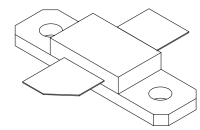
The RF Sub–Micron MOSFET Line
RF Power Field Effect Transistors
N–Channel Enhancement–Mode Lateral MOSFETs

MRF9030R1
MRF9030SR1

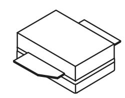
Designed for broadband commercial and industrial applications with frequencies up to 1.0 GHz. The high gain and broadband performance of these devices make them ideal for large–signal, common–source amplifier applications in 26 volt base station equipment.

- 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.

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



CASE 360B–05, STYLE 1
NI–360
MRF9030R1



CASE 360C–05, STYLE 1
NI–360S
MRF9030SR1

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Drain–Source Voltage		V_{DSS}	68	Vdc
Gate–Source Voltage		V_{GS}	–0.5, +15	Vdc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	MRF9030R1	P_D	92 0.53	Watts W/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	MRF9030SR1	P_D	117 0.67	Watts W/°C
Storage Temperature Range		T_{stg}	–65 to +200	°C
Operating Junction Temperature		T_J	200	°C

ESD PROTECTION CHARACTERISTICS

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

THERMAL CHARACTERISTICS

Characteristic		Symbol	Max	Unit
Thermal Resistance, Junction to Case	MRF9030R1 MRF9030SR1	$R_{\theta JC}$	1.9 1.5	°C/W

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

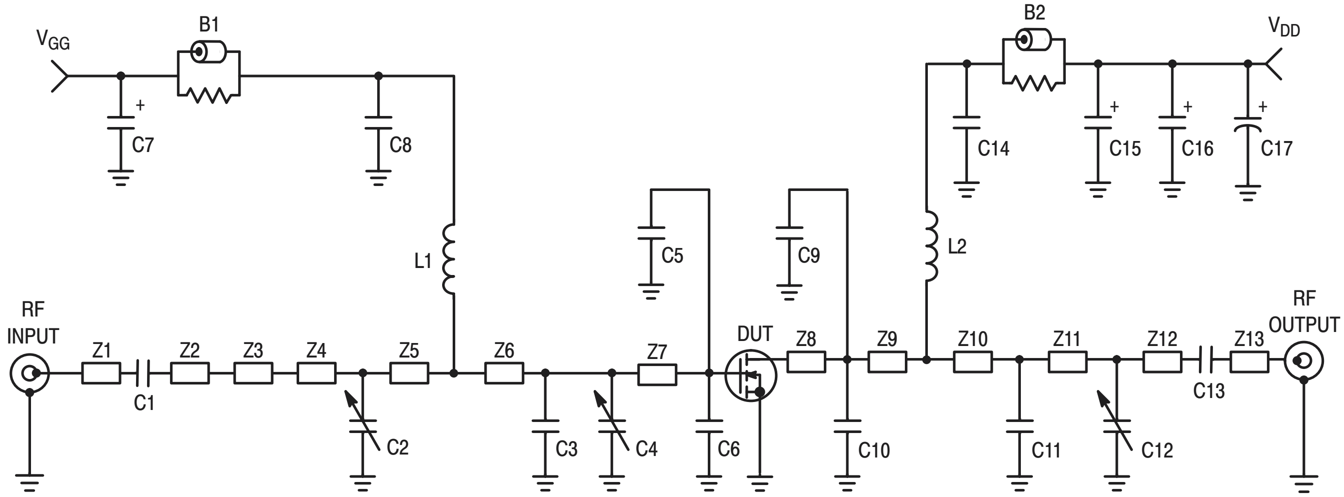
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 68 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	µAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 26 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	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 Vdc, I_D = 100 µAdc)	$V_{GS(th)}$	2	2.9	4	Vdc
Gate Quiescent Voltage (V_{DS} = 26 Vdc, I_D = 250 mAdc)	$V_{GS(Q)}$	—	3.8	—	Vdc
Drain–Source On–Voltage (V_{GS} = 10 Vdc, I_D = 0.7 Adc)	$V_{DS(on)}$	—	0.19	0.4	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 2 Adc)	g_{fs}	—	3	—	S
DYNAMIC CHARACTERISTICS					
Input Capacitance (V_{DS} = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{iss}	—	49.5	—	pF
Output Capacitance (V_{DS} = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	26.5	—	pF
Reverse Transfer Capacitance (V_{DS} = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	1	—	pF

(continued)

ELECTRICAL CHARACTERISTICS — continued (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
FUNCTIONAL TESTS (In Motorola Test Fixture, 50 ohm system)					
Two–Tone Common–Source Amplifier Power Gain (V_{DD} = 26 Vdc, P_{out} = 30 W PEP, I_{DQ} = 250 mA, f1 = 945.0 MHz, f2 = 945.1 MHz)	G_{ps}	18	19	—	dB
Two–Tone Drain Efficiency (V_{DD} = 26 Vdc, P_{out} = 30 W PEP, I_{DQ} = 250 mA, f1 = 945.0 MHz, f2 = 945.1 MHz)	η	37	41.5	—	%
3rd Order Intermodulation Distortion (V_{DD} = 26 Vdc, P_{out} = 30 W PEP, I_{DQ} = 250 mA, f1 = 945.0 MHz, f2 = 945.1 MHz)	IMD	—	–32.5	–28	dBc
Input Return Loss (V_{DD} = 26 Vdc, P_{out} = 30 W PEP, I_{DQ} = 250 mA, f1 = 945.0 MHz, f2 = 945.1 MHz)	IRL	—	–15.5	–9	dB
Two–Tone Common–Source Amplifier Power Gain (V_{DD} = 26 Vdc, P_{out} = 30 W PEP, I_{DQ} = 250 mA, f1 = 930.0 MHz, f2 = 930.1 MHz and f1 = 960.0 MHz, f2 = 960.1 MHz)	G_{ps}	—	19	—	dB
Two–Tone Drain Efficiency (V_{DD} = 26 Vdc, P_{out} = 30 W PEP, I_{DQ} = 250 mA, f1 = 930.0 MHz, f2 = 930.1 MHz and f1 = 960.0 MHz, f2 = 960.1 MHz)	η	—	41.5	—	%
3rd Order Intermodulation Distortion (V_{DD} = 26 Vdc, P_{out} = 30 W PEP, I_{DQ} = 250 mA, f1 = 930.0 MHz, f2 = 930.1 MHz and f1 = 960.0 MHz, f2 = 960.1 MHz)	IMD	—	–33	—	dBc
Input Return Loss (V_{DD} = 26 Vdc, P_{out} = 30 W PEP, I_{DQ} = 250 mA, f1 = 930.0 MHz, f2 = 930.1 MHz and f1 = 960.0 MHz, f2 = 960.1 MHz)	IRL	—	–14	—	dB
Power Output, 1 dB Compression Point (V_{DD} = 26 Vdc, P_{out} = 30 W CW, I_{DQ} = 250 mA, f1 = 945.0 MHz)	P_{1dB}	—	30	—	W
Common–Source Amplifier Power Gain (V_{DD} = 26 Vdc, P_{out} = 30 W CW, I_{DQ} = 250 mA, f1 = 945.0 MHz)	G_{ps}	—	19	—	dB
Drain Efficiency (V_{DD} = 26 Vdc, P_{out} = 30 W CW, I_{DQ} = 250 mA, f1 = 945.0 MHz)	η	—	60	—	%
Output Mismatch Stress (V_{DD} = 26 Vdc, P_{out} = 30 W CW, I_{DQ} = 250 mA, f = 945.0 MHz, VSWR = 10:1, All Phase Angles at Frequency of Tests)	Ψ	No Degradation In Output Power			



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 μF, 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 μF, 50 V Electrolytic Capacitor	Z13	0.290″ x 0.060″ Microstrip
L1, L2	12.5 nH Surface Mount Inductors	Board	Taconic RF–35–0300, (ε_r = 3.5) CAX1/CAX1
Z1	0.260″ x 0.060″ Microstrip		
Z2	0.240″ x 0.060″ Microstrip		

Figure 1. 945 MHz Broadband Test Circuit Schematic

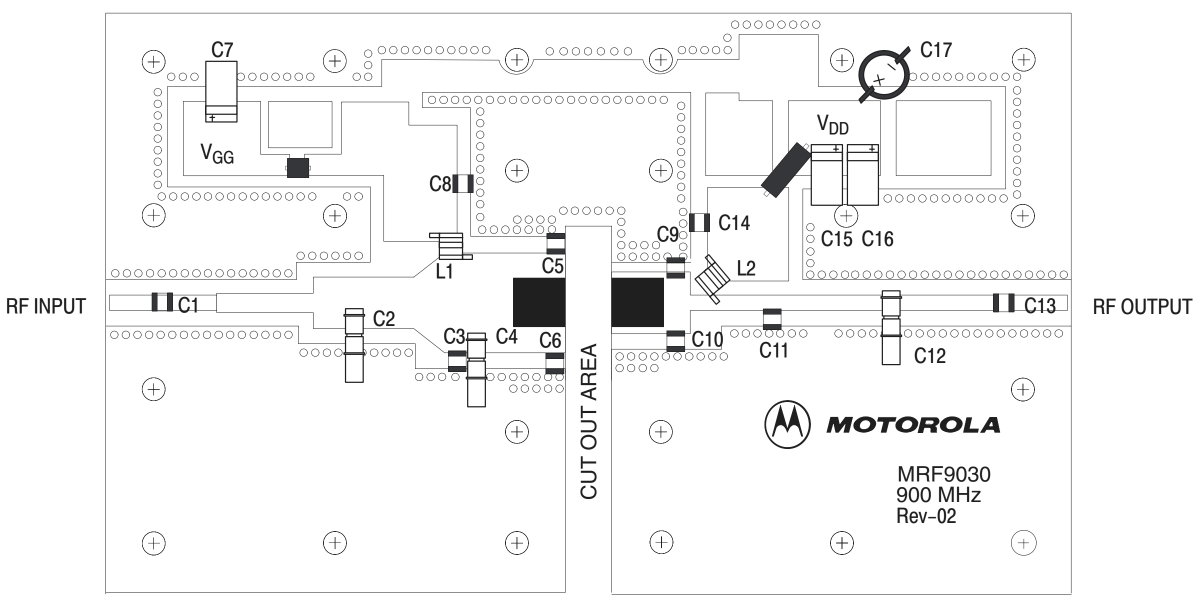


Figure 2. 945 MHz Broadband Test Circuit Component Layout

TYPICAL CHARACTERISTICS

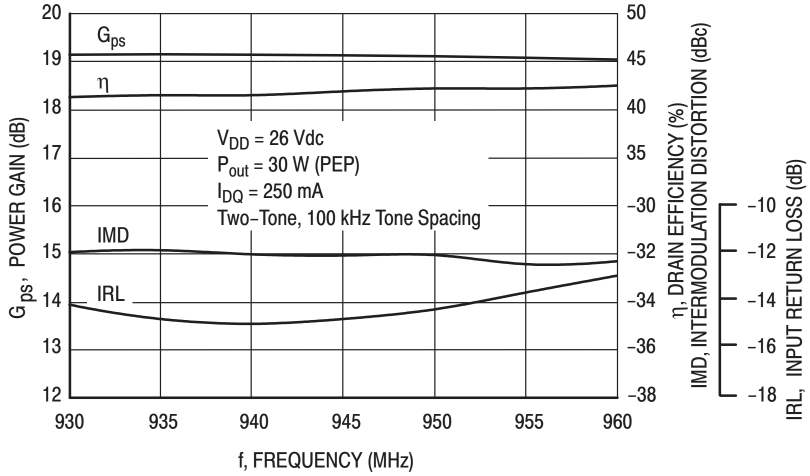


Figure 3. Class AB Broadband Circuit Performance

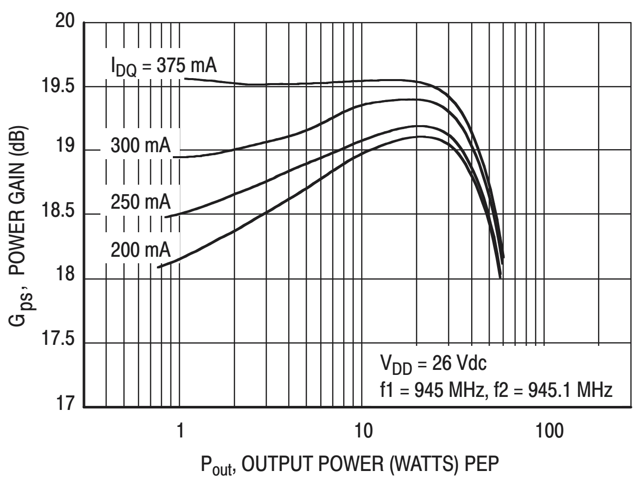


Figure 4. Power Gain versus Output Power

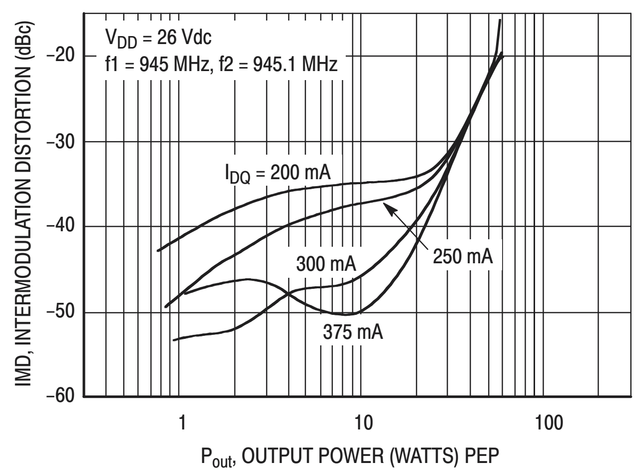


Figure 5. Intermodulation Distortion versus Output Power

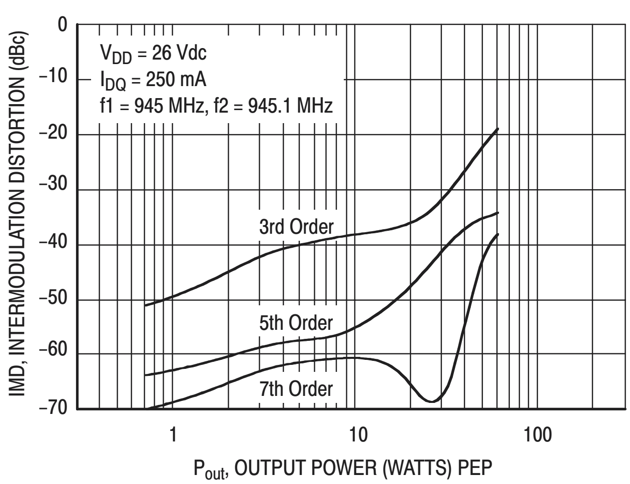


Figure 6. Intermodulation Distortion Products versus Output Power

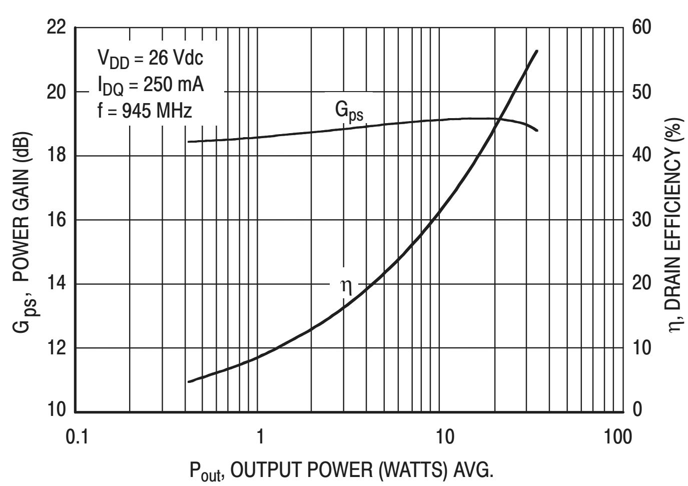


Figure 7. Power Gain and Efficiency versus Output Power

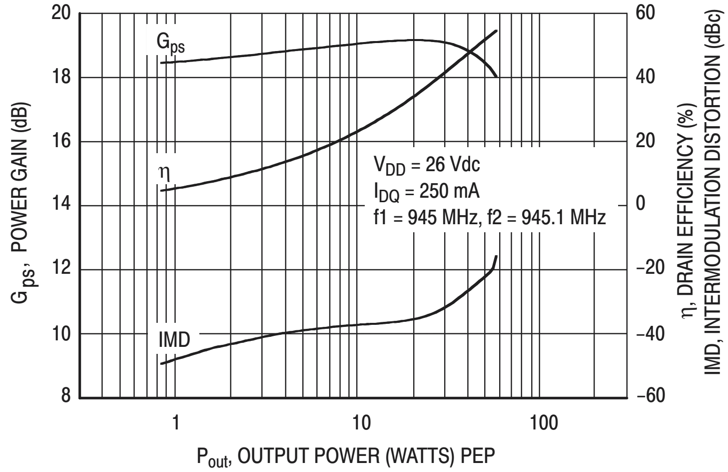
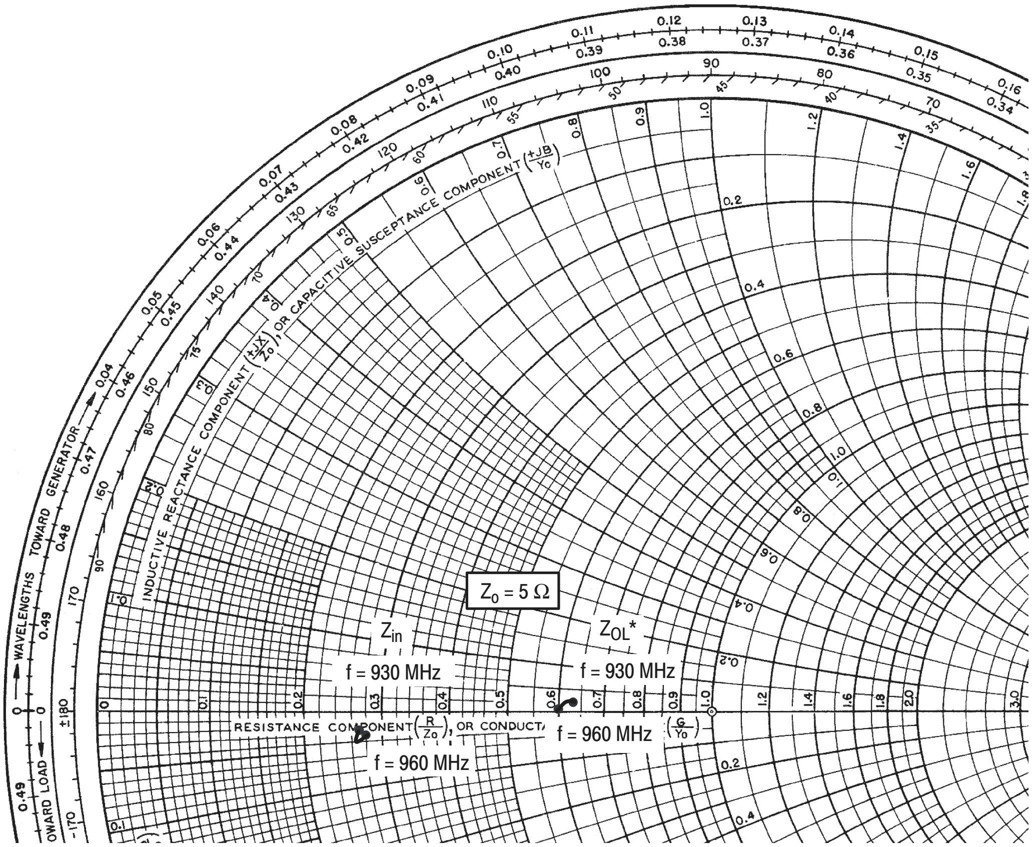


Figure 8. Power Gain, Efficiency and IMD versus Output Power



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

f MHz	Z_{in} Ω	Z_{OL}* Ω
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_{in} = Complex conjugate of source impedance.

Z_{OL}* = Complex conjugate of the optimum load impedance at a given output power, voltage, IMD, bias current and frequency.

Note: Z_{OL}* was chosen based on tradeoffs between gain, output power, drain efficiency and intermodulation distortion.

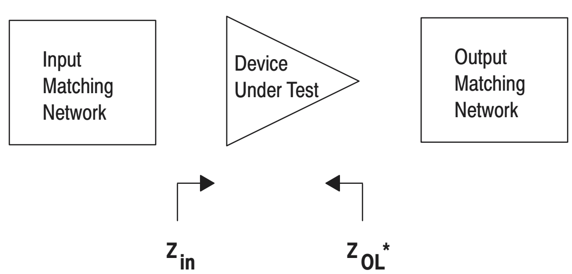


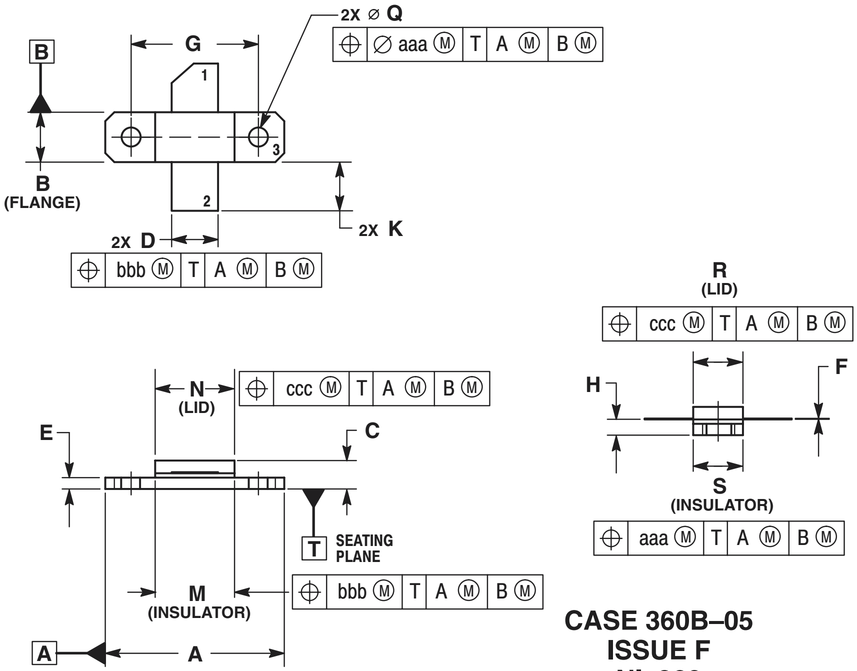
Figure 9. Series Equivalent Input and Output Impedance

NOTES

NOTES

NOTES

PACKAGE DIMENSIONS

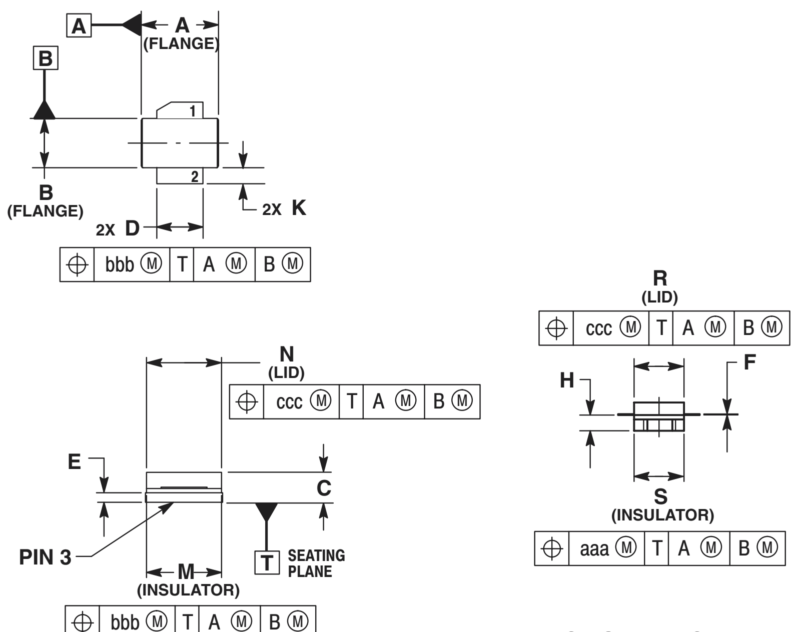


NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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
MRF9030R1



NOTES:
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DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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
MRF9030SR1

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