# RF LDMOS Wideband Integrated Power Amplifiers

The MD7IC2251N wideband integrated circuit is designed with on–chip matching that makes it usable from 2110–2170 MHz. This multi–stage structure is rated for 26 to 32 volt operation and covers all typical cellular base station modulation formats.

- Typical Doherty Single–Carrier W–CDMA Characterization Performance:
  $V_{DD}$ = 28 Volts, $I_{DQ1(A+B)}$ = 80 mA, $I_{DQ2A}$ = 260 mA, $V_{GS2B}$ = 1.4 Vdc, $P_{out}$ = 12 Watts Avg., IQ Magnitude Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

| Frequency | $G_{ps}$ (dB) | PAE (%) | Output PAR (dB) | ACPR (dBc) |
|---|---|---|---|---|
| 2110 MHz | 28.8 | 38.2 | 7.1 | –34.6 |
| 2140 MHz | 29.0 | 37.9 | 7.1 | –36.2 |
| 2170 MHz | 29.2 | 37.4 | 6.9 | –36.1 |

- Capable of Handling 10:1 VSWR, @ 32 Vdc, 2140 MHz, 63 Watts CW Output Power (3 dB Input Overdrive from Rated $P_{out}$)
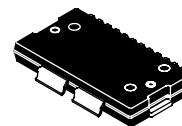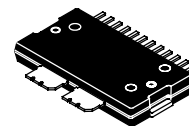- Typical $P_{out}$ @ 3 dB Compression Point $\simeq$ 58 Watts [1]

**Features**

- 100% PAR Tested for Guaranteed Output Power Capability
- Production Tested in a Symmetrical Doherty Configuration
- Characterized with Large–Signal Load–Pull Parameters and Common Source S–Parameters
- On–Chip Matching (50 Ohm Input, DC Blocked)
- Integrated Quiescent Current Temperature Compensation with Enable/Disable Function [2]
- Integrated ESD Protection
- 225°C Capable Plastic Package
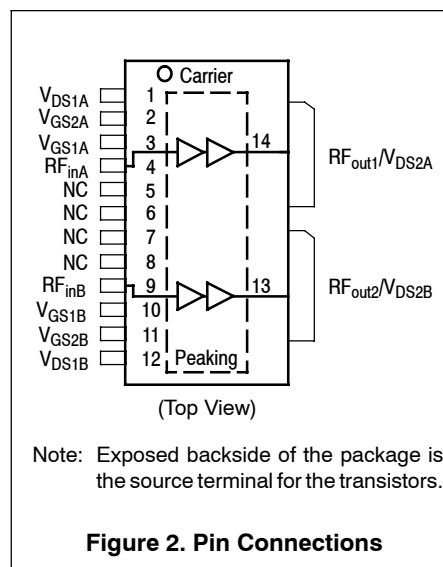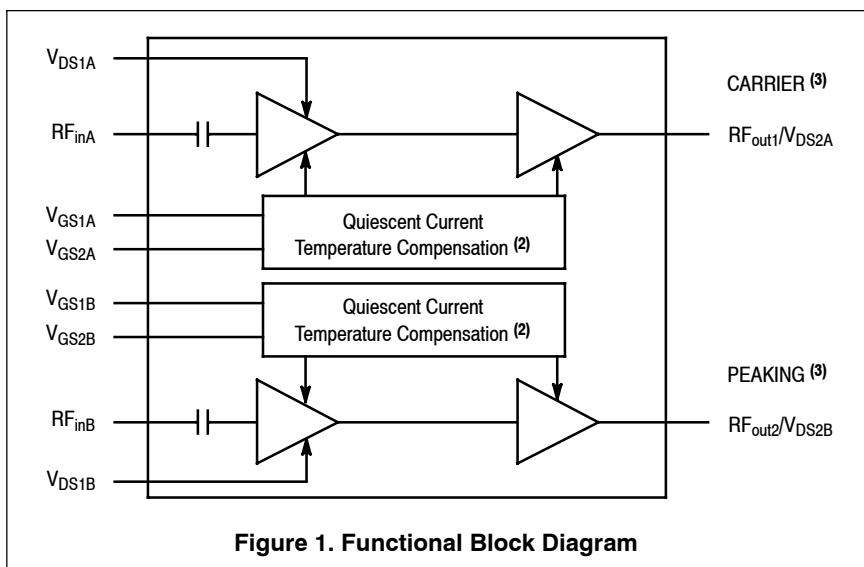- In Tape and Reel. R1 Suffix = 500 Units, 44 mm Tape Width, 13 inch Reel.

## MD7IC2251NR1
## MD7IC2251GNR1

**2110–2170 MHz, 12 W AVG., 28 V SINGLE W–CDMA RF LDMOS WIDEBAND INTEGRATED POWER AMPLIFIERS**

TO–270 WB–14 PLASTIC MD7IC2251NR1

TO–270 WB–14 GULL PLASTIC MD7IC2251GNR1



**Figure 1. Functional Block Diagram**



(Top View)

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

**Figure 2. Pin Connections**

1. P3dB = $P_{avg}$ + 7.0 dB where $P_{avg}$ is the average output power measured using an unclipped W–CDMA single-carrier input signal where output PAR is compressed to 7.0 dB @ 0.01% probability on CCDF.
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. Select Documentation/Application Notes – AN1977 or AN1987.
3. Peaking and Carrier orientation is determined by the test fixture design.

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## Table 1. Maximum Ratings

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain–Source Voltage | $V_{DS}$ | –0.5, +65 | Vdc |
| Gate–Source Voltage | $V_{GS}$ | –0.5, +10 | Vdc |
| Operating Voltage | $V_{DD}$ | 32, +0 | 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 | $P_{in}$ | 28 | dBm |

## Table 2. Thermal Characteristics

| Characteristic | Symbol | Value [2,3] | Unit |
|---|---|---|---|
| **Final Doherty Application** | | | |
| Thermal Resistance, Junction to Case<br>  Case Temperature 78°C, $P_{out}$ = 12 W CW<br>    Stage 1, 28 Vdc, $I_{DQ1(A+B)}$ = 80 mA<br>    Stage 2, 28 Vdc, $I_{DQ2A}$ = 260 mA, $V_{GS2B}$ = 1.4 Vdc<br>  Case Temperature 89°C, $P_{out}$ = 50 W CW<br>    Stage 1, 28 Vdc, $I_{DQ1(A+B)}$ = 80 mA<br>    Stage 2, 28 Vdc, $I_{DQ2A}$ = 260 mA, $V_{GS2B}$ = 1.4 Vdc | $R_{\theta JC}$ | <br><br>4.8<br>1.5<br><br>3.7<br>1.0 | °C/W |

## 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) | II |

## 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 [4]** | | | | | |
| Zero Gate Voltage Drain Leakage Current<br>  ($V_{DS}$ = 65 Vdc, $V_{GS}$ = 0 Vdc) | $I_{DSS}$ | — | — | 10 | μAdc |
| Zero Gate Voltage Drain Leakage Current<br>  ($V_{DS}$ = 28 Vdc, $V_{GS}$ = 0 Vdc) | $I_{DSS}$ | — | — | 1 | μAdc |
| Gate–Source Leakage Current<br>  ($V_{GS}$ = 1.5 Vdc, $V_{DS}$ = 0 Vdc) | $I_{GSS}$ | — | — | 1 | μAdc |
| **Stage 1 – On Characteristics [4]** | | | | | |
| Gate Threshold Voltage<br>  ($V_{DS}$ = 10 Vdc, $I_D$ = 23 μAdc) | $V_{GS(th)}$ | 1.2 | 2.0 | 2.7 | Vdc |
| Gate Quiescent Voltage<br>  ($V_{DS}$ = 28 Vdc, $I_{DQ1(A+B)}$ = 80 mAdc) | $V_{GS(Q)}$ | — | 2.7 | — | Vdc |
| Fixture Gate Quiescent Voltage<br>  ($V_{DD}$ = 28 Vdc, $I_{DQ1(A+B)}$ = 80 mAdc, Measured in Functional Test) | $V_{GG(Q)}$ | 6.0 | 7.0 | 8.0 | Vdc |

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.
4. Each side of device measured separately.

**Table 5. Electrical Characteristics** ($T_A$ = 25°C unless otherwise noted) **(continued)**

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **Stage 2 – Off Characteristics** [1] | | | | | |
| Zero Gate Voltage Drain Leakage Current ($V_{DS}$ = 65 Vdc, $V_{GS}$ = 0 Vdc) | $I_{DSS}$ | — | — | 10 | μAdc |
| Zero Gate Voltage Drain Leakage Current ($V_{DS}$ = 28 Vdc, $V_{GS}$ = 0 Vdc) | $I_{DSS}$ | — | — | 1 | μAdc |
| Gate-Source Leakage Current ($V_{GS}$ = 1.5 Vdc, $V_{DS}$ = 0 Vdc) | $I_{GSS}$ | — | — | 1 | μAdc |
| **Stage 2 – On Characteristics** [1] | | | | | |
| Gate Threshold Voltage ($V_{DS}$ = 10 Vdc, $I_D$ = 150 μAdc) | $V_{GS(th)}$ | 1.2 | 2.0 | 2.7 | Vdc |
| Gate Quiescent Voltage ($V_{DS}$ = 28 Vdc, $I_{DQ2A}$ = 260 mAdc) | $V_{GSA(Q)}$ | — | 2.7 | — | Vdc |
| Fixture Gate Quiescent Voltage ($V_{DD}$ = 28 Vdc, $I_{DQ2A}$ = 260 mAdc, Measured in Functional Test) | $V_{GGA(Q)}$ | 5.5 | 6.3 | 7.5 | Vdc |
| Drain-Source On-Voltage ($V_{GS}$ = 10 Vdc, $I_D$ = 1 Adc) | $V_{DS(on)}$ | 0.1 | 0.24 | 1.2 | Vdc |

**Functional Tests** [2,3,4] (In Freescale Doherty Production Test Fixture, 50 ohm system) $V_{DD}$ = 28 Vdc, $I_{DQ1(A+B)}$ = 80 mA, $I_{DQ2A}$ = 260 mA, $V_{GS2B}$ = 1.4 Vdc, $P_{out}$ = 12 W Avg., f = 2140 MHz, Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset.

| | | | | | |
|---|---|---|---|---|---|
| Power Gain | $G_{ps}$ | 27.6 | 28.2 | 32.0 | dB |
| Power Added Efficiency | PAE | 33.5 | 36.9 | — | % |
| Output Peak-to-Average Ratio @ 0.01% Probability on CCDF | PAR | 6.2 | 6.6 | — | dB |
| Adjacent Channel Power Ratio | ACPR | — | –34.2 | –31.5 | dBc |

**Typical Broadband Performance** (In Freescale Doherty Characterization Test Fixture, 50 ohm system) $V_{DD}$ = 28 Vdc, $I_{DQ1(A+B)}$ = 80 mA, $I_{DQ2A}$ = 260 mA, $V_{GS2B}$ = 1.4 Vdc, $P_{out}$ = 12 W Avg., Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @ ±5 MHz Offset.

| Frequency | $G_{ps}$ (dB) | PAE (%) | Output PAR (dB) | ACPR (dBc) |
|---|---|---|---|---|
| 2110 MHz | 28.8 | 38.2 | 7.1 | –34.6 |
| 2140 MHz | 29.0 | 37.9 | 7.1 | –36.2 |
| 2170 MHz | 29.2 | 37.4 | 6.9 | –36.1 |

1. Each side of device measured separately.
2. Part internally matched both on input and output.
3. Measurement made with device in a Symmetrical Doherty configuration.
4. Measurement made with device in straight lead configuration before any lead forming operation is applied.

**MD7IC2251NR1 MD7IC2251GNR1**

**Table 5. Electrical Characteristics** (T$_A$ = 25°C unless otherwise noted) **(continued)**

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **Typical Performances** [1] (In Freescale Doherty Test Fixture, 50 ohm system) V$_{DD}$ = 28 Vdc, I$_{DQ1(A+B)}$ = 80 mA, I$_{DQ2A}$ = 260 mA, V$_{GS2B}$ = 1.4 Vdc, 2110–2170 MHz Bandwidth ||||||
| P$_{out}$ @ 1 dB Compression Point, CW | P1dB | — | 40 | — | W |
| P$_{out}$ @ 3 dB Compression Point [2] | P3dB | — | 58 | — | W |
| IMD Symmetry @ 18 W PEP, P$_{out}$ where IMD Third Order Intermodulation ≅ 30 dBc (Delta IMD Third Order Intermodulation between Upper and Lower Sidebands > 2 dB) | IMD$_{sym}$ | — | 25 | — | MHz |
| VBW Resonance Point (IMD Third Order Intermodulation Inflection Point) | VBW$_{res}$ | — | 65 | — | MHz |
| Quiescent Current Accuracy over Temperature with 4.7 kΩ Gate Feed Resistors (–30 to 85°C) [3]           Stage 1           Stage 2 | ΔI$_{QT}$ | —     — | 1.5     5.0 | —     — | % |
| Gain Flatness in 60 MHz Bandwidth @ P$_{out}$ = 12 W Avg. | G$_F$ | — | 0.2 | — | dB |
| Gain Variation over Temperature (–30°C to +85°C) | ΔG | — | 0.028 | — | dB/°C |
| Output Power Variation over Temperature (–30°C to +85°C) | ΔP1dB | — | 0.028 | — | dB/°C |

1. Measurement made with device in a Symmetrical Doherty configuration.
2. P3dB = P$_{avg}$ + 7.0 dB where P$_{avg}$ is the average output power measured using an unclipped W–CDMA single–carrier input signal where output PAR is compressed to 7.0 dB @ 0.01% probability on CCDF.
3. 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.
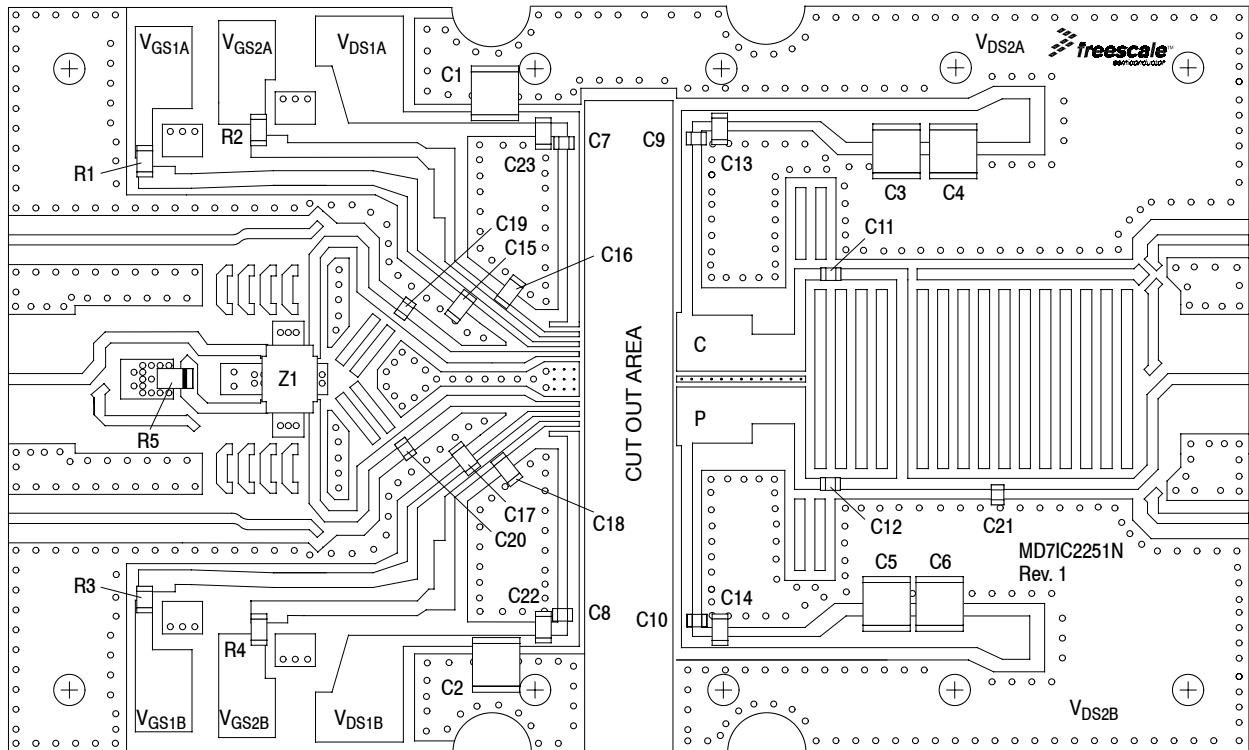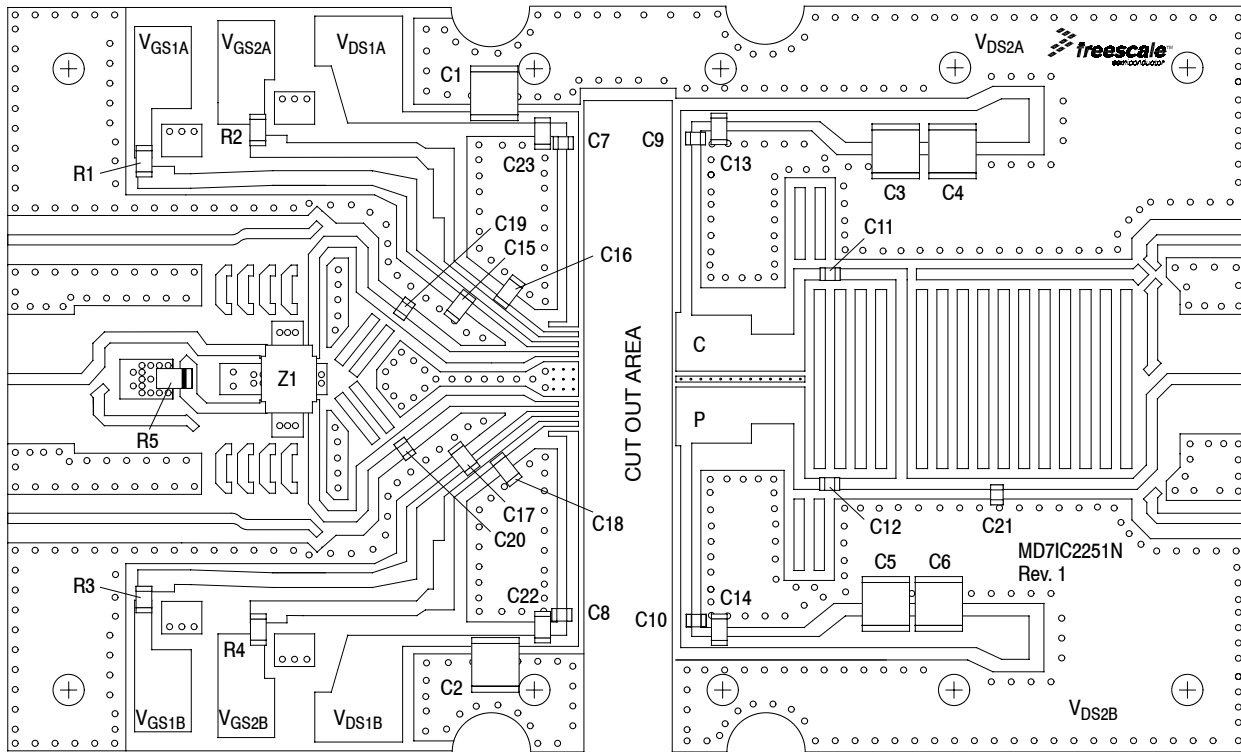
**MD7IC2251NR1 MD7IC2251GNR1**

**Figure 3. MD7IC2251NR1(GNR1) Production Test Circuit Component Layout**

**Table 6. MD7IC2251NR1(GNR1) Production Test Circuit Component Designations and Values**

| Part | Description | Part Number | Manufacturer |
|---|---|---|---|
| C1, C2, C3, C4, C5, C6 | 10 $\mu$F Chip Capacitors | GRM55DR61H106KA88L | Murata |
| C7, C8 | 4.7 pF Chip Capacitors | ATC600F4R7BT250XT | ATC |
| C9, C10 | 5.6 pF Chip Capacitors | ATC600F5R6BT250XT | ATC |
| C11, C12 | 39 pF Chip Capacitors | ATC600F390JT250XT | ATC |
| C13, C14, C15, C16, C17, C18 | 4.7 $\mu$F Chip Capacitors | GRM31CR71H475KA12L | Murata |
| C19, C20 | 0.5 pF Chip Capacitors | ATC600F0R5BT250XT | ATC |
| C21 | 0.9 pF Chip Capacitor | ATC600F0R9BT250XT | ATC |
| C22, C23 | 1.0 $\mu$F Chip Capacitors | GRM31CR71H105KA12L | Murata |
| R1, R2, R3, R4 | 4.7 k$\Omega$, 1/4 W Chip Resistors | CRCW12064K70FKEA | Vishay |
| R5 | 50 $\Omega$, 10 W, Termination | RFP-06012A15Z50 | Anaren |
| Z1 | 2100–2200 MHz, 90°, 3 dB Chip Hybrid Coupler | GSC355-HYB2150 | Soshin |
| PCB | 0.020″, $\varepsilon_r$ = 3.5 | RF-35A2 | Taconic |

**Figure 4. MD7IC2251NR1(GNR1) Characterization Test Circuit Component Layout**

**Table 7. MD7IC2251NR1(GNR1) Characterization Test Circuit Component Designations and Values**

| Part | Description | Part Number | Manufacturer |
|---|---|---|---|
| C1, C2, C3, C4, C5, C6 | 10 μF Chip Capacitors | GRM55DR61H106KA88L | Murata |
| C7, C8 | 4.7 pF Chip Capacitors | ATC600F4R7BT250XT | ATC |
| C9, C10 | 5.6 pF Chip Capacitors | ATC600F5R6BT250XT | ATC |
| C11, C12 | 39 pF Chip Capacitors | ATC600F390JT250XT | ATC |
| C13, C14, C15, C16, C17, C18 | 4.7 μF Chip Capacitors | GRM31CR71H475KA12L | Murata |
| C19, C20 | 0.5 pF Chip Capacitors | ATC600F0R5BT250XT | ATC |
| C21 | 0.9 pF Chip Capacitor | ATC600F0R9BT250XT | ATC |
| C22, C23 | 1.0 μF Chip Capacitors | GRM31CR71H105KA12L | Murata |
| R1, R2, R3, R4 | 4.7 kΩ, 1/4 W Chip Resistors | CRCW12064K70FKEA | Vishay |
| R5 | 50 Ω, 10 W, Termination | RFP-06012A15Z50 | Anaren |
| Z1 | 2100–2200 MHz, 90°, 3 dB Chip Hybrid Coupler | GSC355-HYB2150 | Soshin |
| PCB | 0.020″, $\varepsilon_r$ = 3.5 | RF-35A2 | Taconic |

**MD7IC2251NR1 MD7IC2251GNR1**

## TYPICAL CHARACTERISTICS



**Figure 5. Output Peak‑to‑Average Ratio Compression (PARC) Broadband Performance @ P<sub>out</sub> = 12 Watts Avg.**
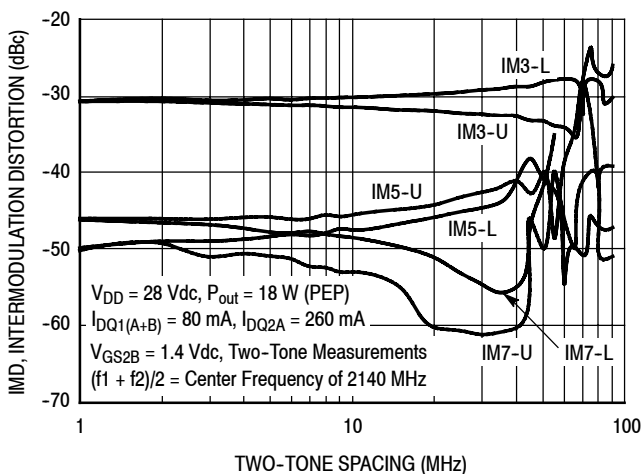


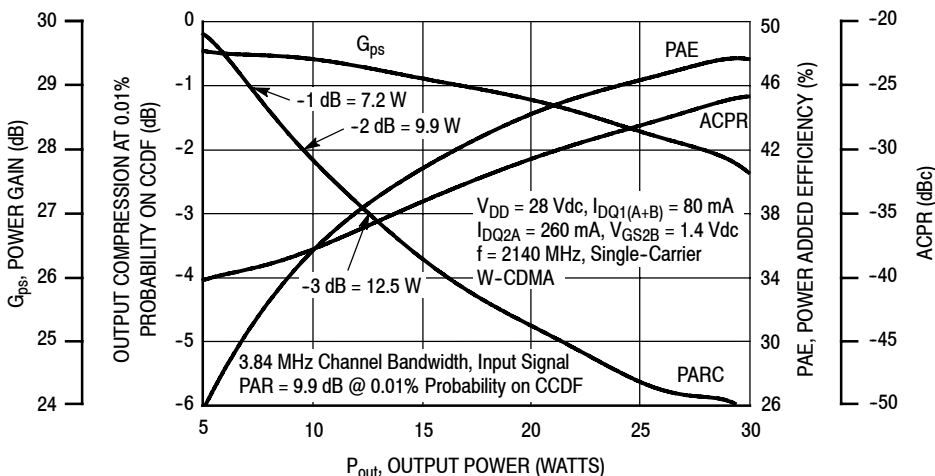**Figure 6. Intermodulation Distortion Products versus Two‑Tone Spacing**



**Figure 7. Output Peak‑to‑Average Ratio Compression (PARC) versus Output Power**

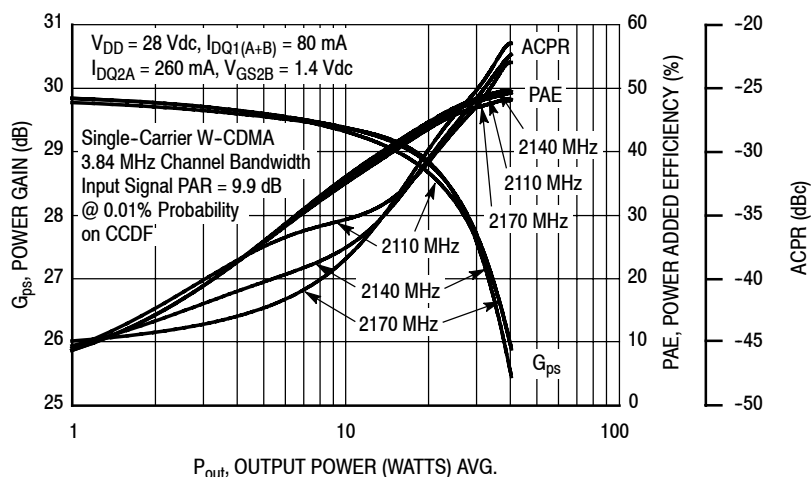**MD7IC2251NR1 MD7IC2251GNR1**

## TYPICAL CHARACTERISTICS



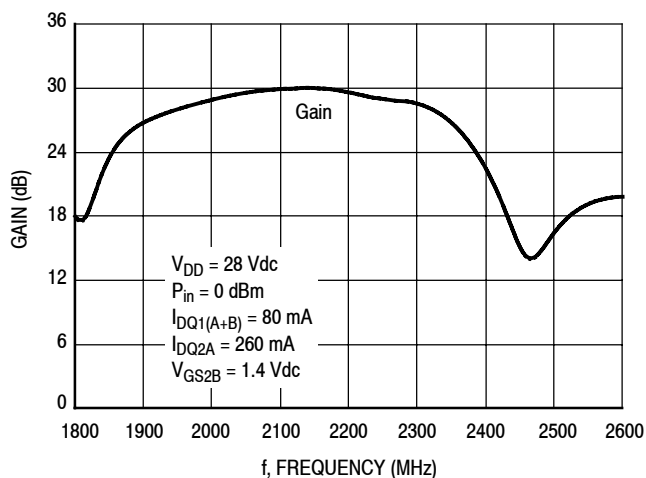**Figure 8. Single-Carrier W-CDMA Power Gain, Power Added Efficiency and ACPR versus Output Power**



**Figure 9. Broadband Frequency Response**
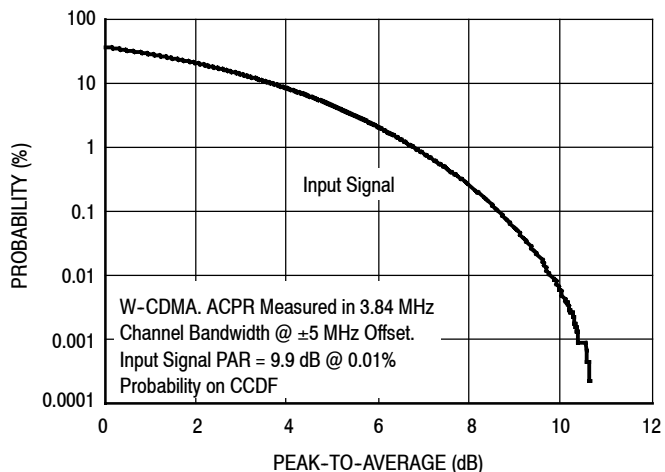
## W-CDMA TEST SIGNAL



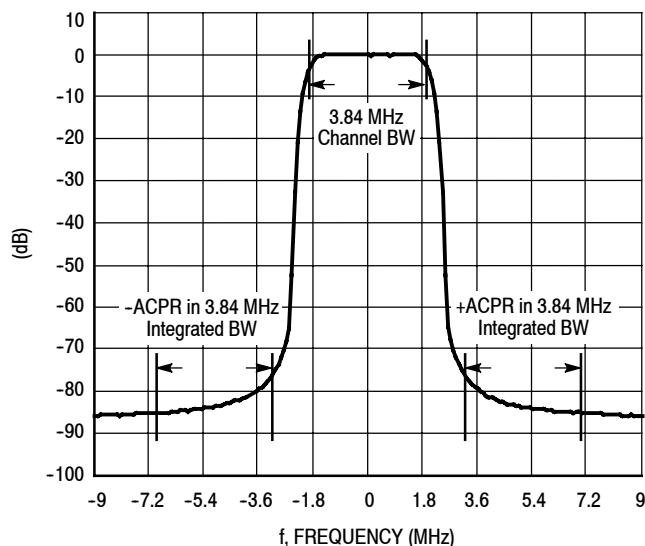**Figure 10. CCDF W-CDMA IQ Magnitude Clipping, Single-Carrier Test Signal**



**Figure 11. Single-Carrier W-CDMA Spectrum**

**MD7IC2251NR1 MD7IC2251GNR1**

$V_{DD}$ = 28 Vdc, $I_{DQ1(A+B)}$ = 80 mA, $I_{DQ2A}$ = 260 mA, CW

| f (MHz) | $Z_{in}$ (Ω) | $Z_{load}$ [1] (Ω) | Max Output Power | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | P1dB | | | P3dB | | |
| | | | (dBm) | (W) | PAE (%) | (dBm) | (W) | PAE (%) |
| 2110 | 68.0 − j42.0 | 7.20 − j14.0 | 45.8 | 38 | 52.2 | 46.4 | 44 | 53.1 |
| 2140 | 60.6 − j37.0 | 7.40 − j14.4 | 45.7 | 37 | 51.9 | 46.4 | 44 | 52.7 |
| 2170 | 54.0 − j31.0 | 7.30 − j14.7 | 45.7 | 37 | 51.6 | 46.4 | 44 | 52.2 |

(1)  Load impedance for optimum P1dB power.

$Z_{in}$  =  Impedance as measured from input contact to ground.

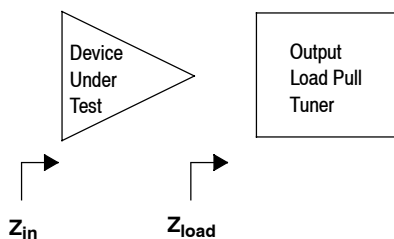$Z_{load}$  =  Impedance as measured from drain contact to ground.



**Figure 12. Carrier Side Load Pull Performance — Maximum P1dB Tuning**

$V_{DD}$ = 28 Vdc, $I_{DQ1(A+B)}$ = 80 mA, $I_{DQ2A}$ = 260 mA, CW

| f (MHz) | $Z_{in}$ (Ω) | $Z_{load}$ [1] (Ω) | Max Power Added Efficiency | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | P1dB | | | P3dB | | |
| | | | (dBm) | (W) | PAE (%) | (dBm) | (W) | PAE (%) |
| 2110 | 60.0 − j53.0 | 9.10 − j8.80 | 44.4 | 28 | 58.1 | 45.0 | 32.0 | 57.6 |
| 2140 | 54.0 − j46.0 | 8.20 − j9.10 | 44.4 | 28 | 57.6 | 44.9 | 31.0 | 57.0 |
| 2170 | 48.0 − j39.0 | 7.90 − j9.60 | 44.4 | 28 | 57.4 | 45.0 | 32.0 | 56.7 |

(1)  Load impedance for optimum P1dB efficiency.

$Z_{in}$  =  Impedance as measured from input contact to ground.

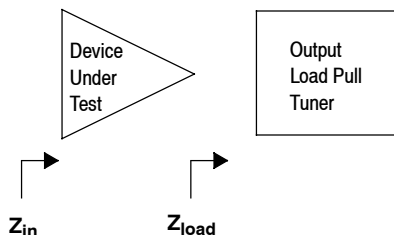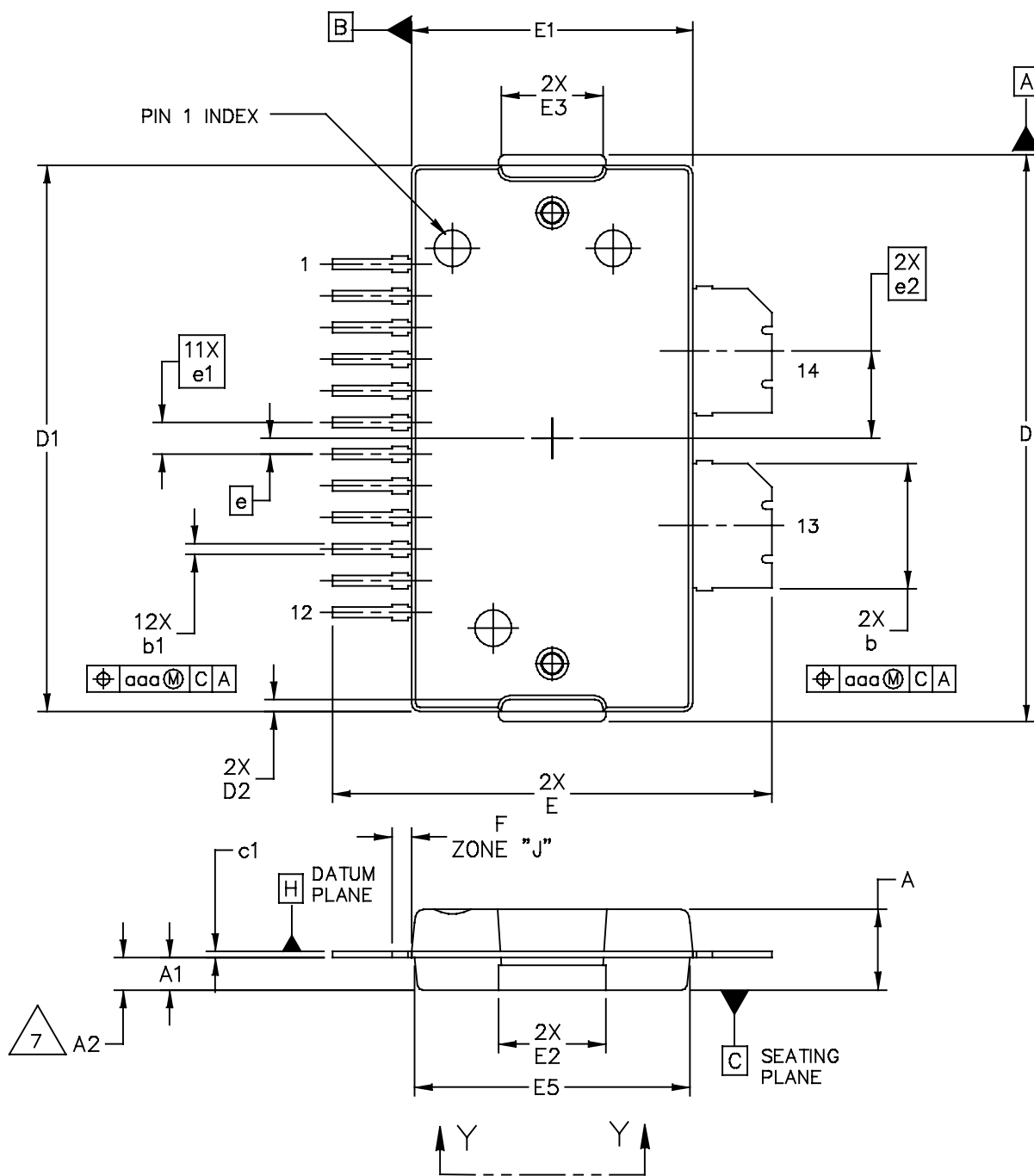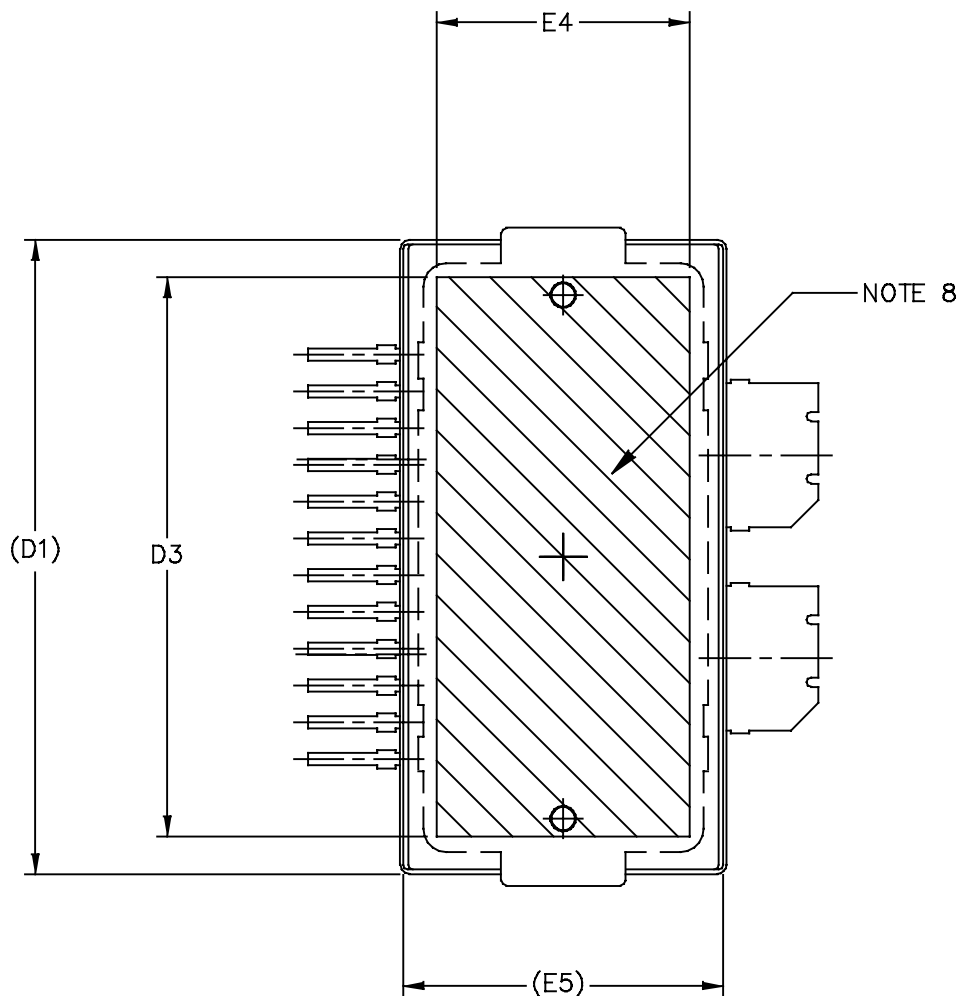$Z_{load}$  =  Impedance as measured from drain contact to ground.



**Figure 13. Carrier Side Load Pull Performance — Maximum Power Added Efficiency Tuning**

**PACKAGE DIMENSIONS**

| MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE | |
|---|---|---|
| TITLE: TO-270 WIDE BODY 14 LEAD | DOCUMENT NO: 98ASA10650D | REV: A |
| | CASE NUMBER: 1618-02 | 19 JUN 2007 |
| | STANDARD: NON-JEDEC | |

**MD7IC2251NR1 MD7IC2251GNR1**

VIEW Y—Y

| © FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED. | MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE | |
|---|---|---|---|
| TITLE: TO−270 WIDE BODY 14 LEAD | DOCUMENT NO: 98ASA10650D | REV: A | |
| | CASE NUMBER: 1618−02 | 19 JUN 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 PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE −H−.

5. DIMENSIONS "b" AND "b1" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE "b" AND "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. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG.

| DIM | INCH MIN | INCH MAX | MILLIMETER MIN | MILLIMETER MAX | DIM | INCH MIN | INCH MAX | MILLIMETER MIN | MILLIMETER MAX |
|-----|------|------|------|------|-----|------|------|------|------|
| A | .100 | .104 | 2.54 | 2.64 | F | .025 BSC | | 0.64 BSC | |
| A1 | .039 | .043 | 0.99 | 1.09 | b | .154 | .160 | 3.91 | 4.06 |
| A2 | .040 | .042 | 1.02 | 1.07 | b1 | .010 | .016 | 0.25 | 0.41 |
| D | .712 | .720 | 18.08 | 18.29 | c1 | .007 | .011 | .18 | .28 |
| D1 | .688 | .692 | 17.48 | 17.58 | e | .020 BSC | | 0.51 BSC | |
| D2 | .011 | .019 | 0.28 | 0.48 | e1 | .040 BSC | | 1.02 BSC | |
| D3 | .600 | ——— | 15.24 | ——— | e2 | .1105 BSC | | 2.807 BSC | |
| E | .551 | .559 | 14 | 14.2 | | | | | |
| E1 | .353 | .357 | 8.97 | 9.07 | aaa | .004 | | .10 | |
| E2 | .132 | .140 | 3.35 | 3.56 | | | | | |
| E3 | .124 | .132 | 3.15 | 3.35 | | | | | |
| E4 | .270 | ——— | 6.86 | ——— | | | | | |
| E5 | .346 | .350 | 8.79 | 8.89 | | | | | |

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

TITLE:
TO−270 WIDE BODY
14 LEAD

DOCUMENT NO: 98ASA10650D     REV: A

CASE NUMBER: 1618−02          19 JUN 2007

STANDARD: NON−JEDEC

**MD7IC2251NR1 MD7IC2251GNR1**

NXP



B ← E1 →

PIN 1 INDEX

2X
E3

A

PIN 1 INDEX

1

11X
e1

2X
e2

14

D1

e

13

D

12X
b1

12

⊕ aaa Ⓜ C A

2X
b

⊕ aaa Ⓜ C A

2X
D2

2X
E

DETAIL "Y"

A2

H   DATUM
PLANE

A

c1

2X
E2

C   SEATING
PLANE

E5

Y        Y

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

TITLE:    TO−270 WIDE BODY
          14 LEAD
          GULL WING

DOCUMENT NO: 98ASA10653D | REV: A

CASE NUMBER: 1621−02 | 19 JUN 2007

STANDARD: NON−JEDEC

MD7IC2251NR1 MD7IC2251GNR1

VIEW Y–Y

DETAIL "Y"

| MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE | |
|---|---|---|
| TITLE:  TO–270 WIDE BODY 14 LEAD GULL WING | DOCUMENT NO: 98ASA10653D | REV: A |
| | CASE NUMBER: 1621–02 | 19 JUN 2007 |
| | STANDARD: NON–JEDEC | |

**MD7IC2251NR1 MD7IC2251GNR1**

RF Device Data
Freescale Semiconductor, Inc.

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 PER SIDE.  DIMENSIONS "D" AND "E1" DO INCLUDE MOLD
   MISMATCH AND ARE DETERMINED AT DATUM PLANE −H−.

5. DIMENSIONS "b" AND "b1" DOES NOT INCLUDE DAMBAR PROTRUSION.  ALLOWABLE
   DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE "b" AND "b1"
   DIMENSION AT MAXIMUM MATERIAL CONDITION.

6. DATUMS −A− AND −B− TO BE DETERMINED AT DATUM PLANE −H−.

7. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG.

| DIM | INCH MIN | INCH MAX | MILLIMETER MIN | MILLIMETER MAX | DIM | INCH MIN | INCH MAX | MILLIMETER MIN | MILLIMETER 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 | .154 | .160 | 3.91 | 4.06 |
| D | .712 | .720 | 18.08 | 18.29 | b1 | .010 | .016 | 0.25 | 0.41 |
| D1 | .688 | .692 | 17.48 | 17.58 | c1 | .007 | .011 | .18 | .28 |
| D2 | .011 | .019 | 0.28 | 0.48 | e | .020 BSC | | 0.51 BSC | |
| D3 | .600 | ——— | 15.24 | ——— | e1 | .040 BSC | | 1.02 BSC | |
| E | .429 | .437 | 10.9 | 11.1 | e2 | .1105 BSC | | 2.807 BSC | |
| E1 | .353 | .357 | 8.97 | 9.07 | t | 2˚ | 8˚ | 2˚ | 8˚ |
| E2 | .132 | .140 | 3.35 | 3.56 | | | | | |
| E3 | .124 | .132 | 3.15 | 3.35 | aaa | .004 | | .10 | |
| E4 | .270 | ——— | 6.86 | ——— | | | | | |
| E5 | .346 | .350 | 8.79 | 8.89 | | | | | |

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

| TITLE: | | |
|--------|--------|--------|
| TO−270 WIDE BODY 14 LEAD GULL WING | DOCUMENT NO: 98ASA10653D | REV: A |
| | CASE NUMBER: 1621−02 | 19 JUN 2007 |
| | STANDARD: NON−JEDEC | |

**MD7IC2251NR1 MD7IC2251GNR1**

# PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following documents, software and tools to aid your design process.

**Application Notes**

- AN1907: Solder Reflow Attach Method for High Power RF Devices in Over-Molded 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
- RF High Power Model
- .s2p File

**Development Tools**

- Printed Circuit Boards

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 |
|----------|------|-------------|
| 0 | May 2012 | • Initial Release of Data Sheet |

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