MD-1366 EBEM

Enhanced Bandwidth Efficient Modem
Strategic MD-1366/U or Tactical MD-1366A/U

The new standard in FDMA throughput & affordability, plus full backward compatibility

The U.S. Government selected the MD-1366 EBEM from ViaSat to set the new standard (MIL-STD-188-165B) for high-speed, high-performance, flexibility and compatibility in a Single Channel Per Carrier (SCPC) modem. The EBEM incorporates the latest technology in advanced modulation and coding, while providing backwards interoperability with the majority of existing SCPC modems. The modem offers optimal power and bandwidth efficiency with 16-ary modulation and turbo-coding. It supports a large range of user data rates, from 64 kbps up to 155 Mbps.

The MD-1366 provides a selectable adaptive coding and modulation mode that automatically adjusts modulation and code rates (while maintaining the symbol rate) matched to channel conditions – preserving link margin while combating rain-fades or other channel impairments.

The optional Ethernet Service Expansion Module (ESEM) for the EBEM is a plug-in module providing an Ethernet data interface for the modem, allowing the modem to support existing and future Ethernet based protocols: IPv4, IPv6, MPLS and non-IP data flows. When the EBEM is in a 165B mode, the ESEM enables a new logical data channel, which carries encapsulated Ethernet framed packets over the satellite link. The ESEM packet stream can be used in conjunction with existing fixed serial rate data streams.

The EBEM is approved to use its internal AES encryption algorithms in lieu of external TRANSEC devices in government installations. The MD-1366 provides encryption intended to protect sensitive, but unclassified data. Featuring Federal Information Processing Standard (FIPS) 197 Advanced Encryption Standard (AES) with 256-bit cipher key, the modem is NIST certified at Security Level 2 as described in FIPS PUB 140-2. AES-256 bulk encryption (TRANSEC) of all over-the-air data channels for 165B modes includes: serial user data, Ethernet user data, overhead data and embedded data channels. Encryption and decryption operate over the entire data rate range of 64 kbps to 155 Mbps with minimal additional delay. Encryption is disabled for backward compatibility with legacy waveforms: OM-73, MIL-STD-165A, IESS 308, 309 & 310.

The MD-1366A/U includes the same features as the MD-1366/U and is housed in a ruggedized chassis with support for antenna handover mode when dual antennas are required.

MD-1366 EBEM AT-A-GLANCE

Highlights

- Industry's only DSCS-certified MIL-STD-188-165B modem
- NIST-certified (FIPS 140-2) AES-256 TRANSEC encryption
- Industry-leading advanced modulation and turbo coding
- Flexibility, interoperability and bandwidth efficiency in a 1U-high, 19 inch rack mount
- Data rates from 64 kbps to 155 Mbps (Symbol rates from 32 ksps to 60 Msps)
- BPSK, QPSK, OQPSK, 8-PSK, 16-APSK
- Versatile IF (selectable 70 MHz, 140 MHz, L-Band)
- IESS-310 Trellis Coded Modulation (TCM), Viterbi, and Reed-Solomon decoders
- Automatic Transmit Power Control algorithm (165B waveforms)
- Built-in test features, including Self Test, internal BERT, and optional internal noise capabilities
- Control and Monitoring: Front Panel, SNMP, Windows GUI, or Command Line Interface (Ethernet or serial)
- Available in strategic or tactical configuration

Unique Features

- Selectable adaptive coding and modulation mode
- AES-256 bulk encryption of all over-the-air data (165B waveforms) eliminates the need for a separate inline network encryptor
- Automated session key generation and distribution, seamless session key rollover and self-synchronization
- Seamless Antenna Handover capability in tactical configuration
- Excellent performance in Ka-band shipboard Doppler environment
- Monitor Status of Distant/Remote EBEM modem
- Adaptive Equalization (16-APSK modulation)

IP-Capable with Ethernet Data Interface (Optional)

- Optional Ethernet Service Expansion Module (ESEM) provides an over-the-air packet data channel (165B waveforms)
- Single Gigabit Ethernet Interface (10/100/1000 Base-T)
- Supports PPPoE with credit extension
- Supports Emission Control (EMCON) operation

Interoperability

- Modems: OM-73, MD-1352/BEM-7650, SLM-3650, MD-1340, MD-1030
- Standards: MIL-STD-188-165A/B, IESS-308, IESS-309, IESS-310
- User Data Interfaces: TIA/EIA-530, NSA 87-20B, TIA/EIA-612/613(HSSI)
- Overhead Data Interfaces: TIA/EIA-422A

SPECIFICATIONS

INTERMEDIATE FREQUENCIES

70 MHz IF Range	52 MHz to 88 MHz in 1kHz steps
140 MHz IF Range	104 MHz to 176 MHz in 1kHz steps
L-Band IF Range	950 MHz to 2000 MHz in 1 kHz steps

REFERENCES

External Modem Reference Input	1, 5, 10 MHz or Internal

MODULATIONS, DATA RATES & SCRAMBLING

Binary Phase Shift Keying (BPSK) [1, 2]	64 kbps->60 Mbps
Quadrature Phase Shift Keying (QPSK) [1, 2]	64 kbps->120 Mbps
Offset Quadrature Phase Shift Keying (OQPSK) [1, 2]	64 kbps->120 Mbps
8-ary Phase Shift Keying (8-PSK) [1, 2]	256 kbps->155 Mbps
16-ary Amplitude Phase Shift Keying (16-APSK) [2]	256 kbps->155 Mbps
Symbol Rate	32 ksps->60 Msps
Scrambling [1, 2]	Synchronous, Asynchronous or None
Differential Encoding/Decoding [1]	MIL-STD-188-165A or None

FEC CODING

165B (Turbo) FEC Rates [2]	1/2, 2/3, 3/4, 7/8, 19/20
Convolutional Encoding & Viterbi Decoding (CEVD) Rates [1]	1/2, 3/4, 7/8
Trellis Coded Modulation (TCM) Rates [1]	2/3, 3/4, 7/8
CEVD and Reed-Solomon (RS) Concatenated [1]	CEVD inner with RS outer
TCM and Reed-Solomon (RS) Concatenated [1, 2]	TCM inner with RS outer
Reed-Solomon Outer Rates [1]	RS(126, 112), RS(225, 205), RS(219, 201), RS(194,178), RS(208, 192)
Uncoded [1]	1/1

MODULATION

IF Output Power	+10 dBm to –35 dBm, in 0.25 dB steps
Output Connectors	TNC for 70/140 MHz, N-Type for L-Band, 50 ohms
Carrier Mode	Modulated or CW
Clock Mode	INTERNAL, TX Terrestrial or Data Source Sync

DEMODULATION

IF Input Power	+10 dBm to –55 dBm
Input Connectors	TNC for 70/140 MHz, N-Type for L-Band, 50 ohms
Acquisition Range	-30,000 to +30,000 Hz
Buffer Clock	Derived from Modem Reference (INT, EXT), RX SAT or TX Terrestrial
Buffer Size	0 to 16,000,000 bits, selectable

BUILT-IN TESTS

Built-In Tests	Programmable BIT test modes, alarm, fault and status reporting, IF Loopback, Baseband Loopback, BERT pattern generation including Mark, Space, 1:1, 1:3, 2047, 2E(15-1), and 2E(23-1), BERT error counting and BER data
(Optional) Eb/No	Internal AWGN generation, 0 to 20 dB Eb/No over -35 to -5 dBm output power
Alarm Interface	Reported via DB-9 (F), FORM C relay contacts for equipment alarm events

SEAMLESS ANTENNA HANDOVER (TACTICAL CONFIGURATION)

Up to 50, 80, 90, 100, 110 ms Ship-to-Shore Interruptions
Up to 1 µs Shore-to-Ship Interruptions
Supports BPSK, QPSK, and 8-PSK Turbo-like Coded Waveforms

Ship-to-Shore	64 kbps - 10 Mbps in Antenna Handover mode
Shore-to-Ship	64 kbps - 30 Mbps in Antenna Handover mode

ENVIRONMENT & PHYSICAL SPECIFICATIONS

Prime Power, AC	100 -120 VAC or 200-240 VAC, 47-63 Hz, 90 Watts (typical)
Mounting	1U-high 19" rack
Size	19"w x 17"d x 1.75"h
Weight	< 10 lbs. (Strategic), < 12 lbs. (Tactical)
Temperature	Operating: 0°C -> 50°C, sea level Operating: 0°C -> 50°C, up to 8,000 ft (Tactical) Storage: -40°C -> 60°C
Humidity	30% < operational < 70%, non-condensing
Shock	MIL-S-901D, Class I, Grade A, Type B (Tactical)

16-APSK Turbo Eb/No vs. BER Performance[3]

BER	1/2	2/3	3/4	7/8	19/20
10^{-6}	4.90	6.65	7.60	8.70	10.70
10^{-8}	5.00	6.75	7.75	8.90	10.90

8-PSK Turbo Eb/No vs. BER Performance[3]

BER	1/2	2/3	3/4	7/8	19/20
10^{-6}	3.90	5.40	6.45	7.80	9.90
10^{-8}	4.05	5.50	6.55	7.90	10.10

QPSK/OQPSK Turbo Eb/No vs. BER Performance[3]

BER	1/2	2/3	3/4	7/8	19/20
10^{-6}	2.20	3.10	3.80	4.60	6.20
10^{-8}	2.30	3.20	3.90	4.70	6.40

BPSK Turbo Eb/No vs. BER Performance[3]

BER	1/2	2/3	3/4	7/8	19/20
10^{-6}	2.05	2.85	3.45	4.55	6.10
10^{-8}	2.15	2.95	3.55	4.65	6.30

16-APSK TCM Eb/No vs. BER Performance[3]

BER	TCM 3/4	TCM 7/8	3/4 with RS	7/8 with RS
10^{-6}	10.20	12.20	7.80	9.50
10^{-8}	12.30	14.60	8.20	9.90

BPSK, QPSK & OQPSK Eb/No vs. BER Performance[4]

BER	CEVD			CEVD with RS	
	1/2	3/4	7/8	1/2	3/4
10^{-6}	6.00	6.90	7.90	3.90	5.10
10^{-8}	7.10	8.10	9.20	4.10	5.40

8-PSK TCM Eb/No vs. BER Performance[4]

BER	TCM R=2/3	TCM R=2/3 with RS
10^{-6}	8.80	5.80
10^{-8}	10.20	6.10

NOTES

[1] In accordance with MIL-STD-188-165A, IESS-308, IESS-309 and IESS-310
[2] In accordance with MIL-STD-188-165B
[3] MIL-STD-188-165B modes at data rates > 4 Mpbs; Typical performance 0.5 to 0.7 dB better
[4] MIL-STD-188-165A and IESS-308, IESS-309, IESS-310 modes; Typical performance 0.5 to 0.7 dB better

Ordering Information

Configuration	Nomenclature	ViaSat PN
Strategic:	MD-1366/U	1075559
Tactical:	MD-1366A/U	1075560

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