MOTOROLA   **Freescale Semiconductor, Inc.**

SEMICONDUCTOR TECHNICAL DATA

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

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.

MRF9030LR1
MRF9030LSR1

**945 MHz, 30 W, 26 V
LATERAL N-CHANNEL
BROADBAND
RF POWER MOSFETs**
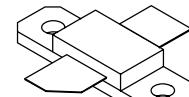
**CASE 360B-05, STYLE 1
NI-360
MRF9030LR1**
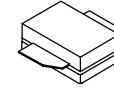
**CASE 360C-05, STYLE 1
NI-360S
MRF9030LSR1**

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
Drain-Source Voltage		V_{DSS}	68	Vdc
Gate-Source Voltage		V_{GS}	-0.5, +15	Vdc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	MRF9030LR1 MRF9030LSR1	P_D	92 0.53 117 0.67	Watts W/°C
Storage Temperature Range		T_{stg}	-65 to +150	°C
Operating Junction Temperature		T_J	200	°C

THERMAL CHARACTERISTICS

Characteristic		Symbol	Max	Unit
Thermal Resistance, Junction to Case	MRF9030LR1 MRF9030LSR1	$R_{\theta JC}$	1.9 1.5	°C/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.

REV 4

MOTOROLA intelligence everywhere™   digitaldna™

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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)

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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			
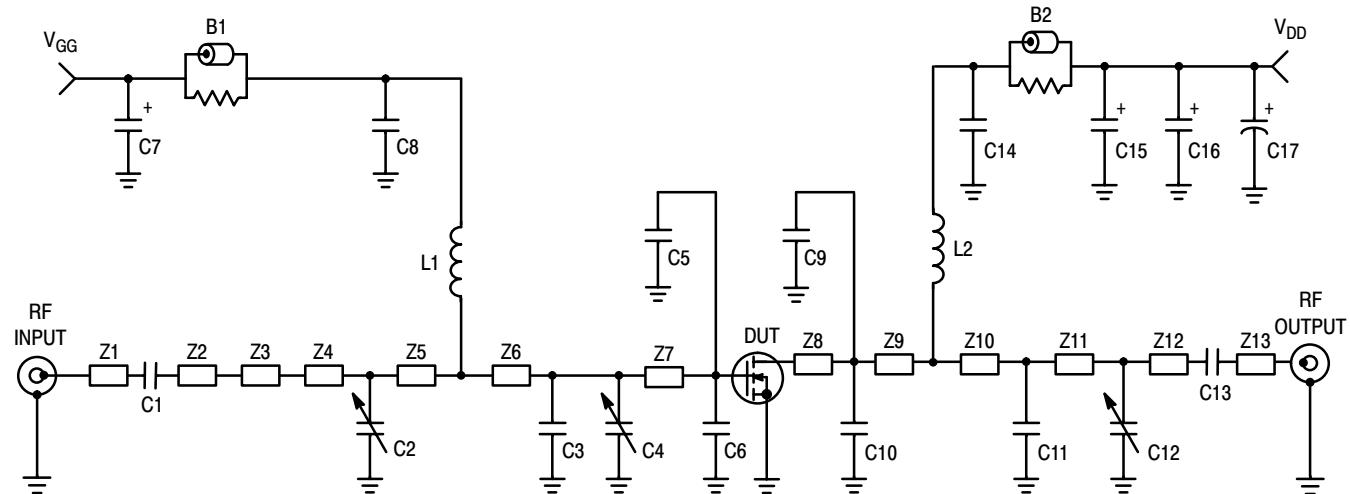
B1	Short Ferrite Bead	Z3	0.500″ x 0.100″ Microstrip
B2	Long Ferrite Bead	Z4	0.215″ x 0.270″ Microstrip
C1, C8, C13, C14	47 pF Chip Capacitors, B Case	Z5	0.315″ x 0.270″ Microstrip
C2, C4	0.8 pF to 8.0 pF Trim Capacitors	Z6	0.160″ x 0.270″ x 0.520″, Taper
C3	3.9 pF Chip Capacitor, B Case	Z7	0.285″ x 0.520″ 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	PCB	Taconic RF-35-0300, 30 mil,
Z1	0.260″ x 0.060″ Microstrip		$\varepsilon_r = 3.55$
Z2	0.240″ x 0.060″ Microstrip		

Figure 1. 945 MHz Broadband Test Circuit Schematic
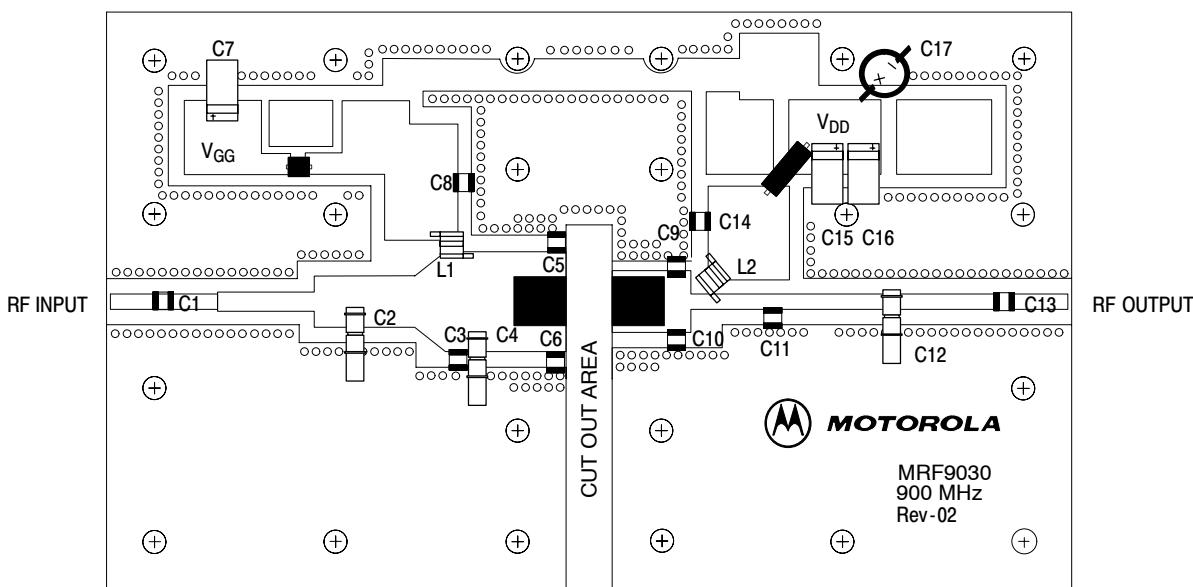
Figure 2. 945 MHz Broadband Test Circuit Component Layout

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TYPICAL CHARACTERISTICS
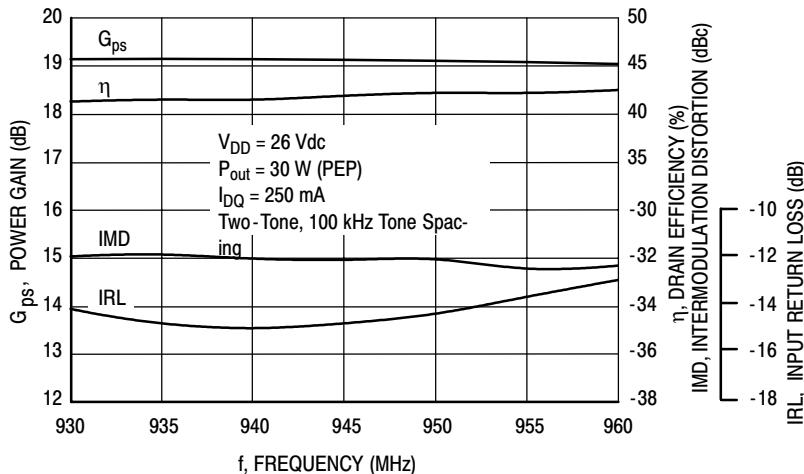
Figure 3. Class AB Broadband Circuit Performance
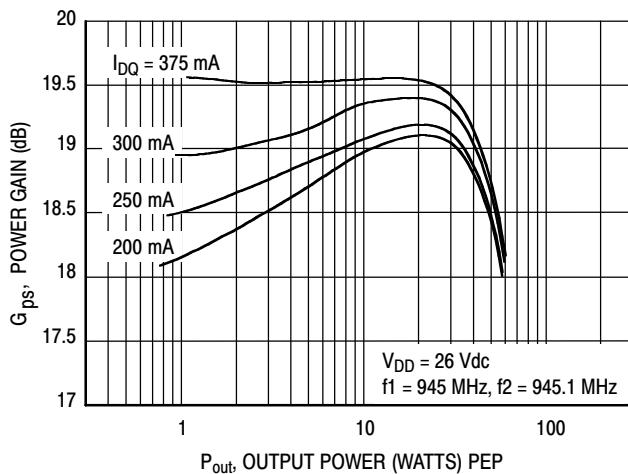
Figure 4. Power Gain versus Output Power
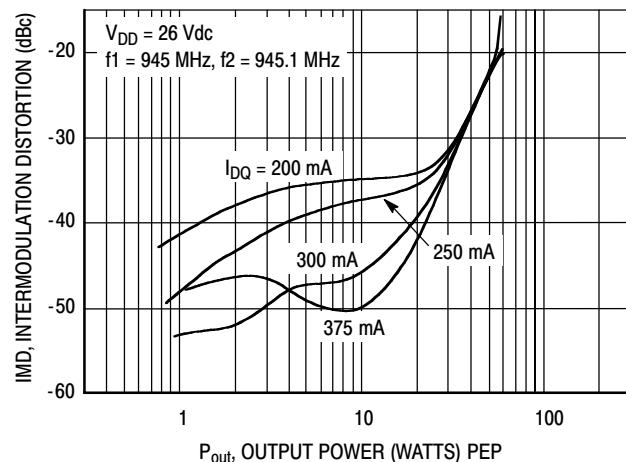
Figure 5. Intermodulation Distortion versus Output Power
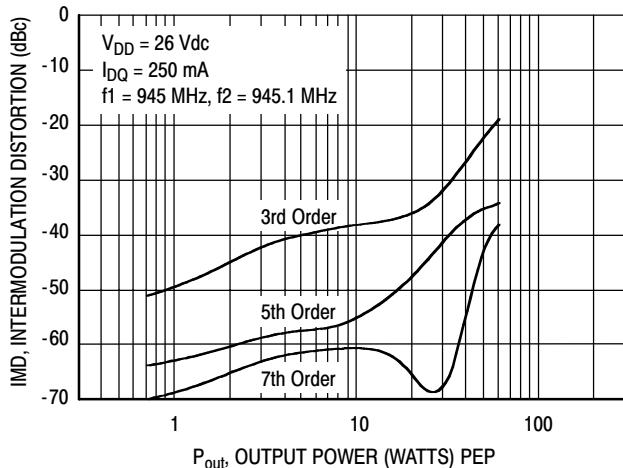
**Figure 6. Intermodulation Distortion Products versus Output Power**
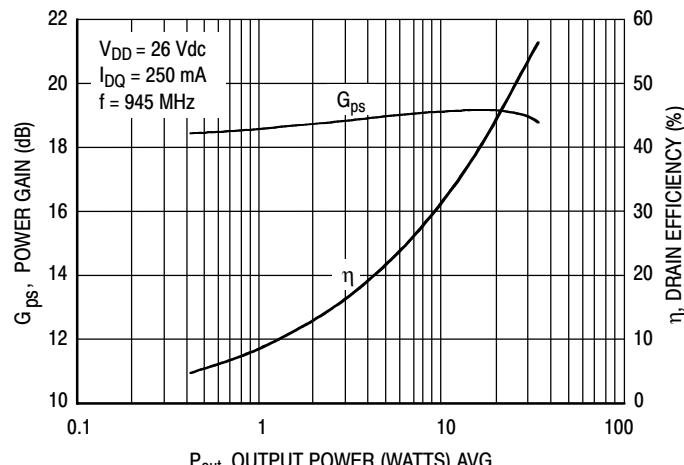

Figure 7. Power Gain and Efficiency versus Output Power
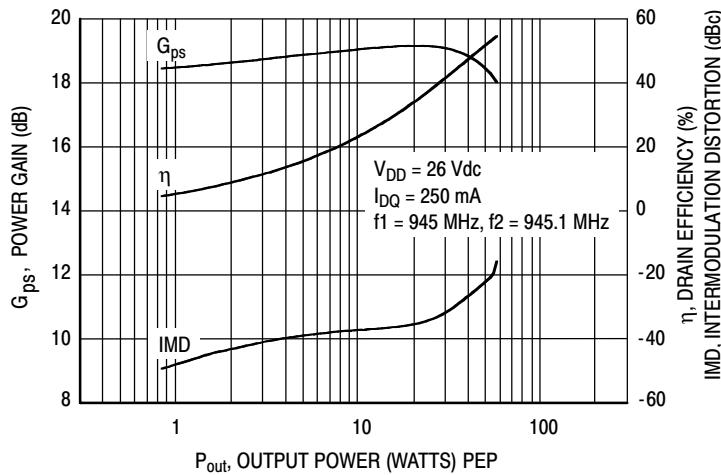
**Figure 8. Power Gain, Efficiency and IMD
versus Output Power**

MOTOROLA RF DEVICE DATA

V_{DD} = 26 V, I_{DQ} = 250 mA, P_{out} = 30 W PEP
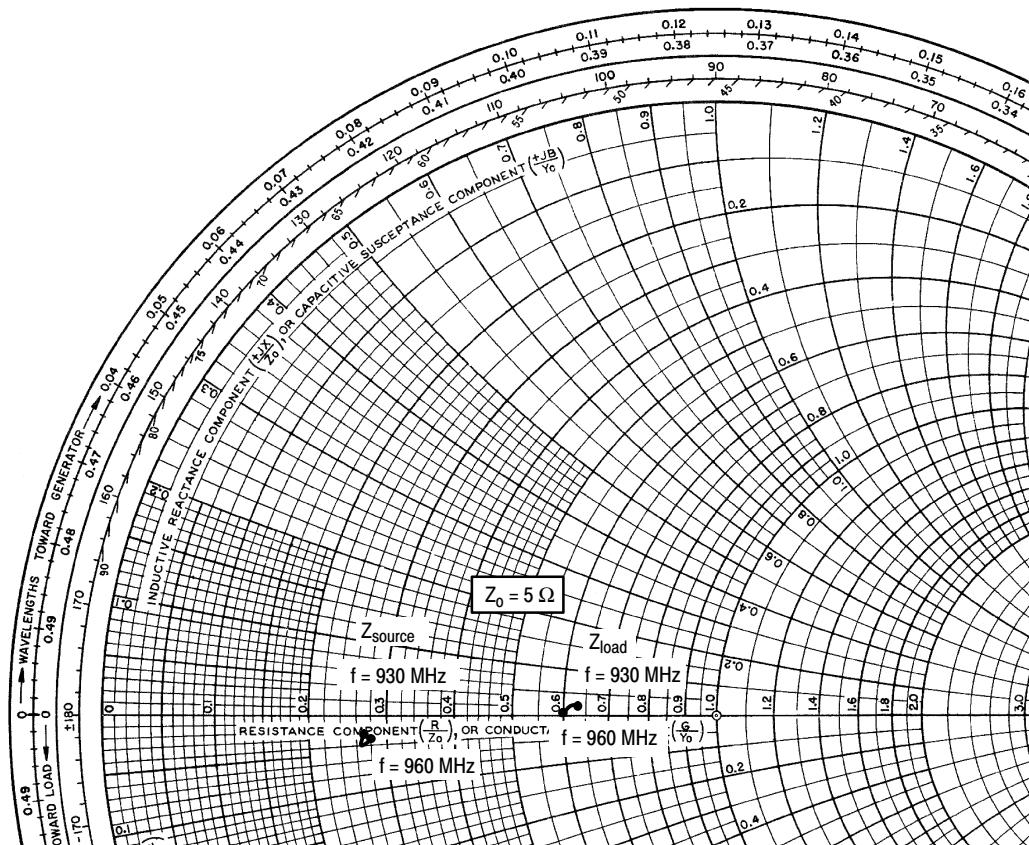
f MHz	Z_{source} Ω	Z_{load} Ω
930	1.34 - j0.1	3.175 + j0.09
945	1.36 - j0.2	3.1 + j0.08
960	1.4 - j0.14	3.0 + j0.05

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

Z_{load} = Test circuit impedance as measured from drain to ground.
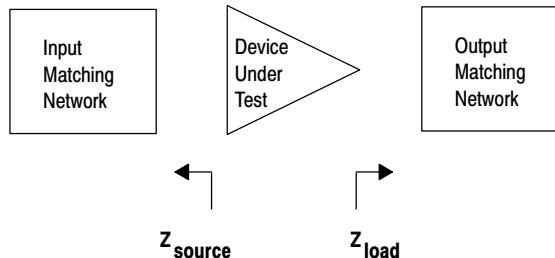
Figure 9. Series Equivalent Input and Output Impedance

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NOTES

NOTES

MRF9030LR1 MRF9030LSR1

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NOTES

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PACKAGE DIMENSIONS

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 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 360C-05
ISSUE D
NI-360S
MRF9030LSR1

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

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