TGA2623

10 – 11GHz 35W GaN Power Amplifier

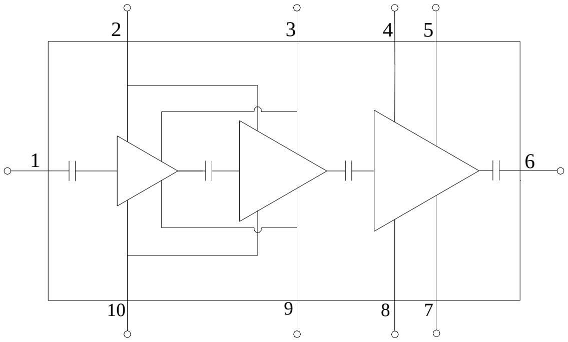
Applications

- X-band radar

Product Features

- Frequency Range: 10 – 11GHz
- P_{SAT}: 45.5dBm @ P_{IN} = 18dBm
- P1dB: 41dBm @ Midband
- PAE: >47% @ P_{IN} = 18dBm
- Large Signal Gain: 27.5dB
- Small Signal Gain: 35dB
- Bias: V_D = 28V, I_{DQ} = 290mA, V_G = -2.7V Typical
- Pulsed $V_{D:}$ PW = 100us and DC = 10%
- Chip Dimensions: 5.0 x 4.86 x 0.10 mm

Functional Block Diagram



General Description

TriQuint's TGA2623 is an x-band, high power MMIC amplifier fabricated on TriQuint's production 0.25um GaN on SiC process. The TGA2623 operates from 10 – 11GHz and provides a superior combination of power, gain and efficiency. Achieving 35W of saturated output power with 27.5dB of large signal gain and 47% power-added efficiency, the TGA2623 provides the level of performance demanded by today's system architectures. Depending on the system requirements, the TGA2623 can support cost saving initiatives on existing systems while supporting next generation systems with increased performance.

Lead-free and RoHS compliant.

Evaluation boards are available upon request.

Pad Configuration

Pad No.	Symbol
1	RF In
2, 10	V_{G1-2}
4, 8	V_{G3}
3, 9	V_{D1-2}
5, 7	V_{D3}
6	RF Out

Ordering Information

Part	ECCN	Description
TGA2623	3A001.b.2.b	10 – 11GHz 35W GaN Power Amplifier

Absolute Maximum Ratings

Parameter	Value
Drain Voltage (V_D)	40V
Gate Voltage Range (V_G)	-10 to -2V
Drain Current (I_{D1-2})	2.3A
Drain Current (I_{D3})	4.3A
Gate Current (I_{G1-2})	-3.5 to 17.5mA
Gate Current (I_{G3})	-11 to 28mA
Power Dissipation (P_{DISS}), 85°C, CW	96W
Input Power (P_{IN}), CW, 50Ω, V_D = 28V, 85°C	24dBm
Input Power (P_{IN}), CW, VSWR 6:1, V_D = 28V, 85°C	20dBm
Channel Temperature (T_{CH})	275°C
Mounting Temperature (30 seconds)	320°C
Storage Temperature	-55 to 150°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.

Recommended Operating Conditions

Parameter	Value
Drain Voltage (V_D)	28V
Drain Current (I_{DQ})	290mA (Total)
Gate Voltage (V_G)	-2.7V (Typ.)

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

Electrical Specifications

Test conditions unless otherwise noted: 25^{0}C, V_D = 28V, I_{DQ} = 290mA, V_G = -2.7V Typical, Pulsed $V_{D:}$ PW = 100us, DC = 10%

Parameter	Min	Typical	Max	Units
Operational Frequency Range	10		11	GHz
Small Signal Gain		35		dB
Input Return Loss		>15		dB
Output Return Loss		>10		dB
Power Gain (Pin = 18dBm)		27.5		dB
Output Power (Pin = 18dBm)		45.5		dBm
Power Added Efficiency (Pin = 18dBm)		>47		%
Power @ 1dB Compression (P1dB)		41@ Midband		dB
Small Signal Gain Temperature Coefficient		-0.075		dB/°C
Recommended Operating Voltage:	20	28	32	V

Thermal and Reliability Information

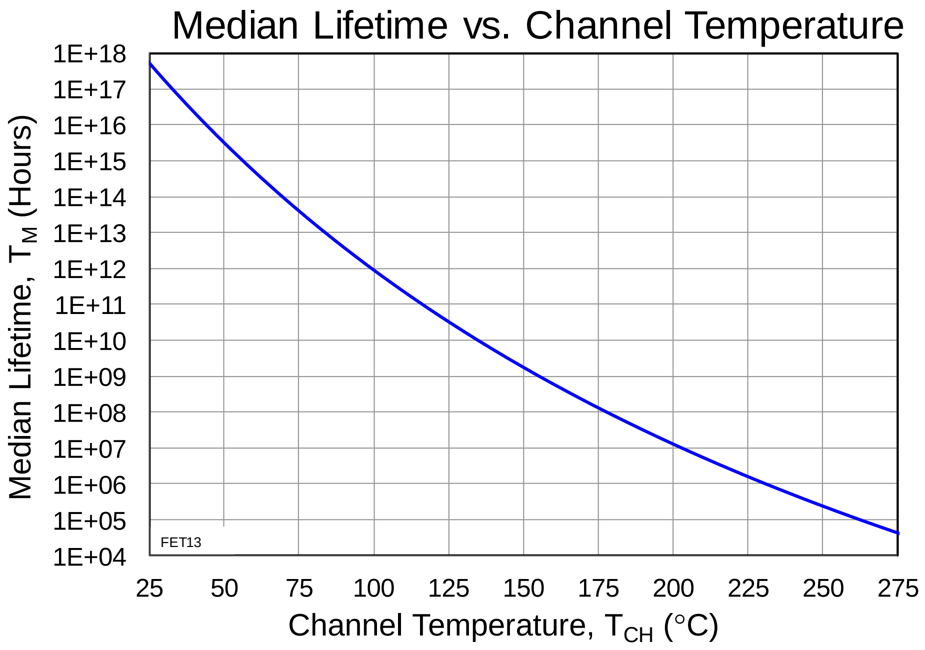
Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85°C, Pulsed V_D: PW = 100us, DC = 10%	1.14	ºC/W
Channel Temperature (T_{CH}) (Under RF drive)	T_{base} = 85°C, **V_D = 28V**, I_{D_Drive} = 3A, P_{IN} =22dBm, P_{OUT} = 45.3dBm, P_{DISS} = 51W	143	°C
Median Lifetime (T_M)		3.85 x 10^10	Hrs

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85°C, CW	1.97	ºC/W
Channel Temperature (T_{CH}) (Under RF drive)	T_{base} = 85°C, **V_D = 28V**, I_{D_Drive} = 2.94A, P_{IN} = 22dBm, P_{OUT} = 44.9dBm, P_{DISS} = 52W	187	°C
Median Lifetime (T_M)		4.12 x 10^7	Hrs

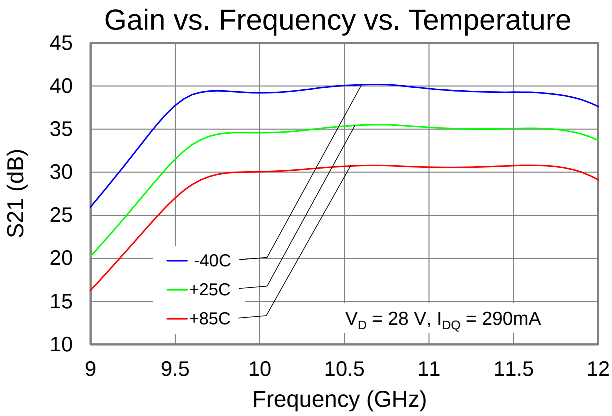
Notes:
1. Thermal resistance measured to back of carrier plate. MMIC mounted on 40 mils CuM0 (80/20) carrier using 1.5 mil AuSn.

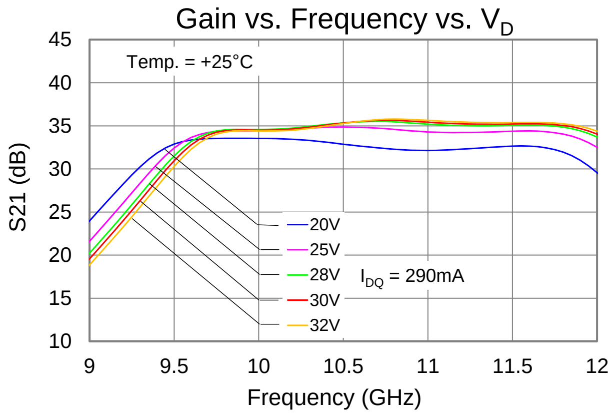
Median Lifetime

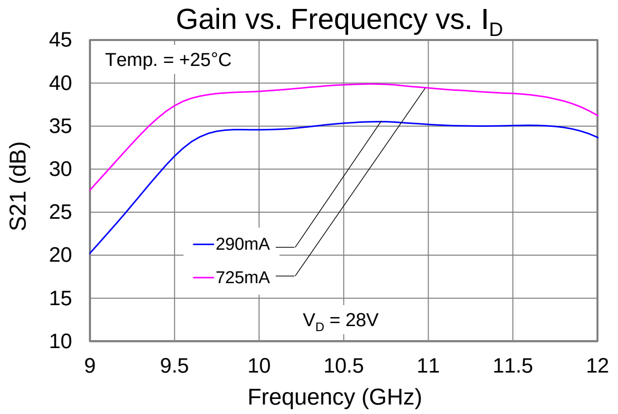
Test Conditions: V_D = 40 V; Failure Criteria = 10% reduction in I_{D_MAX}

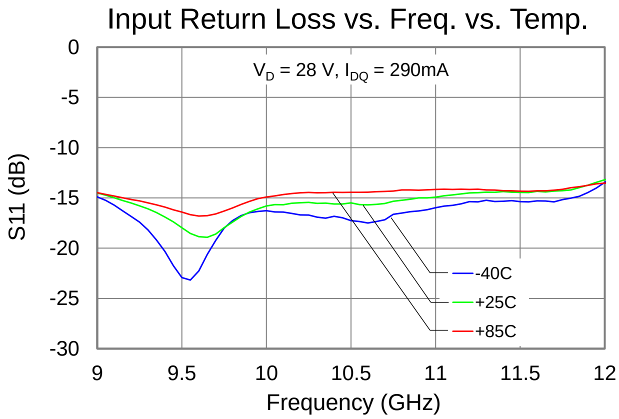


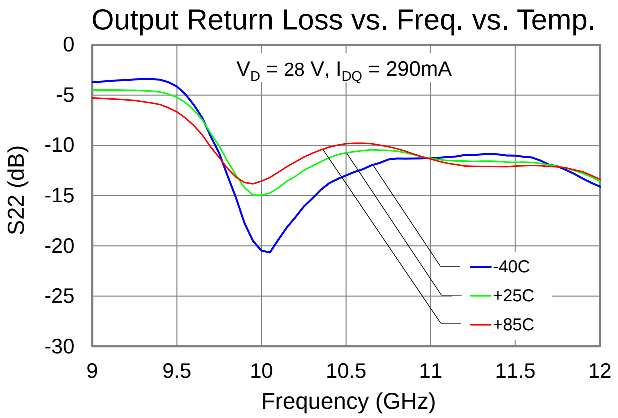
Typical Performance (Small Signal)



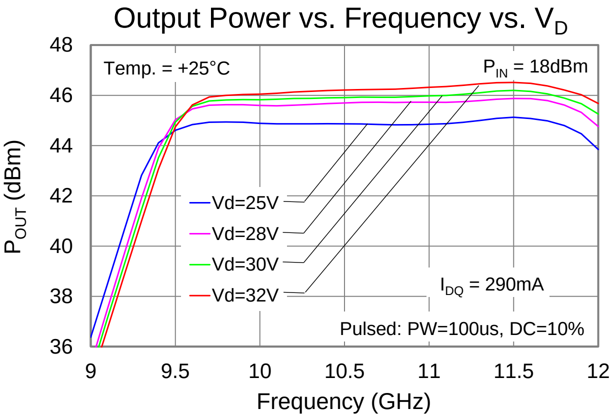




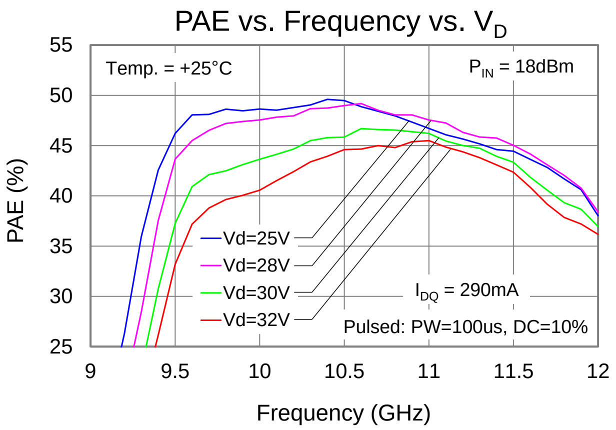




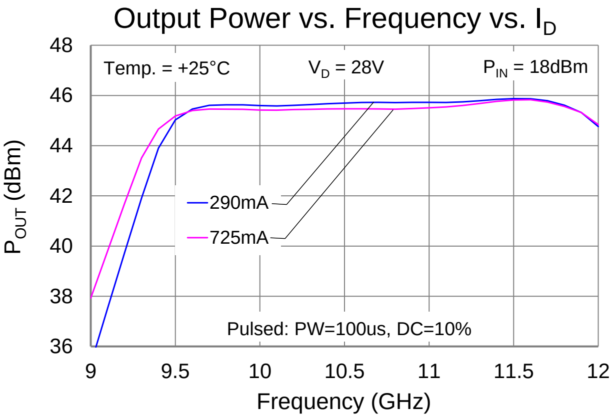
Typical Performance (Pulsed Opeartion)



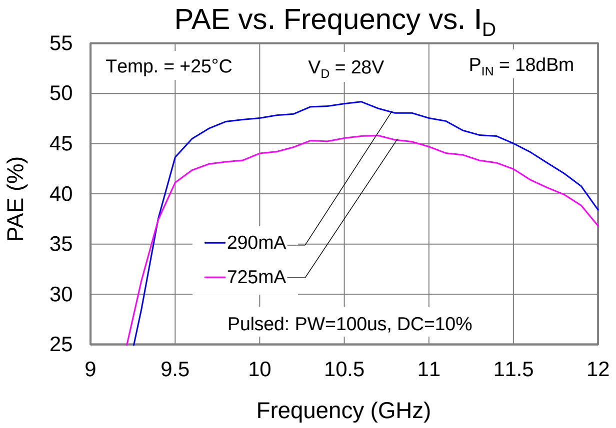
Output Power vs. Frequency vs. V_D



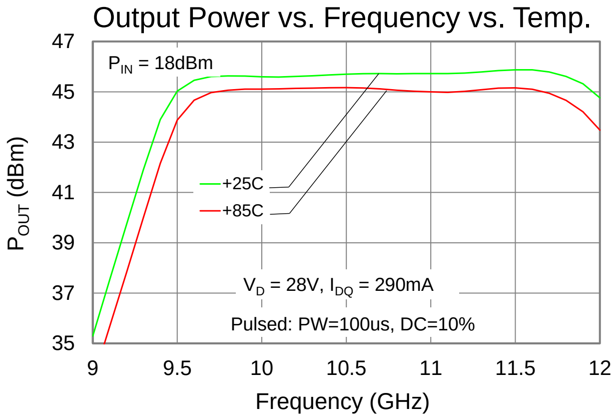
PAE vs. Frequency vs. V_D



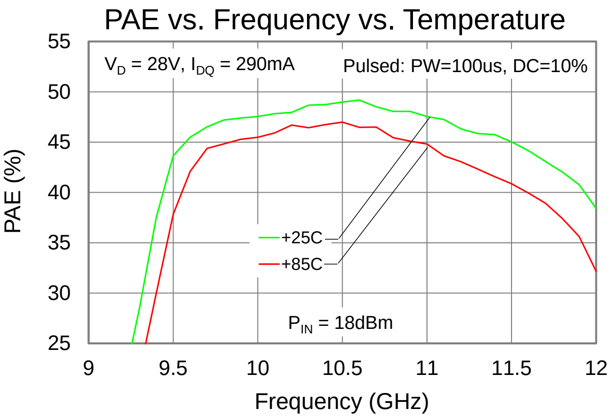
Output Power vs. Frequency vs. I_D



PAE vs. Frequency vs. I_D

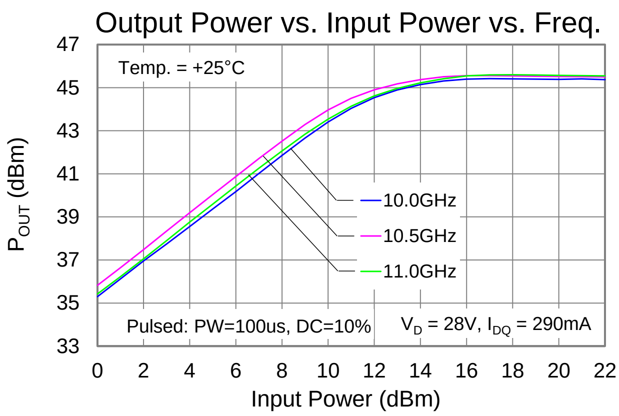


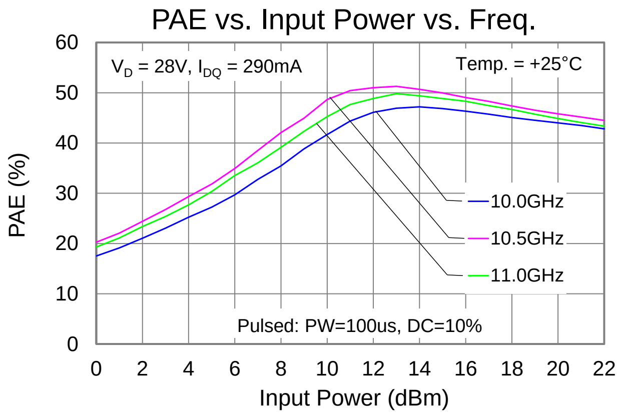
Output Power vs. Frequency vs. Temp.

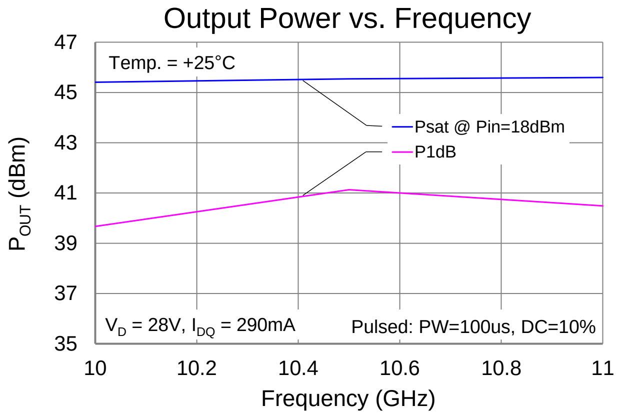


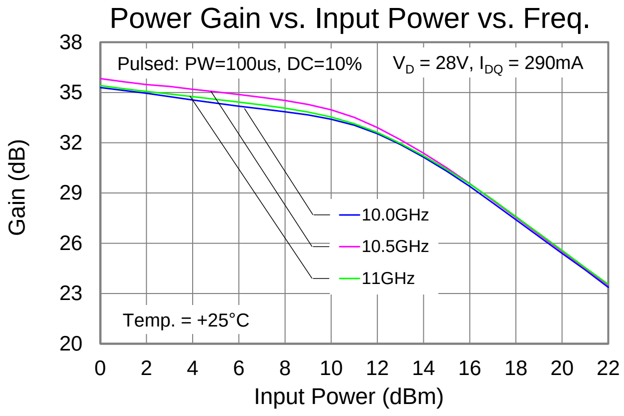
PAE vs. Frequency vs. Temperature

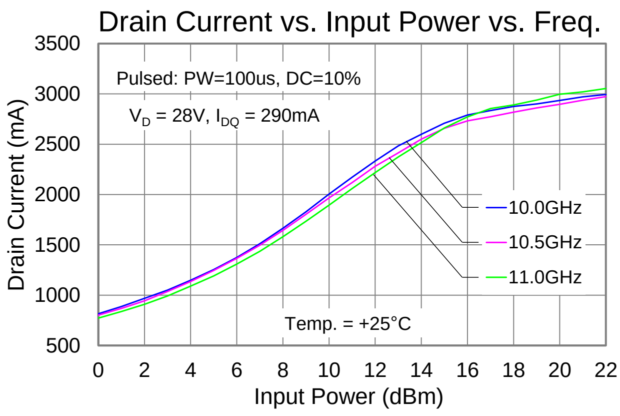
Typical Performance (Pulsed Operation)

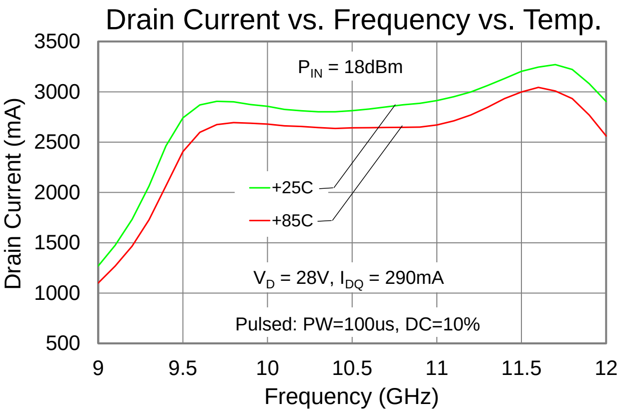




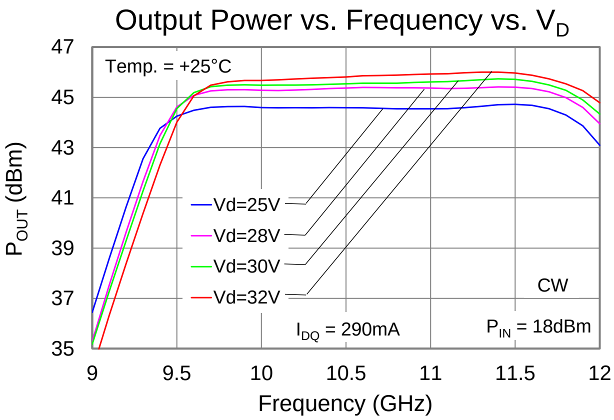


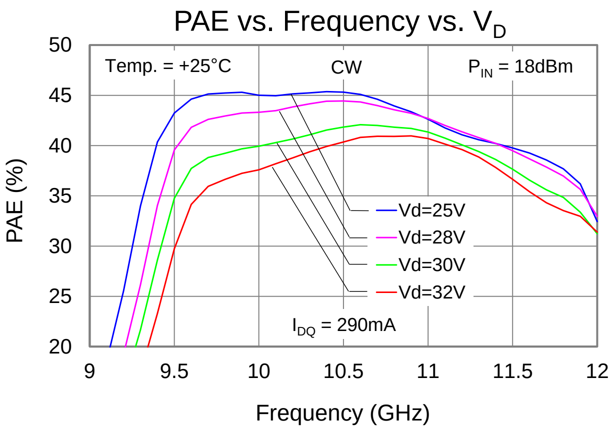


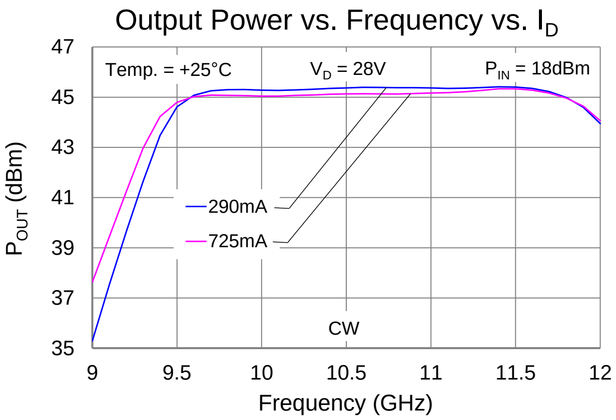


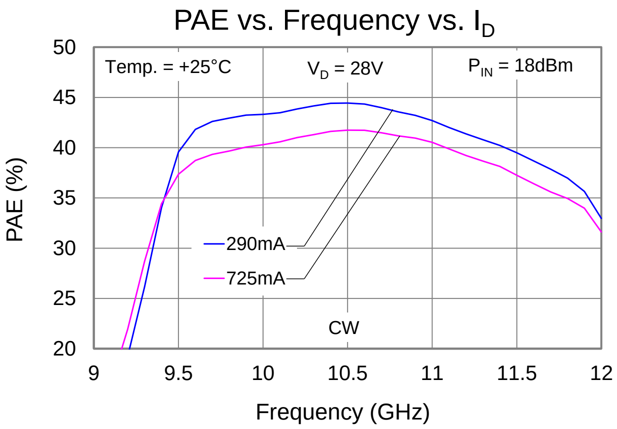


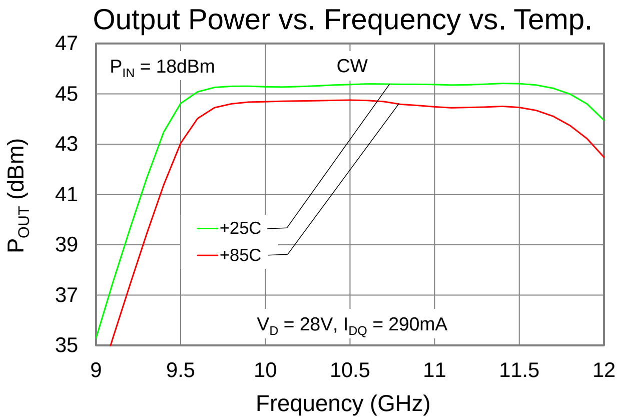
Typical Performance (CW Operation)

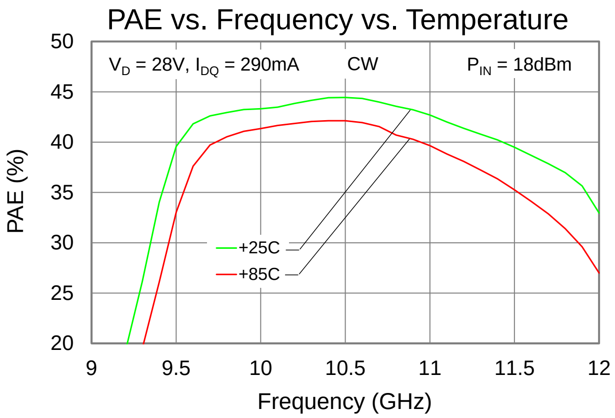




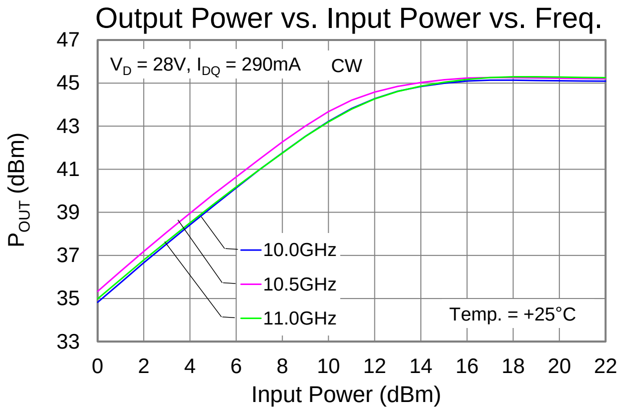


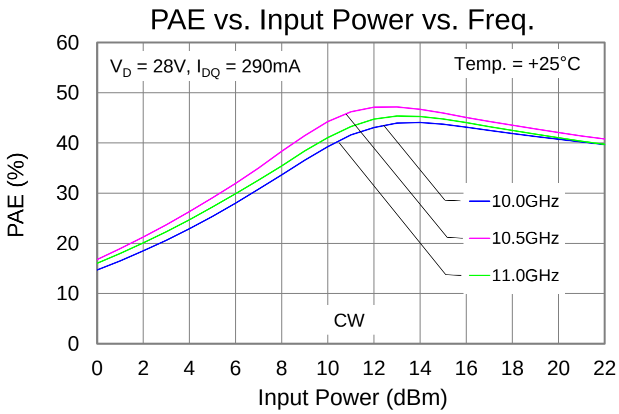


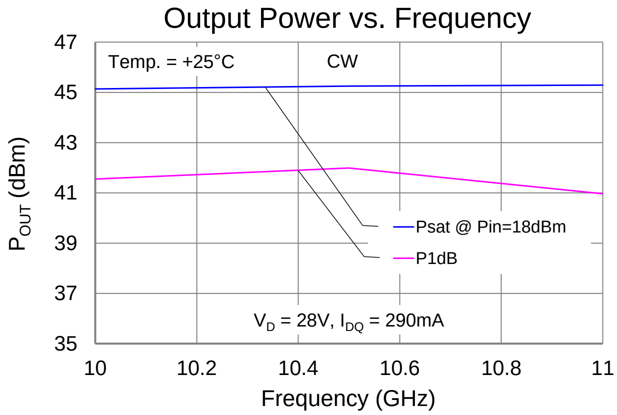


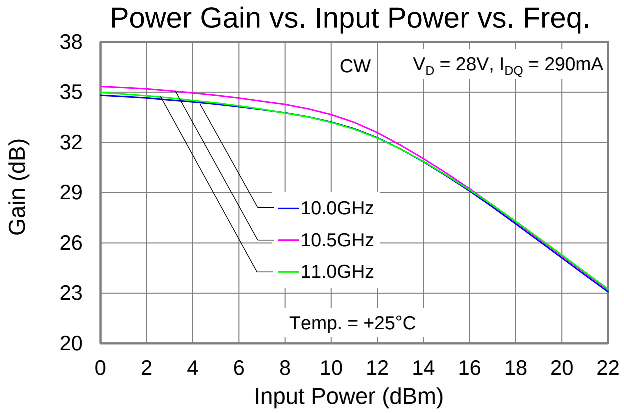


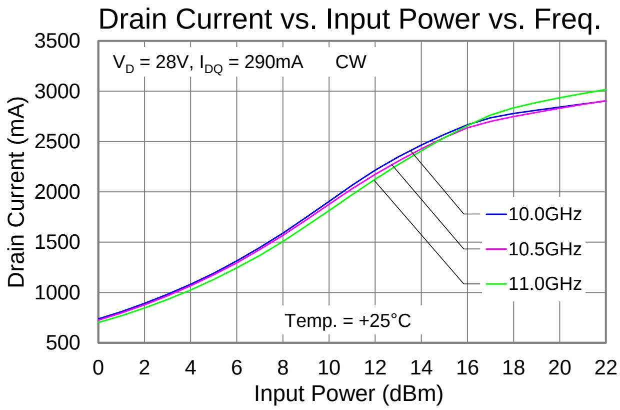
Typical Performance (CW Operation)

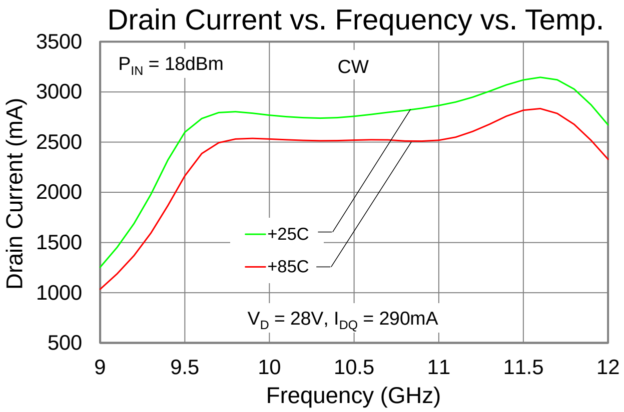




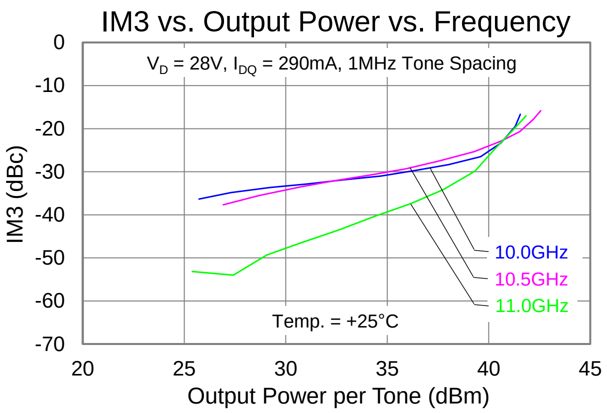


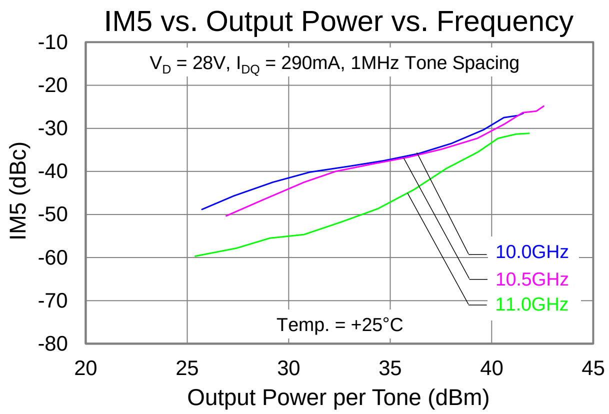


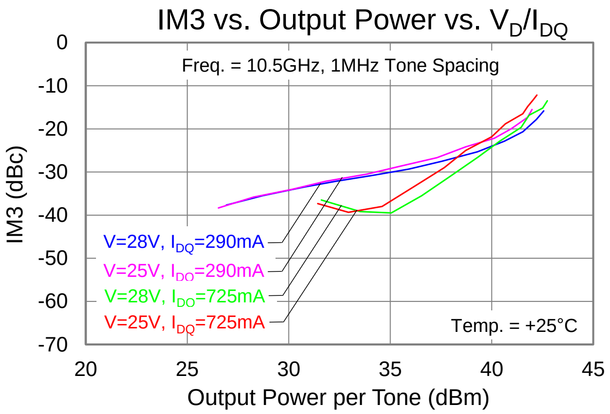


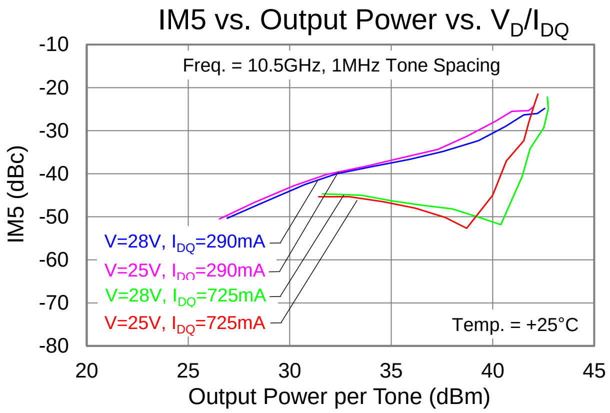


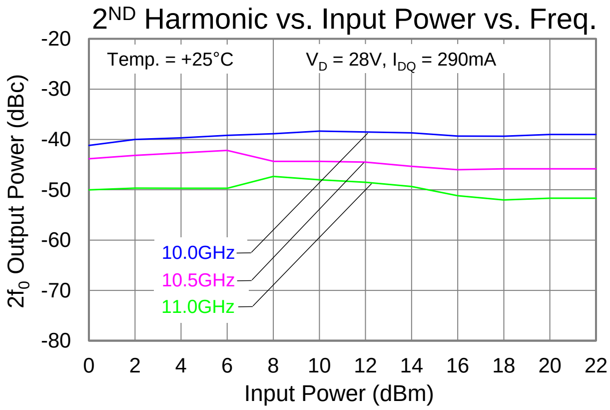
Typical Performance (Linearity)

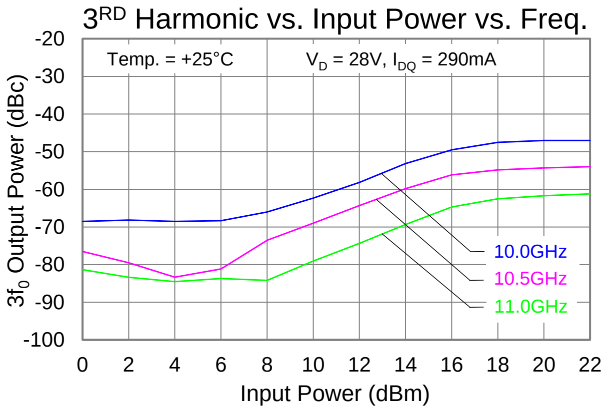




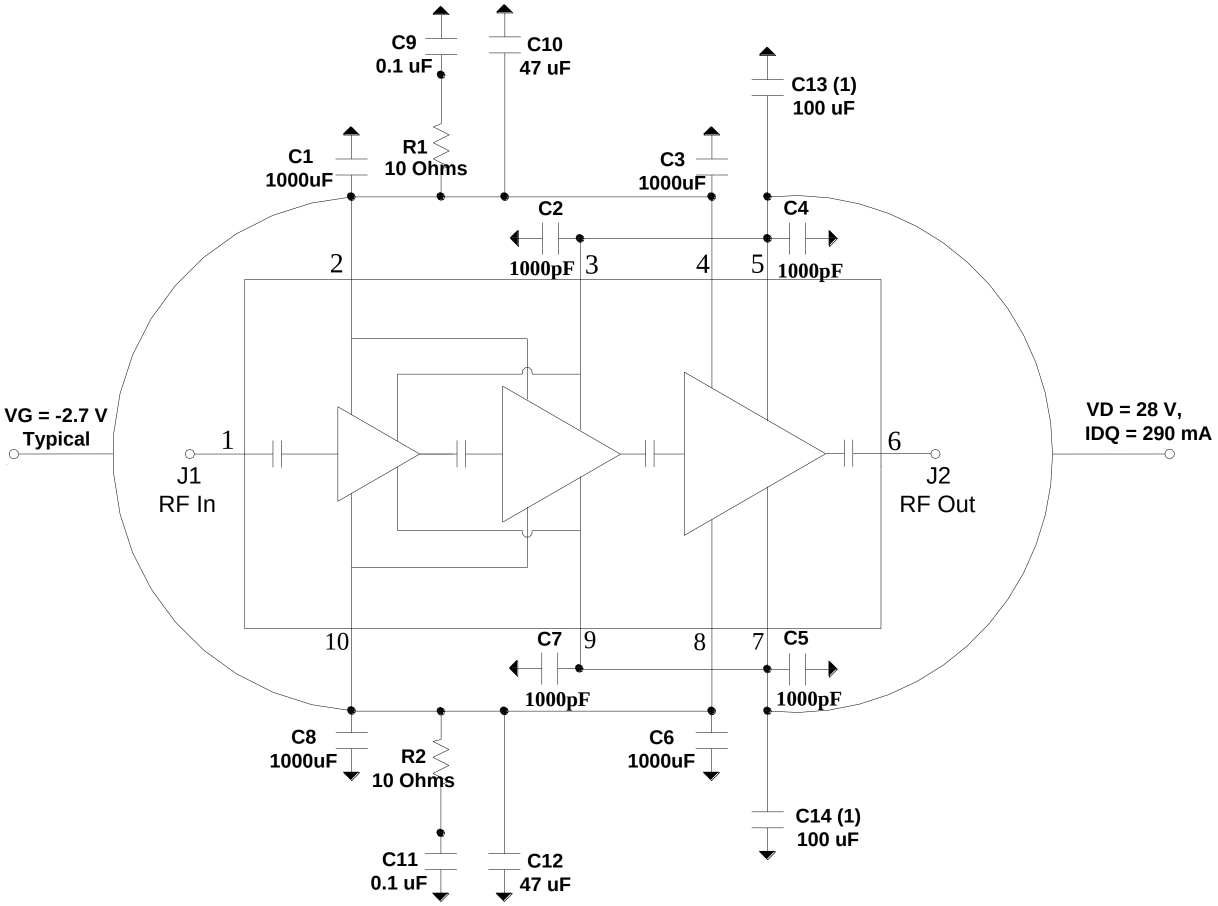








Application Circuit



Notes:

1. Remove caps for pulse operation. These caps are part of the cable harness for CW operation.

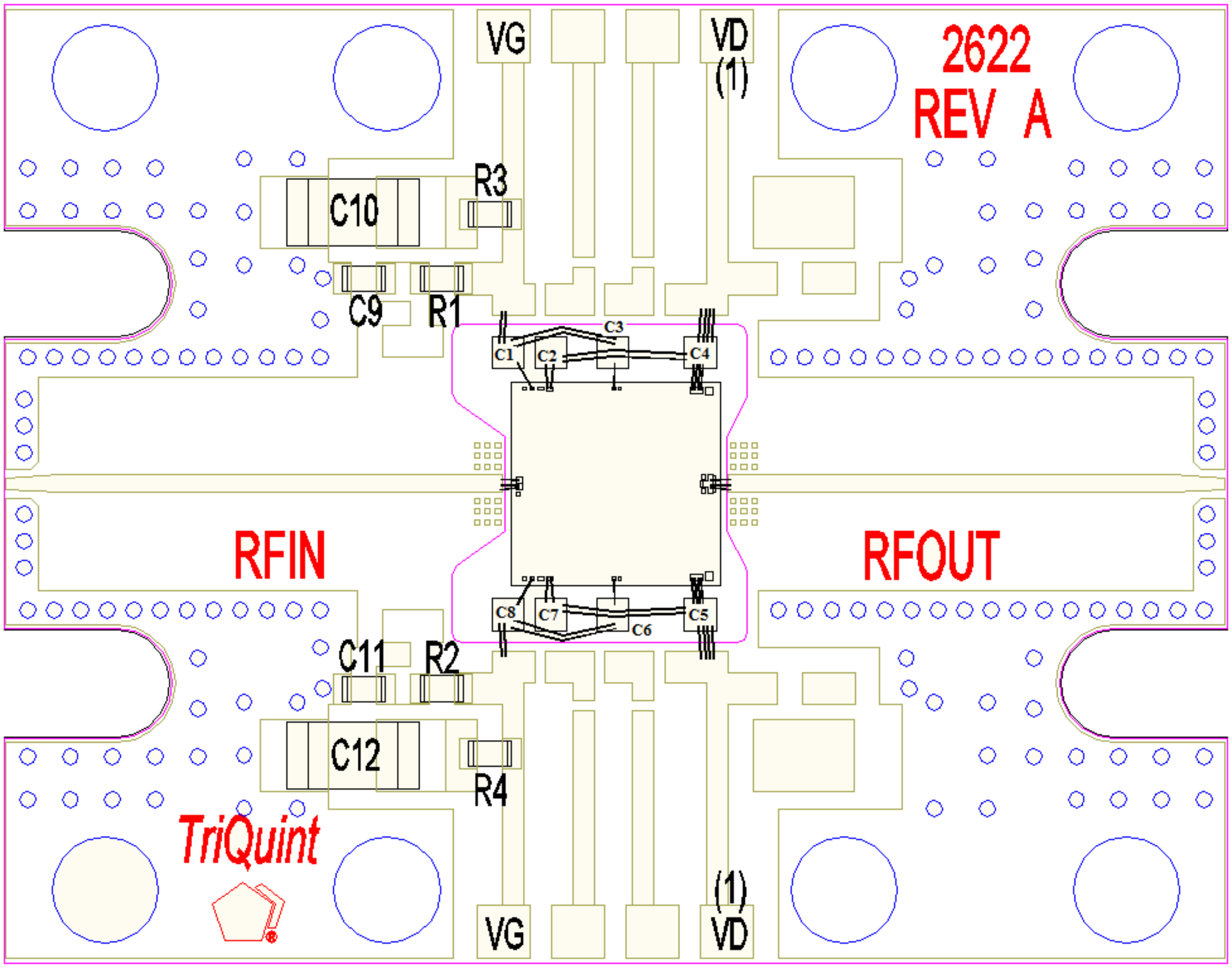
Bias-up Procedure

1. Set I_D limit to 3.5A, I_G limit to 10mA
2. Set V_G to -5.0V
3. Set V_D +28V
4. Adjust V_G more positive until I_{DQ} = 290mA (V_G ~ -2.7V Typical)
5. Apply RF signal

Bias-down Procedure

1. Turn off RF signal
2. Reduce V_G to -5.0V. Ensure I_{DQ} ~ 0mA
3. Set V_D to 0V
4. Turn off V_D supply
5. Turn off V_G supply

Evaluation Board (EVB) Layout Assembly



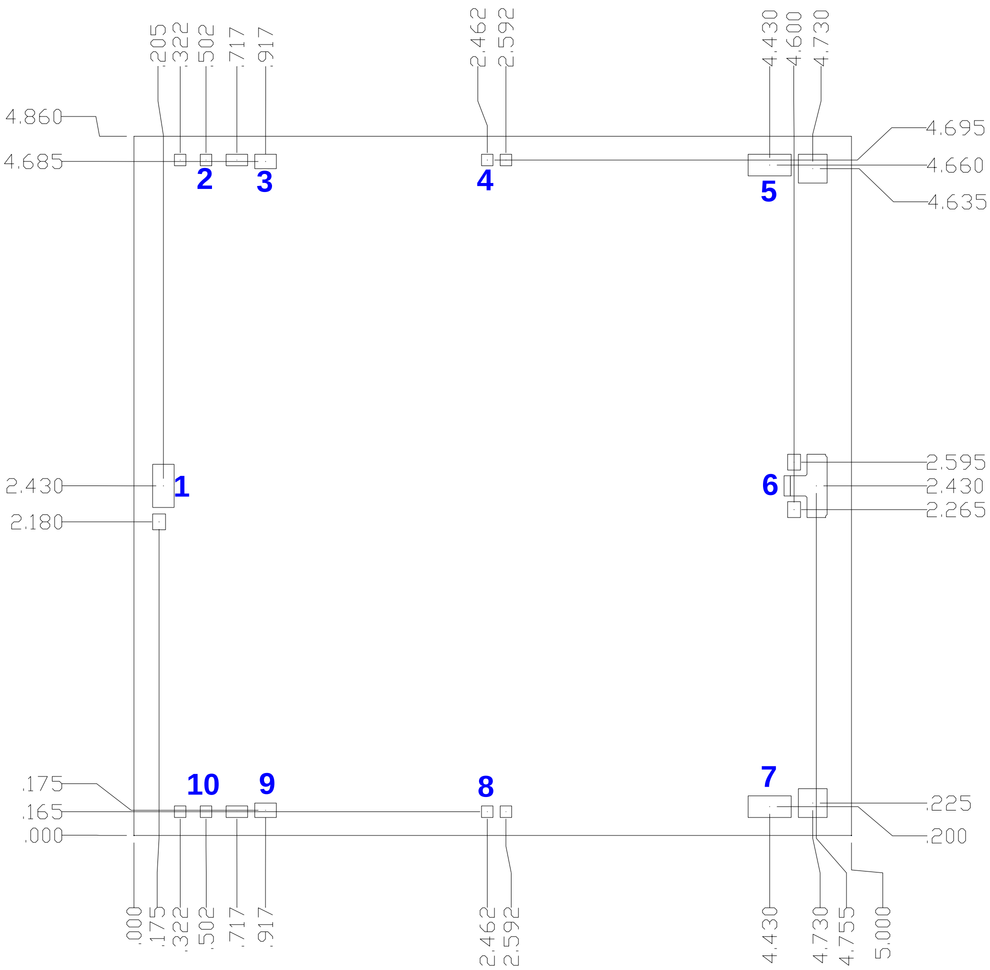
Notes:

1. 100uF/100V charge storage cap is needed on the drain. For pulsed operation this cap must be on the supply-side of the pulse-modulator.

Bill of Materials

Reference Design	Value	Description	Manufacturer	Part Number
C1 – C8	1000pF	SLC, 50V	Various	
C9, C11	0.1uF	Cap, 0402, 50V, 10%, X7R	Various	
C10, C12	47uF	Cap, 1206, 50V, 10%, X7R	Various	
R1 – R2	10Ω	Res, 0402	Various	
R3 – R4	0Ω	Res, 0402	Various	

Mechanical Drawing & Bond Pad Description



Unit: millimeters
Thickness: 0.10
Die x, y size tolerance: +/- 0.050
Chip edge to bond pad dimensions are shown to center of pad
Ground is backside of die

Bond Pad	Symbol	Pad Size	Description
1	RF In	0.150 x 0.300	RF Input; matched to 50Ω
2, 8	V_{G1-2}	0.080 x 0.080	Gate voltage 1, bias network is required; see Application Circuit on page 10 as an example.
4,10	V_{G3}	0.080 x 0.080	Gate voltage 3, bias network is required; see Application Circuit on page 10 as an example.
3, 9	V_{D1-2}	0.150 x 0.100	Drain voltage 1, bias network is required; see Application Circuit on page 10 as an example.
5, 7	V_{D3}	0.300 x 0.150	Drain voltage 3, bias network is required; see Application Circuit on page 10 as an example.
6	RF Out	0.140 x 0.400	RF Output; matched to 50Ω

Assembly Notes

Component placement and adhesive attachment assembly notes:

- Vacuum pencils and/or vacuum collets are the preferred method of pick up.
- Air bridges must be avoided during placement.
- The force impact is critical during auto placement.
- Organic attachment (i.e. epoxy) can be used in low-power applications.
- Curing should be done in a convection oven; proper exhaust is a safety concern.

Reflow process assembly notes:

- Use AuSn (80/20) solder and limit exposure to temperatures above 300°C to 3-4 minutes, maximum.
- An alloy station or conveyor furnace with reducing atmosphere should be used.
- Do not use any kind of flux.
- Coefficient of thermal expansion matching is critical for long-term reliability.
- Devices must be stored in a dry nitrogen atmosphere.

Interconnect process assembly notes:

- Thermosonic ball bonding is the preferred interconnect technique.
- Force, time, and ultrasonic are critical parameters.
- Aluminum wire should not be used.
- Devices with small pad sizes should be bonded with 0.0007-inch wire.