



uDL2 Data Logger for CP Coupons

Configuration and Operation Guide



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	DOCUMENT NO.: UDL2-MAN-001	SHEET: 1 of 28	REV: 1.08

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CURRENT REVISION APPROVALS (Revision 1.08)

Name	Location	Job Function	Signature	Date
Tony da Costa	Calgary	VP of Engineering		

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1 Introduction

The uDL2 is a high accuracy, two channel data logger designed for use with CP coupons. An integral current detector with interruption relay allow direct measurement of coupon AC current density and coupon DC current. A reference cell input provides DC potential, AC voltage and Instant-disconnect DC potential measurements. The unit may also be operated in dual potential mode where the potential of two structures may be measured relative to a common reference point.

A large LCD can be used to locally verify the readings. Measurement storage capacity of 2,000,000 readings and rechargeable battery allow the device to capture readings for over 4 months. An internal GPS receiver provides an accurate time reference and site geo-location coordinates. 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.

This document details the configuration and operation of the uDL2 product.



Figure 1 uDL2 Micro Data Logger



Figure 2 uDL2 Installed In a Test Station

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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.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:

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.

Terms on the Product. These terms may appear on the product:

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.

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3 uDL2 Kit Contents

The Mobiltex part number for the uDL2 kit is A20A03UDL20 (non-USA) or A20A03UDL21 (USA). The following items are included in each kit:

- uDL2 Data Logger for CP Coupons Unit (A15000UDL20 non-USA, A15000UDL21 USA)



Figure 3 uDL2 Front View

- uDL2 USB Cable (W164IFUDL01)

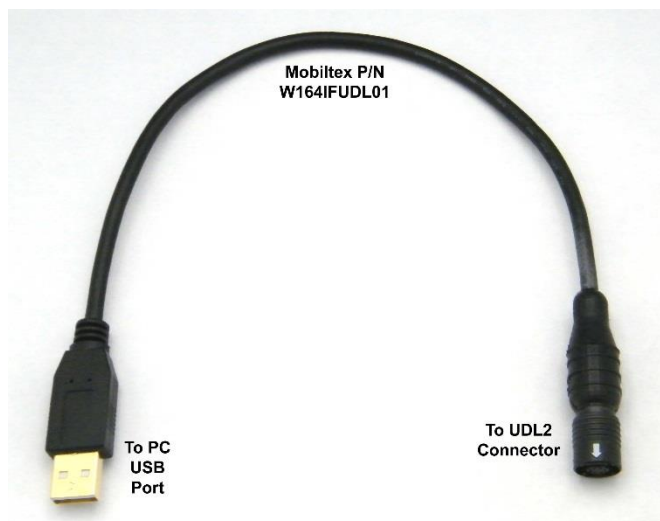


Figure 4 uDL2 USB Cable

- uDL Black Fabric Case (H20712UDL01)



Figure 5 uDL Black Fabric Case

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- uDL2 Analog Cable (W164I0UDL02)
- Extension Banana Plug To Clip Adapters (H27404UDL01/H27404UDL02/H27404UDL03)

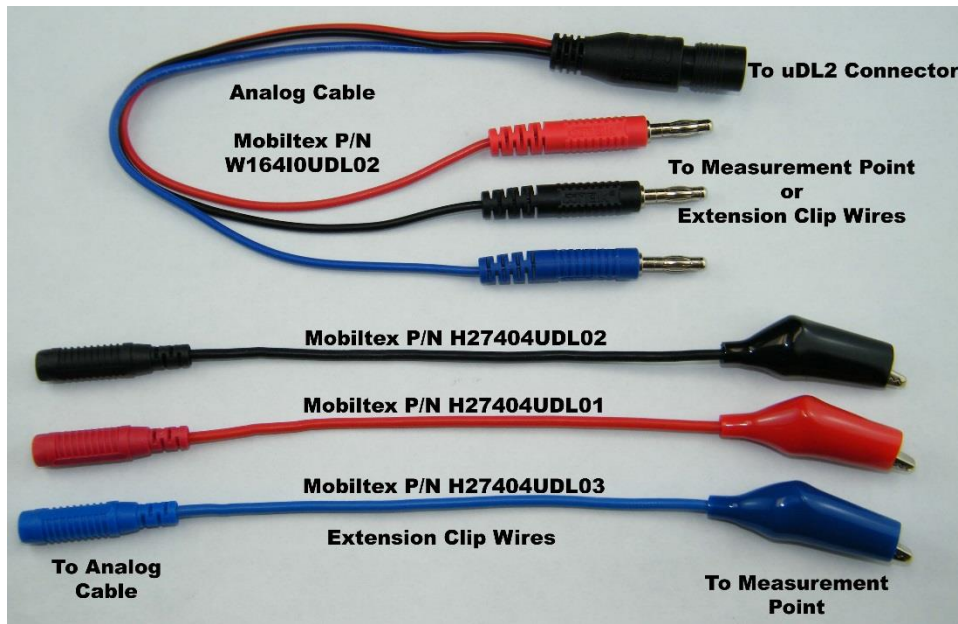


Figure 6 uDL2 Analog Cable and Extension Clip Adapters

- Large Alligator Clips (H27400112BK/H27400112RD/H27400112BU)



Figure 7 Large Alligator Clips

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



Figure 8 Programming Application and Driver USB Flash Drive

To use a PC to communicate with the uDL2, you will require the media (CD or USB flash drive) that shipped with the uDL2. The media contains drivers and the uDL2 configuration application. If you do not have the media, the contents can be downloaded from the Mobiltext web site at the following URL.

<http://www.mobiltext.com/cathodic/udl2>

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The following optional items are also available separately:

- CC Technologies Coupon Test Station Direct Interface Cable (Mobiltex P/N W164I0UDL03)



Figure 9 CC Technologies Coupon Test Station Direct Interface Cable

- USA/Canada AC USB Wall Charger (P11606UDL01)



Figure 10 USA/Canada AC USB Wall Charger

- DC USB Vehicle Charger (P11606UDL02)



Figure 11 DC USB Vehicle Charger

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

H23510RMU01 (Black)
H23530RMU01 (Orange)
H23540RMU01 (Yellow)
H23550RMU01 (Green)



Figure 12 Test Station Spacer Rings

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4 Configuration

4.1 Configuration Equipment Requirements

The following items will be needed when configuring a uDL2.

- uDL2 USB Cable (W164IFUDL01)
- Programming Application and Driver Media (CD or USB flash drive)

To use a PC to communicate with the uDL2, you will require the media (CD or USB flash drive) that shipped with the uDL2. The media contains drivers and the uDL2 configuration application. If you do not have the media, the contents can be downloaded from the Mobiltex web site at the following URL.

<http://www.mobiltex.com/cathodic/udl2>

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 13 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 13 will appear.

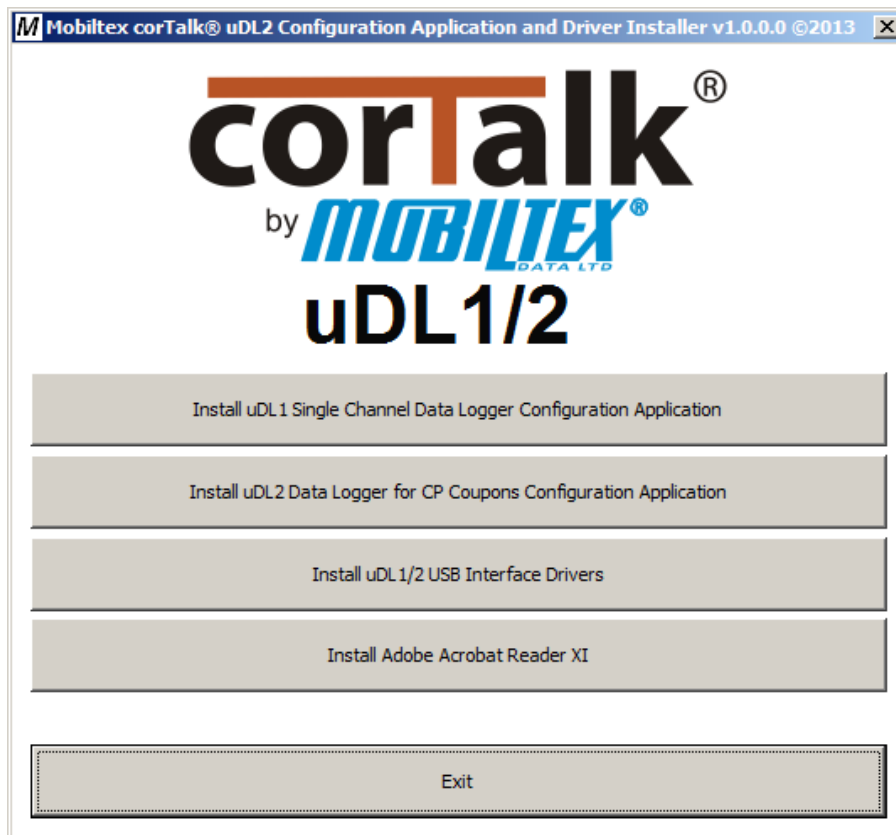


Figure 13 uDLInstaller Dialog

4.2.1 Configuration Application Installation

Click on the “Install uDL2 Data Logger for CP Coupons Configuration Application” button to start the application installer. A security warning dialog may appear. Click the “Run” button to continue.

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The following dialog should now appear:

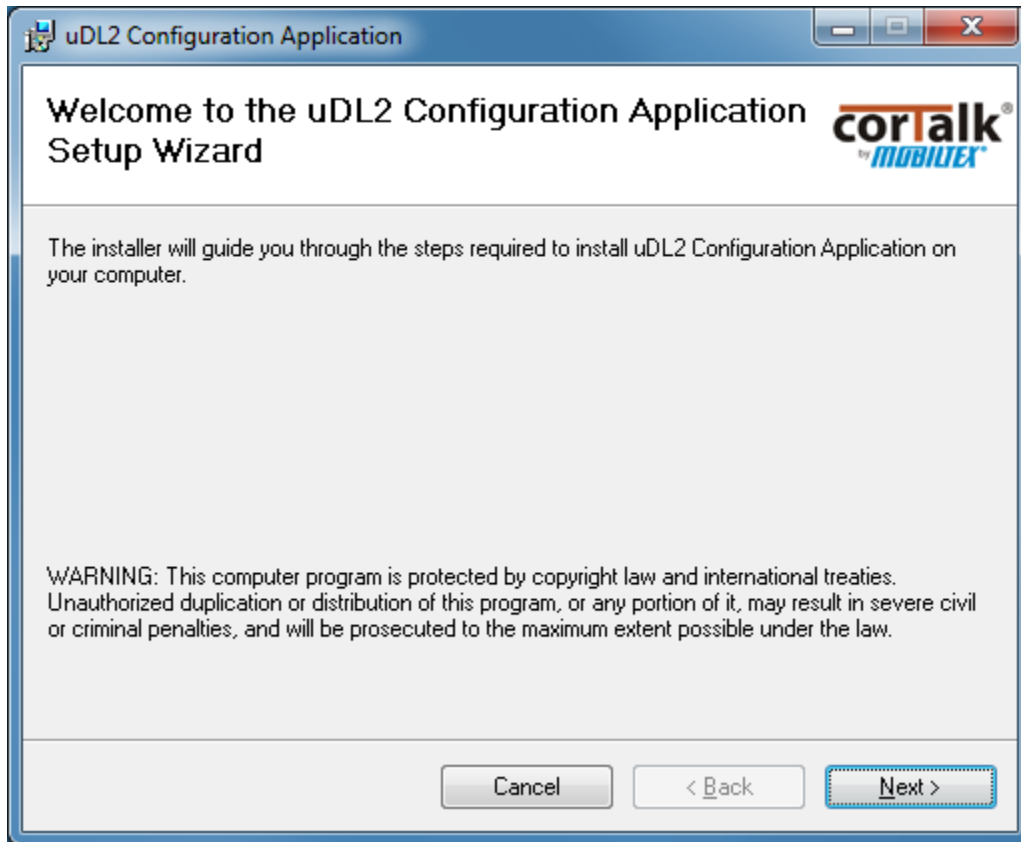


Figure 14 uDL2 Configuration Application Installation Dialog

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 15. Click “Close” to complete the installation.

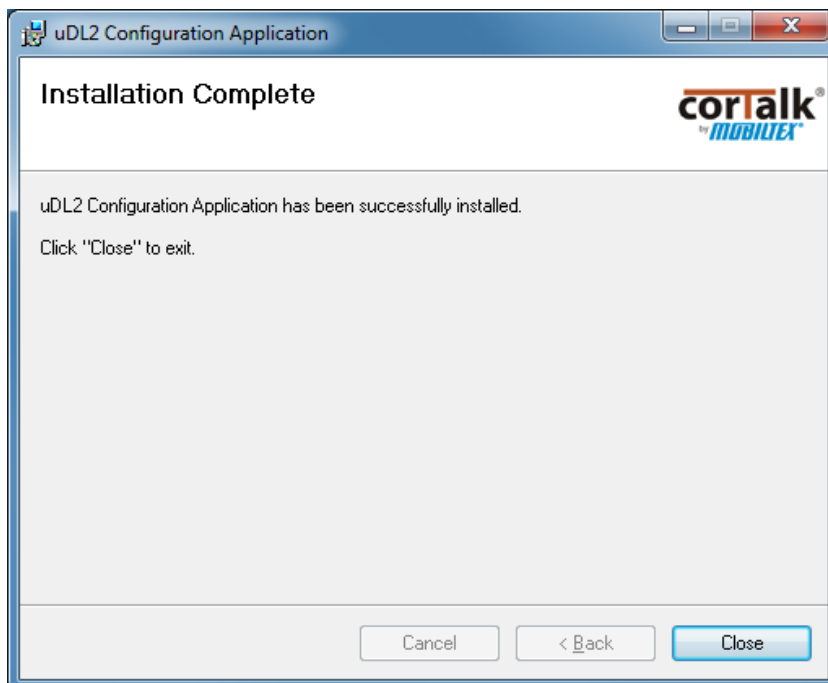


Figure 15 uDL2 Configuration Application Installation Complete

A shortcut to the configuration application and the uDL2 manual are created in the Windows start menu under the “uDL2 Configuration Application” folder.

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4.2.2 Driver Installation

To prevent potential hardware driver issues in Windows, do not attach the uDL2 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.

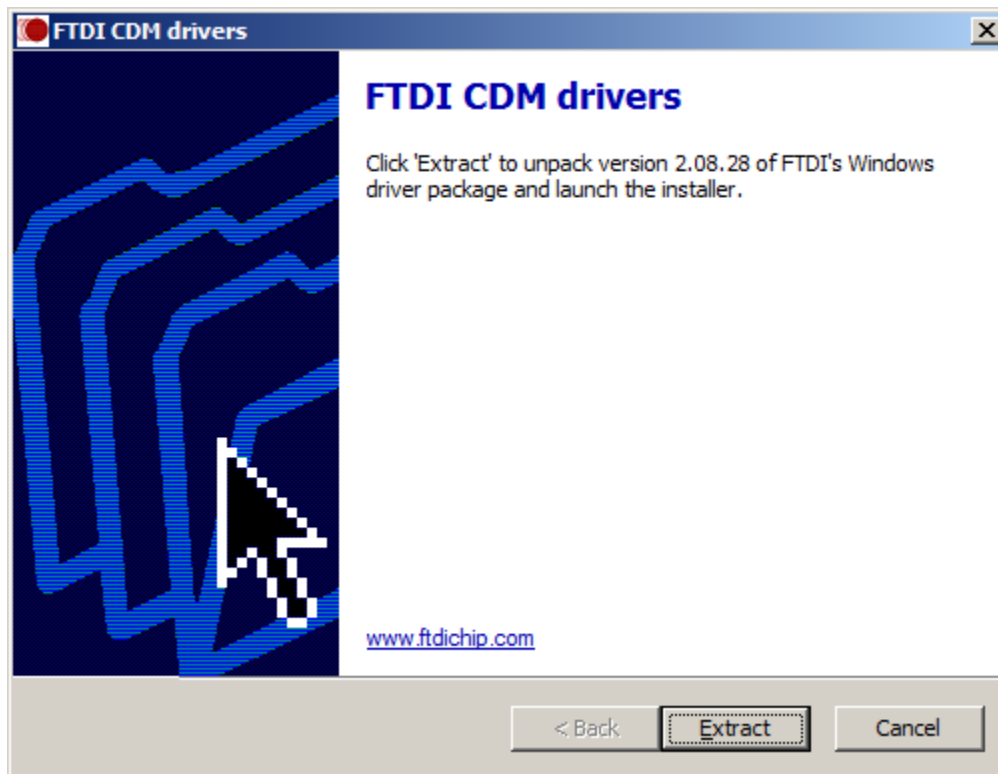


Figure 16 Driver Installation Screen

Once the driver installer completes, you may then plug in the uDL2 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 uDL2 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.

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4.3 uDL2 Configuration and Extraction

Attach the supplied USB cable between the PC and the uDL2.

Start the configuration software by clicking on “uDL2 Configuration” shortcut in Windows start menu, under the “uDL2 Configuration Application” folder. The following screen will appear.

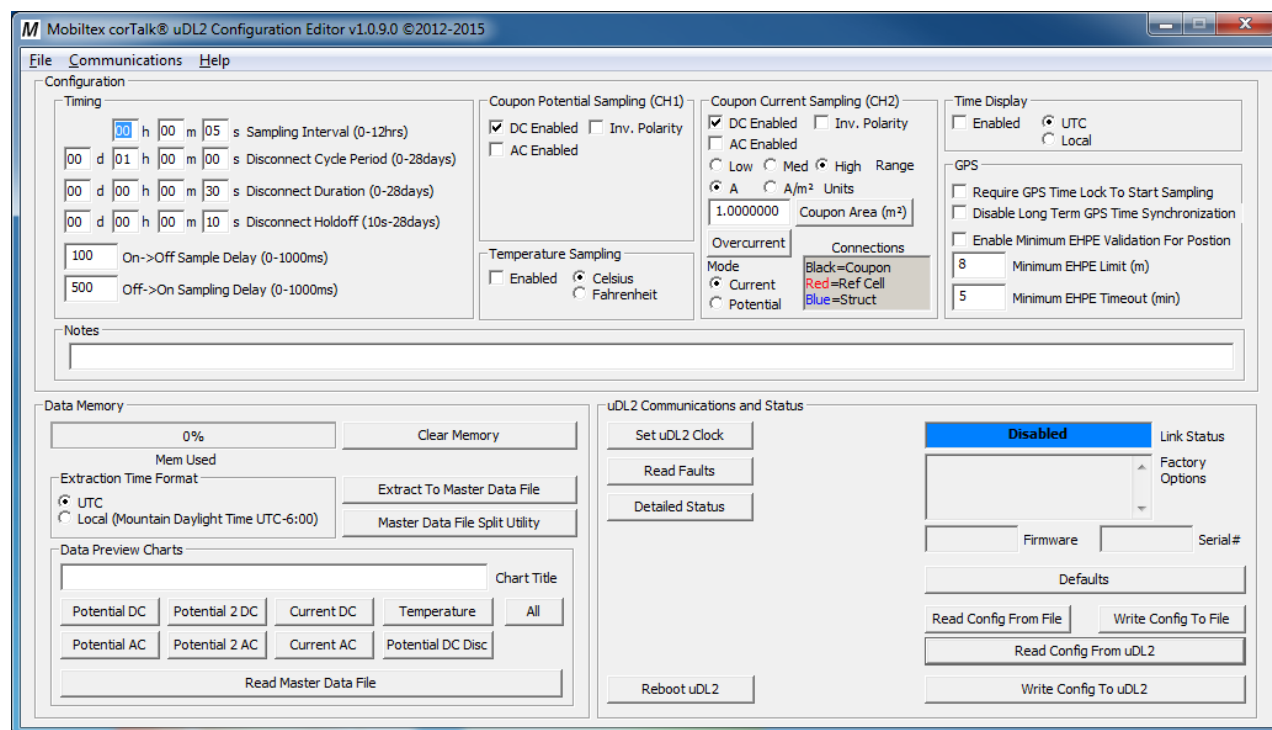


Figure 17 uDL2CONFIG Main Screen

4.3.1 uDL2 Communications and Status

4.3.1.1 Read Config From uDL2

The first step in configuring a device is to read in the current settings from the unit. Click on “Read Config From uDL2”. The “Link Status” field will briefly show “Busy” as the current configuration parameters are read from the uDL2. After the link status returns to “Idle”, you will see the configuration settings currently in the uDL2. If the uDL2 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 uDL2 LCD display is showing ‘bSY’, wait until ‘USb’ is shown before attempting to read the configuration from the uDL2.

Once communications have been established with the uDL2, the operational parameters can be configured for the requirements of a particular measurement session.

4.3.1.2 Write Config To uDL2

Once all configuration items have been set as desired, click the “Write Config to uDL2” button to write the configuration to the uDL2 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 uDL2 hardware. The application will not respond to further actions while “Busy” is displayed.

The uDL2 can be unplugged at any time from the USB port. However if you have changed any parameters, be sure to write them to the uDL2 before unplugging the device.

4.3.1.4 Factory Options

The “Factory Options” box will display any factory configured options.

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4.3.1.5 Firmware

The “Firmware” box will show the firmware version of the uDL2 that was last read.

4.3.1.6 Serial#

The “Serial#” box will show the electronic serial number of the uDL2 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 uDL2 before the changes become effective.

4.3.1.8 Set uDL2 Clock

The “Set uDL2 Clock” is used to set the clock of the uDL2 from the PC clock. Note that in GPS equipped units, the uDL2 clock will automatically be set from the GPS receiver as soon as a valid GPS time fix is detected.

If the GPS receiver is disabled in the configuration, the uDL2 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 uDL2 model can be expected to drift as much as +/-10s each month without GPS synchronization. The uDL2 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 uDL2. 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.

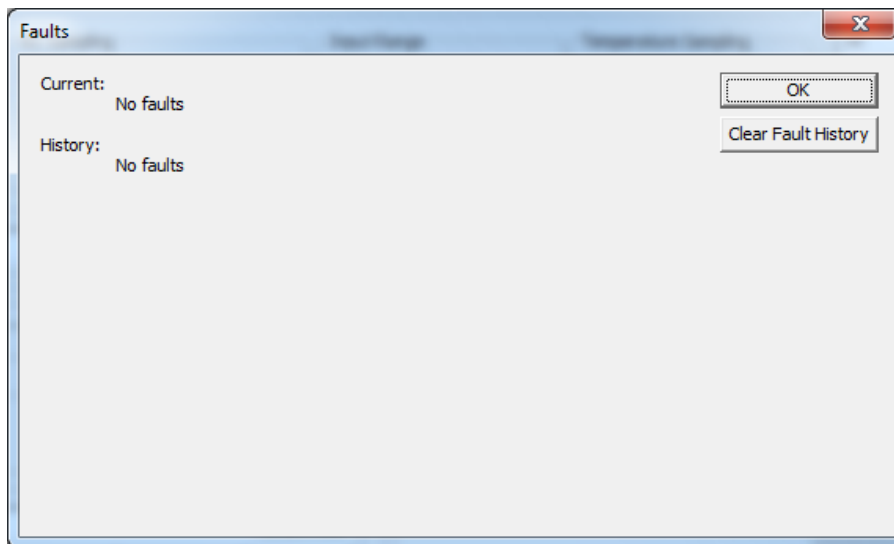


Figure 18 Faults Dialog

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 uDL2.

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.

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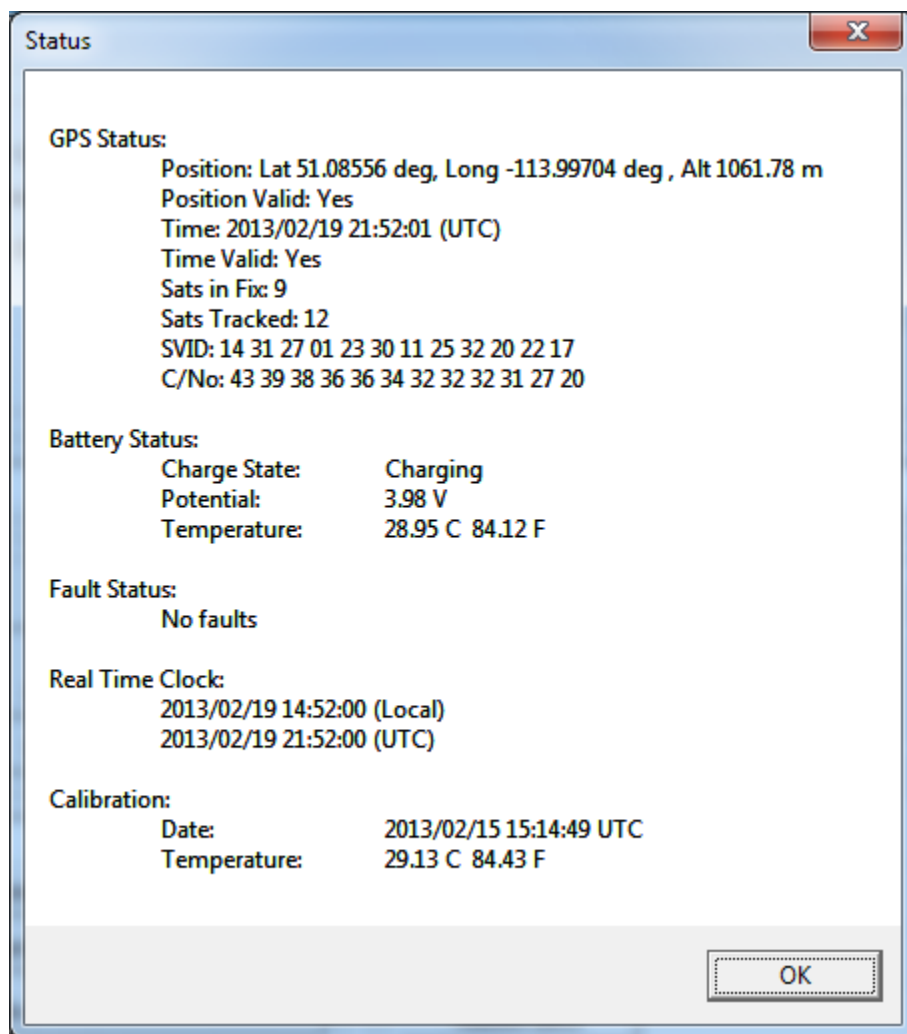


Figure 19 Detailed Status Dialog

4.3.1.11 Reboot uDL2

The “Reboot uDL2” is used to restart the uDL2 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 various timing parameters. The “Sampling interval” (1 second to 12 hours) determines how often the uDL2 takes a sample for each enabled measurement type. Between samples, the uDL2 enters a low power sleep mode to conserve battery power.

The “Disconnect Cycle Period” determines how often the coupon interruption relay will be opened for instant-off and de-polarization measurements. The “Disconnect Duration” value is how long the relay is left open for each disconnect event. After each relay transition, the uDL2 will wait before taking the next DC potential measurement; this wait time is determined by one of the two “Sampling Delay” parameters.

“Disconnect Holdoff” sets how long the uDL2 will wait after the analog acquisition starts before the first coupon disconnect cycle will occur. After the initial disconnect event, disconnect events will repeat at the “Disconnect Cycle Period” setting.

When the uDL2 is operated in dual-potential channel mode, only the “Sampling interval” timing parameters apply. All other timing parameters only apply to coupon mode.

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4.3.2.2 Coupon Potential Sampling (CH1) or Potential Sampling (CH1)

The uDL2 may be configured to read the coupon to reference cell potential. Both DC and AC values may be recorded by checking the appropriate boxes.

The “Inv. Polarity” checkbox can be set if it is desirable for data to be recorded with opposite signs. This option only affects the DC readings.

4.3.2.3 Coupon Current Sampling (CH2) or Potential Sampling (CH2)

The second channel on the uDL2 may be used for measuring coupon current, or it may be used to measure a second potential point. The measurement type is selected by clicking on the appropriate radio button under the mode heading (see Figure 20). In addition, the physical lead connections are shown in the area below the “Connections” heading.

Note that the reference lead color differs between coupon current and dual potential modes.

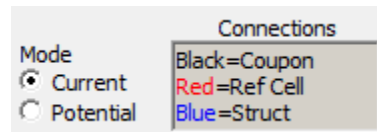


Figure 20 Channel 2 Mode Selection

4.3.2.3.1 CH2 Coupon Current Mode

Coupon current can be measured for both DC and AC values by checking the appropriate boxes. The uDL2 is capable of measuring current in one of two(three for the uDL2-G2/G3) ranges. Select the range based on the expected maximum coupon current and the range specifications from Appendix A. Note that only the uDL2-G2 and uGL2-G3 models supports all three ranges—earlier versions of the hardware only support the medium and high ranges. The low range radio button will be disabled for units that do not support that range.

The “Inv. Polarity” checkbox can be set if it is desirable for data to be recorded with opposite signs. This option only affects the DC readings.

Coupon current may be recorded as raw amps, or it may be recorded as amps per square meter by selecting the A/m2 radio button. When recording in A/m2, the surface area of the test coupon must be entered in square meter units. A coupon area converter calculator (see Figure 21) is provided for simple conversion from other units.

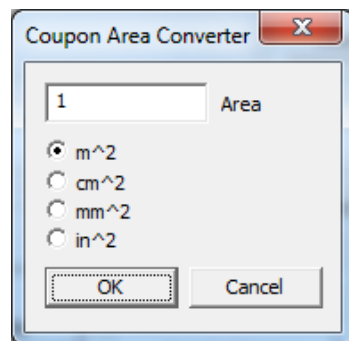


Figure 21 Coupon Area Converter

The uDL2 contains a hardware overcurrent protection circuit that disconnects the current path relay when an excessive amount of current is flowing. With firmware versions prior to v1.09, the uDL2 would remain in the relay-open state until the analog cable was removed and then plugged in. With v1.09 firmware, it is possible to configure automatic reconnection of the current path at predetermined retry intervals. Up to four reconnect retries can be made. Click on the ‘Overcurrent’ button to configure operation of this new feature. The following dialog is shown:

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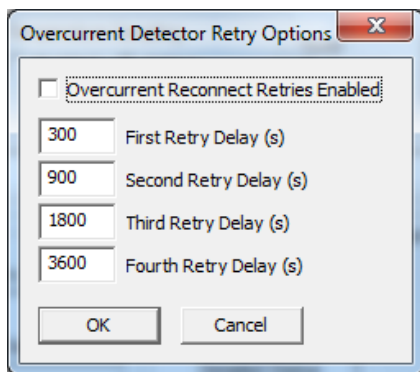


Figure 22 Overcurrent Detector Retries Configuration Dialog

To enable automatic reconnect retries, set the ‘Overcurrent Reconnect Retries Enabled’ check box. The four values shown set the delay between retries, in seconds. If a delay entry is set to a value of 0, that retry delay is skipped.

Care should be taken in using this capability as the current path relay and sense resistor will degrade with each over-current disconnection event. The number of retries and the delays should be tailored to minimize the number of over-current events. By default, the unit is set to 300s (5min), 900s (15min), 1800s (30min), and 3600s (1hour) between reconnection attempts. Also by default, the reconnect retries feature is disabled.

For each automatic reconnection attempt that fails due to overcurrent still being present, a marker will be placed in the datalogger memory. If a reconnect attempt is successful (i.e. current back to normal levels), the retry counter is reset.

4.3.2.3.2 CH2 Potential Mode

When in potential mode, the second potential point can be measured for both DC and AC values by checking the appropriate boxes. The “Inv. Polarity” checkbox can be set if it is desirable for data to be recorded with opposite signs. This option only affects the DC readings. Potential readings are always made in volts.

4.3.2.4 Temperature Sampling

The uDL2 may be configured to measure temperature at the configured sampling interval. Temperature may be logged in either Celsius or Fahrenheit units.

4.3.2.5 Time Display

The uDL2 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 uDL2 display.

4.3.2.6 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.

4.3.2.7 GPS

The “GPS” section allows setting GPS synchronization. The “Require GPS Time Lock To Start Sampling” forces the uDL2 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 uDL2 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 uDL2 will attempt to synchronize the internal clock to the GPS signal every hour if this option is not enabled.

In addition, with firmware v1.06 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 uDL2. To enable this functionality, check the box labelled “Enabled Minimum EHPE Validation For Position”. The minimum estimated horizontal position estimate (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.

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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.

V1.06+ 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.

4.3.3 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 uDL2. 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 uDL2 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.

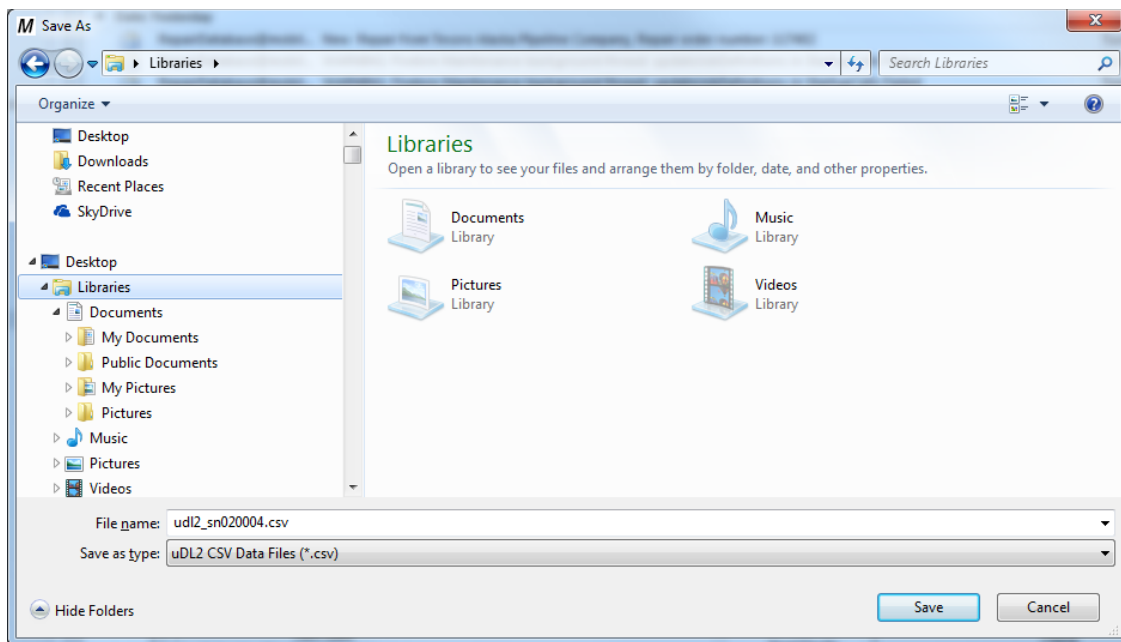


Figure 23 Extract To Master Data File Dialog

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, number of GPS satellites, potential DC reading, potential DC instant off reading, potential AC reading, current DC reading, current AC reading, device temperature, user notes, time-base lock status, interruption relay status, EHPE, EHPE limit, potential 2 DC reading and potential 2 AC reading.

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	A				B		C		D		E	F	G	H	I	J
											Potential DC Reading	Potential DC Units	Potential DC Instant Off Reading	Potential DC Instant Off Units	Potential AC Reading	Potential AC Units
1	Record Type				Date/Time(UTC)		Milliseconds		Excel Time(UTC)							
2	Cable Inserted				02-19-2013 00:14:46		0		41324.01025							
3	Notes(20003:1.00:Low)				02-19-2013 00:14:46		0		41324.01025							
4	Battery				02-19-2013 00:15:45		431		41324.01094							
5	Coupon Potential DC Reading				02-19-2013 00:15:47		563		41324.01097		0.000000 V					
6	Coupon Potential AC Reading				02-19-2013 00:15:47		665		41324.01097						0.000000 V	
7	Coupon Current DC Reading				02-19-2013 00:15:47		767		41324.01097							
8	Coupon Current AC Reading				02-19-2013 00:15:47		767		41324.01097							
9	Temperature				02-19-2013 00:15:47		895		41324.01097							
10	Coupon Potential DC Reading				02-19-2013 00:15:48		37		41324.01097		0.000000 V					
11	Coupon Potential AC Reading				02-19-2013 00:15:48		139		41324.01097						0.000000 V	
J	K	L	M	N	O	P	Q	R	S	T	U			V	W	
Potential AC Units	Current DC Reading	Current DC Units	Current AC Reading	Current AC Units	Temperature Reading	Temperature Units	Battery Potential (V)	GPS Latitude	GPS Longitude	GPS Sats	Notes			Time Lock	Relay Enabled	
											All on overnight test					
							4.120000									
														1	1	
V														1	1	
	0.000011 A													1	1	
			0.000000 A											1	1	
					25.000000 C									1	1	
														1	1	
V														1	1	

Figure 24 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 uDL2 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.

The utility may also be used for splitting master data files into smaller files. This can be useful when row limit counts with processing applications are encountered. For example, Microsoft Excel 2003 has a limit of 65,536 rows, while newer versions have a limit of 1,048,676 rows. Enter the maximum number of lines (rows) desired in the output files and then click the “Split” button to break the input files into smaller files. The output files will have the same names as the input files, but suffixed with an incrementing number for each smaller output file generated.

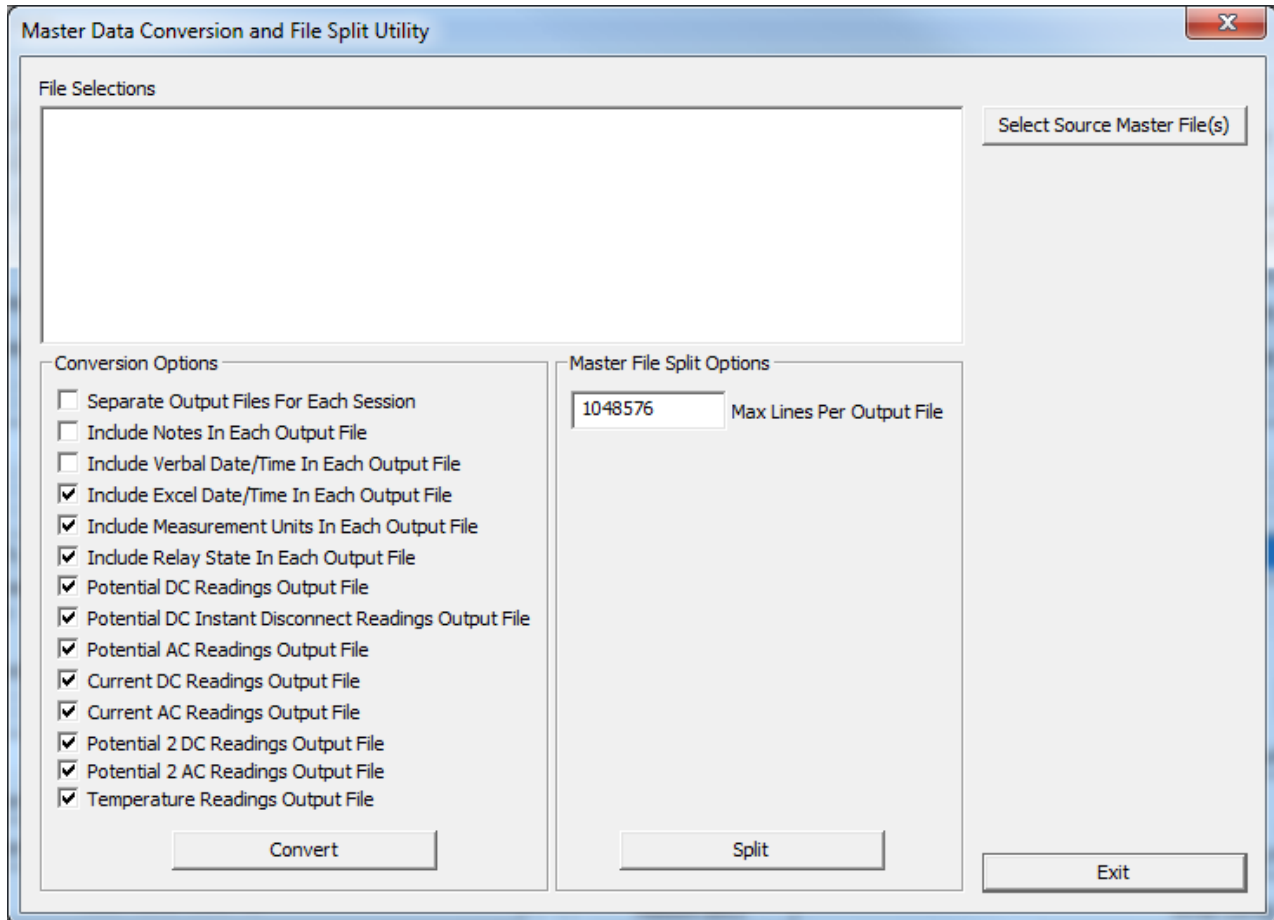


Figure 25 Master Data File Split Utility

Once the data has been extracted, it may be previewed in a chart. Under the “Data Preview Charts” grouping, click the “Potential DC”, “Potential AC”, “Potential 2 DC”, “Potential 2 AC”, “Current DC”, “Current AC”, “Potential DC Disc”, “Temperature”, or “All” buttons to bring up a zoom-able chart of the associated data. 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.

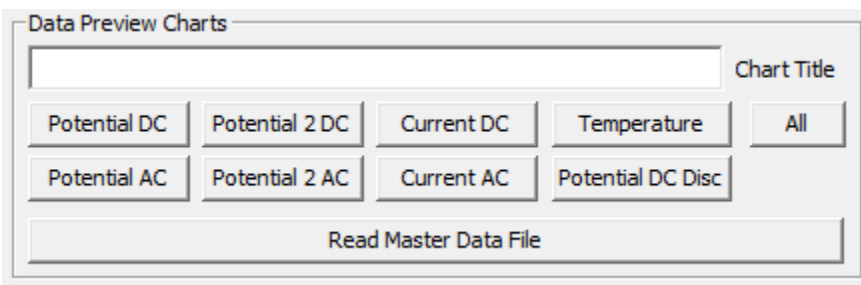


Figure 26 Data Preview Charts Selection

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.

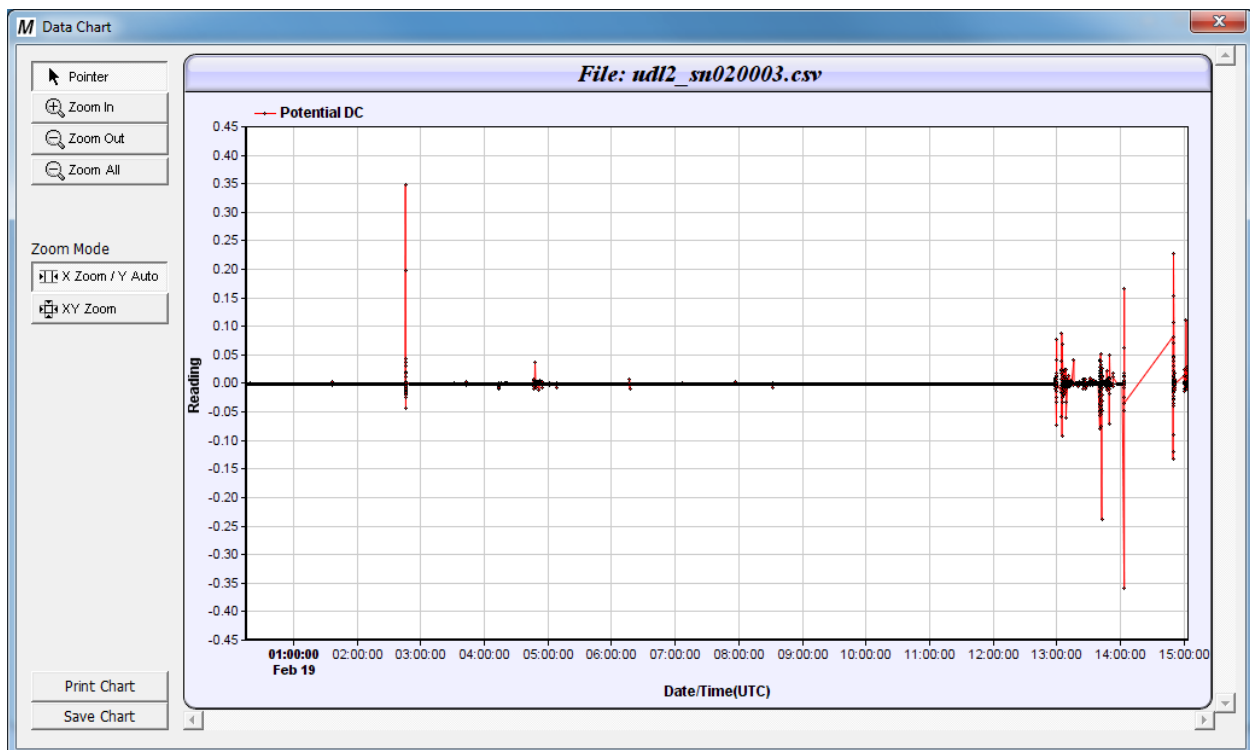


Figure 27 Sample Data Preview Chart

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 uDL2, the data memory on the device may be cleared by clicking the “Clear Memory” button. Note that clearing memory may take up to 60s to complete.

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5 Operation

There are no user controls on the actual uDL2. 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 uDL2 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 uDL2. When the cable is inserted, it will “click” to indicate that the connector is locked in place. New cables may require application of additional force until the “click” is heard in order to properly position the connector internal sealing o-ring. The cable is released by pulling back the black ring (which has the white arrow) of the connector.

The measurement cable has three banana plugs to allow connection directly to banana jacks. There are also three extension clip wires included that can attach to the banana plugs of the measurement cable. The unit can be operated in two modes: coupon mode and dual potential mode.

Coupon Mode

The black wire is connected to the coupon, the blue wire is connected to the structure (pipe), and the red wire is connected to the reference half-cell. **When connected to a coupon test station, ensure that the test station coupon disconnect switch is left in the “open” or “off” position; otherwise, current will not flow through the uDL2 internal current sense.** Figure 28 shows typical attachments to a coupon test station. The optional W164I0ULD03 cable allows direct attachment to the DE-9P test port connector on the CC Technologies Coupon Test Station.

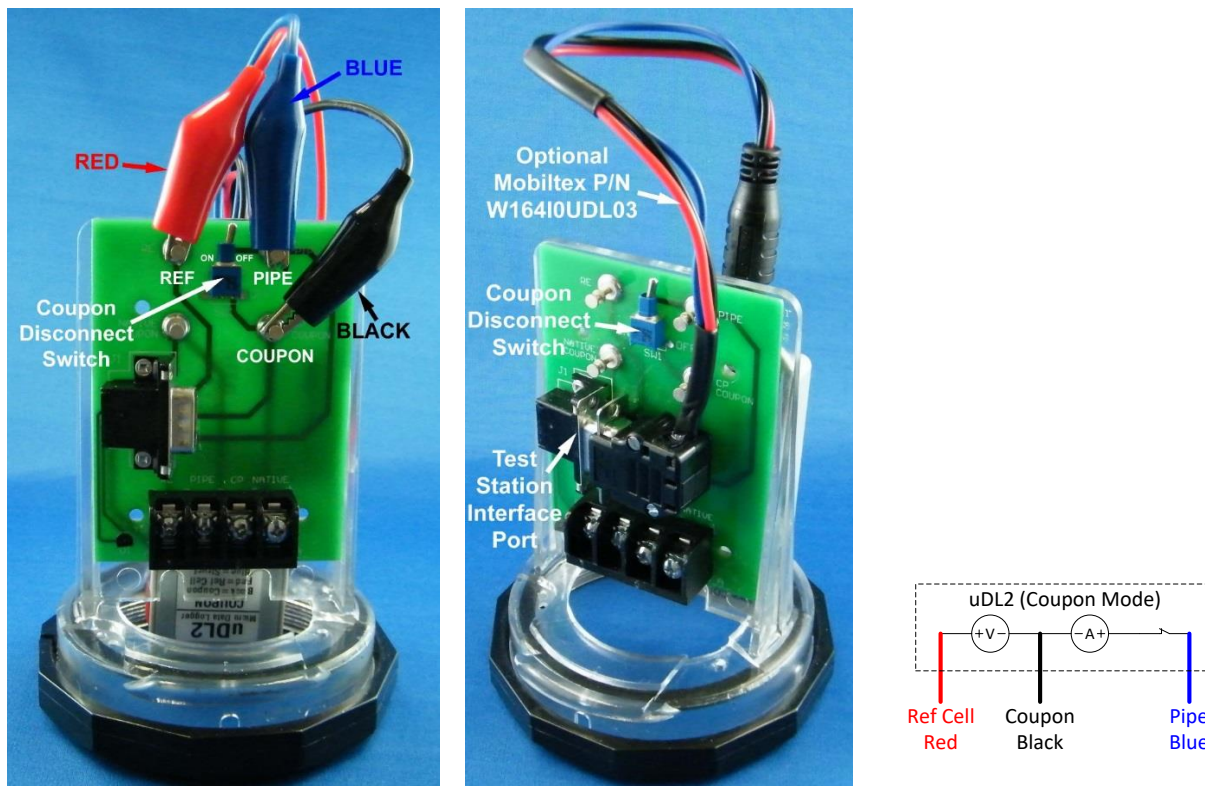


Figure 28 Sample Cable Attachment to a Coupon Test Station

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Dual Potential Mode

The black wire is connected to the common reference point, which in many cases is a reference cell. The red wire is connected to the first potential measurement point, which may be a pipe or a structure. The blue wire is connected to the second potential measurement point, which again may be a pipe or a structure. Figure 29 shows a typical attachment at a test station.

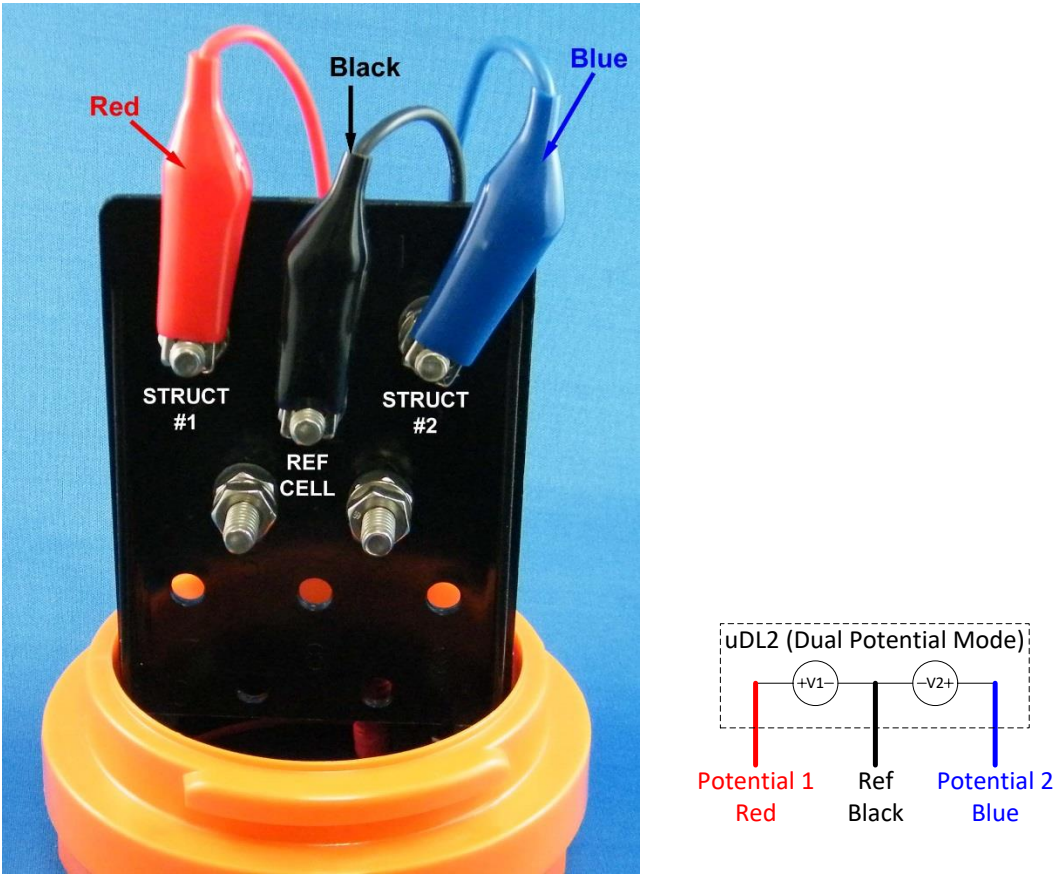


Figure 29 Dual Potential Analog Cable Attachment to a Test Station

The bottom of the uDL2 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. The GPS antenna is located on the end opposite the uDL2 connector. Even though the GPS antenna in the uDL2 is reasonably omni-directional, best GPS signal reception will generally occur when the GPS antenna system is pointed upwards towards the sky.

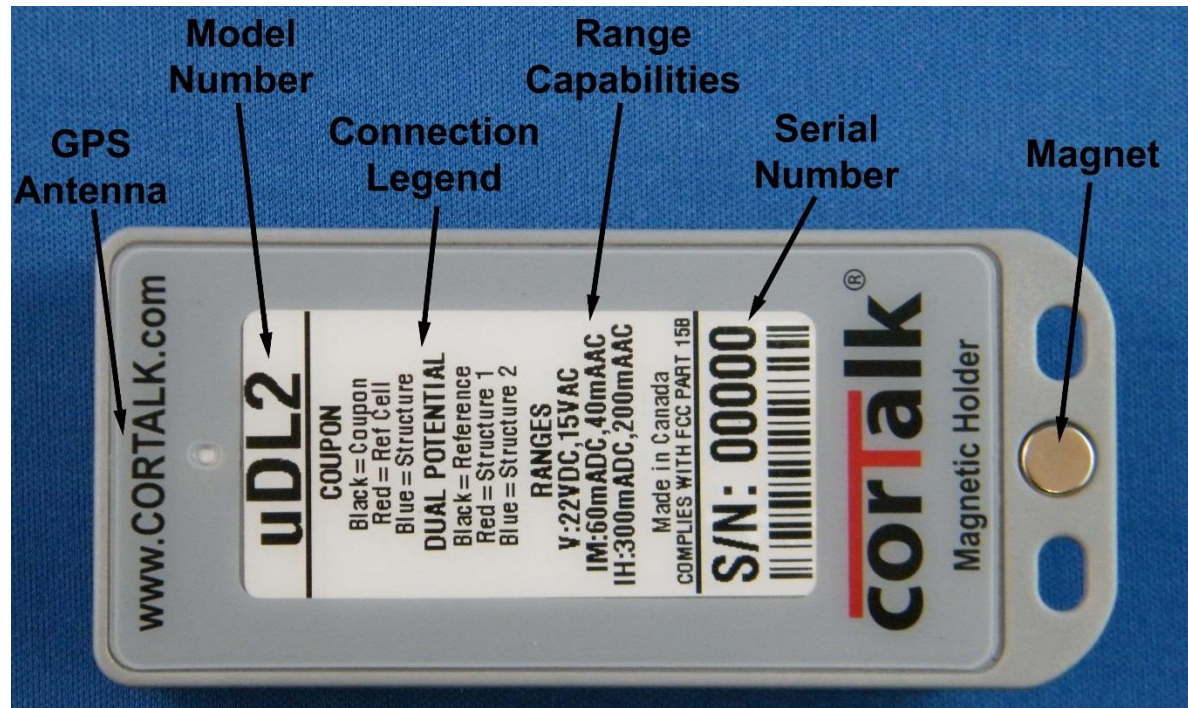


Figure 30 uDL2 Back View

The uDL2 has a custom LCD display that is illustrated below:

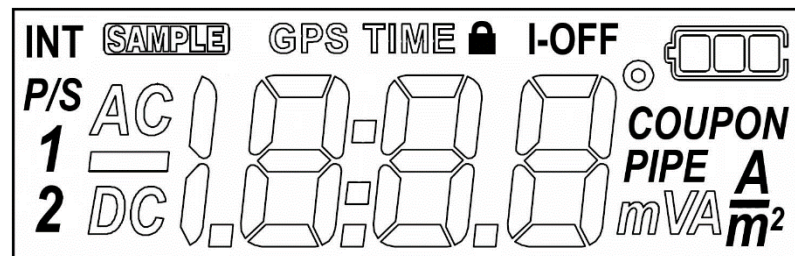


Figure 31 uDL2 LCD Display

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 uDL2 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 uDL2 will enter a real-time measurement display mode for a period of 1 minute. During this time the uDL2 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.

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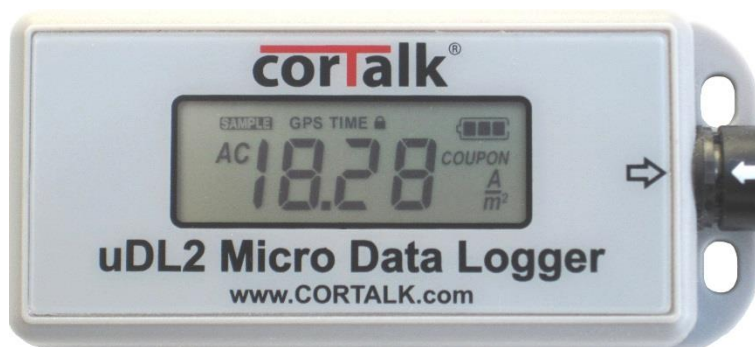


Figure 32 uDL2 Front Face

When more than one signal is being measured the LCD will cycle through each measured signal each time a sample occurs. For example if Potential DC Volts, Potential 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 uDL2 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. 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.

The uDL2 is equipped with an over-current disconnect. If the current flowing through the internal current path exceeds approximately 1A, the uDL2 will open the coupon interruption relay to prevent damage to the uDL2 sense elements. If the over-current disconnect is activated, the relay will remain open until the analog is detached and then re-inserted. An over-current disconnect is indicated by an LCD display showing "[O]" in the reading area.

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 uDL2 will display "FUL" on its LCD, mark the measurement memory with a full indication and stop taking measurements. The 2,000,000 measurement memory will provide about 22.8 days of measurements at a 1 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 uDL2 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 2,000,000 measurements or four 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 uDL2 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 uDL2 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.

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6 Firmware Updates

As required, Mobiltex will periodically release firmware update packages for the uDL2. The firmware is included with the configuration application package. The uDL2 configuration application will warn the user if a firmware update is necessary on an attached uDL2.

To update the uDL2 firmware, exit the uDL2 configuration application and execute the uDL2 Firmware Update application from the Windows start menu. The dialog in Figure 33 will be shown.

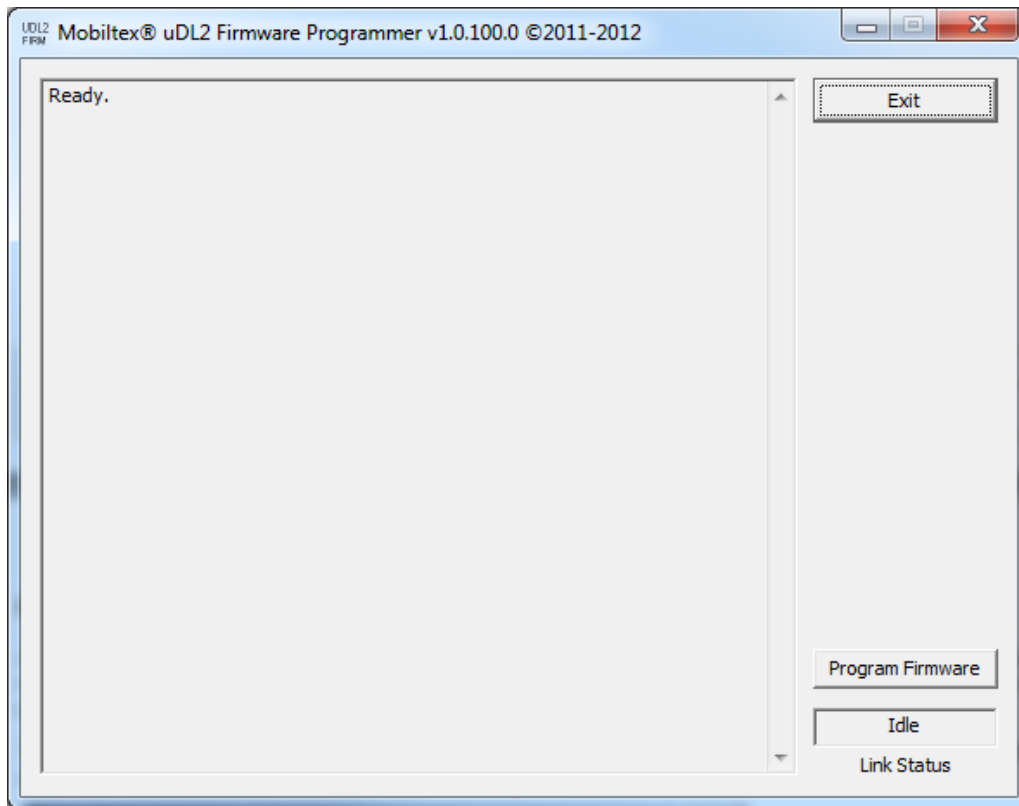


Figure 33 uDL2 Firmware Update Application Dialog

To start the firmware update process, first ensure that the uDL2 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 uDL2 (see Figure 34). Do not attempt to interrupt the firmware download process once it has started. Once the message 'uDL2 completed firmware programming' is display, exit the firmware update application. The uDL2 will reboot and can then be used immediately with the configuration application.

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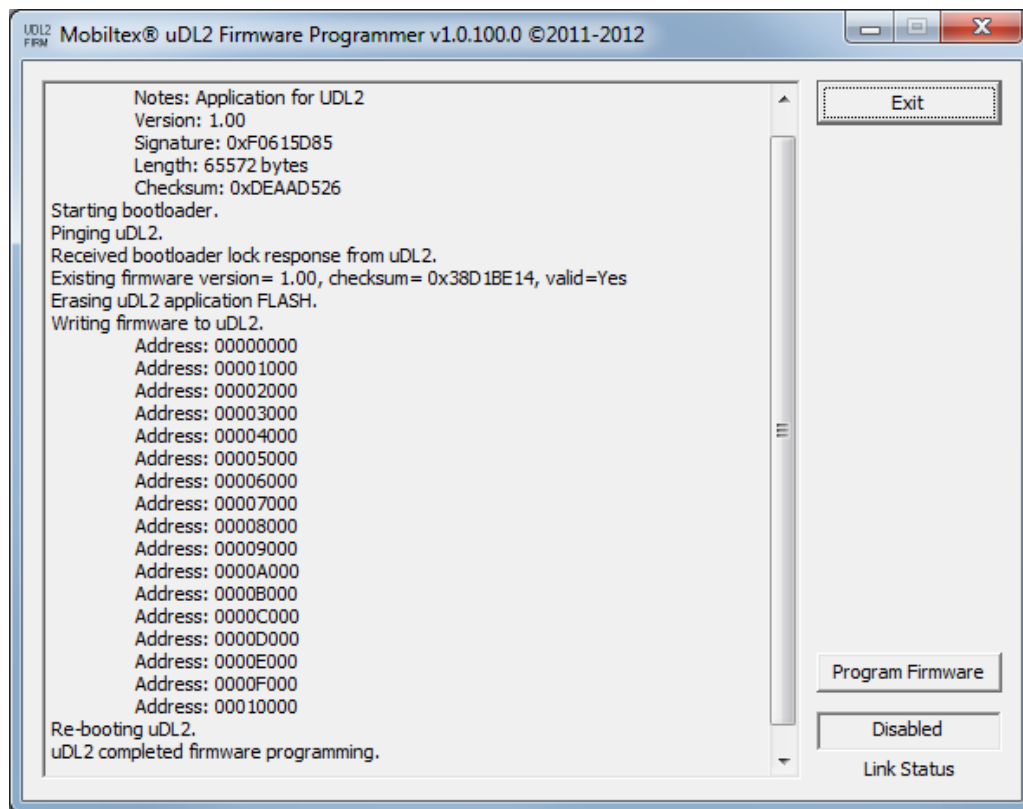


Figure 34 uDL2 Firmware Update Application Progress

The latest uDL2 software package may be downloaded from the Mobiltext web site at the following URL:

<https://www.mobiltext.com/software/>

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A. uDL2 Equipment Specifications

Operating Temperature	-20° to +60° C (-4° to +140° F)
Charging Temperature	0° to +40° C (32° to +104° 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
Pollution Degree	1
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
Measurement Type	Category 2 (as per CSA C22.2 – 61010)
Analog Ranges (Potential)	+/- 22VDC, 15V true RMS AC, +/-22Vpeak
(Current-G1 model*)	Medium: +/-60mADC, 40mA true RMS AC, +/-60mApeak
	High: +/-300mADC, 200mA true RMS AC, +/-300mApeak
(Current-G2/G3 model*)	Low: +/-7mADC, 5mA true RMS AC, +/-7mApeak
	Medium: +/-70mADC, 50mA true RMS AC, +/-70mApeak
	High: +/-300mADC, 200mA true RMS AC, +/-300mApeak
AC Rejection on DC Readings	>65dB @ 50/60Hz
Input Impedance (Potential)	>20Mohm
External Analog Channels	2 galvanically isolated with shared common
Lightning Immunity	Survives multiple 20KV 10mS surges
Temp. Measurement Accuracy	+/-4° C (+/-7° F) over -20° to +60° C (-4° to +140° F)
Potential DC Accuracy	over -20° to +60° C (-4° to +140° F)
	+/-0.55% + 5mV
Potential AC Accuracy	over -20° to +60° C (-4° to +140° F)
	+/-1% + 5mV, 20mV floor
Current DC Accuracy	over -20° to +60° C (-4° to +140° F)
	+/-0.5% + 2uA (low range)
	+/-0.5% + 20uA (med range)
	+/-0.5% + 750uA (high range)
Current AC Accuracy	over -20° to +60° C (-4° to +140° F)
	+/-1% + 20uA, 50uA floor (low range)
	+/-1% + 25uA, 100uA floor (med range)
	+/-1% + 750uA, 750uA floor (high range)
Accuracy Aging	+/-0.13% per year
ADC Resolution	16 bits
Memory Size	2,000,000 readings
Battery	Internal Li-Ion (Not user replaceable)
GPS Receiver	50-channel u-blox
Output File Data Resolution	1uV/1uA for AC and DC readings
	0.1° for temperature readings
	0.00001° for GPS position

*The uDL2 model for a particular unit can be determined by looking at the back label area. G1 models will be labelled as 'uDL2' or 'uDL2-G1', while G2/G3 models will be labelled explicitly as 'uDL2-G2' or 'uDL2-G3'.

Technical assistance may be obtained from:

Attn: Service Department
 Mobiltex Data Ltd.
 3640-26th Street NE
 Calgary, AB T1Y 4T7
 Canada
 Tel: (403)291-2770
 Main Website: <http://www.mobiltex.com>
 Service Website: <http://www.mobiltex.com/service>

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