

Advanced Multi-mode Transponder (AMT)

Software Defined Radio Platform

Processing Module Options

The AMT

- Utilizes one-time programmable components loaded with a mission's custom application
- Platform provides a RS-422 UART control interface and a RS-422 differential data interface
- Discrete General Purpose interfaces (GPIOs) are provided based on customer requirements

The AMT-R

- On-orbit reprogrammable platform utilizing NASA's Space Telecommunication Radio System (STRS) Architecture
- The STRS standard provides a common, consistent framework to develop, qualify, operate, and maintain complex reconfigurable and reprogrammable radio systems
- MIL-STD 1553B control interface
- High speed SpaceWire (IEEE 1355) data interface
- Discrete programmable GPIOs



General Dynamics' AMT is the next generation of communications technology, building on our 50 years of experience in high reliability space transponders and leveraging our proprietary Starlight™ platform architecture.

The AMT provides a flexible communications platform that can be configured for a multitude of mission requirements. Spacecraft designers can now utilize a single family of platforms to meet their mission communication needs. The latest in radiation hardened field programmable logic for high speed waveform processing is utilized combined with a General Dynamics' proprietary radiation hardened microprocessor for lower speed control functions. Custom waveform processing development is available to meet unique requirements including bandwidth efficient root-raised cosine modulation and NTIA spectrum compliance through pre-modulation digital filtering.

Initial waveform offerings include coherent transponders for NASA TDRSS, Unified S-Band/DSN/GN and AFSCN SGLS. Multiple waveform operating modes can reside in the same unit. Operational capabilities on additional frequency bands can be developed as required by the spacecraft mission.

The AMT is operating on the NASA Lunar Reconnaissance Orbiter and AMT-R is scheduled to be launched to the ISS in 2011 as part of the Communications, Navigation, and Networking re-Configurable Testbed (CoNNeCT) program.

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Technical Information

AMT

Interfaces

Control and Status: RS-422 compatible UART
 Data: Serial RS-422 differential signal (recv'd data, rcv clock, xmit data, transmit clock)
 Discrete GPIO: (13) CMOS outputs (3.3V); One CMOS input (3.3V)

Reprogrammable Devices

FPGA: ACTEL RTAX2000
 PROM: 128K-byte (4) UTMC UT28F256LVQLE

Physical/Environmental/Qualification

Size: 8.75" (L) x 6.35" (W) x 5.25" (H)
 Weight: 8.8 lbs
 Power: < 9 W RCV only; < 42 W full duplex

AMT-R

Interfaces

Control & Status: Dual redundant MIL-STD-1553B
 Data: ECSS-E-59-12A Compliant SpaceWire Node with maximum 25Mbps throughput
 Discrete GPIO: LVDS compatible differential signals (Transmitter Enable, Hardline Reset)
 User Definable Input Signals: One LVDS, one RS-422 and one CMOS (3.3V)
 User Definable Output Signals: Seven LVDS, one RS-422 and ten CMOS (3.3V)

Reprogrammable Devices

FPGA: Xilinx QPRO XQR2V3000 providing >2-Mgate for custom DSP logic
 RAM: 128-MByte Maxwell 97SD3240 SDRAM
 Non-Volatile Storage: 4-MByte (2) Maxwell 79LV2040 EEPROM; 1-MByte (2) BAE 251A184 CRAM

Physical/Environmental/Qualification

Size: 8.75" (L) x 6.35" (W) x 5.25" (H)
 Weight: 9.2 lbs
 Power: < 18 W RCV only; < 51 W full duplex

RF CAPABILITIES

Receiver Features

Operating Modes Include:

- TDRSS Spread Spectrum
- SGLS Ternary FSK
- Ground Network (GN aka as STDN, DSN or USB)
 - Direct carrier BPSK
 - Subcarrier BPSK

Noise Figure: < 2.5 dB
 Frequency Stability: < 0.5 ppm 0 to 50C
 Operating Frequencies:

- 2025 – 2120 MHz (TDRSS, GN)
- 1763-1840 MHz (SGLS)

Data Rates: > 1 Mbps

Acquisition:

- TDRSS: Doppler Compensated
- GN: Ground Sweep or Auto Acquisition
- SGLS: Auto Acquisition

Transmitter Features

Operating Modes Include:

- TDRSS Spread Spectrum
- Direct carrier BPSK, QPSK, OQPSK
- Telemetry Subcarrier
- Ranging: PN, SGLS, and DSN
- GN ranging tones

Frequency Stability: < 0.5 ppm, 0 to 50C
 Operating Frequencies: 2200 – 2300 MHz
 Data Rates: up to 6 Mbps
 RF output power: 8 Watts

Physical/Environmental/Qualification

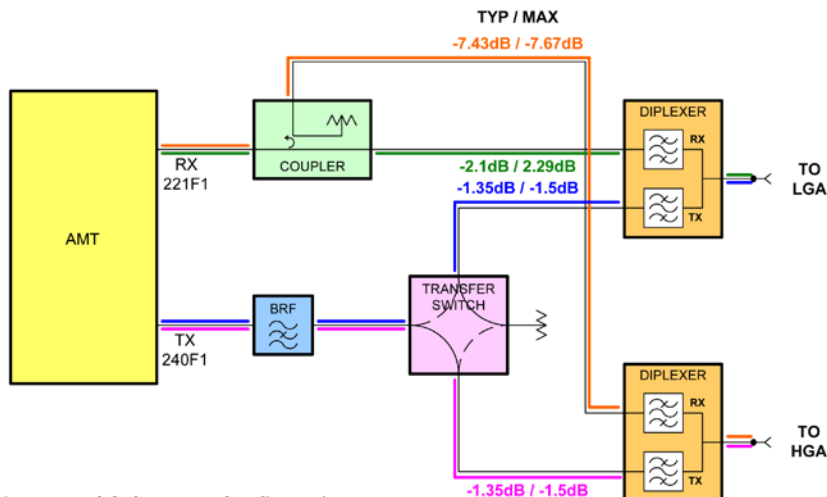
EMI/EMC: MIL-STD-461C
 Vibration: > 14 Grms
 Shock: > 1960 G above 2 kHz
 Temperature: -20°C to +60°C
 Input Supply Voltage: +21 VDC to +35 VDC

SUPPORTED WAVEFORMS

GN/DSN/USB/Lunar Comm Waveform:
 Uplink Commands: 4 kbps BPSK modulated on a 16 kHz subcarrier
 Downlink Telemetry: Direct Carrier BPSK to 2.5 Mbps, rate ½ convolutional encoding option, telemetry subcarrier at 1.7 MHz BPSK modulated at up to 512 kbps.
 Ranging: Supports both DSN and GN turnaround ranging with selectable digital filters. Downlink ranging signal is gain controlled for modulation index stability
 Doppler Turn-around Ratio 240/221, coherent and noncoherent operating modes

TDRSS/BPSK/QPSK Waveform:
 Uplink Commands: PN spread modes up to TDRSS S band service limit of 300 kbps BPSK up to 1 Mbps
 Downlink Telemetry: Direct Carrier QPSK to 2.5 Msps, convolutional encoding. Compatible with TDRSS DG1 modes 1,2 and 3 and DG2 mode
 Ranging: TDRSS PRN ranging
 Doppler Turn-around Ratio 240/221, coherent and noncoherent operating modes

SGLS Waveform:
 Uplink Commands: 2 kbps ternary FSK/ AM/PM compatible with AFSCN ground stations
 Downlink Telemetry: Direct Carrier BPSK to 2.5 Mbps, rate ½ convolutional encoding option, telemetry subcarrier at 1.7 or 1.024 MHz BPSK modulated.
 SGLS PRN ranging: Downlink ranging signal is gain controlled for modulation index stability
 Doppler Turn-around Ratio 256/205, coherent and noncoherent operating modes



Integrated Subsystem Configuration:

Subsystem includes transponder, band rejection filter, RF transfer switch, coupler and two diplexers to interface with two antennas.

For More Information, Contact:

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