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APPENDIX J: MANUAL

Please refer to the following pages.



Oil & Gas Wireless Enabled Monitoring System

Installer's Guide

Oil & Gas Wireless Enabled Monitoring System Installer's Guide

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Chapter 1

1

Introduction

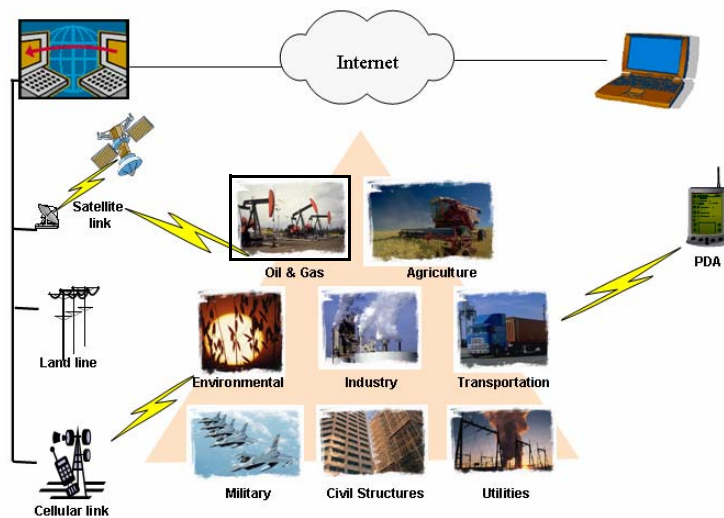


Figure 1-1. Applications for Luna iMonitoring's Intelligent Wireless Sensor Suite

The Luna iMonitoring Oil and Gas Wireless Enabled Monitoring System (WEMS) is a network of monitors and computers used to collect production data within an oil field environment. Sensor and communication modules collect and transmit data via wireless RF and satellite links. These modules are part of Luna iMonitoring's Intelligent Wireless Sensor Suite.

1

The wireless oil field provides innovative, low-cost, remote asset management. Some of the advantages of wireless sensing include

- reduce cost for field labor and transportation;
- reduce administration cost for recording, generating, and distributing reports;
- provide better information to the Production Engineer for decision making;
- provide more efficient tasking of the Pumper;
- enhance revenue through optimized well performance and reduced downtime.

The Intelligent Wireless Sensor Suite

Luna iMonitoring's Intelligent Wireless Sensor Suite includes sensors, computers, software, and communication devices to collect and transmit data in a variety of industries and applications. The iMonitoring "smart" sensors use local processing to minimize power consumption and communication bandwidth. Intelligent software collects, processes, and stores the data in an information database. The iMonitoring system uses RF, cellular, Internet, and satellite links to transmit data between sensors, data collection sites, and central computers. For more information on the Intelligent Wireless Sensor Suite and its components, please visit the Luna iMonitoring web site at www.lunaimonitoring.com

WEMS Components

The current configuration of the WEMS includes one or more of each of the following components:

- Concentration and Communications Unit (iCCU),
- Compact Flash Radio (iCFR),
- Electronic Flow Monitor (iEFM)
- Tank Level Monitor (iTLM-1),
- Wellhead Pressure Monitor (iWPM-T),
- Secure Digital (SD) Card containing the WEMS Software.

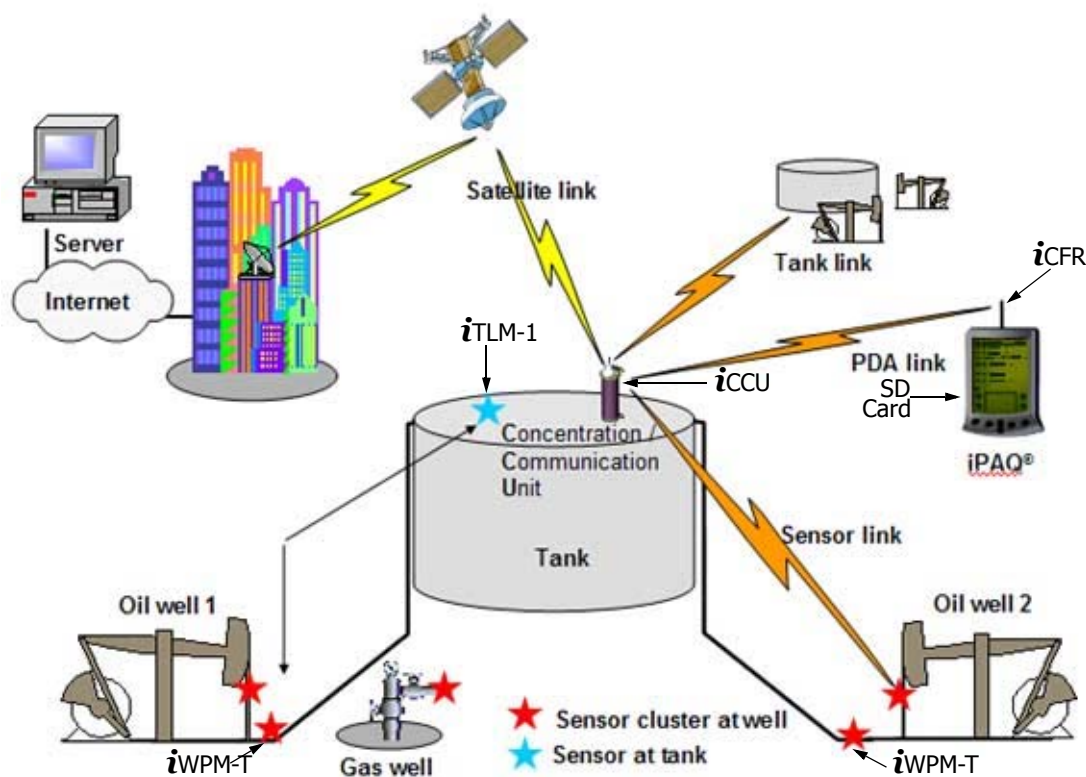


Figure 1-2. Luna iMonitoring's Wireless Oil Field

The following sections discuss features of each component. For detailed specifications see Appendix A, "Specifications," on page 55.

1

Concentration and Communications Unit (iCCU)



The Luna iMonitoring iCCU is an autonomous, wireless-LAN-to-wireless-WAN bridge, and data storage and collection unit. Data flows via a secure, bidirectional, local radio link. The iCCU can perform on-board data storage and processing, and can serve as a LAN repeater. It contains external WAN and LAN antenna ports. A single, solar-assisted battery powers the unit which optimizes power based on the current energy storage. The iCCU supports up to 128 wireless sensors, and is field configurable and upgradeable.

Compact Flash Radio (iCFR)



The Luna iMonitoring iCFR is a self-contained Type I Compact Flash Radio for wireless sensing applications. The iCFR uses a standard interface found on PocketPC®s. The unit communicates with other iCFRs, iCCUs, and iMonitoring's sensors over a customizable, wireless interface. The iCFR does not require a battery since the host unit provides power. Other features include programmable output power, low cost, and the ability to configure and upgrade the unit in the field.

Electronic Flow Monitor (iEFM)



The Luna iMonitoring iEFM is an autonomous, wireless electronic flow monitor which monitors natural gas flow and provides total volumetric flow rate. Typically, the sensor acquires five flow readings per day in monitor mode. Each reading consists of an instantaneous measurement, an average over the previous hour, and an average over the previous 24 hours. An iCCU may interrogate an iEFM at any time within a range of 2500 feet, and a portable device, such as a PocketPC®, can poll the unit within a range of 500 feet. The iEFM performs on-board data storage and processing, and transmits over a secure, bidirectional radio link. The unit optimizes power

based on the current energy storage, and requires only a single, solar-assisted battery. The *i*EFM is easy to install, and is field configurable and upgradeable. The unit incorporates an IP65 ruggedized enclosure and meets UL-913 certification requirements for an intrinsically safe device in Class I, Division 1, Groups C and D hazardous areas.

Tank Level Monitor (*i*TLM-1)



The Luna *i*Monitoring *i*TLM-1 is a self-contained, wireless tank level monitor using Ultrasonic Sensing Technology to provide temperature-compensated fluid level measurements in tanks and silos. Typically, the sensor acquires five pressure readings per day in monitor mode. An *i*CCU can communicate with a *i*TLM-1 within a range of 2500 feet, and a portable device, such as a PocketPC®, can poll the unit within a range of 500 feet. The *i*TLM-1 performs on-board data storage and processing, and transmits over a secure, bidirectional radio link. The unit optimizes power based on the current energy storage, and requires only a single, solar-assisted battery. The *i*TLM-1 is easy to install, and is field configurable and upgradeable. The unit incorporates an IP65 ruggedized enclosure and meets UL-913 certification requirements for an intrinsically safe device in Class I, Division 1, Groups C and D hazardous areas.

Wellhead Pressure Monitor (*i*WPM-T)



The Luna *i*Monitoring *i*WPM-T is an autonomous, wireless pressure monitor for sensing pressure at the wellhead in oil and gas applications. Typically, the sensor acquires five pressure and temperature readings per day in monitor mode. An *i*CCU may interrogate an *i*WPM-T at any time within a range of 2500 feet, and a portable device, such as a PocketPC®, can poll the unit within a range of 500 feet. The *i*WPM-T performs on-board data storage and processing, and transmits over a secure, bidirectional radio link. The unit optimizes power based on the current energy storage, and requires only a single, solar-assisted battery. The *i*WPM-T is easy to install, and is field configurable

and upgradeable. The unit incorporates an IP65 ruggedized enclosure and meets UL-913 certification requirements for an intrinsically safe device in Class I, Division 1, Groups C and D hazardous areas.

Secure Digital (SD) Card



The SD Card supplied with the system contains the WEMS Software for a PocketPC® running version 3.0 of the PocketPC® operating system. The SD Card plugs into the standard SD slot found on all PocketPC®s. The WEMS Software requires a one-time installation per PocketPC®, and includes programs for defining, accessing, and interrogating multiple iMonitoring devices. Chapter 3, “WEMS Software,” on page 13, includes a detailed discussion on the installation and use of the WEMS Software.

User-supplied Components



For on-demand sensor measurements and data acquisition in the field, the user must supply a PocketPC®, such as the one shown at the left, to interrogate the iCCU, iWPM-T, and iTLM-1. The PocketPC® must have a CF Card slot to accommodate the iCFR, and an SD slot for the WEMS Software SD Card.

Chapter 2

2

Installation

The components in Luna iMonitoring's Intelligent Wireless Sensor Suite are easy to install using simple tools. The installation guidelines in this manual outline the steps for selecting the proper site for the device, and for handling, mounting and activating the device.

Site Selection for WEMS Components

The iTLM-1 and iWPM-T sensor modules mount directly onto oil and gas tanks, pipelines, and wellheads in the field. The iCCU mounts on a variety of structures in and around the oil field. Issues affecting the site selected for installation include obstructions in the line-of-sight between the sensor module and the iCCU; distance from the sensor module to an iCCU; height of the iCCU; proximity of the component to other electronic equipment or large metal objects that may affect the transmission of radio signals; orientation of the solar panels on the component; hazardous environmental conditions; and the surface mounting angle of the tank for the iTLM-1 installation.

Guidelines Concerning RF Signal Transmission

Luna iMonitoring's sensor modules use RF signals to communicate with iCCUs and PocketPC®s. Following the guidelines below maximizes the range over which the WEMS components will be able to transmit signals.

- Place the sensor module in the direct line-of-sight with the iCCU, whenever possible. A direct line-of-sight between the sensor module and the iCCU provides optimal signal transmission and reception.

With a direct line-of-sight, the WEMS components communicate up to 2500 feet. However, without a direct line-of-sight, this distance decreases.

- Place the *i*CCU as high as possible to improve signal transmission and reception.
- Avoid placing sensor modules and *i*CCUs near electrical equipment or large metal objects. Electrical devices, such as large electric motors, power lines, antennas, and electric fences cause electro-magnetic interference that adversely affect signal quality. Large metal objects, which are electrically conductive, reflect and scatter radio signals when placed between two RF-linked modules.

The Luna *i*Monitoring sensor modules, *i*CFR, and *i*CCU meet FCC requirements for CFR 47 Part 15, which dictate that operation of the device is subject to the following two conditions:

- 1 The device will not cause harmful interference, and
- 2 The device must accept any interference received, including interference that may cause undesired operation.

Because the device meets FCC requirements for CFR 47 Part 15, the customer requires no operating license to transmit radio signals using the device.

The Luna *i*Monitoring *i*TLM-1 sensor module utilizes ultrasonic technology and is subject to the following additional authorization: Verification as a non-consumer ISM device as specified by Part 18.

The Luna *i*Monitoring *i*CCU is subject to the following additional authorization: Verification as a transmitter as specified by Part 25.

Any changes or modifications not expressly approved by the manufacturer will void the user's authority to operate the equipment.

Every radio-linked device in the Luna *i*Monitoring Intelligent Wireless Sensor Suite carries a label. Figure 2-1 below shows a typical label for a sensor device which includes the Model Number of the device, the FCC ID Number, the UL certification, the FCC certification(s), and the Serial Number.



Figure 2-1. Typical Label Found on all Luna iMonitoring Radio-linked Devices.

Guidelines Concerning Solar Panels

All of Luna iMonitoring's sensor modules and iCCUs employ a single, solar-assisted battery for power. Properly orienting the solar panels on the WEMS component achieves a maximum battery life of more than two years. Place the component in a non-shaded area with the solar panels facing toward the sun. Also, ensure that the site chosen will not become shaded due to tree growth or installation of other structures.

Guidelines Concerning Hazardous Environments

Luna iMonitoring sensor modules mount directly onto structures such as a tanks, pipelines, or wellheads located in hazardous areas. These sensor modules (iEFM, iTLM-1, and iWPM-T) are, by design, intrinsically safe and meet the standard for UL-913 certification for Class I, Division 1, Groups C and D hazardous areas. By definition, an intrinsically safe apparatus is one in which all the circuits are intrinsically safe; and an intrinsically safe circuit is one in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under prescribed test conditions, according to the National Electrical Code.

The iCCU mounts onto structures outside the hazardous zones in the oil field; for example, an area greater than 3 meters from an oil tank.

Guidelines Concerning iTLM-1 Mounting

2

The iTLM-1 uses Ultrasonic Sensing Technology to provide tank fluid level measurements. The sensor projects an ultrasonic beam at the surface of the liquid in a tank. The beam reflects off the liquid's surface back to the sensor. The iTLM-1 acquires the raw measurement and then compensates for the effects of temperature on the raw data. To properly measure the fluid level in the tank, the sensor must be mounted such that the path of the ultrasonic beam is perpendicular to the fluid surface. A mounting angle greater than 5 degrees may cause erroneous data. Figure 2-2 below provides a rendering of a properly installed iTLM-1 sensor module.

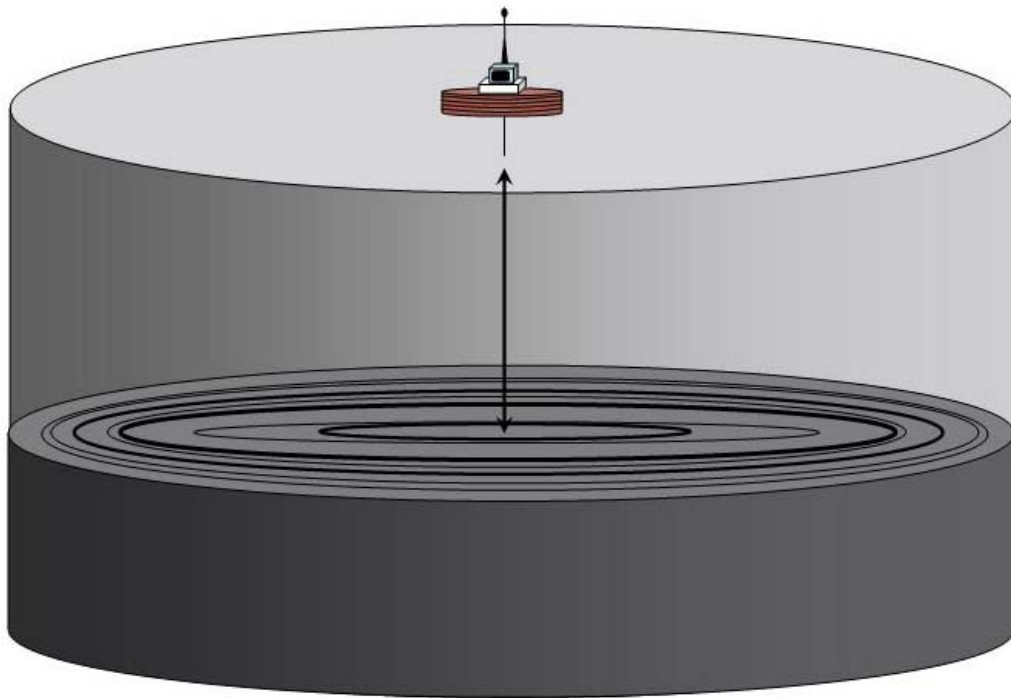


Figure 2-2. Proper Mounting Angle for the iTLM-1 Sensor

Pre-installation iTLM-1 Depth Calibration

Before installing the iTLM-1 sensor device on a tank, perform the iTLM-1 depth calibration procedure. See the Section entitled, "iTLM-1 Depth Calibration" on page 42 of Chapter 3, "WEMS Software", for details.

2

Installation Instructions

When installing any of the iMonitoring wireless devices care must be taken to guarantee that the wireless devices are installed and provisioned in its intended configuration and the installation guarantees compliance to regulatory and safety requirements.

Monitor Installation Instructions

The following instructions are to be performed for each monitor (iEFM, iTLM-1, and iWPM-T) at installation.

- 1 Remove the monitor packing carton.
- 2 Remove the reset button access screw (Phillips head) on the bottom of the unit, and using a non-metalic probe, press and hold the reset button momentarily to bring the unit out of the sleep mode. Replace the screw.
- 3 Install the antenna onto the SMA connector on the monitor.
- 4 On the iEFM and iWPM-T, install the temperature sensor on the monitor.
- 5 Using the WEMS Software module **PocketConfig**, enter the monitor's unique serial number and press the **Configure** button to enter the unit-level configuration. Refer to Chapter 3, "WEMS Software," on page 13 for more information on using **PocketConfig**.
- 6 In the resulting Config tab screen, enter the following information:

- a Enter a value of -3 for the parameter Xmit Power if the antenna supplied with the unit is the Nearson S467AH-915S Omni whip antenna. Enter a value of -6 for Xmit Power if the antenna is the Bluewave EDY-9432 Yagi antenna. FCC compliance requires these power settings.

- b Enable the function Sync to PC by 'checking' (✓) this parameter.

Once the proper value for Xmit Power is entered and Sync to PC is enabled, select the **Set Parameters** button and wait for the progress screen to complete.

- 7 Verify that the settings were accepted by checking the Current Device Settings window.

iCCU Installation Instructions

The following instructions are to be performed for the iCCU at installation.

- 1 Remove the iCCU packing carton.
- 2 Remove the enclosure cover. Locate the unattached red wire and attach it to the positive terminal on the battery. Replace the cover.
- 3 Using the WEMS Software module **PocketConfig**, enter the iCCU's unique serial number and press the **Configure** button to enter the unit-level configuration. Refer to Chapter 3, "WEMS Software," on page 13 for more information on using **PocketConfig**.
- 4 In the resulting Config tab screen, enable the function Sync to PC by 'checking' (✓) this parameter. Once Sync to PC is enabled, select the **Set Parameters** button and wait for the progress screen to complete.
- 5 Verify that the setting was accepted by checking the Current Device Settings window.

Chapter 3

WEMS Software

3

The WEMS Software is a multi-purpose, menu-driven program for configuring and accessing all modules in Luna iMonitoring's Intelligent Wireless Sensor Suite. Once properly configured using the WEMS Software, the devices run autonomously based on the scheduling parameters set in the software. The WEMS Software also provides in-the-field access to any device. The following sections include procedures for initializing all WEMS modules, and instructions for interrogating these devices in the field.

Installing the WEMS Software

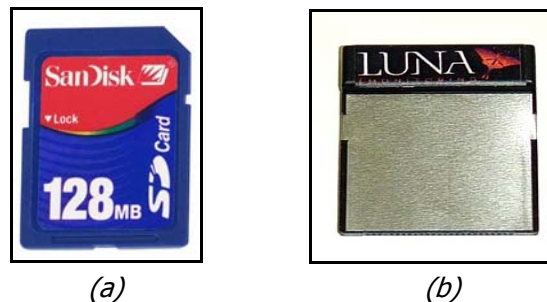


Figure 3-1. (a) SD Card; (b) iCFR

The WEMS Software runs on a PocketPC® using the SD Card provided by Luna iMonitoring. The PocketPC® communicates with the sensors and iCCUs using the iCFR also provided by Luna iMonitoring. The user supplies the PocketPC®, which

must contain a CF slot and SD slot, and must run PocketPC® Version 3.0 or higher. Follow the steps below to install and initialize the WEMS Software.

- 1 Insert the iCFR into the CF slot on the PocketPC®.
- 2 Insert the SD Card containing the WEMS software into the SD slot on the PocketPC®.
- 3 Access the files on the SD Card. The SD Card will contain two programs as shown in Figure 3-2 below.

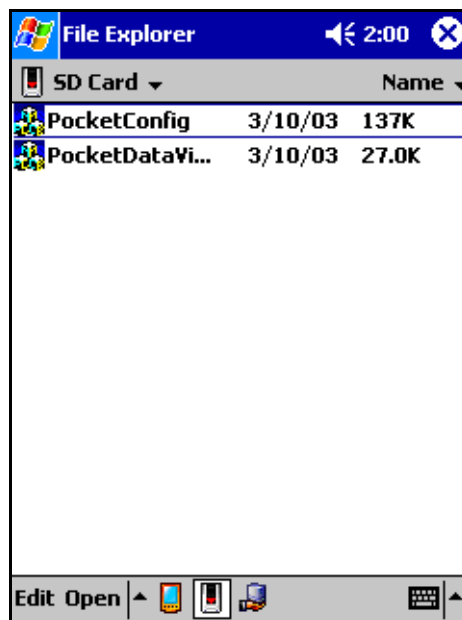


Figure 3-2. WEMS Software Programs on the SD Card.

- 4 Execute either one of the programs.
- 5 The first time the program runs, it will ask for the location of the iCFR as in Figure 3-3 below.

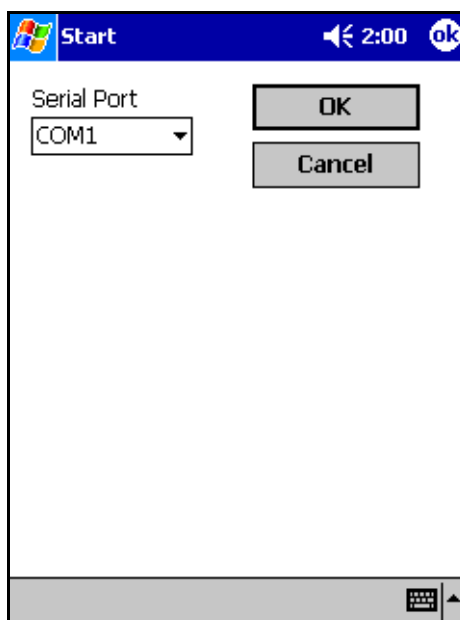


Figure 3-3. iCFR Serial Port Selection Menu.

Typically, the CF slot is located on COM2 or higher. Select COM2 from the Serial Port pull-down list and click **OK**. If the iCFR is on COM2, the program's main menu will open. If the iCFR is not on COM2, the program will return to the Start menu and wait for another port selection. Try other available ports until the program finds the iCFR port and opens the main menu.

PocketConfig

The program **PocketConfig** includes menus for configuring and interrogating devices. Before the PocketPC® can communicate with sensor and communication devices, it must have certain information about the device. Therefore, the software will not list any sensors at initial start-up of the program as in Figure 3-4.

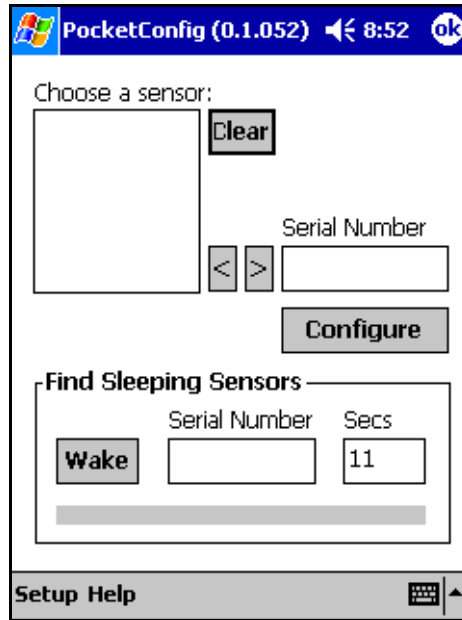


Figure 3-4. **PocketConfig** Main Menu with No Defined Devices.

Adding New Devices

Every Luna iMonitoring device has a unique serial number found on the Luna iMonitoring Serial Number label attached to the device. The software identifies each device by its unique serial number. The sensor list contains the serial numbers of the last ten devices accessed by the software. To add a device to the sensor list, enter the unique serial number of the device in the space provided and hit the "<" button. If the sensor list already contains ten serial numbers as in Figure 3-5 below, then the least recently accessed device drops from the sensor list. To interrogate a sensor already in the list, simply select the proper serial number from the list and hit the ">" button to copy the serial number into the Serial Number field. To access a sensor not in the list, type its serial number in the space provided. The software automatically adds the serial number to the list when the **Configure** button is selected. To clear the selected sensor from the sensor list, hit the **Clear** button.

3

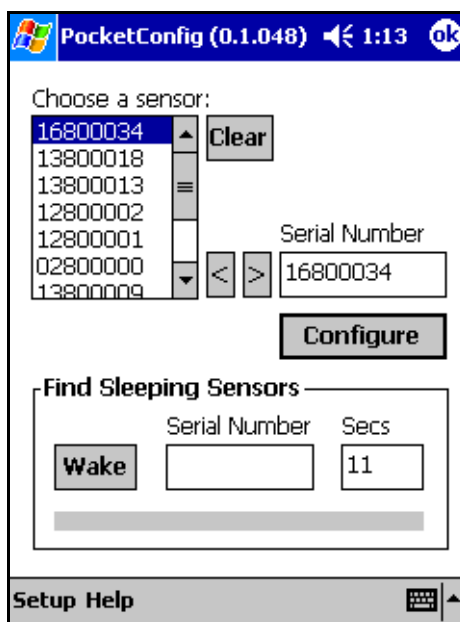


Figure 3-5. PocketConfig Main Menu.

Sensor Charge Modes

Sensor devices have four charge modes based on the current charge capacity of the device's battery. The four modes are

- Always On mode, when the battery is at 100%;
- Fast mode, when the battery is above 76.7% but below 100%;
- Slow mode, when the battery is at or below 76.7% but above 0%;
- Always Off mode, when the battery is fully discharged.

The device stays on continually in Always On mode which usually occurs on sunny days when the solar panels can power the device and keep the battery fully charged. In Fast mode the device "wakes up" every 10 seconds to see if it is being interrogated. In Slow mode the device only wakes up every 2 minutes. If the battery becomes fully discharged, then the device shuts off completely.

Setting the Default ReSync Time

The ReSync Time selected in the setup menu determines how long the software waits for a response from a device. To access this menu, select the **Setup** tab on the main menu, and hit the **Options** button shown in Figure 3-6 below.

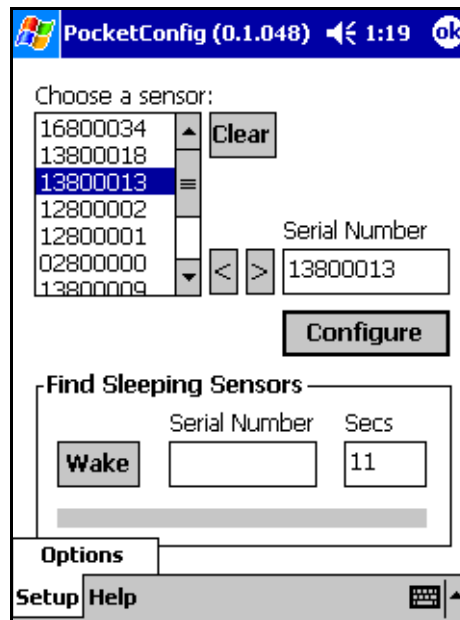


Figure 3-6. Accessing the Setup Menu.

Figure 3-7 shows the setup menu and the ReSync Time options. If Wait for devices in fast mode is selected, the software waits for 11 seconds to access a device. Devices usually “wake up” every 10 seconds in Fast mode; therefore, searching for 11 seconds should find the device. If Wait for devices in slow mode is selected, the software waits for 121 seconds. The device may be in Slow mode and will only “wake up” every 2 minutes. If Custom wait time is selected, enter a wait time in milliseconds in the space provided. Once the proper mode is chosen, hit the **OK** button to set the ReSync Time option.

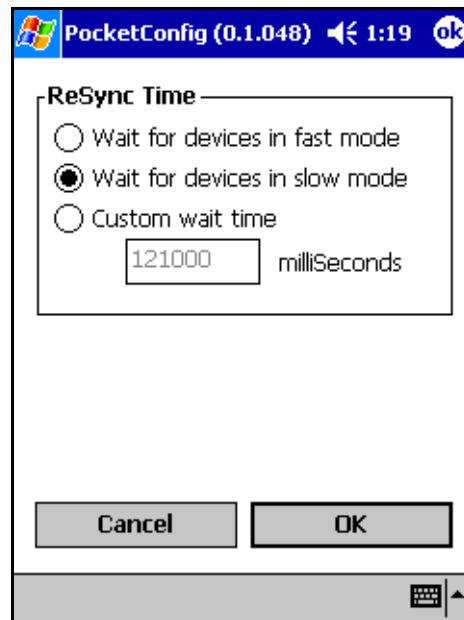


Figure 3-7. ReSync Wait Time Selection Menu.

Finding Sleeping Devices

If a known device does not respond when interrogated, the device may be "sleeping", and the Resync Time may be set to only wait for devices in fast mode. By default, the software searches for the device for the time interval specified in the setup menu. To wake a sleeping device, enter its serial number in the appropriate space under Find Sleeping Sensors in the main menu, and hit the **Wake** button. If the software still does not find the sleeping device, increase the search time to 121 seconds. If the software fails to find the device after 121 seconds, check the device for possible battery failure. Using Find Sleeping Sensors overrides the time interval selected in the setup menu. *Note: Find Sleeping Sensors wakes the device and places it temporarily in Always On mode which significantly increases power consumption.*

About PocketConfig

Luna iMonitoring includes information on each of its software programs that is accessed by selecting the **Help** tab at the bottom of the screen and hitting the **About** button as shown in Figure 3-8 below.

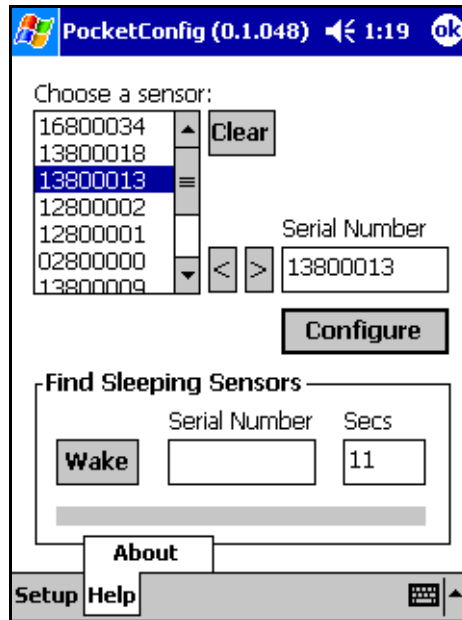


Figure 3-8. Accessing the About PocketConfig Menu.

This window provides copyright and version information on the program and library software.

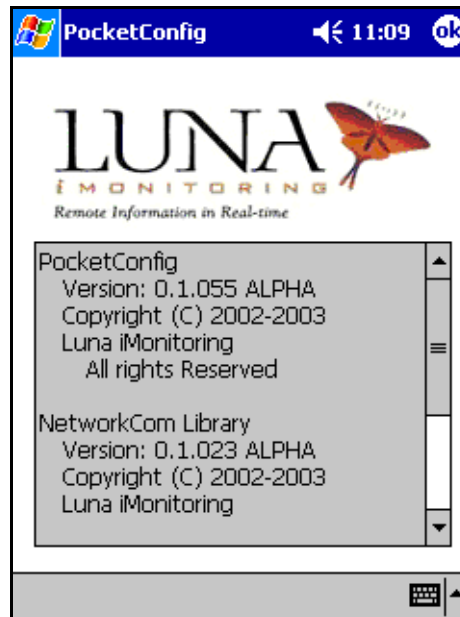


Figure 3-9. Detailed Information on PocketConfig.

Configuration Menus

Luna iMonitoring preconfigures the settings for all its devices. To view the current settings or to reconfigure the device, select the device in the main menu and hit the **Configure** button to bring up one of the menus shown in Figure 3-10. Menu (a) shows the sensor configuration menu for an iWPM-T, but other sensor configuration menus contain the same information and options. The sensor menu includes the serial number for the iCCU to which the sensor uplinks. If the CCU field contains all zeros, as in Figure 3-10, then the sensor broadcasts to all listening iCCUs. Menu (b) shows an iCCU configuration menu which does not include the CCU field.

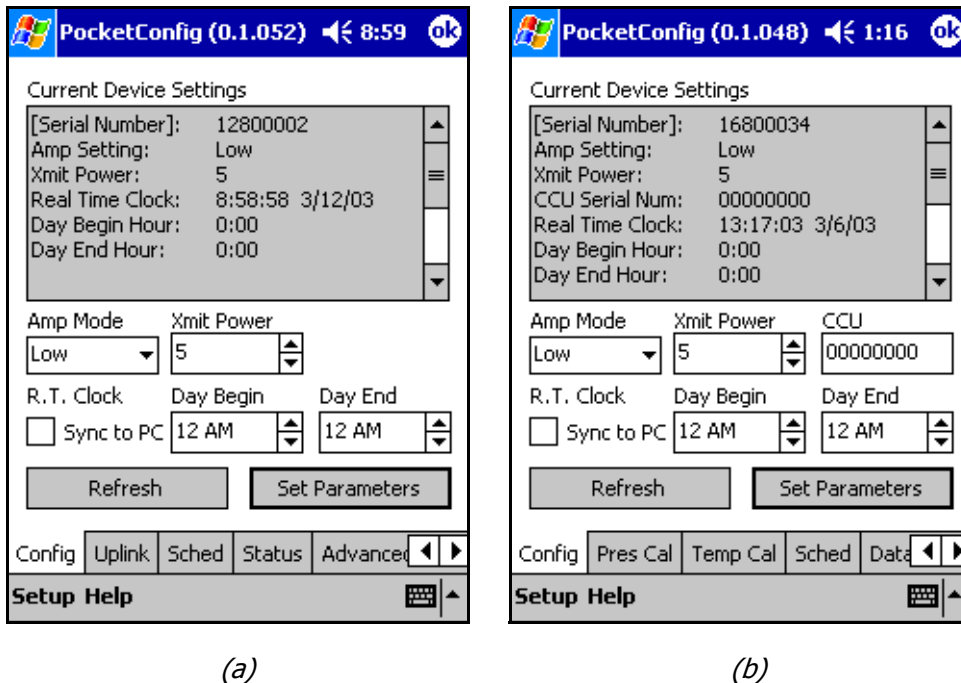


Figure 3-10. Configuration Menus for an (a) iCCU, and an (b) iWPM-T.

To change a parameter value, first highlight the value with a single tap, then enable the value for editing with another tap. Now select the keyboard entry

screen by tapping the keyboard icon at the bottom right of the screen. Use the keyboard to enter the new value. When finished entering the data, exit the keyboard by tapping the icon again. DO NOT USE THE "ENTER" KEY, as this will cause the application to exit. Once all the new parameter values are entered, hit the **Set Parameters** button to accept the changes. Parameters shown in brackets, [], in the Current Device Settings window may not be changed. The new values will appear in the Current Device Settings window.

To change Amp Mode, select an option, Low/Medium/High, from the pull-down list. To change XmitPower, use the up/down arrows to the right of the field. To uplink a sensor to a specific iCCU, enter the serial number of the iCCU in the CCU field, or enter all zeros to broadcast to all iCCUs in listening range. The Sync to PC option synchronizes the Real Time Clock on the device to the clock on the PocketPC®. Use this option to synchronize all devices in the field to the same clock. Normally, Day Begin and Day End are set to 12:00 AM. To change these parameters, use the up/down arrows to the right of the field. These parameters only increment in 1-hour intervals.

The Current Device Settings window provides other valuable information that is accessible using the scroll bar. Figure 3-11 below shows the Current Device Settings window for an iTLM-1 when scrolled down to reveal additional parameters. This other information includes:

- the device serial number;
- a 4-byte encryption key, called the cypher, which must be the same for all devices in a network;
- the home channel that the device waits on when there is no activity, (when active the device scans all channels, 0-52);
- the modulus through the scanning sequence, called the DSS skip, that can create additional sequences and must be the same for all devices in a network, (usually set to 1);
- the version number of the device's firmware.

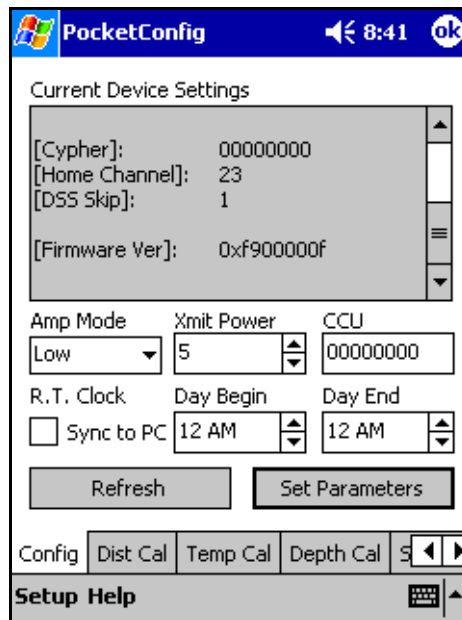


Figure 3-11. Current Device Settings Continuation Window for an iTLM-1.

Each device uses a different set of menus for configuring additional parameters. To access these menus, select one of the tabs along the bottom of the screen. Some menus are similar for all devices, and some menus are device-specific. All devices have menus for configuration, uplink scheduling, updating firmware, setting advanced parameters, and testing the device's radio. The iCCU has a status menu and an uplink menu, and sensor devices have calibration menus and a data menu.

Uplink Scheduling Menu

The WEMS devices run autonomously according to the uplink schedule set in the uplink scheduling menu. Sensors uplink to an iCCU, and an iCCU uplinks to a computer via satellite. To access this menu, select the Sched tab as shown in Figure 3-12 below. The software allows for four time schedules. For each time schedule, the software allows three pull-down options - Enabled, Disabled, or Hourly. In the Enabled mode, the device uplinks once daily at the time specified. In the Hourly mode, the device uplinks every hour at the minute/second specified. Normally, Hourly mode is only used for testing purposes. To change the time, click on the desired field, (hour, minute, second, AM/PM), and use the up/down arrows to change the field. Once the desired schedules and times are entered, hit **Set Uplink Times** to accept the changes.

Sensor devices must uplink to an iCCU at specific time intervals when the iCCU accepts data uplinks. The iCCU is active for one minute every ten minutes "on the tens" of every hour. In other words, the iCCU is active from 00 min. 00 sec. after the hour to 01 min. 00 sec. after the hour; from 10 min. 00 sec. after the hour to 11 min. 00 sec. after the hour; from 20 min. 00 sec. after the hour to 21 min. 00 sec. after the hour; etc. Therefore, synchronizing the real-time clocks on all devices and properly scheduling the uplink times on sensor devices are very important.

When setting the uplink time on a sensor device, keep in mind that, over time, the real-time clock may drift out of synchronization by a few seconds. Therefore, do not select an uplink time that is too close to the beginning or end of the uplink time window. Choose a value for the seconds field that falls between 15 and 45 seconds as in the example in Figure 3-12. Also, if the iCCU is linked to several sensor devices, space the uplink times for each device about five seconds apart to keep two devices from uplinking at the same time.

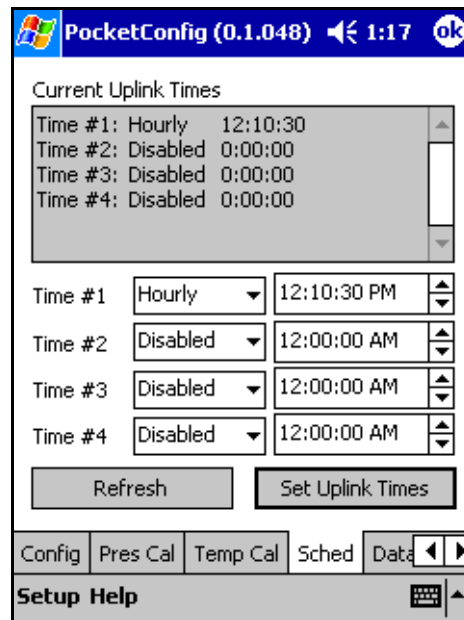


Figure 3-12. Uplink Scheduling Menu for an iWPM-T.

Update Flash Menu

The update flash menu **permanently** updates the firmware in a device and should only be performed with the approval of Luna iMonitoring.

When firmware updates are needed, Luna iMonitoring will provide firmware updates along with instructions on the type of devices to be updated. To open the update flash menu, select the Update tab as shown in Figure 3-13 below.

Always verify that the proper device is selected for updates. Hit the **Update Flash** button to begin the update process. The progress bar shows the update progress. Always test the operation of the device thoroughly after performing firmware updates.

3

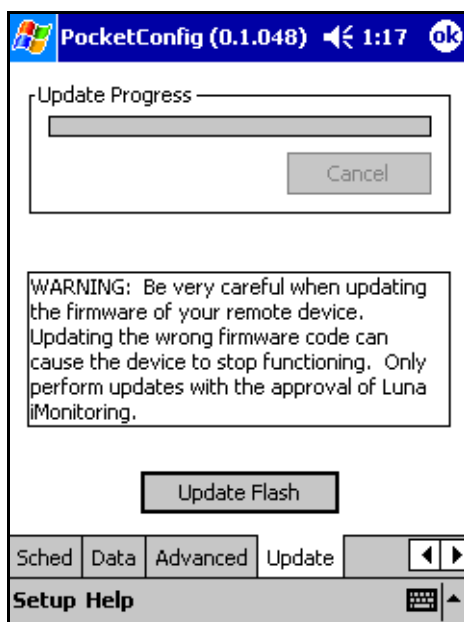


Figure 3-13. Firmware Update Menu.

Advanced Parameters Menu

Figure 3-14 below shows the advanced parameters menu. This menu is password protected, and is used by Luna iMonitoring Technical Support for testing. Under normal operating conditions, the Always On mode and 5-Min. Test mode are disabled.

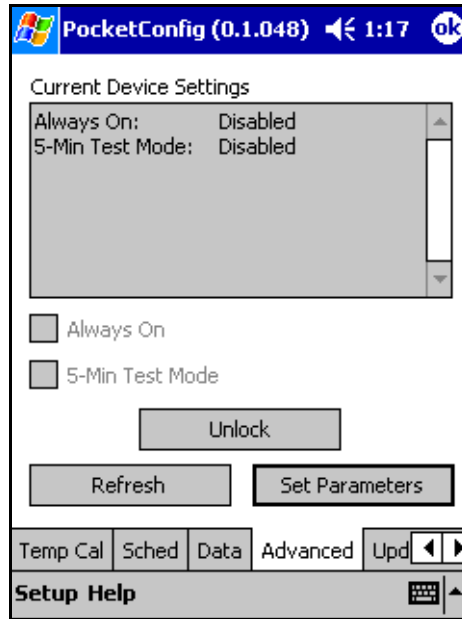


Figure 3-14. Advanced Parameters Menu.

RF Test Menu

The RF Test menu shown in Figure 3-15 below performs a test on the device's radio. During the test, the radio broadcasts on specified channel using the settings in the menu. To select the broadcast channel, choose a channel number from 0 to 52 from the pull-down list. Also, select an Amp Mode from the five options in the pull down list - Off, Low, Medium, High, Cycle modes. Enter the length of time in seconds for the test to run in the Duration field. Once the correct test settings are selected, hit the **Begin** button to perform the test.

3

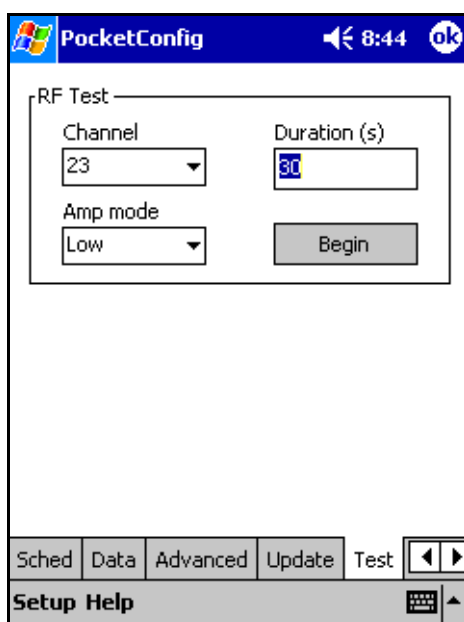


Figure 3-15. RF Test Menu for an iCCU.

Sensor Data Menu

Figure 3-16 below shows the data menu for a sensor device, specifically an *iWPM-T*, that is accessed by selecting the Data tab. To acquire new data points, hit the **Get Data** button. The Sensor Data window indicates the type of sensor, the serial number of the *iCCU*, the sensor data points taken, the battery charge capacity, and the time that the **Get Data** was executed. To send the most recent data points to the *iCCU* indicated by the serial number, hit the **Uplink NOW!** button.

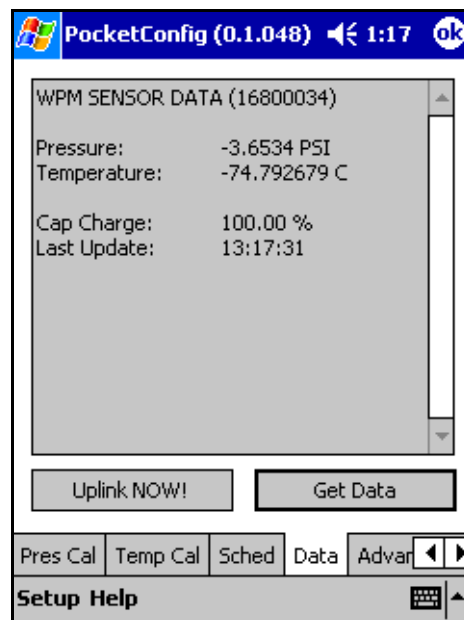


Figure 3-16. *iWPM-T* Data Menu.

iCCU-Specific Menus

The iCCU tabs include menus for uplinking the iCCU to a computer and displaying status information for the iCCU. Figure 3-17 shows the iCCU uplink menu that is accessed by selecting the Uplink tab, and Figure 3-18 shows the iCCU status menu that is accessed by selecting the Status tab.

iCCU Uplink Menu

The iCCU uplink menu, shown in Figure 3-17 below, uplinks the iCCU to a computer which downloads a data set. The Uplink Mode has two options - Modem, which is the default, and Direct. In Modem mode, the iCCU uplinks to a satellite which uses the Phone # to dial up the computer. To use the Direct mode, the iCCU must be hardware-configured to connect directly to the serial port of a computer using a special cable.

Before beginning an uplink, verify that the current battery charge is above the preset Uplink Threshold. To begin an uplink, choose the Uplink Mode, enter the Phone # for the computer, and hit the **Set Parameters** button. Once the software accepts the parameters, hit the **Uplink NOW!** button to send the most recent data points for each device uplinked to the iCCU.

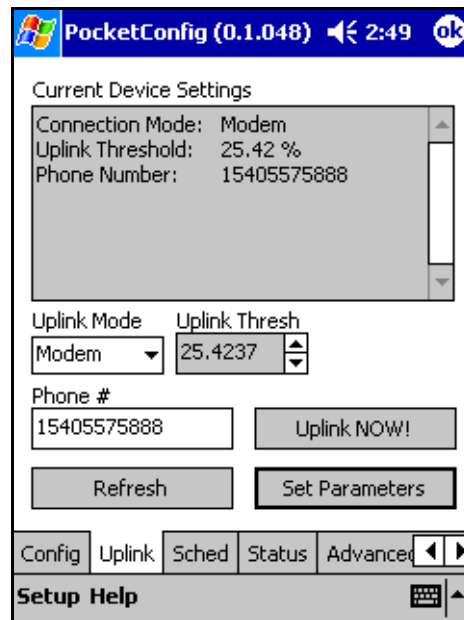


Figure 3-17. iCCU Uplink Menu.

iCCU Status Menu

The iCCU status menu, shown in Figure 3-18 below, provides additional information about the current status of the iCCU indicated by the serial number in the CCU Status window. To get the current status, select the Status tab and hit the **Get Status** button. The Charge field indicates the current charge of the battery. Fast Mode Level is the battery charge level below which the device switches from Fast Mode to Slow Mode, and the Always Off Level is the level where the device shuts itself off.

Under Uplink Status, Last Uplink indicates the time of the most recent uplink to the satellite, and Next Uplink indicates the scheduled time for the next uplink. A Status code of 0x00 indicates that the last uplink was successful.

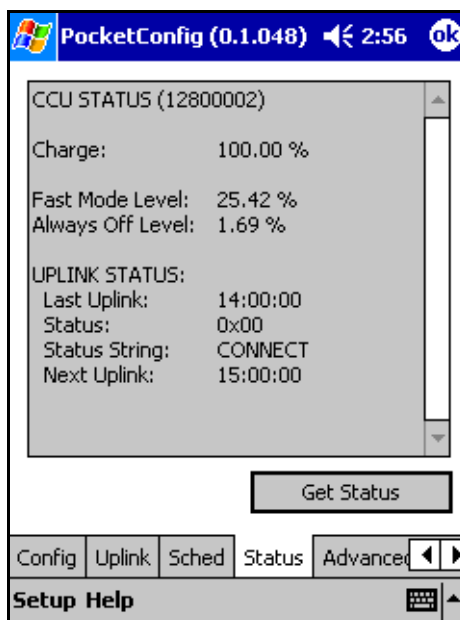


Figure 3-18. iCCU Status Menu.

iEFM-Specific Menus

The iEFM tabs include menus for calibrating the sensor and the gas element on the iEFM device. Figure 3-19 below shows the menu for calibrating the sensor, and Figure 3-20 on the following page shows the gas element calibration menu. This section also discusses the iEFM sensor data window.

3

iEFM Sensor Calibration

The iEFM operation requires a number of parameters for valid measurements that are entered using the sensor calibration menu shown in Figure 3-19 below, which is accessed by selecting the Sensor Cal tab. The values for Temp cal intercept and Temp cal slope are entered at the factory and are matched to the external sensor that is supplied with the iEFM. The other parameters are dependant on the process equipment to which the iEFM is attached.

Cal Params	Value
Orifice ref temp (C)	519.669983
Orifice ref diameter	2.000000
Orifice exp coef	0.000006
Meter ref temp (C)	519.669983
Meter ref diameter	4.000000
Meter exp coef	0.000006
Temp cal intercept	0.000000
Temp cal slope	1.000000
Specific heat cal	1.000000
Low flow cutoff	0.000000

Refresh Set Calibration

Config Sensor Cal Gas Cal PROM Cal Setup Help

Figure 3-19. iEFM Sensor Calibration Menu.

iEFM Gas Calibration

The process gas consists of multiple gas concentrations. The iEFM operation requires that each gas element percentage of concentration be entered for valid measurements. Enter the percentage values in decimal form using the gas calibration menu shown in Figure 3-20 below, which is accessed by selecting the Gas Cal tab. When all values are entered, hit the **Set Calibration** button to accept the values.

3

Gas	Relative Amount
Methane	0.965222
N2	0.002595
CO2	0.005956
Ethane	0.018186
Propane	0.004596
H2O	0.000000
H2S	0.000000
H2	0.000000
CO	0.000000
O2	0.000000
i-Butane	0.000977
n-Butane	0.001007
i-Pentane	0.000473

Refresh Set Calibration

Config Sensor Cal Gas Cal PROM Cal Setup Help

Figure 3-20. iEFM Gas Calibration Menu.

iEFM Sensor Data

The iEFM data may be viewed by selecting the Data tab at the bottom of the screen which opens the sensor data window shown in Figure 3-21 below. The first section of data reported is instantaneous data. The HOURLY DATA section shows data averaged over the last 1-hour period, and the DAILY DATA gives the data averaged over the last 24-hour period.

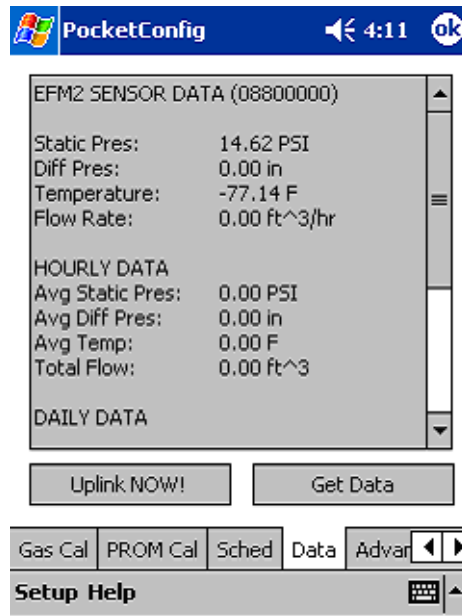


Figure 3-21. iEFM Sensor Data Window.

iTLM-1-Specific Menus

The iTLM-1 tabs include menus for calibrating the temperature and tank level sensors on the iTLM-1 device. Figure 3-23 below shows the menu for calibrating the temperature sensor. Figures 3-22 and 3-24 on the following pages show the distance and depth calibration menus, respectively, for the tank level sensor. Luna iMonitoring performs the temperature and distance calibrations for the temperature and tank level sensors, respectively, before shipping. The installer performs the depth calibration for the tank level sensor.

3

iTLM-1 Temperature Calibration

To set the temperature calibration parameters, select the Temp Cal tab at the bottom of the screen to access the temperature calibration menu shown in Figure 3-22 below. Enter the correct Slope and Intercept, and hit the **Set Calibration** button. The iTLM-1 uses the temperature data to compensate for the effects of temperature on the tank level measurement.

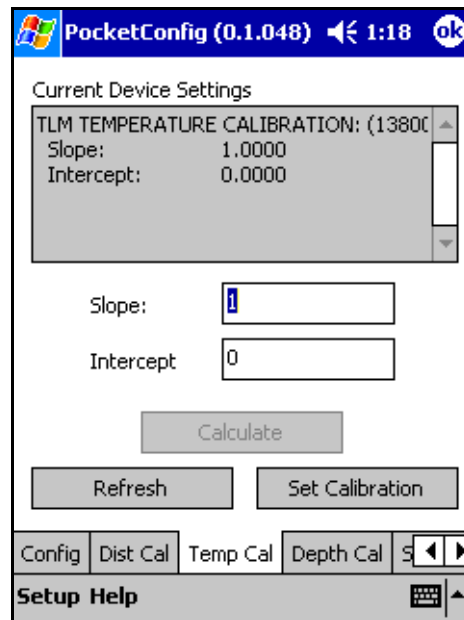


Figure 3-22. iTLM-1 Temperature Calibration Menu.

iTLM-1 Distance Calibration

Luna iMonitoring calibrates the iTLM-1 tank level sensor using a known distance from the sensor to a surface in the lab. To set the distance calibration parameters, select the Dist Cal tab at the bottom of the screen to access the distance calibration menu shown in Figure 3-23 below. Enter the correct Slope and Intercept, and hit the **Set Calibration** button.

3

PocketConfig (0.1.048) 1:18 ok

Current Device Settings

TLM DISTANCE CALIBRATION: (13800013)

Slope: 1.0000

Intercept: 0.0000

Slope:

Intercept:

Calculate

Refresh Set Calibration

Config Dist Cal Temp Cal Depth Cal S

Setup Help

Figure 3-23. iTLM-1 Distance Calibration Menu.

iTLM-1 Depth Calibration

The iTLM-1 depth calibration must be performed during the process of installing the iTLM-1 sensor device on the tank.

At the time of the device installation, the iTLM-1 needs to know the exact depth of the fluid in the tank to perform the depth calibration for the tank level sensor. To set the depth calibration parameter, select the Depth Cal tab at the bottom of the screen to access the depth calibration menu shown in Figure 3-24 below. Enter the current depth of the fluid in the tank in inches in the Measured Depth field, install the iTLM-1 sensor, and hit the **Set Depth Cal** button. Once the depth calibration is complete, the value "-2" appears in the Measured Depth field to block any inadvertent changes to the calibration parameters. Luna iMonitoring personnel use the "-1" value, which removes the depth calibration and reports distance. This is useful when performing the distance calibration.

PocketConfig (0.1.048) 1:18 ok

Current Device Settings

TLM DEPTH CALIBRATION: (13800013)

Depth of Tank: -1.00 in

Measured Depth: -2

NOTE: To calibrate the TLM for depth:
1) Enter the depth in "Measured Depth"
2) Install the sensor and hit "Set Depth Cal"

Enter -1 to remove depth cal and have distance reported. -2 makes no changes.

Refresh Set Depth Cal

Config Dist Cal Temp Cal Depth Cal Setup Help

Figure 3-24. iTLM-1 Depth Calibration Menu.

iWPM-T-Specific Menus

The iWPM-T tabs include menus for calibrating the pressure and temperature sensors on the iWPM-T device. Figure 3-25 below shows the menu for calibrating the pressure sensor, and Figure 3-26 on the following page shows the temperature sensor calibration menu. Luna iMonitoring calibrates all of the iWPM-T's sensors before shipping.

3

iWPM-T Pressure Sensor Calibration

To set the pressure calibration parameters, select the Pres Cal tab at the bottom of the screen to access the pressure calibration menu shown in Figure 3-25 below. Select the proper Units from the pull-down list. The choices for Units are millivolts, PSI, mm Hg, kPa, and mBar. Enter the correct Slope and Intercept for the specified units, and hit the **Set Pressure Cal** button.

PocketConfig (0.1.048) 1:17 ok

Current Device Settings

WPM PRESSURE CALIBRATION: (1680003)

Slope: 263.2654

Intercept: -4.9956

Units: PSI

Slope: 263.265

Intercept: -4.99558

Units: PSI

Refresh Set Pressure Cal

Config Pres Cal Temp Cal Sched Data

Setup Help

Figure 3-25. iWPM-T Pressure Sensor Calibration Menu.

iWPM-T Temperature Calibration

To set the temperature calibration parameters, select the Temp Cal tab at the bottom of the screen to access the temperature calibration menu shown in Figure 3-26 below. Select the proper Source from the pull-down list. The choices for Source are Internal for the iWPM-T, and External for the iWPM-T which has an external temperature sensor. Enter the correct Slope and Intercept, and hit the **Set Temperature Cal** button. The iWPM-T uses the temperature data to compensate for the effects of temperature on the pressure measurement.

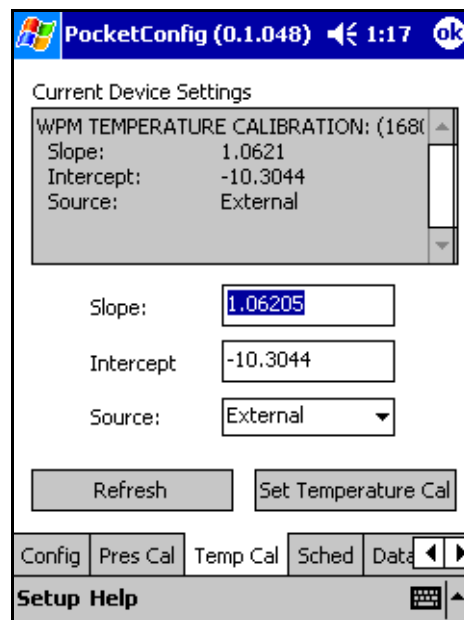


Figure 3-26. iWPM-T Temperature Sensor Calibration Menu.

PocketDataViewer

The other software program on the SD Card is **PocketDataViewer** which downloads a set of data points from a sensor device to the PocketPC®. Figure 3-31 below shows the main menu for the program. This program also includes the same Setup Options and Help About windows as in **PocketConfig** which are discussed in the following sections.

3

Setting the Default ReSync Time

The ReSync Time selected in the setup menu determines how long the software waits for a response from a device. To access this menu, select the **Setup** tab on the main menu, and hit the **Options** button shown in Figure 3-27 below.

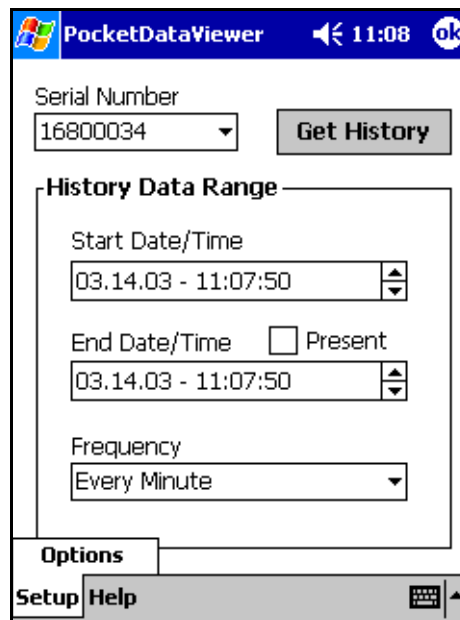


Figure 3-27. Accessing the Setup Menu.

Figure 3-28 shows the setup menu and the ReSync Time options. If Wait for devices in fast mode is selected, the software waits for 11 seconds to access a device. Devices usually “wake up” every 10 seconds in Fast mode; therefore, searching for 11 seconds should find the device. If Wait for devices in slow mode is selected, the software waits for 121 seconds. The device may be in Slow mode and will only “wake up” every 2 minutes. If Custom wait time is selected, enter a wait time in milliseconds in the space provided. Once the proper mode is chosen, hit the **OK** button to set the ReSync Time option.

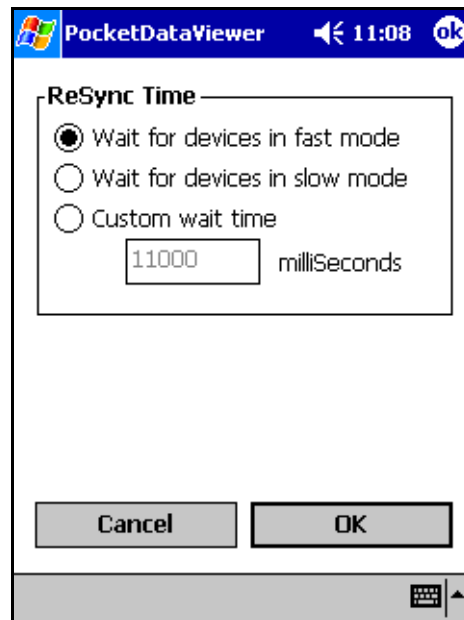


Figure 3-28. ReSync Wait Time Selection Menu.

About PocketDataViewer

Luna iMonitoring includes information on each of its software programs that is accessed by selecting the **Help** tab at the bottom of the screen and hitting the **About** button as shown in Figure 3-29 below.

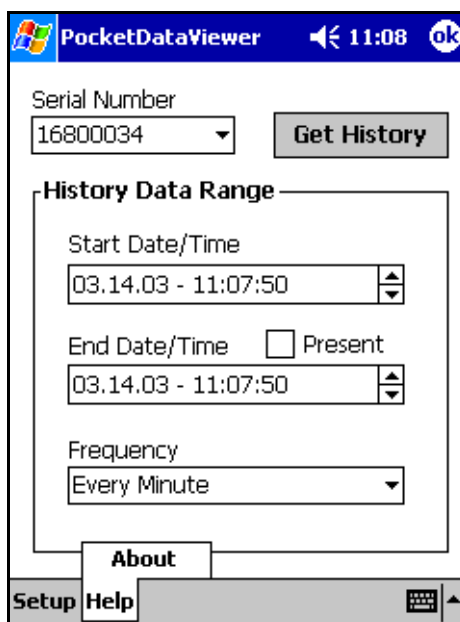


Figure 3-29. Accessing the About PocketDataViewer Menu.

This window provides copyright and version information on the program and library software.

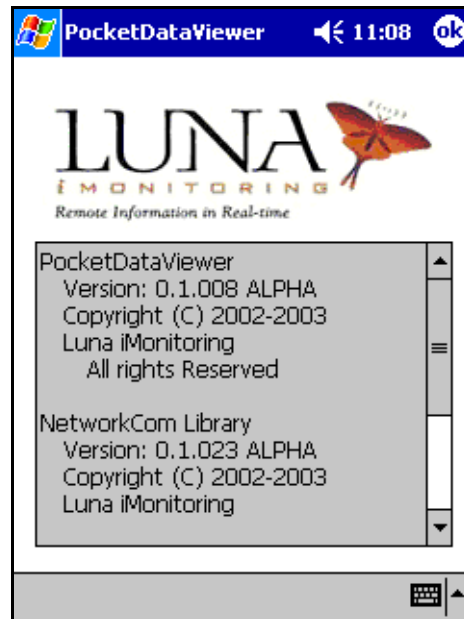


Figure 3-30. Detailed Information on PocketDataViewer.

Selecting a Sensor Device

To select the sensor device from which to download data, enter its unique serial number in the Serial Number field or select it from the pull-down list. *Note: this program only recognizes sensor devices, not iCCU devices.* The Serial Number field in this program functions the same as the Serial Number field in **PocketConfig**. The program stores the ten most recently accessed serial numbers in the pull-down list.

3

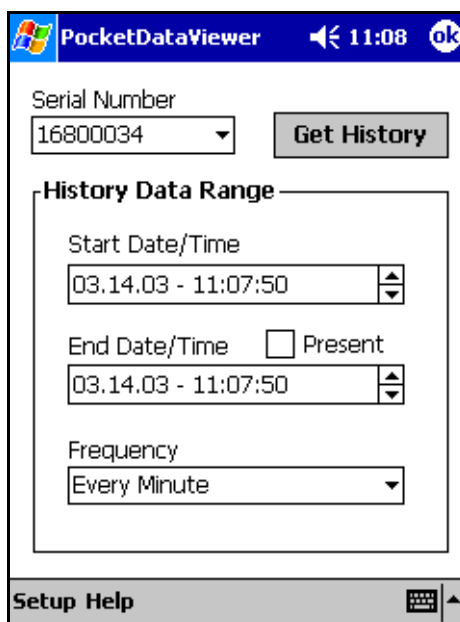


Figure 3-31. PocketDataViewer Main Menu.

Selecting the History Data Range

By default, the Start Date/Time and End Date/Time are initially set to the current time. To change a date or time field, select the appropriate field and change it using the up/down arrow buttons to the right of the field. To “hard code” the software to use the current date and time as the End Date/Time, select the Present option as shown in Figure 3-32 below.

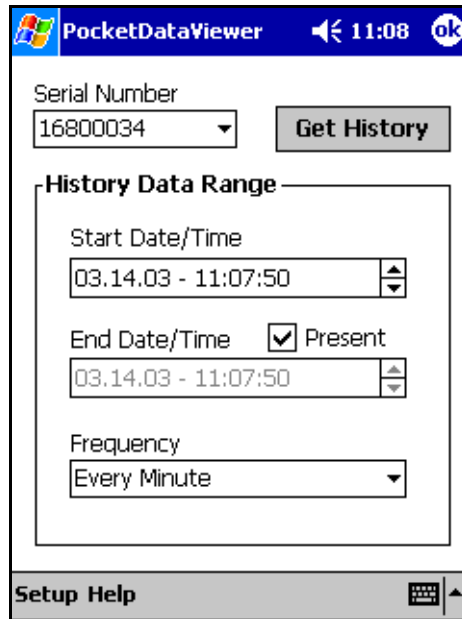


Figure 3-32. Selecting the End Date and Time.

Selecting the Data Point Frequency

By default, sensor devices acquire and internally store data points every minute, even though they may only uplink and transmit one set of data points per day. **PocketDataViewer** provides access to all or part of these data points based on the Frequency interval selected from the pull-down list shown below in Figure 3-33.

3

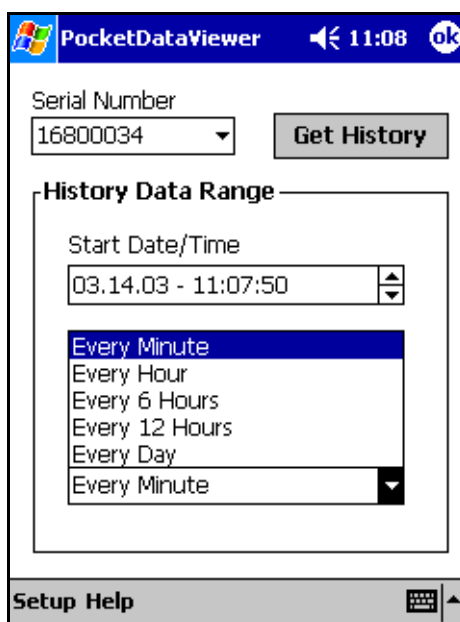


Figure 3-33. Data Point Frequency Interval Options.

Once the Serial Number and History Data Range are selected, hit the **Get History** button to download the data points and bring up the windows shown in the following two Sections. *Note: the software issues a warning if the number of data sets requested is greater than 100.*

Sensor Data History

The next two sections use history data from an *iWPM-T* sensor device; however, other sensor devices have similar displays. The History window has tabs for each of the sensor data measurements and the battery charge capacity. Figure 3-34 below shows the sensor data measurements for an *iWPM-T* which has pressure and temperature sensors. The *iTLM-1* has depth and temperature sensors.

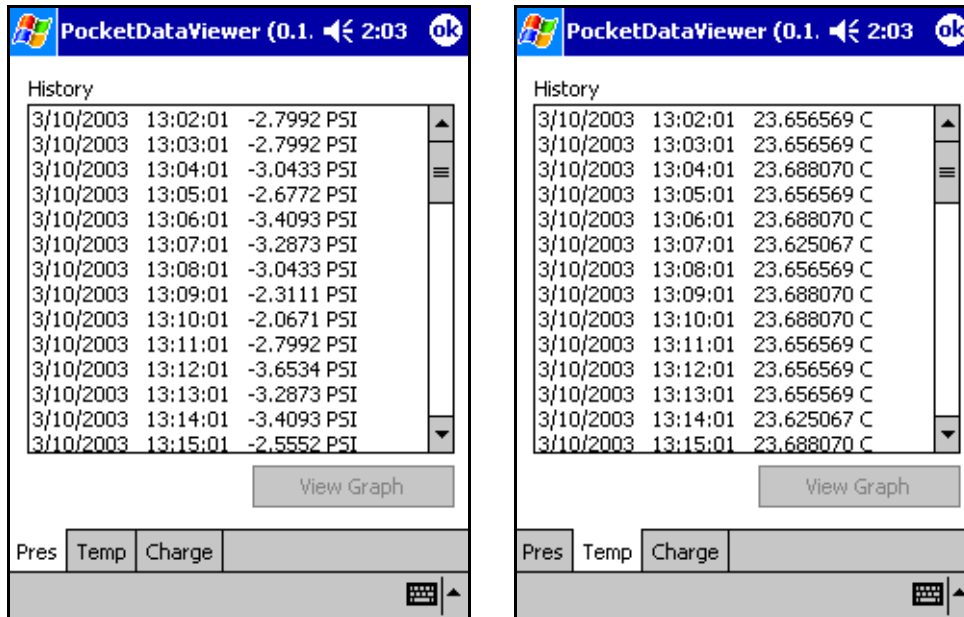


Figure 3-34. (a) Pressure and (b) Temperature Sensor Data History for an *iWPM-T*.

In every data history window, column 1 contains the date, column 2 contains the time, and column 3 contains the data point and units. Use the scroll bar at the right of the window to scroll through the entire data range.

In a later release of the software, the **View Graph** option will display a graph of the entire data range.

Battery Charge History

Figure 3-35 below shows the battery charge capacity history for an iWPM-T sensor device, but this window is the same for all sensor devices.

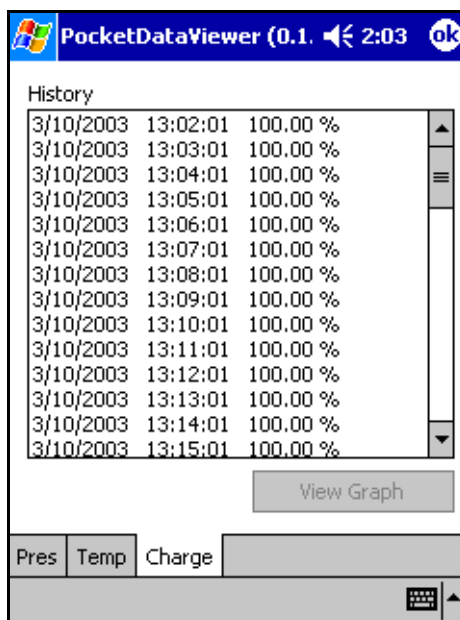



Figure 3-35. Battery Charge Capacity History for an iWPM-T.

Exiting the Software

To safely exit either software program, **PocketConfig** or **PocketDataViewer**, simply hit the  button in the top right corner of the screen.

Appendix A

Specifications

A

Description	Specification
iCCU - Concentration & Communications Unit	
Dimensions:	
Enclosure	11.5" x 8.0" x 5.0"
Solar Panel	10.0" x 9.0" x .5"
LAN Transmit/ Receive Frequency	902 to 928 MHz (customizable)
LAN Output Power	TBD, conducted
LAN Communications Protocol	Proprietary FHSS, per FCC Part 15.247
LAN Data Rate	4800 bps
WAN Options	Simplex or duplex sat com (released), Cellular and land line (near future)
WAN Data Rate	< 9.6 Kbps
Operational Temperature Range	-40 to +55 °C
Radio Link Range:	
iCCU to Sensor	2500 feet; typical, line of sight
iCCU to PocketPC®	500 feet; typical, line of sight
FCC	
LAN	CFR 47 Part 15
WAN	CFR 47 Part 25

Description	Specification
iCFR - Compact Flash Radio	
Transmit/Receive Frequency	902 to 928 MHz (customizable)
Form Factor	Type I compact flash
Power Supply	3 to 5V (from host unit)
Power Consumption: Transmit Receive	25mA max 11.8 mA
Protocol	Propriety FHSS, per FCC Part 15.247
Receive Sensitivity	-97 to -110 dBm (depending on data rate)
Output Power	TBD, conducted
Modulation	FSK
Data Rate	Up to 76 Kbps
Antenna	Internal
FCC	CFR 47 Part 15

Description	Specification
iEFM - Electronic Flow Monitor*	
Operational Temperature Range	-40 to +60°C
Output Power: Omni Antenna Yagi Antenna	17.7 dBm max, conducted 13.4 dBm max, conducted
Radio Link Range: Sensor to iCCU Sensor to PocketPC®	2500 feet; typical, line of sight 500 feet; typical, line of sight
UL	Intrinsically Safe for Class I, Division 1, Groups C and D per UL-913
FCC	CFR 47 Part 15, CFR 47 Part 18 (ultrasonic transducer)

*For additional specifications, see Honeywell specifications for MXA145 Flow Transmitter.

Description	Specification
iTLM-1 - Tank Level Monitor	
Fluid Level Range	12 to 144 inches
Resolution	0.1 inches
Accuracy	± 0.5 inches
Repeatability	± 0.2 inches at fixed temperature
Mounting	1-1/2 inch NPT, up to 0.25 inch thickness
Mounting Angle	5° maximum
Temperature Compensated	Yes
Operational Temperature Range	-40 to +60°C
Output Power: Omni Antenna Yagi Antenna	17.7 dBm max, conducted 13.4 dBm max, conducted
Radio Link Range: Sensor to iCCU Sensor to PocketPC®	2500 feet; typical, line of sight 500 feet; typical, line of sight
UL	Intrinsically Safe for Class I, Division 1, Groups C and D per UL-913
FCC	CFR 47 Part 15, CFR 47 Part 18 (ultrasonic transducer)

Description	Specification
iWPM-T - Wireless Pressure Monitor	
Pressure Range	0 to 1400 psig
Resolution	10 psig
Accuracy	± 30 psig
Overpressure	2000 psig
Temperature Compensated	Yes
Mounting	1/4 inch NPT
Operational Temperature Range	-40 to +60°C
Output Power: Omni Antenna Yagi Antenna	17.7 dBm max, conducted 13.4 dBm max, conducted
Radio Link Range: Sensor to iCCU Sensor to PocketPC®	2500 feet; typical, line of sight 500 feet; typical, line of sight
UL	Intrinsically Safe for Class I, Division 1, Groups C and D per UL-913
FCC	CFR 47 Part 15

Appendix B

Technical Support

B

If you experience any problems using the Oil and Gas Wireless Enabled Monitoring System, please contact Luna iMonitoring Technical Support at

2903 Commerce Street, Suite A

Blacksburg, VA 24060 USA

Voice: 540-557-5880

FAX: 540-951-0760

Email: solutions@lunaimonitoring.com

Web: www.lunaimonitoring.com

Appendix C

Using the Charge Cable

C



Figure C-1. WEMS Charge Cable.

Luna iMonitoring provides a device Charge Cable, shown in Figure C-1 above, with most Beta Test versions of the Wireless Enabled Monitoring System. **The Charge Cable is for use in a lab setting and is not tested or approved for use in hazardous environments.** The Charge Cable has an SMA connector at one end and a USB connector at the other end. The SMA connector plugs into the SMA antenna connector on the WEMS device being tested. The antenna on each WEMS device simply screws off of the SMA connector. The USB connector plugs into the USB port of any computer. The SMA connector serves as an antenna connection as well as a power connection. Therefore, the device receives power from the USB port on the computer when the computer is on. Even though the antenna is disconnected, the device can still receive and transmit radio signals in a lab setting.

64 | Appendix C Using the Charge Cable

The Charge Cable serves two purposes:

- 1 It quickly charges the battery to full capacity.
- 2 It maintains a full charge on the battery in a lab setting where the solar panels can not charge the battery.