SLM-5650C2 & SLM-5650C2 ODU™ Software Defined Modems

SLM-5650C2

SLM-5650C2 ODU

Overview

The SLM-5650C2 & SLM-5650C2 ODU Software Defined Modems are our latest generation multi-waveform software defined satellite modem for government and military applications and small commercial SatCom terminals. Featuring extremely compact form factors and an extensive list of software options, the SLM-5650C2 & SLM-5650C2 ODU can be integrated with a variety of platforms and provide an upgrade path to support your future requirements.

The modems are designed to comply with the widest possible range of U.S. Government and commercial standards and are compatible with the largest number of satellite modems in the industry. MIL-STD-188-165A certification at data rates up to 155 Mbps, symbol rates up to 64 Msps and Chip Rates to 64 Mcps. The modems are certified for use over WGS.

The modems feature AES-256 TRANSEC that is fully compatible with our SLM-5650A, SLM-5650B and SLM5650C Satellite Modems.

The SLM-5650C2 & SLM-5650C2 ODU offer unparalleled protection of your critical network traffic using advanced physical layer waveforms and proven TRANSEC protection to meet your Assured Communication requirements.

There are two packaging options. The SLM-5650C2 is an indoor product that operates from -10°C to +55°C using conductive cooling. The heat is transferred from the electronics to the housing and then out of the housing to an external mounting surface such as a trailer wall. The SLM-5650C2 ODU is a true IP67 rated Outdoor Unit (ODU) that is designed to meet MIL-STD-810G that operates from -32°C to +60°C.

Building on our expertise with the installed and proven SLM-5650A, SLM-5650B and SLM56050C Satellite Modems, the design minimizes the size, weight, and power (SWaP) of the SLM-5650C2 & SLM-5650C2 ODU, while greatly increasing the processing resources and reducing the maximum power consumption for like functionality with previous versions.

The SLM-5650C2 also increases functionality with the addition of a high-speed multi-core packet processor to support, QoS and L2/L3 routing along with an upgraded FIPS 140-3 TRANSEC module (NIST certification in process).

Typical Users

- Government & Military
- Small Commercial SatCom Terminals

Common Applications

- Communications at-the-Pause
- Communications On-the-Move
- Flyaway Communications
- Integrated Satellite Terminal Communications

	SLM-5650C2	SLM-5650C2 ODU
Dimensions	1.8” x 5.3” x 7.2”	2.8” x 6.0” x 8.0”
Volume	68.7 cubic inches	134.4 cubic inches
Maximum Power Consumption	40W (w/NP Card & TRANSEC Module installed)	47W (w/o LNB) 53W (w/LNB)
Cooling	Conduction	Convection/Conduction
Weight	3.8 lbs. (1.7 kg)	6.0 lbs. (2.7 kg)

The SLM-5650C2 & SLM-5650C2 ODU have been designed to support many standard features. The following sections also address capabilities beyond this current feature set that could be supported with the existing hardware.

Features

- WGS certified
- Fully interoperable with the SLM-5650A, SLM-5650B and SLM-5650C/C-ODU
- 950 to 2000 MHz L-Band TX/RX
- 8 kbps to 155.52 Mbps
- 32 ksps to 64 Msps
- BPSK, O/QPSK, 8PSK,8-QAM, 16-QAM, 16APSK Modulation
- Uncoded, Viterbi, Viterbi+Reed Solomon, Sequential coding, STANAG 4486 (EBEM), ITA(ACM), AUPC
- High performance Turbo Product Code (TPC) & Low Density Parity Check (LDPC) FEC FEC rates 1/1, 5/16, 1/3, 21/44, 1/2, 2/3, 3/4, 5/6, 7/8, 17/18
- Direct sequence spread spectrum (DSSS), integer factors 2,3,4…512
- DSSS chip rates up to 64 Mcps
- FIPS 140-3 TRANSEC (NIST certification in process).
- 10 MHz BUC and LNB Reference
- LNB Voltage +13V or +18V)
- External Carrier Mute
- Summary Fault Relay
- Analog antenna pointing signaling
- Field replaceable IP67 rated Fan (ODU only)
- M&C options include SNMP v1, v2, v3, Web browser (HTTP or HTTPS), Telnet and RS-232 terminal port
- Open AMIP support
- Multi Core Network Processor HW Option

Specifications

Operating Frequency Range	950 to 2000 MHz in 1 kHz steps
Modulation Types	BPSK, QPSK, OQPSK, 8PSK, 8QAM, 16QAM, 16APSK
Spreading Factors	Integer factors 2-512; BPSK LDPC only
Digital Data Rate	Gigabit Ethernet: 8 kbps to 155.52 Mbps
Symbol Rate	32 ksps to 64 Msps
Chip Rate	32 kcps to 64 Mcps
Spread Spectrum	DSSS with S.F. 2 to 512 integer steps
INT REF Stability	± 0.06 ppm (± 6 x 10-8)
Scrambling	V.35, OM-73 and synchronous
Built-in Test (BIT)	Fault and status reporting, BER performance monitoring, IF loopback, programmable test modes, built in Fireberd emulation
Summary Fault	Reported via LEDs, 9-pin D sub, FORM A relay (ODU only)
Unit Management	EIA-232, 10/100Base-T Ethernet with HTTP, Telnet and SNMP

Modulation

Output Power	+10 to –40 dBm, adjustable in 0.1 dB steps
Output Return Loss	13 dB minimum
Output Impedance	50 Ω
Output Accuracy	±1.0 dB over frequency and temperature
On/Off Power Ratio	>60 dB
Data Clock Source	Internal
Output Spectrum	Selectable, Meets MIL-188-165A and Intelsat IESS-308, 309, 310 and 315 compliant
Spurious	From Carrier ± Tx SR to 500 MHz –51 dBc (measured in a 10kHz bandwidth).
Harmonics	From carrier (CW) to 4000 MHz -60 dBC
Output Connectors	Indoor unit, SMA female ODU, Type “N” female
BUC Internal Reference	10 MHz, 0 dBm ± 3 dB

Demodulation

Input Carrier Power	+10 to –55 dBm carrier (SR > 3.2 Msps) +10 to [-55 - $10\log_{10}(3.2/SR)$], (SR ≤ 3.2 Msps)
Maximum Composite Power	+20 dBm or +40 dBC
Input Impedance	50 Ω
Input Connectors	Indoor unit, SMA female ODU, Type “N” female
Carrier Acquisition Range	Programmable ± 30 kHz
Input Return Loss	13 dB minimum
Doppler Buffer	32 to 16,777,216 bits, selectable
LNB DC Current	500 mA maximum
LNB Internal Reference	10 MHz, 0 dBm ± 3 dB

Terrestrial Traffic Interfaces

Gigabit Ethernet	1 Port Ethernet switch/bridge/ routed

Coding Options

Uncoded	Standard	1/1
Viterbi	Standard	K=7,1/2, 3/4, and 7/8 rates
Viterbi & Reed-Solomon	Standard	Closed network, per IESS-308 and IESS-309
Trellis	Standard	Per IESS-310
Trellis and Reed-Solomon	Standard	Per IESS-310
Sequential	Optional	1/2, 3/4, and 7/8 rates
Turbo Product Code (TPC)	Optional	5/16, 21/44, 3/4, 7/8, and 17/18 TPC per IESS-315
Low Density Parity Check (LDPC)	Optional	1/3, 0.378, 0.451, 0.541,1/2, 2/3, 3/4, and 7/8 HP, LL, and ULL modes
EBEM Turbo (fall 2019)	Optional	1/2, 2/3, 3/4, 7/8 and 19/20 (CCM or ITA)

Available Options

How Enabled	Option
FAST	Data rates to 5, 10, 20, 52 or 155 Mbps
FAST	8PSK/8-QAM and 16-QAM
FAST	LDPC
FAST	SW Only AES-256 TRANSEC encryption
FAST	Secure Network Management (SSL/SSH/SNMPv3)
FAST	ASYNC RS-485/232 overhead channel /AUPC
FAST	Sequential FEC
FAST	Spread Spectrum (DSSS and/or DSSS-MA)
FAST	STANAG 4486 (EBEM)
FAST	PPPoE Flow Control (Requires STANAG 4486)
FAST	DVB-S2/S2X (Not available in WGS certified FW)
Hardware	SCC
Hardware	NIST validated FIP 140-3 TRANSEC module
Hardware	Layer 2/3 Network Processor

Environmental And Physical – Indoor Unit

Prime Power	12 VDC +/- 0.5VDC (40W max load)
Mounting	Side or bottom attach
Dimensions (height x width x depth)	1.8” x 5.3” x 7.2”
Weight	3.8 lbs. (1.7 kg)
Cooling Method	Conduction
Temperature, Operating	-10 to 70°C (Based upon mounting rail temperature)
Temperature, Storage (Non-operational)	-40 to +85°C
Humidity	0 to 95%, non-condensing

Environmental And Physical – Outdoor Unit

Prime Power	11-33 VDC or 100-240 VAC (53W max)
Mounting	Side or bottom attach
Dimensions (height x width x depth)	2.8” x 6.0” x 8.0”
Weight	6.0 lbs. (2.7 kg)
Cooling Method	Convection
Temperature, Operating	-32 to 60°C
Temperature, Storage (Non-operational)	-40 to +85°C
Rating	IP67

Viterbi BER Performance Measures with AWGN Noise

Viterbi Decoder BPSK, (O)QPSK E_b/N_0 Specifications							
BER	1/2	1/2+RS	3/4	3/4+RS	7/8	7/8+RS	1/1
10^{-3}	3.8		5.0		6.3		
10^{-4}	4.7		5.9		7.1		
10^{-5}	5.3		6.6		7.8		10.8
10^{-6}	5.9	4.1	7.2	5.6	8.4	6.7	11.6
10^{-7}	6.5	4.4	7.8	6.0	9.0	7.1	12.4
10^{-8}	7.1	5.0	8.3	6.3	9.5	7.5	13.0

Viterbi Decoder 8PSK E_b/N_0 Specifications				
BER	2/3	2/3+RS	5/6	5/6+RS
10^{-3}	6.5		8.7	
10^{-4}	7.3		9.4	
10^{-5}	8.1		10.1	
10^{-6}	8.9	6.2	10.8	8.2
10^{-7}	9.6	6.5	11.6	8.5
10^{-8}	10.2	6.7	12.3	8.9
10^{-9}		6.9		9.3
10^{-10}		7.2		9.7

Viterbi Decoder 16QAM E_b/N_0 Specifications		
BER	3/4+RS	7/8+RS
10^{-6}	8.2	9.5
10^{-7}	8.4	9.8
10^{-8}	8.6	10.1
10^{-9}	8.8	10.3
10^{-10}	9.0	10.6

Sequential BER Performance Measures with AWGN Noise

Sequential Decoder E_b/N_0 Specifications					
	BER	BPSK	QPSK/OQPSK		
		1/2	1/2	3/4	7/8
64 kbps	10^{-5}	4.8	4.8	5.8	7.0
	10^{-6}	5.2	5.2	6.4	7.5
	10^{-7}	5.6	5.6	6.9	8.0
1544 kbps	10^{-5}	5.2	5.2	5.9	7.2
	10^{-6}	5.7	5.7	6.5	7.7
	10^{-7}	6.1	6.1	7.0	8.3
With RS(225,205)	10^{-6}	4.4	4.4	5.0	5.6
	10^{-7}	4.6	4.6	5.3	6.0
	10^{-8}	4.8	4.8	5.6	6.4

Turbo BER Performance Measures with AWGN Noise

TURBO Decoder BPSK, (O)QPSK E_b/N_0 Specifications						
BER	BPSK		QPSK/OQPSK			
	21/44	5/16	21/44	3/4	7/8	17/18
10^{-6}	3.3	2.5	3.3	3.9	4.3	6.8
10^{-7}	3.4	2.8	3.4	4.1	4.4	7.1
10^{-8}	3.5	3.1	3.5	4.3	4.5	7.4
10^{-9}	3.6	3.4	3.6	4.8	4.6	7.7
10^{-10}	3.7		3.7		4.7	

TURBO Decoder 8PSK, 8QAM, 16QAM E_b/N_0 Specifications					
BER	8PSK/8QAM			16QAM	
	3/4	7/8	17/18	3/4	7/8
10^{-6}	6.5	7.1	10.0	7.6	8.2
10^{-7}	6.9	7.2	10.6	8.0	8.4
10^{-8}	7.2	7.3	11.2	8.4	8.5
10^{-9}	7.5	7.4	11.8	8.7	8.7
10^{-10}	7.8	7.5		9.0	8.8

LDPC BER Performance Measures with AWGN Noise

ULL Decoder E_b/N_0 Specifications				
BER	BPSK	QPSK		
	1/2	1/2	2/3	3/4
10^{-5}	3.1	3.1	3.6	4.1
10^{-8}	3.7	3.7	4.2	4.7

LL Decoder BPSK, QPSK E_b/N_0 Specifications							
BER	BPSK			QPSK			
	.378	.451	.541	1/2	2/3	3/4	7/8
10^{-5}	1.8	2.0	2.2	2.4	3.0	3.6	4.4
10^{-8}	2.1	2.3	2.5	2.7	3.3	3.9	5.0

LL Decoder 8QAM, 16QAM E_b/N_0 Specifications						
BER	8QAM			16QAM		
	2/3	3/4	7/8	2/3	3/4	7/8
10^{-5}	5.0	5.6	6.5	6.1	6.8	8.0
10^{-8}	5.4	5.9	7.1	6.5	7.1	8.4

HP Decoder E_b/N_0 Specifications								
BER	BPSK		QPSK			8QAM		16QAM
	1/3	1/2	1/2	2/3	3/4	2/3	3/4	3/4
10^{-5}	2.3	2.0	2.0	2.3	3.0	4.6	5.6	6.8
10^{-8}	2.6	2.3	2.3	2.7	3.3	5.0	6.0	7.1

STANAG 4486 (EBEM) BER Performance Measures with AWGN Noise

BPSK Decoder E_b/N_0 Specifications					
BER	16K Block				
	1/2	2/3	3/4	7/8	19/20
10^{-5}	2.00	2.80	3.40	4.50	6.00
10^{-6}	2.05	2.85	3.45	4.55	6.10
10^{-7}	2.10	2.90	3.50	4.60	6.20
10^{-8}	2.15	2.95	3.55	4.65	6.30
10^{-9}	2.20	3.00	3.60	4.70	6.40
10^{-10}	2.25	3.05	3.65	4.75	6.50
BER	4K Block				
10^{-5}	2.10	3.00	3.50	4.60	6.10
10^{-6}	2.20	3.10	3.60	4.70	6.20
10^{-7}	2.25	3.15	3.70	4.80	6.30
10^{-8}	2.30	3.20	3.80	4.90	6.40
10^{-9}	2.35	3.25	3.85	5.00	6.50
10^{-10}	2.40	3.30	3.90	5.10	6.60
BER	1K Block				
10^{-5}	2.95	3.80	4.20	5.40	6.80
10^{-6}	3.10	3.95	4.40	5.60	7.15
10^{-7}	3.20	4.10	4.55	5.80	7.50
10^{-8}	3.30	4.20	4.70	6.00	7.80
10^{-9}	3.40	4.30	4.85	6.20	8.00

QPSK Decoder E_b/N_0 Specifications					
BER	16K Block				
	1/2	2/3	3/4	7/8	19/20
10^{-5}	2.15	3.05	3.75	4.55	6.10
10^{-6}	2.20	3.10	3.80	4.60	6.20
10^{-7}	2.25	3.15	3.85	4.65	6.30
10^{-8}	2.30	3.20	3.90	4.70	6.40
10^{-9}	2.35	3.25	3.95	4.75	6.50
10^{-10}	2.40	3.30	4.00	4.80	6.60
BER	4K Block				
10^{-5}	2.45	3.40	4.00	4.70	6.20
10^{-6}	2.50	3.45	4.10	4.80	6.30
10^{-7}	2.55	3.50	4.20	4.90	6.40
10^{-8}	2.60	3.55	4.25	5.00	6.50
10^{-9}	2.65	3.60	4.30	5.10	6.60
10^{-10}	2.70	3.65	4.35	5.20	6.70
BER	1K Block				
10^{-5}	3.50	4.30	4.80	5.50	6.85
10^{-6}	3.70	4.45	5.00	5.70	7.20
10^{-7}	3.80	4.60	5.15	5.90	7.50
10^{-8}	3.90	4.75	5.30	6.10	7.80
10^{-9}	4.00	4.90	5.40	6.30	8.00

8PSK Decoder E_b/N_0 Specifications					
BER	16K Block				
	1/2	2/3	3/4	7/8	19/20
10^{-5}	3.80	5.35	6.40	7.75	9.80
10^{-6}	3.90	5.40	6.45	7.80	9.90
10^{-7}	4.00	5.45	6.50	7.85	10.00
10^{-8}	4.05	5.50	6.55	7.90	10.10
10^{-9}	4.10	5.55	6.60	7.95	10.20
10^{-10}	4.10	5.60	6.60	8.00	10.30
BER	4K Block				
10^{-5}	4.40	6.00	6.70	7.90	9.70
10^{-6}	4.50	6.10	6.80	8.00	9.90
10^{-7}	4.60	6.20	6.90	8.10	10.00
10^{-8}	4.70	6.30	7.00	8.20	10.20
10^{-9}	4.80	6.40	7.10	8.30	10.35
10^{-10}	4.90	6.50	7.20	8.40	10.50
BER	1K Block				
10^{-5}	5.10	6.60	7.40	8.50	10.20
10^{-6}	5.30	6.80	7.60	8.75	10.60
10^{-7}	5.50	7.00	7.80	9.00	11.00
10^{-8}	5.60	7.15	8.00	9.20	11.40
10^{-9}	5.65	7.25	8.10	9.40	11.70

16APSK Decoder E_b/N_0 Specifications					
BER	16K Block				
	1/2	2/3	3/4	7/8	19/20
10^{-5}	4.85	6.60	7.50	8.60	10.60
10^{-6}	4.90	6.65	7.60	8.70	10.70
10^{-7}	4.95	6.70	7.70	8.80	10.80
10^{-8}	5.00	6.75	7.75	8.90	10.90
10^{-9}	5.05	6.80	7.80	9.00	11.00
BER	4K Block				
10^{-5}	5.30	6.90	8.00	9.20	10.90
10^{-6}	5.40	7.00	8.10	9.30	11.10
10^{-7}	5.50	7.10	8.20	9.40	11.25
10^{-8}	5.60	7.20	8.30	9.50	11.40
10^{-9}	5.70	7.30	8.40	9.60	11.50
BER	1K Block				
10^{-5}	6.10	7.60	8.70	9.50	11.30
10^{-6}	6.30	7.80	8.90	9.70	11.70
10^{-7}	6.45	8.00	9.10	9.90	12.10
10^{-8}	6.60	8.20	9.30	10.10	12.50
10^{-9}	6.65	8.30	9.40	10.30	12.90

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About Us

Comtech Telecommunications Corp. is a leading global technology company providing terrestrial and wireless network solutions, next-generation 9-1-1 emergency services, satellite and space communications technologies, and cloud native solutions to commercial and government customers around the world. Our unique culture of innovation and employee empowerment unleashes a relentless passion for customer success. With multiple facilities located in technology corridors throughout the United States and the world, Comtech leverages its global presence, technology leadership and decades of experience to create the world's most innovative communications solutions.

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