Freescale Semiconductor
Technical Data

Document Number: MRF21010
Rev. 9, 5/2006

RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF21010LR1
MRF21010LSR1

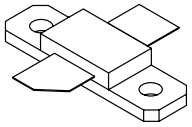
2110-2170 MHz, 10 W, 28 V
LATERAL N-CHANNEL
BROADBAND
RF POWER MOSFETs

Designed for W-CDMA base station applications with frequencies from 2110 to 2170 MHz. Suitable for FM, TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications.

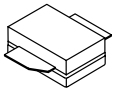
- Typical W-CDMA Performance: -45 dBc ACPR, 2140 MHz, 28 Volts, 5 MHz Offset/4.096 MHz BW, 15 DTCH
  Output Power — 2.1 Watts
  Power Gain — 13.5 dB
  Efficiency — 21%
- Capable of Handling 10:1 VSWR @ 28 Vdc, 2140 MHz, 10 Watts CW Output Power

Features

- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- 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.



CASE 360B-05, STYLE 1
NI-360
MRF21010LR1



CASE 360C-05, STYLE 1
NI-360S
MRF21010LSR1

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
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	43.75 0.25	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	$R_{\theta JC}$	5.5	°C/W

Table 3. ESD Protection Characteristics

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

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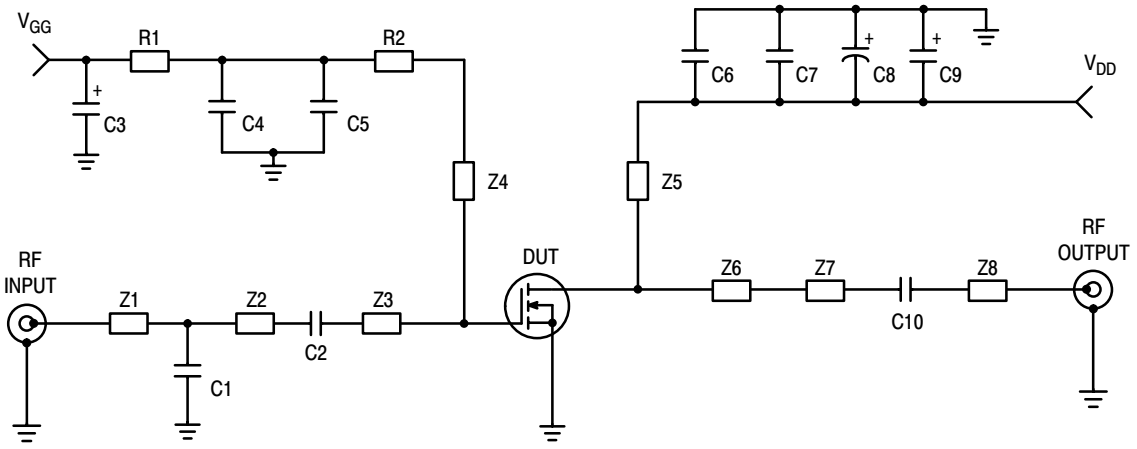
Table 4. Electrical Characteristics (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Drain-Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D =10 μA)	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 V, I_D = 50 μA)	$V_{GS(th)}$	2.5	3	4	Vdc
Gate Quiescent Voltage (V_{DS} = 28 V, I_D = 100 mA)	$V_{GS(Q)}$	2.5	4	4.5	Vdc
Drain-Source On-Voltage (V_{GS} = 10 V, I_D = 0.5 A)	$V_{DS(on)}$	—	0.4	0.5	Vdc
Forward Transconductance (V_{DS} = 10 V, I_D = 1 A)	g_{fs}	—	0.95	—	S
Dynamic Characteristics					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc, V_{GS} = 0, f = 1 MHz)	C_{rss}	—	1	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system)					
Two-Tone Common Source Amplifier Power Gain (V_{DD} = 28 Vdc, P_{out} = 10 W PEP, I_{DQ} = 100 mA, f1 = 2110 MHz, f2 = 2170 MHz, Tone Spacing = 100 KHz)	G_{ps}	12	13.5	—	dB
Two-Tone Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 10 W PEP, I_{DQ} = 100 mA, f1 = 2110 MHz, f2 = 2170 MHz, Tone Spacing = 100 KHz)	η	31	35	—	%
Third Order Intermodulation Distortion (V_{DD} = 28 Vdc, P_{out} = 10 W PEP, I_{DQ} = 100 mA, f1 = 2110 MHz, f2 = 2170 MHz, Tone Spacing = 100 KHz)	IMD	—	-35	-30	dBc
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 10 W PEP, I_{DQ} = 100 mA, f1 = 2110 MHz, f2 = 2170 MHz, Tone Spacing = 100 KHz)	IRL	—	-12	-10	dB
Output Power, 1 dB Compression Point, CW (V_{DD} = 28 Vdc, I_{DQ} = 100 mA, f = 2170 MHz)	P1dB	—	11	—	W
Common-Source Amplifier Power Gain (V_{DD} = 28 Vdc, P_{out} = 10 W CW, I_{DQ} = 100 mA, f = 2170 MHz)	G_{ps}	—	12	—	dB
Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 10 W CW, I_{DQ} = 100 mA, f = 2170 MHz)	η	—	42	—	%



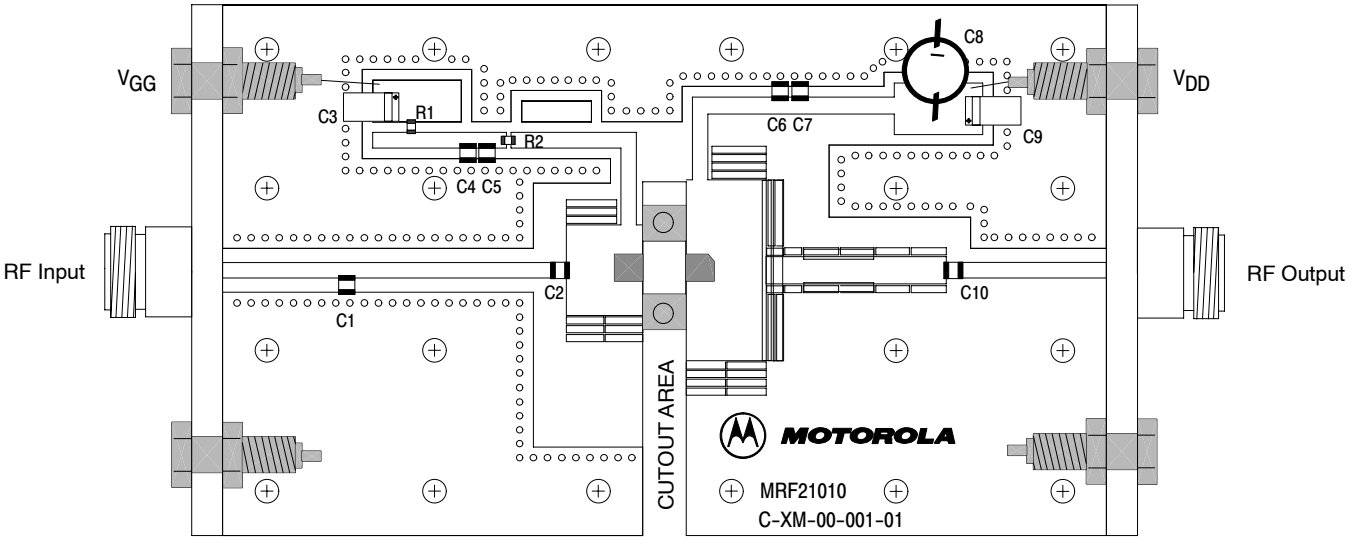
Z1	0.964″ x 0.087″ Microstrip	Z6	0.453″ x 1.118″ Microstrip
Z2	0.905″ x 0.087″ Microstrip	Z7	0.921″ x 0.154″ Microstrip
Z3	0.433″ x 0.512″ Microstrip	Z8	0.925″ x 0.087″ Microstrip
Z4	1.068″ x 0.087″ Microstrip	PCB	Taconic TLX8-0300, 0.030″, ε_r = 2.55
Z5	0.752″ x 0.087″ Microstrip		

Figure 1. MRF21010L Test Circuit Schematic

Table 5. MRF21010L Test Circuit Component Designations and Values

Part		Description	Part Number	Manufacturer
C1 *	(eared)	2.2 pF Chip Capacitor	100B2R2BW	ATC
	(earless)	1.8 pF Chip Capacitor	100B1R8BW	ATC
C2		0.5 pF Chip Capacitor	100B0R5BW	ATC
C3, C9		10 μF, 35 V Tantalum Chip Capacitors	293D106X9035D2T	Sprague-Vishay
C4, C7		1 nF Chip Capacitors	100B102JW	ATC
C5, C6		5.6 pF Chip Capacitors	100B5R6BW	ATC
C8		470 μF, 63 V Electrolytic Capacitor		
C10		10 pF Chip Capacitor	100B100GW	ATC
N1, N2		Type N Connector Flange Mounts	3052-1648-10	Macom
R1		1.0 kΩ Chip Resistor (0805)		
R2		12 Ω Chip Resistor (0805)		

* Piece part depending on eared / earless version of the device.



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. MRF21010L Test Circuit Component Layout

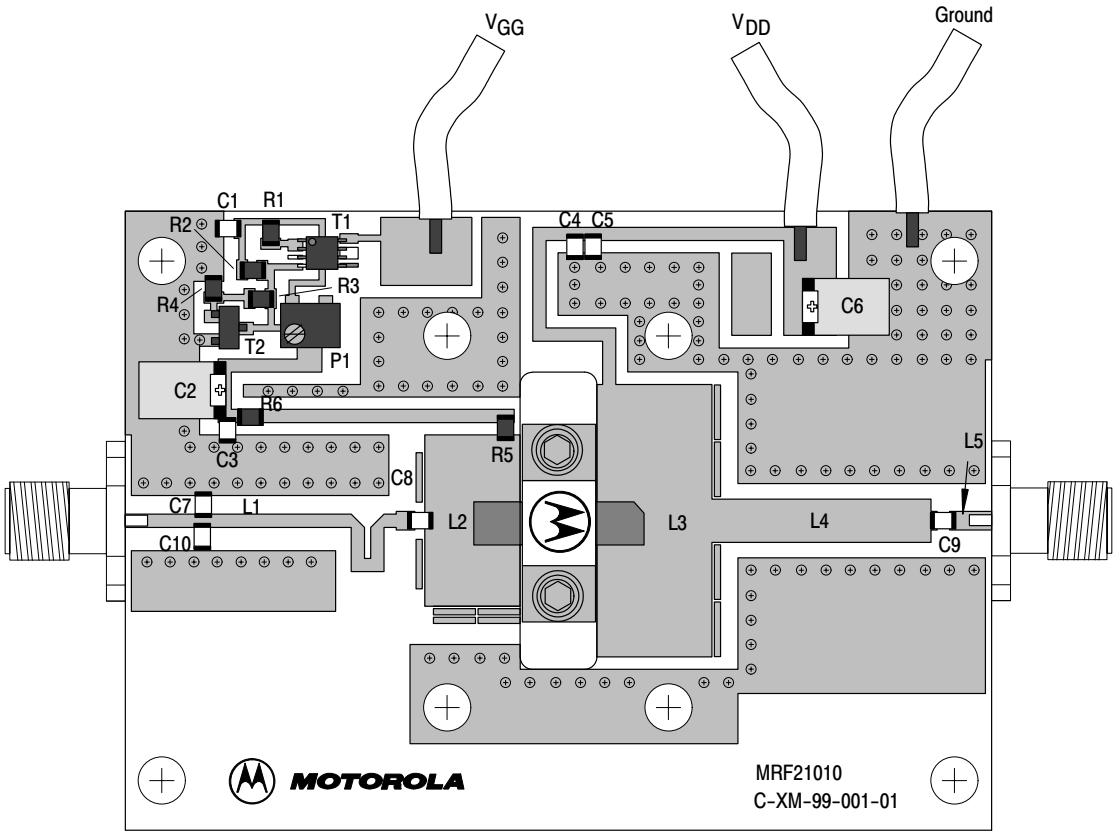


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Figure 3. MRF21010L Demonstration Board Component Layout

Table 6. MRF21010L Demonstration Board Component Designations and Values

Designators	Description
C1	1 μF Chip Capacitor (0805), AVX #08053G105ZATEA
C2, C6	10 μF, 35 V Tantalum Capacitors, Vishay-Sprague #293D106X9035D
C3, C4	6.8 pF Chip Capacitors, ACCU-P (0805), AVX #08051J6R8CBT
C5	10 nF Chip Capacitor (0805), AVX #08055C103KATDA
C7	1.5 pF Chip Capacitor, ACCU-P (0805), AVX #08051J2R2BBT
C8, C10	0.5 pF Chip Capacitors, ACCU-P (0805), AVX #08051J0R5BBT
C9	10 pF Chip Capacitor, ACCU-P (0805), AVX #08055J100GBT
L1	19 mm × 1.07 mm
L2	7.7 mm × 13.8 mm
L3	9.3 mm × 22 mm
L4	17.7 mm × 3.5 mm
L5	3.4 mm × 1.5 mm
R1, R6	10 Ω, 1/8 W Chip Resistors (0805)
R2, R3	1 kΩ, 1/8 W Chip Resistors (0805)
R4	2.2 kΩ, 1/8 W Chip Resistor (0805)
R5	0 Ω, 1/8 W Chip Resistor (0805)
P1	5 kΩ Potentiometer CMS Cermet Multi-Turn, Bourns #3224W
T1	Voltage Regulator, Micro-8, #LP2951
T2	Bipolar NPN Transistor, SOT-23, #BC847
PCB	Rogers RO4350, 0.5 mm, ε_r = 3.53

TYPICAL CHARACTERISTICS

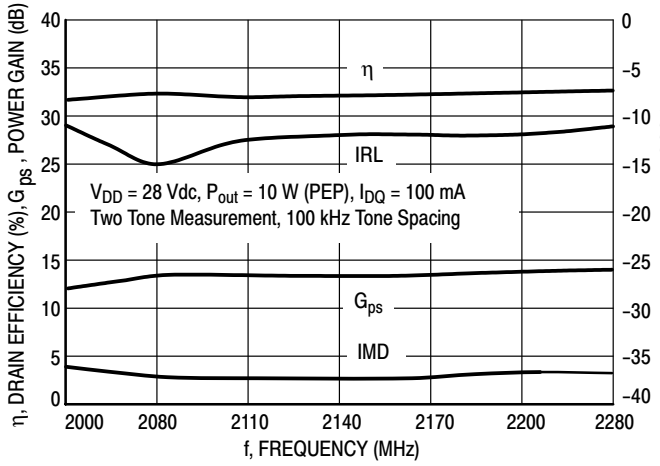


Figure 4. Class AB Broadband Circuit Performance

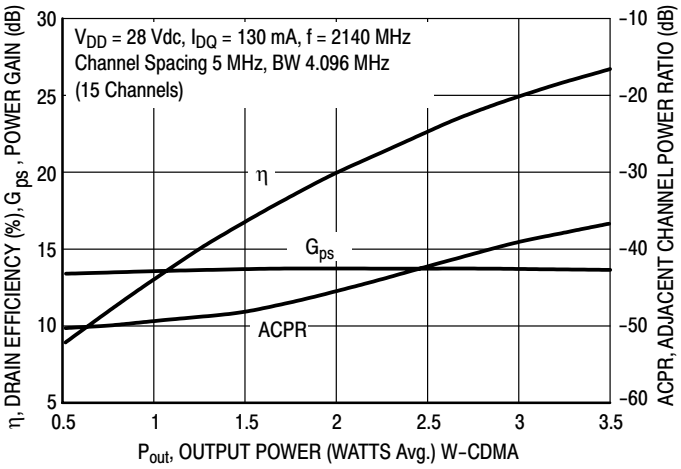


Figure 5. W-CDMA ACPR, Power Gain and Drain Efficiency versus Output Power

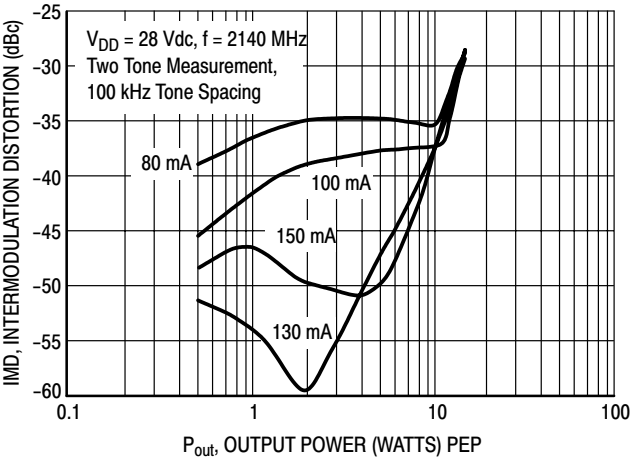


Figure 6. Intermodulation Distortion versus Output Power

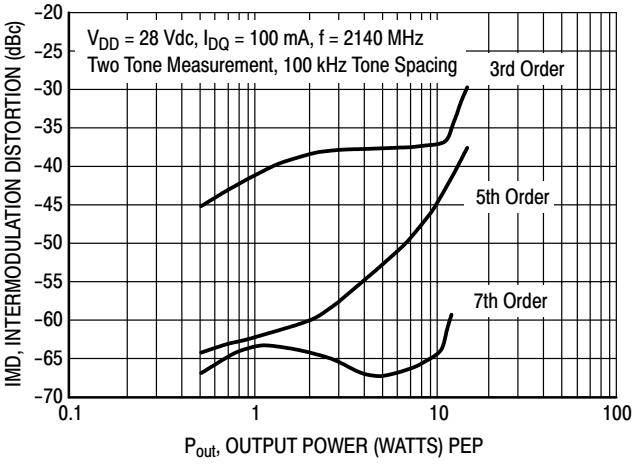


Figure 7. Intermodulation Distortion Products versus Output Power

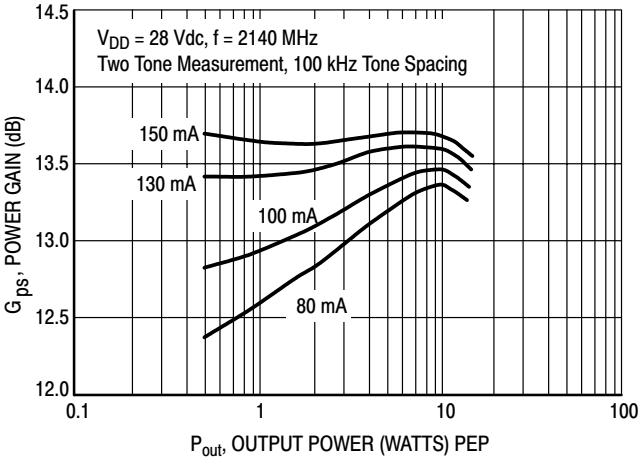


Figure 8. Power Gain versus Output Power

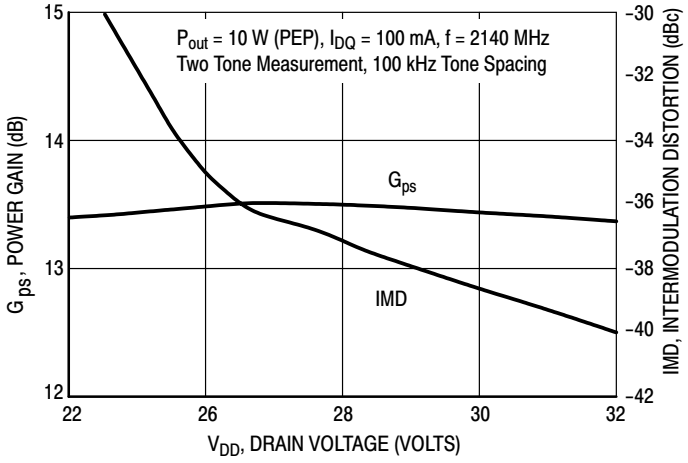
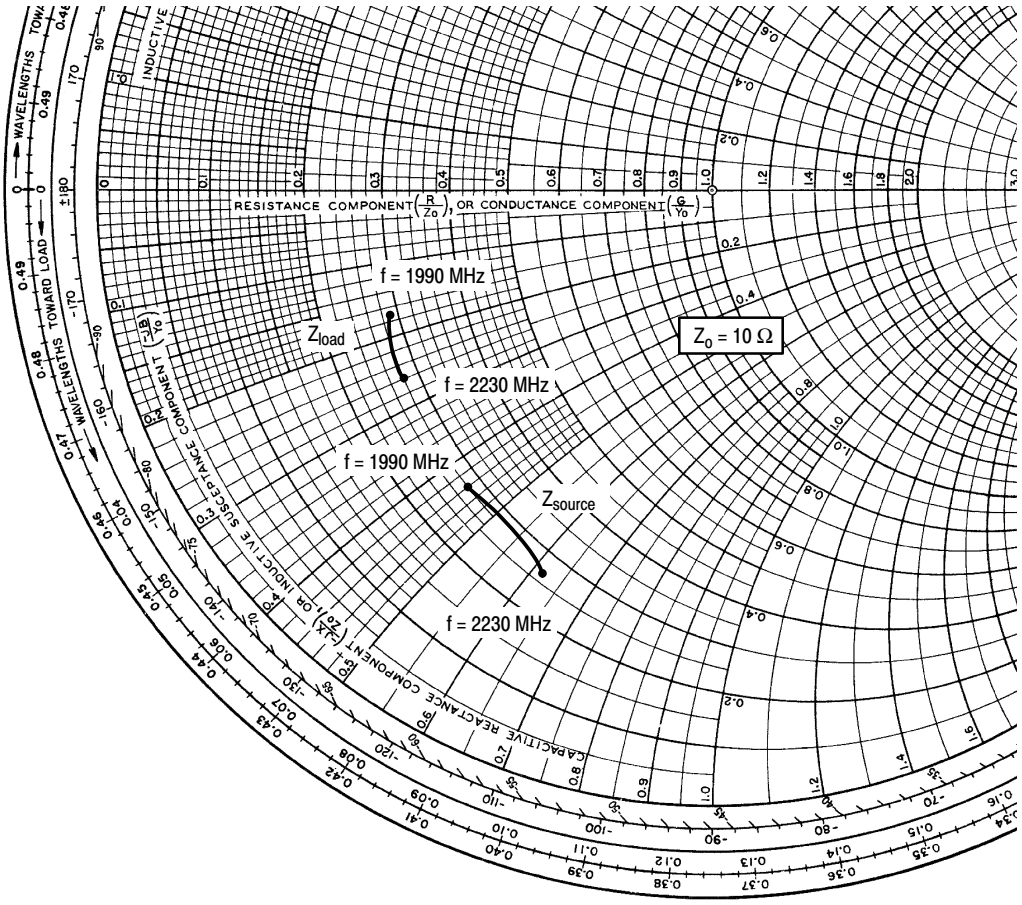


Figure 9. Intermodulation and Gain versus Supply Voltage



V_{DD} = 28 V, I_{DQ} = 100 mA, P_{out} = 10 W PEP

f MHz	Z_{source} Ω	Z_{load} Ω
1990	2.85 - j4.38	2.93 - j1.71
2110	2.89 - j5.04	2.76 - j2.28
2230	2.73 - j6.19	2.83 - j2.59

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

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

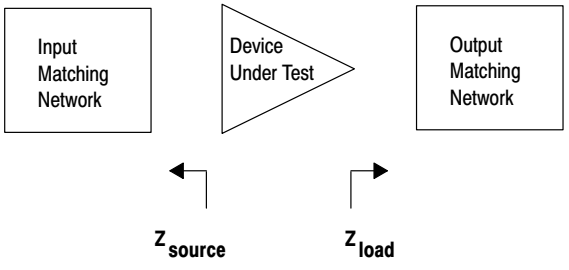
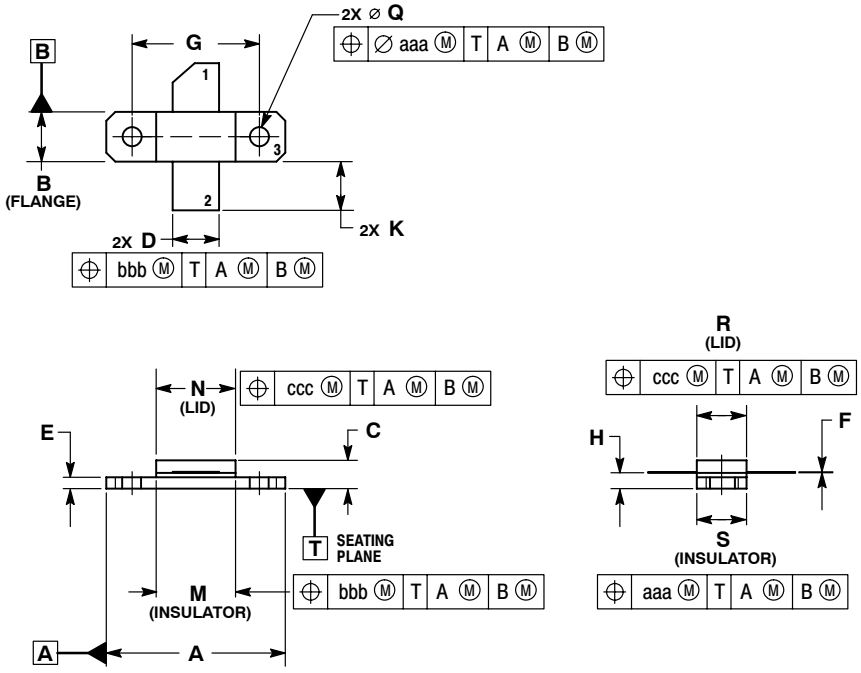


Figure 10. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS

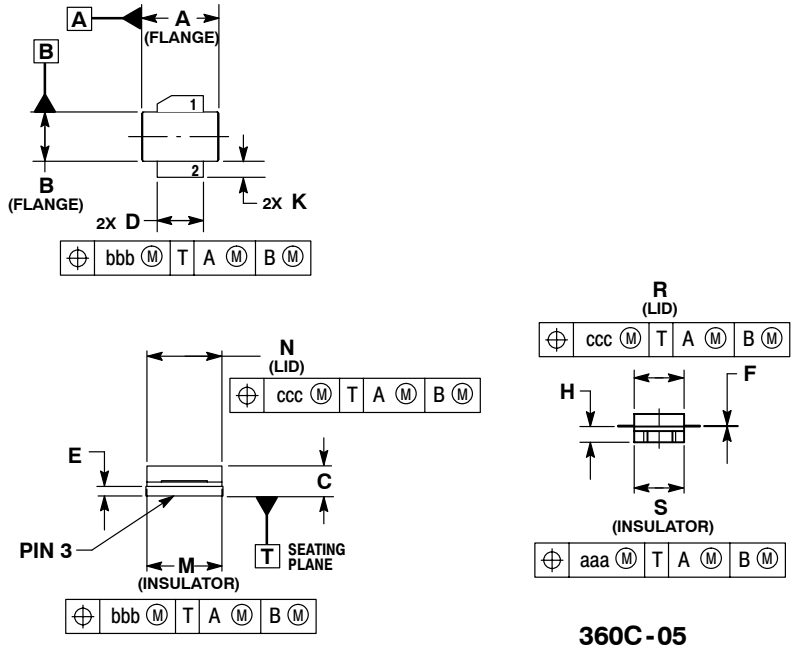


NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

	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
MRF21010LR1



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	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.375	0.385	9.53	9.78
B	0.225	0.235	5.72	5.97
C	0.105	0.155	2.67	3.94
D	0.210	0.220	5.33	5.59
E	0.035	0.045	0.89	1.14
F	0.004	0.006	0.10	0.15
H	0.057	0.067	1.45	1.70
K	0.085	0.115	2.16	2.92
M	0.355	0.365	9.02	9.27
N	0.357	0.363	9.07	9.22
R	0.227	0.23	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
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