NPT25015

GaN Power Transistor 28 V, 23 W
DC - 3 GHz

Rev. V1

Features

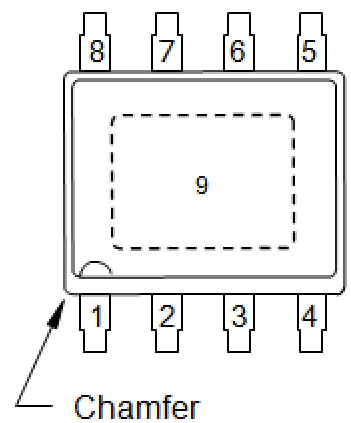
- Optimized for CW, pulsed, WiMAX, and other applications from DC - 3000 MHz
- 23 W P3dB peak envelope power (PEP)
- 1.5 W linear power @ 2% EVM for single carrier OFDM, 10.3 dB peak/average, 3.5 MHz channel bandwidth, 14 dB gain, 23.5% efficiency, 2500-2700 MHz
- 100% RF tested
- Thermally-enhanced 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[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, 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°C

Parameter	Symbol	Min.	Typ.	Max.	Units
Peak Envelope Power 3 dB Compression 1 dB Compression	$P_{3dB, PEP}$ $P_{1dB, PEP}$	20 —	25 15	—	W
Small Signal Gain	G_{SS}	13	14	15	dB
Drain Efficiency @ 3 dB Compression	η	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_{OUT} = 1.5 W avg., T_C = 25°C

Parameter	Symbol	Typical	Units
Power Gain	GP	14.0	dB
Drain Efficiency	η	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°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Off Characteristics						
Drain-Source Leakage Current	V_{GS} = -8 V, I_D = 8 mA	V_{BDS}	100	—	—	V
Gate-Source Leakage Current	V_{GS} = -8 V, V_{DS} = 60 V	I_{DLK}	—	—	4	mA
On Characteristics						
Gate Threshold Voltage	V_{DS} = 28 V, I_D = 8 mA	V_T	-2.3	-1.8	-1.3	V
Gate Quiescent Voltage	V_{DS} = 28 V, I_D = 200 mA	V_{GSQ}	-2.0	-1.5	-1.0	V
On Resistance	V_{GS} = 2 V, I_D = 60 mA	R_{ON}	—	0.45	0.50	Ω
Maximum Drain Current	V_{DS} = 7 V pulsed, pulse width 300 ms 0.2% Duty Cycle	$I_{D,MAX}$	—	5.0	—	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)	28 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 > 1×10^6 hours.

Thermal Characteristics[5]

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

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

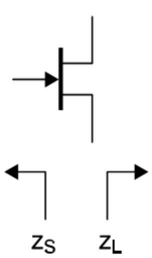
Table 1: Optimum Impedance Characteristics for Linear OFDM Tuning, single carrier OFDM waveform 64-QAM 3/4, 8 burst, continuous frame data, 10 MHz channel bandwidth. Peak/Avg = 10.3 dB @ 0.01% probability on CCDF

Frequency (MHz)	Z_S (Ω)	Z_L (Ω)	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 (Ω)	Z_L (Ω)	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

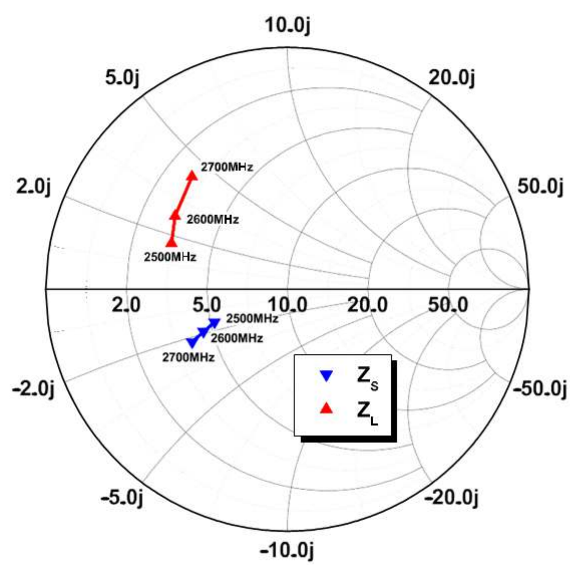


Figure 1 - Optimum Impedance Characteristics for OFDM Tuning, V_{DS} = 28 V, I_{DQ} = 200 mA

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

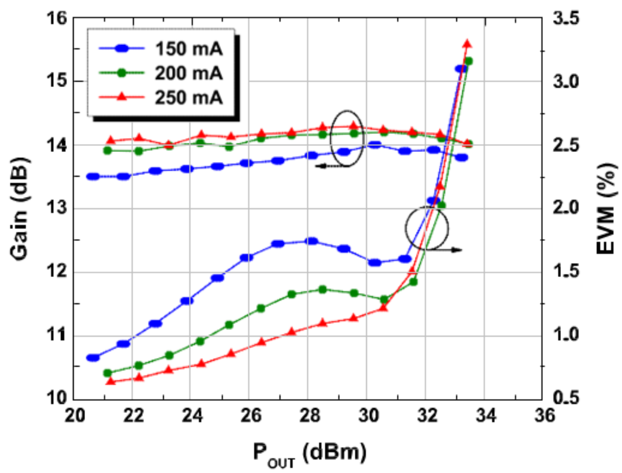


Figure 2 - Typical OFDM Performance

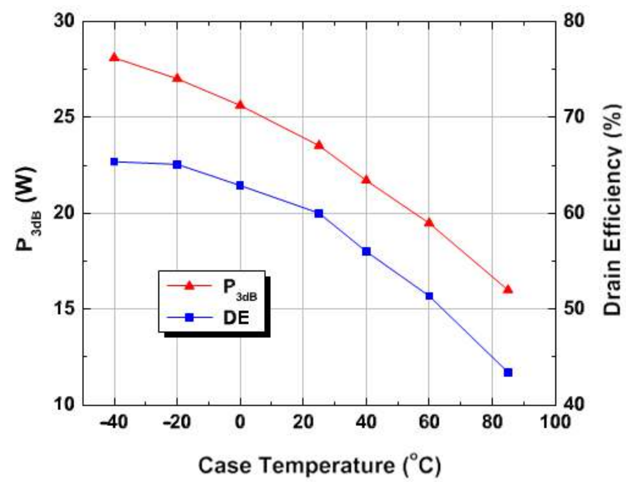


Figure 3 - P3dB,PEP and Drain vs. Temperature

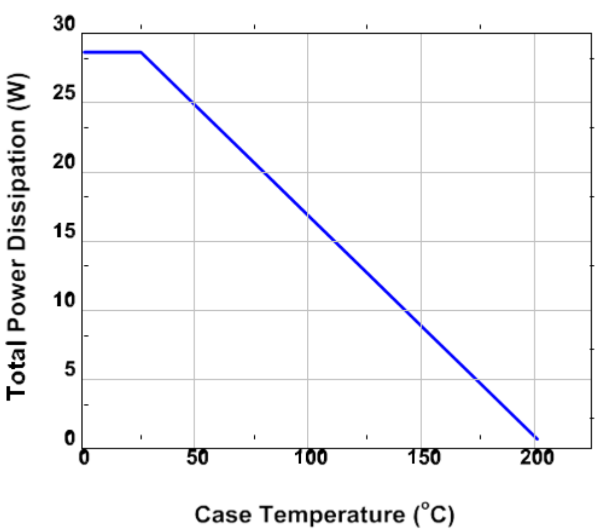


Figure 4 - Power Derating Curve

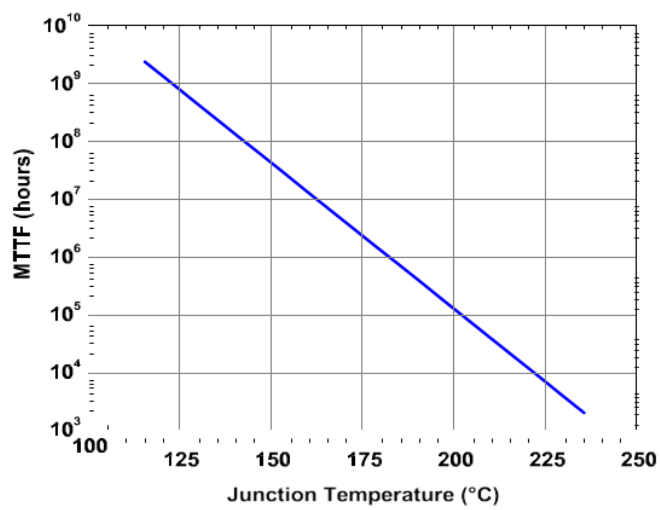
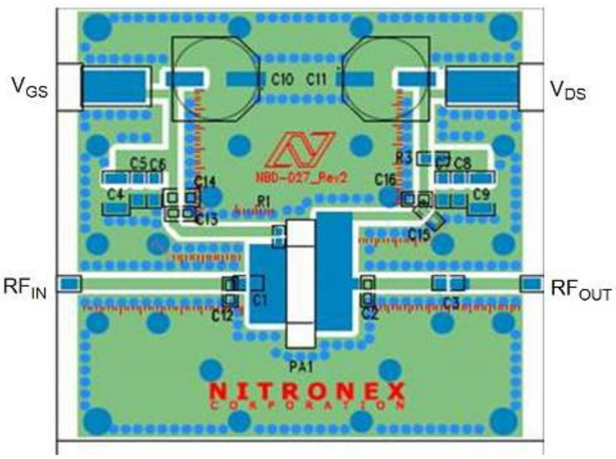
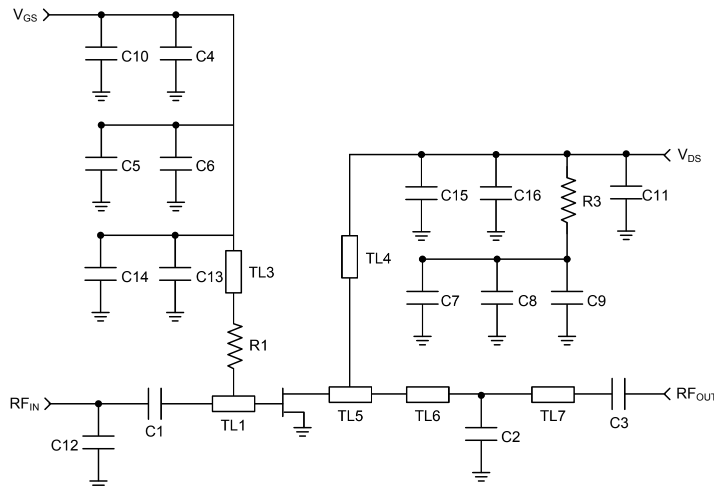


Figure 5 - MTTF of NRF1 devices as a function temperature

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_r=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

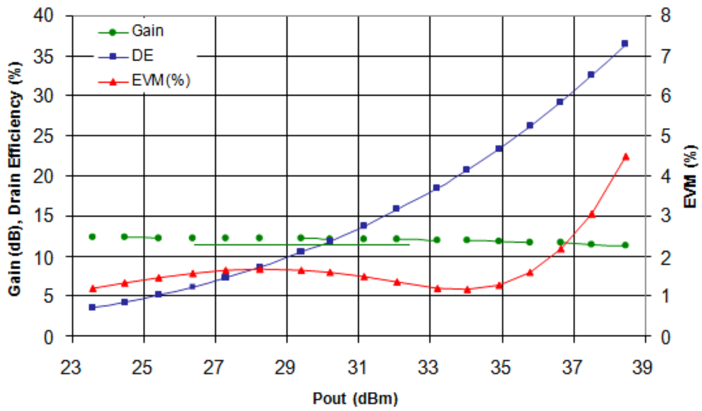


Figure 7 - Gain, Efficiency, EVM @ 2500 MHz

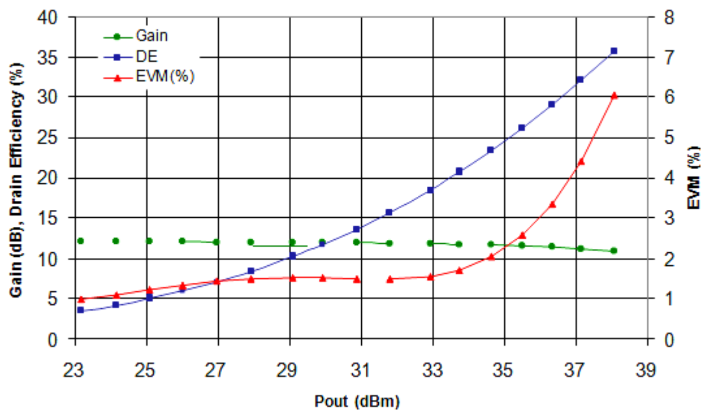


Figure 8 - Gain, Efficiency, EVM @ 2600 MHz

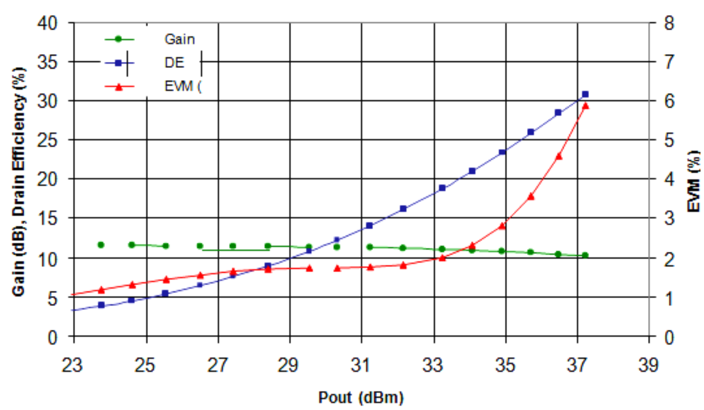
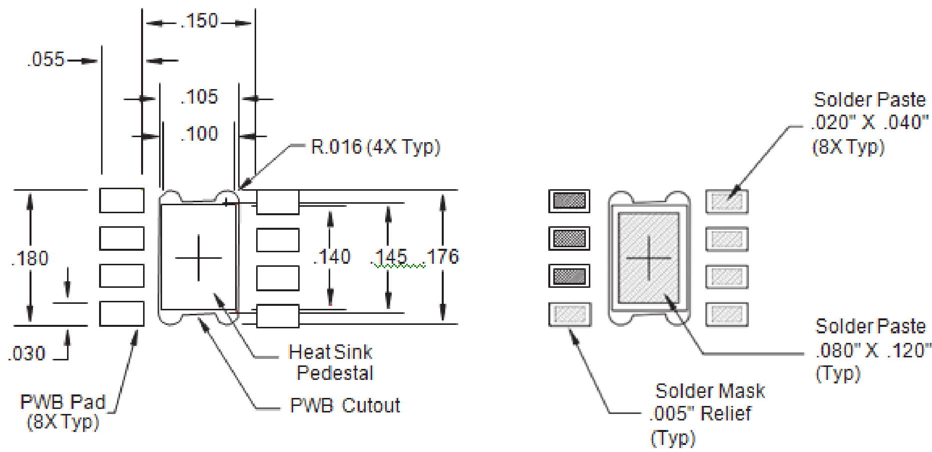
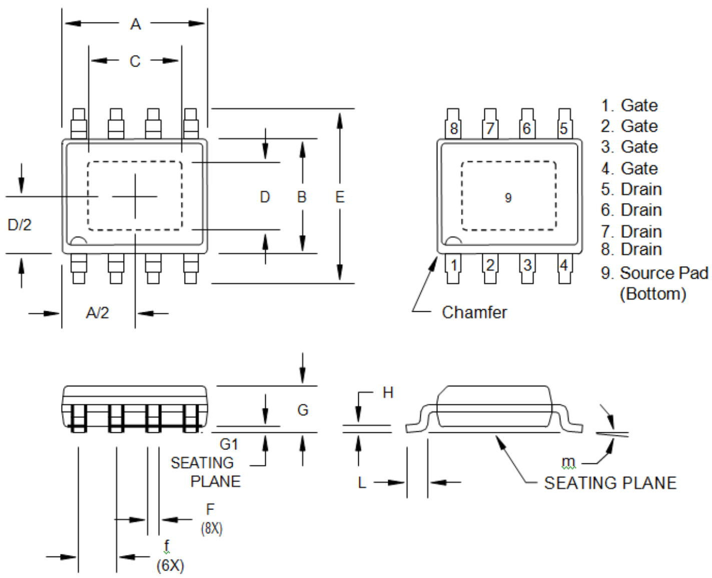


Figure 9 - Gain, Efficiency, EVM @ 2700 MHz

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.