

RF LDMOS Wideband Integrated Power Amplifier

The MHVIC2115NR2 wideband integrated circuit is designed for base station applications. It uses Freescale's newest High Voltage (26 to 28 Volts) LDMOS IC technology and integrates a multi-stage structure. Its wideband On-Chip matching design makes it usable from 1600 to 2600 MHz. The linearity performances cover W-CDMA modulation formats.

Final Application

- Typical W-CDMA Performance: -45 dBc ACPR, 2110-2170 MHz, $V_{DD} = 27$ Volts, $I_{DQ1} = 56$ mA, $I_{DQ2} = 61$ mA, $I_{DQ3} = 117$ mA, $P_{out} = 34$ dBm, 3GPP Test Model 1, Measured in 1.0 MHz BW @ 4 MHz offset, 64 DTCH
 Power Gain — 30 dB
 PAE = 16%

Driver Application

- Typical W-CDMA Performance: -53 dBc ACPR, 2110-2170 MHz, $V_{DD} = 26$ Volts, $I_{DQ1} = 96$ mA, $I_{DQ2} = 204$ mA, $I_{DQ3} = 111$ mA, $P_{out} = 23$ dBm, 3GPP Test Model 1, Measured in 3.84 MHz BW @ 5 MHz offset, 64 DTCH
 Power Gain — 34 dB
- Gain Flatness = 0.3 dB from 2110-2170 MHz
- P1dB = 15 Watts, Gain Flatness = 0.2 dB from 2110-2170 MHz
- Capable of Handling 3:1 VSWR, @ 26 Vdc, 2140 MHz, 15 Watts CW Output Power

Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters
- On-Chip Matching (50 Ohm Input, DC Blocked, >5 Ohm Output)
- Integrated Temperature Compensation with Enable/Disable Function
- Integrated ESD Protection
- RoHS Compliant
- In Tape and Reel. R2 Suffix = 1,500 Units per 16 mm, 13 inch Reel.

Table 1. Maximum Ratings

| Rating | Symbol | Value | Unit |
|--------------------------------|-----------|--------------|------|
| Drain-Source Voltage | V_{DSS} | -0.5, +65 | Vdc |
| Gate-Source Voltage | V_{GS} | -0.5, +15 | Vdc |
| Storage Temperature Range | T_{stg} | - 65 to +150 | °C |
| Operating Junction Temperature | T_J | 150 | °C |

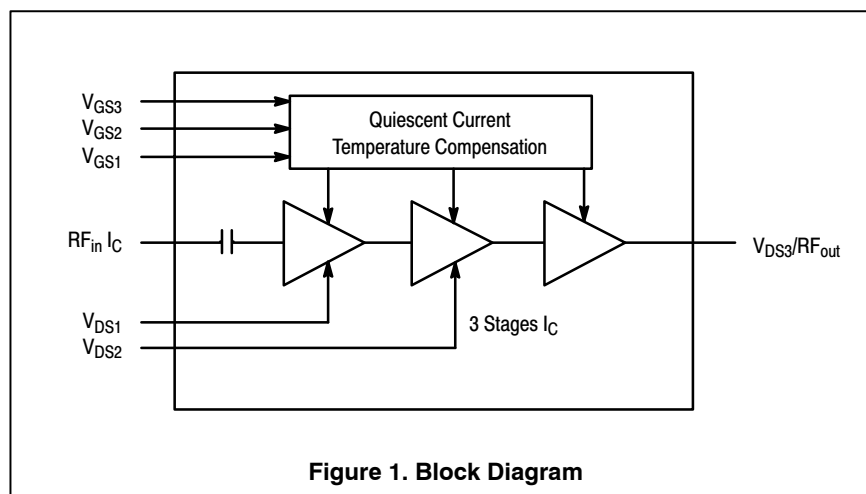
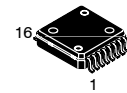


Figure 1. Block Diagram

MHVIC2115NR2

2170 MHz, 26 V, 23/34 dBm
W-CDMA
RF LDMOS WIDEBAND
INTEGRATED POWER AMPLIFIER



CASE 978-03
FFP-16

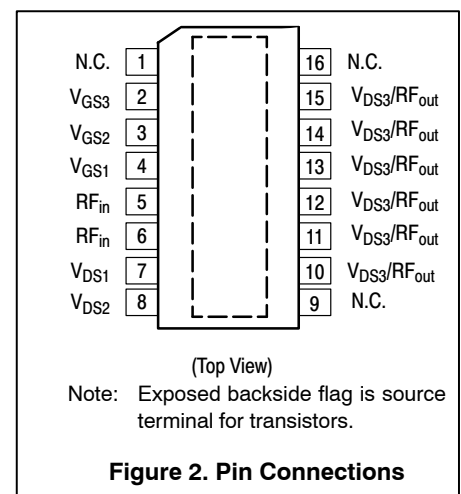


Figure 2. Pin Connections

Table 2. Thermal Characteristics

| Characteristic | Symbol | Value | Unit |
|--|---|-------|-----------------------------|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | | $^{\circ}\text{C}/\text{W}$ |
| Driver Application ($P_{\text{out}} = +0.2 \text{ W CW}$) | Stage 1, 26 Vdc, $I_{DQ} = 96 \text{ mA}$ Stage 2, 26 Vdc, $I_{DQ} = 204 \text{ mA}$ Stage 3, 26 Vdc, $I_{DQ} = 111 \text{ mA}$ | 3.5 | |
| Output Application ($P_{\text{out}} = +2.5 \text{ W CW}$) | Stage 1, 27 Vdc, $I_{DQ} = 56 \text{ mA}$ Stage 2, 27 Vdc, $I_{DQ} = 61 \text{ mA}$ Stage 3, 27 Vdc, $I_{DQ} = 117 \text{ mA}$ | 2.7 | |

Table 3. ESD Protection Characteristics

| Test Conditions | Class |
|---------------------|--------------|
| Human Body Model | 1 (Minimum) |
| Machine Model | M1 (Minimum) |
| Charge Device Model | C2 (Minimum) |

Table 4. Moisture Sensitivity Level

| Test Methodology | Rating | Package Peak Temperature | Unit |
|---------------------------------------|--------|--------------------------|--------------------|
| Per JESD 22-A113, IPC/JEDEC J-STD-020 | 3 | 260 | $^{\circ}\text{C}$ |

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

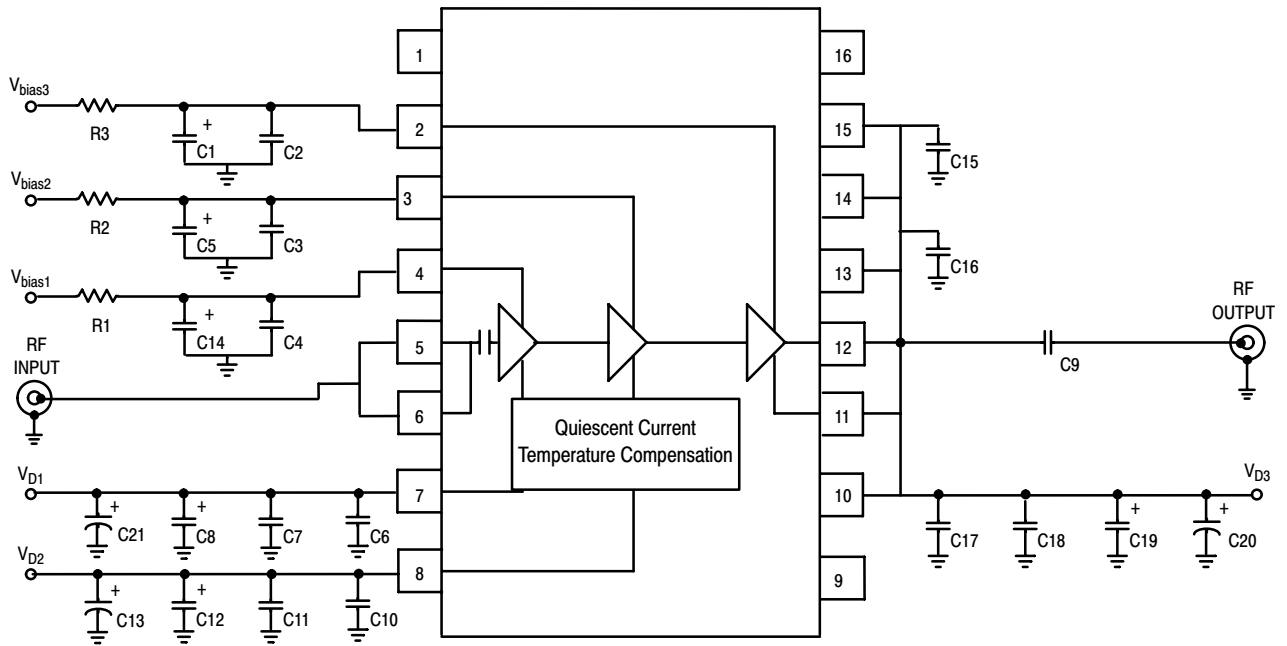
| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

W-CDMA Characteristics (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 26 \text{ Vdc}$, $I_{DQ1} = 96 \text{ mA}$, $I_{DQ2} = 204 \text{ mA}$, $I_{DQ3} = 111 \text{ mA}$, $P_{\text{out}} = 23 \text{ dBm}$, 2110-2170 MHz

| | | | | | |
|---|----------|----|-----|-----|------------|
| Power Gain | G_{ps} | 31 | 34 | — | dB |
| Gain Flatness | G_F | — | 0.3 | 0.5 | dB |
| Input Return Loss | IRL | — | -12 | -10 | dB |
| Group Delay | — | — | 1.7 | — | ns |
| Phase Linearity | — | — | 0.2 | — | $^{\circ}$ |
| 1-Carrier W-CDMA Conditions: Adjacent Channel Power Ratio @ $P_{\text{out}} = 23 \text{ dBm}$, 5 MHz Offset | ACPR | — | -53 | -50 | dBc |
| 1-Carrier W-CDMA Conditions: Adjacent Channel Power Ratio @ $P_{\text{out}} = 28 \text{ dBm}$, 5 MHz Offset | ACPR | — | -50 | — | dBc |

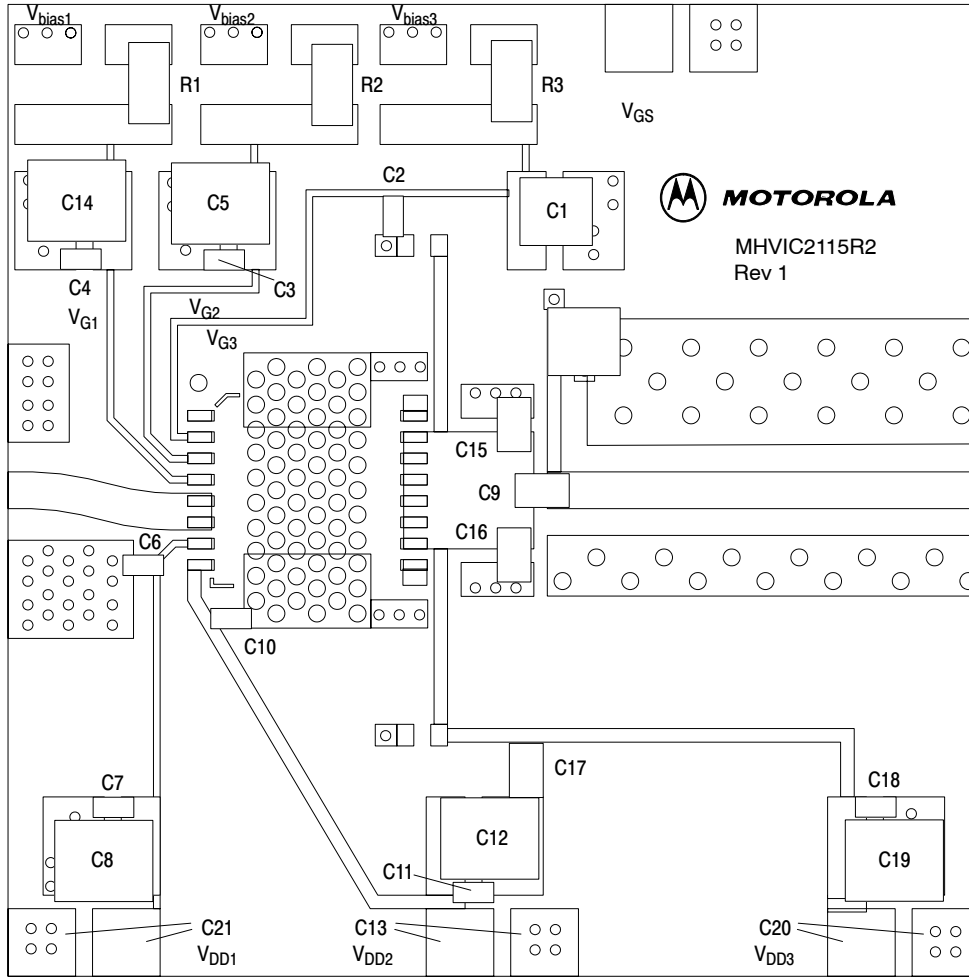
W-CDMA Characteristics (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 27 \text{ Vdc}$, $I_{DQ1} = 56 \text{ mA}$, $I_{DQ2} = 61 \text{ mA}$, $I_{DQ3} = 117 \text{ mA}$, $P_{\text{out}} = 34 \text{ dBm}$, 2110-2170 MHz

| | | | | | |
|---|----------|---|-----|---|-----|
| Power Gain | G_{ps} | — | 30 | — | dB |
| Gain Flatness | G_F | — | 0.2 | — | dB |
| Input Return Loss | IRL | — | -12 | — | dB |
| Power Added Efficiency | PAE | — | 16 | — | % |
| 1-Carrier W-CDMA Conditions: Adjacent Channel Power Ratio @ $P_{\text{out}} = 34 \text{ dBm}$, 4 MHz Offset | ACPR | — | -45 | — | dBc |



- | | | | |
|---------------------------|---|---------------|--|
| C1, C5, C8, C12, C14, C19 | 1 mF SMT Tantalum Chip Capacitors | C13, C20, C21 | 330 mF Electrolytic Capacitors (MCR35V337M10X16) |
| C2, C3, C4, C7, C11, C18 | 0.01 mF Chip Capacitors (0805C103K5RACTR) | R1, R2, R3 | 1 kW Chip Resistors (0805) |
| C6, C10, C17 | 6.8 pF Chip Capacitors, ACCU-P (AVX 08051J6R8BBT) | PCB | Arlon, 0.020,, $\epsilon_r = 2.55$ |
| C9, C15, C16 | 1.8 pF Chip Capacitors, ACCU-P (AVX 08051J1R8BBT) | | |

Figure 3. MHVIC2115NR2 Demo Board Schematic



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

Figure 4. MHVIC2115NR2 Demo Board Component Layout

TYPICAL CHARACTERISTICS

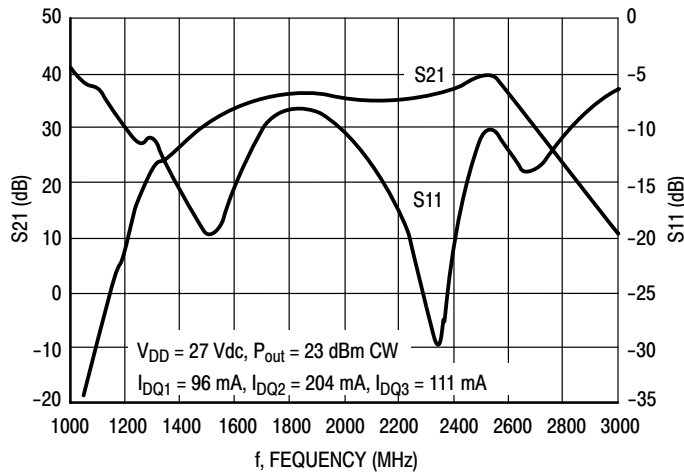


Figure 5. Broadband Frequency Response

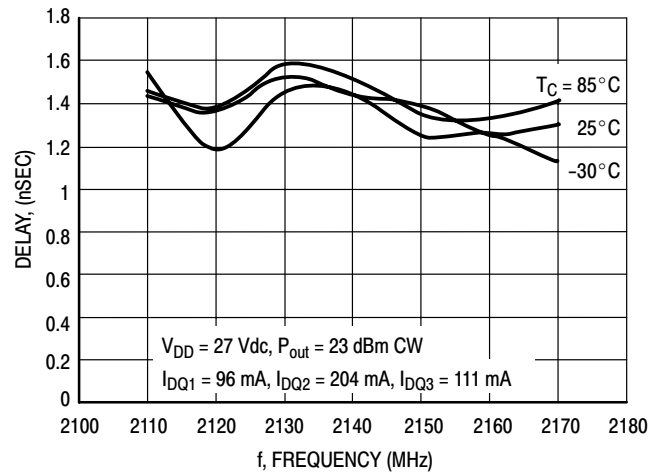


Figure 6. Delay versus Frequency

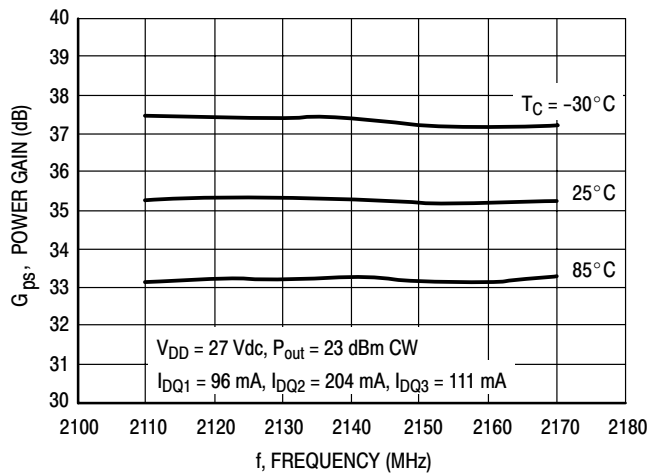


Figure 7. Power Gain versus Frequency

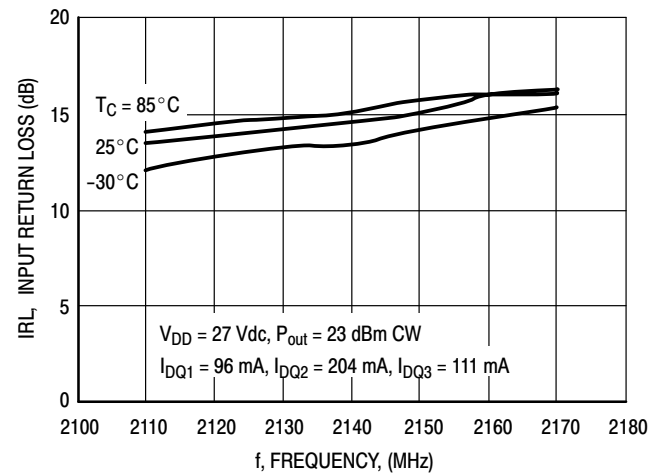


Figure 8. Input Return Loss versus Frequency

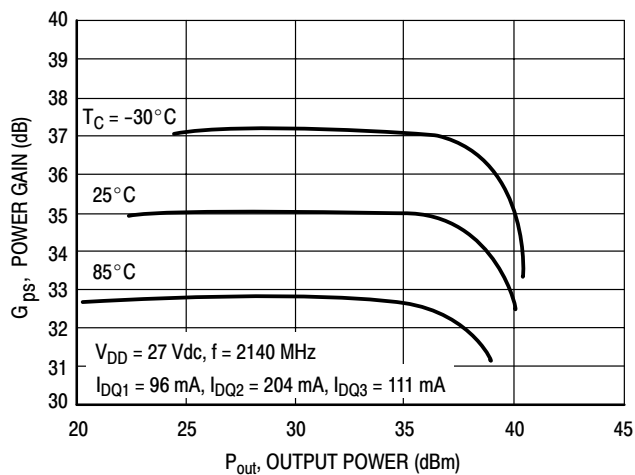


Figure 9. Power Gain versus Output Power

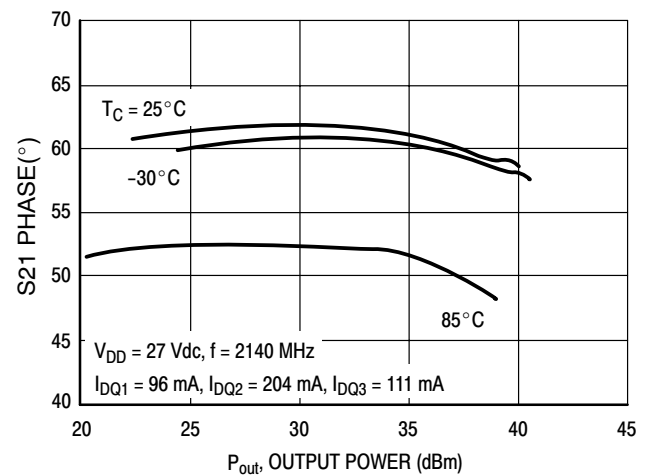


Figure 10. S21 Phase versus Output Power

TYPICAL CHARACTERISTICS

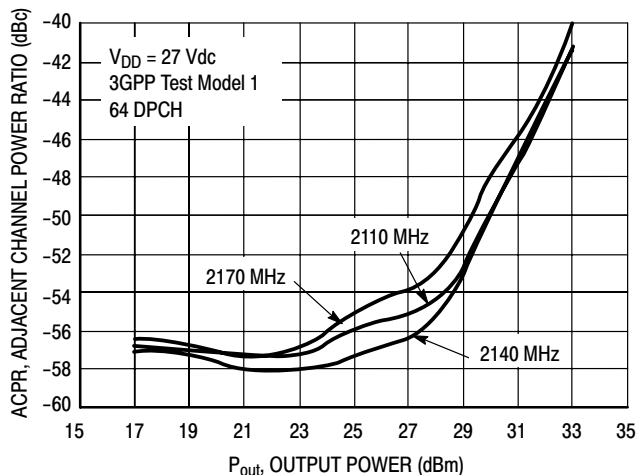


Figure 11. W-CDMA ACPR versus Output Power

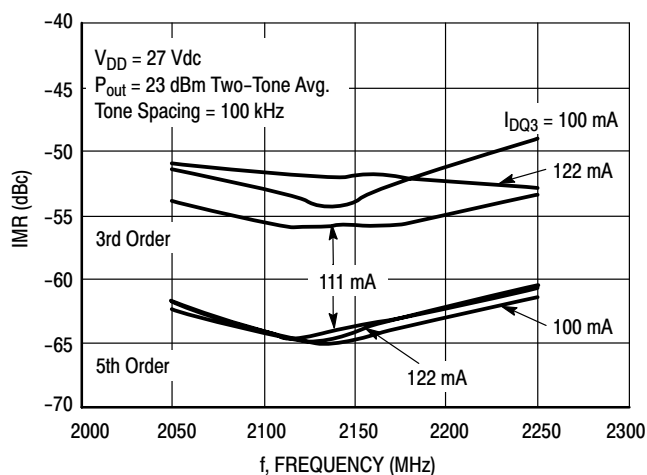


Figure 12. Two-Tone IMR versus Frequency

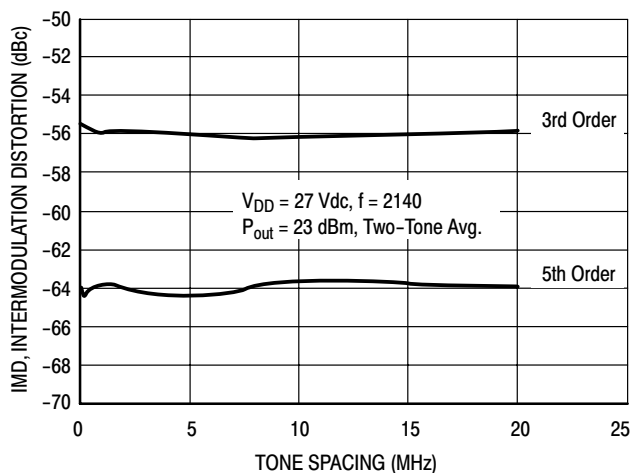


Figure 13. Two-Tone Broadband Performance

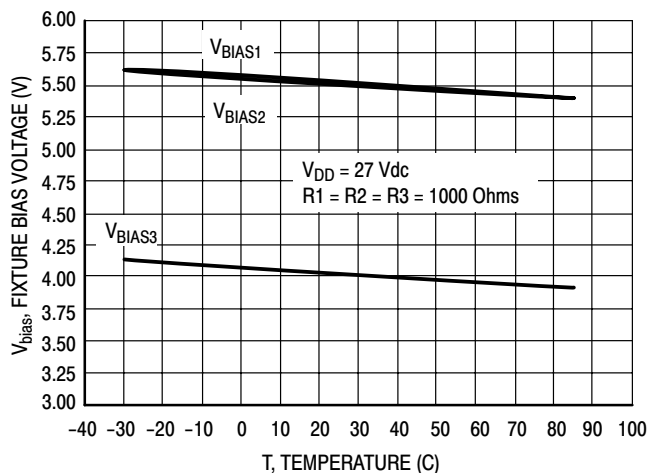


Figure 14. Fixture Bias versus Temperature

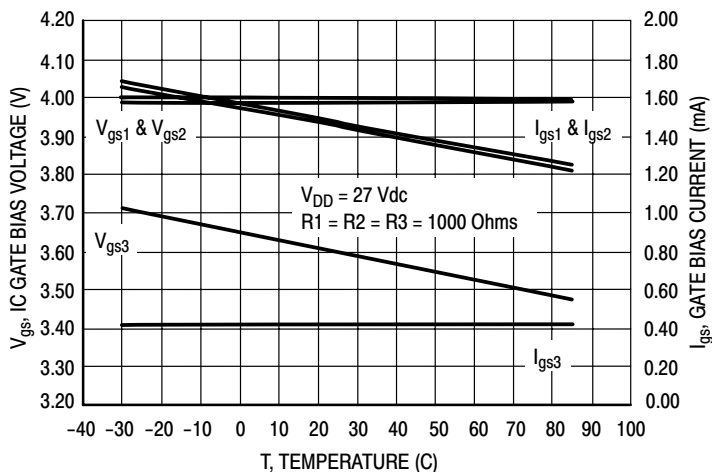
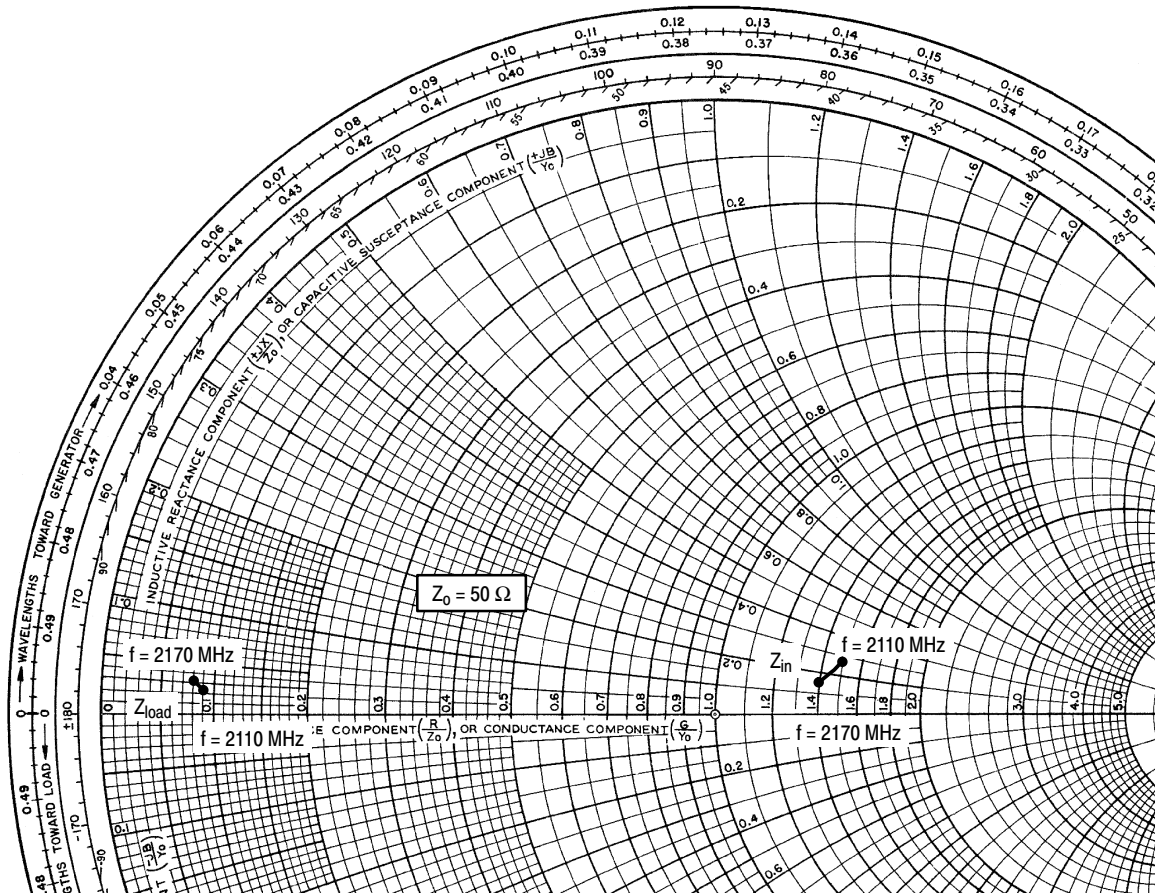


Figure 15. Gate Bias versus Temperature



$V_{DD} = 27 \text{ Vdc}$, $I_{DQ} = 1411 \text{ mA}$, $P_{out} = 15 \text{ W Avg.}$

| f MHz | Z_{in} Ω | Z_{load} Ω |
|----------|----------------------|------------------------|
| 2110 | $72.55 + j12.8$ | $4.25 + j1.00$ |
| 2140 | $71.40 + j9.9$ | $4.13 + j1.37$ |
| 2170 | $70.20 + j7.1$ | $4.12 + j1.46$ |

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

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

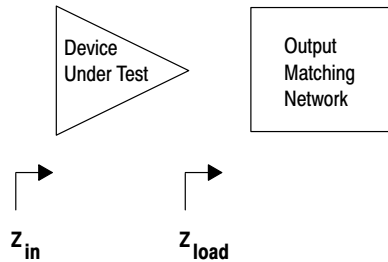


Figure 16. Series Equivalent Input and Load Impedance



NOTES

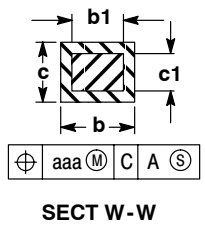
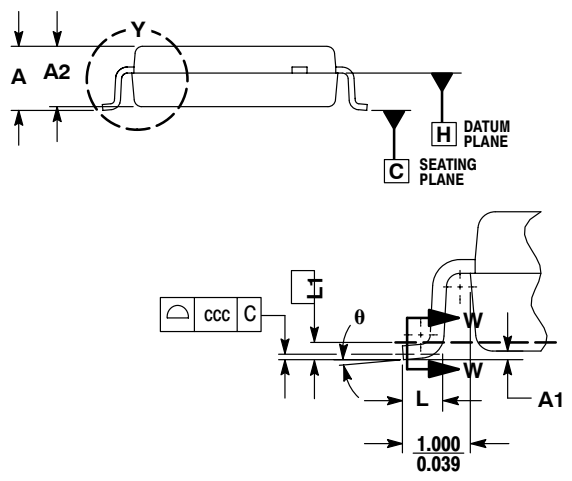
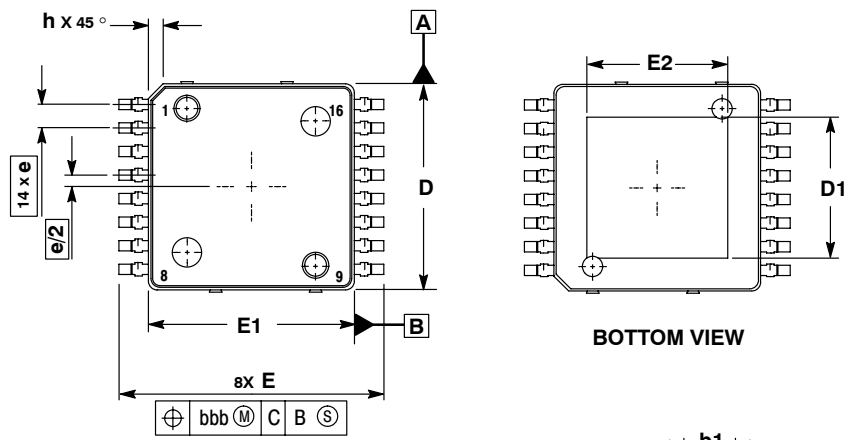


NOTES



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-.

| 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 | |

DETAIL Y

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ISSUE C
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