

## Gallium Nitride 28V, 18W RF Power Transistor

Built using the SIGANTIC® NRF1 process - A proprietary GaN-on-Silicon technology

### FEATURES

- Optimized for CW, Pulsed, WiMAX, and other applications from 3300 - 3800 MHz
- 18W P3dB CW Power
- 25W P3dB peak envelope power
- 1.7W linear power @ 2% EVM for single carrier OFDM, 10.3dB peak/average, 10.3dB @ 0.01% probability on CCDF, 10.5dB gain, 18% drain efficiency
- Characterized for operation up to 32V
- 100% RF tested
- Thermally enhanced industry standard package
- High reliability gold metallization process
- Lead-free and RoHS compliant
- Subject to EAR99 export control



**3300 – 3800 MHz**  
**18 Watt, 28 Volt**  
**GaN HEMT**



**Typical 2-Tone Performance:**  $V_{DS} = 28V$ ,  $I_{DQ} = 200mA$ , Frequency = 3500MHz, Tone spacing = 1MHz,  $T_C = 25^\circ C$ .  
Measured in Nitronex Test Fixture

| Symbol        | Parameter                                    | Min | Typ | Max | Units |
|---------------|----------------------------------------------|-----|-----|-----|-------|
| $P_{3dB,PEP}$ | Peak Envelope Power at 3dB Compression       | 14  | 18  | -   | W     |
| $P_{1dB,PEP}$ | Peak Envelope Power at 1dB Compression       | -   | 10  | -   | W     |
| $G_{SS}$      | Small Signal Gain                            | 10  | 11  | -   | dB    |
| $\eta$        | Peak Drain Efficiency at $P_{OUT} = P_{3dB}$ | 43  | 48  | -   | %     |

**RF Specifications (CW):**  $V_{DS} = 28V$ ,  $I_{DQ} = 200mA$ , Frequency = 3500MHz,  $T_C = 25^\circ C$ , Measured in Load Pull System

| Symbol           | Parameter                                    | Typ | Units |
|------------------|----------------------------------------------|-----|-------|
| $P_{3dB}$        | Average Output Power at 3dB Gain Compression | 18  | W     |
| $P_{3dB,Pulsed}$ | Pulsed Output Power at 3dB Gain Compression  | 20  | W     |
| $P_{1dB,Pulsed}$ | Pulsed Output Power at 1dB Gain Compression  | 15  | W     |

**Typical OFDM Performance:**  $V_{DS} = 28V$ ,  $I_{DQ} = 200mA$ ,  $P_{OUT,AVG} = 1.7W$ , single carrier OFDM waveform 64-QAM 3/4, 8 burst, 20ms frame, 15ms frame data, 3.5MHz channel bandwidth. Peak/Avg = 10.3dB @ 0.01% probability on CCDF. Frequency = 3300 to 3800MHz.  $T_C = 25^\circ C$ . Measured in Load Pull System (Refer to Table 1 and Figure 1)

| Symbol | Parameter              | Typ  | Units |
|--------|------------------------|------|-------|
| $G_P$  | Power Gain             | 10.5 | dB    |
| $\eta$ | Drain Efficiency       | 18   | %     |
| EVM    | Error Vector Magnitude | 2.0  | %     |
| IRL    | Input Return Loss      | 10   | dB    |

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

| Symbol                     | Parameter                                                                                                                | Min  | Typ  | Max  | Units    |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------|------|------|------|----------|
| <b>Off Characteristics</b> |                                                                                                                          |      |      |      |          |
| $V_{BDS}$                  | Drain-Source Breakdown Voltage<br>( $V_{GS} = -8\text{V}$ , $I_D = 8\text{mA}$ )                                         | 100  | -    | -    | V        |
| $I_{DLK}$                  | Drain-Source Leakage Current<br>( $V_{GS} = -8\text{V}$ , $V_{DS} = 60\text{V}$ )                                        | -    | -    | 4    | mA       |
| <b>On Characteristics</b>  |                                                                                                                          |      |      |      |          |
| $V_T$                      | Gate Threshold Voltage<br>( $V_{DS} = 28\text{V}$ , $I_D = 8\text{mA}$ )                                                 | -2.3 | -1.8 | -1.3 | V        |
| $V_{GSQ}$                  | Gate Quiescent Voltage<br>( $V_{DS} = 28\text{V}$ , $I_D = 200\text{mA}$ )                                               | -2.0 | -1.5 | -1.0 | V        |
| $R_{ON}$                   | On Resistance<br>( $V_{GS} = 2\text{V}$ , $I_D = 60\text{mA}$ )                                                          | -    | 0.45 | 0.50 | $\Omega$ |
| $I_D$                      | Drain Current<br>( $V_{DS} = 7\text{V}$ pulsed, $300\mu\text{s}$ pulse width,<br>0.2% duty cycle, $V_{GS} = 2\text{V}$ ) | -    | 5.0  | -    | A        |

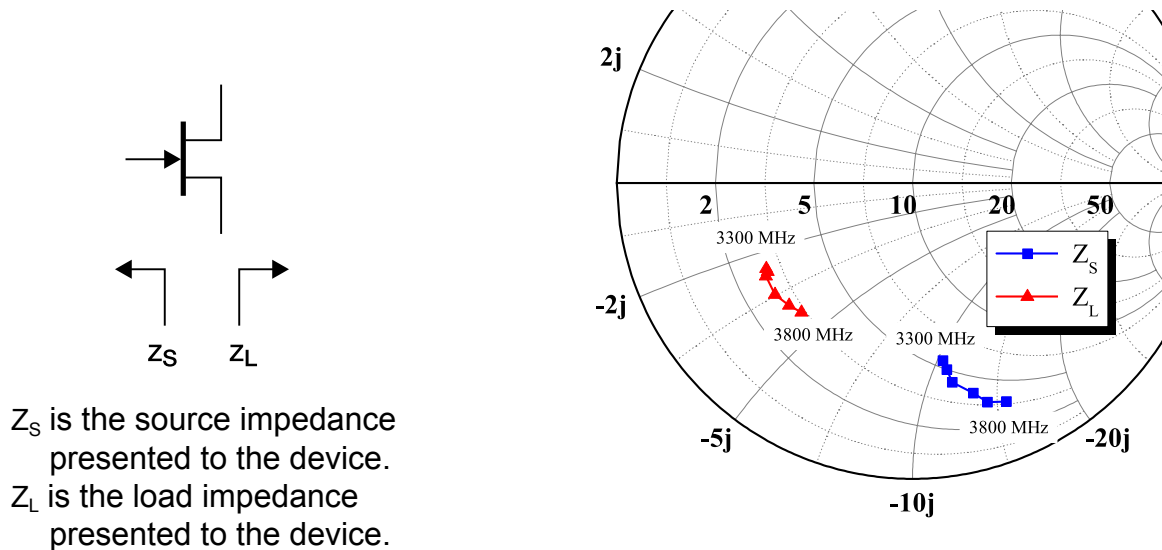
## Absolute Maximum Ratings: Not simultaneous, $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol        | Parameter                                                          | Max        | Units                     |
|---------------|--------------------------------------------------------------------|------------|---------------------------|
| $V_{DS}$      | Drain-Source Voltage                                               | 100        | V                         |
| $V_{GS}$      | Gate-Source Voltage                                                | -10 to 3   | V                         |
| $P_T$         | Total Device Power Dissipation (Derated above $25^\circ\text{C}$ ) | 28         | W                         |
| $\theta_{JC}$ | Thermal Resistance (Junction-to-Case)                              | 6.25       | $^\circ\text{C}/\text{W}$ |
| $T_{STG}$     | Storage Temperature Range                                          | -65 to 150 | $^\circ\text{C}$          |
| $T_J$         | Operating Junction Temperature                                     | 200        | $^\circ\text{C}$          |
| HBM           | Human Body Model ESD Rating (per JESD22-A114)                      | 1A (>250V) |                           |
| MM            | Machine Model ESD Rating (per JESD22-A115)                         | M1 (>50V)  |                           |

**Table 1:** Optimum Source and Load Impedances for OFDM Linearity,  $V_{DS} = 28V$ ,  $I_{DQ} = 200mA$

| Frequency (MHz)   | $Z_S (\Omega)$ | $Z_L (\Omega)$ | $P_{OUT} (W)$ | Gain (dB) | Drain Efficiency (%) |
|-------------------|----------------|----------------|---------------|-----------|----------------------|
| 3300 <sup>1</sup> | 5.4 - j10.3    | 2.9 - j2.5     | 1.7           | 10.9      | 19                   |
| 3400 <sup>1</sup> | 5.0 - j10.7    | 2.9 - j2.6     | 1.8           | 11.0      | 22                   |
| 3500 <sup>1</sup> | 4.4 - j11.2    | 2.8 - j2.7     | 1.7           | 10.9      | 21                   |
| 3600 <sup>1</sup> | 4.0 - j12.5    | 2.8 - j3.3     | 1.7           | 10.9      | 20                   |
| 3700 <sup>1</sup> | 3.5 - j13.4    | 3.0 - j3.8     | 1.8           | 10.8      | 20                   |
| 3800 <sup>1</sup> | 3.5 - j14.6    | 3.2 - j4.2     | 1.8           | 10.7      | 20                   |

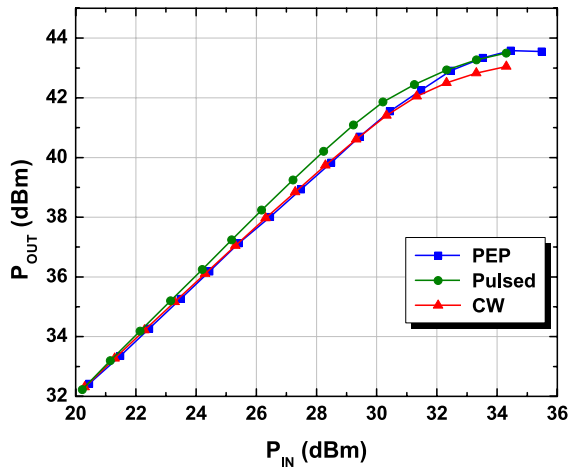
Note 1: Single carrier OFDM waveform 64-QAM 3/4, 8 burst, 20ms frame, 15ms frame data, 3.5 MHz channel bandwidth.  
Peak/Avg = 10.3dB @ 0.01% probability on CCDF, 2% EVM.



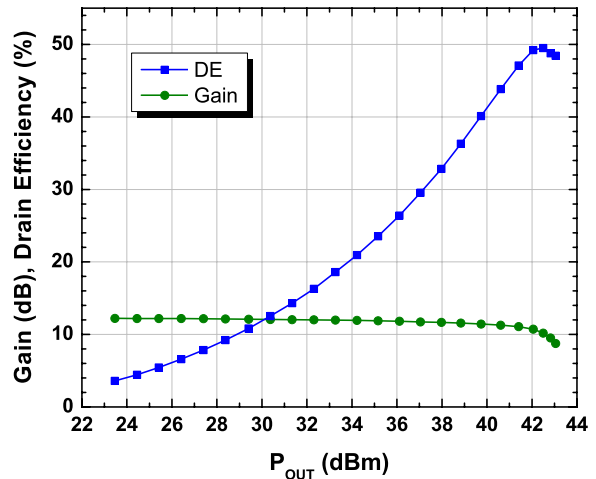
**Figure 1** - Optimal Impedances for OFDM Linearity,  $V_{DS} = 28V$ ,  $I_{DQ} = 200mA$

## Load-Pull Data, Reference Plane at Device Leads

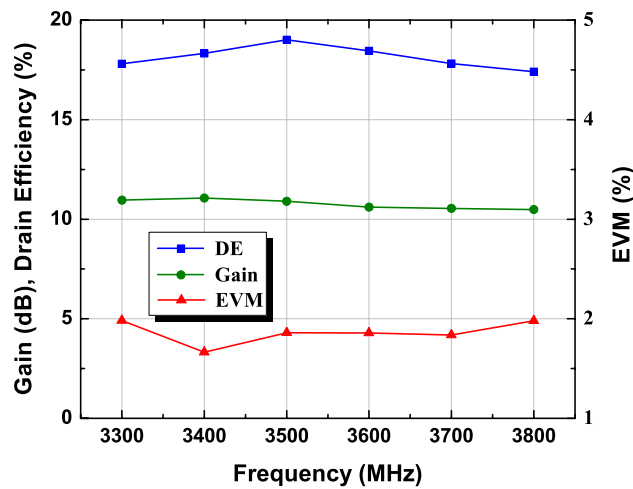
$V_{DS}=28V$ ,  $I_{DQ}=200mA$ ,  $T_A=25^{\circ}C$  unless otherwise noted.



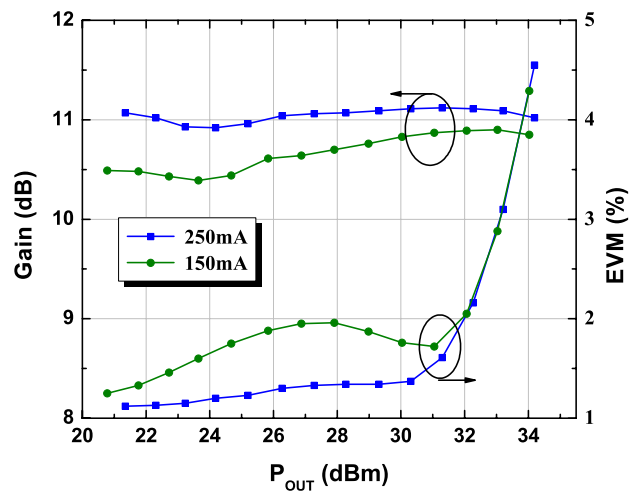
**Figure 2** - CW, pulsed CW, and PEP, 3500MHz, Constant Impedance States



**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

$V_{DS}=28V$ ,  $I_{DQ}=200mA$ ,  $T_A=25^\circ C$  unless otherwise noted.

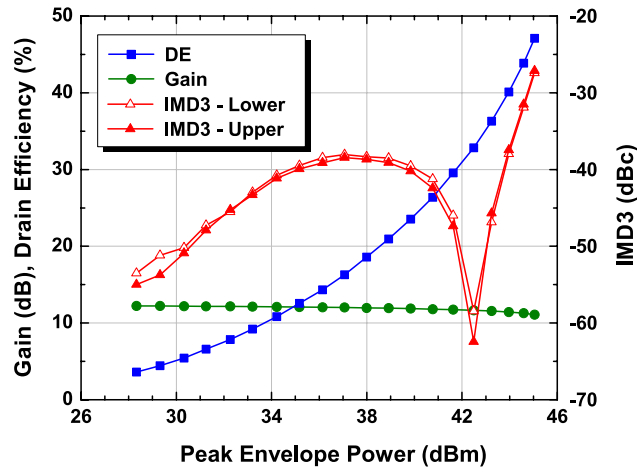


Figure 6 - Typical IMD3 Performance, 3500MHz

## Typical Device Characteristics

$V_{DS}=28V$ ,  $I_{DQ}=200mA$ ,  $T_A=25^\circ C$  unless otherwise noted.

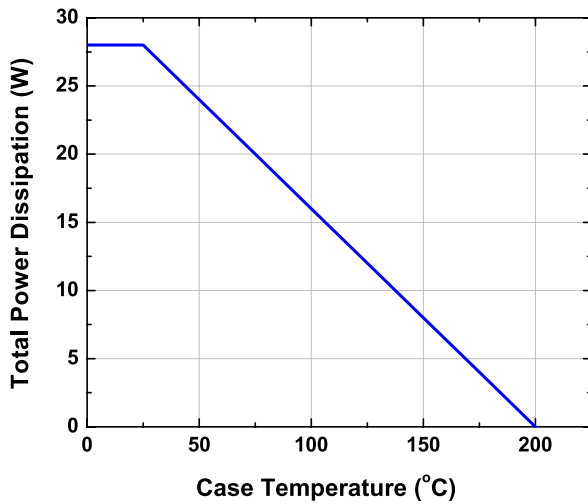


Figure 7 - Power Derating Curve

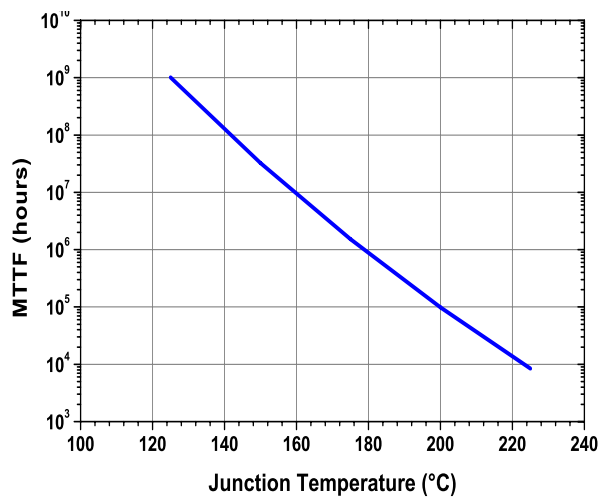
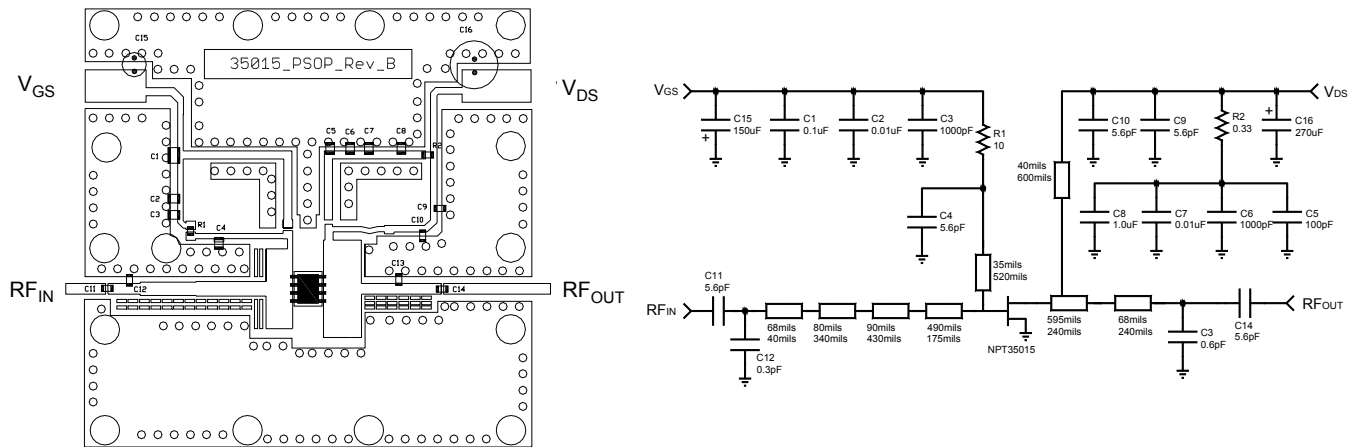


Figure 8 - MTTF of NRF1 Devices

## AD-006 3400-3600MHz 1.7W Linear WiMAX Application Design

802.16e Single Carrier OFDM, 64-QAM 3/4, 8-burst, 20ms frame 100% filled, 3.5MHz channel bandwidth, PAR=10.3dB @ 0.01% CCDF  
 Detailed design information and data available at [www.nitronex.com](http://www.nitronex.com)



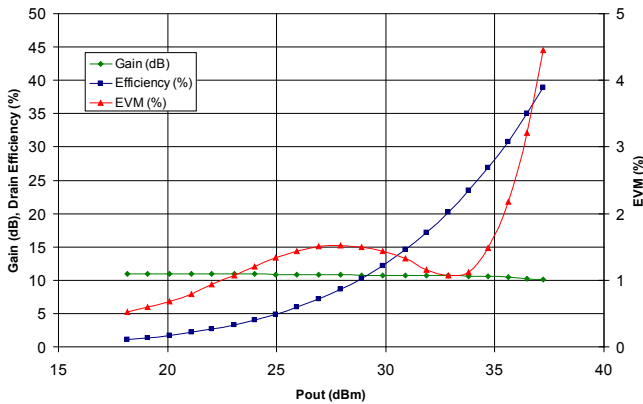
**Figure 9 - AD-006 Demonstration Board and Schematic**

**Table 2: AD-006 Demonstration Board Bill of Materials**

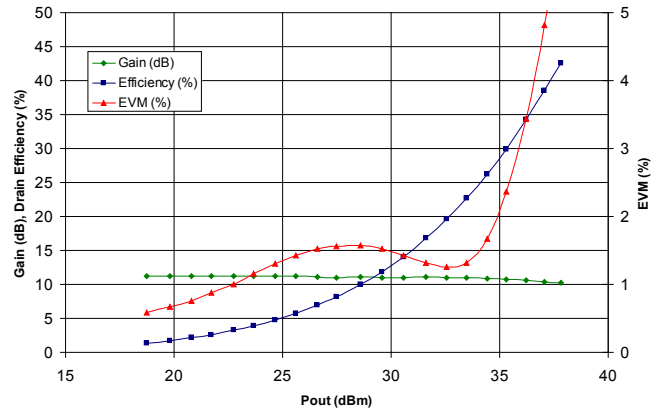
| Name                  | Value    | Tolerance | Vendor           | Vendor Number                        |
|-----------------------|----------|-----------|------------------|--------------------------------------|
| C1                    | 0.1uF    | 10%       | Kemet            | C1206C104K1RACTU                     |
| C2, C7                | 0.01uF   | 10%       | AVX              | 12061C103KAT2A                       |
| C3, C6                | 1000pF   | 10%       | Kemet            | C0805C102K1RACTU                     |
| C5                    | 100pF    | 10%       | Kemet            | C0805C101K1RACTU                     |
| C8                    | 1.0uF    | 10%       | Panasonic        | ECJ-5YB2A105M                        |
| C4, C9, C10, C11, C14 | 5.6pF    | +/- 0.1pF | ATC              | ATC600F5R6B                          |
| C12                   | 0.3pF    | +/- 0.1pF | ATC              | ATC600F0R3B                          |
| C13                   | 0.6pF    | +/- 0.1pF | ATC              | ATC600F0R6B                          |
| C15                   | 150uF    | 20%       | Nichicon         | UPW1C151MED                          |
| C16                   | 270uF    | 20%       | United Chemi-Con | ELXY630ELL271MK25S                   |
| R1                    | 10 ohm   | 1%        | Panasonic        | ERJ-2RKF10R0X                        |
| R2                    | 0.33 ohm | 1%        | Panasonic        | ERJ-6RQFR33V                         |
| PA1                   | --       | --        | --               | NPT35015D                            |
| Substrate             |          |           | Rogers           | R04350, t = 30mil $\epsilon_r = 3.5$ |

## AD-006 3400-3600MHz 1.7W Linear WiMAX Application Design

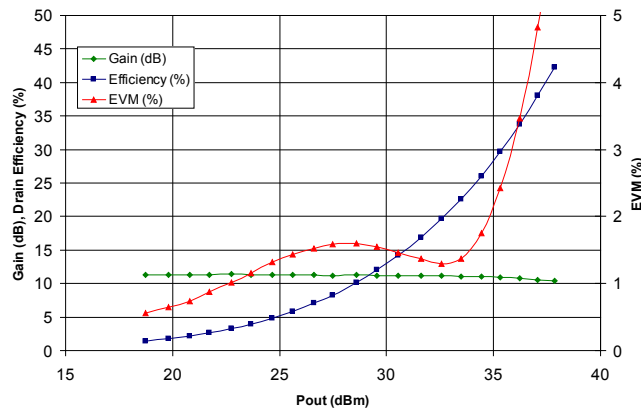
802.16e Single Carrier OFDM, 64-QAM 3/4, 8-burst, 20ms frame 100% filled, 3.5MHz channel bandwidth, PAR=10.3dB @ 0.01% CCDF  
 Detailed design information and data available at [www.nitronex.com](http://www.nitronex.com)



**Figure 10 - Gain, Efficiency, EVM at 3400MHz**



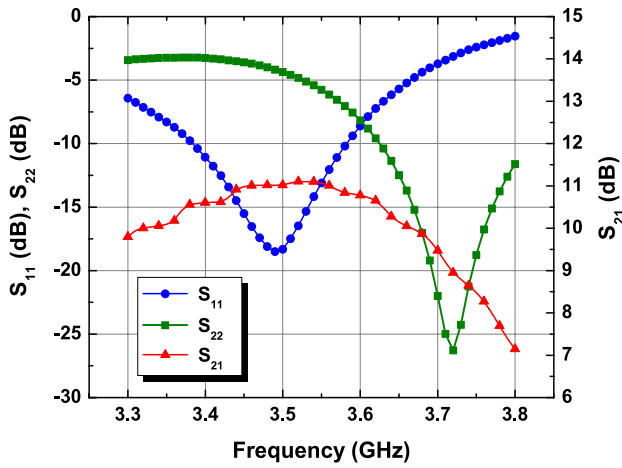
**Figure 11 - Gain, Efficiency, EVM at 3500MHz**



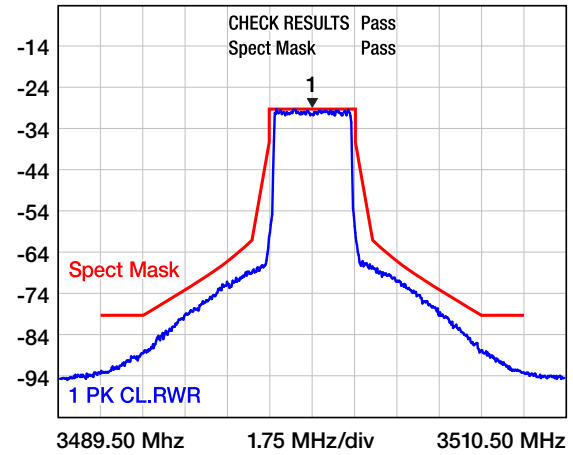
**Figure 12 - Gain, Efficiency, EVM at 3600MHz**

## AD-006 3400-3600MHz 1.7W Linear WiMAX Application Design

802.16e Single Carrier OFDM, 64-QAM 3/4, 8-burst, 20ms frame 100% filled, 3.5MHz channel bandwidth, PAR=10.3dB @ 0.01% CCDF  
 Detailed design information and data available at [www.nitronex.com](http://www.nitronex.com)



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



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



# NPT35015

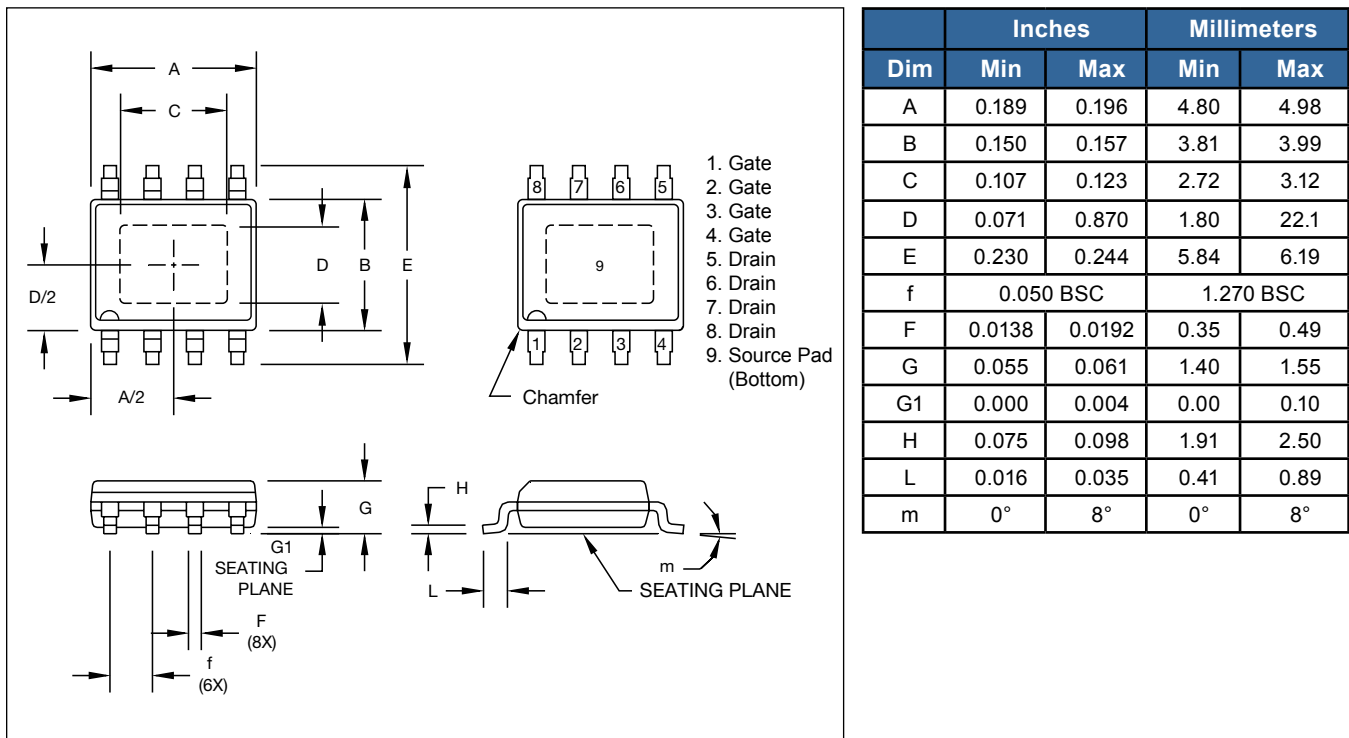


## Ordering Information

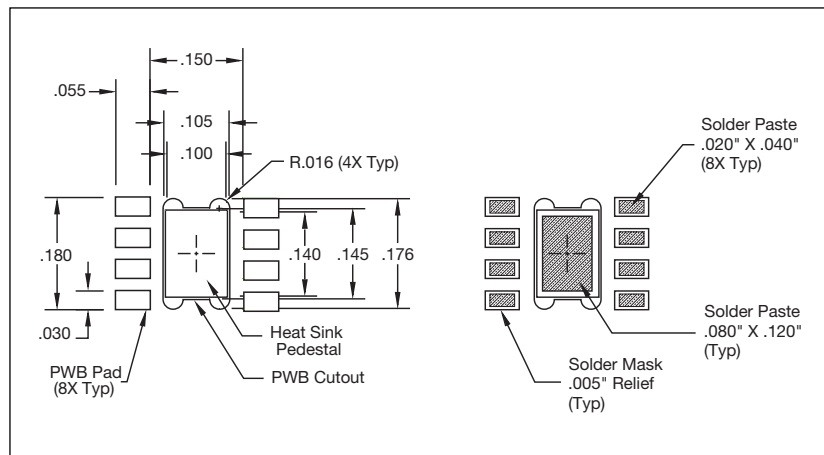
| Part Number | Order Multiple | Description                                  |
|-------------|----------------|----------------------------------------------|
| NPT35015DT  | 97             | Tube; NPT35015 in D (PSOP2) Package          |
| NPT35015DR  | 1500           | Tape and Reel; NPT35015 in D (PSOP2) Package |

1: To find a Nitronex contact in your area, visit our website at <http://www.nitronex.com>

**Figure 15 - D Package Dimensions and Pinout**



**Figure 16 - Mounting Footprint**



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## Additional Information

**This part is lead-free and is compliant with the RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).**

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