

# Gallium Arsenide PHEMT

## RF Power Field Effect Transistor

Designed for WiMAX and WLL base station applications that have a 200 MHz BW requirement in the 2300–3800 MHz frequency range. Suitable for TDMA and CDMA amplifier applications. To be used in Class AB applications.

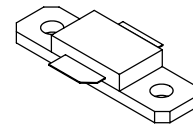
- Typical WiMAX Performance:  $V_{DD} = 12$  Volts,  $I_{DQ} = 300$  mA,  $P_{out} = 2$  Watts Avg.,  $f = 3500$  MHz, 802.16d, 64 QAM  $3/4$ , 4 bursts, 7 MHz Channel Bandwidth, Input Signal PAR = 9.5 dB @ 0.01% Probability on CCDF.  
Power Gain — 11.5 dB  
Drain Efficiency — 22%  
RCE — -33 dB  
Meets ETSI Type G Mask
- 20 Watts P1dB @ 3500 MHz, CW

### Features

- Supports up to 28 MHz Bandwidth OFDM Signals
- Internally Input Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Excellent Thermal Stability
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 32 mm, 13 inch Reel.

**MRFG35020AR1**

**3.5 GHz, 20 W, 12 V  
WiMAX  
POWER FET  
GaAs PHEMT**



**CASE 360E-01, STYLE 2  
NI-360 SHORT LEAD**

**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	15	Vdc
Gate-Source Voltage	$V_{GS}$	-5	Vdc
RF Input Power	$P_{in}$	34	dBm
Storage Temperature Range	$T_{stg}$	-40 to +150	°C
Channel Temperature (1)	$T_{ch}$	175	°C

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value (2)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.7	°C/W

1. For reliable operation, the operating channel temperature should not exceed 150°C. Exceeding 150°C channel operating temperature may result in device performance degradation.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1955.

**Table 3. ESD Protection Characteristics**

Test Methodology	Class
Human Body Model (per JESD22-A114)	2 (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	IV (Minimum)

**Table 4. Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>DC Characteristics</b>					
Off State Drain Current ( $V_{DS} = 3.5\text{ Vdc}$ , $V_{GS} = -2.2\text{ Vdc}$ )	$I_{DSO}$	—	10	425	$\mu\text{Adc}$
Off State Current ( $V_{DS} = 28.5\text{ Vdc}$ , $V_{GS} = -2.5\text{ Vdc}$ )	$I_{DSX}$	—	2	42.5	$\text{mAdc}$
Gate-Source Cut-off Voltage ( $V_{DS} = 3.5\text{ Vdc}$ , $I_{DS} = 42.5\text{ mA}$ )	$V_{GS(th)}$	-1.2	-0.95	-0.7	Vdc

**Functional Tests** (In Freescale Test Fixture, 50 ohm system) <sup>(1)</sup>  $V_{DD} = 12\text{ Vdc}$ ,  $I_{DQ} = 300\text{ mA}$ ,  $P_{out} = 2\text{ W Avg.}$ ,  $f = 3500\text{ MHz}$ , Single-Carrier W-CDMA, 3.84 MHz Channel Bandwidth Carrier. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm 5\text{ MHz}$  Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.

Power Gain	$G_{ps}$	9.5	11.5	—	dB
Drain Efficiency	$\eta_D$	18	22	—	%
Adjacent Channel Power Ratio	ACPR	—	-43	-39	$\text{dBc}$

**Typical RF Performance** (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 12\text{ Vdc}$ ,  $I_{DQ} = 300\text{ mA}$ ,  $f = 3500\text{ MHz}$

Output Power, 1 dB Compression Point, CW	P1dB	—	20	—	W
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1. Measurements made with device in test fixture.

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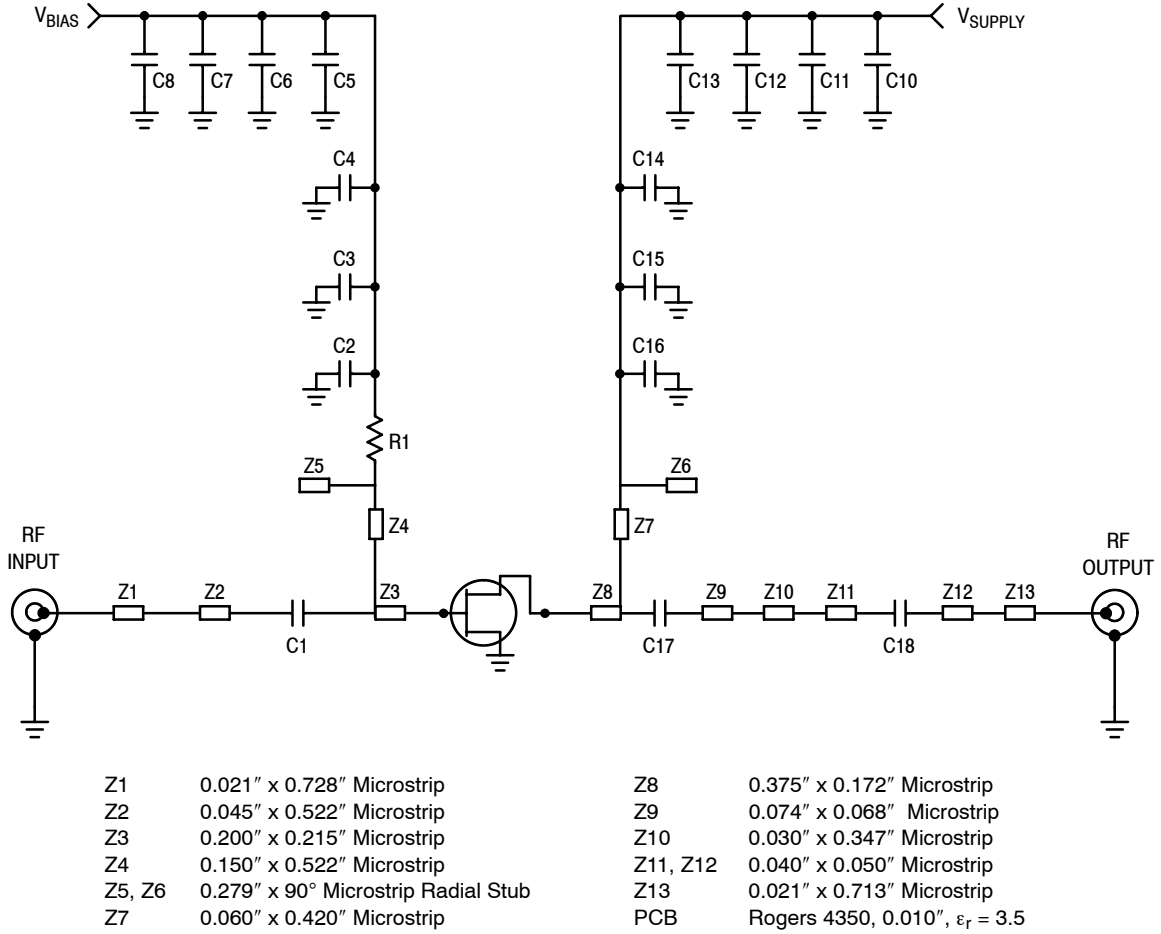


Figure 1. MRFG35020A Test Circuit Schematic

Table 5. MRFG35020A Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	3.9 pF Chip Capacitor	08051J3R9BBS	AVX
C2, C16	10 pF Chip Capacitors	ATC100A100JT150XT	ATC
C3, C15	100 pF Chip Capacitors	ATC100A101JT150XT	ATC
C4, C14	100 pF Chip Capacitors	ATC100B101JT500XT	ATC
C5, C13	1000 pF Chip Capacitors	ATC100B102JT50XT	ATC
C6, C12	0.01 μF Chip Capacitors	ATC200B103KT50XT	ATC
C7, C11	39K pF Chip Capacitors	ATC200B393KT50XT	ATC
C8, C10	10 μF Chip Capacitors	GRM55DR61H106KA88B	Murata
C9	None		
C17	1.8 pF Chip Capacitors	08051J1R8BBS	AVX
C18	1.5 pF Chip Capacitor	08051J1R5BBS	AVX
R1	6.2 Ω, 1/4 W Chip Resistor	CRCW12066R20FKEA	Vishay

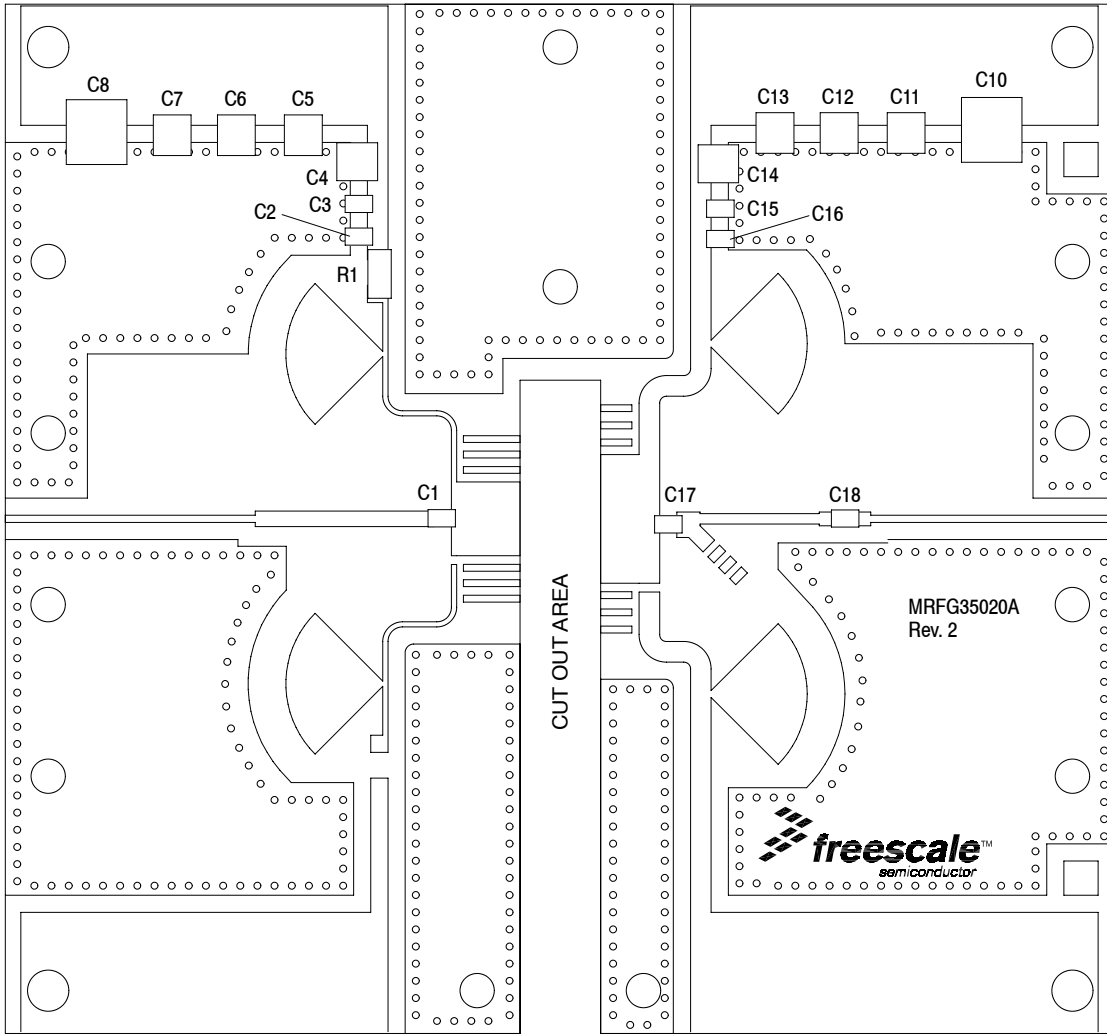
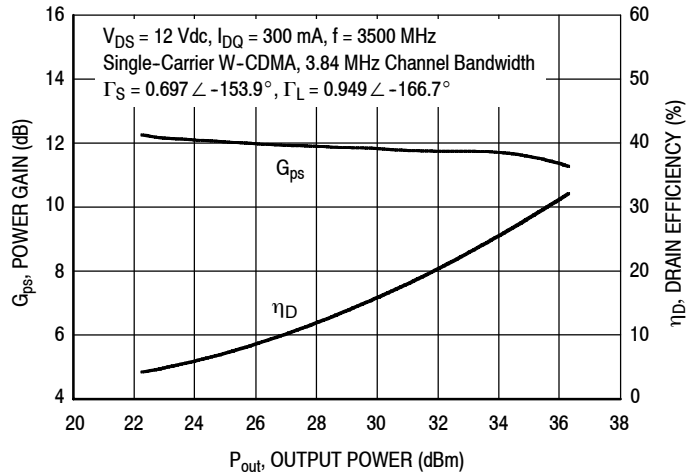
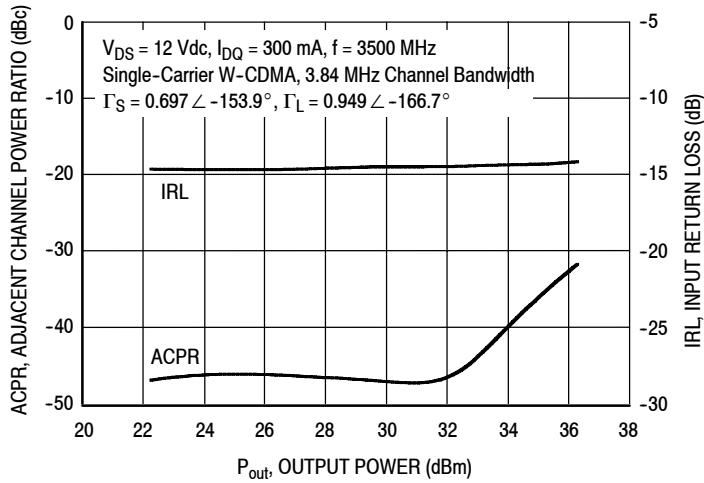


Figure 2. MRF35020A Test Circuit Component Layout

### TYPICAL CHARACTERISTICS



**Figure 3. Single-Channel W-CDMA Power Gain and Drain Efficiency versus Output Power**



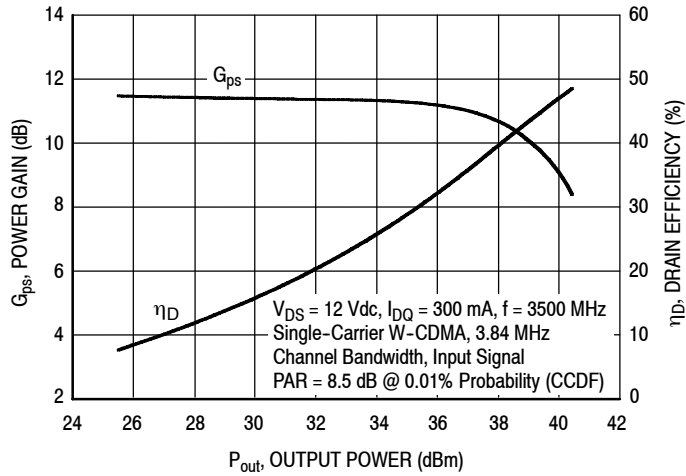
**Figure 4. Single-Channel W-CDMA Adjacent Channel Power Ratio and IRL versus Output Power**

**NOTE:** All data is referenced to package lead interface.  $\Gamma_S$  and  $\Gamma_L$  are the impedances presented to the DUT. All data is generated from load pull, not from the test circuit shown.

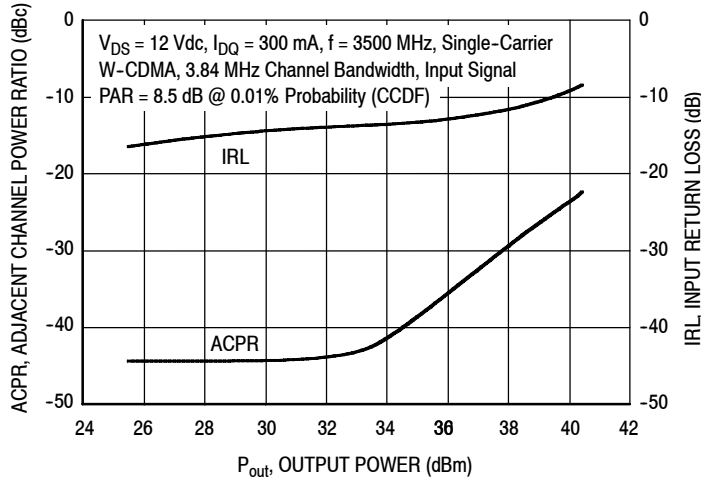
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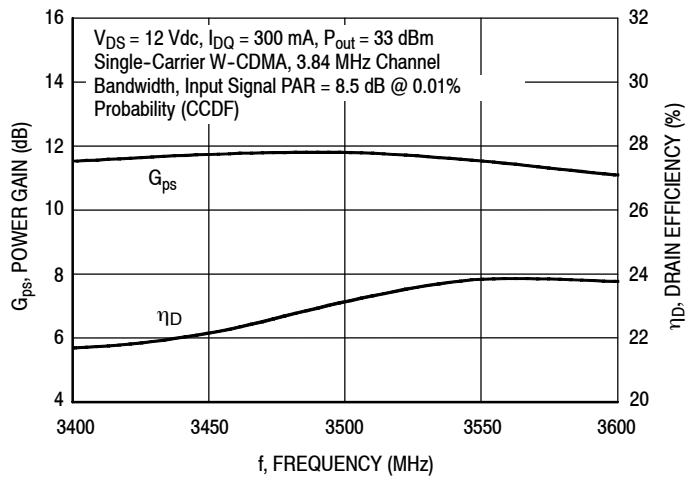
**TYPICAL CHARACTERISTICS**



**Figure 5. Single-Channel W-CDMA Power Gain and Drain Efficiency versus Output Power**



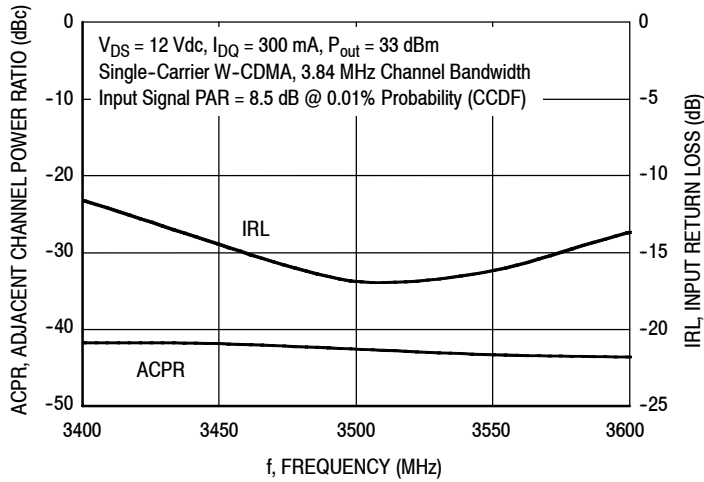
**Figure 6. Single-Channel W-CDMA Adjacent Channel Power Ratio and IRL versus Output Power**



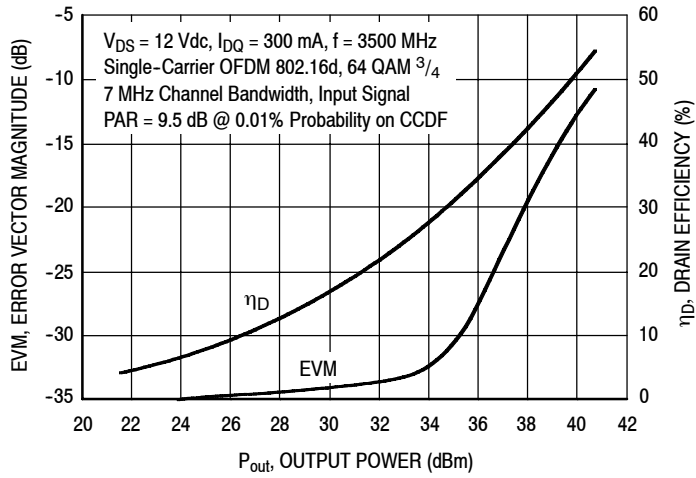
**Figure 7. Single-Channel W-CDMA Power Gain and Drain Efficiency versus Frequency**

**NOTE:** Data is generated from the test circuit shown.

### TYPICAL CHARACTERISTICS



**Figure 8. Single-Channel W-CDMA Adjacent Channel Power Ratio and IRL versus Frequency**

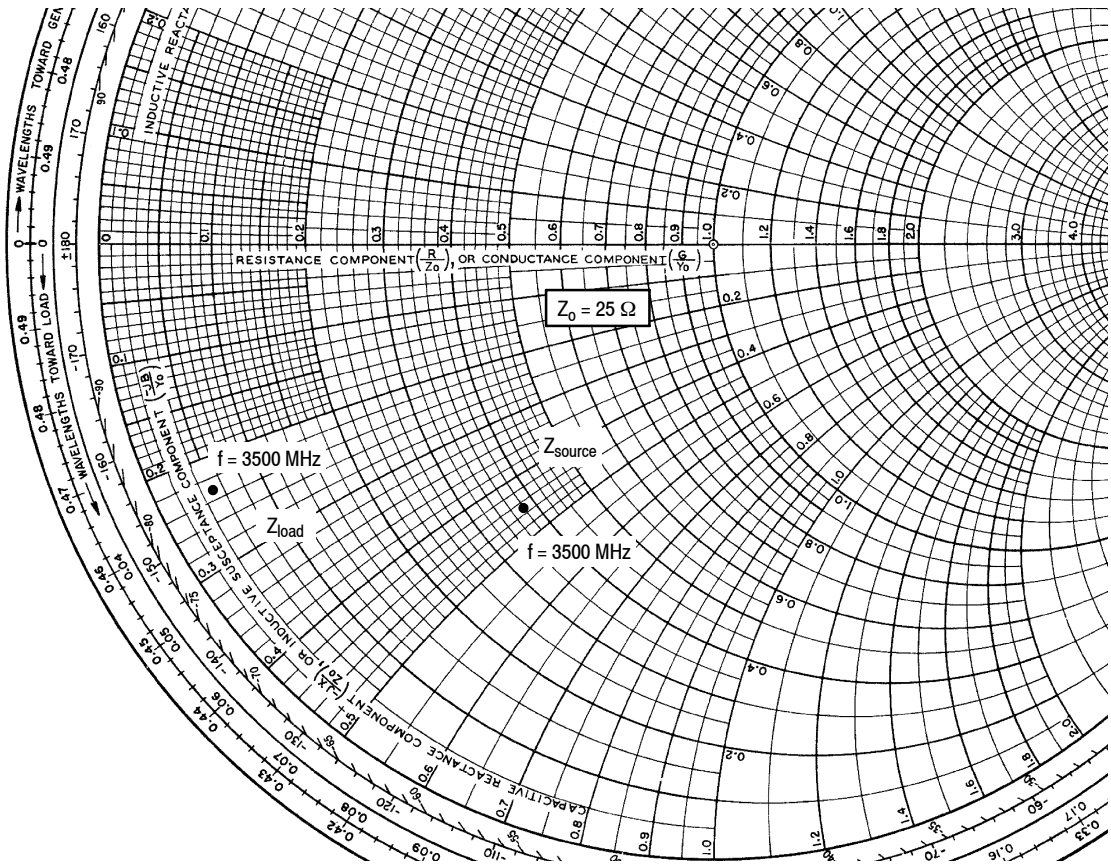


**Figure 9. Single-Channel OFDM Error Vector Magnitude and Drain Efficiency versus Output Power**

**NOTE:** Data is generated from the test circuit shown.

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$V_{DD} = 12 \text{ Vdc}$ ,  $I_{DQ} = 300 \text{ mA}$ ,  $P_{out} = 2 \text{ W Avg.}$

f MHz	Z <sub>source</sub> Ω	Z <sub>load</sub> Ω
3500	9.4 - j11.2	1.3 - j5.8

Z<sub>source</sub> = Test circuit impedance as measured from gate to ground.

Z<sub>load</sub> = Test circuit impedance as measured from drain to ground.

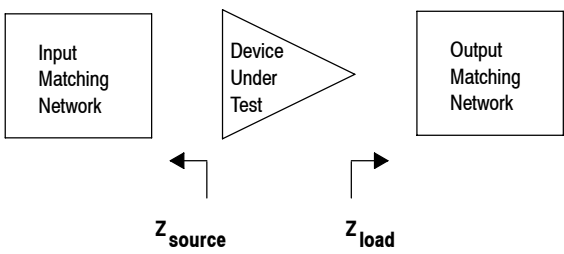
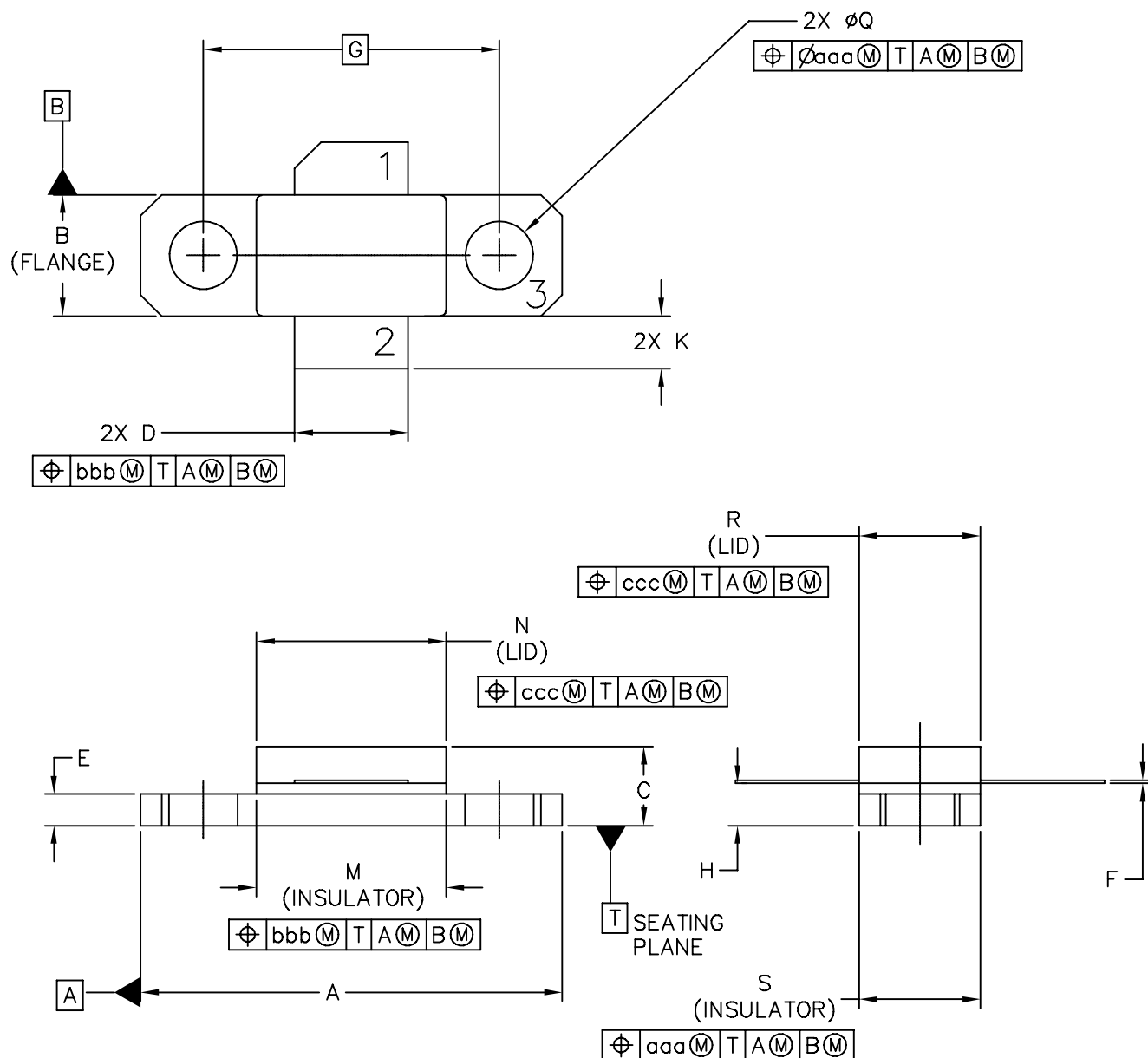


Figure 10. Series Equivalent Source and Load Impedance



**PACKAGE DIMENSIONS**



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TITLE:  NI-360 SHORT LEAD	DOCUMENT NO: 98ASA10715D	REV: A	
	CASE NUMBER: 360E-01	03 APR 2006	
	STANDARD: NON-JEDEC		

NOTES:

1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH
3. DIMENSION H IS MEASURED .030 AWAY FROM PACKAGE BODY

STYLE 1:

- PIN 1 - DRAIN
- 2 - GATE
- 3 - SOURCE

STYLE 2:

- PIN 1 - GATE
- 2 - DRAIN
- 3 - SOURCE

DIM	INCH		MILLIMETER		DIM	INCH		MILLIMETER	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
A	.795	.805	20.19	20.45	N	.357	.363	9.07	9.22
B	.225	.235	5.72	5.97	Q	.125	.135	3.18	3.43
C	.125	.175	3.18	4.45	R	.227	.233	5.77	5.92
D	.210	.220	5.33	5.59	S	.225	.235	5.72	5.97
E	.055	.065	1.40	1.65					
F	.004	.006	0.10	0.15	aaa	.005		0.13	
G	.562 BSC		14.28 BSC		bbb	.010		0.25	
H	.077	.087	1.96	2.21	ccc	.015		0.38	
K	.085	.115	2.16	2.92					
M	.355	.365	9.02	9.27					
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					CASE NUMBER: 360E-01			03 APR 2006	
					STANDARD: NON-JEDEC				

## PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

### Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

### REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Jan. 2008	<ul style="list-style-type: none"> <li>• Initial Release of Data Sheet</li> </ul>
1	Dec. 2008	<ul style="list-style-type: none"> <li>• Changed Storage Temperature Range in Max Ratings table from -65 to +175 to -65 to +150 for standardization across products, p. 1</li> <li>• Removed "Operating Case Temperature Range" from Maximum Ratings table so that the maximum channel temperature rating is the limiting thermal design criteria and not the case temperature range, p. 1</li> </ul>

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