CDM-760 Advanced High-Speed Trunking Modem

Satellite Modems

Overview

The CDM-760 Advanced High-Speed Trunking Modem builds on our award-winning family of high-speed, ultra efficient trunking modems. The CDM-760 further enhances our offerings to include ultra wide band symbol rates, near theoretical performance with minimal implementation loss, our proprietary DVB-S2 Efficiency Boost technology, Super Jumbo Frame (SJF) Ethernet support and many other value-added features.

The CDM-760 Advanced High-Speed Trunking Modem was designed to be the most efficient, highest throughput, point-to-point trunking modem available. The CDM-760 accommodates the most demanding Internet Service Provider (ISP) and telco backhaul links by offering users the most advanced combination of space segment saving capabilities while minimizing the need for unnecessary overhead.

Typical Users

- Mobile Operators
- Telecom Operators
- ISPs
- Government & Military

Common Applications

- IP Trunking
- G.703 Trunking
- High-Speed Content Delivery
- Disaster Recovery & Emergency Communications

The CDM-760 offers an expansive range of symbol rates (100 ksps to 150 Msps) and data rates (100 kbps to 314 Mbps). In a duplex setting, this is a staggering 628 Mbps or 300 Msps. The onboard Ethernet interfaces support Super Jumbo Frames from 64 Bytes to >10,000 Bytes and will process Ethernet frames at a blazing > 1.2 Million packets / second. With the optional Packet Processor card installed the CDM-760 can support > 350,000 packets per second while performing simultaneous Header Compression and QoS.

Expanding on the efficient DVB-S2 EN 302 307 standard, the CDM-760 again furthers spectral efficiency with its DVB-S2-EB1& EB2 (Efficiency Boost) waveforms. DVB-S2 is widely accepted as the most spectrally efficient standards-based waveforms. With our Efficiency Boost technology (DVB-S2-EB1& EB2), you can achieve a 10% – 35% increase in efficiency over the DVB-S2 standard without an increase in power or occupied bandwidth. The CDM-760 accomplishes this task by virtually doubling the number of available MODCODs, introducing three new ROF figures (5%, 10% and 15%) and minimizing implementation loss to near theoretical operation. The CDM-760 is software upgradeable to support future standards including DVB-S2 Efficiency Boost and DVB-S2X. All waveforms are interoperable with the CDM-760 DPD (Dynamic Pre-Distortion). DPD allows satellite amplifiers to push further into saturation, maximizing transponder efficiency. The pre-distortion function is constantly optimized by the modem and does not require any user intervention.

Implementing Adaptive Coding and Modulation (ACM) operation allows link margin to be converted to user capacity during non-faded conditions by taking advantage of the actual signal to noise ratio rather than calculated worst case signal to noise.

By using the best encapsulation methods, the CDM-760 further increases throughput by using minimal overhead. In G.703 synchronous mode, users can implement monitor and control over the satellite with no additional overhead. When using Ethernet bridge mode, less than 1% overhead is used for encapsulation.

An optional high-speed packet processor card has a powerful user-defined QoS engine for traffic shaping, performing header compression (greatly reducing WAN capacity with smaller packets >60%), and enables static routing. The optional K4 GZIP lossless compression engine performs real-time compression of user payload. Performance testing shows a 52% to 59% compression rate when tested against an industry standard Calgary Corpus profile..

DVB-CID ETSI TS 103 129 is the ETSI standard for combating satellite interference and is largely based on Comtech EF Data's award-winning MetaCarrier® technology. MetaCarrier technology embeds and detects a small message and unique ID within a video or data satellite carrier. This embedded message and ID significantly reduce the time to identify and clear interference sources.

Additionally, the CDM-760 leverages our powerful DoubleTalk® Carrier-in-Carrier® "Adaptive Cancellation" technology. With the ability to overlay TX and RX carriers, Carrier-in-Carrier enables the operator to establish the perfect balance between bandwidth and power, enabling the best possible use of the satellite resource and reducing operating expenses (OPEX).

These technologies alone offer enormous savings to the ISP and telco operator. When used in combination, however, the savings are astronomical. The innovative high-performance architecture of the CDM-760 allows efficient networking and transport over satellite links while supporting a wide range of applications and network topologies.

CDM-760 Back Panel

Features

- Symbol Rate: 0.1 to 150 Msps
- Data Rate: 0.1 to 314 Mbps
- DVB-S2 ETSI EN 302 307 compliant
- DVB-S2-EB1&EB2 Efficiency Boost technology
- DoubleTalk Carrier-in-Carrier bandwidth compression
- ACM and CCM
- Embedded MetaCarrier DVB-CID ETSI TS 103 129
- GSE – low overhead <1% encapsulation
- K4 GZIP lossless compression
- Automatic Uplink Power Control (AUPC)
- Dynamic Pre-Distortion (DPD)
- Super Jumbo Frame 64 - 10,240 Byte Support (In Non Packet Processor Mode)
- Packet Processor with > 190,000 PPS simplex and > 350,000 PPS duplex
- 9,000 Byte Jumbo Frame (In Packet Processor Mode)
- Layer 3 Routed Mode operation with up to 256 static routes (>105,000 PPS simplex, >150,000 PPS duplex)
- Modulation: QPSK, 8PSK, 16APSK, 32APSK
- Dual IF: 70/140 MHz, L-Band and L-Band monitor (standard)
- Data Interfaces
  - 2 Gigabit 10/100/1000Base-T interfaces (standard)
  - 1 Optical Gigabit interface (optional)
  - Processes > 600,000 pps simplex, 1.2M pps duplex
  - PIIC optional interface cards
  - G.703 E3/T3/STS-1 (34.368, 44.736, 51.84 Mbps)
  - STM-1 Copper SDH (155.52 Mbps)
  - OC-3 SONET single mode or multi-mode 1300 nm (155.52 Mbps)
- Multistream capable (Multi-Interface mux)
- Supports Medium Earth Orbit (MEO) mode operation
- Management: HTTP, SNMP, Telnet, RS-232/485
- In-band (over satellite) M&C control
- 1:1 and 1:N redundancy switching available

Doubletalk Carrier-in-Carrier

DoubleTalk Carrier-in-Carrier, based on patented “Adaptive Cancellation” technology, allows transmit and receive carriers of a duplex link to share the same transponder space.

Figure 1 shows the typical full duplex satellite link, where the two carriers are adjacent to each other. Figure 2 shows the typical DoubleTalk Carrier-in-Carrier operation, where the two carriers are overlapping, thus sharing the same spectrum.

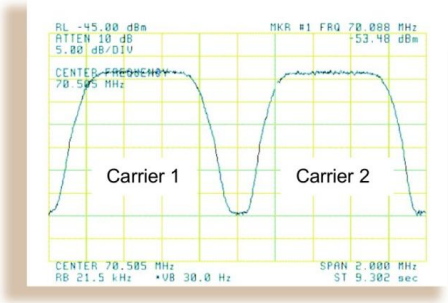

Figure 1: Traditional Full Duplex Link

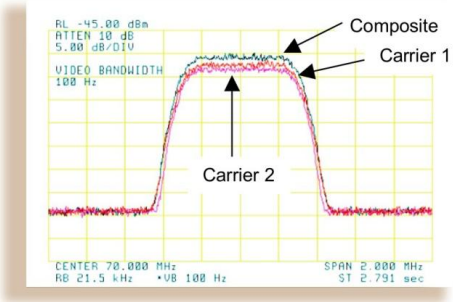

Figure 2: Duplex Link with DoubleTalk Carrier-in-Carrier

When observed on a spectrum analyzer, only the Composite is visible. Carrier 1 and Carrier 2 are shown in Figure 2 for reference only.

Packet Processor

The optional High-Speed Packet Processor enables efficient IP networking and transport over satellite with a processing engine capable of handling >190,000 PPS simplex and >350,000 PPS duplex. The packet processor performs header compression and Quality of Service (QoS) ensuring the highest quality of service with minimal jitter and latency for real-time traffic, priority treatment of mission critical applications and maximum bandwidth efficiency.

The Packet processor functions in Managed Switch Mode of operating as a layer 2 switch with VLAN and MPLS support.

Header Compression

The Packet Processor incorporates industry-leading header compression for Ethernet and IP traffic. In managed switch mode, header compression can reduce the 54 byte Ethernet/IP/UDP/RTP header to as little as 1 byte. For applications such as VoIP, header compression can provide bandwidth savings exceeding 65%. E.g. the 8 kbps G.729 voice codec requires 31.2 kbps once encapsulated into an Ethernet frame with IP/UDP/RTP. With header compression, the same voice call needs about 9 kbps – a saving of almost 70%. And, bandwidth requirements for typical Web/HTTP traffic can be reduced by 10% or more with TCP/IP header compression.

Supported Layer 2, 2+ Headers	Supported Layer 3 Headers
Ethernet	IP
Ethernet + VLAN	TCP
Ethernet + VLAN + VLAN	UDP
Ethernet + MPLS	RTP (Codec Independent)
Ethernet + MPLS + MPLS	
Ethernet + VLAN + MPLS	
Ethernet + VLAN + MPLS + MPLS	
Ethernet + VLAN + VLAN + MPLS	
Ethernet + VLAN + VLAN + MPLS + MPLS	

Traffic Shaping Functionality (QoS)

Traffic Shaping Functionality (QoS) – The high-speed packet processor functions in a layer 2 mode of operation while performing the three processes that comprise traffic shaping: Classification, Prioritization and Drain.

- Classification of traffic is the basic mechanism by which a packet or frame can be sorted and associated with a particular group or priority. The more flexible a classification engine is, the more likely the high value services can be protected.

- Prioritization of traffic is a method of assigning various value levels to a particular packet or frame. Prioritization ensures that the packets / frames are “ordered” in such a manner that the highest level of protection is provided to the most valuable traffic.

- Drain – Once the packets or frames are classified and prioritized, it needs to be determined how to drain the traffic. Does your network require you to pass all high level traffic in a strict priority manner such that lower priority traffic could be “starved” in times of congestion? Or, can determinations be made about the maximum and minimum levels of service you can accept on a per classification basis? The CDM-760 packet processor gives the operator or service provider many options to choose from.

  - DiffServ – Industry-standard method of providing QoS enabling seamless co-existence in networks that implement DiffServ
  - Max/Priority – Provides traffic prioritization with the ability to limit maximum traffic per priority class
  - Min/Max – Provides a Committed Information Rate (CIR) to each user defined class of traffic with the ability to allow a higher burstable rate depending on availability
  - Max/Priority with Weighting Mode
    - Weights are applied all queues that have not reached their max BW limit
    - Once the max BW is reached, the scheduler will not drain any more data irrespective of its weights
  - Min/MAX with Weighting Mode
    - First serves the minimum BW
    - Once the minimum BW is met, the weights are applied until the Max BW is met
    - Once the max BW is met, the scheduler will not drain any more data

Classification	Prioritization	Drain
• DiffServ • MPLS • VLAN • Protocol • Source IP Address • Destination IP Address • Source Port • Destination Port	• Up to 8 different levels of prioritization • Weighting can be enabled per level	• DiffServ • Max / Priority • Min / Max • Max / Priority with Weighting • Min / Max with Weighting

Layer 3 Routed Mode

In some cases it may be desirable to function in a layer 3 routed mode of operation. The packet processor can be configured to run as a layer 3 device with static routing. The packet processor can have up to 256 static routes based on destination IP address mask. The packet processor in layer 3 routed mode can support >105,000 PPS simplex or >150,000 PPS duplex.

Specifications

Symbol Rate Range	DVB-S2: 100 Ksps to 150 Msps in 1 sps steps (modulation dependent) DVB-S2-EB1&EB2: 100 Ksps to 150 Msps in 1 sps steps (modulation dependent)
Modulation Type	DVB-S2: ETSI EN 302 307 compliant DVB-S2-EB1&EB2: DVB-S2 with Efficiency Boost technology
FECFrame	Normal (64,800 bits) or Short (16,200 bits)
Pilots	On or off
Alpha (Rolloff)	DVB Compliant: 20%, 25% or 35% Comtech Efficiency Boost DVB-S2-EB1&EB2: 5%, 10%, 15%, 20%, 25%, 35%
Management	Front panel keypad / display RS-232 /485, or 10/100Base-T with SNMP, Telnet, HTTP
Reflash	Ethernet management port
Frequency Stability	Internal, stability ± 0.06 ppm
External Reference Input / Output (BNC Female)	Internal, 1, 2, 5 or 10 MHz for IF and data, internally phase locked. Output: off or internal 10 MHz
Form C	Modulator, demodulator and unit fault
Spectral Sense	Normal and inverted
Configuration Retention	Non-volatile memory; Returns upon power up

Options

Type	**Option**
FAST	DVB-S2, DVB-S2-EB1&EB2 TX / RX: 8PSK, 16APSK, 32APSK
FAST	Symbol rate options
FAST & Hardware	Carrier-in-Carrier options
FAST & Hardware	Packet Processor (Can not be installed with any PIIC data interface cards)
FAST & Hardware	K4 GZIP lossless compression
FAST	ACM point to point client / controller
FAST	Automatic Uplink Power Control (AUPC)
FAST	Optical Gigbit Ethernet enable
Hardware	PIIC optional interface cards G.703 E3/T3/STS-1 (34.368, 44.736, 51.84 Mbps) STM-1 Copper SDH (155.52 Mbps) OC-3 SONET single mode or multi-mode 1300 nm (155.52 Mbps)
Hardware	Rack slides

Modulator (Dual IF)

70/140 MHz	50 to 180 MHz in 100 Hz steps
Impedance / Connector	75 Ω, BNC female. Return loss ≥ 18 dB
Output Power	0 to -25 dBm, 0.1 dB steps (70/140 MHz)
Power Accuracy	± 0.5 dB of nominal at 25°C; Within ± 0.5 dB from 25°C value at same frequency
L-Band	950 to 2150 MHz in 100 Hz steps
Impedance / Connector	50 Ω, Type N female. Return loss ≥ 15 dB
Output Power	0 to -40 dBm, 0.1 dB steps
Power Accuracy	± 0.5 dB of nominal at 25°C ± 0.5 dB from 25°C value at same frequency
L-Band Monitor	Same as L-Band or 900 + 70/140 MHz IF at -27 dBm ± 3 dB
Harmonics and Spurs	< 60 dBc/4kHz, modulated carrier; Excludes spectral mask area
External TX Carrier Off	TTL low signal
Quadrature Phase Error and Amplitude Imbalance	Sideband 35 dB below unmodulated carrier

Demodulator (Dual IF)

70/140 MHz	50 to 180 MHz in 100 Hz steps
Impedance / Connector	75 Ω, BNC female. Return loss 15 dB min.
Input Power	Desired carrier: Min. = -58 + 10Log (SR_{MSPS}) dBm Max. = -23 + 10Log (SR_{MSPS}) dBm or +10 dBm whichever is less.
Max. Composite Power	+20 dBm or = 14 + 10Log (180 / SR_{MSPS}) dBc (whichever is less)
L-Band	950 to 2150 in 100 Hz steps
Impedance / Connector	50 Ω, Type N female. Return loss 10 dB min.
Input Power	Desired carrier: Min. = -70 + 10Log (SR_{MSPS})dBm Max. = -20 + 10Log (SR_{MSPS}) dBm or +20 dBm whichever is less.
Maximum Composite	+20 dBm or = 43 – 10Log (SR_{MSPS}) dBc (whichever is less)

Doubletalk Carrier-In-Carrier

Symbol Rate Range	1 Msps to 63 Msps in 1sps steps
Delay Range	0 to 400 ms (factory default 230 – 290 ms)
CnC Ratio	+7 dB to -7 dB interferer to desired
Es/No degradation (dB) measured at 0.0 dB CnC Ratio	QPSK: 0.3 dB 8PSK: 0.3 dB 16APSK: 0.4 dB 32APSK: 0.6 dB
Symbol Rate Ratio	Max 3:1 TX/RX or RX/TX
Satellite Configuration	Transmit station sees own carrier. Non-processing satellite.

Base Unit Connectors

Alarm Connector (DB-15 Male)	Form C: TX, RX and unit faults External TX carrier off IQ test point
Unit Management	DB-9 male with RS-232 and RS-485 2-wire / 4-wire RJ-45 Ethernet (maximum Ethernet packet size 1536 bytes including Ethernet header & CRC)
TX & RX IF Connectors	BNC female (70/140 MHz) Type-N female (L-Band)
L-Band Monitor	SMA female
Ethernet Data Interfaces on main modem (Non-Packet Processor)	2 x RJ-45 10/100/1000Base-T Ethernet 1 x Optical Gibabit Ethernet (optional) Note: All Data GigE interfaces support super jumbo frames with a maximum Ethernet frame size of 10,240 bytes including Ethernet header & CRC
Packet Processor Interface	4 x RJ-45 10/100/1000Base-T Ethernet interface (User Traffic), 1 x RJ11 (CLI serial), 1 x 10/100/1000Base-T Ethernet interface (Management) Note: Cannot use any PIIC interfaces cards if Packet Processor is installed.

Test Functions

Data Test Pattern	2^10-1, 2^15-1, 2^23-1 compatible with BERT on TX data on applicable interfaces
CW	Modulation disabled and CW signal is transmitted
SSB Carrier	Provides suppressed carrier and suppressed sideband
Loopback	Full-duplex only

Specifications – continued

Environmental and Physical

Temperature	
Operating	0 to 50°C (32 to 122°F)
Storage	-40 to 70°C (-40 to 158°F)
Humidity	95% maximum, non-condensing
Power Supply Input	100-240 VAC 50/60 Hz 43-60 VDC (48 VDC option)
Power Consumption	
120 VAC at 60 Hz	88 W, 93 VA typical
230 VAC at 50 Hz	88 W, 133 VA typical
48 VDC	85 W typical
Dimensions (1RU) (height x width x depth)	1.75" x 19" x 18.65" (48 x 47.4 x 4.4 cm)
Weight	15 lbs (6.8 kg)
AC Receptacles	Includes restraint for standard IEC-320 inlet
Agency Compliance	CE Mark and FCC part 15

Accessories

Type	Option
1:1 Modem Redundancy	CRS-170A (L-Band), CRS-180 (70/140 MHz)
1:N Modem Redundancy	CRS-500 70/140 MHz or L-Band (Only for use with 10/100/1000Base-T or G.703 T3/E3/STS-1 interfaces)

DVB-S2, Normal Block, Pilot ON, QEF (PER 1E-7)

MOD	FEC	Min SR (Msps)	Max SR (Msps)	Min DR (Mbps)	Max DR (Mbps)	Spec Eff (Bits / Hz)	QEF Eb/No	QEF Es/No
QPSK	1/4	0.1	150	0.05	72.00	0.48	1.1	-2.1
QPSK	1/3	0.1	150	0.06	96.00	0.64	0.9	-1.0
QPSK	2/5	0.1	150	0.08	115.50	0.77	1.0	-0.1
QPSK	1/2	0.1	150	0.10	144.80	0.97	1.5	1.3
QPSK	3/5	0.1	150	0.12	174.00	1.16	1.9	2.5
QPSK	2/3	0.1	150	0.13	193.70	1.29	2.2	3.3
QPSK	3/4	0.1	150	0.15	217.80	1.45	2.7	4.3
QPSK	4/5	0.1	150	0.15	232.40	1.55	3.0	4.9
QPSK	5/6	0.1	150	0.16	242.30	1.62	3.3	5.4
QPSK	8/9	0.1	150	0.17	258.60	1.72	4.0	6.4
QPSK	9/10	0.1	150	0.17	261.90	1.75	4.2	6.6
8PSK	3/5	0.1	120	0.17	208.80	1.74	3.7	6.1
8PSK	2/3	0.1	120	0.19	232.30	1.94	3.6	6.5
8PSK	3/4	0.1	120	0.22	261.40	2.18	4.8	8.2
8PSK	5/6	0.1	120	0.24	290.60	2.42	5.8	9.6
8PSK	8/9	0.1	120	0.26	310.30	2.59	6.9	11.0
8PSK	9/10	0.1	120	0.26	314.20	2.62	7.1	11.3
16APSK	2/3	0.1	90	0.26	231.80	2.58	5.4	9.5
16APSK	3/4	0.1	90	0.29	260.60	2.90	6.0	10.6
16APSK	4/5	0.1	90	0.31	278.10	3.09	6.5	11.4
16APSK	5/6	0.1	90	0.32	290.00	3.22	6.9	12.0
16APSK	8/9	0.1	90	0.34	309.60	3.44	7.8	13.2
16APSK	9/10	0.1	90	0.35	313.50	3.48	8.1	13.5
32APSK	3/4	0.1	72	0.36	260.90	3.62	7.6	13.2
32APSK	4/5	0.1	72	0.39	278.40	3.87	8.1	14.0
32APSK	5/6	0.1	72	0.40	290.20	4.03	8.7	14.8
32APSK	8/9	0.1	72	0.43	309.80	4.30	9.9	16.2
32APSK	9/10	0.1	72	0.44	313.70	4.36	10.1	16.5

Specifications – continued

DVB-S2-EB1 / EB2*, Normal Block, Pilot ON, QEF (PER 1E-7)

MOD	FEC	Min SR (Msps)	Max SR (Msps)	Min DR (Mbps)	Max DR (Mbps)	Spec Eff (Bits / Hz)	QEF Eb/No (* = EB2)	QEF Es/No (* = EB2)
QPSK	1/4	0.1	150	0.05	72.00	0.48	1.1 / 1*	-2.1 / -2.2*
QPSK	53/180	0.1	150	0.06	85.50	0.57	1 / 0.9*	-1.4 / -1.5*
QPSK	1/3	0.1	150	0.06	96.00	0.64	0.9 / 0.8*	-1 / -1.1*
QPSK	11/30	0.1	150	0.07	106.50	0.71	1.0	-0.5
QPSK	2/5	0.1	150	0.08	115.50	0.77	1.0	-0.1
QPSK	77/180	0.1	150	0.08	123.00	0.82	1.2	0.3
QPSK	83/180	0.1	150	0.09	133.50	0.89	1.3	0.8
QPSK	1/2	0.1	150	0.10	145.50	0.97	1.4	1.3
QPSK	8/15	0.1	150	0.10	154.50	1.03	1.6	1.7
QPSK	17/30	0.1	150	0.11	165.00	1.10	1.7	2.1
QPSK	3/5	0.1	150	0.12	174.00	1.16	1.9	2.5
QPSK	19/30	0.1	150	0.12	183.00	1.22	1.9	2.8
QPSK	2/3	0.1	150	0.13	193.50	1.29	2.2	3.3
QPSK	127/180	0.1	150	0.14	205.50	1.37	2.4	3.8
QPSK	3/4	0.1	150	0.15	217.50	1.45	2.7	4.3
QPSK	4/5	0.1	150	0.16	232.50	1.55	3.0	4.9
QPSK	5/6	0.1	150	0.16	243.00	1.62	3.3	5.4
QPSK	31/36	0.1	150	0.17	250.50	1.67	3.7	5.9
QPSK	8/9	0.1	150	0.17	258.00	1.72	4.0	6.4
QPSK	9/10	0.1	150	0.18	262.50	1.75	4.2	6.6
8PSK	17/30	0.1	120	0.16	196.80	1.64	3.8	5.9
8PSK	3/5	0.1	120	0.17	208.80	1.74	3.7	6.1
8PSK	19/30	0.1	120	0.18	220.80	1.84	3.9	6.5
8PSK	2/3	0.1	120	0.19	232.80	1.94	4.0	6.9
8PSK	127/180	0.1	120	0.21	246.00	2.05	4.7 / 4.5*	7.8 / 7.6*
8PSK	3/4	0.1	120	0.22	261.60	2.18	4.8 / 4.7*	8.2 / 8.1*
8PSK	4/5	0.1	120	0.23	278.40	2.32	5.3	9.0
8PSK	5/6	0.1	120	0.24	290.40	2.42	5.8	9.6
8PSK	31/36	0.1	120	0.25	300.00	2.50	6.3	10.3
8PSK	8/9	0.1	120	0.26	310.80	2.59	6.9	11.0
8PSK	9/10	0.1	120	0.26	314.40	2.62	7.1	11.3
16APSK	19/30	0.1	90	0.24	219.60	2.44	5.3 / 5*	9.2 / 8.9*
16APSK	2/3	0.1	90	0.26	231.30	2.57	5.4 / 5.1*	9.5 / 9.2*
16APSK	127/180	0.1	90	0.27	244.80	2.72	5.7 / 5.5*	10 / 9.8*
16APSK	3/4	0.1	90	0.29	261.00	2.90	6 / 5.9*	10.6 / 10.5*
16APSK	4/5	0.1	90	0.31	278.10	3.09	6.5 / 6.3*	11.4 / 11.2*
16APSK	5/6	0.1	90	0.32	289.80	3.22	6.9 / 6.7*	12 / 11.8*
16APSK	31/36	0.1	90	0.33	299.70	3.33	7.6 / 7.2*	12.8 / 12.4*
16APSK	8/9	0.1	90	0.34	309.60	3.44	7.8 / 7.6*	13.2 / 13*
16APSK	9/10	0.1	90	0.35	313.20	3.48	8.1 / 7.9*	13.5 / 13.3*
32APSK	127/180	0.1	72	0.34	245.52	3.41	7.2 / 7*	12.5 / 12.3*
32APSK	3/4	0.1	72	0.36	260.64	3.62	7.5 / 7.3*	13.1 / 12.9*
32APSK	4/5	0.1	72	0.39	278.64	3.87	8.1 / 8*	14 / 13.9*
32APSK	5/6	0.1	72	0.40	290.16	4.03	8.7 / 8.4*	14.8 / 14.5*
32APSK	31/36	0.1	72	0.42	299.52	4.16	9.2 / 8.9*	15.4 / 15.1*
32APSK	8/9	0.1	72	0.43	309.60	4.30	9.9 / 9.4*	16.2 / 15.7*
32APSK	9/10	0.1	72	0.44	313.92	4.36	10.1 / 9.8*	16.5 / 16.2*
64APSK *	4/5	0.1	54	0.46	250.02	4.63	NA / 10.4*	NA / 17.1*
64APSK *	5/6	0.1	54	0.48	260.28	4.82	NA / 11.1*	NA / 17.9*
64APSK *	31/36	0.1	54	0.50	268.92	4.98	NA / 11.5*	NA / 18.5*
64APSK *	8/9	0.1	54	0.52	278.10	5.15	NA / 12.3*	NA / 19.4*
64APSK *	9/10	0.1	54	0.52	281.88	5.22	NA / 12.7*	NA / 19.9*

2114 West 7th Street, Tempe, Arizona 85281 USA
Voice: +1.480.333.2200 ● Fax: +1.480.333.2540 ● Email: sales@comtechefdata.com