



# RF Power Field Effect Transistors

## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for GSM and EDGE base station applications with frequencies from 921 to 960 MHz, the high gain and broadband performance of these devices make them ideal for large-signal, common source amplifier applications in 26 volt base station equipment.

- On-Die Integrated Input Match
- Typical Performance @ Full GSM Band, 921 to 960 MHz, 26 Volts  
 Output Power, P1dB — 110 Watts  
 Power Gain @ P1dB — 16.5 dB  
 Efficiency @ P1dB — 53%
- Capable of Handling 5:1 VSWR, @ 26 Vdc, 921 MHz,  
 100 Watts CW Output Power

### Features

- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Available with Low Gold Plating Thickness on Leads. L Suffix Indicates 40μ" Nominal.
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

**MRF9100LR3**  
**MRF9100LSR3**

**900 MHz, 110 W, 26 V**  
**GSM/EDGE**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**

**CASE 465-06, STYLE 1**  
**NI-780**  
**MRF9100LR3**

**CASE 465A-06, STYLE 1**  
**NI-780S**  
**MRF9100LSR3**

**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	V <sub>DSS</sub>	- 0.5. +65	Vdc
Gate-Source Voltage	V <sub>GS</sub>	- 0.5. +15	Vdc
Total Device Dissipation @ T <sub>C</sub> = 25°C Derate above 25°C	P <sub>D</sub>	175 1.0	W W/°C
Storage Temperature Range	T <sub>stg</sub>	- 65 to +150	°C
Case Operating Temperature	T <sub>C</sub>	150	°C
Operating Junction Temperature	T <sub>J</sub>	200	°C

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	R <sub>θJC</sub>	1.0	°C/W

**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** ( $T_C = 25^\circ\text{C}$ , 50 ohm system unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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**Off Characteristics**

Drain-Source Breakdown Voltage ( $V_{DS} = 65\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Zero Gate Voltage Drain Current ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	1	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$

**On Characteristics**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 500\ \mu\text{Adc}$ )	$V_{GS(th)}$	2	—	4	Vdc
Gate Quiescent Voltage ( $V_{DS} = 26\text{ Vdc}$ , $I_D = 800\ \text{mAdc}$ )	$V_{GS(Q)}$	3	—	5	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )	$V_{DS(on)}$	—	0.19	0.5	Vdc

**Dynamic Characteristics** <sup>(1)</sup>

Reverse Transfer Capacitance ( $V_{DS} = 26\text{ Vdc} \pm 30\text{ mV(rms)}$ ac @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )	$C_{rss}$	—	1.0	—	pF
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**Functional Tests** (In Freescale Test Fixture)

Output Power, 1 dB Compression Point, CW ( $V_{DD} = 26\text{ Vdc}$ , $I_{DQ} = 800\text{ mA}$ , $f = 960\text{ MHz}$ )	$P_{1dB}$	100	110	—	W
Common-Source Amplifier Power Gain ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 100\text{ W CW}$ , $I_{DQ} = 800\text{ mA}$ , $f = 960\text{ MHz}$ )	$G_{ps}$	16	17	—	dB
Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 100\text{ W CW}$ , $I_{DQ} = 800\text{ mA}$ , $f = 960\text{ MHz}$ )	$\eta$	47	51	—	%
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 100\text{ W CW}$ , $I_{DQ} = 800\text{ mA}$ , $f_1 = 921\text{ MHz}$ and $960\text{ MHz}$ , $f_2 = 940\text{ MHz}$ )	IRL	—	—	-10	dB
Third Order Intermodulation Distortion ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 100\text{ W PEP}$ , $I_{DQ} = 800\text{ mA}$ , $f = \text{Full GSM Band } 921\text{ - }960\text{ MHz}$ , Tone Spacing = 100 kHz)	IMD	—	-30	—	dBc

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

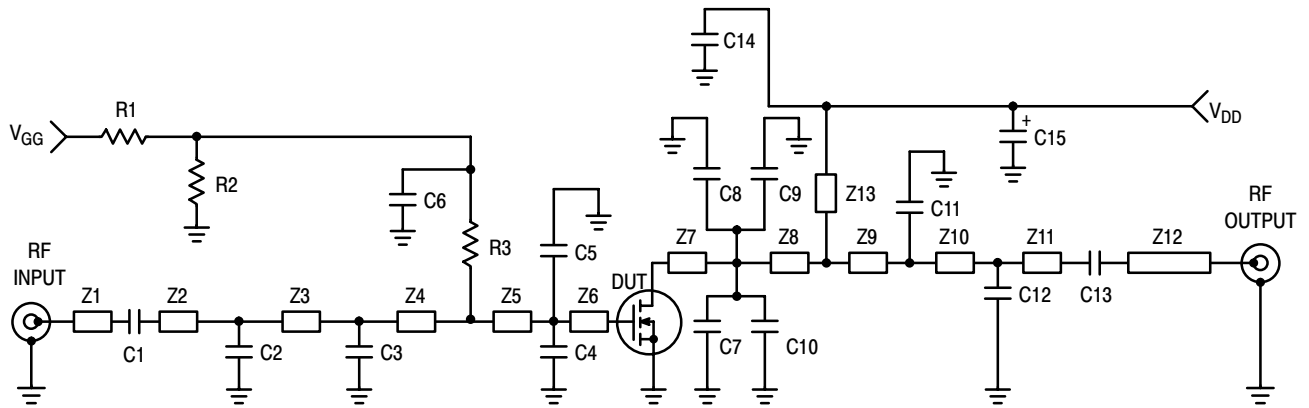
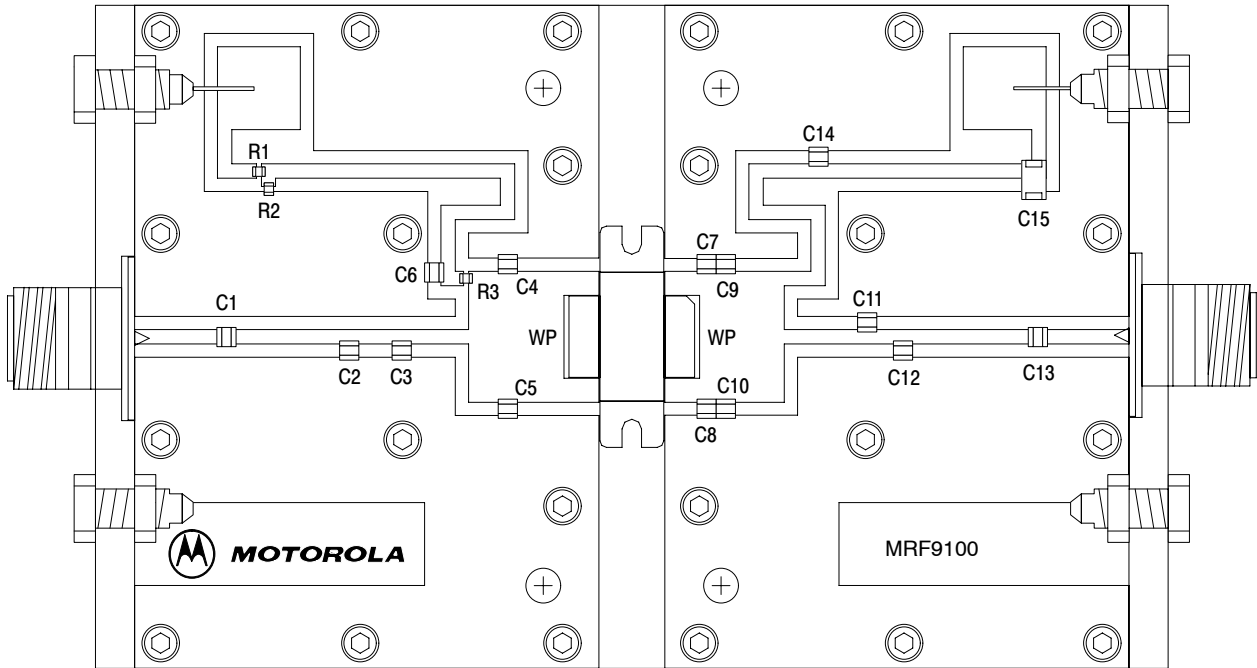


Figure 1. MRF9100L Test Circuit Schematic

Table 5. MRF9100L Test Circuit Component Designations and Values

Designators	Description
C1, C13	22 pF, 100B Chip Capacitors, ATC #100B220GW
C2, C12	2.2 pF, 100B Chip Capacitors, ATC #100B2R2BW
C3	6.8 pF, 100B Chip Capacitor, ATC #100B6R8CW
C4, C5	10 pF, 100B Chip Capacitors, ATC #100B100GW
C6, C14	33 pF, 100B Chip Capacitors, ATC #100B330JW
C7, C8, C9, C10	4.7 pF, 100B Chip Capacitors, ATC #100B4R7BW
C11	2.7 pF, 100B Chip Capacitor, ATC #100B2R7BW
C15	10 $\mu$ F, 35 V Tantalum Chip Capacitor, Vishay-Sprague #293D106X9035D
R1, R2	10 k $\Omega$ , 1/8 W Chip Resistors (0805)
R3	1 k $\Omega$ , 1/8 W Chip Resistor (0805)
Z1	0.495" x 0.087" Microstrip
Z2	0.657" x 0.087" Microstrip
Z3	0.324" x 0.087" Microstrip
Z4	0.429" x 0.087" Microstrip
Z5	0.250" x 0.790" Microstrip
Z6	0.535" x 0.790" Microstrip
Z7	0.312" x 0.790" Microstrip
Z8	0.409" x 0.790" Microstrip
Z9	0.432" x 0.087" Microstrip
Z10	0.220" x 0.087" Microstrip
Z11	0.828" x 0.087" Microstrip
Z12	0.485" x 0.087" Microstrip
Z13	1.602" x 0.087" Microstrip
Substrate	Taconic TLX8, Thickness 0.8 mm



Freescall has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescall Semiconductor signature/logo. PCBs may have either Motorola or Freescall markings during the transition period. These changes will have no impact on form, fit or function of the current product.

**Figure 2. MRF9100L Test Circuit Component Layout**

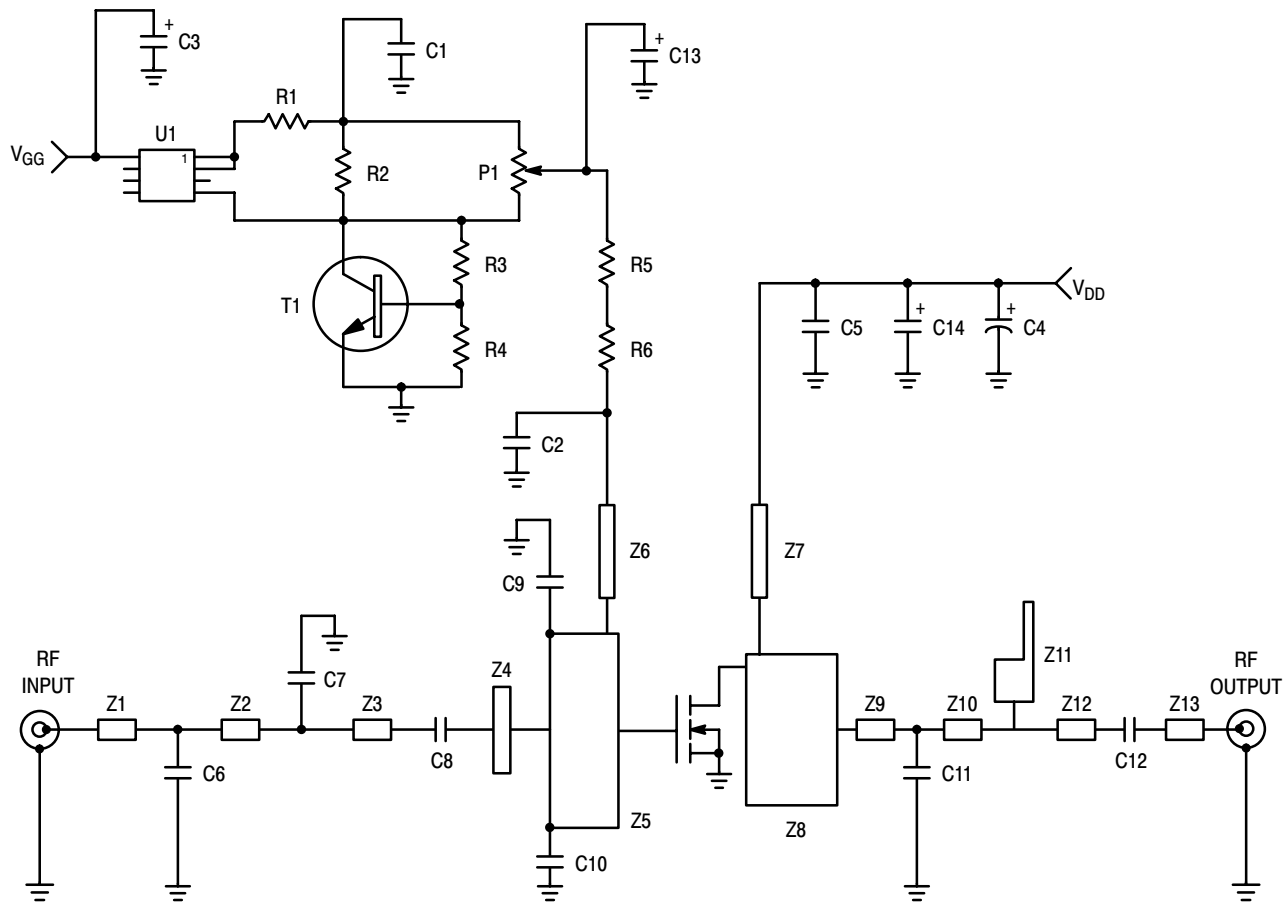
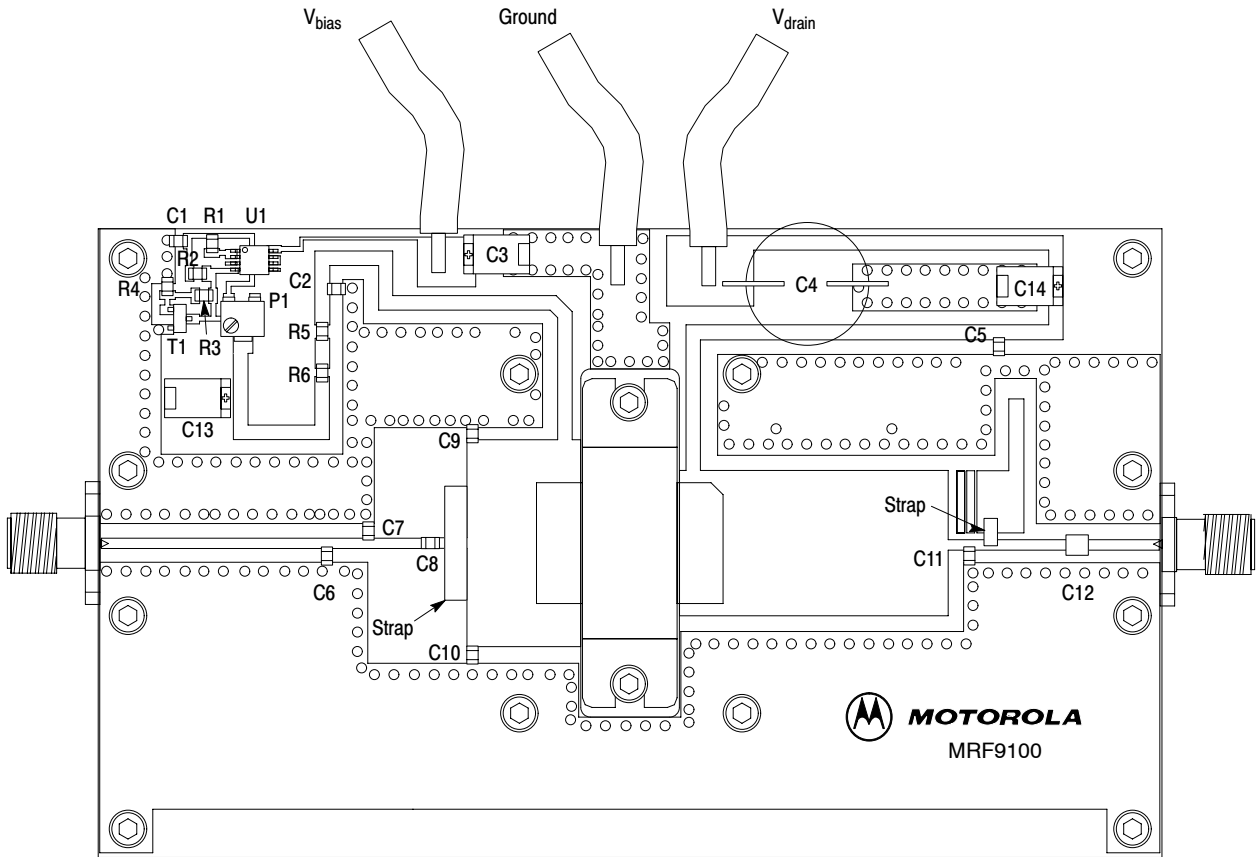


Figure 3. MRF9100L Demo Board Schematic

**Table 6. GSM 900 Optimized Demo Board Component Designations and Values**

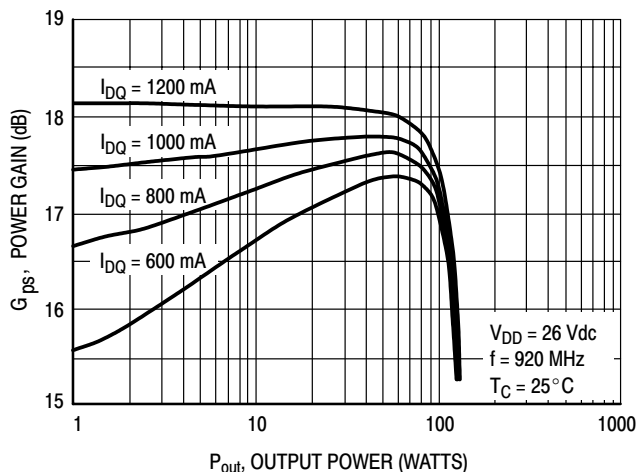
Designators	Description
C1	1.0 $\mu$ F Chip Capacitor, AVX #08053G105ZATEA (0805)
C2, C5	33 pF Chip Capacitors, AVX #08051J330GBT, ACCU-P (0805)
C3, C13, C14	22 $\mu$ F, 35 V Tantalum Chip Capacitors, Kemet #T491x226K035AS4394
C4	220 $\mu$ F, 63 V Electrolytic Capacitor Radial, Philips #13668221
C6	5.6 pF Chip Capacitor, AVX #08051J5R6CBT, ACCU-P (0805)
C7	4.7 pF Chip Capacitor, AVX #08051J4R7CBT, ACCU-P (0805)
C8	22 pF Chip Capacitor, AVX #08051J220GBT, ACCU-P (0805)
C9, C10	3.9 pF Chip Capacitors, AVX #08051J3R9BBT, ACCU-P (0805)
C11	2.2 pF Chip Capacitor, AVX #08051J2R2BBT, ACCU-P (0805)
C12	33 pF, 100B Chip Capacitor, ATC #100B330JW
P1	5.0 k $\Omega$ Potentiometer CMS Cermet multi-turn, Bourns #3224W
R1	10 $\Omega$ , 1/8 W Chip Resistor (0805)
R2	1.0 k $\Omega$ , 1/8 W Chip Resistor (0805)
R3	1.2 k $\Omega$ , 1/8 W Chip Resistor (0805)
R4	2.2 k $\Omega$ , 1/8 W Chip Resistor (0805)
R5	100 $\Omega$ , 1/8 W Chip Resistor (0805)
R6	1.0 $\Omega$ , 1/8 W Chip Resistor (0805)
T1	NPN Bipolar Transistor, SOT-23, #BC847
U1	Voltage Regulator, Micro-8, #LP2951
Z1	0.916" x 0.042" Microstrip
Z2	0.169" x 0.042" Microstrip
Z3	0.212" x 0.042" Microstrip
Z4	0.090" x 0.465" Microstrip
Z5	0.465" x 0.842" Microstrip
Z6	1.776" x 0.059" Microstrip
Z7	1.802" x 0.059" Microstrip
Z8	1.094" x 0.592" Microstrip
Z9	0.085" x 0.042" Microstrip
Z10	0.198" x 0.042" Microstrip
Z11	0.253" x 0.191" + 0.292" x 0.061" Microstrip
Z12	0.181" x 0.042" Microstrip
Z13	0.282" x 0.042" Microstrip
Substrate	Taconic RF35, Thickness 0.5 mm, $\epsilon_r = 3.5$



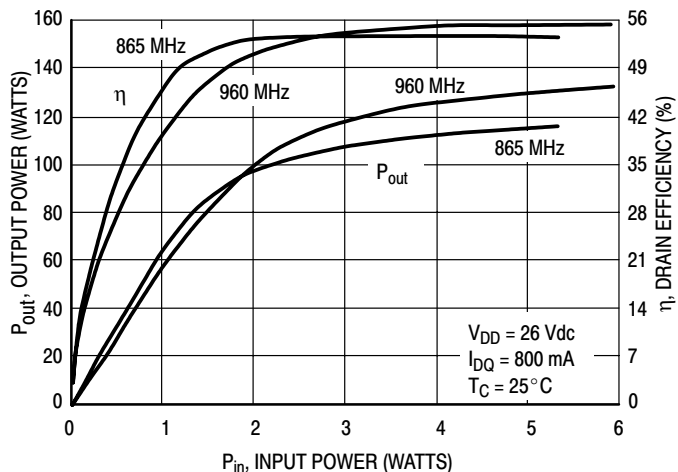
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**Figure 4. MRF9100L Demo Board Component Layout**

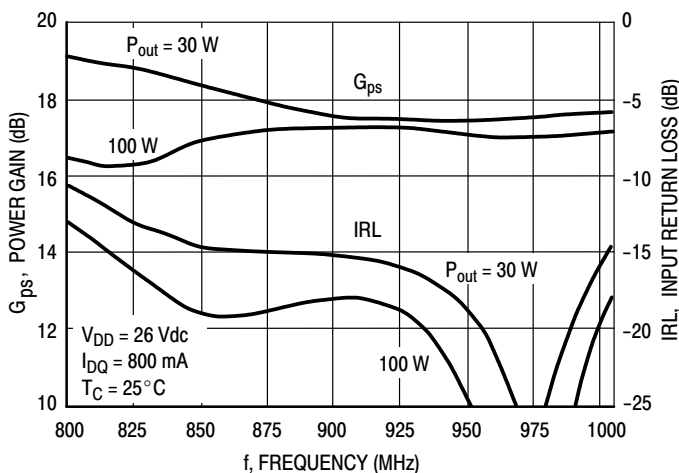
## TYPICAL CHARACTERISTICS



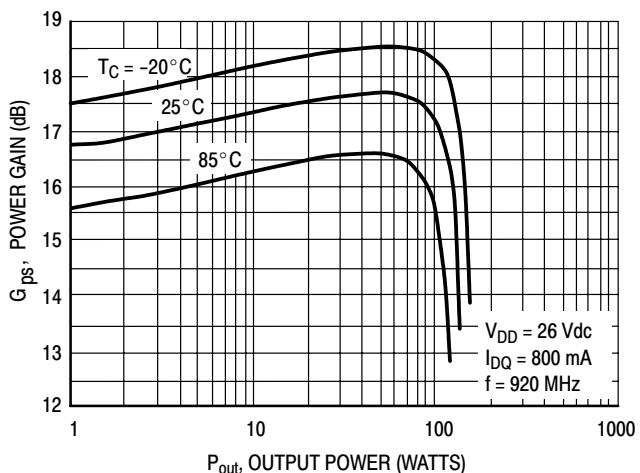
**Figure 5. Power Gain versus Output Power**



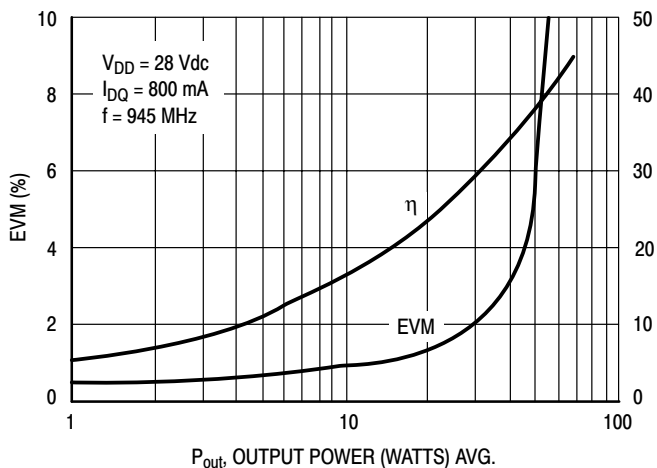
**Figure 6. Output Power and Efficiency versus Input Power**



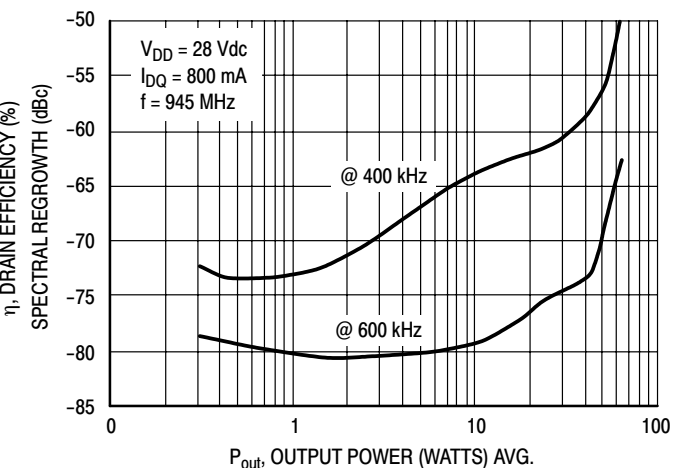
**Figure 7. Power Gain and Input Return Loss versus Frequency**



**Figure 8. Power Gain versus Output Power**

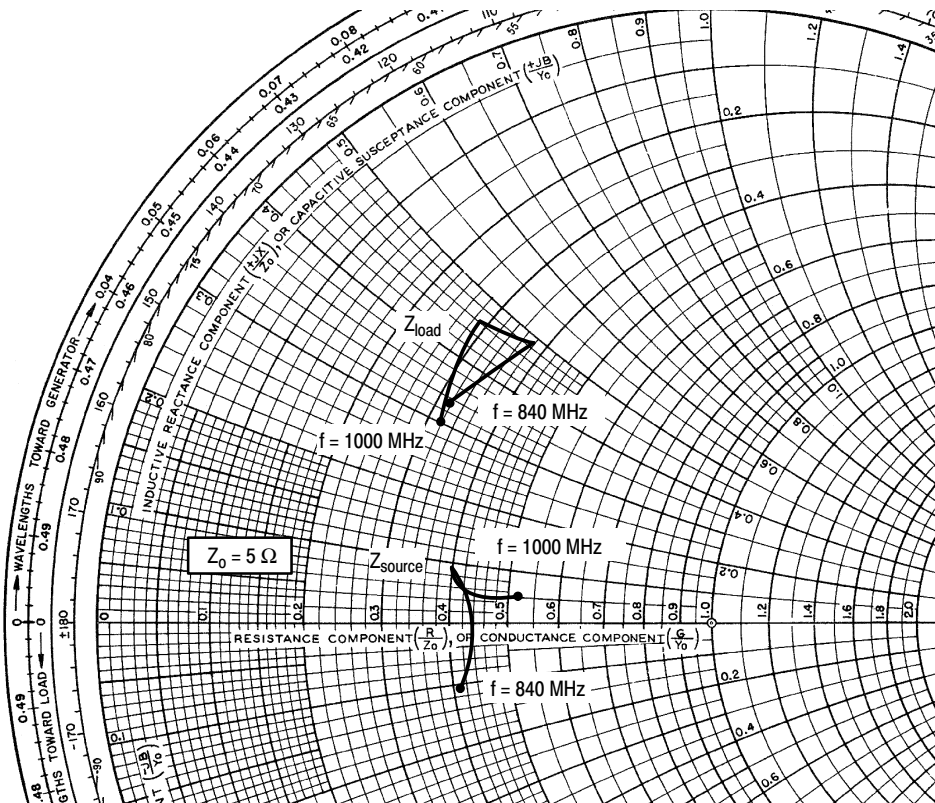


**Figure 9. EVM and Efficiency versus Output Power**



**Figure 10. Spectral Regrowth versus Output Power**





$V_{DD} = 26\text{ V}$ ,  $I_{DQ} = 800\text{ mA}$ ,  $P_{out} = 110\text{ W (CW)}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
840	$2.04 - j0.57$	$1.62 + j1.65$
880	$2.20 - j0.16$	$1.88 + j2.45$
920	$2.00 + j0.44$	$1.79 + j2.40$
960	$2.16 + j0.25$	$1.47 + j1.82$
1000	$2.62 + j0.25$	$1.58 + j1.52$

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

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

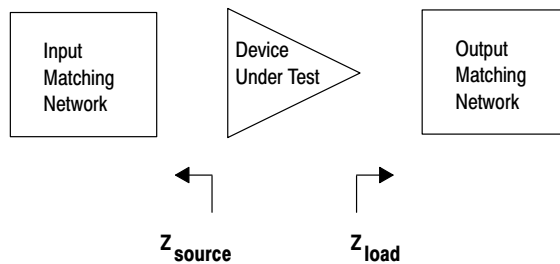
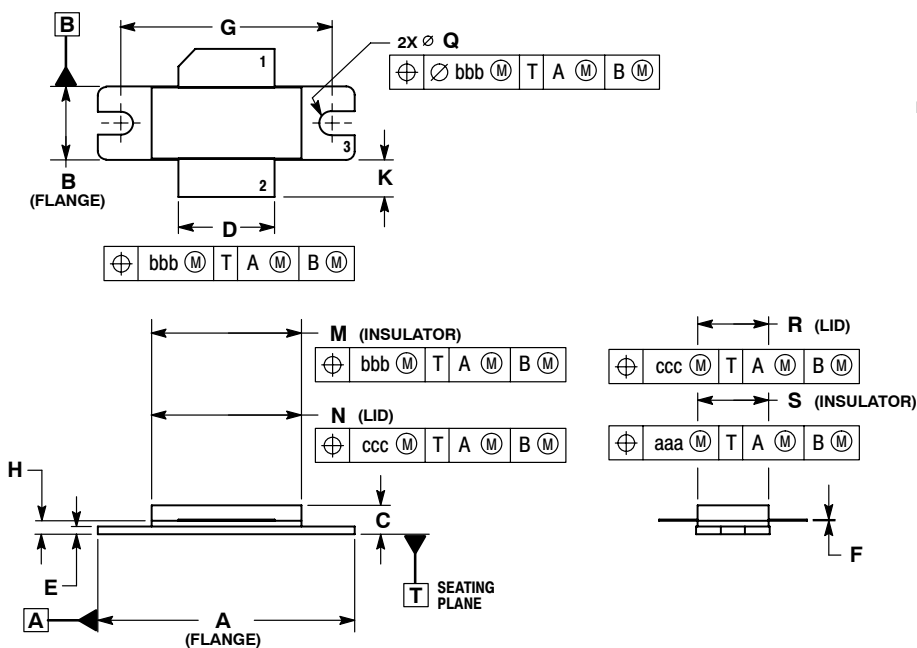


Figure 11. Series Equivalent Source and Load Impedance

# NOTES

## PACKAGE DIMENSIONS

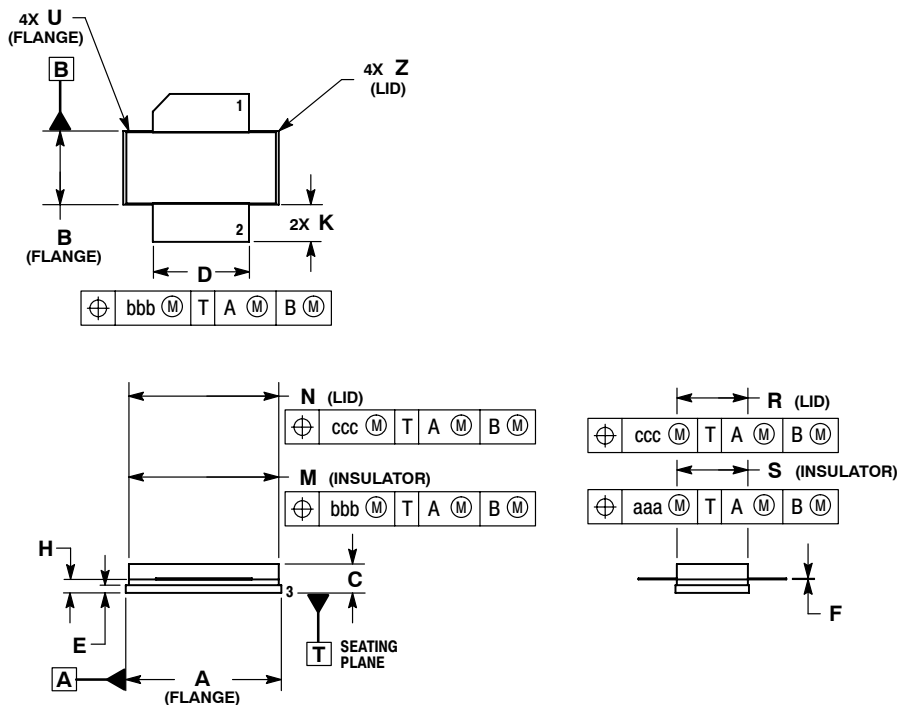


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DELETED
  4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

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 G  
 NI-780  
 MRF9100LR3**



- 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	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  
 MRF9100LSR3**

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### **USA/Europe or Locations Not Listed:**

Freescale Semiconductor  
Technical Information Center, CH370  
1300 N. Alma School Road  
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+1-800-521-6274 or +1-480-768-2130  
support@freescale.com

### **Europe, Middle East, and Africa:**

Freescale Halbleiter Deutschland GmbH  
Technical Information Center  
Schatzbogen 7  
81829 Muenchen, Germany  
+44 1296 380 456 (English)  
+46 8 52200080 (English)  
+49 89 92103 559 (German)  
+33 1 69 35 48 48 (French)  
support@freescale.com

### **Japan:**

Freescale Semiconductor Japan Ltd.  
Headquarters  
ARCO Tower 15F  
1-8-1, Shimo-Meguro, Meguro-ku,  
Tokyo 153-0064  
Japan  
0120 191014 or +81 3 5437 9125  
support.japan@freescale.com

### **Asia/Pacific:**

Freescale Semiconductor Hong Kong Ltd.  
Technical Information Center  
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Tai Po, N.T., Hong Kong  
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