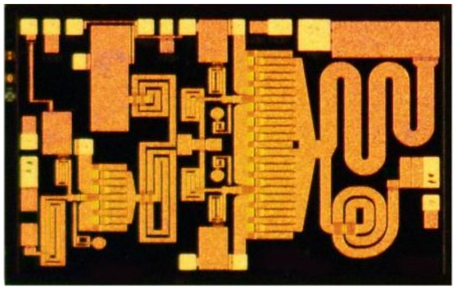
TGA2585

2.7 – 3.7GHz 18W GaN Power Amplifier

Applications

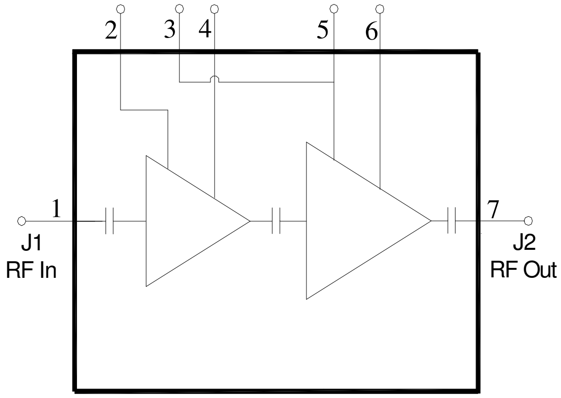
- Commercial and military radar



Product Features

- Frequency Range: 2.7 – 3.7GHz
- P_{SAT}: 42.8dBm at 28V
- PAE: 52%
- Small Signal Gain: 33dB
- Input Return Loss: >15dB
- Output Return Loss: >12dB
- Bias: V_D = 25-32V (CW or Pulsed), I_{DQ} = 225mA, V_G = -2.5V Typical
- Pulsed V_D: PP = 1ms, DC = 10%
- Chip Dimensions: 3.0 x 1.9 x 0.10 mm

Functional Block Diagram



General Description

TriQuint's TGA2585 is an S-band MMIC amplifier fabricated on TriQuint's production 0.25um GaN on SiC process (TQGaN25). Covering 2.7-3.7GHz, the TGA2585 provides 18W of saturated output power and 33dB of small signal gain while achieving 52% power-added efficiency. Higher power can be achieved at the expense of PAE by increasing the drain voltage.

The TGA2585 is ideal for phase array S-band radars and can support both short pulse and CW conditions.

Both RF ports have integrated DC blocking capacitors and are fully matched to 50ohms.

Lead-free and RoHS compliant.

Pad Configuration

Pad No.	Symbol
1	RF In
2	V_{G1}
3, 5	V_{G2}
4	V_{D1}
6	V_{D2}
7	RF Out

Ordering Information

Part	ECCN	Description
TGA2585	EAR99	2.7 – 3.7GHz 18W GaN Power Amplifier

Absolute Maximum Ratings

Parameter	Value
Drain Voltage (V_D)	40V
Gate Voltage Range (V_G)	-8 to 0V
Drain Current (I_{D1})	285mA
Drain Current (I_{D2})	1250mA
Gate Current (I_{G1})	-1.4 to 2.8mA
Gate Current (I_{G2})	-4.0 to 8.4mA
Power Dissipation (P_{DISS}), 85°C	35W
Input Power (P_{IN}), CW, 50 Ω, 85°C,	30dBm
Input Power (P_{IN}), CW, VSWR 10:1, V_D = 28V, 85°C	23dBm
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})	225mA (Total)
Gate Voltage (V_G)	-2.5V (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: 25^0C, V_D = 28V, I_{DQ} = 225mA, V_G = -2.5V Typical, Pulsed V_D : PP = 1ms, DC = 10%

Parameter	Min	Typical	Max	Units
Operational Frequency Range	2.7		3.7	GHz
Small Signal Gain		33		dB
Input Return Loss		>15		dB
Output Return Loss		>12		dB
Output Power (Pin = 18dBm)		42.8		dBm
Power Added Efficiency (Pin = 18dBm)		52		%
IM3 @ 25V, POUT/tone = 30dBm		-35		dBc
IM5 @ 25V, POUT/tone = 30dBm		-45		dBc
Small Signal Gain Temperature Coefficient		-0.05		dB/°C
Output Power Temperature Coefficient		-0.005		dBm/°C
Recommended Operating Voltage:		28	32	V

Thermal and Reliability Information

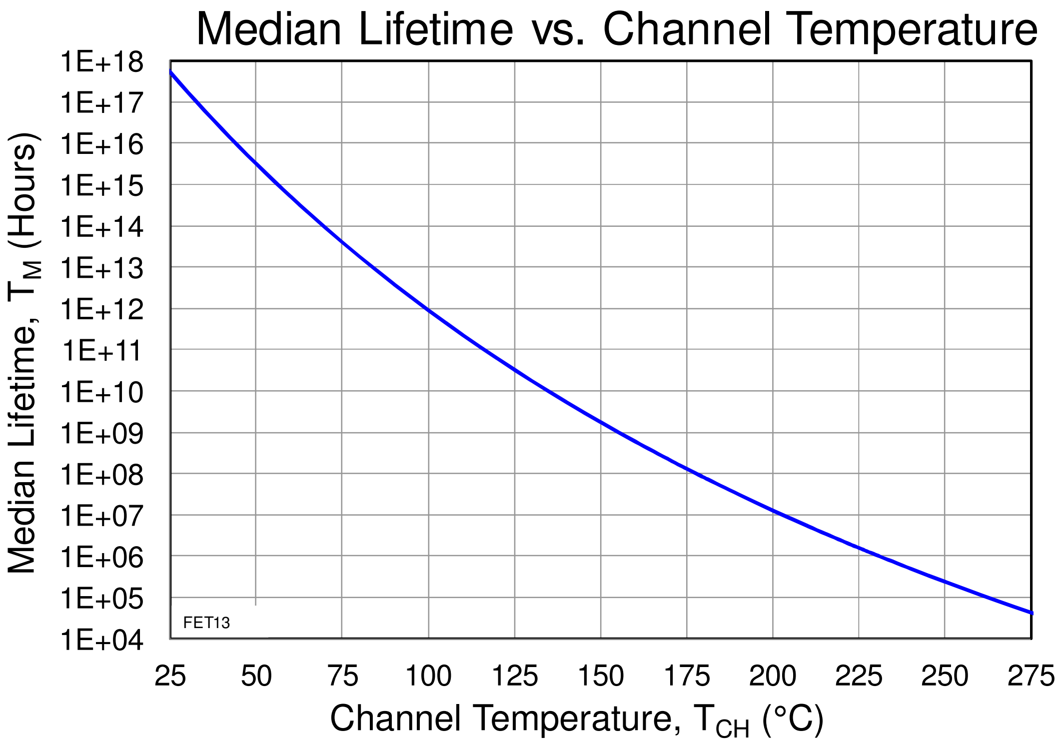
Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85℃, **V_D = 28V** , **I_{DQ} = 225mA** **Pulsed V_D: PP = 1ms, DC = 10%**	2.75	ºC/W
Channel Temperature (T_{CH}) (Under RF drive)	T_{base} = 85℃, V_D = 28V, I_{D_Drive} = 1.32A, P_{IN} = 18dBm, P_{OUT} = 42.7dBm, P_{DISS} = 18W	135	℃
Median Lifetime (T_M)		9.75 X 10^10	Hrs
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85℃, **V_D = 32V** , **I_{DQ} = 225mA** **Pulsed V_D: PP = 1ms, DC = 10%**	3.67	ºC/W
Channel Temperature (T_{CH}) (Under RF drive)	T_{base} = 85℃, V_D = 32V, I_{D_Drive} = 1.36A, P_{IN} = 18dBm, P_{OUT} = 43.4dBm, P_{DISS} = 23W	169	℃
Median Lifetime (T_M)		2.36 X 10^9	Hrs
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85℃, **V_D = 28V** , **I_{DQ} = 225mA, CW**	4.96	ºC/W
Channel Temperature (T_{CH}) (Under RF drive)	T_{base} = 85℃, V_D = 28V, I_{D_Drive} = 1.17A, P_{IN} = 18dBm, P_{OUT} = 42dBm, P_{DISS} = 16.5W	167	℃
Median Lifetime (T_M)		2.89 X 10^8	Hrs
Thermal Resistance (θ_{JC}) (1)	T_{base} = 85℃, **V_D = 32V** , **I_{DQ} = 225mA, CW**	5.86	ºC/W
Channel Temperature (T_{CH}) (Under RF drive)	T_{base} = 85℃, V_D = 32V, I_{D_Drive} = 1.23A, P_{IN} = 18dBm, P_{OUT} = 42.7dBm, P_{DISS} = 20.9W	208	℃
Median Lifetime (T_M)		6.34 X 10^6	Hrs

Notes:

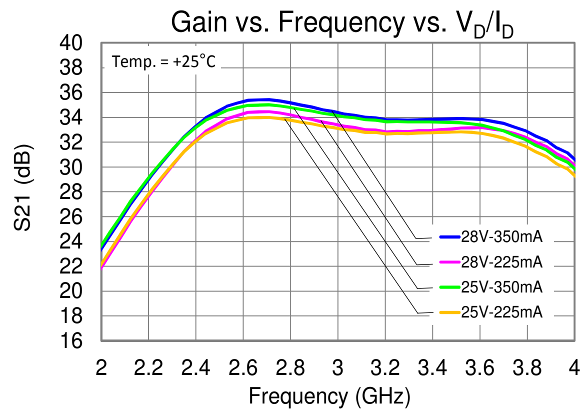
1. Thermal resistance measured to back of carrier plate. MMIC mounted on 40 mils CuMo (80/20) carrier using 1.5 mil AuSn.

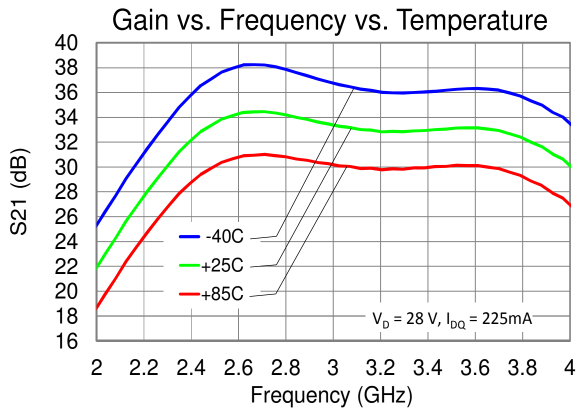
Median Lifetime

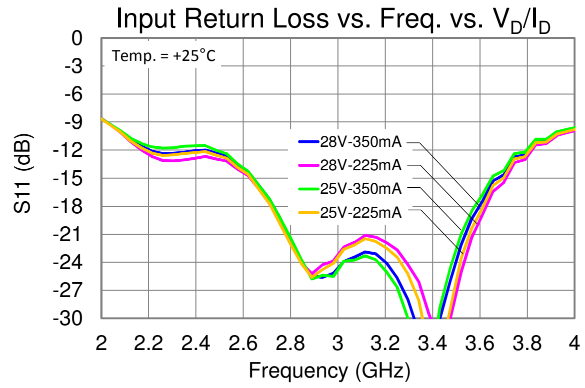
Test Conditions: V_D = 40 V; Failure Criteria = 10% reduction in I_{D_MAX}

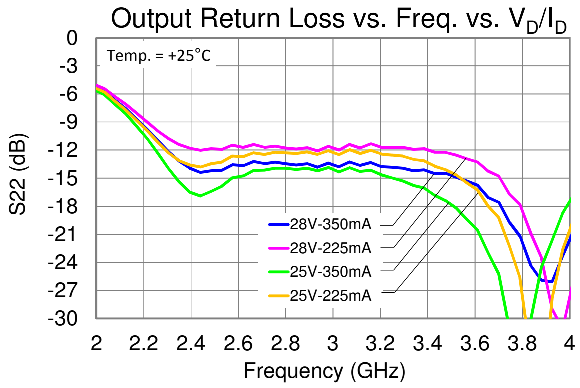


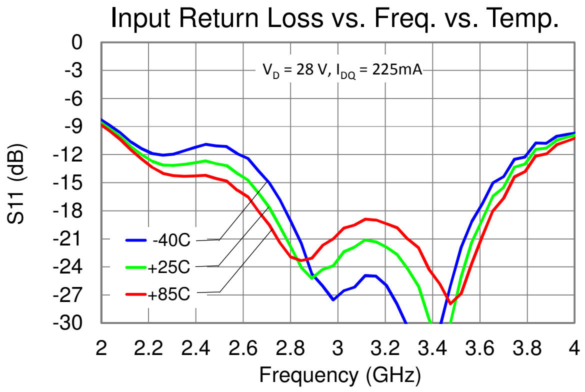
Typical Performance (Small Signal)

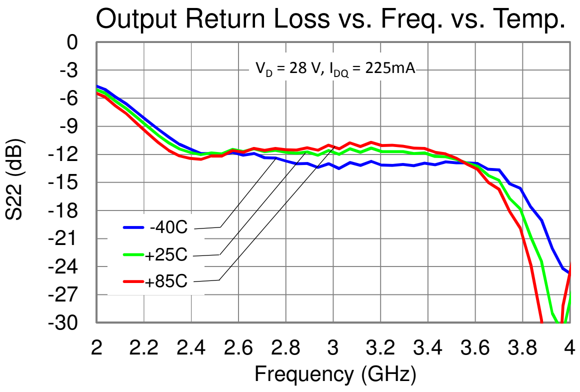




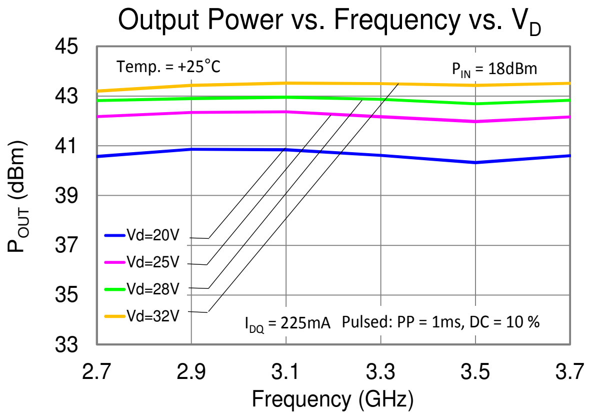


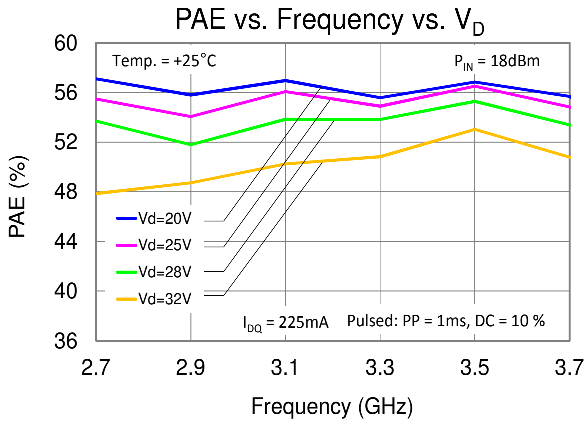


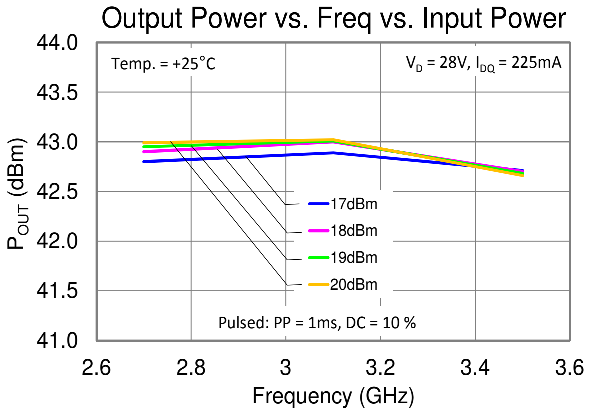


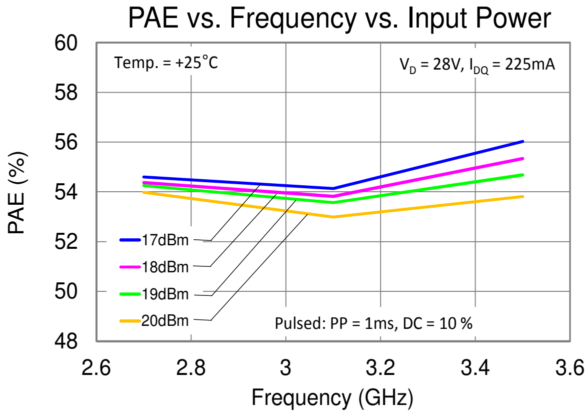


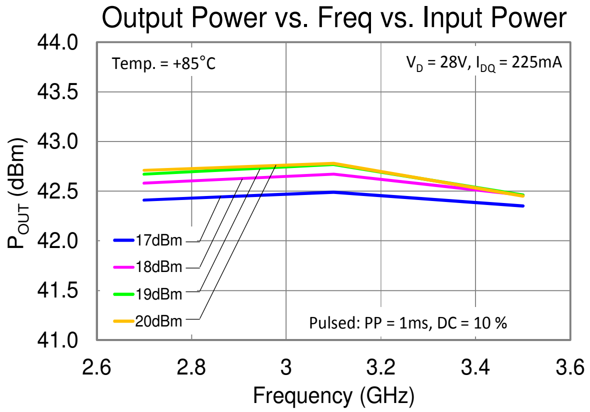
Typical Performance (Pulsed Operation)

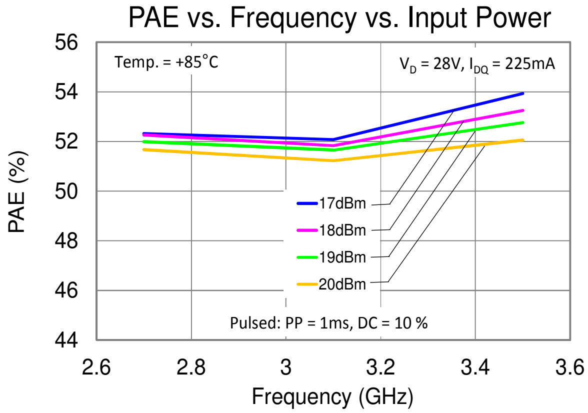




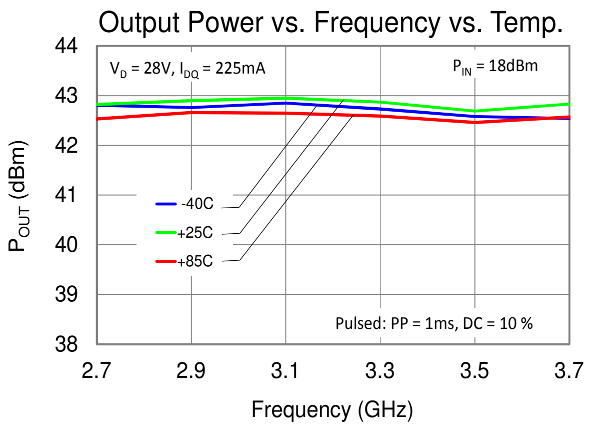


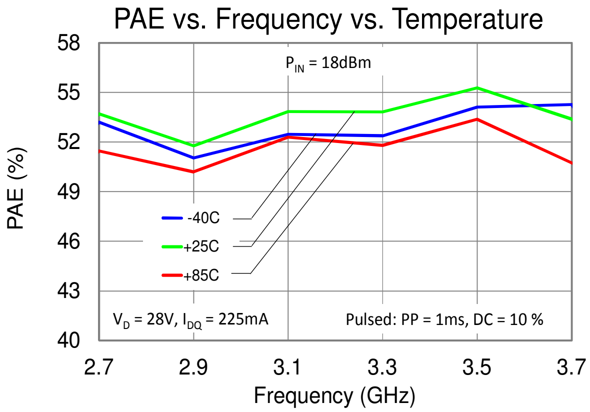


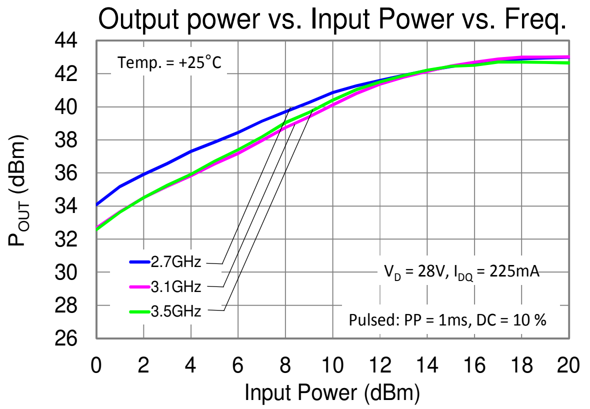


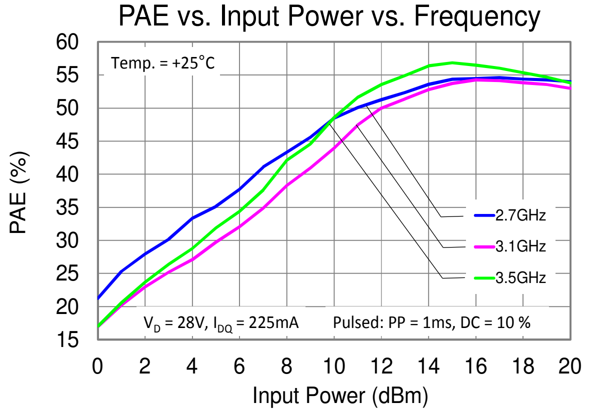


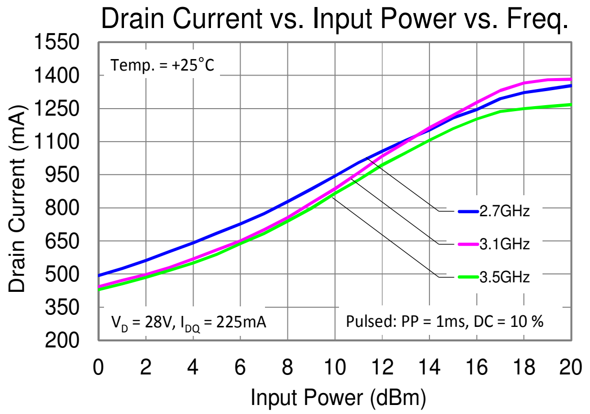
Typical Performance (Pulsed Operation)

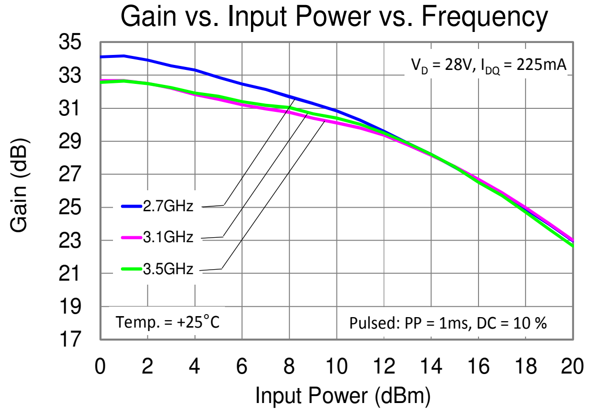




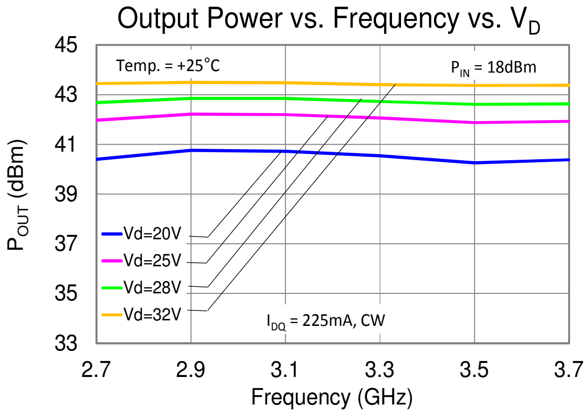


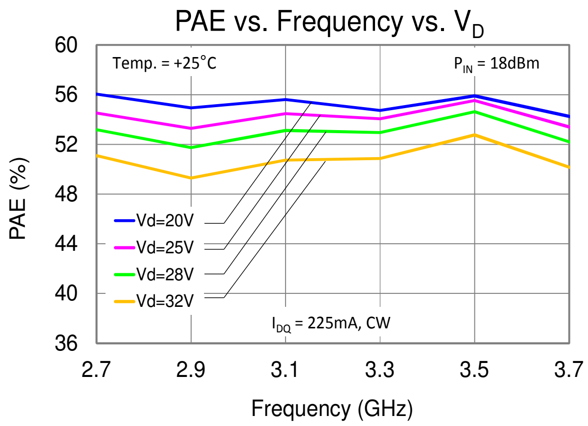


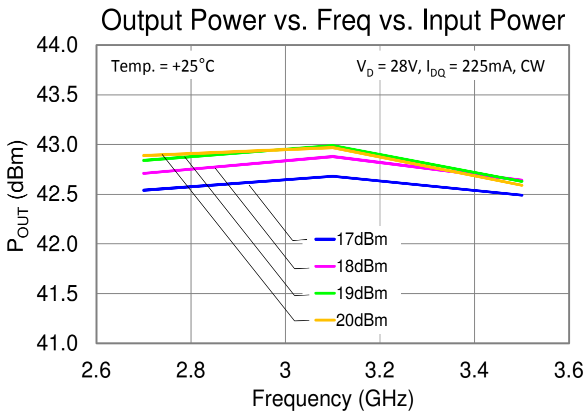


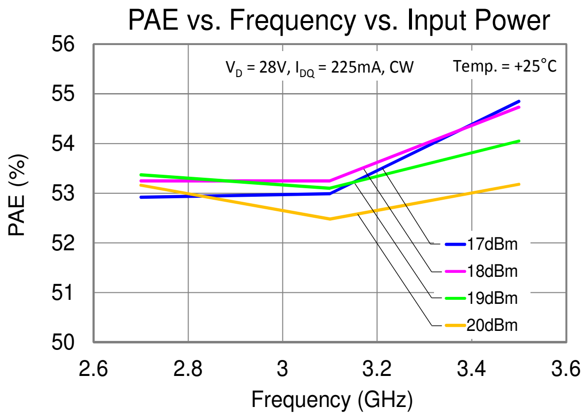


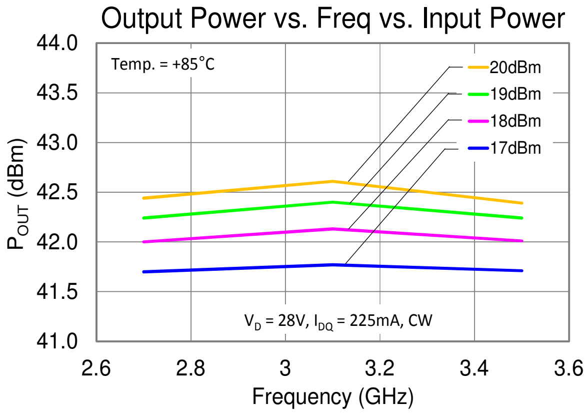
Typical Performance (CW Operation)

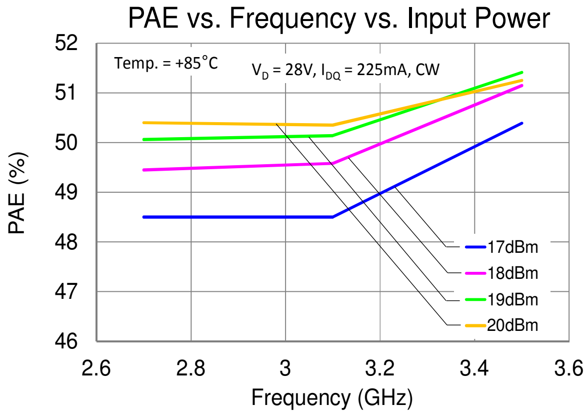






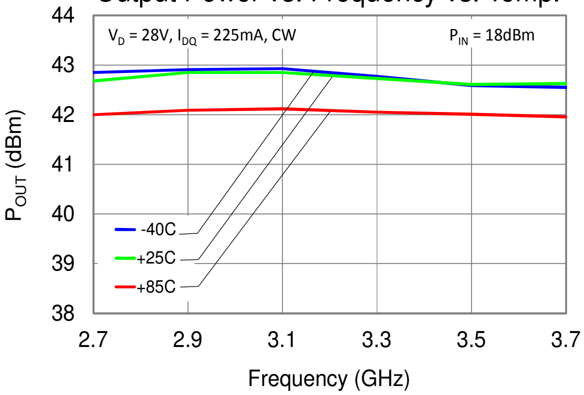




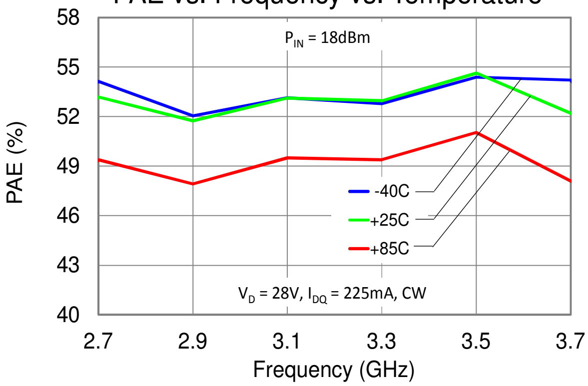


Typical Performance

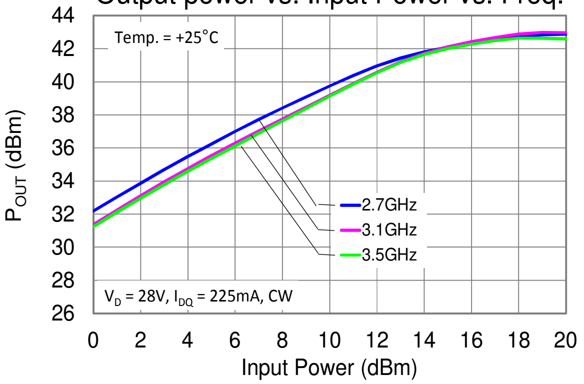
Output Power vs. Frequency vs. Temp.



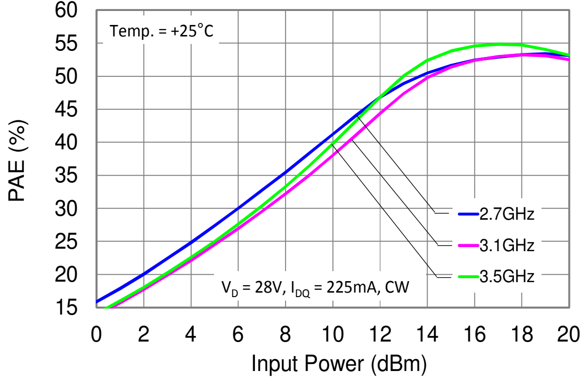
PAE vs. Frequency vs. Temperature



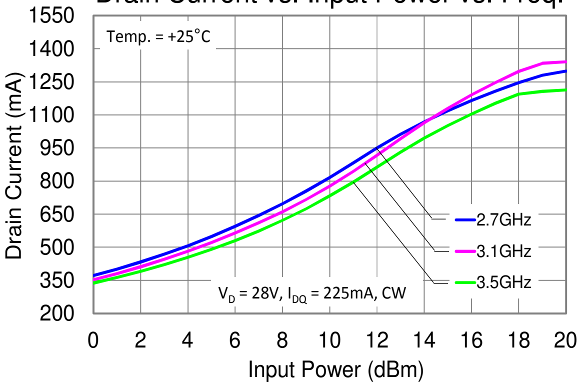
Output power vs. Input Power vs. Freq.



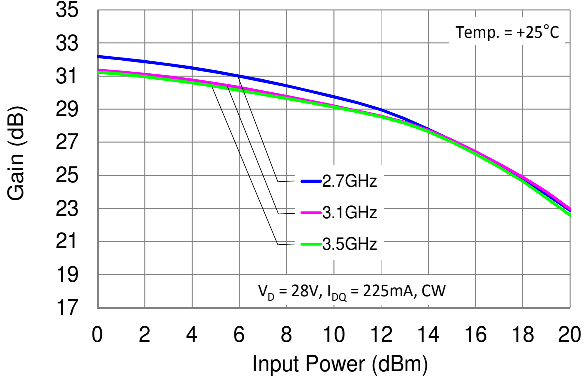
PAE vs. Input Power vs. Frequency



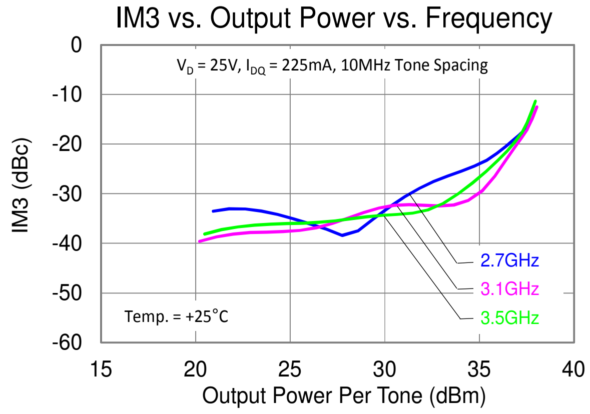
Drain Current vs. Input Power vs. Freq.

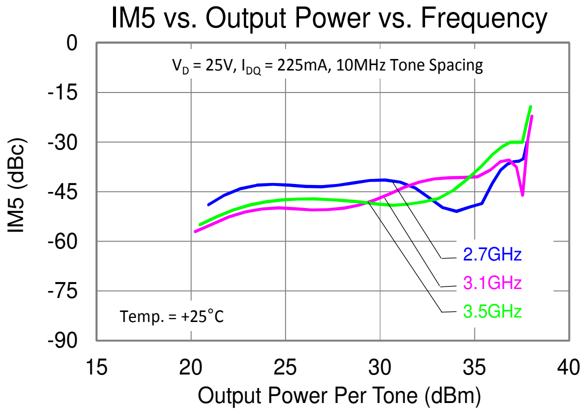


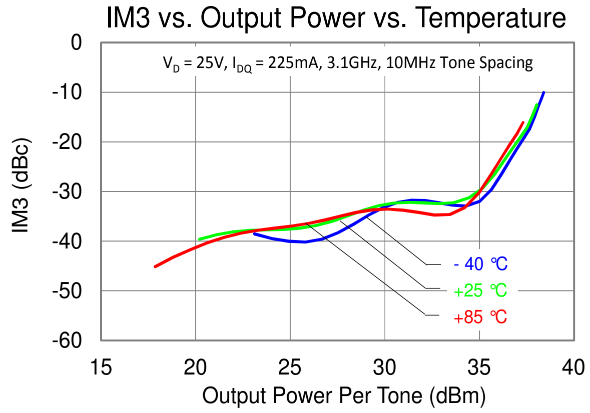
Gain vs. Input Power vs. Frequency

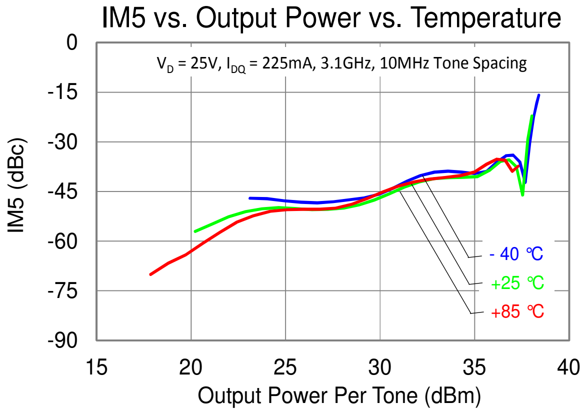


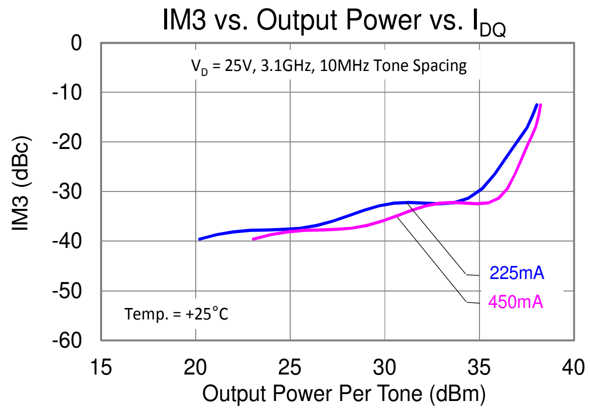
Typical Performance (Linearity)

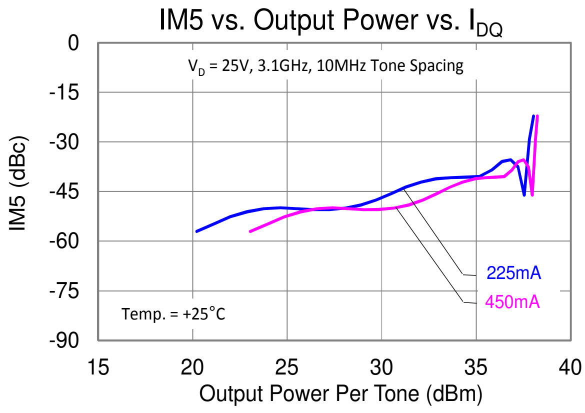

IM3 vs. Output Power vs. Frequency


IM5 vs. Output Power vs. Frequency

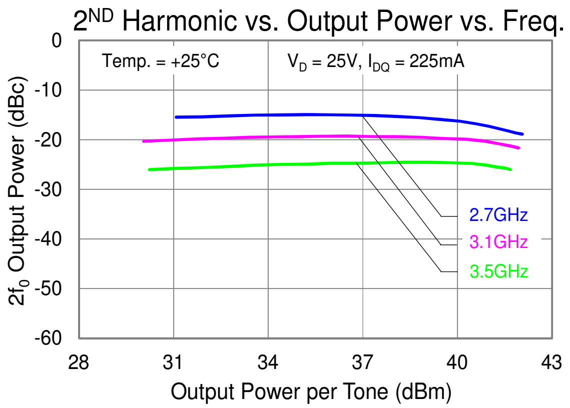

IM3 vs. Output Power vs. Temperature

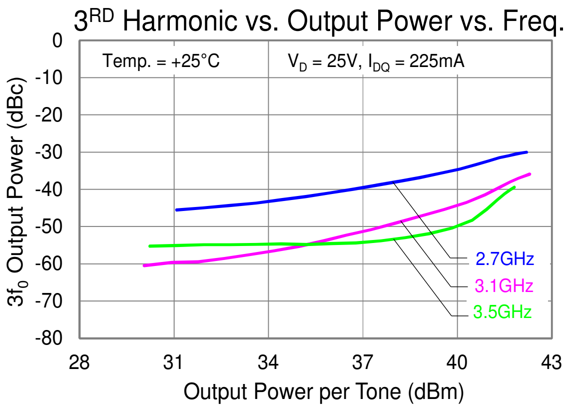

IM5 vs. Output Power vs. Temperature

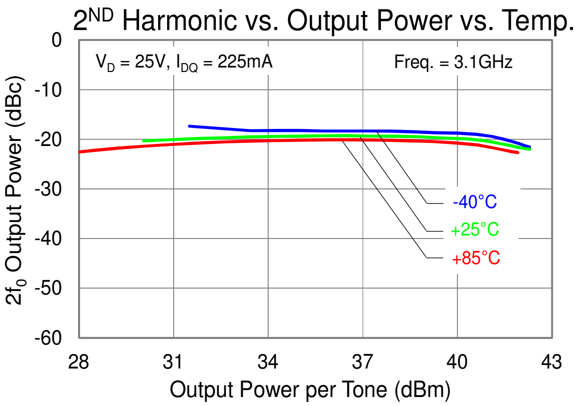

IM3 vs. Output Power vs. I_{DQ}

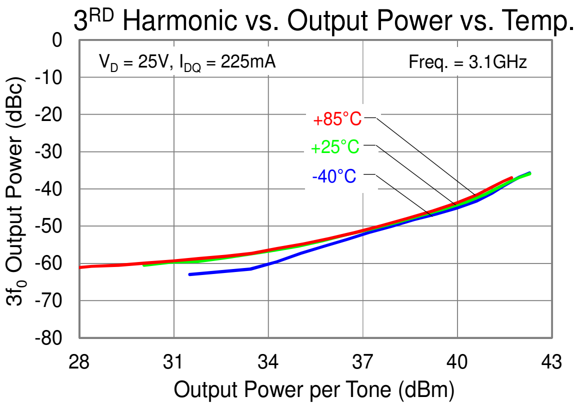

IM5 vs. Output Power vs. I_{DQ}

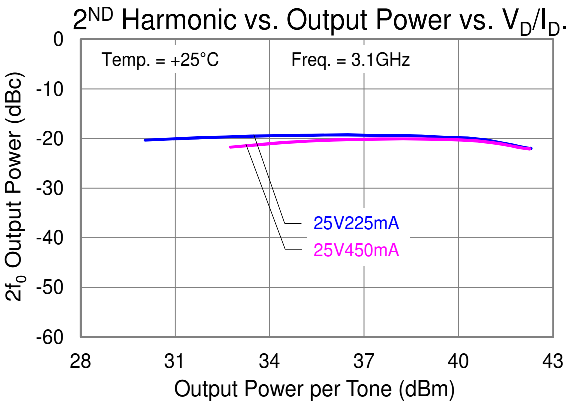
Typical Performance (Linearity)

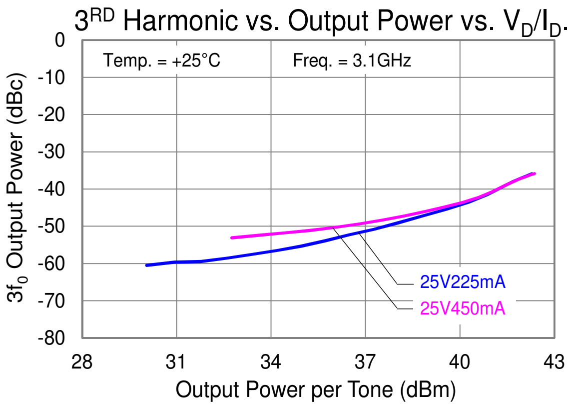

2ND Harmonic vs. Output Power vs. Freq.


3RD Harmonic vs. Output Power vs. Freq.

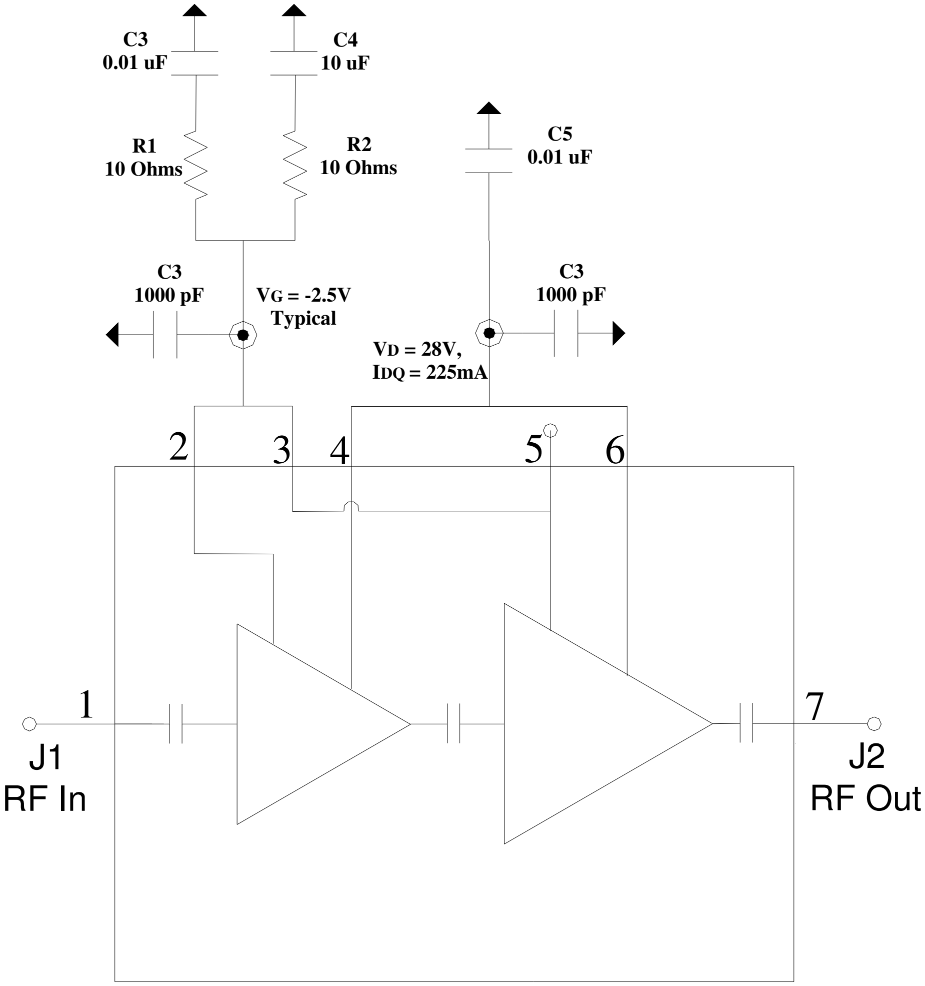

2ND Harmonic vs. Output Power vs. Temp.


3RD Harmonic vs. Output Power vs. Temp.


2ND Harmonic vs. Output Power vs. V_D/I_D.


3RD Harmonic vs. Output Power vs. V_D/I_D.

Application Circuit



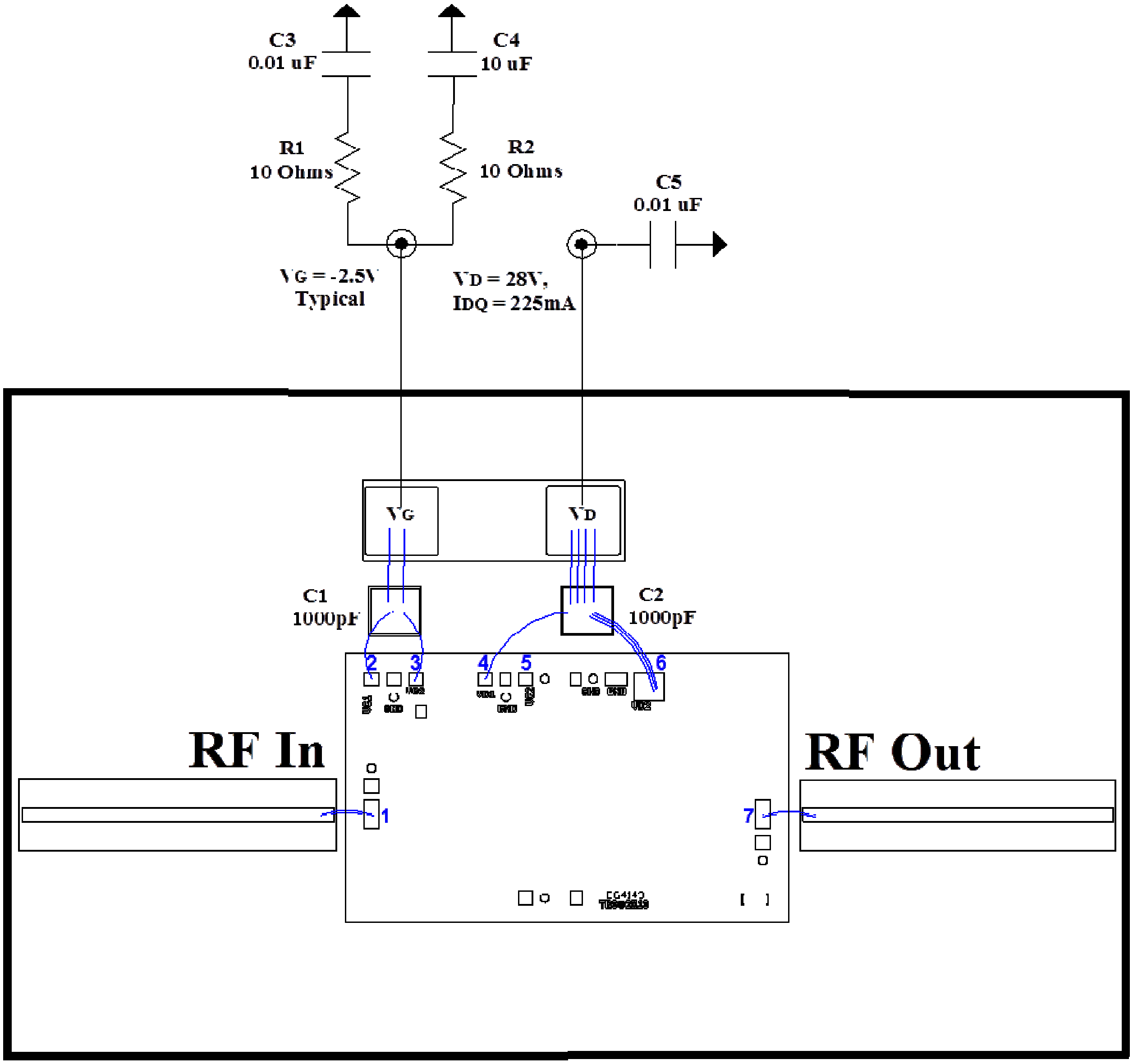
Bias-up Procedure

1. Set I_D limit to 1.5A, I_G limit to 8mA
2. Apply -5.0V to V_G
3. Apply +28V to V_D
4. Adjust V_G more positive until I_{DQ} = 225mA (V_G ~ -2.5 V Typical)
5. Apply RF signal

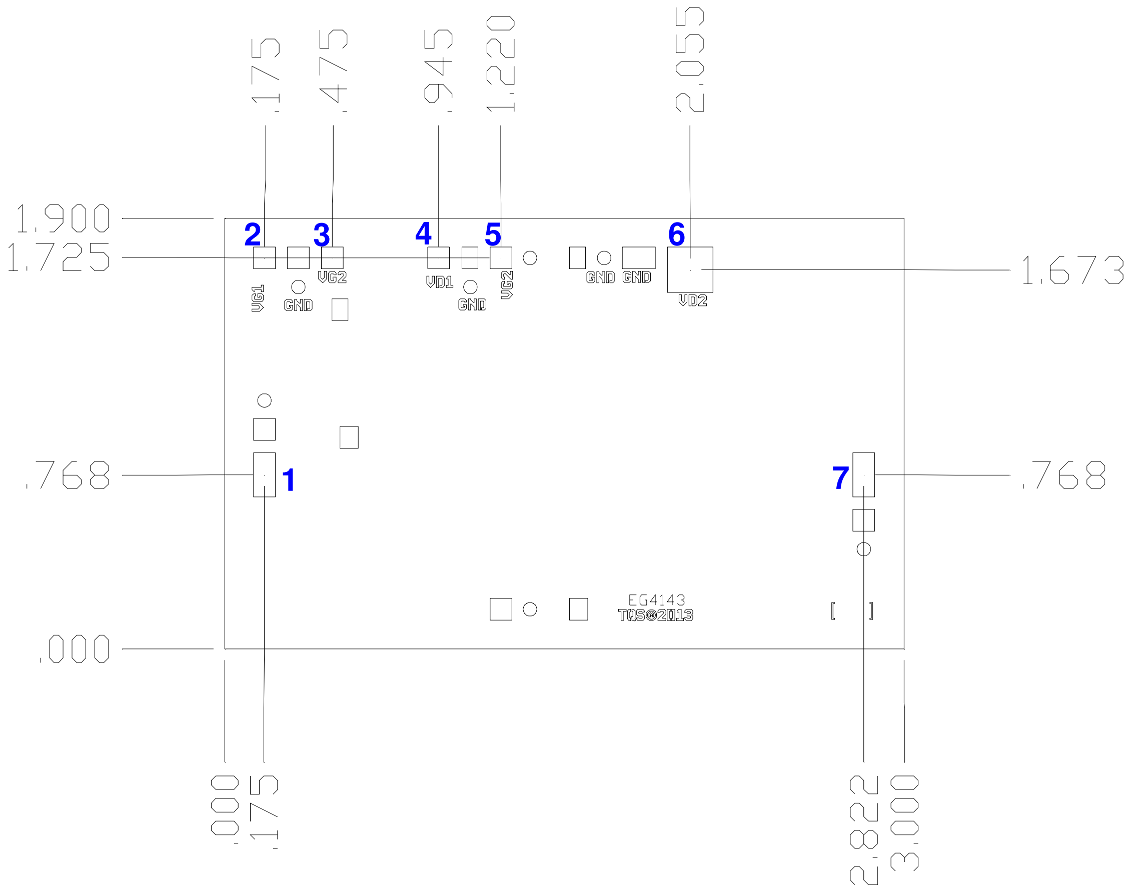
Bias-down Procedure

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

Assembly Drawing



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	0.096 x 0.196	Input; matched to 50 ohms; DCblocked
2	V_{G1}	0.096 x 0.096	Gate voltage 1; bias network is required; see Application Circuit on page 11 as an example
3, 5	V_{G2}	0.096 x 0.096	Gate voltage 2; bias network is required; see Application Circuit on page 11 as an example. Can be biased on either pad
4	V_{D1}	0.096 x 0.096	Drain voltage ; bias network is required; see Application Circuit on page 11 as an example
6	V_{D2}	0.200 x 0.200	Drain voltage 2; bias network is required; see Application Circuit on page 11 as an example
7	RF Out	0.096 x 0.196	Output; matched to 50 ohms; DC blocked

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.