



# MEOS™ Capture HRDFEP v4

## High Rate Demodulator & Front End Processor

The *MEOS™ Capture HRDFEP* is a high performance, fully programmable data receiver, acquisition and telemetry processing system for the most demanding professional users. Developed to bring all your data safely home, always. This mission statement translates into the key properties of all *MEOS™ Capture* products: Performance, Reliability and Flexibility.

The *MEOS™ Capture HRDFEP* receives IF and synchronous ECL (clock & data) input, and outputs raw and processed data on the network, and as synchronous data and clock.

### Performance

| Bit Rate (Mbps) |      |     |     |
|-----------------|------|-----|-----|
|                 | 100  | 250 | 500 |
| BPSK            | 0.15 | 0.2 | -   |
| QPSK            | 0.2  | 0.3 | 0.5 |
| 8PSK            | 0.3  | 0.3 | 0.4 |

Implementation loss at BER 10<sup>-6</sup>

Get data from current and future satellites

- Extremely low implementation loss: 0.1 – 0.5 dB typically, depending on data rate and type of filtering
- Multi-mission frame processing

Get all data right from the start of every satellite contact

- Very fast lock-in times: 0.01 – 0.1 sec. typically

Make acquired data available for end users as fast as possible

- Real-time acquisition, processing and distribution

### Key features

- Data rates from 200 kbps to 1 Gbps per channel
- Up to 4 Front-End Processors
- Receiver implementation loss, typically less than 0,5 dB
- Receiver adaptive equalizer
- JAVA GUI with configurable bandwidth usage
- Real time and offline status available in JAVA GUI
- WEB and PDF quality reports
- CFDP (CCSDS File Delivery Protocol), Class 1 and 2.
- Instrument Source Packets reconstruction
- Real-time buffered distribution, automatic recovery
- SUSE Linux, redundant power and SAS RAID disks
- Automatic operation and scheduling
- Full Space Link Extension (SLE) support at 600 Mbps

### Reliability

Reduce your operations cost by automated “lights-out” operations

- Fully automated operations
- 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

### Flexibility & modularity

Keep your system continuously updated simply by downloading new software.

- State of the art FPGA based hardware – re-programmable and in-field upgradable. New versions and updates are provided as software files

Keep your original system, just add functionality (options)

- Higher order processing: Level 0 processing or higher – contact KSPT for options



*MEOS™ Capture HRDFEP* includes multi-mission support with pre-qualified configurations.

## Demodulator (HRD)

- Fully programmable wideband digital demodulator for BPSK, xQPSK, 8PSK, 16QAM, AQPSK (Landsat-7).

## Front-End Processing

- Frame synchronization, de-randomization, error correction and time tagging
- Two channels per demodulator - fully independent I/Q processing

## Processing

- Splitting and sorting of VCDUs
- Instrument Source Packet (ISP) service processing
- Supports part of the CCSDS AOS Path, Internet and Encapsulation services
- CFDP: CCSDS File Delivery Protocol, Class 1 & 2.

## Modulator

- Output of modulated data, PRBS and stored data
- Matches demodulator specifications

## Data output

- Playback of stored data (real or synthetic) as ECL (clock/data)

## Distribution

- NRT distribution via TCP socket with rate control support. Supports compression, encryption, XML meta data and checksums
- Post-pass file transfer protocols: FTP, SFTP
- SLE: CCSDS Space Link Extension, RAF and RCF

## Automatic storage management

- Oldest data will automatically be purged if space is needed
- Important data can be manually locked

## Graphical user interface

- Programmable (XML definition), Java based GUI. Stand alone or through a web browser, using Java web start technology
- Real time visualization of quality/quantity status
- Real time vector and Spectrum plots
- Real-time visualization of acquired data from optical satellite instruments (Moving Window Display)

## External interface

- TCP socket and XML based external interface with minimal bandwidth usage
- Access authentication
- MEOS™ Connect ready

## Reporting

- Historical view of qualitative and quantitative status information for previous activities, based on satellite and orbit. Both as numeric values and graphs
- Automatic generation of WEB reports, including quality and quantitative status information, plots, events and data analysis. Available through standard WEB browser

## Automatic Scheduling

- Based on orbit prediction for user selected missions.

## Options

- User Specific:** Allows for seamless integration of user specific functionality.
- HL processing:** Inclusion of higher level processing
- Level 0:** for several missions
- LDPC:** 7/8, up to 63 iterations (18 iterations at 600 Mbps)

## Graphical User Interface



MEOS™ Capture HRDFEP user interface



## Demodulator (HRD)

- Dual input ports – female SMA connectors
- 720 MHz (tunable within 500 MHz bandwidth)
- Input impedance: 50 ohms
- VSWR: < 1.5
- AGC range: -10 dBm to -50 dBm
- AGC output level: 0 – 10V - female SMA connector
- Demodulation type:
  - BPSK, CBPSK, QPSK, OQPSK, 1/2 UQPSK, 1/4 UQPSK, 1/8 UQPSK, 8PSK, 16QAM, AQPSK for Landsat-7
- Data rates per channel:
  - xQPSK: 1.25 Mbps to 600 Mbps
  - BPSK: 200 kbps to 300 Mbps
  - 8PSK: 2 Mbps to 750 Mbps
  - 16QAM: to 1Gbps
- Matched filters: SRRC, Integrate & Dump
- Adaptive Equalizer (on board, downlink, on ground RF)
- Digital equalizer for spectrum tilt correction: +/- 6 dB
- Spectrum inversion correction
- Fast, wideband carrier acquisition (up to +/- 100 MHz range)
- Doppler on Carrier: 1500 kHz
- Max Carrier Doppler rate: 100 kHz/s max

## Digital Inputs

- Two serial clock/data inputs per demodulator channel – separate or merged (I+Q) data
- Data rates: Up to 1 Gbps per channel
- Data polarity: - Normal/Inverted
- Clock input phases - Small step phase adjustments
- Electrical standard: Differential ECL (standard), LVDS, RS-422, TTL: Specify on order
- All female SMA connectors

## Frame Processing

- Automatic data ambiguity resolution
- Advanced frame synchronization:
  - Sync options: CCSDS AOS/PT, TDM
  - Fixed length, variable length, adaptive modes
  - Frame length: Up to 64 kBytes
  - Sync pattern: Up to 64 bits
  - Bit error tolerance: Up to 31 bit errors
  - Search-Check-Lock-Flywheel strategy:
    - 0 to 15 frames thresholds
    - Bit slips: Up to ± 7 bits
- Data PN de-randomization: Any pattern supported
- CRC checking:
  - CCSDS polynomial:  $g(x) = x^{16} + x^{12} + x^5 + 1$
  - Programmable offsets

## Decoding

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

## Forward Error Correction and Detection

- Reed-Solomon decoding:
  - R-S (10, 6), R-S (255, 239), R-S (255, 223)
  - Codeword interleaving: 1 to 16
  - Codeword length: 33 to 255
  - Filtering of uncorrectable frames
- LDPC: 7/8, up to 63 iterations (option)
- Other codes: Contact Kongsberg Spacetek.

## Quality and Time Appending

- Frame sync status:
  - Up to 4 bytes appended to the frames
- Reed-Solomon status:
  - Up to 32 bytes appended to the frames (including frame counter, error status, and user defined fields)
- Time-stamping - 8 bytes time field:
  - Day; millisecond of day; microsecond of millisecond
- Mission specific
  - EVCDU, EAP, Sentinels, SMOS, ADM, SWARM etc.

## Special Features

- BER tester: 4 selectable standard polynomials
- Frame data pattern generator
- PN generator: 4 selectable standard polynomials
- Status report file generation

## Digital Outputs

- Two serial clock/data outputs per demodulator channel – separate or merged (I+Q) data
- Data polarity: Normal/Inverted
- Adjustable data polarity and clock/data phasing
- Clock duty cycle: - 50% ± 10%
- External clock input
- Electrical standard: Differential ECL (standard), LVDS, RS- 422. Specify on order
- All female SMA connectors
- Gigabit Ethernet (optional 10Gbit)

## Modulator

- *See the MEOS™ HRTG product sheet for technical details*

## Physical

- Rack mountable chassis
- Height x Width x Depth: 21,8 CM X 48,26 CM X 73,22 CM
- Weight: appr. 40 kg
- Power:
  - 100-240 volts, 50-60 Hz
  - Dual power supplies
  - Consumption: 500 W
- Temperature:
  - Operating: 10°C to 35°C
  - (non-operating: -30°C to 60°C)
- Relative humidity (non condensing):
  - Operating: 10% to 90%
  - (non-operating: 5% to 95%)
- Separate keyboard and monitor unit (optional)

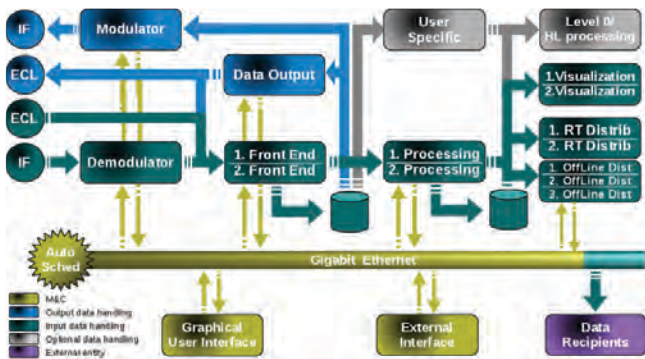




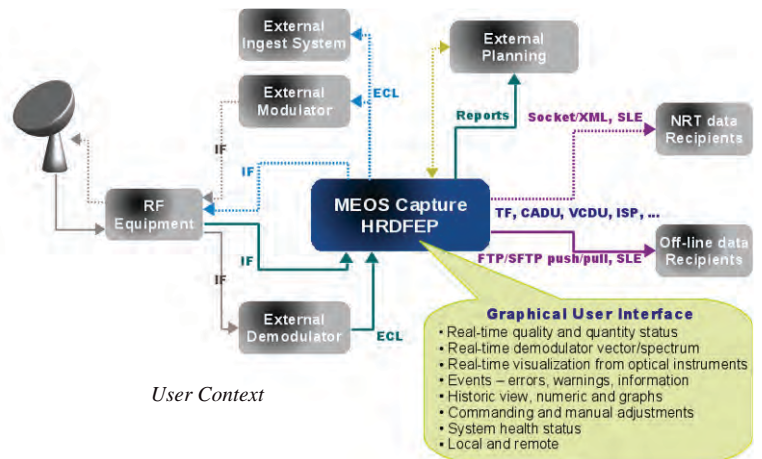
# MEOS™ Capture HRDFEP

## Configurations - alt I

### 1 input channel and 1 output channel, with processing and distribution



Block diagram

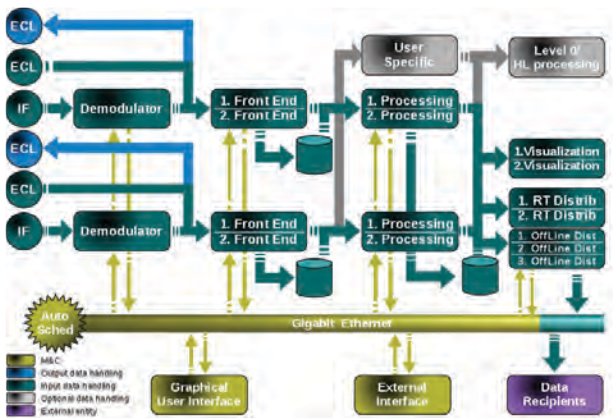


User Context

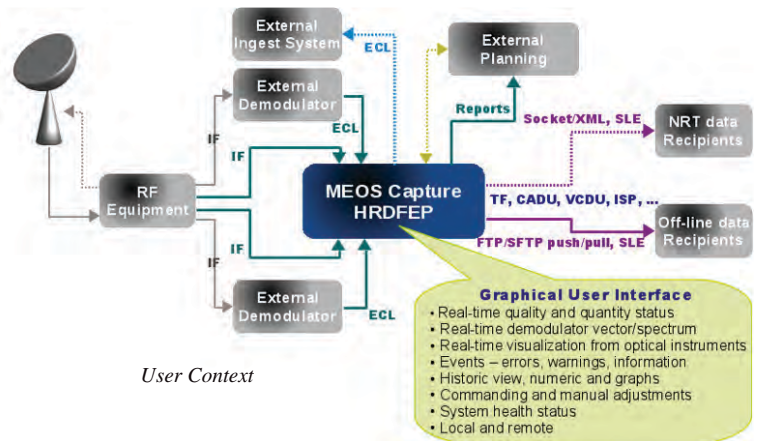
This configuration supports one IF and ECL input channel, two independent front-end processors and two independent reconstructions of Instrument Source Packets (ISPs). It also includes two viewers for simultaneous visualization of data from optical instruments, two independent online distribution channels and three independent offline distribution channels. This configuration also supports one IF and ECL output channel, both from file and PRN patterns.

## Configurations - alt II

### 2 independent input channels, with processing and distribution



Block diagram



User Context

This configuration supports two independent IF and ECL input channels, four independent front-end processors (two per channel) and four independent reconstructions (two per channel) of Instrument Source Packets (ISPs). It also includes two viewers for simultaneous visualization of data from optical instruments, two independent online distribution channels and three independent offline distribution channels. This configuration also supports two ECL output channels.

## Other configurations

The MEOS™ Capture HRDFEP can also be delivered without processing. This configuration supports either two IF and ECL input channels, or one input and one output channel. It provides one ECL output channel per input channel, storage to disk and file delivery through (S)FTP pull.

## Related products

MEOS™ Antenna - 3.0 - 5 m L/X band  
 MEOS™ Capture HRTG - High Rate Test Generator

MEOS™ Connect - Ground Station Networking  
 MEOS™ Control - Controlling external equipment from one system

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