AccuRange 200™ Laser Measurement Sensor

User's Manual

LLL000201 Rev. 2.4
For use with AR200™ Firmware Rev. 1.19 or later
June 23, 2014

Acuity
A product line of Schmitt Measurement Systems, Inc.
2765 NW Nicolai St.
Portland, OR 97210
www.acuitylaser.com

Limited Use License Agreement

YOU SHOULD CAREFULLY READ THE FOLLOWING TERMS AND CONDITIONS BEFORE OPENING THE PACKAGE CONTAINING THE COMPUTER SOFTWARE AND HARDWARE LICENSED HEREUNDER. CONNECTING POWER TO THE MICROPROCESSOR CONTROL UNIT INDICATES YOUR ACCEPTANCE OF THESE TERMS AND CONDITIONS. IF YOU DO NOT AGREE WITH THEM, YOU SHOULD PROMPTLY RETURN THE UNIT WITH POWER SEAL INTACT TO THE PERSON FROM WHOM IT WAS PURCHASED WITHIN FIFTEEN DAYS FROM DATE OF PURCHASE AND YOUR MONEY WILL BE REFUNDED BY THAT PERSON. IF THE PERSON FROM WHOM YOU PURCHASED THIS PRODUCT FAILS TO REFUND YOUR MONEY, CONTACT SCHMITT INDUSTRIES INCORPORATED IMMEDIATELY AT THE ADDRESS SET OUT BELOW.

Schmitt Industries Incorporated provides the hardware and computer software program contained in the microprocessor control unit, and licenses the use of the product to you. You assume responsibility for the selection of the product suited to achieve your intended results, and for the installation, use and results obtained. Upon initial usage of the product your purchase price shall be considered a nonrefundable license fee unless prior written waivers are obtained from Schmitt Industries incorporated.

LICENSE

a. You are granted a personal, nontransferable and non-exclusive license to use the hardware and software in this Agreement. Title and ownership of the hardware and software and documentation remain in Schmitt Industries, Incorporated;
b. the hardware and software may be used by you only on a single installation;
c. you and your employees and agents are required to protect the confidentiality of the hardware and software. You may not distribute, disclose, or otherwise make the hardware and software or documentation available to any third party;
d. you may not copy or reproduce the hardware and software or documentation for any purpose;
e. you may not assign or transfer the hardware and software or this license to any other person without the express prior written consent of Schmitt Industries Incorporated;
f. you acknowledge that you are receiving only a LIMITED LICENSE TO USE the hardware and software and related documentation and that Schmitt Industries Incorporated retains title to the hardware and software and documentation. You acknowledge that Schmitt Industries Incorporated has a valuable proprietary interest in the hardware and software and documentation.

YOU MAY NOT USE, COPY, MODIFY, OR TRANSFER THE HARDWARE AND SOFTWARE, IN WHOLE OR IN ANY PART, WITHOUT THE PRIOR WRITTEN CONSENT OF SCHMITT INDUSTRIES, INCORPORATED.

IF YOU TRANSFER POSSESSION OF ANY PORTION OF THE HARDWARE OR SOFTWARE TO ANOTHER PARTY, YOUR LICENSE IS AUTOMATICALLY TERMINATED.

TERM

The license is effective until terminated. You may terminate it at any other time by returning all hardware and software together with all copies of associated documentation. It will also terminate upon conditions set forth elsewhere in this Agreement or if you fail to comply with any term or condition of this Agreement. You agree upon such termination to return the hardware and software together with all copies of associated documentation. In the event of termination the obligation of confidentiality shall survive.

12 MONTH LIMITED WARRANTY

EXCEPT AS STATED BELOW IN THIS SECTION THIS PRODUCT IS PROVIDED “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Schmitt Industries Incorporated does not warrant that the functions contained in the product will meet your requirements or that the operation of the product will be uninterrupted or error free.

Schmitt Industries Incorporated does warrant as the only warranty provided to you, that the product which is furnished to you, will be free from defects in materials and workmanship under normal use for a period of twelve (12) months from the date of delivery to you as evidenced by a copy of your warrant receipt.

LIMITATIONS OF REMEDIES

Schmitt Industries Incorporated’s entire liability and your exclusive remedy shall be:

1. the replacement of any hardware and software not meeting Schmitt Industries’ “Limited Warranty” and which is returned to Schmitt Industries Incorporated or an authorized Schmitt Industries dealer with a copy of your purchase receipt, or
2. if Schmitt Industries Incorporated or the dealer is unable within ninety (90) days to deliver a replacement product which is free of defects in material or workmanship, you may terminate this Agreement by returning the product and your money will be refunded to you by the dealer from whom you purchased the product.

IN NO EVENT WILL SCHMITT INDUSTRIES INCORPORATED BE LIABLE TO YOU FOR ANY DAMAGES, INCLUDING ANY LOST PROFITS, LOST SAVINGS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE SUCH PRODUCTS EVEN IF SCHMITT INDUSTRIES INCORPORATED OR AN AUTHORIZED DEALER HAD BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BY ANY OTHER PARTY.

SOME AREAS DO NOT ALLOW THE LIMITATIONS OR EXCLUSION OF LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

GENERAL

You may not sublicense, assign or transfer the license or the hardware, software, and documentation except as expressly provided in this Agreement. Any attempt otherwise to sublicense, assign or transfer any of the rights, duties or obligations hereunder is void.

This Agreement will be governed by the laws of the United States and the State of Oregon, United States of America.

Should you have any questions concerning this Agreement, you may contact Schmitt Industries Incorporated by writing to:

Schmitt Industries Incorporated
2765 NW Nicolai St.
Portland, Oregon 97210 USA

YOU ACKNOWLEDGE THAT YOU HAVE READ THIS AGREEMENT, UNDERSTAND IT AND AGREE TO BE BOUND BY ITS TERMS AND CONDITIONS. YOU FURTHER AGREE THAT IT IS THE COMPLETE AND EXCLUSIVE STATEMENT OF THE AGREEMENT BETWEEN YOU AND SCHMITT INDUSTRIES INCORPORATED AND ITS DEALER (“US”) WHICH SUPERSEDED ANY PROPOSAL OR PRIOR AGREEMENT, ORAL OR WRITTEN, AND ANY OTHER COMMUNICATIONS BETWEEN US RELATING TO THE SUBJECT MATTER OF THIS AGREEMENT.

Procedures for Obtaining Warranty Service

1. Contact your Acuity distributor or call Schmitt Industries, Inc. to obtain a return merchandise authorization (RMA) number within the applicable warranty period. Schmitt Industries will not accept any returned product without an RMA number.

2. Ship the product to Schmitt Industries, postage prepaid, together with your bill of sale or other proof of purchase. your name, address, description of the problem(s). Print the RMA number you have obtained on the outside of the package.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this device in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Acuity

User's Manual for the
AR200™ Series Laser Measurement Sensors

Table of Contents

1. Introduction

This section is a guide to getting started with the AR200 and this manual. The AR200 has a number of configurable parameters, but many applications can use the sensor in its default factory configuration.

The recommended order for reading the manual is:

- Quick Start Instructions
- General Description
- Operating Guidelines
- Installation and Checkout using the Power and Interface section as a reference

This should provide the information necessary to connect the sensor and verify its operation, either with a serial terminal program at 9600 baud, or by connecting the current loop interface.

To understand more about the serial configuration options, read the Serial Communications chapter. For details on the current loop, voltage, and limit switch outputs, read the chapter titled Analog Output.

For custom configuration, the AR200 Command Set section provides information on setting up the AR200 for specific application requirements. The remaining sections deal with specifics of the outputs and with general performance characteristics of the sensor.

1.1. Quick Start Instructions

Mount the sensor in such a way that the case is not twisted or warped. Using three hard points along the front and back edges or a slightly compliant mounting system are the best methods. Do not clamp or squeeze the sensor case excessively. If the case is distorted, the sensitivity and accuracy of the sensor may be affected.

Connect the red (+) and Black or flex cable Gray (Ground) wires of the power/signal cable to a 12 to 30 volt power supply (15 volts is suggested for best power efficiency), or plug in the power supply if the sensor came with one.

1.1.1. Analog and Limit Switch Signals

See section 8 for more details.
In 4-20mA analog output mode, the orange (pink for flex cable) wire is the current output, and the brown wire is current return. These may be connected to a resistor such as 500 ohms to get a 2 to 10 volt signal, or connected to a current meter.

In 0-10V analog output mode, the orange (pink for flex cable) wire is the voltage output, and the brown wire is current return. These may be connected to a resistor 1.3K ohms or larger to get a 0 to 10 volt signal.

In NPN limit switch output mode, the orange (pink for flex cable) wire is limit switch 1 output and the brown wire is limit switch 2 output. When the switch is active, the output will sink up to 150mA to the Black or flex cable Gray (Ground) wire. When the switch is

not active, the output will be high impedance and no current will flow through it. These outputs may be connected through a resistance to a voltage between the supply and ground. The resistance should be chosen such that the outputs sink no more than 150mA.

In PNP limit switch output mode, the orange (pink for flex cable) wire is limit switch 1 and the brown wire is limit switch 2 output. When the switch is active, the output will source up to 150mA through the red (+) wire. When the switch is not active, the output will be high impedance and no current will flow through it. These outputs may be connected through a resistance to a voltage between the supply and ground. The resistance should be chosen such that the outputs source no more than 150mA.

1.1.2. Serial Data Wires

The serial data wires may be connected to a standard PC port if the serial LED indicates RS-232 mode. The output from the sensor may be viewed with a terminal emulator such as Windows HyperTerminal.

When power is applied the function LED on the sensor will light, and if a target surface is placed in the measurement range of the sensor, the sensor will print distance to the target from the start of the measurement range in millimeters, 5 times per second. If there is no target in the measurement range, the sensor will output zeros (or occasional random readings if outside lighting is changing rapidly), and the laser will flash 10 times per second.

1.1.3. Important Configuration Considerations

There are 3 sensor configuration commands that significantly affect operation. Satisfactory operation for specific applications will only be attained with appropriate configuration settings. See the AR200 Command Set section for details on configuring the sensor.

Background Light Elimination On/Off When Background Light Elimination is on (the factory default) the sensor captures 2 images, one with the laser off and one with the laser on, and subtracts them to reduce the effects of ambient lighting. **The maximum attainable sample rate** with Background Light Elimination on is 600 samples per second, vs. 1250 with it off. On brightly lit targets performance may be improved with this setting On. If the environmental lighting is changing rapidly, the improvement may be reduced.

Set Sample Interval The sample interval is set in **tenths** of milliseconds: Using 8 as the parameter will set the sample rate to 0.8 milliseconds, or 1250 samples per second. Using 10000 will set the sample rate to once per second. For fastest output, use serial binary format at 57,600 baud or higher or the analog output. **If an analog output is selected,** disable the serial output to attain 1250 samples/second.

Set Sample Priority If the light reflected from the target is low, the time needed to take a sample may be longer than the time set with the Set Sample Interval Command. The Sample Priority command controls whether the sensor outputs a sample at the sample

interval programmed even if there is no sample available (Zero will be output if the reflection from the target is low or the target is out of the measurement range). In the default configuration (priority given to "sample rate") if the sensor is unable to collect enough light to obtain a measurement the sensor will output zero at the specified sample rate. Alternatively, if this command is used to give priority to "sample quality" and the sensor is unable to take measurements, it will reduce the sample rate. If no sample is attained in 0.1 seconds, the sensor will put out zero even if sample quality is given priority. Note that the current loop will hold its value until another sample is available if priority is set to "sample quality".

See the Principles of Operation Section for more information.

Note: The laser may be turned on and off with the Sampling On/Off command.

After making changes to the configuration, it may be saved by using the Write command. The present configuration may display with the Show Configuration command.

2. General Description

The AR200 is a laser diode based distance measurement sensor for ranges from 6 to 100 mm (models are actually ¼, ½, 1, 2, and 4 inch respectively), with 12 and 200 µm accuracy respectively. Each model has a different standoff (center of span) distance, full scale span, and center of span accuracy. These are listed in the table below. For more detailed specifications see the data sheet. The standoff distance represents the distance from the face of the sensor to the center of the measurement range. For the AR200 sensor, the standoff specification is approximated.

Model	Standoff [mm] (approximate)	Span [mm]	Linearity/ Accuracy [µm]
AR200-6	21	6.35	+/- 12.7
AR200-12	24	12.7	+/- 25.4
AR200-25	34	25.4	+/- 50.8
AR200-50	42	50.8	+/- 101.6
AR200-100	79	101.6	+/- 203.2

2.1.Principles of Operation

The AR200 uses triangulation to measure distance. The laser beam is projected from the housing and is reflected from a target surface to a collection lens. The lens focuses an image of the spot on a linear array camera. The camera views the measurement range from an angle that varies from 45 to 65 degrees at the center of the measurement range, depending on the model. The position of the spot image on the pixels of the camera is then processed to determine the distance to the target. The camera integrates the light falling on it, so longer exposure times allow greater sensitivity to weak reflections.

The exposure time and laser power level are controlled to optimize the accuracy of the measurements for the signal strength and environmental light level measured. If the sample rate set allows time for internal averaging of multiple exposures before transmission that is done. Exposure time and laser power are adjusted from sample to sample, so rapidly changing conditions may result in momentary loss of signal or overexposure. If the sensor cannot take another exposure before it is time to transmit a sample, a zero value will be output.

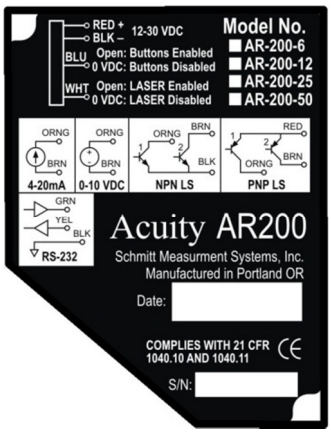
As described in the *Quick Start* section, there are several operating mode options that significantly affect the behavior of the sensor. The first of these is sample rate. Lower sample rates allow more averaging of the range signal and lower noise levels. Higher sample rates may be used when the reflected signal is relatively strong.

The sensor may be set to either wait (up to 0.05 seconds or 0.1 second if background light elimination is on) until it has good data before updating the output, or to update the output at the specified rate even if that interval does not permit acquisition of a good sample and a zero must be sent.

If high levels of ambient light are present, the use of the background light elimination mode may improve measurement quality. In this mode a camera exposure is taken with the laser off and subtracted from a subsequent exposure with the laser on. This will eliminate many ambient light effects, unless the ambient light levels in the target area are changing rapidly. In this case the light measured during the laser on exposure may be different from that during the laser off exposure, reducing the benefits of this mode. The total time required for obtaining a sample in this mode will be approximately twice what it is with background light elimination off.

If the sensor cannot detect a distinct peak in the camera data or the measurement is just beyond the end of the full scale span (but with the spot still on the camera near one end), the sensor will output zero distance. If there is no target in the measurement range and background light elimination is on, the sensor will generally put out zeros. However, if lighting conditions are changing rapidly or if background light elimination is off, a bright spot can be taken as the laser spot and a false range reading generated when there is no target in range.

The AR200 emits visible laser light (red, 650 nm wavelength). All models are Class II laser products and are limited to 1 mW of power. The aperture warning label and product identification placard shown below appear on the AR200 models.



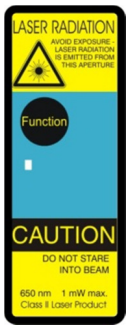


Figure 1 - Laser Aperture Warning Label

2.2. Mechanical Dimensions

The following page shows the mechanical dimensions for the AR200. The rectangular window on the front panel is the collection point for return light. Both of these areas should have a clear path to the target throughout the full measurement span. The sensor has two #4 (M3) clearance holes for mounting the sensor. One face of the sensor has output selection pushbuttons. The top of the sensor has a "Function" button. The cable is for power and communication (both serial and analog limit switch). Weights are shown on the data sheet at the back of the manual. The outer case of the sensor is anodized aluminum. The front windows and the end caps are sealed to the case, creating a dustproof, splash proof enclosure.

Mechanical Dimensions

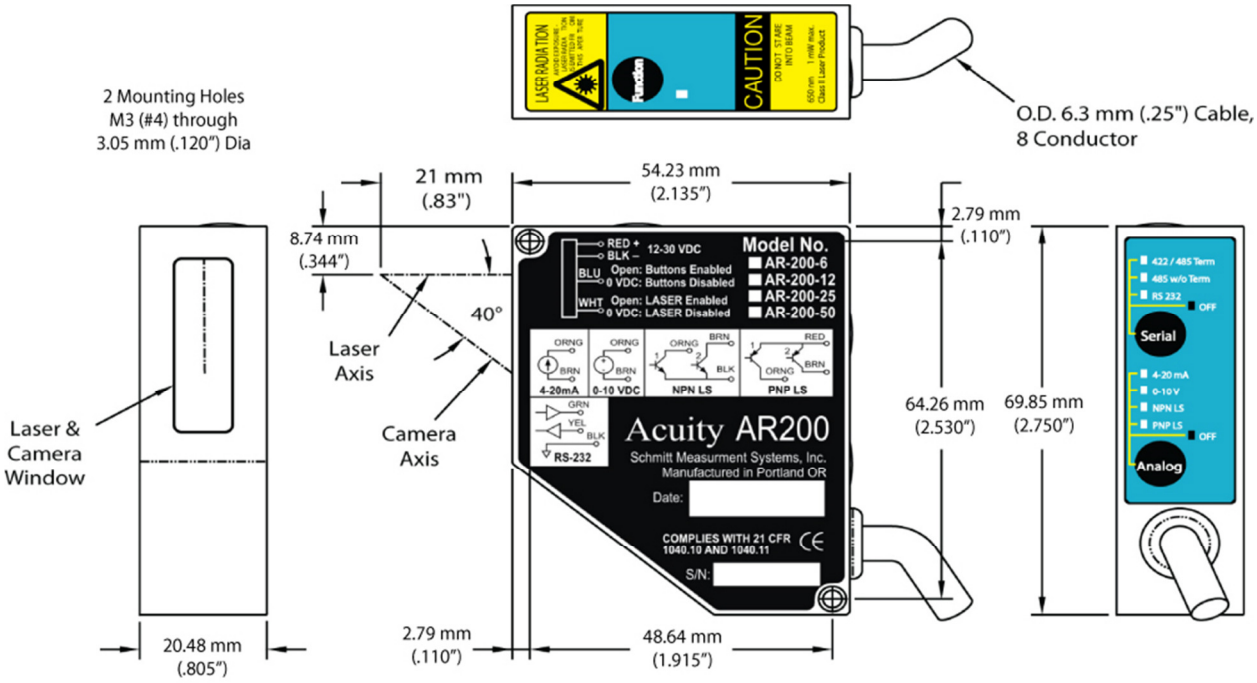


Figure 2 Mechanical Dimensions of AR200

2.3. Installation and safety

The AR200 sensor is typically installed by affixing the sensor to a machined bracket with bolts through the two mounting holes in the sensor. These holes are 3 mm in diameter and their location is shown in the mechanical drawing above. Laser light is emitted from the top of the rectangular window, closest to the "Laser Radiation" placard. An illustration of how light is emitted is shown below.

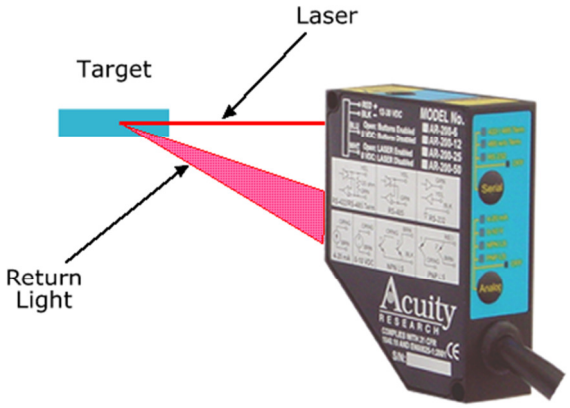


Figure 3 Direction of laser emission

This laser device should not be aimed at human eye. Installers of laser sensors should follow precautions set forth by CFR 1040.10 or by their local safety oversight organization.

3. Operating Guidelines

Use protective eyewear whenever there is a risk of being exposed to the output beam of the AR 200. Use eyewear specifically designed to block laser radiation of the frequency used by the sensor.

Do not point the sensor at any person, particularly a person's eyes or face. Laser radiation can damage the eyes without sensation or warning.

Do not attempt to disassemble the sensor. Improper disassembly will destroy the optical alignment of the sensor and necessitate factory repairs.

Do not operate the sensor in areas where the sensor case is exposed to direct sunlight for extended periods or where the air temperature is more than 50°C (122°F) or less than -10°C (14°F).

Avoid excessive vibration and shocks. The sensor contains securely mounted but precisely aligned optical components.

Do not scratch the windows on the front face of the sensor, particularly in the central area. Keep the front windows clean with a damp cotton cloth. The windows are optical glass. Avoid the use of cleaning solvents other than alcohol.

Operate only with DC supply voltages between 10 and 30 volts, unless the sensor came with an AC to DC power supply.

4. Installation and Checkout

4.1.Cabling

The AR 200 has a multipurpose cable with solder tail wires. Connection and termination according to the instructions is essential for correct sensor operation. Read the wire descriptions for connection information.

4.1.1. Standalone Cabling

To use the AR200 without a serial connection to a host computer, the only connections necessary are the power, ground line, and the analog output connection to your data display or recording equipment. See the Signal and Power Interface section for wire connections. In its default configuration, the AR200 will begin measuring and transmitting range data on power-up.

In 4-20mA analog output mode, the best accuracy and linearity for the current loop is obtained with a 500-ohm load to current loop return at the measurement point.

In 0-10V analog output mode, the best accuracy and linearity for the voltage output is obtained with a 10K-ohm load to the voltage output return at the measurement point.

4.1.2. Connection to a Host Computer

A 9-pin serial D-sub serial connector can be attached to the serial output wires to connect the AR200 directly to a PC compatible 9-pin serial port. Connect a 15 volt power supply to the power and ground lines of the Power/Signal cable. See the Signal and Power Interface for wire connections. The Red, Black or flex cable Gray, Yellow, and Green need to be connected for operation with the serial interface. For testing use a terminal emulation program such as the Windows HyperTerminal, set to 9600 baud, 8 bits, no parity, 1 stop bit, no flow control.

4.2.Power On

When power is applied the function LED will flash briefly and then stay on, and a red laser beam will be emitted from the front laser aperture window. The sensor will begin transmitting range readings as soon as the laser comes on.

4.3.Verifying Operation

In its default configuration, the AR200 transmits 5 samples per second at 9600 baud over the serial line, and transmits measured distance over the current loop output with the same update rate. The current loop should put out 4 mA at zero range, and 20 mA at full span. Check either, or both, signals to verify basic sensor operation.

4.4. Troubleshooting

The sensor displays simple error indications using the LED on the end cap. Trouble shooting steps are shown below:

Symptom	Possible Cause	Correction
LED never turns on	Power lines not connected	Check wire connections
	Power lines reversed polarity	Check wire connections
	Power supply voltage too low or too high	Check power supply voltage when loaded
No laser light and no range data	Sampling is turned off	Turn Sampling on
	Power supply voltage is too low	Check power supply input voltage
	Ambient light level is too high	Reduce the ambient light level.
LED flashes continuously at 1Hz rate. Messages are continuously transmitted over the serial port.	Configuration data lost or Calibration data lost (not customer resolvable)	To reset factory default configuration data, press and hold function button at power up. Need to send W1234 to save settings in nonvolatile memory. See section on nonvolatile memory for more details. Call Acuity for instructions

4.4.1. Serial Communications Check

If no information is received over the serial port, check the power supply and serial cable connection. The sensor may in a configuration that prevents serial communication, such as being set at the wrong baud rate. Turn the power off, press the function button on the AR200, and turn the power on with the button held down. The LED should stay off until the button is released, and then flash briefly. This will reset the sensor to the factory default configuration (9600 baud, 8 bits, no parity, 1 stop bit), and should enable serial communication with the host system.

4.4.2. Range Output Check

If the range output is in error, check that the sensor and target are stationary and stable, that the target is in the middle of the measurement span as an initial test range, and that the beam is hitting the target. The sensor may need to warm up for 5-10 minutes before reaching full accuracy: leave it on for a few minutes and re-check the range accuracy.

5. Signal and Power Interface

The AR200 has a multipurpose cable with solder tail wires. Connection and termination according to the instructions is essential for correct sensor operation. Read the wire descriptions for connection information.

5.1. Wire Power and Signal Cable

Wire	Function in All Modes
Red	Power, +15V (12-30 VDC min/max)
Black or flex cable Gray	Ground
Blue	Buttons Disable
White	Laser Disable
Shield or flex cable Black	Ground at Supply End

The multifunction output wires can be used for 4-20 mA current output, 0-10V voltage output, NPN (sinking) limit switches, or PNP (sourcing) limit switches.

	Function in Selected Analog Mode			
Wire	**4-20mA**	**0-10V**	**NPN LS**	**PNP LS**
Orange (pink for flex cable)	Current Loop Out	Voltage Output	NPN 1 sink	PNP 1 source
Brown	Current Loop RTN	Voltage RTN	NPN 2 sink	PNP 2 source

The serial communications lines can be used for RS232.

	Function in Selected Serial Mode
Wire	**RS-232**
Yellow	RxData
Green	TxData

5.1.1. Power and Signal Cable Wire Descriptions

Wire Color: Red
Function: +15V power at 90 mA (110mA max with Current Loop, 390mA max with Limit Switches). Max. noise and ripple: 100mVpp

Power supplies from 12 to 30VDC may be used. Higher voltages will result in excessive current drawn by the over voltage protection circuitry and may cause permanent damage. Voltages less than 12 VDC at the cable end may result in inaccurate range readings.

The maximum current draw will increase depending on the analog output mode selected. In the current loop and voltage output mode, it will increase 20mA. In the limit switch modes, it will increase up to 300mA. In the limit switch mode, the majority of the power will be dissipated in the load connected to the AR200.

Wire Color: Black (Gray-flex cable)

Function: Ground

Return for the 15V Supply

Wire: Shield or flex cable Black

Function: Ground

Connected to ground internally. Should be grounded at supply end.

Analog Mode: 4-20mA Current Loop

Wire Color: Orange (pink-flex cable)	**Wire Color: Brown**
Function: Current Loop Output	**Function: Current Loop Return**

In this mode the orange (pink-flex cable) wire delivers a current proportional to the measured range. The offset of the zero range point and the span location (point of full-scale output) may be set using the appropriate commands.

The brown wire is the current loop return. This line is switched internally to the 15V power supply return.

Analog Mode: 0-10V Voltage Output

Wire Color: Orange (pink-flex cable)	**Wire Color: Brown**
Function: 0-10V output	**Function: Voltage output return**

In this mode the orange (pink-flex cable) wire delivers a voltage proportional to the measured range. The offset of the zero range point and the span location (point of full-scale output) may be set using the appropriate commands. Best accuracy is obtained by loading the line with a 10K-ohm resistor to the voltage loop return at the measurement point.

The brown wire is the voltage output return. This line is switched internally to the 15V power supply return.

Analog Mode: NPN Limit Switches

Wire Color: Orange (pink-flex cable)	**Wire Color:Brown**
Function: NPN Limit Switch 1	**Function:NPN Limit Switch 2**

In this mode, the NPN limit switches can sink up to 150mA each to the ground wire (black or flex cable gray) when activated. When a switch is not active, its output will be high impedance and no current will flow through it. Each switch direction and activation point can be set through a serial port command or through the function button.

Analog Mode: PNP Limit Switches

Wire Color: Orange (pink-flex cable)	**Wire Color: Brown**
Function: PNP Limit Switch 1	**Function: PNP Limit Switch 2**

In this mode, the PNP limit switches can source up to 150mA each through the red positive supply wire when activated. When a switch is not active, its output will be high impedance and no current will flow through it. Each switch direction and

activation point can be set through a serial port command or through the function button.

Serial Mode: RS-232

Wire Color: Yellow	**Wire Color: Green**	**Wire Color: Black**
Function: RxData	**Function:TxData**	**(Gray-flex cable)**
		Function: Ground

In this mode the yellow wire is used by the AR200 for receiving RS-232 serial data, the green wire is used for transmitting data, and the **Black** or flex cable **Gray** wire is used as a common ground reference.

Wire Color: Blue
Function: Buttons Disable

The function, analog, and serial buttons may be disabled by connecting this wire to ground, or the Black or flex cable Gray wire. If the blue wire is left unconnected, the buttons will be enabled.

This function is useful for preventing accidental changes to an AR 200 through the button interface after the device has been configured.

Wire Color: White
Function: Laser Disable

Connecting this wire to ground, the Black or flex cable Gray wire, will disable the laser. If the white wire is left unconnected, the laser will be enabled.

If this input will be controlled by an operator from more than two meters from the sensor, then an emission indicator near the operator control area may be necessary to comply with laser safety regulations.

6. Serial Interface Specification

6.1.Hardware Port

	RS-232 Function	Wire Color
1	NC	
2	TxData	Green
3	RxData	Yellow
4	NC	
5	GND	Black or flex cable Gray
6	NC	
7	NC	
8	NC	
9	NC	

Figure 4 RS232 wire color reference chart

The serial output mode can be selected by pressing the serial mode button. The default serial port mode is RS-232. Data can be transferred at baud rates from 300 to 115.2K baud, in binary or ASCII format.

A standard 9-pin serial connector can be built to interface with a PC compatible computer using the connection pin out table.

6.1.1. Output Flow Control

The sensor responds to software flow control using Ctrl-S and Ctrl-Q.

The sensor will always stop the transmission of samples if Ctrl-S is received, and will always resume the transmission of samples when Ctrl-Q is received. The sensor will complete any transmission of a sample that is in process when Ctrl-S is received. Sending Ctrl-S does not stop the sensor from taking distance measurements, but all samples that would be transmitted are lost. Sending Ctrl-Q resumes the transmission of samples at the next scheduled transmission time as specified by the sampling interval. Software flow control (Ctrl-S/Ctrl-Q) only affects the transmission of samples. All other serial transmissions are still sent e.g. if 'V1234' is transmitted to the sensor, it will still transmit the version and configuration data, even if the transmission of samples has been stopped with Ctrl-S. Software flow control (Ctrl-S/Ctrl-Q) is not affected by the Flow Control configuration parameter.

6.1.2. Input Flow Control

The sensor does not transmit Ctrl-S/Ctrl-Q. If the host is transmitting command sequences that are more than 10 bytes in length, pause for 0.1 seconds between commands.

7. Serial Data Formats

7.1. Output Data Formats

Data is transmitted from the AR200 as 8 data bits with no parity and 1 stop bit. The data sent consists of calibrated distance readings. There are two data formats: ASCII or binary. In binary, all samples are transmitted least significant byte first.

The location of the zero-point may be changed with the Set Zero-Point command. The direction of increasing output serial values from the zero-point may be reversed by issuing the Set Span command with a distance closer than that used in a previously issued Set Zero-Point command.

7.1.1. ASCII Data format

DDD.DDDDDD<CR><LF>

In this configuration, each sample consists of a string of characters as follows: 5 to 8 distance characters followed by <CR><LF>, for a maximum of 10 characters including <CR><LF> characters. Leading zeros are not printed unless the distance is less than 1, in which case, only the leading zero before the decimal point is printed. The maximum number of characters is dependent on the sensor model and the measurement units selected.

7.1.2. Binary Data format

DD<FF>

In this configuration, each sample consists of 3 bytes: 2 distance bytes, which constitute a data word, and a termination byte. The data word can have the value from 0 to 50,000, which corresponds to the distance from zero to the full-scale distance. To convert the two bytes to a range value, use the following equation:

[(Most Significant Byte*256)+Least Significant Byte]*Full Scale Span/50,000

The distance is transmitted Least Significant byte first. Halting the serial output and then restarting it after flushing the serial input to the host may be done to synchronize the binary serial data stream. The Hex FF terminator may be used to find the first data byte. If one FF appears in any 3 characters, it is the terminator. If 2 FFs appear, the third byte is the high order (middle) byte of the data frame.

8. Analog Output Modes

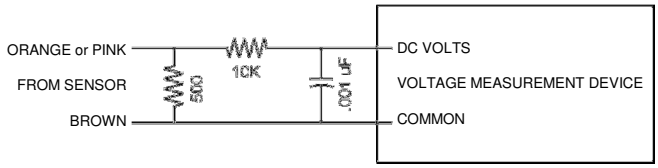
Orange (Pink for flex cable) and Brown lines in the power/signal cable carry the analog signals.

8.1. Current Loop Output

In 4-20mA analog mode, the analog lines will deliver a current which increases linearly from 4 mA at the zero point to 20 mA at the span point. The zero range point (the starting

distance), and the span (point of full-scale output) may be set anywhere within the measurement range of the sensor. See the Set Zero Point and Set Span Commands.

In the default configuration, the current loop output is updated 5 times per second. This may be increased or reduced with the Set Sample Rate Command, using either the pushbutton on the back of the sensor or the 'S' command over the serial port.



Best accuracy and noise immunity is obtained by connecting a 500Ω resistor to the current return wire at the measurement point. The default configuration is for calibrated output, with the zero point at zero distance, and the span at full scale.

The minimum current loop span is 5% of the full measurement distance of the sensor. Attempts to set a smaller span will be ignored, and the span will not be changed.

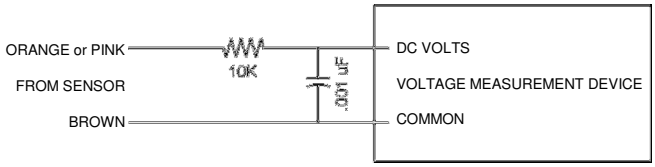
Setting the span to a value closer that the previously set zero point will reverse the direction of increasing current.

The current loop output is two lines: The return line of the "loop" is connected to ground inside the sensor.

8.2. Voltage Output

In 0-10V voltage mode, the analog lines will deliver a voltage which increases linearly from 0V at the zero point to 10V at the span point. The zero range point (the starting distance), and the span (point of full-scale output) may be set anywhere within the measurement range of the sensor. See the Set Zero Point and Set Span Commands.

In the default configuration, the voltage output is updated 5 times per second. This may be increased or reduced with the Set Sample Rate Command, using either the pushbutton on the back of the sensor or the 'S' command over the serial port.



Best accuracy and noise immunity is obtained by connecting a 10KΩ resistor to the voltage return wire at the measurement point. The default configuration is for calibrated output, with the zero point at zero distance, and the span at full scale.

The minimum voltage output span is 5% of the full measurement distance of the sensor. Attempts to set a smaller span will be ignored, and the span will not be changed.

Setting the span to a value closer that the previously set zero point will reverse the direction of increasing voltage output.

The voltage output is two lines: The return line is connected to ground inside the sensor.

8.3.NPN Limit Switch

In NPN limit switch mode, the analog lines provide two switches that can be used to sink up to 150mA of current each.

In the default configuration, the limit switches are updated 5 times per second. This may be increased or reduced with the Set Sample Rate Command, using either the pushbutton on the back of the sensor or the 'S' command over the serial port.

The default configuration is for calibrated output, with the zero point at zero distance, and the span at full scale. Limit switch 1 is active below the zero point and inactive beyond the zero point. Limit switch 2 is active above full scale and inactive below it. The direction of activation can be changed with the set limit directions command. The activation point can be changed with the set limit point command.

The minimum switch point separation is 5% of the full measurement distance of the sensor. Attempts to set a smaller span will be ignored, and the span will not be changed.

8.4.PNP Limit Switch

In PNP limit switch mode, the analog lines provide two switches that can be used to source up to 150mA of current each.

In the default configuration, the limit switches are updated 5 times per second. This may be increased or reduced with the Set Sample Rate Command, using either the pushbutton on the back of the sensor or the 'S' command over the serial port.

The default configuration is for calibrated output, with the zero point at zero distance, and the span at full scale. Limit switch 1 is active below the zero point and inactive beyond the zero point. Limit switch 2 is active above full scale and inactive below it. The direction of activation can be changed with the set limit directions command. The activation point can be changed with the set limit point command.

The minimum switch point separation is 5% of the full measurement distance of the sensor. Attempts to set a smaller span will be ignored, and the span will not be changed.

9. Serial and Analog Output Performance Specifications

9.1.Sample rate

The maximum possible sample rate is 1,250 samples per second. The maximum sample rate is obtained with background light elimination off. Only one output, either analog or serial, should be enabled at given time to obtain the maximum sampling rate. If the serial output is used, it should be set to at least 57,600 baud sending binary samples.

The sample period is programmable to times at or longer than 0.8 milliseconds (1,250 samples per second) using the Set Sample Interval Command. This command allows the sample rate to be set anywhere from 1,250 samples per second (S8) to one sample every 5 seconds (S50000). The sample interval is set in increments of 100µs (0.1 milliseconds).

Sample period has a slightly different meaning for serial output and for the analog output. For serial output, one sequence of characters is transmitted at each sample interval. The sample rate may be limited by the time required to transmit each sample at the specified baud rate. If the baud rate is the limiting factor, data will be transmitted continuously.

For analog output, the output is updated once per sample interval up to the limits of the sensor's sample rate capability. If only the analog output is enabled, the maximum obtainable sample rate is 1,250 samples per second. If both the serial and current loop outputs are enabled, the maximum output rate is 1,111 (S9) samples per second.

9.2.Resolution

Range resolution is dependent on the sensor model. The ASCII serial output resolution is equal to about 1 part in 50,000 over the full scale span. For example, the distance increments for sensors with a 0.50-inch full scale span are 0.00001 inches, and distance readings for a sensor with a 1-inch full scale span is 0.00002 inches. When the distance increments would be greater than "5" in the last digit, the number of decimal points will decrease by 1. The full 50,000 points across the span are always available by using the

binary data output command. The resolution of the sensors is one part in 3000, but smaller target position changes may be evident in the sensor's output. However, the indicated changes in distances below 1 part in 3000 may not equal the actual distance changes to any degree of accuracy.

The current loop output has a resolution of 1 part in 4000. This may become noticeable for large span settings, since the inherent sensor stability is better than 1 part in 3000. Current loop output is linear with respect to measured range to 1 part in 2000. Selectable zero and span allow full resolution over any distance span.

10. Nonvolatile Memory Storage

10.1. Nonvolatile Memory Operation

The AR 200 stores its configuration settings and calibration information in electronically erasable non-volatile memory. Factory configuration values are stored for the configuration settings when the sensor is shipped, and the factory configuration settings may be restored at any time using the Reset Configuration command, or by holding the Function button down while powering up the sensor. The calibration information is specific to the sensor, and cannot be changed.

If the sensor cannot verify the calibration information is valid when the sensor is turned on, the light next to the Function button will flash, and the sensor will continuously transmit, at 9600 baud, the message:

"CALIBRATION DATA CORRUPTED, RELOAD DATA."

The sensor cannot measure distances if the calibration data is corrupted. Contact Acuity for instructions.

If the sensor cannot verify the configuration information when the sensor is turned on, the light on the end cap will flash, and the sensor will continuously transmit, at 9600 baud, the message:

"SAVED CONFIGURATION INVALID. USING DEFAULT SETTINGS."

Pushing the switch on the end cap will stop the light from flashing, stop the error message from transmitting, and will start the sensor using the default factory configuration. The sensor can also send this message as the result of the Read command. If the sensor sends the message as a result of the read command, the message is sent at the user's selected baud rate. The baud rate will be changed to 9600 (factory default) when the switch on the end of the sensor is pressed.

The configuration commands do not automatically store the changes to the nonvolatile memory. The Write command is used to make these changes permanent. The Write command stores all configuration information, so it can be used once after making several changes. The Read command is used to restore the saved configuration from nonvolatile memory, and will immediately replace the sensor's configuration settings.

The Write command should not be issued repeatedly under computer control in the course of normal operation, since the nonvolatile memory expected lifetime is 1,000,000 writes.

11. AR200 Command Set

The AR200 may be configured two different ways:

- Commands may be sent over the serial port.
- Commands may be entered manually by using the Function button and acknowledgment LED on the end panel.

The serial port commands are alphanumeric ASCII characters. Any device that can communicate over a serial port may send the commands. Configuration settings may be retained through power cycling with the Write command.

11.1. ASCII Commands

Each ASCII command is composed of one letter followed by up to 5 digits comprising a numeric parameter. The command letters may be upper or lower case. Some commands have no parameters, and the command executes as soon as the command letter is received. Other commands will not execute unless specific parameters are received.

There is no command termination character. Commands can be terminated three ways:

- When a non-alphanumeric character is received (such as '.', or <CR>)
- When the maximum number of parameter characters is received.
- When the next command letter is received.

The command is evaluated after the command is terminated. If the required, or optional, parameters are valid, the command is executed.

There is no acknowledgement character from the sensor when the command is received, evaluated, or executed. If the command is a valid command string, the command will be executed. If the command is not a valid command string, the entire command is ignored.

Multiple commands may be grouped together in a single transmission. However, sending more than 10 characters in a single transmission at high baud rates may result in loss of characters. The sensor always uses the CTS signal to indicate when there is a danger of losing characters. Enable hardware flow control on the sending system to avoid the loss of characters. The sensor does not send software flow control characters. Commands are executed in the order they are received. When sending multiple commands, each command is executed before the next command is evaluated.

Example: The following all send a valid a Set Sample Interval command: S50<CR> or s00050 or S50A2<CR>. The last example also sets the output to metric units.

It is advisable to always terminate single commands, or the last command in a sequence, with a character such as '.' or <CR> to ensure immediate command execution regardless of the length of numeric parameters entered.

11.2. Function Button Commands

To manually enter commands with the Function button, the sensor should be on and operating normally with the LED lit continuously:

Action	Indication
Press and hold function button	LED goes out for one second.
Continue holding function button until the number of flashes equals the desired command code	LED flashes once per second.
Release function button	LED stays off, if parameters are required.
If Parameters are required, press and hold function button until the number of flashes equals the desired parameter code	LED flashes once per second.
Release function button	Sensor repeats the number of flashes for the command code. If a parameter is required, the number of flashes for the parameter code is repeated. The command takes effect.

Note: The function button may be released any time after the start of a flash, and before the start of the next flash.

The changes will not be permanent unless a Write command (9 flashes) is given before turning off the power.

Example: To set the baud rate to 2400 baud, press and hold the function button and wait for the LED to go out and then flash 7 times. Release the button. The LED will stay out, indicating that a parameter value should be entered. Press and hold the button until the LED has flashed 3 times. Release the button. The LED will flash 7 times, pause, flash 3 times, and the baud rate will be set to 2400.

11.3. Command Quick Reference

One byte commands are shown below as:

ASCII Code: <Commandcharacter>.

Multiple byte commands are shown as:

ASCII Code: <Commandcharacter> <<Parametername>>.

If the command may be entered using the switch, the number of LED flashes for that command is given. The notation (Serial Entry Only) indicates that the command cannot be given using the function button.

Bracketed numeric parameters [...] are optional. Terminating a command without entering an optional numeric parameter will cause the sensor to use the presently measured distance for the parameter. Since high-resolution entry is not possible with the switch as an input device, distance parameters can only be set to the value being measured when the command is processed.

Default settings are for the factory configuration.

Command Name	Length	Command Code	Default Setting
Set Zero-Point / Limit 1	1-6 bytes	ASCII Code: Z[<ZeroPoint>] (0 ≤ ZeroPoint ≤ 50000) Function button code:1	Zero range (Z0)
Set Limit Directions	2 bytes	ASCII Code: F[<LimitCode>] (1 ≤ LimitCode ≤ 4) Function button code:None	F1 Active Inward F2 Active Outward (F1F4)
Set Limit 1	1-6 bytes	ASCII Code: J[<LimitPoint>] (1 ≤ LimitPoint ≤ 50000) Input Switch code:None	Min range (J1)
Set Limit 2	1-6 bytes	ASCII Code: K[<LimitPoint>] (1 ≤ LimitPoint ≤ 50000) Input Switch code:None	Max range (K50000)
Set Span / Limit 2	1-6 bytes	ASCII code: U[<Span>] (0 ≤ Span ≤ 50000) Function button code:2	50000 (U50000)
Set Sample Interval (in 100's increments)	2-6 bytes	ASCII Code: S<Interval> (8 ≤ Interval ≤ 50000) Function button code: 3<Rate Code>	5 samples/second (S2000)
Analog Output Mode	2 bytes	ASCII Code: X<Mode> (Mode:1 = Current, 2 = Voltage, 3 = NPN, 4 = PNP, 5 = off) Function button code: 4 <Mode>	Current Loop On (X1)
Background Light Elimination On/Off	2 bytes	ASCII Code: L<Mode> (Mode:1 = on, 2 = off) Function button code: 5 <Mode>	On (L1)
Sampling On/Off **(also Laser On/Off)**	2 bytes	ASCII Code: H<Mode> (Mode:1 = on, 2 = off) Function button code: 6 <Mode>	On (H1)
Set Baud Rate	2 bytes	ASCII Code: B<BaudRateCode> (BaudRateCode: 1 = 300, 2 = 1200, 3 = 2400, 4 = 4800, 5 = 9600, 6 = 19200, 7 = 38400, 8 = 57600, 9 = 115200) Function button code: 7<BaudRateCode>	9600 baud (B5)
Write Configuration Data	5 bytes	ASCII Code: W1234 Function button Code: 9	
Read Configuration Data	1 byte	ASCII Code: R Function button Code: 10	

Serial Output Control	2 bytes	ASCII Code: A<Mode> (Mode: 1 = English(inches), 2 = Metric(mm), 3 = off) Function button code:11 <Mode>	English (A1)
Initialize Configuration (Factory Defaults)	1 byte	ASCII Code: I Function button Code:12	
Set Sample Priority	2 bytes	ASCII Code: P<Mode> (Mode:1 = Quality, 2 = Rate) Function button code: 13 <Mode>	Rate (P2)
Set Serial Output to ASCII (Serial Entry Only)	1 byte	ASCII Code: D	ASCII Output
Set Serial Output to Binary (Serial Entry Only)	1 byte	ASCII Code: N	
Take Single Sample (Serial Entry Only)	1 bytes	ASCII code: E	
Show Configuration (Serial Entry Only)	5 bytes	ASCII Code: V1234	

11.4. Command Descriptions

Following is a full description of each command's usage, factory setting, and effects. The notation (Serial Entry Only) indicates that the command cannot be given using the Function button.

Set Zero-Point	**Length:** 1 – 6 bytes	Default: 0
ASCII Code: Z[<ZeroPoint>] Function Button Code: 1	0 ≤ ZeroPoint ≤ 50000	
This command sets the zero-point for both the serial and analog mode outputs to the value specified, and where Limit Switch 1 becomes active. The value entered is the fraction of the full scale range times 50,000. If no numeric parameter is entered or the switch is used to enter this command the zero-point will be set to the presently measured distance. *Example:* To set the zero-point to the middle of the sensor's measurement range, enter 'Z25000<CR>' (0.5 x 50,000 = 25,000). *Note:* To set the zero-point to the present measured distance, the sensor should be operating and pointed at a stationary target. The sensor can be made to reverse the direction of increasing distance values for the limit switches, the serial and current loop outputs, by setting the zero-point to a value greater than the span point. The zero point should be set before the span point. The Z command (Zero Point) sets the Limit 1 value to "1" Setting the Z command (Zero Point) after the U command (Span Limit) preserves the Span and shifts the Zero Point *See Also:* Set Span, Set Limit Switch Directions		

Set Limit Directions	**Length:** 2	Default: F1, F4
ASCII Code: F[<LimitCode>]	1 ≤ LimitCode ≤ 4	
Function Button Code: Serial Entry Only.		

The limit outputs are on the orange (pink-flex cable) and brown wires in the power/signal cable. These lines may be configured to have open-collector NPN current sinking outputs or PNP open-collector sourcing outputs. When a limit is active, the line is connected to ground, and can sink up to 150 mA. When a limit is not active, it is an open line.

The limits can be set to become active at any point in the measurement range, and in either direction from that point.. See the **Set Zero (Z**) and **Set Span** (U) commands to set the location at which limits are activated.

F1: Set limit 1 active below zero point.
F2: Set limit 1 active above zero point.
F3: Set limit 2 active below span point.
F4: Set limit 2 active above span point.

Note: If the zero point is set farther from the sensor than the span, the limits will trip according to their settings relative to the new zero and span: “below zero point” now means farther from the sensor than the zero point.
Example: To set limit 1 to be active in the first half of the measurement range, enter 'F1<CR>'. To set limit 2 to be active from the presently measured point to the high end of the range, enter 'F4,<CR>'.
See Also: Set Zero Point, Set Span

Set Limit 1	**Length:** 1-6	Default: J1
ASCII Code: J[<LimitPoint>]	1 ≤ LimitPoint ≤ 50000	
Function Button Code: Serial Entry Only.		

This command sets the first limit-point for analog NPN or PNP mode outputs to the value specified. The value entered is the fraction of the full scale range times 50,000. If no numeric parameter is entered the zero-point will be set to the presently measured distance.
Example: To set the Limit 1-point to the middle of the sensor’s measurement range, enter ‘J25000<CR>’ (0.5 x 50,000 = 25,000).
Note: The J command (Limit 1) must be set after Z (Zero point).
The J and K commands (Limits 1 and 2 respectively) both accept zero as a valid parameter, although this value will never trip the limit.
If the Z parameter is not zero, then the J and K values entered are relative to the zero point and subject to the span direction.
The J and K commands without parameters use values determined as if Z is zero. The limit will be offset by the amount of the zero point and the limit point will be subject to the span direction
See Also: Set Span, Set Limit Switch Directions

Set Limit 2	**Length:** 1-6	Default: K50000
ASCII Code: K[<LimitPoint>]	1 ≤ LimitPoint ≤ 50000	
Function Button Code: Serial Entry Only.		

This command sets the second limit-point for analog NPN or PNP mode outputs to the value specified. The value entered is the fraction of the full scale range times 50,000. If no numeric parameter is entered the zero-point will be set to the presently measured distance.
Example: To set the Limit 2-point to the middle of the sensor’s measurement range, enter ‘K25000<CR>’ (0.5 x 50,000 = 25,000).

Note:	The K command (Limit 2) must be set after U command (Span point). The J and K commands (Limits 1 and 2 respectively) both accept zero as a valid parameter, although this value will never trip the limit. If the Z parameter is not zero, then the J and K values entered are relative to the zero point and subject to the span direction. The J and K commands without parameters use values determined as if Z is zero. The limit will be offset by the amount of the zero point and the limit point will be subject to the span direction
See Also:	Set Span, Set Limit Switch Directions

Set Span	**Length:** 1 – 6 bytes	Default: 50000
ASCII Code: U[<Span>]	0 ≤ Span ≤ 50000	
Function Button Code: 2		

This command sets the point at which the current loop and voltage loop output is at its maximum value, and where Limit Switch 2 becomes active. The value entered is the fraction of the full scale range times 50,000. If the span is set to a distance which is less than a previously set zero-point, the sensor output values will increase as the target point moves closer from the zero-point to the span point (U<Z). If no numeric parameter is entered or the switch is used to enter this command, the distance for the full-scale current loop and voltage loop output will be set to the presently measured distance. If a parameter is entered, it is interpreted as the absolute distance from the start of the sensor's physical measurement range, not the distance from the zero-point set using the Set Zero-Point command.

Example: To set the L2 trip point, maximum current loop and voltage loop output at the middle of the sensor's measurement range, enter 'U25000<CR>' (0.5 x 50,000 = 25,000).
To reverse the current loop and voltage loop output (or serial output) over the full sensor measurement range, enter 'Z50000U0<CR>' Other than causing this reversal of direction in the serial data, this command does not affect the serial output.

Note: To set the current loop or voltage loop maximum output to the presently measured distance, the sensor should be operating and pointed at a stationary target.
The minimum span is 5% of the sensor's full scale span. If the absolute distance entered for the current loop or voltage loop maximum output results in a span less than 5% of the full scale span, the command is ignored, and the span is not changed.
If the zero-point is subsequently changed with Set Zero-Point, the full-scale distance position will change by the same amount, so that the span is preserved. Generally, the span should be set after the zero-point.
The U (span point) command sets the Limit 2 value based on the Z (Zero Point) command.

See Also: Set Zero-Point

Set Sample Interval	**Length:** 2 – 6 bytes	Default: 2000
ASCII Code: S<Interval>	8 ≤ Interval ≤ 50000	
Function Button Code: 3<RateCode>	RateCode: 1 = S10	1KHz sample rate
	2 = S100	100Hz sample rate
	3 = S1000	10Hz sample rate
	4 = S10000	1Hz sample rate

This command affects both serial and analog outputs. When invoked as the "S" command over the serial port, this command sets the output rate of the sensor to the specified sample interval in increments of 100 microseconds.
To set with the function button: The sample rate may be set to 1, 10, 100, or 1000 samples per second. The command code is 3, followed by the sample rate code

Example: To set the maximum sample rate, enter 'S8<CR>'
(8 x 100µs = 800µs sample interval, or 1.25KHz sample rate).

Note: Samples will not be sent unless corresponding output is enabled.
If the interval is set to a time less than the minimum time required to acquire a single distance reading, samples will be sent continuously at the maximum possible sample rate. The maximum rate (minimum sample time) will be limited by baud rate, target reflectance, background light, and exposure mode. For the highest possible sample rates it is necessary to send the data in binary.

See Also: Background Light Elimination
Set Baud Rate
Serial Output Control
Analog Output Mode
Set Serial Output to Binary
Set Sample Priority

Analog Output Mode	**Length:** 2 bytes	Default: Current Loop On
ASCII Code: X<Mode> Function Button Code: 4<Mode>	Mode: 1 = Current 2 = Voltage 3 = NPN 4 = PNP 5 = off	
This command sets the analog output mode. A value of 1 turns the current loop output on or off. When the current loop mode is enabled, a current between 4 milliamps and 20 milliamps will be transmitted out the current loop line. When the voltage loop mode is enabled, a voltage between 0 and 10V will be transmitted out of the voltage loop line. When the NPN LS mode is enabled, two limit switches capable of sinking up to 150mA will be enabled. When the PNP LS mode is enabled, two limit switches capable of sourcing up to 150mA will be enabled. *Example:* To turn the analog output off, enter 'X5' *Note:* The analog mode button can be used to quickly set the analog output mode. Each time the button is pressed, the mode will advance to the next mode.		

Background Light Elimination On/Off	**Length:** 2 bytes	Default: On
ASCII Code: L<Mode> Function Button Code: 5<Mode>	Mode: 1 = on 2 = off	
This command turns the background light elimination on or off. When background light elimination is on a reading of the background light is taken with the laser off. The background reading is then used to eliminate the effects of illumination from other light sources. *Example:* To turn Background Light Elimination off, enter 'L2' *Note:* The highest possible sample rate is obtained when Background Light Elimination is off. However, since the sensor cannot verify that the strongest signal is from the laser, Background Light Elimination should be turned off only in situations when the background light is low and diffuse.		

Sampling (Laser) On/Off	**Length:** 2 bytes	Default: On
ASCII Code: H<Mode> Function Button Code: 6<Mode>	Mode: 1 = on 2 = off	
This command turns the automatic sampling on or off. When automatic sampling is on, the sensor takes continuous measurements of the distance. The sensor calculates and sends the distance sample at the requested sample rate. When automatic sampling is off, the sensor does not take any distance measurements unless commanded by the Take Single Sample command. The laser is off when sampling is off unless the Take Single Sample command is issued. *Example:* To turn automatic sampling off, enter 'H2' *Note:* The sensor calculates distance samples over the time period specified by the Set Sample Interval command. The sensor will output a sample on all outputs that are installed and enabled. *See Also:* Set Sample Interval Serial Output Control Analog Output Mode Take Single Sample		

Set Baud Rate	**Length:** 2 bytes	Default: 9600
ASCII Code: B<BaudRateCode> Function Button Code: 7<BaudRateCode>	BaudRateCode: 1 = 300 2 = 1200 3 = 2400 4 = 4800 5 = 9600 6 = 19200 7 = 38400 8 = 57600 9 = 115200	
This Command sets the baud rate to the specified value, as given by the above table. *Example:* To set the baud rate to 115.2K baud, enter 'B9' *Note:* The baud rate may limit the maximum sample rate. It takes over 1 millisecond to transmit a single ASCII character at 9600 baud. Setting the sample interval to a time less than the time needed to transmit a single sample will result in continuous output of single distance measurement samples. For the highest possible sample rates it is necessary to send the data in binary format at a baud rate of least 57.6K baud. *See Also:* Set Sample Interval Serial Output Control Analog Output Mode Set Serial Output to Binary		

Write Configuration Data	**Length:** 5 bytes	
ASCII Code: W1234 Function Button Code: 9		
This command sets the power up state of all configuration options to their present values. The configuration is immediately preserved and automatically becomes the new power up state. *Example:* To write the sensor's present configuration state, enter 'W1234' *Note:* The argument "1234" is required to prevent accidental writes. Factory defaults may be restored at any time with the Initialize Configuration Command. *Caution:* The sensor uses electronically erasable nonvolatile memory to store configuration Data. The memory is specified to retain the information for over 200 years. However, the memory can only be written to 1,000,000 times. Do not program automated equipment to send the Write Configuration Command. Once this command is executed the previous saved configuration is lost, and cannot be restored. The only way to restore a previous configuration is to change each setting to the desired value. *See Also:* Initialize Configuration		

Read Configuration Data	**Length:** 1 byte	
ASCII Code: R Function Button Code: 10		
This command reads the configuration information from the nonvolatile memory and makes it the current configuration. It may be used to restore the power-up configuration if a temporary change has been made with any of the configuration commands. This command is executed automatically when the sensor is turned on. *Example:* To restore the last saved configuration state, enter 'R' *Note:* Factory defaults may be restored at any time with the Initialize Configuration Command. *See Also:* Initialize Configuration		

Serial Output Control	**Length:** 2 bytes	Default: Metric
ASCII Code: A<Mode> Function Button Code: 11<Mode>	Mode: 1 = English 2 = Metric 3 = off	(inches) (millimeters)
This command sets the serial output to On with English units (inches), On with Metric units (millimeters), or Off. *Example:* To turn off serial output, enter 'A3' *Note:* There is no indication on the ASCII serial output that the data is in English or Metric Units. Serial Output control only affects data sample output. Other serial output (error messages or configuration output) is not affected by this configuration parameter. There is no unit information for Binary Serial Output. All output in Binary Serial Output is in units of 1/50,000 of the sensor's physical measurement range.		

Initialize Configuration (Factory Defaults)	**Length:** 1 byte	
ASCII Code: I Function Button Code: 12		
This Command restores the operating configuration to the original factory defaults. May be used if the present state is unknown or inconvenient. *Example:* To initialize configuration to factory defaults, enter 'I' *Note:* This initialization is NOT saved to nonvolatile memory: The Write command must be used to make this initialization permanent. The configuration may also be set to the factory settings by holding the push-button down on power up. The LED will stay off until the button is released, and the factory configuration will be loaded AND saved to nonvolatile memory. *See Also:* Write Configuration Data		

Set Sample Priority	**Length:** 2 bytes	Default: Rate
ASCII Code: P<Mode> Function Button Code: 13<Mode>	Mode: 1 = Quality 2 = Rate	
This command sets the priority for sample output. When the priority is set to "Quality" the sensor will adjust the time to take a single distance reading to maintain a high signal quality. If the time required for taking a single distance reading is longer than the sample interval, the signal quality is given a higher priority, and the samples are sent at the maximum rate possible to maintain signal quality. If the maximum possible time is exceeded, a value of zero will be sent. When the priority is set to "Rate" the sensor will send sample at the rate set, optimizing and averaging internal samples to the extent the sample time allows. If the signal quality is below a minimum level, a value of zero will be sent. *Example:* To set the sample priority to "Rate", enter 'P2' *Note:* In no case may the sample interval be set below 800 microseconds. This minimum sample interval is the same for both "Quality" and "Rate" priorities. *See Also:* Set Sample Interval Serial Output Control Analog Output Mode		

Set Serial Output to ASCII	**Length:** 1 byte	Default: ASCII
ASCII Code: D Function Button Code: Serial Entry Only		
This Command sets the serial output format to ASCII, allowing it to be read on a terminal. See the Output Data Formats section for a detailed description of the serial data stream in binary format. *Example:* To set the Serial Output to ASCII, enter 'D' *Note:* Each sample is terminated with a <CR><LF> character pair. The Serial Output has to be enabled for data to be transmitted. *See Also:* Set Serial Output to Binary Serial Output Control		

Set Serial Output to Binary	**Length:** 1 byte	Default: ASCII
ASCII Code: N Function Button Code: Serial Entry Only		
This Command sets the serial output format to Binary. See the Output Data Formats section for a detailed description of the serial data stream in binary format. *Example:* To set the Serial Output to Binary, enter 'N' *Note:* Each sample is consists of two data bytes terminated with a byte equal to "0FFH". The Serial Output has to be enabled for data to be transmitted. *See Also:* Set Serial Output to ASCII Serial Output Control		

Take Single Sample	**Length:** 1 byte	
ASCII Code: E Function Button Code: Serial Entry Only		
This command takes a single distance sample and transmits it. The present sample interval setting is used as the period of time to acquire the distance sample. This command can be used to synchronize distance measurements to other processes. *Example:* To take a single distance sample, enter 'E' *Note:* This command is intended for use when automatic sampling is turned off. If automatic sampling is turned on, the current distance measurement is terminated, and distance measurements are restarted with the present sample interval. *See Also:* Set Sample Interval		

Show Configuration	**Length:** 5 bytes	
ASCII Code: V1234 Function Button Code: Serial Entry Only		

The characters V1234 entered in sequence will cause the firmware revision number of the sensor, the Schmitt Measurement Copyright, and the user configuration settings to be output.

Example: To display the firmware version number, enter 'V1234'

Sample Output of Factory Settings:

```
AR200-x - VERSION: 2.03
Copyright 2012, Schmitt Measurement Systems INC.

ZERO-POINT IS SET TO:            0
SPAN IS SET TO:                  50000
SAMPLE INTERVAL IS SET TO:       20000
ANALOG OUTPUT MODE IS:           CURRENT LOOP
BACKGROUND LIGHT ELIMINATION IS: ON
CONTINIOUS SAMPLING IS:          ON
BAUD RATE IS SET TO:             9600
SERIAL OUTPUT IS:                ASCII: METRIC
SAMPLE PRIORITY IS:              RATE
```

Note: If data is being output when this command is used, the configuration data will appear between samples.

The argument "1234" is required to prevent accidental output during data transmission.

The version ring is in ASCII regardless of the Serial Output data format.

12. Maintenance of laser sensor

The AR200 laser sensors require little maintenance from the user. The sensor window should be kept clean of dust buildup as a part of regular preventative maintenance. Use compressed air to blow dirt off the window or use delicate tissue wipes and a light solvent such as isopropyl alcohol or water. Avoid using pressurized water and do not use abrasive wipes on the optical glass. If your sensor does not function according to specifications, contact Schmitt Measurement Systems, Inc.

13. Sheet: Summary of Specifications

Go to http://www.acuitylaser.com/