RMU1-SUB

Installation and Configuration Guide



RMU1G-SUB Cellular
RMU1I-SUB Iridium
RMU1S-SUB Globalstar

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1 Introduction

The RMU1-SUB (Remote Monitoring Unit 1-Subgrade) is part of the Mobiltex Data Ltd. CorTalk® family of cathodic monitoring and control products. Mobiltex Data Ltd. was formed in 1985 and specializes in the design and manufacture of high reliability, industrial mobile data systems for the communications, transportation and utility markets. Mobiltex has been providing solutions for the cathodic monitoring industry since 1991.

The RMU1-SUB is a low cost, high reliability device intended for test stations to monitor coupons and bonds. The device is available in two satellite (RMU1S-SUB and RMU1I-SUB) and one cellular (RMU1G-SUB) communication configurations. The field hardware consists of a single component that is usually mounted inside a plastic test station. The device operates for 10+ years from internal, low cost, field replaceable batteries. This self-powered solution can be used to monitor coupons and bonds without the requirement for nearby line or solar power sources. The RMU1-SUB has integral high-energy surge suppression and provides unprecedented lightning immunity because there are no connections to electrical ground. It is designed to work at road level and can continue to operate despite being partially submerged.

The RMU1-SUB monitors and transmits eight channels of information. An integral accelerometer can be used as a tamper detection alarm and to ensure the unit is upright. The RMU1-SUB measures temperature and internal battery voltage. A user accessible magnetic switch allows the transmission of uniquely identified messages that can be used to record site visit information. The RMU1-SUB can also interrupt if desired. Interruption does cause a significant drain on battery life and so if used, the user can expect to only get 5 years of life from the units before having to replace the batteries (assuming 2 weeks of interruption a year).

Measurement data is wirelessly transmitted to the Mobiltex CorView servers. CorView manages all field data communications, maintains three years of measurement data, sends alarm exception and system performance emails, and provides password protected remote customer access. With the proper credentials, CorView can be accessed using a web browser like Google Chrome or Internet Explorer. The measurement data is presented in an intuitive tabular format or graphical mapping display that color-codes abnormal measurement or site conditions for quick user interpretation. CorView can also provide near real-time email notification of abnormal measurement and alarm conditions.

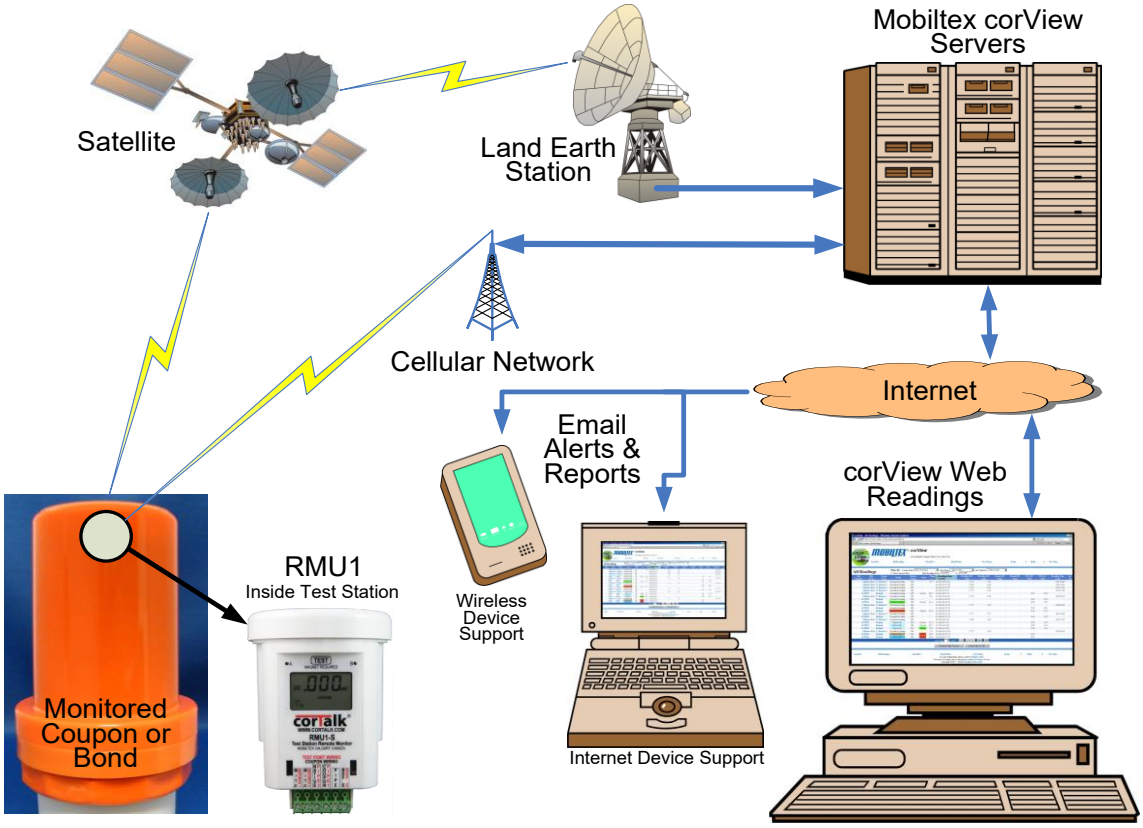


Figure 1 RMU1 Communications Block Diagram

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.

Keep Internal Product Surfaces Clean and Dry.

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.

Symbols on the Product. The following symbols may appear on the product:



CAUTION
Refer to
Manual

3 Kit Contents

3.1 RMU1S-SUB (Globalstar Simplex Satellite) Kit A20A0336601

	1 pc – RMU1S remote monitoring unit. Typically purchased with a valve box, enclosure ring and valve box cover. Mobiltex P/N A20A0336601
	1 pc – Subgrade support ring This item comes pre-attached to the RMU1-SUB unit.
	8 pc – Screws for the support ring

Table 1 RMU1S-SUB Kit Contents

3.2 RMU1I-SUB (Iridium SBD Satellite) Kit A20A0336602

	1 pc – RMU1I remote monitoring unit. Typically purchased with a valve box, enclosure ring and valve box cover. Mobiltex P/N A20A0336602
	1 pc – Subgrade support ring This item comes pre-attached to the RMU1-SUB unit.
	8 pc – Screws for the support ring

Table 2 RMU1I-SUB Kit Contents

3.3 RMU1G-SUB (LTE Cellular) Kit A20A0336603 (US, Canada, Mexico)

	1 pc – RMU1G remote monitoring unit. Typically purchased with a valve box, enclosure ring and valve box cover. Mobiltex P/N A20A0336603
	1 pc – Subgrade support ring This item comes pre-attached to the RMU1-SUB unit.
	8 pc – Screws for the support ring

Table 3 RMU1G-SUB Kit Contents

3.4 RMU1 Optional Installation Items

	Replacement Battery Pack Kit of 4 AA batteries for maintenance purposes Mobiltex P/N B02221RMU10
 	RMU1/2/3-BT Programmer Kit Mobiltex P/N A20A0333101 Universal programming kit for RMU1, RMU2, and RMU3 devices. Includes RMU1/2/3 base programmer (A1506033101), RMU1ADP (A1506033001), LiIon battery pack, and soft case. Capable of Bluetooth communications with a phone/tablet. Can also be used with a PC through the USB connection.
	RBT1 Bluetooth Interface Cable Mobiltex P/N A1506032101 Screw mating end into the SUB1 COMMS connector. Apply power to the SUB1 to enable Bluetooth connectivity.

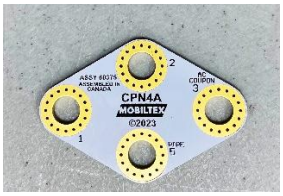
	Test Magnet Mobiltex P/N H00000MAG01
	Separate AC/DC Coupon Mobiltex P/N A20A0337501 Adapter assembly for use with separate DC and AC coupon mode (CP38). Integral 10 ohm shunt resistor.
	Valve Boxes Bingham & Taylor Slide Top w/Flange Mobiltex P/N H20A01SUB01 – GRE5T54S (10.38” total length) Mobiltex P/N H20A01SUB02 – GRE5T55S (15.625” total length) Mobiltex P/N H20A01SUB03 – GRE5T56S (26.5” total length)
	Enclosure Ring Bingham & Taylor cast iron enclosure ring for valve box Mobiltex P/N H20A01SUB04
	Valve box cover (HDPE, AASHTO HS20 certified w/ valve box) Mobiltex P/N H23340SUB01 (Yellow) Mobiltex P/N H23360SUB01 (Blue) Mobiltex P/N H23330SUB01 (Orange) Mobiltex P/N H23390SUB02 (White) Mobiltex P/N H233A0SUB01 (Red)

Table 4 RMU1-SUB Accessories

4 Installation

Warning: Only properly qualified personnel should work on installation of this equipment. Company and industry safety procedures must be followed.

Installation consists of three steps: unit installation, wiring, and device configuration.

4.1 Valve cover and RMU1-SUB Integration

The RMU1-SUB comes separate from its valve box. Install the valve box according to the manufacturer's specifications. Use free draining backfill, if possible, to help wick moisture and water away from the RMU1-SUB. Remove the provided valve box cover ring.

4.1.1 Tools

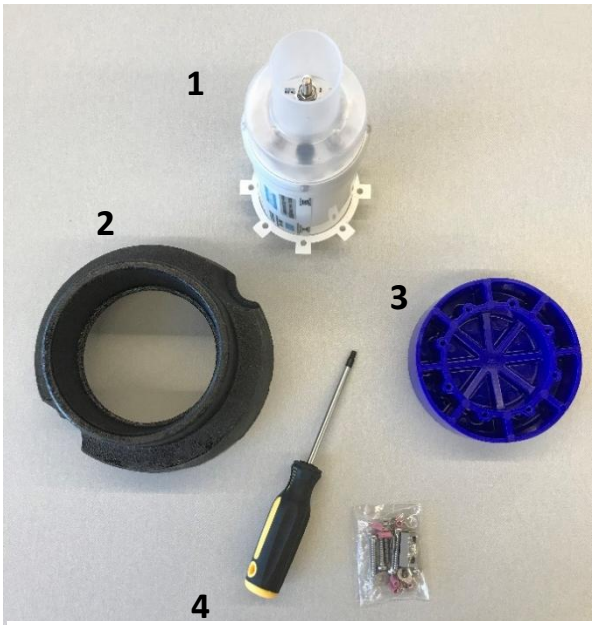


Figure 2 Tools for a RMU1-SUB installation

1. RMU1-SUB
2. Enclosure ring
3. Valve box cover
4. T25 Screwdriver OR impact driver w/ T25 bit
5. Hardware kit (included with the RMU1-SUB)

4.1.2 Procedure

1. Place the Valve box cover face down onto a flat surface.
2. Place the Enclosure ring over the Valve box cover.



Figure 3 Valve box cover in Enclosure ring

3. Put the RMU1-SUB into the Valve box cover and Enclosure ring.



Figure 4 RMU1-SUB ready for screws

4. Take the 8 T25 screws from the Hardware kit. Align the ring around the RMU1-SUB so its screw holes align with the screw holes in the Valve box cover.
5. Place the screws in the ring.

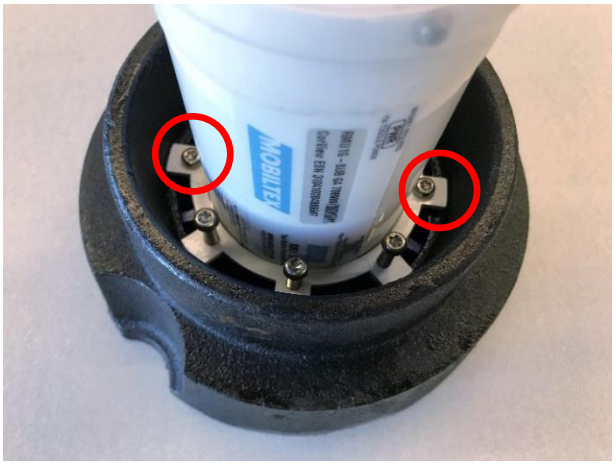


Figure 5 First two screws tightened

6. Tighten screws in opposite pairs until all screws tight. The unit should be able to rotate but feel well secured to the lid.



Figure 6 All screws tightened

7. This is a good moment to do a bench test before fully wiring the unit.

4.2 Quick Bench Test

2. For the RMU1S-SUB or RMU1I-SUB, locate the RMU1-SUB outdoors with a clear view (120 degrees in all directions is optimum) of the sky and with the top Mobiltex valve cover logo of the device facing upwards towards the sky. RMU1I-SUB battery life will be significantly impacted by poor sky views since communication with the satellite constellation is attempted and re-attempted until the satellite system acknowledges the transmission. The RMU1G-SUB cellular antenna, located in the top dome area, requires a clear communications path to a cellular tower; optimal orientation will be site dependent.
3. To power on the RMU1-SUB, apply a magnet to “PWR” switch on the side label. The unit will beep for 3 seconds followed by a short beep about 10 seconds later when it has fully initialized.
4. If the GPS receiver is enabled in the configuration (for the RMU1S-SUB, the GPS is always enabled at power-up). The RMU1-SUB will not send a power-up message until GPS signal acquisition is complete. Once acquired (it usually takes a minute) the unit will beep before sending its power up report.
5. CorView is accessed using a web browser at https://corview.cloud. Enter the Username and Password provided when your CorView account was setup.
6. Upon successful login to CorView you will be presented with an “All Readings” screen that will display the readings for all your RMU device(s). You should see a status of “New Unit” or “Power Up” along with the readings from the device that you just connected.

   Note that transmissions from field devices typically require from <1 minute (good antenna view of the sky) to 30 minutes (poor antenna view of the sky) to arrive at CorView. The displayed measurement screen on CorView will refresh automatically every 5 minutes. If you wish to see more immediate readings, simply click on the refresh button (typically F5) in your browser.

CorView can be configured to automatically send emails containing the measurement readings to an individual or group of email users. Because these emails are short and wireless-friendly, many clients send the readings directly to their field installer's wireless email device(s) for near immediate end-to-end operation confirmation and verification of measurement values.

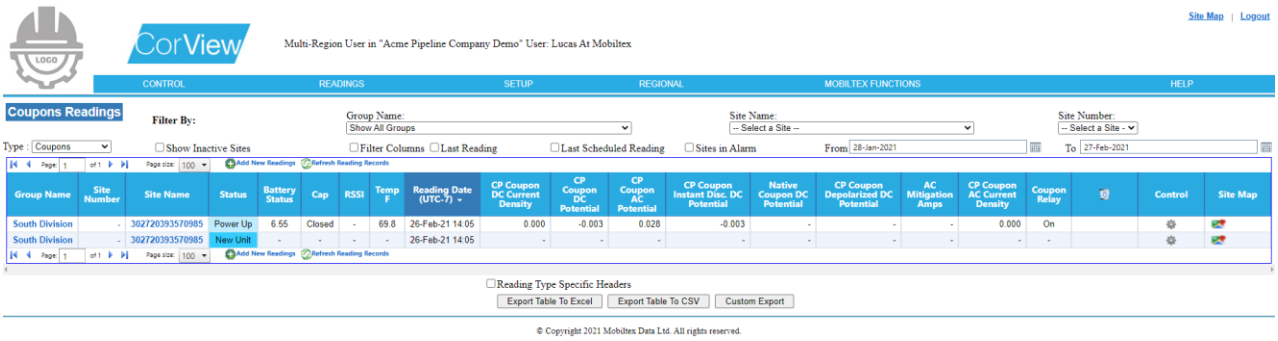


Figure 7 CorView All Readings Page

1. Pressing a magnet against the area marked "TEST" on the RMU1-SUB for 1 to 5 seconds will force an immediate analog measurement and data transmission.
2. After the device has transmitted the measurements, CorView should display a new status of "Test Message" along with the associated readings for the device.
3. When the bench test is completed, simply hold the magnet next to the "PWR" switch for >5s. The RMU1 SUB will make 10 short beeps until shutting down at which point it will go silent. To test it is indeed off, press the magnet to the "TEST" switch. The unit should not beep.

4.3 Measurement Type Wiring

The RMU1-SUB can be wired in several different pre-defined configurations for single coupon, dual coupon, separate AC and DC coupons, and bond monitoring. The diagrams in the following pages illustrate typical installations for each measurement type. Each measurement type diagram contains a table indicating the six measurement points (Slots) that are transmitted to the CorView server.

Note that for pipe-to-soil measurements, as shown in the installation diagrams, the readings sent to CorView will be negative. Also note that the RMU1-SUB measurement inputs must not be directly connected to mains AC power.

The following ranges apply to measured signals of the RMU1-SUB.

Potential:	+/-31VDC, 22VAC	
Coupon Current:	+/-6mADC, 4.25mAAC	Low Range
	+/-60mADC, 42.5mAAC	Med Range
	+/-200mADC, 140mAAC	High Range
Bond Shunt:	+/-6mVDC, 4.25mVAC	Low Range
	+/-60mVDC, 42.5mVAC	Med Range
	+/-200mVDC, 140mVAC	High Range

4.3.1 RMU1-SUB Bolt Labels

The RMU1-SUB label has different colors for bolt labels to help with wiring depending on the type of installation. For Test Points, use the blue labels. For coupons follow the black labels. Finally, for TP40, dual pipe to soil readings with interruption detection, use the red labels.

Bolt #	Test Point Wiring Label	Coupon Wiring Label	TP40 Wiring Label
1	BOND-	MIC AC	
2	BOND+	MIC AC	
3	PIPE2	NATIVE	REF2
4	PIPE1	COUPON	REF1
5		PIPE	
6	REF E	REF E	PIPE

Table 5 RMU1-SUB Bolt Labels



Figure 8 RMU1-SUB Bolt Labels

4.4 Wiring Diagrams

4.4.1 Polarity of Measurements

Figure 9 and Figure 10 below give the measured polarities of the RMU1-SUB expected for positive value readings.

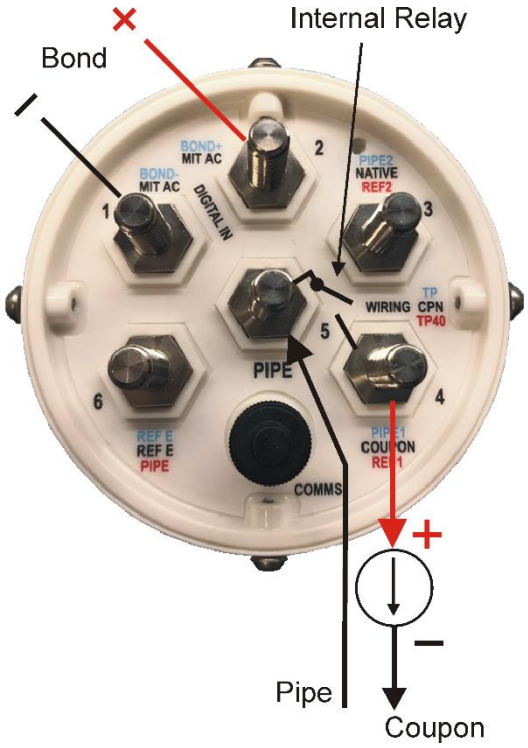


Figure 9 Polarity of Current Measurements

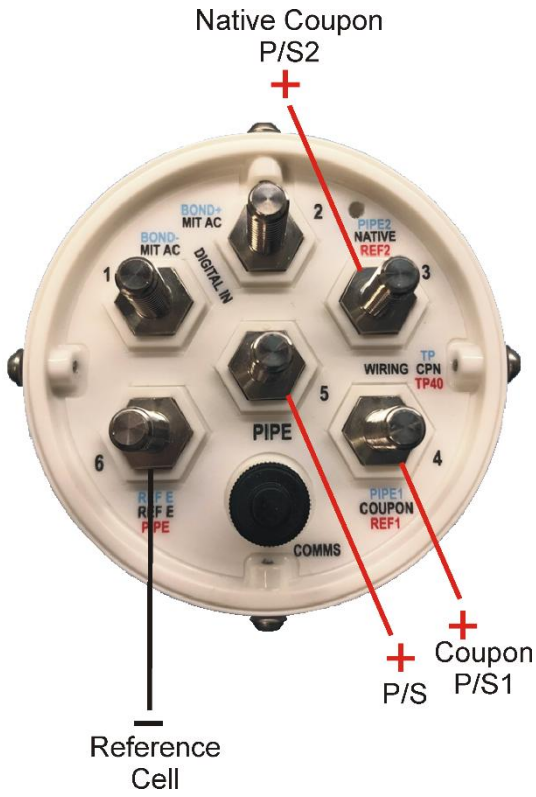


Figure 10 Polarity of Voltage Measurements

4.4.2 Single Coupon (CP33)

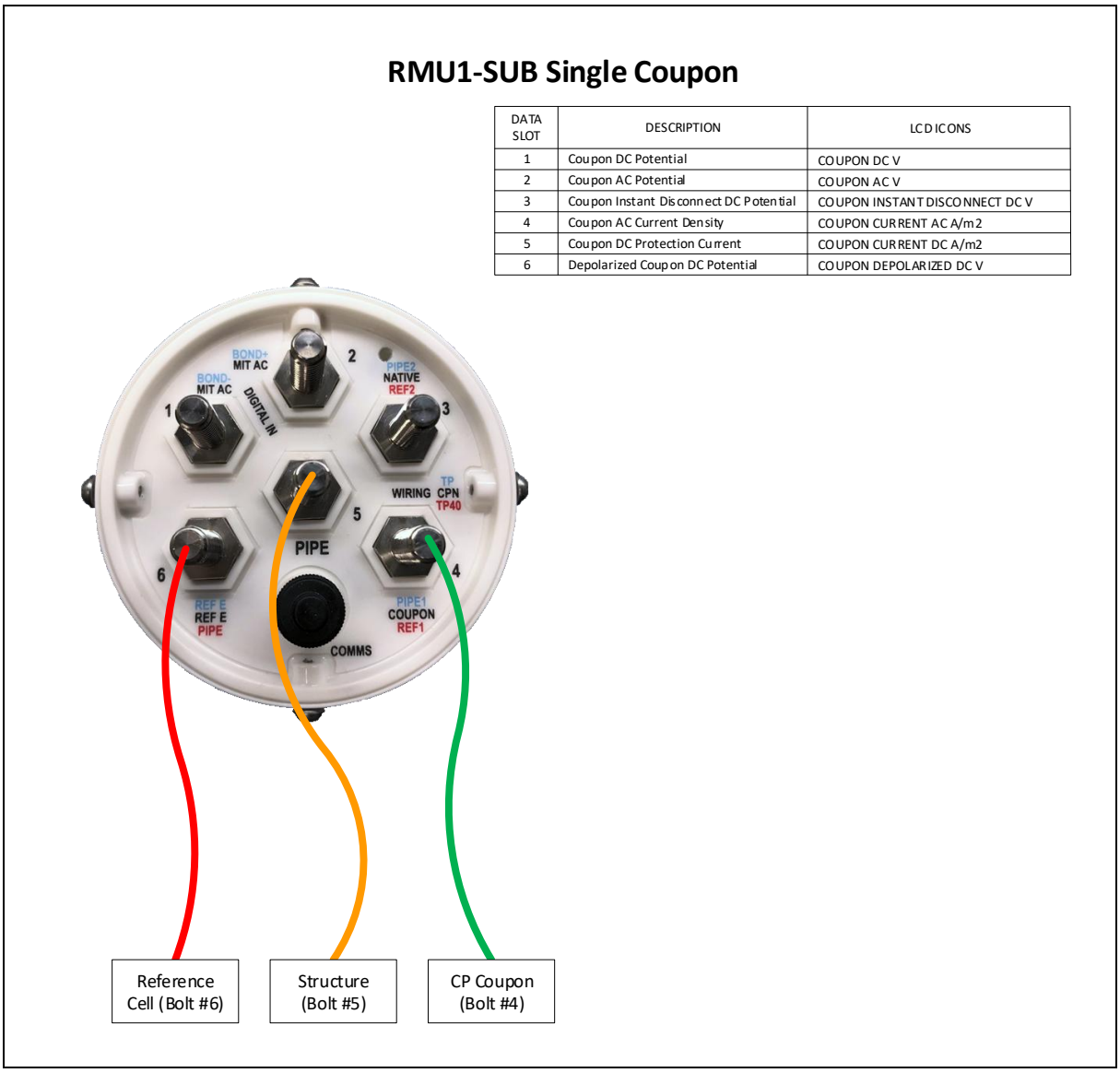


Figure 11 Single Coupon Wiring Diagram (CP33)

4.4.3 Dual Coupon (CP34)

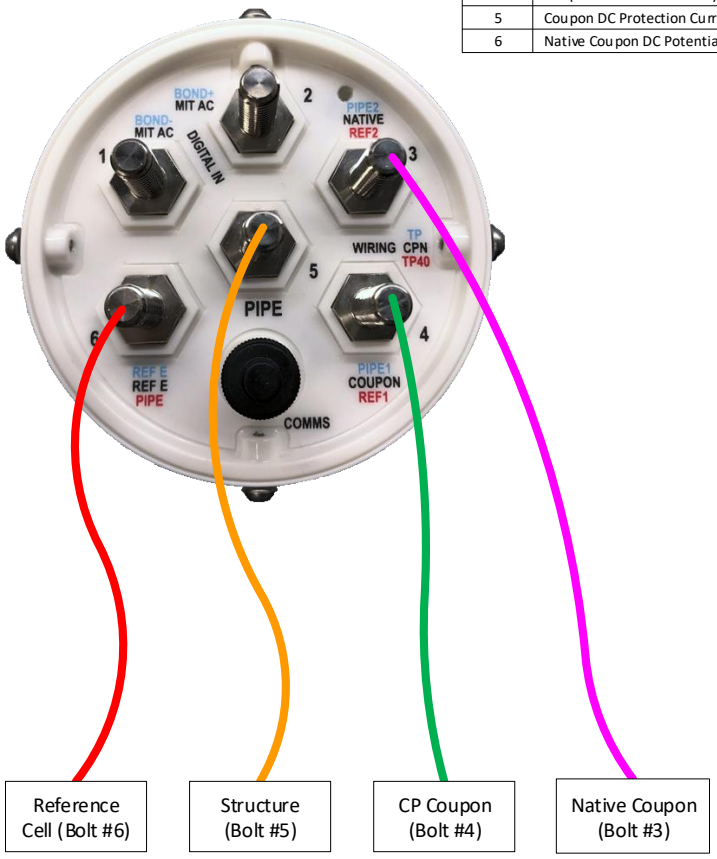


Figure 12 Dual Coupon Wiring Diagram (CP34)

4.4.4 Single Coupon w/AC Mitigation (CP35)

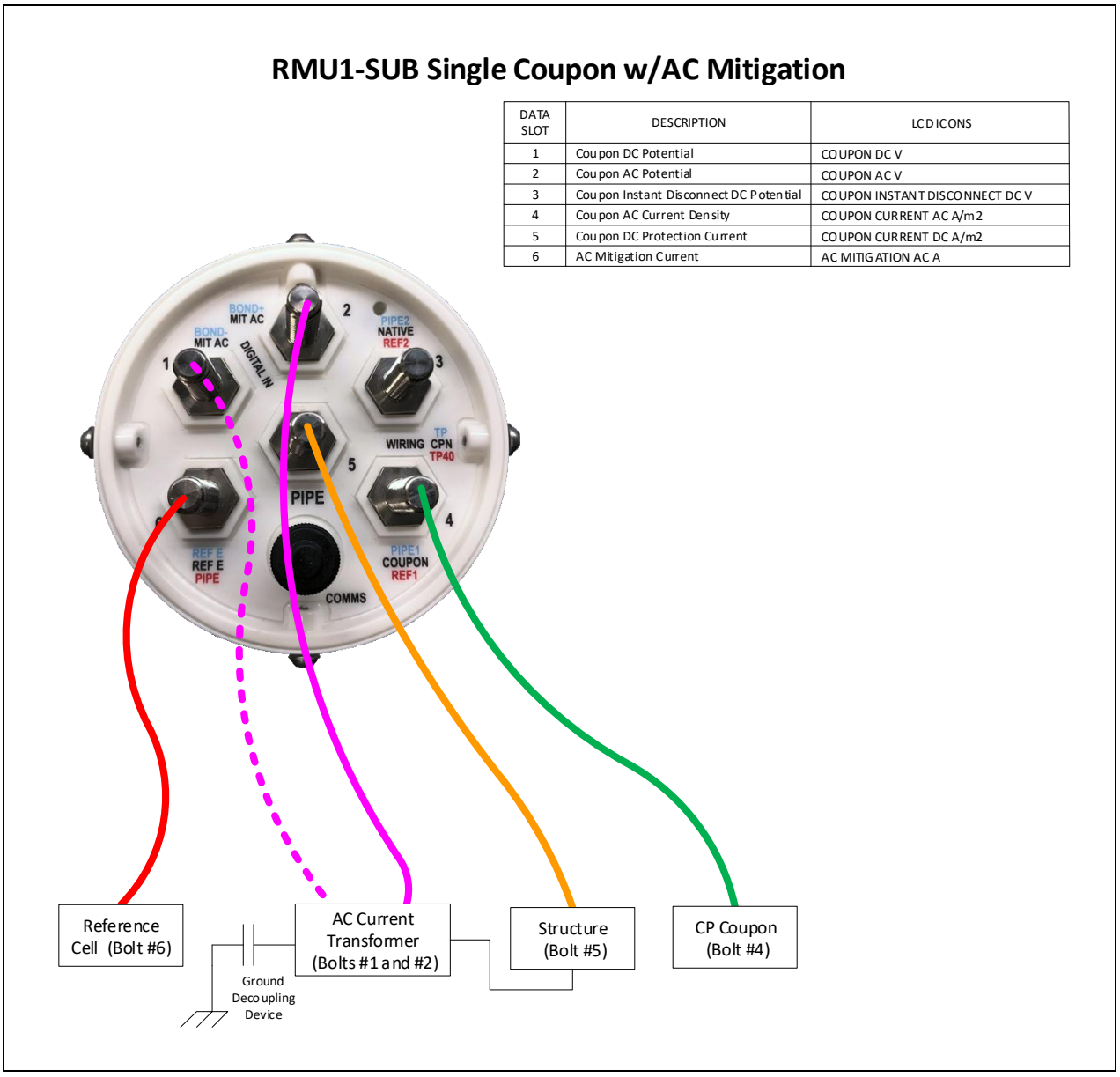


Figure 13 Single Coupon with AC Mitigation Wiring Diagram (CP35)

With this type of installation, a scaling factor must be entered for the AC mitigation slot in the RMU1-SUB configuration. The scaling factor is dependent on the transformer and the burden/divider resistors. For Mobiltex supplied transformer kits, the required slot scale factor is printed on the transformer assembly. The slot input range must be set to 'HIGH' in the RMU1-SUB configuration.

4.4.5 Bond (BOND36)

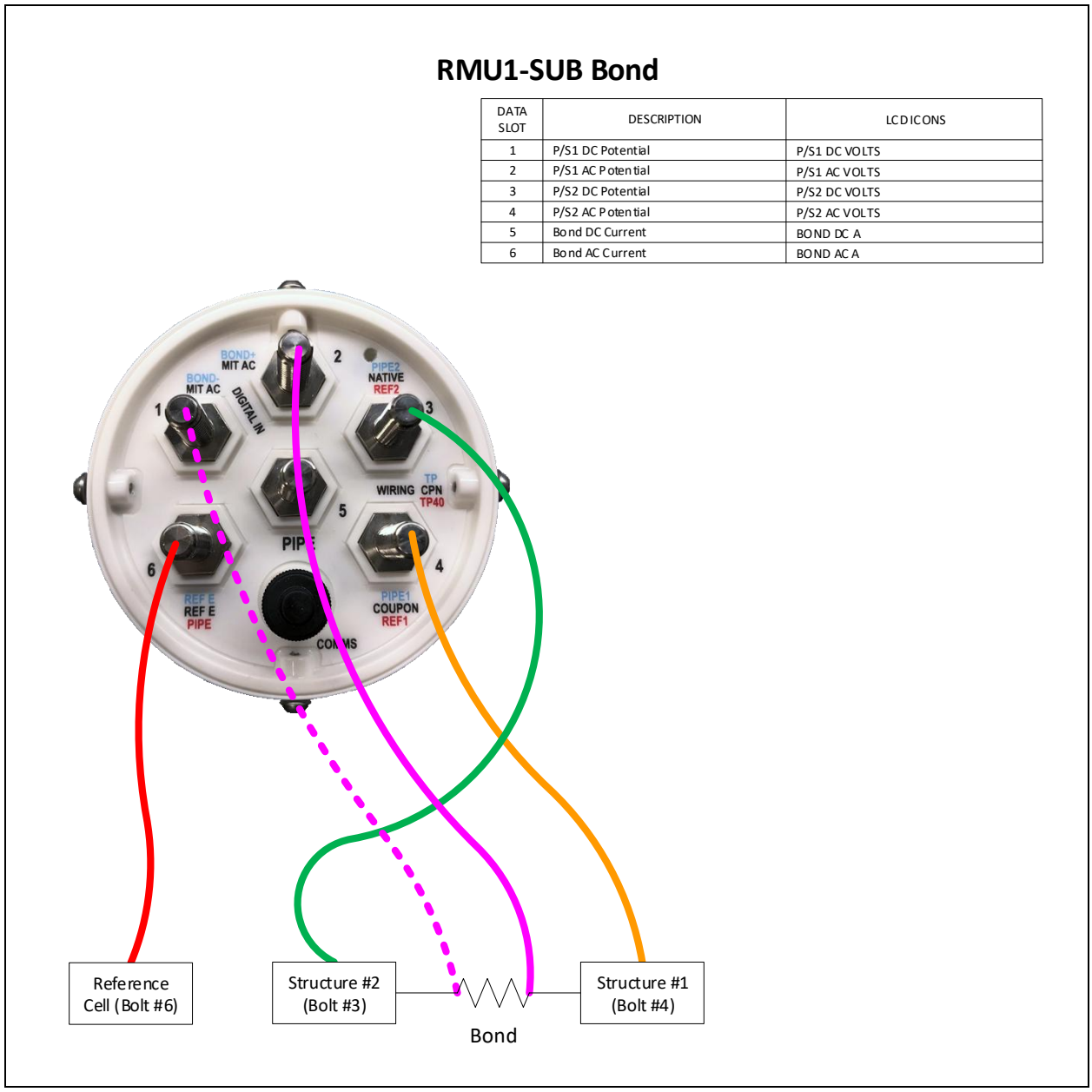


Figure 14 Bond Wiring Diagram (BOND36)

4.4.6 Test Point (TP37)

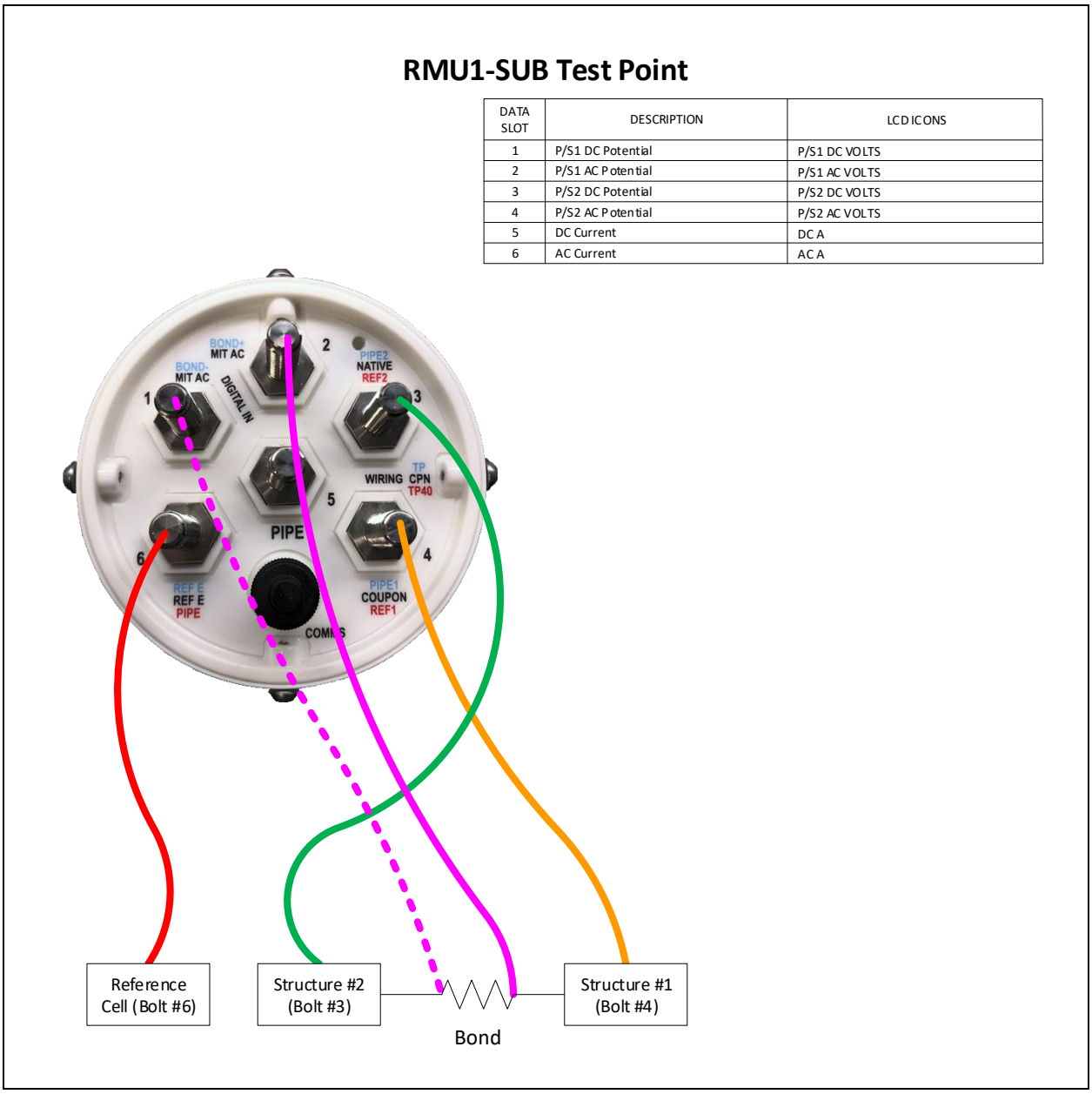


Figure 15 Test Point Wiring Diagram (TP37)

4.4.7 Separate DC and AC Coupons (CP38)

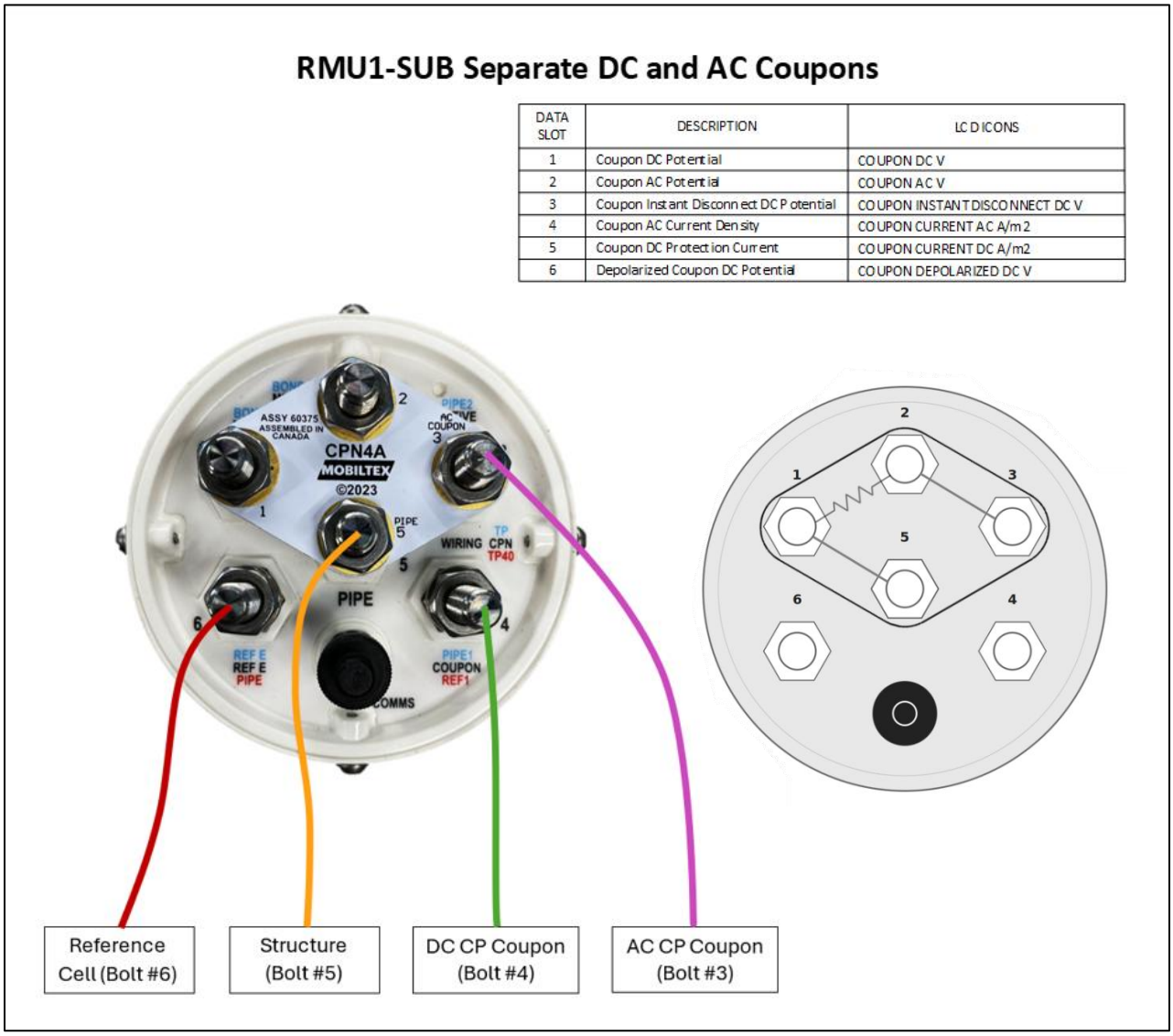


Figure 16 Separate DC and AC Coupons Wiring Diagram (CP38)

When using separate DC and AC coupons with the RMU1-SUB, an adapter board (CPN4A) must be used. This adapter board contains a precision shunt resistor and provides a terminal block for connections to the coupons, structure and reference cell. The shunt is a 10ohm resistor; this shunt resistance must be used in the coupon calculator in the RMU1-SUB configuration application to obtain correct readings.

4.4.8 Single Coupon w/DC Bond (CP39)

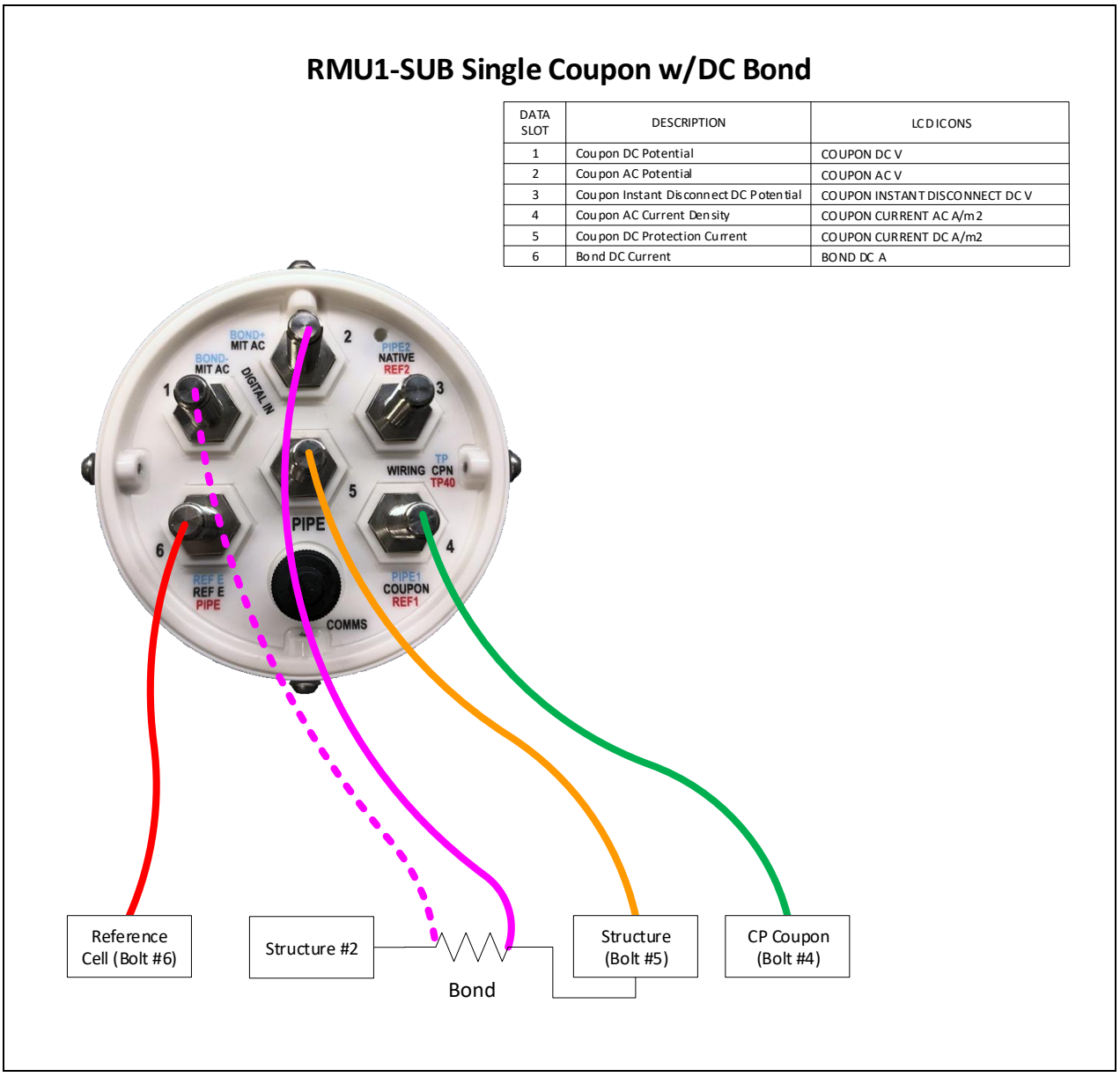


Figure 17 Single Coupon with DC Bond Wiring Diagram (CP39)

4.4.9 Test Point With Interruption On/Off (TP40)

RMU1-SUB Test Point With Interruption On/Off

DATA SLOT	DESCRIPTION	LCD ICONS (RMU1 Only)
1	P/S1 DC Potential (Ref Cell #1)	P/S1 DC VOLTS
2	P/S1 AC Potential (Ref Cell #1)	P/S1 AC VOLTS
3	P/S2 DC Potential (Ref Cell #2)	P/S2 DC VOLTS
4	P/S2 AC Potential (Ref Cell #2)	P/S2 AC VOLTS
5	P/S DC On (Ref Cell #1, Int. Detected)	P/S1 DC VOLTS
6	P/S DC Off (Ref Cell #1, Int. Detected)	P/S1 DC VOLTS INSTANT OFF

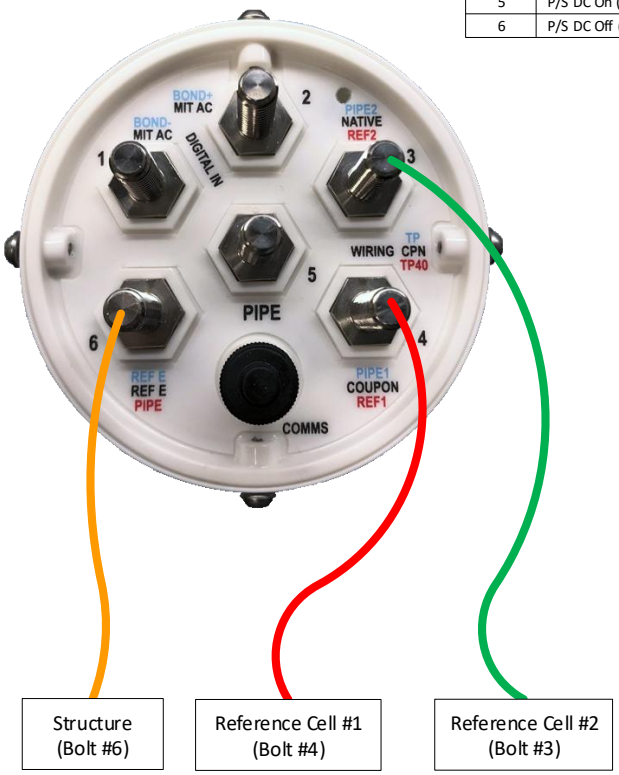


Figure 18 Interruption Detection with On/Off Measurements (TP40)

Note that connection points for the structure and reference cells differ from usual wiring on the RMU1-SUB. The first 4 slots are standard P/S measurements. Slots 5 and 6 support interruption detection.

Two reference cell inputs are provided to allow for validation of reference cell operation over time. The measurements on slots 1 and 2 are made relative to the 'REF1' input and the measurements on slots 3 and 4 are made relative to the 'REF2' input. Interruption measurements in slots 5 and 6 are only made against the 'REF1' input.

When two reference cells are installed, it is then possible to compare the measurements from the two references on CorView. If the measurements are observed to diverge over time, it is an indication that one of the reference cells may need replacement.

When using reference cells of different chemistry, e.g. CuCuSO4 and Zinc, the slot offset parameter for slots 1 or 3 can be used transmit equivalent reference measurements. As an example, if a

CuCuSO4 reference is connected to ‘REF1’ and a Zinc reference is connected to ‘REF2’, the slot 3 offset parameter can be set to a value of -1.1 to send CuCuSO4 equivalent readings for both to CorView.

Int. Det. Threshold (mV): This parameter indicates the minimum voltage difference between the P/S1 DC On Potential and P/S1 DC Off Potential for interruption to be detected. Any voltage fluctuation below its value will not be detected as an interruption.

If interruption is detected, appropriate ‘on’ (slot 5) and ‘instant off’ (slot 6) measurements are taken. The instant off and on measurements are made relative in time to the interruption waveform transition edges according to the ‘Instant Disconnect Offset’ parameter. This interruption measurement check set is taken at power up and at exception check intervals. Because of the sampling involved, the measurement takes over 1 minute to complete. If interruption is not detected, these slots will be displayed as disabled on CorView. A change of state for interruption detection will generate an exception transmission to CorView.

Note: If only one reference cell is used, it should be connected to the terminal labelled ‘REF 1’.

The programmed “Measurement Type” will determine the signals monitored and the associated wiring connection requirements.

Pull the silicone sock off the top and push it down the wires you intend to attach. Strip ¼”(6mm) of insulation off the end of each measurement wire before inserting the wire into the ring terminals and crimping it. Use a 7/16” wrench or deep socket to tighten the ring terminal onto the correct input. Pull the silicone sock back up over the RMU1-SUB when complete so that the raised band goes over the screws at the bottom of the RMU1-SUB.

Unused analog input channels should be disabled using the programming interface.

Electrical connections to the RMU1-SUB1 can be made using direct wire connections (22 to 14 AWG wire size. Lightning immunity is enhanced by utilizing 600 volt, 105C rated wiring (as supplied with the optional wiring kit) which has a thicker insulation system and higher voltage breakdown rating as compared to more common 300 volt rated wiring systems.

4.4.10 Isolated Digital Input

When enabled in the configuration, an isolated digital input is present on the pins labelled 'BOND-/MIT AC' and 'BOND+/MIT AC'. The input is bidirectional (polarity insensitive); an input signal with a magnitude greater than 3VDC will change the input to the active state. The digital input state may replace the transmission value for any data slot or the cap detector state by setting the appropriate options in the RMU1-SUB configuration.

The isolated input may be used to monitor a dry set of contacts by wiring the contacts in series with an external power supply. See Figure 19 for a connection example. Other electronically switched voltage sources may also be used.

Note that when using the isolated digital input, the analog measurement capability, for any measurement type slots that normally use the associated connector pins, will be disabled.

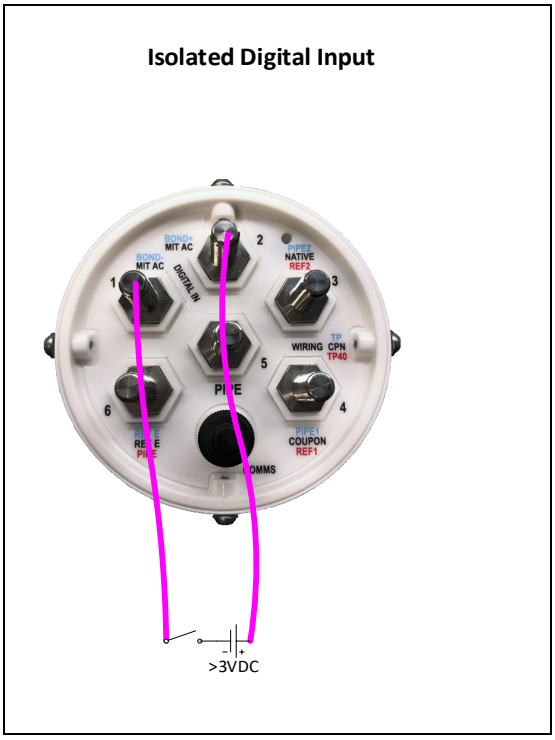


Figure 19 Isolated Digital Input Connection Example

4.5 Configuration

Once the coupon or bond is wired according to one of the diagrams, the measurement type, current shunt/transformer scaling factors (if used), and alarm limits (if used) should be programmed into the RMU1-SUB using the RMU1/2/3PGM configuration tool (see section 5).

4.6 Final Installation Steps

Once the unit is fully wired and ready to be dropped in. Power it off by pressing a magnet to the "PWR" switch for 10s. Then power it on again by pressing the "PWR" switch for 2 seconds and place it in the valve box. It will take about 2 minutes for the unit to fully acquire GPS and send its Power Up message. The Power Up message contains the unit's GPS coordinates and important configuration data. If the device is upside down when it sends the Power Up message and it is a satellite unit (Iridium or Globalstar) it will likely not make it to CorView.



Figure 20 Installation Inside 54S Valve box with yellow valve box cover

4.7 Startup and Verification

All wiring should be secured and inspected before the RMU1-SUB is powered on. The RMU1-SUB will start operation when a magnet is applied to the "PWR" switch. Note that the unit will immediately power on when a RMU1/2/3PGM is connected.

After the RMU1-SUB is powered, the RMU1-SUB will attempt to get a GPS signal before sending a power up transmission. Note that transmissions from RMU1S-SUB field devices typically require from <1 minute (good antenna view of the sky) to 30 minutes (poor antenna view of the sky) to arrive at CorView. The delivery variability is because the RMU1S-SUB transmits the message a total of three times (for airtime plans with periodic reporting intervals greater than 6 hours) to help insure a high message delivery success rate, even under partially degraded sky view conditions. The first transmission occurs within seconds of the measurement cycle. Each of the two retransmissions occurs between 5 and 10 minutes of the prior transmission. Transmissions from RMU1I-SUB and RMU1G-SUB devices should be received usually in less than one minute. If the programming interface is attached to the RMU1-SUB at power-up, the power-up message will be delayed by 5 minutes.

Place a magnet at the point labelled "TEST" on the RMU1-SUB for between 1s and 5s to initiate an immediate measurement cycle and "Test Message" exception transmission to the CorView web

host. Note that a maximum of 6 “Test” transmissions are allowed during a 12-hour period. Test transmissions are only possible after the initial RMU power-up message has been sent to CorView.

The actual measurement readings from the site should appear on CorView shortly after the message was transmitted. CorView can be configured to automatically send emails containing the measurement readings to an individual or group of email users. Because these emails are short and wireless-friendly, many clients send the readings directly to their field installers wireless email device(s) for near immediate end-to-end operation confirmation and verification of measurement values. Alternatively, the measurement readings can be locally retrieved and displayed using the RMU1PGM configuration tool. It is good practice to confirm that all the measurements are as expected and that they are not too close to any programmed alarm limits (if utilized).

The installation and site should be inspected a final time before properly securing the equipment and leaving the site.

4.8 Speaker

The internal speaker will beep for 3 seconds on power up followed by a short beep when the unit has fully initialized. Whenever an M8 cable inserted or removed it will also beep. After GPS has been acquired the unit will beep before sending its power up message. Holding a magnet to either the “PWR” or “TEST” switch will cause the unit to beep while the magnet is present. For a test message, hold the magnet up to the “TEST” switch for up to 5 seconds. Once the magnet is removed the RMU1-SUB will briefly beep to indicate it is trying to send the message (regardless of whether the maximum test messages within a 12 hour windows has been surpassed). If “Cap Detect” is enabled, the RMU1-SUB will beep every time its orientation changes from cap on (upright) to cap off (on its side or upside down) and vice versa. A test message will be sent on every orientation change.

To turn the unit off, hold the magnet up to the “PWR” switch for > 5 seconds. The units will beep 10 times rapidly before shutting down.

4.9 Coupon Disconnect

The internal coupon to pipe connection relay may be manually placed into a disconnect state for single coupon measurement types (CP33 & CP38). Place a magnet over the “TEST” area for a duration longer than 5s to initiate this function. Re-apply the magnet to the “TEST” area for an additional 5s to reconnect the coupon relay. The coupon relay will also automatically reconnect at the next wakeup interval of the RMU1.

The coupon disconnect cannot be toggled if the RMU1-SUB is currently performing a depolarization cycle. Note also that this function is only operational if the “Enable Depolarization” option is enabled in the unit configuration.

5 Configuration Using a PC

5.1 Configuration Equipment Requirements

The following items will be needed when configuring an RMU1-SUB.

1. RMU1/2/3 Programming Interface (Kit A20A0333101)
2. The RMU1-SUB, unlike the RMU1, uses a M8 cable instead of the Infra-red RMU1PGM to be programmed. The RMU1/2/3 programming interface is in Figure 21. One end of the cable is plugged into circular connector on the RMU1/2/3 programming interface labelled “RMU1-SUB” and the other end should be plugged into the RMU1-SUB circular connector. The interface is powered from the PC USB port, so an external power supply in not required.
3. Programming Application

   Drivers and application for the RMU1 programming interface can be downloaded from the Mobiltex support site. Contact your Mobiltex representative for download instructions.
4. Personal Computer (PC)

   The application software and drivers require that the PC be running Windows 7 or higher for an operating system. The PC must have an available USB port.



Figure 21 RMU1/2/3 Programmer

5.2 Software Installation

To install the configuration application and driver software, use Windows Explorer to navigate to the drive and directory containing the installation software downloaded from the Mobiltex support site. Double-click on the “CORTALKINSTALLER.exe” application. The dialog on Figure 22 will appear.



Figure 22 CORTALKInstaller Dialog

5.2.1 Driver Installation

From the Cortalk Installer screen, click the “Install RMU Programming 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.

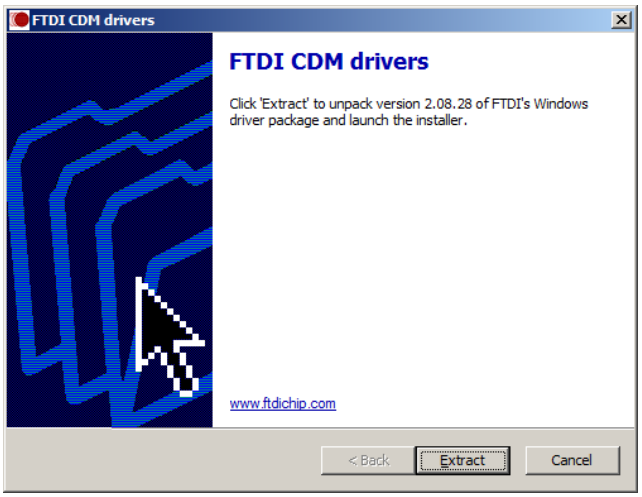


Figure 23 Driver Installation Screen

Once the driver installer completes, you may then plug in the RMU1 programming interface hardware into an available USB port on the PC.

As an alternative method, the drivers may be installed using the Windows “Found New Hardware Wizard” by plugging the RMU1 programming interface into the PC first. If the “Found New Hardware Wizard” does not appear, it is possible that drivers for the programming interface are already installed. Complete the following steps:



Figure 24 Driver Installation - Found New Hardware

From the three choices, select the “No, not this time” radio button and click “Next >”.

The following screen will ask you if you would like to install the software automatically or from a specific location.

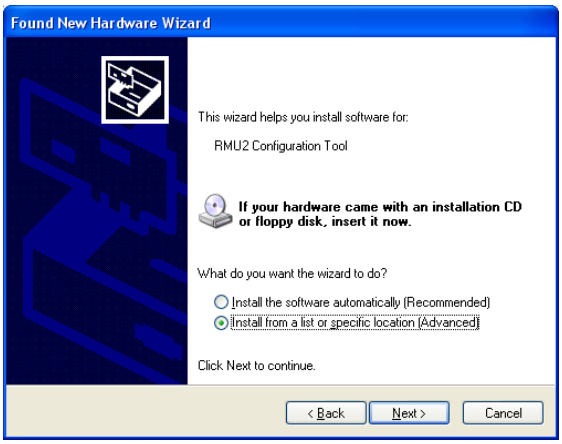


Figure 25 Driver Installation - Install From Specific Location

Choose to install from a specific location since you have the downloaded files. Click the “Next >” button.

The next window will appear and ask you where to search for the drivers. The default selection is shown in Figure 26.

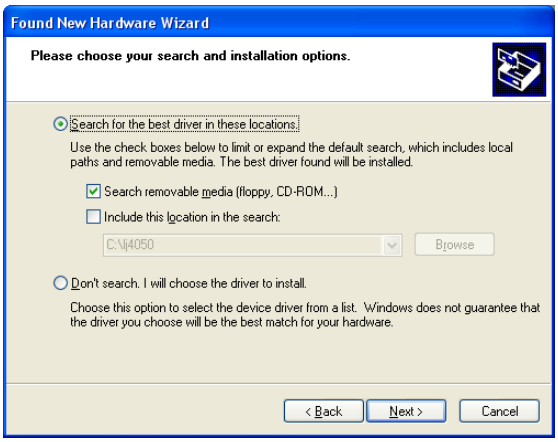


Figure 26 Driver Installation - Driver Location Selection

Check off “Include this location in the search:” and browse for the driver on your computer or network. You can uncheck “Search removable media (floppy, CD-ROM…)” to save time in this case.

Once you click “Next” the following screen will appear until the operating system has found the appropriate driver.

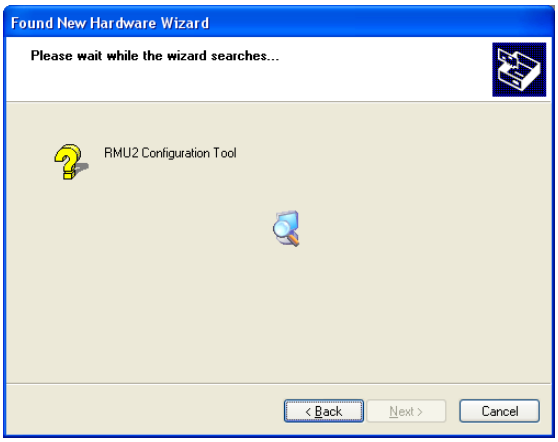


Figure 27 Driver Installation - Driver File Search

Once the correct driver has been found, it will install automatically and the completed screen should appear. Simply click the “Finish” button to complete the driver installation.

5.2.2 Configuration Application Installation

Click on the “Install RMU1 Configuration Application” button to start the application installer. A security warning dialog may appear. Click the “Run” button to continue.

The following dialog should now appear:

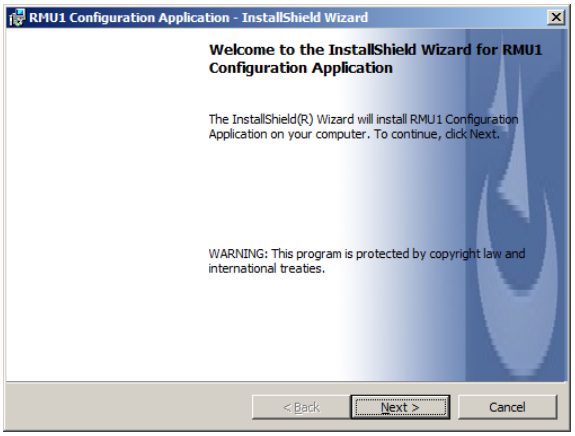


Figure 28 RMU1 Configuration Application Installation Dialog

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 screen in Figure 29. Click “Close” to complete the installation.

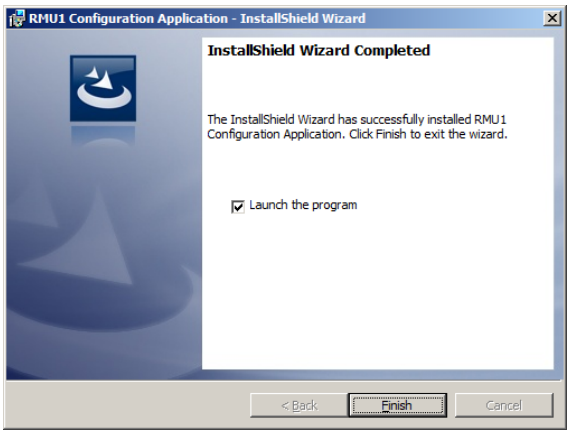


Figure 29 RMU1 Configuration Application Installation Complete

A shortcut to the configuration application and the RMU1 manual are created in the Windows start menu under the “RMU1 Configuration Application” folder.

5.2.3 Adobe Acrobat Reader XI

Adobe Acrobat Reader XI is provided on the download to allow viewing of the PDF version of the RMU1 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 RMU1 Installer dialog, and follow the instructions provided by the Acrobat Reader installation application.

5.3 RMU1-SUB Configuration

Attach the supplied USB cable between the PC and the programming interface. Remove the M8 dust cover from the RMU1-SUB. Plug the M8 cable into the RMU1-SUB and then into the RMU1/2/3 programmer.

Start the configuration software by clicking on “RMU1 Configuration” shortcut in Windows start menu, under the “RMU1 Configuration Application” folder. If the programmer is not connected to one of your USB ports, you will get an error message. Simply connect the USB cable to the computer and try again. The following screen will appear.

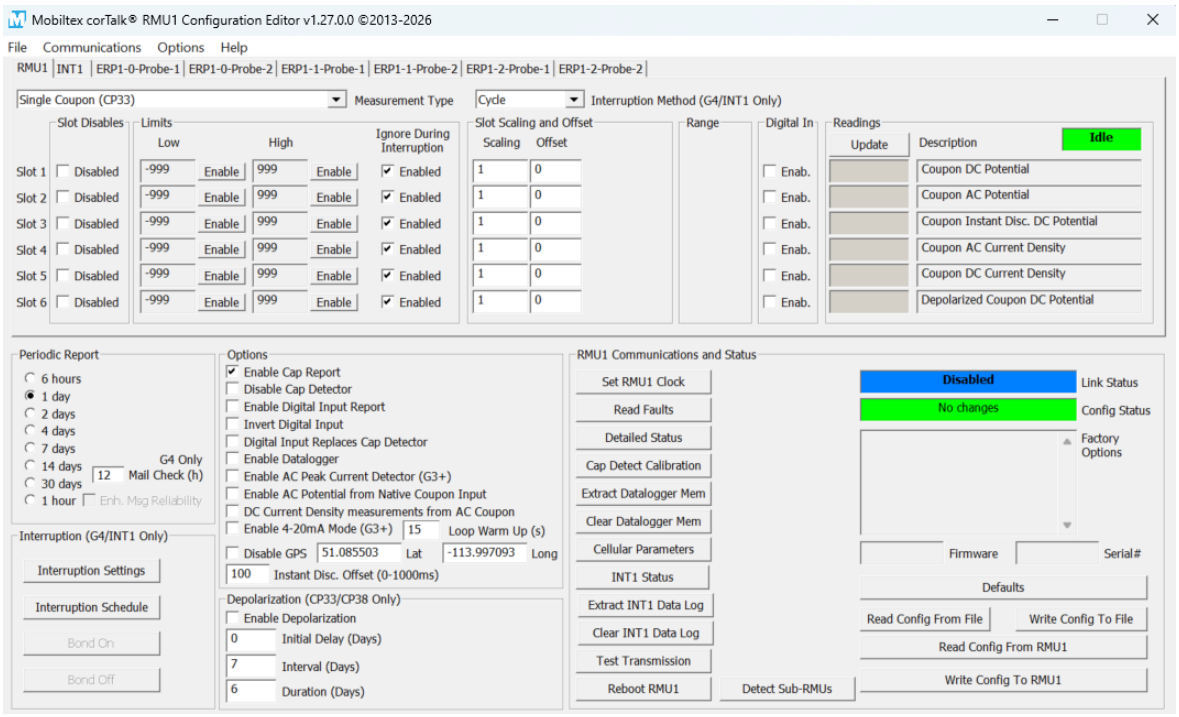


Figure 30 RMU1CONFIG Main Screen

The first step in configuring a device is to read in the current settings from the unit. Click on “Read Config From RMU1”. The “Link Status” field will briefly show “Busy” as the current configuration parameters are read from the RMU1. After the link status returns to “Idle”, you will see the configuration settings currently in the RMU1. If the RMU1-SUB is not responding or not connected, an error dialog will pop up.

If the RMU1-SUB is unresponsive, as it goes into a sleep mode, unplug and plug the programmer cable to wake it up.

Once communications have been established with the RMU1-SUB, the RMU1-SUB parameters can be configured for the requirements of a particular installation site.

Once configuration is complete remember to put the M8 dust cover back on. It is critical for the water proofing of the RMU1-SUB.

5.3.1 RMU1 Communications and Status

“RMU1 Communications and Status” is used for reading and programming the RMU1. It also displays some status information.

5.3.1.1 Link Status

This field has three settings:

Disabled – Serial port is not connected to the programmer

Idle – Programmer is connected but there is no activity

Busy – Programmer is trying to communicate with the RMU1

5.3.1.2 Firmware Version

This field contains the version number of the application code installed in the main processor of the RMU1. RMU1 LITE devices will be identified as “LITE”.

5.3.1.3 Serial#

The manufacturing serial number of the RMU1 is indicated in this field.

5.3.1.4 Read Config From RMU1

This is used to get the current values configured in the RMU1. Note, if you have changed the values in any of the configuration groups, the changes will be over written by pressing this button.

5.3.1.5 Write Config To RMU1

Once all the configuration settings are set to the appropriate specifications, the unit can be configured by pressing the “Write Config to RMU1” button. The write can be confirmed by pressing the “Read From RMU1” button to ensure the values are the same.

5.3.1.6 Defaults

The RMU1 contains factory defaults that can be loaded using this button. This allows for easy return of a unit to a known state. “Write Config to RMU1” must be pressed to write the parameters to the active configuration in the RMU1. The programming interface must be attached to the RMU1 for this function to operate.

5.3.1.7 Set RMU1 Clock

When the GPS receiver is disabled in the configuration, the clock on the RMU1 may be updated from the PC using this button. Note that the RMU1 clock setting is lost whenever the RMU1 is powered down by unscrewing the lid.

5.3.1.8 Read Faults

If the RMU1 detects an operational fault, it will record the event in memory. Clicking the ‘Read Faults’ button will retrieve this history for display. The fault history may be cleared by clicking the ‘Clear Fault History’ button in the displayed dialog.



Figure 31 Faults Dialog

5.3.1.9 Detailed Status

Clicking the 'Detailed Status' button will display a dialog (see Figure 32) with detailed RMU1 information. The display is broken into several areas including GPS, communications, battery, faults, real time clock, and calibration. In the event that a problem is encountered with the operation of the RMU1, Mobiltex may request a screen shot of this dialog to aid in diagnostics.

The ESN shown in the comms status area is the value used by CorView to track communications with the device. Unit Type will be appended with "LITE" for RMU-LITE devices.

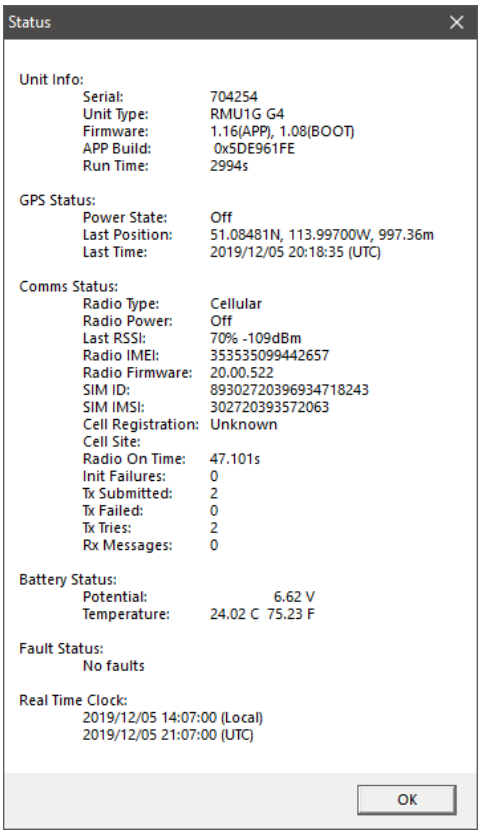


Figure 32 Detailed Status Dialog

5.3.1.10 Extract Datalogger Mem

The 'Extract Datalogger Mem' button allows readings stored in the internal memory to be extracted to a comma-separated-value (CSV) file format that can be used with a spreadsheet application. This function requires the factory-enabled datalogger option be present on the RMU1.

After clicking the button, the contents of the datalogger memory will be transferred from the RMU1. After the transfer is completed, a prompt will appear for the target file name. The resulting file may be opened for analysis in various applications that support the CSV format.

5.3.1.11 Clear Datalogger Mem

The 'Clear Datalogger Mem' button allows the RMU1 datalogger memory to be reset back to a blank state. This function requires the factory-enabled datalogger option be present on the RMU1.

After clicking the button, a confirmation prompt will appear. If confirmation is given, then a progress display will be shown as the RMU1 memory is erased.

5.3.1.12 Test Transmission

A test message can be sent to CorView by clicking on the 'Test Transmission' button. The RMU limits the number of test transmissions possible to six in a 12 hour period. Subsequent test transmission attempts will be ignored.

5.3.1.13 Reboot RMU1

Click the 'Reboot RMU1' button to restart the RMU1.

5.3.2 Measurement Type

Select the measurement type according to the installation application of the RMU1. Refer to section 0 for detailed descriptions of each measurement type.

5.3.3 Measurement slots Configuration

The RMU1-SUB can transmit 6 slots of analog information to CorView. Refer to section 0 for detailed descriptions of each measurement type, including the information transported in each slot. A description of each data slot is also provided in the 'Readings' area of the configuration screen. The RMU1 and INT1 slots are differentiated by tabs. Select the tab for the unit you want to configure. Both the RMU1 and INT1 configurations are sent to the RMU1 regardless of the active tab. The RMU1-SUB does not currently support an INT1 or ERP1 attached.

Each data slot may have the following attributes modified:

- The slot may be disabled if the measurement is not needed
- Low and high limit alarms may be set
- The limit check can be ignored during interruption (preventing spurious alarms)
- The reading taken at the physical inputs may be scaled and offset for transmission
- The input range may be selected for current inputs
- The data slot analog measurement may be replaced with the isolated digital input state

The following ranges apply to coupon current and bond shunt measurements for the RMU1:

Coupon Current:	+/-6mADC, 4.25mAAC	Low Range
	+/-60mADC, 42.5mAAC	Med Range
	+/-200mADC, 140mAAC	High Range
Bond Shunt:	+/-6mVDC, 4.25mVAC	Low Range
	+/-60mVDC, 42.5mVAC	Med Range
	+/-200mVDC, 140mVAC	High Range

A convenient coupon calculator is provided for setting the scaling factor when coupon current density or bond current is desired instead of raw current measurements.

The following ranges apply to bond current and structure potential measurements for the INT1:

Potential:	+/-31VDC, 22VAC	
Bond Current:	+/-300mADC, 210mAAC	Low Range
	+/-3ADC, 2.1AAC	Med Range
	+/-10ADC, 7AAC	High Range

5.3.4 Depolarization (CP33 and CP38 Measurement Types Only)

Depolarization may be enabled in single coupon modes CP33 and CP38. Depolarization parameters allow the RMU1-SUB to disconnect the DC coupon from the structure for configurable amounts of time at periodic intervals. Coupon potential readings taken at the end of depolarization cycle (assuming long enough disconnect duration is configured) will be equivalent to a native coupon potential reading.

The 'Initial Delay' parameter sets how long, in days that the RMU1-SUB will wait after a power-up before initiating the first depolarization cycle. When set to a value of 0, the RMU1-SUB will wait one wakeup cycle (6 hours) before disconnecting the coupon.

The 'Interval' parameter sets how often a depolarization cycle occurs.

The 'Duration' parameter set how long the coupon is disconnected from the structure for each depolarization cycle. The duration parameter must be less than the interval parameter.

5.3.5 Periodic Report Interval

The periodic report interval determines how often the RMU1-SUB will send scheduled readings to CorView. This parameter is normally locked down at the factory according to the purchased airtime plan.

For 1 hour reporting plans, an extra option labelled 'Enh. Message Reliability' is present that is only applicable to the RMU1S. To increase battery life, this option should be left unchecked. However, if the unit is installed in a challenging RF environment and message loss is apparent, then the option should enabled.

Note that the RMU1I and the RMU1G will collect readings at a different rate than the transmission rate for readings periods less than a day. For example, units that take periodic readings every hour will transmit a batch of 12 readings every 12 hours. Similarly, units that take periodic readings every 6 hours will transmit a batch of 4 readings every 24 hours. If satellite/cellular coverage is inadequate for successful data transmission at the scheduled time, the unit will continue to accumulate readings and try to send the data at a later periodic reading interval. The RMU1I/G can buffer up to 16 readings for transmission; if the unit is unsuccessful at sending the readings to CorView at that

point, the oldest reading in the buffer will be discarded to make room for the next periodic reading measurement.

The '**Mail Check (h)**' parameter defines how often the RMU1-SUB checks for messages and commands from CorView. The interval is in hours and it must be a multiple of the RMU1-SUB's wake up interval. For a unit with a 1 hour Periodic Report plan, the wake up interval is 1 hour. For any other reporting plans, the wake up interval is 6 hours.

5.3.6 Interruption

Like our other interruption capable products, schedule and waveform parameters can be set by the configuration software. Unlike some of our other products, the relay is internal to the RMU1-SUB, so their dwell parameters are internal to the units. The Control page in CorView can be used to send interruption commands to the RMU1-SUB. **NOTE: The RMU1-SUB will only check in every mail check interval (12 hours by default) so interruption should be scheduled at least a day in advance**. For more immediate operation, the interruption can be set using the configuration software locally while on site. The Interruption Settings and the Interruption Schedule apply to both the RMU1-SUB and the INT1. The Interruption Method (under the unit tab) is independent and specific to its unit.

The Cycle Time is the sum of the On Time and Off Time parameters. At the top of the minute the interruption cycle will be synchronized by resetting the cycle again regardless of its state. For this reason, it is wise to choose a Cycle Time that evenly divides into 60 seconds to eliminate any cycle clipping.

The UTC Offset is used to synchronize the RMU1-SUB operation to match another venders' equipment. A UTC Offset of 0ms matches UTC time exactly. An offset of 5000ms will lag the UTC time by 5 seconds and -2000ms will lead the UTC time by 2 seconds. The "On First" checkbox will reverse the order of interruption such that the on portion of the interruption cycle will start at the top of the minute. By default, it is unselected, and the off portion of the cycle will start at the top of the minute.

The Interruption Schedule start time/date can be set in addition to its Duration and Daily Repeats. For example, if the interruption starts on Monday at 9am, it can be set to 480 minutes with 4 daily repeats to interrupt 8 hours every day until Friday.

The INT1 bond connections can be directly tested with the Bond On and Bond Off commands. The continuity of the bond can then be tested with a multimeter.

The Interruption Method is specific to the unit, so the INT1 and the RMU1-SUB can have separate interruption methods. There are 3 interruption methods: Cycle, Envelope and Ignore.

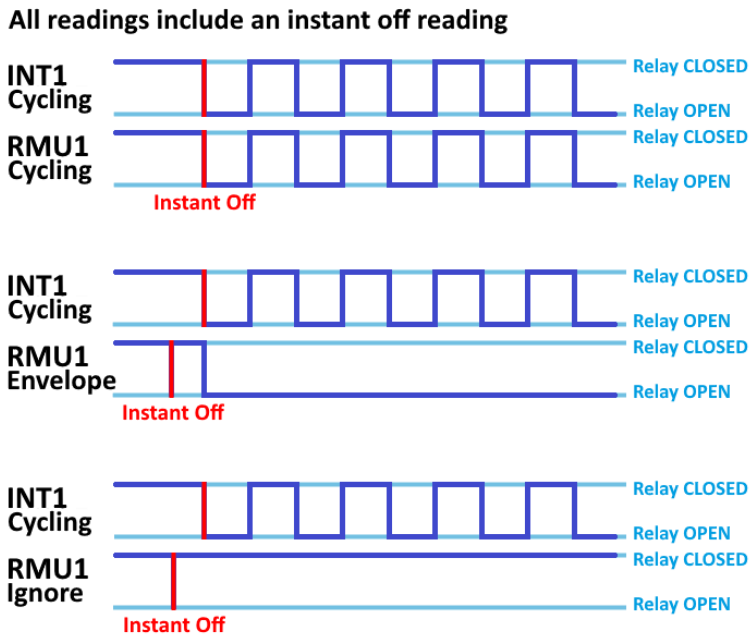


Figure 33 Interruption Methods

The Cycle method is what is normally considered interruption providing a square wave output by opening (disconnecting) and closing (connecting) the relay. The Envelope method opens the relay for the entire period of the interruption each day. It then closes it when interruption is over. The Ignore method keeps the relay closed for the duration of the interruption period.

Both the Envelope and Ignore method take an unsynchronized instant off measurement before starting interruption while the cycle method takes a synchronized instant off reading.

5.3.7 Options

Several options are available that affect the operation of the RMU1-SUB.

The '**Enable Cap Report**' option allows the RMU1-SUB to send an exception report to CorView whenever a transition is detected on the accelerometer. The accelerometer detects if the unit is in an installed position (upright) or not. If this option is enabled, every time the unit transitions from being upright to sideways and vice versa, a reading set will be taken and sent to CorView. As with other exception messages, a maximum of 6 messages can be sent in a given 12 hour window; any additional transitions will be ignored. This feature requires airtime Option 2 – "Add cover removal exception reports to any plan" (RMU1OPTION2).

The '**Disable Cap Detector**' option disables the accelerometer. This option is typically used to increase battery life on the RMU1-SUB.

'**Enable Datalogger**' allows readings to be stored to local non-volatile memory. This option is usable only if the factory datalogger option (Option 3) is enabled on the RMU1-SUB. The stored readings can be extracted by using the 'Extract Datalogger Mem' button under the 'RMU1 Communications and Status' area. The datalogger memory will hold approximately 174,000 readings sets before filling. At a 1 hour measurement rate, approximately 20 years of measurement data can be stored locally.

'**Enable AC Peak Current Detector**' enables the AC peak current density detector mode on the RMU1-SUB. The Coupon **AC Current Density High Limit must be set for operation.** When enabled, the RMU1-SUB will, while sleeping, sample the coupon current density at set intervals (default 20s) and trigger a unit wake-up and full measurement if the sampled AC current density value is above the associated slot high limit. If activated, short AC transients (<30s) can be captured by the RMU1-SUB and exception messages sent to CorView. When the signal again drops below the threshold value, the RMU1-SUB requires a minimum amount of time (default 5 min) of signal below threshold before a clear exception is sent to CorView. Exception messages counts are limited in manner similar to the cap detector function. This feature requires RMU1 Option 5 to be purchased for operation. The peak detector is inoperable while the RMU1-SUB programming interface is attached.

'**Enable Digital Input Report**' causes an exception report to be sent to CorView when the state of the isolated digital input changes. As with other exception messages, a maximum of 6 messages can be sent in a given 12 hour window; any additional transitions will be ignored. This feature requires airtime Option 4.

'**Invert Digital Input**' inverts the reported state of the digital input.

'**Digital Input Replaces Cap Detector**' allows the digital isolated input to replace the cap state information that is transmitted to CorView. The digital input state would then be shown in CorView as the cap state.

The '**Disable GPS**' option turns off the RMU1-SUB automatic location determination and real-time clock synchronization. The GPS receiver could be disabled for several reasons. The first reason is to maximize battery life. The second use would be if the RMU1-SUB is installed in a location that does not have sufficient GPS coverage to attain a position lock. The RMU1-SUB does perform interruption with Disable GPS option set.

When the 'Disable GPS' option is checked, the latitude and longitude co-ordinates of the RMU1-SUB should be entered into the appropriate boxes below the option check mark. This will allow the location of the RMU1-SUB to still be transferred to CorView for use with mapping functions. In addition, the 'Set RMU1 Clock' button should be clicked after configuration is complete to set the internal real time clock.

The '**Instant Disc. Offset**' parameter is used to adjust the delay between the disconnect of a coupon from the structure and when the acquisition of the instant disconnect potential is performed. Typically this value is left as low as possible while still mitigating the effects of relay chatter that occur during the contact disconnect process.

'**Enable AC Potential from Native Coupon Input**' works with any single coupon mode (CP33/CP35/CP39). The user needs to add a jumper wire between the Pipe and Native Coupon input. The Coupon AC Potential (slot 2) measurement will then be taken from the Native Coupon input of the Pipe AC voltage. This provides a Pipe AC voltage reading unaffected by the coupon.

'**DC Current Density measurement from AC Coupon**' works with CP38 mode only (Separate DC/AC Coupons). Enabling this option will route the DC current density measurement (slot 5) through the AC coupon input. Both AC and DC current density measurements will then be taken from the same coupon used for AC measurement.

5.3.8 Readings

The 'Readings' group provides for the ability to validate the configuration of RMU1-SUB. Clicking the 'Update' button will request that the RMU1-SUB perform a new conversion cycle on all of the readings slots (except depolarized coupon potential). A reading update will typically take under 15 seconds to complete.

6 Mobile Device Configuration

The RMU1-SUB may also be programmed with a compatible iOS or Android-based mobile device when an RBT1 Bluetooth interface cable or RMU1/2/3 Programmer is used. They uses Bluetooth Smart (BLE) to enable a wireless connection to a compatible mobile device.



Figure 34 RMU1/2/3 Programmer (left) and RBT1 Bluetooth Interface Cable (right)

The mobile device must have the RMU1Config mobile app loaded from either the Apple App store or the Google Play store, as applicable. Simply search for 'RMU1' on each site to locate the download. Alternatively, use the following direct links:

- https://itunes.apple.com/us/app/rmu1-config/id1232422915 (Apple iOS)
- https://play.google.com/store/apps/details?id=com.mobiltex.RMU1config (Android)

The iOS app is compatible with any Apple device that has Bluetooth Smart (BLE) capabilities—for the iPhone, model 4S or higher. A list of compatible devices is on the App Store.

The Android app is compatible with any Android device that has Bluetooth Smart (BLE) capabilities and is running Android 4.4.2 or higher. Refer to your device specifications to determine Bluetooth capabilities.

With the RBT1 Cable or RMU1/2/3 Programmer and the app, the need for a PC is eliminated. All configuration functions can be performed with a mobile device through the RBT1 Cable or RMU1/2/3 Programmer via a wireless Bluetooth connection. One limitation with the mobile app is that the datalogger on the RMU1-SUB cannot be extracted; this is due to a speed limitation over the Bluetooth Smart connection.

For use with the Bluetooth connection, a portable USB battery pack is needed to power the RMU1/2/3 Programming Interface. Prior to using the USB battery pack, charge the pack using a micro-USB to USB-A cable and a USB power source (see Figure 35, actual battery pack form factor and dimensions may differ from picture). Before use, charge for 10 hours or until the pack charge indicator shows full. A fully charged 3000mAh pack should allow over 60 hours of continuous operation for the RMU1/2/3 Programming Interface.



Figure 35 USB Battery Pack Charging

- Connect the RMU1/2/3 Programming Interface USB connector into the matching connector on the battery pack. Some battery pack models may have a button that needs to be pressed to activate the power output.

- The 'PWR' LED on the RMU1/2/3 Programming Interface should light green when power is being delivered to the device.

- Connect the RMU1/2/3 Programming Interface M8 cable to the RMU1-SUB as shown in the Figure 36.

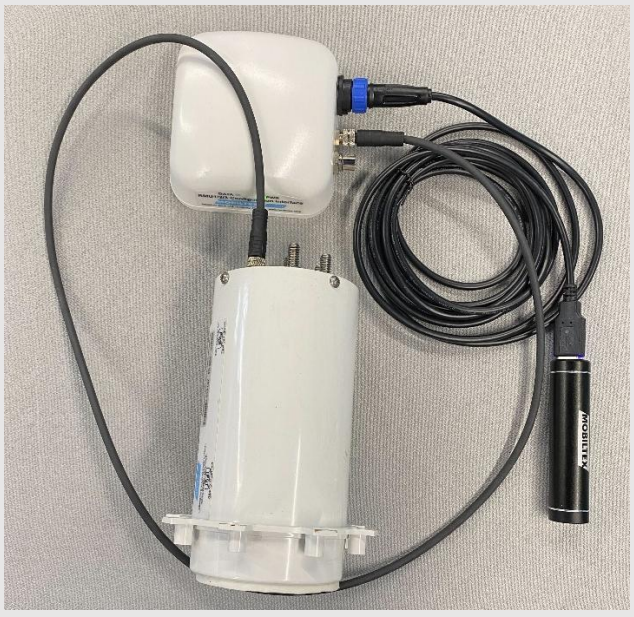


Figure 36 RMU1/2/3 Programming Interface Connected To Battery Pack and RMU1-SUB

- If the RBT1 Bluetooth Interface Cable is used instead, simply power up the RMU1-SUB and connect the RBT1's mating end to the RMU1-SUB's COMMS connector, as shown in Figure 37. The RMU1-SUB will provide power to the RBT1 cable.



Figure 37 RBT1 Bluetooth Interface Cable Connected To RMU1-SUB

- Once the connection is done, the app on the mobile device is started by tapping on the appropriate app icon.
    - A connect button in the app initiates the process to connect with the programming interface.
    - A list of active interface cables in the area is brought up; each RMU1/2/3 Programmer and RBT1 cable has a serial number label on it to identify the unit.
    - Once the unit is selected, if it is the first connection attempt between the portable device and that RMU1/2/3 programmer or RBT1 cable, a pop-up will show up requesting a pairing code.
    - The default pairing code is '123456' (this can be changed).
- After the connection is established, capabilities are similar to the PC application, the configuration can be read, modified and written and status information can be polled.

Figure 38 shows some sample screenshots from the iOS app; the Android app is similar in appearance.

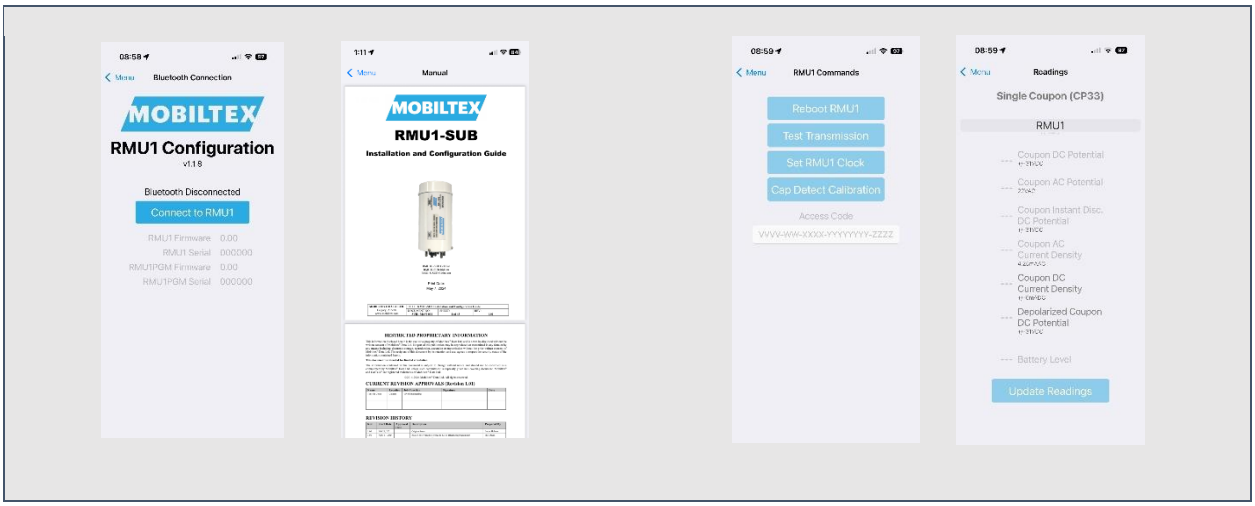


Figure 38 iOS App Sample Screenshots

Upon completion of configuration, disconnect the RBT1 Bluetooth Interface Cable or RMU1/2/3 Programming Interface from the RMU1-SUB, and disconnect the RMU1/2/3 Programming Interface from the battery pack to conserve charge in the pack.

7 Battery Replacement

7.1 RMU1-SUB

7.1.1 Tools

- T10 Torx Screwdriver
- Hex 2mm driver

7.1.2 Procedure

1. Remove the RMU1-SUB from its mounting location.
2. Turn the unit off by holding a magnet to the “PWR” switch for 10 seconds. It will make a 10 short beep before turning off. Test that it is off by holding the magnet to the “TEST” switch. No noise should be heard.
3. Flip it over and remove the silicone sock on top.
4. Remove the 4 T10 Torx around the bottom circular lid of the RMU1-SUB. Place in a safe spot.



Figure 39 Remove the 4 T10 Torx screws around the sides

5. Holding onto the bolts, pull directly out to remove the lid. It may help to wiggle it slightly as you pull.
6. Turn the battery pack off by pressing the rubberized switch.

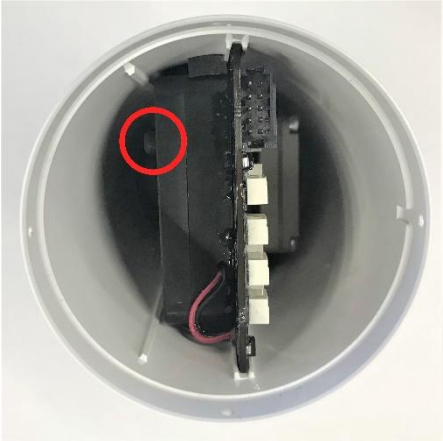


Figure 40 Turn the battery pack off

7. Gently holding onto the white relays and battery pack, pull the RMU1-SUB out of the tube. For Iridium and Globalstar units, there is an initial click as the board disconnects from its antenna.
8. Remove the 4 Hex 2mm screws.



Figure 41 Remove the 4 screws using a 2mm Hex driver

9. Take the top of the battery pack off carefully. The bottom of the battery pack may be loose.
10. Remove the old batteries by popping them out of the battery clips. Install four new AA batteries from the replacement battery kit (Mobiltex P/N B02221RMU10). The batteries are oriented according to the polarity markings shown.
11. Realign the battery pack to its outline and screw it back on. The screws go right through the battery pack and screw into nuts soldered on the PCB. Be very careful to not overtighten the screws.
12. Align the RMU1-SUB to the notches in the plastic. Note that they are not centered, the extra 2 ribs are on the same side as the battery pack. Carefully insert the RMU1-SUB back into its plastics. Be sure to keep the board within the two notches. For Iridium and Globalstar units, a click should be heard when fully inserted as it mates with the antenna board still in the plastics.

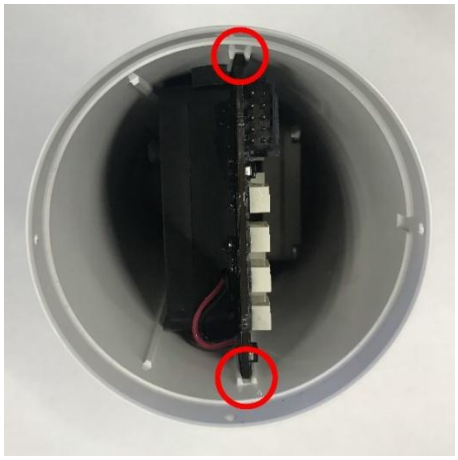


Figure 42 Place the RMU1-SUB between the notches

13. Turn the battery pack back on by pressing the rubberized switch. Test it is on by applying a magnet to the size and ensure the unit beeps. Turn the unit off again with the magnet before the next step.
14. Now place the lid back on. It should slide directly down again. If it is too tight, use a little dielectric grease around its edges to help it in. Be careful not to wedge it in at an angle as the connector pins can get damaged.
15. Re install the 4 T10 Torx around the edges. Then unscrew them all ¼ turn so that they are slightly loose. They should not deform the circular plastics in any way.
16. Put the silicone sock back on. The raised band should sit over the T10 Torx screws around the lid.
17. Reinstall the RMU1-SUB as per 4.1 Valve cover and RMU1-SUB .

8 Technical Support

Technical assistance may be obtained from:

Mobiltex Data Ltd.

3640-26th Street NE

Calgary, AB T1Y 4T7

Canada

Tel: (403)291-2770

Web: http://www.mobiltex.com

Service Email: service1@mobiltex.com

Service Website: http://service.mobiltex.com

A. Equipment Specifications

RMU1-SUB Specifications

Operating Temperature	-40° to +60° C (-40° to +140° F)		
Storage Temperature	-45° to +80° C (-49° to +176° F)		
Maximum Altitude	5000 meters above sea level		
Humidity	0 to 100% RH non-condensing		
Ingress Protection Rating	IP68 1 metre, 7 days		
Weight	500 grams (1.1 lbs)		
Size	110mm x 110mm x 230mm (4.33”x4.33”x9.06”)		
Enclosure	UV stable, wide temperature polycarbonate		
Load Rating	AASHTO M-306 : HS-20		
Pollution Degree	1		
External Analog Channels	2 potential, 1 bond shunt, 1 coupon current		
Measurement Type	Category 1 (as per CSA C22.2 – 61010)		
Analog Ranges (DC & AC True RMS)	Potential:	+/-31VDC, 22VAC	
	Current:	+/-6mADC, 4.25mAAC	Low Range
		+/-60mADC, 42.5mAAC	Med Range
		+/-200mADC, 140mAAC	High Range
	Bond Shunt:	+/-6mVDC, 4.25mVAC	Low Range
		+/-60mVDC, 42.5mVAC	Med Range
		+/-200mVDC, 140mVAC	High Range
AC Rejection on DC Readings	>65dB @ 50/60Hz		
Isolated Digital Input	+/-100VDC maximum <-3VDC or >3VDC for activation (bi-directional sense) Optically isolated (2500V_{RMS})		
Lightning Immunity	Survives multiple 20KV 10mS surges		
DC Measurement Accuracy	Potential:	+/-1% + 1mV	
(over operational temperature)	Current:	+/-0.75% + 10uA	Low Range
		+/-0.5% + 15uA	Med Range
		+/-0.5% + 35uA	High Range
	Bond Shunt:	+/-0.75% + 2uV	Low Range
		+/-0.5% + 5uV	Med Range
		+/-0.5% + 15uV	High Range
AC Measurement Accuracy	Potential:	+/-1.25% + 5mV, 20mV floor	
(over operational temperature)	Current:	+/-1% + 5uA, 5uA floor	Low Range
		+/-1% + 15uA, 50uA floor	Med Range
		+/-1% + 50uA, 150uA floor	High Range
	Bond Shunt:	+/-1.1% + 25 uV, 5uV floor	Low Range
		+/-1.1% + 35 uV, 50uV floor	Med Range
		+/-1.1% + 75uV, 150uV floor	High Range
Input Impedance	>20 Mohm (potential) 130 Kohm (bond current shunt)		
Coupon Current Shunt	1 ohm		
ADC Resolution	16 bits		

Temp. Measurement Accuracy	+/-4° C (+/-7° F) over -40° to +60° C (-40° to +140° F)
Battery Life	Typically 10 years based on readings every 7 days. Typically 5 years based on readings every 12 hours and 2 weeks of interruption per year
Internal Battery Measurement	OK, Warning and Low conditions displayed on CorView
Communications	Globalstar Simplex Satellite (RMU1S-SUB) Iridium SBD Satellite (RMU1I-SUB) Cellular LTE Cat M1/NBIoT B2,4,5,12,13 (RMU1G-SUB)
GPS Receiver	72-channel u-blox 8 series

B. RMU1S-SUB Globalstar Simplex Satellite Coverage Map

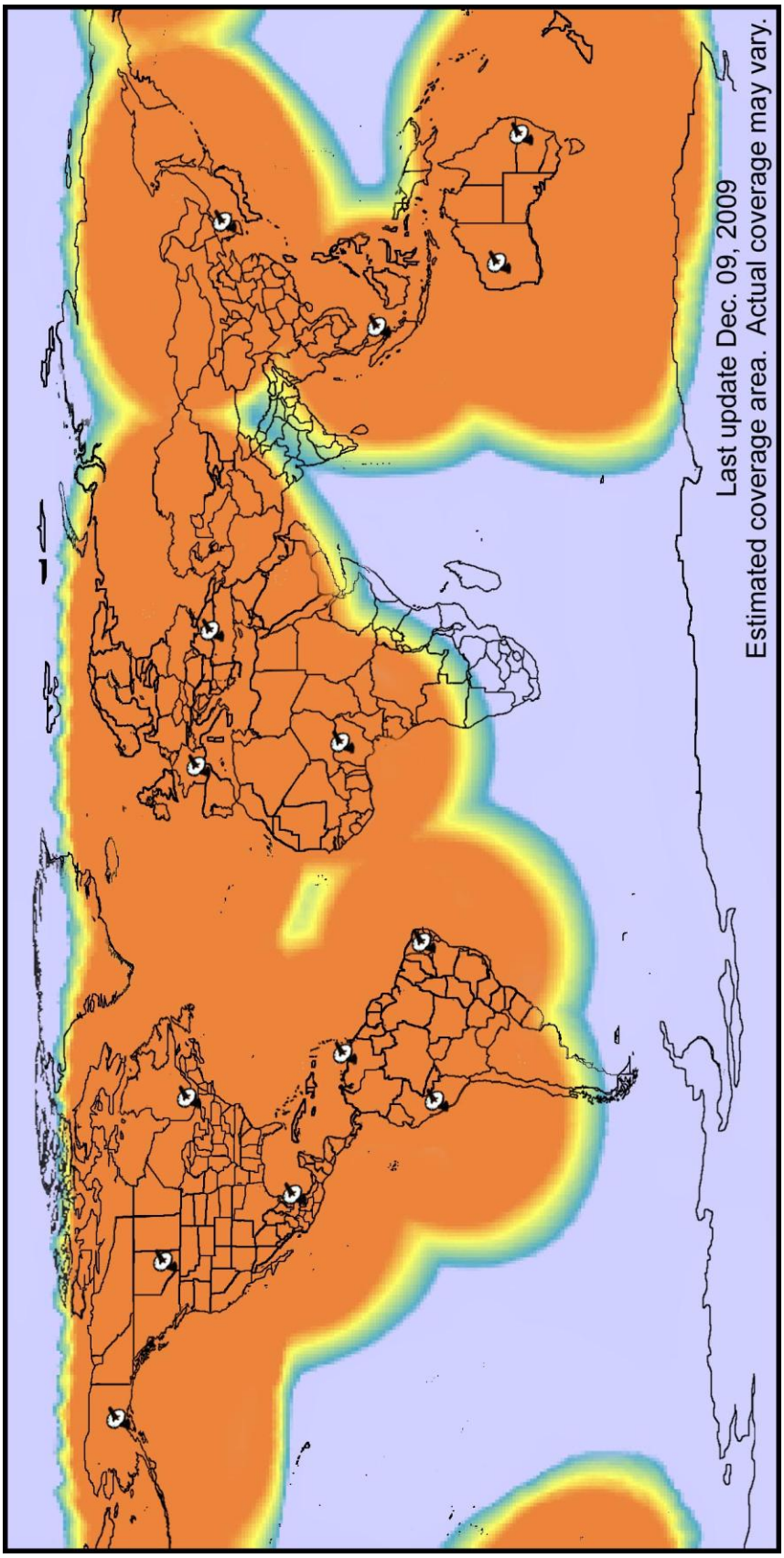


Figure 43 Globalstar Simplex Satellite Coverage Map

C. RMU1I-SUB Iridium SBD Satellite Coverage Map



Iridium offers complete pole-to-pole coverage in all areas of the Earth due to its cross-linked polar orbiting constellation.

D. RMU1-SUB Regulatory Statements

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment OFF and ON, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient or relocate the receiving antenna.

• Increase the separation between the equipment and receiver.

• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

• Consult the dealer or an experienced radio/TV technician for help.

WARNING: Changes or modifications not expressly approved by Globalstar may render the device non-compliant to FCC and other regulatory body standards for operation and may void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This ClassA/ClassB digital apparatus complies with Canadian ICES-003.

NOTICE: This equipment complies with the FCC RF Exposure Limits. A minimum of 20 centimeters (8 inches) separation between the device and the user and all other persons should be maintained.

RMU1S-SUB
FCC ID: L2V-STX3
IC:3989A-STX3

RMU1I-SUB
FCC ID: Q639603N
IC:4629A-9603N

RMU1G-SUB
FCCID: XMR201912BG77
IC: 10224A-201912BG77



Complies with FCC standards.
FOR HOME OR OFFICE USE