MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

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by MRF5S21130/D

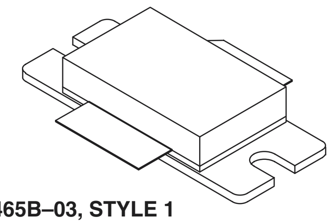
The RF MOSFET Line
RF Power Field Effect Transistors
N–Channel Enhancement–Mode Lateral MOSFETs

MRF5S21130
MRF5S21130R3
MRF5S21130S
MRF5S21130SR3

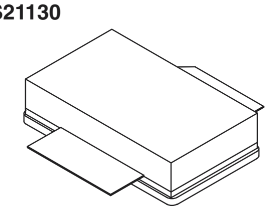
Designed for W–CDMA base station applications at frequencies from 2110 to 2170 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN–PCS/cellular radio and WLL applications.

- Typical 2–carrier W–CDMA Performance for V_{DD} = 28 Volts, I_{DQ} = 1200 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 — 28 Watts Avg.
  Power Gain — 13.5 dB
  Efficiency — 26%
  IM3 — –37 dBc
  ACPR — –39 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, 92 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.

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



**CASE 465B–03, STYLE 1
NI–880
MRF5S21130**



**CASE 465C–02, STYLE 1
NI–880S
MRF5S21130S**

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	315 2	Watts W/°C
Storage Temperature Range	T_{stg}	–65 to +150	°C
Operating Junction Temperature	T_J	200	°C
CW Operation	CW	92	Watts

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 92 W CW Case Temperature 80°C, 28 W CW	$R_{\theta JC}$	 0.54 0.56	°C/W

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

REV 1

MOTOROLA
intelligence everywhere™ digital dna™

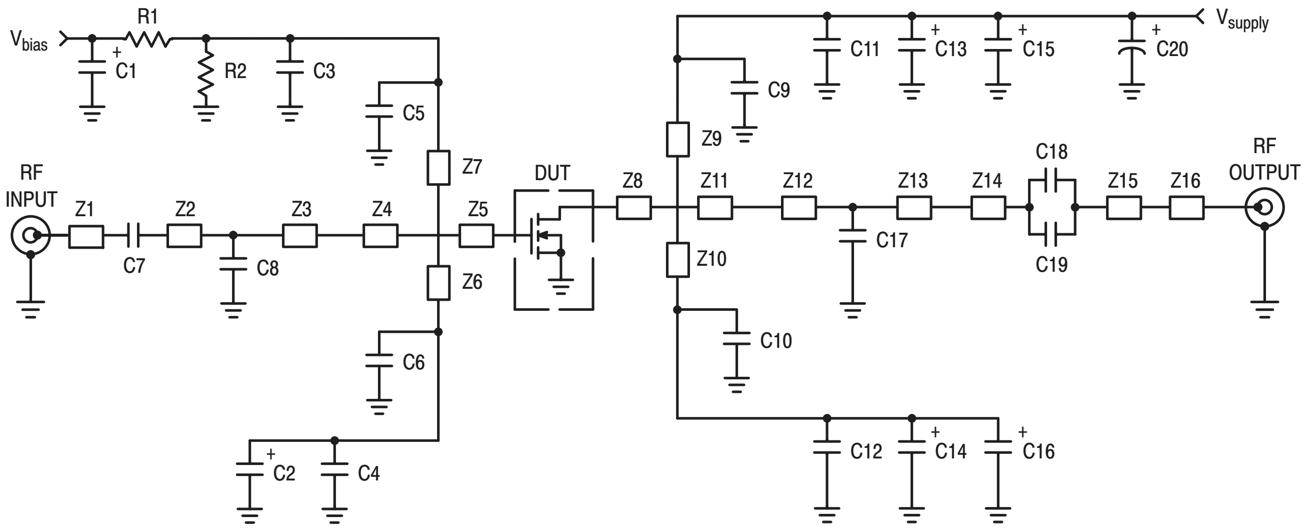
ESD PROTECTION CHARACTERISTICS

Test Conditions	Class
Human Body Model	2 (Minimum)
Machine Model	M4 (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					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 300 µAdc)	$V_{GS(th)}$	2.5	2.7	3.5	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 1200 mAdc)	$V_{GS(Q)}$	—	3.7	—	Vdc
Drain–Source On–Voltage (V_{GS} = 10 Vdc, I_D = 3 Adc)	$V_{DS(on)}$	—	0.26	0.3	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 3 Adc)	g_{fs}	—	7.5	—	S
DYNAMIC CHARACTERISTICS (1)					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	2.6	—	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} = 28 W Avg., I_{DQ} = 1200 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	G_{ps}	12	13.5	—	dB
Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 28 W Avg., I_{DQ} = 1200 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} = 28 W Avg., I_{DQ} = 1200 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} = 28 W Avg., I_{DQ} = 1200 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	—	–39	–37	dBc
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 28 W Avg., I_{DQ} = 1200 mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz)	IRL	—	–12	–9	dB

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



Z1	0.500″ x 0.083″ Microstrip	Z9, Z10	0.709″ x 0.083″ Microstrip
Z2	0.995″ x 0.083″ Microstrip	Z11	0.415″ x 1.000″ Microstrip
Z3	0.905″ x 0.083″ Microstrip	Z12	0.531″ x 0.083″ Microstrip
Z4	0.159″ x 1.024″ Microstrip	Z13	0.994″ x 0.083″ Microstrip
Z5	0.117″ x 1.024″ Microstrip	Z14, Z15	0.070″ x 0.220″ Microstrip
Z6, Z7	0.749″ x 0.083″ Microstrip	Z16	0.430″ x 0.083″ Microstrip
Z8	0.117″ x 1.000″ Microstrip	PCB	Taconic TLX8, 0.030″, ε_r = 2.55

Figure 1. MRF5S21130 Test Circuit Schematic

Table 1. MRF5S21130 Test Circuit Component Designations and Values

Part	Description	Value, P/N or DWG	Manufacturer
C1, C2, C13, C14, C15, C16	10 μF, 35 V Tantalum Capacitors	293D1106X9035D	Vishay–Sprague
C3, C4, C11, C12	220 nF Chip Capacitors (1812)	1812Y224KXA	Vishay–Vitramon
C5, C6, C7, C9, C10, C18, C19	6.8 pF 100B Chip Capacitors	100B6R8CW	ATC
C8	0.1 pF 100B Chip Capacitor	100B0R1BW	ATC
C17	0.5 pF 100B Chip Capacitor	100B0R5BW	ATC
C20	220 μF, 63 V Electrolytic Capacitor, Radial	13668221	Philips
R1, R2	1 kΩ, 1/4 W Chip Resistors		

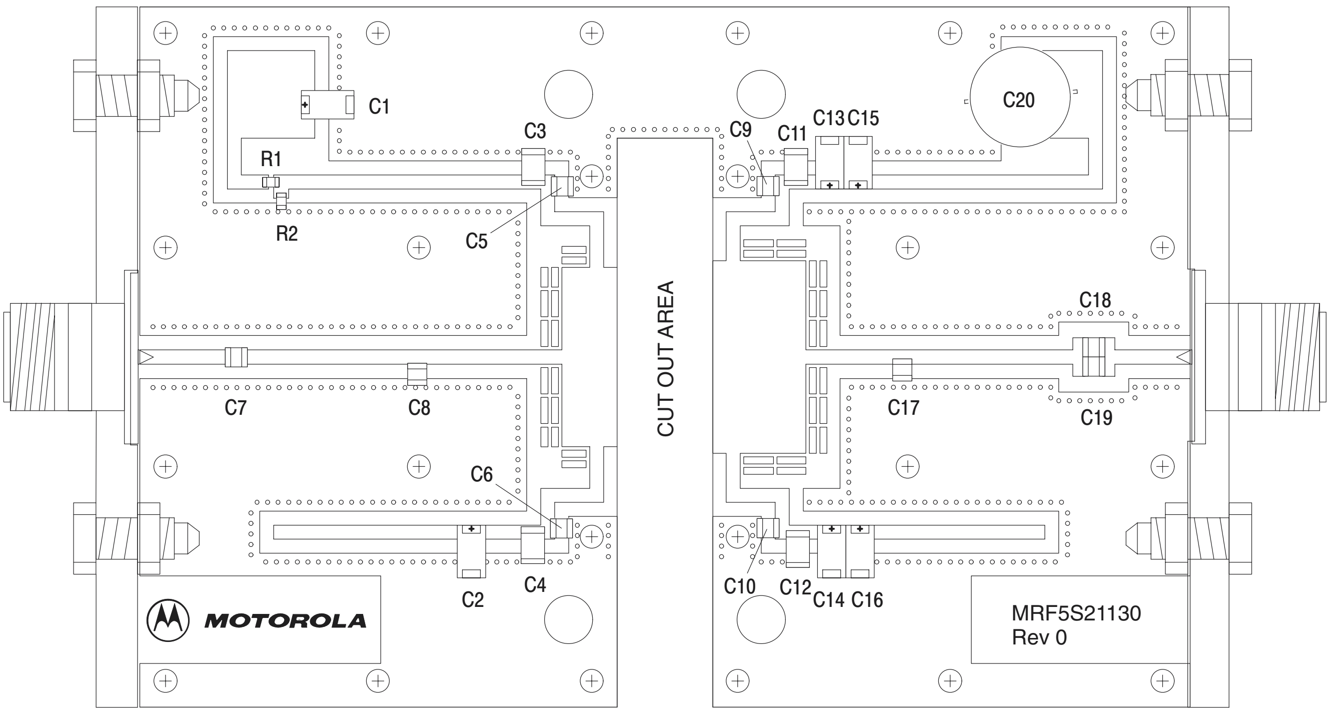


Figure 2. MRF5S21130 Test Circuit Component Layout

TYPICAL CHARACTERISTICS

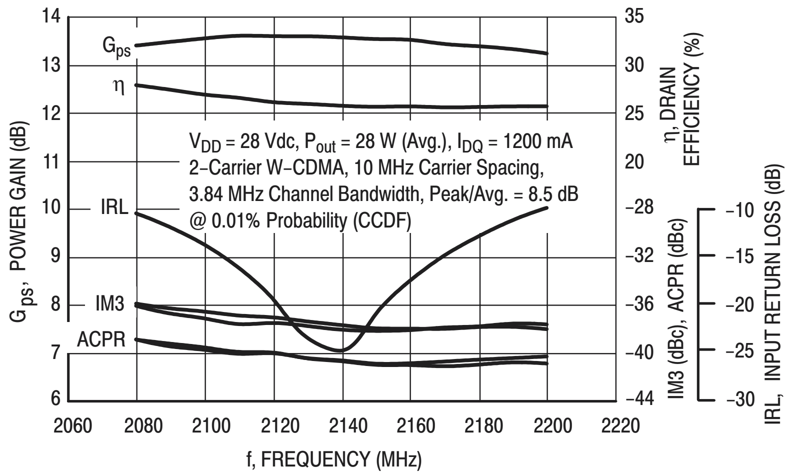


Figure 3. 2−Carrier W−CDMA Broadband Performance

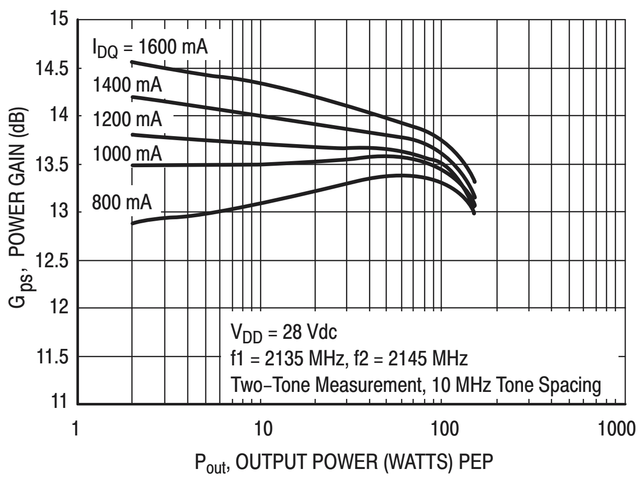


Figure 4. Two−Tone Power Gain versus Output Power

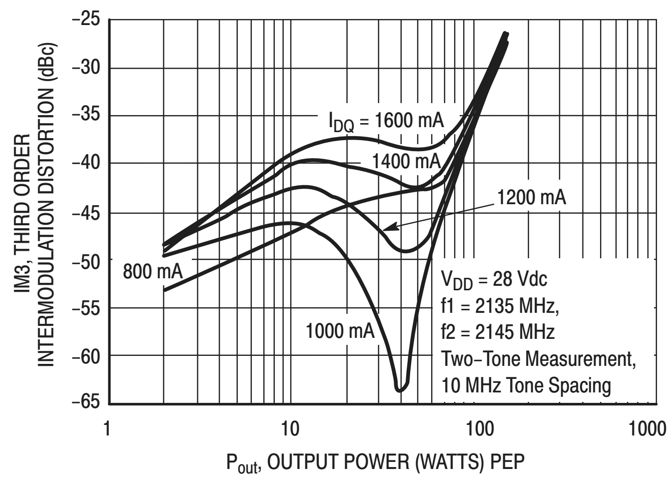


Figure 5. Third Order Intermodulation Distortion versus Output Power

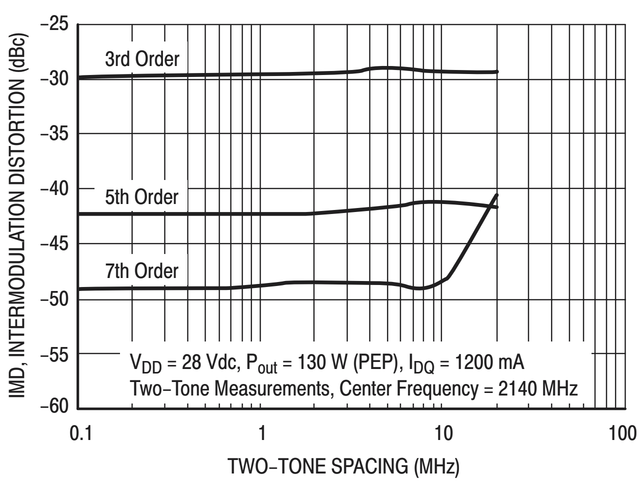


Figure 6. Intermodulation Distortion Products versus Tone Spacing

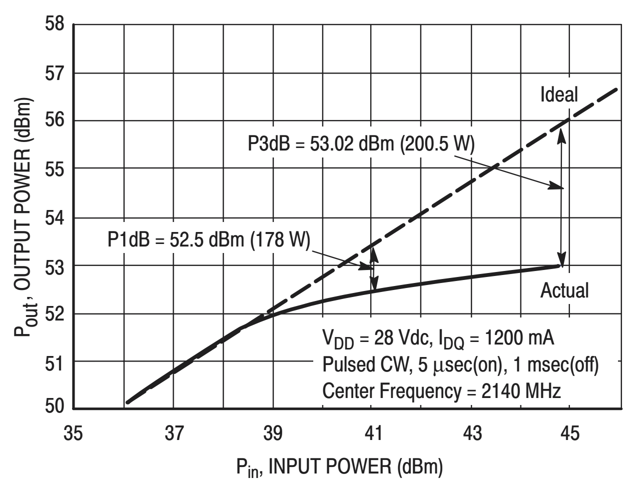


Figure 7. Pulse CW Output Power versus Input Power

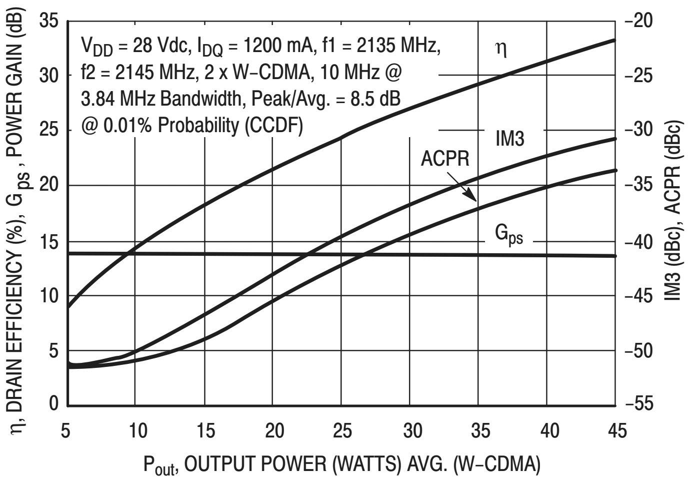


Figure 8. 2−Carrier W−CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

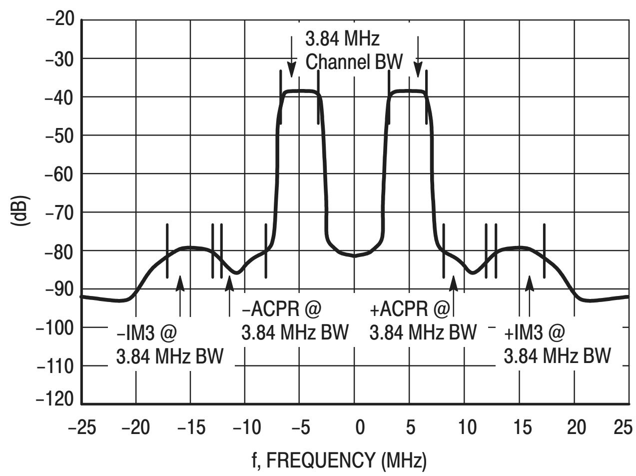


Figure 9. 2-Carrier W-CDMA Spectrum

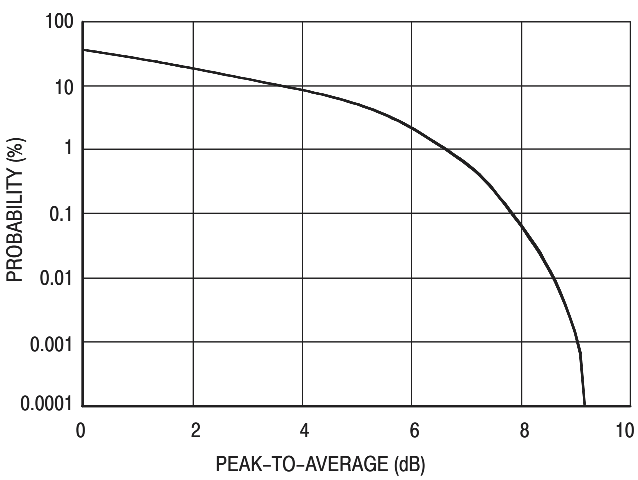
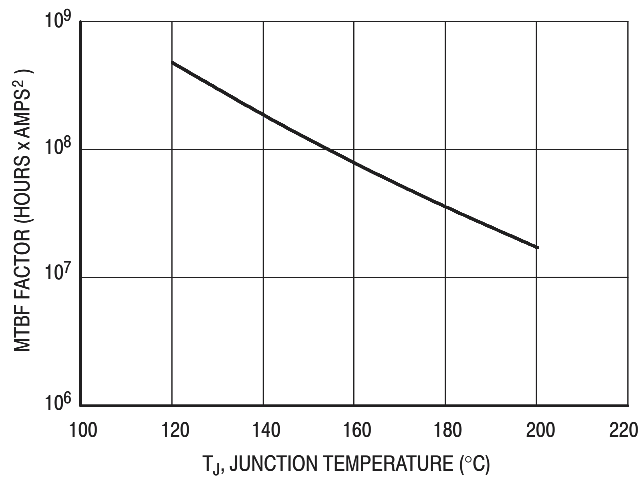
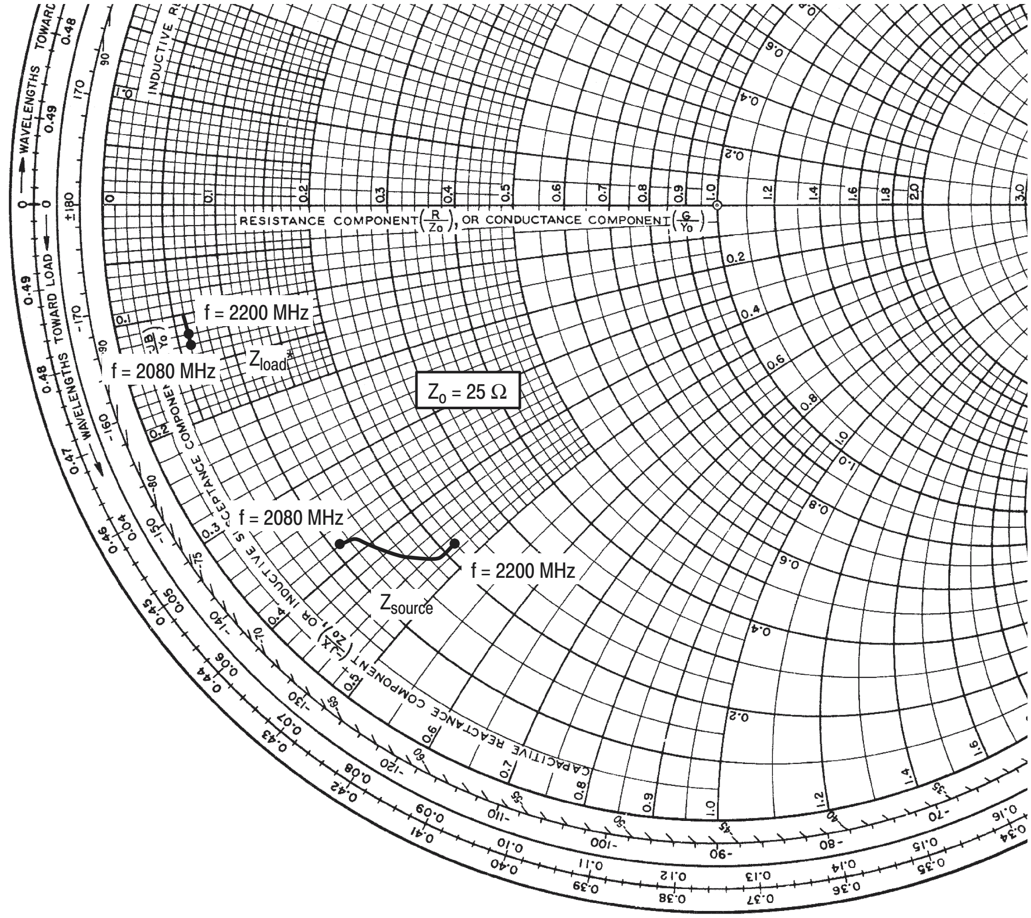


Figure 10. CCDF W−CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single Carrier Test Signal



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} = 1200 mA, P_{out} = 28 W Avg.

f MHz	Z_{source} Ω	Z_{load} Ω
2080	2.87 – j9.49	1.51 – j2.97
2110	3.13 – j9.86	1.52 – j2.54
2140	4.05 – j10.90	1.59 – j2.68
2170	4.80 – j11.75	1.62 – j2.70
2200	5.55 – j11.87	1.54 – j3.13

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

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

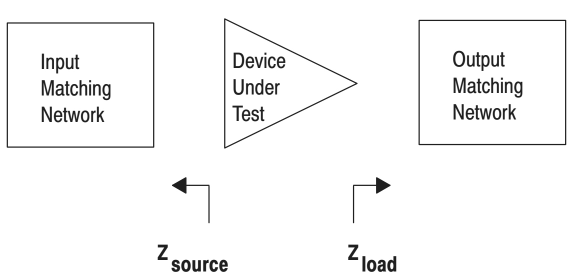


Figure 12. Series Equivalent Input and Output Impedance

NOTES

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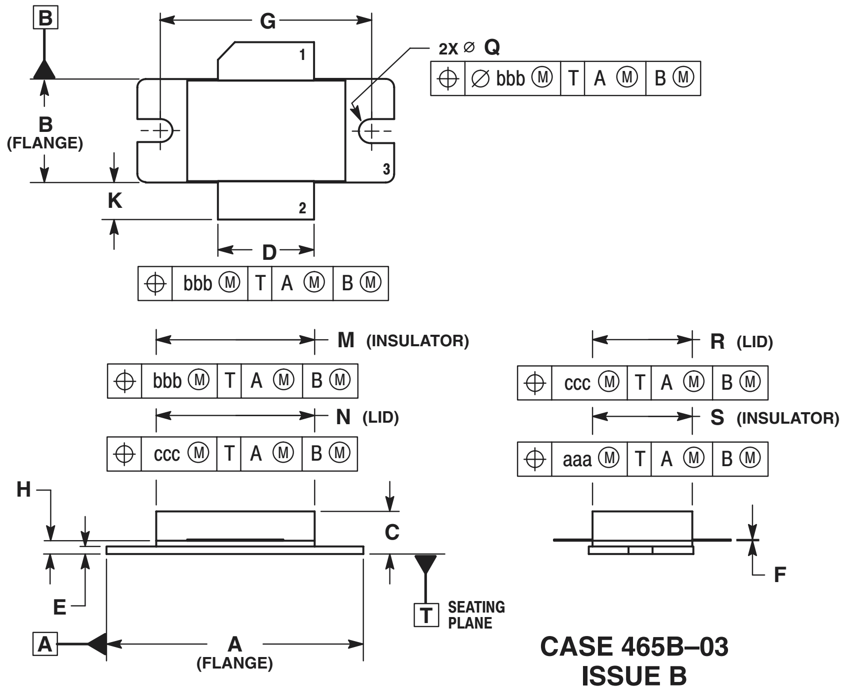
PACKAGE DIMENSIONS

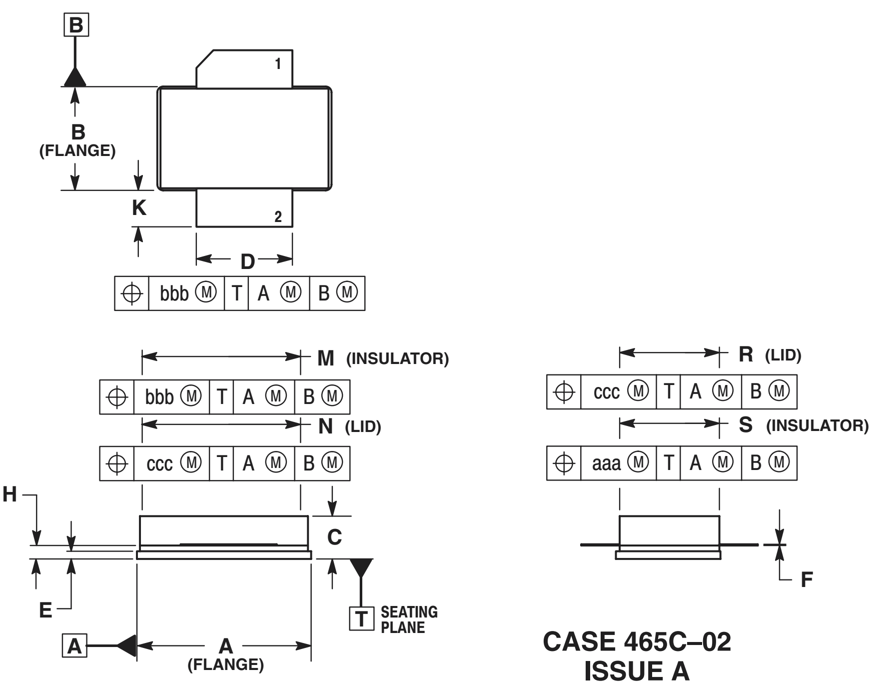


CASE 465B–03
ISSUE B
NI–880
MRF5S21130

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. DELETED

	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	0.170	0.210	4.32	5.33
M	0.872	0.888	22.15	22.55
N	0.871	0.889	19.30	22.60
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 A
NI–880S
MRF5S21130S

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

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