

# 921 MHz-960 MHz SiFET RF Integrated Power Amplifier

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.

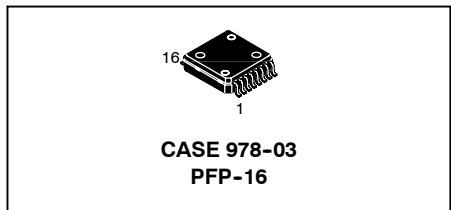
- Typical GSM Performance:  $V_{DD} = 26$  Volts,  $I_{DQ} = 150$  mA,  $P_{out} = 10$  Watts, Full Frequency Band (921-960 MHz)  
 Power Gain — 39 dB (Typ)  
 Power Added Efficiency — 48% (Typ)
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 945 MHz, 10 Watts CW Output Power
- Stable into a 10:1 VSWR. All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

**MHVIC910HNR2**

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



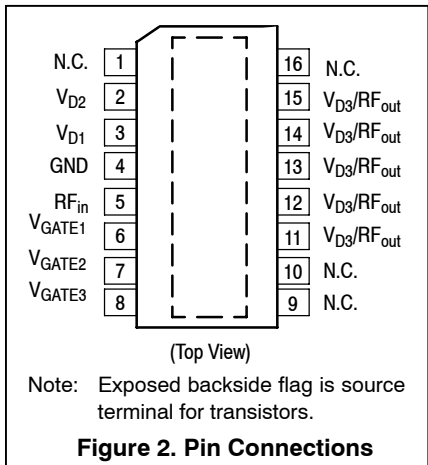
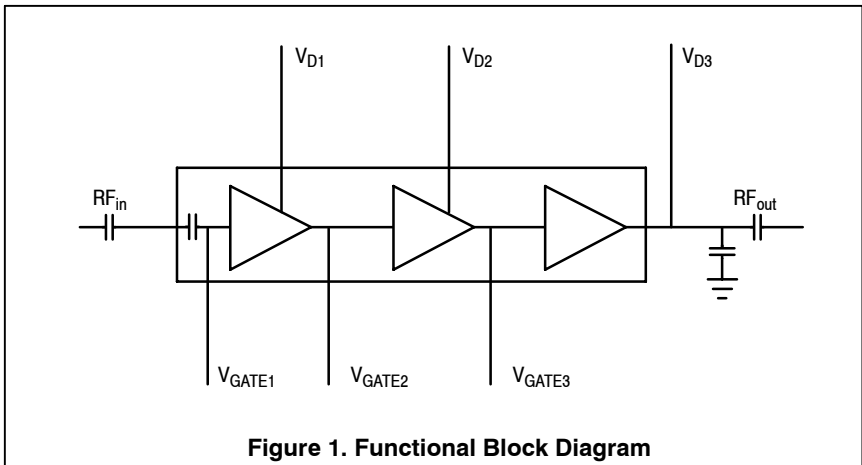
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**Table 1. Maximum Ratings**

| 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 |



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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   |

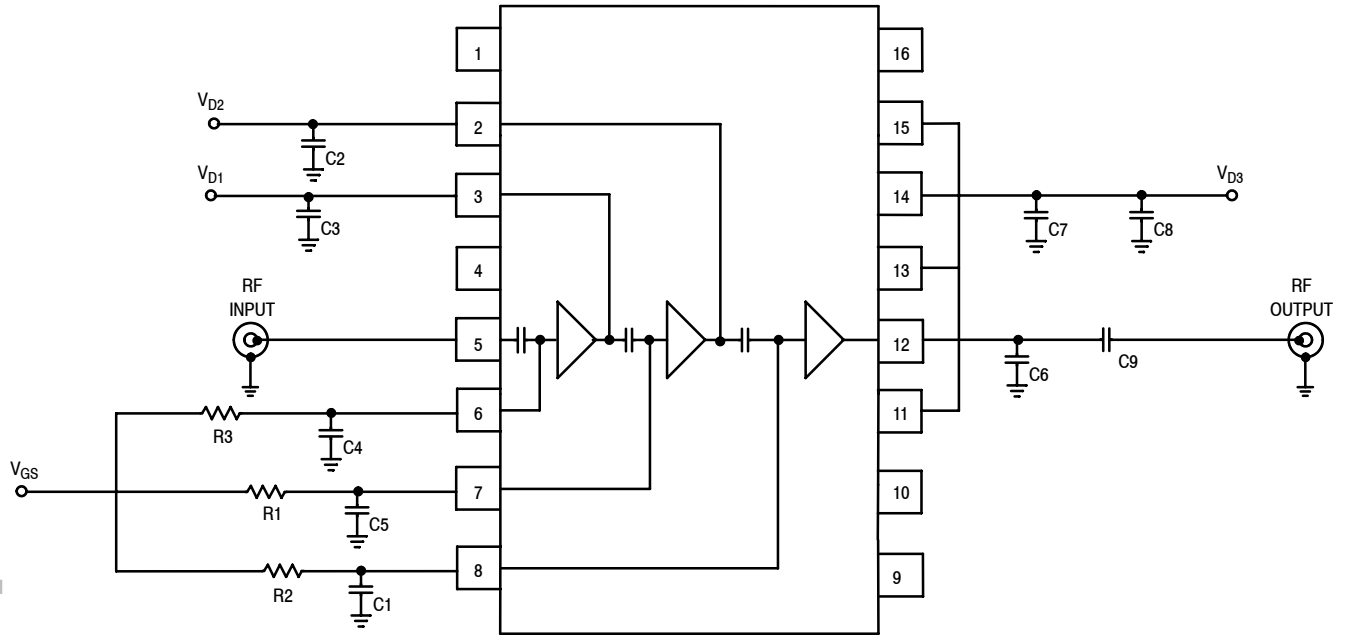
**Table 6. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  matched to a 50  $\Omega$  system, unless otherwise noted)

 $V_{DD} = 26\text{ V}$ ,  $V_{GS}$  set for  $I_{DQ3} = 150\text{ mA}$ , 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 $+85^\circ\text{C}$ @ 40 dBm) | $G_F$<br>$G_V$ | —   | .5<br>5 | —   | dB<br>dB |

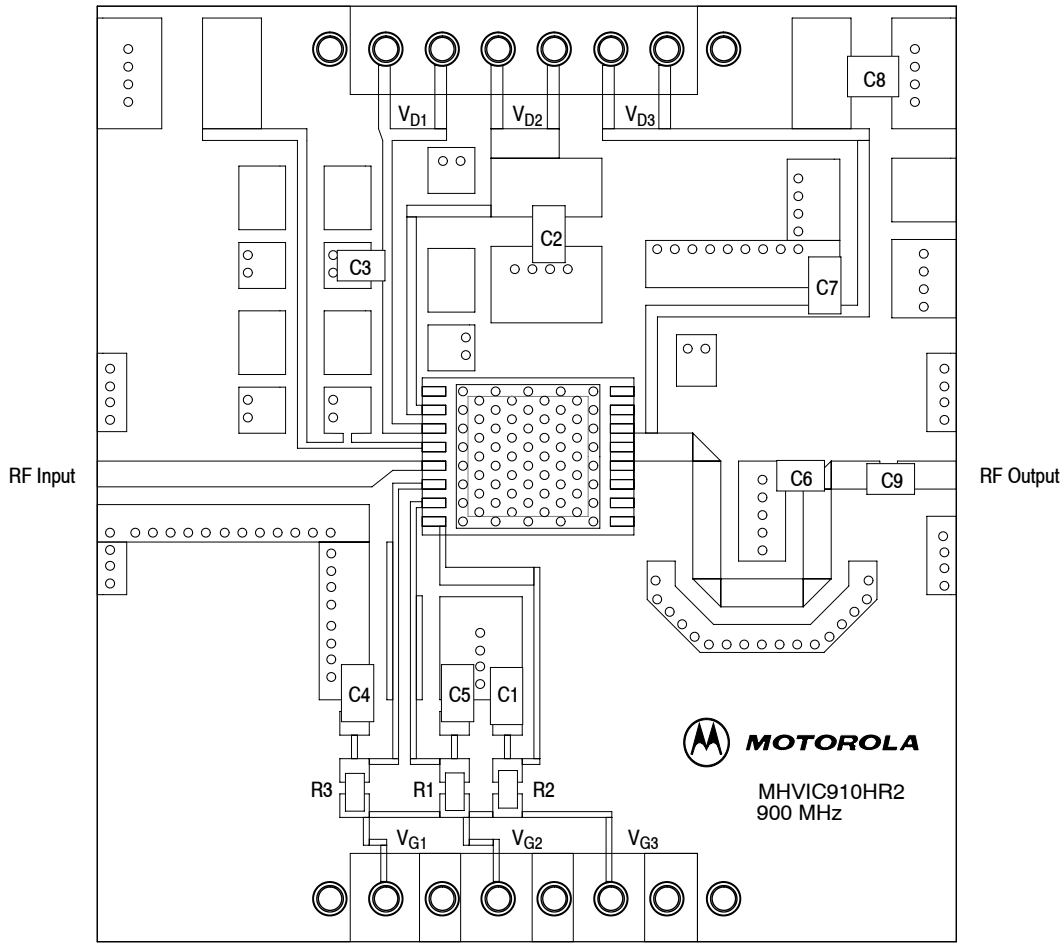
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- |                        |  |            |                                       |
|------------------------|--|------------|---------------------------------------|
| C1, C2, C3, C4, C5, C8 | 1 $\mu$ F Surface Mount Chip Capacitors            | 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 (08055K470JBTTTR) | R1, R2, R3 | 100 $\Omega$ Chip Resistors (0402)    |
| C9                     | 33 pF AVX Chip Capacitor, ACCU-P (08053J330JBT)    | PCB        | Rogers 04350, 20 mils                 |

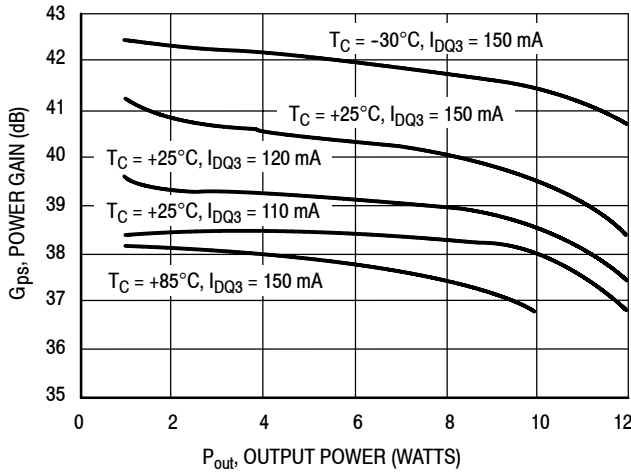
**Figure 3. 921-960 MHz Demo Board Schematic**



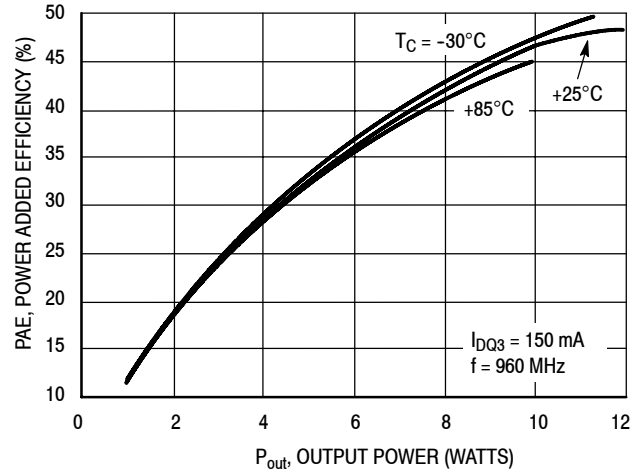
Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 4. 921-960 MHz Demo Board Component Layout

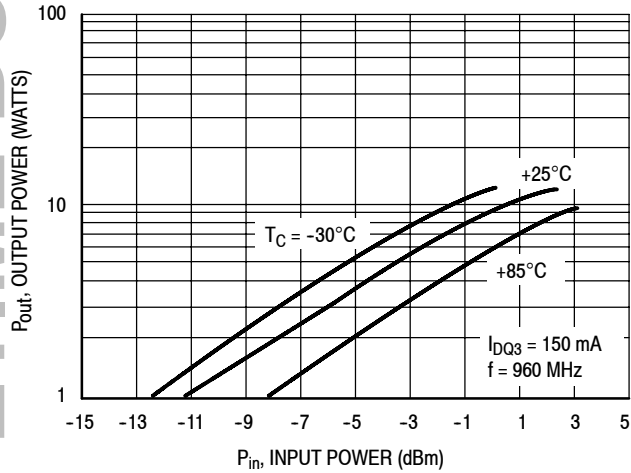
### TYPICAL CHARACTERISTICS



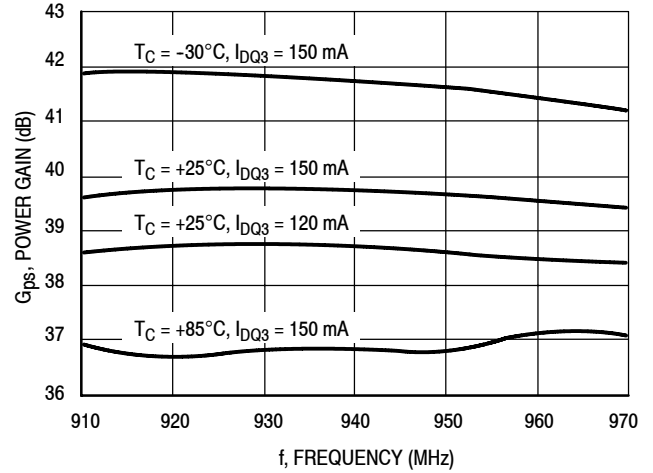
**Figure 5. Power Gain versus Output Power**



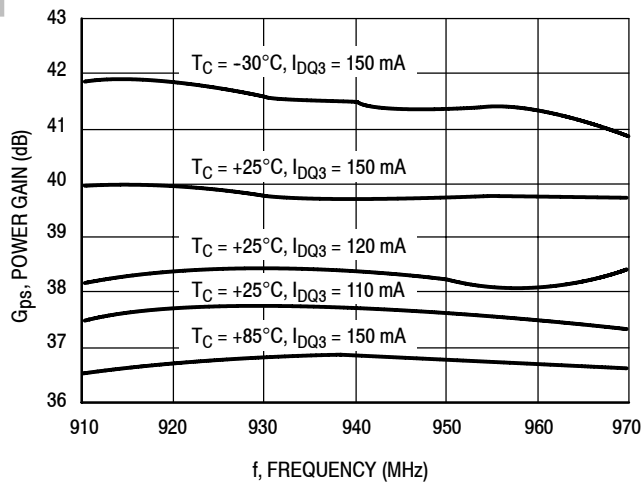
**Figure 6. Power Added Efficiency versus Output Power**



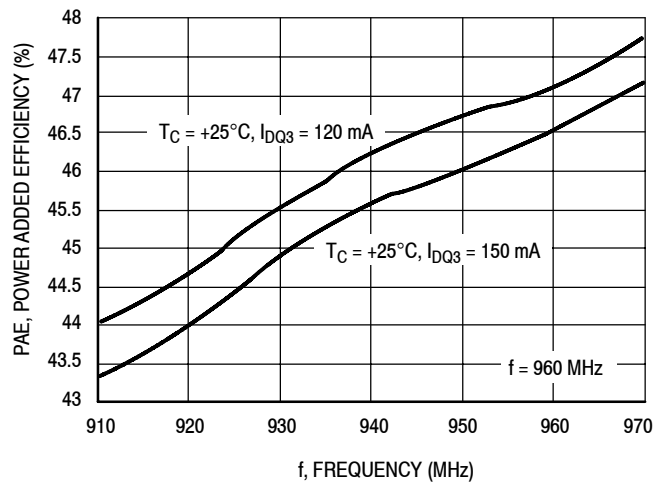
**Figure 7. Output Power versus Input Power**



**Figure 8. Power Gain versus Frequency  
P<sub>out</sub> = 10 W**



**Figure 9. Power Gain versus Frequency  
P<sub>out</sub> = P1dB**

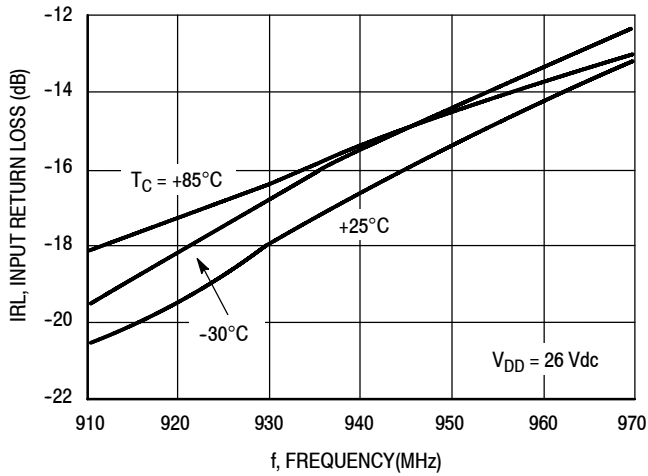


**Figure 10. Power Added Efficiency versus Frequency  
P<sub>out</sub> = 10 W**

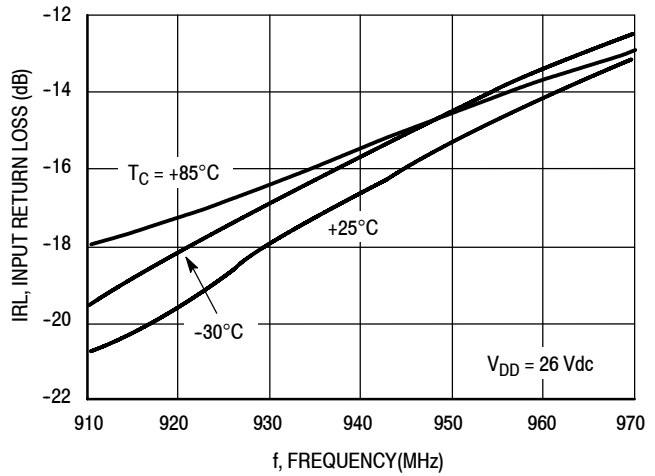
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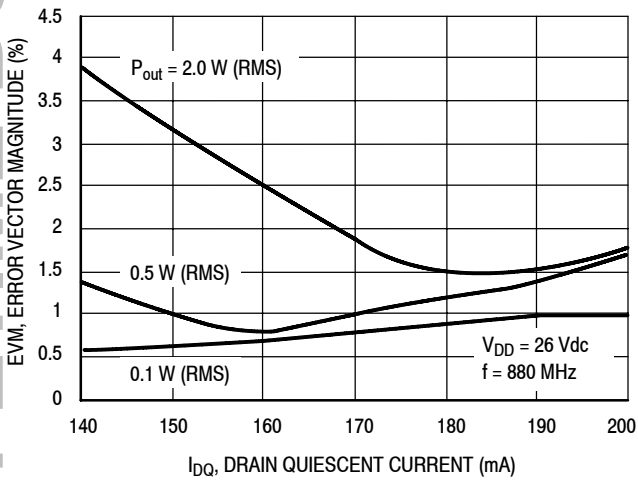
### TYPICAL CHARACTERISTICS



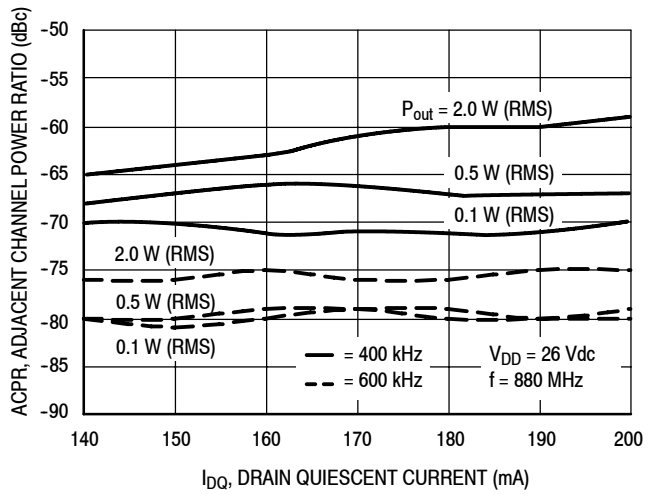
**Figure 11. Input Return Loss versus Frequency**  
 $P_{out} = 10\text{ W}$



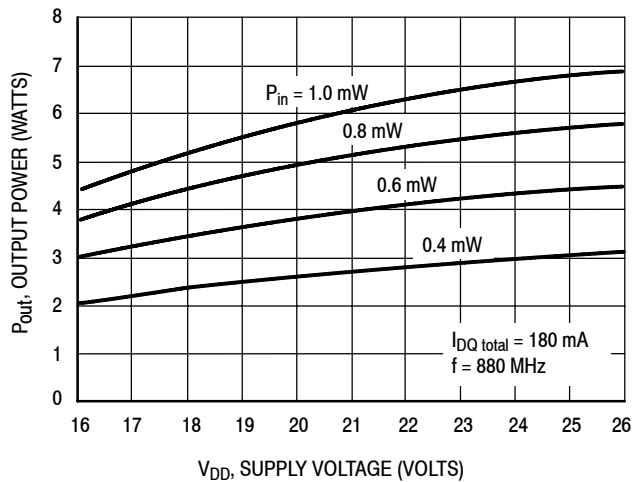
**Figure 12. Input Return Loss versus Frequency**  
 $P_{out} = P1dB$



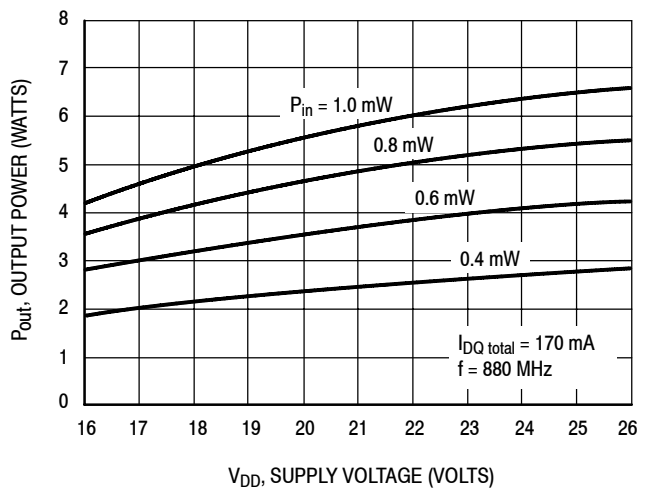
**Figure 13. Error Vector Magnitude versus  $I_{DQ}$  Total**



**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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### TYPICAL CHARACTERISTICS

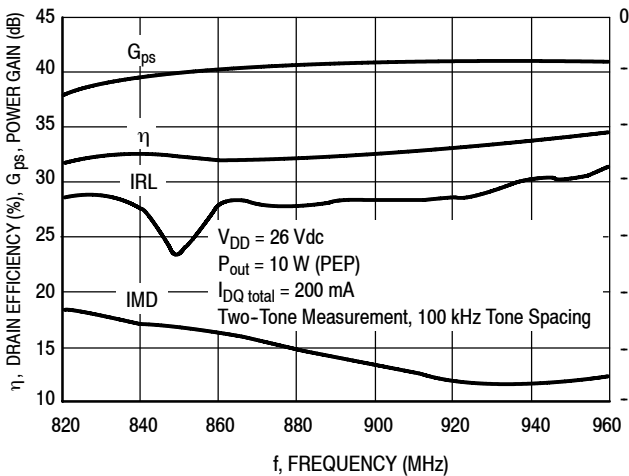


Figure 17. Two-Tone Broadband Performance

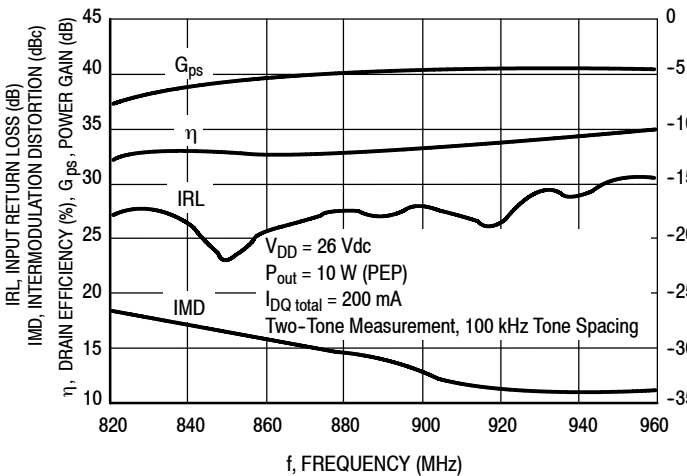


Figure 18. Two-Tone Broadband Performance

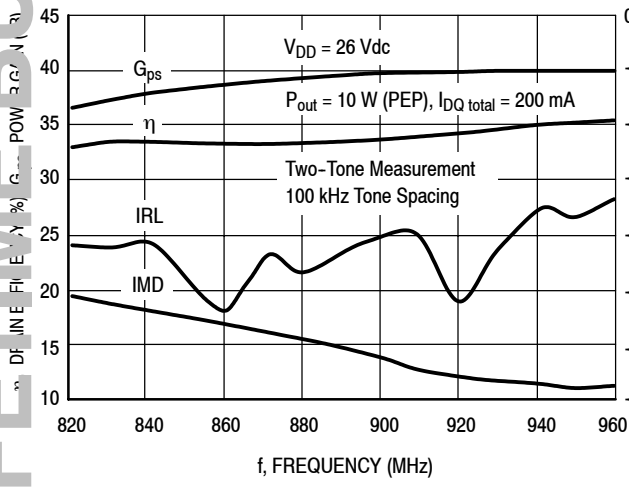


Figure 19. Two-Tone Broadband Performance

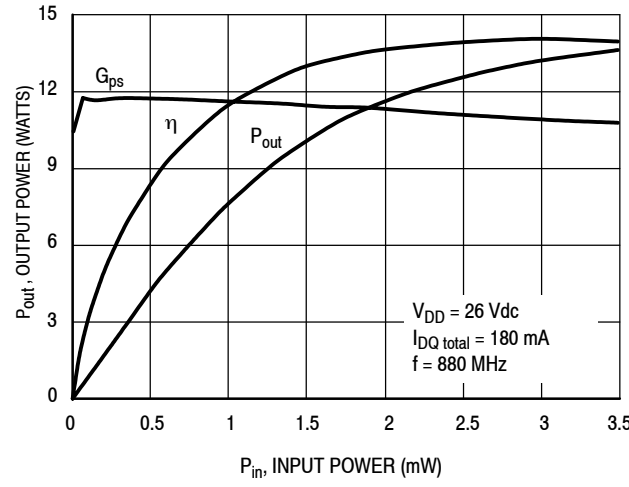


Figure 20. CW Performance @ 880 MHz

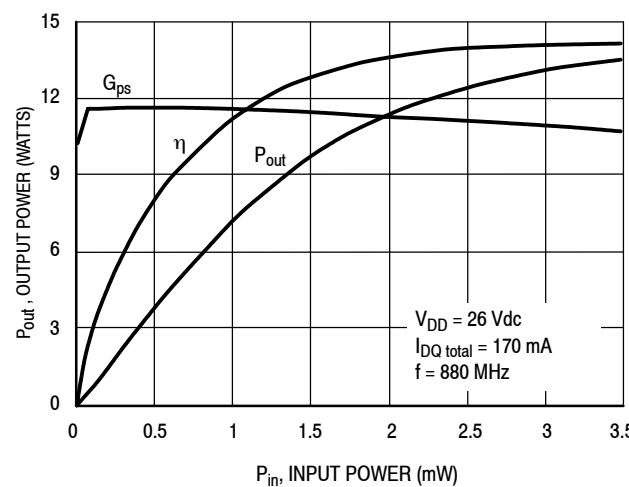


Figure 21. CW Performance @ 880 MHz

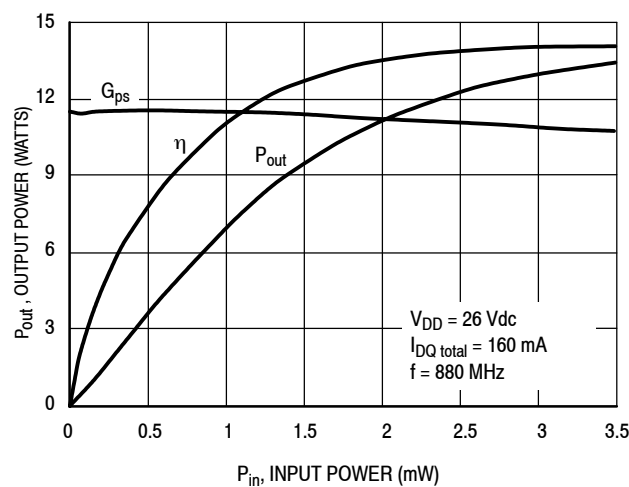


Figure 22. CW Performance @ 880 MHz

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### TYPICAL CHARACTERISTICS

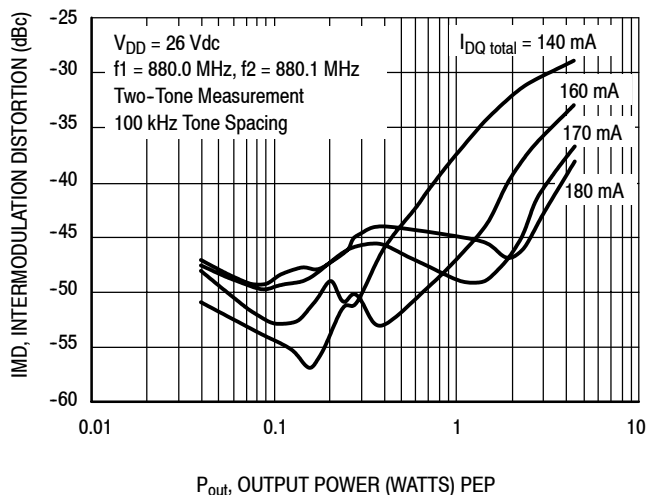


Figure 23. Intermodulation Distortion versus Output Power

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

| f<br>MHz | $Z_{load}$<br>$\Omega$ |
|----------|------------------------|
| 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.

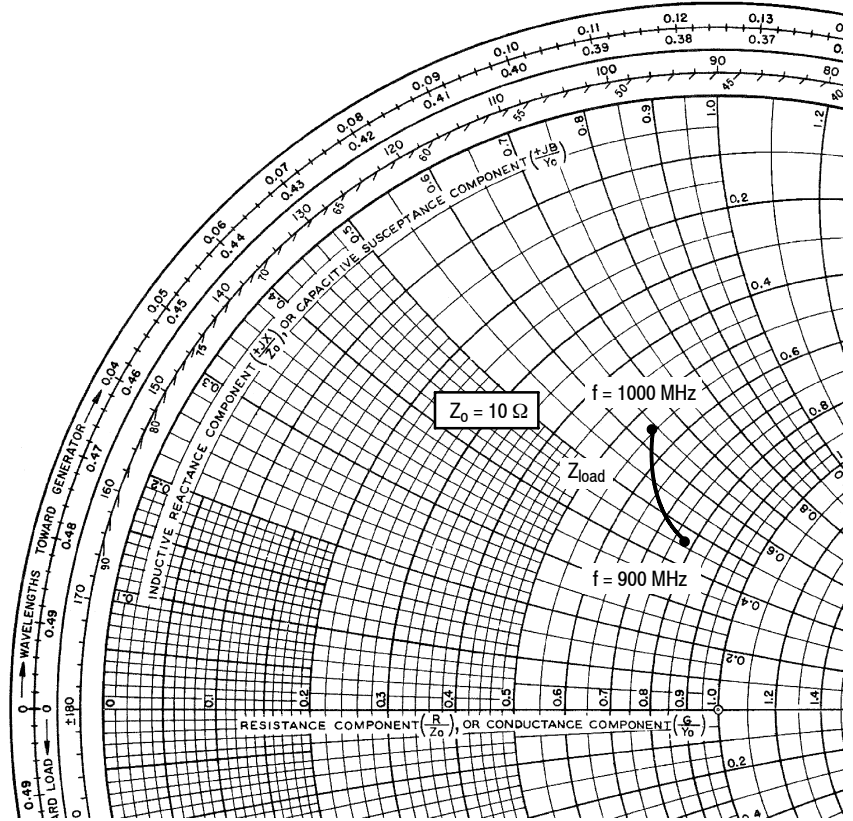
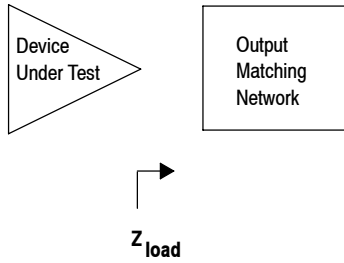
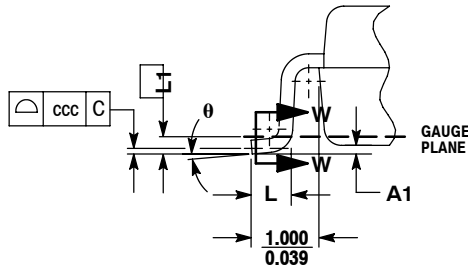
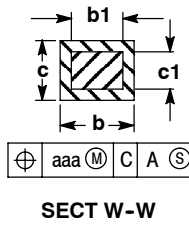
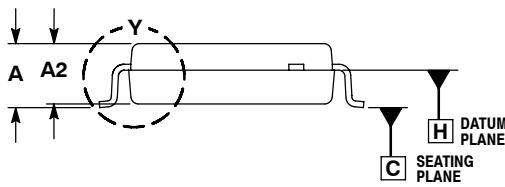
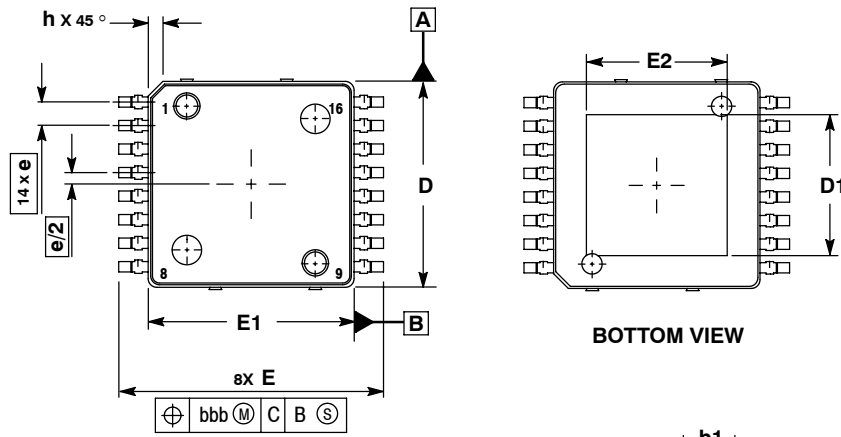


Figure 24. Series Equivalent Load Impedance

# NOTES

## PACKAGE DIMENSIONS



DETAIL Y

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-.

| DIM | MILLIMETERS |       |
|-----|-------------|-------|
|     | 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

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