Freescale Semiconductor
Technical Data

Document Number: MRF21090
Rev. 8, 5/2006

RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF21090R3
MRF21090SR3

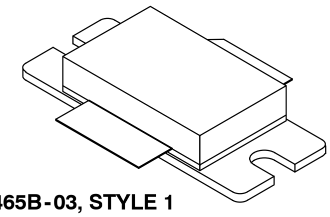
Designed for W-CDMA base station applications with frequencies from 2110 to 2170 MHz. Suitable for FM, TDMA, CDMA and multicarrier amplifier applications.

- 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
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2140 MHz, 90 Watts CW Output Power

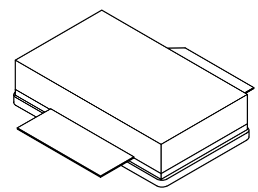
Features

- Internally Matched for Ease of Use
- 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
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

2110-2170 MHz, 90 W, 28 V
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465B-03, STYLE 1
NI-880
MRF21090R3



CASE 465C-02, STYLE 1
NI-880S
MRF21090SR3

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°C Derate above 25°C	P_D	270 1.54	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	$R_{\theta JC}$	0.65	°C/W

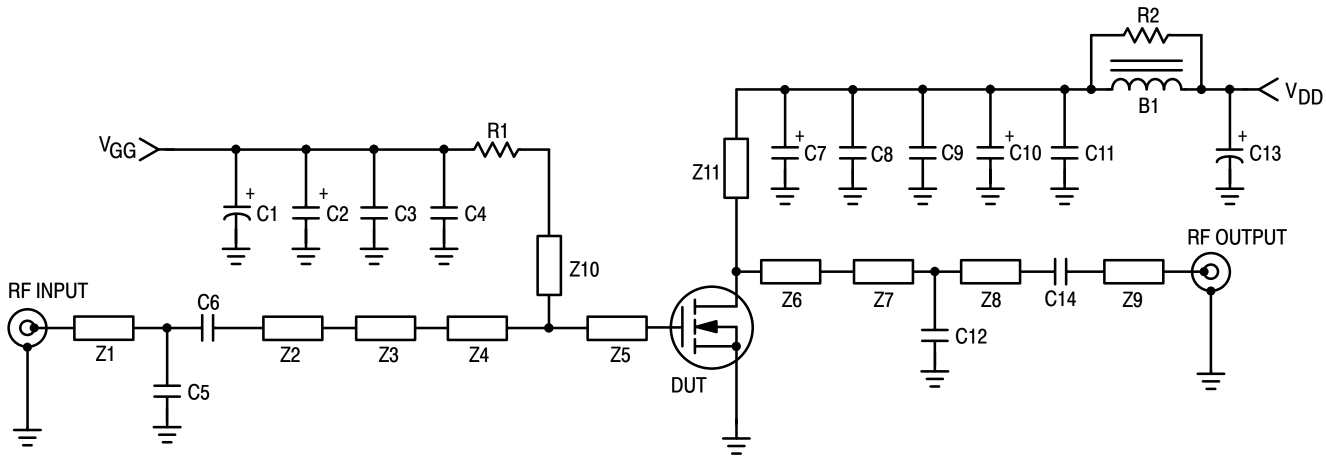
Table 3. ESD Protection Characteristics

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

Table 4. Electrical Characteristics (T_C = 25°C unless otherwise noted)

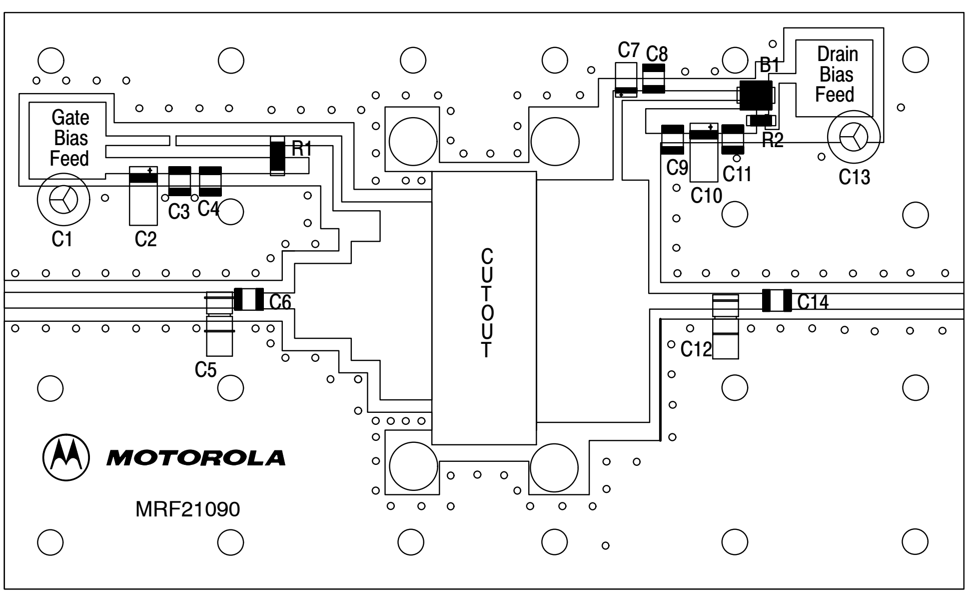
Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Drain-Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 100 μAdc)	$V_{(BR)DSS}$	65	—	—	Vdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 28 Vdc, V_{GS} = 0 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
Functional Tests (In Freescale Test Fixture)					
Common-Source Amplifier Power Gain (V_{DD} = 28 Vdc, P_{out} = 90 W PEP, I_{DQ} = 750 mA, f1 = 2110.0 MHz, f2 = 2110.1 MHz and f1 = 2170.0 MHz, f2 = 2170.1 MHz)	G_{ps}	10	11.7	—	dB
Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 90 W PEP, I_{DQ} = 750 mA, f1 = 2110.0 MHz, f2 = 2110.1 MHz and f1 = 2170.0 MHz, f2 = 2170.1 MHz)	η	30	33	—	%
Intermodulation Distortion (V_{DD} = 28 Vdc, P_{out} = 90 W PEP, I_{DQ} = 750 mA, f1 = 2110.0 MHz, f2 = 2110.1 MHz and f1 = 2170.0 MHz, f2 = 2170.1 MHz)	IMD	—	-30	-27.5	dBc
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 90 W PEP, I_{DQ} = 750 mA, f1 = 2110.0 MHz, f2 = 2110.1 MHz and f1 = 2170.0 MHz, f2 = 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	—	%

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

Figure 1. MRF21090R3(SR3) Test Circuit Schematic



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 2. MRF21090R3(SR3) Test Circuit Component Layout

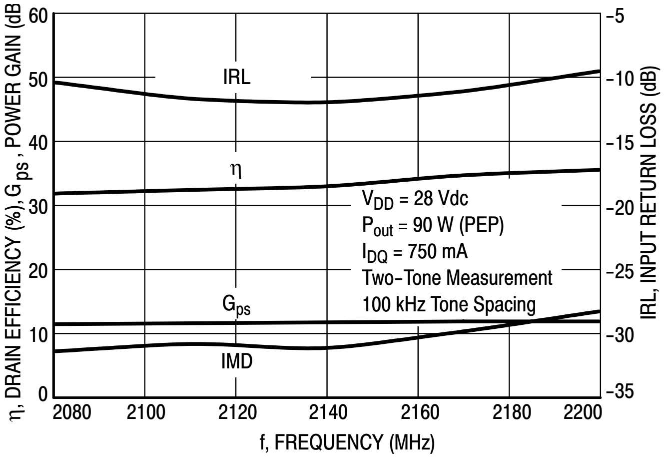


Figure 3. Class AB Broadband Circuit Performance

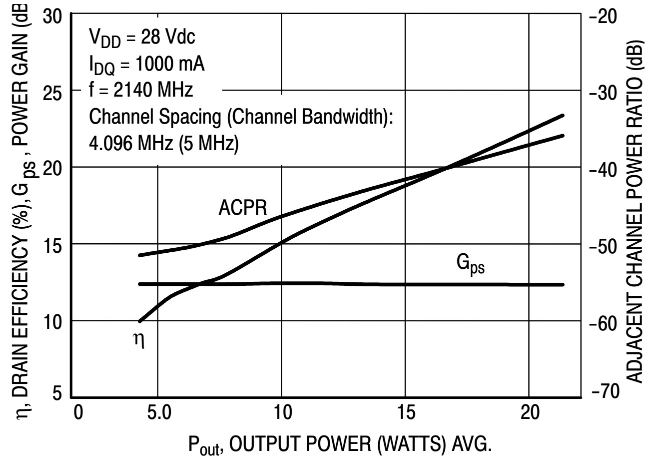


Figure 4. CDMA ACPR, Power Gain and Drain Efficiency versus Output Power

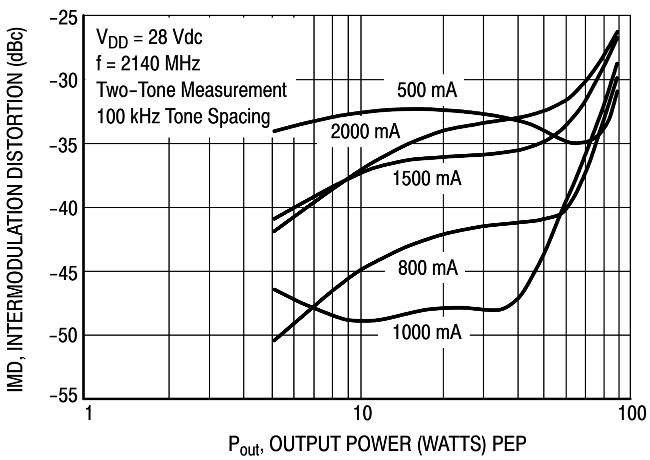


Figure 5. Intermodulation Distortion versus Output Power

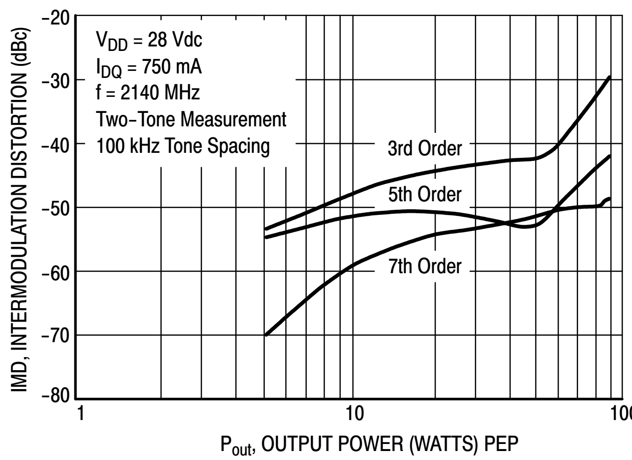


Figure 6. Intermodulation Distortion Products versus Output Power

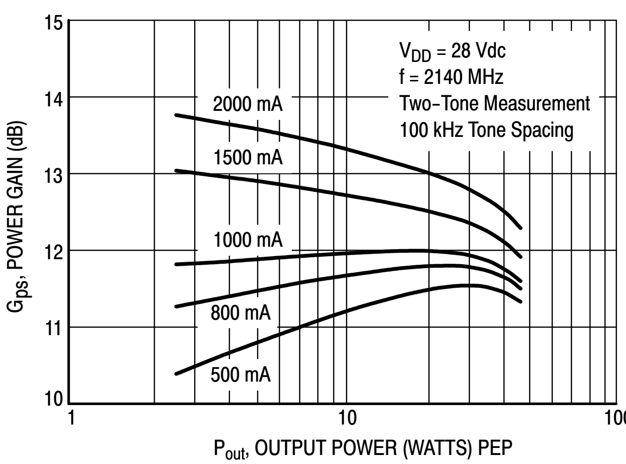


Figure 7. Power Gain versus Output Power

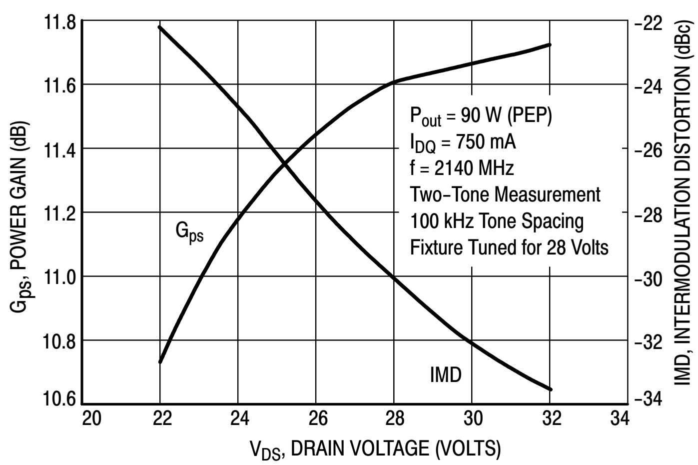
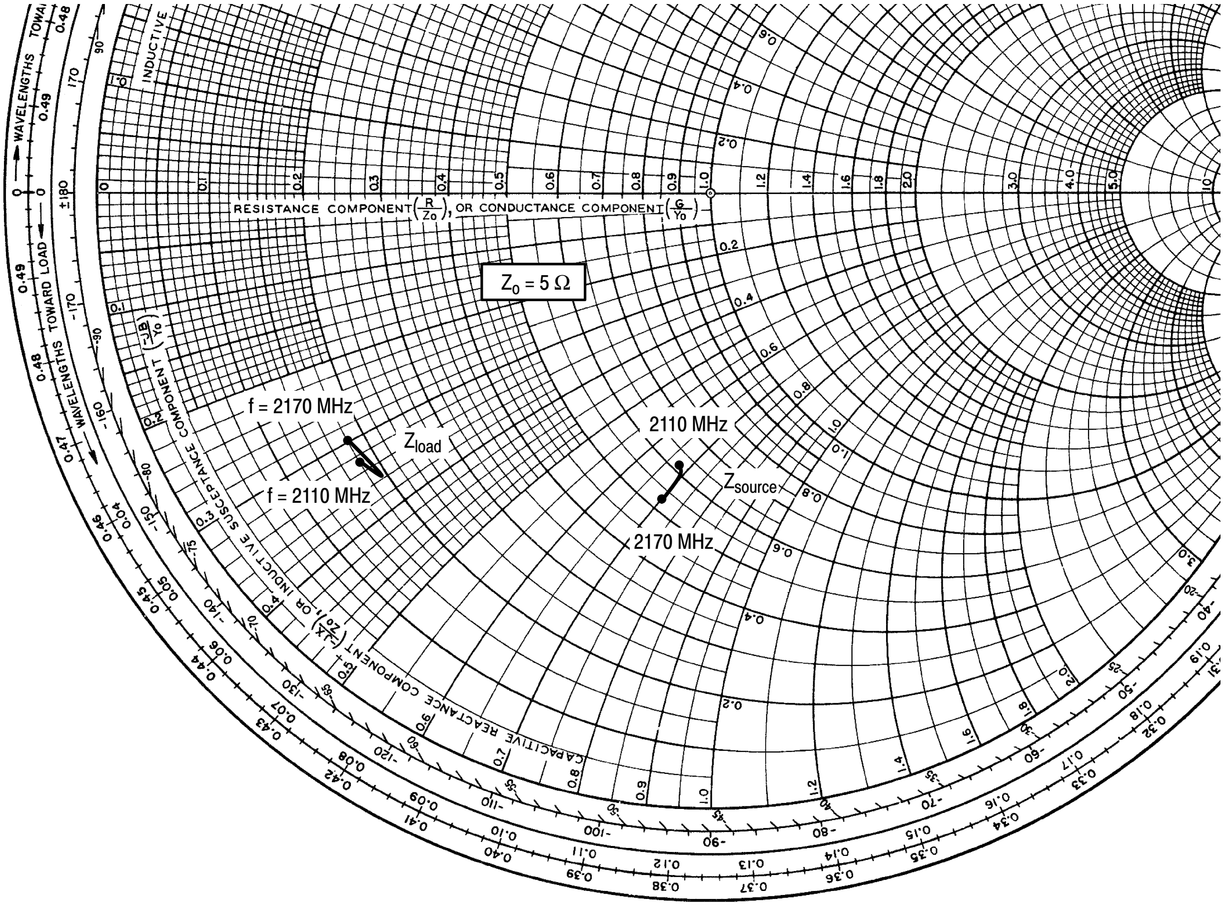


Figure 8. Power Gain and Intermodulation Distortion versus Supply Voltage



V_{DD} = 28 V, I_{DQ} = 750 mA, P_{out} = 90 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.

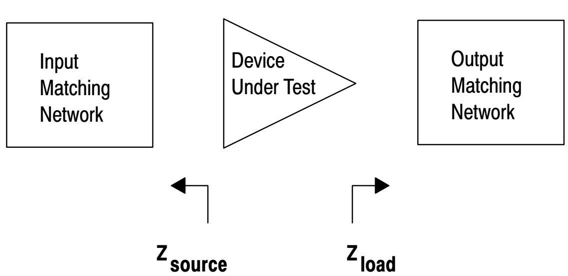
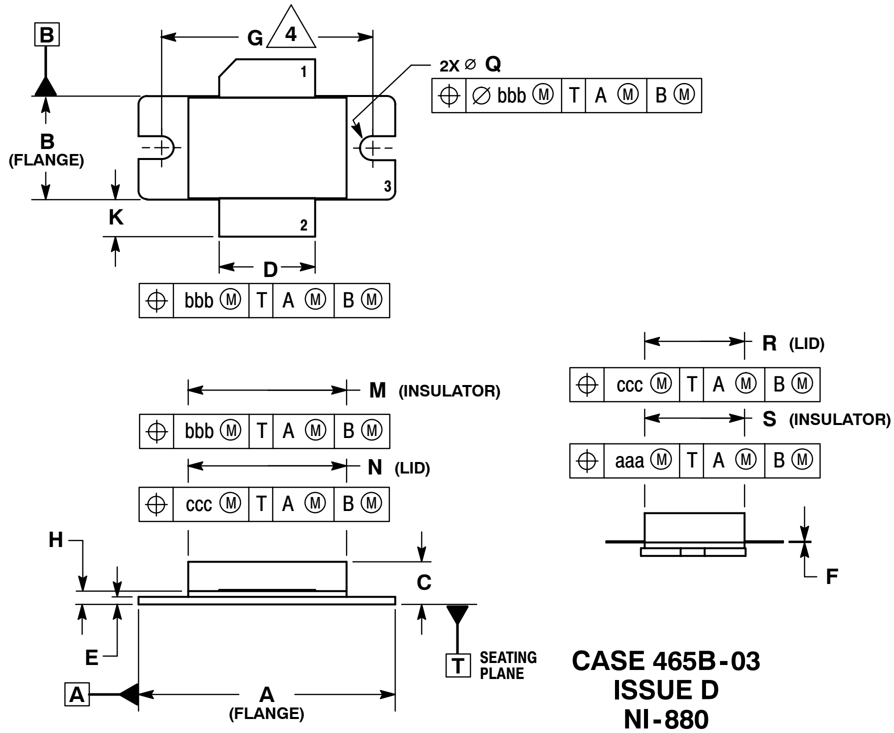


Figure 9. Series Equivalent Source and Load Impedance

NOTES

PACKAGE DIMENSIONS

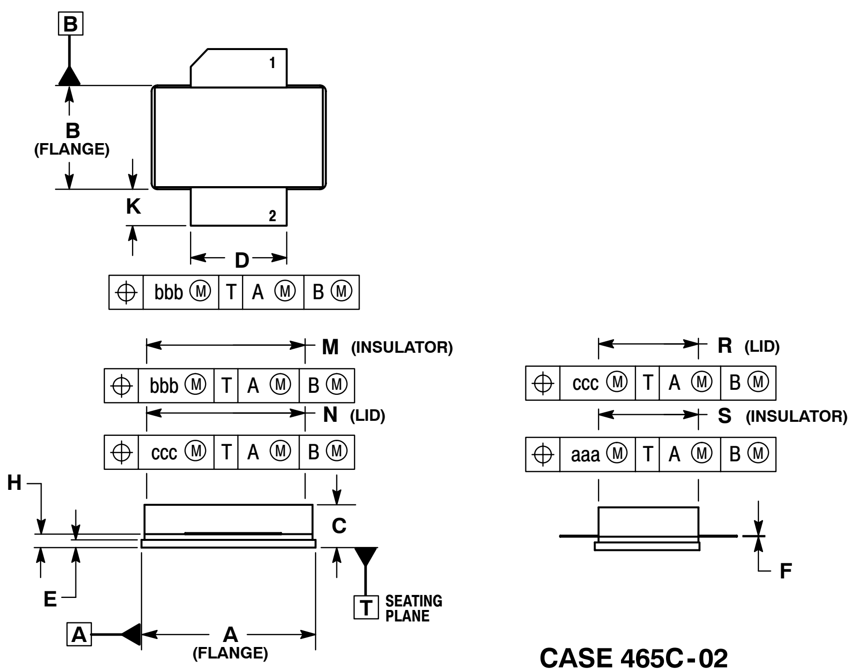


CASE 465B-03
ISSUE D
NI-880
MRF21090R3

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

	INCHES		MILLIMETERS	
DIM	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 465C-02
ISSUE D
NI-880S
MRF21090SR3

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

	INCHES		MILLIMETERS	
DIM	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

How to Reach Us:

Home Page:
www.freescale.com

E-mail:
support@freescale.com

USA/Europe or Locations Not Listed:
Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

Europe, Middle East, and Africa:
Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
support@freescale.com

Japan:
Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:
Freescale Semiconductor Hong Kong Ltd.
Technical Information Center
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