Freescale Semiconductor
Technical Data

Document Number: MRF284
Rev. 19, 10/2008

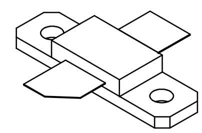
RoHS

RF Power Field Effect Transistor

N-Channel Enhancement-Mode Lateral MOSFET

MRF284LR1

2000 MHz, 30 W, 26 V
LATERAL N-CHANNEL
BROADBAND
RF POWER MOSFET



CASE 360B-05, STYLE 1
NI-360

Designed for PCN and PCS base station applications with frequencies from 1000 to 2600 MHz. Suitable for FM, TDMA, CDMA, and multicarrier amplifier applications. To be used in Class A and Class AB for PCN-PCS/cellular radio and wireless local loop.

- Specified Two-Tone Performance @ 2000 MHz, 26 Volts
  Output Power = 30 Watts PEP
  Power Gain = 9 dB
  Efficiency = 30%
  Intermodulation Distortion = -29 dBc
- Typical Single-Tone Performance at 2000 MHz, 26 Volts
  Output Power = 30 Watts CW
  Power Gain = 9.5 dB
  Efficiency = 45%
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 2000 MHz, 30 Watts CW Output Power

Features

- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ″ Nominal.
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 32 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}	±20	Vdc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	87.5 0.5	W W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C
Case Operating Temperature	T_C	150	°C
Operating Junction Temperature	T_J	200	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	2.0	°C/W

Table 3. Electrical Characteristics (T_C = 25°C unless otherwise noted)

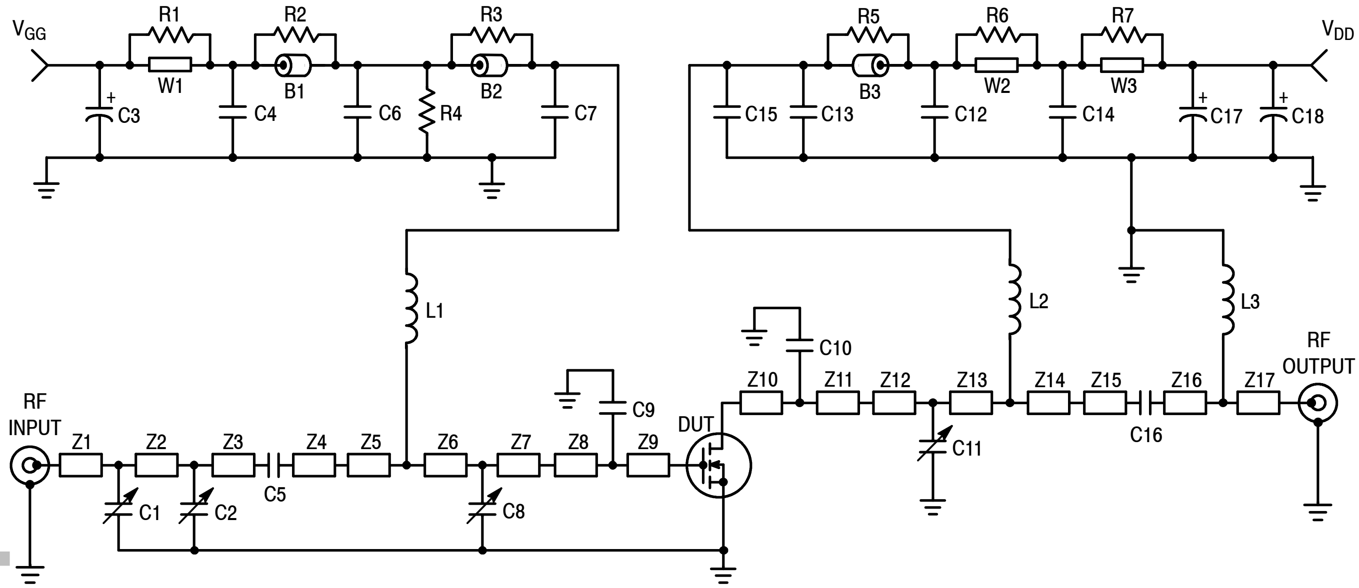
Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Drain-Source Breakdown Voltage (V_{GS} = 0, I_D = 10 μAdc)	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current (V_{DS} = 20 Vdc, V_{GS} = 0)	I_{DSS}	—	—	1.0	μAdc
Gate-Source Leakage Current (V_{GS} = 20 Vdc, V_{DS} = 0)	I_{GSS}	—	—	10	μAdc

(continued)

NOTE - **CAUTION** - MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

Table 3. Electrical Characteristics (T_C = 25°C unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 150 μAdc)	$V_{GS(th)}$	2.0	3.0	4.0	Vdc
Gate Quiescent Voltage (V_{DS} = 26 Vdc, I_D = 200 mAdc)	$V_{GS(q)}$	3.0	4.0	5.0	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 1.0 Adc)	$V_{DS(on)}$	—	0.3	0.6	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 1.0 Adc)	g_{fs}	—	1.5	—	S
Dynamic Characteristics					
Input Capacitance (V_{DS} = 26 Vdc, V_{GS} = 0, f = 1.0 MHz)	C_{iss}	—	43	—	pF
Output Capacitance (V_{DS} = 26 Vdc, V_{GS} = 0, f = 1.0 MHz)	C_{oss}	—	23	—	pF
Reverse Transfer Capacitance (V_{DS} = 26 Vdc, V_{GS} = 0, f = 1.0 MHz)	C_{rss}	—	1.4	—	pF
Functional Tests (in Freescale Test Fixture, 50 ohm system)					
Common-Source Power Gain (V_{DD} = 26 Vdc, P_{out} = 30 W, I_{DQ} = 200 mA, f1 = 2000.0 MHz, f2 = 2000.1 MHz)	G_{ps}	9	10.5	—	dB
Drain Efficiency (V_{DD} = 26 Vdc, P_{out} = 30 W, I_{DQ} = 200 mA, f1 = 2000.0 MHz, f2 = 2000.1 MHz)	η	30	35	—	%
Intermodulation Distortion (V_{DD} = 26 Vdc, P_{out} = 30 W, I_{DQ} = 200 mA, f1 = 2000.0 MHz, f2 = 2000.1 MHz)	IMD	—	-32	-29	dBc
Input Return Loss (V_{DD} = 26 Vdc, P_{out} = 30 W, I_{DQ} = 200 mA, f1 = 2000.0 MHz, f2 = 2000.1 MHz)	IRL	—	-15	-9	dB
Common-Source Amplifier Power Gain (V_{DD} = 26 Vdc, P_{out} = 30 W CW, I_{DQ} = 200 mA, f1 = 2000.0 MHz)	G_{ps}	8.5	9.5	—	dB
Drain Efficiency (V_{DD} = 26 Vdc, P_{out} = 30 W CW, I_{DQ} = 200 mA, f1 = 2000.0 MHz)	η	35	45	—	%

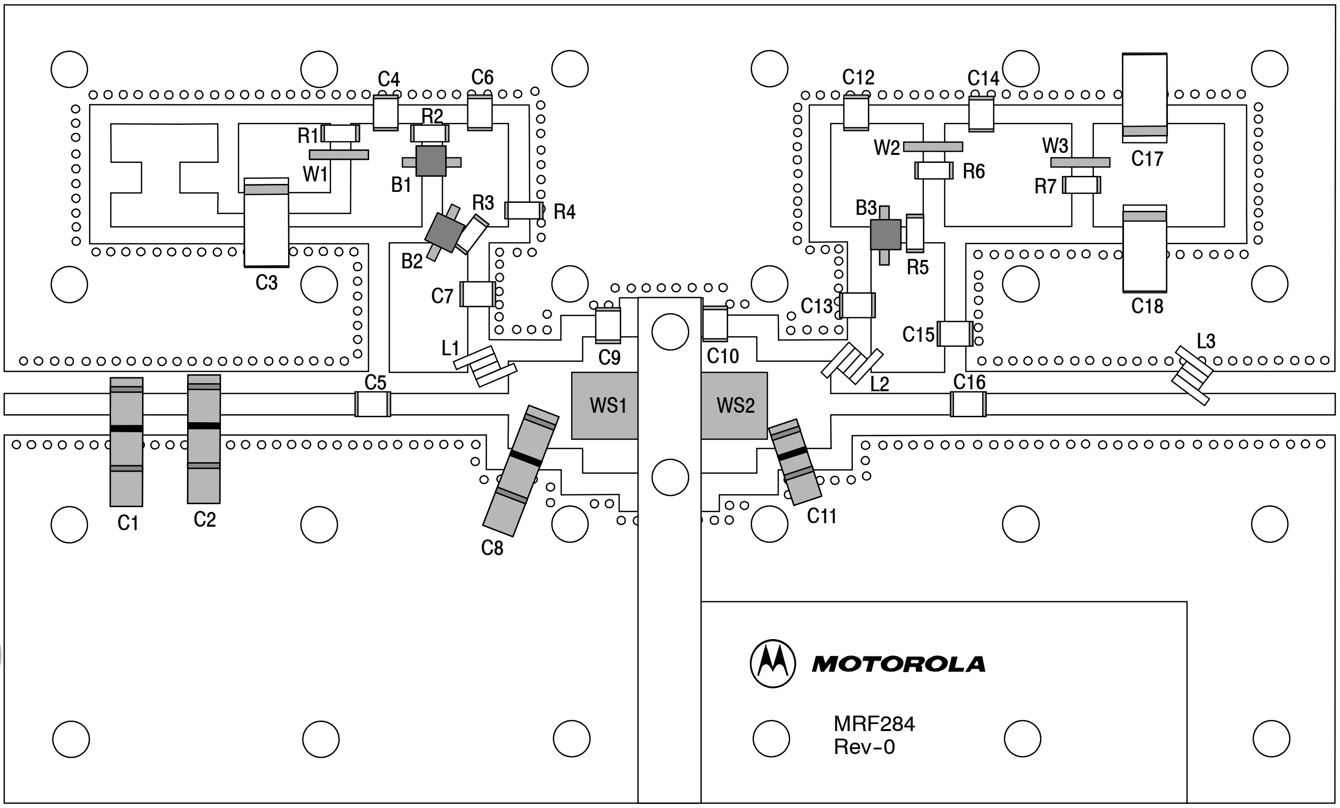


Z1	0.530″ x 0.080″ Microstrip	Z10	0.050″ x 0.515″ Microstrip
Z2	0.255″ x 0.080″ Microstrip	Z11	0.155″ x 0.515″ Microstrip
Z3	0.600″ x 0.080″ Microstrip	Z12	0.120″ x 0.325″ Microstrip
Z4	0.525″ x 0.080″ Microstrip	Z13	0.150″ x 0.325″ Microstrip
Z5	0.015″ x 0.325″ Microstrip	Z14	0.010″ x 0.325″ Microstrip
Z6	0.085″ x 0.325″ Microstrip	Z15	0.505″ x 0.080″ Microstrip
Z7	0.165″ x 0.325″ Microstrip	Z16	0.865″ x 0.080″ Microstrip
Z8	0.110″ x 0.515″ Microstrip	Z17	0.525″ x 0.080″ Microstrip
Z9	0.095″ x 0.515″ Microstrip	PCB	Arlon GX0300-55-22, 0.030″, ε_r = 2.55

Figure 1. 1930-2000 MHz Broadband Test Circuit Schematic

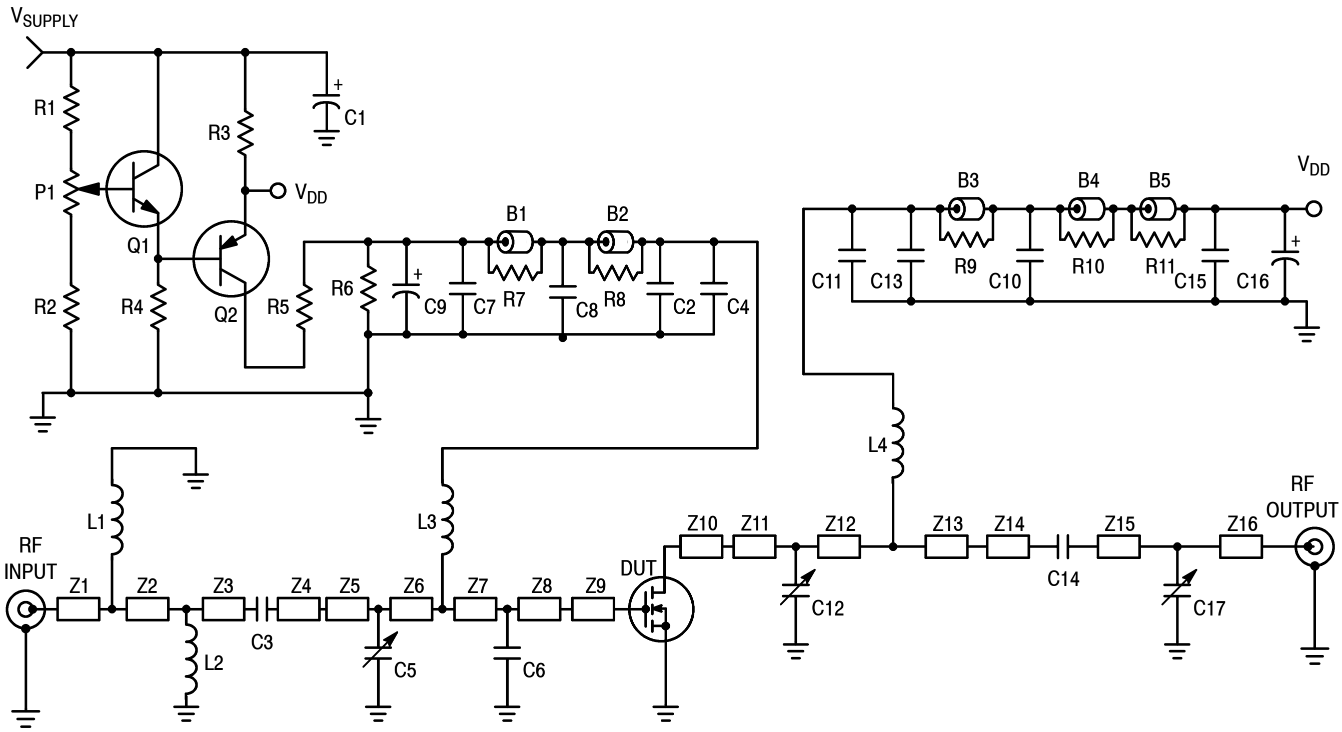
Table 4. 1930-2000 MHz Broadband Test Circuit Component Designations and Values

Designators	Description
B1 - B3	Ferrite Beads, Round, Ferroxcube #56-590-65-3B
C1, C2, C8	0.8-8.0 pF Gigatrim Variable Capacitors, Johanson #27291SL
C3, C17	22 μF, 35 V Tantalum Surface Mount Chip Capacitors, Kemet #T491X226K035AT
C4, C14	0.1 μF Chip Capacitors, Kemet #CDR33BX104AKYS
C5	220 pF Chip Capacitor, ATC #100B221KT500XT
C6, C12	1000 pF Chip Capacitors, ATC #100B102JT50XT
C7, C13	5.1 pF Chip Capacitors, ATC #100B5R1CT500XT
C9	1.2 pF Chip Capacitor, ATC #100B1R2CT500XT
C10	2.7 pF Chip Capacitor, ATC #100B2R7CT500XT
C11	0.6-4.5 pF Gigatrim Variable Capacitors, Johanson #27271SL
C15, C16	200 pF Chip Capacitors, ATC #100B201KT500XT
C18	10 μF, 35 V Tantalum Surface Mount Chip Capacitor, Kemet #T495X106K035AT
L1, L2	4 Turns, #24 AWG, 0.120″ OD, 0.140″ Long, (12.5 nH), Coilcraft #A04T-5
L3	2 Turns, #24 AWG, 0.120″ OD, 0.140″ Long, (5.0 nH), Coilcraft #A02T-5
R1, R2, R3, R5, R6, R7	12 Ω, 1/4 W Chip Resistors, 0.08″ x 0.13″, Vishay #CRCW120612R0FKEA
R4	560 kΩ, 1/4 W Chip Resistor, 0.08″ x 0.13″, Vishay #CRCW12065600FKEA



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 2. 1930-2000 MHz Broadband Test Circuit Component Layout



Z1	0.363″ x 0.080″ Microstrip	Z10	0.210″ x 0.515″ Microstrip
Z2	0.080″ x 0.080″ Microstrip	Z11	0.235″ x 0.325″ Microstrip
Z3	0.916″ x 0.080″ Microstrip	Z12	0.02″ x 0.325″ Microstrip
Z4	0.517″ x 0.080″ Microstrip	Z13	0.02″ x 0.325″ Microstrip
Z5	0.050″ x 0.325″ Microstrip	Z14	0.510″ x 0.080″ Microstrip
Z6	0.050″ x 0.325″ Microstrip	Z15	0.990″ x 0.080″ Microstrip
Z7	0.071″ x 0.325″ Microstrip	Z16	0.390″ x 0.080″ Microstrip
Z8	0.125″ x 0.325″ Microstrip	PCB	Arlon GX0300-55-22, 0.030″, $\varepsilon_r = 2.55$
Z9	0.210″ x 0.515″ Microstrip		

Figure 3. 2000 MHz Class A Test Circuit Schematic

Table 5. 2000 MHz Class A Test Circuit Component Designations and Values

Designators	Description
B1 - B5	Ferrite Beads, Round, Ferroxcube # 56-590-65-3B
C1, C9, C16	100 μF, 50 V Electrolytic Capacitors, Multicomp #MCHT101M1HB-1017-RH
C2, C13	51 pF Chip Capacitors, ATC #100B510JT500XT
C3, C14	10 pF Chip Capacitors, ATC #100B100JT500XT
C4, C11	12 pF Chip Capacitors, ATC #100B120JT500XT
C5	0.8 - 8.0 pF Variable Capacitor, Johansen Gigatrim #27291SL
C6	4.7 pF Chip Capacitor, ATC #100B4R7CT500XT
C7, C15	91 pF Chip Capacitors, ATC #100B910KT500XT
C8	1000 pF Chip Capacitor, ATC #100B102JT50XT
C10	0.1 μF Chip Capacitor, Kemet #CDR33BX104AKYS
C12, C17	0.6 - 4.5 pF Variable Capacitors, Johansen Gigatrim #27271SL
L1	4 Turns, #27 AWG, 0.087″ OD, 0.050″ ID, 0.069″ Long, 10 nH
L2	5 Turns, #24 AWG, 0.083″ OD, 0.040″ ID, 0.128″ Long, 12.5 nH
L3, L4	9 Turns, #26 AWG, 0.080″ OD, 0.046″ ID, 0.170″ Long, 30.8 nH
P1	1000 Ω Potentiometer, 1/2 W, 10 Turns, Bourns #3224W
Q1	Transistor, NPN, #MJD31, Case 369A-10, On Semi #MJD31T4G
Q2	Transistor, PNP, #MJD32, Case 369A-10, On Semi #MJD32T4G
R1	360 Ω, 1/4 W Fixed Film Chip Resistor, Vishay #CRCW12063600FKEA
R2	2 x 12 kΩ, 1/4 W Fixed Film Chip Resistor, Vishay #CRCW120612R0FKEA
R3	1 Ω, Wirewound, 5 W, 3% Resistor, Dale # RE60G1R00C02
R4	4 x 6.8 kΩ, 1/4 W Fixed Film Chip Resistor, Vishay #CRCW12066801FKEA
R5	2 x 1500 Ω, 1/4 W Fixed Film Chip Resistor, Vishay #CRCW12061501FKEA
R6	270 Ω, 1/4 W Fixed Film Chip Resistor, Vishay #CRCW12062700FKEA
R7 - R11	12 Ω, 1/4 W Fixed Film Chip Resistors, Vishay #CRCW120612R0FKEA

TYPICAL CHARACTERISTICS

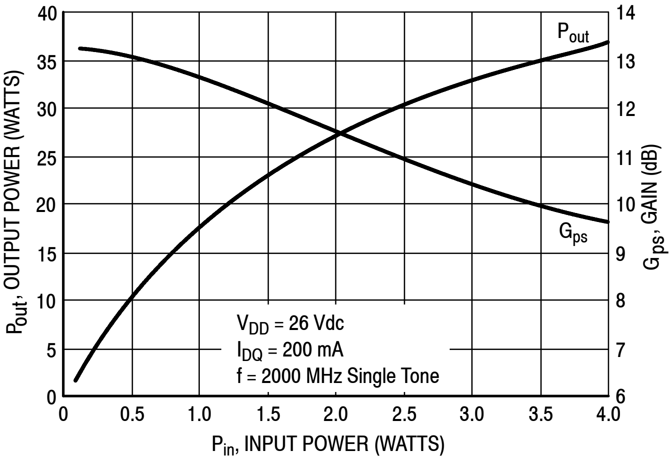


Figure 4. Output Power & Power Gain versus Input Power

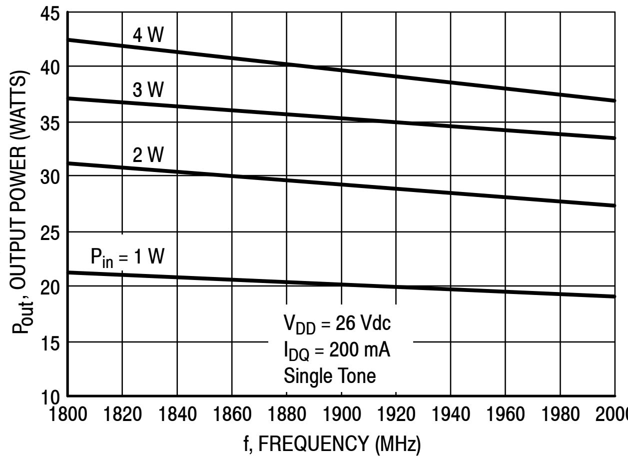


Figure 5. Output Power versus Frequency

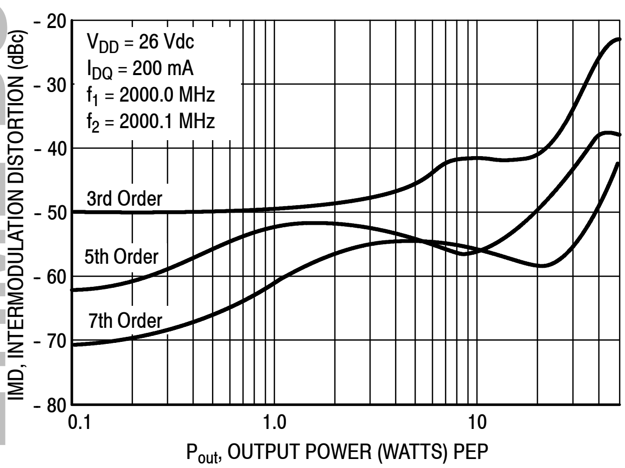


Figure 6. Intermodulation Distortion Products versus Output Power

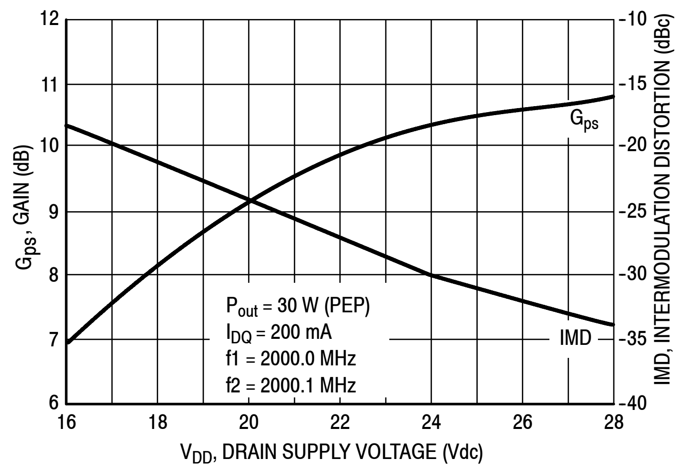


Figure 7. Power Gain and Intermodulation Distortion versus Supply Voltage

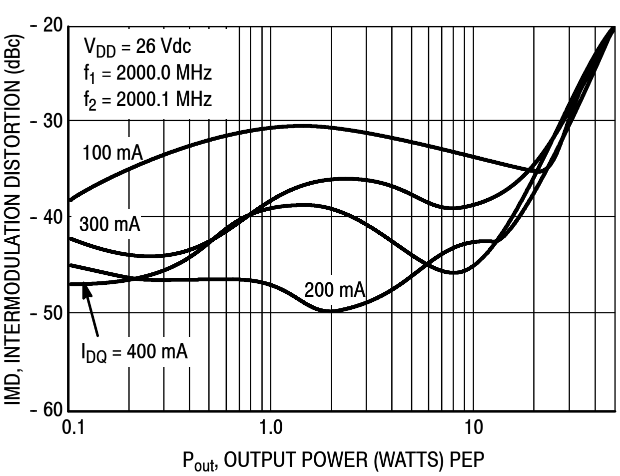


Figure 8. Intermodulation Distortion versus Output Power

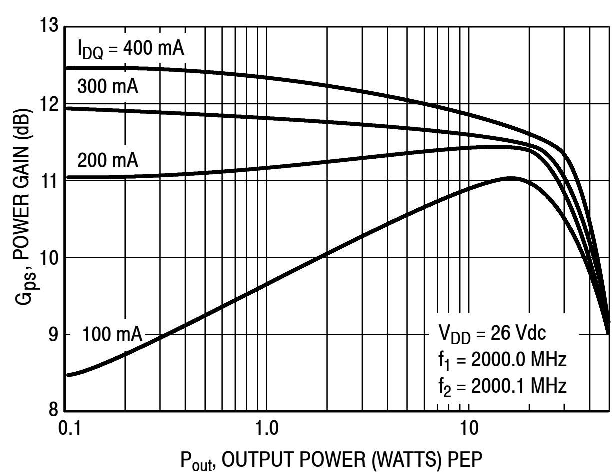


Figure 9. Power Gain versus Output Power

TYPICAL CHARACTERISTICS

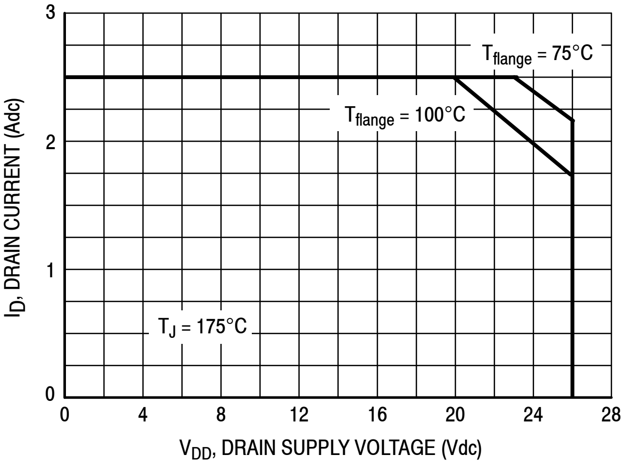


Figure 10. DC Safe Operating Area

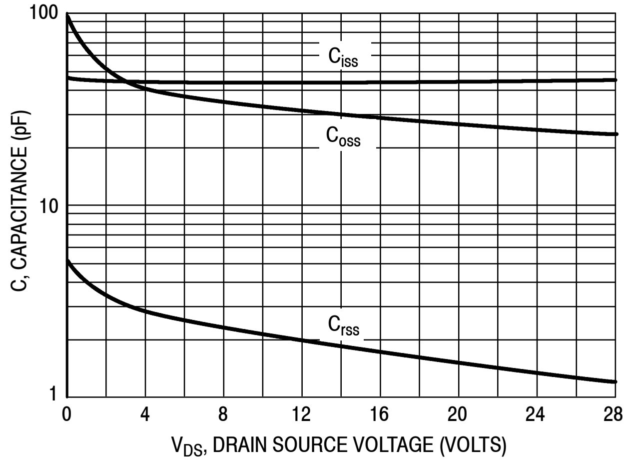


Figure 11. Capacitance versus Drain Source Voltage

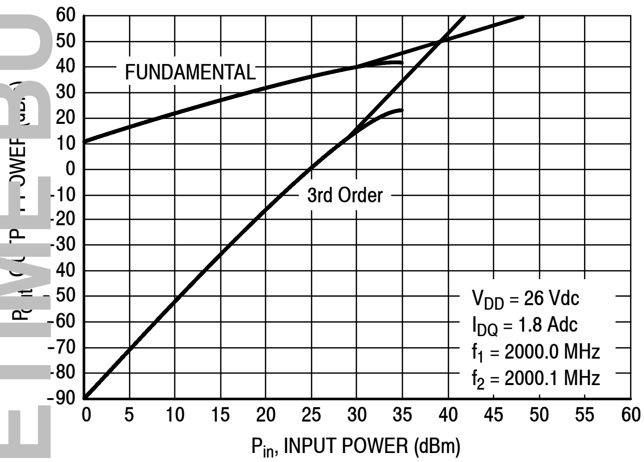


Figure 12. Class A Third Order Intercept Point

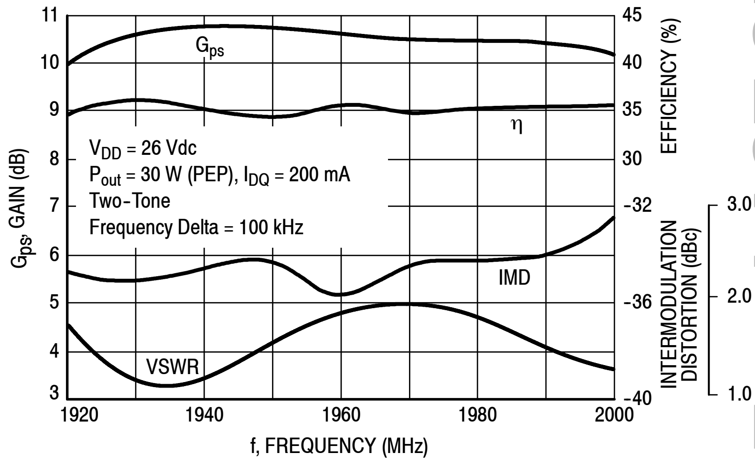
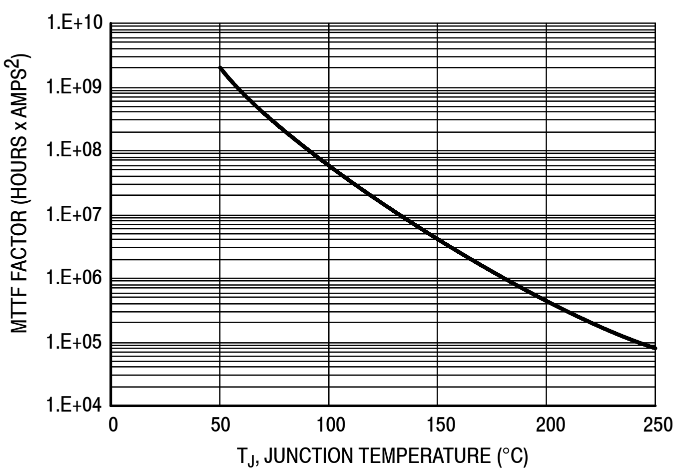
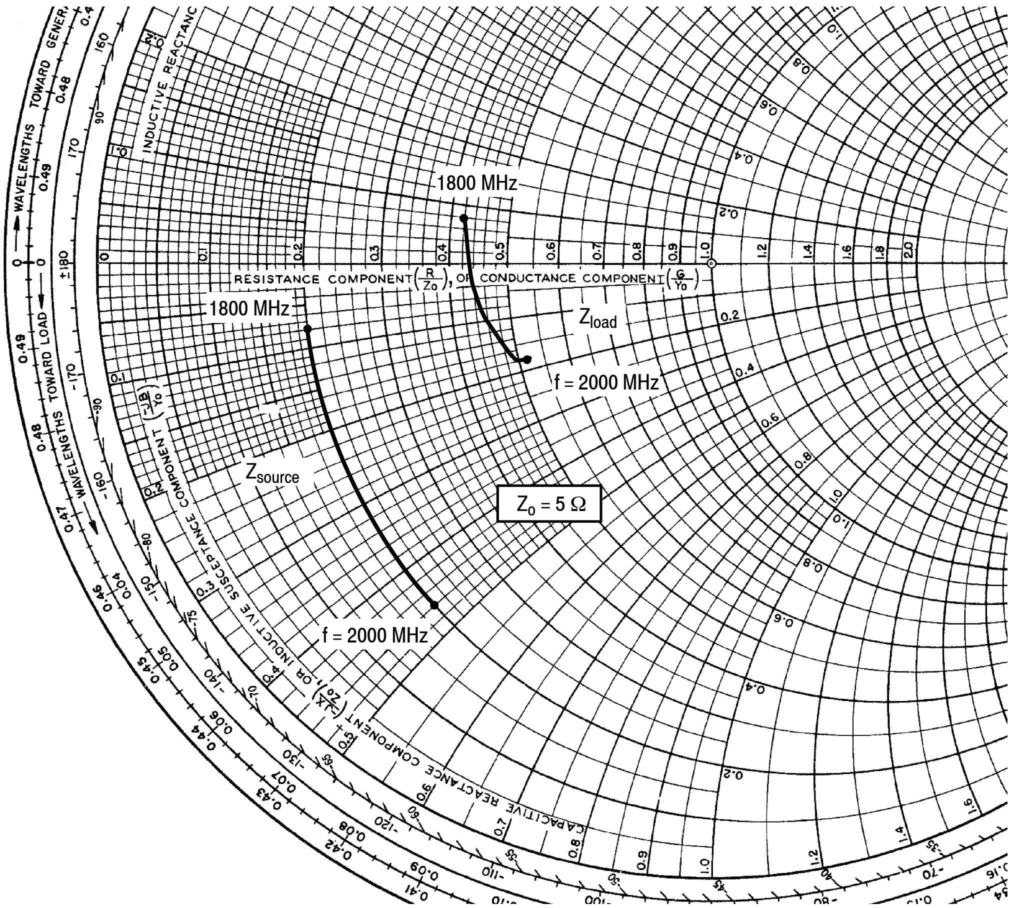


Figure 13. 1920-2000 MHz Broadband Circuit Performance



This graph displays calculated MTTF in hours x ampere^2 drain current. Life tests at elevated temperature have correlated to better than ±10% of the theoretical prediction for metal failure. Divide MTTF factor by I_D^2 for MTTF in a particular application.

Figure 14. MTTF Factor versus Junction Temperature



V_{CC} = 26 V, I_{DQ} = 200 mA, P_{out} = 15 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
1800	1.0 - j0.4	2.1 + j0.4
1860	1.0 - j0.8	2.2 - j0.2
1900	1.0 - j1.1	2.3 - j0.5
1960	1.0 - j1.4	2.5 - j0.9
2000	1.0 - j2.3	2.6 - j0.92

Z_{source} = Test circuit impedance as measured from gate to ground.

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

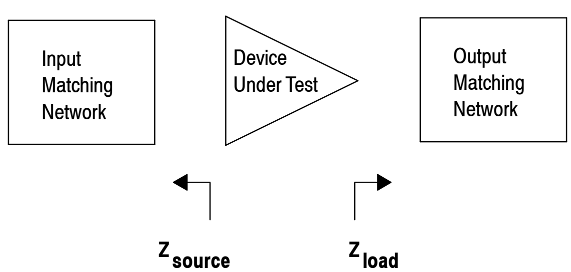
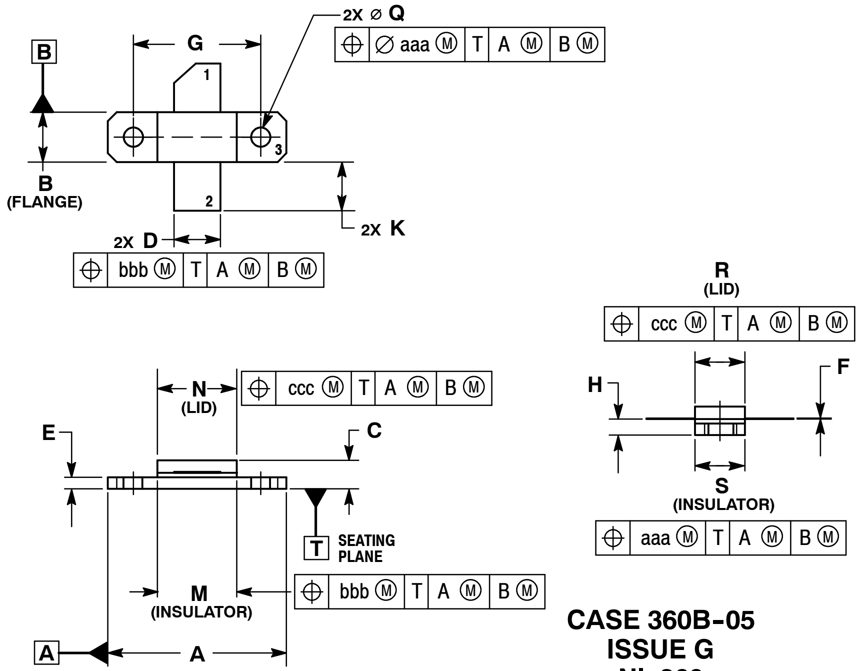


Figure 15. Series Equivalent Source and Load Impedence

PACKAGE DIMENSIONS



NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.795	0.805	20.19	20.45
B	0.225	0.235	5.72	5.97
C	0.125	0.175	3.18	4.45
D	0.210	0.220	5.33	5.59
E	0.055	0.065	1.40	1.65
F	0.004	0.006	0.10	0.15
G	0.562 BSC		14.28 BSC	
H	0.077	0.087	1.96	2.21
K	0.220	0.250	5.59	6.35
M	0.355	0.365	9.02	9.27
N	0.357	0.363	9.07	9.22
Q	0.125	0.135	3.18	3.43
R	0.227	0.233	5.77	5.92
S	0.225	0.235	5.72	5.97
aaa	0.005 REF		0.13 REF	
bbb	0.010 REF		0.25 REF	
ccc	0.015 REF		0.38 REF	

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 360B-05
ISSUE G
NI-360
MRF284LR1

PRODUCT DOCUMENTATION

Refer to the following documents to aid your design process.

Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
19	Oct. 2008	• Data sheet revised to reflect part status change, p. 1, including use of applicable overlay. • Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN12779, p. 2 • Updated Part Numbers in Tables 4 and 5, Component Designations and Values, to RoHS compliant part numbers, p. 3, 6 • Added Product Documentation and Revision History, p. 11

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Freescale Semiconductor, Inc.
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2100 East Elliot Road
Tempe, Arizona 85284
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Europe, Middle East, and Africa:
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Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
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+46 8 52200080 (English)
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www.freescale.com/support

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 China Ltd.
Exchange Building 23F
No. 118 Jianguo Road
Chaoyang District
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China
+86 10 5879 8000
support.asia@freescale.com

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