

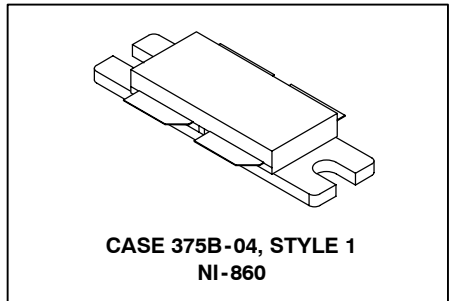
**The RF MOSFET Line**  
**RF Power Field Effect Transistors**  
**N-Channel Enhancement-Mode Lateral MOSFETs**

**MRF9120R3**  
**MRF9120LR3**

Designed for broadband commercial and industrial applications with frequencies from 865 to 895 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.

**880 MHz, 120 W, 26 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**

- Typical CDMA Performance @ 880 MHz, 26 Volts,  $I_{DQ} = 2 \times 500$  mA  
 IS-97 CDMA Pilot, Sync, Paging, Traffic Codes 8 Through 13  
 Output Power — 26 Watts  
 Power Gain — 16 dB  
 Efficiency — 26%  
 Adjacent Channel Power —  
 750 kHz: -45 dBc @ 30 kHz BW  
 1.98 MHz: -60 dBc @ 30 kHz BW
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 880 MHz, 120 Watts (CW) Output Power
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Available with Low Gold Plating Thickness on Leads. L Suffix Indicates 40 $\mu$ " Nominal.
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.



**MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	- 0.5, +65	Vdc
Gate-Source Voltage	$V_{GS}$	- 0.5, +15	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25 $^\circ\text{C}$	$P_D$	250 1.43	W W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	- 65 to +150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$

**THERMAL CHARACTERISTICS**

Characteristic	Symbol	Value (1)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.45	$^\circ\text{C}/\text{W}$

**ESD PROTECTION CHARACTERISTICS**

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M1 (Minimum)

(1) MTTF calculator available at <http://www.motorola.com/semiconductors/rf>. Select Tools/Software/Application Software/Calculators to access the MTTF calculators by product.

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

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## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS (1)

Zero Gate Voltage Drain Leakage Current (V <sub>DS</sub> = 65 Vdc, V <sub>GS</sub> = 0 Vdc)	I <sub>DSS</sub>	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V <sub>DS</sub> = 26 Vdc, V <sub>GS</sub> = 0 Vdc)	I <sub>DSS</sub>	—	—	1	μAdc
Gate-Source Leakage Current (V <sub>GS</sub> = 5 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	—	—	1	μAdc

### ON CHARACTERISTICS (1)

Gate Threshold Voltage (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 200 μAdc)	V <sub>GS(th)</sub>	2	3	4	Vdc
Gate Quiescent Voltage (V <sub>DS</sub> = 26 Vdc, I <sub>D</sub> = 450 mAdc)	V <sub>GS(Q)</sub>	—	3.8	—	Vdc
Drain-Source On-Voltage (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 1.3 Adc)	V <sub>DS(on)</sub>	—	0.17	0.4	Vdc
Forward Transconductance (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 4 Adc)	g <sub>fs</sub>	—	5.3	—	S

### DYNAMIC CHARACTERISTICS (1)

Output Capacitance (V <sub>DS</sub> = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V <sub>GS</sub> = 0 Vdc)	C <sub>oss</sub>	—	50	—	pF
Reverse Transfer Capacitance (V <sub>DS</sub> = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V <sub>GS</sub> = 0 Vdc)	C <sub>rss</sub>	—	2	—	pF

(1) Each side of device measured separately.

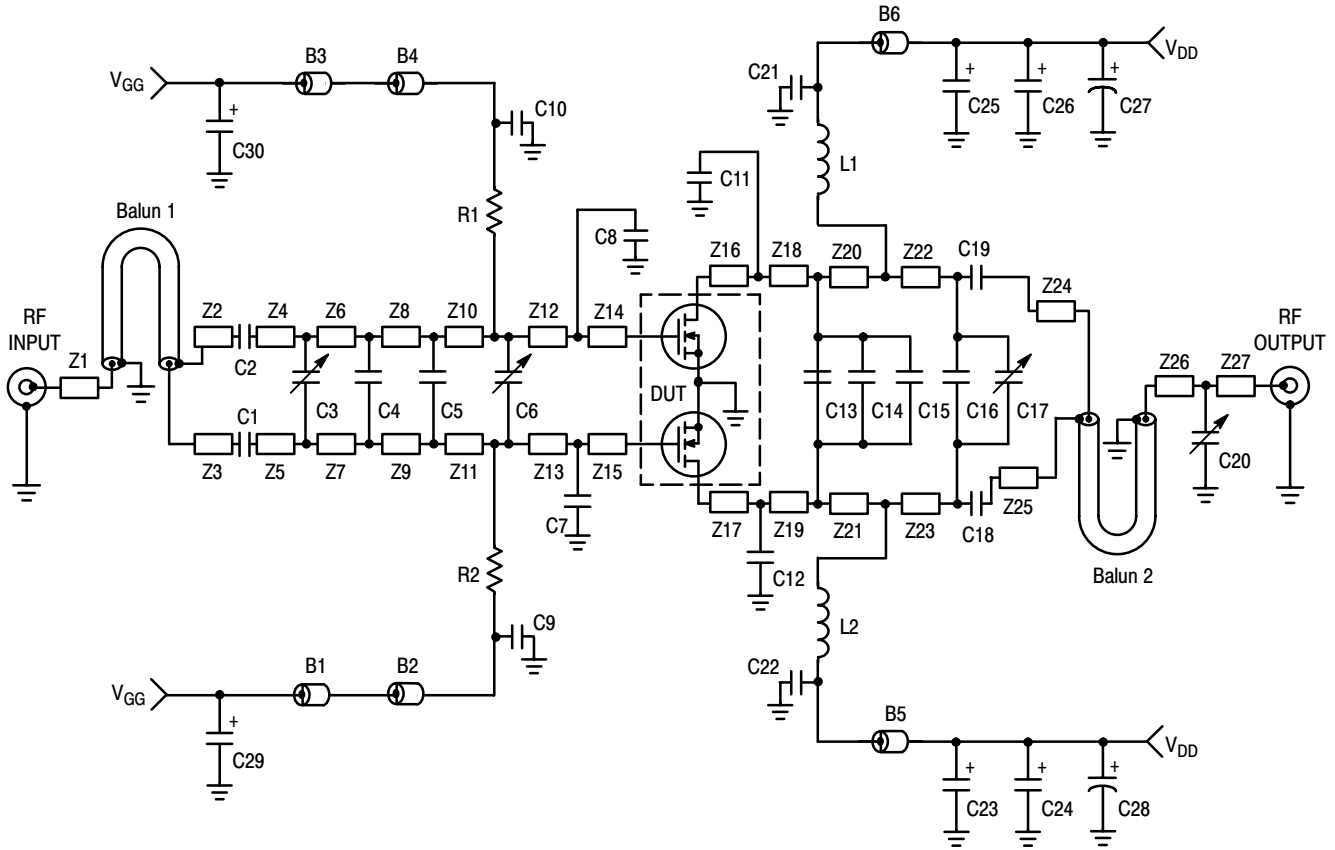
(continued)

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## ELECTRICAL CHARACTERISTICS — continued ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>FUNCTIONAL TESTS</b> (In Motorola Test Fixture, 50 ohm system) <sup>(2)</sup>					
Two-Tone Common-Source Amplifier Power Gain ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 880.0\text{ MHz}$ , $f_2 = 880.1\text{ MHz}$ )	$G_{ps}$	15	16.5	—	dB
Two-Tone Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 880.0\text{ MHz}$ , $f_2 = 880.1\text{ MHz}$ )	$\eta$	36	39	—	%
3rd Order Intermodulation Distortion ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 880.0\text{ MHz}$ , $f_2 = 880.1\text{ MHz}$ )	IMD	—	-31	-28	dBc
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 880.0\text{ MHz}$ , $f_2 = 880.1\text{ MHz}$ )	IRL	—	-16	-9	dB
Two-Tone Common-Source Amplifier Power Gain ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 895.0\text{ MHz}$ , $f_2 = 895.1\text{ MHz}$ )	$G_{ps}$	—	16.5	—	dB
Two-Tone Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 895.0\text{ MHz}$ , $f_2 = 895.1\text{ MHz}$ )	$\eta$	—	40.5	—	%
3rd Order Intermodulation Distortion ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 895.0\text{ MHz}$ , $f_2 = 895.1\text{ MHz}$ )	IMD	—	-30	—	dBc
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W PEP}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 895.0\text{ MHz}$ , $f_2 = 895.1\text{ MHz}$ )	IRL	—	-13	—	dB
Power Output, 1 dB Compression Point ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W CW}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 880.0\text{ MHz}$ )	$P_{1dB}$	—	120	—	W
Common-Source Amplifier Power Gain ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W CW}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 880.0\text{ MHz}$ )	$G_{ps}$	—	16	—	dB
Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W CW}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f_1 = 880.0\text{ MHz}$ )	$\eta$	—	51	—	%
Output Mismatch Stress ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 120\text{ W CW}$ , $I_{DQ} = 2 \times 500\text{ mA}$ , $f = 880.0\text{ MHz}$ , $V_{SWR} = 10:1$ , All Phase Angles at Frequency of Tests)	$\Psi$	No Degradation In Output Power			

(2) Device measured in push-pull configuration.



Z1	0.420" x 0.080" Microstrip	Z14, Z15	0.040" x 0.630" Microstrip
Z2, Z3	0.090" x 0.420" Microstrip	Z16, Z17	0.040" x 0.630" Microstrip
Z4, Z5	0.125" x 0.220" Microstrip	Z18, Z19	0.330" x 0.630" Microstrip
Z6, Z7	0.095" x 0.220" Microstrip	Z20, Z21	0.450" x 0.630" Microstrip
Z8, Z9	0.600" x 0.220" Microstrip	Z22, Z23	0.750" x 0.220" Microstrip
Z10, Z11	0.200" x 0.630" Microstrip	Z24, Z25	0.115" x 0.420" Microstrip
Z12, Z13	0.500" x 0.630" Microstrip	Z26	0.130" x 0.080" Microstrip
		Z27	0.350" x 0.080" Microstrip

Figure 1. 880 MHz Broadband Test Circuit Schematic

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Table 1. 880 MHz Broadband Test Circuit Component Designations and Values

Part	Description	Value, P/N or DWG	Manufacturer
B1, B3, B5, B6	Long Ferrite Beads, Surface Mount	95F787	Newark
B2, B4	Short Ferrite Beads, Surface Mount	95F786	Newark
C1, C2	68 pF Chip Capacitors, B Case	100B680JP500X	ATC
C3, C6	0.8 - 8.0 pF Variable Capacitors	44F3360	Newark
C4	7.5 pF Chip Capacitor, B Case	100B7R5JP150X	ATC
C5	3.3 pF Chip Capacitor, B Case	100B3R3CP150X	ATC
C7, C8	11 pF Chip Capacitors, B Case	100B110BCA500X	ATC
C9, C10, C21, C22	51 pF Chip Capacitors, B Case	100B510JP500X	ATC
C11, C12	6.2 pF Chip Capacitors, B Case	100B6R2BCA150X	ATC
C13	4.7 pF Chip Capacitor, B Case	100B4R7BCA150X	ATC
C14	5.1 pF Chip Capacitor, B Case	100B5R1BCA150X	ATC
C15	3.0 pF Chip Capacitor, B Case	100B2R7BCA150X	ATC
C16	2.7 pF Chip Capacitor, B Case	100B3R0BCA150X	ATC
C17	0.6 - 4.5 pF Variable Capacitor	44F3358	Newark
C18, C19	47 pF Chip Capacitors, B Case	100B470JP500X	ATC
C20	0.4 - 2.5 pF Variable Capacitor	44F3367	Newark
C29, C30	10 $\mu$ F, 35 V Tantalum Chip Capacitors	93F2975	Newark
C23, C24, C25, C26	22 $\mu$ F, 35 V Tantalum Chip Capacitors	92F1853	Newark
C27, C28	220 $\mu$ F, 50 V Electrolytic Capacitors	14F185	Newark
Balun 1, Balun 2	Xinger Surface Mount Balun Transformers	3A412	Anaren
L1, L2	12.5 nH Mini Spring Inductors	A04T-5	Coilcraft
R1, R2	510 $\Omega$ , 1/4 W Chip Resistors		Garret
WB1, WB2, WB3, WB4	10 mil Brass Wear Blocks		
Board Material	30 mil Glass Teflon <sup>®</sup> , $\epsilon_r = 2.55$ Copper Clad, 2 oz Cu	900 MHz Push-Pull Rev 01B	CMR
PCB	Etched Circuit Board	900 MHz Push-Pull Rev 01B	CMR

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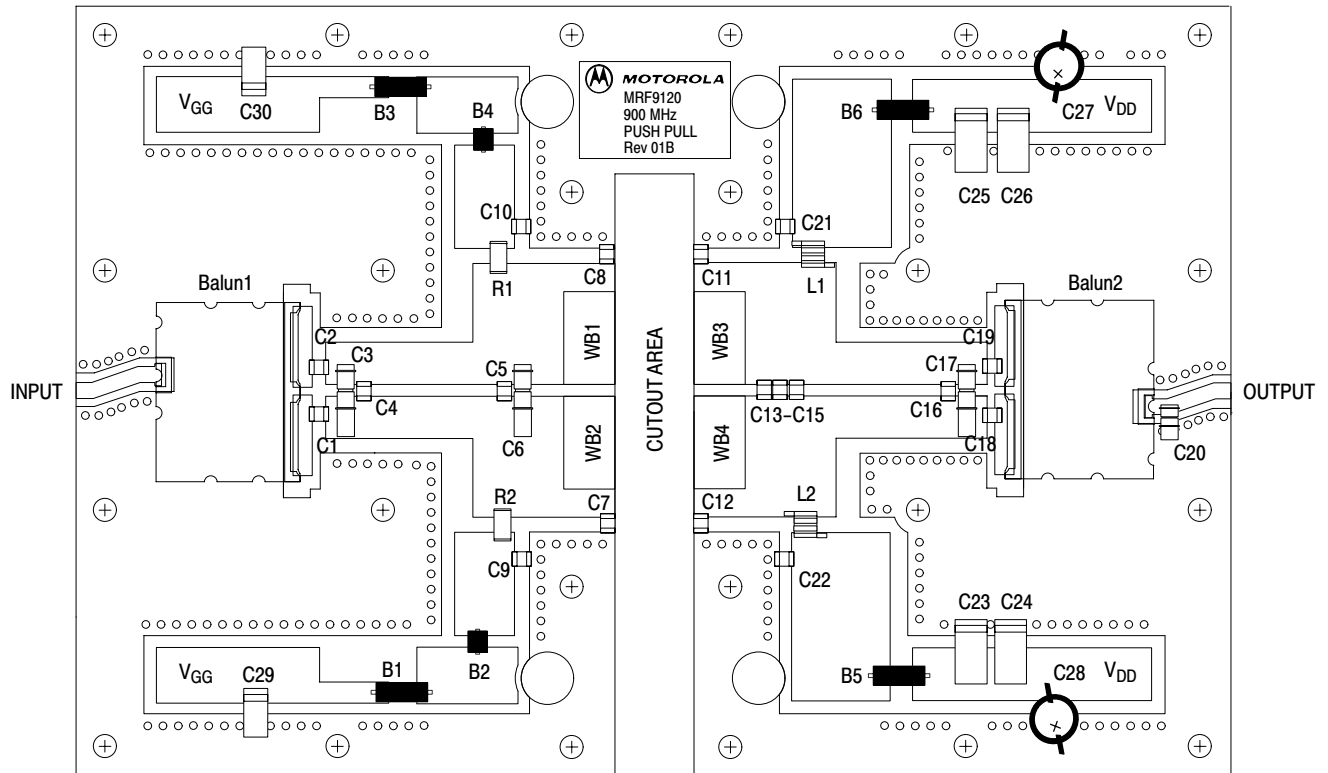


Figure 2. 865-895 MHz Broadband Test Circuit Component Layout

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## TYPICAL CHARACTERISTICS

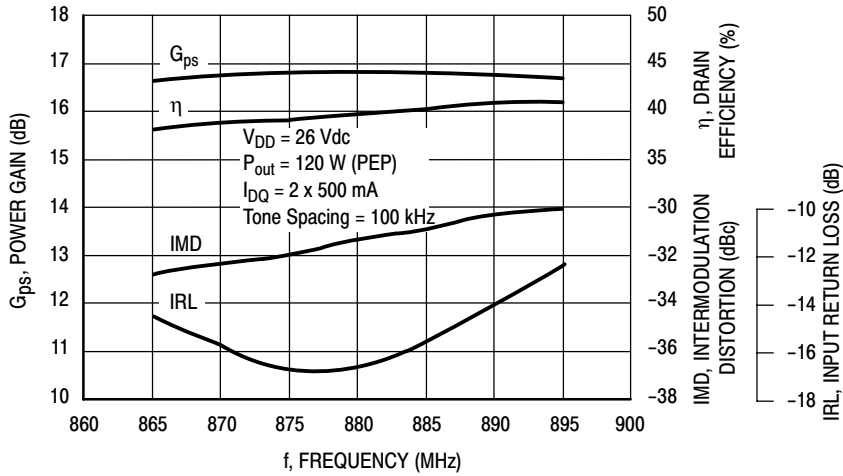


Figure 3. Class AB Broadband Circuit Performance

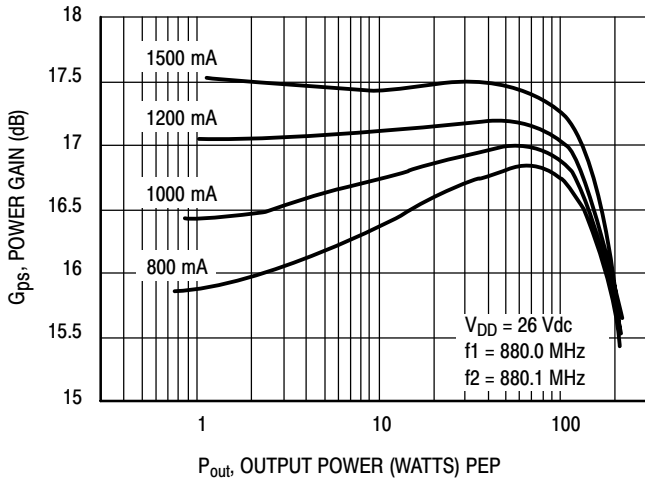


Figure 4. Power Gain versus Output Power

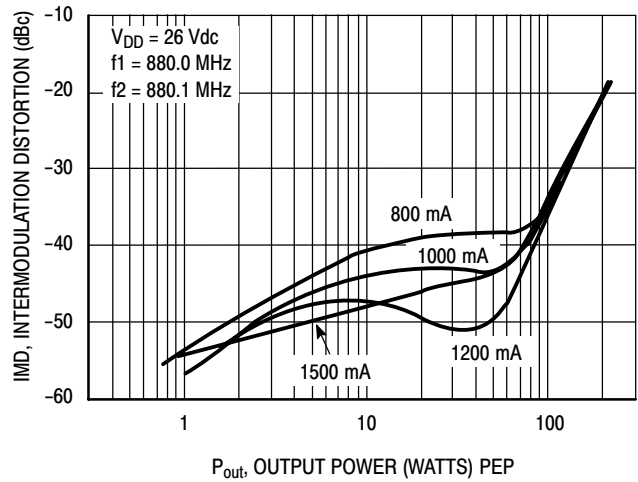


Figure 5. Intermodulation Distortion versus Output Power

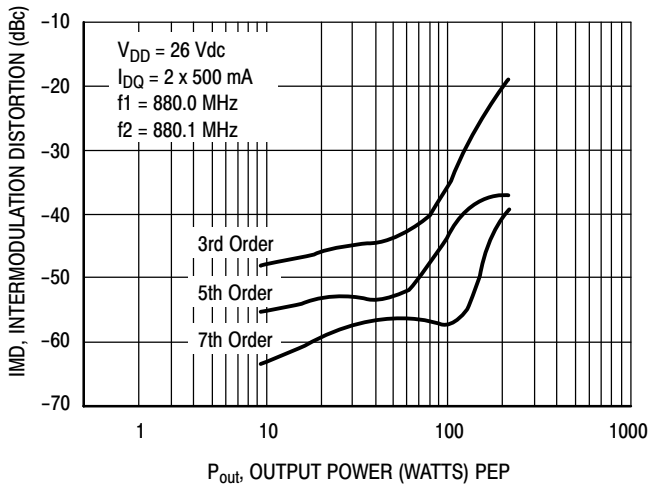


Figure 6. Intermodulation Distortion Products versus Output Power

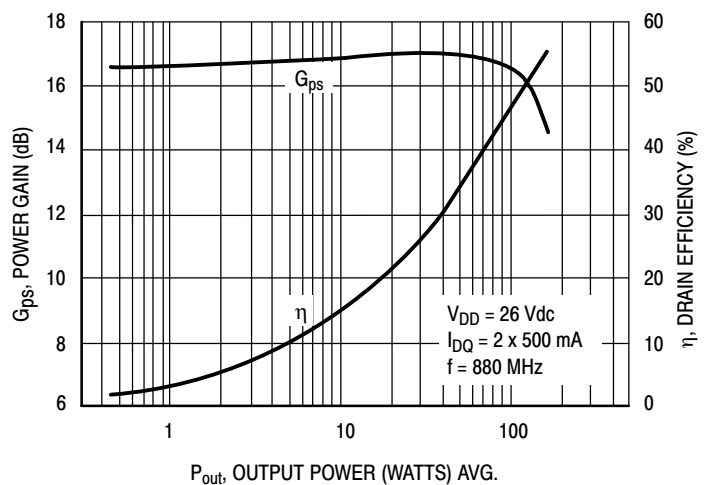
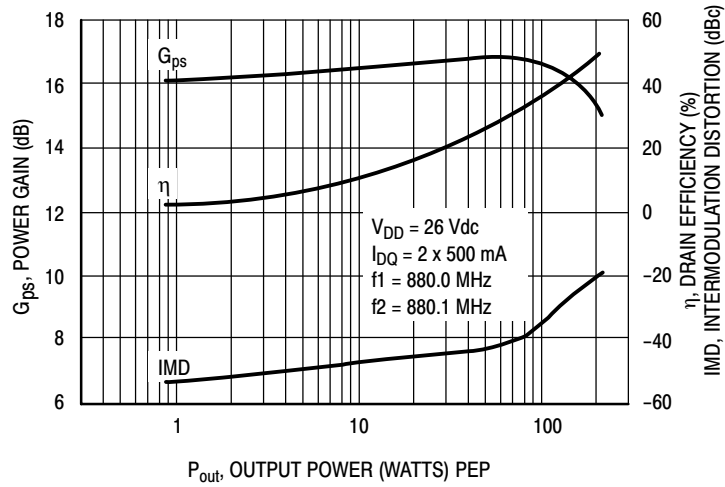


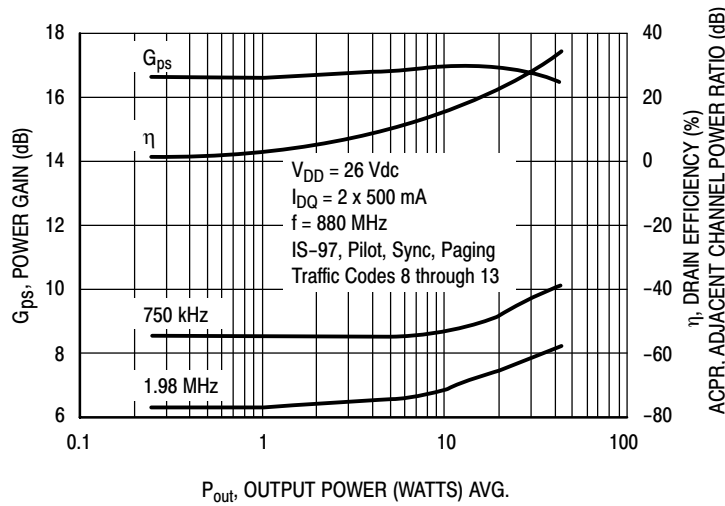
Figure 7. Power Gain and Efficiency versus Output Power

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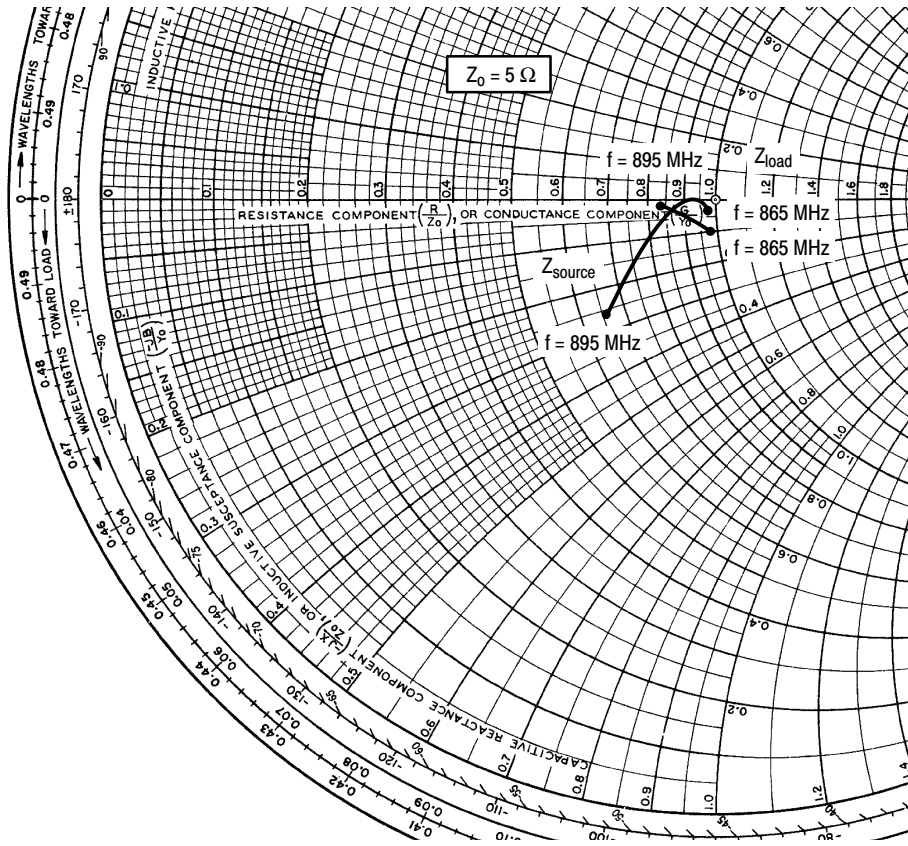
## TYPICAL CHARACTERISTICS



**Figure 8. Power Gain, Efficiency and IMD versus Output Power**



**Figure 9. Power Gain, Efficiency and ACPR versus Output Power**



$V_{DD} = 26\text{ V}$ ,  $I_{DQ} = 2 \times 500\text{ mA}$ ,  $P_{out} = 120\text{ W PEP}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
865	$4.89 - j0.2$	$4.9 - j0.5$
880	$4.54 + j0.07$	$4.6 - j0.32$
895	$3.29 - j1.3$	$4.2 - j0.04$

$Z_{source}$  = Test circuit impedance as measured from gate to gate, balanced configuration.

$Z_{load}$  = Test circuit impedance as measured from drain to drain, balanced configuration.

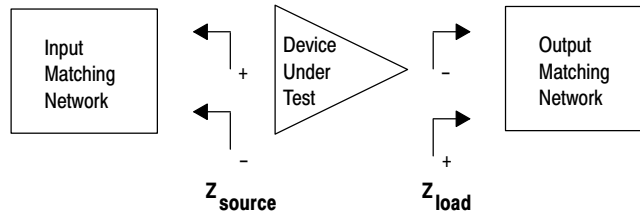


Figure 10. Series Equivalent Input and Output Impedance



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**NOTES**

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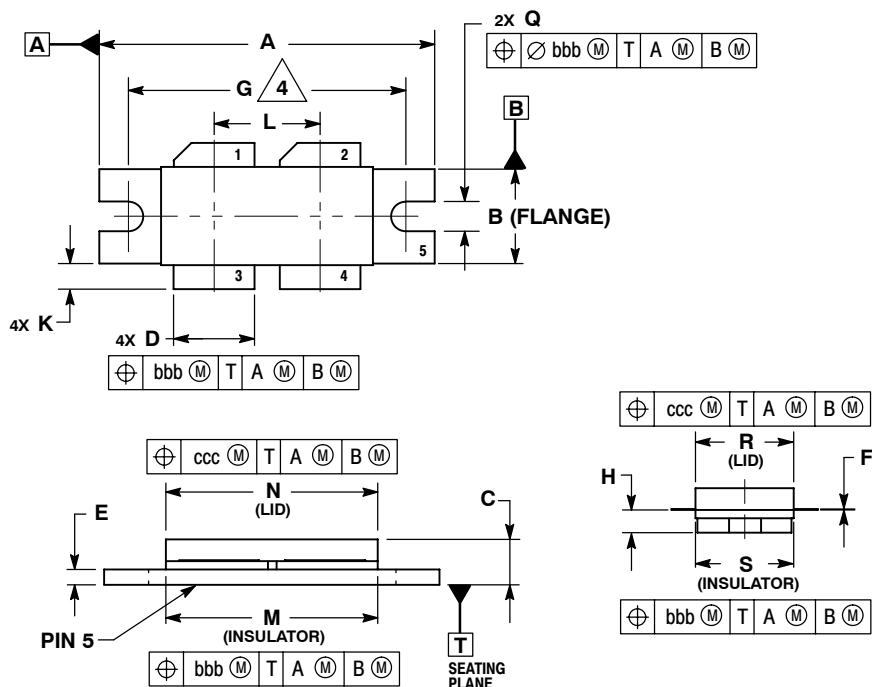


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**NOTES**

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## PACKAGE DIMENSIONS



- NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.
  4. RECOMMENDED BOLT CENTER DIMENSION OF 1.140 (28.96) BASED ON M3 SCREW.

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	0.180	0.224	4.57	5.69
D	0.325	0.335	8.26	8.51
E	0.060	0.070	1.52	1.78
F	0.004	0.006	0.10	0.15
G	1.100 BSC		27.94 BSC	
H	0.097	0.107	2.46	2.72
K	0.085	0.115	2.16	2.92
L	0.425 BSC		10.80 BSC	
M	0.852	0.868	21.64	22.05
N	0.851	0.869	21.62	22.07
Q	0.118	0.138	3.00	3.51
R	0.395	0.405	10.03	10.29
S	0.394	0.406	10.01	10.31
bbb	0.010 REF		0.25 REF	
ccc	0.015 REF		0.38 REF	

- STYLE 1:  
 PIN 1. DRAIN  
 2. DRAIN  
 3. GATE  
 4. GATE  
 5. SOURCE

**CASE 375B-04  
 ISSUE E  
 NI-860**

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