

# RF LDMOS Wideband Integrated Power Amplifiers

The MMRF2005N wideband integrated circuit is designed with on-chip matching that makes it usable from 728 to 960 MHz. This multi-stage structure is rated for 24 to 32 V operation and is ideal for applications including radio communications, data links and UHF radar.

## Driver Application — 900 MHz

- Typical Single-Carrier W-CDMA Performance:  $V_{DD} = 28$  Vdc,  $I_{DQ1} = 106$  mA,  $I_{DQ2} = 285$  mA,  $P_{out} = 3.2$  W Avg., IQ Magnitude Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF.

| Frequency (1) | $G_{ps}$ (dB) | PAE (%) | ACPR (dBc) |
|---------------|---------------|---------|------------|
| 920 MHz       | 36.6          | 16.1    | -48.0      |
| 940 MHz       | 36.8          | 16.7    | -48.7      |
| 960 MHz       | 36.6          | 17.3    | -48.6      |

- Capable of Handling 10:1 VSWR, @ 32 Vdc, 940 MHz, 48 W CW Output Power (3 dB Input Overdrive from Rated  $P_{out}$ )

## Driver Application — 700 MHz

- Typical Single-Carrier W-CDMA Performance:  $V_{DD} = 28$  Vdc,  $I_{DQ1} = 106$  mA,  $I_{DQ2} = 285$  mA,  $P_{out} = 3.2$  W Avg., IQ Magnitude Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF.

| Frequency | $G_{ps}$ (dB) | PAE (%) | ACPR (dBc) |
|-----------|---------------|---------|------------|
| 728 MHz   | 36.4          | 16.1    | -47.7      |
| 748 MHz   | 36.4          | 16.1    | -47.8      |
| 768 MHz   | 36.4          | 16.0    | -47.9      |

## Features

- Characterized with series equivalent large-signal impedance parameters and common source S-parameters
- On-chip matching (50 ohm input, DC blocked, > 5 ohm output)
- Integrated quiescent current temperature compensation with enable/disable function (2)
- Integrated ESD protection

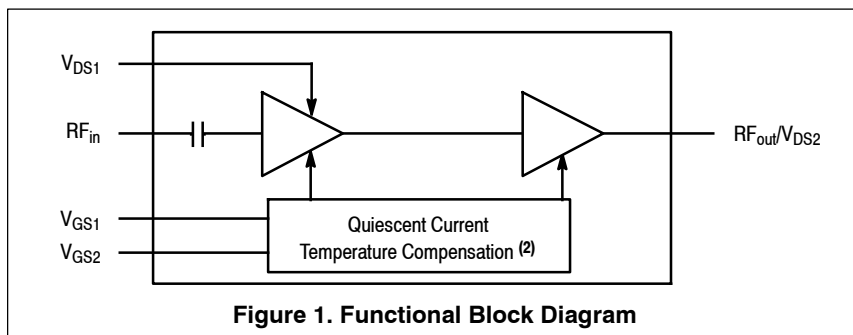
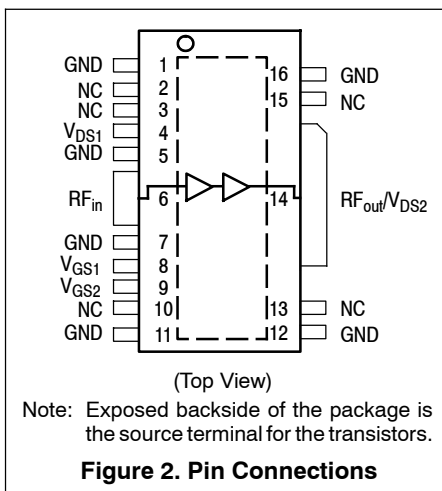


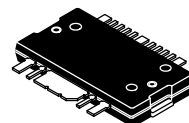
Figure 1. Functional Block Diagram



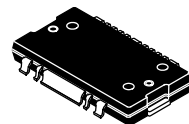
## MMRF2005N MMRF2005GN

728–960 MHz, 3.2 W AVG., 28 V  
RF LDMOS WIDEBAND  
INTEGRATED POWER AMPLIFIERS

TO-270WB-16  
PLASTIC  
MMRF2005N



TO-270WBG-16  
PLASTIC  
MMRF2005GN



1. 900 MHz Driver Frequency Band table data collected in the 900 MHz application circuit. See Fig. 9.

2. Refer to [AN1977](#), Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family, and to [AN1987](#), Quiescent Current Control for the RF Integrated Circuit Device Family. Go to <http://www.freescale.com/rf> and search for AN1977 or AN1987.

**Table 1. Maximum Ratings**

| Rating                                                | Symbol    | Value       | Unit |
|-------------------------------------------------------|-----------|-------------|------|
| Drain–Source Voltage                                  | $V_{DS}$  | –0.5, +65   | Vdc  |
| Gate–Source Voltage                                   | $V_{GS}$  | –6.0, +10   | Vdc  |
| Operating Voltage                                     | $V_{DD}$  | 32, +0      | Vdc  |
| Storage Temperature Range                             | $T_{stg}$ | –65 to +150 | °C   |
| Case Operating Temperature Range                      | $T_C$     | –40 to +150 | °C   |
| Operating Junction Temperature Range <sup>(1,2)</sup> | $T_J$     | –40 to +225 | °C   |
| Input Power                                           | $P_{in}$  | 20          | dBm  |

**Table 2. Thermal Characteristics**

| Characteristic                           | Symbol          | Value <sup>(2,3)</sup> | Unit |
|------------------------------------------|-----------------|------------------------|------|
| Thermal Resistance, Junction to Case     | $R_{\theta JC}$ |                        | °C/W |
| Case Temperature 80°C, 3.2 W CW, 940 MHz |                 |                        |      |
| Stage 1, 28 Vdc, $I_{DQ1}$ = 106 mA      |                 | 5.5                    |      |
| Stage 2, 28 Vdc, $I_{DQ2}$ = 285 mA      |                 | 1.6                    |      |
| Case Temperature 80°C, 30 W CW, 940 MHz  |                 |                        |      |
| Stage 1, 28 Vdc, $I_{DQ1}$ = 40 mA       |                 | 5.8                    |      |
| Stage 2, 28 Vdc, $I_{DQ2}$ = 340 mA      |                 | 1.2                    |      |

**Table 3. ESD Protection Characteristics**

| Test Methodology                      | Class            |
|---------------------------------------|------------------|
| Human Body Model (per JESD22–A114)    | 1B, passes 500 V |
| Machine Model (per EIA/JESD22–A115)   | A, passes 100 V  |
| Charge Device Model (per JESD22–C101) | II, passes 200 V |

**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°C unless otherwise noted)

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

**Stage 1 — Off Characteristics**

|                                                                                   |           |   |   |    |           |
|-----------------------------------------------------------------------------------|-----------|---|---|----|-----------|
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS}$ = 65 Vdc, $V_{GS}$ = 0 Vdc) | $I_{DSS}$ | — | — | 10 | $\mu$ Adc |
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS}$ = 28 Vdc, $V_{GS}$ = 0 Vdc) | $I_{DSS}$ | — | — | 1  | $\mu$ Adc |
| Gate–Source Leakage Current<br>( $V_{GS}$ = 1.5 Vdc, $V_{DS}$ = 0 Vdc)            | $I_{GSS}$ | — | — | 1  | $\mu$ Adc |

**Stage 1 — On Characteristics**

|                                                                                                                        |              |     |     |      |     |
|------------------------------------------------------------------------------------------------------------------------|--------------|-----|-----|------|-----|
| Gate Threshold Voltage<br>( $V_{DS}$ = 10 Vdc, $I_D$ = 14 $\mu$ Adc)                                                   | $V_{GS(th)}$ | 1.2 | 2   | 2.7  | Vdc |
| Gate Quiescent Voltage<br>( $V_{DS}$ = 28 Vdc, $I_{DQ1}$ = 106 mA)                                                     | $V_{GS(Q)}$  | —   | 2.8 | —    | Vdc |
| Fixture Gate Quiescent Voltage <sup>(4)</sup><br>( $V_{DD}$ = 28 Vdc, $I_{DQ1}$ = 106 mA, Measured in Functional Test) | $V_{GG(Q)}$  | 6.9 | 9.4 | 11.9 | Vdc |

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at <http://www.freescale.com/rf/calculators>.
3. Refer to [AN1955](#), *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf> and search for AN1955.
4.  $V_{GG} = 3.3 \times V_{GS(Q)}$ . Parameter measured on Freescale test fixture, due to resistor divider network on the board. Refer to test circuit schematic.

(continued)

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

| Characteristic                                                                                    | Symbol    | Min | Typ | Max | Unit            |
|---------------------------------------------------------------------------------------------------|-----------|-----|-----|-----|-----------------|
| <b>Stage 2 — Off Characteristics</b>                                                              |           |     |     |     |                 |
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS} = 65\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ ) | $I_{DSS}$ | —   | —   | 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>( $V_{GS} = 1.5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )            | $I_{GSS}$ | —   | —   | 1   | $\mu\text{Adc}$ |

**Stage 2 — On Characteristics**

|                                                                                                                                        |              |     |     |     |     |
|----------------------------------------------------------------------------------------------------------------------------------------|--------------|-----|-----|-----|-----|
| Gate Threshold Voltage<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 74\text{ }\mu\text{Adc}$ )                                               | $V_{GS(th)}$ | 1.2 | 2   | 2.7 | Vdc |
| Gate Quiescent Voltage<br>( $V_{DS} = 28\text{ Vdc}$ , $I_{DQ2} = 285\text{ mA}$ )                                                     | $V_{GS(Q)}$  | —   | 2.6 | —   | Vdc |
| Fixture Gate Quiescent Voltage <sup>(1)</sup><br>( $V_{DD} = 28\text{ Vdc}$ , $I_{DQ2} = 285\text{ mA}$ , Measured in Functional Test) | $V_{GG(Q)}$  | 4.2 | 5.9 | 7.6 | Vdc |
| Drain-Source On-Voltage<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 740\text{ mA}$ )                                                        | $V_{DS(on)}$ | 0.1 | 0.3 | 0.8 | Vdc |

**Functional Tests** <sup>(2,3)</sup> (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ1} = 106\text{ mA}$ ,  $I_{DQ2} = 285\text{ mA}$ ,  $P_{out} = 3.2\text{ W Avg.}$ ,  $f = 940\text{ MHz}$ , Single-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carrier, IQ Magnitude Clipping, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm 5\text{ MHz}$  Offset.

|                              |          |    |       |     |     |
|------------------------------|----------|----|-------|-----|-----|
| Power Gain                   | $G_{ps}$ | 33 | 35.9  | 38  | dB  |
| Power Added Efficiency       | PAE      | 14 | 16.5  | —   | %   |
| Adjacent Channel Power Ratio | ACPR     | —  | -49.5 | -46 | dBc |
| Input Return Loss            | IRL      | —  | -18.7 | -9  | dB  |

**Typical Performance — 900 MHz** (In Freescale 900 MHz Application Test Fixture, 50 ohm system)  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ1} = 106\text{ mA}$ ,  $I_{DQ2} = 285\text{ mA}$ , 920–960 MHz Bandwidth

|                                                                                                                                                                                    |                    |   |       |   |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---|-------|---|--------|
| $V_{DD} = 28\text{ Vdc}$ , $I_{DQ1} = 40\text{ mA}$ , $I_{DQ2} = 340\text{ mA}$<br>$P_{out}$ @ 1 dB Compression Point, CW                                                          | P1dB               | — | 31    | — | W      |
| IMD Symmetry @ 25 W PEP, $P_{out}$ where IMD Third Order Intermodulation $\cong 30\text{ dBc}$<br>(Delta IMD Third Order Intermodulation between Upper and Lower Sidebands > 2 dB) | IMD <sub>sym</sub> | — | 45    | — | MHz    |
| VBW Resonance Point<br>(IMD Third Order Intermodulation Inflection Point)                                                                                                          | VBW <sub>res</sub> | — | 80    | — | MHz    |
| Quiescent Current Accuracy over Temperature <sup>(4)</sup><br>with 3 k $\Omega$ Gate Feed Resistors (-30 to 85°C)                                                                  | $\Delta I_{QT}$    | — | 0.02  | — | %      |
| Gain Flatness in 40 MHz Bandwidth @ $P_{out} = 3.2\text{ W Avg.}$                                                                                                                  | $G_F$              | — | 0.2   | — | dB     |
| Gain Variation over Temperature<br>(-30°C to +85°C)                                                                                                                                | $\Delta G$         | — | 0.036 | — | dB/°C  |
| Output Power Variation over Temperature<br>(-30°C to +85°C)                                                                                                                        | $\Delta P_{1dB}$   | — | 0.01  | — | dBm/°C |

**Table 6. Ordering Information**

| Device       | Tape and Reel Information                             | Package      |
|--------------|-------------------------------------------------------|--------------|
| MMRF2005NR1  | R1 Suffix = 500 Units, 44 mm Tape Width, 13-inch Reel | TO-270WB-16  |
| MMRF2005GNR1 |                                                       | TO-270WBG-16 |

- $V_{GG} = 2.25 \times V_{GS(Q)}$ . Parameter measured on Freescale test fixture, due to resistor divider network on the board. Refer to test circuit schematic.
- Part internally matched both on input and output.
- Measurements made with device in straight lead configuration before any lead forming operation is applied. Lead forming is used for gull wing (GN) parts.
- Refer to [AN1977](#), Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family, and to [AN1987](#), Quiescent Current Control for the RF Integrated Circuit Device Family. Go to <http://www.freescale.com/rf> and search for AN1977 or AN1987.

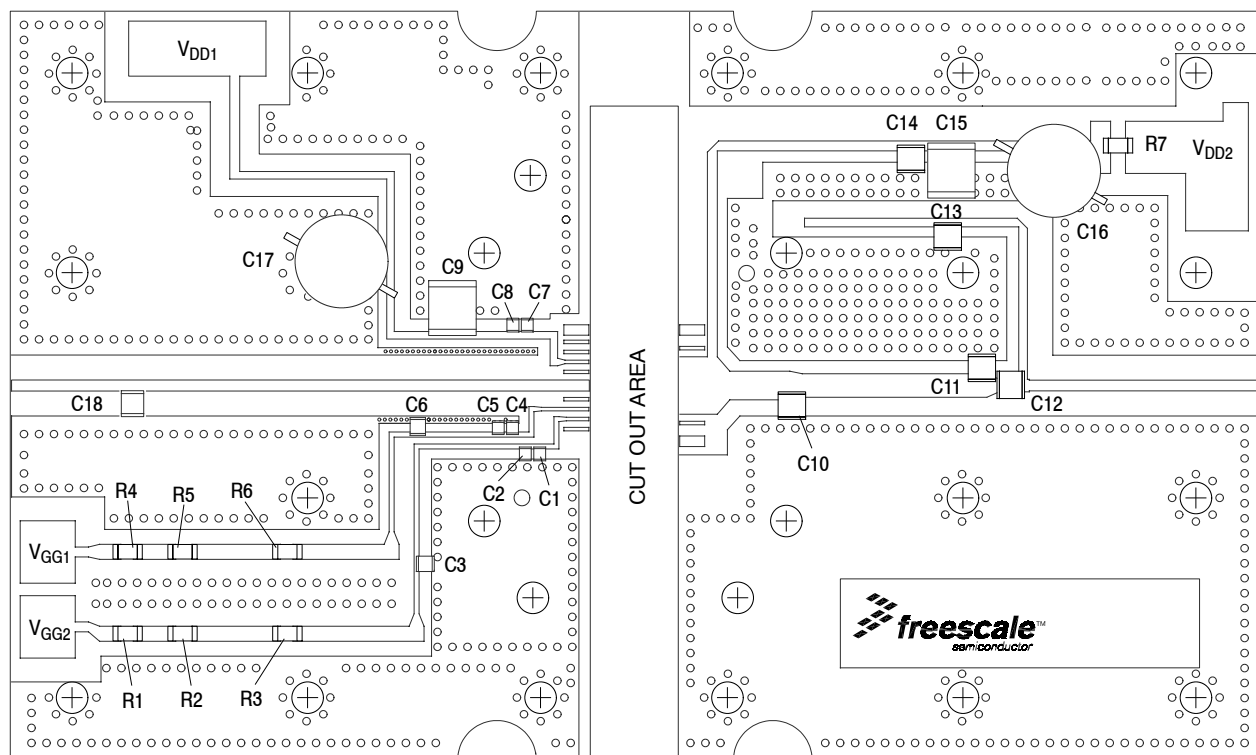


**Figure 3. MMRF2005N Test Circuit Component Layout — 900 MHz**

**Table 7. MMRF2005N Test Circuit Component Designations and Values — 900 MHz**

| Part                   | Description                               | Part Number          | Manufacturer |
|------------------------|-------------------------------------------|----------------------|--------------|
| C1, C4, C7             | 47 pF Chip Capacitors                     | ATC600F470JT250XT    | ATC          |
| C2, C5, C8             | 10 nF, 50 V Chip Capacitors               | C0603C103J5RAC-TU    | Kemet        |
| C3, C6                 | 1 $\mu$ F, 50 V Chip Capacitors           | GRM21BR71H105KA12L   | Murata       |
| C9, C15                | 10 $\mu$ F, 50 V Chip Capacitors          | GRM55DR61H106KA88L   | Murata       |
| C10                    | 16 pF Chip Capacitor                      | ATC100B160JT500XT    | ATC          |
| C11                    | 6.2 pF Chip Capacitor                     | ATC100B6R2BT500XT    | ATC          |
| C12                    | 7.5 pF Chip Capacitor                     | ATC100B7R5CT500XT    | ATC          |
| C13, C14               | 47 pF Chip Capacitors                     | ATC100B470JT500XT    | ATC          |
| C16, C17               | 100 $\mu$ F, 50 V Electrolytic Capacitors | MCGPR35V337M10X16-RH | Multicomp    |
| C18                    | 0.5 pF Chip Capacitor                     | ATC100B0R5BT500XT    | ATC          |
| R1, R2, R3, R4, R5, R6 | 1000 $\Omega$ , 1/4 W Chip Resistors      | CRCW12061K00FKEA     | Vishay       |
| R7                     | 0 $\Omega$ , 3A Chip Resistor             | CRCW12060000Z0EA     | Vishay       |
| PCB                    | 0.020", $\epsilon_r = 3.5$                | RF-35                | Taconic      |

## TYPICAL CHARACTERISTICS — 900 MHz

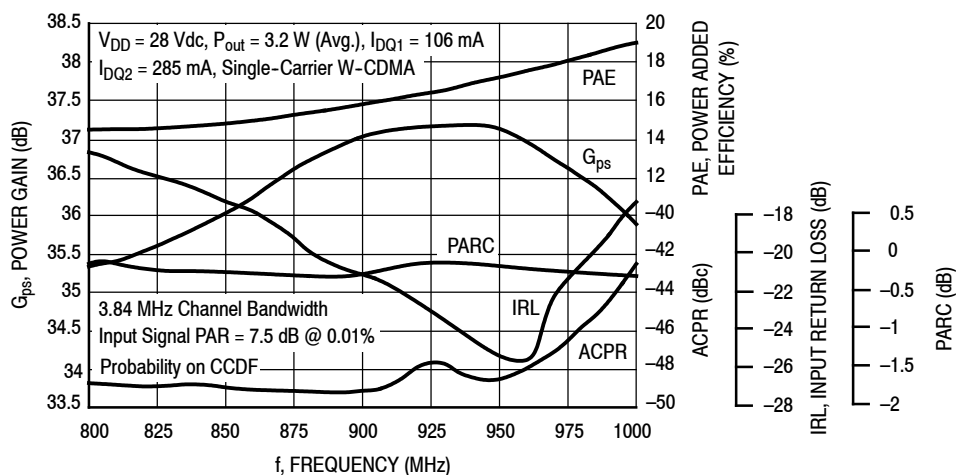


**Figure 4. Output Peak-to-Average Ratio Compression (PARC)  
Broadband Performance @  $P_{out} = 3.2$  Watts Avg.**

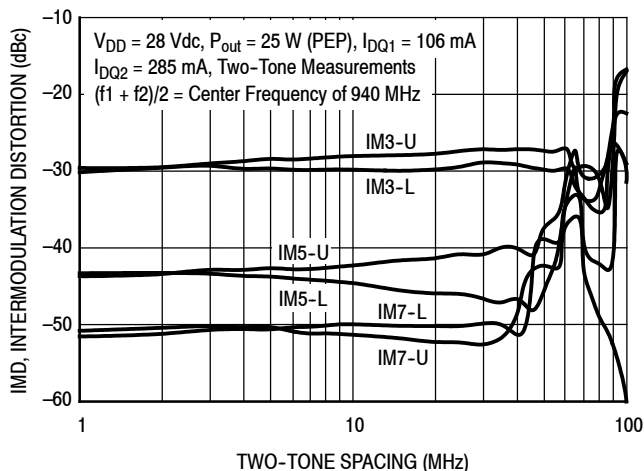


**Figure 5. Intermodulation Distortion Products  
versus Two-Tone Spacing**

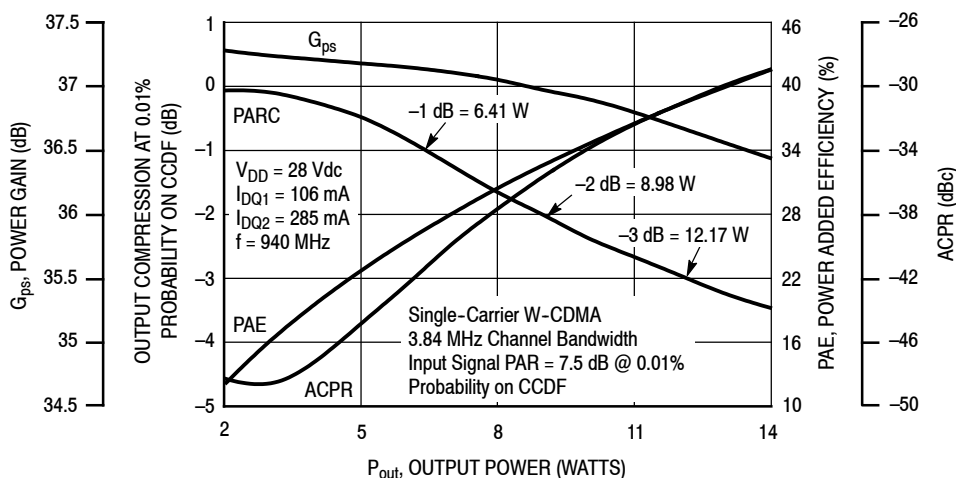


**Figure 6. Output Peak-to-Average Ratio  
Compression (PARC) versus Output Power**

## TYPICAL CHARACTERISTICS — 900 MHz

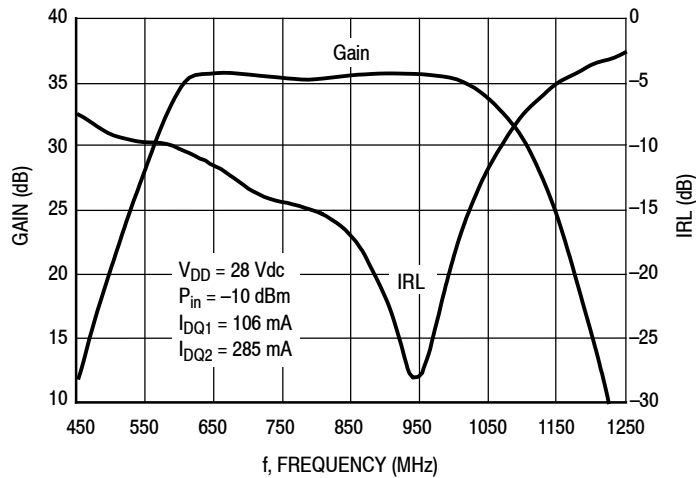


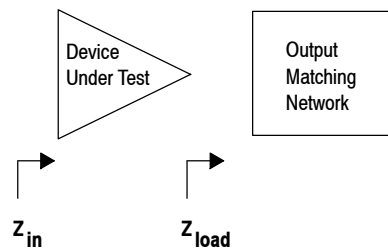
Figure 7. Broadband Frequency Response

Table 8. Series Equivalent Input and Load Impedance — 900 MHz

| f<br>MHz | $Z_{in}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|----------------------|------------------------|
| 820      | $37.95 + j2.31$      | $4.70 + j0.98$         |
| 840      | $39.95 + j2.72$      | $4.29 + j1.23$         |
| 860      | $42.70 + j1.02$      | $3.93 + j1.67$         |
| 880      | $44.40 - j1.38$      | $3.63 + j2.15$         |
| 900      | $46.25 - j4.92$      | $3.41 + j2.61$         |
| 920      | $45.70 - j8.41$      | $3.14 + j3.05$         |
| 940      | $45.46 - j11.47$     | $2.94 + j3.48$         |
| 960      | $45.07 - j15.19$     | $2.85 + j3.90$         |
| 980      | $43.49 - j18.03$     | $2.69 + j4.32$         |

$Z_{in}$  = Device input impedance as measured from gate to ground.

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



## LOAD PULL CHARACTERISTICS — 900 MHz

**Table 9. Load Pull Performance**  $V_{DD} = 28 \text{ Vdc}$ ,  
 $I_{DQ1} = 106 \text{ mA}$ ,  $I_{DQ2} = 285 \text{ mA}$ , Pulsed CW,  $10 \mu\text{sec}(\text{on})$ , 10% Duty Cycle

| f<br>(MHz) | P1dB  |      | P3dB  |      |
|------------|-------|------|-------|------|
|            | Watts | dBm  | Watts | dBm  |
| 920        | 43    | 46.3 | 51    | 47.1 |
| 940        | 42    | 46.3 | 50    | 47   |
| 960        | 42    | 46.3 | 50    | 47   |

NOTE: Load Pull Test Fixture Tuned for Peak P1dB Output Power @ 28 V

Test Impedances per Compression Level

| f<br>(MHz) |      | $Z_{\text{source}}$<br>$\Omega$ | $Z_{\text{load}}$<br>$\Omega$ |
|------------|------|---------------------------------|-------------------------------|
| 920        | P1dB | $55.82 + j15.71$                | $4.54 + j1.15$                |
| 940        | P1dB | $52.56 + j20.20$                | $4.38 + j1.21$                |
| 960        | P1dB | $49.18 + j25.00$                | $5.04 + j1.15$                |

## 900 MHz APPLICATION CIRCUIT

**Table 10. 900 MHz Performance** (In Freescale Application Circuit, 50 ohm system)  $V_{DD} = 28$  Vdc,  $I_{DQ1} = 106$  mA,  $I_{DQ2} = 285$  mA,  $P_{out} = 3.2$  W Avg., Channel Bandwidth = 3.84 MHz, Input Signal PAR = 7.5 dB @ 0.01% Probability on CCDF

| Frequency (MHz) | $G_{ps}$ (dB) | PAE (%) | ACPR (dBc) |
|-----------------|---------------|---------|------------|
| 920             | 36.6          | 16.1    | -48.0      |
| 940             | 36.8          | 16.7    | -48.7      |
| 960             | 36.6          | 17.3    | -48.6      |

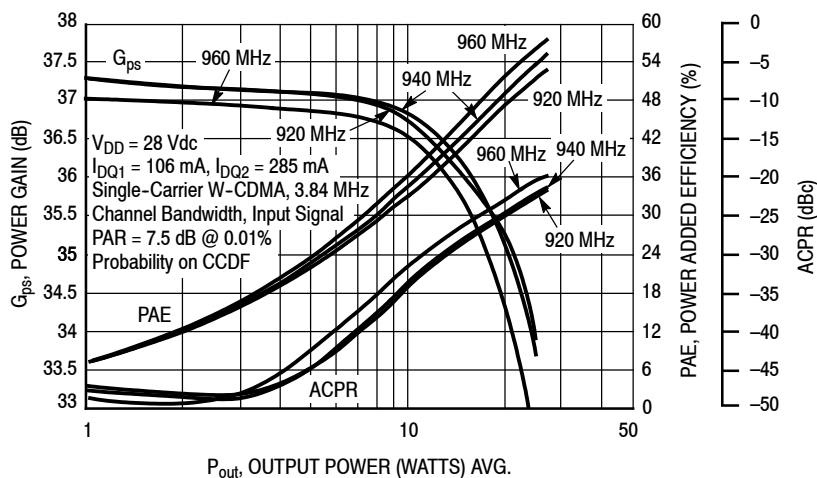


**Figure 8. Single-Carrier W-CDMA Power Gain, Power Added Efficiency and ACPR versus Output Power**

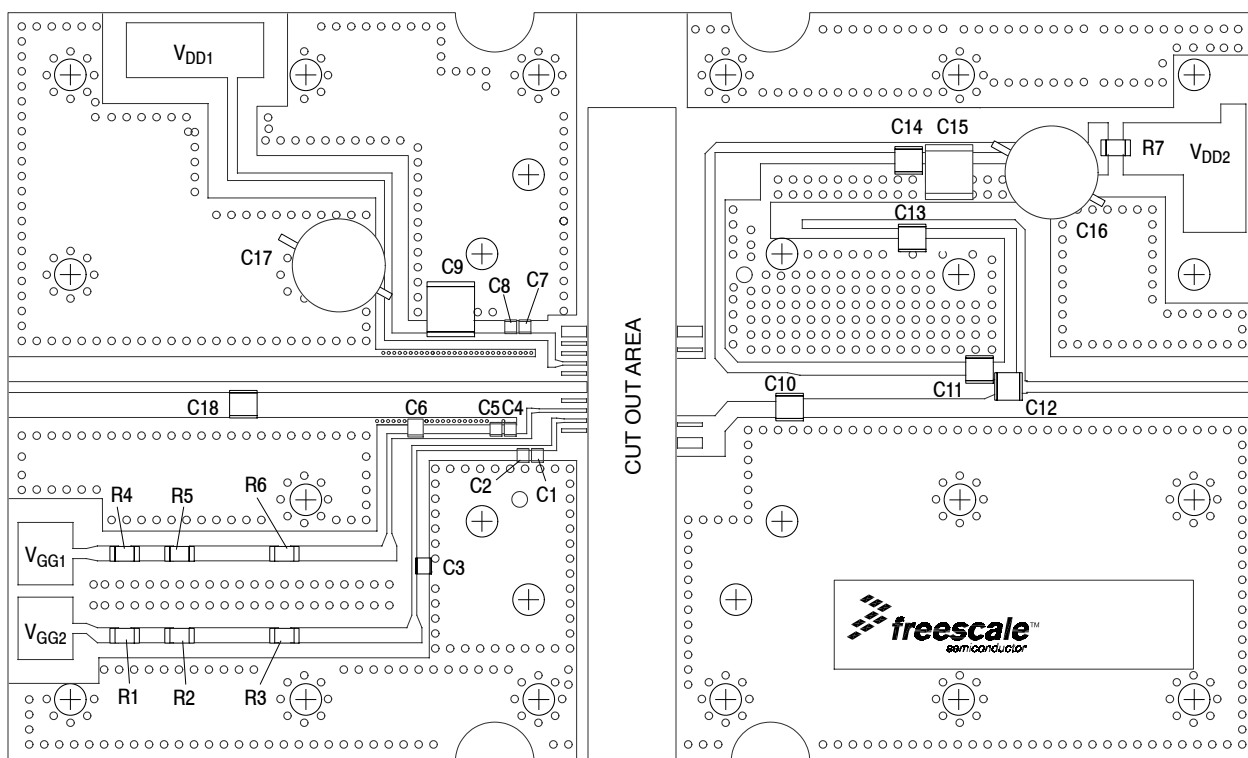


**Figure 9. MMRF2005N Test Circuit Component Layout — 700 MHz**

**Table 11. MMRF2005N Test Circuit Component Designations and Values — 700 MHz**

| Part                   | Description                               | Part Number          | Manufacturer |
|------------------------|-------------------------------------------|----------------------|--------------|
| C1, C4, C7             | 47 pF Chip Capacitors                     | ATC600F470JT250XT    | ATC          |
| C2, C5, C8             | 10 nF, 50 V Chip Capacitors               | C0603C103J5RAC       | Kemet        |
| C3, C6                 | 1 $\mu$ F, 50 V Chip Capacitors           | GRM21BR71H105KA12L   | Murata       |
| C9, C15                | 10 $\mu$ F, 50 V Chip Capacitors          | GRM55DR61H106KA88L   | Murata       |
| C10                    | 13 pF Chip Capacitor                      | ATC100B130JT500XT    | ATC          |
| C11                    | 7.5 pF Chip Capacitor                     | ATC100B7R5CT500XT    | ATC          |
| C12                    | 6.8 pF Chip Capacitor                     | ATC100B6R8CT500XT    | ATC          |
| C13, C14               | 47 pF Chip Capacitors                     | ATC100B470JT500XT    | ATC          |
| C16, C17               | 100 $\mu$ F, 50 V Electrolytic Capacitors | MCGPR35V337M10X16-RH | Multicomp    |
| C18                    | 1.8 pF Chip Capacitor                     | ATC100B1R8BT500XT    | ATC          |
| R1, R2, R3, R4, R5, R6 | 1000 $\Omega$ , 1/4 W Chip Resistors      | CRCW12061K00FKEA     | Vishay       |
| R7                     | 0 $\Omega$ , 3A Chip Resistor             | CRCW12060000Z0EA     | Vishay       |
| PCB                    | 0.020", $\epsilon_r = 3.5$                | RF-35                | Taconic      |

## TYPICAL CHARACTERISTICS — 700 MHz

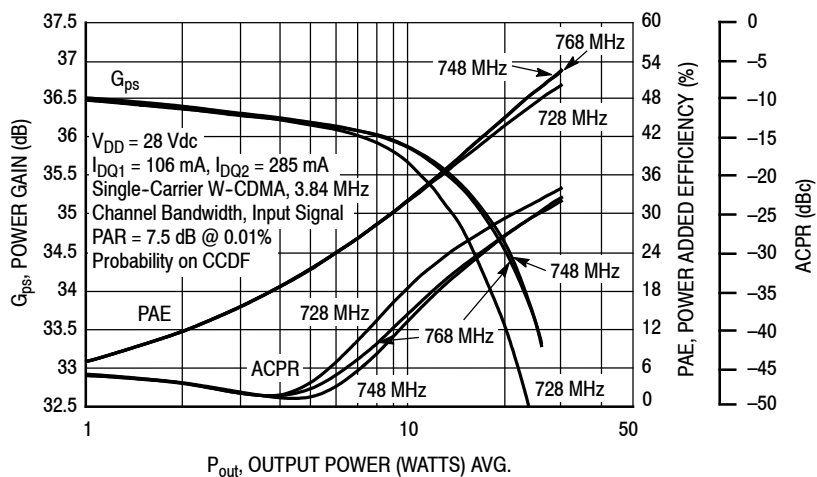


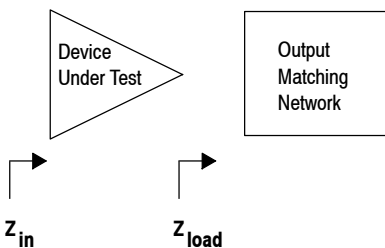
**Figure 10. Single-Carrier W-CDMA Power Gain, Power Added Efficiency and ACPR versus Output Power — 700 MHz**

**Table 12. Series Equivalent Input and Load Impedance — 700 MHz**

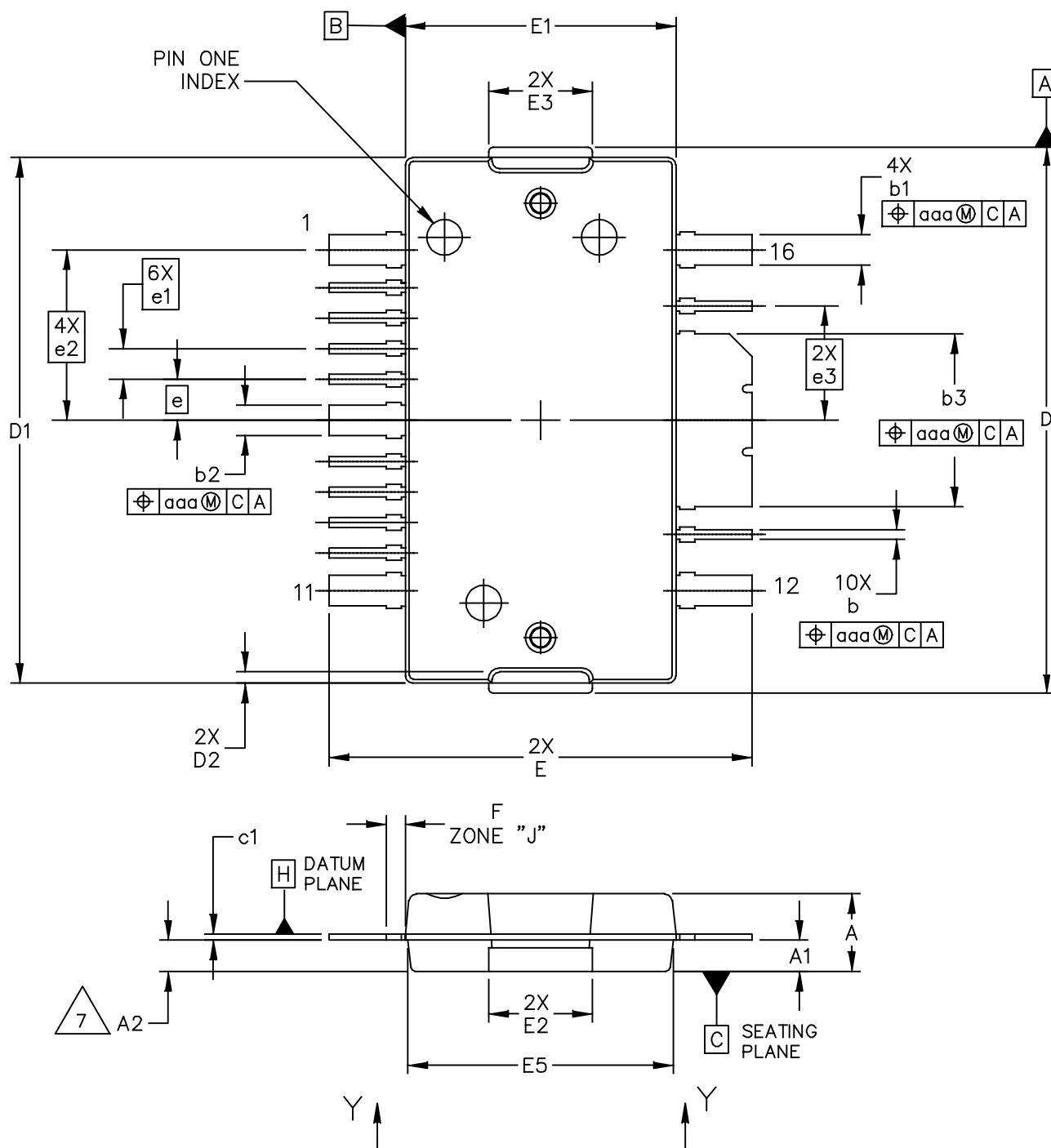
| f<br>MHz | $Z_{in}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|----------------------|------------------------|
| 710      | $25.21 - j1.21$      | $8.57 + j2.52$         |
| 720      | $33.76 + j5.36$      | $8.52 + j2.46$         |
| 730      | $38.78 + j1.40$      | $8.44 + j2.34$         |
| 740      | $40.14 - j0.76$      | $8.36 + j2.16$         |
| 750      | $35.46 - j1.15$      | $8.30 + j2.00$         |
| 760      | $34.65 - j0.53$      | $8.32 + j1.90$         |
| 770      | $34.75 - j0.43$      | $8.31 + j1.86$         |
| 780      | $36.20 + j0.81$      | $8.27 + j1.98$         |
| 790      | $36.18 + j1.33$      | $8.23 + j2.12$         |

$Z_{in}$  = Device input impedance as measured from gate to ground.

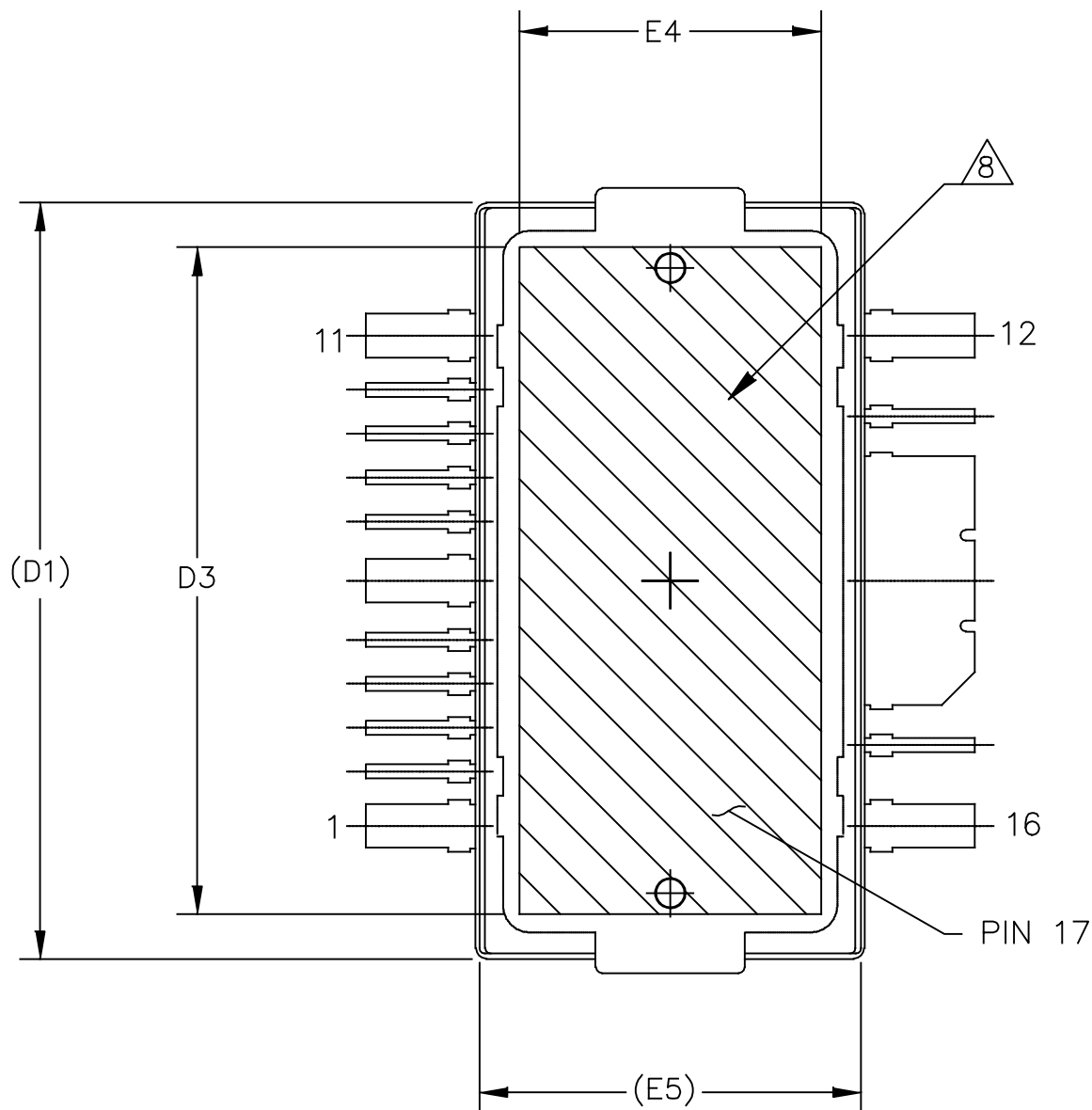
$Z_{load}$  = Test circuit impedance as measured from drain to ground.



## PACKAGE DIMENSIONS



|                                                         |  |                    |                          |                            |             |
|---------------------------------------------------------|--|--------------------|--------------------------|----------------------------|-------------|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. |  | MECHANICAL OUTLINE |                          | PRINT VERSION NOT TO SCALE |             |
| TITLE:<br><br>TO-270 WIDE BODY<br>16 LEAD               |  |                    | DOCUMENT NO: 98ASA10754D |                            | REV: A      |
|                                                         |  |                    | CASE NUMBER: 1886-01     |                            | 31 AUG 2007 |
|                                                         |  |                    | STANDARD: NON-JEDEC      |                            |             |



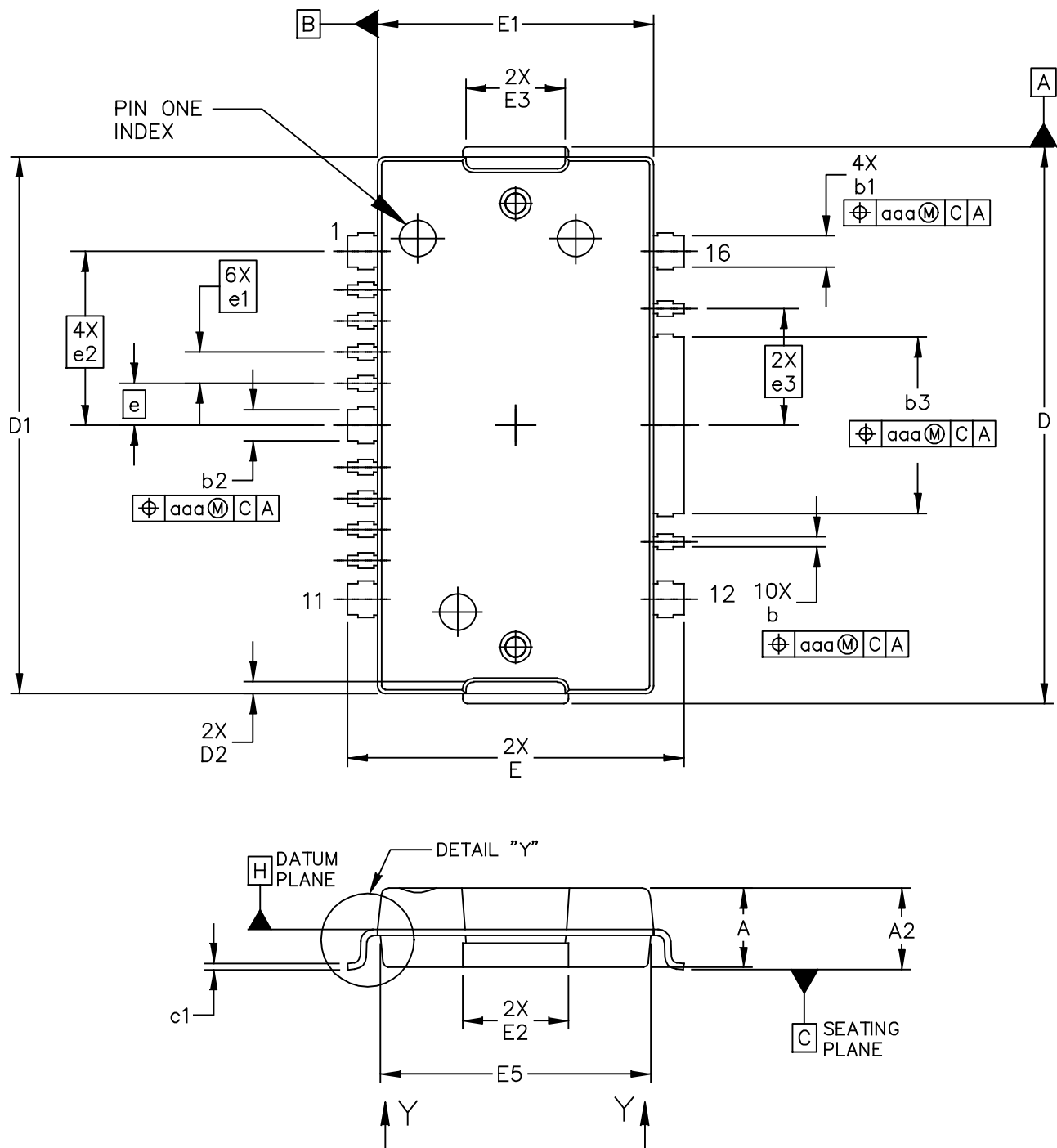
VIEW Y-Y

|                                                         |                          |                            |             |
|---------------------------------------------------------|--------------------------|----------------------------|-------------|
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| TITLE:<br>TO-270 WIDE BODY<br>16 LEAD                   | DOCUMENT NO: 98ASA10754D |                            | REV: A      |
|                                                         | CASE NUMBER: 1886-01     |                            | 31 AUG 2007 |
|                                                         | STANDARD: NON-JEDEC      |                            |             |

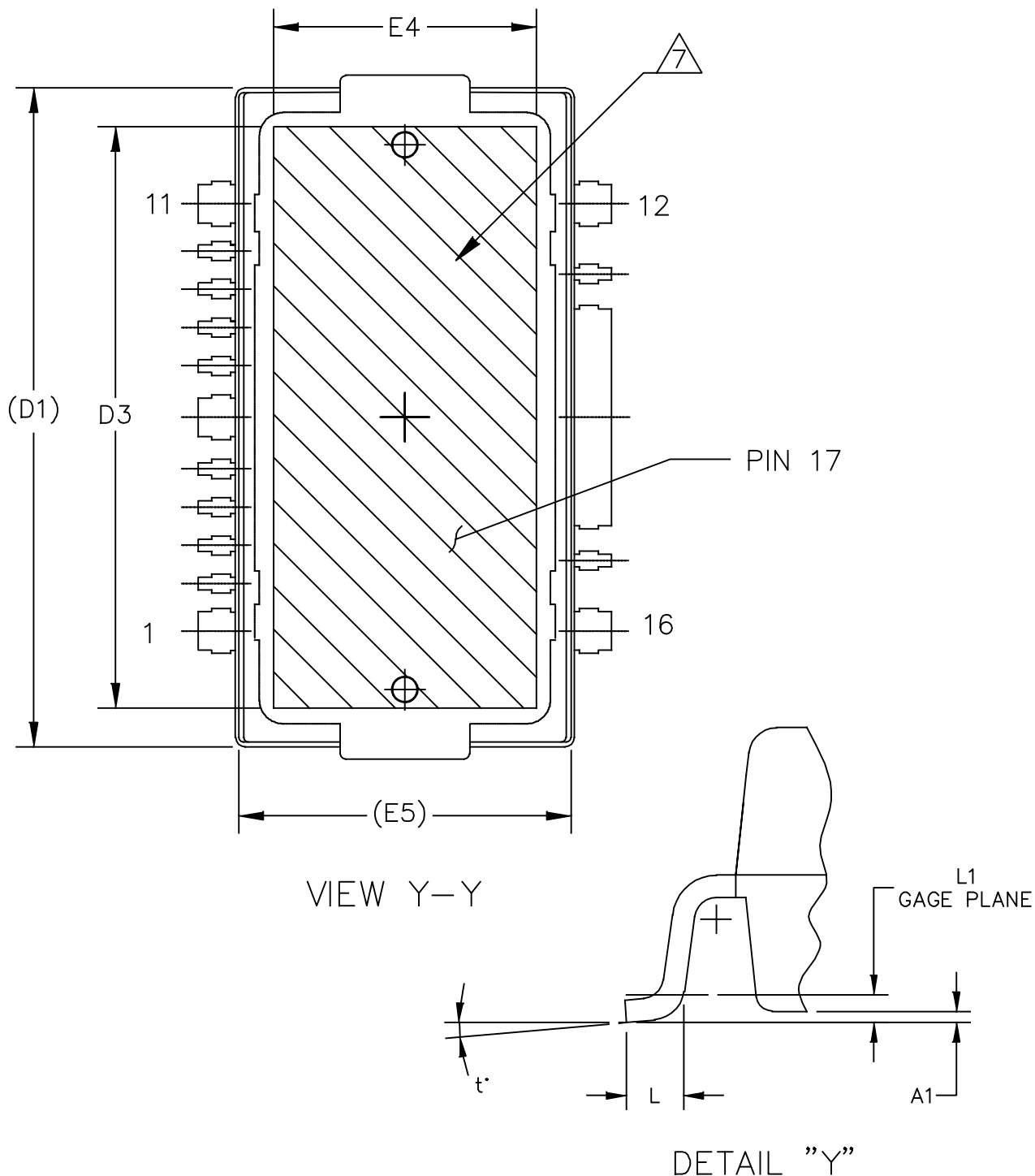
NOTES:

1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DATUM PLANE -H- IS LOCATED AT THE 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 "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 (0.15) PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
5. DIMENSIONS "b", "b1", "b2" AND "b3" DO NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 (0.13) TOTAL IN EXCESS OF THE "b", "b1", "b2" AND "b3" DIMENSIONS AT MAXIMUM MATERIAL CONDITION.
6. DATUM -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-.
7. DIMENSION A2 APPLIES WITHIN ZONE "J" ONLY.
8. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG. HATCHED AREA SHOWN IS ON THE SAME PLANE.

| INCH                                                    |      |      | MILLIMETER         |       | INCH                     |                            |      | MILLIMETER  |      |
|---------------------------------------------------------|------|------|--------------------|-------|--------------------------|----------------------------|------|-------------|------|
| DIM                                                     | MIN  | MAX  | MIN                | MAX   | DIM                      | MIN                        | MAX  | MIN         | MAX  |
| A                                                       | .100 | .104 | 2.54               | 2.64  | F                        | .025 BSC                   |      | 0.64 BSC    |      |
| A1                                                      | .039 | .043 | 0.99               | 1.09  | b                        | .011                       | .017 | 0.28        | 0.43 |
| A2                                                      | .040 | .042 | 1.02               | 1.07  | b1                       | .037                       | .043 | 0.94        | 1.09 |
| D                                                       | .712 | .720 | 18.08              | 18.29 | b2                       | .037                       | .043 | 0.94        | 1.09 |
| D1                                                      | .688 | .692 | 17.48              | 17.58 | b3                       | .225                       | .231 | 5.72        | 5.87 |
| D2                                                      | .011 | .019 | 0.28               | 0.48  | c1                       | .007                       | .011 | .18         | .28  |
| D3                                                      | .600 | ---  | 15.24              | ---   | e                        | .054 BSC                   |      | 1.37 BSC    |      |
| E                                                       | .551 | .559 | 14                 | 14.2  | e1                       | .040 BSC                   |      | 1.02 BSC    |      |
| E1                                                      | .353 | .357 | 8.97               | 9.07  | e2                       | .224 BSC                   |      | 5.69 BSC    |      |
| E2                                                      | .132 | .140 | 3.35               | 3.56  | e3                       | .150 BSC                   |      | 3.81 BSC    |      |
| E3                                                      | .124 | .132 | 3.15               | 3.35  | aaa                      | .004                       |      | .10         |      |
| E4                                                      | .270 | ---  | 6.86               | ---   |                          |                            |      |             |      |
| E5                                                      | .346 | .350 | 8.79               | 8.89  |                          |                            |      |             |      |
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| TITLE:<br>TO-270 WIDE BODY<br>16 LEAD                   |      |      |                    |       | DOCUMENT NO: 98ASA10754D |                            |      | REV: A      |      |
|                                                         |      |      |                    |       | CASE NUMBER: 1886-01     |                            |      | 31 AUG 2007 |      |
|                                                         |      |      |                    |       | STANDARD: NON-JEDEC      |                            |      |             |      |



|                                                         |  |                          |                            |
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| TITLE: TO-270 WIDE BODY<br>16 LEAD,<br>GULL WING        |  | DOCUMENT NO: 98ASA10755D | REV: A                     |
|                                                         |  | CASE NUMBER: 1887-01     | 31 AUG 2007                |
|                                                         |  | STANDARD: NON-JEDEC      |                            |



|                                                         |                          |                    |                            |
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| TITLE: TO-270 WIDE BODY<br>16 LEAD,<br>GULL WING        | DOCUMENT NO: 98ASA10755D |                    | REV: A                     |
|                                                         | CASE NUMBER: 1887-01     |                    | 31 AUG 2007                |
|                                                         | STANDARD: NON-JEDEC      |                    |                            |

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| INCH                                                    |      |      | MILLIMETER |                    | INCH                     |          |                            | MILLIMETER |             |
|---------------------------------------------------------|------|------|------------|--------------------|--------------------------|----------|----------------------------|------------|-------------|
| DIM                                                     | MIN  | MAX  | MIN        | MAX                | DIM                      | MIN      | MAX                        | MIN        | MAX         |
| A                                                       | .100 | .104 | 2.54       | 2.64               | L                        | .018     | .024                       | 0.46       | 0.61        |
| A1                                                      | .001 | .004 | 0.02       | 0.10               | L1                       | .010 BSC |                            | 0.25 BSC   |             |
| A2                                                      | .099 | .110 | 2.51       | 2.79               | b                        | .011     | .017                       | 0.28       | 0.43        |
| D                                                       | .712 | .720 | 18.08      | 18.29              | b1                       | .037     | .043                       | 0.94       | 1.09        |
| D1                                                      | .688 | .692 | 17.48      | 17.58              | b2                       | .037     | .043                       | 0.94       | 1.09        |
| D2                                                      | .011 | .019 | 0.28       | 0.48               | b3                       | .225     | .231                       | 5.72       | 5.87        |
| D3                                                      | .600 | ---  | 15.24      | ---                | c1                       | .007     | .011                       | 0.18       | 0.28        |
| E                                                       | .429 | .437 | 10.9       | 11.1               | e                        | .054 BSC |                            | 1.37 BSC   |             |
| E1                                                      | .353 | .357 | 8.97       | 9.07               | e1                       | .040 BSC |                            | 1.02 BSC   |             |
| E2                                                      | .132 | .140 | 3.35       | 3.56               | e2                       | .224 BSC |                            | 5.69 BSC   |             |
| E3                                                      | .124 | .132 | 3.15       | 3.35               | e3                       | .150 BSC |                            | 3.81 BSC   |             |
| E4                                                      | .270 | ---  | 6.86       | ---                | t                        | 2'       | 8'                         | 2'         | 8'          |
| E5                                                      | .346 | .350 | 8.79       | 8.89               | aaa                      | .004     |                            | 0.10       |             |
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| TITLE: TO-270 WIDE BODY<br>16 LEAD,<br>GULL WING        |      |      |            |                    | DOCUMENT NO: 98ASA10755D |          |                            |            | REV: A      |
|                                                         |      |      |            |                    | CASE NUMBER: 1887-01     |          |                            |            | 31 AUG 2007 |
|                                                         |      |      |            |                    | STANDARD: NON-JEDEC      |          |                            |            |             |

## 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
- AN1977: Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family
- AN1987: Quiescent Current Control for the RF Integrated Circuit Device Family
- 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

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

1. Go to <http://www.freescale.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        | Aug. 2015 | • Initial Release of Data Sheet |

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