



# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral 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.

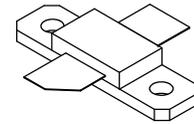
- Typical W-CDMA Performance: -45 dBc ACPR, 2140 MHz, 28 Volts, 5 MHz Offset/4.096 MHz BW, 15 DTCH  
Output Power — 2.1 Watts  
Power Gain — 13.5 dB  
Efficiency — 21%
- Capable of Handling 10:1 VSWR @ 28 Vdc, 2140 MHz, 10 Watts CW Output Power

### Features

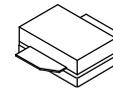
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ" Nominal.
- RoHS Compliant.
- In Tape and Reel. R1 Suffix = 500 Units per 32 mm, 13 Inch Reel.

**MRF21010LR1**  
**MRF21010LSR1**

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



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



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

ARCHIVE INFORMATION

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**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 @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	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**

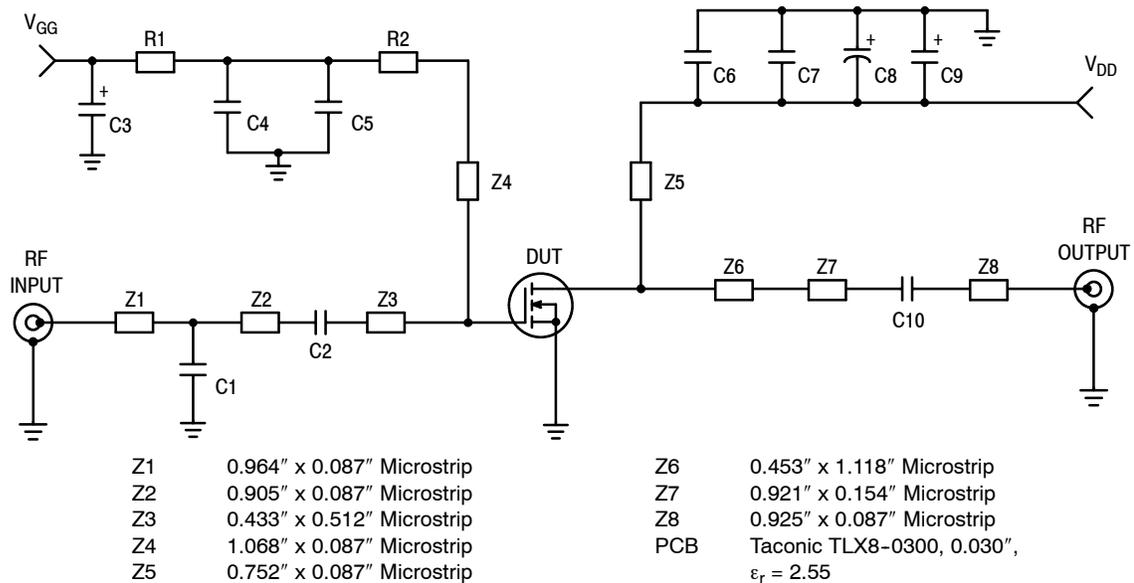
Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	5.5	°C/W

**Table 3. ESD Protection Characteristics**

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

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b>					
Drain-Source Breakdown Voltage ( $V_{GS} = 0 \text{ Vdc}$ , $I_D = 10 \mu\text{A}$ )	$V_{(BR)DSS}$	65	—	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 28 \text{ Vdc}$ , $V_{GS} = 0 \text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 5 \text{ Vdc}$ , $V_{DS} = 0 \text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$
<b>On Characteristics</b>					
Gate Threshold Voltage ( $V_{DS} = 10 \text{ V}$ , $I_D = 50 \mu\text{A}$ )	$V_{GS(th)}$	2.5	3	4	Vdc
Gate Quiescent Voltage ( $V_{DS} = 28 \text{ V}$ , $I_D = 100 \text{ mA}$ )	$V_{GS(Q)}$	2.5	4	4.5	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10 \text{ V}$ , $I_D = 0.5 \text{ A}$ )	$V_{DS(on)}$	—	0.4	0.5	Vdc
Forward Transconductance ( $V_{DS} = 10 \text{ V}$ , $I_D = 1 \text{ A}$ )	$g_{fs}$	—	0.95	—	S
<b>Dynamic Characteristics</b>					
Reverse Transfer Capacitance ( $V_{DS} = 28 \text{ Vdc}$ , $V_{GS} = 0$ , $f = 1 \text{ MHz}$ )	$C_{rss}$	—	1	—	pF
<b>Functional Tests</b> (In Freescale Test Fixture, 50 ohm system)					
Two-Tone Common Source Amplifier Power Gain ( $V_{DD} = 28 \text{ Vdc}$ , $P_{out} = 10 \text{ W PEP}$ , $I_{DQ} = 100 \text{ mA}$ , $f_1 = 2110 \text{ MHz}$ , $f_2 = 2170 \text{ MHz}$ , Tone Spacing = 100 KHz)	$G_{ps}$	12	13.5	—	dB
Two-Tone Drain Efficiency ( $V_{DD} = 28 \text{ Vdc}$ , $P_{out} = 10 \text{ W PEP}$ , $I_{DQ} = 100 \text{ mA}$ , $f_1 = 2110 \text{ MHz}$ , $f_2 = 2170 \text{ MHz}$ , Tone Spacing = 100 KHz)	$\eta$	31	35	—	%
Third Order Intermodulation Distortion ( $V_{DD} = 28 \text{ Vdc}$ , $P_{out} = 10 \text{ W PEP}$ , $I_{DQ} = 100 \text{ mA}$ , $f_1 = 2110 \text{ MHz}$ , $f_2 = 2170 \text{ MHz}$ , Tone Spacing = 100 KHz)	IMD	—	-35	-30	dBc
Input Return Loss ( $V_{DD} = 28 \text{ Vdc}$ , $P_{out} = 10 \text{ W PEP}$ , $I_{DQ} = 100 \text{ mA}$ , $f_1 = 2110 \text{ MHz}$ , $f_2 = 2170 \text{ MHz}$ , Tone Spacing = 100 KHz)	IRL	—	-12	-10	dB
Output Power, 1 dB Compression Point, CW ( $V_{DD} = 28 \text{ Vdc}$ , $I_{DQ} = 100 \text{ mA}$ , $f = 2170 \text{ MHz}$ )	P1dB	—	11	—	W
Common-Source Amplifier Power Gain ( $V_{DD} = 28 \text{ Vdc}$ , $P_{out} = 10 \text{ W CW}$ , $I_{DQ} = 100 \text{ mA}$ , $f = 2170 \text{ MHz}$ )	$G_{ps}$	—	12	—	dB
Drain Efficiency ( $V_{DD} = 28 \text{ Vdc}$ , $P_{out} = 10 \text{ W CW}$ , $I_{DQ} = 100 \text{ mA}$ , $f = 2170 \text{ MHz}$ )	$\eta$	—	42	—	%

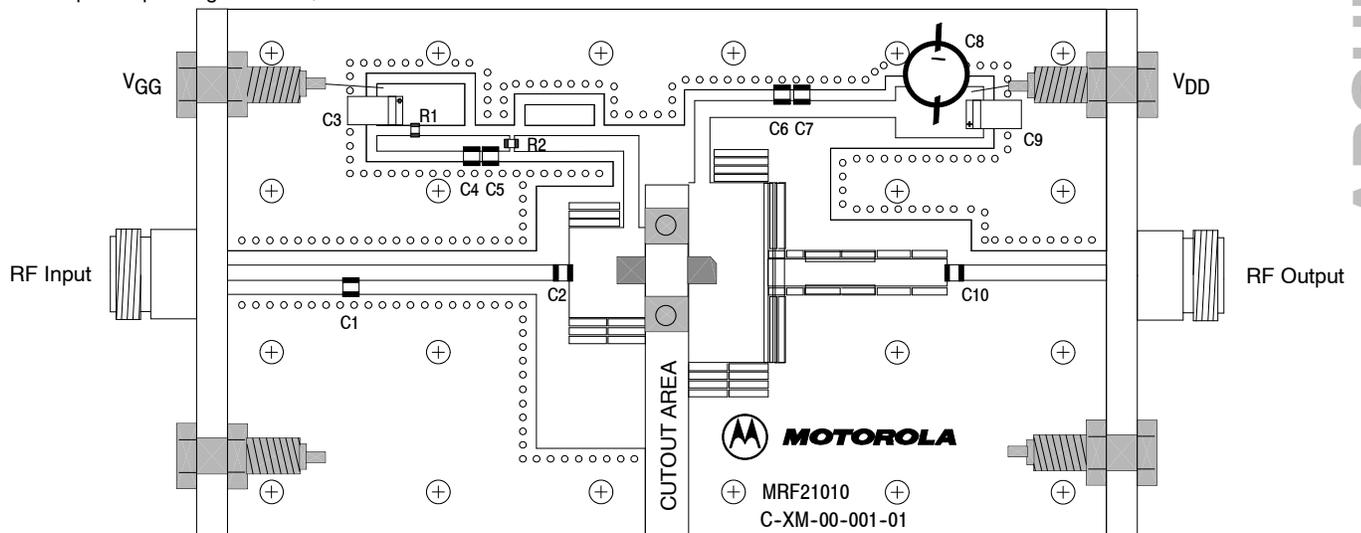


**Figure 1. MRF21010L Test Circuit Schematic**

**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 $\mu$ F, 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 $\mu$ F, 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 k $\Omega$ Chip Resistor (0805)		
R2	12 $\Omega$ Chip Resistor (0805)		

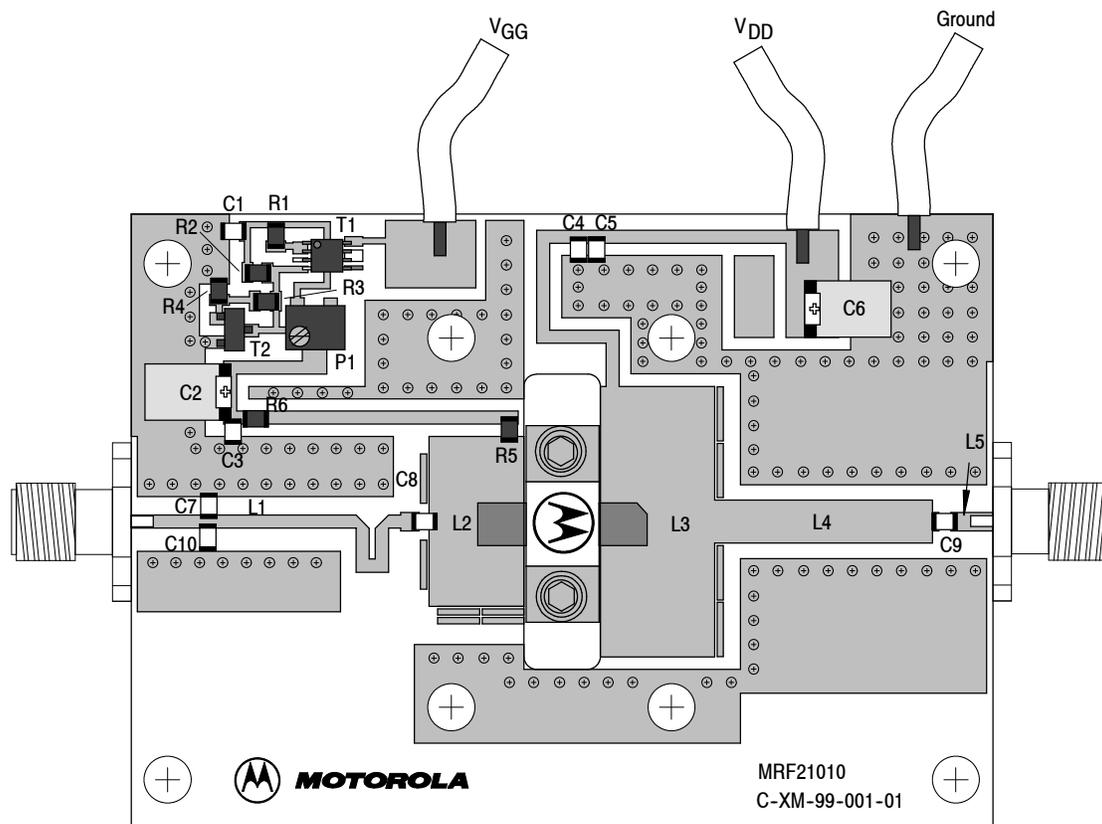
\* Piece part depending on eared / earless version of the device.



Freescle has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescle Semiconductor signature/logo. PCBs may have either Motorola or Freescle 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**

MRF21010LR1 MRF21010LSR1



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 3. MRF21010L Demonstration Board Component Layout**

**Table 6. MRF21010L Demonstration Board Component Designations and Values**

Designators	Description
C1	1 $\mu$ F Chip Capacitor (0805), AVX #08053G105ZATEA
C2, C6	10 $\mu$ F, 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 $\times$ 1.07 mm
L2	7.7 mm $\times$ 13.8 mm
L3	9.3 mm $\times$ 22 mm
L4	17.7 mm $\times$ 3.5 mm
L5	3.4 mm $\times$ 1.5 mm
R1, R6	10 $\Omega$ , 1/8 W Chip Resistors (0805)
R2, R3	1 k $\Omega$ , 1/8 W Chip Resistors (0805)
R4	2.2 k $\Omega$ , 1/8 W Chip Resistor (0805)
R5	0 $\Omega$ , 1/8 W Chip Resistor (0805)
P1	5 k $\Omega$ 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, $\epsilon_r = 3.53$

**MRF21010LR1 MRF21010LSR1**

## TYPICAL CHARACTERISTICS

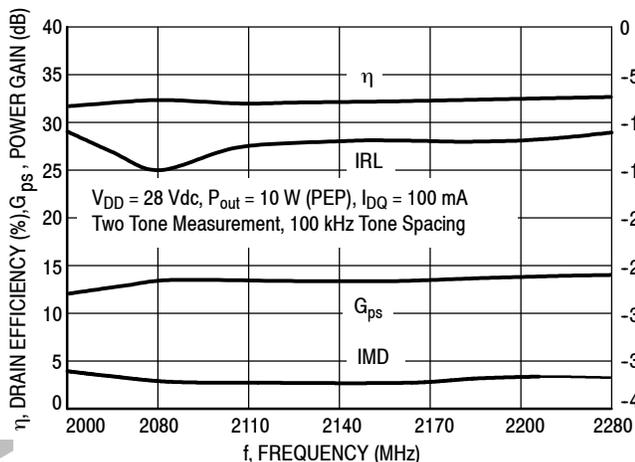


Figure 4. Class AB Broadband Circuit Performance

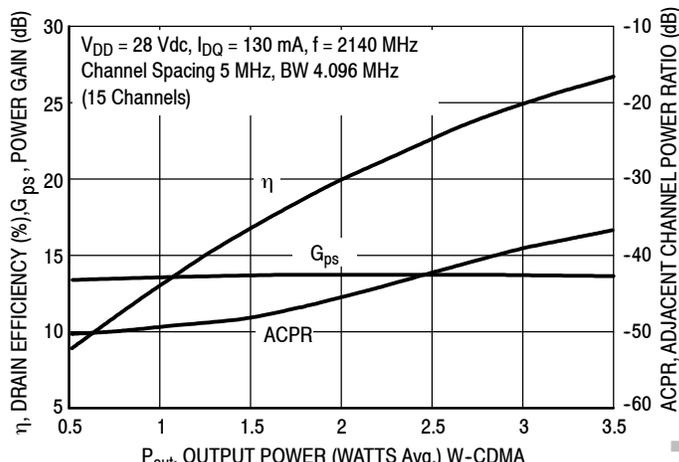


Figure 5. W-CDMA ACPR, Power Gain and Drain Efficiency versus Output Power

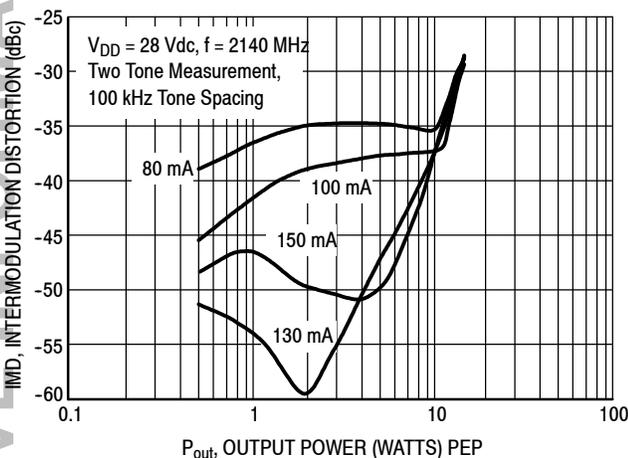


Figure 6. Intermodulation Distortion versus Output Power

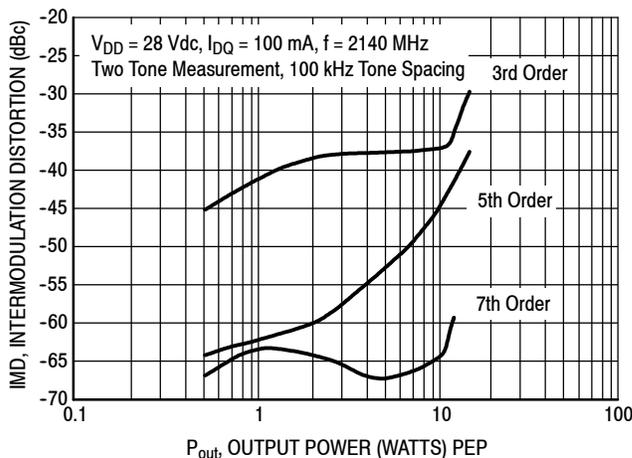


Figure 7. Intermodulation Distortion Products versus Output Power

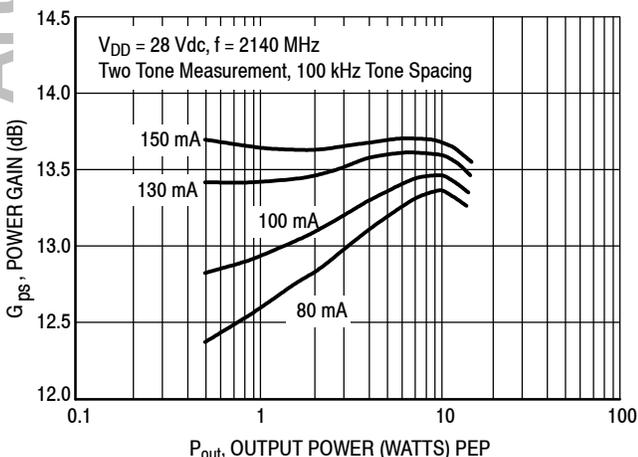


Figure 8. Power Gain versus Output Power

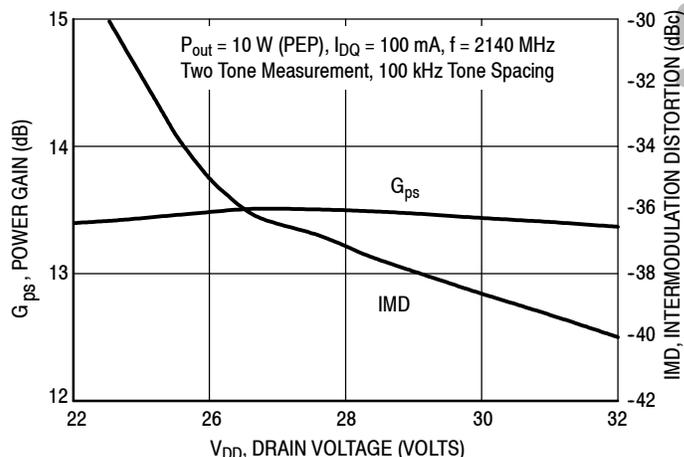
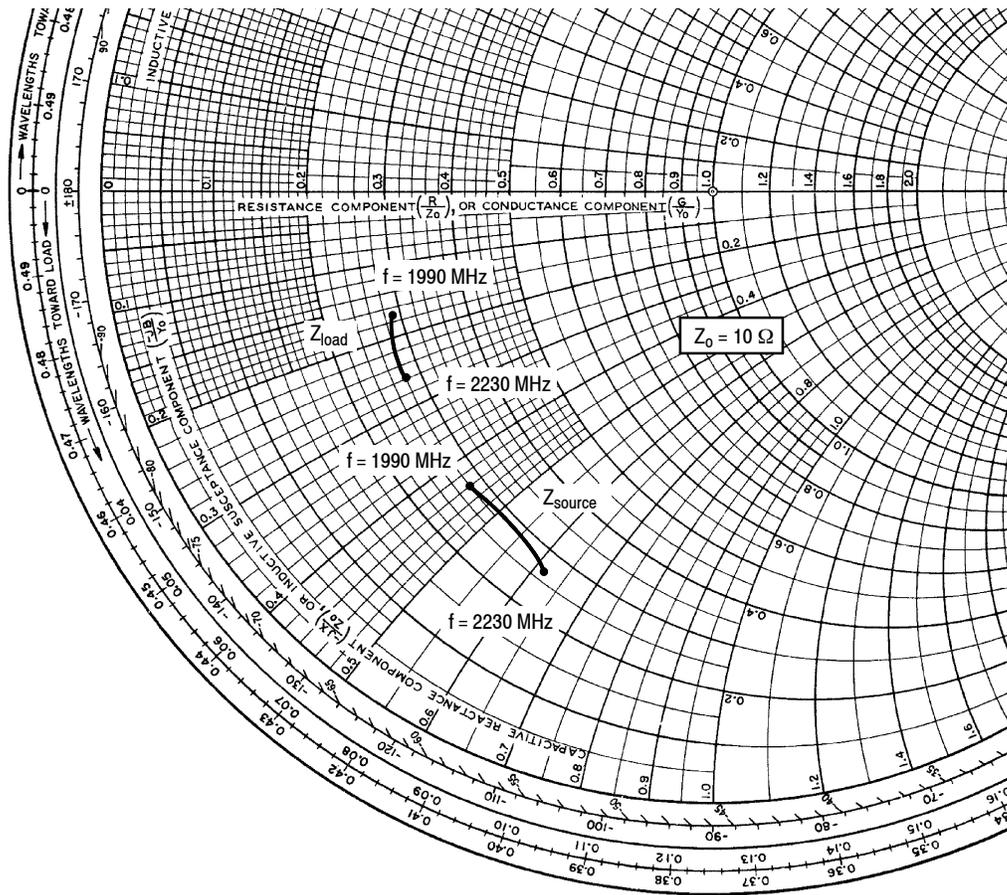


Figure 9. Intermodulation and Gain versus Supply Voltage

MRF21010LR1 MRF21010LSR1



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

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

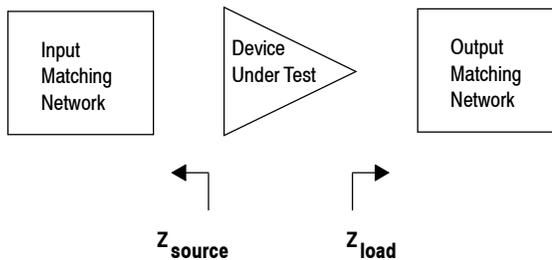
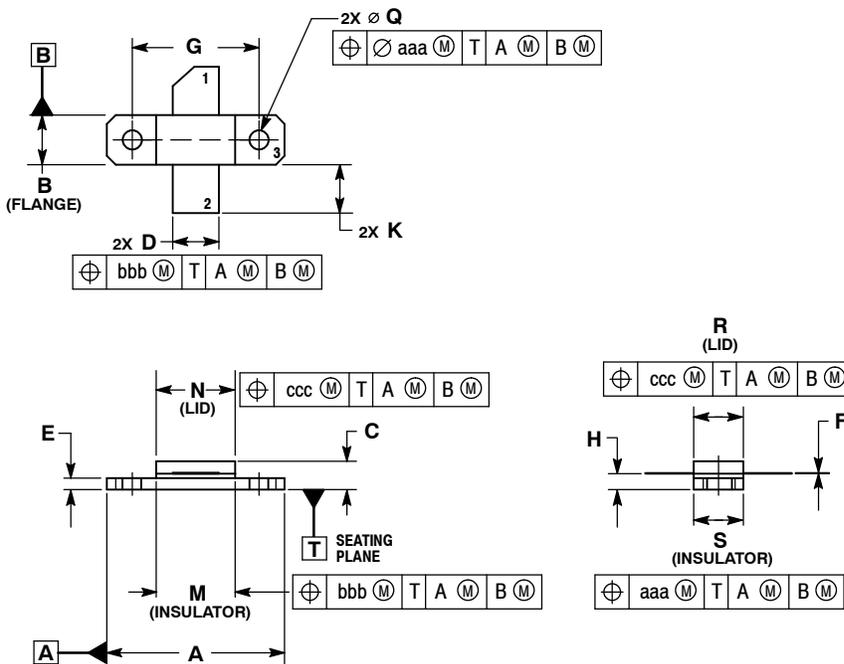


Figure 10. Series Equivalent Source and Load Impedance

## PACKAGE DIMENSIONS

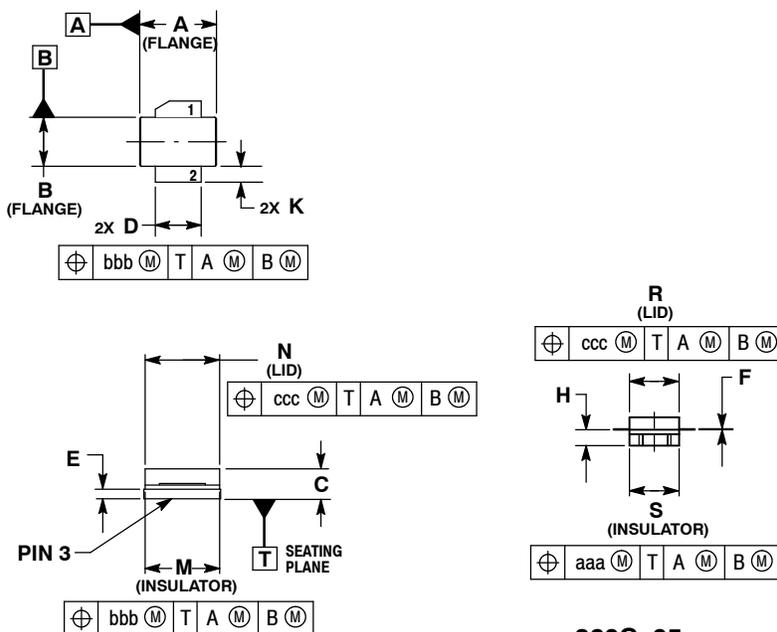


- NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	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  
 MRF2101LR1**



- 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.

DIM	INCHES		MILLIMETERS	
	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  
 3. SOURCE

**360C-05  
 ISSUE E  
 NI-360S  
 MRF2101LSR1**

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