

# RF LDMOS Wideband Integrated Power Amplifier

The MW6IC1940GNB wideband integrated circuit is designed with on-chip matching that makes it usable from 1920 to 2000 MHz. This multi-stage structure is rated for 26 to 32 Volt operation and covers all typical cellular base station modulation formats.

## Final Application

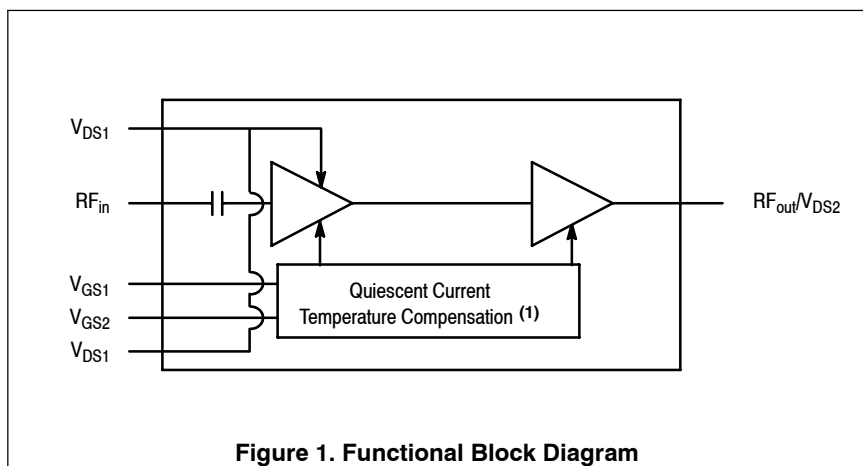
- Typical 2-Carrier W-CDMA Performance:  $V_{DD} = 28$  Volts,  $I_{DQ1} = 200$  mA,  $I_{DQ2} = 440$  mA,  $P_{out} = 4.5$  Watts Avg.,  $f = 1922.5$  MHz, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.  
Power Gain — 28.5 dB  
Power Added Efficiency — 13.5%  
IM3 @ 10 MHz Offset — -43 dBc in 3.84 MHz Bandwidth  
ACPR @ 5 MHz Offset — -46 dBc in 3.84 MHz Bandwidth

## Driver Applications

- Typical 2-Carrier W-CDMA Performance:  $V_{DD} = 28$  Volts,  $I_{DQ1} = 200$  mA,  $I_{DQ2} = 350$  mA,  $P_{out} = 26$  dBm, Full Frequency Band (1920-2000 MHz), Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF.  
Power Gain — 27 dB  
IM3 @ 10 MHz Offset — -59 dBc in 3.84 MHz Bandwidth  
ACPR @ 5 MHz Offset — -62 dBc in 3.84 MHz Bandwidth
- Capable of Handling 3:1 VSWR, @ 28 Vdc, 1960 MHz, 40 Watts CW Output Power
- Stable into a 3:1 VSWR. All Spurs Below -60 dBc @ 100 mW to 20 W CW  $P_{out}$ .

## Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters and Common Source Scattering Parameters
- On-Chip Matching (50 Ohm Input, DC Blocked, >3 Ohm Output)
- Integrated Quiescent Current Temperature Compensation with Enable/Disable Function <sup>(1)</sup>
- Integrated ESD Protection
- 225°C Capable Plastic Package
- Designed for Lower Memory Effects and Wide Instantaneous Bandwidth Applications
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 44 mm, 13 inch Reel.

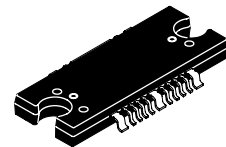


**Figure 1. Functional Block Diagram**

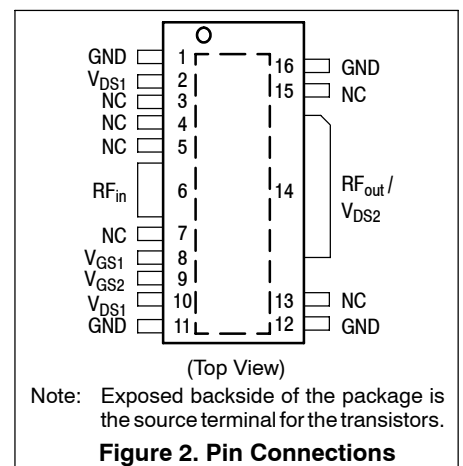
1. Refer to AN1977, *Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family* and to AN1987, *Quiescent Current Control for the RF Integrated Circuit Device Family*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1977 or AN1987.

**MW6IC1940GNBR1**

**1920-2000 MHz, 40 W, 28 V**  
**2 x W-CDMA**  
**RF LDMOS WIDEBAND**  
**INTEGRATED POWER AMPLIFIER**



**CASE 1329A-04**  
**TO-272 WB-16 GULL**  
**PLASTIC**



**Figure 2. Pin Connections**

**Table 1. Maximum Ratings**

| Rating                               | Symbol    | Value       | Unit |
|--------------------------------------|-----------|-------------|------|
| Drain-Source Voltage                 | $V_{DS}$  | -0.5, +68   | Vdc  |
| Gate-Source Voltage                  | $V_{GS}$  | -0.5, +6    | 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   |
| Input Power                          | $P_{in}$  | 20          | dBm  |

**Table 2. Thermal Characteristics**

| Characteristic                                                                          | Symbol          | Value (2,3) | Unit |
|-----------------------------------------------------------------------------------------|-----------------|-------------|------|
| Thermal Resistance, Junction to Case<br>W-CDMA Application<br>( $P_{out} = 4.5$ W Avg.) | $R_{\theta JC}$ | 2.1<br>1.2  | °C/W |
| Stage 1, 28 Vdc, $I_{DQ1} = 200$ mA                                                     |                 |             |      |
| Stage 2, 28 Vdc, $I_{DQ2} = 440$ mA                                                     |                 |             |      |

**Table 3. ESD Protection Characteristics**

| Test Methodology                      | Class        |
|---------------------------------------|--------------|
| Human Body Model (per JESD22-A114)    | 1B (Minimum) |
| Machine Model (per EIA/JESD22-A115)   | A (Minimum)  |
| Charge Device Model (per JESD22-C101) | IV (Minimum) |

**Table 4. Moisture Sensitivity Level**

| Test Methodology                      | Rating | Package Peak Temperature | Unit |
|---------------------------------------|--------|--------------------------|------|
| Per JESD 22-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 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------|------|------|------|
| <b>Functional Tests</b> (In Freescale Wideband 1920–2000 MHz Test Fixture, 50 ohm system) $V_{DD} = 28$ Vdc, $I_{DQ1} = 200$ mA, $I_{DQ2} = 440$ mA, $P_{out} = 4.5$ W Avg., $f_1 = 1922.5$ MHz, $f_2 = 1932.5$ MHz, 2-Carrier W-CDMA, 3.84 MHz Channel Bandwidth @ $\pm 5$ MHz Offset. IM3 measured in 3.84 MHz Channel Bandwidth @ $\pm 10$ MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF. |          |      |      |      |      |
| Power Gain                                                                                                                                                                                                                                                                                                                                                                                          | $G_{ps}$ | 26   | 28.5 | 31.5 | dB   |
| Power Added Efficiency                                                                                                                                                                                                                                                                                                                                                                              | PAE      | 12.5 | 13.5 | —    | %    |
| Intermodulation Distortion                                                                                                                                                                                                                                                                                                                                                                          | IM3      | —    | -43  | -40  | dBc  |
| Adjacent Channel Power Ratio                                                                                                                                                                                                                                                                                                                                                                        | ACPR     | —    | -46  | -43  | dBc  |
| Input Return Loss                                                                                                                                                                                                                                                                                                                                                                                   | IRL      | —    | -15  | -10  | dB   |

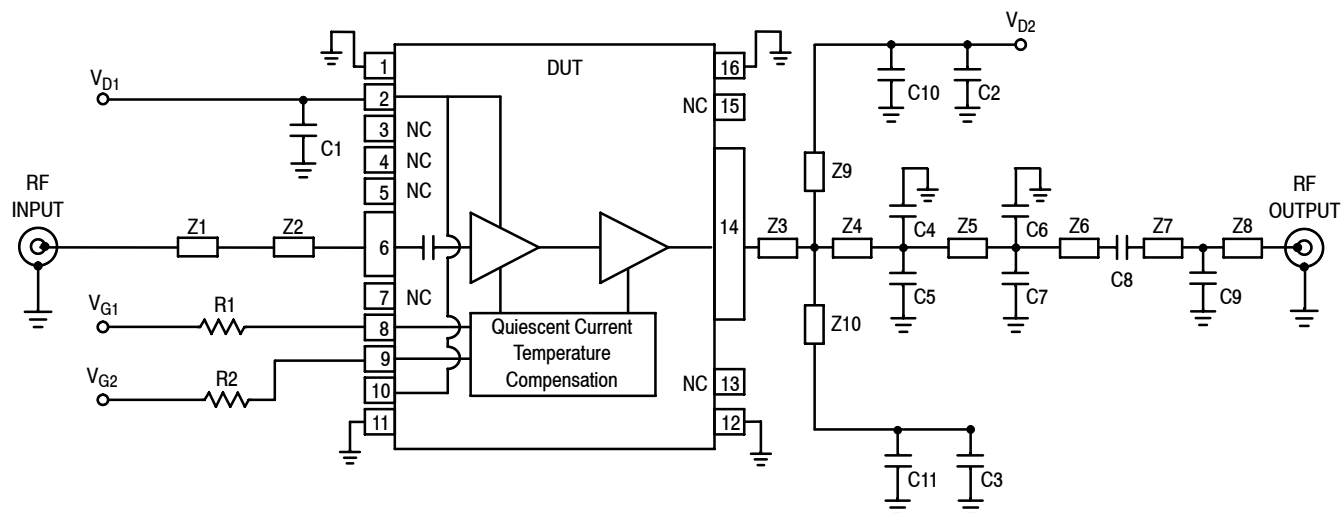
1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at <http://www.freescale.com/rf>. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1955.

(continued)

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

| Characteristic                                                                                                                                                                                                   | Symbol          | Min | Typ      | Max | Unit |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|----------|-----|------|
| <b>Typical Performances</b> (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$ , $I_{DQ1} = 210\text{ mA}$ , $I_{DQ2} = 370\text{ mA}$ , 1920-2000 MHz                                          |                 |     |          |     |      |
| Video Bandwidth @ 40 W PEP $P_{out}$ where $IM3 = -30\text{ dBc}$<br>(Tone Spacing from 100 kHz to VBW) $\Delta IMD3 = IMD3 @ \text{VBW}$<br>frequency - $IMD3 @ 100\text{ kHz} < 1\text{ dBc}$ (both sidebands) | VBW             | —   | 30       | —   | MHz  |
| Quiescent Current Accuracy over Temperature<br>with 18 k $\Omega$ Gate Feed Resistors (-10 to 85°C) (1)                                                                                                          | $\Delta I_{QT}$ | —   | $\pm 5$  | —   | %    |
| Gain Flatness in 30 MHz Bandwidth @ $P_{out} = 1\text{ W CW}$                                                                                                                                                    | $G_F$           | —   | 0.75     | —   | dB   |
| Average Deviation from Linear Phase in 30 MHz Bandwidth<br>@ $P_{out} = 1\text{ W CW}$                                                                                                                           | $\Phi$          | —   | $\pm 1$  | —   | °    |
| Average Group Delay @ $P_{out} = 1\text{ W CW}$ Including Output Matching                                                                                                                                        | Delay           | —   | 2.5      | —   | ns   |
| Part-to-Part Insertion Phase Variation @ $P_{out} = 1\text{ W CW}$ ,<br>Six Sigma Window                                                                                                                         | $\Delta\Phi$    | —   | $\pm 10$ | —   | °    |
| <b>Typical Performances</b> (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$ , $I_{DQ1} = 240\text{ mA}$ , $I_{DQ2} = 440\text{ mA}$ , 1920-2000 MHz                                          |                 |     |          |     |      |
| Saturated Pulsed Output Power<br>(12 $\mu\text{sec(on)}$ , 1% Duty Cycle)                                                                                                                                        | $P_{sat}$       | —   | 60       | —   | W    |

1. 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>. Select Documentation/Application Notes - AN1977 or AN1987.



|     |                          |         |                                                |
|-----|--------------------------|---------|------------------------------------------------|
| Z1  | 2.20" x 0.09" Microstrip | Z7*     | 0.98" x 0.082" Microstrip                      |
| Z2  | 0.13" x 0.04" Microstrip | Z8*     | 0.76" x 0.082" Microstrip                      |
| Z3  | 0.17" x 0.41" Microstrip | Z9, Z10 | 0.08" x 0.079" Microstrip                      |
| Z4* | 0.20" x 0.41" Microstrip | PCB     | Taconic TLX8-0300, 0.030", $\epsilon_r = 2.55$ |
| Z5* | 0.11" x 0.41" Microstrip |         |                                                |
| Z6* | 0.06" x 0.41" Microstrip |         |                                                |

\* Variable for tuning

Figure 3. MW6IC1940GNBR1 Test Circuit Schematic

Table 6. MW6IC1940GNBR1 Test Circuit Component Designations and Values

| Part           | Description                          | Part Number       | Manufacturer |
|----------------|--------------------------------------|-------------------|--------------|
| C1, C2, C3     | 2.2 $\mu$ F Chip Capacitors          | C3225X5R1H225MT   | TDK          |
| C4, C5, C6, C7 | 0.5 pF Chip Capacitors               | ATC100B0R5BT500XT | ATC          |
| C8             | 1.5 pF Chip Capacitor                | ATC100B1R5BT500XT | ATC          |
| C9             | 0.2 pF Chip Capacitor                | ATC100B0R2BT500XT | ATC          |
| C10, C11       | 10 pF Chip Capacitors                | ATC100B100JT500XT | ATC          |
| R1             | 4.7 k $\Omega$ , 1/4 W Chip Resistor | CRCW12064701FKEA  | Vishay       |
| R2             | 3.3 k $\Omega$ , 1/4 W Chip Resistor | CRCW12063301FKEA  | Vishay       |

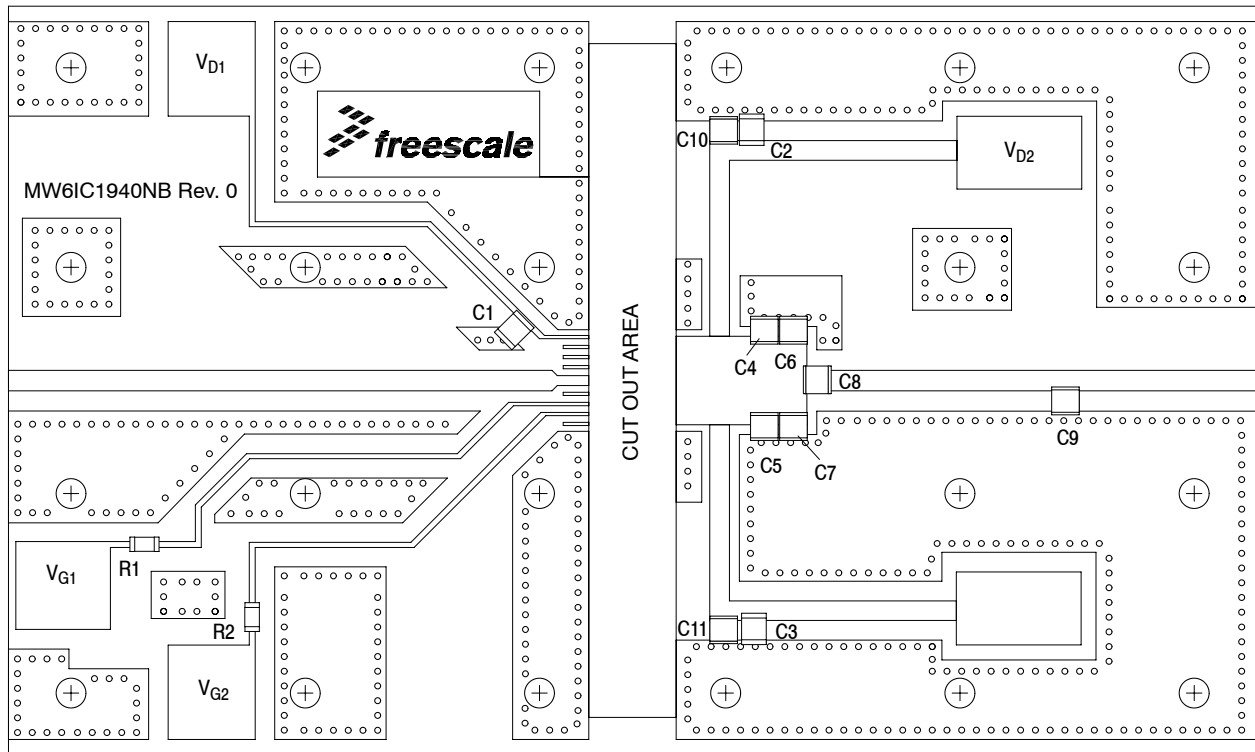


Figure 4. MW6IC1940GNBR1 Test Circuit Component Layout

# TYPICAL CHARACTERISTICS

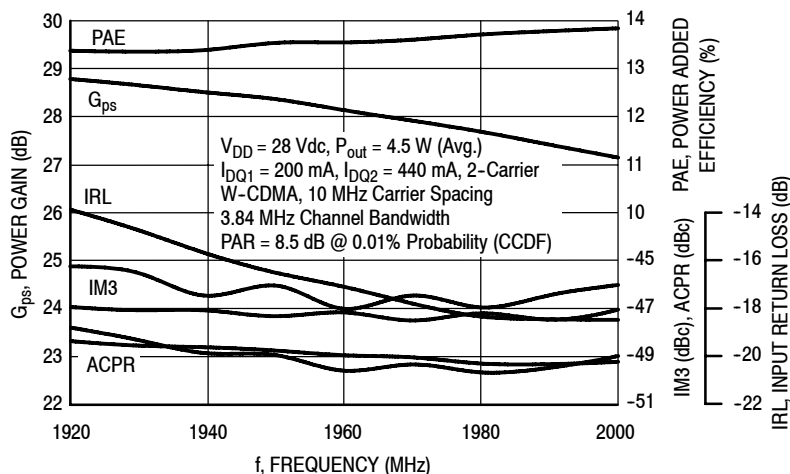


Figure 5. 2-Carrier W-CDMA Wideband Performance @  $P_{out} = 4.5$  Watts Avg.

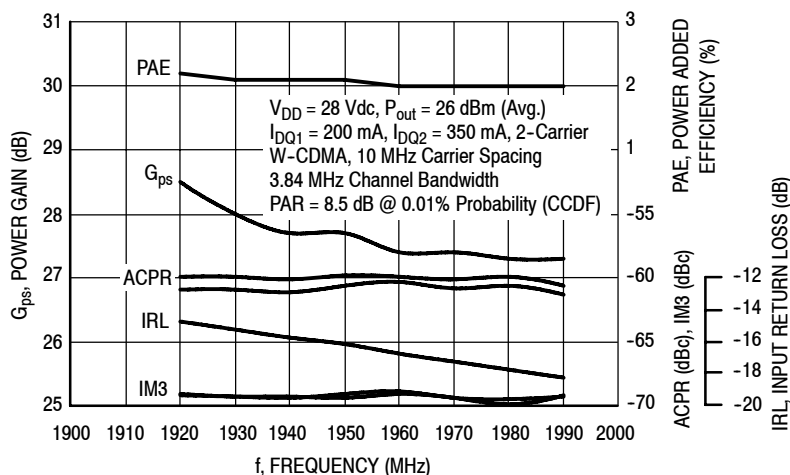


Figure 6. 2-Carrier W-CDMA Wideband Performance @  $P_{out} = 26$  dBm Avg.

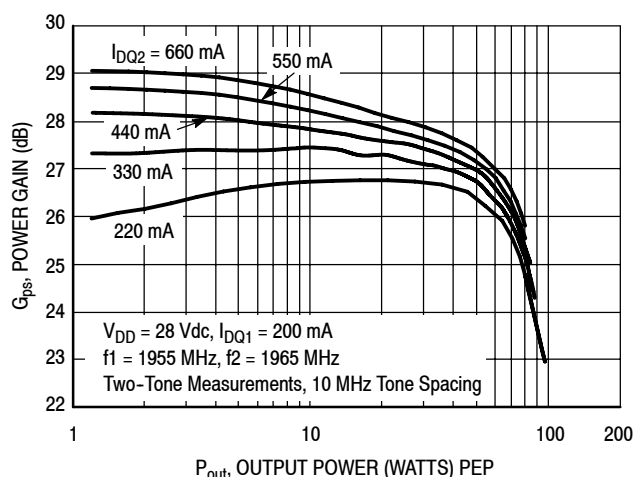


Figure 7. Two-Tone Power Gain versus Output Power @  $I_{DQ1} = 200$  mA

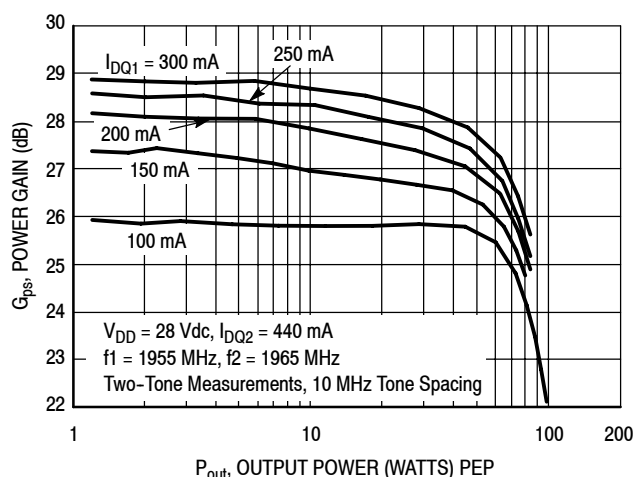
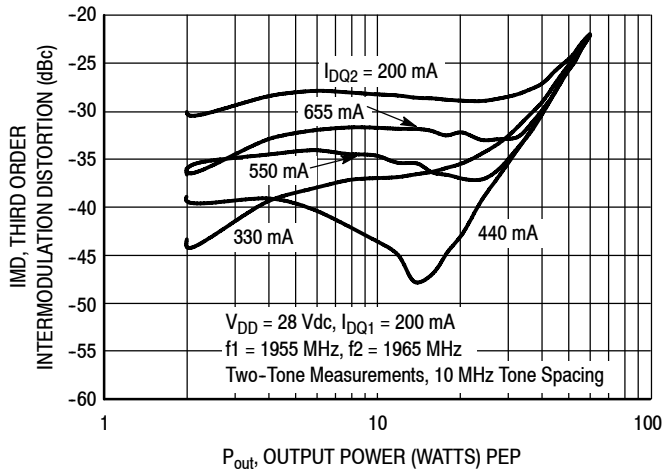
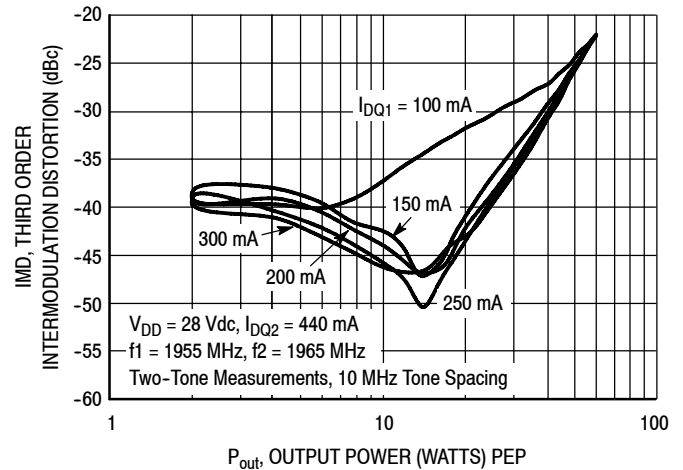


Figure 8. Two-Tone Power Gain versus Output Power @  $I_{DQ2} = 440$  mA

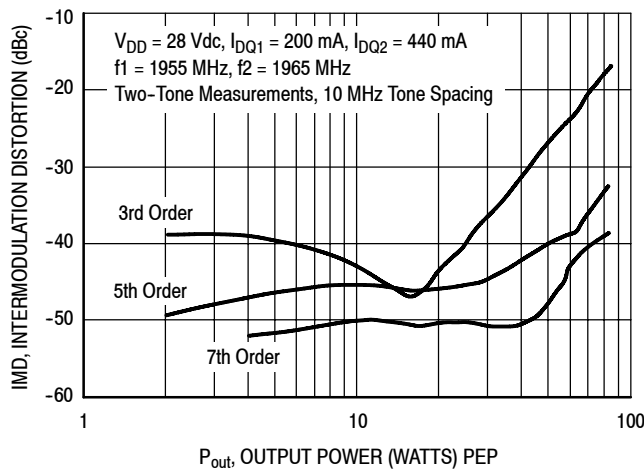
## TYPICAL CHARACTERISTICS



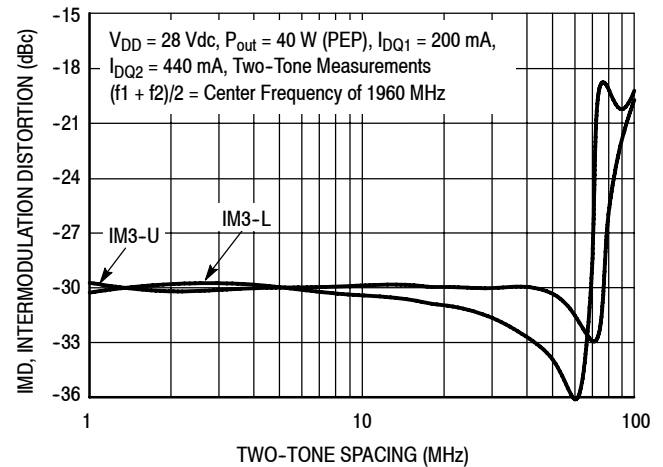
**Figure 9. Third Order Intermodulation Distortion versus Output Power @  $I_{DQ1} = 200$  mA**



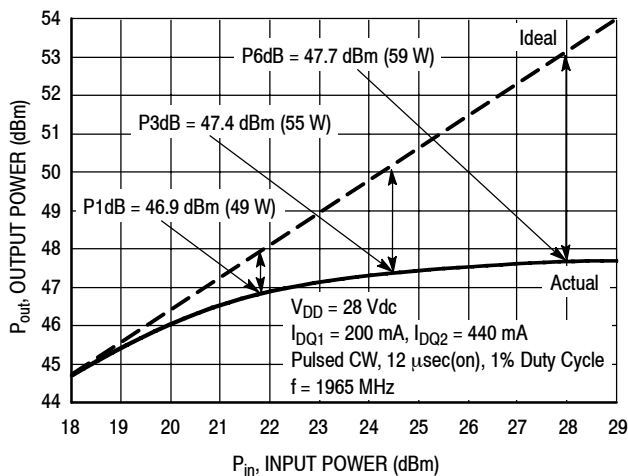
**Figure 10. Third Order Intermodulation Distortion versus Output Power @  $I_{DQ2} = 440$  mA**



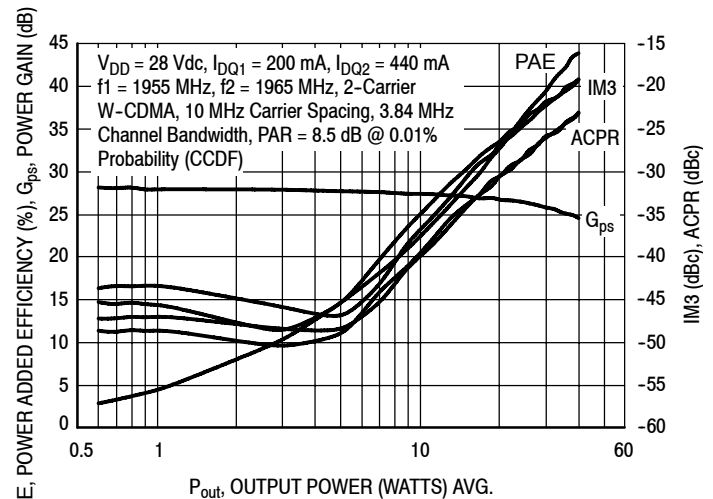
**Figure 11. Intermodulation Distortion Products versus Output Power**



**Figure 12. Intermodulation Distortion Products versus Tone Spacing**

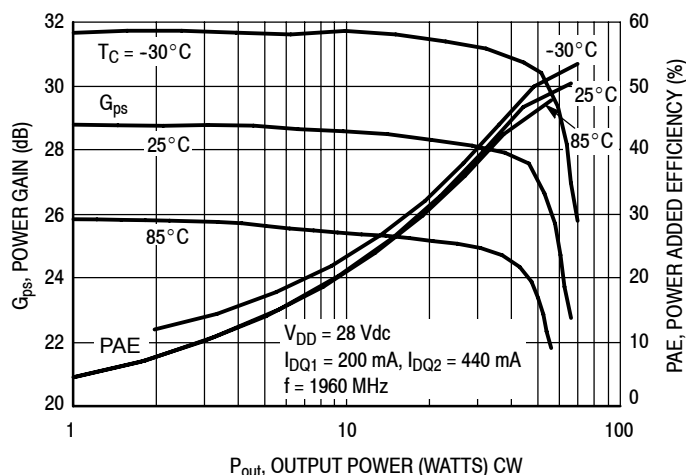


**Figure 13. Pulsed CW Output Power versus Input Power**

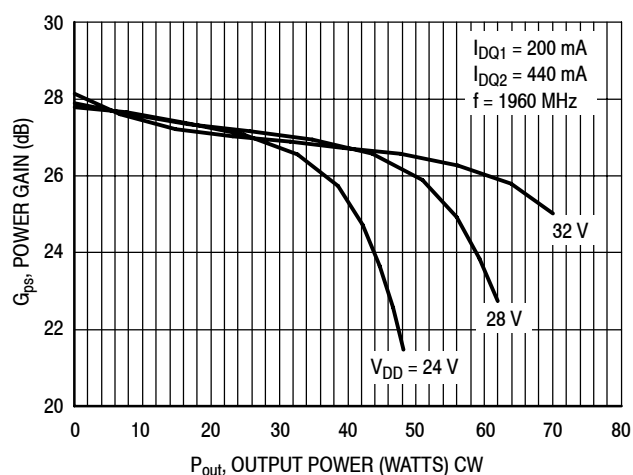


**Figure 14. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power**

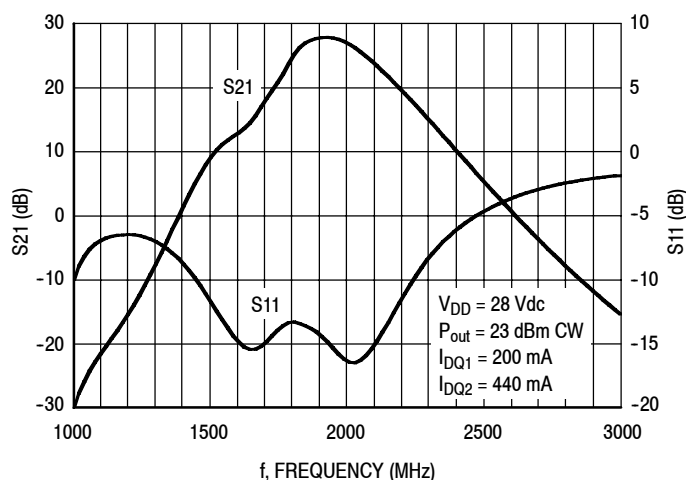
## TYPICAL CHARACTERISTICS



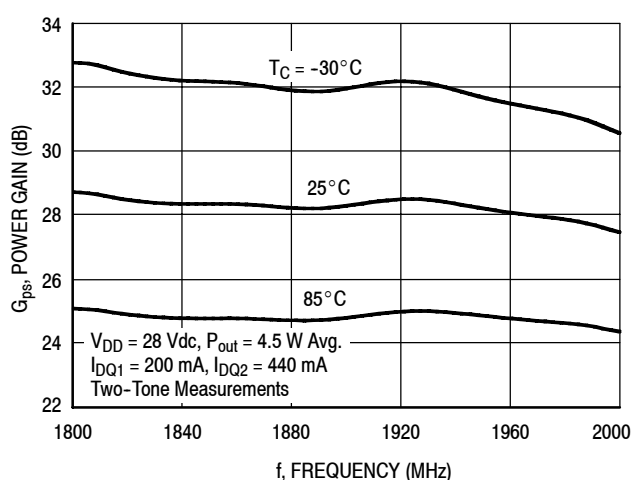
**Figure 15. Power Gain and Power Added Efficiency versus Output Power**



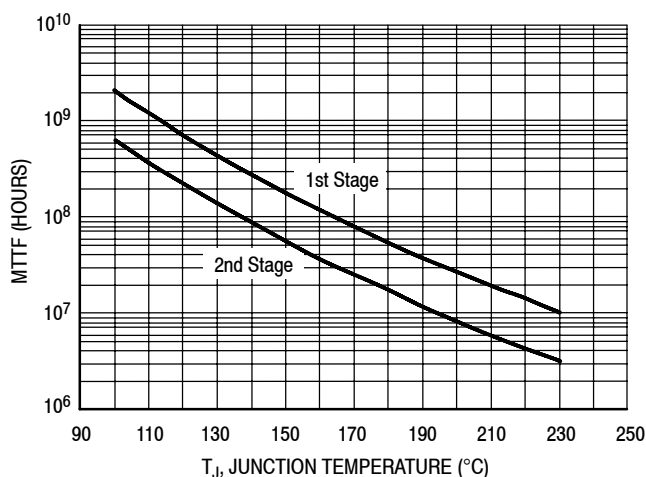
**Figure 16. Power Gain versus Output Power**



**Figure 17. Broadband Frequency Response**



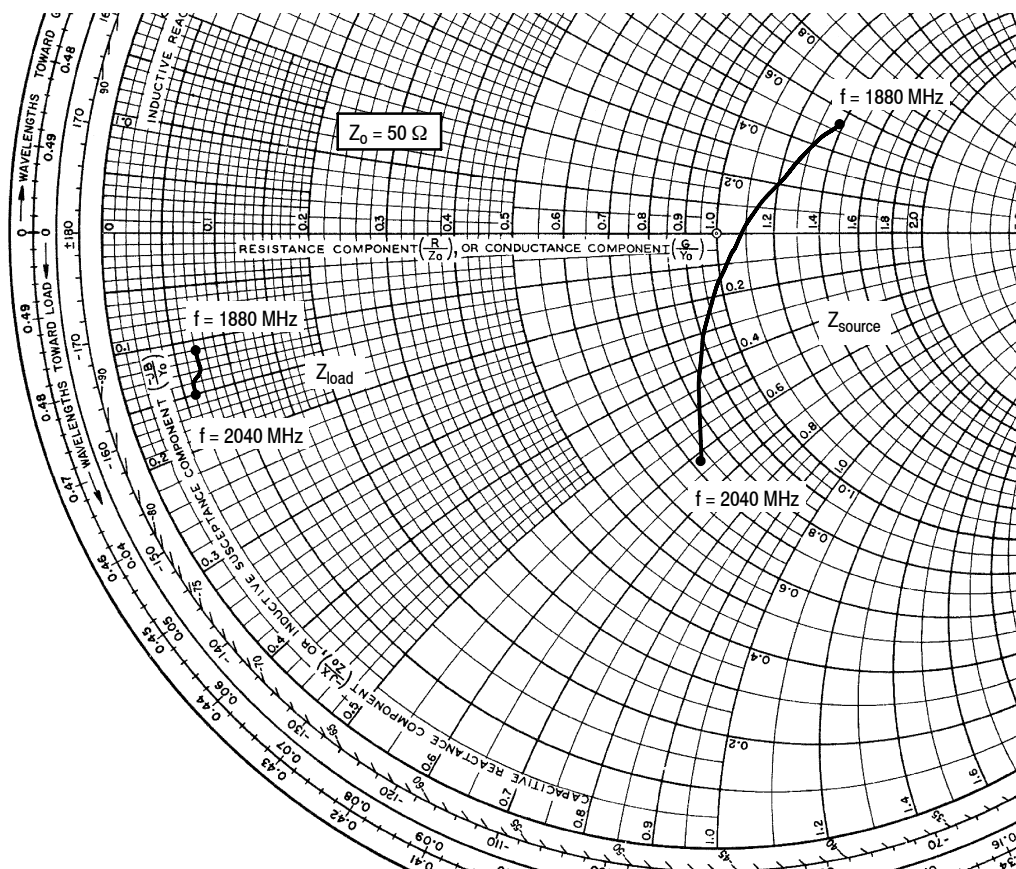
**Figure 18. Power Gain versus Frequency**



This above graph displays calculated MTTF in hours when the device is operated at  $V_{DD} = 28$  Vdc,  $P_{out} = 4.5$  W Avg., and  $PAE = 13.5\%$ .

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

**Figure 19. MTTF versus Junction Temperature**



$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ1} = 200 \text{ mA}$ ,  $I_{DQ2} = 440 \text{ mA}$ ,  $P_{out} = 4.5 \text{ W Avg.}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 1880     | $69.33 + j26.65$         | $3.65 - j5.717$        |
| 1900     | $65.20 + j19.39$         | $3.55 - j5.95$         |
| 1920     | $61.07 + j12.13$         | $3.45 - j6.18$         |
| 1940     | $56.93 + j4.87$          | $3.35 - j6.42$         |
| 1960     | $52.80 - j2.39$          | $3.25 - j6.65$         |
| 1980     | $48.67 - j9.65$          | $3.15 - j6.88$         |
| 2000     | $44.53 - j16.91$         | $3.05 - j7.12$         |
| 2020     | $40.40 - j24.17$         | $2.95 - j7.35$         |
| 2040     | $36.27 - j31.43$         | $2.85 - j7.583$        |

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

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

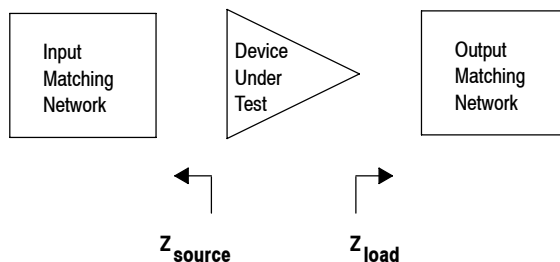


Figure 20. Series Equivalent Source and Load Impedance

**Table 7. Common Source Scattering Parameters** ( $V_{DD} = 28\text{ V}$ ,  $I_{DQ1} = 200\text{ mA}$ ,  $I_{DQ2} = 440\text{ mA}$ ,  $T_C = 25^\circ\text{C}$ , 50 ohm system)

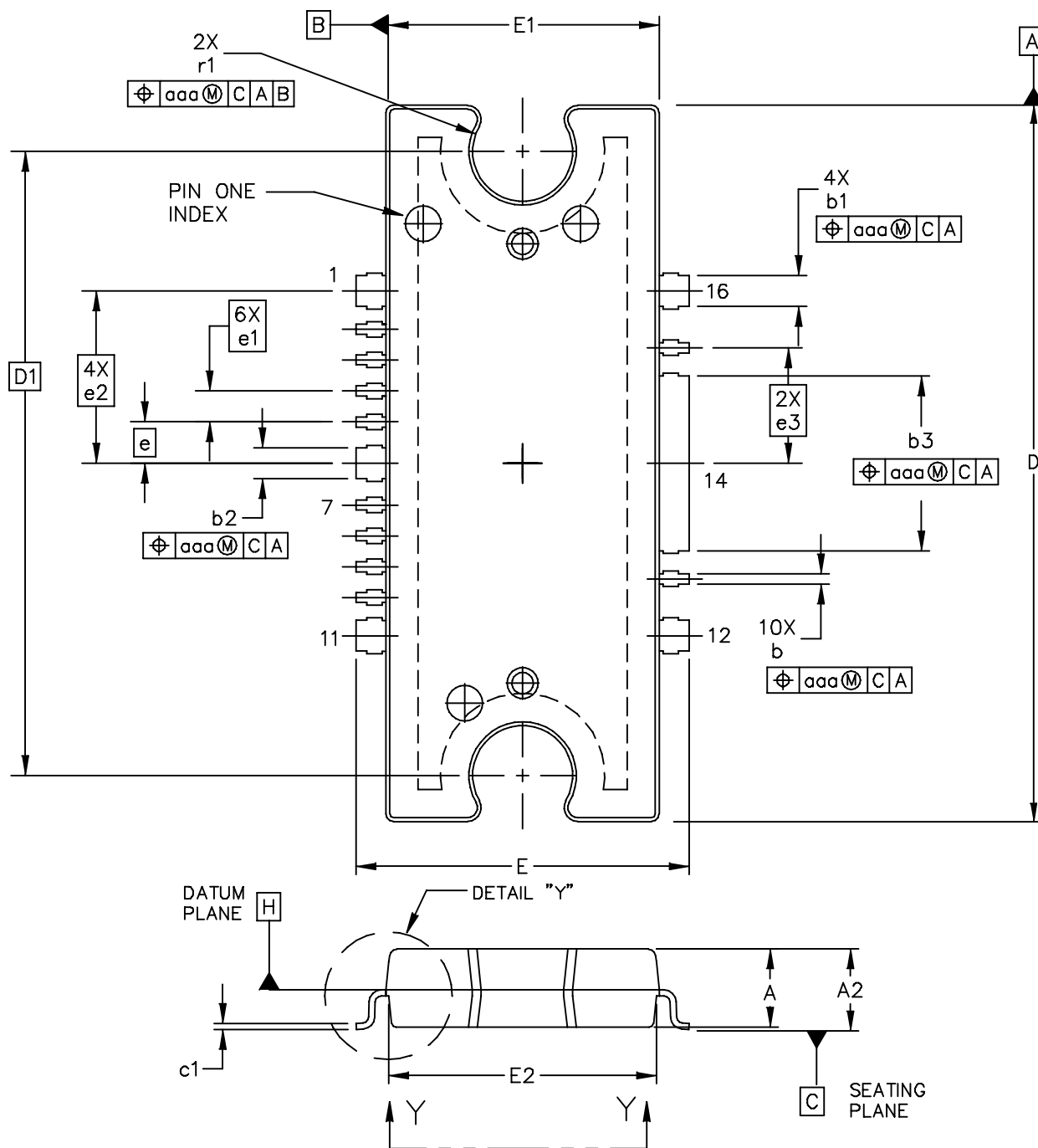
| f<br>MHz | S <sub>11</sub> |      | S <sub>21</sub> |      | S <sub>12</sub> |     | S <sub>22</sub> |      |
|----------|-----------------|------|-----------------|------|-----------------|-----|-----------------|------|
|          | S <sub>11</sub> | ∠ φ  | S <sub>21</sub> | ∠ φ  | S <sub>12</sub> | ∠ φ | S <sub>22</sub> | ∠ φ  |
| 1.00     | 0.196           | -167 | 0.014           | -146 | 0.001           | 67  | 0.994           | 172  |
| 1.05     | 0.331           | -176 | 0.026           | -164 | 0.001           | 79  | 0.991           | 172  |
| 1.10     | 0.419           | 170  | 0.041           | 178  | 0.001           | 67  | 0.990           | 171  |
| 1.15     | 0.461           | 157  | 0.057           | 160  | 0.001           | 66  | 0.990           | 170  |
| 1.20     | 0.474           | 145  | 0.068           | 147  | 0.001           | 55  | 0.990           | 169  |
| 1.25     | 0.467           | 134  | 0.084           | 144  | 0.001           | 56  | 0.989           | 168  |
| 1.30     | 0.446           | 122  | 0.116           | 143  | 0.001           | 56  | 0.987           | 167  |
| 1.35     | 0.411           | 109  | 0.171           | 138  | 0.001           | 59  | 0.987           | 166  |
| 1.40     | 0.365           | 94   | 0.256           | 131  | 0.001           | 39  | 0.986           | 165  |
| 1.45     | 0.312           | 78   | 0.384           | 122  | 0.001           | 45  | 0.984           | 164  |
| 1.50     | 0.255           | 56   | 0.580           | 111  | 0.001           | 78  | 0.982           | 163  |
| 1.55     | 0.205           | 29   | 0.879           | 98   | 0.001           | 116 | 0.980           | 161  |
| 1.60     | 0.173           | -6   | 1.345           | 85   | 0.001           | 101 | 0.977           | 159  |
| 1.65     | 0.172           | -45  | 2.121           | 70   | 0.001           | 130 | 0.973           | 157  |
| 1.70     | 0.191           | -80  | 3.478           | 53   | 0.001           | 125 | 0.968           | 153  |
| 1.75     | 0.217           | -110 | 6.197           | 33   | 0.002           | 141 | 0.958           | 147  |
| 1.80     | 0.236           | -144 | 13.515          | 5    | 0.003           | 157 | 0.920           | 130  |
| 1.85     | 0.154           | 136  | 39.126          | -69  | 0.009           | 129 | 0.453           | 23   |
| 1.90     | 0.090           | -117 | 20.507          | -160 | 0.006           | 66  | 0.816           | -159 |
| 1.95     | 0.081           | -143 | 12.215          | 170  | 0.005           | 54  | 0.881           | -178 |
| 2.00     | 0.026           | -151 | 9.054           | 147  | 0.003           | 47  | 0.892           | 175  |
| 2.05     | 0.049           | -31  | 7.340           | 126  | 0.003           | 48  | 0.894           | 172  |
| 2.10     | 0.119           | -31  | 6.199           | 105  | 0.002           | 41  | 0.895           | 170  |
| 2.15     | 0.198           | -42  | 5.298           | 85   | 0.002           | 57  | 0.895           | 169  |
| 2.20     | 0.270           | -52  | 4.537           | 66   | 0.002           | 60  | 0.896           | 168  |
| 2.25     | 0.334           | -61  | 3.875           | 47   | 0.002           | 66  | 0.899           | 167  |
| 2.30     | 0.391           | -70  | 3.282           | 29   | 0.002           | 68  | 0.905           | 167  |
| 2.35     | 0.441           | -78  | 2.771           | 13   | 0.002           | 75  | 0.913           | 166  |
| 2.40     | 0.485           | -85  | 2.330           | -3   | 0.002           | 74  | 0.921           | 166  |
| 2.45     | 0.523           | -92  | 1.965           | -17  | 0.002           | 73  | 0.930           | 165  |
| 2.50     | 0.557           | -97  | 1.661           | -31  | 0.002           | 67  | 0.937           | 165  |
| 2.55     | 0.587           | -103 | 1.413           | -43  | 0.002           | 73  | 0.944           | 164  |
| 2.60     | 0.617           | -109 | 1.213           | -55  | 0.003           | 76  | 0.950           | 163  |
| 2.65     | 0.643           | -114 | 1.044           | -66  | 0.002           | 76  | 0.955           | 162  |
| 2.70     | 0.665           | -119 | 0.905           | -77  | 0.003           | 78  | 0.959           | 162  |
| 2.75     | 0.687           | -124 | 0.789           | -88  | 0.003           | 75  | 0.961           | 161  |
| 2.80     | 0.706           | -129 | 0.693           | -99  | 0.003           | 74  | 0.963           | 160  |
| 2.85     | 0.723           | -134 | 0.610           | -109 | 0.003           | 74  | 0.966           | 160  |
| 2.90     | 0.737           | -139 | 0.538           | -120 | 0.003           | 78  | 0.967           | 159  |
| 2.95     | 0.751           | -143 | 0.475           | -130 | 0.003           | 79  | 0.969           | 158  |

(continued)

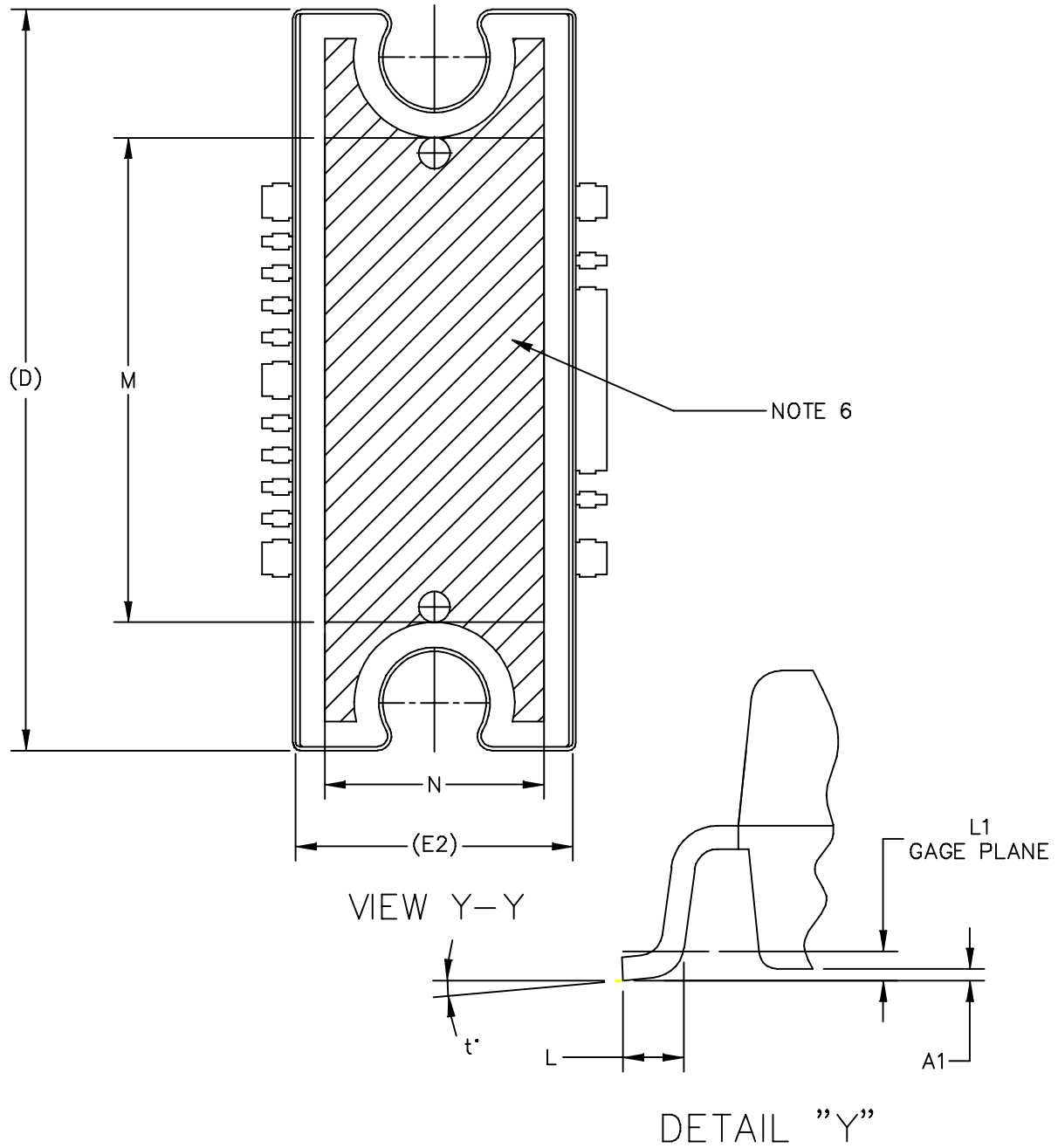
**Table 7. Common Source Scattering Parameters** ( $V_{DD} = 28\text{ V}$ ,  $I_{DQ1} = 200\text{ mA}$ ,  $I_{DQ2} = 440\text{ mA}$ ,  $T_C = 25^\circ\text{C}$ , 50 ohm system) (continued)

| f<br>MHz | S <sub>11</sub> |      | S <sub>21</sub> |      | S <sub>12</sub> |     | S <sub>22</sub> |     |
|----------|-----------------|------|-----------------|------|-----------------|-----|-----------------|-----|
|          | S <sub>11</sub> | ∠ φ  | S <sub>21</sub> | ∠ φ  | S <sub>12</sub> | ∠ φ | S <sub>22</sub> | ∠ φ |
| 3.00     | 0.763           | -147 | 0.418           | -141 | 0.003           | 80  | 0.968           | 158 |
| 3.05     | 0.774           | -152 | 0.367           | -152 | 0.004           | 75  | 0.969           | 157 |
| 3.10     | 0.785           | -156 | 0.319           | -162 | 0.004           | 80  | 0.966           | 157 |
| 3.15     | 0.796           | -159 | 0.278           | -173 | 0.004           | 75  | 0.967           | 156 |
| 3.20     | 0.806           | -163 | 0.239           | 177  | 0.004           | 77  | 0.965           | 156 |
| 3.25     | 0.815           | -166 | 0.206           | 167  | 0.005           | 75  | 0.964           | 155 |
| 3.30     | 0.825           | -170 | 0.176           | 157  | 0.005           | 73  | 0.964           | 155 |
| 3.35     | 0.833           | -173 | 0.151           | 148  | 0.005           | 74  | 0.962           | 154 |
| 3.40     | 0.841           | -176 | 0.128           | 140  | 0.005           | 71  | 0.961           | 154 |
| 3.45     | 0.849           | -178 | 0.110           | 132  | 0.005           | 71  | 0.958           | 153 |
| 3.50     | 0.856           | 179  | 0.095           | 125  | 0.005           | 65  | 0.957           | 153 |
| 3.55     | 0.864           | 177  | 0.081           | 117  | 0.005           | 63  | 0.955           | 152 |
| 3.60     | 0.872           | 174  | 0.070           | 111  | 0.006           | 66  | 0.952           | 152 |
| 3.65     | 0.877           | 172  | 0.061           | 104  | 0.006           | 60  | 0.950           | 151 |
| 3.70     | 0.885           | 170  | 0.053           | 99   | 0.006           | 61  | 0.946           | 151 |
| 3.75     | 0.891           | 169  | 0.047           | 93   | 0.006           | 57  | 0.943           | 150 |
| 3.80     | 0.898           | 167  | 0.041           | 89   | 0.006           | 57  | 0.941           | 150 |
| 3.85     | 0.902           | 166  | 0.037           | 84   | 0.006           | 52  | 0.938           | 149 |
| 3.90     | 0.911           | 164  | 0.033           | 80   | 0.006           | 55  | 0.934           | 149 |
| 3.95     | 0.915           | 163  | 0.030           | 76   | 0.007           | 54  | 0.932           | 148 |
| 4.00     | 0.921           | 162  | 0.028           | 72   | 0.007           | 55  | 0.928           | 148 |

# PACKAGE DIMENSIONS



|                                                         |  |                           |                            |
|---------------------------------------------------------|--|---------------------------|----------------------------|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. |  | MECHANICAL OUTLINE        | PRINT VERSION NOT TO SCALE |
| TITLE: TO-272WB, 16 LEAD<br>GULL WING<br>PLASTIC        |  | DOCUMENT NO: 98ASA10532D  | REV: F                     |
|                                                         |  | CASE NUMBER: 1329A-04     | 20 JUN 2007                |
|                                                         |  | STANDARD: JEDEC MO-253 BA |                            |



|                                                         |  |                           |  |                            |  |
|---------------------------------------------------------|--|---------------------------|--|----------------------------|--|
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. |  | MECHANICAL OUTLINE        |  | PRINT VERSION NOT TO SCALE |  |
| TITLE: TO-272WB, 16 LEAD<br>GULL WING<br>PLASTIC        |  | DOCUMENT NO: 98ASA10532D  |  | REV: F                     |  |
|                                                         |  | CASE NUMBER: 1329A-04     |  | 20 JUN 2007                |  |
|                                                         |  | STANDARD: JEDEC MO-253 BA |  |                            |  |

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. HATCHING REPRESENTS EXPOSED AREA OF THE HEAT SLUG. HATCHED AREA SHOWN IS ON THE SAME PLANE.

| DIM                                                     | INCH     |      | MILLIMETER         |       | DIM                       | INCH                       |      | MILLIMETER  |      |
|---------------------------------------------------------|----------|------|--------------------|-------|---------------------------|----------------------------|------|-------------|------|
|                                                         | MIN      | MAX  | MIN                | MAX   |                           | MIN                        | MAX  | MIN         | MAX  |
| A                                                       | .100     | .104 | 2.54               | 2.64  | b                         | .011                       | .017 | 0.28        | 0.43 |
| A1                                                      | .001     | .004 | 0.02               | 0.10  | b1                        | .037                       | .043 | 0.94        | 1.09 |
| A2                                                      | .099     | .110 | 2.51               | 2.79  | b2                        | .037                       | .043 | 0.94        | 1.09 |
| D                                                       | .928     | .932 | 23.57              | 23.67 | b3                        | .225                       | .231 | 5.72        | 5.87 |
| D1                                                      | .810 BSC |      | 20.57 BSC          |       | c1                        | .007                       | .011 | .18         | .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                                                      | .346     | .350 | 8.79               | 8.89  | e2                        | .224 BSC                   |      | 5.69 BSC    |      |
| L                                                       | .018     | .024 | 0.46               | 0.61  | e3                        | .150 BSC                   |      | 3.81 BSC    |      |
| L1                                                      | .01 BSC  |      | 0.25 BSC           |       | r1                        | .063                       | .068 | 1.6         | 1.73 |
| M                                                       | .600     | ---- | 15.24              | ----  | t                         | 2°                         | 8°   | 2°          | 8°   |
| N                                                       | .270     | ---- | 6.86               | ----  | aaa                       | .004                       |      | .10         |      |
| © FREESCALE SEMICONDUCTOR, INC.<br>ALL RIGHTS RESERVED. |          |      | MECHANICAL OUTLINE |       |                           | PRINT VERSION NOT TO SCALE |      |             |      |
| TITLE: TO-272 WB 16 LEAD<br>GULL WING<br>PLASTIC        |          |      |                    |       | DOCUMENT NO: 98ASA10532D  |                            |      | REV: F      |      |
|                                                         |          |      |                    |       | CASE NUMBER: 1329A-04     |                            |      | 20 JUN 2007 |      |
|                                                         |          |      |                    |       | STANDARD: JEDEC M0-253 BA |                            |      |             |      |

## PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

### Application Notes

- 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

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

## REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | Nov. 2006 | <ul style="list-style-type: none"><li>• Initial Release of Data Sheet</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 1        | Jan. 2007 | <ul style="list-style-type: none"><li>• Updated verbiage on Typical Performances table, p. 2</li><li>• Updated Part Numbers in Table 6, Component Designations and Values, to RoHS compliant part numbers, p. 3</li><li>• Added new Figure 13, Pulsed CW Output Power versus Input Power, p. 6</li><li>• Added new Figure 18, Power Gain versus Frequency, p. 7</li><li>• Replaced Figure 19, 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>• Updated Product Documentation adding AN1907 and AN3263, p. 17</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 2        | Dec. 2008 | <ul style="list-style-type: none"><li>• Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN13232, p. 1, 2</li><li>• Changed 220°C to 225°C in Capable Plastic Package bullet, p. 1</li><li>• Added Footnote 1 to Quiescent Current Temperature bullet under Features section and to callout in Fig. 1, Functional Block Diagram, p. 1</li><li>• Changed Storage Temperature Range in Max Ratings table from -65 to +200 to -65 to +150 for standardization across products, p. 2</li><li>• Added Case Operating Temperature limit to the Maximum Ratings table and set limit to 150°C, p. 2</li><li>• Operating Junction Temperature increased from 200°C to 225°C in Maximum Ratings table and related "Continuous use at maximum temperature will affect MTTF" footnote added, p. 2</li><li>• Updated verbiage on Typical Performances table, p. 3</li><li>• Updated Part Numbers in Table 6, Component Designations and Values, to latest RoHS compliant part numbers, p. 4</li><li>• Adjusted scale for Fig. 11, Intermodulation Distortion Products versus Output Power, to show wider dynamic range, p. 7</li><li>• Added new Figure 13, Pulsed CW Output Power versus Input Power, p. 7</li><li>• Added new Figure 18, Power Gain versus Frequency, p. 8</li><li>• Replaced Figure 19, MTTF versus Junction Temperature with updated graph. Removed Amps<sup>2</sup> and listed operating characteristics and location of MTTF calculator for device, p. 8</li><li>• Replaced Case Outline 1329-09, Issue L, with 1329-09, Issue M, p. 12-14. Added pin numbers 1 through 17.</li><li>• Replaced Case Outline 1329A-03 with 1329A-04, Issue F, p. 1, 15-17. Added pin numbers 1 through 17. Corrected mm dimension L for gull-wing foot from 4.90-5.06 Min-Max to 0.46-0.61 Min-Max. Corrected L1 mm dimension from .025 BSC to 0.25 BSC. Added JEDEC Standard Package Number.</li><li>• Data sheet archived. Part no longer manufactured.</li><li>• Updated Product Documentation adding AN1907 and AN3263, p. 18</li></ul> |

(continued)

## REVISION HISTORY (continued)

| Revision | Date      | Description                                                                                                                                                                                                                                                                                                        |
|----------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3        | Mar. 2009 | <ul style="list-style-type: none"><li>• Data sheet revised to reflect part status change, p. 1, 4-5, including use of applicable overlay.</li><li>• Updated Product Documentation removing AN1907 and AN3263, p. 15</li></ul>                                                                                      |
| 3.1      | Dec. 2009 | <ul style="list-style-type: none"><li>• Corrected data sheet to reflect RF Test Reduction frequency described in Product and Process Change Notification number, PCN13232, p. 1, 2</li><li>• Rev. 3.1 (MW6IC1940GNBR1) data sheet archived. Part no longer manufactured. See Rev. 4.1 for MW6IC1940NBR1.</li></ul> |

ARCHIVE INFORMATION

ARCHIVE INFORMATION

## ***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. 2006-2009. All rights reserved.

