



uDL1

Configuration and Operation Guide

UDL1-MAN-001, 2.01

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UDL1



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CURRENT REVISION APPROVALS (Revision 2.01)

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1 Introduction

The uDL1 is a high accuracy, low cost data logger designed specifically for cathodic applications. The device is very simple to use and has a large LCD that can locally verify the readings. Two models of the uDL1 are available:

- The Basic model has a 500,000 readings measurement memory with a configurable sample rate between 1 second and 12 hours.
- The Advanced model has a 1,000,000 (2,000,000 for G2 hardware revision) readings measurement memory, internal GPS receiver, and a DC voltage waveform capture mode which samples at rate of 10 times per second.

A long life rechargeable battery allows the device to operate for 6 months or capture 1,000,000 readings per battery charge. The internal GPS receiver in the Advanced model provides an accurate time reference and site geo-location coordinates. Both the Basic and Advanced models are capable of measuring DC volts, AC volts and internal temperature. The small physical size and water resistant (non-submersible) enclosure allow the device to be utilized in a wide range of field environments including within common CP test stations. The generation 2 (G2) advanced model also supports interruption waveform tracking for impressed current cathodic protection close interval survey use.

This document details the configuration and operation of the uDL1 product.



Figure 1 uDL1 Micro Data Logger



Figure 2 uDL1 Installed In a Test Station

2 General Safety Information

The following safety precautions must be reviewed to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component's manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

- **Connect and Disconnect Properly.** Do not connect or disconnect terminal wiring while the wires are connected to a voltage source.
- **Observe All Terminal Ratings.** To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product. Do not use an input marked with measurement category I for measurements within measurement categories II, III or IV. Do not connect category II inputs directly to mains—a Class 2 CSA/UL transformer must be used for isolation.
- **Do Not Operate Without Covers.** Do not operate this product with covers or panels removed.
- **Avoid Exposed Circuitry.** Do not touch exposed connections and components when power is present.
- **Do Not Operate With Suspected Failures.** If you suspect there is damage to this product, have it inspected by qualified service personnel.
- **Only use Mobiltex approved cables and accessories.** Use of unapproved cables and accessories may cause a safety hazard for users.

Symbols and Terms

These terms may appear in this **manual**:

TERM	MEANING
WARNING	Warning statements identify conditions or practices that could result in injury or loss of life.
CAUTION	Caution statements identify conditions or practices that could result in damage to this product or other property.

These terms may appear on the **product**:

TERM	MEANING
DANGER	Danger indicates an injury hazard immediately accessible as you read the marking.
WARNING	Warning indicates an injury hazard not immediately accessible as you read the marking.
CAUTION	Caution indicates a hazard to property including the product.

The following symbols may appear on the **product**:

SYMBOL	MEANING
	CAUTION Refer to Manual
	DC Input

3 uDL1 Kit Contents

The Mobiltex part number for the Basic uDL1 kit is A20A03UDL01. A20A03UDL02 is the part number for the Advanced uDL1 kit. The following items are included in each kit:

1. uDL1 Unit (Basic A15000UDL01 or Advanced A15000UDL02)



Figure 3 uDL1 Front View

2. uDL1 USB Cable (W164IFUDL01)

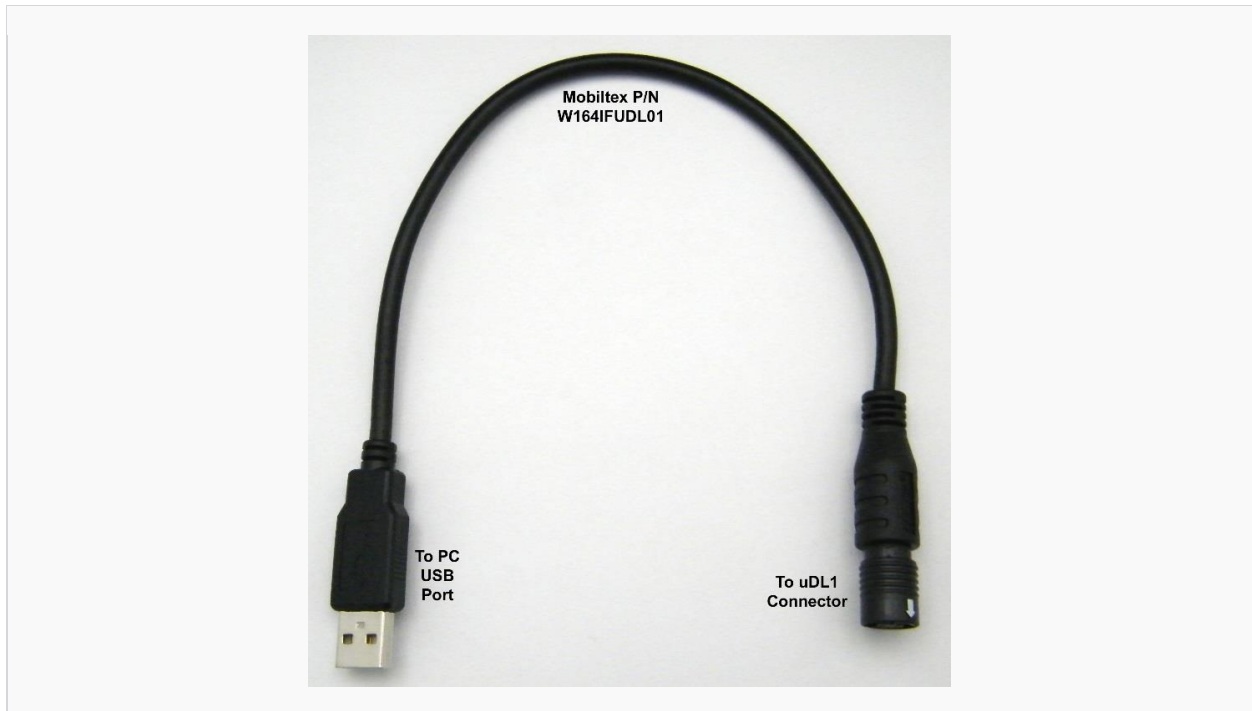


Figure 4 uDL1 USB Cable

3. uDL1 Analog Cable (W164I0UDL01)
4. Extension Banana Plug To Clip Adapters (H27404UDL01/H27404UDL02)



Figure 5 uDL1 Analog Cable and Extension Clip Adapters

5. Programming Application and Driver Media (CD or USB flash drive)

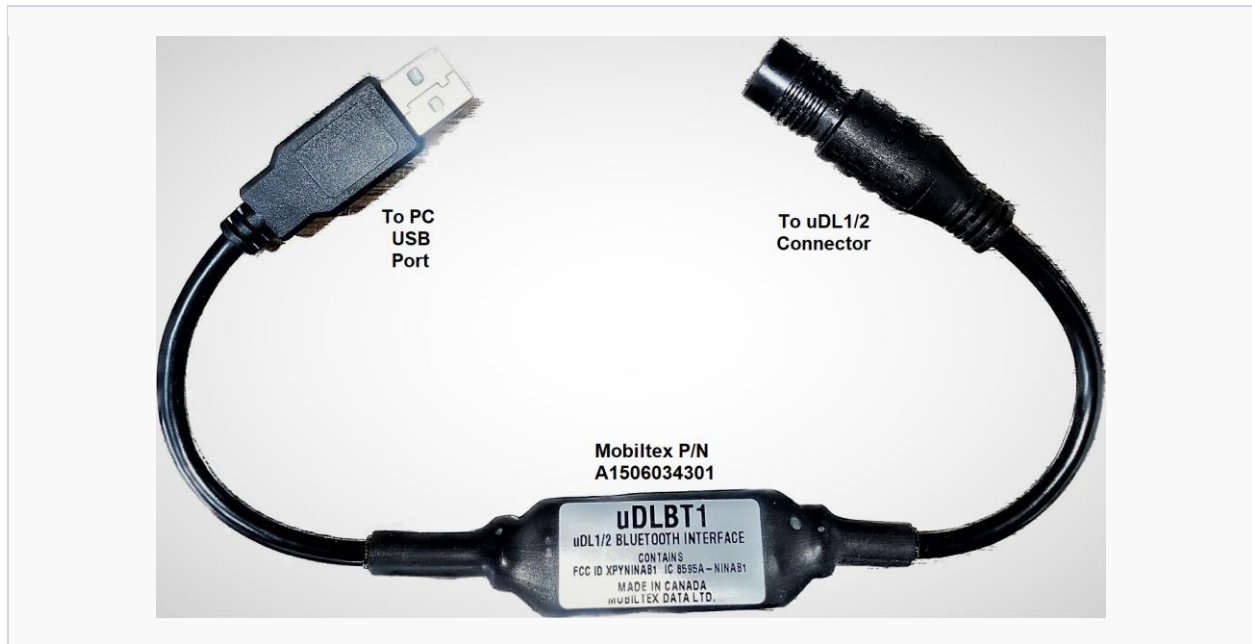


Figure 6 Programming Application and Driver USB Flash Drive

To use a PC to communicate with the uDL1, you will require the media (CD or USB flash drive) that shipped with the uDL1. The media contains drivers and the uDL1 configuration application. If you do not have the media, the contents can be downloaded from the Mobiltex web site at the following URL: <https://www.mobiltex.com/solutions/cathodic-protection-portable-instruments/cortalk-udl1/>

The following optional items are available separately:

- uDLBT1 Bluetooth Programmer (A1506034301), provides USB connection and Bluetooth capabilities for the connected uDL1

**Figure 7 uDLBT1 Programmer**

- uDLBT1 Bluetooth programmer Kit (A20A0334301), comes with USB Power Bank 2600mAh, DC USB Vehicle Charger, USA/Canada AC USB Wall Charger, USB flash drive with software installation and a Black Fabric Case.
- Large Alligator Clips (H27400112BK/H27400112RD)

**Figure 8 Large Alligator Clips**

- USA/Canada AC USB Wall Charger (P11606UDL01)
- DC USB Vehicle Charger (P11606UDL02)

**Figure 9 USA/Canada AC USB Wall Charger****Figure 10 DC USB Vehicle Charger**

- Test Station Spacer Rings (Provide More Height Inside Standard Test Station)

**H23510RMU01**
(Black)**H23550RMU01**
(Green)**H23530RMU01**
(Orange)**H23540RMU01**
(Yellow)**Figure 11 Test Station Spacer Rings**

4 Configuration

4.1 Configuration Equipment Requirements

The following items will be needed when configuring a uDL1.

- uDL1 USB Cable (W164IFUDL01)
- Programming Application and Driver Media (CD or USB flash drive)
 - To use a PC to communicate with the uDL1, you will require the media (CD or USB flash drive) that shipped with the uDL1. The media contains drivers and the uDL1 configuration application. If you do not have the media, the contents can be downloaded from the Mobiltex web site at the following URL.
<https://www.mobiltex.com/solutions/cathodic-protection-portable-instruments/cortalk-udl1/>
- The installation media contains configuration applications for both the uDL1 and the uDL2.
- Personal Computer (PC)
 - The application software and drivers require that the PC be running Windows XP SP3 or higher for an operating system.
 - The PC must have an available USB port.

4.2 Software Installation

To install the configuration application and driver software, insert the media (CD or USB flash drive) that came with the configuration interface into the appropriate drive or USB port on the PC. If “autorun” is enabled on the PC, the screen in Figure 12 will appear.

If “autorun” is not enabled, or the contents of the media have been copied to a local directory, use Windows Explorer to navigate to the media drive or the directory containing the installation software. Double-click on the “uDLINSTALLER.exe” application. The dialog on Figure 12 will appear.

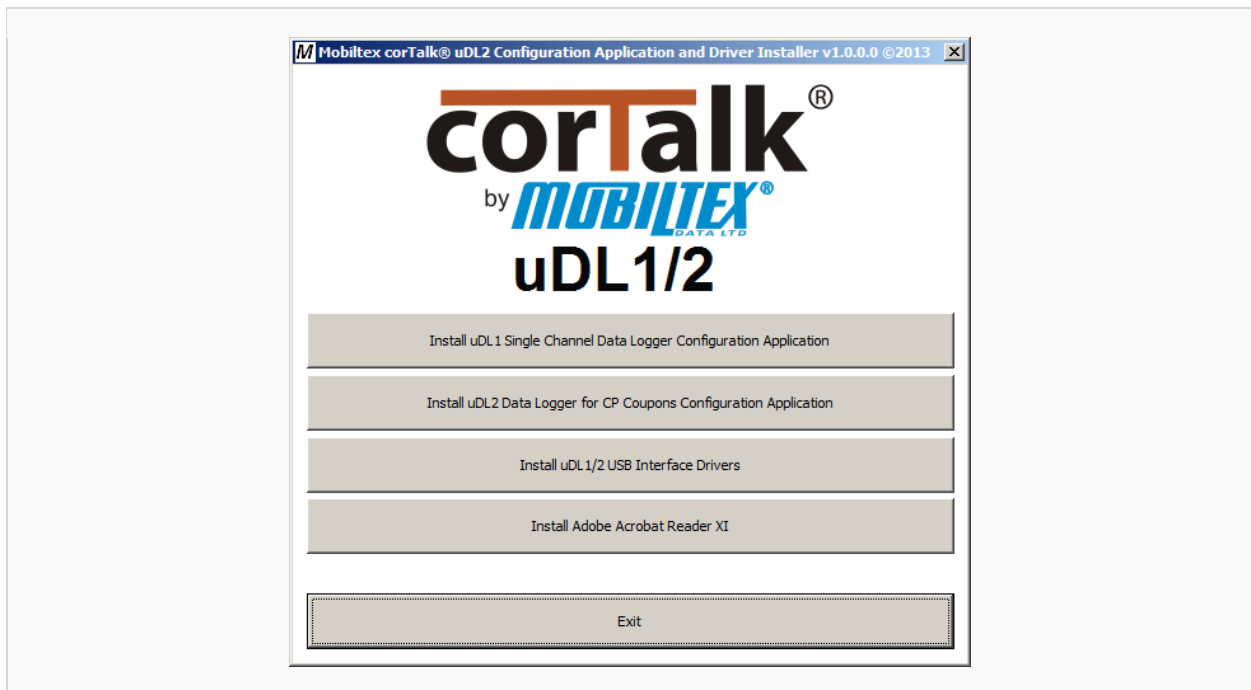


Figure 12 uDL1/2 Installer Dialog

4.2.1 Configuration Application Installation

Click on the “Install uDL1 Single Channel Data Logger Configuration Application” button to start the application installer. A security warning dialog may appear. Click the “Run” button to continue. The following dialog should now appear:

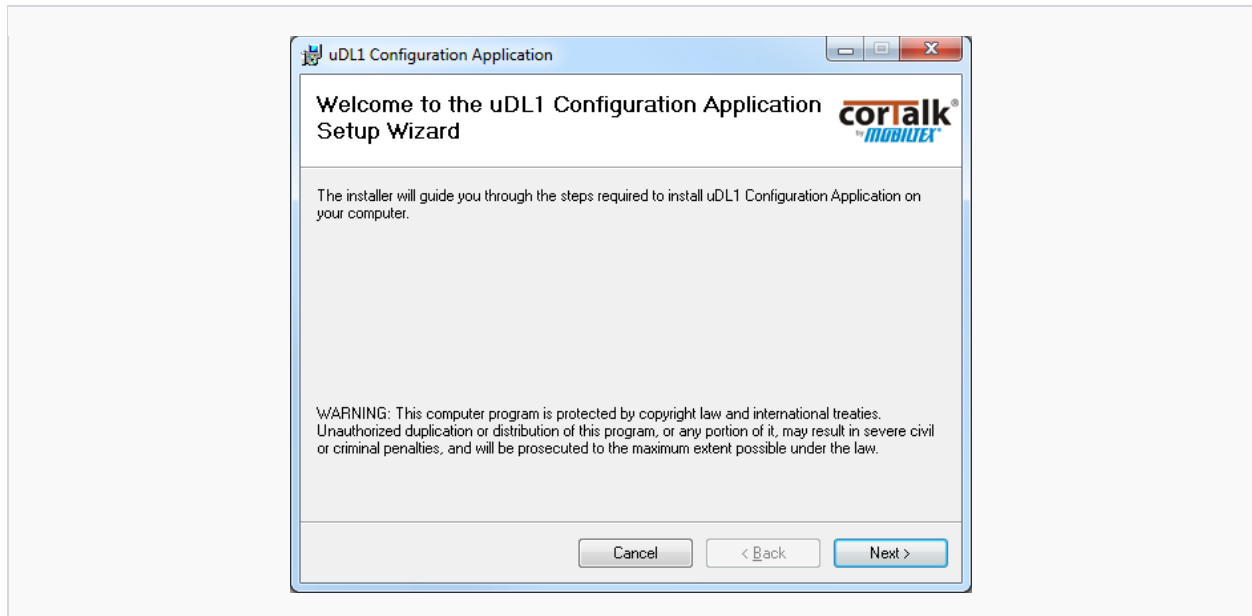


Figure 13 uDL1 Configuration Application Installation Dialog

Follow the instructions presented in the installation screens, clicking “Next” to move to the next screen each time. Some screens may pause for tens of seconds as the Windows installation procedure is processing. The final screen should show the dialog in Figure 14. Click “Close” to complete the installation.

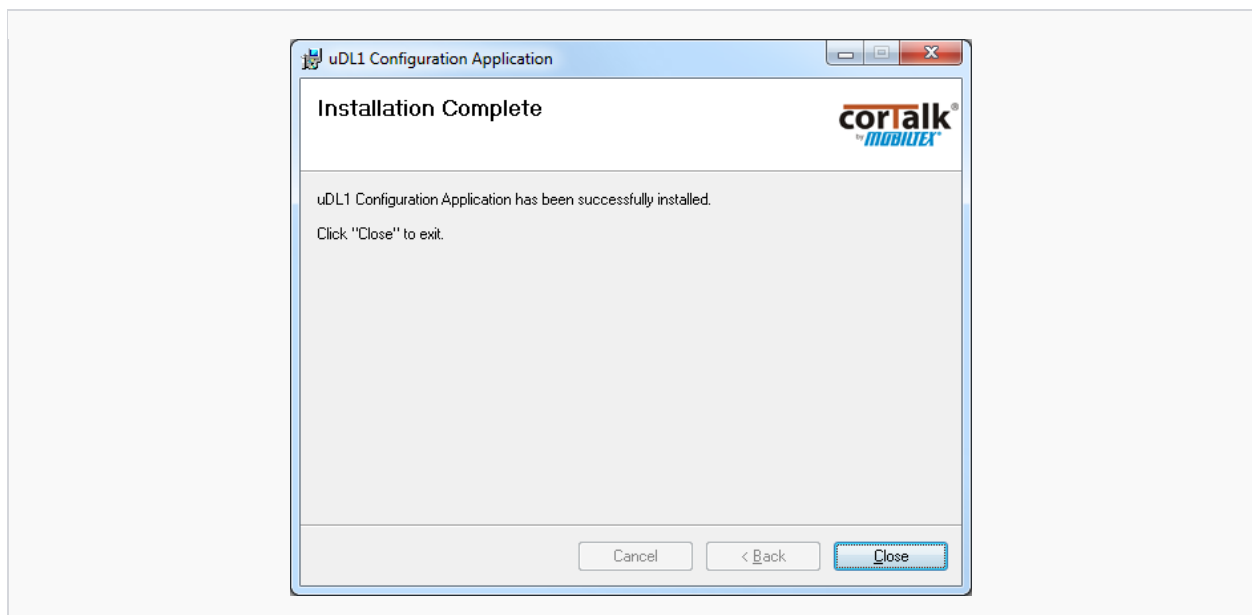


Figure 14 uDL1 Configuration Application Installation Complete

A shortcut to the configuration application and the uDL1 manual are created in the Windows start menu under the “uDL1 Configuration Application” folder.

4.2.2 Driver Installation

To prevent potential hardware driver issues in Windows, do not attach the uDL1 to the PC USB port before installing the device drivers.

From the uDL Installer screen, click the “Install uDL1/2 USB Interface Drivers” button. **Note that to install drivers, you must be logged into the PC with an account that has administrative privileges.** The following screen should display. Follow the installation instructions presented by the driver installer application.

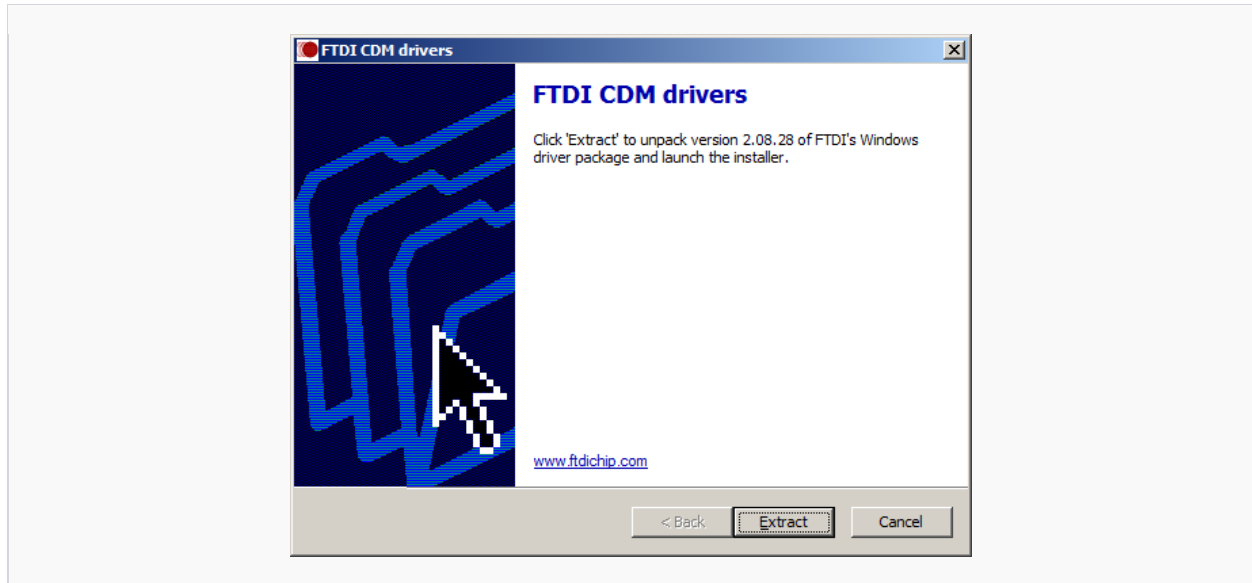


Figure 15 Driver Installation Screen

Once the driver installer completes, you may then plug in the uDL1 through the USB cable into an available USB port on the PC.

4.2.3 Adobe Acrobat Reader XI

Adobe Acrobat Reader XI is provided on the installation media to allow viewing of the PDF version of the uDL1 manual. If Acrobat Reader is already installed on the PC, it is not necessary to re-install it. To install Acrobat Reader, click on the “Install Adobe Acrobat Reader XI” button on the uDL Installer dialog, and follow the instructions provided by the Acrobat Reader installation application.

4.3 uDL1 Configuration and Extraction

- Attach the supplied USB cable between the PC and the uDL1.
- Start the configuration software by clicking on “uDL1 Configuration” shortcut in Windows start menu, under the “uDL1 Configuration Application” folder. The following screen will appear.

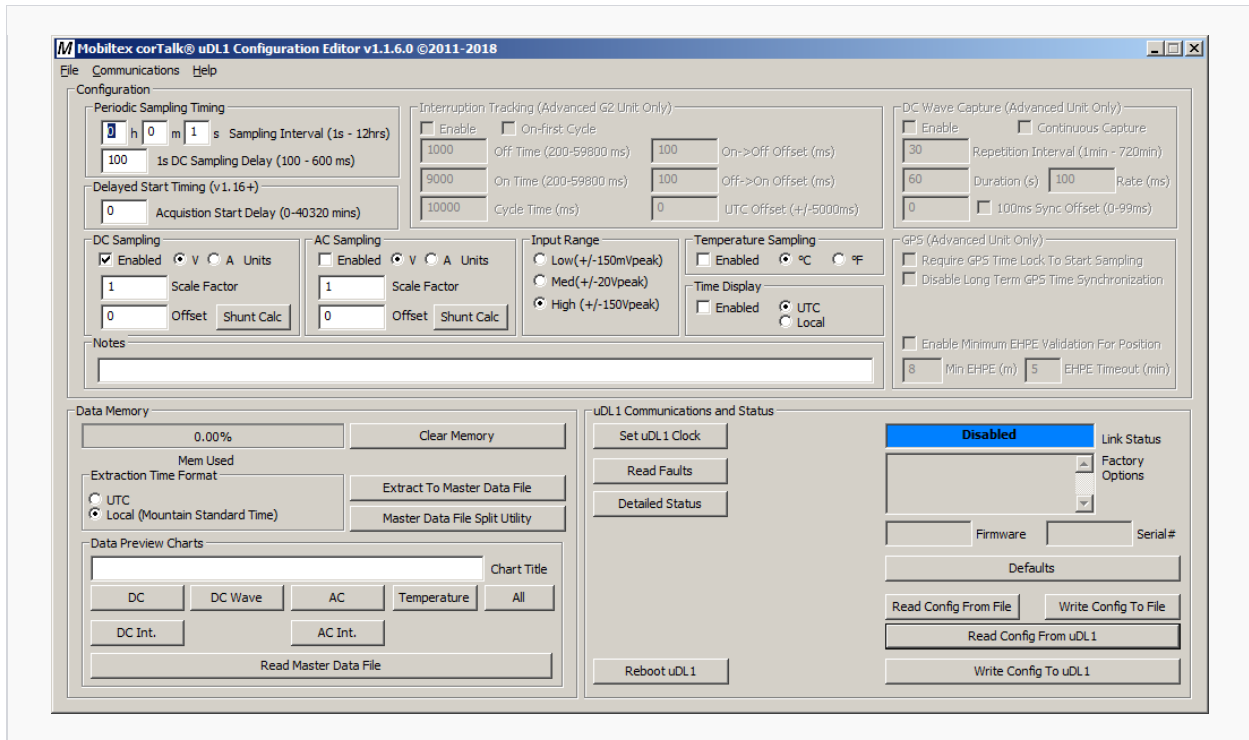


Figure 16 uDL1CONFIG Main Screen

4.3.1 uDL1 Communications and Status

4.3.1.1 Read Config From uDL1

The first step in configuring a device is to read in the current settings from the unit.

- Click on “Read Config From uDL1”. The “Link Status” field will briefly show “Busy” as the current configuration parameters are read from the uDL1.
- After the link status returns to “Idle”, you will see the configuration settings currently in the uDL1.
 - If the uDL1 is not responding or not connected, an error dialog will pop up.
 - If it is not connected, simply connect the USB cable to the computer and try again.
 - If the uDL1 LCD display is showing ‘bSY’, wait until ‘USb’ is shown before attempting to read the configuration from the uDL1.
- Once communications have been established with the uDL1, the operational parameters can be configured for the requirements of a particular measurement session.

4.3.1.2 Write Config To uDL1

Once all configuration items have been set as desired, click the “Write Config to uDL1” button to write the configuration to the uDL1 and activate it.

4.3.1.3 Link Status

The “Link Status” field will indicate “Disabled”, “Busy” or “Idle”. While “Busy” is shown, the application is actively communicating with the uDL1 hardware. The application will not respond to further actions while “Busy” is displayed.

The uDL1 can be unplugged at any time from the USB port. However if you have changed any parameters, be sure to write them to the uDL1 before unplugging the device.

4.3.1.4 Factory Options

The “Factory Options” box will display any factory configured options. A basic uDL1 will show “None”, whereas an advanced uDL1 will show “GPS TIMESYNC” and “LARGE MEM”.

4.3.1.5 Firmware

The “Firmware” box will show the firmware version of the uDL1 that was last read.

4.3.1.6 Serial#

The “Serial#” box will show the electronic serial number of the uDL1 that was last read.

4.3.1.7 Read/Write Config File

The “Write Config To File” button may be used to store a copy of the current configuration to a file on the PC. The configuration may be retrieved by using the “Read Config From File” button. After loading the configuration from a file, it must still be written to the uDL1 before the changes become effective.

4.3.1.8 Set uDL1 Clock

The “Set uDL1 Clock” is used to set the clock of the uDL1 from the PC clock. Note that in GPS equipped units, the uDL1 clock will automatically be set from the GPS receiver as soon as a valid GPS time fix is detected.

On basic units, the uDL1 clock should be set at least once before data acquisition is attempted. Beyond that, the clock should be updated periodically to resynchronize the clock to actual time. The internal clock of the uDL1 basic model can be expected to drift as much as +/-10s each month. The uDL1 will maintain the real time clock as long as the battery is not fully depleted.

4.3.1.9 Read Faults

The “Read Faults” button is used to read out any faults that might be present within the uDL1. The information present in this box should be sent to Mobiltex for analysis when faults are encountered. A history of faults and their associated time stamps is maintained.

To clear the fault history, click the “Clear Fault History” button.

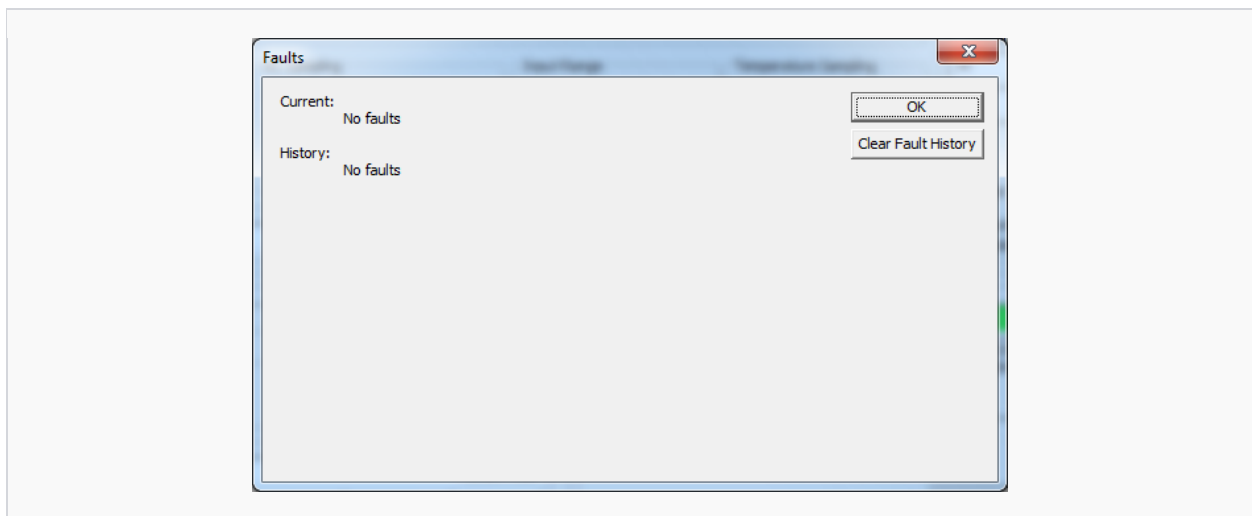


Figure 17 Faults Dialog

4.3.1.10 Detailed Status

The “Detailed Status” button causes a pop-up window to appear. The window includes detailed information about several items used by the uDL1.

The GPS Status information may be used to diagnose GPS satellite signal reception issues that may prevent time lock from occurring. Ideally, more than 3 satellites should be in the fix for a reliable lock. The GPS Status information is only applicable to the advanced model of uDL1.

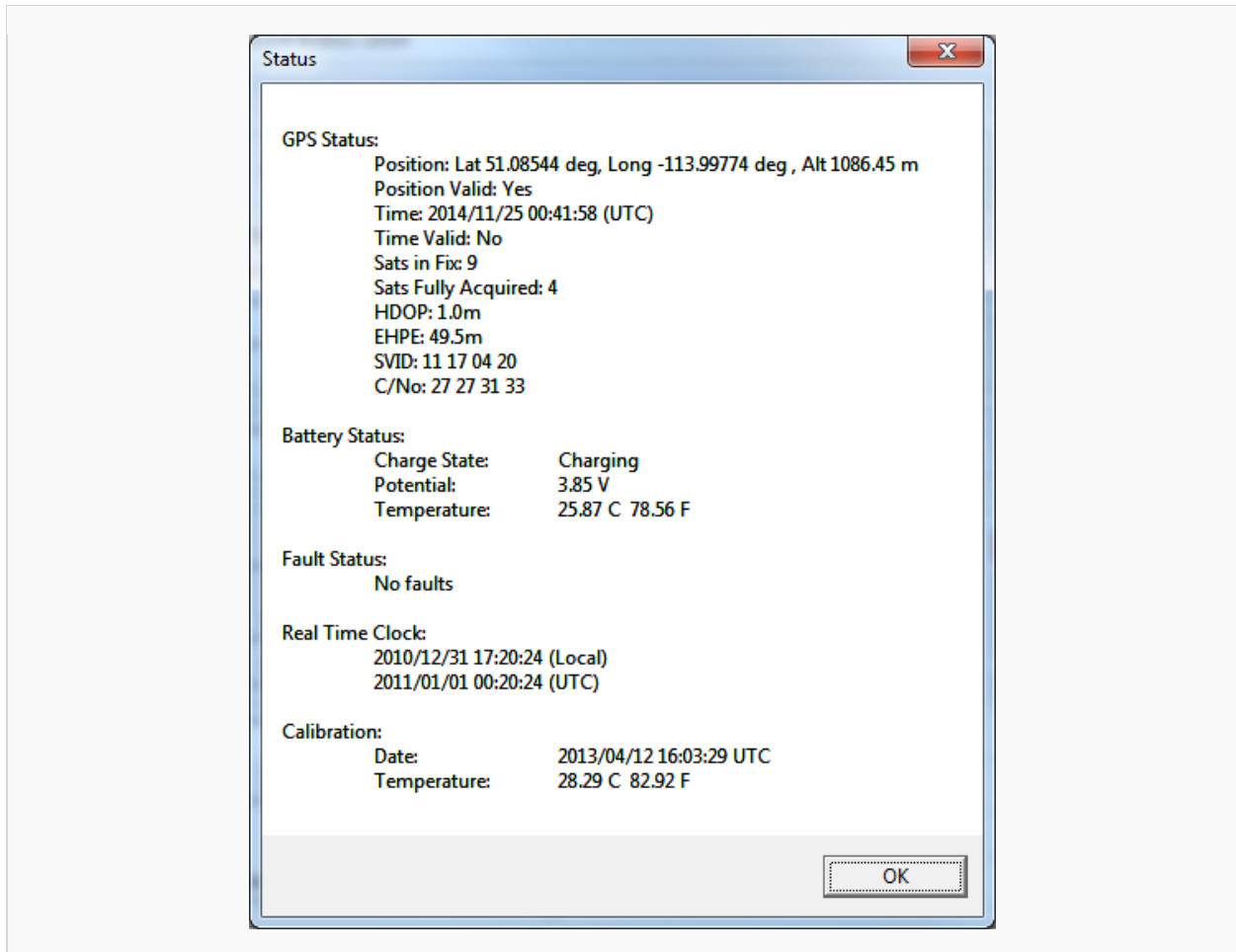


Figure 18 Detailed Status Dialog

4.3.1.11 Reboot uDL1

The “Reboot uDL1” is used to restart the uDL1 application.

4.3.2 Configuration Group

All items in the configuration group may be reset back to factory defaults by clicking on the “Defaults” button.

4.3.2.1 Timing

The “Timing” section allows you to select the measurement sampling interval (1 second to 12 hours).

An additional parameter “1s DC Sampling Delay” can be used when DC acquisition is enabled and the sampling interval is 1 second. This parameter delays the acquisition of a data sample from the top of the second. This could be used when a signal is expected to transition co-incident with the transition of the second, but there is an associated settling time with the signal transition. Delaying the sampling past the settling time will then yield a post-transition reading.

This parameter is only useful on advanced uDL1 models. Normally, when not needed, the parameter should be left at the default value of 100ms to minimize battery consumption during unit operation.

4.3.2.2 Delayed Start Timing (v1.16+)

Starting with version 1.16 firmware, the uDL1 can now be programmed to delay data acquisition start by a programmable number of minutes. This allows the unit hardware to be deployed days or weeks in advance of a desired measurement period.

- The acquisition start delay can be set to a value between 0 and 40320 minutes (28 days).
- When the analog cable is plugged into the unit, it will perform its normal first minute of measurement previews and then enter the delayed start mode for the programmed number of minutes.
- While waiting, the LCD display will show 'hLD', indicated the unit is holding for the delay to expire.

4.3.2.3 Interruption Tracking (Advanced G2 Unit Only)

Advanced uDL1 units based on the generation 2 (G2) hardware platform can be programmed to tracking interruption waveforms typically used with impressed current cathodic protection close interval surveys. When programmed with interruption cycle parameters matching survey waveform parameters, the uDL1 can measure on and off potentials of structures relative to a half-cell reference.

- This mode is enabled by checking the 'Enable' option under the interruption tracking parameter group.
- The interruption waveform operation matches the rest of the Mobiltex corTalk RMU line for timing capabilities.
- Interruption cycles are always synchronized to the top-of-the-minute.
- If the 'On-first Cycle' option is checked, then the first measurement take after the top-of-the-minute will be an on measurement.
- The 'On-time' and 'Off-time' parameters should be configured such that the total cycle time divides into 60s as a whole number; if this condition is not met, then a partial cycle will occur just before the top-of-the-minute.
- The cycle time is calculated and displayed after the on-time or off-time is changed and another configuration field is selected.
- Note that interruption cycle parameters are specified in millisecond units. Interruption waveform on/off times are limited to a minimum of 200ms each.

To allow for measurements to be made after the potential has stabilized on the structure, two delay parameters are provided, 'On->Off Offset' and 'Off->On Offset'. The uDL1 will wait the programmed amount of delay after an on-to-off transition or off-to-on transition before initiating a measurement.

Note that there are limitations on the values programmed for the offsets. The offsets must be less than the waveform on/off times with the unit sampling time taken into account. For DC measurements, the unit requires 150ms for a sample to be taken. When AC and DC measurements are enabled, 250ms is required for measurements to complete. For example, with a 1000ms on and 500ms off waveform and both AC and DC measurements enabled, the off-to-on offset parameter may only be set between 0 and 750ms and the on-to-off offset parameter may only be set between 0 and 250ms.

Finally, the 'UTC Offset' parameter allows the time base of the uDL1 to be skewed by +/-5s relative to actual UTC time. When using the uDL1 with some other manufacturers' interruption equipment, it may be necessary to adjust the time base to match the other manufacturers' time. When using the uDL1 with Mobiltex corTalk interruption equipment, this parameter should be set to 0ms.

4.3.2.4 DC, AC, Temperature Sampling

The “DC Sampling”, “AC Sampling, and “Temperature Sampling” sections allow selection of the item(s) you wish to measure.

- Scale and offset factors can be entered for DC Volts and AC Volts.
- Readings may be tagged as volts or amps by selecting the appropriate radio button in the AC/DC Sampling areas.
- Temperature readings may be tagged as Celsius or Fahrenheit by selecting the corresponding radio button in the Temperature Sampling section.
- You can enable any combination of DC, AC, or temperature.
 - For example if you wish to only measure DC then check only the “DC Sampling” box. If you wish to measure both DC and AC then check the “DC Sampling” and “AC Sampling” boxes.
 - Note that each measurement reading consumes a memory location. So, if you enabled all 3 items with a sample period every 10 seconds, 3 memory locations would be utilized every 10 seconds.

“Scale Factor” defines the software multiplication that will be given to the reading.

- This is used in most cases for current readings taken using a shunt resistor.
- If a shunt is to read 50mV at 100A, the scaling factor would be $100 / 0.05 = 2000$.
- A scale factor calculator is provided for use with current shunts.
 - Next to each scale factor entry in the AC and DC sections is a button labeled “Shunt Calc”.
 - Clicking the button next to the scale factor to be configured brings up the following dialog box:

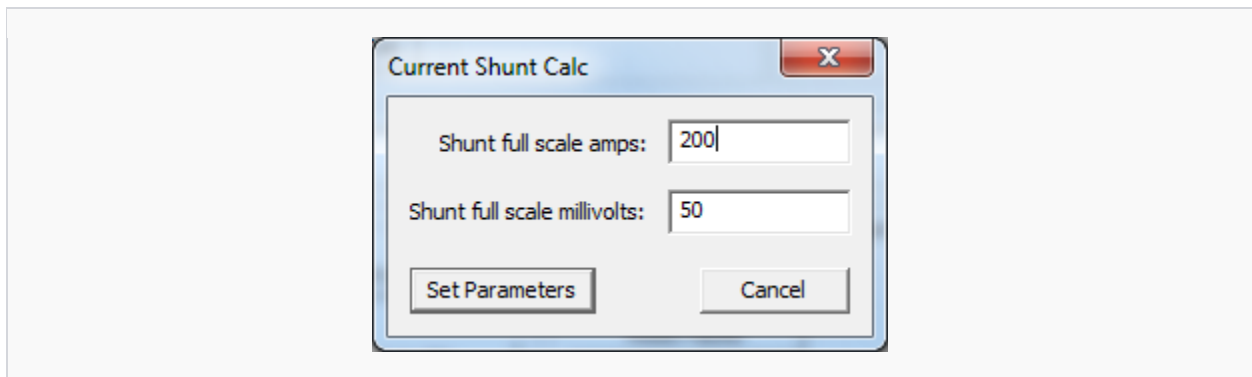


Figure 19 Current Shunt Calculator Dialog

- Entering the two parameters for the shunt and pressing “Set Parameters” will update the scale factor value in the uDL1 configuration with the appropriate value for the shunt.

4.3.2.5 Input Range

The “Input Range” section is used to select the measurement range.

- The low range accepts a maximum of +/- 150mV DC or 110mVRMS AC and is typically used for current shunt measurement.
- The medium range accepts a maximum of +/- 20 VDC or 14 VRMS AC and is typically used to measure reference cells.

- The high range accepts a maximum of +/- 150 VDC or 106 VRMS AC.
- All three ranges have a greater than 20Mohm input impedance. For measurement of AC line voltages (i.e. 120 or 240 VAC) an external attenuator is required.

4.3.2.6 Time Display

The uDL1 can be configured to display the current time during the initial 60 seconds after the analog cable is attached and for 5 seconds after the analog cable is removed. After the analog cable is attached, the display will cycle through the measurement data and the time for 60 seconds. Time is shown in 12 hour format with an 'A' in the lower right of the display indicating AM times. To enable this feature, check the 'Enabled' box.

The time may be displayed in UTC or local time. Click on the corresponding radio button to select the display time type. For local time, the time zone of the configuration PC is used to select time zone offset for the uDL1 display.

4.3.2.7 Notes

The "Notes" section allows the user to enter freeform text. This text is inserted into the start of the exported CSV file. A maximum of 100 characters can be entered into this field.

4.3.2.8 GPS (Advanced Unit Only)

The "GPS (Advanced Unit Only)" section allows setting GPS synchronization options for the Advanced Unit operation.

- The "Require GPS Time Lock To Start Sampling" forces the uDL1 to wait until accurate time is received from the GPS satellites before starting data recording after the analog cable is inserted.
 - This option would be checked when high accuracy time stamps are needed on the measurement points.
- When checked, the "Disable Long Term GPS Time Synchronization" option stops the uDL1 from periodically turning on the GPS receiver to maintain accurate time.
 - This option would be enabled to save power when high accuracy timing is not required for a particular measurement session.
 - The uDL1 will attempt to synchronize the internal clock to the GPS signal every hour if this option is not enabled.
- In addition, with firmware v1.11 and higher, it is also possible to apply a limit check to the position accuracy of the GPS receiver before a latitude/longitude position is logged by the uDL1.
 - To enable this functionality, check the box labelled "Enabled Minimum EHPE Validation For Position".
 - The minimum estimated horizontal position error (EHPE) limit can then be entered, in meters, in the box labelled "Min EHPE (m)". The limit must be between 3.0 and 200.0 meters.
 - A timeout is specified in the "EHPE Timeout (min)" box in minutes. If the minimum EHPE limit is not met within this timeout period, the current position is logged anyway and the unit continues with data acquisition. The EHPE timeout can be set between 1 and 3600 minutes.
 - V1.11 firmware will also place the EHPE at the time of position logging into the datalog memory. The EHPE value will be included in the output master data file.

4.3.2.9 DC Wave Capture (Advanced Unit Only)

The "DC Wave Capture (Advanced Unit Only)" section configures the DC fast sampling capability on the Advanced uDL1 unit.

- While the uDL1 is in wave capture mode, normal sampling of DC/AC/temperature is suspended (including interruption tracking measurements).
- Wave capture mode can be configured to run periodically for a certain duration, or it may be configured to run continuously. In wave capture mode, DC samples are taken every 100ms.
- With firmware v1.11 or higher, it is possible to synchronize the DC wave capture to an offset from a 100ms multiple.
 - Enable this functionality by checking the box labelled “100ms Sync Offset (0-99ms)”.
 - The offset from 100ms can then be set by entering the value, in milliseconds, in the box next to the enable check box. As an example, if this feature is enabled and the offset is set to zero, then DC wave capture samples would start at a whole number multiple of 100ms and continue every 100ms thereafter.

4.3.3 Data Memory Group

The data memory group is used to extract and preview measurement data.

- The “Mem Used” section provides a bar graph of the measurement memory usage within the connected uDL1.
 - The larger the bar graph, the more memory that is used in the device.
 - The color of the bar graph changes from blue to red as the memory fills.
- The “Extract To Master Data File” button allows extraction of the measurement data from the uDL1 into a CSV file.
 - Prior to clicking this button, ensure that the desired time format is selected. Data may be extracted in UTC (GMT) time, or in local time.
 - Local time is based on the time zone selected in the operating system of the computer being used to extract the data.
 - When the “Extract To Master Data File” button is clicked the following save as screen will prompt the user for the storage filename.

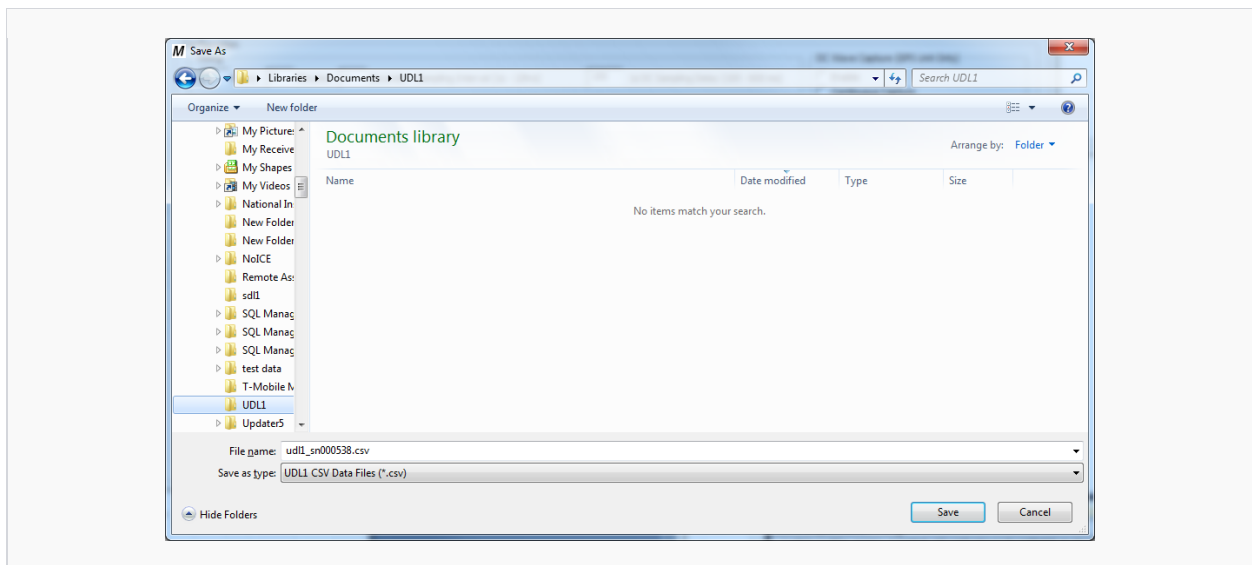


Figure 20 Extract To Master Data File Dialog

The stored file is saved in a comma separated value (CSV) format that can be imported into spreadsheets (i.e. Excel) and other applications that support CSV import. Note that older versions of Excel support a maximum of 65,000 lines so large measurement files may not be completely displayed when using those Excel versions. Excel versions prior to and including version 2003 will have this limitation.

The CSV file is arranged as indicated in the following Excel screen capture. The first line contains header information which identifies the contents of each column. Each row contains a time stamped event which can include cable insertion (unit turned on), cable removal (unit turned off), device battery voltage level, GPS Location (in GPS equipped devices), number of GPS satellites (in GPS equipped units), DC reading, AC reading, device temperature, user notes, and time-base lock status.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Record Type	Date/Time(UTC)	Milliseconds	Excel Time(UTC)	DC Reading	DC Units	AC Reading	AC Units	Temperature Reading	Temperature Units	Battery Potential(V)	GPS Latitude	GPS Longitude	GPS Sats	Notes
1															
2	Cable Inserted	09-07-2011 02:10:02	0	40793.0903											
3	Notes(40:1.04:Med)	09-07-2011 02:10:02	0	40793.0903											This is a test file.
4	Battery	09-07-2011 02:10:03	0	40793.09031							3.88				
5	Location	09-07-2011 02:10:46	0	40793.09081								51.0642	-114.25549	3	
6	DC Reading	09-07-2011 02:11:00	0	40793.09097		0 V									
7	AC Reading	09-07-2011 02:11:00	0	40793.09097				0 V							
8	Temperature	09-07-2011 02:11:00	0	40793.09097					22 C						
9	DC Reading	09-07-2011 02:11:01	0	40793.09098	0.000648	V									
10	AC Reading	09-07-2011 02:11:01	0	40793.09098				0 V							
11	Temperature	09-07-2011 02:11:01	0	40793.09098					21.9 C						
12	DC Reading	09-07-2011 02:11:02	0	40793.091		0 V									
13	AC Reading	09-07-2011 02:11:02	0	40793.091				0 V							
14	Temperature	09-07-2011 02:11:02	0	40793.091					21.9 C						
15	DC Reading	09-07-2011 02:11:03	0	40793.09101	0.028504	V									
16	AC Reading	09-07-2011 02:11:03	0	40793.09101				0 V							
17	Temperature	09-07-2011 02:11:03	0	40793.09101					21.9 C						
18	DC Reading	09-07-2011 02:11:04	0	40793.09102	-0.063486	V									
19	AC Reading	09-07-2011 02:11:04	0	40793.09102			0.122171	V							
20	Temperature	09-07-2011 02:11:04	0	40793.09102					22 C						
21	Cable Removed	09-07-2011 02:11:05	0	40793.09103											
22	Cable Inserted	09-07-2011 02:11:18	0	40793.09118											
23	Battery	09-07-2011 02:11:18	0	40793.09118							3.88				
24	Location	09-07-2011 02:11:18	0	40793.09118								51.0642	-114.25549	3	
25	DC Reading	09-07-2011 02:12:17	0	40793.09186		0 V									
26	AC Reading	09-07-2011 02:12:17	0	40793.09186				0 V							
27	Temperature	09-07-2011 02:12:17	0	40793.09186					22.3 C						
28	DC Reading	09-07-2011 02:12:18	0	40793.09188		0 V									
29	AC Reading	09-07-2011 02:12:18	0	40793.09188				0 V							
30	Temperature	09-07-2011 02:12:18	0	40793.09188					22.3 C						
31	DC Reading	09-07-2011 02:12:19	0	40793.09189	-0.005183	V									
32	AC Reading	09-07-2011 02:12:19	0	40793.09189				0 V							
33	Temperature	09-07-2011 02:12:19	0	40793.09189					22.2 C						
34	DC Reading	09-07-2011 02:12:20	0	40793.0919		0 V									
35	AC Reading	09-07-2011 02:12:20	0	40793.0919				0 V							
36	Temperature	09-07-2011 02:12:20	0	40793.0919					22.2 C						
37	DC Reading	09-07-2011 02:12:21	0	40793.09191	-0.000648	V									
38	AC Reading	09-07-2011 02:12:21	0	40793.09191				0 V							
39	Temperature	09-07-2011 02:12:21	0	40793.09191					22.2 C						
40	DC Reading	09-07-2011 02:12:22	0	40793.09192	0.004535	V									

Figure 21 Sample Master Data File

The “Master Data File Split Utility” button invokes a utility function that is used to further process the data from the uDL1 for use in other analysis applications. The function allows a master data file to be split into separate output files for DC, AC, temperature, and DC wave readings. As well, separate files can be created for different recording sessions.

- Click the “Select Source Master File(s)” button to select the master files to be converted.
- Next, set the output file options check boxes as required.
- Finally, click the “Convert” button. The utility function will create the new output files in the same directory as the source, but with new extensions to the source file name.

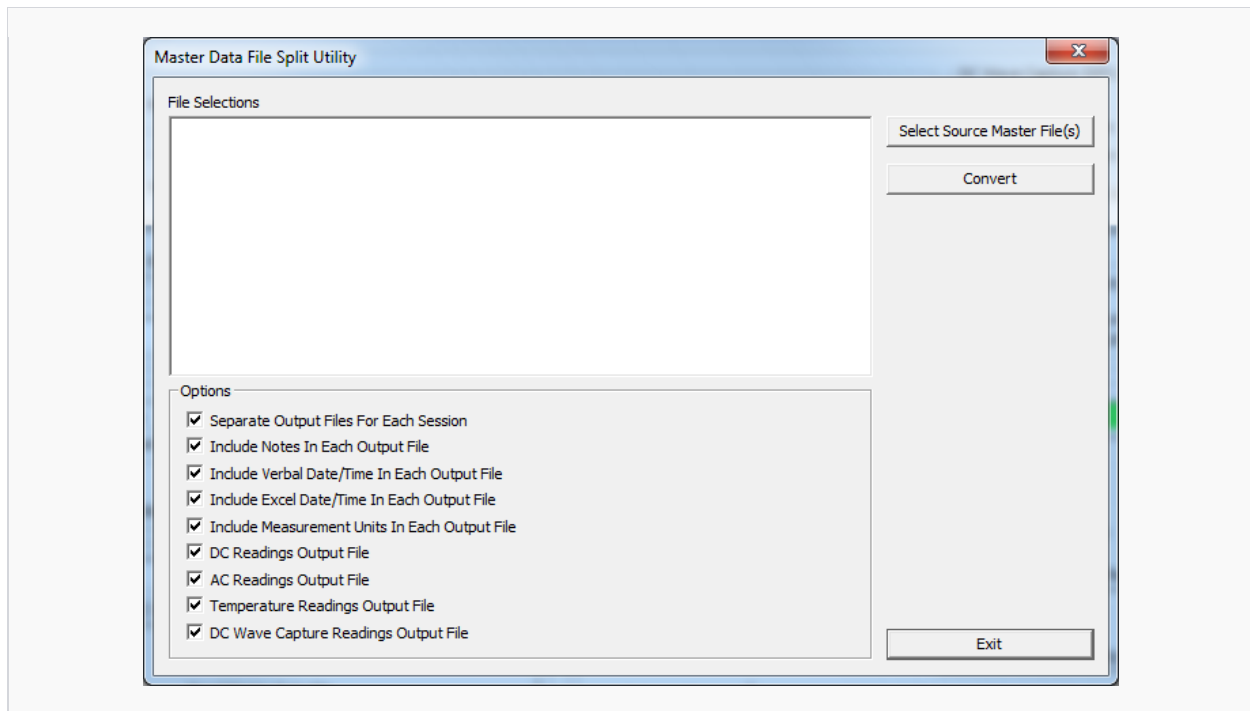


Figure 22 Master Data File Split Utility

Once the data has been extracted, it may be previewed in a chart. Under the “Data Preview Charts” grouping, click the “DC”, “DC Wave”, “AC”, or “Temperature” buttons to bring up a zoom-able chart of the associated data.

For units capable of interruption tracking, the ‘DC Int.’ and ‘AC Int.’ charts may also be displayed.

Note that this function is intended to provide quick previews of captured measurement data and not intended as a data analysis tool. The PC mouse can be used to hover over the graph to display the actual values associated with that measurement point. Detailed data analysis will need to be done using a third party tool such as Excel or specialized data analysis program.

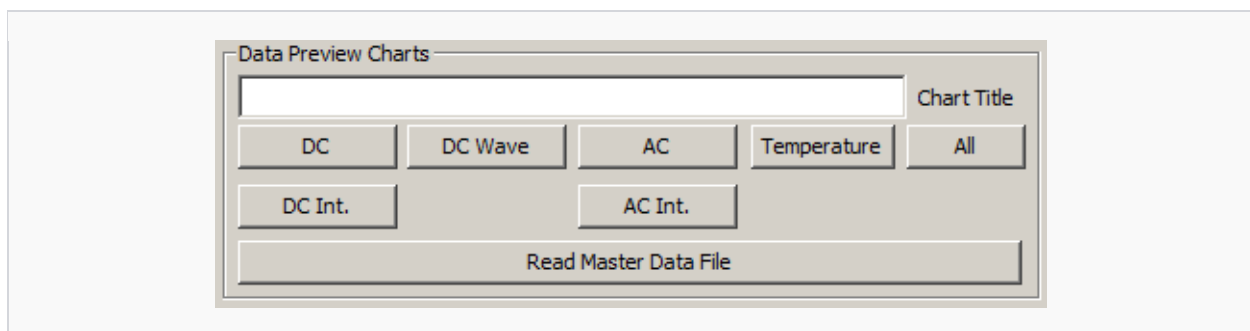


Figure 23 Data Preview Charts Selection

- The current chart display may be zoomed in by selecting the “Zoom In” button and then clicking on the chart. Each click zooms the chart in further.
 - The zoom-in mode may be changed between “X Zoom/Y Auto” and “XY Zoom”.
 - If “X Zoom/Y Auto” mode is selected, the Y-axis scale is automatically adjusted to the data being displayed.
 - If “XY Zoom” mode is selected, then both the X and Y-axes are both zoomed in with each click on the chart.

- To zoom out, select the “Zoom Out” button and click on the chart. Again, each click zooms out the chart further. If a view of the entire data set is desired, click on the “Zoom All” button.
- When viewing DC Wave capture segments, the currently displayed data segment may be selected by clicking the ‘Previous’, ‘Next’, ‘First’ or ‘Last’ buttons under the ‘Wave Print Segment’ area. These buttons do not appear for other preview chart types.
- The current chart view may be saved to a file. Click the “Save Chart” button to save a bitmap of the chart. The bitmap may be saved in JPEG, BMP, WBMP, PNG, GIF, SVG or SVGZ formats by selecting the appropriate type in the save file dialog.
- The current chart view may also be printed by clicking the “Print Chart” button.

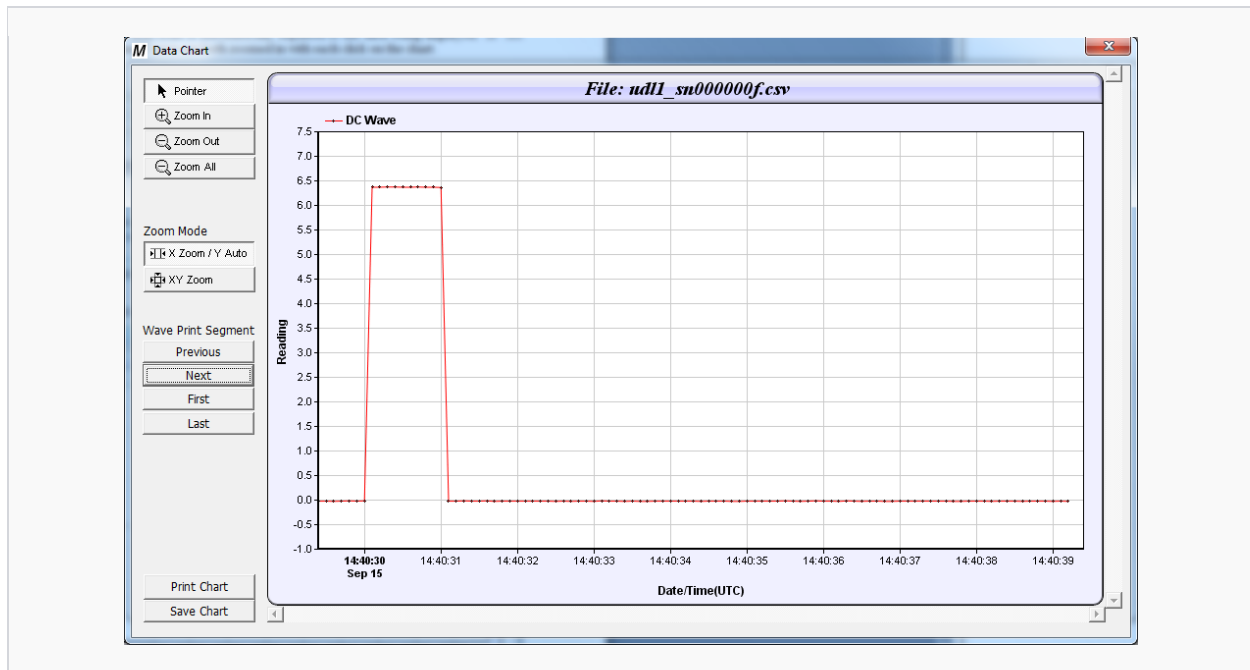


Figure 24 Sample Data Preview Chart

- The “Read Master Data File” button can be used to load a previously stored measurement file into the data chart memory. Data charts can be printed and saved.
- After the data has been extracted from the uDL1, the data memory on the device may be cleared by clicking the “Clear Memory” button. Note that clearing memory may take up to 30s to complete.

4.4 uDL1 Config Mobile App

4.4.1 Equipment Requirements

The following items will be needed when configuring a uDL1.

- uDL1 Bluetooth Programmer (A1506034301)
- Mobile phone or tablet (IOS or Android) to communicate with uDL1

4.4.2 App Installation

On your IOS or Android device go to the app store and search for “uDL1 Config”, follow the prompts to install the app.

4.4.3 Connection

Note: Below screenshots are from an IOS device, for Android devices the operation is similar with some minor graphical differences.

Plug the uDLBT1 Bluetooth Programmer to the uDL1 via the connector, plug the USB side to a 5VDC power source, this could be a PC, power bank, wall, or car charger.

On the main app screen click on “Connect to uDL1”, wait for the list of available uDLBT1 devices, select the correct one based on the SN displayed.

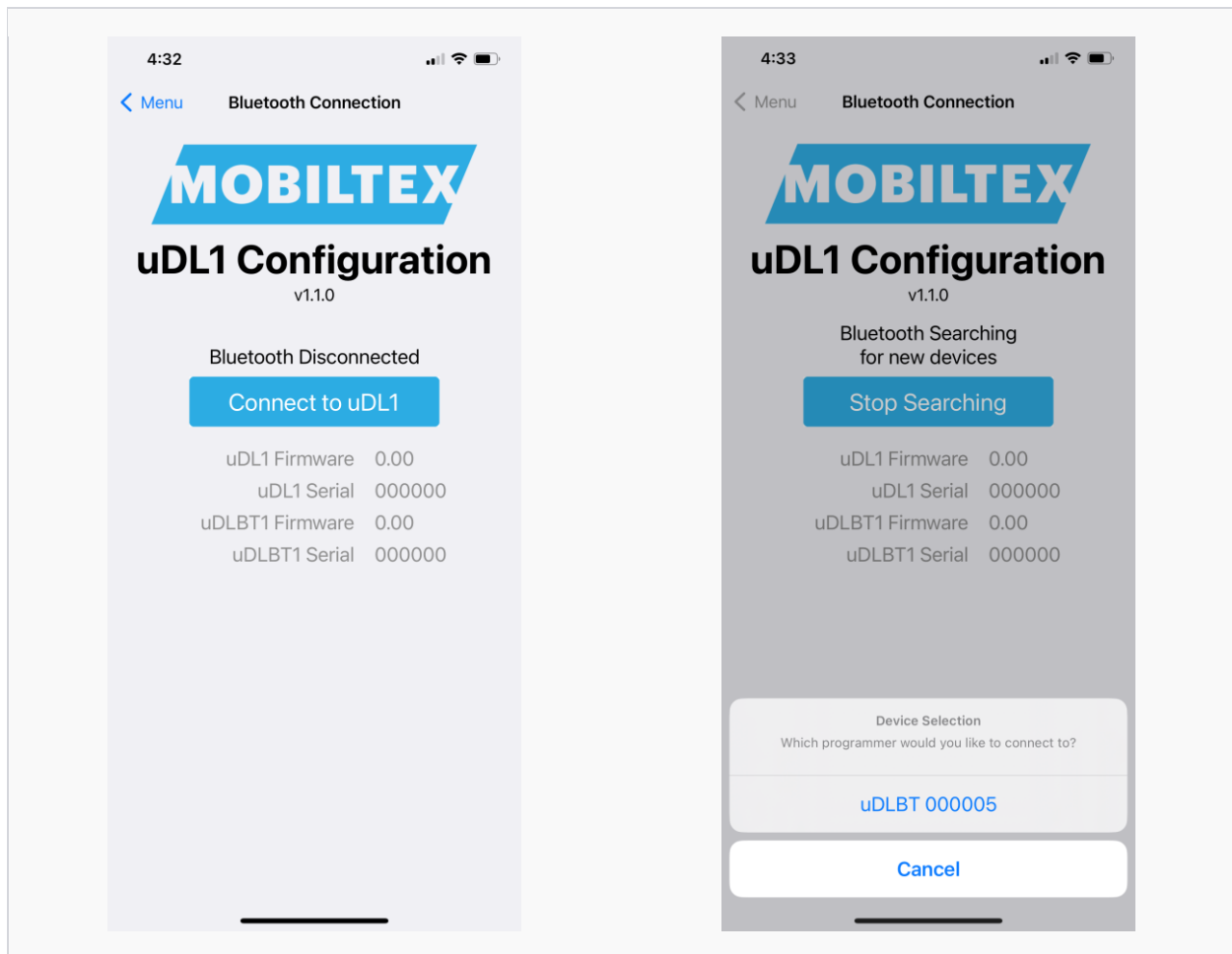


Figure 25 Bluetooth Connection

4.4.4 Configuration

Note: The app allows full configuration of the uDL1, but still needs a computer to extract the data from the uDL1.

Once the connection is established successfully, the main screen will display the SN and Firmware Version of both the uDLBT1 and the uDL1. Click on “Menu” at the upper left corner to view and/or edit all configurations. For details about the configurations refer to section 4.3 of this manual.

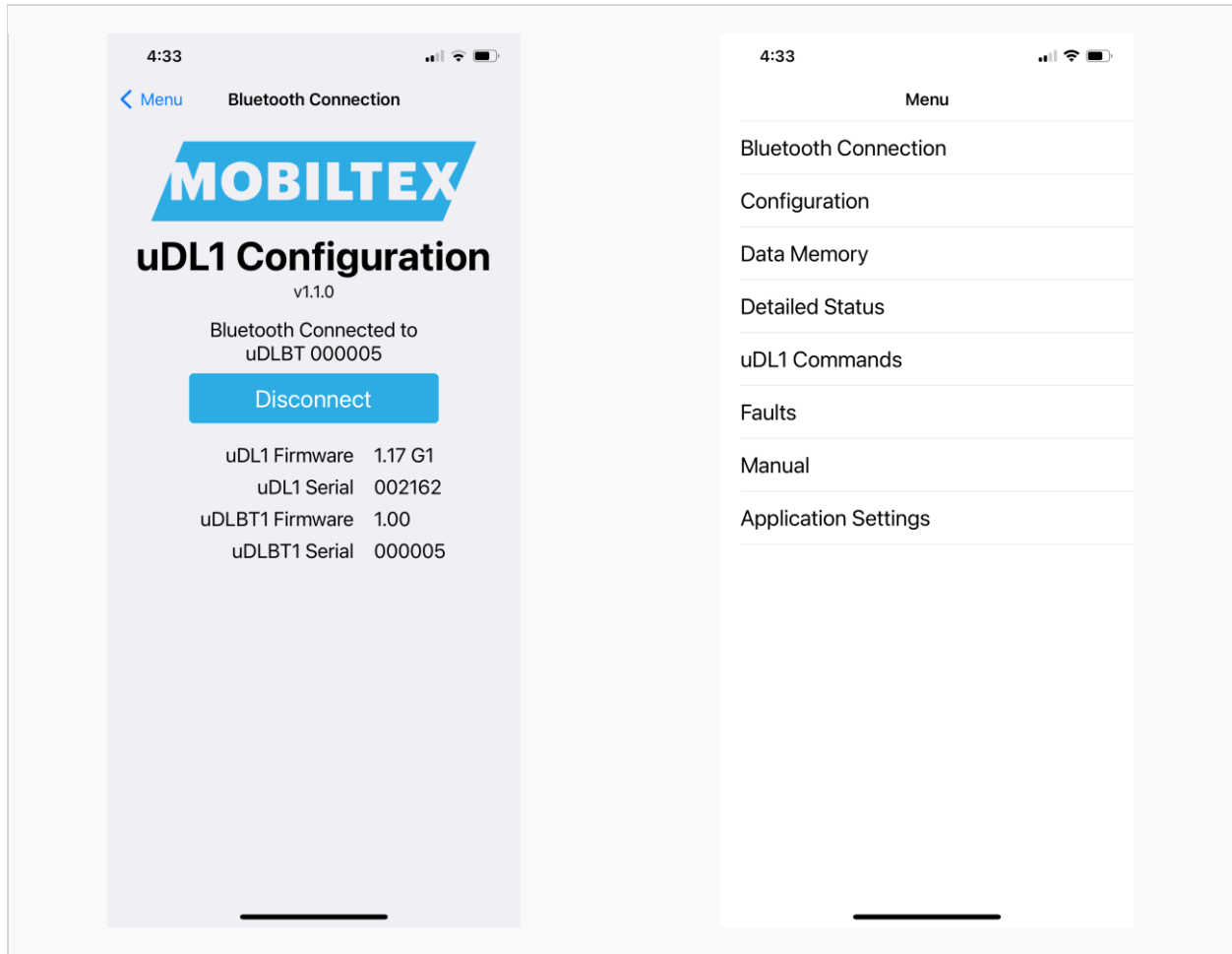


Figure 26 App Menu

5 Operation

There are no user controls on the actual uDL1.

Data acquisition cannot be scheduled to start at a particular date and time. Instead, the device automatically powers up when the measurement cable is installed and immediately starts data acquisition activities. The device ceases data acquisition and powers down when the measurement cable is removed.

The waterproof connector that mates to the uDL1 has an automatic physical locking function. The white arrow on the cable should align with the black arrow on the top graphic overlay of the uDL1. When the cable is inserted it will “click” to indicate that the connector is locked in place. The cable is released by pulling back the black ring (which has the white arrow) of the connector.

The measurement cable has two banana plugs to allow connection directly to banana jacks. There are also two extension clip wires included that can attach to the banana plugs of the measurement cable.

The bottom of the uDL1 includes a magnet which allows the device to be attached to ferrous surfaces.

There are also two holes in the base of the device that allow the device to be secured to a string or structural wire in applications where it is dropped down a tube such as test point stations.

In GPS equipped models the GPS antenna is located on the end opposite the uDL1 connector. Even though the GPS antenna in the uDL1 is reasonably omni-directional, best GPS signal reception will generally occur when the GPS antenna system is pointed upwards towards the sky.

The label on the bottom of the uDL1 identifies the type of unit, the hardware generation, the factory options and the unit serial number.

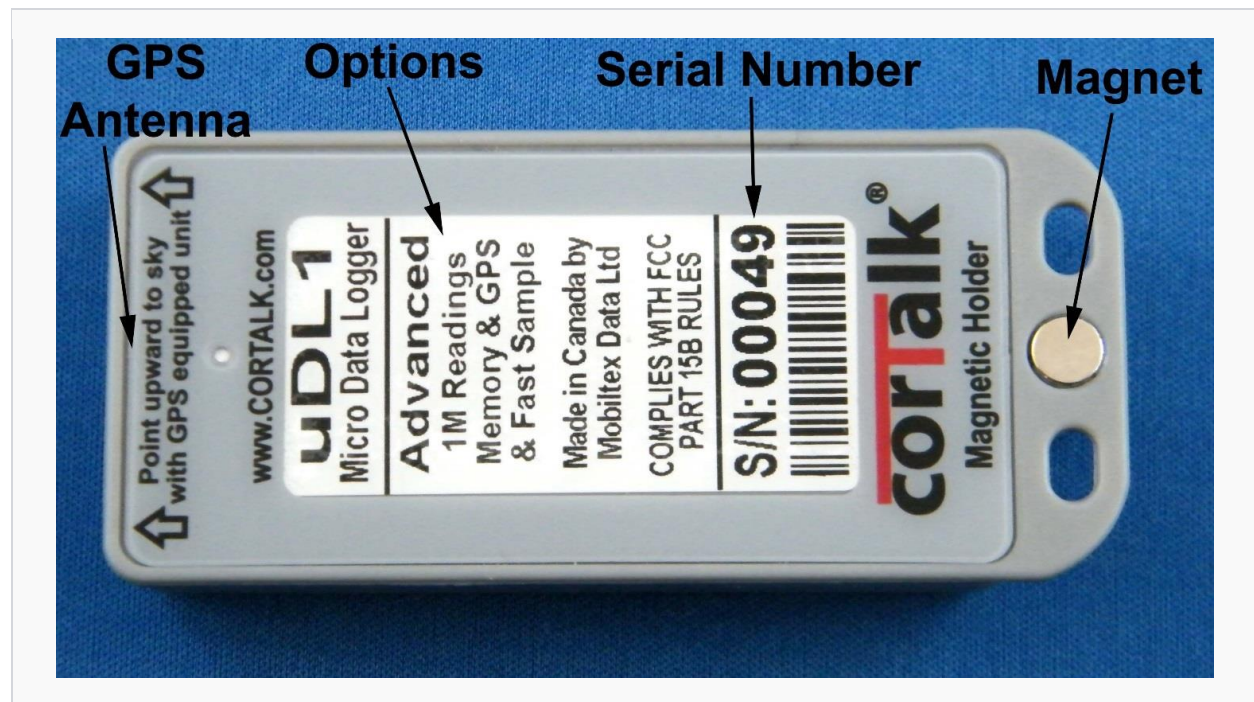


Figure 27 uDL1 Back View

The uDL1 has a custom LCD display that is illustrated below:

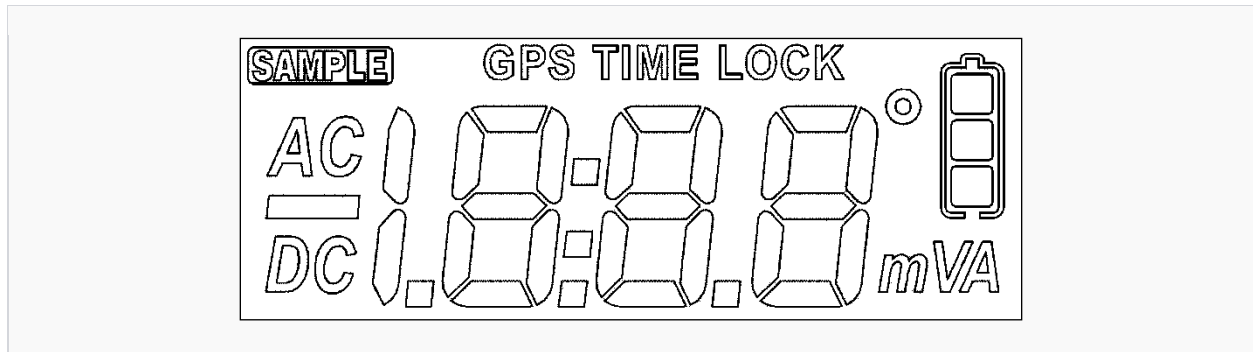


Figure 28 uDL1 LCD Display

The primary purpose of the LCD is to provide the installer/user with an indication that they are connected to and measuring the desired signal(s). The uDL1 has a high resolution measurement system that records the measurements in high resolution to the measurement storage memory. The LCD provides 3 ½ digits of measurement information.

- When the analog cable is first attached, the uDL1 will enter a real-time measurement display mode for a period of 1 minute.
 - During this time the uDL1 doesn't store information to memory and it provides real-time measurement data on the LCD which is updated every 2 seconds.
 - The "SAMPLE" icon continuously illuminates during this real-time display mode.
 - After the real-time mode expires, the "SAMPLE" icon will turn off and then flash during each measurement.
- When a DC Voltage is being measured the LCD "DC" icon will illuminate. The LCD will not show any polarity mark for positive signals. The "-" icon will illuminate for negative voltages.
- When an AC voltage is being measured, the "AC" icon will be illuminated.
- When temperature is being measured the degree symbol will illuminate.
- The battery symbol on the right of the LCD provides an approximate indication of remaining battery capacity.
 - The battery is at nearly full capacity when all three internal battery bars are illuminated.
 - As the battery charge becomes depleted, the number of bars displayed is reduced.
 - When the battery is nearly depleted there will not be any remaining bars and the LCD will display "Lo". Sampling operation will cease at that point. The "Lo" indication will remain even after the analog cable is disconnected.



Figure 29 uDL1 Front Face

- When more than one signal is being measured the LCD will cycle through each measured signal each time a sample occurs. For example if DC Volts, AC Volts and Temperature were all enabled the display would cycle through each of these measured values, while in the real-time display mode each measurement would be displayed for 2 seconds.
- If an over-range condition is detected on the input signal, the uDL1 will display 'OVR' or '-O-' in the measurement value area.
 - 'OVR' is displayed when the magnitude of the measured signal multiplied by the configured scale factor exceeds 1999.
 - When 'OVR' is displayed for a measurement, the correct measurement value will still be stored correctly in the measurement data as the measurement memory can hold values larger than 1999.
 - '-O-' is displayed when the input signal exceeds the hardware capabilities of the currently selected range.
 - If '-O-' is displayed for a measurement, the extracted measurement data will show 'OVER+' or 'OVER-' for the reading.
- After the 1 minute elapses the real-time measurement display mode will stop and the device will automatically begin data logging and measurement storage at the rate determined by the parameters.
 - The LCD display value will update each time a sample occurs.
 - For example if a 10 second sample period was selected the display would update every 10 seconds.
 - When more than one signal is being measured the LCD will cycle through each measured signal each time a sample occurs. So if all three measurement signals were enabled the LCD would display DC Volts for 10 seconds, then AC Volts for 10 seconds, then temperature for 10 seconds and then return to DC Volts. The CSV data file will contain all three measurements every 10 seconds.
- During DC wave capture mode, the "SAMPLE" icon on the LCD display will blink at a rate of 10 times per second.
 - In that mode, 10 DC readings per second are written to the CSV file.
 - Normal sampling is suspended during DC wave capture mode.
- To stop data logging simply unplug the measurement cable. The device will automatically shut off.

- Each time the measurement cable is inserted the device will begin the 1 minute real-time measurement display mode and then begin data logging.
 - Each new measurement session is appended to the previous measurements in device memory.
 - In GPS equipped units that have a GPS signal lock, the GPS location is recorded in the CSV file at the start of each new measurement session.
- When the memory of the device is full the uDL1 will display “FUL” on its LCD, mark the measurement memory with a full indication and stop taking measurements. The 1,000,000 measurement memory will provide about 114 days of measurements at a 10 second sample rate for a single channel.
- The device has an internal rechargeable Li-Ion cell that is automatically recharged when the unit is connected to the computer USB port.
 - The battery can be fully recharged in about 4 hours.
 - The battery icon flashes while the unit is being charged and becomes steady state on once the battery is fully charged.
 - The uDL1 has an internal charge controller so there is no problem in leaving the device connected to a USB port for extended periods of time.
 - The fully charged battery will provide at least 1,000,000 measurements or six months on a charge.
- The useful battery lifetime is targeted to be 5-7 years at which time it can be factory replaced. The water resistant and compact design of the uDL1 makes field battery replacement impractical.
- In order to maintain the high accuracy it is suggested the device be factory calibrated at least every 5 years.
 - The last calibration date can be viewed by utilizing the ‘Detailed Status’ function in the uDL1 configuration application. The unit should be recalibrated as required to maintain accuracy for the measurement application.
 - Re-calibration intervals are suggested to be nominally every 2 years and as a maximum every 5 years. However, as customer accuracy requirements will vary, the individual customer may determine optimal re-calibration intervals based on accuracy aging specifications found in Appendix A.

5.1 Advanced G1 Model Operation for Interruption Surveys

The uDL1 advanced model may be used for monitoring interruption surveys if the sampling interval is set to 1s. In addition, the “1s DC Sampling Delay” parameter should be set to a value that will allow for settling of the signal originating from the measurement point. Typically, a value of 250ms would ensure settling of the waveform.

When configured in this manner, the uDL1 will ensure that measurements are always taken at the configured delay from the transition of the second. Since the time on the advanced model is locked to the GPS system clock, all measurements will be synchronized to the interruption device waveform if the interruption device is also GPS synchronized. The interruption waveform being monitored must have a cycle time that is a whole number of seconds.

Note that when this mode is used, the battery life on the uDL1 will vary depending on the value of the sampling delay parameter. With the sampling delay parameter set to 600ms, only 2 days of operation can be expected from a fully charged battery. Reducing the sampling delay parameter to 250ms will result in approximately 4.5 days of operation on a full charge.

5.2 Advanced G2 Model Operation for Interruption Surveys

The uDL1 G2 advanced model is based on a more sophisticated processor that is able to directly track interruption cycles. Sampling with 1s intervals, as was needed with G1 hardware, is no longer necessary. Also, the G1 limitation on the interruption cycle on/off times being only whole seconds does not apply to the flexible G2 interruption tracking

mode. The parameters associated with interruption waveform can be directly programmed into the unit and it will then take on and off measurements at the proper point in the waveform.

Battery life in this mode will be less than the normal sampling mode. Battery life will be dependent on the configured interruption wave form parameters. Two weeks of operation will be possible even with worst case timing parameters.

6 Firmware Updates

As required, Mobiltex will periodically release firmware update packages for the uDL1. The firmware is included with the configuration application package. The uDL1 configuration application will warn the user if a firmware update is necessary on an attached uDL1.

To update the uDL1 firmware, exit the uDL1 configuration application and execute the uDL1 Firmware Update application from the Windows start menu. The dialog in Figure 30 will be shown.

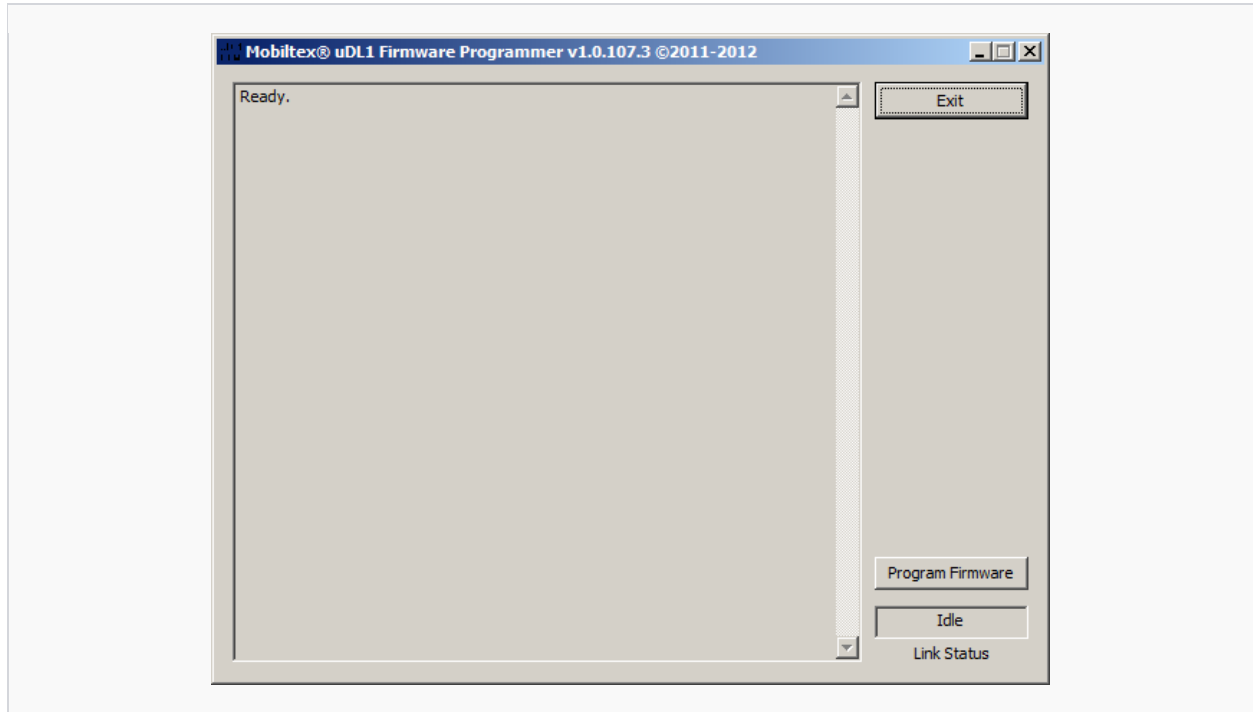


Figure 30 uDL1 Firmware Update Application Dialog

- To start the firmware update process, first ensure that the uDL1 is connected to a USB port on the computer.
- Next, click on the 'Program Firmware' button. The application will indicate progress as the firmware is downloaded to the uDL1 (see Figure 31).
- Do not attempt to interrupt the firmware download process once it has started.
- Once the message 'uDL1 completed firmware programming' is display, exit the firmware update application.
- The uDL1 will reboot and can then be used immediately with the configuration application.

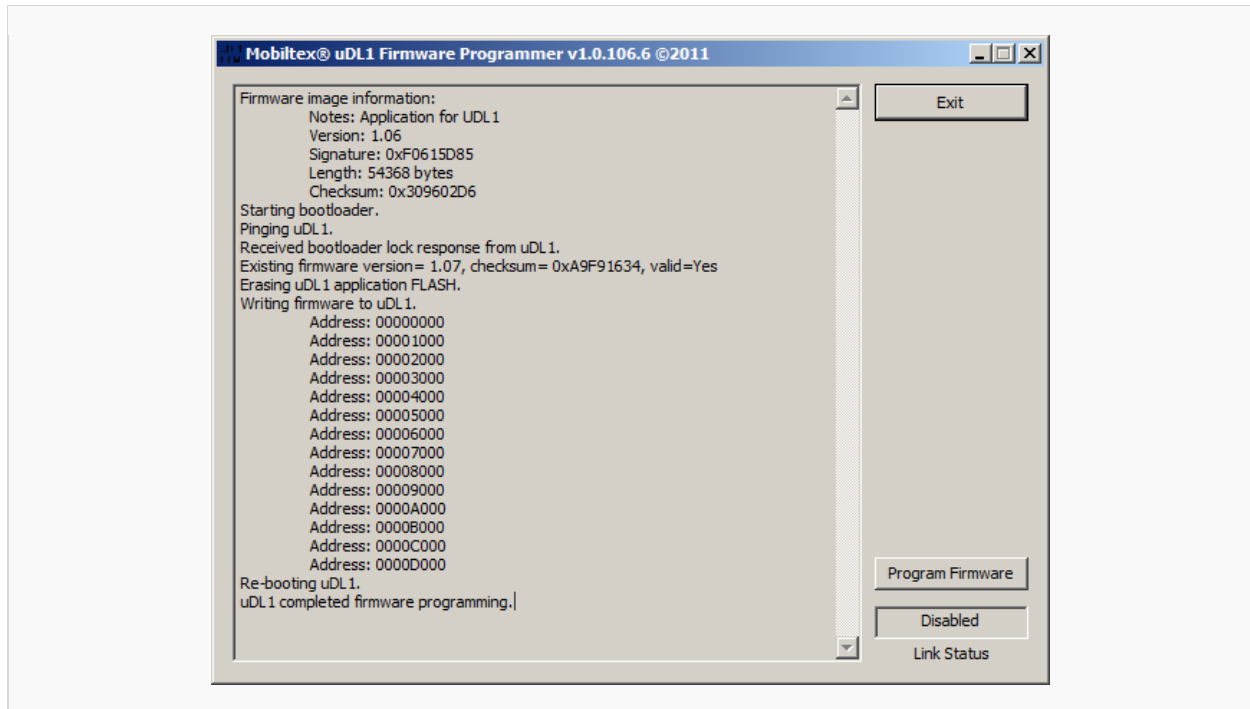


Figure 31 uDL1 Firmware Update Application Progress

The latest uDL1 software package may be downloaded from the Mobiltex web site at the following URL:
<https://www.mobiltex.com/solutions/cathodic-protection-portable-instruments/cortalk-udl1/>

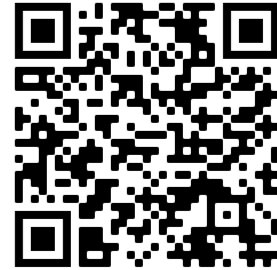
7 Cleaning Requirements

No special cleaning is required for the uDL1. Avoid any cleaning products that are not compatible with polycarbonate plastics.

uDL Registration

Visit <https://www.mobiltex.com/support/product-registrations/> and register your uDL to receive notification of free firmware updates.

Information provided will be used for the sole purpose of sending notification of firmware updates, and will never be shared or sold.



A. uDL1 Equipment Specifications

Operating Temperature	-20° to +55° C (-4° to +131° F)
Charging Temperature	0° to +35° C (32° to +95° F)
Storage Temperature	-40° to +70° C (-40° to +158° F)
Humidity	0 to 100% RH non-condensing
Maximum Altitude	5000 meters above sea level
Environmental Conditions	Pollution degree 2, indoor use
Size	89mm x 40mm x 18mm (3.5" x 1.6" x 0.72")
Weight	75 grams (2.7 oz)
Enclosure	UV stable, wide temperature polycarbonate
Charging Mode	5V DC, 500mA max input, supplied from USB-style connector through custom accessory cable
Battery	Internal Li-Ion 3.7V/1150mAH, non-user replaceable
Measurement Type	Category 2 (as per CSA C22.2 – 61010)
Analog Ranges (DC & AC)	+/- 150mVDC, 110mV true RMS AC, 150mVpeak +/- 20VDC, 14V true RMS AC, 20Vpeak +/-140VDC, 100V true RMS AC, 140Vpeak
AC Rejection on DC Readings	>65dB @ 50/60Hz
Input Impedance	>20Mohm
External Analog Channels	1 galvanically isolated, high impedance
Lightning Immunity	Survives multiple 20KV 10mS surges
Temp. Measurement Accuracy	+/-4° C (+/-7° F) over -20° to +60° C (-4° to +140° F)
DC Measurement Accuracy	over -20° to +60° C (-4° to +140° F) low range: +/-0.25% + 100uV med range: +/-0.5% + 12mV high range (-75V to +75V): +/-0.5% + 100mV high range (<-75V and >+75V): +/-1% + 100mV
AC Measurement Accuracy	over -20° to +60°C (-4° to +140° F) low range: +/-0.3% + 80uV, 180uV floor med range: +/-0.65% + 10mV, 22mV floor high range (-75V to +75V): +/-0.65% + 80mV, 170mV floor high range (<-75V and >+75V): +/-1% + 80mV, 170mV floor
Accuracy Aging	+/-0.13% per year
ADC Resolution	16 bits
Memory Size	Up to 500,000 readings (Basic model) Up to 1,000,000 readings (Advanced G1 model) Up to 2,000,000 readings (Advanced G2 model)
Battery	Internal Li-Ion (Not user replaceable)
GPS Receiver	20-channel SiRFStarIII (Advanced G1 model) 72-channel u-blox M8 (Advanced G2 model)
Output File Data Resolution	1uV for AC and DC readings 0.1° for temperature readings 0.00001° for GPS position

Technical assistance may be obtained from:

Attn: Service Department
Mobiltex Data Ltd.
#36, 56 Freeport Cres. NE
Calgary, AB, Canada
T3J 0T7

Tel: (403) 291-2770

Main Website: <https://www.mobiltex.com/>

Service Website: <https://www.mobiltex.com/support/>