Quadra-Chek® 200

User's Guide

METRONICS®

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METRONICS®

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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.

Although Metronics strongly recommends that you read all parts of this guide, it is essential for reliable and safe operation to read the first portions up to and including Chapter 3: Operation, prior to operating the QC200.

Location & Mounting

The QC200 must be placed or mounted on a stable, reliable surface. If the QC200 should fall, it could become seriously damaged and more importantly could cause injuries to the user. For mounting instructions, refer to the Getting Started section of Chapter 3: Operation, for the mounting bolt hole pattern.

Cleaning

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.

Electrical

Do not allow the power cord to be located such that it can be walked on or create a tripping hazard.

WARNING
Unplug the QC200 from the electrical outlet before cleaning.

WARNING
The QC200 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 2-wire power plug adapters or any other connection accessories that remove the third grounded connection create a safety hazard and should not be permitted. If a 3-wire grounded outlet is not available, ask your electrician to provide one.

General Maintenance

Unplug the QC200 from the wall outlet 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 QC200 has been dropped or the exterior has been damaged
- The QC200 exhibits degraded performance or indicates a need for service some other way

Backup Battery Charging

The QC200 utilizes an internal battery to maintain system configuration settings during power interruptions. A battery circuit charges this backup battery during periods of normal operation.

When the QC200 is used on a daily basis, the backup battery will be adequately charged to maintain configuration settings during power outages. However, over extended periods of nonuse, the battery might lose the charge necessary to maintain configuration settings. To keep the backup battery charged over extended periods of nonuse, apply power to the QC200 and leave it turned on for a minimum of 2 days each month.

FCC Compliance Statement

Introduction

About this Guide

The material in this guide is divided into eight chapters. Topics range from basic operating instructions to programming and system configuration. Chapters 1 through 3 contain the essential information to use the QC200. Do not operate the QC200 unless the material in these chapters is thoroughly understood.

Keep this guide in a convenient location. Refer to it any time additional information about the use and operation of the QC200 is needed. Use the index to locate information by subject. Additional information related to this guide can be found on the Internet at *www.metronics.com/help.html*.

Who Should Read This Guide

This guide is intended for operators, technicians, supervisors, and dealer representatives.

NOTE
System setup and configuration instructions provided in chapter 7 are intended for qualified supervisors, dealer representatives and OEMs only. Operators should not attempt to alter the configuration of the QC200.

What This Guide Covers

Chapter 1: Overview
This chapter describes the use and application of the QC200 digital readout and includes an annotated drawing and technical specifications.

Chapter 2: Quick-start
Use this chapter as a basic user tutorial. The quick start demonstration provides QC200 operation instructions with a minimum of details.

Chapter 3: Operation
This chapter includes detailed descriptions of controls and indicators, and instructions for measuring, constructing, creating, and tolerancing features.

Chapter 4: Programming
This chapter contains instructions for recording, running, and editing QC200 programs.

Chapter 5: Edge detectors
Information in this chapter provides background and reference material regarding edge detector installation and operation.

Chapter 6: Communications
Use this chapter to connect the QC200 to a printer or computer via the RS-232 or parallel port.

Chapter 7: Setup
This chapter contains system configuration instructions for qualified supervisors and dealer representatives.

Chapter 8: Reference
This chapter contains additional information about quantization error, best fit algorithms, and repeatability.

Conventions & Terms

The terms *Quadra-Chek 200*, *QC200* in this guide refer to the Quadra-Chek 200 digital readout. *System* refers to the QC200 and the measuring device connected to it.

Comparator refers to any device intended to measure parts in 2 dimensions. C*rosshairs* and *edge detector* refer to the probing method of the connected measuring device. *Probing* refers to the process of measuring a point on a feature.

A *program* is simply a series of key-presses used to perform measurements and stored by the system for later use.

Icons

This guide uses the following icons to highlight information:

Warning

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. Warning messages are shown in bold type.

Caution

The exclamation point icon indicates a situation or condition that can lead to equipment malfunction or damage. Do not proceed until the caution message is read and thoroughly understood. Caution messages are shown in bold type.

Note

The note icon indicates additional or supplementary information about an activity or concept. Notes are shown in bold type.

Type Styles

Warnings, cautions, and notes are shown in this typeface.

Italics indicate menu items, front panel keys, input fields, or soft keys.

Measurement Polarity

Instructions in this guide assume that:
- Moving crosshairs to the right causes the X axis counts to increase in a positive direction; 1 to 2 to 3 and so on.
- Moving crosshairs up causes the Y axis counts to increase in a positive direction; 1 to 2 to 3 and so on.
- Rotating crosshairs counterclockwise causes the Q axis counts to in crease in a positive direction; 1 degree to 2 degrees to 3 degrees and so on.
- To reverse the count direction of any axis, see the *encoders* section of *chapter7: setup*.

Display Resolution in this Guide

Generally, the display resolution shown in this guide is one ten-thousandth of an inch (0.0001in) or two microns (0.002mm). Display resolutions in this guide are examples only. User display resolutions are likely to vary according to the specific application.

Accuracy & Precision

Measurement accuracy is determined by the resolution of the encoders on the measuring device. Generally, the display resolution of the QC200 can exceed the encoder resolution. Setting the display resolution to exceed the encoder resolution does not increase measurement accuracy. See *chapter 7: setup* for more information.

System Configuration & Setup

All system setup and configuration must be performed by an authorized Metronics distributor or OEM. Setup includes calibration with the measuring device and configuration of non-linear error compensation (NLEC) if needed.

Anytime the QC200 is connected to a different measuring device, it is necessary to perform configuration and setup again. Qualified supervisory personnel should refer to *chapter 7: setup* or contact their Metronics distributor for assistance.

WARNING
Electrical shock risk: do not open the QC200 enclosure. There are no user-serviceable components or assemblies inside. Contact your Metronics distributor for service and maintenance.

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Chapter 1
Overview

Metronics is the world's premiere developer of metrology software and digital readouts for measuring and inspecting 2D and 3D geometric components. The Quadra-Chek 200® is an advanced digital readout system for 2, 3 and 4 axis measurement systems.

Use the QC200® to inspect manufactured parts that demand very high levels of precision and accuracy. Connect the QC200® to optical comparators, toolmaker's microscopes, or video measurement systems as part of in-line production activities or final quality inspection.

Save time and increase productivity with the QC200. Enter points using crosshairs or optical edge detection. Use Measure Magic® to interpret point data and determine feature geometry automatically. Compensate for imperfect part alignment using the skew function. Define hot keys to perform common tasks at the press of a button. Automate repetitive inspections using the programming capability.

The user interface retains many functions and features familiar to users of the Quadra-Chek 2000® and other Metronics products. In addition, more information is given to the operator via the graphic LCD display. Data is clearly presented on one screen, eliminating the need to page or scroll for information.

The compact ergonomic design allows the QC200 to mount on a wide variety of equipment. Use the tilt front panel to adjust the display to your viewing requirements. Rubber feet on the bottom prevent slipping when the system is not permanently bolted to a surface. Bolt holes on the mounting stand match the pattern on the QC2000 for ease of retrofitting.

Above all, the QC200 simplifies complex inspection tasks. Essentially there are only three things to measure: points, lines, and circles. Angles and distances are really just relationships between points, lines, and circles. Points, lines, and circles are referred to as *features* while angles and distances are called *relationships*. Plan inspections by identifying features on the part.

Use the front panel keys to perform standard inspection tasks. Select measurement functions, change operation and display modes, enter numeric data, zero axes, turn the LCD display on/off, or send data to a printer or computer with the press of a button. The illustration below shows the location of the various panel keys.

Soft keys execute measurement-specific functions. Depending on the current task, various soft key options are displayed on the bottom of the LCD screen. Press the soft key beneath the displayed option to execute the desired function.

Fast track keys are located above the LCD. By default, the left fast track key is the same as the *enter key* and the right is the same as the *finish key*. Users can save time by programming the fast track keys to perform common tasks. Most front panel keys can be programmed in the same way. Since the fast track keys are fairly large, users can find them by touch without looking at the QC200.

All front panel keys (except fast track keys) provide tactile sensory feedback. Additionally, supervisors can configure keys to provide audio feedback. The QC200 is equipped with a speaker and external speaker jack. Adjust speaker volume to suit the operating environment or plug a headset into the speaker jack.
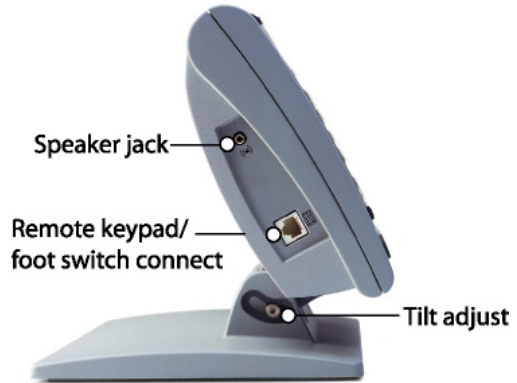
Transmit measurement data to a computer over the RS-232 port connection, or to a printer over the parallel or RS-232 port.

An optional foot switch and remote keypad are available for feature-point and numeric data entry. Use these devices when the QC200 is mounted out of the operator's reach.

Specifications

Input Voltage Range:	85 VAC to 264 VAC. 1.0 Amp maximum (Auto switchable)
Fuse:	1.6 Amp 250V Slow Blow 5X20mm
Input Frequency:	43Hz to 63Hz

CAUTION
For continued protection against fire, use replacement fuse with the specified voltage and current ratings only.

Environmental Conditions

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

Dimensions

Enclosure (WxHxD):	11.5" X 7.5" X 2.75"
Base (WxHxD):	10" X 2" X 7.8"
Enclosure weight:	3.5 lbs.
Base weight:	7 lbs.

LCD

Size/color:	5.7" black and white
Display digit size:	0.5"
Resolution:	0.000004" or 0.0001mm

ENC tests:	EN61326:1998 EMC for electrical equipment for measurement, control and laboratory use EN61010 Safety requirements for electrical equipment for measurement, control and laboratory use

WARNING
Electrical shock risk: do not remove cover or open the enclosure. There are no user-serviceable parts inside. Contact your Metronics distributor for service.

Chapter 2
Quick-Start Demonstration

Before You Begin

Use this chapter to learn the basic operation of the Quadra-Chek 200. The demonstrations in this chapter help experienced operators start using the QC200 immediately. Less experienced operators may need to read *chapter 3: operation* to understand some of the material in this chapter. Perform the indicated steps on your QC200 while reading this material for best results. Demonstrations in this chapter show crosshair measurement on an optical comparator. Apply these concepts to the use of optical edge detection as well.

In this chapter users will learn to:
- Set up the QC200 for measuring
- Skew a part
- Datum a part
- Construct a point
- Measure a line and circle
- Perform a tolerance

See *chapter 3: operation* for complete operating principles and step-by-step demonstrations.

Illustrations in this chapter show a 2 axis (XY) system with factory default settings.

Getting Started

Read and understand all safety and operating instructions before operating the QC200. To complete the tasks described in this chapter, users must understand the inspection process, the measuring device used, and the controls, indicators, and information presented on the QC200 display.

NOTE
Operators are required to understand part fixturing and probing techniques that apply to the measuring device connected to the QC200.

Safety Reminders

Location and mounting

Mount the QC200 on a stable surface. If it falls, serious damage or injury can result.

Checking connections

Perform routine inspections on all connections to the digital readout system. Keep connections clean and tight. Locate cables away from moving objects. Do not create tripping hazards with the power cords and connection cables.

Use shielded cables to connect to the parallel and serial (RS-232) output ports. Make certain cables are properly terminated and firmly connected on both ends.

CAUTION
Never connect the power cable to the QC200 with the power switch in the ON position. Optical edge detector cables may be connected or disconnected without placing the switch in the OFF position.

Power cord and plug

Make sure the power cord is not located where it can be walked on or create a tripping hazard. Connect the 3-wire power plug to a 3-wire grounded outlet only. Do not attempt to adapt or remove the 3rd ground wire to fit the plug in 2-wire electrical outlet. Modifying or overriding these features creates a safety hazard and should not be permitted.

Power surge suppressor

Use a high-quality power surge suppressor to limit the amplitude of potentially damaging power line transients caused by electrical machinery or lightning. The surge suppressor found on inexpensive power strips is insufficient to protect the QC200 from damage.

Liquids

Do not spill or splash liquids on the QC200 enclosure.

Configuration & System Setup

Only qualified supervisors and dealer representatives should perform system configuration and setup. Operators should not attempt to alter the configuration of the QC200.

Applying power

Move the power switch located on the back of the QC200 to the ON position. The system initializes and displays the power-up screen.

Power-up screen

The power-up screen is displayed each time the QC200 is turned on. Press any key to display the DRO screen.
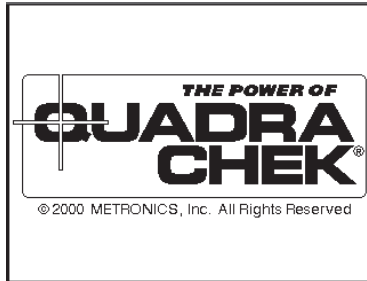
The DRO screen shows the current position of the encoders on each axis.

NOTE
Some encoders require the user to move each axis across a reference mark before the QC200 displays the DRO screen.

Adjusting LCD tilt

Adjust the tilt angle of the QC200 for comfortable viewing. If the tilt angle cannot be adjusted, loosen the two Allen screws at the base of the enclosure and tilt the QC200 to the desired angle. Retighten the Allen screws so the enclosure is held firmly but can be adjusted again without loosening.

Adjusting LCD contrast

Adjust the LCD contrast for optimum viewing of the DRO screen. Press the *decimal point key* to decrease contrast or the *+/- key* to increase contrast.

Selecting measurement and display modes

Use the mode selection keys located above the numeric keypad to choose measurement units, datums, and display coordinates. These parameters are user defined and depend on the application performed.

mm/inch

Use the mm/inch mode selection key to toggle the display units between millimeters and inches. The current unit of measure is displayed in the upper right corner of the screen.

Datum

Use the datum mode selection key to toggle between datum 1 and datum 2. Datum 2 is a temporary datum that is useful for performing incremental measurements. The current datum number is displayed in the upper right corner of the screen.

Polar/Cartesian

Use the polar/cartesian mode selection key to toggle the display between polar and cartesian display coordinates. Select the appropriate display coordinates for your application. See *chapter 3: operation* for a complete discussion of polar and cartesian display coordinates.

Probing methods

Probe features with crosshairs or optical edge detection. Align crosshairs on the desired point and press *enter* to take points. The crosshair probe indicator appears on the upper right corner of the LCD as shown.

Optical edge detection requires the user to 'teach' the system to detect dark-to-light or light-to-dark transitions in order to find an edge and take points. QC200s equipped with optical edge detection display *probe* and *teach* soft key commands at the bottom of the LCD. Press the *probe* soft key to toggle between crosshair and edge detection.

To select optical edge/crosshair probe

Step 1
Press the *probe soft key*.
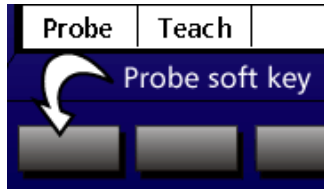
One of the following edge detector icons is displayed depending on the edge detection mode selected by the user. The optical edge probe indicator for auto edge detection appears on the upper right corner of the LCD as shown.

The optical edge probe indicator for manual edge detection appears on the upper right corner of the LCD as shown.

Backward/forward annotation

Use forward annotation to set the required number of points for each feature type. Use backward annotation to allow the operator to determine the number of points. When using forward annotation, the number of required points is shown on the top left corner of the screen. As points are entered the number counts down.

Forward annotation displays the required number of points and counts down as points are probed.

```
┌─────────────────────────────────────┐
│Probe Circle          mm |1  +        │
│ ┌──┐                                 │
│ │Pts│ X       0.0000                 │
│ │Req│                                │
│ │ 3 │ Y       0.0000                 │
│ └──┘                                 │
│                                      │
│                                      │
│ ┌───┐                                │
│ │DRO│                                │
│ └───┘                                │
│ Probe │ Recall │ Create │    │       │
└─────────────────────────────────────┘
```

Backward annotation starts at zero and displays the number of points as they are taken.

```
┌─────────────────────────────────────┐
│Probe  Circle         mm |1  +        │
│ ┌──┐                                 │
│ │Pts│ X       0.0000                 │
│ │ 0 │                                │
│ │   │ Y       0.0000                 │
│ └──┘                                 │
│                                      │
│                                      │
│ ┌───┐                                │
│ │DRO│                                │
│ └───┘                                │
│ Probe │ Recall │ Create │    │       │
└─────────────────────────────────────┘
```

Skewing the Part

Accurate measurements require the part to be perfectly aligned on the coordinate measuring system. An imperfectly aligned part yields inaccurate measurements. Use the skew function to convert machine coordinates to part coordinates and compensate for part misalignment. Perform a skew each time a new part is mounted on the measuring system.

Measure a skew line by probing a straight edge of known orientation. Use a minimum of 2 points and a maximum of 100 when probing the line. Use more points for greater accuracy.

NOTE
It is a good idea to clear any existing features from the features list before skewing a new part. To clear the features list, press the *menu key*, followed by the *clear soft key*, then press the *clear all (clr all) soft key*.

NOTE
Place the part within 45 degrees of the measuring machine's true orientation.

To skew a part

Step 1
Press the *skew key*.

Step 2
Probe the first point as shown.

Step 3
Press the *enter key*.

Step 4
Probe two more points along the line as shown. Press the *enter key* after each point.

Step 5
Press the *finish key*.

The skew data screen is displayed and the skew is added to the feature list. The small skew icons displayed next to the X and Y axes indicate that the part is mechanically misaligned. An electronic alignment is applied to the skew line to compensate for the part skew. The skew data screen displays the electronically aligned part coordinates NOT the actual machine coordinates. If the part is perfectly aligned on the machine axis, the skew icons are not displayed and no compensation is applied. In real world applications, a perfectly aligned part is very rare. Press the *view soft key* for a graphic representation of the skew line. Press the *view soft key* a second time to return to the skew data screen.

The part is now compensated for mechanical misalignment. This compensation is applied to all subsequent measurements of the part.

Set the Datum

All measurements are relative to the datum. The datum is the zero point or origin of the coordinate system. Establish a datum once the part is skewed. The simplest way to establish a datum is to zero the X and Y axes on a point. In the example below, the skew line and a second line are used to construct a point. Both axes (X and Y) are zeroed on that point which then becomes the datum.

The QC200 allows users to construct two reference datums for measurements. Datum 1 is the original datum and datum 2 is a temporary datum useful for incremental measurements. See *chapter 3: operations* for more details.

To construct a datum

Steps 1 through 3 measure a second line. This line and the skew line will be used to construct a point.

Step 1
Press the *line key*.

Step 2
Probe a minimum of two points along the line as shown. Press the *enter key* after each point.

Step 3
Press the *finish key*.

finish

The result is displayed as shown.

LINE 2	mm	⊥1	+
X	-0.9889
Y	0.6350
∠	90°00'00"
Pts=3	F	0.0000
DRO			
Recall	View	Change		Tol

LINE 2	mm	⊥1	+
X	-0.9889
Y	0.6350
A	90°00'00"
Pts=3
F	0.0000
LSBF
DRO				
Recall	View	Change	Zoom	Tol

Steps 4 through 9 construct a point from *line 2* and *skew 1*. See *chapter 3: operation* for more information about constructions.

Step 4
Press the *point key*.

Step 5
Press the *constr (construct) soft key*.

Probe Point	mm	⊥1	+
Pts 0	X	0.4200
1 2	Y	0.5150
DRO			
Probe	Recall	Create	Constr	

Step 6
Use the arrow keys to highlight line 2 as shown.

Step 7
Press the *enter key*.

A check mark appears next to the line 2 in the feature list and line 1 is now highlighted.

NOTE
In this example, skew 1 is the next feature for the construction so it is not necessary to move the cursor to select the next feature. Occasionally, the user needs to use the arrow keys to highlight the next feature for a construction. In this case the next desired feature happens to be highlighted already.

Step 8
Press the *enter key*.

Step 9
Press the *finish key*.

The constructed point appears in the feature list and is highlighted.

Step 10 zeros the X and Y axes on the newly constructed point. Use the *zero axes keys* to establish a datum on any point feature.

Step 10
Press the *zero X and zero Y axes keys*. The *zero X axis key* is located next to the X axis display and the *zero Y axis key* is located next to the Y axis display as shown.

When both axes are zeroed the screen appears as shown.

Measuring   Lines

The QC200 allows the user to probe up to 100 points while measuring a line. A minimum of two points are required to measure a line. Use more points for greater accuracy. A best-fit algorithm is applied to lines with more than two points. The resulting *F (Form) value* is included in the feature data.

To measure a line

Step 1
Press the *line key.*

NOTE
Press the *line key* twice to measure a series of lines using *auto repeat.*

Step 2
Probe the first point as shown.

Step 3
Press the *enter key.*

Step 4
Probe two more points along the line as shown. Press the *enter key* after each
point.

Step 5
Press the *finish key*.
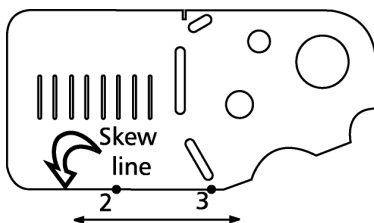
The line feature data is displayed on the screen and added to the feature list. Press the *view soft key* for a graphic representation of the line feature.

NOTE

Press the *change soft key* to change the best-fit algorithm used to calculate the line if desired. Fit algorithms used by the QC200 for lines are as follows:

- **LSBF: Fit determined by minimizing the sum of the squared point deviation from the form fit.**
- **ISO: Fit determined by minimizing the form (straightness) deviation.**

Press the *view soft key* to return to the line data screen.

Measuring Circles

A minimum of three points are required to measure a circle. The QC200 allows the user to probe up to 100 points for circle measurements. Use more points for greater accuracy. A best-fit algorithm is applied to circles with more than three points. The resulting *F (Form) value* is included in the feature data.

To measure a circle

Step 1
Press the *circle key*.

NOTE
Press the *circle key* twice to measure a series of circles using *auto repeat*.

Step 2
Probe the first point as shown.

The X and Y coordinates are displayed as shown.

Step 3
Press the *enter key*.

Step 4
Probe three more points along the edge of the circle. Press the *enter key* after each
point.

NOTE
**Space points approximately 90 to 120 degrees apart for best
results.**

The X and Y coordinates are displayed after each point as shown.

Step 5
Press the *finish key*.

The circle feature data will be displayed on the screen and the feature is added to the feature list.

The circle feature data is displayed on the screen and added to the feature list. Press the *view soft key* for a graphic representation of the circle feature.

CIRCLE 5	mm ⌊1 +
X	0.9166
Y	-0.3891
D/r	0.3811
Pts=4 F	0.0011
DRO	
Recall	View	Change		Tol

CIRCLE 5	mm ⌊1 +
X	0.9166
Y	-0.3891
D	0.3811
Pts=4	
F	0.0011
LSBF	
DRO	
Recall	View	Change	Zoom	Tol

NOTE
Press the *change soft key* to change the best-fit algorithm used to calculate the circle if desired. Fit algorithms used by the QC200 for circle are as follows:
- **LSBF: Fit determined by minimizing the sum of the squared point deviation from the form fit.**
- **ISO: Fit determined by minimizing the form (straightness) deviation.**
- **Outer: Yields the biggest circle.**
- **Inner: Yields the smallest circle.**

Press the *view soft key* to return to the circle data screen. Use the *zero axes key* next to the diameter/radius display to toggle the display between diameter and radius.

D/r   0.3953

CIRCLE 4	mm ⌊1 +
X	2.5491
Y	0.9203
D/r	0.3953
Pts=4 F	0.0148
DRO	
Recall	View	Change		Tol

CIRCLE 4	mm ⌊1 +
X	2.5491
Y	0.9203
r /D	0.1977
Pts=4 F	0.0148
DRO	
Recall	View	Change		Tol

Tolerancing

The following tolerances are available on the QC200:

Feature type	Tolerances
Line	Positional (bi-directional, true position) Form (straightness) Perpendicularity Parallelism
Circle	Positional (bi-directional, true position, LMC, MMC) Form Concentricity Runout
Distance	Width
Angle	Angle
Point	Bi-directional True position

NOTE
Use the following example to learn how to perform tolerances with the QC200. See *chapter 3: operation* for complete information.

To perform a true position tolerance on a circle

NOTE
True position tolerancing is shown as RFS (regardless of feature size) tolerancing on QC200 software versions 1.20 - 1.22.

Step 1
Highlight a circle in the features list as shown.

Step 2
Press the *tol soft key*.

Change		Tol

Tolerance soft key

Step 3
Press the *positional tolerance (pos) soft key* to perform a positional tolerance.

Pos	Form	Runout	Con	

Positional tolerance soft key

Step 4
Press the *true position (TP) soft key*.

TP	MMC	LMC	No

True position soft key
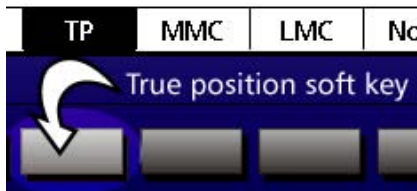
Step 5
Use the numeric keypad to enter the nominal values for X and Y.

CIRCLE 5		mm	1	+

Tolerance: TP

Nominal
X 2.56   Tol. Zone
                 0.0500
Y 0.9046
                 +/-
D 0.4034   +0.0500
             -0.0500

CIRCLE 5		mm	1	+

Tolerance: TP

Nominal
X 2.5600   Tol. Zone
                 0.0500
Y .9
                 +/-
D 0.4034   +0.0500
             -0.0500

NOTE
Until the user enters nominal values, the QC200 displays the actual coordinates in the nominal X and Y fields.

Step 6
Enter the nominal diameter.

```
┌─────────────────────────────────────────┐
│ CIRCLE 5              mm │1│ + │          │
│       Tolerance:     TP                   │
│                                           │
│       Nominal                             │
│   X  2.5600      Tol. Zone                │
│                  0.0500                    │
│   Y  0.9000                                │
│                    +/-                     │
│   D  .4         +0.0500                    │
│                 -0.0500                    │
│                                           │
│                                           │
└─────────────────────────────────────────┘
```

Step 7
Enter the *tol zone* of the circle as shown.

```
┌─────────────────────────────────────────┐
│ CIRCLE 5              mm │1│ + │          │
│       Tolerance:     TP                   │
│                                           │
│       Nominal                             │
│   X  2.5613      Tol. Zone                │
│                  0.0500                    │
│   Y  0.9046                                │
│                    +/-                     │
│   D  0.4034     +                          │
│                 -                          │
│                                           │
│                                           │
└─────────────────────────────────────────┘
```

NOTE
The *tol zone (tolerance zone)* of the circle is the radius within which the center point of the circle must be. If the center point lies outside this radius the tolerance will fail.

Step 8
Select *limits* or +/-.

CIRCLE 5	mm ↓1 ✛
Tolerance:	TP
Nominal	
X 2.5613	Tol. Zone
	0.0500
Y 0.9046	+/-
D 0.4034	+
	-
+/- Limits	

CIRCLE 5	mm ↓1 ✛
Tolerance:	TP
Nominal	
X 2.5613	Tol. Zone
	0.0500
Y 0.9046	Limits
D 0.4034	+
	-
+/- **Limits**	

NOTE

Use the *limits field* to set upper and lower limits on a value. For example, a nominal value of 10.3250 mm might have an upper limit of 10.3260 mm and a lower limit of 10.3240 mm. Select +/- to enter the actual tolerance value. For example, if a part drawing gives a +/- tolerance of 0.05 mm, simply enter 0.05 mm in the plus and minus fields. This example uses +/-.

Step 9
Enter the diameter tolerance (+/-) or limits.

CIRCLE 5	mm ↓1 ✛
Tolerance:	TP
Nominal	
X 2.5613	Tol. Zone
	0.0500
Y 0.9046	+/-
D 0.4034	+ .05
	-

CIRCLE 5	mm ↓1 ✛
Tolerance:	TP
Nominal	
X 2.5613	Tol. Zone
	0.0500
Y 0.9046	+/-
D 0.4034	+ 0.0500
	- .05

Step 10
Press the *finish key.*

finish

The results for the tolerance are displayed as shown. Features that pass the tolerance are displayed with a check mark as shown.

CIRCLE 5	mm ⌐1 ✛
Circle TP Tolerance Results	

	Nominal	Err.Dia.	
X	2.5600		
		0.0096	✓
Y	0.9000		
	Nominal	Dev	
D	0.4000	0.0034	✓

Edit	Nominal	Actual	Err.Dia.	Other

CIRCLE 5	mm ⌐1 ✛

X   **2.5613**
Y   **0.9046**
D/r **0.4034**
Pts=3   F   0.0000

DRO

Recall	View	Change		✓ Tol

Failed features are displayed with a circled X and hollow fonts as shown.

CIRCLE 5	mm ⌐1 ✛
Circle TP Tolerance Results	

	Nominal	Err.Dia.	
X	2.5600		
		0.0096	⊗
Y	0.9000		
	Nominal	Dev	
D	0.4000	0.0034	✓

Edit	Nominal	Actual	Err.Dia.	Other

CIRCLE 5	mm ⌐1 ✛

X   *2.5613*
Y   *0.9046*
D/r **0.4034**
Pts=3   F   0.0000

DRO

Recall	View	Change		⊗ Tol

Chapter 3
Operation

Using the QC200

The QC200 measures features based on point data received from a measuring system. For example, the QC200 measures the diameter/radius of a circle based on a series of points from the crosshairs (or optical edge detector) of an optical comparator.

In general, users simply enter a series of points and the QC200 applies the appropriate geometric calculations to each feature. Use this chapter to learn how to operate the QC200 and maximize its capabilities.

Demonstrations in this chapter use the Metronics 'quickie' slide to demonstrate typical two-dimension (X and Y axes) inspection.
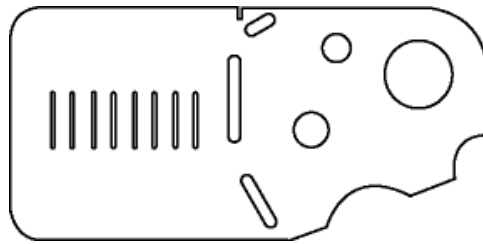
NOTE
Expect variations between the measurement results illustrated in this chapter and actual end user QC200 results. The measurements shown are to demonstrate general operating principles under typical circumstances.

Use the QC200 to perform precise measurements of physical part geometries. Part measurement includes:
*   fixturing and securing the part on the inspection surface
*   compensating for part misalignment in the fixture
*   establishing a datum
*   probing part geometry, collecting points, and applying geometric calcu lations

Getting Started

Read and understand all safety and operating instructions before operating the QC200. To complete the tasks described in this chapter, users must understand the inspection process, the measuring device used, and the controls, indicators, and information presented on the QC200 display.

Safety Reminders

NOTE
Operators are required to understand part fixturing and probing techniques that apply to the measuring device connected to the QC200.

Location and mounting
Mount the QC200 on a stable surface. If it falls, serious damage or injury can result.

Power cord and plug
Do not locate the power cord where it can be walked on or create a tripping hazard. Connect the 3-wire power plug to a 3-wire grounded outlet only. Do not attempt to adapt or remove the 3rd ground wire to fit the plug in 2-wire electrical outlet. Modifying or overriding these features creates a safety hazard and should not be permitted.

Power surge suppressor
Use a high-quality power surge suppressor to limit the amplitude of potentially damaging power line transients caused by electrical machinery or lightning. The surge suppressor found on inexpensive power strips is insufficient to protect the QC200 from damage.

Liquids
Do not spill or splash liquids on the QC200 enclosure.

Checking connections
Perform routine inspections on all connections to the digital readout system. Keep connections clean and tight. Locate cables away from moving objects. Do not create tripping hazards with the power cords and connection cables.

Use shielded cables to connect to the parallel and serial (RS-232) output ports. Make certain cables are properly terminated and firmly connected on both ends.

CAUTION
Never connect the power cable to the QC200 with the power switch in the ON position. Optical edge detector cables may be connected or disconnected without placing the switch in the OFF position.

Configuration & System Setup

Only qualified supervisors and dealer representatives should perform system configuration and setup. Operators should not attempt to alter the configuration of the QC200.

Applying power

Move the power switch located on at the back of the QC200 to the ON position. The system initializes and displays the power-up screen.

Power-up screen

The power-up screen is displayed each time the QC200 is turned on.

Press any key to display the DRO screen. The DRO screen shows the current position of the encoders on each axis.

NOTE
Some encoders require the user to move each axis across a reference mark before the QC200 displays the DRO screen.

Adjusting LCD tilt

Adjust the tilt angle of the QC200 for comfortable viewing. If necessary, loosen the two Allen screws at the base of the enclosure and tilt the QC200 to the desired angle. Tighten the Allen screws so the enclosure is held firmly but can be adjusted again without loosening.

Adjusting LCD contrast

Adjust the LCD contrast for optimum viewing of the DRO screen. Press the *decimal point key* to decrease contrast or the *+/- key* to increase contrast.

Controls & Display

There are several types of keys (buttons) located on the front of the QC200.
- mode selection
- feature selection
- command keys
- soft keys
- fast keys
- arrow keys
- numeric keypad
- display on/off

Mode selection keys

There are four mode selection keys located above the numeric keypad:
- mm/inch
- datum
- polar/Cartesian
- help

mm/inch

Use the mm/inch mode selection key to toggle the display units between milli-meters and inches. The current unit of measure is displayed in the upper right corner of the screen.

Datum

Use the datum mode selection key to toggle between datum 1 and datum 2. The current datum number is displayed in the upper right corner of the screen.

Polar/Cartesian

Use the polar/cartesian mode selection key to toggle between polar and cartesian display coordinates.

X	2.6355	R	2.8597
Y	1.1100	A	22°50'20"
D/r	0.4180	D/r	0.4180

Cartesian coordinates   Polar coordinates

All points probed with the QC200 exist within a coordinate system. Coordinate systems are simply a way of describing the location of a point or points in a given space. More importantly, the coordinate system determines how the QC200 displays measurements.

There are two kinds of coordinate systems used by the QC200: polar coordi-nates and cartesian coordinates. Users can select the coordinate system appropri-ate for their specific application.

Cartesian coordinates describe the locations of points as linear distances from the datum. For example, a point with the coordinates (2,3) is located 2 units from the datum along the X axis and 3 units from the datum along the Y axis.

Polar coordinates describe the locations of points as a radial distance and angle from the datum. For example, a point given as (2, 60 degrees) is located by following a 2 unit radial distance from the datum (pole) at an angle of 60 degrees.

Help

Press the help mode selection key to display help topics on the screen. Help topics explain the how to use the current QC200 function.

Feature selection keys

There are seven feature selection keys located beneath the soft keys on the QC200. Use feature selection keys to measure and calculate features, skew parts, and activate Measure Magic.

NOTE
Use *auto repeat* to perform a series of measurements on a specific feature type. For example, use *auto repeat* for a series of circle measurements. Activate *auto repeat* by pressing the desired feature selection key twice. *Auto repeat* is allowed for point, line, circle, distance, angle, and measure magic measurements.

Point

Press the *point key* once to measure one point, or twice to use *auto repeat* to measure a series of points. One data point is required to measure a point.

Line

Press the *line key* once to measure one line, or twice to use *auto repeat* to measure a series of lines. A minimum of two (max. 100) data points are required to measure a line.

Circle

Press the *circle key* once to measure one circle, or twice to use *auto repeat* to measure a series of circles. A minimum of three (max. 100) data points are required to measure a circle.

Distance

Press the *distance key* once to measure one distance, or twice to use *auto repeat* to measure a series of distances. Two points are required to measure a distance.

Angle

Press the *angle key* once to measure one angle, or twice to use *auto repeat* to measure a series of angles. A minimum of two (max. 100) data points are required to measure each leg of an angle.

Skew

Press the *skew key* to compensate electronically for non-square part alignment.

Measure Magic

Press the *measure magic key* to automatically measure any geometric feature or twice to measure a series of like features. Enter the desired points and measure magic analyzes the data to determine the feature type.

Soft keys

There are five soft keys located beneath the LCD display. Soft keys correspond to the functions that appear above each key at the bottom of the LCD display.
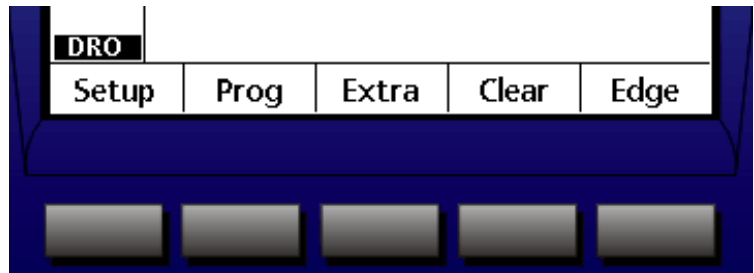
For example, the soft keys above correspond to the setup, program (prog), extra, clear, and edge functions.

Command keys

There are four command keys located beneath the numeric keypad: enter, finish, cancel, and quit.

Enter

Press the *enter key* to enter points during feature measurements. The *enter key* is also used to enter data into input fields such as on a setup screen. See *chapter 7: setup* for more information. In general the enter key indicates that data, from a measurement or in a field, is ready for use. Users typically press the *enter key* to enter each point in a measurement.

Finish

Press the *finish key* to complete feature measurements. Pressing the *finish key* a second time returns the user to the DRO screen. Users typically press the *finish key* after the final point in a measurement is entered.

Cancel

Press the *cancel key* to erase the last point entered. The *cancel key* is also used to erase data in input fields such as on a setup screen or delete any highlighted feature from the feature list.

Quit

Press the *quit key* to abandon the current task and return to the DRO screen. Use the *quit key* to exit the feature list also.

Arrow keys

There are four *arrow keys* located beneath the menu button. Use the *arrow keys* to scroll through lists and navigate menus. The *up arrow key* is the same as the *construction (constr) soft key* when pressed after a feature selection key. For example, press the *circle key* and then the *up arrow key* to construct a circle.

Zero axes keys
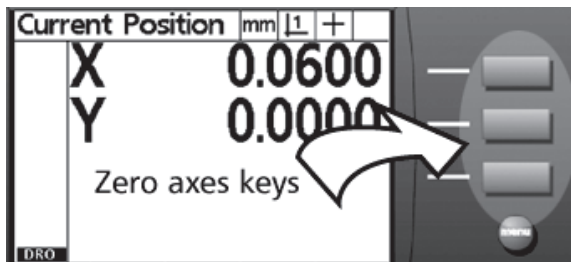
There are three *zero axes keys* located to the right of the LCD display. Press the *zero axis key* adjacent the desired axis to zero it.

Fast track keys
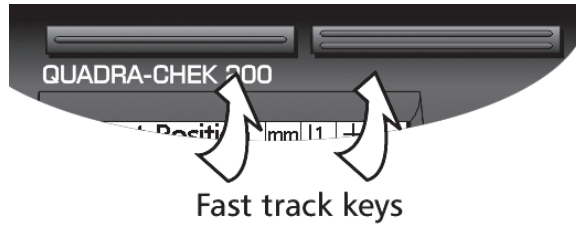
Fast track keys

There are two programmable *fast track keys* located above the LCD display. By default the left *fast track key* is the same as the enter key and the right is the same as the finish key. Users can program either *fast track key* to perform any frequently used functions. These keys are easily located by touch without taking your eyes off the part.

Numeric keypad

Use the numeric keypad to enter numeric data. Additionally, the *decimal point key* and *+/- key* are used to adjust the contrast of the LCD display. For more information on adjusting contrast, see the *system setup & configuration* section of chapter 2.

Send/print

Press the *send/print key* to transmit measurement results to a computer or printer.

LCD on/off
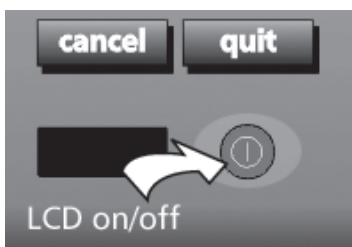
Press the LCD on/off button to shut down the LCD display without removing power from the QC200. Press the button a second time to restore the LCD display.

Menu key

Press the *menu key* to view additional soft key menus. There are five menus to choose from: *setup*, *program (prog)*, *extra*, *clear*, and *edge*. The options contained in each of these menus is discussed in the next section: *menus*.

Menus

Setup menu

Press the setup menu soft key to access the QC200 setup screens.

Setup menu soft key
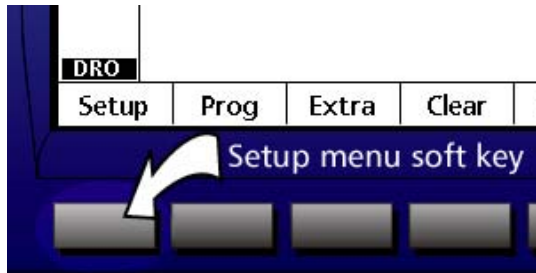
Supervisors and dealer representatives use the setup menu to configure measurement, display, and communication parameters of the QC200. Use the arrow keys to highlight the desired setup screen. In the example below, the *about setup screen* is highlighted. See *chapter 7: setup* for more information about the various setup screens.

NOTE
Setup and system configurations should be changed only by qualified personnel.

Program (prog) menu

Press the program (prog) soft key to access the QC200 program screen.

Program menu soft key
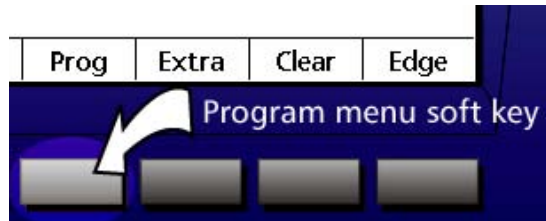
The program menu contains a list of programs created by the user. Programs are prerecorded sequences of key-presses and measurements. Highlight the desired program in the list and press the *run soft key* to run a program.

Programs	mm	1	+	
001				
Record	Run	Edit	Copy	Delete
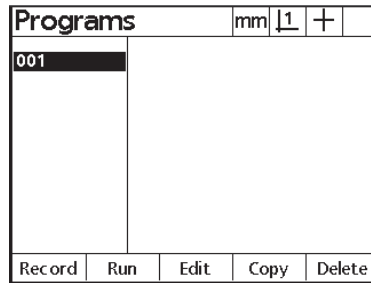
Recording programs is discussed in chapter 4.

Extra menu

Press the *extra soft key* to display the extra menu.

Prog	Extra	Clear	Edge
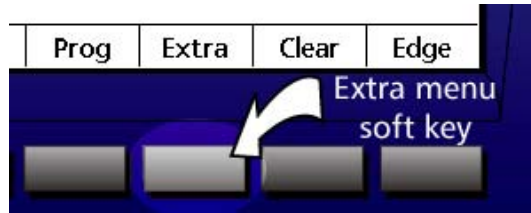
Extra menu
soft key

The extra menu contains a list of additional functionality. Use the up and down arrow keys to highlight items in the extra menu list. Press the *enter key* to select the highlighted item. A brief explanation of each function is given below.
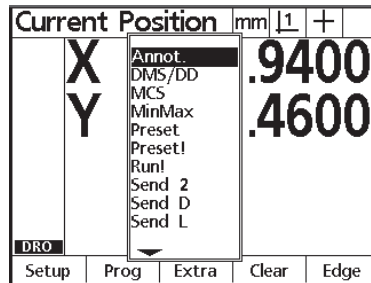
Current Position	mm	1	+	
X	Annot.		.9400	
Y	DMS/DD		.4600	
	MCS			
	MinMax			
	Preset			
	Preset!			
	Run!			
	Send 2			
	Send D			
	Send L			
DRO				
Setup	Prog	Extra	Clear	Edge

Annot
Highlight *annotation (annot)* in the menu list to toggle between backward and forward annotation.

DMS/DD
Toggles the display of angles between degrees, minutes and seconds and decimal degrees.

MCS
Highlight *MCS* to clear datums and re-establish machine coordinates.

NOTE
Previous datums cannot be recovered once machine coordinates are re-established.

MinMax
Highlight *MinMax* to collect minimum and maximum point values until the *finish key* is pressed. Use *MinMax* for touch-probe measurements of runout.

Preset
Highlight *preset* to preset an axis or axes to a desired feature or location. Use the preset function to measure features that are datumed on another part. Typically this is required for component parts of larger assemblies. Another use for the preset function is to find the offset between the nominal and actual location of a preset feature.

Preset!
Sets the axis or axes to the last entered preset location.

Run! (run last program)
Highlight *run!* to run the last program again.

NOTE
All send data menu items send data to the RS-232 port. These commands do not send data through the parallel port.

Send 2
Select *send 2* to send the current X and Y axes data to a printer or computer.

Send D
Select *send D* to send the current diameter data to a printer or computer.

Send L
Select *send L* to send the current length data to a printer or computer.

Send r
Select *send r* to send the current radius data to a printer or computer.

Send X
Select *send X* to send the X axis data to a printer or computer.

Send Y
Select *send Y* to send the Y axis data to a printer or computer.

Send <
Select *send <* to send angle measurement data to a printer or computer.

Time
Displays the current date and time.

Zero 2
Zeroes both X and Y axes in the current datum.

Clear menu

Press the *clear menu soft key* to display the clear function soft keys.

Press the *clear feature (clr ft) soft key* to erase all features from the feature list. Press the *clear skew (clr sk) soft key* to erase all skew features from the system. Press the *clear all (clr all) soft key* to erase features and skews from the system.

Edge menu

Pressing the *edge soft key* to display the edge detector soft keys.

p	Prog	Extra	Clear	Edge

Edge menu soft key

There are five edge detector soft keys:

Current Position	mm	⊥1	+	

X   1.9400
Y   1.4600

DRO

Teach	D. Cal	Install	X Cal	Auto E

Teach
Use the *teach soft key* to 'teach' the edge detector to recognize light-to-dark or dark-to-light transitions.

D cal
Distance calibrations (*d cal) are* performed by supervisors or dealer representatives during the installation of edge detector systems. Users should not use the *d cal soft key* unless directed to by qualified personnel.

Install
Supervisors and dealer representatives use the *install soft key* to install the edge detector system. Users should not use the *install soft key* unless directed to by qualified personnel.

X cal
Cross calibrations (*x cal) are* performed by supervisors or dealer representatives during the installation of edge detector systems. Users should not use the *x cal soft key* unless directed to by qualified personnel.

Auto e
Use the *auto e soft key* to toggle auto edge detection on and off when edge detection is used in place of crosshairs.

LCD screens

The *digital readout (DRO) screen* shows the location of the axes prior to measuring a feature.

Once the feature is measured there are two basic types of screens displayed by the QC200: *data screens* and *graphic screens*.

Data screen   Graphic screen

Both data and graphic screens are associated with a feature. For example, there are *circle data screens* and *circle graphic screens* as shown above.

Screens displayed when probing or constructing features are referred to by their respective titles. For example, there are *probe angle* and *construct point screens*.

DRO screen

The DRO screen shows the current positions of axes, current units (mm/inch), current datum, current probe (crosshair or edge detector), and the feature list. Soft key assignments may or may not be shown across the bottom of the screen.

```
┌─────────────────────────────────┐
│Current Position │mm│⊥1│ + │     │
│      X        0.0000             │
│      Y        0.0000             │
│                                 │
│                                 │
│                                 │
│ ■DRO                            │
│ Probe │ Teach │    │    │       │
└─────────────────────────────────┘
```

Data screens

Data screens display numeric feature data. Information on data screens includes feature type, number, polar or cartesian coordinates, number of points probed, and form (f) value.

```
┌─────────────────────────────────┐
│CIRCLE 1        │mm│⊥1│ + │       │
│ ○  1  X        1.7658            │
│       Y        0.8070            │
│       D/r      0.1732            │
│      Pts=4    F      0.0079      │
│ DRO                             │
│ Recall │ View │ Change │  │ Tol │
└─────────────────────────────────┘
```

There are four soft keys displayed on a data screen: *recall*, *view*, *change*, and *tolerance (tol)*.

Press the *recall soft key* to view the data screen of another feature.
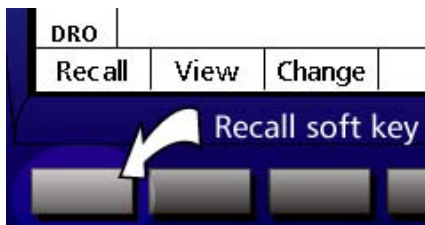
Press the *view soft key* to toggle the screen between data and graphic screens.
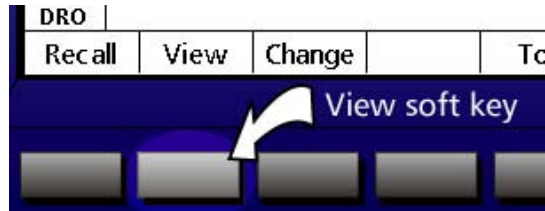
Press the *change soft key* to select the desired algorithm used to calculate the feature.
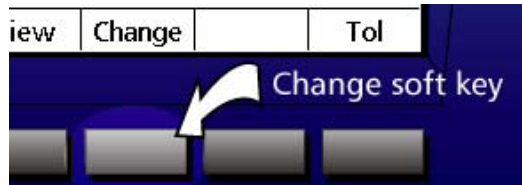
Press the *tolerance (tol) soft key* to perform a tolerance on the feature.

Graphic screens

Graphic screens display a graphic feature and numeric data. Information on graphic screens includes the data points measured and the best-fit geometry calculated for those points.

Numeric data displayed on graphic screens is identical to the data screen. Additional information includes form values and the algorithm used to calculate the feature.

There are five soft keys displayed on a graphic screen: *recall*, *view*, *change*, *zoom*, and *tolerance (tol)*.

Press the *recall soft key* to view the data screen of another feature.
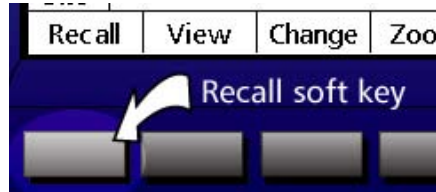
Press the *view soft key* to toggle the screen between data and graphic.
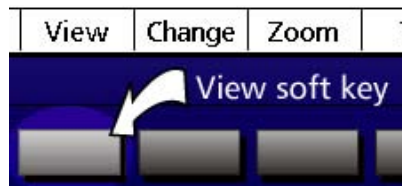
Press the *change soft key* to select the desired algorithm used to calculate the feature.

NOTE
Features measured with the minimum required points are calculated using LSBF only. No other algorithm can be chosen. Additional points are required to calculate with any other algorithm.

NOTE
Features measured with measure magic have different *change soft key* options. For example, press the *change soft key* to change the type of feature from line to circle.
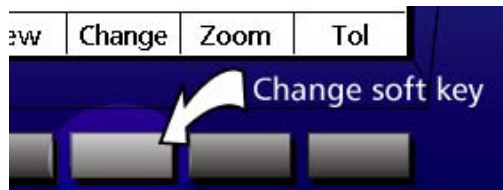
Press the *zoom soft key* to zoom in/out of the graphic feature image.
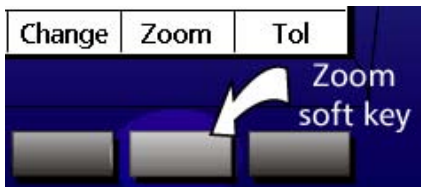
Press the *increase (inc) soft key* to zoom in on the graphic feature image. Press the *decrease (dec) soft key* to zoom out.

Press the *tolerance (tol) soft key* to perform a tolerance on the feature.

Features

Features consist of data points obtained by probing the geometry of the part. For example, several points probed along the perimeter of a circle generate a graphic and numeric representation of the measured circle geometry. In this guide, a measured geometry is referred to as a *feature*. Features are displayed graphically or numerically on the QC200. There are several types of features and each has different distinguishing information. For example, a circle has a center and a radius, a point has a location, and an angle has degrees.

Features list

Each feature is added to the *features list* when it is measured. The features list is simply a listing of all features measured in a given session. It is displayed on the left-hand side of the LCD screen and is visible in DRO and measuring modes. Features are identified by number and an icon indicating its type (i.e. circle, line, etc.). Up to 200 features can be added to the features list. Use the up and down arrow keys to scroll through the list. Highlight the desired feature to recall, print, or send the feature data to a computer. Select features from the features list to construct new features. Users can also delete individual features or the entire list. In general, the user should delete old features, datums, and skews from the features before each new inspection.

Probing Features

There are two probing methods used to collect data points for the QC200: crosshairs and optical edge detection. To collect points using crosshairs, align the crosshairs over the desired point and press the *enter key*. Optical edge detection takes points at light-to-dark (or dark-to-light) transitions. When an edge is crossed the QC200 beeps. Press the *enter key* to accept the point. Systems equipped with auto-edge detection enter points automatically when an edge is detected.

NOTE
This guide refers to the process of measuring points as *probing points* or *measuring features* regardless of the probing method used.

Probing Technique

Probe features with crosshairs or optical edge detection. Align crosshairs on the desired point and press *enter* to take points. The crosshair probe indicator appears on the upper right corner of the LCD as shown.

Optical edge detection requires the user to 'teach' the system to detect dark-to-light or light-to-dark changes in order to find an edge and take points. QC200s equipped with optical edge detection display *probe* and *teach* soft key commands at the bottom of the LCD. Press the *probe* soft key to toggle between crosshair and edge detection.

To select optical edge/ crosshair probe

Step 1
Press the *probe soft key.*
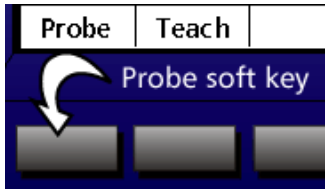
The auto edge detection icon is shown on the left and the crosshair icon is on the right. The icon displayed indicates the current selection.

To toggle between auto edge and manual edge detection

Step 1
Press the *menu key.*

Step 2
Press the *edge soft key.*
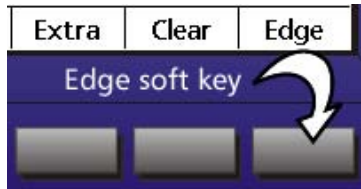
Step 3
Press the *auto edge (auto e) soft key.*

The auto edge detection icon is shown on the left and the manual edge detection icon is on the right. The icon displayed indicates the current selection.

Backward/forward annotation

Use forward annotation to require a specified number of points for each feature type. Use backward annotation to allow the operator to determine the number of points. When using forward annotation, the number of required points is shown on the top left corner of the screen. As points are entered the number counts down. Backward annotation displays the number of points as they are entered. Some users prefer forward annotation because it sets 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 points. Since the QC200 expects a certain number of points using forward annotation the system automatically displays the feature after the last required point is entered. It is not necessary to press the *finish key* in forward annotation measurements.

NOTE
Operators can toggle between backward and forward annotation with the procedure below. Use the *measure setup screen* to set the required number of points for forward annotation. See *chapter 7: setup* for more information.

To select backward/forward annotation

Step 1
Press the *menu key*.

Step 2
Press the *extra soft key*.

Step 3
Use the arrow keys to highlight *annot* (annotation) in the list as shown.

| Current Position | mm | 1 | + |

```
Current Position  mm 1 +
   X  | Annot.    |.0000
      | DMS/DD    |
      | MCS       |
   Y  | MinMax    |.0000
      | Preset    |
      | Preset!   |
      | Run!      |
      | Send 2    |
      | Send D    |
      | Send L    |
 DRO
 Setup | Prog | Extra | Clear | Edge
```

Step 4
Press the *enter key*.

Forward annotation displays the required number of points as shown.

NOTE
This example of forward annotation required four points. For space reasons the measuring sequence is shown from three points. The total number of points is given on the last screen.

```
Probe Circle    mm 1 +
Pts   X    1.8444
Req
3     Y    1.5500
 DRO
 Probe | Recall | Create
```

```
Probe Circle    mm 1 +
Pts   X    2.1556
Req
2     Y    1.5300
 DRO
 Probe | Recall | Create
```

```
Probe Circle    mm 1 +
Pts   X    1.9778
Req
1     Y    1.4400
 DRO
 Probe | Recall | Create
```

```
CIRCLE 1        mm 1 +
  1   X    2.6890
      Y    0.8760
      D/r  0.8295
    Pts=4   F   0.0018
 DRO
 Recall | View | Change | | Tol
```

Backward annotation displays the number of points as they are taken.

Probe Circle	mm 1 +
Pts 0	X 0.0000
	Y 0.0000
DRO	
Probe	Recall	Create		

Probe Circle	mm 1 +
Pts 1	X 2.5333
	Y 1.5500
DRO	
Probe	Recall	Create		

Probe Circle	mm 1 +
Pts 2	X 2.0444
	Y 1.5300
DRO	
Probe	Recall	Create		

Probe Circle	mm 1 +
Pts 3	X 1.6000
	Y 1.5300
DRO	
Probe	Recall	Create		

If a feature requires a few additional points to ensure accuracy, press the bottom zero axis key to increase the required number of points for that measurement. Increasing the required points with the zero axis affects only the current measurement. Subsequent measurements will require the number of points defined on the measure setup screen. See chapter 7: setup for more information.

To increase the required number of points (forward annotation only)

Step 1
Press the desired feature selection key.

NOTE
This example shows a circle measured with forward annotation but the basic procedure is the same for any feature measured with forward annotation.

Step 2
Press the bottom zero axis key as shown.

The number of required points increases by one for each key press.

Begin the measurement when the desired number of required points is set.

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Skewing the part

Accurate measurements require the part to be perfectly aligned on the coordinate measuring system. An imperfectly aligned part yields inaccurate measurements. Use the skew function to convert machine coordinates to part coordinates and compensate for part misalignment. Measure a skew each time a new part is mounted on the measuring system.

Measure a skew line by probing a straight edge of known orientation. Use a minimum of 2 points and a maximum of 100 when probing the line. Remember that more points means greater accuracy.

Construct a skew line from previously measured features.   For example, construct a skew line using two circles. Keep in mind that the more points probed on features used in the construction of a skew line, the greater the accuracy.

NOTE
Place the part within 45 degrees of the measuring machine's true orientation.

To skew a part

Step 1
Press the *skew key*.

Step 2
Probe the first point as shown.

Step 3
Press the *enter key*.

Step 4
Probe two more points along the line. Press the *enter key* after each point.

The skew data screen is displayed and the skew is added to the feature list. Small skew icons are displayed next to the X and Y axes display. Press the *view soft key* for a graphic representation of the point feature. Press the *view soft key* a second time to return to the skew data screen.

Step 5
Press the *finish key*.

The part is now compensated for mechanical misalignment. This compensation is applied to all subsequent measurements of the part.

Datum

All measurements are relative to a datum. A datum is the zero point or origin of the coordinate system. Establish a datum once the part is skewed. The simplest way to establish a datum is to zero the X and Y axes on a point. In the example below, the skew line and a second line are used to construct a point. Both axes (X and Y) are zeroed on that point which then becomes the datum. Datum points can be constructed from the center point of a circle or any other construction that produces a point. Generally the datum, or the features used to construct the datum, are called out on a part drawing.

The QC200 allows users to construct two reference datums for measurements. Datum 1 is the original datum and datum 2 is a temporary reference frame useful for incremental measurements. Use datum 2 for incremental measurement while maintaining the position of datum 1. For example, obtain the incremental distance (X axis travel) of a series of features. Probe a point on the first feature and establish it as datum 2. Place the crosshairs on the next feature in the series and measure a point. The X axis displays the distance from the first feature to the second. Now establish datum 2 on the point on the second feature. Place the crosshairs on the third feature and measure a point. The X axis now displays the distance from the second feature to the third. Continue in this fashion until the entire series measured.

To construct a datum

Steps 1 through 3 measure a second line. This line and the skew line will be used to construct a point.

Step 1
Press the *line key*.

Step 2
Probe a minimum of two points along the line as shown. Press the *enter key* after each point.

Step 3
Press the *finish key*.

The result is displayed as shown.

Steps 4 through 9 construct a point from *line 2* and *skew 1*. See *chapter 3: operation* for more information about constructions.

Step 4
Press the *point key.*

Step 5
Press the *constr (construct) soft key.*

Step 6
Use the arrow keys to highlight line 2 as shown.

Step 7
Press the *enter key.*

A check mark appears next to the line 2 in the feature list and line 1 is now highlighted.

```
Construct Point  mm |1 +
✓━1 X        0.0000
  2 Y        0.0000
    ⊿      0°00'00"
    Pts=3   F     0.0000
DRO
    Recall | View | Probe
```

NOTE
In this example, skew 1 is the next feature for the construction so it is not necessary to move the cursor to select the next feature. Occasionally, the user needs to use the arrow keys to highlight the next feature for a construction. In this case the next desired feature happens to be highlighted already.

Step 8
Press the *enter key.*

Step 9
Press the *finish key.*

The constructed point appears in the feature list and is highlighted.

```
POINT 3         mm |1 +
 ⟋━1 X       -0.9889
   2 Y        0.0000
●━3
    Fts=2
DRO From 2,1
Recall | View | Change |    | Tol
```

Step 10 zeros the X and Y axes on the newly constructed point. Use the *zero axes keys* to establish a datum on any point feature.

Step 10
Press the *zero X and zero Y axis keys*.
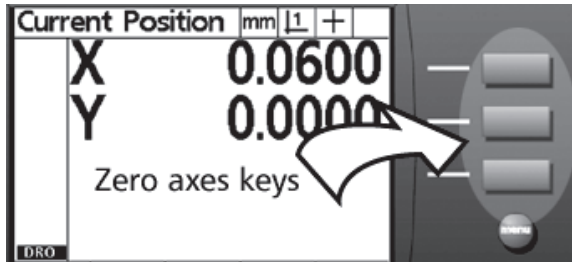
When both axes are zeroed the screen appears as shown.
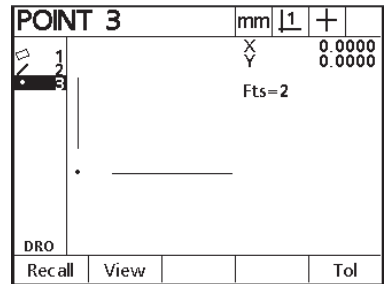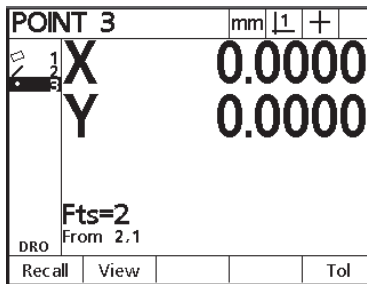
The datum is complete.

Measuring Features

Use the measurement procedures in this section to measure points, lines, circles, angles, and distances. To measure a feature, press the desired feature selection key, probe the required points, and press the *finish key*. For example, to measure a circle press the *circle key,* probe a minimum of three points, and press the *finish key*.

Use *auto repeat* to measure several features of the same type (such as a series of lines). Press the desired feature selection key twice to activate auto repeat. For example, press the *circle key* twice to measure a series of circles. When auto repeat is selected the *probe feature screen* becomes the *probe features screen*. For example, the *probe circle* and *probe circles* screens are shown below.

Use *auto repeat* and *forward annotation* to speed up repetitive inspections. For example, an inspection of a dozen circles requires the user to press the *circle key* before measuring each circle and press the *finish key* for *each* measurement. The same inspection using *auto repeat* and *forward annotation* requires the user to press *circle key* twice before and the *finish key* once after measuring *all 12* circles. Pressing the *finish key* turns off auto repeat.

Measuring points

Points are the simplest features to probe. Only one point is required to define the location. A maximum of two points can be probed to measure a single point. The QC200 averages the points to produce the resulting point feature.

To measure a point

Step 1
Press the *point key*.

NOTE
Press the *point key* twice to measure a series of points using *auto repeat*.

Step 2
Probe the first point as shown.

Step 3
Press the *enter key*.

Step 4
Press the *finish key*.

The point feature data is displayed on the screen and added to the feature list. Press the *view soft key* for a graphic representation of the point feature.

Measuring lines

The QC200 allows the user to probe up to 100 points while measuring a line. A minimum of two points are required to measure a line. Use more points for greater accuracy. A best-fit algorithm is applied to lines with more than two points to determine location. The resulting *F (Form) value* is included in the feature data.

To measure a line

Step 1
Press the *line key*.

NOTE
Press the *line key* twice to measure a series of lines using *auto repeat*.

Step 2
Probe the first point as shown.
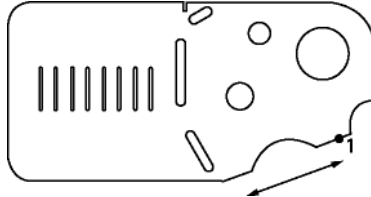
Step 3
Press the *enter key*.

Step 4
Probe two more points along the line. Press the *enter key* after each point.
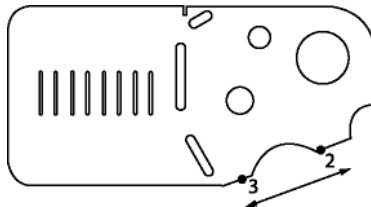
The display shows the points as they are entered.

Probe Line	mm |1 +
Pts 2	X -0.2300
1 2 3	Y 0.0000
DRO	
Probe	Recall	Create	Constr

Probe Line	mm |1 +
Pts 3	X 0.5300
1 2 3	Y 0.0100
DRO	
Probe	Recall	Create	Constr

Step 5
Press the *finish key*.

The line feature data is displayed on the screen and added to the feature list.
Press the *view soft key* for a graphic representation of the line feature.

LINE 4	mm |1 +
1 2 3 4	X 0.7602
	Y -0.6256
	A 19°48'10"
	Pts=3
	F 0.0022
	LSBF
DRO	
Recall	View	Change	Zoom	Tol

NOTE
Press the *change soft key* to change the best-fit algorithm used to calculate the line if desired. Fit algorithms used by the QC200 for lines are as follows:
- **LSBF: Fit determined by minimizing the sum of the squared point deviation from the form fit.**
- **ISO: Fit determined by minimizing the form (straightness) deviation.**

Press the *view soft key* to return to the line data screen.

Measuring circles

A minimum of three points are required to measure a circle. The QC200 allows the user to probe up to 100 points for circle measurements. Use more points for greater accuracy. A best-fit algorithm is applied to circles with more than three points. The resulting *F (Form) value* is included in the feature data.

To measure a circle

Step 1
Press the *circle key*.

NOTE
Press the *circle key* twice to measure a series of circles using *auto repeat*.

Step 2
Probe the first point as shown.

The X and Y coordinates are displayed as shown.

Step 3
Press the *enter key*.

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Step 4
Probe three more points along the edge of the circle. Press the *enter key* after each point.

NOTE
Space points approximately 90 to 120 degrees apart for best results.

The X and Y coordinates are displayed after each point as shown. Only points three and four are shown for space reasons.

Step 5
Press the *finish key*.

The circle feature data is displayed on the screen and added to the feature list. Press the *view soft key* for a graphic representation of the circle feature.

NOTE
Press the *change soft key* to change the best-fit algorithm used to calculate the circle if desired. Fit algorithms used by the QC200 for circle are as follows:
- **LSBF: Fit determined by minimizing the sum of the squared point deviation from the form fit.**
- **ISO: Fit determined by minimizing the form deviation.**
- **Outer: Yields the biggest circle.**
- **Inner: Yields the smallest circle.**

Press the *view soft key* to return to the circle data screen. Use the *zero axes key* next to the diameter/radius display to toggle the display between diameter and radius.

Measuring distances

Distances are actually relationships between two features. Two points are required to measure a distance. Users can probe two points to measure a distance but it is more common to construct a distance from previously measured features. For example, the distance between two circles. Measuring a distance by probing two points follows essentially the same as measuring a line. Since real life applications tend to require distances between previously measured features, this example shows how to *construct* a distance from two circles. See the *constructions* section of this chapter for more details.

NOTE
Make sure there are two circles in the features list before attempting this demonstration.

To construct a distance between two circles
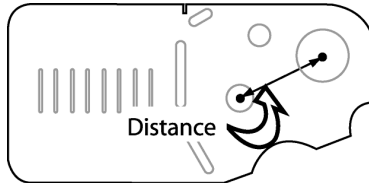
Distance

Step 1
Press the *distance key*.

Step 2
Use the arrow keys to highlight the first circle in the features list as shown.

Step 3
Press the *enter key*.

Step 4
Highlight the second circle in the features list as shown.

Step 5
Press the *enter key*.
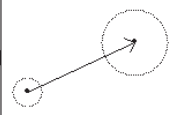
Step 6
Press the *finish key*.

The distance feature data is displayed on the screen and added to the feature list. The distance results screen displays the length of the distance as *L* and shows the distance traveled by the X and Y axes. Press the *view soft key* for a graphic representation of the distance feature.

Notice the information displayed beneath the length result. The number of features used in the construction is shown as: *Fts = 2*. This means that two features were used in the current construction. Beneath the number of features is a line that reads: *From 5,4*. This means that *features 5* and *4* from the features list were used in the current construction.

Measuring angles

Angles are measured by probing points on the two lines (legs) that make up the angle. Up to 100 points can be probed on each line. A minimum of two points (per leg) is required. Use more points for greater accuracy. When more than two points are probed on any line, a best-fit algorithm determines the location of the line and a *form (F) value* is calculated the line. Angles can also be constructed from previously measured features.

To measure an angle

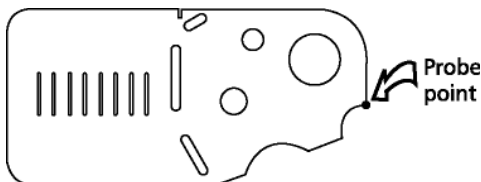Steps 1 through 5 measure the first leg of the angle.

Step 1
Press the *angle key*.

NOTE
Press the *angle key* twice to measure a series of angles using *auto repeat*.

Step 2
Probe the first point as shown.

Probe Angle	mm	|1	+
Pts Req 1	X	0.0700
	Y	0.5100
DRO		
Probe	Recall	Create

The *probe angle screen* is displayed as shown.

Probe Angle	mm	|1	+
Pts Req 1	X	0.0700
	Y	0.5100
DRO		
Probe	Recall	Create

Step 3
Press the *enter key*.

Step 4

Probe the second point as shown in step 2. Press the *enter key* to enter the point.

Step 5

Press the *finish key*.

The first leg of the angle is displayed in the features list as shown.

Steps 6 through 9 measure the second leg of the angle and complete the angle measurement.

Step 6

Probe the first point on the second leg as shown.
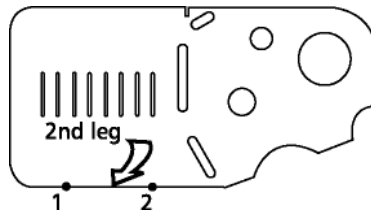
The *probe angle screen* is displayed as shown.

Step 7
Press the *enter key*.

Step 8
Probe the second point on the second leg as shown in step 6. Press the *enter key* to enter the point.

Step 9
Press the *finish key*.

The angle feature data is displayed on the screen and added to the feature list. Press the *view soft key* for a graphic representation of the angle feature.

Press the change soft key to select a different angle result. There are four possible results from any angle measurement. The included angle is the default result. Use the illustration below to help you choose the desired angle result.
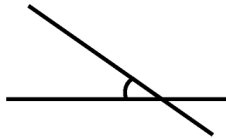
Included angle < 180 degrees
Included (incld) softkey
default
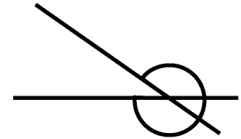
360 degrees - included angle
360-A1 softkey
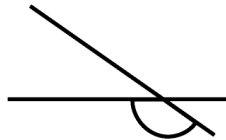
180 degrees - included angle
180-A1 soft key
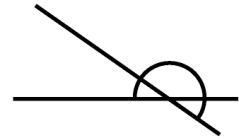
180 degrees + included angle
180+A1 soft key

The illustrations below show how the different angles appear on the screen.

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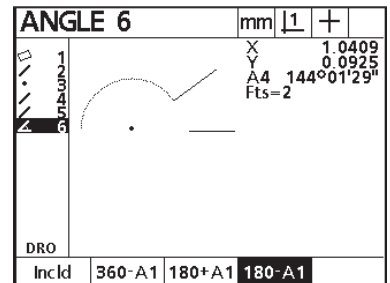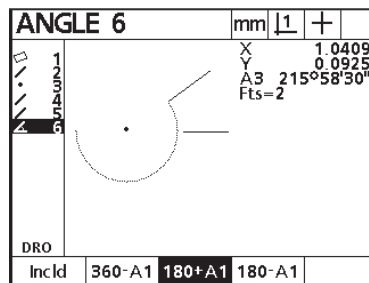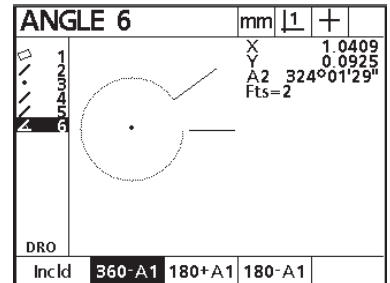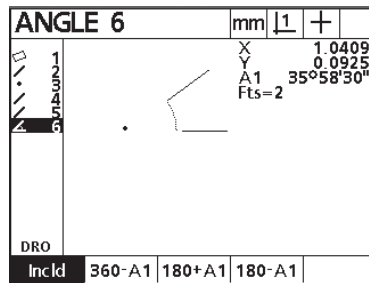
Using Measure Magic

Measure magic is a time saving feature that recognizes the geometric pattern of data points. Use measure magic to automatically measure point, line, and circle features. To use measure magic, press the *measure magic key*, probe the desired points, and press the *finish key*. Measure magic analyzes the points and calculates the desired feature.

Probe additional points on each feature to get the best results when using measure magic. It also helps to space the points evenly around the feature geometry. Sound probing and inspection technique ensures accurate results from *measure magic*.

Use *auto repeat* and *measure magic* to measure a series of features of any type. For example, use *auto repeat* and *measure magic* to measure a point, a line, and a circle. Using measure magic, the operator can quickly move from one feature to the next. Simply enter the points, press the *finish key*, and move on to the next feature.

Press the *measure magic key* twice to activate *auto repeat*. When auto repeat is selected the *probe feature screen* becomes the *probe features screen* as shown below.

Probe Feature	mm ↓1 +		Probe Features	mm ↓1 +
Pts 0	X 1.7111		Pts 0	X 1.7111
	Y 1.2500			Y 1.2500
DRO			DRO	
Probe			Probe	

Use *auto repeat* and *measure magic* to speed up inspections. For example, an inspection of a variety of point, line, and circle features. Even inspections with distances and angles can be sped up with *measure magic*. Simply measure point, line, and circle features with *measure magic* and use them to construct the required angles and distances.

To measure a circle using *measure magic*

NOTE
This demonstration shows how to use measure magic to measure a circle. Follow the same basic steps to measure points or lines. Simply probe the desired feature points for a line or point instead of a circle.
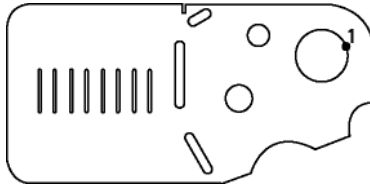
Step 1
Press the *measure magic key*.

NOTE
Press the *measure magic key* twice to measure a series of circles using *auto repeat*.
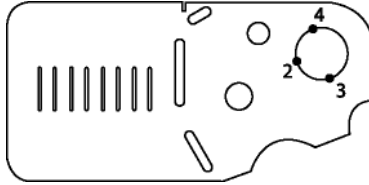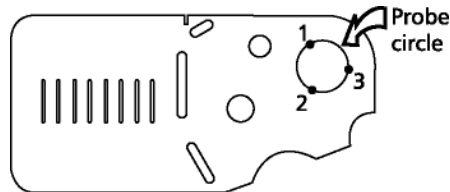
Step 2
Probe the first point.

The X and Y coordinates are displayed as shown.

Step 3
Probe the second point as shown in step 2. The X and Y coordinates are dis-played as shown.

```
Probe Feature    mm |1 +
Pts  X      2.5400
1    Y      1.0300



DRO
Probe
```

Step 4
Probe the third point as shown in step 2. The X and Y coordinates are displayed as shown.

```
Probe Feature    mm |1 +
Pts  X      2.1900
2    Y      1.0600



DRO
Probe
```

NOTE
Up to 100 points can be probed when using measure magic to measure circle features. A minimum of three points is required. Probe additional points for greater accuracy.

Step 4
Press the *finish key.*

The circle feature data is displayed on the screen and added to the feature list.

```
┌──────────────────────────────────────┐
│ CIRCLE 1              mm  ⊥1  ✛       │
│ ⊙━━1 X        2.3689                  │
│      Y        1.1168                  │
│      D/r      0.3793                  │
│      Pts=3    F       0.0000          │
│ DRO                                   │
│ Recall │ View │ Change │    │  Tol    │
└──────────────────────────────────────┘
```

Press the *view soft key* for a graphic representation of the circle feature.

```
┌──────────────────────────────────────┐
│ CIRCLE 1              mm  ⊥1  ✛       │
│ ⊙    1            X      2.3689       │
│                   Y      1.1168       │
│                   D      0.3793       │
│                   Pts=3              │
│                   F      0.0000       │
│                   LSBF                │
│                                       │
│ DRO                                   │
│ Recall │ View │ Change │ Zoom │ Tol   │
└──────────────────────────────────────┘
```

To measure a series of features using *measure magic* and *auto repeat*

Step 1
Press the *measure magic key* twice.

The *probe features screen* is displayed as shown.

Steps 2 and 3 measure a point.

Step 2
Probe the desired point as shown.
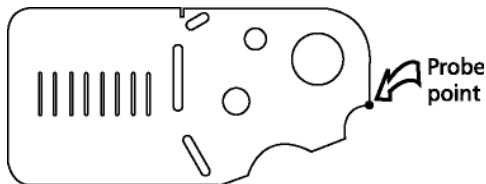
NOTE
Enter only one point when using measure magic to measure point features.

The *probe features screen* is displayed as shown.

Step 3
Press the *finish key*.

The point appears in the features list and the *probe features screen* is displayed as shown.

Steps 4 through 6 measure a line.

Step 4
Probe the first point as shown.
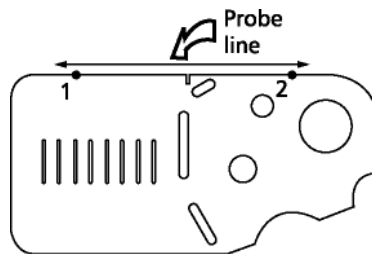
The *probe features screen* is displayed as shown.

```
┌─────────────────────────────────┐
│Probe Features   mm 1 +          │
│Pts  X      0.5222               │
│1                                │
│·   1 Y      1.4900              │
│                                 │
│                                 │
│                                 │
│ DRO                             │
│ Probe │     │     │     │       │
└─────────────────────────────────┘
```

Step 5
Probe the second point as shown in step 4. The *probe features screen* is displayed
as shown.

```
┌─────────────────────────────────┐
│Probe Features   mm 1 +          │
│Pts  X      2.4667               │
│2                                │
│·   1 Y      1.4900              │
│                                 │
│                                 │
│                                 │
│ DRO                             │
│ Probe │     │     │     │       │
└─────────────────────────────────┘
```

NOTE
**Up to 100 points can be probed when using measure magic to
measure line features. A minimum of two points is required.
Probe additional points for greater accuracy.**

Step 6
Press the *finish key*.

The line appears in the features list and the *probe features screen* is displayed as
shown.

```
┌─────────────────────────────────┐
│Probe Features   mm 1 +          │
│Pts  X      2.3778               │
│0                                │
│⸝   2 Y      1.5500              │
│                                 │
│                                 │
│                                 │
│ DRO                             │
│ Probe │     │     │     │       │
└─────────────────────────────────┘
```

Steps 7 through 10 measure a line.

Step 7
Probe the first point.
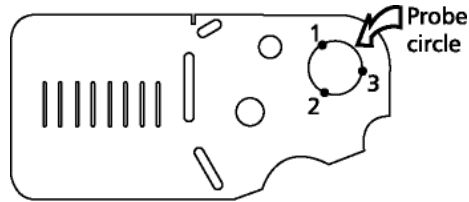
The X and Y coordinates are displayed as shown.

Step 8
Probe the second point as shown in step 7. The X and Y coordinates are displayed as shown.

Step 9
Probe the third point as shown in step 7. The *probe features screen* is displayed as shown.

```
Probe Features   mm |1 +
Pts X      2.8556
3
     Y      1.0600
;   1
    2

DRO
Probe
```

NOTE
Up to 100 points can be probed when using measure magic to measure circle features. A minimum of three points is required. Probe additional points for greater accuracy.

Step 10
Press the *finish key*.

The circle appears in the features list and the *probe features screen* is displayed as shown.

```
Probe Features   mm |1 +
Pts X      1.8889
0
     Y      1.4400
;   1
    2
    3

DRO
Probe
```

Step 11
Press the *finish key*.

The measurement series is complete.

Changing feature types

Occasionally, measure magic produces a different feature than the user intends. This is usually the result of unevenly spaced points. For example, measure magic might recognize three points but not be able to tell if the user intended a line or a circle. In that case, the QC200 measures the most likely of the two features.

Use the *change soft key* to change the feature type. Alternative feature types are displayed across the bottom of the LCD as soft keys. Press the desired feature type soft key to change the feature.

To change a feature type

Step 1
Highlight the feature in the features list as shown.

NOTE
Press the *view soft key* to see a graphical view of the feature.
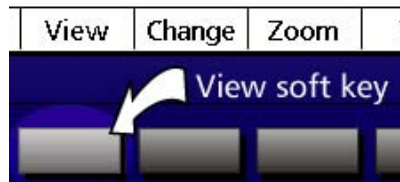
Step 2
Press the change soft key.
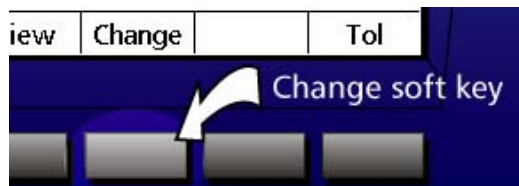
Step 3
Press the desired soft key to change the feature.
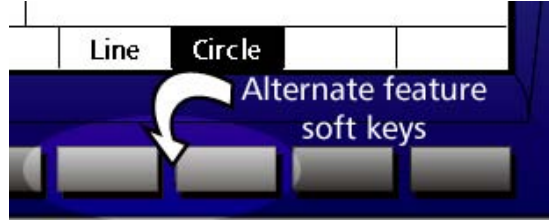
The feature is changed from a line to a circle as shown.

NOTE
In this example, graphic view screens are shown to illustrate the various geometries that can result from uneven spacing of points. Here, the user intended a circle but measure magic produced a line because two of the points were spaced close together. The *change soft key* **was used to produce the resulting circle.**

Creating Features

It is sometimes useful to create features that are not found on the part geometry. Created features are often used as reference points for inspection purposes. For example, a feature on a part might be referenced to a point off the part geometry. In that situation, the user needs to create the reference point.

Users can create points, lines, circles, distances, angles, and part skews. Created features are the same as probed features except that the created features are geometrically perfect. Form and tolerance values are not included in the feature data for created features since they are geometrically perfect.

It is important to understand that created features are not the same as constructed features. Created features are defined by the user. For example, to create a circle, the user defines the location of the center point and the size of the diameter or radius. Constructed features are built from previously measured features. For example, to construct a line the user selects two points (or other suitable features) from the features list. The QC200 then constructs the line from the points (or other features).

To create a point

Step 1
Press the *point key*.

Step 2
Press the *create soft key*.
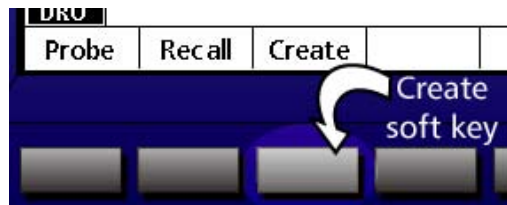
Step 3
Use the numeric keypad to enter the X and Y coordinates of the point.

```
Create Point        mm |1 +
              Position
            X 1.00
            Y 1.00
```

Step 4
Press the *finish key*.

The point feature data is displayed on the screen and added to the feature list.

```
POINT 1             mm |1 +
    1  X      1.0000
       Y      1.0000

       Created
DRO
Recall   View              Tol
```

Press the *view soft key* for a graphic representation of the point feature.

```
POINT 1             mm |1 +
    1              X      1.0000
                   Y      1.0000
                   Created



DRO
Recall   View              Tol
```

To create a line

Step 1
Press the *line key*.

Step 2
Press the *create soft key*.
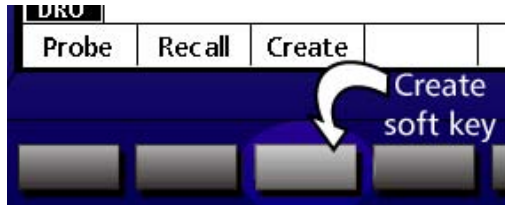
Step 3
Use the numeric keypad to enter the point coordinates for the first point.

Step 4
Enter the desired angle.

Step 5
Press the *finish key*.
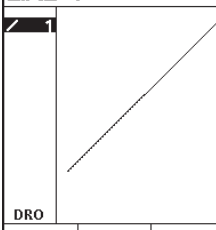
The line feature data is displayed on the screen and added to the feature list.

Press the *view soft key* for a graphic representation of the line feature.

To create a circle

Step 1
Press the *circle key*.

Step 2
Press the *create soft key*.
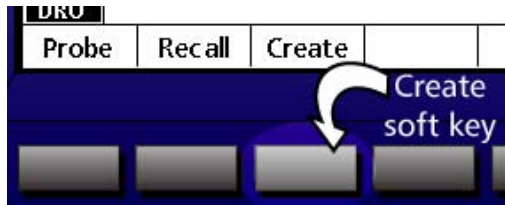
Step 3
Use the numeric keypad to enter the point coordinates for the center point.

Step 4
Enter the desired radius.

NOTE

Press the diameter (diam) soft key to enter a diameter instead of a radius.

Step 5
Press the *finish key*.

The circle feature data is displayed on the screen and added to the feature list. Press the *view soft key* for a graphic representation of the circle feature.

To create a distance

Step 1
Press the *distance key*.

Step 2
Press the *create soft key*.
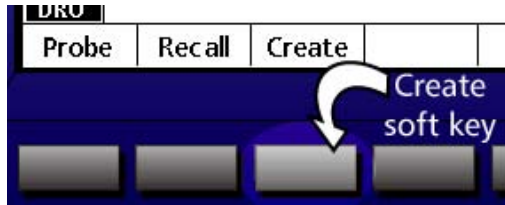
Step 3
Use the numeric keypad to enter the size for the X and Y axes. For example, the distance shown here has an X axis size of 1 mm and a Y axis size of 1mm.
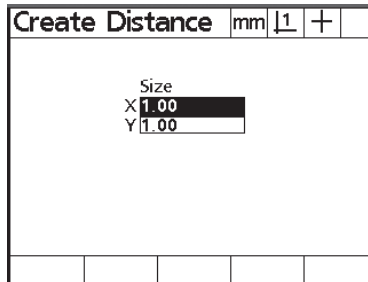
NOTE
All created distances are measured from the datum.

Step 4
Press the *finish key*.

The distance feature data is displayed on the screen and added to the feature list. Press the *view soft key* for a graphic representation of the distance feature.

To create an angle

Step 1
Press the *angle key*.

Step 2
Press the *create soft key*.

Step 3
Use the numeric keypad to enter the point coordinates for the vertex.

Step 4
Use the numeric keypad to enter the desired angle.
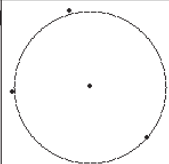
Step 5
Press the *finish key*.
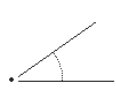
The angle feature data is displayed on the screen and added to the feature list.

```
ANGLE 1               mm  1  +
  1  X       1.0000
     Y       1.0000
     ∠¹  35°00'00"
     Created
DRO
Recall  View             Tol
```

Press the *view soft key* for a graphic representation of the angle feature.

```
ANGLE 1               mm  1  +
  1                    X       1.0000
                       Y       1.0000
                       A1   35°00'00"
                       Created




DRO
Recall  View             Tol
```

To create a skew

Step 1
Press the *skew key*.

Step 2
Press the *create soft key*.

Step 3
Use the numeric keypad to enter the point coordinates for the vertex.

Step 4
Use the numeric keypad to enter the desired angle.

Step 5
Press the *finish key*.

The skew feature data is displayed on the screen and added to the feature list.

Press the *view soft key* for a graphic representation of the skew feature.

Constructing Features

New features can be constructed from probed, created, or constructed features in the features list. Essentially, constructions use previously measured features to build new features.

Construct features by pressing the desired feature selection key. For example, press the *circle key* to construct a circle. Press the *recall* or *construct soft key*. Then select the required features from the features list. For example, select three points to construct a circle. Use the following pages to perform sample constructions. This section ends with a listing of all possible constructions.

It is important to understand that constructed features are not the same as created features. Constructed features are built from previously measured features. For example, to construct a line the user selects two points (or other suitable features) from the features list. The QC200 then constructs the line from the points (or other features). Created features are defined by the user. For example, to create a circle, the user defines the location of the center point and the length of the diameter or radius.

Construction type	Features produced
Intersection	Constructs point(s) from the intersection of 2 lines, 2 circles, or a line and circle.
Duplicate	Constructs a duplicate of the selected feature.
Offset	Constructs an offset point, line, or circle from the selected feature(s).
Relationship	Constructs distance, angle, midpoint, or bisector line from the selected feature(s).
Perpendicular	Constructs a point or line perpendicular to the selected feature(s).
Complement	Constructs complementary angle of selected angle feature.

Using the *recall soft key*

It is sometimes inconvenient to scroll through the features list using the arrow keys. This is particularly true when there are many features in the features list. The *recall soft key* is a handy way to select a feature without scrolling through the entire features list. For example, if the cursor happens to be on *circle 73* and you want to view the results screen for *line 4*, press the *recall soft key* and enter *4*. The *recall soft key* is also useful for constructions.

To construct a distance from a point and circle

Step 1
Press the *distance key*.

Step 2
Press the *recall soft key*.
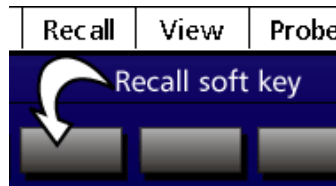
NOTE
This example uses the *recall soft key* to select features for the construction. Users can select features using the arrow keys if they prefer.

Step 3
Use the numeric keypad to enter the feature number of the first feature used in the construction. This construction uses *point 5* from the features list.
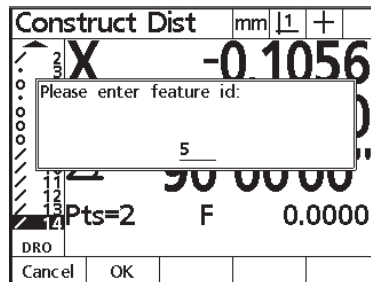
Step 4
Press the *enter key*.

Step 5
Press the *recall soft key*.

Step 6
Use the numeric keypad to enter the feature number of the second feature used in the construction. This construction uses *circle 4* from the features list.

```
Construct Dist    mm 1 +
    2 X        0.0000
    3
  o Please enter feature id:
  o
  o                          7
  o
  /
  / 11
  / 12
  / 13 Created
  / 14
 DRO
 Cancel   OK
```
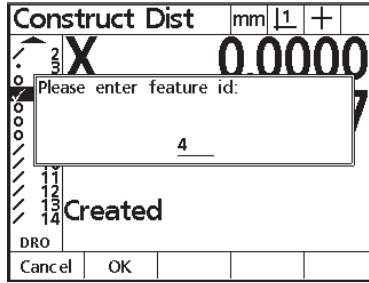
Step 7
Press the *enter key*.

Step 8
Press the *finish key*.

The constructed distance feature is displayed on the screen and added to the feature list. Press the *view soft key* for a graphic representation of the distance feature.

```
DISTANCE 15      mm 1 +
    3 X      1.5383
    4
  o 5 Y      0.0000
  o 6
  o 7 L      1.5383
  o 8
  o 9
  / 10
  / 11
  / 12
  / 13
  / 14 Fts=2
 ↔ 15 From 5,4
 DRO
 Recall  View  Change      Tol
```

```
DISTANCE 15      mm 1 +
    3           X   1.5383
    4           Y   0.0000
  o 5           L   1.5383
  o 6           Fts=2
  o 7
  o 8
  o 9
  / 10
  / 11
  / 12
  / 13
  / 14
 ↔ 15
 DRO
 Recall  View  Change      Tol
```
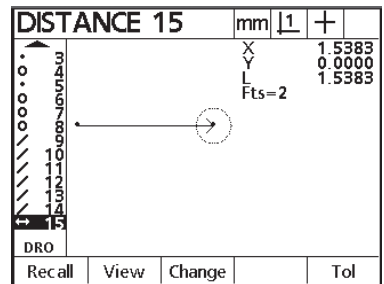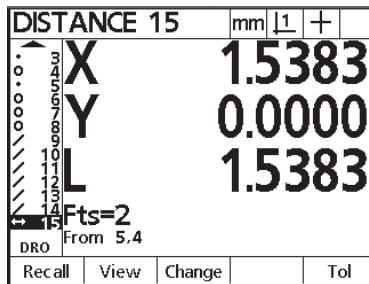
Constructing a skew

Skew lines are commonly constructed from features on a part. Any construction that produces a line can be used to construct a skew. Check the construction chart in this section for a list of all line constructions. The procedure below shows how to skew a part from two previously measured circles.

To construct a skew from two circles

Step 1
Press the *skew key*.

Step 2
Press the *construct (constr) soft key*.

Step 3
Highlight the first feature in the features list. This construction uses *circles 1* and *2* in the features list.

NOTE
This example uses the arrow keys to select features for the construction. Users can select features using the recall soft key if they prefer.

Step 4
Press the *enter key.*

Step 5
Highlight the next feature in the features list.

```
Construct Skew  mm ⊥1 +
 ○  1  X    2.6375
 ✓  2  Y    1.0983
       D/r  0.3946
       Pts=4    F    0.0020
 DRO
       Recall  View  Probe
```

Step 6
Press the *enter key.*

Step 5
Press the *finish key.*

The constructed skew feature is displayed on the screen and added to the feature list. Press the *view soft key* for a graphic representation of the point feature.

```
SKEW 3         mm ⊥1 +
 ○  1  X    0.0000
 ○  2  Y    0.0000
    3  ⊿    0°00'00"
       Fts=2
 DRO   From 2,1
 Recall  View        Tol
```

```
SKEW 3         mm ⊥1 +
 ○  1          X    0.0000
 ○  2          Y    0.0000
    3          A    0°00'00"
               Fts=2

 DRO
 Recall  View        Tol
```

Point Constructions
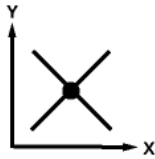
Intersection of two lines

1. Press the point key
2. Press the construct (constr) soft key
3. Select two intersecting lines
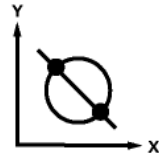
Intersection of a line and circle

1. Press the point key
2. Press the construct (constr) soft key
3. Select an intersecting line & circle
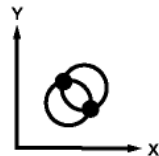
Intersection of two circles

1. Press the point key
2. Press the construct (constr) soft key
3. Select two intersecting circles
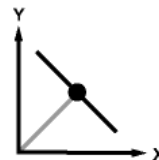
Point on line closest to datum

1. Press the point key
2. Press the construct (constr) soft key
3. Select the desired line
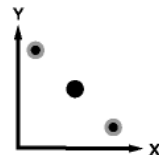
Mid-point between two points

1. Press the point key
2. Press the construct (constr) soft key
3. Select two points
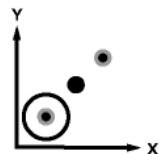
Mid-point between a point and circle

1. Press the point key
2. Press the construct (constr) soft key
3. Select a point and circle
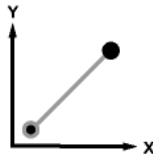
Offset distance from a point
1. Press the point key
2. Press the construct (constr) soft key
3. Select a point and distance
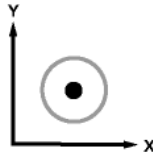
Center point of a circle
1. Press the point key
2. Press the construct (constr) soft key
3. Select a circle
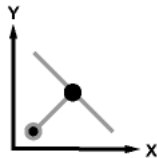
Perpendicular bisector between a line and point
1. Press the point key
2. Press the construct (constr) soft key
3. Select a line and point

Line Constructions
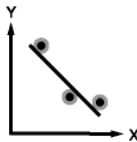
Best fit line
1. Press the line key
2. Press the construct (constr) soft key
3. Select the desired points
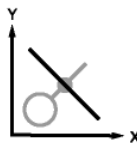
Perpendicular to line through feature
1. Press the line key
2. Press the construct (constr) soft key
3. Select the desired feature & line
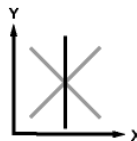
Bisector line
1. Press the line key
2. Press the construct (constr) soft key
3. Select any two interesecting lines
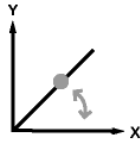
Calculated line
1. Press the line key
2. Press the construct (constr) soft key
3. Select a point & angle
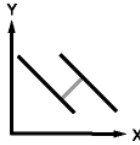
Offset line
1. Press the line key
2. Press the construct (constr) soft key
3. Select a line & distance

Circle Constructions
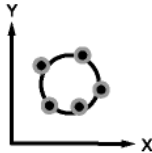
Best fit circle
1. Press the circle key
2. Press the construct (constr) soft key
3. Select the desired points
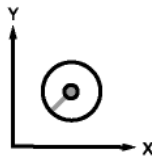
Calculated circle
1. Press the circle key
2. Press the construct (constr) soft key
3. Select a point & distance
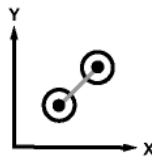
Offset circle
1. Press the circle key
2. Press the construct (constr) soft key
3. Select a circle & distance
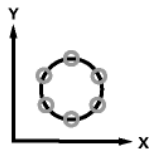
Bolt hole circle
1. Press the circle key
2. Press the construct (constr) soft key
3. Select the bolt hole pattern features

Distance Constructions
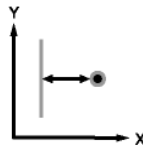
Straight line distance
1. Press the distance key
2. Press the construct (constr) soft key
3. Select two points, a point & line, a point & circle, or a line & circle

NOTE
Distance constructions between circles are center-to-center by default. Use the *change soft key* to select nearest or farthest constructions.
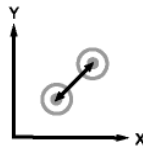
Distance between two circles (center-to-center)
1. Press the distance key
2. Press the construct (constr) soft key
3. Select two circles
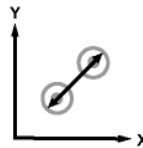
Distance between two circles (farthest)
1. Press the distance key
2. Press the construct (constr) soft key
3. Select two circles
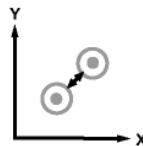
Distance between two circles (nearest)
1. Press the distance key
2. Press the construct (constr) soft key
3. Select two circles
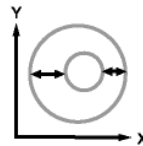
Distance between two annular circles (nearest/farthest)
1. Press the distance key
2. Press the construct (constr) soft key
3. Select two circles

Angle Constructions
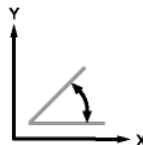
Vertex angle of two lines
1. Press the angle key
2. Press the construct (constr) soft key
3. Select two lines

Deleting Features

Users can delete features from the features list individually or delete the entire list. Deleted features cannot be restored. Make certain that features are no longer required before deleting them. The QC200 requires users to verify the intent to delete features before actually deleting them..

CAUTION
Deleted feature information cannot be restored.

To delete individual features

Step 1
Highlight the desired feature in the feature list using the arrow keys.

CIRCLE 1		mm ⊥1 +
X		2.3660
Y		1.1060
D/r		0.3567
Pts=4	F	0.0034
DRO		
Recall	View	Change		Tol

Step 2
Press the *cancel key*.

Step 3
Press the *yes soft key*.

DRO				
No	Yes			

Yes soft key
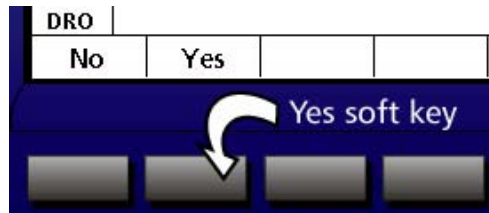
NOTE
Press the *no soft key* if you do not wish to delete the feature.

The feature is removed from the features list.

Current Position	mm	⊥1	+
X			0.8000
Y			1.4700

DRO

Probe	Teach			

To delete all features from the features list

NOTE
Any skews or datums established on the QC200 remain until new skew and datums are established by the user. Deleting features from the features list does not restore the QC200 to machine coordinates.

Step 1
Press the *menu key*.

Step 2
Press the *clear soft key*.

Step 3
Press *clear features (clr ft) soft key*.
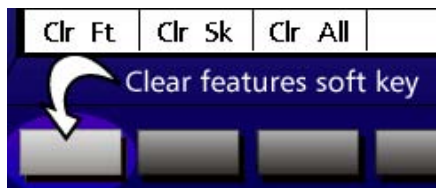
The following dialog box is displayed.
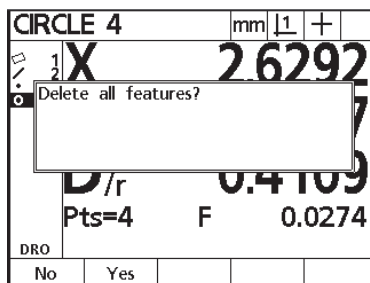
Step 4
Press the *yes soft key*.
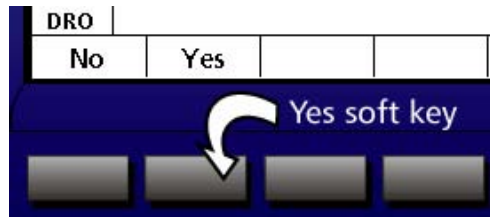
NOTE
Press the *no soft key* if you do not wish to delete the feature list.

The feature list has been deleted.

Deleting a Skew

Use the *clear soft key* to delete a skew. Skew features compensate for part misalignment.

NOTE
Deleting the skew restores the QC200 to machine coordinates. All features remaining in the features list display machine coordinates after the skew is deleted.

To delete a skew

Step 1
Press the *menu key*.

Step 2
Press the *clear soft key*.

Step 3
Press *clear skew (clr sk) soft key*.

The following dialog box is displayed.
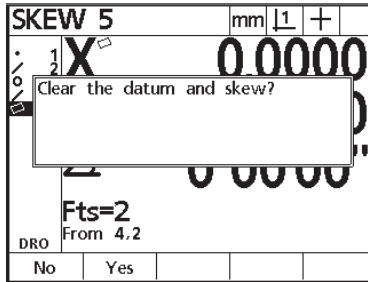
Step 4
Press the *yes soft key*.
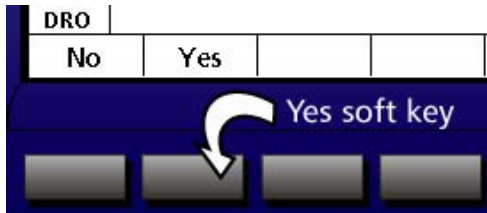
NOTE
Press the *no soft key* if you do not wish to delete the skew.

The skew has been deleted.
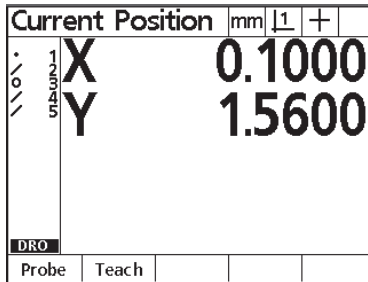
To delete all features, datums, and skews

NOTE
Use the *clear all soft key* to restore the QC200 to machine coordinates.

Step 1
Press the *menu key*.

Step 2
Press the *clear soft key*.

Step 3
Press *clear all (clr all) soft key*.
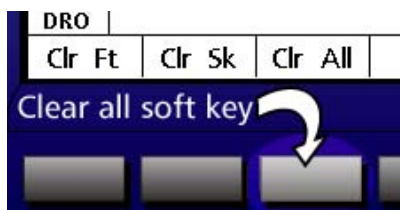
The following dialog box is displayed.
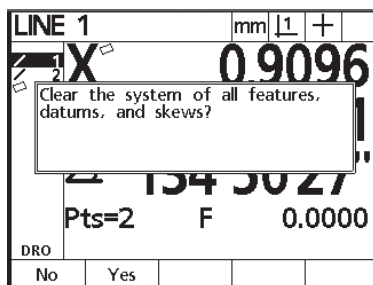
Step 4
Press the *yes soft key*.

DRO

| No | Yes | | |

Yes soft key
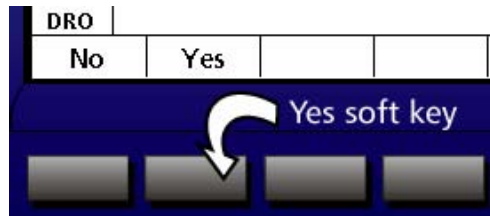
NOTE
Press the *no soft key* if you do not wish to delete the features, datums, and skews.

The features, datums, and skews are deleted.

Current Position   mm |1| +

X   0.0700
Y   1.3900

DRO

| Probe | Teach | | | |

Tolerancing

Tolerancing helps users maximize productivity. A tolerance is an acceptable deviation from the nominal specification of a part. For example, a pin might have a nominal diameter of .250 inches. Without tolerancing, only pins with a diameter of .250 inches are acceptable. This means that pins that measure .249 inches or .251 inches must be rejected. With tolerancing an acceptable deviation from the nominal specification is defined. For example, the diameter of .250 inches might have a tolerance of +/- .005. This means that pins as small as .245 and as large as .255 are acceptable.

The QC200 displays tolerance results as shown. Features within tolerance are displayed with a check mark next to them. Failed features are displayed with a circled 'X' and displayed with an outline font on the data screen.

CIRCLE 1		mm	⌊1	+
Circle Position and Size Tolerance				
Tol Type: BiDir				
Nominal		Dev		
X	2.3700	0.0008		✓
Y	1.1100	0.0015		✓
D	0.4000	-0.0083		⊗
Edit	**Nominal**	Actual	Dev	Other

CIRCLE 1		mm	⌊1	+
o 1	X			2.3708
	Y			1.1115
	D/r			0.3917
Pts=4		F		0.0098
DRO				
Recall	View	Change		⊗ Tol

The following tolerances are available on the QC200:

Feature type	Tolerances
Line	Positional (bi-directional, true position)
	Form (straightness)
	Perpendicularity
	Parallelism
Circle	Positional (bi-directional, true position, LMC, MMC)
	Form
	Concentricity
	Runout
Distance	Width
Angle	Angle
Point	Bi-directional
	True position

NOTE
Use the following examples to learn how to perform tolerances with the QC200. Step-by-step procedures are available for every tolerance at http://www.metronics.com/help.html.

Point Tolerances

To perform a true position tolerance on a point

NOTE
Version 1.22 of the QC200 software shows true position tolerancing as RFS tolerancing.

Step 1
Highlight the desired point in the features list.

Step 2
Press the *tolerance (tol) soft key*.

Step 3
Press the *true position (TP) soft key*.
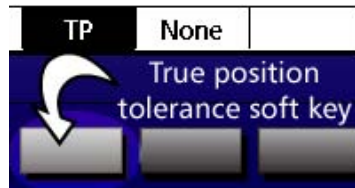
Step 4
Enter the nominal values for X and Y.

POINT 4	mm	1	+

Tolerance: TP

Nominal
X 2.5000   Tol. Zone
Y 1.0000

POINT 4	mm	1	+

Tolerance: TP

Nominal
X 2.5000   Tol. Zone
Y 1.0000

NOTE
Until the user enters nominal values, the QC200 displays the actual coordinates in the nominal X and Y fields.

Step 5
Enter the desired tolerance zone value as shown.

POINT 4	mm	1	+

Tolerance: TP

Nominal
X 2.5000   Tol. Zone
                 .5
Y 1.0000

NOTE
The tol zone (tolerance zone) is the radius within which the point must be located. If the point lies outside this radius the tolerance fails.

Step 6
Press the *finish key*.

The tolerance results are displayed as shown.

```
┌─────────────────────────────────┐  ┌─────────────────────────────────┐
│ POINT 4            mm │1│ +      │  │ POINT 4            mm │1│ +      │
│     Point Tolerance Results     │  │ ▱  1                            │
│        Tol Type: TP             │  │ ╱  2 X        2.4676            │
│                                 │  │ ·  3                            │
│     ┌─────────┐                 │  │ ■  4 Y        1.0000            │
│     │ Nominal │    Err.Dia.     │  │                                 │
│   X   2.5000                    │  │                                 │
│                   0.0648    ✓   │  │    Pts=1      F       0.0000    │
│   Y   1.0000                    │  │ DRO                             │
│                                 │  │ Recall │ View │    │    │ ✓ Tol │
│ Edit │ Nominal │Actual│Err.Dia.│Tol.Zone│ └─────────────────────────────────┘
└─────────────────────────────────┘
```

Line Tolerances

To perform a bi-directional tolerance on a line

Step 1
Highlight a line in the features list as shown.

Step 2
Press the *tol soft key*.
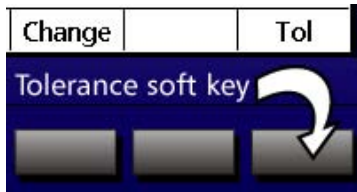
Step 3
Press the *pos soft key* to perform a positional tolerance.

Step 4
Press the *BiDir soft key*.
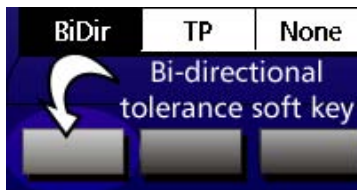
Step 5
Select +/- or limits as shown.

NOTE
Limits allows the user to set upper and lower limits on a value. For example, a nominal value of 10.3250 might have an upper limit of 10.3260 and a lower limit of 10.3240. Select +/- to enter the actual tolerance value. For example, if a part drawing gives a +/- tolerance of 0.005, simply enter 0.005 in the plus and minus fields.

Step 6
Enter the nominal values for X and Y.

NOTE
Until the user enters nominal values, the QC200 displays the actual coordinates in the nominal X and Y fields.

Step 7
Enter the X axis tolerance (+/-) or limits.

LINE 4	mm ⌞1 ✛
Tolerance:	BiDir
Nominal	+/-
X 0.7600	+ 0.0500
	-
Y -0.6250	+
	-

LINE 4	mm ⌞1 ✛
Tolerance:	BiDir
Nominal	+/-
X 0.7600	+ 0.0500
	- 0.0500
Y -0.6250	+
	-

Step 8
Enter the Y axis tolerance (+/-) or limits.

LINE 4	mm ⌞1 ✛
Tolerance:	BiDir
Nominal	+/-
X 0.7600	+ 0.0500
	- 0.0500
Y -0.6250	+ 0.0500
	-

LINE 4	mm ⌞1 ✛
Tolerance:	BiDir
Nominal	+/-
X 0.7600	+ 0.0500
	- 0.0500
Y -0.6250	+ 0.0500
	- 0.0500

Step 9
Press the *finish key*.

The results for the tolerance are displayed as shown.

LINE 4	mm ⌞1 ✛
Line Tolerance Results	
Tol Type: BiDir	
Nominal	Dev
X 0.7600	0.0002 ✓
Y -0.6250	-0.0006 ✓
Edit	Nominal	Actual	Dev	Other

LINE 4	mm ⌞1 ✛
X	2.3549
Y	0.2018
⊿	18°40'39"
Pts=3 F	0.0072
DRO	
Recall	View	Change		✓ Tol

To perform a perpendicularity tolerance on a line

NOTE
Use the perpendicularity tolerance to verify that a line is perpendicular to a given feature within a specified tolerance zone.

Step 1
Highlight the desired line in the features list.

```
LINE 5              mm  ⊥1  +
  1 X        1.0778
  2
  3 Y        1.2950
  4
  5 ⊿   178°26'16"
  Pts=2    F    0.0000
DRO
Recall | View | Change |  | Tol
```

Step 2
Press the *tolerance (tol) soft key*.

```
Change |     |  Tol
Tolerance soft key
```
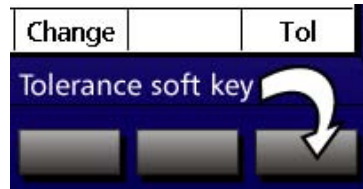
Step 3
Press the *orientation (orient) soft key*.

```
Orient |     |
        Orentation soft key
```
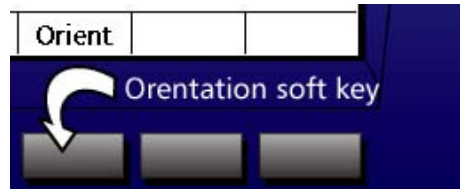
Step 4
Press the *perpendicular (perp) soft key.*

Perp	Para	None	

Perpendicular soft key

Step 5
Enter the desired tolerance zone value.

LINE 5   mm |1 +

Tolerance: Perp

Tol.Zone
1.0

Reference Feature ☐

Step 6
Enter the feature number of the desired reference feature.

LINE 5   mm |1 +

Tolerance: Perp

Tol.Zone
1.0000

Reference Feature 4

NOTE
**A reference feature must be measured before the feature to be
toleranced. Reference features must be of the right type. For
example, a feature cannot be perpendicular to a point therefore
points cannot be used as reference features for perpendicularity.**

Step 7
Press the *finish key*.

The tolerance results are displayed as shown.

```
┌─────────────────────────────┐   ┌─────────────────────────────┐
│ LINE 5          mm ⊥1  +     │   │ LINE 5          mm ⊥1  +     │
│     Line Tolerance Results   │   │ ▱  1                         │
│       Tol Type: Perp         │   │ ⟋  2 X      1.0778           │
│                              │   │    3                         │
│    Tol.Zone    Amt.Ov.       │   │ ⟍  4 Y      1.2950           │
│    1.0000      0.0000     ✓  │   │    5                         │
│                              │   │   ⟁  178°26'16"              │
│    Reference Feature 4       │   │                              │
│                              │   │ Pts=2      F     0.0000      │
│                              │   │ DRO                          │
│  Edit  Tol.Zone Actual Amt.Ov.│  │ Recall  View  Change    ✓ Tol│
└─────────────────────────────┘   └─────────────────────────────┘
```

To perform a form tolerance on a line

NOTE
The form tolerance for a line is a straightness tolerance.

Step 1
Highlight the desired line in the features list.

```
LINE 4                    mm |1  +
  1 X        0.3722
  5 Y        0.7900
  4
  5 △    90°00'00"
Pts=4      F      0.0000
DRO
Recall  View  Change       Tol
```

Step 2
Press the *tolerance (tol) soft key*.

```
Change              Tol
Tolerance soft key
```

Step 3
Press the *form soft key*.
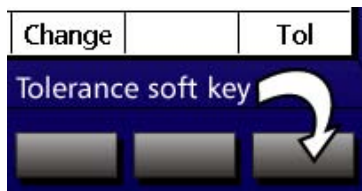
```
Pos    Form    Orient
              Form
              soft key
```
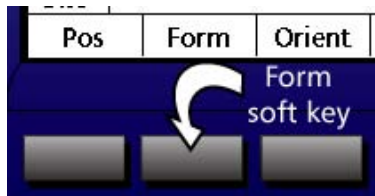
Step 4
Enter the desired tolerance zone value.

```
┌─────────────────────────────────────┐
│ LINE 4              mm │1 │ + │      │
│       Tolerance:    Form             │
│                                      │
│            Tol.Zone                  │
│            .05                       │
│                                      │
│                                      │
│                                      │
│                                      │
│                                      │
│ None │      │      │      │      │   │
└─────────────────────────────────────┘
```

Step 5
Press the *finish key*.

The tolerance results are displayed as shown.

```
┌─────────────────────────────────────┐   ┌──────────────────────────────────────┐
│ LINE 4              mm │1 │ + │      │   │ LINE 4            mm │1 │ + │         │
│      Line Tolerance Results          │   │ ⬦  1  X          0.3722              │
│        Tol Type: Form                │   │ ∴  2                                  │
│                                      │   │    3  Y          0.7900              │
│     Tol.Zone     Actual              │   │    4                                  │
│     0.0500       0.0000      ✓       │   │    5  ∠       90°00'00"              │
│                                      │   │                                      │
│                                      │   │ Pts=4      F         0.0000          │
│                                      │   │ DRO                                  │
│ Edit │      │      │      │      │   │   │ Recall │ View │ Change │   │ ✓ Tol │ │
└─────────────────────────────────────┘   └──────────────────────────────────────┘
```

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Circle Tolerances

To perform a true position tolerance on a circle

NOTE
Version 1.22 of the QC200 software shows true position tolerancing as RFS tolerancing.

Step 1
Highlight a circle in the features list as shown.

Step 2
Press the *tol soft key*.

Step 3
Press the *pos soft key* to perform a positional tolerance.

Step 4
Press the *true position soft key*.

Step 5
Enter the nominal values for X and Y.

NOTE
Until the user enters nominal values, the QC200 displays the actual coordinates in the nominal X and Y fields.

Step 6
Enter the nominal radius or diameter.

Step 7
Use the numeric keypad to enter the desired tolerance zone in the *tol zone* field as shown.

```
CIRCLE 6              mm |1 |+|
      Tolerance:      TP

      Nominal
  X  1.5700      Tol. Zone
                  .5
  Y  0.9000
                 +/-
  D  0.4000    +|
              -|
```

NOTE
The *tol zone (tolerance zone)* of the circle is the radius within which the center point of the circle must be. If the center point lies outside this radius the tolerance fails.

Step 8
Select *limits* or +/-.

```
CIRCLE 6              mm |1 |+|        CIRCLE 6              mm |1 |+|
      Tolerance:      TP                    Tolerance:      TP

      Nominal                               Nominal
  X  1.5700      Tol. Zone             X  1.5700      Tol. Zone
                  0.5000                              0.5000
  Y  0.9000                            Y  0.9000
                 +/-                                  Limits
  D  0.4000    +|                      D  0.4000    +|
              -|                                    -|
  +/-   Limits                          +/-   Limits
```

NOTE
Limits allows the user to set upper and lower limits on a value. For example, a nominal value of 10.3250 might have an upper limit of 10.3260 and a lower limit of 10.3240. Select +/- to enter the actual tolerance value. For example, if a part drawing gives a +/- tolerance of 0.005, simply enter 0.005 in the plus and minus fields.

Step 9
Enter the diameter tolerance (+/-) or limits.

CIRCLE 6	mm	⌐1	+

	Tolerance:	TP	

Nominal
X 1.5700   Tol. Zone
                          0.5000
Y 0.9000
                          +/-
D 0.4000   + 5
                       -

CIRCLE 6	mm	⌐1	+

	Tolerance:	TP	

Nominal
X 1.5700   Tol. Zone
                          0.5000
Y 0.9000
                          +/-
D 0.4000   + 0.5000
                       - 5

Step 10
Press the *finish key.*

The results for the tolerance are displayed as shown.

CIRCLE 6	mm	⌐1	+

Circle TP Tolerance Results

	Nominal	Err.Dia.	
X	1.5700		
		0.0378	✓
Y	0.9000		

	Nominal	Dev	
D	0.4000	0.0064	✓

Edit	Nominal	Actual	Err.Dia.	Other

CIRCLE 6	mm	⌐1	+

X   1.5720
Y   0.9188
D/r   0.4064
Pts=4   F   0.0026

DRO

Recall	View	Change		✓ Tol

To perform a MMC tolerance on a circle

Step 1
Highlight the desired circle in the features list.

Step 2
Press the *tolerance (tol) soft key*.

Step 3
Press the *positional (pos) soft key*.

Step 4
Press the *MMC soft key*.

Step 5

Use the soft keys to choose *boss* if tolerancing a pin or *bore* if tolerancing a hole.

```
CIRCLE 4              mm |1  +
      Tolerance:     MMC
      Circle Type:   Bore

      Nominal
   X  2.5428        Tol. Zone
                    [        ]
   Y  0.9206
                    +/-
   D  0.4076      + [        ]
                  - [        ]


  Boss    Bore
```

Step 6

Enter the desired nominal values for the X and Y coordinates.

```
CIRCLE 4              mm |1  +         CIRCLE 4              mm |1  +
      Tolerance:     MMC                     Tolerance:     MMC
      Circle Type:   Bore                    Circle Type:   Bore

      Nominal                               Nominal
   X  2.5           Tol. Zone            X  2.5000        Tol. Zone
                    [        ]                            [        ]
   Y  0.9206                             Y  1.0
                    +/-                                   +/-
   D  0.4076      + [        ]           D  0.4076      + [        ]
                  - [        ]                          - [        ]
```

Step 7

Enter the desired nominal diameter value.

```
CIRCLE 4              mm |1  +
      Tolerance:     MMC
      Circle Type:   Bore

      Nominal
   X  2.5000        Tol. Zone
                    [        ]
   Y  1.0000
                    +/-
   D  0.4000      + [        ]
                  - [        ]
```

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Step 8
Enter the desired tolerance zone for the X and Y coordinates.

NOTE

X and Y nominal coordinates represent the nominal location of the center point of the circle. The tolerance zone is a radius from the nominal center point. If the actual center point of the circle lies outside the tolerance zone radius the tolerance fails.

Step 9
Select +/- or limits.

NOTE

Limits allows the user to set upper and lower limits on a value. For example, a nominal value of 1.5 inches might have an upper limit of 1.55 inches and a lower limit of 1.45 inches. Select +/- to enter the actual tolerance value. For example, if a part drawing gives a +/- tolerance of 0.005 inches, simply enter 0.005 in the plus and minus fields. In this example, +/- is chosen.

Step 10
Enter the desired diameter tolerance values.

CIRCLE 4	mm 1 +
Tolerance:	MMC
Circle Type:	Bore
	Nominal
X	2.5000 · Tol. Zone
	0.5000
Y	1.0000
	+/−
D	0.4000 · + .5
	−

CIRCLE 4	mm 1 +
Tolerance:	MMC
Circle Type:	Bore
	Nominal
X	2.5000 · Tol. Zone
	0.5000
Y	1.0000
	+/−
D	0.4000 · + 0.5000
	− .5

Step 11
Press the *finish key*.

The tolerance results are displayed as shown.

CIRCLE 4	mm 1 +
Circle MMC Tolerance Results	
Circle Type:	Bore
	Nominal Err.Dia.
X	2.5000
	0.1804 ✓
Y	1.0000
	Nominal Dev
D	0.4000 0.0076 ✓
Edit	Nominal	Actual	Err.Dia.	Other

CIRCLE 4	mm 1 +
1 2 3 4	X 2.5428
	Y 0.9206
	D/r 0.4076
Pts=4	F 0.0268
DRO	
Recall	View	Change	✓ Tol

To perform a concentricity tolerance on a circle

NOTE
Concentricity relates the location of the toleranced circle to the location of a reference circle. Concentric circles share a common center point but may have varying radii. Make sure the reference circle has been measured before performing a concentricity tolerance on the current circle.

Step 1
Highlight the desired circle in the features list.

Step 2
Press the *tolerance (tol) soft key*.

Step 3
Press the *concentricity (conc) soft key*.
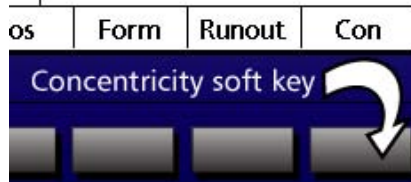
Step 4

Enter the desired tolerance zone value. The tolerance zone is a diameter from the center point of the reference feature. The center point of the tolerance circle must lie within the tolerance zone to pass the tolerance.

```
| CIRCLE 5                    mm |1 | + |
|       Tolerance:    Concentricity      |
|                                        |
|                     Tol.Zone           |
|                     .5                  |
|                                        |
|       Reference  Feature  [    ]       |
|                                        |
|                                        |
|                                        |
| None    |        |        |        |  |
```

Step 5

Enter the desired reference feature number. The reference feature must be a previously measured, concentric circle.

```
| CIRCLE 5                    mm |1 | + |
|       Tolerance:    Concentricity      |
|                                        |
|                     Tol.Zone           |
|                     0.5000             |
|                                        |
|       Reference  Feature  4            |
|                                        |
|                                        |
|                                        |
| None    |        |        |        |  |
```

Step 6

Press the *finish key*.

The tolerance results are displayed as shown.

```
| CIRCLE 5              mm |1 | + |   | CIRCLE 5              mm |1 | + |
|   Circle Tolerance Results      |   |  1 X        2.5302               |
|    Tol Type: Concentricity      |   |  2                              |
|                                 |   |  3 Y        0.9165               |
|   Tol.Zone     Amt.Ov.          |   |  4                              |
|   0.5000       0.0000      √    |   |  5 D/r      0.4102               |
|                                 |   |   Pts=4      F      0.0246      |
|   Reference  Feature 4          |   | DRO                            |
|                                 |   | Recall | View | Change |  | √Tol|
| Edit | Tol.Zone | Actual | Amt.Ov. |
```

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About the runout tolerance

Like the concentricity tolerance, the runout tolerance requires the use of a reference feature. Use any feature that shares its center point with the toleranced circle. Generally, the reference feature is a circle but a point co-located with the center of the toleranced circle works as well. This example uses a previously measured circle as the reference feature. Make sure the reference feature has been measured before performing the tolerance.

Runout tolerances typically are performed using a dial indicator placed against the edge of a circle. The circle is rotated on its axis and the plus or minus deviations from nominal are noted. Thus every point around the circumference of the circle is toleranced.

The QC200 checks runout at the points probed. This means that, if four points are probed, only those four points are checked. Since runout is concerned with the deviation from nominal throughout the entire rotation of the circle, four points provides very little of the picture. A more complete picture is had by probing additional points. Each additional point increases the reliability of the result.

The example below shows a circle with four points for demonstration purposes. In real world applications, users are advised to probe more points.

To perform a runout tolerance on a circle

Step 1
Highlight the desired circle in the features list.

```
┌─────────────────────────────────┐
│ CIRCLE 5              mm │1│ + │ │
│ ▱  1                            │
│ ╱  2  X      1.5674             │
│ •  3                           │
│ o  4  Y      0.9205             │
│ o  5                           │
│       D/r    0.4040             │
│       Pts=4    F     0.0150     │
│ DRO                             │
│ Recall │ View │ Change │   │ Tol│
└─────────────────────────────────┘
```

Step 2
Press the *tolerance (tol) soft key*.

Step 3
Press the *runout soft key*.

Step 4
Enter the desired tolerance zone value.

Step 5
Enter the desired reference feature number.

Step 6
Press the *finish key*.

The tolerance results are displayed as shown.

Distance Tolerances

To perform a width tolerance on a distance

Step 1
Highlight the desired distance in the features list.

Step 2
Press the *tolerance (tol) soft key*.

Step 3
Press the *width soft key*.
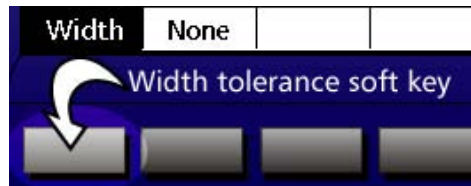
Step 4
Select limits or +/-.

```
┌──────────────────────────────────────────┐
│ DISTANCE 6              mm  ⌊1  ┼         │
│      Tolerance:     Width                 │
│                                           │
│      Nominal        +/-                    │
│  X  [0.0700]      + [            ]         │
│                   - [            ]         │
│  Y  [0.0000]      + [            ]         │
│                   - [            ]         │
│                                           │
│                                           │
│  L  [0.0700]      + [            ]         │
│                   - [            ]         │
│ ┌─────┬───────┐                           │
│ │ +/- │ Limits│                           │
└──────────────────────────────────────────┘
```

NOTE
Limits allow the user to set upper and lower limits on a value. For example, a nominal value of 10.3250 might have an upper limit of 10.3260 and a lower limit of 10.3240. Select +/- to enter the actual tolerance value. For example, if a part drawing gives a +/- tolerance of 0.005, simply enter 0.005 in the plus and minus fields.

Step 5
Enter the nominal values for X and Y.

```
┌───────────────────────────────┐  ┌───────────────────────────────┐
│ DISTANCE 6         mm  ⌊1  ┼  │  │ DISTANCE 6         mm  ⌊1  ┼  │
│    Tolerance:    Width         │  │    Tolerance:    Width         │
│                                │  │                                │
│    Nominal       +/-           │  │    Nominal       +/-           │
│  X [.07]       + [        ]     │  │  X [0.0700]    + [        ]     │
│                - [        ]     │  │                - [        ]     │
│  Y [0.0000]    + [        ]     │  │  Y [0.0000]    + [        ]     │
│                - [        ]     │  │                - [        ]     │
│                                │  │                                │
│  L [0.0778]    + [        ]     │  │  L [.07]       + [        ]     │
│                - [        ]     │  │                - [        ]     │
│                                │  │                                │
└───────────────────────────────┘  └───────────────────────────────┘
```

NOTE
Until the user enters nominal values, the QC200 displays the actual coordinates in the nominal X and Y fields.

Step 6
Enter the nominal length.

```
┌─────────────────────────────────────────┐
│ DISTANCE 6          mm |1  +             │
│       Tolerance:     Width              │
│                                          │
│       Nominal        +/-                 │
│   X  0.0700      +┌──────────┐           │
│                  -└──────────┘           │
│   Y  0.0000      +┌──────────┐           │
│                  -└──────────┘           │
│                                          │
│                                          │
│   L  ▮.07▮       +┌──────────┐           │
│                  -└──────────┘           │
│                                          │
│  ┌──┐  ┌──┐  ┌──┐  ┌──┐  ┌──┐            │
└─────────────────────────────────────────┘
```

Step 7
Enter the +/- tolerance values for the X and Y coordinates as shown.

```
┌──────────────────────────────┐   ┌──────────────────────────────┐
│ DISTANCE 6        mm |1  +   │   │ DISTANCE 6        mm |1  +   │
│    Tolerance:     Width      │   │    Tolerance:     Width      │
│                              │   │                              │
│    Nominal       +/-         │   │    Nominal       +/-         │
│  X 0.0700     +0.0500        │   │  X 0.0700     +0.0500        │
│               - ▮05▮         │   │               - 0.0500       │
│  Y 0.0000     +┌──────┐      │   │  Y 0.0000     +0.0500        │
│               -└──────┘      │   │               - ▮05▮         │
│                              │   │                              │
│  L 0.0700     +┌──────┐      │   │  L 0.0700     +┌──────┐      │
│               -└──────┘      │   │               -└──────┘      │
│                              │   │                              │
└──────────────────────────────┘   └──────────────────────────────┘
```

Step 8
Enter the +/- tolerance values for the length as shown.

```
┌─────────────────────────────────────────┐
│ DISTANCE 6          mm |1  +             │
│       Tolerance:     Width              │
│                                          │
│       Nominal        +/-                 │
│   X  0.0700      +0.0500                 │
│                  -0.0500                 │
│   Y  0.0000      +0.0500                 │
│                  -0.0500                 │
│                                          │
│   L  0.0700      +0.0500                 │
│                  -▮05▮                   │
│                                          │
└─────────────────────────────────────────┘
```

Step 9
Press the *finish key*.

The tolerance results are displayed as shown.

DISTANCE 6	mm	⌊1	+	
Distance Tolerance Results				
Tol Type: Width				
Nominal	Dev			
X 0.0700	0.0078	✓		
Y 0.0000	0.0000	✓		
L 0.0700	0.0078	✓		
Edit	**Nominal**	Actual	Dev	Other

DISTANCE 6	mm	⌊1	+
X	0.0778		
Y	0.0000		
L	0.0778		
Fts=2			
From 5,4			
DRO			
Recall	View	Change	✓ Tol

Angle Tolerances

To perform an angle tolerance

Step 1
Highlight the desired angle in the features list.

Step 2
Press the *tolerance (tol) soft key.*
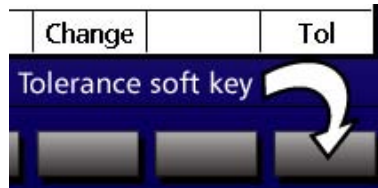
Step 3
Press the *angle soft key.*
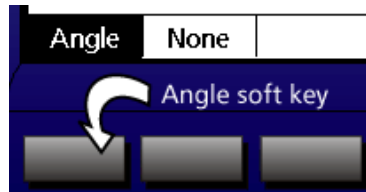
Step 4
Select limits or +/-.

```
┌─────────────────────────────────────┐
│ ANGLE 12              mm │1│ ┼      │
│        Tolerance:    Angle           │
│                                      │
│        Nominal      +/-              │
│     A  44°17'28"   +                 │
│                    -                 │
│                                      │
│                                      │
│                                      │
│                                      │
│  +/-    Limits                       │
└─────────────────────────────────────┘
```

NOTE
Limits allow the user to set upper and lower limits on a value. For example, a nominal value of 10.3250 might have an upper limit of 10.3260 and a lower limit of 10.3240. Select +/- to enter the actual tolerance value. For example, if a part drawing gives a +/- tolerance of 0.005, simply enter 0.005 in the plus and minus fields.

Step 5
Enter the desired nominal value of the angle.

```
┌─────────────────────────────────────┐
│ ANGLE 12              mm │1│ ┼      │
│        Tolerance:    Angle           │
│                                      │
│        Nominal      +/-              │
│     A  44°17'28"   + 5               │
│                    -                 │
│                                      │
│                                      │
│                                      │
│                                      │
│                                      │
└─────────────────────────────────────┘
```

Step 6
Enter the +/- tolerance values of the angle.

```
┌─────────────────────────────────────┐
│ ANGLE 12              mm │1│ ┼      │
│        Tolerance:    Angle           │
│                                      │
│        Nominal      +/-              │
│     A  44°17'28"   +0°50'00"         │
│                    - .5              │
│                                      │
│                                      │
│                                      │
│                                      │
│                                      │
└─────────────────────────────────────┘
```

Step 7
Enter the nominal value of the angle.

```
┌─────────────────────────────────────┐
│ ANGLE 12              mm │1│ ┼       │
│        Tolerance:     Angle          │
│                                      │
│         Nominal     +/-              │
│     A   44         +│0°50'00"│       │
│                    -│0°50'00"│       │
│                                      │
│                                      │
│                                      │
│                                      │
│  │       │       │       │       │   │
└─────────────────────────────────────┘
```

Step 8
Press the *finish key.*

The tolerance results are displayed as shown.

```
┌─────────────────────────────────────┐   ┌─────────────────────────────────────┐
│ ANGLE 12              mm │1│ ┼       │   │ ANGLE 12              mm │1│ ┼       │
│       Angle  Tolerance  Results      │   │ ◇  1  X        0.8747                │
│        Tol  Type:  Angle             │   │ ·  2                                 │
│                                      │   │ ∠  3  Y        0.6084                │
│      Nominal        Dev              │   │ ⟋  4                                 │
│   A  44°00'00"     0°17'28"    ✓     │   │ ⟋  5  ∠¹   44°17'28"                 │
│                                      │   │ o  6                                 │
│                                      │   │ o  7                                 │
│                                      │   │ o  8                                 │
│                                      │   │ ⟋  10                                │
│                                      │   │ ⟋  11                                │
│                                      │   │ ∠ 12 Fts=2                           │
│                                      │   │ DRO  From 11,10                      │
│ Edit│Nominal│Actual│ Dev │ Other     │   │Recall│ View │Change│     │ ✓ Tol     │
└─────────────────────────────────────┘   └─────────────────────────────────────┘
```

Chapter 4
Programming

The QC200 programming capability automates repetitive inspection tasks. Programs are inspection sequences recorded by users and stored in the QC200. Using programs saves time by reducing the amount of key-presses required by the user. For example, a circle requires at least five key-presses (*circle key*, *enter key* for each point, and *finish key*). A program for the same task requires only three key-presses (*enter key* after each point). For a lot of 100 parts, this program saves 200 key-presses.

Create programs using a series of measurements that satisfy the part specifications. Using a program ensures greater repeatability of inspection results because all parts are measured the same way. Any measurement or display function from the front panel can be included in a program.

The QC200 programming function works like a tape recorder. To begin a program simply press the *record soft key*. Each key press and measurement is then recorded into the program. Programs can be run at any time, by any user to simplify and automate the inspection process.

Select the graphic screen view when running a program to turn on the *targeting view*. Targeting view displays a feature graphic and an arrow indicating the next point required for the program. Move the crosshairs (or edge detector) to the indicated point. Follow the targeting arrow until the probe is on the point and press the *enter key*. Keep in mind that targeting arrows give the user a general location for a point. Always use the view screen of the comparator for final positioning of crosshairs. Continue probing in this fashion until the program is complete.

Edit existing programs to change, insert or delete steps. It is often easier to modify an existing program than to record a new program for similar parts. See the *editing programs* section of this chapter for more information.

Sample Program

It is a good idea to plan the part inspection before recording a program. Look at the part drawing to identify the required measurements and determine the points required for each feature. Choose a measurement order that is efficient and practical for your application. For example, consider the type and location of the features to be measured and look for ways to use *auto repeat* and *measure magic*. Keep in mind that any features used in constructions must be measured before the construction can be completed. Likewise, features used as reference features in a tolerance must be measured before the tolerance can be performed. A few minutes of planning saves time and ensures smooth program recording.

Use the sample program in this chapter to familiarize yourself with standard programming tasks. The sample program shows the basic process of recording a program. Apply the tasks shown here to record programs for your applications.

Keep in mind that the essential difference between small and large programs is simply the number of steps. A large program is not necessarily more difficult to create, it simply contains more steps.

This demonstration records a program to do the following tasks:
- Clear skew settings and features from the feature list
- Skew a new part
- Zero axes on a new datum
- Measure a line
- Measure a circle
- Perform a tolerance

To create the sample program

Steps 1 through 4 begin the recording process.

Step 1
Press the *menu key*.

Step 2
Press the *program (prog) soft key*.
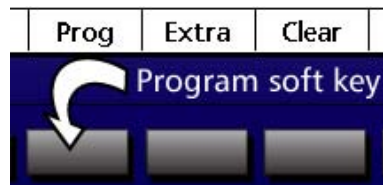
Step 3
Press the *record soft key*.

Record | Record soft key

Step 4
Use the numeric keypad to enter the desired program number, then press the *OK soft key*.

Programs   mm |1 +

Enter program number:

001

Cancel | OK
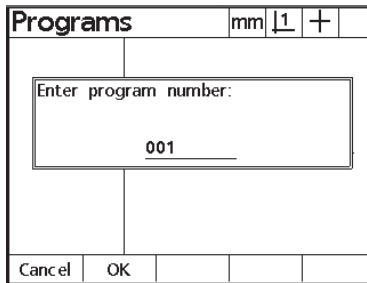
NOTE
If there are any datum/skew features in the system the following dialog box appears.

Programs   mm |1 +

Do you want to clear the existing datum/skew?

No | Yes
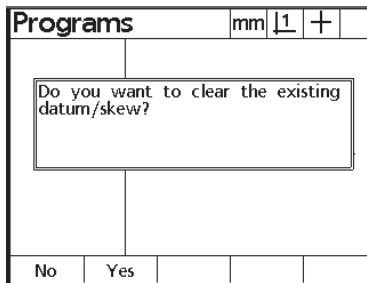
Press the *OK soft key* to delete the existing skew/datum. It is strongly recommended that you create a new skew/datum at the beginning of a program.

Steps 5 through 8 clear old features, datums, and skews from the features list.

NOTE
It is a good practice to clear all features and skews before recording a new program. Previously measured skews can affect measurements even if deleted from the features list. Skews must be cleared using the *clear all* or *clear skew soft keys*.

Step 5
Press the *menu key.*

Step 6
Press the *clear soft key.*

Step 7
Press the *clear all (clr all) soft key.*
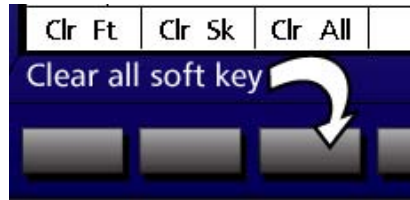
Step 8
Press the *yes soft key.*
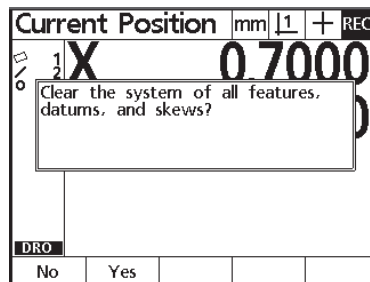
Steps 9 through 11 establish a skew line

Step 9
Press the *skew key*.

Step 10
Probe the skew line as shown. Press *enter* to take each point.
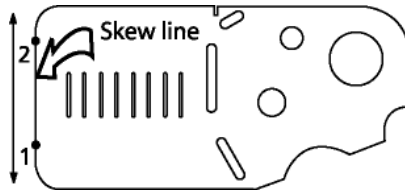
Probe Skew	mm ⌐1 ✛ REC
Pts 1	X 0.0700
	Y 0.4600
DRO	
Probe	Recall	Create

Probe Skew	mm ⌐1 ✛ REC
Pts 2	X 0.0400
	Y 1.1500
DRO	
Probe	Recall	Create

Step 11
Press the *finish key*.

The skew results appear as shown.

SKEW 1	mm ⌐1 ✛ REC
1	X 0.0000
	Y 0.0000
	⊿ 90°00'00"
Pts=2	F 0.0000
DRO	
Recall	View			Tol

4-5

Steps 12 through 14 measure a line feature.

Step 12
Press the *line key.*

Step 13
Probe the line as shown. Press *enter* to take each point.
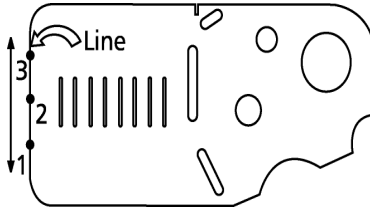
Step 14
Press the *finish key.*

The line results appear as shown.

Steps 15 through 20 construct a point and zero the X and Y axes on that point.

Step 15
Press the *point key*.

Step 16
Press the *construct (constr) soft key*.

Step 17
Highlight line 2 in the features list as shown and press *enter*.

Step 18
Highlight skew 1 in the features list as shown and press *enter*.

Step 19
Press the *finish key*.

The point results appear as shown.

Step 20
Press the *X and Y zero axes keys*.
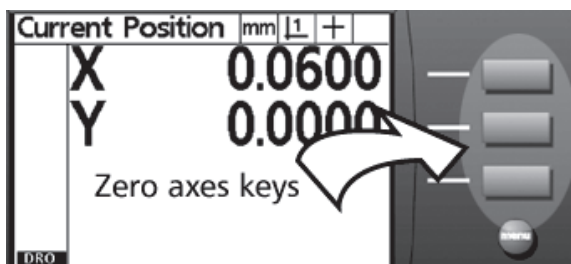
The datum is now set at the intersection of skew 1 and line 2.

Steps 20 through 22 measure a circle feature

Step 21
Press the *circle key*.

Step 22
Probe the circle as shown. Press *enter* to take each point.

Step 23
Press the *finish key*.

The circle results appear as shown.

Steps 24 through 27 tolerance the circle for form.

NOTE
Any tolerance can be inserted into a program. See *chapter 3: operation* for more information on tolerances.

Step 24
Press the *tolerance (tol) soft key*.

Change		Tol
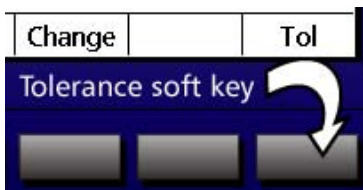
Tolerance soft key

Step 25
Press the *form soft key*.

Form	Runout	Con

Form soft key

Step 26
Enter the desired tolerance zone value.
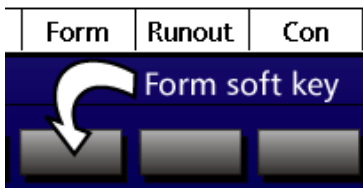
CIRCLE 4	mm |1 + REC

Tolerance: Form

Tol.Zone
.5

None
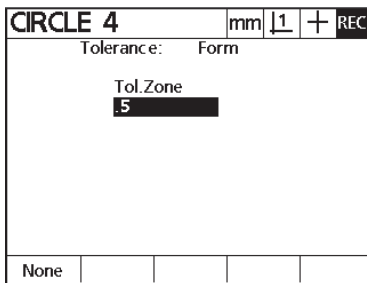
Step 27
Press the *finish key*.

The tolerance results appear as shown.

Steps 28 through 31 complete the recording of the program.

Step 28
Press the *finish key*.

Step 29
Press the *menu key*.

Step 30
Press the *program (prog) soft key*.

Step 31
Press the *end record (end rec) soft key*.

The program is complete.

Running a program

It is a good idea to test a program after you record it. This gives you an opportunity to make certain all required measurements and tolerances are included. If anything is missing, use the program editing functions to correct the program.

Select the desired program from those listed on the programs screen. Use the arrow keys to highlight the desired program and then press the *run soft key*. Then simply follow the QC200's lead.

Select the graphic screen view when running a program to turn on the *targeting view*. Targeting view displays a feature graphic and an arrow indicating the next point required for the program. Move the crosshairs (or edge detector) to the indicated point. Follow the targeting arrow until the probe is on the point and press the *enter key*. Keep in mind that targeting arrows give the user a general location for a point. Always use the view screen of the comparator for final positioning of crosshairs. Continue probing in this fashion until the program is complete.

This example shows how to run the sample program recorded in the previous section. Use these basics steps to run any program.

To run a program

Step 1
Press the *menu key*.

Step 2
Press the *program (prog) soft key*.

| Prog | Extra | Clear | E|

Program soft key

Step 3
Highlight the desired program as shown.

Programs		mm	⌊1	＋	
001					

| Record | Run | Edit | Copy | Delete |

Step 4
Press the *run soft key*.

| Run | Edit | Copy |

Run soft key

NOTE
The run indicator is displayed on the upper right corner of the screen after pressing the run soft key.

Probe Skew		mm	⌊1	＋	Run

Pts
Req
2

X   1.6800
Y   1.4900

DRO

| Probe | | View | | |

Step 5
Press the *view soft key*.

| View | | |

View soft key

4-13

NOTE

This step displays the program graphically. The plus (+) sign represents the current position of the crosshair. An arrow points toward the next data point. Targeting view may be slightly offset until the datum is established.
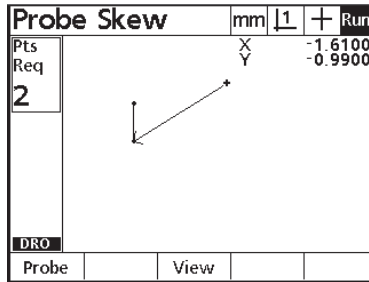
Step 6
Position the crosshair over the next data point as shown.
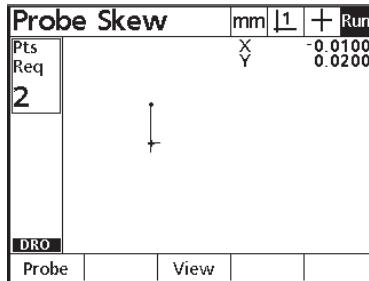
NOTE

Do not rely on the graphic display of the QC200 to determine the fine positioning of the crosshair. Use the comparator view screen for final positioning.

Step 7
Press the *enter key* to enter the point.

Repeat steps 6 and 7 until the program is complete.

When the program is finished, the run indicator no longer appears on the upper right corner of the screen. Results are typically printed or sent to a computer at this time.

Editing Programs

Edit programs to change, insert, or delete steps. There are a variety of reasons to edit programs. A program may contain an error or omission. For example, a feature may have been left out or measured from the wrong reference frame. Part specifications may change and editing an existing program is often faster than creating an entirely new program. Use program editing to:

- Expand and change program steps
- Inserting new program steps
- Delete program steps
- Copy programs
- Delete programs

To display program steps

Step 1
Press the *menu key*.

Step 2
Press the *program (prog) soft key*.

Step 3
Highlight the desired program as shown.

Step 4
Press the *edit soft key*.

Edit	Copy	Dele

Edit soft key

The *edit screen* displays the contents of the highlighted program.

002		mm	1	+	EDT

```
     1  Prg Properties
     2⊞Settings
     9  Clr All
∕   10⊞Probe Skew 1 (Pts=2)
∕   14⊞Probe Line 2 (Pts=2)
·   18⊞Construct Point 3 (Fts=2)
    22  Zero Y Axis Of Feat ⊟d
    23  Targeting View On
○   24⊞Probe Circle 4 (Pts=3) Form
    29  End Prg
```

Record	Run	Edit		Tol

Viewing compressed steps

Program steps are sometimes compressed to save space on the edit screen. Compressed steps are displayed with a plus (+) sign in front of them as shown.

```
/   10⊞Probe Skew 1 (Pts=2)
/   14⊞Probe Line 2 (Pts=2)
·   18⊞Construct Point 3 (Fts=2)
```

In this example, step 18 contains all the steps required to construct the datum point. Use the procedure below to expand the step and view its sub-steps.

To expand a compressed program step

Step 1
Use the arrow keys to highlight the desired step as shown.

Step 2
Press the edit soft key.

The expanded step is displayed as shown. Notice that steps 19 through 21 are now displayed. Use the above procedure to view the sub-steps in any compressed step.

```
┌─────────────────────────────────────────┐
│ 002                    mm │1│ + │EDT     │
├─────────────────────────────────────────┤
│      9  Clr All                          │
│ ╱  10⊞Probe Skew  1 (Pts=2)             │
│ ╱  14⊞Probe Line  2 (Pts=2)             │
│ ·  18⊟Construct Point 3 (Fts=2)         │
│     19     Select Feature 2              │
│     20     Select Feature 1              │
│     21     Finish Measurement            │
│     22  Zero Y Axis Of Feat ⊟d           │
│     23  Targeting View On                │
│ o  24⊞Probe Circle  4 (Pts=3) Form       │
│     29  End Prg                          │
├─────────┬──────┬──────┬──────┬──────────┤
│ Record  │ Run  │ Edit │      │  Tol     │
└─────────┴──────┴──────┴──────┴──────────┘
```

Program properties step

Program properties is a set of basic parameters for each program. Users can edit program properties using the soft keys.

Program properties include:

Use machine reference
Press the *yes soft key* to use machine coordinates in the program until a datum is established while recording. Press the *no soft key* to use the skew/datum established before recording the program. The default depends on whether there is a datum (skew or hard zero) in the system before recording.

Clear features
Press the *yes soft key* to clear the features list at the beginning of the program. Press the *no soft key* to keep the features in the features list.

Use as recorded
Use as recorded applies to programs using optical edge detection. Press the *no soft key* to prompt the user to perform an edge teach before the first edge detection measurement. Press the *yes soft key* to use the edge detection as is. Most systems are stable enough to use as is. Some applications, for parts with varying light and edge definition, require an edge teach for each part.

Pause tolerance (tol) results
Press the *never soft key* to continue the program regardless of tolerance results. Press the *if fail soft key* to pause the program if a tolerance fails. Press the *if pass soft key* to pause the program if a tolerance passes. Press the *always soft key* to pause the program after each tolerance pass or fail.

Print tolerance (tol) results

Press the *never soft key* to never print the tolerance results. Press the *if fail soft key* to print the results if a tolerance fails. Press the *if pass soft key* to print the results if a tolerance passes. Press the *always soft key* to print the results after each tolerance pass or fail.

To edit program properties step

Step 1
Highlight the program properties step as shown.

Step 2
Press the *edit soft key*.

Step 3
Use the arrow keys to highlight the desired parameter as shown.

NOTE
In this example, the clear features parameter is highlighted.

Step 4
Press the desired soft key.

```
Prg Properties        mm |1 + EDT
Use Machine Ref       Yes
Clear Features        Yes
Use As Recorded       No
Pause Tol Results     If Fail
Print Tol Results     Never




    No     Yes
```

Step 5
Press the *finish key*.

System settings step

The system settings step is a 'snapshot' of the QC200 settings at the time the program was recorded. Parameters in the system settings step include:
• Targeting view on/off
• Select datum 1/ datum 2
• Probe
• Units
• Mode

Targeting view on/off
Targeting view indicates the location of feature points using a graphic display as shown. Press the *edit soft key* to toggle targeting view on and off.

NOTE
Users can press the *view soft key* to switch to targeting view while a program is running. Select *targeting view on* to make the targeting view the default display for a program.

Select datum 1/ datum 2
Use the *select datum 1/ datum 2 system setting* to select the desired datum for the program. Press the *edit soft key* to toggle between datum 1 and datum 2.

Probe
Use the *probe system setting* to select the desired probe for the program. Press the *edit soft key* to toggle between edge detection and crosshair probes.

Units

Use the *units system setting* to select the desired units of measure for the program. Press the *edit soft key* to toggle between millimeters and inches.

Mode

Use the *mode system setting* to select the desired coordinate display for the program. Press the *edit soft key* to toggle between polar and Cartesian coordinates.

To edit the system settings step

Step 1

Use the arrow keys to highlight the system settings step as shown.

Step 2

Press the *edit soft key*.

Step 3
Highlight the desired setting.

NOTE
In this example, the mode system setting is highlighted.

Step 4
Press the *edit soft key* to select the desired setting.

NOTE
In this example, the display coordinates for the program are toggled between polar and cartesian.

Step 5
Press the *finish soft key*.

To edit a feature measurement step

Step 1
Use the arrow keys to highlight the desired measurement step as shown.

Step 2
Press the *edit soft key*.

The step expands to show the compressed steps indented under the segment heading.

Inserting new steps

Sometimes, a critical step is inadvertently left out of a program. For example, a required tolerance might have been forgotten. In this case, simply use the edit functions to insert the tolerance as a new step.

The example below adds a new line measurement to an existing program. Use the basic steps in this example to insert steps into any program. When inserting new steps, make certain the datum used is the same as the one in the prior step.

To insert a new step in a program

NOTE
Record new program steps using the same datum as the step before it in the program.

Step 1
Highlight the desired step as shown.


```
002                      mm |1| + EDT

    1  Prg Properties
    2⊞Settings
    9  Clr All
 ╱ 10⊞Probe Skew 1 (Pts=2)
 ╱ 14⊞Probe Line 2 (Pts=2)
 · 18⊞Construct Point 3 (Fts=2)
   22  Zero Y Axis Of Feat ⊟d
   23  Targeting View On
 ○ 24⊞Probe Circle 4 (Pts=3) Form
   29  End Prg

Record | Run | Edit |     | Tol
```

NOTE
New steps are inserted after the highlighted step. For example, if the highlighted step is step 14 the new step is step 15.

Step 2
Press the *record soft key*.
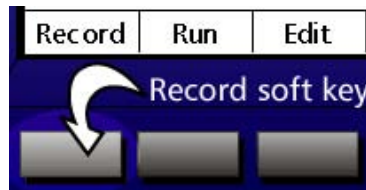
Step 3
Perform the new step.

NOTE
**In this example a new line measurement is added to the program.
See chapter 3: operation for information about measuring lines.**

Step 4
Press the menu key.

Step 5
Press the program (prog) soft key.

Step 6
Press the end (rec) record soft key.

The new line measurement step is added to the program as shown.

```
┌─────────────────────────────────────┐
│ 002                    mm │1 │ + │EDT│
│      1  Prg Properties               │
│      2⊞Settings                      │
│      9  Clr All                      │
│ ╱  10⊞Probe Skew 1 (Pts=2)           │
│ ╱  14⊞Probe Line 2 (Pts=2)           │
│    18  Mode = Cartesian              │
│ ╱  ▐19⊞Probe Line 5 (Pts=2)▌         │
│ •  23⊞Construct Point 3 (Fts=2)      │
│    27  Zero Y Axis Of Feat ⊟d        │
│    28  Targeting View On             │
│ ⚲ 29⊞Probe Circle 4 (Pts=3) Form     │
├──────┬──────┬──────┬──────┬──────────┤
│Record│ Run  │ Edit │      │ Tol      │
└──────┴──────┴──────┴──────┴──────────┘
```

To delete a program step

CAUTION
Deleted steps cannot be restored. Think carefully before deleting any program step.

NOTE
Do not delete measurement steps that are used for constructions later in the program. This causes the program to fail or yield unsatisfactory measurements.

Step 1
Highlight the desired step as shown.

```
┌─────────────────────────────────────────────┐
│ 002                        mm │1 │ + │EDT    │
│                                              │
│      1  Prg Properties                       │
│      2⊞Settings                              │
│      9  Clr All                              │
│ ╱  10⊞Probe Skew 1 (Pts=2)                   │
│ ╱  14⊞Probe Line 2 (Pts=2)                   │
│    18  Mode = Cartesian                       │
│ ╱  19⊞Probe Line 5 (Pts=2)                   │
│ ·  23⊞Construct Point 3 (Fts=2)              │
│    27  Zero Y Axis Of Feat ⊟d                │
│    28  Targeting View On                      │
│ ⚲  29⊞Probe Circle 4 (Pts=3) Form            │
│ Record │ Run │ Edit │      │ Tol             │
└─────────────────────────────────────────────┘
```

Step 2
Press the *cancel key*.

The step is deleted from the program.

```
┌─────────────────────────────────────────────┐
│ 002                        mm │1 │ + │EDT    │
│                                              │
│      1  Prg Properties                       │
│      2⊞Settings                              │
│      9  Clr All                              │
│ ╱  10⊞Probe Skew 1 (Pts=2)                   │
│ ╱  14⊞Probe Line 2 (Pts=2)                   │
│    18  Mode = Cartesian                       │
│ ·  19⊞Construct Point 3 (Fts=2)              │
│    23  Zero Y Axis Of Feat ⊟d                │
│    24  Targeting View On                      │
│ ○  25⊞Probe Circle 4 (Pts=3) Form            │
│    30  End Prg                                │
│ Record │ Run │ Edit │      │ Tol             │
└─────────────────────────────────────────────┘
```

Copying programs

Copy and edit existing programs to save time instead of creating new programs for similar parts. Use the editing functions to change, insert, or delete program steps to accommodate the new part.

To copy a program

Step 1
Press the *menu key*.

Step 2
Press the *program (prog) soft key*.

Step 3
Highlight the desired program as shown.
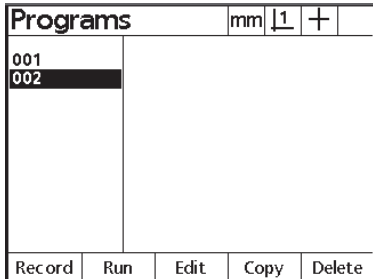
Step 4
Press the *copy soft key*.

Step 5
Press the *yes soft key*.
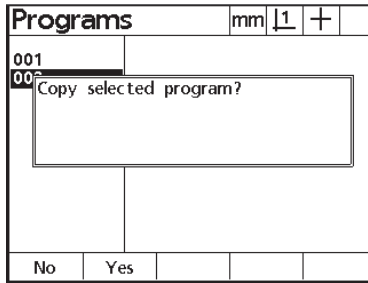
NOTE
Press the no soft key to abort the copy process.

Step 6
Enter the desired program number for the copied program.
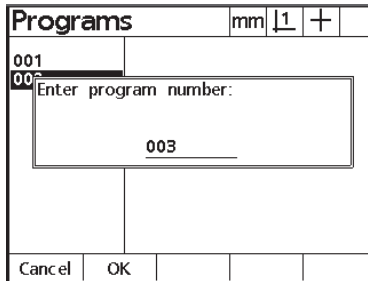
Step 7
Press the *OK soft key*.

The new program is added to the list of programs. Edit the copied program to accommodate the new part.

```
┌─────────────────────────────────────┐
│ Programs          mm│1 │+│           │
├──────────────┬──────────────────────┤
│ 001          │                      │
│ 002          │                      │
│ 003          │                      │
│              │                      │
│              │                      │
│              │                      │
│              │                      │
├────────┬─────┴───┬──────┬─────┬──────┤
│ Record │  Run    │ Edit │Copy │Delete│
└────────┴─────────┴──────┴─────┴──────┘
```

Deleting programs

Delete programs when longer needed to conserve system memory and make space for new programs.

To delete a program

CAUTION
Deleted programs cannot be restored. Think carefully before deleting any program.

Step 1
Press the *menu key*.

Step 2
Press the *program (prog) soft key*.

Step 3
Highlight the desired program as shown.

Step 4
Press the *delete soft key*.

Step 5
Press the *yes soft key*.

```
┌─────────────────────────────────────┐
│ Programs          mm ⌊1  ✛           │
│ 001                                  │
│ 00┌─────────────────────────────┐    │
│ 00│Delete selected program?     │    │
│   │                             │    │
│   │                             │    │
│   └─────────────────────────────┘    │
│                                      │
│                                      │
│                                      │
│   No      Yes                        │
└─────────────────────────────────────┘
```

NOTE
Press the *no soft key* to abort the deletion process.

The program is deleted from the list.

```
┌─────────────────────────────────────┐
│ Programs          mm ⌊1  ✛           │
│ 001                                  │
│ ▐002▌                                │
│                                      │
│                                      │
│                                      │
│                                      │
│                                      │
│ Record│ Run │ Edit │ Copy │ Delete   │
└─────────────────────────────────────┘
```

Chapter 5
Edge Detectors

Use optical edge detection to increase throughput, accuracy, repeatability and reduce operator fatigue. Optical edge detection recognizes light-to-dark or dark-to-light edge crossings on projection-based measuring machines. Each time a light-to-dark (or dark-to-light) is detected the QC200 identifies a point.

Manual edge detection

Manual optical edge detection recognizes light-to-dark or dark-to-light edge transitions. As each transition is detected a bell tone sounds. The operator must then press the enter key to accept the point.

Auto edge detection

Enter points automatically using auto edge detection. Auto edge detection recognizes light-to-dark or dark-to-light edge transitions and automatically enters the point. Each time an edge is crossed a point is entered.

To toggle between auto edge and manual edge detection

Step 1
Press the *menu key*.

Step 2
Press the *edge soft key*.

Step 3
Press the *auto edge (auto e) soft key.*

| al | Install | X Cal | Auto E |
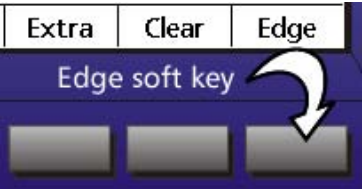
Auto edge soft key

The selected edge detection mode is indicated on the upper right portion of the screen. The auto edge detection icon appears as shown.

The manual edge detection icon appears as shown.

Connections

There are two fiber-optic cables that connect the QC200 to the optical comparator. One cable mounts over the view screen and detects light-to-dark (or dark-to-light) transitions. Press the curved metal tip of the cable through the hole in the plastic mounting plate on the view screen. Connect the second cable to the light source to serve as a reference.

CAUTION
Do not bend or pinch fiber-optic cables. Bending fiber-optic cables to a radius smaller than one inch degrades performance.

CAUTION
Do not expose fiber-optic cables to temperatures higher than 212° Fahrenheit/100° Celsius. High temperatures can degrade fiber-optic cable performance.

Connecting fiber-optic cables

Connect fiber-optic cables to the QC200 first and then connect to the comparator. Fiber-optic cable connections are located on the back panel of the QC200. The sensor cable connector is marked with a crosshair icon and the reference cable connector is marked with a light bulb icon. Attach all cables securely to the appropriate connections.
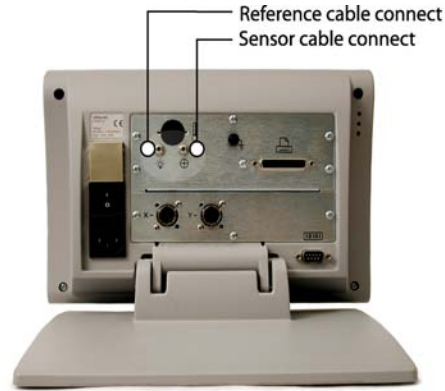
Fiber optic cable connections

Connecting the screen sensor cable to the comparator

Secure the sensor cable to the comparator screen using the plastic mounting plate provided. Place the mounting plate under the comparator's chart clips so the small hole in the plate is positioned over a lit portion of the comparator screen.

Clean the collecting end of the sensor cable with a soft lint-free cloth as necessary.

Place the metal tip of the sensor cable through the hole in the mounting plate and flush against the screen.

CAUTION
Be careful not to scratch the screen with the metal tip.

Secure the sensor cable to the plastic mounting plate.

Connecting the reference cable

Point the reference sensor directly at the comparator lamp. Consult the comparator manufacturer's information for specific mounting instructions.

CAUTION
Avoid mounting fiber-optic cables next to the lamp. High temperatures degrade fiber-optic cable performance. Install the cable to receive cooling air from the lamp fan if possible.

Checking the sensor light levels

Check fiber-optic cables and light sensors before using the edge detector. Light levels received by the sensor and reference cables are displayed on the optical edge detection install screen as shown. Adjust light levels by moving the sensors.

To check sensor cable light levels

NOTE
Make sure the sensor cable is positioned over a dark area of the comparator screen and make sure the comparator light source is on.

Step 1
Press the *menu key*.

Step 2
Press the *edge soft key*.
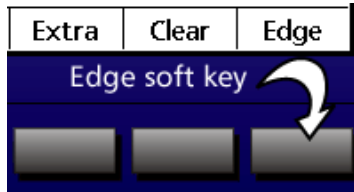
Step 3
Press the *install soft key*.

The light levels screen appears as shown.
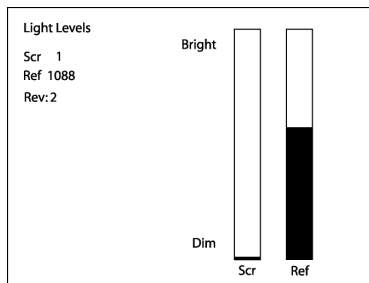
Step 4

Position the sensor cable is positioned over a light area of the comparator screen

The light levels screen appears as shown. Screen levels generally range from 500 to 4000. Reference levels generally range from 1000 to 2000.

```
Light Levels              Bright

Scr  536
Ref 1088
Rev: 2




                                                 Dim
                            Scr    Ref
```
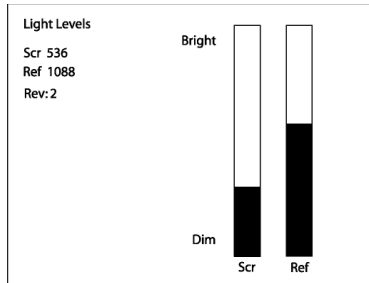
Troubleshooting
Light Levels

Screen level too high
- Check the rear connection to the QC200.
- Verify that the sensor tip is positioned over a dark area of the screen.

If the problem persists...
Disconnect the screen sensor cable from the QC200 and cover the cable connector with a finger . The screen level should drop to *dim*. If the light level does not drop, contact your Metronics distributor.

Screen level too low
- Check the rear connection to the QC200.
- Verify that the sensor tip is positioned over a light area of the screen.

If the problem persists...
Disconnect the screen sensor cable from the QC200 and shine a flashlight into the sensor cable connector . The screen level should rise. If the light level rises, check cables for wear. If the light level does not rise, contact your Metronics distributor.

Reference level too high
- Reposition the sensing end of the reference cable slightly away from the light source.

Reference level too low
- Reposition the sensing end of the reference cable to point more directly at the light source.

CAUTION
Avoid mounting fiber-optic cables too close to the lamp. High temperatures degrade fiber-optic cable performance. Install the cable to receive cooling air from the lamp fan if possible.

Edge Detector Calibration

Perform the following calibrations before operating the edge detector:
- Teach
- Distance cal
- Cross cal

Use *teach* to calibrate the edge detector to recognize light and dark areas of the comparator screen. Use the *distance calibration (d. cal)* to calibrate the edge detector to accurately read irregular or fuzzy edges. Use the *cross calibration (x cal)* to calibrate the edge detector to compensate for the offset between crosshairs and the edge detector sensor cable.

Teach

Perform a teach calibration after each startup or whenever the part or magnification level changes. The teach calibration trains the QC200 to recognize the light-to-dark and dark-to-light transitions on your comparator. Any change in the light conditions on the comparator should be followed by a teach calibration.

To perform a teach calibration

NOTE
Press the *probe soft key* to select the edge detection probe before calibration.

Step 1
Press the *menu key*.

Step 2
Press the *edge soft key*.
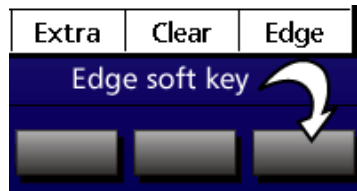
Step 3
Press the *teach soft key* to perform the calibration.

Teach | D. Cal | Install
Teach soft key

The user is prompted to place the edge detector sensor over a dark area of the comparator screen.

Current Position mm ⊥ ⦿
X   5.4410
Place edge detector in dark and
press Enter.

DRO
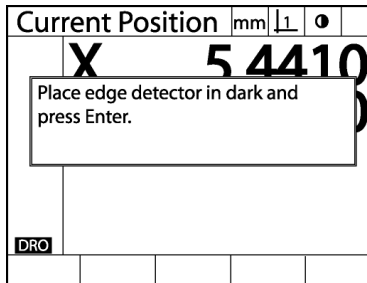
Step 4
Place the edge detector sensor over a dark area.

Step 5
Press the *enter key*.

The user is instructed to prompted to place the edge detector sensor over a light area of the comparator screen.

Current Position mm ⊥ ⦿
X   4.4410
Place edge detector in light and
press Enter.

DRO
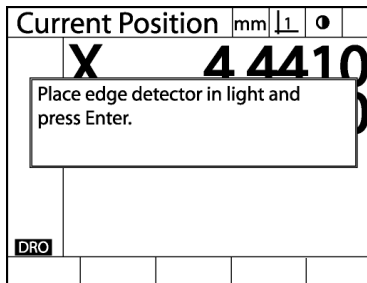
Step 6
Place the edge detector sensor over a light area.

Step 7
Press the *enter key*.

The teach calibration is complete. Test the edge detector over a few transitions to verify the teach calibration was successful.

Distance calibration (d. cal)

It is not necessary to perform a distance calibration unless measuring parts with poorly defined edges. Perform a distance calibration to fine tune the edge detector for irregular edges. Parts with rounded edges or thick parts require distance calibrations.

To perform a distance calibration

NOTE
Place a standard on the measuring device to perform a distance calibration.

Step 1
Press the *menu key.*

Step 2
Press the *edge soft key.*
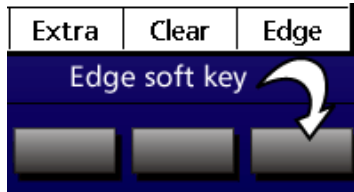
Step 3
Press the *distance calibration (d. cal) soft key.*
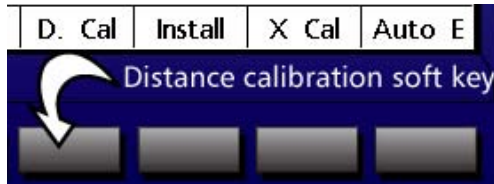
The user is prompted to place the edge detector sensor over a dark area of the comparator screen.

Step 4
Place the edge detector sensor over a dark area.

Step 5
Press the *enter key*.

The user is prompted to place the edge detector sensor over a light area of the comparator screen.

Current Position mm ⊥ ◑

X   4.4410

Place edge detector in light and
press Enter.

DRO

Step 6
Place the edge detector sensor over a light area.

Step 7
Press the *enter key*.

The user is prompted to place the edge detector sensor over a dark area of the comparator screen.

Current Position mm ⊥ ◑

X   5.4410

Place edge detector in dark and
press Enter.

DRO
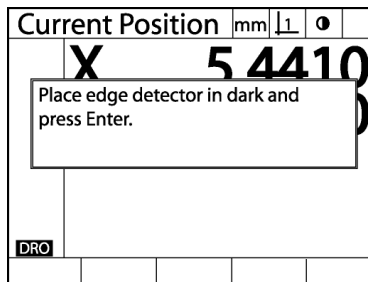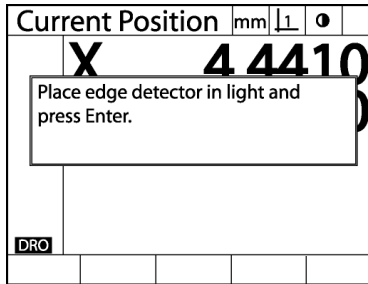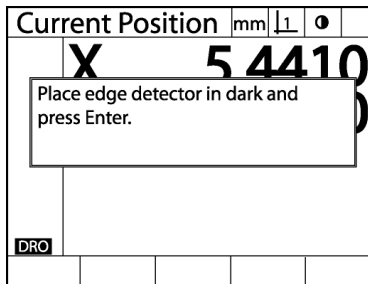
Step 8
Place the edge detector sensor over a dark area.

Step 9
Press the *enter key*.

The user is prompted to enter the standard's size.

Current Position mm ⊥ ◐

X   4.4410

Please enter the standard size

_____

DRO

Step 10
Use the numeric keypad to enter the standard's size.

Current Position mm ⊥ ◐

X   4.4410

Please enter the standard size

25.000_____

DRO

Step 11
Press the *enter key*.

The user is prompted to press the *enter key* and measure a distance using the edge detector.

Current Position mm ⊥ ◐

X   4.4410

When ready to measure a Distance
with the edge detector, press
ENTER.

DRO

Step 12
Measure the distance of the standard.

```
┌─────────────────────────────────────────┐
│ Current Position  mm │⊥│ ◑ │            │
├─────────────────────────────────────────┤
│ ↔  1                                     │
│  ┌────────────────────────────────────┐ │
│  │Distance measured was 24.999070.    │ │
│  │The standard size was  25.000000.   │ │
│  │This is within 2 counts so you      │ │
│  │have completed the distance cal.    │ │
│  └────────────────────────────────────┘ │
│                                          │
│                                          │
│ DRO                                      │
├─────┬─────┬─────┬─────┬─────────────────┤
│ OK  │     │     │     │                 │
└─────┴─────┴─────┴─────┴─────────────────┘
```
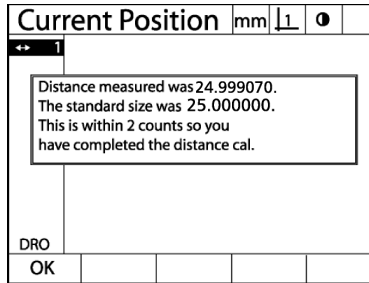
NOTE
See chapter 3: operation for information on measuring distances.

NOTE
If the difference between the nominal standard distance and the actual distance measured is too large the user is prompted to press the enter key and begin a new distance measurement. The QC200 repeats this step until an acceptable result is produced.

Step 13
Press the *finish key*.

The distance calibration is complete.

Cross calibration (x cal)

Cross calibration compensates for the offset between the crosshairs and the edge detector sensor in the different probing modes (crosshair, edge, and auto-edge) to ensure accurate results. If your comparator is edge detection only it is not necessary to perform a cross calibration. Perform cross calibrations each time the edge detector sensor is changed or repositioned.

To perform cross calibration

NOTE
Use the Metronics Quickie slide for the cross calibration.

Step 1
Press the *menu key*.

Step 2
Press the *edge soft key*.

Extra	Clear	Edge

Edge soft key
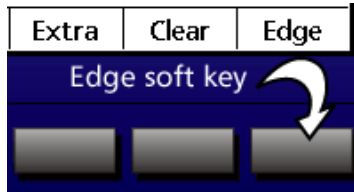
Step 3
Press the *cross calibration (x. cal) soft key*.

Teach	D. Cal	Install	X Cal

Cross calibration soft key

The user is prompted to measure a circle with the crosshairs. The probe changes to crosshair automatically.

Current Position mm ⊥ +

X   5.4410

Prepare to measure a circle with
the Crosshair. Press ENTER when
ready to start.

DRO
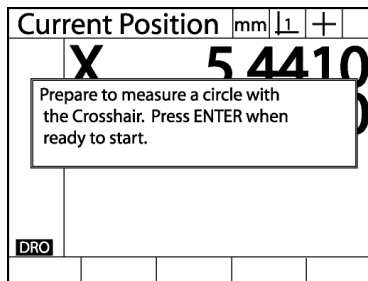
Step 4
Measure the circle.

NOTE
Use the largest circle on the slide. See chapter 3: operation for information about measuring circles.

Step 5
Press the *finish key*.

The user is prompted to measure the same circle using the edge detector. The probe changes to edge detector automatically.

```
Current Position  mm ⊥ ◐
○  1
   ┌─────────────────────────────┐
   │ Prepare to measure the same circle │
   │ with the Edge Detector. Press │
   │ Enter when ready to start.    │
   └─────────────────────────────┘



 DRO
  OK
```
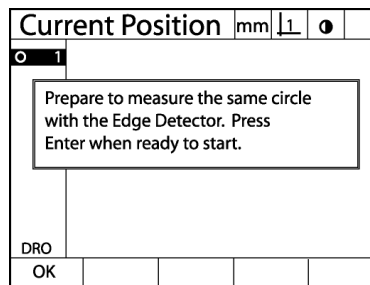
Step 6
Measure the circle.

When the second circle measurement is complete, the cross calibration is finished.

```
Current Position  mm ⊥ ◐
○  1
○  2
   ┌─────────────────────────────┐
   │ The cross calibration was    │
   │ succesful!                   │
   │                              │
   └─────────────────────────────┘


 DRO
  OK
```
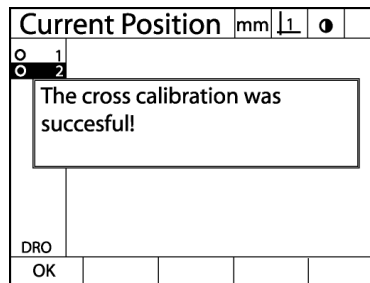
Step 7
Press the *finish key* to return to the DRO screen.

The cross calibration is complete.

Chapter 6
Communications

Use this chapter to establish a connection between the QC200 and a computer or printer. There are three PC applications used to receive data from the QC200:
- HyperTerminal
- WinWedge®

The QC200 prints to both serial and parallel printers. Parallel printers must support the *text only* mode.

NOTE
Only printers sold by Metronics are tested for compatibility with the QC200. Other printers may work with the QC200 but Metronics has not evaluated their compatibility.

Contact your Metronics distributor to purchase a RS-232 cable if you do not have one. The cable part number is 11B12176.

Connections

To connect to a PC using the RS-232 cable

NOTE
Turn off the power to both the PC and the QC200 before connecting the RS-232 cable.

RS-232 pin outs for QC-100, QC-200, TC-100, & TC-200
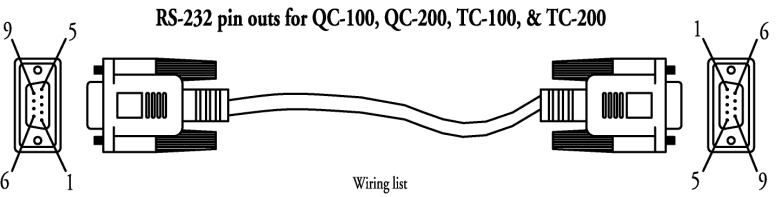
Wiring list

9 pin DSUB (f)	cable	9 pin DSUB (f)
2	RX/TX	2
3	TX/RX	3
4	DTR/NC	4
5	GND/GND	5
7	RTS/CTS	7
8	CTS/RTS	8
case	shield	case

Step 1
Connect the RS-232 cable to *com 1* or *com 2* port on the PC.

Step 2
Connect the RS-232 cable to the RS-232 port on the QC200.

Step 3
Restore power to the PC and the QC200.

Using HyperTerminal

Use HyperTerminal to connect a computer to the QC200 and transfer data to the computer.   HyperTerminal uses the RS-232 ports on the computer and the QC200 and is included on most Windows® PCs.

To connect to a computer using HyperTerminal

Steps 1 through 15 describe how to set up HyperTerminal to receive data from the QC200.

Step 1
Double-click on the *HyperTerminal icon.*

Hypertrm.exe

NOTE
Use the *Windows® start menu* to open HyperTerminal if there is no shortcut icon on the desktop. Click on the *start button*, followed by *programs*, then *accessories*.

Step 2
Type a file name and highlight an icon.
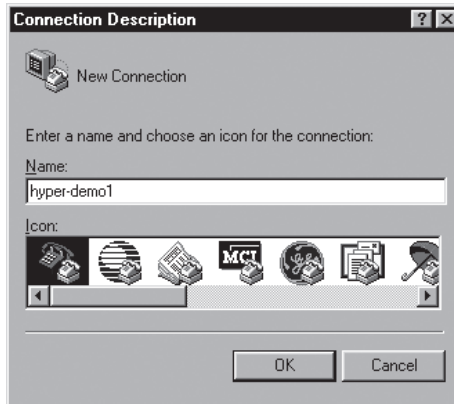
Step 3
Click *OK.*

Step 4
Select the desired port (*direct to com1* or *direct to com2*) from the connect using list box.

Step 5
Click *OK.*

Step 6
Enter the port settings as shown.
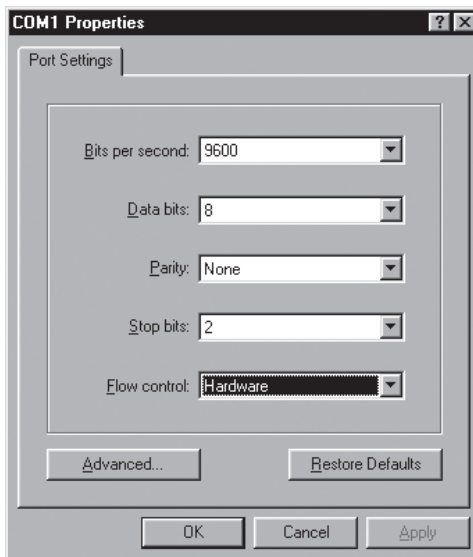
Port settings:

Bits per second:	9600
Data bits:	8
Parity:	None
Stop bits:	2
Flow control:	Hardware

NOTE
Use the same port settings on the QC200. See steps 15 through 21.

Step 7
Click *OK.*

Step 8
Click on the *file menu* and select *properties*.
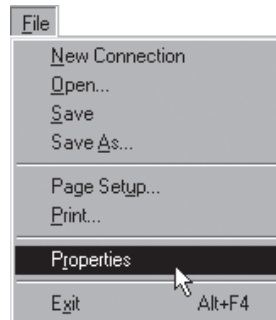
Step 9
Click on the *settings tab* and match the following settings:
- *Terminal keys*
- Set *emulation* to *auto detect*
- Set *backscroll buffer lines* to *100*

Leave the remaining settings as is.
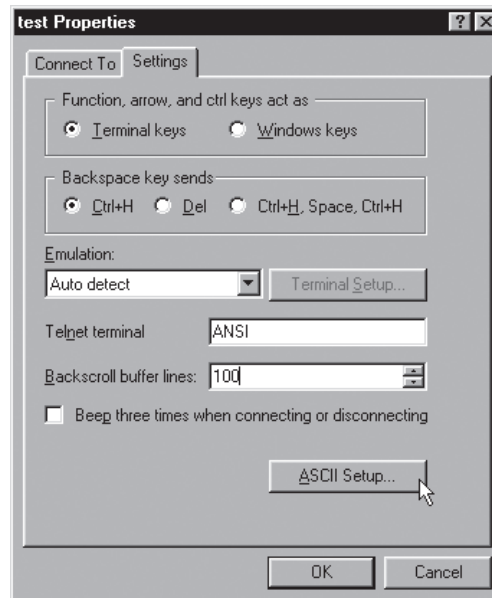
Click the *ASCII setup button* when finished.

Step 10
Match the following settings:

- Check *echo typed characters locally*
- Enter 0 milliseconds for *line delay*
- Enter 0 milliseconds for *character delay*
- Check *append line feeds to incoming line ends*
- Check *wrap lines that exceed terminal width*
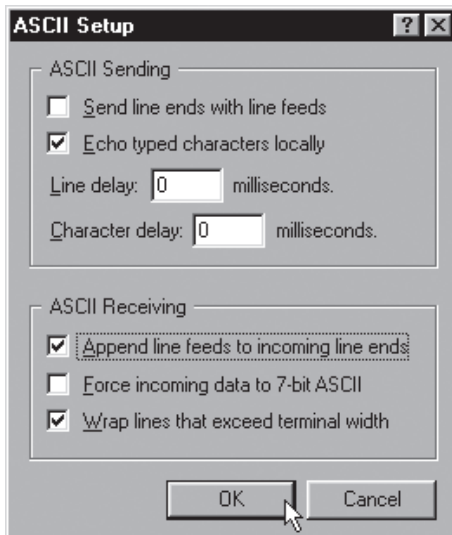
Step 11
Click *OK.*

Step 12
Click *OK.*
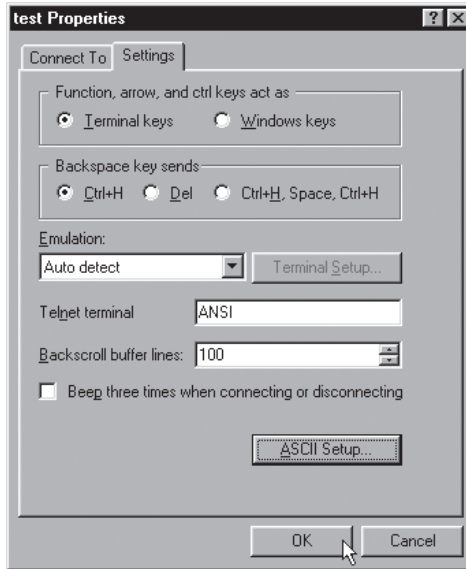
Step 13
Click on the *file menu* and select *save as...* in the HyperTerminal application.
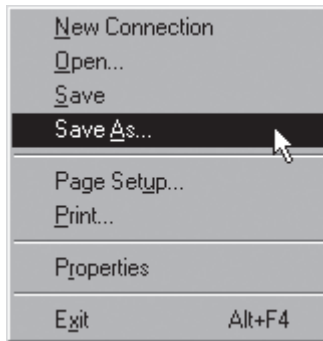
Step 14
Type the desired file name and click *save*.
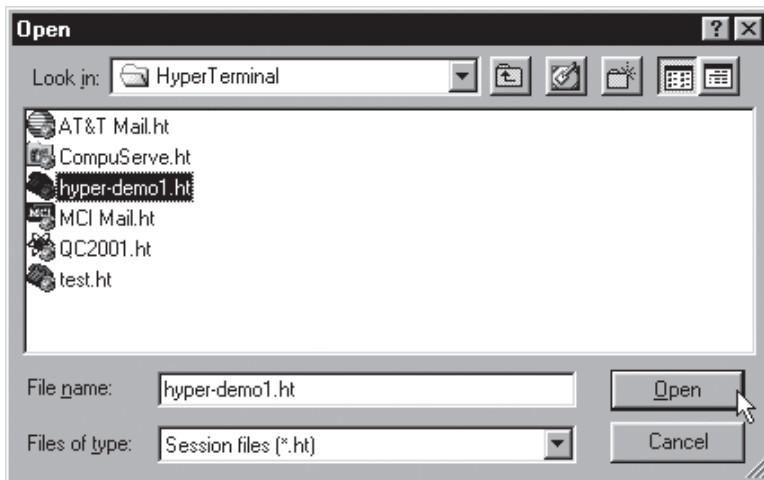
Steps 15 through 21 describe how to set up the QC200 to send data to HyperTerminal.

Step 15
Press the *menu key*.

Step 16
Press the *setup soft key*.

Step 17
Highlight *ports* in the list as shown.

Step 18
Enter the following RS-232 port settings.

Port settings:

Baud:	9600
Word length:	8
Stop bits:	2
Parity:	None
Handshake:	Hardware

Step 19
Set the RS-232 data field to either *display*, *report*, or *tolerance (tol rpt) report*.

Step 20
Highlight the *parallel data field* and press the *none soft key*.

```
Ports                    mm |1  +
          RS232
About     Baud              9600
Display   Word Len         8
Encoders  Stop Bits        2
Hot Keys  Parity            None
Print     Handshake        Hard.
Form Chars Data             Display
Ports     EOC Delay        330
Measure   EOL Delay        0
Sounds    Parallel
Supervisor  Data           None
   ─
   None  Display  Report  Tol Rpt
```

Step 21
Press the *finish key* twice.

To send data from the QC200 to HyperTerminal

Step 1
Press the *send/print key*.

NOTE
Users can also select print options from the *extra menu*. Press the *menu key*, followed by the *extra soft key*, and use the arrow keys to highlight the desired print option. For example, highlight *send D* to print the diameter of a circle. See chapter 3: operation for more information about the extra menu print options.

The QC200 data appears in HyperTerminal as shown.


```
Id: 4 Circle
X      -2.9972 in
Y      -1.1915 in
r       0.2509 in
d       0.5018 in
F       0.0000 in
_
```
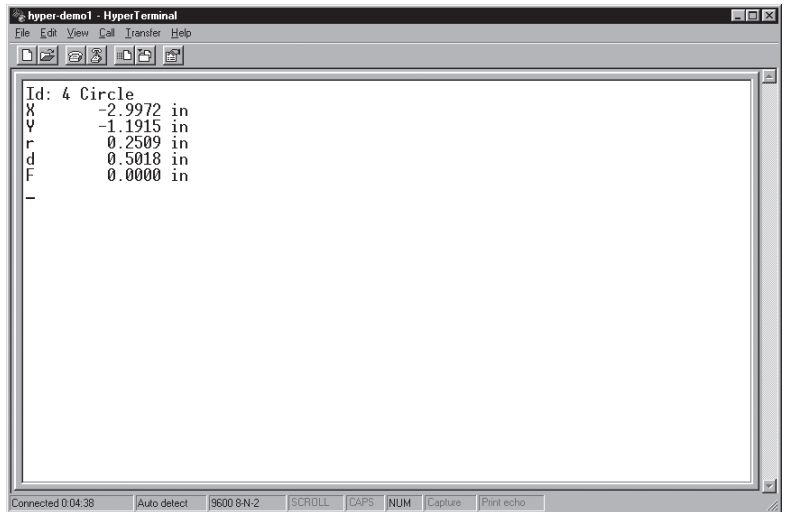
NOTE
If no data appears in HyperTerminal when the send/print key is pressed, verify that the RS-232 cable is connected to the correct port (com1 or com2) of the computer. Check that the port settings on the QC200 match the settings for the HyperTerminal session.

Using WinWedge®

Use WinWedge® to connect a computer to the QC200 and transfer data to the computer. WinWedge® uses the RS-232 ports on the computer and the QC200 to send data to a spreadsheet or other applications.   Contact your Metronics distributor to purchase WinWedge® for your computer.

To connect to a computer using WinWedge®

NOTE
WinWedge® sends data to a user defined application. For example, this example uses WinWedge® to send data to Microsoft® Excel.

Step 1
Double-click on the WinWedge® icon.

Software
Wedge

NOTE
Use the *Windows® start menu* to open WinWedge® if there is no shortcut icon on the desktop.

Step 2
Click on *mode menu...*

and choose *send keystrokes to...*
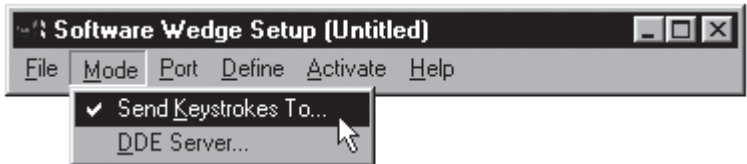
Step 3
Type *EXCEL* in the *application title bar text box* as shown.

NOTE
Type the name of the application that will receive the QC200 data. This example uses Microsoft® Excel spreadsheet. Type the application name in all capitals as shown .

Playback Keystrokes To:

Application Title Bar Text
EXCEL

OK

Command Line

Cancel

In "Send Keystrokes" mode, WinWedge converts incoming serial data to keystrokes and sends these keystrokes to another application program.

The "Application Title Bar Text" and "Command Line" allow you to specify the application that is to receive all keystrokes from WinWedge.

Leave both items blank to have WinWedge send keystrokes to whatever window has the input focus when serial data is received.

NOTE
Leave the Command Line Box blank

Step 4
Click *OK.*

Step 5
Click on the *port menu...*

Software Wedge Setup (Untitled)

File   Mode   Port   Define   Activate   Help

and choose *settings...*

Software Wedge Setup (Untitled)

File   Mode   Port   Define   Activate   Help

Settings...
Analyze...
Beep On Input
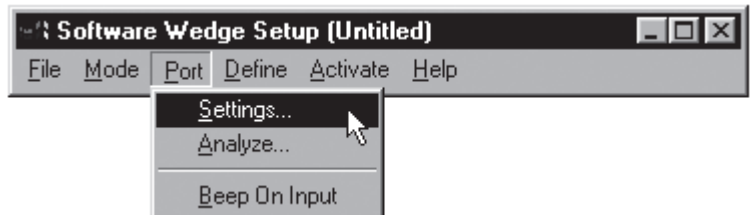
Step 6
Enter the following settings:
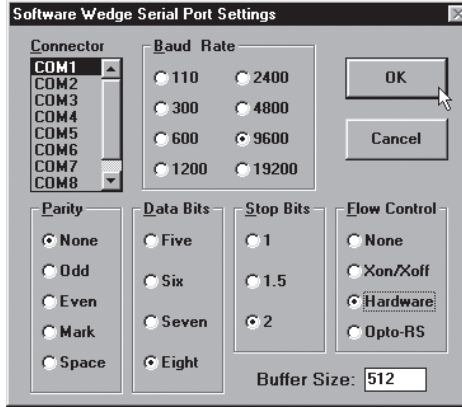
- Connector: COM 1 or COM2 (as connected)
- Baud rate: 9600
- Parity: None
- Data bits: 8
- Stop bits: 2
- Flow control: Hardware
- Buffer size: 512

Step 7
Click *OK*.

Step 8
Click on the define menu...

and choose *input data record structure*.
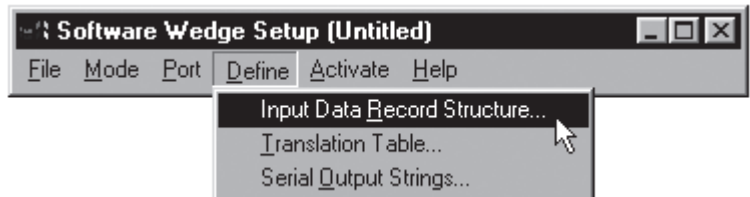
Step 9
Select Carriage Return or CrLf Received
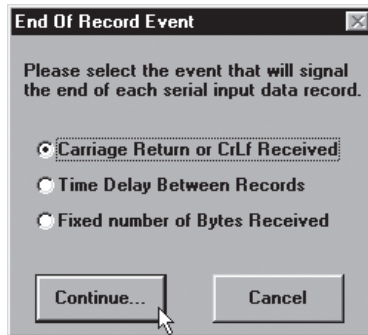
Step 10
Click on *continue*.

Step 11
Select *single field data records*.
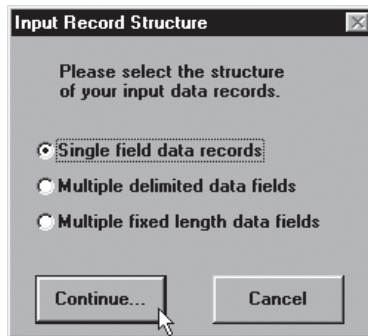
Step 12
Click on *continue*.

Step 13
Select *numeric* from the *filter list* as shown.
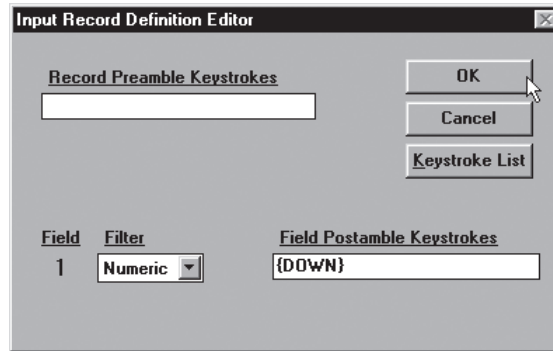
Step 14
Type *{DOWN}* in the *field postamble keystrokes text box.*

NOTE
Leave the *record preamble keystrokes field* blank.

Step 15
Click *OK.*

Step 16
Click on the *activate menu* and choose *test mode.*
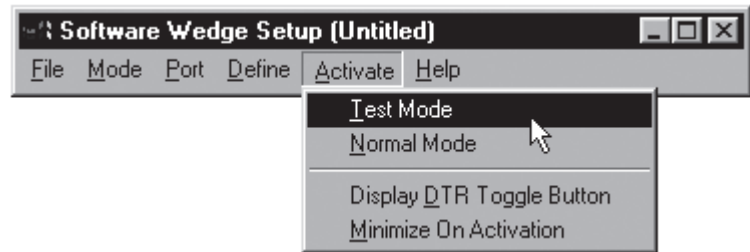
The WinWedge® connection window appears.
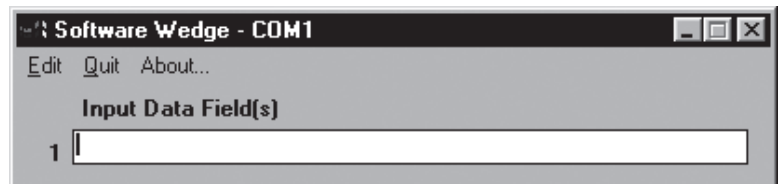
Steps 16 through 22 describe how to set up the QC200 to send data to WinWedge®.

Step 16
Press the *menu key*.

Step 17
Press the *setup soft key*.

Step 18
Highlight *ports* in the list as shown.

Step 19
Enter the following RS-232 port settings.

```
Ports                    mm |1 +
        RS232
About   Baud              9600
Display Word Len          8
Encoders Stop Bits        2
Hot Keys Parity           None
Print   Handshake         Hard.
Form Chars Data           Display
Ports   EOC Delay         330
Measure EOL Delay         0
Sounds  Parallel
Supervisor Data           None
  Dec     Inc
```

Port settings:

Baud:	9600
Word length:	8
Stop bits:	2
Parity:	None
Handshake:	Hardware

Step 20
Set the RS-232 data field to *display*.

```
Ports                    mm |1 +
        RS232
About   Baud              9600
Display Word Len          8
Encoders Stop Bits        2
Hot Keys Parity           None
Print   Handshake         Hard.
Form Chars Data           Display
Ports   EOC Delay         330
Measure EOL Delay         0
Sounds  Parallel
Supervisor Data           None
  None  Display  Report  Tol Rpt
```

Step 21
Highlight the *parallel data field* and press the *none soft key*.

```
Ports                    mm |1 +
        RS232
About   Baud              9600
Display Word Len          8
Encoders Stop Bits        2
Hot Keys Parity           None
Print   Handshake         Hard.
Form Chars Data           Display
Ports   EOC Delay         330
Measure EOL Delay         0
Sounds  Parallel
Supervisor Data           None
  None  Display  Report  Tol Rpt
```

Step 22
Press the *finish key* twice.

The QC200 is now set up to send data to the WinWedge® application.

To send data to WinWedge®

Step 1
Press the *send/print key*.

NOTE
Users can also select print options from the *extra menu*. Press the *menu key*, followed by the *extra soft key*, and use the arrow keys to highlight the desired print option. For example, highlight *send D* to print the diameter of a circle. See chapter 3: operation for more information about the extra menu print options.

The data is displayed in the WinWedge window as shown.
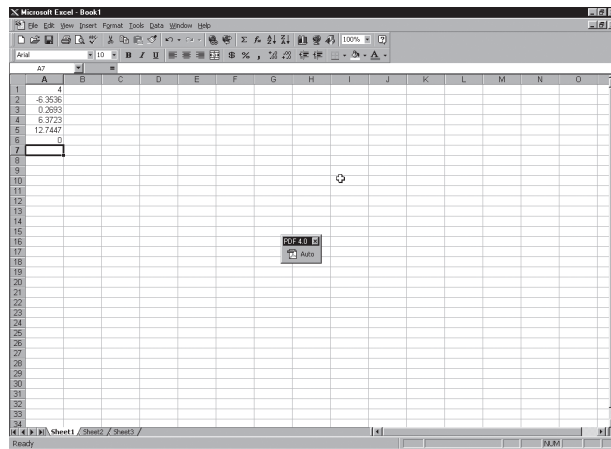
NOTE
If no data appears in WinWedge® when the send/print key is pressed, verify that the RS-232 cable is connected to the correct port (com1 or com2) of the computer. Check that the port settings on the QC200 match the settings in the WinWedge® application.

Ascii codes

Use *ascii character codes* to adjust the format of printed reports. Insert the desired ascii character codes in the preline, post line, and post form fields of the print setup screen. For example, use ascii character codes to insert a line feed and carriage return command as shown here.

```
Print                        mm  1  +
              Report Width 80
About         Lines / Page   60
Display       Form Feed      Yes
Encoders      Pre Line       _____
Hot Keys      Post Line      10 13
Print         Post Form      _____
Form Chars    Auto Label     Yes
Ports         Print Edges    Off
Measure       Print Units    Yes
Sounds        IRDA Enabled   No
Supervisor    Parallel Retry 0
```

NOTE
Insert pre-form characters on the *form characters (form chars) screen*.

In the example above, ascii character codes 10 (line feed) and 13 (carriage return) are included in the post line field. This instructs the printer to perform a line feed and carriage return after each line of print.

Use the decimal key on the numeric keypad to space ascii character codes in the fields. The QC200 does not recognize multiple unspaced ascii codes.

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	

6-21

Printer connections

Connect the QC200 to a printer via the printer port or the RS-232 port. Use the printer port to connect to a parallel printer and use the RS-232 port to connect to a serial printer. See the illustration at the beginning of this chapter to locate the printer and RS-232 ports.

To connect to a parallel printer

NOTE
Shut off power to the printer and the QC200 while connecting the printer cable.

Step 1
Connect the printer cable to the printer port located on the rear of the QC200.

Step 2
Connect the printer cable to the parallel printer.

Step 3
Restore power to the printer and QC200.

Step 4
Press the *menu key*.

Step 5
Press the *setup soft key*.

Step 6
Highlight the *ports field* as shown.

```
Ports                        mm |1  +
                   RS232
About              Baud           9600
Display            Word Len       8
Encoders           Stop Bits      2
Hot Keys           Parity         None
Print              Handshake      Hard.
Form Chars         Data           Display
Ports              EOC Delay      330
Measure            EOL Delay      0
Sounds           Parallel
Supervisor         Data           None
   ▼
```

Step 7
Enter the following RS-232 port settings.

```
Ports                        mm |1  +
                   RS232
About              Baud           9600
Display            Word Len       8
Encoders           Stop Bits      2
Hot Keys           Parity         None
Print              Handshake      Hard.
Form Chars         Data           None
Ports              EOC Delay      330
Measure            EOL Delay      0
Sounds           Parallel
Supervisor         Data           Report
   ▼
 None  | Display | Report | Tol Rpt
```

Port settings:

RS-232 data:	None
Parallel data:	Display, report, or tolerance (tol rpt) report

Step 8
Press the *finish key* twice.

The parallel printer is connected to the QC200. Press the send/print key to
print reports.

To connect to a serial printer

NOTE
Shut off power to the printer and the QC200 while connecting the printer cable.

Step 1
Connect the RS-232 cable to the RS-232 port located on the rear of the QC200.

Step 2
Connect the RS-232 cable to the serial printer.

Step 3
Restore power to the printer and the QC200.

Step 4
Press the *menu key*.

Step 5
Press the *setup soft key*.

Step 7
Highlight the *ports field* as shown.

NOTE
Use the arrow keys to highlight the desired field.

Step 8
Enter the following RS-232 port settings.

```
Ports                      mm |1  +

         RS232
About    Baud              9600
Display  Word Len          8
Encoders Stop Bits         2
Hot Keys Parity            None
Print    Handshake         Hard.
Form Chars Data            Report
Ports    EOC Delay         10000
Measure  EOL Delay         125000
Sounds   Parallel
Supervisor Data            None
   ▼
```

Port settings:

Bits per second:	9600
Word length:	8
Parity:	None
Stop bits:	1
Flow control:	Hardware
EOL delay:	125,000
EOC delay:	10,000
Parallel data:	None

Step 9
Highlight the *print field* as shown.

```
Print                      mm |1  +

         Report Width  80
About    Lines / Page   60
Display  Form Feed      Yes
Encoders Pre Line
Hot Keys Post Line      10 13
Print    Post Form
Form Chars Auto Label   Yes
Ports    Print Edges    Off
Measure  Print Units    Yes
Sounds   IRDA Enabled   No
Supervisor Parallel Retry 0
   ▼
```

Step 10
Enter the following print settings.

```
Print                      mm |1  +
                   Report Width 80
About              Lines / Page  60
Display            Form Feed     No
Encoders           Pre Line
Hot Keys           Post Line     10 13
Print              Post Form
Form Chars         Auto Label    Yes
Ports              Print Edges   Off
Measure            Print Units   Yes
Sounds             IRDA Enabled  No
Supervisor         Parallel Retry 0
   ▼
   No      Yes
```

Print settings:
        Form feed: No
        Post line: 10   13

NOTE
Use ascii character codes *10 (line feed)* and *13 (carriage return)* to instruct the printer to perform a line feed and carriage return at the end of each line. Press the decimal key on the numeric keypad to put a space between the ascii codes.

Step 11
Press the *finish key* twice.

The serial printer is connected to the QC200. Press the send/print key to print reports.

NOTE
Some additional configuration may be required for serial printers. Consult the printer manufacturer's literature for more information.

Keyboard Commands

Use keyboard commands to operate the QC200 via a computer connection. Keyboard commands can perform the task of any button on the front of the QC200. For example, typing keyboard command *KEY 33* in HyperTerminal is the same as pressing the *enter key*.

NOTE
Versions 1.21 and above recognize the following keyboard command format: @Id. For example, typing @33 is the same as pressing the enter key.

QC200 Keyboard Commands

Id	Key Name	Id	Key Name
1	Left fast track key	23	2
2	Right fast track key	24	3
3	Zero X axis	25	4
4	Zero Y axis	26	5
5	Zero Q axis	27	6
7	Left arrow	28	7
8	Up arrow	29	8
9	Right arrow	30	9
10	Down arrow	31	.
11	Soft key 1	32	+/-
12	Soft key 2	33	Enter
13	Soft key 3	34	Finish
14	Soft key 4	35	Cancel
15	Soft key 5	36	Quit
16	Print	37	Point
17	mm/inch	38	Line
18	Datum	39	Circle
19	Polar/cartesian	40	Distance
20	Help	41	Angle
21	0	42	Skew
22	1	43	Measure magic
		44	Power (display only)

Chapter 7
Setup

Before You Begin

Day to day use of the QC200 does not require re-configuration of system settings. Most of the procedures in this chapter are performed during initial installation and are rarely changed. Understand that changes made on any of the setup screens affect the operation of the QC200. Only properly trained supervisory personnel should alter the QC200 setup. To prevent unintended or unauthorized changes to the system setup, many setup fields are password restricted. For example, the encoder setup screen is displayed on the left with password restriction. Only the axis field can be accessed. The encoder setup screen shown on the right is how the screen is displayed once the supervisor password is entered. All the fields can now be accessed.

CAUTION
Do not change any QC200 setup screens or fields unless you are certain what the change will do. Attempting to correct a problem by changing setup fields at random will worsen any existing problem. Contact your Metronics distributor before proceeding.

Supervisor password
Enter the supervisor password on the supervisor setup screen to access password restricted setup fields. Contact your Metronics distributor to receive your password. Limit password use to operators or supervisors properly trained to change the QC200 setup.

To enter the supervisor password

NOTE
Contact your Metronics distributor to receive your password.

Step 1
Press the *menu key*.

Step 2
Press the *setup soft key*.
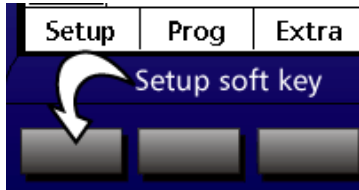
Step 3
Highlight *supervisor field* as shown.
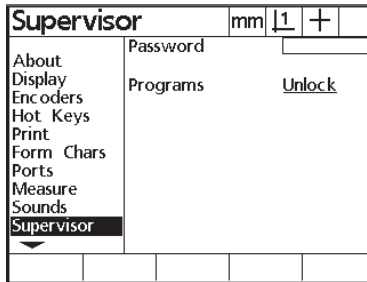
NOTE
Use the arrow keys to highlight the desired field.

Step 4
Highlight the *password field* as shown.
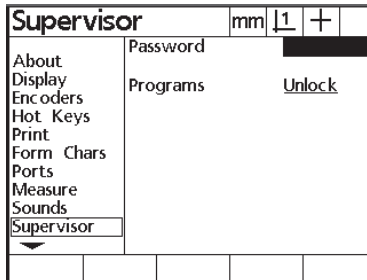
Step 5
Enter the *supervisor password* as shown.

```
Supervisor              mm |1 +
                 Password    XXXXXX
About
Display          Programs    Unlock
Encoders
Hot Keys
Print
Form Chars
Ports
Measure
Sounds
Supervisor
  ▼
```

Step 6
Press the *finish key*.

All password restricted setup fields can now be accessed.

Setup Screens

Press the *menu key* and then the *setup soft key* to view setup screens. Use the list on the left-hand side of the screen to select the desired setup screen. Setup screens on the QC200 are as follows:

- About
- Display
- Encoders
- Hot keys
- Print
- Form (form chars) characters
- Ports
- Measure
- Sounds
- Supervisor
- Squareness
- LEC
- SLEC
- NLEC
- Scale factor
- Miscellaneous (misc)
- Clock

About

Highlight the *about field* in the list as shown.

Use the *about setup screen* to change the language on the QC200 display. Software version information and factory options are displayed on the bottom of the screen.

Display

Highlight the *display field* as shown.

Use the display setup screen to enter measurement resolution and display parameters.

Set display resolution fields to match encoder resolution.

Set the *startup linear* and *startup angular fields* to define the default display of linear and angular measurements.   For example, set *startup linear* to mm (millimeters) to display linear measurements in metric units each time the QC200 is started.

Set the *radix field* to *decimal* or *comma*. There is no difference between measurements displayed with a decimal radix or a comma radix. Select the radix appropriate for your reporting needs.

Display		mm	⌊1	+
	MM Disp Res	0.0001		
About	Inch Disp Res	0.0001		
Display	DMS Disp Res	0.00.01		
Encoders	DD Disp Res	0.001		
Hot Keys	Startup Linear	MM		
Print	Startup Angular	DMS		
Form Chars	Radix	Decimal		
Ports	Current Angular	DMS		
Measure				
Sounds				
Supervisor				
Decimal Comma				

Set the *current angular field* to define the angular units of measure for the current session. If the *current angular field* is different from the *startup angular field*, the units shown in the *startup angular field* are displayed when power is cycled off and on.

Display		mm	⌊1	+
	MM Disp Res	0.0001		
About	Inch Disp Res	0.0001		
Display	DMS Disp Res	0.00.01		
Encoders	DD Disp Res	0.001		
Hot Keys	Startup Linear	MM		
Print	Startup Angular	DMS		
Form Chars	Radix	Decimal		
Ports	Current Angular	DMS		
Measure				
Sounds				
Supervisor				
DD **DMS**				

Encoders

Highlight the encoder field as shown.

```
Encoders                  mm  1  +
                Axis        X
About
Display         Res         0.0010000000
Encoders
Hot Keys
Print
Form Chars      Type        TTL
Ports           Ref Marks   None
Measure         M.Z. Cnts   0
Sounds          Reversed    No
Supervisor      Interpolation X1
                Units       MM
```

Use the encoder setup screen to define encoder parameters for each axis.

Match the resolutions entered on this screen exactly to the resolution printed on your TTL encoders.

Resolution of analog encoders is determined by the following method. Multiply the interpolation (selected on this screen) by four and divide the glass pitch by the result. For example, a system with 8 micron pitch glass with an interpolation of X5 is as follows:

$$\frac{8 \text{ micron pitch glass}}{4 * 5 \text{ interpolation}} = .0004 \text{ mm resolution}$$

Enter the resolution values carefully; improperly entered resolutions result in inaccurate measurements. If you notice counting errors on a given axis check that the resolution for that axis is entered properly on this screen.

```
Encoders                  mm  1  +
                Axis        X
About
Display         Res         0.0010000000
Encoders
Hot Keys
Print
Form Chars      Type        TTL
Ports           Ref Marks   None
Measure         M.Z. Cnts   0
Sounds          Reversed    No
Supervisor      Interpolation X1
                Units       MM
```

Highlight the type field and select the desired encoder type.

```
┌─────────────────────────────────────────┐
│ Encoders                    mm │1 ┼      │
│         ┌─────────────────────────────── │
│ About   │ Axis          X                │
│ Display │ Res           0.0010000000     │
│ Encoders│                                │
│ Hot Keys│                                │
│ Print   │ Type          TTL              │
│ Form Chars Ref Marks     None            │
│ Ports   │ M.Z. Cnts     0                │
│ Measure │ Reversed      No               │
│ Sounds  │ Interpolation X1               │
│ Supervisor Units        MM               │
│   ▼     │                                │
│   TTL   │ Analog │ MTISer │ MTI 2        │
└─────────────────────────────────────────┘
```

There are four types of encoder interfaces supported by the QC200:
- TTL
- Analog
- Mitutoyu (MTISer) serial
- Mitutoyo (MTI 2) 2

NOTE
Use Mitutoyo (MTISer) serial for Mitutoyo products that use 10 pin rectangular connectors. Choose Mitutoyo (MTI2) 2 when there is an EXE box between the QC200 and the actual encoder device.

Highlight the *reference (ref marks) field* and select the desired reference marks.

```
┌─────────────────────────────────────────┐
│ Encoders                    mm │1 ┼      │
│         ┌─────────────────────────────── │
│ About   │ Axis          X                │
│ Display │ Res           0.0010000000     │
│ Encoders│                                │
│ Hot Keys│                                │
│ Print   │ Type          TTL              │
│ Form Chars Ref Marks     None            │
│ Ports   │ M.Z. Cnts     0                │
│ Measure │ Reversed      No               │
│ Sounds  │ Interpolation X1               │
│ Supervisor Units        MM               │
│   ▼     │                                │
│  None   │ Ref │ Abs AC │ Abs HH │ Manual │
└─────────────────────────────────────────┘
```

Reference marks are used for *segmented linear error correction (SLEC)* or *non-linear error correction (NLEC)*. There are four types of reference marks recognized by the QC200:
- Reference (ref)
- Absolute (Abs AC) acu-rite
- Absolute (Abs HH) Heidenhain
- Manual

Press the *none soft key* if your system does not use reference marks.
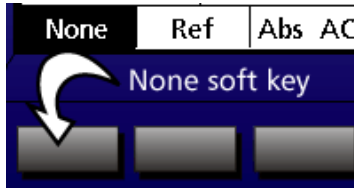
Highlight the *machine zero (MZ Cnts) counts field*. Use the *machine zero (MZ Cnts) counts field* to define the machine zero position of an (Acu-Rite Absolute) encoder.

Enter *zero (0)* to record the current encoder position as the machine zero for the next system startup. Machine zero does not change during power cycles unless this field is reset to zero.

NOTE
Use the following settings with machine zero counts: select *absolute (abs ac) acu-rite* **in the** *reference (ref marks) field* **and set the** *startup zero field* **on the** *measurement setup screen* **to** *yes*.

Highlight the *reversed field*. Reverse the direction of the selected axis by pressing the yes soft key. Press the no soft key to maintain the current direction of the axis.

Highlight the interpolation field. Press the soft key for the desired interpolation value.

Encoders	mm	1	+	
About	Axis	X		
Display	Res	0.0010000000		
Encoders				
Hot Keys				
Print	Type	TTL		
Form Chars	Ref Marks	None		
Ports	M.Z. Cnts	0		
Measure	Reversed	No		
Sounds	Interpolation	X1		
Supervisor	Units	MM		
X1	X2	X5	X10	

Highlight the units field. Press the soft key for the desired units of measure (millimeters or inches) that correspond to the encoder used.

Encoders	mm	1	+	
About	Axis	X		
Display	Res	0.0010000000		
Encoders				
Hot Keys				
Print	Type	TTL		
Form Chars	Ref Marks	None		
Ports	M.Z. Cnts	0		
Measure	Reversed	No		
Sounds	Interpolation	X1		
Supervisor	Units	MM		
In	MM			

NOTE
Perform the above encoder setup functions for each axis.

To calibrate the Q axis

NOTE
This example assumes that the type, interpolation, and units fields are properly set for the encoders in use.

NOTE
Rotate the Q axis to zero (0) degrees before calibrating.

Step 1
Highlight the *axis field* as shown.

Step 2
Press the *Q axis soft key*.

Step 3
Highlight the *units field* as shown.

7-11

Step 4
Press the *degrees (deg) soft key*.

Step 5
Highlight the *teach amount (teach amt) field* as shown.

Step 6
Enter the desired teach amount.

NOTE
Use a large teach amount. For example, enter a teach amount between 180 degrees and 270 degrees.

Step 7
Highlight the scale counts (scale cnts) field as shown.

Step 8
Press the *teach soft key*.

NOTE
Press the reset soft key to set the scale counts (scale cnts) fields to zero. It is not necessary to press the reset soft key if the scale counts field reads zero.

Step 9
Rotate the Q axis 180 degrees.

NOTE
This example uses a teach amount of 180 degrees. Rotate the Q axis by the amount entered in the teach amount field.

7-13

Step 10
Press the *teach soft key*.
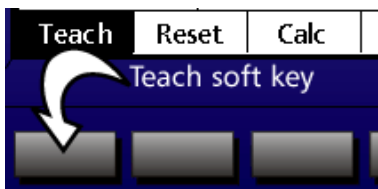
Step 11
Press the *finish key twice*.

The Q axis calibration is complete.

To check Q axis calibration

Step 1
Rotate the *Q axis* to zero degrees.

Step 2
Press the *zero axis key* for the Q axis.

Step 3
Rotate the Q axis by the teach amount.

Step 3
Compare the Q axis display to the teach amount.

To calibrate a filar axis

NOTE
This example assumes that the type, interpolation, and units fields are properly set for the encoders in use.

Step 1
Highlight the *encoders field* as shown.

Encoders	mm	1	+

About	Axis	X
Display	Res	0.0010000000
Encoders		
Hot Keys		
Print	Type	TTL
Form Chars	Ref Marks	None
Ports	M.Z. Cnts	0
Measure	Reversed	No
Sounds	Interpolation	X1
Supervisor	Units	MM

Step 2
Highlight the *axis field* as shown.

Encoders	mm	1	+

About	Axis	X
Display	Res	0.0010000000
Encoders		
Hot Keys		
Print	Type	TTL
Form Chars	Ref Marks	None
Ports	M.Z. Cnts	0
Measure	Reversed	No
Sounds	Interpolation	X1
Supervisor	Units	MM

X	Y			F

NOTE
Use the arrows keys to highlight the desired field.

Step 3
Press the *F axis soft key*.

		F

Filar axis soft key

Step 4
Highlight the *resolution (res) field* as shown.

Encoders   mm |1 +

	Axis	F
About		
Display	Res	**0.00000100**
Encoders	Teach Amt	180°00'00"
Hot Keys	Scale Cnts	5600
Print	Type	TTL
Form Chars	Ref Marks	None
Ports	M.Z. Cnts	0
Measure	Reversed	No
Sounds	Interpolation	X1
Supervisor	Units	Deg

| Mag 1 | Mag 2 | Mag 3 | Mag 4 |

Step 5
Press the soft key for the desired magnification.

| Mag 1 | Mag 2 | Mag 3 | Mag |

Magnification soft key

NOTE
This example calibrates magnification 1. Choose the desired magnification.

Step 6
Highlight the *teach amount (teach amt) field* as shown.

Encoders   mm |1 +

	Axis	F
About		
Display	Res	0.00000100
Encoders	Teach Amt	**0**
Hot Keys	Scale Cnts	5600
Print	Type	TTL
Form Chars	Ref Marks	None
Ports	M.Z. Cnts	0
Measure	Reversed	No
Sounds	Interpolation	X1
Supervisor	Units	Deg

| Teach | Reset | Calc | | |

Step 7
Use the numeric keypad to enter the length of the standard artifact.

Encoders	mm	⌊1	+
	Axis	E	
About			
Display	Res	0.00000100	
Encoders	Teach Amt	1.000	
Hot Keys	Scale Cnts	5600	
Print	Type	TTL	
Form Chars	Ref Marks	None	
Ports	M.Z. Cnts	0	
Measure	Reversed	No	
Sounds	Interpolation	X1	
Supervisor	Units	Deg	
▼			
Teach	Reset	Calc	

NOTE
This example uses a 1 mm artifact. Enter the correct size for the artifact on your standard.

NOTE
Use the units of measure that correspond to your standard. For example, set the QC200 to mm for a metric standard.

Step 8
Press the *teach soft key*.

Teach	Reset	Calc

Teach soft key

NOTE
Press the reset soft key to set the scale counts (scale cnts) fields to zero. It is not necessary to press the reset soft key if the scale counts field reads zero.

Step 9
Measure the artifact.

Step 10
Press the *teach soft key*.
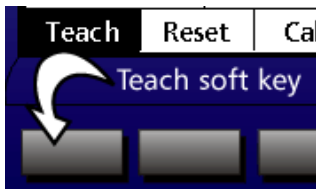
Step 11
Press the *finish key twice*.

The filar axis is calibrated.

To check filar axis calibration

Step 1
Press the *zero axis key* for the filar axis.

Step 2
Measure the artifact used for calibration.

Step 3
Compare the measurement result to the nominal printed on the standard.

Hot Keys

Highlight the *hot keys field* as shown.

Use the *hot keys setup screen* to save time by assigning common or repetitive tasks as hot keys. For example, it takes four steps to clear all features from the features list. Save three steps by assigning the clear all function as a hot key.

Highlight the keys field as shown.

Assign hot key functions to the following groups of keys:
- soft keys
- numeric keys
- remote numeric keys
- foot switches
- fast track keys

Press the *soft soft key* to assign a hot key function to a soft key button. Press the *unit soft key* to assign a hot key function to numeric keys 0 through 9. Press the *remote soft key* to assign a hot key function to numeric keys 0 through 9 on a remote keypad. Press the *foot soft key* to assign a hot key function to a foot switch. Press the *wide soft key* to assign a hot key function to a fast track key.

Highlight a key number as shown.

Assign one of the following functions using the soft keys:

- None: no hot key function assigned
- Key: hot key function assigned by pressing the desired front panel key
- Special: hot key function assigned from list
- Program: hot key assigned to run designated program

To assign a hot key function

NOTE
This example shows how to assign the teach function to soft key 2. Use these basic steps to assign hot key functions to other keys.

Steps 1 through 3 designate the key to be assigned a hot key function.

Step 1
Highlight the *keys field* as shown.

NOTE
Use the arrow keys to highlight the desired field.

Step 2
Press the *soft soft key*.
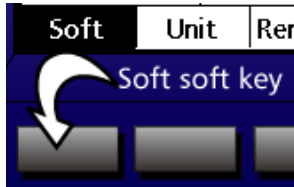
Step 3
Highlight the *key 2 field* as shown.

Step 4
Press the *special soft key*.

Step 5
Highlight the *teach function* as shown.

Step 6
Press the *finish key*.

The teach function is now assigned to soft key 2.

```
┌─────────────────────────────────────────┐
│ Hot Keys              mm |1  +           │
│                Keys    Soft              │
│ About          1)      Probe             │
│ Display        2)      ▐Teach▌           │
│ Encoders       3)      None              │
│ Hot Keys       4)      None              │
│ Print          5)      None              │
│ Form Chars                               │
│ Ports                                    │
│ Measure                                  │
│ Sounds                                   │
│ Supervisor                               │
│  ▼                                       │
│ ┌──────┬─────┬─────────┬──────┐          │
│ │ None │ Key │ Special │ Prog │          │
│ └──────┴─────┴─────────┴──────┘          │
└─────────────────────────────────────────┘
```

Functions in the special list include:

Annot
Highlight *annotation (annot)* in the menu list to toggle between backward and forward annotation.

DMS/DD
Toggles the display of angles between degrees, minutes and seconds and decimal degrees.

MCS
Highlight *MCS* to clear datums and re-establish machine coordinates.

MinMax
Highlight *MinMax* to display the maximum and minimum encoder count on the selected axis. An absolute range (from the minimum to maximum) is displayed as well.

Preset
Highlight *preset* to preset datums to nonzero values that correspond to known part coordinates such as dimensions specified by a part drawing.

Preset!
Repeats the last preset datum performed.

Run! (run last program)
Highlight *run!* to run the last program again.

NOTE
All send data menu items send data to the RS-232 port. These commands do not send data through the parallel port.

Send 2
Select *send 2* to send the current X and Y axes data to a printer or computer.

Send D
Select *send D* to send the current diameter data to a printer or computer.

Send L
Select *send L* to send the current length data to a printer or computer.

Send r
Select *send r* to send the current radius data to a printer or computer.

Send X
Select *send X* to send the X axis data to a printer or computer.

Send Y
Select *send Y* to send the Y axis data to a printer or computer.

Send <
Select *send <* to send angle measurement data to a printer or computer.

Time
Displays the current time.

Zero 2
Zeroes both X and Y axes in the current datum.

Print

Highlight the print field as shown.

Use the print setup screen to format printed reports.

Highlight the report width field as shown.

Select the desired report width using the soft keys. The following widths are available: 32, to, and 80 characters.

Highlight the lines/page field as shown.

Enter the desired number of lines per report page. Use a value between 1 and 999 in this field. A typical 8.5 by 11 page contains 60 lines of print.

Highlight the form feed field as shown.

```
Print                    mm |1  +
                 Report Width 80
About            Lines / Page 60
Display          Form Feed    No
Encoders         Pre Line
Hot Keys         Post Line    10 13
Print            Post Form
Form Chars       Auto Label   Yes
Ports            Print Edges  Off
Measure          Print Units  Yes
Sounds           IRDA Enabled No
Supervisor       Parallel Retry 0
   
    No      Yes
```

Use the yes and no soft keys to toggle on/off the form feed printer command. Essentially, form feed advances the printer to the top of the next page after printing. This primarily used when printing on pre-formatted forms.

Highlight the *pre line field* as shown.

```
Print                    mm |1  +
                 Report Width 80
About            Lines / Page 60
Display          Form Feed    No
Encoders         Pre Line
Hot Keys         Post Line    10 13
Print            Post Form
Form Chars       Auto Label   Yes
Ports            Print Edges  Off
Measure          Print Units  Yes
Sounds           IRDA Enabled No
Supervisor       Parallel Retry 0
   
```

Use the numeric keypad to enter up to four ascii key codes. Ascii key codes entered in the *pre line field* occur before each line of print on a report. For example, enter *ascii key code 32* to insert a space before each line of print. See *chapter 6: communications* for more information on the use of ascii key codes.

Highlight the *post line field* as shown.

```
┌─────────────────────────────────────────────┐
│ Print                        mm │1│  ╋       │
├─────────────────────────────────────────────┤
│ About        Report Width 80                 │
│ Display      Lines / Page  60                 │
│ Encoders     Form Feed     No                │
│ Hot Keys     Pre Line      ┌──────┐          │
│ Print        Post Line     │10 13 │          │
│ Form Chars   Post Form     └──────┘          │
│ Ports        Auto Label    Yes               │
│ Measure      Print Edges   Off               │
│ Sounds       Print Units   Yes               │
│ Supervisor   IRDA Enabled  No                │
│  ▼           Parallel Retry 0                │
├─────────────────────────────────────────────┤
│                                             │
└─────────────────────────────────────────────┘
```

Use the numeric keypad to enter up to four ascii key codes. Ascii key codes entered in the *post line field* occur after each line of print on a report. For example, enter *ascii key code 10 and 13* to insert a line feed and carriage return after each line of print. See *chapter 6: communications* for more information on the use of ascii key codes.

NOTE
Enter *ascii key codes 10 and 13* as shown for best results when printing reports.

Highlight the *post form field* as shown.

```
┌─────────────────────────────────────────────┐
│ Print                        mm │1│  ╋       │
├─────────────────────────────────────────────┤
│ About        Report Width 80                 │
│ Display      Lines / Page  60                 │
│ Encoders     Form Feed     No                │
│ Hot Keys     Pre Line      ┌──────┐          │
│ Print        Post Line     │10 13 │          │
│ Form Chars   Post Form     └──────┘          │
│ Ports        Auto Label    Yes               │
│ Measure      Print Edges   Off               │
│ Sounds       Print Units   Yes               │
│ Supervisor   IRDA Enabled  No                │
│  ▼           Parallel Retry 0                │
├─────────────────────────────────────────────┤
│                                             │
└─────────────────────────────────────────────┘
```

Use the numeric keypad to enter up to four ascii key codes. Ascii key codes entered in the *post form field* occur after each report form. For example, enter *ascii key code 13* to insert a carriage return after each report form. See *chapter 6: communications* for more information on the use of ascii key codes.

Highlight the auto label field as shown. Use the *no* and *yes soft keys* to toggle on/ off the auto label function. Auto label inserts labels into report data fields. For example, auto label inserts an "X" label next to X axis data. Turn of auto label when printing on pre-labeled forms.

```
┌─────────────────────────────────────────────────┐
│ Print                        mm │1│ ＋           │
│              Report  Width 80                    │
│ About        Lines  /  Page  60                  │
│ Display      Form  Feed      No                  │
│ Encoders     Pre  Line      ┌──────────┐         │
│ Hot Keys     Post  Line      10  13              │
│ Print        Post  Form     ┌──────────┐         │
│ Form  Chars  Auto  Label    ▐Yes▌                │
│ Ports        Print  Edges    Off                 │
│ Measure      Print  Units    Yes                 │
│ Sounds       IRDA  Enabled   No                  │
│ Supervisor   Parallel  Retry 0                   │
│  ▼                                               │
│   No      ▐Yes▌                                  │
└─────────────────────────────────────────────────┘
```

Highlight the *print edges field* as shown.

```
┌─────────────────────────────────────────────────┐
│ Print                        mm │1│ ＋           │
│              Report  Width 80                    │
│ About        Lines  /  Page  60                  │
│ Display      Form  Feed      No                  │
│ Encoders     Pre  Line      ┌──────────┐         │
│ Hot Keys     Post  Line      10  13              │
│ Print        Post  Form     ┌──────────┐         │
│ Form  Chars  Auto  Label    Yes                  │
│ Ports        Print  Edges   ▐Off▌                │
│ Measure      Print  Units    Yes                 │
│ Sounds       IRDA  Enabled   No                  │
│ Supervisor   Parallel  Retry 0                   │
│  ▼                                               │
│   List                                           │
└─────────────────────────────────────────────────┘
```

Press *list soft key* to view the list of print edges options.

```
┌─────────────────────────────────────────────────┐
│ Print                        mm │1│ ＋           │
│             ┌──────────┐ 80                      │
│ About       │▐Off▌     │ 60                      │
│ Display     │Standard  │ No                      │
│ Encoders    │Stf2      │                         │
│ Hot Keys    │Stf3      │ 10  13                  │
│ Print       │          │                         │
│ Form  Chars │          │                         │
│ Ports       │          │ Yes                     │
│ Measure     │          │ ▐Off▌                   │
│ Sounds      │          │ Yes                     │
│ Supervisor  │          │ No                      │
│  ▼          └──────────┘ 0                       │
│   List                                           │
└─────────────────────────────────────────────────┘
```

NOTE
Use print edges options with optical edge detection only.

Select one of the four options from the list:

- Off: turn off print edges options
- Standard: print X and Y coordinates when crossing edge
- Stf2: print X and Y coordinates of edge crossed and last known coordinates before edge. Stf2 prints results to two decimal places.
- Stf3: print X and Y coordinates of edge crossed and last known coordinates before edge. Stf3 prints results to three decimal places.

Highlight the *print units field* as shown.

```
Print                    mm |1  +
                 Report Width 80
About            Lines / Page  60
Display          Form  Feed    No
Encoders         Pre  Line     [        ]
Hot Keys         Post  Line    10  13
Print            Post  Form    [        ]
Form  Chars      Auto  Label   Yes
Ports            Print  Edges  Off
Measure          Print  Units  Yes
Sounds           IRDA  Enabled No
Supervisor       Parallel Retry 0
  ◄►
    No      Yes
```

Press the *yes soft key* to include the units of measurement on printed reports. Press the *no soft key* to delete the units of measurement on printed reports.

Highlight the parallel retry field as shown.

```
Print                    mm |1  +
                 Report Width 80
About            Lines / Page  60
Display          Form  Feed    No
Encoders         Pre  Line
Hot Keys         Post  Line    10  13
Print            Post  Form
Form  Chars      Auto  Label   Yes
Ports            Print  Edges  Off
Measure          Print  Units  Yes
Sounds           IRDA  Enabled No
Supervisor       Parallel Retry 0
  ◄►
```

Enter the desired retry number. Thes retry number is the number of times the QC200 will re-send data to the parallel port when it is busy.

Form characters (form chars)

Highlight the form characters (form chars) field as shown.

```
Form Chars        mm |1 +
                Pre Form
About          ┌─────────┐
Display        ├─────────┤
Encoders       ├─────────┤
Hot Keys       ├─────────┤
Print          ├─────────┤
Form Chars     ├─────────┤
Ports          ├─────────┤
Measure        └─────────┘
Sounds
Supervisor
  ▼
```

Use the form characters setup screen to enter pre form ascii key codes. See chapter 6: communications for more information on the use of ascii key codes.

Ports

Highlight the ports field as shown.

```
Ports             mm |1 +
               RS232
About           Baud          9600
Display         Word Len      8
Encoders        Stop Bits     2
Hot Keys        Parity        None
Print           Handshake     Hard.
Form Chars      Data          None
Ports           EOC Delay     330
Measure         EOL Delay     0
Sounds         Parallel
Supervisor      Data          Report
  ▼
```

Use the ports setup screen to establish RS-232 and parallel port settings for communication with a computer. See chapter 6: communications for more information about using the QC200 with a computer.

The ports setup screen is divided into two section: RS-232 and parallel. RS-232 fields include Baud, word length (word len), stop bits, parity, handshake, data, EOC (end-of-character) delay, and EOL (end-of-line) delay. There is one parallel field: data.

NOTE
The *handshake field* is fixed and cannot be changed by the user.

Highlight the *baud field* as shown.

```
Ports                    mm |1 +
        RS232
About    Baud              9600
Display  Word Len          8
Encoders Stop Bits         2
Hot Keys Parity            None
Print    Handshake         Hard.
Form Chars Data            None
Ports    EOC Delay         330
Measure  EOL Delay         0
Sounds   Parallel
Supervisor Data            Report
    Dec      Inc
```

Use the baud field to set the baud rate.   Press the decrease (dec) soft key to decrease the baud rate.   Press the increase (inc) soft key to increase the baud rate.

Highlight the *word length (word len) field* as shown.

```
Ports                    mm |1 +
        RS232
About    Baud              9600
Display  Word Len          8
Encoders Stop Bits         2
Hot Keys Parity            None
Print    Handshake         Hard.
Form Chars Data            None
Ports    EOC Delay         330
Measure  EOL Delay         0
Sounds   Parallel
Supervisor Data            Report
    7        8
```

Press the *7 soft key* to set word length to 7? Press the *8 soft key* to set word length to 8?

Highlight the *stop bits field* as shown.

```
Ports                    mm |1 +
        RS232
About    Baud              9600
Display  Word Len          8
Encoders Stop Bits         2
Hot Keys Parity            None
Print    Handshake         Hard.
Form Chars Data            None
Ports    EOC Delay         330
Measure  EOL Delay         0
Sounds   Parallel
Supervisor Data            Report
    1        2
```

Press the *1 soft key* to set one stop bit. Press the *2 soft key* to set two stop bits.

Highlight the *parity field* as shown.

```
┌─────────────────────────────────────────┐
│ Ports                    mm  ⌊1  ┼        │
├─────────────────────────────────────────┤
│             RS232                         │
│ About       Baud            9600          │
│ Display     Word Len        8             │
│ Encoders    Stop Bits       2             │
│ Hot Keys    Parity          None          │
│ Print       Handshake       Hard.         │
│ Form Chars  Data            None          │
│ Ports       EOC Delay       330           │
│ Measure     EOL Delay       0             │
│ Sounds      Parallel                      │
│ Supervisor  Data            Report        │
│   ▼                                       │
├─────────────────────────────────────────┤
│  None  │  Odd  │  Even  │       │         │
└─────────────────────────────────────────┘
```

Press the *none soft key* to select no parity. Press the *odd soft key* to select odd parity. Press the *even soft key* to select even parity.

NOTE
The *handshake field* is fixed and cannot be changed by the user.

Highlight the *data field* as shown.

```
┌─────────────────────────────────────────┐
│ Ports                    mm  ⌊1  ┼        │
├─────────────────────────────────────────┤
│             RS232                         │
│ About       Baud            9600          │
│ Display     Word Len        8             │
│ Encoders    Stop Bits       2             │
│ Hot Keys    Parity          None          │
│ Print       Handshake       Hard.         │
│ Form Chars  Data            None          │
│ Ports       EOC Delay       330           │
│ Measure     EOL Delay       0             │
│ Sounds      Parallel                      │
│ Supervisor  Data            Report        │
│   ▼                                       │
├─────────────────────────────────────────┤
│  None  │ Display │ Report │ Tol Rpt │     │
└─────────────────────────────────────────┘
```

Use the data field to select the data output from the QC200. There are four data output options:
- *None*: no data output
- *Display*: outputs content of DRO screen
- *Report*: prints standard results report
- *Tolerance report (tol rpt)*: prints tolerance results report

Press the *none soft key* to select no data output. Press the *display soft key* to output the DRO display. Press the *report soft key* to print a standard results report. Press the *tolerance report (tol rpt) soft key* to print a tolerance report.

Highlight the *EOC (end-of-character) delay field* as shown.

EOC delay is a chronological delay following each character sent. Use the numeric keypad to enter a delay value from 0 to 99,999.

Highlight the *EOL (end-of-line) delay field* as shown.

EOL delay is a chronological delay following each line sent. Use the numeric keypad to enter a delay value from 0 to 9,999,999.

Highlight the *parallel data field* as shown.

Use the parallel data field to select the parallel data output from the QC200. There are four parallel data output options:
- *None*: no data output
- *Display*: outputs content of DRO screen
- *Report*: prints standard results report
- *Tolerance report (tol rpt)*: prints tolerance results report

Press the *none soft key* to select no data output. Press the *display soft key* to output the DRO display. Press the *report soft key* to print a standard results report. Press the *tolerance report (tol rpt) soft key* to print a tolerance report.

Measure

Highlight the *measure field* as shown.

```
Measure                    mm |1  +
              Annotation     Back.
About         Fwd Point      1
Display       Fwd Line       2
Encoders      Fwd Circle     4
Hot Keys    Retain Features  Yes
Print       Distances        Abs
Form Chars  Startup Zero     No
Ports       Targeting Zone   1.0000
Measure     Pause Tol Results If Fail
Sounds      Print Tol Results Never
Supervisor
  ▼
```

Use the *measure setup screen* to set parameters for various measurement functions.

Highlight the *annotation field* as shown.

```
Measure                    mm |1  +
              Annotation     Back.
About         Fwd Point      1
Display       Fwd Line       2
Encoders      Fwd Circle     4
Hot Keys    Retain Features  Yes
Print       Distances        Abs
Form Chars  Startup Zero     No
Ports       Targeting Zone   1.0000
Measure     Pause Tol Results If Fail
Sounds      Print Tol Results Never
Supervisor
  ▼
 Back.   Forw.
```

Use the *annotation field* to select forward or backward annotation. *Forward annotation* requires the user to enter the prescribed number of points for a feature measurement. *Backward annotation* allows the user to probe up to 100 points per feature.

NOTE
Backwards annotation requires a minimum number of points per feature. For example, a minimum of three points are required to measure a circle.

Press the *backward (back.) soft key* to select backwards annotation. Press the *forward (forw.) soft key* to select forward annotation.

Highlight the *forward point (fwd point) field* as shown.

```
Measure                    mm  1  +
              Annotation        Back.
About          Fwd Point        1
Display        Fwd Line         2
Encoders       Fwd Circle       4
Hot Keys      Retain Features   Yes
Print         Distances         Abs
Form Chars    Startup Zero      No
Ports         Targeting Zone    1.0000
Measure       Pause Tol Results If Fail
Sounds        Print Tol Results Never
Supervisor
```

Use the numeric keypad to enter the number of points required to measure a point using forward annotation.

Highlight the *forward line (fwd line) field* as shown.

```
Measure                    mm  1  +
              Annotation        Back.
About          Fwd Point        1
Display        Fwd Line         2
Encoders       Fwd Circle       4
Hot Keys      Retain Features   Yes
Print         Distances         Abs
Form Chars    Startup Zero      No
Ports         Targeting Zone    1.0000
Measure       Pause Tol Results If Fail
Sounds        Print Tol Results Never
Supervisor
```

Use the numeric keypad to enter the number of points required to measure a line using forward annotation.

Highlight the *forward circle (fwd circle) field* as shown.

```
Measure                    mm  1  +
              Annotation        Back.
About          Fwd Point        1
Display        Fwd Line         2
Encoders       Fwd Circle       4
Hot Keys      Retain Features   Yes
Print         Distances         Abs
Form Chars    Startup Zero      No
Ports         Targeting Zone    1.0000
Measure       Pause Tol Results If Fail
Sounds        Print Tol Results Never
Supervisor
```

Use the numeric keypad to enter the number of points required to measure a circle using forward annotation.

Highlight the *retain features field* as shown.

```
Measure                    mm  ↓1  +
                  Annotation        Back.
About              Fwd Point        1
Display            Fwd Line         2
Encoders           Fwd Circle       4
Hot Keys          Retain Features   Yes
Print             Distances         Abs
Form Chars        Startup Zero      No
Ports             Targeting Zone    1.0000
Measure           Pause Tol Results If Fail
Sounds            Print Tol Results Never
Supervisor
   ▾
     No      Yes
```

Press the *no soft key* to delete features in the features list when power is cycled off
and on. Press the *yes soft key* to retain features in the features list when power is
cycled off and on.

Highlight the *distances field* as shown.

```
Measure                    mm  ↓1  +
                  Annotation        Back.
About              Fwd Point        1
Display            Fwd Line         2
Encoders           Fwd Circle       4
Hot Keys          Retain Features   Yes
Print             Distances         Abs
Form Chars        Startup Zero      No
Ports             Targeting Zone    1.0000
Measure           Pause Tol Results If Fail
Sounds            Print Tol Results Never
Supervisor
   ▾
  Signed    Abs
```

Press the *signed soft key* to display the + or - displacements. Press the *absolute (abs)
soft key* to display absolute distances.

Highlight the *startup zero field* as shown.

```
Measure                    mm  ↓1  +
                  Annotation        Back.
About              Fwd Point        1
Display            Fwd Line         2
Encoders           Fwd Circle       4
Hot Keys          Retain Features   Yes
Print             Distances         Abs
Form Chars        Startup Zero      No
Ports             Targeting Zone    1.0000
Measure           Pause Tol Results If Fail
Sounds            Print Tol Results Never
Supervisor
   ▾
     No      Yes
```

Use startup zero to prompt the user to zero the machine after startup. Press the
yes soft key to prompt for machine zero. Press the *no soft key* to skip the machine
zero prompt.

Highlight the *targeting zone field* as shown.

```
Measure                    mm |1  +
                 Annotation      Back.
About             Fwd Point      1
Display           Fwd Line       2
Encoders          Fwd Circle     4
Hot Keys         Retain Features Yes
Print            Distances       Abs
Form Chars       Startup Zero    No
Ports            Targeting Zone  1.0000
Measure          Pause Tol Results If Fail
Sounds           Print Tol Results Never
Supervisor
```

Use the numeric keypad to specify the size of the targeting zone box. The targeting zone box is displayed when running a program. Only points within the targeting zone box are accepted when a program is running.

Highlight the *pause tolerance results field* as shown.

```
Measure                    mm |1  +
                 Annotation      Back.
About             Fwd Point      1
Display           Fwd Line       2
Encoders          Fwd Circle     4
Hot Keys         Retain Features Yes
Print            Distances       Abs
Form Chars       Startup Zero    No
Ports            Targeting Zone  1.000
Measure          Pause Tol Results If Fail
Sounds           Print Tol Results Never
Supervisor

  Never | If Fail | If Pass | Always
```

Use the *pause tolerance results field* to pause a program depending on the results of feature tolerances. Press the *never soft key* to continue the program regardless of tolerance results. Press the *if fail soft key* to pause the program for failed tolerance results. Press the *if pass soft key* to pause the program for passed toleranced results. Press the *always soft key* to pause the program after each tolerance step pass or fail.

Highlight the *print tolerance results field* as shown.

```
┌─────────────────────────────────────────────┐
│Measure              mm │1  +      │
│            Annotation      Back.            │
│About        Fwd Point      1                │
│Display      Fwd Line       2                │
│Encoders     Fwd Circle     4                │
│Hot Keys    Retain Features Yes              │
│Print       Distances       Abs              │
│Form Chars  Startup Zero     No              │
│Ports       Targeting Zone  1.000            │
│Measure     Pause Tol Results If Fail        │
│Sounds      Print Tol Results Never          │
│Supervisor                                   │
│  ▼                                          │
├─────────────────────────────────────────────┤
│ Never │ If Fail │ If Pass │ Always │        │
└─────────────────────────────────────────────┘
```

Use the *print tolerance results field* to print a report depending on the results of feature tolerances. Press the *never soft key* to print no report regardless of tolerance results. Press the *if fail soft key* to print only failed tolerance results. Press the *if pass soft key* to print only passed toleranced results. Press the *always soft key* to print each tolerance result pass or fail.

Sounds

Highlight the *sounds field* as shown.

```
┌─────────────────────────────────────────────┐
│Sounds               mm │1  +      │
│            Warning         Simple           │
│About       Point Entry     Simple           │
│Display     Begin Measure   None             │
│Encoders    Good Result     None             │
│Hot Keys    Failed Result   None             │
│Print       Excess Form     None             │
│Form Chars  Volume          2                │
│Ports                                        │
│Measure                                      │
│Sounds                                       │
│Supervisor                                   │
│  ▼                                          │
├─────────────────────────────────────────────┤
│       │         │         │        │        │
└─────────────────────────────────────────────┘
```

Use the *sounds setup screen* to toggle sound features on/off and adjust speaker volume.

Highlight the *warning field* as shown.

```
┌─────────────────────────────────────────────┐
│ Sounds                    mm │1│ ┼           │
│              Warning          Simple          │
│ About        Point Entry      Simple          │
│ Display      Begin Measure    None            │
│ Encoders     Good Result      None            │
│ Hot Keys     Failed Result    None            │
│ Print        Excess Form      None            │
│ Form Chars   Volume           2               │
│ Ports                                         │
│ Measure                                       │
│ Sounds                                        │
│ Supervisor                                    │
│ ▾                                             │
├─────────────────────────────────────────────┤
│   None    Simple                              │
└─────────────────────────────────────────────┘
```

Use the *warning field* to toggle the *warning beep* on/off. The *warning beep* sounds anytime the QC200 displays an on-screen warning. Press the *none soft key* to turn off the warning beep. Press the *simple soft key* to turn on the warning beep.

Highlight the *point entry field* as shown.

```
┌─────────────────────────────────────────────┐
│ Sounds                    mm │1│ ┼           │
│              Warning          Simple          │
│ About        Point Entry      Simple          │
│ Display      Begin Measure    None            │
│ Encoders     Good Result      None            │
│ Hot Keys     Failed Result    None            │
│ Print        Excess Form      None            │
│ Form Chars   Volume           2               │
│ Ports                                         │
│ Measure                                       │
│ Sounds                                        │
│ Supervisor                                    │
│ ▾                                             │
├─────────────────────────────────────────────┤
│   None    Simple                              │
└─────────────────────────────────────────────┘
```

Use the *point entry field* to toggle the *point entry beep* on/off. The *point entry beep* sounds after each point is entered during a measurement. Press the *none soft key* to turn off the point entry beep. Press the *simple soft key* to turn on the point entry beep.

Highlight the *begin measure field* as shown.

Use the *begin measure field* to toggle the *begin measure beep* on/off. The *begin measure beep* sounds prior to each feature measurement. Press the *none soft key* to turn off the begin measure beep. Press the *simple soft key* to turn on the begin measure beep.

Highlight the *good result field* as shown.

Use the *good result field* to toggle the *good result beep* on/off. The *good result beep* sounds for passed tolerance results. Press the *none soft key* to turn off the good result beep. Press the *simple soft key* to turn on the good result beep.

Highlight the *failed result field* as shown.

```
┌─────────────────────────────────────────┐
│ Sounds                    mm  1  +       │
│                                          │
│             Warning          Simple      │
│ About       Point Entry      Simple      │
│ Display     Begin Measure    None        │
│ Encoders    Good Result      None        │
│ Hot Keys    Failed Result   ▐None▌       │
│ Print       Excess Form      None        │
│ Form Chars  Volume           2           │
│ Ports                                    │
│ Measure                                  │
│ Sounds                                   │
│ Supervisor                               │
│   ▼                                      │
│ ┌─────┬──────┬────┬────┬────┐            │
│ │None │Simple│    │    │    │            │
│ └─────┴──────┴────┴────┴────┘            │
└─────────────────────────────────────────┘
```

Use the *failed result field* to toggle the *failed result beep* on/off. The *failed result beep* sounds for failed tolerance results. Press the *none soft key* to turn off the failed result beep. Press the *simple soft key* to turn on the failed result beep.

Highlight the *excess form field* as shown.

```
┌─────────────────────────────────────────┐
│ Sounds                    mm  1  +       │
│                                          │
│             Warning          Simple      │
│ About       Point Entry      Simple      │
│ Display     Begin Measure    None        │
│ Encoders    Good Result      None        │
│ Hot Keys    Failed Result    None        │
│ Print       Excess Form     ▐None▌       │
│ Form Chars  Volume           2           │
│ Ports                                    │
│ Measure                                  │
│ Sounds                                   │
│ Supervisor                               │
│   ▼                                      │
│ ┌─────┬──────┬────┬────┬────┐            │
│ │None │Simple│    │    │    │            │
│ └─────┴──────┴────┴────┴────┘            │
└─────────────────────────────────────────┘
```

Use the *excess form field* to toggle the *excess form beep* on/off. The *excess form beep* sounds for features with form values the exceed software defined limits. Press the *none soft key* to turn off the excess form beep. Press the *simple soft key* to turn on the excess form beep.

Highlight the *volume field* as shown.

Use the numeric keypad to enter a volume level from 0 to 10.

Supervisor

Highlight the *supervisor field* as shown.

Use the *supervisor setup screen* to enter the supervisor password lock/unlock programs.

See the beginning of this chapter for more information on the *password field*.

Highlight the *programs field* as shown.

```
┌─────────────────────────────────────────┐
│ Supervisor          mm │1 │ + │          │
│                  ┌──────────┬──────────┐ │
│ About            │Password  │ XXXXXX   │ │
│ Display          │          │          │ │
│ Encoders         │Programs  │ Unlock   │ │
│ Hot Keys         │          │          │ │
│ Print            │          │          │ │
│ Form Chars       │          │          │ │
│ Ports            │          │          │ │
│ Measure          │          │          │ │
│ Sounds           │          │          │ │
│ Supervisor       │          │          │ │
│    ▼             │          │          │ │
│ Unlock   Lock │      │      │      │     │
└─────────────────────────────────────────┘
```

Use the *programs field* to lock or unlock the following programming functions: *record*, *edit*, *copy*, and *delete*. Press the *unlock soft key* to unlock the programming features. Press the *lock soft key* to lock the programming features.

Squareness

Highlight the s*quareness field* as shown.

```
┌─────────────────────────────────────────┐
│ Squareness          mm │1 │ + │          │
│    ▲             ┌──────────┬──────────┐ │
│ Display          │Angle     │90°00'00" │ │
│ Encoders         │Master Axis│  X      │ │
│ Hot Keys         │          │          │ │
│ Print            │          │          │ │
│ Form Chars       │          │          │ │
│ Ports            │          │          │ │
│ Measure          │          │          │ │
│ Sounds           │          │          │ │
│ Supervisor       │          │          │ │
│ Squareness       │          │          │ │
│    ▼             │          │          │ │
│       │      │      │      │      │      │
└─────────────────────────────────────────┘
```

Use the *squareness setup screen* to compensate for small machine errors between the X and Y axes.

Highlight the *angle field* as shown.

```
┌─────────────────────────────────────────────┐
│ Squareness          mm │1│  +                │
│ ▲                                            │
│ Display      Angle          90°00'00"        │
│ Encoders     Master  Axis   X                │
│ Hot Keys                                     │
│ Print                                        │
│ Form Chars                                   │
│ Ports                                        │
│ Measure                                      │
│ Sounds                                       │
│ Supervisor                                   │
│ Squareness                                   │
│ ▼                                            │
│  Teach  │      │       │       │       │     │
└─────────────────────────────────────────────┘
```

Use a standard imprinted with a perfect right angle to obtain the measurement for the angle field. Enter the result of the angle measurement in the *angle field* using the numeric keypad or press the *teach key* and measure the angle.

Highlight the *master axis field* as shown.

```
┌─────────────────────────────────────────────┐
│ Squareness          mm │1│  +                │
│ ▲                                            │
│ Display      Angle          90°00'00"        │
│ Encoders     Master  Axis   X                │
│ Hot Keys                                     │
│ Print                                        │
│ Form Chars                                   │
│ Ports                                        │
│ Measure                                      │
│ Sounds                                       │
│ Supervisor                                   │
│ Squareness                                   │
│ ▼                                            │
│   X   │  Y   │       │       │       │       │
└─────────────────────────────────────────────┘
```

The master axis is the machine reference for angular measurements. Press the *X soft key* to designate the X axis as the master axis. Press the *Y soft key* to designate the Y axis as the master axis.

LEC, SLEC, NLEC
See the *error correction* section of this chapter for a detailed discussion of these setup screens.

Scale factor

Highlight the *scale factor field* as shown.

```
┌─────────────────────────────────────────────┐
│ Scale Factor          mm │1│ + │              │
│  ▲         Active      No                      │
│ Ports      Multiplier  0.00000100              │
│ Measure    User Settable No                    │
│ Sounds                                         │
│ Supervisor                                     │
│ Squareness                                     │
│ LEC                                            │
│ SLEC                                           │
│ Scale Factor                                   │
│ Misc.                                          │
│ Clock                                          │
│  ▼                                             │
│                                                │
└─────────────────────────────────────────────┘
```

Use the *scale factor setup screen* to define a multiplier for measurement results. Scale factors compensate for part shrinkage or expansion during actual-use conditions.

Highlight the *active field* as shown.

```
┌─────────────────────────────────────────────┐
│ Scale Factor          mm │1│ + │              │
│  ▲         Active      No                      │
│ Ports      Multiplier  0.00000100              │
│ Measure    User Settable No                    │
│ Sounds                                         │
│ Supervisor                                     │
│ Squareness                                     │
│ LEC                                            │
│ SLEC                                           │
│ Scale Factor                                   │
│ Misc.                                          │
│ Clock                                          │
│  ▼                                             │
│   No      Yes                                  │
└─────────────────────────────────────────────┘
```

Press the *yes soft key* to turn on the scale factor compensation. Press the *no soft key* to turn off the scale factor compensation.
Press the *yes soft key* to activate the Scale factor function.

Highlight the *multiplier field* as shown.

Scale Factor	mm	1	+
Ports	Active	No	
Measure	Multiplier	0.00000100	
Sounds	User Settable	No	
Supervisor			
Squareness			
LEC			
SLEC			
Scale Factor			
Misc.			
Clock			

Use the numeric keypad to enter the user-defined multiplier value.

Highlight the *user settable field* as shown.

Scale Factor	mm	1	+
Ports	Active	No	
Measure	Multiplier	0.00000100	
Sounds	User Settable	No	
Supervisor			
Squareness			
LEC			
SLEC			
Scale Factor			
Misc.			
Clock			
No	Yes		

Press *no soft key* to password restrict the scale factor setup screen. Press the *yes soft key* to grant user access to the scale factor setup screen.

Miscellaneous (misc)

Highlight the *miscellaneous (misc) field* as shown.

```
Misc.                    mm |1 |＋
  ▲
Ports          Key Delay        6
Measure        Contrast        400
Sounds         Backlight       200
Supervisor     Auto Dro Cnts   20
Squareness
LEC            Scr Saver Min   10
SLEC
Scale Factor   X External 0    No
Misc.          Y External 0    No
Clock
  ▼
```

Use the miscellaneous setup screen to set/adjust the following functions:

*   Key delay
*   Contrast
*   Backlight
*   Auto DRO counts
*   Screen saver minutes
*   X external 0
*   Y external 0

Highlight the *key delay field* as shown.

```
Misc.                    mm |1 |＋
  ▲
Ports          Key Delay        6
Measure        Contrast        400
Sounds         Backlight       200
Supervisor     Auto Dro Cnts   20
Squareness
LEC            Scr Saver Min   10
SLEC
Scale Factor   X External 0    No
Misc.          Y External 0    No
Clock
  ▼
```

Use the *key delay field* to set the a*uto-repeat delay* for front panel keys. *Auto-repeat* repeats the key function if it is held down longer than the delay interval. For example, press and hold the down arrow key. Notice the cursor block scrolls repeatedly until the key is released. Use the numeric keypad to enter a key delay value between 0 and 99. Enter small values for fast repetition or large values for slow repetition.

Highlight the *contrast field* as shown.

```
Misc.                          mm |1  +
  ▲
Ports          Key Delay         6
Measure        Contrast         400
Sounds         Backlight        200
Supervisor     Auto Dro Cnts    20
Squareness
LEC            Scr Saver Min    10
SLEC
Scale Factor   X External 0     No
Misc.          Y External 0     No
Clock
  ▼
```

Use the *contrast field* to adjust the LCD display contrast. Use the numeric keypad to enter a contrast value between 350 to 425. Values above and below this range tend to make the display unreadable. Adjust the contrast setting to suit the lighting conditions of your work area.

Highlight the *backlight field* as shown.

```
Misc.                          mm |1  +
  ▲
Ports          Key Delay         6
Measure        Contrast         400
Sounds         Backlight        200
Supervisor     Auto Dro Cnts    20
Squareness
LEC            Scr Saver Min    10
SLEC
Scale Factor   X External 0     No
Misc.          Y External 0     No
Clock
  ▼
```

Use the *backlight field* to adjust the backlighting of the LCD display. Use the numeric keypad to enter a backlight value between 0 and 999. Values at the high and low end of this range tend to make the display unreadable. Adjust the backlight setting to suit the lighting conditions of your work area.

Highlight the *auto DRO counts (auto DRO cnts) field* as shown.

```
Misc.                    mm  1  +
  ▲            Key Delay        6
Ports          Contrast       400
Measure        Backlight       200
Sounds         Auto Dro Cnts   20
Supervisor
Squareness     Scr Saver Min    10
LEC
SLEC           X External 0    No
Scale Factor   Y External 0    No
Misc.
Clock
  ▼
```

Use the numeric keypad to enter an auto DRO count value between 0 and 999. Auto DRO counts define the amount of part movement required before the DRO refreshes the axis counts.

Highlight the *screen saver minutes (scr saver min) field* as shown.

```
Misc.                    mm  1  +
  ▲            Key Delay        6
Ports          Contrast       400
Measure        Backlight       200
Sounds         Auto Dro Cnts   20
Supervisor
Squareness     Scr Saver Min    10
LEC
SLEC           X External 0    No
Scale Factor   Y External 0    No
Misc.
Clock
  ▼
```

Use the numeric keypad to enter a number between 1 and 9999. Screen saver minutes define the number of minutes before the DRO screen saver is displayed.

Highlight the *X external 0 field* as shown.

Press the *yes soft key* if using a rotary type micrometer equipped with a manual zero button. Selecting *yes* enables the manual zero button on the rotary micrometer. For all other encoder types, or to disable the manual zero button, press the *no soft key*. The same principles apply to the *Y external 0 field*.

Clock
Highlight the *clock field* as shown.

Use the *clock setup screen* to set and format date/time information.

Highlight the *year field* to enter the four digit year.

Highlight the *month field* to enter the month (1 to 12; January to December respectively).

Highlight the *day field* to enter the calendar day of the month.

Highlight the *hours field* to enter the hour.

NOTE
Use the appropriate hours for the desired time format. For example, enter 1 for 1 pm when using the 12 hour time format. Enter 13 for 1 pm when using the 24 hour time format.

Highlight the *minutes field* to enter the minutes.

Highlight the *seconds field* to enter the seconds.

Highlight the *date format field* as shown.

Press the *M/D/Y soft key* to select month/day/year format. Press the *D/M/Y soft key* to select day/month/year format.

Highlight the *time format field* as shown.

Press the *12 soft key* to select 12 hour time format. Press the *24 soft key* to select 24 hour time format.

Error Correction

There are three error correction methods used with the QC200:

- Linear error correction (LEC)
- Segmented linear error correction (SLEC)
- Non-linear error correction (NLEC).

All QC200 models are equipped with LEC and SLEC. NLEC is sold as a separate option. Each method compensates for encoder and machine travel variations with error correction coefficients. Coefficients are determined by comparing actual measurements of a standard to the nominal values imprinted on the standard.

Linear error correction (LEC) compensates for variations along the axes using one correction coefficient for each axis. For example, a LEC coefficient of 0.0002 per inch applied to a 6 inch measurement along an axis produces a result of 6.0012 inches.

```
LEC                          mm |1 | +
┌──────────────┬──────────────────────────┐
  ▲              Linear Error Correction
  Ports          X Standard      1.0000
  Measure        X Observed      1.0000
  Sounds         Y Standard      1.0000
  Supervisor     Y Observed      1.0000
  Squareness
  LEC
  SLEC
  Scale Factor
  Misc.
  Clock
  ▼
```

Segmented linear error correction (SLEC) divides each axis into a number of user-defined segments.
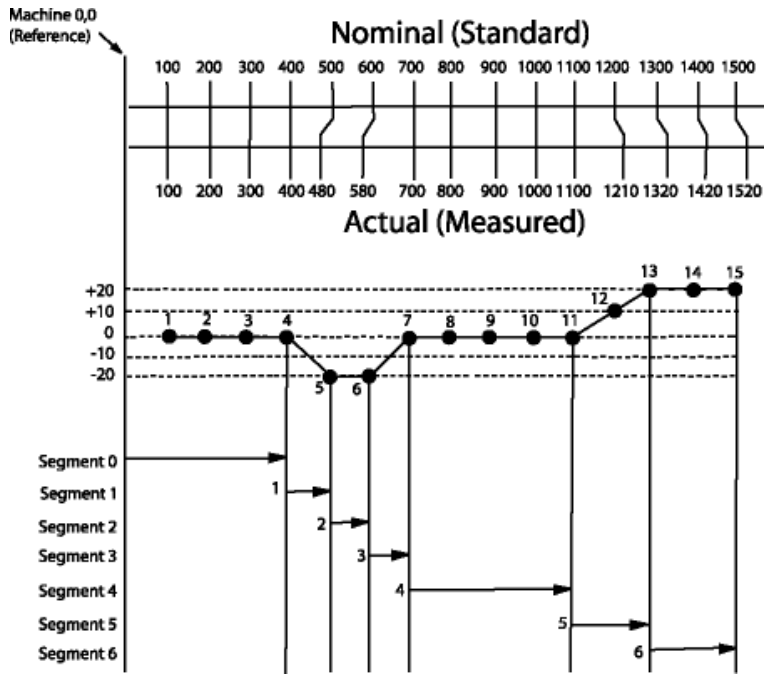
Each segment has one error correction coefficient to compensate for variation within the segment. Each axis is also offset (MZ reference) to account for the variation between the standard datum and machine zero. Apply the nominal (standard) and measured (observed) segment values from the standard during the setup process. Specify the machine zero offset during setup as well. Move the each axis to cross a reference mark/hard-stop during startup to initialize SLEC.

Non-linear error correction (NLEC) divides the entire measurement area into a grid.
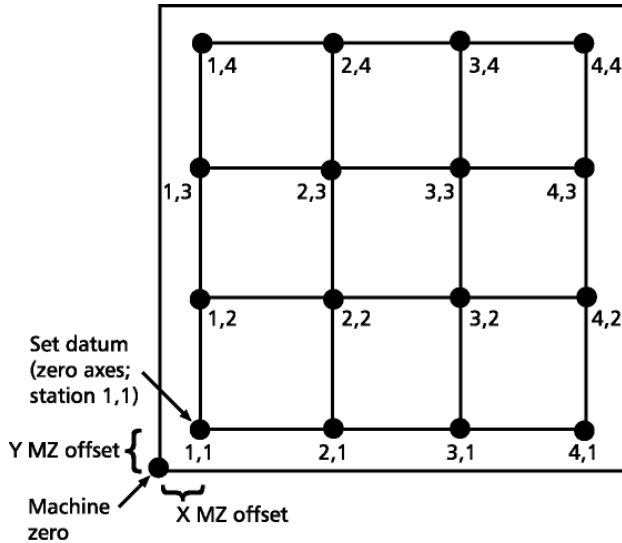
3 X 3 inch grid standard

Each grid cell compensates for variation with its own error correction coefficient. Specify the nominal and measured X and Y coordinates from the standard during the setup process. Enter the machine zero offset from the grid datum during startup as well. NLEC requires a repeatable machine zero defined on startup.

NOTE
Set the machine zero by crossing reference marks on the X and Y axes calibrating the SLEC and NLEC error corrections.

Linear error correction (LEC)

Highlight the LEC field as shown.

```
LEC                      mm |1  +
 ▲                Linear Error Correction
Ports             X  Standard    1.0000
Measure           X  Observed    1.0000
Sounds            Y  Standard    1.0000
Supervisor        Y  Observed    1.0000
Squareness
LEC
SLEC
Scale Factor
Misc.
Clock
 ▼
```

Use LEC to compensate for encoder and machine travel variations.

Highlight the *X standard field* as shown.

```
LEC                      mm |1  +
 ▲                Linear Error Correction
Print             X  Standard    1.0000
Form Chars        X  Observed    1.0000
Ports             Y  Standard    1.0000
Measure           Y  Observed    1.0000
Sounds
Supervisor
Squareness
LEC
SLEC
NLEC
 ▼
```

Use the numeric keypad to enter the nominal value of a point on the X axis of the standard. For example, if the scale on the standard indicates 1 inch, enter 1 inch in the *X standard field*.

Highlight the *X observed field* as shown.

```
LEC                        mm 1  +
  ▲            Linear Error Correction
Print          X  Standard      1.000
Form  Chars    X  Observed      1.0000
Ports          Y  Standard      1.0000
Measure        Y  Observed      1.0000
Sounds
Supervisor
Squareness
LEC
SLEC
NLEC
  ▼
```

Use the numeric keypad to enter the actual value of the point as shown on the X axis DRO display.

Highlight the *Y standard field* as shown.

```
LEC                        mm 1  +
  ▲            Linear Error Correction
Print          X  Standard      1.000
Form  Chars    X  Observed      1.000
Ports          Y  Standard      1.0000
Measure        Y  Observed      1.0000
Sounds
Supervisor
Squareness
LEC
SLEC
NLEC
  ▼
```

Use the numeric keypad to enter the nominal value of a point on the Y axis of the standard. For example, if the scale on the standard indicates 1 inch, enter 1 inch in the *Y standard field*.

Highlight the *Y observed field* as shown.

```
LEC                        mm 1  +
  ▲            Linear Error Correction
Print          X  Standard      1.000
Form  Chars    X  Observed      1.000
Ports          Y  Standard      1.000
Measure        Y  Observed      1.0000
Sounds
Supervisor
Squareness
LEC
SLEC
NLEC
  ▼
```

Use the numeric keypad to enter the actual value of the point as shown on the Y axis DRO display.

To setup linear error correction

Step 1
Place a glass standard on the measuring device.

Step 2
Zero the X and Y axes on the standard's datum.

Step 3
Move the crosshair to the desired point on the X axis.

Step 4
Record the X axis result on a piece of paper.

Step 5
Move the crosshair to the desired point on the Y axis.

Step 6
Record the Y axis result on a piece of paper.

Step 7
Press the *menu key*.

Step 8
Press the *setup soft key*.

Step 9
Highlight the *LEC field* as shown.

```
┌─────────────────────────────────────────┐
│ LEC                    mm │ 1 │ +        │
├─────────────────────────────────────────┤
│    ▲          Linear Error Correction    │
│ Ports         X Standard      1.0000     │
│ Measure       X Observed      1.0000     │
│ Sounds        Y Standard      1.0000     │
│ Supervisor    Y Observed      1.0000     │
│ Squareness                               │
│ LEC                                      │
│ SLEC                                     │
│ Scale Factor                             │
│ Misc.                                    │
│ Clock                                    │
│    ▼                                     │
│                                          │
└─────────────────────────────────────────┘
```

NOTE
Use the arrow keys to highlight the desired field.

Step 10
Highlight the *X standard field* as shown and enter the nominal value of the point on the X axis of the standard.

```
┌─────────────────────────────────────────┐
│ LEC                    mm │ 1 │ +        │
├─────────────────────────────────────────┤
│    ▲          Linear Error Correction    │
│ Print         X Standard      1.0000     │
│ Form Chars    X Observed      1.0000     │
│ Ports         Y Standard      1.0000     │
│ Measure       Y Observed      1.0000     │
│ Sounds                                   │
│ Supervisor                               │
│ Squareness                               │
│ LEC                                      │
│ SLEC                                     │
│ NLEC                                     │
│    ▼                                     │
│                                          │
└─────────────────────────────────────────┘
```

Step 11
Highlight the *X observed field* as shown.

```
┌─────────────────────────────────────────┐
│ LEC                    mm │ 1 │ +        │
├─────────────────────────────────────────┤
│    ▲          Linear Error Correction    │
│ Print         X Standard      1.000      │
│ Form Chars    X Observed      1.0000     │
│ Ports         Y Standard      1.0000     │
│ Measure       Y Observed      1.0000     │
│ Sounds                                   │
│ Supervisor                               │
│ Squareness                               │
│ LEC                                      │
│ SLEC                                     │
│ NLEC                                     │
│    ▼                                     │
│                                          │
└─────────────────────────────────────────┘
```

Step 12

Enter the actual value of the point as recorded from the X axis DRO display.

Step 13

Highlight the *Y standard field* as shown and enter the nominal value of the point on the Y axis of the standard.

Step 14

Highlight the *Y observed field* as shown and enter the actual value of the point as recorded from the Y axis DRO display. .

Step 15
Press the *finish key* twice.

Linear error correction (LEC) setup is complete. The LEC correction coefficient is applied to all subsequent measurements.

Segmented linear error correction (SLEC)

Highlight the *SLEC field* as shown. Use the *SLEC setup screen* to define error correction coefficients for segments on the X and Y axes. Segments are comprised of the axial distance from one SLEC station to the next. There is no specified minimum or maximum distance between stations. Position stations to compensate for the known variation of each axis. For example, if the midsection of an axis has more variation than the ends, position several stations close together through the midsection. Use fewer stations toward the ends and space them further apart.

Keep in mind that *station 0* should not have a correction value assigned to it. Generally, *station 0* can be any point on the axis where the standard and observed values are the same. Sometimes there is no point on the axis without error. In this case, *station 0* is located at the zero point of the axis. All other stations follow sequentially from *station 0*. For example, *station 0* is followed by *station 1* followed by *station 2* and so on. Up to 30 stations can be defined per axis.

To use SLEC, make sure the the *startup zero field* on the *measure setup screen* is set to *yes*. This prompts the user to define machine zero at startup. Keep in mind that SLEC stations are always relative to machine zero. It is important to select a repeatable location for machine zero. If the location of machine zero changes so do the locations of all SLEC stations.

There are three ways to establish machine zero at startup. Each method depends on the type of encoder used. Use the *ref marks field* on the *encoder setup screen* to define the machine zero method.

Select *manual* when using encoders with no reference marks. Users are prompted at startup to move the axis to the zero point manually.

Encoders		mm	⌊1	✛
About	Axis	X		
Display				
Encoders	Res	0.0010000000		
Hot Keys				
Print	Type	TTL		
Form Chars	Ref Marks	**Manual**		
Ports	M.Z. Cnts	0		
Measure	Reversed	No		
Sounds	Interpolation	X1		
Supervisor	Units	MM		
None	Ref	Abs AC	Abs HH	**Manual**

Select *ref* when using encoders with a single reference mark. Users are prompted at startup to move the axis until a reference mark is crossed.

There are two types of absolute reference marks supported by the QC200: absolute Acu-Rite and absolute Heidenhain. Select *abs AC* when using Acu-Rite encoders and *abs HH* when using Heidenhain encoders. Users are prompted at startup to move the axis until two reference marks are crossed.

To setup SLEC

Steps 1 through 3 turn on *startup zero*. Startup zero prompts the user to set machine zero each time it is turned on.

Step 1
Use the arrow keys to highlight the *startup zero field* on the *measure setup screen* as shown.

Step 2
Press the yes soft key.

Step 3
Press the *finish key*.

Steps 4 through 6 identify the type of reference marks used on the measuring device's encoders. The method of establishing machine zero depends on the encoders used and the type of reference mark.

Step 4
Use the arrow keys to highlight the *ref marks field* on the *encoder setup screen* as shown.

```
Encoders              mm |1  +
                Axis        X
About
Display         Res         0.0010000000
Encoders
Hot Keys
Print
Form Chars      Type        TTL
Ports           Ref Marks   None
Measure         M.Z. Cnts   0
Sounds          Reversed    No
Supervisor      Interpolation  X1
                Units       MM
  None     Ref    Abs AC  Abs HH  Manual
```

Step 5
Press the soft key that corresponds to the type of reference marks used on the measuring device's encoders. This example uses manual reference marks. Select the appropriate reference marks for your encoders.

```
Encoders              mm |1  +
                Axis        X
About
Display         Res         0.0010000000
Encoders
Hot Keys
Print
Form Chars      Type        TTL
Ports           Ref Marks   Manual
Measure         M.Z. Cnts   0
Sounds          Reversed    No
Supervisor      Interpolation  X1
                Units       MM
  None     Ref    Abs AC  Abs HH  Manual
```

Step 6
Press the *finish key* twice.

Steps 7 through 10 clear all features, datums, and skews from the QC200. Old skews and datums can interfere with the SLEC setup procedure.

Step 7
Press the *menu key*.

Step 8
Press the *clear soft key*.

Step 9
Press the *clear all soft key*.

The following dialog box is displayed.
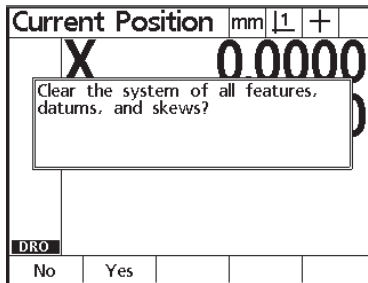
Step 10
Press the *yes soft key*.

Step 11 ensures that systems equipped with non-absolute reference marks always cross the same reference marks during the machine zero process.

Step 11
Move all axes to the most negative position.

Steps 12 through 14 establish machine zero.

Step 12
Use the *power switch* to turn off the QC200.

Step 13
Turn on the QC200. Press any key when the startup screen is displayed.

Step 14
Set machine zero according to the on screen prompt. This example shows encoders using manual reference marks.
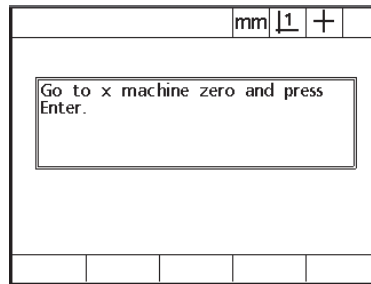
Steps 15 through 20 establish the offset between machine zero and the standard zero.

Step 15
Place the crosshair on the standard zero.

Step 16
Use the arrow keys to highlight the *MZ offset field* on the *SLEC setup screen*.
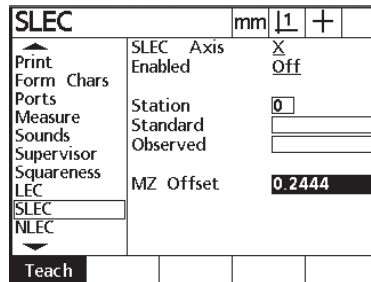
Step 17
Press the *teach soft key*.

Step 18
Press the *enter key*.

Step 19
Press the *finish key* twice.

Step 20
Press the *zero axis key* next to the desired axis. This example uses the X axis.
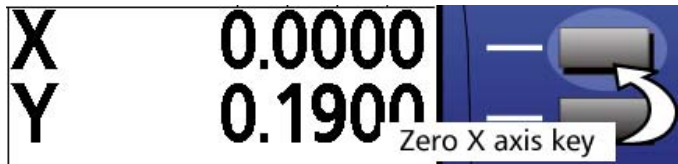
Steps 21 through 32 describe how to define *station 0* as the last known point with no variation between standard and observed values. If no point on the axis has the same standard and observed values, enter *0* for both the standard and observed fields.

Step 21
Use the arrow keys to highlight the *SLEC axis field*.

Step 22
Press the desired *axis soft key*.

NOTE
This example uses the *X axis soft key*. Press the *Y axis soft key* to define a station on the Y axis.

Step 23
Highlight the *enabled field* as shown.

Step 24
Press the *off soft key*.

NOTE
Use the *on* and *off soft keys* to toggle the station on and off. Turn off stations when no error correction is desired and during error correction setup.

Step 25

Use the arrow keys to highlight the *station field* as shown. Make sure *station 0* is entered for this step.

```
SLEC                    mm │1 │ +
 ▲            SLEC   Axis     X
Print         Enabled        Off
Form Chars
Ports         Station       │0 │
Measure       Standard      │      │
Sounds        Observed      │      │
Supervisor
Squareness
LEC           MZ Offset     │0.00000│
SLEC
NLEC
 ▼
 Dec    Inc   Remove
```

Step 26

Use the numeric keypad to enter the nominal value printed on the standard.

```
SLEC                    mm │1 │ +
 ▲            SLEC   Axis     X
Print         Enabled        Off
Form Chars
Ports         Station       │0 │
Measure       Standard      │0      │
Sounds        Observed      │      │
Supervisor
Squareness
LEC           MZ Offset     │0.00000│
SLEC
NLEC
 ▼

```

Step 27

Highlight the *observed field* as shown.

```
SLEC                    mm │1 │ +
 ▲            SLEC   Axis     X
Print         Enabled        Off
Form Chars
Ports         Station       │0 │
Measure       Standard      │0.00000│
Sounds        Observed      │0      │
Supervisor
Squareness
LEC           MZ Offset     │0.00000│
SLEC
NLEC
 ▼
 Teach
```

Step 28
Use the numeric keypad to enter the same value entered in the *nominal field.*

```
SLEC                    mm  |1  +
  ▲          SLEC   Axis      X
Print        Enabled         Off
Form Chars
Ports        Station         0
Measure      Standard        0.00000
Sounds       Observed        0.0000
Supervisor
Squareness
LEC          MZ  Offset      0.00000
SLEC
NLEC
  ▼
  Teach
```

NOTE
This example assumes that the last known point with no variation is 0.

Step 29
Highlight the *machine zero offset (MZ offset) field* as shown.

```
SLEC                    mm  |1  +
  ▲          SLEC   Axis      X
Print        Enabled         Off
Form Chars
Ports        Station         0
Measure      Standard        0.00000
Sounds       Observed        0.00000
Supervisor
Squareness
LEC          MZ  Offset      0.0000
SLEC
NLEC
  ▼
  Teach
```

Step 30
Place the crosshair on the standard's datum.

Step 31
Press the *teach soft key.*

```
  Teach
        Teach soft key
```
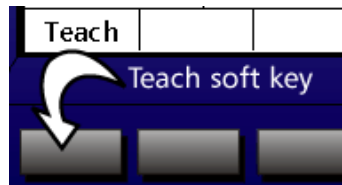
The MZ offset value is automatically entered in the *MZ offset field*.

```
SLEC                    mm |1 | +
  ▲           SLEC  Axis      X
Print         Enabled        Off
Form Chars
Ports         Station        0
Measure       Standard       0.00000
Sounds        Observed       0.00000
Supervisor
Squareness    MZ Offset      0.24440
LEC
SLEC
NLEC
  ▼
  Teach
```

Step 32
Press the *finish key*.

Station 0 is now defined as the last known point on the X axis with no variation between standard and observed values. All subsequent stations should show some variation between standard and observed values.

Steps 33 through 42 define station 1. Station 1 is the first station with variation between standard and observed values.

Step 33
Use the arrow keys to highlight the station field as shown.

```
SLEC                    mm |1 | +
  ▲           SLEC  Axis      X
Print         Enabled        Off
Form Chars
Ports         Station        0
Measure       Standard       0.0000
Sounds        Observed       0.00000
Supervisor
Squareness    MZ Offset      0.00000
LEC
SLEC
NLEC
  ▼
  Dec    Inc    Remove
```

Step 35
Use the *increase soft key* to enter the desired station number.

Step 36
Highlight the *standard field* as shown.

SLEC		mm	⌊1	+	
▲	SLEC Axis		X		
Print	Enabled		Off		
Form Chars					
Ports	Station		1		
Measure	Standard				
Sounds	Observed				
Supervisor					
Squareness	MZ Offset		0.00000		
LEC					
SLEC					
NLEC					
▼					

Step 37
Use the numeric keypad to enter the nominal value printed on the standard.

SLEC		mm	⌊1	+	
▲	SLEC Axis		X		
Hot Keys	Enabled		Off		
Print					
Form Chars	Station		1		
Ports	Standard		1		
Measure	Observed				
Sounds					
Supervisor	MZ Offset		0.24440		
Squareness					
LEC					
SLEC					
▼					

Step 38
Highlight the *observed field* as shown.

SLEC		mm	⌊1	+	
▲	SLEC Axis		X		
Hot Keys	Enabled		Off		
Print					
Form Chars	Station		1		
Ports	Standard		1.00000		
Measure	Observed				
Sounds					
Supervisor	MZ Offset		0.24440		
Squareness					
LEC					
SLEC					
▼					
Teach					

Step 39
Press the *teach soft key*.
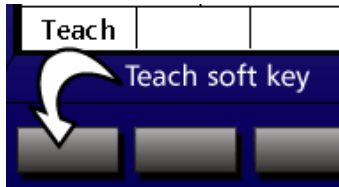
Step 40
Move the crosshairs to the desired point on the standard. This is the same point entered as the nominal value in step 37.

Step 41
Press the *enter key*.

NOTE
Do not enter a new value in the *MZ offset field*. MZ offset is entered only for station 0. All subsequent stations should show the same MZ offset value as station 0.

Step 42
Press the *finish key*.

Station is now defined.

```
┌─────────────────────────────────────────┐
│ SLEC                    mm  |1  +        │
│ ▲          SLEC  Axis      X             │
│ Hot Keys   Enabled        Off            │
│ Print                                    │
│ Form Chars Station        1              │
│ Ports      Standard       1.0000         │
│ Measure    Observed       0.94450        │
│ Sounds                                   │
│ Supervisor MZ Offset      0.24440        │
│ Squareness                               │
│ LEC                                      │
│ SLEC                                     │
│ ▼                                        │
│ Teach │      │      │      │      │      │
└─────────────────────────────────────────┘
```

Use steps 34 through 42 to define the remaining SLEC stations. Up to 29 additional stations can be entered on each axis. Do not turn on SLEC until all the desired stations are defined. The SLEC correction coefficients are applied to all subsequent measurements when turned on.

Non-linear error correction (NLEC)

Highlight the *NLEC field* as shown.

```
┌─────────────────────────────────────────────────┐
│ NLEC                        mm │1│ +              │
│ ┌──────────┬──────────────────────────────────┐  │
│ │ ▲        │ NLEC              Off             │  │
│ │ Print    │ X Pos             1              │  │
│ │ Form Chars│ Y Pos            1              │  │
│ │ Ports    │     Nominal       Actual         │  │
│ │ Measure  │ X 0.00000         0.00000        │  │
│ │ Sounds   │ Y 0.00000         0.00000        │  │
│ │ Supervisor│    Machine 0     Cell Size      │  │
│ │ Squareness│ X 0.0000         0.0000         │  │
│ │ LEC      │ Y 0.0000          0.0000         │  │
│ │ SLEC     │ X Grid Size       0              │  │
│ │ NLEC     │ Y Grid Size       0              │  │
│ │ ▼        │                                  │  │
│ └──────────┴──────────────────────────────────┘  │
│ │        │        │        │        │            │
└─────────────────────────────────────────────────┘
```

Use NLEC to compensate for encoder and machine variation by applying error correction coefficients. NLEC correction coefficients apply to each cell of a grid standard laid out on the measuring envelope.

NOTE
NLEC is not included on all QC200s. Contact your Metronics distributor to purchase NLEC.

Grid intersections form the corners of a cell. NLEC compares measured values of intersections to nominal values then generates a correction coefficient for the cell. Correction coefficients provide error compensation for the entire area of the grid standard.

Complete the following tasks before performing NLEC setup. Set the startup zero field to yes on the measure setup screen. Turn on reference marks on the encoder setup screen. Cycle power to the QC200 to establish machine zero during startup.

To setup NLEC

NOTE
Place the standard grid on the measuring device before you begin.

NOTE
Turn off LEC and SLEC before setting up NLEC. LEC and SLEC correction coefficients applied during NLEC setup produce inaccurate NLEC correction coefficients.

Step 1
Highlight the *NLEC field* as shown.

NLEC		in	⌊1	+	
	NLEC	Off			
Form Chars	X Pos	1			
Ports	Y Pos	1			
Measure	Nominal	Actual			
Sounds	X 0.00000	0.00000			
Supervisor	Y 0.00000	0.00000			
Squareness	Machine 0	Cell Size			
LEC	X 0.0000	0.00000			
SLEC	Y 0.0000	0.00000			
NLEC	X Grid Size	0			
Scale Factor	Y Grid Size	0			
Off	On				Teach

Step 2
Press the *off soft key*.

Off soft key
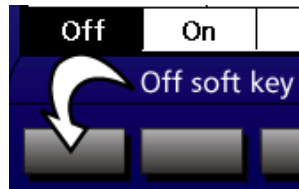
Step 3
Highlight the *X grid size field* as shown.

NLEC		in	⌊1	+	
	NLEC	Off			
Form Chars	X Pos	1			
Ports	Y Pos	1			
Measure	Nominal	Actual			
Sounds	X 0.00000	0.00000			
Supervisor	Y 0.00000	0.00000			
Squareness	Machine 0	Cell Size			
LEC	X 0.0000	0.00000			
SLEC	Y 0.0000	0.00000			
NLEC	X Grid Size	0			
Scale Factor	Y Grid Size	0			
					Teach

Step 4
Enter the grid length for the X axis.

NOTE
This example uses a 3 inch by 3 inch grid.

Step 5
Highlight the *Y grid size field* as shown.

Step 6
Enter the grid length for the Y axis.

Step 7
Enter the desired cell size for the X and Y axes as shown.

NOTE
This example uses 1 inch by 1 inch cells.

Step 8
Highlight the *actual/error field* as shown.

Step 9
Press the *actual soft key.*
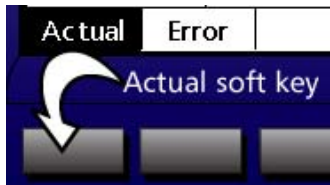
Step 10
Press the *teach soft key*.
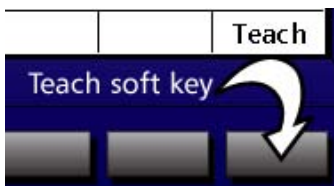
Step 11
Move the crosshair to the *station 1,1* on the grid standard.

Step 12
Press the *enter key*.

Step 13
Press the *finish key*.

The QC200 prompts the user to measure the remaining stations on the grid. Finish NLEC setup by moving the crosshair to the prompted station. Press the *enter key* and then the *finish key* to enter the station. Repeat this process until all stations are entered.

Step 14
Press the *finish key*.

Step 15
Highlight the *NLEC field* as shown.

Step 16
Press the *on soft key*.

Step 17
Press the *finish key* twice.

NLEC station setup is complete. Up to 29 cells can be entered on each axis. The NLEC correction coefficient is applied to all subsequent measurements when turned on.

Chapter 8
Reference

Three non-collinear points are the minimum required to measure a circle. Up to 100 points can be probed during a circle measurement. Use more points for greater accuracy. Every point on a circle is weighted equally but the first three points are used to estimate the form. Space the first three points widely to ensure an accurate form estimate.

The QC200 applies a mathematical algorithm to the probed points. The algorithm shifts the circle around until its circumference is as close to every point as possible. Further shifting to better accommodate a few points leads to greater distances from other points.

In the illustration below *circle 1* shows three points distributed around a theoretically perfect circle. Given perfect geometry there is little need to worry about probing additional points. In real life applications, geometry is never perfect. A more realistic circle is represented by *circle 2*. Clearly three points are insufficient to measure *circle 2* accurately.

Circle 1   Circle 2
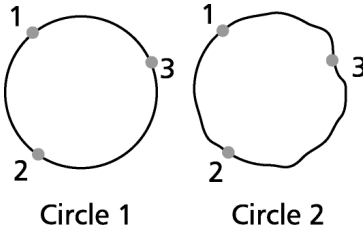
Probe more than the three required points to average out inconsistencies in the geometry. For example, a circle with rough edges is difficult to measure accurately without probing additional points.

Circle 1   Circle 2
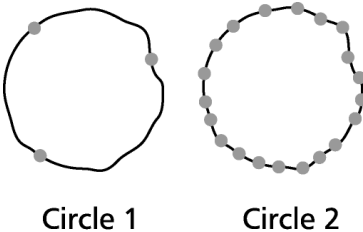
When more than 3 points are used, a rough edge can be measured with greater repeatability. When 3 points are probed on a circle, each point contributes approximately 33% to the result. When 100 are used, each point contributes only 1%. Any single stray point will not severely change the measurement of the circle as a whole.

Apply these principles to all measurement with the QC200.

Repeatability

Quantization error exists in all geometric measuring systems including the QC200 digital readout system. Repeatability problems can occur when circle measurements distribute the points over less than 90 degrees of arc. Circle points distributed over less than 30 degrees of arc can cause serious repeatability problems. An arc of less than 30 degrees may cause serious repeatability problems. Very short legs of angles may also introduce an error factor.

NOTE
If using a system with a Q axis, increase the magnification of small angles to help resolve the angle quantization error to one minute.

The following chart shows the mathematical effects of the number of points and the distribution of points on circle measurements. Data on the chart applies to a circle with a radius of .250" measured with .00008" (2 Micron) resolution scales. This chart assumes no system error. Notice the average error above 90 degrees of arc is the scale resolution and the repeatability of the calculation of +/- 1 count of the scale.

Circle Radius = .250" Encoder Resolution = .00008" (2 Micron)
Unless shown differently, the numbers in this chart are shown to the nearest .0001" because of metric scale resolution.

Mean = The average true position of the calculated circles center for 0,0.
Max = The total repeatability error that can be expected from the calculated circles center.

	Degrees of arc							
	10°		30°		45°		60°	
# points	Mean	Max	Mean	Max	Mean	Max	Mean	Max
3	.0060	.0186	.0007	.0020	.0003	.0009	.0002	.0006
4	.0053	.0174	.0006	.0018	.0002	.0008	.0002	.0004
10	.0041	.0143	.0005	.0017	.0002	.0007	.0001	.0004
15	.0035	.0126	.0004	.0015	.0002	.0006	.0001	.0004
20	.0032	.0107	.0004	.0013	.0002	.0006	.0001	.0003
30	.0027	.0108	.0003	.0010	.0002	.0005	.0001	.0003

	90°		120°		180°	
# points	Mean	Max	Mean	Max	Mean	Max
3	.0001	.0003	.0001	.0002	.0000	.0001
4	.0001	.0002	.0001	.0002	.0000	.0001
7	.0001	.0002	.0001	.0002	.0000	.0001
10	.0001	.0002	.0001	.0002	.0000	.0001
15	.0001	.0002	.0001	.0001	.0000	.0001
20	.0001	.0002	.0001	.0001	.0000	.0001
30	.0001	.0002	.0000	.0001	.0000	.0001

Best Fit Algorithms

There are four basic algorithms used by the QC200 to determine the best geometrical form fit of measured features. When the QC200 measures a line it uses the first two points probed to estimate the form fit of the line. The first three points are used to estimate the form of a circle. Keep in mind that the form estimate simply defines the starting point for the best fit algorithm. The estimated form geometry is shifted among the data points by the selected algorithm to find the actual form.

NOTE
LSBF and ISO algorithms apply to lines and circles. Inner and outer algorithms apply only to circles.

Here's how the various QC200 algorithms determine form fit.

LSBF (lines and circles)
The deviation of each point from the estimated form is measured, then squared, and then added together. Adjustments are made to the line seeking the smallest possible sum of the squared deviations. All points count equally when using LSBF.

ISO (lines and circles)
The ISO best fit algorithm simply shifts the angle and location of the line until it has achieved the smallest possible deviation of the outlying points. This algorithm yields the geometry with the closest outlying data points. The ISO algorithm considers only the furthest data points.

Inner (circles only)
This algorithm produces the largest inscribed circle possible. This means that the circle form is defined by the inner most points of the data cloud. In simpler terms, the inner algorithm produces the smallest circle geometry possible from the data points.

Outer (circles only)
This algorithm produces the smallest circumscribed circle possible. This means that the circle form is defined by the outer most points of the data cloud. In simpler terms, the outer algorithm produces the largest circle geometry possible from the points.

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