

# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for Class A or Class AB base station applications with frequencies up to 1500 MHz. Suitable for analog and digital modulation and multicarrier amplifier applications.

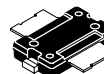
- Typical Two-Tone Performance at 960 MHz:  $V_{DD} = 28$  Volts,  $I_{DQ} = 125$  mA,  $P_{out} = 10$  Watts PEP  
Power Gain — 18 dB  
Drain Efficiency — 32%  
IMD — -37 dBc
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 960 MHz, 10 Watts CW Output Power

### Features

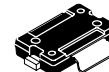
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- On-Chip RF Feedback for Broadband Stability
- Qualified Up to a Maximum of 32  $V_{DD}$  Operation
- Integrated ESD Protection
- 225°C Capable Plastic Package
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 24 mm,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

**MW6S010NR1**  
**MW6S010GNR1**

**450 - 1500 MHz, 10 W, 28 V**  
**LATERAL N-CHANNEL**  
**BROADBAND RF POWER MOSFETs**



**CASE 1265-09, STYLE 1**  
**TO-270-2**  
**PLASTIC**  
**MW6S010NR1**



**CASE 1265A-03, STYLE 1**  
**TO-270-2 GULL**  
**PLASTIC**  
**MW6S010GNR1**

**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>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 100\ \mu\text{Adc}$ )                           | $V_{GS(th)}$ | 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>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 0.3\text{ Adc}$ )                              | $V_{DS(on)}$ | —   | 0.27 | 0.35 | Vdc |

**Dynamic Characteristics**

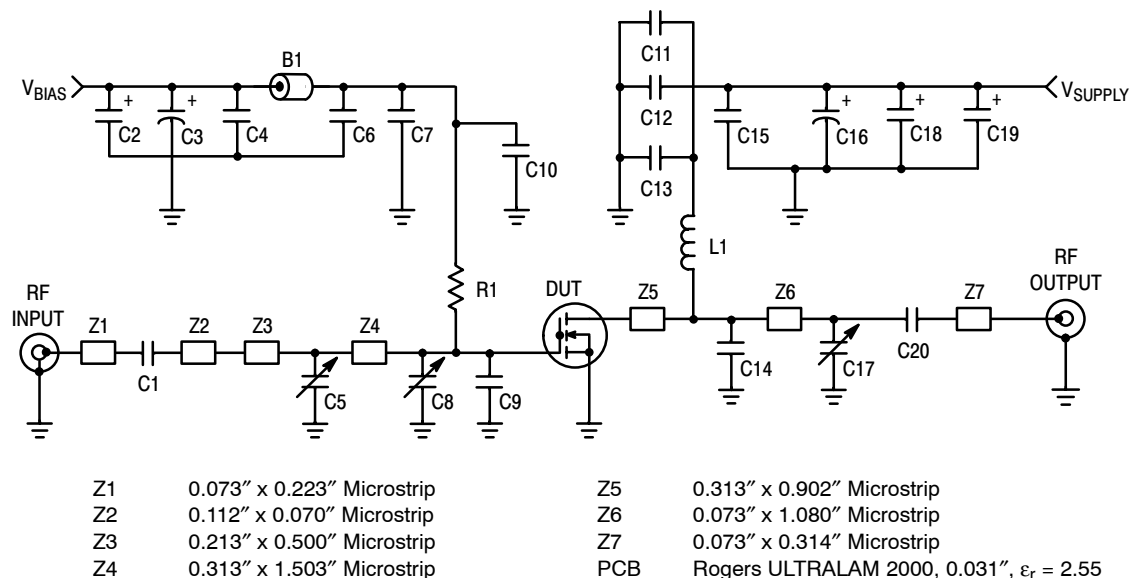
|   |           |   |      |   |    |
|---|-----------|---|------|---|----|
| Reverse Transfer Capacitance<br>( $V_{DS} = 28\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ ) | $C_{rss}$ | — | 0.32 | — | pF |
| Output Capacitance<br>( $V_{DS} = 28\text{ Vdc} \pm 30\text{ mV(rms)ac}$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



**Figure 1. MW6S010NR1(GNR1) Test Circuit Schematic — 900 MHz**

**Table 6. MW6S010NR1(GNR1) 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       |

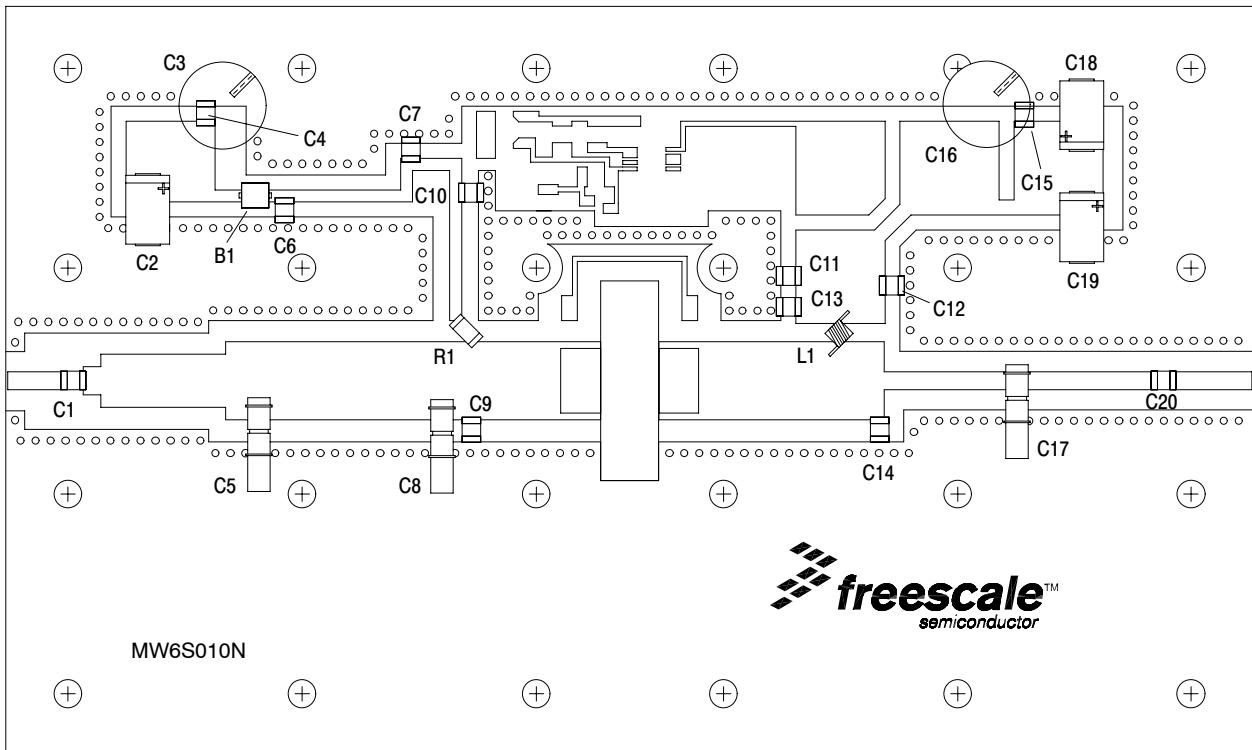
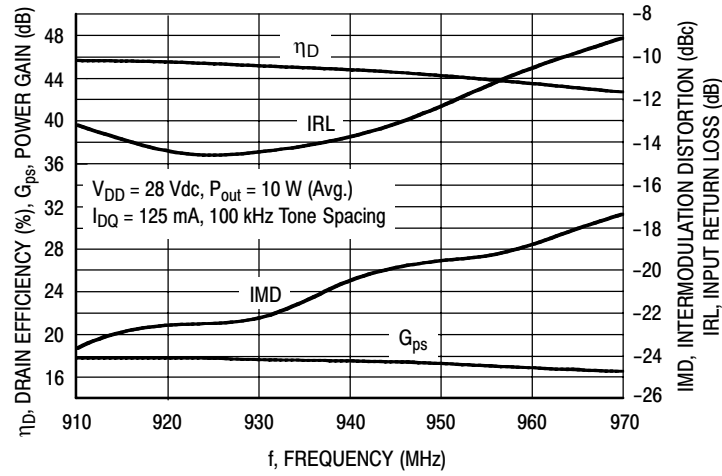
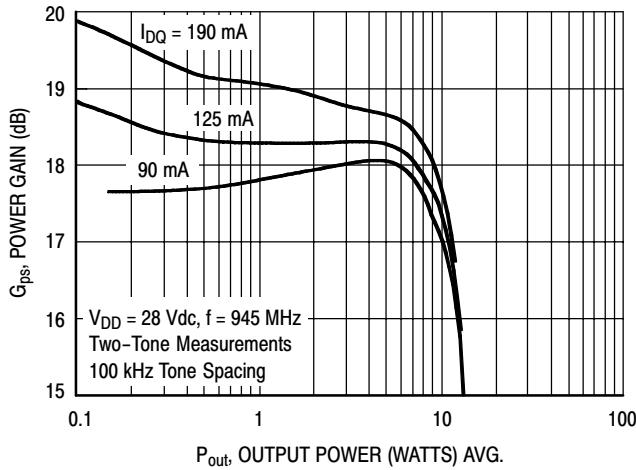


Figure 2. MW6S010NR1(GNR1) Test Circuit Component Layout — 900 MHz

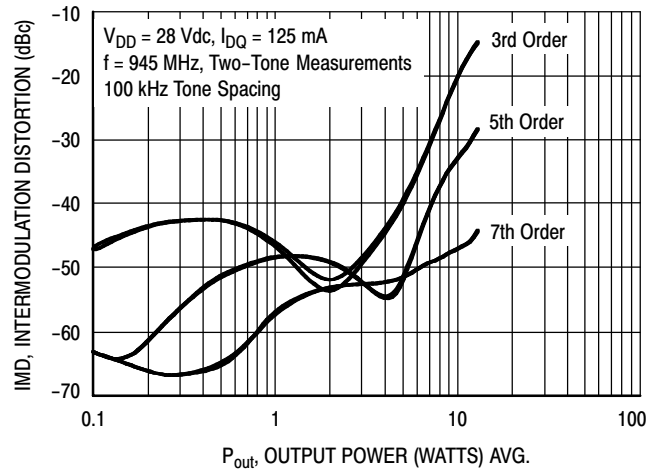
### TYPICAL CHARACTERISTICS — 900 MHz



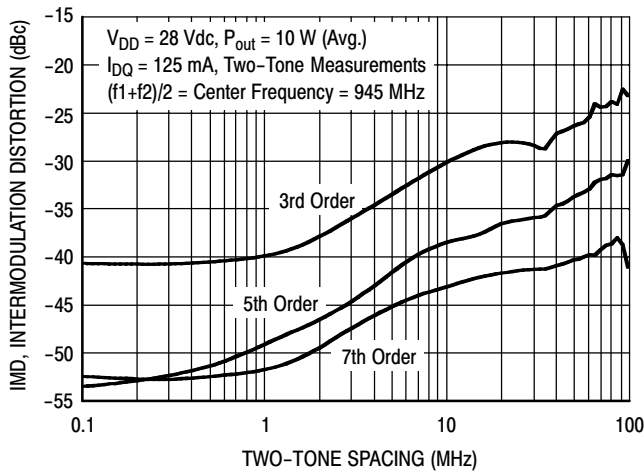
**Figure 3. Two-Tone Wideband Performance @  $P_{out} = 10$  Watts**



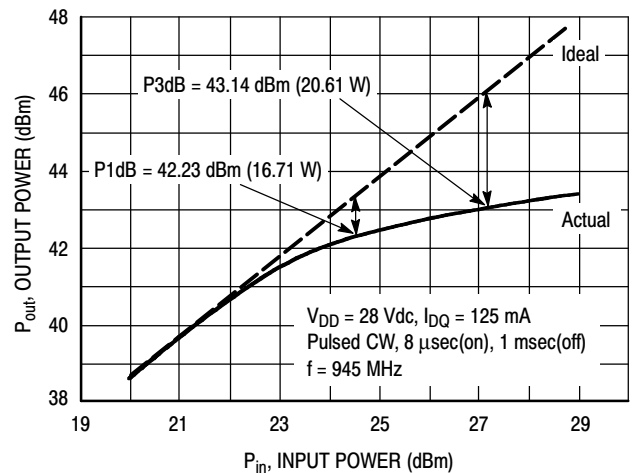
**Figure 4. Two-Tone Power Gain versus Output Power**



**Figure 5. Intermodulation Distortion Products versus Output Power**

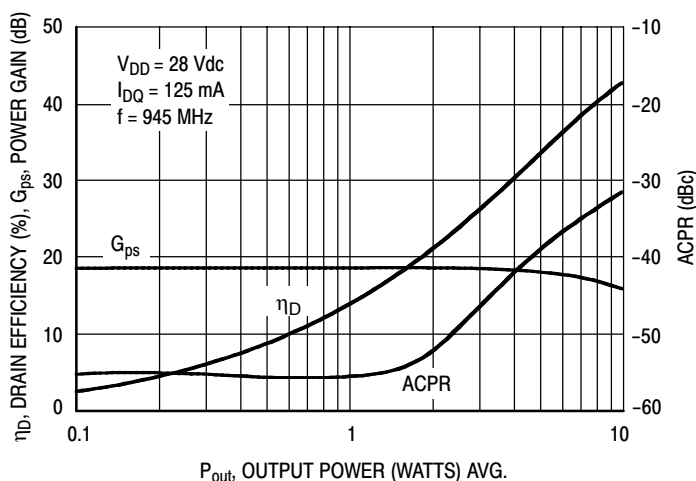


**Figure 6. Intermodulation Distortion Products versus Tone Spacing**

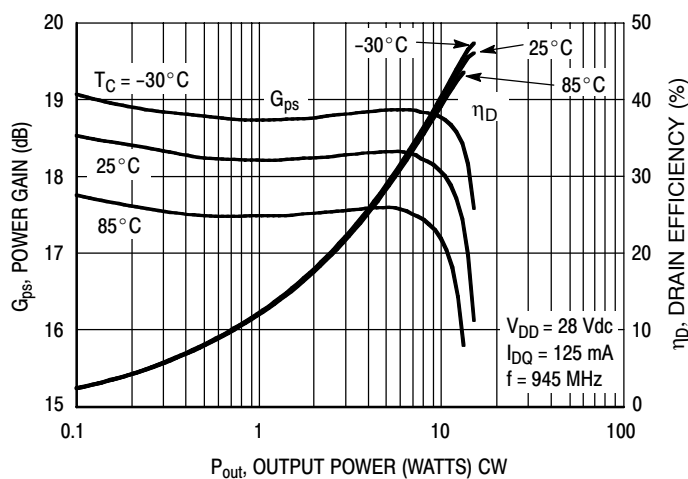


**Figure 7. Pulse CW Output Power versus Input Power**

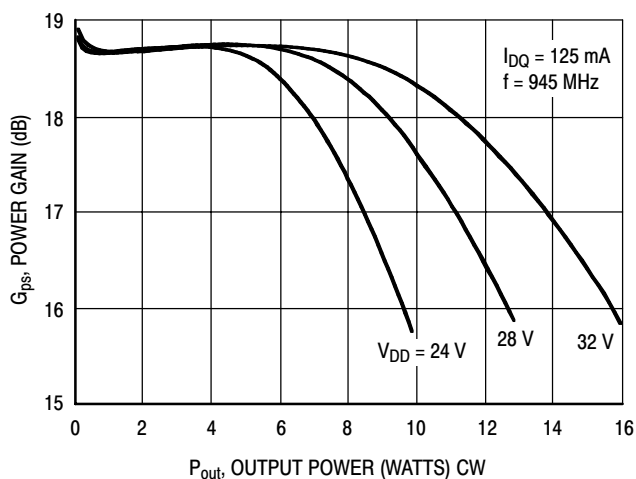
### TYPICAL CHARACTERISTICS — 900 MHz



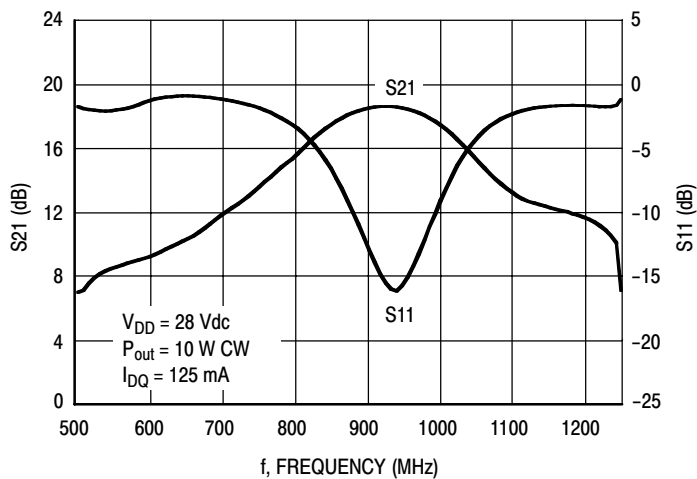
**Figure 8. Single-Carrier CDMA ACPR, Power Gain and Power Added Efficiency versus Output Power**



**Figure 9. Power Gain and Power Added Efficiency versus Output Power**

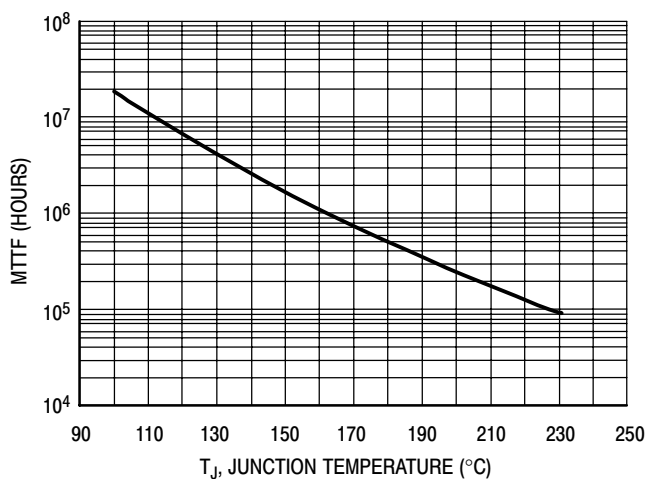


**Figure 10. Power Gain versus Output Power**



**Figure 11. Broadband Frequency Response**

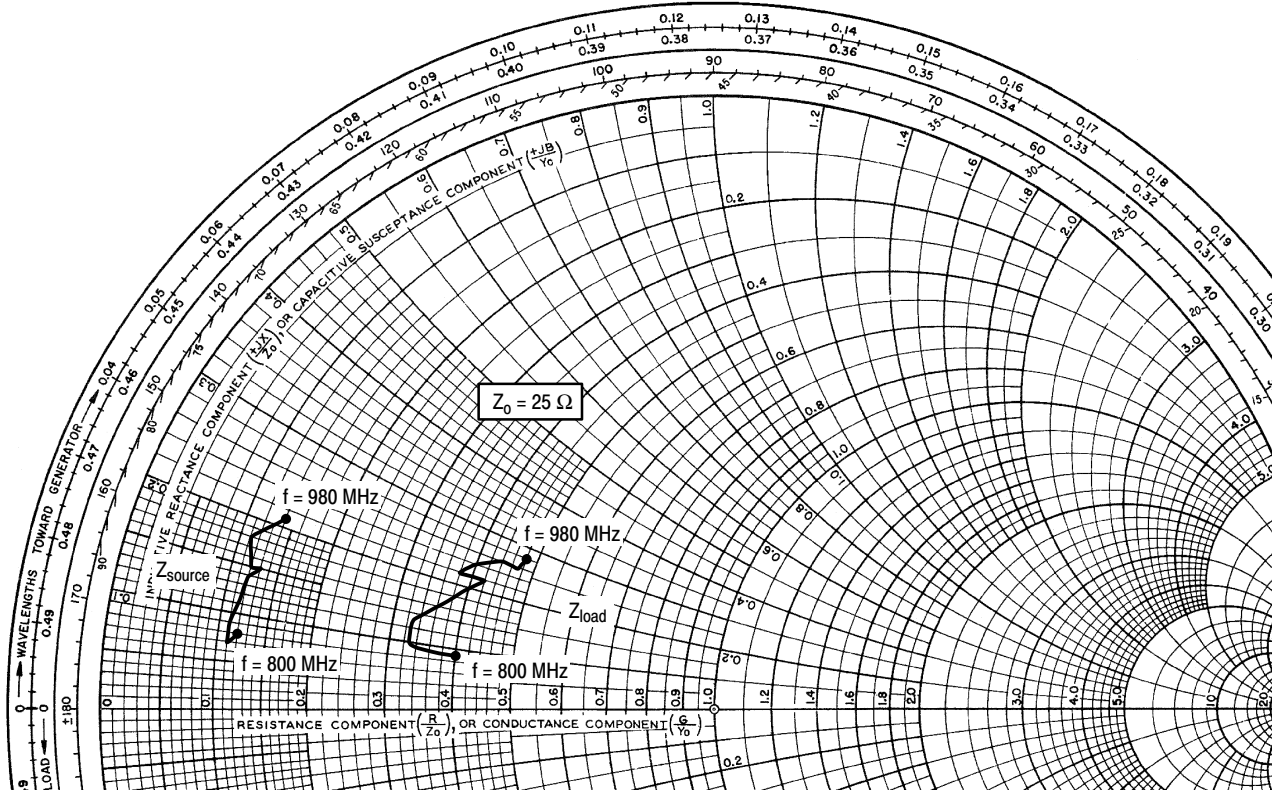
### TYPICAL CHARACTERISTICS



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 12. MTTF Factor versus Junction Temperature**



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

| f MHz | $Z_{source}$ $\Omega$ | $Z_{load}$ $\Omega$ |
|-------|-----------------------|---------------------|
| 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.

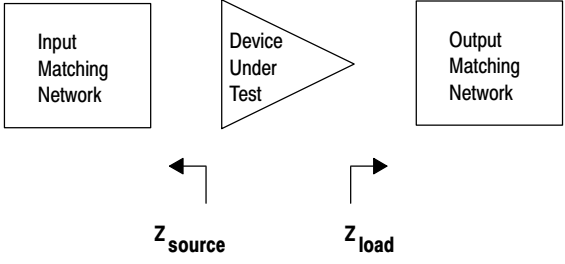
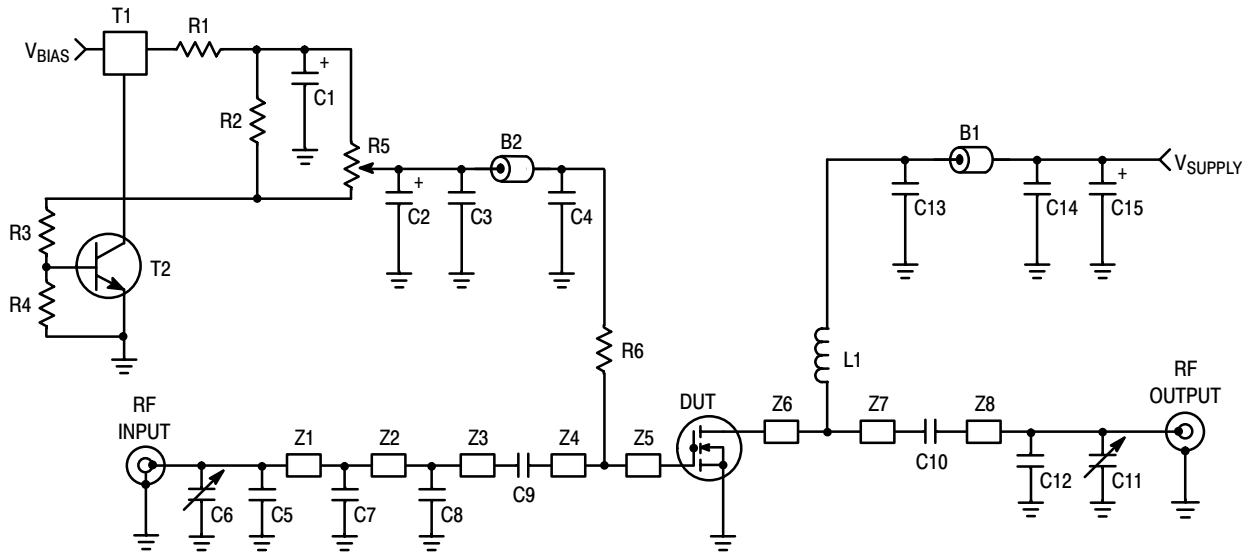


Figure 13. Series Equivalent Source and Load Impedance — 900 MHz





|        |                            |     |   |
|--------|----------------------------|-----|---|
| Z1     | 0.540" x 0.080" Microstrip | Z5  | 0.475" x 0.330" Microstrip                        |
| Z2     | 0.365" x 0.080" Microstrip | Z6  | 0.475" x 0.325" Microstrip                        |
| Z3     | 0.225" x 0.080" Microstrip | Z8  | 1.250" x 0.080" Microstrip                        |
| Z4, Z7 | 0.440" x 0.080" Microstrip | PCB | Rogers ULTRALAM 2000, 0.030", $\epsilon_r = 2.55$ |

**Figure 14. MW6S010NR1(GNR1) Test Circuit Schematic — 450 MHz**

**Table 7. MW6S010NR1(GNR1) 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 |

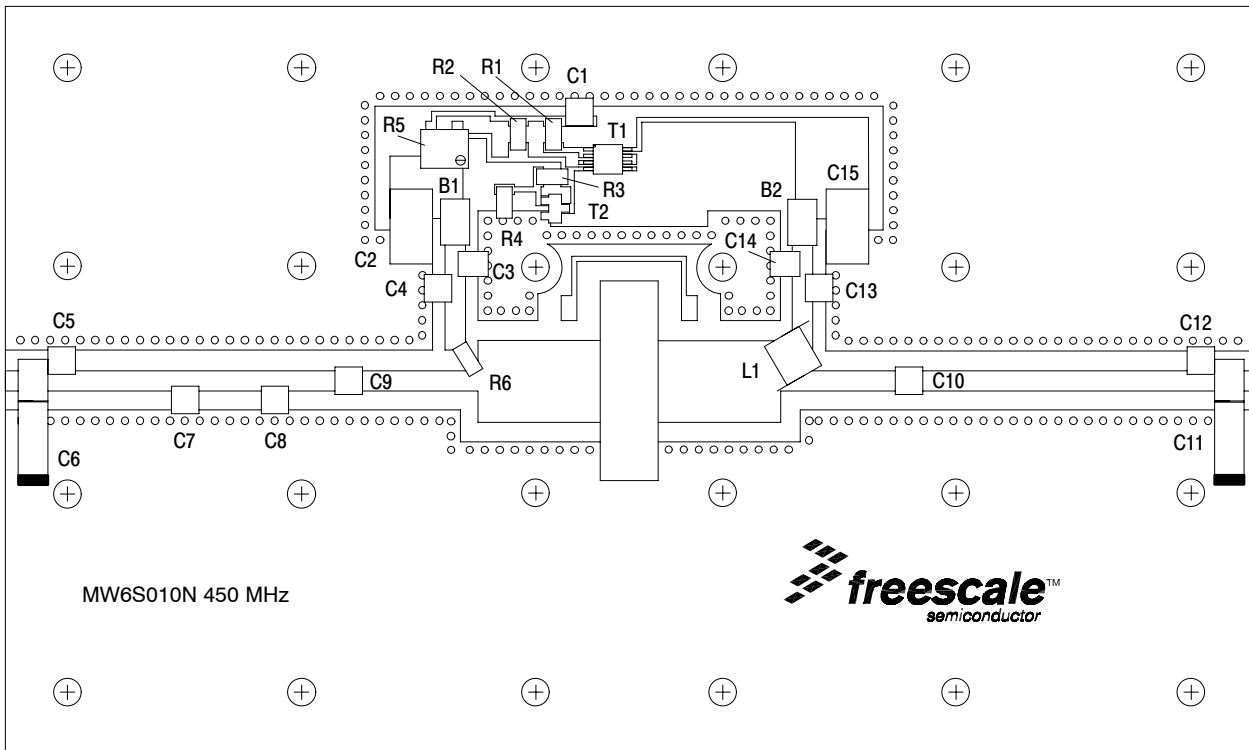


Figure 15. MW6S010NR1(GNR1) Test Circuit Component Layout — 450 MHz

### TYPICAL CHARACTERISTICS — 450 MHz

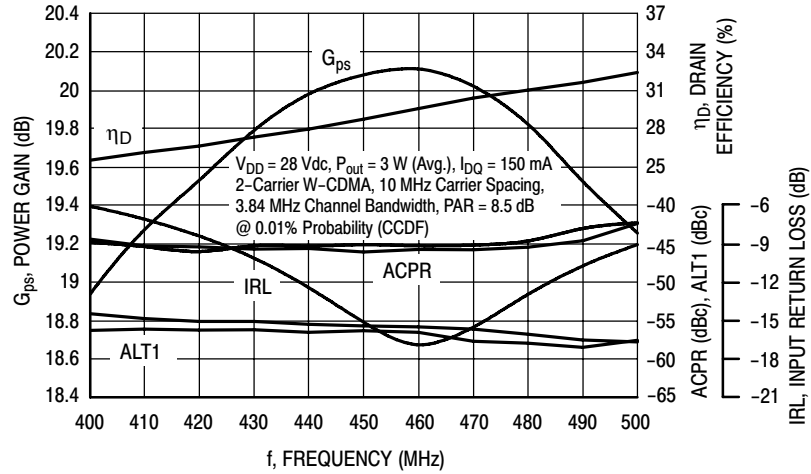


Figure 16. 2-Carrier W-CDMA Broadband Performance @  $P_{out} = 3$  Watts Avg.

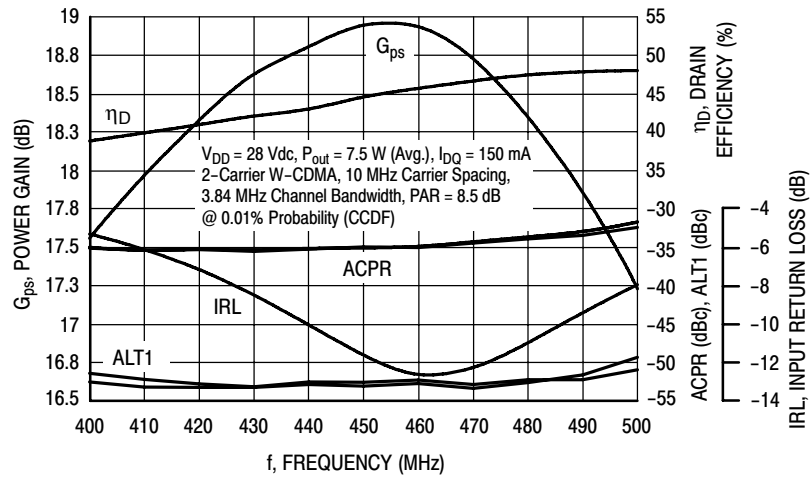


Figure 17. 2-Carrier W-CDMA Broadband Performance @  $P_{out} = 7.5$  Watts Avg.

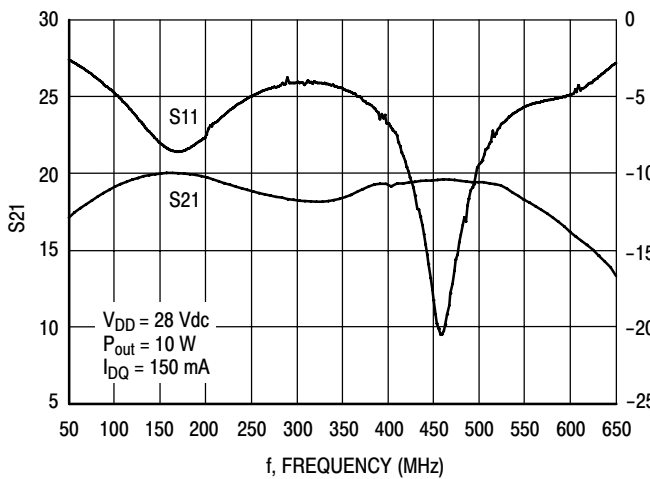


Figure 18. Broadband Frequency Response

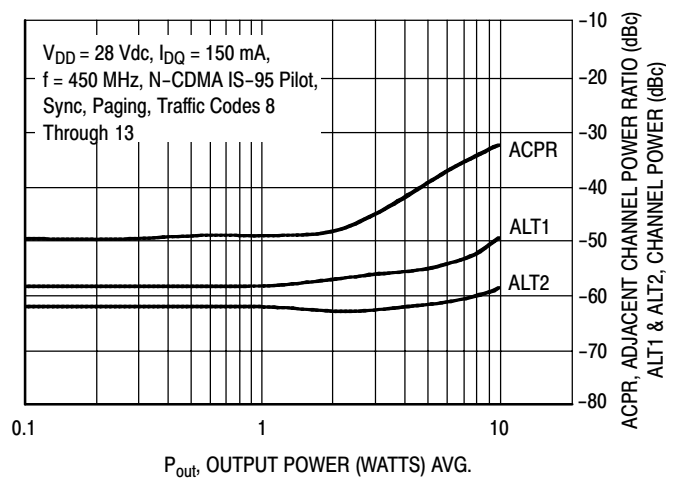
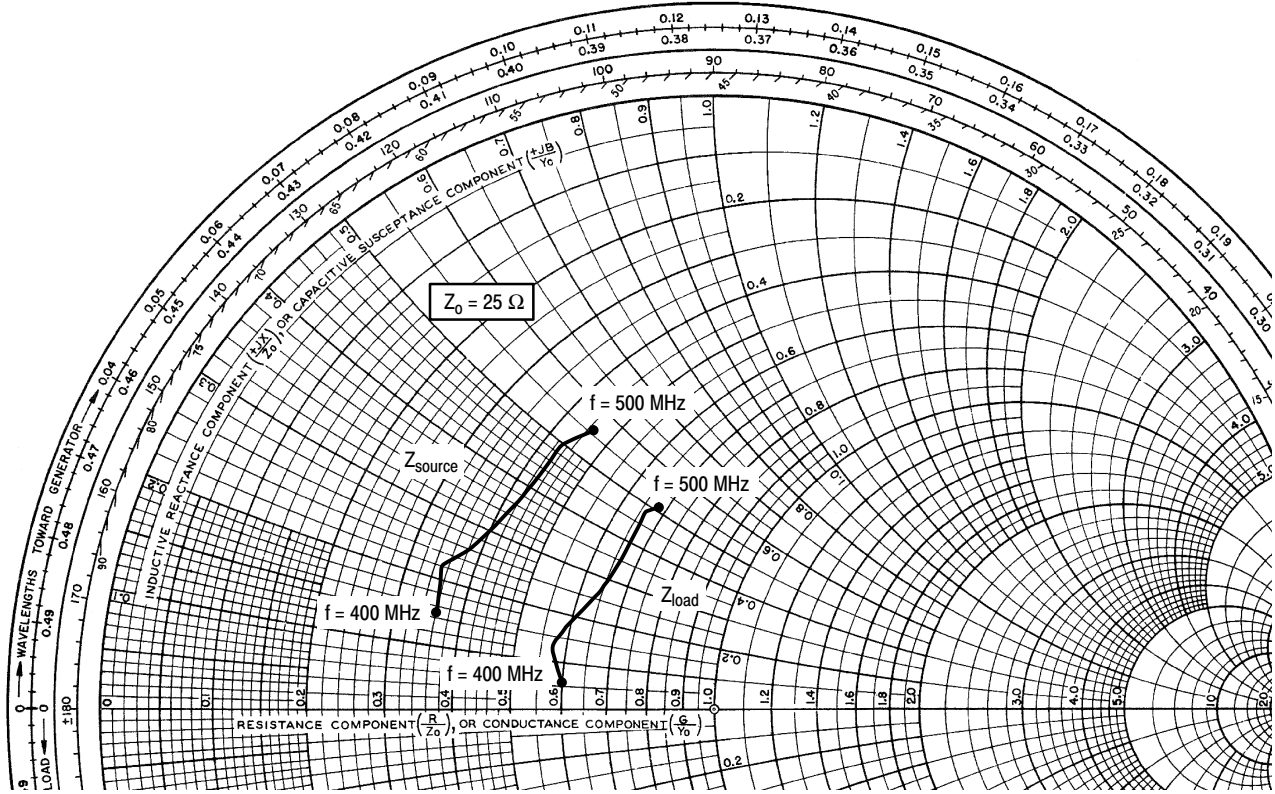


Figure 19. Single-Carrier N-CDMA ACPR, ALT1 and ALT2 versus Output Power



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

| 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.

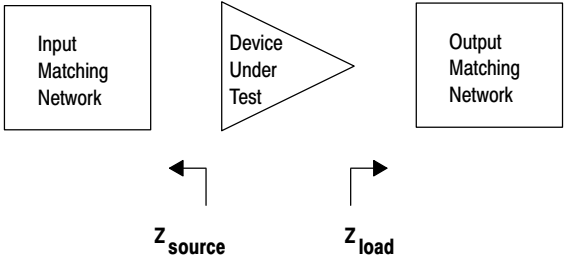
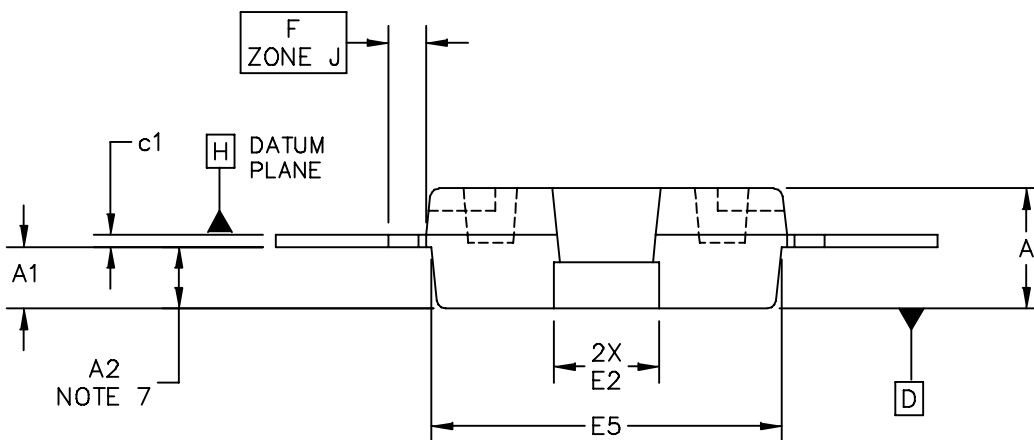
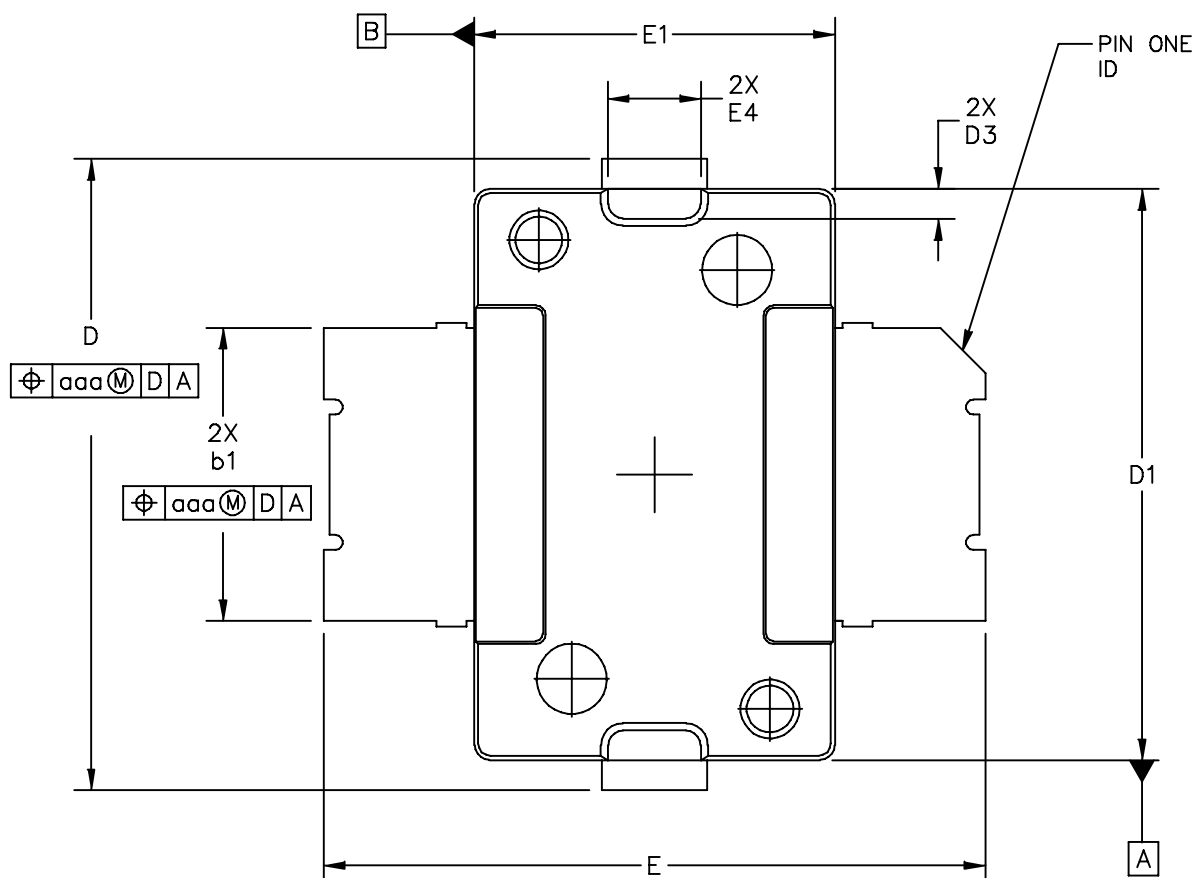
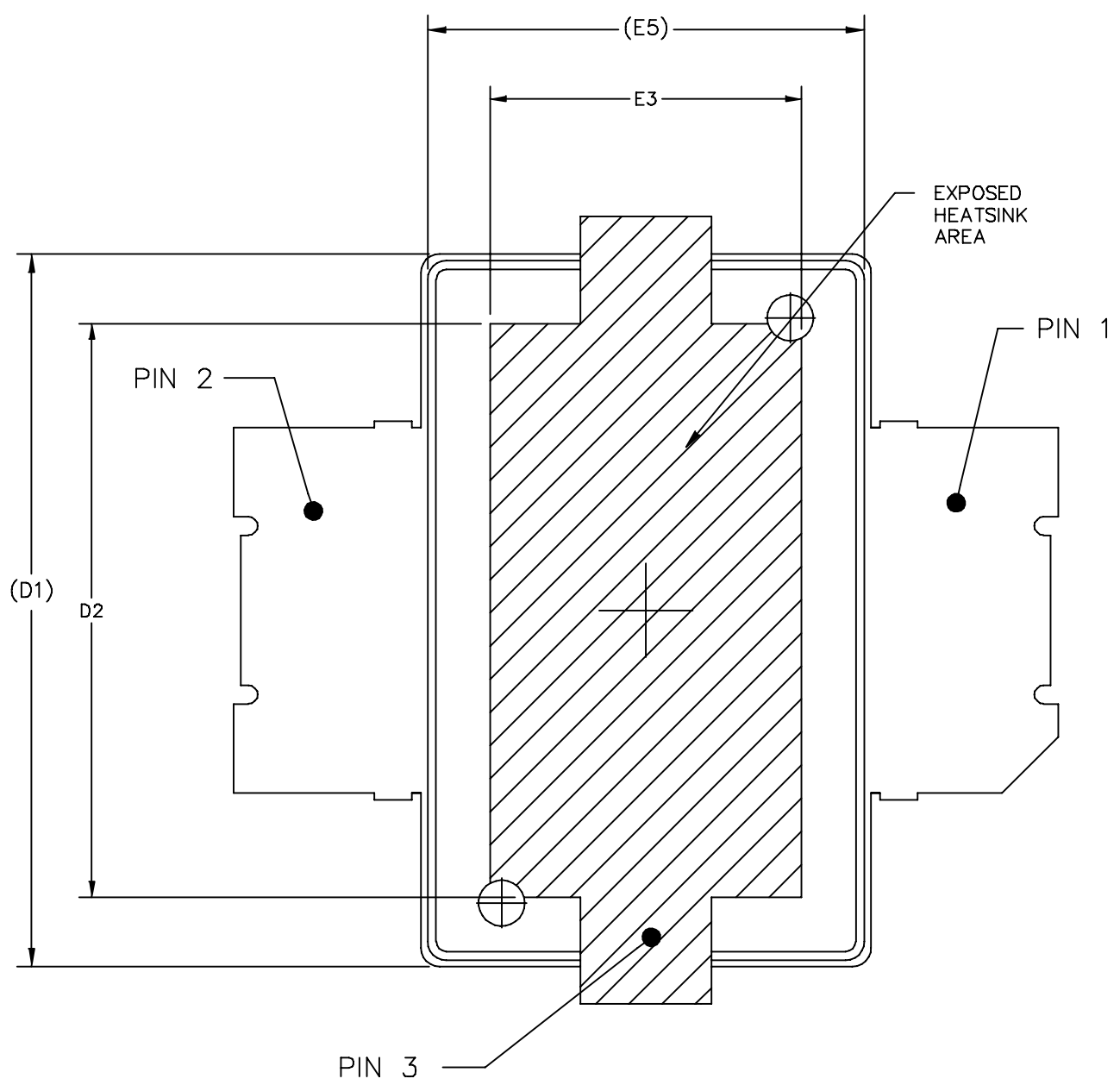


Figure 20. Series Equivalent Source and Load Impedance — 450 MHz

**PACKAGE DIMENSIONS**



|   |                           |                            |  |
|---|---------------------------|----------------------------|--|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. | MECHANICAL OUTLINE        | PRINT VERSION NOT TO SCALE |  |
| TITLE:<br>TO-270<br>SURFACE MOUNT                       | DOCUMENT NO: 98ASH98117A  | REV: K                     |  |
|   | CASE NUMBER: 1265-09      | 29 JUN 2007                |  |
|   | STANDARD: JEDEC TO-270 AA |                            |  |



BOTTOM VIEW

|   |                           |                            |  |
|---|---------------------------|----------------------------|--|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. | MECHANICAL OUTLINE        | PRINT VERSION NOT TO SCALE |  |
| TITLE:<br>TO-270<br>SURFACE MOUNT                       | DOCUMENT NO: 98ASH98117A  | REV: K                     |  |
|   | CASE NUMBER: 1265-09      | 29 JUN 2007                |  |
|   | STANDARD: JEDEC TO-270 AA |                            |  |

NOTES:

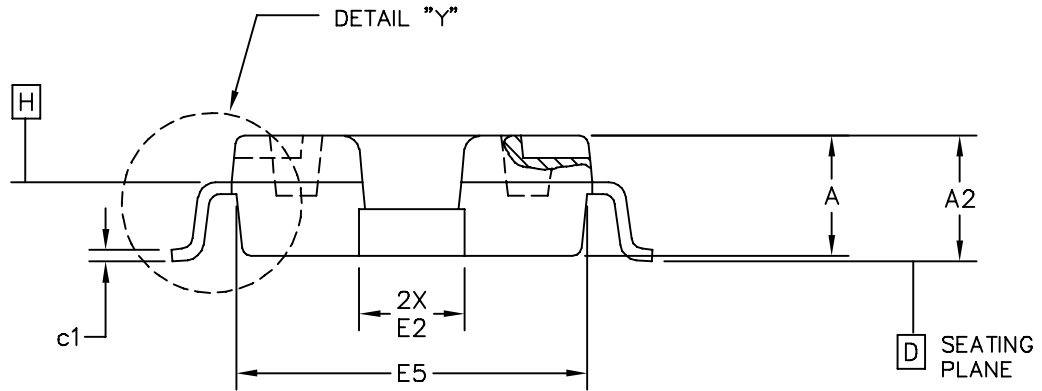
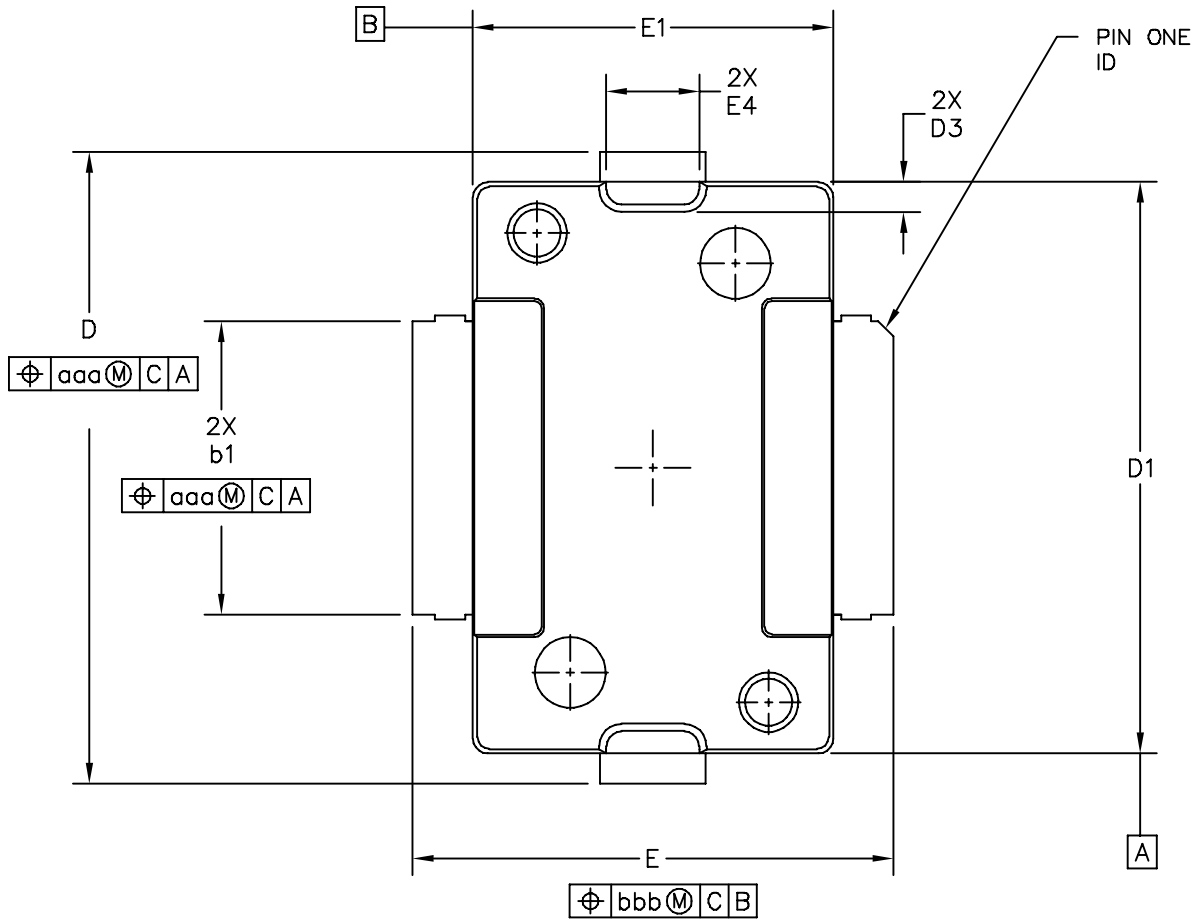
1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DATUM PLANE -H- IS LOCATED AT TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS "D1" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE 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. DIMENSION "A2" APPLIES WITHIN ZONE "J" ONLY.
8. DIMENSIONS "D" AND "E2" DO NOT INCLUDE MOLD PROTRUSION. OVERALL LENGTH INCLUDING MOLD PROTRUSION SHOULD NOT EXCEED 0.430 INCH FOR DIMENSION "D" AND 0.080 INCH FOR DIMENSION "E2". 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

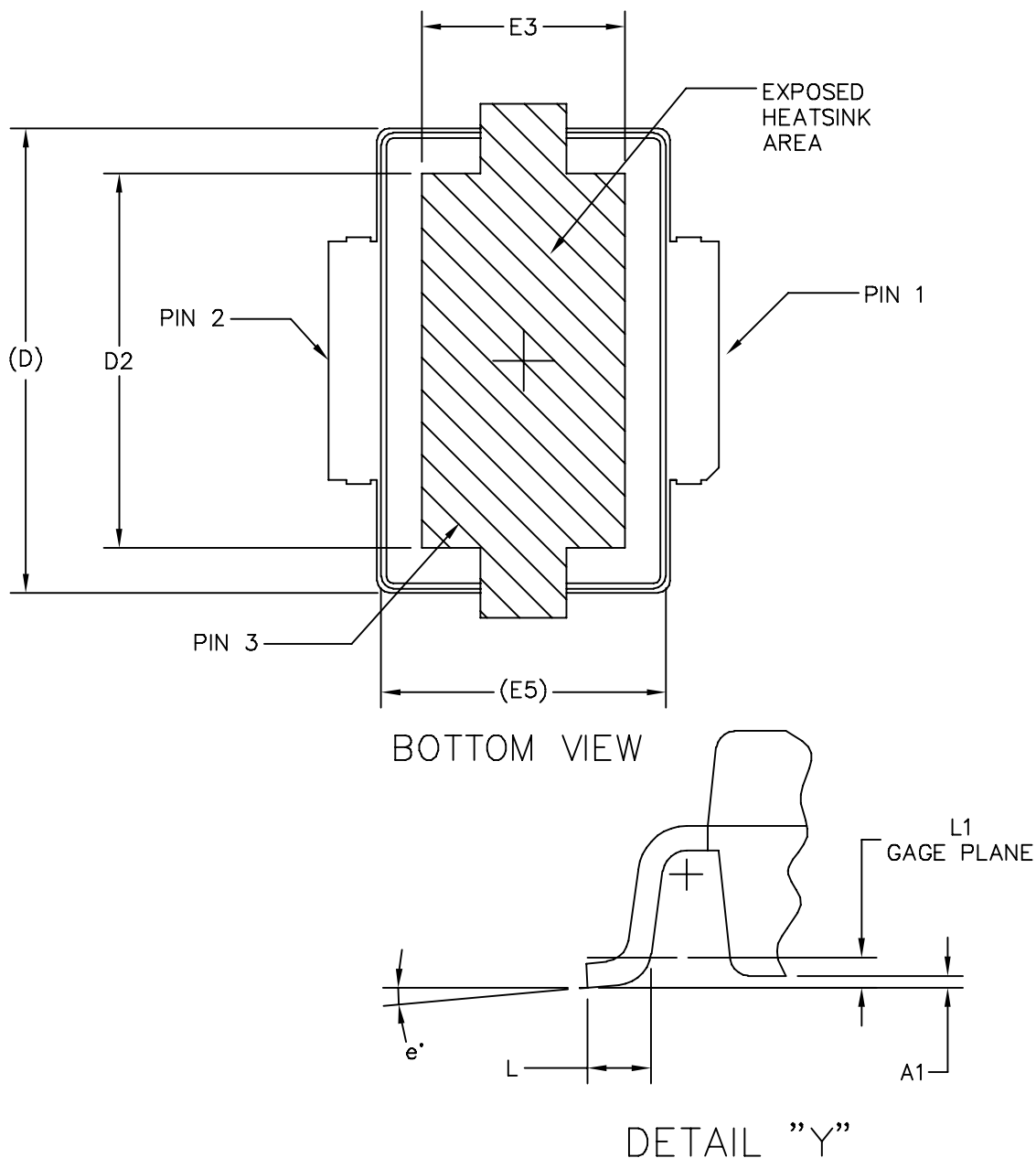
| DIM | INCH |      | MILLIMETER |       | DIM | INCH     |      | MILLIMETER |      |
|-----|------|------|------------|-------|-----|----------|------|------------|------|
|     | MIN  | MAX  | MIN        | MAX   |     | MIN      | MAX  | MIN        | MAX  |
| A   | .078 | .082 | 1.98       | 2.08  | F   | .025 BSC |      | 0.64 BSC   |      |
| A1  | .039 | .043 | 0.99       | 1.09  | b1  | .193     | .199 | 4.90       | 5.06 |
| A2  | .040 | .042 | 1.02       | 1.07  | c1  | .007     | .011 | 0.18       | 0.28 |
| D   | .416 | .424 | 10.57      | 10.77 | aaa | .004     |      | 0.10       |      |
| D1  | .378 | .382 | 9.60       | 9.70  |     |          |      |            |      |
| D2  | .290 | ---- | 7.37       | ----  |     |          |      |            |      |
| D3  | .016 | .024 | 0.41       | 0.61  |     |          |      |            |      |
| 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       | ----  |     |          |      |            |      |
| E4  | .058 | .066 | 1.47       | 1.68  |     |          |      |            |      |
| E5  | .231 | .235 | 5.87       | 5.97  |     |          |      |            |      |

|   |  |                           |  |                            |  |
|---|--|---------------------------|--|----------------------------|--|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. |  | MECHANICAL OUTLINE        |  | PRINT VERSION NOT TO SCALE |  |
| TITLE:<br><br>TO-270<br>SURFACE MOUNT                   |  | DOCUMENT NO: 98ASH98117A  |  | REV: K                     |  |
|   |  | CASE NUMBER: 1265-09      |  | 29 JUN 2007                |  |
|   |  | STANDARD: JEDEC TO-270 AA |  |                            |  |



|   |                           |                            |  |
|---|---------------------------|----------------------------|--|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED.                                       | <b>MECHANICAL OUTLINE</b> | PRINT VERSION NOT TO SCALE |  |
| TITLE:<br><div style="text-align: center; padding: 10px;"> <b>TO-270<br/>GULL WING</b> </div> | DOCUMENT NO: 98ASA99301D  | REV: C                     |  |
|   | CASE NUMBER: 1265A-03     | 02 JUL 2007                |  |
|   | STANDARD: JEDEC TO-270 BA |                            |  |





|   |                           |                            |             |
|---|---------------------------|----------------------------|-------------|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED.                                       | <b>MECHANICAL OUTLINE</b> | PRINT VERSION NOT TO SCALE |             |
| TITLE:<br><div style="text-align: center; padding: 10px;"> <b>TO-270<br/>GULL WING</b> </div> | DOCUMENT NO: 98ASA99301D  |                            | REV: C      |
|   | 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

| DIM   | INCH |      | MILLIMETER                |       | DIM                       | INCH                       |      | MILLIMETER  |      |
|---|------|------|---------------------------|-------|---------------------------|----------------------------|------|-------------|------|
|   | MIN  | MAX  | MIN                       | MAX   |                           | 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  |                           |                            |      |             |      |
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. |      |      | <b>MECHANICAL OUTLINE</b> |       |                           | PRINT VERSION NOT TO SCALE |      |             |      |
| 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 |                            |      |             |      |

Refer to the following documents to aid your design process.

**Application Notes**

- AN1907: Solder Reflow Attach Method for High Power RF Devices in Plastic Packages
- AN1949: Mounting Method for the MHVIC910HR2 (PFP-16) and Similar Surface Mount 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
- RF High Power Model

For Software and Tools, 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   |
|----------|-----------|---|
| 4        | Dec. 2008 | <ul style="list-style-type: none"> <li>• Changed Storage Temperature Range in Max Ratings table from -65 to +175 to -65 to +150 for standardization across products, p. 1</li> <li>• Removed Total Device Dissipation from Max Ratings table as data was redundant (information already provided in Thermal Characteristics table), p. 1</li> <li>• Added Case Operating Temperature limit to the Maximum Ratings table and set limit to 150°C, p. 1</li> <li>• Operating Junction Temperature increased from 200°C to 225°C in Maximum Ratings table, related “Continuous use at maximum temperature will affect MTTF” footnote added and changed 200°C to 225°C in Capable Plastic Package bullet, p. 1</li> <li>• Corrected <math>V_{DS}</math> to <math>V_{DD}</math> in the RF test condition voltage callout for <math>V_{GS(Q)}</math> and added “Measured in Functional Test”, On Characteristics table, p. 2</li> <li>• Corrected <math>C_{iss}</math> test condition to indicate AC stimulus on the <math>V_{GS}</math> connection versus the <math>V_{DS}</math> connection, Dynamic Characteristics table, p. 2</li> <li>• Updated Part Numbers in Tables 6, 7, Component Designations and Values, to RoHS compliant part numbers, p. 3, 9</li> <li>• Removed lower voltage tests from Fig. 10, Power Gain versus Output Power, due to fixed tuned fixture limitations, p. 6</li> <li>• Replaced Fig. 12, MTTF versus Junction Temperature with updated graph. Removed Amps<sup>2</sup> and listed operating characteristics and location of MTTF calculator for device, p. 7</li> <li>• Replaced Case Outline 1265-08 with 1265-09, Issue K, p. 1, 13-15. Corrected cross hatch pattern in bottom view and changed its dimensions (D2 and E3) to minimum value on source contact (D2 changed from Min-Max .290-.320 to .290 Min; E3 changed from Min-Max .150-.180 to .150 Min). Added JEDEC Standard Package Number.</li> <li>• Replaced Case Outline 1265A-02 with 1265A-03, Issue C, p. 1, 16-18. Corrected cross hatch pattern and its dimensions (D2 and E2) on source contact (D2 changed from Min-Max .290-.320 to .290 Min; E3 changed from Min-Max .150-.180 to .150 Min). Added pin numbers. Corrected mm dimension L for gull-wing foot from 4.90-5.06 Min-Max to 0.46-0.61 Min-Max. Added JEDEC Standard Package Number.</li> <li>• Added Product Documentation and Revision History, p. 19</li> </ul> |
| 5        | June 2009 | <ul style="list-style-type: none"> <li>• Modified data sheet to reflect MSL rating change from 1 to 3 as a result of the standardization of packing process as described in Product and Process Change Notification number, PCN13516, p. 2</li> <li>• Added AN3789, Clamping of High Power RF Transistors and RFICs in Over-Molded Plastic Packages to Product Documentation, Application Notes, p. 19</li> <li>• Added Electromigration MTTF Calculator and RF High Power Model availability to Product Software, p. 19</li> </ul>   |

## **How to Reach Us:**

### **Home Page:**

[www.freescale.com](http://www.freescale.com)

### **Web Support:**

<http://www.freescale.com/support>

### **USA/Europe or Locations Not Listed:**

Freescale Semiconductor, Inc.  
Technical Information Center, EL516  
2100 East Elliot Road  
Tempe, Arizona 85284  
1-800-521-6274 or +1-480-768-2130  
[www.freescale.com/support](http://www.freescale.com/support)

### **Europe, Middle East, and Africa:**

Freescale Halbleiter Deutschland GmbH  
Technical Information Center  
Schatzbogen 7  
81829 Muenchen, Germany  
+44 1296 380 456 (English)  
+46 8 52200080 (English)  
+49 89 92103 559 (German)  
+33 1 69 35 48 48 (French)  
[www.freescale.com/support](http://www.freescale.com/support)

### **Japan:**

Freescale Semiconductor Japan Ltd.  
Headquarters  
ARCO Tower 15F  
1-8-1, Shimo-Meguro, Meguro-ku,  
Tokyo 153-0064  
Japan  
0120 191014 or +81 3 5437 9125  
[support.japan@freescale.com](mailto:support.japan@freescale.com)

### **Asia/Pacific:**

Freescale Semiconductor China Ltd.  
Exchange Building 23F  
No. 118 Jianguo Road  
Chaoyang District  
Beijing 100022  
China  
+86 10 5879 8000  
[support.asia@freescale.com](mailto:support.asia@freescale.com)

### **For Literature Requests Only:**

Freescale Semiconductor Literature Distribution Center  
1-800-441-2447 or +1-303-675-2140  
Fax: +1-303-675-2150  
[LDCForFreescaleSemiconductor@hibbertgroup.com](mailto:LDCForFreescaleSemiconductor@hibbertgroup.com)

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals", must be validated for each customer application by customer's technical experts. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold Freescale Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale Semiconductor was negligent regarding the design or manufacture of the part.

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.  
© Freescale Semiconductor, Inc. 2005-2006, 2008-2009. All rights reserved.

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



Тел: +7 (812) 336 43 04 (многоканальный)

Email: [org@lifeelectronics.ru](mailto:org@lifeelectronics.ru)