In-Situ Inc.

Level TROLL™

OPERATOR'S MANUAL

Level TROLL 500

August 2005

Contents

1 INTRODUCTION

SYSTEM DESCRIPTION

Your new Level TROLL 500 is a compact, modular system for measuring level and temperature in natural groundwater and surface water, as well as industrial, waste, and other installations. Components include the instrument body, vented and non-vented cables, communication cables, external power accessories, desiccants and other installation accessories, and software.

HOW TO USE THIS MANUAL

This operator's manual is designed as both a start-up guide and a permanent reference for the features, uses, and applications of the Level TROLL 500.

Section 1: Introduction to the Level TROLL Operator's Manual and to In-Situ Inc. — Warranty Provisions — Instrument Repair & Return Recommendations

Section 2: Components and features of the Level TROLL system — Accessories — Product Specifications

Section 3: Getting Started — Attaching Cable — Installing & Launching the Software — Connecting for the First Time — Setting the Clock — Setting a Device Site — Preparing to Log Data

Section 4: About the Pressure (Level) Sensor: The two basic types of pressure sensors — Factory and field calibration

Section 5: Field Installation — Guidelines and Precautions for Long-Term Deployment of the Level TROLL

Section 6: Connecting for use with SDI-12, Analog (4-20 mA), and Modbus loggers and controllers

Section 7: Care & Maintenance

Section 8: Troubleshooting

CERTIFICATION

The Level TROLL complies with all applicable directives per the CE and FCC and was tested to the EN 55022 / ICES-003 / FCC specifications.

CONVENTIONS

Throughout this operator's manual you will see the following symbols.

The check mark highlights a tip about a convenient feature of the Level TROLL

The exclamation point calls your attention to a requirement or important action that should not be overlooked

UNPACKING AND INSPECTION

***TIP:** Please save packing materials for future storage and shipping of your Level TROLL. The shipping boxes have been performance-tested and provide protection for the instrument and its accessories.*

Your Level TROLL was carefully inspected before shipping. Check for any physical damage sustained during shipment. Notify In-Situ and file a claim with the carriers involved if there is any such damage; do not attempt to operate the instrument. Accessories may be shipped separately and should also be inspected for physical damage and the fulfillment of your order.

SERIAL NUMBER

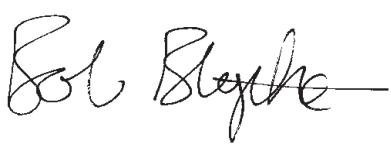
The serial number is engraved on the body of the Level TROLL. It is also programmed into the instrument and displayed when the instrument is connected to a computer running Win-Situ. We recommend that owners keep a separate record of this number. Should your Level TROLL be lost or stolen, the serial number is often necessary for tracing and recovery, as well as any insurance claims. If necessary, In-Situ maintains complete records of original owner's names and serial numbers.

TO OUR CUSTOMERS . . .

Thank you for your purchase of an In-Situ product. We are glad you chose us and our products to help you with your environmental monitoring needs. In-Situ Inc. has been designing and manufacturing world-class environmental monitoring instrumentation for over 25 years in the Rocky Mountains of the United States. As it was in the beginning, our expectation is that this product will provide you with many trouble-free years of use. To that end, we pride ourselves on delivering the best customer service and support possible—24 hours a day, 7 days a week. We believe that this level of commitment to you, our customer, is imperative in helping you ensure clean, safe groundwater and surface water resources across the globe. We also understand the need for accurate, reliable assessments and we continue to make significant investments in Research and Development to ensure that we deliver the latest product and technological innovations to support your needs.

Whether you are gathering information about your body of water for a few moments, or over a period of years, you can rely upon us to provide you with a quality product and outstanding customer support at a fair price and have that product delivered to you when and where you need it.

We want your experience with In-Situ Inc. to be pleasant and professional, whether you are renting from us, or purchasing from us. We would be pleased to hear from you and learn more about your needs, and your experiences with our products. Again, we thank you for choosing In-Situ Inc. and we look forward to serving your needs now, and in the future.



Bob Blythe, President and CEO
In-Situ Inc.
bblythe@in-situ.com

WHAT WE PROVIDE

WARRANTY PROVISIONS

In-Situ Inc. warrants all products sold, excluding batteries sold with such products, against defects in materials and workmanship under normal operating conditions. Consult the separate warranty for specific warranties that may apply.

Maintenance & calibration plans as well as extended warranties are available. Contact your In-Situ representative for complete information.

FIRMWARE & SOFTWARE UPGRADES

The Level TROLL 500 is upgradeable. Contact In-Situ Inc. for details.

HOW TO CONTACT US

Technical Support:	800 446 7488
	Toll-free 24 hours a day in the U.S. and Canada
Address:	In-Situ, Inc. 221 E. Lincoln Ave. Fort Collins, CO 80524 USA
Phone:	970 498 1500
Fax:	970 498 1598
Internet:	www.in-situ.com

TO OBTAIN REPAIR SERVICE (U.S.)

If you suspect that your Level TROLL is malfunctioning and repair is required, you can help assure efficient servicing by following these guidelines:

1. Call In-Situ Customer Service toll-free at 1-800-446-7488 or 1-970-498-1500. Have the product model and serial number handy.

2. Be prepared to describe in detail the exact nature (symptoms) of the problem, including how the instrument was being used and the conditions noted at the time of the malfunction.

3. If service personnel determine that service is required, they will assign an RMA (return material authorization) number.

4. Clean the Level TROLL and cable. Decontaminate thoroughly if it has been used in a toxic or hazardous environment. See the Cleaning Guidelines and form later in this section.

5. Complete and sign a Decontamination & Cleaning Statement (print out the form on the next page) for each instrument.

6. Carefully pack your Level TROLL in its original shipping box, if possible. Include a statement certifying that the instrument and cable have been decontaminated, and any supporting information.

If an instrument returned for servicing shows evidence of having been deployed in a toxic or hazardous environment, Customer Service personnel will require written proof of decontamination before they can service the unit.

7. Send the package, shipping prepaid, to

   In-Situ, Inc.
   Customer Service
   ATTN: RMA # (assigned no. here)
   221 E. Lincoln Ave.
   Fort Collins, CO 80524

The warranty does not cover damage during transit. In-Situ recommends the customer insure all shipments. Warranty repairs will be shipped back prepaid.

Outside the U.S.

Contact your international In-Situ distributor for repair and service information.

GUIDELINES FOR CLEANING RETURNED EQUIPMENT

Please help us protect the health and safety of our employees by cleaning and decontaminating equipment that has been subjected to any potential biological or health hazards, and labeling such equipment. Unfortunately, *we cannot service your equipment without such notification*. Please complete and sign the form below (or a similar statement certifying that the equipment has been cleaned and decontaminated) and send it along to us with each downhole instrument.

- A good cleaning solution, such as Alconox® (a glassware cleaning product available from laboratory supply houses) is recommended.
- Clean all cabling. Remove all foreign matter.
- Clean cable connector(s) with a clean, dry cloth. Do not submerge.
- Clean the probe body—including the nosecone, restrictor, cable head, and protective caps. Remove all foreign matter.
- Remove and clean any removable sensors. Rinse with deionized or distilled water after cleaning.

If an instrument is returned to our Service Center for repair or recalibration without a statement that it has been cleaned and decontaminated, or in the opinion of our Service Representatives presents a potential health or biological hazard, we reserve the right to withhold service until proper certification has been obtained.

Decontamination & Cleaning Statement

Company Name _____ Phone _____

Address _____

City _____ State _____ Zip _____

Instrument Type _____ Serial Number _____

Contaminant(s) (if known) _____

_____

Decontamination procedure(s) used _____

_____

Cleaning verified by _____ Title _____

Date _____

In-Situ Inc.

2 SYSTEM COMPONENTS

BODY

There are no user-serviceable parts in the Level TROLL body.

The Level TROLL's all-titanium body, 18.3 mm (0.72 in) diameter, includes pressure and temperature sensors, real-time clock, micro–processor, sealed lithium battery, data logger, and memory. Options include a vented or non-vented pressure sensor in a variety of ranges.

CABLE

Several basic cable types are used in the Level TROLL system.

TIP: *Cable markings include VF = vent-free, HF = halogen-free*

- Rugged Cable™, TPU-jacketed (Thermoplastic PolyUrethane)
  - vented or non-vented
  - Halogen-Free vented or non-vented (LSZH-rated, low smoke zero halide)
- Vented FEP* cable
- Stainless steel suspension wire for deployment of a non-vented Level TROLL 500
- Communication cables for programming the device/downloading the logged data

** FEP (fluorinated ethylene propylene) is the generic equivalent of DuPont Teflon®*

RUGGED CABLE™

Cable includes conductors for power and communication signals, a strength member, and a Kellems® grip to anchor the Level TROLL securely. Available in standard and custom lengths.

Uphole and downhole ends are identical bayonet-type Twist-Lock™ connectors that mate with the Level TROLL body, TROLL Com™ communication cable, desiccants, and other accessories.

Vented cable is designed for use with vented pressure/level sensors (gauged measurements). The cable vent tube insures that atmospheric pressure is the reference pressure applied to the sensor diaphragm. Vented cable includes a Desicap™ desiccant cap.

Non-vented cable may be used with non-vented pressure/level sensors (absolute measurements).

Rugged Cable "Stripped & Tinned"

In place of the "uphole" Twist-Lock connector, this cable ends in bare conductors for custom wiring to a logger or controller using SDI-12, analog (4-20 mA), or Modbus communication protocols. Vented cable includes an outboard desiccant pack to protect against condensation.

Desicap™ Desiccant Cap

Vented cable includes a clear cap of indicating silica gel desiccant to protect the cable and electronics from condensation. The desiccant is blue when active. It will absorb moisture from the top down and for best results should be replaced before the entire volume has turned pink. Replacements and refills are available from In-Situ Inc. or your distributor.

MAXUM™ Desiccant

The optional high-volume desiccant pack may last up to 20 times longer than the Desicap in humid environments. It attaches to the Level TROLL cable in place of the Desicap. Refill kits are also available from In-Situ Inc. or your distributor.

TIP: Protect new desiccant from moisture until ready to use.

Outboard Desiccant

Vented “stripped & tinned” cable includes an outboard desiccant pack attached to the cable vent tube. Same size as MAXUM. Replacements and refills are available.

Accessory	Catalog No.
Desicap (replacement)	52230
Desicap refill kit	52180
MAXUM	51810
Outboard Desiccant (replacement)	51380
Refill kit for MAXUM & Outboard Desiccant pack	29140

COMMUNICATION CABLES

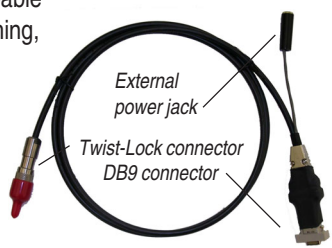
TROLL Com™

The DB9 end of the TROLL Com is not submersible.

Vented polyurethane cable (0.9 m, 3 ft), connects the Level TROLL's Rugged Cable to a PC's serial port to display readings, to program the instrument for data collection, and to download the collected data. Converts the Level TROLL's RS485 signal to a standard RS232 signal for communication via the serial port on a host computer. Weatherproof, withstands a temporary immersion. Cable vents into unit, protected by a hydrophobic membrane.

The DB9 end of the Programming cable is not submersible.

Programming Cable



Vented polyurethane or halogen-free polyurethane cable (1.8 m, 6 ft) combines the functions of the Rugged Cable and TROLL Com for profiling, programming, and downloading; connects the Level TROLL directly to a serial port; includes RS485/RS232 converter and external power input jack. A good choice for permanent connection to a PC, or where external power is desirable, or for programming a non-vented Level TROLL that will be deployed without Rugged Cable.

Accessory	Catalog No.
TROLL Com	52170
Programming cable	51840
Programming cable, halogen-free	51850
USB to serial adapter	31090

POWER COMPONENTS

INTERNAL POWER

TIP: Win-Situ can display the approximate percentage of internal battery life remaining when the Level TROLL is connected to a computer.

The Level TROLL 500 operates on 3.6 VDC, supplied by a completely sealed, non-replaceable AA lithium battery. Typical battery life is 5 years or 2,000,000 data points, whichever occurs first.

EXTERNAL POWER

External Battery Pack

TIP: When a Level TROLL is used as an Analog (4-20 mA), SDI-12, or Modbus device, power is supplied by the data logger or controller to which the Level TROLL is wired.

The sealed, submersible TROLL Battery Pack (lithium) supplies 14.4 V. When this power source is connected, the Level TROLL will use the external battery source first and switch to the internal batteries when external battery power is depleted. For a Level TROLL 500, external batteries can be expected to last approximately a year, regardless of sampling speed.

AC Adapter

Use only In-Situ's AC adapter. Damage to the Level TROLL caused by the use of third-party converters is not covered by the warranty.

In-Situ's AC adapter provides 24 VDC, 0.75 A, AC input 100-250 V, includes North American power cord. The Programming Cable includes an external power input for connection to this adapter.

Accessory	Catalog No.
External Battery Pack	51450
AC Adapter	52440

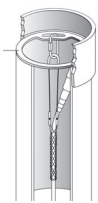
INSTALLATION ACCESSORIES

NPT Adapter

Twist-Lock Hanger

Cable Extender

Locking Wellcap



Well Dock

- 1/4" NPT Adapter: allows Level TROLL installation in piping
- Twist-Lock™ Hanger: stainless steel hanger to suspend a non-vented Level TROLL or Baro TROLL while taking data; no venting, no communication capabilities
- Cable Extender: connects two lengths of Rugged Cable
- Wellcaps, locking and vented
- Well Docks: top-of-well support for 2", 4", or 6" well

Accessory	Catalog No.
NPT Adapter	51470
Twist-Lock Hanger	51480
Cable Extender	51490
Locking Wellcap, 2"	20360
Locking Wellcap, 2" vented	20370
Locking Wellcap, 4"	20380
Locking Wellcap, 4" vented	20390
Top-of-well installation ring	WELLDOCK2", 4", 6"

CONTROL SOFTWARE

Win-Situ™ is easy-to-use software for programming the Level TROLL.

Win-Situ provides instrument control for direct reads and profiling, long-term data logging, data downloads, data viewing, data export to popular spreadsheet programs, choice of units and other display options, battery/memory usage tracking, interface to networks and telemetry. Available in basic and Professional versions to suit customer needs.

Minimum system requirements: 400 MHz Pentium® II processor, 128 Mb RAM, 100 Mb free disk space, Internet Explorer® 5.0 or higher, Windows® 2000 Professional SP2 or better or Windows XP Professional SP1 or better.

Win-Situ connects through a serial COM port. If your computer does not have one, a USB-to-serial adapter is available from In-Situ Inc. (Catalog No. 31090).

Complete information on using the software is available from Win-Situ's Help menu.

PRODUCT SPECIFICATIONS

General

Wetted materials	Titanium, acetal (nose cone)
Dimensions	21.6 mm (8.5 in) long, 18.3 mm (0.72 in) O.D.
Weight	0.2 kg (0.44 lb)
Operating temperature	-20°C to +80°C (-4°F to +176°F)
Storage temperature	-40°C to +80°C (-40°F to +176°F)

Pressure/Level

Sensor type	Silicon strain gauge, vented or non-vented
Material	Titanium
Pressure ranges	5, 15, 30, 100, 300, 500 PSIG; 30, 100, 300, 500 PSIA
Max. pressure	2X range
Burst pressure	3X range
Accuracy*	
15°C	± 0.05 % full scale
-5 to +50°C	± 0.1 % full scale
-20 to -5 & +50 to +80°C	± 0.25 % full scale typical
Response time	Dependent on software/firmware update rate: 2 per sec
Resolution	0.005 % full scale or better

Vented Level TROLL 500

Range		Usable Depth	
PSIG	kPa	Meters	Feet
5	34.5	0-3.5	0-11.5
15	103.4	0-11	0-35
30	206.8	0-21	0-69
100	689.5	0-70	0-231
300	2068	0-210	0-692
500	3447	0-351	0-1153

Non-Vented Level TROLL 500

Range	Effective Range**		Usable Depth	
PSIA	PSIA	kPa	Meters	Feet
30	15.5	106.9	0-10.9	0-35.8
100	85.5	589.5	0-60.1	0-197.3
300	285.5	1968	0-200.7	0-658.7
500	485.5	3347	0-341.3	0-1120

*** At sea level (14.5 PSI atmospheric pressure).*

** Accuracy with 4-20 mA output option: ± 0.25 % typical*

Temperature

Sensor material	Silicon
Range	-20°C to +80°C (-4°F to +176°F)
Accuracy	
0 to +50°C	± 0.1°C
-20 to 0 & +50 to +80°C	± 0.25°C
Response time	T63 = 15 seconds, T90 = 30 seconds
Resolution	0.01°C or better

Communications

Output options	RS-485 Modbus, RS-232 (via TROLL Com converter), SDI-12, 4-20mA

Logging

Memory	1 MB (at least 100,000 data points)
Log type	Linear
Fastest logging rate	1 sample/minute (Modbus, SDI-12: 2 samples/second)
Max. no. of logs	2

Power

Battery	3.6 V, 2.25 Ah, lithium, sealed, not replaceable or rechargeable
Typical life	2,000,000 data points or 5 years (whichever comes first)
External power	8 to 36 VDC
External battery pack	Lithium thionyl chloride batteries, 14.4 V, 2.4 g lithium

Cable

Jacket options	Polyurethane, halogen-free (HF) polyurethane, FEP (generic Teflon)
Conductors	6 conductors, 24 AWG, polypropylene insulation
Diameter	Cable, 6.7 mm (0.265 in); Connector, 18.5 mm (0.73 in)
Break strength	127 kg (280 lb)
Minimum bend radius	2X cable diameter (13.5 mm, 0.54 in)
Weight	Vented, regular & HF: 14 kg/300 m (32.3 lb/1000 ft) Non-vented, regular & HF: 16 kg/300 m (35.6 lb/1000 ft) Vented FEP: 23 kg/300 m (52 lb/1000 ft)

3 GETTING STARTED

This section provides a quick overview of the initial steps necessary to get the Level TROLL ready to log data.

You will need—

- Level TROLL
- Cable
  - Rugged Cable and TROLL Com communication cable (for Level TROLLs that will be deployed on Rugged Cable)
    or
  - Programming Cable (for Level TROLLs that will be deployed on suspension wire)
- Win-Situ software
- Desktop or laptop PC

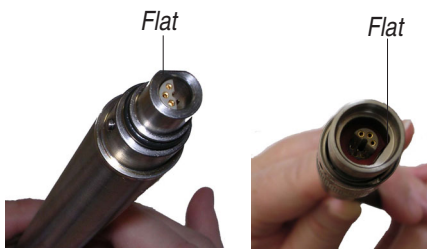
A. CONNECT THE RUGGED CABLE OR PROGRAMMING CABLE TO THE LEVEL TROLL

1. Remove the protective caps from the Level TROLL and cable.

TIP: *Retain the dust caps to protect the pins and o-ring from damage when cable is not attached.*

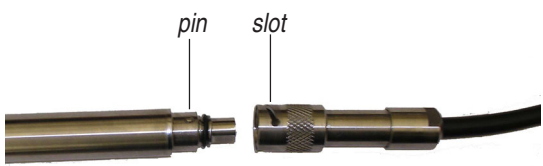
Level TROLL (or TROLL Com) *Cable*

2. Take a moment to look at the connectors. Each has a flat side.



Level TROLL (or TROLL Com) *Cable*

Note the pins on the body connector (one on each side) and the slots on the cable connector (one on each side).

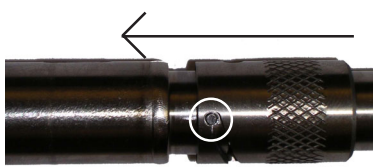


3. Slide back the sleeve on the cable connector.

4. Orient the “flats” so they will mate up, and insert the Level TROLL connector firmly into the cable connector.

Level TROLL *Cable*

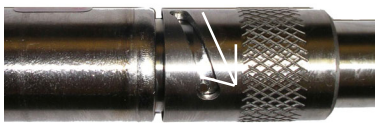
5. Slide the sleeve on the cable toward the Level TROLL body until the pin on the body pops into the round hole in the slot on the cable connector.



Level TROLL *Cable*

6. Grasp the knurled (textured) section of the cable connector in one hand and the Level TROLL body in the other. Push and twist firmly so that the pin on the body connector slides along the slot on the cable connector and locks securely into the other hole.

Be sure you hear the "click." The "click" ensures the cable is securely attached.



Level TROLL *Cable*

If you connected Rugged Cable, continue to step B. If you connected a Programming Cable, skip to step C.

B. CONNECT THE TROLL COM TO THE RUGGED CABLE

1. Remove the Desicap desiccant cap from the free end of the Rugged Cable (if present) by grasping the knurled (textured) section of the cable connector in one hand and the Desicap in the other. Twist in opposite directions to unlock the Desicap from the cable.

2. Slide back the sleeve on the cable connector. Locate the "flats" on the cable connector and the TROLL Com connector as before.
3. Orient the "flats" so they will mate up, and insert the TROLL Com connector firmly into the cable connector.

4. Slide the metal sleeve on the cable toward the TROLL Com body until the pin on the body pops into the hole in the slot on the cable connector.

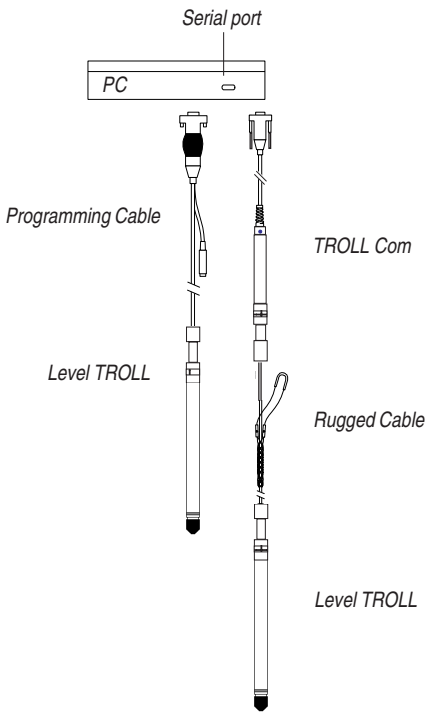
Be sure you hear the "click." The "click" ensures the cable is securely attached.

5. Grasp the knurled (textured) section of the cable connector in one hand and the TROLL Com body in the other. Push and twist firmly so that the pin on the body slides along the slot on the cable connector and snaps securely into the other hole.

C. CONNECT TO THE HOST PC

Attach the DB9 connector on the TROLL Com or Programming Cable to a PC's standard 9-pin RS232 serial port.

TIP: A serial port is required. If your computer does not have one, a USB-to-serial adapter is available from In-Situ Inc. (Catalog No. 31090).



D. INSTALL THE SOFTWARE

For communication using a desktop or laptop PC, install Win-Situ:

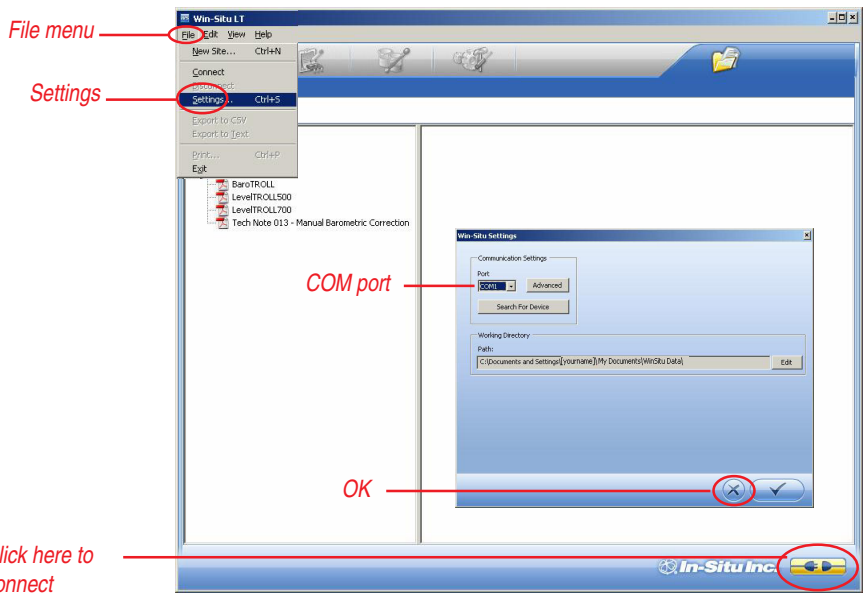
1. Insert the Win-Situ installation CD in the appropriate drive of your computer.
   - If the CD-ROM drive is set to Auto-Play, the installation program will start automatically.
   - If necessary, choose Run from the Windows Start Menu and type D:\Setup, where *D* is your CD-ROM drive letter.
2. Follow the instructions to install the program to your local hard drive. We recommend you select when prompted:
   - the default Destination Folder — C:\Program Files\InSitu\WinSitu
   - a "Complete" setup type
   - Win-Situ shortcut on the desktop

E. LAUNCH THE SOFTWARE & CONNECT

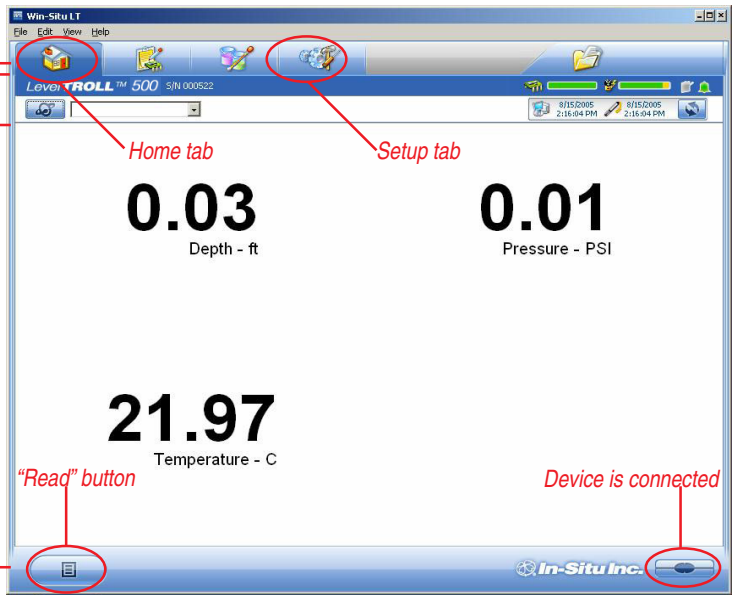
1. Start Win-Situ by double-clicking the shortcut created on the desktop during installation. 

2. When the Win-Situ application window opens, select File menu > Settings and check your PC's COM port (usually COM 1 for direct serial port connection). Click the "OK" button  .

3. Click the "Connect" button  to connect to the Level TROLL.



4. The software will connect to the Level TROLL and display current level/ depth, pressure, and temperature readings.



TIP: *To change the units: Click the Setup tab. Select units for each parameter in the Parameter Configuration section of the Setup screen. Return to the Home tab and refresh the readings with the "Read" button.*

- Note the Tabs at the top of the screen— this is the 'Home" tab, which displays current readings from the connected device.
- The Dashboard (status area) below the tabs displays information about the Level TROLL, including its model and serial number, battery and memory capacity, the device clock and the computer clock, and current Site setting.
- The Control Panel at the bottom contains action buttons. You can update the readings by clicking the "Read" button.

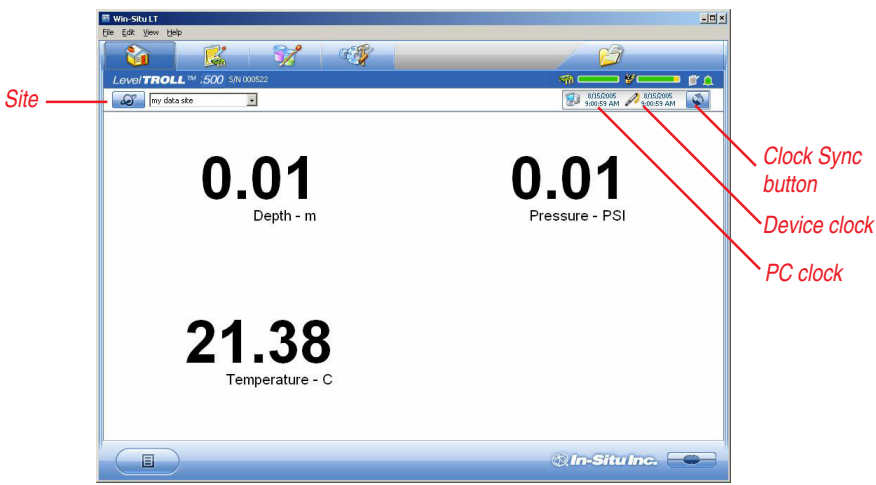
Now you're ready to give the Level TROLL some specific information through the software. Win-Situ provides many options. At a minimum:

- set the Level TROLL clock
- define the site where the Level TROLL will collect data
- enter data logging instructions

A brief overview is provided here. For more detailed information, see Win-Situ's Help menu.

SET THE CLOCK

Data collection schedules depend on the device's real-time clock. Both the device clock and the system (PC) clock are shown on the dashboard when the device is connected. The clocks update every 2 seconds. If the device clock is more than 2 seconds off the system clock, the device clock is displayed in red. To synchronize the clocks, click the Sync button.



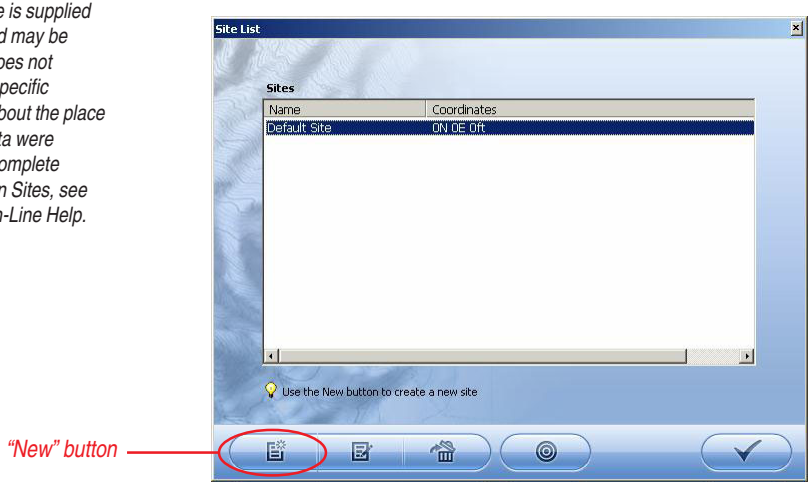
ADD A NEW SITE

Logged data are organized by the **sites** where the data were logged. For easy data file management, downloaded data files are saved to a folder on your PC that has the same name as the site.

To specify a site for the connected Level TROLL:

1. Select File menu > New Site.
2. When the Site List is displayed, click the “New” button.

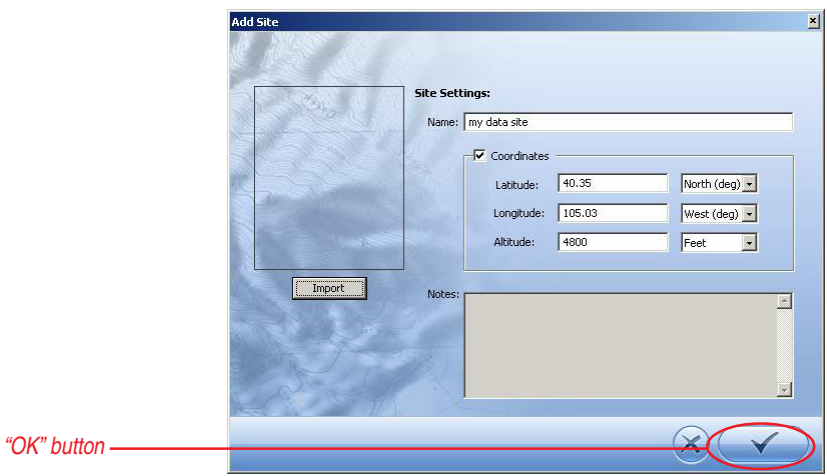
TIP: *A default site is supplied and may be used, but it does not provide any specific information about the place where the data were logged. For complete information on Sites, see Win-Situ’s On-Line Help.*



3. In the Add Site dialog, enter a name for the site. A short, descriptive name is best—for example, a project, well, water body, gauging station, town, nearby landmark, etc. Length is limited to 32 characters.

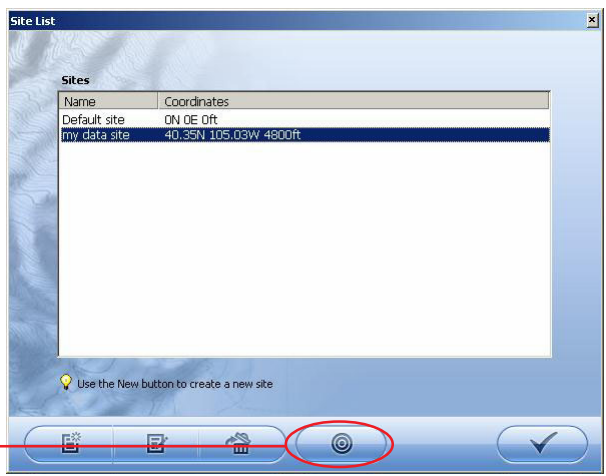
4. Enter the optional site coordinates if you wish. They are used to uniquely identify a data location. They are not used elsewhere by the software.

5. Click "OK" to add the new site to the site database in the Win-Situ working directory on your computer. Now it is available to use in any connected device.



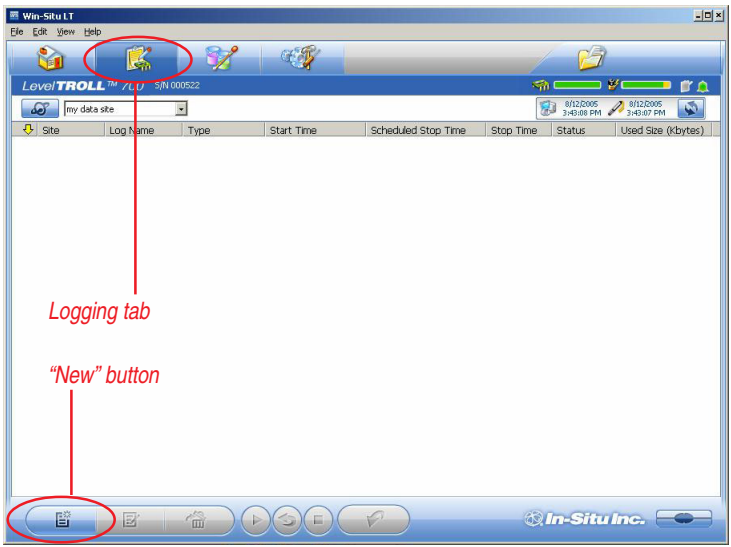
6. The Site List will be displayed again, with your new site.
7. Select (highlight) your new site and click the “Set” button—it looks like a target—to store this site in the connected Level TROLL.

Tip: *You can create as many sites as you like with the “New” button. Only one site at a time is stored in the Level TROLL.*



PREPARE TO LOG DATA

1. To prepare the device to log data, first select the Logging tab.
2. Click the "New" button.



TIP: For more complete information on setting up data logs, see Win-Situ's On-Line Help.

The Logging Setup Wizard will prompt you through the configuration of a data log—including the site, log name, parameters to measure, sample schedule, start time, stop time (optional), output (pressure, depth, or water level with a reference), and other options.

To Start logging:

- A “Pending” (scheduled) log will start at its programmed time
- You can start a “Ready” (manual) log at any time while connected by selecting the log and pressing “Start”

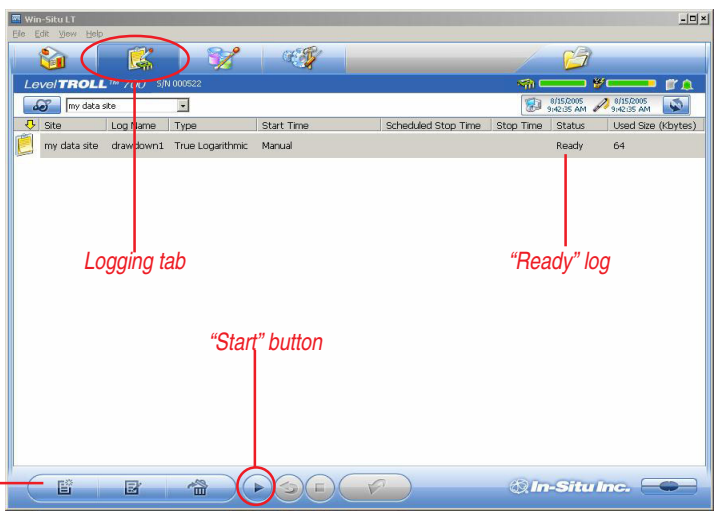
To Stop logging:

- Select the log and press the “Stop” button
- Or suspend (temporarily stop) it with the “Pause” button

To Download the log to the connected PC:

- Select the log and press the “Download” button

TIP: *As an alternative to the log control buttons, right-click a log to display a short context menu of available actions.*



DISCONNECTING

After the Level TROLL is programmed to log data, you're ready to

- Exit the software (File menu > Exit).
- Disconnect the TROLL Com from the cable connector, by grasping the knurled (textured) section of the cable connector in one hand and the TROLL Com in the other. Twist in opposite directions to unlock the TROLL Com from the cable.
- Vented cable: Place the Desicap desiccant cap on the cable connector.
- Non-vented Level TROLL: Attach a Twist-Lock hanger and suspension wire (if using)
- Install the instrument in its field location. See Section 5 for guidelines.

4 ABOUT THE PRESSURE (LEVEL) SENSOR

A pressure transducer senses changes in pressure, measured in force per square unit of surface area, exerted by water or other fluid on an internal media-isolated strain gauge. Common measurement units are pounds per square inch (PSI) or newtons per square meter (pascals).

NON-VENTED (ABSOLUTE) VS. VENTED (GAUGED) SENSORS

A non-vented or “absolute” pressure sensor measures all pressure forces exerted on the strain gauge, including atmospheric pressure. Its units are **PSIA** (pounds per square inch “absolute”), measured with respect to zero pressure.

Non-vented pressure measurements are useful in vacuum testing, in short-term testing when atmospheric pressure would not be expected to change, in very deep aquifers where the effects of atmospheric pressure are negligible, and in unconfined aquifers that are open to the atmosphere.

With vented or “gauged” pressure sensors, a vent tube in the cable applies atmospheric pressure to the back of the strain gauge. The basic unit for vented measurements is **PSIG** (pounds per square inch “gauge”), measured with respect to atmospheric pressure. Vented sensors thus exclude the atmospheric or barometric pressure component.

This difference between absolute and gauged measurements may be represented by a simple equation:

$$P_{gauge} = P_{absolute} - P_{atmosphere}$$

PRESSURE, DEPTH, AND LEVEL

Output options for pressure measurement are completely software-selectable. Each log configuration presents the following choices:

- Pressure in PSI or kPa
- Depth
- Water Level with a reference (an “offset”)
  - Surface Elevation reference
  - Distance to Water reference

Pressure is a simple check box. For depth or level, the software presents additional options:

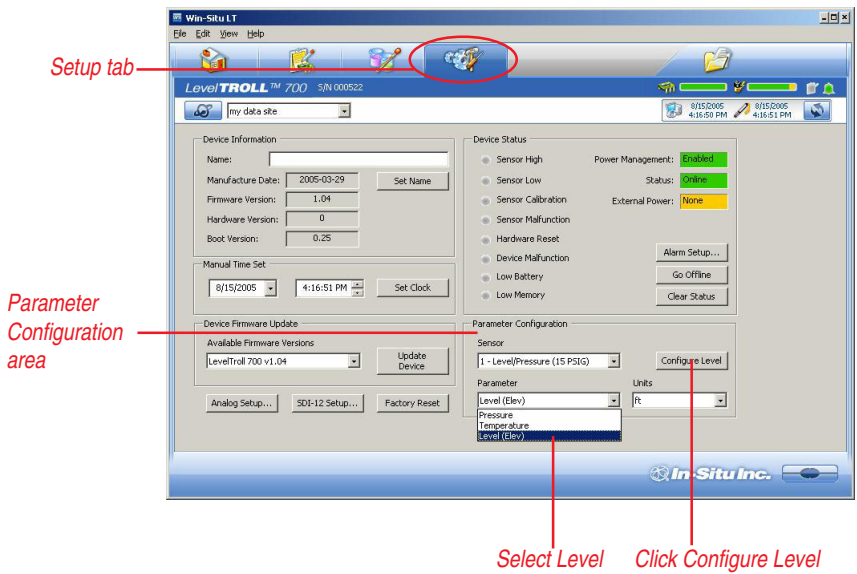
- the type of Level measurement you wish to log.
- the conversion from pressure (in PSI) to depth or level (in feet or meters), including a very accurate conversion that compensates pressure readings for fluid density, altitude, and latitude.

CONFIGURING DEPTH AND LEVEL

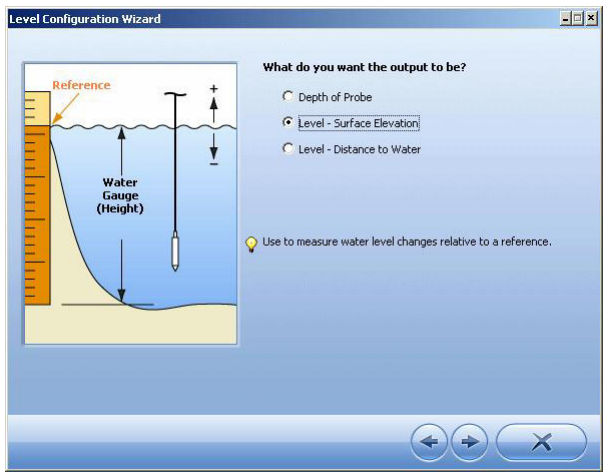
TIP: When you configure level using the Setup tab, the settings are stored in the Level TROLL and are available for use in Modbus, SDI-12, and analog communications, as well as in Win-Situ. Different configuration may be selected when setting up a log.

This procedure stores the configuration settings in the Level TROLL. When setting up a log, the same options are presented.

1. While connected to the Level TROLL in software, click the Setup tab.
2. In the Parameter Configuration section of the Setup screen, select the Level parameter, then click Configure Level. The Level parameter shown is the one currently stored in the device (device's default or the most recent choice).



3. In the Level Configuration Wizard, select the options you want. For more information, see Win-Situ's On-Line Help.



PRESSURE SENSOR CALIBRATION

FACTORY RECALIBRATION

Pressure sensor accuracy can be adversely affected by improper care and handling, lightning strikes and similar surges, exceeding operating temperature and pressure limits, physical damage or abuse, as well as normal drift in the device's electronic components. Aside from damage to the sensor, the need for factory recalibration is dependent upon the amount of drift a customer is willing to tolerate. Factory calibration every 12-18 months is recommended. Contact In-Situ Customer Service for information on the factory maintenance and calibration plan.

FIELD RECALIBRATION

The following procedure may be used, **with caution,** to "zero" the offset of a vented pressure sensor to correct for electronic drift. The drifted offset is visible when the sensor is in air and reading other than zero.

It is recommended you **do not** zero the offset if it is outside the specified accuracy of your pressure sensor, as shown in the table below. If the reading in air deviates from zero by more than the amounts shown, you may want to consider a factory recalibration.

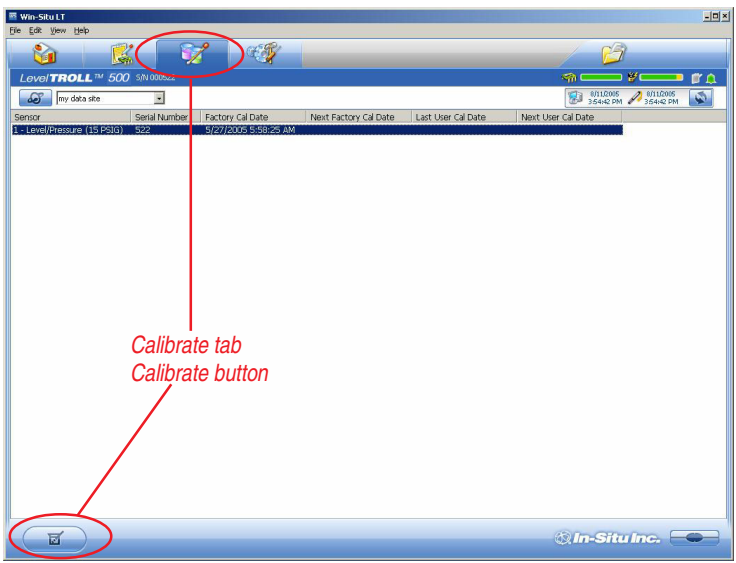
Sensor range	Accuracy (-5°C to +50°C)	Acceptable Offset from zero
5 PSI	± 0.1% FS	± 0.005 PSI
15 PSI	± 0.1% FS	± 0.015 PSI
30 PSI	± 0.1% FS	± 0.03 PSI
100 PSI	± 0.1% FS	± 0.10 PSI
300 PSI	± 0.1% FS	± 0.30 PSI
500 PSI	± 0.1% FS	± 0.50 PSI

Field Recalibration Procedure

1. With the Level TROLL connected in software, select the **Calibrate** tab.
2. Select the pressure sensor and click the **Calibrate** button.

   You will be prompted to ensure the device is in air.
3. With the device in air, click **Calibrate**.

The current pressure reading will be set to zero.



5 FIELD INSTALLATION

POSITION THE LEVEL TROLL

Lower the Level TROLL gently to approximately the desired depth. Position the instrument below the lowest anticipated water level, but not so low that its range might be exceeded at the highest anticipated level. Refer to the tables below for usable depth.

Vented Level TROLL 500

Range		Usable Depth	
PSIG	kPa	Meters	Feet
5	34.5	0-3.5	0-11.5
15	103.4	0-11	0-35
30	206.8	0-21	0-69
100	689.5	0-70	0-231
300	2068	0-210	0-692
500	3447	0-351	0-1153

Non-Vented Level TROLL 500

Range	Effective Range*		Usable Depth	
PSIA	PSIA	kPa	Meters	Feet
30	15.5	106.9	0-10.9	0-35.8
100	85.5	589.5	0-60.1	0-197.3
300	285.5	1968	0-200.7	0-658.7
500	485.5	3347	0-341.3	0-1120

** At sea level (14.5 PSI atmospheric pressure).*

Kellems grip

CHECK THE INSTRUMENT'S DEPTH

At this point, if convenient, you can connect the Level TROLL to a PC, start Win-Situ or Pocket-Situ, and take a reading. If the instrument is at the desired depth, secure it in position as suggested below. If not, reposition the Level TROLL as necessary.

If you requested the software to "Remind me later" to set a Level Reference, enter the level reference after installation when prompted.

SECURE THE CABLE

The Rugged Cable has a handy device called a Kellems® grip near the surface end. You can slide it along the cable to the desired position by compressing it. When you pull on it, it tightens and stops sliding. You may need to pull on both ends of the Kellems grip to properly tighten it and keep it from slipping.

Use the loop of the Kellems grip to anchor the cable to a convenient stationary object. It works well with In-Situ's "well dock" installation ring. Simply insert the loop into the locking clip on the well dock, and position the assembly on the top of a well.

INSTALLATION TIPS

- Never let a probe "free fall" down a well. The resulting shock wave when it hits the water surface can damage the strain gauge (the "waterhammer" effect).
- It is always wise to check the level of water above the probe, then move it and read again to be sure that the probe is giving a reasonable reading and showing change. It might not be

located where you think it is — for example, it could be wedged against the casing with a loop of cable hanging below it. A probe in such a position might become dislodged and move while logging, giving a false change in level. *A secure placement is critical to accurate measurements.*

- Do not allow the vented cable to kink or bend. If the internal vent tube is obstructed, water level measurements can be adversely affected. The recommended minimum bend radius is 13.5 mm (0.54 in), which is twice the cable diameter.

The minimum bend radius for vented cable is 13.5 mm (0.54 in).

- For accurate measurements, the instrument should remain immobile while logging data.

Do not submerge the connector at the uphole end of the cable.

- Be sure the "uphole" cable end is capped—Desicap on the vented cable connector, soft dust cap on non-vented cable—and positioned above the highest anticipated water level. Avoid areas that may flood.

STABILIZATION TIME

Allow the Level TROLL to stabilize to the water conditions for *about an hour* before logging data. A generous stabilization time is always desirable, especially in long-term deployments. Even though the cable is shielded, temperature stabilization, stretching, and unkinking can cause apparent changes in the probe reading. If you expect to monitor water levels to the accuracy of the probe, it's worth allowing the extra time for the probe to stabilize to its environment.

INSTALLATION OF A NON-VENTED LEVEL TROLL 500

A Level TROLL with a non-vented (absolute, PSIA) pressure sensor does not require vented cable for proper operation. It may be deployed on non-vented Rugged Cable or with a Twist-Lock Hanger and economical stainless steel suspension wire while logging data.

TIP: Be sure to program a non-vented Level TROLL before attaching the Twist-Lock Hanger, as this accessory has no communication capability.

- Because the Twist-Lock Hanger has no communication capabilities, you must program the Level TROLL 500 in advance using a Programming Cable, and download the data the same way
- Logged pressure data will show the effects of changes in barometric pressure (unlike vented Level TROLLs). However, post-processing tools may be used to eliminate the effects of barometric pressure changes from the data.
- In-Situ's Baro TROLL™ is a special model of non-vented Level TROLL designed to log barometric pressure at the surface near a submerged non-vented Level TROLL. Baro TROLL data may then be used to correct the Level TROLL data for barometric pressure fluctuations. For more detailed information refer to
  - Baro TROLL Operator's Manual, installed with this manual in your Win-Situ working directory
  - Tech Note 011 - Manual Barometric Correction, installed with this manual in your Win-Situ working directory. A spreadsheet for making the corrections is in the same location.

DO NOT submerge a non-vented Level TROLL without first attaching a Twist-Lock Hanger, or a cable, as the unit could be damaged by flooding.

6 ANALOG, SDI-12 & MODBUS CONNECTIONS

The Level TROLL may be connected to a controller or logger for communication via:

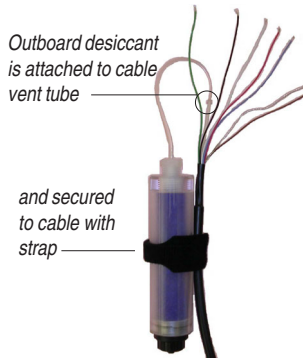
- Analog (4-20 mA)
- SDI-12
- RS-485 Modbus
- RS-232 Modbus (with a customer-supplied converter)

Rugged Cable™ Stripped & Tinned has a Twist-Lock™ connector on one end to mate with the Level TROLL body. The uphole end terminates in bare wires for connection to a PLC or data logger.

DESICCANT

Vented cable includes removable outboard desiccant to protect the cable vent tube and Level TROLL electronics from condensation in high-humidity environments.

The desiccant may be removed from the vent tube, if needed, to trim the conductor wires. Pull the vent tube extender off the cable vent tube to remove, replace desiccant after trimming and connecting wires.

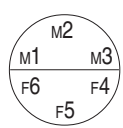


WIRING

Refer to diagrams on the following pages. Trim back and insulate unused wires.

Rugged Cable (TPU)

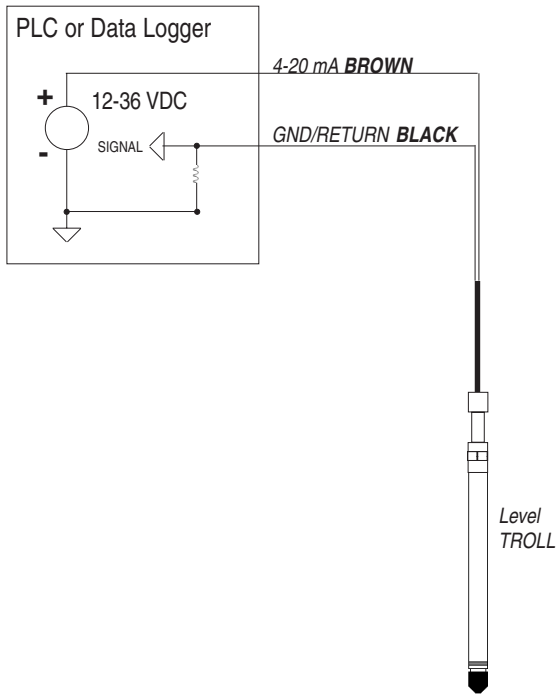
Signal	Color	Pin
Gnd/Return	BLACK	6
Ext Power	RED	5
4-20 mA	BROWN	4
RS485(–)	GREEN	3
RS485(+)	BLUE	2
SDI-12	WHITE	1



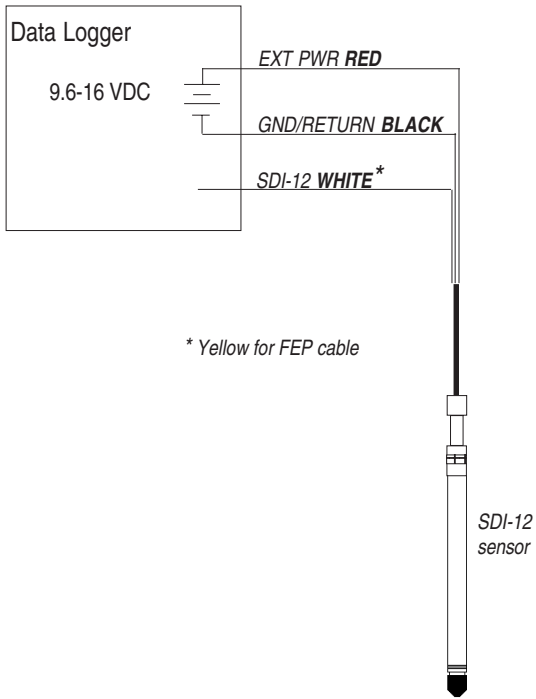
FEP Cable

Signal	Color
Gnd/Return	BLACK
Ext Power	RED
4-20 mA	BROWN
RS485(–)	GREEN
RS485(+)	ORANGE
SDI-12	YELLOW

ANALOG (4-20 mA) 2 WIRE

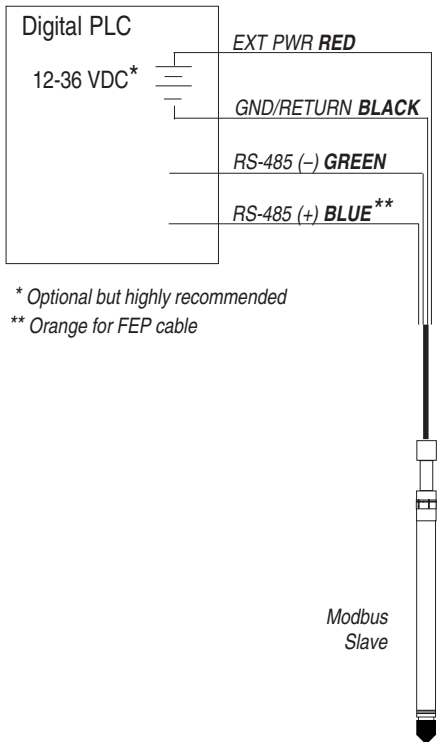


SDI-12 3 WIRE


Data Logger
9.6-16 VDC
EXT PWR RED
GND/RETURN BLACK
SDI-12 WHITE*
* Yellow for FEP cable
SDI-12
sensor

MODBUS MASTER

with RS-485 built in

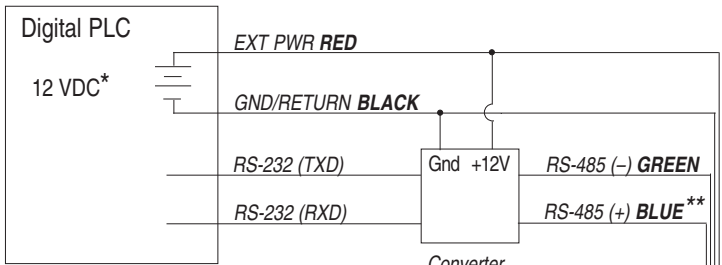


** Optional but highly recommended*

*** Orange for FEP cable*

MODBUS MASTER

with RS-232 built in (converter required)

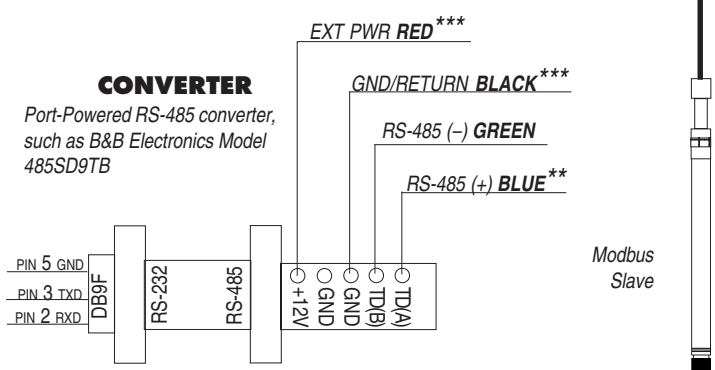


* Voltage limited by converter

**Orange for FEP cable

CONVERTER

Port-Powered RS-485 converter, such as B&B Electronics Model 485SD9TB



***Required if port power is not available

POWER CONNECTIONS

The Red wire provides power for Modbus and SDI-12 modes. The Brown wire provides power for the 4-20 mA mode. If power is present on the Brown wire and not on the Red wire, the device enters the 4-20 mA mode automatically and stays in the 4-20 mode until power is removed from the Brown wire or is applied to the Red wire. The Red wire has priority — if power is applied to both wires at the same time, the device will operate in Modbus or SDI-12 modes but not in 4-20.

COMMUNICATIONS

The device automatically switches between Modbus and SDI-12 modes depending on which of the two interfaces has activity. Modbus and SDI-12 cannot be used at the same time — whichever one is currently in use will block communication on the other.

USING WIN-SITU

Win-Situ provides options for configuring analog/SDI-12 communications (Setup tab) and Modbus communications (File menu > Settings). In addition, the Level TROLL is capable of internal logging (programmed in Win-Situ) while participating in a Modbus, SDI-12 or analog network. However, Win-Situ cannot communicate with the Level TROLL while it is transmitting Modbus, SDI-12 or analog data, and conversely, the instrument cannot receive or respond to Modbus, SDI-12 or analog commands while connected to a PC serial port.

This “redundant logging” feature means

- if the PLC or recorder somehow “loses” data, the Level TROLL data can be retrieved using Win-Situ.

- if the PLC or recorder ceases to function due to power loss, the Level TROLL will continue to collect data using its own internal batteries and clock.

A port-powered RS-485 converter like that shown for Modbus connections may be used for temporary connection of the Level TROLL to a serial port on a PC.

7 CARE & MAINTENANCE

OPERATING CONSIDERATIONS

The Level TROLL has been designed to withstand harsh field conditions. However, as with any electronic instrument, it can be permanently damaged if used outside its operating specifications.

TEMPERATURE

The Level TROLL is designed to operate within a temperature range of -20°C to +80°C (-4°F to 176°F).

PRESSURE RANGE

The Level TROLL can withstand pressures of up to two times (2X) the rated range of the pressure sensor without damage, although it may not read correctly at such pressure. If the pressure range is exceeded by 3X, the sensor will be destroyed.

CALIBRATION

Accuracy can be adversely affected by improper care and handling, lightning strikes and similar surges, exceeding operating temperature and pressure limits, physical damage or abuse. Factory calibration every 12-18 months is recommended. Contact In-Situ Customer Service for information on the factory maintenance and calibration plan.

STORAGE

Store the Level TROLL clean and dry. Place the protective red dustcap on the cable end, or store with cable attached to protect the connector pins and o-ring.

Store the instrument where it will be safe from mechanical shocks that may occur, such as rolling off a bench onto a hard surface.

Protect the instrument from temperature extremes. Store within a temperature range of -40°C to +80°C (-40°F to +176°F).

GENERAL MAINTENANCE

CLEANING—BODY AND FRONT END

When the nose cone is removed, the sensitive pressure sensor diaphragm is completely exposed. Do not touch this area with any object! Replace the nose cone as soon as possible.

Clean the Level TROLL body with water and a soft brush, or soak overnight in a mild acidic solution, such as household vinegar, or clean in an ultrasonic bath with a good concentrated detergent solution.

If the ports in the front end are clogged with silt or mud, try the following:

- Swish the instrument vigorously in a bucket of clean water
- Apply a gentle squeeze of water from a wash bottle
- In severe cases, remove the nose cone and clean out the holes with a soft brush or pipe cleaner

Nose cone in place

Nose cone removed

To avoid damage to the pressure sensor diaphragm, *do not insert any object into the sensor opening or attempt to dig out dirt or other materials.*

Damage caused by digging or scraping in the pressure sensor opening to remove silt, mud, etc. is not covered by the warranty.

If contamination cannot be removed using the recommendations above, please contact In-Situ Inc. for cleaning.

Do not submerge the cable connector; do not immerse in any fluid.

TWIST-LOCK CONNECTORS

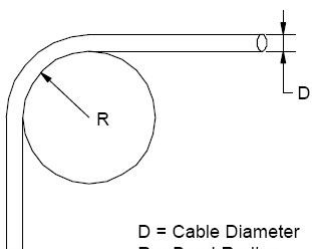
Keep the pins on all connectors free of dirt and moisture by using the soft protective dustcap when cable is not attached.

CABLE VENT TUBE (VENTED CABLE)

Vented cable assures that atmospheric pressure is the reference pressure to the vented pressure sensor diaphragm. *The vent tube should not be blocked, kinked, or otherwise obstructed.* Such obstructions will cause barometric pressure to appear in measurements, and errors will be introduced due to thermal expansion and contraction of air within the vent tube and probe body.

The minimum bend radius for vented cable is 13.5 mm (0.54 in).

The recommended minimum bend radius is 13.5 mm (0.54 in), which is twice the cable diameter.



***TIP:** If batteries are completely exhausted, remember that external power and battery pack options are available.*

BATTERIES

Internal batteries in the Level TROLL are not user-replaceable. The approximate percentage remaining is displayed on the Dashboard when the Level TROLL is connected in software.

8 TROUBLESHOOTING

TROUBLESHOOTING CONNECTIONS

Problem: Win-Situ or Pocket-Situ cannot connect to the Level TROLL

Probable Cause: Wrong COM port selected, incompatible Communication settings, loose or dirty cable connections, low batteries

Suggested Remedy: Check the following:

- all cable connections are tight, connectors are clean and dry
- the cable is securely attached to the instrument
- the correct COM port is selected (select Settings from Win-Situ's File menu to check this)
- the software settings are correct for the device (check Win-Situ's on-line Help for "Communication Settings")
- the internal battery has voltage remaining

Problem: Real-time readings are in the wrong units

Probable Cause: Default units are being used

Suggested Remedy: Click the Setup tab and select the desired units for each parameter in the Parameter Configuration section of the Setup screen. Return to the Home tab and refresh the readings with the "Read" button.

Problem: I cannot add a new log

Probable Cause 1: The device has its maximum number of logs already stored—the Level TROLL 500 has a capacity of 2 logs.

Suggested Remedy: Download, and then delete a log you are through with. This will make room for an additional log on the device

Probable Cause 2: Only one "active" log can reside in the device at a time—an "active" log is a log that is Ready, Pending, Running, or Suspended as shown in the Status column of the Logging Tab

Problem: I just defined a new log, but the software is telling me it exceeds the available memory

Probable Cause: The log as configured would exceed the device memory

Suggested Remedy: Edit the log and try these:

Select a longer sampling interval

If available, select the "Wrap data" option (later data will overwrite earlier data when the memory is full)

For a log with a scheduled start, select "None" as the stop condition, or select a stop time that is closer to the start time

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