

# RF Power LDMOS Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for Class A or Class AB power amplifier applications with frequencies up to 2000 MHz. Suitable for analog and digital modulation and multicarrier amplifier applications.

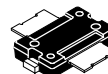
- Typical Two-Tone Performance at 960 MHz:  $V_{DD} = 28$  Vdc,  $I_{DQ} = 125$  mA,  $P_{out} = 10$  W PEP  
Power Gain — 18 dB  
Drain Efficiency — 32%  
IMD — -37 dBc
- Capable of Handling 10:1 VSWR @ 28 Vdc, 960 MHz, 10 W CW Output Power

### Features

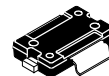
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- On-Chip RF Feedback for Broadband Stability
- Qualified Up to a Maximum of 32  $V_{DD}$  Operation
- Integrated ESD Protection
- 225°C Capable Plastic Package
- In Tape and Reel. R1 Suffix = 500 Units, 24 mm Tape Width, 13-inch Reel.

**MMRF1015NR1**  
**MMRF1015GNR1**

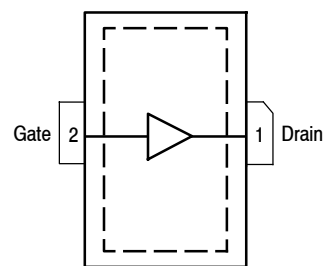
**1-2000 MHz, 10 W, 28 V**  
**CLASS A/AB**  
**RF POWER MOSFETs**



**TO-270-2**  
**PLASTIC**  
**MMRF1015NR1**



**TO-270G-2**  
**PLASTIC**  
**MMRF1015GNR1**



(Top View)

Note: Exposed backside of the package is the source terminal for the transistor.

**Figure 1. Pin Connections**

**Table 1. Maximum Ratings**

| Rating                               | Symbol    | Value       | Unit |
|--------------------------------------|-----------|-------------|------|
| Drain-Source Voltage                 | $V_{DSS}$ | -0.5, +68   | Vdc  |
| Gate-Source Voltage                  | $V_{GS}$  | -0.5, +12   | Vdc  |
| Storage Temperature Range            | $T_{stg}$ | -65 to +150 | °C   |
| Case Operating Temperature           | $T_C$     | 150         | °C   |
| Operating Junction Temperature (1,2) | $T_J$     | 225         | °C   |

**Table 2. Thermal Characteristics**

| Characteristic                                                          | Symbol          | Value (2,3) | Unit |
|-------------------------------------------------------------------------|-----------------|-------------|------|
| Thermal Resistance, Junction to Case<br>Case Temperature 80°C, 10 W PEP | $R_{\theta JC}$ | 2.85        | °C/W |

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at <http://www.freescale.com/rf>. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.
3. 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)    | 1A    |
| Machine Model (per EIA/JESD22-A115)   | A     |
| Charge Device Model (per JESD22-C101) | III   |

**Table 4. Moisture Sensitivity Level**

| Test Methodology                     | Rating | Package Peak Temperature | Unit |
|--------------------------------------|--------|--------------------------|------|
| Per JESD22-A113, IPC/JEDEC J-STD-020 | 3      | 260                      | °C   |

**Table 5. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

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

**Off Characteristics**

|                                                                                                   |           |   |   |    |                 |
|---------------------------------------------------------------------------------------------------|-----------|---|---|----|-----------------|
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS} = 68\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ ) | $I_{DSS}$ | — | — | 10 | $\mu\text{Adc}$ |
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ ) | $I_{DSS}$ | — | — | 1  | $\mu\text{Adc}$ |
| Gate-Source Leakage Current<br>( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )              | $I_{GSS}$ | — | — | 1  | $\mu\text{Adc}$ |

**On Characteristics**

|                                                                                                               |              |      |      |      |     |
|---------------------------------------------------------------------------------------------------------------|--------------|------|------|------|-----|
| Gate Threshold Voltage<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 100\text{ }\mu\text{Adc}$ )                     | $V_{GS(th)}$ | 1.5  | 2.3  | 3    | Vdc |
| Gate Quiescent Voltage<br>( $V_{DD} = 28\text{ Vdc}$ , $I_D = 125\text{ mAdc}$ , Measured in Functional Test) | $V_{GS(Q)}$  | 2    | 3.1  | 4    | Vdc |
| Drain-Source On-Voltage<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 0.3\text{ Adc}$ )                              | $V_{DS(on)}$ | 0.15 | 0.27 | 0.35 | Vdc |

**Dynamic Characteristics**

|                                                                                                                       |           |   |      |   |    |
|-----------------------------------------------------------------------------------------------------------------------|-----------|---|------|---|----|
| Reverse Transfer Capacitance<br>( $V_{DS} = 28\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ ) | $C_{rss}$ | — | 0.32 | — | pF |
| Output Capacitance<br>( $V_{DS} = 28\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )           | $C_{oss}$ | — | 10   | — | pF |
| Input Capacitance<br>( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz)            | $C_{iss}$ | — | 23   | — | pF |

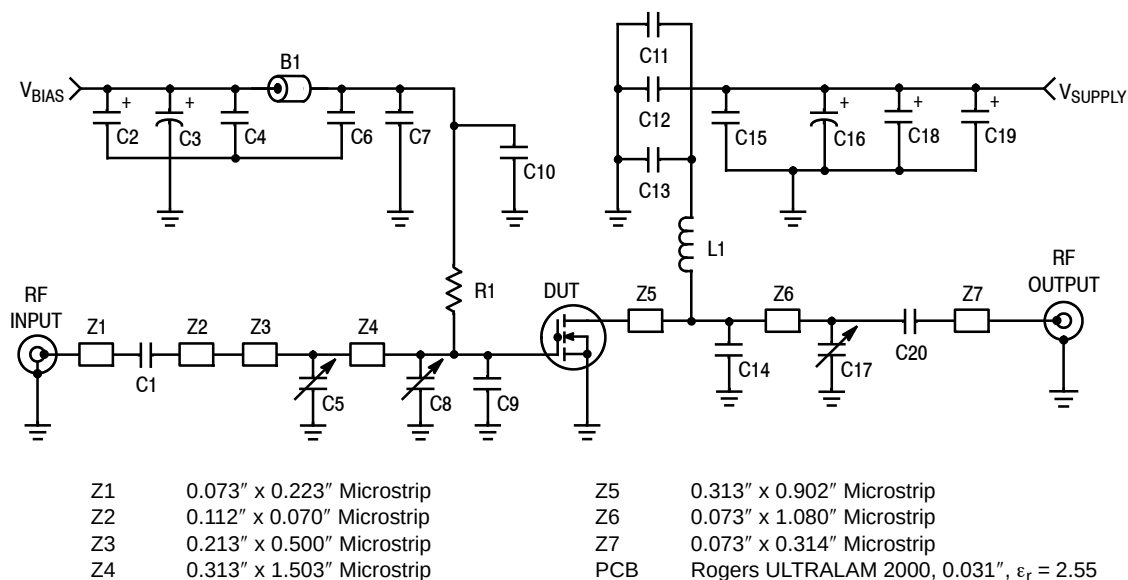
**Functional Tests** <sup>(1)</sup> (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ} = 125\text{ mA}$ ,  $P_{out} = 10\text{ W PEP}$ ,  $f = 960\text{ MHz}$ , Two-Tone Test, 100 kHz Tone Spacing

|                            |          |      |     |      |     |
|----------------------------|----------|------|-----|------|-----|
| Power Gain                 | $G_{ps}$ | 17.5 | 18  | 20.5 | dB  |
| Drain Efficiency           | $\eta_D$ | 31   | 32  | —    | %   |
| Intermodulation Distortion | IMD      | —    | -37 | -33  | dBc |
| Input Return Loss          | IRL      | —    | -18 | -10  | dB  |

**Typical Performance** (In Freescale 450 MHz Demo Board, 50 ohm system)  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ} = 150\text{ mA}$ ,  $P_{out} = 10\text{ W PEP}$ , 420-470 MHz, Two-Tone Test, 100 kHz Tone Spacing

|                            |          |   |     |   |     |
|----------------------------|----------|---|-----|---|-----|
| Power Gain                 | $G_{ps}$ | — | 20  | — | dB  |
| Drain Efficiency           | $\eta_D$ | — | 33  | — | %   |
| Intermodulation Distortion | IMD      | — | -40 | — | dBc |
| Input Return Loss          | IRL      | — | -10 | — | dB  |

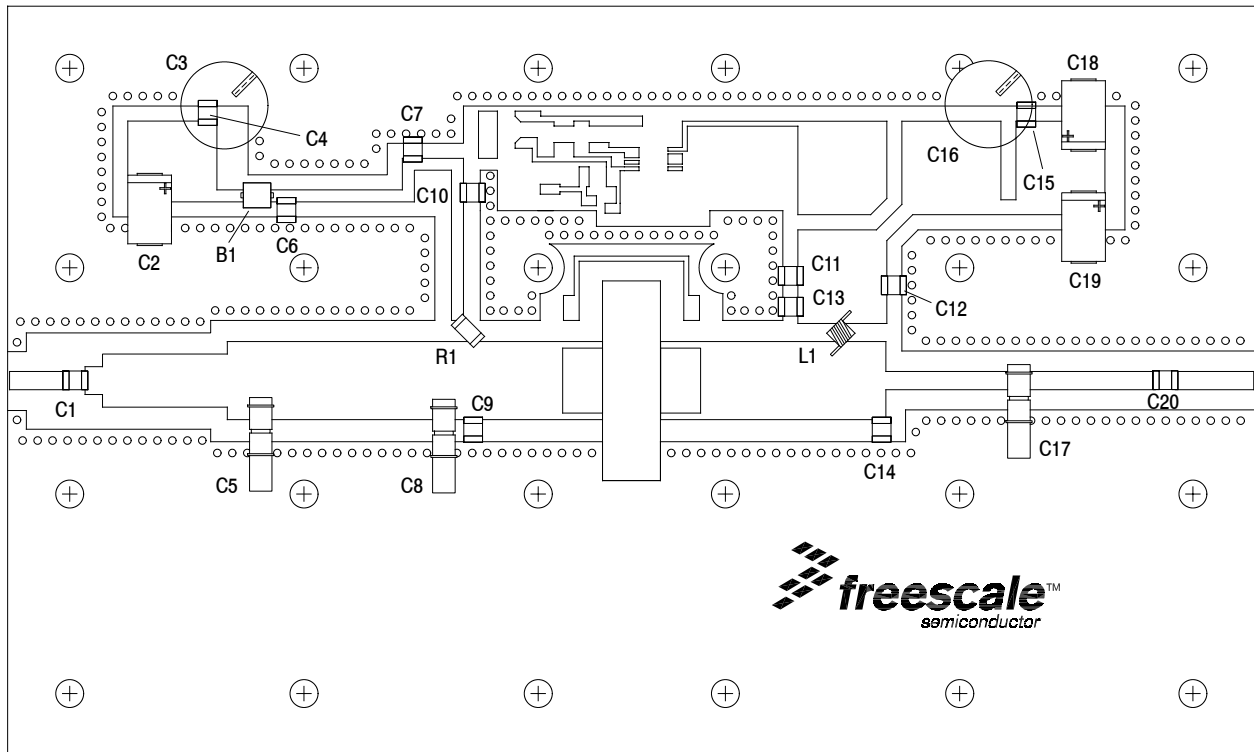
- Measurements made with device in straight lead configuration before any lead forming operation is applied. Lead forming is used for gull wing (GN) parts.



**Figure 2. MMRF1015NR1 Test Circuit Schematic — 900 MHz**

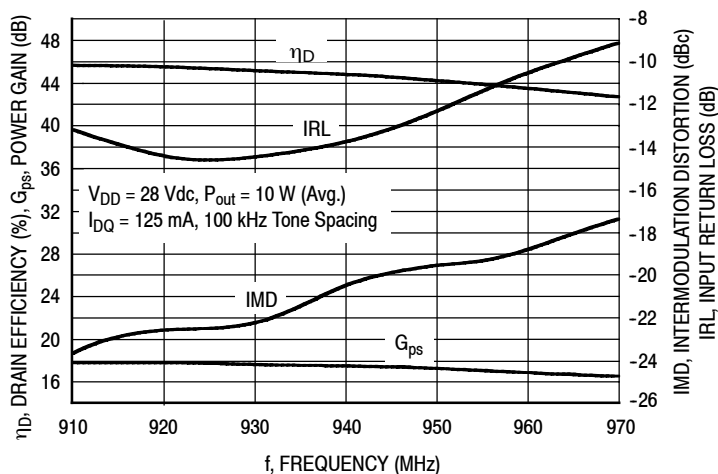
**Table 6. MMRF1015NR1 Test Circuit Component Designations and Values — 900 MHz**

| Part             | Description                                       | Part Number       | Manufacturer |
|------------------|---------------------------------------------------|-------------------|--------------|
| B1               | Ferrite Bead                                      | 2743019447        | Fair-Rite    |
| C1, C6, C11, C20 | 47 pF Chip Capacitors                             | ATC100B470JT500XT | ATC          |
| C2, C18, C19     | 22 $\mu$ F, 35 V Tantalum Capacitors              | T491D226K035AT    | Kemet        |
| C3, C16          | 220 $\mu$ F, 63 V Electrolytic Capacitors, Radial | 2222-136-68221    | Vishay       |
| C4, C15          | 0.1 $\mu$ F Chip Capacitors                       | CDR33BX104AKWS    | Kemet        |
| C5, C8, C17      | 0.8-8.0 pF Variable Capacitors, Gigatrim          | 272915L           | Johanson     |
| C7, C12          | 24 pF Chip Capacitors                             | ATC100B240JT500XT | ATC          |
| C9, C10, C13     | 6.8 pF Chip Capacitors                            | ATC100B6R8JT500XT | ATC          |
| C14              | 7.5 pF Chip Capacitor                             | ATC100B7R5JT500XT | ATC          |
| L1               | 12.5 nH Inductor                                  | A04T-5            | Coilcraft    |
| R1               | 1 k $\Omega$ , 1/4 W Chip Resistor                | CRCW12061001FKEA  | Vishay       |

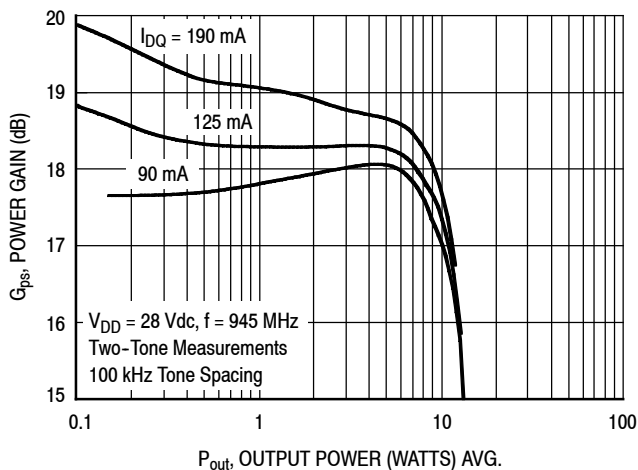


**Figure 3. MMRF1015NR1 Test Circuit Component Layout — 900 MHz**

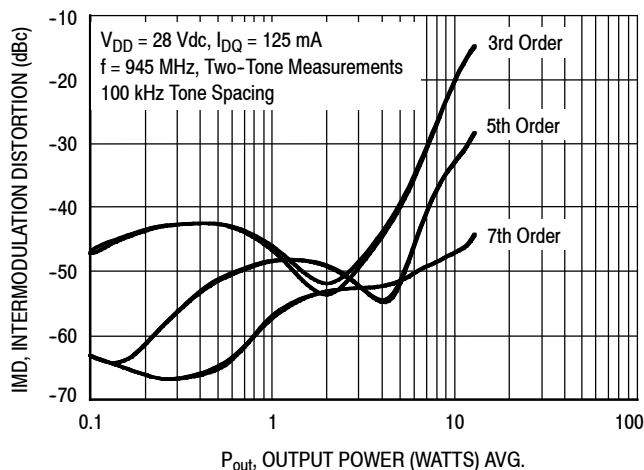
# TYPICAL CHARACTERISTICS — 900 MHz



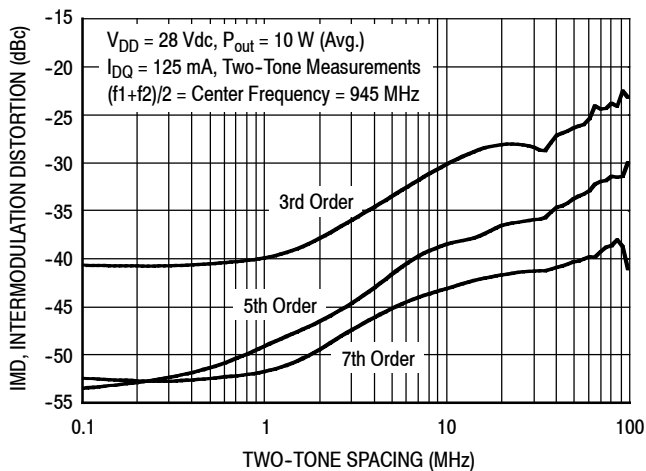
**Figure 4. Two-Tone Wideband Performance  
@  $P_{out} = 10$  Watts**



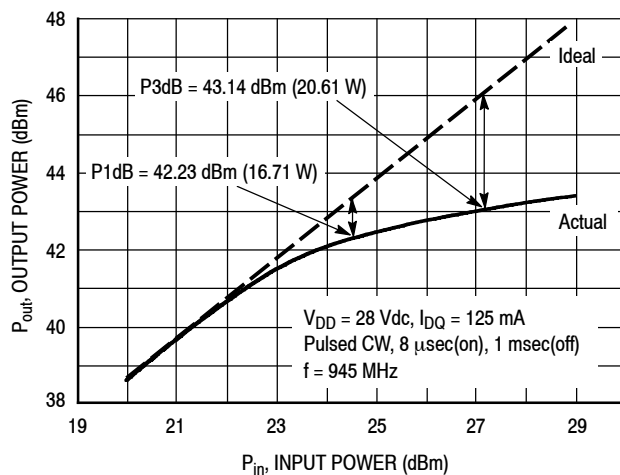
**Figure 5. Two-Tone Power Gain versus  
Output Power**



**Figure 6. Intermodulation Distortion Products  
versus Output Power**

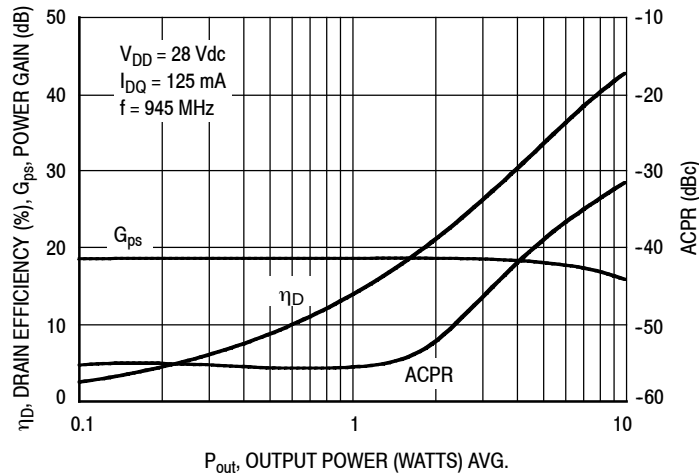


**Figure 7. Intermodulation Distortion Products  
versus Tone Spacing**

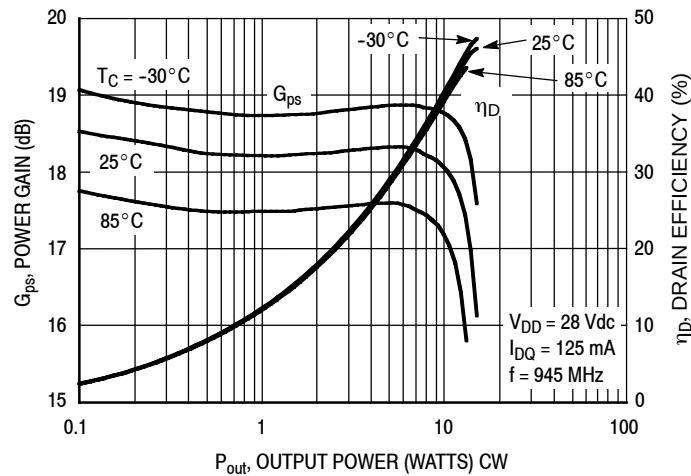


**Figure 8. Pulse CW Output Power versus  
Input Power**

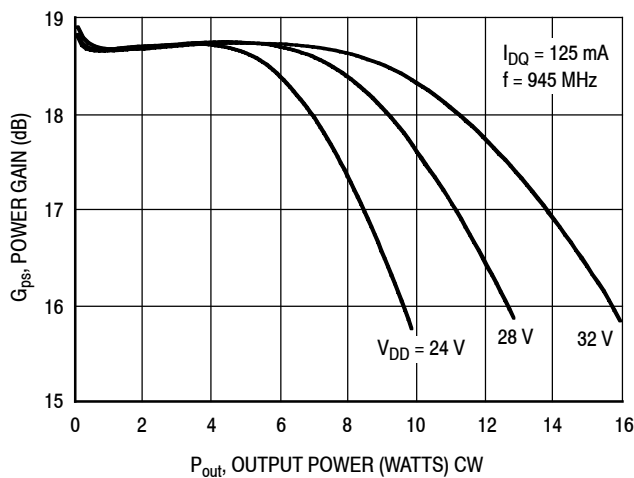
# TYPICAL CHARACTERISTICS — 900 MHz



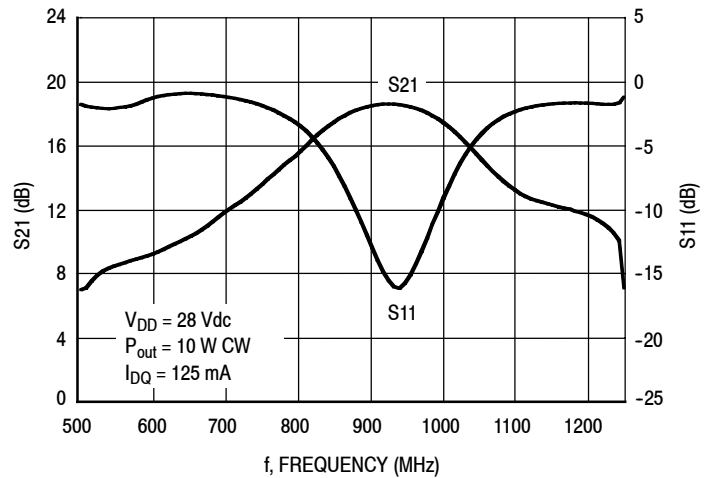
**Figure 9. Single-Carrier CDMA ACPR, Power Gain and Power Added Efficiency versus Output Power**



**Figure 10. Power Gain and Power Added Efficiency versus Output Power**

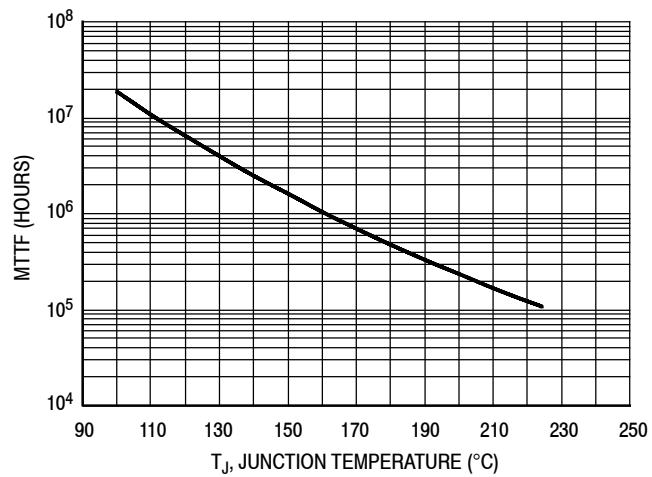


**Figure 11. Power Gain versus Output Power**



**Figure 12. Broadband Frequency Response**

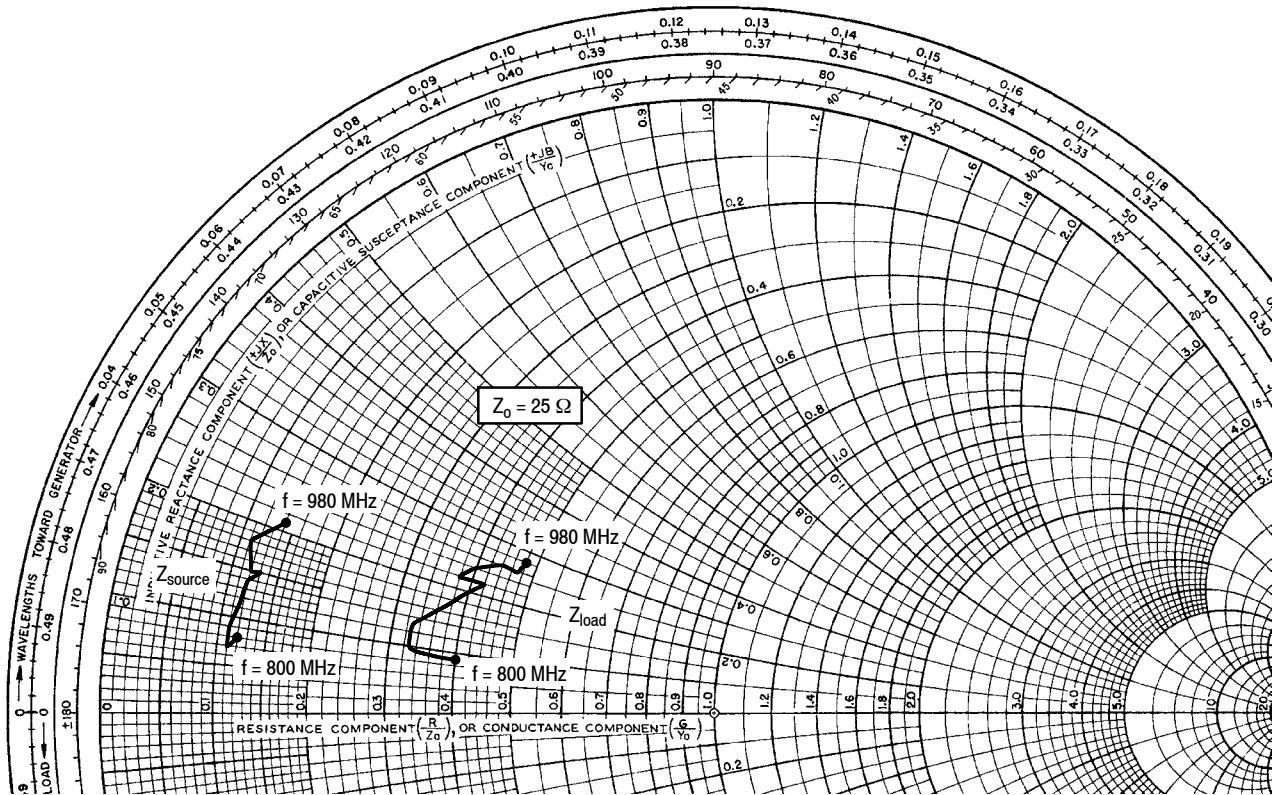
## TYPICAL CHARACTERISTICS



This above graph displays calculated MTTF in hours when the device is operated at  $V_{DD} = 28$  Vdc,  $P_{out} = 10$  W PEP, and  $\eta_D = 32\%$ .

MTTF calculator available at <http://www.freescale.com/rf>. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.

**Figure 13. MTTF Factor versus Junction Temperature**



$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ} = 125 \text{ mA}$ ,  $P_{out} = 10 \text{ W PEP}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 800      | $3.1 + j1.9$             | $10.1 + j2.3$          |
| 820      | $2.8 + j1.7$             | $8.3 + j2.5$           |
| 840      | $2.7 + j2.2$             | $8.2 + j3.3$           |
| 860      | $3.1 + j3.4$             | $9.8 + j4.8$           |
| 880      | $3.3 + j3.8$             | $10.6 + j5.6$          |
| 900      | $2.9 + j3.7$             | $9.5 + j5.5$           |
| 920      | $2.8 + j4.4$             | $10.1 + j5.9$          |
| 940      | $3.0 + j4.7$             | $11.0 + j6.4$          |
| 960      | $3.2 + j4.9$             | $11.8 + j6.6$          |
| 980      | $3.6 + j5.2$             | $12.1 + j7.1$          |

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

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

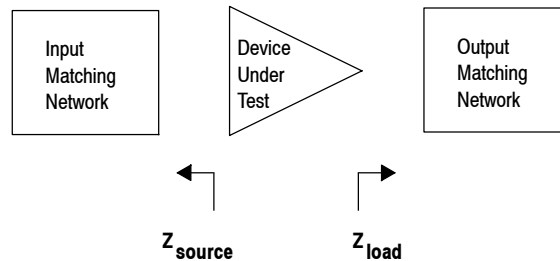
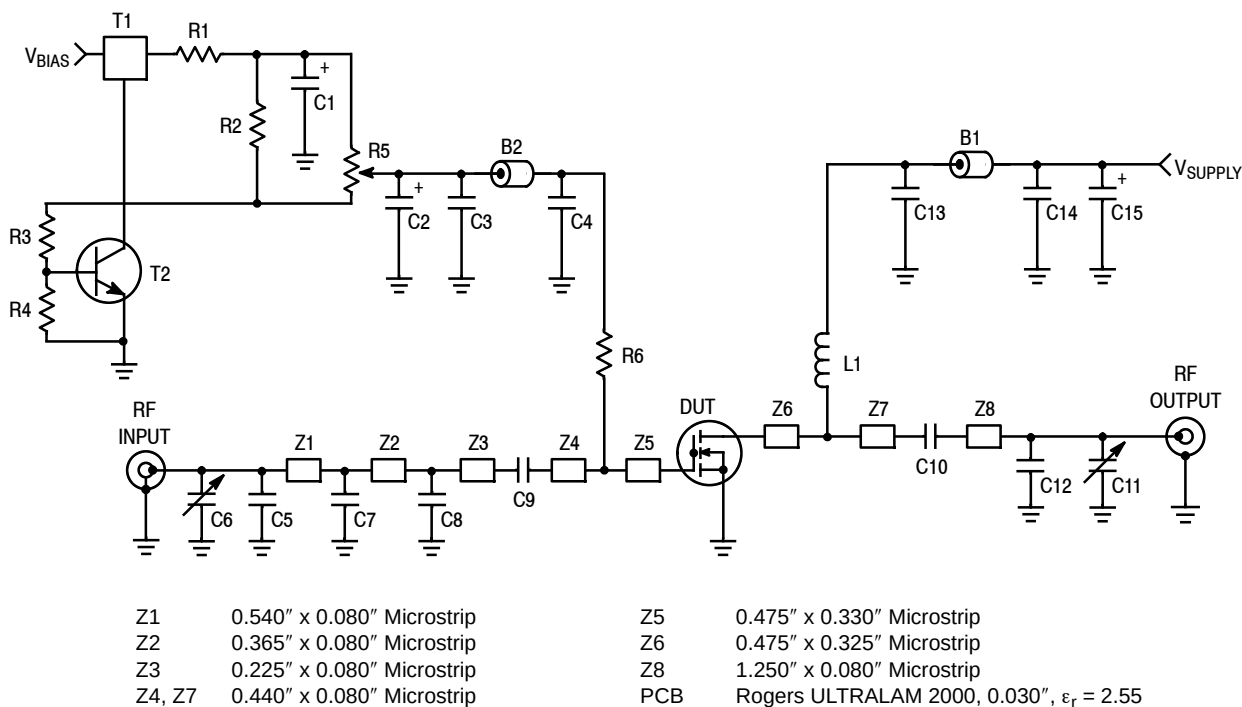


Figure 14. Series Equivalent Source and Load Impedance — 900 MHz





**Figure 15. MMRF1015NR1 Test Circuit Schematic — 450 MHz**

**Table 7. MMRF1015NR1 Test Circuit Component Designations and Values — 450 MHz**

| Part             | Description                          | Part Number       | Manufacturer     |
|------------------|--------------------------------------|-------------------|------------------|
| B1, B2           | Ferrite Bead                         | 2743019447        | Fair-Rite        |
| C1               | 1 $\mu$ F, 35 V Tantalum Capacitor   | T491C105K050AT    | Kemet            |
| C2, C15          | 22 $\mu$ F, 35 V Tantalum Capacitors | T491X226K035AT    | Kemet            |
| C3, C14          | 0.1 $\mu$ F Chip Capacitors          | C1210C104K5RAC    | Kemet            |
| C4, C9, C10, C13 | 330 pF Chip Capacitors               | ATC700A331JT150XT | ATC              |
| C5               | 4.3 pF Chip Capacitor                | ATC100B4R3JT500XT | ATC              |
| C6, C11          | 0.6–8.0 pF Variable Capacitors       | 27291SL           | Johanson         |
| C7, C8, C12      | 4.7 pF Chip Capacitors               | ATC100B4R7JT500XT | ATC              |
| L1               | 39 $\mu$ H Chip Inductor             | ISC-1210          | Vishay           |
| R1               | 10 $\Omega$ Chip Resistor            | CRCW080510R0FKEA  | Vishay           |
| R2               | 1 k $\Omega$ Chip Resistor           | CRCW08051001FKEA  | Vishay           |
| R3               | 1.2 k $\Omega$ Chip Resistor         | CRCW08051201FKEA  | Vishay           |
| R4               | 2.2 k $\Omega$ Chip Resistor         | CRCW08052201FKEA  | Vishay           |
| R5               | 5 k $\Omega$ Potentiometer           | 1224W             | Bourns           |
| R6               | 1 k $\Omega$ Chip Resistor           | CRCW12061001FKEA  | Vishay           |
| T1               | 5 Volt Regulator, Micro 8            | LP2951CDMR2G      | On Semiconductor |
| T2               | NPN Transistor, SOT-23               | BC847ALT1G        | On Semiconductor |

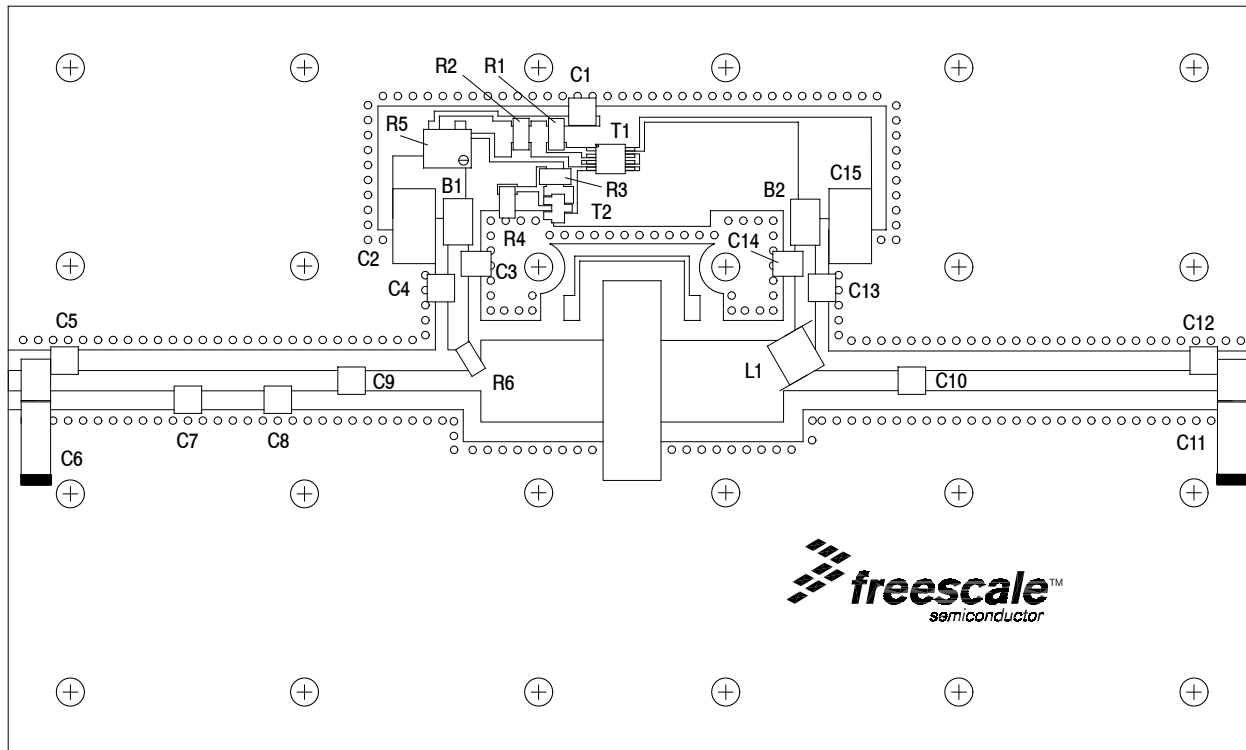


Figure 16. MMRF1015NR1 Test Circuit Component Layout — 450 MHz

## TYPICAL CHARACTERISTICS — 450 MHz

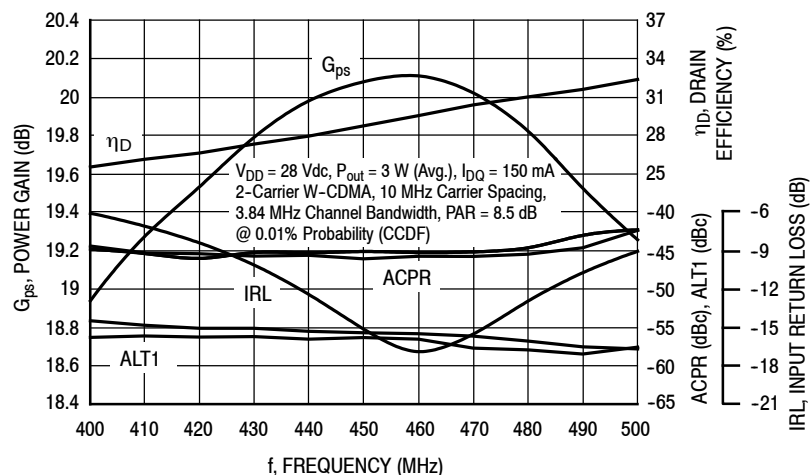


Figure 17. 2-Carrier W-CDMA Broadband Performance @  $P_{out} = 3$  Watts Avg.

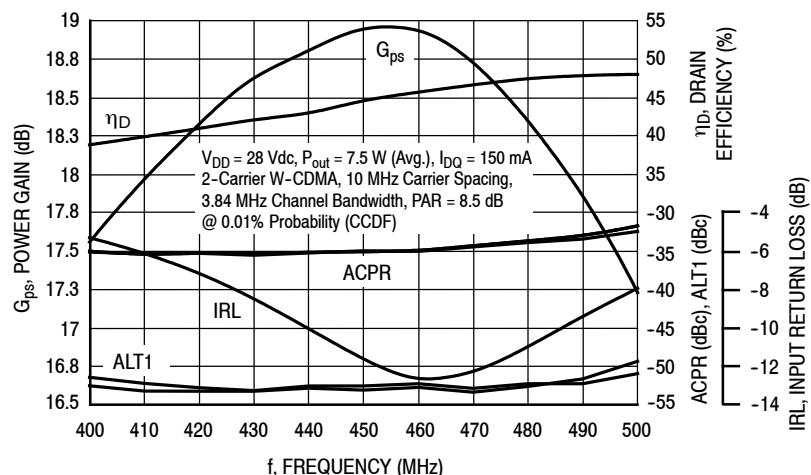


Figure 18. 2-Carrier W-CDMA Broadband Performance @  $P_{out} = 7.5$  Watts Avg.

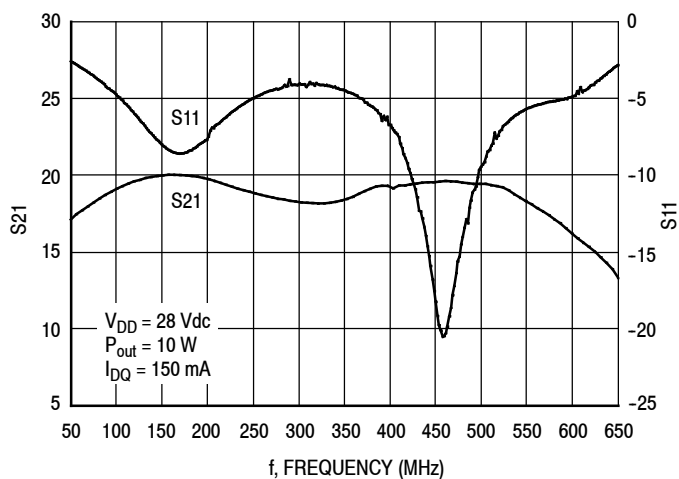


Figure 19. Broadband Frequency Response

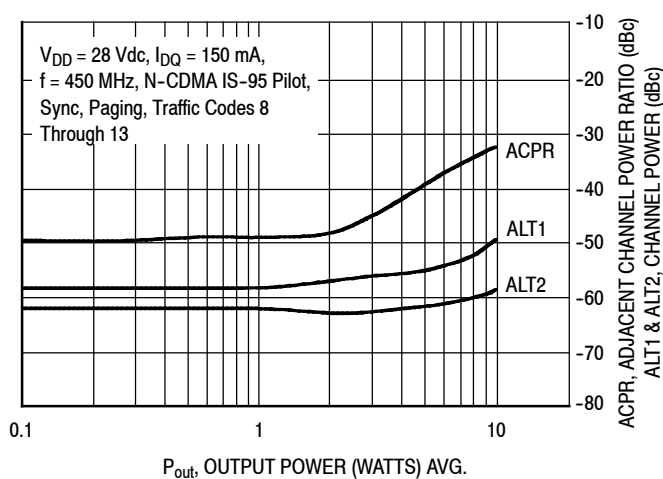
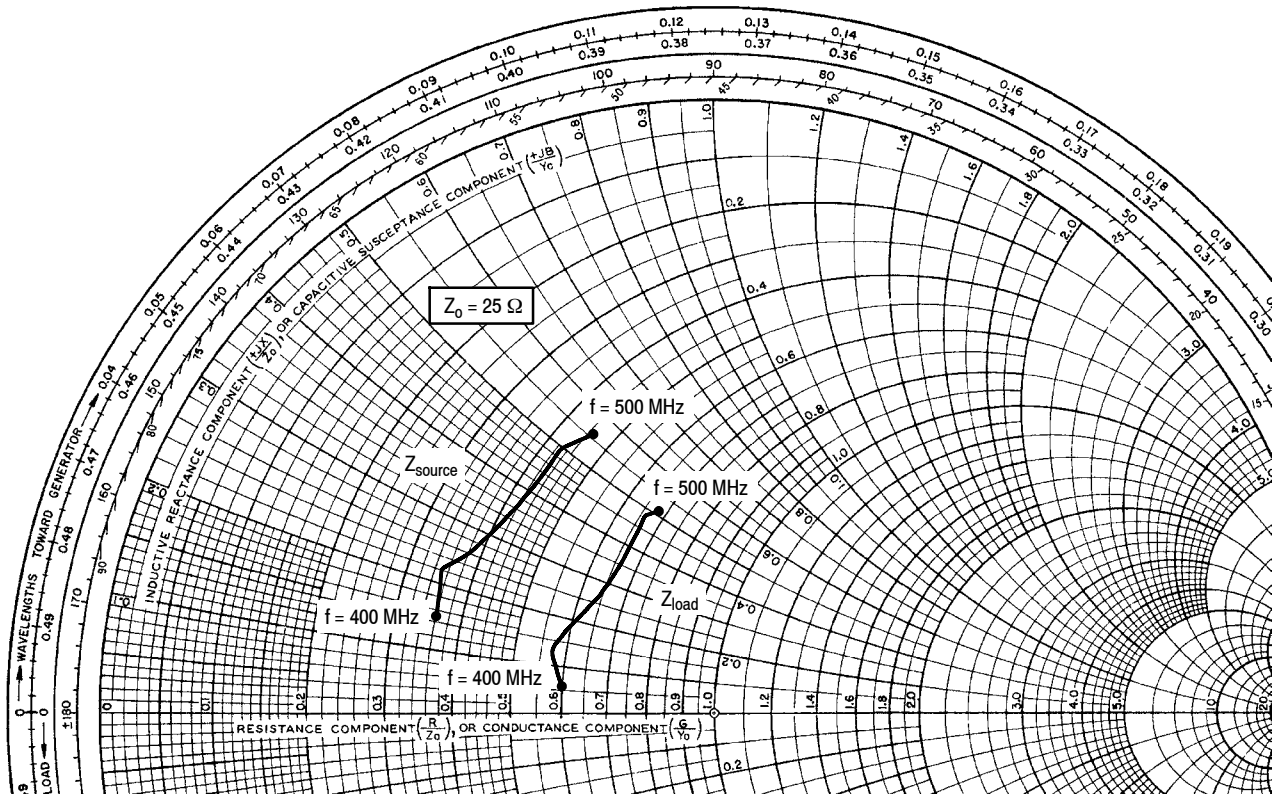


Figure 20. Single-Carrier N-CDMA ACPR, ALT1 and ALT2 versus Output Power



$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ} = 150 \text{ mA}$ ,  $P_{out} = 10 \text{ W PEP}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 400      | $9.0 + j3.8$             | $15.0 + j1.4$          |
| 420      | $8.8 + j5.4$             | $14.3 + j3.3$          |
| 440      | $9.6 + j6.6$             | $15.0 + j4.7$          |
| 460      | $10.6 + j9.5$            | $16.3 + j7.3$          |
| 480      | $10.7 + j12.6$           | $16.4 + j11.1$         |
| 500      | $11.5 + j13.9$           | $16.9 + j12.7$         |

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

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

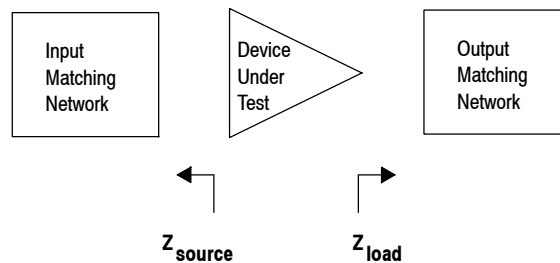
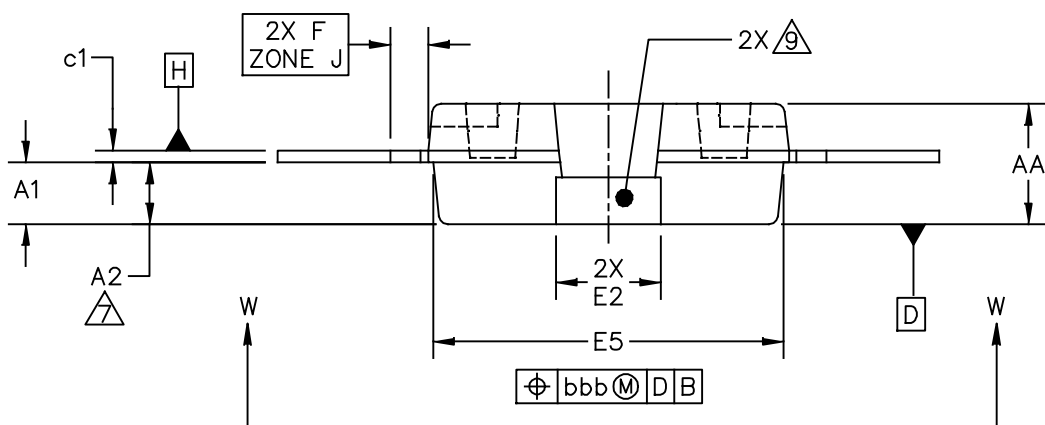
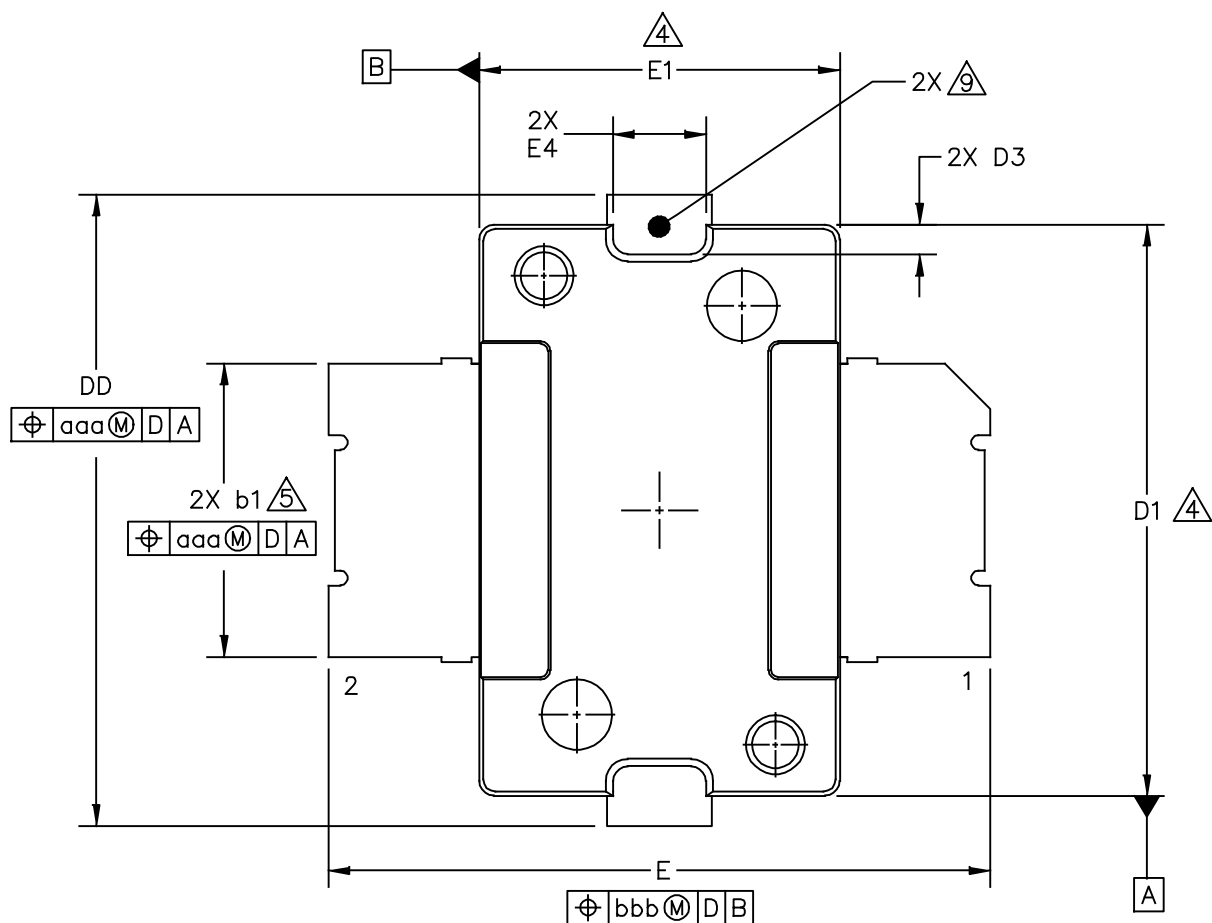
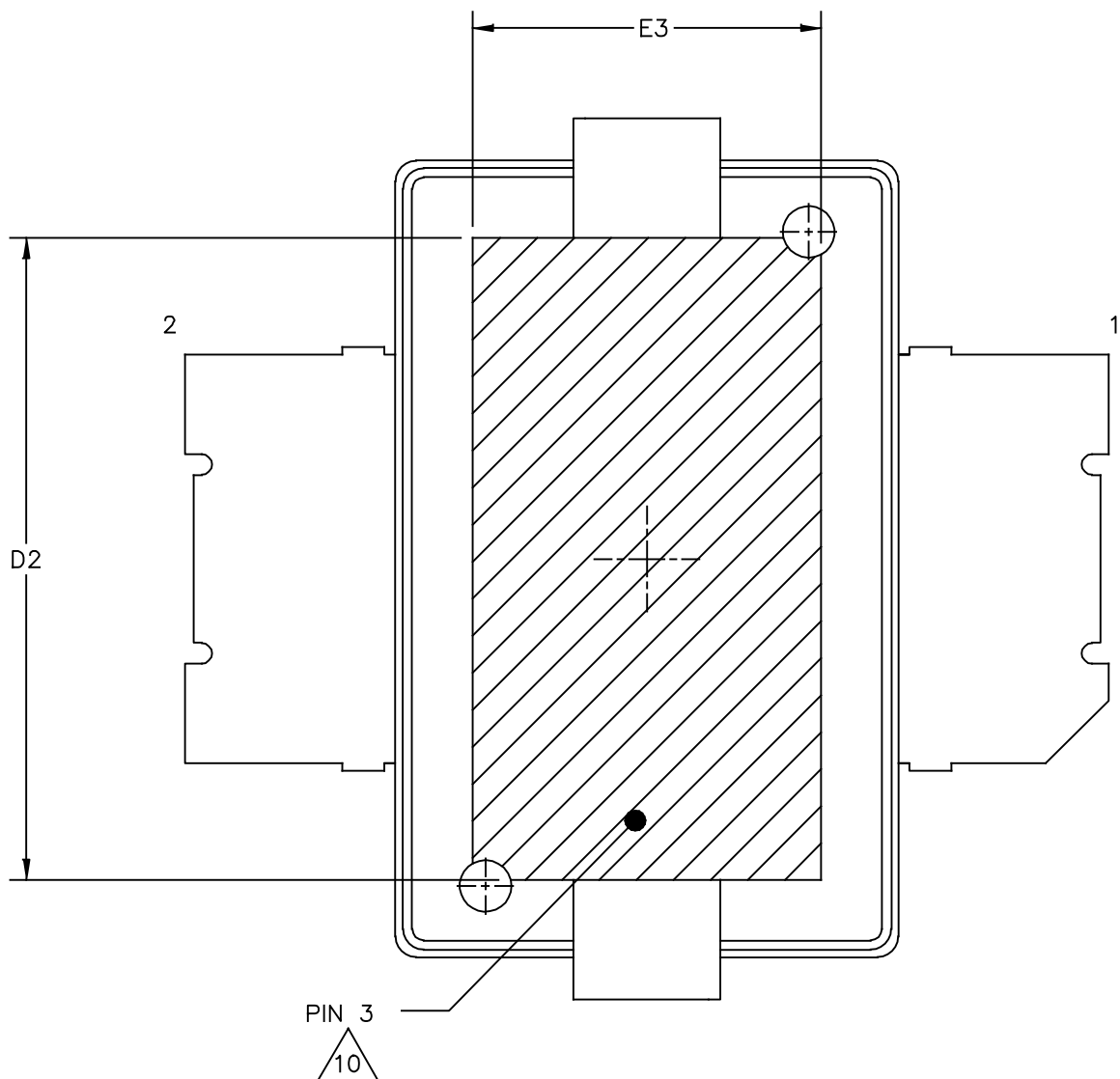


Figure 21. Series Equivalent Source and Load Impedance — 450 MHz

## PACKAGE DIMENSIONS



|                                                         |  |                    |                          |                            |        |
|---------------------------------------------------------|--|--------------------|--------------------------|----------------------------|--------|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. |  | MECHANICAL OUTLINE |                          | PRINT VERSION NOT TO SCALE |        |
| TITLE:<br><br>TO-270-2                                  |  |                    | DOCUMENT NO: 98ASH98117A |                            | REV: P |
|                                                         |  |                    | STANDARD: NON-JEDEC      |                            |        |
|                                                         |  |                    | 02 JUN 2014              |                            |        |



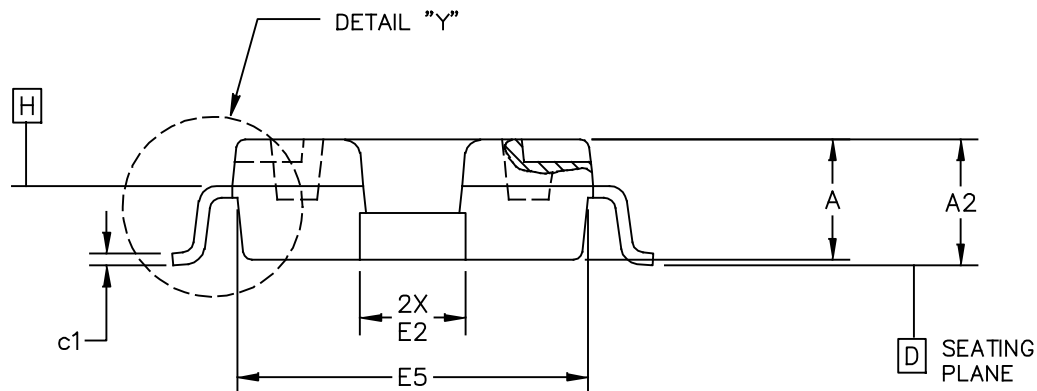
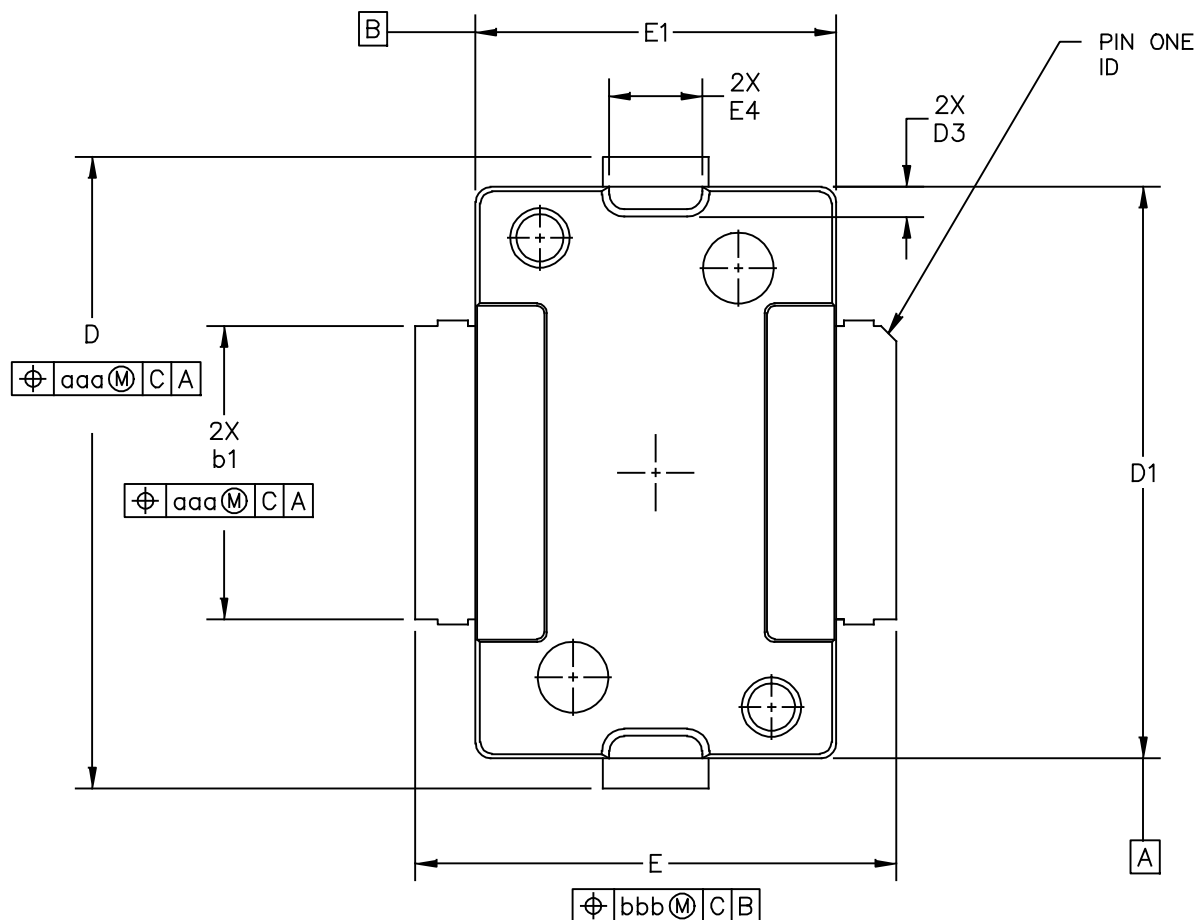
VIEW W-W  
BOTTOM VIEW

|                                                         |                                      |                            |
|---------------------------------------------------------|--------------------------------------|----------------------------|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. | MECHANICAL OUTLINE                   | PRINT VERSION NOT TO SCALE |
| TITLE:<br><br>TO-270-2                                  | DOCUMENT NO: 98ASH98117A      REV: P |                            |
|                                                         | STANDARD: NON-JEDEC                  |                            |
|                                                         | 02 JUN 2014                          |                            |

# NOTES:

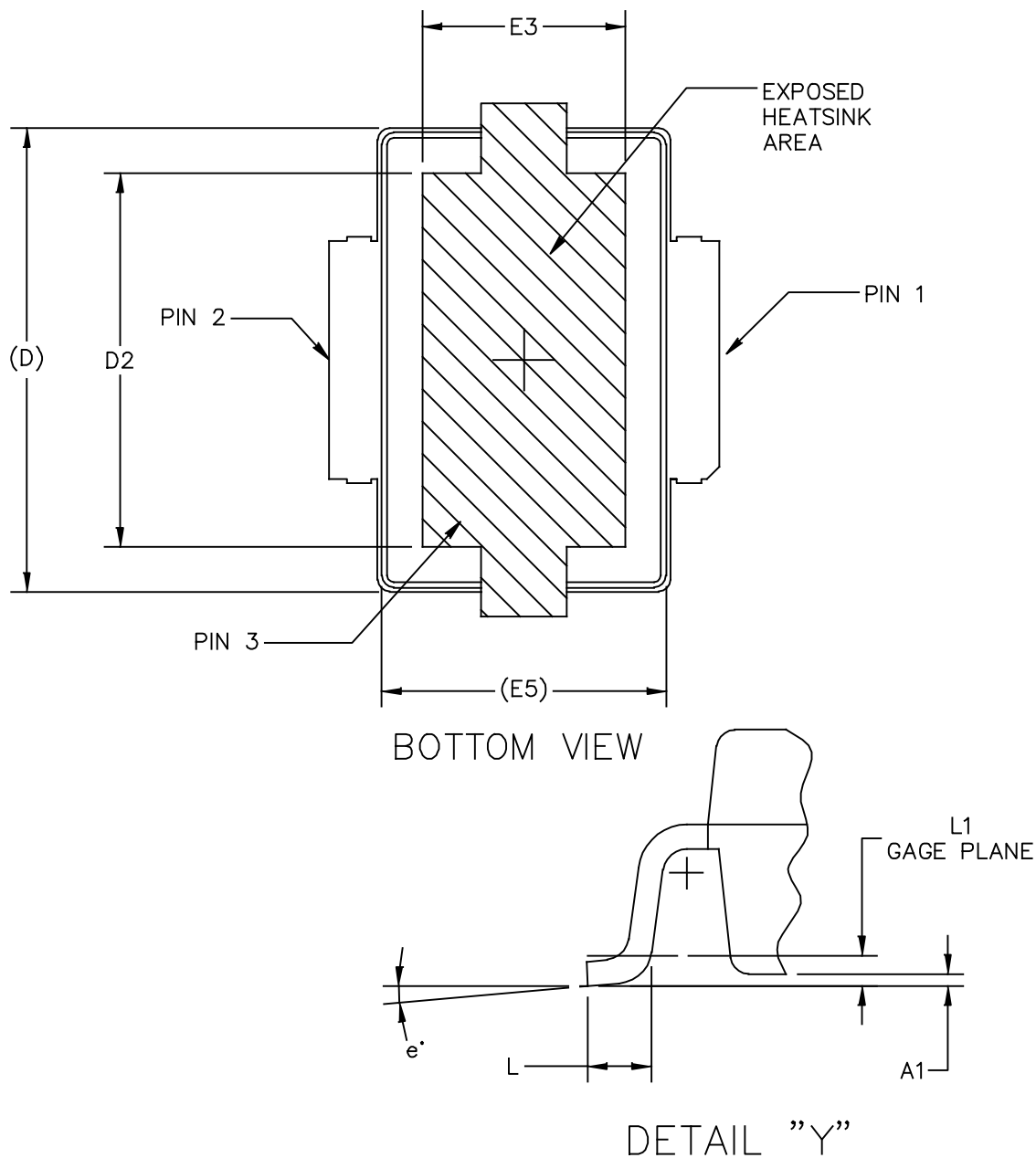
1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DATUM PLANE H IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS D1 AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 INCH (0.15 MM) PER SIDE. DIMENSIONS D1 AND E1 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
5. DIMENSION b1 DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 INCH (0.13 MM) TOTAL IN EXCESS OF THE b1 DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS A AND B TO BE DETERMINED AT DATUM PLANE H.
7. DIMENSION A2 APPLIES WITHIN ZONE J ONLY.
8. DIMENSIONS DD AND E2 DO NOT INCLUDE MOLD PROTRUSION. OVERALL LENGTH INCLUDING MOLD PROTRUSION SHOULD NOT EXCEED 0.430 INCH (10.92 MM) FOR DIMENSION DD AND 0.080 INCH (2.03 MM) FOR DIMENSION E2. DIMENSIONS DD AND E2 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE D.
9. THESE SURFACES OF THE HEAT SLUG ARE NOT PART OF THE SOLDERABLE SURFACES AND MAY REMAIN UNPLATED.
10. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG. DIMENSIONS D2 AND E3 REPRESENT THE VALUES BETWEEN THE TWO OPPOSITE POINTS ALONG THE EDGES OF EXPOSED AREA OF THE HEAT SLUG.

| INCH                                                    |      |       | MILLIMETER         |       | INCH                                                 |                            |      | MILLIMETER |      |
|---------------------------------------------------------|------|-------|--------------------|-------|------------------------------------------------------|----------------------------|------|------------|------|
| DIM                                                     | MIN  | MAX   | MIN                | MAX   | DIM                                                  | MIN                        | MAX  | MIN        | MAX  |
| AA                                                      | .078 | .082  | 1.98               | 2.08  | E4                                                   | .058                       | .066 | 1.47       | 1.68 |
| A1                                                      | .039 | .043  | 0.99               | 1.09  | E5                                                   | .231                       | .235 | 5.87       | 5.97 |
| A2                                                      | .040 | .042  | 1.02               | 1.07  | F                                                    | .025 BSC                   |      | 0.64 BSC   |      |
| DD                                                      | .416 | .424  | 10.57              | 10.77 | b1                                                   | .193                       | .199 | 4.90       | 5.06 |
| D1                                                      | .378 | .382  | 9.60               | 9.70  | c1                                                   | .007                       | .011 | 0.18       | 0.28 |
| D2                                                      | .290 | ----- | 7.37               | ----- | aaa                                                  | .004                       |      | 0.10       |      |
| D3                                                      | .016 | .024  | 0.41               | 0.61  | bbb                                                  | .008                       |      | 0.20       |      |
| E                                                       | .436 | .444  | 11.07              | 11.28 |                                                      |                            |      |            |      |
| E1                                                      | .238 | .242  | 6.04               | 6.15  |                                                      |                            |      |            |      |
| E2                                                      | .066 | .074  | 1.68               | 1.88  |                                                      |                            |      |            |      |
| E3                                                      | .150 | ----- | 3.81               | ----- |                                                      |                            |      |            |      |
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|                                                         |      |       |                    |       | STANDARD: NON-JEDEC                                  |                            |      |            |      |
|                                                         |      |       |                    |       | 02 JUN 2014                                          |                            |      |            |      |



|                                                         |  |                           |                            |
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|                                                         |  | CASE NUMBER: 1265A-03     | 02 JUL 2007                |
|                                                         |  | STANDARD: JEDEC TO-270 BA |                            |





|                                                         |                           |                    |                            |
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|                                                         | CASE NUMBER: 1265A-03     |                    | 02 JUL 2007                |
|                                                         | STANDARD: JEDEC TO-270 BA |                    |                            |

NOTES:

1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DATUM PLANE –H– IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS "D1" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D1 AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –H–.
5. DIMENSION b1 DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE b1 DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS –A– AND –B– TO BE DETERMINED AT DATUM PLANE –H–.
7. DIMENSIONS "D" AND "E2" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .003 PER SIDE. DIMENSIONS "D AND "E2" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE –D–.

STYLE 1:

PIN 1 – DRAIN  
PIN 2 – GATE  
PIN 3 – SOURCE

| INCH                                                    |      |      | MILLIMETER         |       | INCH                      |                            |      | MILLIMETER  |      |
|---------------------------------------------------------|------|------|--------------------|-------|---------------------------|----------------------------|------|-------------|------|
| DIM                                                     | MIN  | MAX  | MIN                | MAX   | DIM                       | MIN                        | MAX  | MIN         | MAX  |
| A                                                       | .078 | .082 | 1.98               | 2.08  | L                         | .018                       | .024 | 0.46        | 0.61 |
| A1                                                      | .001 | .004 | 0.02               | 0.10  | L1                        | .01 BSC                    |      | 0.25 BSC    |      |
| A2                                                      | .077 | .088 | 1.96               | 2.24  | b1                        | .193                       | .199 | 4.90        | 5.06 |
| D                                                       | .416 | .424 | 10.57              | 10.77 | c1                        | .007                       | .011 | 0.18        | 0.28 |
| D1                                                      | .378 | .382 | 9.60               | 9.70  | e                         | 2°                         | 8°   | 2°          | 8°   |
| D2                                                      | .290 | —    | 7.37               | —     | aaa                       | .004                       |      | 0.10        |      |
| D3                                                      | .016 | .024 | 0.41               | 0.61  |                           |                            |      |             |      |
| E                                                       | .316 | .324 | 8.03               | 8.23  |                           |                            |      |             |      |
| E1                                                      | .238 | .242 | 6.04               | 6.15  |                           |                            |      |             |      |
| E2                                                      | .066 | .074 | 1.68               | 1.88  |                           |                            |      |             |      |
| E3                                                      | .150 | —    | 3.81               | —     |                           |                            |      |             |      |
| E4                                                      | .058 | .066 | 1.47               | 1.68  |                           |                            |      |             |      |
| E5                                                      | .231 | .235 | 5.87               | 5.97  |                           |                            |      |             |      |
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| TITLE:<br><br>TO—270<br>GULL WING                       |      |      |                    |       | DOCUMENT NO: 98ASA99301D  |                            |      | REV: C      |      |
|                                                         |      |      |                    |       | CASE NUMBER: 1265A—03     |                            |      | 02 JUL 2007 |      |
|                                                         |      |      |                    |       | STANDARD: JEDEC TO—270 BA |                            |      |             |      |

## PRODUCT DOCUMENTATION AND SOFTWARE

Refer to the following resources to aid your design process.

### Application Notes

- AN1907: Solder Reflow Attach Method for High Power RF Devices in Plastic Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers
- AN3789: Clamping of High Power RF Transistors and RFICs in Over-Molded Plastic Packages

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

### Software

- Electromigration MTTF Calculator

For Software, do a Part Number search at <http://www.freescale.com>, and select the “Part Number” link. Go to the Software & Tools tab on the part’s Product Summary page to download the respective tool.

## REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date      | Description                                                                       |
|----------|-----------|-----------------------------------------------------------------------------------|
| 0        | July 2014 | <ul style="list-style-type: none"> <li>• Initial Release of Data Sheet</li> </ul> |

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