

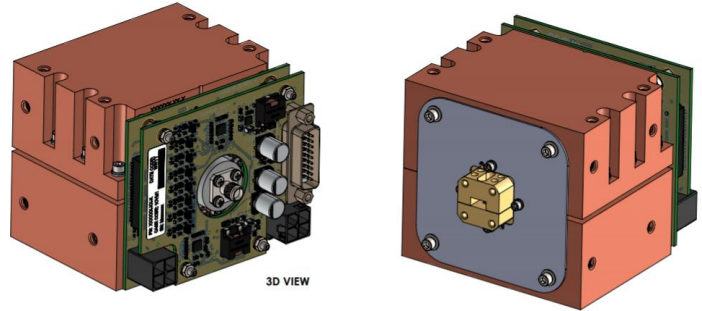
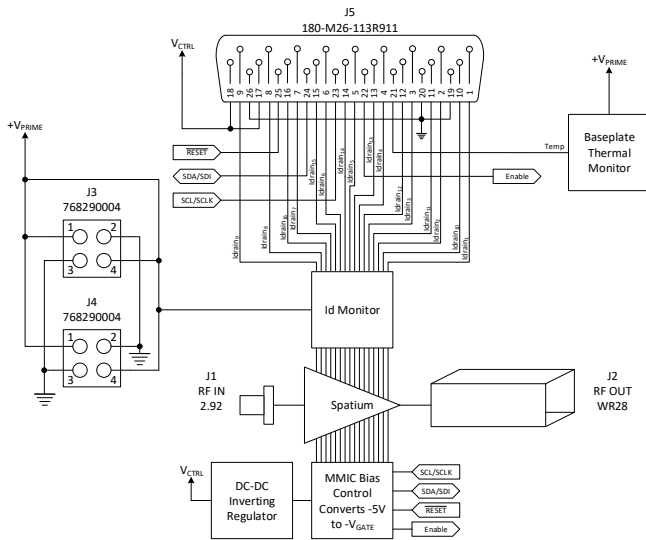
## Product Description

An excellent alternative to traveling wave tube amplifiers, Qorvo’s Spatium™ QPB2731N is a solid state, spatial-combining amplifier with an operating range of 27.5–31 GHz while achieving greater than 49 dBm of instantaneous linear power. With its maximum performance in output power, gain, power added efficiency, and power flatness, this Spatium is the ideal building block for Satcom BUC’s and other millimeter-wave subsystems 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.

The QPB2731N is equipped with an integrated bias card, which allows for convenience of operation, reducing electrical losses in the bias networks, and weight reduction over using a separate bias card. It provides individualized bias settings for each amplifier blade in the Spatium SSPA.

## Functional Block Diagram



Input (L) and Output (R)

## Product Features

- Frequency Range: 27.5–31 GHz
- Saturated Output Power: > 51.5 dBm ( $P_{IN} = 39$  dBm)
- Linear Power (71°C): > 49 dBm
- Solid State MMIC Reliability
- Multi-Element Redundancy
- Instant On (no warm-up)
- Integrated Bias Card

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

## Applications

- TWTA Replacement

## Ordering Information

Part No.	Description
QPB2731N	27.5 – 31 GHz Spatium™ Amplifier

## Absolute Maximum Ratings

Parameter	Value / Range
Prime Power ( $V_{DC}$ )*	29.5 V
Drain Current ( $I_{D\_DRIVE}$ )	40 A
Operating Temperature**	-40 to +71 °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.

\* Rating for GaN Process

\*\* Refers to outside clamp surface temperature

## Recommended Operating Conditions

Parameter	Value / Range
Drain Voltage ( $V_D$ )	22 V
Quiescent Drain Current ( $I_{DQ}$ )	< 6.0 A
Operating Drain Current ( $I_D$ )	< 36 A
Operating Temperature (Linear Power)	-10 to +71 °C
Operating Temperature (Saturated Power)	-10 to +55 °C

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	27.5		31	GHz
Saturated Output Power ( $P_{SAT}$ ) ( $P_{IN} = 39$ dBm)		52.6		dBm
Power Added Efficiency (PAE) ( $P_{IN} = 39$ dBm)		23.8		%
Power Gain ( $P_{IN} = 39$ dBm)		13.6		dB
Gain Flatness ( $P_{IN} = 39$ dBm)		1.3		dB
Linear Power <sup>1,2</sup> ( $P_{LIN}$ ) at 55 °C		50.4		dBm
Linear Power <sup>1,2</sup> ( $P_{LIN}$ ) at 71 °C		50.0		dBm
Small Signal Gain		22.4		dB
Input Return Loss		17		dB
DC Power at $P_{SAT}$ (55°C)		732		W
Input RF Interface	2.92 mm (F) Coaxial Connector			
Output RF Interface	WR-28 Waveguide			
Gate Voltage Range	-3.6		-1.3	V
Gate Current (per channel, continuous)	-75		100	mA
Average Drain Current (per channel)		2.2		A
PCB Temperature Monitor Response	-14		-13	mV/°C
Temperature Monitor Accuracy	-5		5	%
Drain Current Monitor Response		0.5		V/A
Drain Current Monitor Accuracy	-10		10	%
Transmit Ready Time			6	ms
Gate Enable Switching Speed		100	125	µs
Weight – Complete Amplifier Unit		5.66 (2.57)		lbs. (kg)
Dimensions – Amplifier Unit (L) x (W) x (H)		3.25 x 2.91 x 3.86		inches
		82.6 x 73.9 x 98.0		millimeters

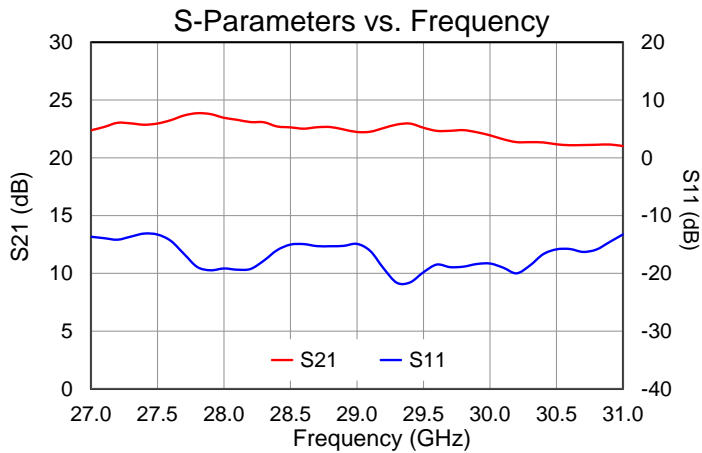
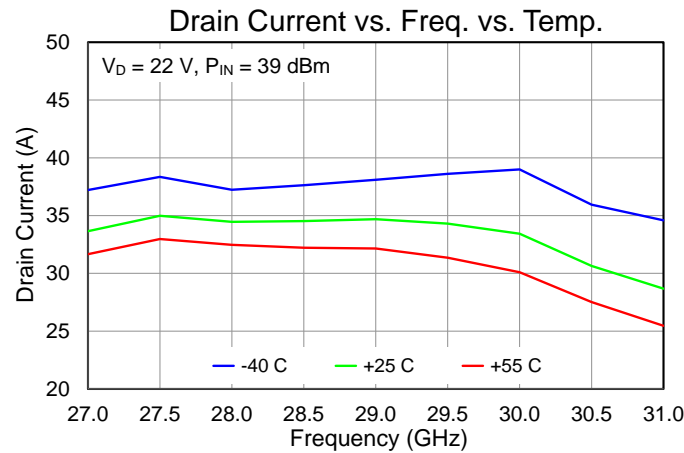
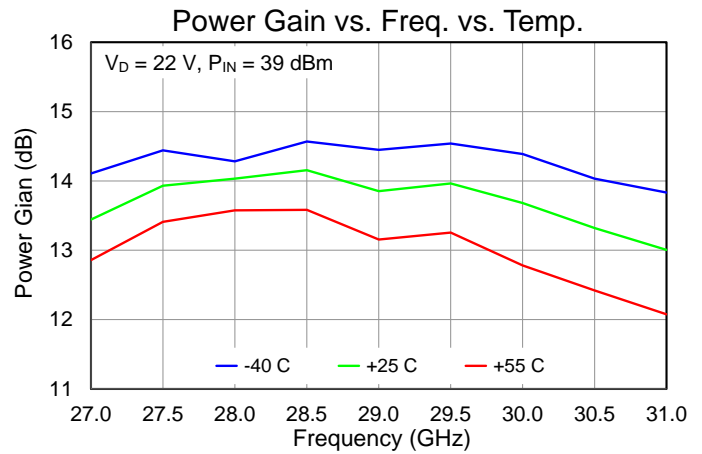
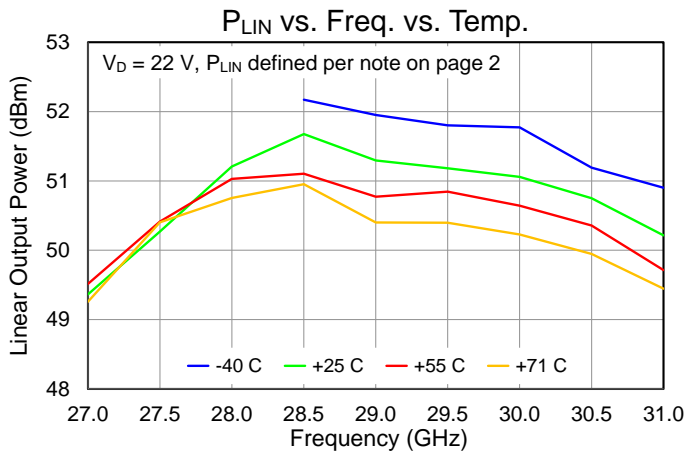
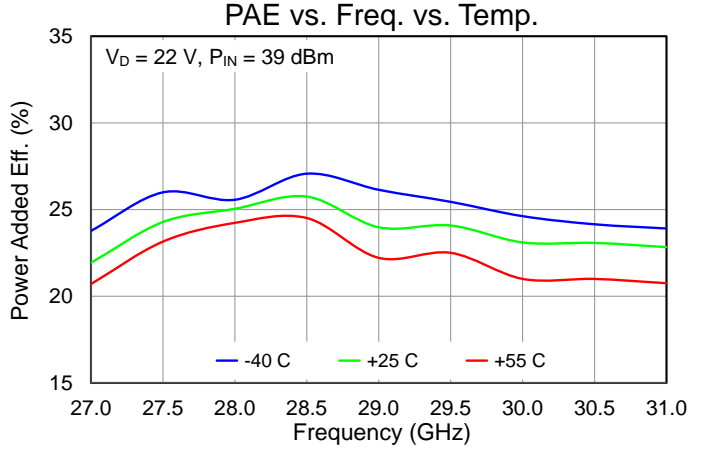
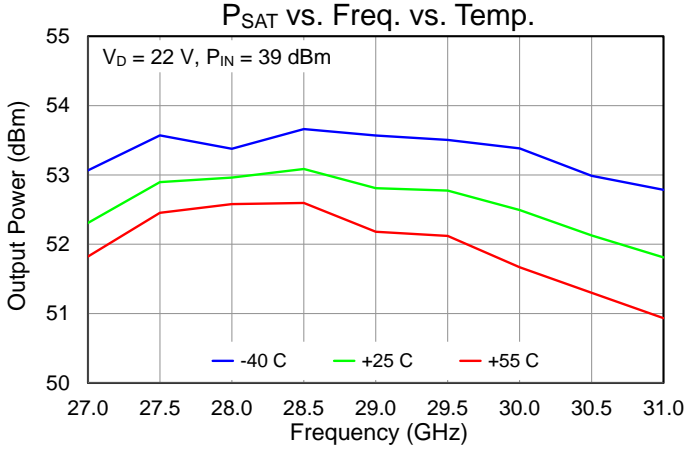
Test conditions unless otherwise noted:  $V_D = 22$  V,  $I_{DQ} = 4.3$  A,  $T = 25$  °C

<sup>1</sup> Linear Power is defined as max output power at flange with -30dBc at 1 MHz offset for 1MSPS OQPSK ( $\alpha=0.35$ ) per MIL-STD-188-164b.

<sup>2</sup> Linear power is not guaranteed at cold temperatures ( $\ll 25$  °C) below 28.5 GHz.

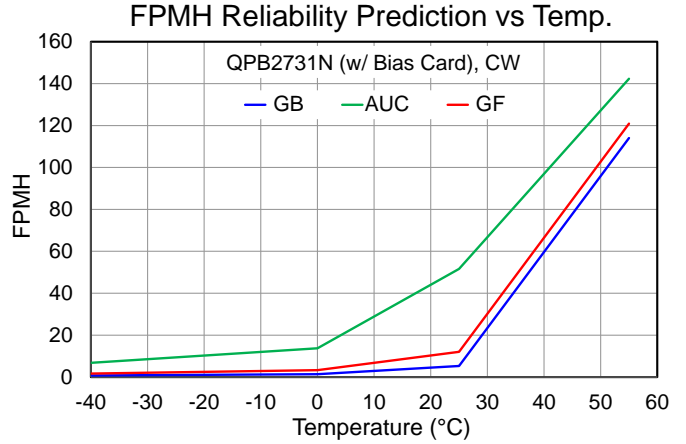
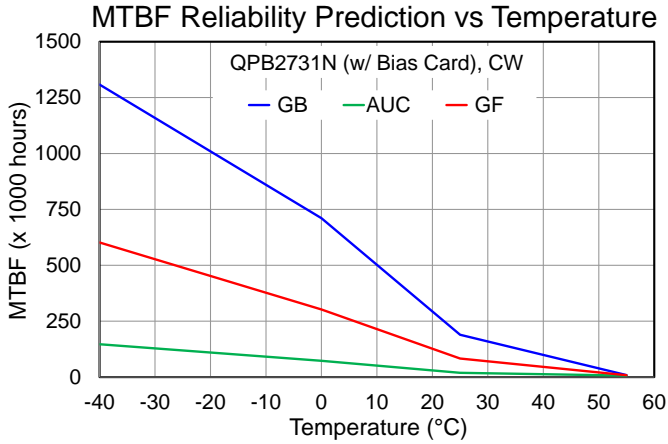
Typical Performance –  $P_{SAT}$ , PAE,  $P_{LIN}$ , Power Gain,  $I_{Drain}$ , S-Parameters

Conditions unless otherwise specified:  $V_D = +22\text{ V}$ ,  $I_{DQ} = 4.3\text{ A}$ ,  $T = 25\text{ }^\circ\text{C}$ , CW Operation



## Reliability Information

Conditions unless otherwise specified:  $V_D = +22\text{ V}$ ,  $I_{DQ} = 4.3\text{ A}$ ,  $T = 25\text{ }^\circ\text{C}$ , CW Operation



Calculations derived from MIL-HDBK-217F

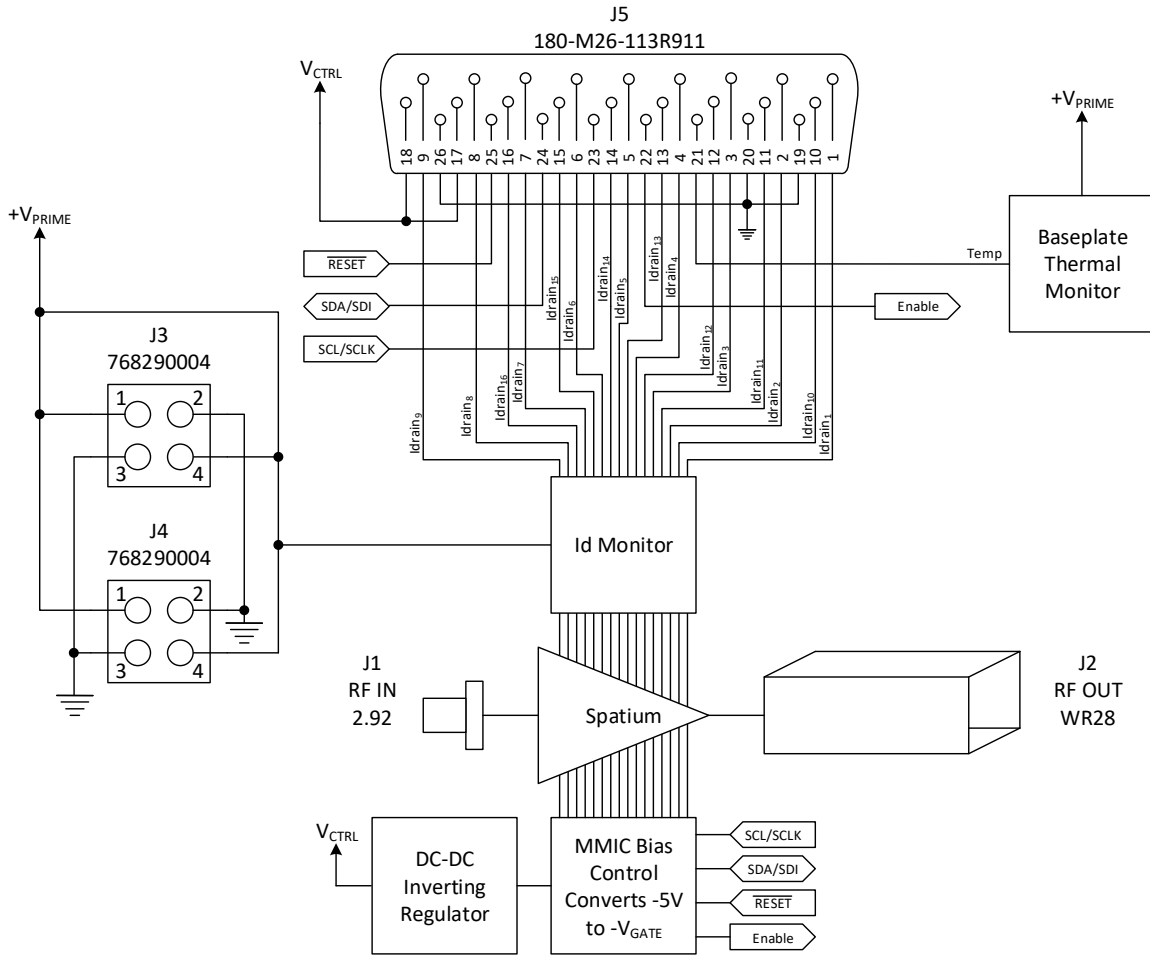
Operational environments are:

GB – Ground Benign

GF – Ground Fixed

AUC – Airborne Uninhabited Cargo

## Block Diagram and Description



Pin 22 ENABLE (5V CMOS compatible level signal):  
 Logic L for Standby mode  
 Logic H for Transmit Ready Mode

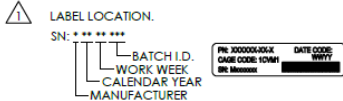
Pin 21 VTEMP is a temperature monitor pin

Pins 23, 24, 25 are for factory use only

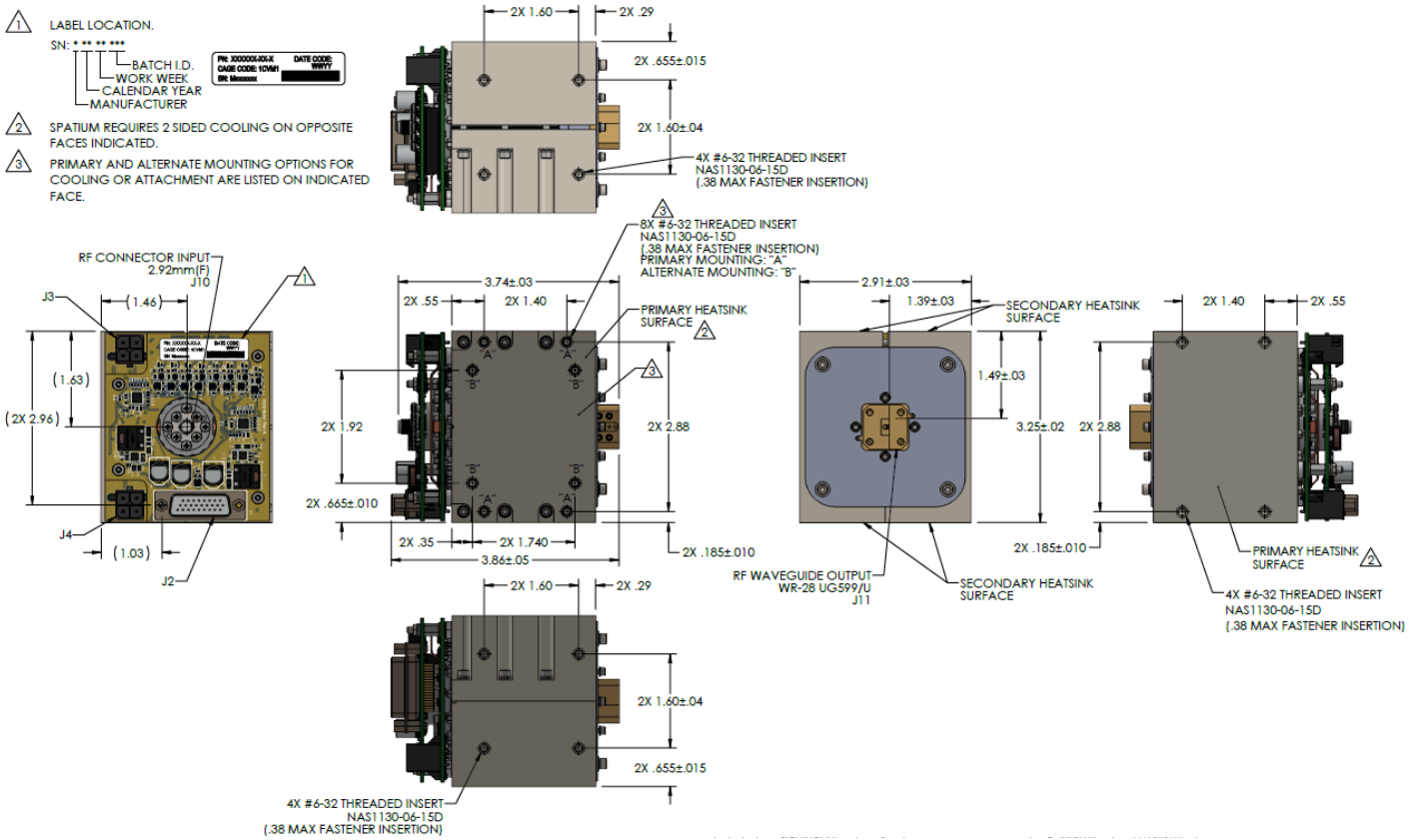
Pin No.	Label	Description
J10	RF In	2.92 mm (F) Coaxial RF Input.
J11	RF Out	WR28 Waveguide High Power RF Output
J3	76829-0004	V <sub>PRIME</sub> input power connector
J4	76829-0004	V <sub>PRIME</sub> input power connector
J5	180-M26-113R911	Mating bias connector to Spatium

**Mechanical Information – Outline Drawing (Spatium™ Unit with Bias Card)**

NOTES: UNLESS OTHERWISE SPECIFIED



- 2 SPATIUM REQUIRES 2 SIDED COOLING ON OPPOSITE FACES INDICATED.
- 3 PRIMARY AND ALTERNATE MOUNTING OPTIONS FOR COOLING OR ATTACHMENT ARE LISTED ON INDICATED FACE.



Dimensions are in INCHES

## Mechanical Information – Bias Card Connector Pins

J5 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.

J3 Molex 76829-0004	
Pin No	Function
1	+Vd
2	GND
3	GND
4	+Vd

J4 Molex 76829-0004	
Pin No	Function
1	+Vd
2	GND
3	GND
4	+Vd

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



## 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.

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

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## Contact Information

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

Web: [www.qorvo.com](http://www.qorvo.com)

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