

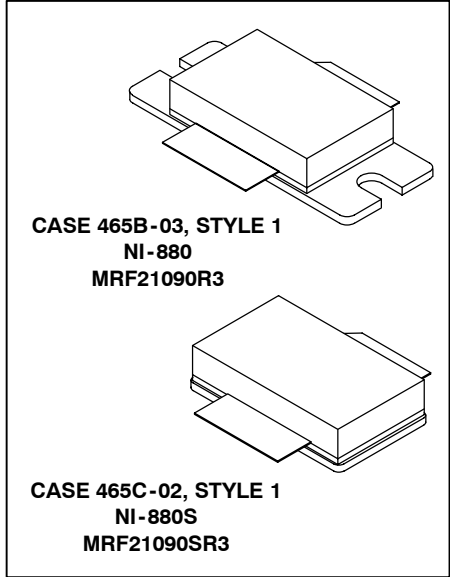
The RF Sub-Micron MOSFET Line
RF Power Field Effect Transistors
N-Channel Enhancement-Mode Lateral MOSFETs

MRF21090R3
MRF21090SR3

Designed for W-CDMA base station applications with frequencies from 2110 to 2170 MHz. Suitable for FM, TDMA, CDMA and multicarrier amplifier applications.

2170 MHz, 90 W, 28 V
LATERAL N-CHANNEL
RF POWER MOSFETs

- Typical W-CDMA Performance for 2140 MHz, 28 Volts
 4.096 MHz BW @ 5 MHz offset, 1 PERCH 15 DTCH:
 Output Power — 11.5 Watts
 Efficiency — 16%
 Gain — 12.2 dB
 ACPR — -45 dBc
- Internally Matched, Controlled Q, for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2110 MHz, 90 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	65	Vdc
Gate-Source Voltage	V_{GS}	+15, -0.5	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	270 1.54	Watts $\text{W}/^\circ\text{C}$
Storage Temperature Range	T_{stg}	- 65 to +150	$^\circ\text{C}$
Operating Junction Temperature	T_J	200	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.65	$^\circ\text{C}/\text{W}$

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

Freescale Semiconductor, Inc.

ESD PROTECTION CHARACTERISTICS

Test Conditions		Class
Human Body Model	MRF21090R3 MRF21090SR3	2 (Minimum) 1 (Minimum)
Machine Model	MRF21090R3 MRF21090SR3	M3 (Minimum) M4 (Minimum)

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

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain-Source Breakdown Voltage (V _{GS} = 0 Vdc, I _D = 100 μAdc)	V _{(BR)DSS}	65	—	—	Vdc
Gate-Source Leakage Current (V _{GS} = 5 Vdc, V _{DS} = 0 Vdc)	I _{GSS}	—	—	1	μAdc
Zero Gate Voltage Drain Leakage Current (V _{DS} = 28 Vdc, V _{GS} = 0 Vdc)	I _{DSS}	—	—	10	μAdc

ON CHARACTERISTICS

Forward Transconductance (V _{DS} = 10 Vdc, I _D = 3 Adc)	g _{fs}	—	7.2	—	S
Gate Threshold Voltage (V _{DS} = 10 V, I _D = 300 μA)	V _{GS(th)}	2	3	4	Vdc
Gate Quiescent Voltage (V _{DS} = 28 V, I _D = 750 mA)	V _{GS(Q)}	3	3.8	5	Vdc
Drain-Source On-Voltage (V _{GS} = 10 V, I _D = 1 A)	V _{DS(on)}	—	0.1	0.6	Vdc

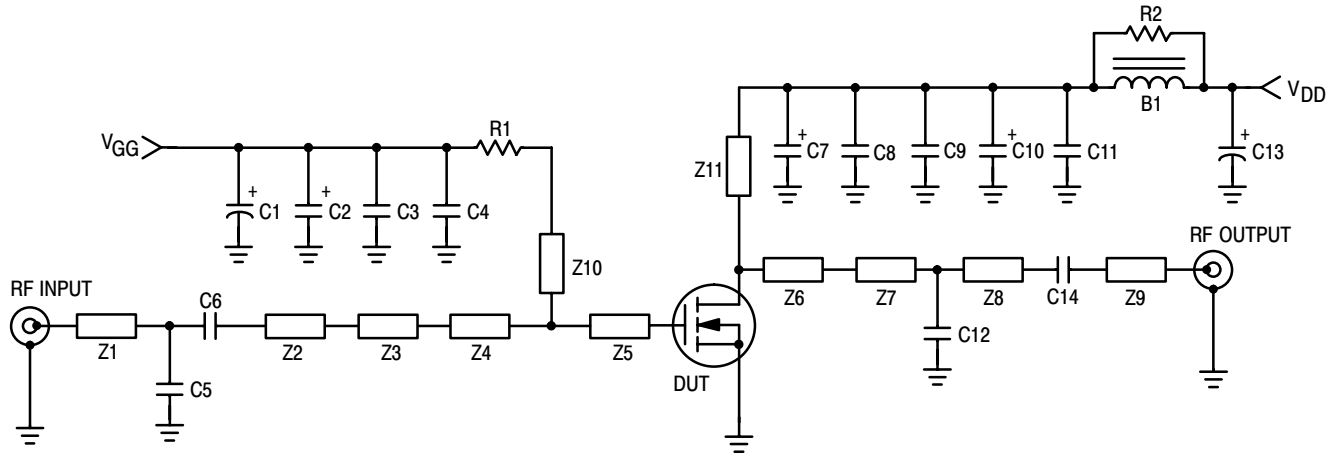
DYNAMIC CHARACTERISTICS

Reverse Transfer Capacitance (1) (V _{DS} = 28 Vdc, V _{GS} = 0, f = 1 MHz)	C _{rss}	—	4.2	—	pF
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FUNCTIONAL TESTS (In Motorola Test Fixture)

Common-Source Amplifier Power Gain (V _{DD} = 28 Vdc, P _{out} = 90 W PEP, I _{DQ} = 750 mA, f ₁ = 2110.0 MHz, f ₂ = 2110.1 MHz and f ₁ = 2170.0 MHz, f ₂ = 2170.1 MHz)	G _{ps}	10	11.7	—	dB
Drain Efficiency (V _{DD} = 28 Vdc, P _{out} = 90 W PEP, I _{DQ} = 750 mA, f ₁ = 2110.0 MHz, f ₂ = 2110.1 MHz and f ₁ = 2170.0 MHz, f ₂ = 2170.1 MHz)	η	30	33	—	%
Intermodulation Distortion (V _{DD} = 28 Vdc, P _{out} = 90 W PEP, I _{DQ} = 750 mA, f ₁ = 2110.0 MHz, f ₂ = 2110.1 MHz and f ₁ = 2170.0 MHz, f ₂ = 2170.1 MHz)	IMD	—	-30	-27.5	dBc
Input Return Loss (V _{DD} = 28 Vdc, P _{out} = 90 W PEP, I _{DQ} = 750 mA, f ₁ = 2110.0 MHz, f ₂ = 2110.1 MHz and f ₁ = 2170.0 MHz, f ₂ = 2170.1 MHz)	IRL	—	-12	-9.0	dB
Common-Source Amplifier Power Gain (V _{DD} = 28 Vdc, P _{out} = 75 W CW, I _{DQ} = 750 mA, f = 2170 MHz)	G _{ps}	—	11.7	—	dB
Drain Efficiency (V _{DD} = 28 Vdc, P _{out} = 75 W CW, I _{DQ} = 750 mA, f = 2170 MHz)	η	—	41	—	%
Output Mismatch Stress (V _{DD} = 28 Vdc, P _{out} = 90 W CW, I _{DQ} = 750 mA, f = 2110 MHz, VSWR = 10:1, All Phase Angles at Frequency of Tests)	Ψ	No Degradation In Output Power Before and After Test			

(1) Part is internally matched both on input and output.



B1	Ferrite Bead, Fair Rite #2743019447	Z7	10.23 x 2.09 mm Microstrip
C1, C13	470 μ F, 50 V Electrolytic Capacitors	Z8	6.03 x 2.09 mm Microstrip
C2, C10	22 μ F, 35 V Tantalum Surface Mount Chip Capacitors, Kemet	Z9	23.98 x 2.09 mm Microstrip
C3, C9	20 nF Chip Capacitors, ATC #100B203MCA500X	Z10	29.82 x 1.15 mm Microstrip
C4, C8	5.1 pF Chip Capacitors, ATC #100B5R1CCA500X	Z11	17.08 x 1.15 mm Microstrip
C5, C12	0.4 - 2.5 pF Variable Capacitors, Johanson Gigatrim	WS1, WS2	Beryllium Copper Wear Blocks 5 mils Thick
C6	10 pF Chip Capacitor, ATC #100B100JCA500X		Brass Banana Jack and Nut
C7	1 μ F, 35 V Tantalum Surface Mount Chip Capacitor, Kemet		Red Banana Jack and Nut
C11	1 nF Chip Capacitor, ATC #100B102JCA500X		Green Banana Jack and Nut
C14	8.2 pF Chip Capacitor, ATC #100B8R2CCA500X		Type N Jack Connectors, 3052-1648-10, Omni Specra
R1	13 Ω , 1/4 W Chip Resistor, Garret Instrument #RM73B2B130JT,		4-40 Head Screws 0.125" Long
R2	12 Ω , 1/4 W Chip Resistor, Garret Instrument #RM73B2B120JT		4-40 Head Screws 0.188" Long
Z1	30.7 x 2.09 mm Microstrip		4-40 Head Screws 0.312" Long
Z2	5.99 x 2.09 mm Microstrip		4-40 Head Screws 0.438" Long
Z3	7.55 x 9.89 mm Microstrip		
Z4	3.77 x 15.71 mm Microstrip		
Z5	6.89 x 26.17 mm Microstrip		
Z6	14.93 x 32.05 mm Microstrip		
		Endplates Brass	Endplates for Copper Bedstead
		Bedstead	Copper Bedstead/Heatsink
		Insert	Copper Bedstead Insert
		Raw PCB	0.030" Glass Teflon [®] , 2 oz Copper Clad
			3" x 5" Arion
		RF Circuit	3" x 5" Copper Clad PCB Teflon [®] , MRF21090, CMR

Figure 1. MRF21090R3(SR3) Test Circuit Schematic

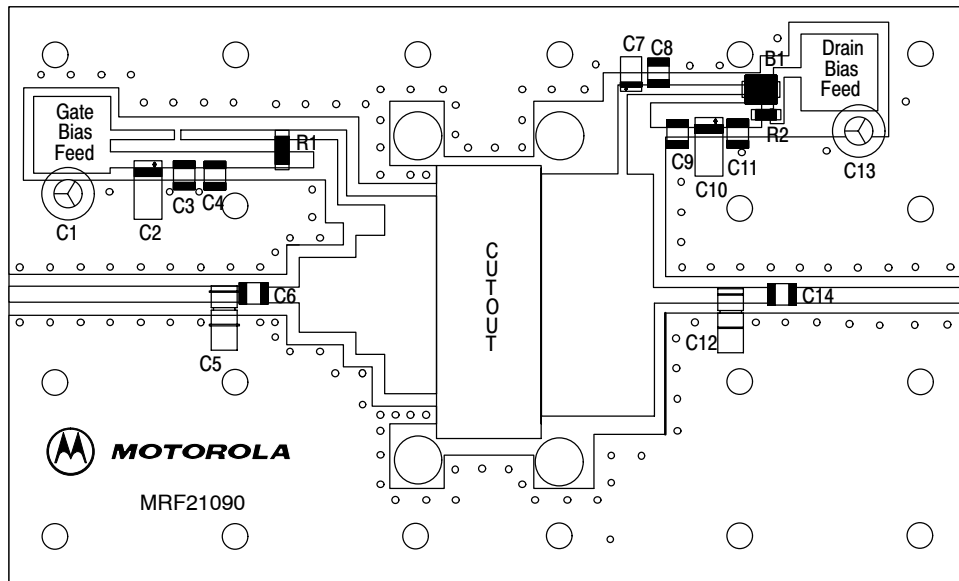


Figure 2. MRF21090R3(SR3) Test Circuit Component Layout

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TYPICAL PERFORMANCE (IN MOTOROLA TEST FIXTURE)

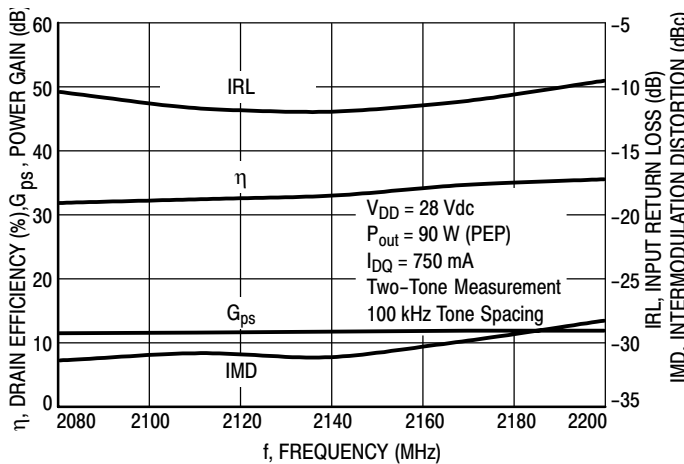


Figure 3. Class AB Broadband Circuit Performance

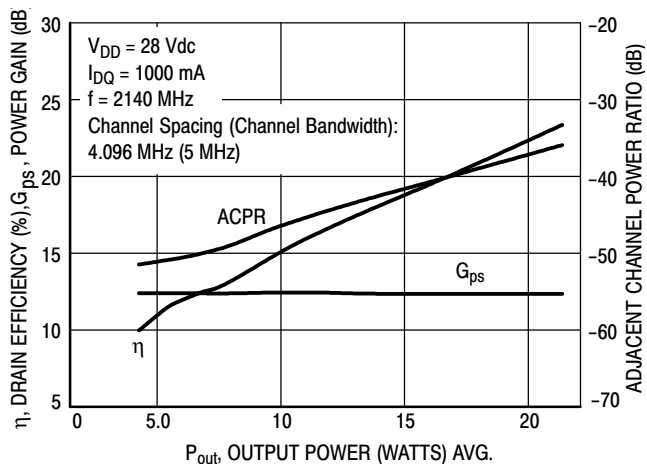


Figure 4. CDMA ACPR, Power Gain and Drain Efficiency versus Output Power

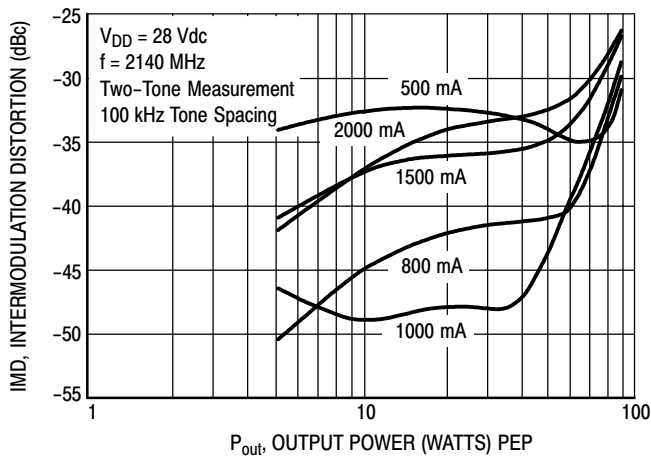


Figure 5. Intermodulation Distortion versus Output Power

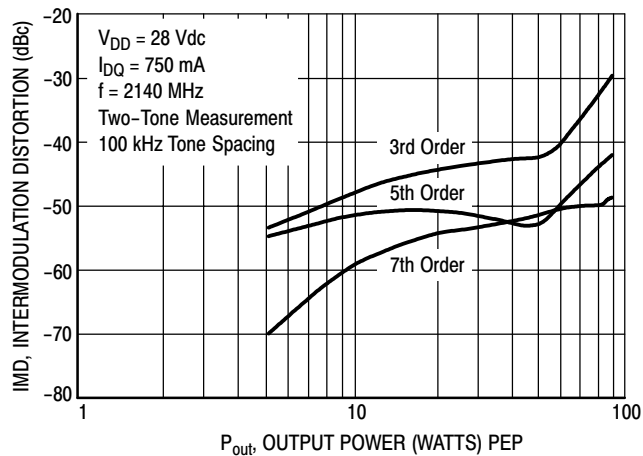


Figure 6. Intermodulation Distortion Products versus Output Power

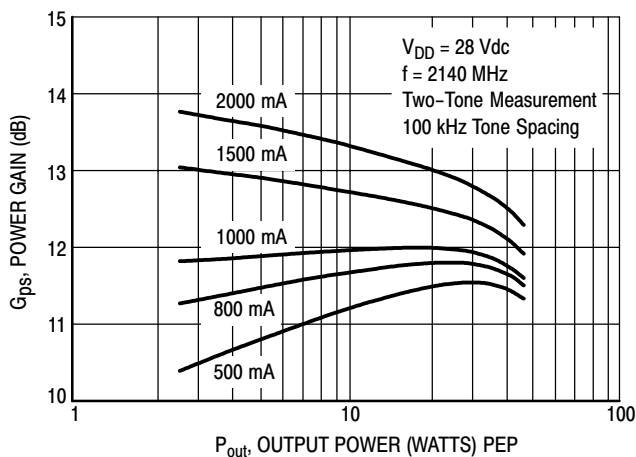


Figure 7. Power Gain versus Output Power

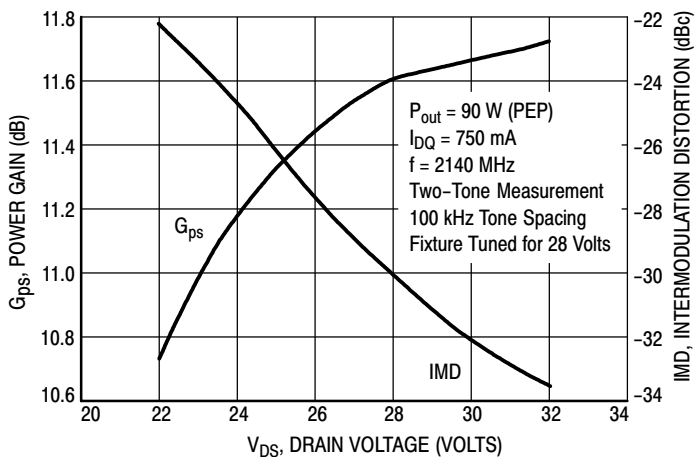
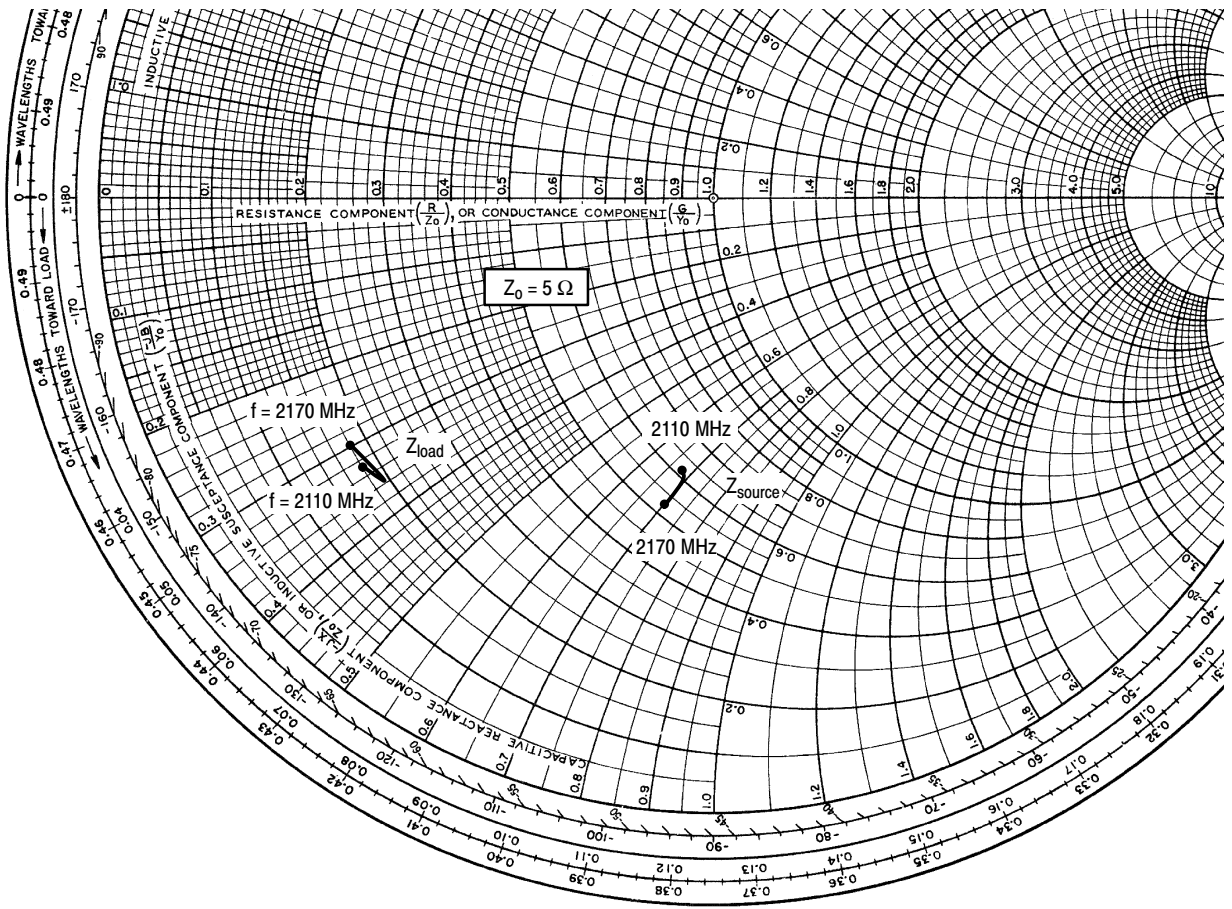


Figure 8. Power Gain and Intermodulation Distortion versus Supply Voltage



$V_{DD} = 28 \text{ V}$, $I_{DQ} = 750 \text{ mA}$, $P_{\text{out}} = 90 \text{ W (PEP)}$

f MHz	Z_{source} Ω	Z_{load} Ω
2110	$3.03 - j3.40$	$0.92 - j1.67$
2140	$3.02 - j3.46$	$0.97 - j1.80$
2170	$2.60 - j3.50$	$0.90 - j1.52$

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

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

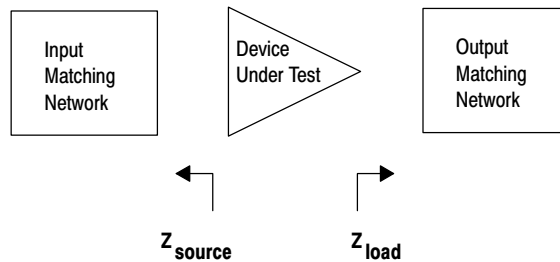


Figure 9. Series Equivalent Source and Load Impedance

NOTES

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PACKAGE DIMENSIONS

2X ∅ Q
 $\oplus \text{ } \ominus \text{ } \text{bbb} \text{ (M)} \text{ T A (M) B (M)}$

NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
- CONTROLLING DIMENSION: INCH.
- DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
- \triangle RECOMMENDED BOLT CENTER DIMENSION OF 1.16 (29.57) BASED ON M3 SCREW.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16
B	0.535	0.545	13.6	13.8
C	0.147	0.200	3.73	5.08
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
G	1.100 BSC		27.94 BSC	
H	0.057	0.067	1.45	1.70
K	0.175	0.205	4.44	5.21
M	0.872	0.888	22.15	22.55
N	0.871	0.889	19.30	22.60
Q	∅.118	∅.138	∅3.00	∅3.51
R	0.515	0.525	13.10	13.30
S	0.515	0.525	13.10	13.30
aaa	0.007 REF		0.178 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

STYLE 1:
 PIN 1. DRAIN
 2. GATE
 3. SOURCE

**CASE 465B-03
 ISSUE C
 NI-880
 MRF21090R3**

NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
- CONTROLLING DIMENSION: INCH.
- DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.905	0.915	22.99	23.24
B	0.535	0.545	13.60	13.80
C	0.147	0.200	3.73	5.08
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
M	0.872	0.888	22.15	22.55
N	0.871	0.889	19.30	22.60
R	0.515	0.525	13.10	13.30
S	0.515	0.525	13.10	13.30
aaa	0.007 REF		0.178 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

STYLE 1:
 PIN 1. DRAIN
 2. GATE
 3. SOURCE

**CASE 465C-02
 ISSUE A
 NI-880S
 MRF21090SR3**

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MRF21090/D