AS1100™ Accurate Distance Sensor

User's Manual

For use with AS1100™ Accurate Distance Sensor

June 14, 2024

Acuity
A product line of Schmitt Measurement Systems, Inc.
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2. Ship the product to Schmitt Measurement Systems, 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 has been tested for electromagnetic emissions and immunity and has been found to be in compliance with the following directives for class A equipment:

EN 60825-1:2014

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 or her own expense.

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1 Introduction

1.1 General Overview

The AS1100 is a long-distance sensor can measure targets with an accuracy of ± 3mm (0.12 in) up to 100m (328 ft) away on natural targets and up to 150m (492 ft) away with the aid of an Acuity reflective target. The AS1100 is a rugged laser sensor that can accurately measure on difficult targets, including dark surfaces, surfaces in sunlight, and glowing targets up to 1400°C. The maximum measurement frequency of the AS1100 is 100Hz in optimal conditions.

The AS1100 can communicate using RS-232, RS-422, or RS-485 serial protocols by adjusting a single parameter. There is also a mini-USB connection under the back cover that can be connected to a PC for easy configuration and troubleshooting. The AS1100 also comes with a current loop analog output with a user-configurable measurement span that can output at a 4-20 mA or 0-20 mA current range.

1.2 Component Diagram

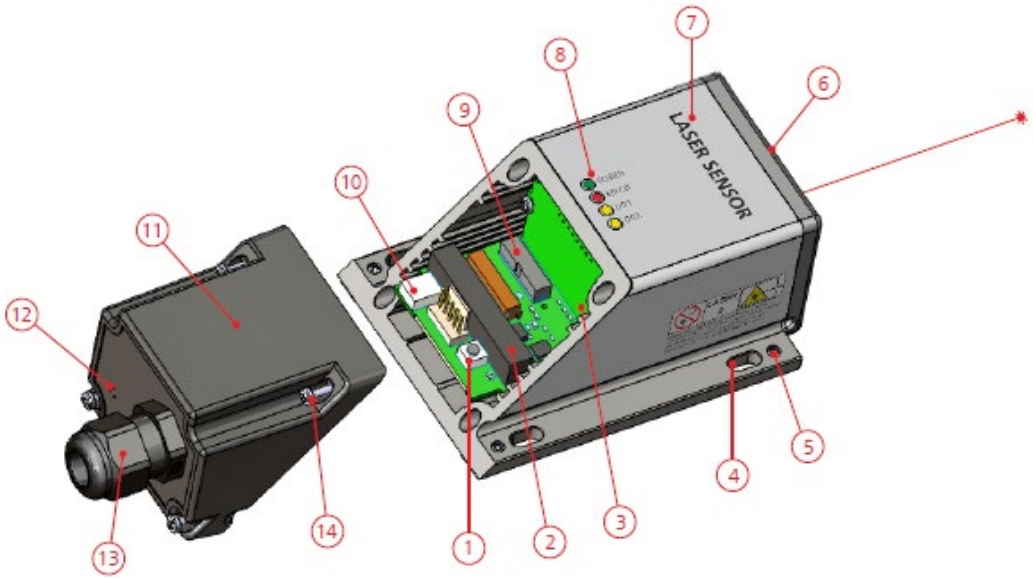

***Figure 1:* Diagram of AS1100 Components**

1) Reset Button
2) Screw terminal block and plug. Accommodates up to 16 AWG (0.05" dia.) wire.
3) Tab to connect wire shielding.
4) Slot holes for installation.
5) Socket set screw for sensor alignment.
6) Sensor front.
7) Product label.
8) Status LEDs.
9) Communications port (not currently used)
10) USB 2.0 socket (mini-B).
11) User removable back cover.
12) Valve diaphragm.
13) Cable connector.
14) Screws (recommended torque: 1.6 Ncm)

1.3 Technical Specs

Table 1: AS1100 Specifications

	English Units	Metric Units
Range	~2 in. min. to 328 ft. max (natural targets) ~131 ft. min. to 492 ft. max (reflective foil*)	0.05…~100 m (natural targets) ~40…150 m max (reflective foil*)
Accuracy @ 2σ	± 0.119 in.	± 3 mm
Repeatability @ 2σ	0.028 in.	0.7 mm
Resolution	0.004 in.	0.1 mm
Laser spot diameter @ 10, 50, 100 m	0.28 x 0.12 in.; 1.10 x 0.51 in.; 2.16 x 1.81 in.	7 x 3 mm; 28 x 13 mm; 55 x 30 mm
Dimensions (l x w x h)	5.51 x 3.07 x 1.89 in.	140 x 78 x 48 mm
Weight (less cable)	0.77 lbs.	350 grams
Laser class	Class 2, Complies with 21 CFR 1040.10 and with Laser Notice 50, IEC/EN60825-1:2014	
Laser type	Typical 650 nm (620 – 690 nm), <1 mW visible RED	
Power	12 - 30 Volts DC; Max. Current: 0.2A	
Sample rates	100 Hz	
Operating temp	14 to 122 °F	-10 to 50 °C
Environmental	IP65	
Material	Sensor body: Aluminum Alloy EN-AW 6060 (Anodized 20µm) Front and back cover: Mineral reinforced nylon resin	
Shock & Vibration	IEC 60068-2-27 (Shock); IEC 60068-2-6 (Vibration)	
Outputs: Serial	RS232, RS422, RS485, (USB connection only for configuration)	
Analog output, programmable	4-20 mA/0-20mA software configurable	
Measuring accuracy of analog output	± 0.1 % of the programmed AO range or ± 3.0 mm (Whichever is greater)	

*Contact Acuity for these targets. Other reflectivity targets can damage the sensor. Contact a sales rep for pricing.

2 Sensor Description

2.1 Principle of Operation

The AS1100 measures distance using a direct time-of-flight measurement of the laser beam and a measurement of the phase shift between the beam as it exits and reenters the sensor. In combination, this allows for precise measurements with targets at long distances.

The laser beam leaves the sensor front through a small lens that is adjacent to the larger main lens. The light reflects off the target then is collected through the main lens. The light is then both measured to determine its time of flight and is compared to the outgoing beam to determine the phase shift. This information is processed by the sensor and the information communicated through serial and analog outputs accessed through the cable connector, the screw terminals, or the mini-USB port.

2.2 Prohibited Use/Limits to Use

The AS1100 may not be used in any way contrary to this manual, in any way that may jeopardize the safety of the user or others, or in any way contrary to local laws and regulations.

2.2.1 Prohibited Actions

Prohibited actions include, but are not limited to:

- Using the sensor without proper safety training.
- Using outside of stated limits.
- Deactivating of safety systems or removal of hazard labels.
- Opening the sensor (Except the user removable back cover. See section 1.2)
- Modifying the sensor internals or the main body of the sensor.
- Aiming sensor directly into the sun.
- Pointing the laser beam directly at 3rd parties or in areas where others may be affected by the beam.

2.2.2 Environmental Limits

Do not use the AS1100 in the following environmental conditions:

- Volatile or corrosive vapor or liquids (Salt, acid, poison, etc.)
- Snow or rain (without an appropriate protective casing)
- Radiation
- Explosive environments
- High-gloss (mirror-like) targets.

2.2.3 Application Limits

The AS1100 cannot be used in the following applications:

- Aerospace (Aviation and Space Flight)
- Nuclear technology

2.3 Laser Dimensions

The diagram below is measured in mm [in.]. The red line is the path of the laser beam.

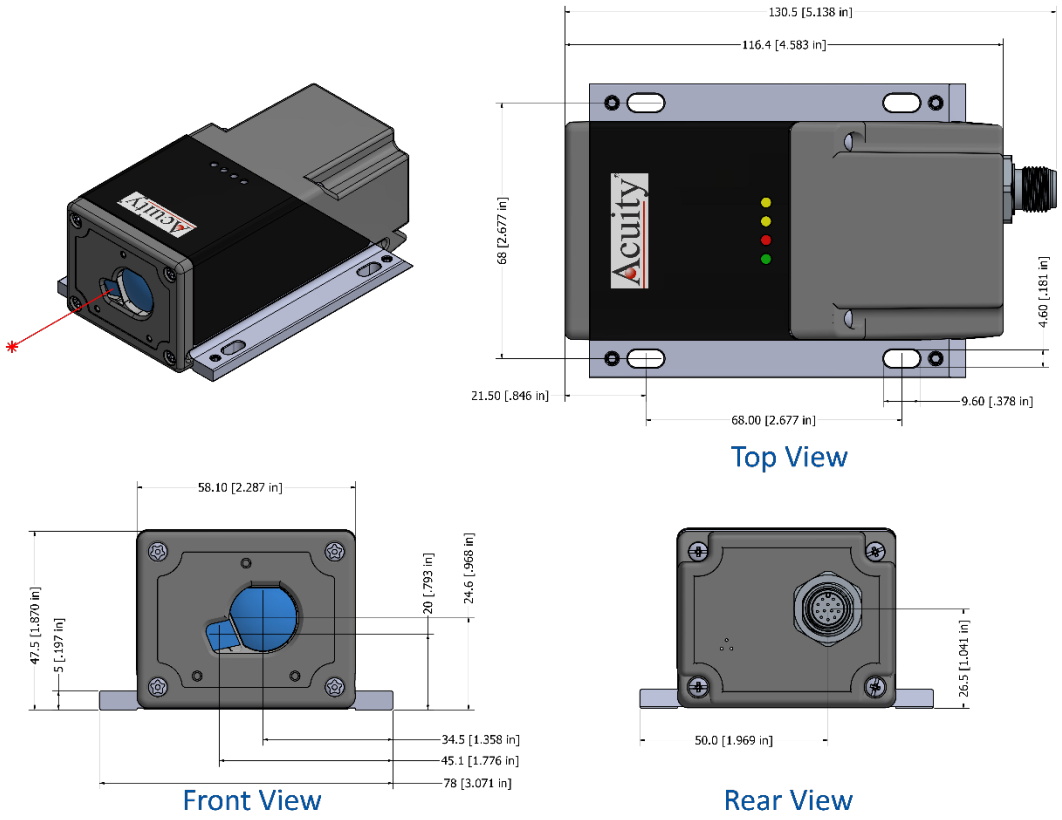

***Figure 2:** AS1100 Dimensions*

2.4 Laser Safety Label

The AS1100 uses a Class 2 laser with a continuous output of < 1mW. The following warning label is placed on the sensor body.

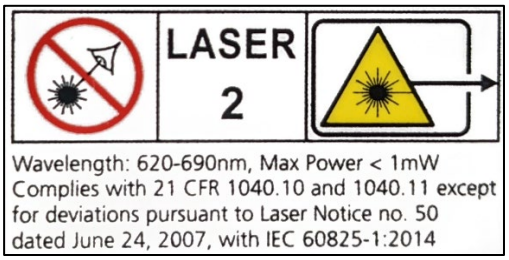

***Figure 3**: Laser Safety Label*

2.5 Identification Label

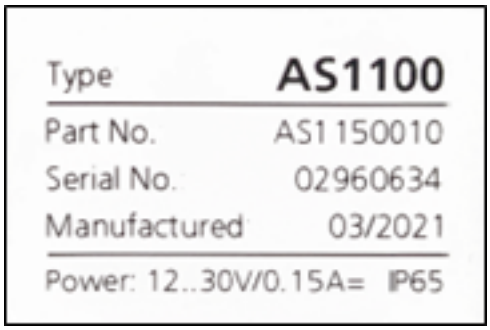

Figure 4: ***AS1100 ID Label***

2.6 Label Location

Figure 5: ***Laser Safety Label Location***

Figure 6: ***ID Label Location***

2.7 Sensor Maintenance

The AS1100 sensor requires little maintenance from the user. The sensor lens should be kept clean of dust buildup as a part of regular preventative maintenance. Use compressed air to blow dirt off the windows or use delicate tissue wipes. Do not use any organic cleaning solvents on the sensor. If your sensor does not function according to specifications, contact Schmitt Measurement Systems, Inc.

Except for the removable back cover, do not attempt to loosen any screws or open the sensor housing.

2.8 Sensor Service

The AS1100 sensor is not user-serviceable. Refer all service questions to Schmitt Measurement Systems, Inc.

Except for the removable back cover, do not attempt to loosen any screws or open the sensor housing.

3 Signal and Power Interface

3.1 Cable Description

The AS1100 comes with an M12, 1.25 mm thread, 12 pin male connector attached (similar to a Binder 713 series connector). A connecting cable that terminates in flying leads can be ordered from an Acuity salesperson at lengths of up to 35 meters (115 feet).

3.2 Connector Pinout/Cable Color Codes

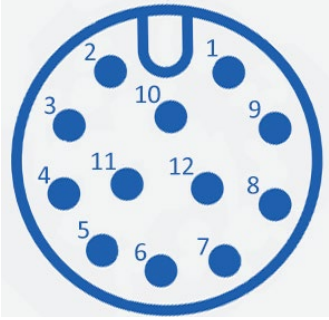

***Figure 7:** AS1100 Male Connector*

***Table 2:** Cable Pinout*

Pin #	Wire Color	Function
1	Brown	Analog Out (AO)
2	Orange	RS232 RX Data (RXD)
3	Black	Ground (GD)
4	White	Digital Error Output (DOE)
5	Gray-Pink	RS232 TX Data (TXD)
6	Pink	Digital Signal Output #1 (DO1)/ Digital Trigger Input (DI1)*
7	Gray	Digital Signal Output #2 (DO2)
8	Red	Power 12-30 VDC (V+)
9	Blue	RS422 T+ /485 D+ (T+)
10	Green	RS422 T- /485 D- (T-)
11	Violet	RS422 R+ /485 D+ (R+)
12	Yellow	RS422 R- /485 D- (R-)

* "DO1" is the label used on the AS1100 screw terminals. In this manual this connection will be referred to as "DI1" when it is used as a trigger input (See sections 3.9 and 3.10)

3.3 Screw Terminals

Removing the back cover of the AS1100 will reveal screw terminals that connect to the connector on the back cover. The wires can be removed from the screw terminals by the user so that other wires or a cable can be attached.

Note: The labels on the terminals correspond to the wire functions in section 4.2. The terminals use the abbreviations listed in parentheses.

Caution: Wires connected to the terminals incorrectly can damage the AS1100. Take steps to verify the correct wiring before attempting to apply voltage.

3.4 USB Mini Jack

Also found inside the back cover of the AS1100 is a USB Mini-B jack. Connecting a standard USB 2.0 A male to Mini-B male cable will allow the sensor to act as its own RS232 serial to USB adapter to a PC. This can aid in quick testing and troubleshooting of the sensor.

Note: Connecting the AS1100 to a PC using the USB Mini jack is not recommended for long term use. Exposing the rear circuit board increases the risk of damage to the board. The IP65 rating only applies when the rear cover is securely attached and operated through the rear connector.

3.5 Reset Button

The reset button is also found inside the AS1100 back cover. To reset the AS1100 to factory settings please use the following procedure:

1. Remove power from the AS1100 if it is currently powered on.
2. Press the reset button and hold while applying power.
3. Continue holding the reset button with the power on until the status LEDs all flash for a half second.
4. Release the reset button and power off.

Upon restoring power, the AS1100 will be configured to factory settings.

3.6 Power Supply (Red, Black wires)

The Black wire is the Power Supply Common return, also named Ground. It carries the return current for the power supply and the analog signals.

The Red wire is the Power Supply Input to the sensor. The sensor requires 12 - 30 VDC power and consumes 2 – 4 Watts of power (< 0.2A draw) depending on the sensor's configuration.

Power supplies from 12 – 30 VDC may be used, but 15 – 24 VDC power supplies are recommended to protect against any excursions. Higher voltages will result in excessive current drawn by the over-voltage protection circuitry and may cause permanent damage. Voltages less than 10 VDC may result in inaccurate measurement readings.

3.7 Serial Communications

The AS1100 uses a serial connection for sensor configuration and issuing commands. It can also be used to collect data. Commands and replies are all ASCII based. Please refer to Section 5.1 for a comprehensive list of commands and detailed descriptions of each command's function and parameters.

The AS1100 supports RS232, RS422, and RS485 serial protocols. The default communication rate is 19,200 baud, but 9,600 baud and 115,200 baud are also supported for all serial protocols. For the measurement speeds of 100Hz, a 115,200 baud connection is required.

(See section 4.3.3: Set Serial Interface Parameters)

The AS1100 cable has dedicated wires for the RS232 and RS422/485 connections.

Note: For PCs without dedicated serial ports, Acuity recommends serial to USB converters that use FTDI chips.

3.7.1 RS232 Serial Communication (Orange, Gray-Pink)

The RS232 Serial Communication Standard is normally used for shorter distances of communications (max. cable length: 15 meters). Only one transmitter and one receiver are allowed per network. A standard DB9 RS232 serial female connector can be built to interface with an RS232 serial port or a serial to USB converter using the pins below.

Table 3: RS232 Cable Wires and Functions

Wire Color	DB9 Pin	Function
Gray-Pink	2	Transmit data from sensor (TXD)
Orange	3	Receive data from sensor (RXD)
Black	5	Ground (GD)

3.7.2 RS422/RS485 Serial Communication (Blue, Green, Violet, Yellow)

RS422 and RS485 serial connections can be used to connect multiple AS1100 units to your PC or PLC. Up to 100 AS1100s can be connected on the same network in this fashion. RS422 and RS485 connections also support much longer cables. A 115,200 baud connection can be transmitted over cables up to 500 meters long.

When wiring a RS422 or RS485 connection to a PC using a serial to USB connector or a PLC, follow the pinout for the connecting hardware. There is no standard pinout for wiring an RS422 or RS485 connection to a DB9 connection, so the correct pin configuration will vary. The table below shows the appropriate wires from our cable, the abbreviations used on the screw terminals, and their functions.

Table 4: RS422/RS485 Cable Wires and Functions

Wire Color	Term. Abbr.	RS422	RS485
Blue	T+	Transmit +	Data +
Green	T-	Transmit -	Data -
Violet	R+	Receive +	
Yellow	R-	Receive -	
Black	GD	Ground	Ground

Note: When connecting multiple AS1100s to an RS422 or RS485 connection, termination resistors should be used that are equal to the cable impedance.

Caution: When connecting more than one AS1100s on the same RS422 or RS485 connection, do not issue commands with continuous answers (ex. Single Sensor Tracking). The constant responses will prevent issuance of additional commands. If tracking is needed, use Buffered Sensor Tracking (Section 4.2.5) and issue commands to read each sensor's buffer as needed.

3.8 Analog Output (Brown)

The analog output for the AS1100 is a current loop transmitted through the brown (AO) wire that can be set to 4-20 mA or 0-20 mA (See section 4.3.5). The return signal should be routed through the black (ground, GD) wire.

The AO wire delivers a current proportional to the measured distance over a user-set distance range. The command to set this range can be found in section 4.3.7. This range The AO wire is supplied by a 12-bit digital to analog converter. This gives the analog output a resolution of 0.025% of the user-set distance range. Therefore, if the +/- 3 mm accuracy must be kept while using the analog signal, the AO measurement range should be set to no more than twelve meters.

3.8.1 Minimum Analog Output Measurement Value

The minimum analog output measurement value can be set to either 0 or 4 mA (see section 4.3.5). The AO resolution is the same regardless of the value selected.

3.8.2 Analog Error Value

When the AS1100 is in an error state, the analog output will transmit a value that can be defined by the user (see section 4.3.6). This value can be anywhere between 0 and 20 mA regardless of the minimum AO measurement value selected. For example, if the minimum AO value is set at 4 mA, the error value could be set and displayed at 3 mA.

3.9 Digital Signal Outputs (White, Pink, Gray)

The AS1100 contains two digital outputs (DO1 and DO2) for limit monitoring and one digital output (DOE) that signals when the sensor is in an error state. These outputs can be configured as NPN, PNP or Push-Pull outputs. The digital outputs are able to transmit up to 150 mA and are specified for a voltage of up to 30 VDC. All 3 outputs can be configured by the user (see sections 4.3.8 and 4.3.9).

Below are the digital signal output cable wires, their functions, and the associated abbreviations on the AS1100 screw terminals:

Table 5: Digital Output Wires and Functions

Wire Color	Function	Term. Abbr.
White	Digital Error Output	DOE
Pink	Digital Signal Output #1	DO1
Gray	Digital Signal Output #2	DO2

Note: If any of the digital signal outputs are to be connected to a digital input of a control device such as a PLC, either the Push-Pull output should be selected, or an additional pull-up/pull-down resistor should be used along with an NPN or PNP output.

Note: If the AS1100 is configured to use a digital trigger input (see section 4.3.10), DO1 cannot be used as an output.

3.10 Digital Trigger Input (Pink)

If the AS1100 is configured to accept a digital trigger input (see section 4.3.10), the pink wire (DO1) no longer outputs current, but it is instead used as the digital input (DI).

The DI can be used for single measurement triggering or to start/stop tracking measurements.

DI Signal Specification:

- Low: Less than 2 VDC
- High: Between 9 and 30 VDC

Caution: To protect against damage from a short circuit, always use a 1 kΩ resistor between the input voltage source and the DI.

3.11 Status LEDs

The AS1100 has 4 LEDs on the top of the sensor. They show the operating status of the sensor and the digital outputs (DO1, DO2). See the table below for more detail:

***Table 6:* Status LED Indicators and Corresponding Sensor Status**

Power	Error	DO1	DO2	Sensor Status
ON	OFF	OFF	OFF	Powered and ready for operation.
ON	ON	OFF	OFF	Normal sensor error. The error code is transmitted over serial connections. (see section _____ for error codes)
ON	OFF	ON/OFF	ON/OFF	Normal operation with digital signal outputs. DO1 and DO2 will be ON or OFF when their signals are ON or OFF.
ON	ON	ON	ON	(Flashing for 0.5s) Sensor resetting to factory default.
OFF	ON	ON	ON	Voltage supplied to sensor is too low or high. If the voltage is correct and this continues to occur after a power cycle, contact Acuity technical support.
OFF	OFF	OFF	ON	Ready for firmware download.

4 Commands

4.1 Syntax

4.1.1 Command termination - <CrLf>

All commands for the AS1100 are ASCII-based and are terminated with a Carriage Return and Line Feed (<CrLf>) at the end of each command. All replies from the AS1100 terminate the same way.

Note 1: When commands or replies are written in this manual, the terminating <CrLf> should be assumed unless stated otherwise.

Note 2: If you are attempting to communicate with the AS1100 using a terminal emulator, and you find the sensor unresponsive, check that it is terminating each command correctly.

4.1.2 Sensor Identification -

Each AS1100 has an ID number that can be assigned by the user. The character '#' will represent this ID number in any command in this manual. Please substitute the target AS1100's ID number when entering the command.

4.1.3 Parameter Separator - +/ -

Commands and replies will often use a plus (+) or minus (-) between the command or reply and a parameter. If both plus (+) and minus (-) can be used, the command will be written with '(+/-)', but only one will be used in the actual command.

4.1.4 "Set" and "Read" Commands

Commands that are saved with parameters will have different syntax to "Set" a parameter or "Read" a saved parameter to the user. These terms will be used to make this distinction throughout this manual.

4.1.5 Startup String

When an AS1100 is powered on, it will transmit the following string after initialization:

g#?

Once this string is received, the sensor is ready for operation. (Remember: '#' is the sensor's ID number)

4.1.6 Errors

When the sensor sends an error in response to a command, it will take the following form:

g#@Ezzz

Where "zzz" is the error code. (See section 5.2 for a list of error codes)

4.1.7 DO1/DI (Pink Wire)

When the digital trigger input function is enabled (See section 4.3.10), The digital output function of DO1 (pink wire) is disabled, and it is used for the digital input. When DO1 is used for digital input, it is referred to as DI to eliminate confusion.

4.2 Operation Commands

4.2.1 Stop/Clear – [s#c]

Stops any commands currently executing and resets the digital outputs and status LEDs

Command	s#c	
Response	g#?	
Key	#	Sensor ID

4.2.2 Single Distance Measurement – [s#g]

Takes a single distance measurement and cancels any previous measurement command.

Command	s#g	
Response	g#g+aaaaaaaa	
Key	#	Sensor ID
	aaaaaaaa	Distance (unit: 0.1 mm)

4.2.3 Single Sensor Tracking – [s#h]

Starts output of continuous measurements for a single sensor. The measurements will be made as quickly as possible dependent on target conditions (Max. 100 Hz) and will continue until the Stop/Clear command [s#c] is given.

Note on RS422: When using this command with multiple sensors over an RS422 connection, stop sensor tracking before attempting to communicate with another sensor.

Note on RS485: Sensor tracking can't be stopped with a command over an RS485 connection. If tracking is started over an RS-485 connection it can only be stopped by cycling the sensors power or by issuing the Stop/Clear command over an RS232 or RS422 connection.

Command	s#h	
Response	g#h+aaaaaaaa (continuously updated)	
Key	#	Sensor ID
	aaaaaaaa	Distance (unit: 0.1 mm)

4.2.4 Timed Sensor Tracking – [s#h+aaaaaaaa]

Starts continuous distance measurements of a single sensor at a rate defined by the user. These measurements will continue until the Stop/Clear command [s#c] is given.

See the RS422 and RS485 notes in section 8.2.3.

Command	s#h+aaaaaaaa	
Response	g#h+bbbbbbbb (continuously updated)	
Key	#	Sensor ID
	aaaaaaaa	Sampling Time (unit: 1 ms) [Range: 0-86400000 (0 = max possible rate)]
	bbbbbbbb	Distance (unit: 0.1 mm)

4.2.5 Buffered Sensor Tracking – [s#f]

Starts continuous distance measurements of a single sensor to its measurement buffer at a rate defined by the user. The buffer holds one distance measurement at a time. When a new measurement is taken the previous measurement is overwritten. At any time the measurement in the buffer can be retrieved with the [s#q] command (See section 4.2.6). These measurements will continue until the Stop/Clear command [s#c] is given.

	Set Command		Read Command
Command	s#f+aaaaaaaa		s#f
Response	g#f?		g#f+aaaaaaaa
Key	#	Sensor ID	
	aaaaaaaa	Sampling Time (unit: 1 ms) [Range: 0-86400000 (0 = max possible rate)]	

4.2.6 Read Tracking Buffer – [s#q]

Reads distance measurement tracking buffer after the [s#f] command is given (see section 4.2.5). This command returns the current distance measurement in the buffer and a value that signals if the buffer has updated since the previous [s#q] command and if the buffer has been updated more than once.

If distance tracking into the buffer has not been started [s#f], this command will not work.

Command	s#q	
Response	g#h+aaaaaaaa+b	
Key	#	Sensor ID
	aaaaaaaa	Distance (unit: 0.1 mm)
	b	0 – Not updated since last request 1 – Updated once since last request 2 – Updated more than once since last request

4.2.7 Signal Strength Measurement – [s#m]

Triggers a single signal measurement or continuous signal measurements. The signal strength is returned as a relative number in the range of 0 to ~25,000. The signal strength value is approximate. It can differ from sensor to sensor and can depend on environmental conditions.

If continuous measurements are requested, they will continue until the Stop/Clear command is given. Continuous signal measurements are subject to the same RS422/RS485 notes as in section 4.2.3.

Command	s#m+a	
Response	g#h+bbbbb	
Key	#	Sensor ID
	a	0 – Single measurement 1 – Continuous measurements
	bbbbb	Approximate signal strength (0 - ~25,000)

4.2.8 Temperature Measurement – [s#t]

Triggers a single internal sensor temperature measurement.

Command	s#t	
Response	g#h+aaaaa	
Key	#	Sensor ID
	aaaaa	Temperature (unit: 0.1°C)

4.2.9 Read/Clear Error Stack – [s#re]/[s#ce]

These two commands allow the user to read and clear the error stack. Errors are stored in the error stack until the error stack clear command is issued.

	Read Command		Clear Command
Command	s#re		s#ce
Response	g#re+aaa+aaa+…		g#ce?
Key	#	Sensor ID	
	aaa+aaa+…	List of error codes in the error stack. The first code is the most recent. (0 = no errors in stack)	

4.2.10 Laser On – [s#o]

Turns laser on to aid in sensor adjustment. The laser remains on until the Stop/Clear command is issued [s#c]. **This command does not trigger measurements.**

Command	s#o	
Response	g#?	
Key	#	Sensor ID

4.3 Configuration Commands

4.3.1 Save Configuration – [s#s]

Saves current configuration commands to flash (non-volatile) memory.

For the configuration commands in sections 4.3 and 4.4, issuing these commands alone updates the sensor configuration in the volatile memory only, and a power cycle will reset the configuration to the previous values. The save configuration command [s#s] writes all current configuration parameter to the flash memory so that they will be retained after a power cycle.

Note: The reset to factory default command [s#d] (See section 4.3.2) and the auto start configuration (See section 4.3.14) automatically save their settings to the flash memory.

Command	s#s	
Response	g#?	
Key	#	Sensor ID

4.3.2 Reset to Factory Default – [s#d]

Resets all configuration parameters to factory default and saves them to the flash memory.

Note: This also returns communication settings to factory default. If the communication settings have been changed you may have to reconfigure your communication device to continue issuing commands.

Command	s#d	
Response	g#?	
Key	#	Sensor ID

4.3.3 Set Serial Interface Parameters – [s#br]

Sets the communication parameters (baud rate, data bits, parity, stop bits) for the serial interface.

Command	s#br+aa	
Response	g#?	
Key	#	Sensor ID
	aa	Sets the communication parameters per the following chart:

aa	Baud Rate	Data Bits	Parity	Stop Bits
1	9600	8	none	1
2	19200	8	none	1
6	9600	7	even	1
7	19200	7	even	1
10	115200	8	none	1
11	115200	7	even	1

Default	7

4.3.4 Set Sensor ID – [s#id]

Sets the sensor ID number (#). **After this command is issued, future commands to the target sensor will need to use the new ID.**

Command	s#id+aa	
Response	g#?	
Key	#	Sensor ID
	aa	New sensor ID (0-99)
Default	0	

4.3.5 Analog Output Minimum Current – [s#vm]

Sets/reads the analog output minimum current to 0 or 4 mA.

	Set Command		Read Command
Command	s#vm+a		s#vm
Response	g#vm?		g#vm+a
Key	#	Sensor ID	
	a	Minimum current for analog output 0 – Minimum current = 0 mA 1 – Minimum current = 4 mA	
Default	1 – Minimum current = 4 mA		

4.3.6 Analog Output Error Value – [s#ve]

Sets/reads the analog output current value transmitted in the case of an error. If the minimum current is set to 4 mA, the error current can be less than the minimum.

	Set Command		Read Command
Command	s#ve+aaa		s#ve
Response	g#ve?		g#vm+aaa
Key	#	Sensor ID	
	aaa	Error current output (unit: 0.1 mA) If set to 999, the output will transmit the last valid distance.	
Default	0 mA		

4.3.7 Analog Output Distance Range – [s#v]

Sets/reads the current distance measurements that will result in the minimum analog output (0 or 4 mA) and the maximum analog output (20 mA)

	Set Command	Read Command
Command	s#v+aaaaaaaa+bbbbbbbb	s#ve
Response	g#v?	g#v+aaaaaaaa+bbbbbbbb
Key	# Sensor ID aaaaaaaa Distance (unit: 0.1 mm) set to minimum analog output (0 or 4 mA) bbbbbbbb Distance (unit: 0.1 mm) set to maximum analog output (20 mA)	
Default	Minimum: 0 mm Maximum: 10,000 mm	

4.3.8 Digital Signal Output Type – [s#ot]

Sets/reads the output type for all digital signal outputs (DO1, DO2, and DOE). The options are NPN, PNP, Push-Pull.

	Set Command	Read Command
Command	s#ot+a	s#ot
Response	g#ot?	g#ot+a
Key	# Sensor ID a Output type for all digital signal outputs: 0 = NPN 1 = PNP 2 = Push-Pull	
Default	0 = NPN	

4.3.9 Digital Signal Output Thresholds – [s#1], [s#2]

Sets/reads the distance thresholds that will trigger and turn off digital signal outputs DO1 and DO2.

	Set Command	Read Command
Command	s#a+bbbbbbbb+cccccccc	s#a
Response	g#a?	g# a+bbbbbbbb+cccccccc
Key	# Sensor ID a 1 or 2 for DO1 and DO2, respectively bbbbbbbb ON value for output (unit depends on data source) cccccccc OFF value for output (unit depends on data source)	
Default	DO1: ON value – 2005 mm; OFF value – 1995 mm DO2: ON value – 995 mm; OFF value – 1005 mm	

4.3.10 Digital Trigger Input Function – [s#DI1]

Enables digital input control and sets/reads the current function/event that the digital trigger inputs control.

Note: When the digital trigger inputs are activated DO1 is automatically set to be a trigger input, and the signal output capability of DO1 is automatically deactivated.

	Set Command	Read Command
Command	s#DI1+a	s#DI1
Response	g#DI1?	g#DI1+a
Key	# Sensor ID a Trigger input function: 0 = Trigger inputs disabled 2 = Trigger single distance measurement 3 = Start/stop single sensor tracking 4 = Start/stop buffered sensor tracking 8 = Start/stop timed sensor tracking	
Default	0 = Trigger inputs disabled	

4.3.11 Read Digital Trigger Input Status – [s#RI]

Reads out the digital trigger input status as either active or inactive. An active status will occur when the trigger input wire detects a high enough current to activate the trigger input function.

Command	s#RI
Response	g#RI+a
Key	# Sensor ID a 0 = Input inactive 1 = Input active

4.3.12 Measuring Mode – [s#mc]

Sets/reads the current measuring mode. Measuring modes help optimize measurements for speed and/or accuracy depending on the application.

The AS1100 has 5 measuring modes:

- **Normal**
  - Max. Measuring Rate: 20 Hz
  - Typical Accuracy: +/- 3 mm
  - Normal mode is a multi-purpose measurement mode that can be used in a wide variety of applications.
- **Fast**
  - Max. Measuring Rate: 100 Hz
  - Typical Accuracy: +/- 4.5 mm
  - Fast mode allows the measurement rate to be increased to the sensor's maximum with a slight cost in accuracy.
- **Precise**
  - Max. Measuring Rate: 10 Hz
  - Typical Accuracy: +/- 2.4 mm
  - Precise mode improves the measurement accuracy by lowering the measurement rate and increasing integration time.
- **Timed**
  - Max. Measuring Rate: User programmed (up to 100 Hz)
  - Typical Accuracy: Dependent on measuring rate and conditions.
  - Timed mode lets the user set the measurement speed that best fits the application. The typical accuracy will fall between Precise and Fast modes for a given target.
- **Moving Target**
  - Max. Measuring Rate: 100 Hz
  - Typical Accuracy: +/- 3 mm
  - Moving target mode optimizes the sensor to measure fast moving targets. This mode requires the best measurement signal of all the measurement modes.

	Set Command	Read Command
Command	s#mc+a	s#mc
Response	g#mc?	g#mc+a
Key	# Sensor ID a Measuring mode: 0 = Normal 1 = Fast 2 = Precise 3 = Timed 4 = Moving target	
Default	0 = Normal	

4.3.13 Measurement Filter Configuration – [s#fi]

Sets/reads the parameters of the measurement filter.

In the simplest configuration, the measurement filter takes the previous 2 to 32 measurements as directed by this command and calculates a moving average.

However, in addition to averaging, the filter can be set up to omit a set number of min/max pairs of measurements or a set number of errors from the average. Omitting min/max pairs reduces the effect of measurement spikes on the average. Omitting errors allows the sensor to calculate the average as long as there are no more error values than the programmed amount. Both of these options can be useful when target quality changes over time or are otherwise less cooperative than optimal.

	Set Command	Read Command
Command	s#fi+aa+bb+cc	s#fi
Response	g#fi?	g#fi+aa+bb+cc
Key	# Sensor ID aa Filter Length: 0 = Filter Off 2-32 = Filter length (32 measurements max.) bb Pairs of min/max values to suppress. (1 = suppresses the highest and lowest value, 2 = suppressed the 2 highest and 2 lowest values, etc.) cc Maximum number of errors to suppress. **Note** **Values must adhere to this formula:** **(2 * bb) + cc ≤ (0.4 * aa)**	
Default	Filter Off	

4.3.14 Auto Start Configuration – [s#A]

Sets/reads the auto start configuration parameter.

Setting this parameter does the following:

- Starts distance tracking into the measurement buffer immediately. (same as [s#f], see section 4.2.5)
- Writes this command to the flash (non-volatile) memory.
- Restarts the tracking immediately upon power on.

To stop this command, the Stop/Clear command [s#c] must be given. To keep this command from reactivating after a power cycle, the Save command [s#s] must be given after the Stop/Clear command.

Except for the above, [s#A] operates just like [s#f], and measurement values can be read from the buffer in the same manner. (See section 4.2.6)

	Set Command	Read Command
Command	s#A+aaaaaaaa	s#A
Response	g#A?	g#A+aaaaaaaa
Key	# Sensor ID aaaaaaaa Sampling Time (unit: 1 ms) [Range: 0-86400000 (0 = max possible rate)]	

4.4 Advanced Configuration Commands

4.4.1 User Output Format – [s#uo]

This command allows the configuration of a user specific output format. The configuration only affects the serial interface. A parameter value of 0 is the default. (ex. g0g+00001234)

The user output format can be configured to fit the requirement of an external ASCII display. A parameter values between 101 and 199 define the format for an external display. (See command key below)

The command parameter value of 200 allows the user to set a distance offset and gain factor (See sections 4.4.2 and 4.4.3) and outputs the distance in the default format. (ex. g0g-00000234)

The command parameter values of 300 and 301 allows the user to select extended output formats. 300 outputs distance (unit: 0.1mm), signal, and temperature (unit: 0.1°C) in that order (ex. g0g+00000234+008384+254). 301 outputs distance (unit: 0.1mm), signal, temperature (unit: 0.1°C), and speed (unit: mm/s) in that order (ex. g0g+00000234+008384+254+000500). Like with parameter value 200, 300 and 301 allow user defined distance offset and gain factor.

	Set Command	Read Command
Command	s#uo+aaa	s#uo
Response	g#uo?	g#uo+aaa
Key	# Sensor ID aaa Output format: 0 = Default format (ex. g0g+00001234) 1xy = External display output format x – Digits after decimal point y – Total digits in output **y must be ≥ 1, and x must be ≤ y** (ex. an output of 1.234 could be given by 1xy = 134) 200 = Default format with gain/offset active 300 = Extended format with distance, signal, and temperature (distance gain/offset active) 301 = Extended format with distance, signal, Temperature, and speed (distance gain/offset active)	
Default	0 = Default format	

4.4.2 User Distance Offset – [s#uof]

Sets/reads the user defined distance offset. This affects all distance measurement commands if and only if a user output format (see section 4.4.1) is set that allows for it. **This command does not affect the analog output signal.**

	Set Command	Read Command
Command	s#uof(+/-)aaaaaaaa	s#uof
Response	g#uof?	g#uof(+/-)aaaaaaaa
Key	# Sensor ID aaaaaaaa Distance offset (units: 0.1 mm) Both positive (+) and negative (-) offsets can be Entered.	
Default	0 mm	

4.4.3 User Distance Gain Factor – [s#uga]

Sets/reads the user defined distance gain factor. The gain factor is a fraction that is entered as 2 parameters, a numerator and denominator. The gain factor will be used by the sensor to multiply the distance value +/- any set offset. This affects all distance measurement commands if and only if a user output format (see section 4.4.1) is set that allows for it. **This command does not affect the analog output signal.**

	Set Command	Read Command
Command	s#uga+aaaaaaaa+bbbbbbbb	s#uga
Response	g#uga?	g#uga+aaaaaaaa+bbbbbbbb
Key	# Sensor ID aaaaaaaa Gain factor numerator. bbbbbbbb Gain factor denominator. **(Cannot be 0)**	
Default	Gain factor = 1	

4.5 Informational Commands

4.5.1 Firmware Version [s#sv]

Reads the firmware version of the sensor.

Command	s#sv	
Response	g#sv+aaaabbbb	
Key	#	Sensor ID
	aaaa	Measuring module firmware version
	bbbb	Interface firmware version

4.5.2 Serial Number [s#sn]

Reads the serial number of the sensor.

Command	s#sn	
Response	g#sn+aaaaaaaa	
Key	#	Sensor ID
	aaaaaaaa	Sensor serial number

5 Quick Reference Tables

5.1 Command Reference.

Below is a table of all the commands listed in this manual. Please refer to the section listed for a detailed explanation.

Table 7: Command Reference

	Function	Description	Section	Command
Operation	Stop/Clear	Stops commands and resets digital outputs.	4.2.1	s#c
	Single Distance Measurement	Takes a single distance measurement	4.2.2	s#g
	Single Sensor Tracking	Starts output of continuous measurements.	4.2.3	s#h
	Timed Sensor Tracking	Starts output of continuous measurements at specified rate.	4.2.4	s#h+aaaaaaaa
	Buffered Sensor Tracking	Starts output of continuous measurements to buffer.	4.2.5	s#f
	Read Tracking Buffer	Reads measurement buffer.	4.2.6	s#q
	Signal Strength Measurement	Starts measurements of signal strength.	4.2.7	s#m
	Temperature Measurement	Takes a single sensor temperature measurement.	4.2.8	s#t
	Read/Clear Error Stack	Read or clear saved error stack.	4.2.9	s#re, s#ce
	Laser On	Turns laser beam on for alignment or adjustment.	4.2.10	s#o
Configuration	Save Configuration	Saves current configuration to flash.	4.3.1	s#s
	Reset to Factory Default	Reset configuration to factory defaults	4.3.2	s#d
	Set Serial Interface Parameters	Sets serial communication parameters.	4.3.3	s#br
	Set Sensor ID	Sets sensor ID number.	4.3.4	s#id
	Analog Output Minimum Current	Sets the minimum analog output value.	4.3.5	s#vm
	Analog Output Error Value	Sets the analog output value for errors.	4.3.6	s#ve
	Analog Output Distance Range	Sets the distance measurements that will correspond to min. and max. analog output values.	4.3.7	s#v
	Digital Signal Output Type	Sets the output type for DO1, DO2, and DOE.	4.3.8	s#ot
	Digital Signal Output Thresholds	Sets distance thresholds for DO1 and DO2	4.3.9	s#1, s#2
	Digital Trigger Input Function	Enables digital input and sets what it will control.	4.3.10	s#DI1
	Read Digital Trigger Input Status	Returns the digital input status.	4.3.11	s#RI
	Measuring Mode	Sets current sensor measuring mode	4.3.12	s#mc
	Measurement Filter Configuration	Enables and configures the measurement filter.	4.3.13	s#fi
	Auto Start Configuration	Enables and configures the auto start function.	4.3.14	s#A
Advanced	User Output Format	Configures measurement output format.	4.4.1	s#uo
	User Distance Offset	Configures distance offset.	4.4.2	s#uof
	User Distance Gain Factor	Configures measurement gain factor/multiplier.	4.4.3	s#uga
Info	Firmware Version	Returns current firmware version	4.5.1	s#sv
	Serial Number	Returns sensor serial number.	4.5.2	s#sn

5.2 Error Codes

Below is a table of error codes and suggestions for troubleshooting each error. If the troubleshooting suggestions do not resolve the error, please contact Acuity Technical Support.

***Table 8:* Error Code Reference**

Code	Description	Troubleshooting
200	This code denotes a sensor boot in the error stack. Not an error itself.	None
203	Wrong command or syntax.	Check command is entered correctly. Check communication settings
210	Sensor not in tracking mode.	Start tracking measurement first.
211	Tracking measurement time too short for measurement conditions.	Increase measurement time or improve measurement conditions.
212	Command can't be executed while tracking measurement is active.	Stop tracking before issuing command.
220	Serial communication error.	Check communication settings.
230	Distance value overflow.	Check user offset/gain configuration.
233	Number can't be displayed.	Check output format.
234	Distance not in measurement range.	Check measurement setup.
236	Conflict in digital input/output DI1/DO1 configuration.	Check DI1/DO1 config. If digital input is activated both DI1 and DO1 can be used for input only.
252	Temperature too high.	Reduce ambient temperature. Should not occur at room temperature
253	Temperature too low.	Increase ambient temperature. Should not occur at room temperature.
255	Signal too low.	If target is in range, use a more reflective target surface.
256	Signal too high.	Use a less reflective target surface.
257	Signal to noise ratio is too low.	Reduce sources of background light. Try using a more reflective target surface.
258	Power supply voltage is too high.	Check supplied voltage is within specifications.
259	Power supply voltage is too low.	Check supplied voltage is within specifications.
260	Signal unstable.	Stabilize target surface. (Decrease variations in reflectivity or angle.)
261	Distance measurement spike greater than set limit.	Check target for unexpected movements. Reconfigure sensor limits. Restarting measurement clears error condition.
284	Signal disturbance in laser output.	Clean window. Be sure to use optically safe cloths or wipes.
290	Signal disturbance in sensor optics.	Clean window. Be sure to use optically safe cloths or wipes.
402	Firmware installation error.	Check power and connection. Power cycle the sensor before reattempting.