

# The RF Sub-Micron MOSFET Line

## RF Power Field Effect Transistors

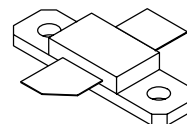
### N-Channel Enhancement-Mode Lateral MOSFETs

**MRF9030LR1**  
**MRF9030LSR1**

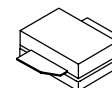
Designed for broadband commercial and industrial applications with frequencies up to 1.0 GHz. The high gain and broadband performance of these devices make them ideal for large-signal, common-source amplifier applications in 26 volt base station equipment.

- Typical Two-Tone Performance at 945 MHz, 26 Volts
  - Output Power — 30 Watts PEP
  - Power Gain — 19 dB
  - Efficiency — 41.5%
  - IMD — -32.5 dBc
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 945 MHz, 30 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- In Tape and Reel. R1 Suffix = 500 Units per 32 mm, 13 inch Reel.
- Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ" Nominal.

**945 MHz, 30 W, 26 V**  
**LATERAL N-CHANNEL**  
**BROADBAND**  
**RF POWER MOSFETs**



**CASE 360B-05, STYLE 1**  
**NI-360**  
**MRF9030LR1**



**CASE 360C-05, STYLE 1**  
**NI-360S**  
**MRF9030LSR1**

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}$	68	Vdc
Gate-Source Voltage	$V_{GS}$	- 0.5, + 15	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	92 0.53 117 0.67	Watts W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	- 65 to +150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$

#### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.9 1.5	$^\circ\text{C}/\text{W}$

#### ESD PROTECTION CHARACTERISTICS

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

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

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## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Zero Gate Voltage Drain Leakage Current (V <sub>DS</sub> = 68 Vdc, V <sub>GS</sub> = 0 Vdc)	I <sub>DSS</sub>	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V <sub>DS</sub> = 26 Vdc, V <sub>GS</sub> = 0 Vdc)	I <sub>DSS</sub>	—	—	1	μAdc
Gate-Source Leakage Current (V <sub>GS</sub> = 5 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	—	—	1	μAdc

### ON CHARACTERISTICS

Gate Threshold Voltage (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 100 μAdc)	V <sub>GS(th)</sub>	2	2.9	4	Vdc
Gate Quiescent Voltage (V <sub>DS</sub> = 26 Vdc, I <sub>D</sub> = 250 mAdc)	V <sub>GS(Q)</sub>	—	3.8	—	Vdc
Drain-Source On-Voltage (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 0.7 Adc)	V <sub>DS(on)</sub>	—	0.19	0.4	Vdc
Forward Transconductance (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 2 Adc)	g <sub>fs</sub>	—	3	—	S

### DYNAMIC CHARACTERISTICS

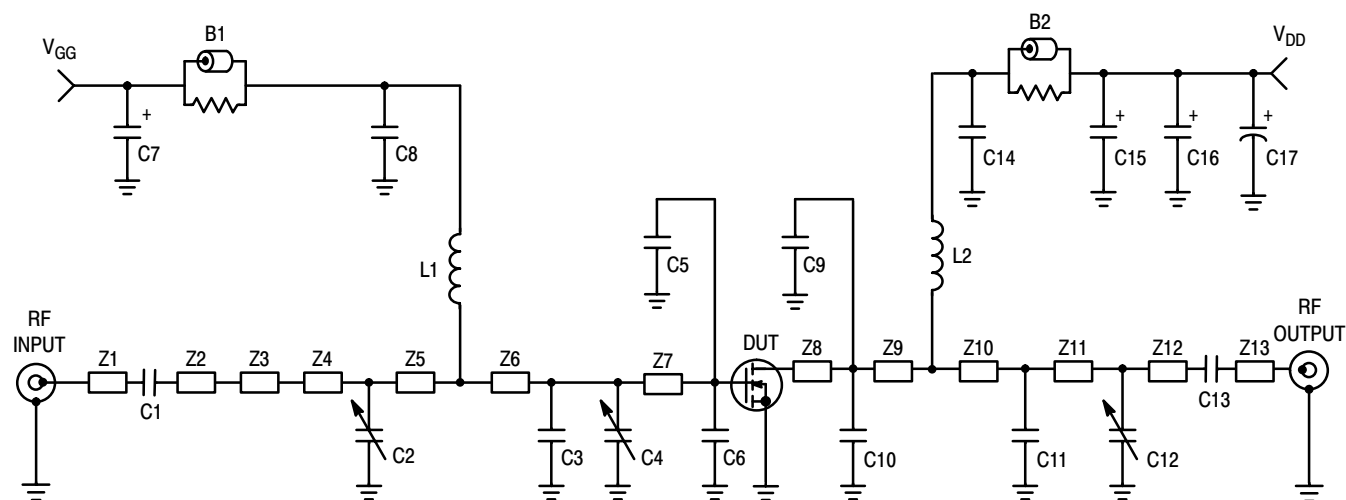
Input Capacitance (V <sub>DS</sub> = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V <sub>GS</sub> = 0 Vdc)	C <sub>iss</sub>	—	49.5	—	pF
Output Capacitance (V <sub>DS</sub> = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V <sub>GS</sub> = 0 Vdc)	C <sub>oss</sub>	—	26.5	—	pF
Reverse Transfer Capacitance (V <sub>DS</sub> = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V <sub>GS</sub> = 0 Vdc)	C <sub>rss</sub>	—	1	—	pF

(continued)

## ELECTRICAL CHARACTERISTICS — continued (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>FUNCTIONAL TESTS</b> (In Motorola Test Fixture, 50 ohm system)					
Two-Tone Common-Source Amplifier Power Gain (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W PEP, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 945.0 MHz, f <sub>2</sub> = 945.1 MHz)	G <sub>ps</sub>	18	19	—	dB
Two-Tone Drain Efficiency (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W PEP, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 945.0 MHz, f <sub>2</sub> = 945.1 MHz)	η	37	41.5	—	%
3rd Order Intermodulation Distortion (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W PEP, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 945.0 MHz, f <sub>2</sub> = 945.1 MHz)	IMD	—	-32.5	-28	dBc
Input Return Loss (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W PEP, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 945.0 MHz, f <sub>2</sub> = 945.1 MHz)	IRL	—	-15.5	-9	dB
Two-Tone Common-Source Amplifier Power Gain (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W PEP, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 930.0 MHz, f <sub>2</sub> = 930.1 MHz and f <sub>1</sub> = 960.0 MHz, f <sub>2</sub> = 960.1 MHz)	G <sub>ps</sub>	—	19	—	dB
Two-Tone Drain Efficiency (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W PEP, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 930.0 MHz, f <sub>2</sub> = 930.1 MHz and f <sub>1</sub> = 960.0 MHz, f <sub>2</sub> = 960.1 MHz)	η	—	41.5	—	%
3rd Order Intermodulation Distortion (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W PEP, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 930.0 MHz, f <sub>2</sub> = 930.1 MHz and f <sub>1</sub> = 960.0 MHz, f <sub>2</sub> = 960.1 MHz)	IMD	—	-33	—	dBc
Input Return Loss (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W PEP, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 930.0 MHz, f <sub>2</sub> = 930.1 MHz and f <sub>1</sub> = 960.0 MHz, f <sub>2</sub> = 960.1 MHz)	IRL	—	-14	—	dB
Power Output, 1 dB Compression Point (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W CW, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 945.0 MHz)	P <sub>1dB</sub>	—	30	—	W
Common-Source Amplifier Power Gain (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W CW, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 945.0 MHz)	G <sub>ps</sub>	—	19	—	dB
Drain Efficiency (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W CW, I <sub>DQ</sub> = 250 mA, f <sub>1</sub> = 945.0 MHz)	η	—	60	—	%
Output Mismatch Stress (V <sub>DD</sub> = 26 Vdc, P <sub>out</sub> = 30 W CW, I <sub>DQ</sub> = 250 mA, f = 945.0 MHz, VSWR = 10:1, All Phase Angles at Frequency of Tests)	Ψ	No Degradation In Output Power			

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B1	Short Ferrite Bead	Z3	0.500" x 0.100" Microstrip
B2	Long Ferrite Bead	Z4	0.215" x 0.270" Microstrip
C1, C8, C13, C14	47 pF Chip Capacitors, B Case	Z5	0.315" x 0.270" Microstrip
C2, C4	0.8 pF to 8.0 pF Trim Capacitors	Z6	0.160" x 0.270" x 0.520", Taper
C3	3.9 pF Chip Capacitor, B Case	Z7	0.285" x 0.520" Microstrip
C5, C6	7.5 pF Chip Capacitors, B Case	Z8	0.140" x 0.270" Microstrip
C7, C15, C16	10 $\mu$ F, 35 V Tantalum Capacitors	Z9	0.450" x 0.270" Microstrip
C9, C10	10 pF Chip Capacitors, B Case	Z10	0.250" x 0.060" Microstrip
C11	9.1 pF Chip Capacitor, B Case	Z11	0.720" x 0.060" Microstrip
C12	0.6 pF to 4.5 pF Trim Capacitor	Z12	0.490" x 0.060" Microstrip
C17	220 $\mu$ F, 50 V Electrolytic Capacitor	Z13	0.290" x 0.060" Microstrip
L1, L2	12.5 nH Surface Mount Inductors	PCB	Taconic RF-35-0300, 30 mil, $\epsilon_r = 3.55$
Z1	0.260" x 0.060" Microstrip		
Z2	0.240" x 0.060" Microstrip		

Figure 1. 945 MHz Broadband Test Circuit Schematic

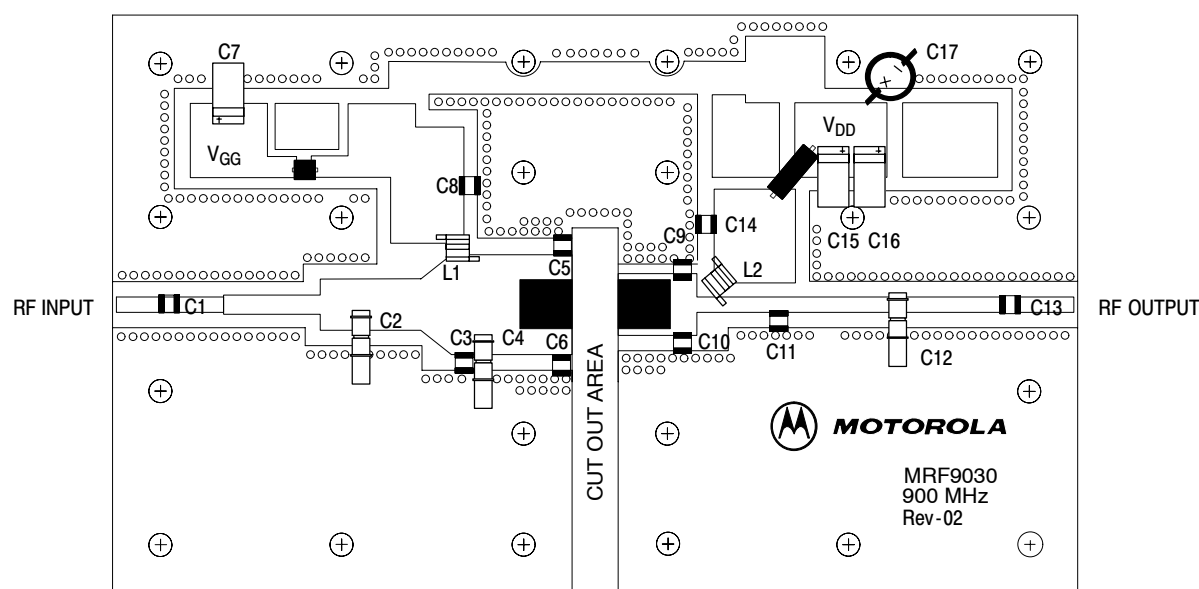


Figure 2. 945 MHz Broadband Test Circuit Component Layout

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## TYPICAL CHARACTERISTICS

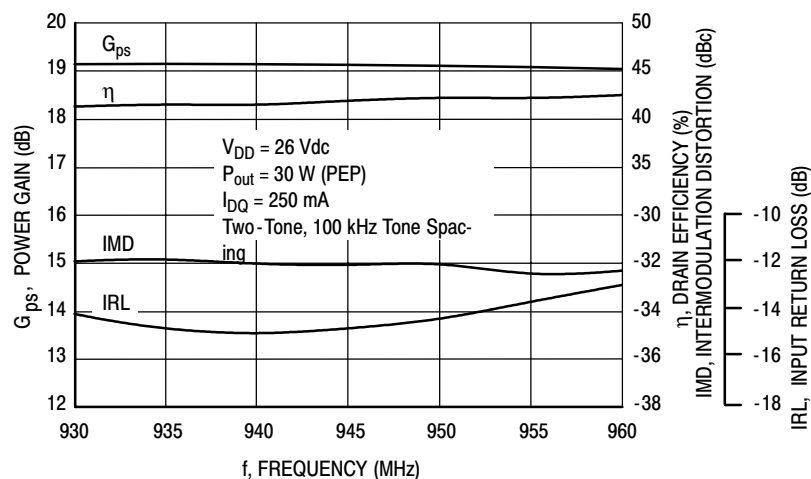


Figure 3. Class AB Broadband Circuit Performance

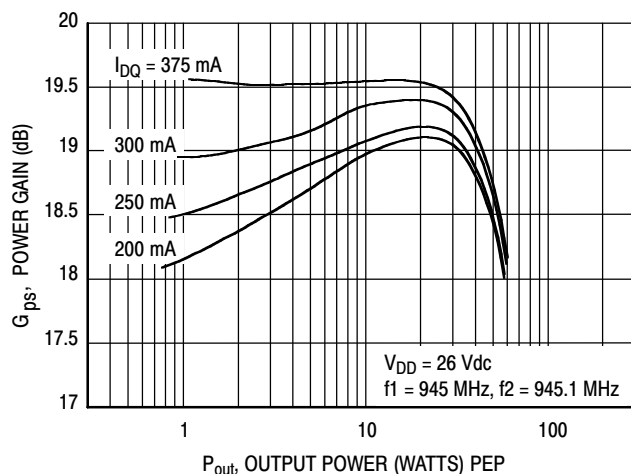


Figure 4. Power Gain versus Output Power

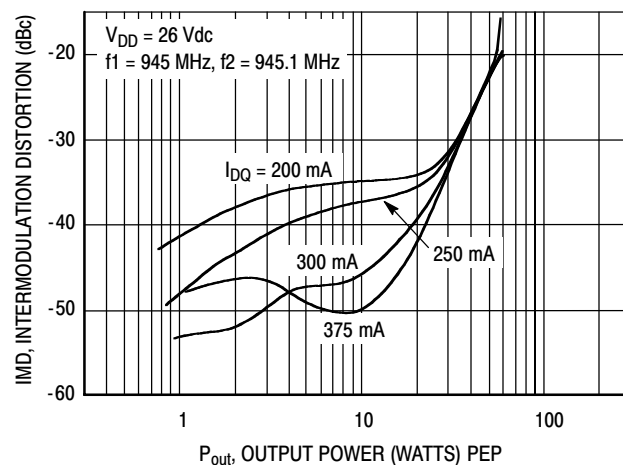


Figure 5. Intermodulation Distortion versus Output Power

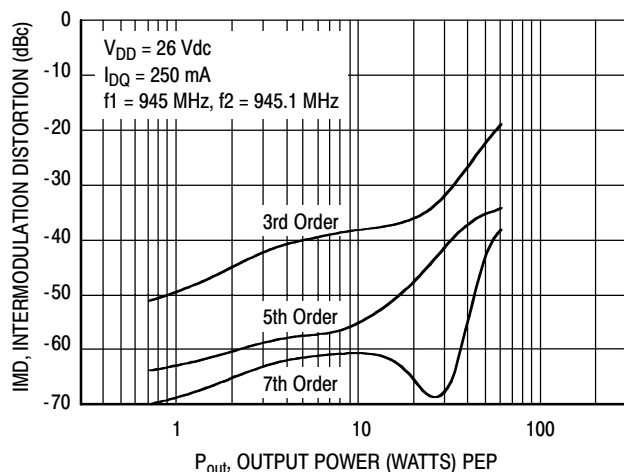


Figure 6. Intermodulation Distortion Products versus Output Power

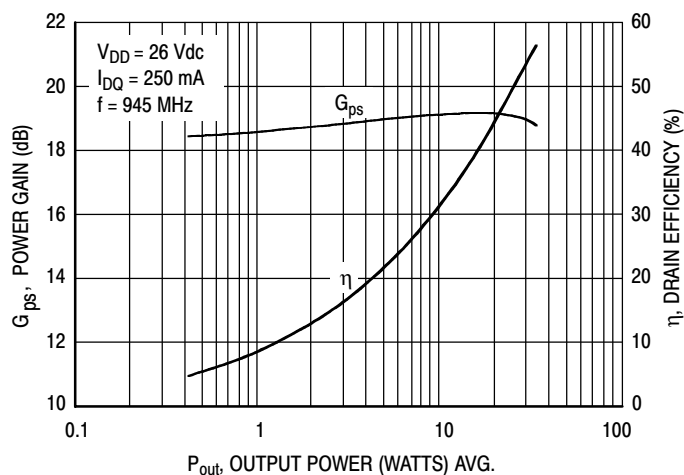
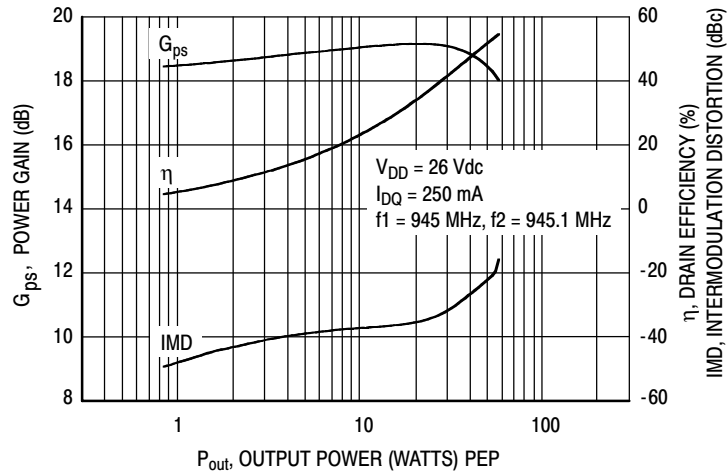
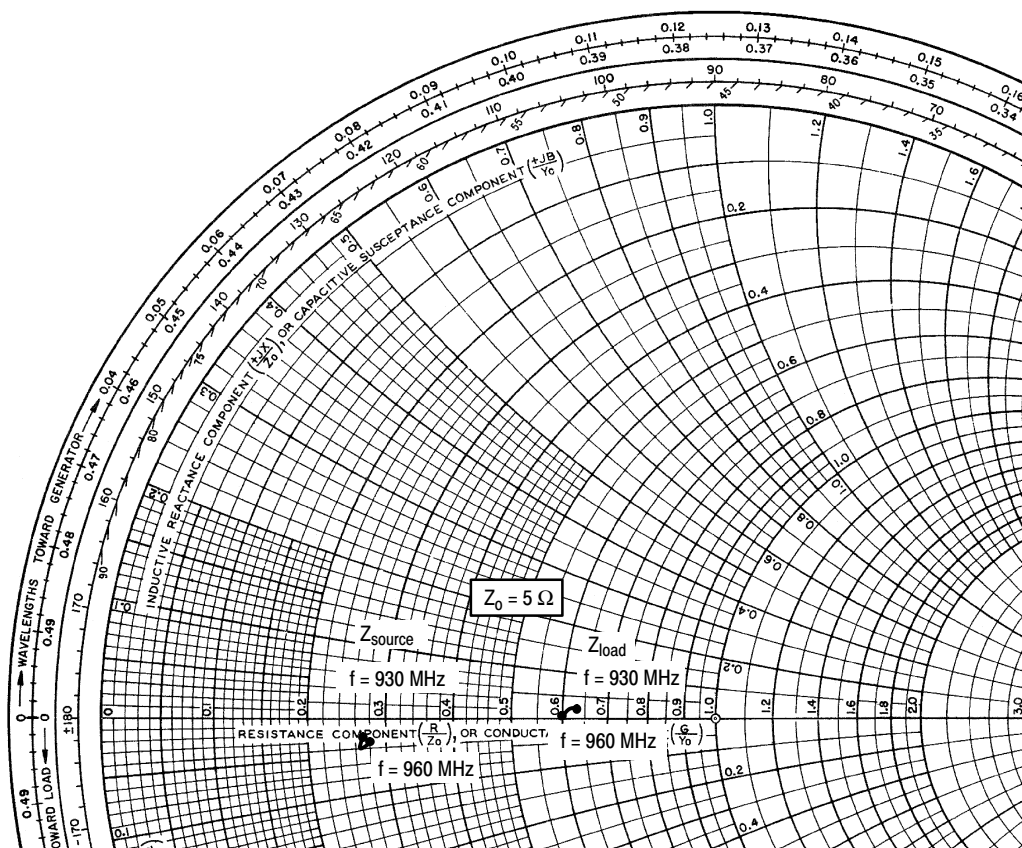


Figure 7. Power Gain and Efficiency versus Output Power

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**Figure 8. Power Gain, Efficiency and IMD versus Output Power**



$V_{DD} = 26 \text{ V}$ ,  $I_{DQ} = 250 \text{ mA}$ ,  $P_{out} = 30 \text{ W PEP}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
930	$1.34 - j0.1$	$3.175 + j0.09$
945	$1.36 - j0.2$	$3.1 + j0.08$
960	$1.4 - j0.14$	$3.0 + j0.05$

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

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

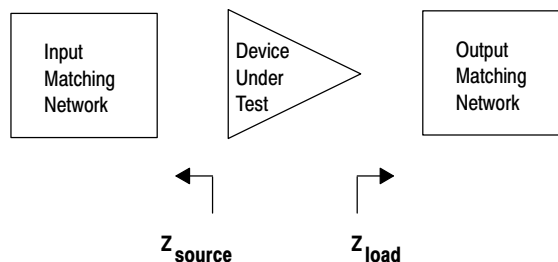


Figure 9. Series Equivalent Input and Output Impedance

# NOTES

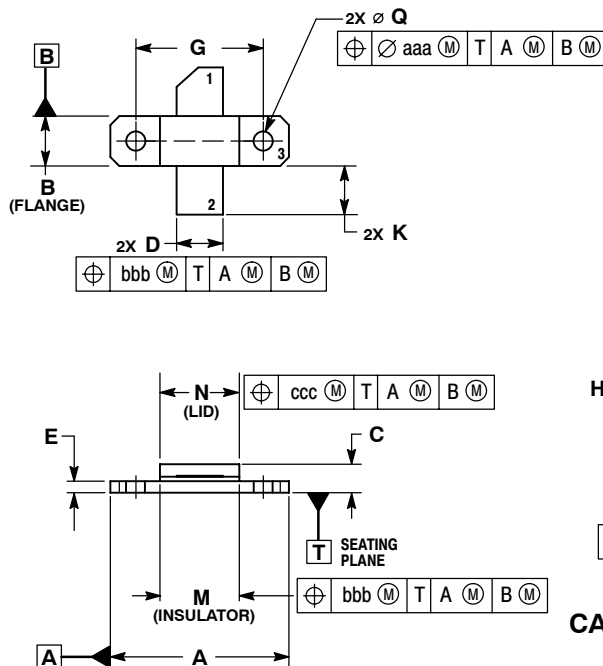


# NOTES

# NOTES

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## PACKAGE DIMENSIONS

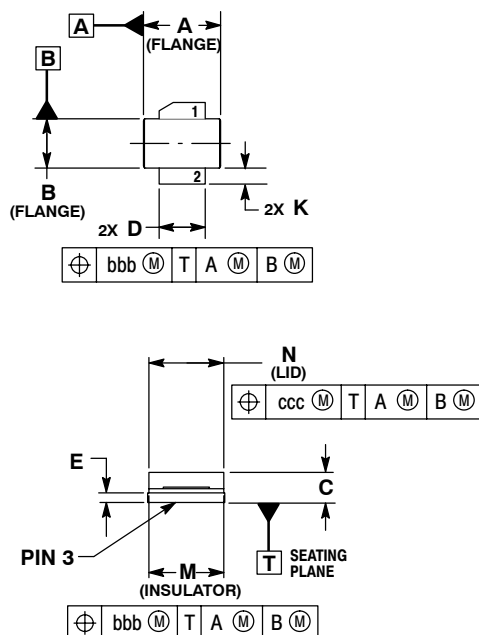


- NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

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 F  
NI-360  
MRF9030LR1**



- 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

**CASE 360C-05  
ISSUE D  
NI-360S  
MRF9030LSR1**

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