CCSDS / ECSS

TELEMETRY AND TELECOMMAND EGSE

The CCSDS / ECSS Telemetry and Telecommand EGSE (Electrical Ground Support Equipment) provides the necessary means for communicating with the on-board space segment. It has been designed to support satellite integration and test activities, on-board space segment development, ground segment applications, etc.

The TM/TC EGSE communicates directly with the on-board telemetry encoder and telecommand decoder devices, TM/TC boards and units, bypassing the transponder. The EGSE is ideally suited for the verification of FPGA designs and validation of ASIC devices, as well as during integration of complete TM/TC boards or communication subsystems.

The TM/TC EGSE comprises two parts: a generic hardware implementing the lower CCSDS / ECSS protocol levels; and advanced software implementing the higher CCSDS / ECSS protocol levels. The TM/TC EGSE is fully compliant with the latest CCSDS recommendations and ECSS standards.

TM/TC EGSE hardware interfaces
(front and back panels)

Hardware

The TM/TC EGSE hardware establishes the link between the on-board flight segment and the ground segment software. The hardware features standardized RS422 interfaces supporting up to 10 MBPS transfers on the downlink and up to 1 MBPS on the uplink. It also features three SpaceWire interfaces, a CAN interface, and two PacketWire receive interfaces and one transmit interface. The hardware communicates with the ground segment software through a 10/100/1000 Mbit/s Ethernet interface via TCP/IP. The firmware can be updated via a web interface.

The TM/TC EGSE hardware is based on the GRTMRX and GRTCTX VHDL IP cores, which are available with the GRLIB VHDL IP core library.

TM/TC EGSE hardware interfaces:

- 2x HDD15 PacketWire RX (single)
- 1x HDD15 PacketWire TX (dual)
- 1x HDD26 TM/TC (redundant)
- 1x JTAG
- 1x DSUB9 RS232 UART
- 1x RJ45 Ethernet (10/100/1000 Mbps)
- 3x MDM9 SpaceWire (for future use)
- 1x DSUB9 CAN (for future use)

More information:
gaisler.com/tmtc-egse

TELEMETRY AND TELECOMMAND EGSE

Telemetry receiver capabilities

- Operation Control Field (OCF) extraction
- Frame Error Control Field (FECF) calculation
- Pseudo-De-Randomizer (PSR)
- Attached Sync Marker search (ASM)
    - Programmable and maskable
    - Normal/Inverse auto-detection
    - Non-standard Transfer Frame length support
- Non-Return-to-Zero Mark/ Level decoder (NRZ-M/L)
- Convolutional Quick-Look Decoder
- Split-Phase Level de-modulator (SP-L)
- Sub-Carrier de-modulator (auto-detection)
- 10 MPBS sustained symbol rate

Telecommand transmitter capabilities

- Frame Error Control Field (FECF)
- Pseudo-Randomizer (PSR) / Bit Transition Generator (BTG)
- Communications Link Transmission Unit (CLTU)
- Start Sequence insertion
- Bose-Chaudhuri-Hocquenghem (BCH)
- Tail Sequence insertion
- Physical Layer Operations Procedures (PLOP-1, PLOP-2)
- Non-Return-to-Zero Mark/ Level (NRZ-M/L)
- 1 MPBS sustained symbol rate

Software

The TM/TC EGSE hardware is delivered with the CCSDS/ ECSS library, which provides basic routines for generating uplink commands and checking downlink data. It is delivered in source code, together with example applications operating on ASCII files.
The library currently does not include support for the Space-Wire, CAN, and PacketWire interfaces.

CCSDS/ ECSS library capabilities

- TC Space Packet, Segment and Transfer Frame generators
- TC Pseudo-Randomizer and CLTU generator (Start Sequence, BCH coding, Tail Sequence)
- TM / AOS Transfer Frame print out
- TM / AOS Transfer Frame / Idle Frame check
- OCF/CLCW print out and FECF/CFC check
- First Header Pointer (FHP) check
- Space Packet protocol check
- Pseudo De-Randomizer
- Reed-Solomon (E=16/E=8) check