

# HDRM

## High Data Rate Modem

### THE INTEGRAL DIFFERENCE



COMMAND  
+ CONTROL



SIGNAL PROCESSING  
+ DATA COMM.



ENTERPRISE  
NETWORK MGMT.



COMM. INFO  
ASSURANCE



SERVICES

### Overview

High performance, total flexibility. The High Data Rate Modem is a high-rate multi-mission satellite data receiver, data processing and simulation system that supports CCSDS (for Conventional and Advanced Orbiting Systems), Standard CDL, DVB-S2 and Direct Sequence Spread Spectrum. The HDRM performs data reception, ingest, processing, distribution and archiving functions at rates up to 1.7 Gbps. It is most commonly deployed within a satellite ground station, but is also ideal for applications including satellite integration/test and aircraft data acquisition.

Support for multiple missions is a core design principle of the HDRM, therefore the system's receiver is implemented as a digital software-defined radio. The radio is configurable to accommodate multiple modulation schemes, data rates, coding algorithms and data formats. It provides demodulation match filters which can be tuned to correspond to characteristics of individual transmitters, improving communication performance. The system's linear wideband front end and high dynamic range enable adaptive filtering of the received signal based on symbol rate and Doppler. These characteristics also ensure compatibility with the complex modulation and coding schemes that will be developed for future missions.

### Key Features

- Fully digital, tunable transmitter and receiver
- Modulation and demodulation at rates up to 1.7 Gbps
- Common Data Link (CDL) Support
- DVB-S2 up to 300 MSymbols/s
- Direct Ethernet or ECL data output to network (IP, Multicast & network attached storage)
- Near-theoretical receive performance, fast signal acquisition
- Digital software receiver for multi-mission versatility
- IF digital modulator; 650 MHz IF bandwidth
- Optimized for low signal strength applications at very low Eb/No
- Signal-source-specific programmable match filters to optimize communication performance
- Robust built-in test capabilities

### Applications

- Reception and processing of high data rate signals from aircraft, LEO or GEO satellites.
- Turnkey reception and demodulation for high data rate scientific, remote sensing and telecommunications applications
- High-precision Doppler measurement
- High-reliability ground station radio
- High data rate full duplex radio
- Common Data Link terminals
- LPI/LPD applications
- Advanced military datalinks



## Receiver Specifications

- IF inputs: 2 selectable IF inputs
- IF frequency: 370 MHz, 720 MHz or 1.2 GHz
- IF bandwidth: 650 MHz, automatically adjusted based on the symbol rate
- IF impedance: 50 Ohms
- IF VSWR: 1.4:1
- Doppler tracking: up to 10 MHz
- BPSK modulation up to 400 Mbps
- QPSK modulation up to 800 Mbps
- SQPSK modulation up to 800 Mbps
- 8ary PSK up to 1.5 Gbps
- Implementation loss: < 1 dB
- Dynamic range: > 40 dB
- Signal tracking down to < 0 dB Es/No

## High-Speed Front-End Processing

- Data rates up to 1.7 Gbps
- Viterbi decoding, differential decoding, frame synchronization, derandomization, LDPC, Reed-Solomon decoding and CRC decoding
- Time tagging and data quality annotation
- CCSDS virtual channel sorting with support for VCDU
- Real time disk logging and high speed network transfer

## Simulation & Testing

- CCSDS, Std CDL, DVB-S2 and DSSS simulation at rates up to 1.7 Gbps
- Onboard 64 MB memory for high speed simulation
- Hardware synch marker, ID counter, and time stamp insertion
- CRC encoding, LDPC, Viterbi, Reed-Solomon encoding, randomization, and convolution coding
- Data Quality Monitoring (CCSDS and TDM) and bit/packet error rate testing
- High Speed data logging and playback

## High Rate Data I/O

- High-performance Gigabit Ethernet for data transfer, control & monitoring
- Real-time network data transfer (UDP, IP, multicast, TCP client/server)
- User encapsulation formats including NASCOM RTP, IPDU, SFDU, LEO-T, EDOS
- Network protocol conversion
- Embedded SLE provider
- ECL serial I/O

## Frame Synchronizer

- Configurable frame sync pattern and mask
- Sync bit error threshold up to 15 bit errors
- Adaptive sync strategy with 0 to 7 check frames and 0 to 7 flywheel frames
- Bit slip window from 0 to +/-3 bits
- BPSK or QPSK automatic ambiguity resolution and correction
- Frame length up to 4096 bytes/frame
- Time tagging: 5 usec accuracy with IRIG, 10 MHz & 1 PPS input (IRIG input only, 100 usec)
- Time stamp using internal or external 10 MHz reference and 1 PPS

## LDPC Decoder

- Rate 7/8, LDPC (8160, 7136)
- Error floor no higher than 10-10 BER
- Rate 1/2 AR4JA
- Supports block sizes of 1024, 4096, or 16384 bits

## DVB-S2

- Support from 1 to 300 MSymbols/s
- LDPC/BCH FEC rates of 1/2, 3/4, 2/3
- Packet Error Rate w/in 1dB of theory

## Reed-Solomon EC Encode/Decode

- CCSDS Reed-Solomon (RS) (255,223) error correction
- Support for interleave depth up to 16
- CCSDS Reed-Solomon (10,6) header error correction
- Shortened codeword support using "virtual fill"
- Real-time quality generation and annotation for each VCDU

## CRC Error Detection Encode/Decode

- Compute frame error control field from received data using the polynomial  $g(x) = x^{16} + x^{12} + x^5 + 1$
- Programmable offset from 0 to 8 bytes

## Derandomizer/Pseudo-randomizer

- Exclusive OR received from data following sync pattern with pattern given by  $h(x) = x^8 + x^7 + x^5 + x^3 + 1$
- Programmable start offset frame 0 to 8 bytes

## Convolutional Encode/Viterbi Decode

- CCSDS rate=1/2, rate 3/4 constraint length K=7
- Programmable G1, G2 order
- Programmable inversion of G1 and G2

## Physical Specifications

- 19" rack mountable 3U (6 slot), or 4U (8 slot) chassis offerings
- 120-220 VAC at 50 to 60 Hz power

