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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



## Features

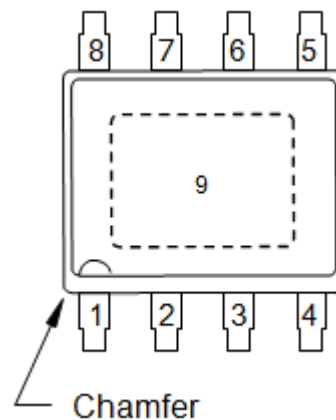
- Optimized for CW, pulsed, WiMAX, and other applications from DC - 3000 MHz
- 23 W P3dB peak envelope power (PEP)
- 1.5 W linear power @ 2% EVM for single carrier OFDM, 10.3 dB peak/average, 3.5 MHz channel bandwidth, 14 dB gain, 23.5% efficiency, 2500-2700 MHz
- 100% RF tested
- Thermally-enhanced 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                 | $P_{3dB, PEP}$<br>$P_{1dB, PEP}$ | 20   | 25   | —    | W     |
| 3 dB Compression                    |                                  | —    | 15   | —    |       |
| 1 dB Compression                    |                                  |      |      |      |       |
| Small Signal Gain                   | $G_{SS}$                         | 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,  $P_{OUT} = 1.5$  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<br>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.

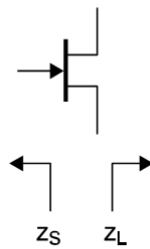
**Table 1: Optimum Impedance Characteristics for Linear OFDM Tuning, single carrier OFDM waveform 64-QAM 3/4, 8 burst, continuous frame data, 10 MHz channel bandwidth. Peak/Avg = 10.3 dB @ 0.01% probability on CCDF**

| 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**

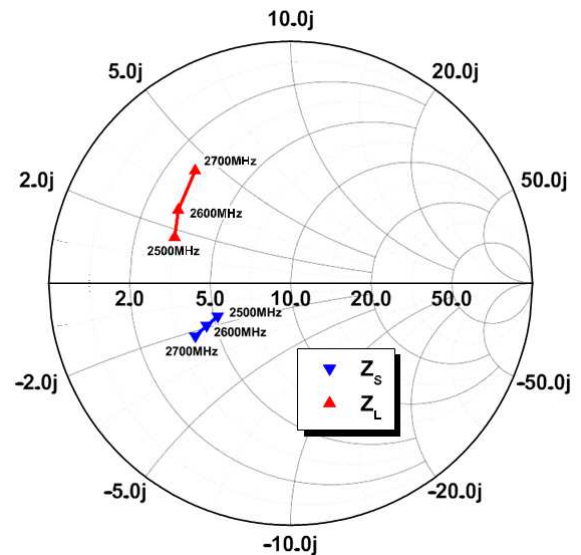
| Frequency (MHz) | $Z_S$ ( $\Omega$ ) | $Z_L$ ( $\Omega$ ) | $P_{SAT}$ (W) | $G_{SS}$ (dB) | Drain Efficiency (%) |
|-----------------|--------------------|--------------------|---------------|---------------|----------------------|
| 2500            | 3.7 - j 4.7        | 6.9 + j 1.2        | 23  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

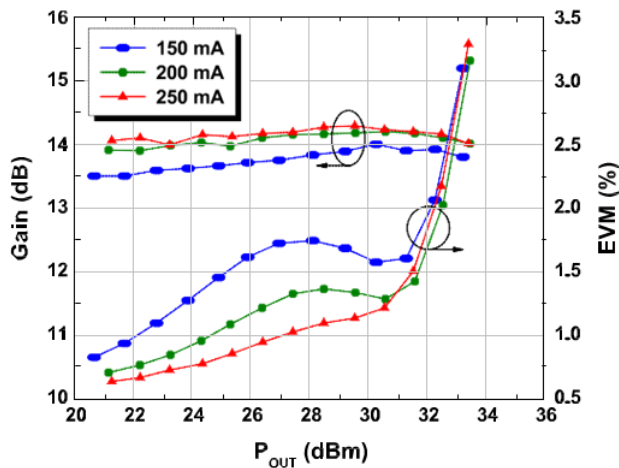


Figure 2 - Typical OFDM Performance

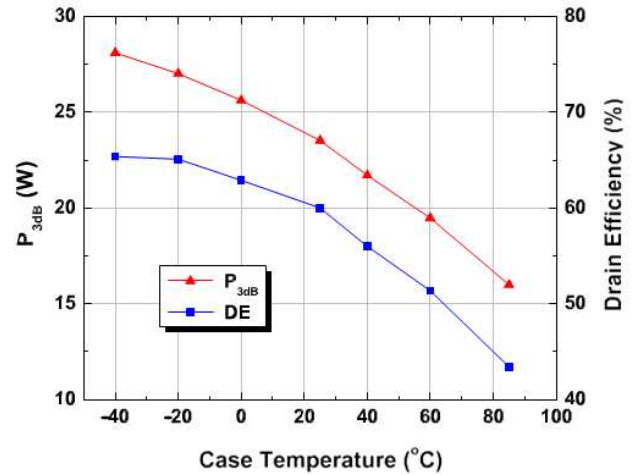


Figure 3 - P3dB, PEP and Drain vs. Temperature

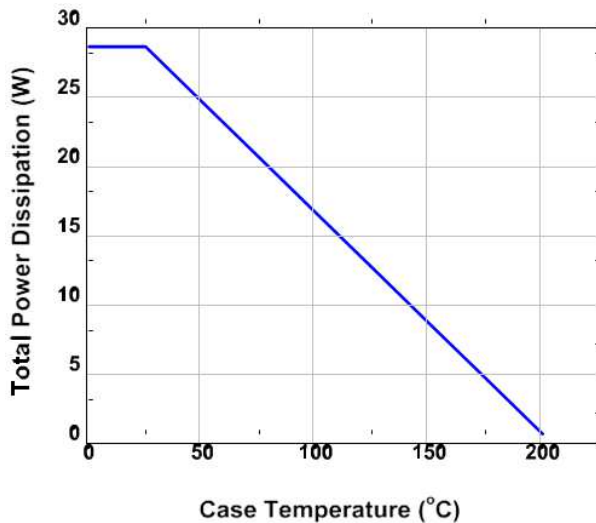


Figure 4 - Power Derating Curve

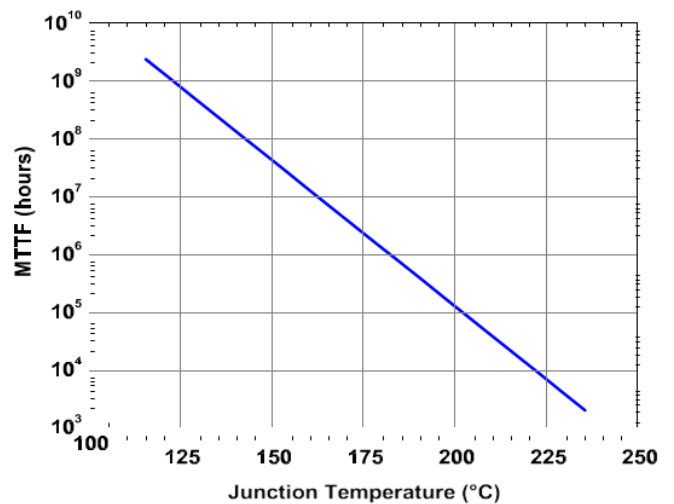
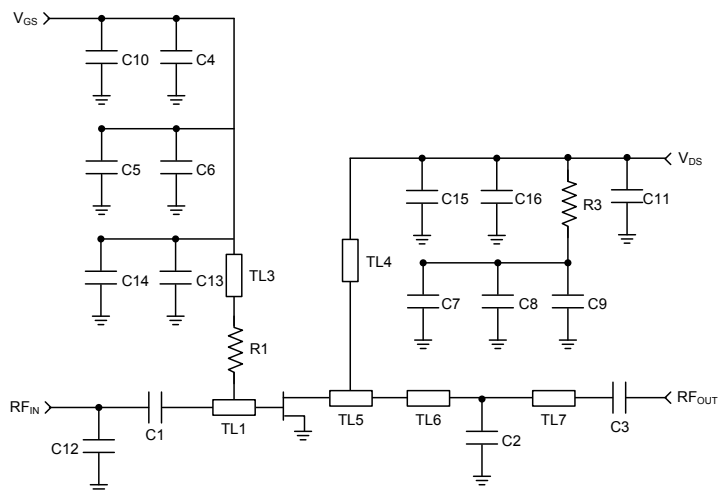
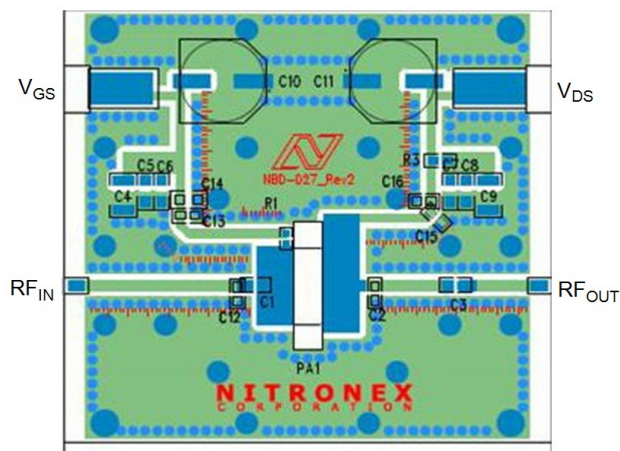


Figure 5 - MTTF of NRF1 devices as a function temperature

## 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 <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

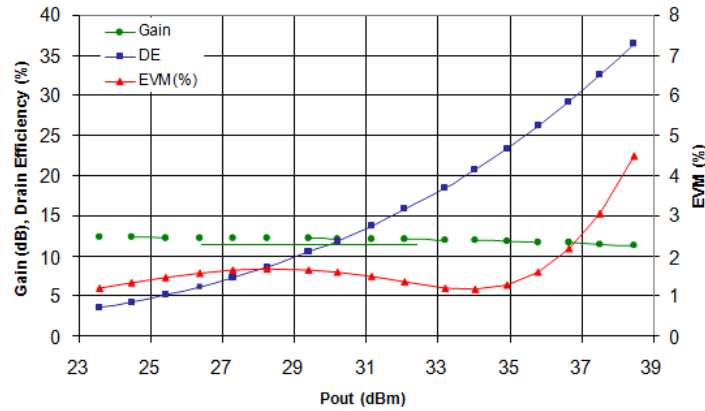


Figure 7 - Gain, Efficiency, EVM @ 2500 MHz

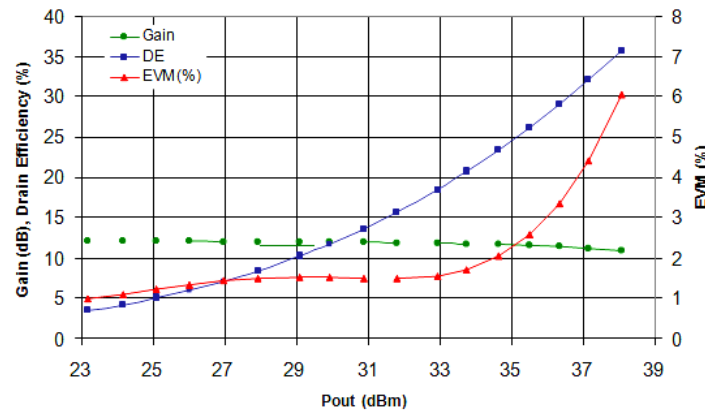


Figure 8 - Gain, Efficiency, EVM @ 2600 MHz

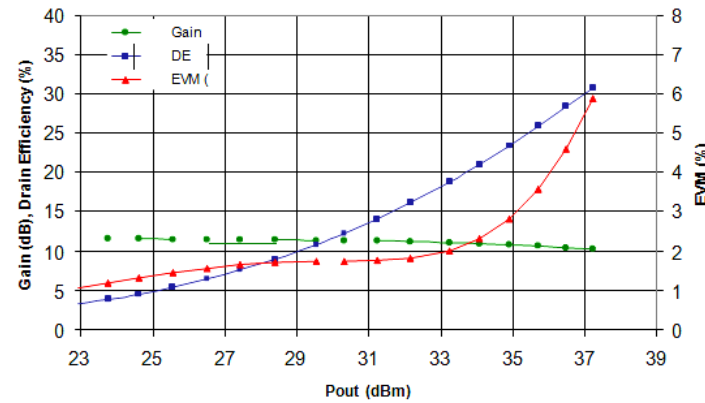
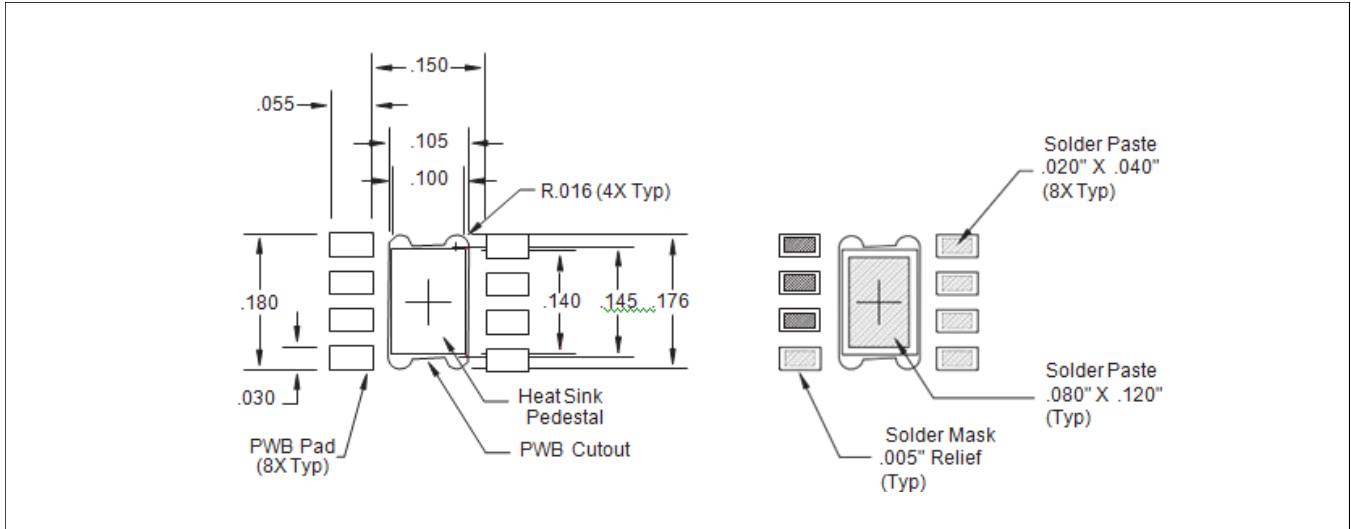


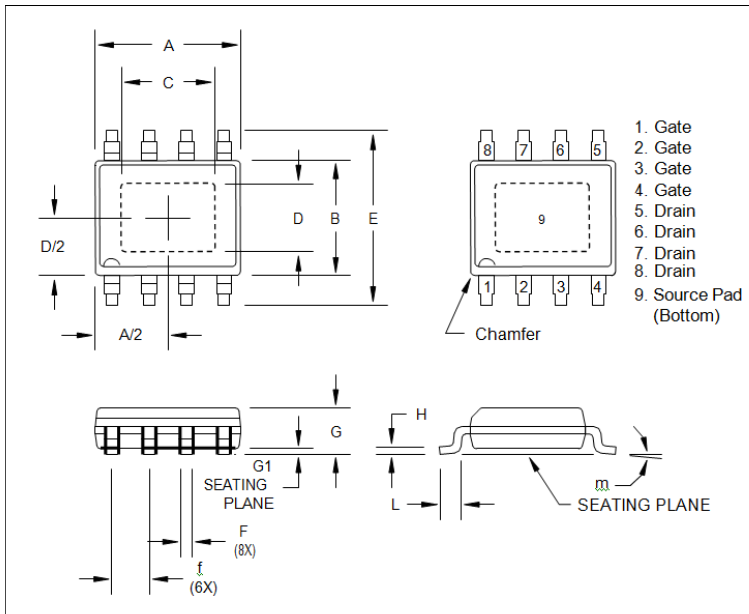
Figure 9 - Gain, Efficiency, EVM @ 2700 MHz



## 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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