

# The Wideband IC Line

## RF LDMOS Wideband Integrated Power Amplifier

The MHVIC2115R2 wideband integrated circuit is designed for base station applications. It uses Motorola'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 a 1.0 MHz BW @ 4 MHz offset, 64 DTCH  
 Power Gain — 30 dB  
 PAE = 16%

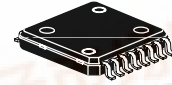
### Driver Application

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 a 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
- 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
- In Tape and Reel. R2 Suffix = 1,500 Units per 16 mm, 13 inch Reel.

## MHVIC2115R2

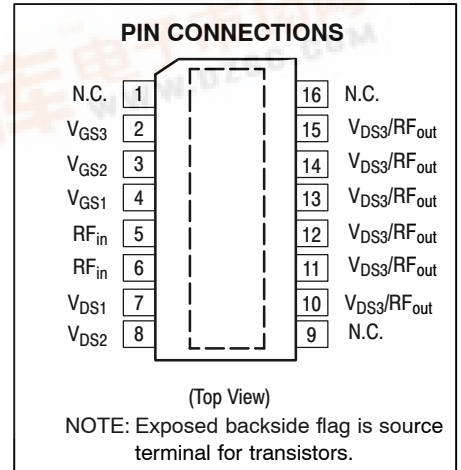
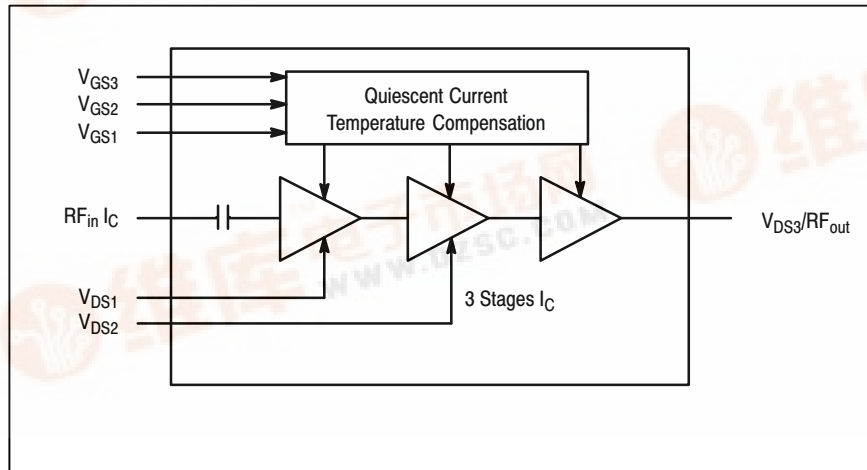
2170 MHz, 26 V, 23/34 dBm  
 W-CDMA  
 RF LDMOS WIDEBAND  
 INTEGRATED POWER AMPLIFIER



CASE 978-03  
 PFP-16

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	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



Refer to AN1987/D, Quiescent Current Control for the RF Integrated Circuit Device Family. Go to <http://www.motorola.com/semiconductors/rf>. Select Documentation/Application Notes - AN1987.



# Freescale Semiconductor, Inc.

## THERMAL CHARACTERISTICS

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

## ESD PROTECTION CHARACTERISTICS

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

## MOISTURE SENSITIVITY LEVEL

Test Methodology	Rating
Per JESD 22-A113	3

## ELECTRICAL CHARACTERISTICS ( $T_C = 25^{\circ}C$ unless otherwise noted)

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

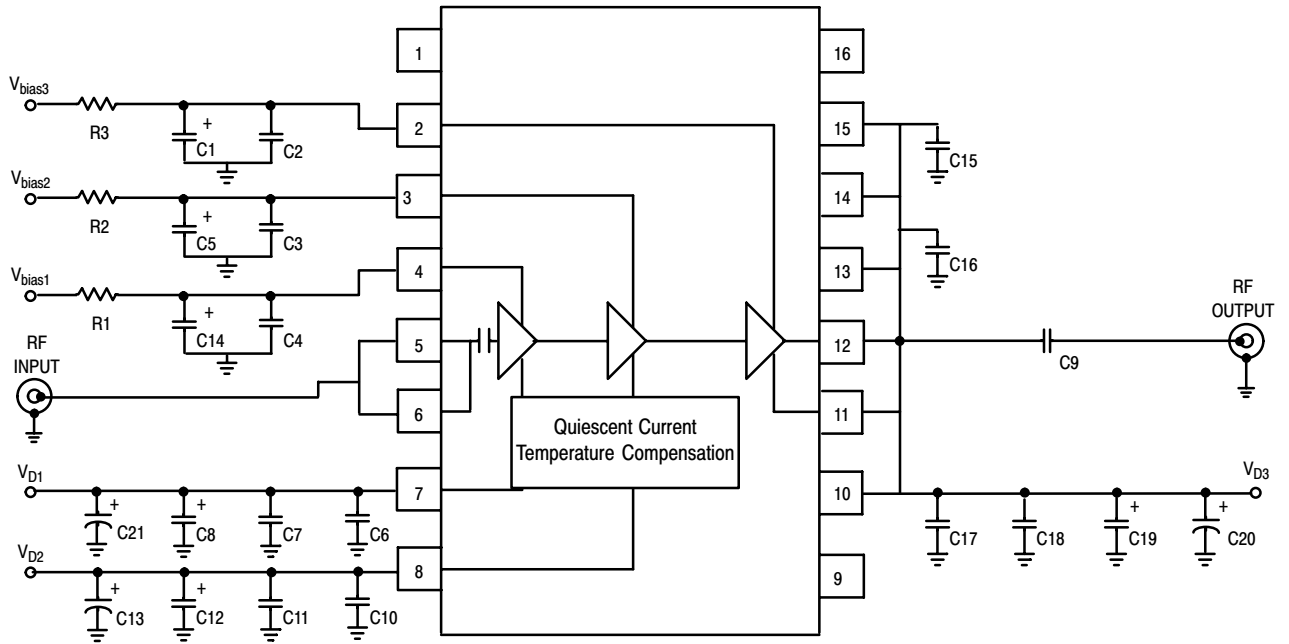
**W-CDMA CHARACTERISTICS** (In Motorola Test Fixture, 50 ohm system)  $V_{DD} = 26$  Vdc,  $I_{DQ1} = 96$  mA,  $I_{DQ2} = 204$  mA,  $I_{DQ3} = 111$  mA,  $P_{out} = 23$  dBm, 2110-2170 MHz

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 @ $P_{out} = 23$ dBm, 5 MHz Offset	ACPR	—	-53	-50	dBc
1-Carrier W-CDMA Conditions: Adjacent Channel Power Ratio @ $P_{out} = 28$ dBm, 5 MHz Offset	ACPR	—	-50	—	dBc

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

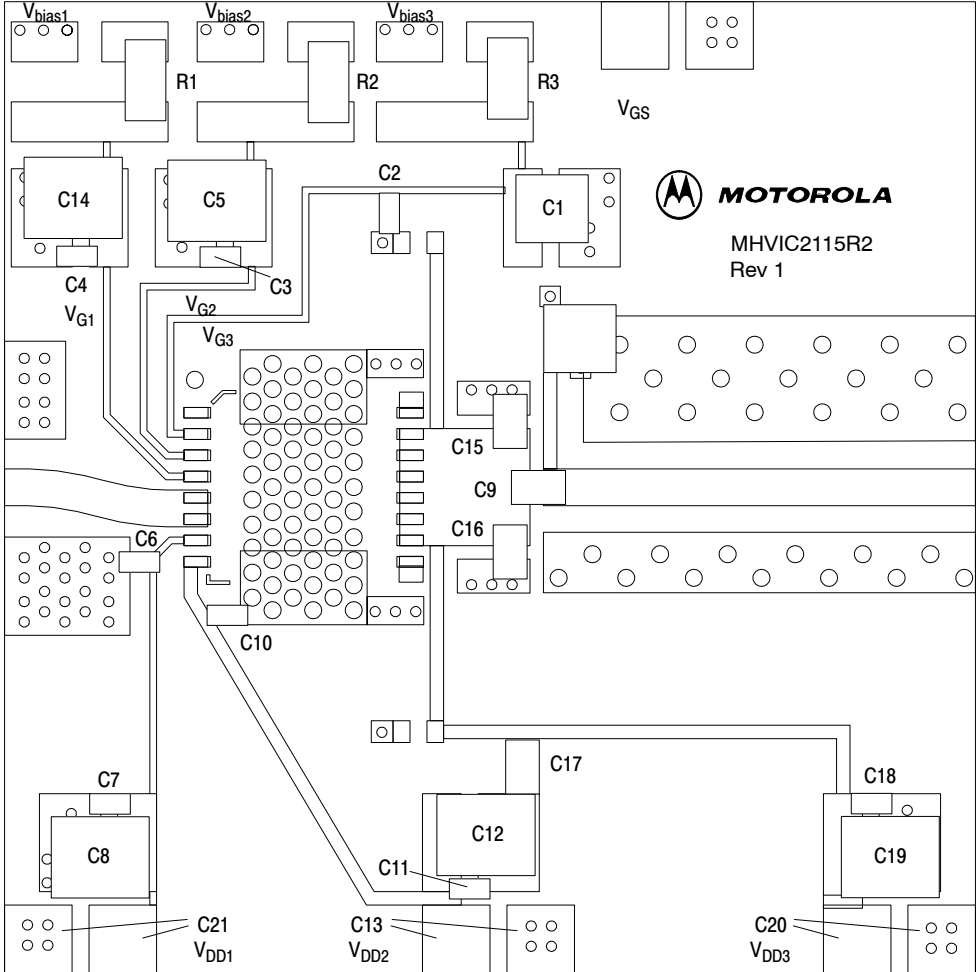
Power Gain	$G_{ps}$	—	30	—	dB
Gain Flatness	$G_F$	—	0.2	—	dB
Input Return Loss	IRL	—	-12	—	dB
Power Added Efficiency	PAE	—	16	—	%
1-Carrier W-CDMA Conditions: Adjacent Channel Power Ratio @ $P_{out} = 34$ dBm, 4 MHz Offset	ACPR	—	-45	—	dBc

## Freescale Semiconductor, Inc.



- |                           |   |               |   |
|---------------------------|---|---------------|---|
| C1, C5, C8, C12, C14, C19 | 1 $\mu$ F SMT Tantalum Chip Capacitors            | C13, C20, C21 | 330 $\mu$ F Electrolytic Capacitors (MCR35V337M10X16) |
| C2, C3, C4, C7, C11, C18  | 0.01 $\mu$ F Chip Capacitors (0805C103K5RACTR)    | R1, R2, R3    | 1 k $\Omega$ 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 1. MHVIC2115R2 Demo Board Schematic**



**Figure 2. MHVIC2115R2 Demo Board Component Layout**

# Freescale Semiconductor, Inc.

## TYPICAL CHARACTERISTICS

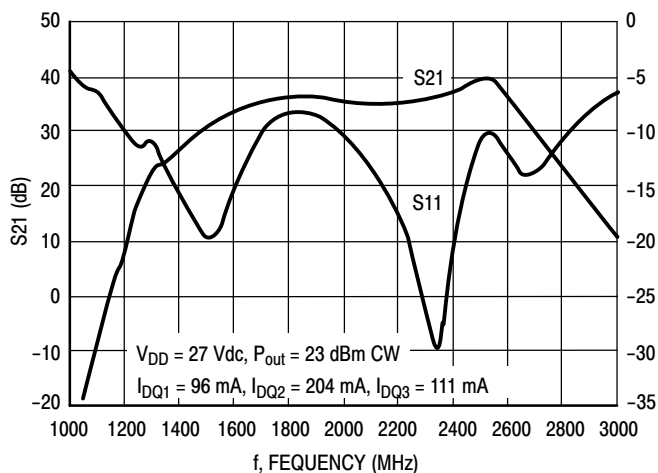


Figure 3. Broadband Frequency Response

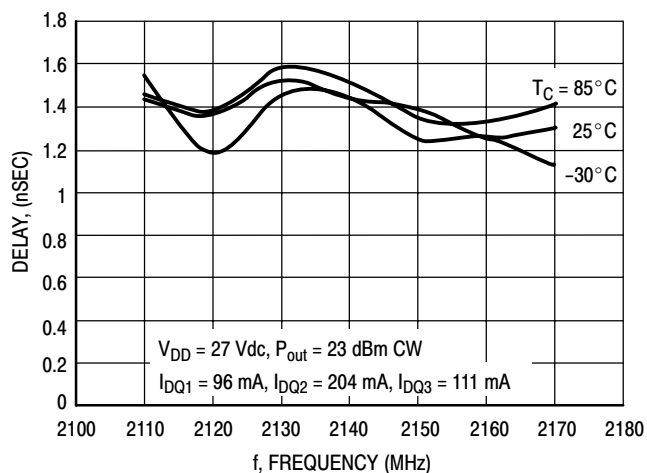


Figure 4. Delay versus Frequency

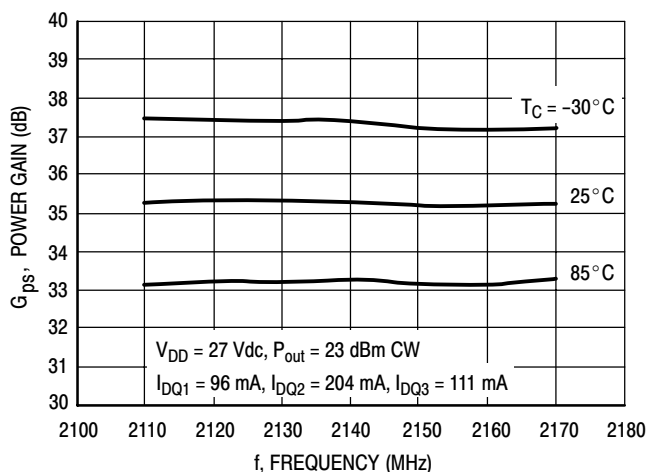


Figure 5. Power Gain versus Frequency

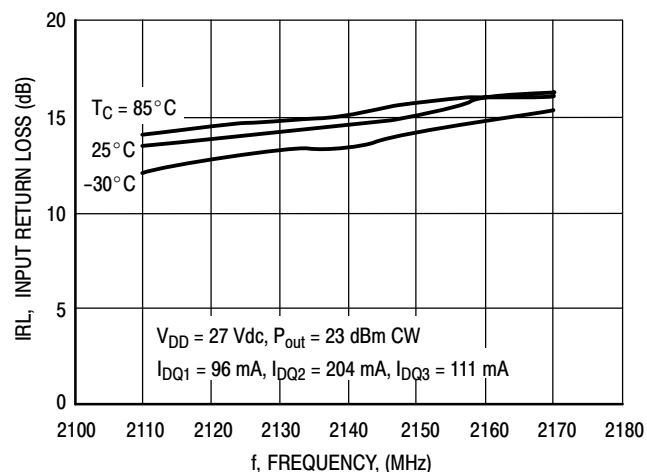


Figure 6. Input Return Loss versus Frequency

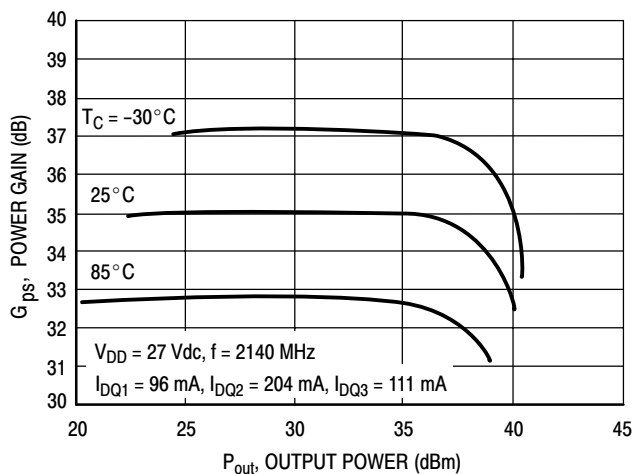


Figure 7. Power Gain versus Output Power

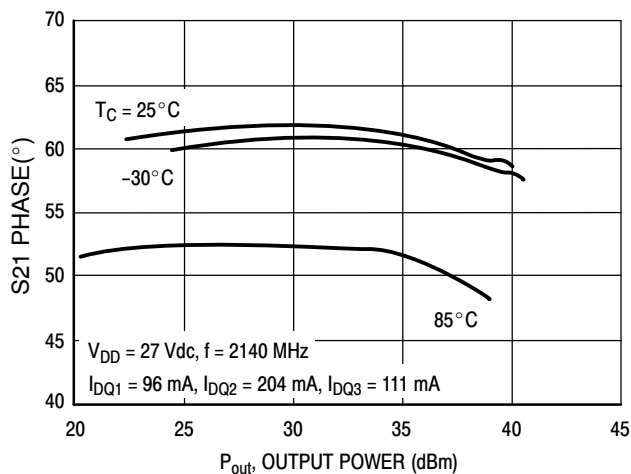


Figure 8. S21 Phase versus Output Power

# Freescale Semiconductor, Inc.

## TYPICAL CHARACTERISTICS

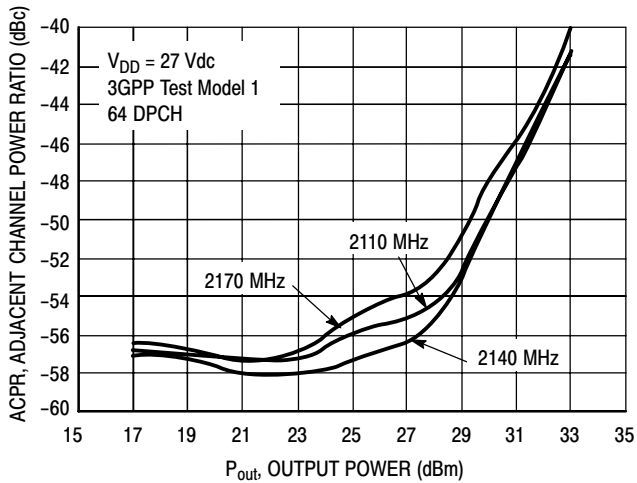


Figure 9. W-CDMA ACPR versus Output Power

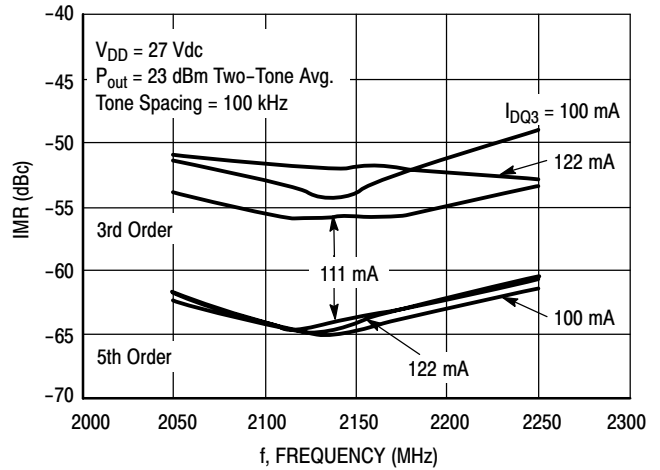


Figure 10. Two-Tone IMR versus Frequency

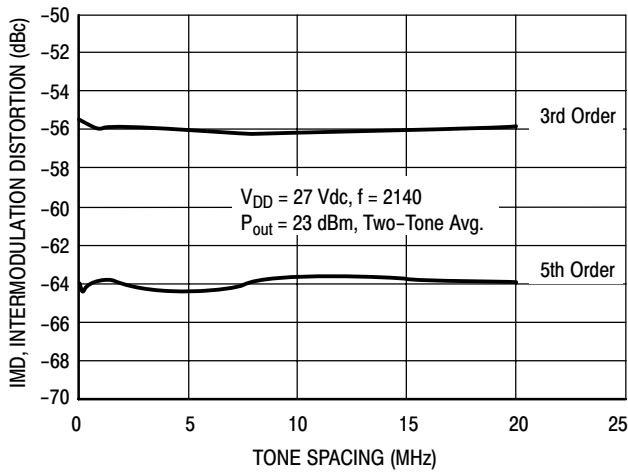


Figure 11. Two-Tone Broadband Performance

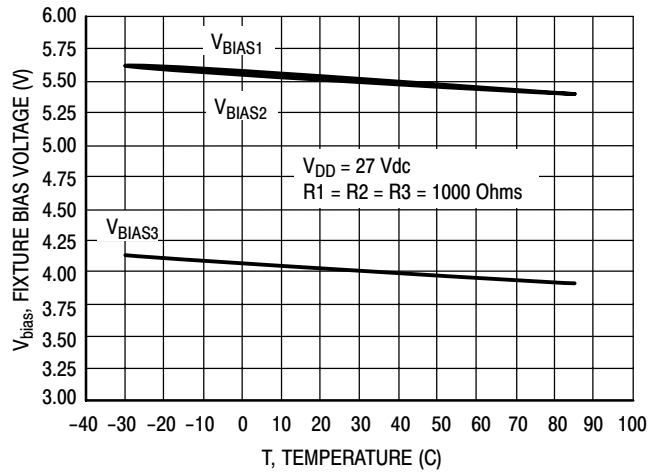


Figure 12. Fixture Bias versus Temperature

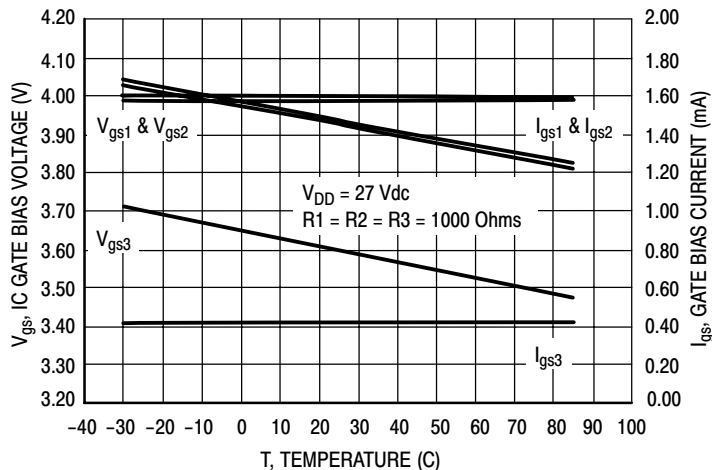
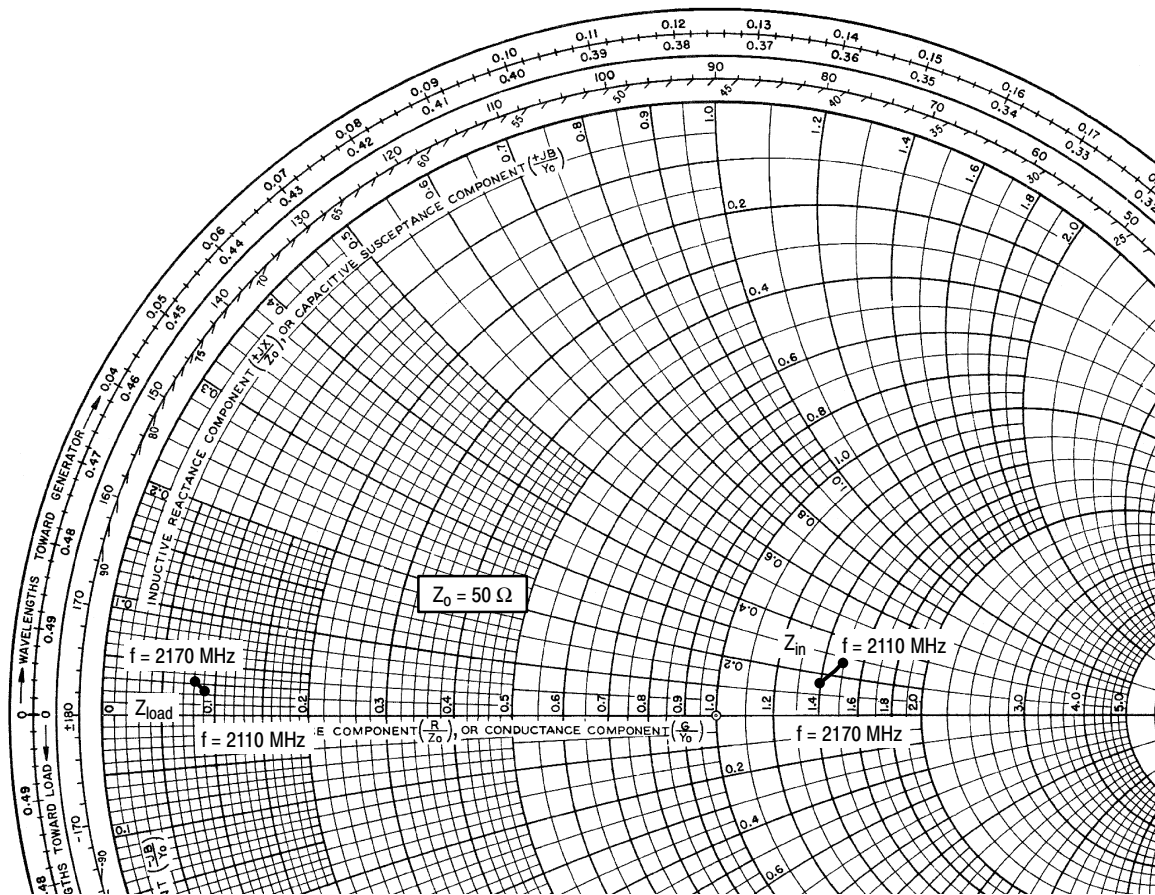


Figure 13. Gate Bias versus Temperature

# Freescale Semiconductor, Inc.

Freescale Semiconductor, Inc.



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

f MHz	$Z_{in}$ $\Omega$	$Z_{load}$ $\Omega$
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.

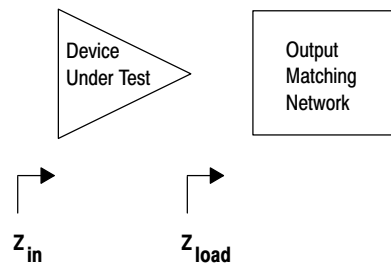


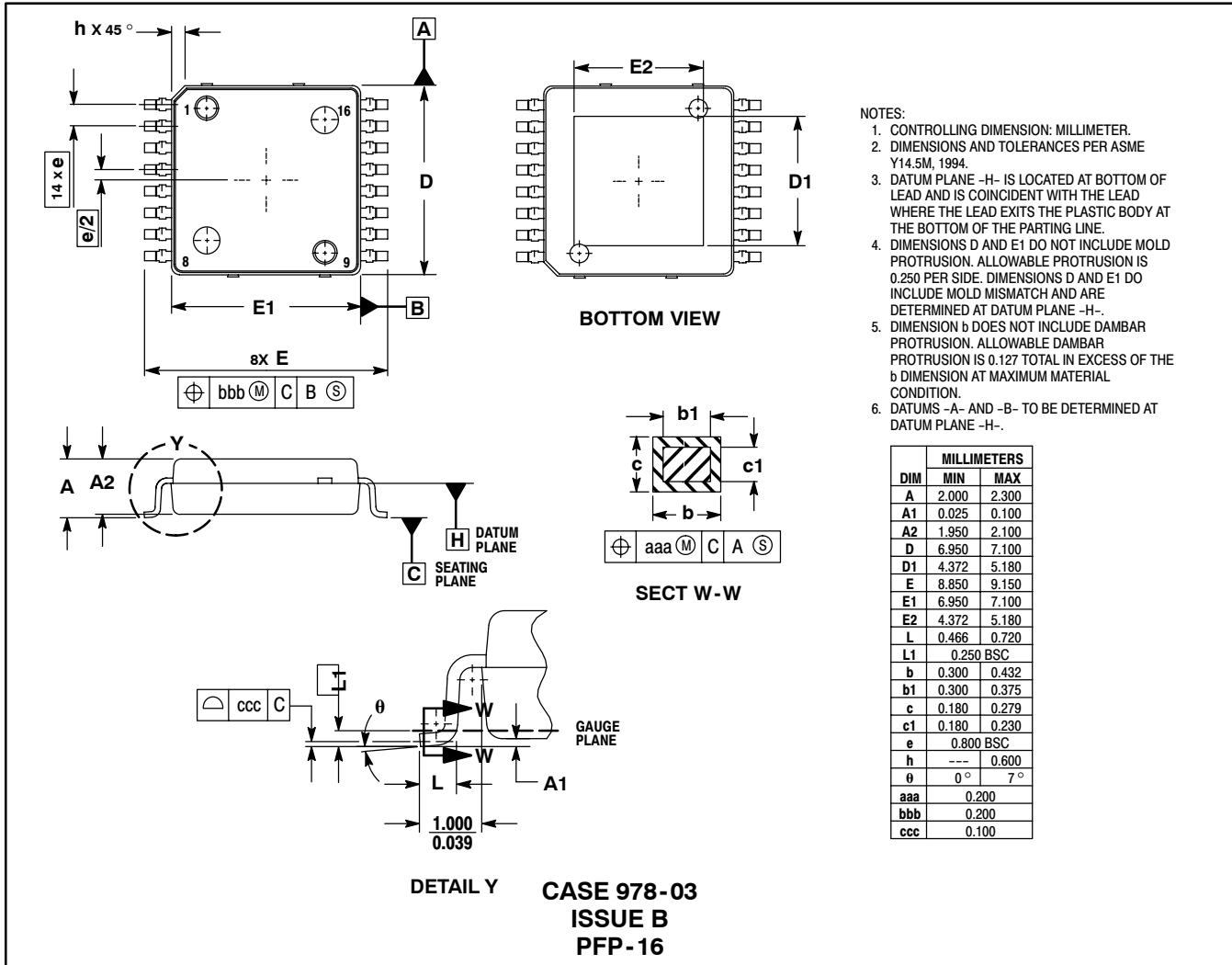
Figure 14. Series Equivalent Input and Load Impedance

**Freescale Semiconductor, Inc.**  
**NOTES**

**Freescale Semiconductor, Inc.**

# Freescale Semiconductor, Inc.

## PACKAGE DIMENSIONS



Information in this document is provided solely to enable system and software implementers to use Motorola 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.

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola 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 Motorola 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. Motorola does not convey any license under its patent rights nor the rights of others. Motorola 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 Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola 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 Motorola was negligent regarding the design or manufacture of the part.

MOTOROLA and the Stylized M Logo are registered in the US Patent and Trademark Office. All other product or service names are the property of their respective owners. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

© Motorola Inc. 2004

### HOW TO REACH US:

#### USA/EUROPE/LOCATIONS NOT LISTED:

Motorola Literature Distribution  
P.O. Box 5405, Denver, Colorado 80217  
1-800-521-6274 or 480-768-2130

**JAPAN:** Motorola Japan Ltd.; SPS, Technical Information Center,  
3-20-1, Minami-Azabu, Minato-ku, Tokyo 106-8573, Japan  
81-3-3440-3569

**ASIA/PACIFIC:** Motorola Semiconductors H.K. Ltd.; Silicon Harbour Centre,  
2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong  
852-2668334

**HOME PAGE:** <http://motorola.com/semiconductors>