Ordering Information

HW-00035 IBB
Please contact Antwerp Space for the variant that suits your needs in terms of number of TM/TC boards, input frequency and interface options.

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Antwerp Space’s Integrated BaseBand system (IBB) is a key component in ground stations for satellite Tracking, Telemetry and Telecommand (TT&C).

The IBB ensures reliable and flexible communication between the Satellite Control Center (SCC) and the satellite.
Main Functionality

- Carrier acquisition, tracking and demodulation
  - PM/PSK/PCM
  - FM/PSK/PCM
  - BPSK
  - QPSK
- Telemetry (TM) subcarrier demodulation and bit synchronization
- Processing of Telecommand (TC) data
- TC subcarrier generation and modulation
- Uplink carrier generation and modulation
  - PCM/PSK/FM
  - PCM/PM
  - PCM/FM
  - BPSK
  - QPSK
- Generation and reception of ranging tones and associated delay measurement
- Processing of ranging data
- Doppler and Doppler rate measurements
- Data logging
- Local and remote monitoring and control
- Spectrum analyzer for real time analyses of the received input spectrum

Applications

- Baseband equipment for reception of housekeeping & payload telemetry from GEO and LEO satellites, and transmission of telecommand to GEO and LEO satellites
- Ranging of GEO and LEO satellites
- TTC SCOE

Key Benefits

- Extremely short acquisition time, even in challenging receiving conditions like low Signal/Noise, Doppler ...
- Easy and flexible to use
  - Easy (re)configuration thanks to the modular software architecture and the intuitive graphical user interface.
  - Real-time built-in spectrum analyzer (Xspect)
  - Optional internal frequency converter, allowing direct interface at L-band or S-band
- Carrier acquisition range: ±300kHz
- Acquition and tracking threshold (C/N0): down to 10dB
- Maximum Doppler rate: ±10kHz/s for C/N0 = 25dBHz
- Carrier acquisition time: <0.5s

Reception of Satellite Telemetry Data

### Carrier Acquisition and Demodulation

- Number of receivers: Standard 1 or 2 TM/TC chains (more chains available on request)
- Receiver input frequency: Standard 65MHz - 75MHz (other frequencies on request)
- Received carrier modulation: PM and FM
- Signal dynamic range: 80dB (-100dBm to -20dBm)
- Input noise density:
  - Maximum: -115dBm/Hz
  - Typical: -125dBm/Hz
- AGC mode: Non coherent mode to optimize the ADC input loading and reducing signal degradation
- Input C/N0 measurement accuracy: <1dB (starting from 60dBHz down to threshold)
- Receiver IF bandwidth: ±450kHz

### FM receiver characteristics

- Symbol rate: up to 2Msymbol/s
- Threshold for TM reception (E_b/N_0): 1dB
- Reed Solomon decoding (255, 223)
- Interleaving factor automatically selected as function of the frame length
- Number of processing chains per carrier: standard 1 (2 processing chains on request)
Frame Synchronization

- Search for a configurable sync-word
- Allow 0 to 2 bit errors
- Invert data if the inverse sync-marker is found (user-settable)
- Search/verify/lock algorithm
- User-settable thresholds for frame sync lock/unlock
- Synchronization word size: 8 to 64 bits programmable
- Frame size: 1 to 2^16 - 1 bytes, or according to the Reed Solomon code length when Reed Solomon coding is used
- Synchronization strategy parameters:
  - SYNi (0 to 8 errors) depends on the synchronization word size STL & LTS
  - (0 to 7 frames)
  - Bit slip (0 to 7 bits)
  - Frame descrambling
  - Real time decommutation with graphical display
  - Telemetry storage on hard disk: Time-tagged frames or blocks

Ranging

- Ranging tone waveform: sine wave
- Tone frequencies: fully programmable respecting the required mathematical relation between major and minor tones for ambiguity resolution
- Ranging downlink modulation index: 2kHz → 150kHz
- Min. SNR on received major tone: 25dB
- Min. SNR on received minor tone: 15dB
- Phase estimation based on 1st order or 2nd order phase trajectory estimation
- No phase (delay) measurement bias due to Doppler rate
- Allows for extremely long estimation time, not achievable with classic PLLs
- Different major tone modulation indices are programmable for ambiguity resolution and for the ranging measurement; switchover is automatic
- Max. measurement jitter due to thermal noise=0.03rad under the conditions:
  - SNR(max) = 25dB
  - Estimation time = 2s
  - 100kHz major tone
- Measurement resolution: <1nsec
- Ranging measurement timing accuracy: 1µs
- Ambiguity Resolution Performance
- Probability of ambiguity resolution error: up to 10^-4

Doppler Measurement (PM mode only)

- Method: based on reconstruction of phase trajectory
- Resolution: Floating point calculation
- Accuracy: according to reference frequency [external or internal]
- Jitter:
  - 10mHz at C/N0 = 25dB
  - 1mHz at C/N0 = 35dB with 1s estimation time
- Rate: 1 per second

Transmission of Satellite Telecommand Data

Telecommand pre-processing

- Reception and acknowledgement of the Telecommand request messages
- Generation and transfer of telecommand transaction messages
- Telecommand check of the syntax of “TC request”, spacecraft receiver lock status and uplink status and transmission
- High and low priority TC queues
- Idle pattern: Programmable length (1 to 16 bits) and content
- Local TC capability: based on customized database

Sub-carrier modulation

- Modulation formats: PSK
- PCM format: NRZ-L/M/S, SP-L/M/S, RZ
- PSK sub-carrier frequency f(sc): 2kHz → 150kHz
- PSK-BW/symbol rate (f(sc)/f(b)) → 10kHz
- PSK-Ratio (f(sc)/f(b)): 2 → 1024 (integer)
- Priority switching between RNG and TC

Telecommand Transmission

- Transmission of Satellite Telecommand Data
- Suppressed carrier modulation
  - Modulation types: BPSK, QPSK, OQPSK
  - Symbol rate: 2Msym/s maximum
- Uplink carrier Generation
  - Number of uplink chains: 1 or 2 [more chains available on request]
  - Modulation format: FM/PM
  - Output frequency: 65 → 75MHz (others on request)
  - Number of outputs: 2 (nominal + auxiliary)
  - Output level range: -60dBm → -60dBm, 0.1dB steps
  - Uplink sweep range: ±150kHz
  - Uplink sweep rate: 50kHz/s → 30kHz/s
  - Spurious, harmonics:
    - < -60dBc (not mains related)
    - < -50dBc (mains related)
  - Max. modulating frequency: 200kHz
  - Phase noise (PM mode): -51dBc + 10logΔf dBc/Hz
  - RF phase noise integrated from 10Hz to 100kHz: <0.7 degrees RMS

PM mode modulation characteristics

- Max. PM mode modulation level: 2.5rad [TC and RNG combined]
- FM mode modulation characteristics
  - Max. FM mode freq. deviation: ±50kHz

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Calibration and Test Features

- Generation of a Telemetry sub-carrier for test purposes
- Generation of a pseudo-random bit pattern
- Emission of a fixed pattern TM frame
- Loop testing at IF for ranging calibration
- Loop testing of TM functions
- BER counting using the built-in pseudo-random bit pattern generation
- Storage of test results in files

Monitor and Control Functions

- Local Monitoring & Control via front mounted TFT screen, keyboard and mouse pad
- The communication link between the IBB workstation and the M&C computer is connection-oriented (TCP/IP)
- Unlimited amount of dedicated configuration files for each functional block and global configuration files for the complete equipment can be built via the Graphical User Interface (GUI), stored and reloaded

Interfaces

- Exchange of TM data, TC data, RNG data and Doppler data with the SCC via an Ethernet interface using the TCP/IP protocol
- Optional SLE interface (RAF, RCF, ROCF, forward CLTU)
- Timing reference: Built-in IRIG-B decoder
- Frequency reference: 10MHz, automatic switch to its internal reference in case of lack of external reference
- Optional RS422 interfaces for TM and TC (up to 10Mbps)

Environmental & Power

- Operating temperature: +10°C to +40°C
- Storage temperature: -20°C to +60°C
- Relative humidity: 40% to 90% non condensing
- The equipment is CE compliant and CB scheme tested
- Power Supply: 90V-265V, 47-63Hz

Physical Dimensions

- The IBB equipment is a 4U high, 19” rack-mount industrial PC with a 6.4” LCD display, built-in slim drawer with keyboard and touch pad
- Dimensions (WxHxD): 43.7 x 17.6 x 50.0 cm
- Weight: 32kg max

Related Product

i2b2 is an inverse IBB, which allows to test the ground segment by simulating the satellite.