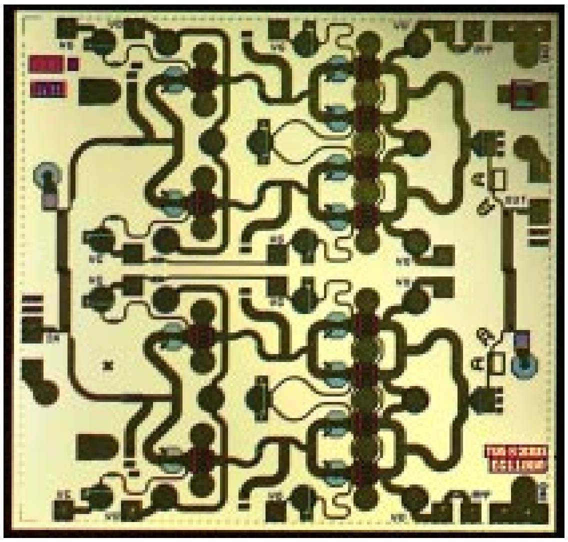
36 to 40 GHz 1W Power Amplifier TGA1171-SCC



Key Features and Performance

- 0.25 um pHEMT Technology
- 36-40 GHz Frequency Range
- 29 dBm Nominal Pout @ P1dB, 38 GHz
- 14 dB Nominal Gain
- OTOI 36 dBm at 40 GHz typical
- Bias 6-7 V @ 500 mA
- Chip Dimensions: 2.863 mm x 2.740 mm x 0.1016 mm

Primary Applications

- Point-to-Point Radio
- Point-to-Multipoint Radio

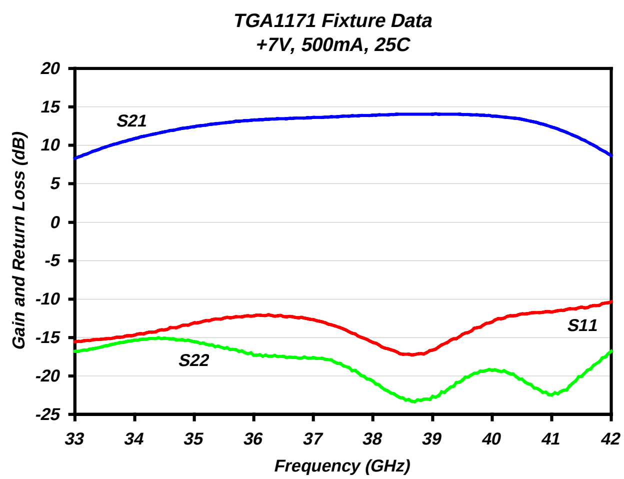
Product Description

The TriQuint TGA1171-SCC is a two-stage PA MMIC design using TriQuint's proven 0.25 µm Power pHEMT process to support a variety of millimeter wave applications including point-to-point digital radio and point-to-multipoint systems.

The balanced design consists of four 400 µm input devices driving eight 400 µm output devices.

The TGA1171 provides 29 dBm of output power at 1 dB gain compression and >30 dBm saturated output power across 36-40 GHz with a typical small signal gain of 14 dB. Typical Input/Output RL is typically greater than 12-15 dB across the band.

The TGA1171 requires minimal off-chip components. Each device is 100% DC and RF tested on-wafer to ensure performance compliance. The device is available in chip form.



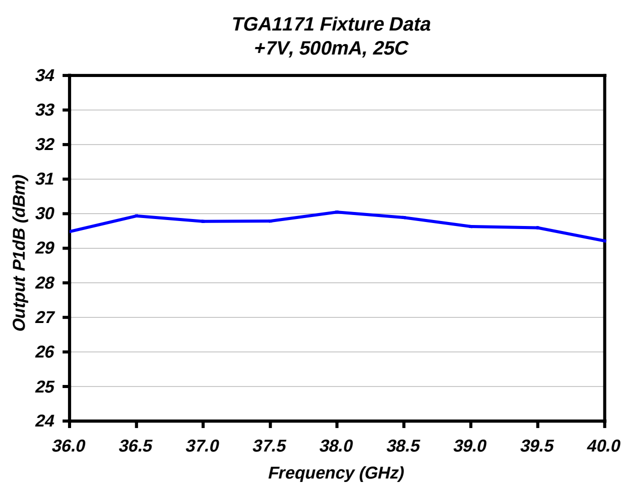


TABLE I
MAXIMUM RATINGS

Symbol	Parameter 5/	Value	Notes
V^+	Positive Supply Voltage	8 V	4/
V^-	Negative Supply Voltage Range	-5V TO 0V	
I^+	Positive Supply Current (Quiescent)	960 mA	4/
$\lvert I_G \rvert$	Gate Supply Current	56.32 mA	
P_{IN}	Input Continuous Wave Power	27 dBm	4/
P_D	Power Dissipation	5.25 W	3/ 4/
T_{CH}	Operating Channel Temperature	150 ^{0}C	1/ 2/
T_M	Mounting Temperature (30 Seconds)	320 ^{0}C	
T_{STG}	Storage Temperature	-65 to 150 ^{0}C	

1/ These ratings apply to each individual FET.

2/ Junction operating temperature will directly affect the device median time to failure (T_M). For maximum life, it is recommended that junction temperatures be maintained at the lowest possible levels.

3/ When operated at this bias condition with a base plate temperature of 70 ^{0}C, the median life is reduced from 9.5 E+6 to 6.1 E+5 hours.

4/ Combinations of supply voltage, supply current, input power, and output power shall not exceed P_D.

5/ These ratings represent the maximum operable values for this device.

TABLE II
DC PROBE TEST
(TA = 25 °C ± 5 °C)

Symbol	Parameter	Minimum	Maximum	Unit
Idss $_{(Q3-6)}$	Saturated Drain Current	160	752	mA
Gm$_{(Q3-6)}$	Transconductance	352	848	mS
V_P	Pinch-off Voltage	-1.5	-0.5	V
BVGS$_{(Q3-6)}$	Breakdown Voltage Gate-Source	-30	-11	V
BVGD$_{(Q3-6)}$	Breakdown Voltage Gate-Drain	-30	-11	V

TABLE III
AUTOPROBE FET PARAMETER MEASUREMENT CONDITIONS

FET Parameters	Test Conditions
I_{DSS} : Maximum drain current (I_{DS}) with gate voltage (V_{GS}) at zero volts.	V_{GS} = 0.0 V, drain voltage (V_{DS}) is swept from 0.5 V up to a maximum of 3.5 V in search of the maximum value of I_{DS}; voltage for I_{DSS} is recorded as VDSP.
G_m : Transconductance; $\frac{(I_{DSS} - IDS1)}{VG1}$	For all material types, V_{DS} is swept between 0.5 V and VDSP in search of the maximum value of I_{ds}. This maximum I_{DS} is recorded as IDS1. For Intermediate and Power material, IDS1 is measured at V_{GS} = VG1 = -0.5 V. For Low Noise, HFET and pHEMT material, V_{GS} = VG1 = -0.25 V. For LNBECOLC, use V_{GS} = VG1 = -0.10 V.
V_P : Pinch-Off Voltage; V_{GS} for I_{DS} = 0.5 mA/mm of gate width.	V_{DS} fixed at 2.0 V, V_{GS} is swept to bring I_{DS} to 0.5 mA/mm.
V_{BVGD} : Breakdown Voltage, Gate-to-Drain; gate-to-drain breakdown current (I_{BD}) = 1.0 mA/mm of gate width.	Drain fixed at ground, source not connected (floating), 1.0 mA/mm forced into gate, gate-to-drain voltage (V_{GD}) measured is V_{BVGD} and recorded as BVGD; this cannot be measured if there are other DC connections between gate-drain, gate-source or drain-source.
V_{BVGS} : Breakdown Voltage, Gate-to-Source; gate-to-source breakdown current (I_{BS}) = 1.0 mA/mm of gate width.	Source fixed at ground, drain not connected (floating), 1.0 mA/mm forced into gate, gate-to-source voltage (V_{GS}) measured is V_{BVGS} and recorded as BVGS; this cannot be measured if there are other DC connections between gate-drain, gate-source or drain-source.

TABLE IV
RF WAFER CHARACTERIZATION TEST
(T_A = 25°C ± 5°C)
(Vd = 7V, Id = 500 mA ±5%)

Parameter	Unit	Min	Typical	Max
Frequency	GHz	36		40
Output P1dB	dBm	26	29	
Small Signal Gain	dB	12	14	
Input Return Loss	dB		-15	
Output Return Loss	dB		-15	
Output TOI	dBm		36	

TABLE V
THERMAL INFORMATION*

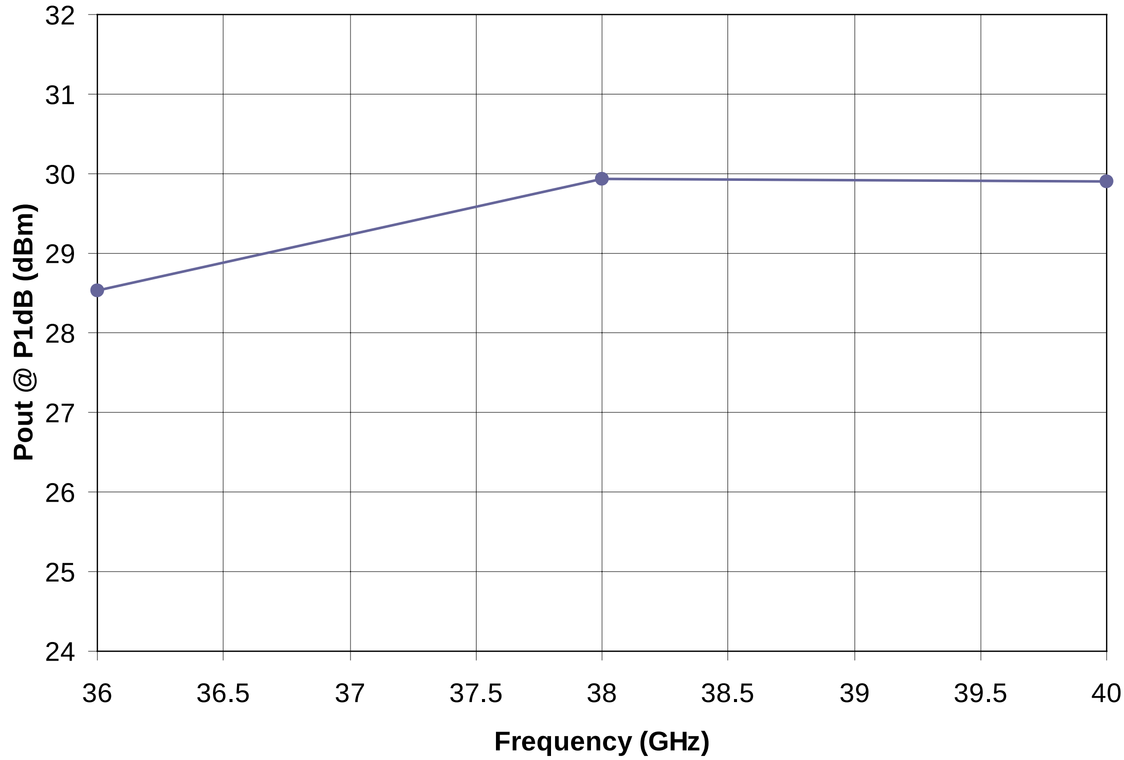
Parameter	Test Conditions	T_{CH} (°C)	$R_{\theta JC}$ (°C/W)	T_M (HRS)
$R_{\theta JC}$ Thermal Resistance (channel to backside of carrier)	Vd = 7V I_D = 500 mA Pdiss = 3.5 W	125.03	15.79	9.5 E+6

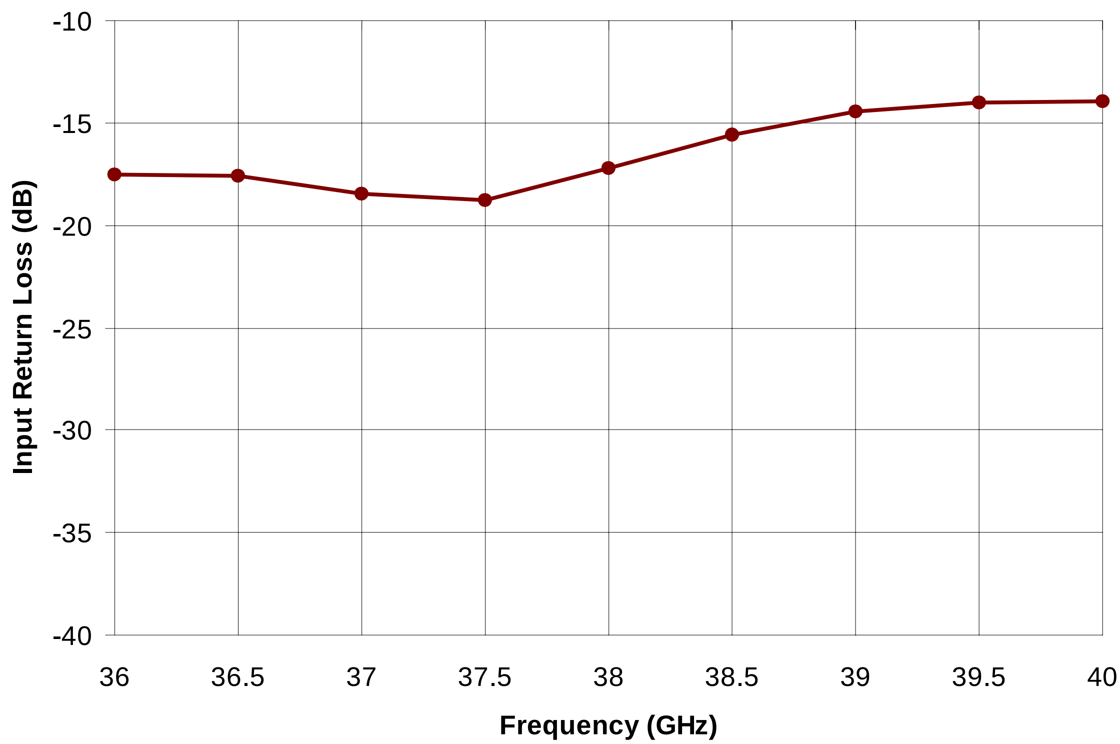
Note: Assumes eutectic attach using 1.5 mil 80/20 AuSn mounted to a 20 mil CuMo Carrier at 70°C baseplate temperature. Worst case condition with no RF applied, 100% of DC power is dissipated.

* This information is a result of a thermal model analysis.

Data Based on the 50th percentile On-Wafer RF Probe Test Results, Sample Size = 13971 Devices

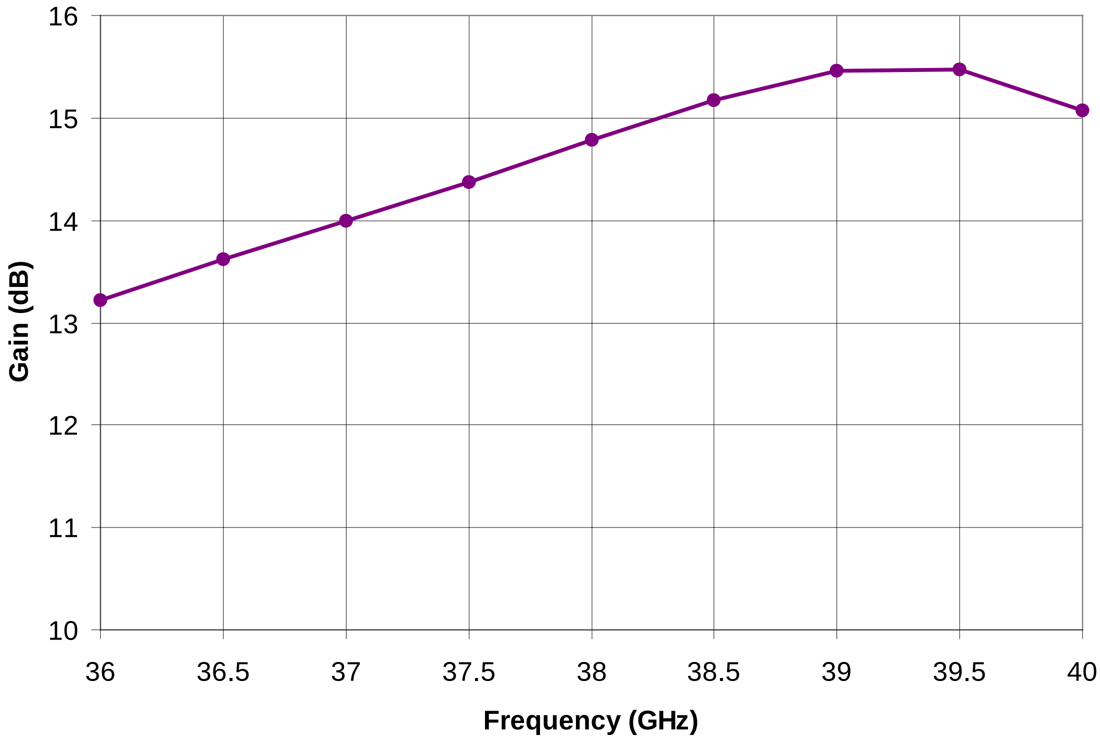
Bias Conditions: Vd = 7 V, Id = 500 mA

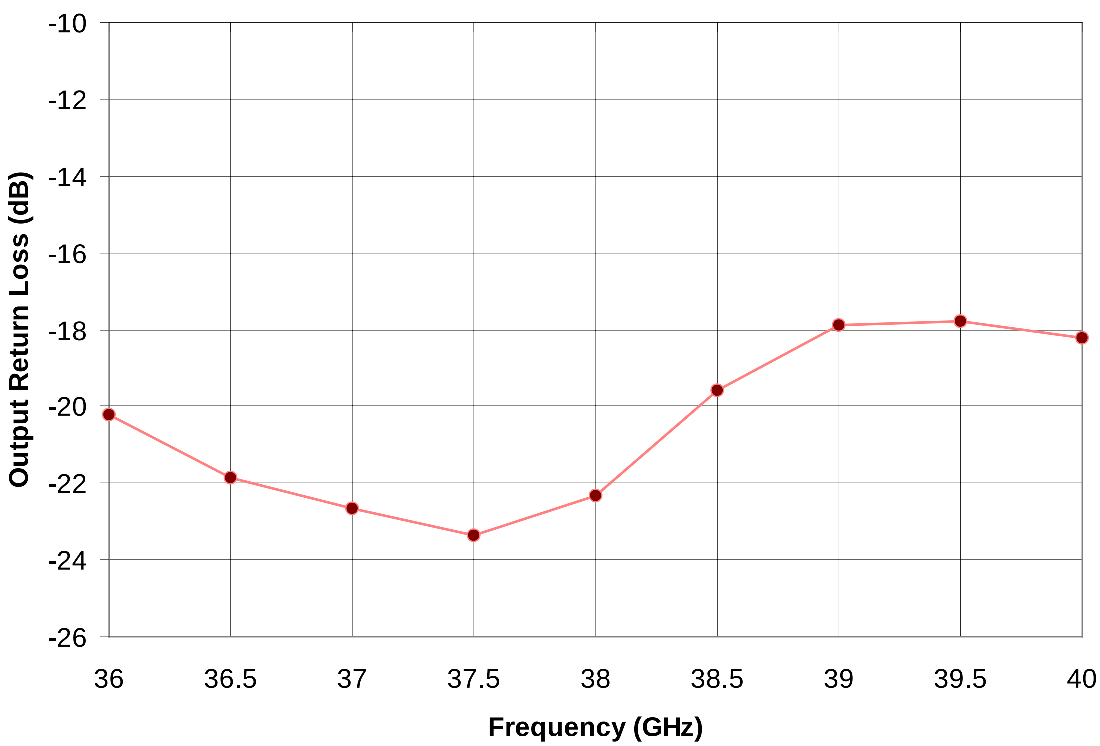




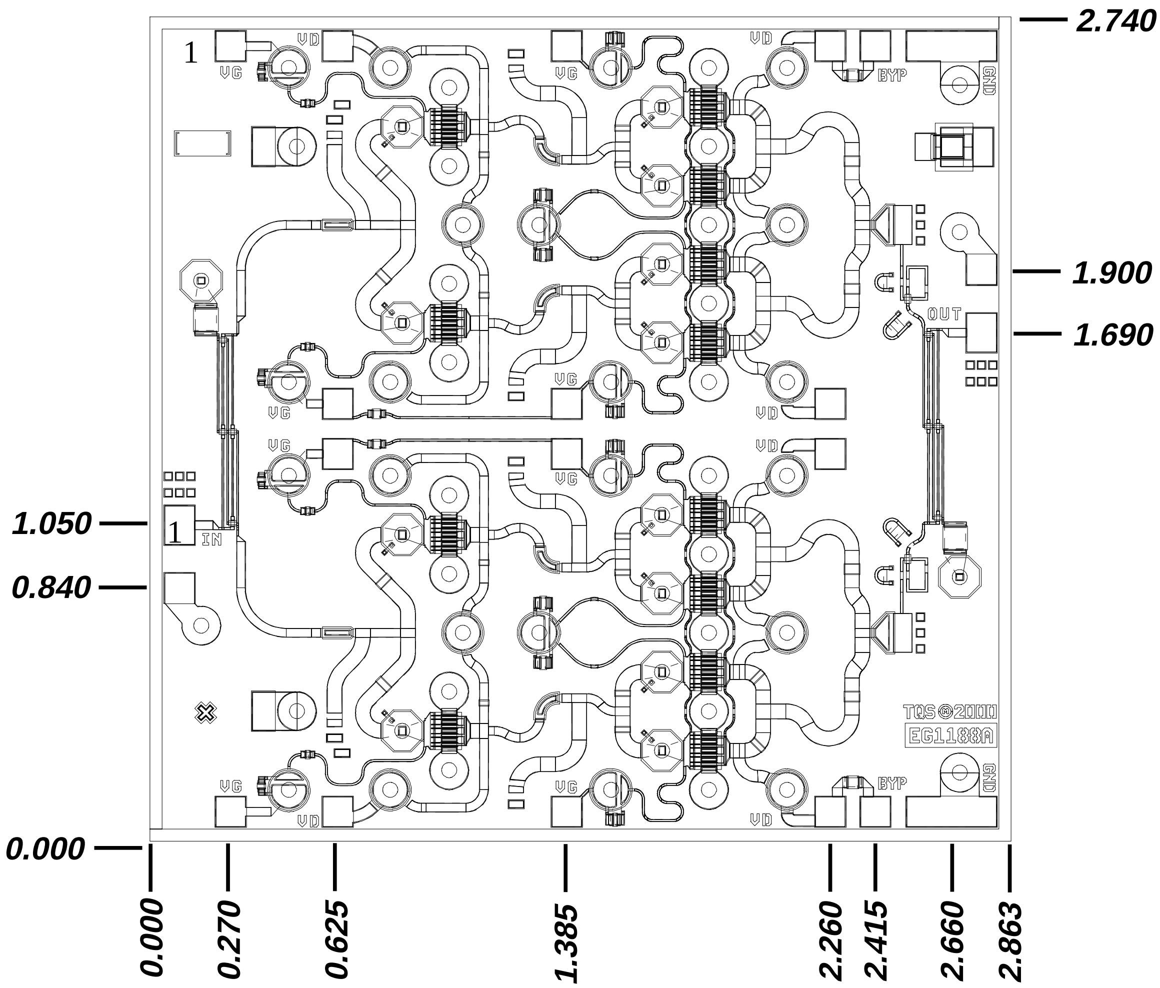
Data Based on the 50th percentile On-Wafer RF Probe Test Results, Sample Size = 13971 Devices

Bias Conditions: Vd = 7 V, Id = 500 mA





Mechanical Characteristics

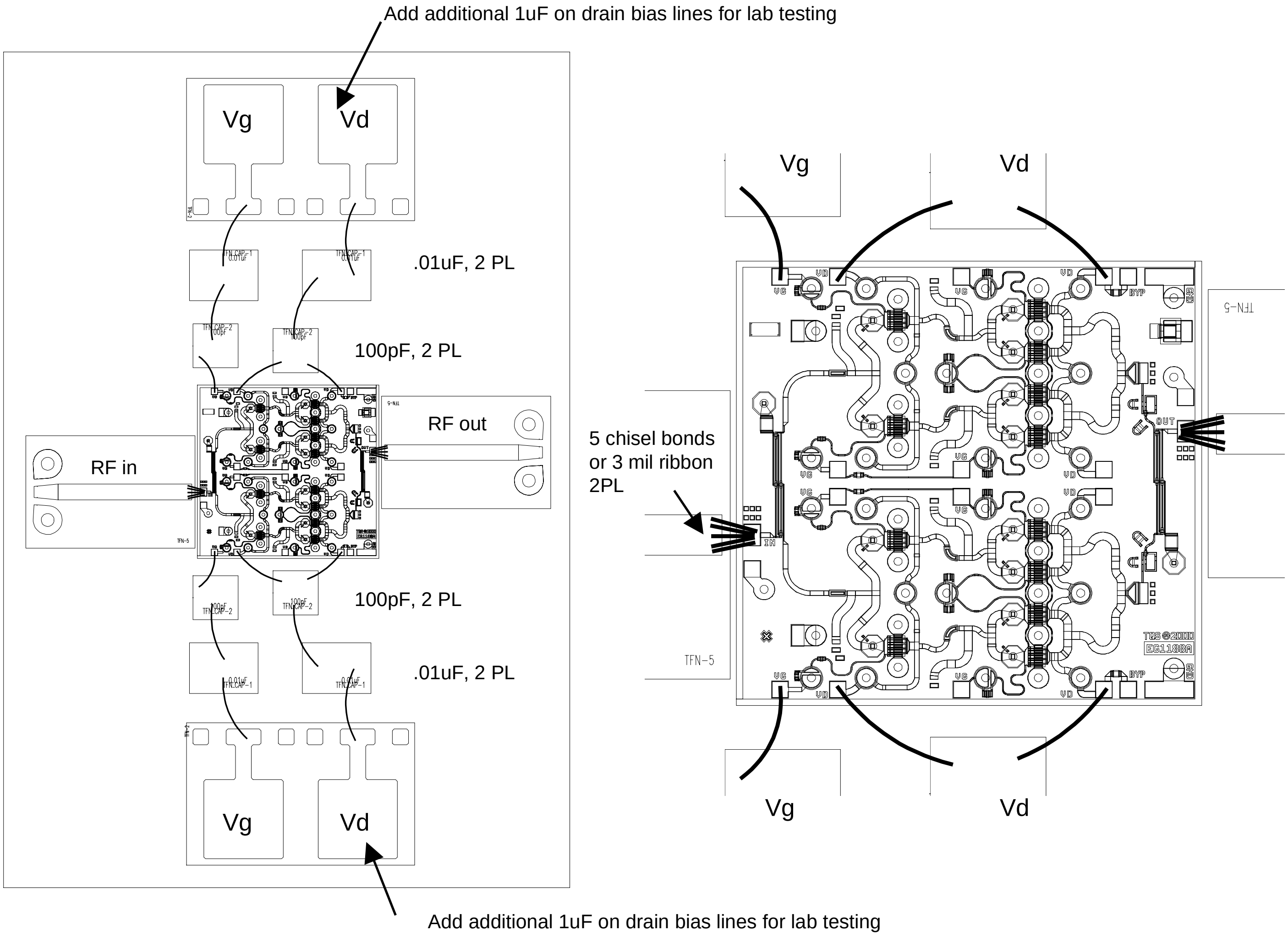


Dimensions in mm

RF Pads: 130x100 µm

DC Pads: 100x100 µm

Die Area: 7.845 mm²



Chip Assembly and Bonding Diagram

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

Assembly Process Notes

Reflow process assembly notes:

- Use AuSn (80/20) solder with limited exposure to temperatures at or above 300°C.
- An alloy station or conveyor furnace with reducing atmosphere should be used.
- No fluxes should be utilized.
- Coefficient of thermal expansion matching is critical for long-term reliability.
- Devices must be stored in a dry nitrogen atmosphere.

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 can be used in low-power applications.
- Curing should be done in a convection oven; proper exhaust is a safety concern.
- Microwave or radiant curing should not be used because of differential heating.
- Coefficient of thermal expansion matching is critical.

Interconnect process assembly notes:

- Thermosonic ball bonding is the preferred interconnect technique.
- Force, time, and ultrasonics are critical parameters.
- Aluminum wire should not be used.
- Discrete FET devices with small pad sizes should be bonded with 0.0007-inch wire.
- Maximum stage temperature is 200°C.

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