# RF Power GaN Transistor

This 50 W asymmetrical Doherty RF power GaN transistor is designed for cellular base station applications requiring very wide instantaneous bandwidth capability covering the frequency range of 2496 to 2690 MHz.

This part is characterized and performance is guaranteed for applications operating in the 2496 to 2690 MHz band. There is no guarantee of performance when this part is used in applications designed outside of these frequencies.

**A2G26H281-04SR3**

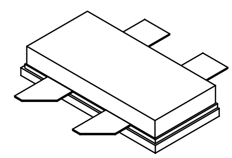
**2496–2690 MHz, 50 W AVG., 48 V AIRFAST RF POWER GaN TRANSISTOR**

**2600 MHz**

- Typical Doherty Single-Carrier W-CDMA Characterization Performance: $V_{DD}$ = 48 Vdc, $I_{DQA}$ = 150 mA, $V_{GSB}$ = –5.4 Vdc, $P_{out}$ = 50 W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. (1)

| Frequency | $G_{ps}$ (dB) | $\eta_D$ (%) | Output PAR (dB) | ACPR (dBc) |
|---|---|---|---|---|
| 2575 MHz | 14.3 | 61.9 | 7.2 | –29.1 |
| 2605 MHz | 14.3 | 61.7 | 7.1 | –29.5 |
| 2635 MHz | 14.3 | 60.9 | 6.8 | –30.4 |

1. All data measured in fixture with device soldered to heatsink.



**NI-780S-4L**

**Features**

- High terminal impedances for optimal broadband performance
- Advanced high performance in-package Doherty
- Able to withstand extremely high output VSWR and broadband operating conditions

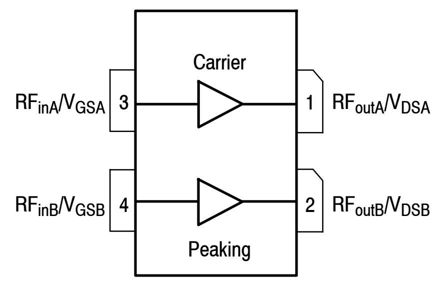



**Figure 1. Pin Connections**

**Table 1. Maximum Ratings**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DSS}$ | 125 | Vdc |
| Gate-Source Voltage | $V_{GS}$ | –8, 0 | Vdc |
| Operating Voltage | $V_{DD}$ | 0 to +55 | Vdc |
| Maximum Forward Gate Current @ $T_C$ = 25°C | $I_{GMAX}$ | 31 | mA |
| Storage Temperature Range | $T_{stg}$ | –65 to +150 | °C |
| Case Operating Temperature Range | $T_C$ | –55 to +150 | °C |
| Operating Junction Temperature Range | $T_J$ | –55 to +225 | °C |
| Absolute Maximum Junction Temperature (1) | $T_{MAX}$ | 275 | °C |

**Table 2. Thermal Characteristics**

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance by Infrared Measurement, Active Die Surface-to-Case<br>Case Temperature 74°C, $P_D$ = 38.3 W | $R_{\theta JC}$ (IR) | 1.0 (2) | °C/W |
| Thermal Resistance by Finite Element Analysis, Junction-to-Case<br>Case Temperature 72°C, $P_D$ = 38.3 W | $R_{\theta JC}$ (FEA) | 1.77 (3) | °C/W |

**Table 3. ESD Protection Characteristics**

| Test Methodology | Class |
|---|---|
| Human Body Model (per JESD22-A114) | 1B |
| Charge Device Model (per JESD22-C101) | C3 |

**Table 4. Electrical Characteristics** ($T_A$ = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **Off Characteristics (4)** | | | | | |
| Drain-Source Breakdown Voltage<br>($V_{GS}$ = –8 Vdc, $I_D$ = 12.0 mAdc) Carrier<br>($V_{GS}$ = –8 Vdc, $I_D$ = 18.9 mAdc) Peaking | $V_{(BR)DSS}$ | <br>150<br>150 | — | — | Vdc |
| **On Characteristics - Side A, Carrier** | | | | | |
| Gate Threshold Voltage<br>($V_{DS}$ = 10 Vdc, $I_D$ = 12.0 mAdc) | $V_{GS(th)}$ | –3.8 | –3.1 | –2.3 | Vdc |
| Gate Quiescent Voltage<br>($V_{DD}$ = 48 Vdc, $I_{DA}$ = 150 mAdc, Measured in Functional Test) | $V_{GSA(Q)}$ | –3.6 | –2.8 | –2.3 | Vdc |
| Gate-Source Leakage Current<br>($V_{DS}$ = 0 Vdc, $V_{GS}$ = –5 Vdc) | $I_{GSS}$ | –3.7 | — | — | mAdc |
| **On Characteristics - Side B, Peaking** | | | | | |
| Gate Threshold Voltage<br>($V_{DS}$ = 10 Vdc, $I_D$ = 18.9 mAdc) | $V_{GS(th)}$ | –3.8 | –3.1 | –2.3 | Vdc |
| Gate-Source Leakage Current<br>($V_{DS}$ = 0 Vdc, $V_{GS}$ = –5 Vdc) | $I_{GSS}$ | –5.9 | — | — | mAdc |

1. Functional operation above 225°C has not been characterized and is not implied. Operation at $T_{MAX}$ (275°C) reduces median time to failure by an order of magnitude; operation beyond $T_{MAX}$ could cause permanent damage.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.nxp.com/RF and search for AN1955.
3. $R_{\theta JC}$ (FEA) must be used for purposes related to reliability and limitations on maximum junction temperature. MTTF may be estimated by the expression MTTF (hours) = $10^{[A + B/(T + 273)]}$, where *T* is the junction temperature in degrees Celsius, *A* = –10.3 and *B* = 8260.
4. Each side of device measured separately.

(continued)

**Table 4. Electrical Characteristics** ($T_A$ = 25°C unless otherwise noted) **(continued)**

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **Functional Tests** [1,2] (In NXP Doherty Production Test Fixture, 50 ohm system) $V_{DD}$ = 48 Vdc, $I_{DQA}$ = 150 mA, $V_{GSB}$ = –5.4 Vdc, $P_{out}$ = 50 W Avg., f = 2635 MHz, Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset. **[See note on correct biasing sequence.]** | | | | | |
| Power Gain | $G_{ps}$ | 12.9 | 14.2 | 16.9 | dB |
| Drain Efficiency | $\eta_D$ | 55.7 | 58.7 | — | % |
| Output Peak-to-Average Ratio @ 0.01% Probability on CCDF | PAR | 6.5 | 7.1 | — | dB |
| Adjacent Channel Power Ratio | ACPR | — | –31.4 | –27.0 | dBc |
| **Load Mismatch** [2] (In NXP Doherty Characterization Test Fixture, 50 ohm system) $I_{DQA}$ = 150 mA, $V_{GSB}$ = –5.4 Vdc, f = 2605 MHz, 12 μsec(on), 10% Duty Cycle | | | | | |
| VSWR 10:1 at 55 Vdc, 275 W Pulsed CW Output Power (3 dB Input Overdrive from 180 W Pulsed CW Rated Power) | No Device Degradation | | | | |
| **Typical Performance** [2] (In NXP Doherty Characterization Test Fixture, 50 ohm system) $V_{DD}$ = 48 Vdc, $I_{DQA}$ = 150 mA, $V_{GSB}$ = –5.4 Vdc, 2575–2635 MHz Bandwidth | | | | | |
| $P_{out}$ @ 3 dB Compression Point [3] | P3dB | — | 251 | — | W |
| VBW Resonance Point (IMD Third Order Intermodulation Inflection Point) | $VBW_{res}$ | — | 110 | — | MHz |
| Gain Flatness in 60 MHz Bandwidth @ $P_{out}$ = 50 W Avg. | $G_F$ | — | 0.35 | — | dB |
| Gain Variation over Temperature (–30°C to +85°C) | ΔG | — | 0.01 | — | dB/°C |
| Output Power Variation over Temperature (–30°C to +85°C) | ΔP1dB | — | 0.01 | — | dB/°C |

**Table 5. Ordering Information**

| Device | Tape and Reel Information | Package |
|---|---|---|
| A2G26H281-04SR3 | R3 Suffix = 250 Units, 32 mm Tape Width, 13-inch Reel | NI-780S-4L |

1. Part internally input matched.
2. Measurements made with device in an asymmetrical Doherty configuration.
3. P3dB = $P_{avg}$ + 7.0 dB where $P_{avg}$ is the average output power measured using an unclipped W-CDMA single-carrier input signal where output PAR is compressed to 7.0 dB @ 0.01% probability on CCDF.

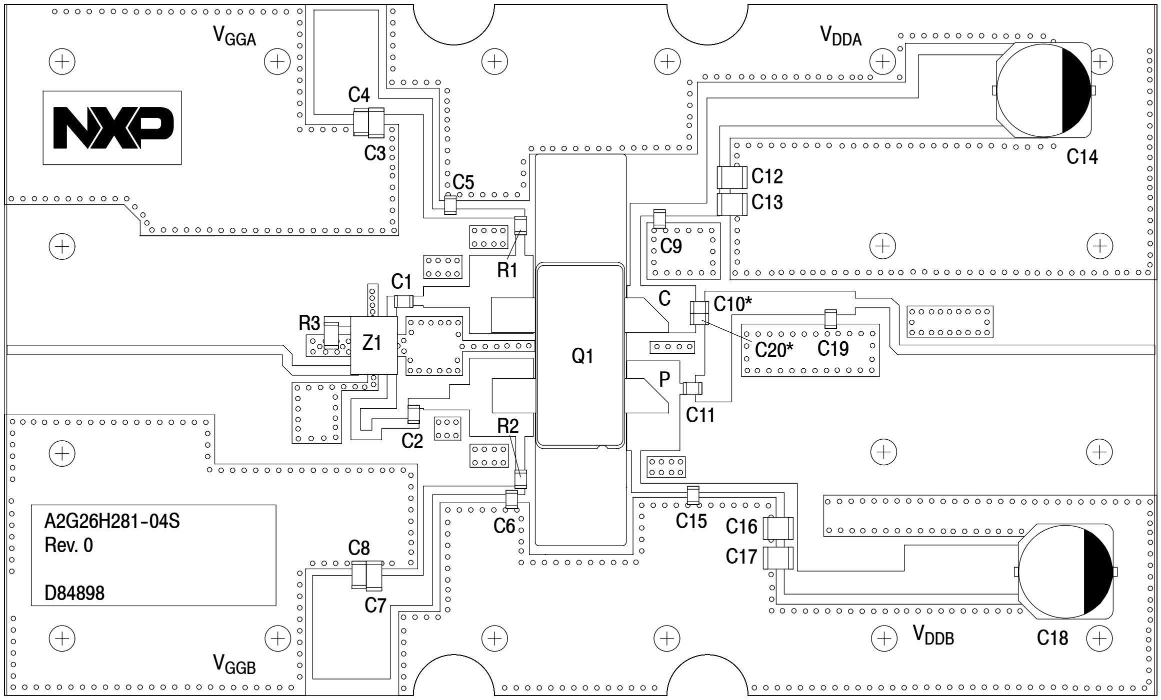
## NOTE: Correct Biasing Sequence for GaN Depletion Mode Transistors

### Turning the device ON

1. Set $V_{GS}$ to –5 V
2. Turn on $V_{DS}$ to nominal supply voltage (48 V)
3. Increase $V_{GS}$ until $I_{DS}$ current is attained
4. Apply RF input power to desired level

### Turning the device OFF

1. Turn RF power off
2. Reduce $V_{GS}$ down to –5 V
3. Reduce $V_{DS}$ down to 0 V (Adequate time must be allowed for $V_{DS}$ to reduce to 0 V to prevent severe damage to device.)
4. Turn off $V_{GS}$




*C10 and C20 are mounted vertically.

Note: All data measured in fixture with device soldered to heatsink. Production fixture does not include device soldered to heatsink.

**Figure 2. A2G26H281-04SR3 Characterization Test Circuit Component Layout**

**Table 6. A2G26H281-04SR3 Characterization Test Circuit Component Designations and Values**

| Part | Description | Part Number | Manufacturer |
|---|---|---|---|
| C1, C2, C5, C6, C9, C15 | 6.8 pF Chip Capacitors | ATC600F6R8BT250XT | ATC |
| C3, C7 | 10 μF Chip Capacitors | GRM31CR61H106KA12L | Murata |
| C4, C8 | 1 μF Chip Capacitors | GRM31CR72A105KA01L | Murata |
| C10 | 2.0 pF Chip Capacitor | ATC600F2R0BT250XT | ATC |
| C11 | 4.7 pF Chip Capacitor | ATC600F4R7BT250XT | ATC |
| C12, C13, C16, C17 | 2.2 μF Chip Capacitors | GRM32ER72A225KA35L | Murata |
| C14, C18 | 220 μF, 100 V Electrolytic Capacitors | EEV-FK2A221M | Panasonic |
| C19 | 0.2 pF Chip Capacitor | ATC600RF0R2BT250XT | ATC |
| C20 | 0.1 pF Chip Capacitor | ATC600RF0R1BT250XT | ATC |
| Q1 | RF Power GaN Transistor | A2G26H281-04S | NXP |
| R1, R2 | 5.6 Ω, 1/4 W Chip Resistors | CRCW12065K60FKEA | Vishay |
| R3 | 50 Ω, 30 W Termination Resistor | RFP-375375N6Z50-2 | Anaren |
| Z1 | 2300–2700 MHz Band, 90°, 2 dB Hybrid Coupler | X3C25P1-02S | Anaren |
| PCB | Rogers RO4350B, 0.020″, $\varepsilon_r$ = 3.66 | D84898 | MTL |

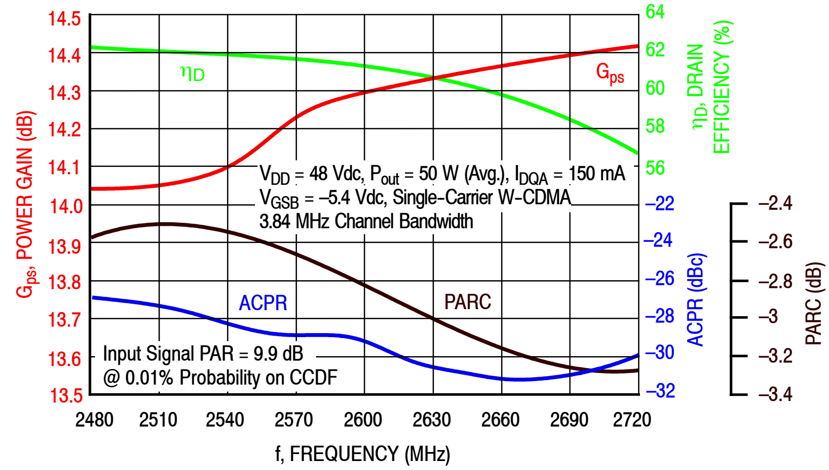



**Figure 3. Single-Carrier Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @ $P_{out}$ = 50 Watts Avg.**

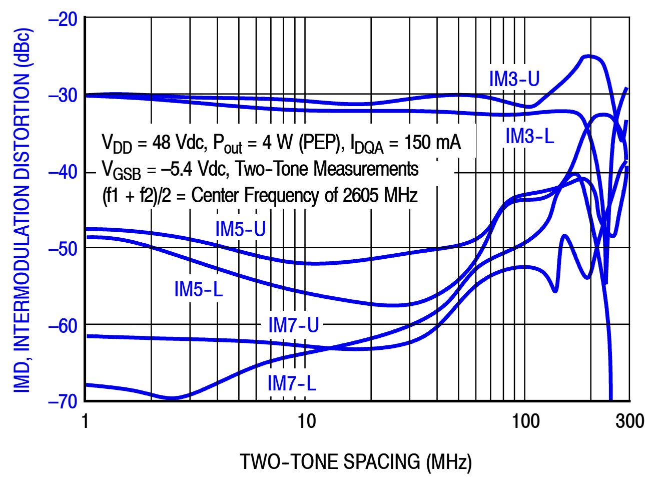



**Figure 4. Intermodulation Distortion Products versus Two-Tone Spacing**

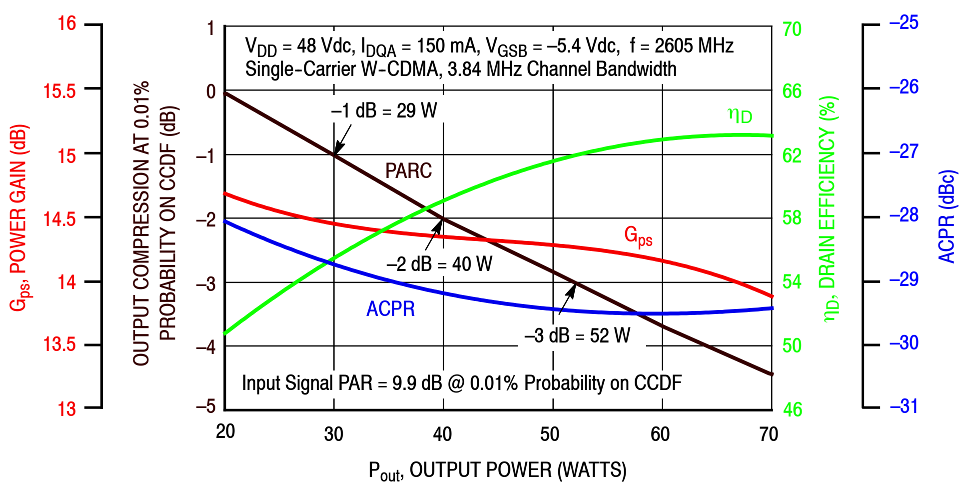



**Figure 5. Output Peak-to-Average Ratio Compression (PARC) versus Output Power**

## TYPICAL CHARACTERISTICS — 2575–2635 MHz

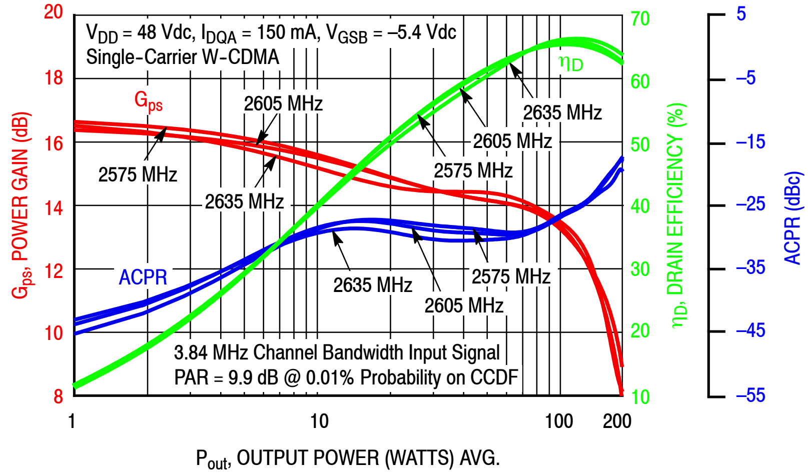



**Figure 6. Single-Carrier W-CDMA Power Gain, Drain Efficiency and ACPR versus Output Power**

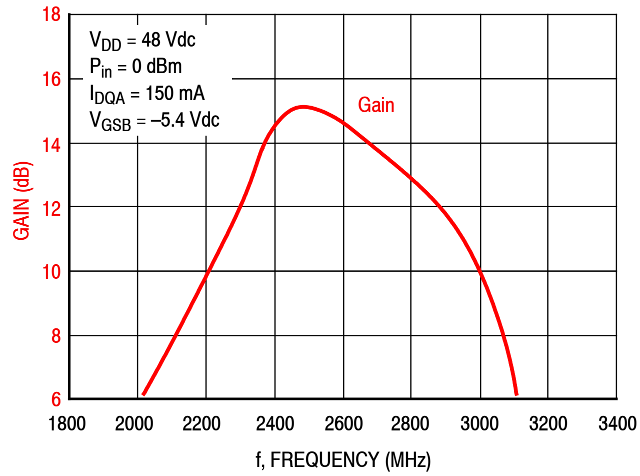
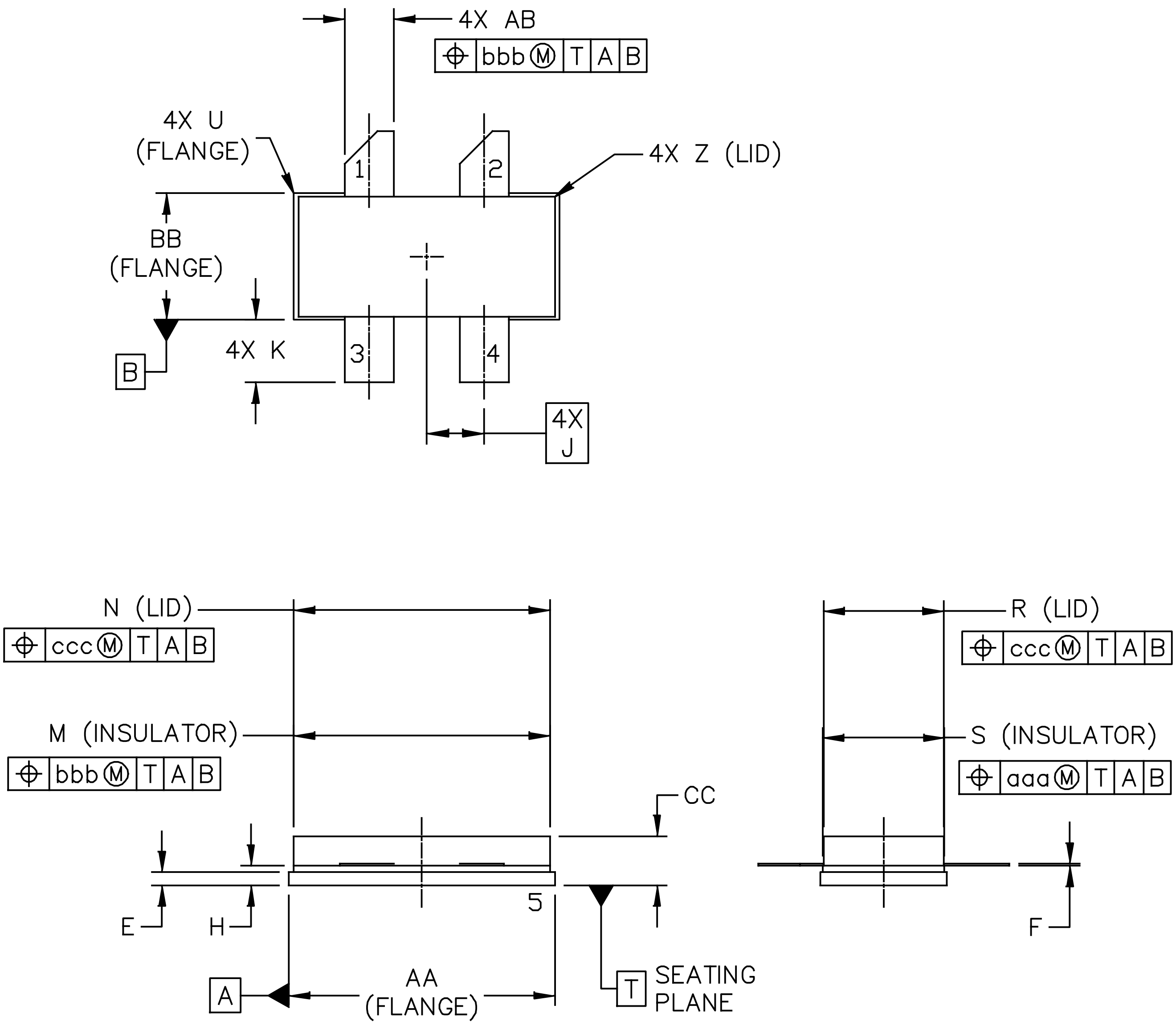



**Figure 7. Broadband Frequency Response**

## PACKAGE DIMENSIONS

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NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.

2. CONTROLLING DIMENSION: INCH.

3. DELETED

4. DIMENSION H IS MEASURED .030 (0.762) AWAY FROM FLANGE TO CLEAR EPOXY FLOW OUT PARALLEL TO DATUM B.

| DIM | INCH MIN | INCH MAX | MILLIMETER MIN | MILLIMETER MAX | DIM | INCH MIN | INCH MAX | MILLIMETER MIN | MILLIMETER MAX |
|---|---|---|---|---|---|---|---|---|---|
| AA | .805 | .815 | 20.45 | 20.70 | U | | .040 | | 1.02 |
| BB | .382 | .388 | 9.70 | 9.86 | Z | | .030 | | 0.76 |
| CC | .125 | .170 | 3.18 | 4.32 | AB | .145 | .155 | 3.68 – | 3.94 |
| E | .035 | .045 | 0.89 | 1.14 | | | | | |
| F | .003 | .006 | 0.08 | 0.15 | aaa | .005 | | 0.127 | |
| H | .057 | .067 | 1.45 | 1.70 | bbb | .010 | | 0.254 | |
| J | .175 BSC | | 4.44 BSC | | ccc | .015 | | 0.381 | |
| K | .170 | .210 | 4.32 | 5.33 | | | | | |
| M | .774 | .786 | 19.61 | 20.02 | | | | | |
| N | .772 | .788 | 19.61 | 20.02 | | | | | |
| R | .365 | .375 | 9.27 | 9.53 | | | | | |
| S | .365 | .375 | 9.27 | 9.52 | | | | | |



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## PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

**Application Notes**

- AN1908: Solder Reflow Attach Method for High Power RF Devices in Air Cavity Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

**Engineering Bulletins**

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

**Software**

- .s2p File

**Development Tools**

- Printed Circuit Boards

**To Download Resources Specific to a Given Part Number:**

1. Go to http://www.nxp.com/RF
2. Search by part number
3. Click part number link
4. Choose the desired resource from the drop down menu

## REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date | Description |
|---|---|---|
| 0 | Sept. 2016 | • Initial release of data sheet |
| 1 | Feb. 2017 | • Functional test table: Min, Typ and Max values updated to reflect the true capability of the device, p. 3<br>• Bias Sequencing Note, Turning the device ON, step 2: 50 V changed to 48 V to reflect the functionality of the part, p. 3 |

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Document Number: A2G26H281-04S
Rev. 1, 02/2017