



## INTRODUCTION

The BEM-7650 advances the existing multi-modem chassis designs with newer technology. The modulators and demodulators function with most major satellite systems. A robust, Windows-based monitor and control interface is available allowing independent circuit card configuration. The design focus meets Defense Satellite Communications Systems (DSCS) specifications.

## FEATURES

- 10 separate modulators and demodulators (9U x 160 VME) (Maximum)
- 9.6 kbps to 20.0 Mbps (code rate dependent)
- BPSK, OQPSK, QPSK, 8PSK, 16QAM
- Built-in Self Test include 2047 test pattern
- Flash upgradeable firmware
- IDR/IBS
- IESS-310, trellis coded modulation
- MIL-STD-188-165 compliant (Type A)
- Multiple scrambling methods including OM-73
- Reed-Solomon Codec
- Turbo Codec

## APPLICATIONS

The BEM-7650 can be used on DSCS, SKYNET, NATO, PANAMSAT, DOMSATs, and EUTELSAT, and all U.S. domestic satellites. Open network applications follow IESS 308, 309 and 310 for framing only.

## COMPATIBILITY

The BEM-7650 is compatible with (but not limited to) the following equipment, within the data rate limitations specified for those systems.

- |            |               |
|------------|---------------|
| • OM-73    | • SLM-8650    |
| • MD-1002  | • LM-46/40446 |
| • SLM-3650 | • SDM-300A    |
| • SLM-4650 | • MD-945      |
| • SLM-6650 | • CDM-600     |

## MAJOR BEM COMPONENTS

The BEM7650 primary components are:

- Modulator Assembly – accepts data and clock from a digital signal source and after processing, modulates the data on an IF carrier.
- Demodulator Assembly – accepts a signal from an intermediate frequency (IF) carrier, demodulates the IF carrier after processing, outputs the data and clock to the user.
- Turbo FEC Assembly – encodes data with turbo coding if installed in a modulator or decodes turbo coded data if installed in a demodulator.
- SICCA Card Assembly – provides functionality in the BEM needed to support the other cards in the system.
- Controller CCA Assembly – provides for monitoring and control (M&C) of the modulator/demodulator cards using the VME bus for communications.
- TICCA Card Assembly – extends the backplane of the BEM chassis to the 37-pin D-type connector on the back of the modem.

## SYSTEM GRAPHICAL USER INTERFACE

Two remote ports for external monitor and control are available. One personal computer can control up to 25 fully configured BEM-7650 chassis. Monitor and Control (M&C) for the unit can be accessed through a terminal, a PC running emulation software, or a system graphical user interface software program.

The BEM HOST software will store fault status for all modulators and demodulators and provide common equipment faults and status.



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## SYSTEM

Operating Frequency Range	50 to 90, 100 to 180 MHz, in 1 Hz steps
TX IF (Output)	+5.0 dBm to -30.0 dBm, in 1 dB steps
RX IF (Input)	-15 dBm to -55 dBm,
	TNC 50Ω, 17 dB Return Loss
Modulation Type	BPSK, QPSK, Offset QPSK, 8PSK, 16QAM
Digital Data Rate	9.6 kbps to 20.0 Mbps, in 1 bit/s steps
Symbol Rate	9.6 Ks/s to 10 Ms/s
External Modem Reference Input	1, 5, 10, or 20 MHz, selectable
Energy Scrambling	CCITT V.35, synchronous, MIL-STD-188-165, or None
Differential Encoding/Decoding	MIL-STD-188-165, or None
FEC (Inner Code)	Viterbi, K=7 (Trellis for 8PSK) Optional Turbo
FEC (Outer Code)	Concatenated Reed-Solomon (INTELSAT polynomial)
IDR/IBS Framing Compatibility	Support for IDR and IBS framing. Allows basic IDR/IBS operation.
Reference Frequency	External or Internal
Built-in Test (BIT)	Fault and status reporting, BER performance monitoring, IF Loopback, programmable test modes, Tx/Rx 2047 and Mil-2047 patterns provides an estimated BER.
$E_b/N_0$ Reporting (DFCS)	Continuous $E_b/N_0$ reporting from each demodulator via 25-pin D sub female, 1 wire per demodulator, EIA-485 levels.
Summary Faults	Reported via 9-pin D sub, FORM C relay contacts for Tx, Rx, and common equipment faults.

## Modulator

Output Power	+5.0 to -30 dBm, in 0.1 dB steps
Output Impedance	50Ω
RF Output	On or Off
Scrambler Type	IESS, Turbo or OM73
Differential Encoder	Enabled or Disabled
Modulator Type (Spectrum Shape)	INTELSAT or CEFD
Modulator Spectrum Rotation	Normal or Invert
TX BPSK Data Ordering	Standard or Non-Standard
Carrier Mode (Only)	OFF (Normal-Modulated) DUAL (Dual-CW) OFFSET (Offset-CW) CENTER (Center-CW)

## Demodulator

Demodulator Frequency	50 to 90, 100 to 180 MHz, in 1 Hz steps
Input Impedance	50Ω
Demodulator Rate	BPSK, QPSK, Offset QPSK, 8PSK, 16QAM
Descrambler Type	IESS, Turbo or OM73
Sweep Width Range	0 to 70000 Hz
Sweep Center Frequency	-35000 to +35000 Hz
Buffer Clock	INT, EXTERNAL, Tx Terrestrial, Rx SAT
Elastic Buffer	32 to 1,048,576 bits, selectable

## Coding Options

Viterbi	K = 7
Uncoded	1/1
Viterbi and Reed-Solomon	Concatenated
Turbo	5/16, 21/44, 3/4, 7/8, 17/18

## BER PERFORMANCE

### BPSK BER Performance

BER	Viterbi 1/2 Rate	Viterbi 1/2 Reed-Solomon 225/205	Turbo 5/16	Turbo 21/44
10 <sup>-4</sup>	6.1	4.1	2.5	3.0
10 <sup>-6</sup>	7.2	4.4	3.1	3.6
10 <sup>-10</sup>	8.2	5.0	3.8	4.2

### QPSK/OQPSK/BER Performance

BER	Viterbi			Viterbi RS			Turbo			
	1/2	3/4	7/8	1/2	3/4	7/8	21/44	3/4	7/8	17/18
10 <sup>-4</sup>	6.1	7.5	8.6	4.1	5.6	6.7	3.3	3.9	4.1	6.8
10 <sup>-6</sup>	7.2	8.8	9.9	4.4	6.0	7.1	3.5	4.3	4.3	7.4
10 <sup>-10</sup>	8.2	10.1	11.2	5.0	6.3	7.5	3.7	5.2	4.5	7.9

### 8PSK BER Performance

BER	Trellis Decoder		Trellis RS		Turbo		
	2/3	5/6	2/3	5/6	3/4	7/8	17/18
10 <sup>-4</sup>	8.7	10.8	6.2	8.2	6.5	7.1	10.0
10 <sup>-6</sup>	10.2	12.3	6.7	8.9	7.2	7.3	11.2
10 <sup>-10</sup>	12	13.8	7.2	9.7	7.8	7.5	12.4

### 16QAM BER Performance

BER	Trellis RS		Turbo	
	3/4	7/8	3/4	7/8
10 <sup>-4</sup>	8.4	9.8	7.6	8.2
10 <sup>-6</sup>	8.8	10.3	8.3	8.5
10 <sup>-10</sup>	9.2	10.8	9.0	8.8

## Environmental And Physical Specifications

Prime Power, AC	100 to 120, 200 to 240 VAC, 47 to 63 Hz, 400W Redundant Power Supplies
Mounting	13RU
Size	19W x 16.72D x 22.75H inches (48.26W x 42.5D x 57.8H cm)
Weight	< 80 lbs (< 37 kg)
Temperature:	
Operating	0 to 50°C (32 to 122°F)
Storage	-40° to +70°C (-40° to +158°F)
Humidity:	
Operational	< 95%, non-condensing



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