

NWTRM9498-14-1

X-Band and L-Band
Transmit/Receive Module

GENERAL DESCRIPTION

The NWTRM9498-14-1 is a dual frequency (L-Band and X-Band) Transmit/Receive Module (TRM) for spacecraft payload applications. The L-Band Transmit/Receive Band is from 1215MHz to 1300MHz and the X-Band is from 9400MHz to 9800MHz. The nominal transmit power in L-band is 45dBm and in the X-band is 39dBm.

The TRM has the following:

- Two High Power Amplifiers (HPA) (one each at L-Band and X-Band) with local pulse storage capacitors for the purpose of amplification of the transmit waveforms
- Two Low Noise Amplifiers (LNA) (one each at L-Band and X-Band) for the purpose of amplification of the received signals
- Two Circulators (one each at L-Band and X-Band) for the purpose of directing transmit signals from the HPAs to the antenna sub-arrays and receiving signals from the antenna sub-arrays to the LNAs
- Four RF divider/combiners (two each at L-Band and X-Band) to route the RF to and from the sub-arrays of the antenna associated with that TRM
- Two Limiters (one each at L-Band and X-Band) for protecting the LNAs from damage caused by high power signals being leaked to the LNAs during transmission
- An Electrical Power Conditioner (EPC) with Pulse Energy Storage Capacitors for the purpose of supplying the HPAs and LNAs with the appropriate voltages, at the appropriate currents, and implementing the gate and drain modulation of the HPA lineups (at L-Band and X-Band)
- A TRM Controller with CAN Bus and LVDS interfaces to provide the TM/TC Interface to the Payload controller, and the High Speed Control of the TRM Enable/Disable functions.



This TRM is originally designed for Synthetic Aperture Radar (SAR) applications and it enables individual control for TRMs so it can be operated with independent control duty cycles (in typical Radar form). The unit has capability to control the output power level for optimal performance over mission life. It has capability of providing in-orbit diagnostic and protection for each subassembly. In addition, there is provision to allow in-orbit reconfiguration through firmware upgrades.

FEATURES

- Integrated L-Band TRM
- Integrated X-Band TRM
- Tx/Rx switching and Tx output switching
- Digitally-controlled EPC
- Intelligent auto-configuration for optimal operation
- Telemetry/Telecommands
- Radiation qualified

APPLICATIONS

- Spacecraft Payloads for LEO
- Synthetic Aperture Radar (SAR)
- New Space
- SATCOM
- Aerospace

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ELECTRICAL PARAMETERS

Parameter	Unit	Min	Typ	Max	Remarks
L-band Frequency Range	MHz	1215		1300	
X-band Frequency Range	MHz	9400		9800	
L-band Transmitter (High Power Amplifier)					
Output Power	dBm		45		Measured on all four ports at Pin = -12dBm
Amplitude Channel Matching	dB			± 0.1	Measured in pairs among the four channels
Phase Channel Matching	Degrees (°)			± 1	Measured in pairs among the four channels
Output Power Flatness	dB			0.5	Measured at Pin = -12dBm
Pulse Amplitude droop	dB			0.4	Measured at Pin = -12dBm
Pulse-to-Pulse Phase Stability	dBc			-29	Measured at Pin = -12dBm
Pulse-to-Pulse Amplitude Stability	dBc			-40	Measured at Pin = -12dBm
Pulse Amplitude Ripples	dB			±0.5	Measured at Pin = -12dBm
Pulse Phase Ripples	Degrees (°)			± 4	Measured at Pin = -12dBm
Output return loss	dB			≤-14	Measured at Pin = -12dBm
L-band Receiver (Low Noise Amplifier)					
Small Signal Gain	dB	39.5		40.5	
Amplitude Channel Matching	dB			±0.3	
Amplitude Phase Matching	Degrees (°)			±3	
Noise Figure	dB			<2.5	
Input Return Loss	dB			≤-14	
Output Return Loss	dB			≤-14	
X-band Transmitter (High Power Amplifier)					
Output Power	dBm		39		Measured on all four ports at Pin = -12dBm
Amplitude Channel Matching	dB	-2.1		-1.5	Measured in pairs among the four channels

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Parameter	Unit	Min	Typ	Max	Remarks
Phase Channel Matching	Degrees (°)			± 3	Measured in pairs among the four channels
Output Power Flatness	dB			0.3	Measured at Pin = -12dBm
Pulse Amplitude droop	dB			0.4	Measured at Pin = -12dBm
Pulse Phase Ripples	Degrees (°)			± 4	Measured at Pin = -12dBm
Input return loss	dB			≤-14	Measured at Pin = -12dBm
Output return loss	dB			≤-14	Measured at Pin = -12dBm
X-band Receiver (Low Noise Amplifier)					
Small Signal Gain	dB		38		
Amplitude Channel Matching	dB	1.5		2.1	
Amplitude Phase Matching	Degrees (°)			±3	
Out-of-Band Rejection	dBc	30			
Noise Figure	dB			<3	
Output Return Loss	dB			≤-14	

Mechanical and Environmental Parameters

Parameter	Unit	Min	Typ	Max	Remarks
Operating Temperature Range	°C	-35		+45	
RF Connectors			SMA		
Size (L, W, H)	inch		6.27 3.50 3.70		including mounting stands
Weight	g		1050		
Input Bus Voltage	V		+30.0 +6.0 -6.0		
DC Power	W			117	Combined on the three input voltage lines 1)
Total Ionizing Dose (TID)	krad			40	Including RDM = 2
LET	MeVcm2/mg	20			

Notes:

- 1) Based on 20% duty cycle for Transmit and 80% duty cycle for Receiver

Digital Control Interface

The unit has an internal EPC integrated with the monitor and control subassembly (MCS). The EPC is digitally controlled to maintain optimal efficiency and input current limiting capability depending on the TRMs modes of operation. The input current limiting can be synchronized with the Spacecraft Payload Controller (SPC) to be adjusted depending on the spacecraft modes of operation. TRM's control signals for Tx/Rx functionality of each band come from SPC through dedicated high speed LVDS lines. The telemetry and not-real-time control is done via a customized CAN-Bus communication link, which carries out the control as requested, reports failures and monitored status, and has the ability to shutdown various sections of the unit in the event of a catastrophic failure. Both communication links (LVDS and CANBUS) are fully redundant. The unit has capability to maintain nominal RF performance through automatic compensation and over mission life. It provides in-orbit diagnosis and protection for each subassembly while allowing possible in-orbit reconfiguration through firmware upgrades.

Monitored parameters are:

- Temperature for L-band TRM
- Temperature of X-band TRM
- Temperature of main EPC&MCS
- Voltage Monitoring
- Current Monitoring
- Monitoring of L-band transmit pulse and duty cycle
- Monitoring of X-band transmit pulse and duty cycle
- In-orbit status diagnosis

The following functions can be remote controlled:

- L-band fast Tx/Rx control
- X-band fast Tx/Rx control
- RF gain temperature compensation
- Intelligent input current regulation
- L-band and X-band Attenuation Control
- Graceful degradation
- Automatic RF module voltage compensation for optimal performance over mission life
- MUTE Mode
- (further options on request)

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Outline Drawing

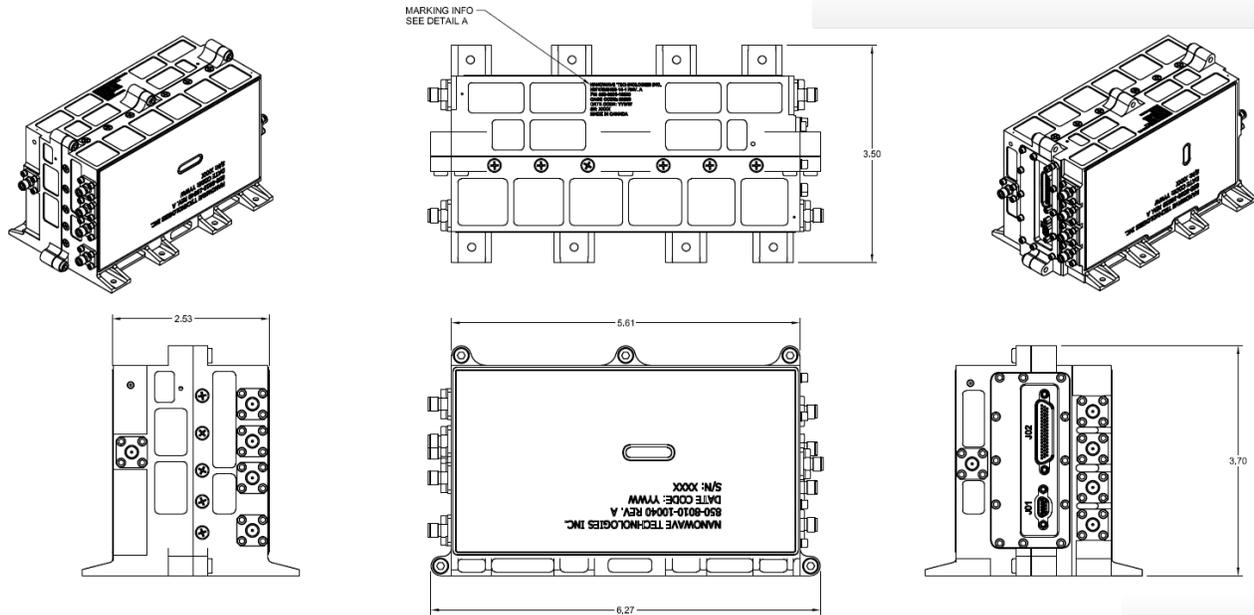


Fig 1: Outline Drawing of TRM

ADDITIONAL FEATURES

- Marking: The unit is marked with Manufacturer Part Number, Date Code, and Serial Number.
- All plating and painting is RoHS compliant

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