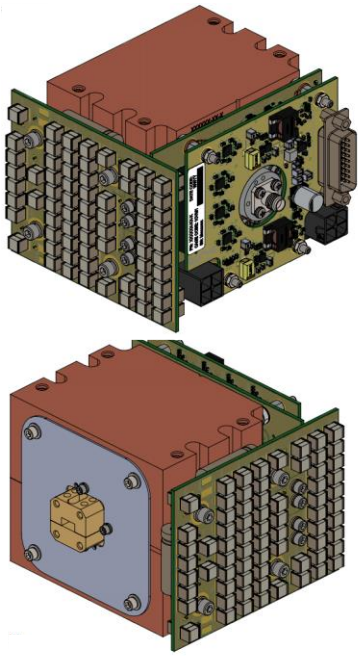
Spatium™ QPB1111

34 – 36 GHz 250 Watt GaN SSPA

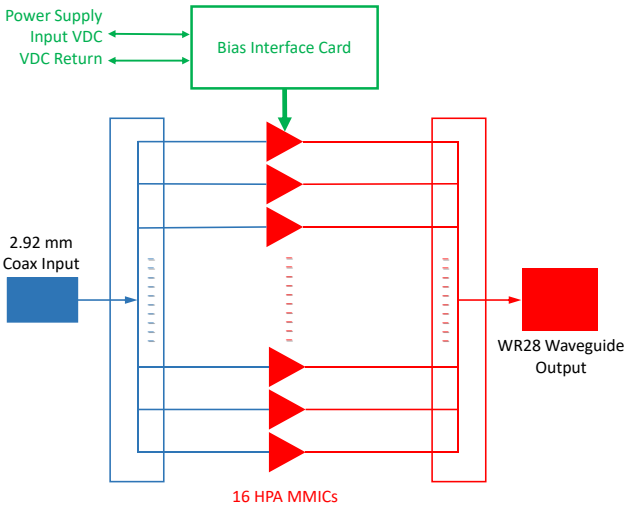
Product Description

An excellent alternative to traveling wave tube amplifiers, Qorvo's Spatium™ QPB1111 is a solid state, spatial-combining amplifier with an operating range of 34-36 GHz while achieving a minimum of 54 dBm (250 Watts) of instantaneous saturated power. With its maximum performance in gain, efficiency, signal flatness, and RF output power, this Spatium is the ideal building block for millimeter-wave sub-systems with wide-ranging applications.

Qorvo's patented and field-proven Spatium combining technology provides unprecedented Solid-State Power Amplifier (SSPA) performance in a rugged, compact size and weight which reduces total cost of ownership compared to alternative technologies. This product offering combines Qorvo's market leadership in GaN technology and Ka-band MMIC design along with our high-count combining techniques for a best in class solution to power amplification.



Functional Block Diagram



Product Features

- Frequency Range: 34 – 36 GHz
- Saturated Power: 55.4 dBm
- Efficiency: 16 %
- Solid State MMIC Reliability
- Multi-Element Redundancy
- Instant On (no warm up)

Performance is typical across frequency. Please reference electrical specification table and data plots for more details.

Applications

- TWTA Replacement

Part No.	Description
QPB1111	34 – 36 GHz GaN SSPA

Absolute Maximum Ratings

Parameter	Value / Range
Max. DC Supply Voltage (V_{DC})	29.5 V
Min. DC Supply Voltage (V_{DC})	23.0 V
Drain Current (I_{D_DRIVE})	90 A
Max. RF Input Power (1.5:1 VSWR)	43 dBm
Operating Temperature*	−40 to +75 °C
Storage Temperature	−40 to +85 °C

Operation of this device outside the parameter ranges given above may cause permanent damage. These are stress ratings only, and functional operation of the device at these conditions is not implied.

* Refers to max/min temperature as measured on the two clamp surfaces utilized for heat rejection. See Sheet 10 for locations.

Recommended Operating

Parameter	Value / Range
Drain Voltage (V_D)	+28 V
Quiescent Drain Current (I_{DQ})	5.4 A
Operating Drain Current (I_D)	38 A

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

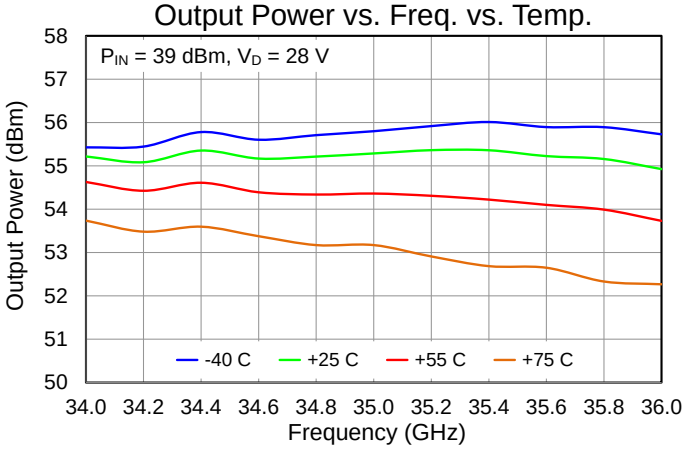
Electrical Specifications

Parameter	Min	Typ	Max	Units
Frequency	34		36	GHz
Output Power (Pulsed, P_{IN} = 39 dBm)		55.2		dBm
Power Gain (Pulsed, P_{IN} = 39 dBm)		16.2		dB
Gain Flatness vs Freq. (Pulsed, P_{IN} = 39 dBm)		0.6		dB
Efficiency (Pulsed, P_{IN} = 39 dBm)		16.0		%
Pulse Droop (PW=50 us, F=35 GHz, P_{IN}=39 dBm)				
−40 C		0.7		dB
+25 C		0.8		dB
+55 C		1.0		dB
+75 C		1.6		dB
Rise/Fall Time (PW=20 ns, F=35 GHz, P_{IN}=39 dBm)				
−40 C		5.0 / 2.9		ns
+25 C		5.8 / 3.1		ns
+55 C		6.4 / 3.1		ns
+75 C		9.3 / 3.4		ns
Input Return Loss (CW)		13		dB
DC Power (average)		1100		W
Input RF Interface	2.92 mm (F) Coaxial Connector			
Output RF Interface	WR-28 Waveguide			
Weight: Amplifier + Bias Card		6.1 (2.77)		lbs. (kg)
Dimensions: Amplifier + Bias Card (L) x (W) x (H)		3.94 x 2.91 x 3.85		inches
		100 x 74 x 98		millimeters
Test conditions unless otherwise noted: V_{DC} = 28 V, I_{DQ} = 5.4 A, PW = 5 us, DC = 50%, 25 °C ambient				

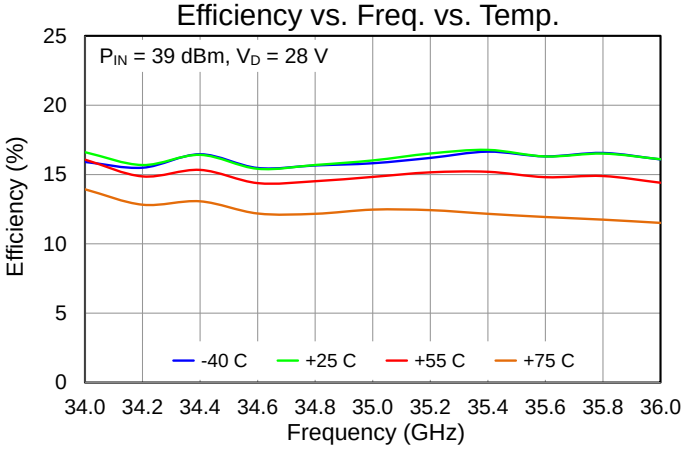
Typical Performance – Large Signal

Conditions unless otherwise specified: V_D = +28 V, I_{DQ} = 5.4 A, P_{IN}= 39 dBm, Pulse Width = 5 us, Duty Cycle = 50%

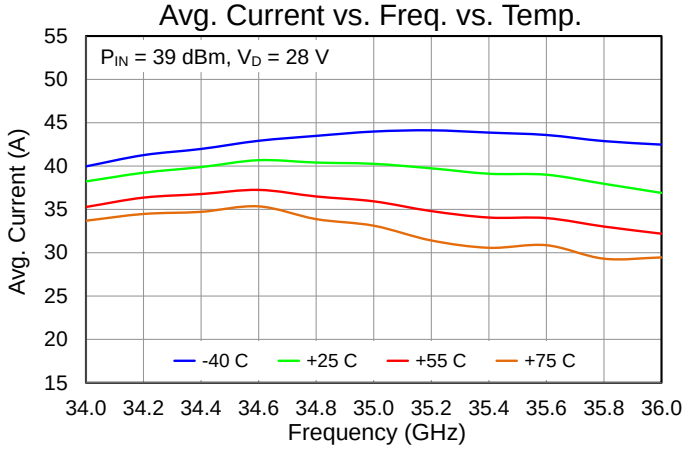
Output Power vs. Freq. vs. Temp.



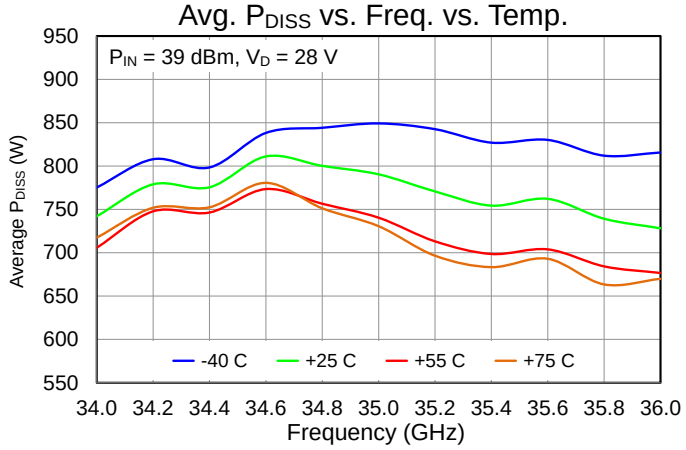
Efficiency vs. Freq. vs. Temp.



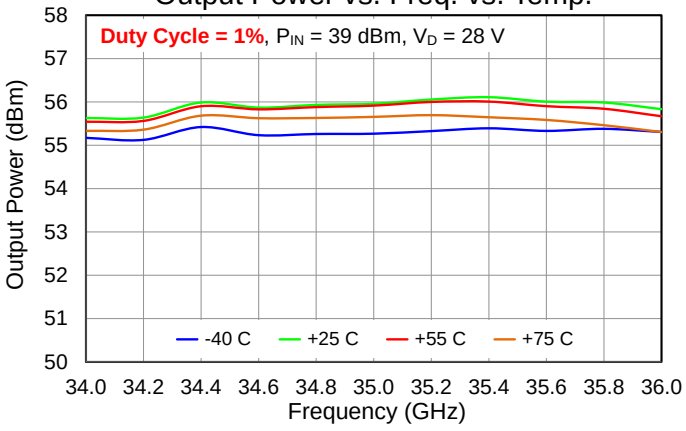
Avg. Current vs. Freq. vs. Temp.



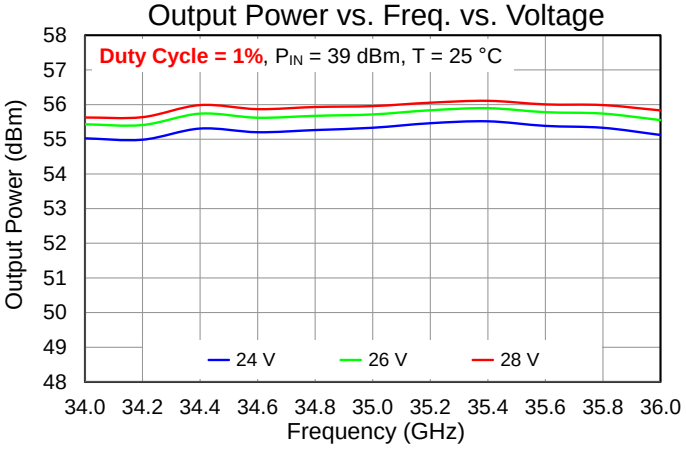
Avg. P_{DISS} vs. Freq. vs. Temp.



Output Power vs. Freq. vs. Temp.

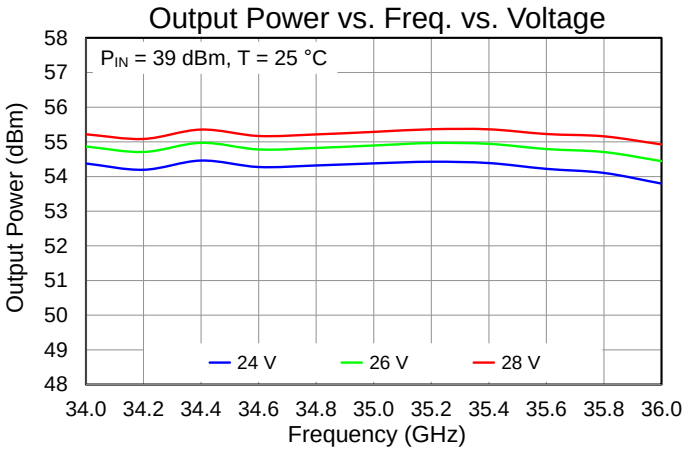


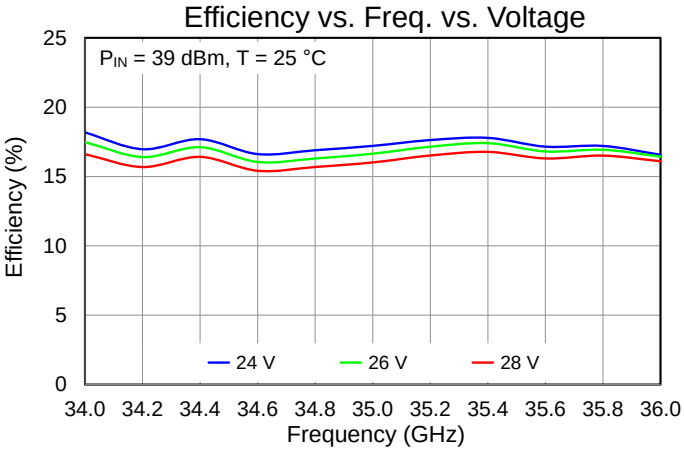
Output Power vs. Freq. vs. Voltage

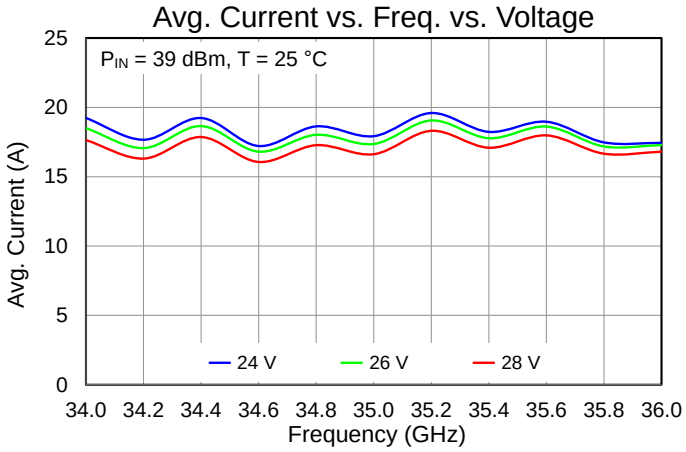


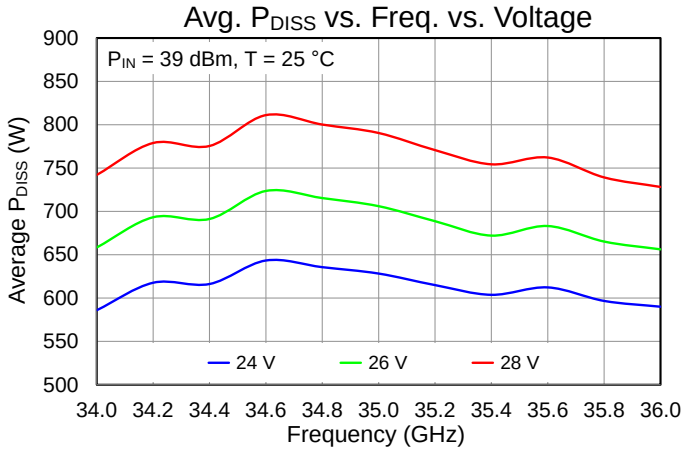
Typical Performance – Large Signal

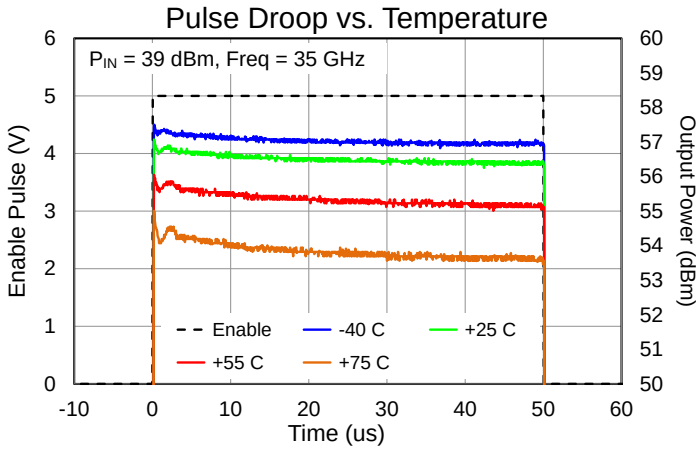
Conditions unless otherwise specified: V_D = +28 V, I_{DQ} = 5.4 A, P_{IN}= 39 dBm, Pulse Width = 5us, Duty Cycle = 50%

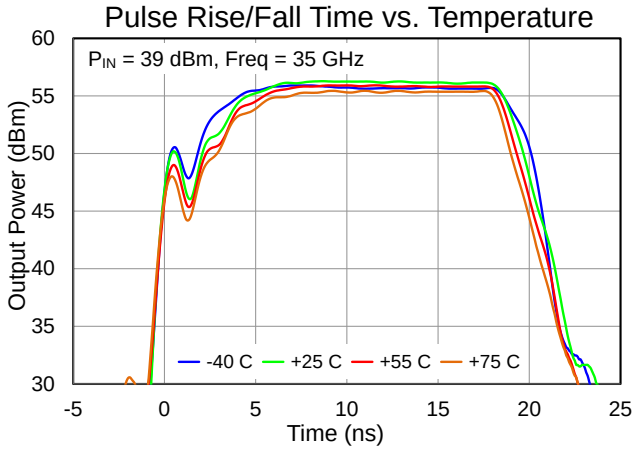






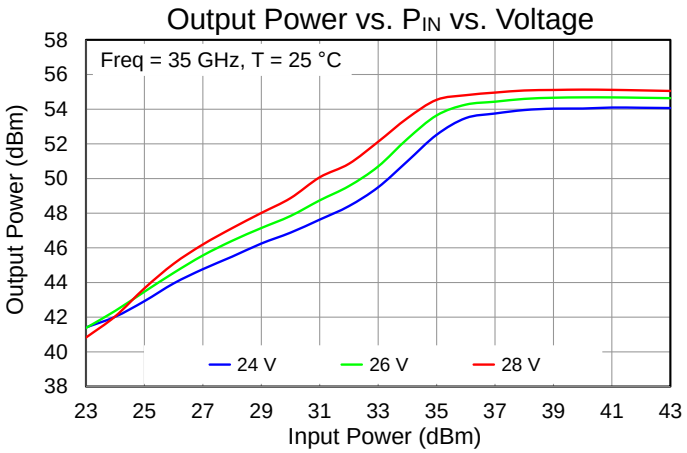


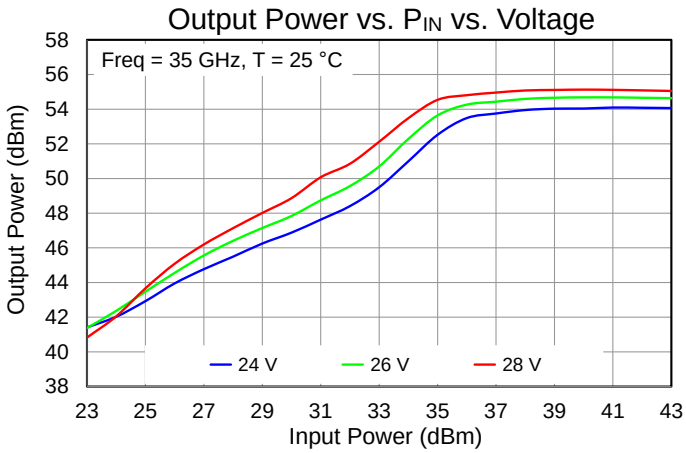


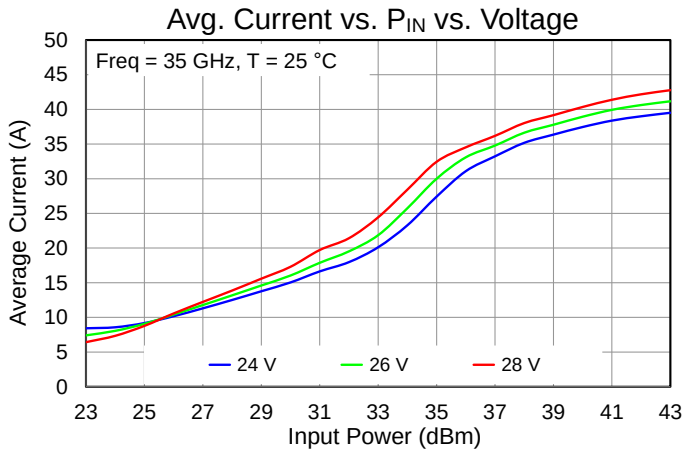


Typical Performance – Large Signal

Conditions unless otherwise specified: V_D = +28 V, I_{DQ} = 5.4 A, T = 25 °C, Pulse Width = 5us, Duty Cycle = 50%

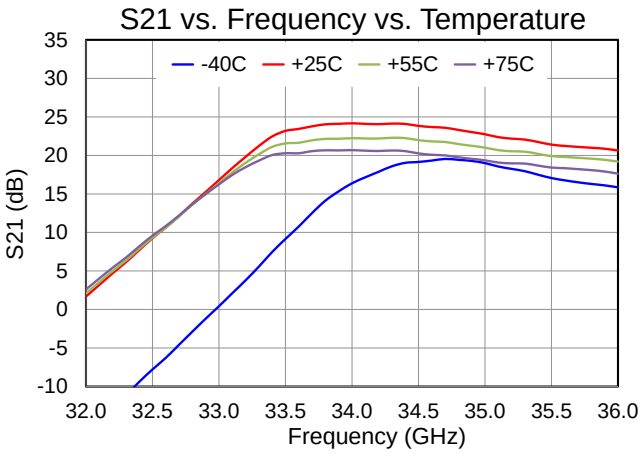


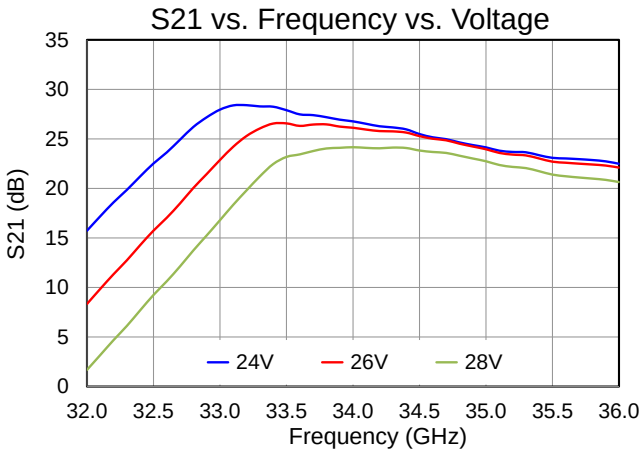


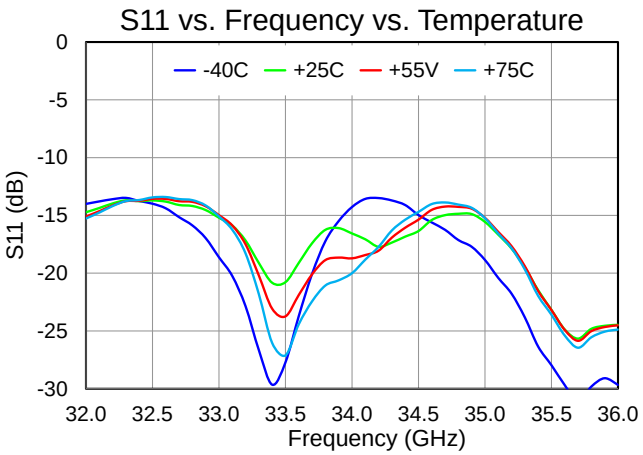


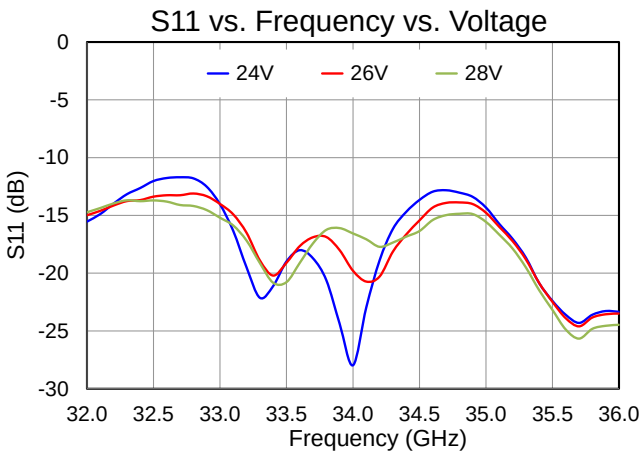
Typical Performance – Small Signal

Conditions unless otherwise specified: V_D = +28 V, I_{DQ} = 5.4 A, T = 25 °C, CW

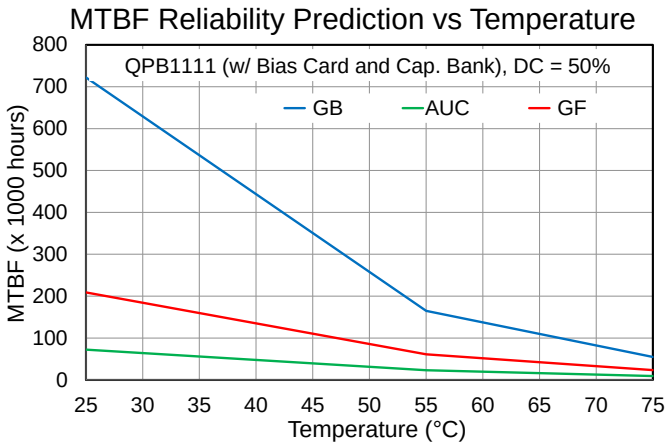


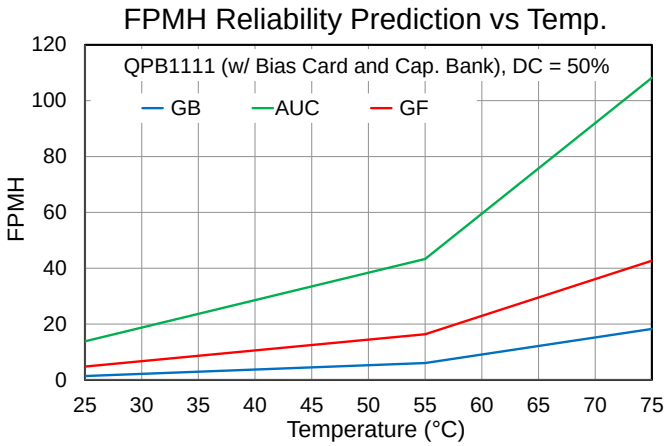






Reliability Information

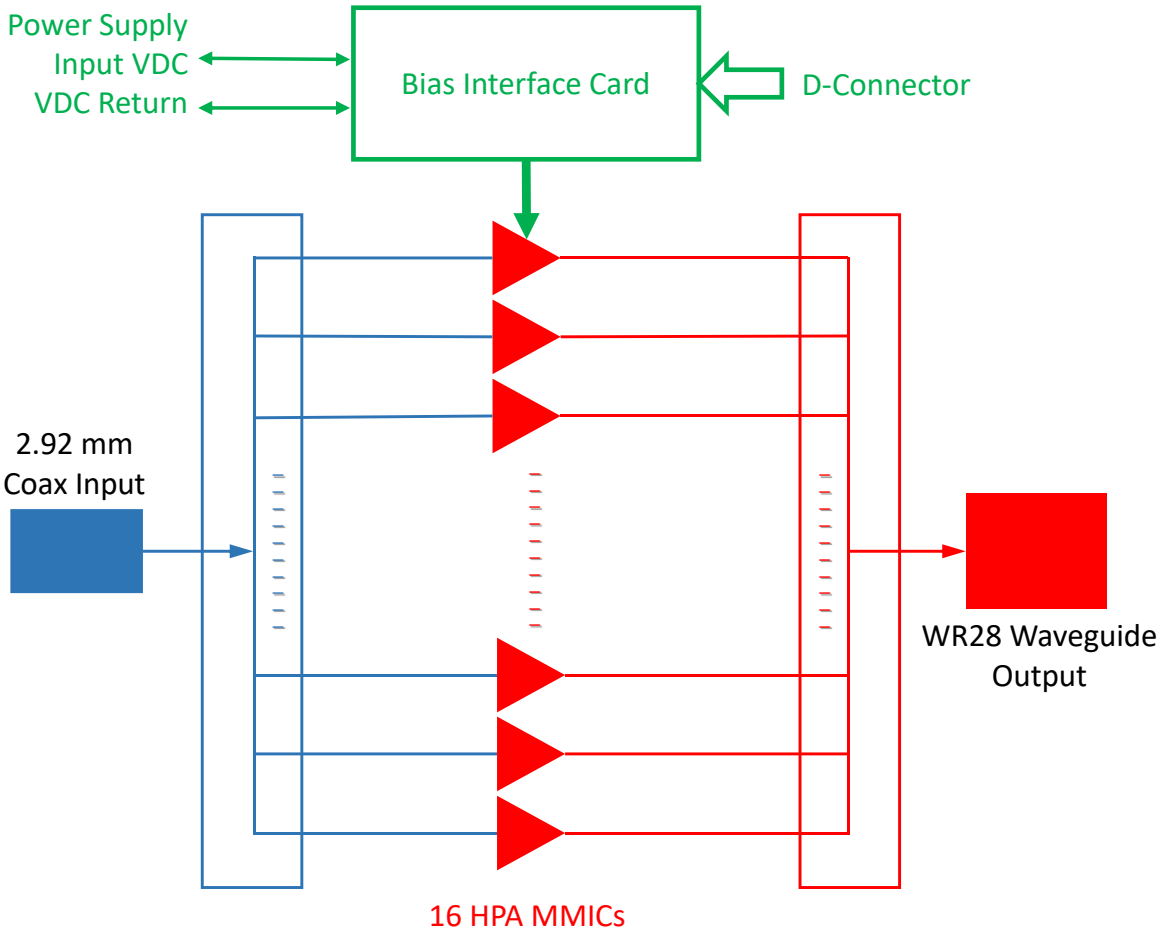




Calculations derived from MIL-HDBK-217F

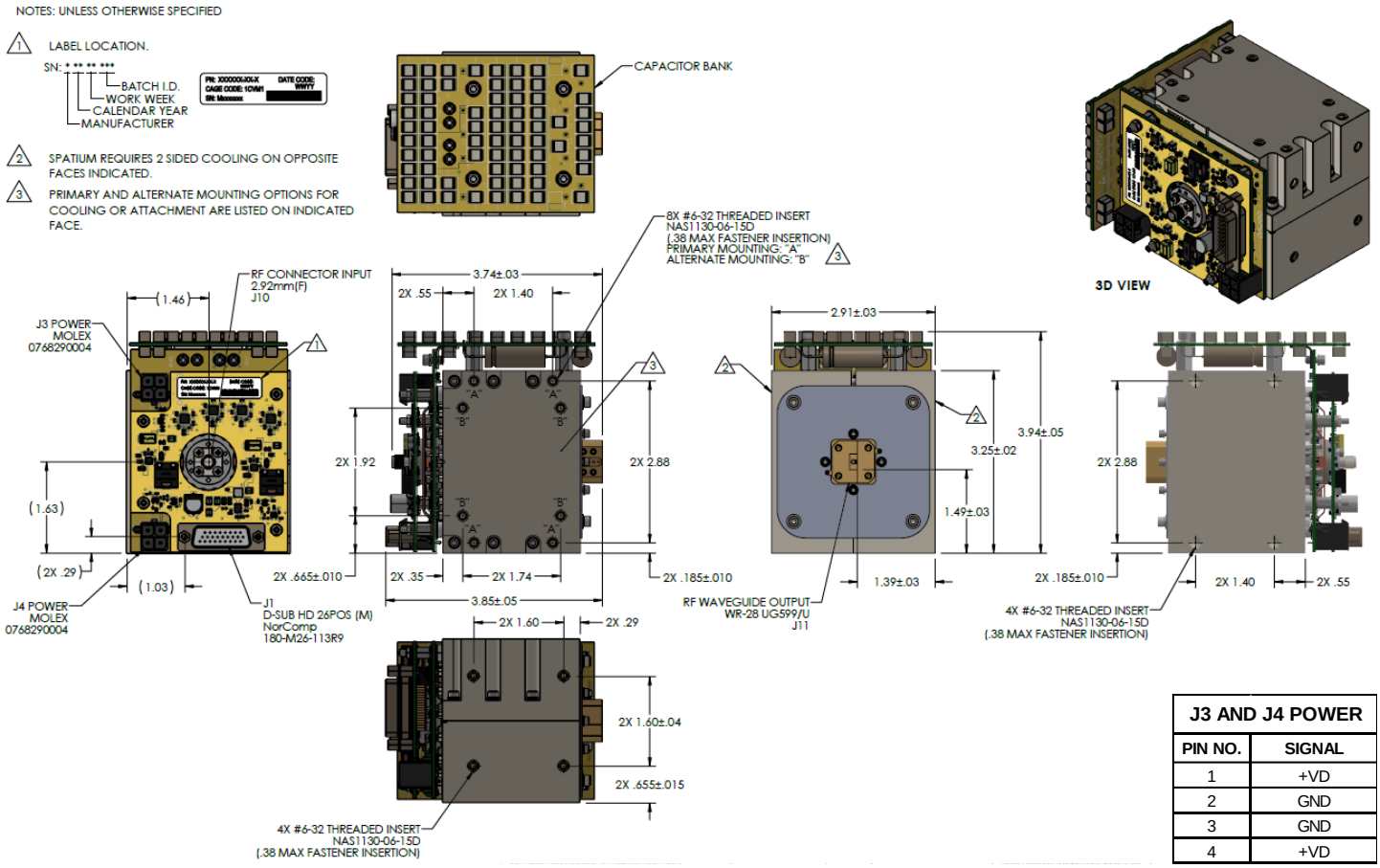
Operational environments are:
GB – Ground Benign
GF – Ground Fixed
AUC – Airborne Uninhabited Cargo

Block Diagram and Description



Pin No.	Label	Description
RF In	J10	2.92mm (F) Coaxial RF Input.
RF Out	J11	WR28 UG599/U Waveguide High Power RF Output
Auxiliary	J1	D-SUB HD 26POS (M), NorComp, 180-M26-113R9
Power	J3, J4	MOLEX, 07682900

Mechanical Information – Outline Drawing



J3 AND J4 POWER	
PIN NO.	SIGNAL
1	+VD
2	GND
3	GND
4	+VD

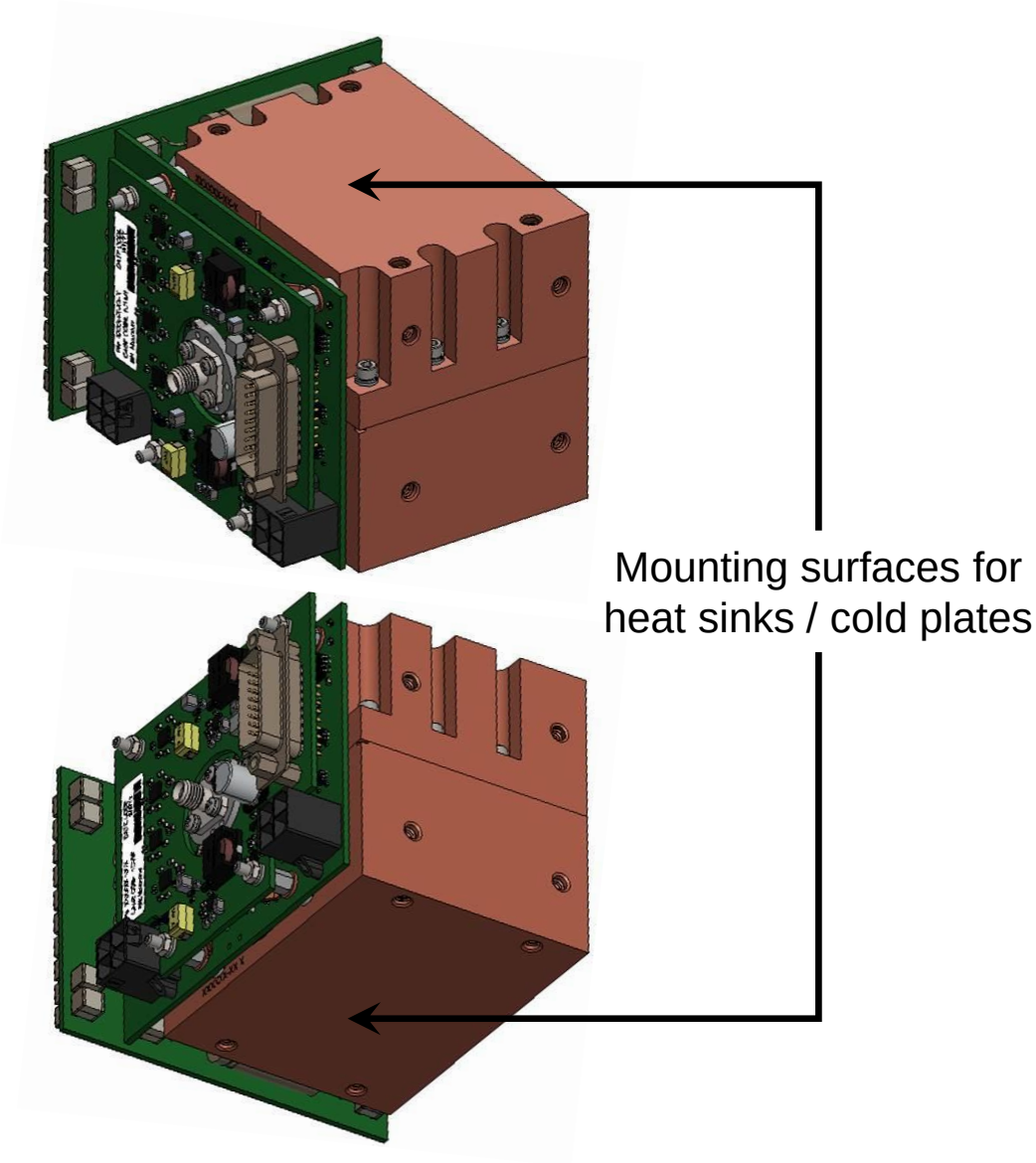
Dimensions are in INCHES.

Mechanical Information – Bias Card Connector Pins (Original)

J1 CONNECTOR PIN FUNCTION AND DEFINITION		
PIN NO.	**FUNCTION**	**DESCRIPTION**
J1-1	DRAIN 1 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 1 of the Spatium
J1-2	DRAIN 2 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 2 of the Spatium
J1-3	DRAIN 3 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 3 of the Spatium
J1-4	DRAIN 4 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 4 of the Spatium
J1-5	DRAIN 5 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 5 of the Spatium
J1-6	DRAIN 6 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 6 of the Spatium
J1-7	DRAIN 7 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 7 of the Spatium
J1-8	DRAIN 8 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 8 of the Spatium
J1-9	DRAIN 9 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 9 of the Spatium
J1-10	DRAIN 10 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 10 of the Spatium
J1-11	DRAIN 11 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 11 of the Spatium
J1-12	DRAIN 12 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 12 of the Spatium
J1-13	DRAIN 13 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 13 of the Spatium
J1-14	DRAIN 14 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 14 of the Spatium
J1-15	DRAIN 15 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 15 of the Spatium
J1-16	DRAIN 16 (1)	Voltage output on this pin follows 0.5V/A times the current flowing through channel 16 of the Spatium
J1-17	5V0 (2)	5V internally generated reference voltage
J1-18	5V0 (2)	5V internally generated reference voltage
J1-19	GND	Connect to logic ground
J1-20	GND	Connect to logic ground
J1-21	VTEMP (3)	Connects to Texas Instruments LMT87 temperature sensor output
J1-22	ENABLE	5V logic command bit to turn on/off the drain voltage leading to each channel of the Spatium. 0V puts the unit into a low-power state while 5V will allow normal operation. In the absence of an external logic signal (open), the amplifier will power on with the application of the supply voltage.
J1-23	SCL	I2C bus used to program amplifier for operation. Please contact Qorvo applications engineering for further information.
J1-24	SDA	I2C bus used to program amplifier for operation. Please contact Qorvo applications engineering for further information.
J1-25	RESET	I2C bus used to program amplifier for operation. Please contact Qorvo applications engineering for further information.
J1-26	GND	Connect to logic ground.
(1) J1-1 through J1-16 can be used for diagnostics / status of MMIC; otherwise, leave open.		
(2) J1-17 and J1-18 can be used to supply up to 100 mA of current if required. Otherwise, leave open. Do not apply a voltage to these pins.		
(3) J1-21 can be used to monitor the reference temperature of the Spatium. For the relationship between the sensor output voltage and temperature, please see the LMT87 datasheet.		

https://www.ti.com/lit/ds/symlink/lmt87.pdf/

Mechanical Information – Location Drawing for Heat Sinks / Cold Plates



Handling Precautions

Caution!
ESD-Sensitive Device

RF VOLTAGE HAZARD: Contact with RF fields at the output connector can cause burns or electric shock. High levels of RF/Microwave energy may be present when the unit is operating.

HIGH DC CURRENT HAZARD: High levels of DC current are present when the unit is operating.

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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