SURF™ MIU
Wall Meter Interface Unit

Hardware Instruction Manual

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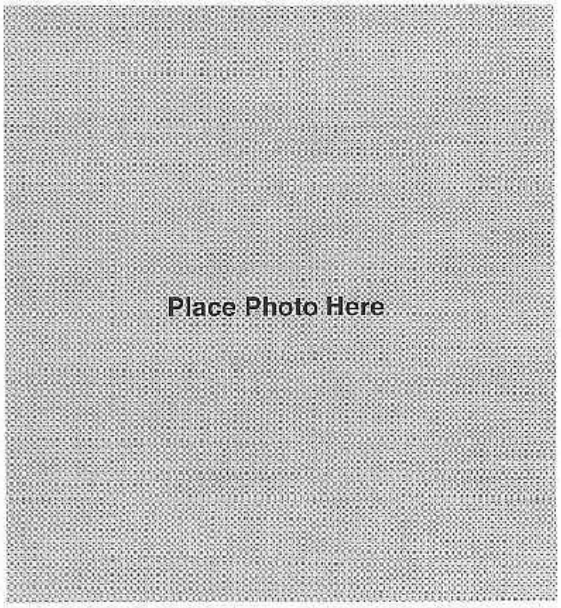
EFFECTIVE OCTOBER 1998



IMPORTANT NOTICE :

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.

(c) The provisions of paragraphs (a) and (b) of this section do not apply to digital devices exempted from the technical standards under the provisions of §15.103.

(d) For systems incorporating several digital devices, the statement shown in paragraph (a) or (b) of this section needs to be contained only in the instruction manual for the main control unit.

Caution

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Chapter 1 INTRODUCTION

About Thls manual

This instruction manual explains the installation, operation, and maintenance of the Schlumberger SURF® Meter Interface Unit. Schlumberger urges you to read the entire manual before attempting installation, tests, operations, or maintenance.

Table 1.1

Section 1	Introduction	This section describes the organization of this manual, provides a product description, operations overview, and product specifications.
Section 2	Installation	This section describes storage and unpacking instructions, preliminary tests, tools and materials, site selection, and installation.
Section 3	Operating Instructions	This section describes controls and indicators, application of power, power ON/OFF procedures, operating procedures, and any special procedures.
Section 4	Theory Of Operation	This section explains how the product works.
Section 5	Testing And Maintenance	This section explains how to test, troubleshoot, and maintain the product.
Section 6	Replacement Parts, Schematics, And Drawings	This section provides part numbers for replacement parts, and any applicable schematic and block diagrams.
Section G	Glossary	
Index		

PRODUCT DESCRIPTION

The SURF® Meter Interface Unit (SURF® MIU or MIU) by Schlumberger, is a compact electronic device that collects meter reading data from an encoder register and transmits the data for collection by the meter reader. A walk-by (hand held) or Drive-By unit receives the data and stores it, to be downloaded into the utility billing system for processing

The SURF® MIU is easily installed and operates within an RF bandwidth which does not require an operating license. Since the SURF MIU can be mounted as much as 500 feet from the encoder register, (See Table 1.5 for system compatible encoders and maximum installation cable length/distance.), optimum broadcast signal strength is obtainable, insuring a high percentage of accurate, one pass readings.

The SURF® MIU also meets FCC regulations part 15.247, allowing higher output power and greater range. The SURF MIU uses frequency-hopping spread-spectrum technology to avoid RF interference and enhance security.

The SURF® MIU was designed to offer many advantages to utility organizations of all sizes. Among

- Increases meter reading accuracy.
- Eliminates "hard to read" meters.
- Protects utility liability by increasing meter reader safety.
- Requires no programming.
- Economizes manhours needed to collect and process meter reading data,thereby increasing utility profits.

Figure 1-2. Wall MIU

OPERATIONS OVERVIEW

The SURF® MIU collects meter readings from the encoder register on an hourly basis and transmits the information every four seconds, allowing the meter to be read by either a hand held, walk-by unit or the Drive-By Data Collection Unit.

SPECIFICATIONS

Electrical Specifications

Table 1.2 Electrical Specifications

Battery	3.6V D size Lithium
Transmit Period	Every 4 seconds
Register Read Period	Once each hour

Transmitter Specifications

Table 1.3 Transmitter Specifications

Transmitter Channels	50
Channel Frequency	910-920 MHz
FCC Verification	Part 15.249 or 15.247

Environmental Conditions

Table 1.4 Environmental Conditions

Operating Temperature	-22° to 149°F (-30° to 65°C)
Storage Temperature	-22° to 149°F (-30° to 65°C)
Operating Humidity	0 to 95% Condensing

Encoder Register Interface

Table 1.5 Encoder Register Interface

Encoder Register	Maximum Cable Length
Schlumberger ARB III, IV, V*	91 meters
Schlumberger Pro Read™	152 meters
Sensus ECRII*	61 meters

* Meets manufacturers' published specification for wire legth between encoder and remote receptacle.

Dimensions and Weight

Table 1.6 Dimensions and Weight

Dimensions	Refer to following figures
Weight	1 lb (450 grams.)

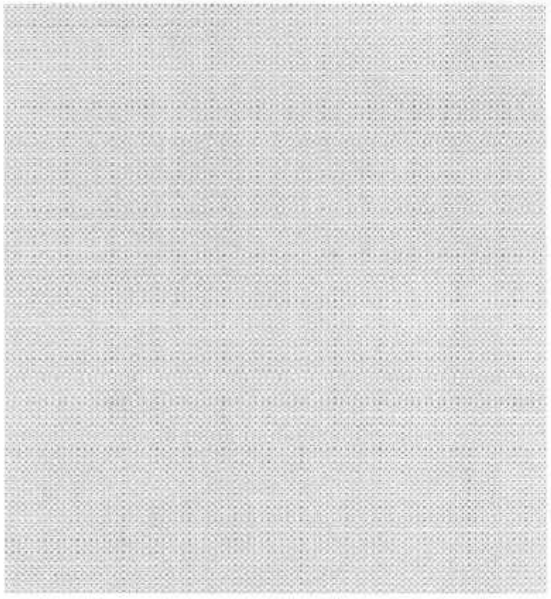


Figure 1-7. MIU Dimensions - Front View

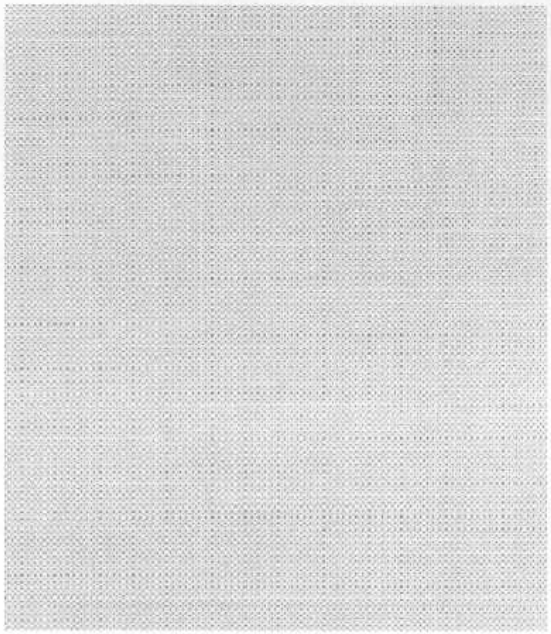


Figure 1-8. MIU Dimensions - Side View

Chapter 2 INSTALLATION

This section describes storage and unpacking instructions, preliminary tests, tools and materials, site selection, and installation.

STORAGE

Inspect shipping containers for damage upon receipt and inspect contents of any damaged cartons prior to storage.

Store the cartons in a clean, dry environment. The temperature should remain between -22° and 149°F (-30° and 65°C). Keep in mind that the SURF® MIU has an internal battery. Storage for more than one year, of the SURF® wall MIU, may affect product life. Be sure to use a first-in first-out inventory control system.

UNPACKING

As with all precision electronic instruments, the SURF® MIU should be handled with care; however, special handling is unnecessary.

After unpacking the MIU, inspect it for damage. If the MIU appears to be damaged, or proves to be defective upon installation, notify your Schlumberger Sales Representative. If the MIU requires reshipment, use the original cardboard box and packing material.

PRELIMINARY TESTS

The SURF® MIU does not require any tests or programming prior to installation.

TOOLS AND MATERIALS

Tables 1 and 2 show the recommended tools and materials you may need to successfully install the SURF ® MIU or to replace the MIU's internal Battery. Note that some items may not apply to your specific installation or the list may not contain all required tools or materials.

RECOMMENDED TOOLS

Table 2-1 Recommended Tools

Item	Description/Recommendation	Use
Tool kit	Contains standard tools including: Assorted screwdrivers Needle-nose pliers Wire stripper Diagonal cutters Electrician's knife Hammer	Various installation procedures
Magnet	6 lb. force	Activating the MIU

RECOMMENDED MATERIALS

Table 2-2 Recommended Materials

Item	Description/Recommendation	Use
Cable	Solid 3 conductor, #22 AWG (black/green/red)	Connecting MIU to encoder register
Moisture protection compound	Dow Corning #4 or GE Novaguard GB24®	Covering exposed wires and Terminal Screws on register and MIU
Scotchloks®		Splicing three-conductor cables
Gel-caps®		Splicing replacement battery wires
Site Work Order	Documentation provided by your utility	Receiving and recording information about the work site

INSTALLATION

SAFETY AND PRELIMINARY CHECKS

Observe the following safety and preliminary checks before and during each installation:

- Verify that you are at the location specified on the Site Work Order.
- Verify that the site is safe for you and your equipment.
- Notify the customer of your presence and tell the customer that you will need access to the water meter.
- If the Site Work Order does not have an MIU ID number on it, write in the ID number of the MIU you are about to install. If the Site Work Order already has an MIU ID number on it, verify that it matches the ID number on the MIU you are about to install.

Note:
- Always follow your company's safety practices and installation guidelines when installing an MIU.
- Never perform an installation during a lightning storm or under excessively wet conditions.
- Use only approved climbing equipment.

SITE SELECTION

The SURF® MIU should be installed and operated in an environment where the temperature stays between -22° and 149°F (-30° and 65°C). Installation and operation in moderate temperatures increases reliability and product life.

Follow these guidelines when selecting a location to install the SURF® MIU:

- For best results, Schlumberger recommends mounting the MIU on the outside of the building and in a location that provides a direct line-of-sight to the path of the meter reading device.
- For best results, Schlumberger recommends, the MIU be installed approximately five feet above the ground.
- The MIU must be installed in a vertical and upright position.
- The preferred mounting surface for the MIU is a flat wall, but it can also be mounted to a pipe.
- The selected location should be clear of all obstructions.
- Avoid installing the MIU behind metal fences or walls.

- The maximum cable length between the encoder register and MIU depends on the register's manufacturer and model. Refer to Table 3-C for maximum cable lengths.

Table 2-3 Cable Length and Manufacturer

Encoder Register	Maximum Cable Length
Schlumberger ARB III, IV, V® *	91 meters
Schlumberger PRO-READ® *	152 meters
Sensus ECRII® *	61 meters

* Meets manufacturers' published specification for wire legth between encoder and remote receptacle.

VERIFYING/PREPARING THE ENCODER REGISTER

This SURF® MIU is designed for use with three types of encoder registers: Schlumberger's ARB® and Pro Read®, and Sensus ECRII®. Before installing an MIU, the encoder register must be correctly wired and/or programmed to work with the MIU.

If a three-conductor cable is not connected to the encoder register, it will have to be connected and run to the outside of the building. Refer to Steps 1 - 9 in this procedure for that information.

If a three-conductor cable is already connected to the encoder register and available on the outside of the building, the wire color/terminal screw connections on the encoder register will have to be verified. Refer to Step 4 in this procedure for that information.

If a three-conductor cable already connects a Pro Read® encoder register to a wall-mounted receptacle, the Pro Read® must be programmed for three-wire mode. Refer to Step 4 in this procedure for that information.

If a three-conductor cable already connects an ARB® or Pro Read® encoder register to a wall-mounted receptacle, the cable may have to be extended to a location that is appropriate for mounting the MIU. Refer to the section "Splicing a Three-Conductor Cable."

1 Remove the terminal screw cover from the encoder register.

2 Strip off 3/4" from the jacket of the three-conductor cable.

3 Strip off 1/2" of insulation from each of the three wires.

4 Connect one wire to each terminal screw per the manufacturer's instructions. See Figure 2.1 and Figure 2.2.

Note: Make sure the Sensus ECRII® is wired as noted above (Black wire to the **R** terminal, Green wire to **B** terminal, and Red wire to **G** terminal).

Note:	If the MIU will be connected to a Pro Read™ encoder register, the Pro Read™ must be programmed for three-wire mode using a Pro Read™ programmer and its ten-digit TDI format. Do this through the Pro-Read™ receptacle before removing the receptacle. For more information about Pro-Read™ programmers, contact your Schlumberger sales representative.

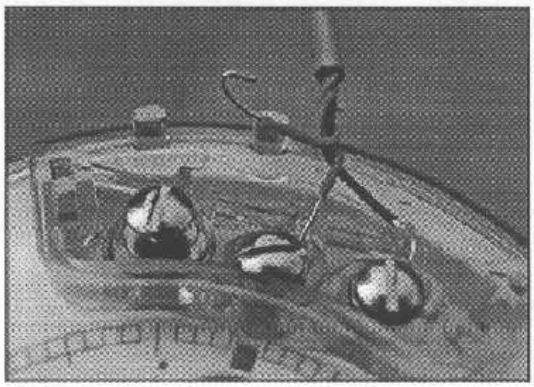


Figure 2-1. Wiring a Schlumberger Encoder Register

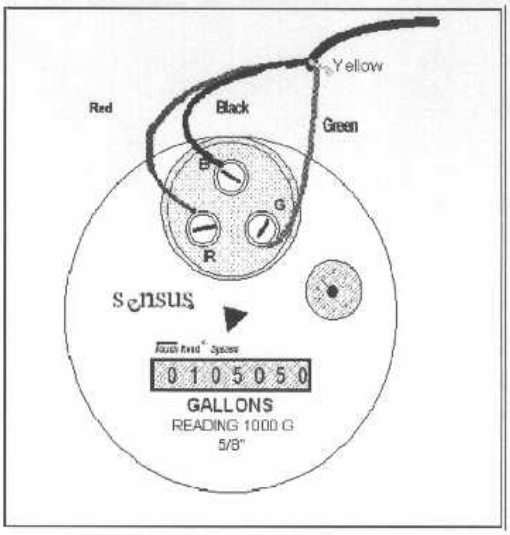


Figure 2-2. Wiring a Sensus ECRII

Figure 2-3. Cable Threaded Around Strain Relief Posts

5 Thread the cable around the strain relief posts (Figure 2-3.).

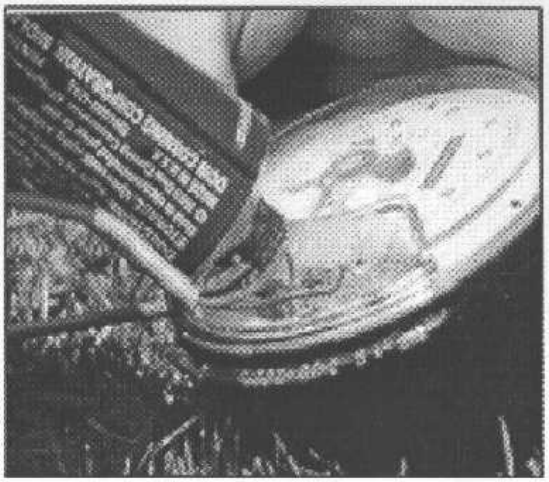


Figure 2-4 Applying Moisture Protection Compound

6 **Use a generous amount of moisture protection compound (Dow Corning #4® or GE Novaguard GB24®) to completely cover the terminal screws and exposed wire ((Figure 2-4).**

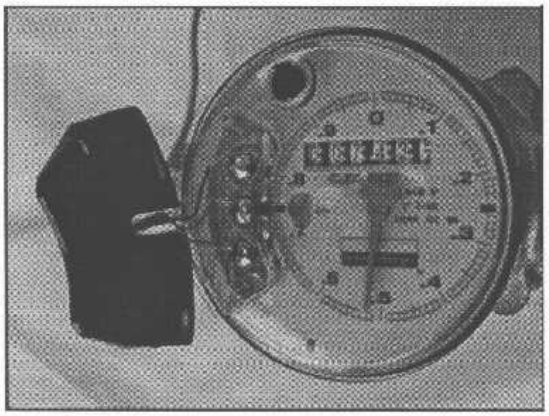


Figure 2-5. Covering the Terminal Screws

7 **Align the cable with the notch in the terminal screw cover and snap the cover onto the encoder register (Figure 2-5).**

8 Run the cable from the encoder register installation point to the MIU, fastening it securely as necessary.

9 If necessary, drill a hole in an appropriate location and run the cable through the hole to the outside of the building.

INSTALLING THE MIU

Please read and comply with all of the information in "Verifying/Preparing the Encoder Register" before continuing with this section.

Please read this entire section before attempting an MIU installation:

1 Select a location for the MIU that meets the recommendations in "Site Selection."

2 Fastening the three-conductor cable securely as necessary, run it from where it exits the building to where the MIU will be mounted.

3 Unscrew the bolt holding the Main Housing to the Mounting Adapter.

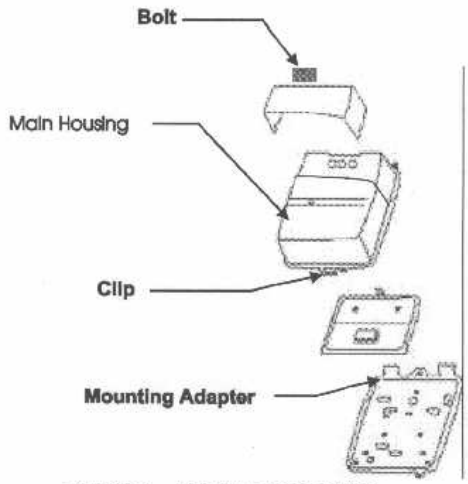


Figure 2-4. Wall MIU Exploded View

4 Release the Clip at the bottom of the MIU and separate the Main Housing from the Mounting Adapter (Figure 2-4.).

5 **Based on Figure 2-5. and the particular requirements of the installation site, decide how you will install the MIU.**

Note: A variety of holes in the Mounting Adapter allows for a quick and easy installation:

- When the cable will enter through the rear of the MIU, rather than the bottom of the MIU, use the indicated hole to enter the cable.
- When the MIU will replace a receptacle, using the correct holes allows use the receptacle's original mounting holes.
- When the MIU will be mounted to a pipe, use the indicated hole to bolt the Mounting Adapter to a pipe clamp.

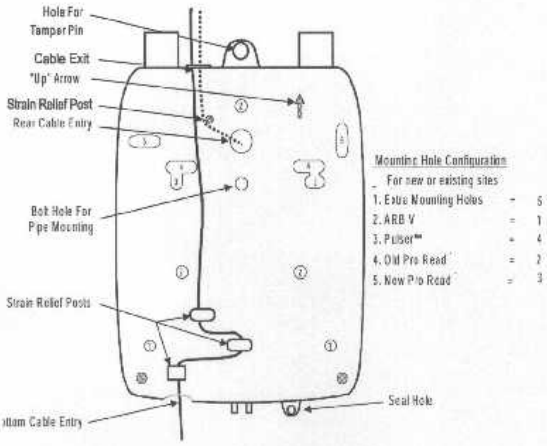


Figure 2-5. Figure 2-7 Mounting Adapter

6 **With the Mounting Adapter in the desired position and the Arrow pointing up, screw the Mounting Adapter to the wall.**

7 **If the cable was not routed through the "Rear Cable Entry Hole," route the cable through the notch at the bottom of the Mounting Adapter (Figure 2-6.See Figure 2-7).**

8 **To provide maximum strain relief, wrap the cable around the Strain Relief Posts (Figures 2-6 and 2-7).**

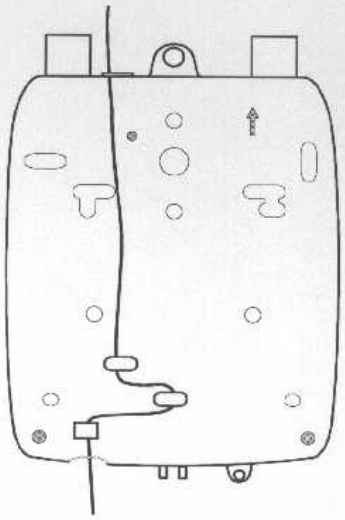


Figure 2-6. Cable Entering Bottom of Mounting Adapter

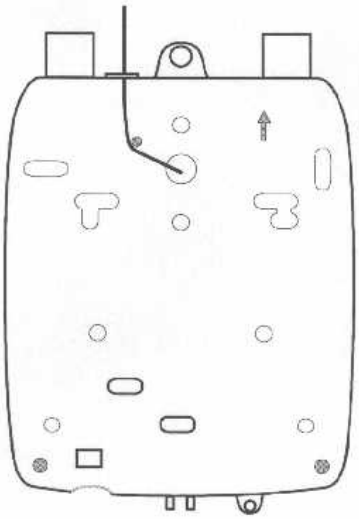


Figure 2-7. Cable Entering Back of Mounting Adapter

9 Route the cable through the notch in the top of the Mounting Adapter. Make sure the cable stays in the notch during the installation of the Main Housing (Figures 2-62.6 and 2-72.7).

10 Install the Main Housing by mating the hinge elements at the top of the Main Housing to the hinge elements at the top of the Mounting Adapter and then lowering the Main Housing until is snaps into place.

11 Connect one wire to each terminal screw as described in Table 2-13.

12 Follow the steps in "Testing the Installation."

Table 2-13 Encoder Register Wire Color Codes

Encoder Register	Wire Color / Encoder Terminal		
Schlumberger ARB III, IV, V®	Black / B	Green / G	Red / R
Schlumberger Pro Read™	Black / B	Green / G	Red / R
Sensus ECRII®	Black / R	Green / B	Red / G

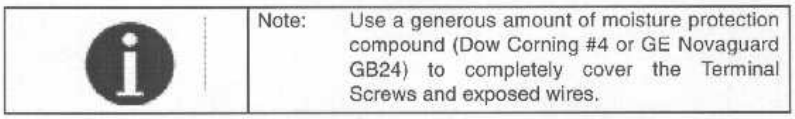
TESTING THE INSTALLATION

Refer to Section 5, "Testing And Maintenance."

COMPLETING THE INSTALLATION

After verifying that the MIU is working correctly, follow these steps to complete the installation:

1 Install the bolt that holds the Main Housing to the Mounting Adapter.



2 Slide the Terminal Cover onto the Main Housing. Make sure the Terminal Cover is seated properly and the cable is fitted into the notch at the top of the Terminal Cover.

3 Install the Tamper Pin into the Terminal Screw Cover.

4 Install a seal wire or seal clip through the Seal Holes at the bottom of the Main Housing.

5 Verify that the requirements of the Site Work Order have been met and that you have recorded all required information.

6 Clean up the installation site before leaving.

SPLICING A THREE-CONDUCTOR CABLE

Splicing three-conductor cables together should be avoided whenever possible. However, if an existing ARI® or Pro Read™ wall receptacle is not in an appropriate location for replacement by an MIU, it may be necessary to splice the cable and extend it to an appropriate location.

Follow these steps to splice a three-conductor cable:

	Note: If the MIU will be connected to a Pro-Read® encoder register, the Pro-Read® must be programmed for three-wire mode using a Pro-Read® programmer and its ten-digit TDI format. Do this through the Pro-Read® receptacle before removing the receptacle.

1. **Remove the receptacle from the wall.**
2. **Remove the wires from the receptacle.**
3. **Cut away the exposed copper from each wire.**
4. **On the three-conductor cable that is to be spliced on, strip off 3/4" of the jacket. Do not strip the insulation from the individual wires.**
5. **Match up one pair of colored wires (Black to Black, Green to Green, and Red to Red) and insert the matching-colored pair into a Scotchlok (Figure 2-8).**

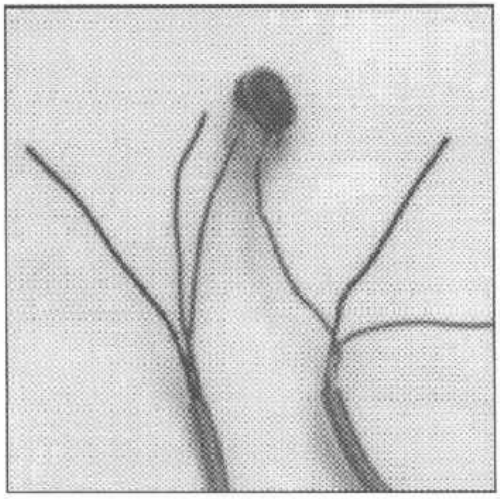


Figure 2-8. Unstripped Wires in a Scotchlok

6 **Using a Scotchlok crimping tool or a pair of Channel locks, squeeze the "button" on the Scotchlok until it is completely flat (Figure 2-11).**

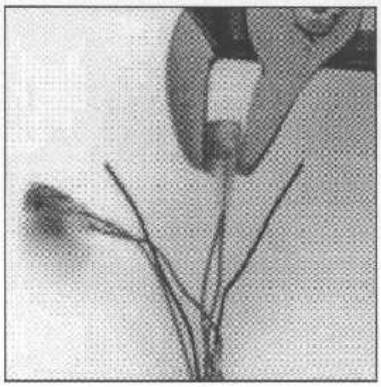


Figure 2-9. Depressing the Scotchlok Button

7 **Inspect the Scotchlok to verify that both wires are fully inserted. If they are not, redo the splice (Figure 2-10).**

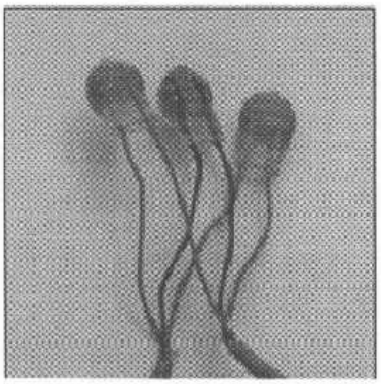


Figure 2-10. Completed Scotchlok Splices

8 **Repeat Steps 5 through 7 for each pair of wires.**

9 **Tuck the Scotchloks into the splice enclosure and route the cables through the cutouts at the ends of the splice enclosure (Figure 2-11).**

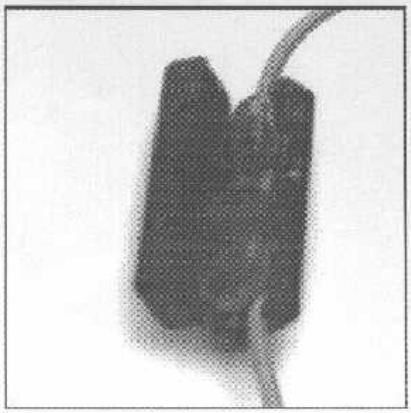


Figure 2-11. Spliced Cables in a Splice Enclosure

10 Coat the inside of the splice enclosure with Dow Corning #4® or GE Novaguard GB24® moisture protection compound (Figure 2-12).

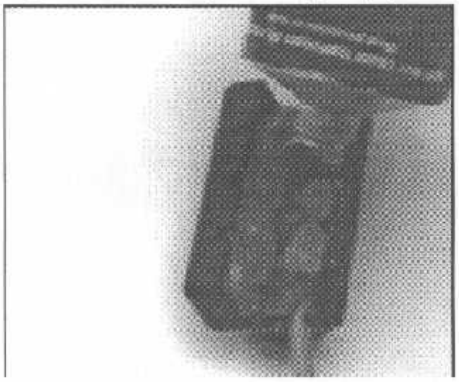


Figure 2-12. Filling the Splice Enclosure

11 Close the splice enclosure, pressing it firmly until the teeth lock together (Figure 2-13).

Figure 2-13. A Completed Splice

REPLACING THE BATTERY

Follow these steps to change-out the wall SURF® MIU's internal Battery:

1 **Unscrew the bolt holding the Main Housing to the Mounting Adapter.**

2 **Remove the seal wire or seal clip from the Seal Holes at the bottom of the Main Housing.**

3 **Punch the Tamper Pin out of the Terminal Screw Cover.**

4 **Remove the Terminal Screw Cover.**

5 **Remove the wires from the Terminal Screws.**

6 **Using a flat-head screwdriver, gently pry down the clip on the bottom of the Main Housing. When the clip clears the tab on the Mounting Adapter, pull the Main Housing away from the Mounting Adapter.**

7 **Remove the Main Housing by lifting it until it unhinges and comes free from the Mounting Adapter.**

8 **Remove the Battery from the Main Housing by pressing in on the left end of the Battery until it releases and comes free from the Main Housing.**

9 **As close to the Battery as possible, cut the battery connection wires one at a time.**

Note: Cutting the battery connection wires one at a time prevents shorting.

10 **Use gel-caps to splice the wires from the new Battery to the wires that connected to the old Battery.**

11 **Snap the Battery into the Receiving Clips on the Main Housing.**

Note: Insure the SURF® Wall MIU's black wire is connected to ground (-) and the red wire is connected to the positive (+) wires of the new battery.

12 **Go back to the section entitled "Installing the MIU" and repeat each step, starting with Step 7, as necessary.**

Chapter 3 OPERATING INSTRUCTIONS

At the time of installation, the installer should use a Hand Held to verify that the SURF® MIU is operating properly. After following the installation instruction (See Chapter 2) , the SURF®MIU will operate automatically and continuously without any type of human intervention.

Chapter 4 THEORY OF OPERATION

SURF® MIU PROGRAMMING

The MIU is not field programmable. At the factory, each of the following items are programmed into the MIU:

Serial number - Each MIU is given a unique serial number/identification number. Custom serial numbers are not available. The default value is the last programmed value plus one.

Time between encoder register reads -The time between encoder register reads is set for one hour.

Time between MIU transmissions - The time between MIU transmissions is set for approximately 4 seconds.

RF PROTOCOL ERROR DETECTION

The RF protocol is comprised of a header, data packet, and an error detection mechanism that reduces the erroneous data.

RF FREQUENCY CONTROL ALGORITHM

The MIU's frequency hopping spread spectrum has a sequence of at least 50 different channels for transmitting data. Associated with the 50 channels are 50 frequencies (or actually PLL pre-scalar values) that can be pre-selected in a pseudo random manner. These 50 pre-scalars are coded into the software.

Note: The SURF® MIU avoids the 914 MHz to avoid collision with the Advantage® probe.

RF TRANSMISSION PERIOD AND RANDOMNESS

The random period generation uses the same random seed created for the channel definition to generate the transmit randomness. The randomness algorithm is defined so that no two consecutive transmissions from two MIUs will interfere with one another.

LOW BATTERY RF EMISSIONS

The MIU stops RF transmissions when the battery discharges below the normal operating voltage.

TROUBLESHOOTING

Six-Wheel Encoder Normal Operation

If the odometer reads 123456, the display should be 1 2 3 4 5 5.

Note: Note that the last digit displayed is a five if the last digit on the odometer is five through nine. The last digit displayed is a zero if the last digit on the odometer is zero through four.

Four-Wheel Encoder Normal Operation

If the odometer reads 123456, the display should be 1 2 3 4 0 0.

Abnormal Operation

Below are examples of abnormal operation for four-wheel encoders. Abnormal operation for six-wheel encoders is similar except that digits occupy all six positions.

A **If an (H) or a (-) occurs on any of the four positions, the display on the HHU will display it.**
Examples: 1 2 - 4 0 0 or 1 2 H 4 0 0

Note: If the wire between the SURF® wall MIU and the encoder is cut or reads as open, the display on the HHU will be dashes.

Example: - - - - -

B **If the odometer reads 123456, the display should be 1 2 3 4 - - with the last two digits blinking on and off four times and then remaining on. Then, opens**
(-) are displayed in all digit positions.
Example: - - - - - -

For three-wire installation, the problem may be in the register, wiring between register and receptacle, receptacle pins, or the TU-89 pins. If all pins are clean and the wiring is verified to be good, replace the register.

C **CIf the odometer reads 123456, the display should be 1 2 3 4 - - with the last two digits blinking on and off four times and then remaining on. Then, shorts (H) are displayed in all digit positions.**
Example: H H H H - -

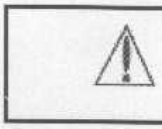
For three-wire installation, replace the register.

Chapter 5 TESTING AND MAINTENANCE

After the MIU has been installed and wired, follow these steps to verify that the MIU is working properly:

1 Activate the MIU by holding the magnet for two seconds against the arrow on the Main Housing. The arrow is just to the right of the Terminal Screws.

2 Power up the Hand-Held Unit (HHU) test device and start the testing program provided.



Warning **To avoid RF signal saturation of the HHU, position yourself at least 2 to 3 feet from the MIU.**

3 When the MIU is installed correctly, its ID number and a meter reading appears on the HHU's display. Verify that this is the correct meter reading by comparing it to the meter's dial. If the readings are the same, proceed to "Completing the Installation."

4 If a meter reading does not appear on the HHU's display or the meter reading in the HHU's display is not the same as the reading on the meter's dial:

- Verify all electrical connections.
- Test the installation again.

5 If a Pro-Read® Encoder Register is used:

- Insure the unit is programmed in "3-wire mode."
- Verify all electrical connections.
- Reactivate the MIU. (See Step 1)

6 If a problem still exists, contact your Schlumberger sales representative.

Chapter 6 REPLACEMENT PARTS, SCHEMATICS, AND DRAWINGS

Tabel 6.0 lists the available replacement parts for the SURF®MIU.

Table 6.0 Available Replacement Parts

Part Name	Part Number
Battery	
Tamper Pin	
Terminal Screw Cover	
Mounting Adapter	