

μ STDNTM Transponder

The μ STDNTM S-Band Transponder design meets the requirements for NASA Earth Observing System (EOS). This compact, low power implementation is the “next-generation” system, and is available with Commercial Space, Class B, and upon request, Class S (Grade 1) screened components.

The μ STDNTM Transponder provides telemetry, tracking and command (TT&C) between the STDN, ground systems, and satellites. The receiver/detector section detects and locks to the S-Band uplink signals, demodulates the BPSK (PCM/PSK optional) telecommand signal, outputs command data and bit timing.

The transmitter section receives data from the Command & Data Handling (C&DH) unit, encodes and modulates it on an internal subcarrier and/or directly on the S-Band downlink. (The Ranging feature (optional) demodulates range tones from the receiver and remodulates on the downlink carrier to provide range information for the ground equipment.) The system can be operated in either coherent or non-coherent mode. Output monitor functions are included in both the transmitter and receiver sections.

The Transmitter unit operates at a single frequency within the 2200-2300 telemetry band, and adheres to the standard STDN 240/221 turnaround ratio for compatibility with established ground stations. The transmit frequency is controlled by an internal crystal oscillator circuit meeting the stability requirements defined in the specifications and phase locked to the carrier of the uplink signal in a ratio of 240/221.

The Receiver frequency is factory set for 2025 to 2120 MHz consistent with the 240/211 TxRx turnaround ratio.

Features for Space

- Radiation Hardened:
 - TID from 30 to 100 krad
 - No SEL or SEFI (>75MeV/mg/cm²)
 - SEU hardened to >37MeV/mg/cm²
- Ruggedized: against vibration /shock/thermal
- Temperature: -24 to +61 °C Operating
- Ranging Options
- Parts Screening
 - NASA -002 (Class B) Standard
 - Optional: See page 5 for other screening grades.

Elements

- S-Band , CCSDS compliant
- Transmit: 512 kbps@2200-2300 MHz
- Receive: 2.0 kbps@2025-2120 MHz
- RF Output: 5W
- Standby (Receive only): 5W max dissipation
- Input Power: +28V \pm 6V



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Transmitter Section

Operating Frequency	2200-2300 MHz
Coherent Turnaround Ratio	240/221
Frequency Stability	± 20 ppm
RF Power	5 (min) to 6 (max) Watts (see page 5 for other options)
Output Protection	No damage, open or short circuit
Peak Phase Deviation	3 radians max
Incidental Phase Modulation (IPM)	$< 3.5^\circ$ rms (ambient environmental conditions)
Incidental Amplitude Modulation (IAM)	$< 1\%$
Telemetry Channel Bandwidth	Normal: 1.024 MHz (512 kbps) L&EO: 16 kHz (8 kbps)
Modulation	BPSK (see page 5 for other options)
Data Format	NRZ-L/M (CCSDS or JPL type)
Subcarrier Frequency	1.024 MHz
Subcarrier Stability	$\pm 0.005\%$
Phase Modulation Index	Range of 0.2 to 1.7 radians, with option of 3 preset "sets": Ranging Channel Modulation Index Command Channel Modulation Index Transmitter Phase Modulation Index
Binary Phase Shift Keying	< 23 dB subcarrier null
Telemetry Modulation Data Rate	125 bps to 128 kbps max
Command Inputs	Ranging On/Off SCO On/Off Encoder On/Off Coherent Mode Override Transmitter On/Off Set Index Values
Convolutional Encoding	Non-encoded. Optional mode: K=7, Rate=1/2
Command Type	28 V latching relay
Telemetry Outputs	Temperature, monitored at: Transmitter power supply Transmitter output power amplifier RF Power Out DC Conv. Voltage Index set acknowledgement
Power Requirements	
Voltage	$+28 \pm 6$ VDC
Power Consumption	35 W max (ON), 0 W max (OFF)
Reverse Polarity Protection	No damage down to -50 V
Overvoltage	No damage up to 40 VDC
Isolation	1 Mega-Ohm min between power or return to chassis
Optional Transmitter Operating Modes	
Modulation Format	PCM/PSK
Modulation Data Rate	Normal Mode: 32 kbps, compatible with TDRSS at 1, 2, 4, 16 kbps (higher rates available) Backup Mode: up to 5 Mbps
Encoding	Normal Mode: None Backup Mode: Convolutional & Reed-Solomon K=7, Rate = 1/2

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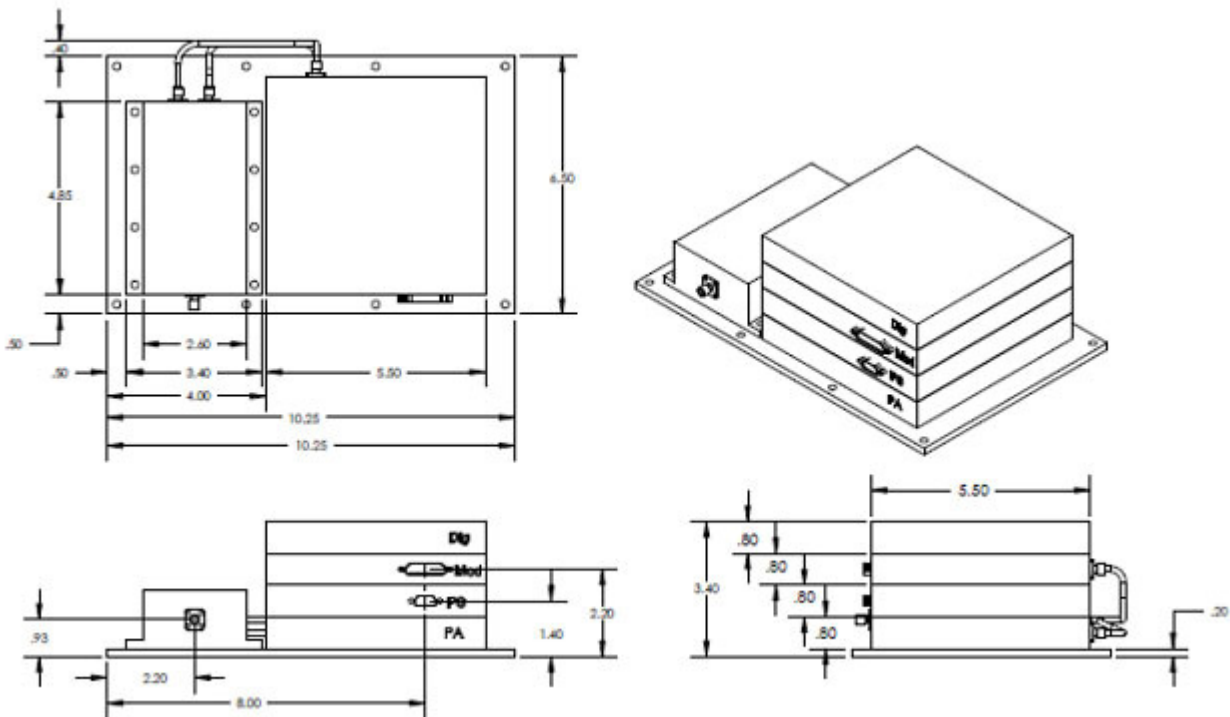
Receiver Section

Operating Frequency	2025-2120 MHz
Carrier Tracking Range	± 140 kHz
Carrier Acquisition	-125 dBm with 35 kHz/s sweep
Carrier Tracking Threshold	-127 dBm
Noise Figure	4 dB max
Dynamic Range	60 dB min
Max Input Signal	+10 dBm
Spurious Response	>60 dB below desired response with diplexer
Ranging Channel	
Bandwidth	≤ 2.048 MHz
Delay	2.5 μ s max
Delay Variation	± 40 ns max with ± 5 ns uncertainty
Modulation Index	Range of 0.2 to 1.7 radians, with option of 3 preset "sets": Ranging Channel Modulation Index Command Channel Modulation Index Transmitter Phase Modulation Index
Turnaround Ratio	1.0 \pm 10%
Command Channel	
Modulation Index	Range of 0.2 to 1.7 radians, with option of 3 preset "sets": Ranging Channel Modulation Index Command Channel Modulation Index Transmitter Phase Modulation Index
Subcarrier Frequency	16 kHz
Uplink Data Rate	2 kbps
Bit Error Rate (BER)	-118 dBm at 2000 bits/s, 1.00 radian mod index -117 dBm at 4000 bits/s, 1.00 radian mod index
Outputs	
Output Interface	Data Clock and Demod Lock
Telemetry Outputs	Differential RS-422 (other formats optional)
Signal Strength	0 to 5 VDC analog*
Frequency Offset	0 to 5 VDC analog*
Converter Voltage	0 to 5 VDC analog*
Receiver Lock	+5 \pm 0.5 VDC locked*
CDU Lock	0 \pm 0.5 VDC locked*
	*Option for RS-422 digital output is available.
Receiver Power Requirements	
Voltage	+28 \pm 6 VDC
Power	5 W max
Reverse Polarity Protection	No damage down to -40 VDC
Overvoltage Protection	No damage up to +40 VDC
Current Limiting	500 mA max
Isolation	1 Mega-Ohm min between power or return to chassis

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Physical Characteristics

Size	5.5" x 5.5" x 3.4"
Mass	2.5 lbs (1.1 kg)
Environmental Conditions	
Radiation	100 krads
Vibration	20 G rms
Pressure	10E-5 Torr to 1 Atmosphere
Humidity	0 to 100% Without Condensation



Note: Figure contains a diplexer on a common baseplate. This configuration is optional, contact Space Micro if more information is desired on this option.

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Detailed Options

Option 001	Part Number:	μSTDN-XXX-001
	Modulation:	BPSK
	Rx Data Rate:	2 kbps
	Tx Data Rate:	1.5 Mbps
	ECC:	Reed-Solomon/Convolutional Code
	RF Power Out:	Medium Gain Antenna-5 Watts minimum Omnidirectional Antenna-2.5 Watts minimum

Other Option	Part Number:	μSTDN-XXX-00X
	Modulation:	BPSK/QPSK/OQPSK, etc.
	Rx Rate:	2/4 kbps
	Tx Rate:	512 kbps to 5 Mbps
	ECC:	Customizable
	RF Power Out:	2-10 W

Part Number Details

μSTDN-XXX-YYY

XXX =	EM	Engineering Model
	FMC	Flight Model, Commercial Space* Grade Parts
	FMB	Flight Model, Class B Parts
	FM1	Flight Model, Grade 1 Parts
	FM2	Flight Model, Grade 2 Parts
	FM3	Flight Model, Grade 3 Parts
	FM5	Flight Model, Grade 5 Parts

*Commercial Space Grade Screening:

- Industrial Temperature grade components (when available)
- <97% Tin solder plating
- No outgassing (passing ASTM E595/NASA SP-R-0022A)
- To pass mission specifications

Please contact Space Micro for application specific configurations or further details.