MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

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by MRF5S19090L/D

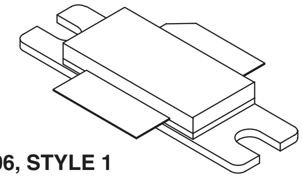
The RF MOSFET Line
RF Power Field Effect Transistors
N–Channel Enhancement–Mode Lateral MOSFETs

MRF5S19090L
MRF5S19090LR3
MRF5S19090LSR3

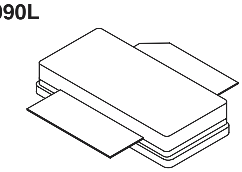
Designed for PCN and PCS base station applications with frequencies up to 1.9 to 2.0 GHz. Suitable for TDMA, CDMA and multicarrier amplifier applications.

- Typical 2–Carrier N–CDMA Performance for V_{DD} = 28 Volts, I_{DQ} = 850 mA, f1 = 1958.75 MHz, f2 = 1961.25 MHz
  IS–95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13)
  1.2288 MHz Channel Bandwidth Carrier. Adjacent Channels Measured over a 30 kHz Bandwidth at f1 –885 kHz and f2 +885 kHz. Distortion Products Measured over 1.2288 MHz Bandwidth at f1 –2.5 MHz and f2 +2.5 MHz. Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF.
  Output Power — 18 Watts Avg.
  Power Gain — 14.5 dB
  Efficiency — 25.8%
  ACPR — –51 dB
  IM3 — –37 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, 1960 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 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.

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



CASE 465–06, STYLE 1
NI–780
MRF5S19090L



CASE 465A–06, STYLE 1
NI–780S
MRF5S19090LSR3

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	261 1.49	Watts W/°C
Storage Temperature Range	T_{stg}	–65 to +200	°C
Operating Junction Temperature	T_J	200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 90 W CW Case Temperature 80°C, 18 W CW	$R_{\theta JC}$	 0.67 0.75	°C/W

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

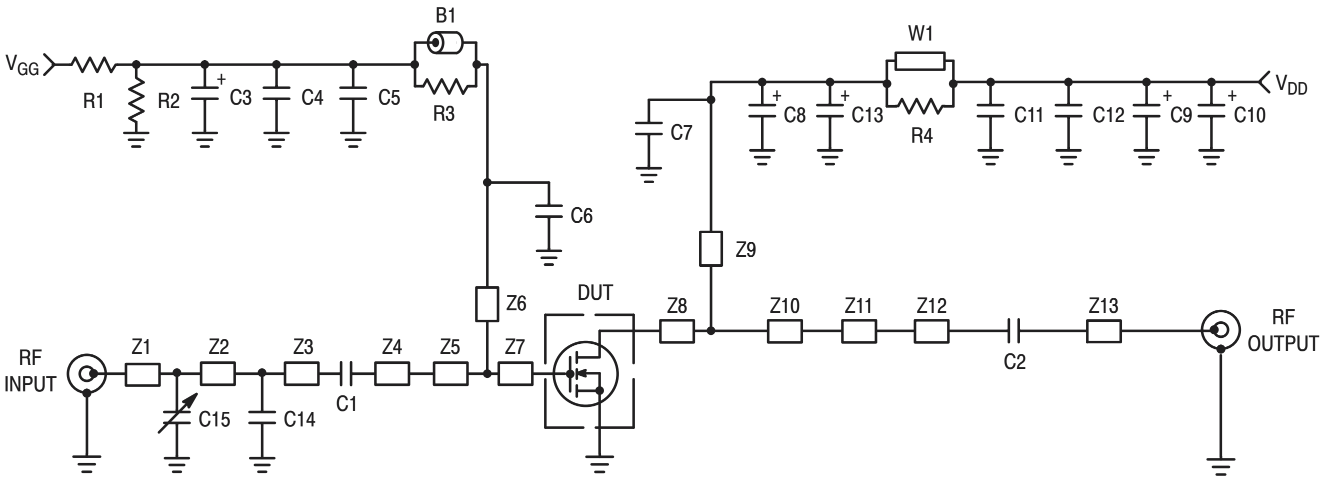
ESD PROTECTION CHARACTERISTICS

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	2.7	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					
Reverse Transfer Capacitance (1) (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 N–CDMA, 1.2288 MHz Channel Bandwidth Carriers. ACPR measured in 30 kHz Bandwidth and IM3 measured in 1.2288 MHz Bandwidth. Peak/Avg. Ratio = 9.8 dB @ 0.01% Probability on CCDF.					
Common–Source Amplifier Power Gain (V_{DD} = 28 Vdc, P_{out} = 18 W Avg., I_{DQ} = 850 mA, f1 = 1930 MHz, f2 = 1932.5 MHz and f1 = 1987.5 MHz, f2 =1990 MHz)	G_{ps}	13.5	14.5	—	dB
Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 18 W Avg., I_{DQ} = 850 mA, f1 = 1930 MHz, f2 = 1932.5 MHz and f1 = 1987.5 MHz, f2 =1990 MHz)	η	24	25.8	—	%
Third Order Intermodulation Distortion (V_{DD} = 28 Vdc, P_{out} = 18 W Avg., I_{DQ} = 850 mA, f1 = 1930 MHz, f2 = 1932.5 MHz and f1 = 1987.5 MHz, f2 =1990 MHz); IM3 measured over 1.2288 MHz bandwidth at f1 –2.5 MHz and f2 = +2.5 MHz)	IM3	—	–37	–35	dBc
Adjacent Channel Power Ratio (V_{DD} = 28 Vdc, P_{out} = 18 W Avg., I_{DQ} = 850 mA, f1 = 1930 MHz, f2 = 1932.5 MHz and f1 = 1987.5 MHz, f2 =1990 MHz); ACPR measured over 30 kHz bandwidth at f1 –885 kHz and f2 +885 kHz)	ACPR	—	–51	–48	dBc
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 18 W Avg., I_{DQ} = 850 mA, f1 = 1930 MHz, f2 = 1932.5 MHz and f1 = 1987.5 MHz, f2 =1990 MHz)	IRL	—	–14.5	–9	dB

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



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, 30 mil, ε_r = 2.55

Figure 1. MRF5S19090 Test Circuit Schematic

Table 1. MRF5S19090 Test Circuit Component Designations and Values

Part	Description	Value, P/N or DWG	Manufacturer
B1	Short RF Bead	95F786	Newark
C1	22 pF Chip Capacitor, B Case	100B220CP 500X	ATC
C2	10 pF Chip Capacitor, B Case	100B100CP 500X	ATC
C3, C13	1 μF, 50 V SMT Tantalum Capacitors	T494C105(1)050AS	Kemet
C4, C12	0.1 μF Chip Capacitors, B Case	CDR33BX104AKWS	Kemet
C5, C11	1k pF Chip Capacitors, B Case	100B102JP 500X	ATC
C6, C7	4.3 pF Chip Capacitors, B Case	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, B Case	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		

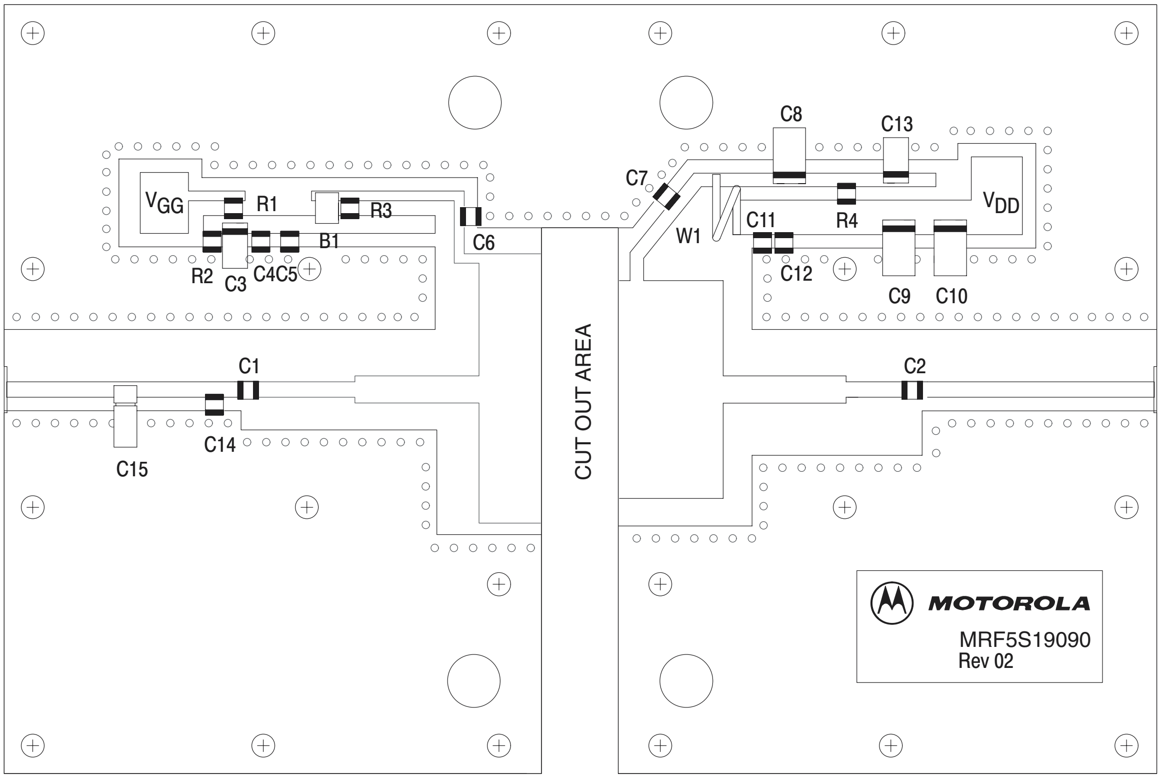


Figure 2. MRF5S19090 Test Circuit Component Layout

TYPICAL CHARACTERISTICS

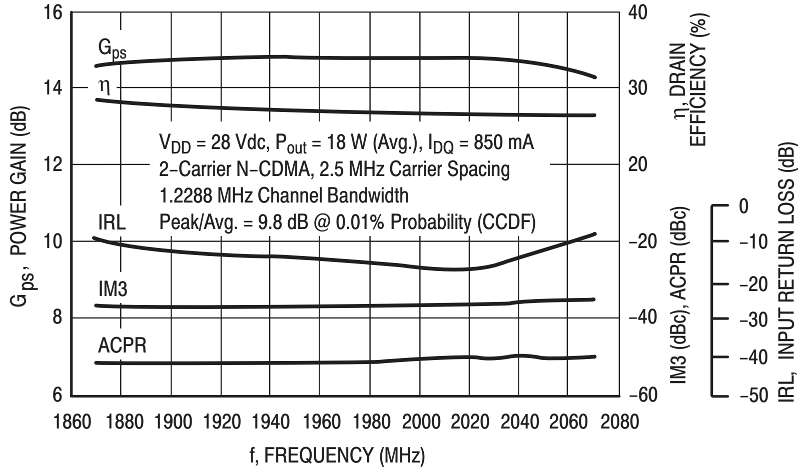


Figure 3. 2–Carrier N–CDMA Broadband Performance

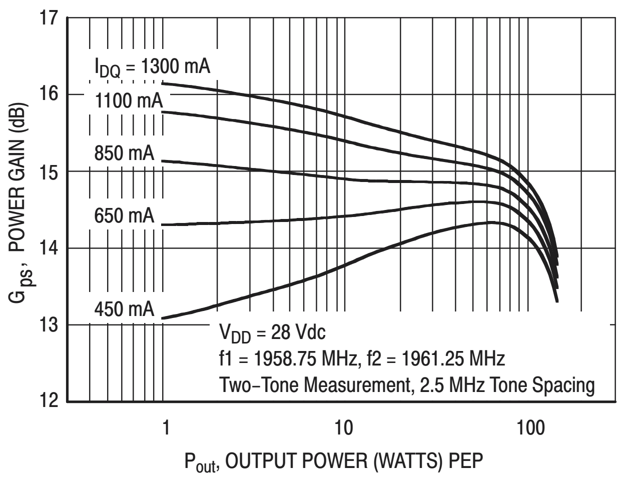


Figure 4. Two–Tone Power Gain versus Output Power

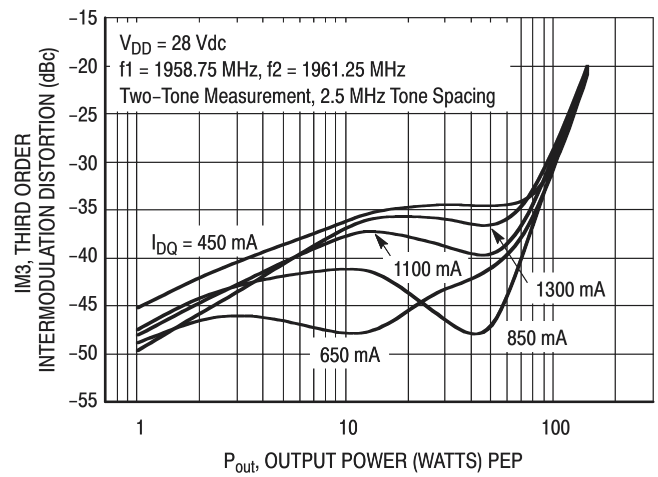


Figure 5. Third Order Intermodulation Distortion versus Output Power

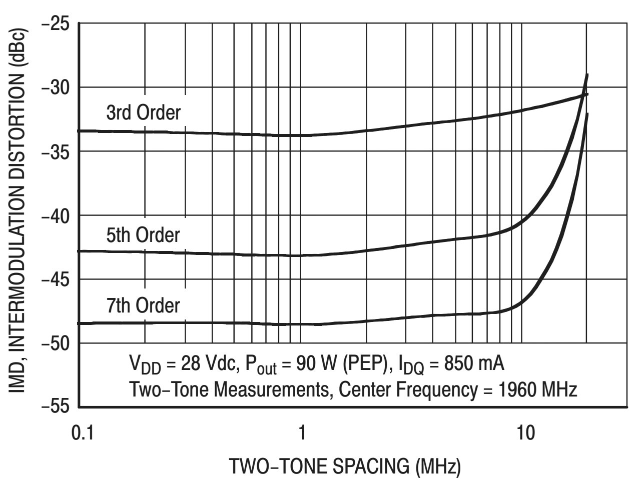


Figure 6. Intermodulation Distortion Products versus Tone Spacing

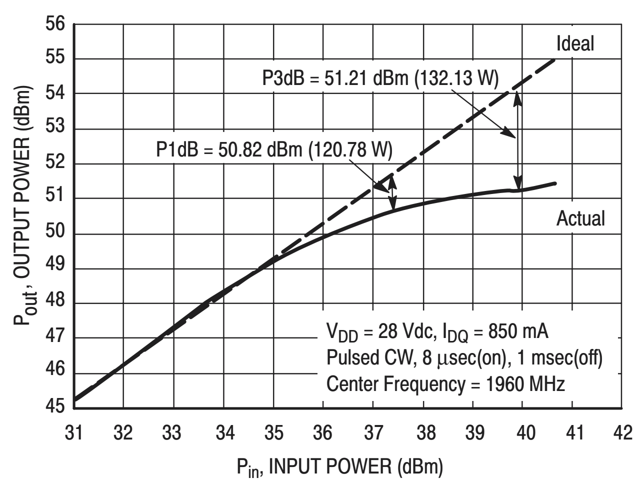


Figure 7. Pulse CW Output Power versus Input Power

TYPICAL CHARACTERISTICS

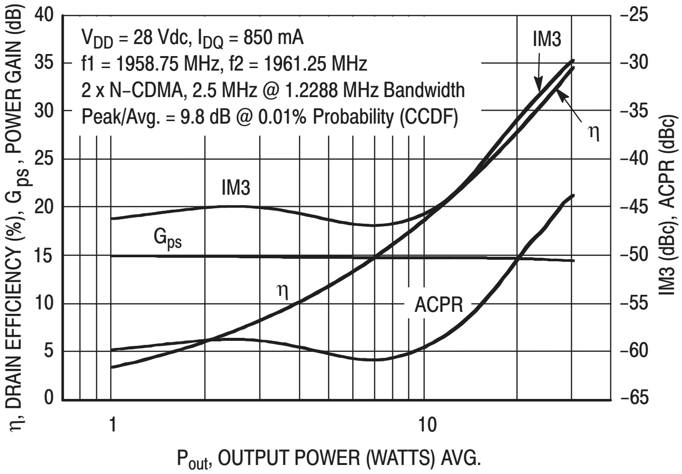


Figure 8. 2–Carrier N–CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

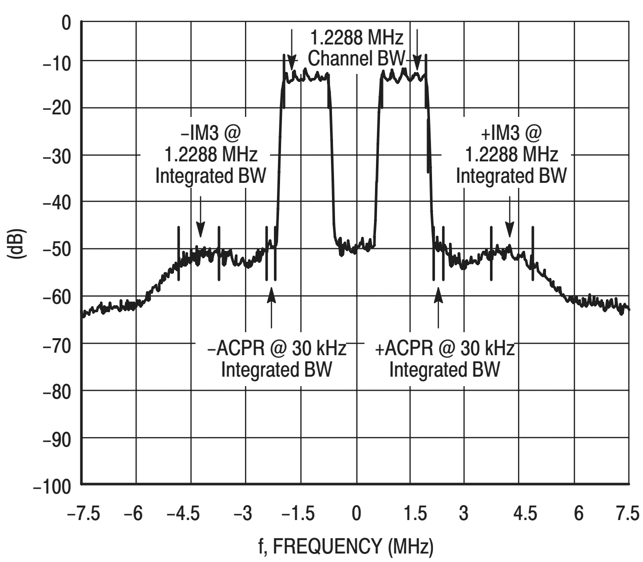
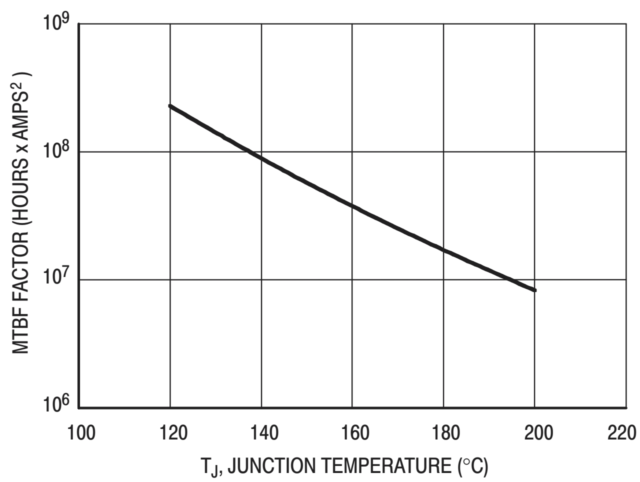
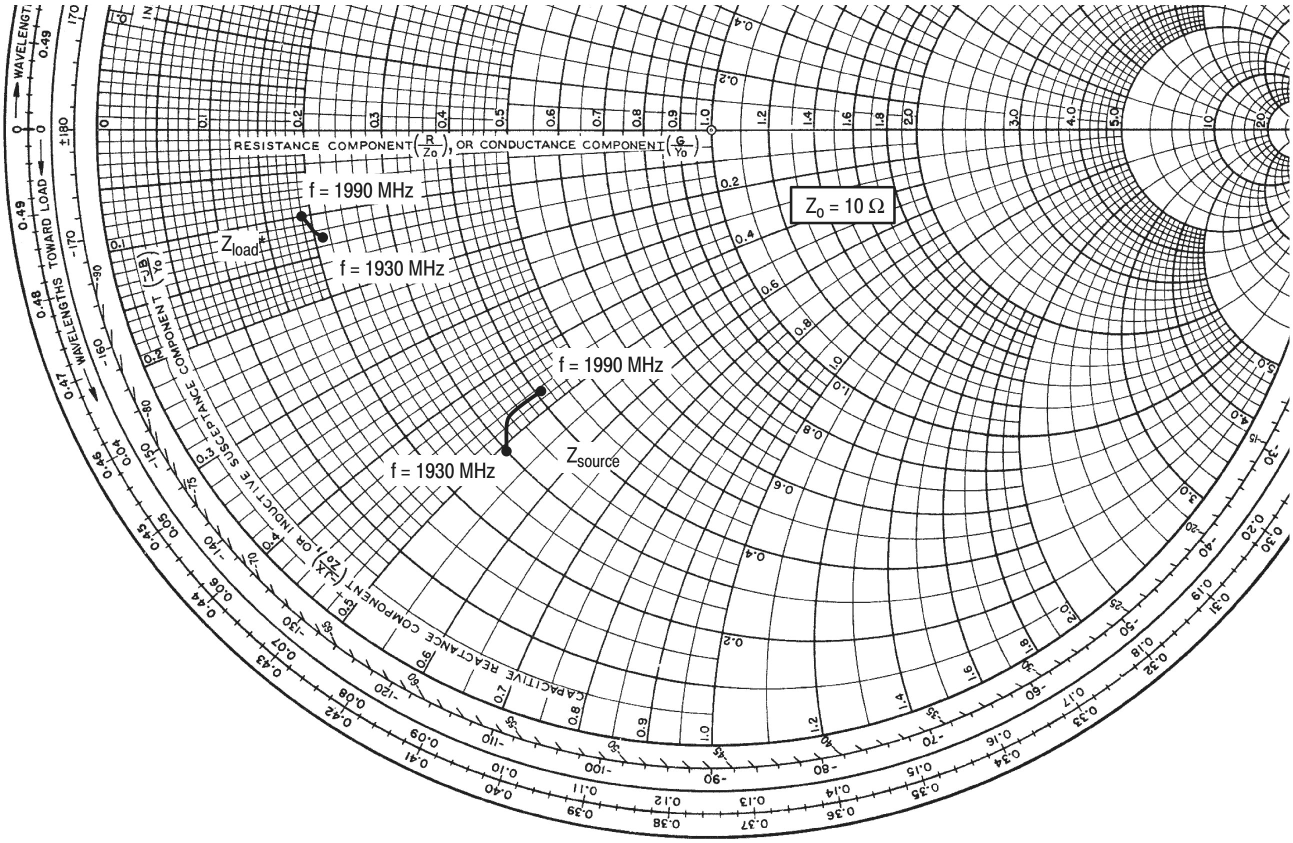


Figure 9. 2–Carrier N–CDMA Spectrum



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 10. MTBF Factor versus Junction Temperature



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.

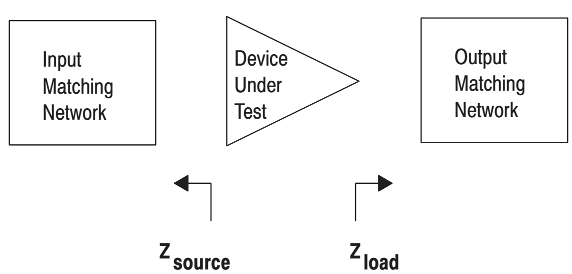


Figure 11. Series Equivalent Input and Output Impedance

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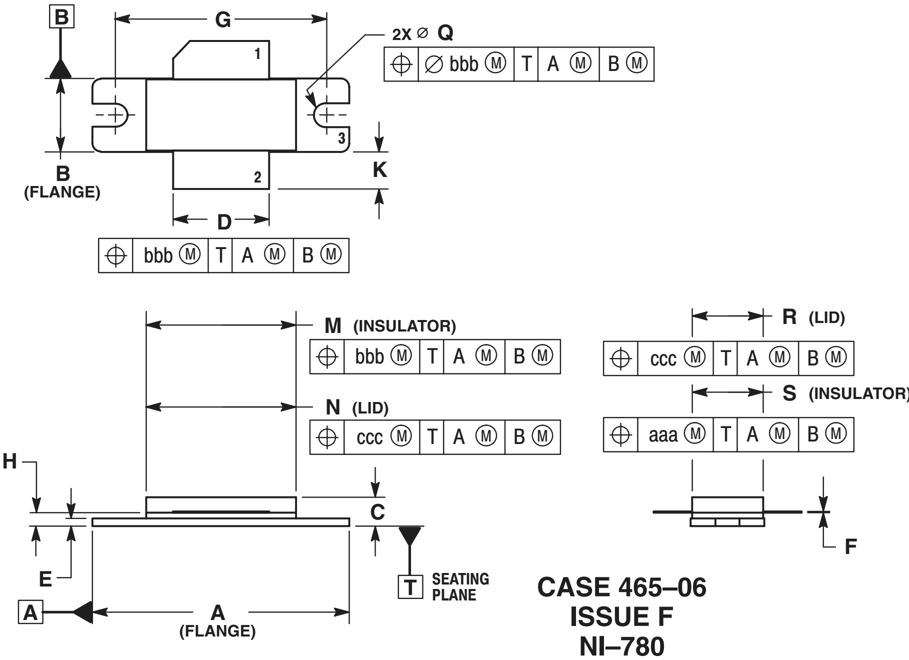
PACKAGE DIMENSIONS

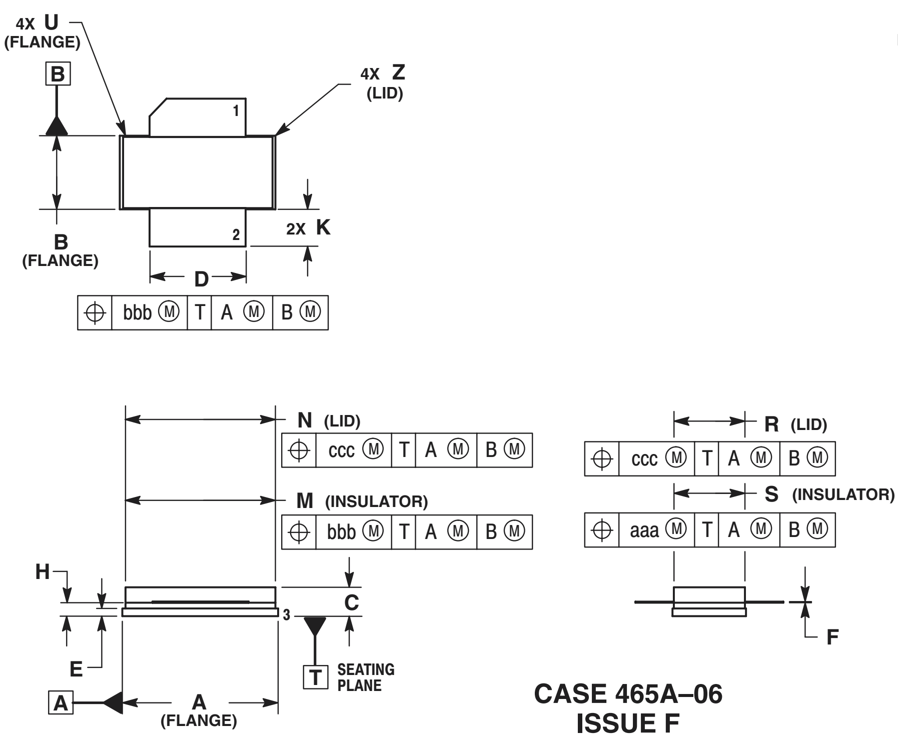


CASE 465–06
ISSUE F
NI–780
MRF5S19090L

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	∅.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 465A–06
ISSUE F
NI–780S
MRF5S19090LSR3

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	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

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