✓RoHS

RF Power Field Effect Transistors
N-Channel Enhancement-Mode Lateral MOSFETs

Designed for PCN and PCS base station applications with frequencies from 1900 to 2000 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications.

- Typical 2-Carrier N-CDMA Performance: V_{DD} = 28 Volts, I_{DQ} = 850 mA, P_{out} = 18 Watts Avg., Full Frequency Band, IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13) Channel Bandwidth = 1.2288 MHz. PAR = 9.8 dB @ 0.01% Probability on CCDF.

  Power Gain — 14.5 dB
  Drain Efficiency — 25.8%
  IM3 @ 2.5 MHz Offset — -37 dBc in 1.2288 MHz Bandwidth
  ACPR @ 885 kHz Offset — -51 dB in 30 kHz Bandwidth

- Capable of Handling 10:1 VSWR, @ 28 Vdc, 1960 MHz, 90 Watts CW Output Power

Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters

- Internally Matched for Ease of Use

- Qualified Up to a Maximum of 32 V_{DD} Operation

- Integrated ESD Protection

- Lower Thermal Resistance Package

- Low Gold Plating Thickness on Leads, 40μ″ Nominal.

- RoHS Compliant

- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

MRF5S19090HR3
MRF5S19090HSR3

1930–1990 MHz, 18 W AVG., 28 V
2 x N-CDMA
LATERAL N-CHANNEL
RF POWER MOSFETs

CASE 465-06, STYLE 1
NI-780
MRF5S19090HR3

CASE 465A-06, STYLE 1
NI-780S
MRF5S19090HSR3

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	266 1.52	W W/°C
Storage Temperature Range	T_{stg}	-65 to +200	°C
Case Operating Temperature	T_C	150	°C
Operating Junction Temperature	T_J	200	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value [1,2]	Unit

Thermal Resistance, Junction to Case
    Case Temperature 80°C, 65 W CW
    Case Temperature 78°C, 18 W CW
	$R_{\theta JC}$	
		0.66
		0.68
			°C/W

1. MTTF calculator available at http://www.freescale.com/rf. Select Tools/Software/Application Software/Calculators to access the MTTF calculators by product.

2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

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Table 3. ESD Protection Characteristics

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M3 (Minimum)
Charge Device Model	C7 (Minimum)

Table 4. 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} = 65 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 28 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 (DC)					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 200 μAdc)	$V_{GS(th)}$	2.5	2.7	3.5	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 850 mAdc)	$V_{GS(Q)}$	—	3.7	—	Vdc
Drain–Source On-Voltage (V_{GS} = 10 Vdc, I_D = 2 Adc)	$V_{DS(on)}$	—	0.26	—	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 2 Adc)	g_{fs}	—	5	—	S
Dynamic Characteristics [1]					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	1.7	—	pF

Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 850 mA, P_{out} = 18 W Avg., f1 = 1930 MHz, f2 = 1932.5 MHz and f1 = 1987.5 MHz, f2 =1990 MHz,2-Carrier N–CDMA, 1.2288 MHz Channel Bandwidth Carriers. ACPR measured in 30 kHz Channel Bandwidth @ ±885 kHz Offset. IM3 measured in 1.2288 MHz Channel Bandwidth @ ±2.5 MHz Offset. PAR = 9.8 dB @ 0.01% Probability on CCDF.

Power Gain	G_{ps}	13.5	14.5	—	dB
Drain Efficiency	η_D	24	25.8	—	%
Intermodulation Distortion	IM3	—	–37	–35	dBc
Adjacent Channel Power Ratio	ACPR	—	–51	–48	dBc
Input Return Loss	IRL	—	–14.5	–9	dB

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

Figure 1. MRF5S19090HR3(HSR3) Test Circuit Schematic
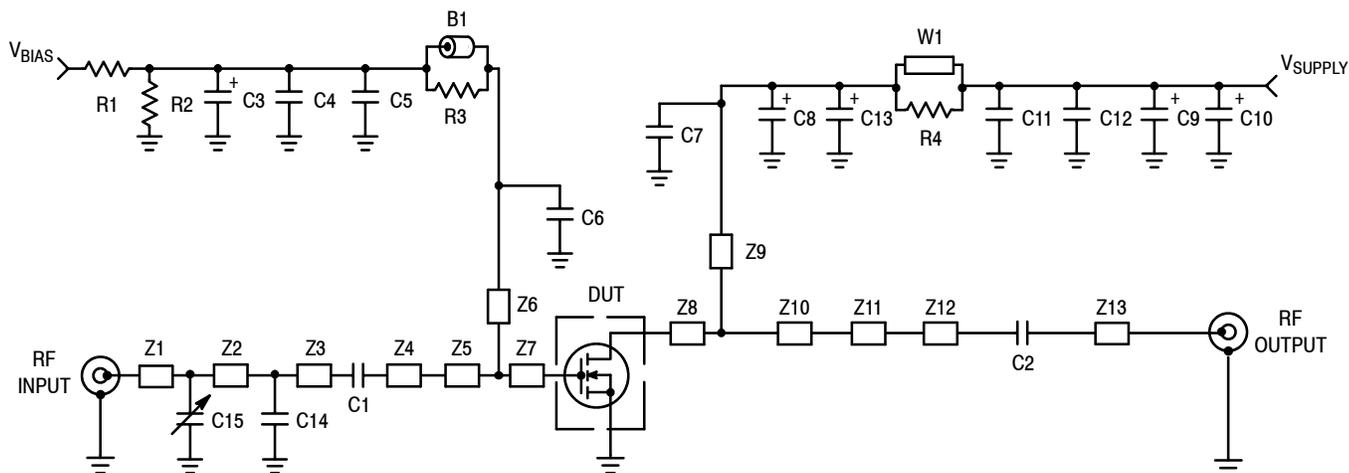
Z1	0.140″ x 0.080″ Microstrip	Z8	0.091″ x 1.133″ Microstrip
Z2	0.450″ x 0.080″ Microstrip	Z9	0.542″ x 0.071″ Microstrip
Z3	0.140″ x 0.080″ Microstrip	Z10	0.450″ x 1.133″ Microstrip
Z4	0.525″ x 0.080″ Microstrip	Z11	0.640″ x 0.141″ Microstrip
Z5	0.636″ x 0.141″ Microstrip	Z12	0.316″ x 0.080″ Microstrip
Z6	0.340″ x 0.050″ Microstrip	Z13	1.209″ x 0.080″ Microstrip
Z7	0.320″ x 1.401″ Microstrip	PCB	Arlon GX-0300-55-22, 0.030″, ε_r = 2.55

Table 5. MRF5S19090HR3(HSR3) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1	Short RF Bead	95F786	Newark
C1	22 pF Chip Capacitor	100B220CP 500X	ATC
C2	10 pF Chip Capacitor	100B100CP 500X	ATC
C3, C13	1 μF, 50 V SMT Tantalum Capacitors	T494C105(1)050AS	Kemet
C4, C12	0.1 μF Chip Capacitors	CDR33BX104AKWS	Kemet
C5, C11	1k pF Chip Capacitors	100B102JP 500X	ATC
C6, C7	4.3 pF Chip Capacitors	100B4R3JP 500X	ATC
C8	10 μF, 35 V SMT Tantalum Capacitor	T494D106(1)035AS	Kemet
C9, C10	22 μF, 35 V SMT Tantalum Capacitors	T494X226(1)035AS	Kemet
C14	2.7 pF Chip Capacitor	100B2.7BP 500X	ATC
C15	0.6 − 4.5 Gigatrim Variable Capacitor	44F3358	Newark
R1	1 kΩ Chip Resistor	D5534M07B1K00R	Newark
R2	560 kΩ Chip Resistor	CR1206 564JT	Newark
R3, R4	12 Ω Chip Resistors	RM73B2B120JT	Garrett Electronics
W1	1 turn 14 gauge wire		
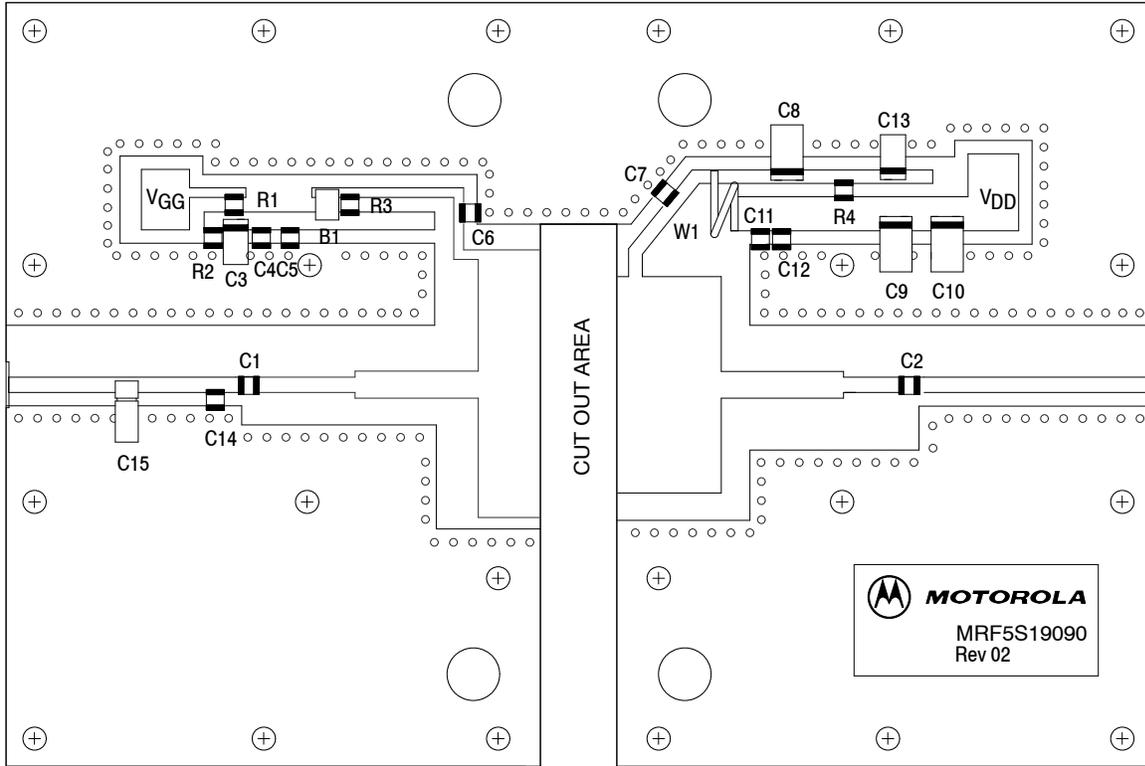
Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 2. MRF5S19090HR3(HSR3) Test Circuit Component Layout

MRF5S19090HR3 MRF5S19090HSR3

RF Device Data
Freescale Semiconductor

TYPICAL CHARACTERISTICS
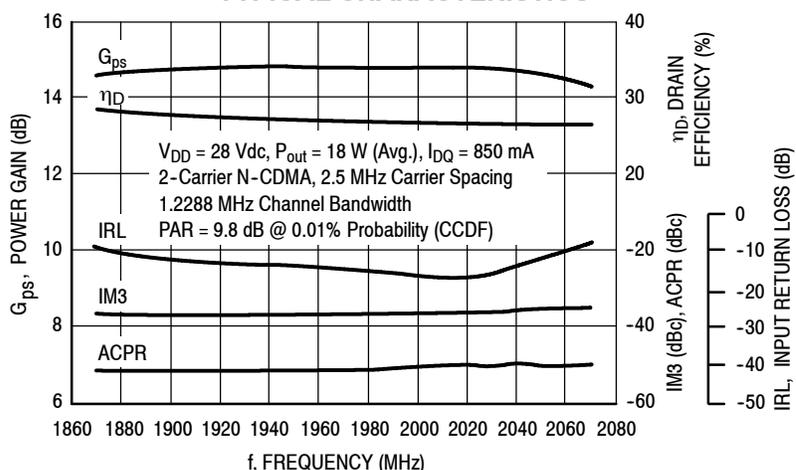
Figure 3. 2-Carrier N-CDMA Broadband Performance
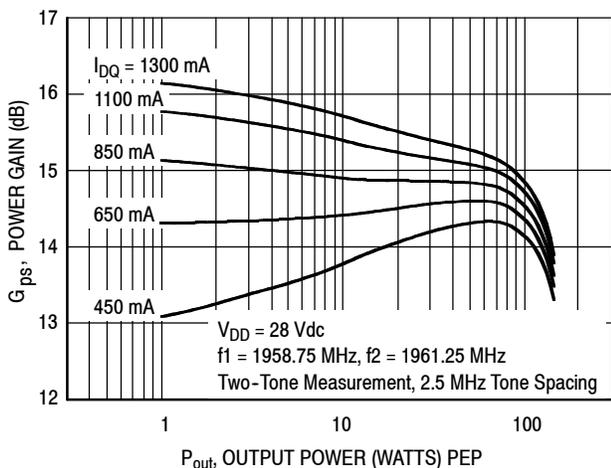
Figure 4. Two-Tone Power Gain versus
Output Power
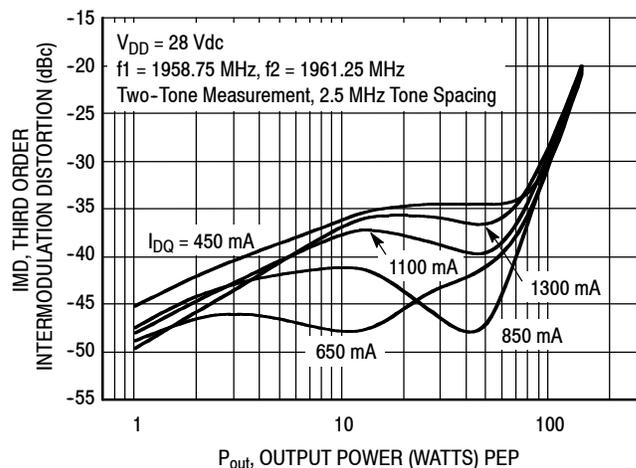
Figure 5. Third Order Intermodulation Distortion
versus Output Power
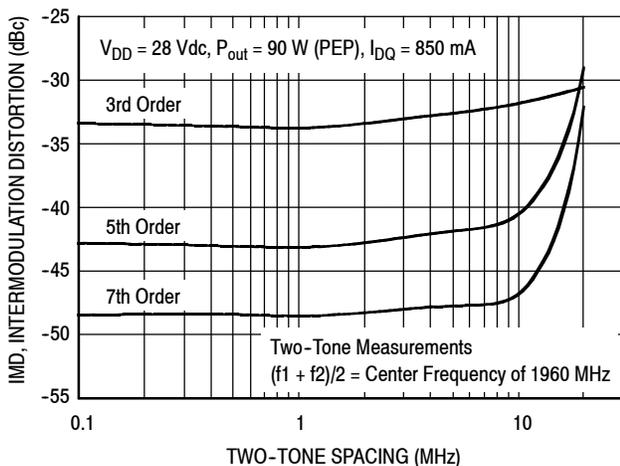
Figure 6. Intermodulation Distortion Products
versus Tone Spacing
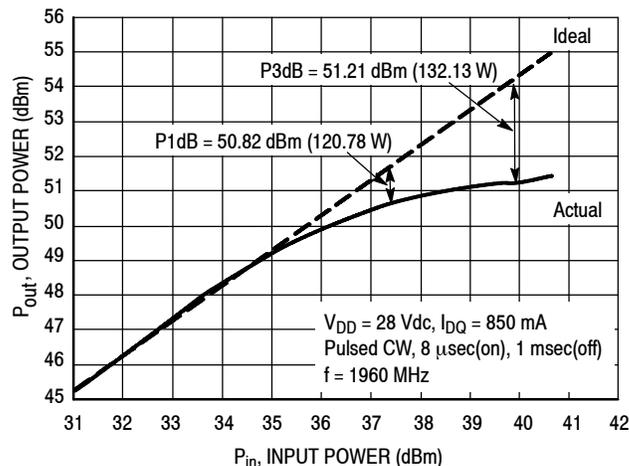
Figure 7. Pulse CW Output Power versus
Input Power

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TYPICAL CHARACTERISTICS
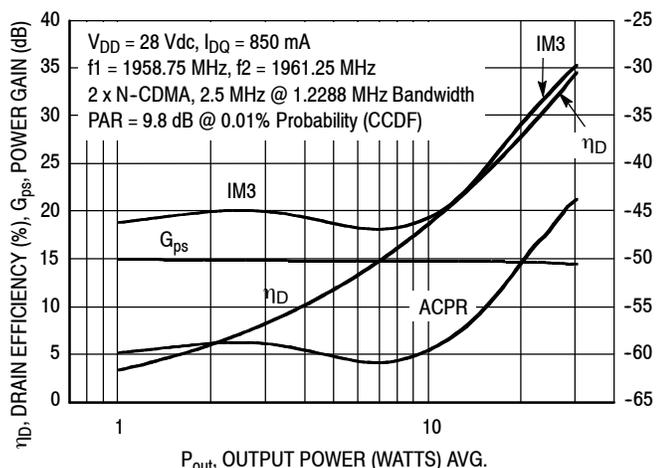
Figure 8. 2-Carrier N-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power
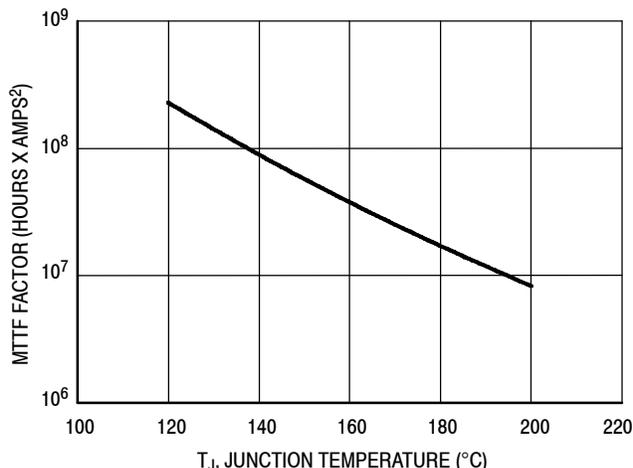
This above graph displays calculated MTTF in hours x ampere^2 drain current. Life tests at elevated temperatures have correlated to better than ±10% of the theoretical prediction for metal failure. Divide MTTF factor by I_D^2 for MTBF in a particular application.

Figure 9. MTTF Factor versus Junction Temperature

N-CDMA TEST SIGNAL

IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13) 1.2288 MHz Channel Bandwidth Carriers. ACPR Measured in 30 kHz Bandwidth @ ±885 kHz Offset. IM3 Measured in 1.2288 MHz Bandwidth @ ±2.5 MHz Offset. PAR = 9.8 dB @ 0.01% Probability on CCDF.
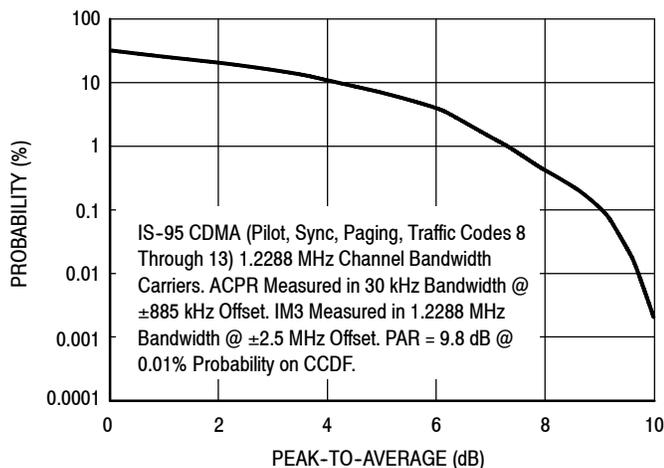
Figure 10. 2-Carrier CCDF N-CDMA
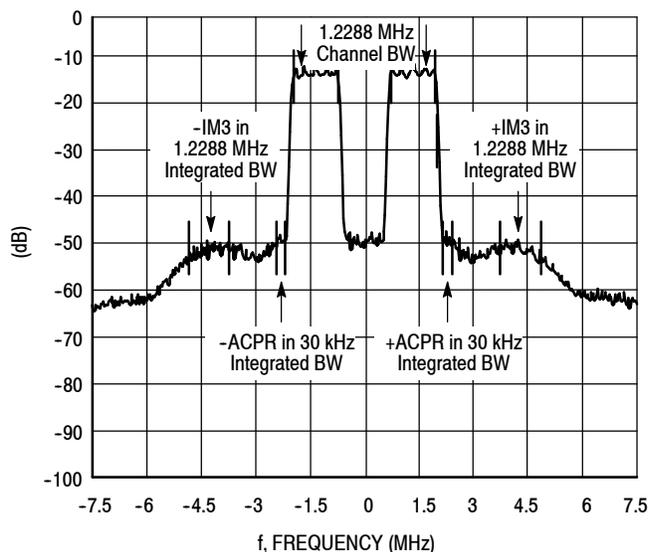
Figure 11. 2-Carrier N-CDMA Spectrum

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Smith chart with the following labels:
- $Z_0 = 10 \ \Omega$
- f = 1990 MHz (upper region, near Z_{load})
- Z_{load}
- f = 1930 MHz
- f = 1990 MHz (lower region, near Z_{source})
- Z_{source}
- f = 1930 MHz
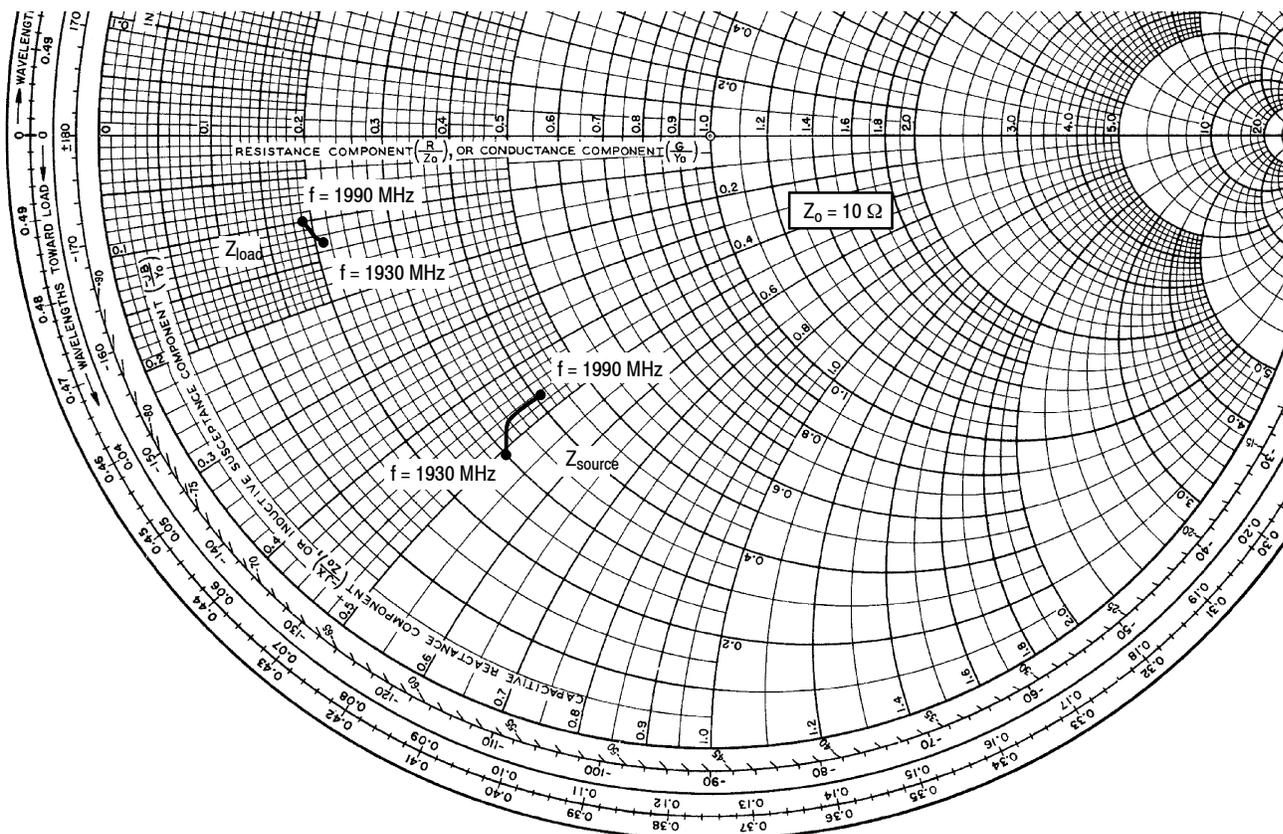
$V_{DD} = 28$ V, $I_{DQ} = 850$ mA, $P_{out} = 18$ W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
1930	2.98 – j5.12	2.07 – j1.31
1960	3.36 – j4.65	2.02 – j1.18
1990	4.06 – j4.64	1.93 – j1.01

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

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

Block diagram: Input Matching Network → Device Under Test → Output Matching Network, with Z_{source} and Z_{load} labeled.
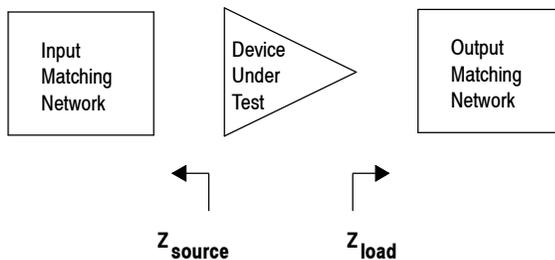
Figure 12. Series Equivalent Source and Load Impedance

NOTES

NOTES

MRF5S19090HR3 MRF5S19090HSR3

NOTES

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RF Device Data
Freescale Semiconductor

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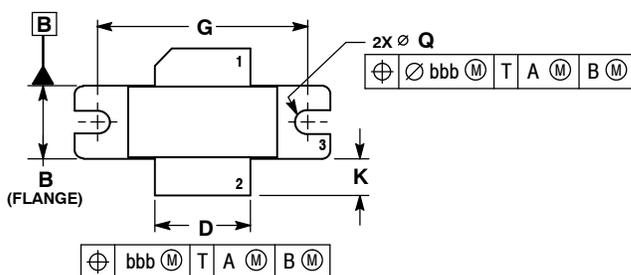
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
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	0.170	0.210	4.32	5.33
M	0.774	0.786	19.66	19.96
N	0.772	0.788	19.60	20.00
Q	Ø.118	Ø.138	Ø3.00	Ø3.51
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	
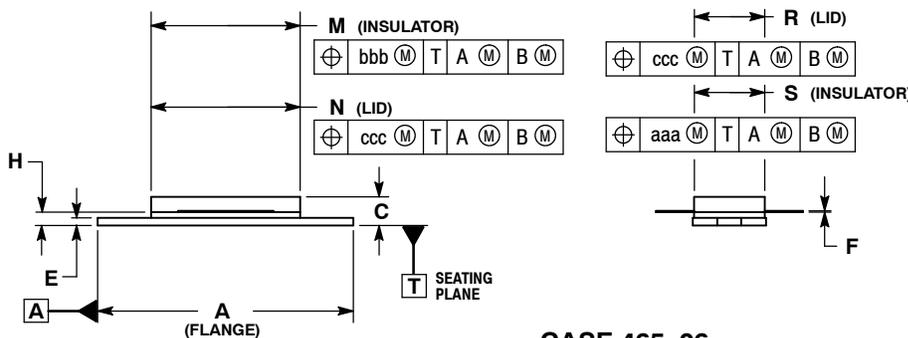
STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE

CASE 465-06
ISSUE G
NI-780
MRF5S19090HR3
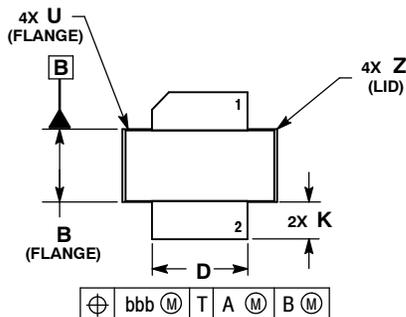
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3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.805	0.815	20.45	20.70
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
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	0.774	0.786	19.61	20.02
N	0.772	0.788	19.61	20.02
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
U	---	0.040	---	1.02
Z	---	0.030	---	0.76
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	
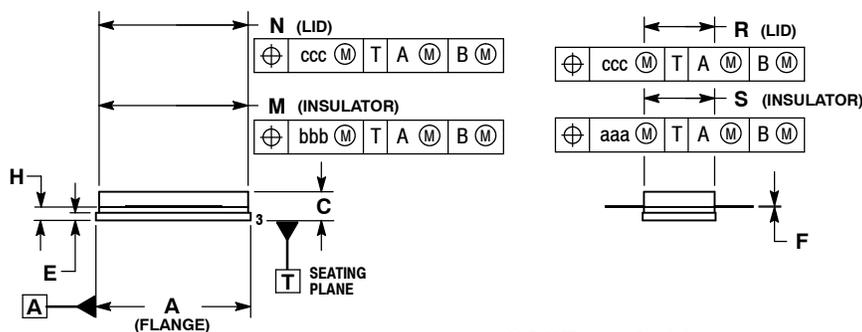
STYLE 1:
PIN 1. DRAIN
2. GATE
5. SOURCE

CASE 465A-06
ISSUE H
NI-780S
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MRF5S19090HR3 MRF5S19090HSR3

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