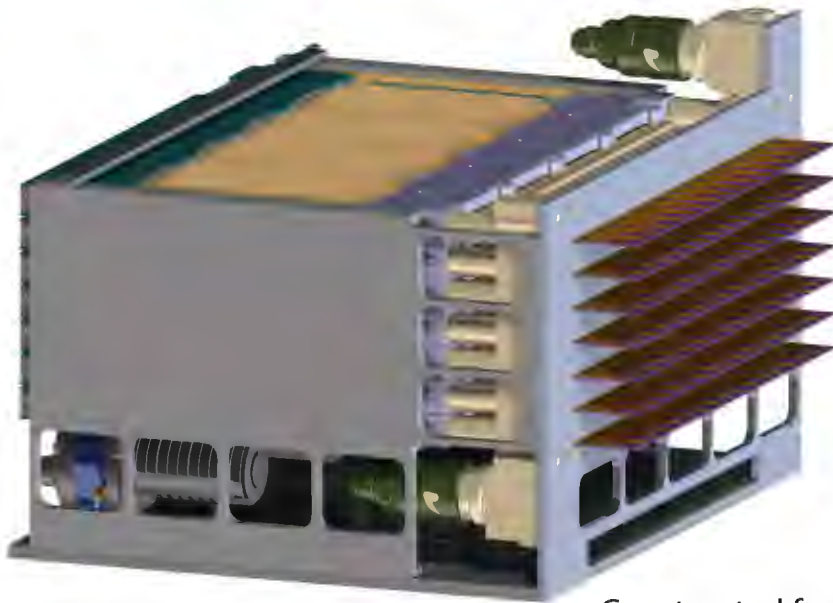


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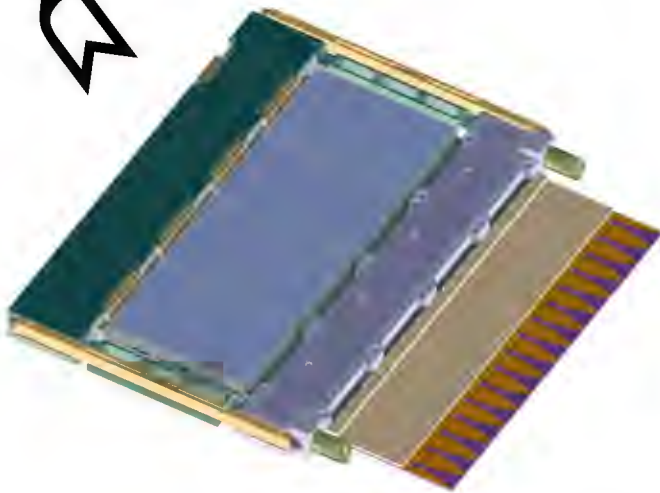
technologies corp.



Scaleable AAAU

(Active Antenna Array Unit)

Constructed from common building blocks QTRMs, contained within a modular Plank assembly. Multiple applications Datalinks, Satcom & Radar. Platform diverse.



Plank assembly

- Consists of multiple QTRMs
- Incorporates RF Manifold & printed antenna elements
- Ease of assembly and maintenance
- Incorporates liquid 'cooling' solution
- Re-configurable



QTRM

- Common module 'Building Block'
- 4-Channel integrated assembly comprising of DC, Logic CTRL/Interface & T/R Module
- Designed for high volume manufacture
- Minimal alignment, custom ATE for factory 'calibration'

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X-Band QTRM Product Capability

QTRM - **Q**uad **T**ransmit **R**eceive **M**odule (4-Channel T/R Module)



- RS485 Half-Duplex, 5.0 Mbps serial data bus for control and monitoring.
- DSP externally programmable via JTAG
- Factory amplitude and phase setting inaccuracies calibrated at the cold-wall operating temperature
- TX output power, HPA temperature, operating current and power supply health monitored and reported on request
- Automatic shut-down if internal temperature reaches a critical limit where damage could occur. Hysteresis applies.
- Positive supplies inhibited (with the exception of the digital control circuits) if negative supply is lost
- Direction cosines used for beam steering
- 4-bit array address code giving up to 16 QTRM sub-array (64- element array)
- TRM's respond to individual address or broadcast messages.
- Module position assignment
- Ability to schedule up to 16 phase & amplitude settings for rapid execution.
- Array CAL allows end-user to add additional TRU phase & amplitude calibration.
- Read-back of set phase & amplitude values for each TRU.
- Selection of internal/external Clock source.
- European Manufacture.



Electrical Performance

Over T_{op} Unless Otherwise stated. Limits & Conditions are indicated values. Indicated values given per channel unless otherwise stated.

Parameter	Min.	Typ.	Max.	Units	Conditions
Parameters: Common					
Centre Frequency		9.5		GHz	
Operating BW		1		GHz	See Note 1
TX/RX Switching Speed			50	ns	Target. From receipt of Gating pulse.
Port-Port Isolation (Antenna)	40			dB	Target 60dB
Input Return Loss	10			dB	
Output Return Loss (Antenna)	10			dB	
Pulse Width	0.2		100	μS	80μS at 30% Duty max.
Duty Cycle	5		30	%	
RF Pulse Rise & Fall time		20		ns	
Data Control Rate		5.0		Mbps	Asynchronous UART RS485 Bus.
Global TX Gating Pulse		Differential			Gate TX PA on 1.0 μS before RF pulse
Beam Steering Pulse		Differential			
No. of Stored Beam Settings			16		Scheduler Mode
Beam Steer Pulse Repetition Rate	15		250	μS	Scheduler Mode – Beam direction change rate.
Power Supplies		+28,+6,-6		V	
Ext. Clock (If used)				MHz	±20ppm LVDS
DC Input CurrentPort)			6	Amps (pk)	+28v supply, TX mode
			1.8	Amps	+6v supply, TX mode
			0.2	Amps	-6v supply
DC Input Consumption (Pk)			170	Watts (pk)	TX mode
Phase Control					
Phase Shift Range	0		355	deg	6-Bits, 64 States, 5.625° Steps.
RMS Error					
9.0 – 10.0GHz	2		4	deg	See Note (2)
Switching Time		500		ns	Target. From receipt of Beam Steer pulse.
Amplitude Control					
Attenuator Range	0		28.5	dB	5-Bits, 32 States, 0.9dB Steps. See Note (3)
RMS Error					
9.0 – 10.0GHz	0.4		0.6	dB	See Note (4)
Switching Time		500		ns	Target. From receipt of Beam Steer pulse.

Environmental

Operating Ambient: -30 to +70°C. Assumes QTRM is fixed to a cold-wall held at 35 ±10 °C

Storage: -40 to +85°C; MTBF : 100,000 hrs target

Notes

- (1) Can operate over a wider bandwidth at reduced performance. Limited by circulator bandwidth.
- (2) RMS Phase error given for reference attenuator state.
- (3) Up to 3dB reduction in useable attenuation range due to Calibration.
- (4) RMS Attenuator error given for reference phase state.
- (5) Figure given for Ref Attenuator state, Ref Phase State.
- (6) Noise Figure given for Ref Attenuator state, Ref Phase State.

Electrical Performance

Over T_{op} Unless Otherwise stated. Limits & Conditions are indicated values. Indicated values given per channel unless otherwise stated.

Parameter	Min.	Typ.	Max.	Units	Conditions
Parameters: Transmit					
TX Psat		8.5		Watts (pk)	8.5 Watts output per antenna at Fo
TX Gain		>40		dB	8.5 to 10.5GHz
TX Power Variation		± 0.5		dB	Per 100MHz in operating bandwidth
TX Power Variation		± 1.0			9.0 to 10.0GHz
Power Variation Between Outputs		± 1.0		dB	
TX Input Power Level		+5		dBm	For Ps at Out.
Spurious		-60		dBc	
TX Phase Variation across pulse		4.0		deg	Across 80 μ S Pulse at 30% Duty
TX Amplitude Variation across pulse		0.5		dB	Across 80 μ S Pulse at 30% Duty
Harmonics		-20		dBc	
TX Insertion Phase Balance		± 15		deg	Between any two channels.Target ± 10
TX Insertion Phase Balance		± 2.0		dB	Between any two channels.Target ± 1.0
Parameters: Receive					
RX P1dB		12		dBm	
RX Gain		35		dB	See Note (5)
RX Input IP3		-15		dBm	
RX Gain Variation		± 0.25		dB	Per 100MHz in operating bandwidth
RX Gain Variation		± 1.5		dB	9.0 to 10.0GHz
RX Noise Figure			3.5	dB	See Note (6). Target <3dB
Receiver Protection			10	Watts (pk)	Protection from reflected TX Power
RX Insertion Phase Balance		± 15		deg	Between any two channels.Target ± 10
RX Gain Balance		± 2.0		dB	Between any two channels.Target ± 1.0
Recovery Time		100		ns	
Spurious Free Dynamic Range		88		dB	5MHz Bandwidth

Mechanical

Size: 150(L) x 59.5(W) x 14.5mm(D) excluding connectors

Mass: < 200gm, target <150gm

RF Connectors: Male GPO hermetic shroud (Corning Gilbert)

DC Connectors: 177-704H37SS (Glenair Hermetic Micro-D)

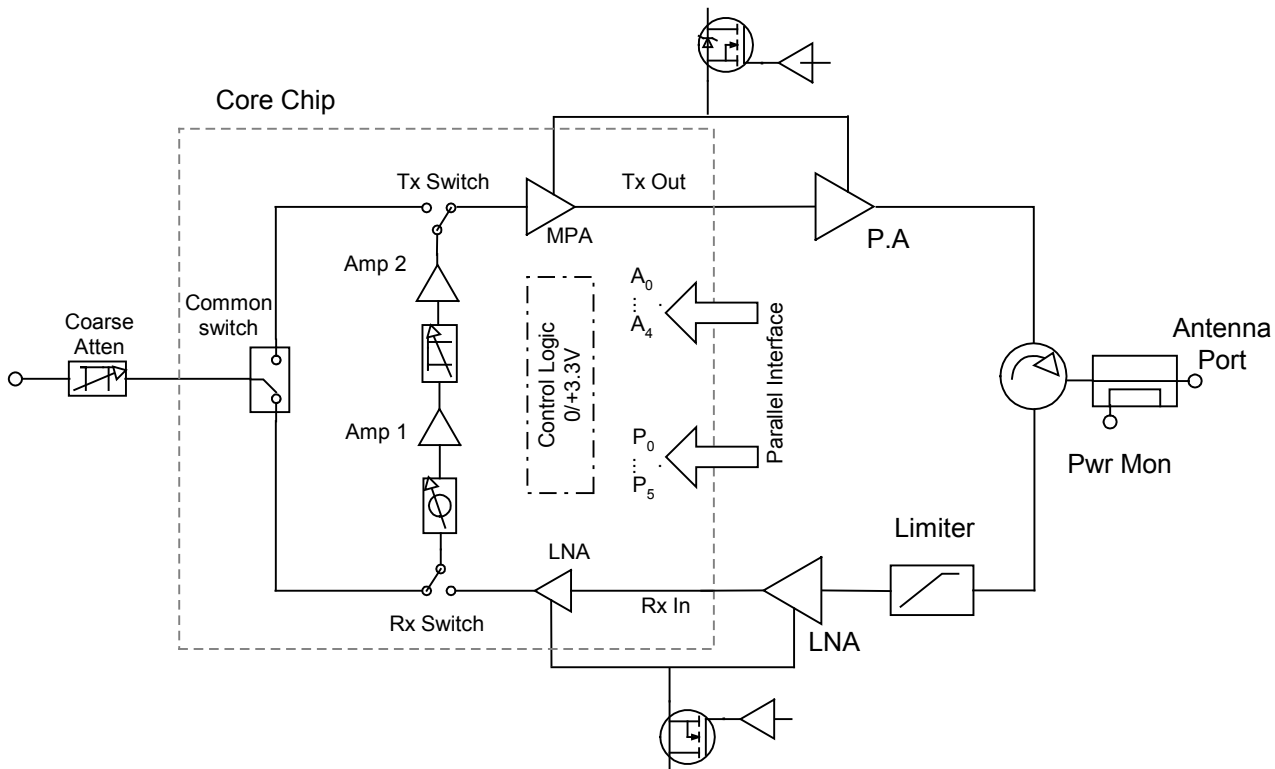
Cooling Method: Heatsink mounted, forced air cooled for demonstration purposes.

(Unit designed to mount against a liquid cooled cold-wall, meeting height constraints for stacked QTRM's in X and Y to form a 2D array)

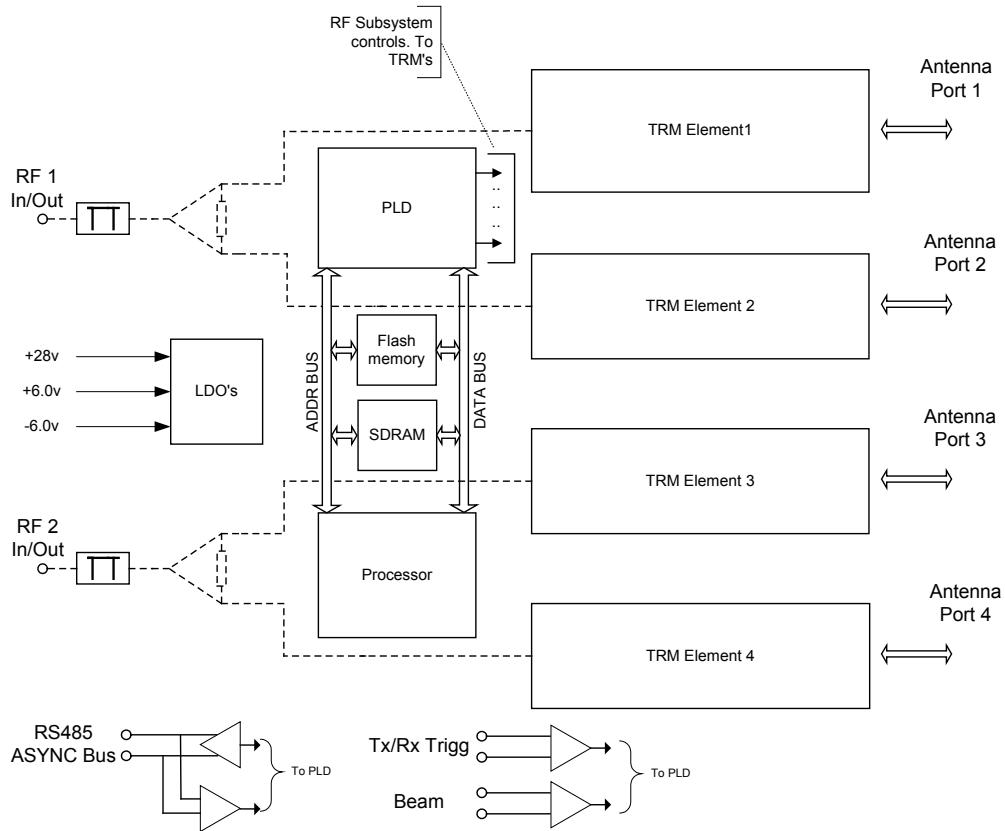
Notes

- (1) Can operate over a wider bandwidth at reduced performance. Limited by circulator bandwidth.
- (2) RMS Phase error given for reference attenuator state.
- (3) Up to 3dB reduction in useable attenuation range due to Calibration.
- (4) RMS Attenuator error given for reference phase state.
- (5) Figure given for Ref Attenuator state, Ref Phase State.
- (6) Noise Figure given for Ref Attenuator state, Ref Phase State.

Functional Block Diagram



TRM Element Block diagram



QTRM Block diagram

Typical Performance

DC Pin-Out Connection's (MWDM2L-37 Series)

Pin No.	Description	Pin No.	Description	Pin No.	Description	Pin No.	Description
1 ₍₇₎	Ext_CLK +ve	11	ADDR_4	21	+6V	31	Beam +ve
2 ₍₇₎	Ext_CLK -ve	12 ₍₈₎	WD_DIS_DSP	22	GND	32	TxPreTrigg +ve
3	ADDR_5	13 ₍₈₎	EM_VDD	23	GND	33	Beam -ve
4	Spare	14 ₍₈₎	TDO_DSP	24	GND	34	+28V
5	Spare	15 ₍₈₎	TMS_DSP	25	GND	35	+28V
6	GND	16 ₍₈₎	TRSTn_DSP	26	GND	36	+28V
7	ADDR_0	17 ₍₈₎	EMUn_DSP	27	GND	37	+28V
8	ADDR_1	18 ₍₈₎	TDI_DSP	28	RS485 -ve		
9	ADDR_2	19 ₍₈₎	TCK_DSP	29	RS485 +ve		
10	ADDR_3	20	-6V	30	Tx PreTrigg -ve		

Notes

(7) External Clock (if used) 100MHz LVDS ± 20 ppm

(8) For Factory use only, do not connect leave open circuit.

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4通道C頻段發射接收模組

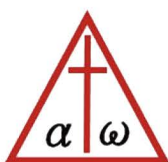
C-Band QTRM Product Capability

QTRM - Quad *T*ransmit *R*eceive *M*odule (4-Channel T/R Module)



- Gallium Nitride Power Amplifier Technology
- 1GHz Bandwidth
- Low Noise Figure (<4.5dB)
- 6-Bit Phase Control
- 6-Bit Attenuator Control
- Single +28V Supply
- BITE and PSU Supervisory
- Built in Tx and Rx Power BITE Detectors
- Factory Calibrated
- Accessible memory for External Calibration data
- Cooling interface
- Designed to fit Typical Antenna Aperture Spacing
- Line Replaceable Unit
- European Manufacture.

主動式電子掃描陣列(AESA)使用



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• <http://www.nearson.com.tw>

Description

The C-Band Module contains four Transmit/Receive (T/R) channels providing four RF ports which can be connected to individual antenna elements to form part of a phased array active antenna unit.

The module is fitted with blind mate RF connectors and its height and antenna port spacing dimensions are specifically designed to allow direct connection to the back of antenna aperture face. Alternatively, RF cable assemblies may be used to connect to the individual antenna elements.

The power amplifier section of each channel incorporates Gallium Nitride technology, this along with provision for liquid cooling allows high power levels, long pulse widths and high duty cycles to be realised.

The Module is supplied from a single 28 volt DC supply and contains the necessary supply conditioning to power the four channels. Built in power supply sequencing and built in test equipment (BITE) functions are included to allow individual channel monitoring and shut-down in the presence of a fault condition.

Module communication for control and monitoring is provided by a half-duplex, asynchronous serial EIA485 bus.

The serial data takes the form of a number of messages assigned to either control the individual T/R channels or to retrieve information about the module's settings or health status. RF2M have developed a Graphical User Interface (GUI) to control and monitor the module which can be run from a laptop or desktop computer.

Each module has a unique address which may be interrogated by an external controller; this allows the external controller to address and individual module within an array.

The QTRM's are factory calibrated to minimise amplitude and phase variations over temperature and frequency, making them line-replaceable units. Additional calibration constants that are User system related (such as the interface between the radiating element to T/R channel and any associated antenna taper requirements) can be uploaded to the module via the EIA485 serial data link.

The QTRM supports 'scaleable' AESA Radar thus providing flexibility for different platforms applications.

Mechanical

Approximate Size: 150 mm(L) x 128 mm(W) x 28 mm(H) excluding connectors

Approximate Mass: 1.2 Kg

RF Connectors: Male SMP

DC Connectors : 37-way Micro-D (Power Supply & Control) and 15-way Micro-D (Factory Use Only) plugs

Hydraulic Connectors : Staubli non-spill CGO 03 type or Similar

Cooling Fluid : Glycol Mix

Inlet Temperature: +48°C max.

Fluid Flow Rate : 1Litre/min Typ

Pressure Drop : < 0.2 bar with a fluid flow rate of 1L/min

Environmental

Operating Ambient: -40 to +70°C Dependent upon Transmit Pulse Width, Duty Cycle and Inlet Cooling Fluid Temperature.

Storage: -40 to +85°C

NOTES

- (1) Up to 3dB reduction in useable attenuation range due to factory Calibration
- (2) Gallium Nitride Power Amplifier technology enables long pulse durations
- (3) Figure given for Ref Attenuator state, Ref Phase State

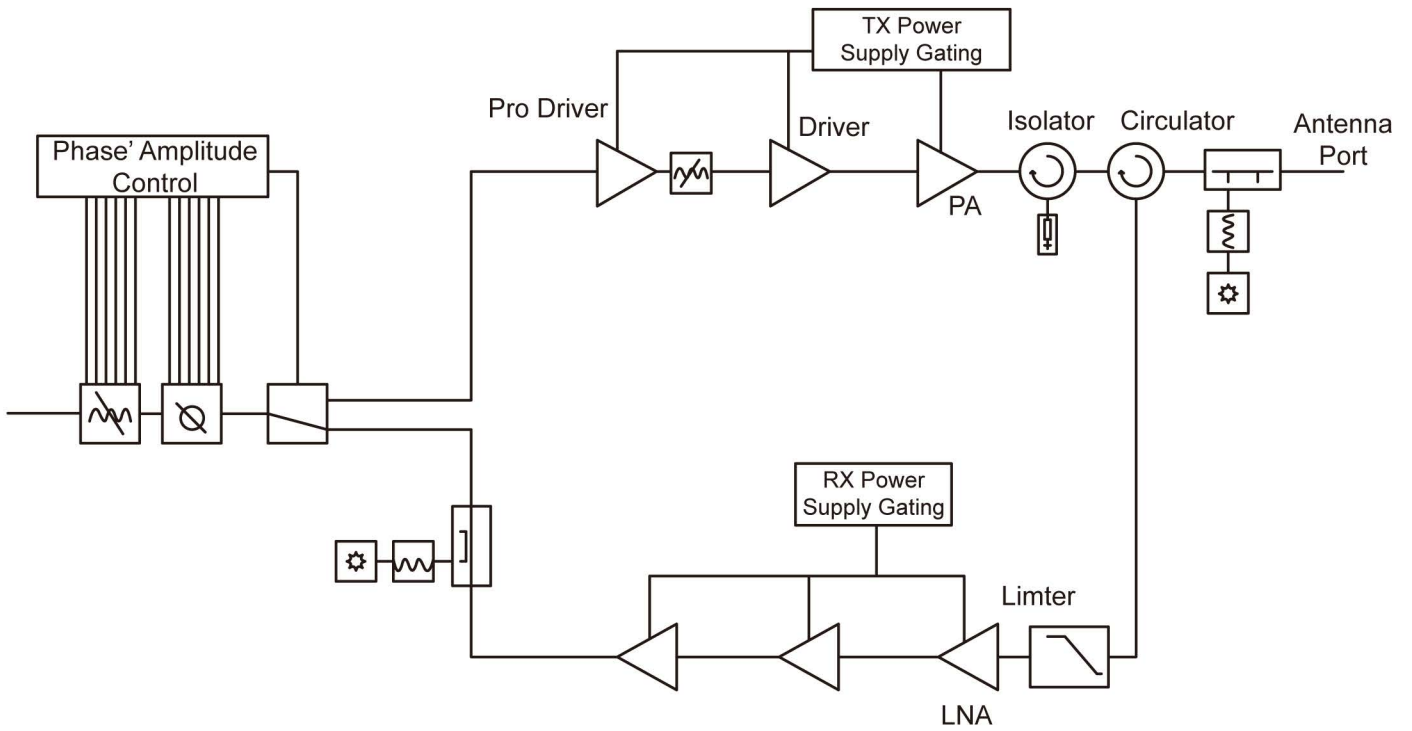
Electrical Performance

Over T_{OP} Unless Otherwise stated. Limits & Conditions are indicated values. Indicated values given per channel unless otherwise stated.

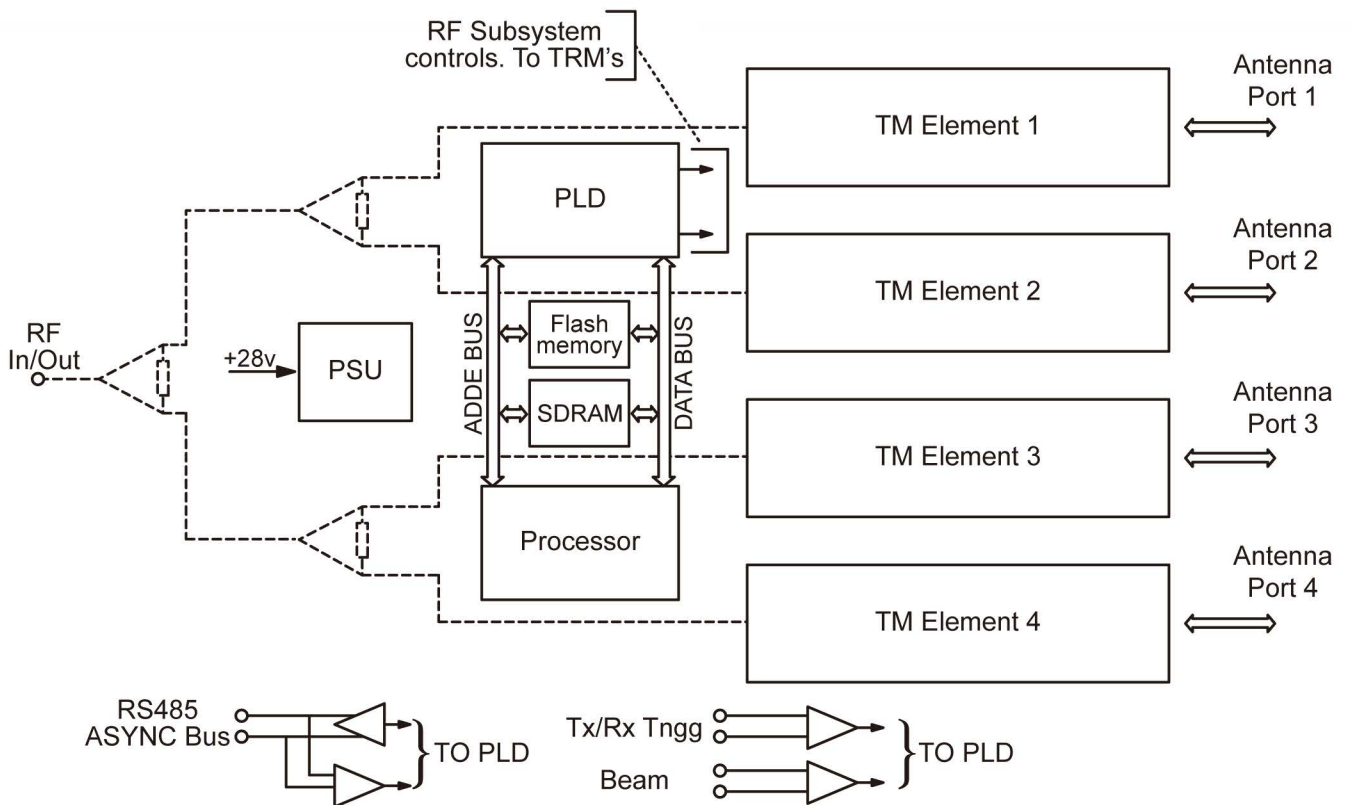
Parameter	Min.	Typ.	Max.	Units	Conditions
Parameters: Common					
Centre Frequency		5		GHz	
Operating BW		1		GHz	
Input Return Loss		12		dB	Common RF In/Out port
Output Return Loss		12		dB	Individual Antenna ports
RS485 Serial Data Bus		Differential			Asynchronous UART, half-duplex
Data Control Rate		5.0		Mbps	Asynchronous UART RS485 Bus.
TX PA Gating Pulse		Differential			
Beam Steering Pulse		Differential			Triggers Beam Direction change
No. of Stored Beam Settings			16		Scheduler Mode
Beam Steers Data Transfer Time			350	μS	Time taken to re-load Scheduler register
Supply Voltage		+28		Volts	
Supply Current		7.5		Amps	Average current @ 28v. 50% duty
DC Input Consumption		210		Watts	Average power @ 28v. 50% duty
Amplitude Control					
Attenuation Range		31.5		dB	6-Bits, LSB = 0.5dB, See Note 1
RMS Attenuation Error			1.5	dB	Reference Phase State
Phase Control					
Phase Shift Range		355		deg	6-Bits, LSB = 5.62°
RMS Phase Error			4.5	deg	Reference Attenuation State

Parameter	Min.	Typ.	Max.	Units	Conditions
Parameters: Transmit					
TX Psat		8.5		Watts(pk)	Per Channel
TX Input Power Level		+18		dBm	For Saturated Power
Spurious		-60		dBc	
Pulse Droop		0.2		dB	100 μS, 10% Duty Cycle
Pulse Droop (Long Pulse)		0.4		dB	40 mS, 80% Duty Cycle, See Note 2
Harmonics		-30		dBc	
TX Insertion Phase Balance		±15		deg	
TX Power Balance		±1.25		dB	
Parameters: Receive					
RX Output P1dB		+6		dBm	
RX Gain		15.5		dB	See Note 3
RX Noise Figure			4.5	dB	
Receiver Protection per Channel		100		dB	300 μS Pulse
RX Insetion Phase Balance		±15		dB	
RX Gain Balance		±1.25		dB	

Functional Block Diagram



Single TRM Element Block diagram



QTRM Block diagram

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