Laser Technology, Inc.

TruSense® S300 Series

User's Manual

LTI TruSense® S300 Series User's Manual
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Revision History

Date	Revision	Description of Changes
		Original document

Approval History

Date	Revision	Description of changes

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1 Introduction

Purpose

This document defines and provides the means to control the interfaces for the Laser Technology TruSense S300 series laser sensors for the following configurations:

- ☐ S300 = TRIG, SDI-12, RS232 without alignment laser
- ☐ S310 =TRIG, SDI-12, RS232 with alignment laser
- ☐ S330 = 4-20 HART, RS232 with alignment laser

This manual represents the S300 Series models. S300 is used as a generic term for all S300 Series models.

Basic Package

- ☐ S300 Series Sensor or S300 OEM Sensor
- ☐ Communication Cable with Flying Leads
- ☐ LTI Limited Warranty

Accessory Items

- ☐ Power/Comm Cable
- ☐ Universal Mounting Plate
- ☐ Diffuser Lenses
- ☐ Sun Shade
- ☐ Swivel Mount

For more information on S300 accessories, please visit:
http://www.lasertech.com/Laser-Sensors.aspx

Safety Precautions

- Avoid staring directly at the laser beam for prolonged periods. The TruSense S300 is designed to meet FDA eye safety requirements and is classified as eye safe to FDA (CFR21). Note: The TruSense 310 and S330 have a Class 2 Alignment Laser that is not rated eye safe. 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.
- Do not use the laser within 15 meters (50 feet) of a prism. The reflective energy from a prism within this range can oversaturate the laser receiver, resulting in permanent damage to the sensor.
- 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 S310 and S330 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 S300

IMPORTANT!
When mounting the S300, always use a washer between the housing feet and the screw head.
Do not exceed 5 inch-pounds of torque when securing.

OEM Models

Due to the sensitivity of the OEM models, LTI recommends all ESD, Electrostatic Discharge procedures as outlined in ANSI/ESD S20.20, ESD Association Standard for the Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts are followed whenever handling an OEM sensor.

2 Getting Started

- LTI recommends getting familiar with the sensor operation and configuration in a controlled environment.
- After unpacking, power on the unit with the supplied cabling and connect the DB9 pin serial connector (optional) to a serial I/O device such as a PC.
- A DB9 to USB adaptor is required if the PC does not have a DB9 serial port available. A ready to use power and communication cable is available from LTI, see Accessory Items from previous page.
- 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.

Sensor Performance

LTI sensors come with a variety of target mode and configuration settings than can optimize the sensor to a particular application and set of conditions. This set up flexibility is one of the primary advantages of LTI sensors. LTI's algorisms with respect to target discrimination, target acquisition and target extraction are what set it apart from other laser sensors.

Measurement Technique

Acquiring a Target

The S300 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 sensor. The exact distance is then calculated by comparing the return time to the speed-of-light constant.

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, or foliage. 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 colored target is generally more reflective than a darker one and thick dust will reduce the signal strength more than light dust.

The S300 is a highly-sensitive precision sensor and can measure to most targets within its range specification. This includes penetrating light dust or fog using the Last target mode, for instance. A general rule of thumb when measuring through fog or dust is if you can visually see the target, the sensor likely can as well. Remember, humans see in the visible light spectrum whereas the LTI laser sensor utilizes the Infrared spectrum (IR) 905. Certain objects will appear differently in these two spectrums, which is why the human eye test is only a general rule of thumb and not an absolute test of what the laser sensor is able to detect.

Liquids & Fluids Application

The S300 series sensor is engineered and specifically designed to directly measure all types of fluids, including those that are highly reflective (such as clear water), turbulent and without regard to their dielectric properties. The S300 generates reliable results by stabilizing the reflections picked up by the receiver and by smoothing out the reflective peaks and valleys caused by fluids in random motion.

Optional Beam Diffuser

The optional beam diffuser is available to spread the laser beam wider than the standard 3mrad divergence. This option is typically recommended when measuring still or turbulent clear liquids. To enhance performance, in may be also used in the following conditions:

- measuring liquids in random motion
- measuring liquids where mounting the sensor at 90° to the liquid surface (± 5°) is not guaranteed

The optional beam diffuser is not necessary or should not be used when measuring over a distance of 50 meters (164 feet), when measuring down a long and narrow stilling well or bypass pipe, or when other obstacles such as pipes, mixing blades, etc. are located very close to the sensor's beam.

Window Application

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 from a very close reflector like a window is combined with the actual target reflection and could lead to an inaccurate measurement.

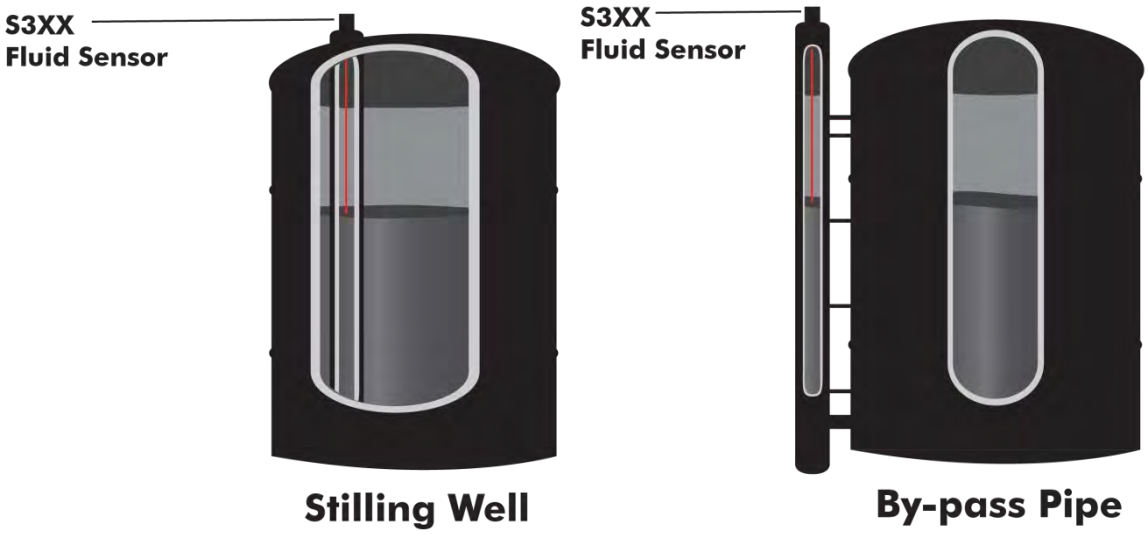
Borosilicate glass typically works well. Also, there is no degradation using plane glass or even plastic. Soda lime glass will not give the best results.

Typically, a transmission of over 90% is desirable. Through uncoated glass, there is about a 4% reflection loss on each surface of the glass (a total of 8% going through the glass), so it's better if each side is coated with an anti-reflection coating. This can reduce the reflection loss to close to 0%.

Foam Application

Unless the foam is very low-density and laser light will get through it, the laser will likely measure to the top of the foam while it is present. However, the use of a stilling well or by-pass pipe can mitigate this condition. These devices allow the fluids to enter through perforations and reach the same level as the rest of the vessel, but reducing the amount of agitation and foam that may be present outside of the stilling well. Another technique to counter foam is to create a small "wash-down" area at the side of the tank which will clear a small area through the foam, down to the material layer. Shoot the laser through this spot.

If both the foam layer and the material layer below it are required to be monitored, two separate S300s can be set up to provide both measurements. For example, one can be used inside a stilling well and the other outside to measure both targets.



Stilling wells and by-pass pipes are techniques used to calm turbulent fluids in vessels or rapids in rivers, offering a calmer, cleaner surface to measure to. Often stilling wells can mitigate issues arising from agitation, flow, foam and other conditions that might compromise accuracy.

Dense Steam Application

The presence of steam is a particularly challenging condition. Like most scenarios, it depends on the density & composition of the steam and the nature of the surface to be measured: composition, clear or opaque, still or turbid, etc. A general rule of thumb is that if you can see through it, the laser will be able to as well.

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.

Transmit & Receive Lens

Viewing the sensor from the front (refer to adjacent illustration), the transmit lens is on the left side, as indicated by the red arrow. The receive lens is on the right side.

Measurement Reference

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

Hazardous Locations

LTI recommends using the Ruggedized Housing Enclosure designed to house the S300 (see Appendix A of the document for more information). This can be mounted to an adaptor and flange for easy installation in a tank or silo. A dust tube will attach to the adaptor and provides a ¼ X 18 NPT access for an air tube to provide positive air pressure inside the tube to prevent dust from settling on the sensor lens.

Sunlight

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 heat the sensor above its operating temperature.

¶

3 Interface

Electrical

12-24 volt dc.

I/O

Default = 115200 baud rate, no parity, 8 data bits, 1 stop bit, no flow control.

Mechanical

Mounting slots are 4 X 3.2mm (0.13 inches), always use a washer and do not exceed 5 inch pounds of torque when securing. Recommended bolt size is M3, or 4-40.

Alignment

The S300 will output a signal strength (intensity) reading-1-xxxx,2-xxxx,3-xxxx,4-xxxx where the increasing number indicates a stronger target.

Example: To center the sensor on the desired target, slide the sensor in the X and Y direction in order to determine the location of the maximum signal return. This ensures the target is centered. This example shows an orange pole with reflective tape wrapped around it. 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.

In this example, the beam is centered on the reflector when the 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

S300 Alignment

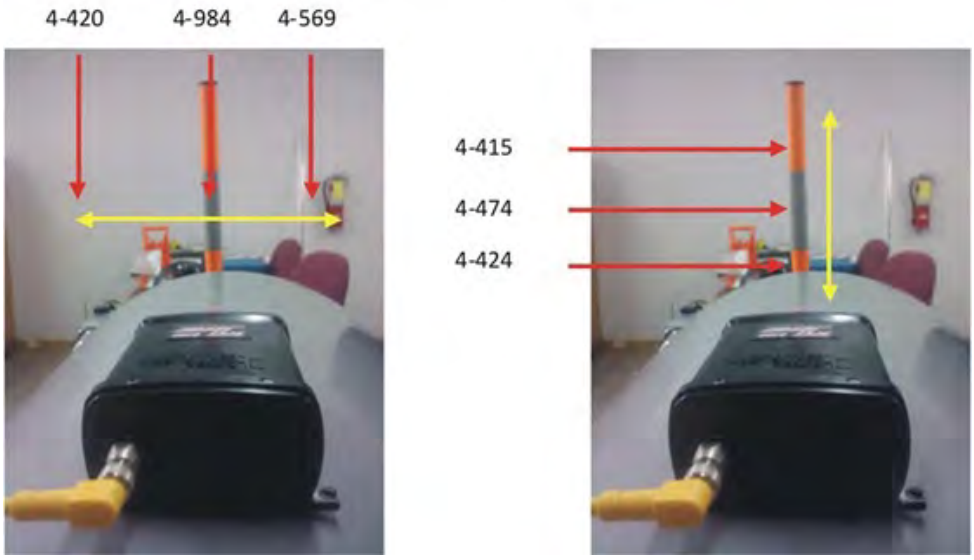


Figure 1 Intensity Alignment

Outputs for Each Model

	I/O					
	Visible Alignment Laser	RS232	SDI 12	4-20	4-20 HART	Trigger
S300		●	●			●
S310	●	●	●			●
S330	●	●		●	●	

Table 1

4 Configuration

Graphic User Interface Utility

- **Top Window Measurement is in either Meters, Feet, or Yards.**
- **Bottom Window is Laser Return Intensity.**
- **Green "Laser Active":** Laser is firing
- **Counter:** Measurement count.
- **Laser Pointer:** Visible Alignment laser (S310 and S330 models only).
- **Bottom Status Bar:** Shows model, SN, serial number, Target Mode, Fluid Characteristics, and Com Port.
- **Terminal:** Brings up Terminal Mode. User can type in commands and see response as well as scrolling data as the sensor is measuring.
- **Configure Sensor** for setup menus.

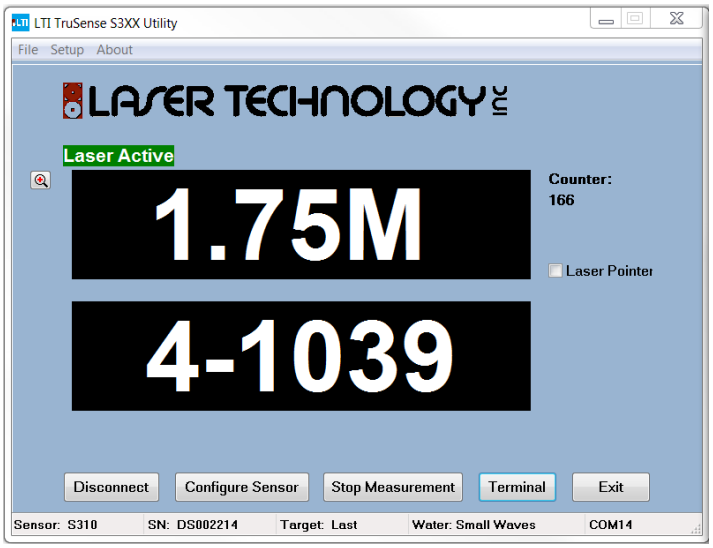


Figure 2 Main Utility Page

Configure Sensor Tab

- The Interface will read the configuration from the sensor.
- A pop up notice will display while the configuration is being read.

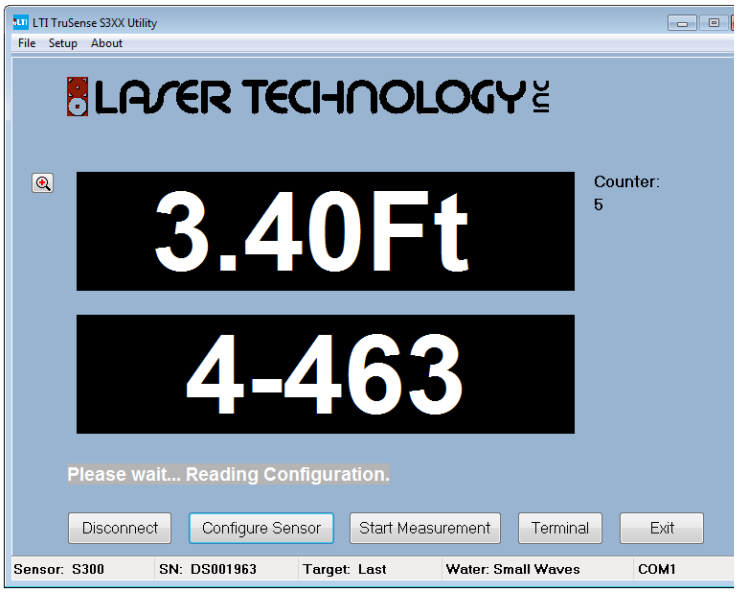


Figure 3 Reading Configuration

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.

Note: Serial string at right shows time since power on; this can be disabled with $DT command as explained in Section 6 Serial Commands.

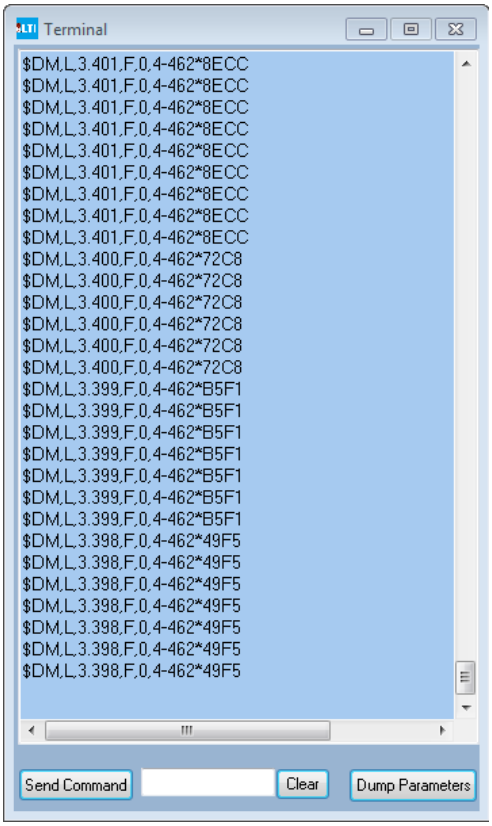


Figure 4 Terminal Window

Range Units Tab

- **Range Units:** User may select measurement units.
- **Short Gate:** Allows user to set a short gate distance.
- **Autostart:** Enable **Autostart** for sensor to automatically begin measuring on power up.
- **Offset:** Adds or subtracts from overall measurement.
- **Weather Mode:** Allows the sensor to eliminate weather related returns out to a pre-set distance
- **Re-Read Configuration:** Reads the unit's configuration again.
- **Save Configuration:** Saves the configuration to a file, as shown in the appendix.
- **Open Configuration:** Allows the user to open a saved configuration file.
- **Apply & Save Configuration:** Loads the menu settings to sensor and saves to file.
- **Apply:** Save menu settings to sensor.
- **Exit:** Simply exit.
- **Restore Factory Defaults:** Load settings from the factory from non-volatile memory.

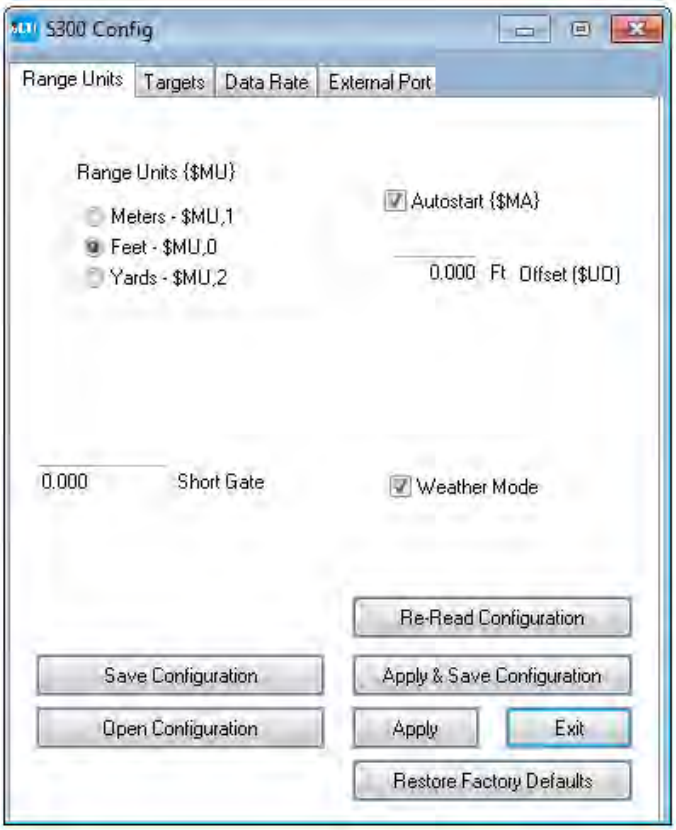


Figure 5 Range Units Tab

Targets Tab

- **Target Selection:** Target Discrimination Menu. User selects target based on application.
- **Fluid Characteristics:** Will be set for the agitation level.
- Advanced target displays are available in the Serial Communication Protocol section.

Figure 6 Targets Tab

Data Rate Tab

- User selects the number of measurements.
- User selects the Delay between Measurements. User sets Number of Measurements to 1 and Delay to 0 for maximum update rate of 14 Hz using these settings.
- Example #1: The user wants an update rate of 5 Hz. 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 enter 1 for number of Measurements and 10 for delay between measurements.

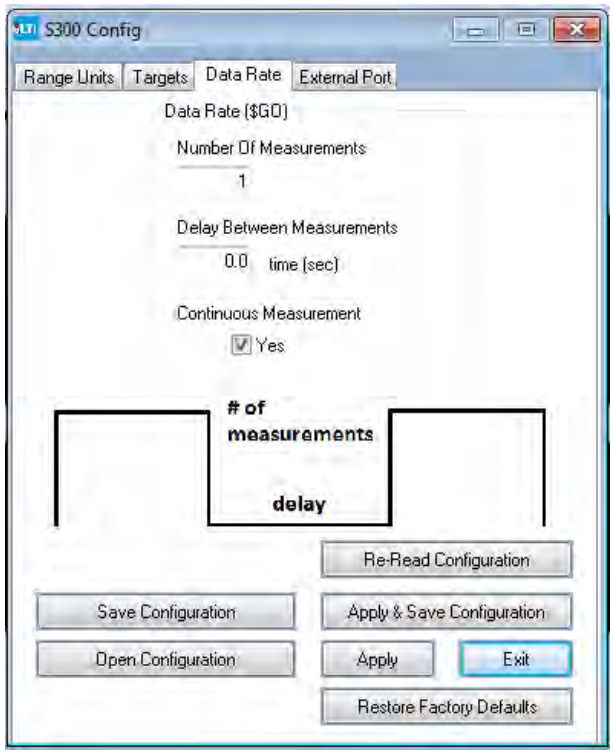


Figure 7 Data Rate Tab

External Port Tab

- This menu only appears when connected to an S300 or S310 and allows the user to select Trigger Modes and Trip Distance.
- Allows user to select SDI-12 output.
- 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.
- Set Trip Distance allows user to set minimum and maximum distance for triggering.
- After settings are made, it is necessary to Apply then Exit.

Figure 8 External Port Tab

External Port S330

- This menu is only active with an S330.

4-20 mA Tab

- **4-20 mA** menu allows the user to set ranges at 4 and 20 scale. The serial command is **$FT**.
- Error current is set here as well.
- A difference of at least 2 meters (6.6 feet) must be between the range of 4 mA and 20 mA.
- After settings are made, it is necessary to Apply then Exit.

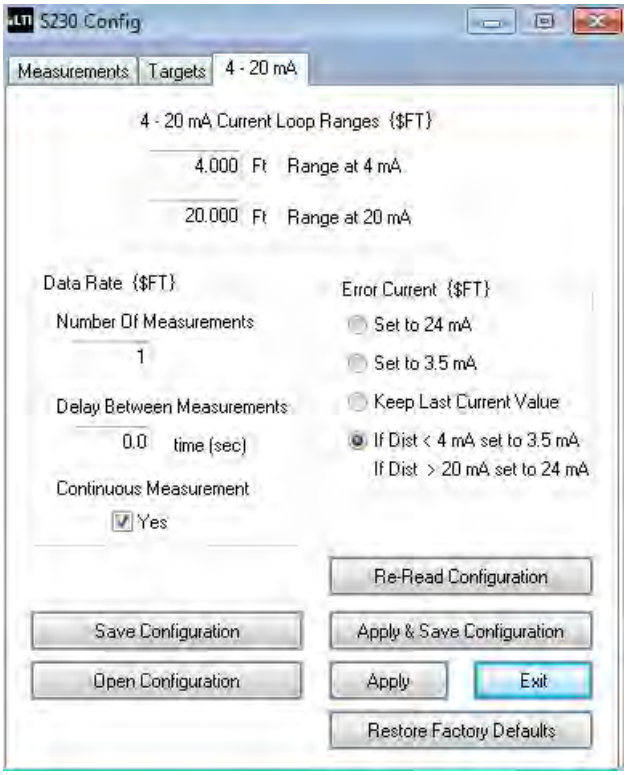


Figure 9 4-20mA Tab

5 Serial Communication Protocol

- Each command and reply starts with a '$' sign and ends with <CR><LF>, CR is carriage return and LF is line feed. The *XXX is a checksum.
- Default communication parameters: baud rate 115200, no parity, 8 data bits, 1 stop bit, no flow control.
- Issuing a mnemonic command without an associated parameter, prompts the S300 to reply with the current setting of that parameter (examples follow).
- Before entering a command, issue a Stop command, **$ST**, and after changing any commands, issue a Save command, **$SU**.
- 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.

Default Settings

$BA,115200
$DB,1
$DE,4
$DM.4
$DT,0
$FT,1.000,30.000,0.0,240,1,4,4,4,4
$MA,0
$MM,0
$MU,M
$OB,0
$OP,64
$PE,0.0
$RD,0.000,9999.999
$TG,0
$WU,1

TruSense S300 Configuration
$GO Command Parameters
-
$MM,0
Mode: 0
- # Iterations: 1
- Update Period: 0.0
; Measurement Mode = Standard Range
"Default setting $XXXX"

$DM,4
Target Mode = Last Target
"Default setting $XXXX"

$LS,0
Long Range Scan Mode = Do not report weaker targets.
"Default setting $XXXX"

$OP,64
Number of Pulses Per Measurement = 8 interations
“Default setting $XXXX”

$MA,0
Manual Start = Manual Start active.
“Default setting $XXXX”

$TG,0
Remote Trigger = External port disabled.
“Default setting $XXXX”

$MU,M
Measurement Units = Meters
“Default setting $XXXX”

$O0,0
User Offset for Standard Range Measurement Mode = 0cm

$O1,0
User Offset for Extended Range Measurement Mode = 0cm

$OB,0
User Offset for Intelligent Long Range Measurement Mode = 0cm
“Default setting $XXXX”

$DB,1
Display Banner = enabled
“Default setting $XXXX”

$WU,1
Warm Up Period = 1 measurement
“Default setting $XXXX”

$DT,0
; Time Since Power ON = disabled
“Default setting $XXXX”

$DE,4
Error Code Format = Display Error Code with Mnemonic
“Default setting $XXXX”

$PE,0.0
Update Period = 0.0 seconds
“Default setting $XXXX”

$RD,0.000,9999.999
Trip Distance:
- Minimum: 0.000 M
- Maximum: 9999.999 M
“Default setting $XXXX”

$FT,1.000,30.000,0.0,240,1,4,4,4,4
Current Loop Settings:
- Range at 4 mA = 1.000 Meters
- Range at 20 mA = 30.000 Meters
- Update Period = 0.0 secs.
- Error Current = If distance < 4 mA, set to 3.5 mA. If distance > 20 mA, set to 24 mA.
- Number of measurements = 1
- HART Parameter: PV = Last Target
- HART Parameter: SV = Last Target
- HART Parameter: TV = Last Target
- HART Parameter: QV = Last Target

"Default setting $XXXX"

$BA,115200
RS232 Baud Rate = 115200
"Default setting $XXXX"

6 Serial Commands

- Serial commands can be sent via the Terminal Window through the Graphic Interface, or directly from an emulator program, such as Tera Term or Putty.
- Before entering a command, issue a Stop command, $ST, and after changing any commands, issue a Save command, $SU.

$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 S300 gives actual aux board configuration as well as working configuration. Normally, actual configuration is same as the working one, but some functions are disabled if there is conflict. If actual configuration set wrong, the S300 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: **$ CL** = message identifier
n = mnemonic for Convert Error Code to Error Message
message = the error code
*CRC16 = the error message
= 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 iterations>,<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, 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 S300-1.14 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
1 = 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 identifies 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 identifies 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 modes. 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

Multiple target operating modes. 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.

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 2nd 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

$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. The 4mA value is not required to be less than the 20mA value. If 4mA value is greater than 20mA value, S300 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 S300 is configured as periodic sampling. Once S300 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 gets the same response as if the Ext-Trig control signal is activated and held active.

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

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 "$GO,8". If <number of measurements> is omitted, it executes same as the previous run. To extend laser diode life time, the S300 can measure periodically. For example, if 10 measurements are required every 20 seconds, enter "$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 TruSenseS300**-version-build number, firmware date, **4E62F63C*A8CD<CR><LF>**

where:		
	$	= message identifier
	ID	= mnemonic for firmware version information
	DS-200	= product model
	TruSenseS300	= 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 S300-1.14.53, FEB 12 2013,4E62F63C*A8CD

$IS $IS<CR><LF>

Instrument Status **$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>

$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.
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.

Automatic Start is recommended to command the sensor to start operation after a power restart.

$MU Change Measurement Unit

Note: Some models may not allow this command.

Set: **$MU,***u,*NN,K,MM**<CR><LF>** Instrument Reply: **$MU,**u,NN,K,MM*CRC16**<CR><LF>**
Get: **$MU<CR><LF>** Instrument Reply: **$MU**,u,NN,K,MM*CRC16**<CR><LF>**

where:
- **$** = message identifier
- **MU** = mnemonic for Measurement Units
- u = measurement units
  - 0 or m = meters
  - 1 or f = feet
  - 2 or y = yards
- N1 = decimal point for display, display is locked on 2 decimal places
- N2 = decimal point for serial output, output is locked on 3 decimal places
- K = KPH
- M1 = decimal point, cannot be changed
- M2 = decimal point, cannot be changed

*CRC16 = 16-bit CRC
<CR> = carriage return
<LF> = line feed

$OP Output Precision

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

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

where:
- **$** = message identifier
- **OP** = mnemonic for Output Precision
- *n* = Output Precision
- *CRC16 = 16-bit CRC
- **<CR>** = carriage return
- **<LF>** = line feed

$OZ Instrument Temperature

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

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

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

Example Reply: $OZ, 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 lifetime, the S300 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 in volatile memory. Use **$SV** or **$PD** to store the Update Period into non-volatile memory.

$RD Set Trip Distance

S300 and S310 will assert trip output when distance is greater than min value and less than max value.

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

where:		
	$	= message identifier
	RD	= mnemonic for Trip Distance
	x y	= minimum value
	z	= measurement unit
	*CRC16	= maximum value
	<CR>	= carriage return
	<LF>	= line feed

$SG SHORT GATE

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

Where $ = message identifier
SG = mnemonic for Display Short Gate
n = Display Short Gate = distance in measurement units configured
*CRC16 = 16-Bit CRC
<CR> = carriage return
<LF> = line feed

Example: $SG,0.00,F*2C3F
$SG,0.00,M*EB7E

$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

Note:

$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 S300 will draw an 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, available on S300 and S310 only	
		*CRC16	= 16-bit CRC	
		<CR>	= carriage return	
		<LF>	= line feed	

Note: The S310 Trigger recommended input voltage is **5 VDC**. The sensor trigger will activate down to **3 VDC**. Trigger duration must be **40ms** or greater.

$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:	$UOLF>	Instrument Reply:	**$UO,***n**CRC16**<CR><LF>**

where:	**$**	= message identifier
		= mnemonic for User Offset
		= User Offset. Either positive or negative from the faceplate
	n	= 16-bit CRC
	*CRC16	
	<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 (S310 and S330 Only)

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

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

NOTE: Because a laser pointer has different operating temperature ranges, it may not accept the **$VO** command if it is too cold or hot.

$VF Turn Laser Pointer Off (S310 and S330 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

NOTE: Because a laser pointer has different operating temperature ranges, it may not accept the **$VF** command if it is too cold or hot.

$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.

8 Application References

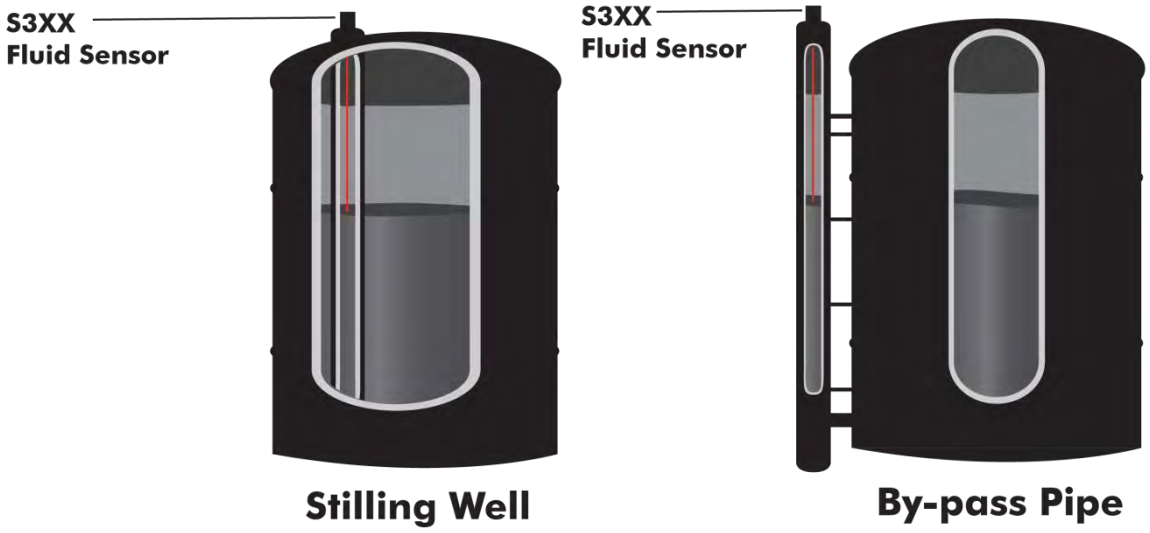
Application Examples

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

Liquid Measurement

To measure the material depth in the tank or silo (the top of a liquid):

- The sensor must be able to penetrate air-born fog or mist inside of the silo. Choose Last Target for this.
- Set the unit to begin measuring upon power up - enable Autostart. Autostart will allow sensor to automatically re-start after a power re-start. See command, $MA.
- Each type of liquid may react differently and the user will need to adjust the settings for optimum performance.
- Measuring liquid in an agitated state might achieve better results if a stilling well or a by-pass pipe is used, as shown below.



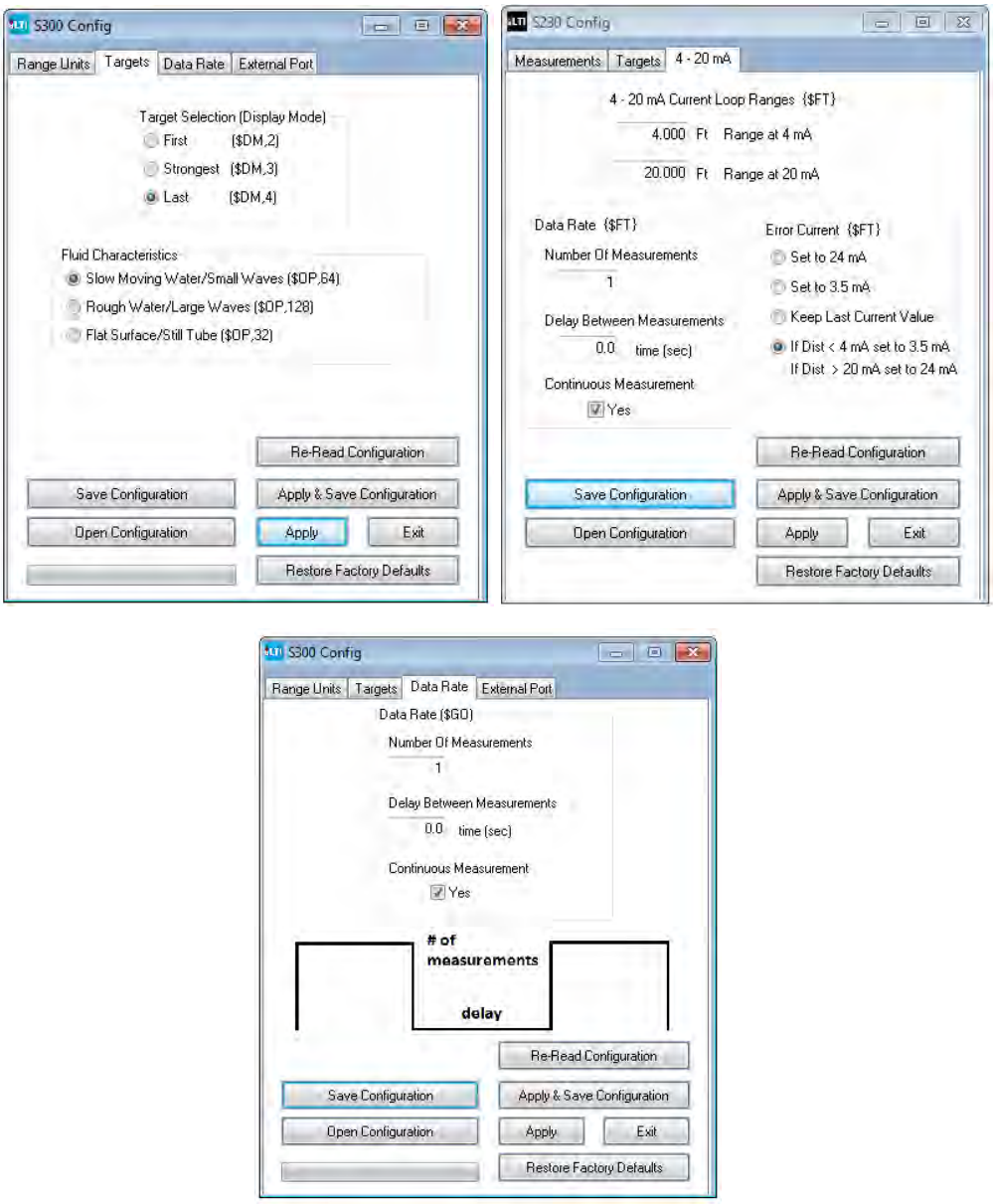


Figure 10 Tank and Silo Liquid

HART Communication

The HART compatible model allows the user to communicate 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*

Table 2: HART Commands

Figure 11 HART Settings

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

Table 3: SDI-12

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!013LASERTECHS3
00

9 Specifications

Performance:	Min. Range:	46 cm (1.5 feet)
	Max. Range:	200 meters (656 feet) without beam diffuser 50 meters (164 feet) with beam diffuser
	Accuracy:	±4 cm (0.1 feet)
	Data Output Rate:	Option 1: <1 up to 14 Hz depending on target.
	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 30 cm at 100 meters or (1 foot beam diameter at 328 feet)
	I/O:	S-300 = TRIG,SDI-12, RS232 no alignment laser S-310 = TRIG, SDI-12, RS232 with alignment laser S-330 = 4-20 HART, RS232 with alignment laser
	Input Power:	12-24 VDC
	Current Draw:	Measuring = 150 mA, Standby = 40 mA
Physical:	Dimensions (LxWxH):	104.4 x 81.7 x 41.6 mm (4.11 x 3.22 x 1.64 in)
	Weight:	Standard = 138.6 g (4.8 oz) OEM = 76 g (2.7 oz)
	Housing & Frame Material:	Glass-filled polycarbonate
Environmental:	Eye Safety:	Class I, 7mm (FDA CFR21)
		Class 1m (IEC 60825-1:2001)
	Shock Vibration:	MIL-STD-810
	Moisture:	IP67 (for cased version)
	Operating Temperature:	-28º to 60º C (-20º to 140º F)

10 Error Codes

Error Code	Description
0	Good. No error
7	Light interference, (normally, old fashion jammer, sunshine, lamp)
52	Temperature is cold -25 degree Celsius (-13F). Wait a minute for warm up
59	RX_Cal Error.
63-67	Memory Error, call LTI for service
68	High voltage error from TX board (*68 and 70 can happen together)
69	TX reference signal error
70	High voltage error from TX board (*68 and 70 can happen together)
71	If it persists, call LTI for service
Note	If critical errors happen more than 5 times, unit will re-boot automatically. Therefore, if unit re-boots periodically, call LTI for service

11 Troubleshooting

Problem	Remedy	Section Number
Sensor not powering on	Check all cable connections Check for broken connector pins Check power supply	12
Sensor not communicating	Check for broken connector pins Check the correct com port is available Verify the configuration and baud rate Check Output Setup Port	12 See PC operations 3, 4 Appendix B
Inaccurate measurement	Check if gate is set Verify measurement units	7, $SG 7, $MU
Error Codes	Reset configuration	9
Measurement not reading	Make sure lens is clean	Use a brush to remove surface dust. Use lens cleaning solution with lens cloth or tissue 11

12 Care and Maintenance

Operating Temperature

The S300 is rated for a temperature range of -28° to 60° C, (-20° to 140° F). Do not operate the instrument in temperatures outside of this range. It is recommended the laser sensor be allowed to warm up for several minutes to stabilize the electronics for accurate measurements.

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:	Use a small blower brush to blow off or brush away loose dust or debris
Dirty Lenses:	The best way to clean a lens is to use a piece of lint free lens cleaning tissue and a small amount of lens cleaning solution. Do not use anything containing abrasives or solvents. Place a drop or two of cleaner on the tissue (never directly onto the lens) and then wipe the lens in a circular motion, beginning in the center and working your way outward, removing any marks or smear. Do not use acetone; it could have adverse effects on the plastic, as well as the optical coatings. Avoid touching the lens with fingers, as this will leave oily smudges. Using household window cleaners is not recommended on coated optics. Only use dedicated lens-cleaning solutions, alcohol, or de-ionized water.

Returning Sensor for Repair

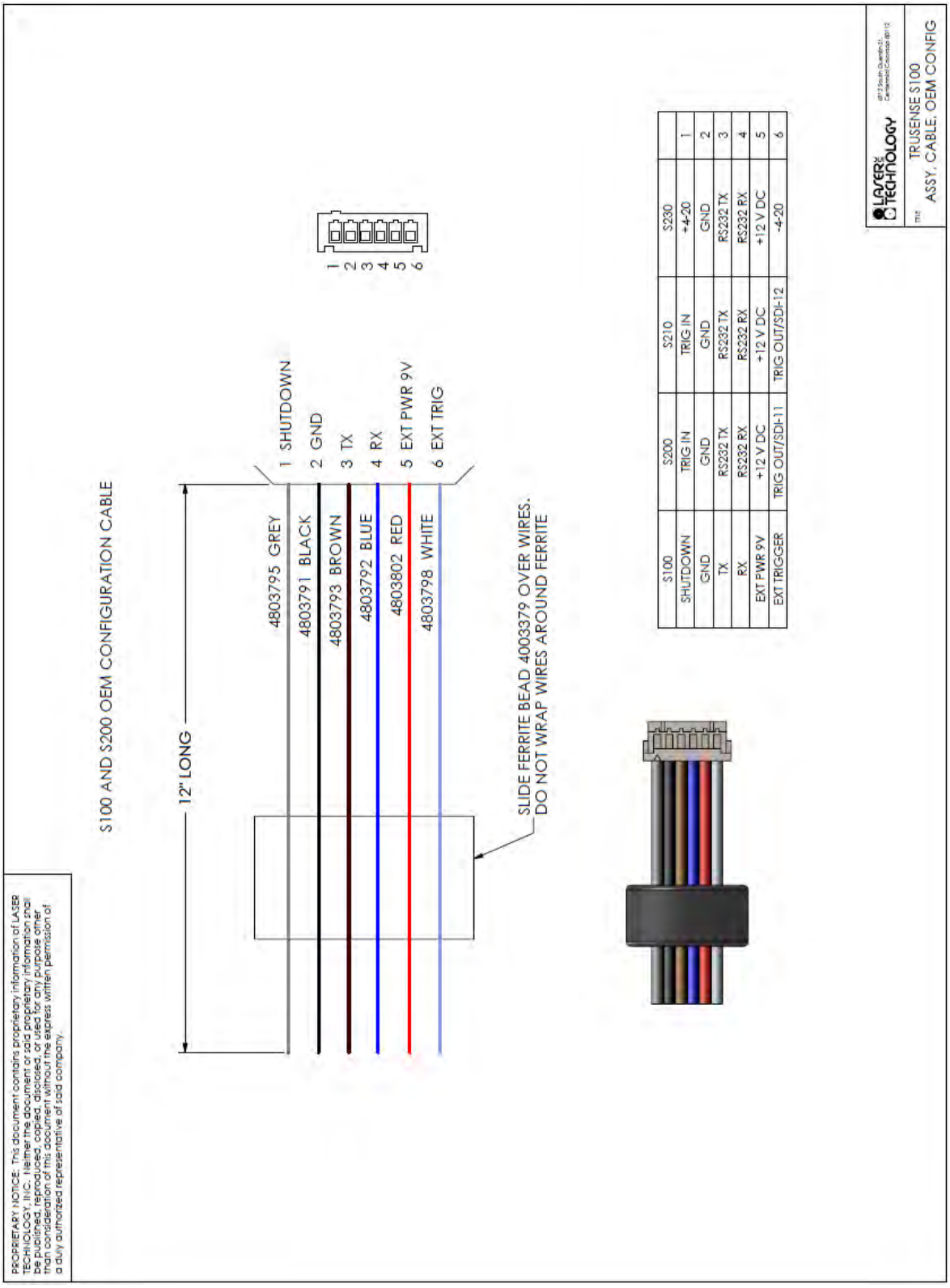
If repairs are necessary, go to the web site, http://www.lasertech.com/RMA-Service-Request.aspx?s=1 and fill out the RMA form.

WARNING:

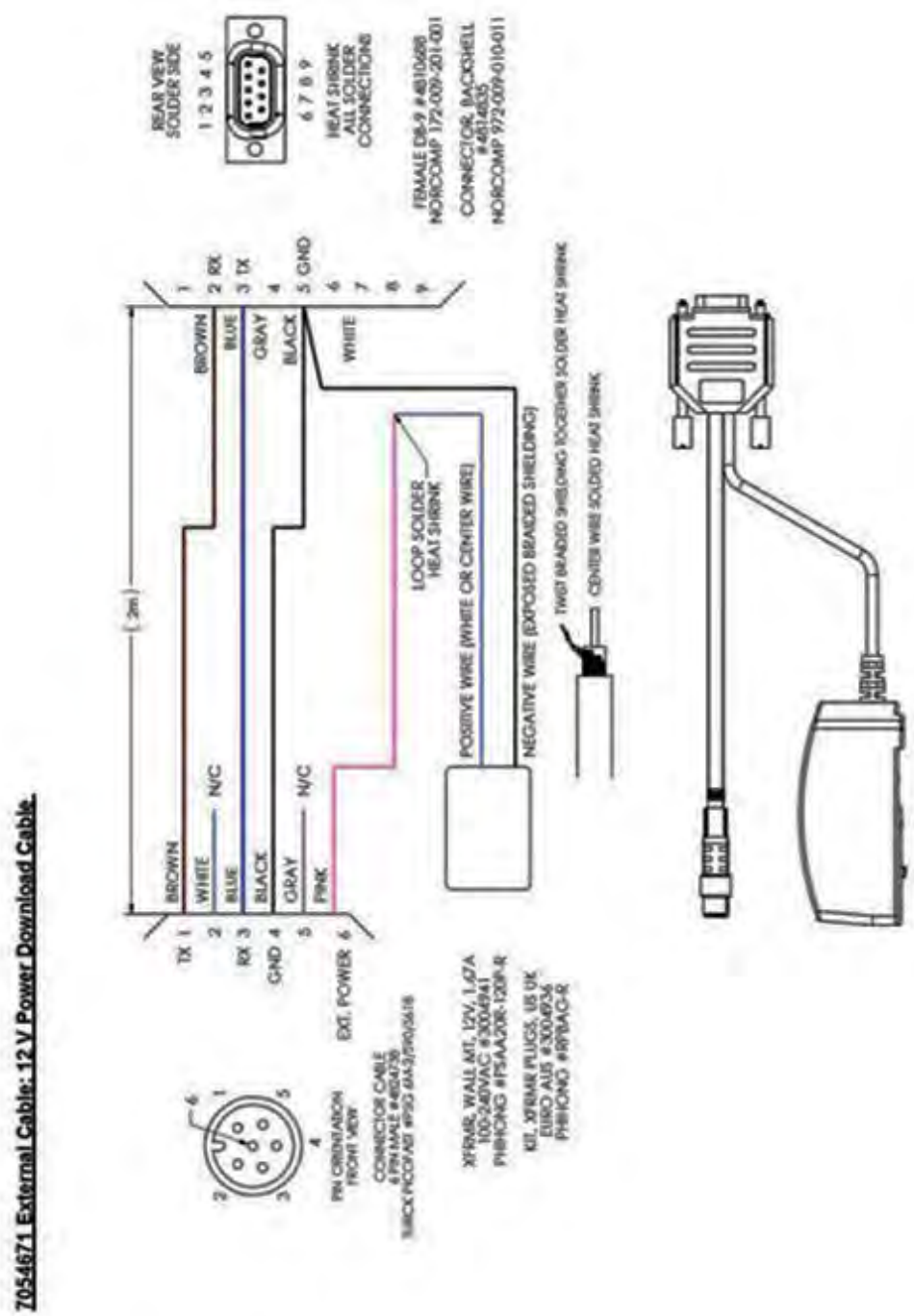
Any sensor that has been placed in a hazardous material environment or that has been potentially exposed to hazardous materials must be cleaned and decontaminated before being returned to Laser Technology or one of its authorized repair centers for service.

13 Diagrams - Wiring and Pinouts

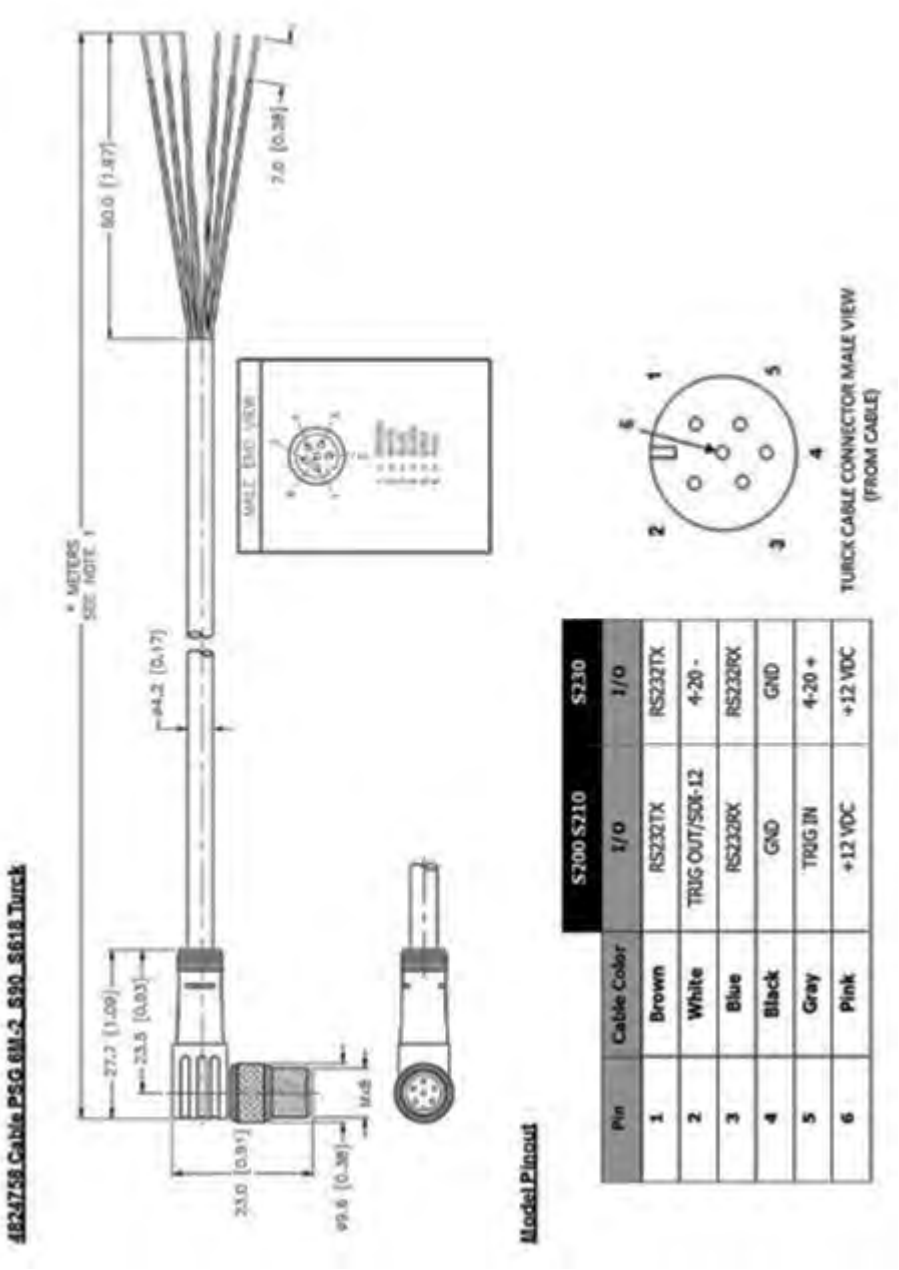
7054674 OEM Cable



7054671 External Cable: 12 V Power Download Cable

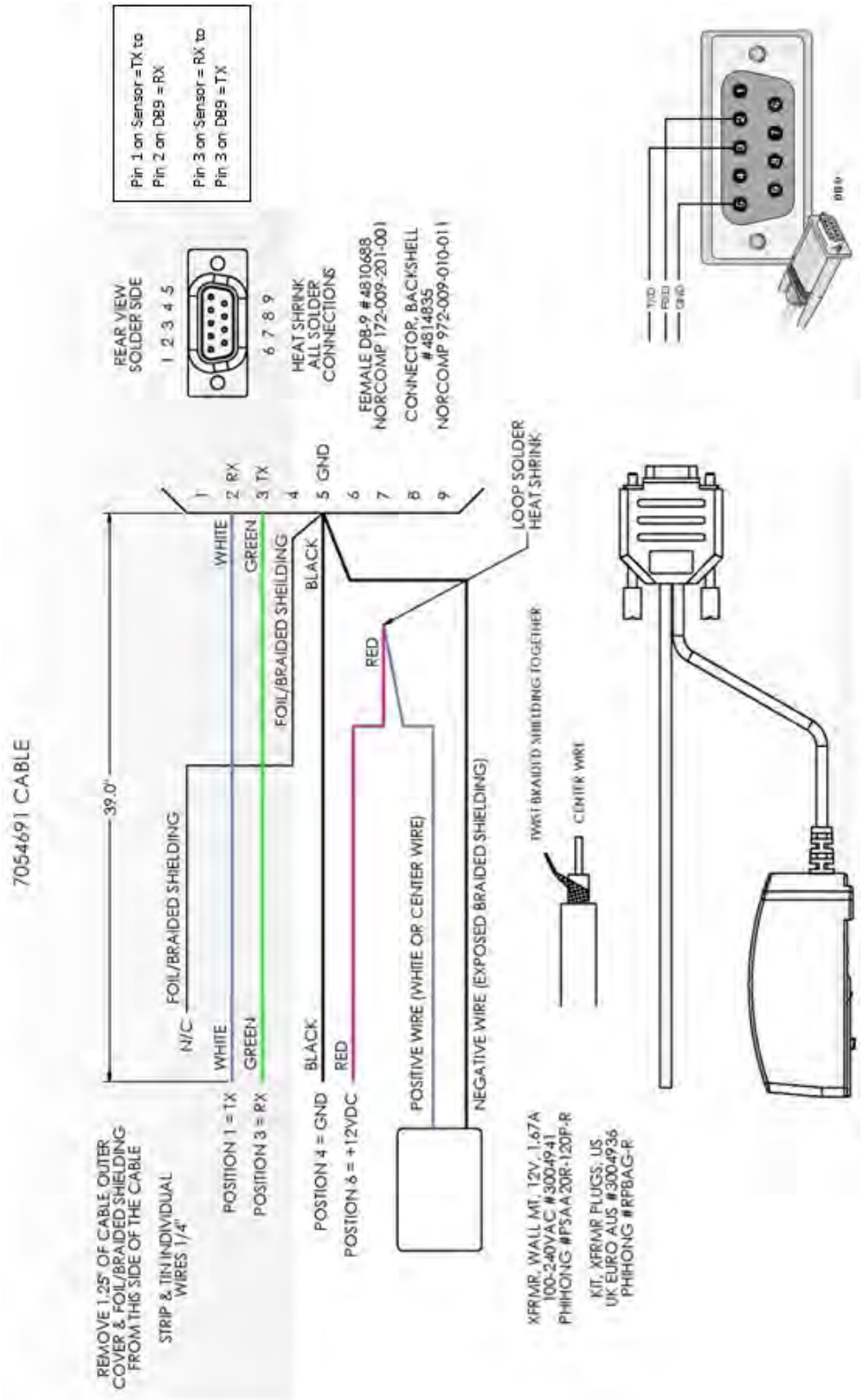


4824758 Cable Integration Cable with Leads

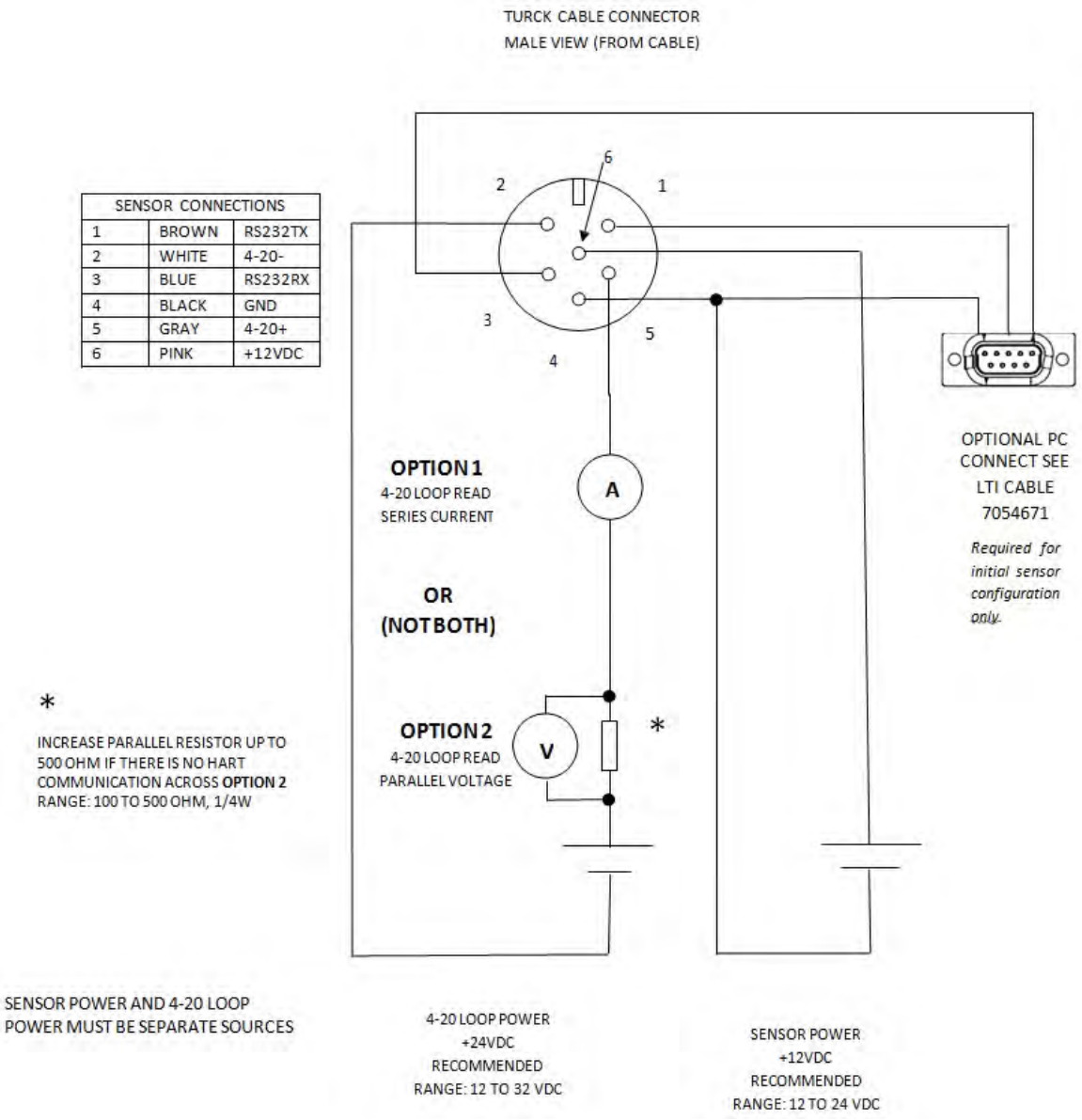


Pin	Cable Color	S200 S210 I/O	S230 I/O
1	Brown	RS232TX	RS232TX
2	White	TRIG OUT/SDI-12	4-20 -
3	Blue	RS232RX	RS232RX
4	Black	GND	GND
5	Gray	TRIG IN	4-20 +
6	Pink	+12 VDC	+12 VDC

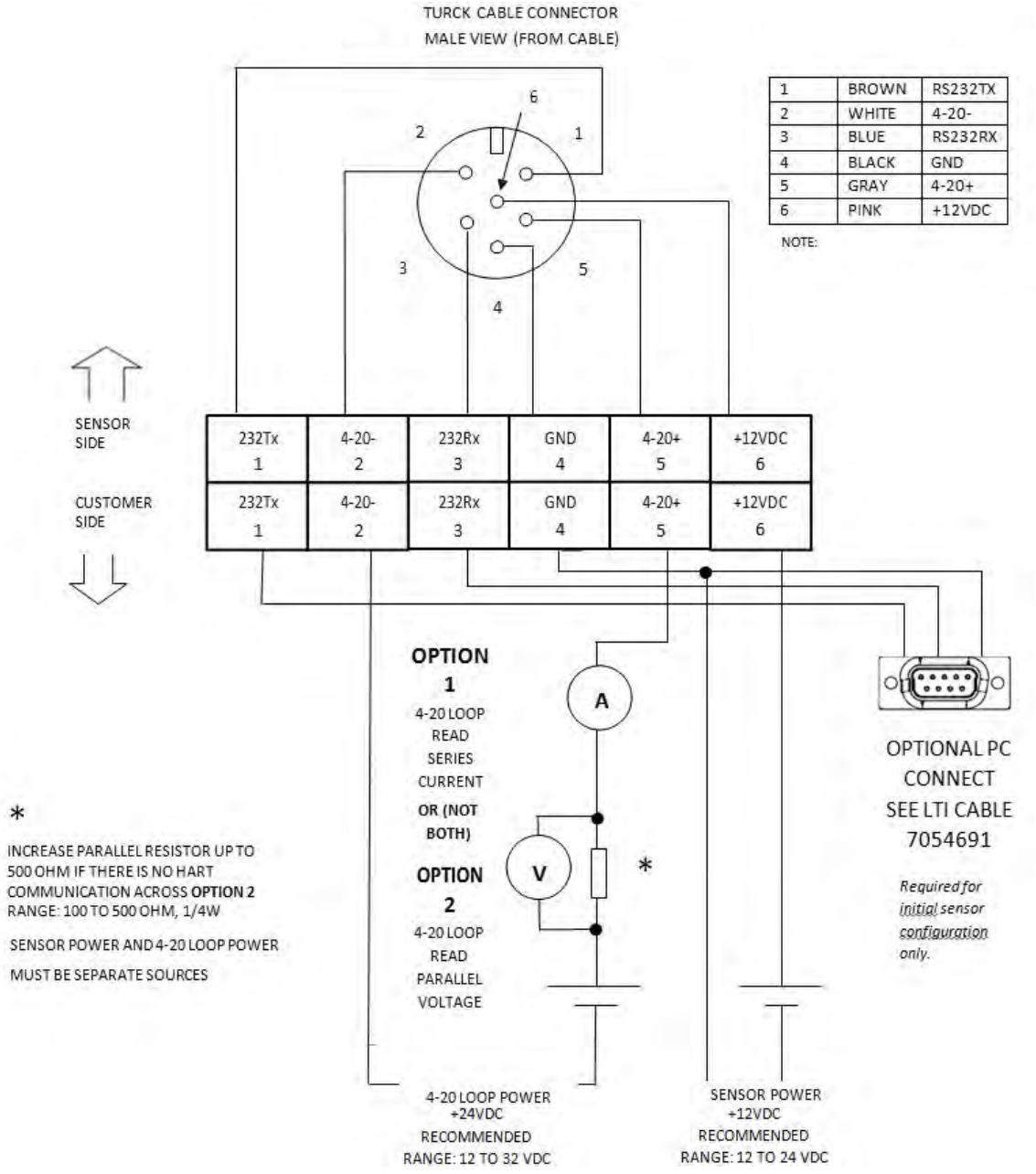
7054691 External Cable: Ruggedized Enclosure Terminal Block Cable



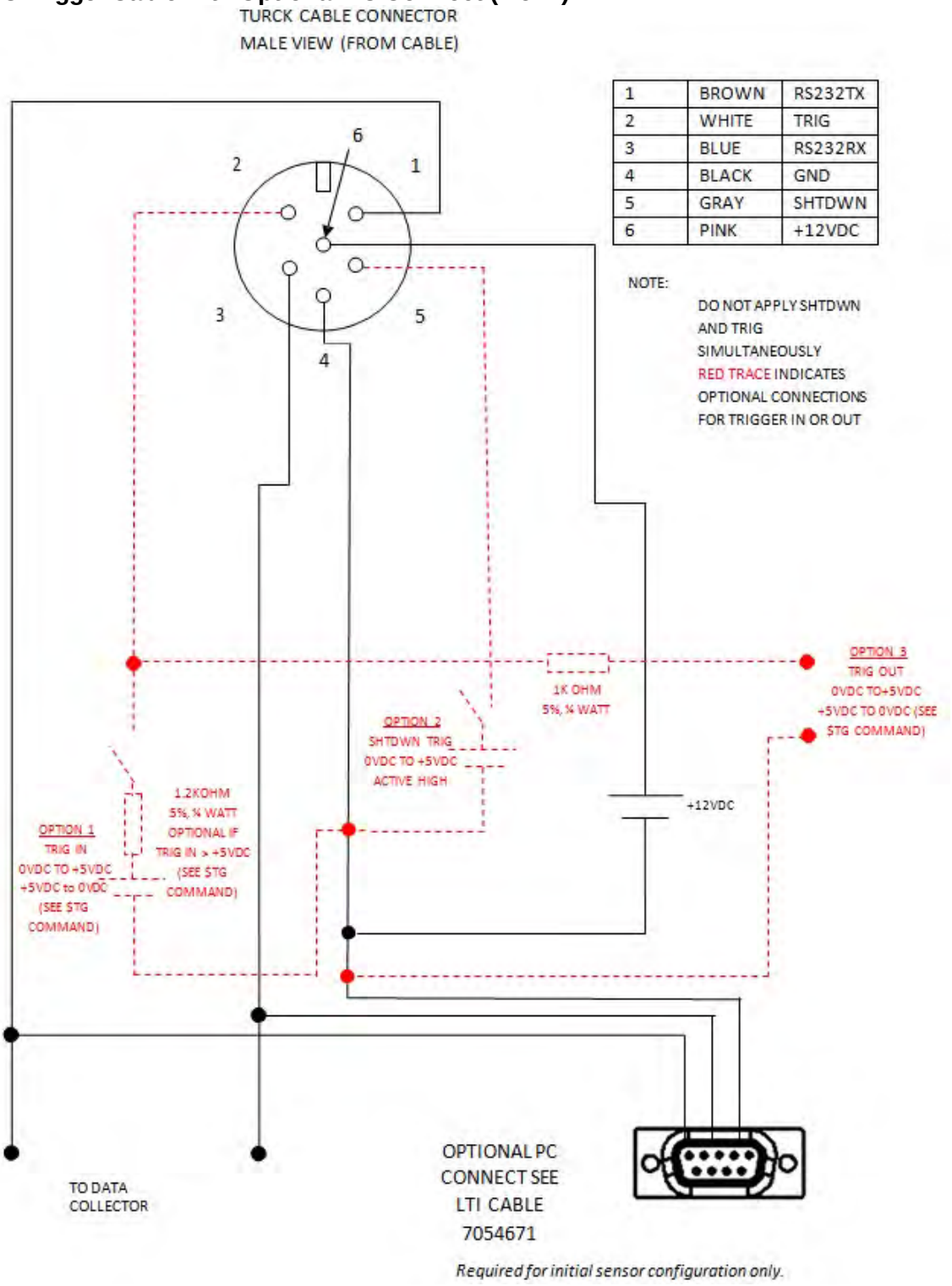
S330 4-20 Cable with Optional PC Connect (1 of 2)



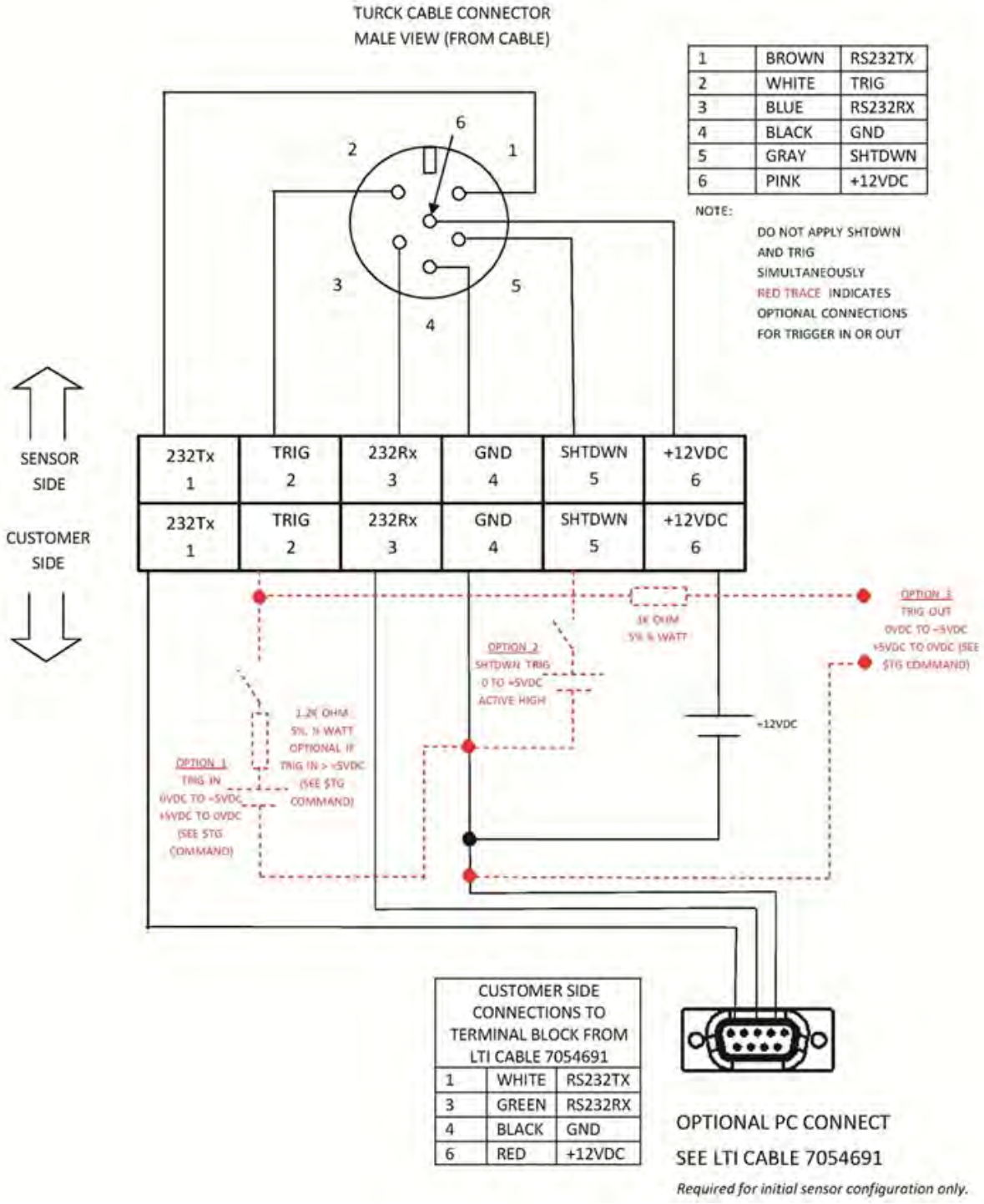
S330 4-20 Ruggedized Enclosure Terminal Block with Optional PC connect (2 of 2)



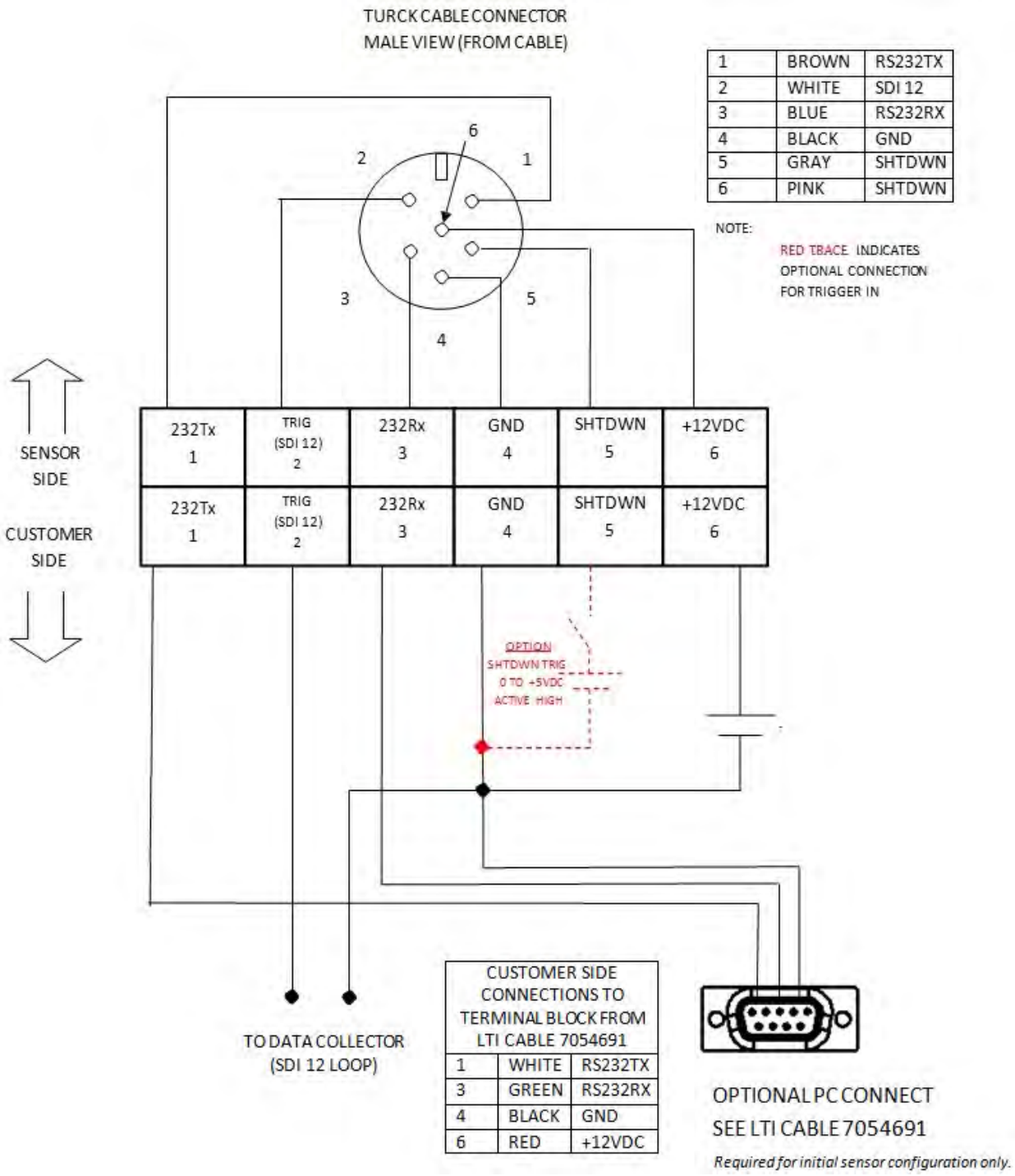
S300 / S310 I/O Trigger Cable with Optional PC Connect (1 of 2)



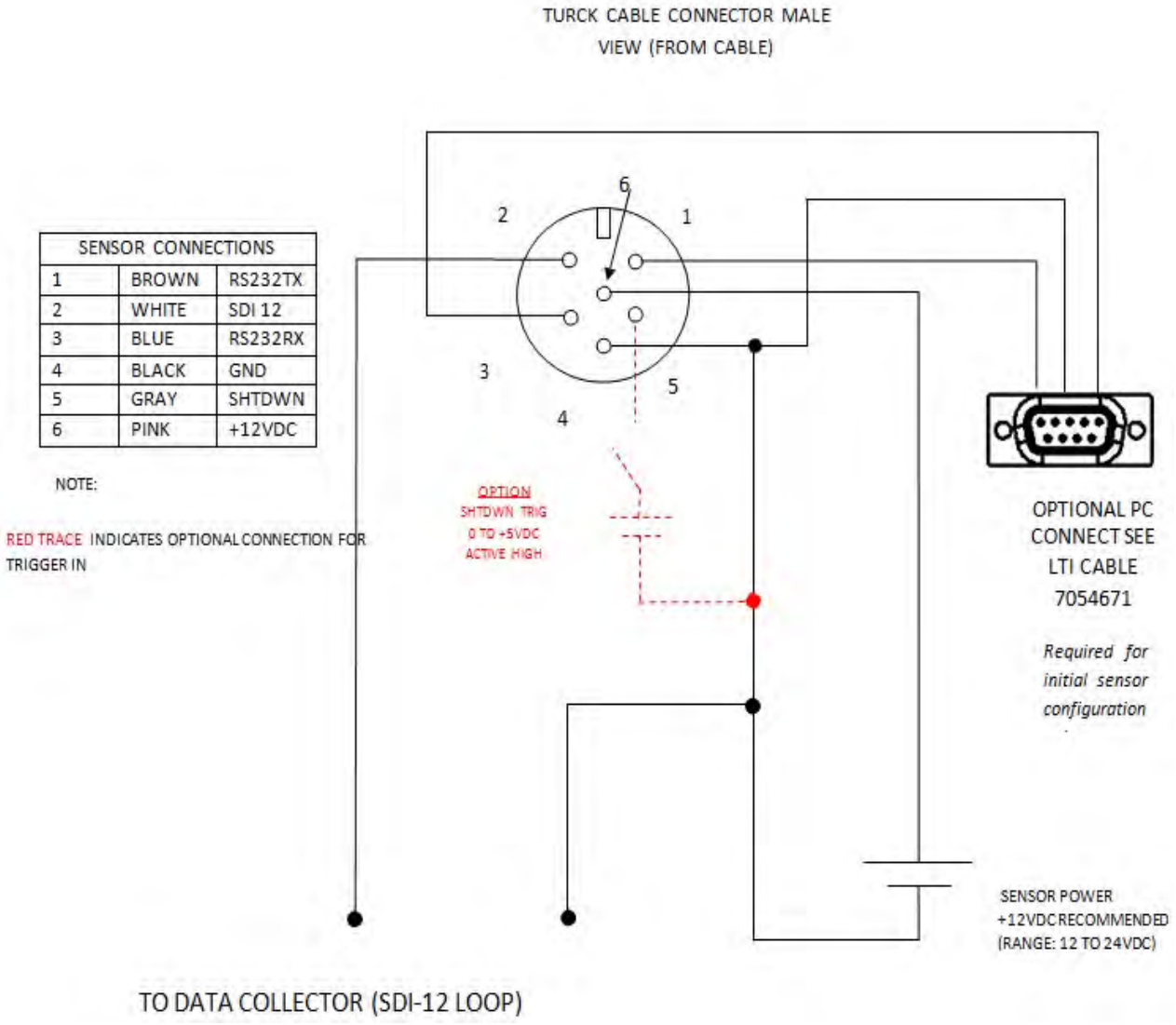
S300/S310 I/O Trigger Ruggedized Enclosure Terminal Block w/Optional PC Connect (2 of 2)



S300 / S310 SDI-12 Ruggedized Enclosure Terminal Block with Optional PC Connect (1 of 2)



S300 / S310 SDI-12 Cable with Optional PC Connect Wiring Diagram (2 of 2)



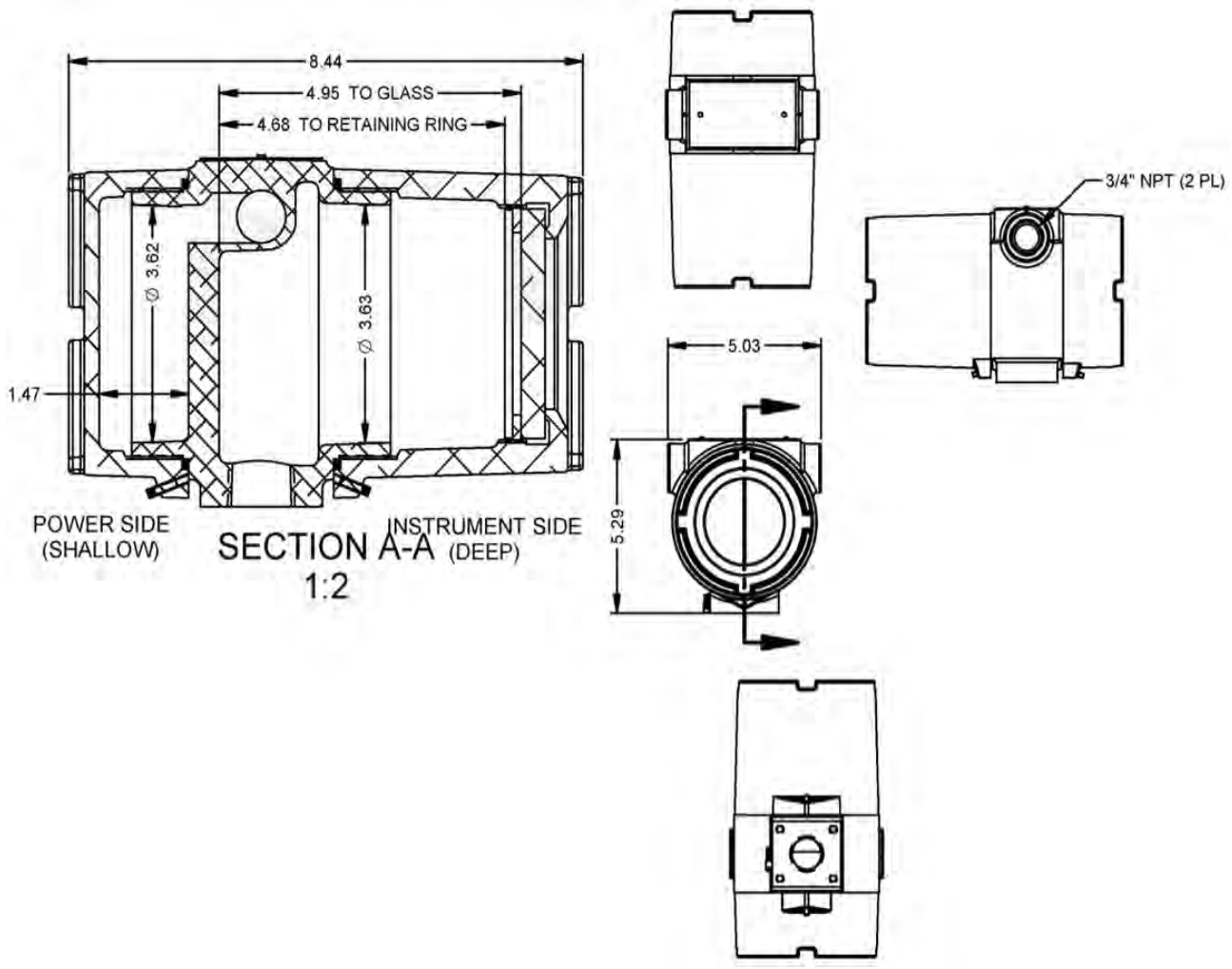
SENSOR CONNECTIONS		
1	BROWN	RS232TX
2	WHITE	SDI 12
3	BLUE	RS232RX
4	BLACK	GND
5	GRAY	SHTDWN
6	PINK	+12VDC

NOTE:

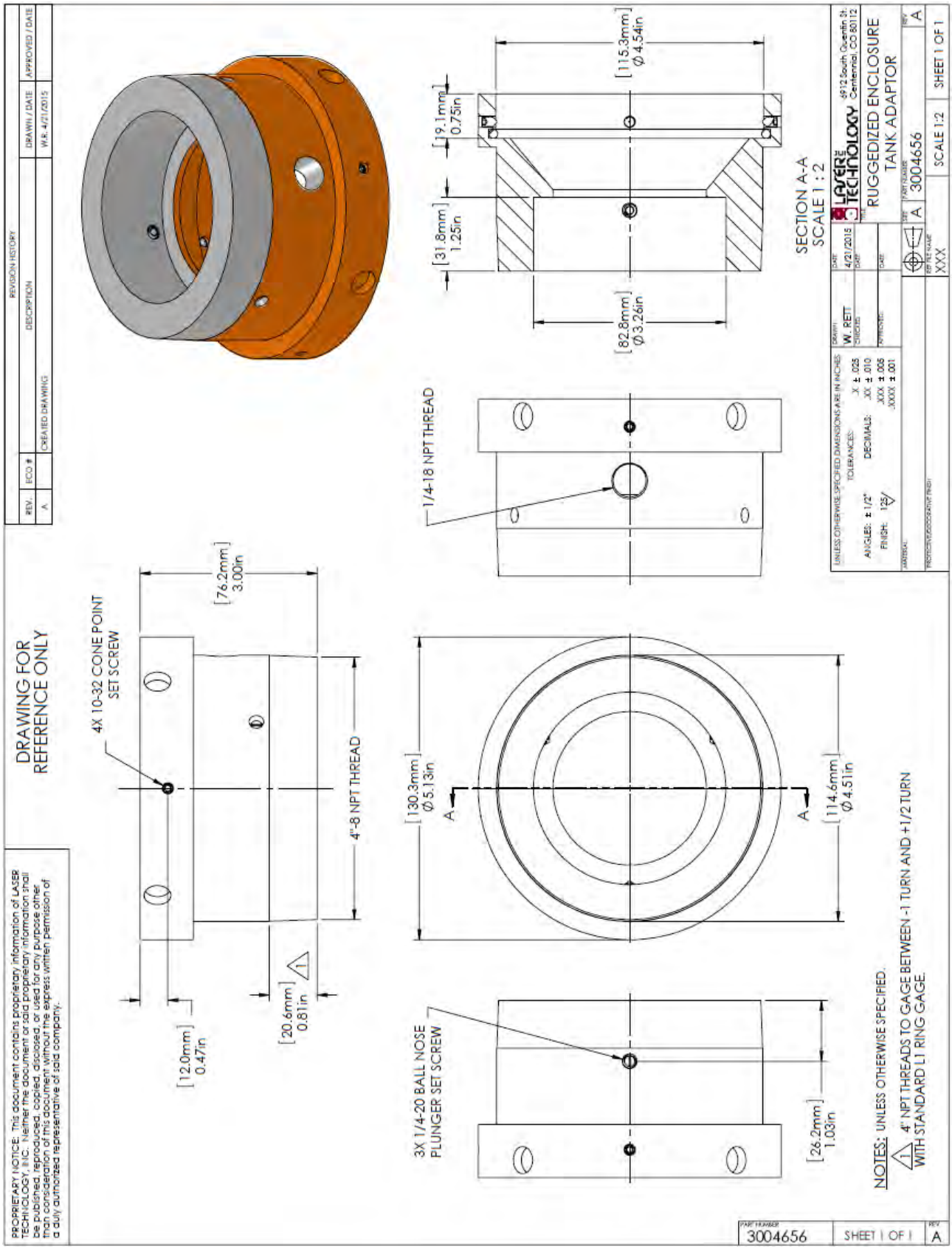
RED TRACE INDICATES OPTIONAL CONNECTION FOR TRIGGER IN

14 Diagrams - Mechanical

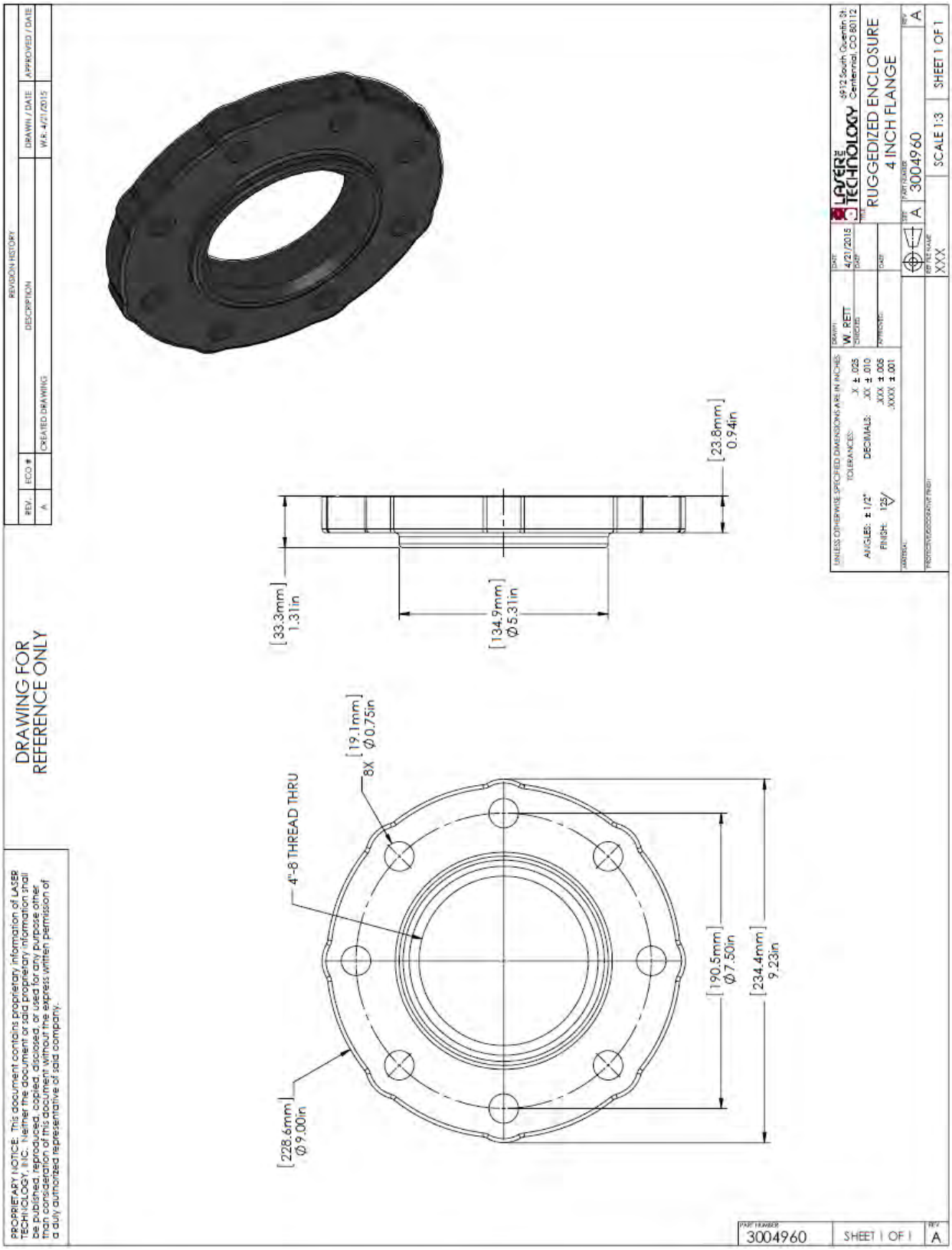
Ruggedized Enclosure



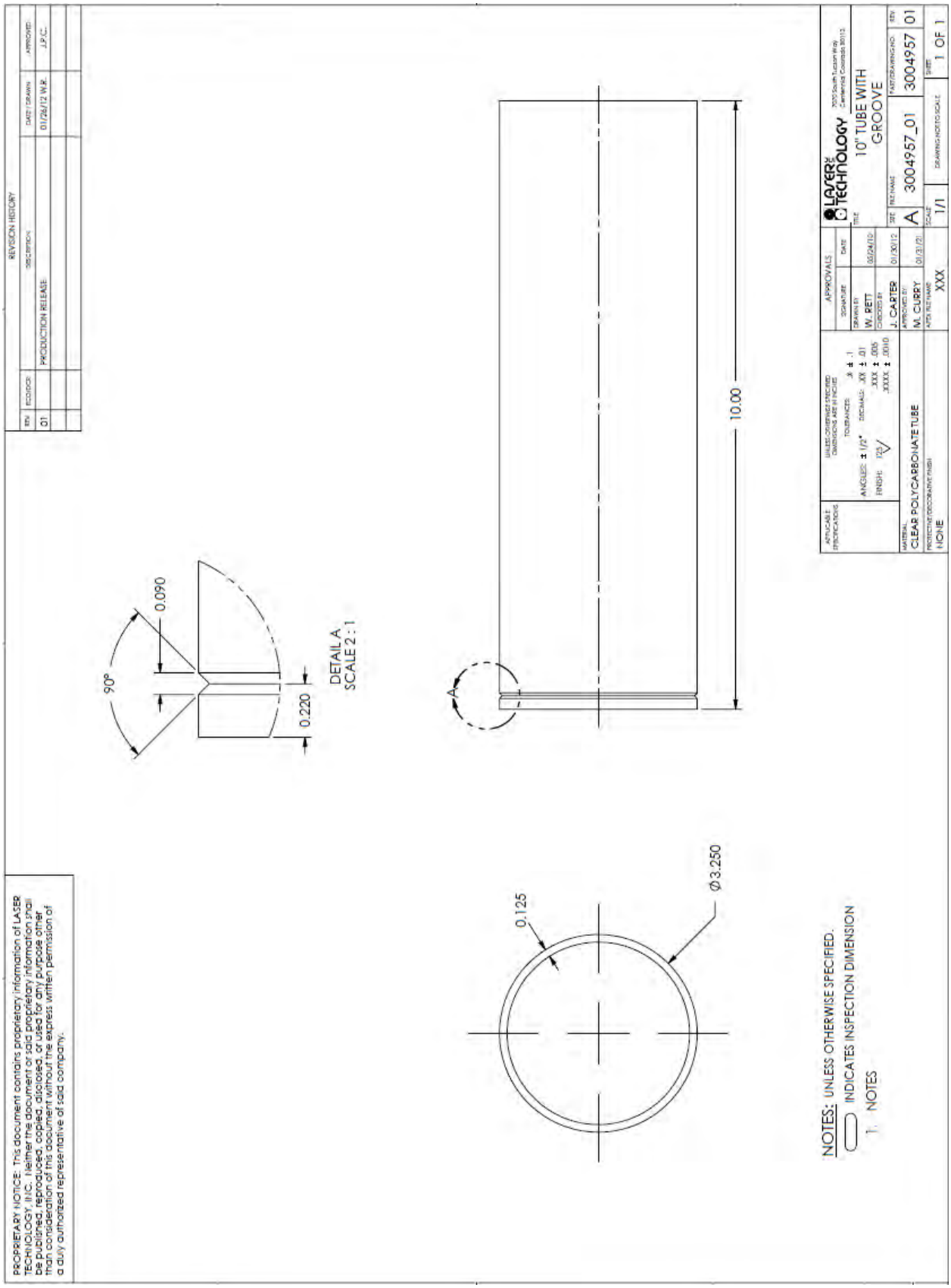
3004956 Tank Adaptor



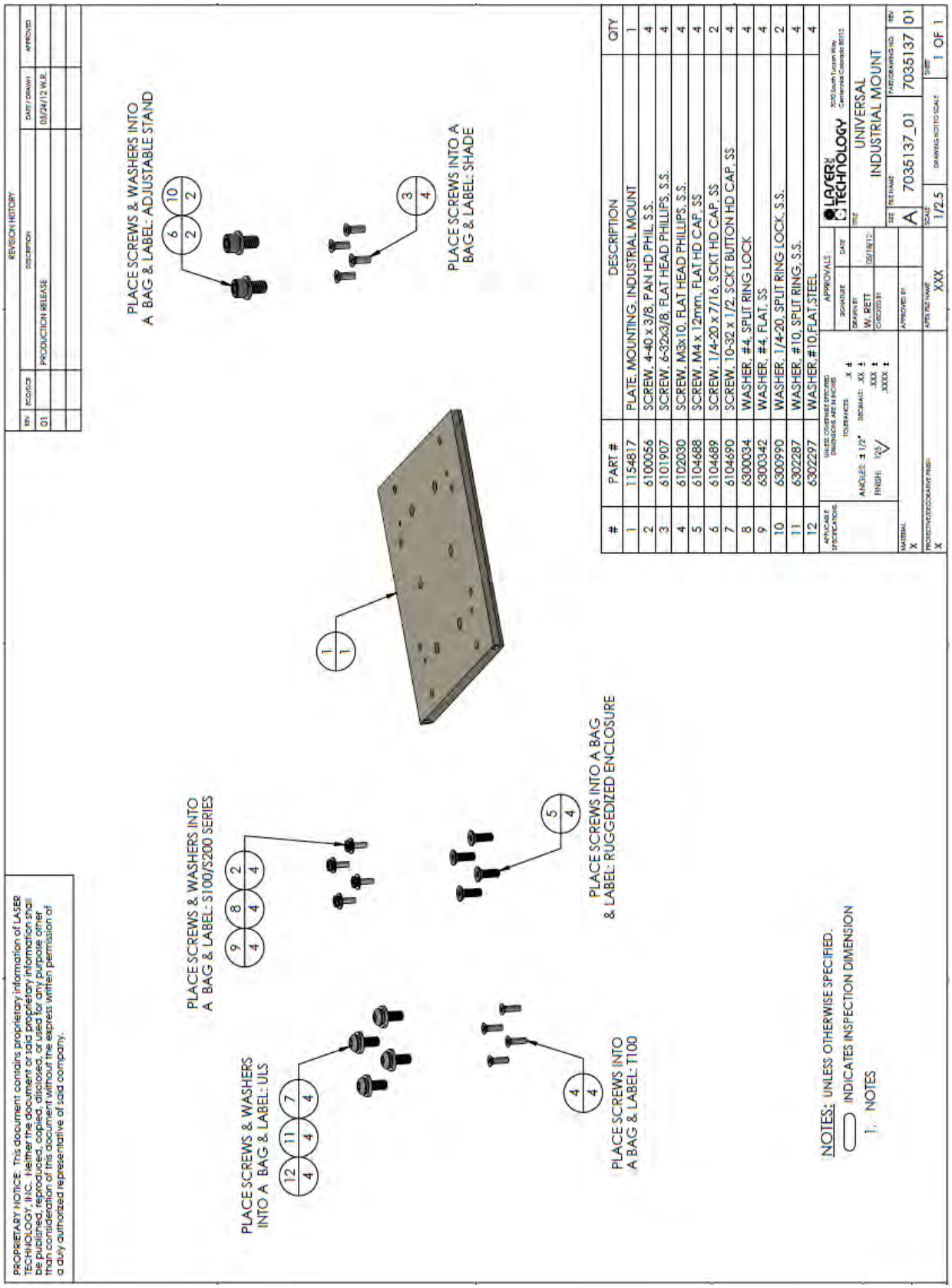
3004960 4 Inch Flange



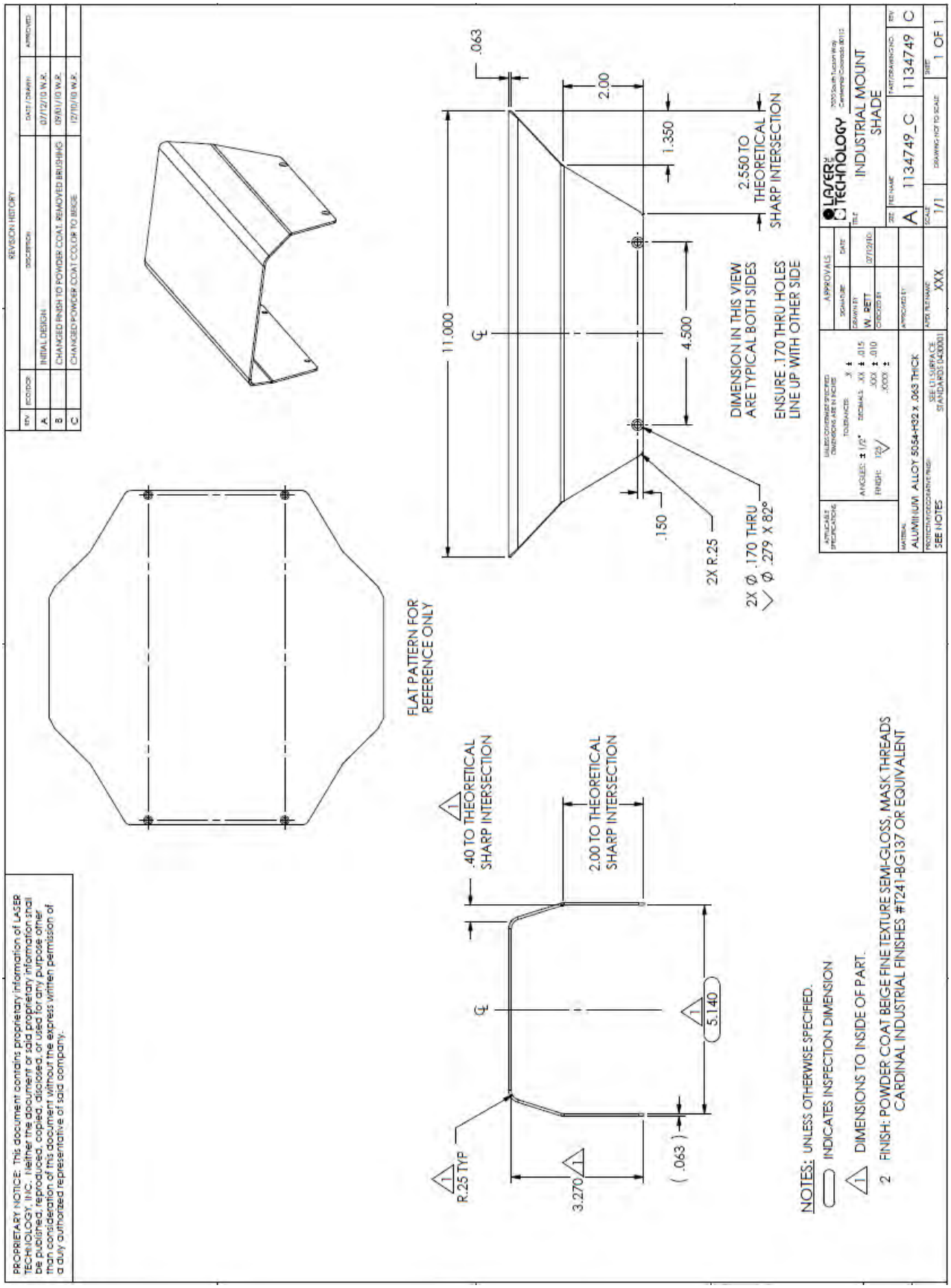
3004957 Dust/Splash Tube



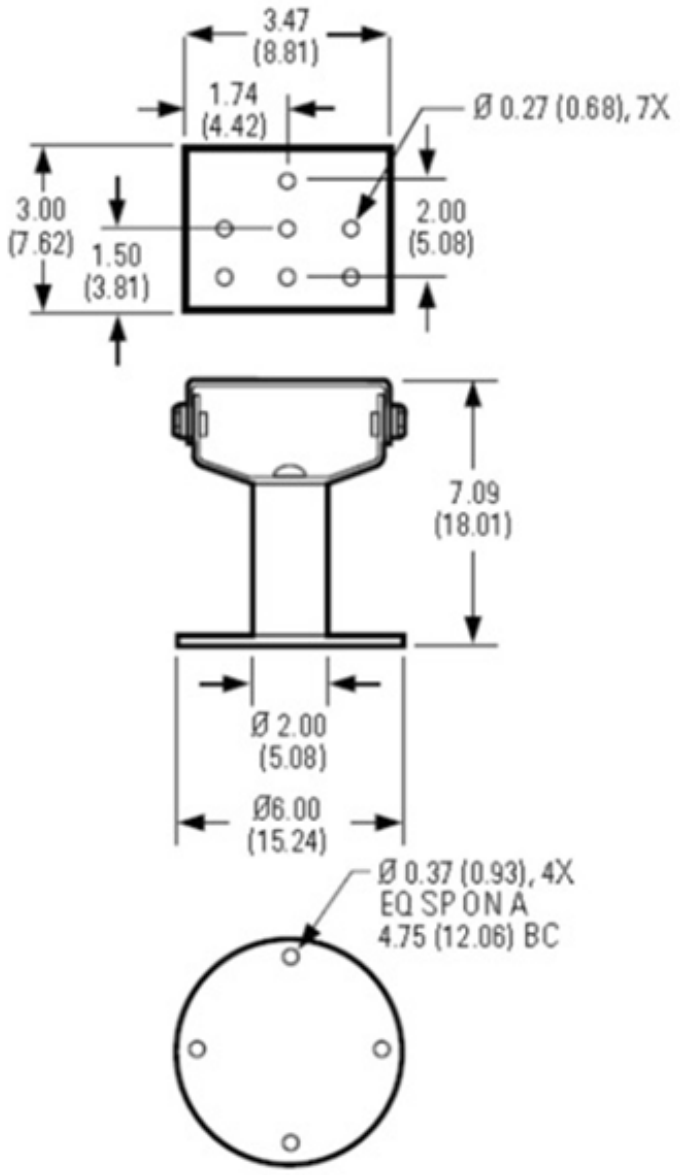
77035137 Mounting Plate



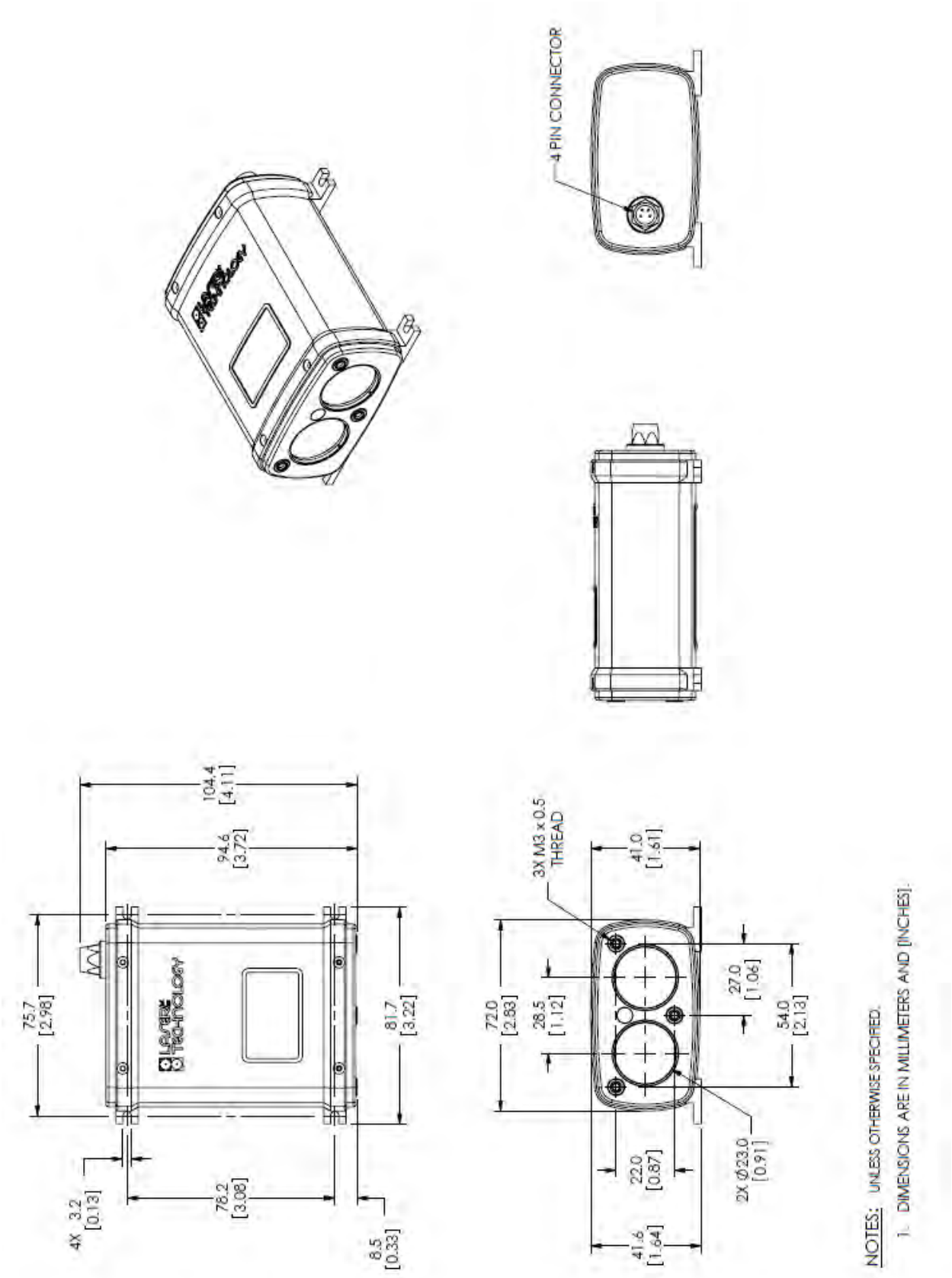
1134749 Sun Shade Industrial Mount



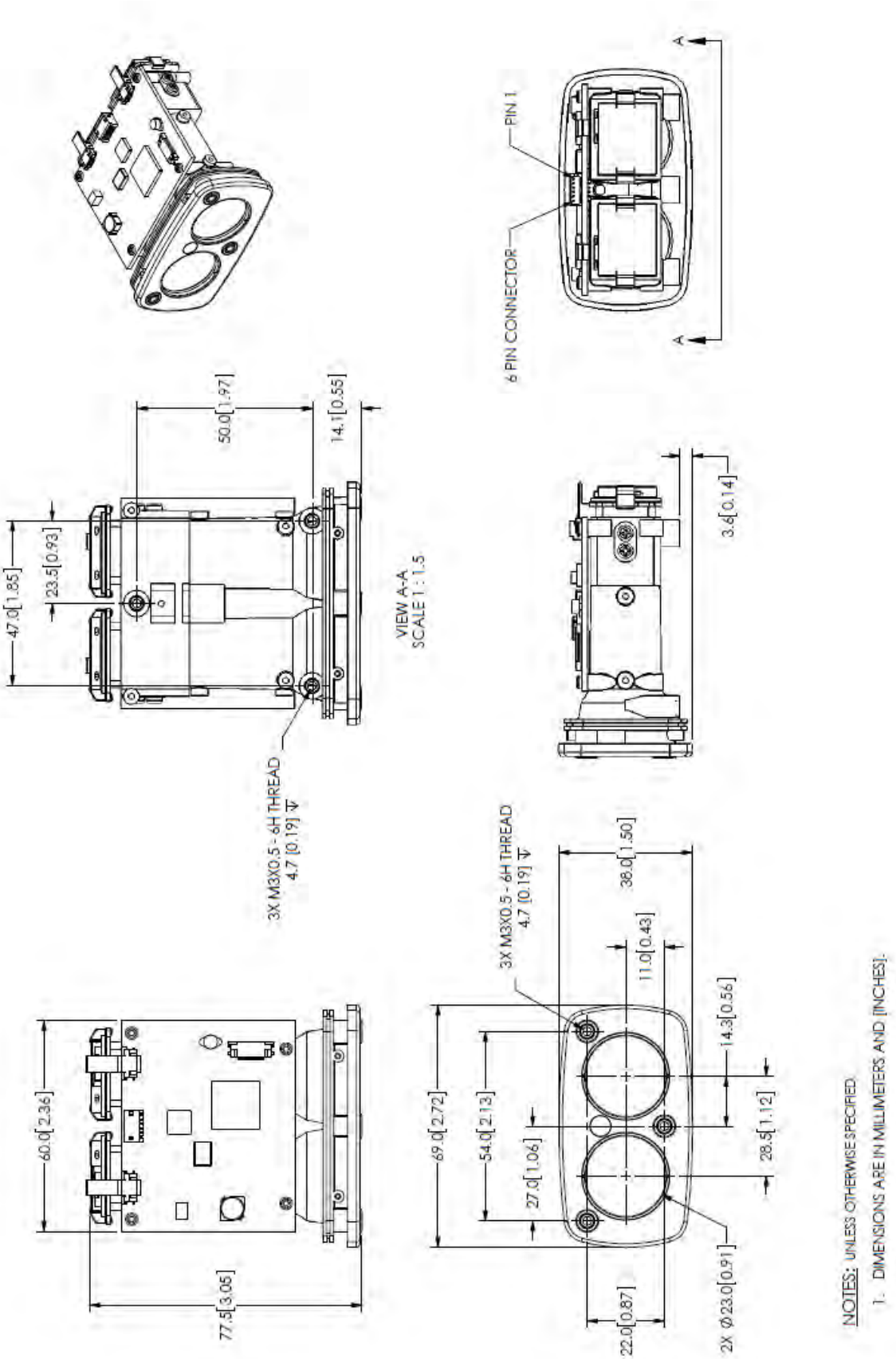
3004959 Swivel Mount



Housed Model Dimensions (without Diffusing Lenses)



OEM Model Dimensions



9 Appendix A – Ruggedized Enclosure for the TruSense S300 Series

US Ratings for Enclosure:

Division Ratings

Classified

Class I, Div 1 Groups B, C, D
Class II, Div 1 Groups E, F, G
Class III
Type 4x

Zone Ratings

Class I, Zone 1, AEx d IIC
Ex d IIC
Class III
Type 4x
Approved Instrument Housing
Class I, Div 1 Groups B, C, D FM 3615
Class II, Div 1 Groups E, F, G
Type 4x

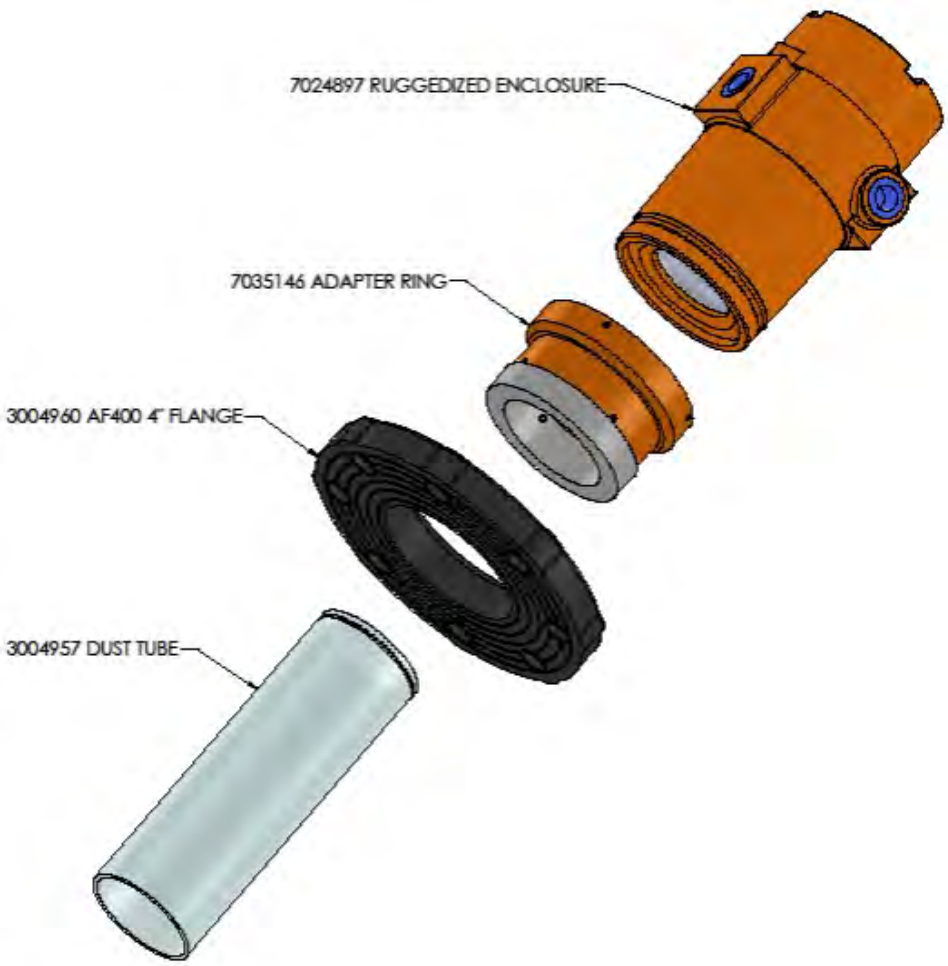
Global Ratings

ATEX (flameproof–DEMKO)
II 2G Ex d IIB+H2
II 2D Ex tD A20
IP66
IECEx (flameproof–UL)
Ex d IIB+H2
IP66 IEC60529

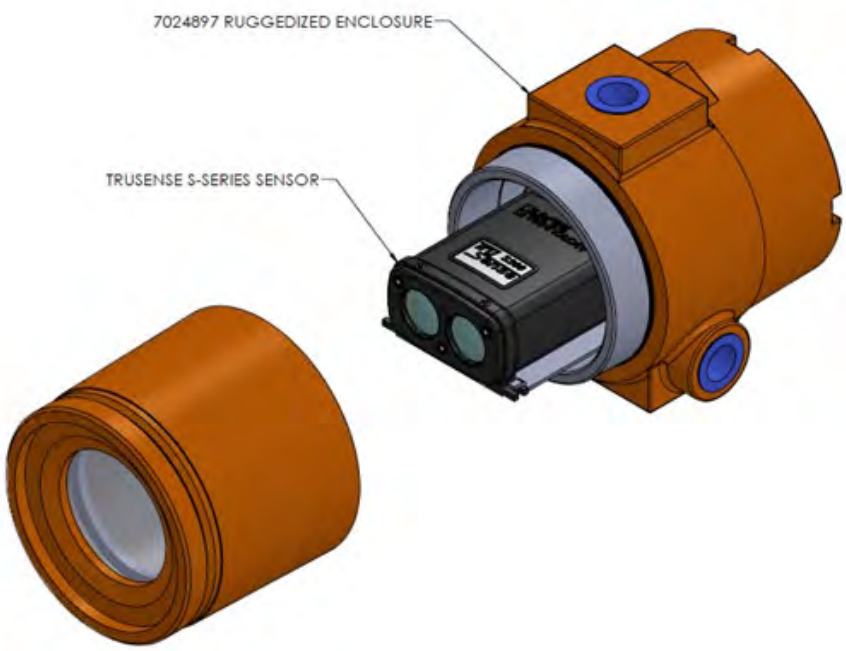
Physical

Weight: 8 lbs (3.62kg)
Dimensions: 5 in diameter x 10 in long (12.7 x 25.4 cm)
Conduit fitting: 3/4 in NPT

The Ruggedized Enclosure components:
Enclosure, Adapter, Flange and Dust Tube



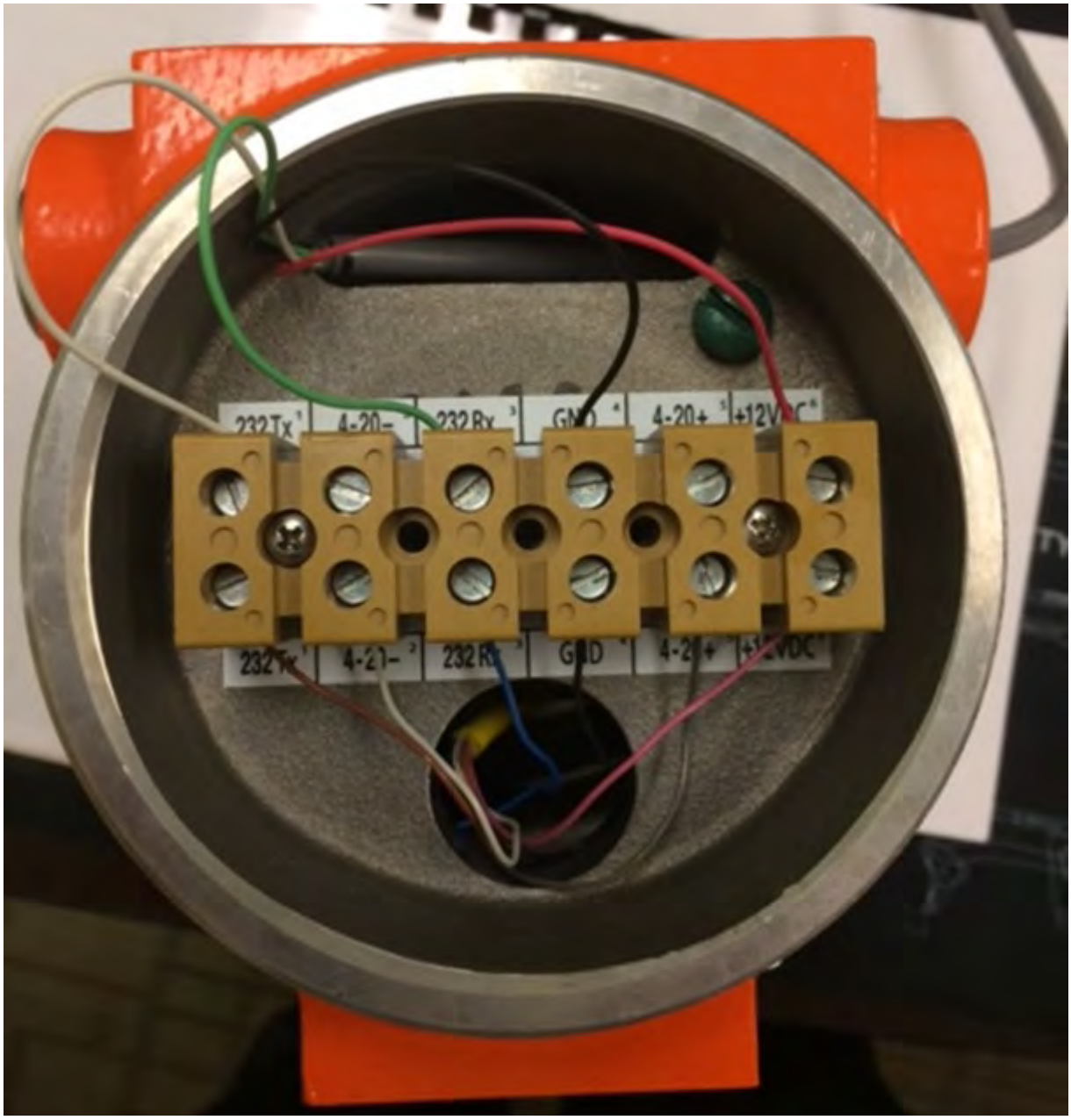
The S200 series sensor mounted inside the enclosure:



Ruggedized Enclosure Parts List

	Description	Part Number
	Ruggedized Enclosure	7024897
	Tank Adaptor	7035146
	4 inch Flange	3004960
	Dust/Splash Tube	3004957
	Spanner Wrench	9034501

Ruggedized Enclosure Wiring

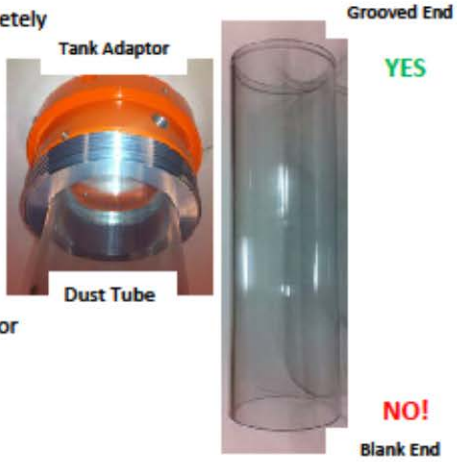


Ruggedized Enclosure Installation Instructions & Cautions

Fold and place this in the rear terminal block location of the Ruggedized Enclosure prior to shipping

IMPORTANT

- Do not open the sensor (window) side of Ruggedized Enclosure. This side of the Enclosure is locked at the factory. Failure to comply with this will result in sensor damage and voids the warranty
- Only open the decal side or back of the Enclosure for wiring
- If using the Tank Adaptor, completely seat home the Ruggedized Enclosure into the Tank Adaptor before securing the set screws around the Tank Adaptor. Push firmly on top of the Ruggedized Enclosure until it seats completely past the Tank Adaptor o-ring and is level in the Tank Adaptor-when enclosure is completely seated home into the Tank Adaptor-secure the set screws (4 each with a 3/32" Allen Wrench) around the Tank Adaptor to firm (do not over tighten)
- (Do not tighten the 3 flat grooved set screws near the 4 inch threaded portion of the Tank Adaptor)
- If using the Dust Tube with the Tank Adaptor, completely seat home the Dust Tube Grooved End into the Tank Adaptor ensuring the part "snaps" into place
- If using the Terminal Block PC cable this is for connecting the Ruggedized Enclosure to a PC and observing the readings and performing configuration changes for setup. This cable is not intended as a permanent field installation cable
- Reference the Diagram section of the User Manual for wiring instructions



LASER TECHNOLOGY INC.

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6912 S. Quentin St, Centennial, CO 80112 USA • Phone: 1 (303) 649-1000 • Fax: 1 (303) 649-9710 • www.lasertech.com

10 Appendix B - Definitions

Accuracy: the degree of conformity of a measurement to a standard or a true value.

Converge: two or more light rays proceeding inward toward a point.

Cooperative target: a highly reflective surface or object, such as a glass.

Crest: The crest is the top of a dam, dike, weir, or spillway, which water must reach before passing over the structure. (The highest elevation reached by flood waters flowing in a channel is also called the crest.)

Dielectric Constant- a physical property of all materials, this refers to the material's ability to conduct or hold an electric charge.

Diffuse reflection: a light striking a target and being scattered over a wide angle.

Diverge: two or more light rays proceeding outward from a point.

Electrostatic Discharge (ESD): A transfer of electrostatic charge between bodies at different electrostatic potentials caused by direct contact or induced by an electrostatic field.

ESD-Protective Material: Material capable of one or more of the following characteristics: limiting the generation of static electricity; safely dissipating electrostatic charges over its surface or volume; or providing shielding from ESD spark discharge or electrostatic fields.

ESD-Protective Packaging: Packaging with ESD-protective materials to prevent damage to ESDS items.

ESD Sensitive (ESDS) Items: Electrical and electronic parts, assemblies and equipment that are sensitive to ESD voltages

Eye safe: lasers emitting energy with no hazards to the human eye.

Frequency: the number of repeating events per unit of time. A 14 Hz laser firing rate means a laser is firing 14 times per second.

Harsh ambient conditions: the challenging atmosphere between the sensor and a target.

HART- (Highway Addressable Remote Transducer) an industry-standard "smart" protocol that extends basic 4-20mA functionality.

Infrared light: invisible light with wavelengths roughly between 700 nm and 1550 nm.

Laser: acronym for light amplification by stimulated emission of radiation. A device that produces a monochromatic coherent beam of light by energizing atomic energy levels.

Lens: an optical element that converges or diverges light.

Maximum range: the longest distance, the sensor can acquire a measurement.

Minimum range: accuracy may be compromised if a measurement is made from less than this distance.

Non-contact: a measurement made without a sensor touching the target. A preferred measurement method in many applications.

Non-Cooperative target: a target not designed to reflect light and that has less than 90% reflectivity.

Opacity: the degree to which light is not allowed to travel through.

Parallax: displacement or difference in a focus along two different optical axes; e.g., closing the left eye and viewing an object with the right eye-the object will appear to shift when the right eye is closed and viewed with the left eye.

Precision: the repeatability of a series of test results; whether the method gives the same answer under the same set of circumstances or sampling criteria.

Reflectance: the fraction of incident light returned by a surface. Higher target reflectance will increase range. General surface reflectance (R) ratios are: reflective=90+%, white=90%, gray=20%, black=5%.

Refraction: the change in direction of light as it passes from one medium to another of a different density; e.g., from air to water.

Resolution: the minimum distance between two adjacent features or objects or the minimum size of a feature or object that can be detected. For a measurement, it is the smallest unit of resolve; for example, 0.001 meter has 1 millimeter of resolution. Not to be confused with accuracy.

Sample rate: the frequency with which the sensor updates its range output. This can be set as low as one sample every few seconds and as high as 2,000 per second.

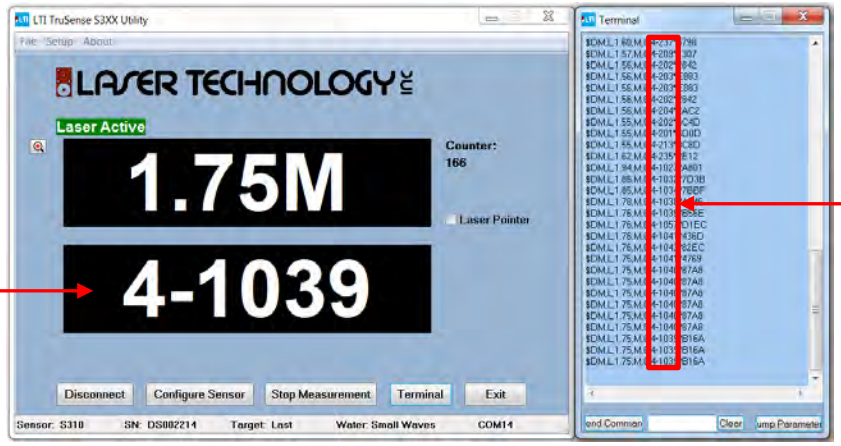
Target: term used to refer to an object or point that is being measured or detected.

Wavelength: the distance between two points on adjacent waves that have the same phase, such as the distance between two consecutive peaks or troughs; e.g., 905 nanometers means this distance is 0.000000905 meters be- tween two adjacent points on the light wave.

11 Appendix C - S300 Intensity Reading

The S200 series supplies an intensity reading along with a distance measurement. This intensity value can be viewed in both the utility software main screen as well as the terminal window. The intensity value presented is a relative value of intensity, based on an arbitrary numbering system. This intensity value is not a correlation for absolute power and should not be used as a precise measurement of target characteristics.

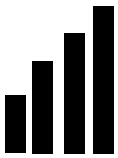
S200 series Utility Software-Main Screen



Terminal Window

The S200 series intensity system will return a response of 4-1039, for example. The first number is an intensity bracket, where 1- series is the weakest and the 4- series is the strongest. For most measurements within 60 meters (200 feet), a 4- series intensity would be expected to a quality target. The second part of the intensity number is the relative intensity within that intensity bracket (the higher the number, the stronger the signal).

This system of intensity is roughly equivalent to the power bars on a cell phone, where 4 bars represents the strongest signal strength, 3 bars the next level, 2 bars a weaker signal, and finally 1 bar which is the weakest signal indication.

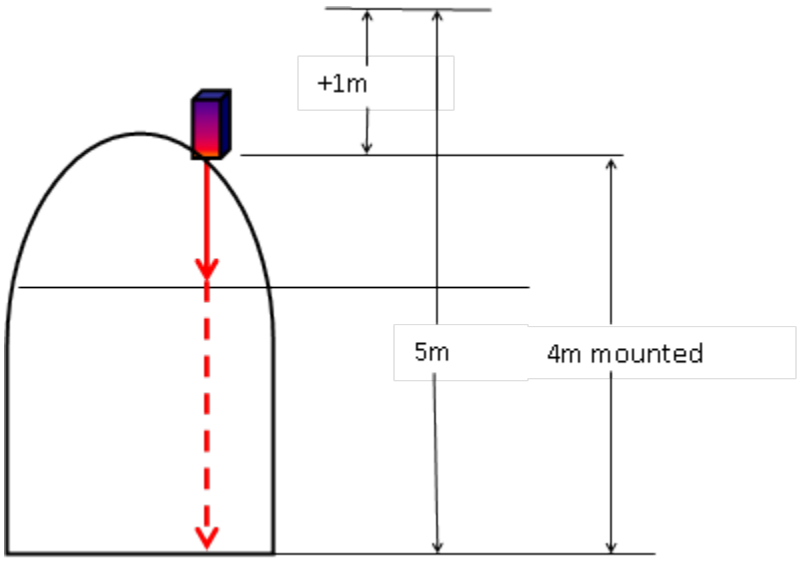


Power bars on a cell phone

4-xxxx – excellent signal strength
3-xxxx – good signal strength
2-xxxx – marginal signal strength
1-xxxx – weak signal strength

Relative Intensity Strength of S200 series sensor

12 Appendix D - S3XX OFFSETS

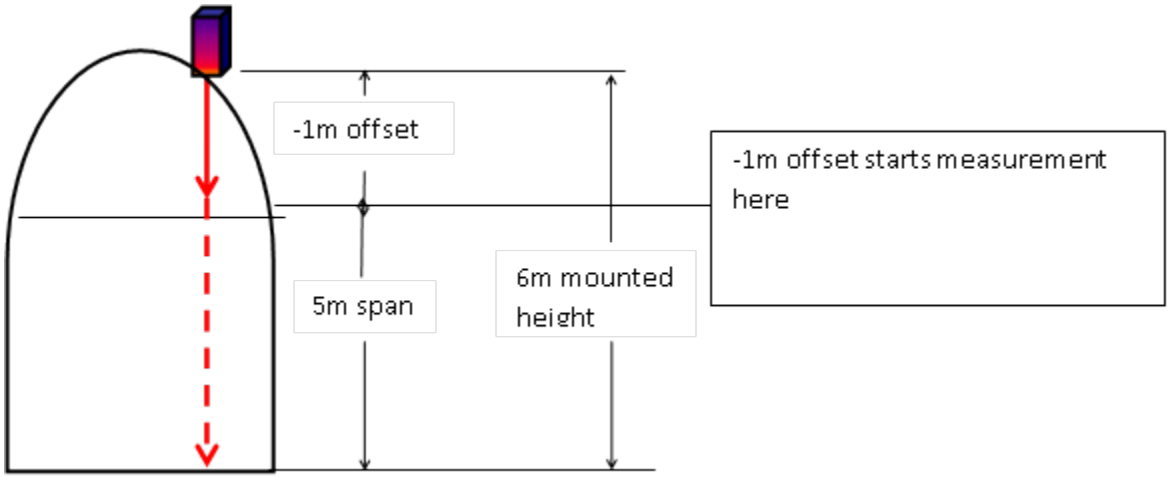


With no Offsets ($UO), the sensor displays the measurement from face plate to bottom of tank.

With Offset of +1m (UO,1), the sensor ADDS 1m to measurement. Total measurement is now 5 meters.

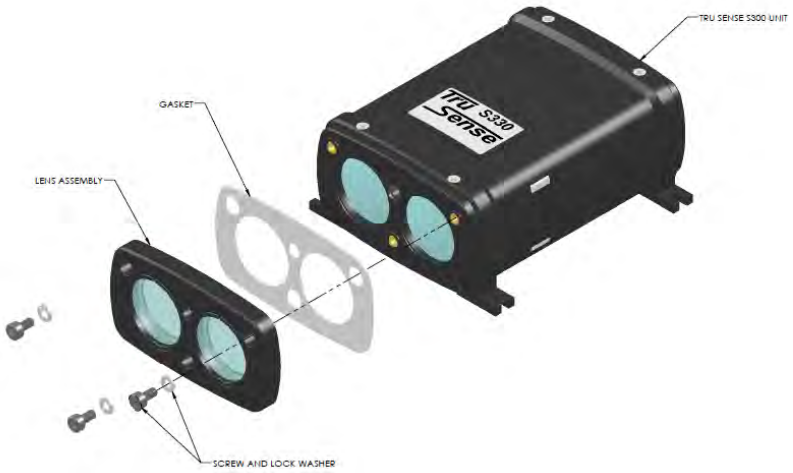
To start a measurement at top of tank fill line, subtract 1m in Offset. (UO,-1). Now the sensor will display an Error out to the -3m Offset point, then start measuring.

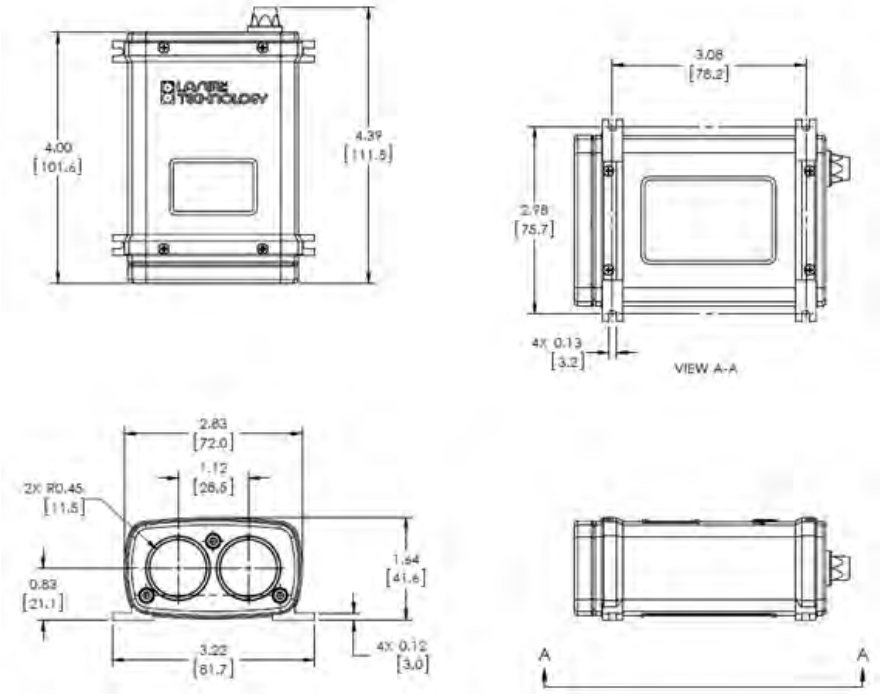
The 4 – 20 mA output will follow the measurement settings.
With the -1m Offset, the mA will start at the Offset point, either 4 – 20 or 20 – 4 depending on which direction you want the reading.



13 Appendix E - Diffuser Lenses

LTI has an optional diffuser lenses that will improve the performance when shooting clear liquids in either a still or turbulent state. Contact LTI for more information and application needs.





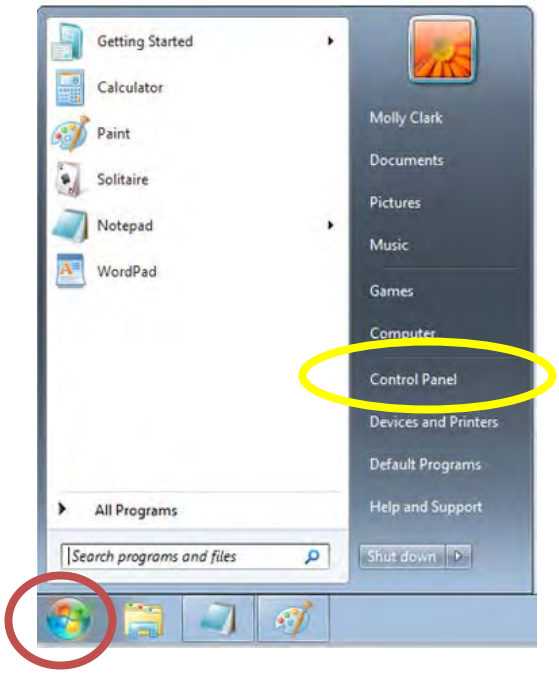
IMPORTANT!

When mounting the S300 lenses always use the washer between the screw head and sensor and install the gasket. Do not exceed 2.70 N-m of torque when securing.

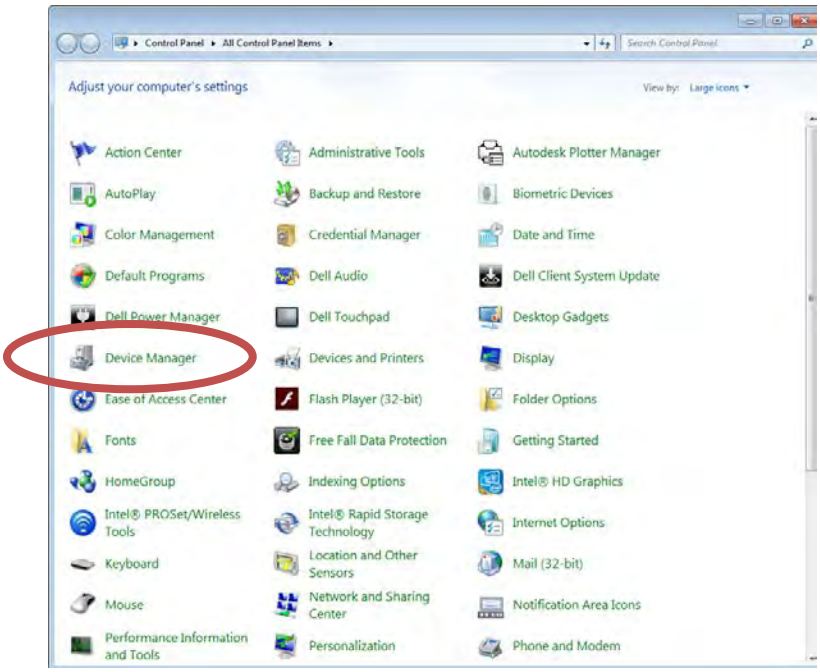
14 Appendix F - Finding the Com Port

If the S3XX Utility Software cannot automatically configure to an available serial port, first confirm all connections are secure, including any RS-232-to-USB conversions and to a USB port on a computer. If the instrument cannot be found, close and then reopen the Utility software. The software will remember the USB port last used, and will attempt to connect to that port; if you are using a different USB port, closing and reopening the utility software will reset and search all available ports. To manually set to a specific COM Port, follow the instructions below:

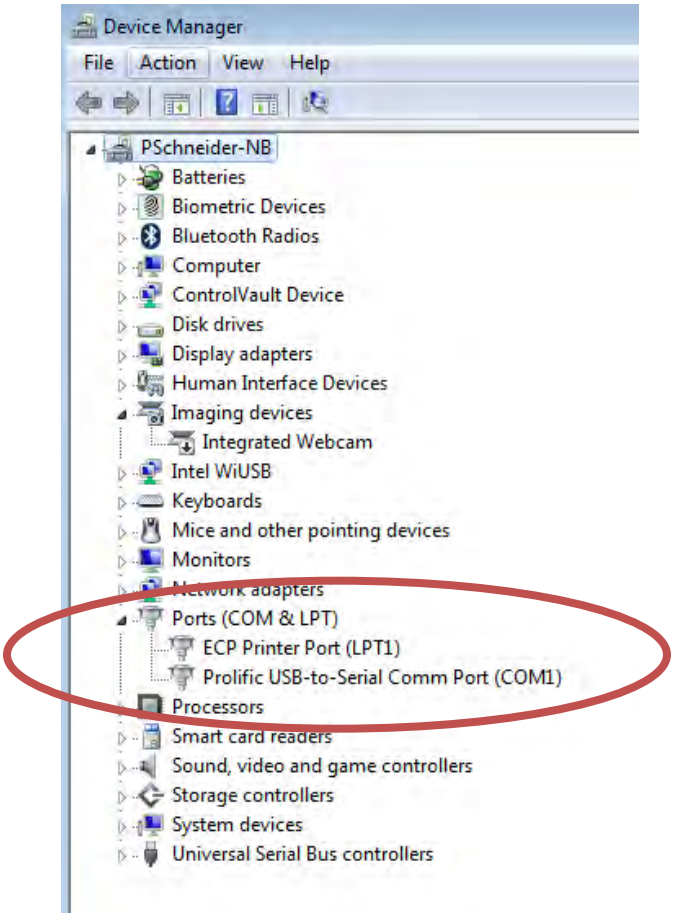
1) Left click Windows Logo



2). Open Control Panel



3). Open Device Manager.

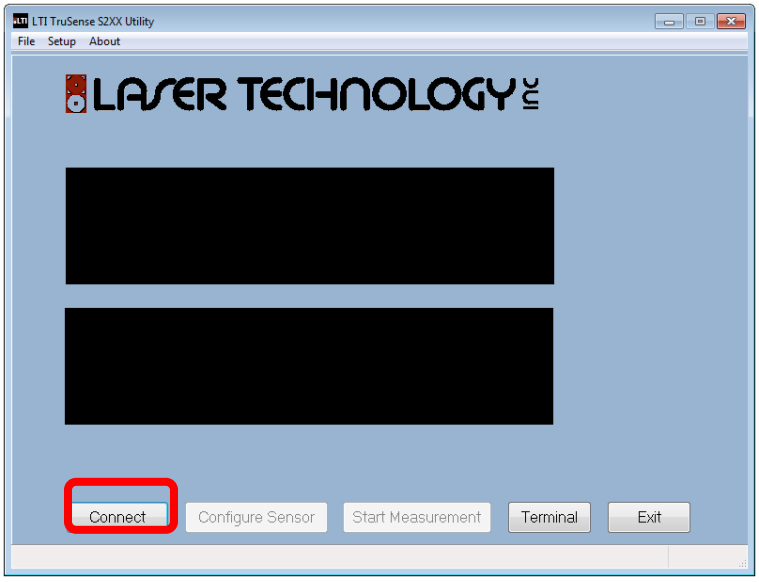


4). Ports, Prolific USB-to-Serial Comm Port, and note Com number

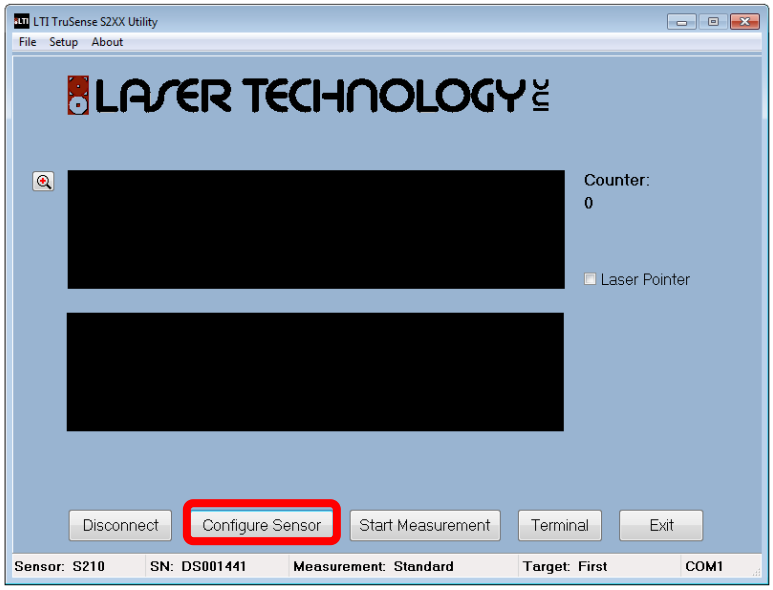
4). On the GUI display, select Setup and then select Manual Serial Port Setup. Select the Serial Port number from the menu. This will also be used for Tera Term or Putty applications.

Appendix G – S300 Series Capture Log Graphic User Interface

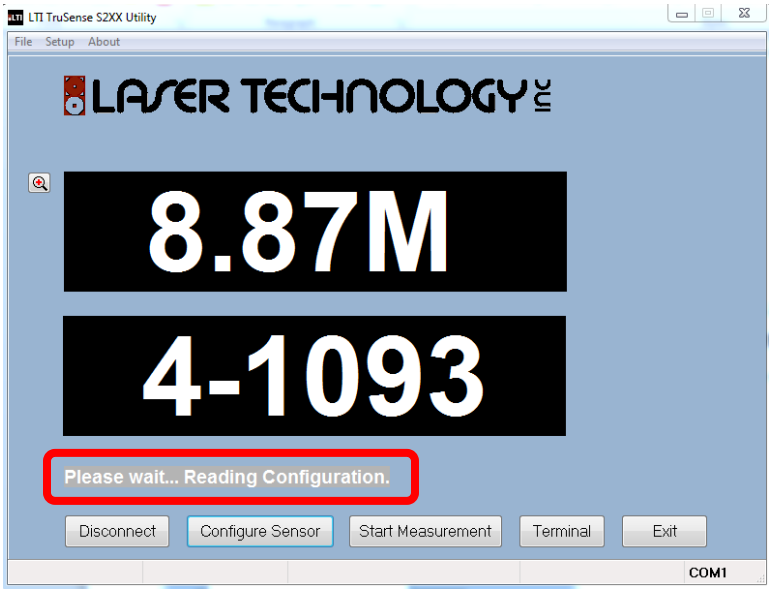
S TruSense Series Saving and Uploading Configuration Settings



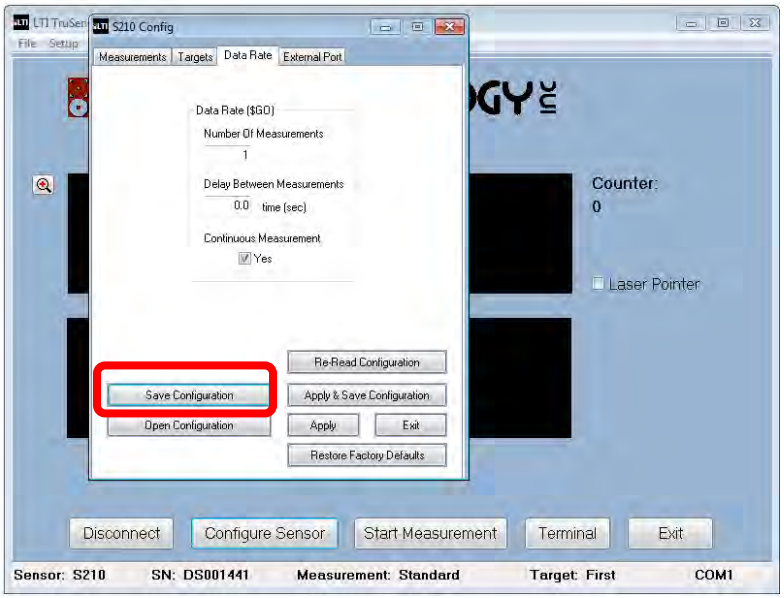
1). Connect to the Sensor



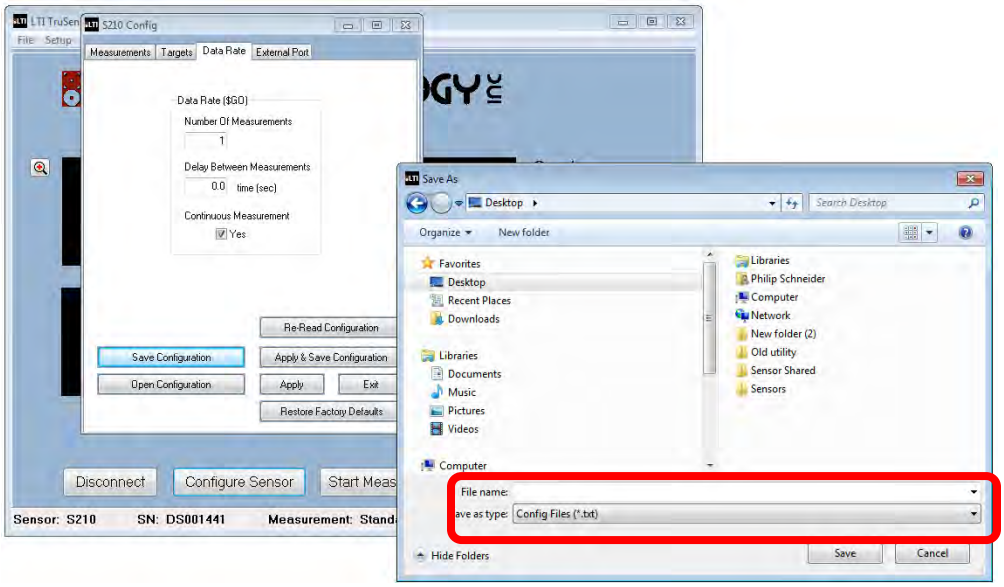
2). Click “Configure Sensor”



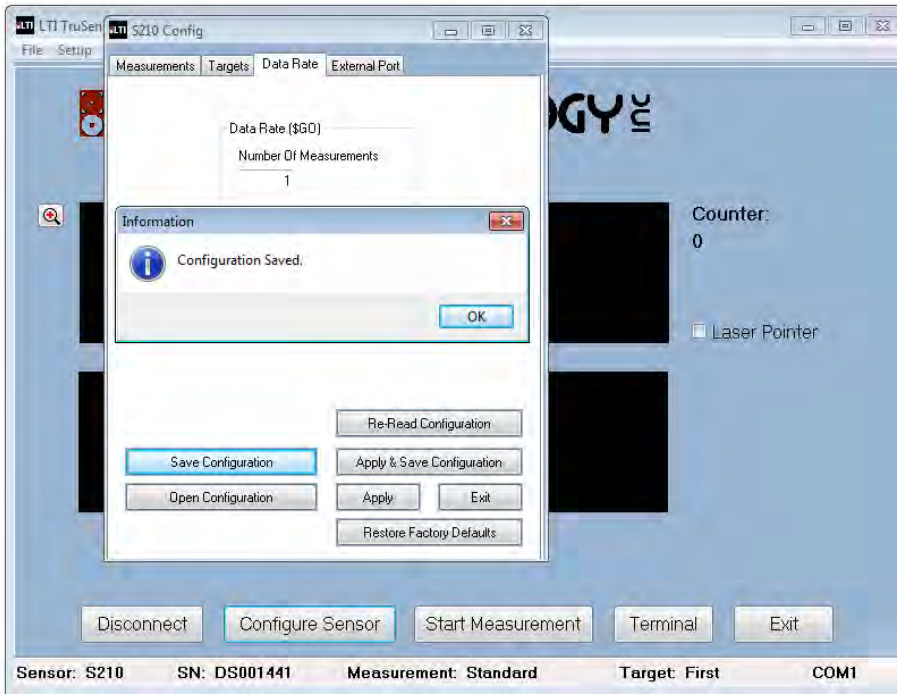
3). The Utility will Read the Configuration



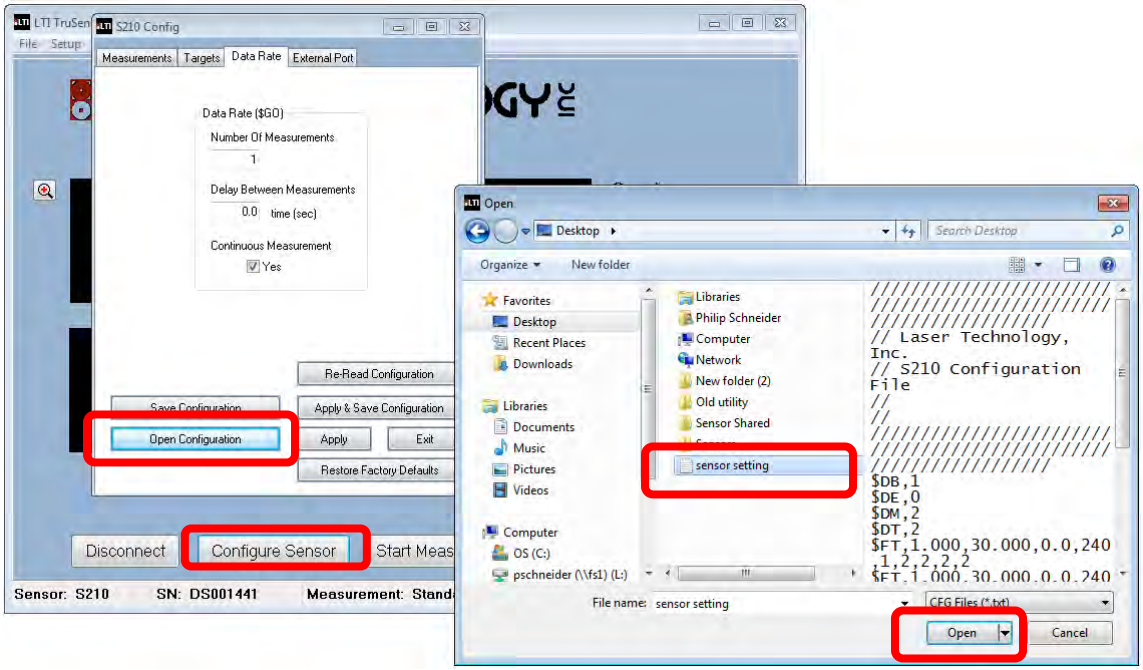
4). Save Configuration



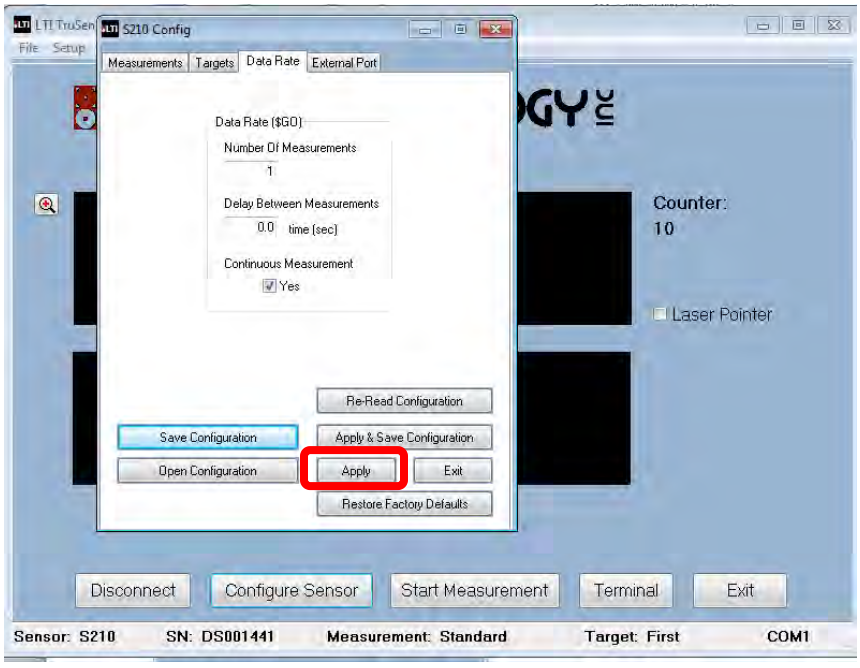
5). Select where to save the configuration file and name



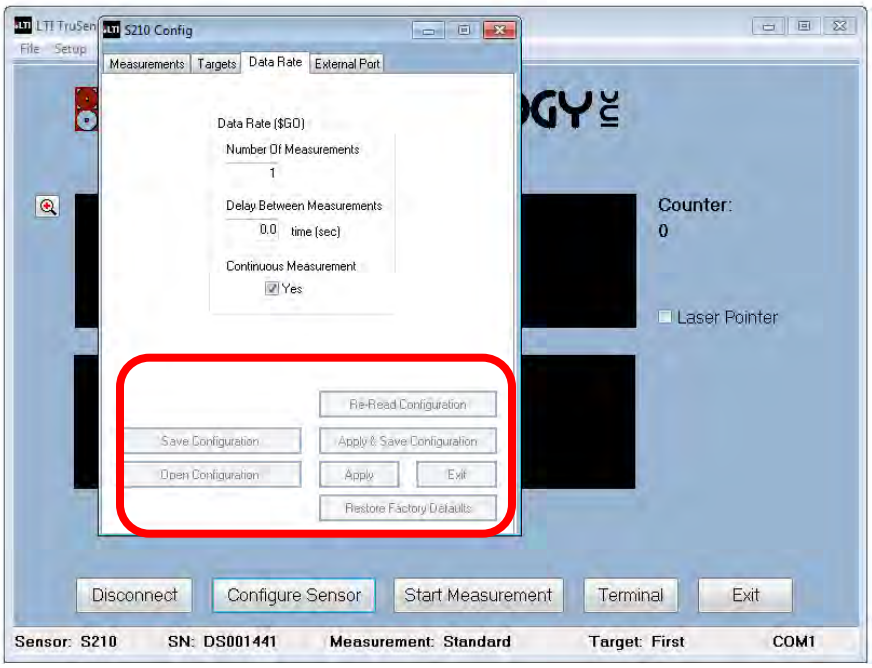
6). Utility will confirm the file is saved.



7). To Load a saved file, A. Go to Configure Sensor, B Open Configuration, C Select the saved file, D Open:

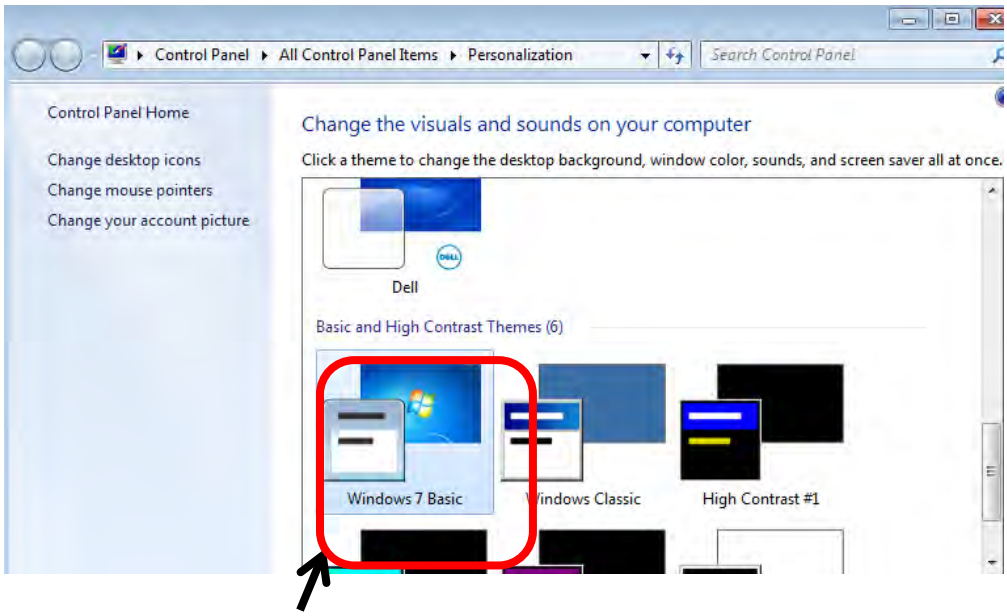


8). Apply the file

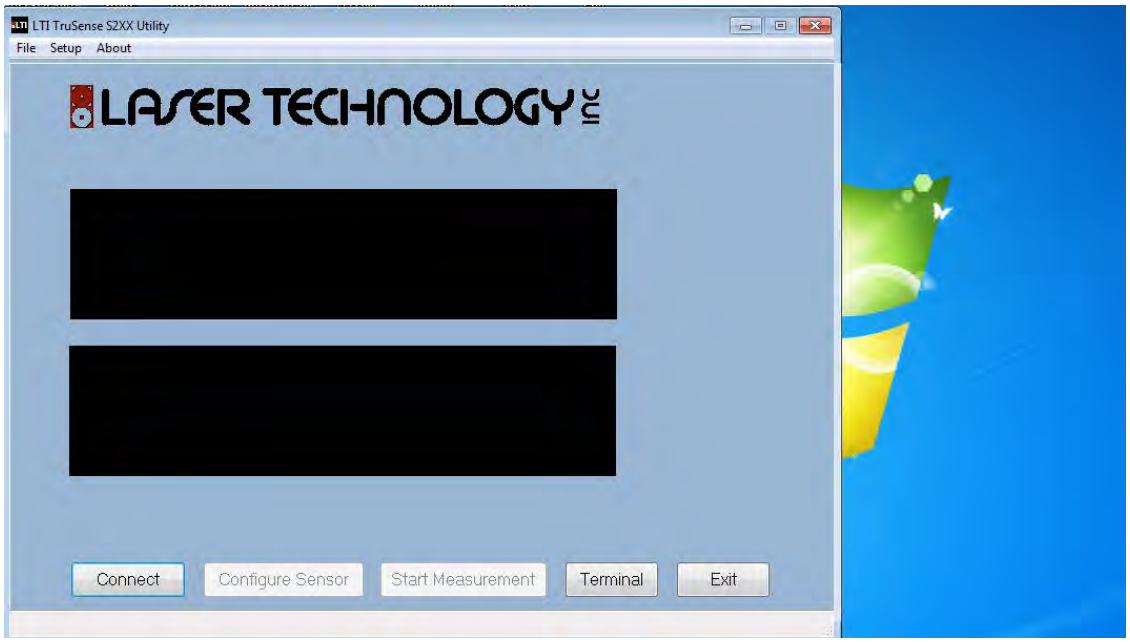


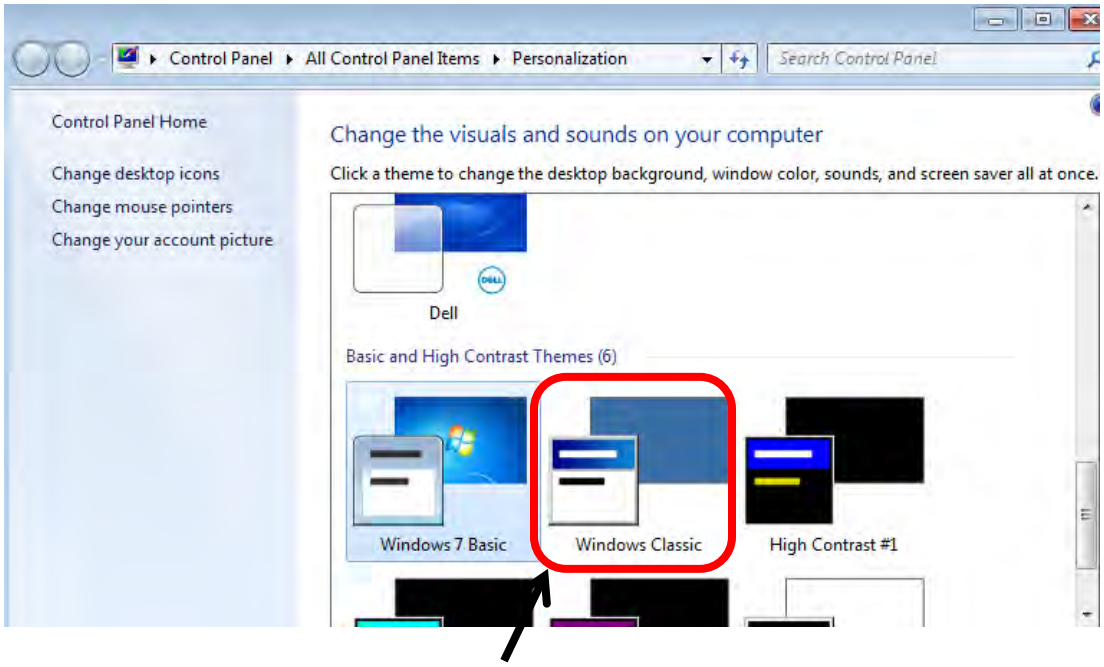
Boxes will be grayed out while the file is being loaded

15 Appendix H - Graphic Utility Contrast Color



When Windows Background is set to “Windows 7 Basic” the S2XX Graphic Utility is a light blue.





When Windows background is set to "Windows Classic" the S2XX Graphic Utility is a dark blue. The Graphic Utility color changes when the background changes.