

USER'S GUIDE

Installation & Operation
Instructions

Pump Station Level Controller

Model PSL 5.0

Manual Series A.1.4

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IMPORTANT NOTE: This instrument is manufactured and calibrated to meet product specifications. Please read this manual carefully before installation and operation. Any unauthorized repairs or modifications may result in a suspension of the warranty.

Available in Adobe Acrobat pdf format

CONNECTIONS:

POWER INPUT: The standard model requires AC power input between 100 to 240 VAC 50/60Hz . No adjustments are necessary for voltages within this range.

Optional DC input model requires 9-32 VDC/9 Watts. Connect to + and - terminals.

Optional Thermostat and Heater modules are available rated for 115 VAC or 230 VAC.

IMPORTANT NOTE: To comply with CSA/UL electrical safety standards, AC power input and relay connection wires must have conduit entry to the instrument enclosure. Installation requires a switch, overcurrent fuse or circuit breaker in the building (in close proximity to the equipment) that is marked as the disconnect switch.

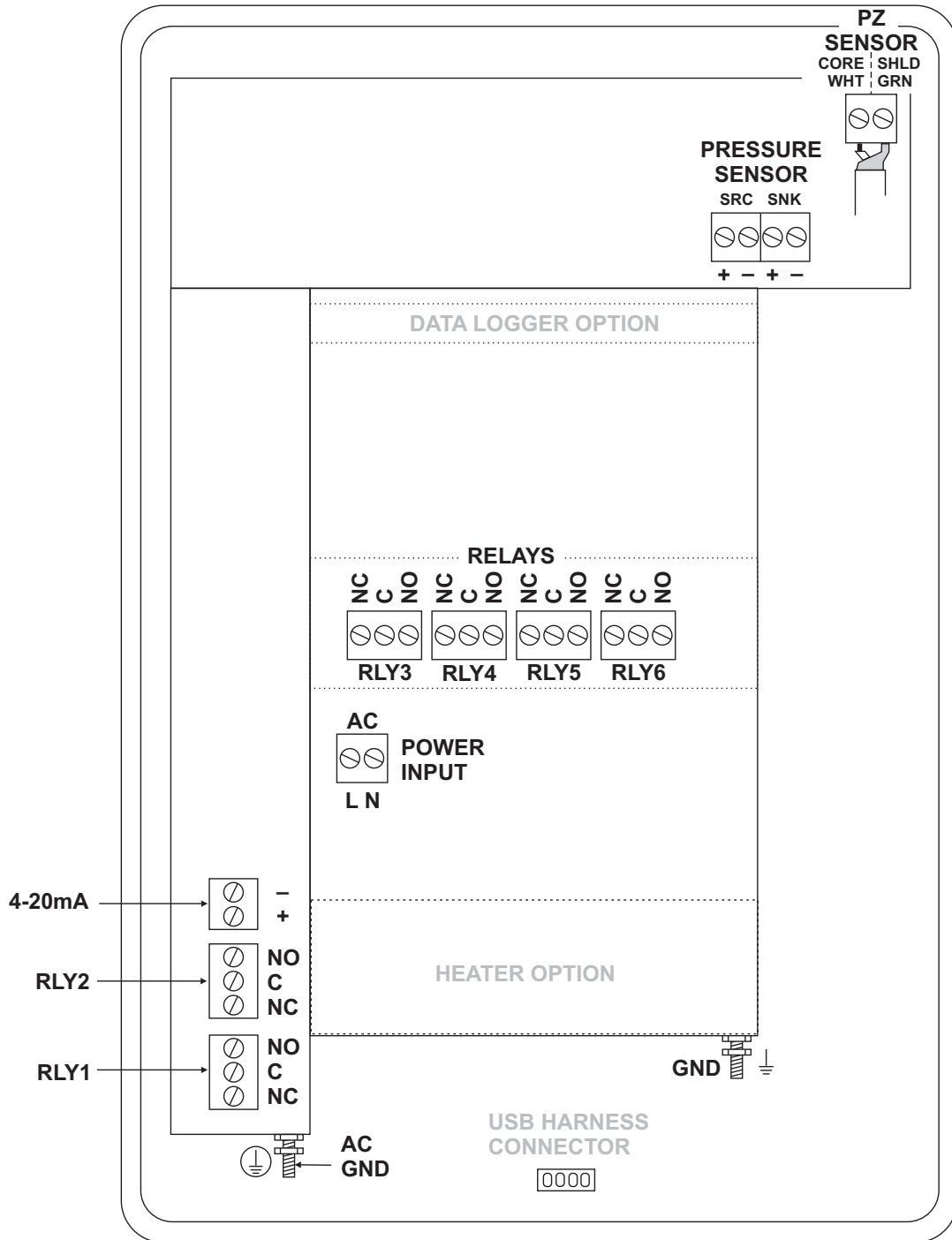


Risk of electric shock. Loosen cover screw to access connections. Only qualified personnel should access connections.

Note: Use of instrumentation over 40°C ambient requires special field wiring.

Note: User replaceable fuse is 2 Amp 250V (T2AL250V).

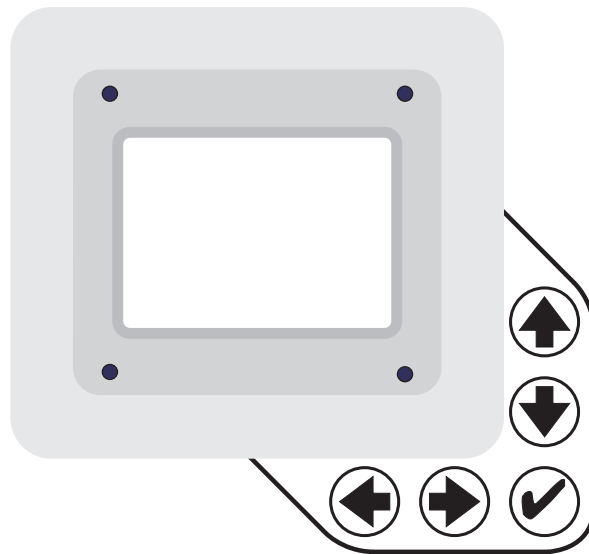
CONNECTIONS



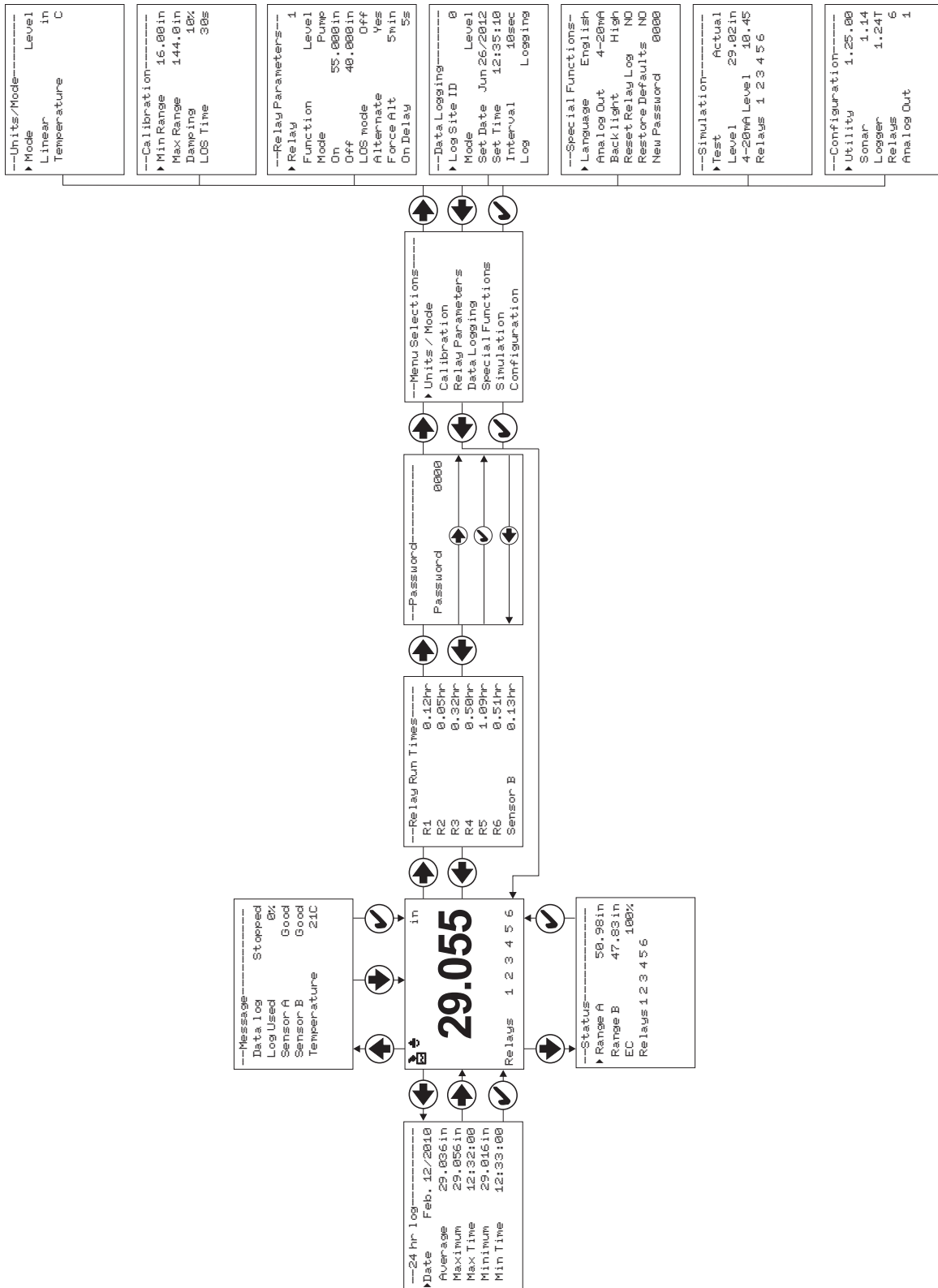
KEYPAD SYSTEM

The following diagram shows the PSL 5.0 menu system. Arrows show the four directions to leave a menu box. Pressing a corresponding keypad arrow will move to the next item in the direction shown. Move the cursor (underline) under numerals and increase or decrease numerals with the **↑** and **↓** keys.

To store calibration values permanently (even through power interruptions), press the **✓**.



CALIBRATION MENU



ICONS



1.



2.

Message waiting. Press .



Data logging off.



1.



2.

Data logging on.



1.



2.



3.



4.

USB file download.



File download completed.



Download Error.



1.



2.



3.

Echo OK.



No Echo .



1.



2.



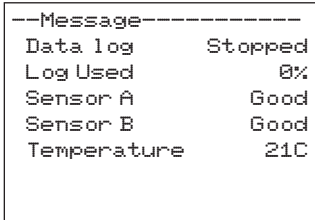
3.

Measurement switched to pressure sensor.



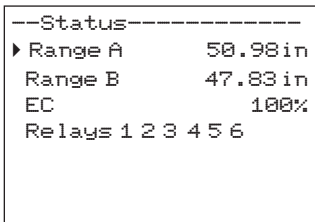
MAIN DISPLAY

The main display shows the units selected from the Units/Mode menu, Level or Range being measured and RELAY states.



MESSAGE ICON

Press **↑** from the MAIN display to view status of the data logger and error/warning messages provided by the instrument. The Message icon **Ⓜ** will blink on the MAIN display if error messages are being generated by the instrument. Refer to the manual section Error/Warning Messages for a description. Press **✓** to return to the main display.



STATUS

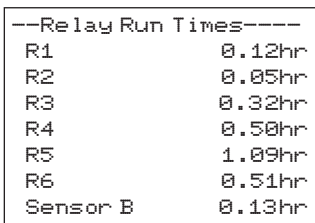
Press **↓** from the MAIN display to view instrument status. Range will be displayed in linear units, for both the sonar and pressure sensors.

Range A Range measurement of PZ transducer.

Range B Equivalent range measurement of pressure transducer.

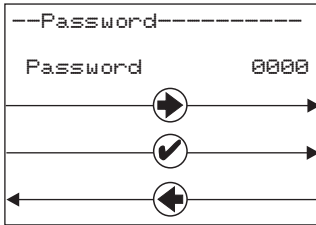
EC Displays echo confidence.

Relays Energized relays will display as a white character on a black background.



RELAY RUN TIMES

Tracks run times of the six relays. Also indicates total down time of the ultrasonic transducer.



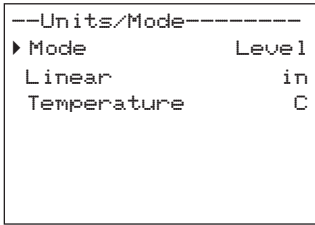
PASSWORD

The password (a number from 0000 to 9999) prevents unauthorized access to the Calibration menu.

From the Main display press the **➡** key to get to **Password**. Factory default password is 0000 and if it has not been changed press the **✓** to proceed to the Menu Selections screen.

If a password is required, press **➡** to place the cursor under the first digit and **↓** or **↑** to set the number, then **➡** to the second digit, etc. Press **➡** or **✓** to proceed to the Menu Selections screen.

A new password can be stored by going to **Special Functions/New Password**.



UNITS/MODE

From ▶**Mode** press the ➡ and then the ⬆ or ⬇ to select **Level** or **Range**.

Range mode displays distance from the sensor to the target or liquid surface like a tape measure. Range mode is useful to measure the exact distance from the sensor to the zero level during calibration, or to monitor "outage" or free space in a tank.

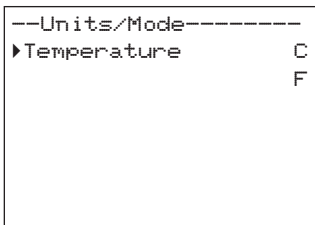
Level mode can be used to measure tank level in linear units.

Press the ✓ to store your selection then the ⬇ to the next menu item and ➡ to enter.

Linear press the ➡ key and then the ⬆ or ⬇ to select your units of measurement. Press the ✓ to store your selection.

Temperature press ➡ and then ⬆ or ⬇ to select **C** or **F** (Centigrade or Fahrenheit).

Press ⬅ or ✓ to return to the Menu Selections screen.



```
--Calibration-----  
▶ Min Range      8.000in  
Max Range      80.000in  
Damping         10%  
LOS Time       30s
```

CALIBRATION

Press the **↓** to **▶Calibration** and **➡** to enter. Use **↓** or **↑** to position **▶** before each menu item and **➡** to enter. When settings are completed press **✓** to store and return to the Calibration menu.

Min Range Distance from the sensor face to highest expected level.

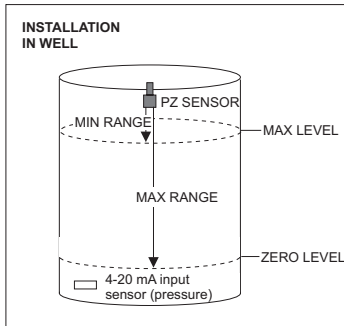
Max Range Distance from sensor to Zero level.

Damping Minimum damping allows fast response to level changes. Increasing damping slows the PSL 5.0's response to level changes and is ideal to smooth the display and outputs in turbulent conditions. Damping value is shown in percent (0-99%). Some experimentation may be required to select the optimum damping value. A value of 1% is recommended for most applications. For fast level changes (up to ½ inch/sec - 13 mm/sec), a Damping value of 1% is recommended.

LOS Time Press **➡** and **↑** or **↓** to change the number of seconds without receiving a level measurement from either the PZ or pressure sensor before the PSL 5.0 displays ECHO LOSS, and Control relays change state as calibrated under Relay Parameters.

Factory default is 30 seconds and is recommended for most applications. Minimum is 1 second and maximum is 99 seconds.

Press **✓** from the **Units/Mode** display to return to Menu Selections.



CALIBRATION

Calibrate the PZ Sensor for Level Measurement

1. Before starting the calibration determine:

- a) $\text{MAX RANGE} = \underline{\hspace{2cm}}$
(Maximum range = distance from Sensor to Zero level)
- b) $\text{MAX LEVEL} = \underline{\hspace{2cm}}$
(Maximum level of product being measured)
- c) $\text{MIN RANGE} = \underline{\hspace{2cm}}$
(Distance from sensor to Max Level)
 $\text{Minimum range} = \text{MAX RANGE} - \text{MAX LEVEL}$
(must be at least 8" / 203 mm depending on sensor model)

2. Check the maximum range with the sensor installed by:

- a) When liquid is at zero level press \blacktriangledown to view the Range reading in the Status menu. Use this range measured by the PSL 5.0 as the Max Range setting.
or
- b) Carefully measure distance from sensor to zero level with a tape measure, and use this measurement as the Max Range setting.

Redundant 4-20mA input (pressure) Sensor Installation and Self-Calibration

1. Install the redundant 4-20mA input sensor near the bottom of the well according to manufacturer's instructions and below the zero level.
2. Ensure that the PSL 5.0 with PZ sensor has been properly calibrated to measure water level and is functioning properly.
3. Connect the 4-20mA redundant sensor to the PSL 5.0 SRC terminals when the transmitter is loop-powered (24VDC power provided by the PSL 5.0) or to SNC terminals when the 4-20mA transmitter is powered from another source.
4. Operate the PSL 5.0 through several pump cycles to allow the 4-20mA input sensor to self-calibrate.
5. Note: When 4-20mA input sensor has completed self-calibration the Message window will indicate that Sensor B status is Good.

```

--Relay Parameters--
▶ Relay          1
Function         Level
Mode            Pump
On              55.000in
Off            40.000in
LOS mode        Off
Alternate        Yes
Force Alt       5min
On Delay        5s
  
```

RELAY PARAMETERS

- Relay** Press **➡** and **⬇** or **⬆** to select a corresponding relay number (6 relays are standard).
- Function** Press **⬇** or **⬆** to select **Off**, **Range**, or **Level**.
- Level** Press **⬇** to **Mode** and **➡** to select **Pump**, **Low Alarm** or **Hi Alarm**.

Note: **Function** setting **Level** will change according to selections made under **Units/Mode** eg **Level** or **Range**,

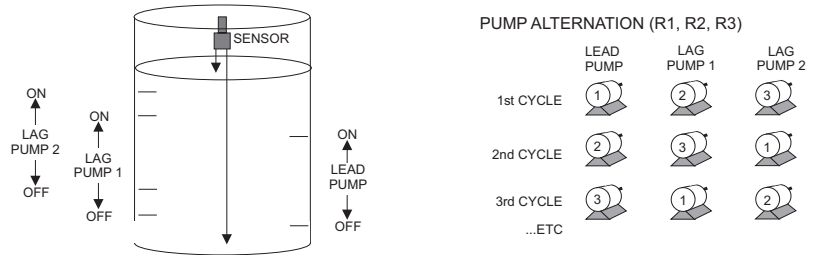
Press **✓** to return to **Menu Selections**.

LOS mode

Set the desired relay condition in the case that PSL cannot obtain a level measurement or set relay to provide a LOS alarm:

- Off** Sets Relay state to Off if PSL cannot obtain level reading.
- On** Sets Relay state to On if PSL cannot obtain level reading.
- Hold** Holds relay state if PSL cannot obtain level reading.
- Sensor B** Acts as PZ sensor signal loss alarm when Pump On and Off set to the same level. Alarm will indicate whenever PSL is operating off of the redundant 4-20mA input (pressure) sensor.
- Sen B Fault** Acts as 4-20mA input sensor fault alarm when Pump On and Off set to the same level. Alarm will indicate fault of the 4-20mA input sensor.

Alternate Up to six pumps/relays can be set to alternate when in pump mode. Following the end of a pump cycle pumps will swap ON and OFF relay settings.



Note: Alternating pumps must have different On setpoints to alternate correctly, otherwise alternating pumps will turn On at the same time.

Force Alt Set time for forced alternation. PSL will automatically trigger pump alternation if time expires over a longer pump cycle.

On Delay Set On Delay to invoke a delay between simultaneous changes to pump states.

```

--Data Logging-----
▶Log Site ID      00
                  99
Mode              Level
                  Range
Set Date         Feb 18/2008
                  Mar 19/2009
Set Time         11:27:40
                  12:28:41
Interval         10sec
                  60min
                  30min
                  15min
                  10min
                  5min
                  2min
                  1min
                  30sec
Log              Start
                  Stop
                  Delete
  
```

DATA LOGGING

Setup

Select Data Logging from Menu Selections.

- Log Site ID** Enter a number from **00** to **99**. The site ID will become part of the downloaded file name to help distinguish downloads from different instruments. Press **✓** to store the setting.
- Mode** Select **Level** or **Range**. Press **✓** to store the setting.
- Set Date** Press **↑** or **↓** to scroll and select Month, Day and Year. Press **✓** to store the setting.
- Set Time** Press **↑** or **↓** to select the current time in Hours, Minutes and Seconds. Press **✓** to store the setting.
- Interval** Press **↑** or **↓** to select the logging interval. Press **✓** to store the setting.
- Log** **Stop**, **Start** or **Delete** the log file. Press **↑** or **↓** to **Delete** and **✓** to delete the log file. Press **↑** or **↓** to **Start** and **✓** to restart the logger.

Note: You **MUST** delete old file and start a new log to apply any changes that have been made to the **Log Site ID**, **Mode** or **Interval**.

RETRIEVE LOG FILE

Plug a USB Flash Memory Drive (not supplied by Greyline) into the USB output cable from the instrument. The instrument display will show the USB file download icon until the log file is transferred to the memory card and then display file download completed icon. The USB flash drive may be removed.

Download file names will appear in this format:



Tag is set according to the Log Site ID entered in the instrument Data Logging menu.

Download letter will be A for the first download from an instrument. B for the second, then C etc. At the letter Z a - character will appear indicating that the maximum number of downloads for that instrument are on the USB flash drive. Older files can be erased or moved from the flash memory drive or a new memory drive can be used.

OPENING LOG FILES

Install Greyline Logger on your PC or laptop. Refer to the Help menu in the program for detailed instructions.

Select File/Open/Instrument Log (.log) to open the log file from your USB flash drive.

```
--Special Functions--
▶ Language      English
  Analog Out    4-20mA
  Backlight     High
  Reset Relay Log NO
  Restore Defaults NO
  New Password  0000
```

```
--Special Functions--
  Language      English
▶ Backlight     High
                Medium
                Low
  Key Hi/Lo
  Key High
  Key Med
  Key Low
  Off
```

SPECIAL FUNCTIONS

- Language** Select **English, French** or **Spanish** and press ✓.
- Analog Out** Select 4-20mA or 0-5V mode for the analog output.
- Backlight** Select **High, Medium** or **Low** for continuous backlight.
- Select **Key Hi/Lo** for high backlight for 1 minute after a keypress and then **Lo** backlight until a key is pressed again.
- Select **Key High, Med** or **Low** for backlight for 1 minute after a keypress and then backlight off until a key is pressed again.
- Reset Relay Log** Select **Yes** and press ✓ to erase Relay Runtime log.
- Restore Defaults** Select **Yes** and press ✓ to erase all user settings and return the instrument to factory default settings
- New Password** Select any number from 0000 to 9999 and press ✓. Default setting of 0000 will allow direct access to the calibration menus. Setting of any password greater than 0000 will require the password to be entered to access the calibration menus.

Press ✓ to return to **Menu Selections**.

```
--Simulation-----
▶ Test          Actual
  Range         8.00in
  4-20mARange   4.00
  Relays 1 2 3 4 5 6
```

SIMULATION

Exercises the 4-20mA (0-5V) output, digital display and control relays.

Test Select **Maximum** and press ✓ to simulate maximum Range or Level and to output 20mA (5V) to the analog channel.

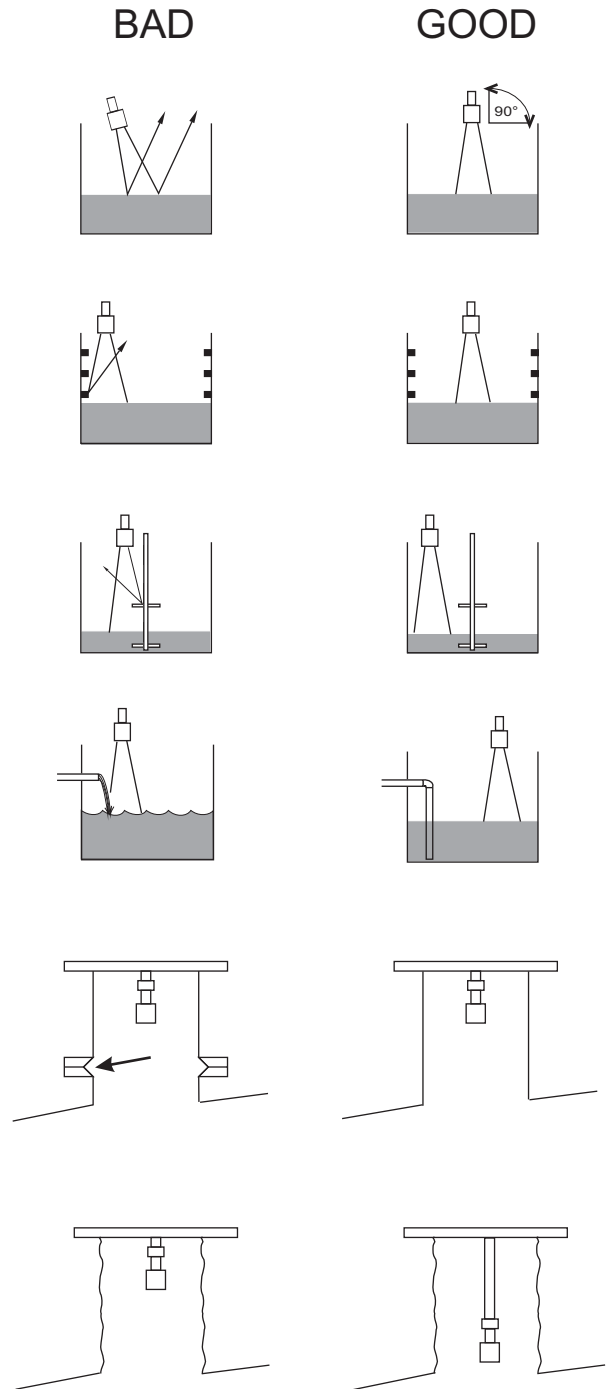
Select **Minimum** and press ✓ to simulate minimum Range or Level and to output 4mA (0V) to the analog channel.

To simulate an intermediate Range or Level set **Test** to **Actual** and then enter a value for the **Range** or **Level**. The analog output and control relays will respond to the simulated value.

SENSOR MOUNTING/LOCATION
- Tank Level/Inventory Applications

Each PSL 5.0 Level Transmitter includes a non-contacting ultrasonic sensor. The sensor must be installed in a position to obtain unobstructed echoes from the liquid or material being measured.

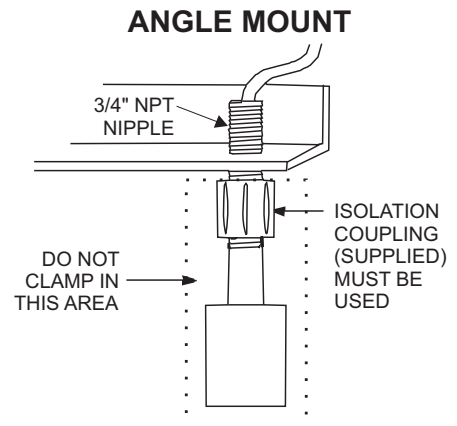
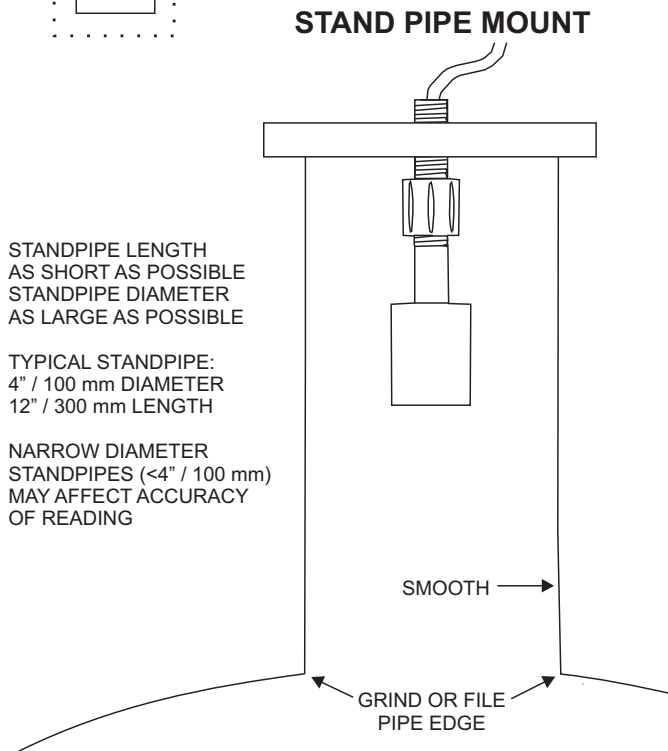
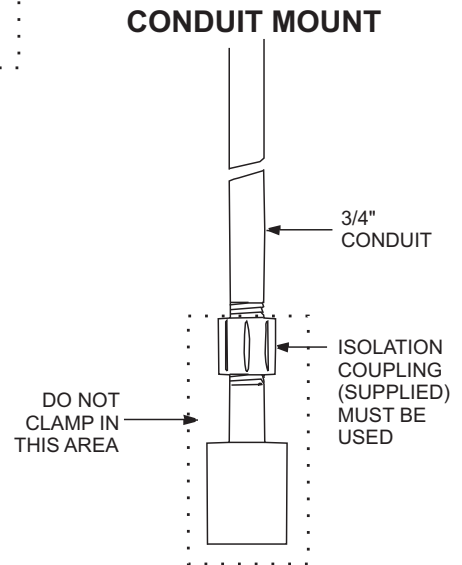
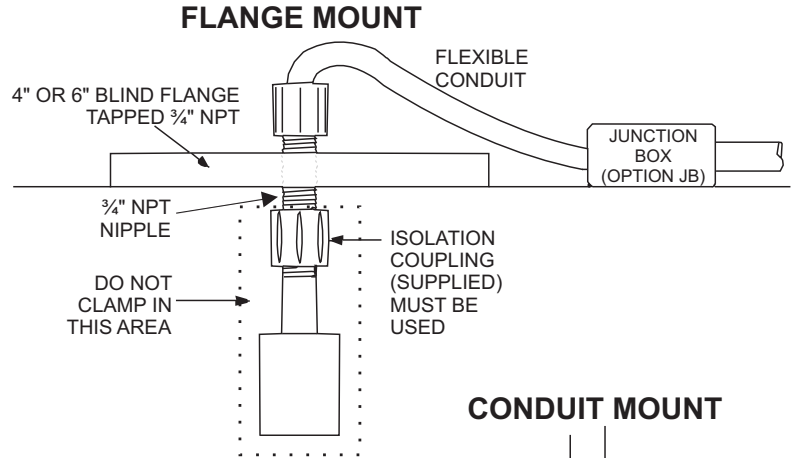
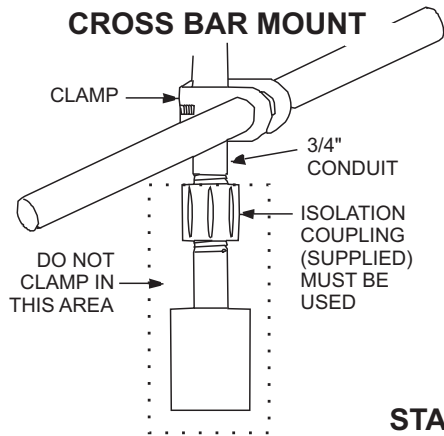
Mount the sensor away from pipes, ladders, or structural members which might cause continuous false echoes.



SENSOR MOUNTING METHODS

Notes:

1. Use the 3/4" NPT "Isolation Coupling" supplied and *hand tighten* only. Do not clamp sensor body or stem.
2. Locate the sensor 1 ft (30 cm) from the sidewall or obstruction for every 10 ft (3 m) depth.
3. *Do not* mount in direct sunlight.
4. Extend sensor cable up to 500 ft (150 m) with RG62AU coaxial only.



ENCLOSURE INSTALLATION

Locate the enclosure within 20 ft (6 m) of the sensor (500 ft -150 m optional). The enclosure can be wall mounted with the four mounting screws (included) or panel mounted with Option PM Panel Mount kit from Greyline Instruments.

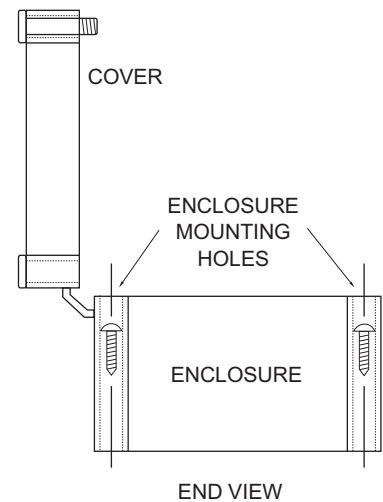
Avoid mounting the enclosure in direct sunlight to protect the electronics from damage due to overheating and condensate. In high humidity atmospheres, or where temperatures fall below freezing, Option TH Enclosure Heater and Thermostat is recommended. Seal conduit entries to prevent moisture from entering enclosure.

NEMA4X (IP66) WITH CLEAR COVER

1. Open hinged enclosure cover.
2. Insert #8 screws (supplied) through the four enclosure mounting holes to secure the enclosure to the wall or mounting stand.

Additional conduit holes can be cut in the bottom of the enclosure when required. Use a hole saw or Greenlee-type hole cutter to cut the required holes.

DO NOT make conduit/wiring entries into the top of the enclosure.



Note: This non-metallic enclosure does not automatically provide grounding between conduit connections. Grounding must be provided as part of the installation. Ground in accordance with the requirements of the National Electrical Code. System grounding is provided by connecting grounding wires from all conduit entries to the steel mounting plate or another point which provides continuity.

CLEANING

Cleaning is not required as a part of normal maintenance.

ERROR/WARNING MESSAGES

ECHO LOSS	No valid echoes received within the LOE TIME setting. The PSL 5.0 will hold the display and outputs at the last reading until a new echo is received. If a redundant level sensor is connected the PSL 5.0 will seamlessly switch to the second sensor without an echo loss error message.
- or -	Your choice of Units exceeds 9,999,999. Use USMG/d , IMG/d or m3/d so that Units will be 9,999,999 or less
ECHO TOO CLOSE	Indicates that the target is less than Min Range distance from the sensor (too close to the sensor).
SENSOR A OPEN	Instrument has detected PZ sensor connection/cable Open.
SENSOR A SHORTED	Instrument has detected PZ sensor connection/cable Shorted.
SENSOR B Check Sensor	Instrument has detected invalid measurement from redundant 4-20mA input (pressure) sensor or that sensor is not connected.
SENSOR B Not tracking	Usually indicates that 4-20mA input sensor is not yet self-calibrated or may indicate temporary discrepancy in level measurement between the two sensors.

FIELD TROUBLESHOOTING

SYMPTOMS

CHECK

Display - full scale	A
- zero	B
- erratic - random	C
- drifting up	D
- drifting down	E
ECHO LOSS prompt - flashing	F
Calibration Non-Linear	H

SYMPTOMS

FAULTS

SOLUTIONS

Unit "See's" Wrong Target Due To:

A	- sensor cover not removed	- remove protective cover after installation
A,C,D,F	- sensor not aimed correctly	
A,D,F	- dust/dirt buildup on sensor	- clean <i>carefully</i> (do not scratch sensor face)
A,D,F	- condensation on sensor	- lower Sensor
		- insulate sensor mounting location
		- increase Min Range (CALIBRATION menu) by 1-3" / 2.5-7.5 cm
		- wipe sensor face and body with Rain-X
A,D	- sensor mounting stand pipe	- lower Sensor below stand pipe intrusion
	- too long / - too narrow	
	- dirty / - gasket intruding	
C,E	- very turbulent level in tank	- increase Damping (CALIBRATION menu)
		- change tank fill method

Unit Picks-Up Interference Due To:

A,C	- noise from high pressure fill	- install submerged fill pipe
A,D	- sensor coupling over tightened	- hand tighten only (like a light bulb)
A,D	- sensor coupling not used	- use coupling supplied
C	- other ultrasonic unit in close proximity	- relocate the other ultrasonic sensor or install a redundant 4-20mA level sensor

Electrical interference:

C	- sensor cable connections reversed	
C	- through sensor cable	- use properly <i>grounded</i> metal conduit

- | | | |
|---|--|---|
| C | - sensor cable extended and junction not insulated | - Use metal Junction Box |
| C | - through enclosure | - use metal enclosure |
| C | - through 4-20mA output cable | - use shielded twisted pair (shielded to AC ground) |
| | | - use grounded metal conduit |
| C | - wiring or installation close to variable speed drive or inverter | - follow V.S.D. manufacturer's instructions for Drive grounding, wiring and shielding |

Unit Receives No Return Echo Due To:

- | | | |
|-------|----------------------------------|--|
| C,F,E | - foam on liquid surface | - locate ultrasonic sensor as low as possible in the wet well and above an area where foam is less present |
| | | - install a redundant 4-20mA level sensor |
| B | - target beyond Max Range | - recalibrate |
| F | - sensor damaged | - remove sensor from mounting and aim at a flat, stable target to test |
| F | - sensor misalignment | - check with a level |

Wiring Problems Due To Sensor Cable:

- | | | |
|--------|---|--|
| A,C,F, | - open circuit | - check connections/continuity (8850 to 12700 ohms max./-30°C to +70°C) |
| B,F | - short circuit | - check connections/continuity (8850 ohms min.) |
| F | - too long (max 500 ft., 150 m) | |
| C | - bundled/run in conduit with power cable | |
| C | - sensor ground shorted to conduit/enclosure | - insulate |
| A | - extended with wrong type of wire | - use RG62A/U coaxial only |
| C | - close to high voltage/large motors | |
| C | - AC chassis/ground missing on instrument power connections | |

Non-Linearity Due To:

- | | | |
|---|--------------------------------------|--|
| H | - vapour | - dissipate fumes, Calibration in-situ |
| H | - zero not set accurately | - see "Zero Positioning of Sensor" |
| H | - temperature measurement inaccuracy | - install sensor sunscreen |
| | | - mount sensor closer to maximum water level |

PZxx Series Sensors Troubleshooting

Resistance measured (between the shield and center wire) across the coaxial cable ends by multimeter indicates ambient temperature.

Resistance vs. Temperature

Values are in Ohms

Temp °C	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	10000.0	10039.0772	10078.1429	10117.1970	10156.2396	10195.2706	10234.2901	10273.2980	10312.2944	10351.2792
10	10390.2525	10429.2142	10468.1644	10507.1030	10546.0301	10584.9456	10623.8496	10662.7420	10701.6229	10740.4922
20	10779.3500	10818.1962	10857.0309	10895.8540	10934.6656	10973.4656	11012.2541	11051.0310	11089.7964	11128.5502
30	11167.2925	11206.0232	11244.7424	11283.4500	11322.1461	11360.8306	11399.5036	11438.1650	11476.8149	11515.4532
40	11554.0800	11592.6952	11631.2989	11669.8910	11708.4716	11747.0406	11785.5981	11824.1440	11862.6784	11901.2012
50	11939.7125									

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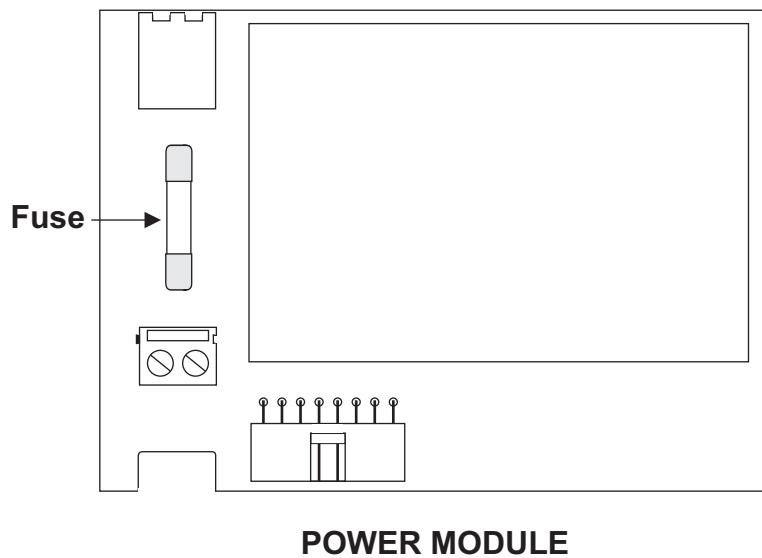
Values are in Ohms

Temp °F	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
30			10000.0	10021.7110	10043.4184	10065.1223	10086.8226	10108.5193	10130.2125	10151.9021
40	10173.5881	10195.2706	10216.9495	10238.6249	10260.2967	10281.9649	10303.6295	10325.2906	10346.9481	10368.6021
50	10390.2525	10411.8993	10433.5426	10455.1823	10476.8184	10498.4510	10520.0800	10541.7054	10563.3273	10584.9456
60	10606.5604	10628.1716	10649.7792	10671.3832	10692.9837	10714.5806	10736.1740	10757.7638	10779.3500	10800.9327
70	10822.5118	10844.0873	10865.6593	10887.2277	10908.7925	10930.3538	10951.9115	10973.4656	10995.0162	11016.5632
80	11038.1067	11059.6466	11081.1829	11102.7156	11124.2448	11145.7704	11167.2925	11188.8110	11210.3259	11231.8373
90	11253.3451	11274.8493	11296.3500	11317.8471	11339.3406	11360.8306	11382.3170	11403.7999	11425.2792	11446.7549
100	11468.2270	11489.6956	11511.1606	11532.6221	11554.0800	11575.5343	11596.9851	11618.4323	11639.8759	11661.3160
110	11682.7525	11704.1854	11725.6148	11747.0406	11768.4629	11789.8816	11811.2967	11832.7082	11854.1162	11875.5206
120	11896.9215	11918.3188	11939.7125							

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FUSE REPLACEMENT

1. Turn OFF power.
2. Loosen cover screw and open.
3. Remove power module.
4. Locate fuse on Power Board.
5. Replace fuse with 2 AMP/ 250V, 5 x 20mm fuse.
6. Reinstall power module into chassis.





APPLICATIONS HOTLINE

For applications assistance, advice or information on any Greyline Instrument contact your Sales Representative, write to Greyline or phone the Applications Hotline below:

United States:	Tel: 315-788-9500	Fax: 315-764-0419
Canada:	Tel: 613-938-8956	Fax: 613-938-4857
Toll Free:	888-473-9546	
Email:	info@greyline.com	
Web Site:	www.greyline.com	

Greyline Instruments Inc.

Canada
16456 Sixsmith Drive
Long Sault, Ont. K0C 1P0

USA:
105 Water Street
Massena, NY 13662

PRODUCT RETURN PROCEDURE

Instruments may be returned to Greyline for service or warranty repair.

1) Obtain an RMA Number from Greyline -

Before shipping a product to the factory please contact Greyline by telephone, fax or email to obtain an RMA number (Returned Merchandise Authorization). This ensures fast service and correct billing or credit.

When you contact Greyline please have the following information available:

1. Model number / Software Version
2. Serial number
3. Date of Purchase
4. Reason for return (description of fault or modification required)
5. Your name, company name, address and phone number

2) Clean the Sensor/Product -

Important: unclean products will not be serviced and will be returned to the sender at their expense.

1. Rinse sensor and cable to remove debris.
2. If the sensor has been exposed to sewage, immerse both sensor and cable in a solution of 1 part household bleach (Javex, Clorox etc.) to 20 parts water for 5 minutes. Important: do not immerse open end of sensor cable.
3. Dry with paper towels and pack sensor and cable in a sealed plastic bag.
4. Wipe the outside of the enclosure to remove dirt or deposits.
5. Return to Greyline for service.

3) Ship to Greyline -

After obtaining an RMA number please ship the product to the appropriate address below:

Canadian and International
Customers:

Greyline Instruments Inc.
16456 Sixsmith Drive
Long Sault, Ont. K0C 1P0

RMA#

USA
Customers:

Greyline Instruments Inc.
204 150th Avenue
Madeira Beach, FL 33708

RMA#

LIMITED WARRANTY

Greyline Instruments warrants, to the original purchaser, its products to be free from defects in material and workmanship for a period of one year from date of invoice. Greyline will replace or repair, free of charge, any Greyline product if it has been proven to be defective within the warranty period. This warranty does not cover any expenses incurred in the removal and re-installation of the product.

If a product manufactured by Greyline should prove defective within the first year, return it freight prepaid to Greyline Instruments along with a copy of your invoice.

This warranty does not cover damages due to improper installation or handling, acts of nature, or unauthorized service. Modifications to or tampering with any part shall void this warranty. This warranty does not cover any equipment used in connection with the product or consequential damages due to a defect in the product.

All implied warranties are limited to the duration of this warranty. This is the complete warranty by Greyline and no other warranty is valid against Greyline. Some states do not allow limitations on how long an implied warranty lasts or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

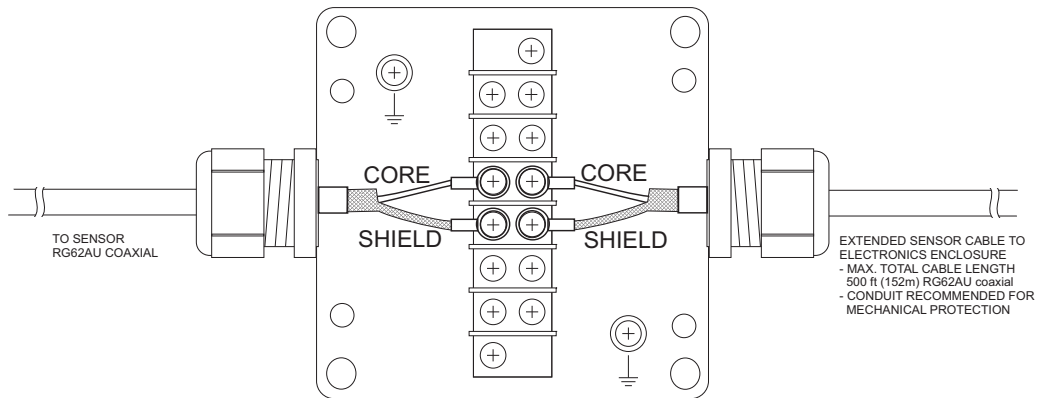
Greyline Instruments Inc.

APPENDIX A - OPTIONS

EXTRA SENSOR CABLE - OPTION XC

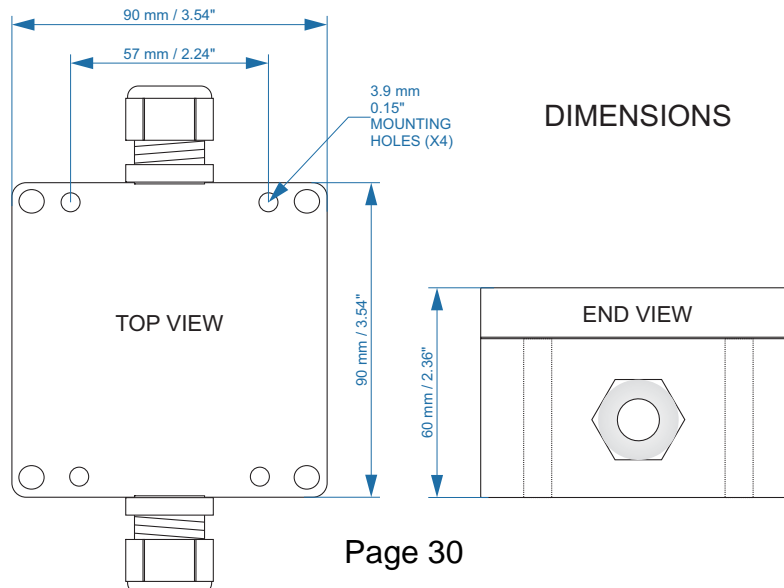
Each Greyline level instrument includes 25 ft. (7.6 m) RG62AU coaxial cable. Additional RG62AU coaxial cable and Cable Junction Box (Option JB2X) may be installed to extend cable up to 500 ft (152m) as required during installation. No adjustment is required when the sensor cable is extended or shortened. Use only RG62AU (or RG62U) coaxial cable which is available from Greyline Instruments or your local distributor. Nominal impedance of RG62AU cable is 93 ohms.

Extended sensor cable maybe installed in metal or plastic conduit. Recommended installation with a junction box is illustrated below:

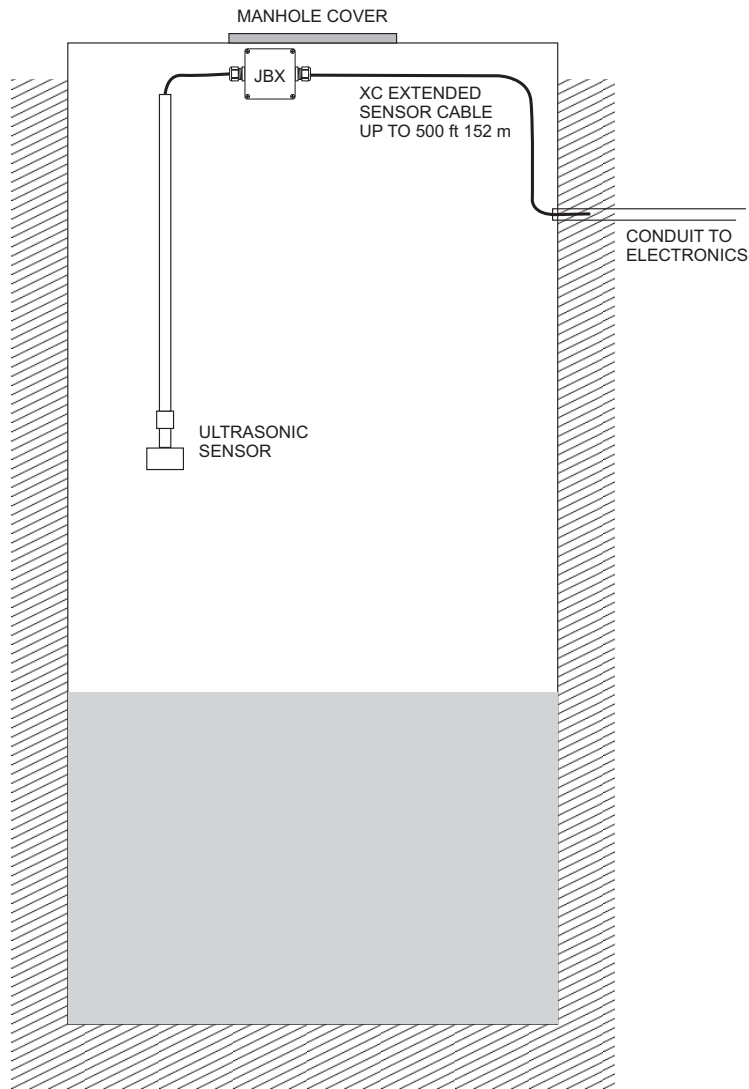


JUNCTION BOX - OPTION JB2X

NEMA4X (IP66) polycarbonate Junction Box with terminal strips is available from Greyline Instruments. Includes compression fittings for watertight coaxial cable entries.



EXTENDED SENSOR CABLE INSTALLATION IN MANHOLE



Wetwell, Sump or Pump Station

**SENSOR INTRINSIC SAFETY
(OPTION ISB)**

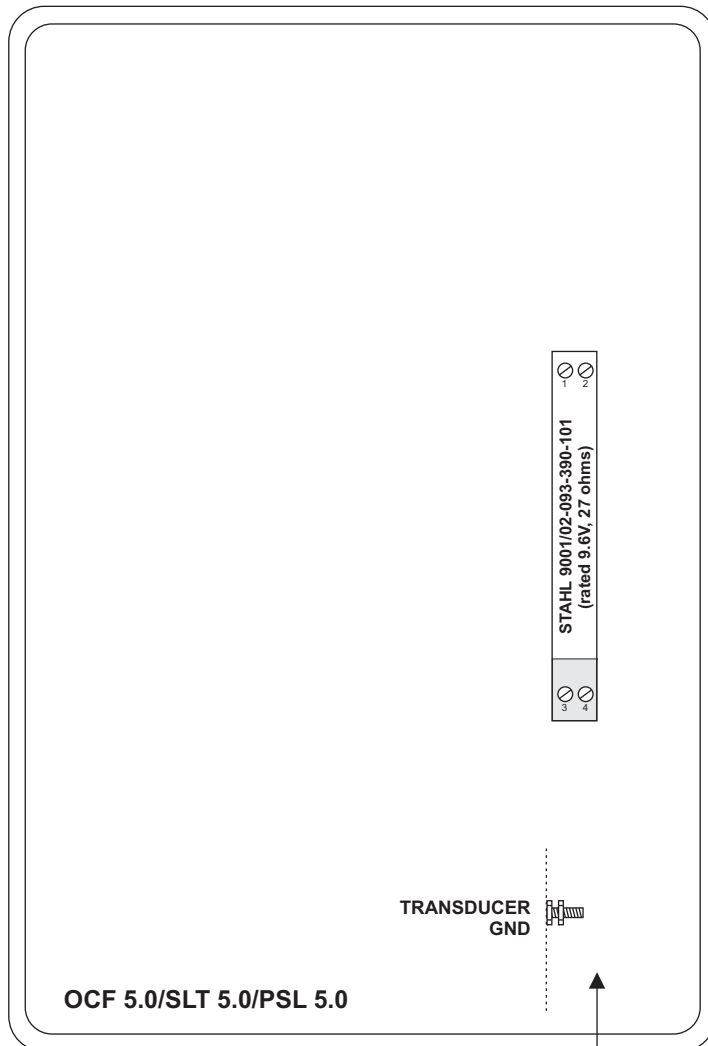
When connected through Intrinsic Safety Barriers, Greyline PZ** Series sensors are certified for installation in a hazardous location rated:

Class I, Groups C,D
Class II, Groups E,F,G
Class III

The Intrinsic Safety Barrier may be ordered with the Greyline instrument and is supplied mounted in the Greyline instrument enclosure. Replacement barrier fuses (Part No. ISB- 011239) may be purchased separately. The instrument enclosure containing the ISB Intrinsic Safety Barrier must be installed in a non-hazardous location.

GN3SPEC-ISB-03

The intrinsic safety barrier assemblies installed in the OCF 5.0/SLT 5.0/PSL 5.0 limit the voltage and current supplied to the transducers to the values listed under 'Barrier Specifications'. To safely install a Greyline transducer certified for use in hazardous locations you must refer to the installation drawings/specifications of the certified transducer.



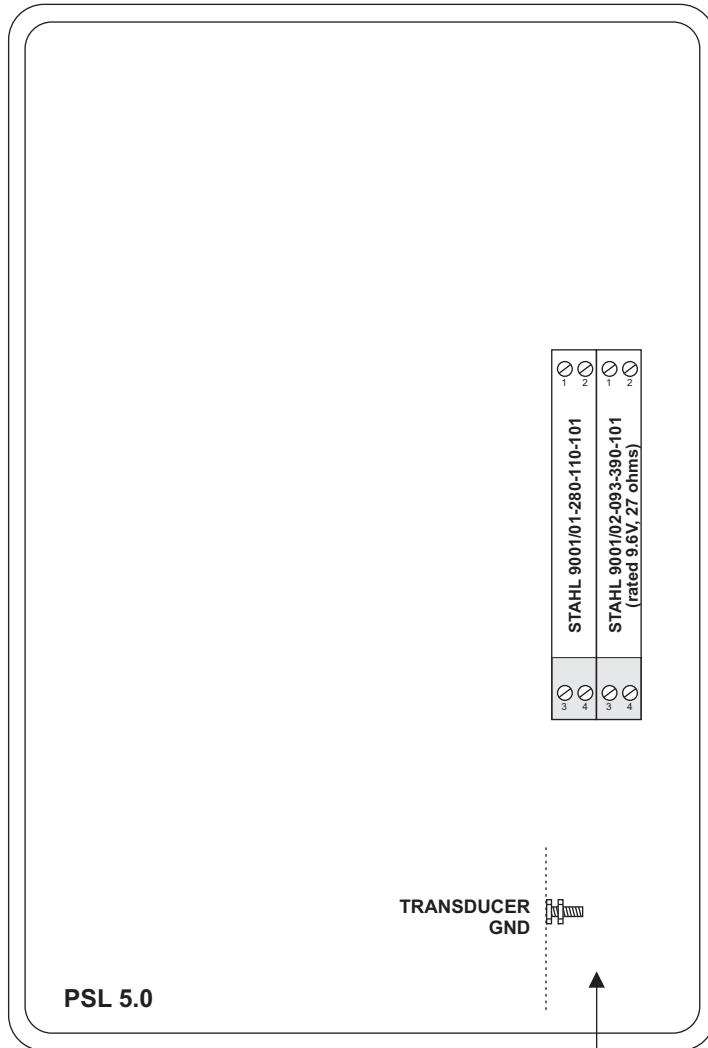
Installed in
Non-Hazardous Location

BARRIER SPECIFICATIONS

STAHL BARRIER	System Parameters	Entity Parameters					
		U_m	V_{oc}	I_{sc}	P_0	C_a	L_a
9001/02-093-390-101	9.6V, 27 ohms	250V	9.3V	390mA	906.8mW	4.1 μ F	0.16mH

GN3SPEC-ISB-05

The intrinsic safety barrier assemblies installed in the PSL 5.0 limit the voltage and current supplied to the transducers to the values listed under 'Barrier Specifications'. To safely install a Greyline transducer certified for use in hazardous locations and a 4-20mA pressure transducer certified for use in hazardous locations you must refer to the installation drawings/specifications of the certified transducers.



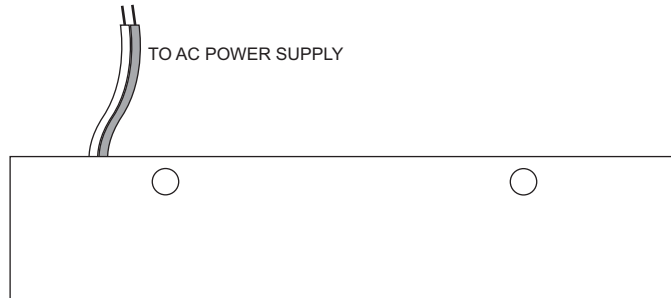
Installed in
Non-Hazardous Location

BARRIER SPECIFICATIONS

STAHL BARRIER	System Parameters	Entity Parameters					
		U_m	V_{oc}	I_{sc}	P_0	C_a	L_a
9001/02-093-390-101	9.6V, 27 ohms	250V	9.3V	390mA	906.8mW	4.1 μ F	0.16mH
9001/01-280-110-101	-	250V	28V	110mA	770mW	0.083 μ F	1.2mH

ENCLOSURE HEATER AND THERMOSTAT - Option TH

Instruments can be factory-equipped with an Enclosure Heater and Thermostat or the module can be customer-installed. The Thermostat is factory set to turn ON at 40°F (4.5°C) and OFF at 60°F (15.5°C). Power consumption is 15 Watts.



ENCLOSURE SUNSCREEN - Option SCR

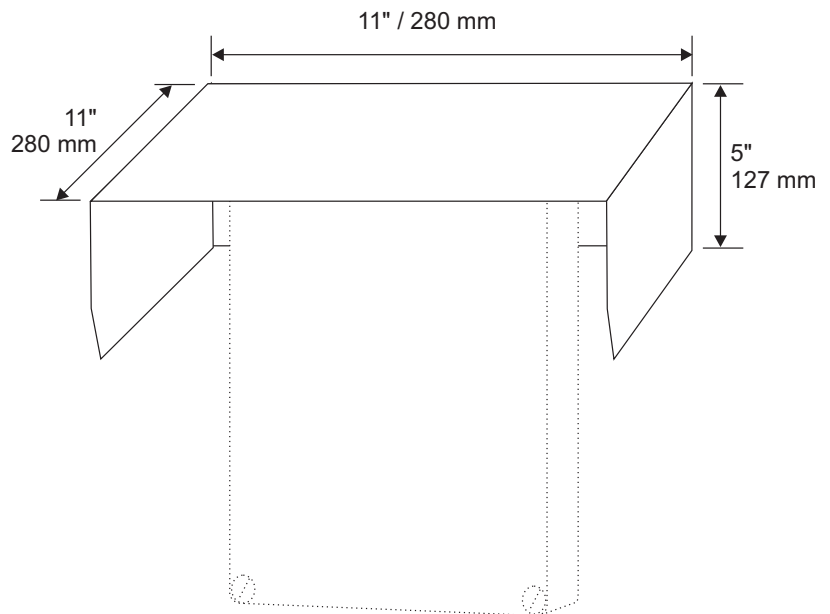
Do not mount instrument electronics in direct sunlight. Overheating will reduce the life of electronic components and condensate may form during the heat/cool cycles and cause electrical shorts.

Note:

Exposure to direct sunlight can cause overheating and moisture condensation which will reduce the operating life of electronics.

Protect Instruments from direct sunlight with this iridite finished aluminum sun screen (Greyline Option SCR).

Seal conduit entries with caulking compound to further reduce moisture condensation.



**POWER INPUT OPTION
9-32VDC**

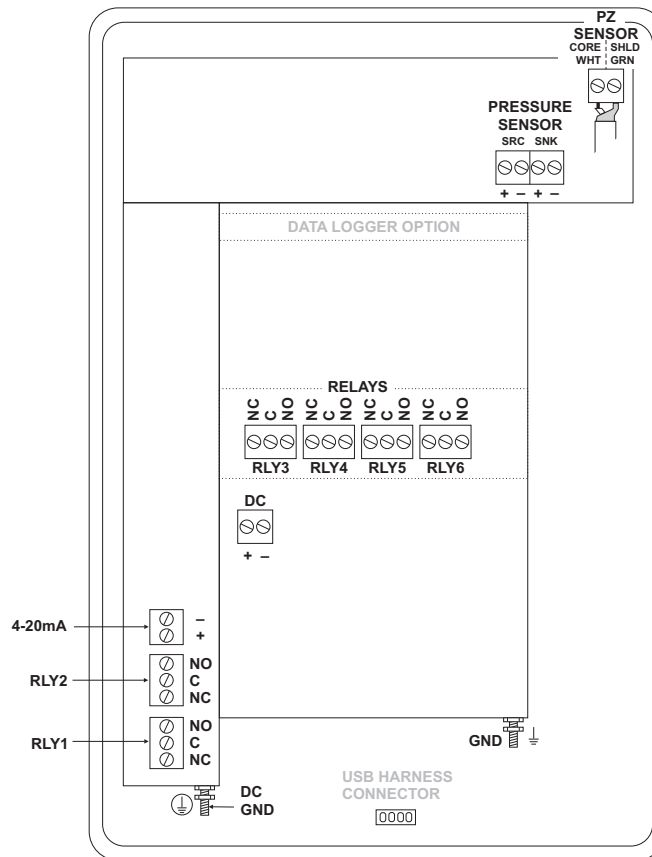
PSL 5.0 Level Monitors may be ordered factory-configured for 9-32VDC power input.

QUICK BENCH TEST:

Connect Sensor as shown below, then Power. When properly connected figures will show on the large LCD display. Test operation of the PSL 5.0 by holding the sensor steadily and aiming at a flat, stable target 16 to 48" (400 to 1200 mm) away from the end of the sensor. Allow a few seconds for the PSL 5.0 to lock onto the target before displaying its distance. The PSL 5.0 will now display Range in ft or cm (factory calibration).

CONNECTIONS:

POWER INPUT: Connect 9-32VDC/0.5 Amps to the + and - terminals. The Power Input GND must be connected to the nearest Ground pole. A 1 amp fuse in line is recommended.



APPENDIX B - APPLICATIONS BACKGROUND

Conditions in the tank or channel where the ultrasonic sensor is installed can affect the performance, range and accuracy of the system. The following notes are for general reference. Contact Greyline Instruments or your local representative for specific information on your application.

FOAM - Solid or dense surfaces such as a smooth liquid surface will give the best echos in an ultrasonic level measuring system. Foam acts as a sound insulator and may eliminate, or reduce the strength of an echo. Measurement range may be reduced in a system where foam is present. Ultrasonics are not recommended where thick dense foam is continually present. Thin layers of light foam (½ in. or less) can generally be disregarded. Use a stilling well in open channel applications.

LIQUIDS - The PSL is ideal to monitor tank liquid level or inventory. Caustic, corrosive or very viscous liquids can be monitored without contacting the liquid.

SOLIDS - The PSL will measure most granular material and powders as well as liquids. Powders will not generally provide the same echo strength as liquids. Therefore maximum expected range should be reduced to approximately 20 feet (6 m) for powders. There are many exceptions to this rule and installation of a test system is recommended when in doubt.

DUST - Any obstructions to the sound will affect performance of the system. In silo's where heavy concentrations of dust are expected ultrasonics may not work. Where moderate dust is encountered care should be taken to mount the sensor in a position where dust accumulation will be minimized and where the sensor can be cleaned if necessary.

SENSOR TEMPERATURE - The standard sensor model PZ34 supplied with each Pump Station Level Controller includes a built-in temperature sensor. The PSL automatically compensates for temperature fluctuations to retain high accuracy. Note the operating temperature ranges listed in the product specifications section. Do not exceed the sensor temperature ratings or damage may occur.

ELECTRONICS TEMPERATURE - Note operating temperature ranges listed in the product specifications. Temperatures higher than the maximum shown can reduce the operating life of the electronics. Moisture condensation from those temperatures below the range shown can also damage electronics components. In cold or outdoor environments the optional factory-installed enclosure heater and thermostat is recommended.

NOISE - Because the PSL's sensor operates at high sound frequency, regular process noise or vibration will not affect the system. Sensors installed in close proximity to one another in the same tank may "cross-talk" and should be synchronized.

VAPOUR - May affect but it can be compensated for by calibration in-situ. Severe vapour stratification can cause false echoes. Variable vapour cannot be compensated.

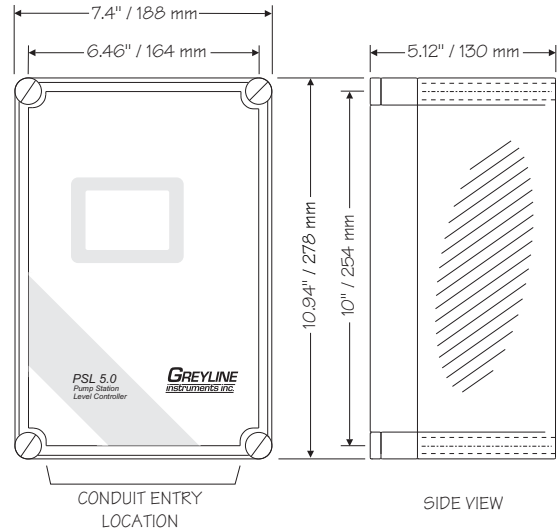
CHEMICAL COMPATIBILITY - The PSL's Sensor is constructed of very durable materials with broad compatibilities. Tank contents should be checked for their compatibility with PVC. An all-teflon sensor is available for corrosive applications.

CONVERSION GUIDE		
FROM	TO	MULTIPLY BY
US GALLONS	CUBIC FEET	0.1337
US GALLONS	IMPERIAL GALS	0.8327
US GALLONS	LITRES	3.785
US GALLONS	CUBIC METERS	0.003785
LITRES/SEC	GPM	15.85
LITRES	CUBIC METERS	0.001
BARRELS	US GALLONS	42
BARRELS	IMPERIAL GALS	34.9726
BARRELS	LITRES	158.9886
INCHES	MM	25.4
DEGREES F	DEGREES C	(°F-32) x 0.556
POUNDS	KILOGRAMS	0.453
PSI	BAR	0.0676
FOOT ²	METER ²	0.0929

VOLUME CALCULATION FOR ROUND TANKS: $3.142 \times R^2 \times H$
 R = TANK RADIUS (½ TANK DIAMETER)
 H = TANK HEIGHT

SPECIFICATIONS

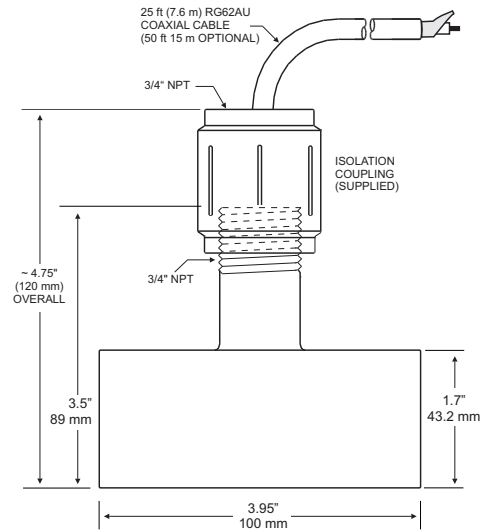
Accuracy:	±0.25% of Range or 2 mm, whichever is greater
Displays:	White, backlit matrix - displays level, relay states, operating mode and calibration menu
Calibration:	built-in 5-key calibrator with English, French or Spanish language selection
Power Input:	100-240VAC, 50/60Hz, 30 Watts or 9-32VDC, 9 Watts max
Output:	Isolated 4-20mA (1000 ohm load max.)
Control Relays:	Qty 6, rated 5 amp 240VAC SPDT, programmable pump control and alternation, level/status alarm
Enclosure:	watertight, dust tight NEMA4X (IP 66) polycarbonate with a clear shatter-proof face
Environmental Conditions:	Relative humidity up to 80% -23 to 60°C ambient temperature, maximum 5000 m altitude, pollution degree 4, Installation Category II.
Sensitivity:	adjustable. Damping: adjustable
Electrical Surge Protection:	Sensor, 4-20mA output and AC power input
Approximate Shipping Weight:	10 lbs (4.5 kg)



Standard PZ34

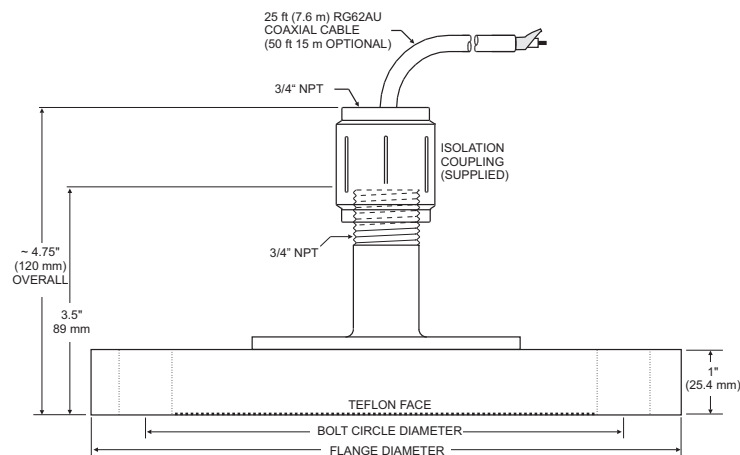
Maximum Range:	32 ft. (10 m)
Minimum Range (Deadband):	16" (406.4 mm)
Operating Frequency:	46 KHz
Beam Angle:	8°
Temperature Compensation:	Automatic, continuous
Operating Temperature:	-40° to 150°F (-40° to 65°C)
Maximum Operating Pressure:	20 psi (1.35 Bar)
Exposed Materials:	PVC
Sensor Mounting:	¾" NPT
Maximum Cable Length:	500 ft (152 m)
Optional Hazardous Rating:	CSA rated Intrinsically Safe Class I, Groups C,D, Class II, Groups E,F,G with optional Intrinsic Safety Barrier.

Note: Max Range reduced to 25 ft (7.8 m) with ISB option.



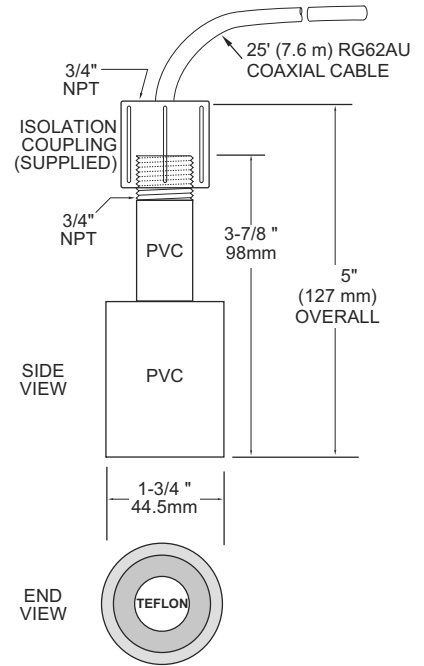
Optional PZ34T_F

- Maximum Range:** 32 ft. (10 m)
- Minimum Range (Deadband):** 16" (406.4 mm)
- Operating Frequency:** 46 KHz
- Beam Angle:** 8°
- Temperature Compensation:** Automatic, continuous
- Operating Temperature:** -40° to 150°F (-40° to 65°C)
- Maximum Operating Pressure:** 20 psi (1.35 Bar)
- Sensor Face:** Teflon
- Sensor Body:** PVC (not exposed to tank contents)
- Cable Length:** 25 ft. (7.6 m) continuous RG62AU coaxial Optional 50 ft. (15 m) continuous
- Maximum Cable Length:** 500 ft (152 m) RG62AU coaxial (splice)
- Hazardous Rating:** CSA rated Intrinsically Safe Class I, Groups C,D, Class II, Groups E,F,G with optional Intrinsic Safety Barrier.



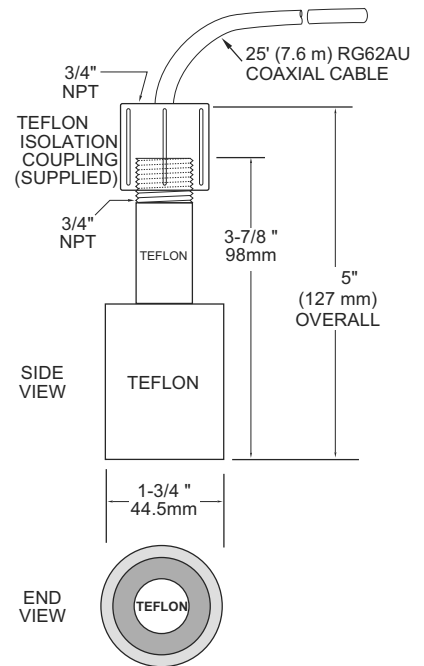
Optional Sensor PZ32T

- Maximum Range:** 32 ft. (10 m)
- Deadband (blinking):** Programmable, minimum 12" (305 mm)
- Beam Angle:** 8° at 3 DB
- Temperature Compensation:** Automatic, continuous
- Operating Frequency:** 42 KHz
- Exposed Materials:** PVC and Teflon
- Operating Temperature:** - 40° to 150°F (-40° to 65°C)
- Operating Pressure:** 20 psi (1.35 Bar) maximum
- Mounting:** ¾" NPT (PVC isolation coupling supplied)
- Sensor Cable:** RG62AU coaxial, 25 ft. (7.6 m) standard
- Hazardous Rating:** with optional Intrinsic Safety Barrier: CSA, Class I,II,III, Div. I,II, Groups C,D,E,F,G
Note: Max Range reduced to 25 ft (7.6 m) with ISB option.



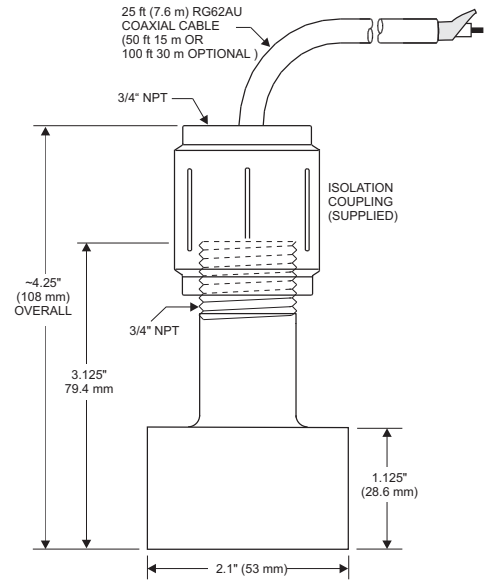
Optional Sensor PZ32TE

- Maximum Range:** 32 ft. (10 m)
- Deadband (blinking):** Programmable, minimum 12" (305 mm)
- Beam Angle:** 8° at 3 DB
- Temperature Compensation:** Automatic, continuous
- Operating Frequency:** 42 KHz
- Exposed Materials:** Teflon
- Operating Temperature:** -40° to 170°F (-40° to 76°C)
- Operating Pressure:** 20 psi (1.35 Bar) maximum
- Mounting:** ¾" NPT (Teflon isolation coupling supplied)
- Sensor Cable:** RG62AU coaxial, 25 ft. (7.6 m) standard
- Hazardous Rating:** with optional Intrinsic Safety Barrier: CSA, Class I,II,III, Div. I,II, Groups C,D,E,F,G,
Note: Max Range reduced to 25 ft (7.6 m) with ISB option



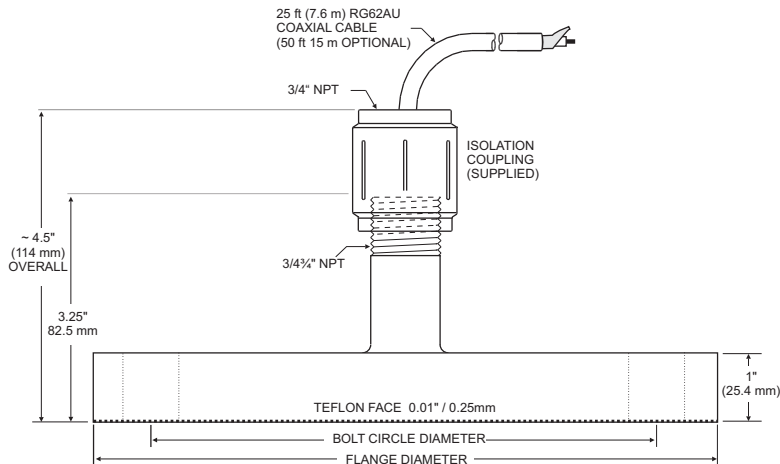
Optional PZ15

- Maximum Range:** 15 ft (4.57 m)
- Minimum Range (Deadband):** 8" (203.2 mm)
- Operating Frequency:** 92 KHz
- Beam Angle:** 8°
- Operating Temperature:** -40° to 150° (-40° to 65°C)
- Temperature Compensation:** Automatic, continuous
- Max. Operating Pressure:** 20 psi (1.35 bar)
- Sensor Face:** PVC
- Sensor Body:** PVC
- Mounting:** 3/4" NPT
- Cable Length:** 25 ft. (7.6 m) continuous RG62AU coaxial. Optional 50 ft. (15 m) continuous RG62AU coaxial (splice)
- Max. Cable Length:** 500 ft. (152 m) RG62AU coaxial (splice)
- Hazardous Rating:** CSA rated Intrinsically Safe Class I, Groups C,D, Class II, Groups E,F,G with Optional Intrinsic Safety Barrier.



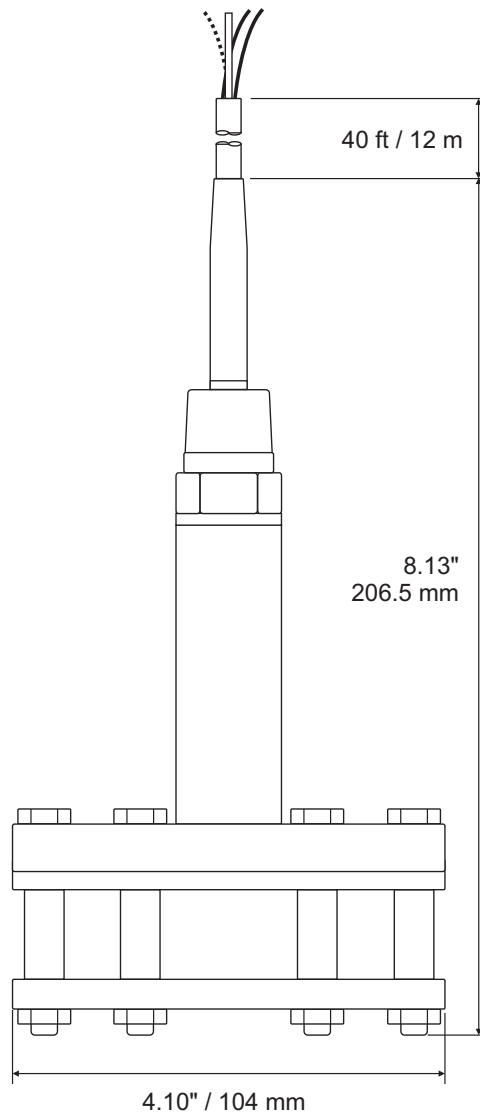
Optional PZ12T_F

- Maximum Range:** 12 ft (3.66 m)
- Minimum Range (Deadband):** 8" (203.2 mm)
- Operating Frequency:** 92 KHz
- Beam Angle:** 8°
- Operating Temperature:** -40° to 150° (-40° to 65°C)
- Temperature Compensation:** Automatic, continuous
- Max. Operating Pressure:** 20 psi (1.35 bar)
- Sensor Face:** Teflon
- Sensor Body:** PVC
- Mounting:** 3/4" NPT
- Cable Length:** 25 ft. (7.6 m) continuous RG62AU coaxial. Optional 50 ft. (15 m) continuous RG62AU coaxial (splice)
- Max. Cable Length:** 500 ft. (152 m) RG62AU coaxial (splice)
- Hazardous Rating:** CSA rated Intrinsically Safe Class I, Groups C,D, Class II, Groups E,F,G with optional Intrinsic Safety Barrier.



Optional LTB35

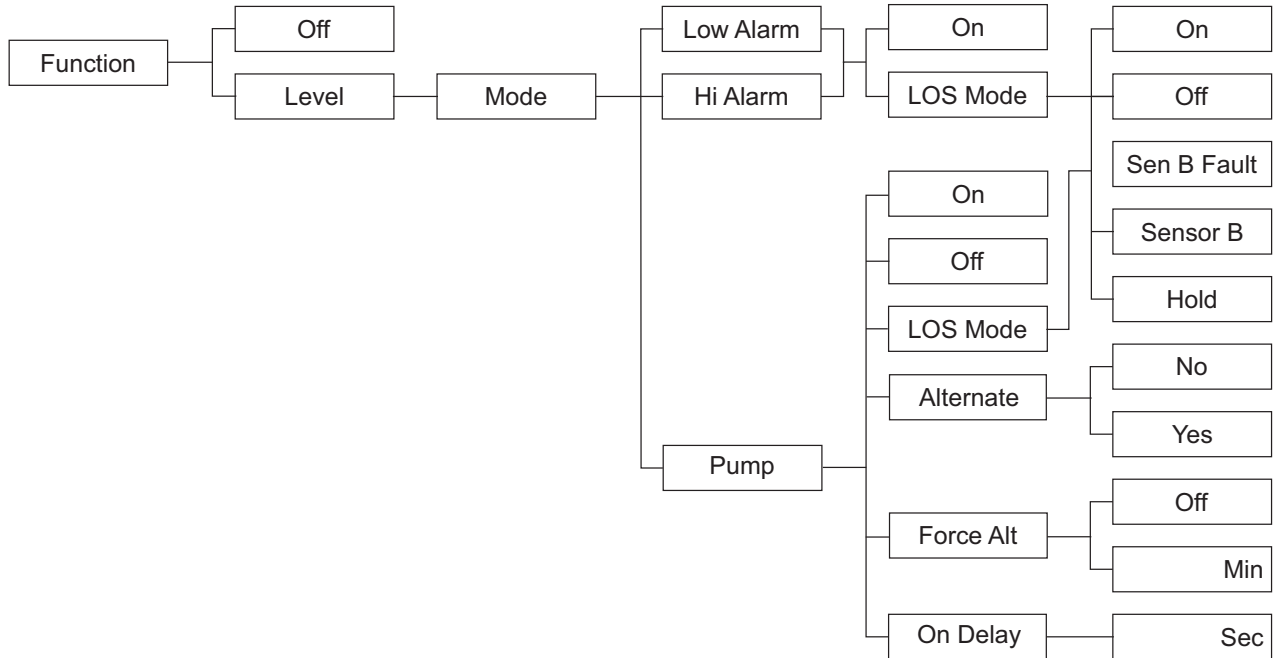
- Operating Level Range:** 0-15 psi (35 ft) / 1.0 bar (10 m)
- Wetted Materials:** 316 stainless steel, Delrin, Viton, PTFE, polyurethane
- Cable:** 40 ft (12 m) polyurethane jacketed, shielded, with vent tube and rated to 200 lb. (90 kg) pull strength
- Accuracy:** $\pm 0.25\%$ FSO (BFSL)
- Operating Temperature:** -4°F to 140°F (-20°C to 60°C)
- Compensated Temp:** 32°F to 122°F (0°C to 50°C)
- Load Impedance:** 750 ohms max at 24VDC
- Proof Pressure:** 1.5 times full scale pressure range
- Burst Pressure:** 2 times full scale pressure range
- Hazardous Locations:** with optional Intrinsic Safety Barrier: UL, CUL and FM rated for Class I,II,III, Div. 1, Groups A,B,C,D,E,F,G



PSL 5.0 RELAY CALIBRATION RECORD

Circle Selected Units and Enter Values in the Blank Spaces.

RELAY 1 2 3 4 5 6



RELAY 1 2 3 4 5 6

