

## Features

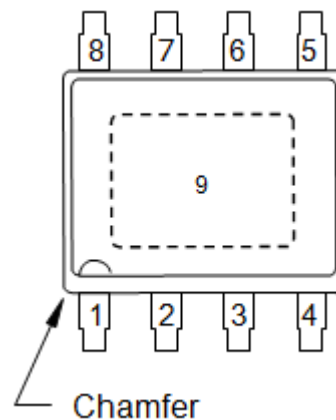
- Optimized for CW, pulsed, WiMAX, and other applications from DC - 3000 MHz
- 23 W P3dB peak envelope power (PEP)
- 1.5 W linear power @ 2% EVM for single carrier OFDM, 10.3 dB peak/average, 3.5 MHz channel bandwidth, 14 dB gain, 23.5% efficiency, 2500-2700 MHz
- 100% RF tested
- Thermally-enhanced industry standard package
- High reliability gold metallization process
- Lead-free and RoHS compliant
- Subject to EAR99 export control

## Description

The NPT25015 GaN HEMT is a power transistor optimized for DC - 3 GHz operation. This device supports CW, pulsed, and linear operation with output power levels to 23 W. This transistor is assembled in an industry standard surface mount plastic package.

The NPT25015 is ideally suited for defense communications, land mobile radio, avionics, wireless infrastructure, ISM applications and VHF/UHF/L/S-band radar.

## Functional Schematic



## Ordering Information

Part Number	Package
NPT25015DT	Tube (97 pieces)
NPT25015DR	1500 piece reel

## Pin Configuration

Pin No.	Function
1 - 4	Gate
5 - 8	Drain
9	Paddle <sup>1</sup>

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, European Union Directive 2011/65/EU.

**Typical 2-Tone Performance:  
(measured in test fixture)**

**Freq. = 2500 MHz,  $V_{DS} = 28$  V,  $I_{DQ} = 200$  mA, Tone Spacing = 1 MHz,  $T_C = 25^\circ\text{C}$**

Parameter	Symbol	Min.	Typ.	Max.	Units
Peak Envelope Power	P <sub>3dB, PEP</sub> P <sub>1dB, PEP</sub>	20	25	—	W
3 dB Compression		—	15	—	
1 dB Compression					
Small Signal Gain	G <sub>SS</sub>	13	14	15	dB
Drain Efficiency @ 3 dB Compression	$\eta$	53	58	—	%

**Typical OFDM Performance:**

**(measured in load pull system (refer to Table 1 and Figure 1))**

**Frequency = 2500 - 2700 MHz,  $V_{DS} = 28$  V,  $I_{DQ} = 200$  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<sub>OUT</sub> = 1.5 W avg.,  $T_C = 25^\circ\text{C}$**

Parameter	Symbol	Typical	Units
Power Gain	GP	14.0	dB
Drain Efficiency	$\eta$	23.5	%
Error Vector Magnitude	EVM	2.0	%

### 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 1A devices.

## DC Electrical Characteristics: $T_C = 25^\circ\text{C}$

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
Drain-Source Leakage Current	$V_{GS} = -8\text{ V}, I_D = 8\text{ mA}$	$V_{BDS}$	100	—	—	V
Gate-Source Leakage Current	$V_{GS} = -8\text{ V}, V_{DS} = 60\text{ V}$	$I_{DLK}$	—	—	4	mA
<b>On Characteristics</b>						
Gate Threshold Voltage	$V_{DS} = 28\text{ V}, I_D = 8\text{ mA}$	$V_T$	-2.3	-1.8	-1.3	V
Gate Quiescent Voltage	$V_{DS} = 28\text{ V}, I_D = 200\text{ mA}$	$V_{GSQ}$	-2.0	-1.5	-1.0	V
On Resistance	$V_{GS} = 2\text{ V}, I_D = 60\text{ mA}$	$R_{ON}$	—	0.45	0.50	$\Omega$
Maximum Drain Current	$V_{DS} = 7\text{ V}$ pulsed, pulse width 300 ms 0.2% Duty Cycle	$I_{D,MAX}$	—	5.0	—	A

## Absolute Maximum Ratings<sup>2,3,4</sup>

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)	28 W
Junction Temperature, $T_J$	+200°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

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

## Thermal Characteristics<sup>5</sup>

Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	$V_{DS} = 28\text{ V}, T_J = 200^\circ\text{C}$	$R_{\theta JC}$	6.25	$^\circ\text{C/W}$

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

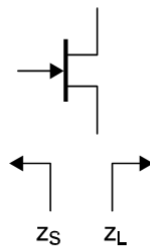
**Table 1: Optimum Impedance Characteristics for Linear OFDM Tuning, single carrier OFDM waveform 64-QAM 3/4, 8 burst, continuous frame data, 10 MHz channel bandwidth. Peak/Avg = 10.3 dB @ 0.01% probability on CCDF**

Frequency (MHz)	$Z_S$ ( $\Omega$ )	$Z_L$ ( $\Omega$ )	$P_{OUT}$ (W)	Gain (dB)	Drain Efficiency (%)
2500	5.2 - j 1.6	3.3 + j 1.7	1.5	14.5	25
2600	4.6 - j 1.9	3.1 + j 2.7	1.5	14.5	25
2700	4.0 - j 2.2	2.9 + j 4.3	1.5	14.4	24

**Table 2: Optimum Impedance Characteristics for CW  $P_{SAT}$ , Efficiency, and Gain**

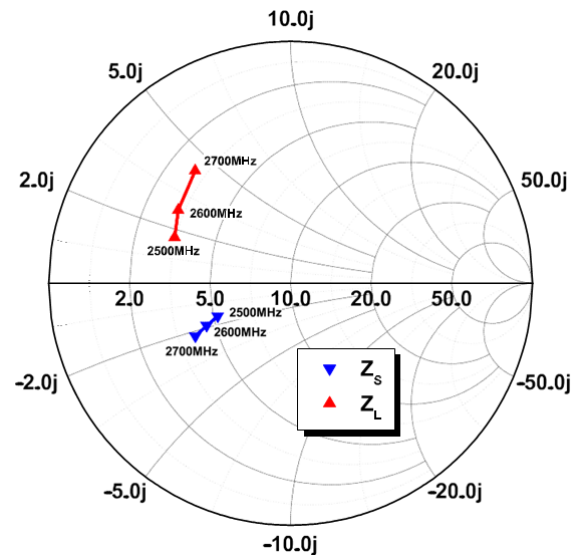
Frequency (MHz)	$Z_S$ ( $\Omega$ )	$Z_L$ ( $\Omega$ )	$P_{SAT}$ (W)	$G_{SS}$ (dB)	Drain Efficiency (%)
2500	3.7 - j 4.7	6.9 + j 1.2	23	14.5	60

### 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 - Optimum Impedance Characteristics for OFDM Tuning,  $V_{DS} = 28$  V,  $I_{DQ} = 200$  mA**

Load-Pull Data, Reference Plane at Device Leads:  
Freq. = 2500 MHz,  $V_{DS} = 28$  V,  $I_{DQ} = 200$  mA (unless noted)

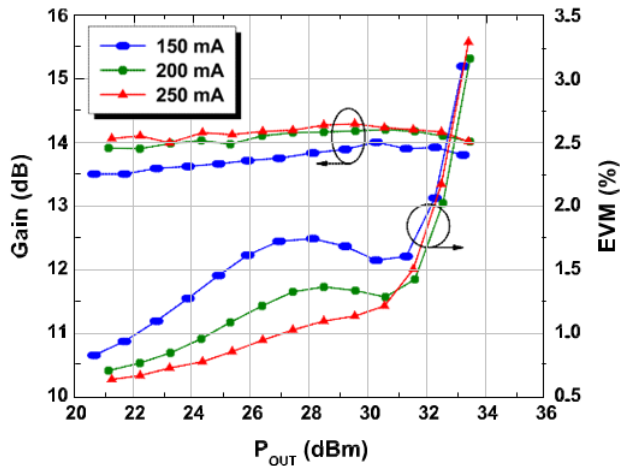


Figure 2 - Typical OFDM Performance

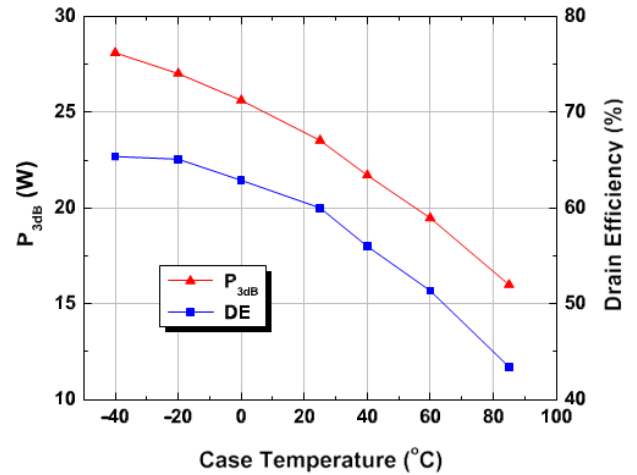


Figure 3 -  $P_{3dB}$ , PEP and Drain vs. Temperature

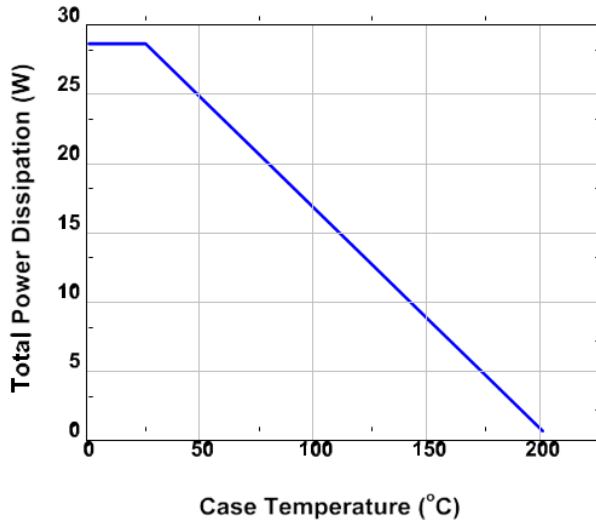


Figure 4 - Power Derating Curve

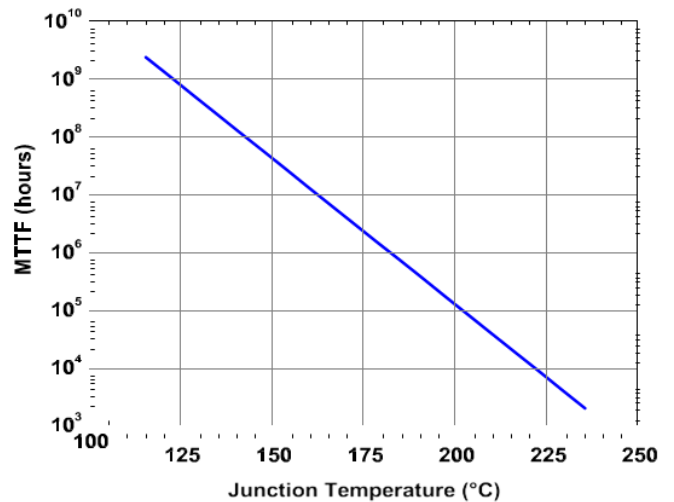
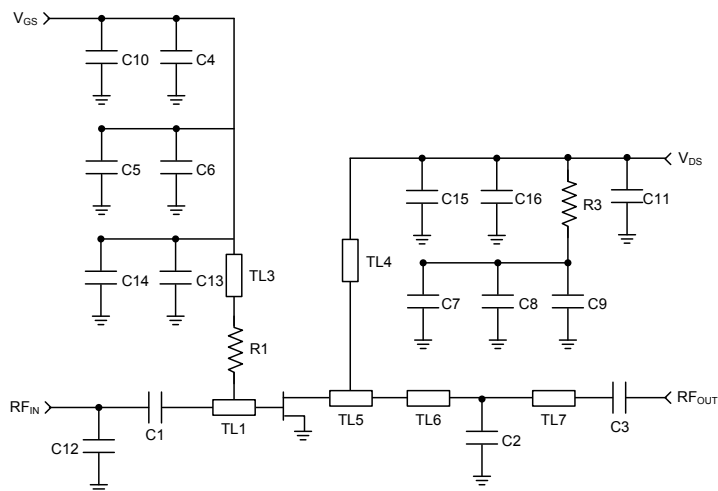
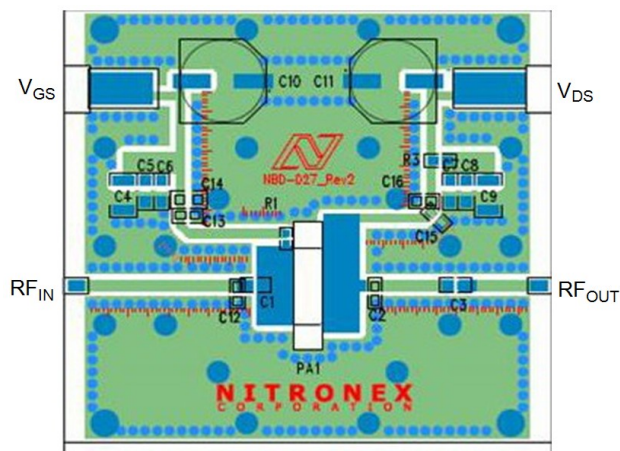


Figure 5 - MTTF of NRF1 devices as a function temperature

## APP-NPT25015-25, 2500 - 2700 MHz Linear WiMAX Application Board

802.16e Single Carrier OFDM, 64-QAM 3/4, 8-burst, 20 ms frame 75% filled, 10 MHz channel bandwidth, PAR = 10.3 dB @ 0.01% CCDF



### Parts list

Reference	Value	Tolerance	Manufacturer	Part Number
C1	5.6 pF	±0.1 pF	ATC	ATC600F5R6B
C2	2.2 pF	±0.1 pF	ATC	ATC600F2R2B
C3	3.3 pF	±0.1 pF	ATC	ATC600F3R3B
C4, C9	1 μF	10 %	Panasonic	ECJ-5YB2A105M
C5, C8	0.1 μF	10 %	Kemet	C1206C104K1RACTU
C6, C7	0.01 μF	10 %	AVX	12061C103KAT2A
C10	150 μF	20 %	Nichicon	UPW1C151MED
C11	270 μF	20 %	United Chemi-Con	ELXY630ELL271MK25S
C12	1 pF	±0.1 pF	ATC	ATC600F1R0B
C13, C15	33 pF	5 %	ATC	ATC600F330B
C14, C16	1000 pF	10 %	Kemet	C0805C102K1RACTU
R1	49.9 Ω	1 %	Panasonic	ERJ-2RKF49R9X
R3	0.33 Ω	1 %	Panasonic	ERJ-6RQFR33V
PCB	Rogers RO4350, ε <sub>r</sub> =3.5, t = 30 mils			

## APP-NPT25015-25, 2500 - 2700 MHz Linear WiMAX Application Board

802.16e Single Carrier OFDM, 64-QAM 3/4, 8-burst, Continuous Frame Data, 10 MHz channel bandwidth, PAR = 10.3 dB @ 0.01% CCDF

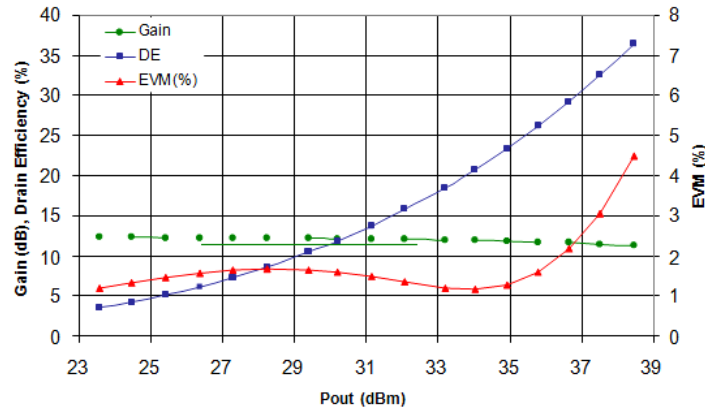


Figure 7 - Gain, Efficiency, EVM @ 2500 MHz

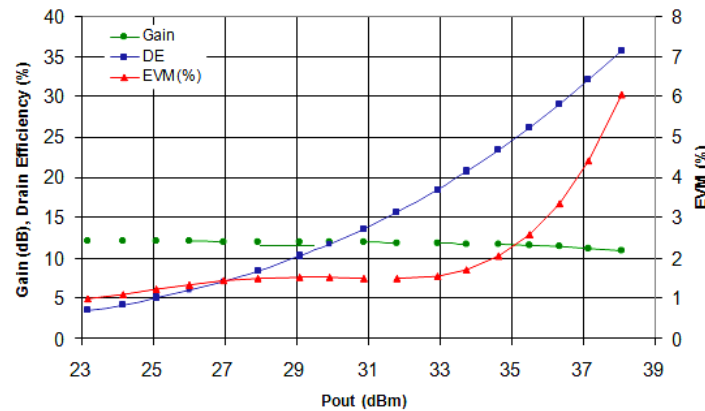


Figure 8 - Gain, Efficiency, EVM @ 2600 MHz

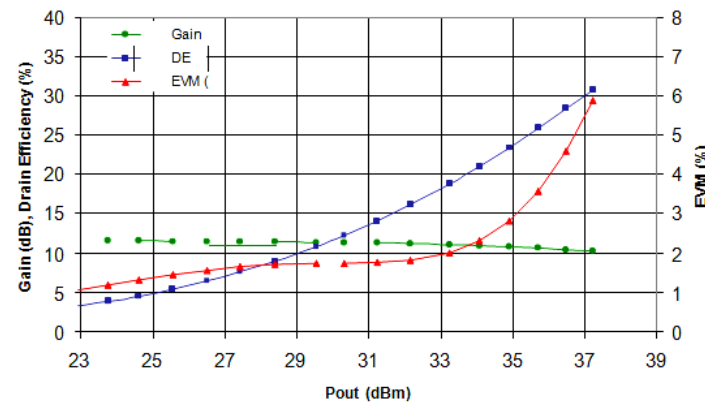
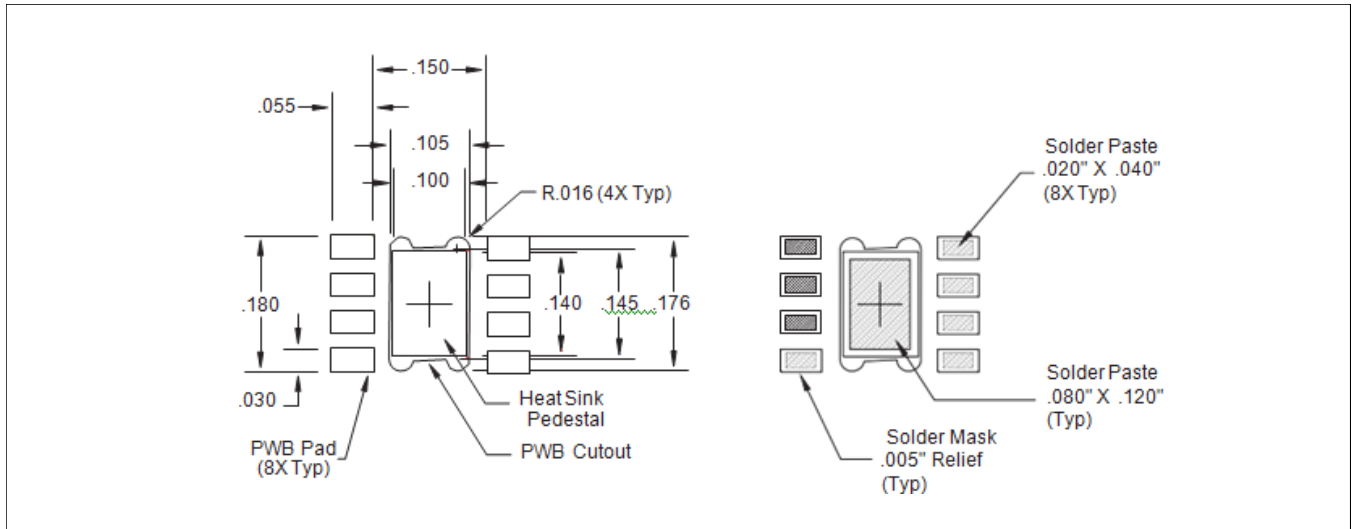
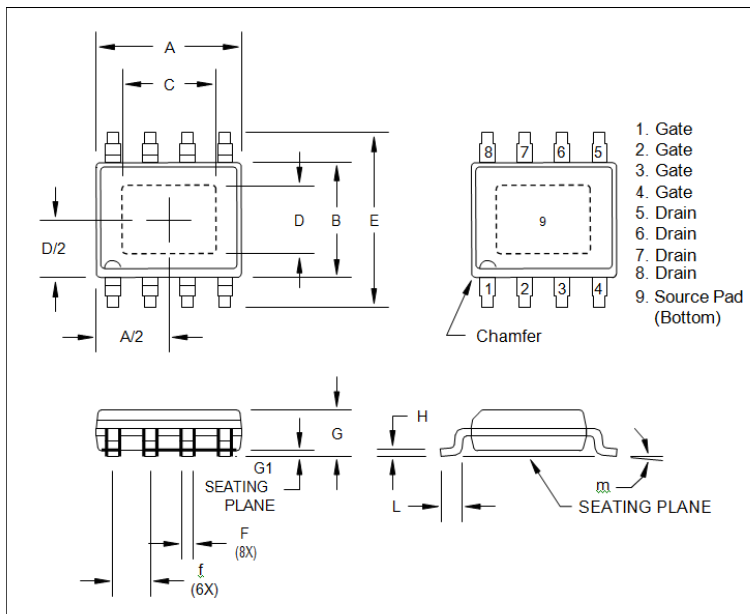


Figure 9 - Gain, Efficiency, EVM @ 2700 MHz

## Mounting Footprint



## Package Dimensions and 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.



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