



Datum Systems, Inc.

M5 VSAT/SCPC Satellite Modem

Installation and Operation Manual

Covers

PSM-4900 - 70 MHz IF

PSM-4900 - 140 MHz IF

PSM-4900H - Hybrid IF

PSM-4900L - L-Band IF

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Safety Notice

This equipment has been designed in accordance with UL and CSA standards for Safety of Information Technology Equipment.

The PSM-4900 Modem contains potentially lethal voltages inside the case. Extreme caution should be exercised when the cover is removed by following the precautions listed below

Never operate the equipment with the cover removed. Never remove the cover with power applied. As a safety measure the power cord should be disconnected from the unit when preparing to remove the cover.

This modem is designed for indoor use. Do not operate this equipment in a wet environment or outdoors.

Do not operate the modem in an unsafe environment near explosive or flammable gases or liquids

Insure good grounding practices. The grounding lug on the rear of the modem should be connected to a good earth ground with low impedance cable in rack installations.

The modem is supplied with an IEC filtered power inlet module designed to accept a 3-wire mains connection consisting of an earth ground, neutral and line conductors. The mating power cord should have a line cord and plug suitable for the country of operation.

EMC Notice



This equipment has been designed in accordance with FCC and CE standards.

FCC: Part 15, Subpart B, Class A
CE Emissions: EN 55022 Class A, EN 61000-3-3 Class A, EN 61000-3-3
CE Immunity: EN 55024

To maintain compliance with these standards the following the precautions must be observed.

The equipment must be operated with the cover and all cover screws in place.

Do not remove the rear panel option plate without replacing it with one designed for a specific option assembly.

All rear connections are designed to have integral shielding on the cable and connector assembly. "D" type signal connectors must have grounding fingers on the connector shell.

About This Manual

This manual is composed of several separable documents. They include the main body of the manual and several "Appendices". The main body itself is separated into several "Sections" or "Chapters". A "Section is considered a sub-section of a Chapter, such as Section 4.1.2 is a numbered section within Chapter 4. Page numbers include the Chapter, as in page 3-14.

This manual is available in a printed form and as an electronic "Portable Document Format" or .PDF file. The electronic format is produced as a universal Adobe Acrobat readable file, and can be requested directly from Datum Systems, Inc., or via download from the web at www.datumsystems.com. The electronic format on the web is always the latest revision.

Revision History

- Revision 1.8 1/17/2003 Added information on release of modifications to firmware for Auto Modulator data clock mode and GA Step processor compatibility. Requires minimum Modem Software Revision 0.80.
- Revision 1.7 12/10/2002 Added information on release of modifications to firmware for Turbo Product Codes enhancement and compatibility. Requires minimum Modem Software Revision 0.76.
- Revision 1.6 7/27/2002 Added information on release of the "L-Band" Modem Version PSM-4900L. Requires minimum Modem Software Revision 0.72.
- Revision 1.5 12/17/2001 Format Changes and removed redundant information.
- Revision 1.4 8/20/2001 Added information on release of the "Hybrid" Modem Version PSM-4900H and Turbo Product Codes FEC Option. Requires minimum Modem Software Revision 0.62.
- Revision 1.3 12/20/2000 Added information for the preliminary release of the SDMS Ethernet Interface Option. Requires minimum Modem Software Revision 0.34.
- Revision 1.2 12/5/2000 Added information for the release of the Reed-Solomon/IBS Multiplexer Option Card and instructions for operating the internal modem's software update. Requires minimum Modem Software Revision 0.32.
- Revision 1.1 9/5/2000 Added preliminary information for the operation of 1:1 Redundancy. Requires minimum Modem Software Revision 0.11.
- Revision 1.0 5/5/2000 Initial Release. Requires minimum Modem Software Revision 0.08.

Pen and Ink Changes Made to this Manual

Chapter 1 - PSM-4900 Modem Description

1.0 Introduction

The Datum Systems' PSM-4900 VSAT/SCPC Satellite Modem is a microprocessor-controlled Binary Phase Shift Keyed (BPSK) or Quadrature Phase Shift Keyed (QPSK) Modulator and Demodulator for use as part of the transmitting and receiving ground equipment in a satellite communications system. The PSM-4900 uses the latest Digital Signal Processing (DSP) technology and proprietary techniques to provide unsurpassed performance at a low cost.

The PSM-4900 with a standard 70 (or 140) MHz IF is the first member of Datum Systems' M5 Class Modem products, representing a fifth generation of innovative design concepts proven and refined over ten years of production. The PSM-4900H is the second, combining a 70 MHz transmit IF with an L-Band receive IF ideally suited for small stations and complex VSATs. The PSM-4900L is the third, utilizing L-Band frequencies for both the Transmit and Receive IF, it creates the ability to build extremely simple and low cost high performance VSATs. All M5 class products encompass significant performance improvement over previous modems at reduced cost.

The modem is designed for service in varied types of satellite systems. Either SCPC systems where two modems are set for continuous operation with each other, or shared resource systems where modem carriers are not continuous in nature, such as DAMA and TDMA networks, where outgoing signals from the modem can be operated in a "burst" mode. *Note: As of the time of this manual the "TDMA burst" mode is a special factory request option and not installed in standard modems.*

The modem is designed to be easily integrated into either a master or remote station via rack mounting. A highly integrated design allows the PSM-4900 to be built into a one rack unit (1 RU, 1.75") high mounting case, using minimal power for dense applications. The modem is an integral part of a satellite earth station's equipment operating between the Data Terminal Equipment and the station Up and Downconverter equipment.

1.0.1 How to Use This Manual

This manual provides Installation, Operating and Maintenance procedures for the PSM-4900 Satellite Modem and available options at the time of printing.

This manual is an integral part of the modem and is used to explain the installation and operating procedures for the PSM-4900 and present its capabilities and specifications. The manual is divided into 4 Chapters with Appendices. The 4 Chapters are the Modem Description, Installation, Operation and Maintenance. The Appendices include the Specifications, Remote Control Protocol and gives further information on Options, Cabling and information related to placing the Modem in service.

The divisions of the manual are intended for use by personnel to answer questions in general areas. Planners and potential purchasers may read the Introduction and Specifications to determine the suitability of the modem to its intended use; Installers should read the Installation Chapter and the Cabling Specification Appendix; Operating Personnel would use the Operations Chapter to become familiar with the Modem; while System Programmers would use the Remote Control Protocol to determine control requirements.

The PSM-4900, 4900H and 4900L modems are fully interchangeable with the single exception of the IF input frequency range. In addition all options available for the PSM-4900 are usable with the PSM-4900H or L. The term PSM-4900 is used throughout this manual where references apply to either the PSM-4900, 4900H and 4900L modems. Where a subject is specific to one modem the "H" or "L" suffix is used or the specific differences in operation between the three modem versions are detailed.

1.0.1 Quick Start For Experienced Modem Users

If you are experienced with modems, but not this particular one, you may want to skip some of the introductory material and learn how to operate the front panel to set up the modem immediately. Go directly to Section 3.1 – “Operating Procedures” and get a feel for how the front panel operates. Then scan Tables 3-1 through 3-4 listing the parameters that can be changed, and set up the modem for your application. We strongly recommend that you go back to learn more, as these modems have extensive capabilities and features that are unique. A list of abbreviations is located at the end of the “Frequently Asked Questions” (FAQ) in Chapter 4.

1.1 Modem Capabilities

1.1.1 Modem IF Variations

The M5, PSM-4900 series is currently offered with 3 main Intermediate Frequency (IF) variations designed to meet the needs of various station types. The standard PSM-4900 modem has a 70 MHz transmit and receive IF which is typical for use in large stations with indoor or outdoor up and down converters. The PSM-4900H has a 70 MHz transmit IF and an L-Band receive IF, making it suitable for small or medium size stations where more than 1 modem may be required. The PSM-4900L unit features L-Band transmit and receive making it ideal for low cost one or two modem stations.

1.1.2 Applications

Following are just a few representative forms of satellite communications links and networks in which the PSM-4900 modem series may be used.

1.1.2.1 SCPC Point-to-Point Links

The most straightforward application for a satellite modem is to serve as the Data Communications Equipment (DCE) for a point-to-point data link. When used in this mode, two modems located at two different sites are tuned to complementary transmit and receive frequencies. Each direction of the communications link may have the same or entirely different transmission parameters. In this application it is typical that the link is established and maintained on a continuous basis, although a special “on demand” case is described later.

In SCPC point-to-point links the power required from the satellite or the size of the receive antenna is dependent upon the modem receive performance. The PSM-4900 modem uses the most rigorous methods to maintain performance as close to the theoretical “waterfall” curves as possible. In most cases the modem will perform at 0.1 to 0.2 dB from the curve (although we say “typically” 0.3 dB). This consistent performance, plus advanced technology such as TPC results in the absolute minimum power requirements, which equates to the minimum operating.

Ku Band satellite systems are subject to changing performance due to rain at one or more sites. The PSM-4900 contains built in software to perform Automatic Uplink Power Control (AUPC). If the modems at each link end are provided with an external asynchronous channel of 300 bps they can be set to automatically maintain a constant Eb/No within programmable limits. This can result in significantly lower satellite power requirements in a large system in addition to maintaining proper performance in any system. The optional Multiplexer/interface card can provide this low rate channel in addition to an Earth Station to Earth Station overhead service channel.

1.1.2.2 SCPC Point to Multi-Point Links in a Broadcast Application

A broadcast application might involve the necessity of sending continuous or intermittent data from one source and “broadcasting” the information to many remote locations. For instance, constant pricing information and updates may be sent by a central location to many store locations. There may be minor return information from the remotes acknowledging receipt.

Another broadcast application could be transmitting background music from a central location to many store sites. In this case there would be no return path.

The topology of the network in both of these broadcast examples would typically be called a “Star” network. As shown in Figure 1-1, the shape of the configuration is drawn with the central “Hub” as the center of the star and the remotes as points of the star. In both cases the transmit frequency and other parameters may be shared by the receive of all the remotes.

The PSM-4900H and L are ideally suited for use at remote or small stations. Since the receive down-converter requirement is significantly reduced in this version, requiring only that a data grade LNB (Low Noise Block down-converter) be connected to the modem. The Hybrid and L-Band version modems can even supply power and reference to the LNB if needed. In addition the PSM-4900L is designed for use with a Block Up Converter or “BUC” and can supply power and reference signals on the transmit cable. Most BUCs today are designed to receive these signals on the cable.

In Broadcast type systems where the remotes only require a receiver, the PSM-4900H or L is very low cost and the transmit modulator section can be simply turned off.

A “Star” network configuration is also commonly used with multiple point-to-point links where the hub is common to every link. An example might be where each remote represents a house or building with voice or data traffic all destined for a common switch located near the hub. Each link is then usually dedicated to that customer and the link

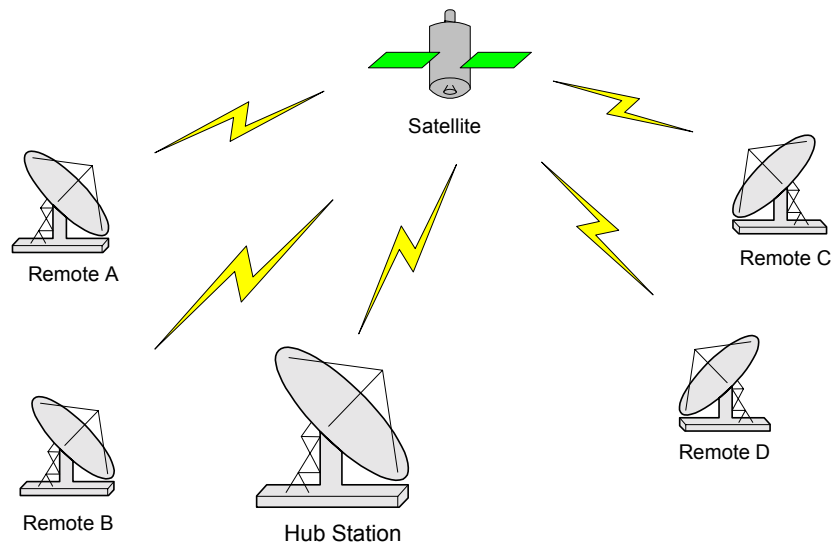


Figure 1-1 Simple Star Network

resources are wasted when no traffic is carried. That loss is partially offset by being able to use smaller antennas and power at each of the remotes, concentrating costs at the hub.

1.1.2.3 DAMA (Demand Assigned Multiple Access)

Suppose that we wanted to simulate a telephone network with a virtual switch between modems carrying digitized voice information. We might use a central computer to assign a pair of frequencies for any conversation and send this connection information to the proper sites to set up the connection. Many systems of this type use “Star” network topology, but this has the disadvantage that for a person at Remote A to talk to someone at Remote D the traffic must go through the hub. The resulting delay through 2 satellite hops is just at the limit of what is tolerable for voice traffic.

In this application a new network configuration is usable. That is a “Mesh” network where any of the voice modems at any site can be programmed to link with any other modem directly at any other site. The resulting link diagram looks like a mesh of interconnects. Now there must be sufficient antenna size and power at each remote to link to every other remote. The station costs can go up significantly, and are multiplied by the number of stations.

Since the frequencies can be assigned on demand, the network is then called “Demand Assigned, Multiple Access”, or DAMA. One important characteristic of a DAMA system used for voice information is the lock-up time of the modem. At the low data rates used to digitize voice today (4.4 to 32 kbps) the modem receive acquisition method of sweeping results in lock-up times of tens of seconds to minutes. The PSM-4900 modem is uniquely designed to significantly reduce this time:

The fast acquisition digital signal processor used in the PSM-4900 looks at the receive signals within its acquisition range much like a person might view the same region using a spectrum analyzer. It

then “homes in” and locks to the most probable carrier. This acquisition mode can reduce the receive acquisition time to approximately $1/3^{\text{rd}}$ of a second at 9.6 kbps in QPSK mode over +/- 30 kHz, and less in BPSK mode.

1.1.2.4 TDMA (Time Division Multiple Access) Remote Site Application

In a TDMA network the central Hub continually transmits a stream of outbound data containing information for multiple remote sites, while the remotes transmit back to the Hub on a timed basis. Each of these remotes is said to “burst” its information back on a specific frequency. This may be the same inbound frequency for all sites. Each of the remotes is responsible for accessing its own information from the outbound data stream by reading the address assigned to specific parts of the data.

The TDMA network usually looks like the Star network described above. The outbound (from the Hub) data rate may be quite high to accommodate many remotes with low latency, while the inbound data rate may be low to allow use of a small antenna and power amplifier at the many remote sites.

The PSM-4900 (and especially the Hybrid “H” or “L” version) is specifically designed to be usable as the remote site modem of a TDMA network when coupled with a proper “Burst” demodulator at the hub site. **Note: As of the time of this manual the “TDMA burst” mode is a special factory request option and not installed in standard modems.**

Another variation could use both the DAMA (star or mesh configuration) with a concurrent TDMA system as the monitor/control network for the DAMA. Again the PSM-4900 modem is ideally suited for both modem applications at both low and high speeds.

1.2 Modem Functional Assemblies

The PSM-4900 VSAT/SCPC Modem consists of seven main functional elements arranged on three electronic printed circuit assemblies, as shown in Figure 1-2.

The Main Modem Circuit Assembly consists of the following major assemblies:

1. The Modem digital PSK modulator with carrier generation in the 50 to 90 MHz range for standard and Hybrid modems, or 950 to 1750 MHz with the 4900L.
2. The Modem digital PSK demodulator accepting signals in the 50 to 90 MHz range for the standard modem or 950 to 1950 MHz with the Hybrid PSM-4900H or L.
3. The Modem microprocessor monitor/control subsystem.
4. The Modem Digital Signal Processor Acquisition subsystem.
5. The Programmable Data Interface. Seven standard data interfaces are built onto the main modem assembly. The unit can also accept special interfaces via an optional interface card.

The other two printed circuit assemblies are the Front Panel Control Assembly, and the Power Supply Assembly.

In addition the main PWB can accept two optional sub-assemblies. The first “daughter card” is designed to bypass the on-board Forward Error Correction (FEC) with an optional design FEC of which the first type is a Turbo Products Codes (TPC) Unit.

The second daughter card can fit in-line between the interface circuitry and the rest of the modem transmit and receive paths. This is designed to hold the optional Reed-Solomon Codec and IBS Multiplexer circuitry.

Note in the functional block diagram below that, with the exception of the receive FIFO buffer, there are complementary signal processing blocks in the transmit and receive paths. Note also that there are no typical superhetrodyne mixing and filtering blocks. That is because there are none used in the direct modulation and demodulation scheme used in the PSM-4900.

The following sections described more detail on the design of the modulator and demodulator.

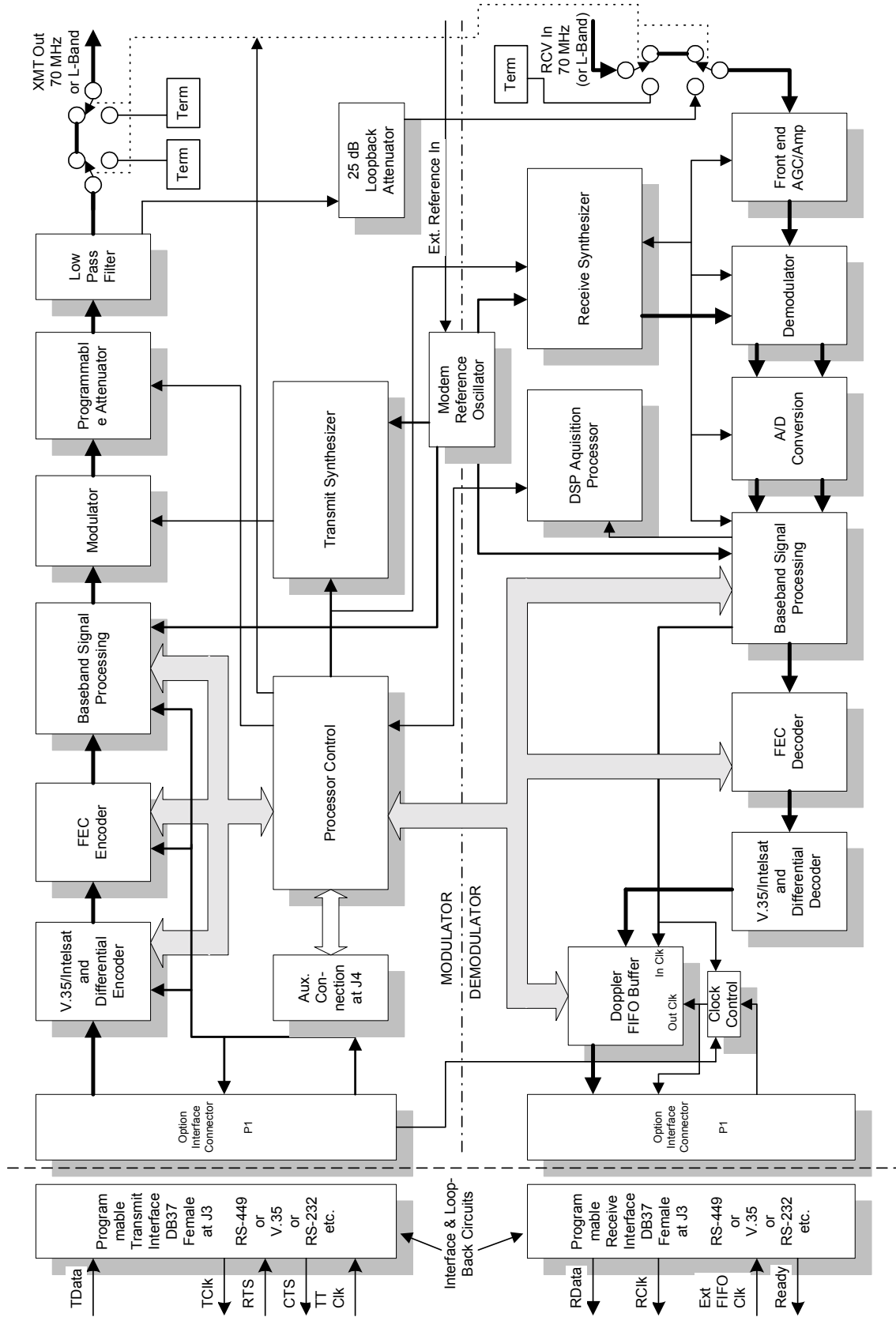


Figure - M5 Modem Block Diagram

Figure 1-2 Modem Block Diagram

1.2.1 Modulator

The PSK modulator in the modem employs a unique digital modulation scheme requiring no heterodyne operations (mixing and filtering to an IF) to arrive at the transmit RF frequency. The desired carrier frequency is synthesized and directly modulated with the baseband signal. The baseband signal is itself digitally derived and generated using a digital to analog (D/A) converter. The digital signal processing of the transmit signal includes the equivalent of a 144 tap FIR filter function.

As previously shown in Figure 1-2, synchronous transmit data and clock signals are accepted by the modulator, then processed by the V.35/Intelsat scrambler and differential encoder. The modulator can be set by the processor to operate at a number of data rates between 1.2 kbps (BPSK, rate 1/2) and 4,920 kbps (QPSK, rates 3/4 or 7/8). Refer to the specification in Appendix A for exact rate capabilities. The data is then convolutionally encoded for Forward Error Correction (FEC) at rate 1/2, 3/4 or 7/8 resulting in an encoded signal at between 2.4 and 3280 Ksps (kilo symbols per second). The convolutional encoder can be programmed for rate 1/2, 3/4 or 7/8 and is set for a constraint factor (K) of 7 for use by a (receiving end) Viterbi convolutional decoder with the same rate and K factor. An optional Reed-Solomon FEC is available for concatenated operation with the Viterbi Codec and a new "Turbo Codes" Codec is also available to replace the Viterbi Codec.

The FEC is followed by an optional differential encoder. The differential encoder output is then sent to the transmit baseband signal processor whose main function is to convert the data stream into analog baseband I and Q channels for modulating the carrier. The actual conversion process is accomplished in a lookup table, latch and D/A converter. The lookup table represents a digitally preprocessed function required to produce the proper RF signal output when mixed with the desired carrier frequency. A low-pass filter is applied to the D/A output to reduce the level of sampling components.

Transmit Local Oscillator generation is accomplished in two parts. A PLL step synthesizer is used to generate a basic LO in the 52 to 92 (or 104 to 184 or 952 to 1752) MHz range with 500 kHz step size. A Direct Digital Synthesizer (DDS), consisting of an NCO and D/A conversion, is used to generate an approximate 2 MHz signal with fine step size of approximately 1 Hz and a range of ± 1.25 MHz. When the DDS is subtracted from the step synthesizer output in a second PLL, the available LO can be tuned in 1 Hz steps over the full range of 50 to 90 MHz (100 to 180 MHz if built for that version).

The processed baseband signal is then mixed with the transmit synthesizer's LO carrier signal to generate an output modulated carrier in the 50 to 90 MHz range (or 950 to 1750 MHz in the L-Band modem). A classic IQ modulator with two mixers is used and the LO is fed into the second mixer shifted 90 degrees from the first. The modulated baseband signal can take two forms at this point depending on whether BPSK or QPSK modulation is used. In BPSK mode, the baseband signal fed to the two mixers is identical. In QPSK mode, the two signals represent the baseband I and Q channels of the baseband.

The resultant RF signal is then low pass filtered and amplified to produce a signal at approximately over 5 dBm into 75 Ω . An output attenuator controlled by the onboard processor is used to set the modulator output level over a range of +5 to -35 dBm. The actual attenuator is a set of pin diodes whose voltage is derived from the processor via a 12-bit D/A converter. The processor also holds a calibration table of DAC input vs. RF output level/frequency in non-volatile memory.

No physical adjustments are present in the modulator. All necessary adjustments are electronically performed during calibration and are intended to last the life of the unit without requiring resetting.

The modulator is capable of operating in two different modes: Continuous mode for SCPC use and "Burst" mode for use at a VSAT location. When set to VSAT operating mode, the transmit signal is turned off and on according to the status of the data interface control lines and framing information in the data stream as described in the "Operation" Chapter of this document. The burst mode allows multiple station modulators to link up consecutively with a single master station "burst demodulator".

Note: As of the time of this manual the burst mode is a special factory request option and not installed in standard modems.

The Modulator IF output can be routed to the Demodulator input using a built-in “IF Loop-back” function. The loop-back path provides a 25 dB attenuator to avoid overloading the receive input. The PSM-4900H employs a simple upconverter to L-Band frequencies to permit this IF Loop-back even when the transmit and receive are at vastly different frequencies.

1.2.2 Demodulator

The Modem Demodulator uses direct conversion techniques for recovery of data from an incoming carrier, and therefore like the modulator does not use heterodyning, and has no internal IF signal or processing. Referring to Figure 1-2, the input RF signal is first input to the receive AGC amplifier. The AGC amplifier has a range of greater than 40 dB at any data rate, allowing inputs over that range while still meeting performance criteria. The range is controlled in several steps depending on the data rate extending over the range of -20 dBm at high data rates to -84 dBm at low data rates. The proper AGC gain is digitally determined as that which produces an optimal output from the A/D converters and is thus derived after the A/D converters.

The RF input is then demodulated using a “Costas Loop”, phase locked loop demodulator where the signal is split using a 90 degree hybrid into I and Q channels. In BPSK mode, the I channel carries the data information and the Q channel represents the noise and carrier phase information in the Costas loop. For QPSK operation, the I and Q channels each carry data information. The I and Q channel “eye” signals are not available as in many other modems because the signal/data representation at this point is still strictly digital for direct signal processing.

A receive synthesizer generates the demodulator local oscillator which is at the desired receive carrier frequency. The synthesizer is tunable over the range of 50 to 90 MHz (or 950 to 1900 MHz in the Hybrid modem) and has two tuning components; the LO step synthesizer used to tune in steps of 500 kHz, and a Direct Digital Synthesizer (DDS) component used to acquire and track the received carrier. The DDS control has two tuning sources; (1) the digital Costas demodulation loop phase detector used to track an already “locked” signal and (2) the processor control used to set the carrier frequency and acquire new signals. The processor controls the acquisition search over a programmable range from ± 100 Hz to ± 1.25 MHz.

The I and Q channel baseband outputs of the Costas Loop demodulator are converted to digital data streams by parallel 12 bit D/A converters. The digital information is then filtered via a Datum Systems’ proprietary programmable digital filter. The filtered sample output is sent to the input of the Forward Error Correction (FEC) process (either Viterbi convolutional or Turbo Codes decoder) circuit. Multiple bits of the filtered A/D converter are used for “soft decision” decoding in the FEC, providing an improvement in performance over hard decision decoding.

The A/D output is also available to a special Digital Signal Processor (DSP), which is used to examine the incoming signals for known energy patterns and acquire carriers significantly faster than conventional sweep acquisition. This DSP controlled acquisition is especially useful at low data rates and can improve over a typical sweep by more than 2 orders of magnitude.

The receive signal processing shown in Figure 1-2 serves the following multiple functions:

1. Generates the soft decision symbol information for input to the FEC.
2. Recovers the bit rate clock from the incoming signal.
3. Measures the E_s/N_0 of the received signal.
4. Generates the receive AGC signal to set the input stage gain.

The FEC decoder uses a single IC Viterbi decoder on board (or the optional Turbo Product Codes decoder), which is under control of the onboard processor.

A differential decoder and INTELSAT / V.35 descrambler for the received data signal can be individually enabled or disabled by the processor under control of the front panel or command interface. This configuration is held in the nonvolatile EEPROM and does not have to be reconfigured on power-up. The resulting received data and clock signals are sent to the interface assembly. Receive interface clocking can take several forms as explained below.

1.2.3 Modem Bit Rate Timing

The Modulator and the Demodulator each have 4 possible sources for their bit rate timing.

The Modulator always outputs the Send Timing signal, but the source of this timing may be either:

1. An Internally generated bit rate NCO locked to the Internal Reference,
2. The Demodulator Receive Clock,
3. An External input at the data rate or
4. An external input on the Interface Terminal Timing input.

The modem's internal reference is a 2.0 parts per million clock oscillator, which is sufficiently accurate for most applications. If system timing requirements dictate a better reference, the internal oscillator may be phase locked to an external reference applied at the rear panel.

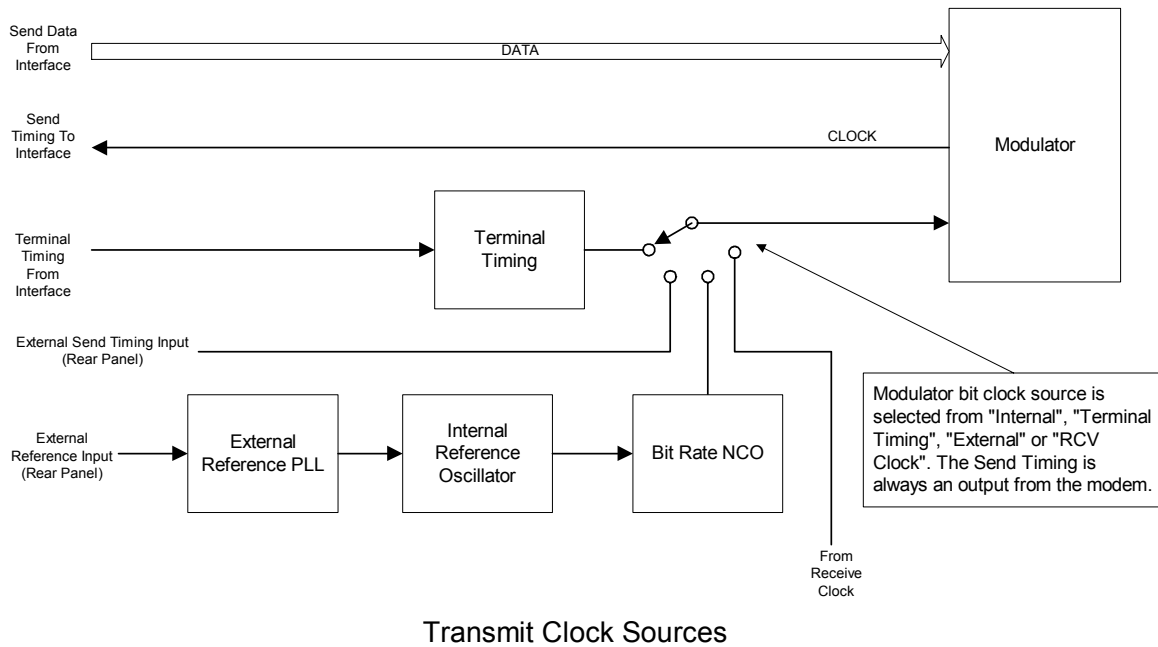
The Demodulator always outputs the Receive Timing signal. The receive demodulator clock derived from the receive signal is synchronous with the Receive Data and is the normal source of the receive timing. If the systems requires a different clock (which still must be the same average rate as the demodulator's receive clock) then provisions are made to buffer the data in a programmable FIFO. The demodulator receive clock is always used to clock the data into the FIFO. The clock output can be either:

1. The Demodulator Receive Clock,
2. The Modulator Clock
3. An internally generated bit rate NCO locked to the Internal Reference, or
4. An External FIFO Clock applied on the interface connector.

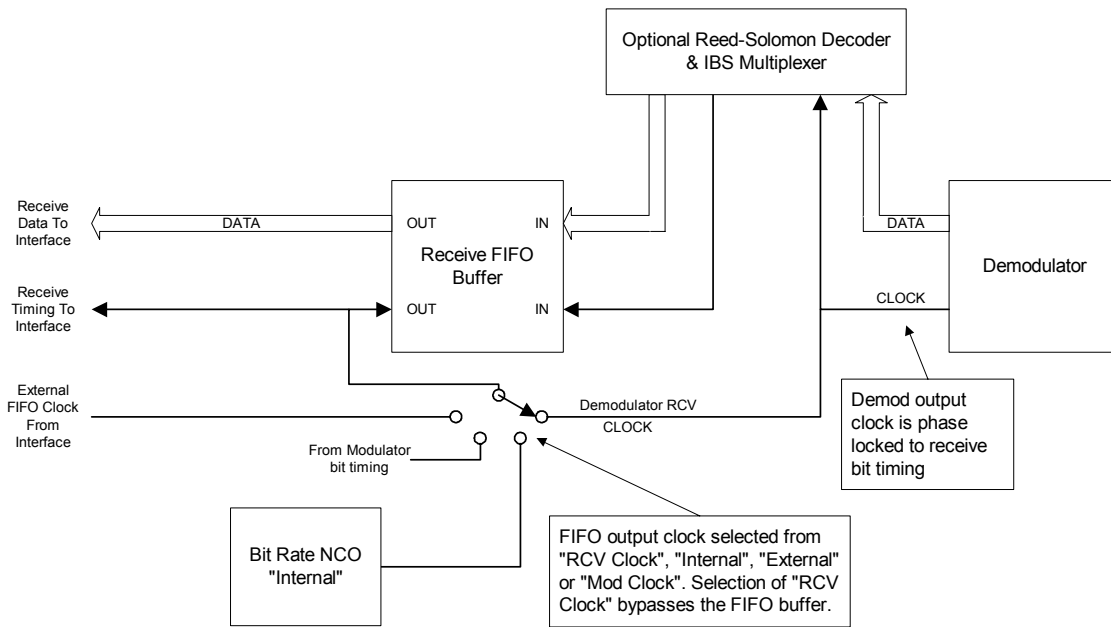
If the demodulator receive clock is selected then the FIFO itself is physically bypassed by switching circuitry.

The internally generated bit rate NCO locked to the Internal Reference oscillator is settable to 40 bit accuracy. That is 1 part in 10 to the 12 or 1 part per trillion.

A block diagram simplified representation of the Transmit and Receive clock sources are shown in Figure 1-3.



Transmit Clock Sources



Receive Clock Sources

Figure 1-3 Clock Source Options

These Clock sources may be used in various ways in a system implementation to provide correct timing at a destination. Each of the clock sources can be set either from the front panel or from an external monitor and control system.

1.2.4 Control Processor

A single microprocessor manages all monitor, control and communications functions on the modem board. The processor continuously monitors all onboard status signals.

The modem control processor uses external address and data buses to connect to external Flash PROM containing the instruction code. The processor uses both internal and external RAM for all operations and maintains configuration and permanent parameters in parallel EEPROM. The processor also connects to the FEC, the custom ASICs, the DSP processor, the front panel, and various onboard peripheral functions via the address and data bus.

The control processor also maintains a serial peripheral interface to connect to several onboard peripherals. These include external D/A converters holding calibration and current analog settings, identification EEPROMs on option and interface cards and step synthesizers.

The control processor also contains an internal 12-Channel 10-bit A/D converter for gathering analog information from various onboard monitored points including the phase locked loop tuning voltages.

Digital I/O used to monitor and control the modem is handled mainly through the DSP circuits and their interface to the processor. Such parameters as the current Eb/No and receive offset frequency information are read by the processor from the DSPs while most configuration information is written to the DSPs.

The control processor uses a full-duplex Universal Asynchronous Receiver/Transmitter (UART) for communications with either the RS-232 / RS-485 remote command port or with a separate VT100 type "console" terminal device connected to the modem.

The control processor has provisions for communicating with another PSM-4900 modem for implementation of Automatic Uplink Power Control (AUPC). The channel for this communications is normally provided by equipping the unit with the optional IBS multiplexer interface card.

1.2.5 Acquisition Processor

The acquisition processor, a Texas Instruments 320C5xxx Digital Signal Processor, manages the receive signal acquisition and lock functions to achieve fast acquisition performance at low data rates. This DSP is controlled by the control processor via a communications protocol managed through a special bi-directional parallel interface to the main processor.

The signal acquisition DSP accepts sampled data from the receive chain A/D Converters and mathematically determines the location of the incoming carrier. This is accomplished in a multi-step process which continues to narrow down the exact frequency until it is known within the lock range of the PLL demodulator. At data rates below 16 kbps this process is more than an order of magnitude faster than a standard sweep method. Typical signal acquisition times at 16 kbps QPSK are 0.2 seconds using the acquisition processor vs. over 20 seconds using a standard sweep.

1.2.6 Standard Data Interface

The standard Interface in the PSM-4900 is built onto the main PWB and contains the drivers and receivers for one of five possible data interface standards (seven including minor variations of each). All interface standards are selected under program control via the front panel or remote control. Five of these standards are common interfaces used in the communications industry:

- RS-449, terminated and un-terminated
- V.35,
- V.36
- Synchronous RS-232 (Limited to 128 kbps by drivers and receivers.)
- EIA-530 and EIA-530A

The un-terminated versions of these standard interfaces and are used to implement one for one (1:1) redundancy between two PSM-4900 units.

A single 37 pin “D” type female connector is available on the rear panel at J3 providing the terrestrial data interface. The interface standard is electronically selectable via front panel or remote control.

Optional interfaces are provided by a separate option interface card which is mounted inside the modem chassis. The provision of an optional interface “adds” to the available interfaces which can be selected under program control. An interface field kit of parts to add an option interface is available from the manufacturer for installation by qualified technical field service personnel. When an optional interface is installed the main processor automatically queries and installs the necessary software controls for accessing the interface.

1.2.6.1 Data Interface Loop-Back Function

The standard and most optional interfaces also provide the data loop-back function. Ethernet interfaces do not have this function. The data loop-back can be controlled from the front panel or via remote control command. The data towards both the terrestrial and satellite sides can be looped back individually by enabling this function via the front panel or remote control

⇒ Caution: Enabling the “Data Loop-Back” functions will result in loss of traffic. It should not be used in operating links without prior arrangements.

The data loop-back allows testing of the signal path connection up to the loop-back and back to the source. Since both terrestrial and satellite sides of the signal path can be looped, the connection from a local DTE can be checked on the terrestrial side while the connection from the far end DTE over the satellite and through the modem can be checked on the satellite side.

More information on use of the loop-back modes is given in Section 4.1 *Common Test Procedures*.

1.2.6.2 Data Interface BERT Function

The standard interfaces also includes a programmable Bit Error Rate Test (BERT) set. It is located between the modem’s satellite and terrestrial data loop-back functions. Ethernet interfaces do not have this function. The BERT can be controlled from the front panel or via remote control command and provides extensive test result data.

⇒ Caution: Enabling the “BERT” function will result in loss of traffic. It should not be used in operating links without prior arrangements.

More on use of the BERT functions and modes is given in Section 4.1.2 *“Using the Built-in BERT”*.

1.2.6.3 Data Interface 1:1 Redundancy Function

The standard interfaces are also capable of operating in a special 1:1 redundancy mode. In this mode the data interfaces are tied directly in parallel using a special “Y” cable. Software control built into the modem can then be set to indicate that the two connected modems are operating in a redundant mode. The two modems communicate with each other to determine the alarm status of each and force the “off-line” unit’s data interface into an un-terminated condition. This allows both interfaces to receive incoming data and clock signals, which are necessary to ascertain correct functioning. At the same time the transmit and receive IF ports are also connected together through the stations (or separately supplied) transmit and receive IF combiner/splitter assemblies.

The alarms that are used to determine switching criteria are programmable, and the first modem set up for this mode automatically loads its configuration information to the second or “back-up” unit. These features create a very low cost redundancy system that is both flexible and easily set up.

More information on the set-up and use of the 1:1 redundancy functions and modes is given in Sections 2.3.5 *“1:1 Redundancy Connection”* and 3.10 *“Built-in 1:1 Redundancy Mode Operation”*.

1.2.7 Optional Modem Daughter Cards

All of the M5 class modems can accept the same optional function cards. The main modem board can accept two daughter cards that provide optional capabilities.

- The IBS Framing Multiplexer and Reed-Solomon FEC Option Card.
- The Turbo Product Codes Option FEC Card.

These two option cards are designed for specific locations in the signal path. The Framing and Reed-Solomon card is designed to be placed between the modem and the data interface, while the Turbo Product Codes FEC card is designed to serve as an alternate to the main Viterbi FEC. Essentially one is in series with the Viterbi FEC while the other is in parallel to it.

1.2.7.1 *Optional Framing/Multiplexer/Reed-Solomon Codec Card*

Installation of the optional Multiplexer/Reed-Solomon Codec provides the PSM-4900 with a greater level of functional capability. It is provided in two possible configurations; 1) Framing and IBS Multiplexer, and 2) Framing and IBS Multiplexer with Reed-Solomon Codec. The Reed-Solomon Codec may be added later to a multiplex-only card. The following are general descriptions of the characteristics of each of these cards. More information is available in the Option Appendix RS. A common clock generator circuit is used to support both the multiplexer and Reed-Solomon Codec.

The framing/multiplexer is capable of multiplexing a relatively low speed overhead channel onto the terrestrial data stream resulting in a slightly higher combined or "aggregate" data rate through the modem. The overhead channel is recovered at the far end. This added channel is termed variously an overhead channel, ESC, service channel, "asynch" channel or, in IESS terminology, an ES to ES data channel. A simplified block diagram of the data multiplexer is shown in Appendix RS.

The basic frame structure used by the multiplexer is that specified in the IESS-309 standard, Page 60, Figure 10, resulting in a 16/15 aggregate to through data ratio. This means that when the multiplexer is enabled the modem aggregate operating data rate is computed as the terrestrial connection (through) data rate multiplied by 16/15. The user sets only the desired through data rate while the modem computes the aggregate rate required. The multiplexer is also capable of expanded operating modes which include custom setting of the ratio of data to framing bytes.

The Multiplexer provides the following modes of operation. They are described more fully in The IBS Multiplexer/Reed-Solomon Appendix RS.

Mode	Standard/ Compatibility	Overhead Ratio	Notes
Disabled	N/A	1/1	
Standard	IESS-309	16/15	Fixed synchronous ESC, No AUPC, No MCC
Enhanced	Modified IESS-309	16/15	M4 compatible ESC and AUPC (limited MCC).
Custom	Modified IESS-309	Variable	Full ESC and MCC including AUPC, Remote Modem Control, 2 one-bit control channels. Also variable data load per frame.

The ESC Data Channel can be set under software-control to either RS-232 or RS-485 mode. The pin assignments for both modes are shown in Appendix RS as supplied with the Multiplexer or Multiplexer plus Reed-Solomon options. These pin assignments appear on the rear panel "AUX" (Auxiliary) connector J4 only when the Multiplexer or Multiplexer plus Reed-Solomon Option is installed. The RS-485 Transmit Data Drivers can be set to "RS-485" or "RS-485 ON" when in "Enhanced" mode. The "ON" setting forces the driver continuously on while the "RS-485" setting controls the output into tri-state when the modem is not transmitting data, allowing multiple modem outputs to be connected together. In the standard IBS mode only the "RS-485 ON" mode is available.

In Enhanced or Custom mode a 2 wire receive operating mode can be selected for the receive data into the ESC channel. In this mode the receive input is muted while the transmit data output is active. In 4 wire mode the receive is always enabled. In the standard IBS mode only the 4 wire mode

is available. Note that the transmit and receive pairs are physically separate wires and must be connected together if true RS-485 2 wire connectivity is desired.

The processor on the main board performs software/hardware assignment of bits to specific purposes in the Custom mode and buffers the ESC Data Channel to standard asynchronous data rates.

The user does not have to compute data framing variables to use the Custom Multiplexer Mode. When placed in this mode the entry parameters are the ESC and MCC channel rates selected from standard asynchronous data rates (300 to 38,400 bps). The modem then computes the proper relationship between the framing and terrestrial data rates to achieve the proper operation. The modem also displays the terrestrial data to aggregate ratio.

1.2.7.1.1 Modem Control Channel (MCC)

The MCC is available in both the Enhanced and Custom Multiplexer modes. In the Enhanced mode the MCC provides for an AUPC channel. In the Custom mode the MCC provides for the AUPC plus the Remote Modem Control (RMC) Channel and the Auxiliary control bits (RFC).

1.2.7.1.1.1 AUPC Control Channel (MCC)

When the modem is placed into either the "Enhanced" or "Custom" modes the AUPC control channel becomes available. The AUPC operation itself is under control of the modem while the AUPC facility in the MCC provides the channel for the information. This channel provides a minimum 300 baud control channel in each direction to allow the modems at two ends of a link to interactively maintain the receive Eb/No by controlling the power output at the transmit site.

Refer also to the AUPC operation description of the main manual in Section 3.8 titled "*Automatic Uplink Power Control (AUPC) Operation*".

1.2.7.1.1.2 Remote Modem Control Channel (RMC)

When the modem is placed in the "Custom" mode the Remote Modem Control channel becomes available. This channel allows the control of a far end modem from the near end site. This control is not however allowed from the near end front panel, but only via the remote control interface port. The command protocol for remote unit control is explained in Appendix B, "*Remote Control Protocol*".

Note that the Automatic Configuration Recovery or ACR is partially designed as a safety feature to be used with the remote programming of modems. It can help prevent "losing" the modem at an unattended site. Refer to the ACR section of the main manual in 3.14 "*Automatic Configuration Recovery*".

1.2.7.1.1.3 Auxiliary Bit Control Channels (RFC)

When the Multiplexer is placed into the "Custom" mode the auxiliary bit control RFC channels becomes available. These consist of two single line or "one-bit" control channels that can be used to send control information independently in both directions over the link. The input signals on these channels can be either a contact closure or a logic type signals while the output is a form C relay contact set whose state depends on the state of the input signal. The low input logic level is 0 to 0.4 VDC, while the logic high level can be from 2.4 to approximately 20 VDC. The input is current limited to accept this wide voltage range without damage. Higher voltages may damage the inputs however and caution should be exercised. Pin connections for these one bit channels are shown in the RS Appendix.

1.2.7.2 Reed-Solomon Codec Capability

The addition of a Reed-Solomon Codec places a second Forward Error Correction (FEC) process outside of and in series with the existing Viterbi FEC. The two FECs are thus considered "Concatenated". In addition, the data between the two FECs is "interleaved" which effectively reduces the possibility of multiple consecutive errored block symbols, thus improving the Reed-

Solomon Codec performance. The performance improvement achieved by this combination is significant. For example, the BER vs. Eb/No performance of concatenated Viterbi rate 3/4 coding with R-S is better than Viterbi rate 1/2 alone and it uses less bandwidth than the Viterbi rate 1/2 alone.

The clock generation for the RS Codec is accomplished in the same Framing/Multiplexer circuits used for the ESC Data Channel. The M5 type R-S Codec is capable of operating in multiple standard and custom modes as shown in the table below.

Mode	Compatibility	Terrestrial Data Rate	Overhead Ratio	n, k and depth Values
Disabled	N/A		1/1	
IESS-308	IESS-308	1.2 kbps to <1.544 Mbps	9/8	126, 112, 4 (M4 modem compatible)
	IESS-308	1.544 Mbps to <2.048 Mbps	45/41	225, 205, 4
	IESS-308	>2.048 Mbps	73/67	219, 201, 4
IESS-309	IESS-309	All	73/67	219, 201, 4
Custom	Modified IESS-309	All	Variable	Allows setting the “n”, “k” and “depth” values for special requirements. Can also be set for M4 compatibility to max M4 data rate.

The IESS 308 mode automatically adjusts the n and k factors dependent on the data rate. The “Overhead” ratio is the ratio of the data rate at the R-S encoder output to the data rate at the input. It is defined as n/k. The modem automatically adjusts to accommodate the new rate.

The Reed-Solomon Codec function can be turned on and off under software control, and is independent of the IBS ESC Data Channel enabling.

1.2.7.3 Turbo Product Codes FEC Capability

The addition of the Turbo Product Codes (TPC) option allows replacement of the on board Viterbi FEC selectively for the transmit and receive paths. The performance improvement achieved by the TPC is significant. For example, the BER vs. Eb/No performance of TPC Rate $\frac{3}{4}$ is approximately equal to Rate $\frac{1}{2}$ Viterbi and uses over 40% less bandwidth. TPC also provides better bandwidth/power utilization than either Reed-Solomon concatenated on Viterbi or 8PSK/TCM with Reed-Solomon.

The Turbo Product Codes FEC is more fully explained in Appendix TPC.

1.2.7.4 Optional Interface Capability

The M5 modems are also capable of accepting optional interface cards to replace the standard synchronous serial interfaces. The first of these cards will be an Ethernet bridge interface.

1.2.8 Modem Circuit Implementation

Much of the functionality and size reduction in this modem has been achieved by incorporation of extensive circuitry into Digital Signal Processing parts and Field Programmable Gate Arrays (FPGA). The modems unique direct modulation and demodulation scheme also completely eliminates all IF mixing and filtering circuitry.

Chapter 2 - Installation

2.0 Installation Requirements

The PSM-4900 VSAT/SCPC Modem is designed for installation in any standard 19-inch equipment cabinet or rack, and requires 1 RU mounting space (1.75 inches) vertically and 12 inches of depth. Including cabling, a minimum of 15-inches of rack depth is required. The rear panel of the PSM-4900 is designed to have power enter from the left and IF cabling enter from the right when viewed from the rear. Data and control cabling can enter from either side although they are closer to the left. The unit may be placed on a table or suitable surface as required.

⇒ **CAUTION:** *There are no user-serviceable parts or configuration settings located inside the PSM-4900 modem case. There is a shock hazard internally at the power supply module. DO NOT open the modem case.*

⇒ **CAUTION:** *Before initially applying power to the modem, it is a good idea to disconnect the transmit output from the operating satellite ground station equipment. This is especially true if the current modem configuration settings are unknown, where incorrect setting could disrupt existing communications traffic.*

2.1 Unpacking

The PSM-4900 Modem was carefully packed to avoid damage and should arrive complete with the following items for proper installation:

1. PSM-4900 Modem Unit. L-Band Units may include an external BUC power supply.
2. Power Cord, 6 foot with applicable AC connector.
3. Installation and Operation Manual.

2.1.1 Removal and Assembly

If using a knife or cutting blade to open the carton, exercise caution to ensure that the blade does not extend into the carton, but only cuts the tape holding the carton closed. Carefully unpack the unit and ensure that all of the above items are in the carton. If the Prime AC power available at the installation site requires a different power cord/AC connector, then arrangements to receive the proper device will be necessary before proceeding with the installation.

The PSM-4900 Modem unit is shipped fully assembled and does not require removal of the covers for any purpose in normal installation. All normal hardware configurations including setting the data interface type and IF impedance are under software control. The type of options installed can be read from the LCD display on the front panel under **<Int'f: I/O – Mode>**

Should the power cable AC connector be of the wrong type for the installation, either the cable or the power connector end should be replaced. The power supply itself is designed for world-wide application using from 90 to 264 VAC (100 to 240 VAC +/- 10%).

2.2 Mounting Considerations

When mounted in an equipment rack, adequate ventilation must be provided. The ambient temperature in the rack should preferably be between 10 and 35° C, and held constant for best equipment operation. The air available to the rack should be clean and relatively dry. The modem units may be stacked one on top of the other to a maximum of 10 consecutive units before providing a 1 RU space for airflow. Modem units should not be placed immediately above a high heat or EMF generator to ensure the output signal integrity and proper receive operation.

Do not mount the PSM-4900 in an unprotected outdoor location where there is direct contact with rain, snow, wind or sun. The modem is designed for indoor applications only.

The only tools required for rack mounting the PSM-4900 is a set of four rack mounting screws and an appropriate screwdriver. Rack mount brackets are an integral part of the front panel plate of the unit and are not removable.

The following interface connections should be available at the mounting location as a minimum:

1. Prime AC power.
2. A 75 Ω Transmit IF cable with BNC male connector. (50 Ω optional) or a 50 Ω Transmit IF cable with type N male connector for the L-Band version.
3. A 75 Ω Receive IF cable with BNC male connector. (50 Ω optional) or a 75 Ω Receive IF cable with type F male connector for the Hybrid or L-Band version.
4. A Terrestrial data interface cable to mate with the modem or installed option; either a 37-pin male "D" sub connector for all standard or appropriate connector for an optional interface (such as G.703 or Ethernet 10 Base T).

Other optional connections are shown below.

2.3 Modem Connections

All modem connections are made to labeled connectors located on the rear of the unit: The connector definitions below are those on the modem unit. Any connection interfacing to the modem must be the appropriate mating connector. Cabling and Connections are detailed in Appendix C, "*Cabling Specifications*". Refer to Figure 2-1 to locate the following connectors:

Prime AC power to the far left IEC male input at J1:

90 to 260 VAC, 47 – 63 Hz.

Maximum unit power consumption is 50 Watts (Typical < 30 Watts).

Integral switch provided as part of power entry connector.

Chassis ground connection at #8 stud location J2.

Data Interface Connection at Data Connector J3:

Standard RS-449 Connector (37-pin female "D" sub connector).

DB25 adaptor cable supplied with modem for V.35, EIA 530, RS-232.

Alarm Connection at 9-pin male "D" connector J5.

RS-485 Control Port connection at 9-pin female "D" sub connector J6:

Shield ground on pin 15

Transmit A on pin 6 (output from modem)

Transmit B on pin 1. (output from modem)

Receive A on pin 9 (input to modem)

Receive B on pin 8. (input to modem)

OR

RS-232 Control port connection at 9-pin female "D" sub connector J6:

Transmit on pin 3 (input to modem)

Receive on pin 2 (output from modem)

Common on pin 5.

The Modulator 70 MHz IF Output at female BNC J7

50 – 90 MHz

Programmable +5 to –35 dBm output at 75Ω

Programmable +3 to –35 dBm output at 50Ω.

The L-Band Modulator (PSM-4900L) L-Band IF Output at female Type N J7

950 – 1750 MHz

Programmable +3 to –35 dBm output at 50Ω.

BUC Power Source (normally 24VDC @ <4A) to be output on this connector. Various supplies are available and all are connected to the 5 pin DIN connector at J10.

Programmable 10 MHz Reference signal to be output on this connector.

⇒ CAUTION! *Extreme Care should be exercised when connecting test equipment in the transmit line either directly to the modem output or within the line to the BUC. The voltage present to power the BUC can cause severe damage to the input of test equipment like spectrum analyzers.*

⇒ CAUTION! *Extreme Care should be exercised when handling the transmit cable as it is possible to have hazardous voltages on the transmit line. When higher voltages are used to supply BUCs that require 48VDC the transmit line can seriously injure personnel.*

To avoid injury or equipment damage unplug the L-Band modem and BUC power supply whenever the transmit cable is disconnected!

The L-Band Modulator (PSM-4900L) Block Up Converter Power Supply at J10

12 to 56 Volts DC, up to 6 Amp capability.

Programmable enable and disable onto the transmit cable at J7

The BUC Power Status LED next to J7 shows the status as follows

Red – No voltage sensed on DIN input connector or power is input and the enabled but the cable to the BUC is shorted.

Green – Power sensed and enabled (connected) to transmit cable

Off – Power sensed but disabled (disconnected) from transmit cable.

The Demodulator 70 MHz IF Input at female BNC J9

50 – 90 MHz

–20 to –60 dBm input at 75 or 50Ω. (to –84 dBm at lower bit rates)

The Hybrid or L-Band Demodulator (PSM-4900H/L) L-Band IF Input at female Type F J9

950 – 1900 MHz

–20 to –60 dBm input at 75Ω. (to –100 dBm at lower bit rates)

Programmable 0, 13VDC or 18VDC @ <500mA to be output on this connector

Programmable 10 MHz Reference signal to be output on this connector.

⇒ CAUTION! *Extreme Care should be exercised when connecting test equipment in the receive line to the LNB. The voltage present to power the LNB can cause severe damage to the input of test equipment like spectrum analyzers.*

The Modem External Reference Input at female BNC J8

1, 5, 9 or 10 MHz input

+10 to –15 dBm input level at 50Ω (normally a sine wave).

The ESC channel connection at 37-pin male "D" sub connector J4 (AUX). (When the optional IBS multiplexer is installed). See Appendix C, "Cabling Specifications" for the pins used for each of the following interfaces available on the "AUX" connector.

RS-232 Standard Mode Connection (synchronous)

RS-232 Transmit on pin 4 (input to modem, sampled on rising clock edge)

RS-232 Transmit Clock on pin 13 (output from modem)

RS-232 Receive on pin 6 (output from modem, changes on falling clock edge)

RS-232 Receive Clock on pin 7 (output from modem)

RS-232 Enhanced/Custom Mode Connection:

RS-232 Transmit on pin 4 (input to modem)

RS-232 Receive on pin 6 (output from modem)

RS-232 CTS on pin 7 (output from modem)

RS-232 RTS on pin 9 (input to modem)

RS-232 DSR on pin 11 (output from modem)

RS-232 DTR on pin 12 (input to modem)

RS-232 DCD on pin 13 (output from modem)

RS-485 Connection:

RS-485 Receive A on pin 11 (output from modem)

RS-485 Receive B on pin 6. (output from modem)

RS-485 Transmit A on pin 12 (input to modem)

RS-485 Transmit B on pin 4. (input to modem)

User Remote Facility Control channel A

Pin 33 - RFC channel A Input (TTL, Internal 1mA Pull-Up)

Pin 34 - RFC channel A Form-C Common

Pin 35 - RFC channel A Form-C N.C.

Pin 16 - RFC channel A Form-C N.O.

User Remote Facility Control channel B

Pin 15 - RFC channel B Input (TTL, Internal 1mA Pull-Up)

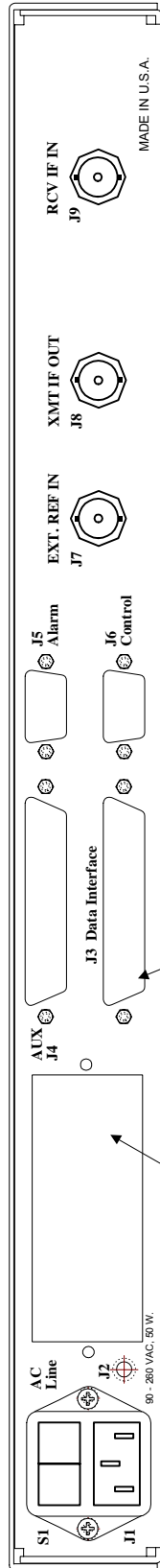
Pin 17 - RFC channel B Form-C Common

Pin 18 - RFC channel B Form-C N.C.

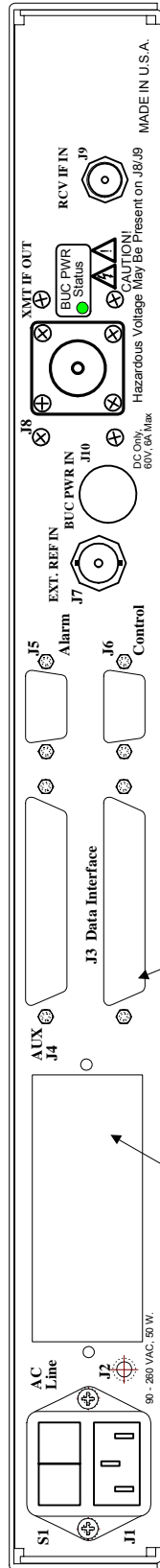
Pin 36 - RFC channel B Form-C N.O.

Grounds

Pins 14, 19, 20, 32, 37



70 / 140 MHz and Hybrid IF Modem



L-Band IF Modem

Figure 2-1 Modem Rear Panel

2.3.1 Data Interface Pin Connections

The unit is supplied with an electronically programmable data interface assembly. Table 2-1 shows the pin assignments for the possible standard interfaces. Additional information aiding the creation of “adaptor” cables from the unit’s 37-pin female “D” sub connector to other types of interface connections such as V.35 “Winchester” type connector standard pin-outs or RS-232 type DB25 connector is presented in Appendix C “Cabling Specifications”.

Table 2–1 Data Interface Connector J3 Pin Assignment by Signal					
Modem Pin #	RS-449 Signal Name	V.35, V.36 Signal Name	RS-232 Signal Name *(5)	Eia-530 Signal Name	Direction
1	Shield (Open)	Shield (Open)	Shield (Open)	SHD (Open)	Open(4)
4	Transmit Data (A) –	SD A (SD-)	SD	TD A	Input
22	Transmit Data (B) +	SD B (SD+)		TD B	Input
5	Transmit Clock (A) –	SCT A (ST-)	ST	TTSETC A	Output
23	Transmit Clock (B) +	SCT B (ST+)		TSETC B	Output
6	Receive Data (A) –	RD A (RD-)	RD	RD A	Output
24	Receive Data (B) +	RD B (RD+)		RD B	Output
8	Receive Clock (A) –	SCR A (RT-)	RT	RSETC A	Output
26	Receive Clock (B) +	SCR B (RT+)		RSETC B	Output
7	RTS (A) –	RTS	RTS	RTS A	Input
25	RTS (B) +			RTS B	Input
9	CTS (A) –	CTS	CTS	CTS A	Output
27	CTS (B) +			CTS B	Output
11	Data Mode (A) –	DSR	DCR	DCR A	Output
29	Data Mode (B) +			DCR B	Output
12	TR (A) –	DTR	DTR	DTR A	Input
30	TR (B) +			DTR B	Input
13	Receive Ready (A) –	RLSD	RLSD	RLSD A	Output
31	Receive Ready (B) +			RLSD B	Output
17	Terminal Timing (A) –	SCTE A (TT-)	TSETT	TSETT A	Input
35	Terminal Timing (B) +	SCTE B (TT+)		TSETT B	Input
3	External data Clock (transmit data clock or receive FIFO Buffer output Clock (A) – *(3)	Ext Data/FIFO Clock A (-)*(3)	Ext Data/FIFO Clock A (-)*(3)	Ext Data/FIFO Clock A (-)*(3)	Input
21	External data Clock (transmit data clock or receive FIFO Buffer output Clock (B) + *(3)	Ext Data/FIFO Clock B (+)*(3)	Ext Data/FIFO Clock B (+)*(3)	Ext Data/FIFO Clock B (+)*(3)	Input
19	Signal GND	SIG GND	GND	SGND	GND
20	Common	Chassis			GND
10	Mod Fault Alarm *(2)	Mod Fault Alarm *(2)	Mod Fault Alarm *(2)	Mod Fault Alarm *(2)	OC TTL output

Table 2–1 Data Interface Connector J3 Pin Assignment by Signal					
Modem Pin #	RS–449 Signal Name	V.35, V.36 Signal Name	RS-232 Signal Name *(5)	Eia-530 Signal Name	Direction
28	Demod Fault Alarm *(2)	Demod Fault Alarm *(2)	Demod Fault Alarm *(2)	Demod Fault Alarm *(2)	OC TTL output
32	Aux RS-232 Receive *(1)	Aux RS-232 Receive *(1)	Aux RS-232 Receive *(1)	Aux RS-232 Receive *(1)	Input
34	Aux RS-232 Transmit *(1)	Aux RS-232 Transmit *(1)	Aux RS-232 Transmit *(1)	Aux RS-232 Transmit *(1)	Output
37	Send Common				GND

Notes on Data Interface Connections:

1. If Automatic Uplink Power Control is provided by an external multiplexer the control channel may use the Aux RS-232 signal lines. These lines are however dedicated when the 1:1 redundancy mode is enabled for inter-modem communications.
2. The modulator and demodulator fault alarms are Open Collector TTL outputs used to interface to redundancy control equipment.
3. The External Data/FIFO clock pins are an input to the modem. An input at the receive data rate can be used to clock data out of the demodulator FIFO buffer. An input at the transmit data rate can be used to provide a transmit send timing clock which the modem will phase locked to (if within acceptable range). The send timing signal is still an output from the modem, but in this case will be at the input signal rate. Both functions can be used simultaneously if the transmit and receive data rates are the same.
4. The Shield is normally connected to the cables shield at one end of the cable only. Connecting at the DTE end only prevents ground loop currents being carried on the shield.
5. The synchronous RS-232 connection is limited to 128 kbps.

2.3.1.1 Connecting the Data Interface to Other Equipment

The PSM-4900 physical connector is that of an RS-449 interface. The electrical interface however can be changed under front panel or remote program control to include the types of interfaces shown above. Connecting the Data Interface to other types of equipment involves building cables between the PSM-4900 and that other equipment's physical interface. Refer to Appendix C, "Cabling Specifications" for more information on building and connecting these cables.

2.3.2 Remote Control Connection

The modem has a command interface serial control port which can be configured for either of two electrical interface modes of operation. Both are located on the rear panel 9-pin female "D" sub connector J6. Connection to either the RS–232 or RS–485 is selected by connecting to the proper set of pins as shown in table 2-4, and setting the remote mode as applicable via the front panel control. If the user desires a 2 wire RS-485 bus then the transmit and receive 485 lines should be externally connected together (1 to 8 and 6 to 9).

Table 2-2. Remote Control Connector J6 Pin Assignment			
P2 Pin #	Signal Name	Use	Direction
1	Transmit B	RS-485 Transmit Data (B) +	Output
2	Transmit	RS-232 Transmit Signal	Output
3	Receive	RS-232 Receive Signal	Input
4		Not Used	
5	Common	RS-232 Signal Common	I/O
6	Transmit A	RS-485 Transmit Data (A) -	Output
7		Not Used	
8	Receive B	RS-485 Receive Data (B) +	Input
9	Receive A	RS-485 Receive Data (A) -	Input

Refer to Appendix C, "Cabling Specifications" for information on making a remote control cable.

2.3.3 Alarm Connection

The modem has two form-C dry contact alarm relays on board and an alarm connector located on the rear panel, the 9-pin male "D" sub connector J5.

The two relays are designated "A" and "B" and the particular alarms that are summarized on each relay are programmable from the front panel of the unit or via remote control. Connection to the A and B relays is via the proper set of pins as shown in Table 2-5 below and programming the applicable alarm entries via the front panel control or remote control. Non-Alarm is defined as the powered state of the relay resulting in an alarm when power is lost.

The analog monitor output is programmable from the front panel to select either receive Eb/No, receive AGC voltage or transmit output power.

Table 2-3. Alarm Connector J5 Pin Assignment	
J5 Pin #	Connection
1	Relay A - NO on Alarm
2	Relay A - Common
3	Relay A - NC on Alarm
4	No Connection
5	Analog Monitor Output (1kOhm)
6	GND for analog monitor
7	Relay B - NO on Alarm
8	Relay B - Common
9	Relay B - NC on Alarm

Note:

By convention "NO" means Normally Open, and "NC" means Normally Closed.

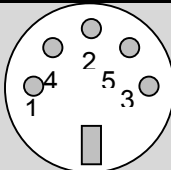
Both conditions are the non-powered, Alarm State.

2.3.4 Auxiliary (AUX) Connection

The modem has an auxiliary connector located on the rear panel, the 37-pin male “D” sub connector J4. The pin-out of this connector is determined by option board(s) installed in the modem; for example a multiplexer option would present overhead channel and analog channel inputs at this connector. The pin definitions are defined in the addendum related to installed options, for example when the IBS Multiplexer/Reed-Solomon option card is installed the I/O on connector J4 is defined in Appendix RS.

2.3.5 L-Band BUC Power Connection

The PSM-4900L modem has a 5 pin circular DIN connector at the rear panel J10. This connector is used to connect an auxiliary DC supply to power Block Up Converters that accept DC power via the transmit line. This connector applies the input voltage to the transmit cable via a relay internal to the modem and a “Bias-T” circuit. The relay is under processor control and can be enabled or disabled using the front panel or remote control. The processor also reads the voltage and current applied to the BUC and can create alarms in addition to reading voltage and current at the front panel. The power connector pin-out and rear panel LED (labeled “BUC Power Status”) meanings are shown below.

Table 2–4. BUC Power Connector J10 Pin Assignment	
	
J10 Pin #	Connection
1	Ground
2	Ground
3	V+
4	Ground
5	V+

⇒ **Caution: The BUC power input is DC Only, 60 VDC maximum, 6 Amps maximum. The power input is only intended for positive voltages with respect to ground.**

Rear Panel BUC Status Indicator

Red – No voltage sensed on DIN input connector or power is input and enabled but the cable to the BUC is shorted.

Green – Power sensed and enabled (connected) to transmit cable.

Off – Power sensed but disabled (disconnected) from transmit cable.

2.3.6 Redundancy Connection

The modem is capable of operating in a limited 1:1 redundancy protection mode without the use of a separate redundancy switch. It does require specific minimal facilities at the transmit and receive IF signal connections and at the terrestrial data connection. These are a combiner at the transmit IF, a splitter at the receive IF and a “Y” cable at the terrestrial data connection. With this connection scheme the switching is only performed on the outputs from the modem. The modem IF and data inputs are always available at the modem allowing internal circuitry to determine if one modem is correctly accepting and “locking” to the input signals while the other is unable to if in a failed state.

The two modems communicate with each other over the data “Y” cable. In this cable all connections are 1 to 1 except the auxiliary RS-232 transmit and receive lines. These two lines are swapped between the two modems allowing them to talk over an auxiliary serial link. Specifics of this cable wiring are shown in Appendix C, “Cabling Specifications”. Operation of the data interface connected in parallel depends upon the programmable interface drivers to be tri-stated and the receivers to be set in an un-terminated mode. This is accomplished under control of the modem’s internal software.

Note: The two modems should be at the same firmware revision for proper redundant operation.

The two modems operate in a “non-priority” redundancy mode, that is, no modem is specified as “primary”, or having preference when both modems are operational. The first modem turned on assumes a non-redundancy mode until the second connected unit is powered up. The on-line unit can be set to send its configuration information to a second unit via the front panel. The modems will remain in this state, constantly sending status information back and forth until one unit indicates a failure. If that modem is currently on line, it is switched off-line and the alternate unit is switch on.

The modem is also capable of operating in 1:N and M:N redundancy switching schemes. The necessary connections to monitor and control switching are available on the data connector itself in the form of the modulator and demodulator fault outputs and the auxiliary RS-232 control port. The alarm outputs are also available. The other facility provided to aid in these redundancy schemes is the ability to save and recall configuration information. Thus a back-up modem can obtain and save the configurations from 8 other modems and switch immediately to the necessary parameters to replace any of those units by simply recalling that unit’s stored configuration. In addition, the programmable interface and common physical data connector allows different interface protocols between the primary modems.

A diagram of the connections required for installing 1:1 redundancy is shown in the figure below.

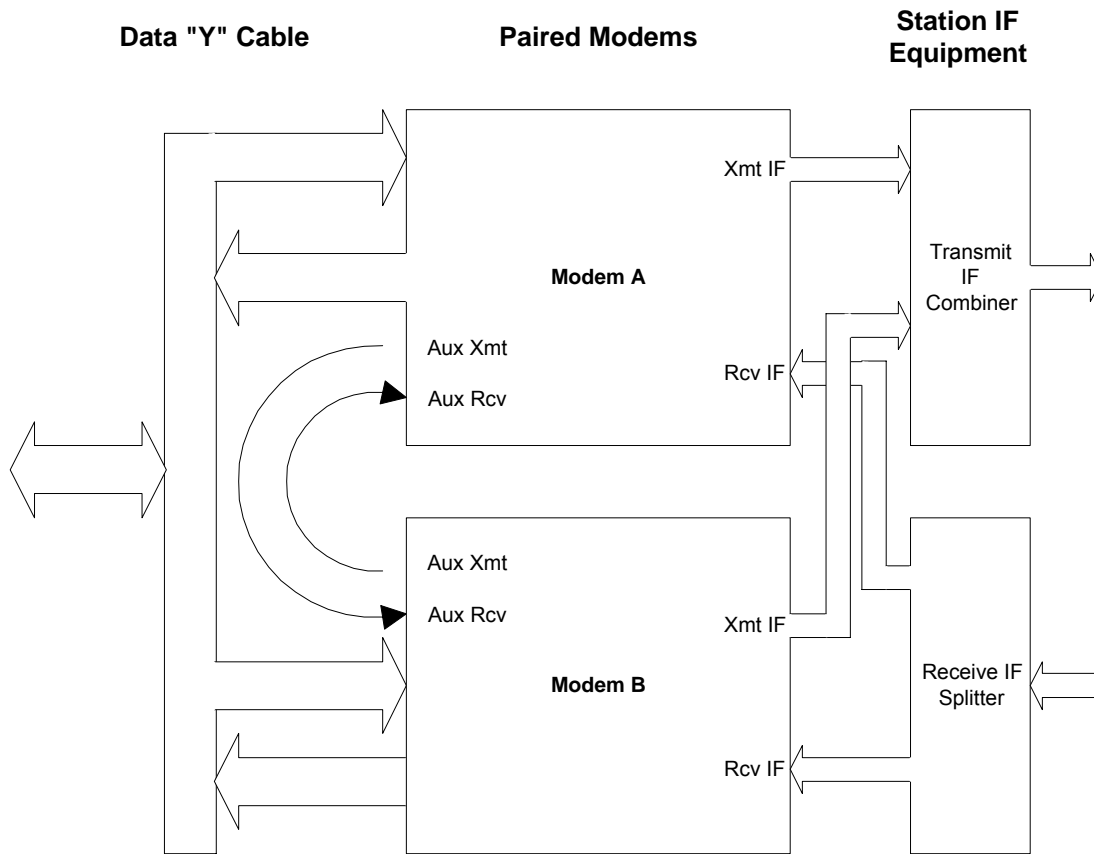


Figure 2-2 - Modem Connections for 1:1 Redundancy

2.3.6.1 Set-Up Procedure for 1:1 Redundancy

If redundancy mode is to be set up between a pair of modems then the following procedure is followed during installation, other wise this section can be skipped. In overview the procedure is:

1. Physically install both units to be paired and connect the IF transmit and receive coaxial cables and data cables to both units. The special data “Y” cable is connected between the redundant pair. For convenience we will arbitrarily call one modem “Primary” and the other “Secondary”.
2. Power-up and configure the primary modem completely for the intended operating parameters, including setting the **<Unit: Redundancy – Mode>** parameter to “1:1”. This initial unit should not be in alarm. The second unit should still be turned off.
3. Turn the power on the secondary unit on.
4. Go to the primary unit menu item **<Unit: Redundancy – Config>** and press the “Edit” key. The on-line unit will ask permission to transfer configuration to the second unit with the prompt “Config Backup?”. Confirm by pressing “Enter”. The primary unit should say “Sending Config” for approximately 1 second. If the transfer of any packet results in an error, a “Send Fail” message will be displayed, but transfer will continue.
5. Verify that the units are functioning correctly in redundancy mode. Go to the **<Unit: Status – Redundancy>** item in both units. The on-line unit will say “On-Line, Bckup OK” while the off-line unit will say “Standby, OK”.

Physical installation of the two units is best accomplished with one unit directly above the other in the rack. This allows the status of the two modems to be seen together and avoids confusion.

Care should be taken that both units are not turned on in a non-redundant configuration with the “Y” data cable installed. This will result in the two unit’s data output drivers possibly conflicting and causing damage.

During configuration of the primary unit several new parameters will become available after the mode is set to 1:1. In addition to the **<Unit: Redundancy - Config>** parameter of step 4 above there will also be parameters that allow the alarms and timing to be configured for the application. The default values for these parameters are probably good in most installations, but they may require specific configuration, especially if the unit had been configured for another unique application. These new parameters are:

- **<Unit: Redundancy – Sw Rqst>** This parameter allows you to determine which alarm indications result in a switch request. The possible selections are “On Any Alarm”, “On Alarm A”, “On Alarm B”, or “On Alarm A & B”. Since the specific alarms which comprise Alarm A and Alarm B are programmable themselves, then a switch request is highly programmable itself. For most applications though the default “On Any Alarm” is a preferred selection.
- **<Unit: Redundancy – Sw Hold>** This parameter determines how long an alarm must exist on the on-line unit and not the off-line unit before switching will occur. Allowable values are 0.0 to 600.0 seconds. The value could be set to zero, but this is not advised. A nominal value of 0.5 seconds insures that intermittent cases do not cause undue switching. A built in factor of 10 seconds is provided once a switch has occurred before a switch back to the original unit is allowed (except in the case of a manual switch request or loss of power in the on-line unit which requires 2 seconds).

Teardown or un-pairing of two redundant units is accomplished by turning both units off before removing the “Y” cable. Then power on and set the **<Unit: Redundancy – Mode>** to “Disabled”.

A unique case can arise when both units are off-line and powered up at the same time. They will probably go out of alarm at virtually the same time. In such tie cases, which unit will be placed on line is determined by the unit serial numbers, where the highest serial number wins the tie.

2.4 Modem Checkout

The following descriptions assume that the modem is installed in a suitable location with prime AC power and supporting equipment available.

2.4.1 Initial Power-Up

⇒ **CAUTION:** *Before initial power-up of the modem, it is a good idea to disconnect the transmit output from the operating satellite ground station equipment. This is especially true if the current modem configuration settings are unknown, where incorrect setting could disrupt existing communications traffic. New modems from the factory are normally shipped in a default configuration which includes setting the transmit carrier off.*

Turn the unit “ON” by placing the rear panel switch (above the power entry connector) to the “ON” position. At every power-up, the modem processor tests itself and several of its components before beginning its main monitor/control program. These power-up diagnostics take approximately 1 second and show no results if successful. If a failure is detected, the indications vary by the type of fault detected. A serious failure will result in the front panel Alarm LEDs flashing at a rate of approximately 4 times a second, and the unit beeper sounding.

Most potential failures will result in the modem giving a verbal indication of the problem on the front panel LCD display. Status indications are shown highest priority first.

The initial field checkout of the modem can be accomplished from the front panel or in the Terminal Mode. The Terminal Mode has the advantage of providing full screen access to all of the modem’s parameters, but requires a separate VT100 terminal or computer running a terminal program in VT100 or ANSI mode. The modem unit is placed into terminal mode by setting two options via the front panel. First set the **<Unit: Remote – Protocol>** parameter to “VT100” (option 0), then set the **<Unit: Remote – Port>** parameter to “RS-232” (option 0). The **<Unit: Remote – Bit Rate>** and **Format** also require setting to match the terminal settings. The **<Unit: Remote – Address>** serves no function in the Terminal mode. See below for a quick introduction on the use of the front panel and steps for entering parameters.

2.5 Modem Control from the Front Panel

The front panel can be used to completely control the modem setup and operating parameters. Front panel control of the modem is more thoroughly discussed in the Operations Section, 3.1.3 “Guide to Front Panel Monitor and Control”, but a quick introduction to the front panel operations is given here to allow initial setup. The Navigation figure in Section 3.1.3 is especially useful.

The modem parameters are arranged in four matrices, one each for “Unit”, “Mod”, “Demod” and “Int’f”, representing Unit, Modulator, Demodulator and Interface. Each matrix is 4 to 10 columns wide and up to 20 rows long as shown in the parameter matrix tables. The particular functional matrix is selected by pressing one of the four buttons to the immediate right of the LCD display. In response the modem will highlight the particular button text selected. Within each matrix the columns designation is shown in the upper left hand corner of the LCD Display and is selected using the left and right arrow keys. Columns common to all matrices are “Status”, “Alarm” and “Test”, while others vary by the parameters required. The particular parameter within a column is shown in the upper right hand of the LCD display and is selected using the up and down arrow keys. The LCD display allows viewing only one of the many parameters at one time, while the four arrow keys (↑), (↓), (→), (←), allow scrolling through the rows and columns of the parameter matrix. The complete matrix is shown as Tables 3-1 through 3-4 in Chapter 3, “Operation” of this manual.

In this manual operation of the keypad to access a certain parameter is shown in the format **<Function: Column – Row>**. For example, to get to the Modulator IF Level the method is to press the “Mod” key then use the left and right arrow keys to access the “IF” column and the up

and down arrow keys to arrive at the “Level” parameter. This is shown by convention in this manual as **<Mod: IF – Level>**

2.5.1 Parameter Setup

Each individual item that may be read or set is referred to as a “parameter”. Parameters are arranged in a matrix of rows and columns. To set any parameter:

1. Select the functional matrix by choosing one of the four function keys; Unit, Mod, Dem and Int’f.
2. Select the parameter to be set using the four arrow keys to the right of the LCD display. The Left and right arrow keys control the column of the matrix and is shown in the upper left position of the LCD display. The up and down arrow keys control the row of the matrix and is shown in the upper right of the LCD display. Then
3. Press the “Edit” key to indicate that a new entry is desired (If the “Quick” keyboard entry is enabled this step may be skipped), next
4. Set the parameter via the numeric keypad, and
5. Finalize the data entry using the “Enter” key.

The current input can be canceled by pressing the “Clear” key at any time before pressing “Enter”.

When the entry involves selection of one of several choices; this is accomplished by either:

1. Use the up and down arrow keys to scroll through the available options, pressing “Enter” when the desired option is displayed. When scrolling through the available options the current setting is denoted by an arrow in the left column position, or
2. Pressing an option number selection (0 to max. where max. may be 1 to 8), then pressing the “Enter” key. This method is faster when the option scheme becomes more familiar. For instance, all options that can be enabled or disabled use “1” to enable and “0” to disable. Note that the “yes” and “no” below the 1 and 0 key aid this convention.

Following a valid input, the modem will place the new setting into the nonvolatile EEPROM making it available immediately and also automatically the next time the unit is powered on.

2.6 Modem Terminal Mode Control

The modem can be interactively monitored and controlled in the VT100 Terminal mode, with a full screen presentation of current settings and status. Programming is accomplished by selecting the item to be modified and pressing the terminal key of the option letter “A” through “Z”. For example, to change the transmit data rate, press the terminal’s “A” key (upper case is not necessary for letters). The modem will respond by presenting the options available and requesting input. Two types of input may be requested. If the input is multiple choice, the desired choice is selected by pressing the indicated number key. This input type does not require pressing the “Enter” or carriage return key. The other possible input type requires a numerical input (such as entering a frequency or data rate). This type of input is followed by pressing the “Enter” or carriage return key. An input can be aborted at any time by pressing the “TAB” key. Invalid input keys are signaled by a beep or bell signal from the terminal. Note that the “ESC” key is not used to escape or cancel an input because the common ANSI and VT100 terminal control sequences use the escape character to flag start of sequence.

Following a valid input, the modem will place the new setting into the nonvolatile EEPROM making it available not only immediately but also automatically the next time the unit is powered up.

2.7 Self-Test Mode

⇒ **CAUTION:** *The Self-Test Mode will disconnect the transmit and receive IF from the ground station equipment and will therefore disrupt any traffic currently through the PSM-4900 under test. This Test Mode should not be used on a live traffic unit.*

The PSM-4900 provides a built-in self-test mode which uses the IF Loop-back and a predefined sequence of actions to test the basic modem operation. This test mode can be used to verify correct functioning of the modem before placing it into service. The modem is placed into self-test mode by using the front panel controls to initiate the test mode sequence.

The Self-Test Mode does not use or change the current configuration parameters, and returns to these parameters after the test is completed.

To access the Self-Test Mode from the front panel, select "Unit" and use the right arrow key to scroll to the "Test" column of the configuration matrix and then scroll down until "Test Modem" is displayed. Then press "Edit", the "3" key then "Enter" to start the test. The modem self-test only requires approximately one minute. This tests both the lamp and unit functioning. Just the lamp test is performed by selecting "1" above or the Loop tests by selecting "2" above.

If any portion of the self-test fails, the modem will halt on the failed test and enter a loop with 4 short "beeps" then pause for several seconds and repeat the 4 short beeps.

The Self-Test Mode state is not stored in EEPROM, therefore if the unit is powered off during Self-Test Mode it will be configured for Self-Test Mode disabled when powered up again

2.8 IF Loop-back Test Mode

⇒ **CAUTION:** *The IF Loop-back Mode will disconnect the receive IF from the ground station equipment and will therefore disrupt any traffic currently through the PSM-4900 under test. The transmit output is still active if it was enabled before initiating an IF Loop-back. This Test Mode should not be used on a live traffic unit.*

The PSM-4900 provides a built-in IF loop-back mode which couples the transmit output to the receive input via physical relays at the modem IF and an internal attenuator to achieve proper input levels. This mode can be used to test modem operation with data, for instance using a BER test set, before going on the satellite.

The IF Loop-back Test Mode uses the current modulator carrier frequency (plus offset setting) only and sets the demodulator to the same carrier frequency setting when in loop-back. The user is responsible for all other compatible settings in order for the modulator and demodulator to operate properly. When the IF Loop-back Test Mode is disabled, the demodulator carrier frequency is returned to that stored in EEPROM (present before Loop-back was initiated).

To access the IF Loop-back Mode using the front panel, select the "Demod" and use the arrow keys to scroll to the "Test" column of the configuration matrix and then scroll down until "IF Loopback" is displayed. Then press "Edit", the "1" key for enable and then "Enter" to enable the IF Loop-back. When finished using this mode, return to the "Test - IF Loop" position and press the "0" option key to disable.

2.8.1 Built-in BERT

When in IF Loop-back mode a Bit Error Rate Test (BERT) can also be performed using the modem's built in BER test capabilities. The transmit and receive BERTs are independent and are enabled in the <Int'f: Test – Mod BER> and <Int'f: Test – Dem BER> parameters. Note this convention for accessing a parameter. It means press the "Int'f" key (if not already set) and scroll left or right to the Test column and then up or down until the LCD displays "Test – Mod BER" on the upper line. The BER test is enabled by pressing "Edit" and then pressing either "1" for a

“2047” pattern or “2” for a “2²³-1” pattern. The “0” key will disable the BER test mode. BERT test readings are displayed in the **<Int’f: Status - BER>** parameter and the 6 items below it.

Since there is no noise added in the IF Loop-back mode the BER results should show no errors. This test is more useful once the modem is configured and a Loop-back over the satellite is performed by setting the receive frequency to that output by the modulator.

The IF Loop-back state and the BERT state are both stored in EEPROM, therefore if the unit is powered off during IF loop-back and/or BERT test it will return to this state when powered up again.

More information on the BERT functions is given in Section 4.1.2 “*Using the Built-in BERT*”.

2.9 Modem Configuration

Configuring the PSM-4900 Modem operating parameters is essential before placing the unit into service. The PSM-4900 Modem operating parameters may be set up using the front panel, the IrDA front panel input or the terminal command mode. The binary remote control input may also be used if the remote interface parameters are already known and set.

2.9.0 Configuring the Modem for Operation

The following description assumes that the modem setup is to be done manually at a depot location or in the field via the front panel. Alternately, the modem could be automatically set up using a controller and the command interface. No software is provided for such an external control application and therefore this task is the responsibility of the using organization.

2.9.1 Setting Essential Parameters

The setting of several basic parameters is essential to achieve proper operation and carrier lock with the modem. Improper setting of any of these parameters will probably result in failure to communicate with the far end of the link. These basic parameters are listed here to serve as a minimum checklist for installation.

Modulator and Demodulator

1. Carrier Frequency (Note special procedures below available for L-Band interfaces.)
2. Modulation Mode (BPSK or QPSK)
3. Bit Rate
4. FEC Code Rate
5. Differential Encoder (Normally Enabled)
6. Scrambler (Normally Enabled in IESS 308/309 mode – See “*Using The Proper Scramble*” below)
7. Clock sources set per system requirements.
8. Reed-Solomon Codec settings if installed
9. IBS Multiplexer settings if installed
10. External reference set properly
11. Modulator and Demodulator functions enabled

Modulator

1. Output Level
2. Carrier Enable
3. The L-Band modem can also supply power and reference to a BUC.

Demodulator

1. Carrier Acquisition Mode and Acquisition Range
2. The Hybrid and L-Band modems with L-Band Receive can be set to supply power at either 13 or 18 VDC and/or a 10 MHz reference signal on the receive input connector for coupling to the LNB via the receive cable.

2.9.1.1 Using The Proper Scrambler

The M5 modems have had a preferred scrambler setting in the “IESS 308” or “IESS-309” modes for the modulator and demodulator. These modes automatically select the proper scrambler to use when in any standard Intelsat IESS 308 or 309 mode. There is no IESS Standard covering the new Turbo Product Codes FEC, and the auto modes no longer works in certain cases with the TPC installed and enabled. Following is the guideline to use with the TPC:

- When TPC is either not installed or not enabled the preferred scrambler and descrambler is “IESS 308” or “IESS 309”. See below for the difference.
- When TPC is enabled but the IBS multiplexer option is not installed or not enabled use the new Scrambler and Descrambler option #7 “TPC Sync” this uses a synchronous scrambler specific to the TPC Codec. **Note with Software Version 0.73+:** *Each time that TPC is enabled the modem automatically sets the TPC Sync scrambler mode.*
- When both TPC and IBS multiplexer are installed and enabled use the “IESS 308” option.

Remember that the scrambler and descrambler may be set independently in each link direction.

IESS-308 Scrambler Mode Operation

- With no mux or RS then the self-synchronizing Intelsat scrambler is enabled.
- With just the IBS mux enabled then the IBS synchronous scrambler is used
- With just the R-S enabled then the R-S synchronous scrambler is used
- With both IBS Mux and R-S enabled then the IBS synchronous scrambler is used.

IESS-309 Scrambler Mode Operation

The operation is the same as the IESS-308 option with the exception that

- With just R-S enabled then the self-synchronizing Intelsat scrambler is used.

Fixed Scrambler Mode Operation

The V.35 and Intelsat scrambler modes use the V.35 and Intelsat self-synchronizing scramblers respectively in all modes.

Alternate Scrambler Mode Operation

The alternate V.35 and alternate Intelsat scrambler mode performs a data inversion required by some “Comstream” modems.

2.9.1.2 Using The L-Band PSM-4900L Transmit RF Frequency Feature

The PSM-4900L can cover the entire satellite’s receive range from its transmit output. This output can be tuned to any frequency on 1 Hz increments in the 950 to 1750 MHz range. The coverage can be “projected” to the actual satellite RF frequency being transmitted at the BUC output. To enable this feature simply supply the **<Mod: BUC – LO Frequency>** parameter with a value other than “0”. When the value set here is equal to the BUC’s LO frequency then the modem can automatically compute the RF frequency at the BUC output.

The PSM-4900L modem will also determine if the LO is high or low side and sets the spectrum so that it is always “Normal”, i.e. not inverted. You do not have to change the IF spectrum setting from “Normal” to achieve this.

Note: After entering a new BUC LO frequency the modem requires a new Transmit IF frequency input to recalculate the proper output frequency setting.

To return to using the L-Band IF frequency setting, simply enter a value of “0” into the BUC LO parameter. A common BUC LO frequency for the C-Band 5.925 to 6.425 GHz Range is 4900 MHz (low side LO), while a low side LO for the Ku Band 14.0 to 14.5 GHz range is 13150 MHz.

2.9.1.3 Using The L-Band PSM-4900H & L Receive RF Frequency Feature

The PSM-4900H or L can cover the entire satellite’s transmit range on its receive input. This input can be tuned to any frequency on 1 Hz increments in the 950 to 1900 MHz range. The coverage can be “projected” to the actual satellite RF frequency being received at the LNB input. To enable this feature simply supply the **<Dem: LNB – LO Frequency>** parameter with a value other than “0”. When the value set here is equal to the LNB’s LO frequency then the modem can automatically compute the RF frequency at the LNB input.

The PSM-4900H/L modem will also determine if the LO is high or low side and sets the spectrum so that it is always “Normal”, i.e. not inverted. You do not have to change the IF spectrum setting from “Normal” to achieve this.

Note: After entering a new LNB LO frequency the modem requires a new Receive IF frequency input to recalculate the proper input frequency setting.

To return to using the L-Band IF frequency setting, simply enter a value of “0” into the LNB LO parameter. A common LO frequency for the C-Band 3.7 to 4.2 GHz Range is 5150 MHz (high side LO), while a common LO for the Ku Band 11.7 to 12.2 GHz range is 10750 MHz (low side LO).

2.9.2 Carrier Acquisition Parameters

The PSM-4900 Modem has two main modes and several programmable receive carrier acquisition parameters available. These parameters control the initial acquisition of a carrier and reacquisition of a carrier when it has been removed and reapplied.

There are two main acquisition methods used by the PSM-4900. The normal mode for fastest possible acquisition (especially at low data rates) is the “Fast” mode which utilizes an onboard digital signal processor (DSP) to mathematically determine the location of the carrier and lock as fast as possible. This mode initially goes for the largest carrier power within the acquisition range. A new acquisition attempt will always repeat the same process and go to the same carrier. The “fast” acquisition mode is optimized for the fastest possible acquisition speed, and is set as the default acquisition mode for the modem.

A second mode called “Search” also uses the DSP but performs a piece-wise sweep of the programmable acquisition range to locate the carrier and lock to it. If the modem cannot lock to the first carrier it detects it will attempt to find another carrier in the next step of frequency. The sweep always starts at the low end of the acquisition range and moves upward, wrapping around to the low end when the top is reached. The Search mode is optimized for crowded spectrum applications where nearby high power carriers may interfere with the standard “Fast” acquisition mode. To our knowledge no one has ever had a problem using the standard Fast mode over several years with many thousands of units, but the “Search” mode is still supplied just in case.

The hybrid “Auto Narrow” and “Auto Track” modes available in previous generations of this modem are no longer available as separate entries. The “Auto Narrow” function of initially searching in a smaller acquisition range is incorporated into the latest version of the “Search” mode. Setting the “Search” mode also enables a new menu item for “Sweep Time”. To be enabled the **<Dem: IF – Sweep Time>** is set to a value other than 0 Seconds. Then, when a carrier lock is lost, the modem will search in a reduced acquisition range (equal to the symbol rate in Hertz) for the specified Sweep Time.

The “Search” acquisition mode also allows a modified version of the previous “Auto Track” function. When in this mode the modem can be commanded to an offset from the set receive IF frequency and the modem will begin its narrow search about that offset for the specified Sweep

Time. In this mode the Demod Offset may be set by any command method and the demodulator will search at that point in the narrow DSP mode. (Note that in the standard fast acquisition mode the Demod Offset is read only) This mode is intended for possible DAMA use where the offset can be maintained to insure the fastest lock time.

The acquisition mode is set by setting the **<Demod: IF - Sweep Mode>** option parameter to either “Fast” (0), or “Search” (1). The “Fast” mode is the standard setting.

2.9.2.1 Initial Acquisition

For initial acquisition, a single setting allows programming the acquisition sweep range that the modem will search to find an available carrier. This parameter can be set from $\pm 100 \text{ Hz} \pm 1.25 \text{ MHz}$, where $\pm 30 \text{ kHz}$ is common for standard demodulators. If all of the system offsets are known and stable for a given installation, the initial acquisition range can be set to a low value which will slightly reduce acquisition time, especially at low data rates. Conversely if a very “loose” downconverter is in use such as a block down converter, for example, the initial acquisition range can be set very wide to allow locking to a carrier well outside the range of standard modems. Several cautions are in order here. If the acquisition range is set too small and the system offsets drift, then a carrier may be locked out of acquisition or lost during operation. If the acquisition range is set too wide and other compatible carriers are within the acquisition range, then the wrong carrier may be locked.

If a Demodulator Offset frequency parameter is entered in “Search” mode, the Demodulator carrier frequency setting plus the offset setting is used as the start point for attempting to acquire a signal. If a sweep time has been set in the “Search” mode the modem uses the last carrier lock offset as the initial setting.

If the demodulator lock to a signal is forcibly aborted in “Search” mode, the Demodulator will attempt to acquire another signal immediately higher in frequency than the aborted signal. This pseudo-sweep always progresses more positive in frequency until it reaches the upper limit of the set acquisition range, where it will start searching again beginning at the lower limit of the set acquisition range. This allows a user to “search” through all of the available carriers within the acquisition range by viewing the **<Dem: Lock – Status>** and pressing the “Edit” or “Enter” key. At this keypress the modem will prompt with “Enter to unlock”. Pressing “Enter” will cause the modem to unlock and find the next higher frequency carrier within the acquisition range.

2.9.2.2 Carrier Re-acquisition

For the “Search” acquisition modes the PSM-4900 attempts to find a carrier in a reduced or “narrow” search range for a specified period of time before reverting to the standard search range. The reduced sweep range is equal to the symbol rate in Hertz. Once the “Search” acquisition mode is set, the “Sweep Time” Demod parameter setting controls the acquisition search time in the reduced range.

NOTE: The Narrow sweep range is relative to the receive frequency offset that is commanded via the remote control or front panel, or the last lock offset.

2.9.3 Sample Configuration Setting

The following procedures are used to set each of the modem’s parameters using the front panel.

Assuming the modem is to be used in the SCPC mode for a point-to-point link with another PSM-4900, the following sample configuration is representative of the required procedures:

For easier entry we can first set the entry mode to “Quick”. Go to **<Unit: Keybrd – Entry>** and set the “Quick” mode. This is the default setting.

The desired transmit operating mode is 81.275 MHz, QPSK, 56 kbps, Rate 1/2 FEC, and receive at 81.550 MHz, BPSK, 128 kbps, Rate 1/2 FEC. This example uses different transmit and receive

parameters to illustrate several points. The other end of the link would naturally have the opposite transmit and receive parameter settings.

The transmit parameters will be set first. With the unit powered on, press the “Mod” function button. Next, press the left or right arrow keys until the “IF” identifier is in the upper left line of the LCD display indicating that we are in the Modulator IF column of the parameter matrix. Now scroll down (or up) until the upper right of the LCD display indicates “Frequency”. The value displayed in the lower line is the current setting for the transmit frequency. A new frequency can now be directly entered by using the numeric keypad. First indicate that a new entry is desired by pressing the “Edit” key, which will display the current setting with the cursor set on the first available digit. Enter a frequency in MHz not including the decimal point, entering all digits required to specify the shown frequency, then press the “Enter” key to apply this new parameter value. In this first setting we did not use the quick entry mode, but the following will use that mode. Note that when not using quick entry the frequency edit function skipped over the decimal point. Later you might try returning to the frequency setting and enter the frequency directly using quick entry and the decimal point.

Next scroll down to the “Modulation” entry and press the “1” key to request QPSK, then press the “Enter” key to apply this new parameter value. Scroll right to the “Data” column and down to the “Bit Rate” parameter and press “56” and “Enter”. *(Without Quick entry we would have to press “Edit”, “0”, “0”, “5”, “6” and “Enter”. Note that if digits other than “0” had been set in positions after the last “6” of the valid entry, then they must be overwritten with “0”s.)* Last, scroll down to the “Code Rate” parameter and press “Edit”, “0” and “Enter”.

To set the receive parameters, press the “Demod” button and the right arrow key until the “IF” identifier is in the upper left line of the LCD display indicating that we are in the Demodulator IF column of the parameter matrix. Now scroll down (or up) until the upper right of the LCD display indicates “Frequency”, and press the “Edit” key. Then edit the displayed frequency to 81.55 MHz and press “Enter”. Note that if digits other than “0” had been set in positions after the last “5” of the valid entry, then they must be overwritten with “0”s. Scroll down to the “Modulation” entry and press the “Edit”, the “0” key to request BPSK and press the “Enter”. Scroll right to the “Data” column and down to the “Bit Rate” parameter and press “Edit”, “0”, “1”, “2”, “8” and “Enter”. Last scroll down to the “Code Rate” parameter and press “Edit”, “0” and “Enter”. Next scroll left and down in the IF list to the “Sweep Range” parameter and set the value to 30 kHz.

This configuration example has illustrated how to “navigate” through the available parameter matrix and has shown two modes of entry for numerical and list selected values. If the Unit keyboard Entry had been set to “Quick” then all of the parameters shown above could have been set directly without pressing the “Edit” key first. This mode also does not require that existing characters be overwritten when entering new data.

Using the front panel or terminal command mode, set all modem parameters as necessary for the type of service intended. This should prepare the unit for operation. If the modem is to be controlled by an external command controller, set the modem address properly as described in the next section. The modem should now be ready for service in an operating satellite system.

Once all parameters have been set and verified, the transmit output can be connected to the ground station equipment for transmission to the satellite. Verify that the alarms are extinguished and that the demodulator has locked.

2.9.4 Setting Additional Parameters

As stated before, the basic parameter settings are essential to achieve modem operation and carrier lock. There are many other parameters, which must be set on the PSM-4900 to configure the unit to operate within your own system. These include setting those parameters which fall into three major categories; Data Interface compatibility; Automatic Correction for link properties; and Alarm configuration.

2.9.4.1 Data Interface Compatibility

1. Mod and Demod Data Sense
2. Mod and Demod Clock Source
3. Mod and Demod Clock Phase (Default Mod Clock is now "Auto").
4. Modulator RTS Enable

2.9.4.2 Automatic Correction

1. Automatic Uplink Power Control (if equipped)
2. Demod FIFO Operation

2.9.4.3 Alarm configuration

The PSM-4900 Alarm system represents a sophisticated method of controlling visual, relay and logical alarm outputs which can be used for multiple purposes including redundancy. A basic representation of the alarm system functioning is shown in the figure below.

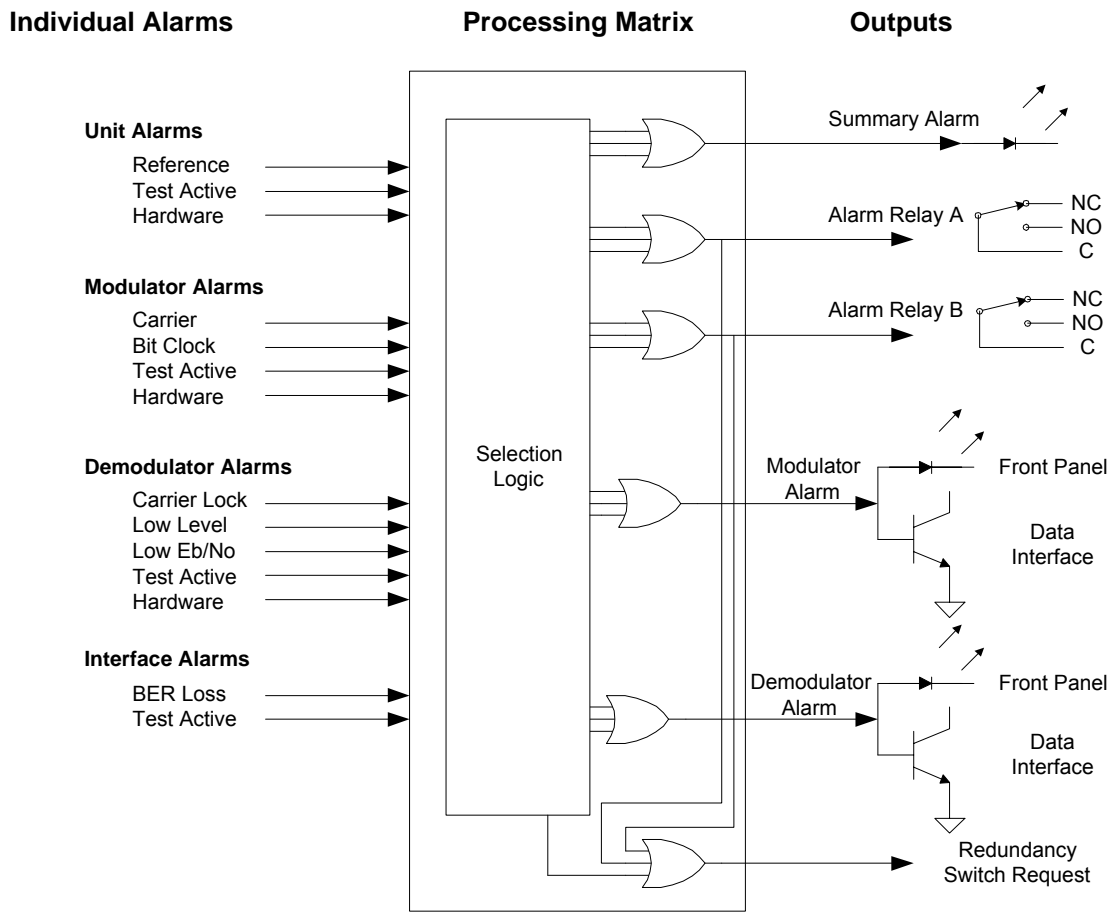


Figure 2-3 - Alarm Processing

There are also other possible alarm inputs depending on the modem options and configuration. Each of the individual alarm inputs has a configuration selection parameter under the "Alarm" column of its matrix. The general options available are to set the alarm to either be ignored or to form one of the "OR" inputs to the A or B alarm relay or both. The default set-up for these alarms

is to have all the modulator related alarms assigned to Alarm A and all demodulator alarms assigned to Alarm B. The two alarm relays could be changed to represent "Major" and "Minor" alarms.

The open collector outputs for the modulator and demodulator alarms are available on the data interface connector and are used by some types of redundancy switches for determining alarm status. The modem's built-in redundancy switch logic uses either all alarms or combinations of the A and B alarms to activate a switch request.

A description of each of these settings is contained in Operations, Section 3.2 and Tables 3-5 through 3-8 later in this manual. A brief description of alarm configuration is also given here. Possible alarm sources include the following items:

1. Unit Reference missing.
2. Unit Test Active.
3. Unit Hardware Fault.
4. Transmit Carrier Off.
5. Modulator Bit Rate Lock.
6. Modulator AUPC Alarm.
7. Modulator Test Active.
8. Modulator Hardware Fault.
9. Demodulator Signal Lock.
10. Receive Input Level below AGC range.
11. Receive Low E_b/N_0 below threshold.
12. Demod Test Active.
13. Demodulator Hardware Fault.
14. Interface Test mode Active.
15. Interface BER Test Sync Loss.
16. Backward Alarm from IBS multiplexer (if equipped).

The inputs are read by the processor and eight outputs are produced including two alarm relays, one Modulator, one Demodulator and one Summary alarm LED on the front panel, and a modulator and demodulator redundancy open collector alarms on the interface card, plus the redundancy switch request. The summary Alarm LED is the OR function of either of the alarm relays. The front panel or remote control can be used to select which of the possible alarm sources are assigned to each of the relays or can individually ignore any of the sources. Some modems only present alarms based upon a hardware fault in either the modulator or demodulator. The PSM-4900 allows the user to select such items as a low input level or E_b/N_0 to activate an alarm. By providing two relays and the configuration options, several alternative alarm scenarios can be used. The A and B alarm relays could represent a minor and major alarm, or they could be separated into modulator and demodulator functions, or one could be a summary alarm while the other is a dry contact input to a redundancy control unit.

2.9.5 Using the Internal or an External Reference

The PSM-4900 contains an internal Temperature Compensated Crystal Oscillator (TCXO) reference which determines the basic accuracy of all modem frequency and rate settings. This internal reference is a nominal 2.0 ppm stability over normal operating temperature, and exhibits aging less than 1 ppm per year. This is accurate for most applications, and for example, produces a worst case transmit center output frequency accuracy of $2.0 \times 10^{-6} \times 70 \text{ MHz} \times 10^6$ or $\pm 140 \text{ Hz}$ (176 Hz at 88 MHz). If this accuracy is not sufficient, or the network operating mode dictates, an external reference can be used.

The L-Band modem, PSM-4900L, uses an Oven Controlled Crystal Oscillator (OCXO) and the standard unit has a 1×10^{-7} stability and 2 to 3×10^{-7} aging rate per year. The increased stability is necessary because the oscillator can be used as the reference for a BUC.

The external reference frequency is applied at the rear panel BNC connector, J7, at a frequency of 1, 5, 9 or 10 MHz. Use of the external reference and the reference frequency are selected at the front panel from the **<Unit: Ref – Source>**, setting to external which then enables the entry for **<Unit: Ref – Frequency>**.

The external reference input does not perform any clean-up of an input other than band-pass filtering with a pass-band from approximately 1 to 12 MHz. The reference input should therefore been a low noise source.

If the Hybrid modem is currently set to supply a 10 MHz reference signal on the receive input connector for use by the LNB, then the currently selected reference is the source of that signal.

2.9.5.1 Reference Calibration

During factory testing and calibration the modem unit is compared to a known in-house reference and calibrated. A default value is permanently stored representing this factory calibration. The unit may be offset from this factory value by using the manual tuning or automatic recalibration.

Manual tuning of the modem’s reference is accomplished using the **<Unit: Ref – Fine Tune>** parameter and entering a value from –127 to +127

Automatic calibration of the modem’s internal reference is accomplished by inserting a known high accuracy reference at the rear panel “External Reference” input and enabling the **<Unit:Test – Cal Ref>** item. The calibration should take several seconds and will indicate a successful completion. If the calibration fails then the external reference was out of range in either level or frequency.

The factory calibration may be restored by setting the **<Unit: Ref – Fine Tune>** value to “0”.

2.9.6 Setting the Modem Station ID Name

Each PSM-4900 contains two unique identification entries available at the front panel or remotely. They are the unit serial number and the Unit Name or “Unit ID”. The serial number is set at the factory and cannot be changed, but the Unit ID can be set and changed whenever necessary. This field allows identification of the modem with up to 16 characters.

The Unit ID can be set easily from the VT100 terminal mode, and with slightly more effort from the unit front panel. To set the Unit ID, use the front panel arrow keys to scroll to the **<Unit: Status – Unit ID>** parameter and pressing “Edit” to begin entry. Each character position is selected using the right and left arrow keys, and the character at that position is set using the up and down arrow keys. When the proper entry is achieved press the “Enter” key to finalize the input. The first character is the “Space” followed by the characters below.

ASCII Characters Available for Unit Station ID							
Char	Char	Char	Char	Char	Char	Char	Char
!	/	.	M]	l		{
“	0	?	N	^	m		
#	1	@	O	_	n		}
\$	2	A	P	‘	o		→
%	3	B	Q	a	p		÷
&	4	C	R	b	q		&
‘	5	D	S	c	r		

(6	E	T	d	s		
)	7	F	U	e	t		
*	8	G	V	f	u		
+	9	H	W	g	v		
,	:	I	X	h	w		
-	;	J	Y	l	x		
.	<	K	Z	j	y		
	=	L	[k	z		

When entering this parameter via a terminal connected to the remote port the Unit ID Name is entered directly as text from the terminal keyboard. The Unit ID can also be entered via remote control at the front IrDA or rear panel control ports.

After any entry mode the processor will center the input characters on the lower line of the LCD display

2.9.7 Setting the Modem Address for Command Mode Operation

If Command Mode Binary Packet Operation is desired the modem packet “address” must be set via the front panel before the modem will recognize packets. To set the address use the arrow keys to go to the **<Unit: Remote – Address>** parameter and press “Edit”, then use the numeric keypad to enter the address from 0 to 255. Then press the “Enter” key to enable the change.

The address 255 is “global” and all units will respond to a message packet with this address regardless of its setting, but no unit will return a response message. It is suggested that you do not use addresses 1 or 255 (1 is the factory setting, and any new unit added to a system will have address 1).

The address “0” is also unique. This address causes the modem to accept commands and send responses without the address fields normally required in the command packets.

2.10 Interface Type Configuration

The PSM-4900 Modem contains on-board circuitry to implement several different interface types:

- 0 Disabled
- 1 RS-232 (Synchronous only, limited to 128 kbps by drivers and receivers)
- 2 RS-449
- 3 RS-449/Unterminated (used in redundancy)
- 4 V.35
- 5 V.36
- 6 EIA-530
- 7 EIA-530A

A single 37 pin female “D” type connector on the rear panel at J3 is used for all interface types. The connector pin-out is shown in Chapter 2, Installation. Adaptor cables are available for other physical connector types. The two we make are the DB25 (P/N DSF00-080) and Winchester M34 style V.35 (P/N DSF00-083). See Appendix C for more cabling information.

The modem is also capable of accepting one of several existing and to be implemented additional option interfaces. These include a 10 Base T Ethernet interface, a G.703 interface and others. The main processor automatically determines the presence and type of interface and options by querying the interface card. Adding an optional interface card or changing an already

installed interface should only be attempted by experienced personnel familiar with electronic communications equipment. Either of these operations requires removing the modem from service, and removal and replacement of the modem top cover to gain access to the interface PCB assembly.

2.10.1 Adding or Changing the Optional Interface Type

An optional interface card may be installed or exchanged in a modem unit by removing the modem's top cover. First the interface option card rear panel plate is released from the chassis by removing the two screws on either side of this plate at the rear panel. The interface card to be removed is disconnected from the main board by releasing the one or two ribbon cables from the IDC connectors at P5 and P7 (or P5 only if so configured). These designations are those on the main modem PWB. The four #6 screws and lock washers are then removed if in an existing board and saved for placing the new interface card into the chassis. Once the new interface card is installed on the standoffs the two rear panel screws are installed first, then the four #6 screws are used to mount the board to the chassis. Finally the required ribbon cables are (re-)attached to the new card and the main PWB at P5 (and also P7 if used). Finally the unit top cover is replaced using the 8 screws removed above.

When the unit is powered-up again the main modem processor will automatically query the new interface card and determine the type and options installed.

Most option interface cards completely co-exist with the on-board interface types, allowing the optional

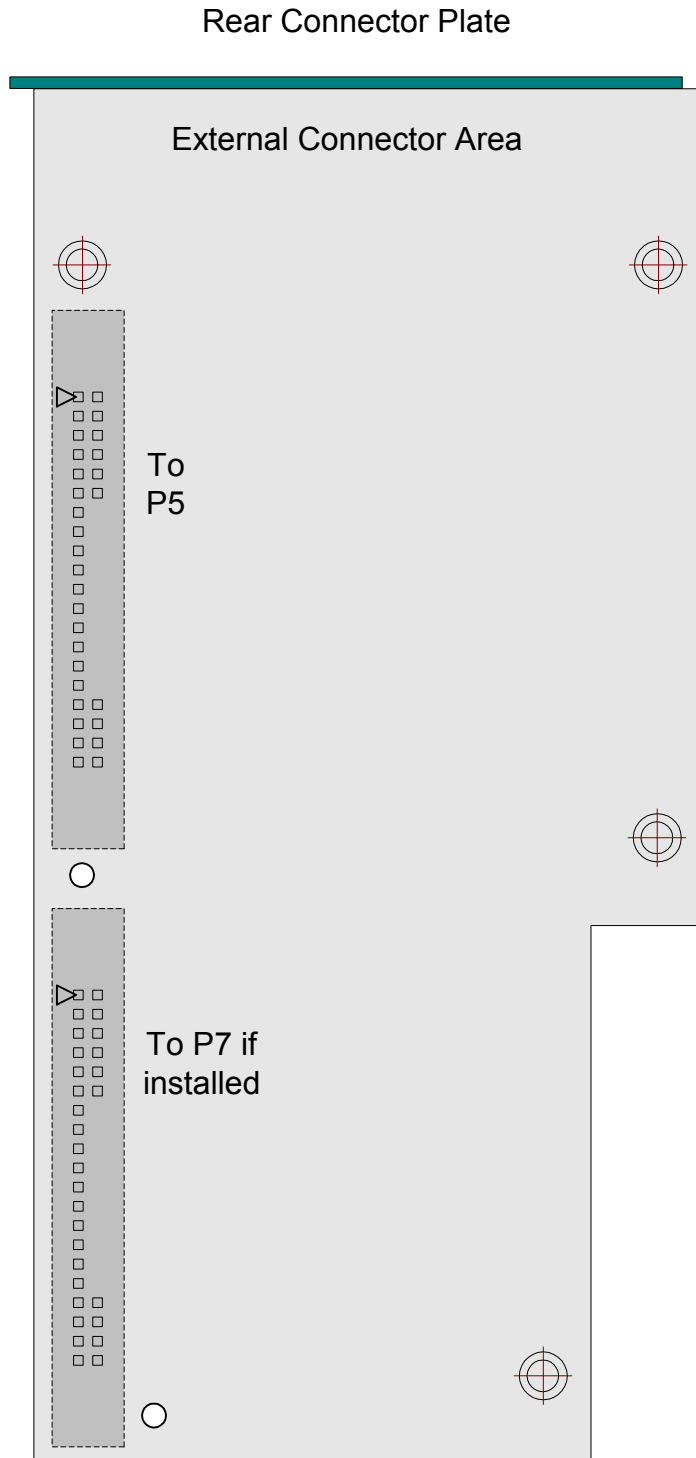


Figure 2-4 Typical Interface Card Layout

interface to represent one or more added interface types available. Only one interface type is however allowed to be enabled at one time.

2.11 Option Card Installation

The PSM-4900 Modem contains on-board circuitry and connectors for adding several option “daughter” boards which plug onto the main modem assembly. Installation of these cards is not difficult, but requires removal of the modem from service and removal of the unit’s cover, and should be accomplished only by a qualified technician. The modem automatically recognizes the presence of the option card and provides additional front panel and remote control parameter settings allowing control of the option.

In some cases when options are first introduced a software update to the modems internal program is necessary to allow use of the option. Refer to Section 4.3 “*Updating Modem Software*”.

2.11.1 IBS Multiplexer and Reed-Solomon Option Installation

The PSM-4900 Modem contains on-board circuitry and connectors for adding an IBS Multiplexer only or an IBS Multiplexer and Reed-Solomon Option Card. When purchased as an IBS Multiplexer only card sockets are provided to add the Reed-Solomon FEC option at a later date. This type of option card is a “daughter” board which is plugged onto the main modem assembly, and should be installed only by a qualified technician. The modem automatically recognizes the presence of the option card and provides additional front panel and remote control parameter settings allowing control of the option.

The IBS Multiplexer and Reed-Solomon functions are independent and each can be enabled and disabled as required. The Modulator (Transmit) and Demodulator (Receive) functions of each option are also independent and can be enabled and disabled as required.

For additional information on the installation and configuration of the IBS Multiplexer/Reed-Solomon option refer to Appendix RS.

2.11.2 Turbo Product Codes Option Installation

The PSM-4900 Modem contains on-board circuitry and connectors for adding a Turbo Product Codes Option Card. This card can co-exist with the IBS Multiplexer option (and the Reed-Solomon function also, but both cannot be used simultaneously). This type of option card is a “daughter” board which is plugged onto the main modem assembly, and should be installed only by a qualified technician. The modem automatically recognizes the presence of the option card and provides additional front panel and remote control parameter settings allowing control of the option.

The Turbo Product Codes option, when enabled, replaces the on-board convolutional encoder/Viterbi decoder functions. The Modulator (Transmit) and Demodulator (Receive) functions of each option are also independent and can be enabled and disabled as required.

For additional information on the installation and configuration of the Turbo Product Codes option refer to Appendix TPC.

Chapter 3 - Operation

3.1 Operating Procedures

Operation of the PSM-4900 Modem consists of controlling the unit's operating parameters and monitoring status and responses via one of the control interfaces. There are four possible control methods for the modem:

1. Front Panel Control.
2. Terminal Mode Control.
3. Command Interface Control.
4. IrDA connected Control

Any of these methods may be used separately or together to monitor and control the modem unit. Each of these four interfaces and their respective methods are discussed separately below.

Additional operating procedures are also presented later in this section on using some of the unique features of the PSM-4900 that would not normally be set-up during installation. These include such items as the FIFO buffer, built-in BERT, storing and recalling configuration information, AUPC, the analog monitor output, redundancy and automatic recovery.

3.1.1 Front Panel Control

The front panel of the PSM-4900 allows complete control and monitor of all modem parameters and functions via a keypad, LCD display and status LEDs.

3.1.2 Front Panel Layout and Features

The front panel layout shown in Figure 3–1, identifies the location and labeling of items on the front panel. The front panel is divided into three functional areas: the LCD display, the Keypad and the LED Indicators, each described below.

3.1.2.1 Front Panel LCD Display

The front panel display is a 2 line by 16 character LCD display. It is augmented by the four LED highlighted legends to the display's right. The display and legends are lighted and the brightness can be set to increase when the front panel is currently in use, automatically dimming with inactivity. The display has four distinct areas showing current information. The four legends indicate the Modem's functional area that is currently being monitored or controlled, including "Unit", "Mod", "Demod" and "Interface". The upper left of the LCD shows the current area of use, such as "Status", "IF", "Data", "Alarm" or "Test" (for the Mod and Demod). The upper right shows the current parameter being monitored, such as "Frequency", "Offset" or "Bit Rate". The lower line shows the current value of that parameter. The LCD display is a single entry window into the large matrix of parameters which can be monitored and set from the front panel. It is convenient to imagine the matrix as 3 dimensional spreadsheet just like a multi-sheet Excel workbook, with the different "sheets" selected by the buttons for Unit, Mod, Demod and Interface, while navigation on a given sheet is accomplished using the up, down, left and right arrow keys.

The backlight brightness can be set for two states: Active and Idle. The active state is entered whenever a key on the front panel is pressed, while the idle state occurs after approximately 60 seconds of inactivity. Each state may be set to "Off", 1/3 brightness, 2/3 brightness and full brightness. The default setting is full in the active state and 1/3 in the idle state. To change the settings for either state go to the "Modem LCD Active" or "Modem LCD Idle" brightness parameter and adjust to the desired values.

3.1.2.2 Front Panel Keypad

The front panel keypad consists of three areas:

First, is a 10-key numeric entry with 5 additional keys. Two keys provide for a "+/-" (change sign) and "." (decimal point) function, while three more on the far right provide "Edit", "Clear" and "Enter". The "Enter" key on the lower right is normally blue while the rest of the numeric keypad keys are gray. This allows easy identification of the Enter key.

The second area is a set of "Arrow" or "Cursor" keys used to navigate the parameter currently being monitored or controlled. During entry, the cursor keys allow moving a cursor to individual digits of a numerical entry or scrolling through the available options of a selection entry. The arrow keys are also in blue.

The third area is the four selection keys previously discussed with the LCD display. They allow selecting which functional area or "sheet" of the display matrix is currently in use. The four functional buttons represent the Unit, Modulator, Demodulator and Interface.

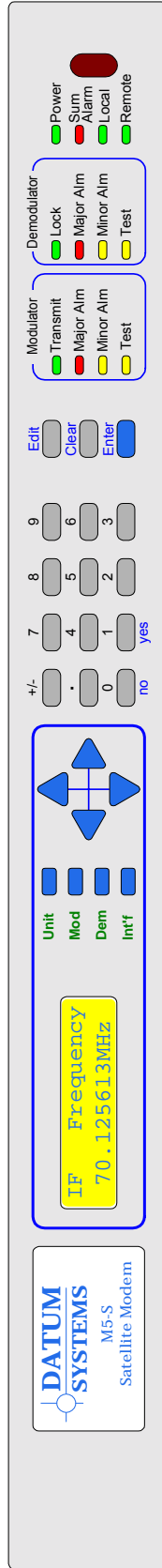


Figure 3-1 PSM-4900 Front Panel Controls and Indicators

3.1.2.3 Front Panel LED Indicators

There are 12 LEDs on the modem front panel to indicate current status of the modem's operation. They are separated into three columns representing (from left to right) the Modulator status, the Demodulator status and the Modem (Unit) status. The LED colors maintain a consistent meaning. Green signifies that the indication is appropriate for normal operation, Yellow means that there is a condition not proper for normal operation. Red indicates a fault condition which will result in lost communications

When one of the Alarm lamps below is illuminated, the highest priority alarm condition is displayed in the LCD window.

Modem LED Indicators

1. Power: Green – Indicates the modem unit is currently under power.
2. Alarm: Red – if summary fault condition exists from either Alarm A or Alarm B.
3. Local: Green – Indicates that the unit is set to respond to the front panel.
4. Remote: Green – Indicates that the unit is set to respond to the remote control input.

Modulator LED Indicators

1. Transmit: Green – Indicates that the transmit output is currently active. Green Flashing when an IF Looback test is active and the carrier is configured to the “disabled” state.
2. Major Alarm: Red – Indicates that the transmit direction has failed, losing traffic.
3. Minor Alarm: Yellow – Indicates a transmit warning condition exists.
4. Test Mode: Yellow Flashing – Indicates the modulator is involved in a current test mode activity.

Demodulator LED Indicators

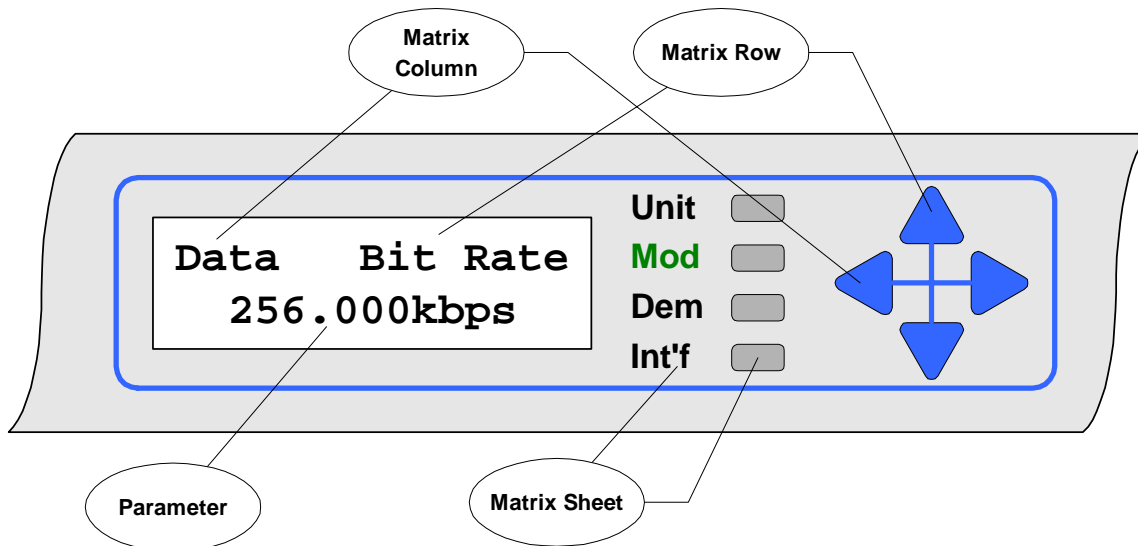
1. Lock: Green – Indicates receiver lock to an incoming CXR and data including FEC sync.
2. Major Alarm: Red – Indicates that the receive direction has failed, losing traffic.
3. Minor Alarm: Yellow – Indicates a receive warning condition exists, either an incoming carrier with a low input level or a low E_b/N_o (programmable threshold), or a backward alarm received from the far end.
4. Test Mode: Yellow Flashing – Indicates the receiver is involved in a current test mode activity.

3.1.3 Guide to Front Panel Monitor and Control

The front panel can be used to perform complete monitor and control of the modem setup and operating parameters. The operation of the front panel should be intuitive after very little use to familiarize the user with basic concepts and operations. Parameter entry operations have two methods of accomplishing the same goal and the method used is up to the user although in most cases one method will have potential advantages.

3.1.3.1 Navigating Modem Parameters

Consider that there are over 180 programmable or monitored parameters on the PSM-4900 and that the LCD display can only show one parameter at a time. To simplify locating any desired parameter, they are organized into a 3 dimensional table or matrix form with 4 layers or “sheets”, each one having 4 to 10 columns and up to 32 rows. This matrix is shown in Tables 3-1 through 3-4. Each matrix sheet represents a major functional area of modem operation (i.e. Unit, Modulator, Demodulator and Interface) while the columns represent groupings within those functional areas and the rows represent individual parameters associated with that function. The columns include such divisions as Status, Alarm and Test areas. The LCD display allows viewing only one of the many parameters at one time. At any time the LCD display shows the monitored parameter value on the lower line of the two-line display. The upper left line of the display shows the column name (such as Status, IF, Data, Alarm and Test) while the upper right shows the parameter (row) name.



Front Panel Parameter Matrix Navigation

The four arrow keys located to the right of the LCD display are used to scroll through the rows and columns of each parameter matrix layer or sheet. The left and right arrow keys scroll through the columns and the up and down arrow keys scroll through the available parameters in each column. Both the columns and rows “wrap around” such that scrolling past the last item in a row starts with the first item in the same row again, and the same for columns.

In this manual operation of the keypad to access a certain parameter is shown in the format **<Function: Column – Row>**. For example, to get to the Modulator IF Level the method is to press the “Mod” key then use the left and right arrow keys to access the “IF” column and the up

and down arrow keys to arrive at the “Level” parameter. This is shown by convention in this manual as **<Mod: IF – Level>**.

It is convenient to imagine the matrix as 3 dimensional spreadsheet just like a multi-sheet Excel workbook, with the different “sheets” selected by the buttons for Unit, Mod, Demod and Interface, while navigation on a given sheet is accomplished using the up, down, left and right arrow keys.

Until you become familiar with the location of parameters using the front panel, it is convenient to use the Matrix Tables 3-1 through 3-4 as a quick reference.

3.1.3.2 Monitoring Modem Parameters

Any available modem parameter is monitored by simply using the function and arrow keys to display the desired parameter in the LCD display. The item displayed will remain until changed or power is removed from the modem unit. The display is “Live”, therefore when a currently displayed parameter changes the display will change without operator intervention. When multiple parameters could be displayed (such as when multiple test modes are currently running or multiple alarms are present) only the highest priority item is displayed. When that item is no longer valid the next highest priority is displayed. The priority of items is fixed within the modem software.

3.1.3.3 Changing Modem Parameters

To set any parameter, the 4 functional area keys and the 4 arrow keys to the right of the LCD display are first used to select the parameter to be set, then one of several “entry” modes is used to change the parameter. In any entry mode pressing the “Edit” key to indicate a new entry, then editing the parameter via the arrow keys and the numeric keypad and finalizing the data entry using the “Enter” key will work. The “Quick” entry mode allows direct entry of a new value without first pressing the “Edit” key. All entry items take one of two forms:

1. Numeric entry such as frequency or bit rate; and
2. Selection from a list such as selecting FEC rates 1/2, 3/4 or 7/8.

Numeric entries may be entered by performing one of the following:

- When a numeric parameter is displayed, it can be changed by pressing the “Edit” key, then using the left and right arrow keys to select the first digit to be changed and entering a new digit. Successive digit entries go to successive characters on the display, skipping over the decimal point which is in a fixed location. Leading zeros must be used to enter smaller numbers than are currently displayed, and trailing zeroes are used to eliminate trailing digits not required. The entry is finalized by pressing the “Enter” key.
- An alternate edit mode is accomplished by first pressing the “Edit” key, then using the left and right arrow keys to select the first digit to be changed. The digit is “scrolled” using the up and down arrow key. Additional digits are pointed to using the left and right arrows and also scrolled. Finish the edit by pressing the enter key. Overflow when scrolling up through 9 will increment the next higher digit while underflow will decrement the next higher digit.
- Direct entry can be accomplished if the **<Unit: Keyboard – Entry Mode>** is set to “Quick”. In this mode the current parameter can be changed by simply entering new information, which completely overwrites the existing parameter. For example when viewing the Modulator Data Bit Rate of 256.000kbps entering the digits 47.243 (including the decimal point) and pressing “Enter” will change to that new data rate. Note that a leading “0” did not have to be entered to overwrite the “2” of the existing parameter.

The current input can be canceled by pressing the “Clear” key at any time before pressing “Enter”. Failure to press a key for approximately 60 seconds results in automatic canceling of the current entry and return of the display to the current setting.

Selection entries may be accomplished by one of the following:

- When a selection entry parameter is displayed, simply press the “Edit” key followed by a digit key 0, 1, 2, 3 or 4. In this scheme “0” represents disabled, OFF, NO or the first possible choice. “1” represents enabled, ON, YES or the second possible choice. “2”, “3” and “4” represents the third, fourth and fifth possible choices. Then press the “Enter” key to finalize the entry.
- Alternately, when a selection parameter is displayed it can be changed by pressing the “Edit” key, then using the up and down arrow keys to scroll through the possible choices. When the desired option is displayed, pressing the “Enter” key selects the displayed choice and finalizes the entry. When scrolling through the available options, an arrow in the left column position denotes the current setting.
- Direct entry can be accomplished if the **<Unit: Keyboard – Entry Mode>** is set to “Quick”. In this mode the current parameter can be changed by simply entering digit key 0, 1, 2, 3 or 4 ... and pressing “Enter” to finalize the entry. Optional selections can be viewed by successively pressing several keys to determine their value, then pressing “Enter”.

Following a valid input, the modem will place the new setting into the nonvolatile EEPROM making it available not only immediately, but also automatically the next time the unit is powered on.

3.2 Front Panel Monitor and Control Parameters

The following tables 3-1 through 3-4 list the parameter matrices available from the front panel. Parameters that appear shaded are only accessible when the modem is configured to use those parameters. For example, those parameters pertaining to the AUPC are only available when the AUPC is enabled, and those pertaining to the Reed-Solomon Codec will appear only if the Reed-Solomon Codec is installed and enabled. This list does not include optional parameters for some interface options such as Ethernet or G.703 E1 interfaces.

The top gray row represents column headers, which are shown on the LCD display in the upper left. Items below the header are row parameter names shown in the upper right of the LCD. Columns are navigated using the left and right arrow keys while rows are navigated using the up and down arrow keys.

The tables below are organized with general “Rules of Thumb” which aid navigation.

1. The “Status” columns are generally read only, providing status on specific areas of modem operation.
2. The Modulator and Demodulator matrixes use common column designations. A current parameter in one area can be immediately accessed in the other by pressing the appropriate “Mod” or “Dem” button. For example when viewing the Mod Bit Rate, the Demod Bit Rate is accessed by simply pressing the “Dem” button.
3. The “Alarm” columns existing in all four matrixes and represents the disposition of alarm information from that source. Therefore the **<Dem: Alarm – CXR Lock>** sets the disposition of the Demodulator Carrier Lock Alarm as either None, to Alarm Relay A, to Alarm Relay B, or to Alarm Relay A & B.
4. The “Test” columns existing in all four matrixes and represents the control and display of test information for that area. The top entries in the Test column contains tests which can be enabled or disabled if available. The lower rows represents measurements of parameters and are read only. Active tests enabled in these columns generate flashing “Test” LED lamps in appropriate areas.

<p align="center">Table 3-1 PSM-4900 Front Panel Parameter Matrix – Unit Sheet</p>									
Status	Redundcy	Config	Keybrd	IrDA	Remote	Ref	Monitor	Alarm	Test
Modem	Mode	Modem	Mode	Mode	Mode	Source	Mode	Reference	Modem
Reference	SW Rqst	Store	Entry	Rate	Protocol	Frequency	Full	Tst Active	Cal Ref
Redundcy	SW Hold	Recall	LCD Actve	Format	Address	Fine Tune	Zero	Hardware	Update ROM
Unit ID	Backup	Restore 1	LCD Idle	Power	Rate			Beep	Ref AFC
Model		Restore 2	LCD Cntst	Activity	Format				SysClk AFC
Serial #		Restore 3	Activity		Port				+3.3V
Version		Restore 4			Activity				+5.0V
Mod Opt		Restore 5							+12.0V
FEC Opt		Restore 6							+21.0V
Mux Opt		Restore 7							-12.0V
Int'f Opt		Restore 8							Boot Code

Notes:

Parameters shown in gray are only available when the entry immediately above is enabled or set to a mode that requires those entries. The gray Redundancy parameters are only shown when connected to another unit in redundancy mode.

Other columns may be added by options added to the modem or software.

Word spelling is purposely truncated to fit in available LCD display window.

Table 3-2 PSM-4900 Front Panel Parameter Matrix – Modulator Sheet							
Status	IF	Data	RS FEC	Mux	BUC	Alarm	Test
CXR	Frequency	Bit Rate	Mode	Mode	Power	CXR	Modulation
Bit Clk	Offset	Fec	(n)	ESC Overhead	Voltage Out	Bit Clk	Symbol Rate
Test	Level	Code Rate	(k)	MCC Overhead	Voltage Min	AUPC	CXR ALC
	Output	Dif Encoder	depth	OverHd Ratio	Current Out	Tst Active	LO AFC
	Modulation	Scrambler		ESC Port	Current Max	Hardware	Step AFC
	Spectrum	Clk Source		ESC Rate	Current Min	BUC Power	
	Mode	FEC C0/C1		ESC Frmt	10 MHz Ref	OEXO Cold	
	Preamble			ESC CTS	LO Frequency		
	AUPC						
	AUPC Eb/No						
	AUPC Max Lvl						
	AUPC Min Lvl						
	Mute						
	Impedance						

BUC parameters are only available on PSM-4900L.
 AUPC settings are only visible if the AUPC is enabled.
 Dif Encoder disabled and not visible with Turbo Product Codes Option installed and enabled.

Table 3-3 PSM-4900 Front Panel Parameter Matrix – Demodulator Sheet							
Status	IF	Data	RS FEC	Mux	LNB	Alarm	Test
CXR	Frequency	Bit Rate	Mode	Mode	Power	CXR Lock	IF Loopbck
Offset	Sweep Range	Fec	(n)	ESC Overhead	Current Out	Low Level	Symbol Rate
Level	Sweep Mode	Code Rate	(k)	MCC Overhead	Current Max	Low Eb/No	AGC
Eb/No	Sweep Time	Dif Decoder	depth	OverHd Ratio	Current Min	Tst Active	LO AFC
Est.BER	Modulation	Descrambler	Eb/No	ESC Port	10 MHz Ref	Hardware	Step AFC
SER	Spectrum	Clk Source		ESC Rate	LO Frequency	Backward	IDcOff
Buffer	Low Level Alm	Buffr Delay		ESC Frmt		LNB Power	QDcOff
Test	Eb/No Alm	Buffer Size		ESC DTR			
	Impedance	FEC C0/C1		ESC DSR			
	LNB Power	FEC Hold					
	LNB 10MHz Ref						
	LNB LO Frq						

IF LNB items only available on PSM-4900H with software versions prior to 0.72.
 LNB column is only available on PSM-4900H and L. software version 0.72 and higher
 Sweep Time is only visible if Sweep Mode is set to "Search".
 Buffer Parameters are only visible if the Data Clock Source is not set to "Demod", enabling the

buffer.

Dif Decoder is disabled and not visible with Turbo Product Codes Option installed and enabled.

Table 3-4 PSM-4900 Front Panel Parameter Matrix – Interface Sheet				
Status	I/O	SDMS or ENET	Alarm	Test
I/O	Mode	IP Addr	Tst Active	Ter Loopbck
RTS	RTS	Netwrk Mask	BER Loss	Sat Loopbck
CTS	CTS	MAC Addr	SDMS	Mod BER
DCD	DCD	Options		Demod BER
DTR	DTR	Version		
DSR	DSR	Serial#		
Test	Xmt Data			
Test BER	Xmt Clock			
Sync Loss	Rcv Data			
Errors	Rcv Clock			
Bits				
EFS				
Erred Sec				
Total Sec				

Note: The seven shaded BERT Status column items are only visible when the Demod BER is enabled in the Test column.

The center column is used for interface option expansion, and is only displayed with an option installed.

Tables 3-5 through 3-8 describe the parameters available from the front panel and entry in more detail. The grayed separators delineate column divisions in the area matrix. The “»” symbol indicates that this parameter is not available unless a preceding parameter is enabled or set to require those parameters, or optional hardware is installed that uses that particular parameter. Parameters can also be added as new options are installed.

Table 3-5. Modem (Unit) Parameter Detail

Unit Parameter Detail			
Representation	Type	Entry	Description
Status Modem Locked & Sending	Read Only	Read Only	Mod & Demod Status
Status Reference Internal, OK	Read Only	Not changeable	Reference source and status
Status Redundcy 1:1 On Line	Read Only	Used to force a transfer away from this unit.	Redundancy Status
Status Unit ID Rmt Santa Cruz	Alpha – Numeric	Entered as ASCII for up to 16 characters	Station Name for user
Status Model PSM-4900	Read Only	Read from software	Modem Model #,
Status Serial# 3923	Read Only	Not changeable	Modem Serial Number
Status Version 1.00	Read Only	Read from software	Version of software installed
Status Mod Opt Burst	Read Only	Read from Installed Option	Type of Installed Option
Status FEC Opt Turbo Code	Read Only	Read from Installed Option	Type of Installed Option
Status FEC Opt Reed-Solomon	Read Only	Read from Installed Option	Type of Installed Option
Status Mux Opt IBS	Read Only	Read from Installed Option	Type of Installed Option
Status Int'f Opt SDMS-Lite	Read Only	Read from Installed Option	Type of Installed Option
Redundcy Mode Internal 1:1	Selection	0 = Disable, 1 = Internal 1:1, 2 = External	Select Redundancy mode. Internal requires “Y” cable.
Redundcy Sw Rqst on Alarm A & B	Selection	0 = On any Alarm 1= On Alarm A 2 = On Alarm B 3 = On Alarm A & B	What will request a switch to backup modem.
Redundcy Sw Hold .5 Sec	Numeric	0.0 to 600.0 seconds in 0.1 second increments.	Sets the minimum time that a redundancy alarm must last before switching occurs.
Redundcy Backup Idle	Selection	Backup Status or Press “0” or “Edit” then “Enter” to transfer current configuration to backup.	View status of or configure backup. Only available when on-line.

Unit Parameter Detail			
Representation	Type	Entry	Description
Config Modem Mod & Demod	Selection	0 = Disable, 1 = Demod Only, 2 = Mod Only, 3 = Mod & Demod	Used to disable the Mod or Demod and also the lamps and indications when not used.
Config Store Factory, 1 to 8	Selection/ Numeric	1 to 8, Factory configuration not alterable	Location to store current configuration to.
Config Recall Factory, 1 to 8	Selection/ Numeric	0 to 8, 0 = Factory	Location to recover current configuration from.
Config Restore 1 After 1 Sec	Selection/ Numeric	Disabled (0), 1 to 14,400 seconds	Time after loss of rcv carrier to restore this configuration.
...Restore 2-7		...	
Config Restore 8 Disabled	Selection/ Numeric	Disabled (0), 1 to 14,400 seconds	Time after loss of rcv carrier to restore this configuration.
Keybrd Mode Full Access	Selection	0 = Disable, 1 = Read Only, 2 = Full Access	Keyboard access control.
Keybrd Entry Quick	Selection	0 = Quick, 1 = Edit Only 2 = Confirm	Keyboard Entry method. Quick is the normal default mode.
Keybrd LCD Active Backlight Full	Selection	0 = off, 1 = 1/3, 2 = 2/3, 3 = Full	Active level of LCD backlight
Keybrd LCD Idle Backlight 1/3	Selection	0 = off, 1 = 1/3, 2 = 2/3, 3 = Full	Idle level of LCD backlight
Keybrd LCD Cntst 10	Numeric	0 to 20	LCD Contrast setting
Keybrd Activity Beep	Selection	0 = None, 1 = Beep, 2 = Blink, 3 = Beep & Blink	Audible "click" and/or "Local" LED Blink on front panel key press.
IrDA Mode Full Access	Selection	0 = Disable, 1 = Read Only, 2 = Full Access.	Remote control access mode allowed from front panel IrDA port.
IrDA Rate 19200bps	Selection	0 to 7 selects 300 to 38,400 bits per second.	IrDA bit rate
IrDA Format N, 8, 1	Selection	0 = N,8,1 1 = E,8,1 2 = O,8,1 3 = M,8,1 4 = S,8,1	IrDA control data/stop bits and parity. Always 8 data bits and 1 stop bit. N= No Parity, E = Even, M = Mark, S = Space.
IrDA Power IR High	Selection	0 = IR Low, 1 = IR Medium, 2 = IR High.	Infrared output power setting. High is normal

Unit Parameter Detail			
Representation	Type	Entry	Description
IrDA Activity Blink	Selection	0 = None, 1 = Beep, 2 = Blink, 3 = Beep & Blink	Audible "click" on/or and "Remote" LED Blink on Infrared port activity.
Remote Mode Full Access	Selection	0 = Disable, 1 = Read Only, 2 = Full Access.	Remote control access mode allowed
Remote Protocol Binary Packet	Selection	0 = VT100, 1 = Quiet VT100, 2 = Binary Packet,	Remote control mode type
Remote Address 1	Numeric	0 to 255 0 = address disabled 255 = global	Address used to access this unit via remote control and IrDA packets.
Remote Rate 19200bps	Selection	0 to 7 selects 300 to 38,400 bits per second.	Remote port bit rate
Remote Format N,8,1	Selection	0 = N,8,1 1 = E,8,1 2 = O,8,1 3 = M,8,1 4 = S,8,1	Remote control data/stop bits and parity. Always 8 data bits and 1 stop bit. N= No Parity, E = Even, M = Mark, S = Space.
Remote Port RS-485	Selection	0 = RS-232, 1 = RS-485	Remote control port used
Remote Activity RS-485	Selection	0 =None, 1 =Beep, 2 =Blink, 3 =Beep & Blink	Audible "click" on/or and "Remote" LED Blink on Remote port activity.
Ref Source Internal	Selection	0 = Internal, 1 = External	Rear panel external reference.
Ref Frequency 10.000MHz	Selection	0 =1.0, 1 =5.0, 2 =9.0, 3 =10.0 MHz	Reference frequency at rear panel. Only available if set to external reference.
Ref Fine Tune 0	Numeric	+127 to -127	Internal reference fine adjustment. Only in Internal
Monitor Mode AGC Level	Selection	0 =AGC Level, 1 =Eb/No, 2 =Mod CXR Level	Selects source of analog output on rear panel alarm connector pins 5 and 6
Monitor Full +5.0V	Numeric	+10.0 to -10.0	Full scale setting for maximum output
Monitor Zero 0.0V	Numeric	+10.0 to -10.0	Minimum scale setting for minimum output.

Unit Parameter Detail			
Representation	Type	Entry	Description
Alarm Reference To Alarm A	Selection	0=None, 1=A, 2=B, 3=A&B, 4 = Mute CXR, 5 = Mute & Alarm A, 6 = Mute & Alarm B, 7 = Mute & Alarm A & B	Selects destination and action taken for reference oscillator alarm types.
Alarm Tst Active To Alarm A	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Alarm Hardware To Alarm A	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Alarm Beep On Alarm A & B	Selection	0=None, 1=On Alarm A, 2=On Alarm B, 3=On Alarm A & B	Selects if alarm causes a unit audible "beep".
Test Modem Disabled	Selection	0 = Disabled, 1 = Lamp Test, 2 = Self Test 3 = Lamp & Self Test	Carrier output mode for test purposes.
Test Cal Ref Disabled	Selection	0 = Disabled, 1 = Enabled	Calibrates the internal reference to an external input.
Test Update ROM Disabled	Numeric	Normally Disabled, Enter unit serial number and "Enter" key to start.	Entering the serial number and pressing "Enter" starts the update process.
Test Ref AFC +1.1V	Read Only	N/A	Internal Loop Voltage
Test SysClk AFC +9.1V	Read Only	N/A	Internal Loop Voltage
Test +3.3V +3.3V	Read Only	N/A	Internal Supply Voltage
Test +5.0V +5.0V	Read Only	N/A	Internal Supply Voltage
Test +12.0V +12.1V	Read Only	N/A	Internal Supply Voltage
Test +21.0V +20.8	Read Only	N/A	Internal Supply Voltage
Test -12.0V -12.1V	Read Only	N/A	Internal Supply Voltage
Test Boot Code 0000:0000:0010	Read Only	N/A	Factory Diagnostic Use

Table 3-6. Modulator Parameter Detail

Modulator Parameter Detail			
Representation	Type	Entry	Description
Status CXR Sending, OK	Read Only	Read Only	Modulator Carrier Status
Status Bit Clk Internal, OK	Read Only	Read Only	Modulator Bit Rate Clock Status
Status Test Normal	Read Only	Read Only	Modulator Test Status
IF Frequency 70.000000MHz	Numeric	50.000 000 to 90.000 000 MHz	Carrier center frequency
IF Offset -8.031kHz	Numeric	-1,250.000 to +1,250.000 kHz	Carrier offset frequency
IF Level -20.4dBm	Numeric	+5.0 to -35.0 dBm +3.0 max at 50Ω	Transmit output power level
IF Output Enabled	Selection	0 = Disable, 1 = Enable	Carrier output enable
IF Modulation QPSK	Selection	0 = BPSK, 1 = QPSK	Modulation Mode
IF Spectrum Normal	Selection	0 = Normal, 1 = Inverted	Modulation Spectrum control
»IF Mode Continuous	Selection	0 = Continuous, 1 = Burst	Only available with burst option installed.
»IF Preamble 64 Symbols	Selection	0 = 32, 1 = 64 Symbols	Selects preamble length when burst option installed.
IF AUPC Disabled	Selection	0 = Disable, 1 = Enable	Automatic Uplink Power Control
»IF AUPC Eb/No 6.5dB	Numeric	3.0 to 20.0 dB	AUPC remote receive Eb/No level set point.
»IF AUPC Max Lvl -10.0 dB	Numeric	+5.0 dBm to Minimum level	Max. Transmit level under AUPC control
»IF AUPC Min Lvl -20.0 dB	Numeric	Maximum level to -35 dBm	Min. Transmit Level under AUPC control
IF Mute Manual	Selection	0 = Automatic, 1 = Confirm, 2 = Manual	Manual requires manual Carrier enable after Mod output change.
IF Impedance Manual	Selection	0 = 50Ω, 1 = 75Ω	Transmit IF impedance.
Data Bit Rate 2.100000Mbps	Numeric	1.200 to 4,920.000 kbps in 1 bps resolution. Entered in kbps to 1bps increments.	Modulator Bit Rate

Modulator Parameter Detail			
Representation	Type	Entry	Description
Data FEC Viterbi	Selection	0 = Viterbi, 1 = TPC Full 2 = TPC Short 3 = TPC (Legacy) 4 = TPC (CT)	TPC Encoder - Only available if installed. Reed-Solomon is enabled in R-S column. Legacy in Rate 3/4, 7/8 only. CT compatibility Rate 3/4 only.
Data Code Rate Rate 1/2	Selection	0 = 1/2, 1 = 3/4, 2 = 7/8	FEC Code Rate
Data Dif Encoder Enabled	Selection	0 = Disable, 1 = Enable	Differential Encoder (disabled in TPC FEC mode)
Data Scrambler IESS-308	Selection	0 = Disable, 1 = IESS-308, 2 = IESS-309, 3 = V.35, 4 = Alt V.35, 5 = Intelsat, 6 = Alt. Intelsat 7 = TPC Sync	Scrambler types. Types are added if optional hardware is installed. The IESS 308 & 309 modes automatically switch to use synchronous scramblers part of R-S and TPC.
Data Clk Source Disabled	Selection	0 = Internal, 1 = TT Clock, 2 = External, 3 = RCV Clock	Transmit Data Clock Source. Type 1, 2 or 3 will fall-back to Internal if clock is not present in these modes.
Data FEC C0/C1 Normal	Selection	0 = Normal, 1 = Swap C0/C1, 2 = Invert C1, 3 = Swap and Invert C1	Alternative FEC Configurations for Viterbi encoder.
R-S Mode IESS-308	Selection	0 = Disabled, 1 = IESS-308 2 = IESS-309 3 = Custom	Reed-Solomon column and options only available if not disabled. Column is not shown when TPC enabled.
»RS FEC (n) 126	Numeric	In Custom Mode only: Available n values Read only in other modes	Block size n = 22 to 255
»RS FEC (k) 112	Numeric	In Custom Mode only: Available k values Read only in other modes	k = 20 to 253, k must be 2 to 20 less than n
»RS FEC depth 4	Selection	In Custom Mode only: 0 = 4, 1 = 8 Read only in other modes	Interleave depth factor
Mux Status IBS Custom	Selection	0 = Disabled, 1 = IBS Standard, 2 = Enhanced	Multiplexer column & options only available if installed
»Mux ESC Overhead 9600 bps	Selection	0 = Disable 1 to 7 selects standard rates 300 bps – 38.4 kbps	Only in Custom Mode. Selects framing resources committed to ESC Comm.

Modulator Parameter Detail			
Representation	Type	Entry	Description
»Mux MCC Overhead 1200 bps	Selection	0 = Disable 1 to 7 selects standard rates 300 bps – 38.4 kbps	Only in Custom Mode. Selects framing resources committed to MCC Comm.
»Mux Ratio 15:16	Read Only		Shows current data to aggregate ratio for mux.
»Mux ESC Port RS-485, 4 Wire	Selection	0 = RS-232, 1 = RS-485 2 wire, 2 = RS-485 4 wire, 3 = RS-485 Drvr On	Physical ESC port type. . (coupled to receive)
»Mux ESC Rate 9600 bps	Selection	0 to 7 selects standard rates 300 bps – 38.4 kbps	Physical ESC port rate at rear panel. (coupled to receive)
»Mux ESC Frmt N,8,1	Selection	0 = N/7/1, 1 = P/7/1, 2 = N/8/1, 3 = P/8/1	Physical ESC port format at rear panel. (coupled to receive)
BUC Power Enabled	Selection	0 = Disabled 1 = Enabled	Selects Power and Voltage to a BUC in the 4900L
BUC Voltage Out +23.8V	Numeric	Read Only	Displays Voltage output on Transmit Cable.
BUC Voltage Min +20.0V	Numeric	0 to 60.0 V	Sets the minimum BUC voltage before an alarm.
BUC Current Out 2.37A	Numeric	Read Only	Displays Current draw of BUC
BUC Current Max 5.00A	Numeric	0 to 6.00 A	Sets the maximum BUC current before an alarm.
BUC Current Min 1.25A	Numeric	0 to 4.00 A	Sets the minimum BUC current before an alarm.
BUC 10 MHz Ref Enabled	Selection	0 = Disabled 1 = Enable	Selects if modem's current 10 MHz reference to be supplied to a BUC in PSM-4900L
BUC LO Frequency 7375.000000MHz	Numeric	0 to 49999.999996 MHz	Selects BUC LO frequency in PSM-4900L. If set non-zero then IF frequency setting is at RF frequency.
Alarm CXR To Alarm A	Selection	0=None, 1=A, 2=B, 3=A&B, 4 = Mute CXR, 5 = Mute & Alarm A, 6 = Mute & Alarm B, 7 = Mute & Alarm A & B	Selects destination of alarm
Alarm Bit Clk To Alarm A	Selection	0=None, 1=A, 2=B, 3=A & B, 4=Send all ones.	Selects destination of alarm
Alarm AUPC To Alarm A	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm

Modulator Parameter Detail			
Representation	Type	Entry	Description
Alarm Tst Active To Alarm A	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Alarm Hardware To Alarm A & B	Selection	0=None, 1=A, 2=B, 3=A&B, 4 = Mute CXR, 5 = Mute & Alarm A, 6 = Mute & Alarm B, 7 = Mute & Alarm A & B	Selects destination of alarm
Alarm BUC Power Mute & Alarm A	Selection	0=None, 1=A, 2=B, 3=A&B, 4 = Mute CXR, 5 = Mute & Alarm A, 6 = Mute & Alarm B, 7 = Mute & Alarm A & B	Selects destination of alarm
Alarm OCXO Cold Mute & Alarm A	Selection	0=None, 1=A, 2=B, 3=A&B, 4 = Mute CXR, 5 = Mute & Alarm A, 6 = Mute & Alarm B, 7 = Mute & Alarm A & B	Selects destination of alarm
Test Modulation Normal	Selection	0 = Normal, 1 = Pure Carrier, 2 = Alt 1/0 3 = Sideband	Carrier output mode for test purposes.
Test Symbol Rate 256.000ksps	Read Only	N/A	Computed Transmit Symbol Rate
Test CXR ALC +3.0V	Read Only	N/A	Internal Loop Voltage
Test LO AFC +9.1V	Read Only	N/A	Internal Loop Voltage
Test Step AFC +9.5V	Read Only	N/A	Internal Loop Voltage

Table 3-7. Demodulator Parameter Detail

Demodulator Parameter Detail			
Representation	Type	Entry	Description
Status CXR Locked, OK	Read Only	N/A	Demodulator receive Carrier Status
Status Offset -8.031kHz	Numeric	Within +/- Narrow Acquisition Range	Receive carrier offset frequency. An entry will reset to 0 after search time has elapsed.
Status Level -52dBm	Read Only	N/A	Receive carrier level
Status Eb/No 4.7dB	Read Only	Measured by internal circuitry.	Measured Eb/No
Status Est. BER 2×10^{-7}	Read Only Resettable	Press "0" or "Edit" and "Enter" to restart.	Estimated Bit Error Rate
Status SER 3.37×10^{-2}	Read Only Resettable	Press "0" or "Edit" and "Enter" to restart.	Measured Symbol Error Rate
Status Buffer 100%	Read Only Resettable	0 = Reset Slip (Flag) 1 = Re-center	FIFO Buffer status in percent fill. Only visible when Demod Data clock source is not set to "RCV Clock". The "slip" flag tells when the FIFO automatically re-centered.
Status Test Normal	Read Only	N/A	Demodulator Test Status
IF Frequency 70.000000MHz	Numeric	50.000 000 to 90.000 000 MHz 950 000 000 to 1900 000 000 MHz for Hybrid unit	Carrier center frequency. Hybrid L-Band frequency shown if LNB LO is set to 0, else is set to RF frequency.
IF Sweep Range +/-30.000kHz	Numeric	+/-0.1 to +1,250.000 kHz	Carrier Acquisition Range in kHz.
IF Sweep Mode Fast	Selection	0 = Fast, 1 = Search	Fast Acquisition mode is standard method
»IF Sweep Time 10.0 Sec	Numeric	0.0 to 600.0 Seconds. 0 Disables Narrow Sweep	Narrow Sweep time applicable to Search sweep mode only.
IF Modulation QPSK	Selection	0 = BPSK, 1 = QPSK	Modulation Mode
IF Spectrum Normal	Selection	0 = Normal, 1 = Inverted	Modulation Spectrum control
IF Low Level Alm -67dBm	Numeric	-26 to -85 dBm in 1 dB increments. Dependent on Bit Rate.	A receive carrier level at or below this level will produce an alarm.
IF Eb/No Alm 5.0dB	Numeric	2.0 to 20.0 dBm in 0.1 dB increments	A receive Eb/No level at or below this level will produce an alarm.

Demodulator Parameter Detail			
Representation	Type	Entry	Description
IF Impedance 50 Ohm	Selection	0 = 50Ω, 1 = 75Ω	Receive IF impedance.
IF LNB Power Disabled H Versions <0.72	Selection	0 = Disabled 1 = +13VDC 2 = +18VDC	Selects power to be supplied to an LNB in PSM-4900H. Current limit = 500mA.
IF LNB 10MHz Ref Disabled H Versions <0.72	Selection	0 = Disabled 1 = Enable	Selects if modem's current 10 MHz reference to be supplied to an LNB in PSM-4900H
IF LNB LO Frq 5150.000000MHz H Versions <0.72	Numeric	0 to 49999.999996 MHz	Selects LNB LO frequency in PSM-4900H. If set non-zero then IF frequency setting is at RF frequency.
Data Bit Rate 2.100000Mbps	Numeric	1.200 to 4,920.000 kbps in 1 bps resolution. Entered in kbps to 1bps increments.	Modulator Bit Rate
Data FEC Viterbi	Selection	0 = Viterbi, 1 = TPC Full 2 = TPC Short 3 = TPC (Legacy) 4 = TPC (CT)	TPC Decoder - Only available if installed. Reed-Solomon is enabled in R-S column. Legacy in Rate ¾, 7/8 only. CT compatibility Rate ¾ only.
Data Code Rate Rate 1/2	Selection	0 = ½, 1 = ¾, 2 = 7/8	FEC Code Rate
Data Dif Decoder Enabled	Selection	0 = Disable, 1 = Enable	Differential Encoder. Disabled in TPC FEC mode
Data Descrambler IESS 308	Selection	0 = Disable, 1 = IESS-308, 2 = IESS-309, 3 = V.35, 4 = Alt V.35, 5 = Intelsat, 6 = Alt. Intelsat 7 = TPC Sync	Descrambler types. Types are added if optional hardware is installed. The IESS 308 & 309 modes automatically switch to use synchronous scramblers part of R-S and TPC.
Data Clk Source Disabled	Selection	0 = RCV Clock 1 = Internal, 2 = External, 3 = Mod Clock	Receive Data Clock Source. Selecting "0" disables FIFO buffer, any other setting enables it.
»Data Buffr Delay 2.00000ms	Numeric	0 to maximum calculated by data rate.	Receive FIFO buffer delay in milli-Seconds.
»Data Buffer Size 512 Bits	Numeric	0 to 131,070 bits in 1 bit increments.	Receive FIFO buffer delay in bits. Buffer has this many bits filled and empty when centered.
Data FEC C0/C1 Normal	Selection	0 = Normal, 1 = Swap C0/C1, 2 = Invert C1, 3 = Swap and Invert C1	Alternative FEC Configurations for Viterbi encoder.

Demodulator Parameter Detail			
Representation	Type	Entry	Description
Data FEC Hold 1	Numeric	0 to 255 Normally set to 1	Number of FEC lock "cycles" the FEC will accomplish before declaring loss of lock.
R-S Mode IESS-308	Selection	0 = Disabled, 1 = IESS-308 2 = IESS-309 3 = Custom	Reed-Solomon column and options only available if not disabled. R-S column only shown if TPC not enabled.
»RS FEC (n) 126	Numeric	In Custom Mode only: Available n values Read only in other modes	Block size n = 22 to 255
»RS FEC (k) 112	Numeric	In Custom Mode only: Available k values Read only in other modes	k = 20 to 253, k must be 2 to 20 less than n
»RS FEC depth 4	Selection	In Custom Mode only: 0 = 4, 1 = 8 Read only in other modes	Interleave depth factor
»RS FEC Eb/No Decoder Output	Selection	0 = Decoder Input, 1 = Decoder Output	Selects whether Eb/No calculations are relative to R-S input or output bit rate.
Mux Status IBS Custom	Selection	0 = Disabled, 1 = IBS Standard, 2 = Enhanced	Multiplexer column and options only available if installed
»Mux ESC Overhead 9600 bps	Selection	0 = Disable 1 to 7 selects standard rates 300 bps – 38.4 kbps	Only in Custom Mode. Selects framing resources committed to ESC Comm.
»Mux MCC Overhead 1200 bps	Selection	0 = Disable 1 to 7 selects standard rates 300 bps – 38.4 kbps	Only in Custom Mode. Selects framing resources committed to MCC Comm.
»Mux Ratio 15:16	Read Only		Shows current data to aggregate ratio for mux.
»Mux ESC Port RS-485, 4 Wire	Selection	0 = RS-232, 1 = RS-485 2 wire, 2 = RS-485 4 wire, 3 = RS-485 Drvr On	Physical ESC port type. (coupled to transmit)
»Mux ESC Rate 9600 bps	Selection	0 to 7 selects standard rates 300 bps – 38.4 kbps	Physical ESC port rate at rear panel. (coupled to transmit)
»Mux ESC Frmt N, 8, 1	Selection	0 = N/7/1, 1 = P/7/1, 2 = N/8/1, 3 = P/8/1	Physical ESC port format at rear panel. (coupled to transmit)
LNB Power +18V	Selection	0 = Disabled 1 = +13VDC 2 = +18VDC	Selects Power and Voltage to an LNB in the 4900H or L

Demodulator Parameter Detail				
Representation	Type	Entry	Description	
LNB Current Out 221mA	Numeric	Read Only	Displays Current draw of LNB	
LNB Current Max 300mA	Numeric	0 to 500 mA	Sets the maximum LNB current before an alarm.	
LNB Current Min 150mA A	Numeric	0 to 500 mA	Sets the minimum LNB current before an alarm.	
LNB 10 MHz Ref Disabled	Selection	0 = Disabled 1 = Enable	Selects if modem's current 10 MHz reference to be supplied to an LNB in PSM-4900H or L	
LNB LO Frequency 5150.000000MHz	Numeric	0 to 49999.999996 MHz	Selects LNB LO frequency in PSM-4900H or L. If set non-zero then IF frequency setting is at RF frequency.	
Alarm CXR Lock To Alarm A	Selection	0=None, 1=A, 2=B, 3=A&B, 4 = Mute CXR, 5 = Mute & Alarm A, 6 = Mute & Alarm B, 7 = Mute & Alarm A & B	Selects destination of alarm	
Alarm Low Level To Alarm A	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm	
Alarm Low Eb/No To Alarm A	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm	
Alarm Tst Active To Alarm A	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm	
Alarm Hardware To Alarm A & B	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm	
»Alarm Backward To Alarm A & B	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm – Only available with mux.	
»Alarm LNB Power To Alarm A & B	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm – Only shown in PSM-4900H/L.	
Test IF Loopbck Normal	Selection	0 = Disable, 1 = Enable	IF Loop-back control.	
Test Symbol Rate 256.000ksp/s	Read Only	N/A	Receive Symbol Rate	
Test AGC -1.9V	Read Only	N/A	Internal Loop Voltage	
Test LO AFC +8.8V	Read Only	N/A	Internal Loop Voltage	
Test Step AFC +9.4V	Read Only	N/A	Internal Loop Voltage	
Test IDcOff -0.1V	Read Only	N/A	Internal Loop Voltage. I channel DC offset	
Test QDcOff -0.1V	Read Only	N/A	Internal Loop Voltage. Q channel DC offset	

Table 3-8. Interface Parameter Detail

Interface Parameter Detail				
Representation	Type	Entry	Description	
Status I/O Online	Read Only	N/A	Interface Status **	
Status RTS Off	Read Only	N/A	Interface RTS line status	
Status CTS On	Read Only	N/A	Interface CTS line status	
Status DCD On	Read Only	N/A	Interface DCD line status	
Status DTR Off	Read Only	N/A	Interface DTR line status	
Status DSR Off	Read Only	N/A	Interface DSR line status	
Status Test Mod BER	Read Only	N/A	Interface Test status	
Status BER 0.0 E-7	Read Only	N/A	Interface Test status	
Status Sync Loss 3	Read Only	N/A	Interface Test status	
Status Errors 7	Read Only	N/A	Interface Test status	
Status Bits 1.45 E7	Read Only	N/A	Interface Test status	
Status EFS 99.95%	Read Only	N/A	Interface Test status	
Status Erred Sec 1	Read Only	N/A	Interface Test status	
Status Total Sec 2135	Read Only	N/A	Interface Test status	
I/O Mode RS-449	Selection	0 = Disable 1 = RS-232 2 = RS-449 3 = RS-449/Unterm 4 = V.35 5 = V.36 6 = EIA-530 7 = EIA-530A	Interface electrical mode. Some option interfaces replace the "0" option (for example the SDMS-Lite Ethernet interface). Other options include G.703 (when released)	
I/O RTS Ignore	Selection	0 = Normal 1 = Control CXR 2 = Ignore	Interface RTS line control	
I/O CTS Normal	Selection	0 = Normal 1 = Force Active	Interface CTS line control	
I/O DCD Normal	Selection	0 = Normal 1 = Force Active	Interface DCD line control	
I/O DTR Normal	Selection	0 = Normal 1 = Ignore	Interface DTR line control	

Interface Parameter Detail			
Representation	Type	Entry	Description
I/O DSR Normal	Selection	0 = Normal 1 = Force Active	Interface DSR line control
I/O Xmt Data Normal	Selection	0 = Normal, 1 = Inverted	Transmit Data Inversion
I/O Xmt Clock Normal	Selection	0 = Normal, 1 = Inverted, 2 = Auto	Transmit Clock Phase. Auto is now default standard.
I/O Rcv Data Normal	Selection	0 = Normal, 1 = Inverted	Receive Data Inversion
I/O Rcv Clock Normal	Selection	0 = Normal, 1 = Inverted	Receive Clock Phase
SDMS IP Addr 192.168.100.1	Numeric		IP Address for Ethernet Interface.
SDMS Netwrk Mask 255.255.255.0	Numeric		IP Mask Address for Ethernet Interface.
SDMS MAC Addr 0080A800256C	Read Only	Read Only	Allows read of fixed Interface MAC Address..
SDMS Options 00007f	Read Only	Read Only	Displays SDMS Options enabled
SDMS Version 021771-001-50	Read Only	Read Only	Displays SDMS Software Version Number
SDMS Serial# 1000047	Read Only	Read Only	Displays SDMS Serial Number
Alarm Tst Active to Alarm A	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Alarm BER Loss to Alarm B	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Alarm SDMS to Alarm B	Selection	0=None, 1=A, 2=B, 3=A & B	Selects destination of alarm
Test Ter Loopbck Disabled	Selection	0 = Disable, 1 = Enable	Interface terrestrial loop-back xmt input to receive output.
Test Sat Loopbck Disabled	Selection	0 = Disable, 1 = Enable	Interface satellite loop-back receive output to xmt input.
Test Mod BER Disabled	Selection	0 = Disable, 1 = 2047, 2 = 2 ²³ -1 3 = Insert 1 Error (if enabled)	BERT enable to modem transmit input.
Test Demod BER Disabled	Selection	0 = Disable, 1 = 2047, 2 = 2 ²³ -1	BERT enable from modem receive output.

** Interface Status when the SDMS option is installed and enabled can be:

- "SDMS FAILURE", Meaning no communications from SDMS card to modem processor.
- "SDMS HARD RESET", Meaning that the SDMS is in process of resetting its parameters.
- "SDMS LIMIT ALARM", Meaning that the SDMS is not able to process data.

The front panel controls for the SDMS are normally only used for basic initial setup. When more sophisticated software is loaded into the SDMS control is usually via the Ethernet connection.

3.3 Terminal Mode Control

The PSM-4900 Terminal Mode Control allows the use of an external terminal or computer to monitor and control the modem from a full screen interactive presentation operated by the modem itself. No external software is required other than VT100 terminal emulation software (e.g. "Procomm" or "HyperTerminal") for a computer when used as a terminal. The control port is normally used as an RS-232 connection to the terminal device. The RS-232 operating parameters can be set using the modem front panel and stored in EEPROM for future use.

3.3.1 Modem Setup for Terminal Mode

Terminal mode communications and protocol is set from the front panel control by setting the **<Unit: Remote – Protocol>** parameter to "VT100" (Option 0), and then setting the **<Unit: Remote – Port>**, **<Unit: Remote – Rate>** and **<Unit: Remote – Format>** parameters as desired. Then a "VT100" protocol terminal is connected to connector J6. All operating software for the terminal mode is contained within the PSM-4900 modem internal control software.

A "break" signal on the communications line, pressing "Control R" on the terminal or power on of the modem will initiate full screen terminal mode printing and redraw the full screen. The terminal mode displays the present status of all user parameters controlled and read by the processor, and offers a menu allowing change to any controlled parameter.

A single terminal mode screen displays one full column of information from any one of the four matrixes, being Unit, Modulator, Demodulator and Interface. The number of terminal mode display screens possible is equal to the total number of columns in the four matrixes (24 at current count). Any possible screen can be accessed by 2 key presses from any other screen.

The 2 key presses are:

1. A first digit representing the functional area:
 - a) 0 = Unit
 - b) 1 = Modulator
 - c) 2 = Demodulator
 - d) 3 = Test
2. A second digit representing the column number. (0 to 9 for the Unit, 0 to 5 for Modulator and Demodulator or 0 to 4 for the Interface).

The resulting screen display shows all items present in that column of the matrix.

For example the basic Unit Status screen shown below lists the status items from the Unit Status column of the Unit Matrix. Notice that at the bottom of the screen is a prompt inviting you to select from one of the 4 items as the first step to change to another screen.

```
PSM-4900 VT100 Terminal Control

Unit Status
Modem Demod Tst Active
Reference Internal, Ok
C) Redundcy Internal 1:1
D) Unit ID
Model PSM-4900
Serial# 3490
Version 0.64

Section ? 0)Unit, 1)Mod, 2)Demod, 3)Intf

Strike Number/Letter of Option to Select, TAB Key Aborts Selection.
```

Figure 3-2a. Terminal Mode – Example of Unit Status Screen

Assuming that we wanted to view another of the Unit column screens. If we first press the “0” key to indicate that we want to change to a “Unit” screen the following lower screen prompt will be displayed:

```
PSM-4900 VT100 Terminal Control

Unit Status
Modem Demod Tst Active
Reference Internal, Ok
C) Redundcy Internal 1:1
D) Unit ID
Model PSM-4900
Serial# 3490
Version 0.64

Unit ? 0)Status, 1)Config, 2)Keybrd, 3)IrDA, 4)Remote, 5)Ref, 6)Redundcy,
7)Monitor, 8)Alarm, 9)Test
Strike Number/Letter of Option to Select, TAB Key Aborts Selection.
```

Figure 3-2b. Terminal Mode – Example of Unit Status Screen Selection

Notice now that we can select from the Status, Configuration, Keyboard, etc. columns of the Unit Matrix. Selecting for example the "Test" item (selection 9), would display the following new screen.

```

                                PSM-4900 VT100 Terminal Control

                                Unit Test
                                A) Modem BER Test
                                B) Cal Ref Disabled
                                  Ref AFC +1.1V
                                  SysClk AFC +9.3V
                                  +3.3V Power +3.3V
                                  +5.0V Power +5.0V
                                  +12.0V Power +12.0V
                                  +21.0V Power +20.8V
                                  -12.0V Power -12.2V
                                J) Boot Code 0000:0000:0000

Mod ? 0)Status, 1)IF, 2)Data, 3)Alarm, 4)Test

Strike Number/Letter of Option to Select, TAB Key Aborts Selection.

```

Figure 3-3. Terminal Mode – Example of Unit Test Screen

Notice that some items have a preceding letter with parentheses. These items are programmable via the communications interface. Items without a preceding letter in parentheses are "Read Only" items.

Any available "screen" can be displayed with only two keystrokes. These are similar to designating the functional area and column of a matrix as when using the front panel.

3.3.2 Programming Modem Operational Values From the Terminal Screens

The modem can be interactively monitored and controlled in the Terminal mode, with a full screen presentation of current settings and status. Programming is accomplished by selecting first the desired screen, then the item to be modified and pressing the terminal key of the option letter "A" through "Z". For example, to change the modulator's carrier frequency you must first go to the modulator screen if not already there (Press "1, 1") and press the terminal's "A" key (lower case is fine!). The modem screen will respond by presenting the options, or input range, available and waiting for input. The operator input is followed by pressing the "Enter" or carriage return key. An input can be aborted at any time before completing by pressing the "TAB" key, restoring the previous setting. Invalid input keys are signaled by a beep or bell signal from the terminal.

Following a valid input, the modem will place the new setting into the nonvolatile EEPROM making it available not only immediately but also automatically the next time the unit is powered up.

3.4 Remote Command Interface Control

The PSM-4900 Command Mode allows the use of an external controller or computer to monitor and control the modem via a packet-based message protocol. This mode normally uses the RS-485 connections allowing multiple modems (and other devices) to share the command link under control of a single or multiple entities. An RS-232 connection is also usable for this application, but lacks the RS-485's ability to work on a "party line" and is therefore limited to a single controller and single modem. The packets use a unique address for each controlled device, which is set using the modem's front panel. The message packets themselves use a binary format for efficiency. The complete protocol is shown in Appendix B.

The protocol consists of messages from the controller to the modem and response messages from the modem back to the controller. The modem never initiates communications without having first received a correctly addressed message requiring a response.

Message packets to the modem can take two forms;

1. Messages requesting information in a response message or "Read";
2. Messages commanding a change in operating parameters or "Write".

Any write information is automatically saved to EEPROM.

The packet of both incoming and outgoing messages take the same generic form. First are pad and opening flag, then the destination and source addresses, followed by the command code (and read or write mode), then necessary data. The message packet is closed with a closing flag and check word to verify the packet integrity. The use of a source address allows multiple controllers on a single control link.

3.4.1 System Unit Programming/Communications

The communications protocol is unique. This mode is termed "command mode" communications in the following discussion and is normally accomplished via an RS-485 4-wire connection to the modem at "Control" connector J6. Note that the transmit and receive pair of this interface are separated to form a 4-wire basis. If a 2-wire connection is desired, the transmit A and B leads may be connected to the Receive A and B leads respectively in the connector applied to J6.

This command mode communications protocol involves the sending of a standard message packet from a controller requesting information or commanding a change. The PSM-4900 modem responds with a message packet containing the information or confirmation of change. The Modem never initiates communications at any time except in response to a command or query message from the station controlling devices.

3.5 Modem Checkout

The following descriptions assume that the full system is in operation and that software is running properly on the central processor.

3.5.1 Power-Up

On initial and every subsequent power-up, the modem microprocessor will test itself and several of its components before beginning its main monitor/control program. These power-up diagnostics show no results if successful. If a serious power on failure is detected, the ALARM LED is flashed at an approximate 4 Hz rate. Other failure modes are displayed on the front panel LCD.

New modems from the factory have default values placed into the EEPROM for operating parameters. If a Monitor/Control System does not configure the modem automatically via the serial command channel, the modem can be easily configured from the front panel or can be

connected to a VT100 protocol terminal to set the modem's operating parameters. To restore the default parameters the modem can be powered on while depressing the "Clear" key.

The most common default parameters placed into the EEPROM are as follows: A modem can be returned to the factory default settings by using the front panel command **<Unit: Config - Recall>**, then editing (or quick edit) and choosing the "Factory" or "0" selection option.

Modulator:

Carrier Frequency = 70.00 MHz
 Data Rate = 256 kbps
 Modulation = QPSK
 Code Rate = Rate 1/2
 Differential Encoder = Enabled
 Scrambler = IESS 308
 Clock phase = Normal
 Data = Normal
 Clock Source = Internal
 RTS = Ignore
 Carrier = Off.
 All Mod Alarms to Relay A

Demodulator:

Carrier Frequency = 70.00 MHz
 Data Rate = 256 kbps
 Modulation = QPSK
 Code Rate = Rate 1/2
 Differential Decoder = Enabled
 Descrambler = IESS 308
 Clock phase = Normal
 Data = Normal
 Clock Source = Receive
 Sweep mode = Fast
 Acquisition Range = +/- 30 kHz
 All Demod Alarms to Relay B

Modem Unit:

Modem Reference: Internal, 10 MHz
 Remote Port Address = 1
 Remote Port = RS-232
 Remote Mode = Binary Packet
 Remote Rate = 9.6 kbps
 Remote Data Format = 8 data bits, 1 stop, no parity

Interface:

Mode = RS-449
 All Tests Off
 Data and Clocks in normal mode (not inverted). The XMT Clock now uses a default "Auto" mode that detects the proper phasing and applies it.

In a properly operating system, with an incoming carrier available for the demodulator, the modem's Alarm (red) and Warning (yellow) LEDs should all go out. Without an acceptable incoming carrier the Demod "Major Alarm" and "Summary Alarm" will illuminate. When the incoming carrier is acquired, the green "Signal Lock" LED should illuminate. The "Transmit On" LED will also illuminate if the transmit output is enabled.

3.6 L-Band Feature Operation

Note: The following special L-Band features refer to the transmit and receive for the PSM-4900L and the receive of the PSM-4900H.

3.6.1 L-Band BUC Control

The PSM-4900L offers 3 specific features related to the control and use of an outdoor Block Up Converter or BUC: Frequency control, power control and reference control.

Transmit Frequency Control – When the BUC Local Oscillator or LO frequency is entered into the **<Mod: BUC – LO Frequency>** parameter the **<Mod: IF – Frequency>** parameter entry allows (and requires) entry of transmit frequency at the actual satellite uplink RF frequency. To return to using L-Band IF frequencies set the BUC – LO Frequency parameter to "0".

BUC Power Control – When a power supply is plugged into the rear panel DIN connector, J10, the PSM-4900L uses an internal power relay to control application of power to the BUC's

transmit input cable under front panel or remote control. The modem can also read the voltage and current being applied to the transmit cable.

BUC Reference Control – The PSM-4900L contains a high stability 10 MHz OCXO reference oscillator designed to provide a suitable reference signal to most BUCs. See the specifications in Appendix A for the exact reference stability, aging, phase noise and level specifications. The application of the reference to the transmit cable is under front panel or remote control, as required by the BUC. Some BUCs use the 10 MHz signal to control application of power to the final PA, removing it and going to a low power state when the 10 MHz is absent.

3.6.2 L-Band LNB Control

The PSM-4900L and H offer 3 specific features related to the control and use of an outdoor Low Noise Block Down Converter or LNB: Frequency control, power control and reference control.

Receive Frequency Control – When the LNB Local Oscillator or LO frequency is entered into the **<Dem: LNB – LO Frequency>** parameter the **<Dem: IF – Frequency>** parameter entry allows (and requires) entry of receive frequency at the actual satellite downlink RF frequency. To return to using L-Band IF frequencies set the LNB – LO Frequency parameter to “0”.

LNB Power Control – The PSM-4900L and H contain an internal LNB power supply and internal power relay to control application of power to the LNB's receive output cable under front panel or remote control. The voltage applied can be chosen for either 18VDC or 13 VDC. The modem can also read the voltage and current being applied to the receive cable.

LNB Reference Control – The PSM-4900L and H contains an internal 10 MHz reference oscillator designed to provide a suitable signal to those LNBs requiring an external reference. See the specifications in Appendix A for the exact reference stability, aging, phase noise and level specifications. The application of the reference to the receive cable is under front panel or remote control, as required by the LNB.

3.7 Data Interface Clock Options

The modem clocking and options for either VSAT or SCPC operation is discussed below:

3.7.1 VSAT Mode

A typical method of synchronization in a VSAT system is as follows. The master station reference is used to synchronize the master station transmit data clock. The VSAT terminal receive data clock maintains this synchronization. The VSAT terminal DTE equipment may use the receive data clock to synchronize itself and generate the transmit data clock for input to the VSAT modulator either directly via setting the Modulator clock source to “Receive Clock” or indirectly via the Terminal Timing input. Alternately it may use an accurate clock to generate the transmit data clock and input it via the Terminal Timing input.

3.7.2 SCPC Mode

Independent – Each station of two linked SCPC modems is considered independent. The transmit data clock is either an input to or output from each station modulator. The other station receive data clock maintains this synchronization. The clocking in each direction is independent and follows the same transmit to receive synchronization.

Master/Slave – One station of two linked SCPC modems is considered the master and the other station is considered the slave. The master transmit data clock is either an input to or output from the master station modulator. The slave station receive data clock maintains this synchronization. The receive data clock is used to generate a contra-directional transmit data clock (from modulator to DTE) of the same frequency, but not necessarily phase, as the receive data clock.

3.7.3 Transmit Interface Clock Auto Mode

A new feature beginning with firmware revision 0.80 is a transmit clock option called “Auto”, which is now the default setting. The new clock mode appears in the “Interface I/O” menu column under “Xmt Clock”. When selected the modem measures the phase relationship between the transmit clock and data and automatically sets the clock phase correctly. This gives improved performance on slightly longer data cables when operating at bit rates above approximately 1.5 Mbps.

3.8 Automatic Uplink Power Control (AUPC) Operation

The PSM-4900 modem has built-in logic for Automatic Uplink Power Control (AUPC). AUPC attempts to maintain a constant E_b/N_o at the receive end of an SCPC link. This is especially useful when operating over a satellite at Ku-Band frequencies in locations with high rainfall periods.

The AUPC function requires a data channel at 300 baud in order to operate. This data channel can either be external to the modem (that is provided by an external multiplexer or telephone line modem) or provided by the internal IBS multiplexer option when installed.

Note: The “Enhanced” or “Custom” Multiplexer mode MUST be selected to provide a channel for AUPC operation from the IBS multiplexer option.

The internal data multiplexer in “Enhanced” mode provides a 300 baud service channel between the two sites of a link permitting the modem processors to send messages and get responses over this channel. AUPC can be set to operate on either or both directions of a link but always requires a bi-directional channel. The AUPC functions and their descriptions are shown in the table below:

Function	Description
AUPC ENABLE/DISABLE	Enables/Disables the AUPC to function locally.
MOD AUPC E_b/N_o	Desired E_b/N_o of remote modem.
MOD AUPC MIN LVL	Sets minimum output power to be used.
MOD AUPC MAX LVL	Sets maximum output power to be used.

The basic AUPC operation is described as follows: Assume that the two modems, one at each end of the link, are set to AUPC operation. Only one direction is discussed, but the same functions could be occurring in both directions simultaneously. Modem “A” is transmitting to modem “B” under normal conditions and modem “B” has a receive E_b/N_o of 7.5 dB. Modem “A” has been set to an AUPC E_b/N_o on the front panel of 7.5 dB, and is currently outputting –15 dBm. Next it begins raining at location “B”, and the E_b/N_o drops to –7.0 then –6.8 dB. Modem “B” is constantly sending update messages to “A” and reports the current E_b/N_o . When “A” sees the drop in E_b/N_o , it slowly begins to raise the output power, and raises it again when it sees further drops. As the rain increases in intensity, and the E_b/N_o decreases again, “A” continues to increase its power level to compensate, and when the rain diminishes and quits, it also lowers its power level to compensate. The operation is therefore a feedback control loop with the added complication of a significant time delay.

There must be safeguards built into the AUPC system. First, the Modulator has two additional parameters which allow control of the maximum and minimum power output level. The other controls are built into the operating control software to limit response times and detect adverse operating conditions.

3.9 Demodulator Receive Data FIFO Operation

The PSM-4900 modem has a built-in First In First Out (FIFO) buffer on the receive data channel that may be enabled to compensate for cyclical variations in the receive data rate or different systems clocks at the two link ends. A receive buffer of this type is sometimes referred to as a pleisochronous buffer when the intent is to absorb different clocks on the transmit and receive end. This type of clock difference is usually uni-directional and cumulative. Cyclical variations are most often caused by the daily movement of the satellite in its position resulting in a varying distance from earth station locations. This movement would cause the receive data rate to increase during a portion of the day and decrease during other periods. This type of variation is termed Doppler variation and the buffer to absorb the variation is a Doppler Buffer. If the daily or weekly average rate is the same then this temporal variation can be absorbed by the receive FIFO without ever losing data (assuming the FIFO is large enough). Other data rate variations between the transmitting and receiving stations which are not periodic (that is average to zero) can still be buffered by the FIFO, but will eventually result in lost data.

Operation of the FIFO requires two clock sources: one that clocks the data into the FIFO, which is always the clock recovered from the received signal; and one that clocks the data out of the FIFO. The “out” clock can come from one of four sources:

1. **Receive Clock** – (Option 0) Meaning that the input and output clocks are the same, disabling the FIFO.
2. **Internal Clock** – (Option 1) Uses a dedicated modem internal NCO generated data rate clock as the output clock. Use of this clock does not require that the modulator and demodulator data rate be identical.
3. **External FIFO Clock** – (Option 2) This option allows a station-derived standard clock rate to be used to clock data out of the FIFO. The externally supplied clock must be equal to the average receive data rate.
4. **Modulator Clock** – (Option 3) Uses the modulator data rate clock as the output clock and obviously requires that the modulator and demodulator data rate be identical.

The Receive FIFO operation can be set from the front panel or remote control, and consists of selecting the output clock source, and either the delay time desired in milliseconds or the number of bits of delay. The processor computes the other value based on the one entered and the current data rate. The modem processor also keeps track of and can display the current FIFO fill percentage status. The FIFO sets the delay or number of bits selected upon activation and this center value represents 100% FIFO fill. At any time the FIFO may contain from 0% to 200% of the set value. The percentage fill can also represent the percentage of delay with respect to the setting. For example if the buffer was set to 2 mS of delay and the fill is 150% this represents 3 mS of delay.

When the data rate is changed the modem maintains delay time constant, automatically changing the number of bits stored in the buffer to compensate.

NOTE: *When the number of bits of delay are very small, one bit may represent a large percentage change (e.g. if the delay is only 4 bits, each bit represents 25%). The delay may be set from 4 bits to 131,070 bits at any data rate, resulting in a delay ranging from 0.00081mS (4 bits at 4.92 Mbps) to over 42,000 mS (131,070 bits at 2400 bps).*

An overrun occurs when a bit is clocked into the FIFO causing the fill to reach a full 200% of the selected value. This causes flushing the upper half of the FIFO, restoring the fill to 100%, re-centering the FIFO. The data flushed is lost and cannot be recovered.

An under-run occurs when the last bit is clocked out of the FIFO, emptying it. This also causes re-centering of the FIFO by resetting the buffer pointers to the mid or 100% level, resending all the data in the buffer. Both conditions result in a potential serious disruption of traffic.

When an under or over-run occurs an internal modem flag is set indicating that a re-center has occurred. The front panel display shows "Slip" and FIFO fill data percentages read from the remote port are negative numbers. This latched flag may be reset at the front panel or by writing to the remote port FIFO parameter.

The FIFO may also be re-centered at any time on command from either the front panel or via the remote control. At the front panel the command is **<Dem: Status - Buffer>** and pressing the "1" key, then "Enter" to confirm. Pressing the "0" key on this parameter will clear the "Slip Status".

In "framed" communications the severity of the disruption can be minimized by setting the buffer size in bits to multiples of the frame size. For example if the total frame size is 512 bits and the buffer is set to a size of 1024 bits an under or over-run would result in the frame flags remaining in the same location in the data stream. Note that frames will still be errored by the under or over-run, but synchronization may not be lost. If a superframe structure is used it is likely that synchronization will still be lost.

3.10 Built-in 1:1 Redundancy Mode Operation

The PSM-4900 modem has a built-in 1:1 redundancy mode that allows two modems to be connected together sharing connections, but with only one unit "on-line". The built-in software provides automatic back-up protection should the on-line unit indicate a failure by switching to a functioning off-line unit.

A diagram of the connections is shown in Section 2.3.6.

This is a very low cost method of achieving redundancy and because of the design has both advantages and disadvantages:

- Advantage – The second or current back-up unit can be sent its full configuration from the on-line unit, making set-up extremely easy.
- Advantage – Since the units are fully programmable concerning alarm content that determines the switching criteria, this method is more flexible than most redundancy schemes.
- Advantage – The single point failure of the switch in a classic 1:1 redundancy scheme is eliminated. Since these switches are often mechanical relays they actually have a poor failure rate, reliability (with respect to a classic scheme) is not seriously compromised.
- Disadvantage – There is no separate physical switch which provides a positive lock-out of a seriously failed unit that may not be able to turn its output signals off.
- Disadvantage – There is no single point control allowing forced switching away from one unit. Forced switching is accomplished only "from" the currently on-line unit.
- Disadvantage – There is no mode forcing a priority unit. In a priority system one unit is considered primary and the other secondary. If both units show good status the primary is always on-line. But, the priority scheme would also create more switching and is not normally used anyway.

Of course the major advantage to the built-in redundancy capability is its extreme low cost.

3.10.1 Setting Up 1:1 Redundancy Mode

Redundancy mode between a pair of modems is normally accomplished during installation. The procedure outlined here provides that information again, but also additional information on options and parameters used to determine operating modes. In overview the procedure is to:

Note: The two modems should be at the same firmware revision for proper redundant operation.

1. Configure the first modem completely for the intended operating parameters, including setting the redundancy parameter to "1:1". This initial unit should not be in alarm.
2. Physically install the second unit to be paired, but with its power off.
3. Connect the IF and data cables to both units. The special data "Y" cable is connected between the redundant pair.
4. Turn the secondary unit on.
5. Go to the menu in the **<Unit: Redundancy – Config>** and press the "Edit" key. The on-line unit will ask permission to transfer configuration to the second unit. Confirm by pressing "Enter". The primary unit should say "Sending Config" for approximately 1 second. If any packet transferred results in an error message a "Send Fail" message will be displayed, but the remainder of the transfer will continue.
6. Verify that the units are functioning correctly in redundancy mode. Go to the **<Unit: Status – Redundancy>** item in both units. The on-line unit will say "On-Line, Bckup OK" while the off-line unit will say "Standby, OK".

Tear-down or un-pairing of two units is accomplished by turning both units off before removing the "Y" cable. Then turn the units back on and set the redundancy to "Disabled"

Two parameters are added to the unit redundancy menu when redundancy is enabled:

- **<Unit: Redundancy – Sw Rqst>** This parameter allows you to determine which alarm indications result in a switch request. The possible selections are "On Any Alarm", "On Alarm A", "On Alarm B", or "On Alarm A & B". Since the specific alarms which comprise Alarm A and Alarm B are programmable themselves, then a switch request is highly programmable itself. For most applications though the default "On Any Alarm" is a preferred selection.
- **<Unit: Redundancy – Sw Hold>** This parameter determines how long an alarm must exist on the on-line unit and not the off-line unit before switching will occur. Allowable values are 0.0 to 600.0 seconds. The value could be set to zero, but this is not advised. A nominal value of 0.5 seconds insures that intermittent cases do not cause undue switching. A built in factor of 10 seconds is provided once a switch has occurred before a switch back to the original unit is allowed (except in the case of a manual switch request or loss of power in the on-line unit which requires 2 seconds).

The possible case can arise when both units go out of alarm at virtually the same time. This might occur if both units are powered on simultaneously or the receive carrier appears after being off or a necessary clock signal is applied to both units. In such tie cases, which unit will be placed on line is determined by the unit serial numbers, where the highest serial number wins the tie.

3.10.2 Operating 1:1 Redundancy Mode

Operation of a redundant pair of modems consists mainly of determining the status of units and forcing transfer of operation from one unit to the other.

A quick status to determine which modem is currently on "On-Line" and the failure state of the paired modems is done by viewing the LED indicators on the front panels. In a fully operating set-up there will be no alarms on either unit, but one modem will have the green Modulator Transmit LED illuminated and the other will have the transmit LED extinguished. The other LED indicators still show the relevant condition of the Modulator, Demodulator and Unit.

A more thorough status condition is viewed by setting both modems to the **<Unit: Status – Redundancy>** parameter. The unit currently On-Line will present its status on the lower line of the LCD display as "Online – xxxxx" where xxxxx could be one of several messages:

- Bckup OK – This modem thinks that everything is fine.
- BCKUP ALM – The backup modem is in an alarm state.
- NO BCKUP – No backup modem was found via the aux communications channel.
- The unit currently Off-Line will present its status on the lower line of the LCD display as “Standby OK” or “OFFLINE – ALARM”.

3.10.2.1 Forcing a Transfer Switch in 1:1 Redundancy Mode

The 1:1 “transfer” process of forcing the two paired modems to swap their on-line/off-line status is a one step process. The procedure however can only be accomplished on the unit that is currently “On-Line”.

- On the currently “On-Line” unit go to the<Unit: **Status – Redundcy**> parameter and press the “Edit” key.
- The LCD display will present the message “Enter to Xsfer?”. Pressing the “enter key will cause the unit to go off-line and the currently “Off-Line” backup unit to go “On-Line”.

If there is no backup unit or the backup unit is itself in alarm then the transfer will not be completed and an error message is displayed.

3.10.3 Removal and Replacement of Units in Redundancy Mode

It may be necessary to remove a unit of a redundant pair and replace that unit with another. The following method performs that function with the minimum disruption to the traffic status. In overview the procedure is to:

1. Force a switch away from the unit to be removed (if it is currently on-line),
2. Disconnection of cables from the now off-line unit, and
3. Physical removal of the unit.

Replacement is the reverse of this procedure.

3.11 Bit Error Rate Test (BERT) Set Operation

The PSM-4900 modem has a built-in BERT that can be individually enabled in the transmit and receive direction. It is capable of operating with two standard patterns; “2047” and “2²³ – 1” and maintains even complex BER test results. BER test results include BER, Sync Loss, Errored Bits, Total Bits, Error Free Seconds, Erred Seconds and Total Seconds. Tests can be re-started at will and run via the remote control and from the front panel.

⇒ **CAUTION:** *Enabling the BER Test set will result in disruption of any traffic currently through the PSM-4900 in the direction that is enabled. BER Tests should not be performed on a live traffic unit.*

The use of the BERT is more fully described in the Maintenance Section 4.1.2.

3.12 Analog Monitor Output Operation

The PSM-4900 modem has a built-in function to output an analog voltage representing the current value of one of three internal parameters. These are the receive Automatic Gain Control (AGC) level, the receive Eb/No and the transmit output power level. Each of these is a digital value accessible to the main processor, which can output the selected value continuously to the rear panel Alarm connector via a 16 bit digital to analog converter.

Processor access and control of these signals allows a highly flexible output format tailored to the user's requirements. In addition to selecting the parameter value to output the processor allows control of the "full scale" and "zero scale" output voltage over a range of -10.0 Volts to +10.0 Volts. These two settings can control the output slope (gain and direction) and offset.

To illustrate consider the example of outputting the receive AGC (representative of received signal level) to automatic antenna positioning equipment. The PSM-4900 has a carrier input range of approximately -20 to -60 dBm. The AGC over this range is a voltage varying from approximately -5 Volts at the maximum input and +5 Volts at the minimum input. Note that these voltages can vary with data rate and other factors. The slope of this response is negative relative to the receive signal level. Next assume that the positioning equipment wants a positive slope between 0 and +10 Volts, where +10 Volts represents the maximum received signal level. In this case we would set the **<Unit: Monitor - Full>** to 0.0 Volts and the **<Unit: Monitor - Zero>** to +10.0 Volts. These settings have the effect of inverting the slope of the AGC signal and applying an offset of +5 Volts to the output.

The analog output presented at the rear panel Alarm connector J5 has a 1k Ω output impedance, protecting the driver circuitry from shorts.

3.13 Storing and Recalling Configuration

The PSM-4900 modem has a built-in function allowing the operator to store the current complete configuration in one of 8 numbered locations.

Any stored configuration can then be recalled, including one permanent configuration called "Factory" which is a set of default configurations.

3.14 Automatic Configuration Recovery

The PSM-4900 modem has an additional feature related to the ability to store and recall configurations. Any or all of the 8 configurations can be set to be automatically recalled in the event of receive carrier loss for more than a specified number of seconds. This automatic recall is termed "Restore" on the control options. Each configuration has an associated time parameter that is normally set to a 0 (zero) value. When any other value up to 14,400 seconds is placed in this parameter then that configuration is recalled if the current configuration results in a loss of carrier for more than the specified number of seconds.

The automatic configuration recovery feature, or ACR is also commonly used with the ability to turn the carrier off after loss of receive carrier.

⇒ **Note: The ACR is not available when the modem is operating in a redundancy mode.**

Several examples more clearly illustrate the use and operation of the automatic configuration recovery (ACR).

Consider a demand access type system where modems not currently in use are intended to be placed at a "home" location. This would consist of mainly a receive IF frequency and data rate where the modem could receive assignment information. By storing the necessary parameters for the home location in configuration #1, and setting the configuration #1 time to 10 seconds, the modem will return to home whenever no carrier is received for 10 seconds. Then upon receiving an assignment, going to the new assigned set-up, and passing data traffic the link "tear-down" only requires removing the inbound carrier. 10 seconds later the modem will return to the home location awaiting another assignment.

Consider a simpler system that uses the multiplexer option to remotely program a far end modem. This ability is only available via remote control, not the front panel. If a remote unattended modem is erroneously commanded to a location and does not find the carrier then it may be impossible to "re-acquire" that modem, necessitating a technician to visit that site. By first

storing the current configuration in one available location, and then setting the time to perhaps 30 seconds (all over the link itself) for that configuration then the remote modem can safely be sent a command to change frequency (for example) knowing that if the modem does not lock up to a receive carrier in 30 seconds it will return to the current configuration.

Multiple configurations can have time settings associated with them. The result is that each configuration will be tried in turn until a carrier is found and locked. Upon losing the receive carrier again the modem will restart the configuration sequence beginning with the lowest numbered configuration having an associated non-zero time. The sequence is repeating with the highest configuration with a non-zero time “wrapping” around to the lowest.

Caution – what is not immediately obvious is that the time set is the time of the “current” configuration with no carrier before switching to that configuration. Thus if configuration #1 is set to 12 seconds and #4 is set to 2 seconds (all others being set to zero) then when on #4 for 12 seconds with no receive carrier the modem will change to #1, and when on #1 for 2 seconds with no receive carrier then the modem changes to #4.

Note that all of the above examples would be “safer” if the **<Dem: Alarm – CXR Lock>** is set to “Mute and ...”. With this setting the transmit carrier is turned off when no receive carrier is present, even if commanded on.

3.15 Burst Mode Operation

Note: As of the time of this manual the burst mode is a special factory request option and not installed in standard modems. The following description is typical of burst operations.

The modulator burst mode is controlled by the interface RTS/CTS and data flag signals. The sequence of events for the burst mode is as follows:

1. The RTS from the DTE device is normally active. The idle character from the DTE is a continuous Mark condition. The modulator output carrier is off in this idle state.
2. The modulator responds to the DTE device when ready to transmit by activating the CTS signal.
3. Any time after the CTS is received by the DTE, the DTE starts transmitting flags and/or data. The first non-SDLC flag character received by the modulator is the start of transmission signal, causing the modem to generate a preamble and initiate the “Carrier ON” command. Transmission continues with data bytes placed after the preamble.
4. The next SDLC flag received by the modulator is the end of transmission signal. The modem maintains a 56-bit buffer which allows placement of the closing flag exactly 56 bits prior to the final data bit. This protocol is specific to the “Comstream” CP-101 hub station burst demodulator and is very efficient.
5. When the closing flag is detected by the modulator, it drops the CTS indicating that a new data message cannot be started. When the last data bit is sent, the modulator will reassert the CTS signal, and turn the carrier OFF.

Chapter 4 - Maintenance

4.0 Periodic Maintenance

The PSM-4900 requires no mandatory periodic field maintenance procedures. The unit contains no adjustments and most calibration is digital and held in EEPROM. Should a unit be suspected of a defect in field operations after all interface signals are verified the proper procedure is to replace the unit with another known working modem. If this does not cure the problem, other equipment in the link, wiring or power should be suspect.

There are no batteries or parts requiring periodic service contained within the case. The only moving part is the internal fan, which is designed for a service life in excess of 200,000 hours.

There is no external fuse on the PSM-4900 Modem. The fuse is located on the power supply assembly inside the case, and replacement is not intended in the field.

4.0.1 Internal Reference Calibration

If desired, or if it is suspected that the modem's internal reference requires calibration, this can be performed on a unit "on-location". A recommended interval for the reference calibration would be after the first 6 months to a year in service and on a yearly basis thereafter. The external reference should be of known accuracy before attempting calibration. The calibration of the modem's internal reference from an externally applied reference is an automatic procedure enabled from the unit's front panel. Go to **<Unit: Test – Cal Ref>** to enable the calibration procedure.

- ⇒ ***Caution: The Reference Calibration procedure may result in lost traffic during performance of the calibration! The calibration should not be performed in operating links without prior arrangements.***

Before beginning an internal reference calibration an external reference must be applied and the **<Unit: Ref – Source>** must be set to "External".

4.1 Common Test Procedures

When a modem, link or system is first installed and placed in service it is common to run several tests to verify proper performance of each of the equipment items in the link. The PSM-4900 is designed to aid in this process by providing built in test modes geared to verifying performance, and isolating potential problems. These aids consist of the modem self test procedure, the multiple "Loop-Back" modes available and the built-in BERT. These facilities are also useful when troubleshooting system or link problems which involve the modem.

- ⇒ ***Caution: All of the modem operating procedures described below will result in loss of traffic. They should not be used in operating links without prior arrangements.***

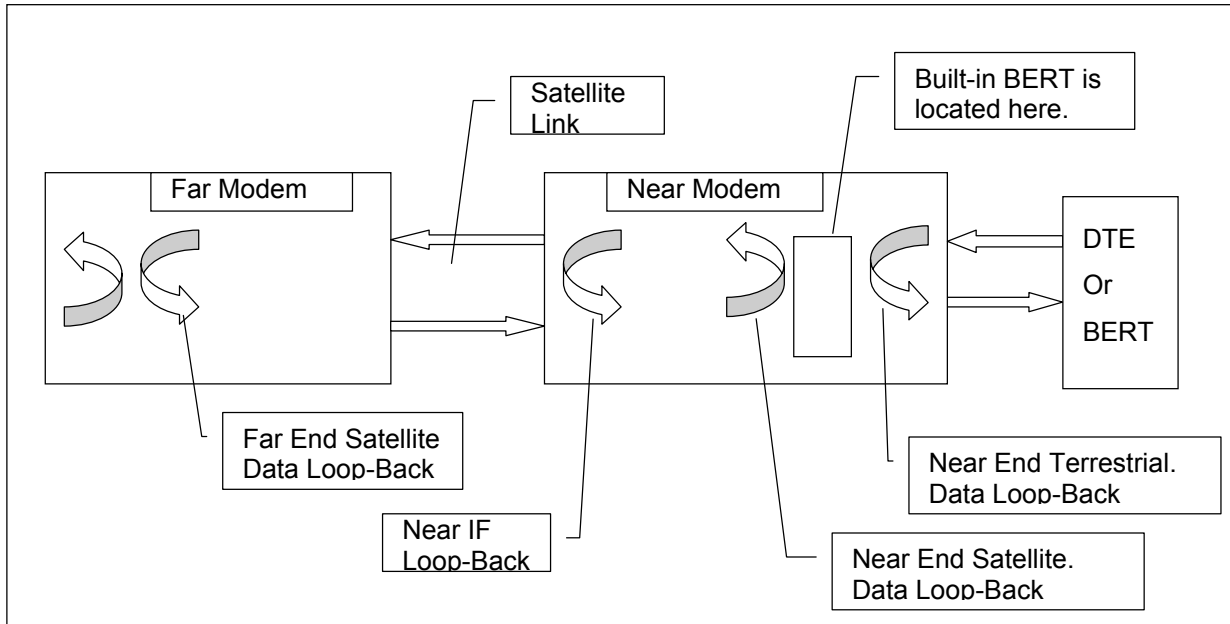
The modem self test can be used to check out a modem within a system or stand alone on a bench. It requires nothing more than power. The procedure is described in more detail in Section 4.2.3 below.

4.1.1 Loop-Back Testing

The Loop-Back modes are typically used in a wired link with DTE equipment that can transmit and verify receipt or preferably a Bit Error Rate Test Set (BERT). The basic procedure used is to

transmit a data signal at one end of the link and sequentially set each of the loop-back options. Proper reception of the loop-back data verifies all components between the source and the loop.

The simplified diagram below shows the location of the PSM-4900's built in loop-back functions within the link from one end of a link to the other. The advantage to having these functions built-in is that they are electronically programmable without having to disconnect existing cabling to connect equipment that must be available for testing. The IF loop-back even works in the PSM-4900H where the transmit is at 70 MHz and the receive is at L-Band frequencies.



Each of these loop-back modes are individually programmable at the modem front panel or remote control interface. More detail on each of the typical loop back uses is given below.

- Near End Terrestrial Data Loop-Back:** This will be the closest loop-back to the DTE or BERT. If data is returned and received properly it indicates that the DTE wiring and connection to the modem are correct. Note from the position of the built-in BERT in the diagram above that this test requires an external source of data. The PSM-4900 can individually set the data path terrestrial side loop-back and the data path satellite side loop-back in **<Int'f: Test - Ter Loopbck>** and **<Int'f: Test - Sat Loopbck>** respectively.
- Near End IF Loop-Back:** This second loop-back will verify the modem transmit data signal processing, modulation, demodulation, receive signal processing, and connection to the receive interface. The PSM-4900 sets the IF loop-back in **<Dem: Test - IF Loopbck>**. Note in this test that the near end satellite loop-back function should not be enabled whether using the internal or an external BERT.
- Far End Satellite Data Loop-Back:** This will test most of the satellite link as well as the functions checked in test 2 above. The signal is sent over the satellite (or test setup) and is looped back at the satellite side of the data interface on the far end. This tests both modems, the satellite link and originating end wiring. The PSM-4900 sets the satellite side loop-back in **<Int'f: Test - Sat Loopbck>**. Note in this test that the near end satellite and IF loop-back functions should not be enabled whether using the internal or an external BERT. Setting this mode slaves the modulator timing to the demod timing and the FIFO buffer remains engaged if enabled.

In this type of testing an external BERT is typically set to provide a terminal timing output, while the connected modem is set to use the terminal timing signal as the transmit bit rate clock source. This modem can alternatively be set to use its internal clock for the transmit clock timing

and provide that signal to the BERT for synchronization. More information on using the PSM-4900's internal BERT is given below.

4.1.2 Using the Built-in BERT

The PSM-4900 contains a complete transmit and receive Bit Error Rate Test (BERT) set. Each direction is independent and can be used for either loop-back testing or uni-directional testing with another PSM-4900 on the other end of the link. Since the test sequences used are industry standard it should also be possible to use the built in BERT with an external BERT and any brand of modem at the other link end, although this has not been extensively tested.

The Modulator (Transmit) BERT is enabled at **<Int'f: Test – Mod BER>**, and the Demodulator (Receive) BERT is enabled at **< Int'f: Test – Dem BER >**. With either transmit or receive being enabled by choosing either the 2047 or 2²³-1 test pattern options. Both should be the same to operate properly.

When the Demodulator receive BER Test is enabled the test results are available in the **<Int'f: Status - Test>** parameter item and the 7 items below it in the Interface Status column. These 7 items are:

1. Test BER – The ratio of errored bits to un-errored bits since the test began or was last reset. Expressed in bits per bit as x.yyy E-power where the mantissa (x.yyy) is always between 0 and 10 and power is the power of 10. For example 1.200 E-6 is 1.2 errored bits in 10⁶ bits, or 1.2 errors per million bits. No errors are expressed as 0.000E-power. Since Errored bits do not accumulate during a sync loss, it is possible to lose sync for several seconds and not have the BER affected.
2. Sync Loss – The total number of sync losses that have occurred since the test began or was last reset.
3. Errors – The total number of bit errors that have occurred since the test began or was last reset. Errored bits do not accumulate during a sync loss.
4. Bits – The total number of bits that have been received since the test began or was last reset.
5. EFS – Error Free Seconds. The percentage of the total number of seconds with no errors occurring during that particular second. Compiled since the test began or was last reset. No errors are shown as “100.00%”. Errored seconds accumulate during a sync loss.
6. Erred Sec – The total number of seconds with errors occurring during that particular second, since the test began or was last reset. Errored seconds accumulate during a synch loss
7. Total Sec – The total number of seconds since the test began or was last reset.

The test is reset or started over by viewing any of the 7 status items listed above and pressing the “Edit” or “0” key, then responding to the prompt “Enter to Restart” by pressing “Enter”. A restart on any items resets all items and values.

A single error may be inserted when the BER test is active to verify proper operation by using the **<Int'f: Test – Mod BER>** parameter and pressing “3” and “Enter”. This could be useful since it is sometimes difficult to see errors with the Turbo Product Codes FEC.

In the loop-back diagram shown above the BER test sets are physically between the satellite and terrestrial loop-back functions. Thus data traversing through either of these loop-backs does not involve the BER test sets, even if enabled. If the built-in BERT is being used the local “satellite loop-back” function should not be enabled.

The transmit output from the built-in BERT always faces toward the modem's transmit or satellite side, while the receive comes from the modem's receive side. It is not designed to transmit and receive signals from the terrestrial side of the data connection.

All of these settings and test results are also available via the remote control interface, allowing for automated and periodic testing of units not in service.

4.2 Troubleshooting

The following is a list of possible problems that could be caused by failures of the modem or improper setup and configuration for the type of service. The list is arranged by possible symptoms exhibited by the modem. When simple solutions yield not results then test equipment may be necessary to help isolate the trouble. A spectrum analyzer is invaluable. So is a Bit Error Rate Test set (BERT). The PSM-4900 has a built in BERT function.

In most cases the first attempt at isolating a problem suspected of being within the modem is to place the modem in the Self-Test Mode. Since this the vast majority of internal circuitry then a pass on this test means that the user should probably concentrate on parameter settings and external equipment and connections.

One obvious and time-honored method of isolating problems is to substitute suspect equipment with known good equipment. Assuming that the configuration setting of the equipment is not the source of the problem, this method will quickly eliminate items from the potential source list. The two drawbacks to this method are the availability of extra equipment and the possibility of interaction between two or more equipment items.

Symptom: The Modem will not acquire the incoming carrier:

Possible Cause: Improper receive input to modem.

Action: Check that the receive cabling is correct.

Possible Cause: Receive carrier level too low.

Action: Check that the receive cabling is correct, that the downconverter is properly set and that the LNA is turned on. If a spectrum analyzer is available, locate and measure the receive level, which should not be below -60 dBm absolute. At lower data rates the input level may be as low as -84 dBm.

Possible Cause: Receive carrier frequency outside of acquisition range.

Action: Check the receive acquisition range is adequate for the possible system offsets. Setting the value to 30 kHz is a standard value encompassing all normal offsets. After acquisition, the actual receive frequency can be read from the front panel.

Possible Cause: Transmit carrier incompatible.

Action: Check the receive parameter settings and ensure that they match those on the modulator.

Possible Cause: Modem is in test mode.

Action: Check the modem front panel for yellow warning LEDs indicating a test mode is enabled. Self Test or IF Loop-back disconnects the Demodulator from the IF receive input connector.

Possible Cause: Interference on the satellite.

Action: The interference can take many forms. The most common are an adjacent large carrier, antenna feed polarization off resulting in carrier interference in opposite

polarization, intermodulation products. Most of these cases can more easily be determined with a spectrum analyzer. If possible move to another operating frequency to see if that resolves the problem.

Symptom: The Modem acquires a carrier but loses lock intermittently.

Possible Cause: Receive acquisition range set too narrow. When the carrier drifts outside of the acquisition range the demodulator loses lock until the carrier returns inside the acquisition range.

Action: Check the actual receive carrier frequency and the receive offset at the front panel and set the acquisition range appropriately.

Possible Cause: Receive level varying out of AGC range.

Action: Check the actual receive input level at the front panel. Change the carrier input level to within the correct range. In Ku-Band systems, rain fade can cause significant receive level variance.

Possible Cause: Transmit or Receive Converter equipment noisy.

Action: The dependence upon good phase noise in converter equipment is especially noticeable at low data rates and when using QPSK modulation. Very low frequency phase noise on the converter oscillators is very difficult to see or measure, but is detrimental to proper low data rate performance. Substitution of another modem will verify the correct modem functioning.

Symptom: The Modem output data is corrupted.

Possible Cause: Receive data or clock inverted.

Action: Check the current state of the Demod Clock and Data Phase. Try inverting the phase.

Possible Cause: Receive Carrier signal E_b/N_0 is too low resulting in poor BER performance.

Action: Ensure that the transmit end is properly set and that the receive subsystems are all operating correctly. In a small station ensure that the antenna is “peaked” on the satellite. In a Ku-Band station, intense rain can cause poor receive performance.

Possible Cause: Transmit and Receive scrambler or differential encoder options do not match or not enabled.

Action: Check the current state of the Scrambler and differential encoder. In all operating systems the differential encoder/decoder and one of the available scramblers must be enabled.

Symptom: The Modem receive FIFO buffer indicates “Slip”.

Possible Cause: The FIFO automatically re-centers when an overrun or under-run condition occurs.

Action: Check that the proper clocking options are used and the FIFO buffer is set large enough to handle the expected satellite Doppler shift over a 24 hour period. No amount of buffering will correct for different clocks on the input and output of the FIFO.

Symptom: Receive DTE equipment indicates “clock slip” or “sync lost”.

Possible Cause: The FIFO automatically re-centers when an overrun or under-run condition occurs.

Action: Check that the proper clocking options are used and the FIFO buffer is set large enough to handle the expected satellite Doppler shift over a 24 hour period. No amount of buffering will correct for different clocks on the input and output of the FIFO.

Possible Cause: Receive signal or clock inverted.

Action: Check the current state of the Demod Clock Phase. Try inverting the phase.

4.2.1 Onboard Diagnostic Indicators

There are 8 LEDs on the main PWB which provide diagnostic information about the status of various functions:

1. **DS1** - *MBIT FAULT*- (Red) – Indicates that the transmit bit timing is not synchronized. The most common reason for this fault should be that the modem is set for external Transmit Timing input and either none is present or the applied signal is off frequency.
2. **DS2** - *MOD ENABLE*- (Green) – Indicates that the modulator hardware has enabled the transmit carrier.
3. **DS3** - *Modulator FPGA program fault*- (Red) – Indicates that the modulator FPGA failed to program correctly.
4. **DS4** - *MSTP FAULT*- (Red) – Indicates that the transmit step synthesizer is unlocked. Normally this would result only from an onboard fault.
5. **DS5** - *REF FAULT*- (Red) – Indicates that the onboard TCXO reference oscillator is not phase locked when set to an external reference input.
6. **DS6** - *System Clock Alarm*-(Red) – Indicates that the 80 MHz clock hardware has failed.
7. **DS7** - *DEM LOCK*- (Green) – Indicates that the demod hardware has locked to an incoming carrier.
8. **DS8** - *DSTP FAULT*- (Red) – Indicates that the receive step synthesizer is unlocked. Normally this would result only from an onboard fault.
9. **DS9** - *Demodulator FPGA program fault*- (Red) – Indicates that the demodulator FPGA failed to program correctly.
10. **DS10** - *I channel FPGA program fault*- (Red) – Indicates that the I channel filter failed to program correctly.
11. **DS11** - *Q channel FPGA program fault*- (Red) – Indicates that the Q channel filter failed to program correctly.
12. **DS12** - *MLO FAULT*- (Red) – Indicates that the transmit Local Oscillator synthesizer is unlocked. Normally this would result only from an onboard fault.
13. **DS13** - *DLO FAULT*- (Red) – Indicates that the receive Local Oscillator synthesizer is unlocked. Normally this would result only from an onboard fault.
14. **DS14** - *Front Panel FPGA program fault*- (Red) – Indicates that the front panel FPGA failed to program correctly.

4.2.2 Onboard Processor Power-On Sequence and Diagnostics

The processor goes through the following sequence every time the modem is powered up.

1. Sets up the stack pointer and initializes the register bank;
2. Disables all interrupts;
3. All internal RAM and all external RAM is tested by writing to it and reading from it. If any value does not work correctly, the initialization is halted and an endless loop is entered putting out a square wave on ALARM LED;
4. The front panel is checked for presence.
5. Checks the Flash memory contents and calculates its checksum value. If the checksum does not correspond to that in the ROM, the initialization is halted and an endless loop is entered putting out a square wave on the ALARM LED;
6. The EEPROM is tested for specific flag bytes in its contents. If the flags are incorrect, the EEPROM is assumed to be corrupted and is re-initialized with the factory defaults, removing the current. A message is displayed on the front panel LCD.
7. Initializes all variables and internal components;
8. The standard or optional interfaces are interrogated for type and installed options.
9. Initializes the serial UARTs, A/D converter and internal timers, enabling these interrupts in the process;
10. Begins operating its main loop program which responds to control inputs, monitors and displays terminal and LED status, controls the modulator output, FEC, operating modes, etc.

4.2.3 Built-in Self-Test Sequence

The built-in self-test goes through a specific sequence outlined here for reference only. The purpose of this test is to verify the integrity of internal modem operations as fully as possible while requiring no or minimal external test equipment or fixtures. Since there is no external testing done, the functioning of the modem data interface, external reference input and physical IF input and output are not tested. Alarm relay connections to external equipment can however be exercised during the test sequence.

⇒ **CAUTION:** *The Self-Test Mode will disconnect the receive IF from the ground station equipment and will therefore disrupt any traffic currently through the PSM-4900 under test. This Test Mode should not be used on a live traffic unit.*

The unit self test is started by the **<Unit:Test - Modem>** setting. Pressing 1, 2 or 3 will test the Lamps, Unit or Lamps and Unit respectively. A self test in progress may be cleared by pressing "0" on the front panel and then "Enter".

Selecting the self test procedure allows 3 options: The lamp test alone, the modem tests alone or both.

4.2.3.1 Lamp Test

The Front Panel LEDs and LCD display backlight are tested. This is meant to be viewed by an operator. During the 4 seconds of this test both alarm relays are forced off.

4.2.3.2 Alarm Relay Test

Alarm relay A is turned on for 1 second, then Alarm B is turned on for 1 second. This is intended for checking externally connected equipment.

4.2.3.3 Alarm Test in 2 passes

In pass one, all parameters are set to force a failure and any non-alarm conditions results in a failure of the test. In pass two, all parameters are set to remove alarms, and any alarm remaining results in failure of the test.

4.2.3.4 AFC Limit Test in 2 steps

In step one, the modulator and demodulator are set to 50 MHz with a –100 kHz offset to 49.90 MHz and the synthesizer loop voltages are tested for proper range. All processor read voltages are monitored for proper range. In step two, the modulator and demodulator are set to 90 MHz with a +100 kHz offset to 90.10 MHz and the loop and other monitored voltages are measured again for proper range.

4.2.4.5 Loop Test 1

The modulator and demodulator are set to 4.92 Mbps, QPSK, Rate $\frac{3}{4}$ and an IF Loop is initiated. The processor checks to see if lock is achieved within a specified period, that the receive Eb/No, input level and offset frequency are all within limits. The internal BERT is used to verify no errors or loss of sync.

4.2.4.6 Loop Test 2

The modulator and demodulator are set to 2.4 kbps, QPSK, Rate $\frac{1}{2}$ and an IF Loop is initiated. The processor checks to see if lock is achieved within a specified period and that the receive Eb/No, input level and offset frequency are all within limits. The internal BERT is used to verify no errors or loss of sync.

4.3 Updating Modem Software

The PSM-4900 modem software is held in flash memory and can be field upgraded by several methods. The most common is to download newer software revisions via the Internet and install using the modem's serial control port. We do occasionally add new features or correct operating procedures within the modem software that might lead to problems. When the operating software changes the Revision number is updated. Some changes involve changes to the information or structure in the non-volatile EEPROM storage.

The complete software update "package" consists of the following files:

- M5LOADER.EXE PC based program to load software to the modem.
- M5UPDATE.BAT or M5HUPDATE.BAT or M5LUPDATE.BAT PC based batch file to run the loader.
- M5Vxxyyy.BIN or Mxxyyyzzz Binary image of the modem's software.
- ReadMe.TXT Instructions for accomplishing the update.

In addition the user must supply a "PC" type computer running DOS or Windows and a serial cable to connect the PC to the modem. The serial cable has a male DB9 connector on the modem end and normally a female DB9 connector on the computer end. Older computers may require a DB25 to DB9 adaptor on the computer end. The 9 pin cable is wired 1:1 with no crossovers (as in "null modem" type cables). This is a standard serial extension cable available at computer outlets.

Any software upgrade requires a "Control Program" hosted on the computer which transmits or "Loads" the new software to the modem. The Control Program is available with the newer software revision. Currently the name of the control program is "M5LOADER.EXE". This Loader is an IBM PC DOS based program that can be run under DOS or Windows 3.1, 95, 98, 2000 and XP. In the Windows operating system the program can be run from a DOS window or with an included batch file from Windows itself (in which case it will open a DOS window for execution). The Loader also keeps a record of the serial number of units updated, the date updated and what revision of code was installed. This file is called "M5UPDATE.LOG".

The batch file “M5UPDATE.BAT” included with the loader sets up the loading process with the latest version of software. The main purpose of this program is to run a DOS window under Windows and free the user from having to type in the current version of binary file. A slightly different loader batch file, such as “M5HUPDATE.BAT” may be included in software updates that handle new firmware for the Hybrid (PSM-4900H) Modem, or “M5LUPDATE.BAT” for the L-Band.

The modem has a complementary program which talks to the loader and controls re-writing of the flash memory. Before the M5Loader can be run on the connected PC the modem must be placed in “update” mode. This is done in the **<Unit:Test – Update ROM>** menu item on the front panel by entering the modem unit’s serial number and pressing “Enter”. The modem is specifically designed to not accept firmware that is not made for it. For example the standard 70 MHz modem would reject firmware for a 140 MHz or L-Band Hybrid Modem.

A “ReadMe.TXT” file is included with the loader and binary image file containing complete instructions on the update process. Please read these instructions carefully.

Extreme care should be taken while loading a new software revision as interrupting the process will result in an unusable modem until the upload is successfully completed.

All user settings and calibration data are maintained when newer software revisions are installed.

⇒ **CAUTION:** *The process of updating software will result in disruption of any traffic currently through the PSM-4900. Upgrade should not be performed on a live traffic unit.*

⇒ **CAUTION:** *The process of updating software must not be interrupted once started. Especially in software versions below 0.30 a new modem boot sector is installed in flash. Failure to complete this portion of the loading process may result in complete loss of the modem programming. In this eventuality the modem must be returned to Datum Systems for software initialization and calibration..*

Complete update of the modem normally requires approximately 4 to 6 minutes. The process cannot be accomplished on multiple modems simultaneously.

NOTE: The IF version of the 70 MHz, 140 MHz and L-Band modem is determined by hardware only, and has nothing to do with the software. The modem will refuse to accept attempts to load the wrong software intended for another version.

4.4 Frequently Asked Questions - FAQ

OR How Do I?, Why Doesn't It?, and Where Is?

This Section is intended to form a smart index pointing to proper sections of the manual with information on performing common actions or answering common questions. The presentation here is divided into common areas such as Front Panel and Remote Control.

A. Link Set Up and Installation.

There are so many options and parameter settings! Where do I start?

The PSM-4900 is highly programmable. This can make the set-up daunting at first. If you are unfamiliar with the common terms and modes used in satellite communications you should first refer to Chapter 2 of this manual "*Installation and Setup*". As a starting point the modem can also be taken to a default basic set of operating parameters by using the front panel **<Unit: Configuration - Recall>** parameter and select option "0" or "Factory". From that point you make necessary changes to set the desired configuration. Once all parameters are set as required the configuration can be saved using the **<Unit: Configuration - Store>** control. From there you can always go back to this configuration by recalling it.

How do I make the PSM-4900 talk to a xxxx brand modem on the other end of a link?

The PSM-4900 has several new programmable features which should make this easier than ever. First, where possible if both modems adhere to Intelsat IESS standards then those defined parameters should be set the same. Still all modem manufacturers have their own conventions for setting parameters with no specified standard, so for example some modems may have a different modulation sense for data bits than others. This would make no difference between two modems of the same type, but would invert data between modems of different types on each end of a link. Most items of this type are programmable in the PSM-4900 modem.

Why doesn't my PSM-4900 talk to another PSM-4900 over the satellite? I have set all the parameters the same.

Any satellite modem has a significant number of parameters, which are settable in order to achieve the maximum performance at the least cost. Because there are so many parameters it is possible to have one unit with a slightly different parameter set than that at the other end of the link. If after insuring that all parameters are set the same and that the acquisition range is correct and that there are no interfering carriers; one other method is to take both modems back to the factory default condition and rebuild the configuration from "scratch". Use the front panel **<Unit: Configuration - Recall>** and select option "0" or "Factory". You may want to save your current configuration before resetting to the default.

What is the delay from end to end using the PSM-4900?

The satellite link itself represents a fixed and very slightly variable delay due to the distance of the satellite from the two stations linked. This delay is approximately 250 milli-seconds. In addition Appendix A lists the specified fixed and rate dependent delays incurred in the modem's transmit and receive processing, including those in the IBS Multiplexer and Reed-Solomon if equipped and enabled.

***Can I use the PSM-4900 to help align the station antenna?
Is an AGC output provided to feed to automatic antenna positioning equipment?***

Yes - The PSM-4900 has a single analog output that is produced by the main processor and converted to analog by a D/A converter. The parameter selected for this output can be either the AGC, Eb/No or Mod CXR Level selected in the **<Unit: Monitor - Mode>**. The slope and polarity are selected using the "Zero" and "Full" parameters below this. The signal is available at the rear panel on the J5 Alarm Connector, pin 5 with the Ground return on pin 6. See Installation Section 2.3.3, "Alarm Connection", and Operations Section 3.11 for more information on connection and use of the monitor function.

The AGC has been the classic parameter used for this type of function, but the PSM-4900 provides an output that may be better in most situations. That is the Eb/No, which is a function without the slope changes and negative signal sense of the AGC signal.

Where is the "Eye Pattern" test points for the I and Q channel receive signals?

The PSM-4900 does not have an analog test point to view the eye pattern. All information at this point in the receive chain is digital and measured by the modem processor. The result of this measurement is presented as the Eb/No. If it is absolutely essential to view the eye pattern as analog test information, contact the factory for availability of a special test fixture for conversion.

My PSM-4900 and PSM-2100 do not agree on the Eb/No parameter with Reed-Solomon Codec installed?

The PSM-2100 was designed before Intelsat IESS 309 added the section defining how the Eb/No was measured with Reed-Solomon concatenated coding, and uses a different method. The method is encapsulated in ASIC and not changeable. Unfortunately the IESS lists two possible methods of computing the Eb/No with Reed-Solomon. The PSM-4900, being of more recent design, adheres to both IESS definitions by allowing the reference point to be varied. The two therefore may read differently, but actually achieve the same performance. Refer to Appendix RS for more information on setting the calculation parameter.

What happened to the Burst Modulator mode in the PSM-4900?

The PSM-4900 has the basic circuitry necessary to implement burst modulation. The burst demodulation scheme compatible with the modulation used in the PSM-2100 is no longer manufactured, and there is no clear standard for implementing this capability. Modifying the PSM-4900 to work with a specific burst demodulator scheme is an option which requires contacting the factory for availability.

How do I use the modulator and demodulator functions to invert the spectrum?

These options were added into the PSM-4900 to aid in building specialized systems which may invert the spectrum sense of the received carrier. The main cause of this would be an up or down converter which performs a spectrum inversion.

How do I use the modulator and demodulator functions to vary the FEC C0 and C1 values?

These options were added into the PSM-4900 to help achieve compatibility with other brands of modems at the other end of a link. These parameter settings also allow changing the modulation of adjacent carriers on the satellite so that a demodulator will not lock to them. This has value if the carriers are placed closer than the required receive acquisition range. Using this scheme requires the use of the demodulator search mode.

Intelsat in the latest IESS 308/309 has changed the definition of the C0 and C1 values. This option allows compatibility with any definition.

Does the PSM-4900 have AUPC and AUFC and are they compatible with the PSM-2100?

The PSM-4900 does not have AUFC, but retains the AUPC from the PSM-2100 type modems. Like the PSM-2100 the built in AUPC (Automatic Uplink Power Control) can be enabled only if the multiplexer option is installed or if an external communications channel is provided.

The PSM-4900 AUPC is compatible with that in the 2100 when the PSM-4900 modem IBS Multiplexer is placed in the "Enhanced" mode. It is not compatible in the "Custom" mode.

How do I set up the IBS Multiplexer and AUPC Option in the PSM-4900 to be compatible with the PSM-2100 Modem?

The PSM-4900 Modem is capable of varying the parameters for the IBS Multiplexer beyond the capabilities of the PSM-2100. To maintain compatibility with the PSM-2100 specific similarly named options are available in the PSM-4900. These modes are the "Standard" and "Enhanced" multiplexer operating modes. The 4900's "Custom" mode is not compatible with the PSM-2100.

For the AUPC to function and to be compatible with a PSM-2100 it must be set in the "Enhanced" mode.

How do I set up the Reed-Solomon Option in the PSM-4900 to be compatible with the PSM-2100 Modem?

The PSM-4900 Modem is capable of varying the parameters for the Reed-Solomon Codec beyond the capabilities of the PSM-2100. To maintain compatibility with the PSM-2100 specific similarly named options are available in the PSM-4900. When enabled the RS FEC Mode should be set to "IESS-308". This will automatically set the "n", "k" and "Depth" options to 126, 112 and 4 respectively. The 4900's "IESS-309" and "Custom" modes are not compatible with the PSM-2100.

Is Datum Systems' Turbo Product Codes compatible with that made by other modem manufacturers?

There is an extremely good chance that it is **not** compatible for several reasons. First is that there is no standard for implementation of TPC. Second, Datum Systems spent a lot of time and development in implementing a full set of TPC parameters (i.e. Rates 1/2, 3/4 and 7/8), and insuring the absolute best performance with no compromises. We have seen no other TPC implementation that even comes close to ours. Third, because we have many customers that use our modems in systems requiring low latency we implemented an alternate "Short Block" mode that reduces the typical TPC delay by approximately 1/3. The techniques used in this TPC achieve the best performance of any modem currently produced.

How do I determine the transmitted "Symbol Rate" of the modem?

This particular parameter used to be a lot simpler to define. With the introduction of Turbo Product Codes coupled with all the other modem modes and options like programmable IBS multiplexer data load it is now extremely hard to define. The modem knows though, and beginning with the first version of software which supports TPC (revision # 0.62) a new front panel parameter has been added showing the current transmit/receive symbol rate. It is in the <Mod: Test – Symbol Rate> and the <Dem: Test – Symbol Rate> parameters.

B. Front Panel Control

How do I enter a number with a minus sign?

At any time during the "Edit" process the "+/-" key will change the sign of the current entry (if the change is possible). In the quick edit mode this can be the first key pressed, so for instance, if the

current setting for modulator transmit output level is –10 dBm then pressing “+/-, 12” will enter a value of –12 dBm. You could also press “1+/-2” or “12+/-” with the same result.

Why doesn't the PSM-4900 front panel act like the PSM-2100? [and] How do I make it act like the PSM-2100?

The PSM-4900 has many more features and programmable options than the PSM-2100 modems. A close match is achieved by disabling the “quick” entry mode and remembering to press the “Edit” key first instead of the “Enter” key. Once you become accustomed to the “Quick” entry mode and using the change sign (+/-) and decimal point keys you will find it more convenient than any entry on the PSM-2100.

Why does the transmit carrier turn off whenever I make a change?

First the transmit carrier can be set to a mode which will turn the carrier off if any change is made that would result in a possible interference with other carriers on the satellite. This mode can be set to one of three states: Automatic, Confirm or Manual. Automatic will turn the carrier off during the parameter change and return the carrier on (if currently enabled) after the change is completed, Confirm will ask if the carrier should be left on (requiring a “yes” or “no” answer), while Manual will always turn the carrier off after a change. This option is set in **<Mod: IF – Mute>**. More directly the setting described is probably set to “Manual” mute mode.

Why can't I find or see a certain option parameter that is shown in the tables?

Many parameters are only available when another option has been enabled which requires that parameter. For example, the **<Demod: IF – Sweep Time>** parameter is only visible if the **<Demod: IF – Sweep Mode>** is set to “Search”. These options are shown in the tables as gray to indicate this status.

Can I control the far end modem from the front panel of a local modem?

The PSM-4900 has the ability to control the far end modem (when linked and locked) from a local modem, but only using the remote control port. This ability requires the addition of the Multiplexer option. Control from the front panel is prone to possible mistakes that would lead to accidentally setting the remote modem in a state that could not be recovered without going to the remote site.

The far right “Remote” LED is blinking. What does it mean?

The Unit IrDA and Remote Activity parameters allow setting this lamp to blink when activity is detected on the IrDA and remote control ports. The same is possible for the “Local” LED using the Unit Keyboard Activity control.

I can't find the control to disable either the modulator or demodulator function?

This function was originally not available in the PSM-4900. We knew of no one who used it except accidentally, resulting in return of the modem as faulty.

Note: This function was added back in beginning with software revisions after 0.50.

What do the abbreviations on the front panel and in the manual mean?

See the abbreviations in FAQ Section E below.

C. Remote Control

Where is the ASCII Control packet structure in the PSM-4900?

The PSM-4900 does not have an ASCII control packet protocol, only the binary packet protocol.

Is there a “compatibility” mode for the remote control binary packet protocol that looks like that in the PSM-2100?

No. The new commands dictated a new structure to implement the significantly greater number of commands available in the PSM-4900. Many items such as the interface structure, data rates and available options are so different that creating a compatible command set was impossible. The packet structure itself is virtually identical though and in most cases the new command set can be accommodated by a “driver” tailored to the PSM-4900.

D. Data Interface

How do I make a cable to connect to my V.35 (or EIA-530) device?

See the “Installation” Chapter 2 and Appendix C on “Cabling Specifications” which shows how to make cables to interface between the modem’s DB37 connector and other types of common connectors used.

Where do I get a “Y” cable to implement 1:1 redundancy?

These may be purchased from Datum Systems or it is possible to build your own. The connections are discussed in Chapter 2 “Installation” and shown in Appendix C, “Cabling Specifications”.

Why do I keep getting “sync losses” on my link? Or why does a BERT test show “sync losses”?

This is usually a sign that some section of the link has a clock or data inversion. See Chapter 4 of the manual for “Loop” testing to try to determine where the problem is and correct either the wiring or change the modem data or clock sense.

Why does the modem occasionally fail to operate with my DTE equipment, and to correct it I have to invert the data or clock?

The only cause in an otherwise functioning modem for this symptom is that the differential encoder/decoder is turned off. Modems use the differential encoding to determine the proper relationship between the clock and data. If the encoder is turned off the modem has a possibility of locking to a signal with the wrong phase. For all normal operation of the modem the Modulator differential encoder and the Demodulator differential decoder must be “Enabled”.

The Turbo Product Codes (TPC) option does not use the differential encoder, and when it is enabled the differential encoder and/or decoder is turned off and the option is removed from the parameter matrix.

How do I use the built-in Bit Error Rate Test (BERT) set?

See Maintenance Section 4.1.2 for information on using the built-in BERT.

Can I use the built-in Bit Error Rate Test (BERT) set to test the line or DTE side equipment?

Yes and No. The BERT is designed to transmit and receive to the modem side. It is however possible to use two other schemes in certain cases. First is to use the BERT at the far end modem to generate and/or sink the BERT test pattern. Second, the local modem can be set into an IF loop-back mode to use just one side of the BERT at a time. For example a test pattern can be sent from the receive output by enabling the transmit BERT only while setting the IF loop-back mode. See Maintenance Section 4.1.2 for information on using the built-in BERT.

Why doesn’t my 1:1 redundant switch on certain alarms?

The 1:1 redundancy logic is programmable on two levels. First is the **<Unit: Redundcy – SW Rqst>** parameter which selects whether a switch is requested on all alarms, alarm A and/or

alarm B. If it is set to any options but "On All Alarms" then the particular alarms that are summed into the A and B alarms are themselves programmable, creating the second level. See the discussion in section for more information.

E. Manual

What do the abbreviations on the front panel and in the manual mean?

A good example is the display and manual representation "Redundcy SW Rqst". Unfortunately the display does not hold enough characters to display the full text of "Redundancy Switch Request". Following is a list of abbreviations used.

Abbreviation	Full Text
1:1, 1:N, M:N	One for One, One for N and M for N. All redundancy switch types.
ACR	Automatic Configuration Recovery
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
ALC	Automatic Level Control
Alm	Alarm
Alt	Alternate
AUPC	Automatic Uplink Power Control
AUFC	Automatic Uplink Frequency Control
BER, BERT	Bit Error Rate, Bit Error Rate Test
BUC	Block Up-Converter
Cal	Calibrate
Clk	Clock
Config	Configuration
Cntst	Contrast
CXR	Carrier
Dem	Demodulator
Dif	Differential
ESC	Engineering Service Channel
Erred	Errored
FEC	Forward Error Correction
Freq, Frq	Frequency
Ffmt	Format
IDcOff, QDcOff	I and Q channel DC Offset
I/O	Input/Output
Int'f	Interface

Abbreviation	Full Text
Keybrd	Keyboard
LCD	Liquid Crystal Display
LNB	Low Noise Block downconverter
LO	Local Oscillator
Loopbck	Loop-back
Lvl	Level
Max	Maximum
MCC	Modem Control Channel
Min	Minimum
Mod	Modulator
Mux	Multiplexer
Opt	Option
OverHd	Overhead
RCV, Rcv	Receive
Redundcy	Redundancy
Ref	Reference
Rqst	Request
RS, R-S	Reed-Solomon – Type of FEC
Sat	Satellite
SCPC	Single Channel Per Carrier
SER	Symbol Error Rate
SW, Sw	Switch
Sync	Synchronous or Synchronization
SysClk	System Clock
Ter, Terr	Terrestrial – Line side of modem
TPC	Turbo Product Codes – Type of FEC
Tst	Test
VSAT	Very Small Aperture Terminal
XMT, Xmt	Transmit