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SLM-3650 Satellite Modem



INTRODUCTION

Comtech EF Data's modems have been designed to communicate with all the world's major satellite systems, including the Defense Satellite Communications Systems (DSCS). The units have an extended range of microprocessor-controlled functions to implement advanced, high-level coding techniques such as Reed-Solomon (RS) FEC for superior performance.

The SLM-3650 includes Fully Accessible System Topology (FAST) enhancement features. With FAST technology, the customer is given the ability to purchase only what is needed at any time, and may add functionality via software upgrades as needed. FAST is a value-added feature exclusive to Comtech EF Data's next generation of satellite communications equipment.

FEATURES

- MIL-STD-188-165 compliant (Type B)
- BPSK, OQPSK, QPSK, 8-PSK
- 2.4 kbps to 5 Mbps
- Fully Accessible System Topology (FAST)
- IDR/IBS
- Drop and Insert (D&I)
- Closed network overhead capability for:
 - Automatic Uplink Power Control (AUPC)
 - Asynchronous Channel Unit Overhead
- Turbo Product Codec
- Reed-Solomon (R-S)
- Fast Acquisition
- Built-In Self Test

COMPATIBILITY

The SLM-3650 is compatible with the OM-73, MD-1002, SLM-6650, SLM-8650, SDM-650, LM-46/4046, and MD-945 within the data rate limitations specified for those modems. The INTELSAT/EUTELSAT option provides compatibility with PTT earth stations worldwide.

A fully operational SLM-3650 can be configured to operate with many existing commercial and proprietary modems by selecting specific parameters via the front panel keypad or remote control.

APPLICATIONS

The SLM-3650 can be used on DSCS, SKYNET, NATO, PANAMSAT, and all U.S. domestic satellites. Options extend the modem range to include EUTELSAT and INTELSAT satellite networks.

The SLM-3650 is the ideal equipment solution when implementing Tri-band terminals that require both commercial and government communication access.

DATA AND CLOCK

The modem is configured to derive timing from either the data clock or a 1, 5, 10 or 20 MHz station clock. The interface type is MIL-STD-188 and accepts balanced differential pairs for data and clock. The data and clock also meet the requirements for EIA-422.

OPEN NETWORK MODE (IDR, IBS, or D&I)

The SLM-3650 can be equipped with the necessary baseband processors to operate with Intermediate Data Rate (IDR), INTELSAT Business Service (IBS), or SMS earth stations worldwide. The open network mode also supports fractional T1 or E1 transmission.

UPLINK POWER CONTROL (SLM-3650-02)

The SLM-3650 can be equipped with an optional Asynchronous Overhead/Automatic Uplink Power Control (AUPC). Operation in the SLM-3650-02 mode adds overhead bits to the data stream for an over-the-satellite communications link. This link can be used to monitor and control the equipment at a remote site. For the AUPC mode, some of the overhead bits of the frame are used to establish a modem-to-modem control link. Thresholds and limits can then be set to automatically compensate for fades. The AUPC mode requires another similarly equipped Comtech EF Data modem operating on the opposite end.

HIGH ORDER MODULATOR

8-PSK operation can significantly increase the capacity of the satellite link. A 2 Mbps circuit may be increased to 2.6 Mbps when changing from QPSK 3/4 with R-S to 8-PSK 2/3 with R-S. Both configurations have equal bandwidth on the satellite transponder. More signal power is required for the satellite to achieve the desired bit error performance.

SLM-3650 Satellite Modem

SYSTEM SPECIFICATIONS

| | |
|---------------------------|---|
| Operating Frequency Range | 50 to 90, 100 to 180 MHz, in 1 Hz steps |
| Modulation Types | BPSK, QPSK, Offset QPSK, 8-PSK |
| Digital Data Rate | 2.4 kbps to 5 Mbps, in 1 bps steps |
| Symbol Rate | 4.8 Ksps to 2.5 Msps |
| External Reference In | 1, 5, 10, or 20 MHz at ≥ 0 dBm |
| External Reference Out | 10 MHz (high stability mode) +10 dBm \pm 5dB |

| | |
|------------------|---|
| Stability | $\pm 2 \times 10^{-7}$ internal reference |
| Energy Dispersal | CCITT, V.35, and others |

MODULATION SPECIFICATIONS

| | |
|--------------------|--|
| Output Power | -5 to -30 dBm, adjustable in 0.1 dB steps (+5 to -20 dBm optional) |
| Output Return Loss | 20 dB typical |
| Output Impedance | 50 Ω |
| Spurious | 0 to 500 MHz (-5 to -30 dBm) -55 dBc 0 to 500 MHz (+5 to -20 dBm) -50 dBc >64 kbps 0 to 500 MHz (+5 to -20 dBm) -45 dBc <64 kbps |
| Output Connector | TNC (BNC optional) |

DEMODULATION SPECIFICATIONS

| | |
|-----------------------------|---|
| Input Power: | |
| Desired Carrier | -15 to -55 dBm |
| Maximum Composite | 0 dBm or +40 dBc |
| Input Impedance | 50 Ω |
| Input Connector | TNC (BNC optional) |
| Carrier Acquisition Range | \pm 35 kHz, selectable |
| Input Return Loss | 20 dB typical |
| Elastic Buffer | 32 to 262,144 bits, selectable |
| OPEN NETWORK OPTIONS | |
| IDR | INTELSAT IESS-308, IESS-310 |
| Interface | G.703 |
| Orderwires | 1 EIA-422 8 kbps, or 1 EIA-422 64 kbps |
| IBS/SMS | INTELSAT IESS-309/EUTALSAT BS7-40 |
| Interface | EIA-422, V.35, G.703 |
| Orderwires | ASYNC, EIA-232, EIA-485, 1/2000 of data rate |

DROP AND INSERT OPTION

| | |
|-------------|--|
| Interface | G.703 |
| Data Rate | T1 or E1 |
| n x 64 kbps | n = 1 - 6, 8, 10, 12, 15, 16, 20, 24, 30 |

CONCATENATED CODING OPTION

| | |
|-------------------|-------------------------------|
| Inner Code | Viterbi or Sequential or none |
| Outer Code | Reed-Solomon |
| N, K, T | Refer to manual for ranges |
| Interleaver Depth | 4, 8, and 16 |

ENVIRONMENTAL AND PHYSICAL SPECIFICATIONS

| | |
|-------------|--|
| Prime Power | 90 to 264 VAC, 47 to 63 Hz, 40 W |
| Mounting | 1 RU |
| Size | 19 W x 15.2 D x 1.71 H in. (48.2 W x 38.6 D x 4.3 H cm) |
| Weight | 11 lbs. (5.0 kg) |
| Temperature | |
| Operating | 0 to 50°C (32 to 122° F) |
| Storage | -40 to +70°C (-40 to 158° F) |
| Humidity | 0 to 95%, non-condensing |

AVAILABLE OPTIONS

| How Enabled | Option |
|-------------|---|
| FAST | Variable Rate Data |
| FAST | Add Viterbi or Sequential decoder |
| FAST | 8-PSK |
| FAST | Asymmetrical loop timing |
| FAST | IBS, IDR, D&I, (Future) |
| FAST + Card | R-S, Rx mode, Ant Handover |
| FAST + Card | R-S, Tx mode, Ant Handover |
| FAST + Card | R-S, Tx, IESS |
| FAST + Card | R-S, Rx, IESS |
| FAST + Card | Concatenated R-S Codec, IESS |
| FAST + Card | Asynchronous overhead (ASYNC/AUPC) w/50-pin connector |
| FAST + Card | AUPC only (requires Tx and Rx boards) |
| FAST + Card | Turbo Product Codec |
| Hardware | High output to +5 dBm |
| Hardware | 2 x 10 ⁻⁷ internal stability for IF and data clock |
| Hardware | 25 Pin (F) D Connector, EIA-530 (EIA-422), EIA-232 and V.35 |
| Hardware | 50 Pin (F) D Connector for use <u>with overhead card</u> |
| Hardware | 50 Pin (F) D Connector for use <u>without overhead card</u> |
| | Includes, EIA-422, EIA-232 and V.35 |
| Hardware | NRZ Interface |

BER PERFORMANCE (E_b/N₀, dB)

| Viterbi with Reed-Solomon | | | | Viterbi/Sequential with Reed-Solomon | | | |
|---------------------------|---------|---------|--|--------------------------------------|-----|-----|-----|
| BER | IBS 1/2 | IDR 3/4 | | BER | 1/2 | 3/4 | 7/8 |
| 10 ⁻⁶ | 4.1 | 5.6 | | 10 ⁻⁶ | 4.1 | 5.6 | 6.7 |
| 10 ⁻⁷ | 4.2 | 5.8 | | 10 ⁻⁷ | 4.2 | 5.8 | 6.9 |
| 10 ⁻⁸ | 4.4 | 6.0 | | 10 ⁻⁸ | 4.4 | 6.0 | 7.1 |
| 10 ⁻¹⁰ | 5.0 | 6.3 | | 10 ⁻¹⁰ | 5.0 | 6.3 | 7.5 |

| 56 kbps, Sequential, BPSK, QPSK, OQPSK | | | | 1544 kbps Sequential, BPSK, QPSK, OQPSK | | | |
|--|-----|-----|-----|---|-----|-----|-----|
| BER | 1/2 | 3/4 | 7/8 | BER | 1/2 | 3/4 | 7/8 |
| 10 ⁻³ | | 4.6 | 5.5 | 10 ⁻³ | 4.8 | 5.2 | 6.0 |
| 10 ⁻⁴ | 4.1 | 5.1 | 6.1 | 10 ⁻⁴ | 5.2 | 5.7 | 6.4 |
| 10 ⁻⁵ | 4.5 | 5.5 | 6.6 | 10 ⁻⁵ | 5.6 | 6.1 | 6.9 |
| 10 ⁻⁶ | 5.0 | 5.9 | 7.3 | 10 ⁻⁶ | 5.9 | 6.5 | 7.4 |
| 10 ⁻⁷ | 5.4 | 6.4 | 7.8 | 10 ⁻⁷ | 6.3 | 7.0 | 7.9 |
| 10 ⁻⁸ | 5.8 | 6.8 | 8.4 | 10 ⁻⁸ | 6.7 | 7.4 | 8.4 |

| 8-PSK with/without R-S | | | Uncoded, BPSK, QPSK, OQPSK | |
|------------------------|--------------|-----------------|----------------------------|------|
| BER | 2/3 with/ RS | 2/3 without/ RS | BER | 1/1 |
| 10 ⁻⁴ | 6.1 | 7.3 | 10 ⁻³ | 8.0 |
| 10 ⁻⁵ | 6.3 | 8.2 | 10 ⁻⁴ | 9.6 |
| 10 ⁻⁶ | 6.5 | 9.0 | 10 ⁻⁵ | 10.8 |
| 10 ⁻⁷ | 6.7 | 9.8 | 10 ⁻⁶ | 11.6 |
| 10 ⁻⁸ | 6.9 | 10.4 | 10 ⁻⁷ | 12.4 |

| Turbo Product Codec | | | | | |
|---------------------|-------------|----------|-------|------|-----------|
| BER | 1/2 (OQPSK) | 3/4 BPSK | 21/44 | 5/16 | 3/4 8-PSK |
| 10 ⁻⁶ | | 4.1 | 2.8 | - | 6.5 |
| 10 ⁻⁷ | 3.2 | 4.3 | 3.1 | - | 6.9 |
| 10 ⁻⁸ | 3.5 | 4.6 | 3.3 | - | 7.2 |
| 10 ⁻⁹ | 3.8 | 4.9 | 3.7 | 4.0 | 7.5 |





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