

SM-975 SMART Modem

User's Manual

P/N M847-0460, Rev. A



TELEDYNE BENTHOS

Teledyne Benthos
49 Edgerton Drive
North Falmouth, MA 02556
U.S.A.
Tel: (508) 563-1000
Fax: (508) 563-6444
www.benthos.com

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Preface

Congratulations on your purchase of a Teledyne Benthos SM-975 Smart Modem Acoustic Release Technology (SMART) Modem! The SM-975 is *both* a full ocean depth release *and* an acoustic modem that employs the latest in digital signal processing technologies for reliable wireless digital communications underwater.

This manual provides information on setting up, testing and operating the SM-975. It is divided into the following 5 sections:

Section 1 - Overview reviews the release and modem components of the SM-975 and describes its construction.

Section 2 - Specifications lists the specifications for the release and modem functions of the SM-975 and the battery pack.

Section 3 - Setup, Deployment and Recovery provides instructions on how to unpack the SM-975, test the release mechanism, connect the SM-975 to an instrument, and deploy and recover the SM-975.

Section 4 - Maintenance and Troubleshooting provides instructions for cleaning and inspecting the SM-975, replacing the battery pack, troubleshooting some operational problems should they occur, and rebuilding the dissolving wire module.

Section 5 - User Replaceable Parts and Part Number Designator Includes lists of spares and accessories for the SM-975 along with a part number designator for simplified ordering.

Notes and Warnings

Where applicable, special notes and warnings are presented as follows:



NOTE A referral to another part of this manual or to another reference; a recommendation to check that certain criteria are met before proceeding further in a step or sequence; or general information applicable to the setup and operation of the SM-975 SMART Modem.



WARNING A reminder that dangerous or damaging consequences could result if certain recommended procedures are not followed.

Customer Service

We welcome your comments and suggestions for improving our products and documentation as well as developing better ways of serving you with acoustic technology. Therefore, please contact Customer Service should you have any comments or suggestions about this manual or the SM-975, or if you require service or support.

Please contact us at:

TELEDYNE BENTHOS
Attention: Customer Service
49 Edgerton Drive
North Falmouth, MA 02556
U.S.A.

Telephone: (508) 563-1000
Fax: (508) 563-6444
E-mail: benthos@teledyne.com

www.benthos.com

Contents

Notices	ii
Proprietary Information	ii
Warranty, Limitation of Liability, and Intellectual Property	
Rights Statement	ii
Liability	iv
Title	iv
Changes	iv
Preface	v
Notes and Warnings	v
Customer Service	vi
Contents	vii
List of Figures	ix
List of Tables	x
 1 Overview	 1-1
Operation as a Release	1-1
Operation as an Acoustic Modem	1-4
Optional Features	1-5
Construction	1-5
Hard Hat	1-5
Transducer	1-7
Modem Electronics	1-7
Electrical Penetrators	1-8
Vacuum Port	1-8
Battery Pack	1-8
Magnetically Activated Switch	1-8
Release Mechanism	1-9
 2 Specifications	 2-1
Release	2-1
General	2-1
Physical Characteristics—SM-975 with 13-Inch Sphere	
Housing	2-1
Physical Characteristics—SM-975 with 17-Inch Sphere	
Housing	2-2

Modem	2-2
General	2-2
Power Requirements	2-3
Real-Time Clock	2-4
Battery Pack	2-4
3 Setup, Deployment and Recovery	3-1
Unpacking and Inspection	3-1
Testing the Release Mechanism	3-2
Connecting the SM-975 to an Instrument	3-3
Deploying the SM-975	3-5
Installing a New Drop Link and Dissolving Wire Module	3-5
Checking the Status of the SM-975	3-6
Verifying Some Important Deployment Considerations	3-7
Performing the Predeployment Checks	3-8
Deployment	3-8
Recovering the SM-975	3-8
4 Maintenance and Troubleshooting	4-1
General Cleaning and Inspection	4-1
Replacing the Battery Pack	4-2
Troubleshooting	4-8
Rebuilding The Dissolving Wire Module	4-8
5 User Replaceable Parts and Part Number Designator	5-1
Modem User Replaceable Parts	5-1
Modem Part Number Designation	5-1

List of Figures

Figure 1-1	<i>The SM-975 SMART Modem</i>	1-2
Figure 1-2	<i>The UDB-9400 Universal Deck Box, Portable and Rack Mount</i>	1-2
Figure 1-3	<i>SM-975 Deployed with a Mooring</i>	1-3
Figure 1-4	<i>SM-975 Construction</i>	1-6
Figure 1-5	<i>Modem Electronics with Burnwire, DSP, Transmitter/Receiver and Optional SD Carrier and Coprocessor Boards</i>	1-7
Figure 1-6	<i>Magnetically Activated Switch and Magnet</i>	1-8
Figure 1-7	<i>Release Base with Release Lever and Drop Link</i>	1-9
Figure 1-8	<i>Release Base with Dissolving Wire Module and Ground Bolt</i>	1-9
Figure 3-1	<i>SM-975 Power/Serial Connector</i>	3-3
Figure 3-2	<i>Location of the Power/Serial Connector</i>	3-4
Figure 4-1	<i>Location of Hardware that Secures the Two Halves of the Hard Hat</i>	4-3
Figure 4-2	<i>Removing the Bottom Half of the Hard Hat</i>	4-3
Figure 4-3	<i>Removing the Glass Sphere Housing</i>	4-4
Figure 4-4	<i>Removing the Mounting Plate Screws and Washers</i>	4-5
Figure 4-5	<i>Removing the Battery Bracket</i>	4-5
Figure 4-6	<i>Location of Notch in Top Half of Hard Hat</i>	4-7
Figure 4-7	<i>Dissolving Wire Module Components</i>	4-9
Figure 4-8	<i>Dissolving Wire Inserted in Burnwire Bolt</i>	4-9
Figure 4-9	<i>Wire Crossed inside Burnwire Bolt</i>	4-10
Figure 4-10	<i>3/8-16 x 5/8 Bolt Temporarily Inserted into Base to Flatten Wire</i>	4-10
Figure 5-1	<i>SM-975 SMART Modem Part Number Designator Legend</i>	5-2

List of Tables

Table 3-1 *SM-975 Power/Serial Connector Pinouts* 3-4

Table 3-2 *SM-975 Power/Serial Cable Pin-to-Pin Connections* 3-5

Table 5-1 *SM-975 SMART Modem User Replaceable Parts* 5-1

1 Overview

The Teledyne Benthos SM-975 Smart Modem Acoustic Release Technology (SMART) Modem is both a full ocean depth acoustic release plus an acoustic modem that provides reliable wireless digital communications with other deployed underwater instrument packages and surface or subsea platforms. It is self buoyant and self contained in a 13 or 17-inch glass sphere housing that is encapsulated in a yellow ribbed hard hat. It also includes an internal battery pack and an omnidirectional transducer that is specifically designed for full ocean depth applications. The SM-975 can transmit real time or stored data from connected instruments and sensors at baud rates up to 15,360 bits/sec. The SM-975 can also receive data at baud rates up to 2400 bits/sec, enabling it to function as a network repeater.

The SM-975, which is shown in Figure 1-1, combines the same reliable electrolytic dissolving wire ("burn wire") type release mechanism used in the Teledyne Benthos Model TR-6000/6001 Series Recoverable Acoustic Transponder with the same modem technology provided by the Teledyne Benthos ATM-900 Series Acoustic Telemetry Modems. The Teledyne Benthos UDB-9400 Universal Deck Box, which is shown in Figure 1-2, is used to communicate with the SM-975 and to acoustically release it. The deck box provides a touch screen display for a user friendly means of configuring and operating the release and the modem.

Operation as a Release

The SM-975 is designed for long range, deep or shallow water applications and can release loads as heavy as 227 kg (500 lb) at the full rated depth of 6700 m (22,000 ft). The SM-975 is shown deployed with a mooring in Figure 1-3. In addition, the SM-975 functions to assist in its own relocation as it can be commanded to operate as a transponder for measuring slant range. As a transponder, the SM-975 transmits replies to interrogation transmissions from the UDB-9400 Universal Deck Box, and the two-way travel time of the sound propagation is measured and converted into the one-way distance. Upon recovery, the SM-975 can be rearmed and redeployed. The battery life is up to two years, depending on the number of transponder replies and the amount of data transmitted and received. In addition, the acoustic telemetry is disabled when the battery voltage falls below a safe threshold at which only the release and transponder functions and the ability to send status messages can be activated.



Figure 1-1 The SM-975 SMART Modem

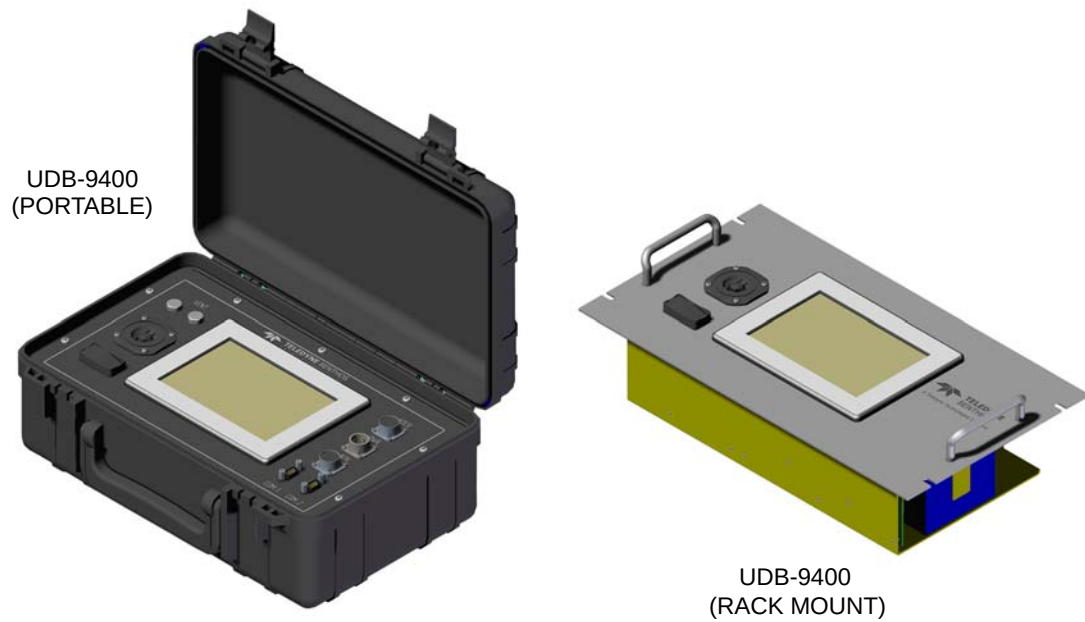


Figure 1-2 The UDB-9400 Universal Deck Box, Portable and Rack Mount



Figure 1-3 SM-975 Deployed with a Mooring

The SM-975 is released by a command from the UDB-9400 Universal Deck Box or from an ATM-900 Series Acoustic Telemetry Modem. The command, which is transmitted using the same secure and highly reliable modulation techniques used by the modem, is sent either by entering it directly from the touch screen display or from the keyboard of a PC that is connected to the deck box or modem. The PC must be set up to run a terminal program, such as ProComm Plus. The command requires both the address of the modem and its release code. The factory default address is 0, and the release code is the serial number of the SM-975 which is printed on the serial tag.



NOTE For instructions on how to release the SM-975 using the touch screen display of the UDB-9400 Universal Deck Box, refer to "Operation using the Touch Screen Display," of the "UDB-9400 Universal Deck Box User's Manual" or the "UDB-9400A Universal Deck Box User's Manual. For instructions on how to enter commands from a PC connected to the UDB-9400 Universal Deck Box or an ATM-900 Series Acoustic Telemetry Modem, refer to Section 5, "Modem Operation," of the "ATM-900 Series Acoustic Telemetry Modems User's Manual."

Operation as an Acoustic Modem

The SM-975 operates as an acoustic modem with the same functions as the Teledyne Benthos ATM-900 Series Acoustic Telemetry Modems. It operates in the same operating modes, includes the same configuration parameters and executes the same commands. Plus it includes Release and Release Status commands. The modem uses an omnidirectional transducer that operates in the 9–14 kHz (LF), 16–21 kHz (MF) or 22–27 kHz (Band C), frequency band. This transducer provides omnidirectional transmit and receive beam patterns and is very effective in both deep and shallow water applications where the direction of the receiving transducer is not known or is not fixed. The modem also includes a power/serial connector that is accessible through the hard hat. This connector is used to input external power for powering the modem instead of using its internal battery pack, and to connect to either the RS-232 or RS-422 serial interface of an instrument or a PC. The modem inputs data from the instrument and outputs data to the instrument on the serial interface.



NOTE For detailed information on the Teledyne Benthos ATM-900 Series Acoustic Telemetry Modems and how to operate them, refer to the "ATM-900 Series Acoustic Telemetry Modems User's Manual."

Optional Features

Three factory installed optional features are available for the SM-975:

SD Datalogger. The SD Datalogger is a factory installed option that expands the available datalogger storage of the SM-975 from 6 MB to 4 GB by adding a 4-GB secure digital high capacity (SDHC) card and its carrier board to the modem. To order the SD datalogger feature, add a "-D" at the end of the modem part number.

PSK Coprocessor. The PSK Coprocessor option adds a coprocessor to the modem, enabling it to receive PSK modulated data over the acoustic link at bit rates as high as 15,360 bits/sec. To order the PSK Coprocessor feature, add a "-P" at the end of the modem part number.

LBL/Multi-Receive. The LBL/Multi-Receive option is a firmware only feature that enables multiple modems to be operated as a long baseline (LBL) acoustic positioning system. To order the LBL/Multi-Receive feature, add a "-M" at the end of the modem part number.

Construction

The SM-975 consists of a glass sphere housing with a hard hat and attached release mechanism as shown in Figure 1-4. The housing is composed of two precision matched glass hemispheres with finely ground flat edges that are bound together with a band clamp assembly. The two halves are sealed with butyl rubber, and the sealant is covered with black vinyl tape. Inside the housing is a mounting plate to which are mounted a battery pack and the modem electronics chassis. Mounted directly to the outside surface of the housing are the transducer, the power/serial connector, two single-pin electrical penetrators, and a vacuum port. In addition, a removable magnet is attached to a bracket on the band clamp assembly and is accessible through the hard hat as shown in Figure 1-6 on page 1-8. The magnet is used to turn on the SM-975 when removed.

Hard Hat

The yellow ribbed two-piece polyethylene hard hat encapsulates and protects the entire glass sphere housing. The two halves of the hard hat are bolted together and cutouts are provided for the transducer, the magnet and the power/serial connector. The hard hat also provides the mounting platform for the release mechanism, and for the 13-inch glass sphere housing, a rope handle is also included.

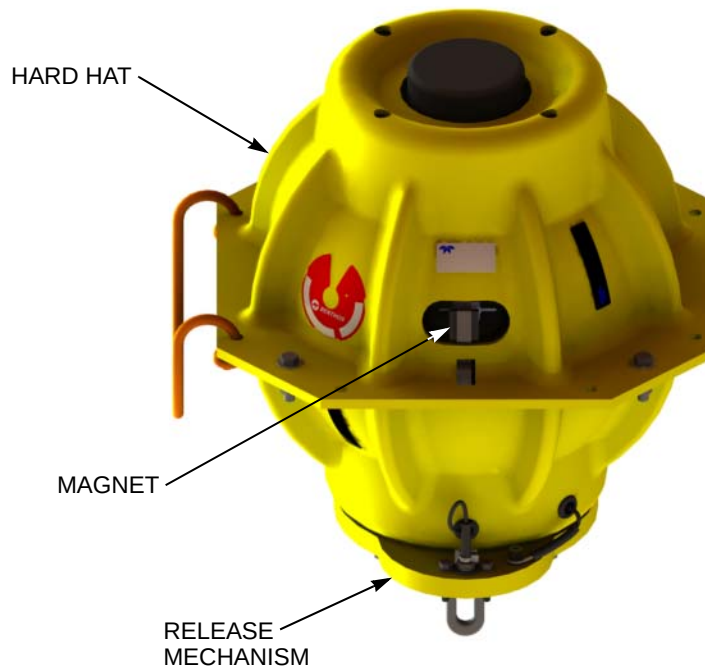
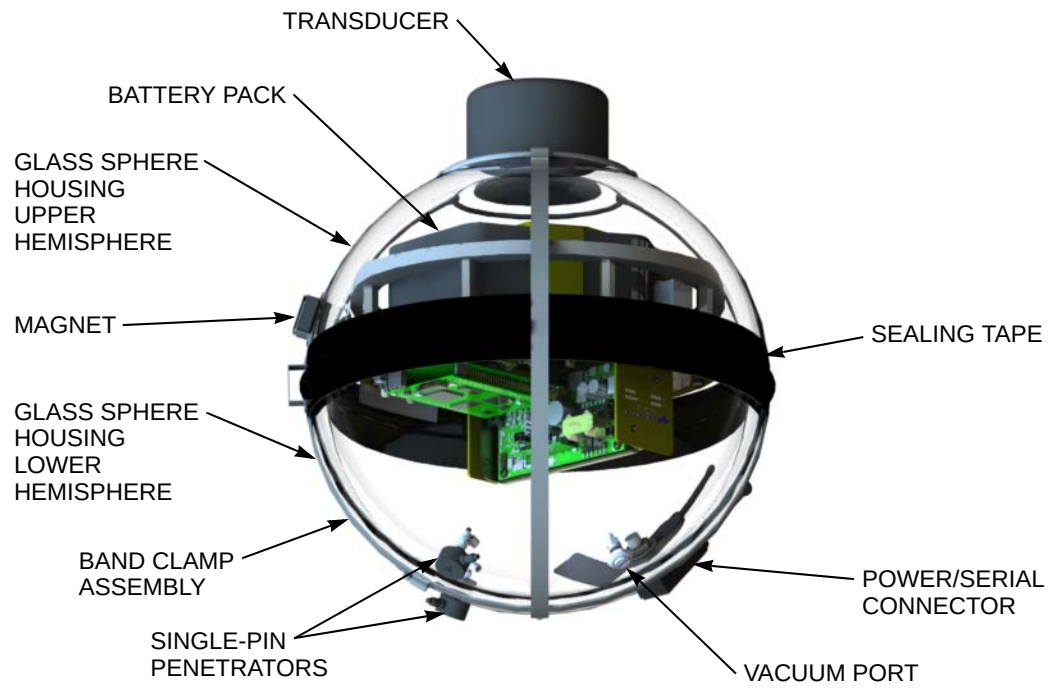


Figure 1-4 SM-975 Construction

Transducer

The transducer is an omnidirectional piezoelectric ceramic ring contained in a polyurethane mold and is secured to the top hemisphere of the glass sphere housing by a center tube that penetrates the housing. The transducer wires run through the tube and connect to the modem electronics.

Modem Electronics

The modem electronics consist of four main circuit boards: the DSP board, the Transmitter/Receiver board and the Burnwire board as shown in Figure 1-5. The DSP and Transmitter/Receiver boards are secured to the modem electronics chassis which mounts to the mounting plate. The Burnwire board, along with an optional Coprocessor board pair and an SD Carrier board are also attached to the mounting plate.

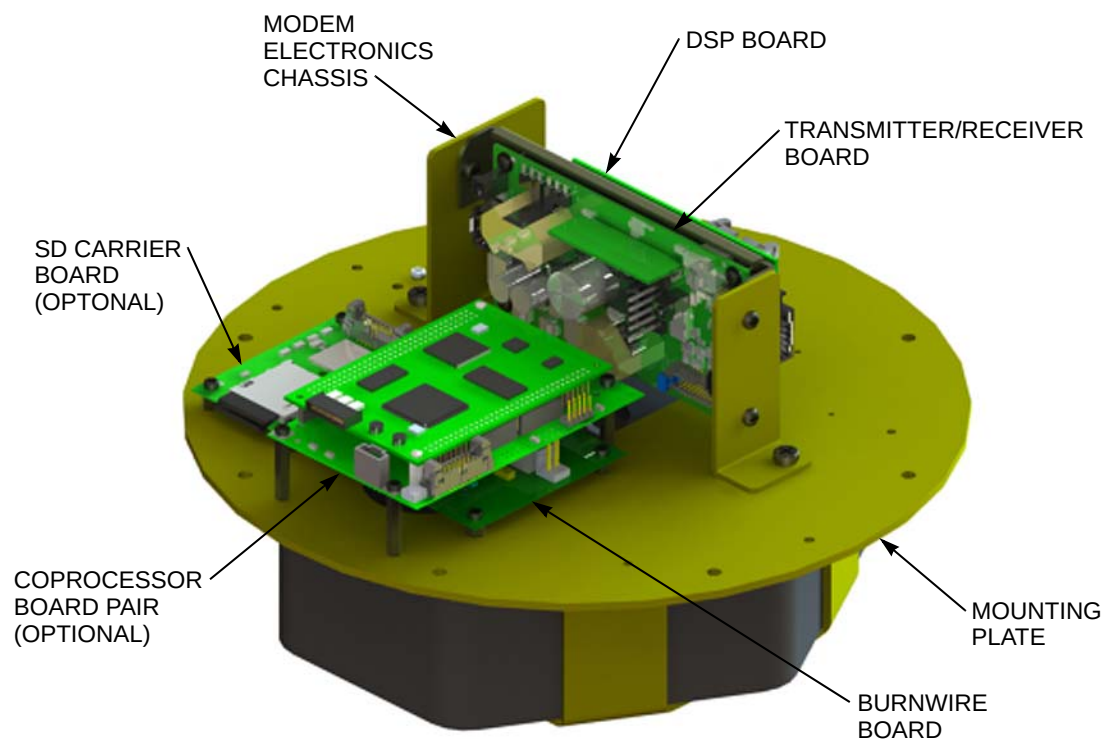


Figure 1-5 Modem Electronics with Burnwire, DSP, Transmitter/Receiver and Optional SD Carrier and Coprocessor Boards

For the 17-inch glass sphere housing only, where two separate battery packs are included, the SM-975 includes two Connector boards (not shown) which enable the combining of the two battery packs.

Electrical Penetrators

There are three electrical penetrators: a 9-pin penetrator which is the power/serial connector, and two single-pin penetrators, which connect to the release mechanism.

Vacuum Port

The vacuum port can be used to partially evacuate the interior of the glass sphere housing. It is typically used after reassembling the housing. Partial evacuation helps to hold the two hemispheres together along with the band clamp assembly. The vacuum port can also be used to release air into the housing to assist in separating the two hemispheres when disassembling.

Battery Pack

The battery pack is composed of 30 alkaline “D” cells that are wired as two sets of 15 series-connected cells in parallel, and includes attached wiring and a connector. The battery pack is secured to the mounting plate with a bracket, and the battery wires connect to the Burnwire board through a hole in the mounting plate. One battery pack is included with the 13-inch sphere ATM-975 and two with the 17-inch.

Magnetically Activated Switch

A magnetically activated switch is attached to the inside surface of the glass sphere housing as shown in Figure 1-6. A removable magnet is attached to a bracket on the band clamp assembly over the switch to maintain the switch in the open state. Removing the magnet closes the switch and turns the SM-975 on. An audible tone is also heard when the magnet is removed.

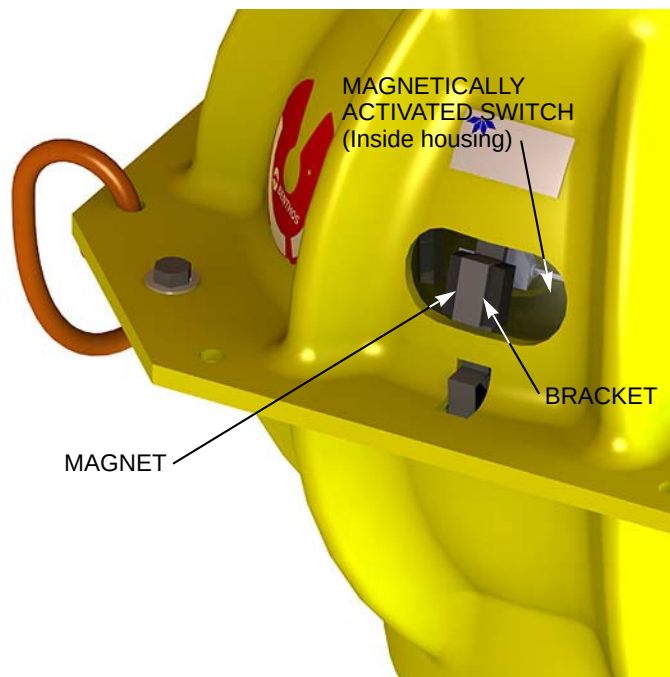


Figure 1-6 Magnetically Activated Switch and Magnet

Release Mechanism

The release mechanism includes a release base with a dissolving wire module, a release lever, and a drop link as shown in Figure 1-7 and Figure 1-8. The release lever also includes a replaceable tip. The release mechanism is attached directly to the bottom half of the hard hat. The dissolving wire module includes an Inconel wire loop that serves as the anode—and a stainless steel ground bolt, which is shown in Figure 1-8, serves as the cathode—in an electrical circuit that is energized when the SM-975 is commanded to release. When energized, the wire loop dissolves, the release lever drops, and the drop link slides away, releasing the SM-975 from its mooring.

Using a single pin female connector, the cable of one of the two single-pin electrical penetrators connects through a grommet protected hole in the hard hat to the dissolving wire module. Similarly, using a wire lug, the cable of the other single-pin penetrator passes through a grommet protected hole and attaches to the ground bolt.

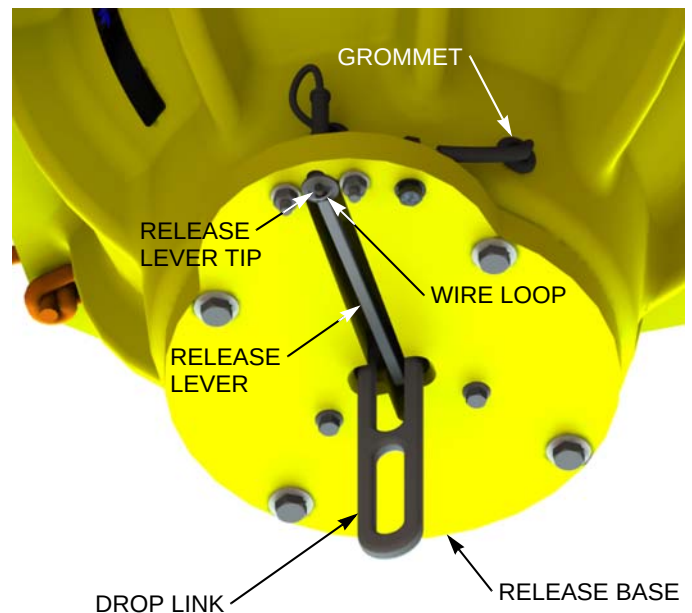


Figure 1-7 Release Base with Release Lever and Drop Link

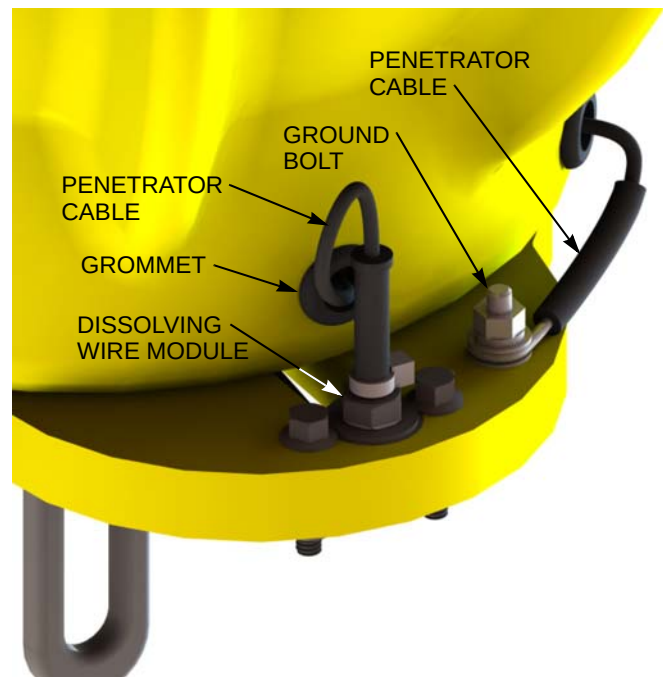


Figure 1-8 Release Base with Dissolving Wire Module and Ground Bolt

2 Specifications

This section provides the specifications for the Teledyne Benthos SM-975 SMART Modem. The specifications encompass separately the release and modem functions and the battery pack. All specifications are subject to change without notification.

Release

The specifications for the release primarily apply to the glass sphere housing and to the release mechanism of the SM-975.

General

Housing:	Glass sphere inside a yellow ribbed hard hat
Release actuation:	Electrolytic dissolving wire ("burn wire")
Rated load:	227 kg (500 lb)
Activation:	In salt water only
Rated depth:	6700 m (22,000 ft)
Operator controls:	Magnet for power on/off
Operating life:	Up to 1 year depending on the number of replies and the amount of data transmitted and received by the modem

Physical Characteristics—SM-975 with 13-Inch Sphere Housing

Dimensions:	48.3 cm (19.0 in.) max dia by 44.5 cm (17.5 in.) maximum height
Weight in air:	18.2 kg (40 lb)
Net buoyancy:	2.3 kg (5 lb)

Physical Characteristics—SM-975 with 17-Inch Sphere Housing

Dimensions:	61.0 cm (24.0 in.) max dia by 57.2 cm (22.5 in.) maximum height
Weight in air:	27.3 kg (60 lb), w/single battery pack 31.8 kg (70 lb), w/two battery packs
Net buoyancy:	13.6 kg (30 lb), w/single battery pack 9.1 kg (20 lb), w/two battery packs

Modem

The specifications for the modem primarily apply to the electrical and transducer components of the SM-975. For information on the PSK and FSK modulation techniques and the processing features, refer the “Acoustic Telemetry Modems User’s Manual.”

General

Frequency band:	8.96–14.08 kHz (LF), 16.00–21.12 kHz (MF) or 22.56–27.68 kHz (Band C)
Data modulation:	PSK and MFSK
Baud rate:	2560–15,360 bits/sec (PSK transmit); 140–2400 bits/sec (MFSK transmit and receive)
Addressable modems:	250
Processing features:	Data redundancy 1/2 rate convolutional coding Multipath guard period
Temperature, operating:	-5°C to 50°C (23°F to 122°F)
Temperature, nonoperating:	-45°C to 85°C (-49°F to 185°F)
Serial interface:	RS-232/422/485 at 115,200; 57,600; 38,400; 19,200; 4800; 2400; or 1200 baud

Power/serial connector:	Subconn LPMCBH9M, for RS-232 and RSH422 serial interface and external DC input power
Flow control:	RS-232—hardware RTS/CTS handshaking or software XON/XOFF RS-422—software XON/XOFF handshaking
Device enable:	Active low, open collector output. Maximum sink current is 20 mA, maximum applied voltage is 40 VDC, and maximum power is 150 mw.

Power Requirements

Average transmit power @ 21 VDC:	20 watts at power level 8 14 watts at power level 7 10 watts at power level 6 7 watts at power level 5 5 watts at power level 4 3.5 watts at power level 3 2.5 watts at power level 2 >2 watts at power level 1 (depending on transducer)
Peak transmit current:	3 A, 50 ms @ 21 VDC
Receive active power:	720 mw max @ 24VDC 650 mw typ @ 24 VDC
Lowpower state power:	12.0 mw max @ 24 VDC 10.2 mw typ @ 24 VDC
Low frequency (LF) omnidirectional transducer:	Frequency band: 9–14 kHz Source level: 185 dB re 1 μ Pa @ 1 m typ Beam pattern: toroidal $\pm 30^\circ$ @ 12 kHz typ
Medium frequency (MF) omnidirectional transducer:	Frequency band: 16–21 kHz Source level: 183 dB re 1 μ Pa @ 1 m typ Beam pattern: toroidal $\pm 30^\circ$ @ 18 kHz typ

**Band C omnidirectional
transducer:**

Frequency band: 22–27 kHz
Source level: 178 dB re 1 μ Pa @ 1 m typ
Beam pattern: toroidal $\pm 30^\circ$ @ 25 kHz typ

Real-Time Clock

The SM-975 includes a temperature compensated real-time clock for the time and date. When the modem is powered on, the clock uses the modem batteries or external power to keep time, and when powered off, the modem uses a backup lithium coin cell.

Clock accuracy: ± 1 minute/year or ± 2 PPM (0° to $+40^\circ\text{C}$)
 ± 4 minute/year or ± 7.5 PPM (-40° to $+85^\circ\text{C}$)

Coin cell life: 1.4 years min, 2 years typ

Battery Pack

The battery pack used in the SM-975 is composed of 30 alkaline “D” cells, where two sets of 15 series-connected cells are wired in parallel. The 13-inch sphere ATM-975 includes one battery pack; the 17-inch, two battery packs. The specifications below are for a single battery pack.

Capacity: 495 watt-hours @ transmit power level 07
445 watt-hours @ transmit power level 08

Open circuit voltage: 22.5 V

Weight: 4.5 kg (10 lb)



NOTE Stated capacities are at an ambient temperature of 21°C . When operating at 0°C , the battery capacity needs to be derated by 25%.



NOTE Remove the battery pack from the SM-975 when it is not expected to be in use for several months. To increase the battery pack's storage life, store it in a cool, dry place. Storing it in this manner will slow down the chemical reaction of the batteries and increase the battery pack's shelf life.

3 Setup, Deployment and Recovery

This section provides instructions on how to unpack the Teledyne Benthos SM-975 SMART Modem, test the release mechanism, connect the SM-975 to an instrument, and deploy and recover the SM-975.

Unpacking and Inspection

The SM-975 is shipped with the following components:

- SM-975 SMART Modem (Refer to Figure 5-1 on page 5-2 for part number information on the SM-975 SMART Modem.)
- Re-arming Kit (P/N 014529)
- Spare Parts Kit (P/N 011685)
- Power/Serial Cable (P/N C846-0020)
- User's Manual (P/N M847-0460)



NOTE A drop link is also included but not installed. Refer to "Installing a New Drop Link and Dissolving Wire Module" on page 3-5 for instructions on how to install it.

All items are carefully packed in a sealed box. Additional drop links, dissolving wire modules, battery packs and other components may be included, depending on the order. Carefully inspect the box for any signs of external damage and immediately report any damage to Teledyne Benthos and to the freight carrier.

After inspecting the box, locate and remove the packing list, which is on the outside of the box. While referring to the packing list, carefully remove the contents of the box, checking the items against the packing list to verify that all the items on the list are included. Inspect the items for any physical damage that might have occurred during shipment. Immediately report any damage to Teledyne Benthos and to the freight carrier.

Testing the Release Mechanism

The release mechanism is tested in air by an acoustic command from a UDB-9400 Universal Deck Box or an ATM-900 Series Acoustic Telemetry Modem. The touch screen display of the deck box can be used to enter the command, or the command can be entered from the keyboard of a PC that is connected to the deck box or modem.

To test the release mechanism:

1. Refer to "Setting Up the Modems" in Section 4, "Setup and Test" of the "ATM-900 Series Acoustic Telemetry Modems User's Manual" and set up the deck box or modem.
2. Place the remote transducer used with the deck box within a foot of the SM-975 transducer. Be sure no obstacles are between the transducers.
3. Attach the positive lead of the multimeter to the wire loop of the dissolving wire module. The wire loop is shown in Figure 1-7 on page 1-9.
4. Attach the negative lead of the multimeter to the ground bolt. The ground bolt is shown in Figure 1-8 on page 1-9.
5. Set the multimeter to a volts scale for measuring approximately 15 volts.
6. Remove the magnet from the bracket on the band clamp assembly. Four pings will be heard. The magnet and its bracket are shown in Figure 1-6 on page 1-8.
7. Switch the OFF/ON switch on the front panel of the UDB-9400 Universal Deck Box to ON or turn on the modem.



NOTE When testing the release mechanism of the SM-975, should the release mechanism not activate, vary the separation of the transducers. In addition, it may be required to change the transmit power level of the UDB-9400 Universal Deck Box or the ATM-900 Series Acoustic Telemetry Modem, usually to a lower level. For a deck box, the transmit power level is set from the touch screen display by touching the Transmit Power control on the Status and Control bar, and then selecting the attenuation level from the drop-down list. From the keyboard of a connected PC, the transmit power level is set with the TxPower configuration parameter. For instructions on how to set the TxPower configuration parameter, refer to Section 7, "Modem Configuration Parameters" of the "ATM-900 Series Acoustic Telemetry Modems User's Manual."

8. If using the touch screen display, refer to "Releasing a SMART Release or Modem" in the "UDB-9400 Universal Deck Box User's Manual" or the "UDB-9400A Universal Deck Box User's Manual," and follow the instructions.

If using a PC, send the Release command by typing `AT$Nn,m [Enter]`, where `n` is the address of the SM-975 and `m` is the release code. The factory default address is 0, and the release code is the serial number of the SM-975 and is printed on the serial tag. The message "Valid Release Code-Waiting for Burn..." should be displayed, and the multimeter should read approximately 13.7 volts.

9. Attach and then remove the magnet and verify that the voltage reads zero volts. Do not deploy the SM-975 if the voltage does not read zero.

Connecting the SM-975 to an Instrument

Connecting the SM-975 to an instrument requires making the serial interface connections to the instrument and, if required, the DC power connections.

The power and serial interface connections are made to the SM-975 using the power/serial connector which is accessible through the hard hat as shown in Figure 3-2. Either an RS-232 or an RS-422 serial interface connection can be made. The power/serial connector pin orientation is shown in Figure 3-1, and the pinout information is shown in Table 3-1. The power/serial connector is a 9-pin Subconn LPMCBH9M bulkhead connector which requires a Subconn MCLPIL9F mating connector pigtail. The SM-975 is shipped with a dummy connector plugged into the power/serial connector.

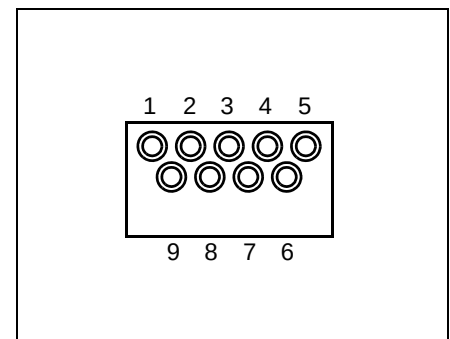


Figure 3-1 SM-975 Power/Serial Connector

To connect the SM-975 to an instrument using the RS-232 or RS-422 serial interface, and if required, to external DC power, refer to the pinout information provided in Table 3-1 and to the connector information provided with the instrument. In addition, the power/serial cable, which includes a mating Subconn MCLPIL9F connector and a DB9 connector, is provided for connecting the RS-232 serial interface to a PC and to a DC power supply. The pinout information for this cable is shown in Table 3-2 on page 3-5. The red lead of the cable connects to Pin 1 (21–28 VDC), and the black lead, to Pin 3 (Common Ground) of the MCLPIL9F connector. When the SM-975 is switched on, the internal batteries automatically power the SM-975 when there is no external power or if the external power drops below 22 VDC.

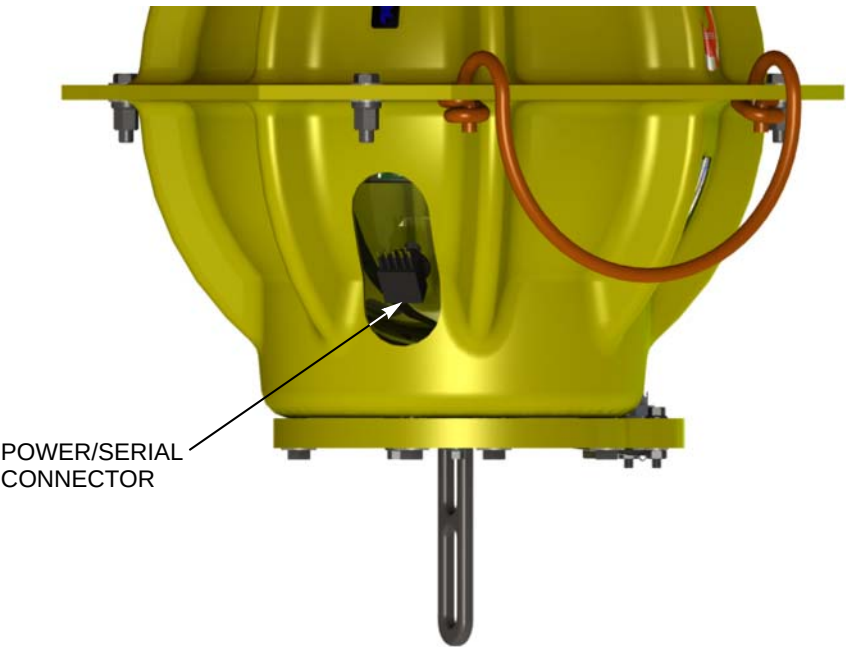


Figure 3-2 Location of the Power/Serial Connector

Table 3-1 SM-975 Power/Serial Connector Pinouts

PIN	LABEL	FUNCTION	SIGNAL DIRECTION
1	Power	External Power Input (21–28 VDC)	To Modem
2	—	Reserved	—
3	GND	Common Ground	
4	TX(+)	RS-422 Transmit(+)	Modem to Instr
5	DE	Device Enable (See NOTE below.)	Modem to Instr
6	RTS/RX(+)	Request to Send/RS-422 Receive(+)	Modem to Instr/ Instr to Modem
7	TX(-)	RS-422 Transmit(-)	Modem to Instr
8	RXD	RS-232 Receive	Instr to Modem
9	TXD/RX(-)	RS-232 Transmit/RS-422 Receive(-)	Modem to Instr/ Instr to Modem



NOTE Refer to Section 6, "Modem Operating Modes and Commands," of the "Acoustic Telemetry Modems User's Manual" for more information on the Device Enable output.

Table 3-2 SM-975 Power/Serial Cable Pin-to-Pin Connections

SM-975 POWER/SERIAL CONNECTOR			SIGNAL DIRECTION	PC DB-9 CONNECTOR		
PIN	LABEL	FUNCTION		PIN	LABEL	FUNCTION
3	GND	Common Ground		5	GND	Ground
6	RTS	Request to Send	Modem to PC	8	CTS	Clear to Send
8	RXD	Receive	PC to Modem	3	TXD	Transmit
9	TXD	Transmit	Modem to PC	2	RXD	Receive

Deploying the SM-975

Before deploying the SM-975, a new drop link and a dissolving wire module should be installed if they have been expended in a previous deployment. In addition, the status of the SM-975 should be checked, some important deployment considerations should be verified, and a few predeployment checks should be performed. After completing these tasks, verify that the magnet is removed, and then deploy the SM-975 and its mooring. Be careful to minimize impact loading on the release mechanism during deployment.

Installing a New Drop Link and Dissolving Wire Module

Drop links, dissolving wire modules and release lever tips are included in the Re-arming Kit. Refer to Section 1, "Overview," for the location of these components. Instead of replacing the dissolving wire module, it can be rebuilt. For instructions on how to rebuild the module, refer to "Rebuilding The Dissolving Wire Module" on page 4-8. The Re-arming Kit also includes the required components to rebuild them.

To install a new drop link and dissolving wire module:

1. Cut the cable tie and disconnect the connector pigtail from the dissolving wire module.
2. Remove the dissolving wire module by removing the two sets of bolts, nuts and washers secure it.
3. If the release lever tip appears damaged, replace the tip by unscrewing it by hand and installing a new one.

4. Slide a new drop link over the release lever and install a new dissolving wire module, slipping the release lever tip through the wire loop.
5. Secure the module with the two sets of bolts, nuts and washers.
6. Connect the connector pigtail and install a new cable tie.

Checking the Status of the SM-975

The status of the SM-975 can be checked at any time, even after it has been released. The status information is displayed in the touch screen display of a UDB-9400 Universal Deck Box or at the command prompt when using a PC that is connected to the deck box or to an ATM-900 Series Acoustic Telemetry Modem.

The status displays are the following:

Armed. Displayed when no command to has been received and the dissolving wire module is currently not activated.

Burn Wire Activated. Displayed when the dissolving wire module is currently activated.

Burn Wire Released, Unit Tilted. Displayed when the SM-975 has been released.

Battery: Reduced. Displayed when the battery capacity is reduced. The transmit power is limited to level 7.

Battery: LOW. Displayed when the battery capacity is low. Data transmissions are disabled, and the transmit power is limited to level 6.

Battery: OK. Displayed when the battery is not low and does not need to be replaced.

To check the status of the SM-975:

1. Refer to "Setting Up the Modems" in Section 4, "Setup and Test" of the "ATM-900 Series Acoustic Telemetry Modems User's Manual" and set up the deck box or modem.
2. Place the remote transducer used with the deck box within a foot of the SM-975 transducer. Be sure no obstacles are between the transducers.
3. Remove the magnet from the bracket on the band clamp assembly. Four pings will be heard. The magnet and its bracket are shown in Figure 1-6 on page 1-8.
4. Switch the OFF/ON switch on the front panel of the UDB-9400 Universal Deck Box to ON or turn on the modem.



NOTE When checking the status of the SM-975, should the status not be displayed, vary the separation of the transducers. In addition, it may be required to change the transmit power level of the UDB-9400 Universal Deck Box or the ATM-900 Series Acoustic Telemetry Modem, usually to a lower level. For a deck box, the transmit power level is set from the touch screen display by touching the Transmit Power control on the Status and Control bar, and then selecting the attenuation level from the drop-down list. From the keyboard of a connected PC, the transmit power level is set with the TxPower configuration parameter. For instructions on how to set the TxPower configuration parameter, refer to Section 7, "Modem Configuration Parameters" of the "ATM-900 Series Acoustic Telemetry Modems User's Manual."

5. If using the touch screen display, refer to "Acquiring and Displaying Status Information from a Remote Modem" in the "UDB-9400 Universal Deck Box User's Manual" or the "UDB-9400A Universal Deck Box User's Manual," and follow the instructions. The status should be displayed in the touch screen display.

If using a PC, send the Release Status command by typing AT\$Tn [Enter], where n is the address of the SM-975. The status should be displayed at the command prompt.

Verifying Some Important Deployment Considerations

Before deploying the SM-975, verify the following important deployment considerations:

- The loading on the release mechanism is within the specified rating.
- The tether securing the SM-975 to the mooring is of sufficient length to avoid a collision with the mooring during deployment.
- The tether is properly and securely attached to the drop link and to the mooring.
- There will be a clear acoustic path to the surface within the specified maximum range, where this range is the slant range from the transmitting transducer on the surface to the SM-975.



NOTE For additional deployment considerations refer to Section 3, "Deployment Considerations" of the "Acoustic Telemetry Modems User's Manual."

Performing the Predeployment Checks

Before deploying the SM-975, perform the following predeployment checks:

- Inspect the SM-975 for possible damage from a previous deployment.
- Verify that the dissolving wire module and the ground bolt are properly installed and securely tightened.
- Verify that the ground bolt and its attached wire are not corroded.
- Verify that the drop link is free to slide away from the release lever.
- Test the release mechanism as described in "Testing the Release Mechanism" on page 3-2.
- Check the battery as described in "Checking the Status of the SM-975" on page 3-6.
- Verify that the magnet is removed.



WARNING The SM-975 cannot be released if the magnet is not removed. Before deploying the SM-975, verify that the magnet is removed.

Deployment

After performing the predeployment checks, deploy the SM-975 by gently lowering it and its anchor into the water. Try to minimize the impact loads on the release mechanism during the deployment.

Recovering the SM-975

The SM-975 is recovered by an acoustic command from a UDB-9400 Universal Deck Box or an ATM-900 Series Acoustic Telemetry Modem. The touch screen display of the deck box can be used to enter the command, or the command can be entered from the keyboard of a PC that is connected to the deck box or modem.

To recover the SM-975:

1. Refer to "Setting Up the Modems" in Section 4, "Setup and Test" of the "ATM-900 Series Acoustic Telemetry Modems User's Manual" and set up the deck box or modem.
2. If using a deck box, lower the remote transducer into the water; if using a modem, lower it or its remote transducer into the water.

3. Switch the OFF/ON switch on the front panel of the UDB-9400 Universal Deck Box to ON or turn on the modem.
4. If using the touch screen display, refer to "Acquiring and Displaying the Range to a Remote Modem" in the "UDB-9400 Universal Deck Box User's Manual" or the "UDB-9400A Universal Deck Box User's Manual," and follow the instructions. Touch Get Range repeatedly in the last step until the range can be acquired.

If using a PC, repeatedly send the Range command by typing `ATRn [Enter]`, where `n` is the address of the SM-975, until the range can be acquired.



WARNING The range is the slant, or direct, distance from the remote transducer to the SM-975, not the horizontal distance.

5. While continuing to acquire range, navigate the vessel to position it such that it will be easy to sight the SM-975 once it surfaces yet ensure it will surface a safe distance from the vessel.
6. If using the touch screen display, refer to "Releasing a SMART Release or Modem" in the "UDB-9400 Universal Deck Box User's Manual" or the "UDB-9400A Universal Deck Box User's Manual," and follow the instructions.

If using a PC, send the Release command by typing `AT$Nn,m [Enter]`, where `n` is the address of the SM-975 and `m` is the release code. The message "Valid Release Code-Waiting for Burn..." should be displayed. If the release code is incorrect, the message "Invalid Release Code" will be displayed, instead.

7. If the correct release code was received, the dissolving wire module will be activated, during which the SM-975 will continue to respond to acoustic commands if they are sent. For example, checking the status of the SM-975 as described in "Checking the Status of the SM-975" on page 3-6 should display the message "Burn Wire Activated," which acknowledges that the dissolving wire module is currently activated.

Once the burn wire is activated and begins to dissolve, it can take anywhere from 5 to 30 minutes, depending on the water salinity, for it to break through and the SM-975 to release from its mooring. While the burn wire is activated, the burn wire current is sampled and stored once per minute, and the `#n getcurrent` command can be used to display the sampled currents. Even after breaking through, what remains of the wire loop will continue to dissolve and draw current.

8. Once the SM-975 has been released from its mooring, it will flip over and trigger the tilt sensor. Once this happens the message "Burn Wire Released, Unit Tilted" will be displayed, indicating the SM-975 has been released and is floating to the surface. However, if the deck box or other surface modem that was used to send the acoustic commands is transmitting, this message may not be received. But again, the Release status can be checked as described in "Checking the Status of the SM-975" on page 3-6 and should display the message "Burn Wire Released, Unit Tilted," which acknowledges that it has been released.

4 Maintenance and Troubleshooting

This section encompasses the recommended care and maintenance procedures for the SM-975 SMART Modem. These tasks primarily involve general cleaning and inspection and replacing the battery pack. In addition, some troubleshooting recommendations are provided should the SM-975 not respond to commands or its release mechanism fails to function, and a procedure is included on how to rebuild the dissolving wire module.

General Cleaning and Inspection

Cleaning and inspecting the SM-975 requires a source of clean, *fresh* water for washing. In addition, the following items are recommended:

- *Silicone O-ring lubricant*
- *Alcohol wipes*
- *Cloths or paper towels*
- *Mild, non-abrasive detergent*

After retrieving the SM-975, clean and inspect it as follows:

1. Wash down the SM-975 with fresh water and remove any debris that may have become attached.
2. Unplug the cable from the power/serial connector, inspect and clean the cable, and then clean the power/serial connector with an alcohol wipe.
3. Lubricate the power/serial connector pins with a light coat of silicone lubricant and install the supplied dummy plug.



NOTE Be especially careful not to get any lubricant on the face of the transducer as this will severely degrade its performance.

4. Clean the transducer with non-abrasive detergent, being careful to remove any buildup. After cleaning, spray the transducer again with fresh water.



NOTE Do not use an ammonia-based cleaner such as a glass cleaner to clean the transducer.

5. Carefully inspect the transducer for any signs of damage.
6. Using a cloth or paper towel, dry the SM-975 thoroughly.

Replacing the Battery Pack

Replacing the battery pack requires that the hard hat and glass sphere housing be disassembled.



NOTE Except for disconnecting and reconnecting the battery packs, the procedure is the same for both the 13-inch and 17-inch glass sphere housings, where the 17-inch housing includes two battery packs.

The tools and materials required for this task are the following:

- ***(2) 3/4-inch adjustable wrenches***
- ***Flat head screw driver***
- ***Heat gun***
- ***18-inch diameter hose clamp***
- ***Small roller***
- ***Cleaning alcohol***
- ***Lint free cloth***
- ***Butyl rubber sealant strip***
- ***Wide black vinyl tape***

The sealant strip and the vinyl tape are included in the Spare Parts Kit. The battery pack is also available from Teledyne Benthos. Refer to Table 5-1 on page 5-1 for the part numbers. Refer to Section 1, "Overview," for the location of the modem components and boards called out in the following procedure.

To replace the battery pack:

1. Carefully lay the SM-975 down on its transducer.
2. Remove the magnet from the bracket on the band clamp assembly.



WARNING With the magnet removed the modem electronics and the transducer terminals may contain potentially harmful high voltages. Always keep hands and fingers away from these components.

3. Using the two 3/4-inch adjustable wrenches, remove the four (13-inch sphere) or eight (17-inch sphere) sets of hardware that secure the two halves of the hard hat—a bolt, a nut, a pair of flat washers, and a lock washer in each set, as shown in Figure 4-1.
4. Disconnect the cable from the dissolving wire module and remove the ground bolt wire from the ground bolt.
5. While pushing the connector pigtail and the ground bolt wire through the grommets, remove the bottom half of the hard hat, the half that includes the attached release mechanism, as shown in Figure 4-2.



Figure 4-1 Location of Hardware that Secures the Two Halves of the Hard Hat

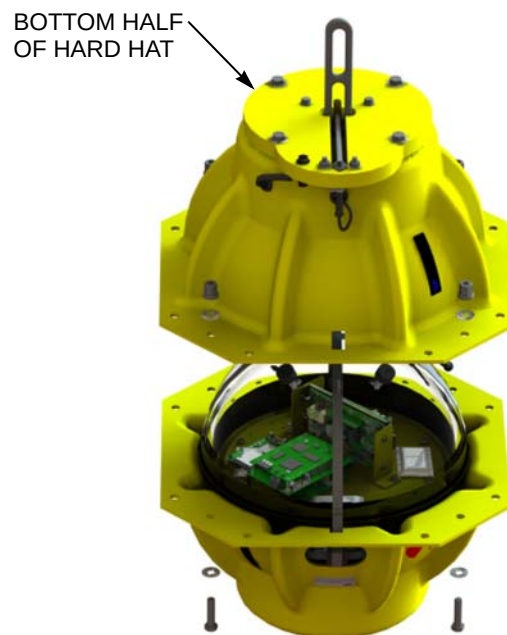


Figure 4-2 Removing the Bottom Half of the Hard Hat

6. Remove the glass sphere housing from the top half of the hard hat as shown in Figure 4-3 and carefully rest the housing on the transducer.
7. Using the flat head screw driver, loosen the two band clamp assembly adjustment screws and remove the band clamp assembly.
8. Turn the SM-975 off by taping the magnet over the match arrow mark near the equator on the upper hemisphere. Wait approximately two minutes for the capacitor to discharge.

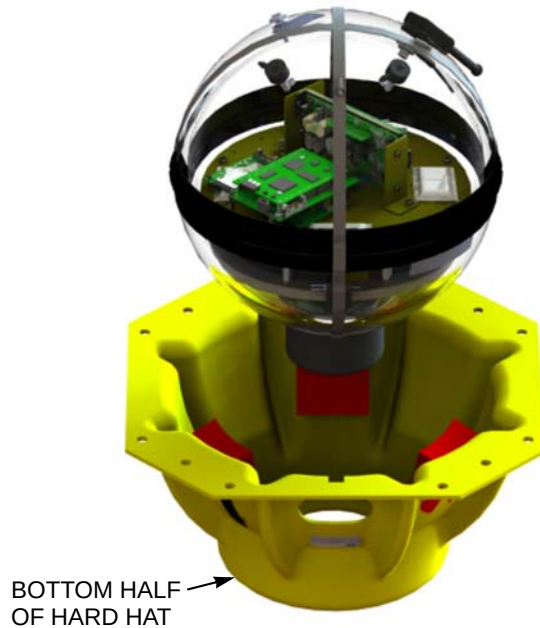


Figure 4-3 Removing the Glass Sphere Housing

9. Verify that the SM-975 is off by attempting to check the status as described in "Checking the Status of the SM-975" on page 3-6, but with the magnet taped to the housing. There should be no response.



WARNING When separating the two glass hemispheres, be careful not to chip the finely ground flat edges of the seam between them.

10. Completely remove the black vinyl tape and the butyl sealant strip underneath the tape.
11. Release the vacuum in the housing by temporarily removing the vacuum port screw and O-ring, and then reinstall them immediately after the vacuum is released.



WARNING If the vacuum port screw and O-ring are not reinstalled into the vacuum port, the housing will leak when it is underwater.

12. Separate the two hemispheres by tapping one of them with the palm of the hand.

13. Carefully set the bottom hemisphere—the one *without* the transducer—aside next to the other hemisphere with the seam edge facing up.
14. Disconnect the two cables that connect the two hemispheres together.
15. Disconnect the reed switch from J4 of the Transmitter/Receiver board.
16. Disconnect the transducer cable from J1 of the Transmitter/Receiver board.
17. Remove the eight screws and washers from the mounting plate, and then remove the modem electronics from the upper hemisphere of the housing as shown in Figure 4-4.
18. For a 13-inch glass sphere housing only, where one battery pack is included, disconnect the battery connector from J1 of the Burnwire board.

For a 17-inch glass sphere housing only, where two battery packs are included, disconnect the battery connectors from J1 of each of the two Connector boards.

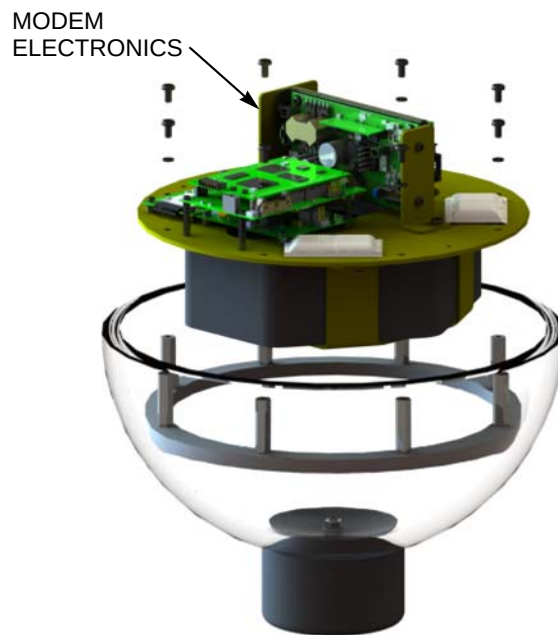


Figure 4-4 Removing the Mounting Plate Screws and Washers

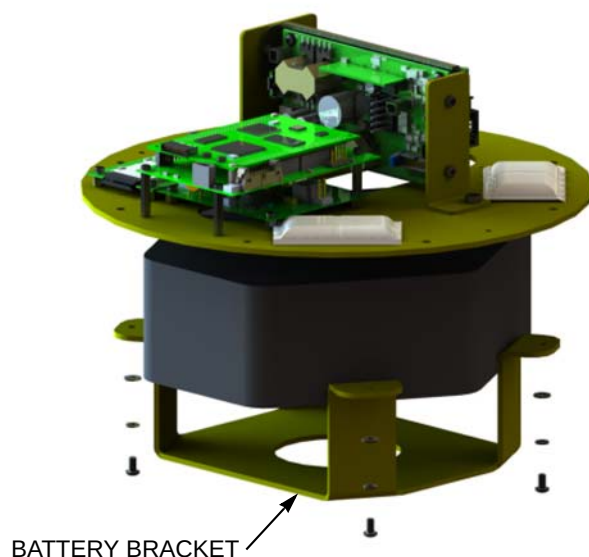


Figure 4-5 Removing the Battery Bracket

19. Remove the four screws and washers from the battery bracket, and then remove the bracket and the battery pack, passing the battery connector through the hole in the mounting plate as shown in Figure 4-5 on page 4-5.
20. Verify that the rubber spaces remain secured to the bottom of the mounting plate.
21. Install the new battery pack, passing the battery connector through the hole in the mounting plate, and then secure it with the battery bracket and the four screws and washers.
22. Insert the modem electronics into the upper hemisphere and secure it with the eight screws and washers.
23. Connect the transducer cable to J1 of the Transmitter/Receiver board.
24. Connect the reed switch to J4 of the Transmitter/Receiver board.
25. Connect the two cables that connect the two hemispheres together.
26. For a 13-inch glass sphere housing, connect the battery connector to J1 of the Burnwire board.

For a 17-inch glass sphere housing, connect the battery connectors to J1 of each of the Connector boards. It does not matter which Connector board connects to which battery pack.
27. Verify that the strip on all the desiccant packs is blue. Replace any pack that shows a pink strip.
28. Clean both hemispheres thoroughly, particularly near the seam, using alcohol and a lint free cloth.
29. Place the bottom hemisphere back on the top hemisphere, positioning it such that the arrow markers on each hemisphere are aligned. Verify that the vacuum port screw and O-ring have been replaced.
30. Temporarily slide the two hemispheres slightly apart, and then use the heat gun to blow hot air into the housing. For a 650-degree, 1200-watt heat gun, it will take about 15 seconds to properly heat the housing; a lower power heat gun will take longer.
31. Immediately slide the two hemispheres back together, realigning them with the arrow.
32. With the palm of the hand, gently tap the two hemispheres as necessary to get the best possible fit at the seam with no overhang and with the arrows aligned.

33. Wrap the butyl rubber sealant strip entirely around the seam, keeping the paper on the outside, and then cut the strip such that the two ends meet without overlapping.
34. While firmly holding the housing to keep the hemispheres from shifting, and without removing the paper on the sealant strip, use the roller to flatten the sealant strip along its entire length until it is about half its original thickness.
35. Remove the paper.
36. Wrap wide black vinyl tape three times around the seam, stretching the tape as it is being wrapped and centering it on the sealant strip.
37. Rub the tape smooth with the hand.
38. Remove the magnet. The SM-975 will activate.
39. Install the band clamp assembly, verifying that the ring is centered around the transducer and that the magnet bracket is positioned over the “match arrow” mark and centered over the leads of the reed switch.
40. Tighten the two adjustment screws. Do not overtighten.
41. Carefully insert the housing into the top half of the hard hat, aligning the notch with the band clamp containing the magnet bracket as shown in Figure 4-6.
42. Secure the two hard hat halves with the four or eight sets of hardware.
43. Replace the magnet by inserting it into the bracket and securing it with electrical tape.

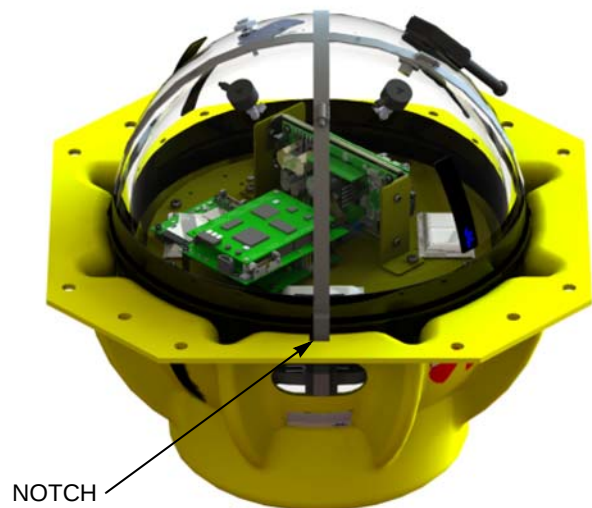


Figure 4-6 Location of Notch in Top Half of Hard Hat

Troubleshooting

If the release mechanism fails to operate when testing it, or if the SM-975 does not respond to commands, check the following in the order presented:

1. Verify that the address and release code are being entered correctly. The factory default address is 0, and the release code is the serial number of the SM-975 which is printed on the serial tag.
2. Check the battery pack by sending the Release Status command as described in "Checking the Status of the SM-975" on page 3-6.
3. Move the remote transducer used with the UDB-9400 Universal Deck Box or ATM-900 Series Acoustic Telemetry Modem and the SM-975 transducer farther apart or closer together
4. When using a PC, use the Remote Power command (AT\$pn,m) to change the transmit power level, usually to a lower level. For instructions on how to use the Remote Power command, refer to Section 6, "Modem Operating Modes and Commands," of the "Acoustic Telemetry Modems User's Manual." If using Telesonar PC, refer to Section 5, "Telesonar PC," of the manual.
5. Check or replace the battery pack as described in "Replacing the Battery Pack" on page 4-2.

Should further help be required, contact Teledyne Benthos directly. Refer to "Customer Service" on page vi for information on how to contact Teledyne Benthos.

Rebuilding The Dissolving Wire Module

Instead of replacing the dissolving wire module, it can be rebuilt. The Re-arming kit includes the necessary components to rebuild the module. In addition, a pair of wire clippers, a small flat head screw driver, an adjustable wrench, and a multimeter are required. Safety glasses are also recommended.

To rebuild the dissolving wire module:

1. Cut the cable tie and disconnect the connector pigtail from the dissolving wire module.
2. Remove the dissolving wire module by removing the two sets of bolts, nuts and washers that secure it.

3. Unscrew the burnwire bolt from the dissolving wire module base and remove the base washer. These components are shown in Figure 4-7.
4. Rinse the base and the burn wire bolt in fresh water and verify that the base of the pin inside the burnwire bolt is clean. The pin, along with attached two O-rings can be removed from the burnwire bolt for cleaning or replacing.

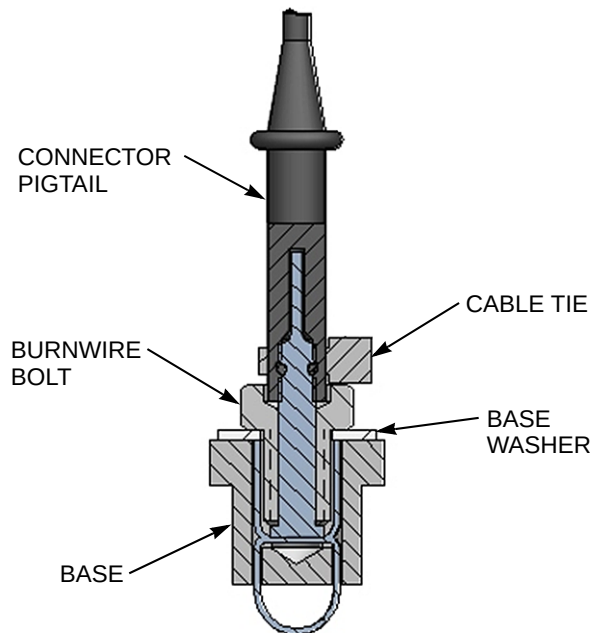


Figure 4-7 Dissolving Wire Module Components

5. Insert a dissolving wire into the burnwire bolt, leaving a 0.3-inch radius loop as shown in Figure 4-8.

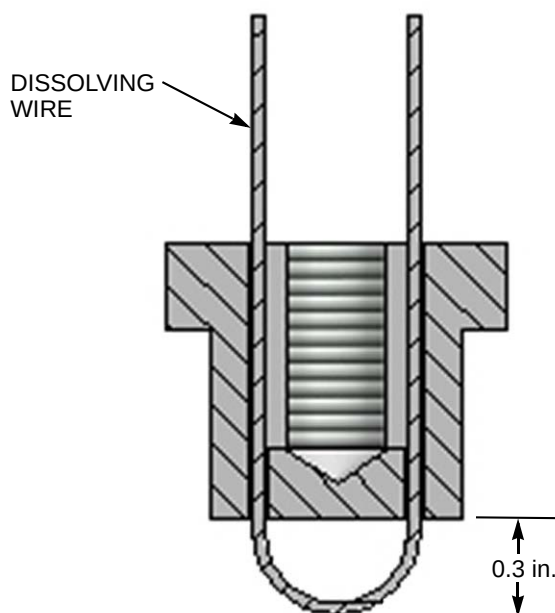


Figure 4-8 Dissolving Wire Inserted in Burnwire Bolt

6. Using a small flat head screw driver, cross the two wire leads as shown in Figure 4-9.

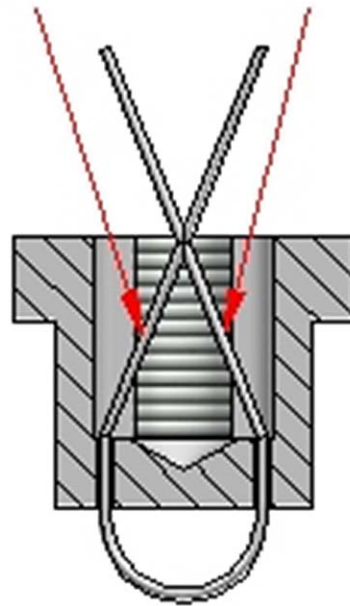


Figure 4-9 Wire Crossed inside Burnwire Bolt

7. Screw the 3/8-16 x 5/8 bolt included with the Re-Arming Kit into the base until the wires are fully flat against the bottom as shown in Figure 4-10, and then remove the bolt.
8. Install the base washer and screw the burnwire bolt into the dissolving wire module base.
9. Use a digital multimeter to verify good electrical contact between the wire loop and the pin.

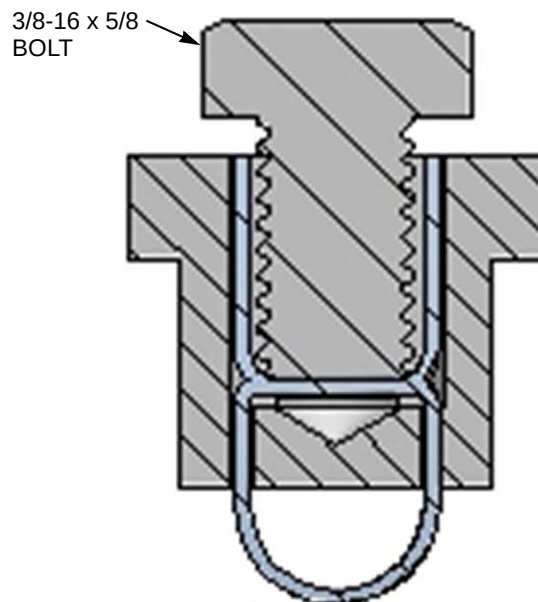


Figure 4-10 3/8-16 x 5/8 Bolt Temporarily Inserted into Base to Flatten Wire

5 User Replaceable Parts and Part Number Designator

This section comprises a list of Teledyne Benthos SM-975 SMART Modem user replaceable parts. Also included is a modem part number designator which provides an easy method for designating the specific part number for a modem when placing an order.

Modem User Replaceable Parts

The modem user replaceable parts are listed in Table 5-1.

Table 5-1 SM-975 SMART Modem User Replaceable Parts

DESCRIPTION	PART NUMBER
Power/Serial Cable	C846-0020
Dummy Plug	011170
Battery Pack	C847-0003
Re-arming Kit	014529
Spare Parts Kit	011685
Butyl Rubber Sealant Strip	0900-024
Wide Black Vinyl Tape	0903-013

Modem Part Number Designation

The SM-975 SMART Modems use an identification number scheme that allows the model number to be used as the part number. This method simplifies the ordering and support processes. To designate the part number for a SM-975 specification, follow the legend shown in Figure 5-1.

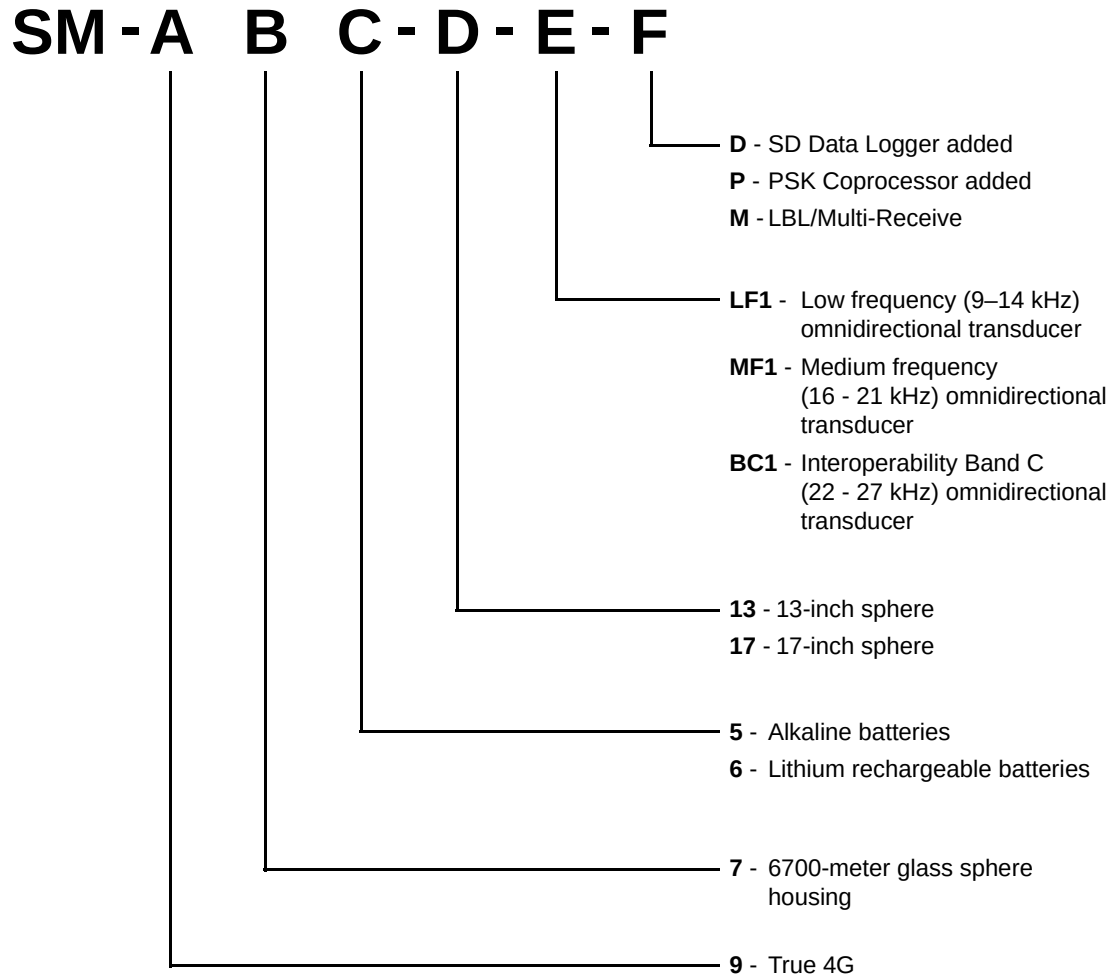


Figure 5-1 SM-975 SMART Modem Part Number Designator Legend