GaN Power Transistor, 28 V, 18 W
3.3 - 3.8 GHz

NPT35015
Rev. V1

Features

- Optimized for CW, Pulsed, WiMAX, and other applications from 3.3 - 3.8 GHz
- 18 W P3dB CW Power
- 25 W P3dB Peak Envelope Power
- 1.7 W Linear Power @ 2% EVM for single carrier OFDM, 10.3 dB peak/average, 10.3 dB @ 0.01% Probability on CCDF, 10.5 dB Gain, 18% Drain Efficiency
- 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

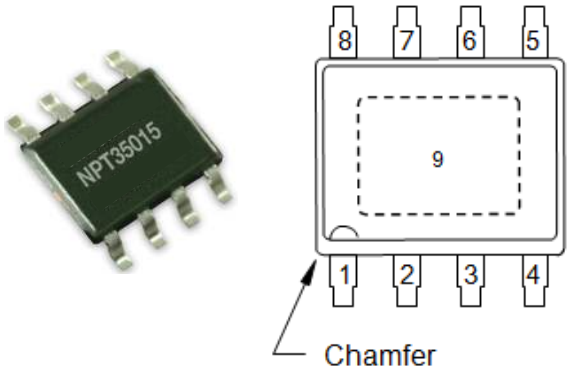
Description

The NPT35015 GaN HEMT is a power transistor optimized for 3.3 - 3.5 GHz operation. This device supports CW, pulsed, and linear operation with output power levels to 18 W. This transistor is assembled in an industry standard surface mount plastic package.

Ordering Information

Part Number	Package
NPT35015DT	Tube (97 pieces)
NPT35015DR	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. = 3.5 GHz, V_{DS} = 28 V, I_{DQ} = 200 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	$P_{3dB, PEP}$ $P_{1dB, PEP}$	14 —	18 10	—	W
Small Signal Gain	—	G_{SS}	10	11	—	dB
Drain Efficiency	3 dB Compression	η	43	48	—	%

Typical RF Specifications (CW): (measured in Load Pull System)
Freq. = 3.5 GHz, V_{DS} = 28 V, I_{DQ} = 200 mA, T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Average Output Power	3 dB Compression	P_{3dB}	—	18	—	W
Small Signal Gain	3 dB Compression 1 dB Compression	$P_{3dB, Pulsed}$ $P_{1dB, Pulsed}$	—	20 15	—	W

Typical OFDM Performance: (measured in load pull system, refer to Table 1 and Figure 1))
V_{DS} = 28 V, I_{DQ} = 200 mA, Single Carrier OFDM waveform 64-QAM 3/4, 8 burst, 20 ms frame, 15 ms frame data, 3.5 GHz channel bandwidth, Peak/Avg = 10.3 dB @ 0.01% probability on CCDF, P_{OUT} = 1.7 W avg., T_C = 25°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Units
Power Gain	3.3 - 3.8 GHz	G_P	—	10.5	—	dB
Drain Efficiency	3.3 - 3.8 GHz	η	—	18	—	%
Error Vector Magnitude	3.3 - 3.8 GHz	EVM	—	2	—	%
Input Return Loss	3.3 - 3.8 GHz	I_{RL}	—	10	—	dB

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 Breakdown Voltage	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
Drain Current	V_{DS} = 7 V pulsed, pulse width 300 µs 0.2% Duty Cycle, V_{GS} = 2 V	I_D	—	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)	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 x 10^6 hours.

Thermal Characteristics[5]

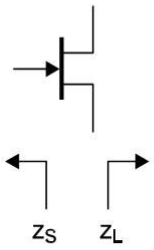
Parameter	Test Conditions	Symbol	Typical	Units
Thermal Resistance	V_{DS} = 28 V, T_J = 200°C	$R_{\theta JC}$	6.25	°C/W

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

Table 1: Optimum Impedance Characteristics for Single Carrier OFDM waveform 64-QAM 3/4, 8 burst, 20 ms frame, 15 ms frame data, 3.5 GHz Channel Bandwidth, Peak/Avg = 10.3 dB @ 0.01% probability on CCDF, 2% EVM.

Frequency (MHz)	Z_S (Ω)	Z_L (Ω)	P_{OUT} (W)	Gain (dB)	Drain Efficiency (%)
3300	5.4 - j10.3	2.9 - j2.5	1.7	10.9	19
3400	5.0 - j10.7	2.9 - j2.6	1.8	11.0	22
3500	4.4 - j11.2	2.8 - j2.7	1.7	10.9	21
3600	4.0 - j12.5	2.8 - j3.3	1.7	10.9	20
3700	3.5 - j13.4	3.0 - j3.8	1.8	10.8	20
3800	3.5 - j14.6	3.2 - j4.2	1.8	10.7	20

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

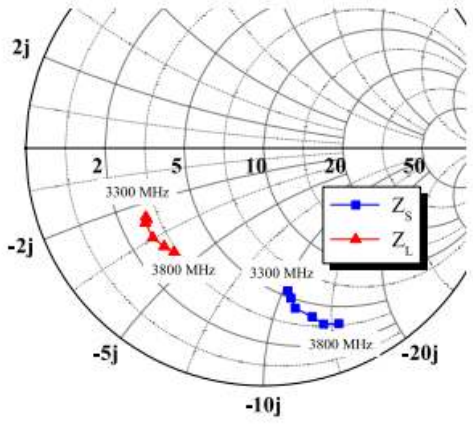


Figure 1 - Optimum Impedance Characteristics for OFDM Tuning, V_{DS} = 28 V, I_{DQ} = 200 mA

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

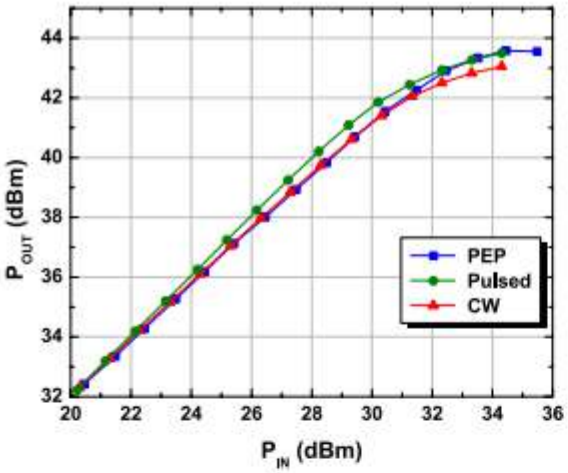


Figure 2 - CW, pulsed CW, and PEP, 3500MHz, Constant Impedance States

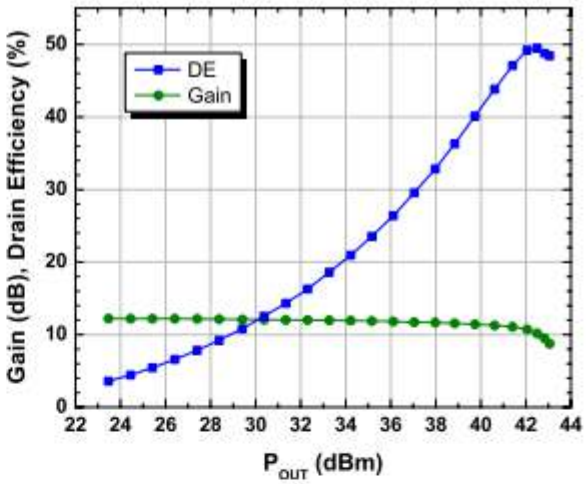


Figure 3 - CW Power Sweep, 3500MHz

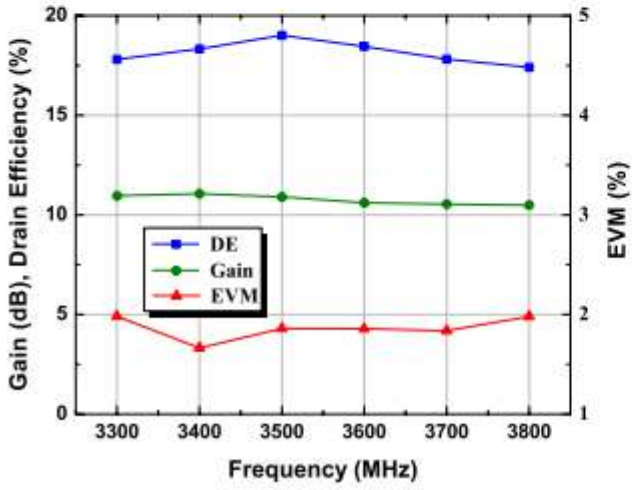


Figure 4 - Typical OFDM Performance
P_{OUT} = 1.5W

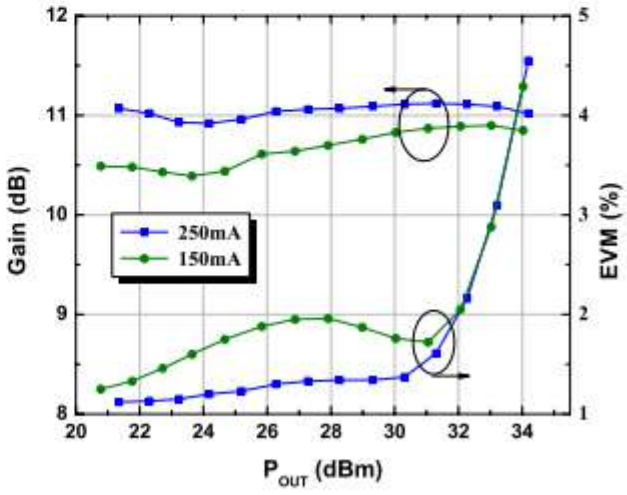


Figure 5 - Typical OFDM Performance at 3500MHz versus I_{DQ}

Load-Pull Data, Reference Plane at Device Leads:

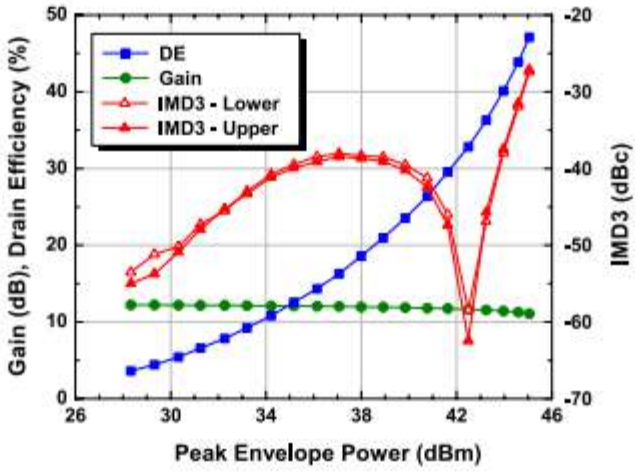


Figure 6 - Typical IMD3 Performance, 3500MHz

Typical Device Characteristics

V_{DS}=28V, I_{DQ}=200mA, T_A=25°C unless otherwise noted.

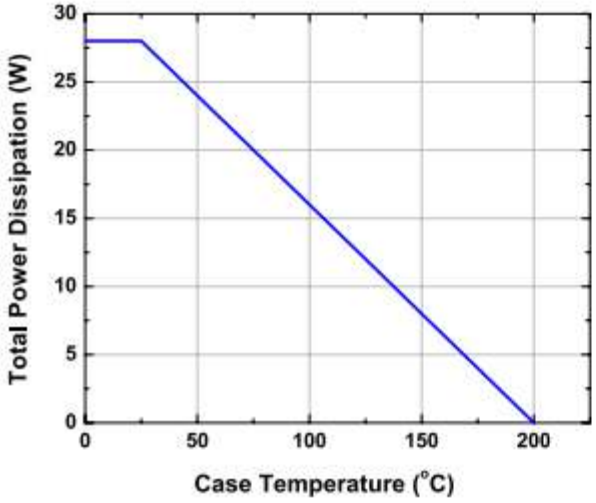


Figure 7 - Power Derating Curve

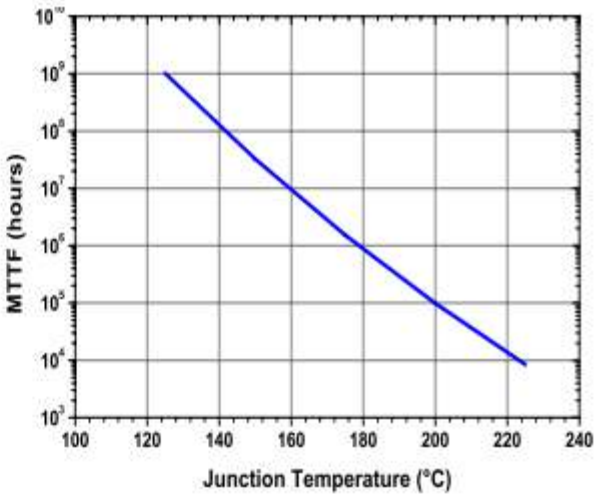
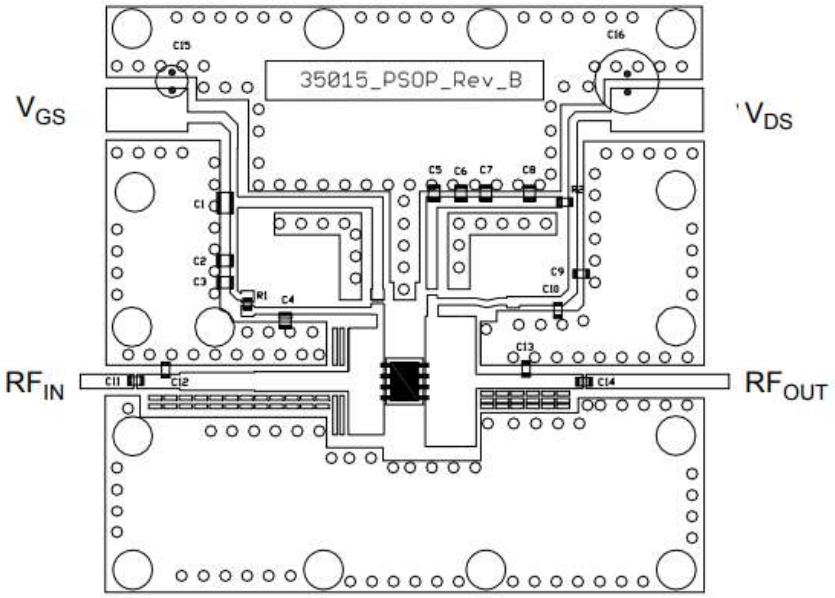


Figure 8 - MTTF of NRF1 Devices

AD-006 3.4 - 3.6 GHz, 1.7 W Linear WiMAX Application Board & Schematic

802.16e Single Carrier OFDM, 64-QAM 3/4, 8-burst, 20 ms frame 100% filled, 3.5 MHz channel bandwidth, PAR = 10.3 dB @ 0.01% CCDF



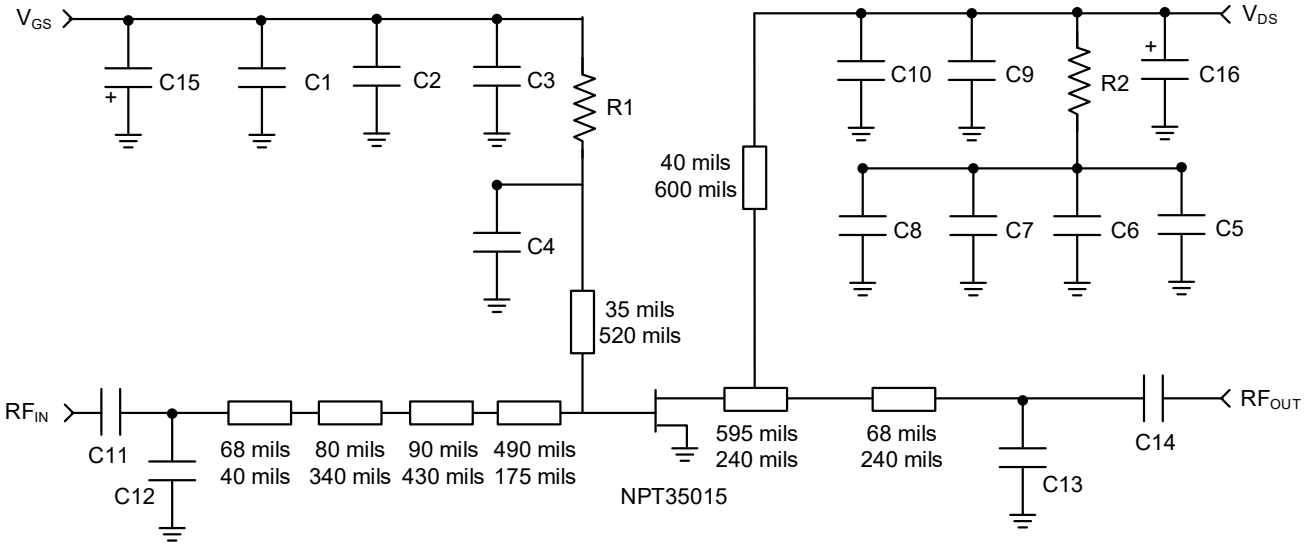


Figure 9 - AD-006 Demonstration Board and Schematic

Parts list

Reference	Value	Tolerance	Manufacturer	Part Number
C1	0.1 µF	10%	Kemet	C1206C104K1RACTU
C2, C7	0.01 µF	10%	AVX	12061C103KAT2A
C3, C6	1000 pF	10%	Kemet	C0805C102K1RACTU
C5	100 pF	10%	Kemet	C0805C101K1RACTU
C8	1 µF	10%	Panasonic	ECJ-5YB2A105M
C4, C9 - C11, C14	5.6 pF	±0.1 pF	ATC	ATC600F5R6B
C12	0.3 pF	±0.1 pF	ATC	ATC600F0R3B
C13	0.6 pF	±0.1 pF	ATC	ATC600F0R6B
C15	150 µF	20%	Nichicon	UPW1C151MED
C16	270 µF	20%	United Chemi-Con	ELXY630ELL271MK25S
R1	10 Ω	1%	Panasonic	ERJ-2RKF10R0X
R2	0.33 Ω	1%	Panasonic	ERJ-6RQFR33V
PCB	Rogers RO4350, ε_r=3.5, t = 30 mils			

AD-006 3.4 - 3.6 GHz, 1.7 W Linear WiMAX Application Design

802.16e Single Carrier OFDM, 64-QAM 3/4, 8-burst, 20 ms frame 100% filled, 3.5 MHz channel bandwidth, PAR = 10.3 dB @ 0.01% CCDF

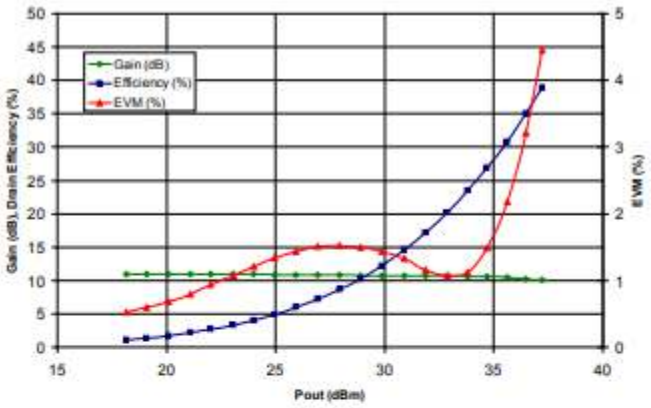


Figure 10 - Gain, Efficiency, EVM at 3400MHz

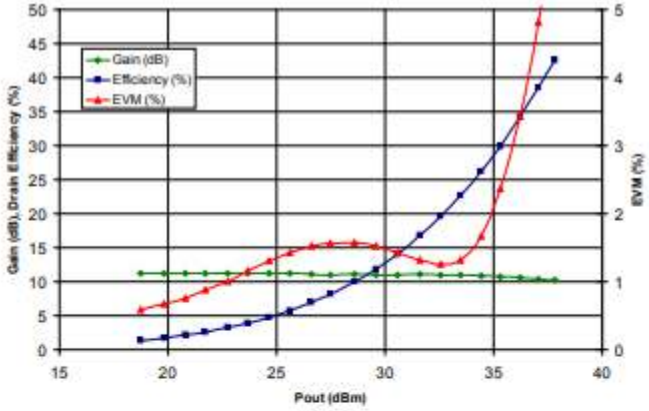


Figure 11 - Gain, Efficiency, EVM at 3500MHz

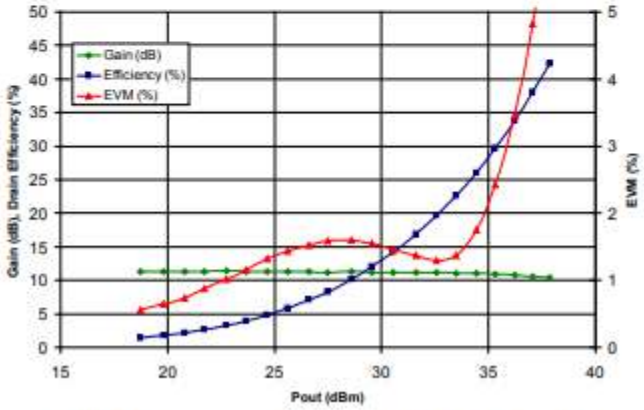


Figure 12 - Gain, Efficiency, EVM at 3600MHz

AD-006 3.4 - 3.6 GHz, 1.7 W Linear WiMAX Application Design

802.16e Single Carrier OFDM, 64-QAM 3/4, 8-burst, 20 ms frame 100% filled, 3.5 MHz channel bandwidth, PAR = 10.3 dB @ 0.01% CCDF

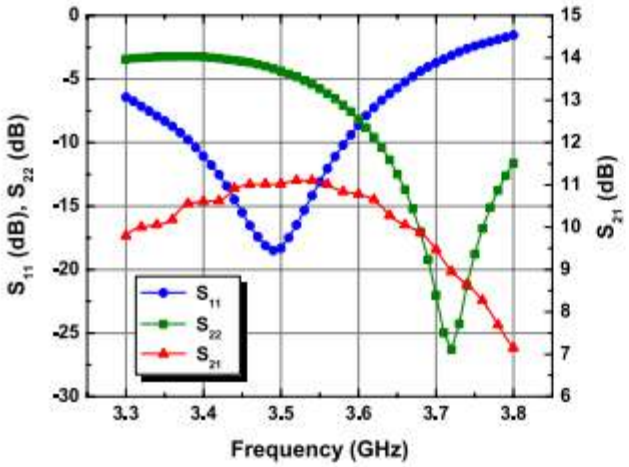


Figure 14 - Typical S_{11} and S_{21}

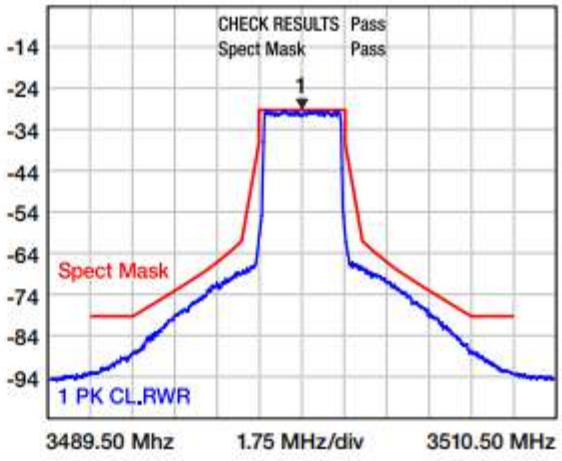
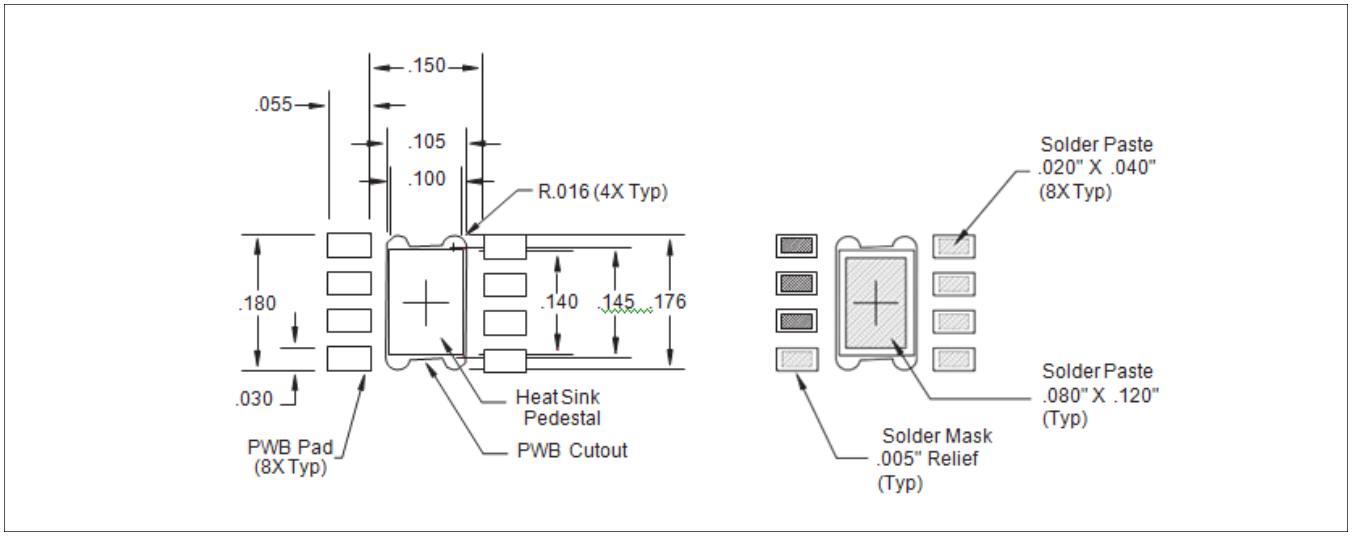
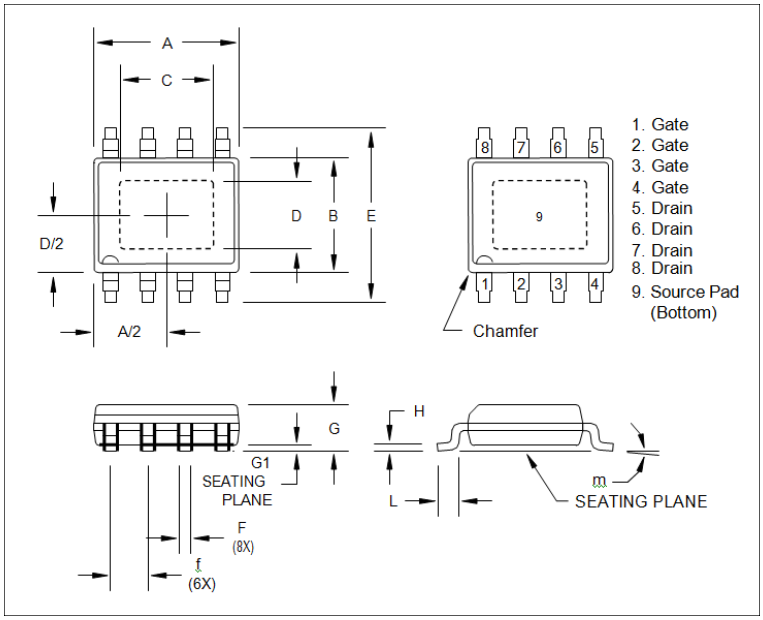


Figure 13 - ETSI Mask Compliance in Nitronex Demonstration Board at 3500MHz and P_{OUT} = 1.5W

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.