Laser Technology, Inc.

TruSense® S200 Series

User's Manual

LASER INC TECHNOLOGY
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LTI TruSense® S200 Series User's Manual
8th Edition Part Number 0144847

Printed in the United States of America

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Introduction

This manual represents the S200 Series models. S200 is used as a generic term for all S200 Series models:

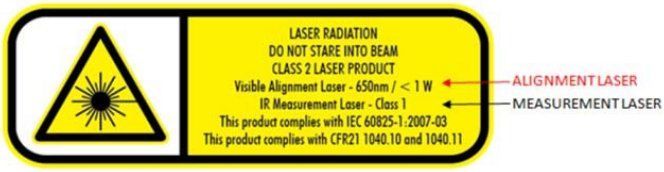
- ☐ S200 = TRIG, SDI-12, RS232 without alignment laser
- ☐ S210 =TRIG, SDI-12, RS232 with alignment laser
- ☐ S230 = 4-20 HART, RS232 with alignment laser

Basic Package

- ☐ S200 Series Sensor or S200 OEM Sensor
- ☐ Communication Cable with Flying Leads
- ☐ CDROM (includes the Interface Software and User's Manual)
- ☐ LTI Limited Warranty

Safety Precautions

- Avoid staring directly at the laser beam for prolonged periods. The TruSense S200 is designed to meet FDA eye safety requirements and is classified as eye safe to FDA (CFR21) Class I 7 mm limits, which means that virtually no hazard is associated with directly viewing the laser output under normal conditions. As with any laser device, however, reasonable precautions should be taken in its operation.
- It is recommended that you avoid staring into the transmit aperture while firing the laser. The use of optical instruments with this product may increase eye hazard.
- Never point the instrument directly at the sun. Exposing the lens system to direct sunlight, even for a brief period, may permanently damage the laser transmitter.
- Effective for the S210 and S230 only: The Class 2 Alignment Laser Exit Aperture is located on the upper portion of the Front Plate between the Transmit and Receive Lenses of the Class 1 Measurement Laser:



ALIGNMENT LASER = CLASS 2
MEASUREMENT LASER = CLASS 1

Mounting the TruSense S200

IMPORTANT!
When mounting the S200, always use a washer between housing feet and screw head.
Do not exceed 5 inch-pounds of torque when securing.

Getting Started

You may choose to get familiar with the sensor performance and configuration in a controlled environment. After unpacking, power on the unit with the supplied cabling and connect the DB9 pin serial connector to a serial I/O device such as a PC. A DB9 to USB adaptor is available from LTI. A ready to use power and communication cable is also available from LTI, see Accessory Items (above).

Connect using either the supplied Interface Software or a terminal emulation program such as Hyperterminal. Default=115200 baud rate, no parity, 8 data bits, 1 stop bit, no flow control.

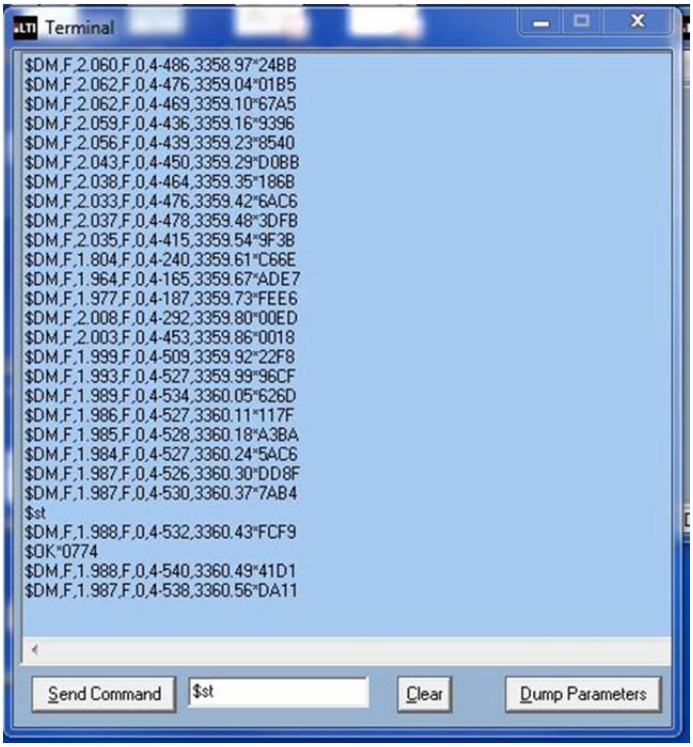
Outputs on Each Model

	I/O					
	Visible Alignment Laser	**RS232**	**SDI 12**	**4-20**	**4-20 HART**	**Trigger**
S200		●	●			●
S210	●	●	●			●
S230	●	●		●	●	

Configuration

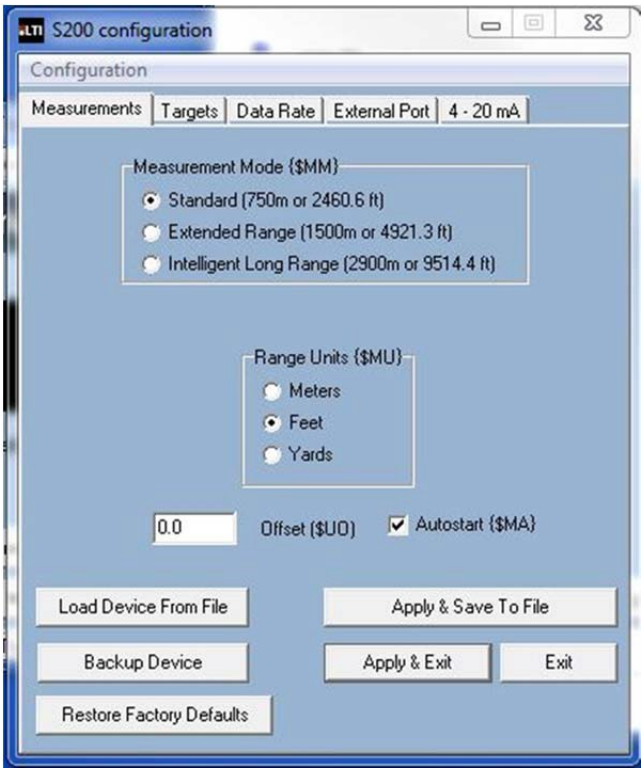
Graphical Users Interface

- **Device**: Model
- **SN**: Device serial number
- **Red "Laser On"**: Laser is firing
- **Counter**: Measurement count
- **Enable Visible Laser Pointer**: Alignment laser
- **Terminal**: Brings up Terminal Mode. User can type in commands and see response as well as scrolling data as the sensor is measuring.
- Enter "Configure Sensor" for setup menus.



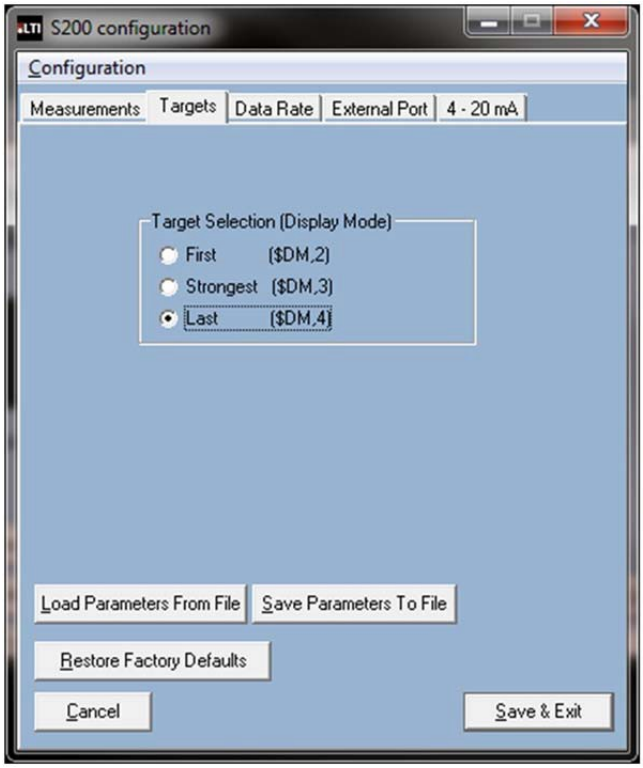
Terminal Window

- User may enter commands in the lower window. The data scrolls in the main window.
- **Dump Parameters**: Scrolls the settings in the sensor for review.



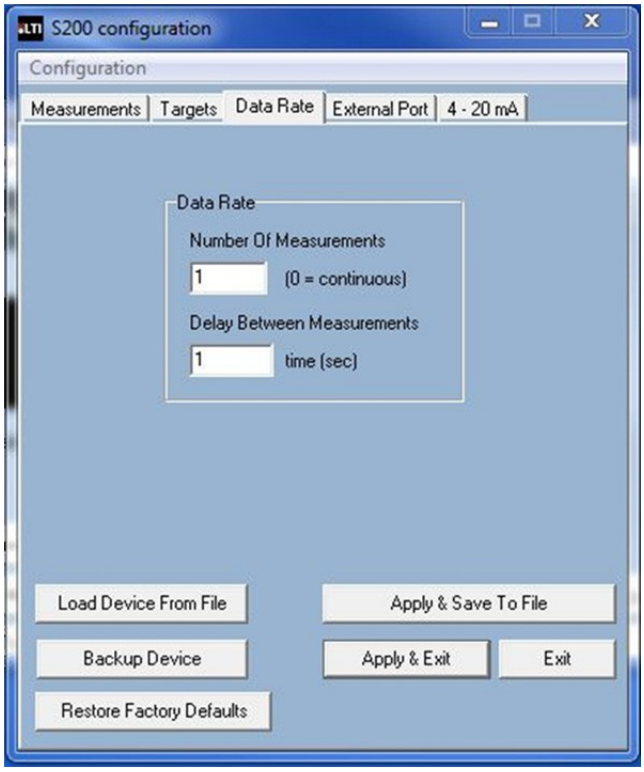
Measurements Tab

- **Measurement Mode**: Selection based on the maximum range.
- **Range Units**: User may select measurement units.
- **Offset**: Adds or subtracts from overall measurement.
- **Autostart**: Enable Autostart for sensor to automatically begin measuring on power up.
- **Load Device from File**: Upload file settings from saved file to sensor.
- **Backup Device**: Save current sensor settings to file.
- **Restore Factory Defaults**: Load settings from the factory from non-volatile memory.
- **Apply & Save to File**: Load menu settings to sensor and save to file.
- **Apply & Exit**: Save menu settings to sensor and exit.
- **Exit**: Simply exit.



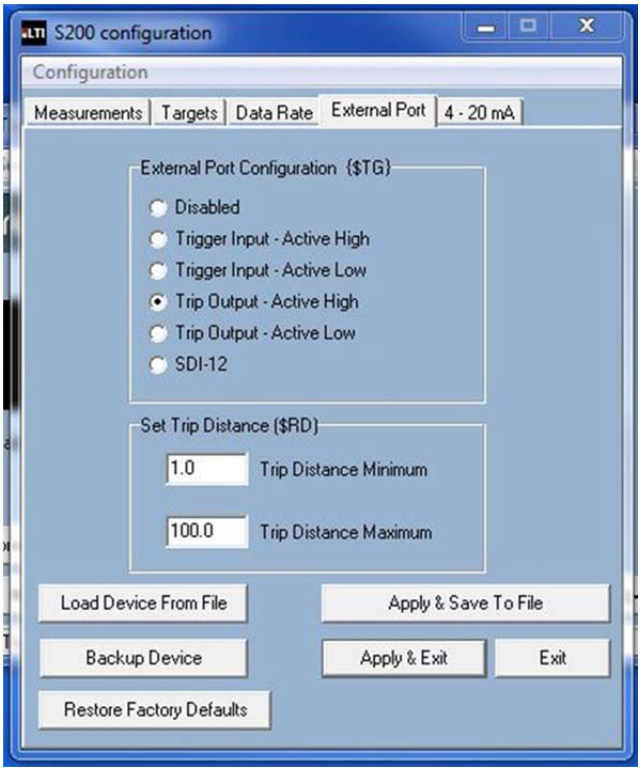
Targets Tab

- **Target Selection**: Target Discrimination Menu. User selects target based on application.
- Advanced target displays are available Serial Communication Protocol section.



Data Rate Tab

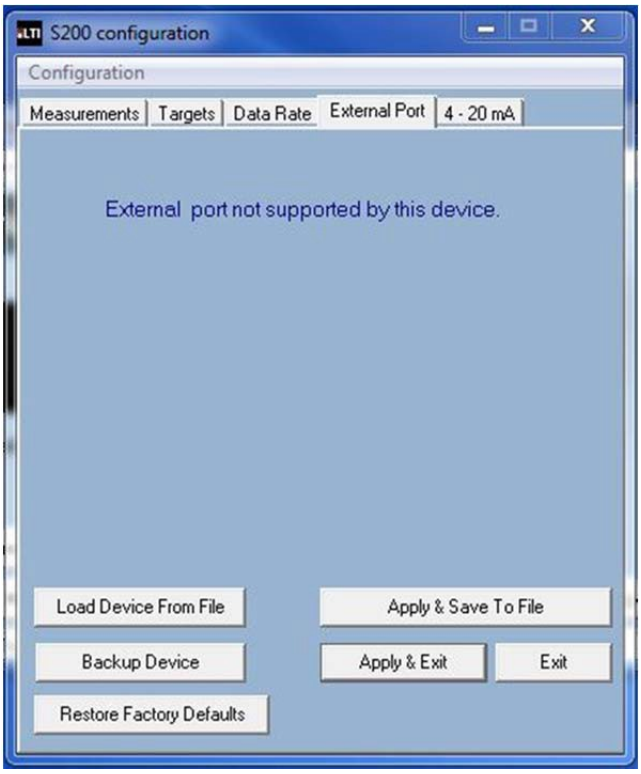
- User can select data update rate. In this example, the update rate is set to 1 Hz or 1 measurement per second.
- User would set both windows to "0" for maximum update rate of 14 Hz using these settings.
- Example #1: The user wants an update rate of 5 Hz. They would enter 1 for number of measurements and 0.2 (the inverse of 5) for delay between measurements.
- Example #2: The user wants 1 reading every 10 seconds. They would enter 1 for number of Measurements and 10 for delay between measurements.
- For the fixed 200 Hz mode see
  page 8
  page 13
  page 18



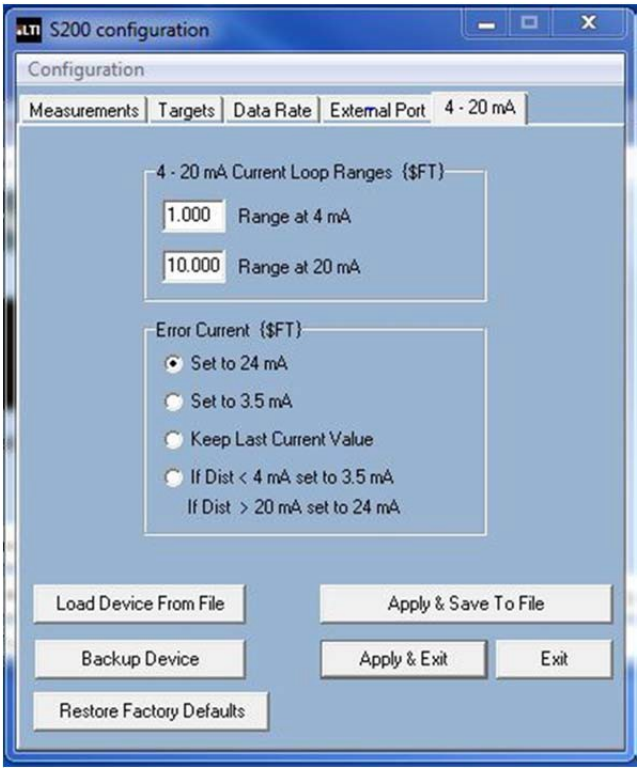
External Port Tab

- This menu appears when connected to an S210 and allows the user to select Trigger Modes and Trip Distance.

- **Trigger Input –Active Low** ($TG,2) The unit will measure continuous if the $GO command is set to 0 ($GO,0). The sensor will not respond to the Stop command ($ST). The user must then enter "$TG,0" To stop the unit.

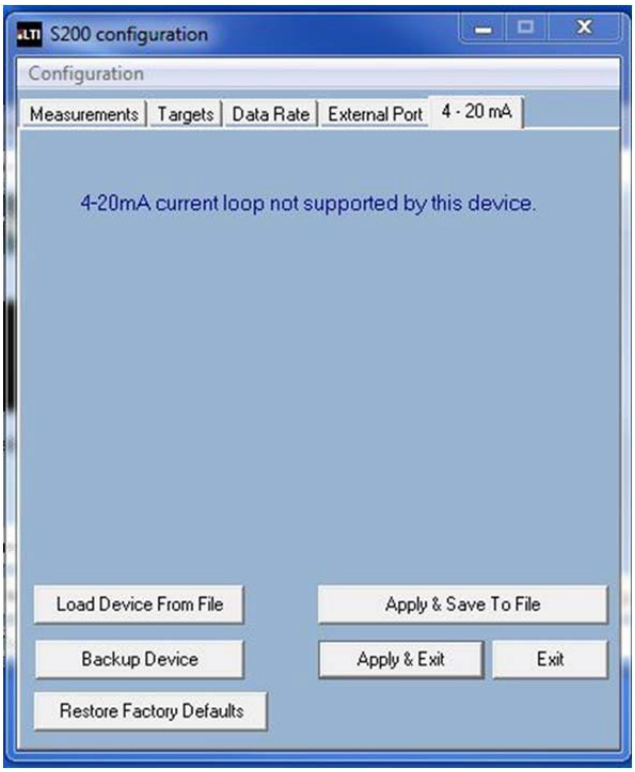


- This menu appears when connected to an S230 as this menu is inactive with this model.



4-20 mA Tab

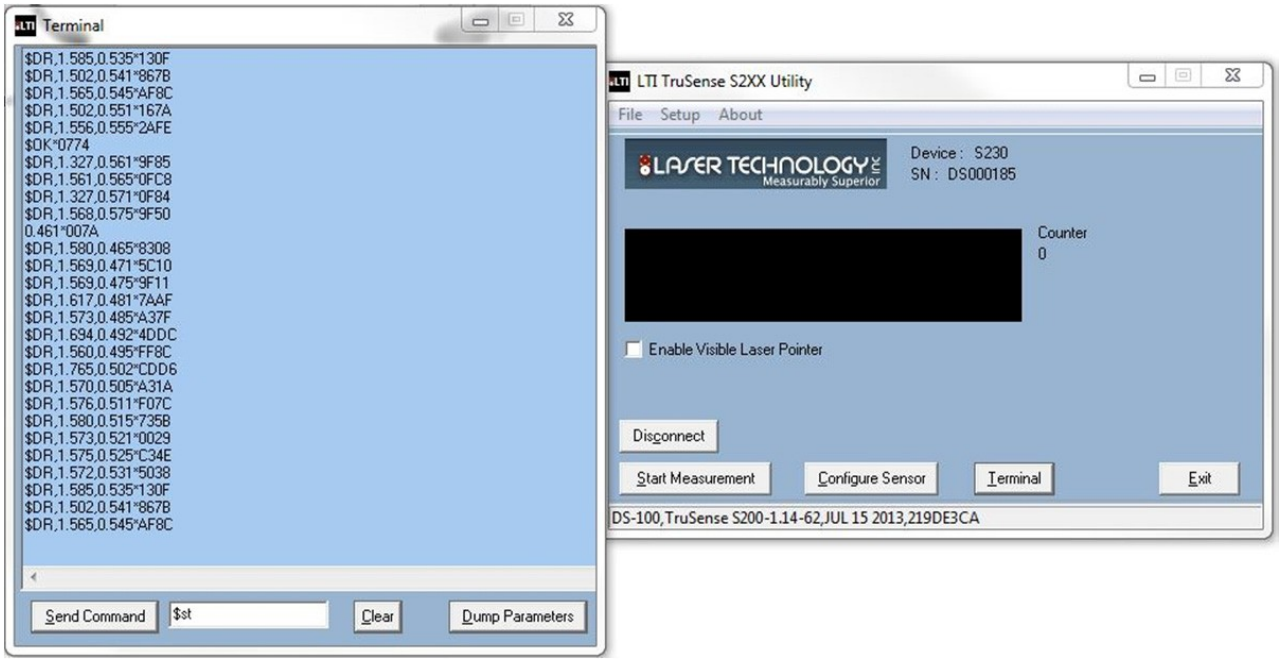
- 4-20 menu allows the user to set ranges at 4 and 20 scale.
- Error current is set here as well.
- A difference of at least 6.6 feet must be between the range of 4 mA and 20 mA.



- This menu appears when connected to an S200 or S210 as these do not support 4-20.

200 Hz Mode

- Type "MM,4" via the terminal window
- To save setting to the device, type "$SU", "$GO,0"
- This mode is not viewable in the main menu.



Serial Communication Protocol

- Each command and reply starts with a '$' sign and ends with <CR><LF>.
- Default communication parameters: baud rate 115200, no parity, 8 data bits, 1 stop bit, no flow control.
- Issuing a mnemonic command without an associated parameter, prompts the S200 to reply with the current setting of that parameter (examples follow).
- Upon applying power, the unit performs an initialization and onboard self test.
- Two methods for initiating a measurement:
  - Serial command request.
  - Hardware control via the Ext-Trig control signal.
- The time for an individual measurement will vary depending on the target mode, target reflectance and distance. Targets that are closer and more reflective will return a measurement quicker than targets that are farther away and less reflective.

Serial Commands

Note: For software development, please contact LTI for the complete command listing.

$AU Display Board AUX Board Status

Get: **$AU<CR><LF>**
Instrument Reply: $AU,<*aux board configuration*>,<*working aux configuration*>,<*factory setting*>
*CRC16**<CR><LF>**

The S200 gives actual aux board configuration as well as working configuration. Normally, actual configuration is same as working one, but some function is disabled if there is conflict. If Actual configuration set a bit for wrong setting, S200 may not work correctly. All data are hexadecimal digits. See below bit description:

#define AUX_VISIBLE	0x01
#define AUX_4_20_MA	0x02
#define AUX_HART	0x04
#define AUX_422_485	0x08
#define SDI_12_ENABLED	0x10
#define AUX_CODE_ERROR	0x80

$BA RS232 Baud Rate

Sets the serial communications data rate. The reply message to this command is sent at the previous baud rate.

Default value = 115200 baud.

Set: **$BA,***n***<CR><LF>** Instrument Reply: **$BA,***n**CRC16**<CR><LF>**
Get: **$BA<CR><LF>** Instrument Reply: **$BA,***n**CRC16**<CR><LF>**

where:
- **$** = message identifier
- **BA** = mnemonic for RS232 Baud Rate
- *n* = baud rate:
  - 9600
  - 19200
  - 38400
  - 57600
  - 115200
  - 230400
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

$CL Convert Error Code to Error Message

Get: **$CL,**n**<CR><LF>**
Instrument Reply: **$ER,***n,message**CRC16**<CR><LF>**

where:
- **$** = message identifier
- **CL** = mnemonic for Convert Error Code to Error Message
- *n* = the error code
- *message* = the error message
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

Example:
Input: $CL,52<CR><LF>
Reply: $ER,52,TOO COLD*53B4<CR><LF>

$CO Display $GO Command Parameters

Get: **$CO<CR><LF>**
Instrument Reply: **$CO,**<mode>,<number of iteration>,<update period>*CRC16**<CR><LF>**

where:
- **$** = message identifier
- **CO** = mnemonic for Display $GO Command Parameters
  - mode
  - number of iteration
  - update period
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

This command is same as $GO (page 15), but it does not initiate measurements.

$DB Display Banner

When the Banner is enabled, as long as no errors are encountered, a message similar to the example below is displayed when the unit is powered ON:

"TruSense S200-1.14 PRF [1000/2800] [CP-WP-U-U]
<c> 2012 Laser Technology Inc. All rights reserved."
$READY

If the Banner is disabled and an error is encountered when the unit is powered ON, the appropriate error code will be displayed.

Set: **$DB,***n***<CR><LF>** Instrument Reply: **$DB,***n**CRC16**<CR><LF>**
Get: **$DB<CR><LF>** Instrument Reply: **$DB,***n**CRC16**<CR><LF>**

where:
- **$** = message identifier
- **DB** = mnemonic for Display Banner
- *n* = display banner status
  - 0 = Banner is disabled
  - 1 = Banner is enabled
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

Example: $DB,0<CR><LF> Disables the Banner

$DE Error Code Format

Set: **$DE,***n***<CR><LF>** Instrument Reply: **$DE,***n**CRC16**<CR><LF>**
Get: **$DE<CR><LF>** Instrument Reply: **$DE,***n**CRC16**<CR><LF>**

where:
- **$** = message identifier
- **DE** = mnemonic for Display Error Code
- *n* = display Error Code status
  - 0 = Display Error Code Only
  - 4 = Display Error Code with Mnemonic
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

Example: $DE,0<CR><LF> Sets to display error code only.

$DM Target Mode

- **First:**
  The unit takes a single measurement, transmits the output results and stops. The measurement output represents the distance to the first target the unit sees that is above the minimum detection level.

- **Strongest:**
  The unit takes a single measurement, transmits the output results and stops. The measurement output represents the distance to the strongest target the unit sees that is above the minimum detection level.

- **Last:**
  Multiple target operating mode. Allows the unit to detect multiple target reflections along the measurement sight line and output the distance to the farthest target it sees. The unit continues to gather target data along the sight line, allowing weaker distant targets to eventually be detected beyond stronger, close-in targets. Example: measuring a distant building while shooting through close-in brush.

- **Advanced Target Displays**
  - **First, Second, Third**:
    Multiple target operating mode. Allows the unit to detect multiple target reflections along the measurement sight line and output the distance to the first three targets it sees.

  - **Last Two (Farthest, Second to Farthest):**
    Multiple target operating mode. Allows the unit to detect multiple target reflections along the measurement sight line and output the distance to the last two targets it sees.

  - **First, Strongest, Last:**
    Multiple target operating mode. Allows the unit to detect multiple target reflections along the measurement sight line and output the distance to the first, strongest, and last targets it sees.

  - **First, Second, Third, Strongest, Last**:
    Multiple target operating mode. Allows the unit to detect multiple target reflections along the measurement sight line and output the distance to the first, second, third, strongest and last target it sees.

See Page 13 for information about Measurement Output Format.

Set: **$DM,***dm***<CR><LF>** Instrument Reply: **$DM,***dm**CRC16**<CR><LF>**
Get: **$DM<CR><LF>** Instrument Reply: **$DM,***dm**CRC16**<CR><LF>**
where: **$** = message identifier
DM = mnemonic for Display Mode
dm = target mode
2 = First Target
3 = Strongest Target
4 = Last Target
5 = First, Second, Third Targets
6 = Last 2 (Farthest and Second to Farthest) Targets
7 = First, Strongest, Last Targets
8 = First, Second, Third, Strongest, Last Targets
*CRC16 = 16-bit CRC
<CR> = carriage return
<LF> = line feed

Example: $DM,3<CR><LF> Sets Target Mode to Strongest Target.

Measurement Output Messages

- First Target

  $DM,F,distance,distance units,error code,signal strength,time since power on*CRC16**<CR><LF>**

  Example: $DM,F,2.91,M,0,4-544,37.365*813B

- Strongest Target

  $DM,S,distance,distance units,error code,signal strength,time since power on*CRC16**<CR><LF>**

  Example: $DM,S,2.91,M,0,4-529,140.454*03B7

- Last Target

  $DM,L,distance,distance units,error code,signal strength,time since power on*CRC16**<CR><LF>**

  Example: $DM,L,2.50,M,0,4-601,586.889*7327

- First, Second, Third Targets

  $DM,F3,distance 1,distance 2,distance3,distance units,error code,signal strength, time since power on*CRC16**<CR><LF>**

  Note: If there are less than 3 targets, distance will be replaced with a dash.

  Example: $DM,F3,2.08,-,-,M,0,759.786*7018

- Last 2 (Farthest and Second to Farthest) Targets

  $DM,L2,distance last,distance 2nd last,distance units,error code,signal strength, time since power on*CRC16**<CR><LF>**

  Note: If there are less than 2 targets, distance will be replaced with an underscore.

  Example: $DM,L2,2.88,-,M,0,802.176*CDBE

- First, Strongest, Last Targets

  $**DM,A,**distance first,distance strrongest,distance last,distance units,error code,signal strength, time since power on*CRC16**<CR><LF>**

  Example: $DM,A,3.08,3.08,3.08,M,0,853.851*B056

- First, Second, Third, Strongest, and Last Targets

  $DM,B,distance first,distance 2nd, distance third,distance strongest,distance last,distance units, error code,signal strength,time since power on*CRC16**<CR><LF>**

  Note: If there are less than 3 targets, distance will be replaced with a dash.

  Example:$ DM,B,2.99,-,-,2.99,2.99,M,0,901.044*6BEE

- 200 Hz Mode

  $DR,distance,time since power on,*CRC16**<CR><LF>**

  Example: $DR,1.565,0.545*AF8C

$DT Time Since Power ON

Set: **$DT,***n***<CR><LF>** Instrument Reply: **$DT,***n**CRC16**<CR><LF>**
Get: **$DT<CR><LF>** Instrument Reply: **$DT,***n**CRC16**<CR><LF>**

where:
- **$** = message identifier
- **DT** = mnemonic for Display Time Since Power ON
- *n* = Display Time Since Power ON = number of sec since power ON.
  - 0 = Display Time Since Power ON is disabled (Not part of measurement output)
  - 2 = Display Time Since Power ON is enabled (Part of measurement output)
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

Example: $DT,2<CR><LF> Enables Display Time Since Power ON
$DT,2*35C8

$FD Reset Factory Default

Display Banner = on, Time Since Power On = included, Error Code only, set user password to "admin" if user password function has not been removed, external trigger = disabled.

Set: **$FD<CR><LR>** Instrument Reply: $OK*CRC16

where:
- **$** = message identifier
- **FD** = mnemonic for Reset Factory Default
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

4-20 Current Loop Setting

Set: **$FT,***<value for 4mA>,<value for 20mA>,<update period>, <error handling>,*
*<number of measurement>***<CR><LF>**

Value for 4mA denotes distance limit for 4mA. Value for 20mA denotes distance limit for 20mA. It does not require that 4mA value should be less than 20mA value. If 4mA value is greater than 20mA value, S200 works like a 20-4mA mode. If it is required to measure periodically, use <update period> whose unit is in seconds.

<Error handling> can be 0,1,239 or 240.

0: distance is out of 4-20mA limits, set current loop as 24mA
1: distance is out of 4-20mA limits, set current loop as 3.5mA
239: distance is out of 4-20mA, keep the previous value
240: distance is out of 4mA, set 3.5mA. If it is out of 20mA, set 24mA

<Number of measurement> is only valid if S200 is configured as periodic sampling.
Once S200 wakes up, it takes <number of measurement>.

NOTE: There will 4 numbers in brackets that are on the end of the string. These numbers are all the same and match the $DM setting or target mode. Users can ignore these numbers.

0: First target
1: Second target
2: Third target
3: Strong target
4: Last target
5: Temperature on board

$GO Start Distance Measurement

This command will make the unit respond the same as if the Ext-Trig control signal is activated and held active.

Set: **$GO**,*n*,*m***<CR><LF>** Instrument Reply: **$OK***CRC16**<CR><LF>**
Measurement Output Messages (Page 13)

where:

$	= message identifier
GO	= mnemonic for Start Distance Measurement
n	= number of measurements 0 = continuous (must issue $ST command to stop) 1 = one measurement 2 = two measurements, etc
m	= update period
*CRC16	= 16-bit CRC
<CR>	= carriage return
<LF>	= line feed

GO command can set the number of measurements. For example, if it is needed to run just once, use "$GO,1". If it is needed to run continuously, use "$GO,0". If it is needed to run 8 times, use "$GO,8". If <number of measurements> is omitted, it executes same as the previous run. To extend laser diode life time, the S200 can measure periodically. For example, if 10 measurements are required every 20 seconds, enter "$GO,10,20".

To set for a measurement every second (1Hz), enter "$go,1,1" and a measurement of 3 Hz enter $GO,1,0.3 where n=1 and m=0.3 (the inverse of the desired update rate).

NOTE: <update period> is stored in volatile memory. To save in non-volatile memory, save with $SU or $PD command.

$HV High Voltage Status

Get: $HV<CR><LF>

Instrument Reply: $HV,**TX**,*n*,*m*,**RX**,*n*,*m*,*f*,*d**CRC16**<CR><LF>**

where:

$	= message identifier
HV	= mnemonic for High Voltage
TX	= Transmit
n	= error
m	= max error
RX	= Receive
n	= error
m	= max error
f	= PWM frequency
d	= PWM duty
*CRC16	= 16-bit CRC
<CR>	= carriage return
<LF>	= line feed

Example Reply: $HV,TX,0,0,RX,0,0,55000Hz,75%*99D3

In this example, the unit is running 55 KHz PWM frequency with 75% duty cycle for APD bias high voltage logic. There are no errors.

$ID Instrument Identification

Get: **$ID<CR><LF>**

Instrument Reply: **$ID,DS-200 TruSenseS200**-*version-build number,firmware date*, **4E62F63C*A8CD<CR><LF>**

where:

$	= message identifier
ID	= mnemonic for firmware version information
DS-200	= product model
TruSenseS200	= product model
-version	= firmware version
firmware date	= firmware date
4E62F63C	= firmware checksum
***A8CD**	= command string checksum
<CR>	= carriage return
<LF>	= line feed

Example Reply: $ID,DS-200,TruSense S200-1.14.53, FEB 12 2013,4E62F63C*A8CD

$IS Instrument Status

Get: **$IS<CR><LF>**

Instrument Reply: **$IS**,*run flag,system error status,password status**CRC16<CR><LF>

where:

- **$** = message identifier
- **IS** = mnemonic for Instrument Status
- *run flag* = laser status
  - 0 = laser is not firing
  - 1 = laser is firing
- *system error status* = system status
  - 0= normal operation
  - Error code.
- *password status* = password status
  - 0 = Password is enabled:
    - User Commands that require password are prohibited and will result in an error.
  - 1 or 2 = Password is disabled:
    - All user commands are allowed.
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

Example Reply: $IS,0,0,0*BCF4<CR><LF>

$LS Long Range Scan Mode

Set: **$LS,***ls***<CR><LF>** Instrument Reply: **$LS,***ls**CRC16**<CR><LF>**

Get: **$LS<CR><LF>** Instrument Reply: **$LS,***ls**CRC16**<CR><LF>**

where:

- **$** = message identifier
- **LS** = mnemonic for Long Range Scan Mode
- *ls* = long range scan mode:
  - 0 = Do not report weaker targets.
  - 1 = Report weaker targets only if no strong target.
  - 2 = Always report weaker targets.
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

Example: $LS,2<CR><LF> Sets Long Range Scan Mode to Always report weaker targets.

$MA Manual Start

This command determines the status of the laser after the unit is powered ON and initialized.

Set: **$MA,***ma***<CR><LF>** Instrument Reply: **$MA,***ma**CRC16**<CR><LF>**
Get: **$MA<CR><LF>** Instrument Reply: **$MA,***ma**CRC16**<CR><LF>**
where: **$** = message identifier
MA = mnemonic for Manual Start
ma = Manual Start status
0 = Manual Start is active:
Enter $GO command to fire laser (Page 15).
2 = Automatic Start is active:
Laser starts to fire immediately after power ON and initialization.
*CRC16 = 16-bit CRC
<CR> = carriage return
<LF> = line feed

Example: $MA,2<CR><LF> Sets Automatic Start Mode to active.

$MM Measurement Mode

Note: Distances listed below are reflective / non-reflective.

- Standard Range: 2,461 / 2,461 ft 750 / 750 m high-accuracy mode
- Extended Range: 4,921 / 2,953 ft 1,500 / 900 m medium-accuracy mode
- Intelligent Long ange: 9,514 / 5,249 ft 2,900 / 1,600 m low-accuracy mode

Set: **$MM,***mm***<CR><LF>** Instrument Reply: **$MM,***mm**CRC16**<CR><LF>**
Get: **$MM<CR><LF>** Instrument Reply: **$MM,***mm**CRC16**<CR><LF>**
where: **$** = message identifier
MM = mnemonic for Measurement Mode
mm = measurement mode
0 = Standard Range
1 = Extended Range
2 = Intelligent Long Range
*CRC16 4 = 200 Hz mode
<CR> = carriage return
<LF> = line feed

Example: $MM,1<CR><LF> Sets Measurement Mode to Extended Range.

$MU Measurement Units

Set: **$MU,***u***<CR><LF>** Instrument Reply: **$MU,***u**CRC16**<CR><LF>**
Get: **$MU<CR><LF>** Instrument Reply: **$MU,***u**CRC16**<CR><LF>**
where: **$** = message identifier
MU = mnemonic for Measurement Units
u = measurement units
0 or m = meters
1 or f = feet
2 or n = nautical miles (knots)
*CRC16 = 16-bit CRC
<CR> = carriage return
<LF> = line feed

Example: $MU,0<CR><LF> Sets measurement units to meters.

$OZ Instrument Temperature

Get: **$OZ<CR><LF>**
Instrument Reply: **$OZ,***n**CRC16**<CR><LF>**

where:
- **$** = message identifier
- **OZ** = mnemonic for Instrument Temperature
- *n* = the instrument temperature (degrees Celsius)
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

Example Reply: $OZ,31.8*0161<CR><LF> The temperature on the board is 31.8° Celsius.

$PD Power Down and Restart Unit with New Baud Rate

Send this command after changing the communication baud rate. The instrument will power down and restart using the new baud rate.

Set: **$PD<CR><LR>**

where:
- **$** = message identifier
- **PD** = mnemonic for Power Down and Restart
- **<CR>** = carriage return
- **<LF>** = line feed

$PE Set Update Period

To extend laser diode life time, the S200 can measure periodically. For example, if 10 measurements are required every 20 seconds, set update period as 20.

Set: **$PE,***n***<CR><LF>** Instrument Reply: **$OK***CRC16**<CR><LF>**

Get: **$PE<CR><LF>** Instrument Reply: **$PE,***n**CRC16**<CR><LF>**

where:
- **$** = message identifier
- **PE** = mnemonic for Set Update Period
- *n* = update period (Number of seconds. Accepts decimal point.)
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

NOTE: The Update Period is stored volatile memory. Use $SV or $PD to store the Update Period into non-volatile memory.

$RD Set Trip Distance

S200 will assert trip output when distance is greater than min value and less than max value.

Set: **$RD,***x,y***<CR><LF>** Instrument Reply: **$OK***CRC16**<CR><LF>**

Get: **$RD<CR><LF>** Instrument Reply: **$RD,***x,y**CRC16**<CR><LF>**

where:
- **$** = message identifier
- **RD** = mnemonic for Trip Distance
- *x* = minimum value
- *y* = maximum value
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

$SN Instrument Serial Number

Get: **$SN<CR><LF>**
Instrument Reply: **$SN, DS**nnnnnn*CRC16**<CR><LF>**

where:
- **$** = message identifier
- **SN** = mnemonic for Serial Number
- **DS**nnnnnn = instrument serial number
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

Example Reply: $SN,DS000001*4C58<CR><LF>

$ST Stop Distance Measurement

This command is only effective if the 'GO' command has been previously sent to the unit, and the unit is measuring. This command will make the unit respond the same as if the Ext-Trig control signal is deactivated.

Set: **$ST<CR><LF>** Instrument Reply: **$OK***CRC16**<CR><LF>**

where:
- **$** = message identifier
- **ST** = mnemonic for Stop Distance Measurement
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

$SU Save User Settings

This command is used to save settings such as measurement mode, target mode, or new password to flash memory. When the power is cycled, the new settings are retained in non-volatile memory.

If user settings are changed and this command is not issued, the new settings will be active until the unit is powered down. In this case, the next time the unit is powered ON, the previous settings will be active.

Set: **$SU<CR><LF>** Instrument Reply: **$OK***CRC16**<CR><LF>**

where:
- **$** = message identifier
- **SU** = mnemonic for Save User Settings
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

$TG Remote Trigger

IMPORTANT: There is additional current draw if the external trigger input voltage is higher than 5.6 VDC. To minimize power consumption, add a serial resistor (10K to 20K is recommended). Without this resistor, the S200 will draw and additional 60 mW at 12VDC. If using 24 VDC, this resistor is required.

IMPORTANT: If the user selects "Trigger Input-Active Low" ($TG,2) the unit will measure continuously if the $go command is set to 0 ($go,0). The sensor will not respond to the stop command ($ST). The user must then enter
$TG,0 to stop the unit.

Set: **$TG,*tg*<CR><LF>** Instrument Reply: **$TG,*tg***CRC16**<CR><LF>**
Get: **$TG<CR><LF>** Instrument Reply: **$TG,*tg***CRC16**<CR><LF>**

where:
- **$** = message identifier
- **TG** = mnemonic for Remote Trigger
- *tg* = Manual Start status
  - 0 = External port disabled.
  - 1 = Trigger input (+5V or 0V) - active high
  - 2 = Trigger input (+5V or 0V) - active low
  - 3 = Trip output (+5V with 1K serial resister) - active high
  - 4 = Trip output (+5V with 1K serial resister) - active low
  - 5 = SDI-12 configuration
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

$UO User Offset

Note: The limits of the offset are -32 or +32 feet or meters. Units are set using the $mu command.

Set: **$UO,*n*<CR><LF>** Instrument Reply: **$OK***CRC16**<CR><LF>**
Get: **$UO<CR><LF>** Instrument Reply: **$UO,*n***CRC16**<CR><LF>**

where:
- **$** = message identifier
- **UO** = mnemonic for User Offset
- *n* = User Offset. Either positive or negative from the faceplate.
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

Example: $UO,2.5<CR><LF> Sets User Offset to 2.5 ft, m or knots. (Depending on the $MU setting.)

$VO Turn Laser Pointer On (S210 and S230 Only)

Get: **$VO<CR><LF>**

where:
- **$** = message identifier
- **VO** = mnemonic for Turn Laser Pointer On
- **<CR>** = carriage return
- **<LF>** = line feed

$VF Turn Laser Pointer Off (S210 and S230 Only)

Get: **$VF<CR><LF>**

where:

$	= message identifier
VF	= mnemonic for Turn Laser Pointer Off
*CRC16	= 16-bit CRC
<CR>	= carriage return
<LF>	= line feed

$WU Warm Up Period

The Warm Up Period is the number of measurements which will be discarded before the first measurement is displayed.

Set: **$WU,*n*<CR><LF>** Instrument Reply: **$WU,*n**CRC16<CR><LF>**

Get: **$WU<CR><LF>** Instrument Reply: **$WU,*n**CRC16<CR><LF>**

where:

$	= message identifier
WU	= mnemonic for Warm Up Period
n	= Number of measurements discarded before the first measurement displayed.
0	= Warm Up Period is disabled.
non-zero	= Warm Up Period is enabled. Valid Range: 1 to 99.
*CRC16	= 16-bit CRC
<CR>	= carriage return
<LF>	= line feed

Example: $WU,0<CR><LF> Disables the Warm Up Period.

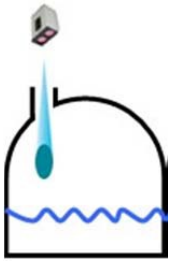
Reference

Application Examples

These examples are not absolute - sensor setup configuration varies depending on ambient conditions, target integrity, distance, constraints, and user requirements.

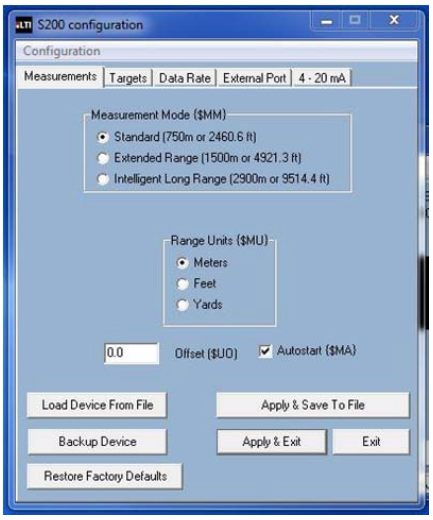
Tank and Silo Measurement

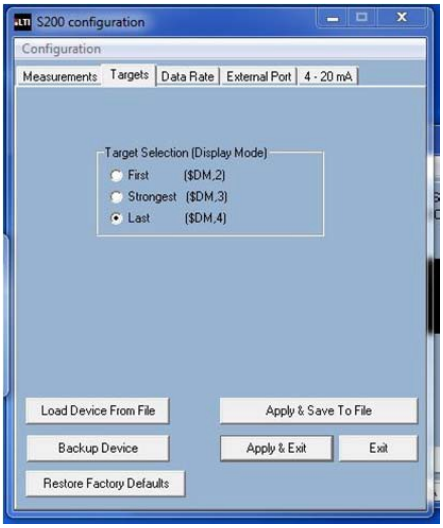
Consideration: Measure the material depth in the tank or silo past any ambient conditions such as dust.

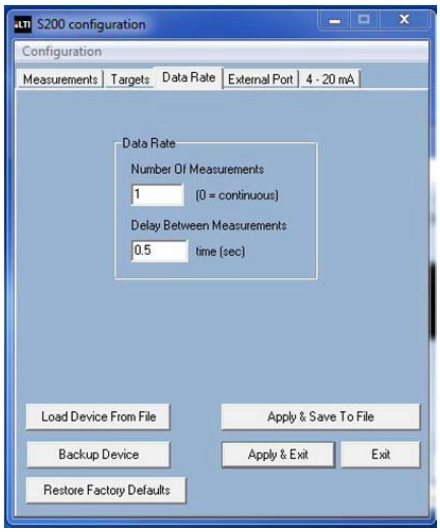


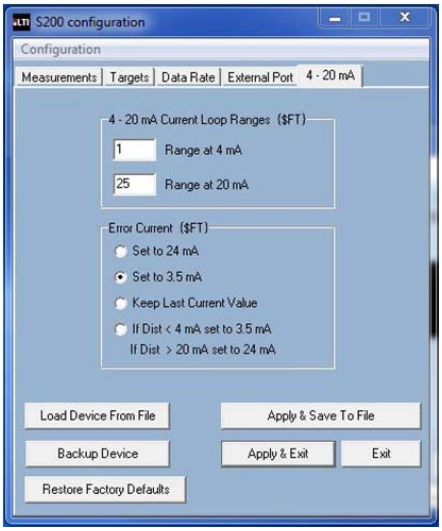
Summary:

- In this example, the maximum distance to the bottom of the tank is 25 meters so the Standard Measurement Mode will yield the best accuracy.
- The sensor must be able to penetrate air-born dust inside of the silo. Choose Last Target for this.
- We want a measurement speed of 2Hz.
- We also want the unit to begin measuring upon power up - enable Autostart.
- If the measured distance exceeds our maximum or minimum, 3.5mA will be output.







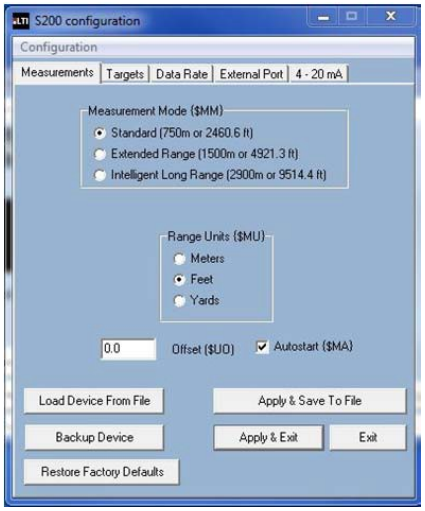


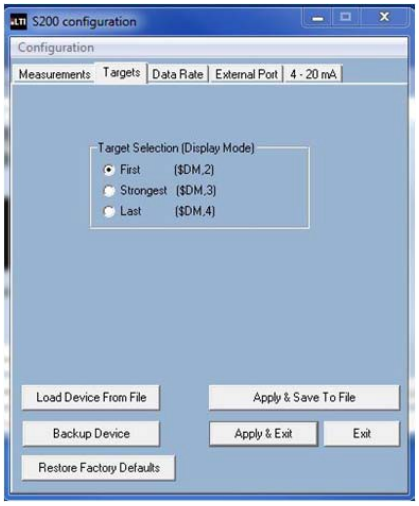
Industrial Plant Management

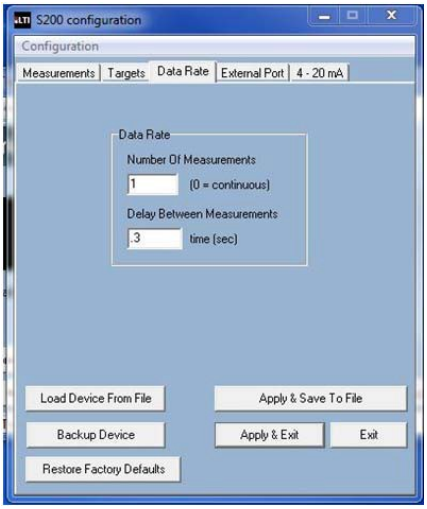
Consideration: Measure container height in clean environment.

Summary:

- In this example, the distance from the faceplate of the sensor to the target is 50 meters so the Standard Measurement Mode will yield the best accuracy.
- Our measuring environment is very clean with minimal air-born particulates so we simply want to measure to the first target that the sensor sees. Our update rate should be 3Hz.
- We also want the unit to start measuring automatically on power up.
- Serial output.





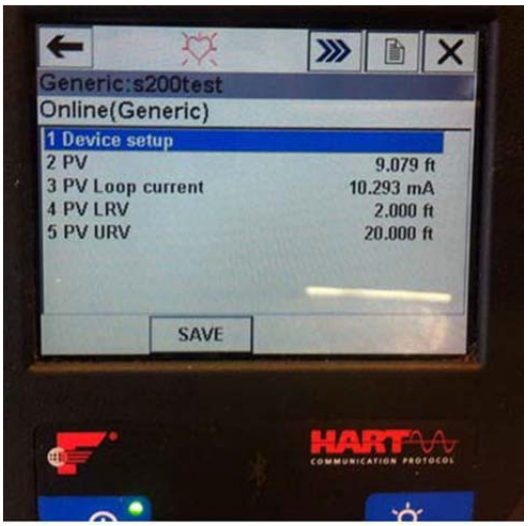


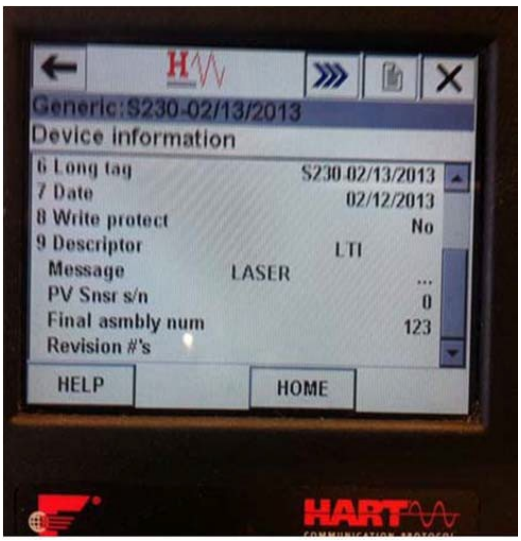
HART Communication

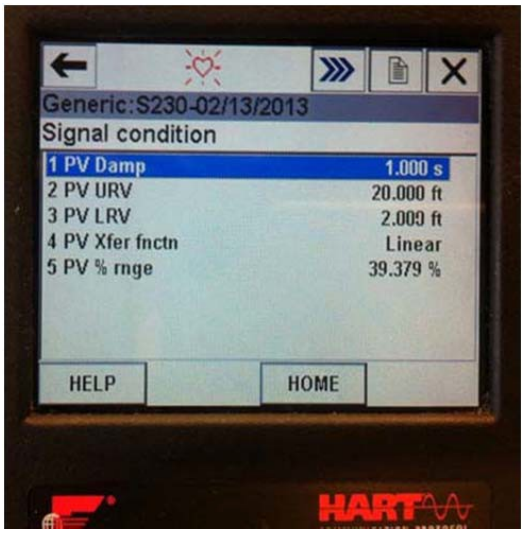
Your HART compatible model allows the user communication with a HART compatible device as a Generic Device. Shown are typical screen shots using a 475 handheld controller.

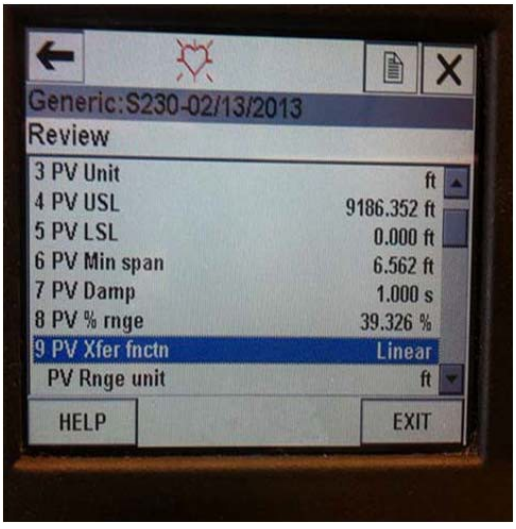
Read/Write	
PV LRV	Primary Value Lower Range Value
PV URV	Primary Value Upper Range Value
Descriptor	Description Field
Final Assembly Number	Description Field
TAG, Long TAG, Message	Description Fields
Read Only or No Write Ability	
Burst	maximized the data rate
4-20 Current	Reading
Range	Reading
Percent of Range	Reading
Units	Measurement Units*

*NOTE: No notes at this time.









SDI-12 Communication

a = sensor address
b = address change
n = setting

a!	acknowledge active
aI!	send ID
aAb!	change address
?!	address query
aM!	start measurement
aR0!	read first measurement
aR1!	read second measurement
aR2!	read third measurement
aR3!	read strongest measurement
aR4!	read last measurement
aR5!	read PCB temp
aXCn!	auto start
aXWn!	warm up time
aXMn!	number of measurements
aXS!	save
aXR!	reset
aXV!	laser pointer on/off

In the example below, the first line is the entry "?!0" where a=0 and the response is shown on the second line.

```
SDI12>?!0
SDI12>0I!013LASERTECHS200
```

Frequently Asked Questions

What measurement technique is used with the S200?

The S200 uses infrared laser light to measure distance. This invisible light is emitted from the transmit lens of the sensor, reflects off of the target and returns to the receive lens of the senor. The exact distance is then calculated by comparing the return time to the speed-of-light constant.

Can the sensor measure to my target?

The ability of a laser sensor to measure to a target depends on the target's reflectance and any interference between the sensor and target such as dust, fog, foliage or other. Reflectance is determined by color, opacity, distance, and the reflection angle as well as the density of any ambient interference between the sensor and the target. For example, a lighter target is more reflective than a darker one and thick dust will reduce the signal strength more than light dust.

The S200 is a highly-sensitive precision sensor and can measure to most targets within its range specification. This includes penetrating dust or fog using the Last target mode for instance. A good rule of thumb when measuring through fog or dust is if you can visually see the target, the sensor likely can as well.

What is the beam diameter?

Beam Diameter at the Target = Free Aperture + (Divergence x Range)

Example:	Distance to the Target	= 100 m
	Divergence	= 3 mrad
	Free Aperture	= 23 mm
	Beam Diameter at the Target	= 0.023 + (0.003 x 100) = 323 mm

Therefore, beam diameter is 32.3 cm at 100 m or 12.7 inches at 328 feet.

Which side is the Transmit lens?

Left side referencing the frontal view as shown in the figure to the right.

The measured distance is using what reference?

Distance measurements are from the sensor front plate to the target as shown in the figure to the right.

Does the sensor need additional protection when using outdoors?

The sunshade accessory is recommended to keep direct moisture and sun rays (heat) from coming in contact with the sensor. Direct sun rays on the sensor housing can easily heat the sensor above its operating temperature.

Is the laser beam eye safe?

Yes, but it is always a good practice not to stare directly into the transmit aperture of any light transmitting device.

How do I protect the housing from damage in vulnerable location?

The Ruggedized Housing accessory is recommended.

My S200, does not have a laser pointer, how do I align it?

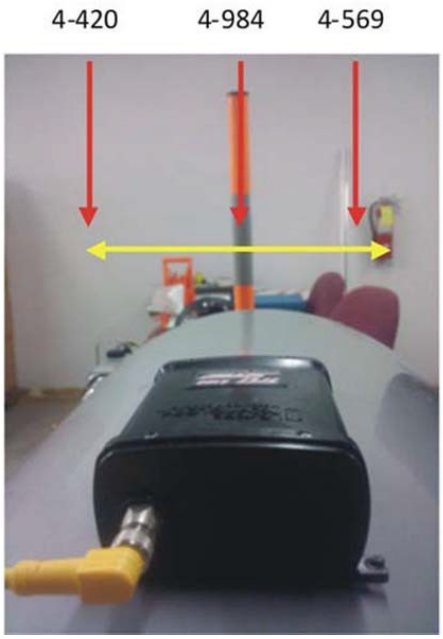
The S200 will output a signal strength reading-1-xxxx,2-xxxx,3-xxxx,4-xxxx where the increasing number indicates a stronger target.

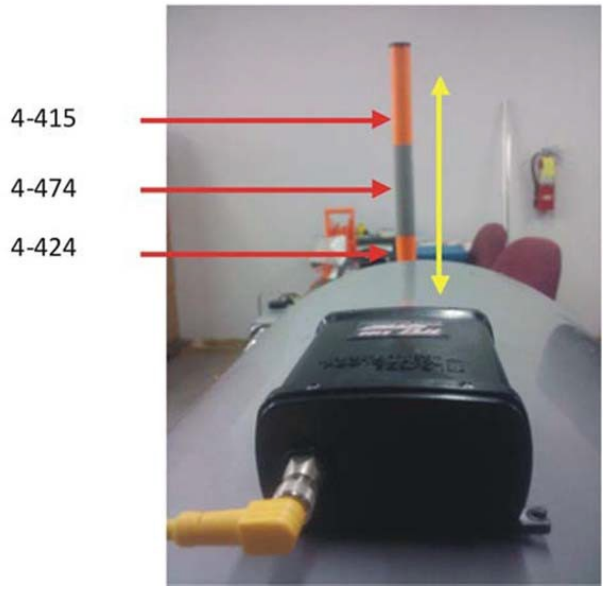
Example: To center the sensor on your desired target "sweep" the sensor in the X and Y direction in order to determine where the maximum signal return is and this ensures your target is centered. This example shows an orange pole with reflective tape wrapped around it. We will scan the sensor first in the X direction and then the Y direction. A higher intensity reading will show on the reflective surface as shown.

So in this example, we would center the beam on the reflector when our measurement is 4-984 in the X direction and 4-474 in the Y direction.

The signal strength is shown below as the highlighted characters. This number will likely be different each time but will always return a larger number from a more reflective or stronger target.

Point 1: $DM,S,2.66,M,0,**4-420***B76D





How can I adjust the sensor after mounting?

The Swivel Mount mounting bracket accessory is recommended.

How do I mount to measure into a tank or silo?

The Ruggedized Housing with Dust Tube accessory is recommended.

What considerations are there when measuring through a window?

When measuring through a window, ensure the face plate of the sensor is 3 mm or closer to the window. Reflections will increase with a larger gap and could result in measurement error. This is due to "crosstalk". Crosstalk occurs when a reflection off of a very close reflector like a window is combined with the actual target reflection and could lead to an inaccurate measurement.

Specifications

Performance:	Min. Range:	1.5 feet (46 cm)
	Max.Range:	(reflective/non-reflective):
	Low Accuracy Mode:	9,514/5,249 feet (2,900/1,600 meters)
	Medium Accuracy Mode:	4,921/2,953 feet (1,500/900 meters)
	High Accuracy Mode:	2,461/2,461 feet (750/750 meters)
	Accuracy:	
	Short Range Mode	±0.1 feet (4 cm)
	Medium Range Mode	±0.3 feet (8 cm)
	Long Range Mode	±0.5 feet (15 cm)
	Data Output Rate:	Option 1: <1 up to 14 Hz depending on target. Option 2: Fixed 200 Hz mode.
	Target Modes:	First, Strongest, Last, First Second Third, Last Second to Last, First Strongest Last, First Second Third Strongest Last
Optical & Electrical:	Wavelength:	905 nm (near IR)
	Beam Divergence:	3 mrad (equal to 1 foot beam diameter at 328 feet or 30 cm at 100 meters)
	I/O:	S-200 = TRIG,SDI-12,RS232 no alignment laser S-210 = TRIG, SDI-12, RS232 with alignment laser S-230 = 4-20 HART, RS232 with alignment laser
	Input Power:	12-24 VDC (12VDC recommended)
	Current Draw:	Measuring = 150 mA, Standby = 40 mA
Physical:	Dimensions (LxWxH)	4.11 x 3.22 x 1.64 in (104.4 x 81.7 x 41.6 mm)
	Weight:	Standard = 4.8 oz (138.6 g) OEM = 2.7 oz (76 g)
	Housing & Frame Material:	Glass-filled polycarbonate
Environmental:	Eye Safety:	Class I, 7mm (FDA CFR21) Class 1 (IEC 60825-1:2001)
	Shock Vibration:	MIL-STD-810
	Moisture:	IP54
	Operating Temperature:	-20° to 140° F (-28° to 60° C)

Care and Maintenance

Operating Temperature

The S200 is rated for a temperature range of -20° F to 140° F (-28° C to 60° C). Do not operate the instrument in temperatures outside of that range.

Moisture and Dust Protection

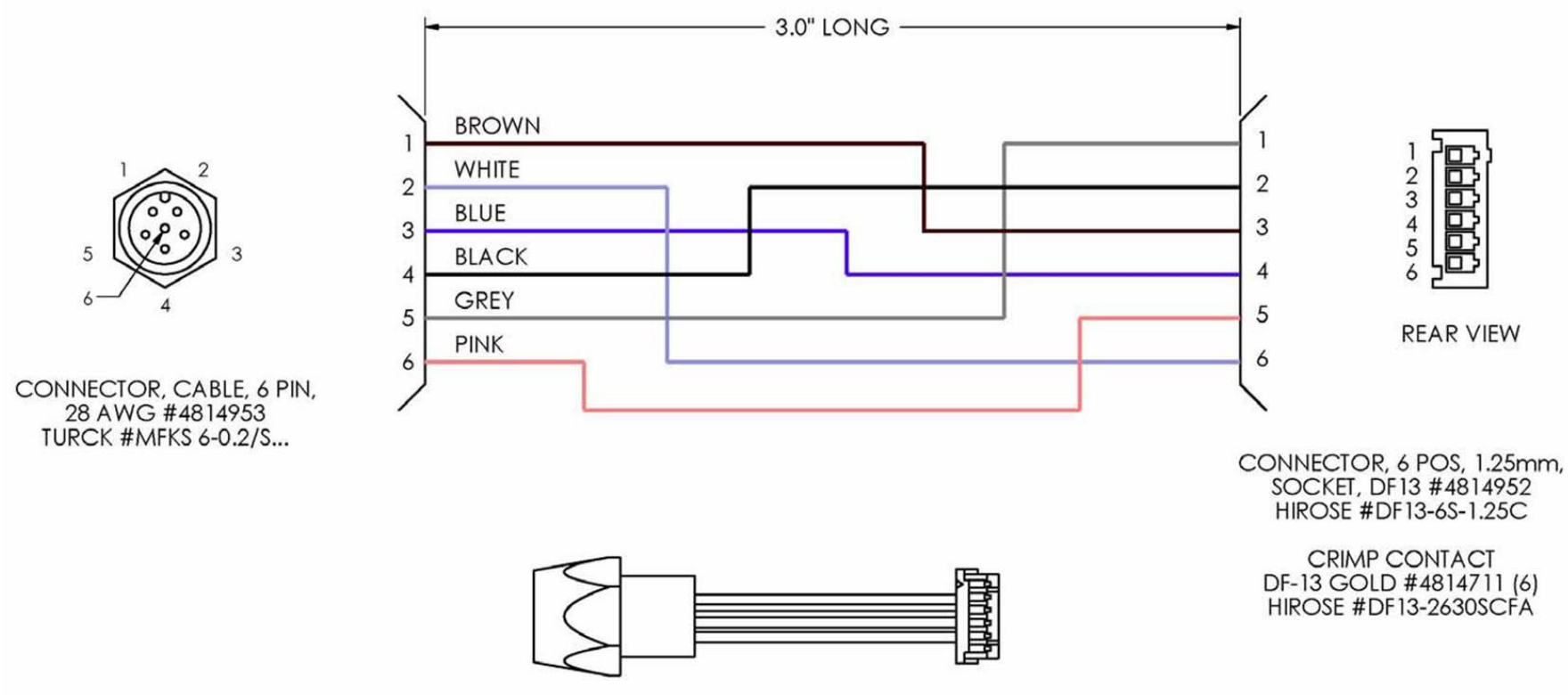
The sun shade is recommended if the sensor is exposed to the elements. The lenses of the sensor should be kept clear of excessive contamination for optimal performance.

Cleaning

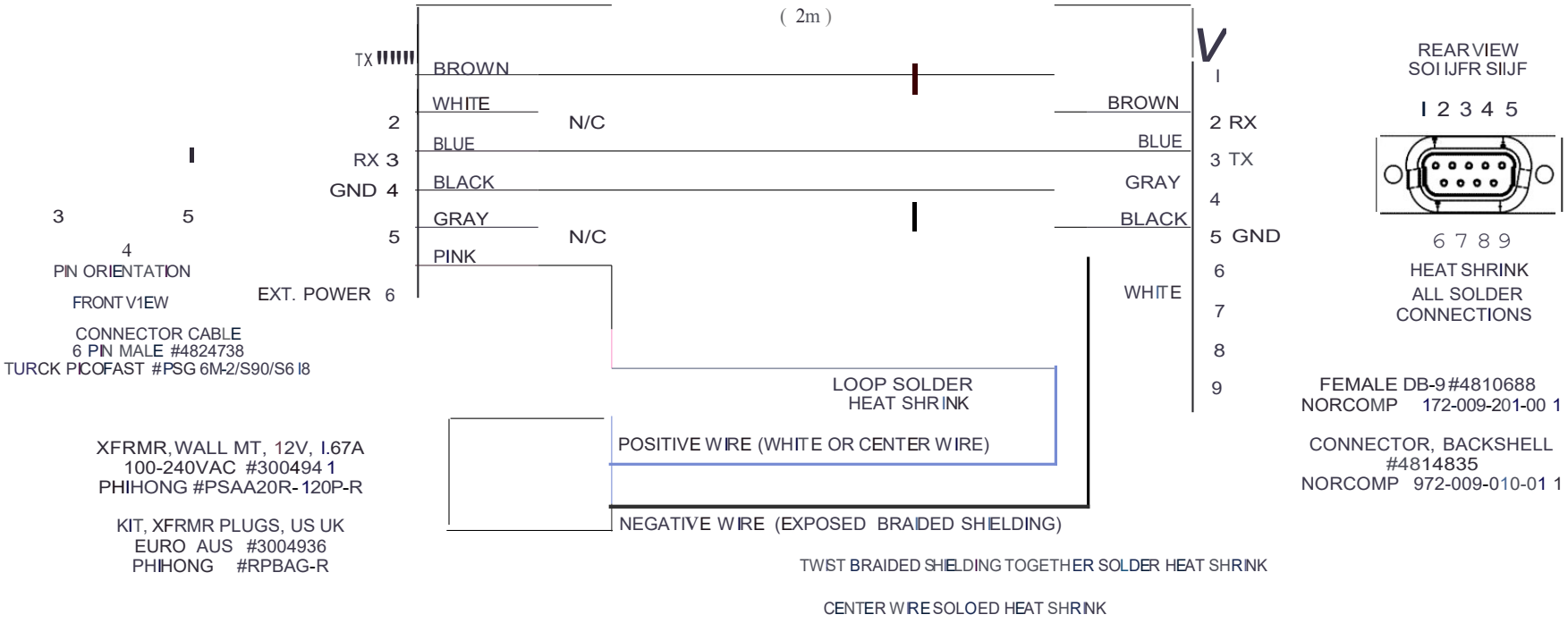
Excess Moisture:	Towel off excess moisture and air dry the instrument at room temperature.
Exterior Dirt:	Wipe exterior surfaces clean.
Dirty lenses:	Use a brush to remove surface dust and loose particles from the transmit and receive lenses. To clean a lens, moisten it with lens cleaning solution and wipe it clean with a lens cloth or lens tissue.

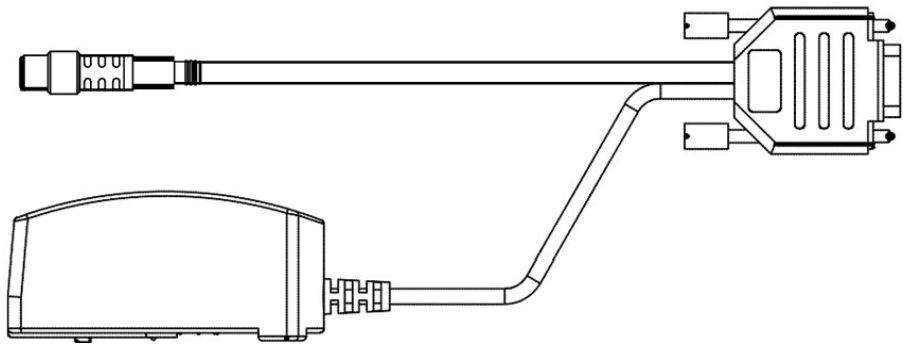
Diagrams - Wiring and Pinouts

7054664 Internal Cable; Cable Rear Plate

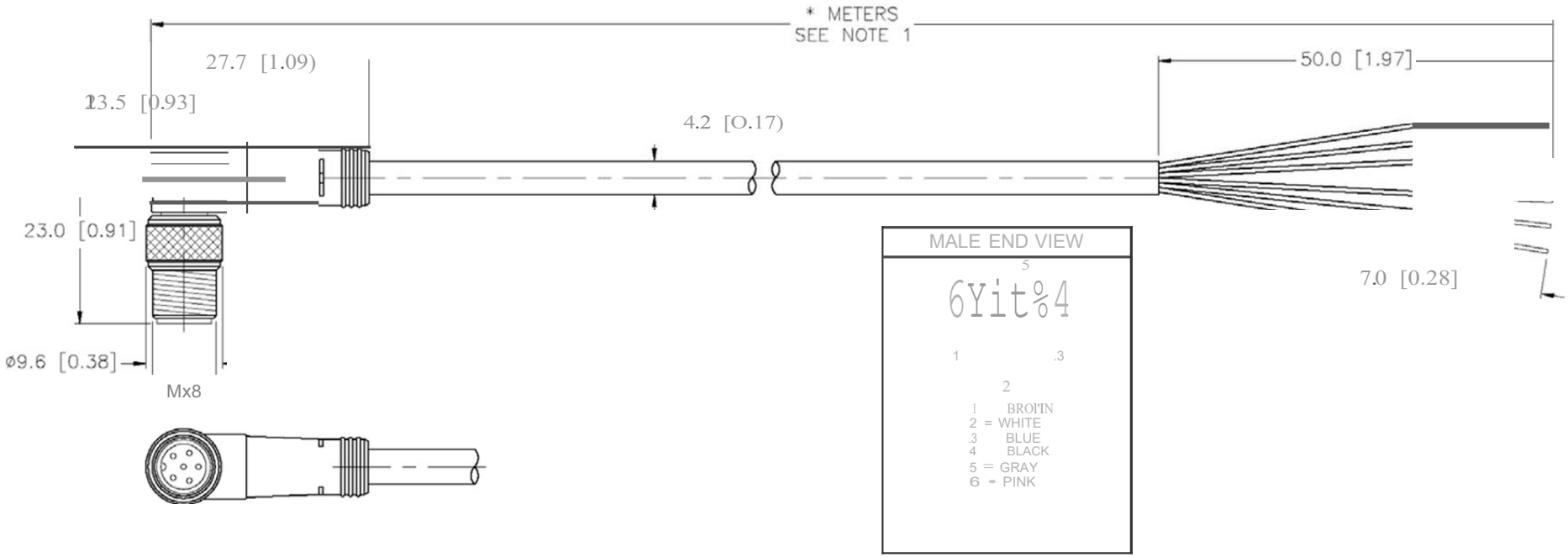


7054671 External Cable: 12 V Power Download Cable



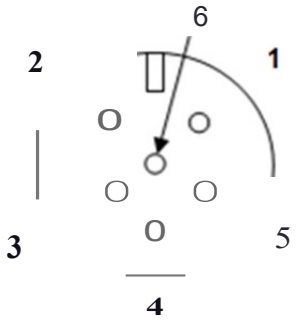


4824758 Cable PSG 6M-2 590 5618 Turck



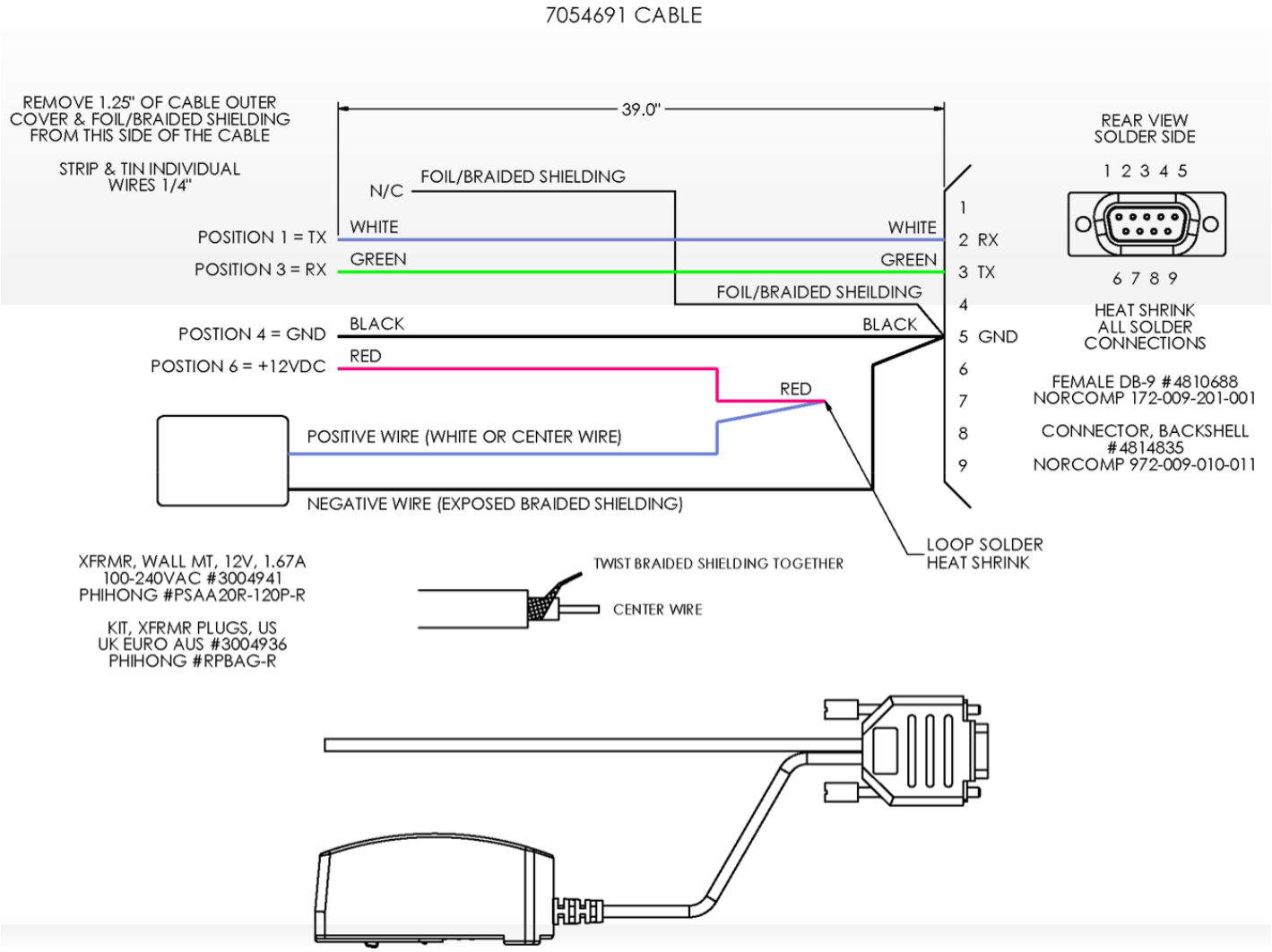
Model pjnoyt

		5200 5210	5230
Pin	**Cable Color**	**1/0**	**1/0**
1	**Brown**	RS232TX	RS232TX
2	**White**	TR G OUT/SDI-12	4-20 -
3	**Blue**	RS232RX	RS232RX
4	**Black**	GND	GND
5	**Gray**	TRIS	4-20 +
6	**Pink**	+12 VDC	+12 VDC



TURCK CABLE CONNECTOR MALE VIEW
(FROM CABLE)

7054691 External Cable: Ruggedized Enclosure Terminal Block Cable

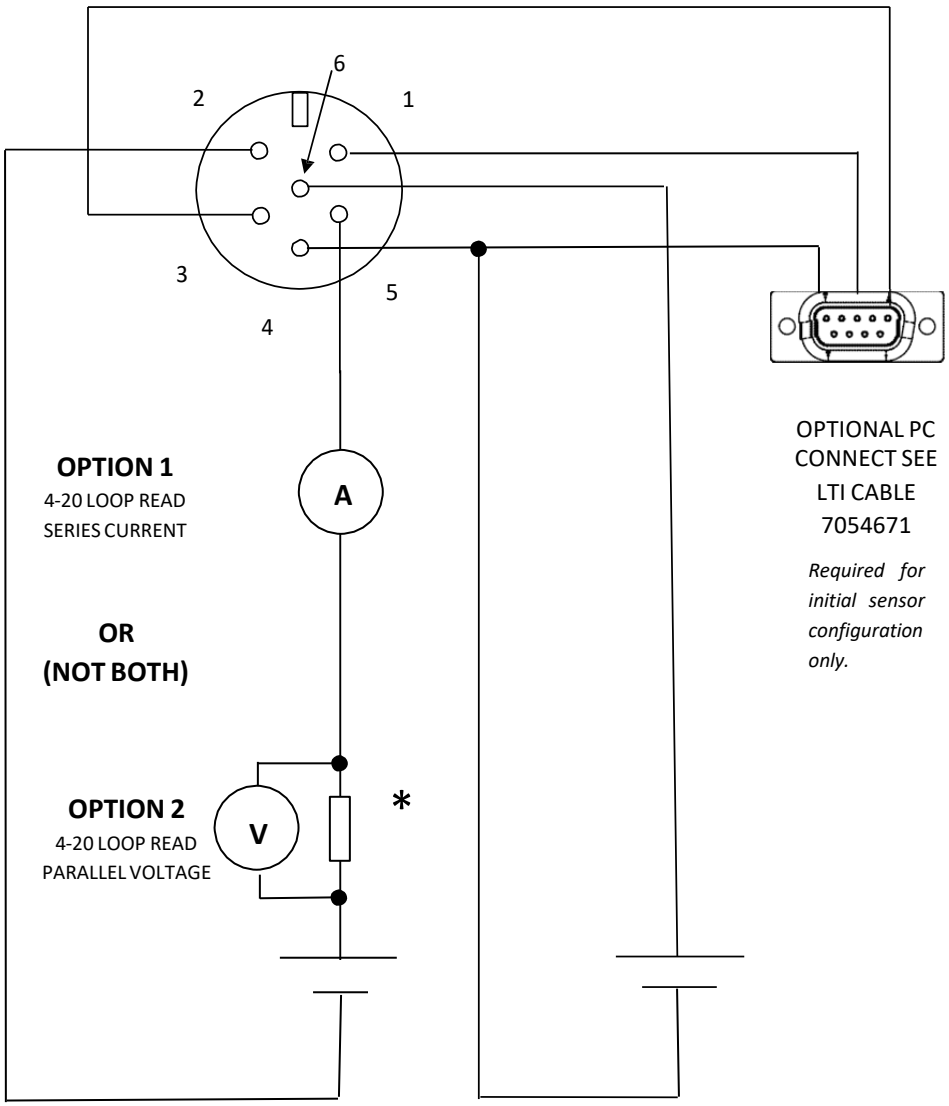


External Wiring Diagrams

	I/O					
	Visible Alignment Laser	**RS232**	**SDI 12**	**4-20**	**4-20 HART**	**Trigger**
S200		●	●			●
S210	●	●	●			●
S230	●	●		●	●	

S230 4-20 Cable with Optional PC Connect (1 of 2)

SENSOR CONNECTIONS		
1	BROWN	RS232TX
2	WHITE	4-20-
3	BLUE	RS232RX
4	BLACK	GND
5	GRAY	4-20+
6	PINK	+12VDC

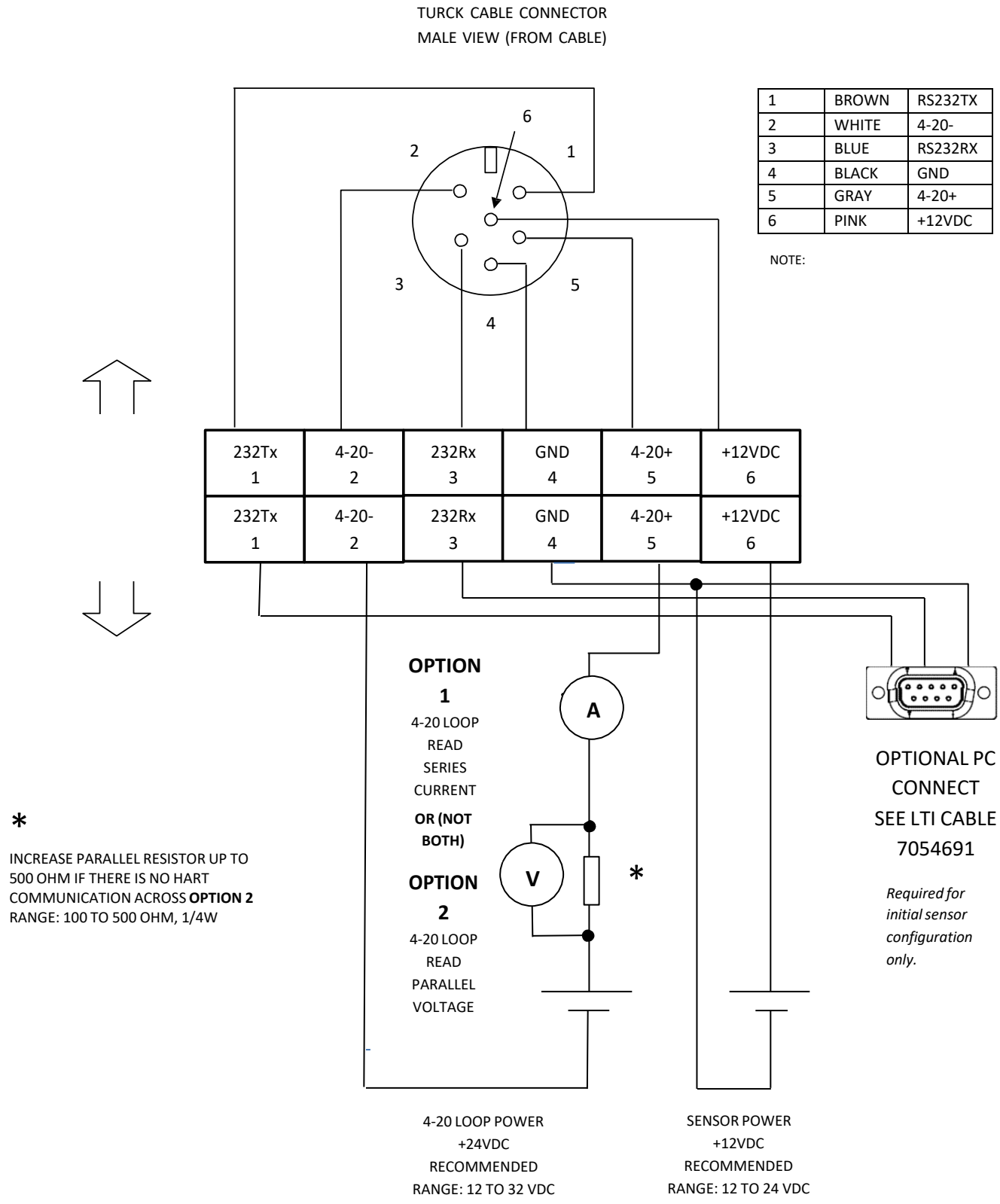


*

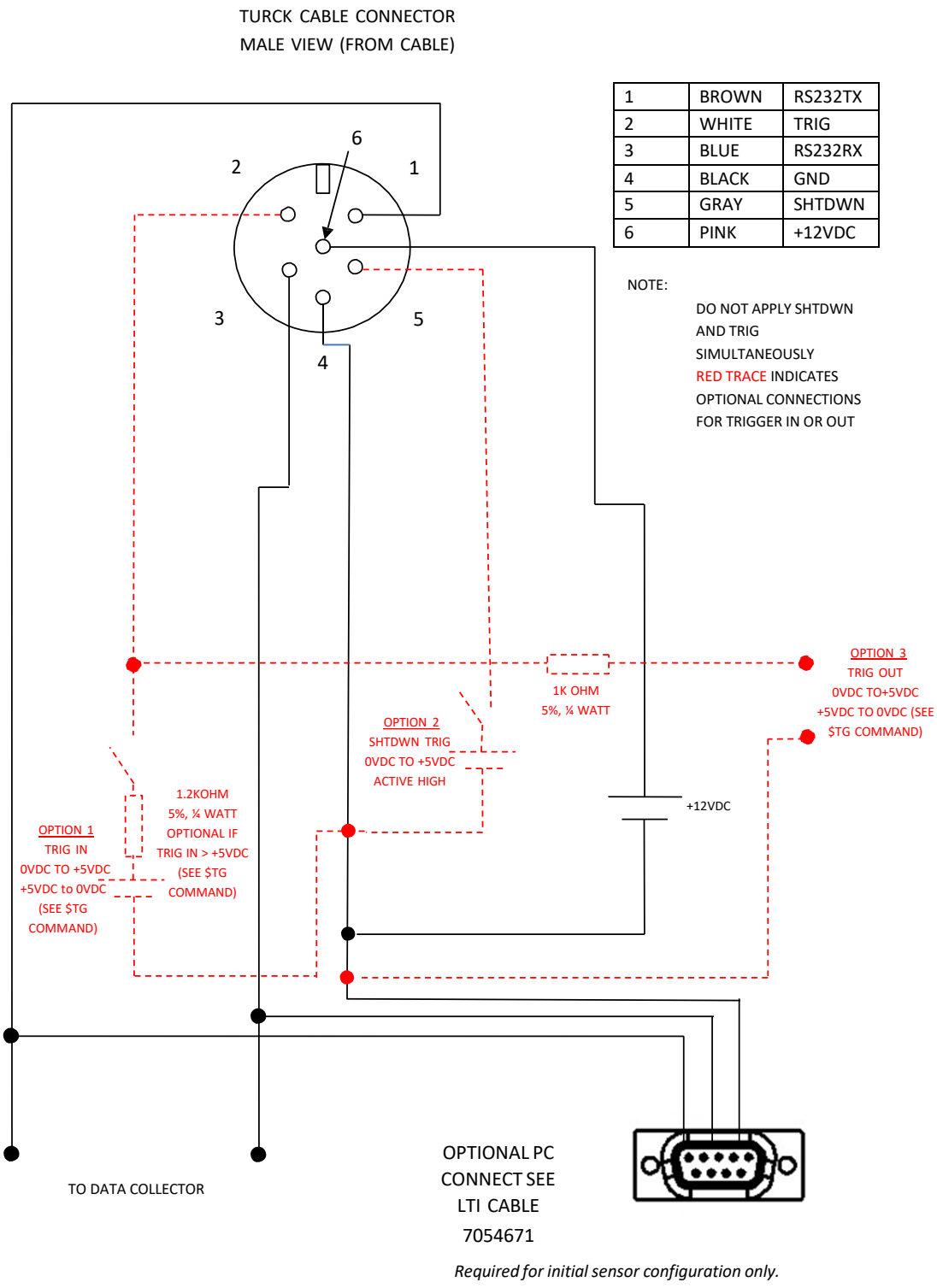
INCREASE PARALLEL RESISTOR UP TO 500 OHM IF THERE IS NO HART COMMUNICATION ACROSS **OPTION 2** RANGE: 100 TO 500 OHM, 1/4W

SENSOR POWER AND 4-20 LOOP POWER MUST BE SEPARATE SOURCES

S230 4-20 Ruggedized Enclosure Terminal Block with Optional PC connect (2 of 2)

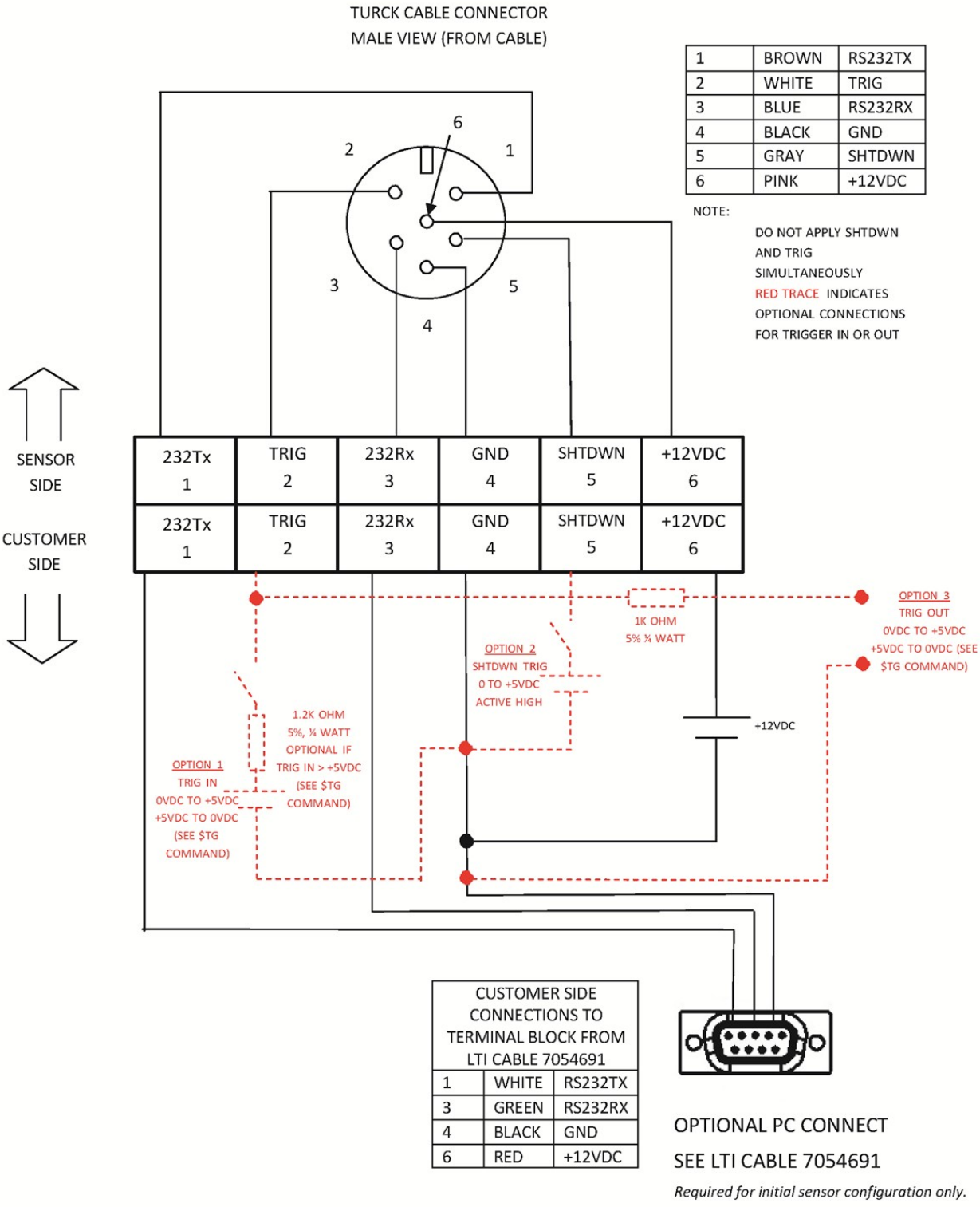


S200 / S210 I/O Trigger Cable with Optional PC Connect (1 of 2)

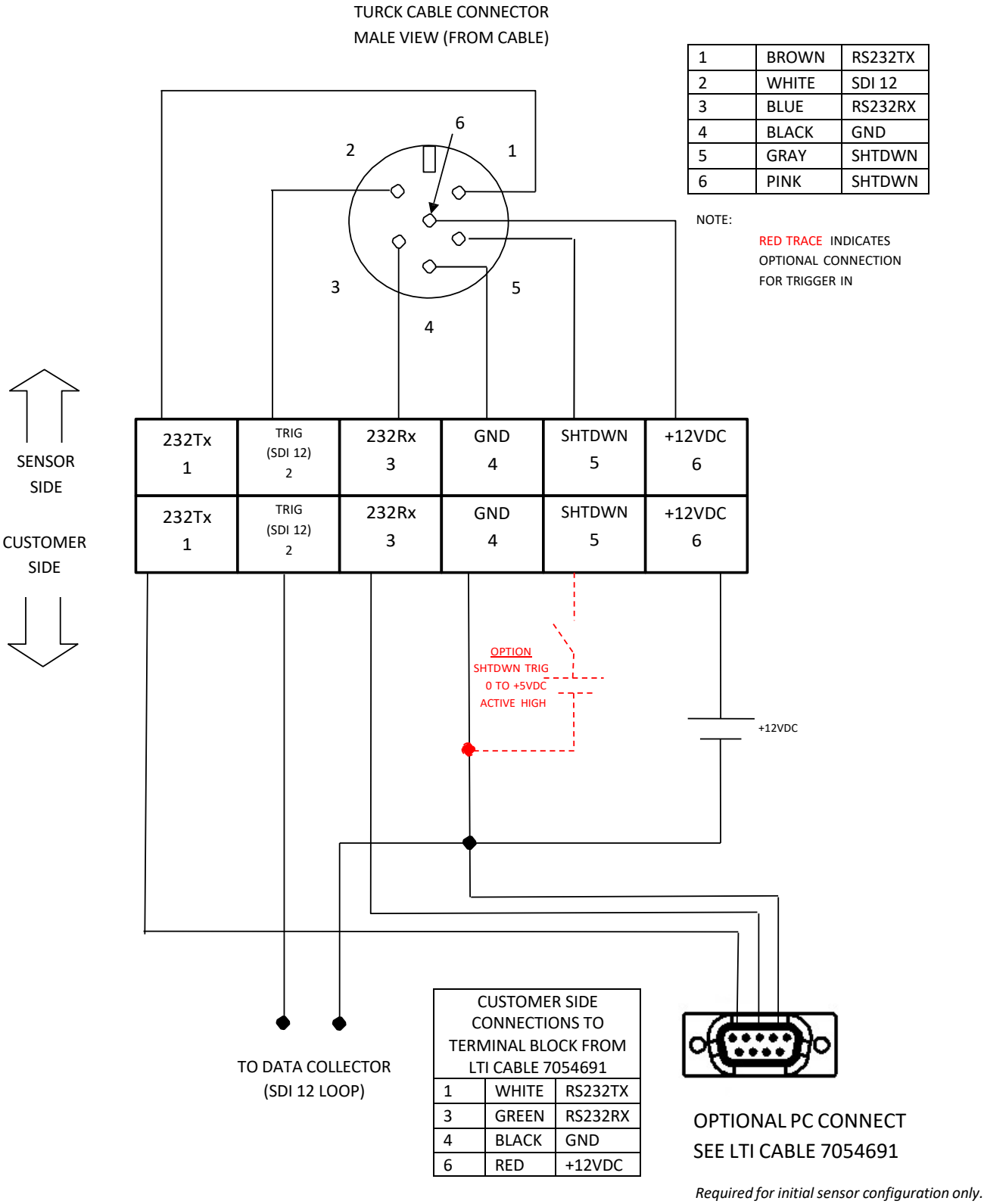


Required for initial sensor configuration only.

S200 / S210 I/O Trigger Ruggedized Enclosure Terminal Block with Optional PC Connect (2 of 2)



S200 / S210 SDI-12 Ruggedized Enclosure Terminal Block with Optional PC Connect (1 of 2)



1	BROWN	RS232TX
2	WHITE	SDI 12
3	BLUE	RS232RX
4	BLACK	GND
5	GRAY	SHTDWN
6	PINK	SHTDWN

NOTE:
RED TRACE INDICATES OPTIONAL CONNECTION FOR TRIGGER IN

CUSTOMER SIDE CONNECTIONS TO TERMINAL BLOCK FROM LTI CABLE 7054691		
1	WHITE	RS232TX
3	GREEN	RS232RX
4	BLACK	GND
6	RED	+12VDC

OPTIONAL PC CONNECT
SEE LTI CABLE 7054691

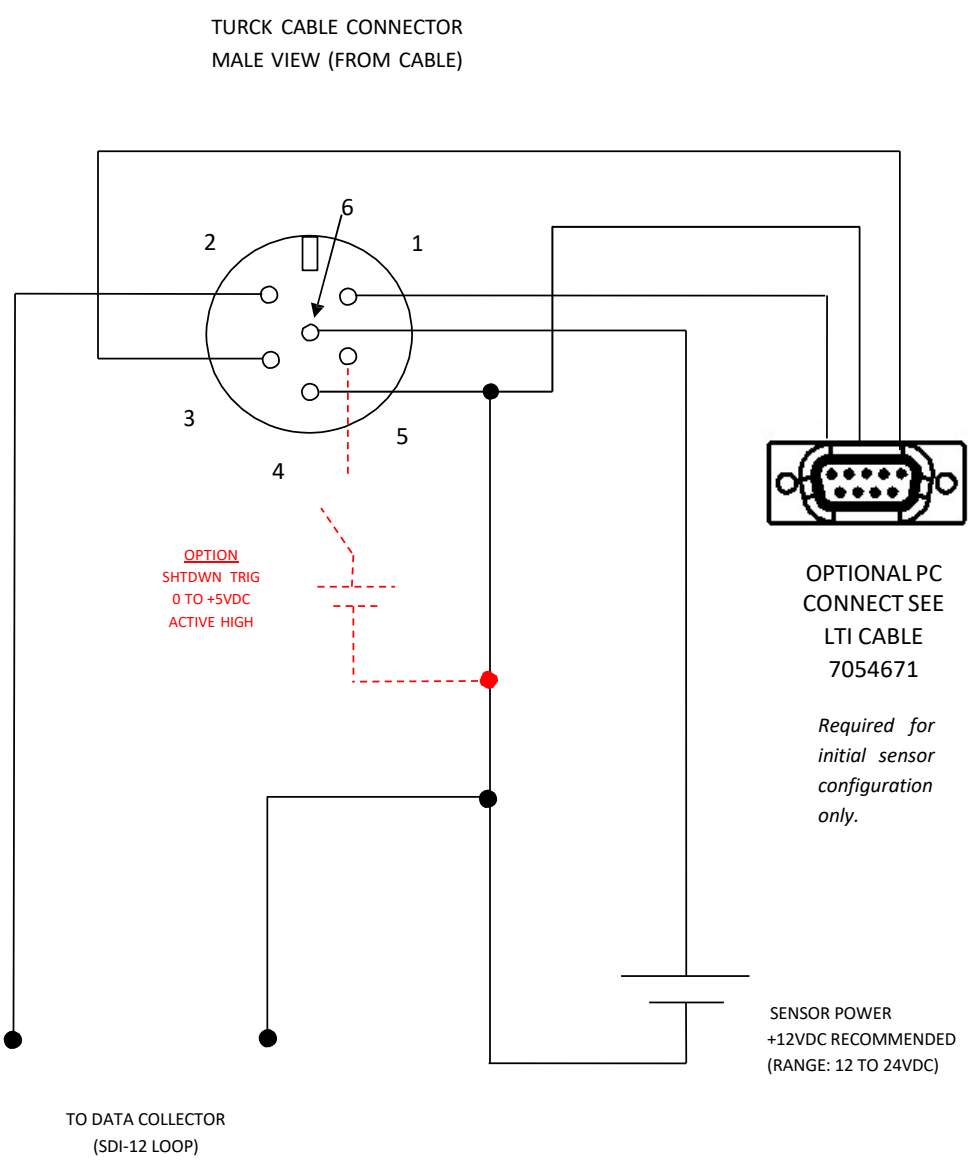
Required for initial sensor configuration only.

S200 / S210 SDI-12 Cable with Optional PC Connect Wiring Diagram (2 of 2)

SENSOR CONNECTIONS		
1	BROWN	RS232TX
2	WHITE	SDI 12
3	BLUE	RS232RX
4	BLACK	GND
5	GRAY	SHTDWN
6	PINK	+12VDC

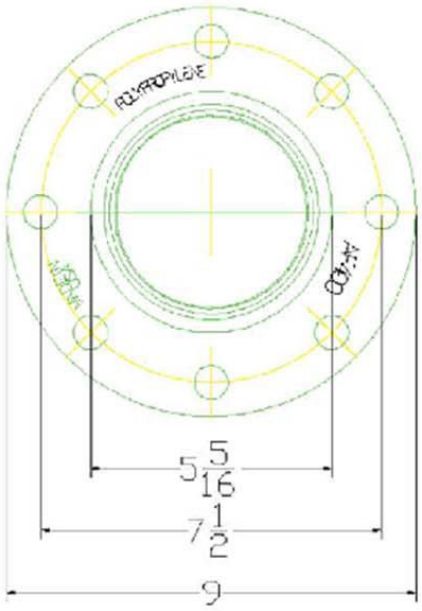
NOTE:

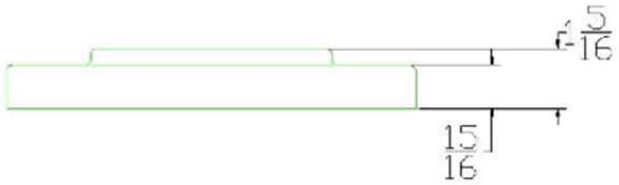
RED TRACE INDICATES OPTIONAL CONNECTION FOR TRIGGER IN

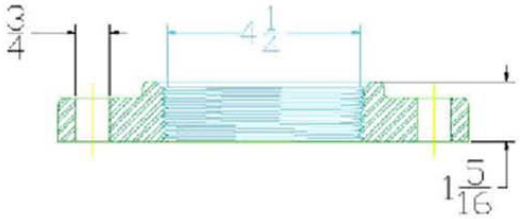


Diagrams - Mechanical

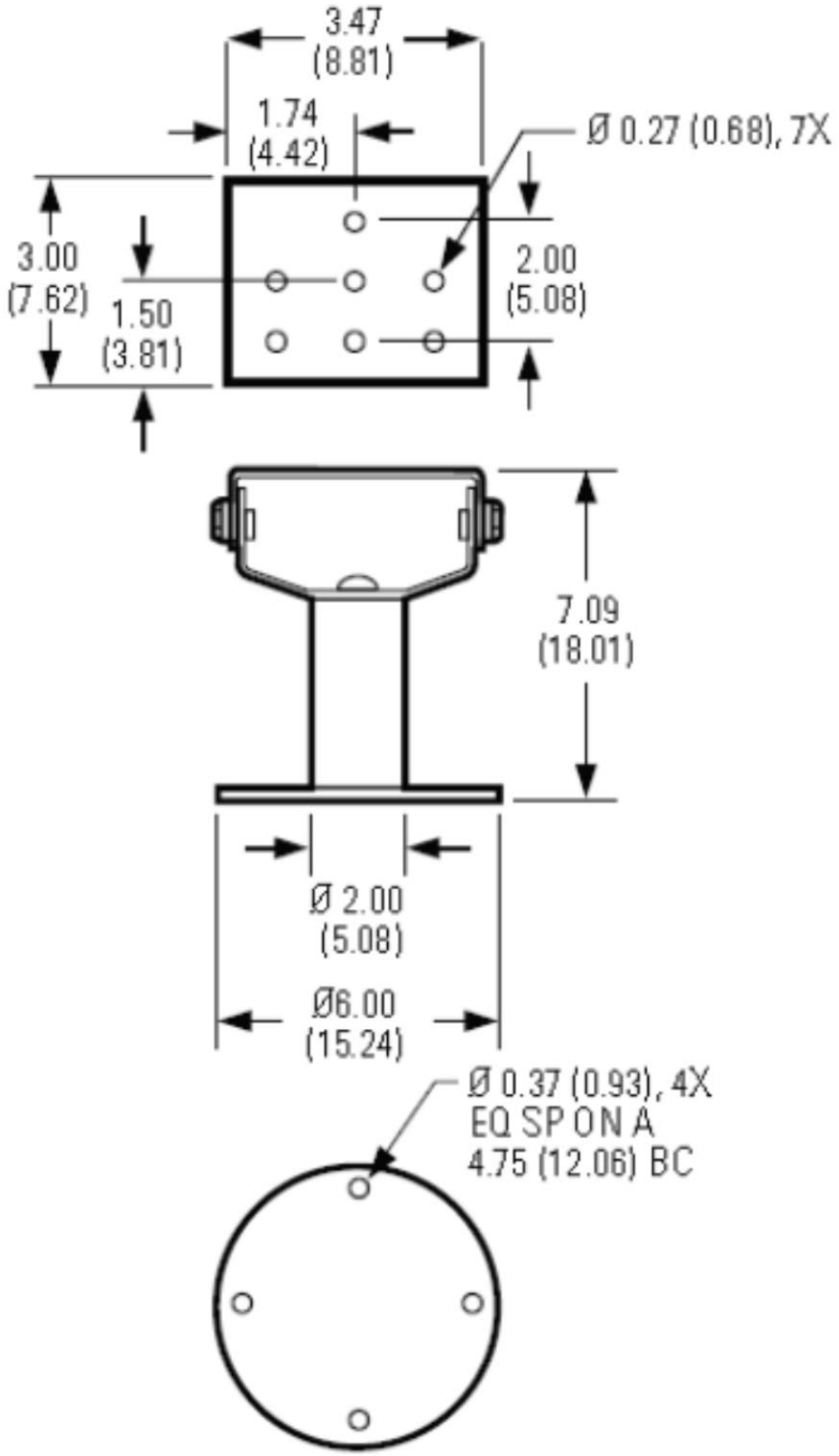
3004960_4_1nch_Flange



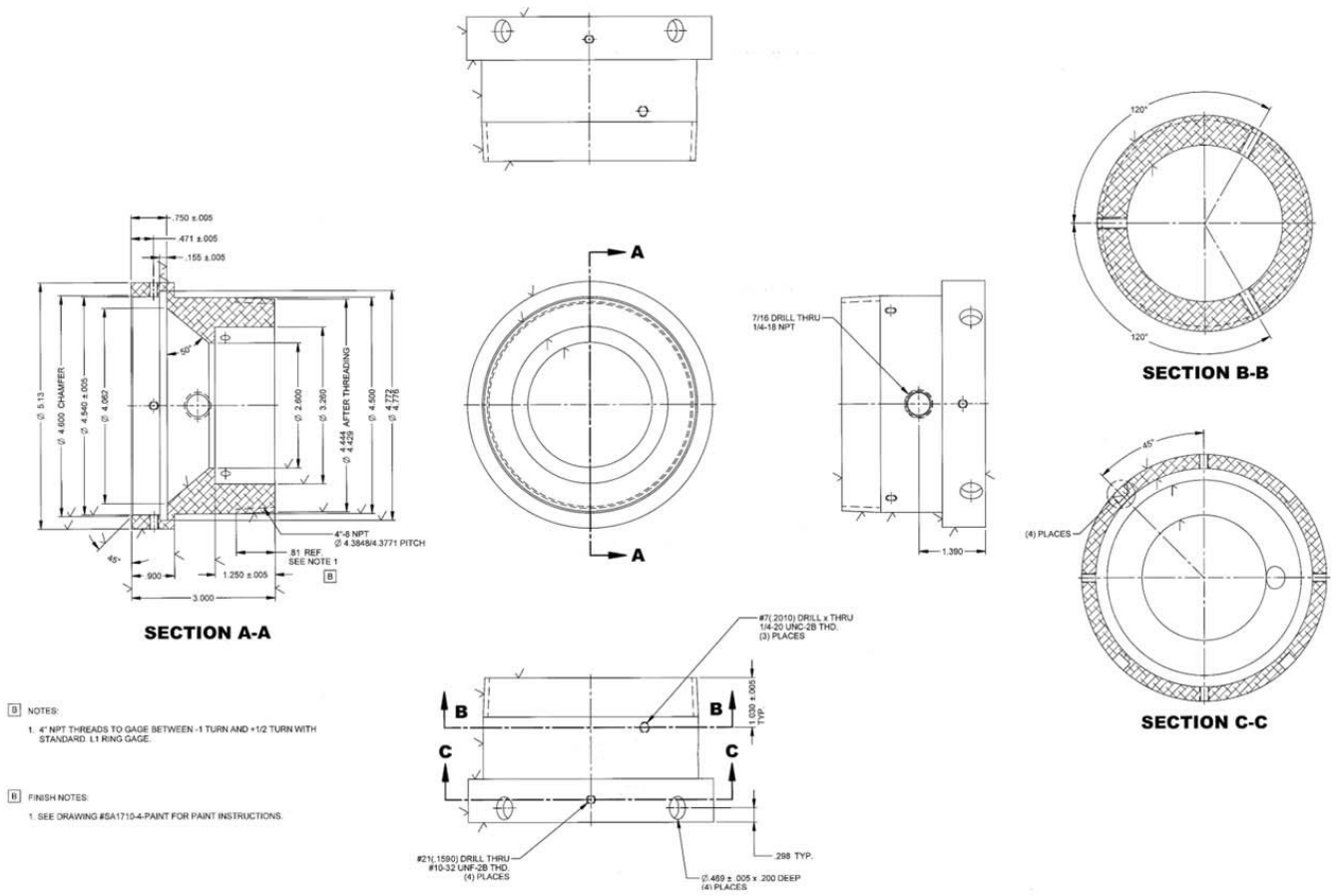




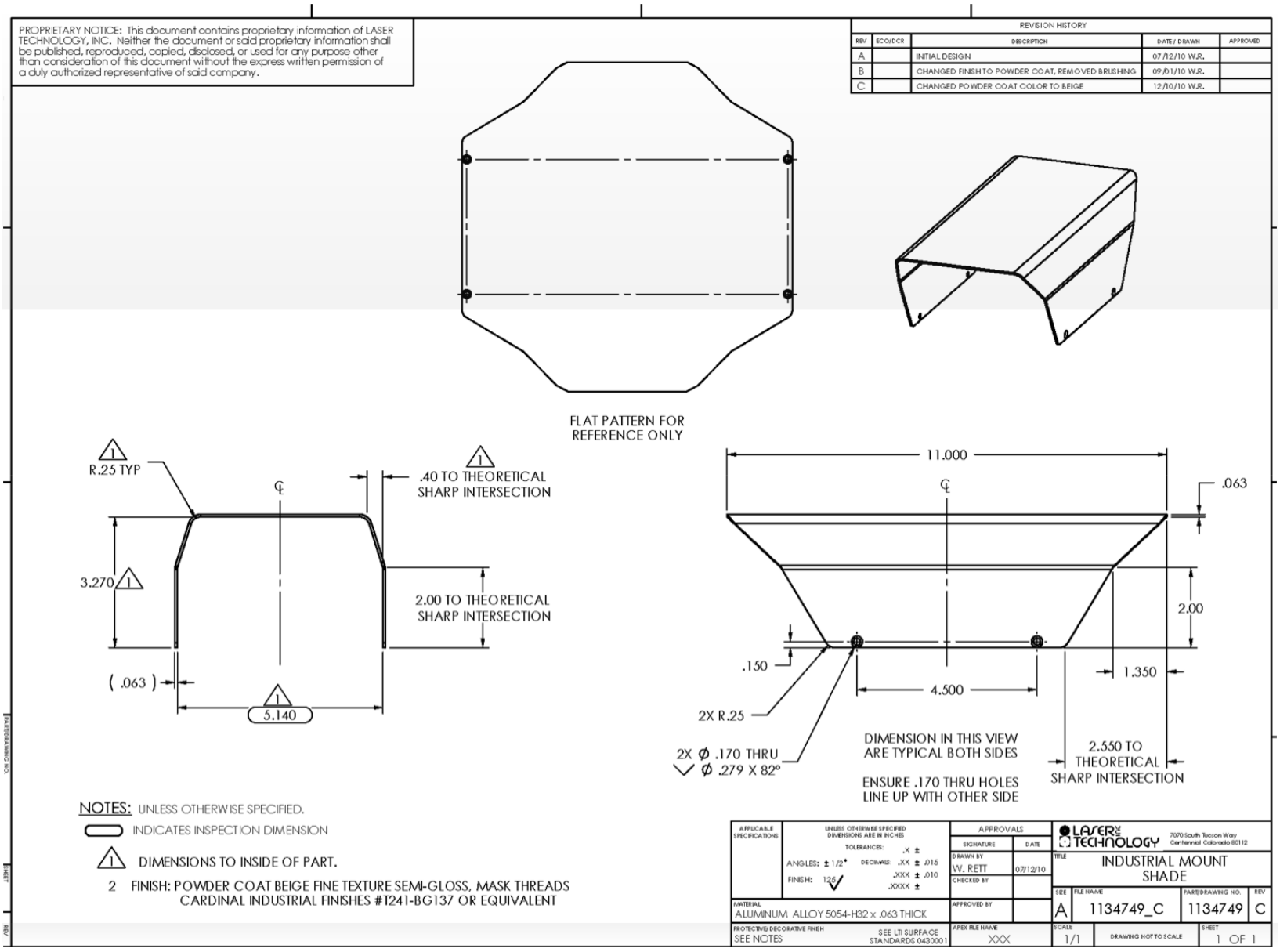
3004959 Swivel Mount



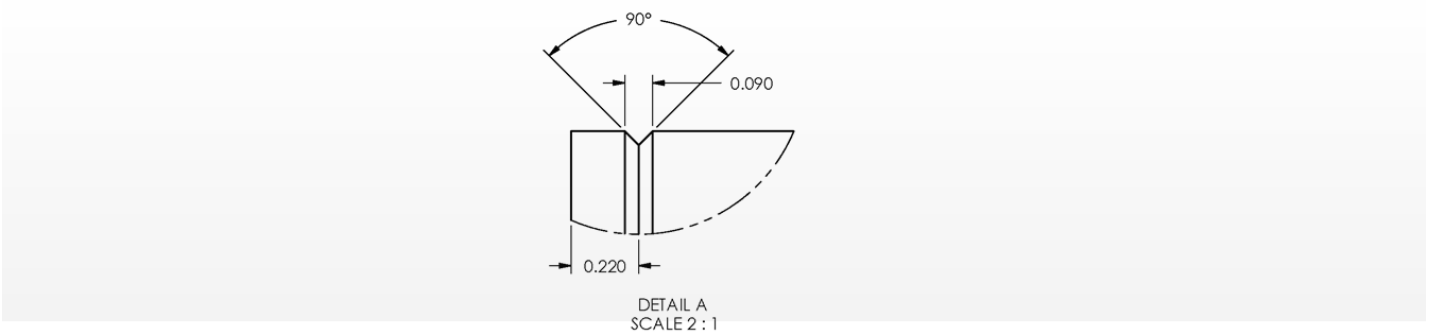
3004956 Tank Adaptor

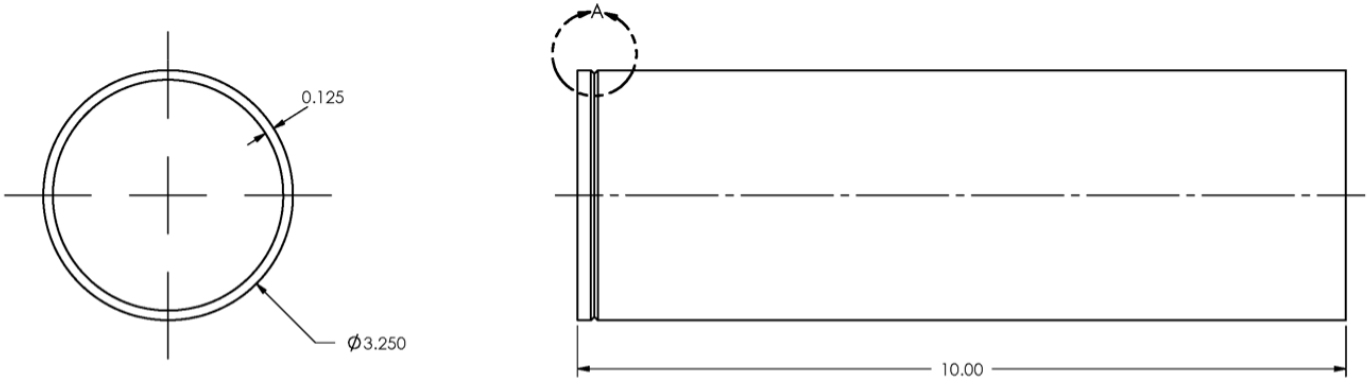


1134749 Sun Shade Industrial Mount



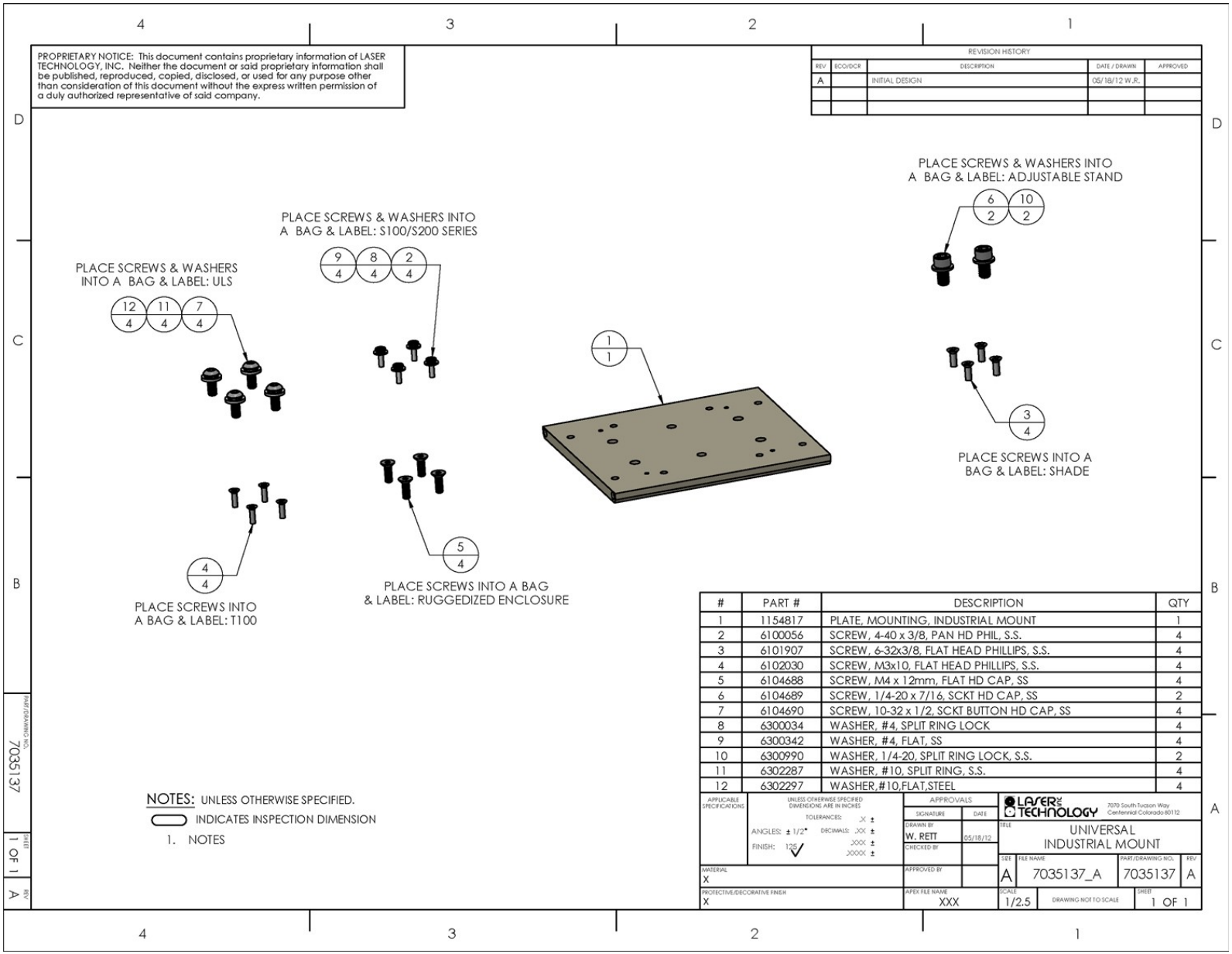
3004957 Dust Tube



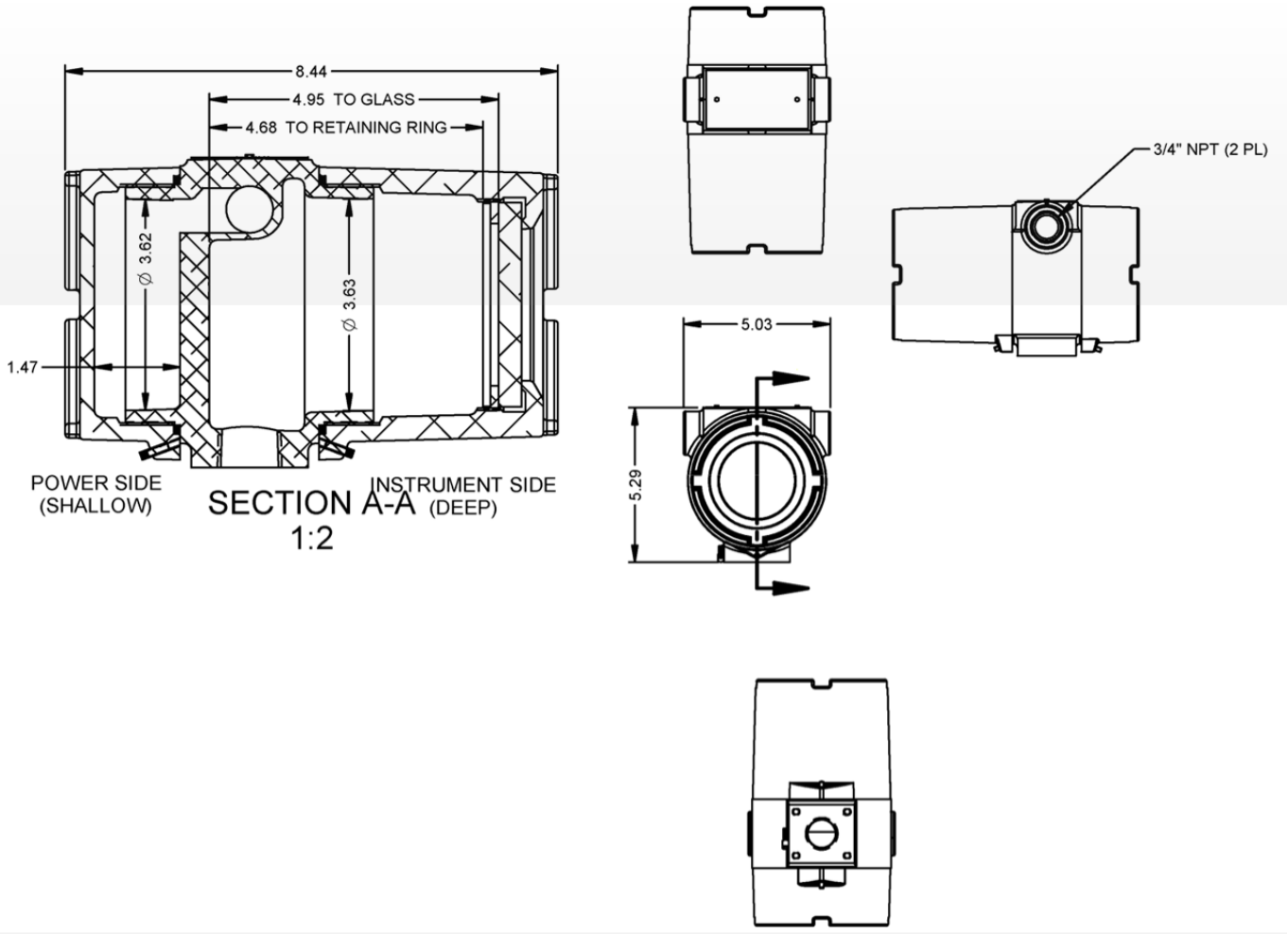


NOTES: UNLESS OTHERWISE SPECIFIED.
INDICATES INSPECTION DIMENSION
1. NOTES

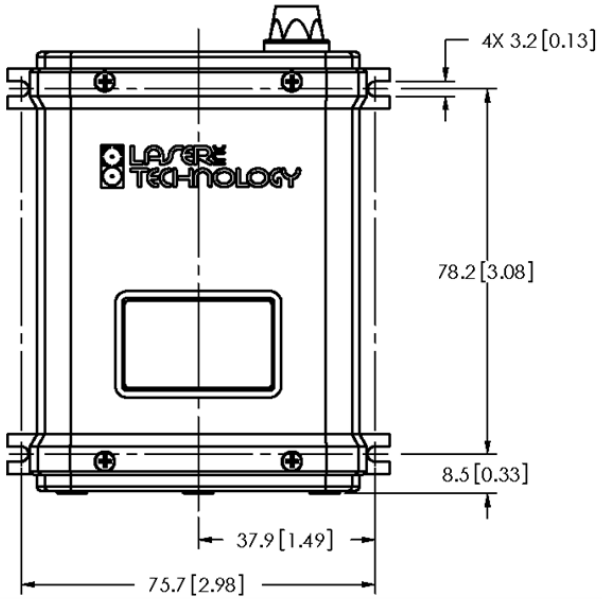
7035137 Mounting Plate

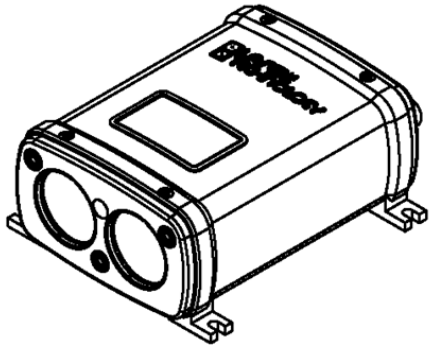


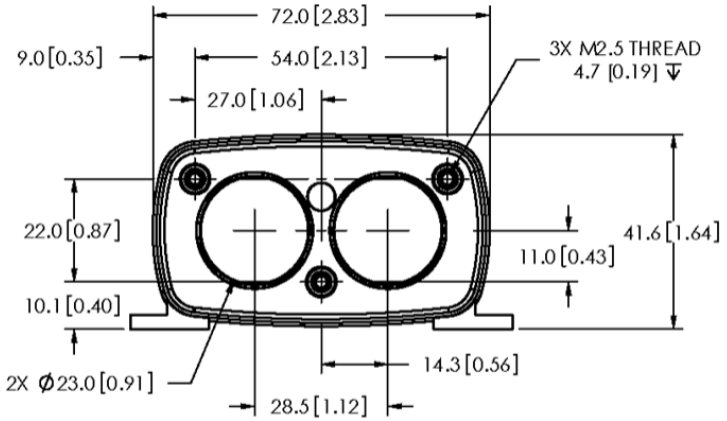
7035139 Ruggedized Enclosure

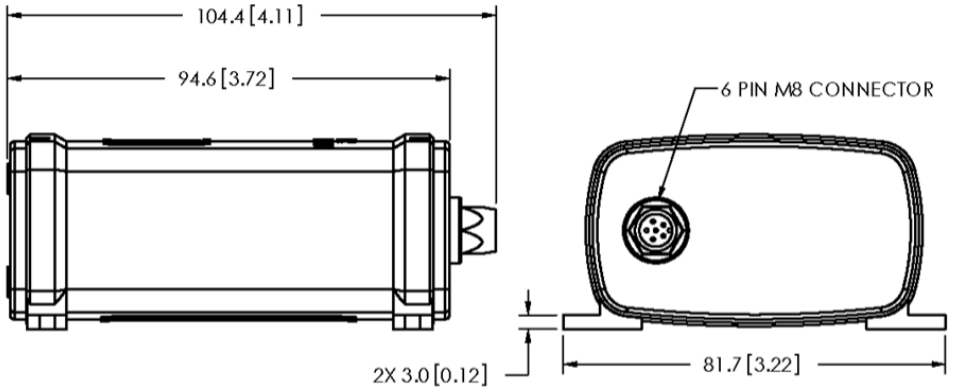


Housed Model Dimensions





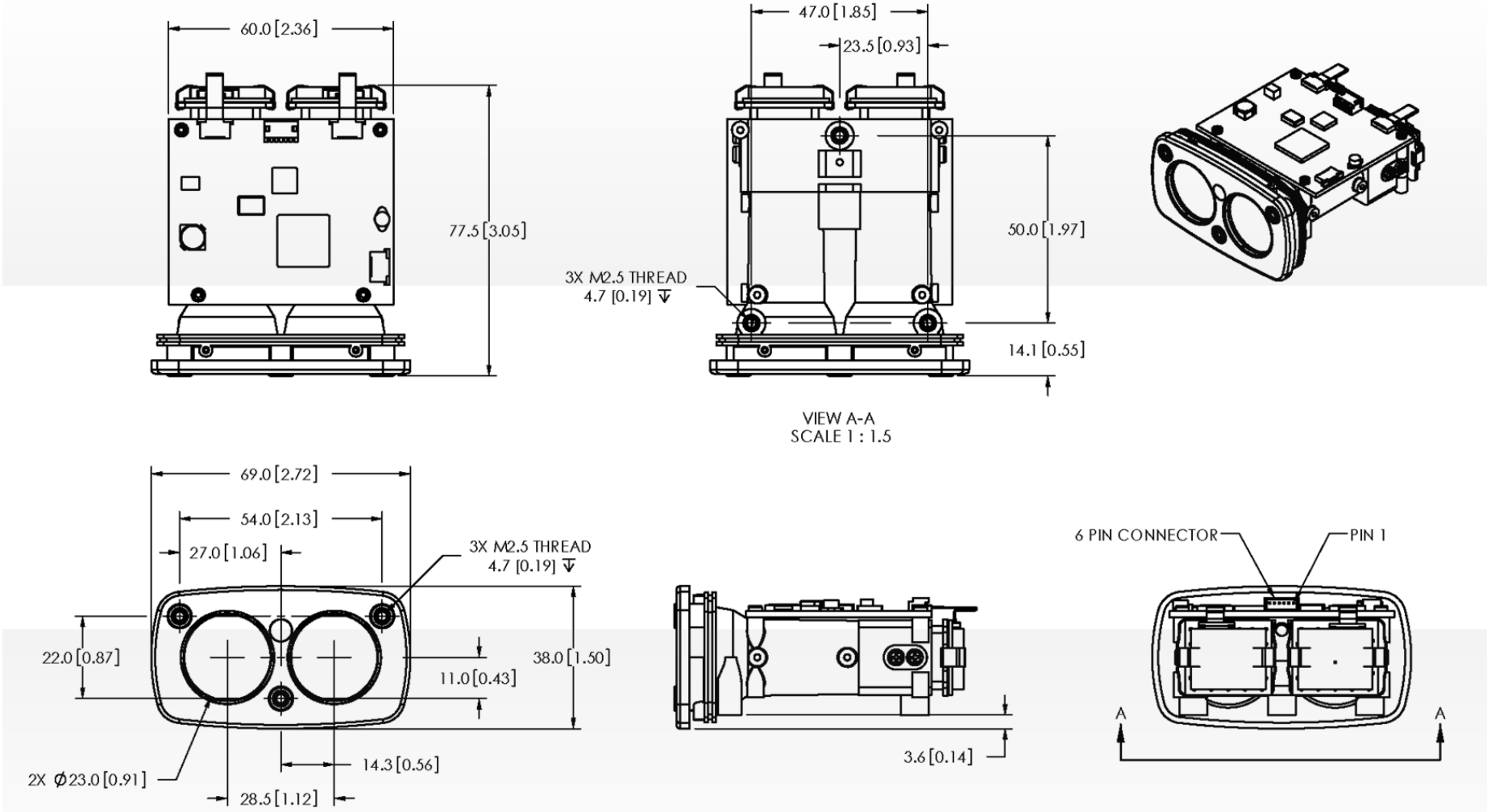




NOTES: UNLESS OTHERWISE SPECIFIED.

1. DIMENSIONS ARE IN MILLIMETERS AND [INCHES].

OEM Model Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED.

1. DIMENSIONS ARE IN MILLIMETERS AND [INCHES].