Features

- Optimized for Pulsed, WiMAX, W-CDMA, LTE, & other light thermal load applications from DC - 4 GHz
- 2.5 GHz Performance
- 45 W P3dB CW Power
- 13.5 dB Small Signal Gain
- 55% Efficiency @ P3dB
- 100% RF Tested
- Thermally-Enhanced Surface Mount SOIC Package
- High Reliability Gold Metallization Process
- Subject to EAR99 Export Control
- RoHS* Compliant

Applications

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

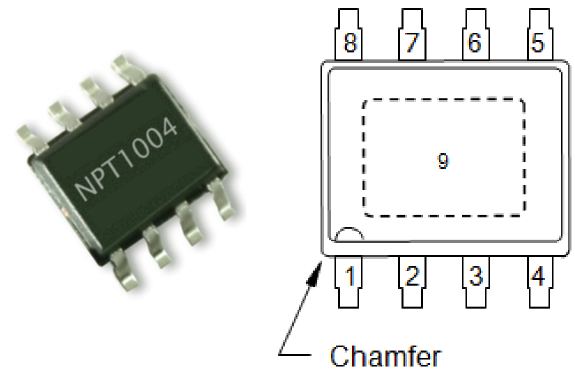
Description

The NPT1004 GaN HEMT is a power transistor optimized for DC - 4 GHz operation. This device supports CW, pulsed, and linear operation with output power levels to 45 W. This transistor is assembled in an industry standard surface mount plastic package.

Ordering Information

Part Number	Package
NPT1004DT	Tube (97 pieces)
NPT1004DR	1500 piece reel

Functional Schematic



Pin Configuration

Pin #	Function
1 - 4	Gate
5 - 8	Drain
9	Paddle[1]

1. The exposed pad centered on the package bottom must be connected to RF and DC ground. This path must also provide a low thermal resistance heat path.

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

Typical 2-Tone RF Performance: (measured in test fixture)
Freq. = 2.5 GHz, V_{DS} = 28 V, I_{DQ} = 400 mA, Tone Spacing = 1 MHz, T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Peak Envelope Power	3 dB Compression 1 dB Compression	$P_{3dB, PEP}$ $P_{1dB, PEP}$	35 —	45 28	—	W
Small Signal Gain	—	G_{SS}	12.5	13.5	—	dB
Drain Efficiency	3 dB Compression	η	50	55	—	%

Typical OFDM Performance: (measured in load pull system (refer to Table 2 and Fig. 1)) V_{DS} = 28 V, I_{DQ} = 350 mA, 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, P_{OUT} = 1.5 W avg., T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	2.5 - 2.7 GHz 3.3 - 3.5 GHz	G_P	—	13.0 10.5	—	dB
Drain Efficiency	2.5 - 2.7 GHz 3.3 - 3.5 GHz	η	—	27 25	—	%
Error Vector Magnitude	2.5 - 2.7 GHz 3.3 - 3.5 GHz	EVM	—	2 2	—	%

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 Class 1B devices.

DC Electrical Characteristics: T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Off Characteristics						
Drain-Source Breakdown Voltage	V_{GS} = -8 V, I_D = 16 mA	V_{BDS}	100	—	—	V
Drain-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 60 V	I_{DLK}	—	2	10	mA
On Characteristics						
Gate Threshold Voltage	V_{DS} = 28 V, I_D = 16 mA	V_T	-2.3	-1.8	-1.3	V
Gate Quiescent Voltage	V_{DS} = 28 V, I_D = 350 mA	V_{GSQ}	-2.0	-1.5	-1.0	V
On Resistance	V_{GS} = 2 V, I_D = 120 mA	R_{ON}	—	0.25	0.30	Ω
Drain Current	V_{DS} = 7 V pulsed, pulse width 300 ms 0.2% Duty Cycle, V_{GS} = 2 V	I_D	7.5	9.5	—	A

Absolute Maximum Ratings[2,3,4]

Parameter	Absolute Maximum
Drain Source Voltage, V_{DS}	100 V
Gate Source Voltage, V_{GS}	-10 to 3 V
Total Device Power Dissipation (derated above 25°C)	40 W
Junction Temperature, T_J	+200°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

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

Thermal Characteristics[5]

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	V_{DS} = 28 V, T_J = 200°C	$R_{\theta JC}$	4.3	°C/W

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

Table 1: Optimum Impedance Characteristics for CW Gain, Drain Efficiency, and Output Power Performance

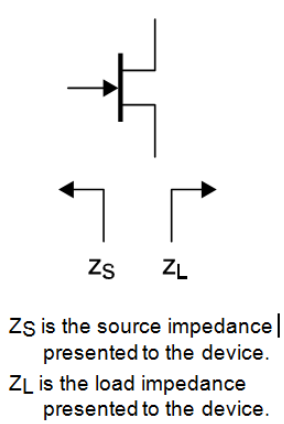
Frequency (MHz)	Z_S (Ω)	Z_L (Ω)	P_{SAT} (W)	G_{SS} (dB)	Drain Efficiency (%)
900	2.0 + j2.7	6.0 + j3.3	45	22.5	72
1500	1.6 - j0.8	4.5 + j0.5	45	18.5	70
2500	2.0 - j3.2	3.5 - j5.0	45	14.0	65
3500	3.2 - j6.5	2.9 - j8.0	35	12.0	60

Table 2: Optimum Impedance Characteristics for WiMAX Gain, Drain Efficiency, Output Power, and Linearity Performance. Single Carrier OFDM waveform 64-QAM 3/4, 8 burst, Peak/Avg = 10.3 dB @ 0.01% probability on CCDF, 2% EVM.

Frequency (MHz)	Z_S (Ω)	Z_L (Ω)	P_{SAT} (W)	G_{SS} (dB)	Drain Efficiency (%)
2500[6]	2.1 - j7.6	3.1 - j3.9	5.0	14.0	27
2600[6]	2.3 - j7.7	3.3 - j4.4	5.0	13.0	27
2700[6]	2.3 - j9.0	3.4 - j4.7	5.0	13.0	27
3300[7]	3.3 - j11.8	3.7 - j7.2	6.3	11.5	30
3500[7]	3.5 - j13.5	3.5 - j10.0	4.5	10.5	25
3800[7]	4.5 - j16.2	3.7 - j11.2	3.2	8.0	17

6. Continuous frame data, 10 MHz channel bandwidth.
7. 20 ms frame, 15 ms frame data, 3.5 MHz channel bandwidth.

Impedance Reference



Z_S and Z_L vs. Frequency

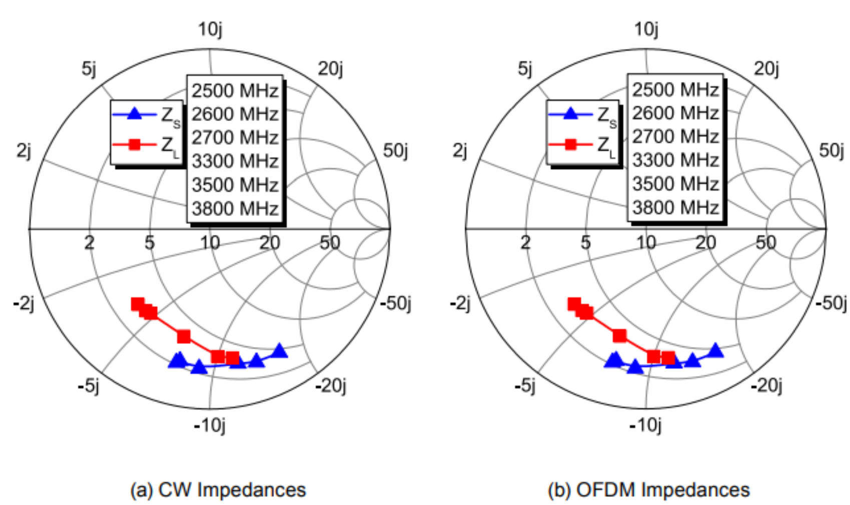


Figure 1 - Optimum Impedance Characteristics for CW and OFDM Performance

Load-Pull Data, Reference Plane at Device Leads: V_{DS} = 28 V, I_{DQ} = 350 mA (unless noted)

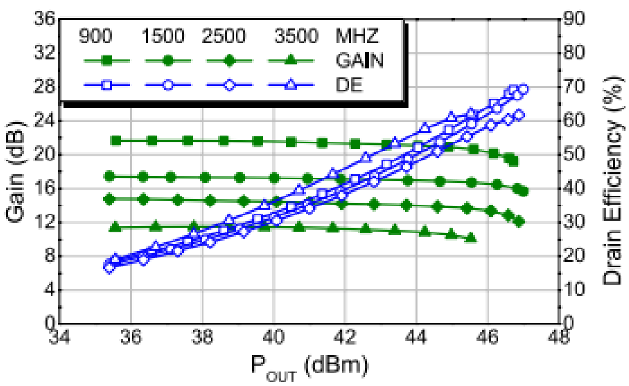


Figure 2 - Typical CW Performance, Frequency = 900 to 3500MHz, I_{DQ}=400mA

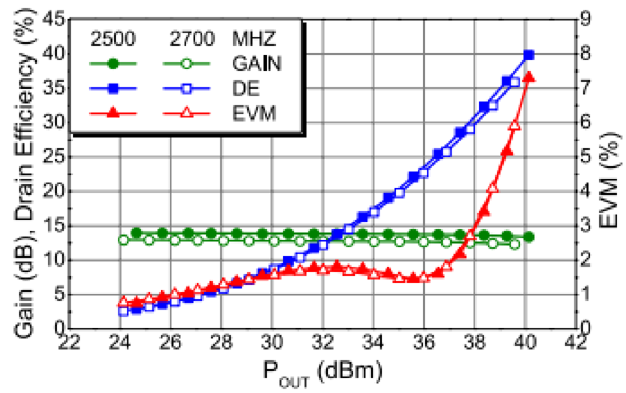


Figure 3 - OFDM Performance Tuned for P_{OUT} at 2% EVM in Load-Pull System

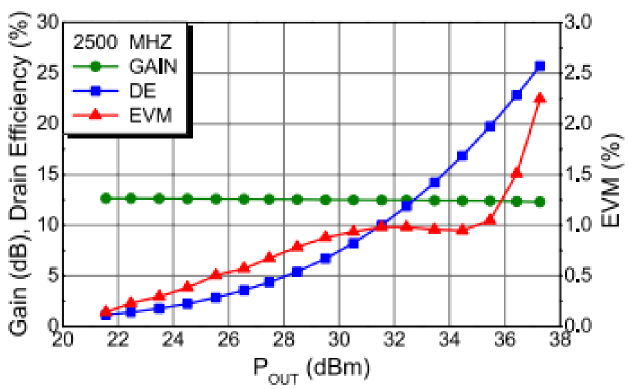


Figure 4 - OFDM Performance Tuned for P_{OUT} at 1.5% EVM in Load-Pull System

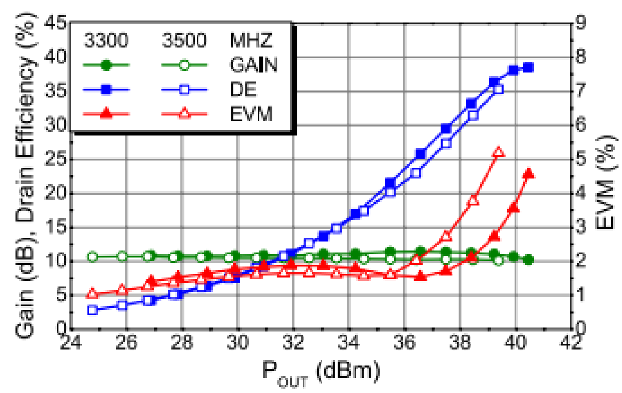


Figure 5 - OFDM Performance Tuned for P_{OUT} at 2% EVM in Load-Pull System

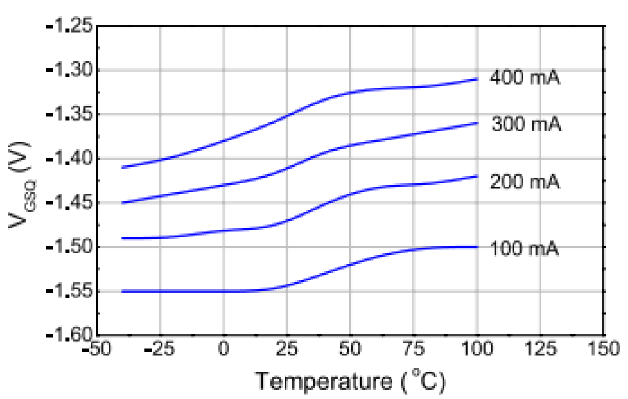


Figure 6 - Quiescent Gate Voltage (V_{GSQ}) Required to Reach I_{DQ} as a Function of Case Temperature

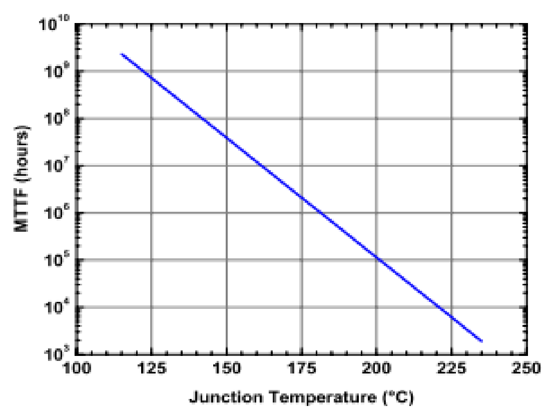
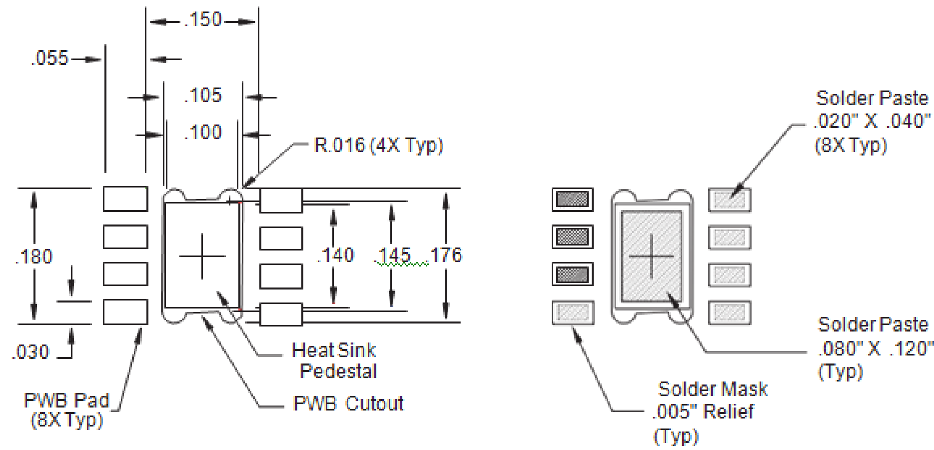
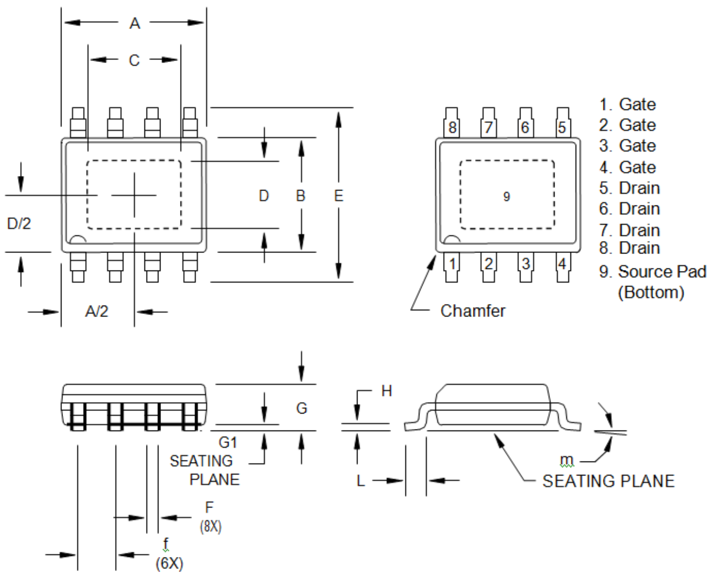


Figure 7 - MTTF of NRF1 devices as a function of junction temperature

Mounting Footprint



Package Dimensions & Pin Out†



Dim.	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	0.189	0.196	4.80	4.98
B	0.150	0.157	3.81	3.99
C	0.107	0.123	2.72	3.12
D	0.071	0.870	1.870	2.21
E	0.230	0.244	5.85	6.19
f	0.050 BSC		1.270 BSC	
F	0.0138	0.0192	0.35	0.49
G	0.055	0.061	1.40	1.55
G1	0.000	0.004	0.00	0.10
H	0.075	0.098	1.91	2.50
L	0.016	0.035	0.41	0.89
m	0°	8°	0°	8°

† Meets JEDEC moisture sensitivity level 3 requirements.
Plating is Matte Sn.