T1G4005528-FS

55W, 28V, DC – 3.5GHz, GaN RF Power Transistor

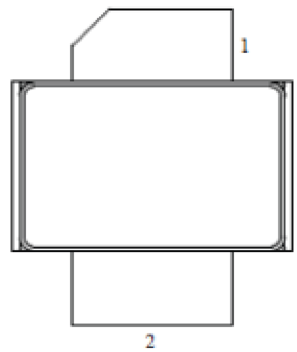
Applications

- Military radar
- Civilian radar
- Professional and military radio communications
- Test instrumentation
- Avionics
- Wideband or narrowband amplifiers

Product Features

- Frequency Range: DC to 3.5 GHz
- Linear Gain: >15 dB at 3.5 GHz
- Operating Voltage: 28 V
- Output Power (P_{3dB}): 55 W at 3.5 GHz
- Lead-free and RoHS compliant

Functional Block Diagram



General Description

The TriQuint T1G4005528-FS is a 55 W (P_{3dB}) discrete GaN on SiC HEMT which operates from DC to 3.5 GHz. The device is constructed with TriQuint's proven 0.25um production process, which features advanced field plate techniques to optimize power and efficiency at high drain bias operating conditions. This optimization can potentially lower system costs in terms of fewer amplifier line-ups and lower thermal management costs.

Pin Configurations

Pin No.	Symbol
1	RF Output
2	RF Input
Flange	Source

Ordering Information

Part	ECCN	Description
T1G4005528-FS	EAR99	Packaged part: Flangeless
T1G4005528-FS-EVB1	EAR99	3.0-3.5 GHz Evaluation Board

Absolute Maximum Ratings

Parameter	Value
Drain to Gate Voltage, Vd - Vg	40 V
Gate Voltage, Vg	-8 to 0 V
Drain Current, Id	9.6 A
Gate Current, Ig	-20 to 33 mA
Power Dissipation, Pdiss	90 W
RF Input Power, CW, T = 25 °C	43 dBm
Channel Temperature, Tch	275 °C
Mounting Temperature, (30 sec)	320 °C
Storage Temperature	-40 to 150 °C

Notes:

1. Operation of this device outside the parameter ranges given may cause permanent damage. These are stress ratings only, and functional operation of the device at these conditions is not implied. Refer to the Median Life Time plot for additional information regarding channel temperature.

DC Characteristics

Recommended operating conditions apply unless otherwise specified: T_A = 25 °C

Characteristics	Symbol	Min	Typ	Max	Unit	Conditions
Break-Down Voltage Drain Source	BV_{DSX}	85	120		V	V_{GS} = -8 V, I_D = 10 mA
Gate Quiescent Voltage	$V_{GS\ (Q)}$		-3.5		V	V_{DS} = 28 V, I_{DQ} = 0.8 A
Gate Threshold Voltage	$V_{GS\ (th)}$		-4.5		V	V_{DS} = 10 V, I_D = 40 mA
Saturated Drain Current	I_{DSX}		16		A	V_{DS} = 5 V, V_{GS} = 0 V

RF Characteristics – Load Pull Performance at 3.0 GHz

V_{DS} = 28 V; I_{DQ} = 200 mA; Pulse: 100 µs, 20 %

Characteristics	Symbol	Min	Typ	Max	Unit
Linear Gain	G_{LIN}		17.3		dB
Output Power at 1 dB Gain Compression	P_{1dB}		51.3		W
Drain Efficiency at 1 dB Gain Compression	DE_{1dB}		59.0		%
Power-Added Efficiency at 1 dB Gain Compression	PAE_{1dB}		57.6		%
Gain at 1 dB Compression	G_{1dB}		16.3		dB

RF Characteristics – Load Pull Performance at 3.5 GHz

V_{DS} = 28 V; I_{DQ} = 200 mA; Pulse: 100 µs, 20 %

Characteristics	Symbol	Min	Typ	Max	Unit
Linear Gain	G_{LIN}		17.6		dB
Output Power at 1 dB Gain Compression	P_{1dB}		55.0		W
Drain Efficiency at 1 dB Gain Compression	DE_{1dB}		62.1		%
Power-Added Efficiency at 1 dB Gain Compression	PAE_{1dB}		60.7		%
Gain at 1 dB Compression	G_{1dB}		16.6		dB

RF Characteristics – Performance at 3.3 GHz in 3.0 to 3.5 GHz Eval. Board

V_{DS} = 28 V; I_{DQ} = 200 mA; Pulse: 100 µs, 20 %

Characteristics	Symbol	Min	Typ	Max	Unit
Linear Gain	G_{LIN}	14.0	15.1		dB
Output Power	P_{3dB}	55.0	65.6		W
Drain Efficiency at 3 dB Gain Compression	DE_{3dB}	50.0	52.5		%
Power-Added Efficiency at 3 dB Gain Compression	PAE_{3dB}	45.0	49.3		%
Gain at 3 dB Compression	G_{3dB}	11.0	12.1		dB

RF Characteristics – Narrow Band Performance at 3.5 GHz

V_{DS} = 28 V; I_{DQ} = 200 mA; CW at P_{1dB}, applied for 3.5 seconds

Characteristics	Symbol	Min	Typ	Max	Unit
Impedance Mismatch Ruggedness [(1)]	VSWR		10:1		

Notes:

1. VSWR testing performed with increasing real impedance value only from reference Z to 10 times reference Z

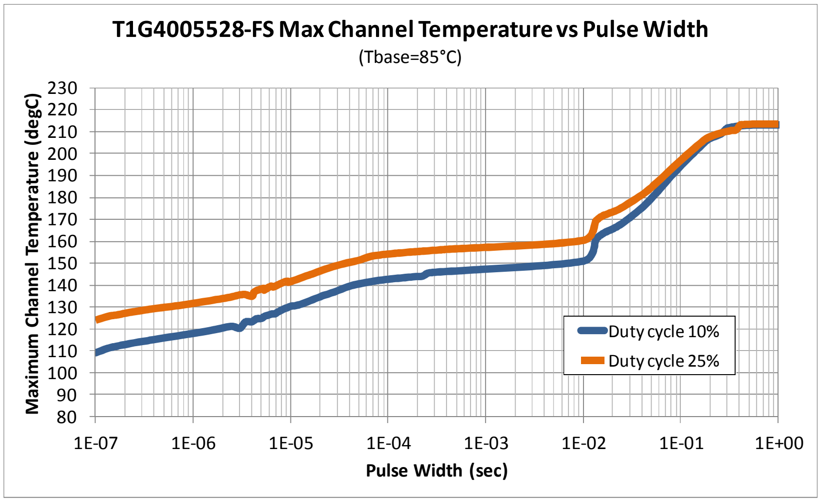
Thermal Information

Test Conditions	T_{CH} (°C)	θ_{JC} (°C/W) [1]
DC at 85 °C Case	211	2.1

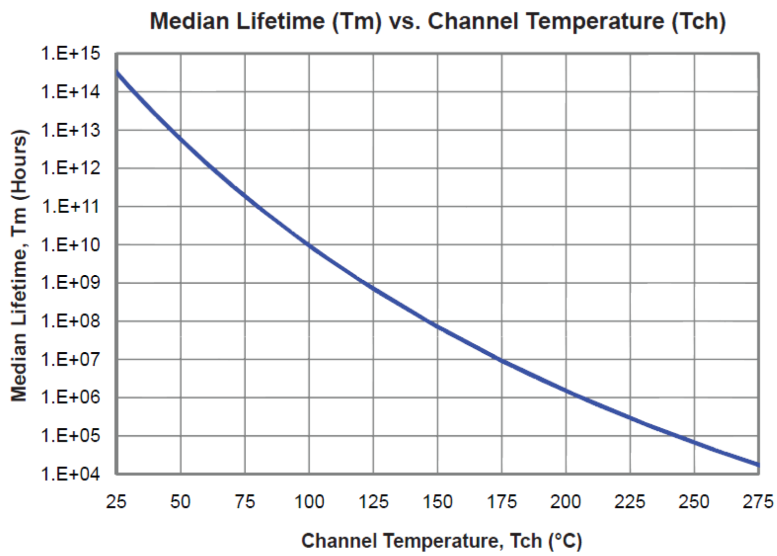
Notes:

1. Thermal resistance (channel to backside of case)

Maximum Channel Temperature



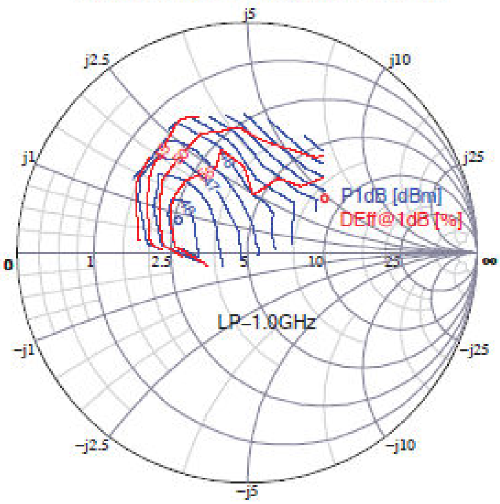
Median Lifetime



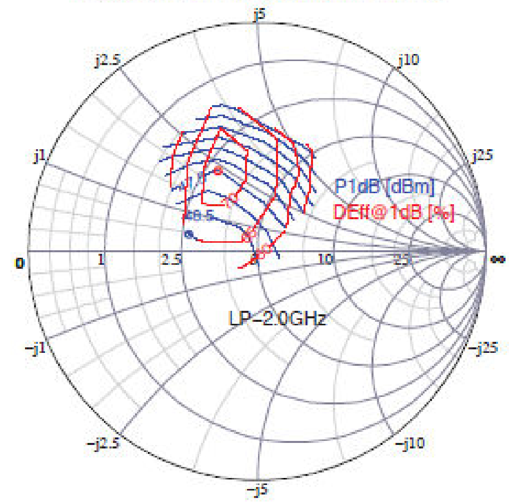
Load-Pull Data

RF performance that the device typically exhibits when placed in the specified impedance environment. The impedances are not the impedances of the device, they are the impedances presented to the device via an RF circuit or load-pull system. The impedances listed follow an optimized trajectory to maintain high power and high efficiency (ZLcmp).

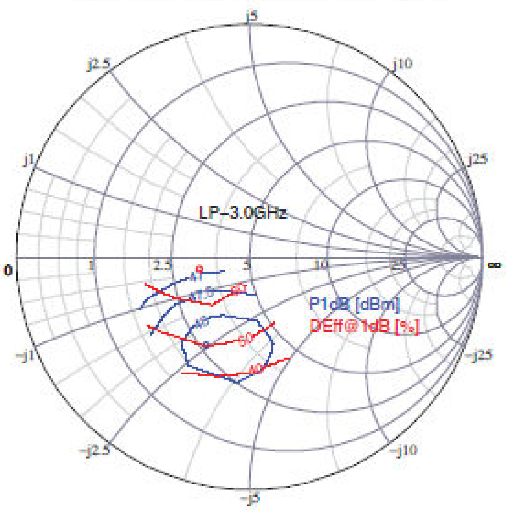
Load-Pull Data at 1 GHz



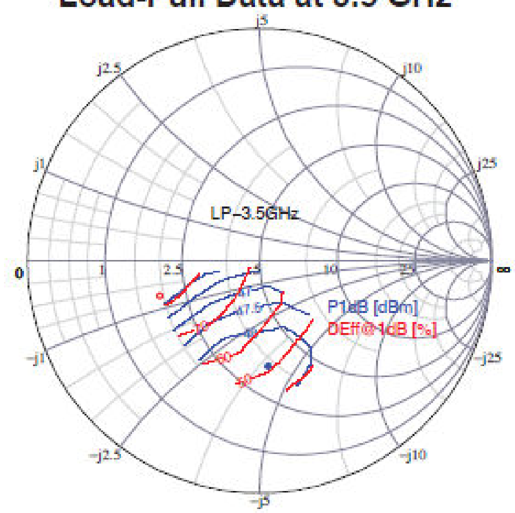
Load-Pull Data at 2 GHz



Load-Pull Data at 3 GHz



Load-Pull Data at 3.5 GHz



Notes:

Test Conditions: V_{DS} = 28 V, I_{DQ} = 200 mA
Test Signal: Pulse Width = 100 µs, Duty Cycle = 20 %

Device Characterization Data

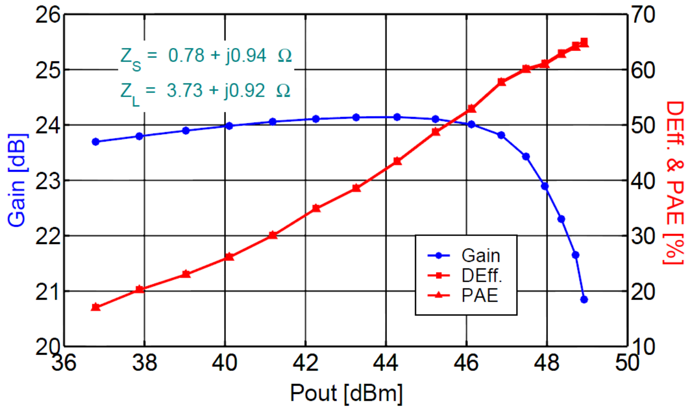
Freq. (GHz)	Real(ZS)	Imag(ZS)	Real(ZL)	Imag(ZL)	G_{1dB} (Db)	P_{1dB} (dBm)	P_{1dB} (W)	$DEff_{1dB}$ (%)	PAE_{1dB} (%)
1.0	0.78	0.94	3.73	0.92	23.1	47.8	59.8	60.8	60.5
2.0	0.90	-2.75	2.70	1.37	18	48.4	68.8	72	70.8
3.0	3.59	-5.46	3.25	-0.90	16.9	47.4	55	63.7	62.4
3.5	7.93	-3.92	3.23	-1.90	17.2	47.7	58.9	65.7	64.4

Note: The higher efficiency at 2 GHz is a result of harmonic terminations with the LP test setup.

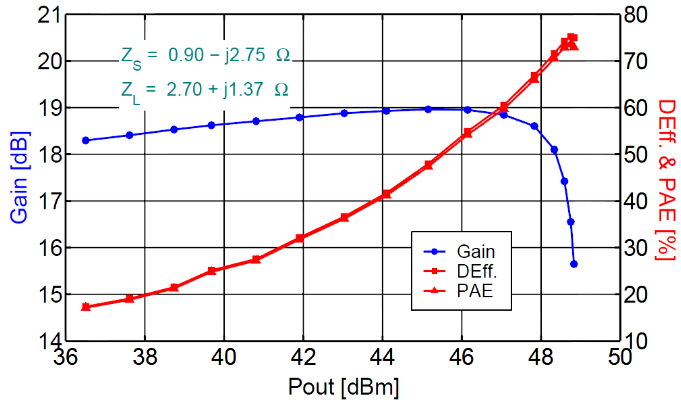
Typical Performance: Gain, Efficiency and Output Power

Performance is measured at DUT reference plane

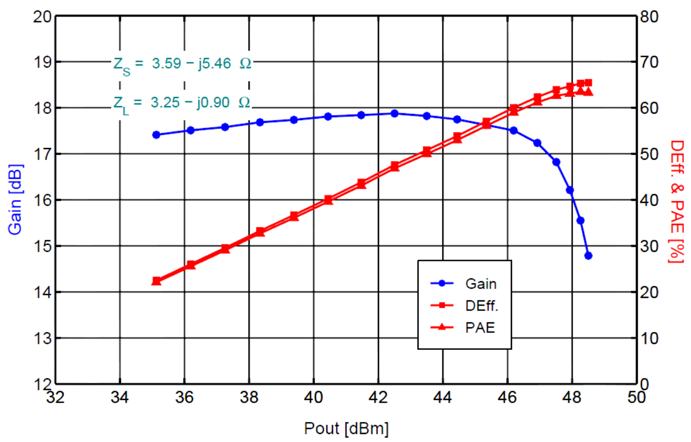
T1G4005528-FS Gain, DEff and PAE vs. Pout
Freq. = 1000 MHz; V_{DS} = 28 V, I_{DQ} = 200 mA; Pulse: 100 µs, 20%



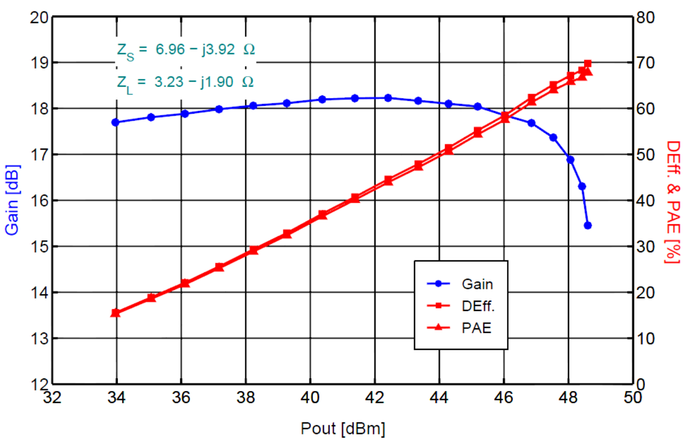
T1G4005528-FS Gain, DEff and PAE vs. Pout
Freq. = 2000 MHz; V_{DS} = 28 V, I_{DQ} = 200 mA; Pulse: 100 µs, 20%



T1G4005528-FS Gain, DEff and PAE vs. Pout
Freq. = 3000 MHz; V_{DS} = 28 V, I_{DQ} = 200 mA; Pulse: 100 µs, 20%

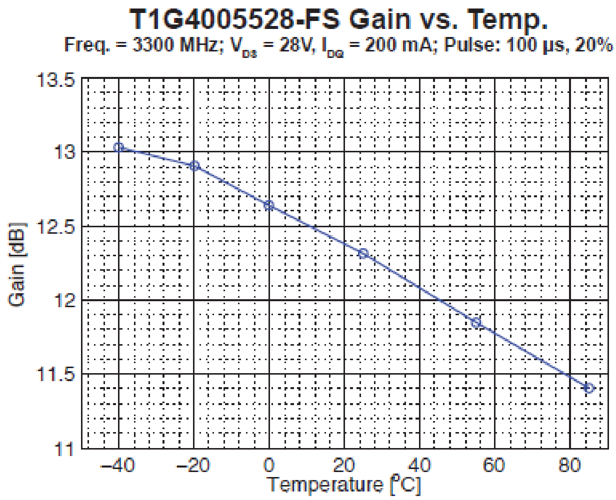


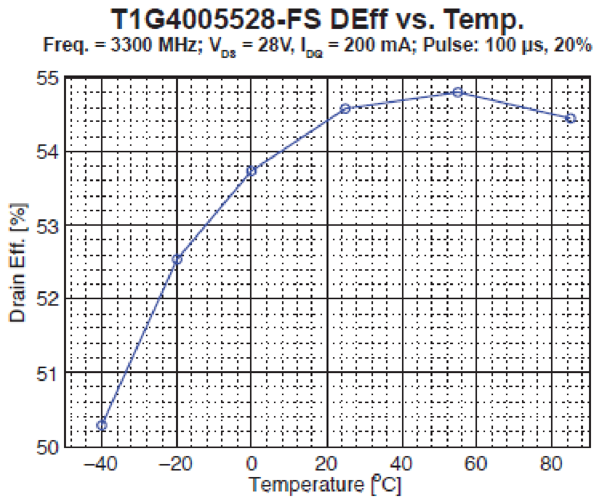
T1G4005528-FS Gain, DEff and PAE vs. Pout
Freq. = 3500 MHz; V_{DS} = 28 V, I_{DQ} = 200 mA; Pulse: 100 µs, 20%

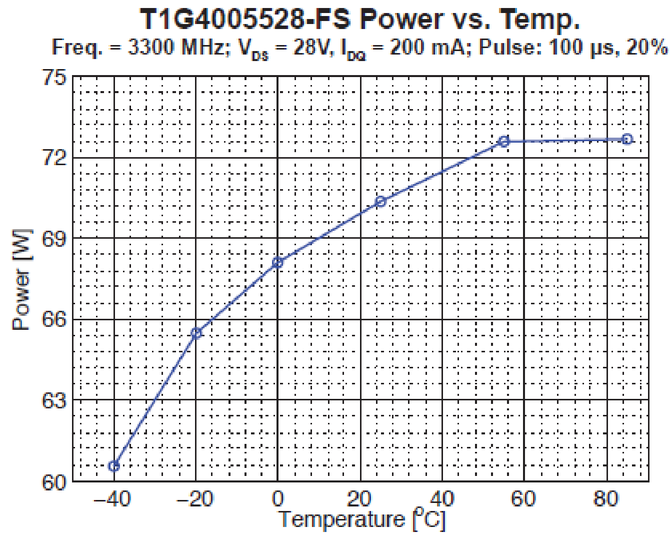


Performance Over Temperature: Gain, Efficiency and Output Power

Performance measured in TriQuint's 3.0 to 3.5 GHz Evaluation Board at 3 dB compression

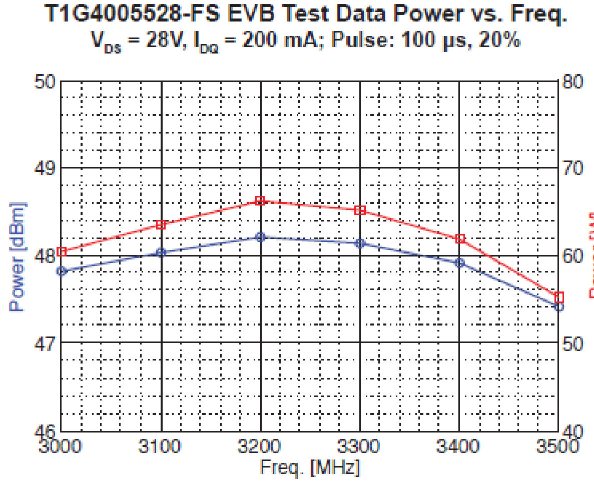


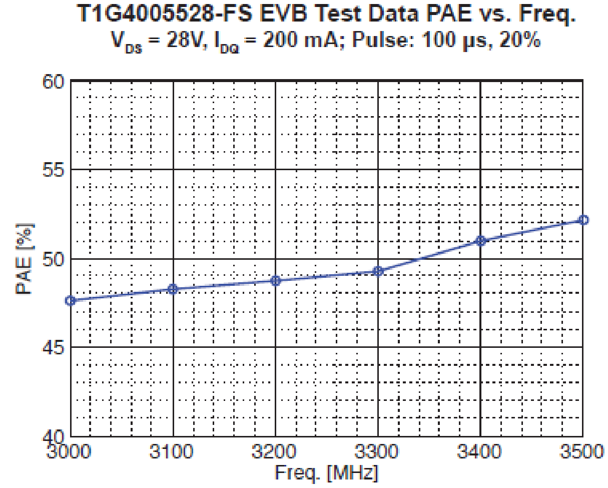


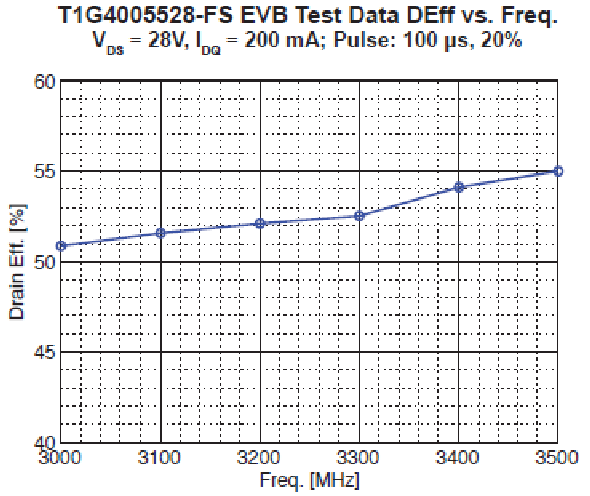


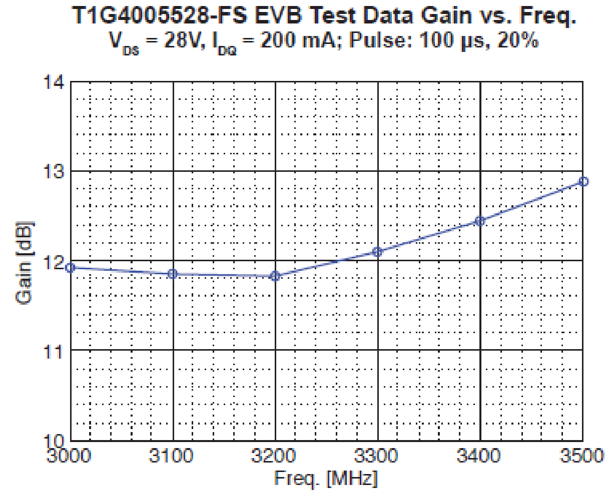
Evaluation Board Performance

Performance measured in TriQuint's 3.0 to 3.5 GHz Evaluation Board at 3 dB compression

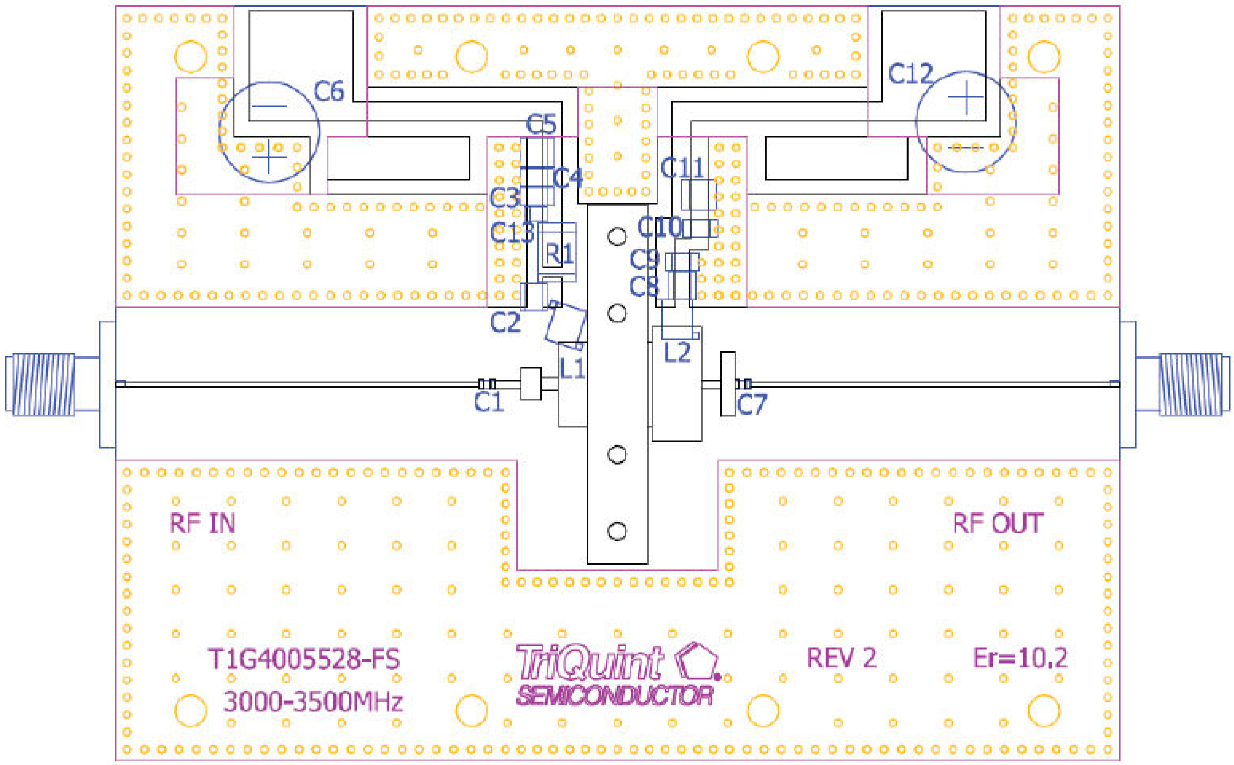








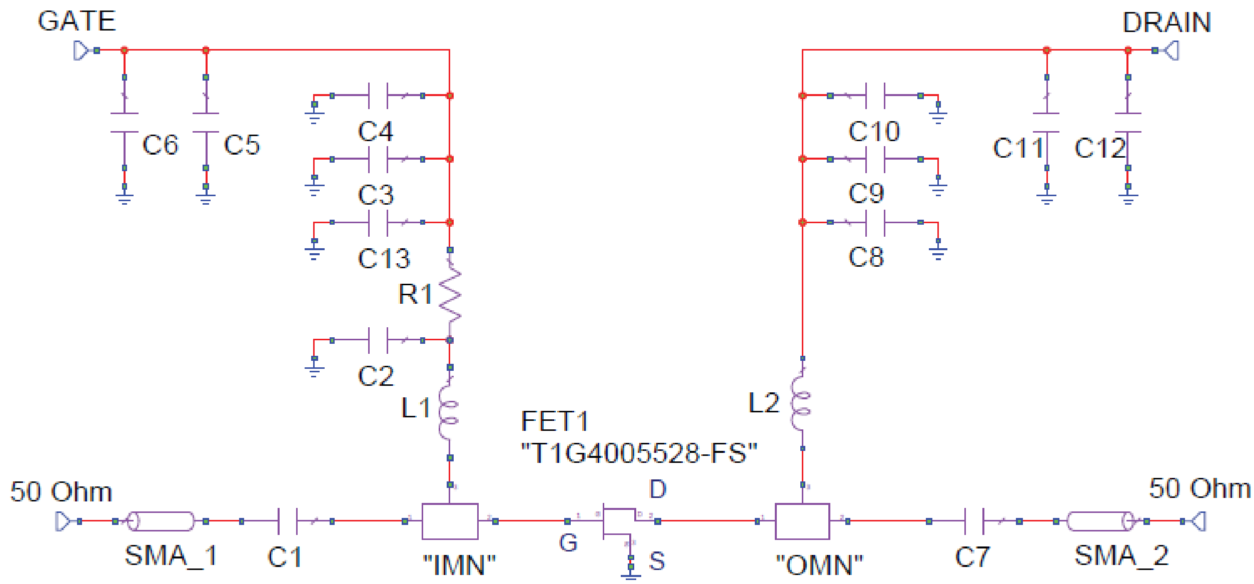
Evaluation Board – PC Board Layout: T1G4005528-FS-EVB1, 3.0 to 3.5 GHz



Bill of Materials

Reference Desg.	Value	Qty	Manufacturer	Part Number
C1, C7	47 pF	2	ATC	100A470JW
C2, C8	82 pF	2	ATC	100B820J7
C3, C9	2200 pF	2	Vitramon	VJ1206Y222KRA
C4, C10	22000 pF	2	Vitramon	48C4641
C5, C11	1 µF	2	Allied	213-0366
C6, C12	470 µF	2	Illinois Cap	477KXM035M
L1, L2	12.5 nH	2	Coilcraft	A04T_JL
R1	2.4 Ω	1	Vishay Dale	CRCW25122R40JNEG
C13	2400 pF	1	Dielectric Labs	C08BL242X-5UN-X0B
PCB	RO3210		Rogers	ε_r = 10.2; h = 25 mil
IMN				Distributed transmission line input network
OMN				Distributed transmission line output network

Evaluation Board – T1G4005528-FS-EVB1, 3.0 to 3.5 GHz



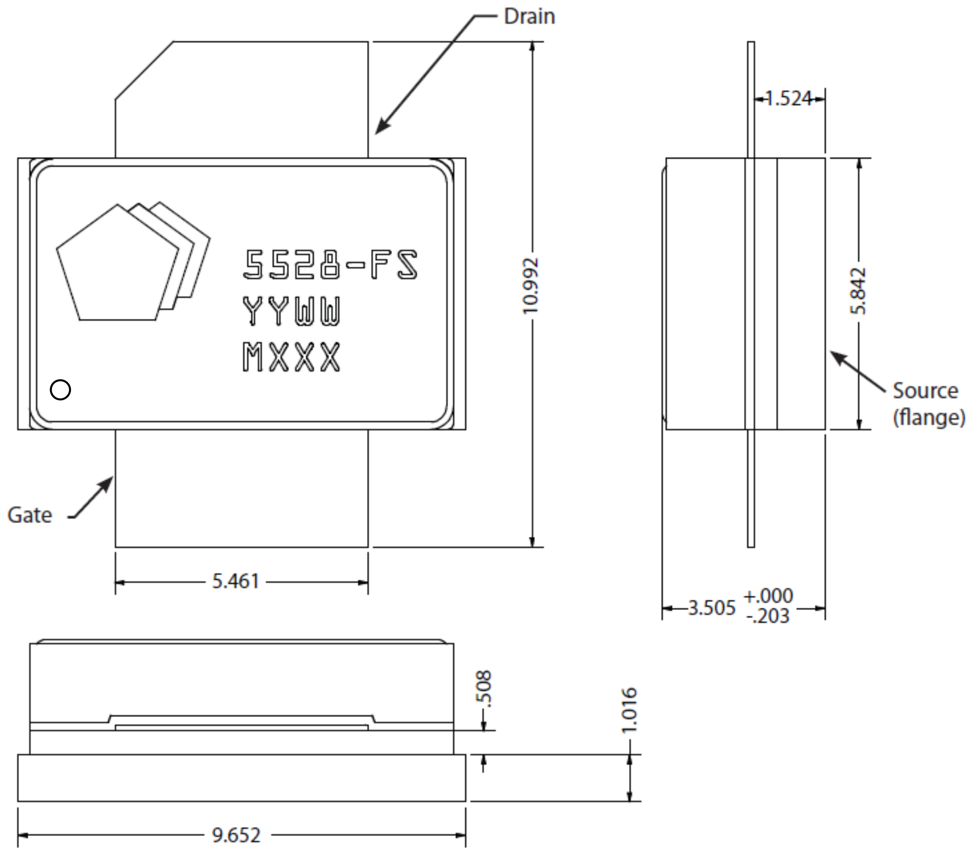
Bias-up Procedure

Set gate voltage (V_G) to -5.0V
Set drain voltage (V_D) to 28 V
Slowly increase V_G until quiescent I_D is 200 mA. Typical V_G is -3.5 V
Apply RF signal

Bias-down Procedure

Turn off RF signal
Turn off V_D and wait 1 second to allow drain capacitor(s) to dissipate
Turn off V_G

Package Information and Dimensions



Notes:
Unless specified otherwise, dimensions are in millimeters

This package is lead-free/ROHS-compliant. It is a 9.7 mm x 5.8 mm ceramic air cavity flat lead package and the base material is CuMoCu.

Product Compliance Information

ESD Sensitivity Ratings

Caution! ESD-Sensitive Device

ESD Rating:	1A
Value:	Passes ≥ 250 V min.
Test:	Human Body Model (HBM)
Standard:	JEDEC Standard JESD22-A114

MSL Rating

Level 3 at +260 °C convection reflow.
The part is rated Moisture Sensitivity Level 3 at 260 °C per JEDEC standard IPC/JEDEC J-STD-020.

ECCN

U.S. Department of Commerce EAR99

Solderability

Compatible with the latest version of J-STD-020, Lead free solder, 260 °C.

RoHs Compliance

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_{4}0_{2}$) Free
- PFOS Free
- SVHC Free

Contact Information

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