MEOS™ CAPTURE HRDFEP

KONGSBERG

High-Rate Demodulator & Front-End Processor V12

The MEOS™ Capture HRDFEP is a high performance, fully programmable data receiver, acquisition, and data processing system for the most demanding professional users. It offers full bandwidth exploitation in Ka-band by a symbol rate up to 2 x 1200 Msps, for an aggregate bitrate of 10+ Gbps.

MEOS™ Capture HRDFEP V12 offers unmatched Performance, Reliability and Flexibility

The MEOS™ Capture HRDFEP is a Software Defined Radio (SDR) with direct IF sampling for reduced implementation losses compared to other sampling strategies.

The MEOS™ Capture HRDFEP performs demodulation or baseband data reception. It records raw and processed data to internal disk in parallel with data outputs to external network and/or ECL/LVDS baseband outputs. It supports conventional satellite downlink standards as well as DVB-S2 and CCSDS SCCC.

HRDFEP V12 offers 2 channels with up to 1200 Msps per channel to make full use of a 1.5 GHz bandwidth as in e.g. Ka-band.

RELIABILITY

Reduce your operations cost by automated operations.

- Fully automated operations end-to-end
- Automatic recovery in case of network problems
- Automated storage management using RAID
- Hot swap disks
- Dual power supplies, hot swappable
- Monitoring of HW resources
- Stable Linux system, supporting 24/7 operations without operator intervention
- Robust server computer and data processing boards

PERFORMANCE

- 1200 Msps per channel: 10+ Gbps total
- Low implementation loss:
  0.1 – 0.8 dB, typically <0.5 dB
- Conventional modulations and coding, DVB-S2/DVB-S2X, CCSDS SCCC

Implementation Losses (dB)						
Modulation	GBit Rates per Channel					
	0.1	0.25	0.5	1.0	2.7	6.2
BPSK	0.15	0.2	0.3	0.4		
QPSK	0.2	0.3	0.5	0.6		
8PSK	0.3	0.3	0.4	0.5	0.7	
16QAM	0.3	0.3	0.4	0.5	0.7	
DVB-S2	< 0.3	< 0.3	< 0.4	< 0.5	< 0.7	
SCCC	< 0.3	< 0.3	< 0.4	< 0.5	< 0.7	< 0.8

Implementation loss at BER 10^{-6}

FLEXIBILITY & MODULARITY

Keep your system continuously updated simply by downloading new software.

Re-programmable / in-field upgradable FPGA technology. New versions and updates are provided as files.

Get all data right from the start of every satellite contact. Make acquired data available for end users as fast as possible.

MEOS™ CAPTURE HRDFEP V12

Single or Dual Demodulator (HRD) Channels – Per Channel:

- Programmable, wideband digital demodulator:
  BPSK, xQPSK, 8PSK, 16QAM
  SCCC per CCSDS 131.2-B-1
  DVB-S2 per ETSI EN 302 307-1
  DVB-S2X per ETSI EN 302 307-2 V1.3.1
- Dual input ports – female SMA connectors
- Carrier frequencies: 720/1200/2400* MHz
  (individually tuneable offsets)
- Input impedance: 50 ohms
- VSWR: < 1.5
- AGC range: 0 dBm to –50 dBm
- Demodulation type:
  BPSK, CBPSK, QPSK, OQPSK, AQPSK (LS-7),
  UQPSK (3, 6, 9 dB), 8PSK, 16QAM
  SCCC: QPSK, 8PSK, 16APSK, 32APSK, 64APSK
- DVB-S2: QPSK, 8PSK, 16APSK, 32APSK
- DVB-S2X: QPSK, 8PSK, 16APSK, 32APSK, 64APSK
- SRRC Matched Filter
- Adaptive Equalizer
- XPIC (Cross Polar Interference Cancellation) filter
- Spectrum inversion correction
- Fast carrier acquisition (up to ±100 MHz range)
- Carrier Doppler tracking range: Up to ±4 MHz
- Max Carrier Doppler rate: 100 kHz/s max
- Reference oscillator input: 10 MHz, 100 MHz
- Time reference input IRIG-B, 1 PPS

Front-End Processor (FEP)
Two FEPs per demodulator – fully independent I/Q processing

Frame Processing

- Frame synchronization, derandomization, error correction and time tagging
- Automatic data ambiguity resolution
- Data PN de-randomization

Advanced frame synchronization:

- Sync options: CCSDS AOS/PT, TDM
- Fixed & variable length, adaptive modes
- Frame length: Up to 64 kBytes
- Sync pattern: Up to 64 bits
- Bit error tolerance: Up to 16 bit errors
- Search-Check-Lock-Flywheel strategy:
  - Thresholds 0 to 15 frames
  - Bit slips: Up to ± 4 bits

CRC checking:

- CCSDS polynomial: G(X) = X16 + X12 + X5 + 1
- Programmable offsets

Decoding:

- Differential Decoding
- PCM: NRZ-M, NRZ-S, NRZ-L
- Trellis Decoding 4D-TCM according to CCSDS 401.0-B-32:
  - Rate: 8/12, 9/12, 10/12, 11/12
- Viterbi decoding: CCSDS compliant polynomial
  - Rate 1/2, 3/4, 2/3, 5/6, 7/8
  - 7 bits constraint length
  - Viterbi BER estimation

Forward Error Correction and Detection:

- R-S (10, 6), R-S (255, 239), R-S (255, 223)
  - Codeword interleaving: 1 to 16
  - Codeword length: 33 to 255
- LDPC 7/8
  - Configurable max number of iterations
- Filtering of uncorrectable frames
- LDPC for DVB-S2(X)
- SCCC Turbo codes

Quality and Frame Sync Status Appending:

- Up to 4 bytes of Frame Sync status appended to frames
- Reed-Solomon status:
  Up to 32 bytes appended to frames
  (including frame counter, error status, and user defined fields)

Time-stamping - 8 bytes time field:

- Day; millisec of day; microsec of millisec

Processing

- VCDU demultiplexing by VCID
- Space Packet (SP; AP/ISP) service processing
- CCSDS AOS Path, Internet, Encapsulation services (partly)
- CFDP: CCSDS File Delivery Protocol, Class 1 & 2

Baseband Data Inputs/Outputs
Input and playback data.

Optional: Differential ECL or LVDS

- Per channel: Two separate or merged (I+Q) synchronous clock/data inputs
- Data rates: Up to 1 Gbps per channel
- Electrical standard: Differential ECL or LVDS
- Clock duty cycle: 50% ±10%
- Configurable clock phase and data polarity
- External clock (output interface)
- Female SMA connectors

10 Gbps Ethernet

Distribution

- Post-pass & Near Real-Time (NRT) protocols: TCP socket, FTP, SFTP, FTPS
- Rate control
- Compression
- Encryption
- XML meta data and checksums
- SLE: CCSDS Space Link Extension: RAF, RCF
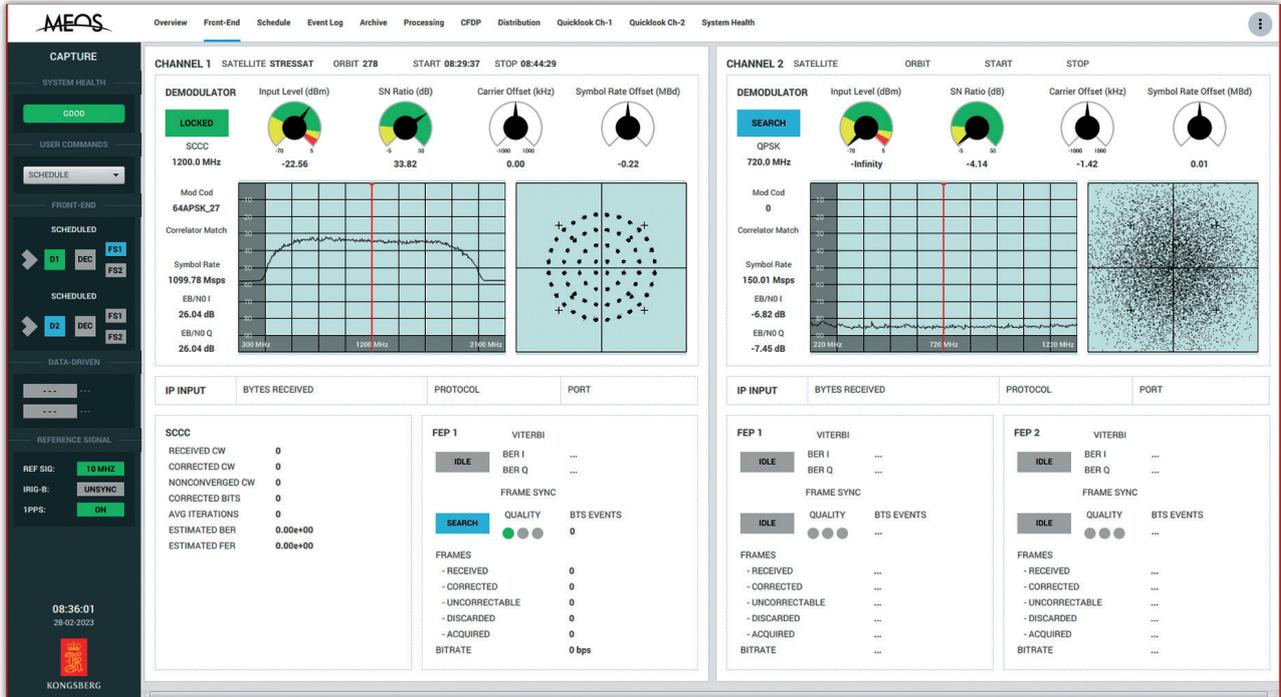- CFDP: Class 1 and Class 2

Special Features

- PN generator & BER testers: Selectable standard polynomials PN9, PN15, PN20, PN23
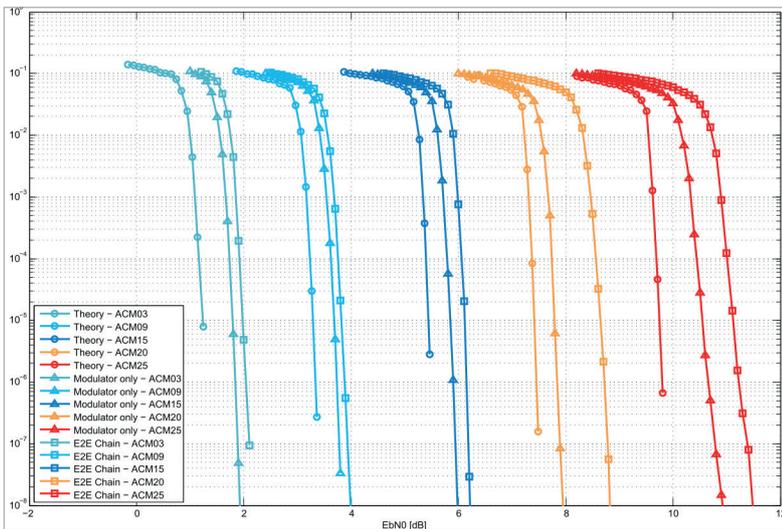- Status report file generation

Automatic Storage Management

- Oldest data stored on disk will automatically be deleted when necessary
- User controlled locking of data

HRDFEP V12 Dashboard GUI: 2 channels version (active signal on Channel 1 only)

End-to-End measurements performed with space transmitter, TWTA, downconverter and MEOS™ Capture HRDFEP receiver: BER vs Eb/NO

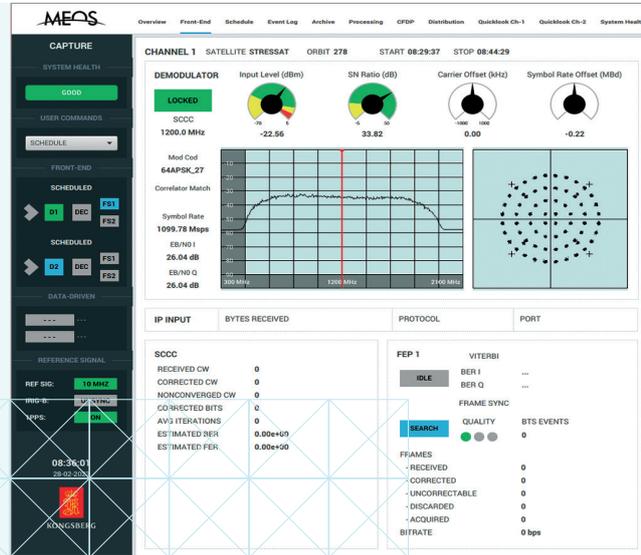| MEOS™ Capture HRDFEP V12	
Rack mountable chassis	Standard
Height x Width x Depth in cm:	8.73 x 44.54 x 67.94 cm
Weight:	Approx. 25 kg
Temperature operating	10°C to 35°C
Power supply:	100-240 V 50-60 Hz 800 W
Number of power supplies:	2
Temperature non-operating	-30°C to 60°C
Relative Humidity operating	10-90%

External Interface

- TCP socket and XML based external interface with minimal bandwidth usage
- Access authentication

Reporting

- Status and statistics from previous activities, sorted on satellite and orbit
- Numeric values and graph
- Automatic generation of WEB reports, including status and statistics, plots, events and data analysis, video of signal spectrum and vector diagram; Available through standard WEB browser

FEATURES

- Real-time acquisition, processing and distribution
- Fast lock-in times: 0.01 – 0.1 sec. typically
- Data rates from 800 kbps to 6.2 Gbps per channel
- Up to 4 Front-End Processors
- Receiver implementation loss typically less than 0.5 dB
- Receiver Adaptive Equalizer compensates for bandwidth mismatch, group delay, ISI, spectrum tilt and multipath
- Cross-Channel Interference Cancellation
- Real time and offline status and plots available in GUI and remotely

- WEB and PDF quality reports
- CFDP (CCSDS File Delivery Protocol), Class 1 and 2
- CCSDS AOS Instrument Source Packets reconstruction
- Real-time buffered distribution, automatic recovery
- SUSE Enterprise Linux, redundant power, and SAS RAID disks
- Automatic operation and scheduling
- High rate Space Link Extension (SLE) support
- GUI is displayable on computers in LAN/WAN

TECHNICAL SPECIFICATIONS

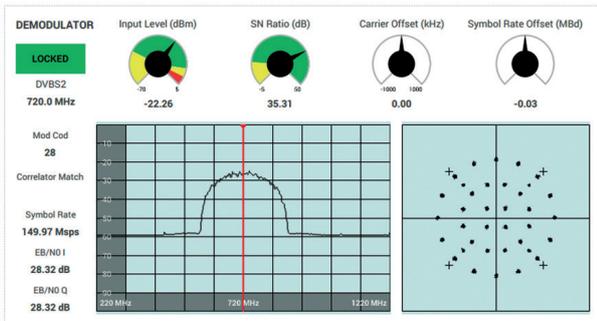## MEOS™ CAPTURE HRDFEP V12

AUTOMATIC COMMANDING

This feature is based on orbit prediction for user-selected missions. Candidate list of satellite missions to receive and process is generated automatically. The list is editable by the operator.

DATA DRIVEN OPERATIONS

Fully automatic reception, processing and distribution of satellite data based on intelligent algorithms.

GRAPHICAL USER INTERFACE

- Stand alone or through remote web browser
- Real time visualization of quality/quantity status
- Real time vector and signal spectrum plots
- Real-time visualization of acquired data from optical satellite instruments (Moving Window Display)

Demodulator View (DVB-S2 ModCod 28, Pilot symbols included)
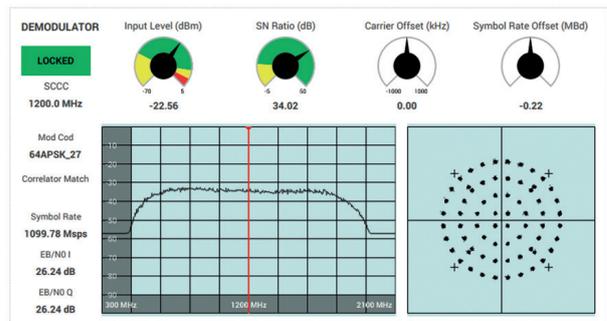
Demodulator View (SCCC ModCod 27, Pilot symbols included)

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