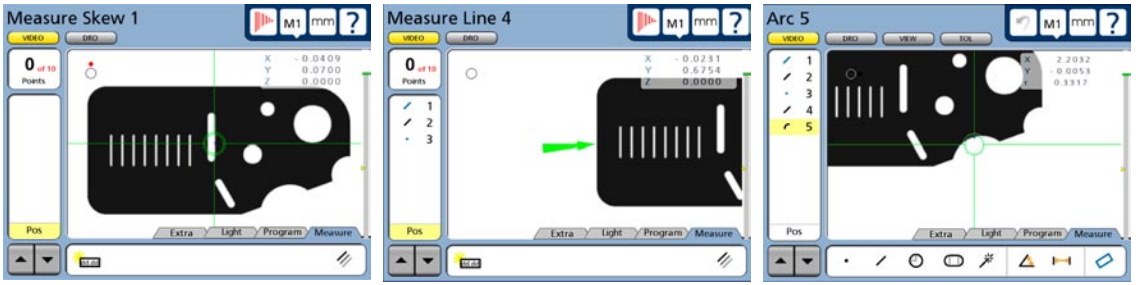
To run a program:

1 Touch the Program tab to display the program screen and then touch a program title to select the desired program.

Touch the Run icon to run the selected program.



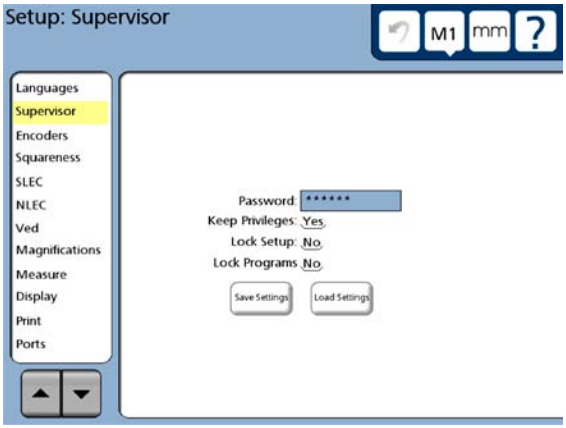
2 During execution after the datum is established, text and the green run-time arrow will guide the operator through the program measurement steps.



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

Archiving and retrieving programs

Programs are included in the settings files and can be saved and retrieved as part of the complete collection of all QC-300 system settings. To save or retrieve programs (and all system settings), touch the Save Settings or Load Settings button on the Supervisor setup screen.



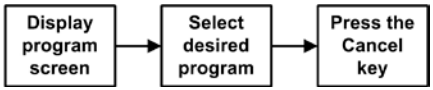
Refer to Chapter 11: Setup for more details regarding the Save Settings and Load Settings functions.

CAUTION

The settings include all operational parameters of the QC-300, including SLEC and other error correction data. When the settings file is loaded from the USB drive, all existing settings will be overwritten and permanently replaced. Be sure that all program and settings data are appropriate for your system before loading a new file.

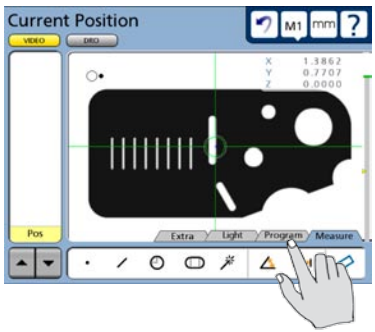
Deleting programs

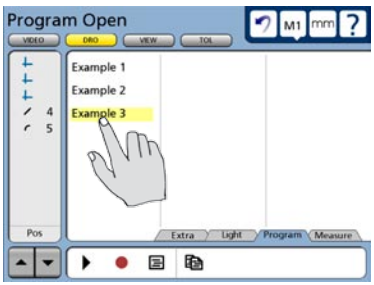
Programs are deleted by selecting the desired program and pressing the Cancel key. You will be asked to confirm your intention to delete the program.

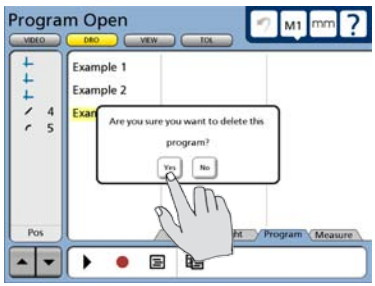


To delete a program, touch the Program tab to display the program screen and then touch a program title to select the desired program. Then press the Cancel key 

to delete the program, then touch the Yes button to confirm your intention.





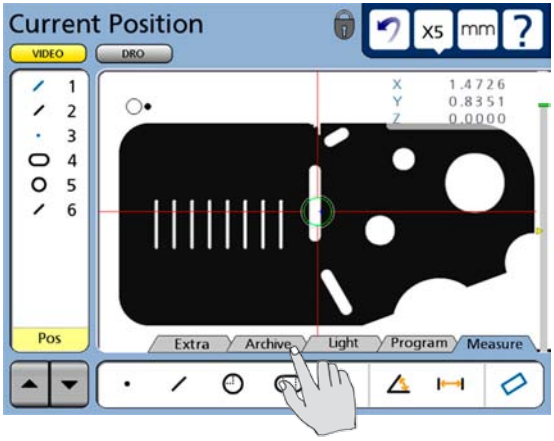


Chapter 9: Image Archiving

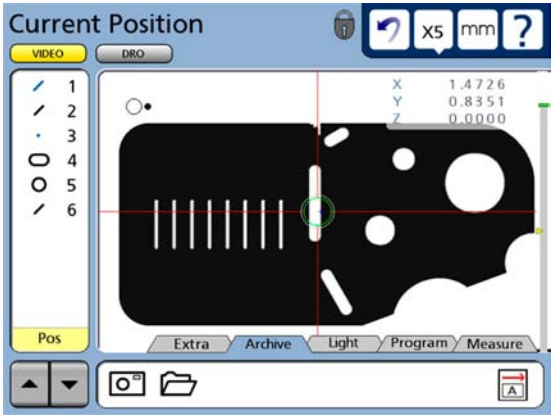
Image archiving is optional for QC-300 products that include video edge detection. The image archiving option can be included in the original purchase or purchased later and enabled in the field.

The image archiving functions allow users to capture JPEG still images of video measurement content. The captured images can be marked up to include text and graphics that highlights feature data and provides additional information regarding the part or part measurements. The marked up images can be edited to change shapes, colors and text. Metadata can be added to the JPEG images to provide information used later when the images are opened in graphics viewing and editing packages. Image archiving functions include:

Touch the Archive tab to launch the image archiving functions.



Touch the Archive tab...



to launch the Video Archiving functions

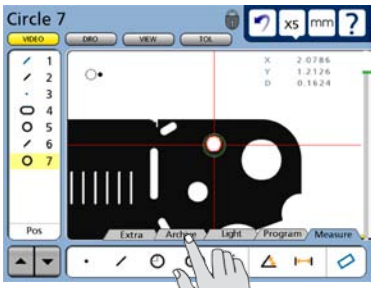
Capturing JPEG still images

Touch the Camera icon to capture the current video image as a JPEG still. The captured image will be saved on the QC-300 internal C: drive and will include the measurement crosshairs and stake marks if the *Archive Crosshair* feature is enabled in the VED setup Screen described in Chapter 11: Setup.

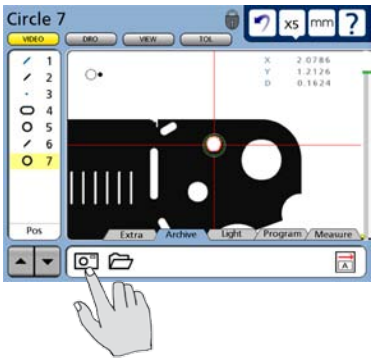
To capture a JPEG still:

1 Display the desired image in the video window. It is often desirable to capture a JPEG of the measure screen immediately after a measurement.

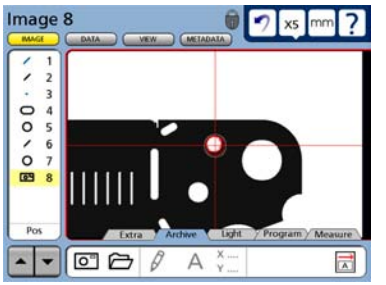
2 Touch the Archive tab, and then touch the Camera icon. A message will be displayed asking you to wait while the image is being captured.



Touch the Archive tab...



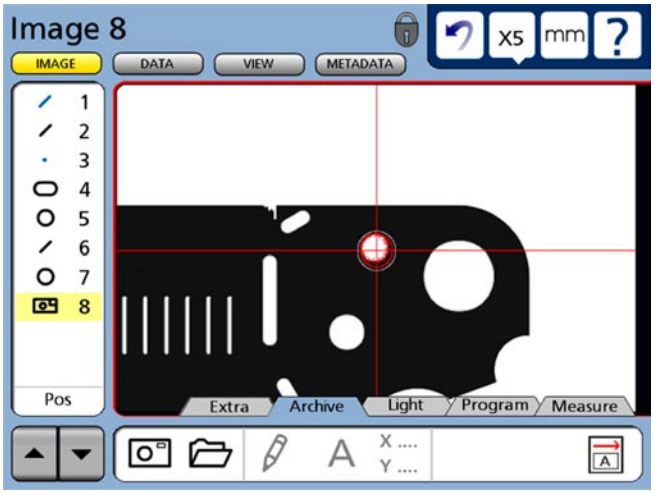
then touch the camera icon...



to capture a JPEG still

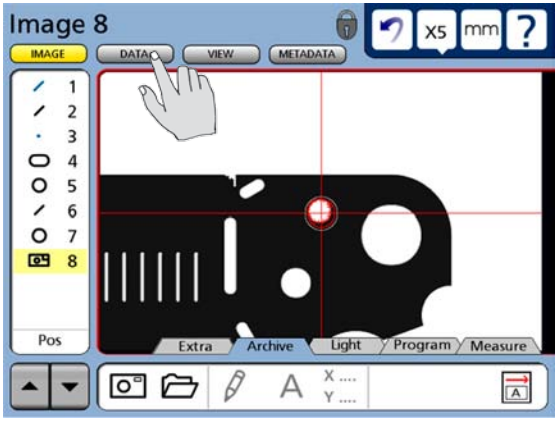
Image screen

Captured JPEG image features will be added to the feature list and shown in the Image screen. The image will be highlighted around its edge by a red line and the image markup tools will be shown in the Archive tab at the bottom of the screen.

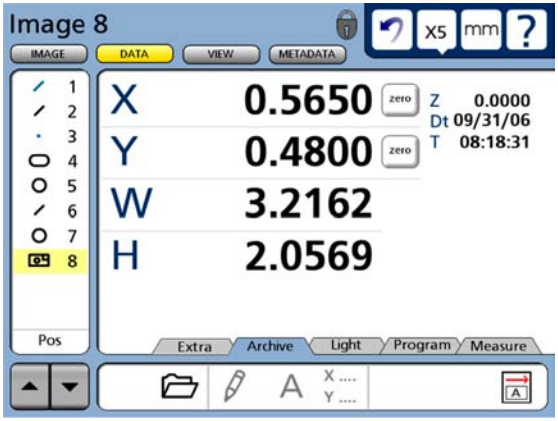


Data screen

Touch the Data button to show the JPEG image feature's X-Y position, image size and the time/date stamp.



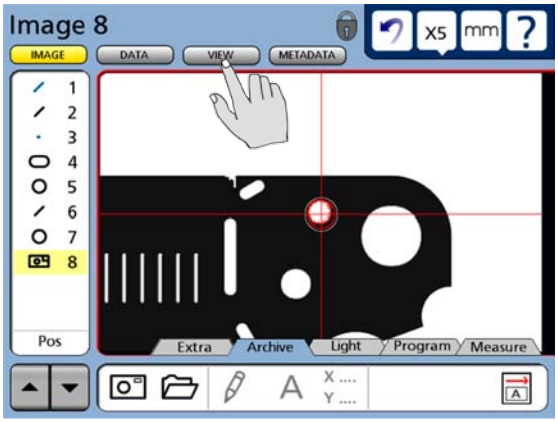
Touch the Data button...



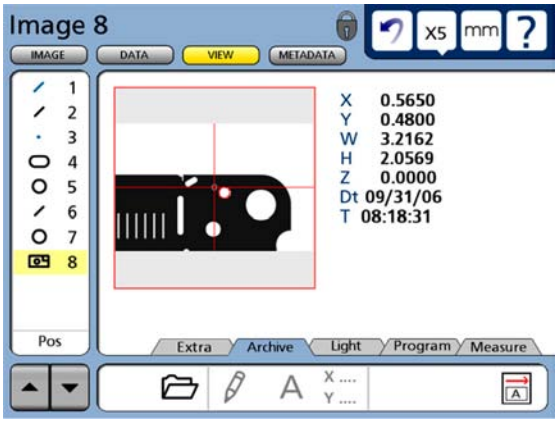
to show image data

View screen

Touch the View button to show a preview of the image with the image data.



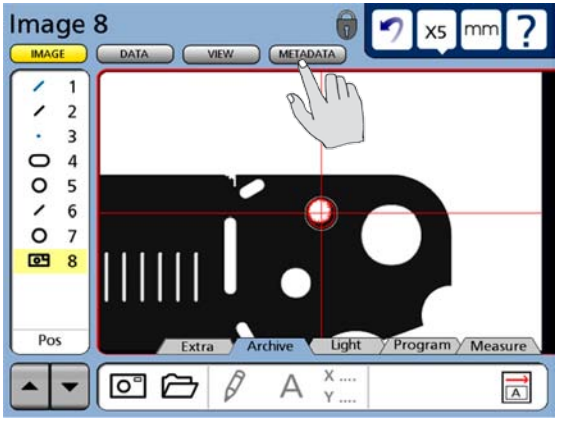
Touch the View button...



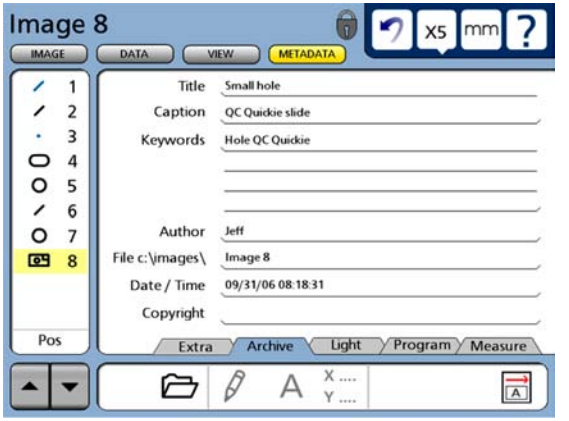
to show an image preview with data

Metadata screen

Touch the Metadata button to show the JPEG image metadata.



Touch the Metadata button...



to show the JPEG image metadata

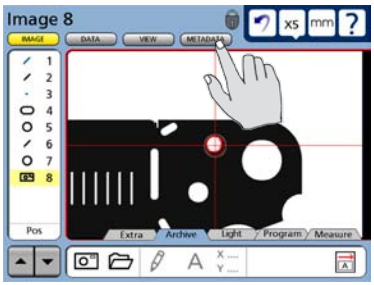
Attaching metadata to a JPEG image

Metadata text files can be composed and attached to JPEG images and can include:

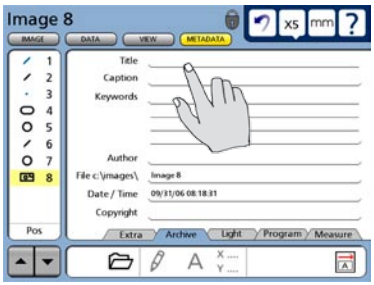
- Image title
- Caption text
- Keywords used for searches
- Author's name
- Date and time of JPEG file creation
- Copyright information

The metadata text files can be opened and viewed later by most popular image viewing, management and processing programs. Metadata is composed in the metadata text entry screen. To create metadata text for an image file:

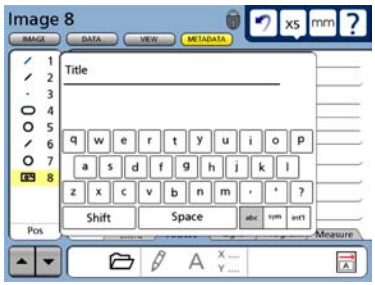
1 Select the image in the feature list, touch the Metadata button, and then touch the desired metadata category text line. In the example shown below, the Title text line is selected.



Touch the Metadata button...



then touch a text category...

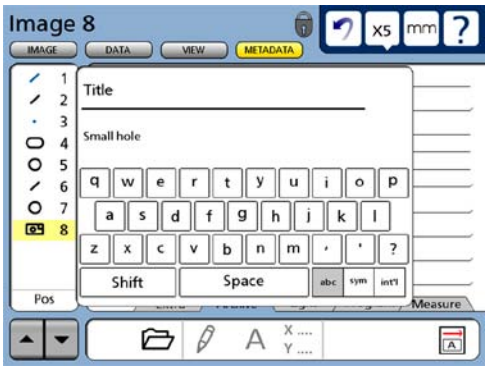


to show the text entry screen

Text entry screens contain keyboard character keys, a shift key, a space key and three character control keys. The character control keys determine whether the keyboard characters are alpha, symbol or international. Press the Cancel key located on the front panel to erase characters.

2 Enter information into the text entry screen using the keyboard character buttons and front panel keypad keys. In this example, the title "Small hole" was entered into the Title category.

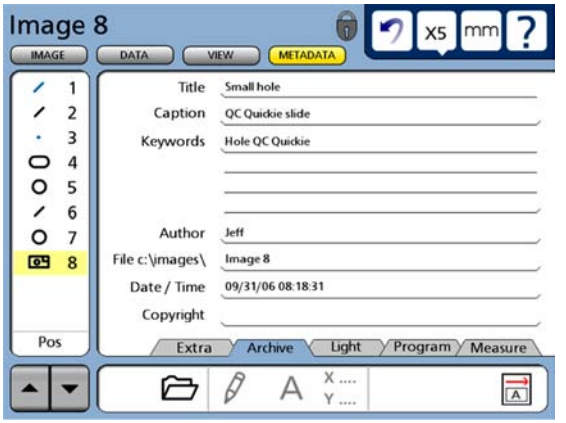
3 Press the Finish key to complete the text entry process for the current category.



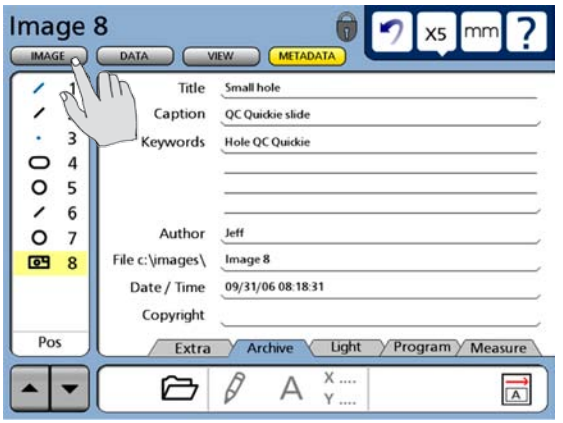
4 Repeat steps 1 to 3 for each Metadata text category that you wish to use. In this example, information was entered into the Title, Caption, Keywords and Author categories.

NOTE

The File and Date/Time categories are filled in automatically by the system. The File and Date/Time information can be edited later if desired.



5 Touch the Image button to return to the image view.



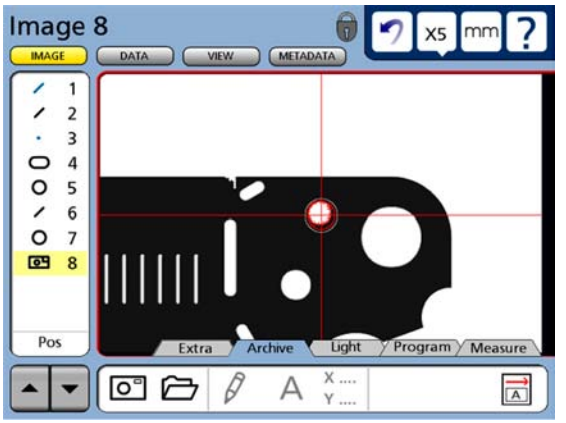


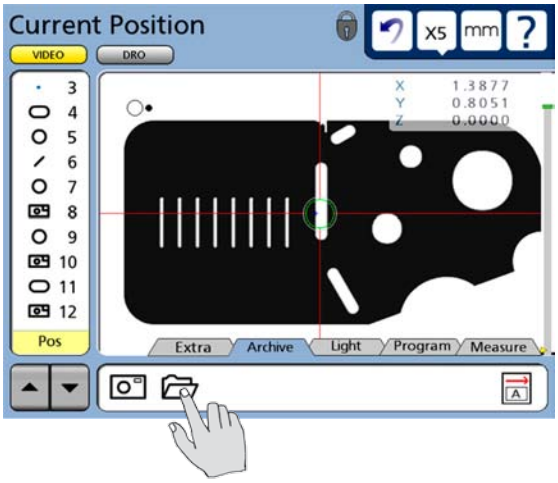
Image file operations

Image files can contain metadata, markups consisting of lines and geometric shapes and descriptive text. Image files are managed using the QC-300 file handler. The file handler is used to perform file operations on individual files or groups of files. File operations include:

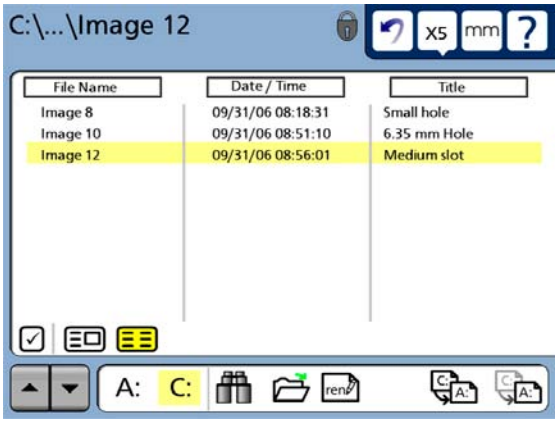
- Selecting files for viewing, markup or edit
- Viewing in the preview or details view
- Sorting by file name, date or title
- Searching for files by keyword
- Opening files for markup or edit
- Renaming files
- Copying files to or from another drive
- Moving files to or from another drive

Launching the file handler

Touch the Folder icon in the Archive tab to launch the file handler. The contents of the internal C: drive will be shown.



Touch the folder icon...



to launch the file handler

NOTE

The C: drive might contain image files that are not shown in the feature list. Image files are retained by the system until they are deleted by the user. A maximum of 40 image files can be stored on the C: drive, so image files should be moved to a USB thumb drive periodically.

Selecting image files

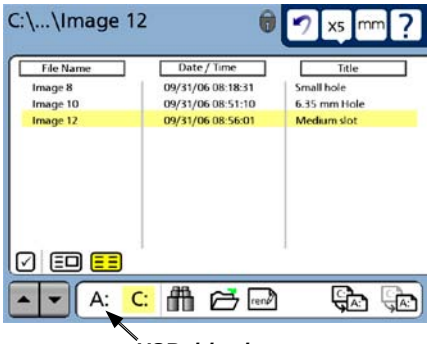
Image files can be located on either of two drives:

- An external USB thumb drive (A:)
- The internal flash drive (C:)

Files are selected by choosing the source drive, and then selecting the desired file(s).

An external USB drive will be recognized by the system if it is inserted into the USB port when the file handler is launched. When the drive is recognized, the USB drive letter (A:) will be displayed in the lower left corner of the file handler toolbar. The number of image files that can be stored on an external USB thumb drive is only limited by the capacity of the drive. Image files are typically smaller than 200 KB.

USB drive



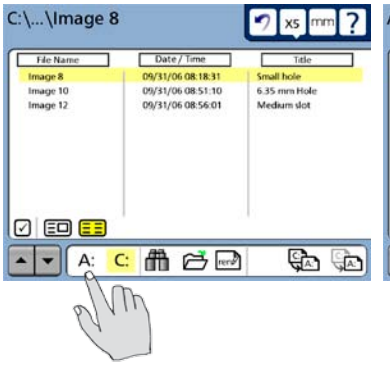
USB drive letter

The internal C: drive will store up to 40 image files. Image files are retained on the C: drive until deleted by the user. When image file storage spans multiple measurement sessions, the file names of image files on the C: drive might not match the file names shown in the feature list.

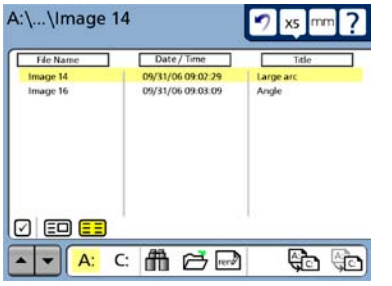
Selecting a drive

The drive letter of the current drive and file name of the selected image are shown in the upper left corner of the screen.

Touch a drive letter in the file handler toolbar to select a different drive and view its contents.



Touch a drive letter...



to select a drive

Selecting files

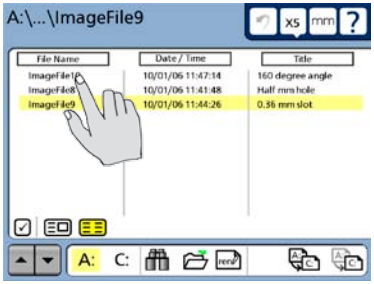
Individual files or groups of files can be selected individually or in groups for the operations shown in this chart.

File Operation	Individual	Groups
Viewing in preview and details	✓	
Sorting by file name, date or title		✓
Searching by keyword	✓	✓
Opening for markup or edit	✓	
Renaming	✓	
Copying to another drive	✓	✓

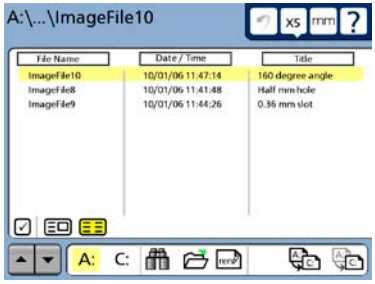
Selecting individual files

To select an individual file:

1 Touch the file name to highlight the file in yellow.



Touch a file name...

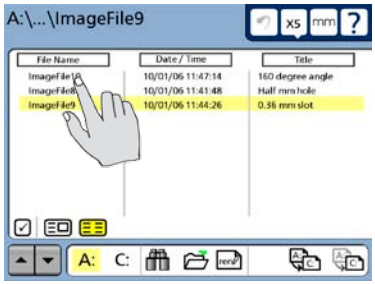


to select an individual file

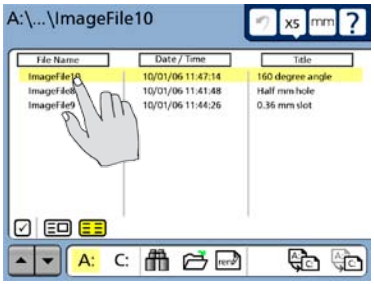
Selecting groups of files

To select groups of files:

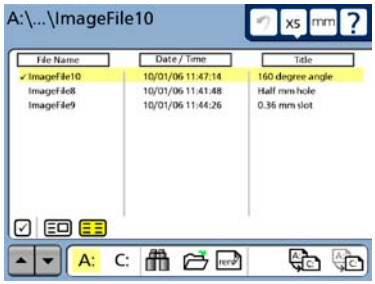
1 Touch a file name to highlight the file in yellow, then touch the file name again to set the checkmark in front of the file name.



Touch a file name to select it...

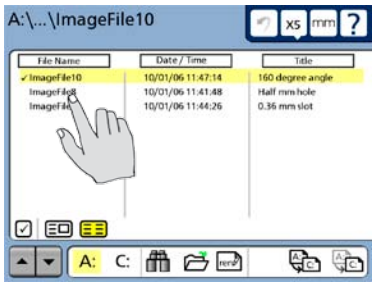


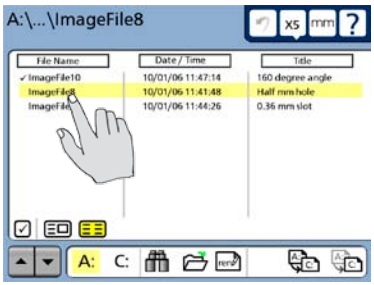
touch the file name again...

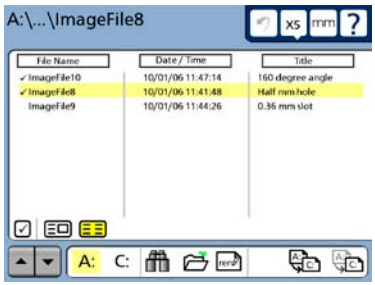


to set the checkmark

2 Repeat step 1 to set checkmarks in front of any additional files you wish to select.





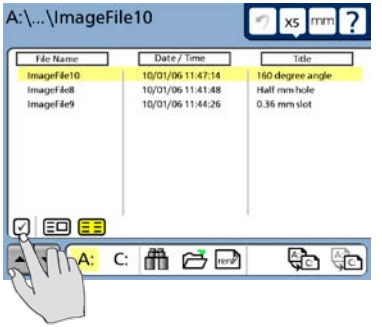


Selecting all files

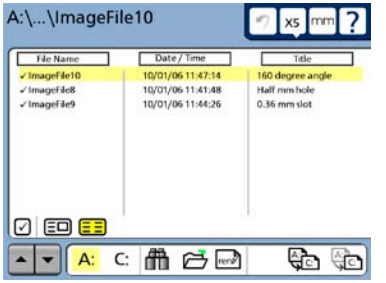
To select all of the files on the current drive:

1 Touch the checkbox in the bottom left corner of the screen. All files on the current drive will be selected and checkmarks will be set in front of the file names.

Touch the checkbox again to de-select all files.



Touch the checkbox...



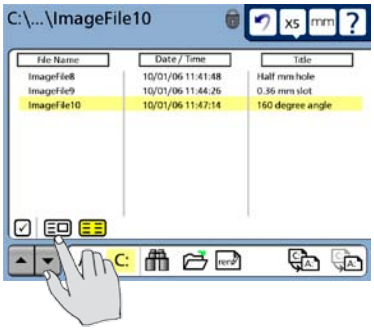
to select all files on the drive

Viewing drive content

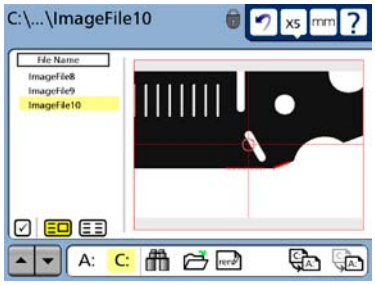
Image files on the internal (C:) or USB (A:) drives can be viewed in the preview or detail modes.

Preview mode

The preview mode shows a list of image files by file name and also shows a large thumbnail of the highlighted image. Touch the preview mode icon to use the preview mode.



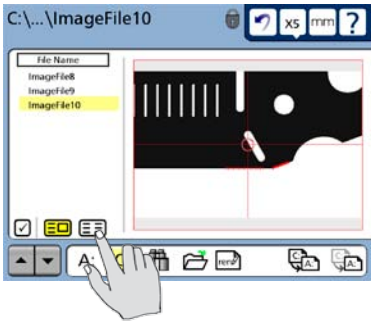
Touch the preview icon...



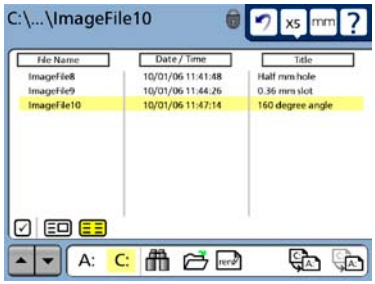
to view file image previews

Details mode

The details mode shows a list of the image files with file names, date/time stamps and image titles. Touch the details mode icon to use the details mode.



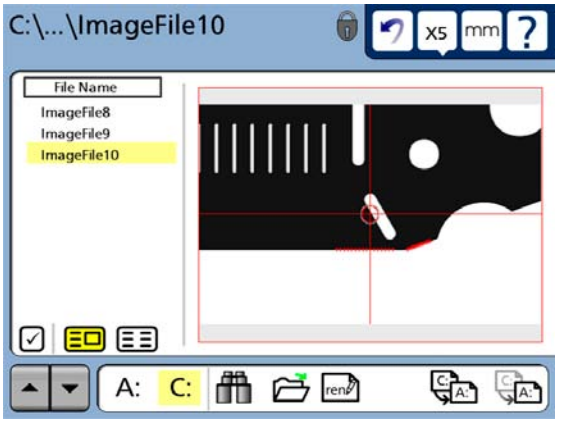
Touch the details icon...



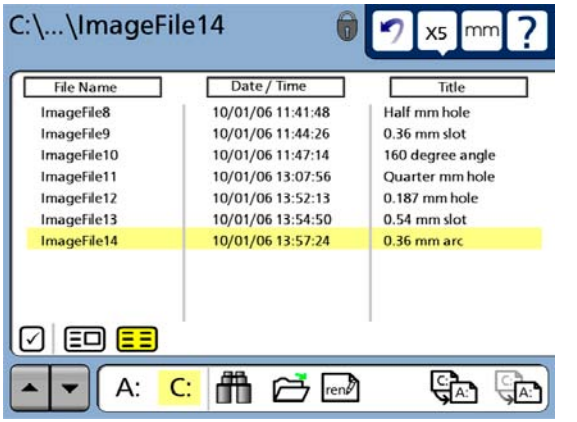
to view file details

Sorting files by name, date or title

Image files can be sorted in the preview or details mode. Sorting in the preview mode is limited to sorting by filename. Sorting in the details mode can be performed using the file name, date or title.



Files can be sorted by filename in the preview mode

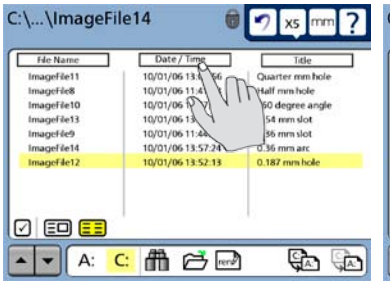


Files can be sorted by filename, date or title in the details mode

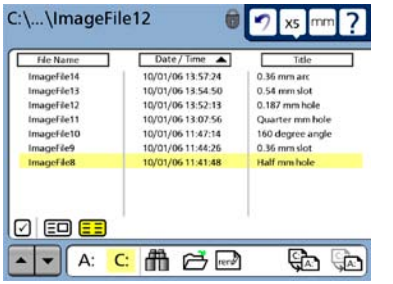
To sort files:

1 Touch the header box of the column you wish to sort by.

An arrow will appear in the header box indicating a descending or ascending sort order.

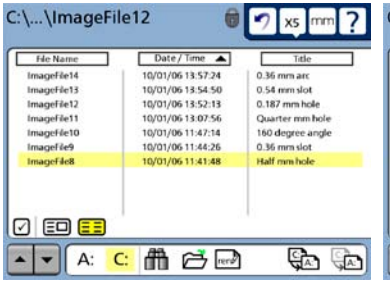


Touch a header box to...

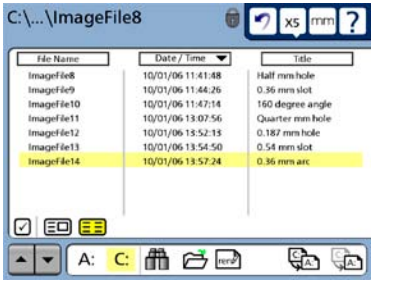


sort by the header category

2 Touch that header box again to reverse the sort order if desired.



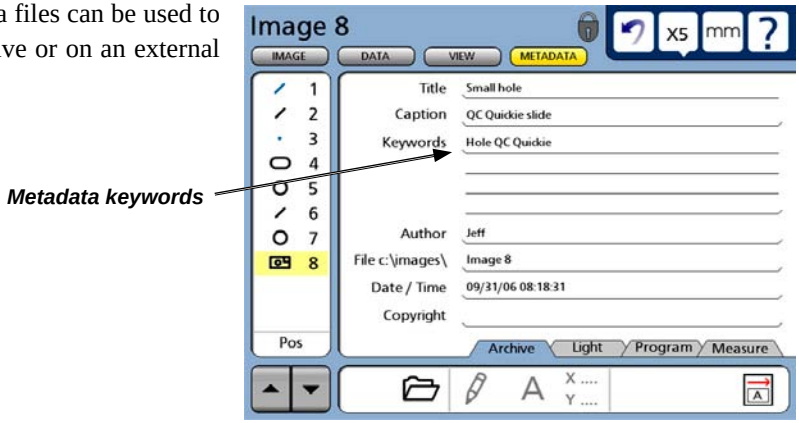
Touch a header box again to...



reverse the sort direction

Searching by keyword

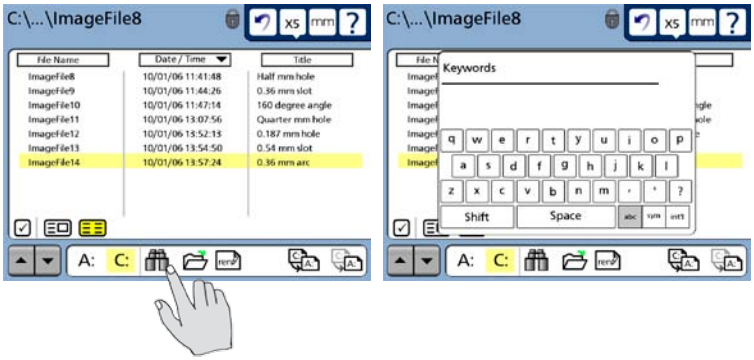
Keywords included in metadata files can be used to find files on the internal C: drive or on an external USB A: drive.



Metadata keywords

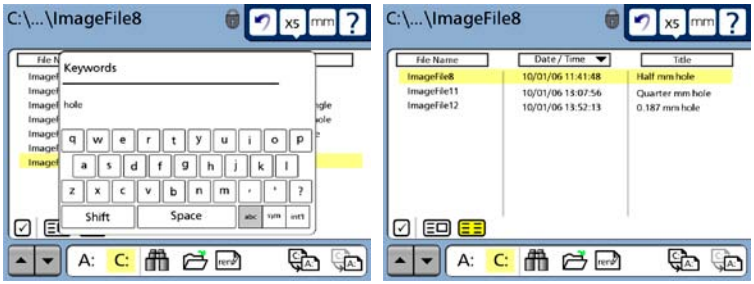
To perform a keyword search:

1 Touch the binocular icon. The Keywords text entry screen will be displayed.



Touch the binocular icon to... ***begin a keyword search***

2 Enter a keyword that was previously included in the image file metadata, and then press the Finish key. A list of only the files that contain the keyword will be displayed.



Enter a keyword and press the Finish key to... ***display a list of only the files that contain the keyword***

NOTE

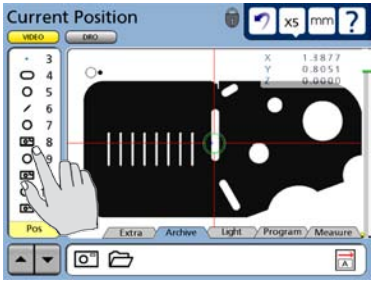
Keywords are not case-sensitive and can be entered in upper or lower case characters.

Opening files for markup or edit

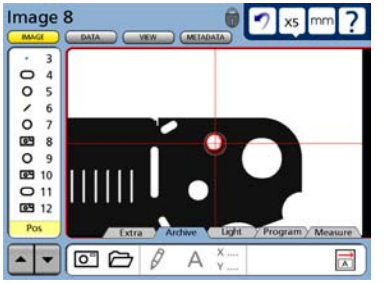
Image files contained in the feature lists are often a subset of files contained on the C: drive. This is because the C: drive stores image files across multiple measurement sessions (from multiple feature lists).

From the feature list

When image files are shown in the feature list, they can be opened by simply touching the image feature in the list.



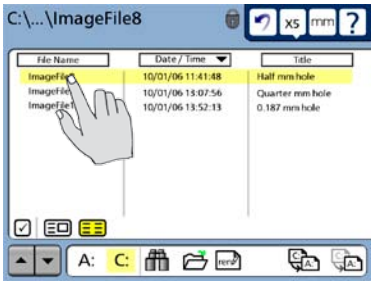
Touch images shown in the feature list...



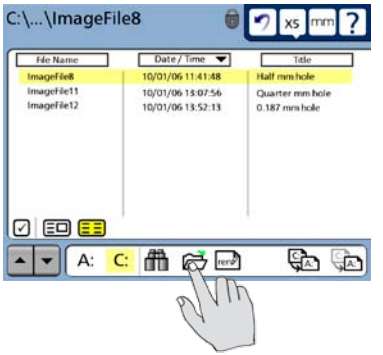
to open them for viewing, markup or edit

From a storage drive

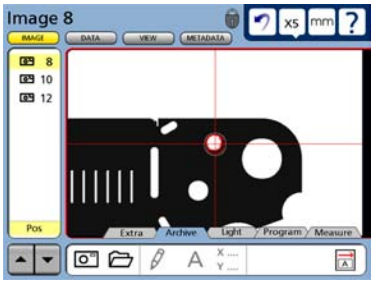
When image files are not shown in the feature list, but are stored on a drive, they can be opened from the file handler by selecting the file and then touching the open folder icon.



Select an image on a drive...



then touch the Open icon to...



open it for viewing, markup or edit

NOTE

Image files opened from the file handler are added to the feature list if they are not already shown in the feature list.

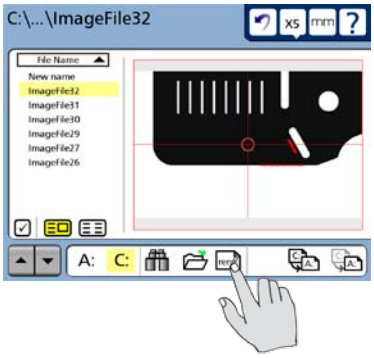
Renaming files

Files are renamed in the file handler screen and can be renamed on the internal C: drive or on the external USB A: drive. When a file is renamed, only the file name is changed and existing file titles are retained.

NOTE
File information can also be changed by editing the contents of the Metadata text entry screen.

To change a file name:

1 Select the file and then touch the Ren icon. A text entry screen will be displayed.

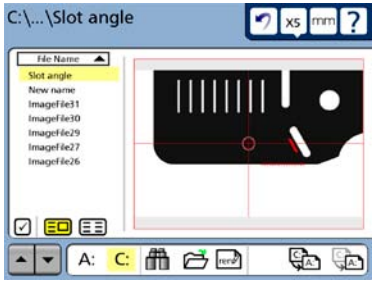


Select an image on a drive, then touch the Ren icon to...

display a text entry screen for renaming the file

2 Erase the existing filename characters by repeatedly pressing the Cancel key, then add the new characters using the text entry keyboard and the front panel numeric keypad. Press the Finish key to save the new filename.

Enter the new name and then...

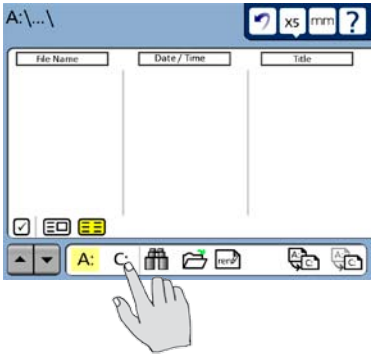


press the Finish key

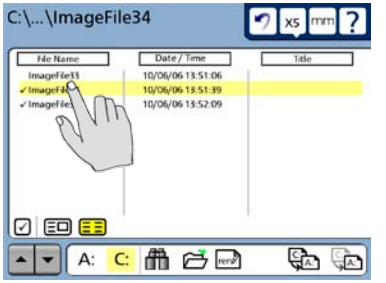
Copying files to another drive

Image files can be copied from either drive to the other; internal (C:) to USB (A:), or USB (A:) to internal (C:) drive. The original files will be retained on the source drive. To copy image files:

1 Select the source drive and then select the files to be copied.

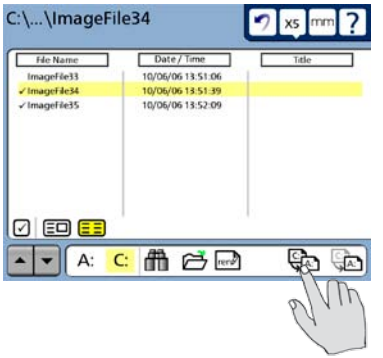


Select the source drive...

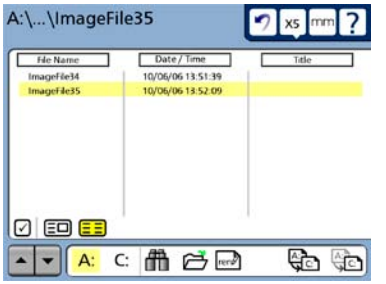


then select the files to be copied

2 Touch the copy icon. Copies of the selected files will be sent from the source drive to the other drive.



Touch the copy icon to...

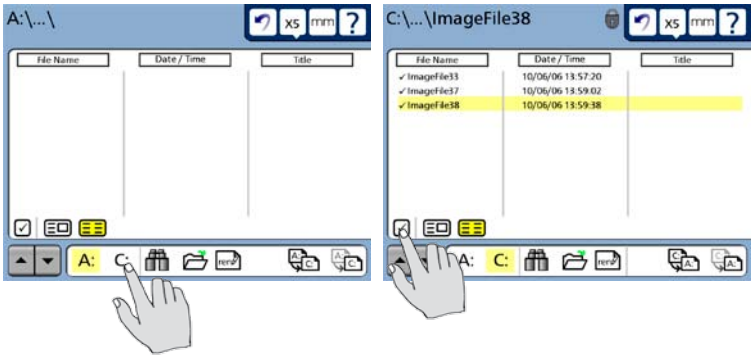


copy files to the other drive

Moving files to another drive

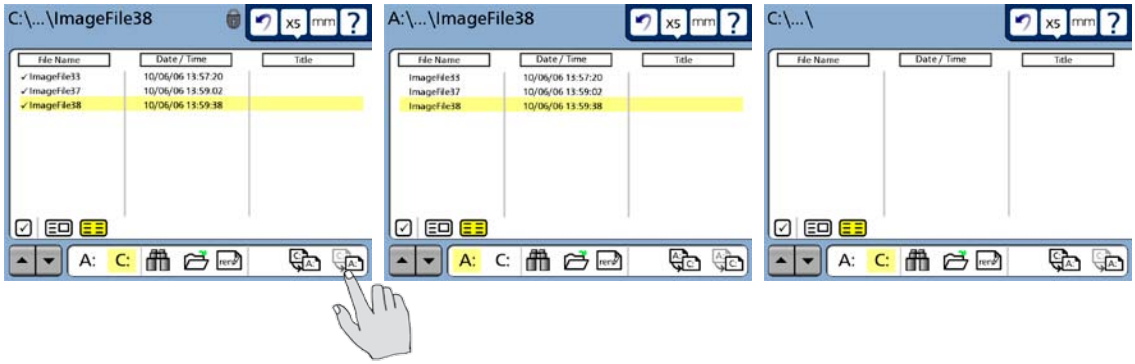
Image files can be moved from either drive to the other; internal (C:) to USB (A:), or USB (A:) to internal (C:) drive. The original file will be removed from the source drive. The move operation is typically used to simultaneously delete files creating space on the C: drive while creating backups of the deleted files. To move image files:

1 Select the source drive and then select the files to be moved. In this example, all the files are selected by touching the check-box.



Select the source drive... ***then select the files to be moved***

2 Touch the move icon. Copies of the selected files will be sent from the source drive to the other drive. The original files will be deleted from the source drive.

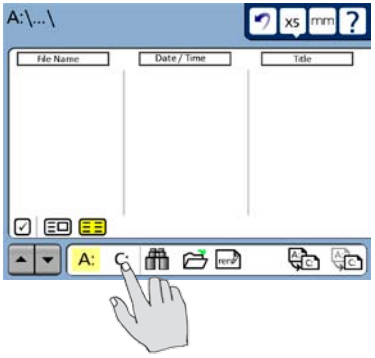


Touch the move icon to... ***copy files to the other drive and...*** ***delete files from the source drive***

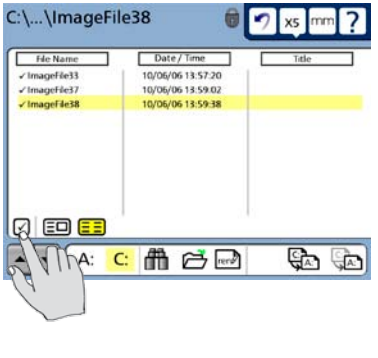
Deleting files from either drive

Files can be deleted from either drive; internal (C:) or USB (A:). To delete files from a drive:

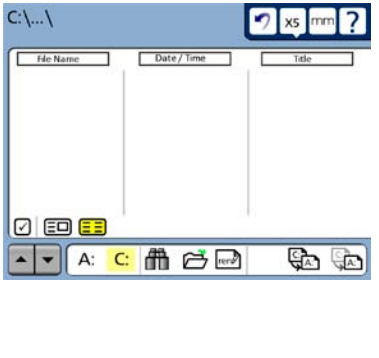
1 Select the desired drive, select the files to be deleted and press the Cancel key. All the selected files will be deleted. In this example, all files are deleted.



Select the source drive...



then select the files to be deleted and press the Cancel key...



to delete the files

Image markup and edit

Image files can be marked up and edited to include text and graphics that highlight feature data and provide additional information regarding the part or part measurements. Images can be marked up to include:

- Shapes and lines
- Text or text boxes
- Data boxes

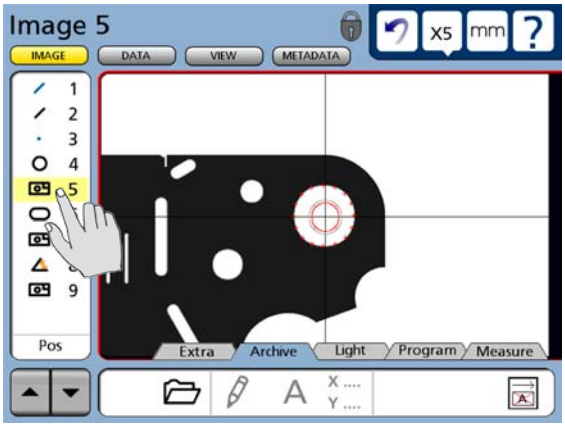
Shapes, lines and text can be edited to change line thickness, shape and color. Text boxes and data boxes can be filled with solid colors to emphasize text. Feature data can show measured values or tolerance values.

Image markup and edit tools

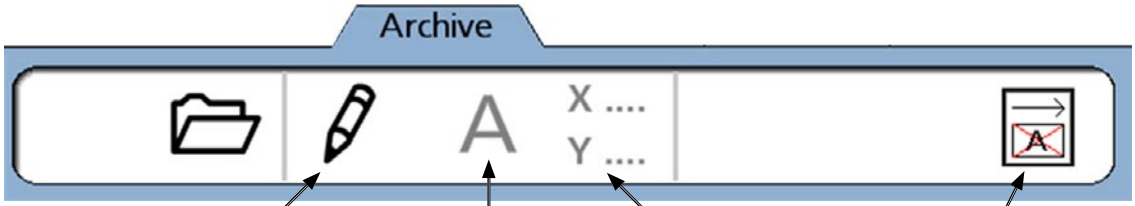
Image markup and edit tools are contained in the Archive tab and are displayed when the Archive tab is shown and an image is selected in the feature list.

The Archive tab contains tools for:

- Drawing shapes and lines
- Adding text and text boxes
- Adding measurement or tolerance data
- Editing shapes, lines, text and color



Select an image to display markup and edit tools



Pencil tool
Draw shapes and lines

Text tool
Add text and text boxes

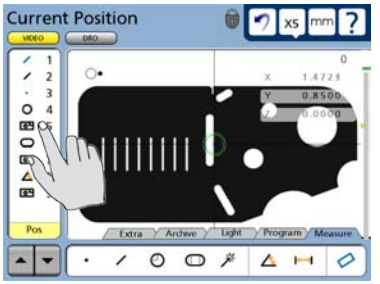
Data tool
Add measurement and tolerance data

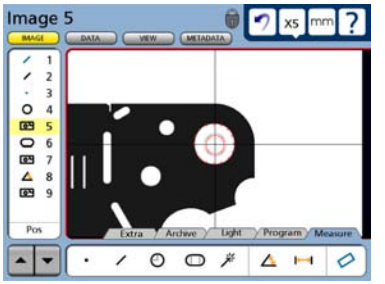
Edit tool
Edit lines, shapes, text and colors

Beginning a markup or editing session

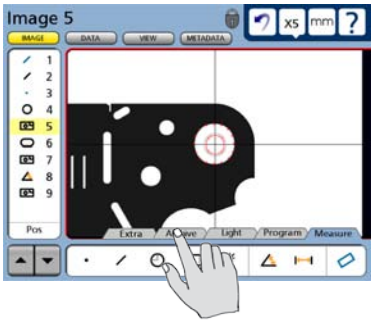
Image markup and editing sessions begin by selecting an image and displaying the archive tools.

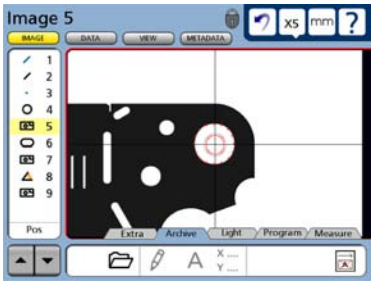
1 Select the desired image file





2 Touch the Archive tab to display the archive markup and editing tools





Shapes and lines

Shapes and lines can be:

- Drawn on an image file
- Edited to change shape line thickness, color or fill color
- Resized for appropriate fit
- Moved to new locations
- Deleted from the image file

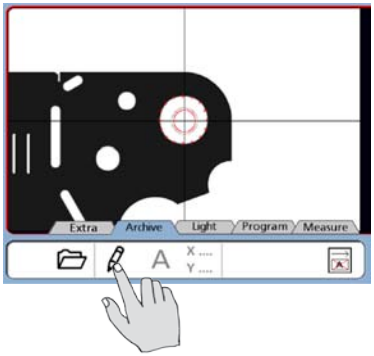
Drawing shapes and lines

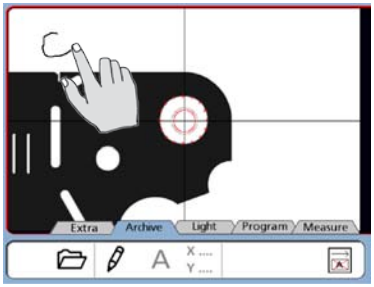
Use the image archive pencil tool to draw shapes and lines.

Squares and rectangles

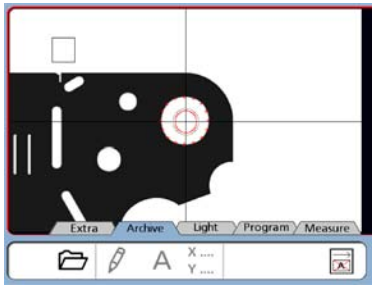
To draw a square or a rectangle:

1 Touch the Pencil tool to enable drawing. Then touch and drag your finger on the screen to create a circle or an oval. Circles will create squares and ovals will create rectangles.

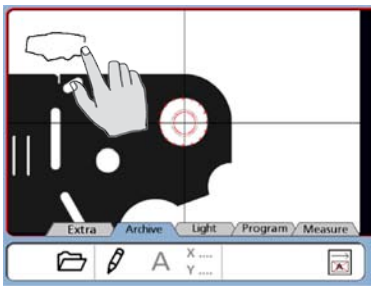




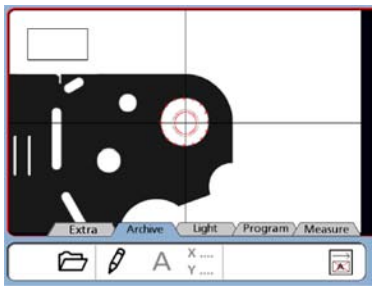
Draw a circle to create...



a square shape



Draw an oval to create...

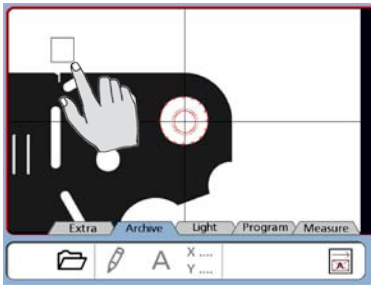


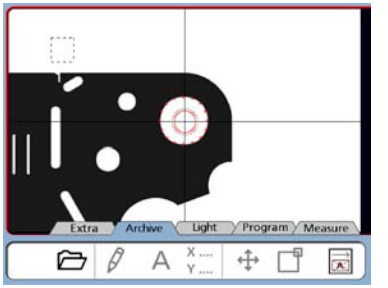
a rectangular shape

Circles

To create a circle:

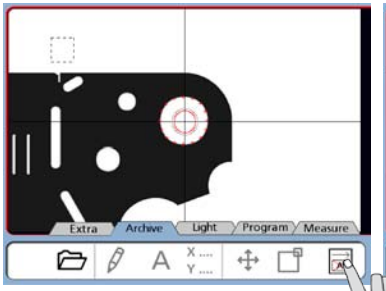
1 Draw a square or a rectangle as described on the previous page.

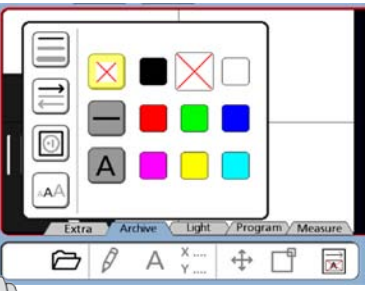




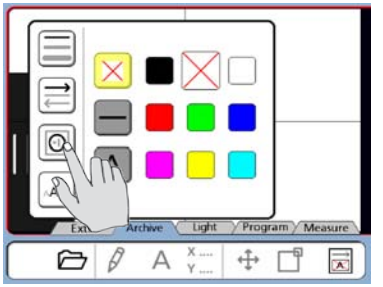
2 Touch the square or rectangle to select it. The selected shape will be shown with dashed lines.

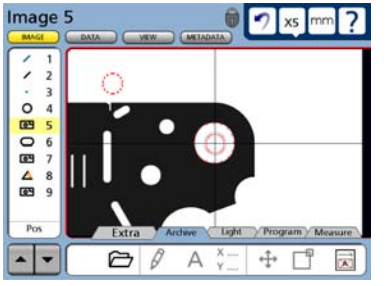
3 Touch the edit tool to display the tool palette.



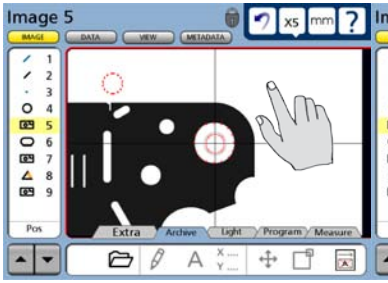


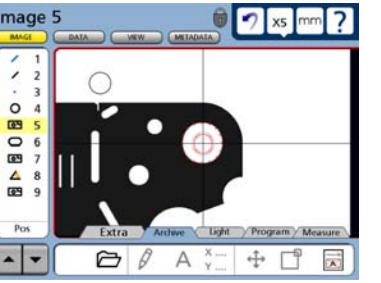
4 Touch the shape button icon to change the shape from a square to a circle, then press the Finish key. The circle will be shown with dashed lines.





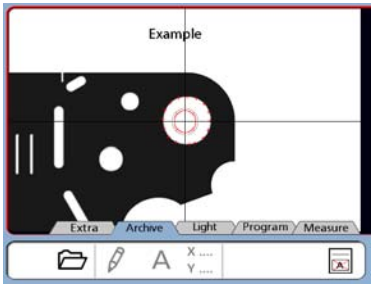
5 Touch the screen at a distance from the circle to deselect it.



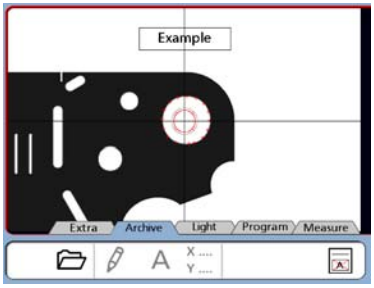


Text boxes

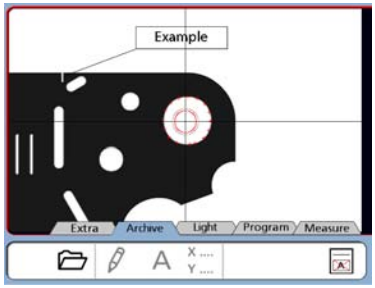
Text can be added to image files with or without text boxes. Text boxes can be added with or without pointer lines.



Text



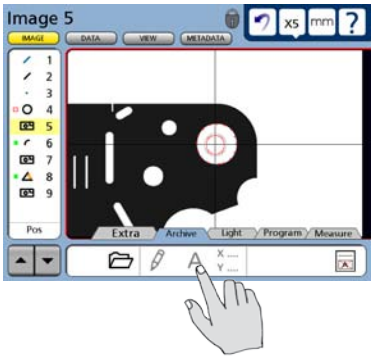
Text with box

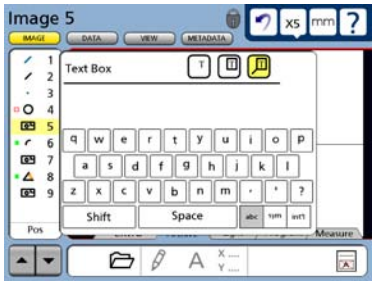


Text with box and pointer line

To add a text note:

1 Touch the text tool to enable text entry. The Text Box screen will be shown.

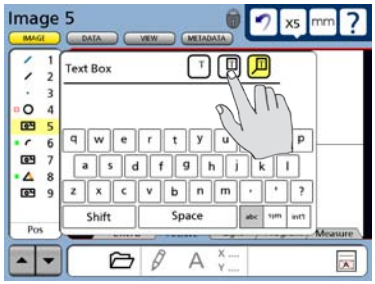




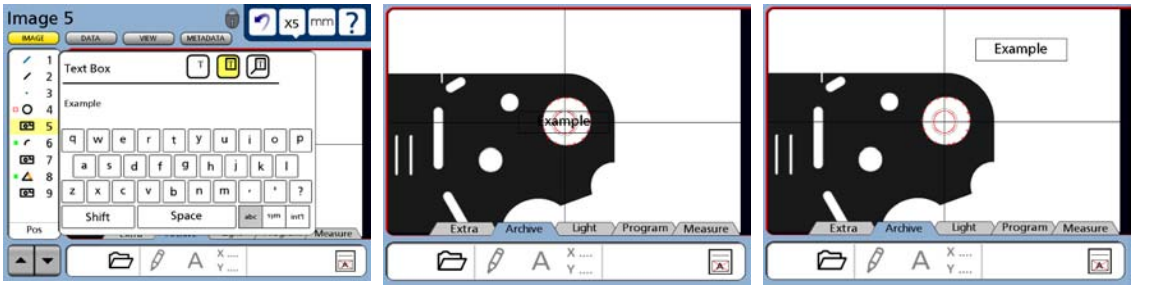
2 Touch one of the three Text Box button icons to:

- Add text only
- Add text with a box
- Add text with a box and pointer line

In this example, text with a box is added to the image.



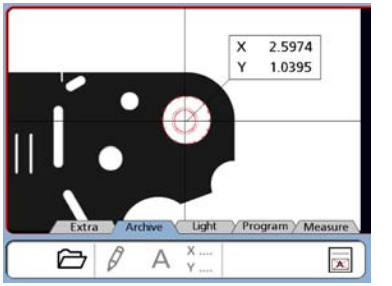
3 Use the Text Box keyboard and front panel keypad to enter the desired text, and then press the Finish key. Text will be added at the center of the screen. The location, size and other characteristics of the text can be edited as described later in this chapter.



Press the Finish key to add the text box, then move it to the desired location

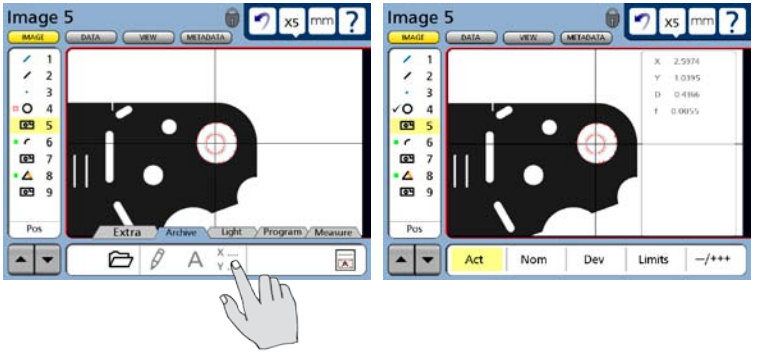
Data boxes

Measurement and tolerance data can be added to an image and will include a data box and pointer line. The data box will contain measurement or tolerance data specified by the user. The pointer line will connect the data box to the center of the feature's image. To add measurement or tolerance data to an image:



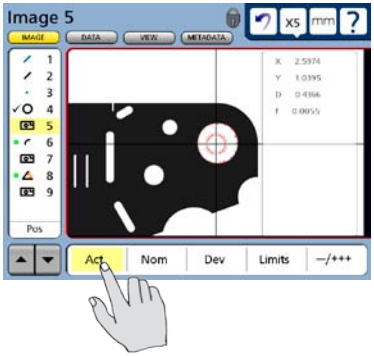
Data box with pointer line

1 Touch the Data tool to enable data entry. The image feature will be checkmarked in the feature list and the data selection buttons will be shown across the bottom of the screen.



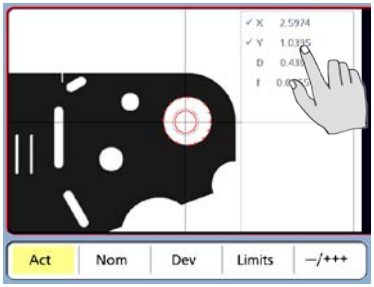
2 Touch the desired data button to select the data category that will be added to the image.

- Act: Actual measurement data, location, size and form error
- Nom: Nominal tolerance values
- Dev: Deviations from the nominal tolerance values
- Limits: Specified tolerance limits
- -/+++: Tolerance performance

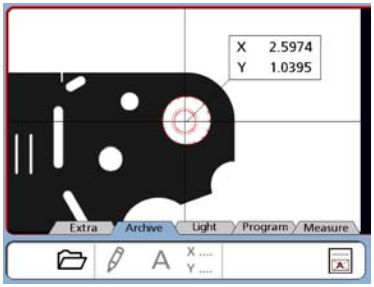


In this example, the actual measurement data category (Act) is selected and the available data for the selected category is be shown in top-right corner the screen.

3 Touch (and checkmark) the specific data that you would like to include on the image. In this example, the X and Y positions were checked.



4 Press the Finish key to add the data box to the image. The location, size and other characteristics of the data box and its contents can be edited as described later in this chapter.



Editing shapes, lines, text boxes and data boxes

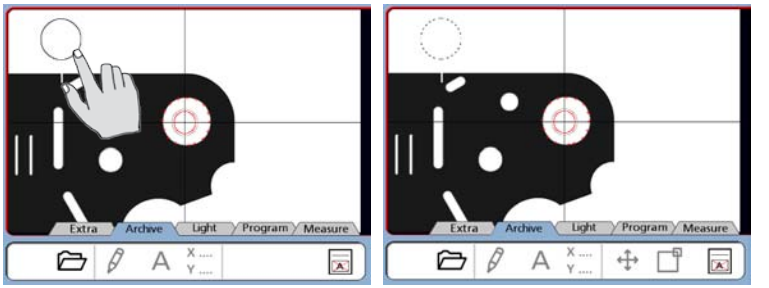
Shapes, lines, text boxes and data boxes can be edited to change:

- Shape
- Location
- size and orientation
- Color of shapes, lines and text
- Line thickness of lines and shapes

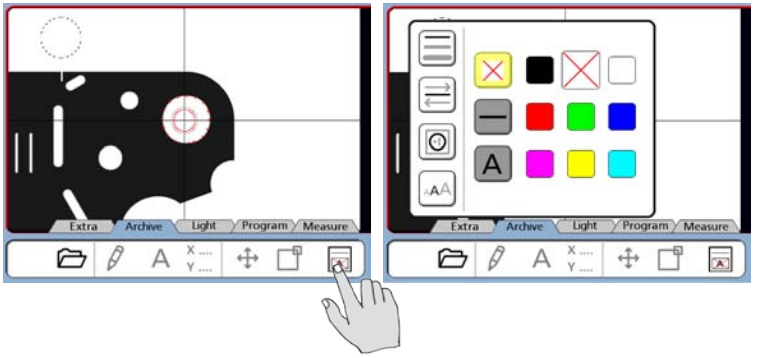
Shape

Shapes, lines, text boxes and data boxes can be edited to change shape. To edit shape:

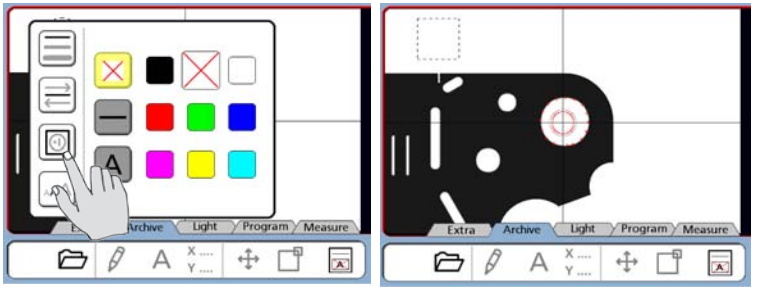
1 Select the desired item. In this example a circle is selected.



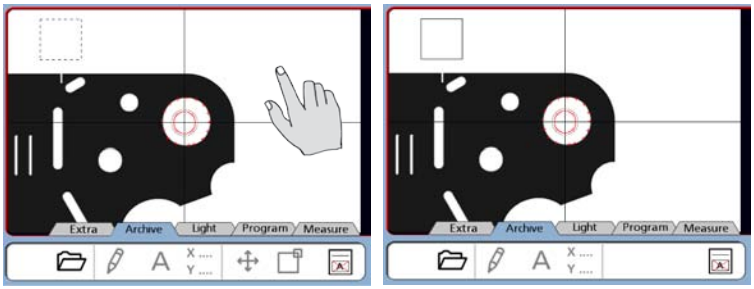
2 Touch the edit tool to display the edit palette.



3 Touch the shape button icon to cycle through the available shapes. Select the desired shape and press the Finish key. In this example the square shape is selected. The new shape will be shown with dashed lines.



4 Touch the screen at a distance from the new shape to deselect it.



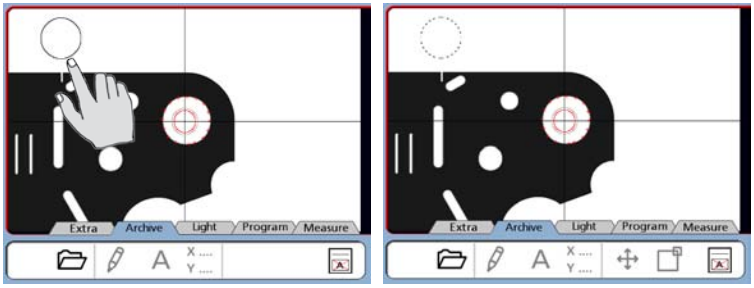
Location and orientation

Shapes, lines, text, text boxes and data boxes can be edited to change location. Text box pointer lines can also be edited to change pointer line angle and endpoint location.

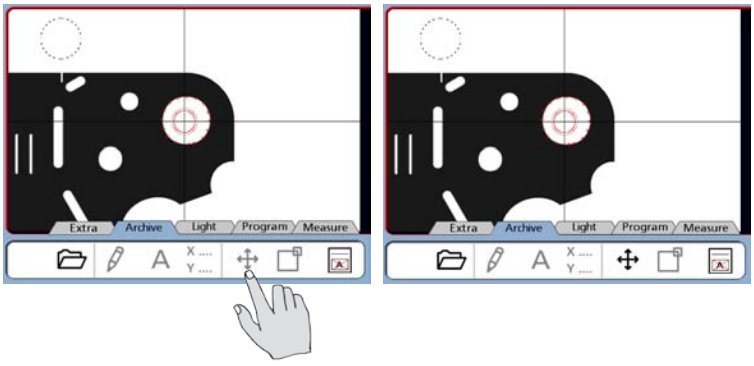
Shapes, lines text, text boxes and data boxes

To edit location:

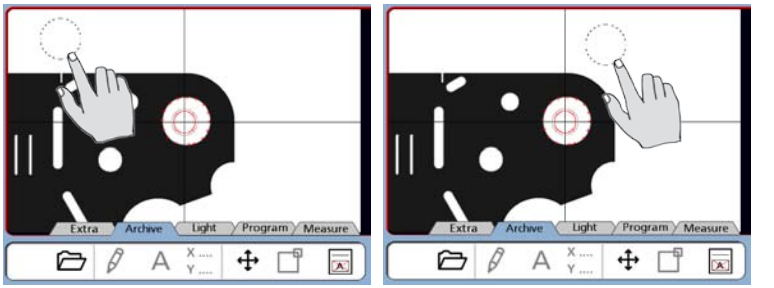
1 Select the desired item. In this example a circle is selected.



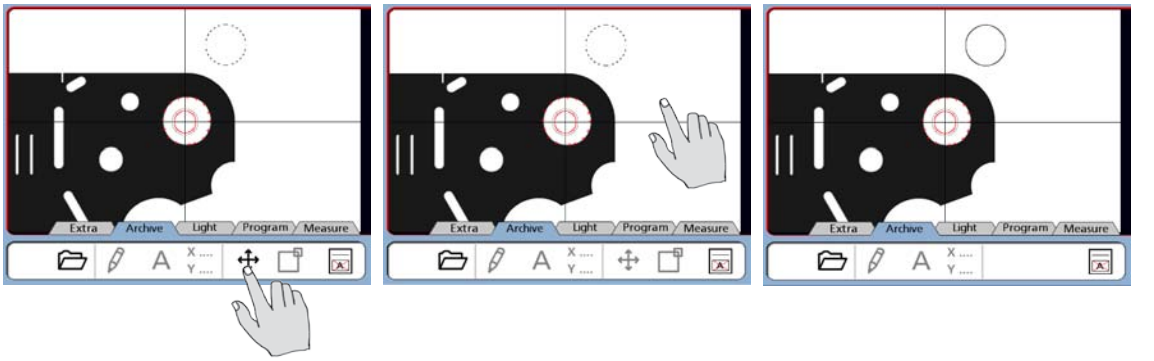
2 Touch the location tool to enable it. It will be displayed in bold.



3 Touch the item and drag your finger across the screen to change the location of the center point of the selected item.



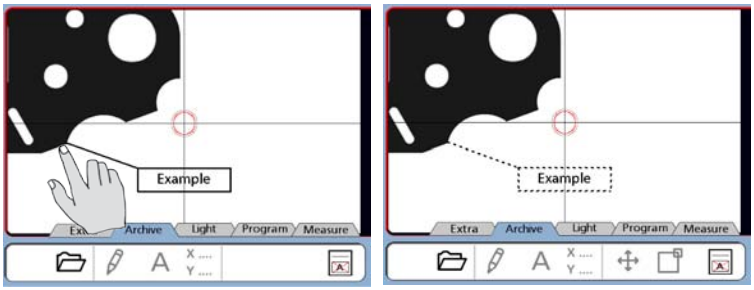
4 Touch the location tool again to disable it, and then touch the screen at a distance from the shape to deselect it.



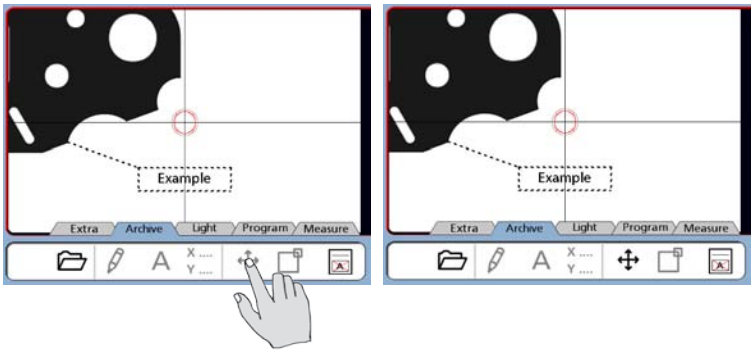
Text box pointer lines

To edit the end-point location and line angle orientation of pointer lines attached to text boxes:

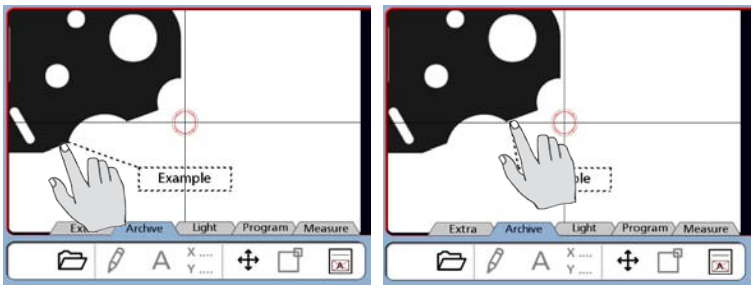
1 Touch the pointer line at its endpoint.



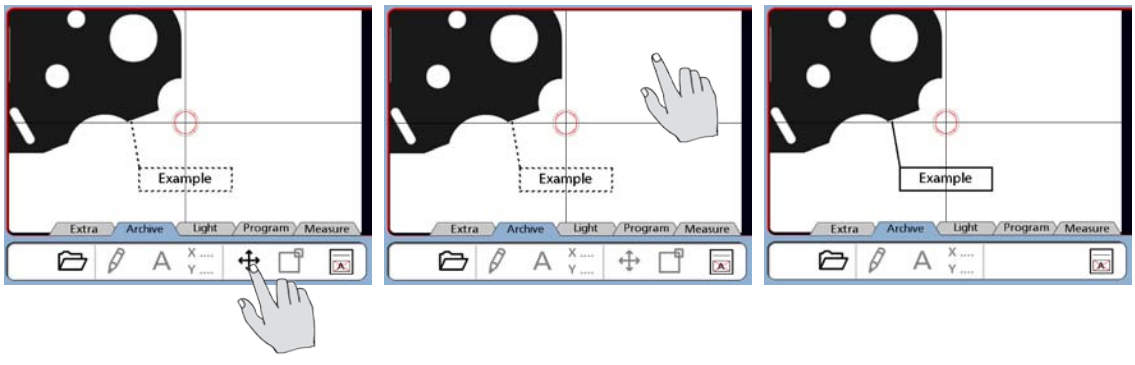
2 Touch the location tool to enable it. It will be displayed in bold.



3 Touch and drag your finger on the screen to change the position of the pointer line endpoint.



4 Touch the location tool again to disable it, and then touch the screen at a distance from the line to deselect it.



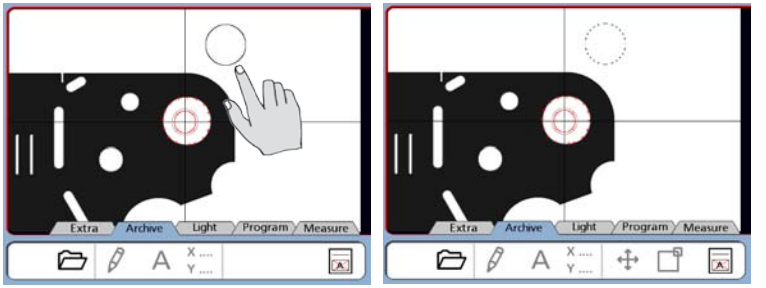
Size

Shapes, lines, text, text boxes and data boxes can be edited to change size.

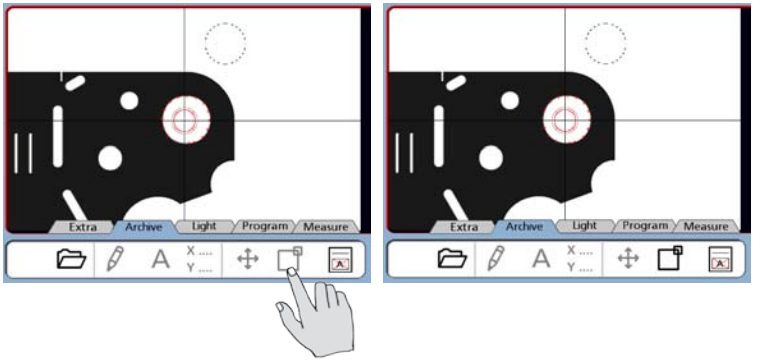
Shapes, lines, text boxes and data boxes

The method used for changing the size of shapes, lines, text boxes and data boxes is identical. In this example the size of a circle is changed. When the size of lines that include arrowheads are changed, the size of the arrowhead changes in proportion to the change in line size. To edit size:

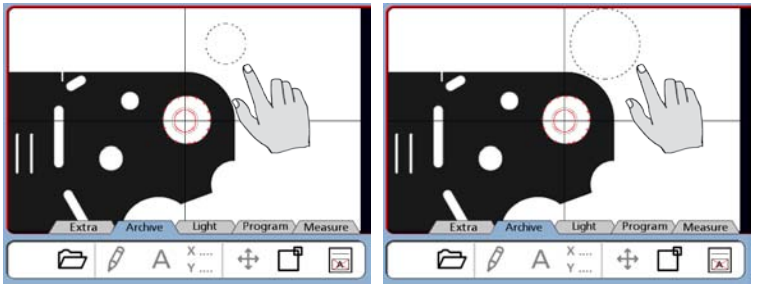
1 Select the desired item. In this example a circle is selected.



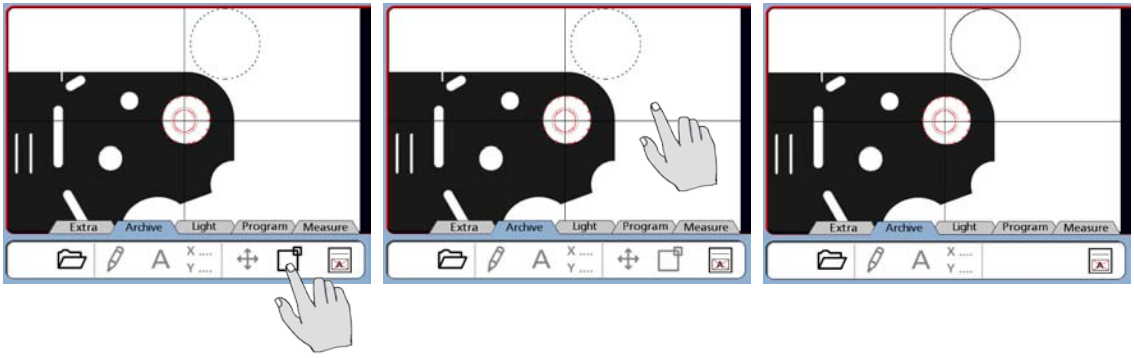
2 Touch the size tool to enable it. It will be displayed in bold



3 Touch the selected item and drag your finger on the screen to change its size.



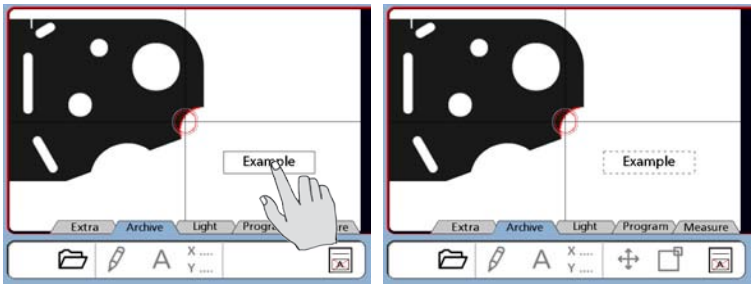
4 Touch the size tool again to disable it, and then touch the screen at a distance from the selected item to deselect it.



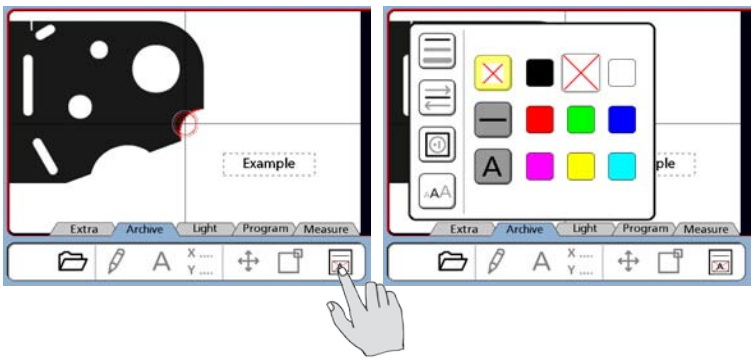
Text

Text contained within text boxes or data boxes, and text without boxes can be edited to change size. When the text is enclosed by a box, the size of the box changes in proportion to the change in text size. To edit text size:

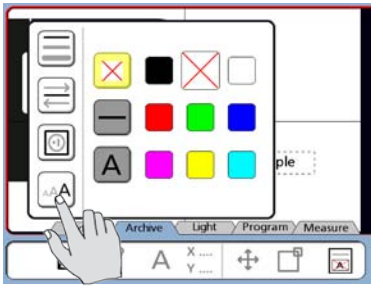
1 Select the desired text item. In this example a text box is selected.

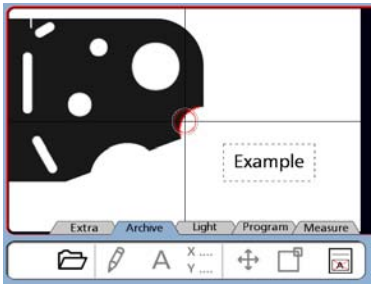


2 Touch the edit tool to display the edit palette.

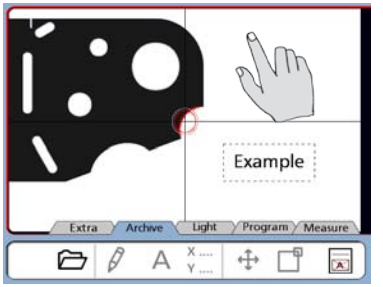


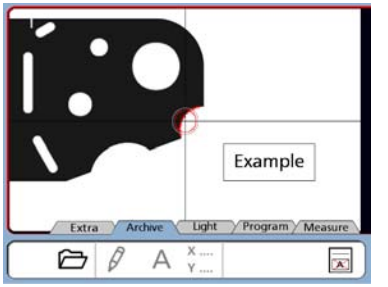
3 Touch the text button icon to cycle through the available text sizes. Select the desired text size and press the Finish key. In this example the largest text size is selected. The text box will be shown with dashed lines.





4 Touch the screen at a distance from the text to deselect it.

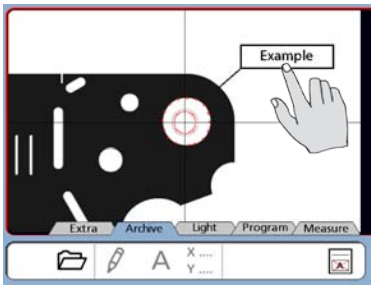


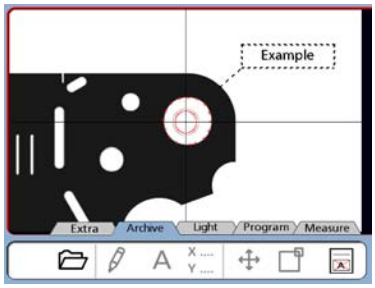


Color

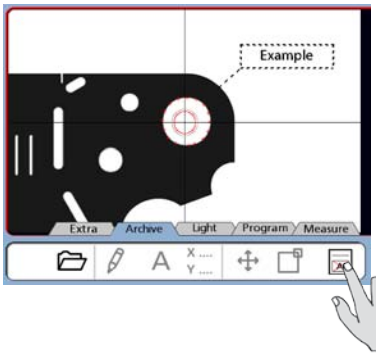
Shapes, lines, text, text boxes, data boxes and text box fills can be edited to change color. In this example, the fill, line, and text colors of a text box are changed. To edit color:

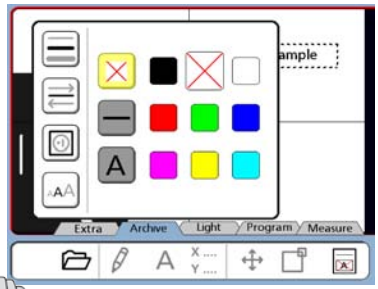
1 Select the desired item. In this example, a text box is selected.



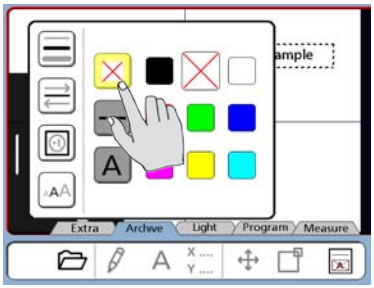


2 Touch the edit tool to display the edit palette.

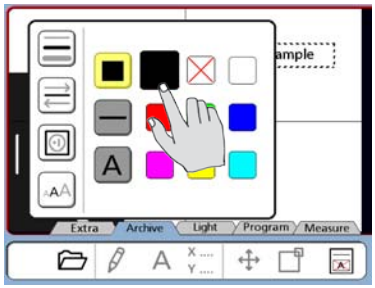




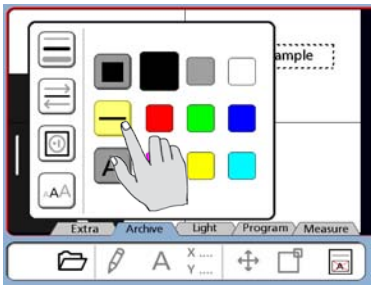
3 Touch the fill, line or text button icon and then touch a color button to change color. This process can be repeated for multiple items while the edit palette is displayed.



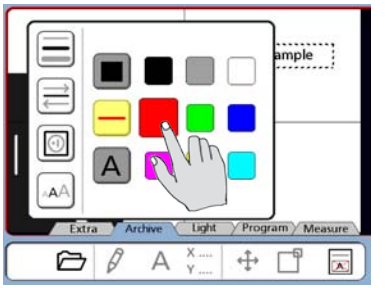
Touch the fill button...



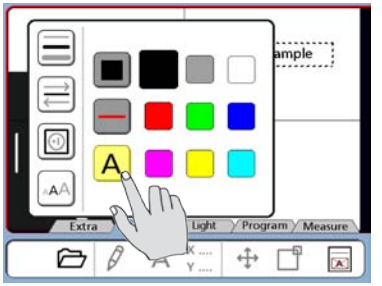
and change fill color to black



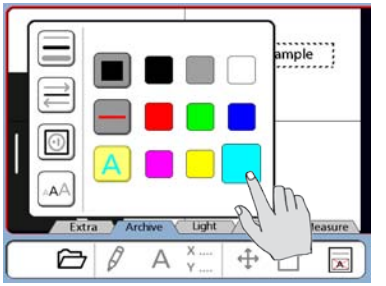
Touch the line button...



and change line color to red

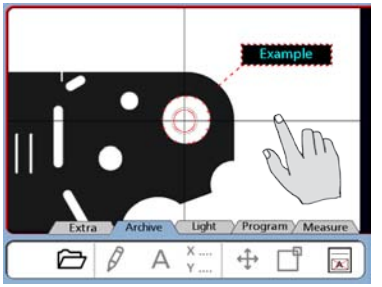


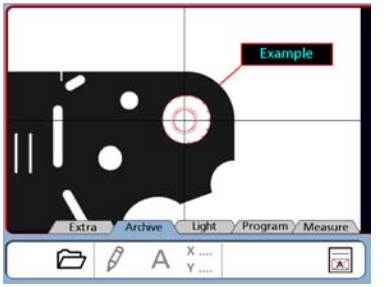
Touch the text button...



and change text color to cyan

4 Press the Finish key to complete the color edit, and then touch the screen at a distance from the selected item to deselect it.





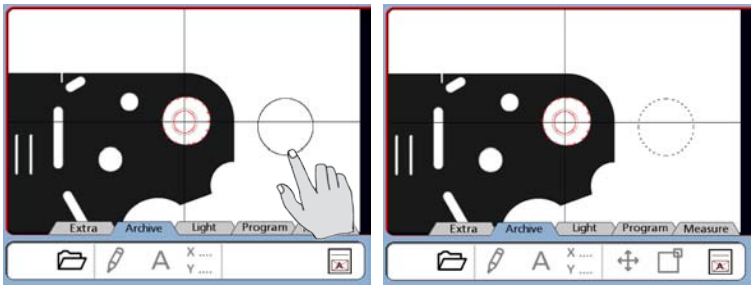
NOTE

Only text boxes and data boxes can be filled with solid colors. Shapes cannot be filled.

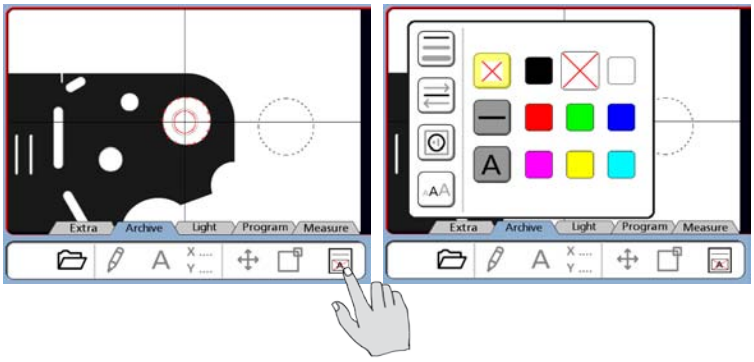
Line thickness

Shape, line, text box and data box lines is can be edited to change thickness. To change line thickness:

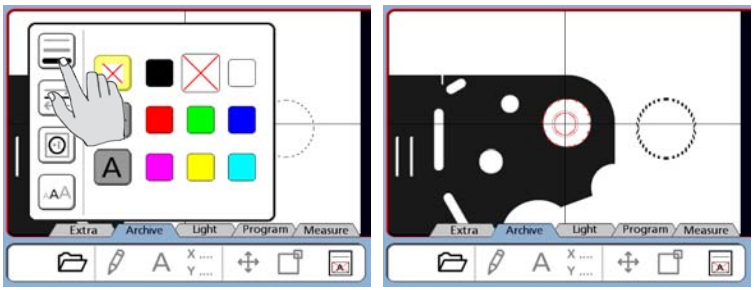
1 Select the desired item. In this example a circle is selected.



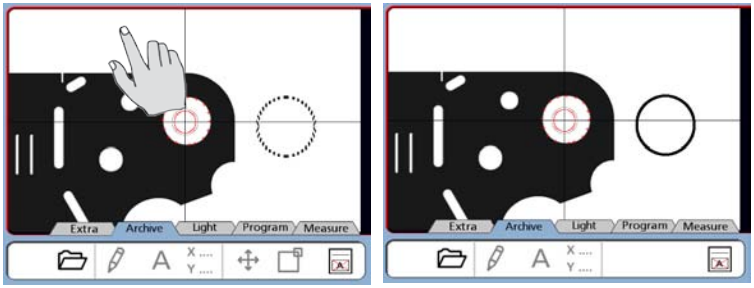
2 Touch the edit tool to display the edit palette.



3 Touch the line thickness button icon to cycle through the available line thickness. Select a line thickness and press the Finish key. The item will be shown with a new line thickness in dashed lines.



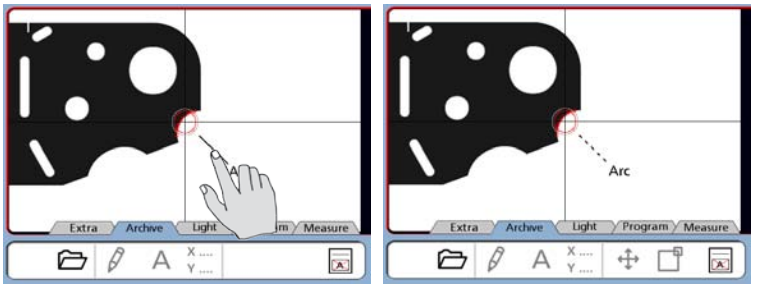
4 Touch the screen at a distance from the item to deselect it.



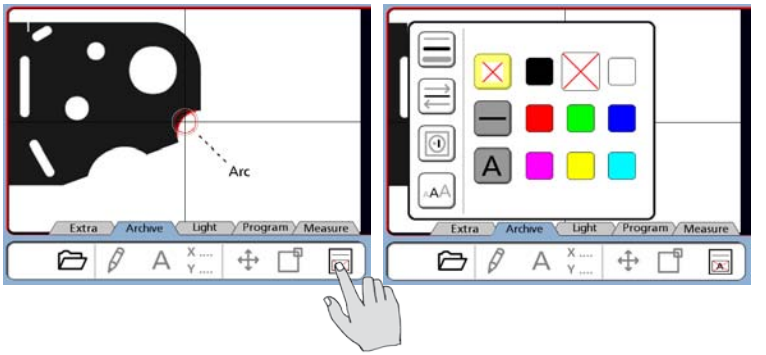
Line ends

Lines can be edited to add or delete arrowheads. In this example, an arrowhead is added. To add or delete arrowheads:

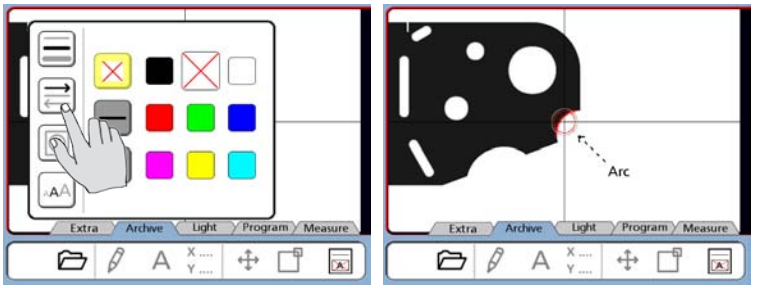
1 Select the line. The line will be shown in dashes.



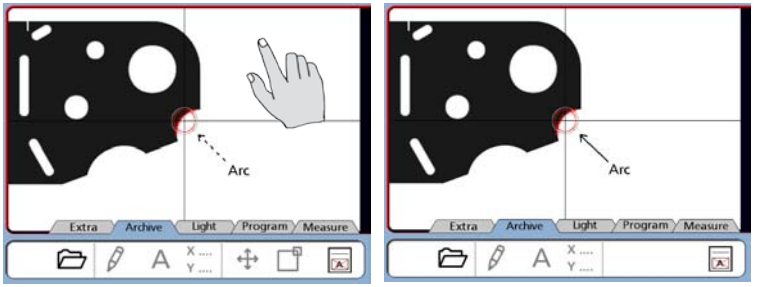
2 Touch the edit tool to display the edit palette.



3 Touch the line end button icon to cycle through the available line ends. Select a line end and press the Finish key. The line will be shown with a new line end in dashed lines.

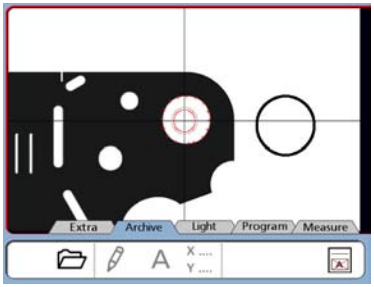


4 Touch the screen at a distance from the line to deselect it.

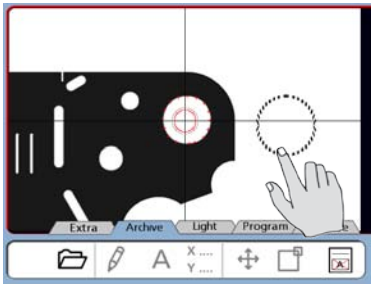


Deleting image markup items

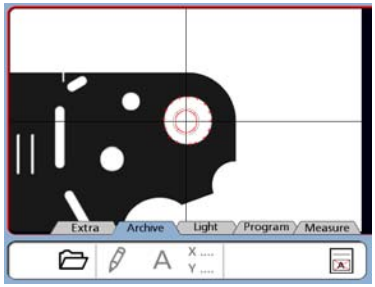
Any image markup item can be deleted from the image file by selecting it and pressing the Cancel key.



To delete a markup item...



select it...



and press the Cancel key

Chapter 10: Communication

The QC-300 can communicate with a computer over a standard RS-232 serial port and with printers over the USB port.

Connecting to a computer

1 Verify that the QC-300 and computer power are off.

2 Connect a computer COM port to the QC-300 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-300. The default QC-300 settings for communication over the RS-232 serial port are shown here.

- Baud rate: 9600
- 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-300, and configure the communication properties of the COM port to match those of the QC-300.

Sending data to a computer

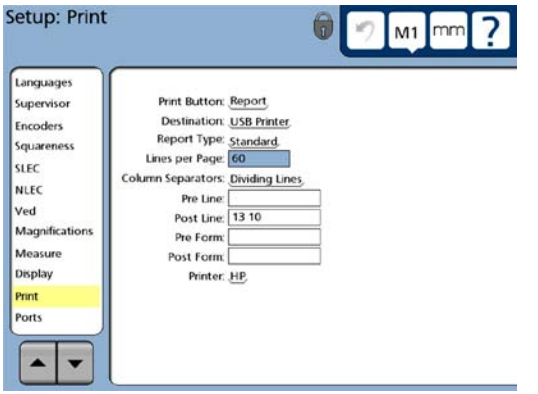
Feature data can be sent to a computer using the Print key or button icons found in the Extra tab.

Sending data using the Print key

Pressing the Print key can send feature measurement data 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
- Screen — Only the encoder values currently shown on the DRO screen (current position) will be sent. Screen values can be sent each time the print key is pressed, or can be buffered and sent when an entire page of values is ready.

To send data to a computer:



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, Report or Screen can be specified. If Screen is specified, set the Buffer Page choice field as desired. In this example, the Report is specified.

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.

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 Tolerance report is specified.

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

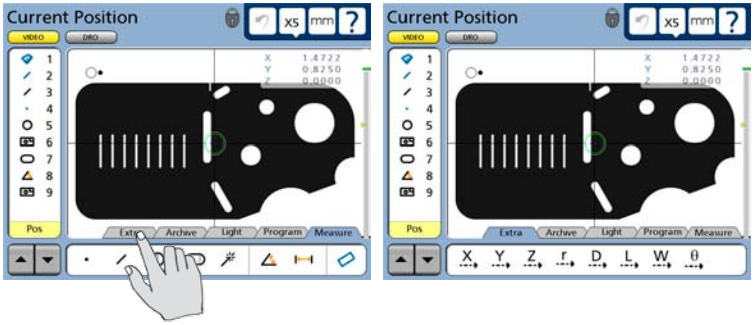
6 Press the Finish key to exit the setup mode, and then press the Print key to send the data to a computer.

Sending data using the Extra tab

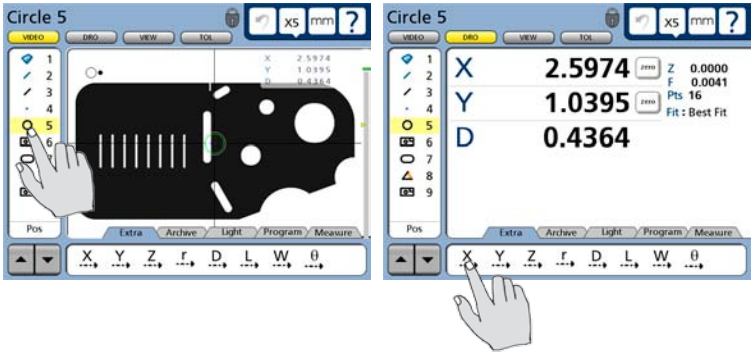
Touching one of the icon buttons in the Extra tab sends the corresponding feature measurement data to a computer over the RS-232 serial port:

To send data to a computer:

1 Touch the Extra tab to display icon buttons.



2 Touch a feature in the feature list, and then touch an icon button to send the desired feature data.



Connecting a printer

The QC-300 supports certain HP USB printers. The printer must be approved for use by Metronics. The current printer is shown in the Print setup screen discussed in Chapter 11: Setup.

1 Verify that the QC-300 and printer power are off. Connect the USB printer to the USB Type A port on the side of the enclosure, or connect the parallel printer to the parallel port connector on the rear connector panel.

2 Make sure the USB cable plug is fully inserted, or that the parallel connector is tight, but be careful not to overtighten the connector screws.

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 11: 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 11: 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 record of QC-300 system settings can be printed at the USB port.

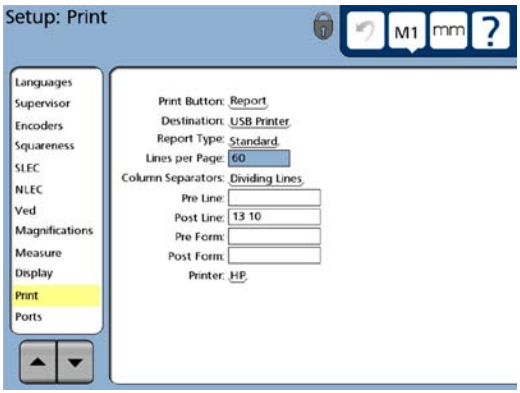
Printing feature measurement data

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
- Screen — Only the encoder values currently shown on the DRO screen (current position) will be printed. Screen values can be printed each time the print key is pressed, or can be buffered and printed when an entire page of values is ready.

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, Report or Screen can be specified. If Screen is specified, set the Buffer Page choice field as desired. 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.

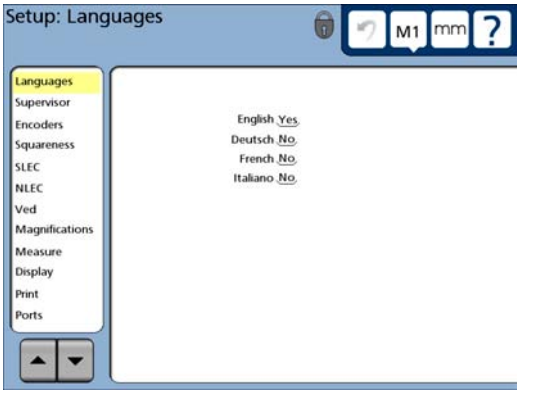
6 Press the Finish key to exit the setup mode, and then press the Print key to send the data to the printer.

Printing QC-300 system settings

To print a report of the QC-300 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 11: Setup

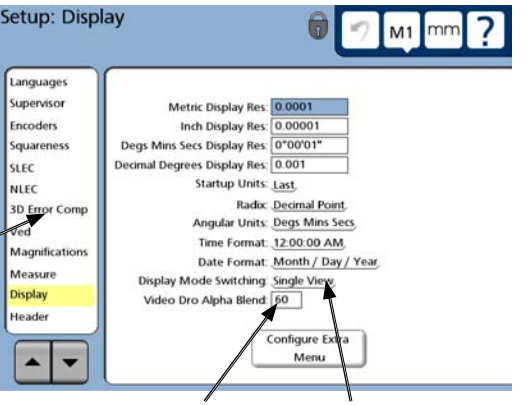
The operating parameters of the QC-300 must be configured prior to using the system for the first time, and any time part measurement, reporting or communication requirements change. Day to day use of the QC-300 does not require reconfiguration of the system settings.

CAUTION

Parameter changes made in any of the setup screens affect the operation of the QC-300. 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-300 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.



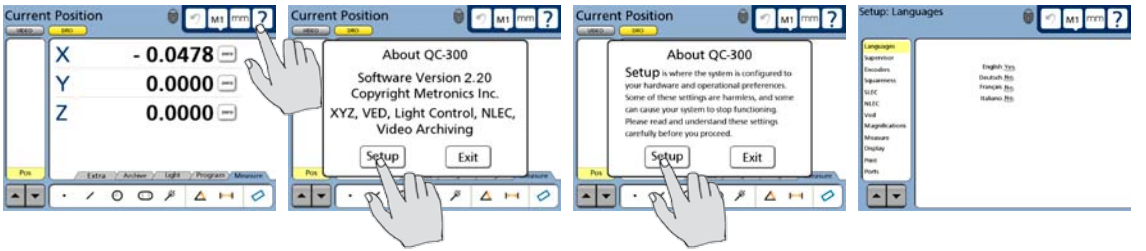
Parameters configured in setup screens will be retained by the QC-300 until:

- 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-300 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.

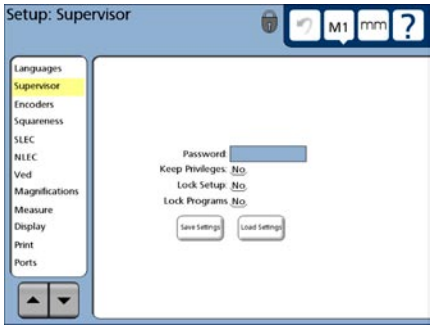
The setup screens and functions are accessed from other screens by touching the Help (?) button, and then pressing the Setup button twice. Access to most setup parameter fields is restricted to users that can provide the supervisor password.



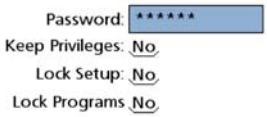
Entering the supervisor password

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

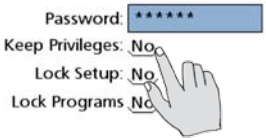
1 Access the setup menu as described on the previous page.



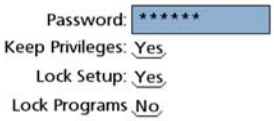
2 Touch the Supervisor menu item, enter the supervisor password using the number keys on the front panel and press the Enter key.

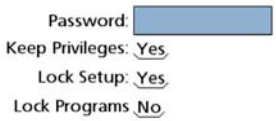


3 Setup editing privileges can be retained until the QC-300 power is cycled, eliminating the need to reenter the password if another setup editing session is required. Touch the Keep Privileges choice field to toggle the Keep Privileges parameter from No to Yes.

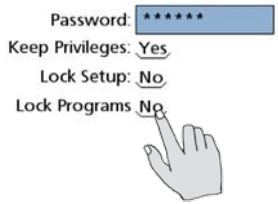


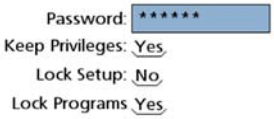
4 Views of the Setup can be locked so that the supervisor password is required to see the setup parameter settings. Touch the Lock Setup choice field to toggle the Lock Setup parameter from No to Yes, then delete the password from the Password field and press the Finish key.





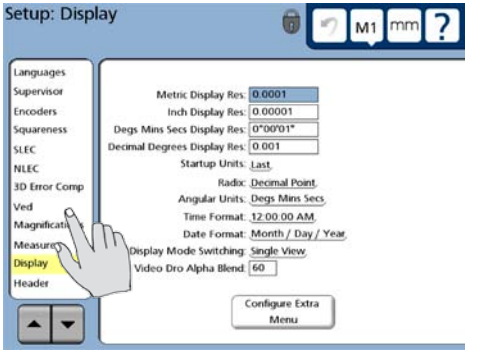
5 Operator access to program functions can be limited to running existing programs by toggling the Lock Programs choice field to Yes. Touch the Lock Programs choice field to toggle the setup parameter from No to Yes.





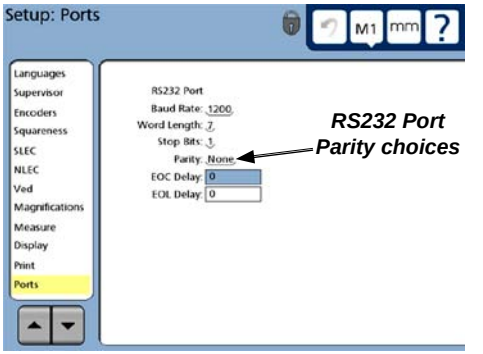
Selecting items from the Setup Menu

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.

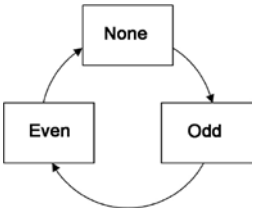


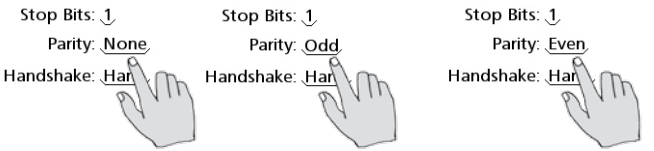
Selecting setup parameter choices

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.



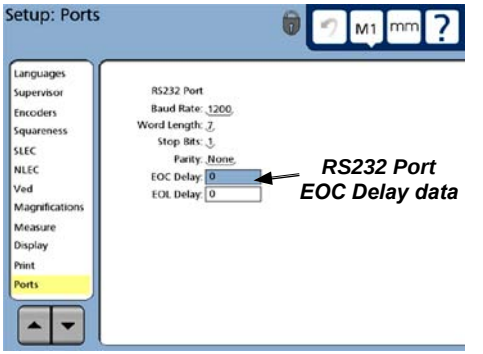
In this example, the RS232 Port Parity choices are shown by repeatedly touching the Parity choice field.





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 RS232 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

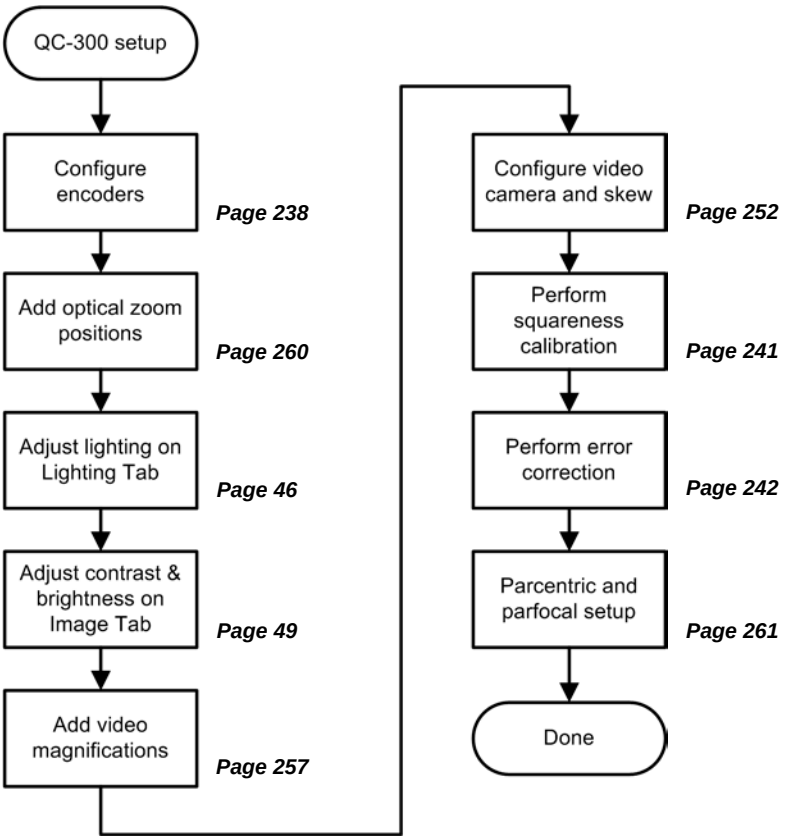
Press the Finish key to conclude the setup session.

Minimum setup requirements

In most cases, the QC-300 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 the block 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

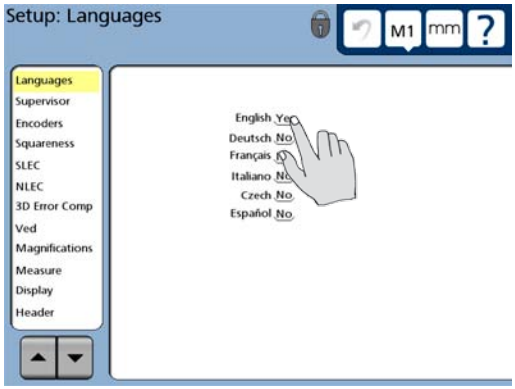
The setup screen descriptions are presented in the order of their appearance in the setup menu. However, the first time the QC-300 is configured, the order of setup screen use should follow the essential setup requirements diagram, and then continue in the order that best satisfies the application or 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.

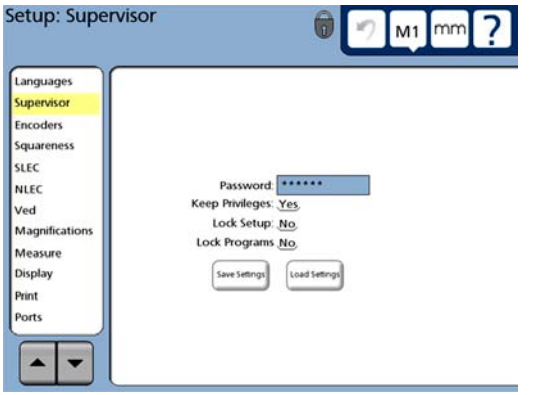
Specifying the displayed language

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



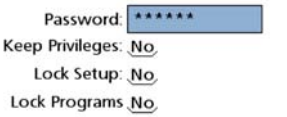
Supervisor screen

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.



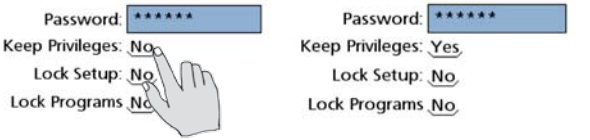
Entering the supervisor password

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.



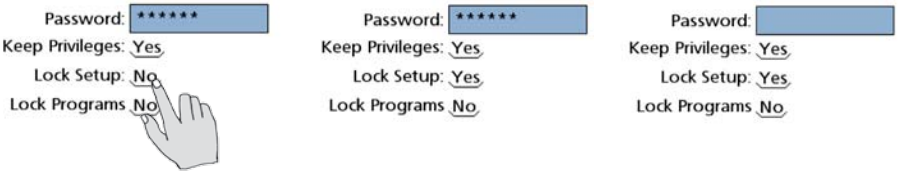
Keeping setup privileges until the power is cycled

Setup editing privileges can be retained until the QC-300 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.



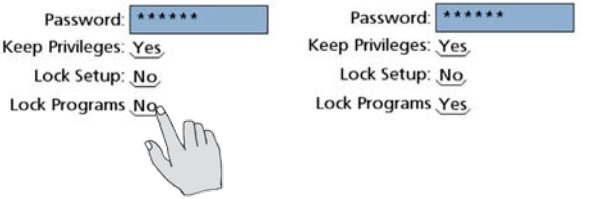
Hiding setup parameters from unauthorized personnel

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.



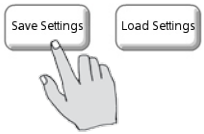
Limiting access to program functions

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.



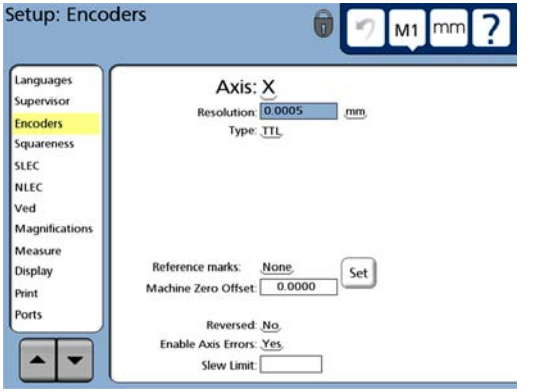
Saving and loading settings

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.

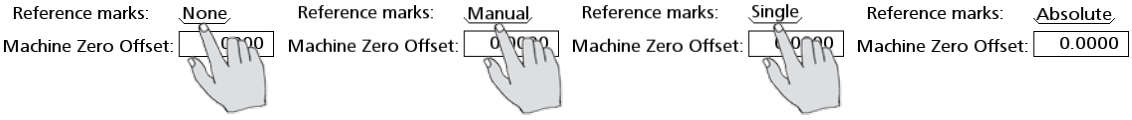
Specifying encoder type

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

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.

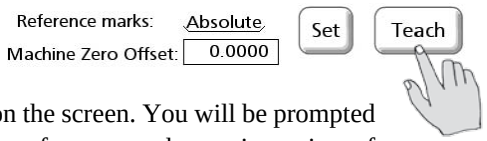
Manual

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

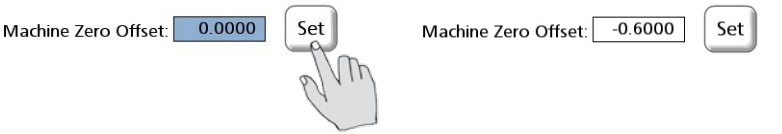


Selecting Absolute reference marks causes a Teach button to be displayed. Touch the Teach button to initiate a process that will guide you through the steps required to cross encoder reference marks. Follow the instructions provided on the screen. You will be prompted to move the stage to cross reference 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-300 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:

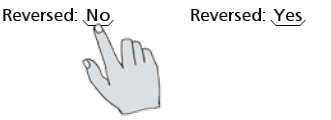
Select the Machine Zero Offset data field, move the stage to the desired new machine zero position and touch the Set button. The new machine zero for the current axis will be established and the offset displacement from the original machine zero to the new machine zero will be shown in the Machine Zero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



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

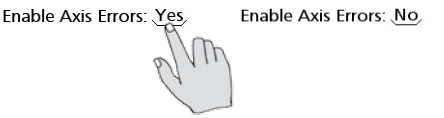
Reversing the encoder count direction

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 repeatedly touching the Enable Axis Errors choice field.

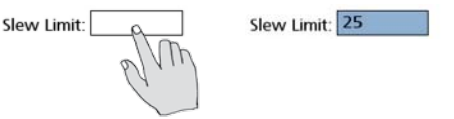


Specifying slew limit

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 by the formula:

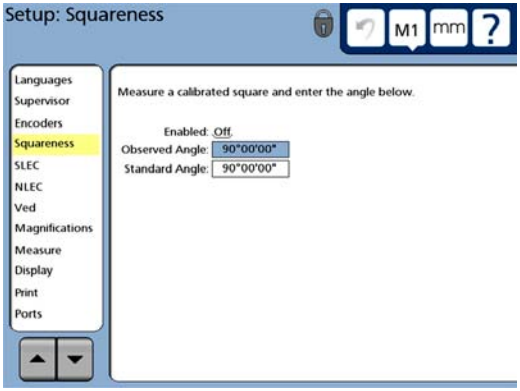
Slew Limit = (500,000 counts/second) X (encoder resolution distance/count)
For example, a 0.0005 mm/count encoder would have a Slew Limit of 25 mm/sec
Slew Limit = (500,000 counts/second) X (0.0005 mm/count) = 25 mm/sec

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



Squareness screen

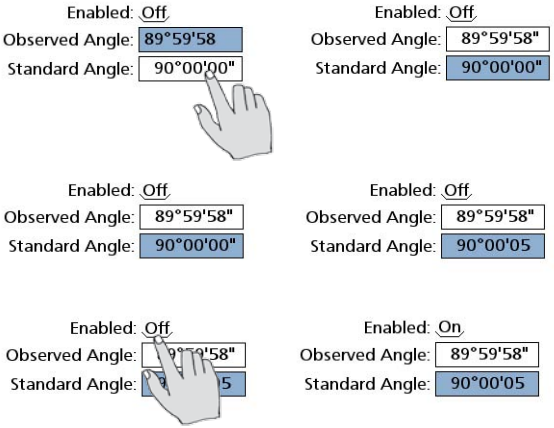
The Squareness screen contains data and choice fields for calibrating the squareness of the measuring system. The calibration of stage squareness requires the use of a certified square artifact. To calibrate squareness:



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).

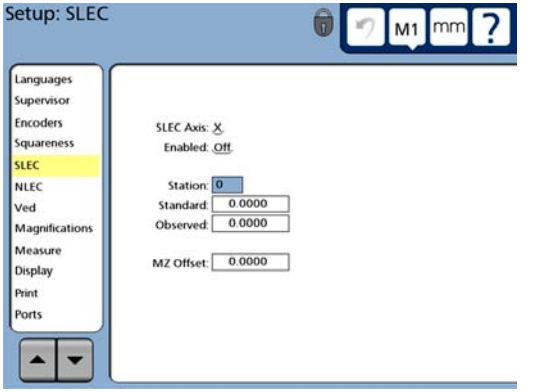
3 Select the Observed Angle data field, enter the measured angle using the number keys and press the Enter key to highlight the Standard Angle field.



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?

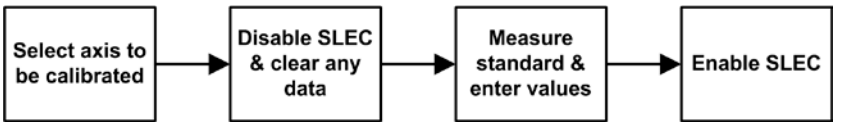
Any channel input device can include slight nonlinearities over its measurement range. LEC compensates for nonlinearities by applying a single linear correction value to the entire range of measurement. SLEC compensates for nonlinearities by applying correction values to the individual nonlinear segments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

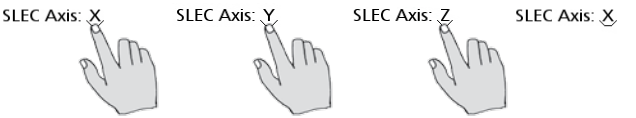
If an overall nonlinearity exists without significant individual errors across the scale, LEC can be applied as an overall correction method. However, if an encoder is thought to have significant individual nonlinearities across the range of measurement, SLEC should be applied as the correction method.

LEC (Linear error correction)

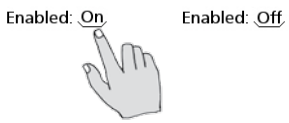
LEC compensates for encoder nonlinearities by applying a single linear correction value to the entire range of measurement. The procedure for configuring the LEC error correction is diagrammed and explained below.



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.



SLEC Axis: X
Enabled: Off

Station: 0
Standard: 0.0000
Observed: 0.0000

MZ Offset: 0.0000

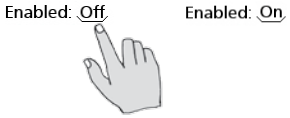
3 The length of the calibration standard should cover as much of the axis range of motion as possible. Measure the standard and enter the Standard (certified) and Observed (measured) values into the corresponding data fields.

SLEC Axis: X
Enabled: Off

Station: 0
Standard: 200.001
Observed: 199.867

MZ Offset: 0.0000

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



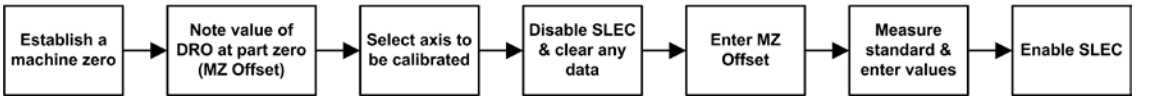
SLEC (Segmented linear error correction)

SLEC compensates for encoder non-linearities by applying correction values to individual nonlinear segments. These SLEC correction values are created by the QC-300 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.

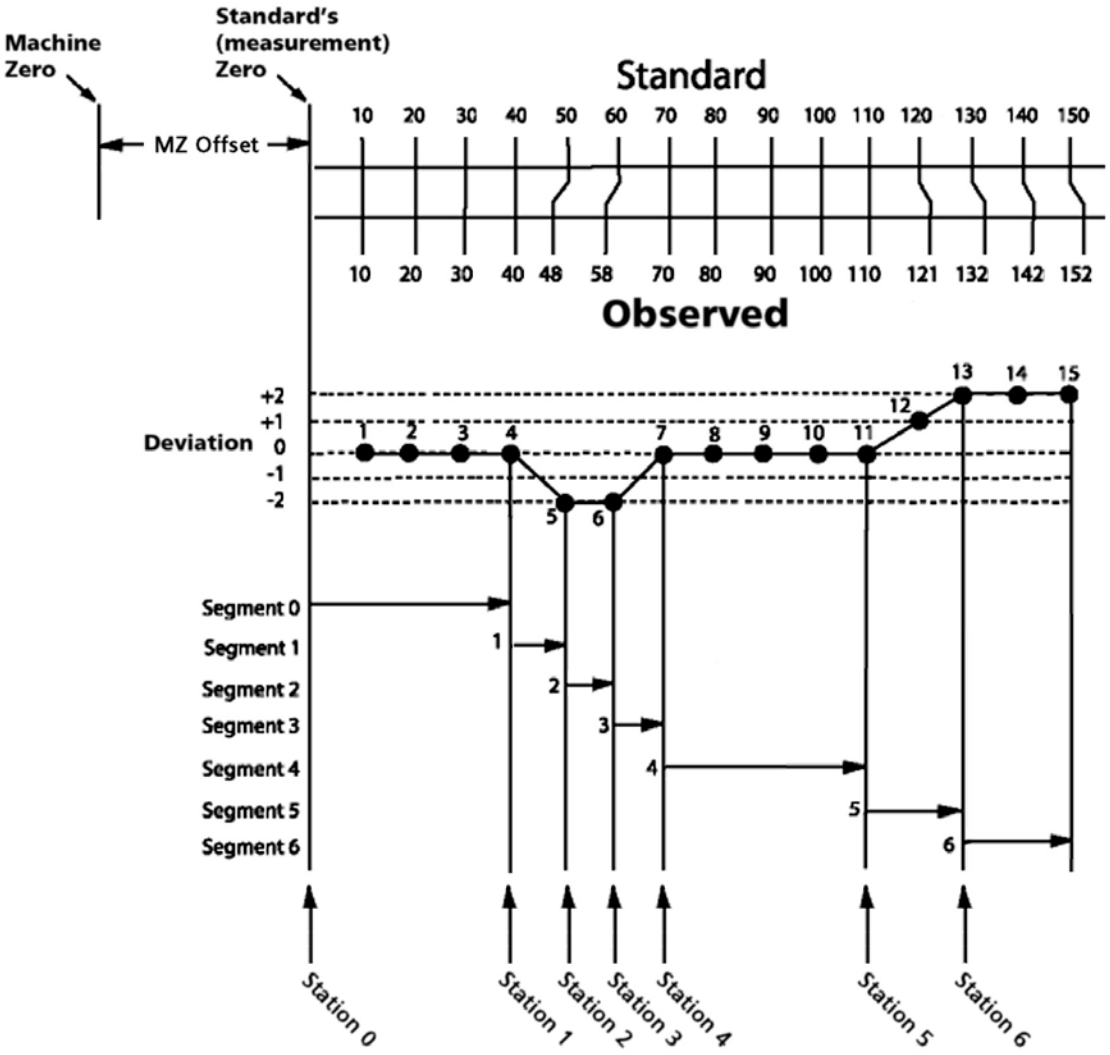


1 Cycle the power to establish a repeatable machine zero. You will be prompted to move the encoders to cross reference marks or perform a hard stop to the establish machine zero. Perform the machine zero operation.

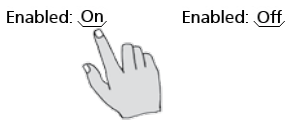
NOTE
If a hard stop zero is performed, the same stop will be required each time the QC-300 is started.

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.

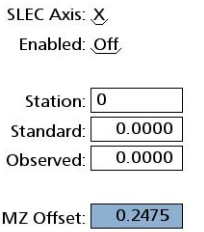


SLEC Axis: X
Enabled: Off

Station: 0
Standard: 0.0000
Observed: 0.0000

MZ Offset: 0.0000

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



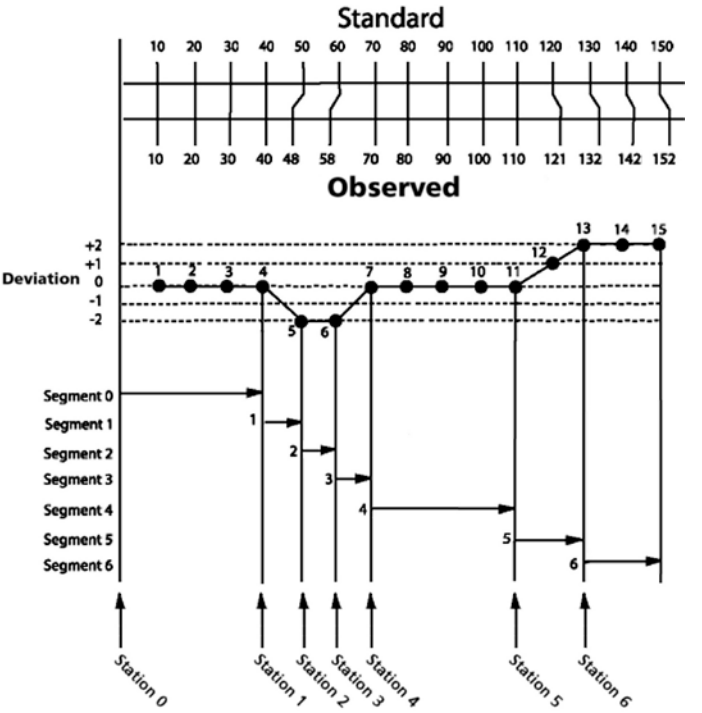
6 Zero the DRO for the axis being calibrated at the part zero position of the standard and enter zeros into the Standard and Observed data fields for Station zero.

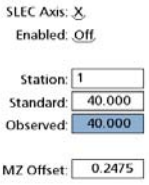
7 Measure the standard, incrementing the Station number and entering the Standard (certified) and Observed (measured) values into the corresponding data fields for each segment.

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.

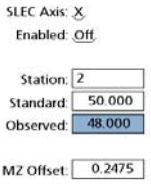
Reminder

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.

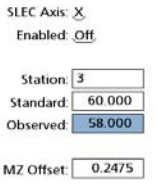




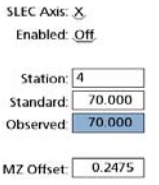
Station 1 of 6



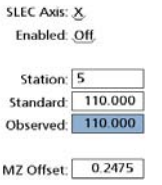
Station 2 of 6



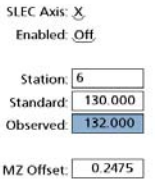
Station 3 of 6



Station 4 of 6



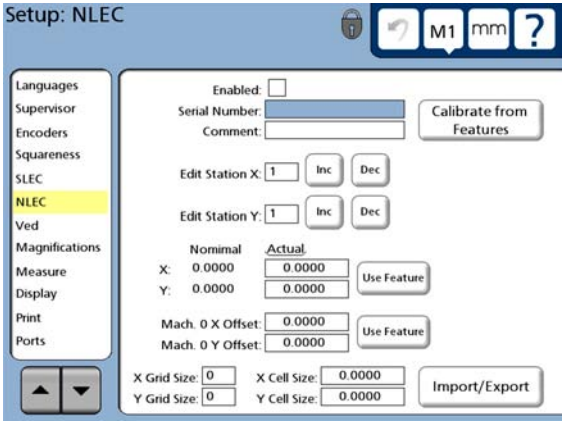
Station 5 of 6



Station 6 of 6

8 Touch the Enabled choice field to toggle it On.

NLEC Screen



The NLEC screen contains fields for enabling and configuring nonlinear error correction (NLEC) for the X and Y encoder axes.

Nonlinear error correction minimizes or eliminates the small inaccuracies in the X-Y measurement plane due to encoder linearity, mounting and machine-travel imperfections. Error correction coefficients are obtained by measuring a certified calibration grid. When the grid is measured, measured values are compared to either the ideal grid values as described by the Grid Size and Cell Size fields, or to the certified grid values listed in an artifact calibration file (.acf file). This comparison of measured values to ideal or actual values results in the final NLEC.txt file that contains the error corrections for all measured grid locations. When NLEC is enabled, the corrections will applied across the entire range of X-Y measurement to minimize or eliminate the inaccuracies mentioned earlier.

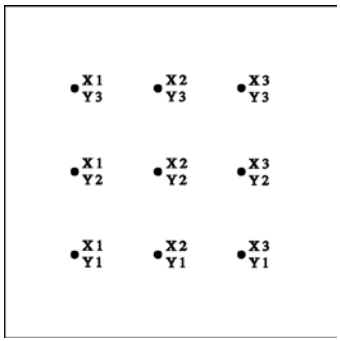
.acf Files

When no .acf file is used, the calibration grid values are assumed to be ideal. When grid certification values are available, an .acf file can be created easily using a word processor application. The format of the .acf file is shown here with an example 3 X 3 grid and corresponding example .acf file. Create a text file of actual grid values from the certification sheet and save the file using the nlec.acf file name and extension.

.acf file format

Unit of measure	Skew axis
Size of Y cells	Size of X cells
Number of X points	Number of Y points
First X grid value	First Y grid value
Next X grid value	First Y grid value
Next X grid value	First Y grid value
.	.
.	.
.	.
Next X grid value	Last Y grid value
Last X grid value	Last Y grid value

Example 3 X 3 grid



Example .acf file

mm	X
25.4	25.4
3	3
0.0000	0.0000
25.4003	0.0001
50.7998	0.0003
-0.0002	24.3997
25.4001	25.4004
50.8003	24.3999
0.0001	50.8001
25.4004	50.8004

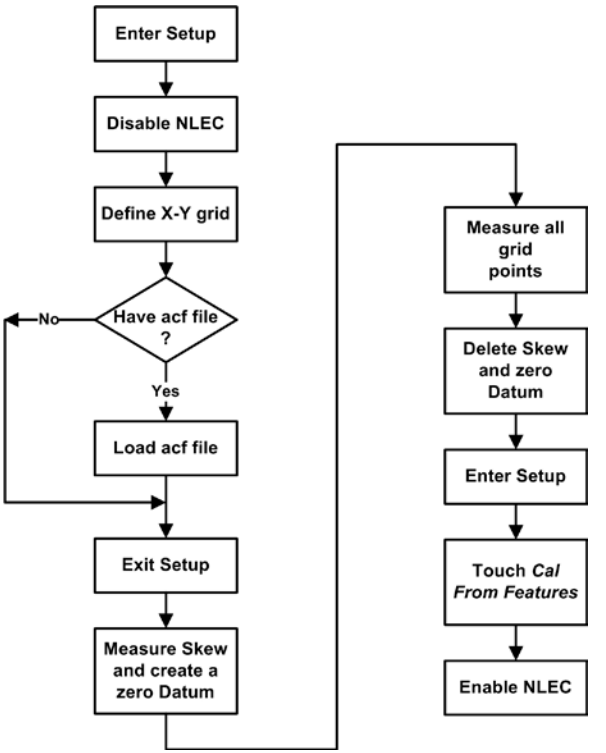
Nonlinear error correction calibration can be performed using one of three methods:

- Calibrate from features obtained by measuring the calibration grid using the QC-300.
- Edit existing QC-300 calibration values if calibration adjustments are required.
- Import calibration values (NLEC text file) collected earlier by measuring the calibration grid using a QC-5000.

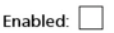
The first two methods listed above can use artifact calibration files (.acf files) to specify certified artifact calibration grid values.

Calibrating from features

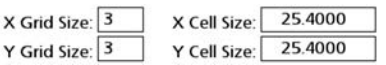
The process of calibrating from features is shown by this chart and described below. In most cases this method is performed in the field.



1 Make sure that NLEC is disabled (Enabled checkbox is cleared).



2 Define the grid. The grid size and cell size data entry fields are shown at the bottom of the NLEC setup screen.

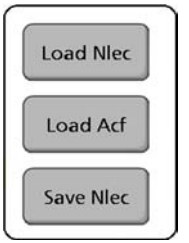


Enter the grid size in terms of the number of X and Y grid points, and then enter the cell size in terms of the distance between points.

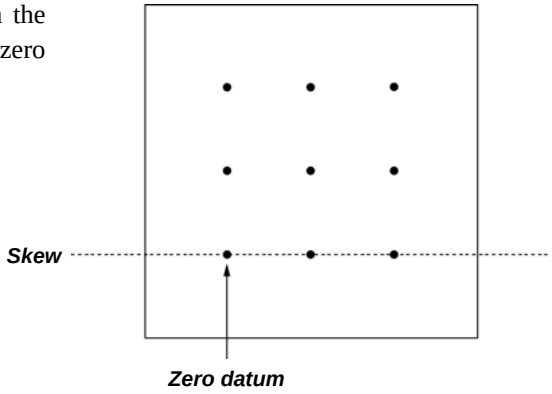
3 Load an .acf file of certified values if desired.

Insert a USB drive into the USB port containing the nlec.acf file at the root of the drive, and the

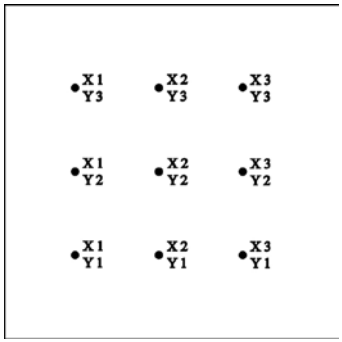
touch the Import/Export button. A pop-up window will display the Import/Export choices. Touch the Load Acf button.



4 Exit the setup mode, measure the skew through the bottom grid points of the calibration grid and create a zero datum at the lower left point of the grid.



5 Measure the grid values starting at the bottom left corner of the grid (X1, Y1) and proceed from left to right and from bottom to top. Be sure that the X and Y values at the lower left corner of the grid are zero.



6 Delete the skew and zero datum features from the feature list.

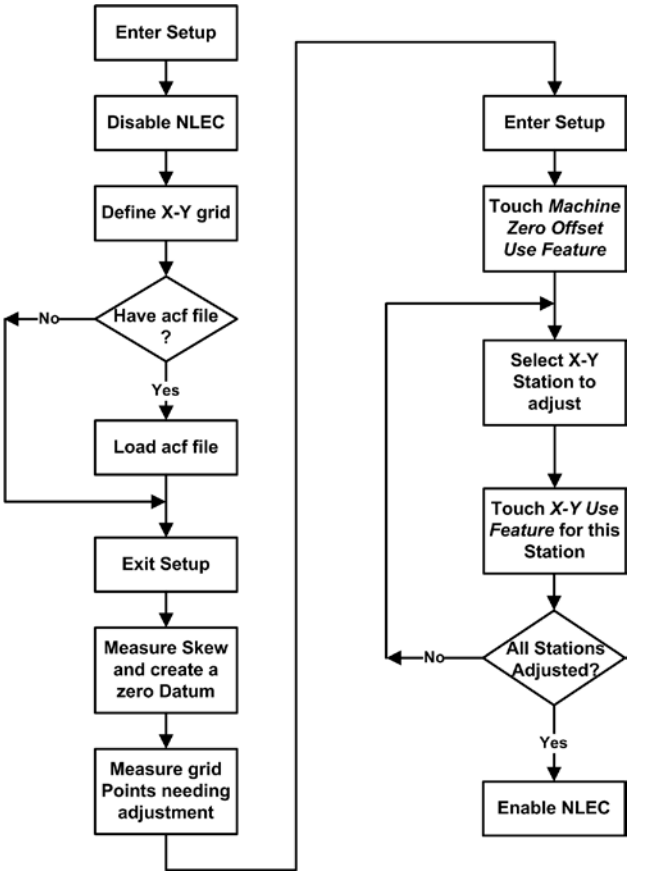
7 Return to the NLEC setup screen.

8 Touch the Calibrate from Features button. A message will show the resulting machine zero offset change. If the change seems reasonable, touch OK.

9 Enable NLEC error correction 

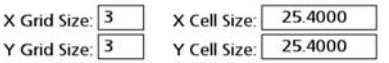
Calibrating NLEC by adjusting station values

The process of calibrating by adjusting station values is shown by this chart and described below. This process is generally used to adjust existing NLEC calibration data.



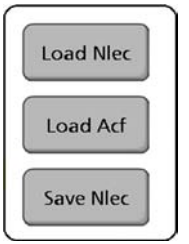
1 Make sure that NLEC is disabled (Enabled checkbox is cleared).

2 Define the grid. The grid size and cell size data entry fields are shown at the bottom of the NLEC setup screen. Enter the grid size in terms of the number of X and Y grid points, and then enter the cell size in terms of the distance between points.

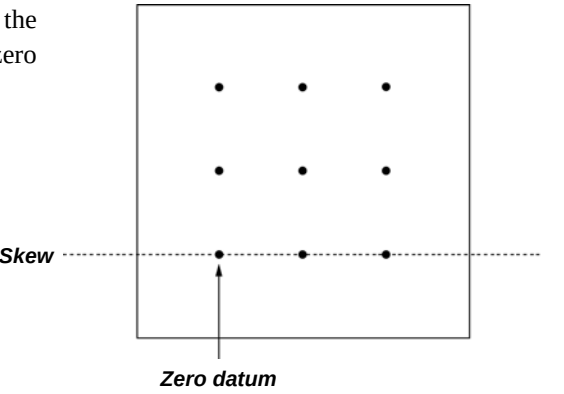


3 Load an .acf file of certified values if desired. Insert a USB drive into the USB port containing the nlec.acf file at the root of the drive, and the touch the Import/Export button.

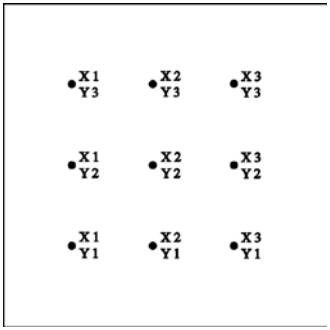
A pop-up window will display the Import/Export choices. Touch the Load Acf button.



4 Exit the setup mode, measure the skew through the bottom grid points of the calibration grid and create a zero datum at the lower left point of the grid.

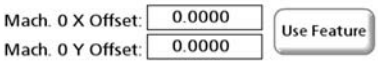


5 Measure only the grid values that need to be adjusted, starting at the bottom left corner of the grid (X1, Y1) and proceeding from left to right and from bottom to top.

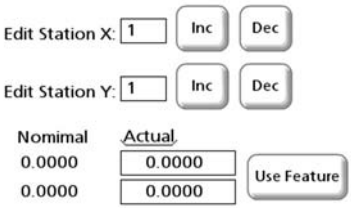


6 Return to the NLEC setup screen.

7 Touch the (Machine 0 Offset) Use Feature button to set the zero datum.



8 Select the grid station to be adjusted by incrementing or decrementing the Edit Station X and Edit Station Y values, then touch the (X/Y) Use Feature button to replace the existing value with a recently measured value.

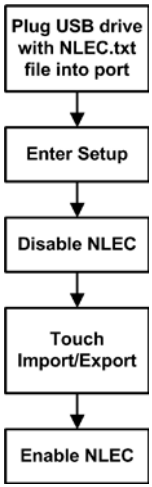


9 Continue this process until all the desired calibration values have been adjusted.

10 Enable NLEC error correction. Enabled: ☑

Calibrating NLEC by importing an existing NLEC correction text file

The process of calibrating by importing an existing NLEC file is shown by this chart and described below.This process is generally used by distributors and OEMs that have created NLEC.txt Files for the stage using a QC-5000.



1 Plug a USB drive into the USB port of the QC-300 that contains an nlec.txt file at the root of the USB drive.

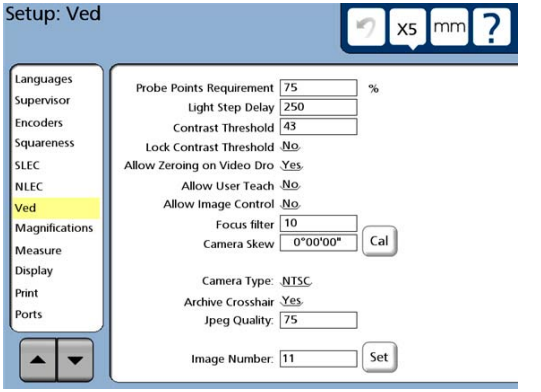
2 Open the NLEC setup screen and make sure that the NLEC feature is disabled (Enabled checkbox is empty). Enabled: ☐

3 Touch the Import/Export button to import the NLEC file from the USB drive.

4 Check the Enabled checkbox if necessary. Enabled: ☑

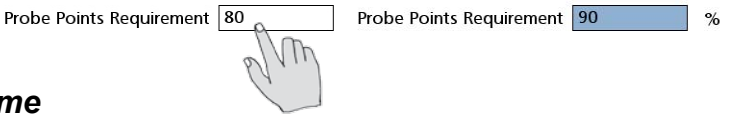
VED screen

The VED screen contains fields for specifying edge detection and auto-enter parameters, setting user permissions for zeroing axes on the video DRO and for performing video magnification and camera skew calibrations.



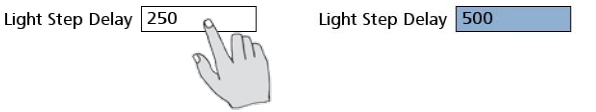
Specifying minimum probed points

The number of points to be collected for a circle, arc or line is specified by the user in the probe pop-up screen discussed in Chapter 5: Probes. When the number of points actually collected falls below the required percentage of the number specified in the probe pop-up screen, a "Failed measurement" error message is displayed and the measurement is aborted. To specify the required percentage of points, touch the Probe Points Requirement data field and enter the desired percentage using the number keys.



Specifying light settling time

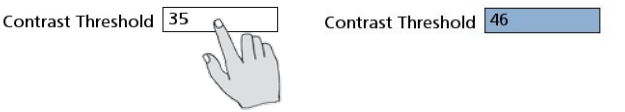
When a lighting level is changed during the execution of a program, a settling time is included that allows the new light level to become stable. To change this settling time, touch the Light Step Delay data field and enter the new time in milliseconds using the number keys.



Specifying contrast threshold

Screen contrast is a combination of the illumination difference between adjacent light and dark regions on the screen and the sharpness of the transition from light to dark. Perfect contrast could be loosely described as very light and very dark regions that meet at a very sharp transition. The contrast threshold is expressed as a percentage of perfect contrast and defines the minimum contrast required for video edge detection.

The contrast threshold value can be specified by touching the contrast threshold data field and entering a percentage, or by touching and sliding the yellow arrow up or down the contrast bar on the right side of the LCD.



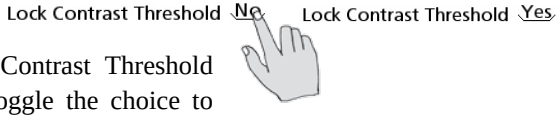
NOTE

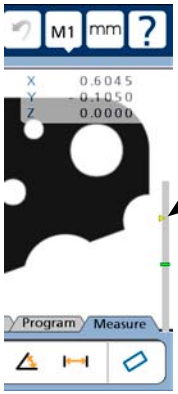
The contrast threshold cannot be changed on the LCD when Lock Contrast Threshold is set to Yes on this screen as described later in this section.

Locking the contrast threshold

When the contrast threshold adjustment is unlocked, the user can change the contrast threshold requirement for edge detection by touching and sliding the yellow arrow up or down the contrast bar on the right side of the LCD. Locking the contrast threshold prevents users from adjusting the contrast threshold on the LCD screen.

To lock the contrast threshold, touch the Lock Contrast Threshold choice field to toggle the choice to Yes.





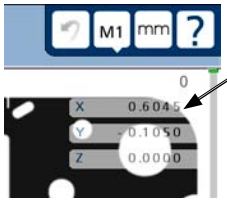
Cannot be adjusted

Contrast threshold adjustment on the LCD Video screen

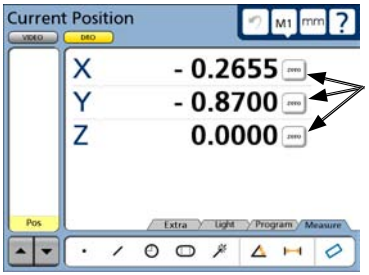
Enabling axis-zeroing on the video DRO

Measurement axes can be zeroed from the DRO screen at any time by touching an axis Zero button.

As a convenience to the user, the small video DRO display can also be configured to include axis zero bars on the LCD video screen.

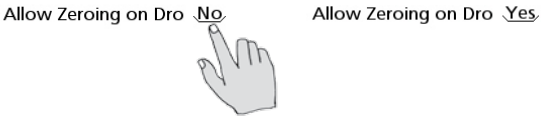


Axis zero bar on LCD Video screen



Axis zero buttons

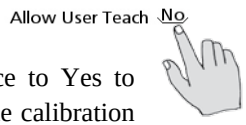
To enable axis-zeroing from the video DRO, touch the Allow Zeroing on the DRO choice field to toggle the choice to Yes.



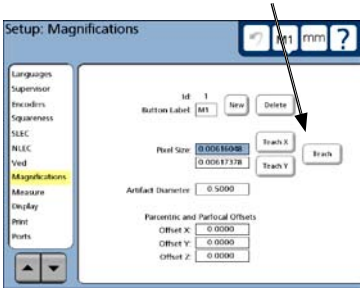
Enabling user access to magnification calibrations

Normally, video magnification calibrations are performed by supervisors, distributors and OEMs. However, the magnification calibration tools located on the Magnification setup screen can also be made available to users.

Touch the Allow User Teach choice field to toggle the choice to Yes to provide user access to the calibration tools.



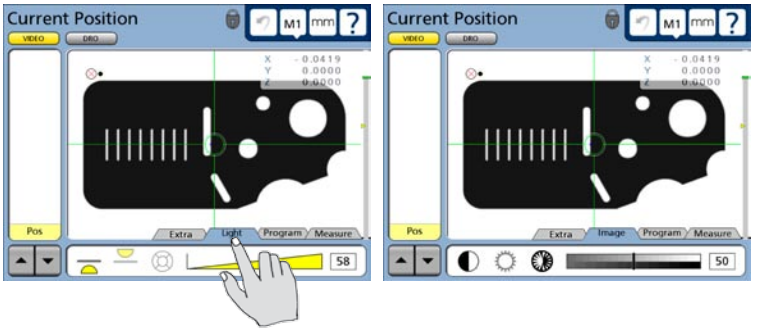
Magnification calibration tools



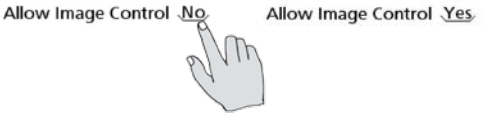
Magnification setup screen

Displaying image controls

Image controls can be displayed in addition to the light adjustment tools for optimizing the video image for measurement. The image controls can be used to adjust the contrast and brightness of the image. Light and Image control tools can be alternately shown by repeatedly touching the Light/Image tab.



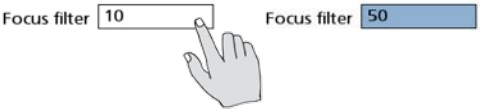
Touch the Allow Image Control choice field to toggle image controls between enabled and disabled.



Adjusting the focus filter

The brightest difference between adjacent pixels is one measure of focus on the QC-300 system. The Focus Filter allows the user to specify the minimum brightness difference between pixels to achieve repeatable focus performance in changing light conditions. The total brightness difference range is from 0 to 255.

Touch the Focus Filter data field and enter the desired brightness difference value. Increase the value to increase focus repeatability in changing or noisy light conditions. Decrease the value to obtain sharper focus when changing light conditions and focus repeatability are not issues.

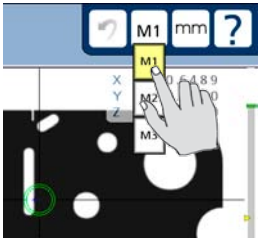


Performing camera skew calibrations

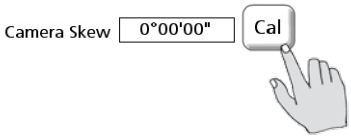
Small amounts of rotational camera misalignment exists in most camera mounting systems. The camera skew calibration measures this misalignment and applies a skew compensation to subsequent measurements to eliminate the effect of rotational misalignments.

To perform a camera skew calibration:

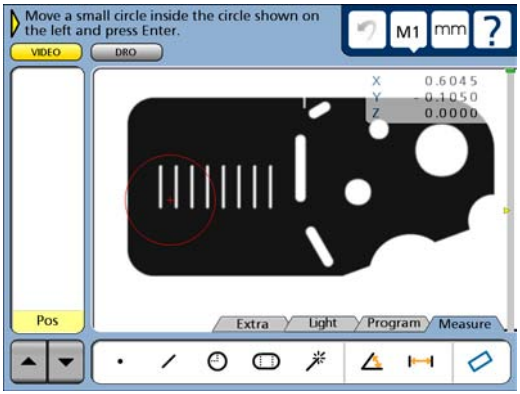
1 Touch the Magnification button to cycle to the lowest magnification.



2 Touch the CAL button.



3 The video screen will be displayed with instructions for performing the calibration in the upper left corner. Follow the instructions to complete the calibration.



NOTE

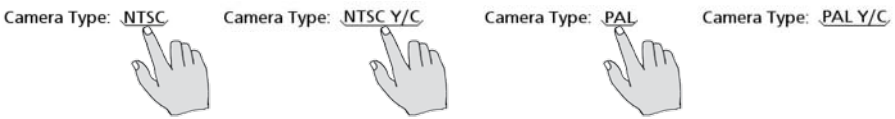
Systems should be aligned mechanically to within a few degrees. This calibration is not intended as a substitute for good mechanical alignment.

Specifying camera type

The QC-300 video camera input supports four popular video standards:

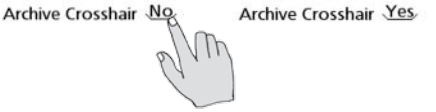
- NTSC
- NTSC Y/C
- PAL
- PAL Y/C

Touch the Camera Type choice field repeatedly to cycle to the desired video input standard.



Including the crosshair and stake marks in video archives

Still JPG images of the video screen can be captured with or without the crosshairs and measurement stake marks that are shown during and after measurements. Touch the Archive Crosshair choice field to toggle to Yes to archive the crosshair and measurement stake marks.



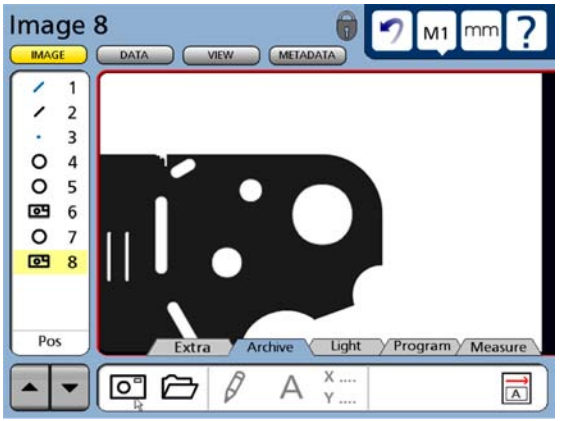


Image without crosshair and stake marks

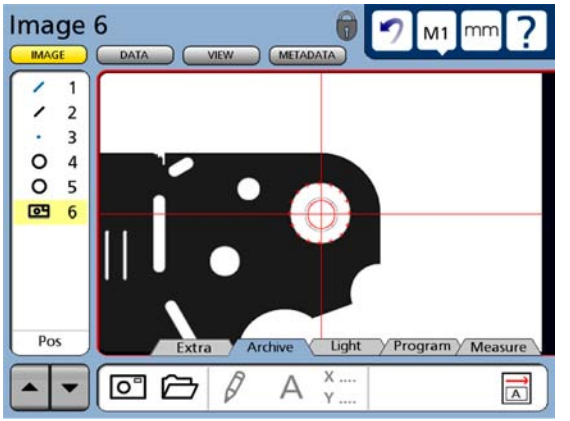
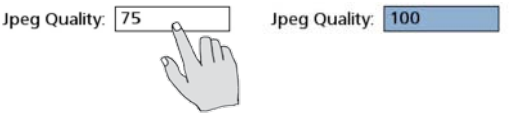


Image with crosshair and stake marks

Specifying the quality of JPEG images

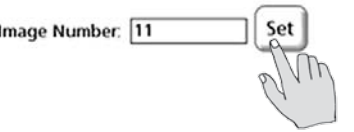
The resolution of captured JPG images are specified by entering a value between 1 and 100 into the Jpeg Quality data field. Touch the Jpeg Quality data field and enter larger values for higher quality images.



Setting the JPEG image number

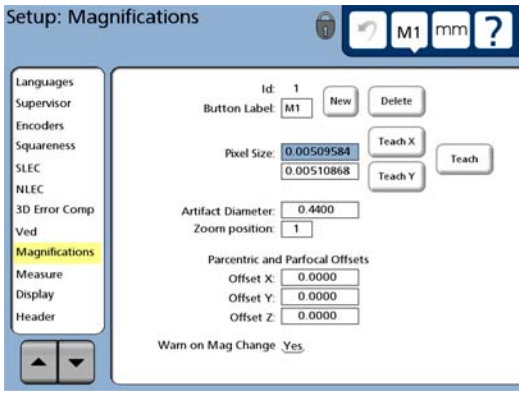
The file names of captured JPEG images always contain a unique identification. Image file identification characters begin with the letter I and include a number. The identification number begins at 1 in a new system, and is incremented each time a new JPEG image is captured. When users create image file names, the unique identification is appended to the name. For example, a JPEG image with the identification *I67* might be given a file name such as *Circle*; resulting in the final file name of *Circle-I67*.

The number portion of the identification can be reset to 1, or changed to any value by touching the Set button icon and then entering the desired value.



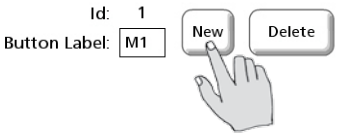
Magnifications screen

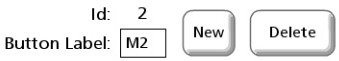
The magnifications screen contains fields and tools for adding and deleting video magnifications, calibrating video pixel size, and performing video parcentric and parfocal calibrations.



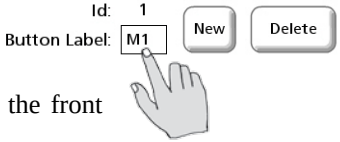
Adding video magnifications

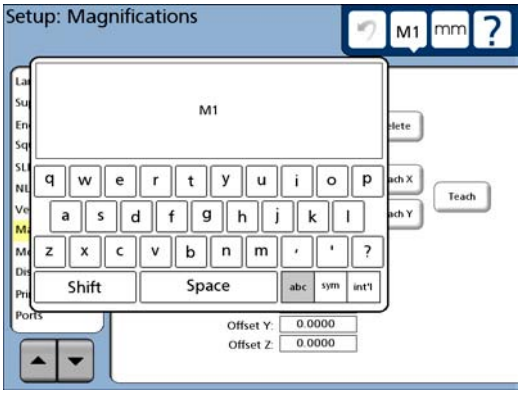
To add a video magnification, touch the New button. The next higher ID number and default button label will be added.





The button label can be changed to any three digit alphanumeric character string by touching the Button Label data field and deleting or entering characters using the keyboard screen or the front panel keys.

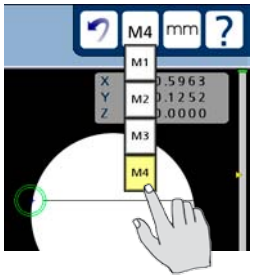


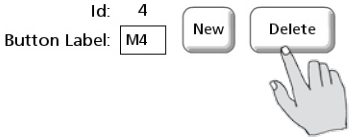


Use the Cancel key to delete characters. Use the Finish key to complete and store the new label. The pixel size of the new video magnifications must be calibrated before using the magnifications in measurements.

Deleting video magnifications

To delete a magnification, touch the Magnification button, select the magnification to be deleted, and then touch the Delete button.





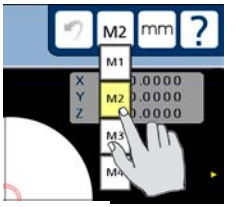
Calibrating video magnification pixel size

The pixel size of each video magnification must be calibrated before conducting measurements. Pixel sizes are calibrated by measuring a circle artifact of known diameter using the Teach function, or by measuring a straight edge using the Teach X and Teach Y functions.

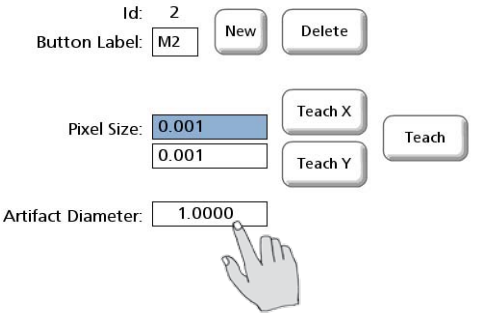
Calibrating with a circle artifact

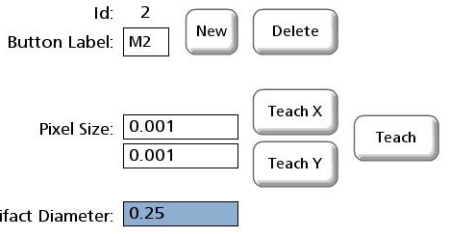
To calibrate pixel size using a circle artifact:

1 Select the desired magnification by touching the Magnification button or by touching the ID number field.

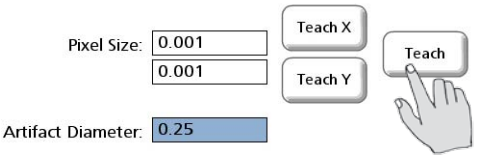


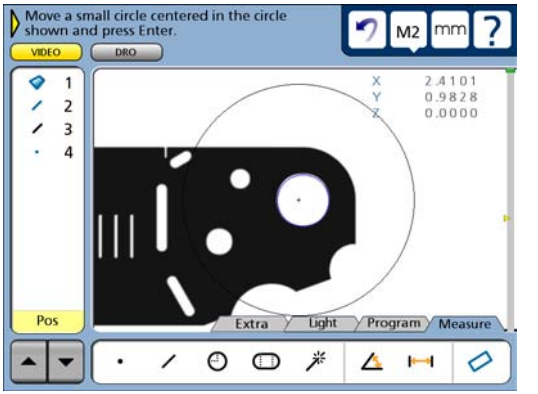
2 Touch the Artifact Diameter data field and enter the known circle artifact diameter using the number keys.



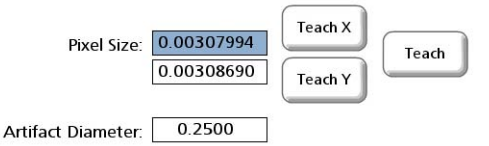


3 Touch the Teach button. The video screen will be shown with instructions for measuring the circle artifact.





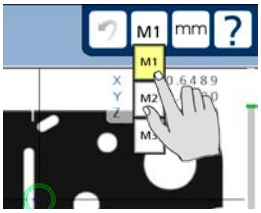
4 Follow the instructions provided on the screen to position and measure the circle. The X and Y pixel sizes will be displayed in the Pixel Size data fields.



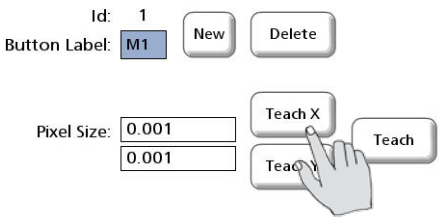
Calibrating with a straight edge

To calibrate pixel size using a straight edge or line:

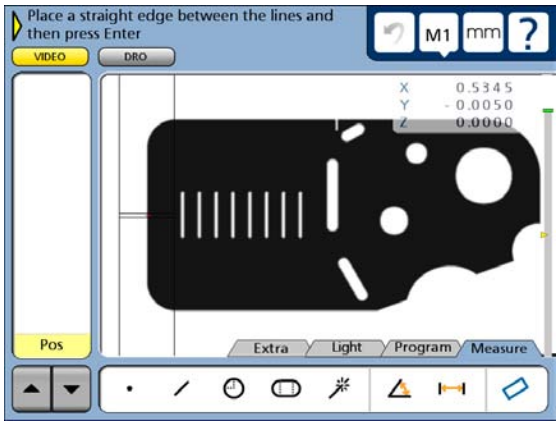
1 Select the desired magnification by touching the Magnification button or by touching the ID number field.



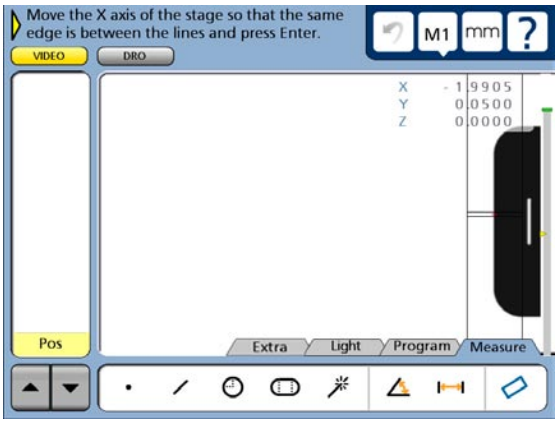
2 Touch the Teach X button. The video screen will be shown with instructions for measuring a straight edge on the x-axis.



3 Follow the instructions to position and measure the edge on both sides of the x-axis. The x-axis pixel size will be displayed in the X pixel size data field.

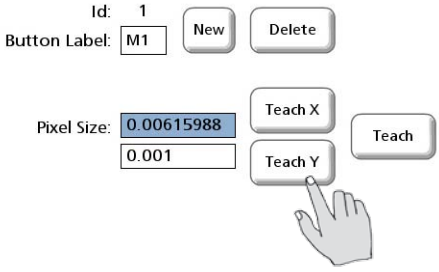


Measure a vertical edge on the left and...

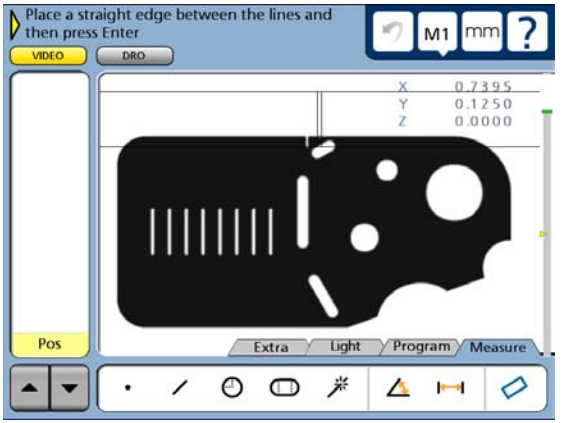


on the right side of the screen

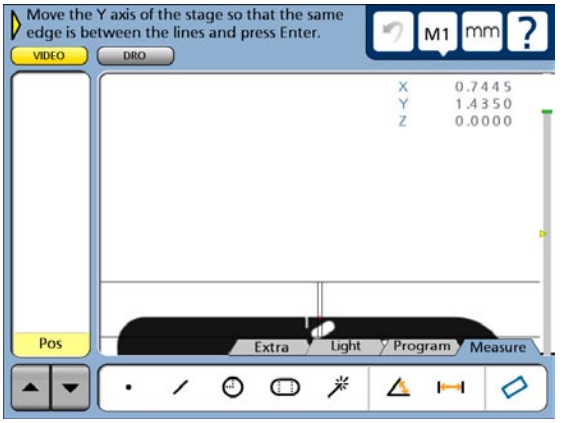
4 Touch the Teach Y button. The video screen will be shown with instructions for measuring a straight edge on the y-axis.



5 Follow the instructions to position and measure the edge on the top and bottom of the y-axis. The y-axis pixel size will be displayed in the Y pixel size data field.



Measure a horizonal edge on the top and...

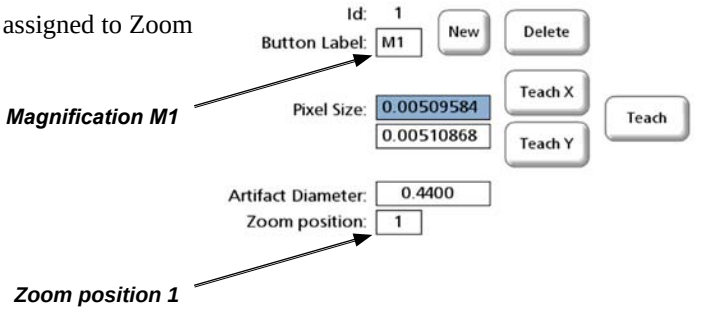


on the bottom of the screen

Assigning magnifications to zoom positions

Magnifications can be assigned to zoom positions at the discretion of the user. Assign the magnification shown in the Button Label field to one of the zoom positions configured earlier by the OEM or distributor in the Zoom setup screen by entering the desired zoom position number into the Zoom Position field.

In this example, magnification M1 is assigned to Zoom position 1.



Performing video parcentric and parfocal calibrations

Parcentric calibration eliminates X and Y axis measurement offset errors that can occur when changing video magnifications. Parfocal calibration eliminates z-axis measurement offset errors that can occur when the video focus is adjusted when changing magnifications.

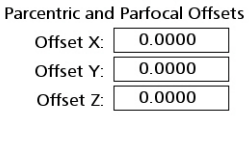
NOTES

As shown in the essential setup requirement diagram earlier in this chapter, camera skew calibration, squareness calibration and error correction must be performed prior to this process.

As shown in the diagram on the right, leveling, establishing a datum and measuring a circle are required steps in this procedure. Refer to Chapter 6: Measuring for details regarding these activities if necessary.

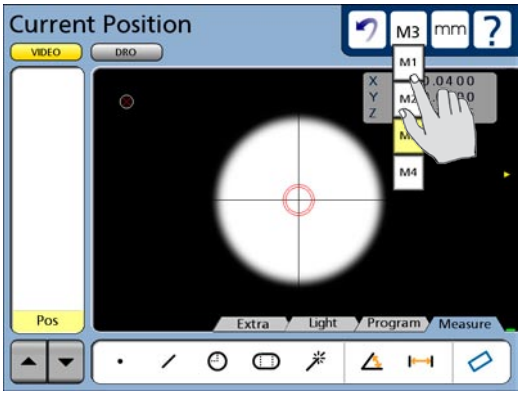
Parcentric and parfocal calibrations are performed simultaneously using a single circle artifact in the calibration process diagrammed at the right and described below. To perform parcentric and parfocal calibrations:

1 Zero any existing Parcentric and Parfocal X,Y and Z offsets by selecting each magnification and entering zero values into the Offset X, Offset Y, and Offset Z data fields.

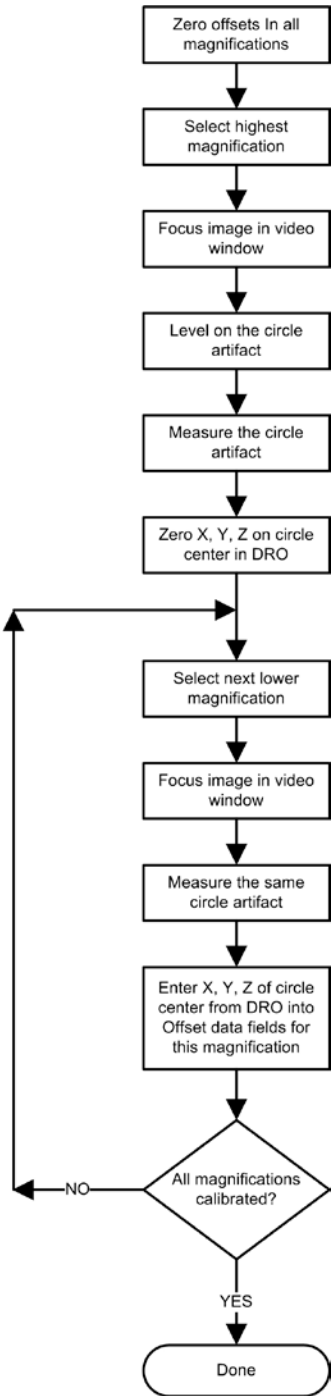


Zero all offsets

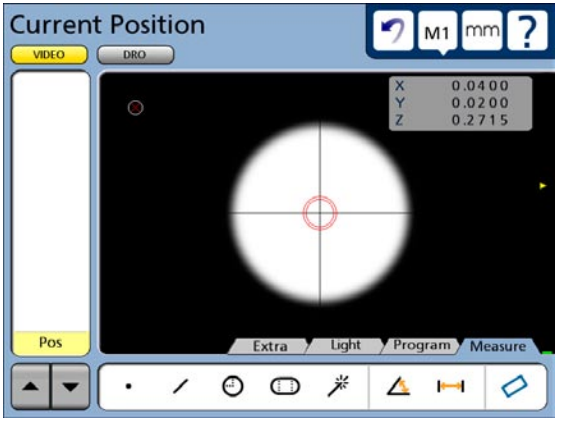
2 Select the highest video magnification. In this example, M1 happens to be the highest magnification. Your system might be different.



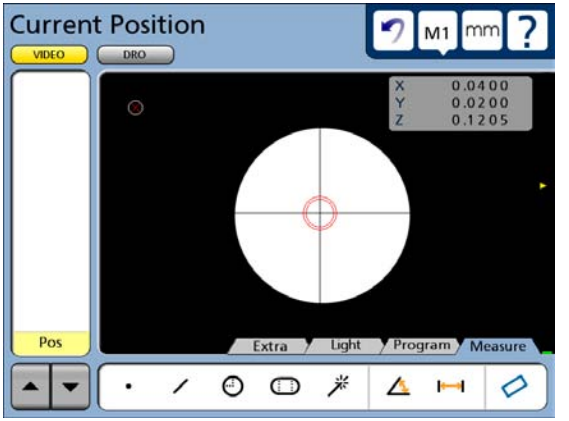
Select the highest magnification



3 Focus the circle artifact image in the video window using the video camera focus adjustment.

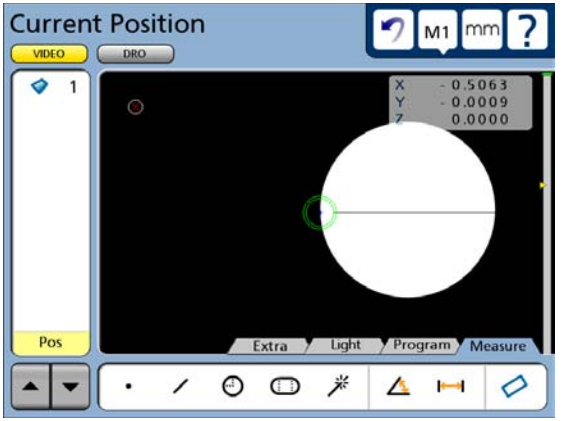


Focus the circle artifact image...

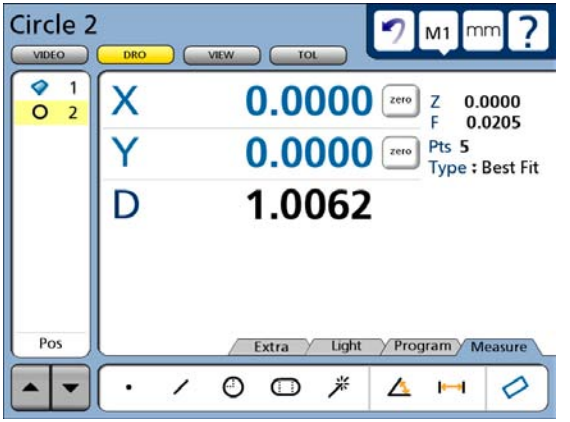


using the camera focus adjustment

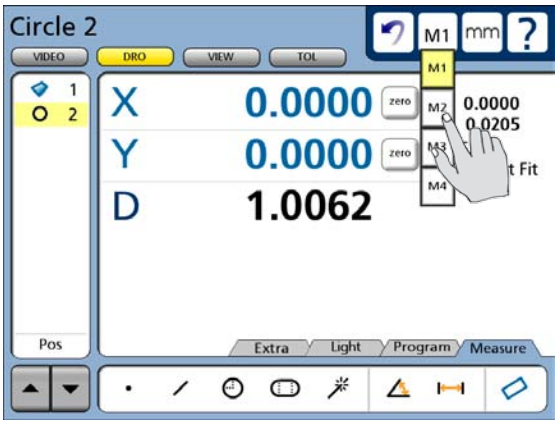
4 Perform a level measurement using the circle artifact. The level measurement will zero the z-axis at the highest video magnification.



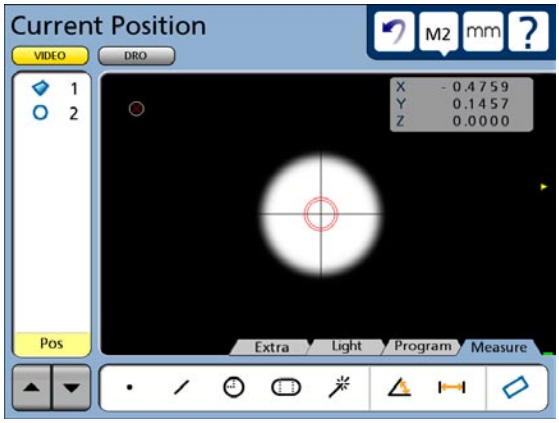
5 Measure the circle artifact and create a zero datum point at the center of the circle feature in the DRO screen. This will zero the X and Y axes at the center of the circle. Subsequent measurements of this circle artifact at other magnifications will result in X, Y and Z axis offsets with respect to this magnification. These offsets will be entered into the Magnification setup screen for each corresponding magnification.



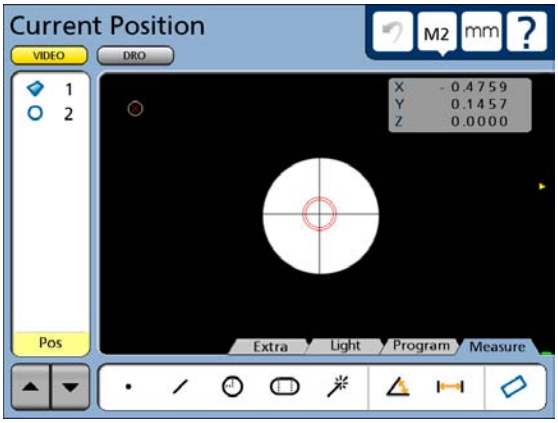
6 Select the next lower magnification. This is M2 in this example.



7 Focus the circle artifact image in the video window at the new magnification.



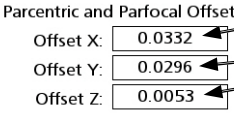
Focus the circle artifact image...

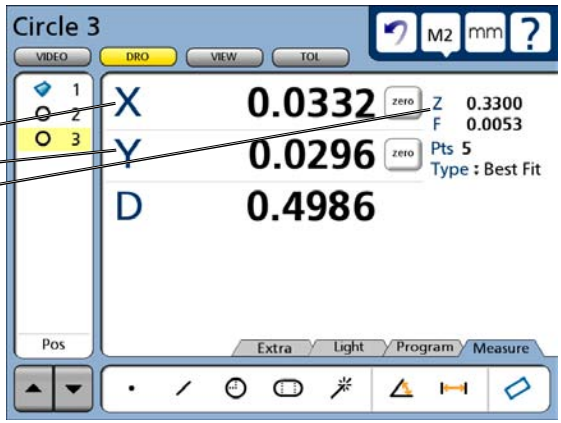


at the new magnification

8 Measure the circle artifact at the new magnification.

9 Enter the X,Y and Z positions of the new circle feature shown in the DRO into the Offset X, Offset Y and Offset Z fields of the Magnification setup screen.





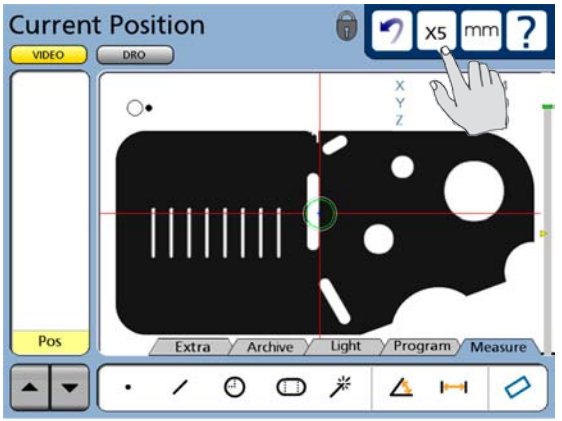
10 Repeat steps 6 through 9 for the remaining video magnifications.

Enabling magnification change messages

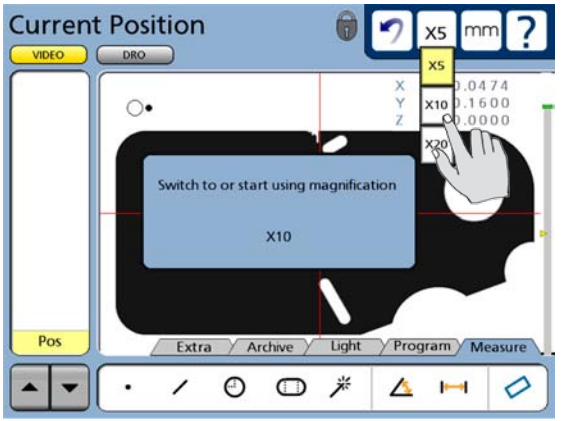
Magnification levels are always changed manually by the user by:

- Selecting a new magnification by touching a value in the magnification drop-down list
- Manually bringing the new lens into the field of view

A reminder can be displayed on the QC-300 screen when a new magnification is selected if desired. Enable the reminder message by touching the Warn on Mag Change choice field and toggling the choice to Yes.



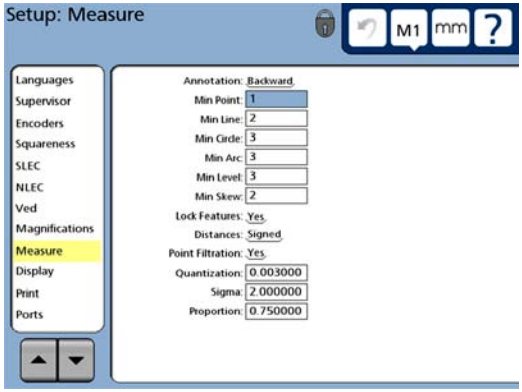
When magnification change messages are enabled...



the user is reminded to change lenses when a new magnification is selected

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.



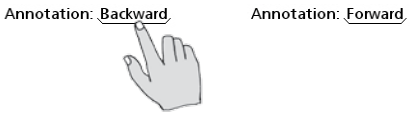
Annotation

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

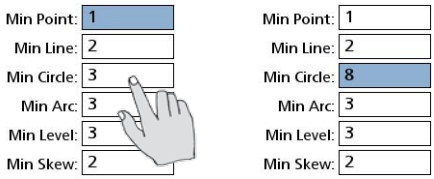
Touch the Annotation choice field to toggle the choice between Backward and Forward annotation.



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.



Locking features to their original datums

Features can be locked to their original datums or can be referred to new datums as datums are created. In the following example illustrating locked and unlocked features, 6 features are measured using 2 datums.

Measurement activity

Datum 1 is created, then

Feature 1 is measured, feature 2 is measured and feature 3 is measured

Datum 2 is created, then feature 4 is measured, feature 5 is measuredand feature 6 is measured

Measurement results when features were locked before measurements

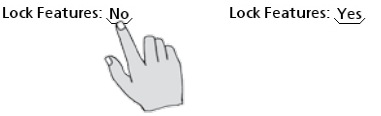
Features 1-3 are referred to datum 1

Features 4-6 are referred to datum 2

Measurement results when features were not locked before measurements

Features 1-6 are referred to datum 2

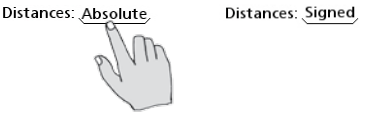
To lock features to their original datums, touch the Lock Features choice field to toggle the choice to Yes.



Specifying signed 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.

To specify signed distances, touch the Distances choice field to toggle the choice to Signed.

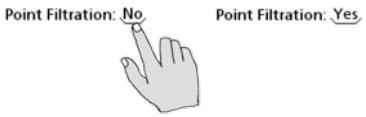


Enabling and configuring point filtration

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.

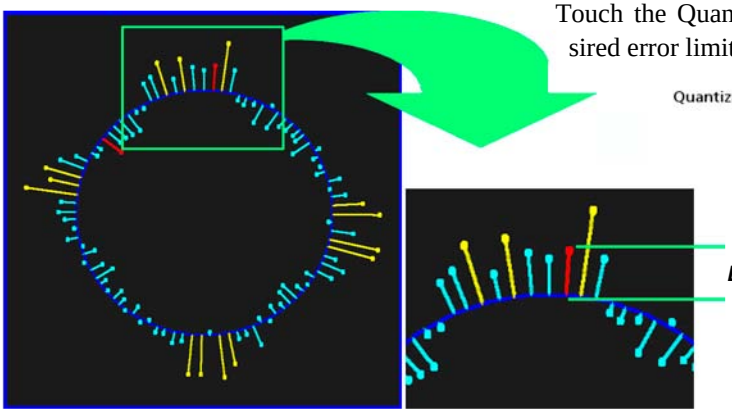
Enabling point filtration

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

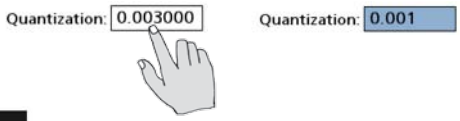


Specifying a filtration error limit

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.

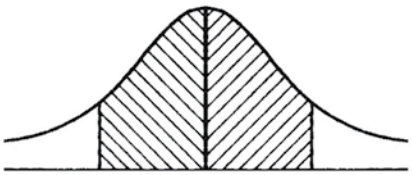


Touch the Quantization data field and enter the desired error limit.



Specifying a filtration standard deviation range

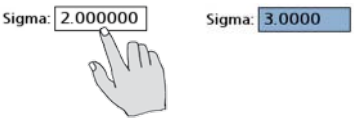
The acceptable standard deviation range is determined by the value of Sigma. For example, a Sigma of 2.0 produces a Standard deviation range that includes 95.5% of the total population.

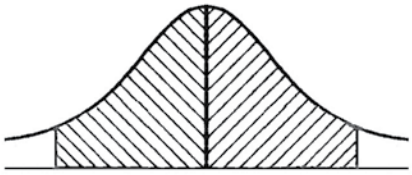


± 1 Sigma

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.

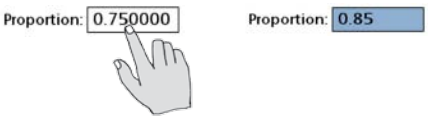




± 2 Sigma

Specifying the minimum percentage of retained points

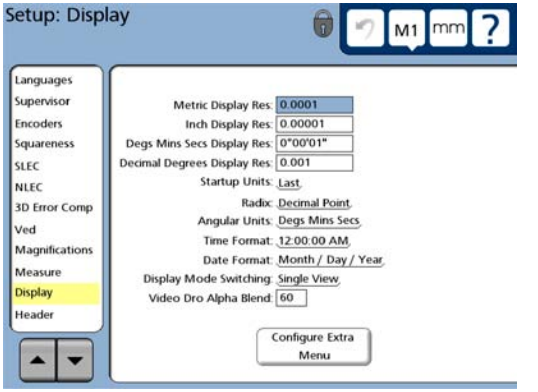
The Proportion value determines the minimum percentage of data points that will be retained. For example, a Proportion value of 0.75 will cause the system to retain a minimum of 75% of all data points collected for a feature.



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

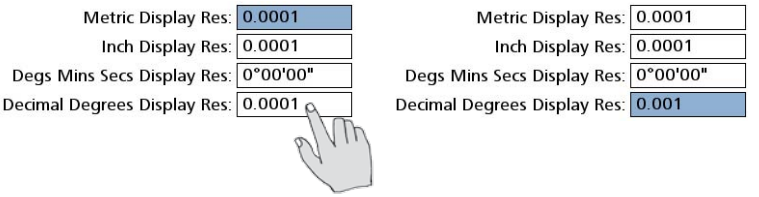
The display resolution fields are used to specify the resolution of measurements shown on the DRO and other screens. Displayed numbers will be rounded as the display resolution is decreased below that of the input. The table below illustrates how the display is governed by the display resolution setting.

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.

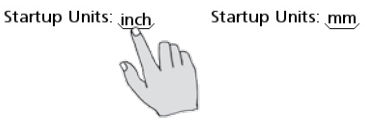
To specify display resolution, touch the data field of the desired Display category and enter the desired resolution using the number keys.



Default units of linear measure

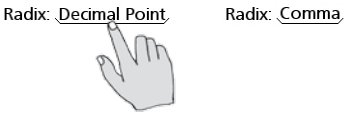
The Startup Units field is used to specify the default display of linear measurements when power is applied to the system. These display settings can be changed temporarily but will revert to the startup defaults when the power is cycled.

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

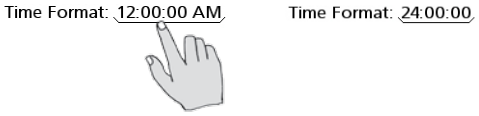
The Angular Units choice field is used to specify the display of angular units of measurement. The display choice can be toggled between degrees, minutes and seconds or in decimal degrees and will be retained across power cycles.

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.

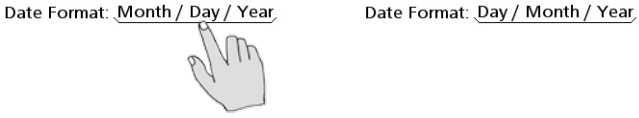
Touch the Time Format choice field to toggle between 12 hour and 24 hour formats.



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.

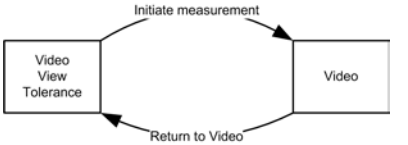
Touch the Date Format choice field to toggle between Month/Day/Year and Day/Month/Year formats.

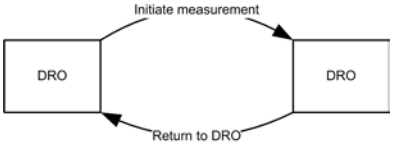


Display mode switching

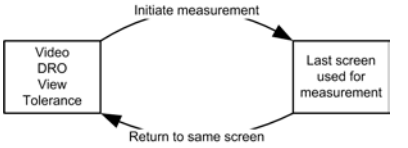
The QC-300 provides two display modes for measurements, Single View and Dual View.

In the Single View mode, the screen used for a measurement (DRO or Video) will be displayed again when the measurement is complete. However, when a measurement is initiated from the View or Tolerance screens, the Video screen will be used for the measurement in systems that include video capabilities.

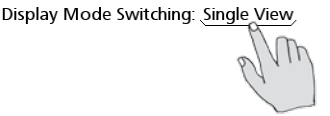




In the Dual View mode, the last screen used for a measurement (DRO or Video) will be used again for the current measurement. When the measurement is complete, the screen displayed before the measurement was initiated will be displayed again.



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



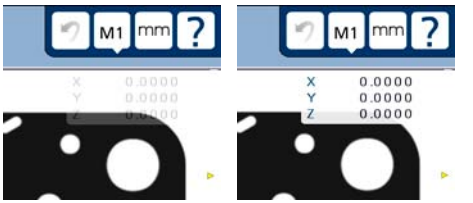
Display Mode Switching: Dual View

Video DRO alpha blending

The opacity of the small video DRO can be adjusted to suit the preferences of the user. The adjustment can be in the range from 0% to 100% opacity.

Touch the Video DRO Alpha Blend data field and enter the desired opacity using the number keys.

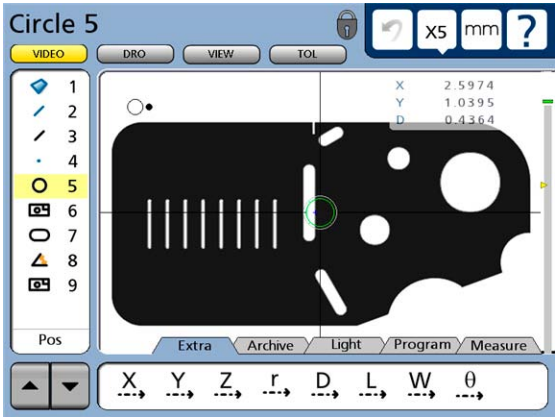
Video Dro Alpha Blend: 80



20% opacity *80% opacity*

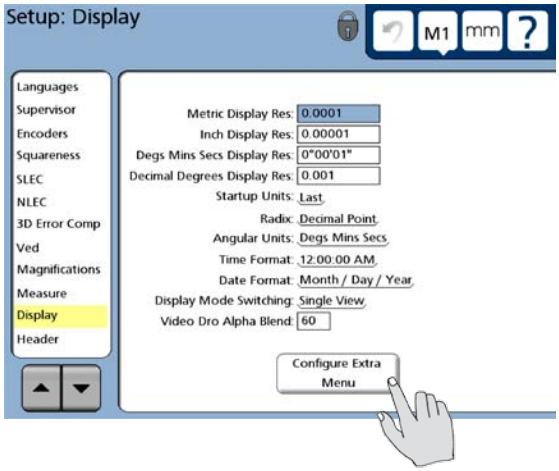
Configuring the Extra tab

The Extra tab can be configured to contain controls for transmitting measurement data, controlling CNC functions, 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, CNC and other functions, and would like to group similar functions on separate Extra tabs.

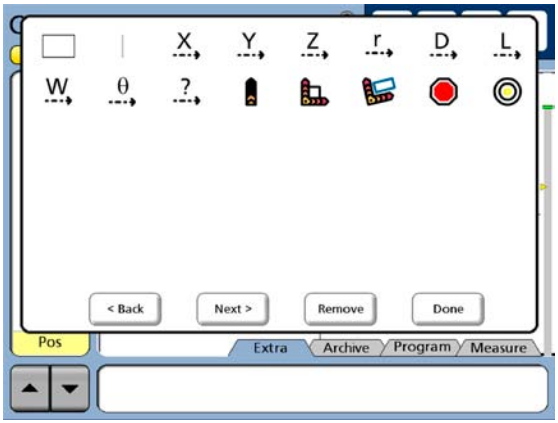


Extra tab at bottom of screen configured to contain controls for transmitting measurement data

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-300 systems. For example, Extra tab functions for a video edge detection QC-300 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 are included in the Extra tab to separate control functions into groups on the tab.

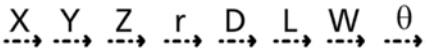
Extra tab divided by space into data and CNC groups

Divider line menu insert

The divider line insert are 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 transmission functions



Data transmission functions are included in the Extra tab to send individual measurements 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 one of the data transmission functions, the corresponding piece of measurement data is transmitted.

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 serial port, USB printer or USB drive as a file. 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.

Laser pointer ON/OFF

The laser pointer ON/OFF function is included in the Extra tab to toggle the laser pointer on or off. When the user touches the laser pointer ON/OFF function, the laser is toggled on or off.

Joystick motor speed

The Joystick motor speed function is included in the Extra tab of systems with the CNC option to adjust the joystick control of motor speed. When the user touches the Joystick motor speed function, the joystick control of motor speed is toggled between fast and slow.

Fast *Slow*

Axis lock

The Axis lock function is included in the Extra tab of systems with the CNC option to restrict stage motion to only one axis. When axis lock is on, motion is permitted only along one axis; diagonal motion is not permitted. When the user touches the Axis lock function, axis lock is toggled on or off.

Axis lock on *Axis lock off*

Part following

The Part following function is included in the Extra tab of systems with the CNC option. Part following changes the motion reference from the machine coordinate system to the part coordinate system after a part skew has been performed. For example, if a skew is performed along the part's X-axis, when part following is enabled, subsequent X-axis motion will follow the part skew, not the machine coordinate's X-axis. When the user touches the Part following function, part following is toggled on or off.

Part following on

Part following off

Stop motion

The Stop motion function is included in the Extra tab of systems with the CNC option to stop all stage motion. When the user touches the Stop motion function, motion is toggled on or off.

Motion stopped

Motion enabled

Goto feature

The Goto feature function is included in the Extra tab of systems with the CNC option. When the user touches the Goto function, the stage is moved to position the probe over the feature currently selected in the feature list.

Header screen

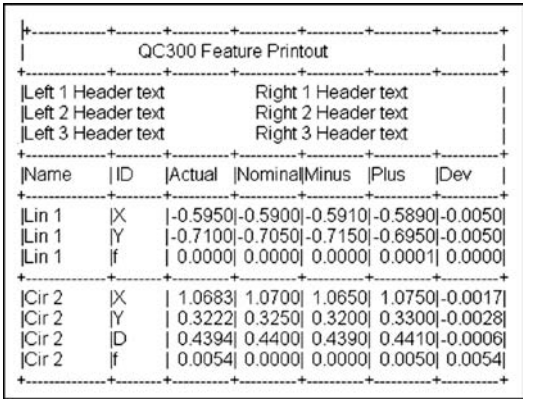
The Header screen contains fields for formatting text headers for printed and exported reports.

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:

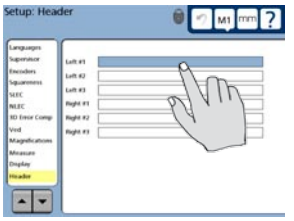
1 Touch the desired header field. The text entry window will be displayed.

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



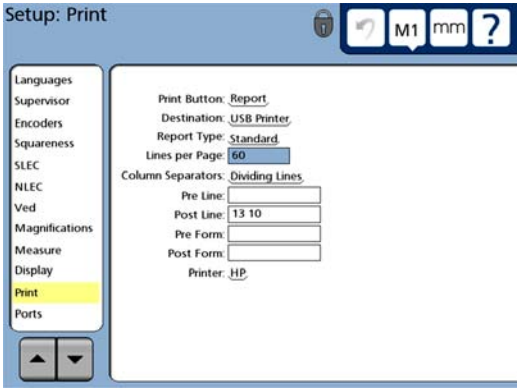
QC300 Feature Printout

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	Nominal	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 RS232 data streams of feature measurement data.



Specifying a data type

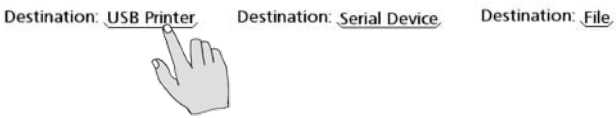
The Print button initiates the transfer of data to the USB port for printing, or to the RS232 serial port for communication with a computer. Specify the type of data to be transmitted by repeatedly touching the Print Button choice field.

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

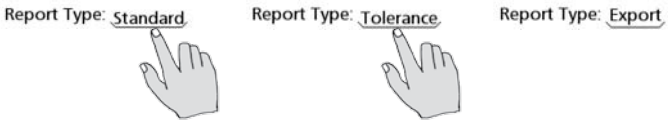
Specifying a data destination

Feature measurement data can be sent to the USB port for printing, to the RS232 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.



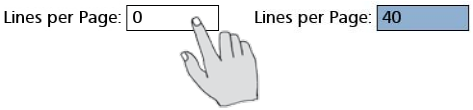
Report Type

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.



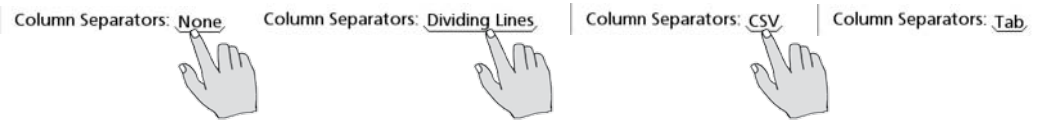
Lines per page

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.



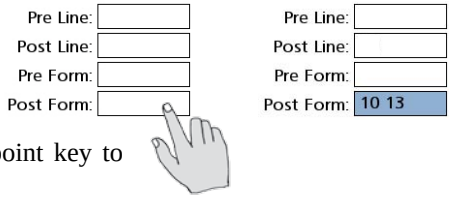
Specifying column separators

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.



RS232 control characters

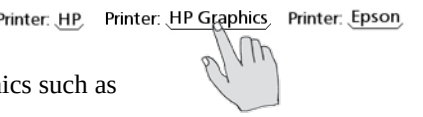
Control characters can be added to the beginning and end of line and form data streams to accommodate the requirements of receiving systems and programs. To add RS232 control characters, touch the desired data field and enter the ASCII character number using the number keys. Use the decimal point key to separate ASCII characters.



NOTE
An ASCII character chart is provided in Chapter 10: Communication.

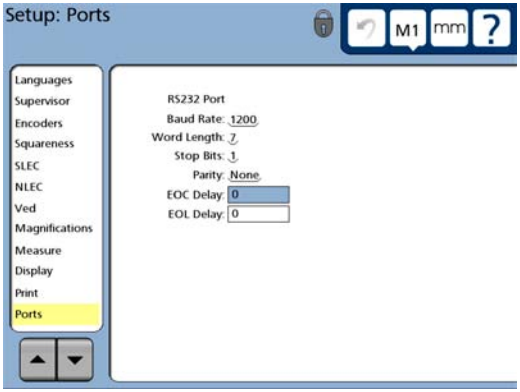
Selecting a USB printer

Touch the Printer choice field to cycle through the available USB Printers. The HP and Epson choices print text to HP and Epson USB printers. The HP Graphics choice prints text and graphics such as video archive images and part views to HP USB printers.



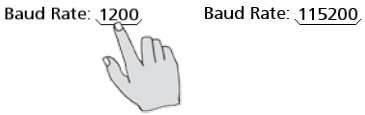
Ports screen

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.



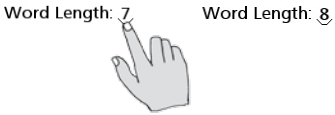
Baud rate

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.



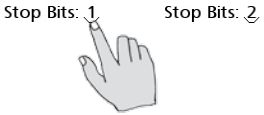
Word length

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



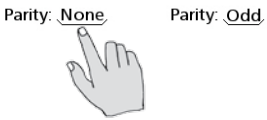
Stop bits

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



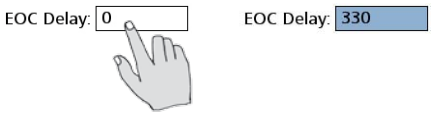
Parity

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



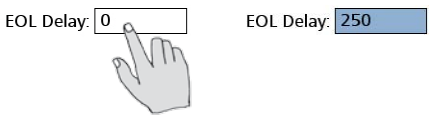
EOC delay

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

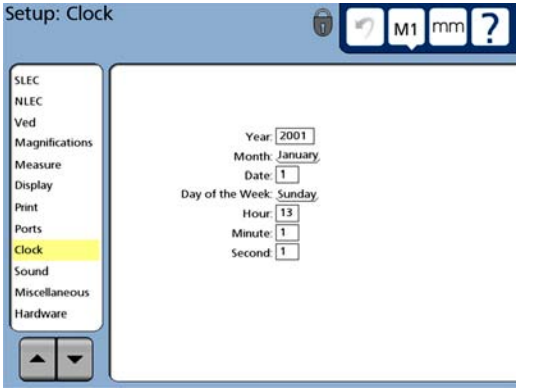
A delay can be inserted at the end of each line of characters to satisfy the communication requirements of receiving systems. Touch the EOL data field and enter the desired delay in milliseconds using the number keys.

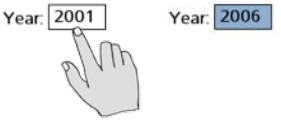


Clock screen

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.



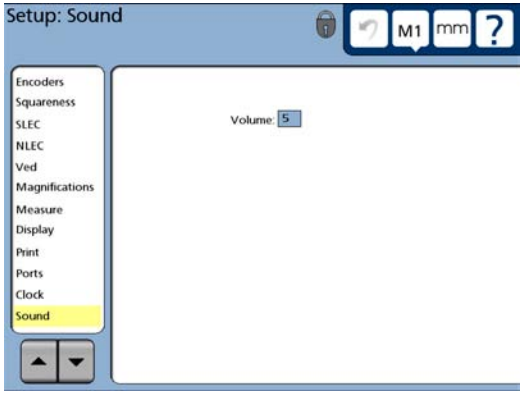


Touch and enter numbers

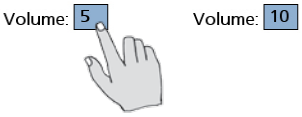
Touch and cycle through choices

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.

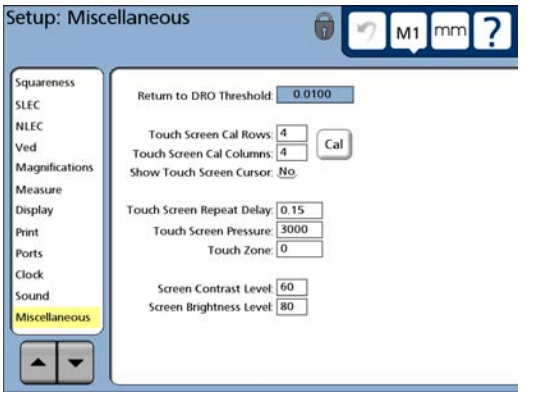


Touch the Volume data field and enter a number to adjust the loudness of all sounds from 1 (very soft) to 10 (loud). Enter a zero to mute all sounds.



Miscellaneous screen

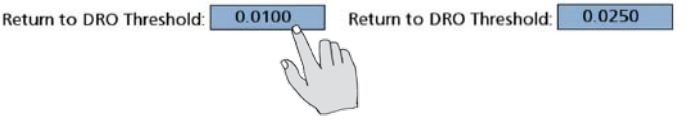
The Miscellaneous screen contains fields for calibrating and configuring the LCD touchscreen.



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.



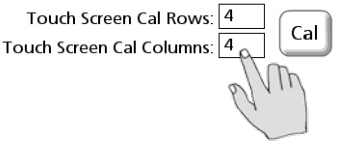
NOTE
Entering a zero disables this function.

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.

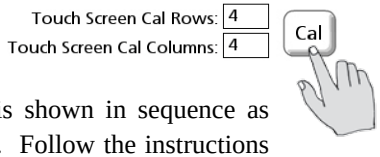


Calibrating the touchscreen

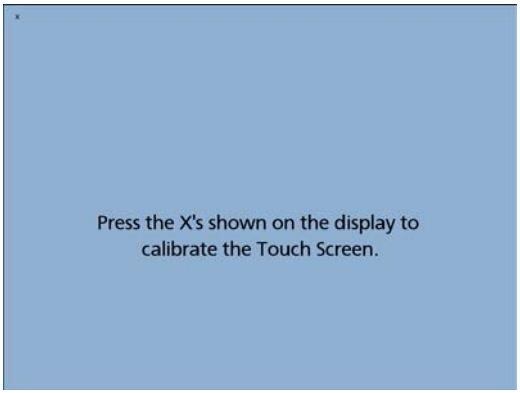
The touch-pressure of the touchscreen should be calibrated as part of the initial setup and when a new operator begins using the system. To calibrate the touchscreen:

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.



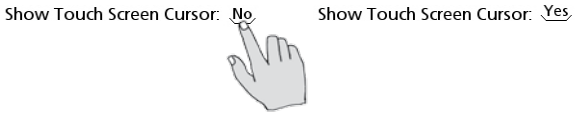
Each touch-point is shown in sequence as an x on the screen. Follow the instructions provided on the screen and then press the Finish key to complete the calibration. The touchscreen pressure calibration value will be shown in the Touchscreen Pressure data field.



Touch screen cursor

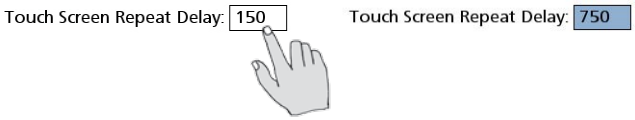
A green cross mark cursor can be displayed on the touchscreen briefly to indicate the touch-point as visual feedback for the user.

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



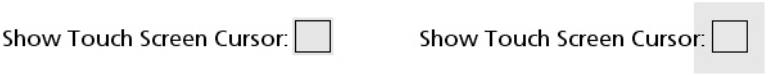
Touch screen repeat delay

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.



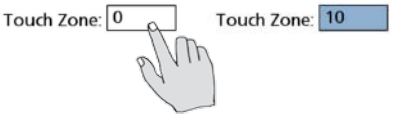
Touch zone size

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.

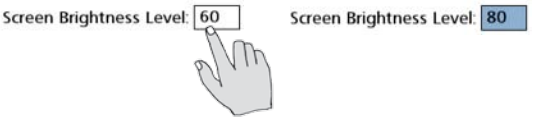


CAUTION
Increasing the touch zone size significantly might cause interference between adjacent fields.

Screen brightness

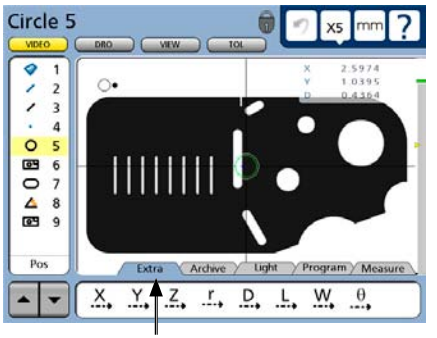
The LCD display brightness can be adjusted to accommodate different ambient lighting conditions.

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



Showing the Extra tab

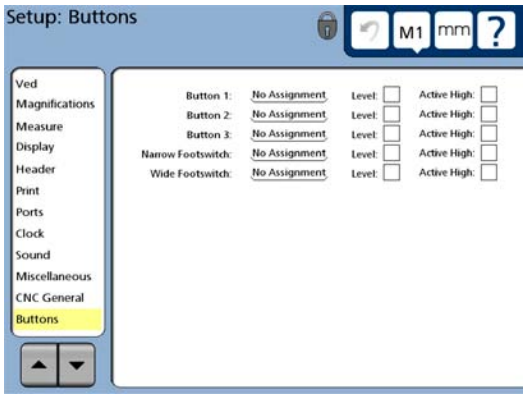
The Extra tab can be hidden or displayed at the bottom of the screen. To display the Extra tab, touch the Show Extra tab choice field to toggle the choice to Yes.

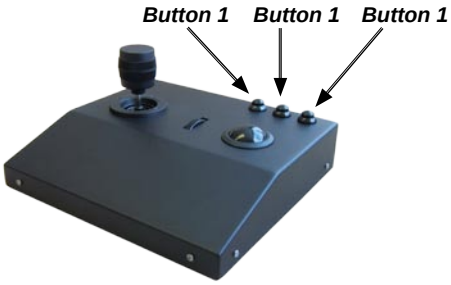


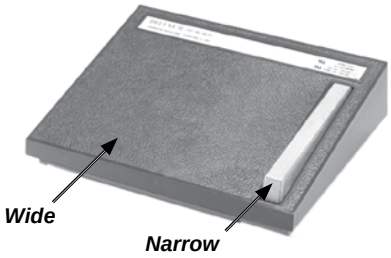
Extra tab at bottom of screen

Buttons screen

The Buttons screen contains fields for assigning frequently used QC-300 functions to joystick and foot switch buttons. Using preassigned buttons saves the time normally required to navigate menus. Each of the joystick and foot switch buttons can be assigned to functions shown in the choice fields. Thereafter, pressing the button invokes the assigned function.





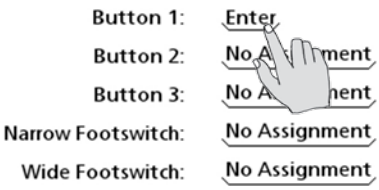


Selecting button functions

Button functions include:

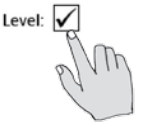
No Assignment	Nothing happens
Enter	Enters data point
Finish	Completes a measurement
Cancel	Erases the last measurement point or erases a character
Quit	Quits a measurement
Axis Lock	Engages CNC axis lock - prevents diagonal motion
Speed toggle	Toggles the joystick speed between fast and slow
Go to Here	Performs CNC move to the selected feature
Part Follow	Engages CNC conversion from machine coordinates to part coordinates

To select a button function, repeatedly touch the button's choice field until the desired function is displayed.



Selecting button responses

All button responses are either momentary or toggle. Momentary functions are level-based and are active only while the button is pressed and held. Toggle functions are activated when the button is pressed and released, and deactivated when the button is pressed and released again. Configure any of the button responses as momentary (level-based) by checking the button's Level box. Clear the Level box to configure the button response as toggle.

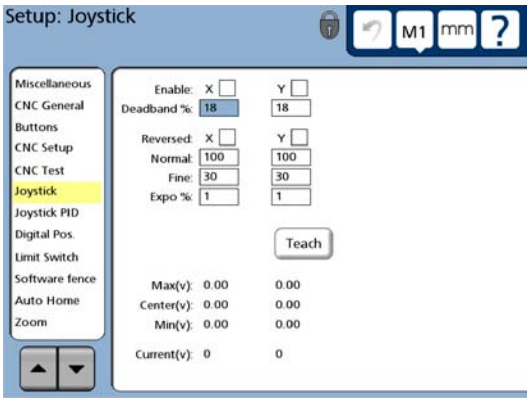


Selecting button logic

All button logic is either active high or active low. Configure each button to match the CNC amplifier input requirement by checking the Active High box for positive logic, or clearing it for negative logic.

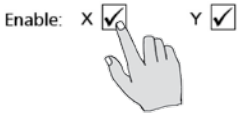
Joystick screen

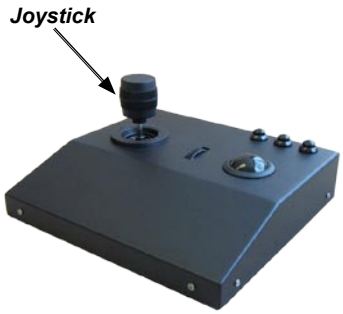
The Joystick screen contains fields calibrating and configuring overall joystick motion.



Enabling joystick motion

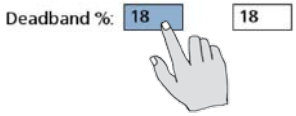
Check an axis Enable box to enable joystick motion, or clear the box to disable joystick motion on that axis.





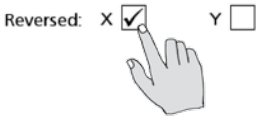
Specifying a joystick deadband

A deadband area of joystick inactivity is specified around the zero position of each axis to eliminate erroneous axis motion due to joystick vibration or noise. The default values are expressed as percentages of total motion and will satisfy the requirements of most environments, however these values can be increased or decreased by selecting the deadband field and entering the desired value.



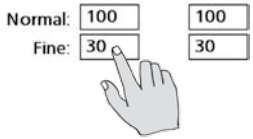
Specifying axis direction

The direction of motion controlled by the joystick on an axis is reversed to accommodate different joystick and system hardware by checking the Reversed axis box.



Specifying normal and fine axis velocity

The normal and fine axis velocities controlled by the joystick are specified by selecting a Normal or Fine velocity field and entering the desired percentage of maximum axis velocity.



Specifying linear and nonlinear joystick motion control

The axis velocity controlled by the joystick is changed from linear to varying degrees of exponential by entering values into the axis Expo% fields. Expo % values are entered from 0 (linear) to 100 (very exponential. Two examples and a graph are shown below.

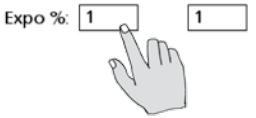
Linear example (Expo % = 0): For each percent of Joystick displacement, the axis velocity increases a percent:

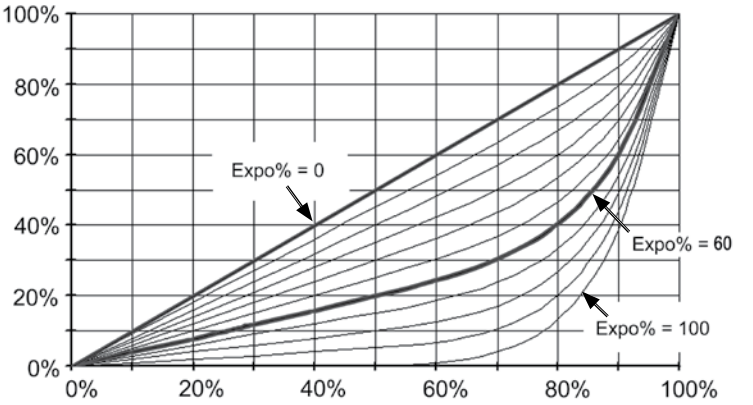
When the joystick is at 50%, the axis velocity is 50%
When the joystick is at 80%, the axis velocity is 80%
When the joystick is at 100%, the axis velocity is 100%

Nonlinear example (Expo % = 60): At first, increased Joystick displacements do not cause the axis velocity to increase much, but then as the Joystick displacement continues to increase, the axis velocity increases at a higher and higher rates:

When the joystick is at 50%, the axis velocity is 20%
When the joystick is at 80%, the axis velocity is 25%
When the joystick is at 100%, the axis velocity is 100%

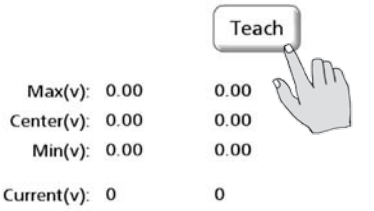
Select an axis Expo % field and enter the desired value.





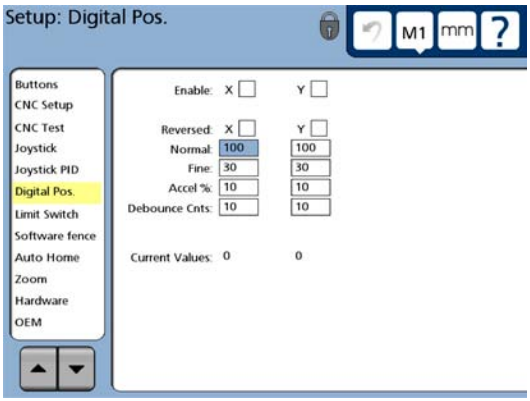
Calibrating the Joystick range of motion

The system must measure the joystick range of motion before the joystick can be used. Touch the Teach button to start the calibration procedure, and then follow the instructions displayed on the screen. Joystick positions will be indicated by Max(v), Center(v), Min(v) and Current(v) voltage values.



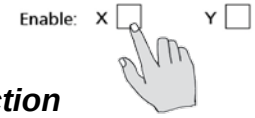
Digital positioner screen

The Digital positioner screen contains fields calibrating and configuring overall digital positioner motion.



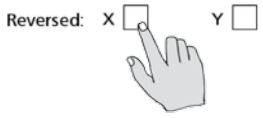
Enabling digital positioner motion

Check an axis Enable box to enable digital positioner motion, or clear the box to disable digital positioner motion on that axis.



Specifying axis direction

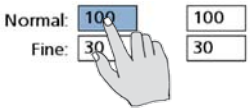
The direction of motion controlled by the digital positioner on an axis is reversed to accommodate different digital positioner and system hardware by checking the Reversed axis box.



Digital positioner

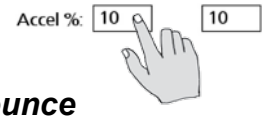
Specifying normal and fine axis velocity

The normal and fine axis velocities controlled by the digital positioner are specified by selecting a Normal or Fine velocity field and entering the desired percentage of maximum axis velocity.



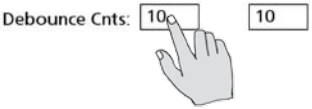
Specifying axis acceleration

The axis acceleration controlled by the digital positioner is specified by selecting an axis field and entering the desired percentage of maximum axis acceleration.



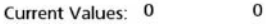
Specifying a digital positioner counter debounce

An area of digital positioner inactivity is specified around the current rest position of each axis to eliminate erroneous axis motion due to digital positioner vibration or noise. The default values are expressed as positioner counts and will satisfy the requirements of most environments, however these values can be increased or decreased by selecting the Debounce Cnts field and entering the desired value.



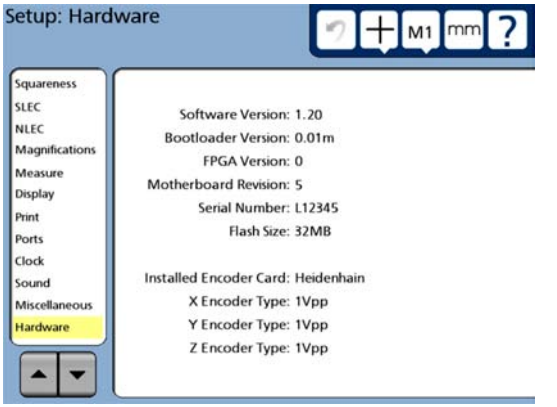
Current value display

The axis current values change as the digital positioner is moved. This display is only provided as a convenience for the user.



Hardware screen

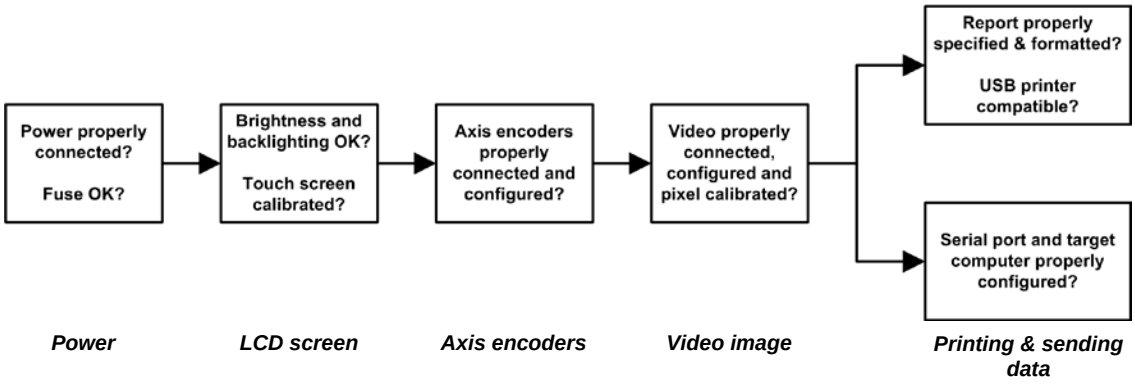
The Hardware screen contains fields that describe the software and hardware configuration of your system. This information will be essential to Metronics technical support personnel if your system is upgraded or repaired.



Chapter 12: Problem Solving

The QC-300 is based on years of experience manufacturing the Metronics QC-100, QC-200 and QC-5000 products. Years of continuous improvement have resulted in extremely reliable operation and few, if any problems. Problems experienced with the operation of the QC-300 are likely to be the result of printer or cable incompatibilities, instrument configuration or setup errors, encoder incompatibilities or malfunctions or video configuration 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 troubleshooting of configuration settings and hardware connections prior to calling the distributor or factory 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 11: Setup have been performed before troubleshooting or requesting assistance.

Symptoms, probable causes and solutions

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

No image is visible on the LCD screen

Probable cause 1: Power is not applied to the QC-300

Possible solutions:

1 Activate the main power source.
2 Connect the power cord or turn the power ON.
3 Replace the fuse.

Probable cause 2: LCD ON/OFF toggle switch is in the OFF mode

Possible solution:

1 Press the LCD ON/OFF button to toggle the LCD ON.

Probable cause 3: LCD contrast or backlighting is out of adjustment

Possible solution:

1 Readjust the backlighting using the decimal point or +/- key.
2 Adjust the brightnes level in the Miscellaneous setup screen.

Values displayed on the LCD screen are incorrect

Probable cause 1: The axis encoder is not connected or is malfunctioning

Possible solutions:

1 Connect the axis encoder cable firmly to the QC-300.
2 Replace the axis encoder.

Probable cause 2: The Encoders setup screen specifies the wrong axis encoder resolution

Possible solution:

1 Specify the correct resolution in the Encoders setup screen.

Probable cause 3: The wrong axis encoder count polarity is specified in the Encoders setup screen

Possible solution:

1 Specify the correct count polarity in the Encoders setup screen.

Probable cause 4: The wrong encoder is connected to the axis

Possible solutions:

1 *Connect the axis encoder specified in the Encoders setup screen.*
2 *Confirm that the each encoder is connected to the correct axis input.*

Probable cause 5: The wrong in/mm unit of measure is specified

Possible solution:

1 *Specify the correct units of measure in the Encoders setup screen.*

Probable cause 6: The wrong encoder reference mark is specified

Possible solution:

1 *Correct the reference mark type in the Encoders setup screen.*

Probable cause 7: Error correction is required to compensate encoder inaccuracies:

Possible solutions:

1 *Perform LEC, SLEC or optional NLEC error correction in the corresponding error screen.*
2 *Error correction was performed but not enabled. Enable error correction in the LEC, SLEC or optional NLEC setup screen.*

Probable cause 8: Video resolution is not calibrated:

Possible solutions:

1 *Calibrate the video pixel resolution in the VED setup screen.*

Probable cause 9: The wrong video camera is specified:

Possible solutions:

1 *Specify the correct camera in the VED setup screen.*

Reports are not printed or are incomplete

Probable cause 1: The channel input device is not connected or is malfunctioning

Possible solution:

1 *The printer is not supported by the QC-300.*

Probable cause 2: The USB cable is not firmly connected or is damaged

Possible solution:

1 *Connect or replace the printer cable.*

Probable cause 3: The printed report setup is incorrect

Possible solution:

1 *Correct the report setup in the Print setup screen.*

Reports are printed incorrectly

Probable cause 1: The printed report setup is incorrect

Possible solution:

1 *Correct the report setup in the Print setup screen.*

Probable cause 2: The wrong control characters are specified

Possible solution:

1 *Correct the control character configurations in the Print setup screen.*

Data cannot be transmitted to a computer

Probable cause 1: The wrong serial cable (or no cable) is connected between the computer and the QC-300

Possible solution:

1 *Connect the computer to the QC-300 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.*

Probable cause 2: The wrong RS-232 port settings are specified

Possible solution:

1 *Correct the RS-232 port settings to match the computer's serial port settings in the Port setup screen.*

Probable cause 3: The wrong control characters are specified

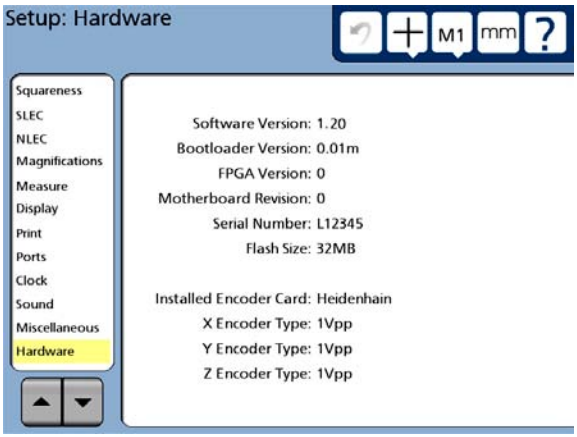
Possible solution:

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-300. 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-300 information:
- Model number
- Serial number
- Approximate purchase date
- Software version number and hardware information from the Hardware setup screen.



Chapter 13: Reference Material

This chapter contains technical information regarding:

- QC-300 product specifications
- Footswitch wiring
- Tolerances
- RS-232 connector wiring
- Lighting/Zoom connector wiring

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, EN61010-1

Footswitch wiring

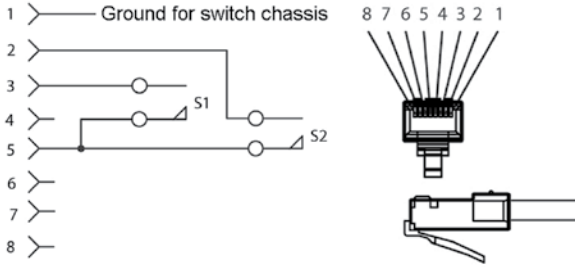
The optional foot switch is connected to the RJ-45 connector on the left side of the QC-300.

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

Footswitch and keypad connector

CAUTION

Never apply power to the foot-switch 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-300 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)

Lighting/Zoom connector wiring

The Lighting/Zoom connector wiring is shown by the table below.

32	Lamp enable ground #1	
16	Lamp output #1	Vout software selectable range 0-5
31	Lamp enable #1	Output TTL
1	Lamp output #2	Vout software selectable range 0-5v
17	Lamp enable #2	Output TTL
2	Lamp output #3	Vout software selectable range 0-5v
18	Lamp enable #3	Output TTL
3	Lamp output #4	Vout software selectable range 0-5v
19	Lamp enable #4	Output TTL
33	Lamp output ground #1	Ground
35	Lamp enable ground #2	Ground
4	Lamp output #5	Vout software selectable range 0-5v
34	Lamp enable #5	Output TTL
20	Lamp output #6	Vout software selectable range 0-5v
5	Lamp enable #6	Output TTL
21		
36		
6		
22		
37	Lamp output ground #2	Ground
38	Zoom ground	Ground
7	Zoom step	Output TTL
8	Zoom limit switch #1	Input TTL 0-5V (only)
23	Zoom direction	Output TTL
24	Zoom limit switch #2	Input TTL 0-5V (only)
9	Encoder (a)	Output TTL
39	Encoder (b)	Input TTL 0-5V (only)
25	+5V	Output TTL
10		
40		
41	TTL output ground	Ground
42	TTL output #1	Output TTL
43	TTL output #2	Output TTL
26		
11		
27		
12		
28		
13		

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-300 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)

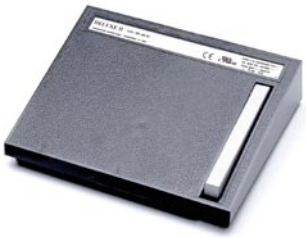
First, a least squares best fit circle is estimated, then the data is iteratively processed to position a perfect circle in the location that minimizes the inside and outside form errors. Form errors are inside and outside the circle.

Chapter 14: Options

Available options for the QC-300 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-300 on vertical surfaces (must be ordered together)
- Taltech WinWedge© for inputing serial data directly from the QC-300 into any PC application

Contact the Metronics sales group by phone at *603.622.0212* or by e-mail at *sales@metronics.com* to order QC-300 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

Taltech WinWedge software
54-775-005

INDEX

Symbols

A

B

C

D

N

O

P

Q

R

S

T

U

V

W

Z

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