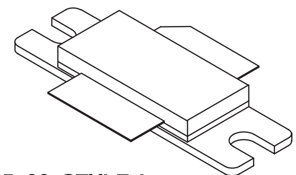
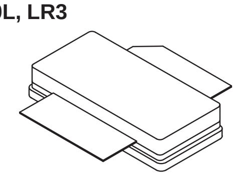
The RF MOSFET Line
RF Power Field Effect Transistors
N–Channel Enhancement–Mode Lateral MOSFETs

MRF5S21100L
MRF5S21100LR3
MRF5S21100LSR3

2170 MHz, 23 W AVG.,
2 x W–CDMA, 28 V
LATERAL N–CHANNEL
RF POWER MOSFETs



CASE 465–06, STYLE 1
NI–780
MRF5S21100L, LR3



CASE 465A–06, STYLE 1
NI–780S
MRF5S21100LSR3

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} = 1050 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 — 23 Watts Avg.
  Power Gain — 13.5 dB
  Efficiency — 26%
  IM3 — –37 dBc
  ACPR — –40 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, 100 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 in Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.
- Low Gold Plating Thickness on Leads. L Suffix Indicates 40µ″ Nominal.

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	250 1.43	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 Case Temperature 80°C, 100 W CW Case Temperature 80°C, 23 W CW	$R_{\theta JC}$	 0.70 0.76	°C/W

ESD PROTECTION CHARACTERISTICS

Test Conditions	Class
Human Body Model	2 (Minimum)
Machine Model	M3 (Minimum)
Charge Device Model	C7 (Minimum)

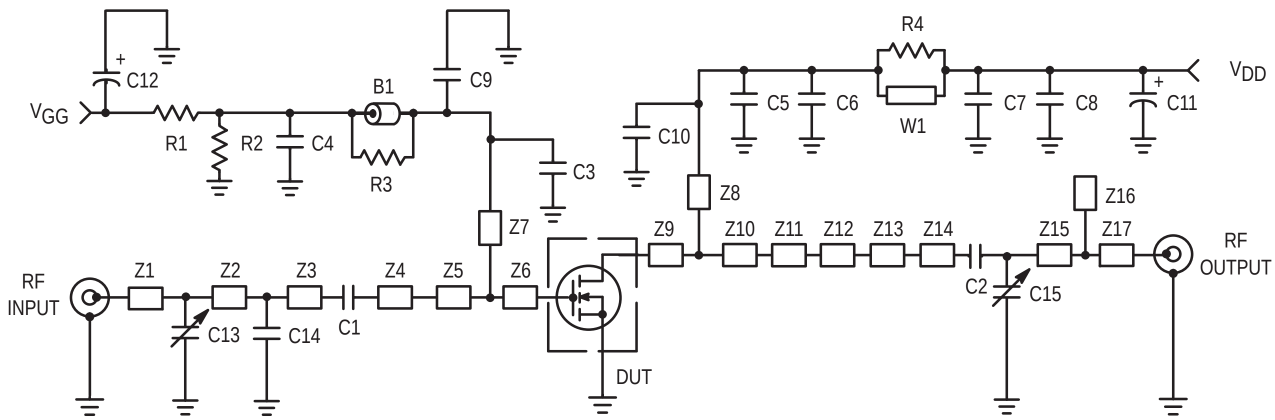
NOTE – **CAUTION** – MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

REV 0

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}	—	—	0.5	µAdc
ON CHARACTERISTICS (DC)					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 250 µAdc)	$V_{GS(th)}$	2.5	2.8	3.5	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 1050 mAdc)	$V_{GS(Q)}$	—	3.8	—	Vdc
Drain–Source On–Voltage (V_{GS} = 10 Vdc, I_D = 2.5 Adc)	$V_{DS(on)}$	—	0.24	0.3	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 2.5 Adc)	g_{fs}	—	6	—	S
DYNAMIC CHARACTERISTICS (1)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	2.14	—	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} = 23 W Avg., I_{DQ} = 1050 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	G_{ps}	12.5	13.5	—	dB
Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 23 W Avg., I_{DQ} = 1050 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	η	24	26	—	%
Third Order Intermodulation Distortion (V_{DD} = 28 Vdc, P_{out} = 23 W Avg., I_{DQ} = 1050 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	–35	dBc
Adjacent Channel Power Ratio (V_{DD} = 28 Vdc, P_{out} = 23 W Avg., I_{DQ} = 1050 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	–38	dBc
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 23 W Avg., I_{DQ} = 1050 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	IRL	—	–16	–9	dB

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



Z1	0.674″ x 0.080″ Microstrip	Z10	0.368″ x 1.136″ Microstrip
Z2	0.421″ x 0.080″ Microstrip	Z11	0.151″ x 0.393″ Microstrip
Z3	0.140″ x 0.080″ Microstrip	Z12	0.280″ x 0.220″ Microstrip
Z4	1.031″ x 0.080″ Microstrip	Z13	0.481″ x 0.142″ Microstrip
Z5	0.380″ x 0.643″ Microstrip	Z14	0.138″ x 0.080″ Microstrip
Z6	0.080″ x 0.643″ Microstrip	Z15	0.344″ x 0.080″ Microstrip
Z7	0.927″ x 0.048″ Microstrip	Z16	0.147″ x 0.099″ Microstrip
Z8	0.620″ x 0.048″ Microstrip	Z17	0.859″ x 0.080″ Microstrip
Z9	0.079″ x 1.136″ Microstrip	PCB	Arlon GX–0300–SS–22, 30 mil, ε_r = 2.55

Figure 1. MRF5S21100L Test Circuit Schematic

Table 1. MRF5S21100L Test Circuit Component Designations and Values

Part	Description	Value, P/N or DWG	Manufacturer
B1	Short RF Bead	95F786	Newark
C1, C2	8.2 pF Chip Capacitors, B Case	100B8R2CP500X	ATC
C3	5.6 pF Chip Capacitor, B Case	100B5R6CP500X	ATC
C4	0.1 µF Chip Capacitor, B Case	CDR33BX104AKWS	Kemet
C5, C7	7.5 pF Chip Capacitors, B Case	100B7R5JP500X	ATC
C6	1.2 pF Chip Capacitor, B Case	100B1R2BP500X	ATC
C8	1K pF Chip Capacitor, B Case	100B102JP500X	ATC
C9, C10	0.56 µF Chip Capacitors, B Case	700A561MP150X	Kemet
C11	470 µF, 63 V Electrolytic Capacitor	95F4579	Newark
C12	100 µF, 50 V Electrolytic Capacitor	51F2913	Newark
C13	0.6–4.5 pF Gigatrim Variable Capacitor	44F3358	Newark
C14	2.7 pF Chip Capacitor, B Case	100B2R7CP500X	ATC
C15	0.4–2.5 pF Gigatrim Variable Capacitor	44F3367	Newark
R1	1 kΩ Chip Resistor	D5534M07B1K00R	Newark
R2	560 kΩ Chip Resistor	CR1206564JT	Newark
R3, R4	12 Ω Chip Resistors	RM73B2B120JT	Garrett Electronics
W1	Wire Strap	14 Gauge Jumper Wire	

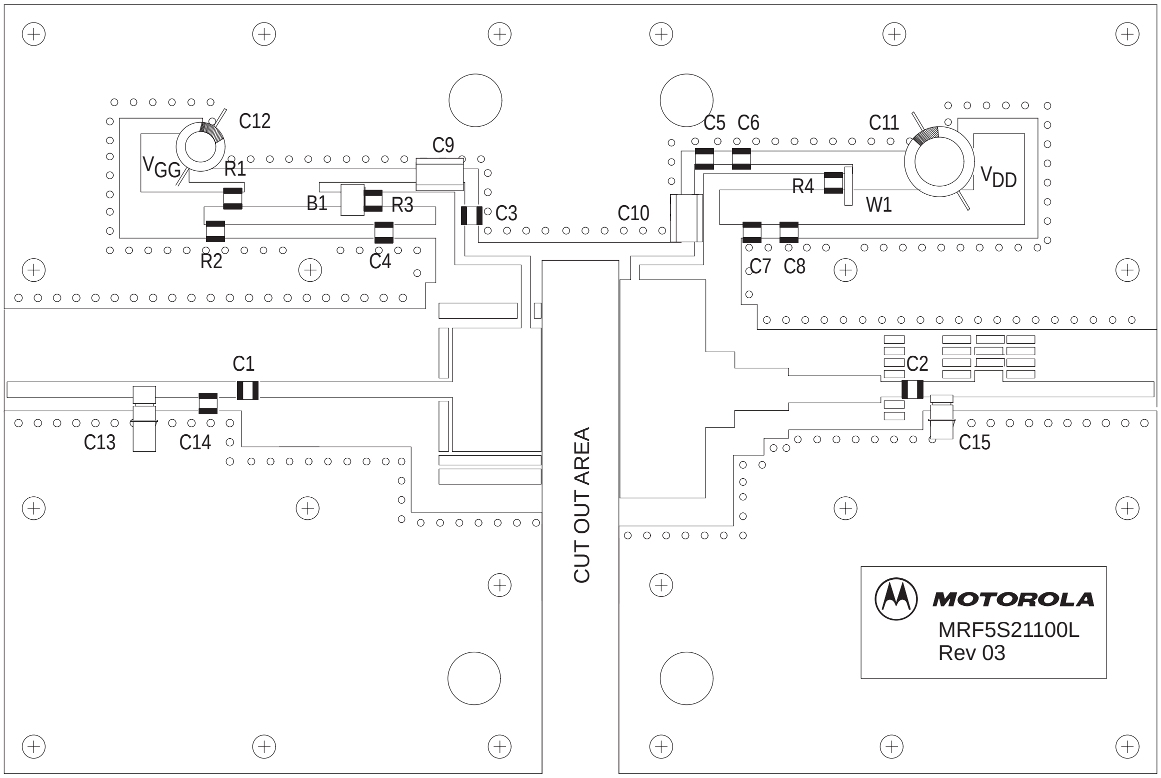


Figure 2. MRF5S21100L Test Circuit Component Layout

TYPICAL CHARACTERISTICS

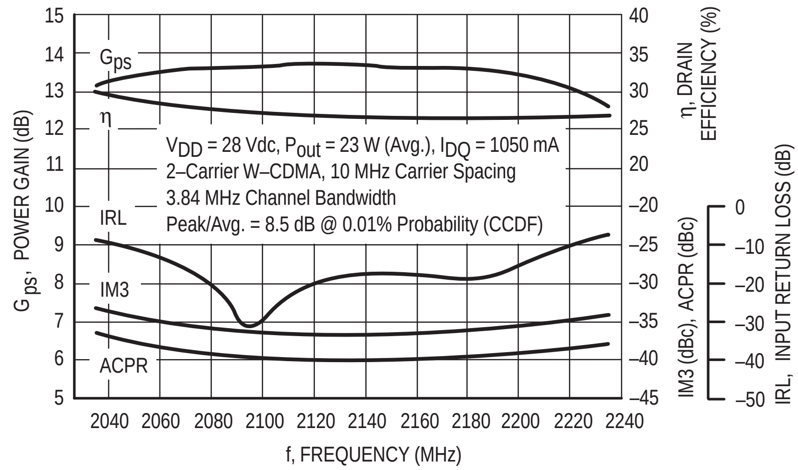


Figure 3. 2–Carrier W–DCMA Broadband Performance

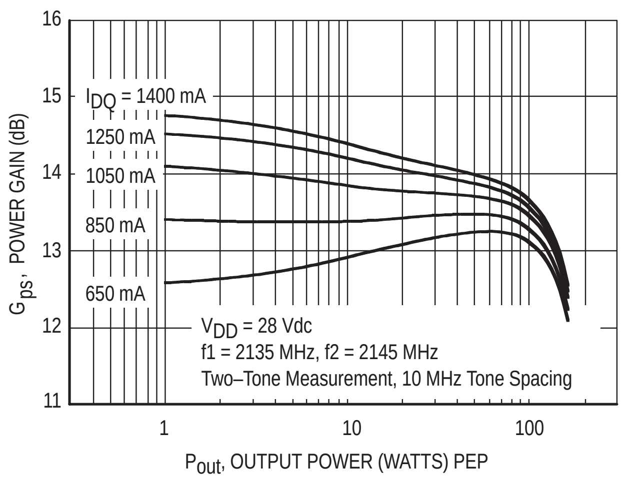


Figure 4. Two–Tone Power Gain versus Output Power

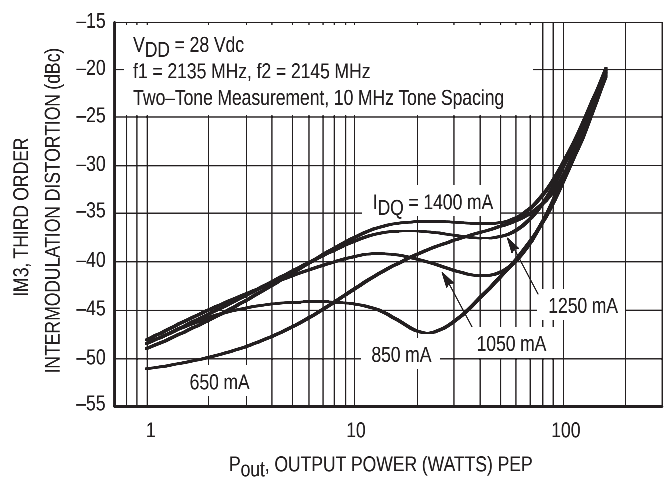


Figure 5. Third Order Intermodulation Distortion versus Output Power

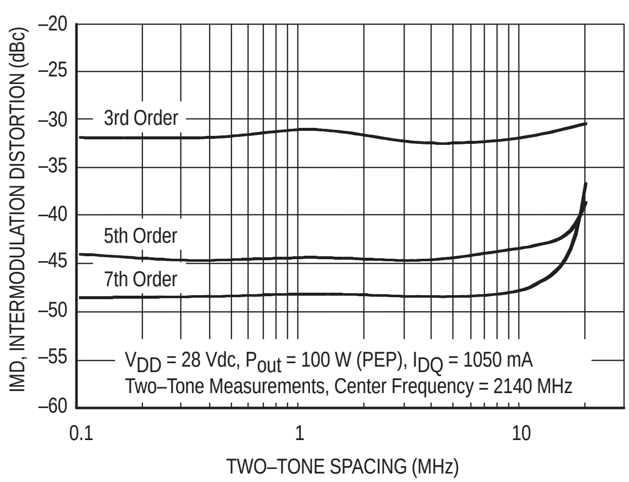


Figure 6. Intermodulation Distortion Products versus Tone Spacing

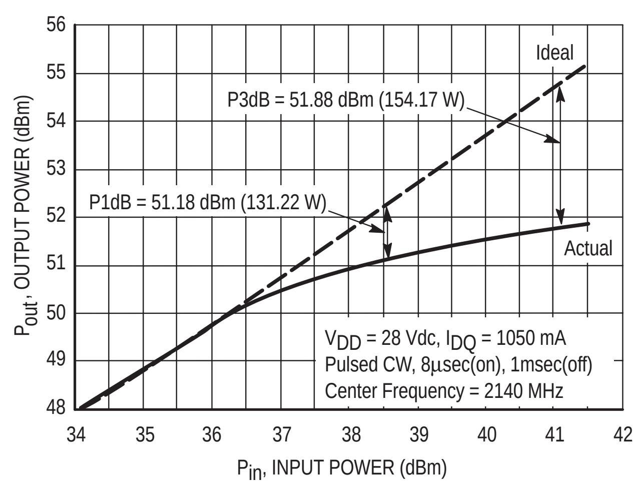


Figure 7. Pulse CW Output Power versus Input Power

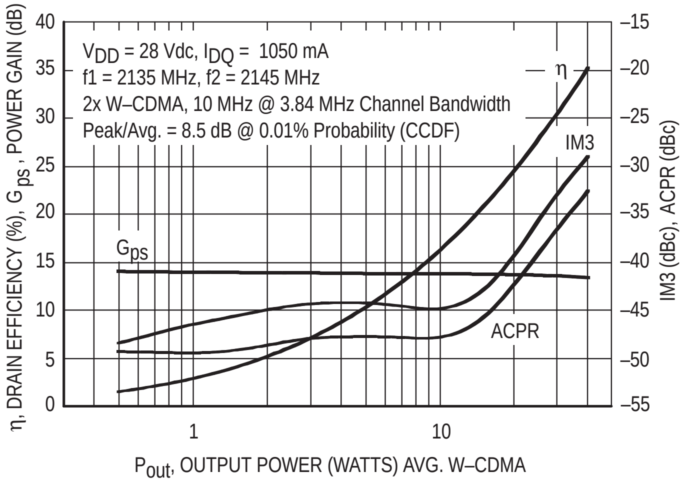


Figure 8. 2–Carrier W–CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

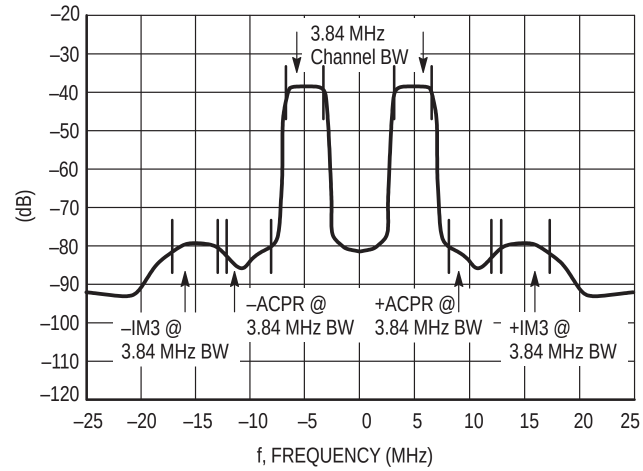


Figure 9. 2-Carrier W-CDMA Spectrum

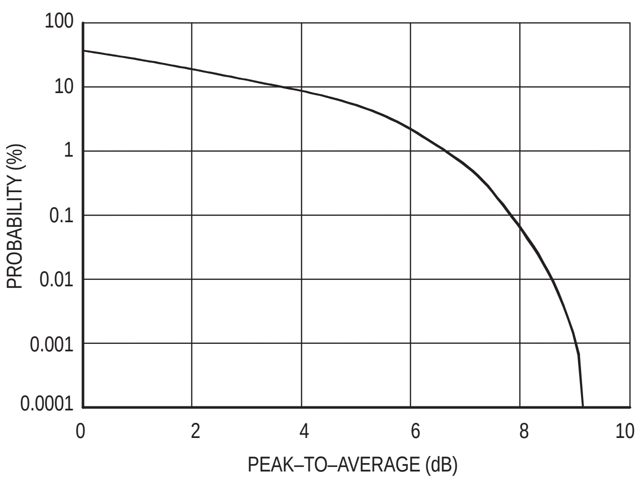
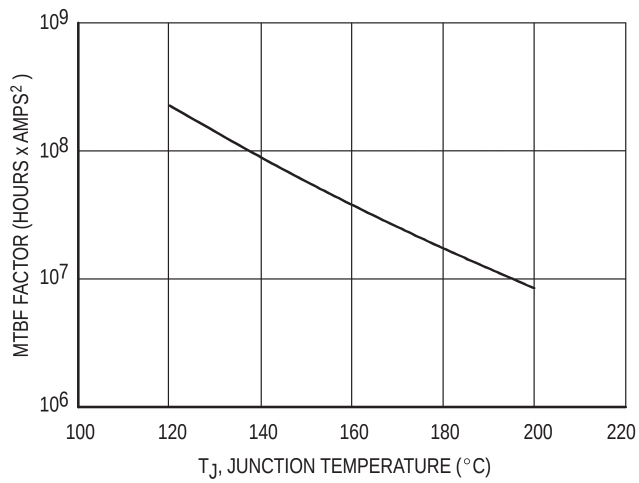
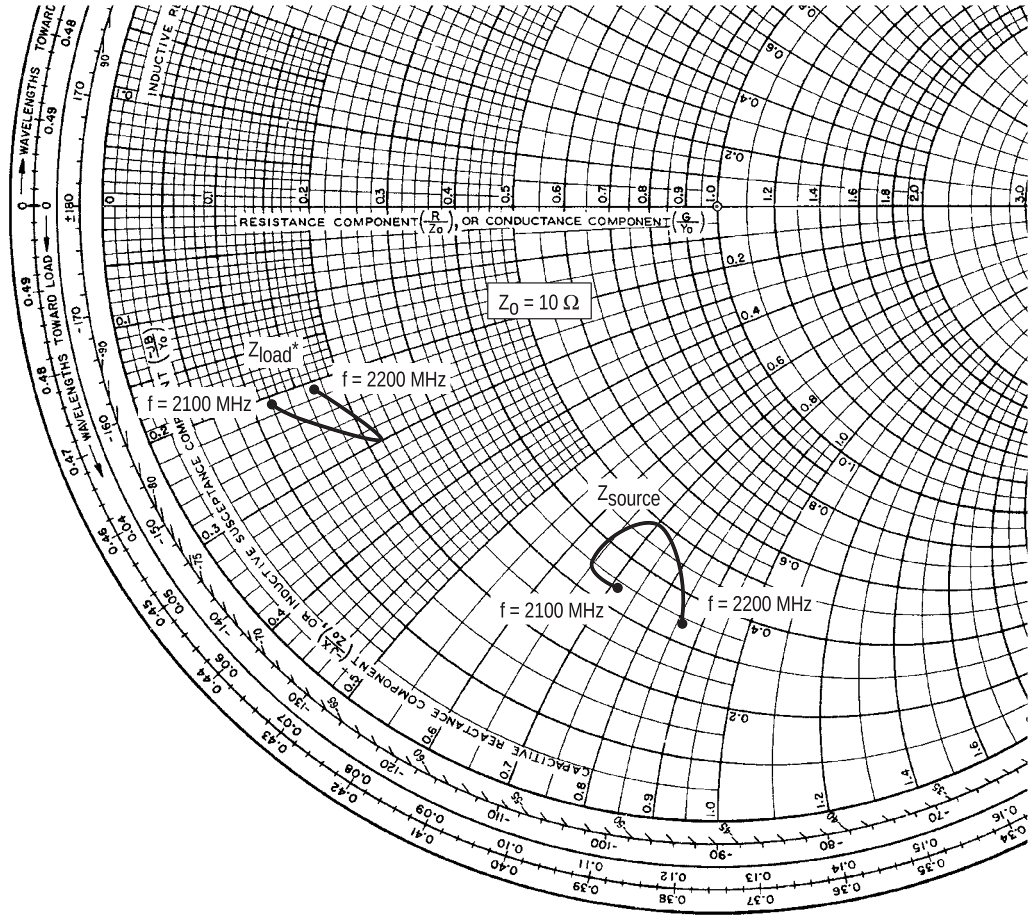


Figure 10. CCDF W–CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single Carrier Test Signal



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



V_{DD} = 28 Vdc, I_{DQ} = 1050 mA, P_{out} = 23 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2100	3.4 – j7.2	1.2 – j2.1
2120	3.4 – j6.5	1.4 – j2.3
2160	4.9 – j7.0	2.2 – j3.0
2200	3.4 – j8.6	1.7 – j2.1

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

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

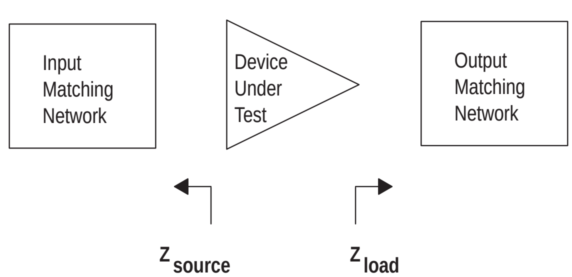


Figure 12. Series Equivalent Input and Output Impedance

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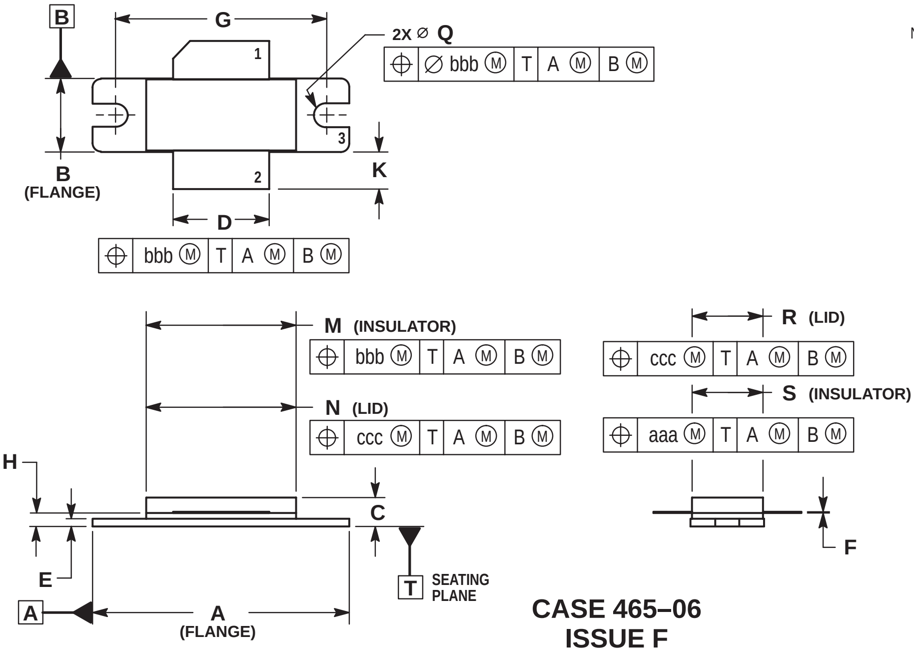
PACKAGE DIMENSIONS

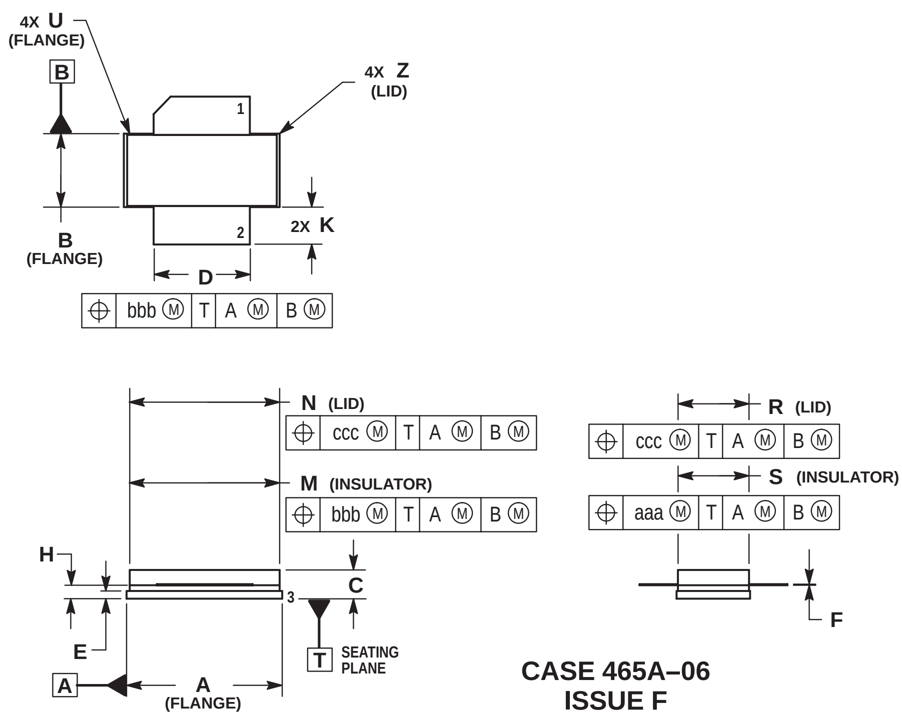


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M–1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

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	∅.118	∅.138	∅3.00	∅3.51
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
MRF5S21100L, MRF5S21100LR3



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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 F
NI–780S
MRF5S21100LSR3

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