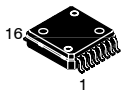
Document Number: MHVIC910HNR2
Rev. 9, 5/2006

RoHS

# 921 MHz–960 MHz SiFET RF Integrated Power Amplifier

**MHVIC910HNR2**

**960 MHz, 10 W, 26 V**
**GSM CELLULAR**
**RF LDMOS INTEGRATED CIRCUIT**




**CASE 978-03**
**PFP-16**

The MHVIC910HNR2 integrated circuit is designed for GSM base stations, uses Freescale's newest High Voltage (26 Volts) LDMOS IC technology, and contains a three-stage amplifier. Target applications include macrocell (driver function) and microcell base stations (final stage). The device is in a PFP-16 Power Flat Pack package which gives excellent thermal performances through a solderable backside contact.

- Typical GSM Performance: $V_{DD}$ = 26 Volts, $I_{DQ}$ = 150 mA, $P_{out}$ = 10 Watts, Full Frequency Band (921–960 MHz)
  Power Gain — 39 dB (Typ)
  Power Added Efficiency — 48% (Typ)
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 945 MHz, 10 Watts CW Output Power
- Stable into a 10:1 VSWR. All Spurs Below –60 dBc @ 0 to 40 dBm CW $P_{out}$.

**Features**

- On-Chip Matching (50 Ohm Input, DC Blocked, >5 Ohm Output)
- Integrated ESD Protection
- Usable Frequency Range — 921 to 960 MHz
- RoHS Compliant
- In Tape and Reel. R2 Suffix = 1,500 Units per 16 mm, 13 inch Reel.

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**Table 1. Maximum Ratings**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain Supply Voltage | $V_{DD}$ | 28 | Vdc |
| Gate Supply Voltage | $V_{GS}$ | 6 | Vdc |
| RF Input Power | $P_{in}$ | 5 | dBm |
| Case Operating Temperature | $T_C$ | – 30 to + 85 | °C |
| Storage Temperature Range | $T_{stg}$ | – 65 to + 150 | °C |
| Operating Channel Temperature | $T_{ch}$ | 150 | °C |

**Table 2. Thermal Characteristics**

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 2.9 | °C/W |

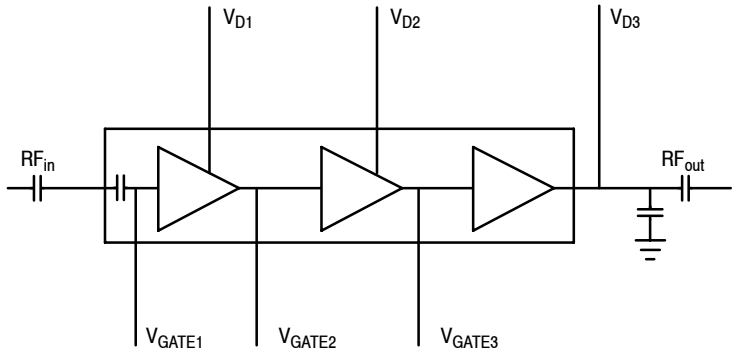
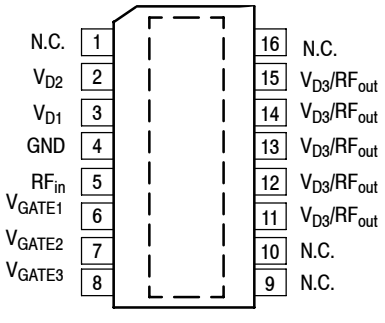



**Figure 1. Functional Block Diagram**




(Top View)

Note: Exposed backside flag is source terminal for transistors.

**Figure 2. Pin Connections**

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**Table 3. ESD Protection Characteristics**

| Test Conditions | Class |
|---|---|
| Human Body Model | 0 (Minimum) |
| Machine Model | M2 (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. Recommended Operating Ranges**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain Supply Voltage | $V_{DD}$ | 26 | Vdc |
| 3rd Stage Quiescent Current | $I_{DQ3}$ | 150 | mA |
| 2nd Stage Quiescent Current | $I_{DQ2}$ | 50 | mA |
| 1st Stage Quiescent Current | $I_{DQ1}$ | 25 | mA |

**Table 6. Electrical Characteristics** ($T_A$ = 25°C matched to a 50 Ω system, unless otherwise noted)
$V_{DD}$ = 26 V, $V_{GS}$ set for $I_{DQ3}$ = 150 mA, frequency range 921-960 MHz

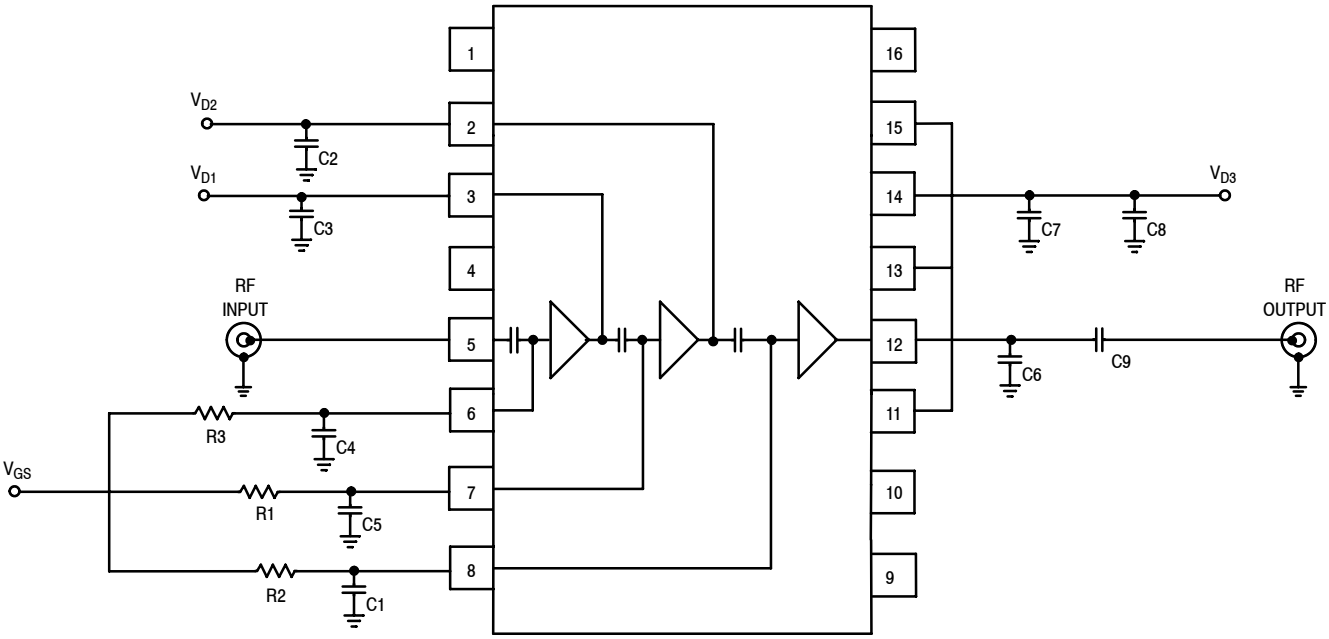
| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Frequency Range | $f_{RF}$ | 921 | — | 960 | MHz |
| Output Power @ 1 dB Compression Point | P @ 1dB | 39 | 40 | — | dBm |
| Power Gain @ P1dB | G @ 1dB | 38 | 39 | — | dB |
| Power Added Efficiency @ 1 dB Compression Point | PAE @ 1dB | 43 | 48 | — | % |
| Input Return Loss @ P1dB | IRL @ 1dB | — | -15 | -10 | dB |
| Gain Flatness @ 40 dBm<br>Variation ($T_C$ = -30 to +85°C @ 40 dBm) | $G_F$<br>$G_V$ | —<br>— | .5<br>5 | —<br>— | dB<br>dB |

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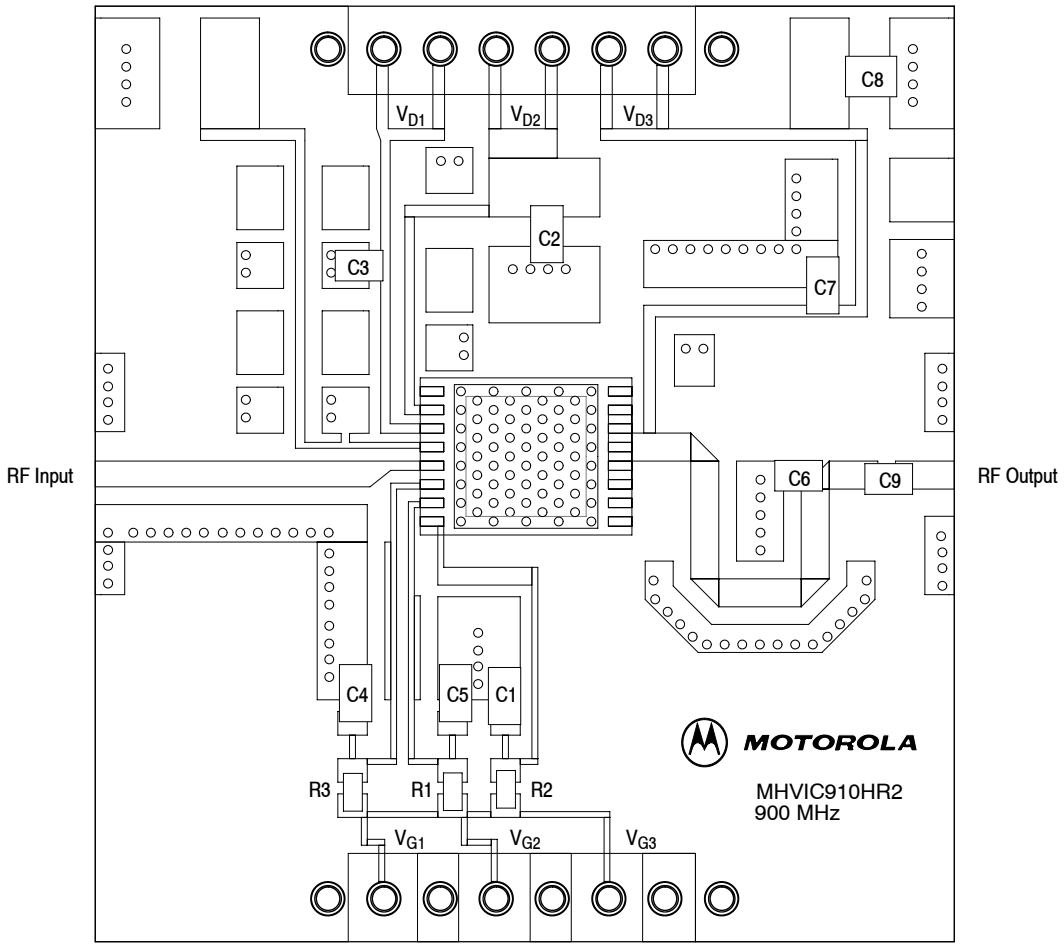



| | | | |
|---|---|---|---|
| C1, C2, C3, C4, C5, C8 | 1 μF Surface Mount Chip Capacitors | J1, J2 | Header (Break-away), HDR2X10STIMCSAFU |
| C6 | 4.7 pF AVX Chip Capacitor, ACCU-P (08051J4R7BBT) | J3, J4 | SMA Connector 2052-1618-02 (Threaded) |
| C7 | 47 pF AVX Chip Capacitor, ACCU-P (08055K470JBTTR) | R1, R2, R3 | 100 Ω Chip Resistors (0402) |
| C9 | 33 pF AVX Chip Capacitor, ACCU-P (08053J330JBT) | PCB | Rogers 04350, 20 mils |

**Figure 3. 921–960 MHz Demo Board Schematic**

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Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/-logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

**Figure 4. 921–960 MHz Demo Board Component Layout**

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## TYPICAL CHARACTERISTICS

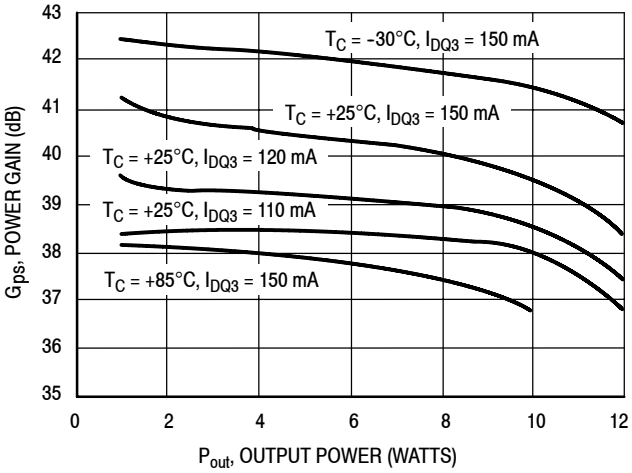



**Figure 5. Power Gain versus Output Power**

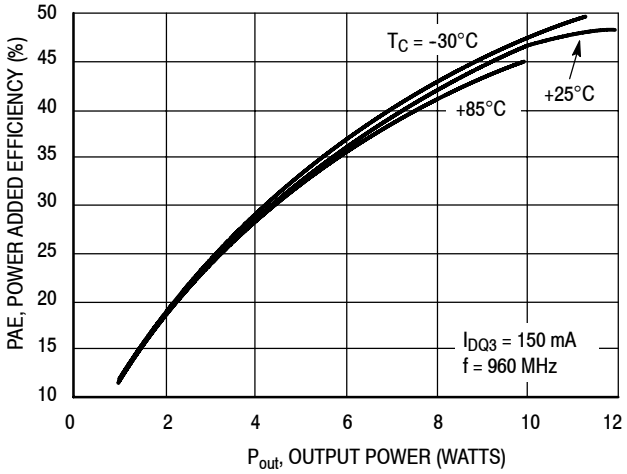



**Figure 6. Power Added Efficiency versus Output Power**

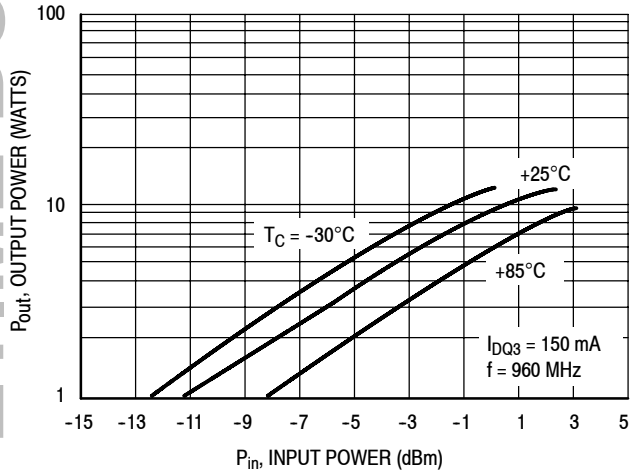



**Figure 7. Output Power versus Input Power**

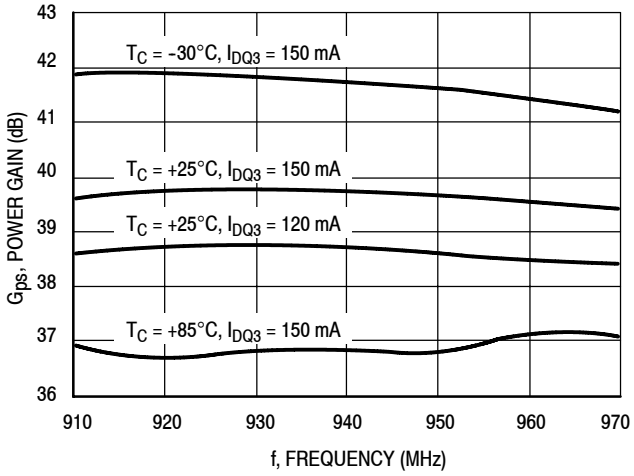



**Figure 8. Power Gain versus Frequency $P_{out}$ = 10 W**

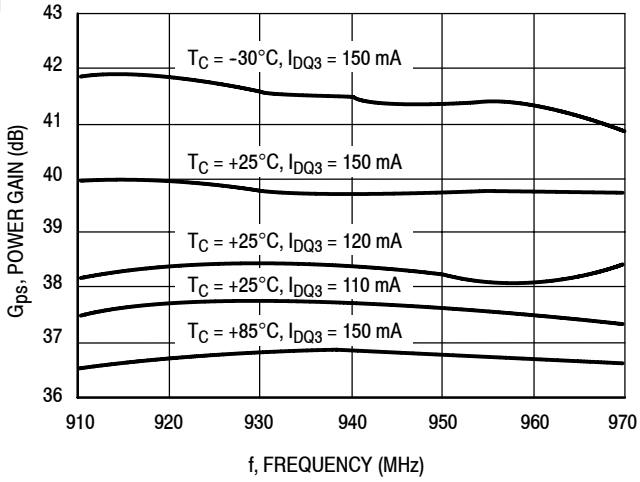



**Figure 9. Power Gain versus Frequency $P_{out}$ = P1dB**

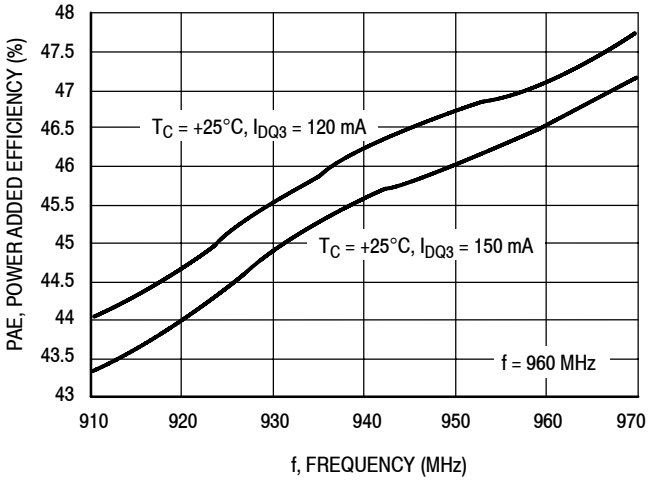



**Figure 10. Power Added Efficiency versus Frequency $P_{out}$ = 10 W**

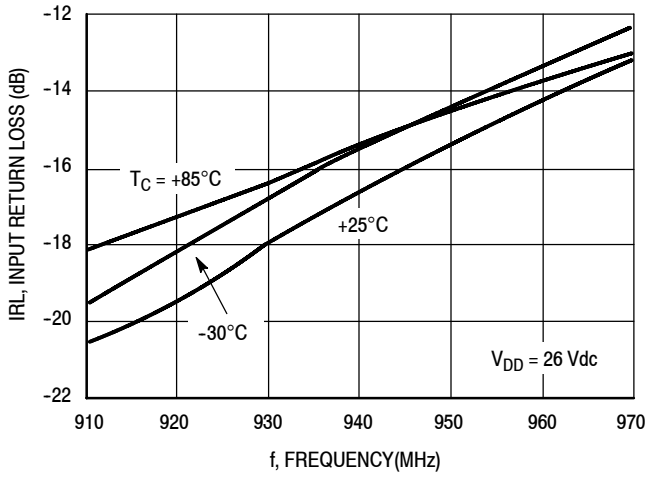



**Figure 11. Input Return Loss versus Frequency $P_{out}$ = 10 W**

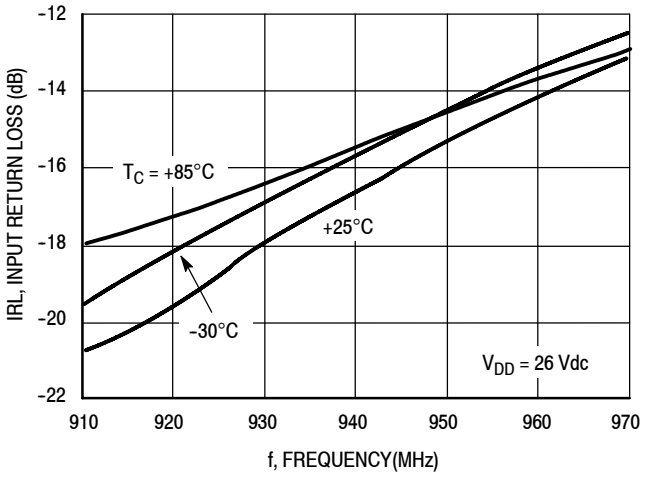



**Figure 12. Input Return Loss versus Frequency $P_{out}$ = P1dB**

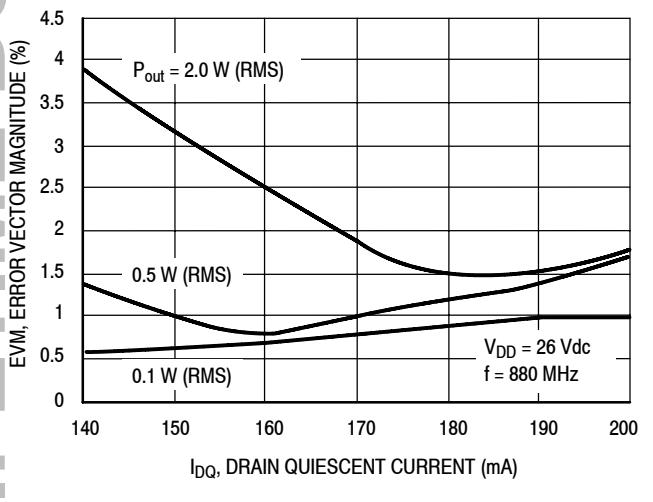



**Figure 13. Error Vector Magnitude versus $I_{DQ}$ Total**

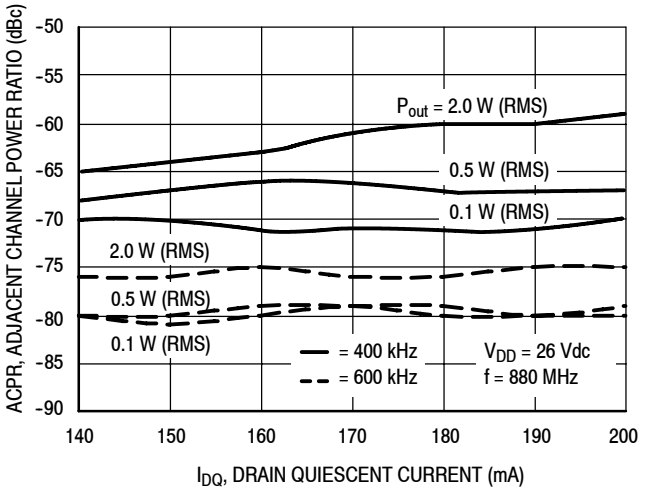



**Figure 14. Adjacent Channel Power Ratio versus $I_{DQ}$ Total**

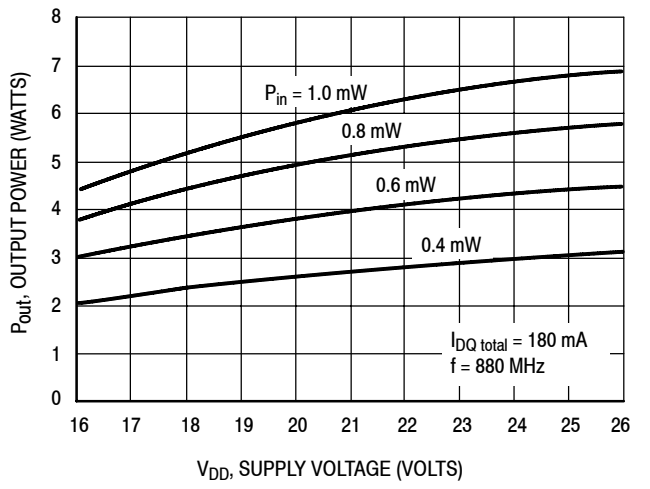



**Figure 15. Output Power versus Supply Voltage**

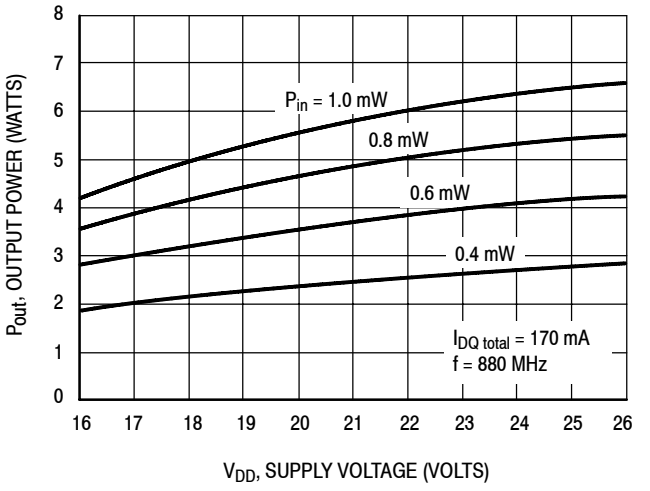



**Figure 16. Output Power versus Supply Voltage**

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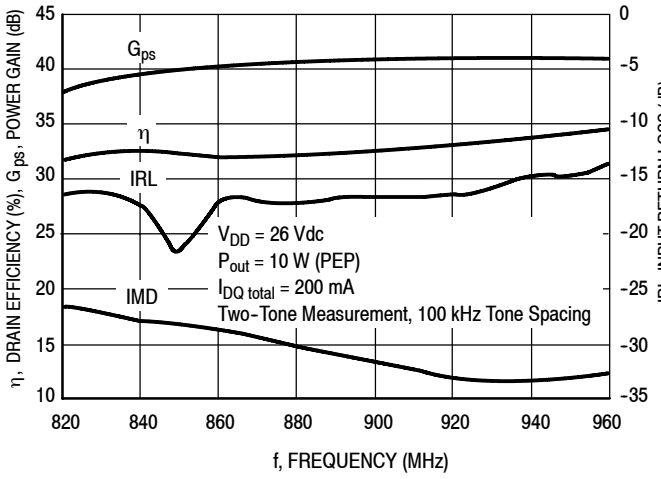



**Figure 17. Two-Tone Broadband Performance**

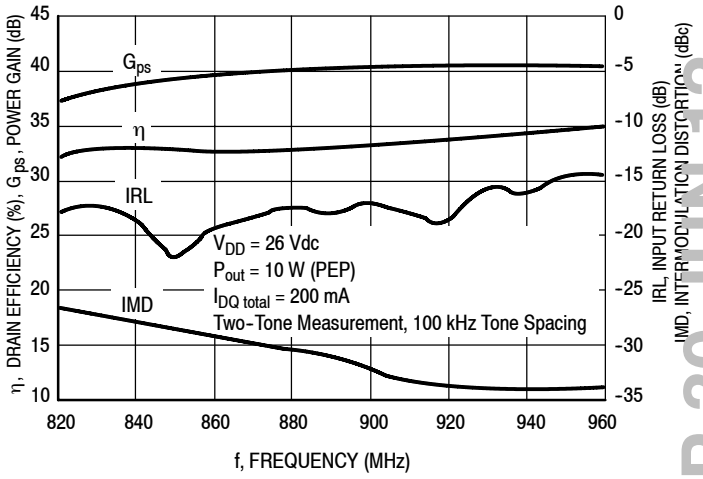



**Figure 18. Two-Tone Broadband Performance**

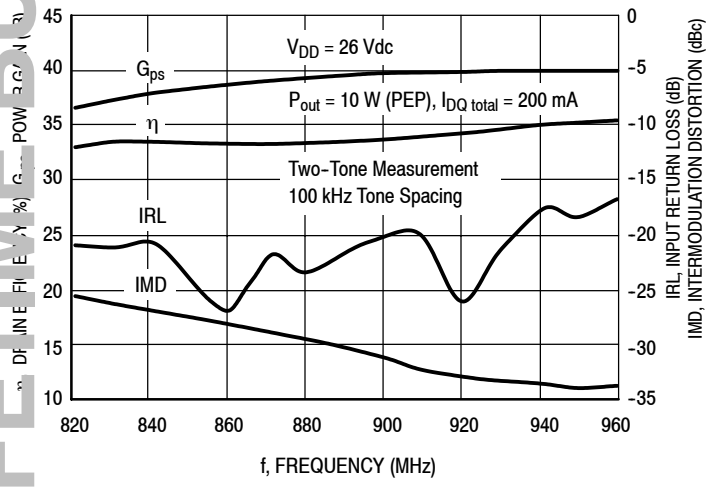



**Figure 19. Two-Tone Broadband Performance**

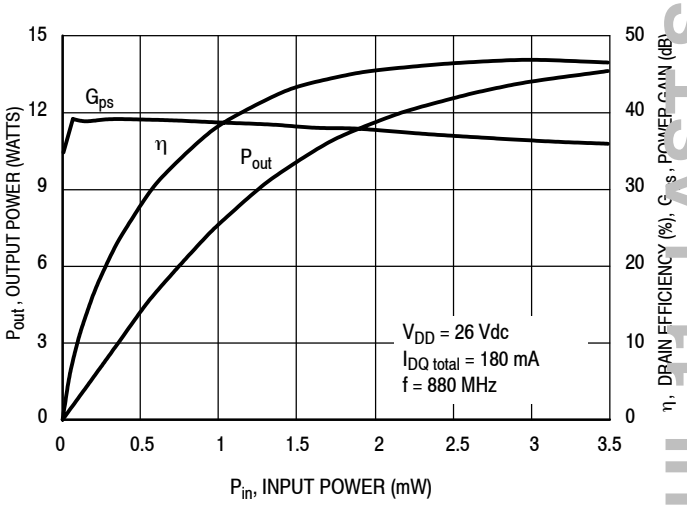



**Figure 20. CW Performance @ 880 MHz**

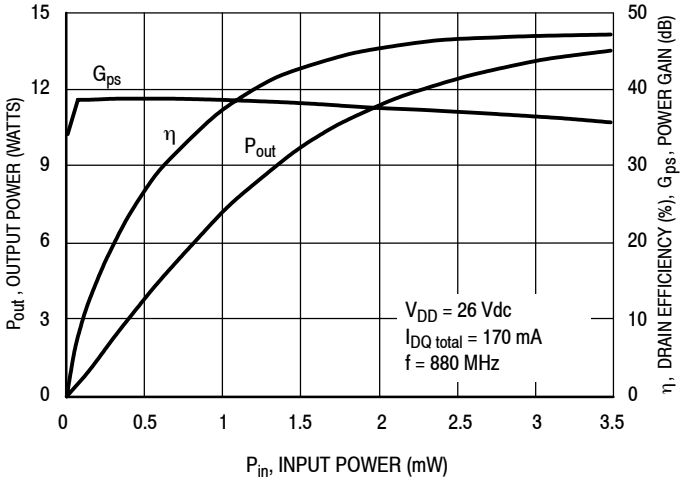



**Figure 21. CW Performance @ 880 MHz**

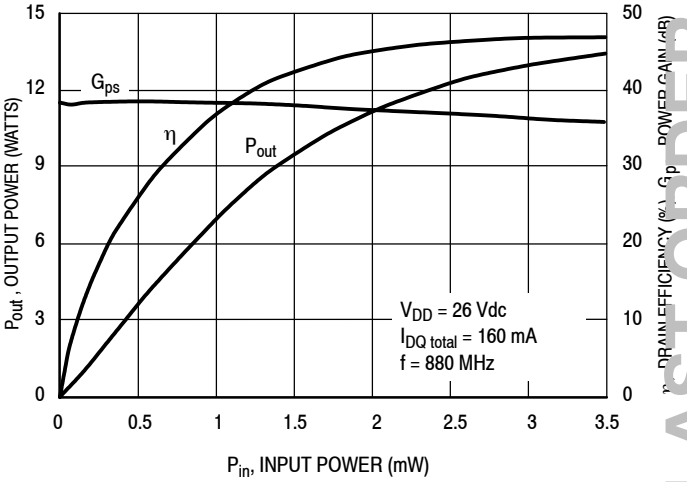



**Figure 22. CW Performance @ 880 MHz**

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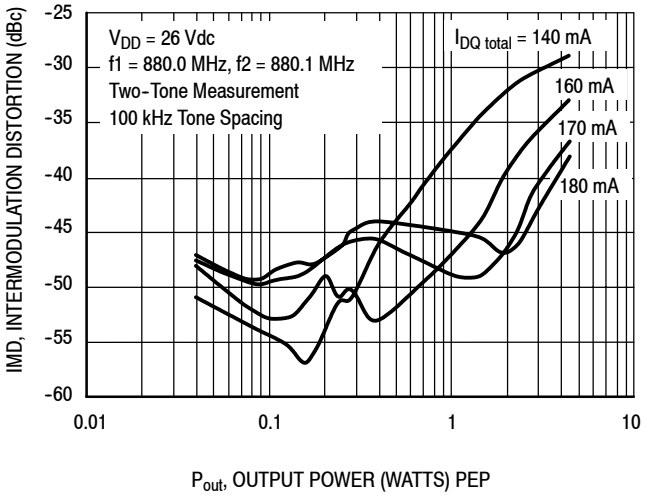



**Figure 23. Intermodulation Distortion versus Output Power**

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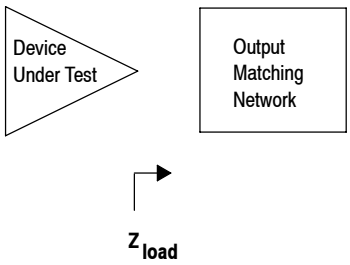
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$V_{DD}$ = 26 V, $I_{DQ}$ = 225 mA, $P_{out}$ = 40 dBm

| f<br>MHz | $Z_{load}$<br>Ω |
|---|---|
| 900 | 7.81 + j4.61 |
| 920 | 7.27 + j4.90 |
| 940 | 6.77 + j5.23 |
| 960 | 6.31 + j5.59 |
| 980 | 5.90 + j5.96 |
| 1000 | 5.53 + j6.36 |

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



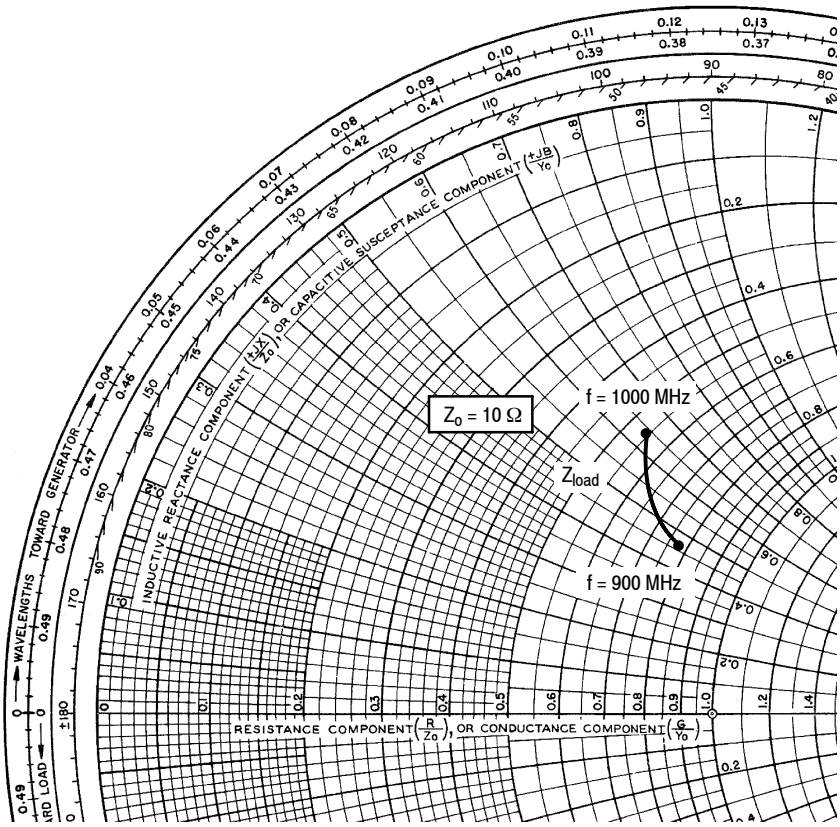
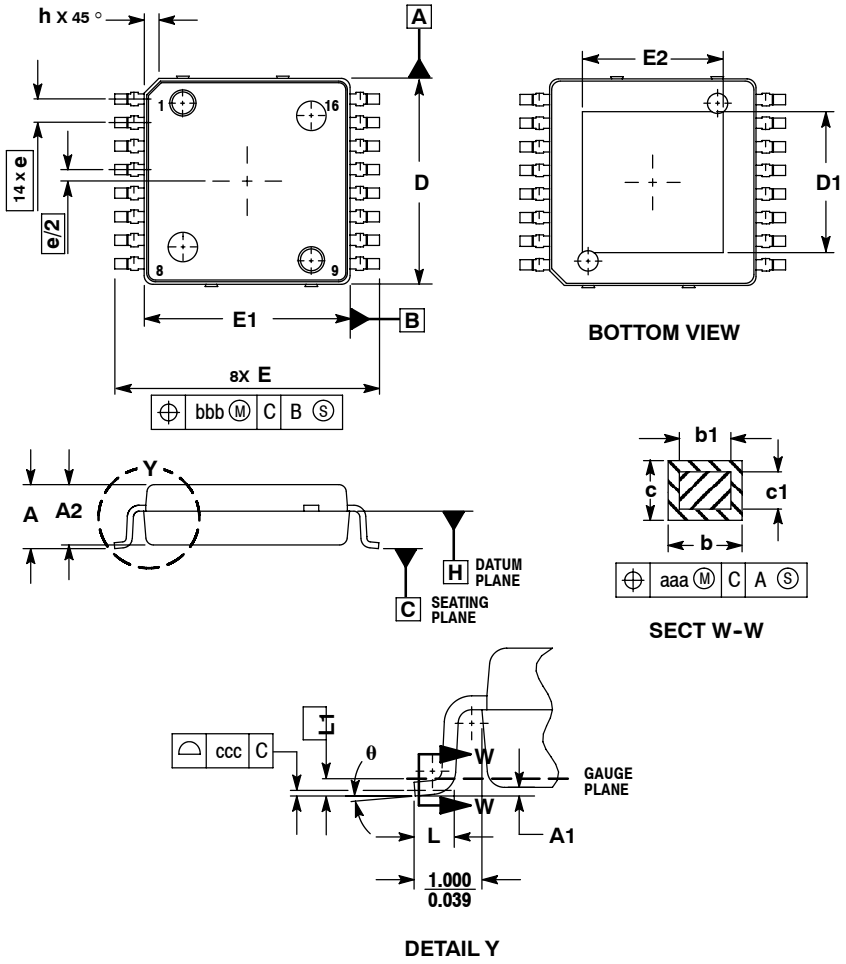




**Figure 24. Series Equivalent Load Impedance**

# NOTES

## PACKAGE DIMENSIONS




NOTES:
1. CONTROLLING DIMENSION: MILLIMETER.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DATUM PLANE -H- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 PER SIDE. DIMENSIONS D AND E1 DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION IS 0.127 TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-.

| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 2.000 | 2.300 |
| A1 | 0.025 | 0.100 |
| A2 | 1.950 | 2.100 |
| D | 6.950 | 7.100 |
| D1 | 4.372 | 5.180 |
| E | 8.850 | 9.150 |
| E1 | 6.950 | 7.100 |
| E2 | 4.372 | 5.180 |
| L | 0.466 | 0.720 |
| L1 | 0.250 BSC | |
| b | 0.300 | 0.432 |
| b1 | 0.300 | 0.375 |
| c | 0.180 | 0.279 |
| c1 | 0.180 | 0.230 |
| e | 0.800 BSC | |
| h | --- | 0.600 |
| θ | 0 ° | 7 ° |
| aaa | 0.200 | |
| bbb | 0.200 | |
| ccc | 0.100 | |

**CASE 978-03**
**ISSUE C**
**PFP-16**

## *How to Reach Us:*

**Home Page:**
www.freescale.com

**E-mail:**
support@freescale.com

**USA/Europe or Locations Not Listed:**
Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

**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)
support@freescale.com

**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

**Asia/Pacific:**
Freescale Semiconductor Hong Kong Ltd.
Technical Information Center
2 Dai King Street
Tai Po Industrial Estate
Tai Po, N.T., Hong Kong
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For information on Freescale’s Environmental Products program, go to http://www.freescale.com/epp.

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Document Number: MHVIC910HNR2
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