



Gallium Arsenide PHEMT

RF Power Field Effect Transistor

Designed for WiMAX and WLL base station applications that have a 200 MHz BW requirement in the 2300 - 3800 MHz frequency range. Suitable for TDMA and CDMA amplifier applications. To be used in Class AB applications.

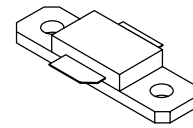
- Typical WiMAX Performance: $V_{DD} = 12$ Volts, $I_{DQ} = 300$ mA, $P_{out} = 2$ Watts Avg., $f = 3500$ MHz, 802.16d, 64 QAM $3/4$, 4 bursts, 7 MHz Channel Bandwidth, Input Signal PAR = 9.5 dB @ 0.01% Probability on CCDF.
 Power Gain — 11.5 dB
 Drain Efficiency — 22%
 RCE — -33 dB
 Meets ETSI Type G Mask
- 20 Watts P1dB @ 3500 MHz, CW

Features

- Supports up to 28 MHz Bandwidth OFDM Signals
- Internally Input Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Excellent Thermal Stability
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 32 mm, 13 inch Reel.

MRFG35020AR1

**3.5 GHz, 20 W, 12 V
 WiMAX
 POWER FET
 GaAs PHEMT**



**CASE 360E-01, STYLE 2
 NI-360 SHORT LEAD**

Table 1. Maximum Ratings

| Rating | Symbol | Value | Unit |
|---------------------------|-----------|-------------|------|
| Drain-Source Voltage | V_{DSS} | 15 | Vdc |
| Gate-Source Voltage | V_{GS} | -5 | Vdc |
| RF Input Power | P_{in} | 34 | dBm |
| Storage Temperature Range | T_{stg} | -40 to +150 | °C |
| Channel Temperature (1) | T_{ch} | 175 | °C |

Table 2. Thermal Characteristics

| Characteristic | Symbol | Value (2) | Unit |
|--------------------------------------|-----------------|-----------|------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 2.7 | °C/W |

1. For reliable operation, the operating channel temperature should not exceed 150°C. Exceeding 150°C channel operating temperature may result in device performance degradation.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1955.

Table 3. ESD Protection Characteristics

| Test Methodology | Class |
|---------------------------------------|--------------|
| Human Body Model (per JESD22-A114) | 2 (Minimum) |
| Machine Model (per EIA/JESD22-A115) | A (Minimum) |
| Charge Device Model (per JESD22-C101) | IV (Minimum) |

Table 4. Electrical Characteristics ($T_C = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

DC Characteristics

| | | | | | |
|--|--------------|------|-------|------|-----------------|
| Off State Drain Current ($V_{DS} = 3.5\text{ Vdc}$, $V_{GS} = -2.2\text{ Vdc}$) | I_{DSO} | — | 10 | 425 | μAdc |
| Off State Current ($V_{DS} = 28.5\text{ Vdc}$, $V_{GS} = -2.5\text{ Vdc}$) | I_{DSX} | — | 2 | 42.5 | mAdc |
| Gate-Source Cut-off Voltage ($V_{DS} = 3.5\text{ Vdc}$, $I_{DS} = 42.5\text{ mA}$) | $V_{GS(th)}$ | -1.2 | -0.95 | -0.7 | Vdc |

Functional Tests (In Freescale Test Fixture, 50 ohm system) ⁽¹⁾ $V_{DD} = 12\text{ Vdc}$, $I_{DQ} = 300\text{ mA}$, $P_{out} = 2\text{ W Avg.}$, $f = 3500\text{ MHz}$, Single-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carrier. ACPR measured in 3.84 MHz Channel Bandwidth @ $\pm 5\text{ MHz}$ Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.

| | | | | | |
|------------------------------|----------|-----|------|-----|-----|
| Power Gain | G_{ps} | 9.5 | 11.5 | — | dB |
| Drain Efficiency | η_D | 18 | 22 | — | % |
| Adjacent Channel Power Ratio | ACPR | — | -43 | -39 | dBc |

Typical RF Performance (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 12\text{ Vdc}$, $I_{DQ} = 300\text{ mA}$, $f = 3500\text{ MHz}$

| | | | | | |
|--|------|---|----|---|---|
| Output Power, 1 dB Compression Point, CW | P1dB | — | 20 | — | W |
|--|------|---|----|---|---|

1. Measurements made with device in test fixture.

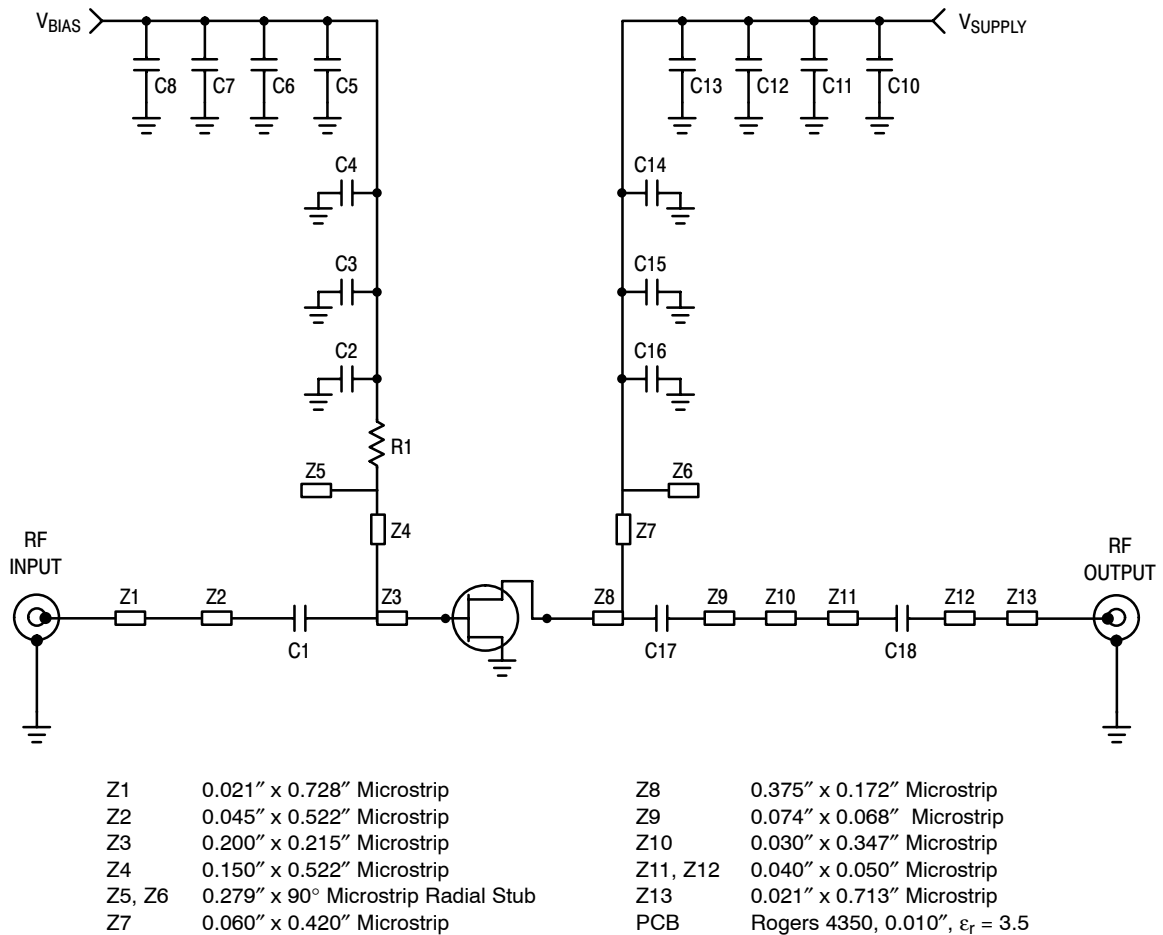


Figure 1. MRFG35020A Test Circuit Schematic

Table 5. MRFG35020A Test Circuit Component Designations and Values

| Part | Description | Part Number | Manufacturer |
|---------|------------------------------------|--------------------|--------------|
| C1 | 3.9 pF Chip Capacitor | 08051J3R9BBS | AVX |
| C2, C16 | 10 pF Chip Capacitors | ATC100A100JT150XT | ATC |
| C3, C15 | 100 pF Chip Capacitors | ATC100A101JT150XT | ATC |
| C4, C14 | 100 pF Chip Capacitors | ATC100B101JT500XT | ATC |
| C5, C13 | 1000 pF Chip Capacitors | ATC100B102JT50XT | ATC |
| C6, C12 | 0.01 μ F Chip Capacitors | ATC200B103KT50XT | ATC |
| C7, C11 | 39K pF Chip Capacitors | ATC200B393KT50XT | ATC |
| C8, C10 | 10 μ F Chip Capacitors | GRM55DR61H106KA88B | Murata |
| C9 | None | | |
| C17 | 1.8 pF Chip Capacitors | 08051J1R8BBS | AVX |
| C18 | 1.5 pF Chip Capacitor | 08051J1R5BBS | AVX |
| R1 | 6.2 Ω , 1/4 W Chip Resistor | CRCW12066R20FKEA | Vishay |



Figure 2. MRFG35020A Test Circuit Component Layout

TYPICAL CHARACTERISTICS

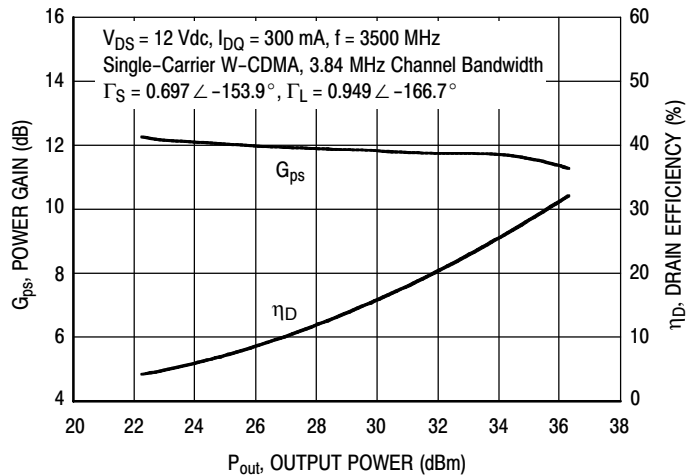


Figure 3. Single-Channel W-CDMA Power Gain and Drain Efficiency versus Output Power

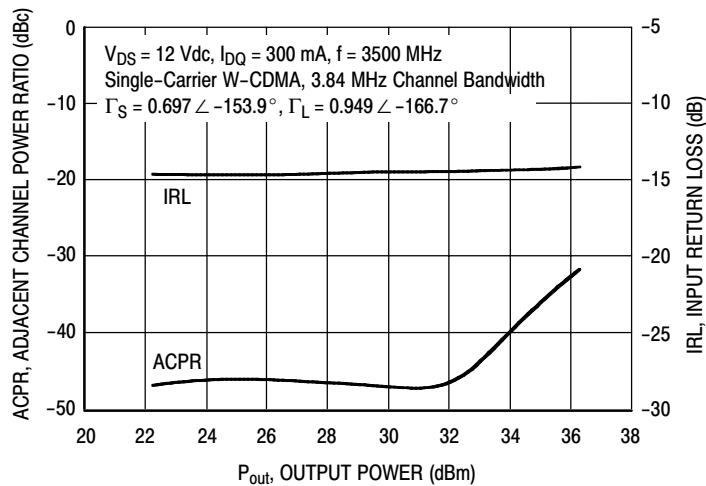


Figure 4. Single-Channel W-CDMA Adjacent Channel Power Ratio and IRL versus Output Power

NOTE: All data is referenced to package lead interface. Γ_S and Γ_L are the impedances presented to the DUT. All data is generated from load pull, not from the test circuit shown.

TYPICAL CHARACTERISTICS

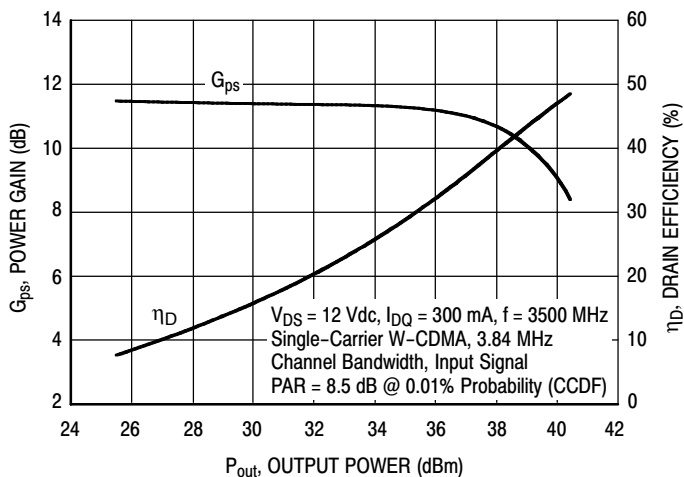


Figure 5. Single-Channel W-CDMA Power Gain and Drain Efficiency versus Output Power

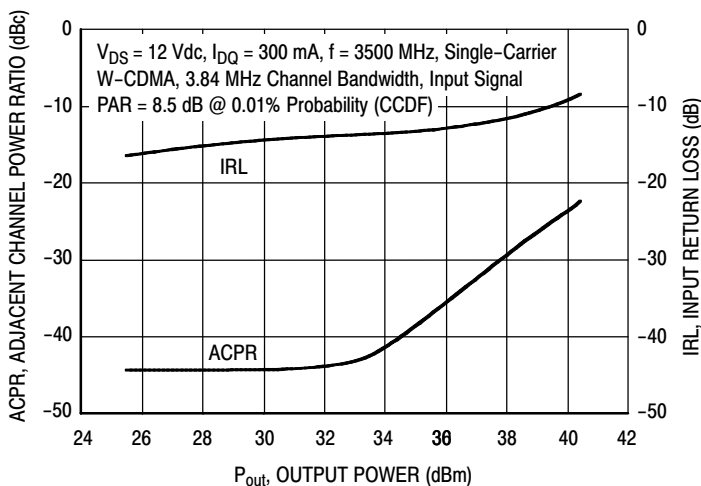


Figure 6. Single-Channel W-CDMA Adjacent Channel Power Ratio and IRL versus Output Power

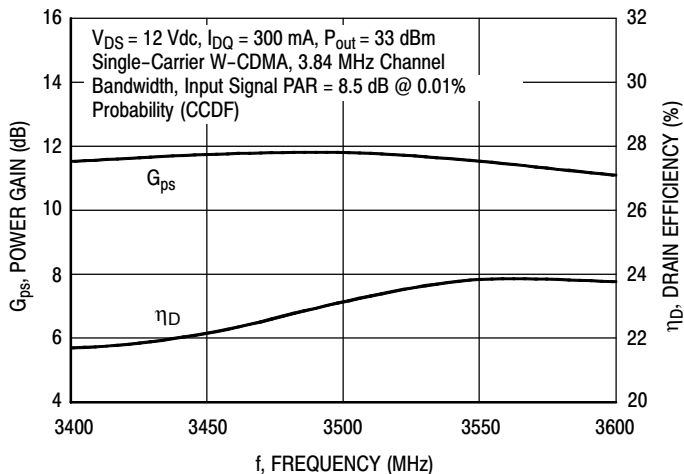


Figure 7. Single-Channel W-CDMA Power Gain and Drain Efficiency versus Frequency

NOTE: Data is generated from the test circuit shown.

TYPICAL CHARACTERISTICS

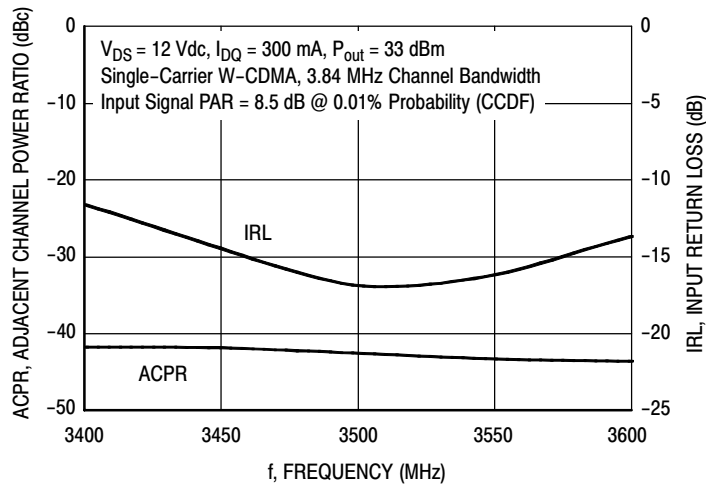


Figure 8. Single-Channel W-CDMA Adjacent Channel Power Ratio and IRL versus Frequency

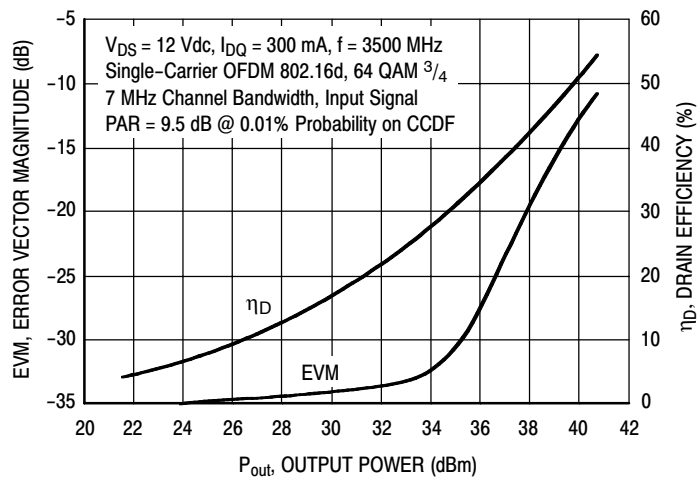
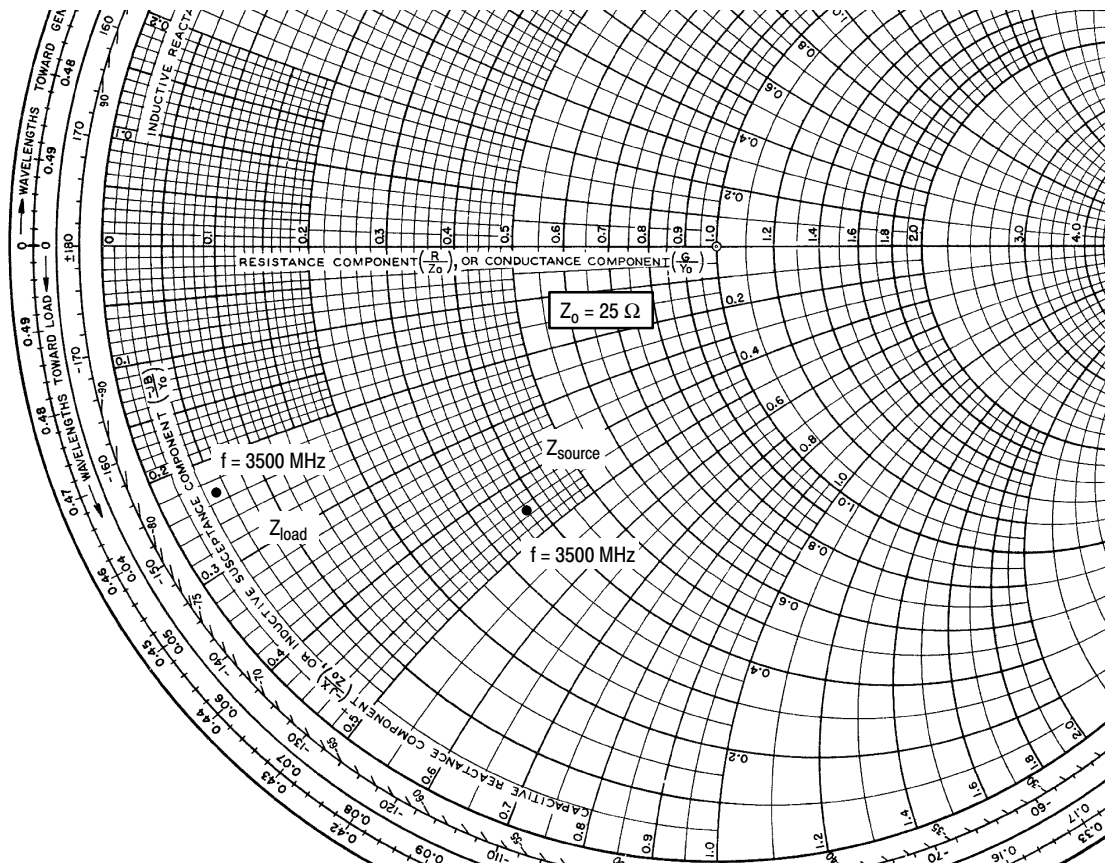


Figure 9. Single-Channel OFDM Error Vector Magnitude and Drain Efficiency versus Output Power

NOTE: Data is generated from the test circuit shown.



$V_{DD} = 12 \text{ Vdc}$, $I_{DQ} = 300 \text{ mA}$, $P_{out} = 2 \text{ W Avg.}$

| f MHz | Z_{source} Ω | Z_{load} Ω |
|----------|--------------------------|------------------------|
| 3500 | $9.4 - j11.2$ | $1.3 - j5.8$ |

Z_{source} = Test circuit impedance as measured from gate to ground.

Z_{load} = Test circuit impedance as measured from drain to ground.

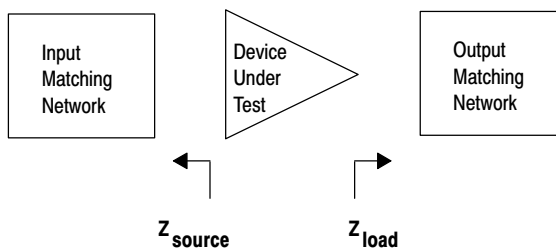
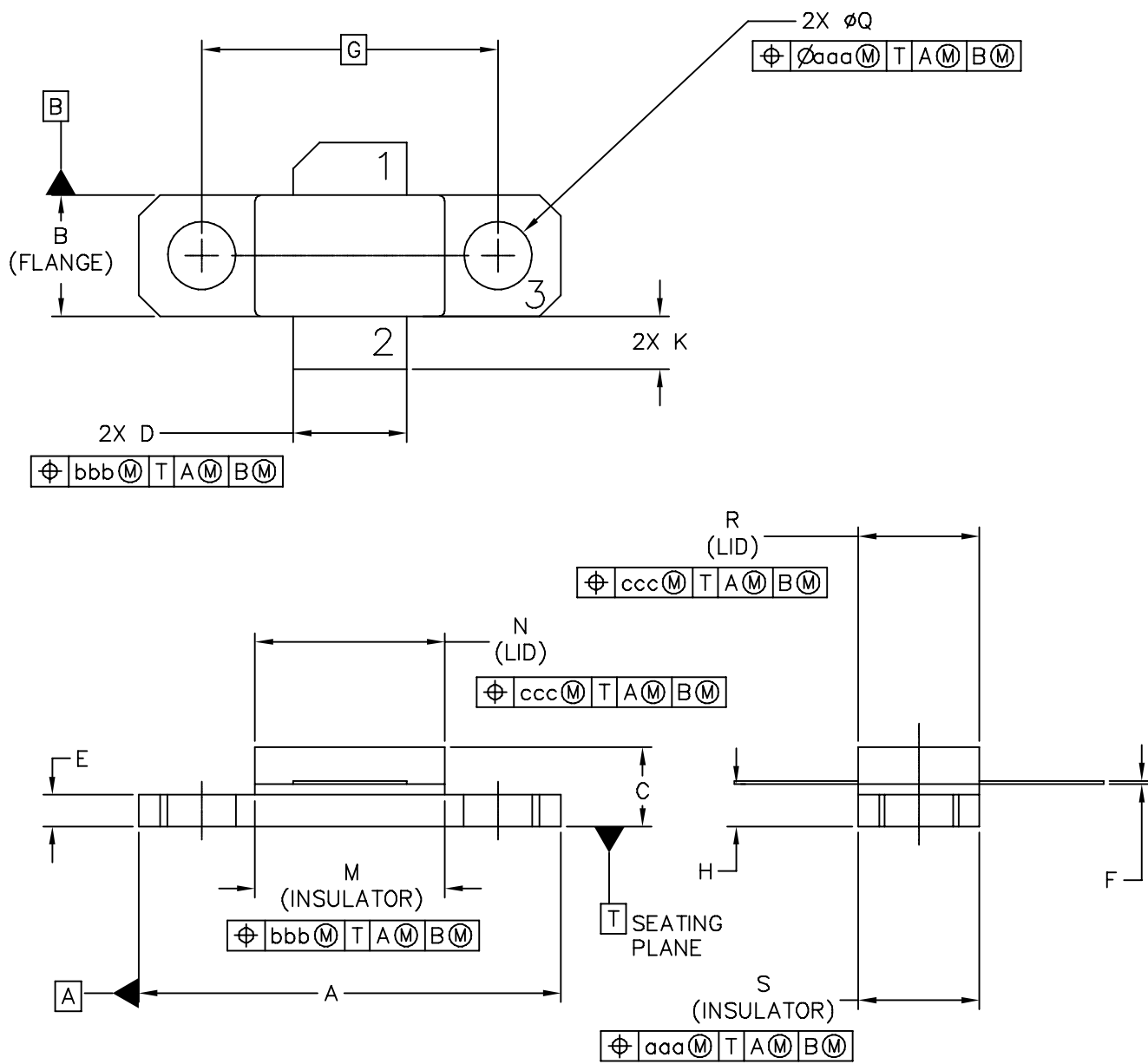


Figure 10. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS



| | | | |
|---|---------------------------|----------------------------|--|
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| TITLE: NI-360 SHORT LEAD | DOCUMENT NO: 98ASA10715D | REV: A | |
| | CASE NUMBER: 360E-01 | 03 APR 2006 | |
| | STANDARD: NON-JEDEC | | |

NOTES:

1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH
3. DIMENSION H IS MEASURED .030 AWAY FROM PACKAGE BODY

STYLE 1:

- PIN 1 - DRAIN
- 2 - GATE
- 3 - SOURCE

STYLE 2:

- PIN 1 - GATE
- 2 - DRAIN
- 3 - SOURCE

| DIM | INCH | | MILLIMETER | | DIM | INCH | | MILLIMETER | |
|---|----------|------|---------------------------|-------|--------------------------|----------------------------|------|-------------|------|
| | MIN | MAX | MIN | MAX | | MIN | MAX | MIN | MAX |
| A | .795 | .805 | 20.19 | 20.45 | N | .357 | .363 | 9.07 | 9.22 |
| B | .225 | .235 | 5.72 | 5.97 | Q | .125 | .135 | 3.18 | 3.43 |
| C | .125 | .175 | 3.18 | 4.45 | R | .227 | .233 | 5.77 | 5.92 |
| D | .210 | .220 | 5.33 | 5.59 | S | .225 | .235 | 5.72 | 5.97 |
| E | .055 | .065 | 1.40 | 1.65 | | | | | |
| F | .004 | .006 | 0.10 | 0.15 | aaa | | .005 | | 0.13 |
| G | .562 BSC | | 14.28 BSC | | bbb | | .010 | | 0.25 |
| H | .077 | .087 | 1.96 | 2.21 | ccc | | .015 | | 0.38 |
| K | .085 | .115 | 2.16 | 2.92 | | | | | |
| M | .355 | .365 | 9.02 | 9.27 | | | | | |
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PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date | Description |
|----------|-----------|--|
| 0 | Jan. 2008 | <ul style="list-style-type: none">• Initial Release of Data Sheet |
| 1 | Dec. 2008 | <ul style="list-style-type: none">• Changed Storage Temperature Range in Max Ratings table from -65 to +175 to -65 to +150 for standardization across products, p. 1• Removed "Operating Case Temperature Range" from Maximum Ratings table so that the maximum channel temperature rating is the limiting thermal design criteria and not the case temperature range, p. 1 |

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