



Levellogger Series

(Levellogger Gold, Barologger Gold, Levellogger Junior, LTC Levellogger Junior and Rainlogger)

User Guide - Software Version 3.4.1

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Solinst[®]

Levellogger[®]
Model 3001

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Note:

This version of software is not compatible with older models of the Levellogger (Silver LT and LTC, Black LTC and old Rain Loggers). To program and use the old versions, Levellogger 3.1.1 Software and User Guides can still be accessed at: www.solinst.com/Downloads/ For Software version 2.0.3, contact Solinst.



Note:

Let Solinst keep you up-to-date with each new software and firmware release. Register your software at: www.solinst.com/Registration/ to receive these updates automatically.

1 Introduction to Solinst Levellogger Series and Software

Levellogger Gold Software Version 3.4.0 is intuitive and easy-to-use. It is designed to support the Levellogger Gold Series of products.

Levellogger Gold

The Levellogger Gold is an absolute (non-vented) datalogger, which measures groundwater and surface water levels and temperature. Water levels are displayed as temperature compensated pressure readings, and can be barometrically compensated with the aid of a Barologger Gold. Solinst recommends customers use Version 3.4.0 Software using with V2.006 firmware or higher.

Levellogger Gold Technical Specifications			
Level Sensor:	Piezoresistive Silicon in 316L Stainless Steel		
Accuracy (Typical):	0.05% FS		
Stability of Readings:	Superior, low noise, 6 times better than previous versions		
Resolution:	0.002 to 0.0006% FS		
Normalization:	Automatic Temp Compensation		
Temperature Sensor:	Platinum Resistance Temperature Detector		
Temp. Sensor Accuracy:	± 0.05°C		
Temp. Sensor Resolution:	0.003°C		
Temp. Comp. Range:	-10 to +40°C		
Battery Life:	10 Years - based on one reading/min		
Clock Accuracy:	± 1 minute/year		
Operating Temperature:	-20°C to 80°C		
Maximum # Readings:	40,000 of level and temperature		
Memory:	Superior reliability EEPROM Slate, rollover and redundant backup of last 1200 readings		
Communication:	Optical Infra-Red Interface, Serial at 9600 Baud, Conversion to RS232 or USB Computer Connection		
Size:	7/8" x 6" (22 mm x 154 mm)		
Weight:	6.3 oz (179 grams)		
Backwards Compatibility:	Full		
Corrosion Resistance:	Zirconium Nitride (ZrN) Coating		
Other Wetted Materials:	316-L Stainless Steel, Delrin, Viton		
Sampling Modes:	Linear, Event and User-Selectable with 30 separate line items		
Measurement Rates:	0.5 sec to 99 hrs		
Barometric Compensation:	Software Wizard and one Barologger in local area (approx. 20 miles/30 km radius and or per 1000 ft/300 m change in elevation)		
LT Models	Full Scale (FS)	Accuracy (Typical)	Resolution
F15, M5	16.4 ft., 5 m	± 0.010 ft., 0.3 cm	0.001% FS
F30, M10	32.8 ft., 10 m	± 0.016 ft., 0.5 cm	0.0006% FS
F65, M20	65.6 ft., 20 m	± 0.032 ft., 1 cm	0.0006% FS
F100, M30	98.4 ft., 30 m	± 0.064 ft., 1.5 cm	0.0006% FS
F300, M100	328.1 ft., 100 m	± 0.164 ft., 5 cm	0.0006% FS



Barologger Gold

The Barologger Gold uses algorithms based on air pressure only. It measures and logs changes in atmospheric pressure, which are then used to compensate water level readings recorded by a Levellogger Gold, or a Levellogger Junior.

LT Models	Full Scale (FS)	Accuracy (Typical)	Resolution
Barologger	0.05%	± 0.003 ft., 0.1 cm	0.002% FS



Levellogger Junior

The Levellogger Junior provides an inexpensive alternative for measuring groundwater and surface water levels and temperature. The Levellogger Junior is compatible with all Levellogger Gold accessories. Solinst recommends customers use Version 3.4.0 Software with V2.006 firmware or higher.

Levellogger Junior Technical Specifications			
Level Sensor:	Piezoresistive Silicon in 316L SS		
Ranges:	F15/M5, F30/M10		
Accuracy (typical):	0.1% FS		
Resolution:	0.028%, 0.021%		
Normalization:	Automatic Temp Compensation		
Temperature Sensor:	Platinum RTD		
Accuracy:	± 0.1 °C		
Resolution:	0.1 °C		
Temp Compensation Range:	- 10°C to 40°C		
Battery life:	5 Years		
Clock Accuracy:	± 1 minute/year		
Operating Temperature:	- 20°C to 80°C		
Memory:	Non-volatile EEPROM, FRAM back-up		
Maximum # Readings	32,000 sets of readings		
Communication:	Optical Infra-Red to USB or RS232		
Size:	7/8" x 5.5" (22 mm x 140 mm)		
Weight:	154 g (5.4 oz)		
Wetted Materials:	316L Stainless Steel, Delrin, Viton		
Sampling Mode:	Linear, SDI-12, Real Time View (from 0.5 sec to 99 hrs)		
Barometric Compensation:	Software Wizard and one Barologger in local area (approx. 20 miles/30 km radius and or per 1000 ft/300 m change in elevation)		
LT Models	Full Scale (FS)	Accuracy (Typical)	Resolution
F15, M5	16.4 ft., 5 m	± 0.020 ft., 0.6 cm	0.028% FS
F30, M10	32.8 ft., 10 m	± 0.032 ft., 1.0 cm	0.021% FS



LTC Levellogger Junior

The LTC Levellogger Junior provides an inexpensive and convenient method to measure level, temperature and conductivity all in one probe. The LTC Levellogger Junior is compatible with all Levellogger Gold accessories. Solinst recommends customers use Version 3.4.0 Software with V2.001 firmware or higher.

LTC Levellogger Junior Technical Specifications

Level Sensor:	Piezoresistive Silicon in 316L SS		
Ranges:	F30/M10, F100/M30		
Accuracy (typical):	0.1% FS		
Resolution:	0.08" (0.2 cm), 0.24" (0.6 cm)		
Normalization:	Automatic Temp Compensation		
Temperature Sensor:	Platinum RTD		
Accuracy:	± 0.1°C		
Resolution:	0.1°C		
Temp Compensation Range:	-10°C to 40°C		
Conductivity Sensor:	4-Electrode Platinum		
Full Range:	0 - 80,000 µS/cm		
Calibrated Range:	500 - 50,000 µS/cm		
Accuracy:	2% of reading or 20 µS/cm		
Resolution:	1 mS		
Temp. Compensation Range:	0°C to 40°C		
Normalization:	Specific Conductance @ 25°C		
General:			
Battery Life:	5 Years (5 minute sampling rate)		
Clock Accuracy:	± 1 minute/year from 0 to 40°C		
Operating Temperature:	- 20°C to 80°C		
Memory:	Non-volatile EEPROM, FRAM back-up		
Maximum Readings:	16,000 sets of readings		
Communication:	Optical Infra-Red to USB or RS232		
Size:	7/8" x 7.5" (22 mm x 190 mm)		
Wetted Materials:	Platinum, 316 Stainless Steel, Delrin®, Viton®		
Sampling Mode:	Linear, (5 sec to 99 hrs) SDI-12, Real Time View		
Barometric Compensation:	Software Wizard and Barologger Gold		
LT Models	Full Scale (FS)	Accuracy (Typical)	Resolution
F30, M10	32.8 ft., 10 m	± 0.032 ft., 1.0 cm	0.021% FS
F100, M30	98.4 ft., 30 m	± 0.128 ft., 1.5 cm	0.021% FS



Rainlogger

The Rainlogger is designed for use with most standard tipping-bucket rain gauges with a reed switch output. It measures total rainfall per sampling period and a five-minute maximum rainfall (intensity). Now users can add rainfall data to their Levelogger network. Compatible with Version 3.4.0 Software using V1.003 firmware or higher

Rainlogger Technical Specifications	
Battery Life:	10 years (logging two parameters/10 minutes)
Clock Accuracy:	± 1 minute/year
Operating Temperature:	-20°C to 80°C
Resolution:	0.004 to 0.008" (0.1 to 0.2 mm) (dependent on rain gauge type)
Maximum # Readings:	40,000 sets of readings
Memory:	Non-volatile EEPROM / FRAM back-up
Communication:	Optical infra-red to RS232 or USB
Sampling Mode:	Linear
Sampling Rate:	5 minutes to 99 hours (5 minute intervals)
Size:	7/8" x 7" (22 mm x 175 mm)
Weight:	4.8 oz (135 grams)
Materials:	Stainless Steel, Delrin, Lexan, Viton



Levelloader Gold

The Levelloader Gold is a data transfer device for use with all versions of Levelloggers. It can be used to download, store, and transfer data from Levellogger to PC, as well as, save settings files for transfer to a Levellogger. Also allows real-time viewing of Levellogger readings. Compatible with Version 3.4.0 Software or higher using V1.200 firmware or higher.

Software Communication

Levelloggers connect to a laptop or desktop PC with an optical reader cable. The optical reader cable uses an infrared data reader/port connected to the Levellogger and an RS232 or USB Com Port to transfer information between the Levellogger and computer.

Version 3.4.0 Software provides Levellogger Gold users with many convenient features. Users can view and program Levellogger settings, begin logging sessions, monitor real-time readings, download data, manage data files, perform compensations, and save and export files, with this software version.

1.1 Level

The Levellogger Gold and Levellogger Junior use a high quality piezoresistive silicon pressure transducer packaged in 316L stainless steel housing. It gives high accuracy and high stability. The Levellogger Gold body is coated with Zirconium Nitride (ZrN) to give corrosion resistance. All Levelloggers measure total or absolute pressure. When the Levellogger is operating in open air, it is recording barometric pressure and converting that pressure reading to its water level equivalent above the datalogger's pressure zero point of 950 cm (31.17ft). When submerged, it is recording the combination of barometric pressure and water pressure. The Levellogger converts the total pressure reading to its corresponding water level equivalent. Actual water level is obtained by compensating for barometric pressure. The best method to compensate for barometric pressure is to employ a Barologger above the water level, somewhere on site, to obtain records of barometric pressure. The Levellogger Software includes a Barometric Compensation Wizard, which guides the user through the automated process of barometric compensation. Manual methods can be employed to determine the absolute water level using barometric records collected on-site or available from a local weather station (i.e. Airport). Water level readings from the Levellogger Gold and Levellogger Junior models are temperature-compensated.

1.1.1 Pressure Calibration

The Levellogger Gold and Levellogger Junior are calibrated against a range of set reference points to an accuracy of 3 decimal places. The units of pressure are in pounds per square inch. The conversion factor for pounds per square inch relates to pressure as follows:

$$\begin{aligned} 1 \text{ pound per square inch} &= 0.0689476 \text{ bar} \\ &= 0.703070 \text{ m} \\ &= 703.070 \text{ kg/m}^2 \\ &= 6.895 \text{ kPa} \\ &= 2.31 \text{ ft. H}_2\text{O @ 4}^\circ\text{C.} \end{aligned}$$

During the calibration procedure, the Levellogger is fully submerged in a highly accurate water bath. The bath is set to 15°C and allowed to stabilize. The pressure is then calibrated to six separate pressure points covering the entire range of pressure for that particular Levellogger to check for any non-linearity. The process is repeated again at 35°C to check for temperature effects. Once done, the Levellogger is approved after all specifications for accuracy, precision, stability and hysteresis have been met. The Levellogger should be calibrated for the life-time of the instrument, as long as it is used within its specified range.

1.2 Barologger

The Barologger Gold is designed for use in air only. It has a specific range and firmware algorithms based on air pressure rather than water pressure. This makes the Barologger less accurate if used in water, but more accurate if used as intended, in air. Using a Barologger is the most accurate and convenient method of obtaining atmospheric pressure and air temperature. When programmed with the same sampling parameters as the Levelloggers on site, a Barologger can avoid barometric data time lags and any errors introduced due to moisture buildup, kinking or damage to vented cable. The Barometric Compensation Wizard in the Levellogger Software simplifies the adjustment of the level measurements for barometric pressure changes, by using the synchronized data from all Levelloggers on site and the site Barologger.

1.3 Temperature

Levellogger Gold and Levellogger Junior, record temperature compensated water levels. Groundwater and surface water temperature measurements are particularly important in situations where temperatures may fluctuate significantly, and when temperature is used in determining liquid level, viscosity and hydraulic conductivity. Temperature monitoring is vital in the calculation of certain temperature dependent contaminant reaction rates. A Platinum Resistance Temperature Detector is used to accurately compensate for temperature changes within the range of -10 to +40°C. The Levelloggers will record temperature in its thermal range of -20 to +80°C, but outside the range of -10 to +40°C compensation will be less accurate.

1.4 Conductivity

The LTC Levellogger Junior provides the added feature of electrical conductivity measurement. Conductivity measurement is particularly useful in monitoring saltwater intrusion, surface water infiltration and mixing, as well as the monitoring of certain pollutants and contaminant parameters. Conductivity is measured via a platinum 4-electrode sensor, which produces highly stable and consistent readings. The sensor is relatively insensitive to dirt and deposits, keeping maintenance to a minimum. Conductivity calibration is performed by using a liquid solution with a known conductivity value and the Calibration Wizard in the Levellogger Windows Software. Raw conductivity measurements can be converted to conductivity at 25°C, which is referred to as Specific Conductance. When programming the LTC the user can select either raw conductivity measurements or specific conductance.

1.4.1 Calibration of the Conductivity Sensor

The conductivity sensor of the LTC Levellogger Junior is a highly sensitive device requiring regular calibration by the user. The conductivity calibration frequency is dependent on the water quality of the Levellogger's monitoring environment. When monitoring in freshwater with good water quality, conductivity calibration may only be required once per year. On the other hand, conductivity calibration will be required more frequently when monitoring in polluted, salty, brackish, eutrophic or highly conductive water. To determine whether an LTC Levellogger Junior should be recalibrated, test the unit in a solution with a known electrical conductivity value at a reference temperature. If that reference temperature is 25°C, set the LTC to record Specific Conductance in the 'Conductivity' Channel, and observe the current reading by using the Read Now function in the Real Time View tab. If this reading varies from the known Specific Conductance of the solution by greater than 2% of the Full Scale of Conductivity measurement, the unit should be recalibrated using the Conductivity Calibration Wizard procedure outlined in Section 6. Ensure that conductivity calibration is performed when the LTC is being set up for its initial use and after long periods of dry storage.

1.5 Total Rainfall

The Solinst Rainlogger is designed to count the tips of an external tipping-bucket rain gauge within a user defined sample interval and output the total rainfall over that sample interval. The Rainlogger can store 40,000 readings. The Rainlogger is designed to be compatible with the Solinst Levellogger series of products. The Rainlogger is programmed and data viewed and exported using the Levellogger Software from a PC, it can be communicated with using a Levelloader and can be integrated into an STS Telemetry System.

1.6 Backwards Compatibility

The Levellogger Gold and the Software Versions 3.4.0 or higher are backward compatible, with limitations. If a Levellogger Gold is to be used with the Levelloader I, Levelloader II, a Protocol Converter, or a first generation STS or RRL Telemetry System, the datalogger must be programmed with the old Levellogger Version 2.0.3 Software. Programming Levellogger Gold loggers using Version 2.0.3 Software limits the capabilities of the Gold unit, to be the same as the older stainless steel Levellogger units. If the user has a mix of Levellogger Gold and older units, they can use the Levellogger Gold Version 3.1.1 Software to program and read all the dataloggers. They will get the accuracy and features inherent in the older stainless steel Levelloggers, but will obtain the higher accuracy and enhanced features and functions of the Levellogger Gold dataloggers.

The LT Levellogger Junior is only compatible with Software Version 3.2.1 and higher, the LTC Levellogger Junior only is compatible with Version 3.3.0 and higher, and the Rainlogger is only compatible with Software Version 3.2.2 and higher.

**Note:**

This version of software is not compatible with older models of the Levellogger (Silver LT and LTC, Black LTC and old Rain Loggers). To program and use the old versions, Levellogger 3.1.1 Software and User Guides can still be accessed at: www.solinst.com/Downloads/ For Software version 2.0.3, contact Solinst.

2 System Requirements

The minimal hardware and software requirements for software installation and operation are:

Hardware	Software
Memory: 32MB or more	OS: Windows 98, 2000, XP, Vista, or 7
Display: VGA: 800 x 600 pixels, 256 colour	
Ports: USB or RS232 Serial Port	

Communication Port Setting for Levellogger Communications:

Bits per second	9600
Data bits	8
Stop bits	1
Flow control	None

3 Software Installation

- Place the Levellogger CD in the CD ROM drive or download the software from www.solinst.com/Downloads/ and save to hard drive.
- Open Windows Explorer and double click the setup.exe icon.
- At this point Windows will prompt you through the remainder of the installation process. Figure 3-1 shows the Levellogger Installation Wizard.
- Restart the computer after installation is completed. Default Directory is C:\Program Files\Solinst\Levellogger3_4 (or higher)

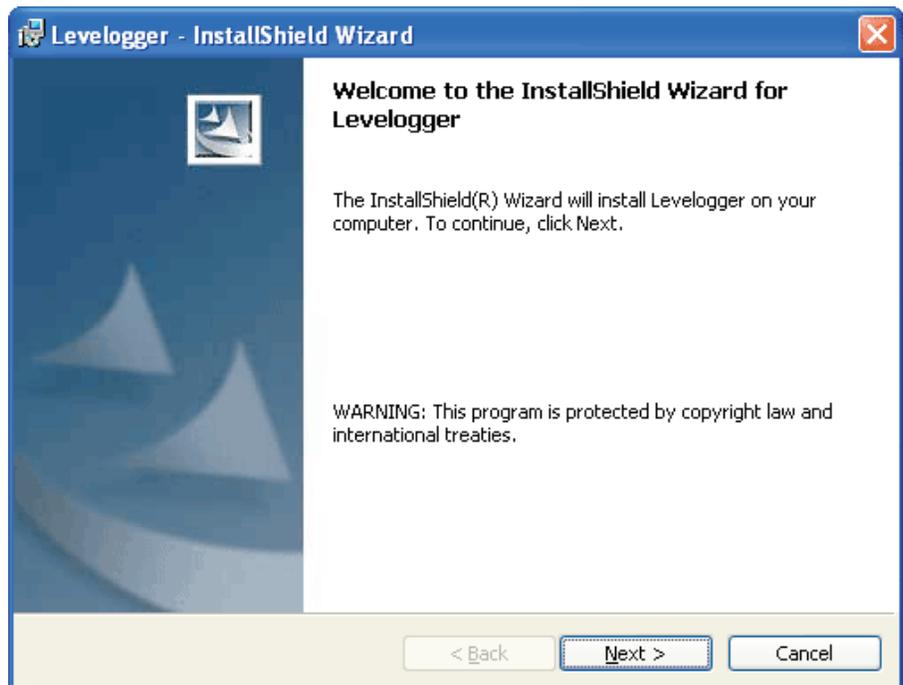


Figure 3-1 Software Installation Wizard



Note:

After plugging in the USB device, if the Hardware Installation Wizard does not automatically appear, proceed to the Manual USB Installation instructions.

3.1 Installing USB Drivers for Levellogger Software V3.4.0 or Higher

Levellogger Software V3.4.0 or higher, for use with Solinst USB Optical Reader, PC Interface Cable and Levellogger Gold, comes equipped with USB drivers for: Windows 98, 2000, XP, Vista, and Windows 7.

USB Installation for Windows 98

- 1) Plug the USB device into the computer, and Windows will automatically detect the connected device and start the Hardware Installation Wizard.
- 2) A message may prompt the user that an 'FTDI USB Drivers Disk' must be inserted (Figure 3-2). A disk is not needed. Just click 'OK'.



Figure 3-2 Insert Disk Window



Figure 3-2 Insert Disk Window

- 3) On the next screen select 'Display a list of all the drivers in a specific location, so you can select the driver you want' (Figure 3-3).
- 4) On the next screen use the 'Browse' function to select the appropriate driver. The directory should be:

C:\Program Files\Solinst\Levellogger3_4\USB Drivers\Win_98

Complete and finish the installation. Please note that a system restart may be required.



Note:

After plugging in the USB device, if the Found

New Hardware Wizard does not automatically appear, proceed to the Manual USB Installation instructions.

USB Installation for Windows 2000

- 1) Plug the USB device into the PC and Windows will automatically detect the connected unit.



Figure 3-4 Found New Hardware Pop-up Window

- 2) This will start the 'Found New Hardware Wizard', click next.
- 3) In the 'Install Hardware Device Drivers' window, select 'Search for a suitable driver for my device (recommended)'.
- 4) In the 'Locate Driver File' window (Figure 3-5), select 'Specify a location' and click 'Next'.



Figure 3-5 Found New Hardware Wizard

- 5) In the next window point the browser to the USB driver folder located in the Levelogger 3_4 folder. Default Destination:
 C:\Program Files\Solinst\Levelogger3_4\USB Drivers\
 Win_2000_XP_Vista_7
- 6) Once the installation completes, a system restart may be required.



Note:

After plugging in the USB device, if the Found New Hardware Wizard does not automatically appear, proceed to the Manual USB Installation instructions.

USB Installation for Windows XP

- 1) Plug the USB device into the computer, and Windows will automatically detect the connected device. This will begin the 'Found New Hardware Wizard'.
- 2) The 'Wizard' will give the option to connect to Windows Update to search for software components, select: "No, not at this time".
- 3) Click 'Install from a list or specific location', then click the 'Next' Button. (Figure 3-6).



Figure 3-6 Found New Hardware Wizard Window

- 4) Select the installation option, 'Include this location in the search' (Figure3-7), then click the 'Browse' Button to search for the appropriate directory:

C:\Program Files\Solinst\Levellogger3_4\USB Drivers\
Win_2000_XP_Vista_7



Figure 3-7 Found New Hardware Window and Figure 3-8 Browse for Folder Window

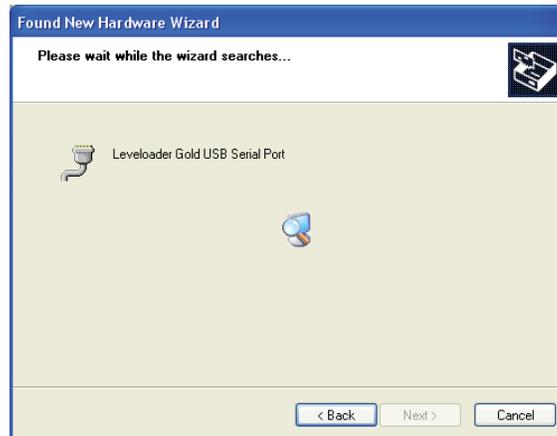


Figure 3-9 Found New Hardware Search Window

- 5) A warning message will then prompt that the software has not passed the Windows Logo Test. Select 'Continue Anyway' (Figures 3-10). This will complete the installation process. A system restart may be required.



Figure 3-10 Hardware Installation Window



Figure 3-11 Found New Hardware Completed Window



Note:

These instructions are for use with Vista 32 bit Operating Systems.



Note:

After plugging in the USB device, if the Found New Hardware Wizard does not automatically appear, proceed to the Manual USB Installation instructions.

USB Installation for Windows Vista

- 1) Plug the USB Optical Reader, Leveloader Gold or PC Interface cable into the desired PC. The system will automatically detect the connected unit and start the 'Found New Hardware' Wizard.
- 2) From the provided list select "Locate and install driver software (recommended)".



Figure 3-12 Found New Hardware Window

- 3) On the next screen select, "I don't have the disc. Show me other options."

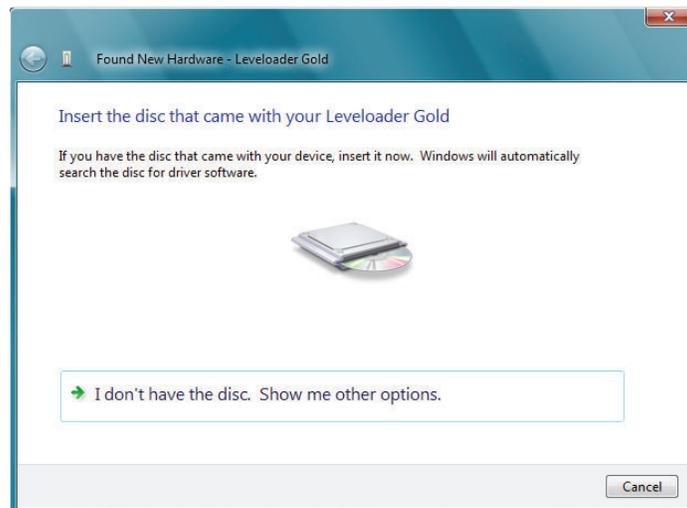


Figure 3-13 Found New Hardware - USB Serial Port Window

- 4) On the next screen select, “Browse my computer for driver software (advanced)” option.

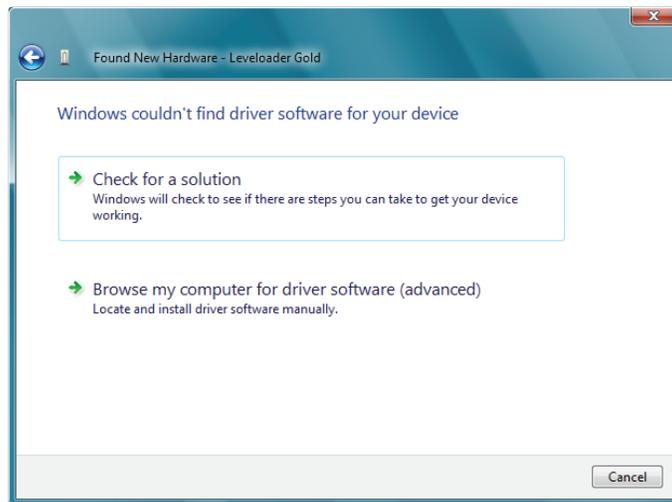


Figure 3-14 Found New Hardware Browse Window

- 5) Select the Browse button and point the navigation window to the provided USB drivers located within the Levellogger 3_4 folder. The default destination is:

C:\Program Files\Solinst\Levellogger3_4\USB Drivers\
Win_2000_XP_Vista_7

The selected pathway will be provided within the window, select Next on the wizard to complete the installation.

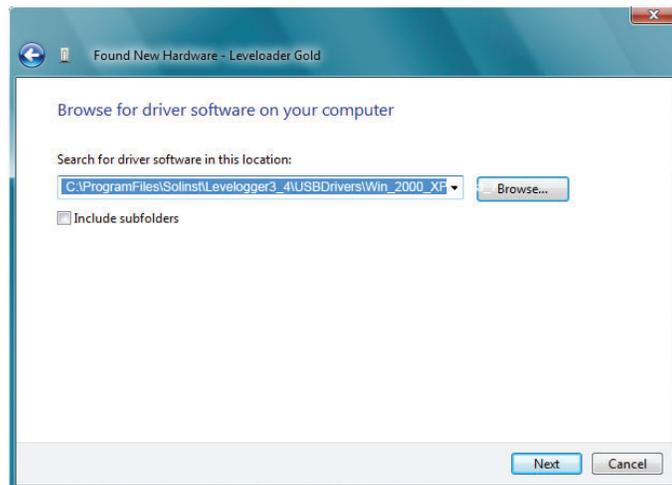


Figure 3-15 Search for Driver Software Window

- 6) Once the installation completes, a system restart may be required. If the found new hardware wizard prompts again, please repeat steps 1-6.



Note:

USB driver installation should be automatic when connecting a PC Interface Cable or Optical Reader. When connecting a Leveloader Gold, you will most likely have to install the USB driver manually.

USB Installation for Windows 7

- 1) Plug the USB Device into the desired PC. The system will automatically detect the connected unit. Windows 7 should automatically install the driver for the device.
- 2) If no driver is automatically found, then the following steps should be taken.
- 3) Press the Windows start button to bring up the start menu, select "Control Panel", then "Device Manager".
- 4) Under "Other Devices" there will be a device shown with a yellow warning symbol. Right click on this device, and select "Update Driver Software".

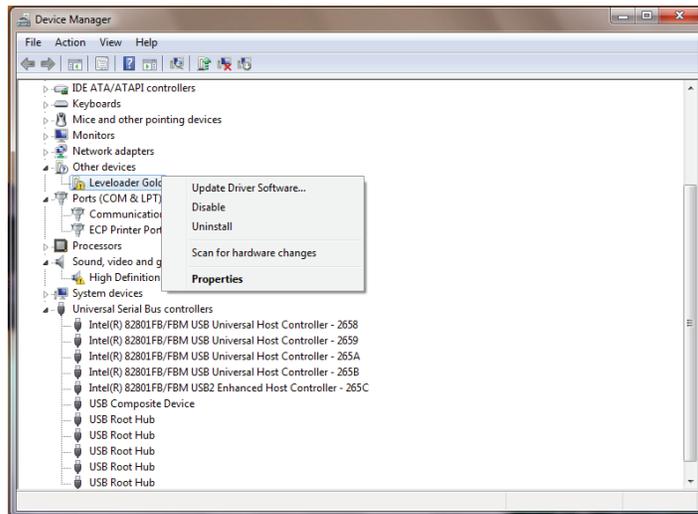


Figure 3-16 Windows 7 Device Manager

- 5) Select "Browse my computer for driver software".

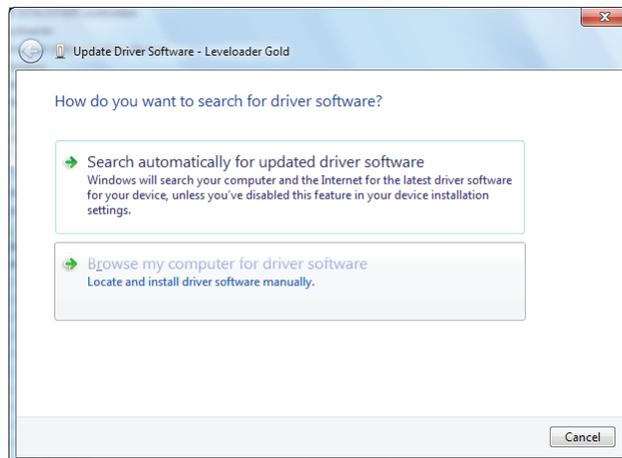


Figure 3-17 Update Driver Software

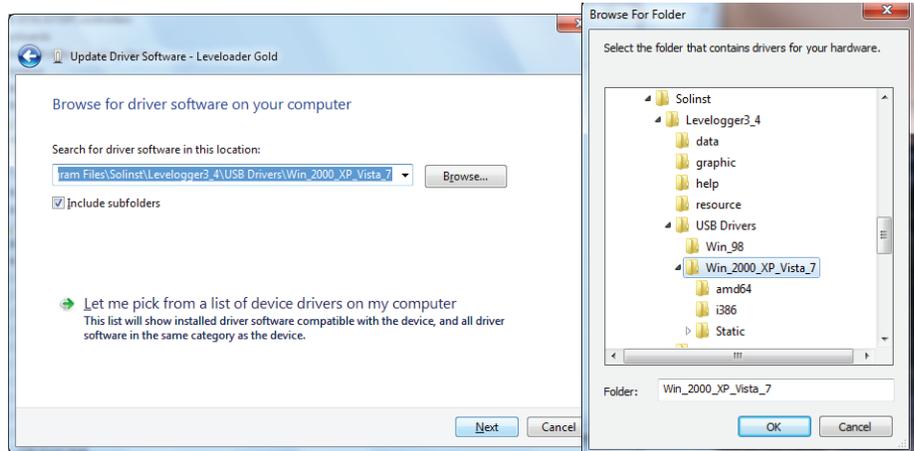


Figure 3-18 Browse for Driver Software

- 6) Click the **Browse** button and point the navigation window to the provided USB drivers located within the Levelogger 3_4 folder. Default destination is:
C:\Program Files\Solinst\Levelogger3_4\USB Drivers\
Win_2000_XP_Vista_7
- 7) Select **Next**. A window may appear stating "Windows can't verify the publisher of this driver software", select "Install this driver software anyway".

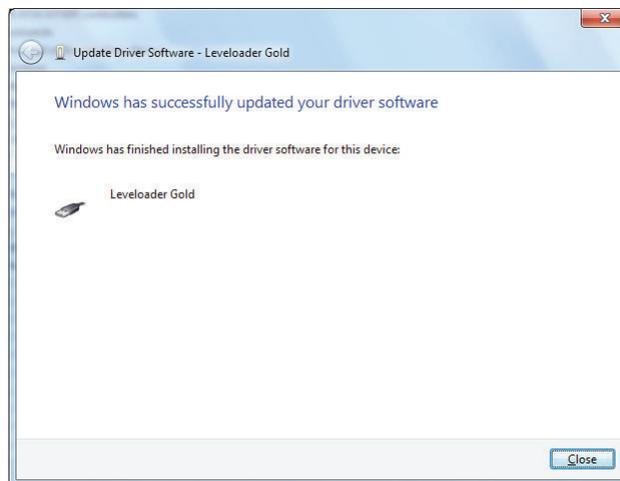


Figure 3-19 Update Complete

- 8) Windows will confirm when the installation is complete. Press **Close** to close the window, then go back to the "Device Manager".

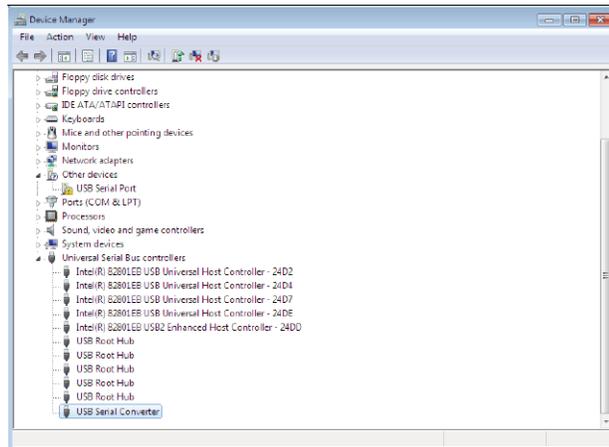


Figure 3-20 Update Serial Port

- 9) You will repeat steps 4-8 to update the USB Serial Port. This will now be shown under "Other Devices" with a yellow warning symbol.
- 10) Once this installation is complete, a window will confirm the COM port assigned to the device.

Manual USB Installation

If your device is plugged in and the Found New Hardware Wizard fails to start, then follow these steps:

1. Open the Device Manager. Typically this is found through the path: Start > Control Panel > System > Hardware > Device Manager
Once the Device Manager is open, a version of the following list(s) will appear:

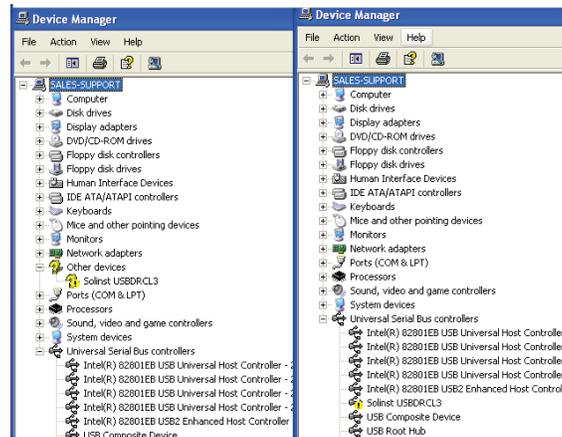


Figure 3-21 Device Manager

2. Identify the Solinst device from the list. The device will be categorized under "Other Devices" or "Universal Serial Bus Controllers".
3. Highlight the device in the list and right click. You will see an option to "Update the driver". This will start the "Hardware Update Wizard". Now follow the instructions for your specific Windows version.

 **Note:**
If you are unsure which is the correct device in the list, with the screen visible, safely remove the device and then reconnect it. The list should automatically refresh accordingly.

 **Note:**
If you do not know the correct Com Port that was assigned to your device, re-open the Device Manager. Expand "Ports (COM & LPT)" to show the Com Port that has been assigned. To change the assigned Port, see Section 4.2.

4 Startup, Configurations and Settings

Startup

To start the Levelogger PC Software, click the  icon, or click the Start button and select:

Programs > Solinst > Levelogger > Levelogger 3.4.0 (or higher).

Communication Port Settings

Note that if using a USB port, plug in the USB cable before starting the Levelogger Software. Once the user starts the program, they can set up the parameters for the Software. Choose the Com Port Setting from the Configuration menu to set up the RS232 or USB communication port for the computer. Figure 4-1 shows the Application Setting Window.

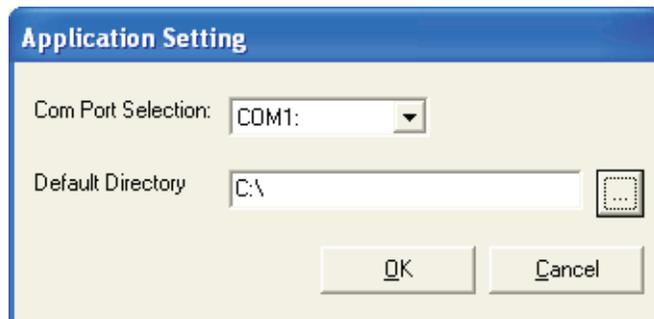


Figure 4-1 Application Setting Window

In the Com Port Selection field, select the communication port that is connected to the Levelogger by clicking the drop down list. The program automatically detects the available Com ports on your computer. If using an RS232 serial port (9-pin male DB9 Com port), identify the Com port number and select it in the Com Port Selection window.

Note that you may have to restart your computer after adding a new USB device, before that port will be detected by the Levelogger Software.

4.1 Communicating with a USB Port

USB port communication requires the installation of USB driver software and the setting up of a Virtual Com port. If communicating via a USB port, the user will either:

- 1) Connect a Levelogger Optical Reader or PC Interface Cable to the USB port
- 2) Use a USB to RS232 Adapter

If 1) during the installation of Levelogger V3.4.0 or higher Software, the virtual com port driver will be installed automatically. The Levelogger Version 3.4.0 or higher Software Installation Wizard also copies a folder to the Levelogger 3 folder containing all the Solinst USB drivers. When you plug in the Solinst USB device, check the com port designation.

**Note:**

Do not install generic drivers that Windows will locate. Generic drivers are completely incompatible with Solinst USB devices.

If 2) Solinst strongly recommends the use of either Keyspan™ or IO Gear™ USB to RS232 Serial Adapters. These adapters have a sufficiently large buffer to accommodate the size of data bundle and bit transfer rate of the Levellogger. Follow the manufacturer's USB Driver and Com port setup installations found on the CD accompanying the adapter.

If you have installed another brand-name adapter, but cannot communicate with the Levellogger, in most cases the problem is that the adapter does not have a large enough internal memory buffer. The minimum buffer size should be 96 bytes.

4.2 Com Port Designation Set Up:

- 1) Click Start > Settings > Control Panel
- 2) Click Systems to open the System Properties
- 3) Click the Hardware tab and click 'Device Manager'
- 4) Double Click the Ports Icon and select the 'USB Serial Port'
- 5) Right click and select Properties
- 6) Click the 'Port Settings' tab and click 'Advanced'
- 7) Select the Com Port Number and click 'OK'

4.3 Data Directory

The program will save data downloaded to the following default directory:

<C:\Program Files\Solinst\Levellogger3_4\Data> unless otherwise specified in the Default Directory field of the Application Settings Window.

After completing Application Settings, click the OK button to confirm and save the settings.

Levellogger V3.4.0 or higher Software is based on 3 functional windows: Levellogger Settings, used to set up, start and stop the Levellogger, Data Control, used to download, view and compensate data and Real Time View, used to actively view data as it is being collected by the logger.

5 Levelogger Settings

After the user starts the Levelogger V3.4.0 or higher Software, the Levelogger settings window will open.

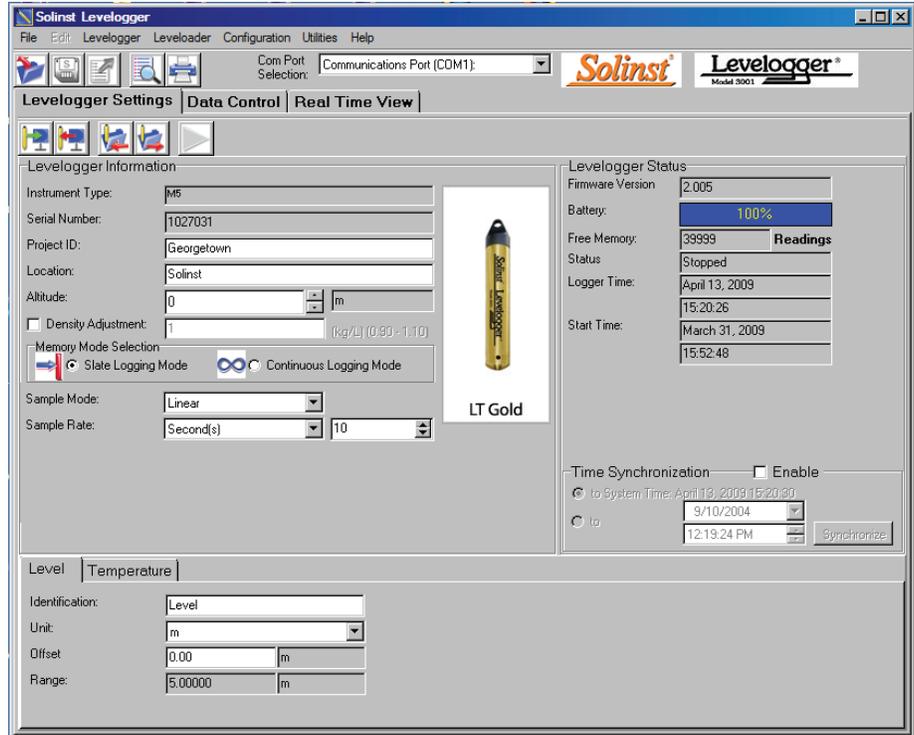


Figure 5-1 Levelogger Settings Window

Click the  button to retrieve the current settings from the connected Levelogger.

5.1 Levelogger Information Settings

The Levelogger Information Settings window includes Levelogger identification, Project ID and Location fields, sampling settings, altitude and fluid density input fields. The following is a description of each of the fields:

- **Project ID**, input your own Levelogger identification system. The Project ID is limited to 32 characters.
- **Location, input specific site / location information.** The location is limited to 32 characters.
- **Altitude** in feet or meters above sea level, at which the logger is actually deployed, is input in the altitude field. Water column equivalent pressure decreases with altitude at a rate of approximately 1.2:1000 in the lower atmosphere below 5000 m. You can compensate for this by entering an elevation between -1000 ft below sea level and 16,400 ft (or -300 m and 5000 m) above sea level. The readings will then be automatically compensated for elevation. See Section 11.1.3 for more information on how the Levelogger and Barologger adjust for altitude

**Note:**

The battery life of the Levelogger Gold is 10 Years,

based on 1 reading per minute. More rapid readings will reduce the battery life.

For example, if a Levelogger Gold is setup in Continuous Mode at a sampling rate of 1 second, the battery will be depleted in approximately 4 months.

If a Levelogger Junior or LTC Levelogger Junior are used at a sampling rate of 5 seconds, the battery will be depleted in approximately 2.5 months.

**Note:**

The Levelogger Junior and LTC Levelogger Junior

record using the linear sampling mode only. The LTC Levelogger Junior has a minimum sampling rate of 5 seconds.

**Note:**

In Event-based sampling mode, battery

consumption is mainly a function of sampling rate. Therefore, with a smaller sampling interval, battery power will be used up quickly whether readings are stored or not.

**Note:**

In Event-based sampling mode, the Levelogger

Gold has a total memory of 25,000 readings of level and temperature.

- **Density Adjustment** is used to adjust the range of the Levelogger based on the sample fluid density. The range for the density adjustment is from 0.9 kg/L to 1.1 kg/L. Uncheck the Density Adjustment field to disable the Density Adjustment function.
- **Sample Mode**, allows you to choose the sampling measurement type. Options are Linear, Event-based and Schedule.
- **Memory Mode Selection** will be grayed-out if not in Linear Mode sampling. When using a Levelogger Gold in Linear Mode, there is a choice of Continuous Logging (wrap around) or Slate Logging. In Continuous Logging the new log is started at the end of any previous log and continues logging, eventually recording over the first logged data. As one of the download options is to 'Append Data', Continuous Logging can be a preferred choice when logging long-term. In Slate Logging the new log is also started at the end of any previous log, but will stop recording after 40,000 readings, so that the beginning of the current log will not be written over.
- **Linear** refers to a set time interval between collection of readings. Sample Rate can be any number from 0.5 seconds to 99 hours. The LTC Levelogger Junior has a minimum sampling rate of 5 seconds. The time unit and number of time unit intervals between each reading are set up in the Sample rate fields. The Levelogger Gold and Barologger Gold can store 40,000 readings of level and temperature. The Levelogger Junior can store 32,000 readings, and the LTC Levelogger Junior holds 16,000 sets of level, temperature, and conductivity readings.
- **Event-based Sample Collection** is the most memory efficient means of data collection. In Event mode, the Levelogger will activate every sampling interval defined in Sample rate and check if readings have changed by the selected percentage (0.1 - 25% of Full Scale) from the last recorded reading. For Levelogger Gold level is the selected parameter where change is monitored. The Levelogger will record a new reading only if the specified change in level has occurred. Note that the percentage of change for sample collection is set in the Percentage field beside the Sampling mode and that the threshold change is a percentage of the Levelogger's Full Scale for that particular parameter. An important reminder is that, although actual memory usage in stable water level conditions may be relatively small, battery power consumption is partially a function of the sample reading rate. Therefore, a small sample reading interval will consume battery power at a higher rate whether readings are stored or not. In Event-based sampling mode, the Levelogger Gold has a total memory of 25,000 readings of level and temperature

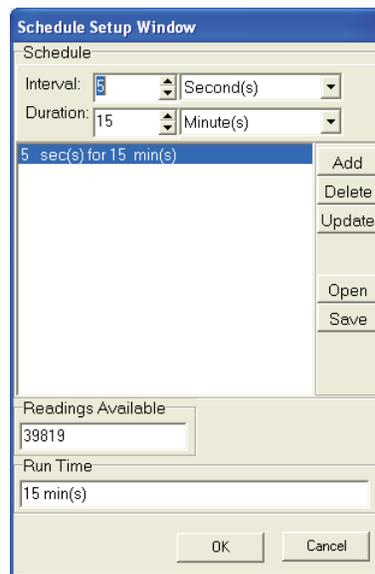


Figure 5-2 Levellogger Schedule Setup Window

- **Schedule Sampling** is set by selecting Schedule and clicking the Edit button in the Levellogger Settings screen to bring up the Schedule Setup Window. Buttons allow adding and deleting of lines, updating, opening and saving of *.sci schedule files. The maximum number of line items in a schedule is 30, each with its own sampling interval of seconds, minutes or hours and duration of seconds, minutes, hours, days or weeks. Running totals of the number of readings still available, from the total possible 40,000, and the run time to date are shown. If the number of readings selected exceeds 40,000 an error message appears. Schedule sampling allows the user to select a logarithmic style sampling schedule adapted to the needs of each application.

5.2 Setting up Channel Information

In the lower portion of the Levellogger Settings window is the window for setting channel (level, temperature, conductivity) parameters. The software will detect the available channels when the Levellogger settings are read.

For the 'Level' Channel, you can set the following parameters:

- **Identification** describes the measurement parameter of the channel and has already been configured as 'Level'. The channel can be renamed to suit each project. The channel monitors water column equivalent pressure. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. The Identification is limited to 32 characters.
- **Units** refers to the channel's units of measurement. There are three units of measure available for the user to select: cm, m or ft. When the user changes the unit, the value of the range and altitude will change according to the Unit Conversion formula. Note that when a metric unit is used, the unit of altitude is meters. When feet are the level channel units, feet are the units of altitude.



Note:

Readings can be corrected or offset with respect to a specific reference elevation or datum for a much wider spectrum of numeric Offsets as part of the Data Compensation Wizard.

- **Offset** refers to an offset correction, such as the distance between the tip of the Levelogger and the monitoring well cap or static water level. It is recommended that the value of 0.00 be used for offset as this keeps all subsequent readings relative to the tip of the Levelogger. The offset range for Levelogger Gold, the Levelogger Junior and Barologger Gold units is -1000 to 16400 ft or -300 m to 5000 m.
- **Range** refers to the full scale water fluctuation range capability of your particular Levelogger model. The full scale reading of any Levelogger Gold unit is based on its metric range. Therefore, the Levelogger Gold, which is available in F15 (M5), F30 (M10), F60 (M20), F100 (M30) and F300 (M100) ranges have actual water level ranges of 16.40 ft (5 meters), 32.80 ft (10 meters), 65.60 ft (20 meters), 98.40 ft (30 meters) and 328.0 ft (100 meters), respectively.

The 'Temperature' Channel includes the following:

- **Identification**, Units and Range
- The Temperature channel has been pre-configured by Solinst in °C and cannot be changed. The temperature range for the instrument will be shown (i.e. -20 to 80°C for a Levelogger Gold).

The 'Conductivity' or ('Specific Conductance') Channel, includes:

- **Identification**
- **Units** refers to the channel's units of measurement. There are two units of measure available for the user to select: mS/cm or µS/cm.
- The **Temperature Coefficient** field allows you to choose the actual conductivity ('Conductivity') at the current temperature or select Specific Conductance ('Spec. Cond'.) measurement in which the conductivity reading is temperature compensated to the standard of 25°C. The Temperature Coefficient default is 2.00 for Specific Conductance readings. The Temperature Coefficient should not be adjusted, unless you know the value specific to the solution you are measuring.



Note:

The Temperature Coefficient should not be adjusted unless you know the value required for a specific solution you are measuring. The default Temperature Coefficient is set at 2.00 for Specific Conductance readings. See Section 6 for details.

Level	Temperature	Conductivity
Identification:	Conductivity	
Unit:	uS/cm	
Temp Coefficient	Spec. Cond.	2.00

Level	Temperature	Conductivity
Identification:	Conductivity	
Unit:	mS/cm	
Temp Coefficient	Conductivity	0.00

Figure 5-3 Levelogger Conductivity Channel Information Tabs

5.3 Levellogger Status

The Levellogger Status Section of the Levellogger Settings Window shows the Firmware Version of the attached Levellogger, an accurate battery level, the number of free readings, the current date and time, and the start date and time of all Levelloggers.

5.4 Setting up the Levellogger Time

The 'Time Synchronization' section at the middle right of the Levellogger Settings window provides the controls for setting the Levellogger clock. The default setting in the Enable box is off, or unchecked. If you want to synchronize the Levellogger's clock, check the Enable box and select the time and click the synchronize button to set the time in the Levellogger. If you start the Levellogger without synchronizing the clock and the time difference between the Levellogger and the PC is more than 3 seconds, the software will give you a message asking 'Do you want to synchronize the clock?'. Click 'Yes' to synchronize the clock. It can be very useful to synchronize the clocks of all the Levelloggers and Barologgers going to one site.

5.5 Program Levellogger Settings

At this point you have completed editing the settings for your logging session, click the  button to send all the settings to the Levellogger.

The Levellogger will store all the new settings. Now that the datalogger has been programmed with your new settings, you can move on to Starting the Levellogger.

5.6 Starting and Stopping the Levellogger

To begin logging, click the  button and the Start Levellogger dialog box will open.

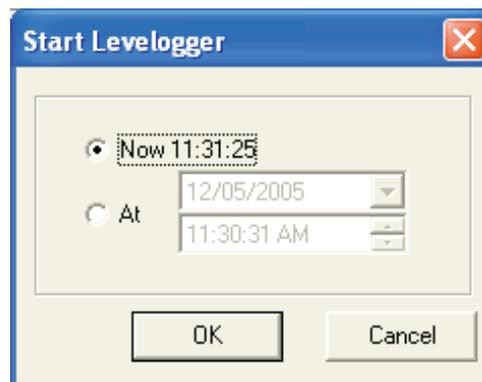


Figure 5-4 Start Levellogger Window

There are two ways to start logging. Choose 'Now' to start logging immediately. The Status field in the Levellogger Status window will state: Started and will indicate the logger time and the Start time. Free memory indicates the number of readings remaining at the time of communication.



Choose  to start the logging at a later date and/or time. This Start mode is referred to as Future Start in the Status field. After confirmation, the starting time is stored in the Levellogger and it will start collecting readings at the specified time. When the Future Start time is reached, the Status will change to Started.

After the Levellogger is started, it will begin collecting readings. The Start icon  will change to a Stop icon .

The Levellogger can be stopped at any time before it reaches the maximum reading capacity. Starting begins a new recording session and clears previously stored data readings.

It is critical to note that when Levelloggers log data in Slate mode, it means they will record data until stopped or their memory is full. When the memory fills, the datalogger will Stop recording. For this reason, it is important to determine, based on your start time and sampling rate, the date and time at which the memory will be full and the datalogger will stop recording. Levellogger Gold units record in Slate mode if Event or Schedule logging, but in Linear mode they can be set to Slate or to Continuous logging.

You can stop logging from the Levellogger Settings window, by clicking the Stop icon .

5.7 Saving and Retrieving Levellogger Settings Files

To store settings as defaults, click the  icon. It will store the settings of the Levellogger into an *.lls file as a series of defaults. The *.lls file will save the Project ID, Location, Sample Mode, Event Percent, Sample Rate, Altitude, Density, Channel ID, Unit and Offset.

To retrieve settings from defaults click the  icon from an *.lls file. This is particularly useful if programming several Levelloggers with similar identical settings. Keep in mind that Project ID and Location identification information will be identical and should be distinguished from logger to logger or monitoring point to point.



Figure 6-1
LTC Levelogger Junior

6 LTC Levelogger Junior Calibration

The LTC Levelogger Junior conductivity sensor must be calibrated for reliable conductivity measurements. Calibrate the LTC Levelogger Junior for conductivity at the start of each new monitoring project or at a minimum each new monitoring season. Calibrating the LTC Levelogger Junior again directly after the monitoring project or season will provide information on the degree of conductivity deviation during the project or season. If necessary, readings can be corrected for any conductivity deviation in a spreadsheet program after the data has been exported.

The process of conductivity calibration is performed automatically by use of the Calibration Wizard. The user need only place the LTC Levelogger Junior in a specified calibration solution and follow the steps provided by the wizard. Conductivity calibration solutions are available from Solinst or any laboratory supply outlet. This LTC Levelogger Junior has an 80,000 $\mu\text{S}/\text{cm}$ conductivity range and a calibrated range from 500 to 50,000 $\mu\text{S}/\text{cm}$. It can be calibrated at up to 3 calibration standard points:

- 1,413 $\mu\text{S}/\text{cm}$
- 5,000 $\mu\text{S}/\text{cm}$
- 12,880 $\mu\text{S}/\text{cm}$

The solution(s) must be between 10°C and 30°C during actual calibration. Temperature should remain stable during the 10 - 20 seconds it takes to perform each calibration.

From within the Levelogger Setting window, start the Calibration Wizard by clicking the Calibration Wizard icon . The wizard will guide you through the calibration process.

You can exit the wizard after any step to cancel the calibration session.

Introduction: The Levelogger must be connected to the computer during the entire calibration process and **must be stopped to calibrate**. Ensure you use fresh calibration solution and allow thermal equilibration of the solution during the process. Also ensure no air bubbles are present on the sensor.

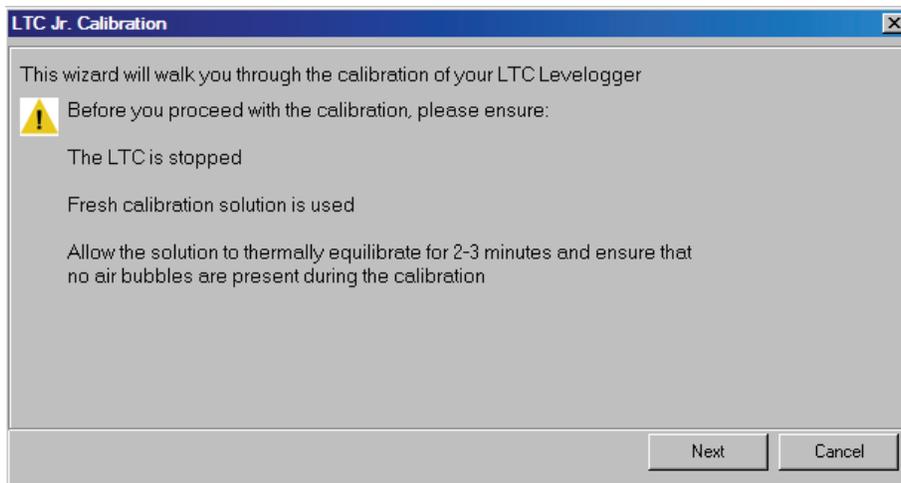


Figure 6-2 LTC Calibration Wizard Introduction

1. **Setting the Temperature Coefficient:** The default setting for the Temperature Coefficient is 2.00. If the conductivity solution you are using to calibrate the LTC Levelogger Junior states a different temperature coefficient on the label, please input that number into the Temp. Coefficient field.

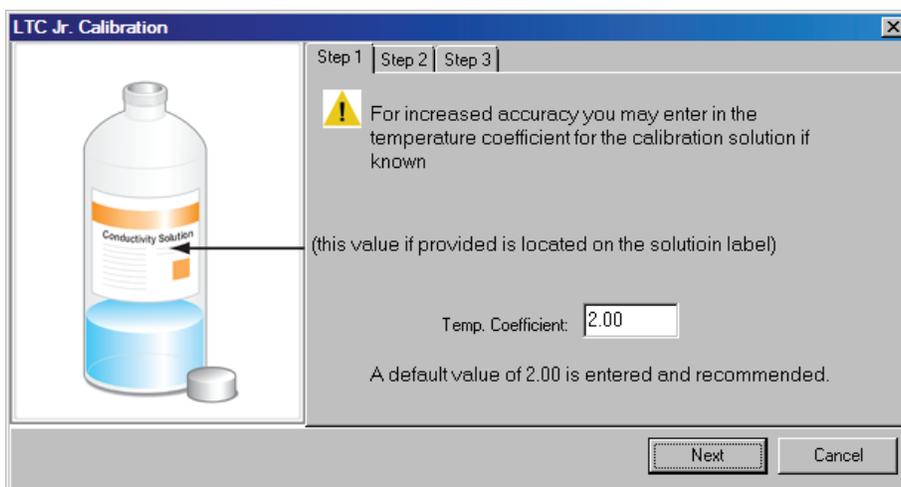


Figure 6-3 LTC Calibration Wizard Step 1



Note:

By selecting more than one solution, you will be performing a multipoint calibration.

2. **Setup:** The Levelogger Software requires the user to choose the calibration solutions. You can choose up to three solutions for a multipoint calibration. Ensure the solutions are ready in the calibration beaker or container. Start the calibration by selecting Next.

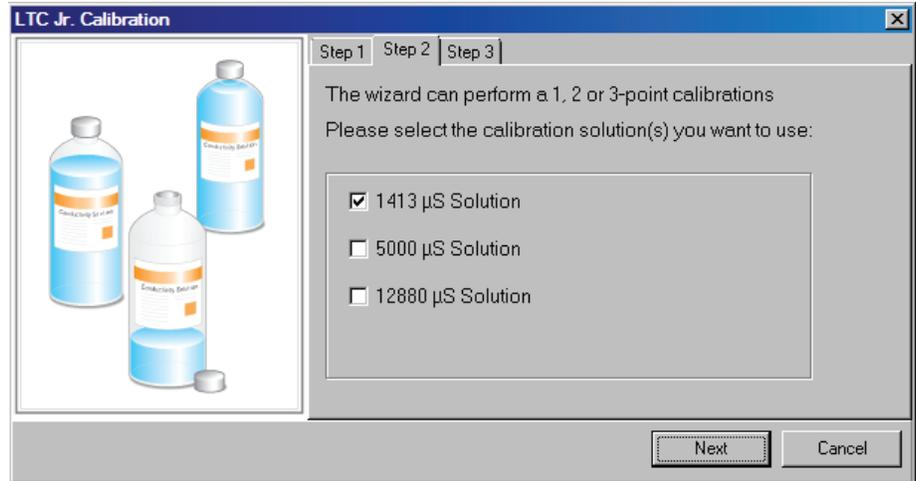


Figure 6-4 LTC Calibration Wizard Step 2



Note:

Ensure that the calibration solution covers the sensor cell grills and the logger is agitated to release entrapped air bubbles (~20ml required if using Solinst supplied test cylinder)

3. **LTC Levelogger Junior Rinsing Process:** Use DI water to rinse the Levelogger first and then rinse the LTC Levelogger Junior with the displayed calibration solution. Use fresh solution for calibration, and immerse the LTC Levelogger Junior in the fresh solution. Lightly tap the LTC Levelogger Junior to remove any bubbles from the sensor. Allow 2-3 minutes, then select next to calibrate.



Note:

Always remember to use fresh solution, remove all bubbles from the sensor pins, and allow for thermal equilibration of the sensor before proceeding.

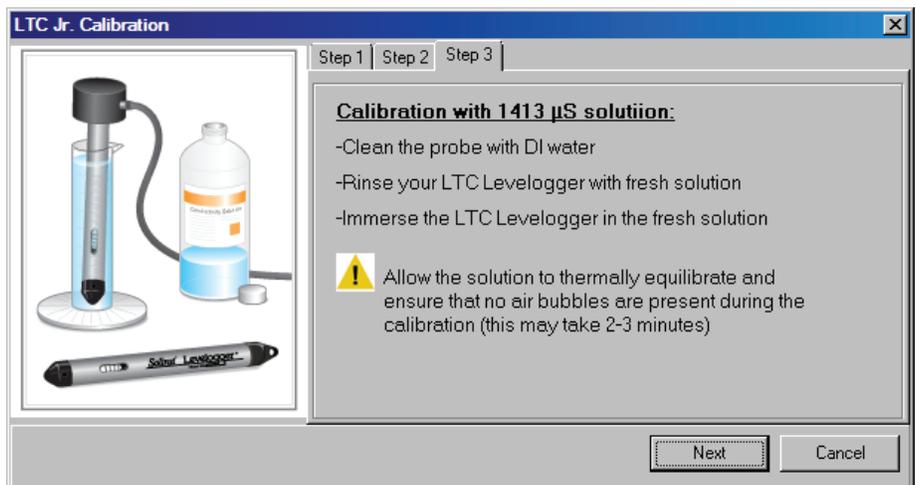


Figure 6-5 LTC Calibration Wizard Step 3 (example of window calibrating with 1413 µS/cm solution)



Note:

Once the calibration is complete for the first solution of a multipoint calibration, the Calibration Wizard will then go back to the beginning of Step 3 to start the rinsing process for the next solution selected.

Calibration: Since all standard calibration solutions state conductivity at a standard temperature of 25°C, the LTC Levellogger Junior can account for temperature differences between 15 - 30°C when you calibrate the unit. The LTC Levellogger Junior will compare the current temperature and conductivity readings against the temperature corrected standard solution. When a single-point calibration is successful the process is completed. If a failure does occur within the single-point calibration procedure. The LTC Levellogger Junior will default back to the last pre-calibrated state. When conducting a multipoint calibration, once the first calibration point is successful the process repeats itself to the next calibration point (back to the beginning of Step 3). If a failure does occur within the multi-point calibration procedure, the LTC Levellogger Junior will accept all of the successful calibration points and default back to the last pre-calibrated state for any failed ones.

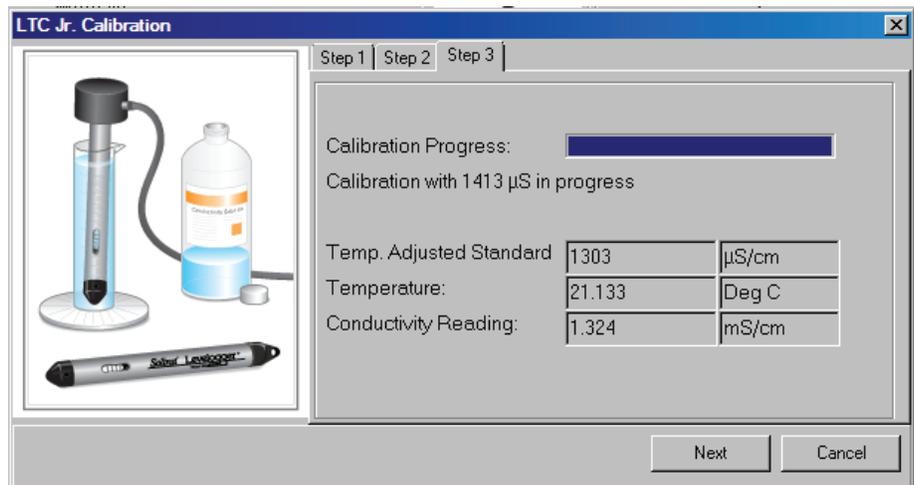


Figure 6-6 LTC Calibration Wizard Progress

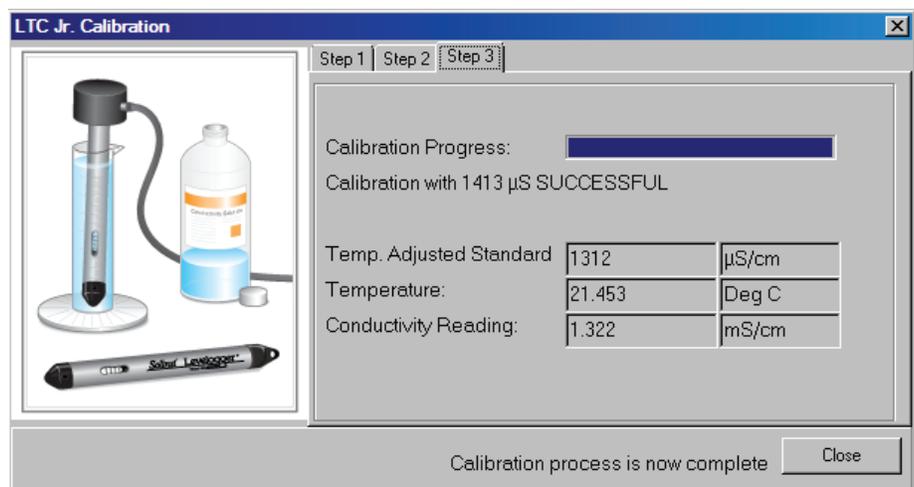


Figure 6-7 LTC Calibration Wizard Results



Figure7-1 Solinst Rainlogger

7 Rainlogger

The Solinst Rainlogger (Fig 7-1) is designed to count the tips of an external tipping-bucket rain gauge within a user defined sample interval and output the total rainfall over that sample interval. The Rainlogger can store 40,000 readings. The Rainlogger is designed to be compatible with the Solinst Levelogger series of products and is therefore programmed and data is viewed and exported using the Levelogger Software. It can be communicated with using a Leveloader Gold and can be integrated into an STS Telemetry System or PLC/SCADA network using SDI-12 Protocol.

The Rainlogger can be set up to log rainfall at intervals from 5 minutes to 99 hours and also calculates and presents the maximum 5 minute rainfall intensity within a minimum 15 minute sampling interval. The waterproof housing is made of stainless steel. Direct exposure to rainfall should be avoided, and the Rainlogger should not be submerged.

7.1 Rainlogger Communication Interface

The Rainlogger is compatible with Solinst Levelogger Gold accessories. It is programmed using the Levelogger Gold Software. It connects to a laptop or desktop PC using a Solinst Optical Reader, or a Direct Read Cable and PC Interface Cable combination. Stored data can be accessed using a PC or Leveloader Gold. Settings files can be uploaded to the Leveloader Gold and used to program the Rainlogger in the field. The Leveloader Gold comes ready with Optical Reader and PC Interface connections.

The Rainlogger is also able to integrate into a Solinst Telemetry System. It is connected to a Direct Read Cable, which is then connected to an armored reader cable to the remote telemetry station.

Rain Gauge Connector

The rain gauge connected to the Rainlogger is supplied by the customer and is a reed-switch type gauge most commonly known as a tipping-bucket rain gauge. The rain gauge connector is 3-pin (Fig 7-2) and connects to the 3-pin cable supplied with the Rainlogger. Longer cables up to 30 m (100 ft) can be supplied when the Rainlogger is ordered. The connector cable has 3 wires, however only two, the blue and brown wires, are connected to the tipping bucket device. As the tipping bucket is just an electrical switch, it does not matter to which terminal on the tipping bucket the blue or brown wire is connected. Longer, exposed cables should be protected from rodents and vandalism by cable armoring or installation within electrical conduit.



3 Pin Rain
Gauge Connector

Figure 7-2
The Tipping Bucket Rain Gauge
Connector of the Rainlogger



Note:

The Rainlogger must be programmed at a specific sample rate in all applications, as there is no Real Time View option for the Rainlogger.



Note:

The Rainlogger **MUST** be programmed with a minimum 15 minute sampling rate in order to obtain correct rainfall intensity values.

Users can still use a 5 or 10 minute sampling rate, but will not obtain accurate rainfall intensity calculations.

7.2 Rainlogger Setup

The Rainlogger is programmed using the Levelogger Settings Window of the Levelogger Software. The appearance of the Window when in communication with a Rainlogger is shown in Fig 7-4.

Setting up and Starting a Rainlogger is a quick and simple process. Identify the logging session and location in the **Project ID** and **Location** fields. The **Sample Mode** for the Rainlogger is Linear. Input the **Sample Rate** from 5 minutes to 99 hours, and input the **Unit** (mm or in) you will be using for rainfall measurement.

The **'Rainfall'** Channel will provide the total rainfall within the sample interval. It does so by multiplying the number of tips within the interval by the tipping bucket's calibration factor. The calibration factor is the amount of rainfall depth (mm, in) per tip. The calibration factor should be indicated on a label on the tipping bucket device or in the manufacturer's documentation. Input the calibration factor in mm or inches in the **Rainfall Cal Constant** field.

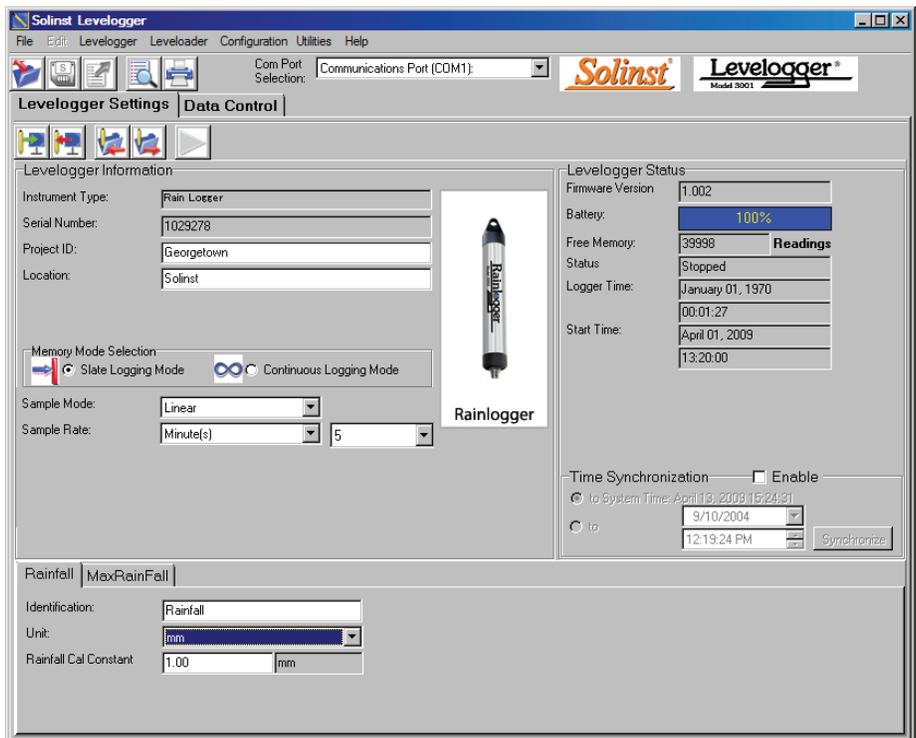


Figure 7-4 The Levelogger Settings Window of the Rainlogger

**Note:**

The Rainlogger **MUST** be programmed with a minimum 15 minute sampling rate in order to obtain correct rainfall intensity values.

Users can still use a 5 or 10 minute sampling rate, but will not obtain accurate rainfall intensity calculations.

The 'MaxRainFall' Channel does not require any setup or user input. The readings are of maximum 5 minute peak intensity within a minimum 15 minute sampling interval. This rainfall intensity value is derived by subdividing the sample interval into 5 minute sub-intervals and temporarily recording the number of tips in each 5 minute sub-interval. The Peak intensity reading is calculated by multiplying the number of tips in the 5 minute interval with the largest number of tips by 12 and presenting peak intensity/hr.

After the user has setup the Rainlogger, click the  button to start logging. A Message Box will pop up to ask for confirmation.

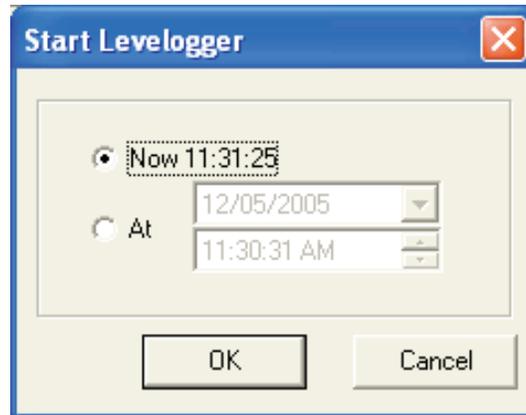


Figure 7-5
Rainlogger Start Logging Message Box

8 Data Control Window (Downloading and Compensating Data)

Click the Data Control Tab from the Main Window, the Data Control window will appear. From the Data Control window, the user can download data from a Levellogger or Leveloader, display data in tabular or graphic form perform data compensations and export.



Note:

The first thing you should do in this window is click one of the following tabs:

- Click the **Logger Info** tab to communicate with a Levellogger.
- Click the **Leveloader** tab to communicate with a Leveloader.
- Click the **Directory** tab to view the current file pathway or to open a specific file.

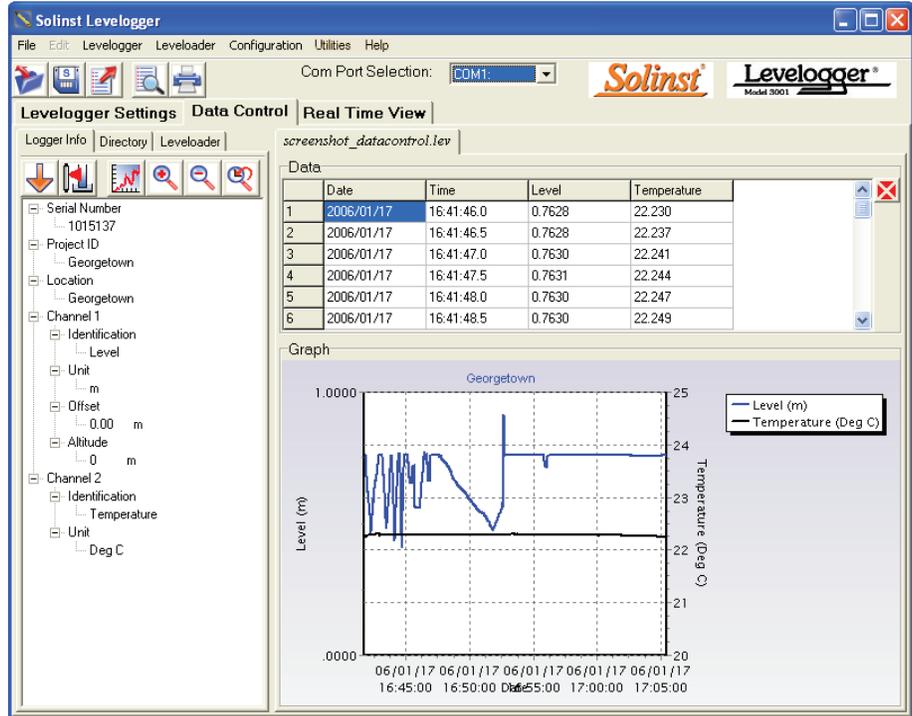


Figure 8-1 Data Control Window

8.1 Downloading Options

Click the Download icon  from the Data Control window to download data from the Levellogger. There are four options for downloading data. They are: All Data, Append Data, Partial Download and Recover Previous Log. If the user selects All Data, the program will download all the data from the current logging session of a Levellogger into a *.lev file. If the user selects Append Data, the program will append the data in the opened *.lev file from the Levellogger. The opened *.lev file and the attached Levellogger should have the same serial number and start time, otherwise an error will occur.

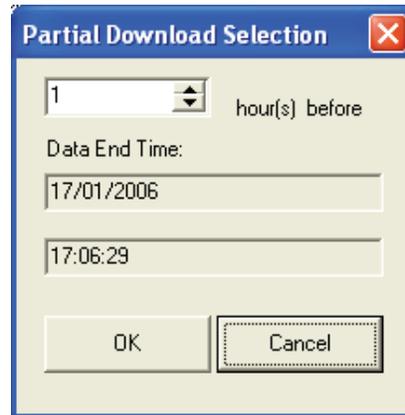


Figure 8-2 Partial Download Window

If the user selects Partial Download, a Partial Download Selection Window will open. The window shows the time stamp of the last reading in the logging session. The users can select the number of hours before the data end time. Once the user clicks OK, all the data within that time will be downloaded to a *.lev file.

If the user selects the Recover Previous Log, the software will try to recover the data from the previous log session and download the data to a *.lev file.

Once the data is downloaded from a Levellogger, it is automatically saved in a temporary file.

Click the Save icon to  save the data in a specific *.lev file. The default directory for saved data is in the 'Data' folder. However, the default directory for saved files can be changed by clicking the Configuration tab at the top of the program window, selecting 'Application Settings' and inputting or navigating to a different folder destination. If an error is experienced in saving your first data file such as depicted in Fig 8-3, you may not have file writing privileges to the default directory. In this case, create and set as the default file save folder, a new Levellogger data folder within the My Documents folder and attempt the file save procedure again.

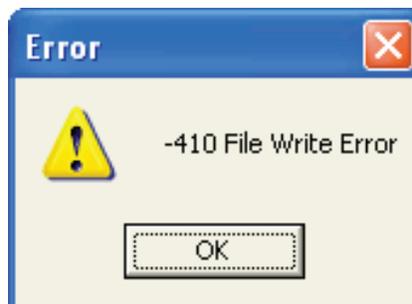


Figure 8-3 File Write Error Message

Click the File Open icon  to open a *.lev file. Multiple files can be opened at the same time and are available for viewing by clicking the File Name Tab on top of the data table. All the Levellogger settings and the channel information effective during data collection are shown on the left of the window. Click the Directory tab on the left of the window to show a directory list of the computer. Click on the *.lev file from the directory list to open a specific *.lev file. The Data Control window with the directory list is shown in Fig 8-4.

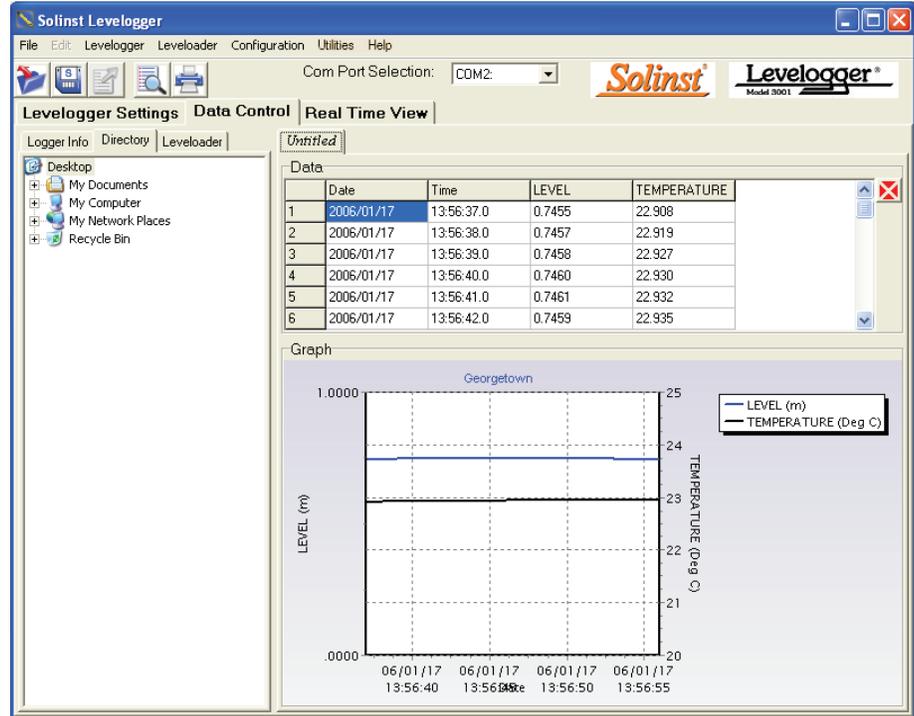


Figure 8-4 Data Control Window with Directory List

 **Note:**
When you click on a data point in the graph, the corresponding data will be highlighted in the data table.

8.2 Graph Manipulation and Zoom Function

To perform the Zoom In function on the graph, click the  button.

To perform a Zoom Out function on the graph click the  button. Click the  button to undo all the zoom functions.

Click the Graph Option icon  to open the Graph Option Dialog. The Graph Dialog is shown in Figure 8.5.

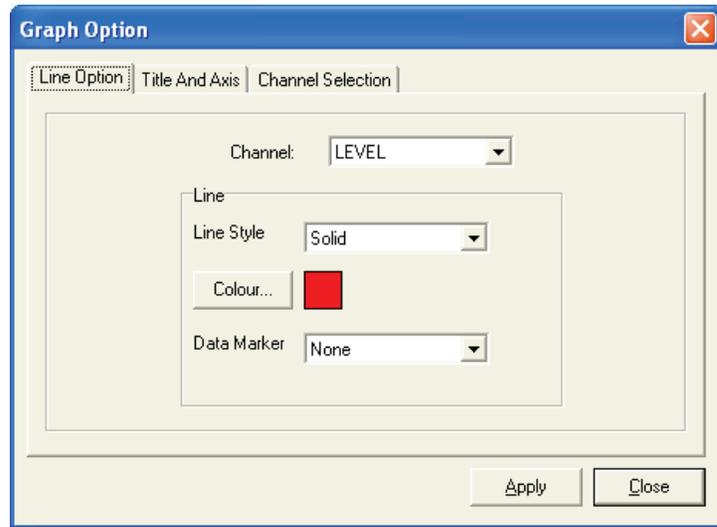


Figure 8-5 Line Option Window

The Line Option is used to adjust the style and colour of the line in the graph for each channel. The user can also select the shape of the data marker or remove the data marker.

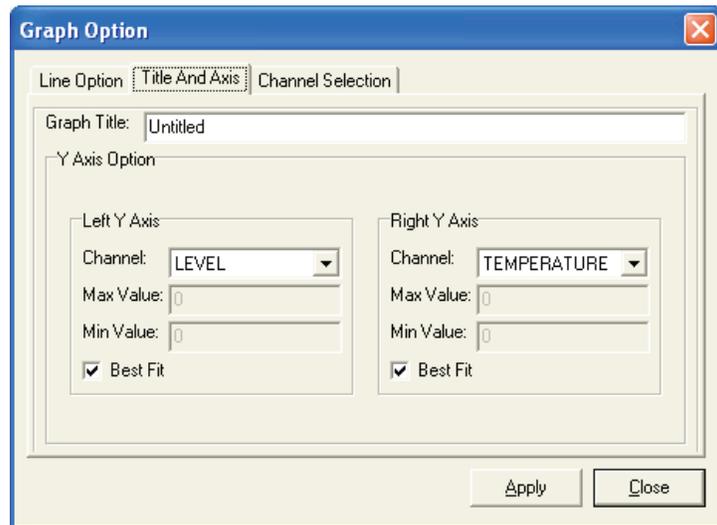


Figure 8-5 Line Option Window

The Title and Axis Option is used to enter the title of the graph and change the Y axis label or user selected scale. Check the Best Fit box to enable the software to determine the best fit scale. If the Best Fit box is not checked, the user has to enter a maximum and minimum value of the selected channel. The X axis is logging time.

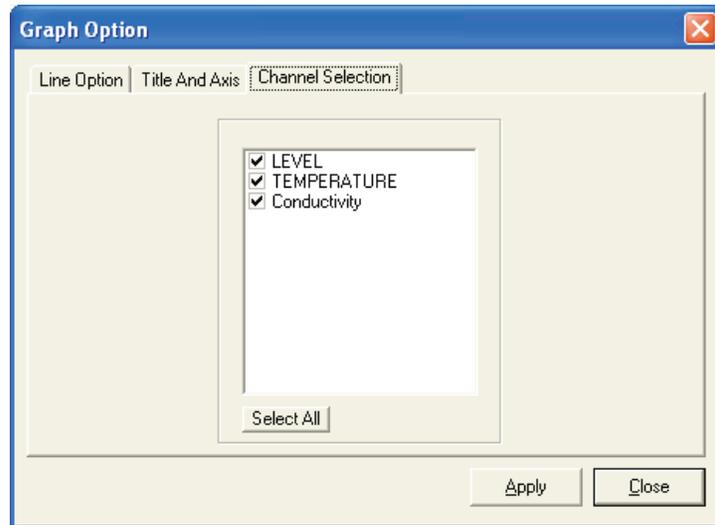


Figure 8-7 Channel Selection Window

The Channel Selection Option is used to control the visibility of each channel on the graph. A check mark beside the channel name indicates that the channel is visible on the graph. Click the Select All button to select all the channels.

8.3 Data Compensation

Click the Data Compensation icon  to open the Data Compensation Wizard. The Data Compensation Wizard is shown in Figure 8-8.A

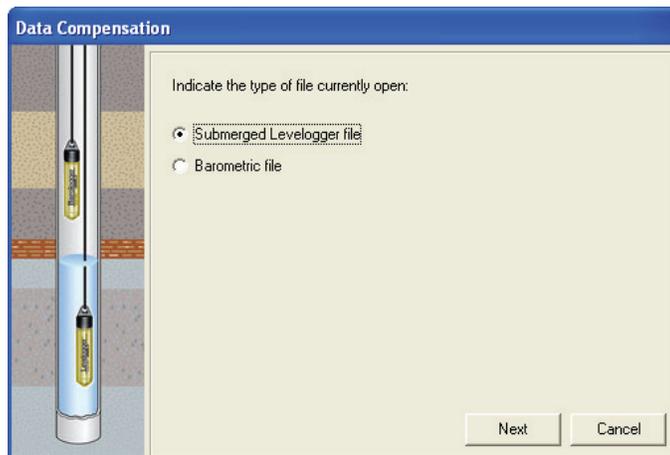
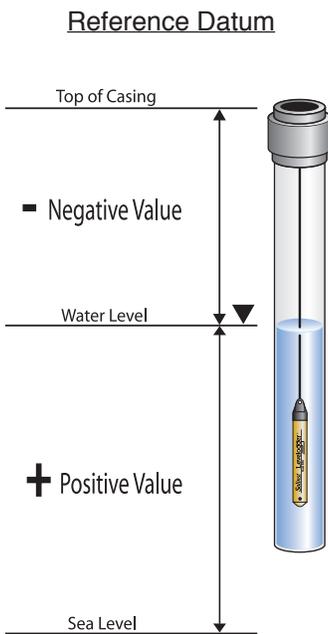


Figure 8-8 Data Compensation Window File Type Selection

In the first window of the wizard, the user identifies the currently opened file type. There are two file types: Barometric files (data that is retrieved from a Barologger) and Submerged Levellogger files (data that is retrieved from Levellogger Gold or Levellogger Junior). After the selection of the file type, click Next and the Data Compensation selection window will open.

There are four data compensation options available: Barometric Compensation, Manual Data Adjustment, Density Adjustment and Barometric Efficiency.

- **Barometric Compensation** requires the Barometric file and the submerged Levellogger file and simply involves subtraction of the barometric reading from the Levellogger reading. If there is an inconsistency of the time stamp between the Barometric file and the Submerged Levellogger file, a linear approximation on the barometric data will be performed.



Note:

You can use the Manual Data Adjustment to display Levellogger readings as depth-to-water measurements from the top of a well casing. Perform this adjustment after barometric and density compensations.

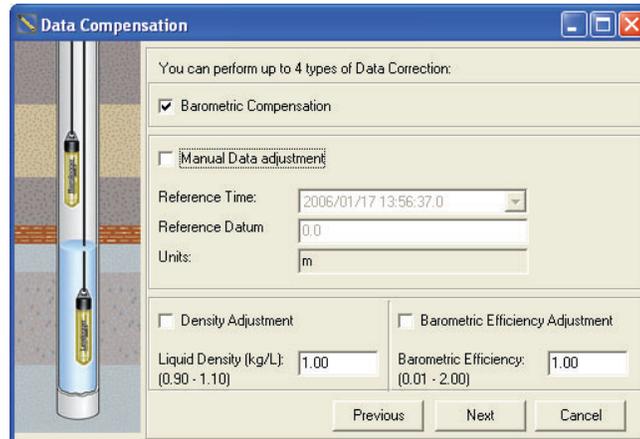


Figure 8-9 Data Compensation Window - Compensation Selection

- **Manual Data Adjustment** allows the user to enter a manual water level measurement as a reference datum or field zero, which all Levellogger water level readings can then be adjusted to. If the reference datum is above water level (e.g. top of well casing), the datum must be input as a negative value. If the reference datum is below water level (e.g. sea level), a positive value is input. The date and time of measurement of the reference datum must be recorded and input to complete the adjustment. The program computes a correction factor based on the time-stamped reference datum, and adjusts all the data in the selected file after barometric, density, and other data compensations are performed.
- **Density Adjustment** corrects the range of the level channel in the data file based on a user input adjustment of fluid density.
- **Barometric Efficiency Adjustment** is used to proportionally adjust Barologger data in relation to a particular Levellogger. Barometric efficiency is often expressed as a percentage or proportion. The input field is proportional and has a default value of 1.00. For more information about Barometric Efficiency, see Section 11.1.3. The barometric efficiency can be set from 0.01 to 3.00.

The compensated data will be saved in a new *.lev file. The default file name will be the <Submerged Levellogger file name> with the word <compensated> added to the file name prefix. Alternatively, the user can name the compensated file. Do not change or delete the file extension.



Note:
Real Time View is not available with the Rainlogger.



Note:
LTC Levellogger Junior Real Time View is only available at intervals of 5 seconds or greater.

9 Real Time View Window

Click the Real Time View tab from the main software window and the Current Readings Window will appear (Fig 9-1). The purpose of this window is to provide on-screen measurement as data is being recorded by the connected logger. The data is displayed in tabular and graphical format. All the channel information and Levellogger settings are displayed in the bottom left window.

First, select a Non-Logged View Rate (middle left). This rate can be set independently of the logging period of the Levellogger and does not interfere with any logging taking place in the Levellogger itself. Real Time View readings can be displayed as a graph or in tabular format. If one channel is not required, it can be removed by unchecking the check box to the right of the data display. If not displayed, it is not being recorded. Real Time View readings are being recorded within the Levellogger Software and prior to closing the window, they can be saved by exporting the data into a *.csv file, by choosing the file export option.

To start the current readings, click the Start  icon. Immediately the readings will be displayed.

To take a reading at any specific time, click the  button and that reading will be added to the displayed data. To turn the Real Time View monitoring off, decide if you want to save the data as described above, and simply click the Real Time View Tab or the Levellogger Settings Tab.

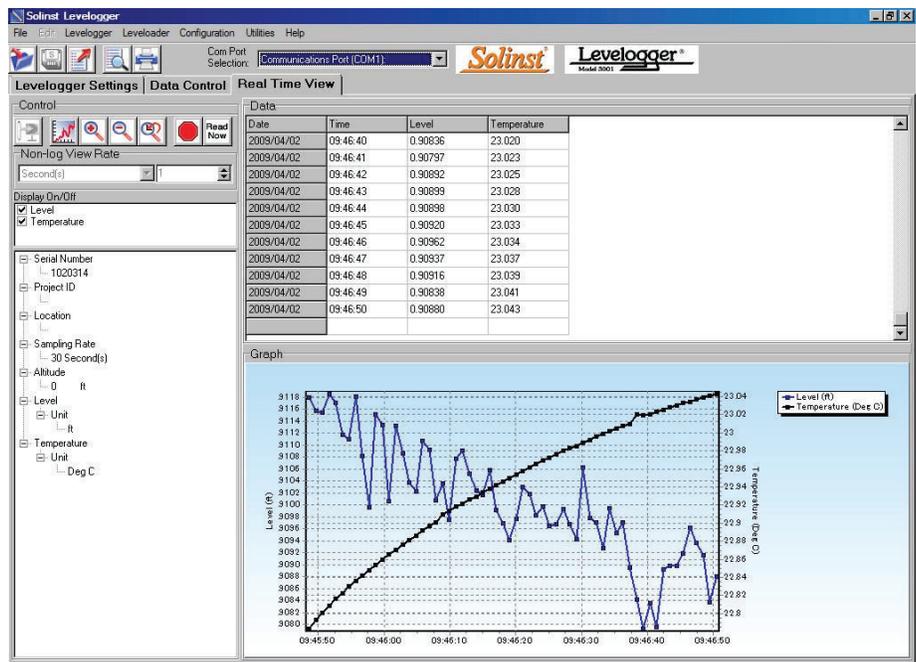


Figure 9-1 Real Time View Window

10 File Export and Print Function

Data can be exported in *.csv (comma separated value) file format by clicking File > Export > Data. The *.csv file format is supported and can be imported by most spreadsheet programs. Also, the data graph can be exported to a *.bmp file or a *.wmf file by clicking File > Export > Graph.

The Logger Settings, data table and data graph can be printed. Click the Print

Preview Icon  to open the Print Preview window. Figure 10-1 shows the print preview of the Logger Settings. The Levellogger Settings are always on the first page of the document. The data graph is on the second page of the document and the rest of the document is data table.

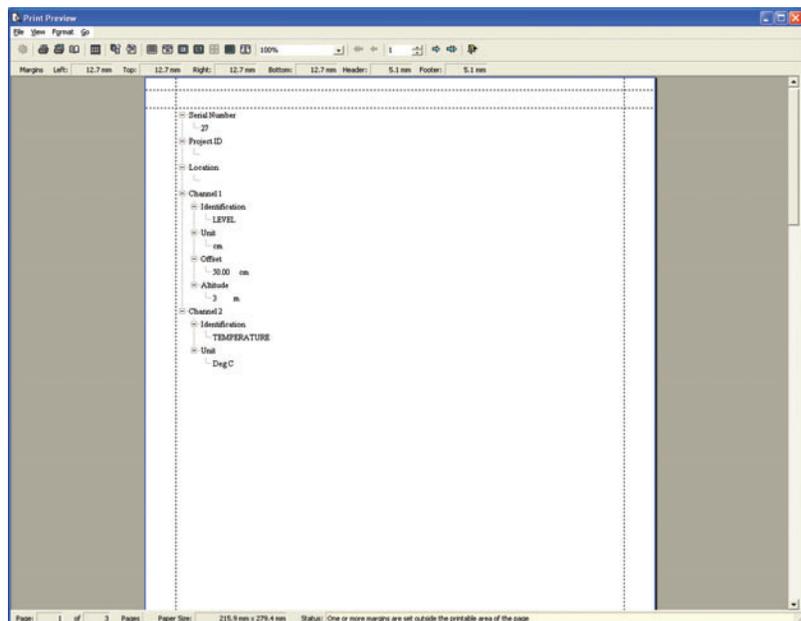


Figure 10-1 Print Preview Window

Click the Print Icon  to open the print dialog and print the document.

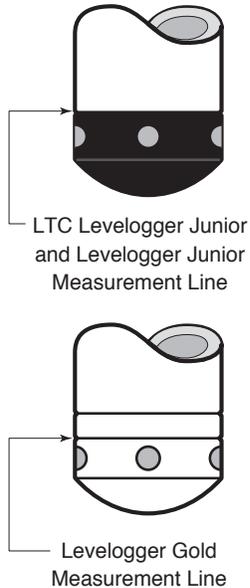


Figure 11-1



Note:

When using Direct Read Cables, the following maximum

lengths apply to the cable according to which PC Interface Cable is to be used:

- USB PC Interface Cable: 1,000 ft (300 m)
- RS232 PC Interface Cable: 500 ft (150 m)
- RS232 PC Interface Booster: 1650 ft (500 m)

11 Installation and Maintenance of Levelloggers

11.1 Installation

Many options exist for installation of the Levellogger, but essentially these installation methods can be classified into two broad categories: free suspended or fixed installations.

1. In free suspended installations, the Levellogger is hung via suspension wire or Direct Read Cable from the well cap, or some fixed tie-off location, at the well head.
2. In fixed installations the Levellogger is fixed in place by a compression fitting, a clamping mechanism or simple metal straps.

Prior to commencing the discussion of installation techniques several general points related to Levellogger installation should be made. First, it is recommended that the Levellogger be installed in a vertical orientation. However, inclined or horizontal installation is acceptable. The level sensor in the Levellogger is indicated by the machined line about the body of the logger just above the pressure access holes. The pressure transducer is oriented in a plane normal to the long axis of the body and detects pressure directed along the plane of the long axis (Fig 11.1). In vertical orientations, the sensor detects pressure above the pressure transducer line, where as in non-vertical orientations, the pressure zero point is proportional to the angle of inclination.

Care should be taken to avoid dropping the Levellogger against a hard surface. Further, the pressure transducer can be damaged if the datalogger is over-pressurized by submergence greater than its level range. The Levellogger is warranted to pressures up to 150% of its full scale level range, however accuracy can not be guaranteed beyond its full scale.

Other important considerations when installing the Levellogger in pressurized or intermittently pressurized locations such as pressure vessels, pressurized pipes, pulse flow conditions, drop structures or near hydraulics works, is to keep in mind the potential effect of water or steam hammer and hydraulic jump. Water hammer is caused by an abrupt alteration of flow direction resulting in pressure surges. Steam hammer occurs when steam enters a cold pipe partially filled with water. The hammer effect has the potential to significantly increase hydraulic pressure possibly exposing the pressure sensor to pressures beyond its maximum rating. Hydraulic jump is a phenomenon that occurs when water is 'lifted' or 'ramped' by velocity or flow obstructions. Hydraulic jump causes turbulence and creates non-representative head conditions in the water column. Care should be taken to avoid logger installation at points susceptible to hydraulic jump.

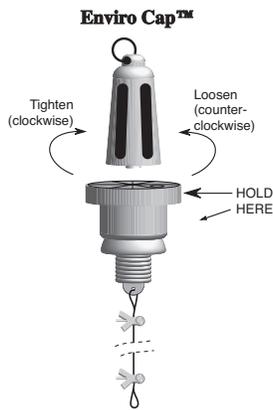


Figure 11-2
Locking, tamper-proof
Enviro-Cap Step 1

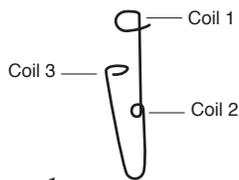


Diagram 1

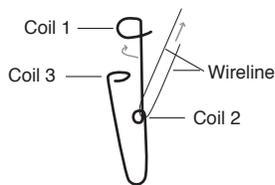


Diagram 2

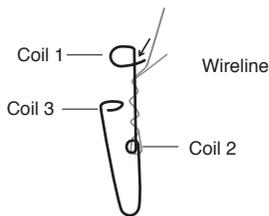


Diagram 3

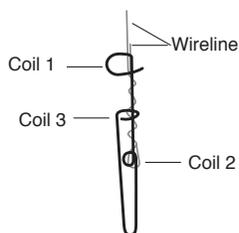


Diagram 4

Figure 11-3 Wireline Hook
Installation

11.1.1 Free Suspended Installations

Suspension Wire/Rope Installation

When installing using a suspension wire or rope, the Levelogger is pre-programmed and started using the software. It is then deployed using a suspension wire or rope connected to the installation cap of the Levelogger to the underside of a well cap. The data is retrieved manually, by withdrawing the Levelogger, removing the installation cap and attaching an Optical Reader directly to the datalogger. Data is downloaded to a desktop or laptop PC or by using a Leveloader Gold.

Solinst supplies stainless steel suspension wire assemblies including SS stranded wire and hooks available in a variety of lengths from 50 ft (15 m) to +500 ft (+150 m), and Kevlar rope assemblies. Solinst also supplies a specially designed, tamper-proof, vented, locking well cap known as the Enviro-Cap™ from which the Levelogger can be suspended.

This type of installation is applicable to both submerged and barometric record applications. Follow these steps to install the Levelogger using stranded cabling and hooks:

1. Loop the cable through the coil 2 of the hook assembly, then wind the looped strands several times around the hook shaft and pass through coil 1.
2. Pass coil 3 through the Enviro-Cap™ eyelet or Levelogger/Barologger eyelet and snap coil 3 to the hook shaft.
3. If the Enviro-Cap™ is not used then some secure tie-off point should be used or installed.
4. If installing a Barologger, ensure the suspension level is above the highest expected water level.
5. When retrieving data and/or reprogramming the Levelogger, extract it from the monitoring location, unthread the installation cap, interrogate and re-suspend the unit rechecking the security of the wireline clamps each time.

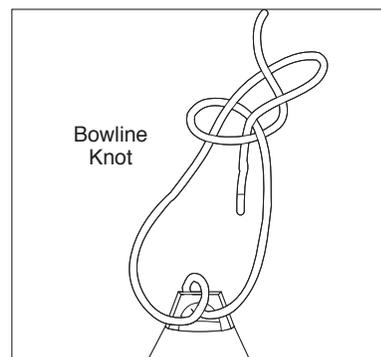


Figure 11-4 Bowline Knot Used to Connect Kevlar Rope to the Levelogger



Figure 11-5
Direct Read Assembly Components

Direct Read Cable Assembly Installation

When installing using a Direct Read Cable Assembly, the Levellogger can be deployed before it is programmed and started with the software. The Levellogger is installed using a Direct Read Cable to a Direct Read Wellhead, where a PC Interface cable is connected allowing the Levellogger to communicate with a desktop or laptop PC, or a Leveloader Gold.

The Direct Read Cable system is composed of the ordered length of Direct Read Cable, the Direct Read Wellhead and the PC Interface Cable. The Direct Read cable threads to the Levellogger, while the socket at the opposite end of the Direct Read Cable fits into the specially designed Direct Read Wellhead. The PC Interface Cable connects to the Direct Read socket at surface and to either a USB or RS232 port on the PC (Fig. 11-5). While use of the Direct Read Wellhead is recommended and convenient, it is optional as long as a satisfactorily secure alternative tie-off point is found for the Direct Read Cable. Follow these steps to install a Direct Read Cable Assembly to the Levellogger:

1. Remove the installation cap from the Levellogger, align and connect the optical socket (two glass ‘eyes’ using the alignment pin) of the Direct Read cable to the Levellogger by threading the coupling onto the Levellogger tightly.
2. The Levellogger and optical socket will fit through the hole in the Direct Read wellhead. Use the eyelet at the bottom of the wellhead to securely tie-off the cable and logger. Do not suspend the logger and cable from the surface socket.
3. Remove the protective cap from the non-optical socket at the wellhead end of the Direct Read cable, seat the socket in the Direct Read Wellhead and align and thread it to the round socket of the PC Interface Cable.
4. Connect the USB or RS232 socket of the PC Interface Cable to the USB or RS232 Com Port on your PC.
5. The plugged hole in the wellhead can be removed to provide an access port for a water level meter probe.

When removing a Direct Read Cable from a Levellogger, ensure you only twist the coupling. To avoid possible damage, do not twist the strain relief on the Direct Read Cable.

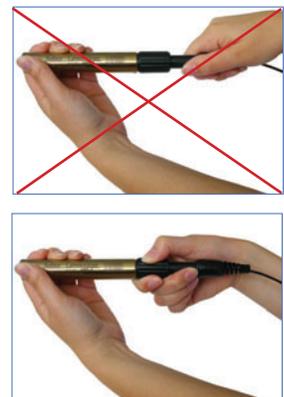


Figure 11-6 Proper way to remove a Direct Read Cable from a Levellogger

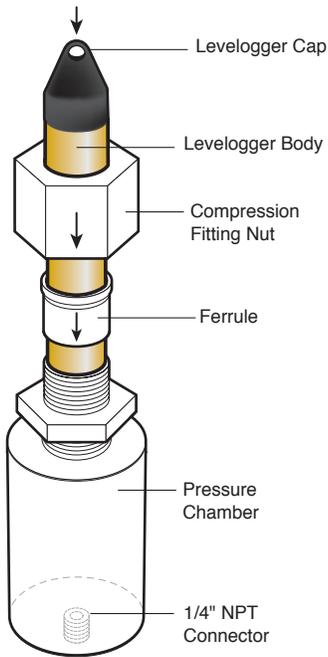


Figure 11-7
7/8" Nylon Compression Fitting
with 1/4" NPT Connector



Note:
The Levellogger
NPT Adaptor is
not recommended

for pressures in excess of
30 psi (66 ft (20 m) of water
column).

11.1.2 Fixed Installations

Artesian Monitoring

Monitoring of artesian conditions in which the piezometric surface is above ground surface or more particularly above the top of well casing elevation using Levelloggers can be quite straight forward.

Continuous artesian conditions infer that the piezometric surface never drops below the level the ground surface or particularly the top of casing elevation and the casing is sealed with a sealed wellhead. In this case, where freezing is not a concern, the Levellogger need only be installed on the wellhead itself by means of a large compression fitting with a 1/4" NPT connector, as illustrated in Figure 11-6. Solinst can supply a 7/8" nylon compression fitting for this purpose. First, a 1/4" NPT hole is tapped into the wellhead. The user slides the Levellogger into the compression fitting, leaving about 1/4 of the logger body exposed above the fitting. The compression fitting nut is tightened around the Levellogger. The 1/4" NPT connector on the bottom of the pressure chamber of the fitting threads into the hole in the sealed wellhead. The user can communicate with the logger simply by removing the logger cap and attaching the optical reader. Ensure that the logger and sealed wellhead are enclosed within an outer protective well cap or enclosure. This method should only be used in low pressure conditions (less than 30 psi or 66 ft (20 m) of water column).

When conducting artesian monitoring with Levelloggers a number of considerations must be kept in mind. First, ensure that the maximum hydraulic pressure the Levellogger will encounter within the well at its installation point will not exceed the hydraulic range of the logger. Second, artesian conditions do not preclude the necessity for barometric compensation of Levellogger data. Artesian conditions are caused by aquacludes forming confined aquifers. Confined aquifers, while not acted on by barometric pressure to the same extent as unconfined aquifers, are typically subject to barometric pressure at some barometric efficiency (See Section 11.1.3). Finally, bear in mind that the total pressure and subsequent water column equivalent depth measured by the Levellogger after barometric compensation may not represent the actual water level within the artesian well. Sealed intermittent artesian wells can be pressurized when artesian, but can also be de-pressurized when non artesian. The Levellogger's reading after barometric compensation represent the height of the piezometric surface.

Vacuum Monitoring

Vacuum monitoring is usually conducted by first installing pressure transducers such as the Levellogger in monitoring wells and then shutting-in or sealing those wells to the atmosphere with pressure sealed wellheads. Air is pumped out from an extraction well amongst the cluster or matrix of monitoring wells, theoretically dropping air pressure in the vicinity of the extraction well. For short-term tests in which data is not required during the extraction event, the Levelloggers can be programmed and simply suspended from hooks or eyelets on the underside of the sealed wellheads, the test run and the data collected at the end of the test by extraction and downloading of the loggers. However, if ongoing data from the Levelloggers is required during the extraction event, the loggers must be installed in a manner similar to the artesian monitoring scenarios described in previously in this section. Levelloggers or Barologgers can be used to monitor the drop in pressure.

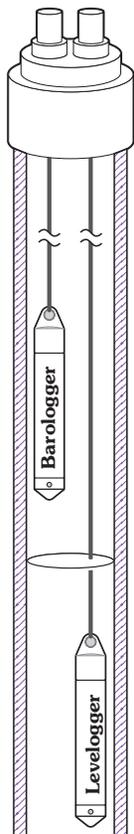


Figure 11-8 Levelogger and Barologger in Well



Note:

The Barologger Gold should not be used

to monitor water, as the internal mathematics for temperature compensation are based on air rather than water.

11.1.3 Barologger Installation

The Barologger is a Levelogger with a small range of 4.92 ft (1.5 m) adequate to monitor the fluctuations that occur in barometric pressure. The Barologger's readings are used to barometrically compensate Levelogger readings. Typically, Barologger readings range from 1 – 3.3 ft (30 – 100 cm) when the Barologger is programmed with its operating altitude. Failure to input the correct altitude will result in incorrect readings and may cause the pressure transducer to go out of range. It is strongly recommended that the altitude input be accurate to ≤ 10 m. When the Barologger is programmed at its operating altitude, its readings can be used to directly compensate for barometric pressure, the readings of any Levelogger programmed at the Levelogger's operating altitude. As a rule of thumb, a Barologger can be used to compensate all the Leveloggers in a 20 mile (30 km) radius and/or with every 1000 ft. (300 m) change in elevation.

To monitor barometric pressure correctly, the Barologger should never be submerged. In well installations, it is recommended that the Barologger be suspended in one of the monitored wells above the high water point (Figure 11-7). For best reading accuracy, the Barologger should be installed in a similar thermal environment to that of the Levelogger. In groundwater wells, the Barologger should be suspended beyond the frost line and deep enough to avoid large temperature fluctuations. In surface water applications, the Barologger is best deployed in a dry well – a well embedded in the bottom of the water body, but sealed at the base from water entry and vented to the atmosphere. If a dry well cannot be installed, the Barologger can be installed on a float in the stilling well. Further information on the Barologger and barometric pressure can be found in Section 12.

Barometric Efficiency

The influence of barometric pressure on a groundwater surface can follow three scenarios. In confined aquifers with capillary or vadose head space, increased atmospheric pressure can tighten the pore spaces in the overlying soil and produce a capillary effect as the water level rises in response to having nowhere else to go but up. Second, some deeper aquifer systems can be quite barometrically isolated from the relatively small change in level that barometric influences can produce. The third scenario occurs in an unconfined aquifer, with high barometric efficiency, in which a barometric pressure change results in an equivalent or highly proportional drop or rise in groundwater pressure. In essence, depending on the aquifer type and depth, increased barometric pressure can result in either increased, static or decreased water levels. Barometric efficiency, the relationship of a barometric change on groundwater pressure, in confined aquifers generally ranges from 20 to 75%, whereas in unconfined aquifers the efficiency can range from 80 - 100%.

A second important element of Barometric efficiency is time lag – the time differential between a unit change in barometric at the surface to the time of transmission of that change to the aquifer. Calculating general barometric efficiency should not be done on a single barometric event, but rather on a statistically significant number of events. As a result, it may take a month or more of submerged Levellogger and Barologger data to determine barometric efficiency and time lag. As Barometric pressure fluctuates over time in excess of 60 cm water column equivalent pressure and as barometric efficiency can be such an important factor in accurately monitoring groundwater levels, it is vital that barometric compensation of the Levellogger data be performed.

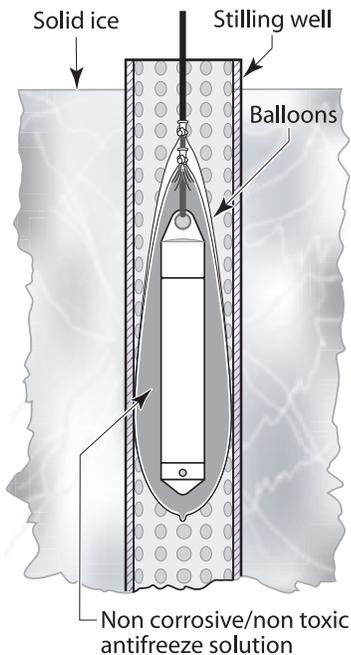
Barometric efficiency and time lag cannot be determined with vented pressure transducers in which barometric efficiency is assumed to be 100% no time lag. The inherent error these assumptions can cause in the incumbent data can be quite significant. The absolute pressure method used in the Levellogger and Barologger provide the user with the data necessary to determine barometric efficiency. If a barometric efficiency value has been determined from the Levellogger and Barologger data, that value can be applied to Barologger data in the Compensation Wizard. Application of this feature can produce net groundwater level data of an accuracy that cannot be produced by vented transducers.

Wells puncturing an aquifer have a negligible to non-existent effect on directly transmitting barometric changes to the larger aquifer. Barometric pressure is transmitted through overlying layers. To obtain the best and most accurate long term water level readings from Levelloggers, the user must first understand how the Levellogger calculates a depth of water above the transducer and second whether barometric efficiency should be considered in barometric compensation.

11.1.4 Installation in Extreme Thermal and Marine Environments

Freezing or High Temperature Conditions

Levellogger installation at submerged depths that may be at risk of freezing during the monitoring session is not recommended without taking adequate precautions to avoid transducer damage. When water freezes it expands approximately 9% by volume. 9% expansion can equate to extreme pressure as demonstrated in Example 11.1. Therefore, solid freezing has the potential to damage the pressure transducer, which is rated to withstand up to 150% of its depth fluctuation range. Pressures beyond this threshold may damage the transducer. With certain precautions, the Levellogger can be used in freezing liquid environments. If monitoring shallow water bodies or groundwater zones susceptible to freezing, the easiest way to avoid transducer damage is to lower the transducer to a point in the water column below the frost line or ice formation depth. In water bodies such as shallow streams, wetlands or ponds where freezing may penetrate to the bottom, install the Levellogger in a vented stilling well imbedded into the bottom of the water body beyond the frost line. In cases where the above noted precautions cannot be taken and the Levellogger must be installed in the freezing zone, it is recommended that the logger be placed inside two elongated silicon, rubber or latex balloons, the balloons be filled with a non-toxic, non-corrosive anti-freeze solution and sealed (Figure 11-8). Place the balloons in a section of perforated, 1.25" (30 mm) ID pipe and install the logger in the monitored water. The antifreeze solution will protect the Levellogger from ice expansion at the pressure transducer, yet transmit any pressure fluctuations that occur. Please note that a similar installation protection can be used when the Levellogger is monitoring liquids which are incompatible with its wetted materials. The operating temperature range for Levelloggers is -20° - 80°C (-4° - 180°F). At the opposite end of the thermal scale, exposing the Levellogger to temperatures beyond 80°C may damage the thermistor and otherwise affect the Levellogger.



11-9
Installation in Freezing Liquid

Example 11.1 Solid Freezing Effects

The pressure exerted by the physical expansion or ice crystallization process on a retaining or enclosing contact surface is related to the temperature gradient over which the process occurs. For example, liquid freezing at -22°C, can create expansion pressures of 22 kg/cm² or 313 psi or the equivalent of 721 ft or 220 m water column depth.

Marine or Brackish Installations

When installing the Levellogger in salt or brackish water or in a liquid having a specific gravity (density) different than fresh water, the density difference is compensated for by checking the Density Adjustment checkbox in the Levellogger Settings window and inputting the density of the monitored fluid. See Section 5.1 for details in compensating the Levellogger for fluid density differences.

The LT Levellogger Gold can be used for monitoring in salt or brackish water. However, long term use of the first generation stainless steel body LTC Levellogger or LT Levellogger, or LTC and LT Levellogger Junior in salt or brackish water is not recommended, as the salt or other pollutants may cause pitting which can lead to perforation of the Levellogger's casing. To minimize this effect, regularly lift the Levellogger from the liquid; within seconds a thin protective layer will be formed by oxidation. Again, this precaution applies to the first generation stainless steel LTC and LT Levelloggers or LTC and LT Levellogger Junior. If using an LT Levellogger or Levellogger Junior in a continuous salt/brackish monitoring scenario, the stainless steel body of the datalogger can be protected in a manner similar to the freezing protection method described in Section 11.1.4. The Levellogger can be placed in balloons and the balloons filled with non-corrosive/non-toxic fluid. As pressure changes, the fluid encasing the loggers will transmit the pressure differential to the datalogger's pressure transducer. Care must be taken in the selection of the balloon material or filling fluid such that the balloon material prevents diffusion of salts across the concentration gradient or that the filling fluid is comprised of polymeric molecules too large to diffuse out of the balloon material.

**Note:**

It is important to ensure the installation cap or Direct Read Cable is attached to the Levellogger during storage to prevent the battery from draining.

11.2 Levellogger Maintenance

Levellogger maintenance consists of cleaning the outside stainless steel casing, the circulation holes and the optical infrared eyes. The required frequency of cleaning is dependent on several aspects of the monitored water quality. In freshwater with good to excellent water quality, the Levellogger cleaning requirements will be very minimal; amounting to a seasonal or even annual maintenance inspection. In most cases cleaning can be accomplished by rinsing the Levellogger and using mild, non-residual, non-abrasive household cleaners using a very soft-plastic, bristled, pipe-cleaner type brush. Do not insert any object through the circulation holes at the sensor end of the Levellogger. In some cases simple cleaners are insufficient to properly clean the Levellogger. Several commonly occurring water conditions require specific maintenance methods, these include hard water, high suspended solids loading, biological or chemical fouling and salt or brackish water conditions.

Hard water monitoring can result in the precipitation of calcium and magnesium deposits on the pressure transducer as well as other components of the Levellogger. These deposits can be safely dissolved using a diluted solution (typically $\leq 10\%$ strength) of acetic or phosphoric acid. Commercially available products for dissolving hard water scaling are also available and can be used if designed for household use. Some industrial strength hard water scaling removers are much higher strength and are not recommended for cleaning the Levellogger.

High suspended solids load may block the circulation ports or clog the internal pressure cell of the Levellogger. The potential clogging effect of solids deposition can be minimized by placing the Levellogger in zones of flow. To remove solids build up, rinse the Levellogger under a low flow of tap water until particles have been washed away.

Bacteriological or chemical fouling can be an important consideration in many ground and surface water monitoring projects. Sessile bacteria will often utilize installed instrumentation as an attachment substrate. Chemical deposit can be the result of electrical charge differential between the instrumentation of the monitored liquid or the result of biological or algal activity. Both forms of fouling can result in difficult to remove deposits on the Levellogger transducer, the conductivity wires and the Levellogger casing. To remove fouling use a diluted ($\leq 10\%$) solution of sulfuric acid. Persistent material may require soaking for several hours.

12 Manual Barometric Compensation

This section describes how to perform manual barometric compensation on Levellogger data files when a Barologger was not dedicated as a barometric recorder. This section describes available sources of barometric record, conversion factors for common barometric units to water column equivalent and how to perform the compensation in spreadsheet formats using available barometric information. Finally, this section describes the most accurate and representative methods of obtaining barometric data and performing barometric compensation on submerged Levellogger data.

For short term tests during which the barometric pressure varies insignificantly, the collection of continuous barometric data may be unnecessary. In this event, take a reading from an open air exposed Levellogger prior to running the short term test and record this level. This level represents the barometric pressure. Similarly, at the end of your test, take another barometric reading and record this measurement. After the submerged Levellogger data has been exported to a spreadsheet program compensate your submerged Levellogger data files for barometric pressure. If no appreciable change in barometric reading occurred, you may write in the first cell of a new column a simple calculation that subtracts the water column equivalent of your barometric reading from the submerged data file, then copy and paste this calculation to all the cells in that new column. The new column will represent the barometrically compensated liquid level.

Barometric data can be collected on site using a recording barometer or from a local weather station. If setting up the barometer, set the recording interval to that of the Levellogger sampling interval or some multiple of the Levellogger interval. To compensate submerged Levellogger data using barometric data collected from an on site barometric datalogger or a nearby weather station several steps must be taken:

1. Export both the Levellogger data file and the barometric file to a spreadsheet.
2. In the spreadsheet, convert the barometric data column from its barometric measurement units (typically atm, mm Hg, psi, mb or kPa) to feet or meters of water column equivalent using the conversion factors in Table 12-1.

Table 12-1		
Common barometric units to water column equivalent conversions		
Barometric unit	Water column equivalent (ft)	Water column equivalent (m)
1 psi	2.3108	0.7043
1 atm	33.959	10.351
1 kPa	0.3352	0.1022
1 mm - Hg	0.04469	0.01362
1 in - Hg	1.1330	0.3453
1 mb	0.03352	0.01022

Table 12-1 Common Barometric Units to Water column Equivalent Conversions

3. Then write another calculation in another column to subtract the Levellogger's pressure zero point offset value from the converted barometric data. The Levellogger's zero point offset is 31.17 ft (9.5 m) of water column less an altitude correction. 31.17 ft (9.5 m) is the lowest expected barometric pressure at mean sea level. As elevation increases above mean sea level, the lowest expected barometric pressure decreases at a rate of approximately 1.21/1000 ft or m (altitude/826) of altitude. Therefore the Levelloggers barometric pressure offset at 1500 ft elevation will be:

$$\begin{aligned} &(\text{Zero Point Offset at MSL}) - (\text{Altitude Correction}) = \\ &(\text{Elevation-Corrected Zero Point Offset}) \\ &(31.17) - (1500/826) = 29.35 \text{ ft} \end{aligned}$$

The Levellogger Gold automatically adjusts to this elevation-corrected zero point offset when the altitude is input into the programming setup accurately. The altitude used to calculate the altitude correction **MUST** be the altitude input in the altitude field of the Levellogger setup. Therefore, if the altitude at time of the above Levellogger setup was uncertain and an altitude value of 1200 ft was input in the altitude field, then 1200 ft must be used to calculate the elevation-corrected zero point offset. The elevation-corrected zero point offset is subtracted from the barometric pressure expressed in water column equivalent to determine the amount of barometric pressure the Levellogger is recording above its elevation-corrected barometric pressure zero offset.

For previous Levellogger versions use an altitude correction of 1:1000.

4. This net barometric pressure expressed as water column equivalent is the amount of barometric pressure the Levellogger is currently sensing. This value is then subtracted from the Levellogger submerged data file. Example 12.1 provide a case study of how manual barometric compensation is performed.

EXAMPLE 12.1

A Levellogger Gold is monitoring at 1625 m (5332 ft) AMSL in Colorado. A recording barometer is also logging at the same sample interval in barometric units of psi. If we examine how to perform manual barometric compensation on Levellogger Gold data from a particular reading time, we will understand how to perform the manual barometric compensation process. The Levellogger's altitude field was set at the accurate elevation of 1625 m and the level reading at the start of submerged data collection was 10.25 ft. The barometric data reading at that time was 12.18 psi which converts to a water column equivalent of 28.15 ft.

The Levellogger's elevation-corrected barometric pressure offset value was:

$$31.17 \text{ ft} - (5332/826) \text{ ft} = 24.715 \text{ ft}$$

This value is subtracted from the recording barometer's reading to obtain the amount of barometric pressure the Levellogger is sensing:

$$28.15 \text{ ft} - 24.715 \text{ ft} = 3.43 \text{ ft}$$

Therefore, at the time of these readings the Levellogger's level reading was being influenced by 3.43 ft of effective barometric pressure. The actual water level above the Levellogger therefore is the total level measurement it records less the effective barometric pressure it sensed:

$$\begin{aligned} 10.25 \text{ ft} - 3.43 \text{ ft} &= \text{Actual Water Level} \\ &= 6.81 \text{ ft of Water Level} \end{aligned}$$

When analyzing barometric data it is important to keep in mind that storm events commonly reduce total atmospheric pressure by about 1.7% from pre-existing high pressure conditions. 1.7% converts to approximately 0.6 ft or 0.2 m of water level equivalent barometric fluctuation.

The most accurate and reliable method of obtaining representative barometric compensation of water level readings is to employ an accurate surface barometric recorder (ie. the Barologger). The traditional convention has been to use a vent tube reaching from the surface to the transducer. This vent tube terminates behind the transducer diaphragm, theoretically filtering barometric effects on level readings from total pressure. After much experience with erroneous barometric compensation due to crimped, damp, wet and cut tubing, unacceptably slow response to small barometric change and many situations where barometric compensation was not required, we decided vented tubing did not offer the level of integrity in barometric compensation our clients deserved. A recording barometer does and will provide the data necessary to access barometric compensation requirements.

Vented tubing has been used in the past for several reasons. One it was a cheap, low tech method of balancing out the effect of barometric pressure on a monitored water surface. Second, when the tubing is cared for, inspected and tested for failure regularly, it responds reasonably well to steep barometric gradients such as when a large scale atmospheric front moves across the surface. The seldom discussed problem is that the response time to the much more common

incremental barometric change is unacceptable. The vented tubing often leaked or its connection to the pressure probe leaked, causing the transducer to fail and experience irreparable damage. Some manufacturers, recognizing the inherent inferiority of passive venting, have adopted a method of automatic vent tube testing whereby a small vacuum pump at the surface constantly clears the vent of water and in some cases provides a warning when the integrity of the tubing has been compromised. This elaborate method of making a cumbersome technology work, requires significant battery power to operate. The use of a Barologger as an on-site barometer or the use of local weather station barometric data is less expensive and provides more reliable results than the real hidden costs associated with the use of vented cable technology to provide barometric compensation.

13 Diagnostics Utility

The Levelogger Gold Diagnostics Utility can be used for troubleshooting the Levelogger Gold and obtaining information about that Levelogger that can assist the Solinst Technical Support representative to identify and fix any problems you may encounter with your Levelogger Gold. The Diagnostics Utility can be launched from the Utilities menu in the main Levelogger Gold Software.

The utility can be used to read Levelogger information, run a self-test, do a Memory Dump and create reports.

13.1 Read Levelogger Information

The 'Read Levelogger Information' function reads the following information from the Levelogger:

1. Model Number
2. Serial Number
3. Firmware Version
4. Battery Voltage
5. Charge Level
6. Current Temperature Reading
7. Current Level Reading
8. Max/Min Pressure Reading
9. Max/Min Temperature Reading
10. Max/Min Conductivity Reading

This information can be used to identify firmware, battery and/or temperature/pressure sensor problems. To execute this function simply click the 'Read Levelogger Info' button.

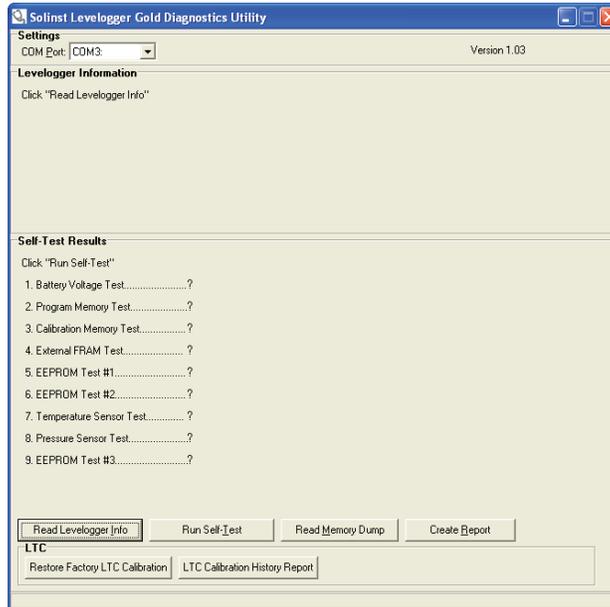


Figure 13-1 Read Logger Info

13.2 Run Self-Test

The 'Run Self-Test' function performs a series of self-tests on the Levellogger to check for problems with the battery, memory, and pressure/temperature sensors. If any of these tests fail then a report should be created and sent to Solinst Technical Support.

To execute this function simply click the 'Run Self-Test' button.

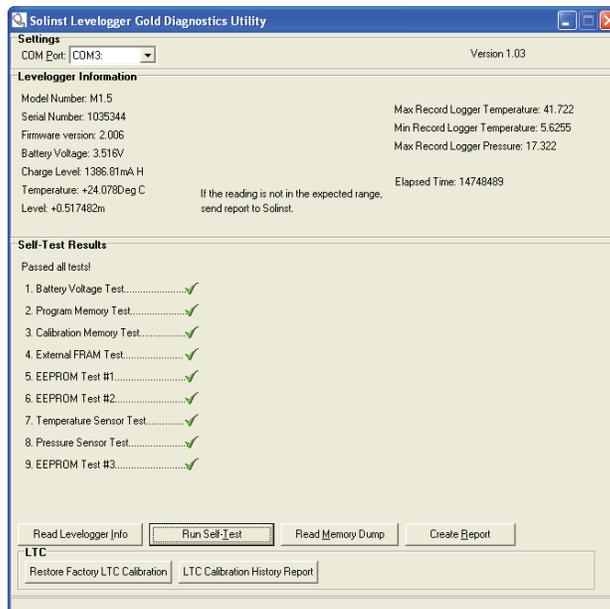


Figure 13-2 Run Self Test



Note:

It is recommended that, before attempting to use this function, you use the 'Create Report' function to send a report to the Solinst Technical Support.

13.3 Read Memory Dump

This function is used as a last resort if the problem still cannot be resolved after performing the above steps. It creates a complete dump of the Levellogger's memory, which can then be sent to Solinst Technical Support for analyzing.

To execute this function simply click the 'Read Memory Dump' button. Performing a memory dump will automatically create *.lev files of all the data.

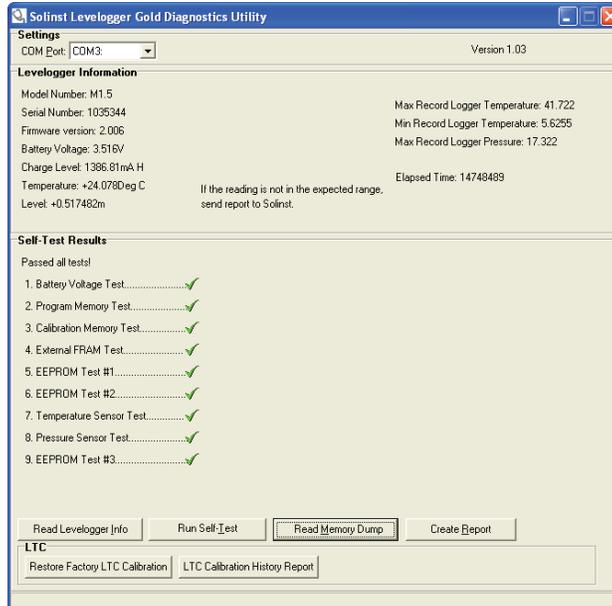


Figure 13-3 Read Memory Dump

13.4 Create Report

This function simply creates a text file containing the information obtained from steps 1 and 2. When you click the 'Create Report' button, a window will pop up asking you to fill out your company information. Simply fill this out and the resulting report can be sent to Solinst Technical Support for troubleshooting.

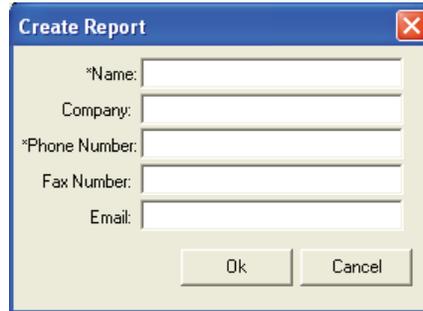


Figure 13-4 Customer Info Input Window

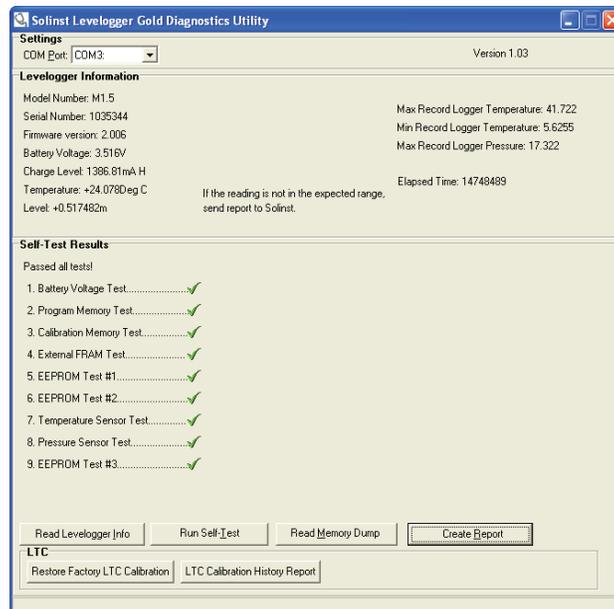


Figure 13-5 Create Report

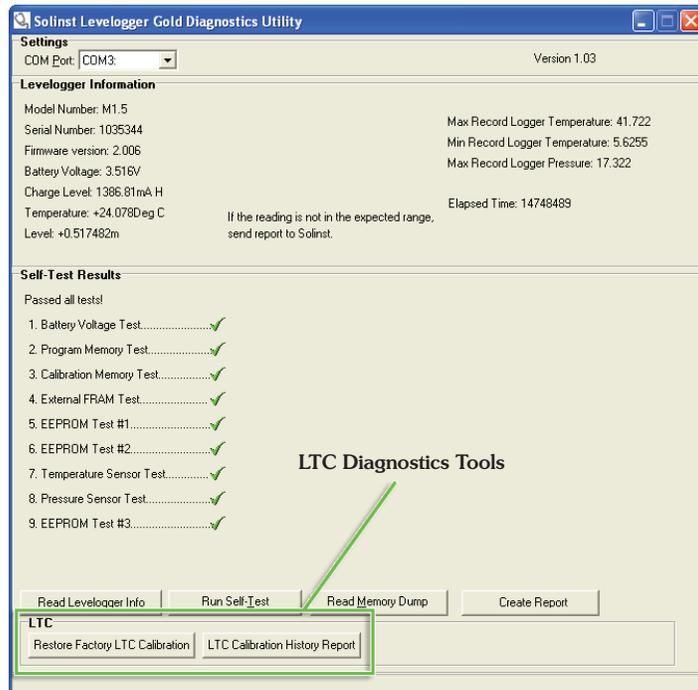


Figure 13-6 LTC Levelogger Junior Diagnostics Tools

13.5 Restore Factory LTC Calibration

An LTC Junior Levelogger can be set back to original factory calibration settings for conductivity at any time, using this function. If you suspect that user calibrations are not working properly, you can restore the LTC Levelogger Junior to its original factory settings and then perform a "first-time" conductivity user calibration to maximize accuracy. (See Section 6).

To execute this function simply click the 'Restore Factory LTC Calibration' button, with the LTC Levelogger Junior connected to the PC.

13.6 LTC Calibration History Report

This function creates a report of all previous user calibrations performed on the LTC Levelogger Junior. Use it to send a history report to Solinst for analysis if the LTC Levelogger Junior readings are irregular and/or the unit does not maintain its calibration.

To execute this function simply click the 'LTC Calibration History Report' button. This creates a text file that can be sent to Solinst Technical Support.


Note:

It is important that the communication between the PC and the Levellogger is not interrupted during a firmware/calibration upload so please make sure to close any other running programs, including screen savers, and do not disconnect the Levellogger before the upload is finished.



Figure 14-1
Firmware Update Utility Window

14 Firmware Uploader Utility

The Firmware Uploader Utility can be used to upload new firmware files into a Levellogger Gold. The firmware file can be obtained from:
<http://www.solinst.com/Downloads/>

To upload new firmware to a Levellogger Gold, follow these steps:

1. Open the Solinst Firmware Update Utility (LLGfirmwareUpdate.exe), which is located in the 'Utility' folder in the Levellogger 3 folder. It can also be launched from the Utilities menu in the main Levellogger Gold Software. Pick the Com Port to which the Levellogger is connected and make sure the Baud Rate is set to 9600.
2. Click the leftmost 'Open'  button, which should open a file dialog asking for the firmware file (*.ssf) to upload. Navigate to the directory where the firmware file is located then click on the file and click 'Open'.
3. Check the 'Firmware File Information' box to make sure that the opened file is the right one.
4. Click the 'Upload Firmware' button , which is the second button from the left, to start the firmware upload process.
5. If a communication error occurs and is indicated in the Levellogger Information Window (Fig.14-1) either before the 'Verified Program Checksum' message or after the 'Program Information Section', then restart the upgrade process.
6. If, however, a communication error occurs between the 'Verified Program Checksum' and the 'Program Information Section' messages, then please contact Solinst. You will need to give the Levellogger Serial Number and explain the exact positioning of the error message.

15 Trouble Shooting

15.1 Problems During Installation of Levellogger Gold Software

'Class not Registered' or 'DLL not found' or 'Access violation'

1. You may not have Administrator Rights to install the software in the Windows NT/Windows 2000/Windows XP environment.
 - Ask your System Administrator for assistance.
2. Some files got corrupted during installation of the Levellogger software. Use 'Add/Remove Programs' to uninstall then re-install Levellogger software.

15.2 Error During Software Uninstall Process

The 'Add/Remove Program' cannot locate the Levellogger Gold <setup.exe> file of the software or the link between the software and the 'Add/Remove Program' is damaged.

The record in the Registry Table must be removed:

1. Ask your System Administrator to remove this.
2. Refer to the following link from Microsoft Website for instructions:
<http://support.microsoft.com/default.aspx?scid=kb;en-us;247501>

15.3 Problems During Installation of RS232 to USB Converter

Unable to install the RS232/USB converter from Keyspan or IO Gear

1. After plugging in the RS232/USB Converter, a Hardware Installation Wizard will open. Follow the instruction from the Wizard and make sure to select the RS232/USB Converter Driver from the Keyspan or IO Gear Installation CD.
2. If the Hardware Installation Wizard does not open after plugging in the RS232/USB Converter, follow the steps below to open the Hardware Installation Wizard:
 - a. Select Control Panels
 - b. Double click on System
 - c. Select the Device Manager Tab
 - d. Double click on Other devices
 - e. Right click on USB Serial Converter
 - f. Select Update Driver ...



Note:

Solinst recommends Keyspan or IO Gear. For problems with converters from other manufacturers, please contact the manufacturer.)

15.4 Data Has Been Erased Accidentally

If Levellogger Gold has been restarted and old data has not been saved, go to Download Options and choose Data Recovery. It downloads the immediately previous log.

15.5 Error Messages During Use of Software

'Communication Time Out' or 'Communication Error' or 'The Command that is sent to the Levellogger Gold is not defined'

1. Try communicating with another Levellogger Gold, Optical Reader or Direct Read Cable. The communication cable, Optical Reader or Levellogger Gold may be damaged.
2. Clean the optical 'eyes' on the Levellogger and the cable, with a soft cloth.
3. Check that the communication cable is connected to the same Com Port that is chosen in the upper middle of the Main Window of the Levellogger software.
4. Check the Com port settings. They should be as follows:
 - Bits per second: 9600
 - Data bits: 8
 - Parity: None
 - Stop bits: 1
 - Flow control: None
(This may have been set to Xon/Xoff – change it to None, Select [OK] and back out of this pathway.)

The route to view your Com port settings is as follows:

- a. Select Control Panels
 - b. Double click on System
 - c. Select the Device Manager Tab
 - d. Double click on Ports
 - e. Double click on Communications Port(s)
 - f. Choose the Port Settings Tab
5. Try using a different computer, to see if this is the cause of the problem.
 6. If using a laptop (especially in conjunction with a Direct Read Cable) your Com Port may not be powered adequately to receive/transmit data. Try using a desktop computer to test this, or contact Solinst to obtain a PC Interface Booster Cable.
 7. If problem persists, contact Solinst.

'Port Cannot Open'

1. Ensure the correct Com Port is selected in the upper middle of the Main Window of the Levellogger Gold software.
2. Check if some other software is using the same Com Port in the background. Shut that software down or choose another Com Port if available. Such background software may be anti-virus software or PDA software.
3. Make sure your Com Port has been enabled:
 - a. Select Control Panels
 - b. Double click on System
 - c. Select the Device Manager Tab
 - d. Double click on Ports
 - e. Double click on Communications Port(s)
 - f. Choose General
 - g. Uncheck 'Disable in this hardware profile box'
4. If you are using a virtual Com Port, like a USB optical reader or USB/RS232 converter, refer to the 'Problems During Installation of RS232 to USB Converter' section to make sure they are installed properly.

'File Create Error' and 'File Write Error'

1. If you do not have file-writing privileges to the Levellogger Gold default data folder, change the folder as follows: in the Levellogger Gold software, click 'Configuration' then 'Application Settings'. Under 'Default Directory', enter a new destination folder, to which you have file writing privileges, e.g. 'My Documents'. Follow the same procedure if you have the same problem when you export the data file in csv format.
2. Ask your System Administrator for assistance.

'File Open Error' and 'File Read Error'

1. Shut down or disable any other software that is active and using the same file.
2. In Notepad or Wordpad, open the <*.lev> or <*.lls> file to check for corruptions in the file. How are the Levellogger files ended?
3. If problems persist contact Solinst for assistance.

'Time Span Error, some data cannot be compensated'

1. Find another barometric data file that has the same time stamp as the Levellogger.
2. Perform the compensation (a simple subtraction) in a spreadsheet program for any missing time stamps.

'A different type of Levellogger is detected'

Replace the Levellogger currently in the Optical Reader with the one that was previously being worked on, and complete the operation.

'The selected file is not a barometer'

Select a Barologger for the compensation process.

'Data Corrupted'

Contact Solinst for assistance. Use Levellogger Gold Diagnostic Utility to do a memory dump and sent the dump file to Solinst for further analysis.

'Internal Error'

Contact Solinst for assistance.

'Fail to append data - A different Levellogger has been detected!' or 'Fail to append data - A different start time has been detected!' or 'Fail to append data - New data is not available in the Levellogger!'

The Levellogger software can only append data to a file that has the same serial number and start time as the connected Levellogger. Find the correct file, or use 'All Data' to download the complete file.

'Only Levellogger Gold supports this function'

The 'Append Data', 'Partial Download' and 'Data Recovery' functions are only supported by the Levellogger Gold loggers, not previous version Levelloggers.

'Schedule cannot be empty'

When using the 'Schedule' sampling option in a Levellogger Gold, the schedule must contain at least one item.

'Readings in schedule exceed the maximum'

The number of readings in a schedule should not result in more than 40,000 individual readings.

Solinst[®]

Quick Start Guide

Levellogger Series



High Quality Groundwater and Surface Water Monitoring Instrumentation

To begin using your Levelogger Gold, download the newest version of Levelogger Gold Software and User Guide by visiting www.solinst.com/Downloads/ or insert the software CD provided.

Installing the Software

1. To activate the software install, click on the 'setup.exe' file located on the software CD.
2. The Software Installation Wizard will guide you through the remaining installation process.

Installing the Hardware

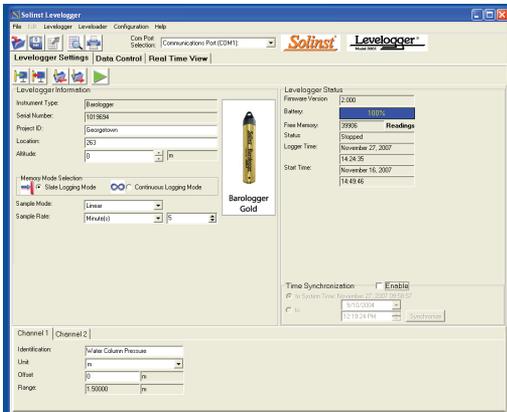
1. Connect the communications device, either the Optical Reader or PC Interface Cable, to the computer.

Notes:

1. The USB connections require the installation of a driver to the assigned device. See the USB Installation Guide for details (back page).
2. Windows 7 drivers should install automatically.

Programming the Levelogger

1. Connect the Levelogger to the communications device and start the software.
2. Select the appropriate COM or USB port for the connected communications device from the centre drop-down menu.
3. Click the 'Retrieve Settings from Levelogger' icon. This will retrieve and display the current programmed settings for the connected Levelogger. You can now customize the Levelogger by entering your Project ID, Location, Altitude (above sea level), and Sampling Mode and Rate. 
4. When programming is complete, click the 'Program Settings to Levelogger' icon. 



Levelogger Settings Window



PC Interface Cable



Optical Reader Connection

Tip

If a number of Leveloggers are to be programmed with identical inputs, clicking the 'Save Default Settings' icon will create a template. 

Levelogger Series Quick Start Guide

Starting and Stopping the Levelogger

1. To start the Levelogger, click on the 'Start' icon. 

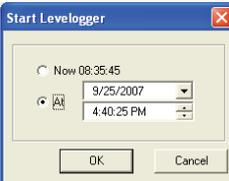
Note: When the 'Start' icon is selected, two windows will pop-up. One will alert that the previous data will be erased; the other will allow the option to synchronize the Levelogger clock to your PC clock.

2. The 'Start Levelogger' window will appear. This will provide the option to start the Levelogger 'Now' or program 'At' a future start time.

3. To stop the Levelogger, click on the 'Stop' icon. 

Tip

The 'future start' option is ideal for synchronizing the data collection of multiple Leveloggers.



Start Levelogger Window

Downloading and Working with Data

1. Click the 'Data Control' tab to access the 'Data Control' window. This window is laid out in three sections: Levelogger settings, tabular data, and graphical data.

2. To download the data from a connected Levelogger, select the 'Logger Info' sub-tab, and then the 'Download Data from Levelogger' icon. The data will be presented in both tabular and graphical format. 

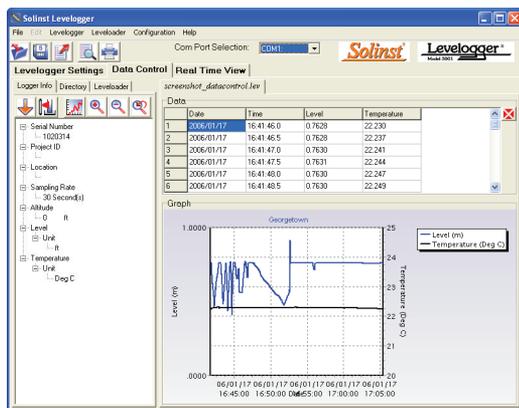
3. To save data, click the 'Save Data' icon and input desired name for the saved file. 

4. To export the file for use in other software, click the 'Export' icon. The file will be exported to a *.CSV file. 



Rainlogger Programming

The Rainfall Calibration Constant of the tipping bucket rain gauge used with the Rainlogger is required when programming the Rainlogger. Consult the Levelogger User Guide for more information on programming the Rainlogger.



Data Control Window



LTC Calibration

Before deploying your LTC Levelogger Junior, be sure to calibrate the instrument. To begin calibration, select the 'Calibration' icon and follow the steps provided. Consult the Levelogger User Guide for more information.

Compensate the Data

Once a data file is opened, the user can select the 'Data Compensation Wizard' icon to perform Barometric, Manual Data Adjustments or other data compensations. Please refer to the Levelogger User Guide for more information on performing compensations. 

USB Installation Guide

Notes: 1. Levelogger Gold Software comes pre loaded with necessary USB drivers.
2. The following steps are based on the Windows® XP operating system, if using another operating system, refer to the Levelogger User Guide.

1. Connect the USB device into the computer. This will begin the 'Found New Hardware Wizard'.
2. The 'Found New Hardware Wizard' will give the option to connect to Windows Update to search for software components, select "No, not at this time".
3. Two options are provided:
 - i. If you have the Levelogger Software CD, select "Install the software automatically".
 - ii. If you do not have the CD, select "Install from a list or specific location". In the next window select "Search for the best drivers in these locations" and "Include this location in the search". Select the browse button and choose this location:

C: → Program Files → Solinst Folder → Levelogger Folder → USB Drivers

Note: During the USB Installation, a message may appear stating that the USB Serial Converter has not passed Windows Logo testing, select "Continue anyway".

4. Windows will confirm that the unit is now installed.

Note: If the 'Found New Hardware Wizard' does prompt once again, please continue through with the same process (steps 1 – 4).

5. Restart your computer.

Troubleshooting Guide

Levelogger Software:

1. You must have administrator privileges to install software on a computer.
2. Windows 98, 2000, XP, Vista, and Windows 7 operating systems support the Levelogger Gold Software.

Levelogger data has been accidentally erased:

If the Levelogger has been restarted and the old data has not been saved, select the download option 'Recover Previous Log'. This will download your previous data set.

Communication Errors:

"Port Cannot Open", "Check Com Port"

1. Reason: Software was started before USB device was connected to computer.
Solution: Restart computer, connect USB device, start software.
2. Reason: Incorrect Com Port is selected in Com Port selection menu.
Solution: Check the Com Port location for the installed device, by accessing the "Device Manager" (through the Control Panel), and selecting the "Ports" section. This will state the Com Port the device is installed on.
3. Reason: Another device shares the same Com Port or is causing a communication conflict.
Solution: Ensure that software for PDA or other devices, which automatically synchronize, are disabled. Ask your system administrator for assistance.
4. Reason: RS-232 Adaptor to USB converter is improperly installed.
Solution: Reinstall supplied driver for converter device.

Note: Not all converters are compatible with all makes and models of computers.

"Communication Time-Out"

1. Reason: Levelogger, Direct Read Cable, or communications device has failed.
Solution: Narrow down the failure by using a different Levelogger, Direct Read Cable, or another communications device. Contact a Solinst technical representative.

Tip

It is important to ensure the installation cap or direct read cable is attached to the Levelogger during storage to prevent the battery from draining.

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