GaN Power Amplifier, 28 V, 125 W 2.1 - 2.7 GHz

Features

- GaN on Si HEMT D-Mode Power Amplifier
- Suitable for Linear & Saturated Applications
- Broadband Operation from 2.1 - 2.7 GHz
- 125 W P3dB Peak Envelope Power
- 90 W P3dB CW Power
- 10 W Linear Power @ 2% EVM for Single Carrier OFDM, 10.3 dB peak/avg., 10 MHz channel bandwidth
- 16.5 dB Gain
- 26% Efficiency
- Characterized for Operation up to 32 V
- 100% RF Tested
- Thermally Enhanced Industry Standard Package
- High Reliability Gold Metallization Process
- RoHS* Compliant

Applications

- Defense Communications
- Land Mobile Radio
- Avionics
- Wireless Infrastructure
- ISM
- VHF/UHF/L/S-Band Radar

Description

The NPT25100 GaN on silicon HEMT D-Mode amplifier optimized for 2.1 - 2.7 GHz operation. This device supports CW, pulsed, and linear operation with output power levels to 125 W in an industry standard plastic package with bolt down flange.

NPT25100B

NPT25100P

Ordering Information

Part Number	Package
NPT25100B	Standard Flange
NPT25100P	Earless Flange

RF Specifications (CW)[1]: Freq: = 2500 MHz, V_{DS} = 28 V, I_{DQ} = 60 mA, T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Average Output Power	3 dB Gain Compression	P_{3dB}	80	90	—	W
Small Signal Gain	—	G_{SS}	14.0	16.5	—	dB
Drain Efficiency	3 dB Gain Compression	η	55	62	—	%

1. Measured in test fixture.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Typical 2-Tone Performance[2]:

Freq. = 2500 MHz, V_{DS} = 28 V, I_{DQ} = 600 mA, Tone spacing = 1 MHz, T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Peak Envelope Power	3 dB Gain Compression 1 dB Gain Compression -35 dB Gain Compression	$P_{3dB,PEP}$ $P_{1dB,PEP}$ P_{IMD3}	—	125 90 80	—	W

2. Measured in Load Pull System (Refer to Table 1 and Figure 1).

Typical OFDM Performance:

Freq. = 2500 - 2700 MHz, V_{DS} = 28 V, I_{DQ} = 600 mA, P_{OUT}/Avg. = 10 W, T_C = 25°C

Single carrier OFDM waveform 64-QAM 3/4, 8 burst, continuous frame data, 10 MHz channel bandwidth. Peak/Avg = 10.3 dB @ 0.01% probability on CCDF.

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	—	G_P	—	16.5	—	dB
Drain Efficiency	—	η	—	26.0	—	%
Error Vector Magnitude	—	EVM	—	2.0	—	%

DC Electrical Characteristics: T_A = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Off Characteristics						
Drain Source Breakdown Voltage	V_{GS} = -8 V, I_D = 36 mA	V_{BDS}	100	—	—	V
Drain Source Leakage Current	V_{GS} = -8 V, V_{DS} = 60 V	I_{DLK}	—	9	18	mA
On Characteristics						
Gate Threshold Voltage	V_{DS} = 28 V, I_D = 36 mA	V_T	-2.3	-1.8	-1.3	V
Gate Quiescent Voltage	V_{DS} = 28 V, I_D = 70 mA	V_{GSQ}	-2.0	-1.5	-1.0	V
On Resistance	V_{GS} = 2 V, I_D = 270 mA	R_{ON}	—	0.13	0.14	Ω
Drain Current	V_{DS} = 7 V pulsed, 300 μs pulse width, 0.2% duty cycle	$I_{D,MAX}$	—	21.0	—	A

Absolute Maximum Ratings[3,4,5]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	100 V
Gate Source Voltage, V_{GS}	-10 V to +3 V
Gate Current, I_G	180 mA
Total Power Dissipation, P_T	100 W
Junction Temperature, T_J	+200°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation near these survivability limits.
5. Operating at nominal conditions with $T_J \leq 200°C$ will ensure MTTF > 1 x 10^6 hours.

Thermal Characteristics[6]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	V_{DS} = 48 V, T_J = 145°C	$R_{\theta JC}$	1.75	°C/W

6. Junction temperature (T_J) measured using IR Microscopy. Case temperature measured using thermocouple embedded in heat-sink.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

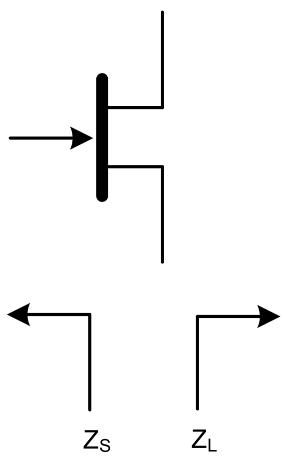
Gallium Nitride Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM (>2000 V), MM (>100 V) Class 1B devices.

Load-Pull Performance: V_{DS} = 48 V, I_{DQ} = 600 mA, T_C = 25°C

Reference Plane at Device Leads, CW Drain Efficiency and Output Power Tradeoff Impedance

Frequency (MHz)	Z_S (Ω)	Z_L (Ω)
2140	12.1 - j20.0	2.6 - j2.6
2300	10.0 - j3.0	2.5 - j2.3
2400	9.5 - j3.0	2.5 - j2.5
2500	9.0 - j3.0	2.5 - j2.7
2600	8.5 - j3.0	2.5 - j3.1
2700	8.0 - j3.0	2.5 - j3.3

Impedance Reference



Z_S is the source impedance presented to the device.
Z_L is the load impedance presented to the device.

Z_S and Z_L vs. Frequency

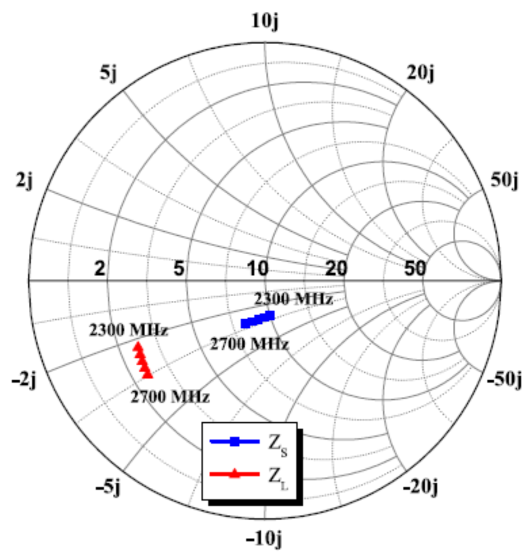
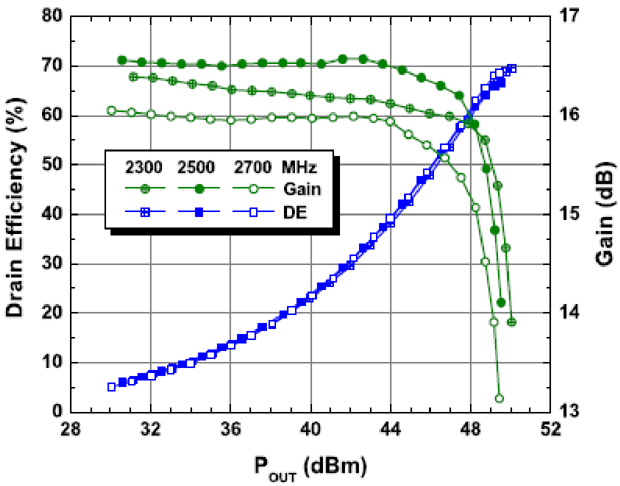


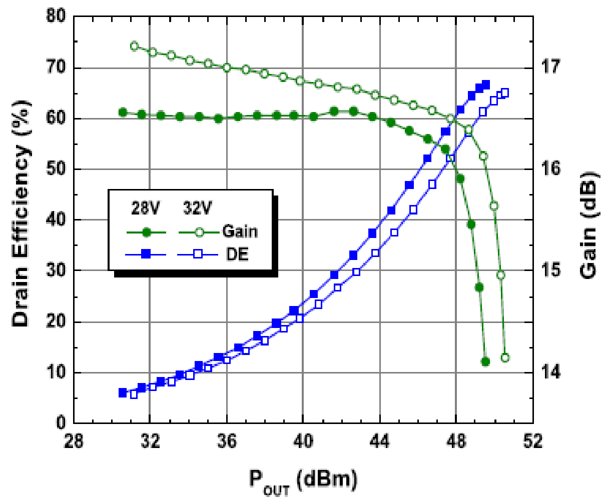
Figure 1 - Optimal impedance for CW performance, V_{DS} = 28 V, I_{DQ} = 600 mA.

Typical CW Performance in Loadpull System:

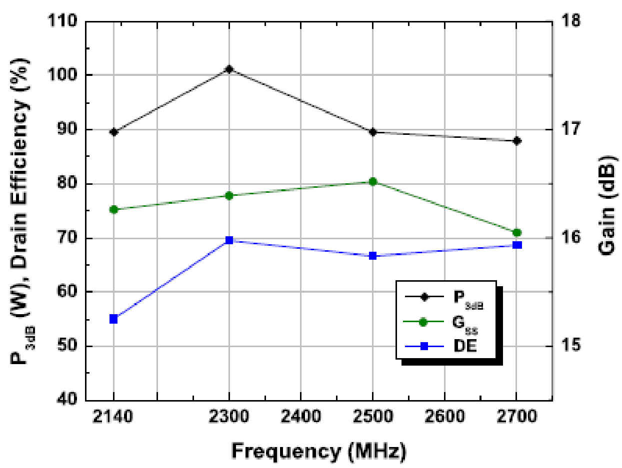
Drain Efficiency & Gain
28 V, 600 mA, 2300 - 2700 MHz



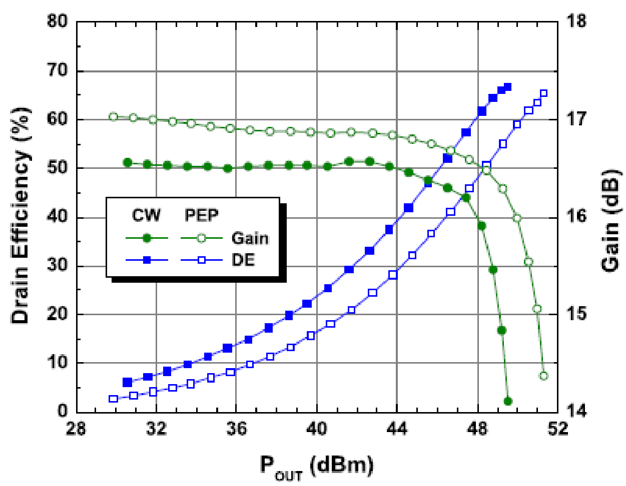
Drain Efficiency & Gain
28 V & 32 V, 600 mA, 2500 MHz



P3dB, Drain Efficiency & Gain
28 V, 600 mA

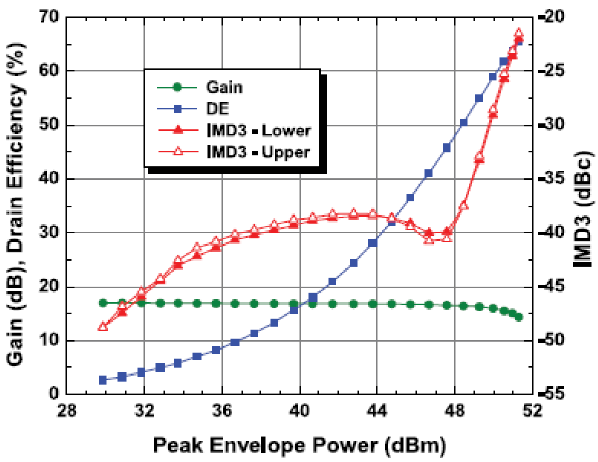


Drain Efficiency & Gain
28 V & 32 V, 600 mA, 2500 MHz, Tone Spacing = 1 MHz

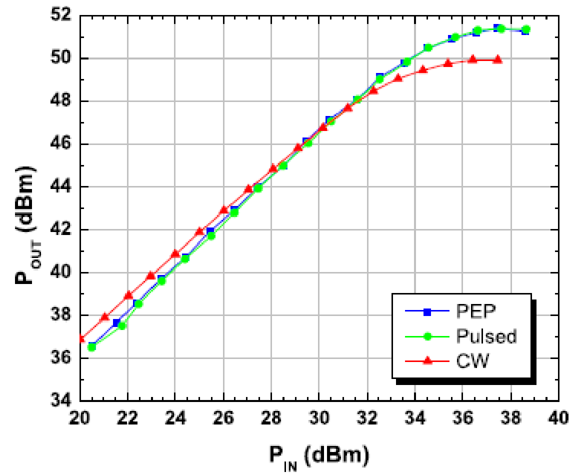


Typical CW Performance in Loadpull System:

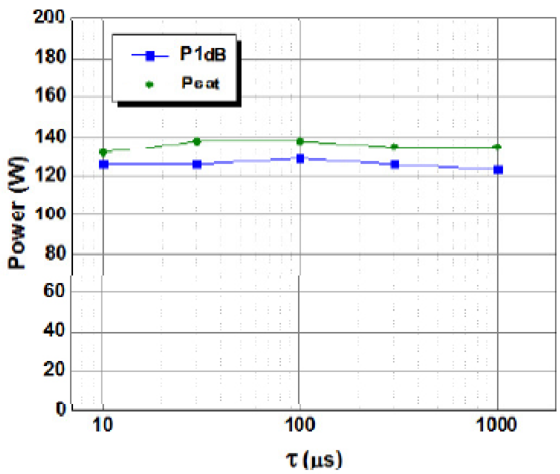
Drain Efficiency, Gain, & IMD3
28 V , 600 mA, 2500 MHz, Tone Spacing = 1 MHz



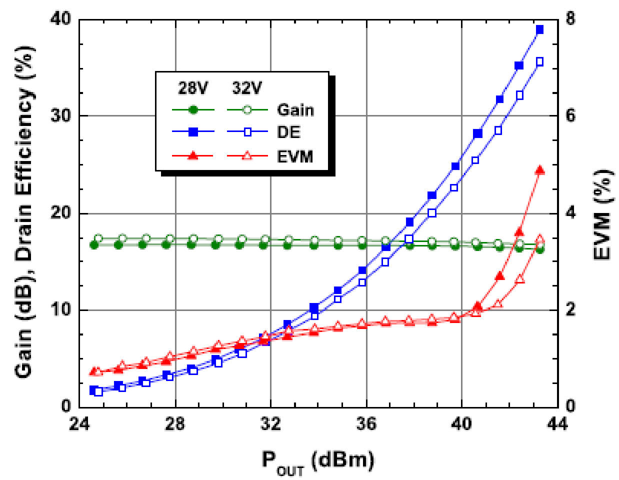
Drain Efficiency, Gain, & IMD3
28 V , 600 mA, 2500 MHz, Tone Spacing = 1 MHz
10 µs Pulse Width, 1% Duty Cycle



Power
28 V, 600 mA, 2500 MHz, 1% Duty Cycle

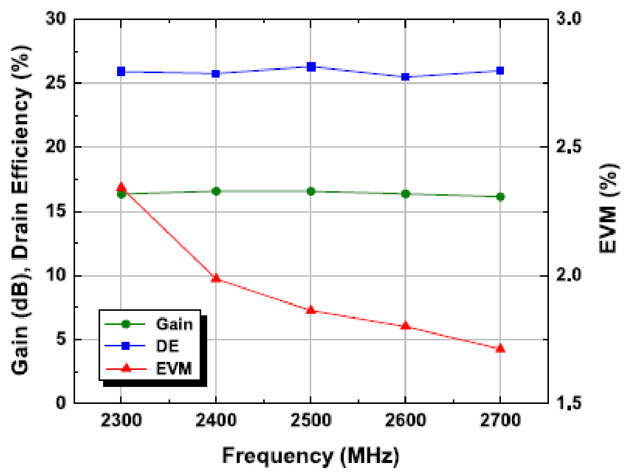


Drain Efficiency , Gain, & EVM
28 V & 32 V, 600 mA, 2500 MHz



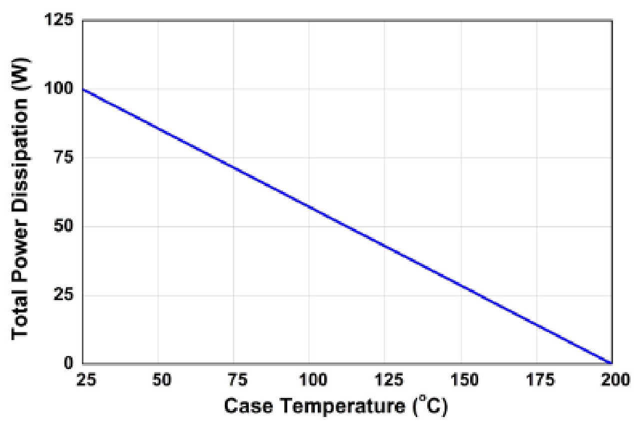
Typical CW Performance in Loadpull System:

Drain Efficiency , Gain, & EVM
28 V & 32 V, 600 mA, 2500 MHz
$P_{OUT,AVG}$ = 10 W

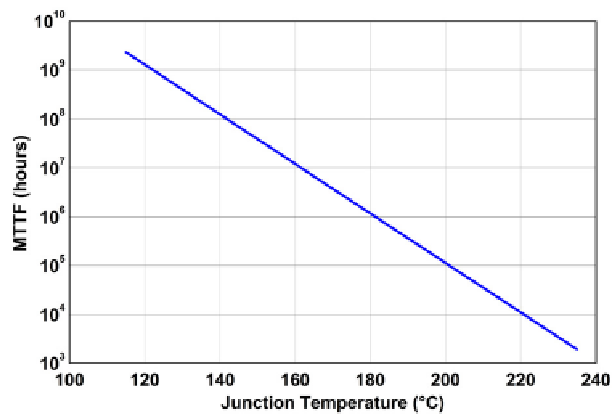


Typical Performance:

Power Derating

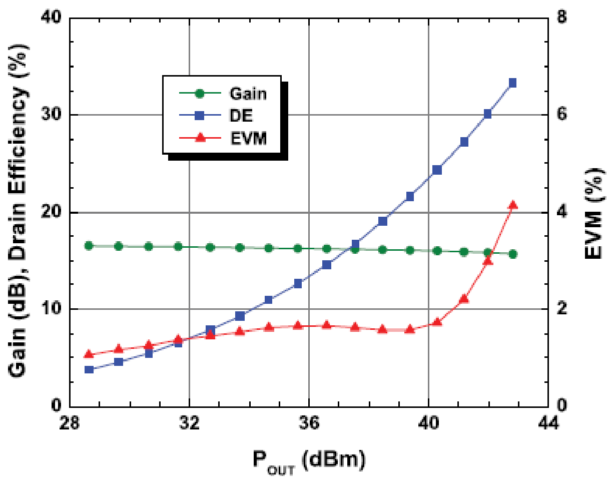


MTTF

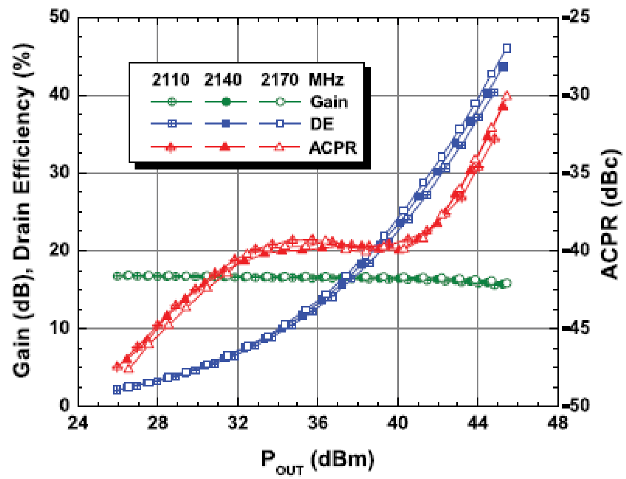


Typical Performance in MACOM Evaluation Circuit:

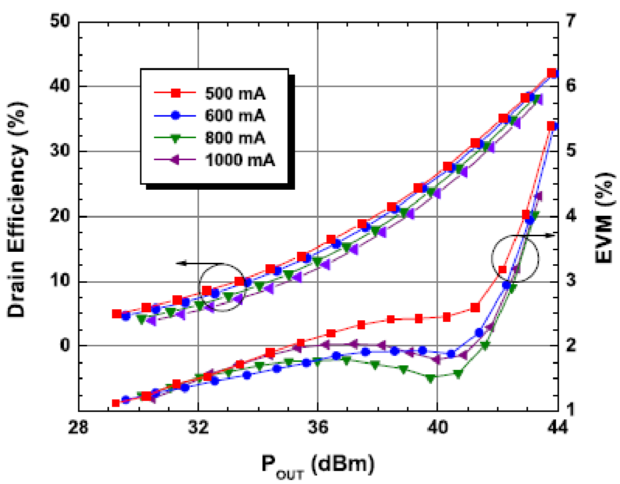
Drain Efficiency , Gain, & EVM
28 V , 600 mA, 2600 MHz
LTE = 20 MHz



Drain Efficiency , Gain, & EVM
28 V , 600 mA, 2110 - 2170 MHz

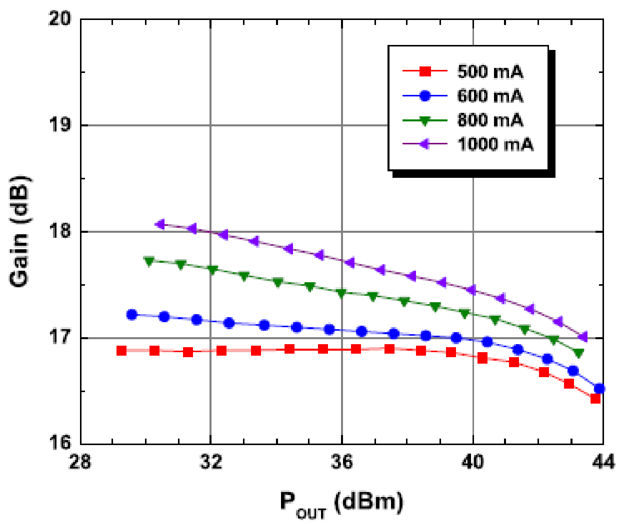


Drain Efficiency & EVM
28 V, 500 - 1000 mA, 2500 MHz

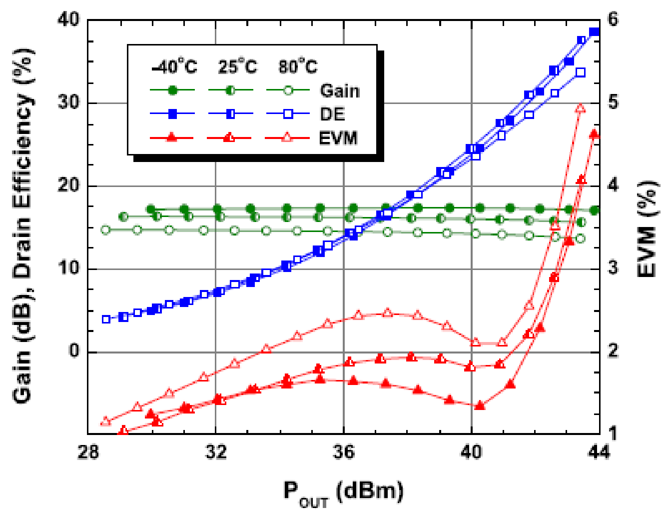


Typical Performance in MACOM Evaluation Circuit:

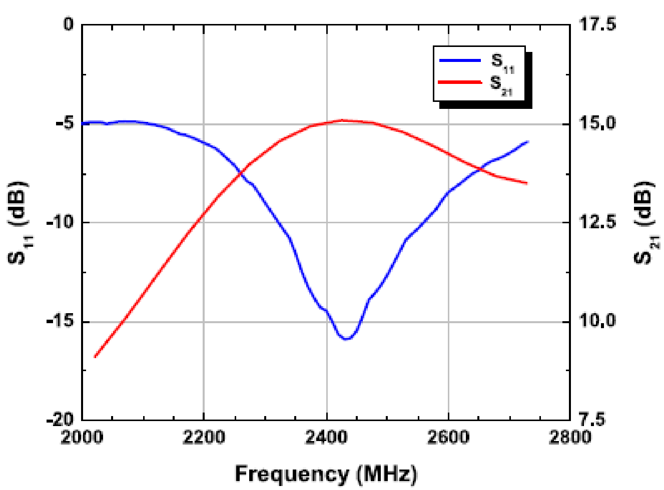
Gain
28 V , 500 - 1000 mA, 2500 MHz



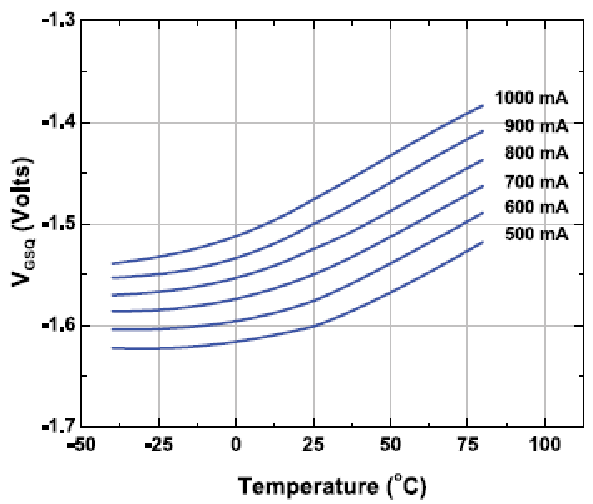
Drain Efficiency , Gain, & EVM
28 V , 600 mA, 2500 MHz



S-Parameters
28 V, 600 mA

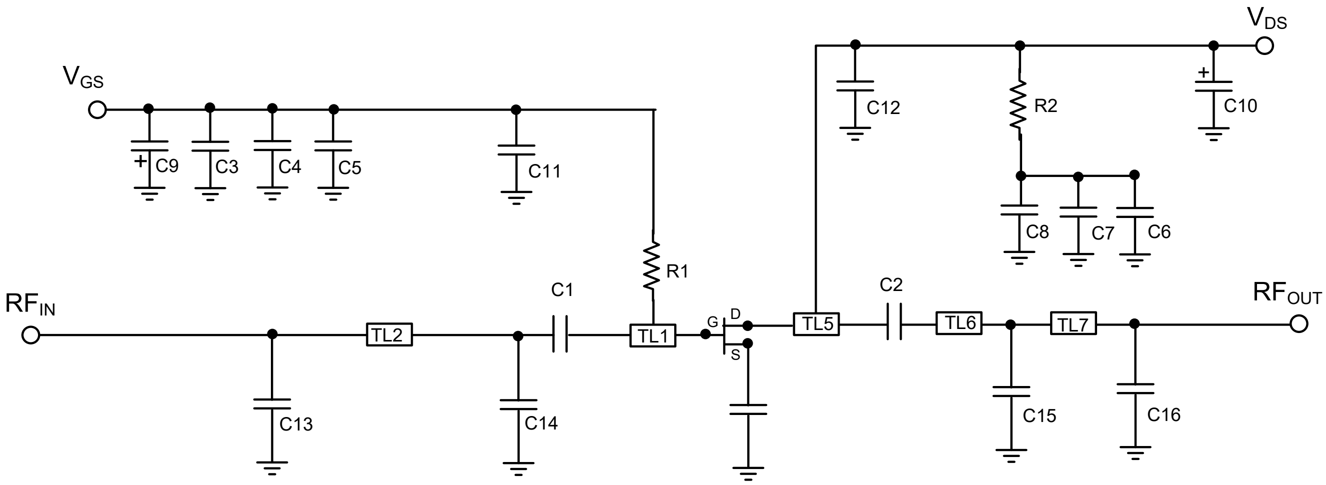


Quiescent Gate Voltage
28 V



Evaluation Board and Recommended Tuning Solution

2500 MHz Narrowband Circuit



Description

Parts measured on evaluation board (30-mil thick RO4350). The PCB's electrical and thermal ground is provided using a standard-plated densely packed via hole array (see recommended via pattern).

Matching is provided using a combination of lumped elements and transmission lines as shown in the simplified schematic above. Recommended tuning solution component placement, transmission lines, and details are shown on the next page.

Bias Sequencing

Turning the device ON

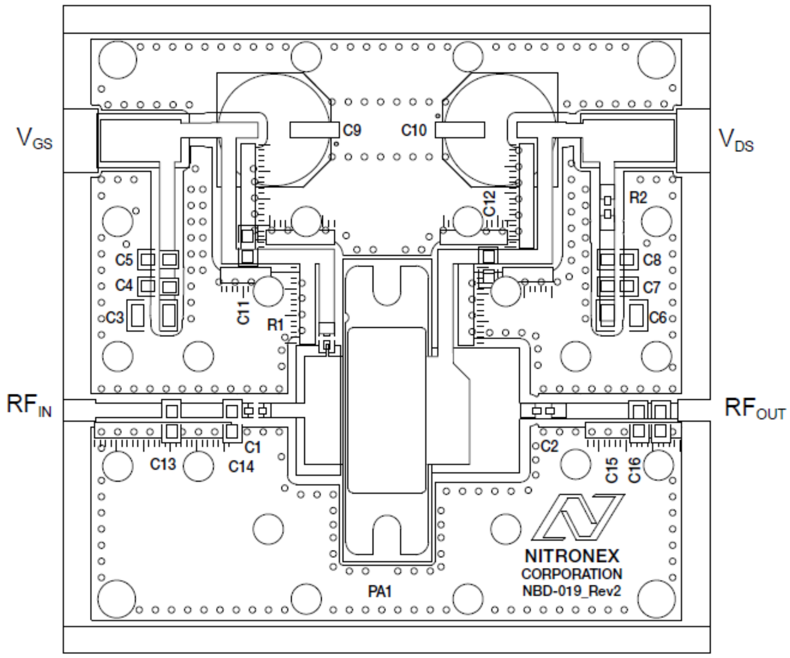
1. Set V_{GS} to the pinch-off (V_P), typically -5 V.
2. Turn on V_{DS} to nominal voltage (48 V).
3. Increase V_{GS} until the I_{DS} current is reached.
4. Apply RF power to desired level.

Turning the device OFF

1. Turn the RF power off.
2. Decrease V_{GS} down to V_P.
3. Decrease V_{DS} down to 0 V.
4. Turn off V_{GS}.

Evaluation Board and Recommended Tuning Solution

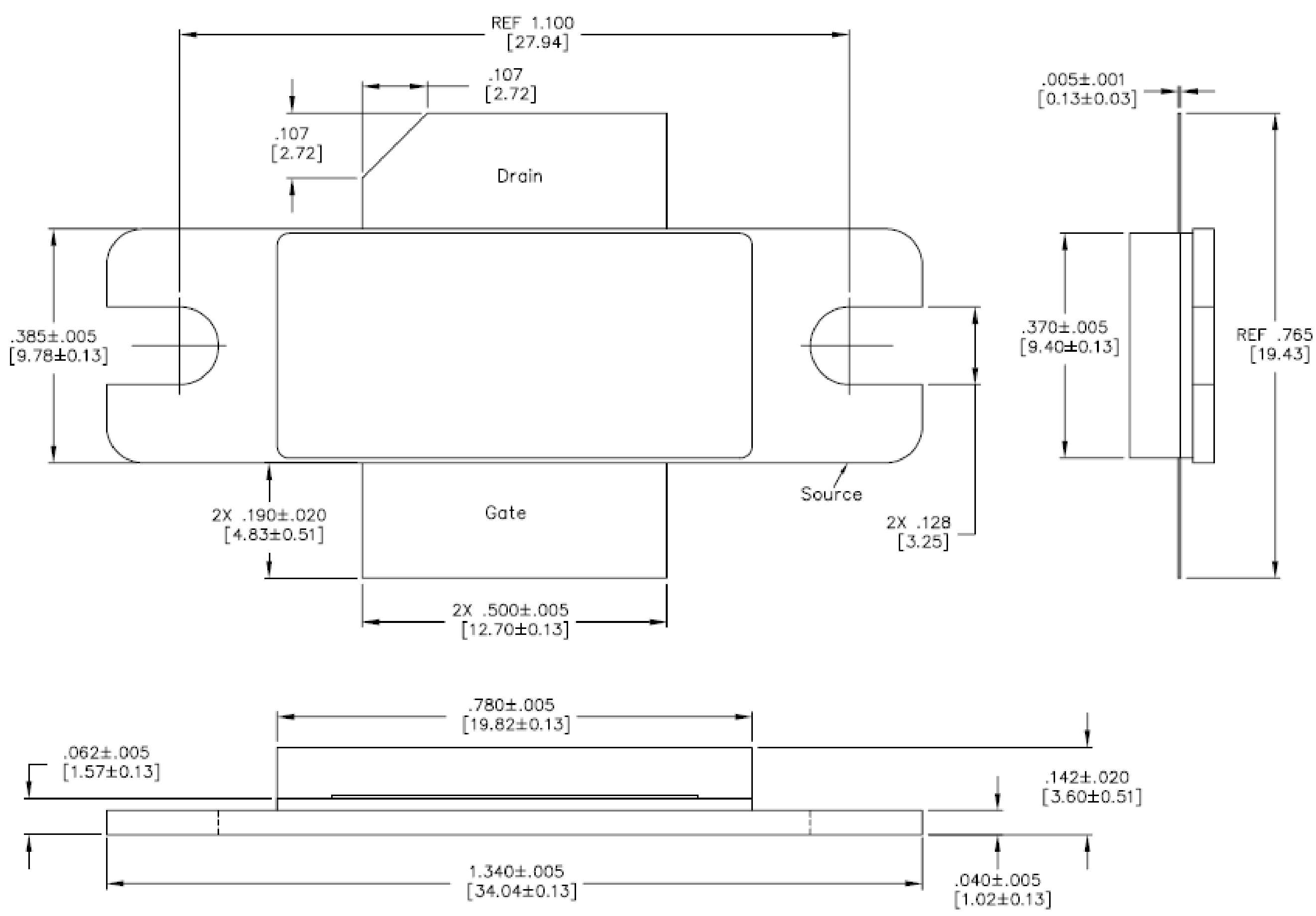
2500 MHz Circuit



Parts list

Reference	Value	Tolerance	Manufacturer	Part Number
C1	3.3 pF	±0.1 pF	ATC	ATC600F3R3B
C2	1.2 pF	±0.1 pF	ATC	ATC100B1R2BT
C3	1 µF	20%	Panasonic	ECJ-5YB2A105M
C4, C7	0.1 µF	10%	Kemet	C1206C104K1RACTU
C5, C8	0.01 µF	10%	AVX	12061C103KAT2A
C6	1 µF	10%	Panasonic	ECJ-5YB2A105M
C9	150 µF	20%	Nichicon	UPW1C151MED
C10	270 µF	20%	United Chmi-Con	ELXY630ELL271MK25S
C11, C12	33 pF	5%	ATC	ATC600F330B
C13	0.9 pF	±0.1 pF	ATC	ATC600F0R9B
C14	1.8 pF	±0.1 pF	ATC	ATC600F1R8B
C15	Do Not Place	—	—	—
C16	0.8 pF	±0.1 pF	ATC	ATC600F0R8B
PA1	—	—	MACOM	NPT25100B
R1	10 Ω	1%	Panasonic	ERJ-2RKF10R0X
R2	0.033 Ω	5%	Coilcraft	ERJ-6RQFR33V
NBD-019_Rev2	—	—	Alberta Printed Circuits	NBD-019_Rev2
PCB	Rogers RO4350, e_r=3.5, 30 mil			

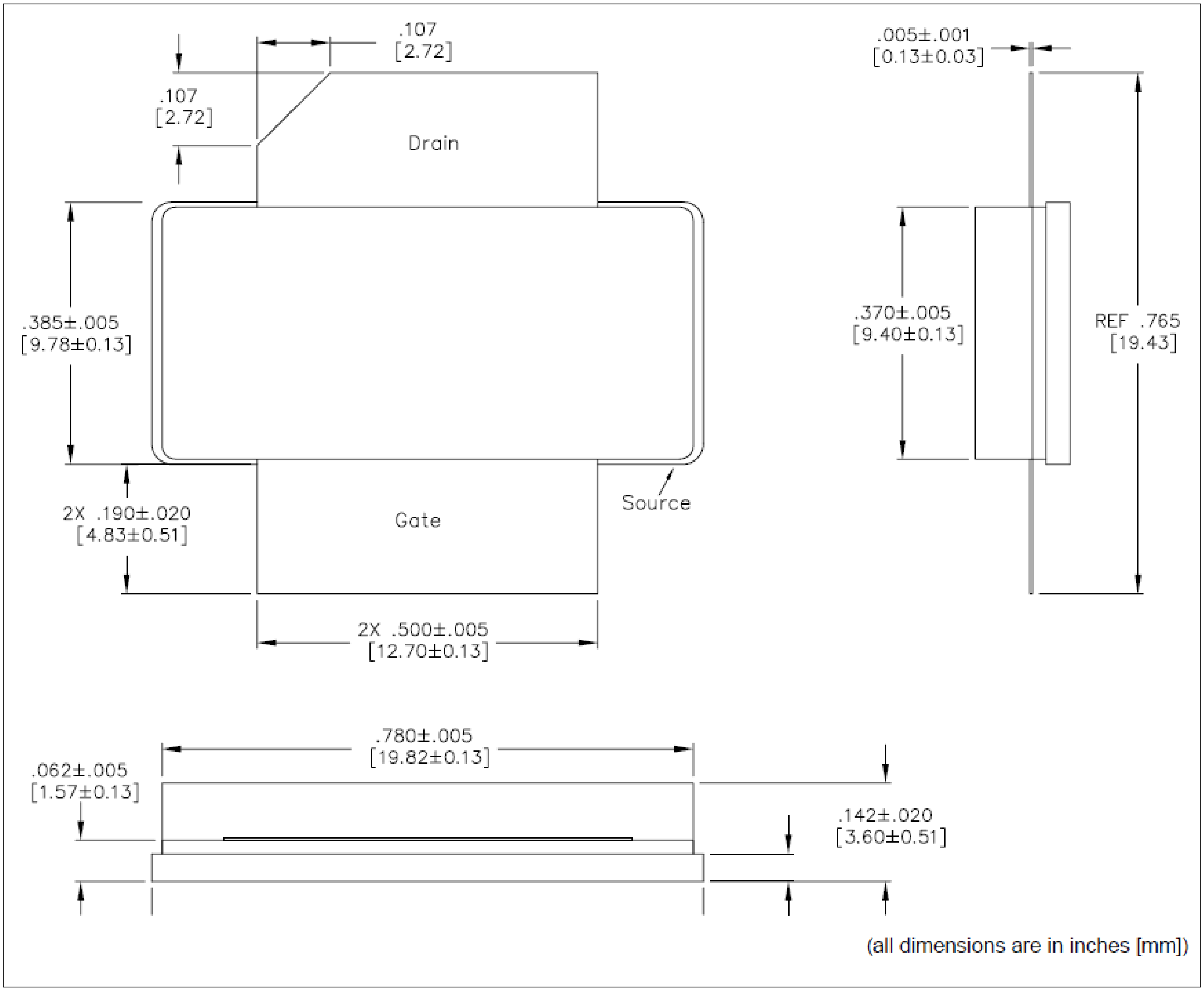
Outline Drawing NPT25100B†



(all dimensions are in inches [mm])

† Reference Application Note AN3025 for mounting/soldering recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is Ni/Au.

Outline Drawing NPT25100P†



† Reference Application Note AN3025 for mounting/soldering recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is Ni/Au.