



User Guide

Levellogger Series Software Version 4

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NOTE

This version of software is not compatible with older models of the Levellogger (Made before Dec. 2005). 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.

NOTE

To use the new compression algorithm, which enables up to 120,000 data points, the Levellogger Edge or Barologger Edge must be in linear sampling mode and slate memory mode.

1 Introduction

This User Guide focuses on the current Levellogger Series, which includes:

- Levellogger Edge
- Barologger Edge
- Levellogger Junior Edge
- LTC Levellogger Junior
- Rainlogger

Software Version 4.0.3 is also compatible with Levellogger Gold, Barologger Gold and Levellogger Junior dataloggers. For details on setting up these dataloggers, see Section 5.9. Software Version 4.0.3 is also compatible with the Levellogger Gold data transfer device, which has a separate User Guide.

This Windows based software provides many convenient features. You can view and program datalogger settings, begin logging sessions, monitor real-time readings, download data, manage data files, perform data compensations, and save and export data files. Depending on the type of datalogger, there will be differences in programming options. See below for a summary of the differences:

Datalogger Programming Options			
Datalogger Type	Sampling Options	Memory Capacity	Battery Life
Levellogger Edge	Linear (0.125 second to 99 hours), Compressed Linear, Event Based, Schedule, Repeat Schedule, Real Time View, Future Start/Stop	40,000 sets of readings or up to 120,000 Compressed. Slate or Continuous Mode (see note)	10 years based on 1 reading per minute
Barologger Edge	Linear (0.125 second to 99 hours), Compressed Linear, Event Based, Schedule, Repeat Schedule, Real Time View, Future Start/Stop	40,000 sets of readings or up to 120,000 Compressed. Slate or Continuous Mode (see note)	10 years based on 1 reading per minute
Levellogger Junior Edge	Linear (0.5 second to 99 hours), Real Time View	40,000 sets of readings in Slate Mode	5 years based on 1 reading per minute
LTC Levellogger Junior	Linear (5 seconds to 99 hours), Real Time View	16,000 sets of readings in Slate Mode	5 years based on 1 reading every 5 minutes
Rainlogger	Event Based (records tips from tipping-bucket rain gauge), Real Time View	Up to 60,000 tip time logs in Slate Mode	10 years based on 2 parameters logged every 10 minutes
Levellogger Gold	Linear (0.5 second to 99 hours), Event Based, Schedule, Real Time View, Future Start/Stop	40,000 sets of readings, Slate or Continuous Mode.	10 years based on 1 reading per minute
Barologger Gold	Linear (0.5 second to 99 hours), Event Based, Schedule, Real Time View, Future Start/Stop	40,000 sets of readings, Slate or Continuous Mode.	10 years based on 1 reading per minute
Levellogger Junior	Linear (0.5 second to 99 hours), Real Time View	32,000 sets of readings in Slate Mode	5 years based on 1 reading per minute


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NOTE

To use the Levellogger Edge with Software Version 4.0.3, ensure you are using version 3.002 firmware.

NOTE

The Model number refers to the depth of submergence below water level that the pressure sensor can withstand. i.e.: The Levellogger Edge, which is available in F7 (M2), F15 (M5), F30 (M10), F65 (M20), F100 (M30) and F300 (M100) ranges has actual water level ranges of 6.6 ft (2 meters), 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.

1.1 Levellogger Series

1.1.1 Levellogger Edge

The Levellogger Edge 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 Edge.

Levellogger Edge Technical Specifications

Level Sensor:	Piezoresistive Silicon with Hastelloy Sensor
Ranges:	7,15, 30, 65, 100, 300 ft. (2, 5, 10, 20, 30, 100 m)
Accuracy (Typical):	± 0.05% FS
Resolution:	24 Bit Resolution
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Temp. Sensor Accuracy:	± 0.05°C
Temp. Sensor Resolution:	0.003°C
Temp. Comp. Range:	0°C to 50°C
Battery Life:	10 years (based on 1 reading/minute)
Clock Accuracy:	± 1 minute/year (-20°C to 80°C)
Operating Temperature:	-20°C to 80°C
Maximum # Readings:	40,000 (up to 120,000 using data compression)
Memory:	FRAM, Continuous or Slate mode
Communication Speed:	9600 bps, 38,400 bps with USB optical reader
Com Interface:	Optical Infra-red: USB, RS-232, SDI-12
Size:	7/8" x 6.25" (22 mm x 159 mm)
Weight:	129 grams (4.5 oz.)
Corrosion Resistance:	Titanium based PVD coated body and superior corrosion resistant Hastelloy sensor
Other Wetted Materials:	Delrin®, Viton®, 316L Stainless Steel
Sampling Modes:	Linear, Event & User-Selectable Schedule with Repeat Mode, Future Start, Future Stop, Real Time View
Measurement Rates:	0.125 second to 99 hours
Barometric Compensation:	High accuracy, air-only, Barologger Edge

LT Edge Models	Accuracy
F7, M2	± 0.05% FS
F15, M5	± 0.05% FS
F30, M10	± 0.05% FS
F65, M20	± 0.05% FS
F100, M30	± 0.05% FS
F300, M100	± 0.05% FS


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NOTE

To use the Barologger Edge with Software Version 4.0.3, ensure you are using version 3.002 firmware.

1.1.2 Barologger Edge

The Barologger Edge 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 Edge.

Barologger Edge Technical Specifications	
Level Sensor:	Piezoresistive Silicon with Hastelloy Sensor
Accuracy (Typical):	± 0.05 kPa
Resolution:	24 Bit Resolution
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Temp. Sensor Accuracy:	± 0.05°C
Temp. Sensor Resolution:	0.003°C
Temp. Comp. Range:	-10°C to 50°C
Battery Life:	10 years (based on 1 reading/minute)
Clock Accuracy:	±1 minute/year (-20°C to 80°C)
Operating Temperature:	-20°C to 80°C
Maximum # Readings:	40,000 (120,000 using data compression)
Memory:	FRAM, Continuous or Slate mode
Communication Speed:	9600 bps, 38,400 bps with USB optical reader
Com Interface:	Optical Infra-red: USB, RS-232, SDI-12
Size:	7/8" x 6.25" (22 mm x 159 mm)
Weight:	129 grams (4.5 oz.)
Corrosion Resistance:	Titanium based PVD coated body and superior corrosion resistant Hastelloy sensor
Other Wetted Materials:	Delrin®, Viton®, 316L Stainless Steel
Sampling Modes:	Linear, Event & User-Selectable Schedule with Repeat Mode, Future Start, Future Stop, Real Time View
Measurement Rates:	0.125 second to 99 hours

Barologger Edge Models	Accuracy
Air Only	± 0.05 kPa


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NOTE

To use the Levellogger Junior Edge with Software Version 4.0.3, ensure you are using version 3.002 firmware.

1.1.3 Levellogger Junior Edge

The Levellogger Junior Edge provides an inexpensive alternative for measuring groundwater and surface water levels and temperature.

Levellogger Junior Edge Technical Specifications

Level Sensor:	Piezoresistive Silicon with Hastelloy Sensor
Ranges:	15, 30 ft. (5, 10 m)
Accuracy (typical):	± 0.1% FS
Resolution:	20 Bit Resolution
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Accuracy:	± 0.1°C FS
Resolution:	0.1°C
Temp Compensation Range:	0°C to 40°C
Battery life:	5 years (based on 1 reading/minute)
Clock Accuracy:	± 1 minute / year (-20°C to 80°C)
Operating Temperature:	-20°C to 80°C
Memory:	FRAM, Slate mode
Maximum # Readings	40,000 (no data compression)
Com Interface:	Optical Infra-red: USB, RS-232, SDI-12
Communication Speed:	9600 bps
Size:	7/8" x 5.5" (22 mm x 140 mm)
Weight:	5.4 oz (154 grams)
Wetted Materials:	Delrin®, Viton®, 316L Stainless Steel, Hastelloy
Sampling Mode:	Linear, Future Start, Real Time View
Measurement Rates:	0.5 seconds to 99 hours
Barometric Compensation:	High accuracy, air-only, Barologger Edge

LT Models	Accuracy
F15, M5	± 0.1% FS
F30, M10	± 0.1% FS


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NOTE

To use the LTC Levellogger Junior with Software Version 4.0.3, ensure you are using version 2.005 firmware.

1.1.4 LTC Levellogger Junior

The LTC Levellogger Junior provides an inexpensive and convenient method to measure level, temperature and conductivity all in one probe.

LTC Levellogger Junior Technical Specifications

Level Sensor:	Piezoresistive Silicon with Hastelloy Sensor
Ranges:	30, 100 ft. (10, 30 m)
Accuracy (typical):	± 0.1% FS
Resolution:	0.03% FS
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (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 to 80,000 µS/cm
Calibrated Range:	500 to 50,000 µS/cm
Accuracy:	± 2% of reading
Resolution:	± 0.01% FS
Normalization:	Specific Conductance normalized to 25°C for full range
User Calibration Points:	1413, 5000, 12,880 µS
Battery Life:	5 years (based on 1 reading/ 5 minutes)
Clock Accuracy:	± 1 minute / year
Operating Temperature:	-20°C - 80°C
Memory:	Non-volatile EEPROM, FRAM back-up, Slate mode only
Maximum Readings:	16,000
Communication Speed:	9600 bps
Com Interface:	Optical Infrared: USB, RS-232, SDI-12
Size:	7/8" x 7.5" (22 mm x 190 mm)
Weight:	200 g (7.05 oz.)
Wetted Materials:	Delrin®, Viton®, 316L Stainless Steel, Platinum
Sampling Mode:	Linear, Future Start, Real Time View
Measurement Rates:	5 seconds to 99 hours
Altitude Input:	-980 to 16,400 ft. (-300 to 5,000 m)
Barometric Compensation:	High accuracy, air-only, Barologger

LTC Models	Full Scale (FS)	Accuracy (Typ)	Resolution
F30, M10	32.8 ft., 10 m	± 0.032 ft., 1.0 cm	0.021% FS
F100, M30	98.4 ft., 30 m	± 0.098 ft., 3 cm	0.021% FS


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NOTE

To use the Rainlogger with Software Version 4.0.3, ensure you are using version 2.000 firmware.

1.1.5 Rainlogger

The Rainlogger is designed for use with most standard tipping-bucket rain gauges with a reed switch output. It records each tip time from the tipping-bucket, and outputs the amount of rainfall per programmed time period (based on rainfall calibration constant).

Rainlogger Technical Specifications

Battery Life:	10 years (logging 2 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:	Up to 60,000 tip times
Memory:	Non-volatile EEPROM, Slate mode only
Communication:	Optical infra-red: USB, RS-232, SDI-12
Measurement:	Records each tip by the tipping-bucket rain gauge and outputs the amount of rainfall
Sampling Mode:	Event Based, Future Start, Real Time View
Size:	7/8" x 7" (22 mm x 175 mm)
Weight:	4.8 oz (135 grams)
Materials:	316L Stainless Steel, Delrin®, Viton®


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NOTE

To use the Leveloader with Software Version 4.0.3, ensure you upgrade to version 2.000 firmware.

1.1.6 Leveloader Gold

The Leveloader 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. The Leveloader is used with Levellogger Software, see separate Leveloader Gold User Guide.



! NOTE

To use the Levellogger Gold with Software Version 4.0.3, ensure you are using version 2.007 firmware.

1.1.7 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.

Levellogger Gold Technical Specifications

Level Sensor:	Piezoresistive Silicon in 316L Stainless Steel
Accuracy (Typical):	0.05% FS
Ranges:	15, 30, 65, 100, 300 ft. (5, 10, 20, 30, 100 m)
Resolution:	0.002 to 0.0006% FS
Normalization:	Automatic Temp Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Temp. Sensor Accuracy:	± 0.05°C
Temp. Sensor Resolution:	0.003°C
Temp. Comp. Range:	10°C 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:	EEPROM Slate, Continuous, and redundant backup of last 1200 readings
Communication:	Optical Infra-red: USB, RS-232, SDI-12
Communication Speed:	9600 bps
Size:	7/8" x 6" (22 mm x 154 mm)
Weight:	6.3 oz (179 grams)
Corrosion Resistance:	Zirconium Nitride (ZrN) Coating
Other Wetted Materials:	316L Stainless Steel, Delrin®, Viton®
Sampling Modes:	Linear, Event & User-Selectable with 30 separate line items
Measurement Rates:	0.5 sec to 99 hrs
Barometric Compensation:	High accuracy, air-only, Barologger Gold

LT Models	Full Scale (FS)	Accuracy (Typ)	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



! NOTE

To use the Barologger Gold with Software Version 4.0.3, ensure you are using version 2.007 firmware.

1.1.8 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.

Barologger Gold Technical Specifications

Level Sensor:	Piezoresistive Silicon in 316L Stainless Steel
Accuracy (Typical):	0.05% FS
Resolution:	0.002% FS
Normalization:	Automatic Temp Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Temp. Sensor Accuracy:	± 0.05°C
Temp. Sensor Resolution:	0.003°C
Temp. Comp. Range:	10°C 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 pressure and temperature
Memory:	EEPROM Slate, Continuous, and redundant backup of last 1200 readings
Communication:	Optical Infra-red: USB, RS-232, SDI-12
Communication Speed:	9600 bps
Size:	7/8" x 6" (22 mm x 154 mm)
Weight:	6.3 oz (179 grams)
Corrosion Resistance:	Zirconium Nitride (ZrN) Coating
Other Wetted Materials:	316L Stainless Steel, Delrin®, Viton®
Sampling Modes:	Linear, Event & User-Selectable with 30 separate line items
Measurement Rates:	0.5 sec to 99 hrs

LT Models	Full Scale (FS)	Accuracy (Typ)	Resolution
Barologger	Air Only	± 0.003 ft., 0.1 cm	0.002% FS



NOTE

To use the Levellogger Junior with Software Version 4.0.3, ensure you are using version 2.007 firmware.

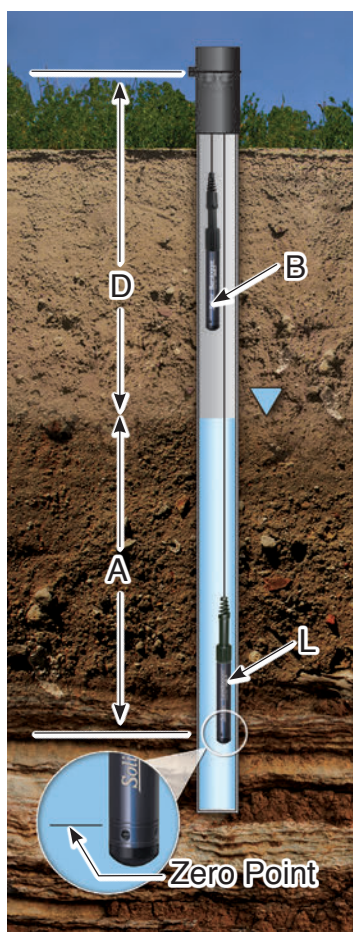
1.1.9 Levellogger Junior

The Levellogger Junior functions like the Levellogger Gold; provides an inexpensive alternative for measuring groundwater and surface water levels and temperature.

Levellogger Junior Technical Specifications

Level Sensor:	Piezoresistive Silicon in 316L Stainless Steel
Ranges:	15, 30 ft. (5, 10 m)
Accuracy (typical):	± 0.1% FS
Resolution:	0.03% FS
Normalization:	Automatic Temperature Compensation
Temperature Sensor:	Platinum Resistance Temperature Detector (RTD)
Accuracy:	± 0.1°C FS
Resolution:	± 0.1°C
Temp Compensation Range:	10°C to 40°C
Battery life:	5 years (based on 1 reading/minute)
Clock Accuracy:	± 1 minute / year
Operating Temperature:	-20°C to 80°C
Memory:	Non-volatile EEPROM, FRAM back-up, Slate mode only
Maximum # Readings	32,000 (no data compression)
Com Interface:	Optical Infra-red: USB, RS-232, SDI-12
Communication Speed:	9600 bps
Size:	7/8" x 5.5" (22 mm x 140 mm)
Weight:	154 g (5.4 oz)
Wetted Materials:	Delrin®, Viton®, 316L Stainless Steel
Sampling Mode:	Linear, Future Start, Real Time View
Measurement Rates:	0.5 seconds to 99 hours
Altitude Input:	-980 to 16,400 ft. (-300 to 5,000 m)
Barometric Compensation:	High accuracy, air-only, Barologger

LT Models	Full Scale (FS)	Accuracy (Typ)	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



$$A = L - B$$

Figure 1-1

Levellogger Measurement Fundamentals

NOTE

Levelloggers measure the pressure of air plus water column above their sensor (zero point). To adjust the level readings after data collection, for example to water level depths below top of casing (**D**), refer to the Manual Data Adjustment options within the software Data Compensation Wizard.

NOTE

The Levellogger Gold, Levellogger Junior and current LTC Levellogger Junior models convert pressure readings to the water level equivalent above the datalogger's pressure zero point of 950 cm (31.17 ft). The Levellogger Edge and Levellogger Junior Edge have no zero point offset. As such, water level data will appear different, although measuring the same amount of pressure.

1.2 Measurement Parameters

1.2.1 Level

All Levelloggers measure total (absolute) pressure. When submerged, the Levellogger is recording the combination of barometric pressure and water pressure. The actual pressure of just water (**A**) above the sensor is obtained by subtracting barometric pressure (**B**) from the total pressure (**L**) (see Figure 1-1).

The best method to compensate for barometric pressure is to employ a Barologger above the water level, to obtain records of barometric pressure. The Levellogger Software includes a Data Compensation Wizard, which guides you 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 Levelloggers are automatically temperature-compensated.

A = Actual water column height

B = Barometric pressure

L = Levellogger total pressure readings

D = Depth to water level, below reference datum

1.2.1.1 Pressure Calibration

The Levellogger Edge is 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 5°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.

1.2.2 Barometric Pressure

The Barologger 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 measurements, which are then synchronized to the Levellogger. The Data 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.

1.2.3 Temperature

Levelloggers 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 0 to +50°C for the Levellogger Edge, -10°C to +50°C for the Barologger Edge, 0 to +40°C for the Levellogger Junior Edge, and 10 to +40 for the LTC Levellogger Junior. The Levellogger will record temperature in its thermal range of -20 to +80°C, but outside the range, compensation will be less accurate.

1.2.4 Conductivity

! NOTE

For every degree change in temperature, there is approximately a 2% change in conductivity. To convert raw conductivity measurements to Specific Conductance measurements, you can use the following equation:

$$\text{Specific Conductance} = \text{Conductivity} / (1 + 0.02 * (\text{temp}(C) - 25))$$

You can also perform this calculation automatically using the Data Compensation Wizard.

The LTC Levellogger Junior provides the added feature of electrical conductivity measurement. It measures the actual conductivity at the current temperature. 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. Conductivity calibration is performed by using a liquid solution with a known conductivity value and the Calibration Wizard in the Levellogger Windows Software. The Data Compensation Wizard allows you to convert conductivity readings to Specific Conductance (at 25°C), or Salinity expressed in Practical Salinity Units (PSU). A Practical Salinity Unit (PSU) is a dimensionless descriptor for the Practical Salinity Scale (PSS). The PSS defines salinity as the ratio of a water sample's conductivity to that of a standard KCL solution. The Data Compensation Wizard uses the equation given in the UNESCO Technical Paper "Algorithms for computation of fundamental properties of seawater", to convert Conductivity readings to Salinity. For more information, see: Fofonoff, N. P. and R.C. Millard, Jr. Algorithms for computation of fundamental properties of seawater, UNESCO, Tech. Pap. Mar. Sci.,44.

1.2.4.1 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. To determine whether an LTC Levellogger Junior should be re-calibrated, test the unit in a solution with a known electrical conductivity value at a reference temperature. In Real Time View, observe current readings by using the Read Now function. 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 re-calibrated using the Conductivity Calibration Wizard procedure outlined in Section 6. As a minimum, calibrate your LTC Levellogger Junior at least twice a year. Ensure that a conductivity calibration is performed when the LTC Levellogger Junior is being set up for its initial use and after long periods of dry storage.

1.2.5 Total Rainfall

The Solinst Rainlogger is designed to record the tip times of an external tipping-bucket rain gauge, and output the amount of rainfall per tip.

! NOTE

For software installation instructions, see Section 3.

1.3 Software Communication

Levellogger Software is Windows based, and is therefore used with a desktop or laptop PC. Dataloggers 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 datalogger and a USB or RS-232 (Serial) Com Port to transfer information between the datalogger and computer.

If you are programming dataloggers in the office, or have deployed your datalogger using a wireline or cord, an Optical Reader is most commonly used for communication with a PC (see Figure 1-2).

If a datalogger is deployed in the field using a Direct Read Cable, a PC Interface Cable is used for communication with the PC, without removing it from the well (see Figure 1-3).



Figure 1-2 Levellogger Connected to a PC Using an Optical Reader



Figure 1-3
Levellogger and Direct Read Cable Connected to PC Using a PC Interface Cable

! NOTE

Always plug in the USB device before starting the Software.

When you plug in a USB device for the first time, you will need to install the USB Driver on the PC. (See Section 4.1.3).

! NOTE

It is always recommended to use the most recent version of software and firmware.

! NOTE

For more information, visit www.solinst.com to view the 3001 Levellogger Series: Hardware Compatibility, which is located on the Downloads page.

1.3.1 Backwards Compatibility

The Levellogger Edge is not backwards compatible with previous versions of Levellogger Software. Only Levellogger Software Version 4 and up can be used to program the Levellogger Edge and Barologger Edge. The Levellogger Junior Edge is only compatible with Levellogger Software Version 4.0.2 and up.

The Levellogger Junior, LTC Levellogger Junior, Rainlogger, and Leveloader are compatible with Levellogger Software Version 4.0.3. If used with previous software versions, they will not have some of the features gained with the release of Version 4.0.3 Software. The Levellogger Gold and Barologger Gold are also compatible with Version 4.0.3 Software, and previous versions.

To use your Levelloggers with Version 4.0.3 Software, ensure your firmware is upgraded to the following versions:

Datalogger	Firmware Version
Levellogger Edge	3.002
Barologger Edge	3.002
Levellogger Junior Edge	3.002
LTC Levellogger Junior	2.005
Rainlogger	2.000
Leveloader	2.000
Levellogger Gold	2.007
Barologger Gold	2.007
Levellogger Junior	2.007

For more information on previous software and firmware versions, visit www.solinst.com to view the **3001 Levellogger Series: Hardware Compatibility**, located on the Downloads page.

2 System Requirements

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

Hardware	Software
Memory: 32 MB or more	OS: Windows XP, Vista, or 7
Display: VGA: 800 x 600 pixels, 256 colour	
Ports: USB or RS-232 Serial Port	

Communication Port Setting for Levellogger Communications:

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

3 Software Installation

Web Download

Download the newest version of Levellogger Software by visiting www.solinst.com/Downloads/

CD Installation

- 1) Insert the software CD provided.
- 2) If the installer does not automatically start, to activate the software install click on the 'setup.exe' file located on the software CD.
- 3) The Software Installation Wizard will guide you through the remaining installation process. Figure 3-1 shows the Levellogger Installation Wizard.
- 4) Restart the computer after installation is completed. Default Directory is C:\Program Files\Solinst\Levellogger4_0

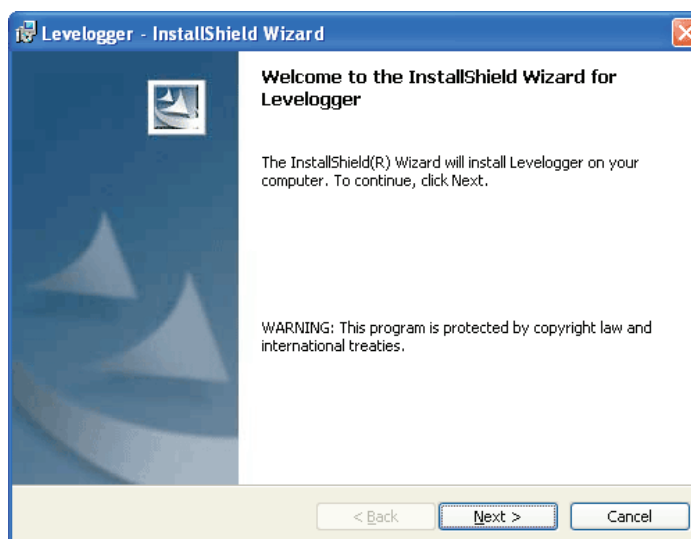


Figure 3-1 Software Installation Wizard

4 Startup, Configurations and Settings

4.1 Startup

If using a USB port, plug in the USB cable before starting the Levellogger Software. If plugging in the USB device for the first time, the driver for the device will have to be installed, see Section 4.1.3 for USB driver installation instructions.

To start the Levellogger Software, click , or click the Start button and select:
Programs > Solinst > Levellogger 4 > Levellogger 4.0.3

Once the program is started, you can set up the parameters for the Software.

4.1.1 Software/Firmware Update Checks

Each time the software is opened, it automatically checks for software updates. If there is an update, "[Software Update Available](#)" will appear in the top right of the menu bar. When you click the message, it will open a web page where you can download the software update.

The Software also checks for firmware updates once you have retrieved settings from a connected Levellogger (see Section 5). "[Firmware Update Available](#)" will appear in the top right menu bar. Clicking the message will open a web page where you can download the firmware update. See Section 12 for firmware update instructions.

4.1.2 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 Levellogger Optical Reader or PC Interface Cable to the USB port
- 2) Use a USB to RS-232 Adapter

If 1) during the installation of Levellogger Software, the **Virtual Com Port Driver** will be installed automatically. The Levellogger Software Installation Wizard also copies a folder to the Levellogger folder containing all the Solinst USB drivers. When you plug in the Solinst USB device, check the com port designation after installing the device (see Section 4.2.1).

If 2) Solinst strongly recommends the use of either Keyspan™ or IO Gear™ USB to RS-232 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.

NOTE

Your PC must have an internet connection to check for software and firmware updates.

You can also check for updates using the Help menu.

NOTES

To check the Com port assigned to a USB device after installation, open the Device Manager. Expand "Ports (COM & LPT)" to show the Com Port that has been assigned. To change the assigned Port, see Section 4.2.1.

You may have to restart your computer after adding a new USB device, before that port will be detected by the Levellogger Software

NOTE

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

NOTE

After plugging in the USB device, if the Found New Hardware Wizard does not automatically appear, proceed to the Manual USB Installation instructions in Section 4.1.4.

4.1.3 Installing USB Drivers for Levellogger 4 Software

Levellogger Software Version 4.0.3, for use with Solinst USB Optical Reader, PC Interface Cable and Levellogger, comes equipped with USB drivers for: Windows XP, Vista, and 7.

4.1.3.1 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 4-1).

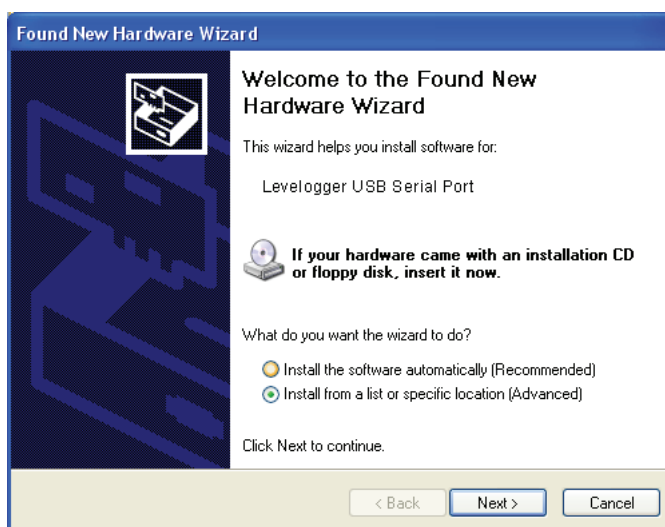


Figure 4-1 Found New Hardware Wizard Window

- 4) Select the installation option, 'Include this location in the search' (Figure 4-2), then click the 'Browse' Button to search for the appropriate directory:
C:\Program Files\Solinst\Levellogger4_0\USB Drivers

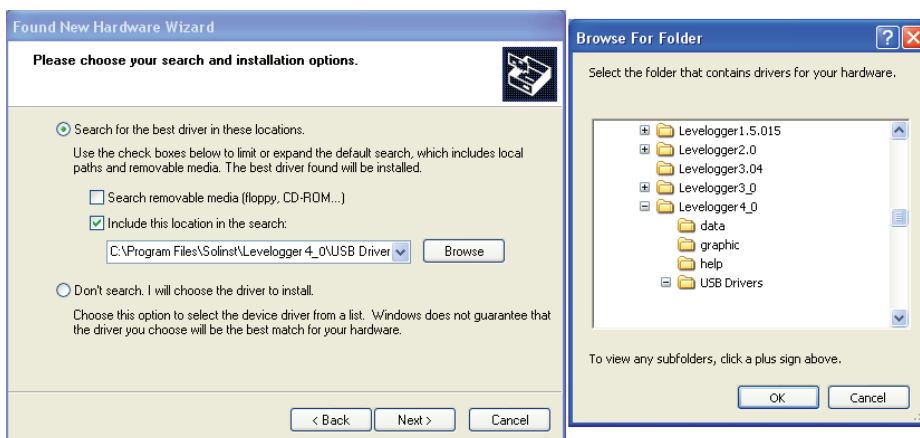


Figure 4-2 Found New Hardware Window and Figure 4-3 Browse for Folder Window

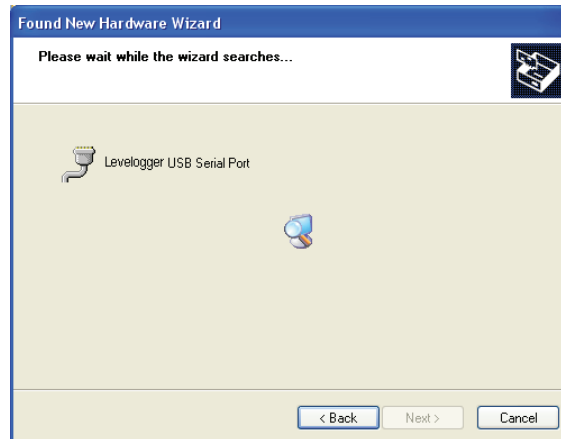


Figure 4-4 Found New Hardware Search Window

- 5) A warning message will then prompt that the software has not passed the Windows Logo Test. Select 'Continue Anyway' (Figure 4-5). This will complete the installation process. A system restart may be required. Repeat the steps if the installation fails the first time.

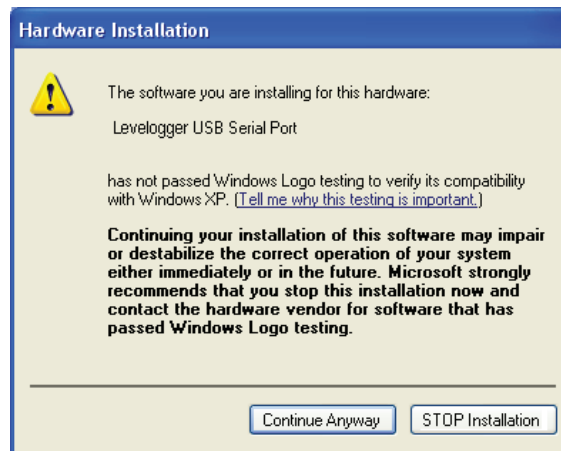


Figure 4-5 Hardware Installation Window



Figure 4-6 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 in Section 4.1.4.

4.1.3.2 USB Installation for Windows Vista

- 1) Plug in the USB device, 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)".

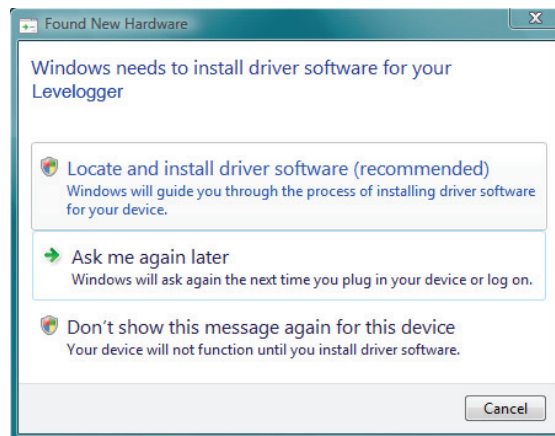


Figure 4-7 Found New Hardware Window

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

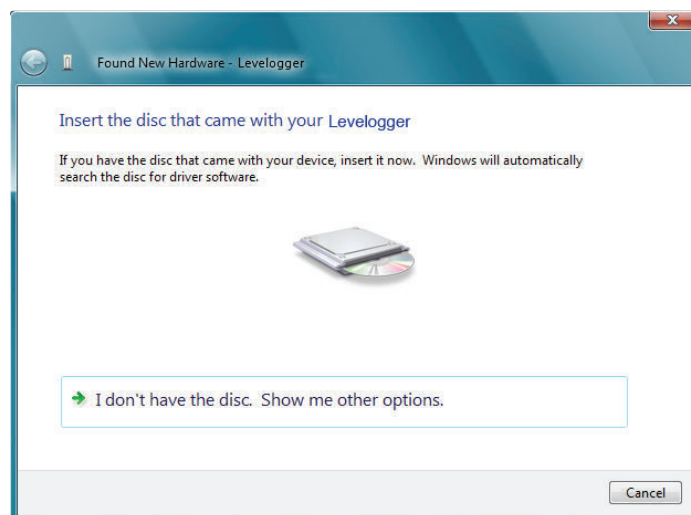


Figure 4-8 Found New Hardware - USB Serial Port Window

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

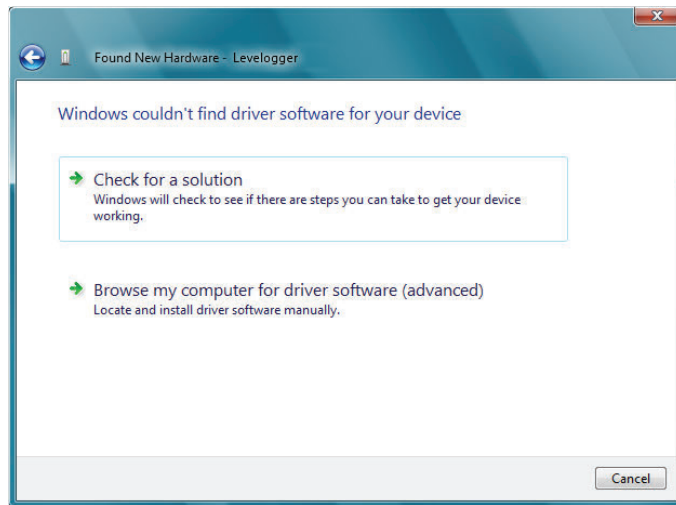


Figure 4-9 Found New Hardware Browse Window

- 5) Select the Browse button and point the navigation window to the provided USB drivers located within the Levellogger4_0 folder. The default destination is:
C:\Program Files\Solinst\Levellogger4_0\USB Drivers
The selected pathway will be provided within the window, select Next on the wizard to complete the installation.

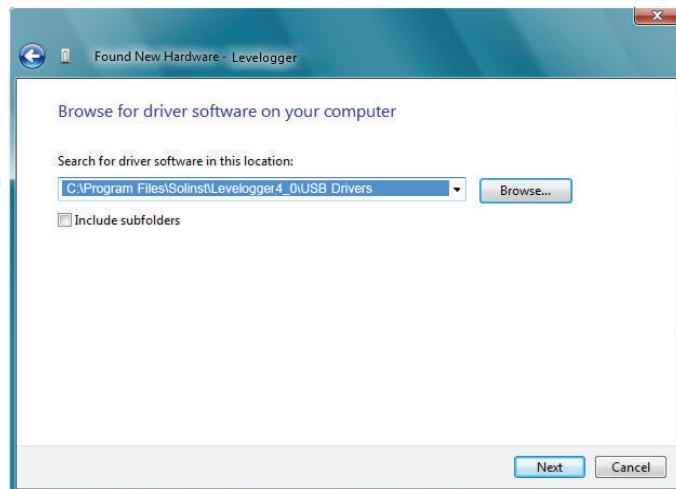


Figure 4-10 Search for Driver Software Window

- 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 Levellogger, you will most likely have to install the USB driver manually.

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.

4.1.3.3 USB Installation for Windows 7

- 1) Plug the USB Device into the 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 "Hardware and Sound", 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".

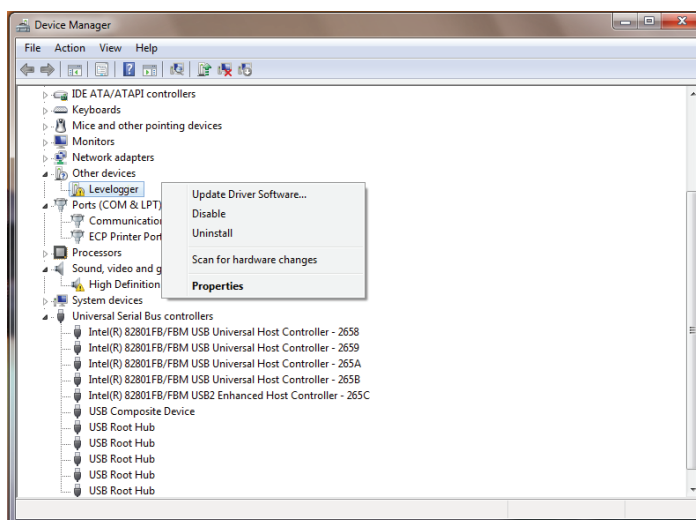


Figure 4-11 Windows 7 Device Manager

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

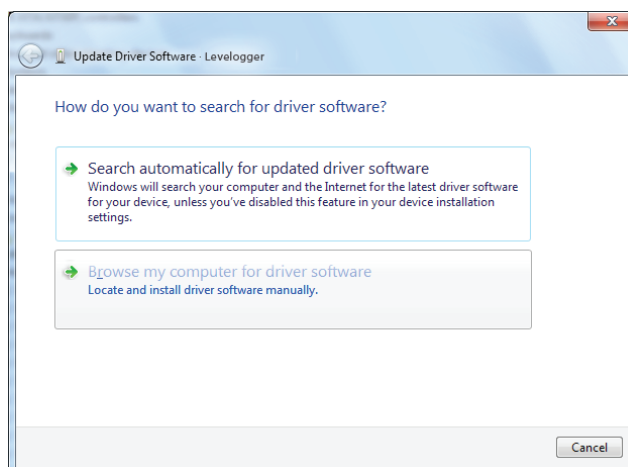


Figure 4-12 Update Driver Software

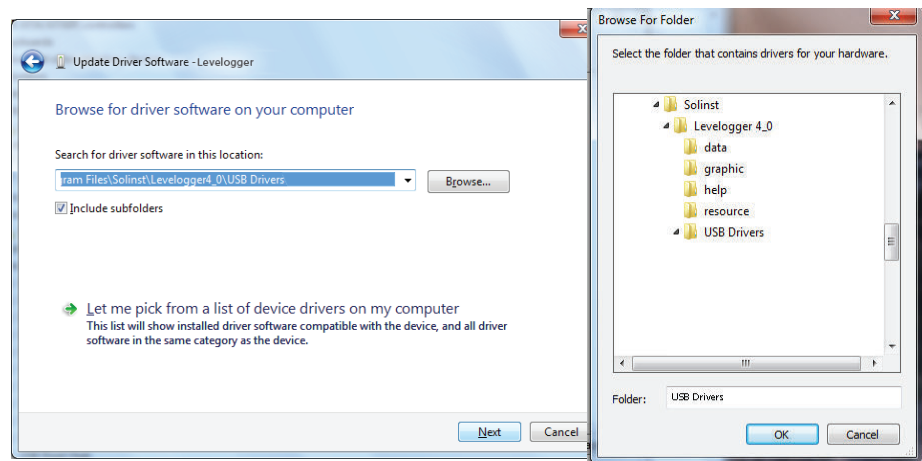


Figure 4-13 Browse for Driver Software

- 6) Click the Browse button and point the navigation window to the provided USB drivers located within the Levellogger4_0 folder. Default destination is:
C:\Program Files\Solinst\Levellogger4_0\USB Drivers
- 7) Select Next. A window may appear stating "Windows can't verify the publisher of this driver software", select "Install this driver software anyway".

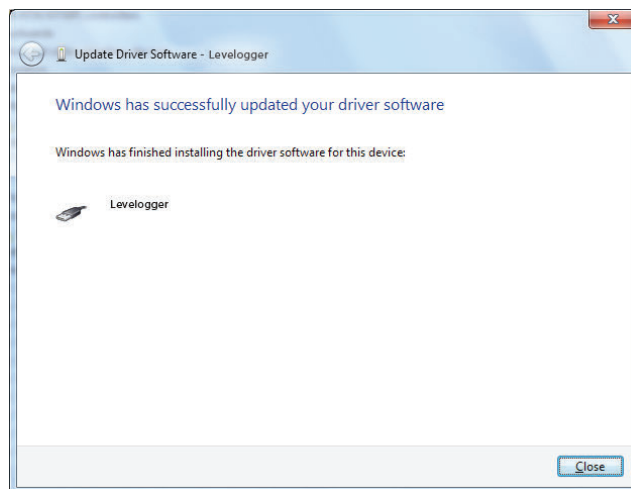


Figure 4-14 Update Complete

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

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.

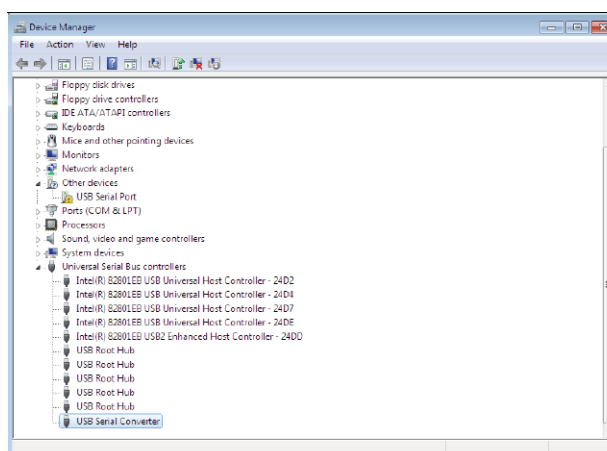


Figure 4-15 Update Serial Port

- 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.

4.1.4 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:

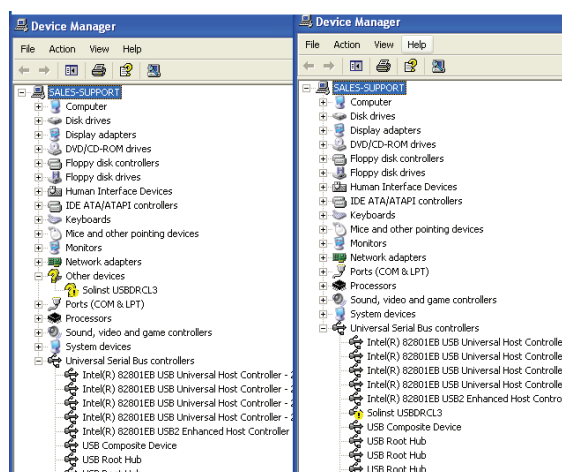


Figure 4-16 Device Manager

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 4.2.1.

- 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.

NOTES

To check the Com port assigned to a USB device after installation, open the Device Manager. Expand 'Ports (COM & LPT)' to show the Com Port that has been assigned.

You may have to restart your computer after adding a new USB device, before that port will be detected by the Levellogger Software

4.2 Configuration and Settings

4.2.1 Com Port Designation Set Up

After installing a USB device, should the Com Port number assigned to the device conflict with your existing devices, it is possible to change the Com Port designation number:

- 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'

Note: the path to the "Port Settings" tab may be different for each Windows operating system. The above is just a guideline.

4.2.2 Data Directory

The program will save data downloaded to the following default directory: <C:\Program Files\Solinst\Levellogger4_0\Data> unless otherwise specified in the Default Directory field of the Application Settings window (Figure 4-17).

Click the Configuration menu at the top of the program window, select Application Settings and input or navigate to a different folder destination. After completing the Application Settings, click the OK button to confirm and save the settings.

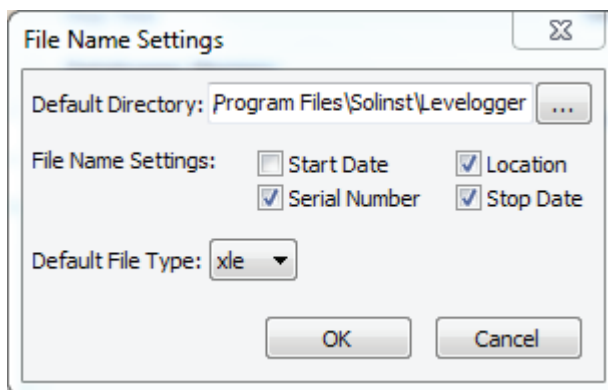


Figure 4-17 Application Setting Window

4.2.3 File Name Settings

From the Application Settings window in the Configuration menu, you can set what information will be included in your default file names of downloaded data (see Figure 4-17). You can include Start Date, Stop Date, Serial Number, and Location. Check-off the information you would like included.

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

4.2.4 Default File Type

From the Application Settings window in the Configuration menu, you can set what default file type you would like to use for downloaded, saved and exported data files. You can select between either *.xle (default) or *.lev file types (see Figure 4-17). For more information about the two file types, see Section 7.1.1.

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

NOTE

Depending on your Levellogger type, there will be different programming options. See Table 1-1 for the major differences. See Section 5.9 for programming the Levellogger Gold, Barologger Gold, and Levellogger Junior.

NOTE

Click on icons to get an explanation of that software feature.

5 Levellogger Edge Series Setup

After you start the Levellogger Software, the main Levellogger Software window will appear, with the Datalogger Settings tab open.

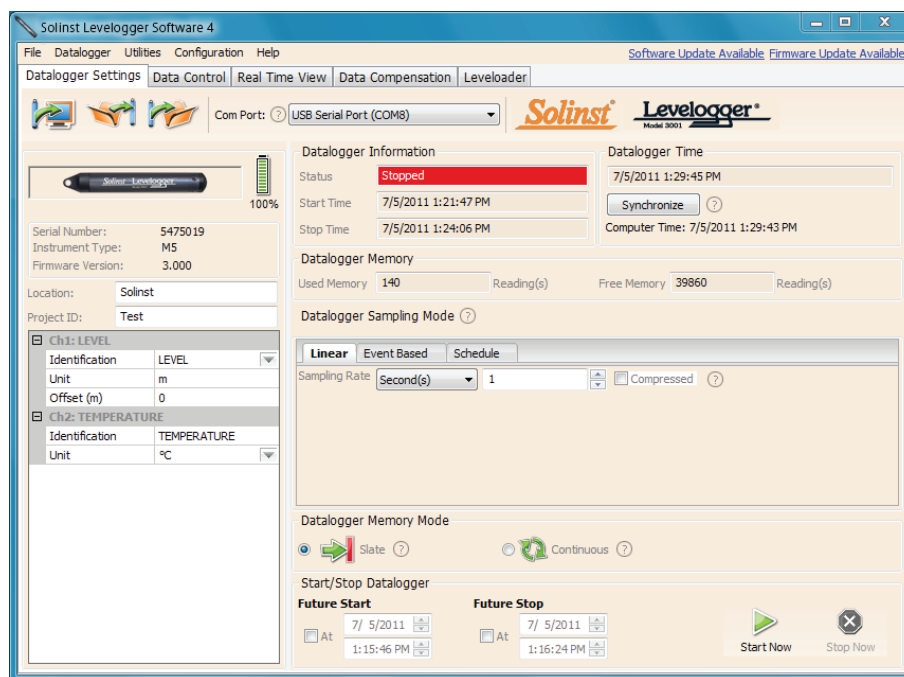


Figure 5-1 Datalogger Settings Tab

Select the appropriate COM or USB Port for the connected communications device from the centre drop-down menu.

Click to retrieve the current settings from the connected datalogger.

5.1 Datalogger Settings

After you have retrieved the settings of the connected datalogger, the Datalogger Settings tab will identify the Instrument Type, Serial Number, Firmware Version, Project ID, Location, and the Channel Settings.

- **Instrument Type:** will display the model of the attached datalogger, i.e.: F100/M30, Barologger, Rainlogger.
- **Serial Number:** the unique serial number of the attached datalogger will be displayed.
- **Firmware Version:** shows the firmware version of the attached datalogger.
- **Project ID:** input your own identification system. The Project ID is limited to 32 characters.
- **Location:** input specific site / location information. The location is limited to 32 characters.

NOTE

The Levellogger Edge, which is available in F15 (M5), F30 (M10), F65 (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.

! NOTE

Readings can be converted to other units using the Data Compensation Wizard.

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.

! NOTE

There is no "Offset" input option for the Barologger Edge.

! NOTE

Levellogger Edge, Barologger Edge, and Levellogger Junior Edge data can be adjusted for altitude and density post data collection using the Data Compensation Wizard.

! NOTE

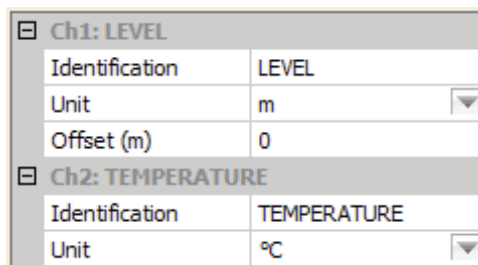
The LTC Levellogger Junior only measures in °C

5.1.1 Setting Up Channel Information

In the lower left portion of the Datalogger Settings tab is the area for setting channel parameters (level, temperature, conductivity, rainfall). The software will detect the available channels when the datalogger settings are retrieved.

5.1.1.1 Level Channel (Ch1)

- **Identification** describes the measurement parameter of the channel and has already been configured as 'LEVEL'. The channel can be re-named 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. Identification is limited to 32 characters.
- **Unit** refers to the channel's unit of measurement. There are six options when using a Levellogger Edge or Levellogger Junior Edge, m (default), cm, ft, kPa, mbar, and psi. When using a Barologger Edge, the options are kPa (default), mbar, and psi.
- **Offset** refers to an adjustment, such as the distance between the tip of the Levellogger and the monitoring well cap or static water level. It is recommended that the value of 0.00 be used for as this keeps all subsequent readings relative to the tip of the Levellogger. The reference range is -1000 to 16,400 ft or -300 m to 5000 m.



Ch1: LEVEL	
Identification	LEVEL
Unit	m
Offset (m)	0
Ch2: TEMPERATURE	
Identification	TEMPERATURE
Unit	°C

Figure 5-2 Levellogger Edge Channel Setup

The LTC Levellogger Junior also has inputs for:

- **Altitude** in feet or meters above sea level, at which the logger is actually deployed, is input in the altitude field. You can enter 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.
- **Density** is used to adjust the range of the Levellogger based on the sample fluid density. The range for the density adjustment is from 0.9 kg/L to 1.1 kg/L.

5.1.1.2 Temperature Channel (Ch2)

- **Identification** describes the measurement parameter of the channel and has already been configured as 'TEMPERATURE'. The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Unit** refers to the channel's unit of measurement. For the Levellogger Edge, Barologger Edge, and Levellogger Junior Edge, the temperature channel can be set to °C (default) or °F.

NOTE

For every degree change in temperature, there is approximately a 2% change in conductivity. To convert raw conductivity measurements to Specific Conductance measurements, you can use the following equation:

$$\text{Specific Conductance} = \frac{\text{Conductivity}}{(1 + 0.02 * (\text{temp}(C) - 25))}$$

You can also perform this calculation automatically using the Data Compensation Wizard.

You can also convert Conductivity readings to Salinity (expressed in Practical Salinity Units (PSU)) using the Data Compensation Wizard.

5.1.1.3 Conductivity Channel (Ch3)

- **Identification** describes the measurement parameter of the channel and has already been configured as 'CONDUCTIVITY'. The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Unit** refers to the channel's unit of measurement. There are two units of measure available for the user to select: mS/cm or µS/cm.

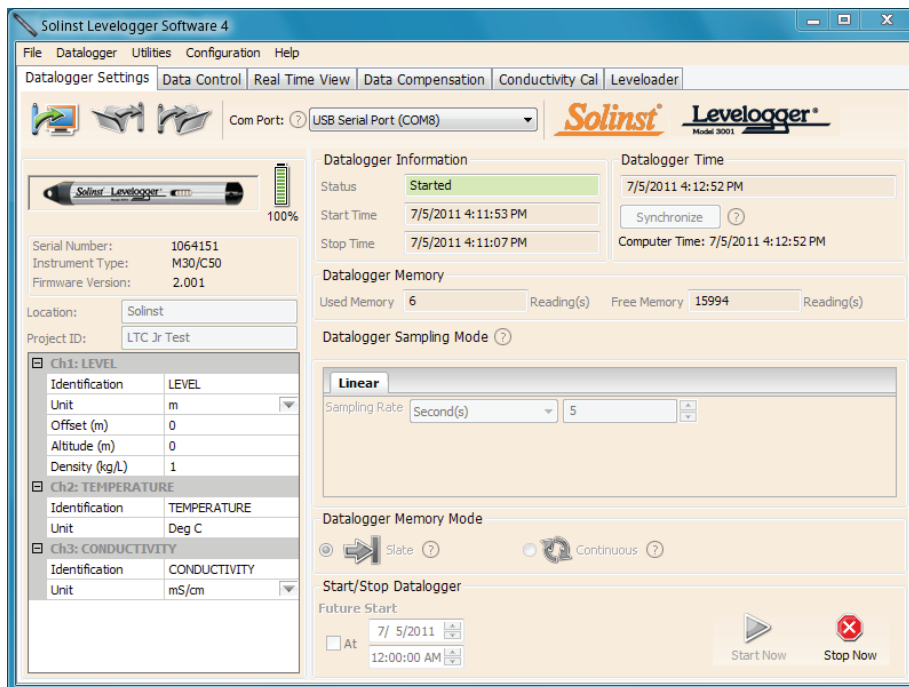


Figure 5-3 Conductivity Channel Setup

5.1.1.4 Rainlogger

Using Firmware Version 2.000 or higher:

There is one channel of measurement for the Rainlogger. The 'RainFall' Channel records each tip time by the connected tipping-bucket and outputs the amount of rainfall per tip (input Rainfall Cal Constant).

- **Identification** describes the measurement parameter of the channel and has already been configured as 'RainFall'. The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Units** refers to the channel's unit of measurement. There are two units of measure available for the user to select: mm or in.
- **The Rainfall Cal Constant** field allows you to enter the calibration factor for the tipping-bucket you will be using. 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.

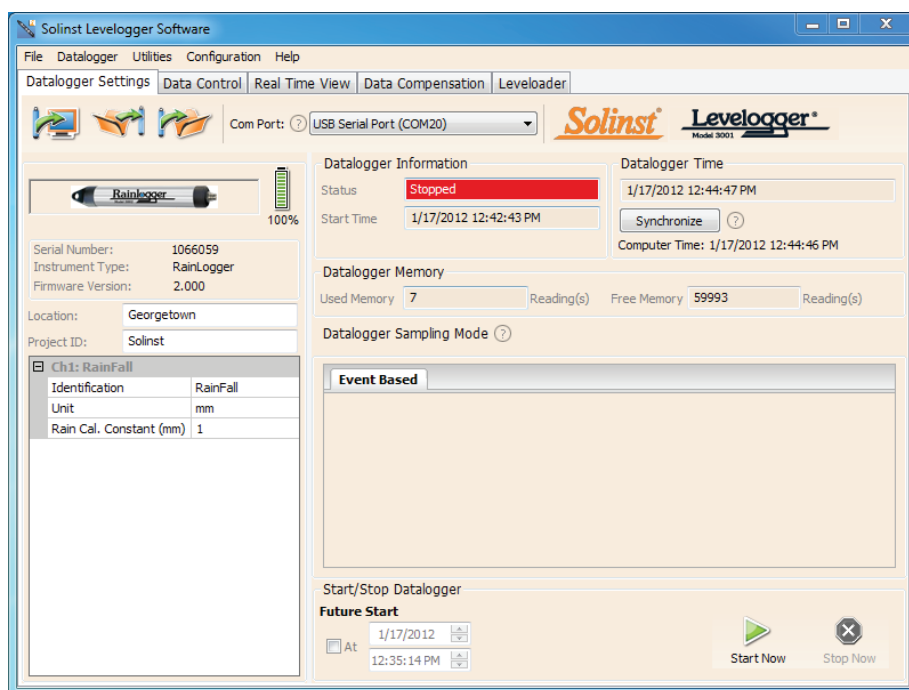


Figure 5-4 Rainlogger Channel Setup - Firmware 2.000 and up

! NOTES

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 minute sampling rate, but will not obtain accurate rainfall intensity calculations.

! NOTE

With older firmware, the battery life of the Rainlogger is 10 years based on 2 parameters logged every 10 minutes, and the memory holds 40,000 readings.

! NOTE

With older firmware, there is no Real Time View option.

Using Firmware Versions Previous to 2.000:

There are two channels of measurement for the Rainlogger, 'RainFall' and 'MaxRainFall'. 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.

- **Identification** describes the measurement parameter of the channel and has already been configured as 'RainFall'. The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Units** refers to the channel's unit of measurement. There are two units of measure available for the user to select: mm or in.
- **The Rainfall Cal Constant** field allows you to enter the calibration factor for the tipping-bucket you will be using. 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 'MaxRainFall', 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.

- **Identification** describes the measurement parameter of the channel and has already been configured as 'MaxRainFall'. The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Units** refers to the channel's unit of measurement. There are two units of measure available for the user to select: mm/hr or in/hr.

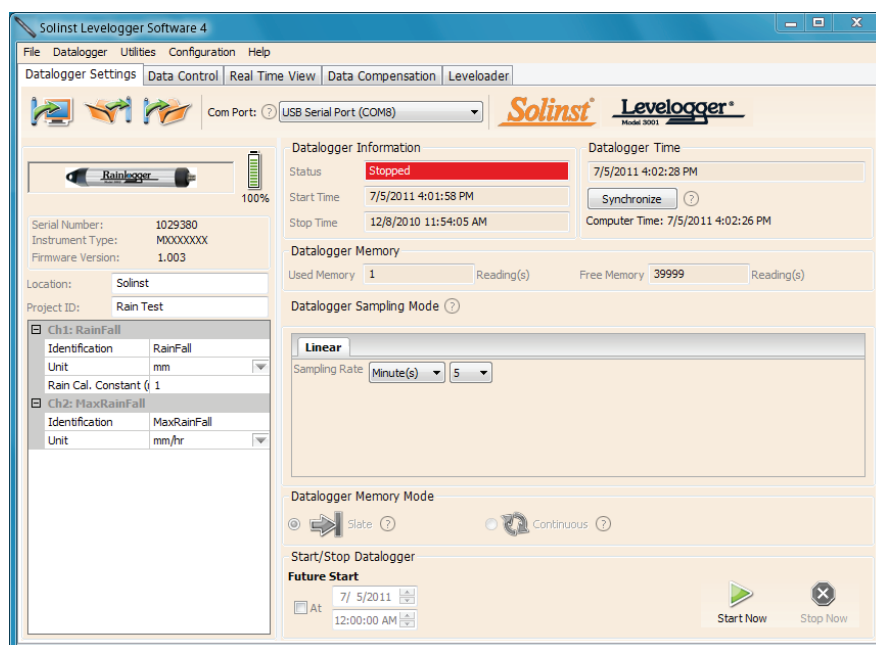


Figure 5-5 Rainlogger Channel Setup - Firmware previous to 2.000

5.2 Datalogger Information

The Datalogger Information section shows the Status of the attached datalogger (i.e.: Started, Stopped, Future Start) and the Start Time and Stop Time of the datalogger. When a Future Start and/or Stop time is set (see Section 5.8), the Start Time and Stop Time fields will fill in. The fields will update each time the datalogger is stopped and started.

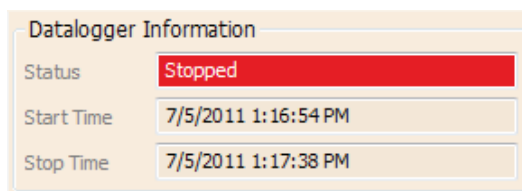


Figure 5-6 Datalogger Information

5.3 Datalogger Memory

The Datalogger Memory section shows the amount of memory used, and the amount of memory remaining (number of readings).



Figure 5-7 Datalogger Memory Remaining

If the Data Compression option is selected (see Section 5.7), the amount of free memory shown is approximated as a visual status bar.

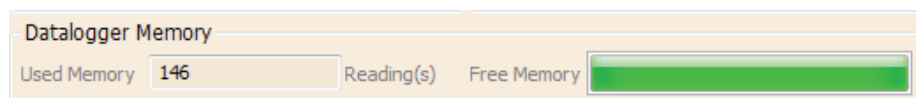


Figure 5-8 Datalogger Compressed Memory

5.4 Datalogger Time

The Datalogger Time section provides the controls for setting the datalogger clock. If you want to synchronize the datalogger's clock to the computer clock, click Synchronize to set the time in the datalogger.

If you start the datalogger without synchronizing the clock and the time difference between the datalogger and the PC is more than 3 seconds, the software will give you a message asking 'Do you want to synchronize the time?'. Click Yes to synchronize the clock.

It can be very useful to synchronize the clocks of all the Levelloggers and Barologgers when it comes to Barometric Compensation.

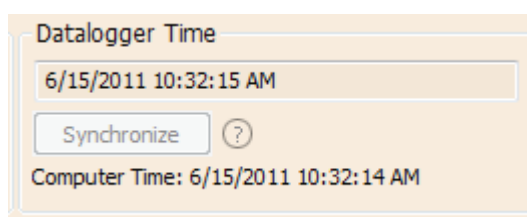


Figure 5-9 Datalogger Time

! NOTE

It is very useful to synchronize the clocks of all the Levelloggers and Barologgers for use on the same project.

NOTES

The battery life of the Levellogger Edge is 10 Years, based on 1 reading per minute. More rapid readings will reduce the battery life. For example, if a Levellogger Edge is setup in Continuous Mode at a sampling rate of 1 second, the battery will be depleted in approximately 4 months.

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

NOTE

The LTC Levellogger Junior and Levellogger Junior Edge record using Linear sampling mode only.

The Levellogger Junior Edge has a sample rate of 0.5 seconds to 99 hours. The LTC Levellogger Junior has a sample rate of 5 seconds to 99 hours.

NOTES

In Event Based sampling mode, the Levellogger Edge has a total memory of 25,000 readings of level and temperature.

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

The Rainlogger records in Event Based mode only. It records the tip times of a connected tipping-bucket. Rainloggers using older firmware record in linear mode.

5.5 Datalogger Sampling Mode

The Datalogger Sampling Mode section allows you to choose the sampling measurement type. Options are Linear, Event Based and Schedule.

Linear refers to a set time interval between collection of readings. Sample Rate can be any number from 0.125 seconds to 99 hours for the Levellogger Edge. There is a data compression option available for the Levellogger Edge. This increases the memory capacity of the Levellogger Edge from 40,000 readings to up to a maximum of 120,000. Check the Data Compression box to allow data compression.

Data Compression works by only saving data changes in memory. For example, if you have linear sampling set to record each second, and your water level varies a little for 60 seconds, the memory will only record incremental values for the 60 seconds. When your data is exported, it will display all 60 intervals with the corresponding level data.

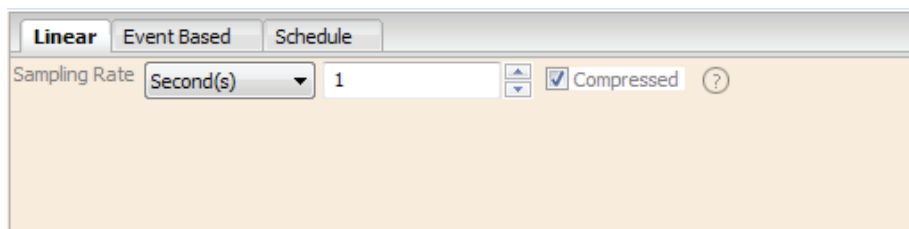


Figure 5-10 Linear Sampling Setup

Event Based sample collection is the most memory efficient means of data collection. In Event mode, the Levellogger will activate every sampling interval defined and check if readings have changed by the selected threshold (Change) from the last recorded reading.

For the Levellogger Edge, 'LEVEL' or 'TEMPERATURE' is the selected parameter where change is monitored. The Levellogger will record a new reading only if the specified change in the parameter has occurred.

A default reading will also be stored in the datalogger memory, every 24 hours from the last recording, if no "event" occurs.

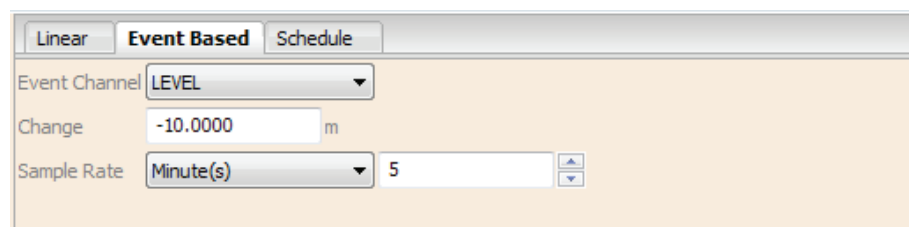


Figure 5-11 Event Based Sampling Setup

NOTE

A schedule can be saved and applied to other Levelloggers, or a Levellogger, by saving the Levellogger Settings file (see Section 5.7).

Schedule Sampling allows you to select a logarithmic style sampling schedule adapted to the needs of each application.



Schedule Sampling is set by using the plus and minus buttons to add or subtract line items in the Schedule window. 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. A 'Pause' interval can also be selected, which stops the Levellogger from recording for the specified duration.

Running totals of the number of readings still available, from the total possible 40,000 or 120,000, and the run time to date are shown. If the number of readings selected exceeds the Levelloggers memory capacity an error message appears.

By checking 'Repeat', the Levellogger will continue to run through the schedule until its memory is full, or it is stopped.

Figure 5-12 Schedule Sampling Setup

5.6 Datalogger Memory Mode

Memory Mode Selection will be grayed-out if not in Linear sampling mode. When using a Levellogger in Linear Mode, there is a choice of **Continuous** Logging (wrap around)  or **Slate** Logging .

Compressed Linear, Event Based and Schedule sampling modes can only use the Slate Mode option.

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 (or up to 120,000 readings), so that the beginning of the current log will not be written over.

Figure 5-13 Datalogger Memory Mode

NOTE

Continuous Memory Mode is only available for Levellogger Edge and Levellogger Gold units using Linear Sampling.

NOTE

Settings files created in Levellogger Software Version 3 or earlier (.ils or .sci files) can not be opened by Software Version 4. These settings files will need to be re-created and saved in Levellogger Software Version 4.

NOTES

If a setting has been changed, it will be highlighted in yellow as a reminder before the datalogger is started.

If a setting has been entered incorrectly it will be highlighted in red.


Changed settings are applied to the datalogger automatically when the Start icon is selected.

NOTE

Remember to download any data on the datalogger before starting a new session. When starting a new logging session, any data from previous recording sessions will be erased.

5.7 Saving and Retrieving Levellogger Settings Files


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

To retrieve settings from defaults, click  from a selected *.dtf 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.

5.8 Starting and Stopping the Datalogger

Starting the Datalogger

There are two ways to start logging: **Start Now** or by programming a **Future Start** time.

To start logging immediately, do not fill in a Future Start time and click, . It should say Start Now below the icon to indicate an immediate start. Any changed settings will automatically be applied to the datalogger, and it will start logging. Datalogger Status will change from Stopped to Started.

After the datalogger is started, and begins collecting readings, the Start icon will be greyed out, and only the Stop icon and Future Stop settings will be active.

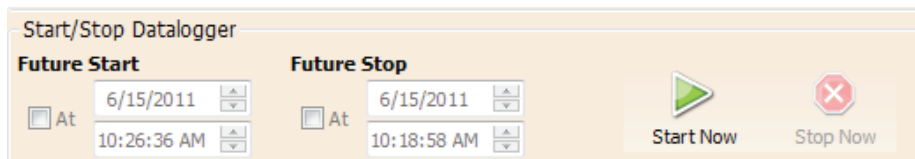



Figure 5-14 Starting the Datalogger Immediately

Check **Future Start** 'At' to set logging to start at a later date and/or time. This Start mode is referred to as Future Start in the Status field. Click  to apply the Future Start time and any changes to the datalogger settings.

When the Future Start time is reached, the datalogger will start logging and the Status will change from Future Start to Started.

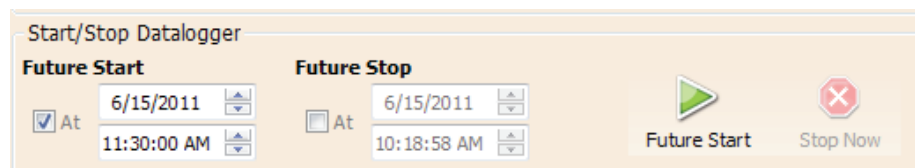


Figure 5-15 Future Start Setting

! NOTE


You can not set a Future Stop time for the Levellogger Junior Edge, LTC Levellogger Junior or Rainlogger.

! NOTE

If you have set a Future Stop time, but wish to stop the datalogger immediately, uncheck the Future Stop 'At' box, and the Stop icon should say Stop Now. Click the icon to stop logging.

Stopping the Datalogger

There are two ways to stop logging: Stop Now or at a programmed Future Stop time for the Levellogger Edge and Barologger Edge.

To stop the datalogger immediately when it is logging, click  , (it should say Stop Now below the icon).

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

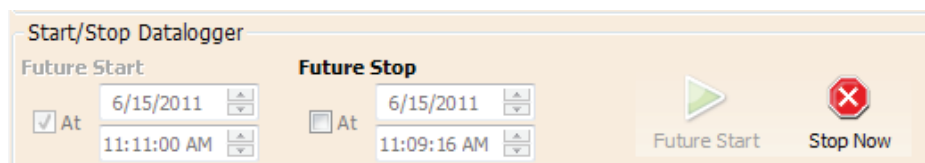




Figure 5-16 Stopping the Datalogger Immediately

To program a **Future Stop** time for your datalogger, check Future Stop 'At' and fill in the desired stop time. The Future Stop time will be applied to the datalogger once  is selected for an immediate or future start.

You can also program a Future Stop time after you have started the datalogger, by checking Future Stop 'At' and filling in the desired stop time. Select  to apply the Future Stop time (it should say Future Stop below the icon). The Stop Time should be shown in the Datalogger Status section.

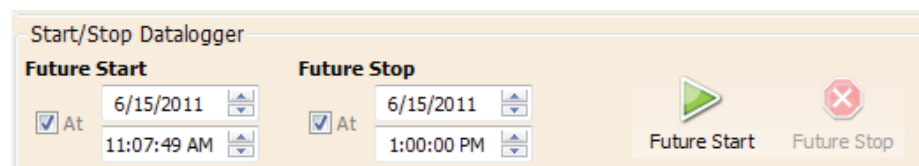



Figure 5-17 Future Stop Setting

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 Edge units record in Slate mode if Event, Schedule, or Compressed logging, but in standard Linear mode they can be set to Slate or to Continuous logging.

5.9 Levellogger Gold Series Setup

This Section briefly describes the Levellogger Gold, Barologger Gold and Levellogger Junior setup.

NOTE

Click on  icons to get an explanation of that software feature.

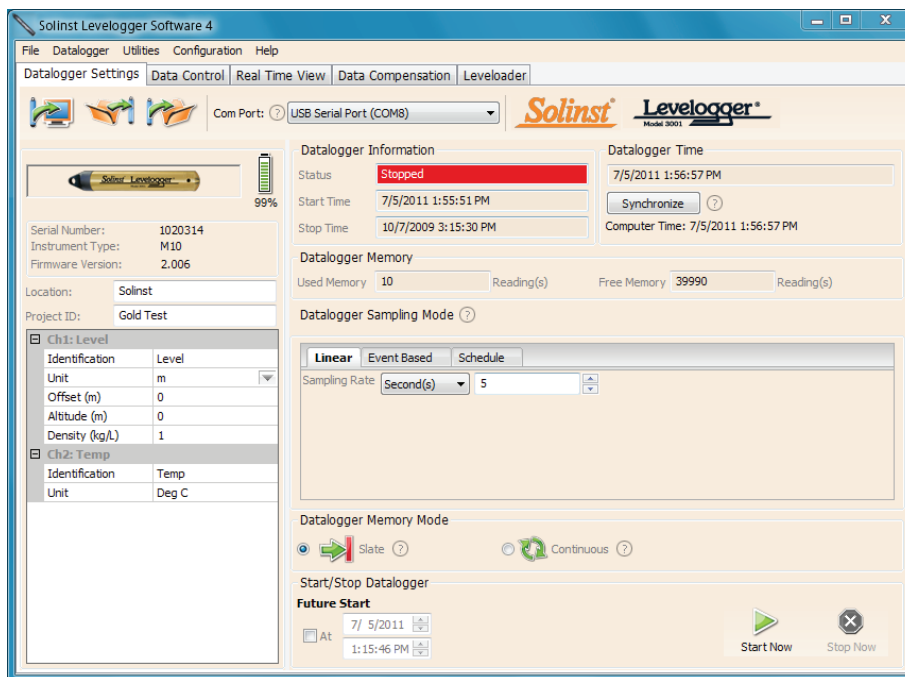


Figure 5-18 Levellogger Gold Settings

Select the appropriate COM or USB Port for the connected communications device from the centre drop-down menu.

Click  to retrieve the current settings from the connected datalogger.

Channel Information

Level Channel (Ch1)

- **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.

- **Offset** refers to an offset correction, such as the distance between the tip of the Levellogger 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 Levellogger. The offset range for Levellogger Gold and Barologger Gold units is -1000 to 16400 ft or -300 m to 5000 m.
- **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.
- **Density Adjustment** is used to adjust the range of the Levellogger based on the sample fluid density. The range for the density adjustment is from 0.9 kg/L to 1.1 kg/L.

Temperature Channel (Ch2)

- **Identification** describes the measurement parameter of the channel and has already been configured as 'TEMPERATURE'. The channel can be re-named to suit each project. The Identification field will be the channel heading, data column heading and graph line name when viewing the data. Identification is limited to 32 characters.
- **Unit** refers to the channel's unit of measurement. The Levellogger Gold and Barologger Gold measure in °C only.

Sample and Memory Modes

Sample Mode, allows you to choose the sampling measurement type. Options are Linear, Event Based and Schedule.

- **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 Levellogger Gold and Barologger Gold can store 40,000 readings of level and temperature.
- **Event Based** sample collection is the most memory efficient means of data collection. In Event mode, the Levellogger will activate every sampling interval defined and check if readings have changed by the selected threshold (Change) from the last recorded reading. For the Levellogger Gold, 'LEVEL' or 'TEMPERATURE' is the selected parameter where change is monitored. The Levellogger will record a new reading only if the specified change in the parameter has occurred.
- **Schedule Sampling** allows you to select a logarithmic style sampling schedule adapted to the needs of each application. Schedule Sampling is set by using the plus and minus buttons to add or subtract line items in the Schedule window. 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.

! NOTE

The Levellogger Junior records using Linear sampling mode only.

! NOTE

In Event Based sampling mode, the Levellogger Gold has a total memory of 25,000 readings of level and temperature


! NOTE

An important reminder for Event Based sampling 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.


Memory Mode selection will be grayed-out if not in Linear Mode sampling. When using a Levellogger 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.

Starting and Stopping the Levellogger


There are two ways to start logging: **Start Now** or by programming a **Future Start** time.

To start logging immediately, do not fill in a Future Start time and click, . It should say Start Now below the icon to indicate an immediate start. Any changed settings will automatically be applied to the datalogger, and it will start logging. Datalogger Status will change from Stopped to Started.

After the datalogger is started, and begins collecting readings, the Start icon will be greyed out, and only the Stop icon and Future Stop settings will be active.

Check **Future Start** 'At' to set logging to start at a later date and/or time. This Start mode is referred to as Future Start in the Status field. Click  to apply the Future Start time and any changes to the datalogger settings.

When the Future Start time is reached, the datalogger will start logging and the Status will change from Future Start to Started.

To stop the datalogger immediately when it is logging, click , (it should say Stop Now below the icon).

The Levellogger can be stopped at any time before it reaches the maximum reading capacity. **Starting again 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, Schedule, or Compressed logging, but in standard Linear mode they can be set to Slate or to Continuous logging.



Figure 6-1
LTC Levellogger Junior

6 Conductivity Calibration

The LTC Levellogger Junior conductivity sensor must be calibrated for reliable conductivity measurements. Calibrate for conductivity at the start of each new monitoring project or at a minimum each new monitoring season (twice a year).

Calibrating the LTC Levellogger Junior 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. You place the LTC Levellogger 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.

The LTC Levellogger 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 to 3 calibration standard points:

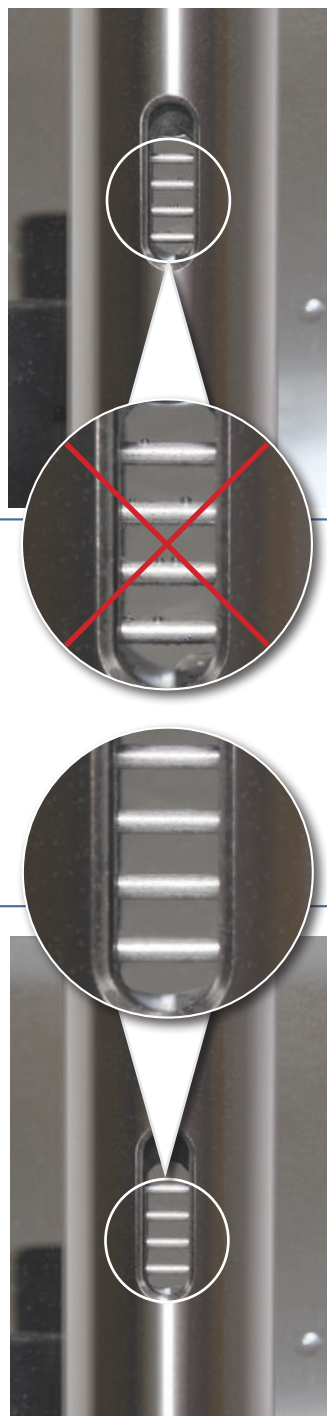
- 1,413 $\mu\text{S}/\text{cm}$
- 5,000 $\mu\text{S}/\text{cm}$
- 12,880 $\mu\text{S}/\text{cm}$

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.

For best accuracy, it is recommended you use calibration solutions that have a temperature error of $\pm 2\%$ or better. You should also keep the solution as close to the stated temperature on the bottle as possible (i.e. 25°C). The closer you get to the temperature extremes of 10°C and 30°C, the less accurate your calibrations may be.

NOTE

Ensure that the calibration solution covers the entire sensor cell and the logger is agitated to release entrapped air bubbles.



Retrieve the settings from the attached LTC Levellogger Junior by clicking

Stop the LTC Levellogger Junior by clicking

Start the Calibration Wizard by clicking the Conductivity Cal tab. The wizard will guide you through the calibration process. You can exit the wizard after any step to cancel the calibration session.

Introduction: The LTC Levellogger Junior must be connected to the computer with an Optical Reader during the entire calibration process and **must be in the stopped mode**. 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 and that the pins are clean. See section 10.2 for recommended methods to clean the sensor pins.

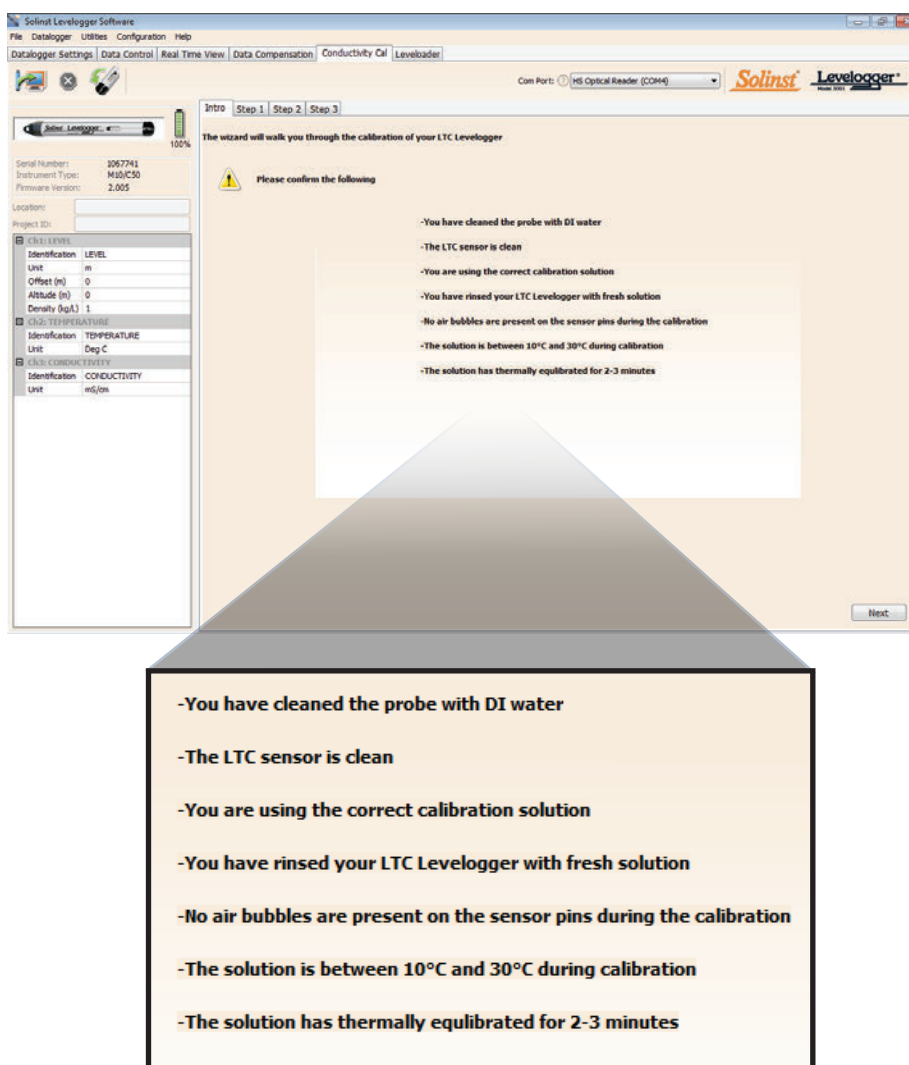


Figure 6-2 LTC Levellogger Junior Calibration Wizard Introduction

- 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 Levellogger Junior states a different temperature coefficient on the label, please input that number into the Temperature Coefficient field.

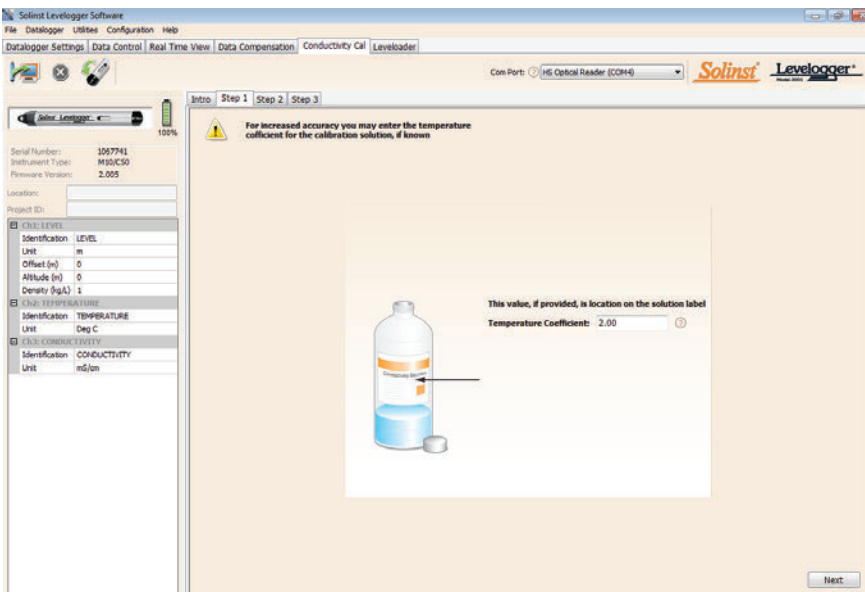


Figure 6-3 LTC Levellogger Junior Calibration Wizard Step 1

NOTE

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

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

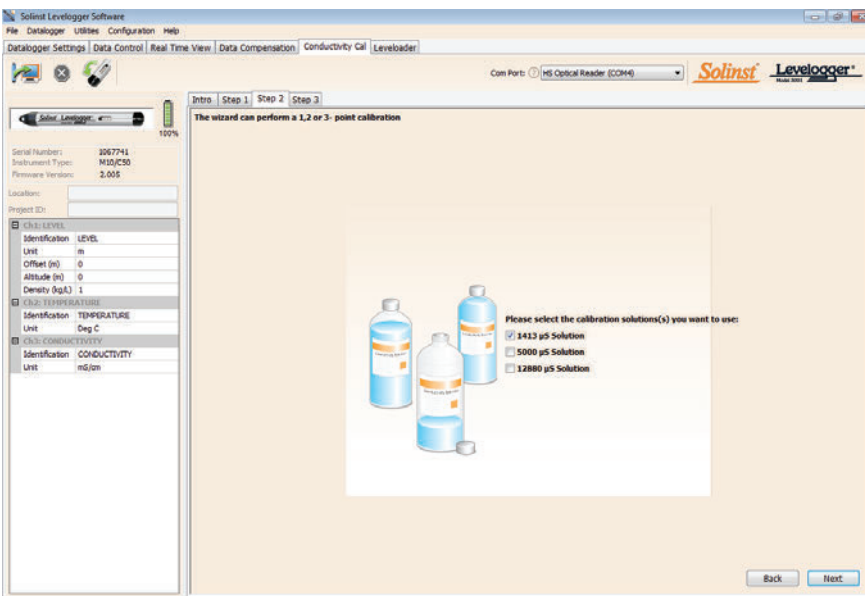


Figure 6-4 LTC Levellogger Junior Calibration Wizard Step 2

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

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.

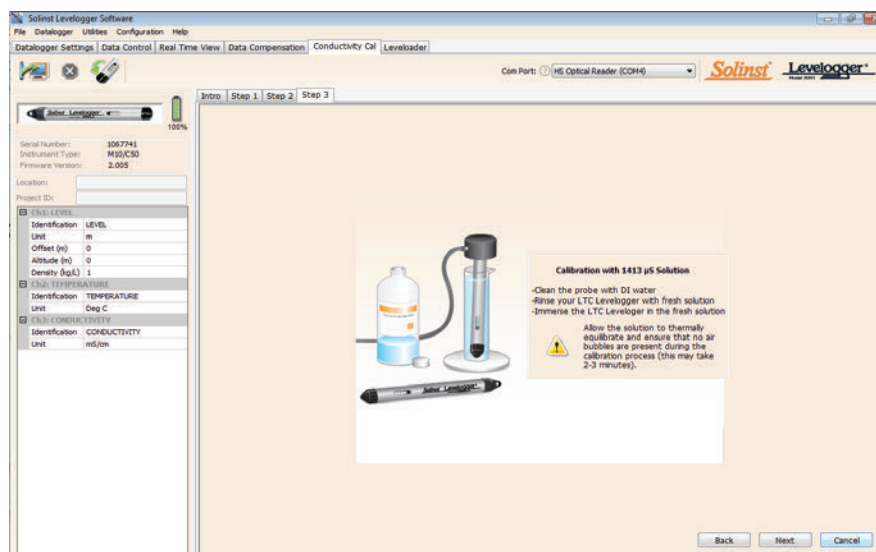


Figure 6-5 LTC Levellogger Junior Calibration Wizard Step 3 (example of window calibrating with 1413 µS/cm solution)

Calibration: Since most standard calibration solutions state conductivity at a standard temperature of 25°C, the LTC Levellogger Junior can account for temperature differences between 10 - 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.

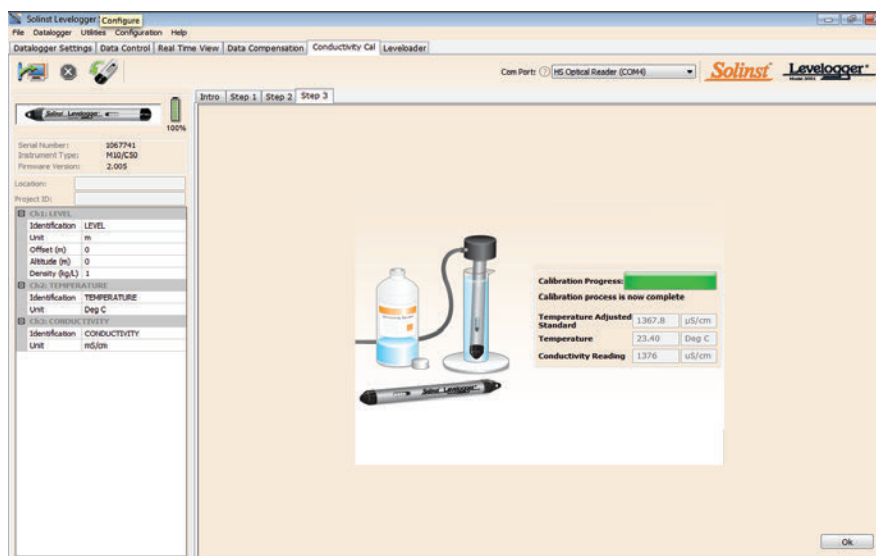


Figure 6-6 LTC Levellogger Junior Calibration Successful

When a single-point calibration is successful the process is complete. Once the calibration is complete for the first solution of a multipoint calibration, a message will appear stating that the calibration was successful. When you select 'Okay', the Calibration Wizard will go back to the beginning of Step 3 to start the rinsing process for the next solution selected. The calibration process will proceed automatically until completed for all solutions.

If a failure occurs at any point during calibration, a message will appear asking you to clean and check your probe, then start the calibration process over for that current solution by selecting 'Yes' (Figure 6-7). If performing a multipoint calibration, any previous successful calibration points will remain.

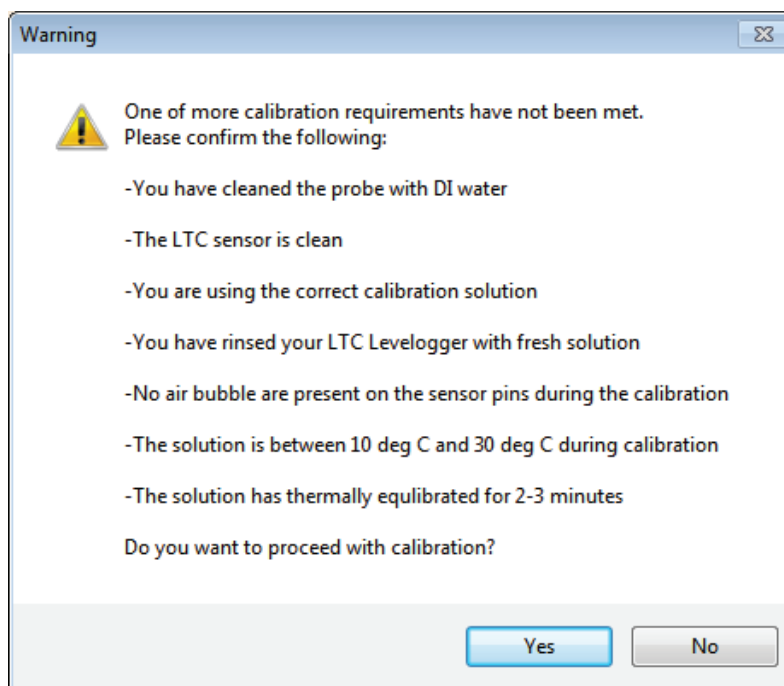


Figure 6-7 LTC Levellogger Junior Calibration Warning 1

If a second failure occurs during calibration, a warning message will appear indicating that your probe may still be dirty, or damaged. This may occur if your LTC Levellogger Junior conductivity sensor has been affected by dirt, mineral build-up, etc., so it no longer responds like it did when it was first factory calibrated. This step allows your sensor to be calibrated within a wider range of the standard solution value.

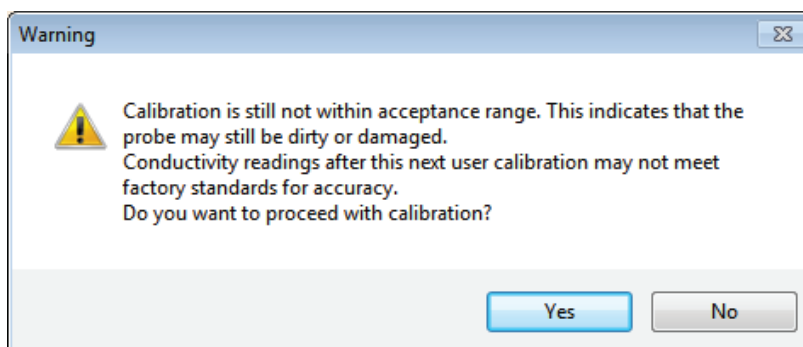


Figure 6-8 LTC Levellogger Junior Calibration Warning 2

If you select 'Yes' to accept the larger tolerance, the calibration process will start over for that current solution (Figure 6-8). If performing a multipoint calibration, any previous successful calibration points will still remain. If you select 'No', the LTC Levellogger Junior will default back to the last pre-calibrated state. You can retry the calibration using the normal tolerance range.

If a third calibration error occurs, or the results of the calibration are outside the error tolerance range, a warning message will appear asking you to contact Solinst for more options (Figure 6-9).

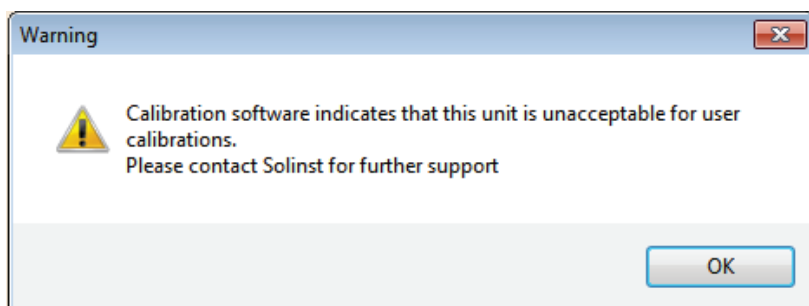


Figure 6-9 LTC Levellogger Junior Calibration Warning 3

6.1 Restore Factory LTC Levellogger Junior Calibration

An LTC Levellogger Junior 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 Levellogger Junior to its original factory settings and then perform a "first-time" conductivity user calibration to maximize accuracy.

To execute this function, simply click the Restore Factory LTC Calibration button,



with the LTC Levellogger Junior connected to the PC.

7 Data Control (Downloading and Viewing Data)

Click the Data Control tab on the Main window. From the Data Control tab you can download data from a Levellogger, display data in tabular or graphic format, and save and export data files.

NOTE

When you click on a data point in the graph, the corresponding data point will be highlighted in the table. You can also highlight a section of data in the graph.

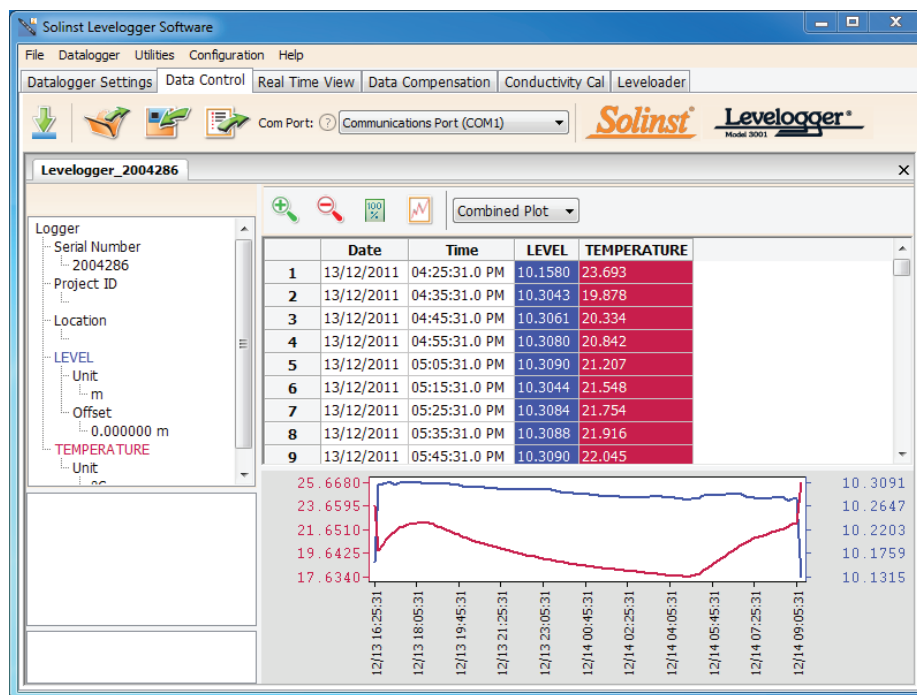



Figure 7-1 Data Control Tab

Click  to open a *.xle or *.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 top left of the window.

The bottom left sections of the window are used to display information after a data compensation has been performed. The middle section displays information from a Barologger, if a barometric compensation is performed, and the bottom section includes information from other compensations, such as offsets or conductivity conversions (see Section 8).

NOTE

As there is only one channel of data for the Rainlogger, there are no graphing options.

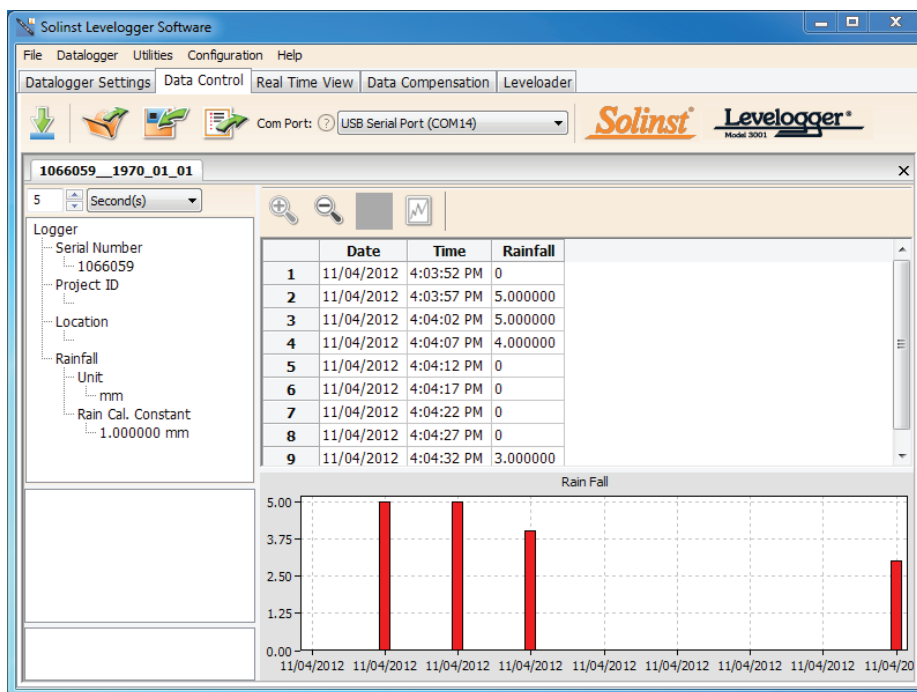


Figure 7-2 Rainlogger Data

When you view data downloaded from a Rainlogger (firmware version 2.000 or higher), the RainFall data will be shown in a table and in a bar graph. A drop-down menu appears that allows you to select the time interval at which you would like the data shown, from 1 second to 99 hours (this acts like a zoom function). Figure 7-2 shows the data every 5 seconds from the start date and time.

7.1 Downloading Options and Saving Data Files

7.1.1 Default File Format


NOTE

The default file type is *.xle, unless changed in the Application Settings (see Section 4.2.4).


The default file type for Levellogger Software Version 4 and up is *.xle, unless changed to *.lev in the Application Settings (see Section 4.2.4). Previous Levellogger Software used *.lev files as the default. The *.xle file type is a *.xml format, which allows for enhanced functionality. The *.xle files can be exported as *.xml files, which can be integrated into external database programs.

The *.lev files of previous Levellogger downloads are compatible with Levellogger Software Version 4 and up, however, *.xle files are not compatible with previous software versions. To ensure compatibility, all Levellogger Software versions allow data to be exported as *.csv files for use in external spreadsheet programs. See Section 7.3 for Export options.

NOTE

Before downloading data you must select the COM Port that the datalogger is connected to and retrieve the settings from the attached datalogger by clicking  in Datalogger Settings tab.

7.1.2 Downloading Data

Click  from the Data Control tab to download data from a connected datalogger. There are four options for downloading data. They are: **All Data**, **Append Download**, **Partial Download** and **Recover Previous Log**.

If you select **All Data**, the program will download all the data from the current logging session of a datalogger into a *.xle file.

The default directory for saved data is in the 'Data' folder:
<C:\Program\Files\Solinst\Levellogger4_0\Data>.

If you select **Append Download**, the program will append the data in an opened *.xle file from the datalogger. The opened *.xle file and the attached datalogger should have the same serial number and start time, otherwise an error will occur.

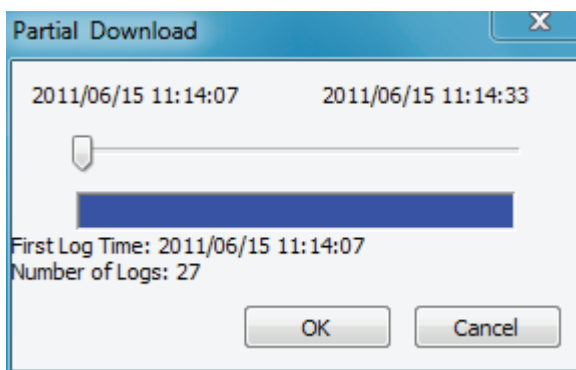


Figure 7-3 Partial Download Window

If you select **Partial Download**, a Partial Download Selection Window will open. The window shows the time stamp of the first and last reading in the logging session. Use the slider to select the time interval you would like data from. Once you click OK, all the data within that time will be downloaded to a *.xle file.

If you select **Recover Previous Log**, the software will try to recover the data from the previous log session and download the data to a *.xle file.

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

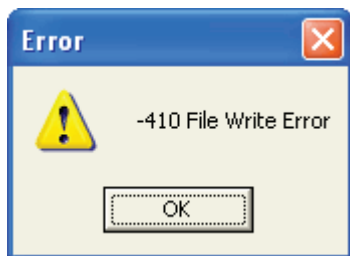


Figure 7-4 File Write Error Message

NOTE

As there is only one channel of data for the Rainlogger, there are no graphing options.

NOTE

Right click, and drag the mouse to scan the data graph.

7.1.3 Saving Data



Click  to save the data in a specific *.xle file.

The default directory for saved data is in the 'Data' folder:
<C:\Program\Files\Solinst\Levellogger4_0\Data>.

However, the default directory for saved files can be changed by clicking the Configuration menu 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 Figure 7-4, 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.

7.2 Graph Manipulation and Zoom Function

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

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

The Zoom functions can also be used for data selections in the graph.

Click  to open the Graph Option Dialog. The Graph Dialog is shown in Figure 7-5.

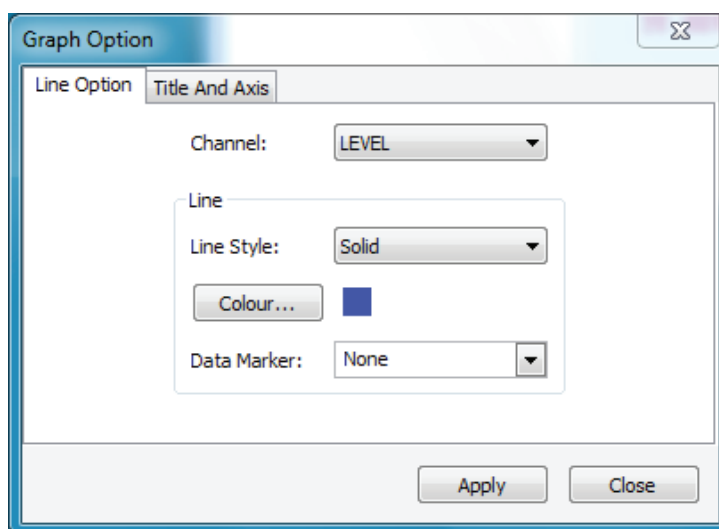


Figure 7-5 Line Option Window

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.

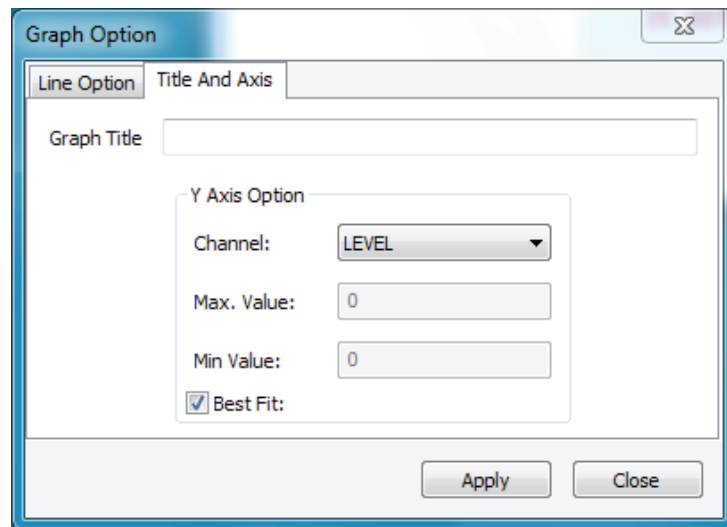


Figure 7-6 Title and Axis Option Window

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.

There is the option to show Combined Plot graphs or Separated Plot graphs of the data. Choosing a Combined Plot will show the data from each of the channels in one graph. The Separated Plot option will show a separate graph for each data channel.

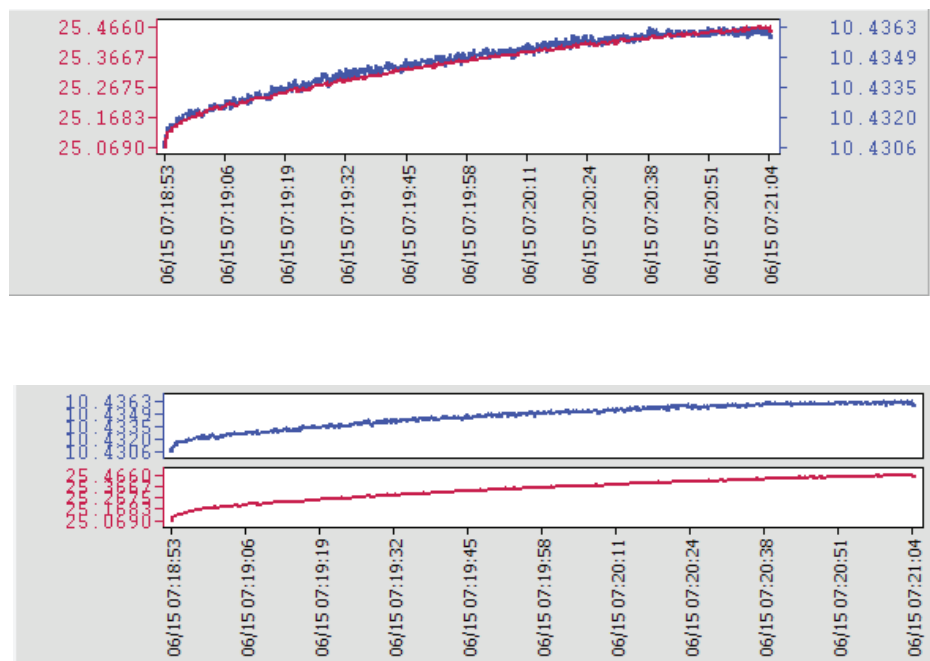


Figure 7-7 Combined and Separated Plot Graphs

There is also the option to view more than one graph at a time. Click and drag a File Name Tab and drop it when you see a shaded area on the window to open a separate graph of that data file. You can view any number of graphs at one time by re-sizing your window as required.

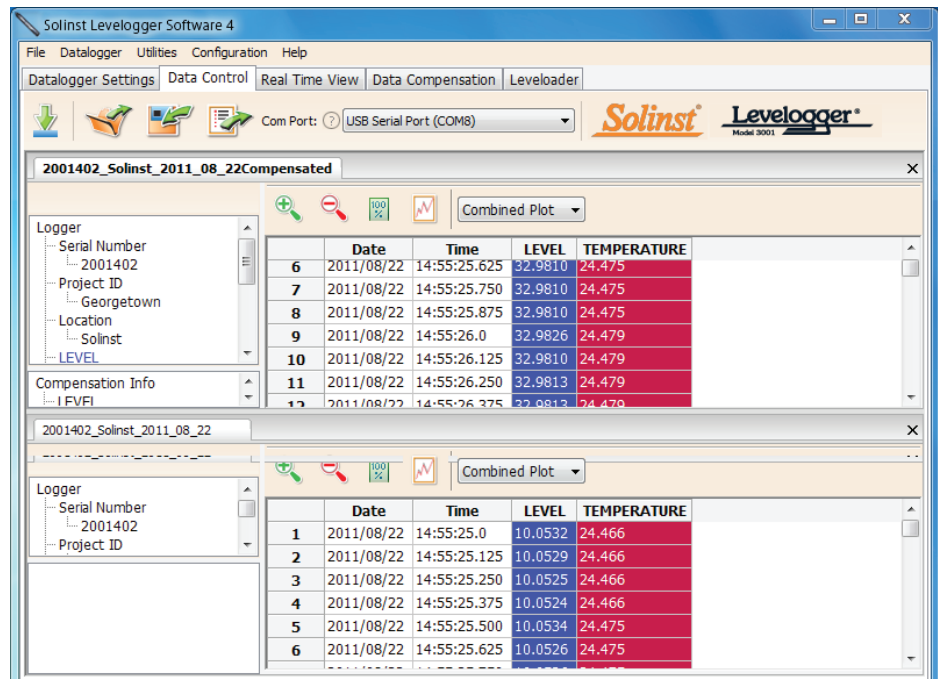



Figure 7-8 Viewing Two Graphs

7.3 File Export and Print Function

Data can be exported in *.csv (comma separated value) file format or *.xml (extensible markup language) file format by clicking File > Export > Data or .

The *.csv and *.xml file formats are supported and can be imported by most spreadsheet and database programs.

Also, the data graph can be exported to a *.bmp file or a *.wmf file by clicking File > Export > Graph.

The Datalogger Settings, data table and data graph can be printed. Click File > Print Preview, to open the Print Preview window. Figure 7-9 shows the print preview of the Datalogger Settings. The Datalogger 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 the data table.

Click Print..., to open the print dialog. You can choose to print the entire document or just a selection. You can also click File > Print, to open the print dialog.

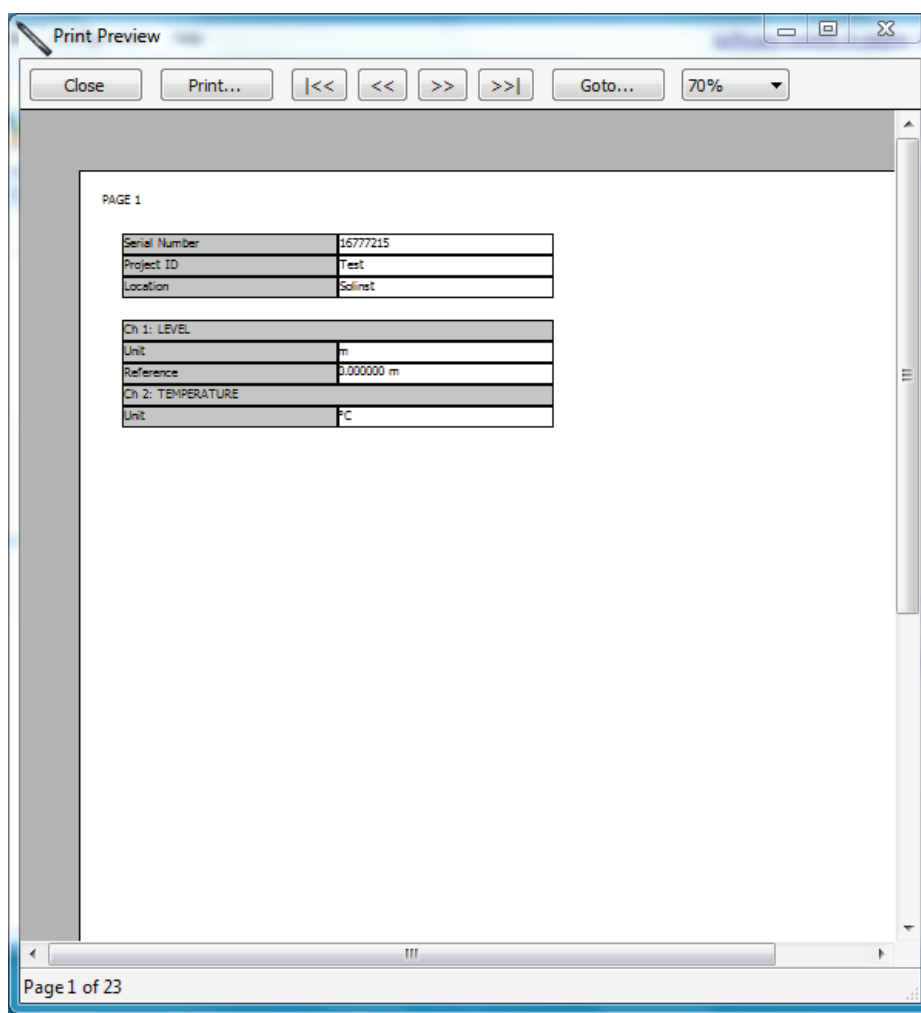


Figure 7-9 Print Preview Window

! NOTE

You **can** select multiple Levellogger files to be barometrically compensated using one Barologger file.


To perform a Manual Data Adjustment, only the one Levellogger file you want to adjust can be checked.

Unit Conversions, Offset, Altitude, Density, Barometric Efficiency, and Conductivity Adjustments can also only be made to a single Levellogger (or Barologger) file.

8 Data Compensation

Click the Data Compensation tab to open the Data Compensation Wizard.

In **Step 1** of the wizard, check the Levellogger data file(s) you would like to compensate. Any files you have open in the Data Control tab will be on the list and checked off.

Use the directory on the left of the window or click  to select any other Levellogger data files you would like to compensate, and ensure they are checked off.

You can select multiple Levellogger files that you wish to barometrically compensate, but all other compensations can only be done on one Levellogger file at a time.

Select Next to continue.

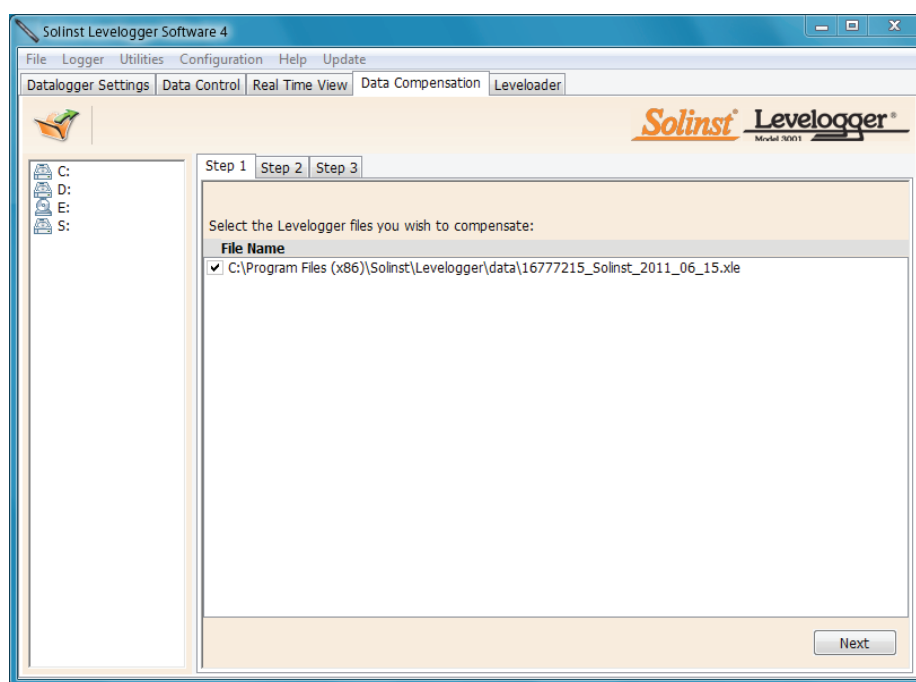


Figure 8-1 Data Compensation Wizard - Step 1

NOTE

Manual Data Adjustment, Unit Conversion, Offset, Altitude, and Density Adjustment are useful for correcting Levellogger data files to make data consistent across a project.

NOTE

Barometric Efficiency Adjustment is only available when you select Barometric Compensation.

There are eight Data Compensation options available: **Barometric Compensation, Manual Data Adjustment, Unit Conversion, Offset, Altitude, Density Adjustment, Barometric Efficiency Adjustment, and Conductivity Conversion.** Only the options available for your opened Levellogger file type will be active (e.g. Conductivity Conversion is only available for LTC Levellogger Junior files).

In **Step 2**, check the type of compensation you want to perform. Note: if multiple Levellogger files have been checked off in the first step, Barometric Compensation will be the only option available. All other options are only available when a single Levellogger file is selected.

A step-by-step approach must be taken when compensating a file; perform the first compensation, then use the new compensated file to perform the next adjustment.

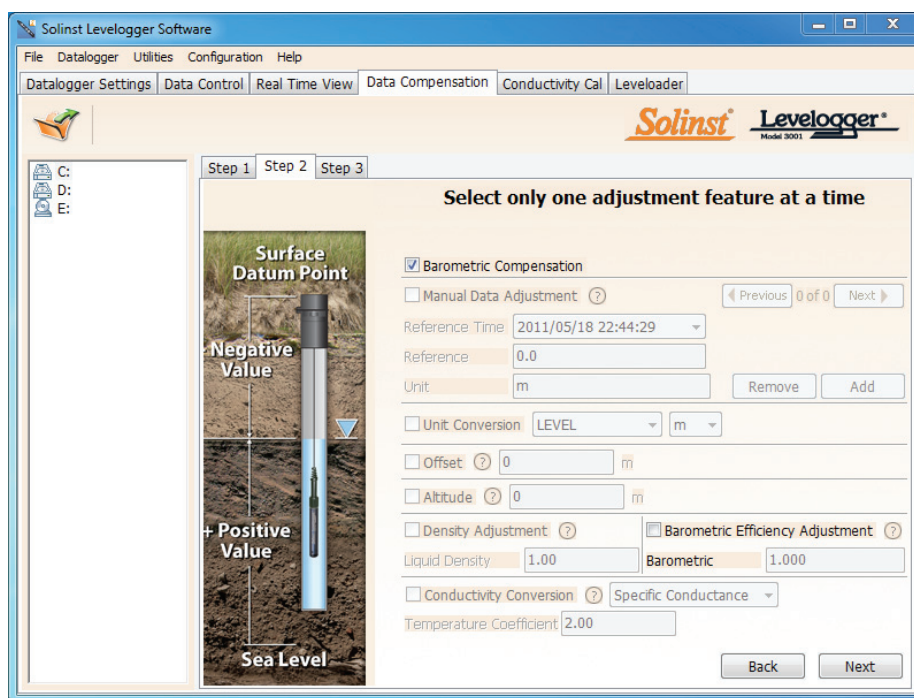


Figure 8-2 Data Compensation Wizard - Step 2

NOTE

For best accuracy, Barometric Compensations should be performed using Levellogger files and a Barologger file with the same start time and logging interval.

Barometric Compensation simply subtracts the barometric reading from the corresponding Levellogger reading(s). **For best accuracy, the Levellogger file(s) and Barologger file should have the same start time and logging interval.** The Future Start option in the Datalogger Settings tab is a convenient way to start all of your loggers at the same time. If there is an inconsistency of the time stamp between the Barometric file and the Levellogger file(s), a linear approximation on the barometric data will be performed.

! NOTE

If you are using Barologger Gold or Levellogger Gold files and had initially set up the loggers with an Altitude (see Section 5.9), you will still need to enter the Altitudes in Step 3 of Barometric Compensation. If not, the Software will assume the Altitude to be 0 (sea level).

! NOTE

If you are using a Levellogger file(s) that has already been compensated for Altitude, you still need to enter a Reference Altitude and Static Water Level from Reference Altitude, or the Software will assume the values to be 0 (sea level).


! NOTE

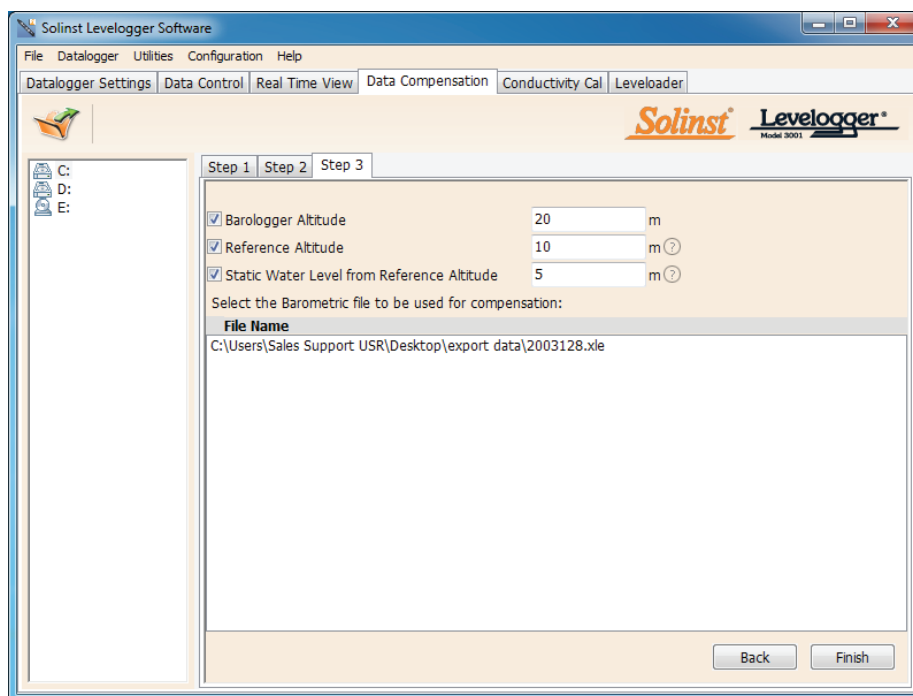
If you have selected multiple Levellogger files to be compensated, the values entered in Step 3 will be used to compensate all of the selected Levellogger files.

When you select Barometric Compensation, **Step 3** will allow you to enter the following values.

- **Barologger Altitude:** enter the Altitude at which the Barologger is actually deployed. The Barologger readings will then be compensated for elevation.
- **Reference Altitude:** i.e. surface datum point, top of well casing or well head. This value will adjust all Levellogger files when multiple file barometric compensation is conducted.
- **Static Water Level from Reference Altitude:** enter the distance between the Reference Altitude and static water level. This value will adjust all Levellogger files when multiple file barometric compensation is conducted.

It should be noted that if you choose not to enter these values, the Software will assume the values to be 0 (sea level). Also, if you have selected multiple Levellogger files to be compensated, the values entered in Step 3 will be used to compensate all of the selected Levellogger files.

In **Step 3**, you will also select the Barologger file you wish to use for compensation using the directory on the left of the window or by clicking . Click Finish to complete the Barometric Compensation.



Solinst Levellogger Software

File Datalogger Utilities Configuration Help

Datalogger Settings Data Control Real Time View Data Compensation Conductivity Cal Leveloader

Solinst Levellogger® Model 3001

Step 1 Step 2 Step 3

☒ Barologger Altitude 20 m

☒ Reference Altitude 10 m

☒ Static Water Level from Reference Altitude 5 m

Select the Barometric file to be used for compensation:

File Name

C:\Users\Sales Support\USR\Desktop\export data\2003128.xle

Back Finish

Figure 8-3 Barometric Compensation - Step 3

NOTE

You can use the Manual Data Adjustment to display Levellogger readings as depth-to-water measurements from the top of a well casing.

NOTE

To perform a Manual Data Adjustment, only a single Levellogger file you want to adjust can be selected in Step 1.

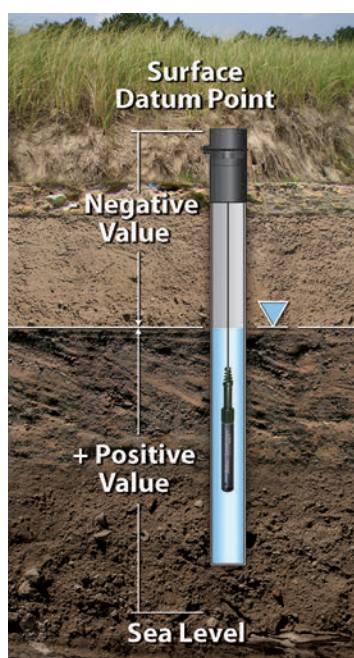


Figure 8-4 Reference Datum

Manual Data Adjustment allows you to enter a manual water level measurement as a Datum Reference or field zero, which all Levellogger water level readings can then be adjusted to.

If the Datum is above water level (e.g. top of well casing), the datum must be input as a negative value. If the Datum is below water level (e.g. sea level), a positive value is input. The date and time of measurement of the Datum Reference must be recorded to complete the adjustment. This Reference Time must replace an actual reading in the Levellogger file, and is selected from the drop-down menu showing all time stamps in the Levellogger file. You can make multiple adjustments to one data file by selecting 'Add' to enter another Datum Reference. All readings after this Reference Time, will be adjusted to this second Datum reference point. You can add as many adjustments to one Levellogger data file as you would like (as long as it doesn't exceed the total number of readings in that file).

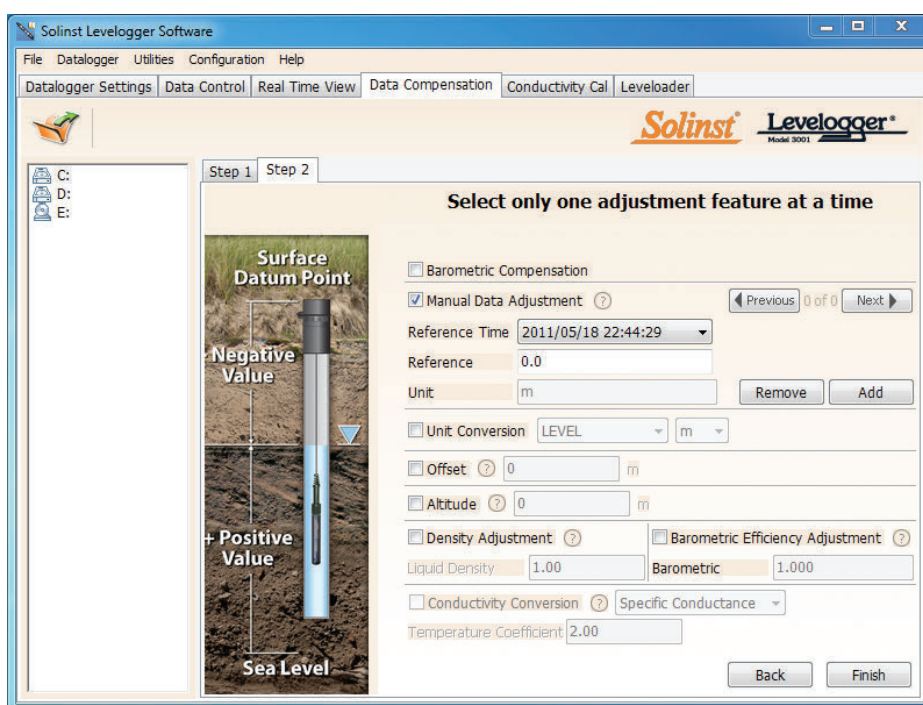


Figure 8-5 Manual Data Adjustment

NOTE

Unit Conversions, Offset, Altitude, Density, Barometric Efficiency, and Conductivity Adjustments can only be made to single Levellogger files.

Unit Conversion allows you to convert water level readings in a Levellogger file to different units (m, cm, ft, kPa, bar, or psi), or temperature readings to °C or °F.

Offset allows you to enter any value, positive or negative, which will be added to each reading in the selected Levellogger file to offset by that amount.

Altitude is used to correct for elevation. Water column equivalent pressure decreases with altitude at a ratio of approximately 1.21/1000 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.

Density Adjustment corrects the range of the level channel in the data file based on a user input adjustment of fluid density. The range of the density adjustment is from 0.9 kg/L to 1.1 kg/L.

NOTE

Barometric Efficiency Adjustment is only available when you select Barometric Compensation.

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 10.1.3. The barometric efficiency can be set from 0.01 to 3.00.

Conductivity Conversion allows you to convert raw Conductivity readings from an LTC Levellogger Junior, to Specific Conductivity (conductivity that is temperature compensated to the standard of 25°C). The Temperature Coefficient default for Specific Conductivity is 2.00. The Temperature Coefficient should not be adjusted, unless you know the value specific to the solution you are measuring. You can also convert Conductivity readings to Salinity expressed in Practical Salinity Units (PSU) (See Section 1.2.4).

Click Finish to complete the selected compensation.

The compensated data will be saved in a new *.xle file. The default file name will be the <original 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. The compensated file can be opened from the Data Control tab. All data files are saved to the default location: <C:\Program Files\Solinst\Levellogger4_0\Data> .

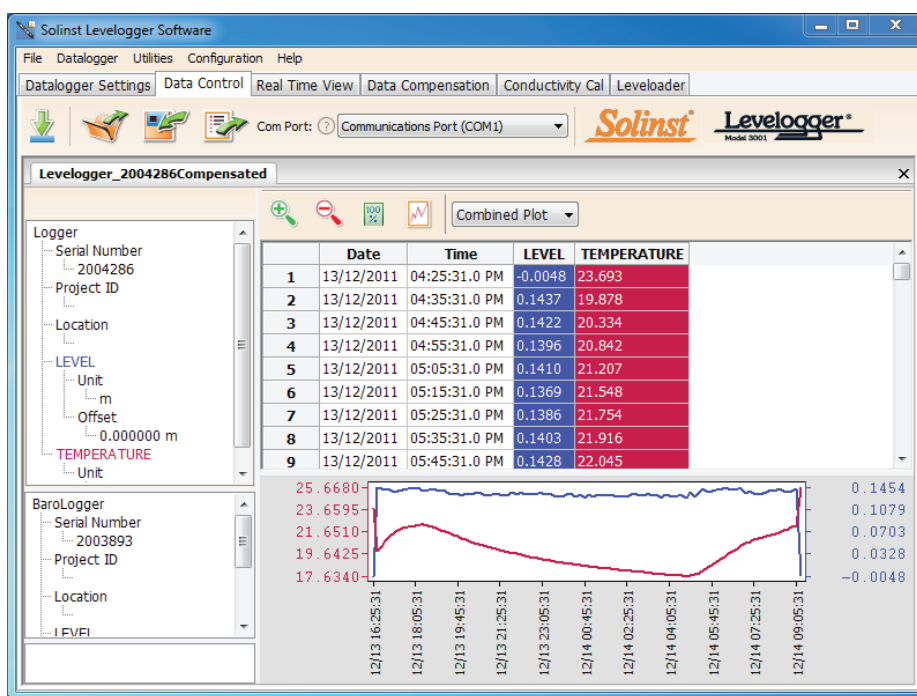


Figure 8-6 Viewing Compensated Data

All the original Levellogger settings and the channel information effective during data collection are shown on the top left of the window. The bottom left sections of the window are used to display the compensation information. The middle section displays information from a Barologger, if a barometric compensation is performed, and the bottom section includes information about other compensations, such as Offsets or Conductivity Conversions.

NOTE

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.

NOTE

For Manual Barometric Compensation instructions for the Levellogger Gold and Levellogger Junior, visit: www.solinst.com and see the Levellogger Software Version 3.4.1 User Guide in the Downloads Section.
Or view "Automatic or Manual Barometric Compensation of Your Levellogger Data" in the Technical Bulletin Section at: <http://www.solinst.com/Prod/3001/Datalogger-Technical-Bulletins.html>

NOTE

You can also convert the Levellogger Edge data units to match the Barometric units using the Data Compensation Wizard.

NOTE

It is important to remember that weather station barometric data will often contain an offset or normalization (i.e. normalization to sea level). Manual data conversion and barometric compensation should account for any variation of the normalization or offset used between the barometric data sourced and Solinst Levelloggers.

8.1 Manual Barometric Compensation

This section describes how to perform manual barometric compensation on Levellogger Edge and Levellogger Junior Edge data files when a Barologger was not dedicated as a barometric recorder.

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 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. To accomplish an accurate manual barometric compensation, the atmospheric pressure station should not be greater than 20 miles (30 km) away and within an elevation change of 1000 ft (300 m). In addition, the date and time of the barometric data should cover the range of data collected by the Levellogger. 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, these steps must be taken:

- 1) Export both the Levellogger data file and the barometric file to a spreadsheet.
- 2) In the spreadsheet, ensure both files are using the same units. If your Levellogger data was recorded in m, cm, or ft, convert the barometric data column from its barometric measurement units (typically atm, mm Hg, psi, mbar or kPa) to feet or meters of water column equivalent using the conversion factors in Table 8-1. (There is also the option to initially set up your Levellogger Edge or Levellogger Junior Edge to record in psi, kPa, or mbar. This makes compensation using other atmospheric pressure devices easier.)

Table 8-1

Common barometric units to water column equivalent conversions		
<u>Barometric unit</u>	<u>Water column equivalent (ft)</u>	<u>Water column equivalent (m)</u>
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 mbar	0.03352	0.01022

Table 8-1 Common Barometric Units to Water column Equivalent Conversions

- 3) Once the units for each column are the same, subtract the barometric column from the Levellogger data to get the true net water level recorded by the Levellogger Edge.

NOTE

Datalogger settings can not be changed in the Real Time tab. Changes must be made in the Datalogger Settings tab. The changes are applied when the Real Time readings are started.

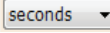



NOTE


You can also view Real Time readings from a Rainlogger using firmware version 2.000 or higher.

9 Real Time View



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

First, select a non-logged view rate  1 . 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.

Checking, **Enable Manual Data Adjustment**, allows you to enter a datum/ field zero (e.g. depth to water level) to which the change in Real Time View level measurements are then adjusted against. This is only available when you are taking readings in m, cm, or ft.

Real Time View readings can be displayed as a graph or in tabular format. The same graphing options as the Data Control tab are available for Real Time View readings. 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 . 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 .

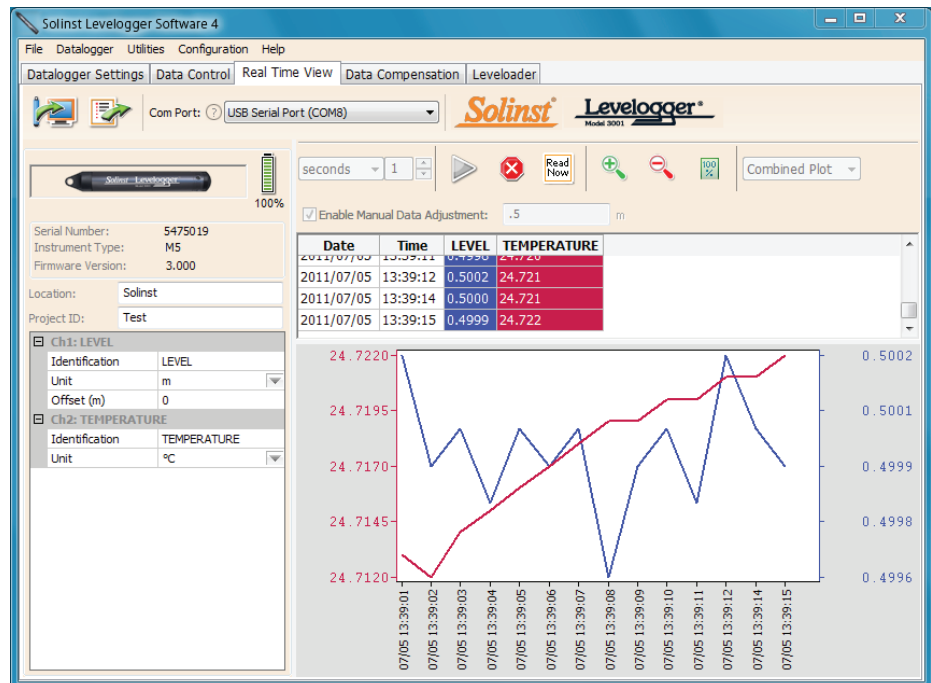


Figure 9-1 Real Time View Window

10 Installation and Maintenance of Levelloggers

10.1 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 a 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.

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 (Figure 10-1). In vertical orientations, the sensor detects pressure above the pressure transducer line, whereas 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. Levelloggers should always be installed with the installation cap on (if not using a Direct Read Cable), whether it is being suspended by it or not. This prevents unnecessary battery drainage and protects the optical eyes.

Make sure you properly estimate the maximum and minimum expected water levels during the monitoring period. You need to install your Levellogger so it remains submerged at all times, and ensure that its maximum submergence depth throughout the monitoring period remains within its specified range. The pressure transducer can be damaged if the datalogger is over-pressurized by submergence greater than its level range. The Levellogger Edge and Levellogger Junior Edge are warranted to pressures up to 200% of their full scale level range (150% for the Levellogger Gold, Levellogger Junior and LTC Levellogger Junior Models), 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.

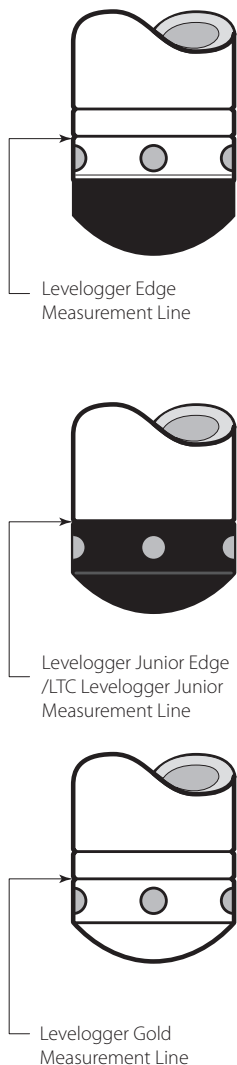


Figure 10-1



Figure 10-2
Solinst 2" Locking Well Cap
for Wireline or Kevlar Cord

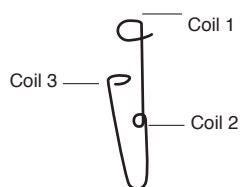


Diagram 1

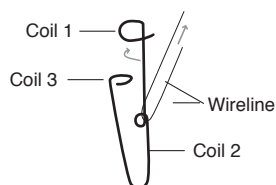


Diagram 2

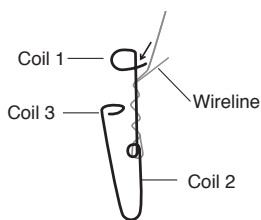


Diagram 3

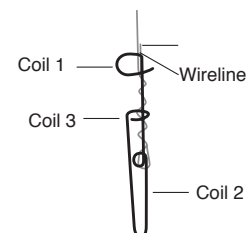


Diagram 4

Figure 10-3 Wireline Hook Installation

10.1.1 Free Suspended Installations

10.1.1.1 Suspension Wire/Cord Installation

When installing on a suspension wire or cord, the Levellogger is pre-programmed and started using the software. It is then deployed with the suspension wire or cord connected to the installation cap of the Levellogger to the underside of a well cap. The data is retrieved manually, by withdrawing the Levellogger, 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. This type of installation is applicable to both submerged and barometric record applications.

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 cord assemblies to 500 ft (150 m). Solinst also supplies the Model 3001 2" Well Cap Assembly from which the Levellogger can be suspended. An Adaptor for 4" wells also available (see Section 10.1.1.3).

Follow these steps to install the Levellogger using **stainless steel wire 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 Well Cap eyelet or Levellogger/Barologger eyelet and snap coil 3 to the hook shaft.
- 3) If the Well 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 Levellogger, extract it from the monitoring location, un-thread the installation cap, interrogate and re-suspend the unit rechecking the security of the wireline clamps each time.



Figure 10-4 Kevlar Cord

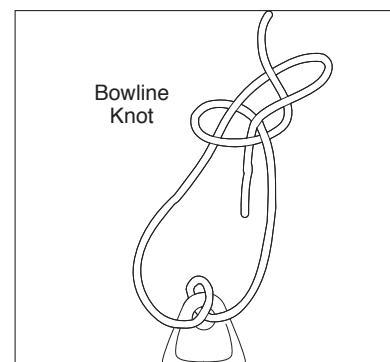


Figure 10-5 Bowline Knot Used to Connect
Kevlar Cord to the Levellogger

It is recommended that the **Kevlar cord** be connected to the Levellogger and well cap using a bowline knot (see Figure 10-5). The Kevlar cord is comprised of multiple Kevlar strands braided with black nylon, and has a break strength of 150 lbs. Kevlar is very suitable for underwater applications in freshwater and marine environments, as the material resists rusting.



Single Well Cap Option



Dual Well Cap Option

Figure 10-6
Solinst 2" Locking Well Caps for
Direct Read Cable Installation



Figure 10-7
Solinst Direct Read Cable

10.1.1.2 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.

The Direct Read Cable system is composed of the ordered length of Direct Read Cable, the Model 3001 Well Cap Assembly (see Section 10.1.1.3) 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 Well Cap insert. The PC Interface Cable connects to the Direct Read socket at surface and to either a USB or RS-232 port on the PC. While use of the Model 3001 Well Cap 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 Well Cap insert.
3. Remove the protective cap from the non-optical socket at the wellhead end of the Direct Read Cable, seat the socket in the Well Cap Insert and align and thread it to the round socket of the PC Interface Cable.
4. Connect the USB or RS-232 socket of the PC Interface Cable to the USB or RS-232 Com Port on your PC.
5. The two plugged holes in the Well Cap can be opened to provide an access port for a Barologger, as well as 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 10-8 Proper way to remove a Direct Read Cable from a Levellogger

10.1.1.3 Model 3001 Well Cap Assembly

The Model 3001 Well Cap Assembly is designed to fit 2" wells, and provides options for installing Levelloggers with wireline, Kevlar cord, or using a Direct Read Cable.

The well cap base provides a tight friction fit onto the well casing. The cap is secured to the base with a twist lock. For further security, a 3/8" (9.5 mm) shackle diameter lock can be used. The Well Cap is vented to allow for the equalization of barometric pressure in the well. Users can choose to permanently secure the PVC Well Cap to the well casing, using three screw points on the inner shoulder of the Well Cap Base.

For wireline or Kevlar cord suspension, simply use the suspension hook on the underside of the insert to secure the Levellogger to the Well Cap (see Section 10.1.1.1). To install using a Direct Read Cable, lower the Levellogger with the Direct Read Cable through one opening in the insert (see Section 10.1.1.2).

! NOTE

The insert has openings to hold two Direct Read Cables in the same well. If only one Direct Read Cable is used, the other hole provides access for Solinst Water Level Meters.



Figure 10-9 Model 3001 Well Cap Assembly (#110099)



Figure 10-10 If installing Levelloggers in a 4" well, a reducer assembly is available. (#110235)



Figure 10-11
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).

10.1.2 Fixed Installations

10.1.2.1 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 10-11. 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 10.1.3.1). 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.

10.1.2.2 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 previously in this section. Levelloggers or Barologgers can be used to monitor the drop in pressure.



Figure 10-12 Levellogger and Barologger in Well

10.1.3 Barologger Installation

The Barologger is a Levellogger with a small range adequate to monitor the fluctuations that occur in barometric pressure. The Barologger's readings are used to barometrically compensate Levellogger readings. As a rule of thumb, a Barologger can be used to compensate all the Levelloggers 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 (the well must be vented). For best reading accuracy, the Barologger should be installed in a similar thermal environment to that of the Levellogger. 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 8.1.

10.1.3.1 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.

NOTE

The Barologger Edge should not be used to monitor water, as the internal mathematics for temperature compensation are based on air rather than water.

The absolute pressure method used in the Levellogger and Barologger provide the user with the data necessary to determine barometric efficiency and time lag. 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.

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.



Figure 10-13 Solinst Rainlogger



3 Pin Rain
Gauge Connector

Figure 10-14
The Tipping-bucket Rain Gauge Connector
of the Rainlogger

10.1.4 Rainlogger Installation

The Solinst Rainlogger (Figure 10-13) is designed to log the tip times of an external tipping-bucket rain gauge, and output the amount of rainfall per tip.

The waterproof housing is made of stainless steel. Direct exposure to rainfall should be avoided, and the Rainlogger should not be submerged.

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 (Figure 10-14) 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 usually matter to which terminal on the tipping-bucket the blue or brown wire is connected. Refer to the tipping-bucket manufacturer's instructions. Longer, exposed cables should be protected from rodents and vandalism by cable armoring or installation within electrical conduit.



Figure 10-15 Rainlogger Connected to Tipping-bucket

10.1.5 Installation in Extreme Environments

10.1.5.1 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. A 9% expansion can equate to extreme pressure as demonstrated in Example 10.1. Therefore, solid freezing has the potential to damage the pressure transducer, which is rated to withstand up to 200% (150% for the Levellogger Gold and Junior Models) of its depth fluctuation range. Pressures beyond this threshold may damage the transducer. As such, care should be taken when choosing the appropriate pressure transducer range for your application.

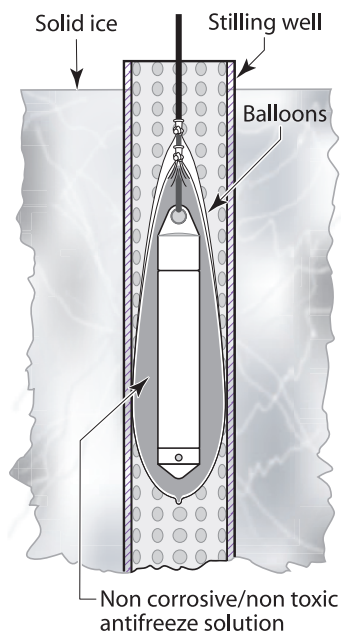


Figure 10-15
Installation in Freezing Liquid

NOTE

Although precautions can be taken, placing a Levellogger in a situation where the water may freeze solid can permanently damage the sensor.

Example 10.1 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, i.e. the speed at which freezing occurs. For example, liquid freezing at -22°C , can create expansion pressures of 22 kg/cm^2 or 313 psi or the equivalent of 721 ft or 220 m water column depth.

With 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 can be filled with a non-toxic, non-corrosive anti-freeze solution and sealed (Figure 10-15). 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. However, it should be noted that even if these precautions are taken, there is still the risk that placing a Levellogger in a situation where the water may freeze solid can permanently damage the sensor (see Example 10.1).

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°C - 80°C (-4°F - 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.

10.1.5.2 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 inputting the density of the monitored fluid in the Datalogger Settings window for the LTC Levellogger Junior and the Levellogger Gold Series (see Section 5.1). Also, see Section 8 for details in compensating the Levellogger Edge and Levellogger Junior Edge for fluid density differences.

The Levellogger Edge can be used for monitoring in salt or brackish water. However, long term use of the stainless steel body Levellogger Junior Edge, LTC Levellogger Junior, Levellogger Junior and first generation LTC and LT Levelloggers 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 Levellogger Junior Edge, LTC Levellogger Junior, Levellogger Junior, and first generation LTC and LT Levelloggers.

If using these dataloggers 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 10.1.5.1. 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 a Direct Read Cable is attached to the Levellogger during storage to prevent unnecessary battery drain and to protect the optical eyes.

10.2 Levellogger Maintenance

Levellogger maintenance consists of cleaning the outside 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.

Cleaning LTC Levellogger Junior sensor pins is recommended before calibrating the unit prior to starting a project. The pins of the LTC Levellogger Junior sensor are platinum-coated, therefore they should not be roughly cleaned or touched with any metal. They can be cleaned with a soft bristle brush, Q-tip, or cloth. Almost any acid solution can be selected to clean the sensor, provided it is highly diluted (generally less than 10% acid). The "soaking" time should be monitored and kept to a minimum.

11 Diagnostics Utility

The Levellogger Diagnostics Utility can be used for troubleshooting Levelloggers and obtaining information about that Levellogger that can assist the Solinst Technical Support representative to identify and fix any problems you may encounter with your Levellogger. The Diagnostics Utility can be launched from the Utilities menu at the top of the software. The utility can be used to run a self-test, do a Memory Dump and create and email reports.

11.1 Run Diagnostics

The Run Diagnostics function reads the following information from the Levellogger:

- 1) Serial Number
- 2) Model Number
- 3) Firmware Version
- 4) Battery Voltage
- 5) Charge Level
- 6) Current Level Reading
- 7) Current Temperature Reading
- 8) Max/Min Pressure Reading
- 9) Max/Min Temperature Reading
- 10) Max/Min Conductivity Reading
- 11) Total Number of Logs

This information can be used to identify firmware, battery and/or temperature/pressure sensor problems. This function also 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 emailed to Solinst Technical Support. To execute this function simply click the 'Run Diagnostics' button.

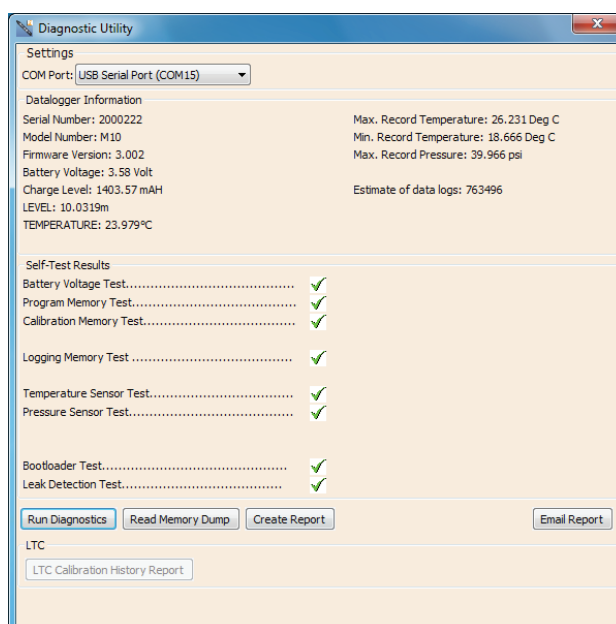


Figure 11-1 Run Diagnostics

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.

11.2 Read Memory Dump

This function 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 create a *.xle file of the data to save.

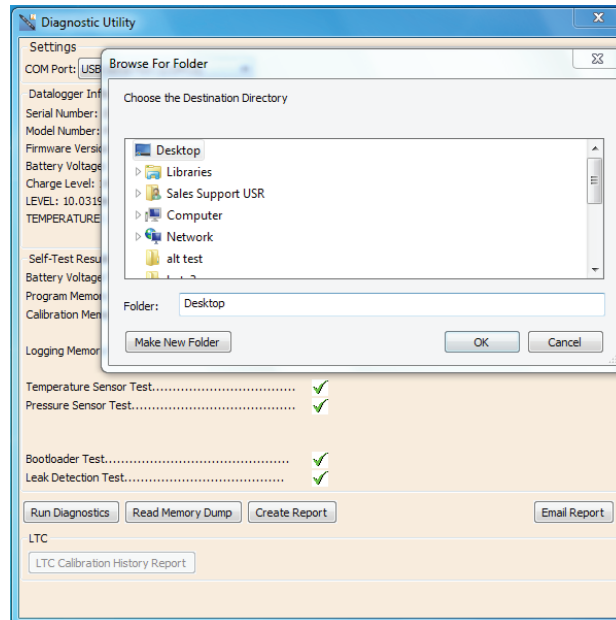


Figure 11-2 Read Memory Dump

NOTE

The 'Email Report' option automatically creates a report and attaches it to an email to send to Solinst - all in one step.

11.3 Create Report

This function simply creates a text file containing the information obtained from the Run Diagnostics function. 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 saved or sent to Solinst Technical Support for troubleshooting. If creating a report for an LTC Levellogger Junior, the LTC Calibration History Report will be included.

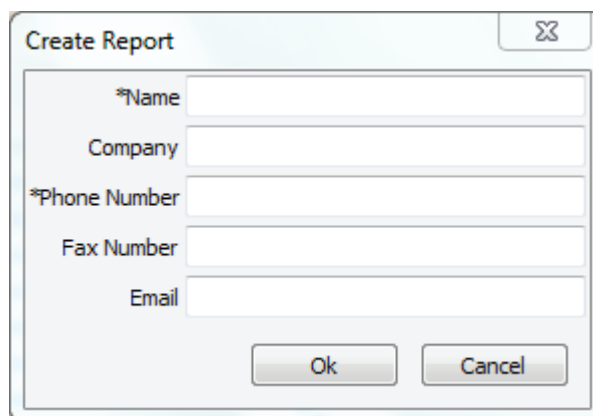


Figure 11-3 Customer Info Input Window

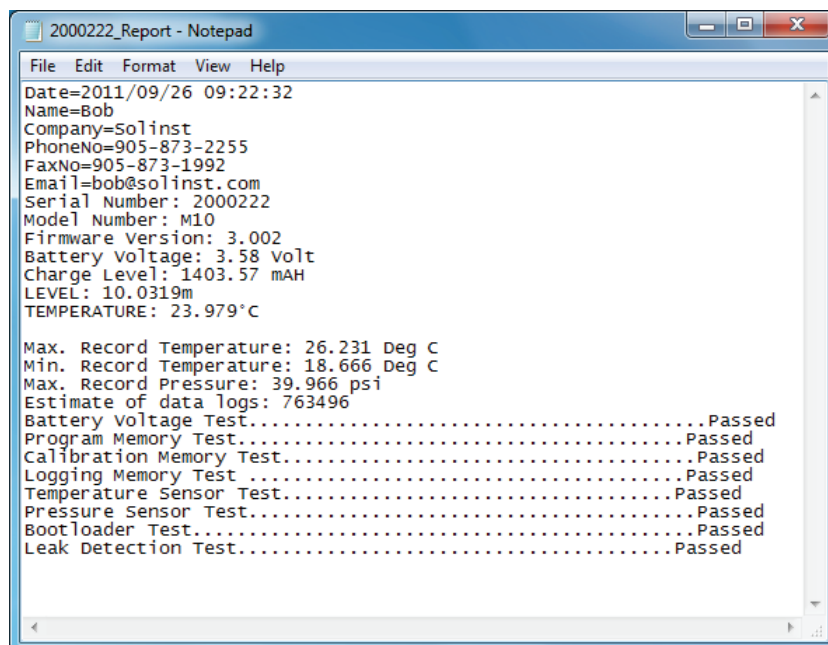


Figure 11-4 Report Example

11.4 Email Report

Clicking Email Report will guide you through the process of creating a Diagnostics Report, and it will automatically attach the report to an email to send to Solinst Technical Staff for troubleshooting. If you are emailing a report for an LTC Levellogger Junior, the LTC Calibration History Report will be included.

11.5 LTC Calibration History Report

This function creates a report of all previous user calibrations performed on the LTC Levellogger Junior. Use it to send a history report to Solinst for analysis if the LTC Levellogger 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.

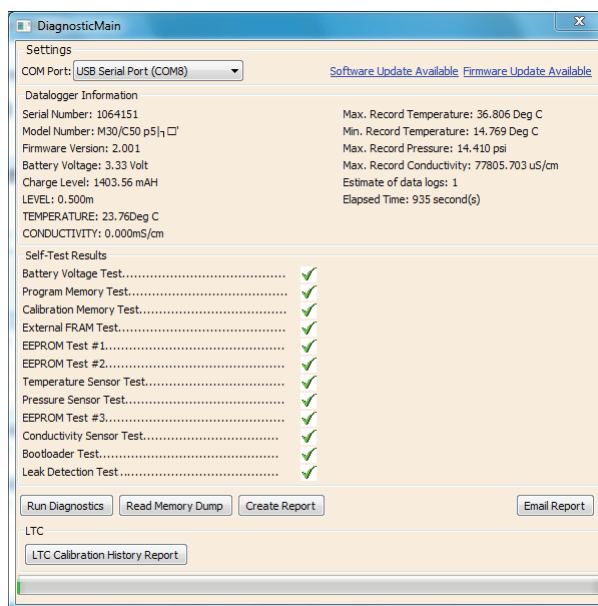


Figure 11-5 LTC Calibration History Report

11.6 Software/Firmware Updates

Each time the Diagnostic Utility is opened, it automatically checks for software updates. If there is an update, "[Software Update Available](#)" will appear in the top right of the window. When you click the message, a web page will open, allowing you to download the software update.

The Utility also checks for firmware updates. "[Firmware Update Available](#)" will appear in the top right of the window. Clicking the message will open a web page where you can download the firmware update. See Section 12 for firmware update instructions.

! NOTE

Your Computer must have an internet connection to check for software and firmware updates.

You can also check for updates using the Help menu.

NOTE

To check for firmware updates using Levellogger Software, retrieve settings from the connected datalogger (see Section 5). "Firmware Update Available" will appear in the top right menu bar if there is an update available. Clicking the message will open a web page where you can download the firmware update. You can also use the Software's Help menu.

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.

12 Firmware Upgrade Utility

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

Make sure to unzip the firmware file after you have downloaded it, so you can access the *.ssf file.

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

- 1) Open the Solinst Firmware Upgrade Utility from the Utilities menu in the main Levellogger Software. Pick the Com Port to which the Levellogger is connected and make sure the Baud Rate is set to 9600.
- 2) Click the 'Open' button , which should open a file dialog asking for the firmware file (*.ssf) to upload. Navigate to the directory where the firmware file was saved on your PC, 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 , to start the firmware upload process.
- 5) If a communication error occurs and is indicated in the Levellogger Information Window (Figure 12-1) 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.

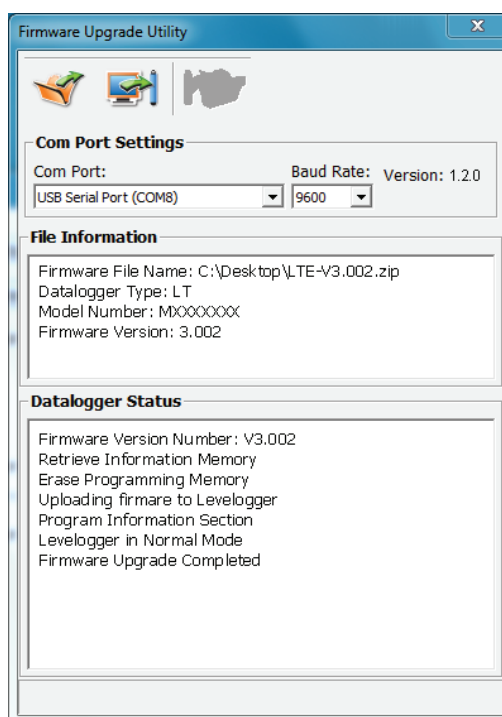


Figure 12-1
Firmware Upgrade Utility Window

13 Trouble Shooting

13.1 Problems During Installation of Levellogger 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 XP/Windows Vista/Windows 7 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.

13.2 Error During Software Uninstall Process

The ‘Add/Remove Program’ cannot locate the Levellogger <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>

13.3 Problems During Installation of RS-232 to USB Converter

Unable to install the RS-232/USB converter from Keyspan or IO Gear

- 1) After plugging in the RS-232/USB Converter, a Hardware Installation Wizard will open. Follow the instruction from the Wizard and make sure to select the RS-232/USB Converter Driver from the Keyspan or IO Gear Installation CD.
- 2) If the Hardware Installation Wizard does not open after plugging in the RS-232/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.

13.4 Data Has Been Erased Accidentally

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

13.5 Error Messages During Use of Software

‘Communication Time Out’ or ‘Communication Error’ or ‘The Command that is sent to the Levellogger Edge is not defined’

- 1) Try communicating with another Levellogger, Optical Reader or Direct Read Cable. The communication cable, Optical Reader or Levellogger 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 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/RS-232 converter, refer to the 'Problems During Installation of RS-232 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 default data folder, change the folder as follows: in the Levellogger 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 <*.xle> 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'

Try clicking the Retrieve Settings icon again, or 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 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/Edge supports this function'

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

'Schedule cannot be empty'

When using the 'Schedule' sampling option in a Levellogger Gold/Edge, 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 (or up to 120,000) individual readings.



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High Quality Groundwater and Surface Water Monitoring Instrumentation

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