MRF5S21090LR3 and MRF5S21090LSR3 replaced by MRF5S21090HR3 and MRF5S21090HSR3. "H" suffix indicates lower thermal resistance package.

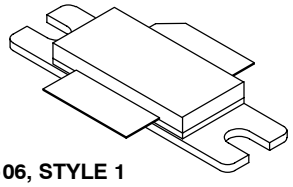
MRF5S21090LR3
MRF5S21090LSR3

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

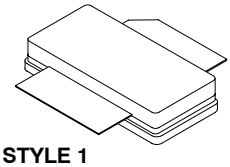
2170 MHz, 19 W AVG.,
2 x W-CDMA, 28 V
LATERAL N-CHANNEL
RF POWER MOSFETs

Designed for W-CDMA base station applications with frequencies from 2110 to 2170 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications.

- Typical 2-carrier W-CDMA Performance for V_{DD} = 28 Volts, I_{DQ} = 850 mA, f1 = 2135 MHz, f2 = 2145 MHz, Channel Bandwidth = 3.84 MHz, Adjacent Channels Measured over 3.84 MHz BW @ f1 -5 MHz and f2 +5 MHz, Distortion Products Measured over a 3.84 MHz BW @ f1 -10 MHz and f2 +10 MHz, Peak/Avg. = 8.5 dB @ 0.01% Probability on CCDF.
  Output Power — 19 Watts Avg.
  Power Gain — 14.5 dB
  Efficiency — 26%
  IM3 — -37.5 dBc
  ACPR — -40.5 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, 2140 MHz, 90 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Qualified Up to a Maximum of 32 V_{DD} Operation
- Available with Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ″ Nominal.
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.



CASE 465-06, STYLE 1
NI-780
MRF5S21090LR3



CASE 465A-06, STYLE 1
NI-780S
MRF5S21090LSR3

ARCHIVE INFORMATION

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	65	Vdc
Gate-Source Voltage	V_{GS}	-0.5, +15	Vdc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	224 1.28	Watts W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C
Operating Junction Temperature	T_J	200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 90 W CW Case Temperature 80°C, 19 W CW	$R_{\theta JC}$	 0.78 0.80	°C/W

(1) MTTF calculator available at http://www.motorola.com/semiconductors/rf. Select Tools/Software/Application Software/Calculators to access the MTTF calculators by product.
(2) Refer to AN1955/D, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.motorola.com/semiconductors/rf. Select Documentation/Application Notes - AN1955.

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

ESD PROTECTION CHARACTERISTICS

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

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	2.9	3.5	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 850 mAdc)	$V_{GS(Q)}$	—	3.9	—	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 2 Adc)	$V_{DS(on)}$	—	0.25	—	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 Motorola Test Fixture, 50 ohm system) 2-carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers, ACPR and IM3 measured in 3.84 MHz Bandwidth. Peak/Avg. = 8.5 dB @ 0.01% Probability on CCDF.					
Common-Source Amplifier Power Gain (V_{DD} = 28 Vdc, P_{out} = 19 W Avg., I_{DQ} = 850 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	G_{ps}	12.5	14.5	—	dB
Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 19 W Avg., I_{DQ} = 850 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	η	24	26	—	%
3rd Order Intermodulation Distortion (V_{DD} = 28 Vdc, P_{out} = 19 W Avg., I_{DQ} = 850 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz; IM3 measured over 3.84 MHz BW at f1 -10 MHz and f2 +10 MHz referenced to carrier channel power.)	IM3	—	-37.5	-35	dBc
Adjacent Channel Power Ratio (V_{DD} = 28 Vdc, P_{out} = 19 W Avg., I_{DQ} = 850 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz; ACPR measured over 3.84 MHz at f1 -5 MHz and f2 +5 MHz.)	ACPR	—	-40.5	-38	dBc
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 19 W Avg., I_{DQ} = 850 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	IRL	—	-15	-9	dB

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

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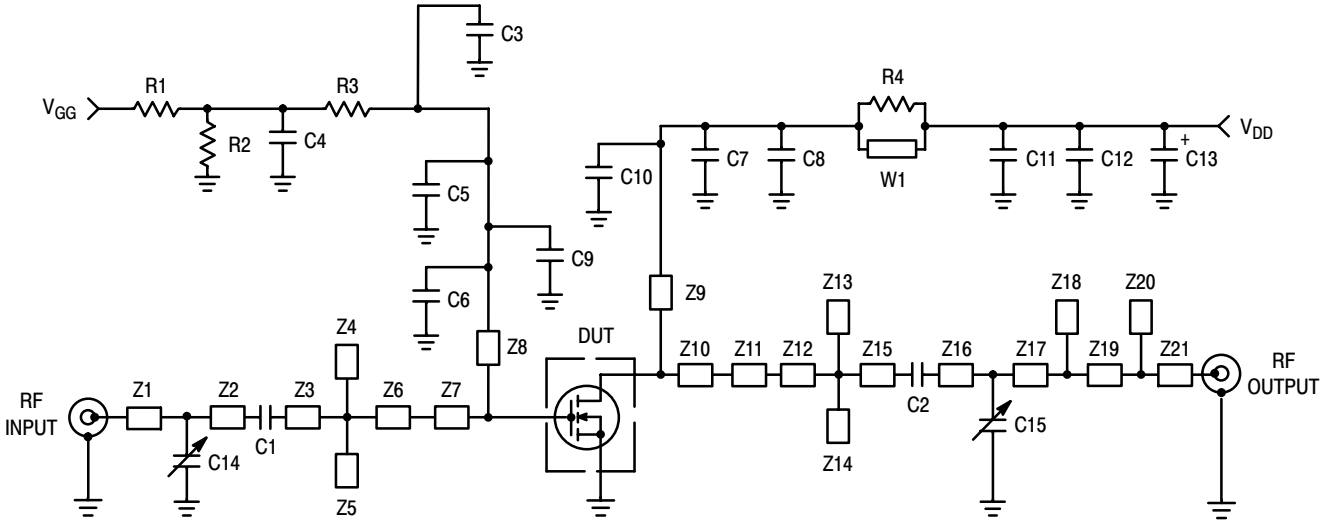

Z1	1.0856″ x 0.080″ Microstrip	Z12	0.609″ x 0.220″ Microstrip
Z2	0.130″ x 0.080″ Microstrip	Z13	0.290″ x 0.106″ Microstrip
Z3	0.230″ x 0.080″ Microstrip	Z14	0.290″ x 0.106″ Microstrip
Z4	0.347″ x 0.208″ Microstrip	Z15	0.080″ x 0.025″ Microstrip
Z5	0.090″ x 0.208″ Microstrip	Z16	1.080″ x 0.160″ Microstrip
Z6	0.650″ x 0.176″ Taper	Z17	0.180″ x 0.080″ Microstrip
Z7	0.623″ x 0.610″ Microstrip	Z18	0.260″ x 0.147″ Microstrip
Z8	0.044″ x 0.881″ Microstrip	Z19	0.500″ x 0.080″ Microstrip
Z9	0.044″ x 0.869″ Microstrip	Z20	0.199″ x 0.147″ Microstrip
Z10	1.076″ x 0.446″ Microstrip	Z21	0.365″ x 0.080″ Microstrip
Z11	0.320″ x 0.393″ Microstrip	PCB	Arlon GX0300-55-22, 0.03″, ε_r = 2.55

Figure 1. MRF5S21090 Test Circuit Schematic

Table 1. MRF5S21090 Test Circuit Component Designations and Values

Part	Description	Value, P/N or DWG	Manufacturer
C1	9.1 pF Chip Capacitor, B Case	100B9R1CP 500X	ATC
C2	8.2 pF Chip Capacitor, B Case	100B8R2CP 500X	ATC
C3	2.0 pF Chip Capacitor, B Case	100B2R0BP 500X	ATC
C4, C12	0.1 μF Chip Capacitors, B Case	CDR33BX104AKWS	Kemet
C5	5.6 pF Chip Capacitor, B Case	100B5R6CP 500X	ATC
C6	5.1 pF Chip Capacitor, B Case	100B5R1CP 500X	ATC
C7	7.5 pF Chip Capacitor, B Case	100B7R5JP 500X	ATC
C8	1.2 pF Chip Capacitor, B Case	100B1R2BP 500X	ATC
C9, C10	0.56 μF Chip Capacitors, B Case	700A561MP 150X	ATC
C11	1000 pF Chip Capacitor, B Case	100B102JP 500X	ATC
C13	470 μF, 35 V Electrolytic Capacitor	95F4579	Newark
C14, C15	0.4 – 2.5 Variable Capacitors, Gigatrim	44F3367	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	Wire Strap		

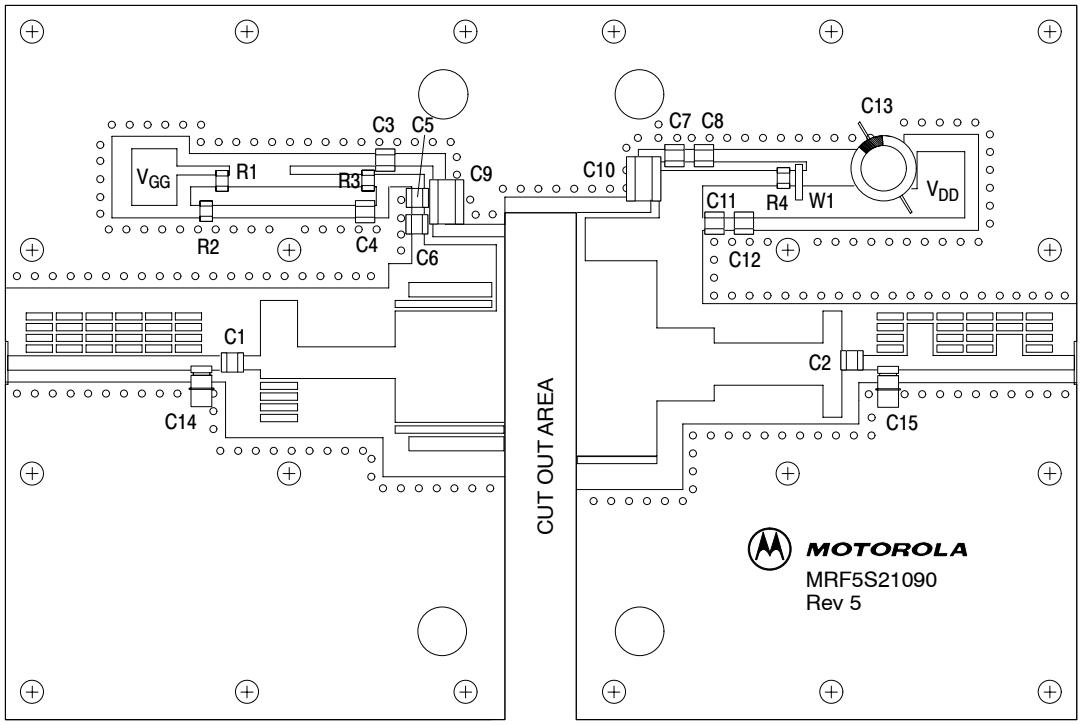

Figure 2. MRF5S21090 Test Circuit Component Layout

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TYPICAL CHARACTERISTICS

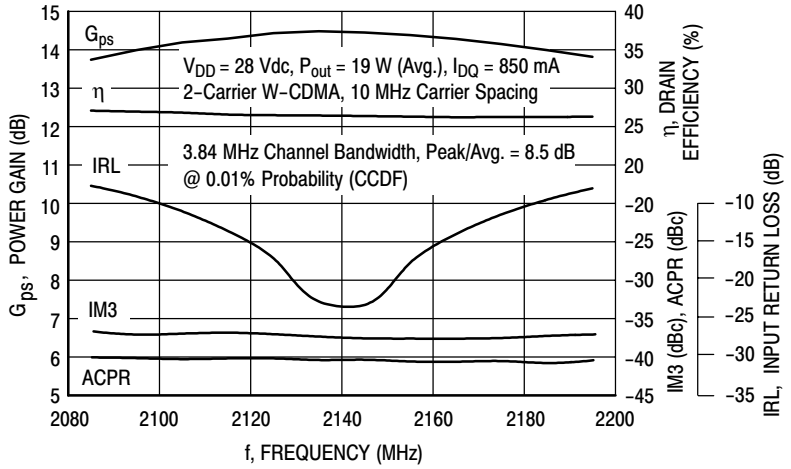


Figure 3. 2-Carrier W-CDMA Broadband Performance

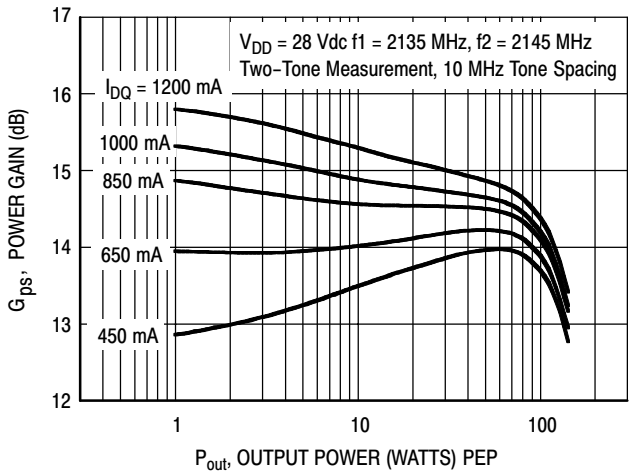


Figure 4. Two-Tone Power Gain versus Output Power

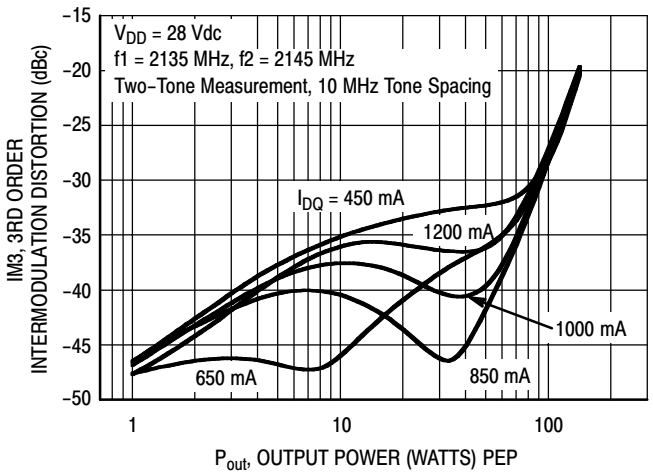


Figure 5. 3rd Order Intermodulation Distortion versus Output Power

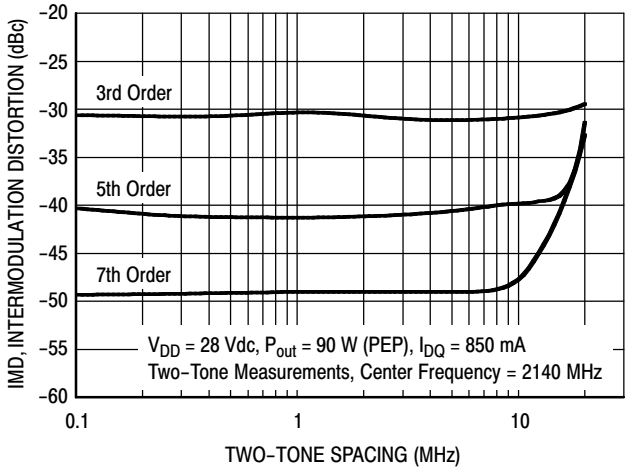


Figure 6. Intermodulation Distortion Products versus Tone Spacing

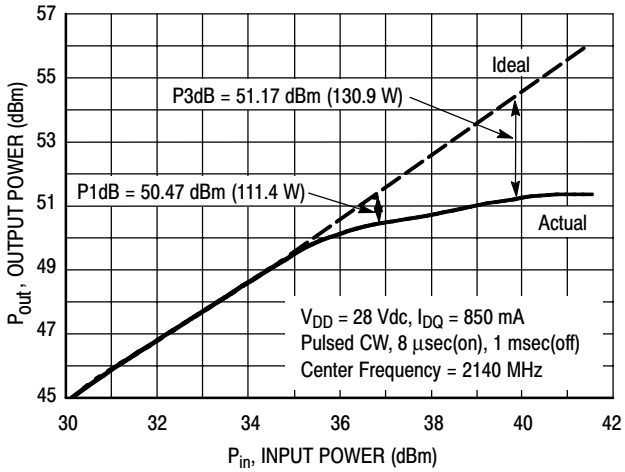


Figure 7. Pulse CW Output Power versus Input Power

TYPICAL CHARACTERISTICS

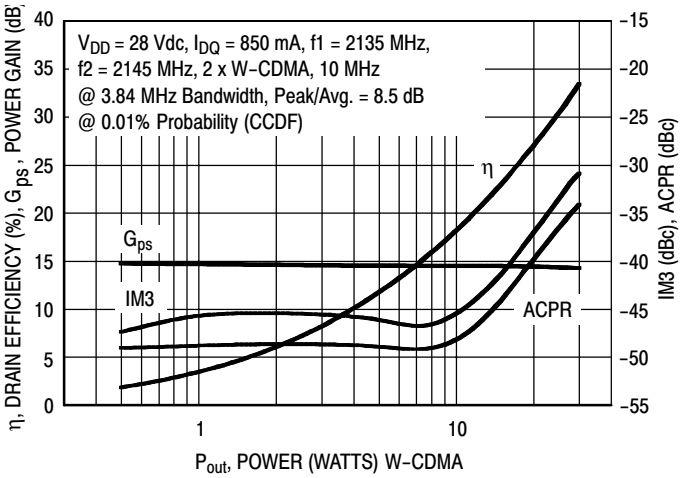


Figure 8. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

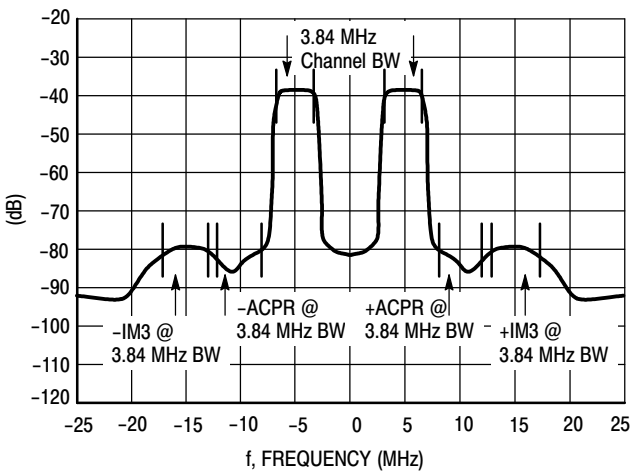


Figure 9. 2-Carrier W-CDMA Spectrum

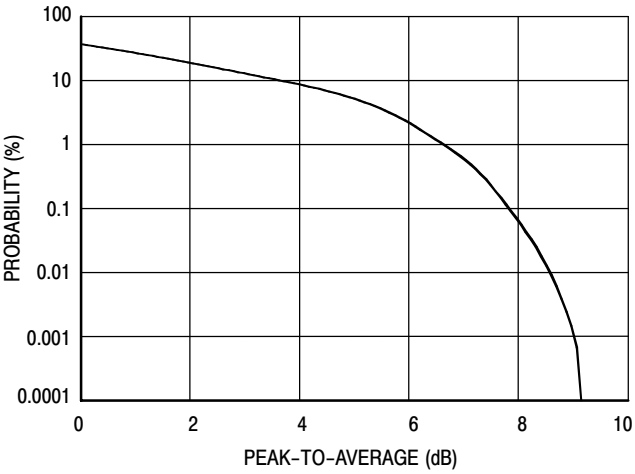
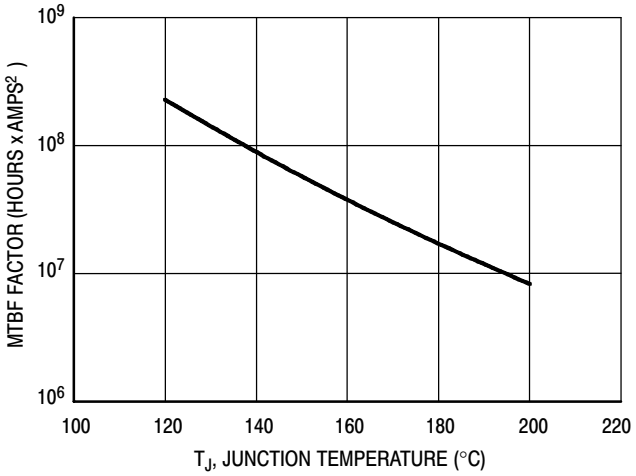


Figure 10. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single Carrier Test Signal



This above graph displays calculated MTBF 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 MTBF factor by I_D^2 for MTBF in a particular application.

Figure 11. MTBF Factor versus Junction Temperature

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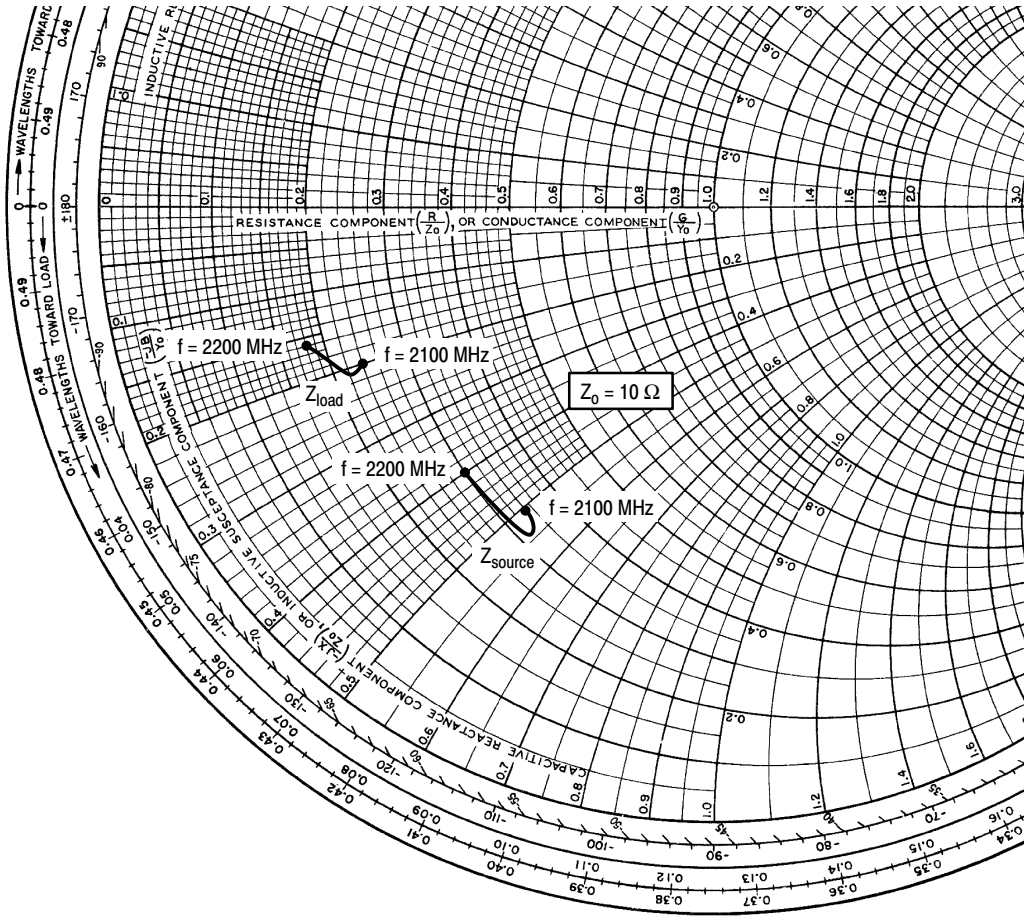

V_{DD} = 28 Vdc, I_{DQ} = 850 mA, P_{out} = 19 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2100	3.4 - j5.1	2.4 - j2.0
2120	3.2 - j5.4	2.2 - j2.1
2160	3.0 - j4.4	2.1 - j1.9
2200	3.0 - j4.0	1.8 - j1.6

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

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

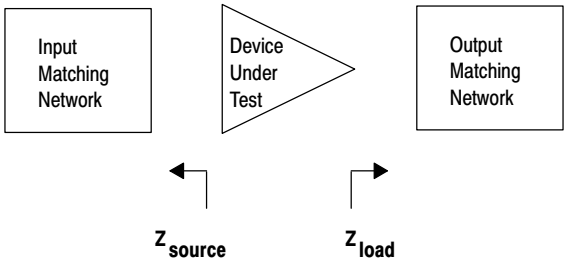

Figure 12. Series Equivalent Input and Output Impedance

NOTES

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NOTES

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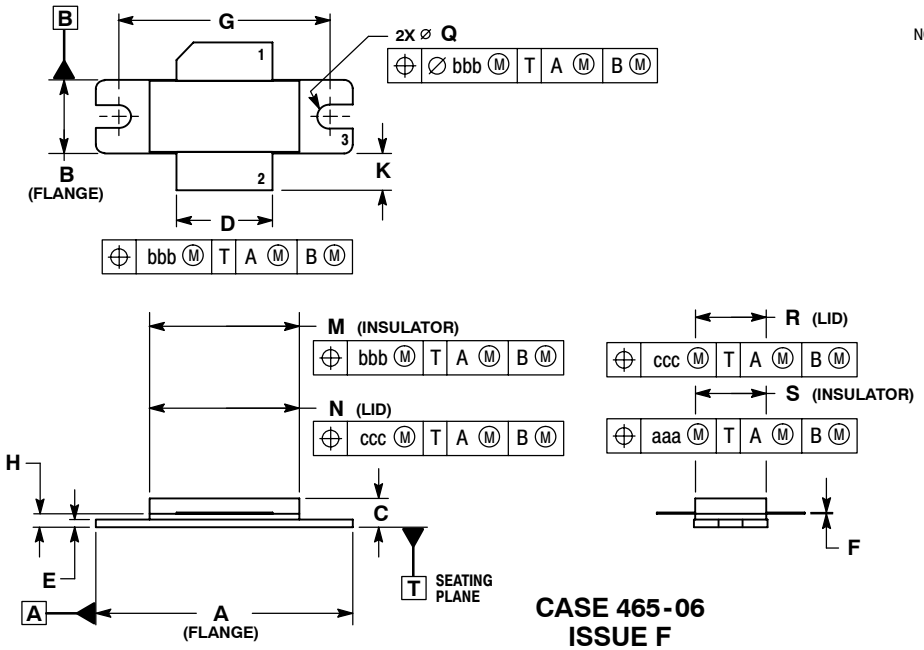
PACKAGE DIMENSIONS

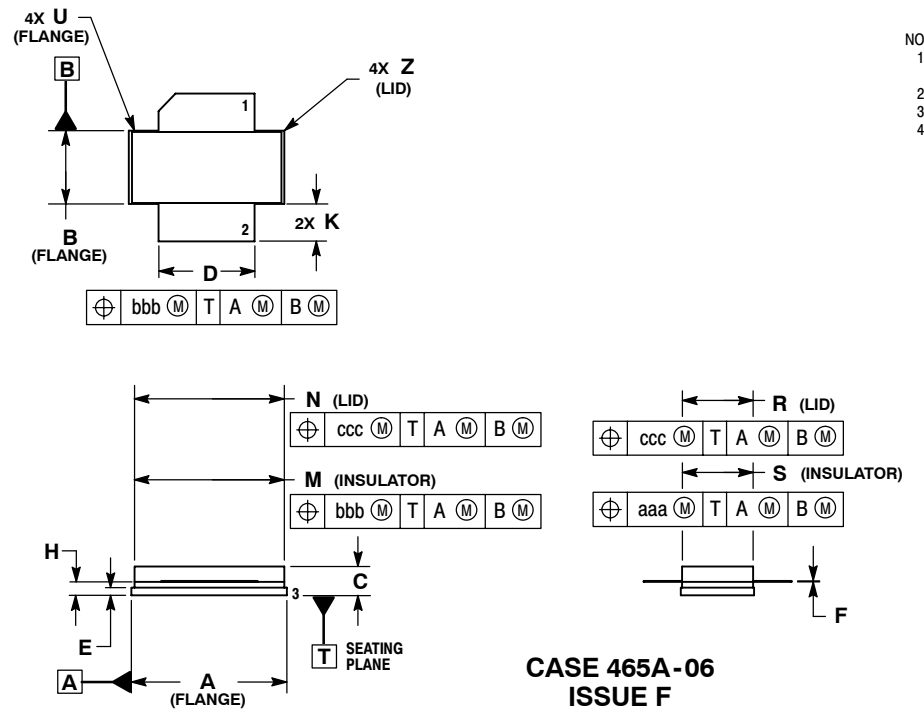


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

	INCHES		MILLIMETERS	
DIM	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 F
NI-780
MRF5S21090LR3



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3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

	INCHES		MILLIMETERS	
DIM	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 F
NI-780S
MRF5S21090LSR3

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