AV300+ and AV350+ Plus Series Multi-Sensor Vision Metrology Systems with QC5300 Software

User Manual

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CE

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1. PREFACE

1.1 Welcome

Thank you for purchasing a Plus Series Vision Metrology System from Starrett. We are pleased that your search has led you to Starrett Kinemetric Engineering, a subsidiary of the L.S. Starrett Company. This manual is intended to maximize your satisfaction with your system and ensure the most in operating performance. Please feel free to contact Starrett Kinemetric at any time. We value your feedback and your satisfaction as a customer.

1.2 Safety Symbols & Terminology

The following symbols and terms are used in this manual to call attention to important safety issues. Heed these notices carefully in order to avoid personal injury or damage to the system.

Symbol or Term	Meaning
	Accompanies a **DANGER**, **WARNING** or **CAUTION** message. Failure to heed the message may result in personal injury or equipment damage or. See terms below for further information.
	**WARNING:** Dangerous voltage. Risk of electrical shock. Failure to observe this warning may result in personal injury, death, or equipment damage.
	**WARNING:** Disconnect equipment from power source. Failure to observe this warning may result in personal injury, death, or equipment damage.
	**CAUTION:** Pinch Point - Keep hands clear. Failure to observe this warning may result in minor to severe personal injury or equipment damage.
DANGER	Immediate hazards which **WILL** result in severe personal injury or death.
WARNING	Hazards or unsafe practices which **COULD** result in severe personal injury or death.
CAUTION	Hazards or unsafe practices which **COULD** result in minor injury or equipment damage.
NOTE	Information that is useful or helpful in operating the equipment properly.

1.3 Warranty

Starrett Kinemetric products carry a one-year (from date of purchase) warranty against defects in material and workmanship (parts and labor), subject to factory inspection. The L.S. Starrett Company will repair or replace, at its option, any part or parts found to be defective in workmanship or material. Starrett warrants repaired or replaced parts for the balance of the original warranty period or 90 days, whichever is longer. Parts returned to the factory under warranty will be repaired at no charge. Freight charges to the factory will be paid by the customer. Return freight charges to the customer will be paid by Starrett.

This warranty does not cover damages from such causes as abuse, accident, neglect, fire or freight damage. It does not apply to defects resulting from modifications made by the customer or improper use of the system or its components.

1.4 Regulatory Compliance

AV300+ and AV350+ Multi-Sensor Vision Metrology Systems comply with Council Directives 2006/42/EC - Machinery. When installed and operated in accordance with this manual, they are allowed to carry the CE mark. Testing and evaluations were conducted on a sample representing the maximum configuration. The Product Safety, EMC Testing and Evaluations were provided by Garwood Laboratories, San Clemente, CA 92672, USA. The systems also comply with 2002/95/EC RoHS.

EMC Standards

EN 55011 Class A	Conducted Electromagnetic Emissions
EN 55011 Class A	Radiated Electromagnetic Emissions
EN 61000-4-2	Electrostatic Discharge (Contact)
EN 61000-4-2	Electrostatic Discharge (Air)
EN 61000-4-4	Electrical Fast Transients (Direct Coupled)
EN 61000-4-4	Electrical Fast Transients (Capacitive Coupled)
EN 61000-4-6	Radio Frequency Conducted Immunity (150khz-80Mhz)
EN 61000-4-5	Surge (for control computer, et al)
EN 61000-4-11	Voltage Dips, Short Interrupts and Voltage Variations Immunity

Safety Standards

EN 292-1	Safety of Machinery, General Principles for Design (Referenced)
EN 60204	Safety of Machinery, Electrical Equipment of Machines
EN 12100	Safety of Machinery, Principles for Risk Assessment
EN 60825	Safety of Laser Products

1.5 Disclaimer of Liabilities

The L.S. Starrett Company shall have no liability or responsibility to the customer or any other person or entity with respect to any liability, loss or damage caused or alleged to be caused directly or indirectly by this documentation, or the hardware described in it. This includes, but is not limited to, any interruption of service, loss of business or anticipatory profits, or consequential damages resulting from the use or operation of hardware or equipment.

1.6 Copyright & Trademark Information

2. PRODUCT INTRODUCTION

Starrett Kinemetric Plus Series Systems provide a comprehensive CNC metrology solution for industrial applications where high accuracy, extended travel, and a stable base for multi-sensor measurements are required. The stage and camera are driven by high-speed and quiet DC servo motors. The vision metrology system includes a 12:1 zoom lens and a high-resolution digital color camera. Ring lighting from the top, back-lighting from below the stage, and through-the-lens coaxial surface lighting are standard. Extensive vision metrology features, 3-axis CNC control, and support for multi-sensor operation are provided by Heidenhain QC5300 software. A touch probe, a laser probe, and a rotary stage are optional.

Model AV300+ is an enhanced version of Starrett's popular AV300 CNC vision metrology system. It improves performance with a precision granite base and an extended travel Z-column, providing a 300 x 150 x 200 mm (12" x 6" x 8") X-Y-Z measuring range.

Model AV350+ is an enhanced version of Starrett's larger AV350 CNC vision metrology system with an expanded 350 x 350 x 200 mm (14" x 14" x 8") X-Y-Z measuring range for larger parts.

Both models are constructed for highest accuracy before compensation is applied, thereby providing high performance that users can rely on. Accurate motion and repeatable positioning are fundamental to all Starrett Video Metrology Systems.

System Specifications:

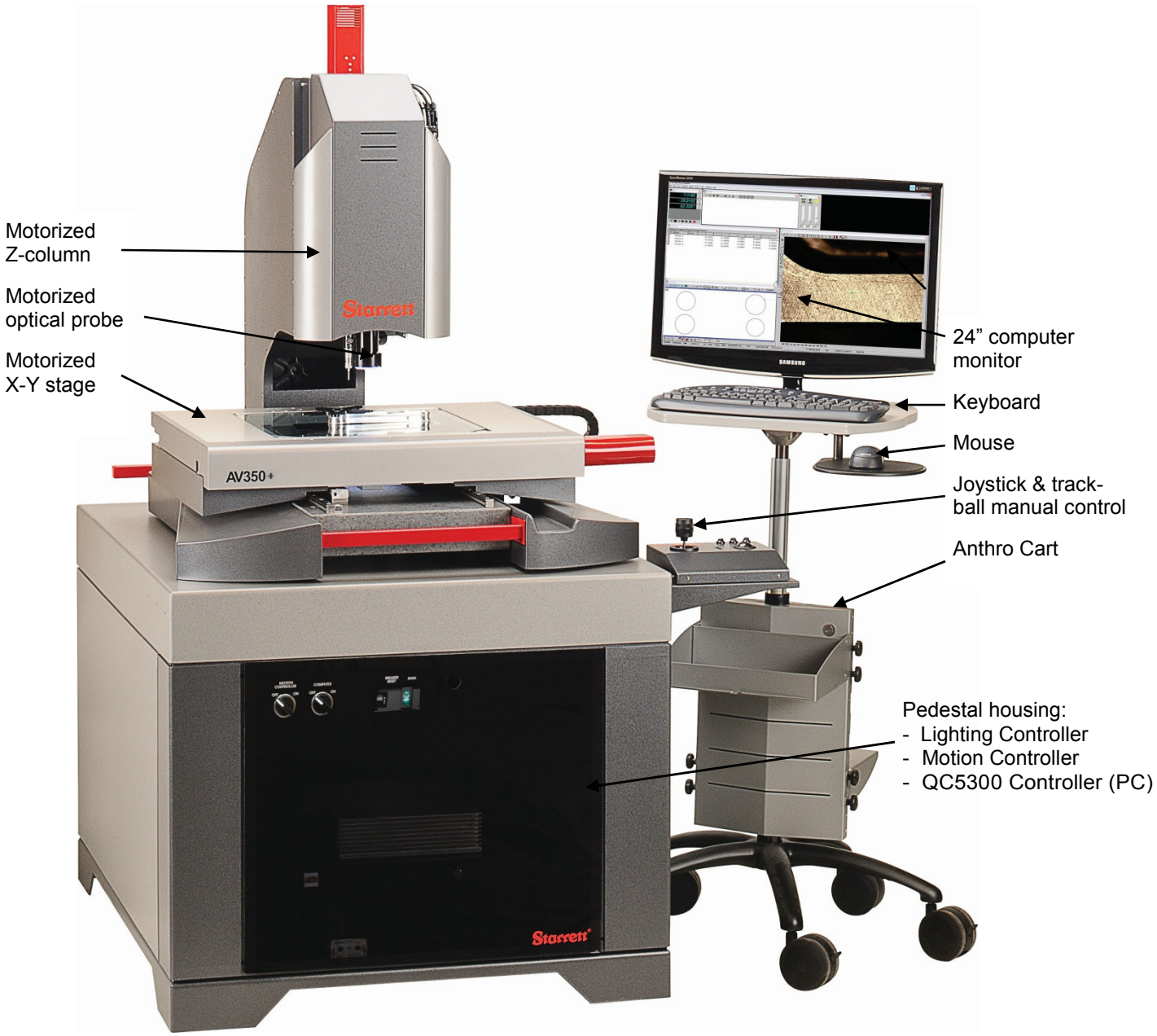
Feature	Model AV300+	Model AV350+
Measurement Range, X-Y-Z	300 x 150 x 200 mm (12" x 6" x 8")	350 x 350 x 200 mm (14" x 14" x 8")
Stage Dimensions, X x Y	513 x 275 mm (20.2" x 10.8")	716 x 549 mm (28.2" x 21.6")
Window Aperture, X x Y	340 x 198 mm (13.4" x 7.8")	389 x 389 mm (15.3" x 15.3")
Lighting Source	External 150-watt fiber-optic illuminator unit or high-intensity LEDs	
Lighting Elements (std)	Ring light, substage light, through-the-lens coaxial light (standard)	
Camera Type	Color digital camera, USB interface	
Zoom Optics	12:1 zoom lens (standard)	
Camera Resolution	1024 x 768 pixels	
Operator Display	610 mm (24") flat-screen color LCD monitor	
Operator Controls	Keyboard, mouse, joystick & trackball unit	
Screen Resolution	1900 x 1200 pixels	
Part Image Resolution	1024 x 768 pixel image window	
Encoder Resolution	0.1 µm	
E2 Accuracy (X & Y)	1.9 µm + 5L/1000	2.5 µm + 5L/1000 mm
E1 Accuracy (Z)	2.5 µm + 5L/1000	
Stage Drive Method	DC servo motors	
Motion Control	QC5300 Controller (3-D X-Y-Z) plus digital amplifier unit.	
Manual Positioning	Joystick & trackball signals to QC5300 Controller.	
CNC Positioning	Software executed by QC5300 Controller.	
Zoom Control	Manual control or software executed by QC5300 Controller.	

Lighting Control	Manual control or software executed by QC5300 Controller.								
Calibration	To NIST traceable artifacts								
Warranty	One year								
Optional Items	Touch probe, laser probe, rotary table, quad ring light, motorized Z-track for quad ring light.								
System Power	120 Vac ± 10A max or 240 Vac ± 5A max (as ordered)								
Touch Probe Option Kit									
Probe Head	Renishaw PH6								
Probe Body 1	Renishaw TP20 SF (standard force)								
Probe Body 2	Renishaw TP20 MF (medium force)								
Stylus	Renishaw 20 mm long stylus with 2 mm ruby tip.								
Probe Tip Repeatability	0.35 µm								
Laser Probe Option Kit	Available lenses:								
Lens focal length, mm	16	25	40	50	75	100	125	150	200
Working range, mm	0.6	1.8	4	8	18	35	45	70	125
Vertical precision, µm	2	3	4	6	10	15	20	35	70
Lateral resolution, µm	5	12	14	15	25	35	50	50	72
Max probe sampling rate	800 samples/sec								
Quad Ring Light Option									
Lighting Elements	96 white LEDs in 4 individually controllable banks.								
Ring Dimensions	125 mm (5”) OD, 100 mm (3.9”) ID, 19 mm (0.75”) H								
Ring Position	Adjustable from bottom end of video probe to 100 mm (4”) below.								
Ring Position Adjustment	Motorized version on Z-track or manual version with setscrew.								
Rotary Table Option									
Clear Aperture	100 mm (3.94”)								
Motor Drive	Stepper or DC servo motor								
Positioning Accuracy	± 0.05° (0.8 mrad)								
Main Spindle Run-out	5 µm (0.0002”) TIR								
Tooling Plate Run-out	10 µm (0.0004”) TIR								
Pedestal (standard)									
Dimensions, H x W x D	95 x 78 x 86 cm (37.4” x 30.7” x 34.0”)						79 x 93 x 119 cm (31.0” x 36.5” x 47.0”)		
Pedestal Clearances, Min									
In back for cable track	25.4 cm (10”)						30 cm (12”)		
On right or left for shelf							25.4 cm (10”)		
On right for cable track							18 cm (7”)		
On left for cable track							6 cm (2.4”)		
Anthro Cart									
Height to center of screen	140 cm (55”) for standing, 114 cm (45”) for sitting position								
Depth of Work Surface	61 cm (24”)								
Width of Work Surface	50.5 cm (20”) for main shelf, 63.5 cm (25”) including mouse shelf								
Wheeled Base	43 cm (17”) from center to tip of wheels								

CAUTION: Exceeding the maximum load capacity of 18 kg (40 lbs) will reduce accuracies of your system and may damage the mechanical structure.

Disclaimer: Due to continual product improvement, specifications may change without notice.

2.1 AV300+ and AV350+ Base System Components



AV350+ CNC System Components

2.1.1 X-Y Stages

Model AV300+ offers a stage for 300 x 150 mm (12” x 6”) of travel. Model 350+ offers a larger stage for 350 x 350 mm (14” x 14”) of travel. Both stages are made from precision machined aluminum. Surface mounting holes allow customer-designed fixtures for part support. Stage motion is by means of quiet-running DC servo motors.

2.1.2 Z-Column

A precision cast-aluminum column supports the video probe (standard), touch probe (optional), laser probe (optional), fixed ring light (standard), coaxial light (standard), and height-adjustable quad ring light (optional). Height adjustment is 200 mm (8”) to accommodate tall parts. Motion along the Z-axis is by means of a quiet-running DC servo motor.

2.1.3 Optical Probe Assembly

The Optical Probe Assembly includes 12:1 zoom optics, a high-resolution digital video camera, a fixed ring light, a coaxial light, and an optional auxiliary lens. The optional 2X Auxiliary Lens (Aux Lens) allows parts inspection at greater magnification and precision. The video camera captures the part image for software analysis and edge detection. Focus is determined by the distance between the optics and the surface to be analyzed. The settings of the video camera are preset at the factory and should not be modified. The zoom lens position and optics height are computer controlled via QC5300 software.

2.1.4 Lighting Controllers

Two lighting systems are offered: a fiber-optic system with quartz halogen light sources, and an LED system. In the fiber-optic system, a separate Lighting Controller houses a 150-watt quartz halogen lamp for each light source (ring light, substage light and coaxial light). The output of each lamp is carried from the Lighting Controller to the Metrology Unit by means of a fiber-optic cable. In the LED lamp system, light is emitted by ultra-bright LEDs mounted directly in the ring light, substage light and optional coaxial light. The output of each light source is controlled via software using the QC5300 Controller.

2.1.5 X-Y-Z Motion Controller

X-Y-Z motion is achieved by a DC servo motor for each axis. Each motor is driven by an output from a Digital Motion Controller unit, which receives signals from a PC interface board in the system QC5300 controller PC. All stage movement is computer controlled via QC5300 software.

2.1.6 Joystick / Trackball Operator Control Unit

For manual motion control, that software senses the output of the system's joystick / trackball control unit, which provides both a joystick and a trackball. This controller is used during manual inspection and in teaching inspection routines for automated inspection.

2.1.7 Computer Peripherals

A high-resolution external 24" flat-screen color LCD monitor is used to program the system's QC5300 software and to display parts video images and data. A keyboard and mouse are used for operator inputs.

2.1.8 Pedestal

The AV300+ and AV350+ systems both come standard with a steel pedestal to support the granite base of the metrology unit. Pedestal dimensions are 95 x 78 x 86 cm (37.4" x 30.5" x 34.0") for the AV300+ system, and 79 x 93 x 119 cm (31.0" x 36.5" x 47.0") for the AV350+ system. Add 25 cm (10") to width of the AV350+ for a shelf.

2.1.9 Anthro Cart

A height-adjustable, wheeled Anthro Cart, supports the 24" video monitor, keyboard and mouse. The height of the cart is adjustable by 25 cm (10") so that the systems can be operated from a standing or sitting position.

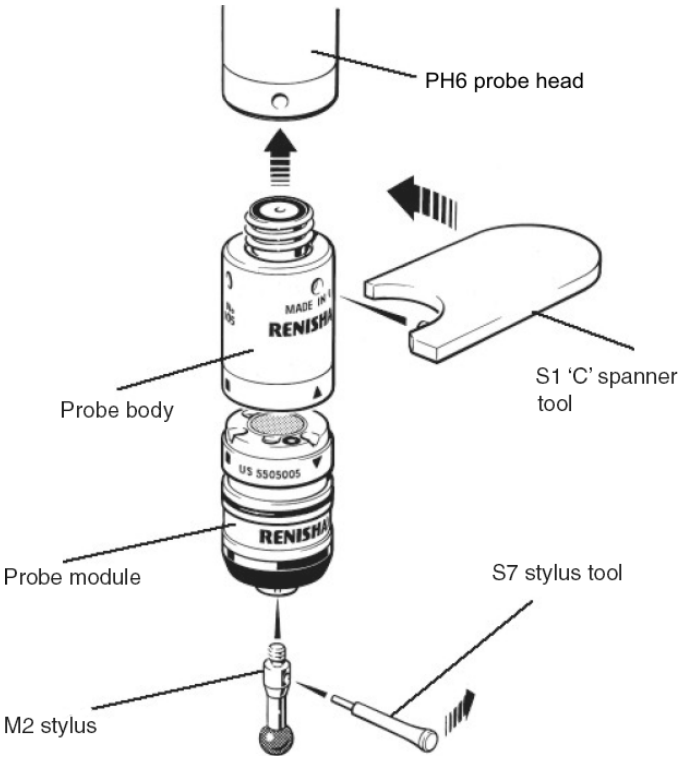
Anthro Cart

2.1.10 CNC Metrology Software

QC5300 Windows-based metrology software controls 3-D CNC operation. It features a state-of-the-art graphical user interface (GUI), flexible data import and export, and a choice of analysis tools. The software is designed for automated part measurements, efficient data management, customizable reports, and data output to a wide variety of applications, printers and databases. For full details, please refer to the separate QC5000 software manual.

2.1.11 Touch Probe Option

Installed touch probe



Touch probe components

Plus Series CNC Metrology Systems are available with an optional Renishaw touch probe, which is fully integrated in QC5000 software. The addition of a touch probe turns a Plus Series Vision Metrology System into a Multi-Sensor Vision Metrology System. A touch probe is ideal to measure the height of flat surfaces or the lateral position of vertical surfaces at different heights.

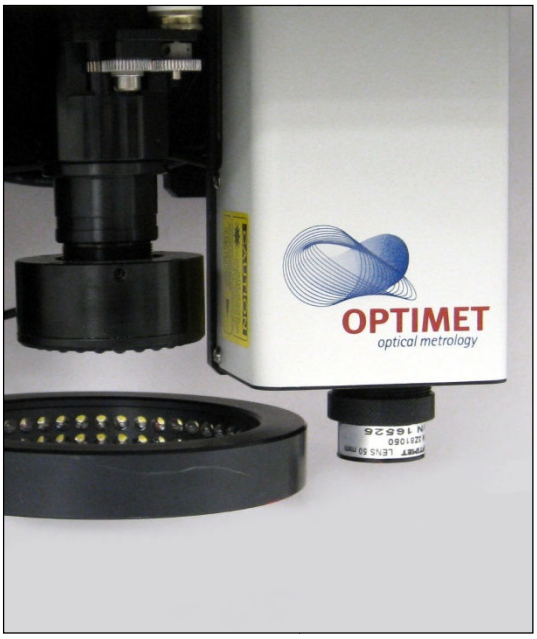
The touch probe kit consists of a Renishaw PH6 probe head, a TP20 probe body, a standard force (SF) probe module (black cap), a TP20 medium force (MF) probe module (gray cap), and a 20 mm long stylus with 2 mm ruby tip. Also included with the kit are a plastic case, tools such as special spanner wrenches, and a Class XXX ring gauge calibrated to ± 0.13 µm (0.000005"). The ring gauge ensures a known offset between the touch probe and the video probe. The standard force probe module is recommended for soft materials, while the medium force probe module is recommended for hard materials.

The PH6 probe head includes a shank, and integral cable, and an LED indicator, which is illuminated when the probe module is seated and ready for use. The TP20 probe body is attached to the PH6 probe head by means of M8 threads. The stylus is attached to the probe module by means of M2 threads. The TP20 probe module with the attached stylus is magnetically attached to the TP20 body, thereby allowing easy changeout of modules.

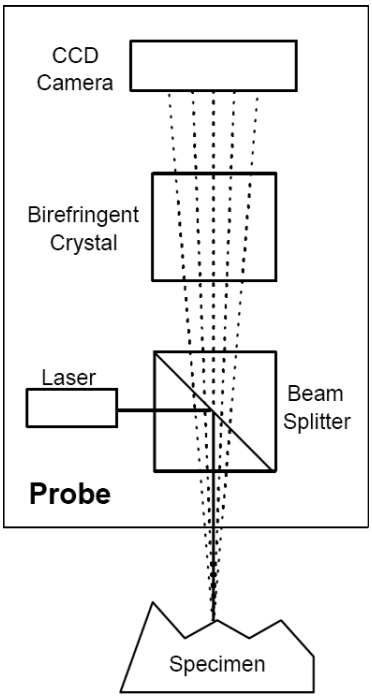
In addition to the components included in the Renishaw touch probe option kit, Starrett Kinemetric offers the full range of compatible components available from Renishaw, such as right-angle probe heads, probe modules with different sensitivities, and styli of different lengths.

Touch Probe Option Kit	
Probe Head	Renishaw PH6
Probe Body 1	Renishaw TP20 SF (soft force) for use with 20 mm stylus.
Probe Body 2	Renishaw TP20 MF (medium force) for use with 60 mm stylus.
Stylus 1	Renishaw 20 mm long stylus with M2 (2 mm) ruby tip.
Stylus 2	Renishaw 60 mm long stylus with M2 (2 mm) ruby tip.
Probe Tip Repeatability	0.35 µm with 20 mm long stylus, 0.65 µm with 60 mm long stylus.

2.1.12 Laser Probe Option



Laser Probe plus Ring Lights



Laser Probe Principle of Operation

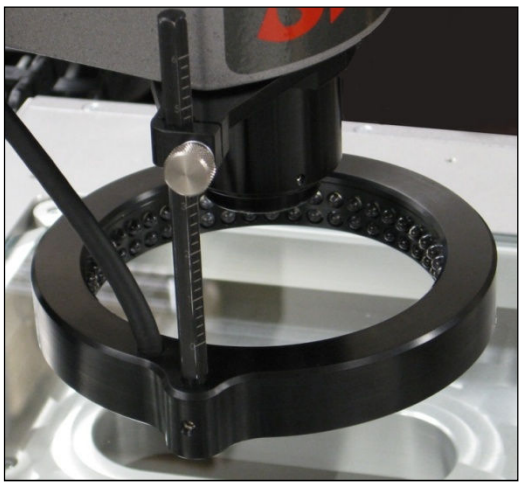
Plus Series CNC Metrology Systems are available with the ConoProbe Mark 3.0 Laser Probe System by Optimet. In this unique technology, a laser that is coaxial with a CCD video detection system illuminates the object to be measured. A holographic pattern is generated as light from the object passes through a birefringent crystal. This pattern is captured by the CCD and is then converted to a mathematical 3-D rendition of the object. This non-contact technology is fully integrated into QC5300 software and offers unique capabilities:

- Micron resolution
- Ability to measure soft surfaces and highly reflective or translucent surfaces, such as waxes and plastics.
- Ability to measure deep, narrow slots, groves and blind holes with a 10:1 ratio of depth to diameter.
- Ability to capture complex 3-D contours at up to 800 samples/sec using QC5300 hardware and software. Ideal for medical applications and reverse engineering.
- Ability to measure surfaces that are within 5° of grazing incidence of the laser. This allows reproduction of difficult shapes with high fidelity to the original and without distorting the profile.

As the focal length of the camera increases, so do the numerical values for working range resolution and precision. Nominal lateral resolution is 1/3000 of the focal length of the lens. To optimize laser probe performance for different object sizes, Optimet offers lenses with focal lengths from 16 mm to 250 mm. Starrett Kinemetric can include any of these lenses in a system. The following three lenses are recommended for a laser probe starter system: 25 mm, 50 mm and 75 mm.

Laser Probe Option Kit	**Lens options**									
Lens focal length, mm	16	25	40	50	75	100	125	150	200	250
Working range, mm	0.6	1.8	4	8	18	35	45	70	125	180
Vertical precision, µm	2	3	4	6	10	15	20	35	70	100
Lateral resolution, µm	5	12	14	15	25	35	50	50	72	94
Max probe sampling rate	800 samples/sec									

2.1.13 Quad Ring Light Option



Quad Ring Light (optional) with Manual Z-Track.

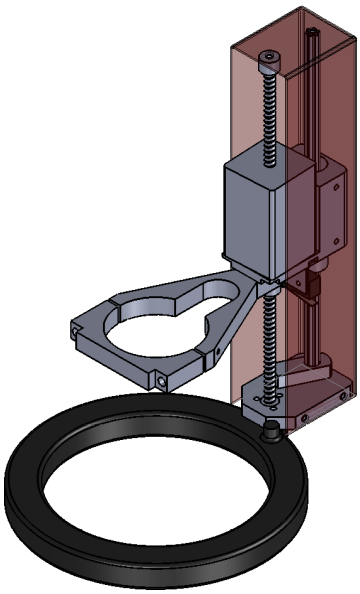
Ring Light (standard, LED version) with Touch Probe (optional)

Plus Series CNC Series Metrology Systems are available with an optional Quad Ring Light to augment the standard top ring light. The Quad Ring Light provides a total of 96 ultra-bright LEDs in four quadrants whose intensity is individually adjustable in via QC5300 software. The height of the Quad Ring Light is also adjustable. In combination, adjustments of height, direction and light intensity provide very flexible illumination for edge detection.

2.1.14 Motorized Z-Track Option

Two mechanisms are available as options for height adjustment of the Quad Ring Light: 1) a manual Z-track where the height of the quad ring light is set by means of a thumb screw, and 2) a motorized Z-track where height is set via under QC5300 software. Height adjustment is approximately 6 cm (2-1/4”) for the manual Z-track and 10 cm (4”) for the motorized Z-track.

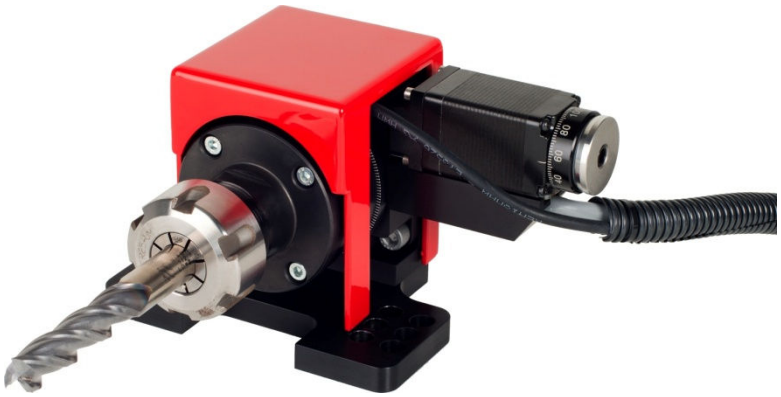
The manual Z-track is shipped with the Quad Ring Light unless the motorized Z-track is ordered. The latter is recommended by Starrett since it allows repeatable lighting under computer control.



Motorized Z-Track Option

2.1.15 Rotary Stage Options

Two precision rotary stages are available as options: a 100 mm stage and a 150 mm stage. (0.0002”). Tooling plate run-out (flatness) is 10 µm (0.0004”). Both stages include a pre-loaded worm and gear assembly, stepper motor, a tooling plate, an enclosure, bidirectional limits, and connectors. Control is via QC5300 software.



Rotary Stage

Rotary Stage Specifications	Model APT100E	Model 150E
Stage plate diameter Overall dimensions	100 mm 76x102x229 mm (3”x4”x9”)	150 mm 76x152x305 mm (3”x6”x12”)
Motor type Main gear type Spindle bearing type Maximum output speed Through spindle clearance Main spindle run-out, TIR Tooling plate run-out, TIR Angular position accuracy Angular position repeatability Angular resolution Mounting	Stepper motor Worm gear assembly, 60:1 ratio Cross roller 30 rpm at 1800 rpm motor speed 30 mm (1.18”) 5 µm (0.0002”) 10 µm (0.0004”) 0.009° 0.003° 0.0008° with 0.5 µm encoder Horizontal or vertical	

Positioning accuracy is 0.009° peak-to-peak, 0.05° goal. Limit switches provide ±160° of rotation for the 100 mm stage and ±160° for the 150 mm stage. Positioning accuracy is 0.09° peak-to-peak, 0.05° goal. Main spindle run-out TIR is 5 µm

2.2 Environmental Considerations

Starrett Vision Metrology Systems are factory calibrated under the standard laboratory environmental conditions shown below:

Specification	Requirement
Ambient Temperature	68°F ± 1°F (20°C ± 0.5°C)
Humidity	40-60% RH
Temperature rate of change	1°F (0.5°C) per hour

If the system is to be operated under environmental conditions that are substantially different from those shown above, the system should be recalibrated under the expected operating conditions. Also consider material characteristics, such as coefficients of thermal expansion, of the parts under inspection. Numerical compensation may be required when measuring parts under conditions different from those controlling the stated dimensional specifications for these parts.

2.3 Safety Considerations

General Safety 	**NOTE:** Plus Series Vision Metrology Systems are designed for safety and proper ergonomics during normal use. Exercise caution when lifting, handling or moving the system to avoid personal injury and to maintain equipment calibration and measurement performance. Disconnect all power sources prior to moving or working on the equipment. Consult Starrett if you have any question regarding transporting, using or maintaining these systems. Follow all standard safety protocols for electrical and mechanical equipment in addition to all guidelines outlined in this manual. Failure to exercise proper safety practices may result in damage to the equipment, serious personal injury or death.
Electrical Safety 	**WARNING:** Follow the guidelines below to protect the equipment, to prevent voiding the warranty, and to avoid hazardous electrical conditions: • Power receptacles used with this equipment must be properly grounded 3-prong polarized 120 Vac types for use in North America, or appropriate safety-rated receptacles as used outside of North America. • Keep component air vents clear, clean and free from dust and debris to provide proper circulation to electrical components and to avoid overheating. • Keep all liquids away from the system. • Ensure that the ground is clean, dry and free from debris at all times. • Do not operate the equipment in excessively humid conditions (> 90% relative humidity). • Do not operate the equipment in an explosive environment, such as around volatile or flammable solvents. • Do not open the metrology cabinet or component housings, except to change light bulbs. All other components are to be serviced by factory-authorized personnel only. • Do not leave covers off the machine components when operating.
	Disconnect power, or do not plug in the power cord, if hazardous conditions exist such as: • Damaged or frayed power cord. • Damaged or improperly grounded power receptacle. • Equipment exposed to excessive moisture or liquid spills. • Impact or damage to the equipment. Have the system inspected by authorized personnel before operating. • Ongoing equipment serviced by a technician
Mechanical Safety 	**CAUTION:** The CNC metrology stage has automatic moving components. Do not place hands or loose articles of clothing near the moving parts. Failure to observe this warning may result in personal injury and equipment damage.

2.4 Power Control Panel

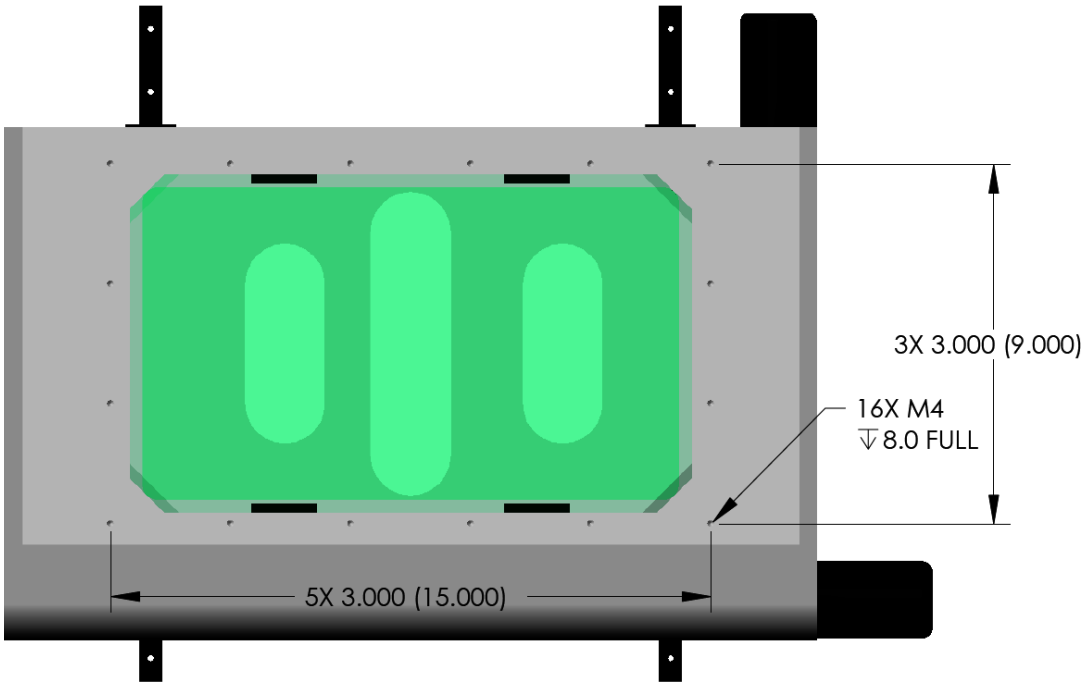
The front of the pedestals for the AV300+ and AV350+ systems includes power distribution panel with three power switches: 1) a main power switch for the entire system, 2) a two-position rotary power switch for the QC5300 Controller (PC), and 3) a two-position rotary power switch for the 3-Axis Servo Motion Controller. Adjacent to the main power switch is a resettable circuit breaker. The two rotary power switches allow the QC5300 Controller (PC) and Servo Motion Controller to be independently reset without having to open the pedestal which houses these units.

Power Control Panel

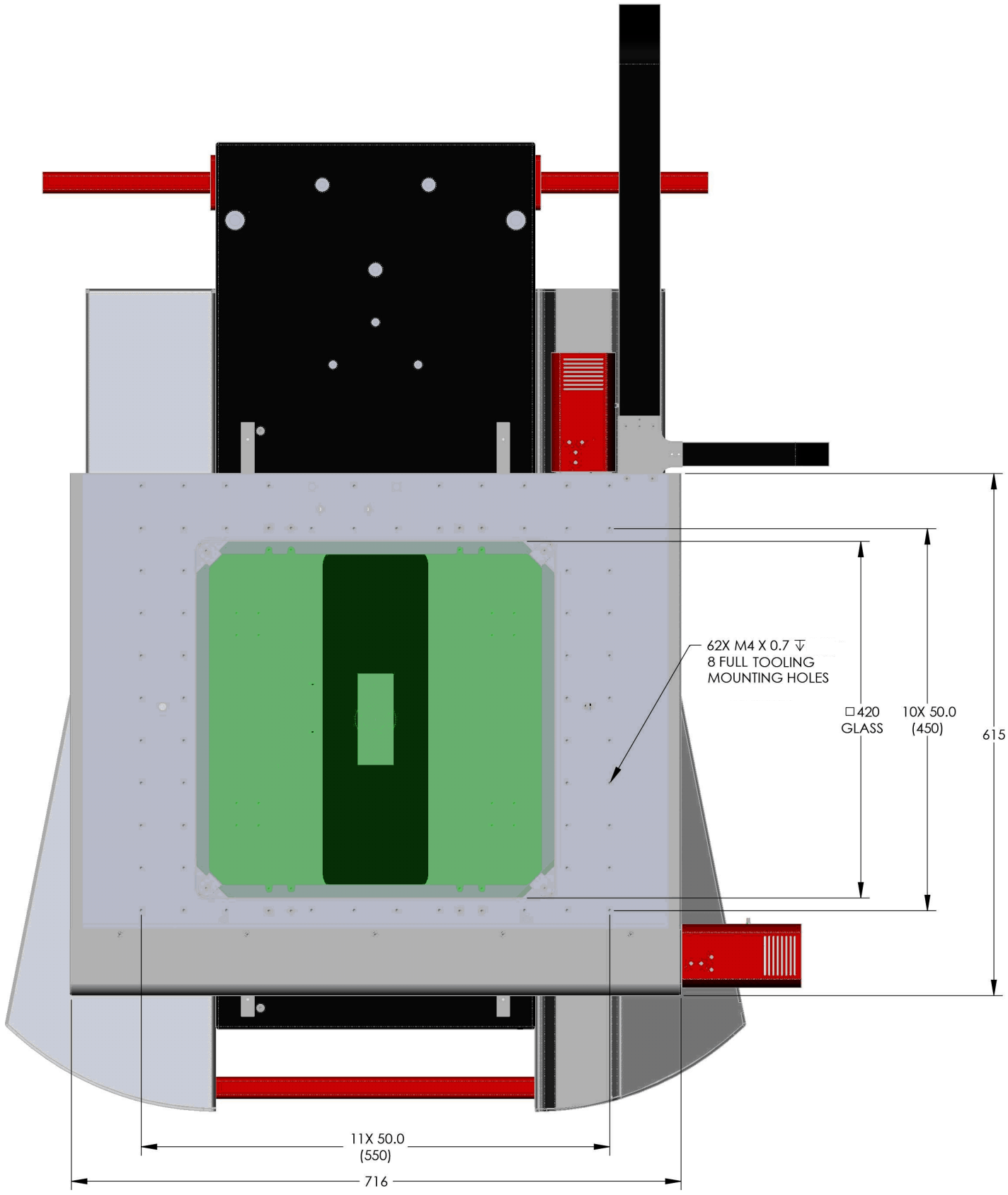
To power up the system, turn on the main power switch, then power up and boot the QC5300 Controller (PC), then power up the Servo Motion Controller. Reverse this sequence to power down the system. Power down the Servo Motion Controller. Power down the QC5300 Controller (PC), then turn off the main power switch.

2.5 Stage Tooling Diagrams

The Stage Tooling Plate allows attachment of customer-designed fixtures for part support. Please refer to the following diagrams for bolt-hole placement and size.



6 x 12 AV300+ Stage Tooling Plate Diagram



14 x 14 AV350+ Stage Tooling Plate Diagram

3. INSTALLATION

Your metrology system was carefully secured in a custom crate for stability and protection during shipment. Exercise care in handling the shipping crate, as excessive force or shock may damage its delicate contents.

3.1 Required Tools

The following items will be required to uncrate and install the metrology system:

1. Phillips screwdriver
2. Battery drill (Phillips bit recommended)
3. Standard slotted screwdriver
4. Small slotted screwdriver for cable connections
5. Industrial level (2 recommended)
6. Hex wrenches: metric set, 6 mm and smaller
7. Needle nose pliers (6” long)
8. Hot-melt glue gun or clay
9. 6” crescent wrench (2 recommended)
10. Black cable ties

3.2 Uncrating

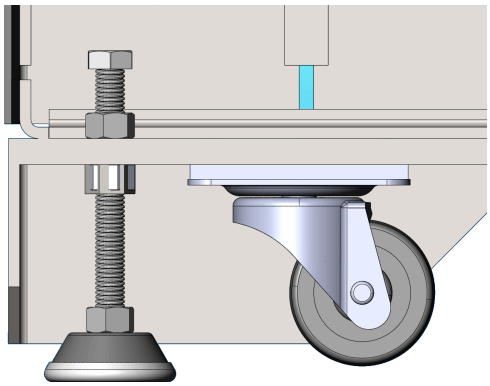
Remove the screws on the top of the crate and carefully remove the top. Remove one of the side panels for access to the contents. Remove and unpack all components. Verify that the contents match the packing checklist included in the documentation packet. Once the presence of all items has been verified, follow the assembly procedures below.

3.3 Placement of Pedestal and Metrology Unit

The pedestal must be leveled before the metrology unit is placed on top. Leave sufficient clearance in the back and on the sides to access the back of the workstation and metrology unit. A minimum clearance of 30 cm (12”) is recommended on both sides and in the back for installation and maintenance. This is in addition to the 30 cm required for travel of the cable track in back of the AC350+ and the 25 cm (10”) to the right or left side for the shelf that will hold the joystick / trackball unit.

3.4 Leveling of Pedestal

The pedestal includes a swiveling wheel on all four corners, plus an adjustable bolt which locks the pedestal in place and provides limited height adjustment. To lock the pedestal in place and adjust height, first turn the lock-nut on the bolt counterclockwise to its upper position. Then use a wrench to rotate the bolt clockwise to achieve the desired corner height. When done, rotate the lock-nut clockwise to prevent the bolt from further rotation. Once the pedestal has been leveled, carefully lift the metrology unit onto it.



Pedestal leveling mechanism

3.5 Stage and Optics Retainer Removal

Once the metrology unit has been properly positioned and leveled, remove and save the shipping retainer. Attach the ring light and optional quad ring light. Reattach cable tracks and secure cables using cable ties.

3.6 Equipment Placement

1. Place the QC5300 Controller (PC) in the back on the floor of the pedestal so that its electrical connections face rearward for easy access.
2. Place the Motion Control Amplifier on the QC5300 Controller (PC) so that its electrical connections face rearward for easy access.
3. Place the Fiber-optic Illumination Controller on the Motion Control Amplifier so that its electrical and fiber-optic connections face rearward for easy access.
4. Place the more compact LED Illumination Controller in an accessible space on the floor of the pedestal, again so that its electrical connections face rearward for easy access.
5. Attach the video monitor to the vertical mounting bracket on the Anthro Cart.
6. Place the keyboard, mouse and mouse pad on the Anthro Cart. Plug the USB cable of the mouse into the keyboard.
7. Place the joystick and trackball control unit on the 25 cm (10”) wide shelf, which may be attached to the right or left of the pedestal.
8. Place the E-Stop switch on the front of the pedestal where it can be easily reached by the operator.

3.7 Country Power Setting

Starrett AV300+ and AV350+ Metrology Systems are factory set 115V or 230V AC power, depending on the destination country. If it is ever necessary to move a system to a country with different AC power, the following power settings will need to be changed:

1. 115/230 slide switch in back of QC5200 Controller (PC).
2. 115/230 slide switch on ABB switching power supply inside 3 Axis Servo Controller.
3. Input connections to fan of 3 Axis Servo Controller, as illustrated on fan.

3.8 Electrical Connections, General

WARNING: Make sure that each power plug is connected to a properly rated and grounded receptacle. Do not energize power cables until the entire system has been properly set up per these instructions. Power goes on last.

INSTALLATION HINT: To facilitate interconnection, the ends of most cables and the matching connectors on the equipment are labeled. Secure cables with cable ties following installation as appropriate.

TABLE NOTES:

1. Some cables are attached to the metrology stage hardware, and come wrapped together and secured to the stage during shipping.
2. Some cables are bundled together in a mesh or shrink-wrapped sleeve. Each separate cable end bears its own label.
3. Some cable numbers are not used for Plus Series systems and are unlisted.
4. Some connections may already be secured.
5. Power connections and power cables are not labeled.

3.9 Electrical Connections, Motion Amplifier Unit

Label on Motion Amplifier Unit	Cable Label on Amplifier End	Cable Label on Other End	Cable Destination
X, Y or Z DRIVE COMMS	X, Y, Z	M3	M3 on QC5300 PC
LIMITS OUT M29	M29	M8	M8 on QC5300 PC
CNC INPUT M20	M20	M10	M10 on QC5300 PC
JOYSTICK M19	M19	M24	Joystick unit
X FEEDBACK	X	None – into stage unit	X Motor
Y FEEDBACK	Y	None – into stage unit	Y Motor
Z FEEDBACK	Z	None – into stage unit	Z Motor
LIMITS IN M32	M32	None – into stage unit	6 limit switches
LED 24 VDC	M12	Coax power connector	LED illumination controller
E-STOP M28	M28	None	E-Stop unit

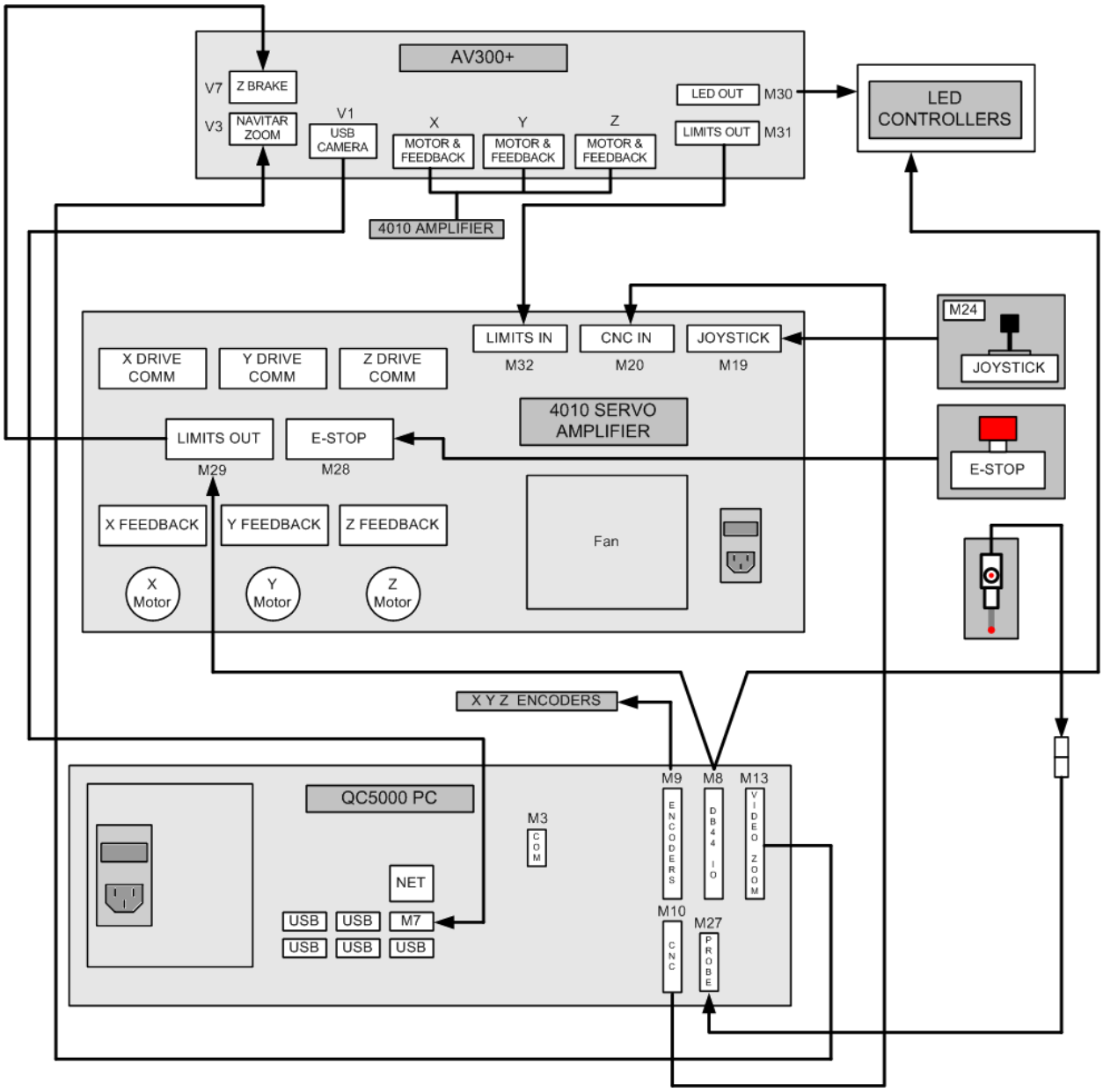
3.10 Electrical Connections, QC5300 Controller (PC) Unit

Label on QC5300 (PC) Unit	Cable Label on QC5300 End	Cable Label on Other End	Cable Destination
M3	M3	X, Y, Z	X, Y or Z DRIVE COMMS of amp.
VGA	None	None	Video monitor
USB	None	None	Keyboard
USB	None	None	Camera in stage unit
M10	M10	M20	CNC INPUT of amp.
M8	M8	M29	LIMITS OUT of amp.
M8	M8	V4	3-light illuminator
USB M7	M7	None – into stage unit	Video camera
M13	M13	None – into stage unit	Zoom motor
M9	M9	None – into stage unit	X, Y, Z encoders
M27	M27	Cylindrical connector	Touch probe

3.11 Electrical Connections, Power Distribution Panel

The front of the pedestals for the AV300+ and AV350+ systems includes power distribution panel with three power switches: 1) a main power switch for the entire system, 2) a two-position rotary power switch for the QC5300 Controller (PC), and 3) a two-position rotary power switch for the Motion Control Amplifier. Plug the QC5300 Controller (PC) into the first switched outlet. Plug the outlet for the Motion Control Amplifier into the second switched outlet. Place other system components, such as the Fiber-optic Lighting Controller, into non-switched outlets. For these, power control will be via the main power switch.

Connect the main power cord to the power distribution panel, but do not plug this cord into a wall outlet until all electrical connections have been made and conditions for Initial Setup have been made (next section of this manual).



Connection Diagram, Basic AV300+

4. OPERATION

4.1 CNC Operation

4.1.1 Power Switches

The AV300+ and AC350+ systems are CNC systems that are configured via the QC5300 Controller, which is a PC (computer).

Steps to properly power on the CNC system:

1. Place the Computer Power and Motion Controller switches to their left rotary (OFF) position.
2. Turn on main power by pressing the main power toggle switch.
3. Rotate the Motion Controller switch to the right (ON) position.
4. Rotate the Computer Power switch to the Computer and launch QC5300 software.

Steps to properly power down the CNC system:

1. Save your work in QC5300 software.
2. Close QC5300 software and all other Windows® applications.
3. Using the mouse, click the Start button and on “Turn Off Computer.”
4. After the PC has shut down, rotate the Computer Power switch to the left to remove power from the Computer and rotate the Motion Controller switch to the left to remove power from the Motion Controller.
5. Turn off main power by pressing the main power toggle switch.

4.1.2 CNC Series Homing Sequence

When the QC5300 metrology software is launched, the metrology stage performs an automatic homing sequence. This process establishes the “home” or “zero” position of the X, Y, and Z axes.

CAUTION: During the homing sequence, follow proper safety protocols, keeping hands and other objects clear of the moving stage components. Failure to do so could result in personal injury or equipment damage.

4.1.3 Joystick & Trackball Controller

Deflecting the joystick from right to left controls movement in the X direction. Deflecting the joystick from front to back controls movement in the Y direction. Rotating the joystick knob controls movement in the Z direction and hence focus. Deflecting the joystick further ramps up speed in the selected direction.

The trackball provides fine control in the X-Y directions or in the Z direction.

The first of three buttons changes maximum joystick speed from slow to fast. The second locks the unused axis so that joystick action can be in only X or Y, with no crosstalk from the other axis. The third toggles trackball action between the X-Y and Z directions.

Joystick & Trackball Stage Control Unit

4.1.4 Image Focus Control

The Z-axis stage control adjusts the image focus. Focus is also partly dependent on magnification. See the General Operation Considerations section below for tips on best adjustment of focus and magnification. The Z axis is controlled by the joystick's center knob; see Figure 3 - 6.

4.1.5 Lighting Control

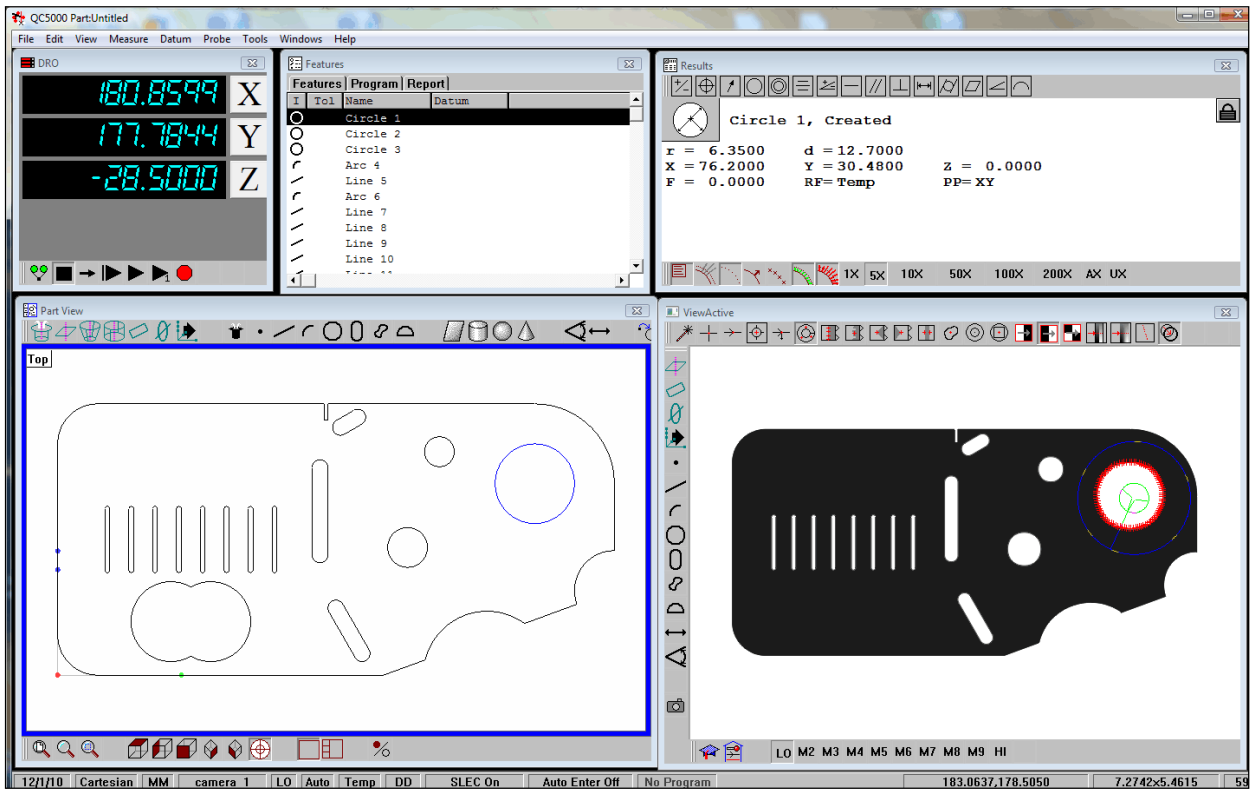
In CNC systems, light intensity is adjusted in software via the QC5300 Controller. Adjustable lights are the ring light, substage light, through-the-lens coaxial light, and optional quad ring light. The quad ring light is available with manual height adjustment or motorized height adjustment, both over 100 mm (4"). Depending on the system ordered, the light source can be a quartz halogen unit with light output via fiber-optic cables, or LED lamps. Please refer to the Bulb Replacement section in the System Maintenance section for instructions on replacing quartz-halogen lamps.

4.1.6 Display Monitor Control

CNC systems are supplied with a 24" diagonal flat-screen color LCD monitor with 1900 x 1200 pixel resolution. The real-time video image of the part is displayed in a 1024 x 768 pixel window. Adjusting the monitor has no effect on the measuring ability of the software. For example, adjusting the monitor to make it brighter does not affect edge detection (but changing lighting does).

4.2 CNC Series QC5300 Metrology Software

QC5300 metrology software is factory configured for Plus Series CNC Multi-Sensor Vision Metrology Systems. The software is based on Microsoft Windows™ and is straightforward to learn and operate. All required controls are easily accessed, and data is displayed simply and clearly for quick measurement results. The software interface is organized into the following on-screen sections:



QC5000 Screen Display

4.2.1 Magnification Control

Video magnification is controlled via preset levels. These are configured during system calibration to precisely control Field-of-View measurements at each magnification. Ten preset magnification levels are available via buttons labeled LO, M2, M3, M4, M5, M6, M7, M8, M9, HI at the top of the video window. The currently selected level is also reported in the status bar. Current pixel size in X and Y is reported at the bottom of the Video window. Pixel size corresponds with the current magnification level. The higher the magnification, the smaller the area represented by each pixel.

4.2.2 Lighting Control

Lighting is programmable and controlled via the Lights window, where sliders and arrow buttons control the level of each light. The current value is reported under each slider. This value is display-only and is not directly editable. The sliders are displayed from left to right for the substage light (transmitted through the stage), on-axis coaxial light (transmitted through the optics), and ring light (illumination from the top).

4.2.3 Part Image / Video Probes

The current video probe (the “tool” used to measure a particular feature) is displayed as an overlay on the part image in the Video window. Probes may be selected from the buttons arranged at the bottom of the Video window. A probe may be positioned on the video image by dragging the tool; the mouse cursor changes to an open hand icon when placed on any free area of the video image. To resize the probe, position the mouse cursor over the probe’s lines; the cursor changes to a closed hand or fist. The relevant portion of the tool may be resized by clicking and dragging the closed hand cursor.

4.2.4 Part View

As features are measured, a graphic representation of the features is displayed in the Part View window. A separate View toolbar allows the Part View to be shown from different angles (front, top, left. and so on).

4.2.5 Measurement Results

Measurement results are displayed in the Results window. Each feature’s results may be displayed separately by selecting the feature in the Part View window. The corresponding result will display in the Results window.

4.2.6 Features List

As features are measured, they are listed in the Features List.

4.2.7 Programming

Features may be measured as walk-up measurements, or programmed for automated measurement using the Program functions of the software. Please refer to the QC5000 software manual for details.

4.3 Operating Considerations

4.3.1 Lighting Considerations

Once the image has been properly focused and magnification has been set, adjust light levels as necessary.

Correct lighting is paramount to accurate measurement with any video-based measurement system. A clear image with lighting toward the low side is recommended. Lighting that is too low will result in a dark, low-contrast image with indiscernible features. Lighting that is too bright may result in a washed-out image that distorts features.

When adjusting lighting, start with light that is lower than desired, and then increase lighting while viewing the image on the monitor. Maintain constant lighting for consistent results. Use the same light level while sampling points for a single feature. Do not to change the light level between points used to measure a circle.

Depending on the part characteristics and the feature being measured, the right combination of lighting from the available sources may aid in bringing out a particular feature. Take time to experiment by balancing these light sources.

	**NOTE:** In order to preserve lamp life and to reduce unnecessary heat in the system, keep the lights turned down when the system is not in use.

4.3.2 Magnification Considerations

Magnification (or zoom) is also important for proper measurements. In general, higher magnification provides greater resolution and accuracy; however, not all features should be inspected at the highest available magnification. Too high a magnification may make it difficult to discern the edge of a feature by exaggerating edge defects such as burrs or chips. Try decreasing the magnification until the edge is more clearly identifiable.

Consider factors such as tolerance requirements, manufacturing processes, functional requirements and optical characteristics of the part. Features with loose tolerances may not need to be inspected at high magnification. Select the highest magnification that is suitable for the feature being inspected.

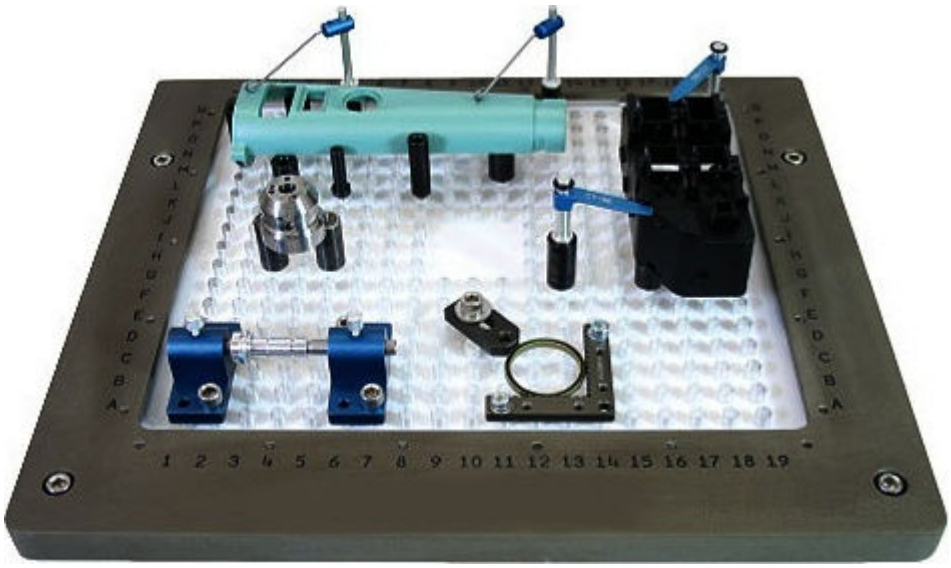
4.3.3 Focus Considerations

Accurate measurement requires proper focus of the image. The part image is at best focus when the magnification is highest. It is often preferable to first focus the image at highest magnification, then decrease the magnification to the desired level.

4.3.4 Parts Fixturing

The part must be fixtured securely to prevent part movement during measurement. Options are available from Starrett Kinemetric for off-the-shelf, semi-custom or custom fixturing. Please contact Starrett Kinemetric sales with your requirements.

Aligning the part's X or Y axis to the stage will improve dimensional measurements. If the part is off-axis from the stage, X-Y-Z measurements will not correlate as well with true part dimensions. Orientation error can also be removed by creating a reference frame based on the part before creating measurements. Please see the QC5000 Software Manual for details.



Example of Custom Fixturing

4.4 Initial Setup

Before using the system to measure parts, run the system through the following steps to verify proper mechanical and measurement functions:

1. **Check that the general operating condition guidelines are observed.** See Daily Inspection in the System Maintenance section.
2. **Check lighting controls.** See Lighting Control in the Operation section.
3. **Check stage hardware controls – control knobs or joystick.** See XYZ CNC Stage Control and Image Focus Control in the Operation section.
4. **Check optical zoom.** See Magnification Considerations in the Operation section.
5. **Check parfocality, parcentricity and squareness.** See Optical Alignment Verification in the System Maintenance section.
6. **Check calibration.** See Calibration Verification in the System Maintenance section. In order to validate that the system is in proper working order, take an artifact of known size (such as those on Starrett's MAG checker), and measure the features utilizing the system controls. Once validated, the system may be used on actual parts.

NOTE: Factory certification can only be provided upon satisfactory of the calibration verification procedures by an authorized representative of the L.S. Starrett Co. Use of your system without proper verification and certification is not recommended.

5. SYSTEM MAINTENANCE

Your Plus Series Multi-Sensor CNC Vision Metrology System is designed for years of superior service. Periodic maintenance outlined in this section should be performed regularly to maintain the system in peak operating condition.

- Daily inspection should be performed to ensure that proper safety guidelines are followed and that the system is operating correctly.
- Basic optical parameters should be verified periodically.
- Cleaning and lubrication should be ongoing for proper mechanical and optical operation.
- Lenses, bulbs and fuses should be maintained and replaced as needed.
- Regular factory-authorized calibration and maintenance service should be scheduled to preserve proper function and accuracy.

5.1 Daily Inspections

On a daily basis, the system should be inspected for general safety issues and basic functionality:

- Inspect the area around the system for proper clearance.
- Remove any debris or loose items from around the system and the metrology stage.
- Verify that the work area is clean, dry and free of debris.
- Verify that the electrical power cord is plugged into a grounded power source and is unobstructed.
- Verify that the environmental conditions (temperature and humidity) are within recommended ranges.
- Allow the system to warm up to normal operating temperature before performing critical part measurements.
- Verify that the stage control mechanisms move freely. On CNC Systems, verify through the software that the zoom mechanism also operates freely.

5.2 Optical Alignment Verification

The system's optical alignment should be verified regularly to ensure accurate measurement. Parfocality, Parcentricity and Squareness verification is straightforward and may be performed as often as desired.

NOTE: Optical alignment verification may be performed by any qualified operator. However, optical alignment correction should only be performed by an authorized technician. Report any observed alignment discrepancies and contact the factory or your local representative to schedule authorized service.

5.2.1 Parfocality & Focus

Parfocality is the condition in which the video image remains in focus as the magnification is adjusted from highest to lowest. Starrett zoom optics are designed to maintain parfocality throughout the available magnification range.

Focus, as described in the Operation section, is adjusted by means of adjusting the Z-axis position of the optical system. Therefore, in order to properly inspect parfocality, always reference a flat, sharp edge. Do not select a rough or sloping feature. Starrett's MAG checker is provided with the system and is an ideal part to use in parfocality inspection.

Steps to check parfocality:

1. Place the MAG checker or other suitable inspection part on the stage and secure properly.
2. Backlight the image as necessary. Set light levels as needed to avoid blooming.

3. At low magnification, select a flat, sharp edge in the center of the field of view (FOV).
4. Select highest magnification, and carefully refocus the image by physically moving the Z-axis up or down.
5. While observing the feature, slowly adjust the magnification lower. Verify that the feature remains focused as the magnification is lowered.
6. Report any observed discrepancy. If the error is verified, contact your Starrett representative for authorized service.

5.2.2 Parcentricity

Parcentricity describes the condition wherein a feature will remain at the optical center of the video image throughout the magnification range. Like parfocality, parcentricity requires that the feature be first located at highest magnification.

Steps to check parcentricity:

1. Place the MAG checker or other suitable inspection part on the stage and secure properly.
2. Select the crosshair image tool and verify that it is at its defined center position. Please refer to the QC5000 manual for details on centering the crosshair. The crosshair is to remain at this position during the parcentricity test.
3. Zoom to low magnification, and adjust the stage position so that the crosshair is centered on the X-Y axis of the calibration standard (or another suitable feature if the standard is not used).
4. Change to high magnification and refocus the image.
5. Adjust the stage position as needed to recenter the crosshair on the feature.
6. While observing the feature, slowly adjust the magnification lower. Verify that the feature remains at the center of the crosshair as the magnification is lowered.
7. Report any observed discrepancy. If the error is verified, contact your Starrett representative for authorized service.

5.2.3 Squareness

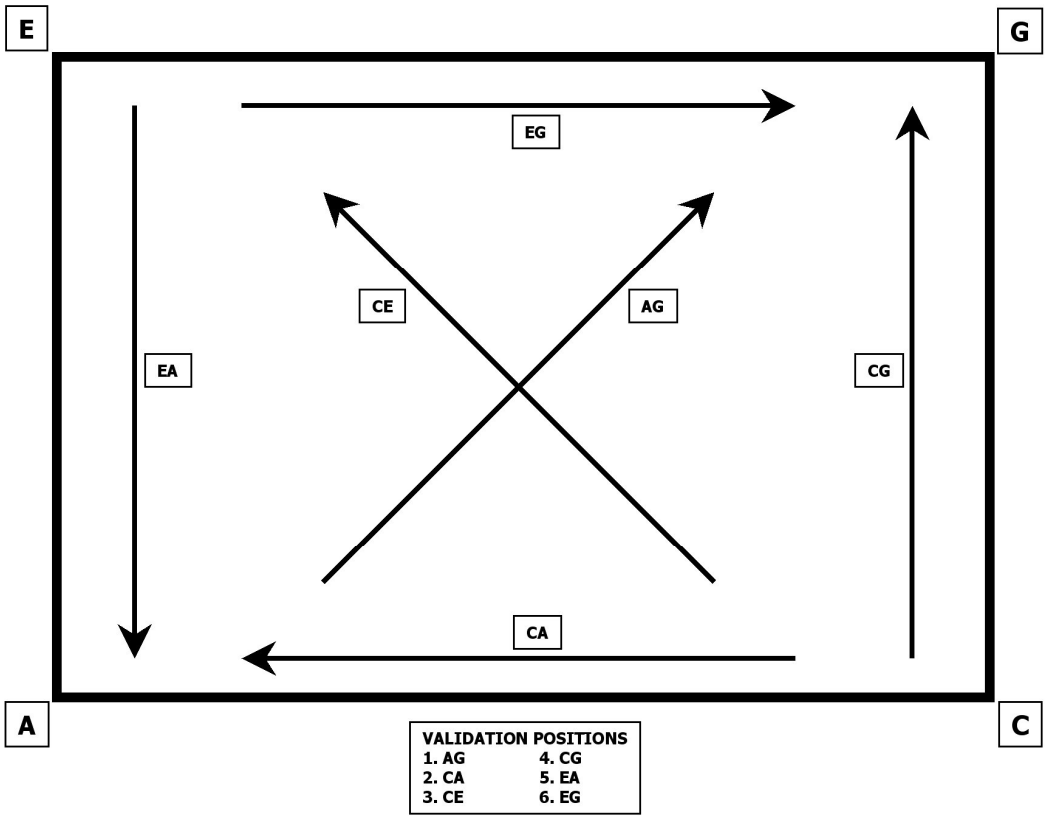
Squareness refers to the alignment of the camera relative to the motion of the metrology stage. If the camera is misaligned (out of square), an image will appear to drift diagonally across the video image as the stage position is moved along one axis.

Steps to check squareness:

1. Place the MAG checker or other suitable inspection part on the stage and secure properly.
2. Select the crosshair image tool and verify that it is at its defined center position. Please refer to the QC5000 manual for details.
3. At low mag, select a point-like feature such as a corner or the standard's X-Y origin. Using the stage, position it to the center of the crosshair.
4. Zoom to high magnification, then refocus and recenter the point as needed.
5. While observing the feature, slowly move the stage X axis ONLY. (Do not move the stage Y axis.) Verify that the point remains aligned on the X axis of the crosshair as the feature is moved to the left and right within the field of view
6. Report any observed discrepancy. If the error is verified, contact your Starrett representative for authorized service.

5.3 Calibration Verification

Calibration should be verified periodically depending on user requirements and systems usage, and should be at least monthly. A calibration verification standard artifact is available from Starrett authorized distributors or directly from the Starrett service department. Calibration should also be verified after the system has been serviced or moved. The following is a brief description of the steps recommended for the verification of your machine. Complete calibration and verification procedures are available upon request.

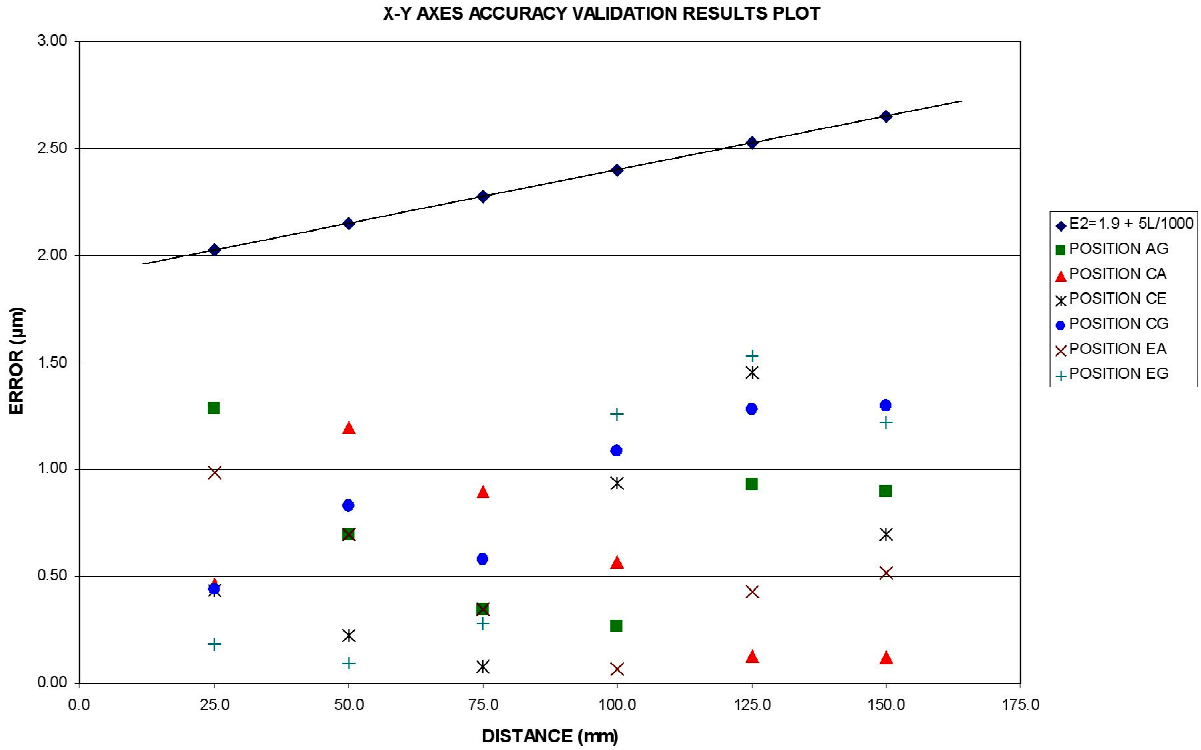


Verification Standard Placement

5.3.1 Calibration Verification Procedure

Steps to validate calibration:

1. Place the calibrated verification standard in one the six positions on the glass stage as shown above. Secure the standard with hot melt glue or other suitable retaining method so that stage translation can not move the standard under any condition.
2. Skew the center of the two end circles. Please refer to the QC5000 manual for proper alignment procedures.
3. Measure the distance between the 1st and 2nd, 1st and 3rd, 1st and 4th, 1st and 5th, and the 1st and 6th fiducials. Repeat these measurements 10 times.
4. Calculate the absolute average deviation for each of the 5 groups of distance measurements.
5. Repeat the measurements for all six locations shown in the illustration.
6. The absolute averages should be within the factory specification, de-rated for the environment and calibration accuracy. See Table 1 - 5, “Travel, Accuracy and Resolution Specifications” for accuracy specifications.



Calibration Error Chart Example

5.4 Cleaning

To the degree possible, the system should be kept in a clean environment, away from dirt, dust, oil and debris which could affect system performance or degrade the system's mechanical and electronic parts. If a clean environment is not available, the machine should be kept as clean and protected as is possible. In harsh environments, preventive maintenance and factory service should be scheduled more frequently to keep the system in top working order.

	**WARNING:** Never pour fluid on the system when cleaning. Do not over-wet cleaning cloth. Excessive moisture can seep into mechanical or electrical parts, damage the equipment and possibly cause an electrical short circuit and physical injury. As a precaution, unplug the system if needed before cleaning the system. Always unplug the system before using any flammable cleaning fluid.

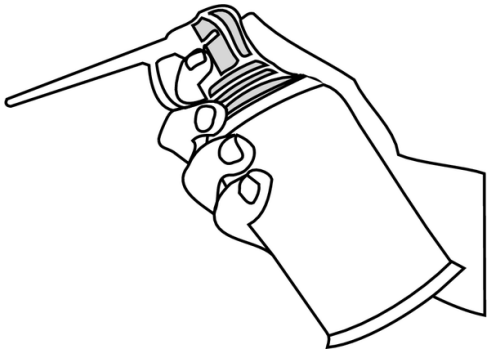
5.4.1 Cleaning External Surfaces

Wipe down with a clean, lint-free cloth moistened (not wet) with plain water or Simple Green®. Never wipe down with acetone or other harsh solvents, which may damage painted or plastic surfaces. Isopropyl alcohol may be used to clean surface contaminants where Simple Green proves ineffective.

5.4.2 Cleaning Optics

	**WARNING:** Do not touch lens surfaces with your fingertips, since the resulting fingerprints will destroy optical coatings over time. Only clean optical surfaces with proper cleaning supplies, and then only when necessary.

If a lens is covered with loose dust, first try blowing off this dust using a can of optical grade (oil-free) canned compressed air. Be careful not to shake the lens, or propellant may blow onto the lens. As alternative, use a lens brush to gently wipe off the dust.



Optical compressed air

If the lens is soiled with greasy deposits which cannot be blown or brushed off, use an alcohol-based commercial lens cleaner and a lens tissue or a lens cloth. These items are available from camera stores. Apply the lens cleaner generously to dissolve the grease, and then blot off the lens cleaner and dissolved grease using minimum motion. Avoid rubbing the lens, since hard particles from the deposit or the lens cloth could scratch the optical coatings.

If the greasy deposits do not come off with the lens cleaner, use a stronger solvent such as reagent-grade acetone as a last resort. Gently wipe the lens surface while moving the lens cloth to always present a clean surface to the lens. Wipe in a circular manner moving from the center of the lens toward the outer edge. Do not reuse the lens cloth to avoid redepositing contaminants.

5.4.3 Cleaning Mechanical Parts

To ensure a long, trouble-free service life, wipe down the system regularly to remove any dust or dirt from the system. Most critical components are covered and require no user service. Should the stage or column mechanics require service, please contact your Starrett representative.

5.5 Lubrication

Every 6 months, lead-screws may be lubricated with a small amount of Tri-Flow®. Apply to each screw and traverse the stage or column through the entire range of travel several times to distribute the lubricant. Use a clean soft cloth or paper towel to wipe up any excess.

▶	**NOTE:** Use only approved lubricants, as inappropriate lubricants can damage system components. Approved lubricants may be obtained by contacting Starrett or an authorized Starrett representative.

5.6 Auxiliary Lens Replacement

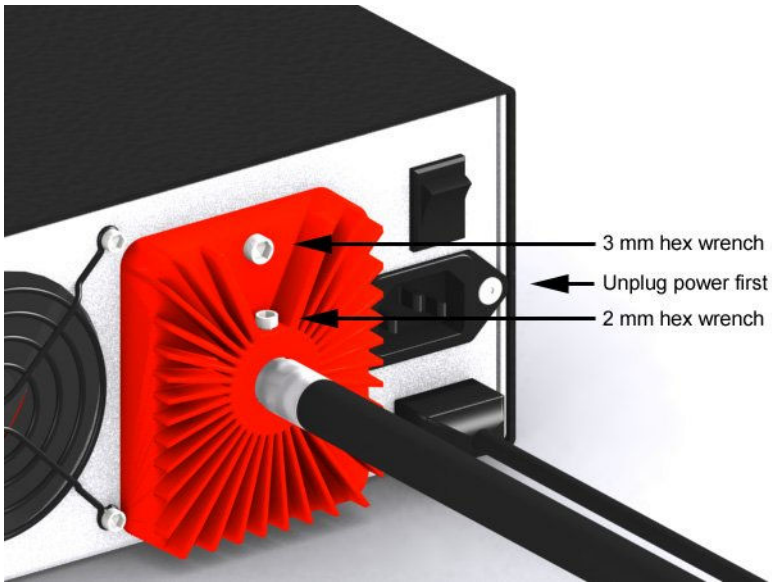
Auxiliary (aux) lenses are available to alter the magnification range of the Manual / CNC optics. When changing the Auxiliary Lens, avoid touching any lens surfaces. No auxiliary lens is required for the standard 1X range of the system.

Steps to change the lens:

1. Remove the ring light prior to changing the lens.
2. If an Auxiliary Lens is in place, unscrew the lens counterclockwise.
3. Verify the new lens and exposed lens of the primary optics assembly are clean and dust free.
4. Carefully screw in the aux lens clockwise, finger-tight only. Do not over-tighten the lens.
5. Update the lens setting in the QC5000 software. Refer to the QC5000 manual for details.

5.7 Bulb Replacement (Fiber-optic Lighting)

	**NOTE:** The lights of a fiber-optic metrology system generate heat. To preserve lamp life and reduce unnecessary heat buildup, turn the lights down when the system is not in use.
	**WARNING:** Power the system down properly and unplug the unit from the power supply before opening the electronics enclosure.
	**CAUTION:** The lamp bulbs are very hot and can cause burns if not allowed to cool properly. Do not touch any part of the new bulb when inserting. The inner reflective surface of the lens and the filament housing are particularly susceptible to damage. Oils from fingers and hands can contaminate the surface and shorten the bulb life. Use a clean cloth or tissue, or wear clean latex gloves to handle the new bulb. Do not to get any part of a tissue or cloth caught in the bulb contacts to avoid a potential fire hazard. The bulb must be fully seated in the socket to prevent arcing and premature failure of the bulb and damage to the socket.

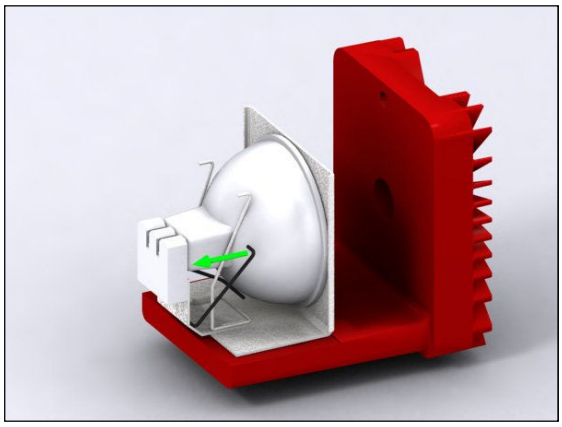


Remove Bulb Housing

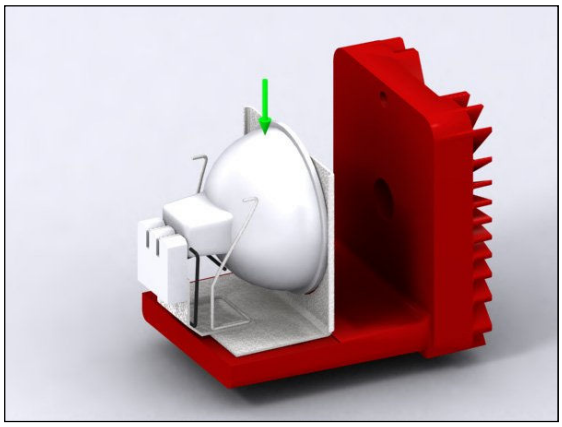
Steps to replace the bulbs:

1. Verify which lamp needs to be replaced before powering the system down. The lamp sockets are labeled TOP, BOT and AUX corresponding to the three system lights.
2. Properly power the system down and unplug the unit from the power source.
3. Using a 2 mm hex wrench, loosen the light bundle retaining screw and remove the light bundle from the heat sink.
4. Using a 3 mm hex wrench, remove the heat sink / enclosure cover retaining screw.
5. Allow the bulbs to cool completely before removing the old bulb.
6. Using the ejector lever as shown, push the old bulb out of its socket.
7. Remove the old bulb by hand when the pins have cleared the socket.
8. Taking care not to touch the new bulb with bare hands, place the bulb in the socket.

9. Firmly push down as shown until the lamp pins are securely seated in the socket. The ejector lever will move back into the closed position when the bulb is fully seated.
10. Replace the cover and properly tighten the retaining screws.
11. Plug the unit in and power the system on to check proper bulb function.
12. If further assistance is required, please contact your Starrett dealer or the factory.



Eject Bulb



Insert New Bulb

5.8 Periodic Calibration and Maintenance Service

It is recommended that Starrett's vision metrology systems and multi-sensor vision metrology systems be serviced and calibrated a minimum of every six (6) months to ensure proper function and accuracy. Under heavy usage conditions, it may be necessary to service the system more frequently. Please contact Starrett an authorized Starrett technician for this service.

6. GLOSSARY

The following terms may have additional meanings. The definitions that follow are in context of the Starrett Vision Metrology Systems.

Accuracy A statement of the maximum error that the system will produce when measuring a true standard.

Resolution A statement of the least significant digit to which a physical quantity can be read. High resolution does not guarantee high accuracy.

Auxiliary Lens An accessory lens that may be attached to zoom optics to increase magnification or increase the field of view.

Coaxial Light A light source that is on the same axis as the camera. Surfaces that face the camera are illuminated brightly, while surfaces angled even slightly away appear much darker. The result is a high-contrast lighting that can help sharpen edges for better detection by the Video Probe. By comparison, light that is not coaxial and shines from different directions (such as from the Ring Light) results in lower image contrast.

Ring Light A ring-shaped light source which illuminates the object from the top with even illumination from all sides.

Quad Ring Light A ring-shaped light source where quadrants of LEDs can be individually controlled. This produces illumination from the top and from the sides, with individually adjustable lighting and shadows from the sides. Further control of lighting and shadows from the sides is provided by height adjustment of the quad ring light at the bottom of the video probe to a point 100 mm (or 4") lower. This height adjustment can be motorized using the Z-Track leadscrew option, or manual along a straight rail and setscrews.

Substage Light A light source located below the glass platen of the X-Y stage.

Axis A direction which allows movement and along which dimensions can be measured. In Manual and CNC metrology systems, three mutually-perpendicular axes are X (left to right), Y (front to back), and Z (bottom to top). Measurement along the X and Y axes is accomplished by moving the metrology stage horizontally. Measurement along the Z axis is accomplished by moving the camera and optics vertically, rather than moving the metrology stage.

AV Automated Video. "AV metrology system" is an alternative designation for "CNC metrology system."

Blooming A condition where the parts of the video image are distorted by oversaturated bright regions so objects can be measured larger than they really are. To avoid blooming errors, observe the video image as you decrease illumination.

CCD Charge Coupled Device. The solid-state image sensing element of a video camera.

CNC Computer Numeric Control. In CNC metrology systems, motion of the stage and optics is both motorized and computer controlled, making these system ideal for repetitive measurements in a production environment. Non-CNC system may also be motorized; control will be manual by an operator.

FOV Field of View. The region of the metrology stage that the camera sees and displays in the video image. "FOV measurement" refers to a measurement that can be done in a single field of view without moving the stage or camera.

MAG Shorthand for magnification.

Pixel A picture element. Term used to describe the individual light detectors of a CCD sensor and the individual light emitters of a video monitor. The spacing and number of pixels determines the resolution of a video metrology system.

Z-Track An optional motorized rail which can be attached to the video probe assembly to support the optional quad ring light.