VSL

Voltage Sensor Logger Manual

Contents

1. Introduction

The Voltage Sensor Logger (VSL) is a complete system for collecting and storing data.

The Voltage Sensor Logger (VSL) is a stand-alone logging instrument for the measurement of any sensor with a voltage input/output. The VSL can support up to 5 differential or up to 10 single ended sensors with the same voltage input requirements.

The VSL is a fully self-contained unit, only requiring power input from a 20W solar panel (field applications) or 24V power supply (laboratory applications). Communication is via a USB port or ICT 2.4GHz wireless. The VSL is IP-65 rated.

The VSL is ideally used in combination with the ICT International range of soil, plant and environmental sensors. To custom design a VSL to your sensor contact ICT International.

2. System Requirements

2.1 Hardware

The ICT Instrument software does not require a powerful computer. Recommended Minimum System Specifications:

Intel Atom 1.66 GHz and 1GB RAM or higher.

2.2 Software

The ICT Instrument software is compatible with the following operating systems:

- Windows 7
- Windows 8 & 8.1
- Windows 10
- Mac OS X

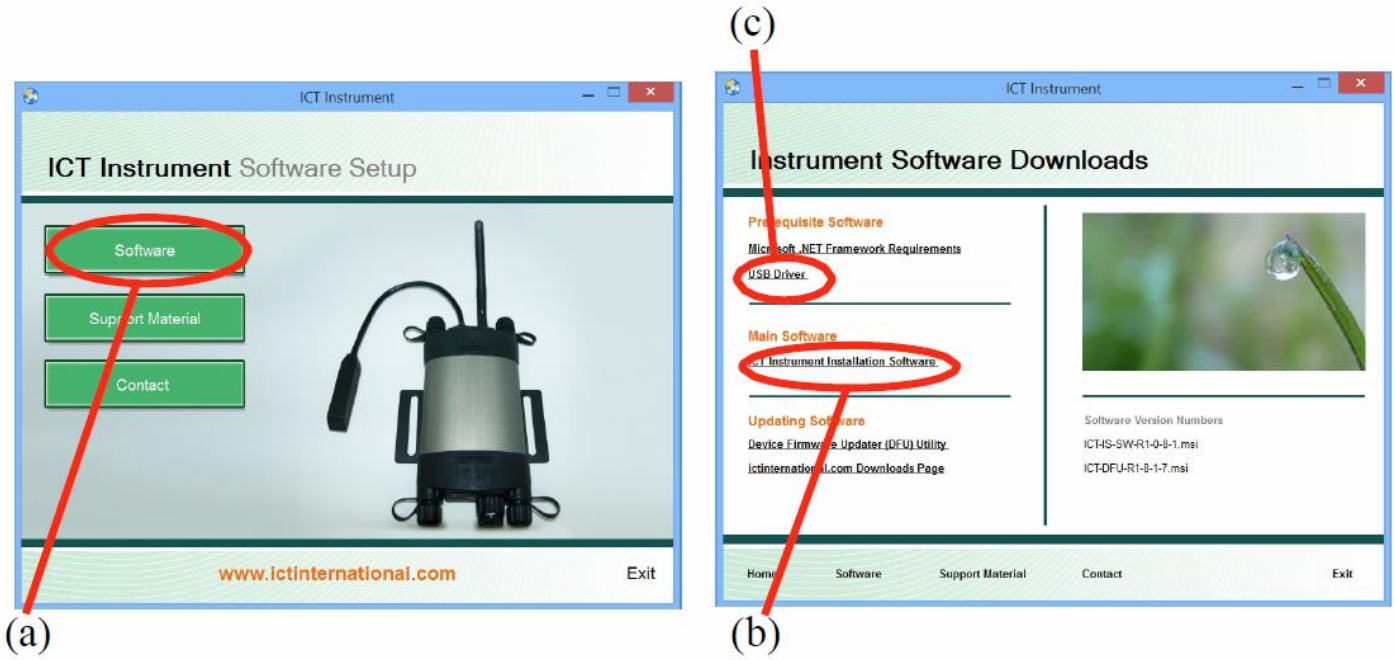
3. Install the VSL Software & USB Driver

Insert the supplied USB drive and run Autorun.exe.

Choose Software (a) then choose ICT Instrument Software (b).

Follow the on-screen prompts until the finished installation screen appears.

To install the USB driver, choose USB Driver (c) and wait for the installation to complete.



Alternatively, the individual installers (Windows and Mac) are available in the Instrument Software folder.

The most recent versions of all ICT Software are available from:
http://www.ictinternational.com/support/software/

4. Charging the VSL Internal Battery

The VSL is a self-contained instrument that incorporates an internal lithium polymer battery. Before using the instrument, this battery should be charged. To choose from a range of charging options see Connecting a Power Supply to the VSL (pages 8 to 12).

The VSL internal battery can supply up to 18 hours of continuous use between recharges. It is recommended to charge the battery overnight with the CH24 power supply for use in the field the next day.

An external power supply can be connected to the VSL in the field. See Connecting a Power Supply to the VSL (Field Operation) (pages 11 & 12) for more details.

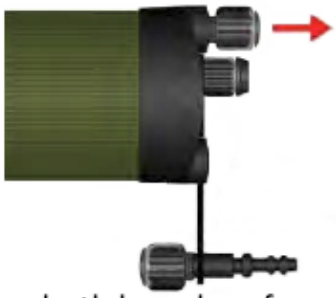
The unique bus plug power-bus design was developed by ICT International to simplify the electrical wiring process. It minimises the need for custom tools in the field requiring only that the outer sheath of the power cable be stripped back to expose the copper wire.

As shown in Connecting a Power Supply to the Instrument (page 8) no other tools are required - all necessary components and fixings are fully incorporated into the instrument design. Retaining straps ensure the power-bus plugs do not separate from the instrument when removed from the power-bus during wiring preparation and connection of external power.

4.1 Connecting a Power Supply to the Instrument

Important: Do not connect external power until the final step

1



Remove both bus plugs from either side of one end of the logger.

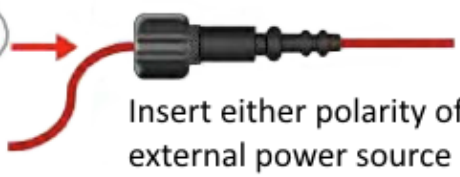
2

Unscrew the end of the plug 1 to 2 turns

3

Remove the sealing cap.

4



Insert either polarity of the external power source cable

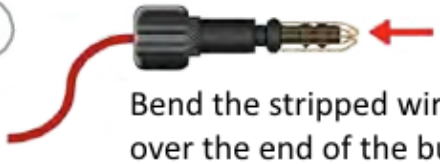
5

Strip about 15mm from from the end of the cable

6

Pull the cable back so that only stripped wire protrudes from the bus plug.

7



Bend the stripped wires back over the end of the bus plug.

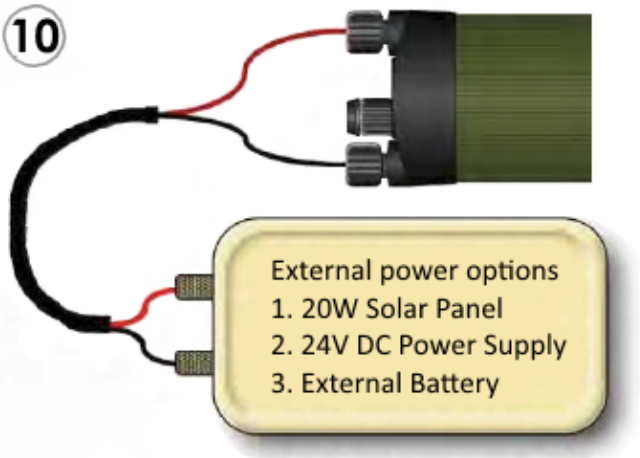
8

Important: Seal the cable against water ingress by tightening the end of the plug.

9 **Repeat for second bus plug**

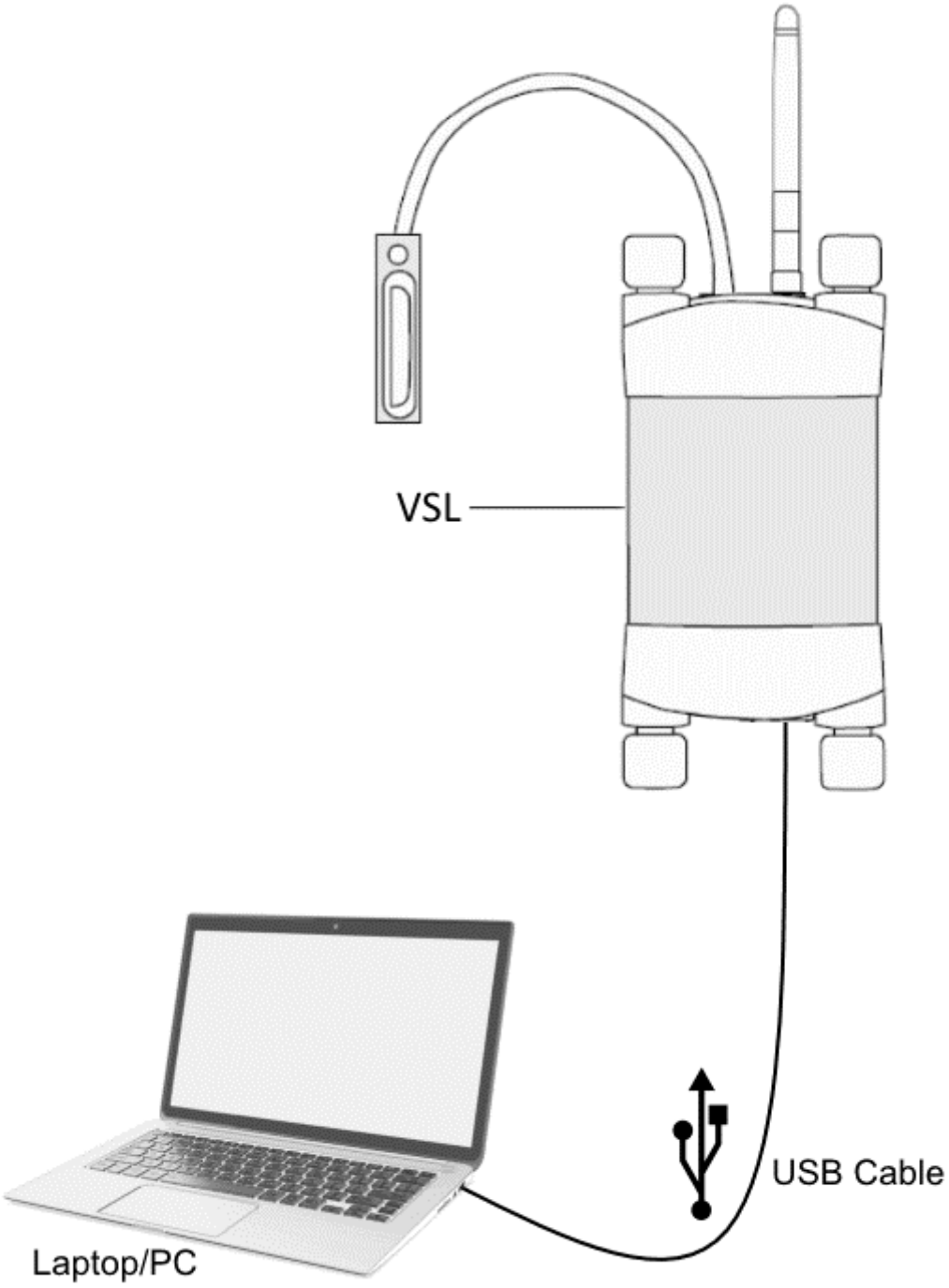
Insert the bus plugs into the endcap of the logger. The plugs can be inserted in either polarity and will click when seated.

10



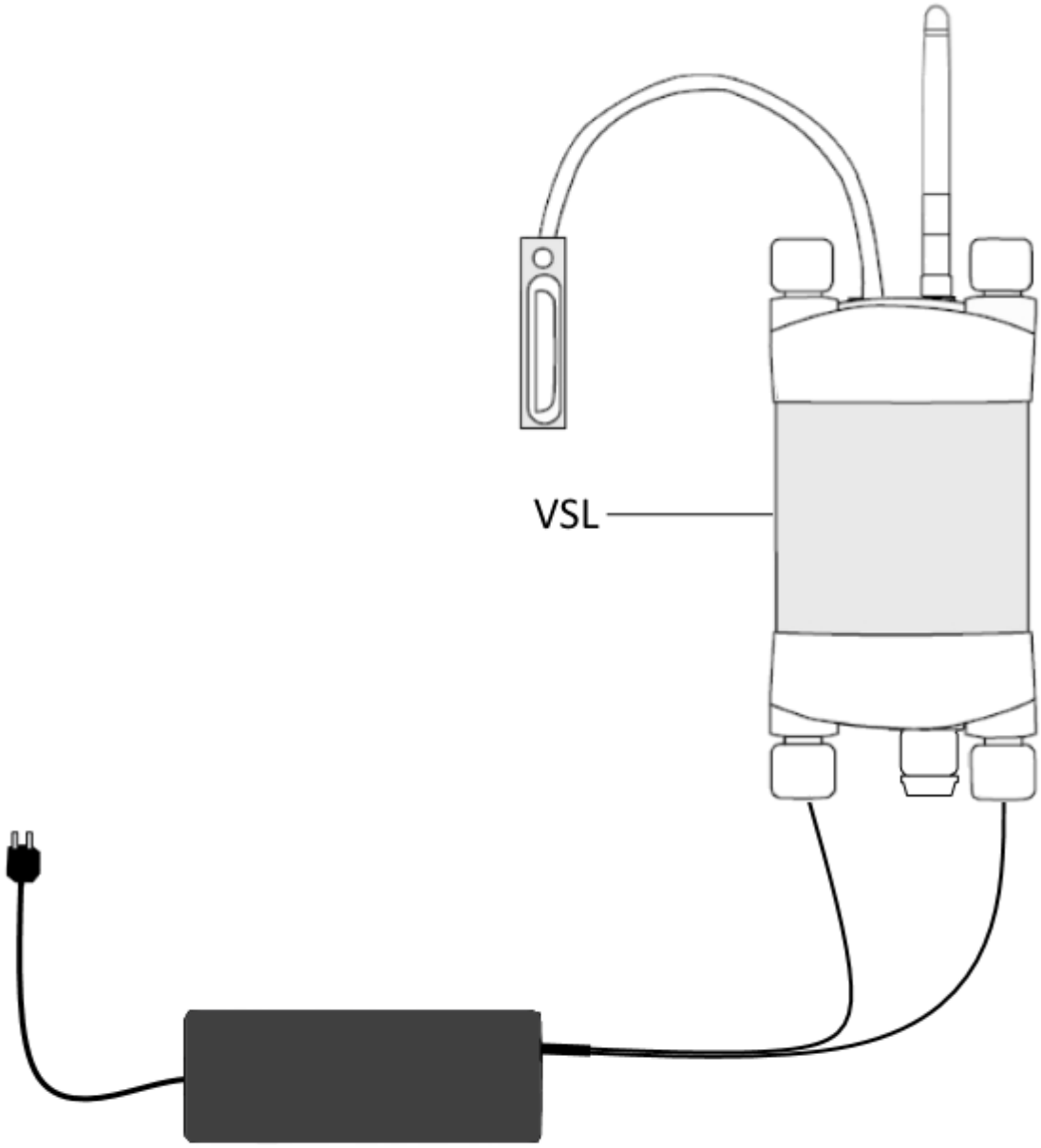
Connect the power cable to the external power source.

4.2 Connecting Power via USB cable to a laptop/PC



4.3 Connecting Power Directly via CH24 Power Supply

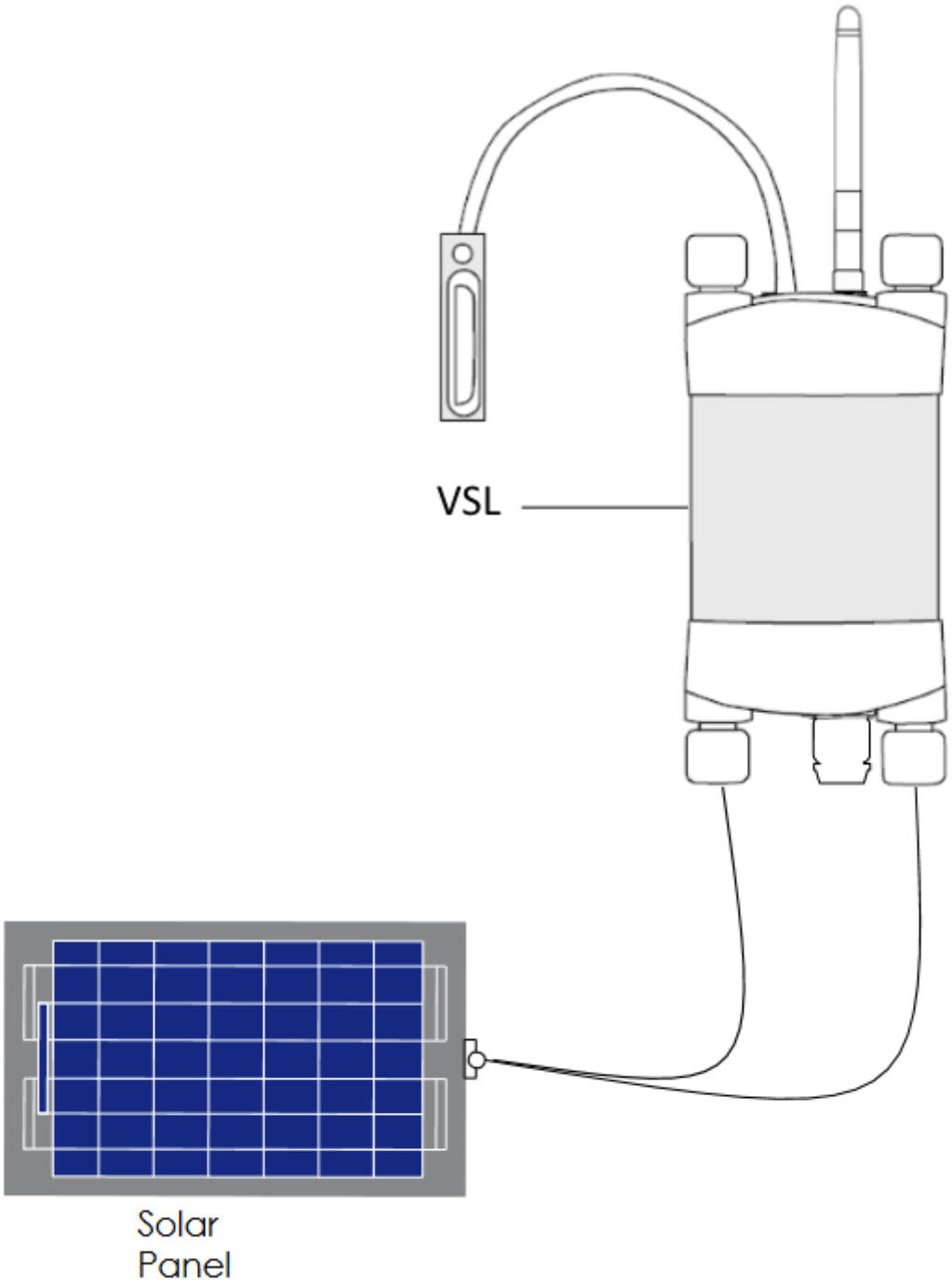
Note: The VSL is non-polarised.



CH24 Power Supply

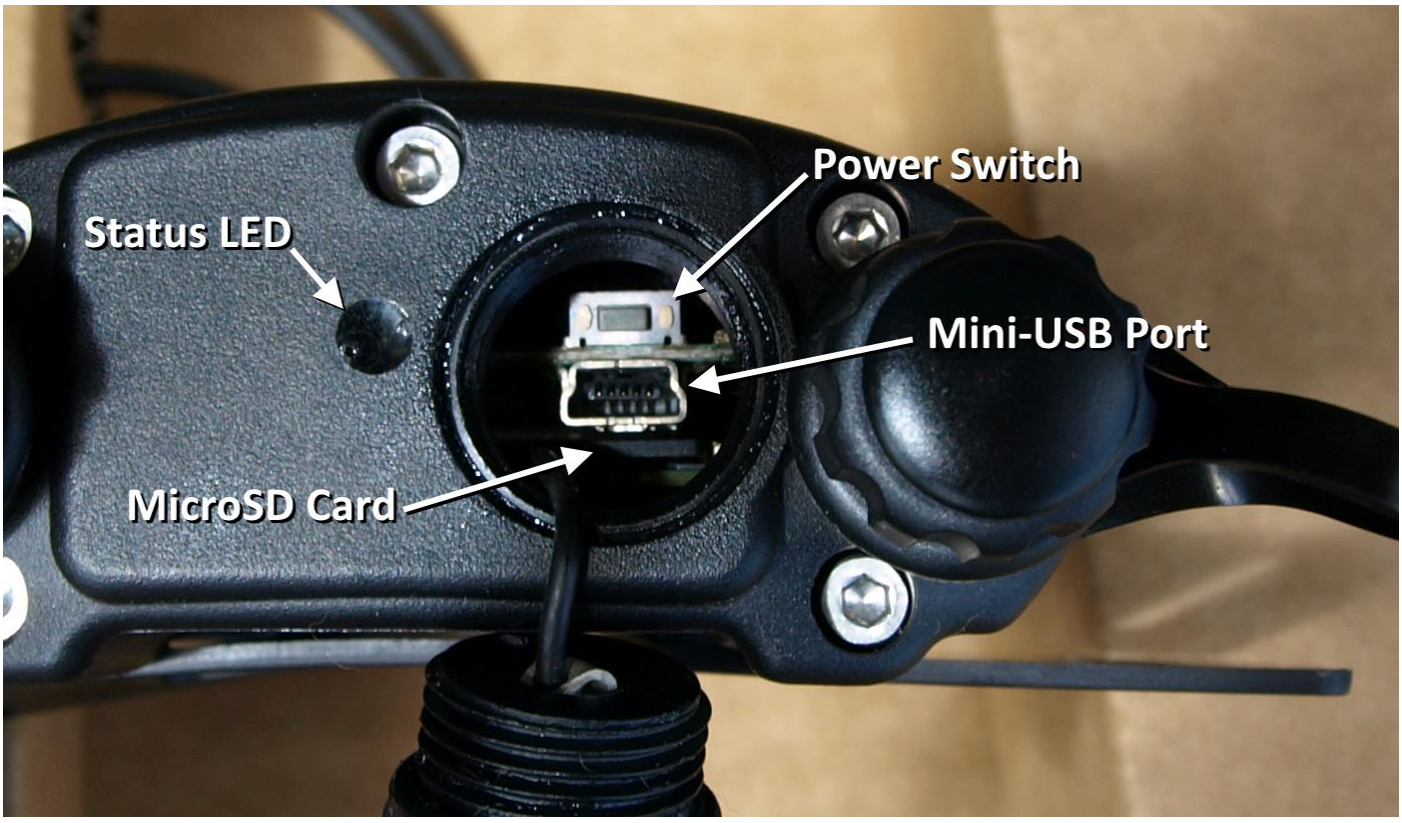
4.4 Connecting Power Directly via Solar Panel (Field Operation)

Note: The VSL is non-polarised.



5. Turn the Instrument On

To charge and turn on your VSL, connect the instrument to a computer via a USB cable. Alternatively, the VSL can either be turned on manually by pressing and holding the power button for 2-3 seconds, or automatically by connecting an external power supply.

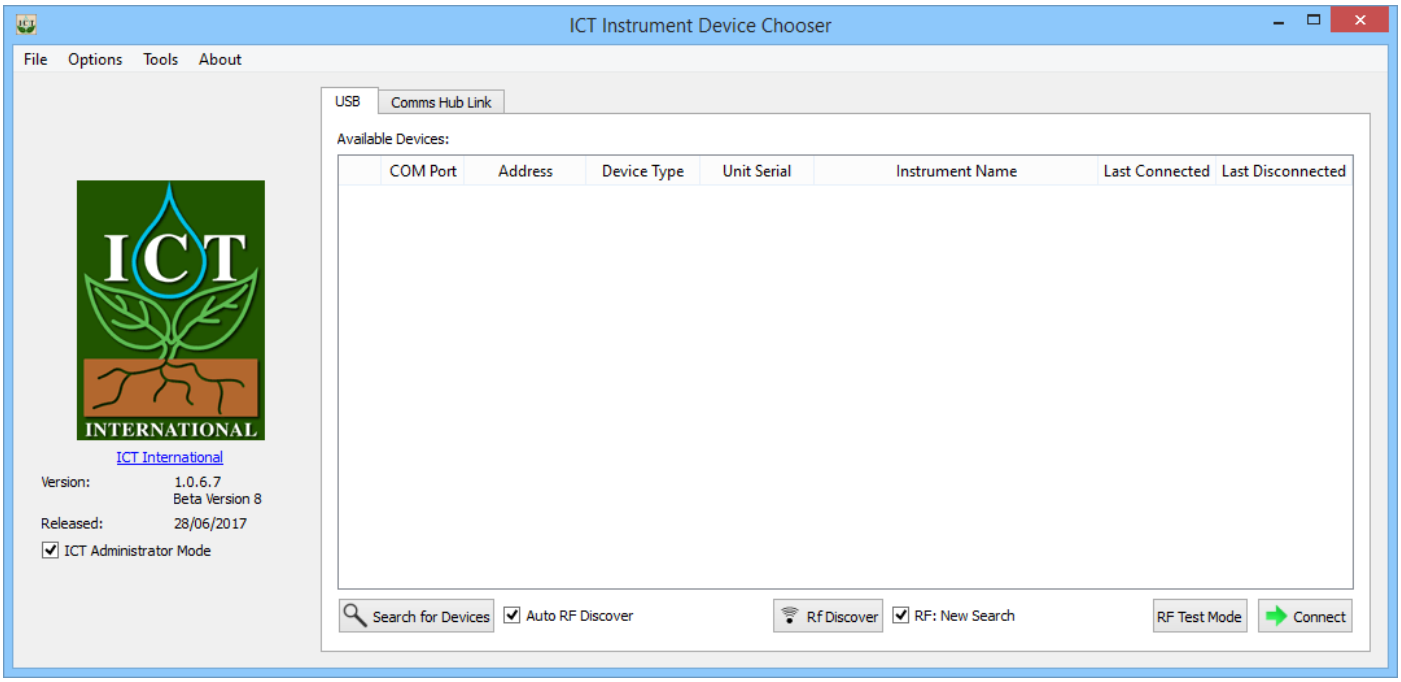


To turn off the instrument, disconnect all external power and hold the power button until the LED flashes red.

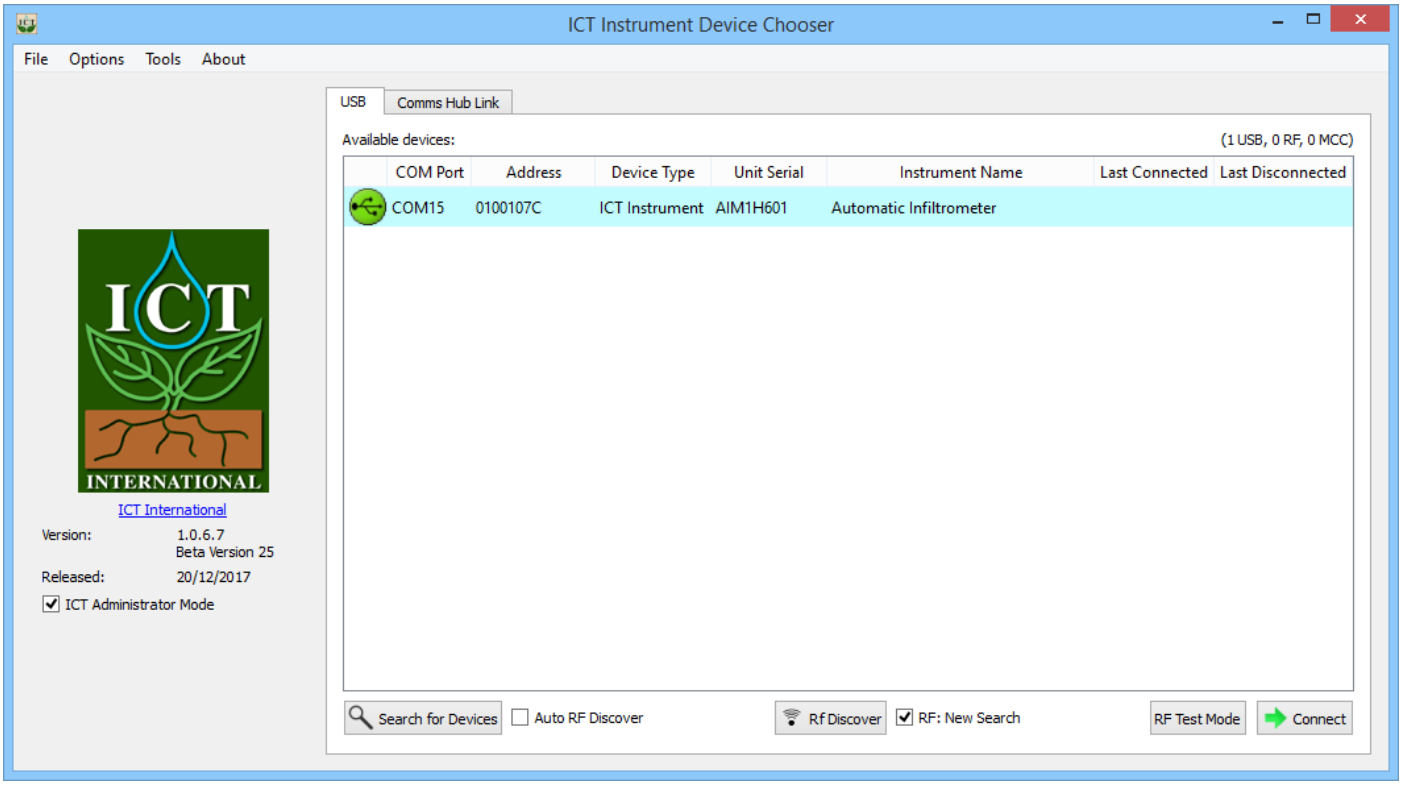
Alternately, you can select Power Down from ICT Combined Instrument Software.

6. Connect to the Instrument

Connect the USB cable to the instrument and the computer. The VSL will automatically be detected by the computer, as with any USB device. Open ICT Instrument Software and Search for Devices.



Double-click the instrument in the list to connect to it, or select it and click 'Connect'.



6.1 Connect via MCC Mini

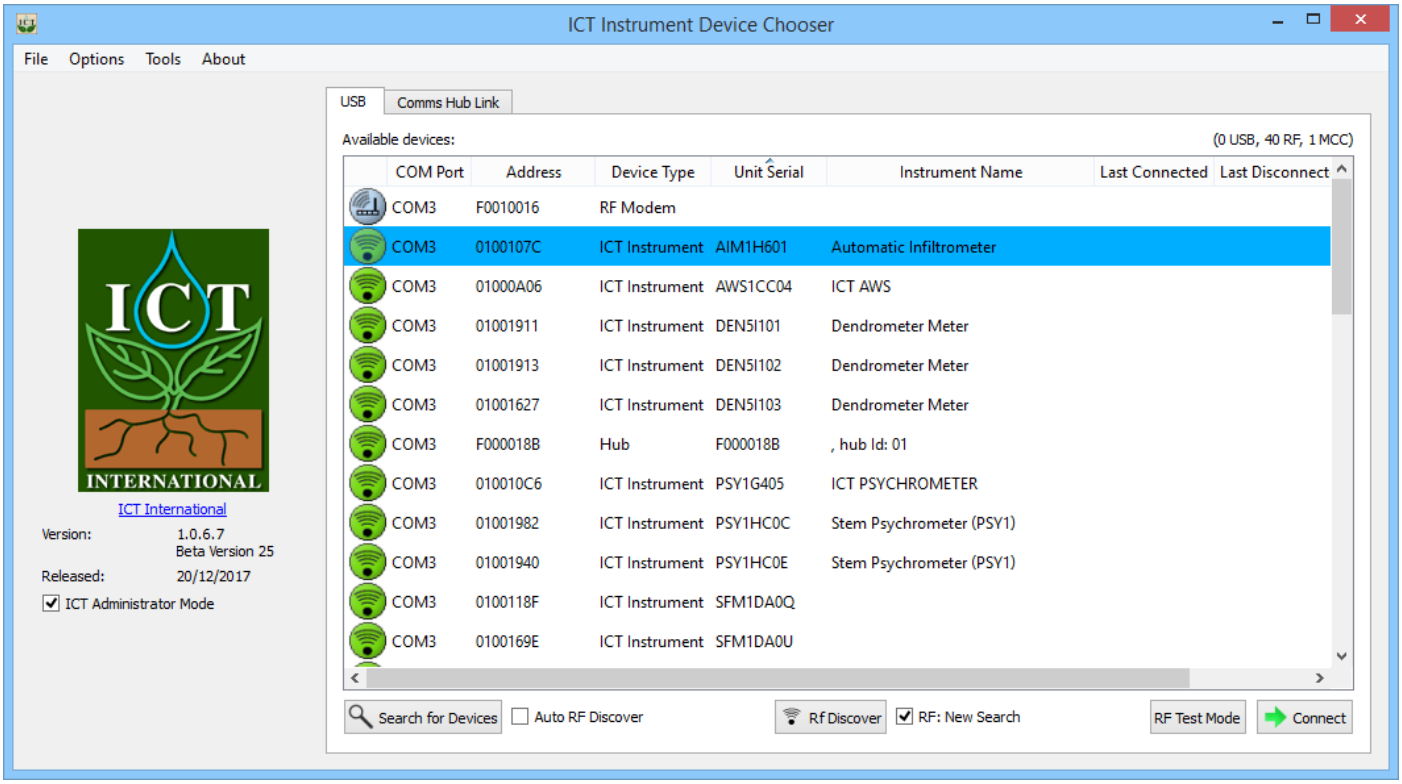
Ensure that the VSL is on. Connect the MCC Mini to your computer, open ICT Combined Instrument Software. Tick 'Auto RF Discover' and then Search for Devices.

The MCC Mini should appear on the list, it will then automatically search for nearby ICT Instruments.

You can double click the instrument, or select it and Connect, as with USB.

You may need to install the MCC Mini USB driver from the ICT International website:

http://www.ictinternational.com/support/software/

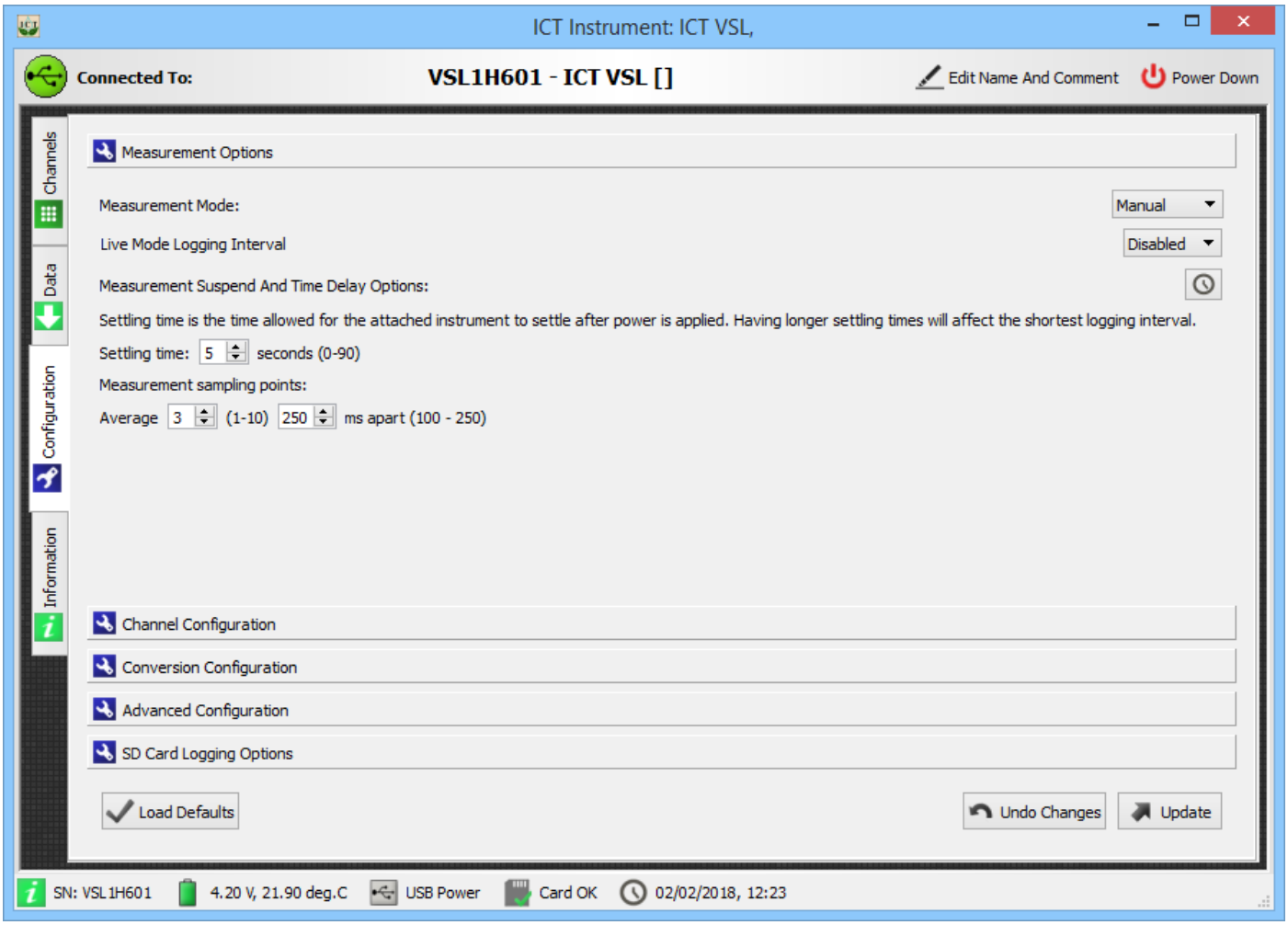


7. Set the Measurement Parameters

When you connect to an instrument, the Channels screen will be displayed. This shows the current measurement status, when the next measurement will take place, the currently configured channels, instrument serial number/name/comment, battery status, external power status, SD card status, and the instrument time and date.

7.1 Configuration

Normally, all instruments provided by ICT International come pre-configured and tested. All that you need to do is select a logging interval. This is done from the Configuration screen:



Note: Click 'Update' after changing any settings in order to send them to the logger.

A range of standard Measurement Modes are available, from every 1 minute to 60 minutes.

In manual mode a measurement will be taken whenever the Start Measurement button on the Channels screen is clicked.

If the VSL is in live mode, measurements can be taken from every 250ms to 60 seconds. ICT recommend connecting the VSL to a continuous external power supply (eg: a CH24) when using live mode, as this significantly increases the power usage of the logger.

7.1.1 Settling Time

Settling time is the time required for the output of the attached sensors to stabilise after power is applied. By default, this is set to 5 seconds. Longer settling times will affect the shortest logging interval. Settling time does not apply to Live Mode.

7.1.2 Measurement Sampling Points

Measurement sampling points are averaged to produce a more stable output. By default, 3 measurements are taken 250ms apart and averaged.

This can be set anywhere from 1 to 10 measurements, 100 to 250ms apart.

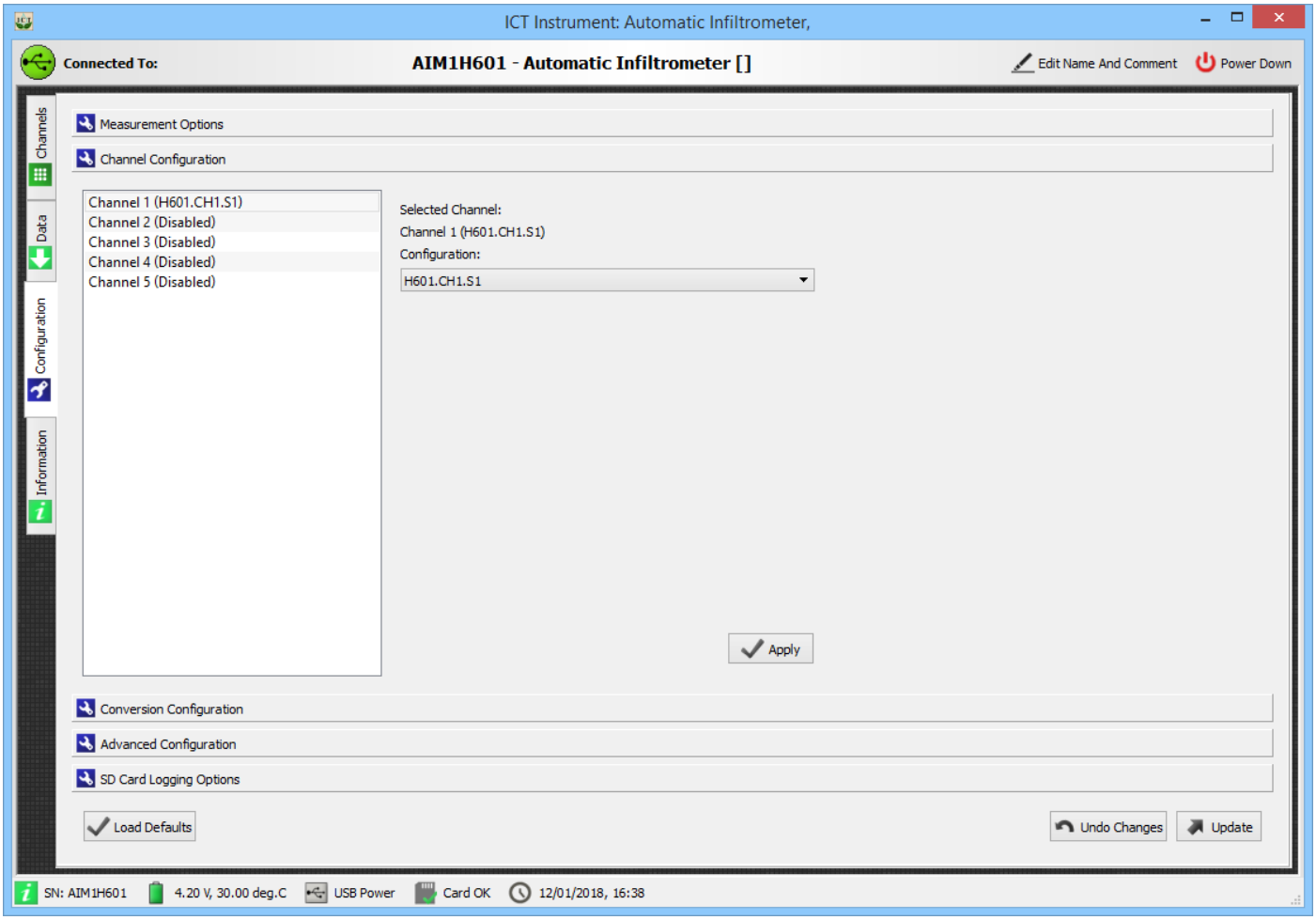
7.1.3 Measurement Suspend and Time Delay

This option allows you to set a time for the instrument to begin logging. This can be handy for completely setting up an instrument prior to installation in the field. Logging can be delayed for up to 24 hours (23:59:59), at which point it will begin to log at the set interval.

7.2 Sensor Configuration

7.2.1 Channel Configuration

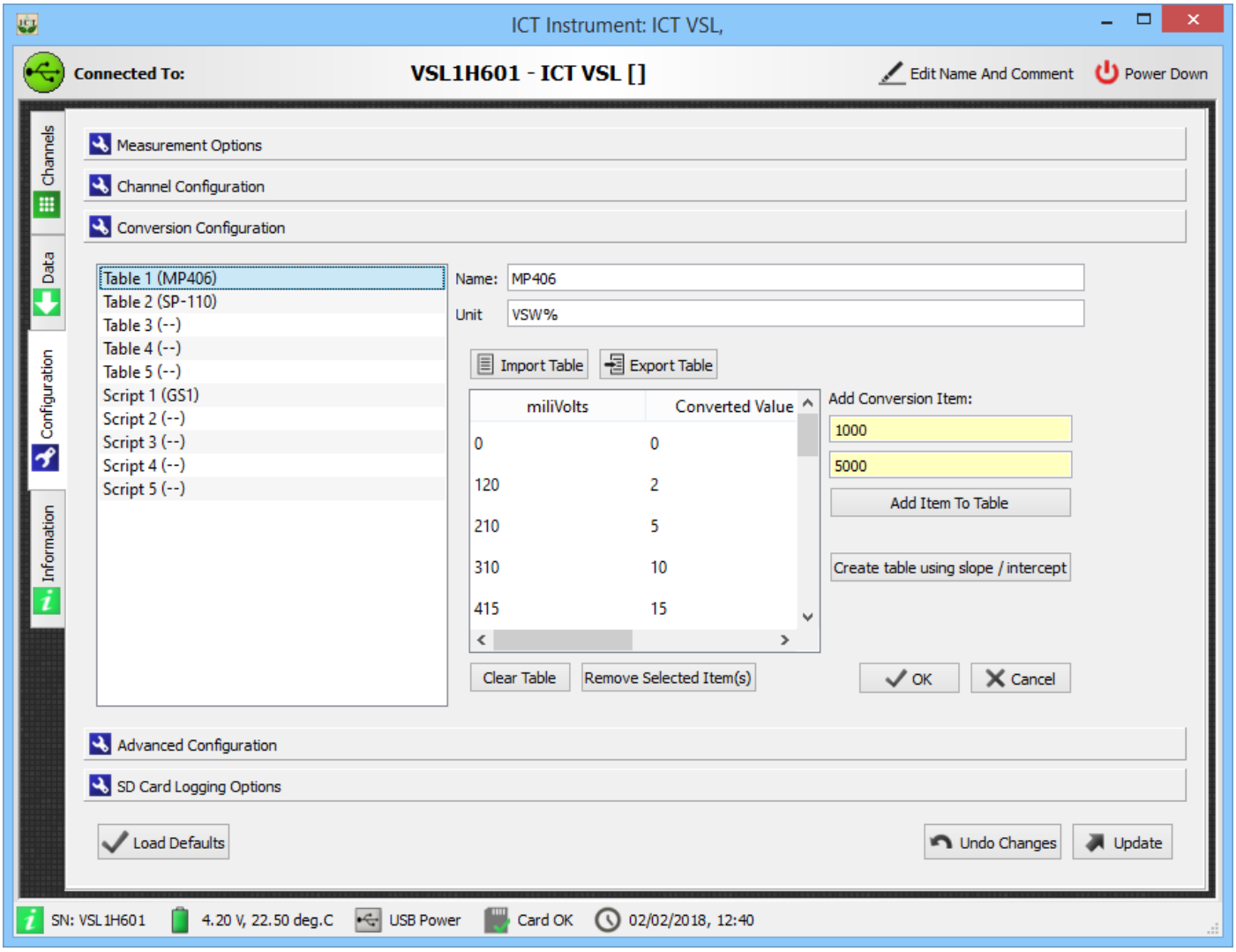
Channel configuration allows you to select a conversion table or script to apply to an input channel. Typically, the appropriate scripts for the sensors will be pre-loaded and configured.



7.2.2 Conversion Configuration

Conversion Configuration allows conversion scripts and tables to be added. These can be assigned to a channel in Channel Configuration.

When your instrument arrives from ICT International it will be preloaded with all necessary tables and/or scripts.



7.2.3 Advanced Configuration

The Advanced Configuration section is used to combine 2 single-ended inputs into a single differential input. This should not be altered unless instructed to do so by ICT International technical support.

7.2.4 SD Card Logging Options

Options for additional parameters to be logged to the data file. By default, all these options are enabled. ICT International recommend logging these options.

Raw millivolt data: Raw mV outputs from the sensors. Useful for post processing or changing conversion options.

Internal battery information: Internal battery voltage and temperature. Used for troubleshooting and diagnostics.

External supply information: External power supply voltage and current. Used for troubleshooting and diagnostics.

8. Download Data

The Data tab can be used for basic data visualisation, SD card management, and to download data files from the instrument.

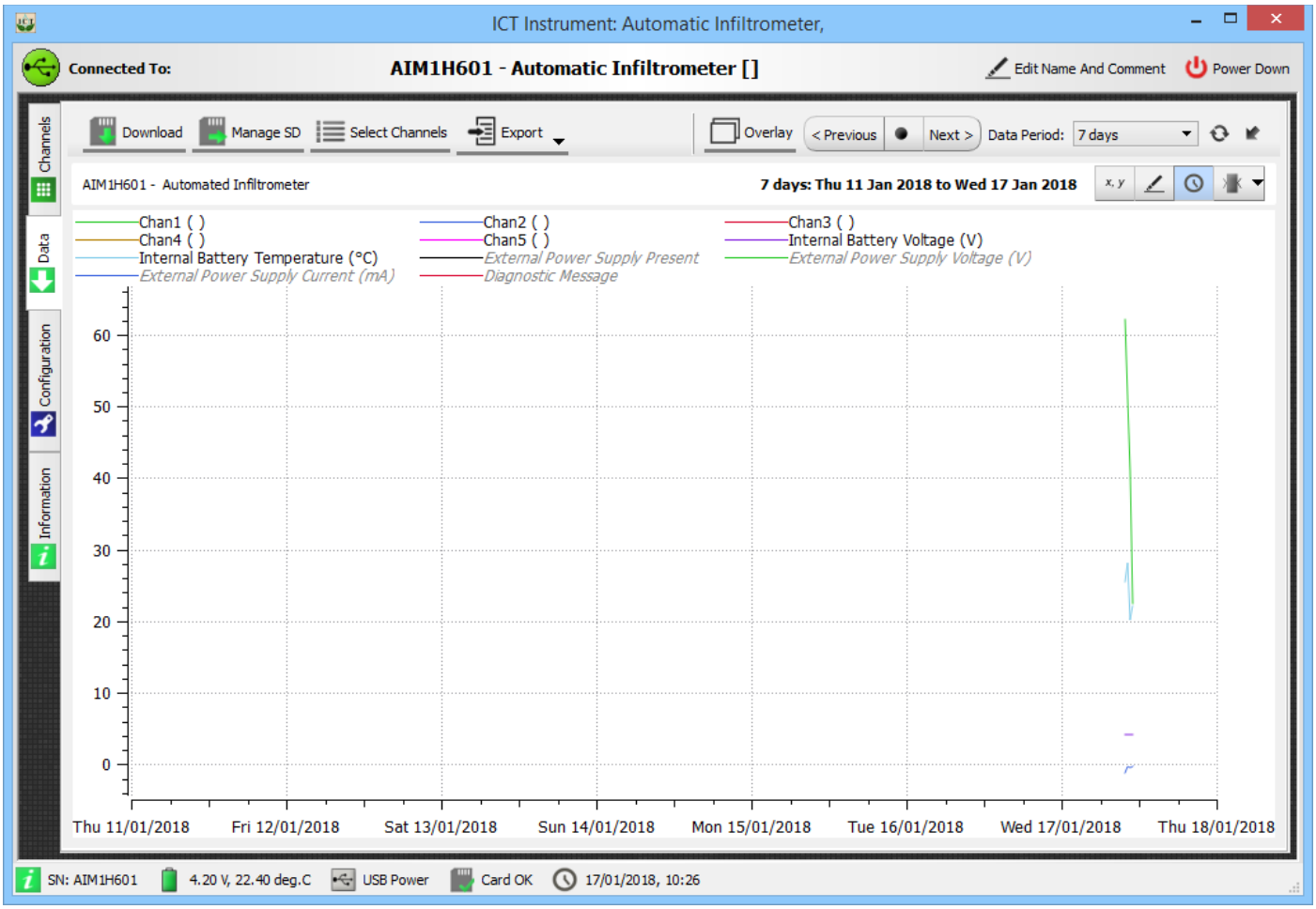
Data is stored on the MicroSD card in csv format. The MicroSD card can also be removed from the logger and read by a computer.

Download saves the instrument data to the Dataview repository and allows for basic graphing from the data tab. On Windows, the repository is located at: %localappdata%\ICT\Data Files

Select Channels is used to select which logger outputs (channels) are displayed on the plot.

Export provides some options for exporting a CSV file of the data:

> **Export Clean** includes measurement data and column headings.
> **Export with Headers** includes measurement data, column headings and the instrument Serial, name and comment.
> **Export a Copy** includes all diagnostic data, in addition to the data and headers. This is what is recorded by the instrument.



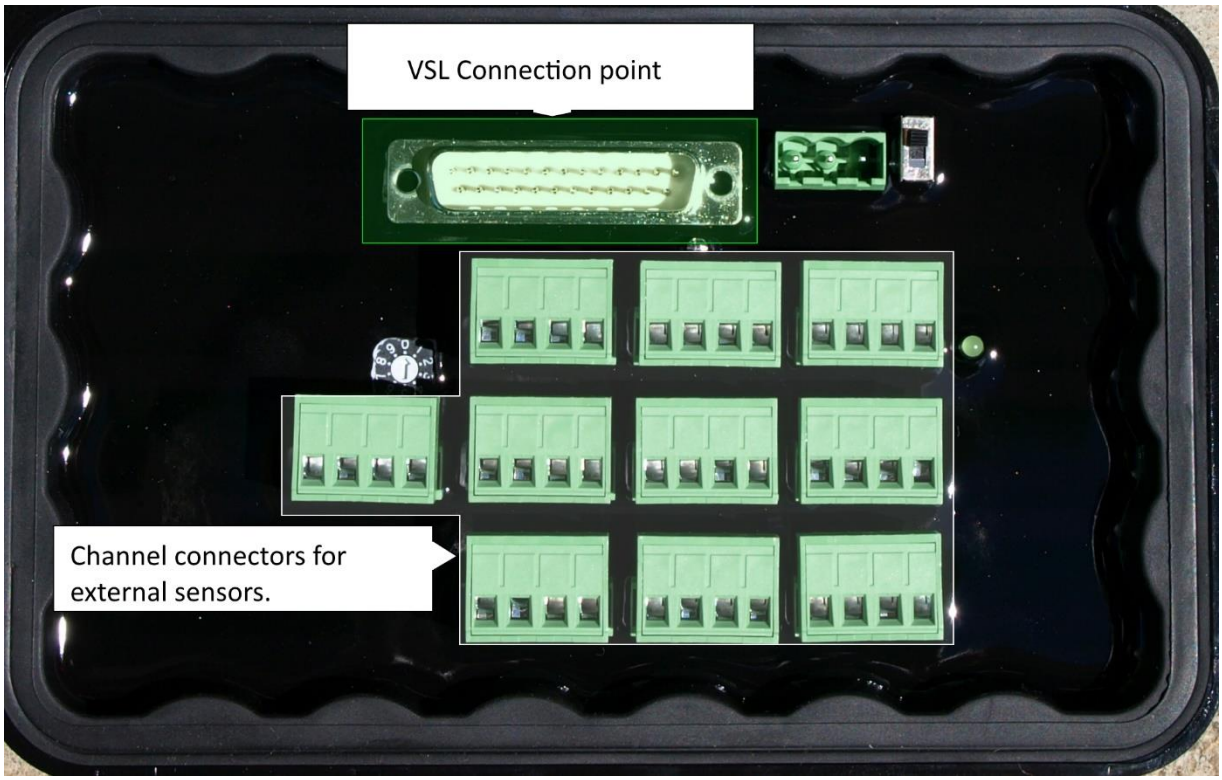
9. Operation

9.1 Distribution Board Connections

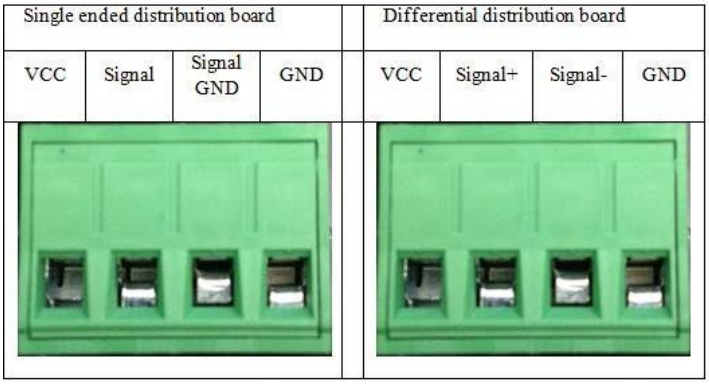
Distribution boards provide connection points for sensors. Available configurations are:

10x individual channels, single ended (pictured below)

5x individual channels, differential mode.



9.2 Connector Terminal Configuration

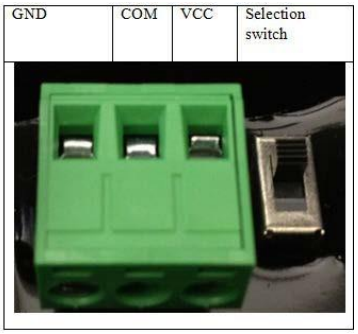


9.3 External Power Connection

When the selection switch is in the up position as set by default (as pictured below), internal power supply from the VSL is selected.

When the switch is in the down position, external power supply connected directly to the VSL breakout box will be used, in 99% of cases the external power connection should not be used.

Note: Before attempting to use external breakout box power supply please contact ICT International.



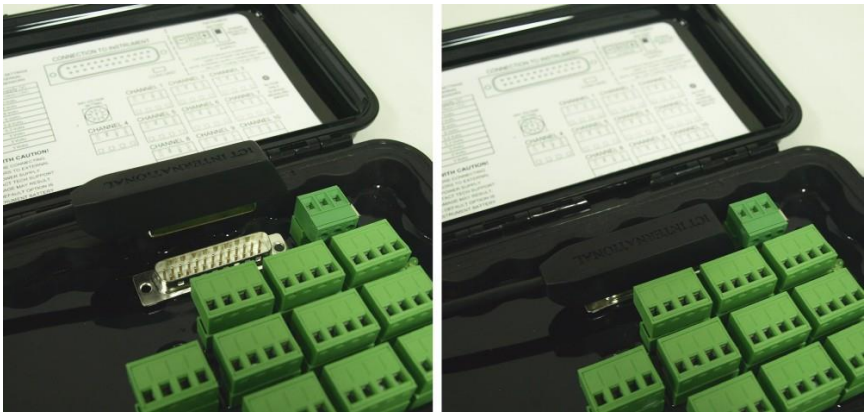
9.4 Input and Output Transient and Overload Protection

All analogue inputs and power supply outputs are protected from electrostatic discharge and lightning surges by protection components on the Breakout Box and inside the VSL.

The sensor power supply is also fused with an auto resetting thermal fuse with a rating of 500mA.

9.5 Connecting ICT VSL to the Distribution Board

The ICT VSL uses a DB-25 (Parallel Port) terminated cable as an interface to the distribution board.

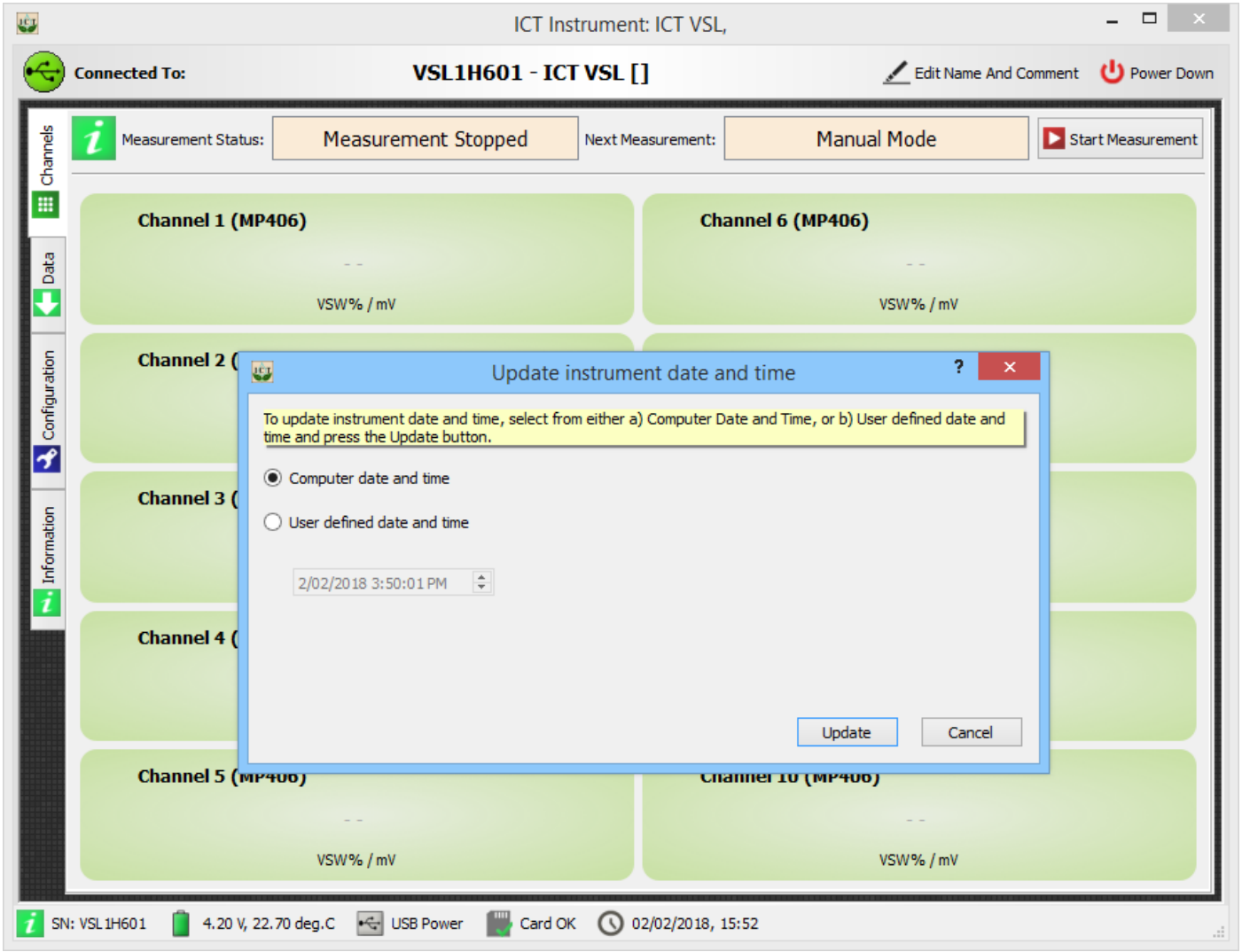


The Black connector needs to be pushed down onto the mating 25-way connector in order to provide power and signal connections.

10. Updating Date and Time

The VSL contains a battery backed clock which is used for time keeping in both logs and measurement scheduling. Time on the device can be set to:

- The same time as the PC
- User selectable time



To update or change the time, click the date and time displayed at the bottom of the window.

11. Lookup Tables and Scripts

Lookup Tables convert raw millivolt (mV) sensor output into meaningful measurements such as volumetric soil moisture content (%VWC), temperature, solar radiation, or oxygen concentration.

Lookup Tables need at least 2 values to be valid, and then assume there is a linear relationship between the 2 values. Typically, the sensors minimum and maximum values are entered. These values can normally be found on a sensor specification sheet under Range.

Your ICT Instrument has already been pre-programmed with the required Lookup Tables or User Scripts. You should not need to change any Lookup Tables or User Scripts.

If you cannot find the table or script corresponding to your sensor please contact ICT International.

Lookup tables can be imported/exported as CSV, where column A is mV and column B is the converted value.

The 2nd and 3rd rows of the table (MP406-VSW%, VSW%) are the name of the conversion table and the converted unit.

<CSV Table>	
MP406-VSW%	
VSW%	
0	0
120	2
210	5
310	10
415	15
510	20
610	25
720	30
825	35
895	40
955	45
1005	50
1015	55
1025	60
1035	65
1045	70
1055	75
1065	80
1075	85
1085	90
1105	95
1160	100

MP406 lookup table – mV to VSW%.

User Scripts allow the conversion of millivolt (mV) sensor output into meaningful measurements, and are particularly useful if the relationship between mV and the converted value is non-linear. Scripts can also be used for linear relationships.

User scripts can be imported/exported as .uscr files, which can be opened in notepad or any similar program. A script can be saved as a .txt and renamed to .uscr.

Line 2 (DBV60) is the name of the script.
Line 3 (mm) is the converted unit.

```
<User Script>
DBV60
mm
r1 = curchan * 0.0254
res = r1
```

The instrument scripting language is quite basic, typically only one operation is performed for each line.

Variables used in scripting are:

r1 to r10	General use registers for storing the value of an operation.
res	Result register, this value will be displayed as the converted value.
curchan	mV value of the current channel the script is executing on. If the script is executing on channel 1, curchan contains the mV value of channel 1.
ach1 to ach10	mV value of channels 1 to 10.
ach1c to ach10c	Converted values of channels 1 to 10.

Available operations are:

Operator	Description
=	Assignment. Places the value of the right-hand variable in the left-hand register. Example: r1 = ach2
+	Addition. Example: r1 = curchan + 2
-	Subtraction. Example: r1 = curchan – 3
*	Multiplication. Example: r1 = curchan * 100
/	Division. Example: r1 = r1 / 2
inv	Inverse. Example: r1 = inv r5
sqr	Square. Example: r1 = sqr ach5
sqrt	Square root. Example: r2 = sqrt r1

log	Natural log. Example: res = log r5
log10	Base 10 log. Example: r2 = log10 r1
log2	Base 2 log. Example: r3 = log2 r1
exp	Exponent e^x Example: res = exp r2
rnd	Round to the nearest integer. Example: r5 = rnd r1 (If r1 contains 5.2, r5 will contain 5.0)
abs	Absolute value. Example: r2 = abs r1

11.1 User Scripts

11.1.1 GS1 – Mineral Soil

```
<User Script>
GS1Mineral-VWC%
GS1Mineral-VWC%
r1 = curchan * 0.000494
r2 = r1 - 0.554
res = r2 * 100
```

11.1.2 GS1 – Soilless Media

```
<User Script>
GS1SoilessM-VWC%
GS1SoilessM-VWC%
r1 = curchan * 0.000591
r2 = r1 - 0.611
res = r2 * 100
```

11.1.3 10HS – Mineral Soil

```
<User Script>
10HSMineral-VWC%
10HSMineral-VWC%
r1 = curchan * curchan
r2 = r1 * curchan
r3 = 2.97e-09 * r2
r4 = 7.37e-06 * r1
r5 = 0.00669 * curchan
r6 = r3 - r4
r6 = r6 + r5
r7 = r6 - 1.92
res = r7 * 100
```

11.2 Lookup Tables

11.2.1 MP306 & MP406

<CSV Table>	
MP406-VSW%	
VSW%	
0	0
120	2
210	5
310	10
415	15
510	20
610	25
720	30
825	35
895	40
955	45
1005	50
1015	55
1025	60
1035	65
1045	70
1055	75
1065	80
1075	85
1085	90
1105	95
1160	100

11.2.2 SP-110

<CSV Table>	
SP-110	
W m^-2	
0	0
1000	5000

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