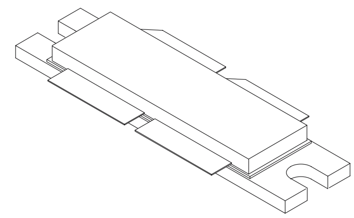
The RF Sub–Micron MOSFET Line
RF Power Field Effect Transistors
N–Channel Enhancement–Mode Lateral MOSFETs

MRF9180
MRF9180S

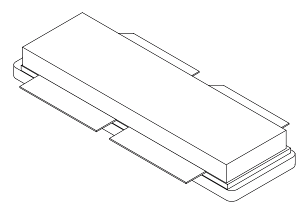
Designed for broadband commercial and industrial applications with frequencies from 865 to 895 MHz. The high gain and broadband performance of these devices make them ideal for large–signal, common–source amplifier applications in 26 volt base station equipment.

- Typical CDMA Performance @ 880 MHz, 26 Volts, $I_{DQ} = 2 \times 700$ mA
  IS–97 CDMA Pilot, Sync, Paging, Traffic Codes 8 Through 13
  - Output Power — 40 Watts
  - Power Gain — 17 dB
  - Efficiency — 26%
  - Adjacent Channel Power –
    - 750 kHz: –45.0 dBc @ 30 kHz BW
    - 1.98 MHz: –60.0 dBc @ 30 kHz BW
- 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, @ 26 Vdc, 880 MHz, 170 Watts (CW) Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large–Signal Impedance Parameters

880 MHz, 170 W, 26 V
LATERAL N–CHANNEL
RF POWER MOSFETs



CASE 375D–04, STYLE 1
NI–1230
MRF9180



CASE 375E–03, STYLE 1
NI–1230S
MRF9180S

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	388 2.22	Watts W/°C
Storage Temperature Range	T_{stg}	–65 to +200	°C
Operating Junction Temperature	T_J	200	°C

ESD PROTECTION CHARACTERISTICS

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

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.45	°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 6

MOTOROLA
intelligence everywhere™
digital dna™

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

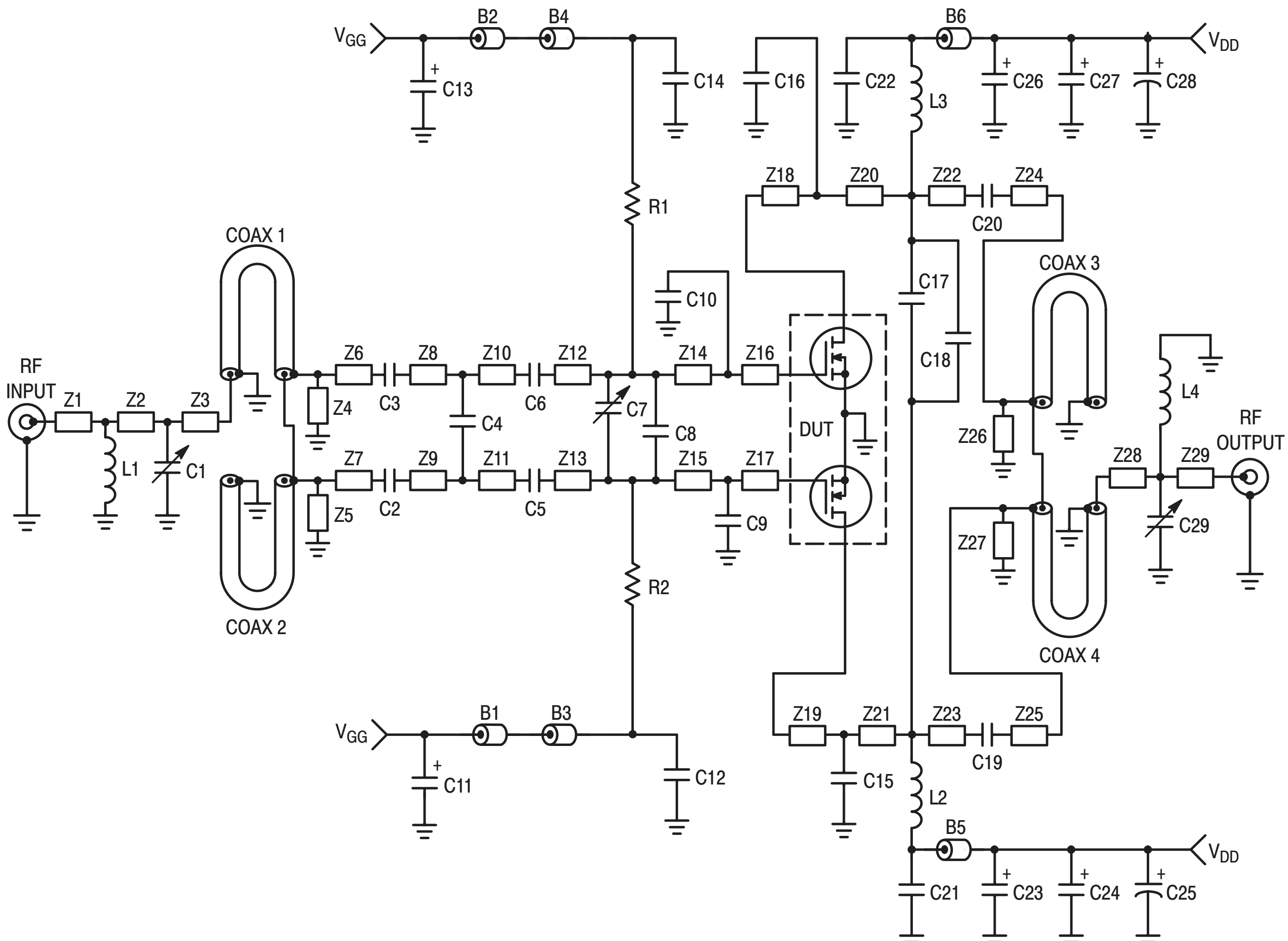
Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (1)					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 65 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 26 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Gate–Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
ON CHARACTERISTICS (1)					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 300 μAdc)	$V_{GS(th)}$	2	2.9	4	Vdc
Gate Quiescent Voltage (V_{DS} = 26 Vdc, I_D = 700 mAdc)	$V_{GS(Q)}$	—	3.7	—	Vdc
Drain–Source On–Voltage (V_{GS} = 10 Vdc, I_D = 2 Adc)	$V_{DS(on)}$	—	0.19	0.5	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 6 Adc)	g_{fs}	—	6	—	S
DYNAMIC CHARACTERISTICS (1)					
Output Capacitance (V_{DS} = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	77	—	pF
Reverse Transfer Capacitance (V_{DS} = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	3.8	—	pF
FUNCTIONAL TESTS (In Motorola Test Fixture, 50 ohm system) (2)					
Two–Tone Common–Source Amplifier Power Gain (V_{DD} = 26 Vdc, P_{out} = 170 W PEP, I_{DQ} = 2 × 700 mA, f1 = 880.0 MHz, f2 = 880.1 MHz)	G_{ps}	16	17.5	—	dB
Two–Tone Drain Efficiency (V_{DD} = 26 Vdc, P_{out} = 170 W PEP, I_{DQ} = 2 × 700 mA, f1 = 880.0 MHz, f2 = 880.1 MHz)	η	35	39	—	%
3rd Order Intermodulation Distortion (V_{DD} = 26 Vdc, P_{out} = 170 W PEP, I_{DQ} = 2 × 700 mA, f1 = 880.0 MHz, f2 = 880.1 MHz)	IMD	—	–31	–28	dBc
Input Return Loss (V_{DD} = 26 Vdc, P_{out} = 170 W PEP, I_{DQ} = 2 × 700 mA, f1 = 880.0 MHz, f2 = 880.1 MHz)	IRL	—	–15	–9	dB
Two–Tone Common–Source Amplifier Power Gain (V_{DD} = 26 Vdc, P_{out} = 170 W PEP, I_{DQ} = 2 × 700 mA, f1 = 865.0 MHz, f2 = 865.1 MHz)	G_{ps}	—	17.5	—	dB
Two–Tone Drain Efficiency (V_{DD} = 26 Vdc, P_{out} = 170 W PEP, I_{DQ} = 2 × 700 mA, f1 = 865.0 MHz, f2 = 865.1 MHz)	η	—	38.5	—	%
3rd Order Intermodulation Distortion (V_{DD} = 26 Vdc, P_{out} = 170 W PEP, I_{DQ} = 2 × 700 mA, f1 = 865.0 MHz, f2 = 865.1 MHz)	IMD	—	–31	—	dBc
Input Return Loss (V_{DD} = 26 Vdc, P_{out} = 170 W PEP, I_{DQ} = 2 × 700 mA, f1 = 865.0 MHz, f2 = 865.1 MHz)	IRL	—	–13	—	dB
Power Output, 1 dB Compression Point (V_{DD} = 26 Vdc, CW, I_{DQ} = 2 × 700 mA, f1 = 880.0 MHz)	P_{1dB}	—	170	—	W

(1) Each side of device measured separately.
(2) Device measured in push–pull configuration.

ELECTRICAL CHARACTERISTICS — continued (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
FUNCTIONAL TESTS (In Motorola Test Fixture, 50 ohm system) (2) (continued)					
Common–Source Amplifier Power Gain (V_{DD} = 26 Vdc, P_{out} = 170 W CW, I_{DQ} = 2 × 700 mA, f1 = 880.0 MHz)	G_{ps}	—	16.5	—	dB
Drain Efficiency (V_{DD} = 26 Vdc, P_{out} = 170 W CW, I_{DQ} = 2 × 700 mA, f1 = 880.0 MHz)	η	—	55	—	%
Output Mismatch Stress (V_{DD} = 26 Vdc, P_{out} = 170 W CW, I_{DQ} = 2 × 700 mA, f = 880 MHz, VSWR = 10:1, All Phase Angles at Frequency of Tests)	Ψ	No Degradation In Output Power Before and After Test			

(2) Device measured in push–pull configuration.



B1, B2, B5, B6	Long Ferrite Beads, Surface Mount
B3, B4	Short Ferrite Beads, Surface Mount
C1	0.6–4.5 pF Variable Capacitor
C2, C3, C5, C6, C12, C14, C19, C20, C21, C22	47 pF Chip Capacitors, B Case
C4, C9, C10, C15, C16	12 pF Chip Capacitors, B Case
C7	0.8–9.1 pF Variable Capacitor
C8	7.5 pF Chip Capacitor, B Case
C11, C13	10 μF, 35 V Tantalum Surface Mount Chip Capacitors
C17	3.6 pF Chip Capacitor, B Case
C18	5.1 pF Chip Capacitor, B Case
C23, C24, C26, C27	22 μF, 35 V Tantalum Surface Mount Chip Capacitors
C25, C28	220 μF, 50 V Electrolytic Capacitors
C29	0.4–2.5 pF Variable Capacitor
Coax1, Coax2	25 Ω, Semi Rigid Coax, 70 mil OD, 1.05″ Long
Coax3, Coax4	50 Ω, Semi Rigid Coax, 85 mil OD, 1.05″ Long
L1, L2, L3	18.5 nH Mini Spring Inductors, Coilcraft
L4	12.5 nH Mini Spring Inductor, Coilcraft
R1, R2	510 Ω, 1/10 W Chip Resistors

Z1	0.420″ x 0.080″ Microstrip
Z2	0.190″ x 0.080″ Microstrip
Z3	0.097″ x 0.080″ Microstrip
Z4, Z5, Z26, Z27	2.170″ x 0.080″ Microstrip
Z6, Z7	0.075″ x 0.080″ Microstrip
Z8, Z9	0.088″ x 0.220″ Microstrip
Z10, Z11	0.088″ x 0.220″ Microstrip
Z12, Z13	0.460″ x 0.220″ Microstrip
Z14, Z15	0.685″ x 0.625″ Microstrip
Z16, Z17	0.055″ x 0.625″ Microstrip
Z18, Z19	0.055″ x 0.632″ Microstrip
Z20, Z21	0.685″ x 0.632″ Microstrip
Z22, Z23	0.732″ x 0.080″ Microstrip
Z24, Z25	0.060″ x 0.080″ Microstrip
Z28	0.230″ x 0.080″ Microstrip
Z29	0.460″ x 0.080″ Microstrip
Board Material	30 mil Teflon®, εr = 2.55, Copper Clad, 2 oz Cu

Figure 1. 880 MHz Broadband Test Circuit Schematic

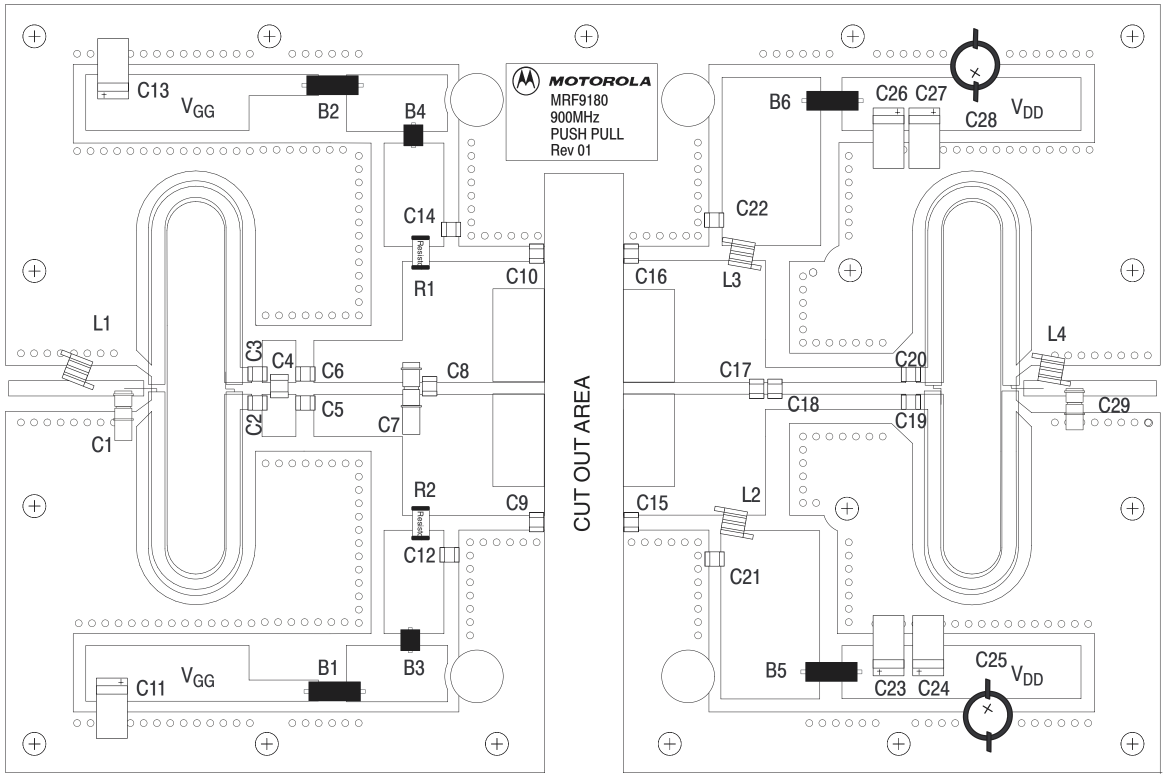


Figure 2. 880 MHz Broadband Test Circuit Component Layout

TYPICAL CHARACTERISTICS

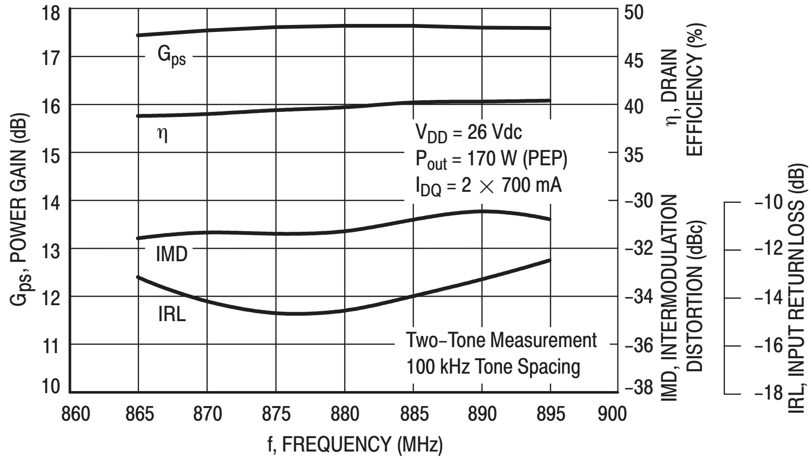


Figure 3. Class AB Broadband Circuit Performance

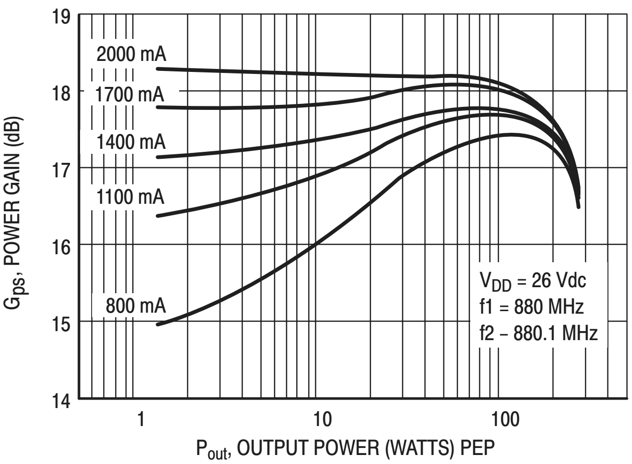


Figure 4. Power Gain versus Output Power

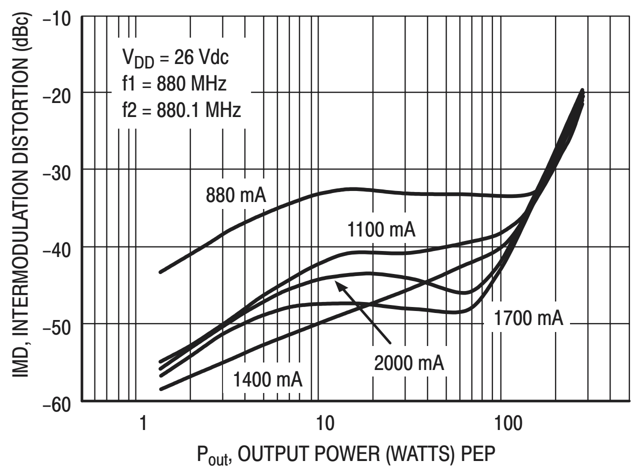


Figure 5. Intermodulation Distortion versus Output Power

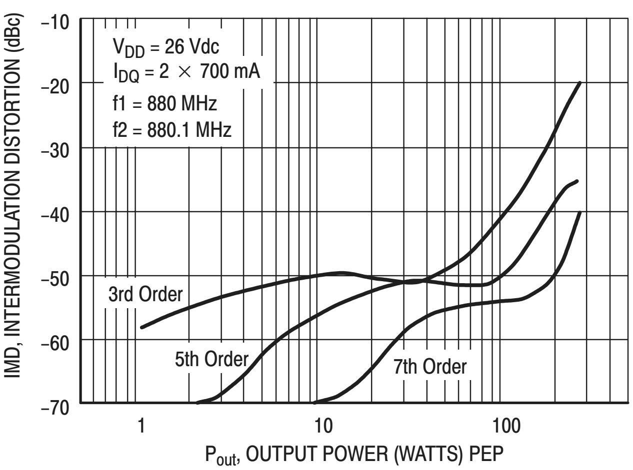


Figure 6. Intermodulation Distortion Products versus Output Power

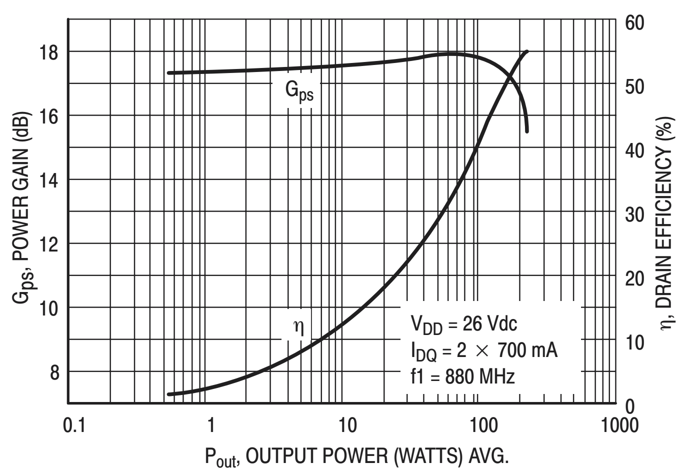


Figure 7. Power Gain and Efficiency versus Output Power

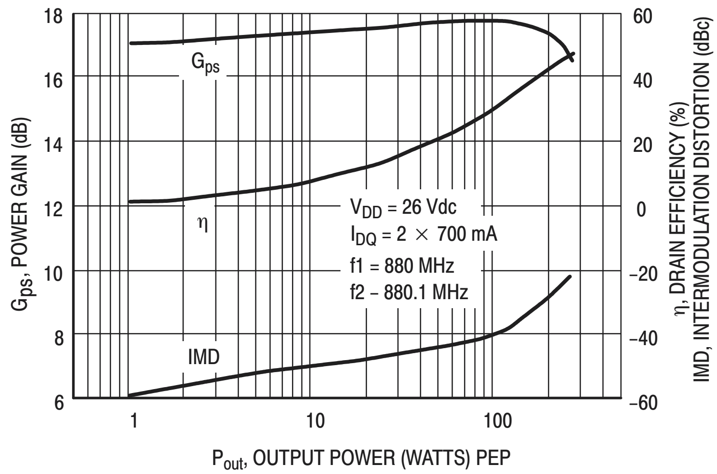


Figure 8. Power Gain, Efficiency and IMD versus Output Power

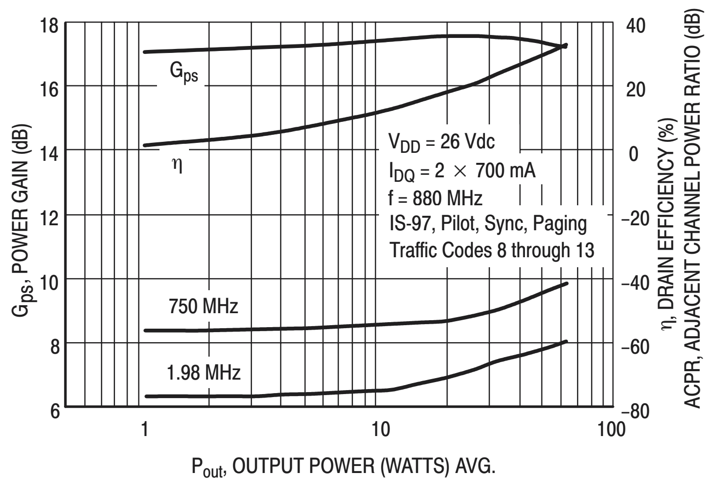
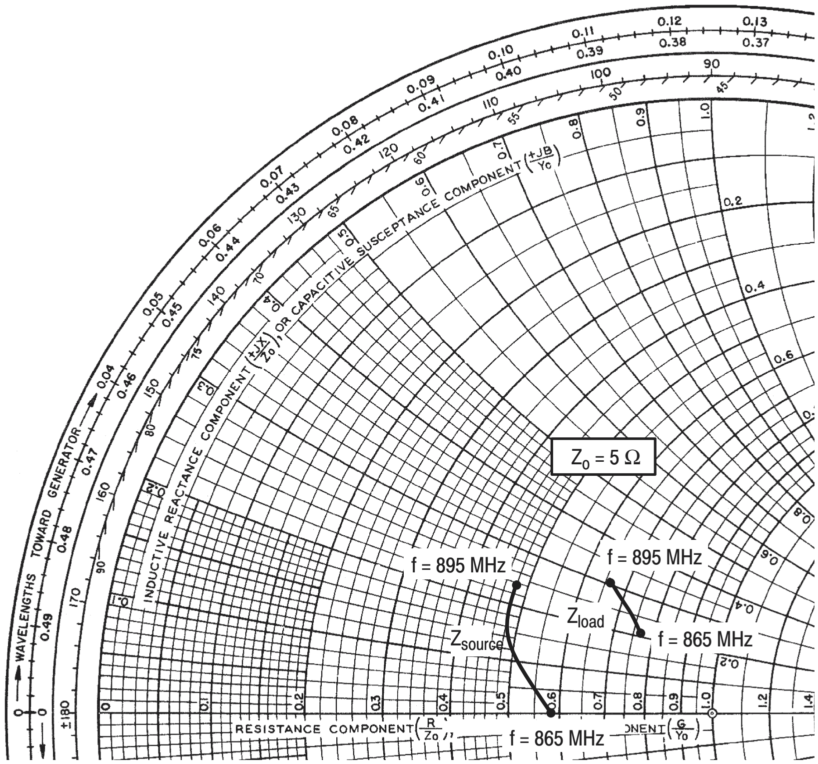


Figure 9. Power Gain, Efficiency and ACPR versus Output Power



V_{DD} = 26 V, I_{DQ} = 2 × 700 mA, P_{out} = 170 W PEP

f MHz	Z_{source} Ω	Z_{load} Ω
865	2.95 + j0.00	3.83 + j1.02
880	2.48 + j0.67	3.55 + j1.38
895	2.44 + j1.18	3.34+ j1.51

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.

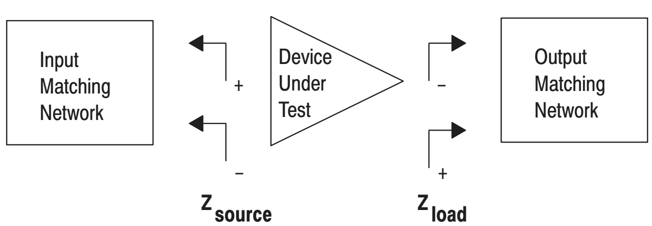
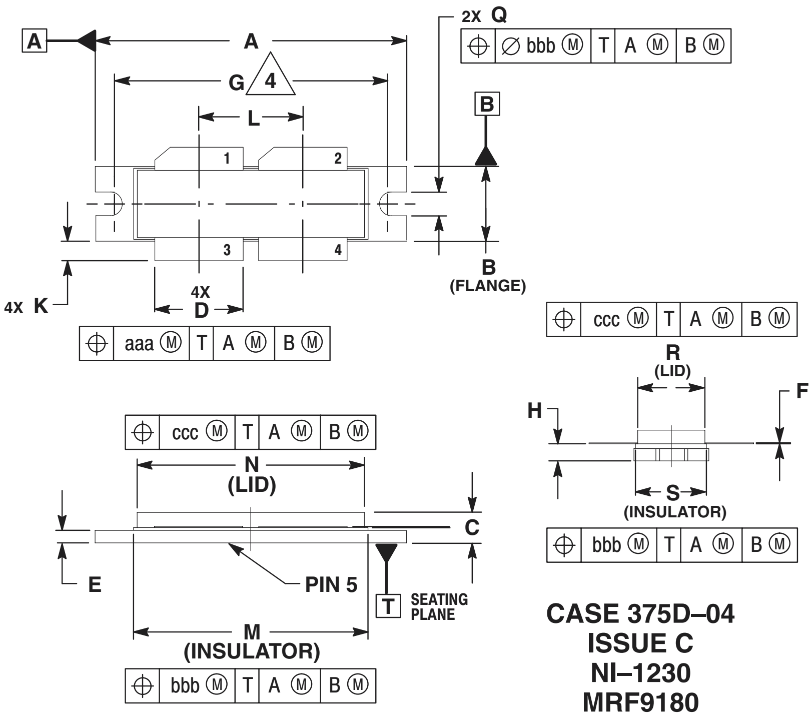


Figure 10. Series Equivalent Input and Output Impedance

NOTES

NOTES

PACKAGE DIMENSIONS

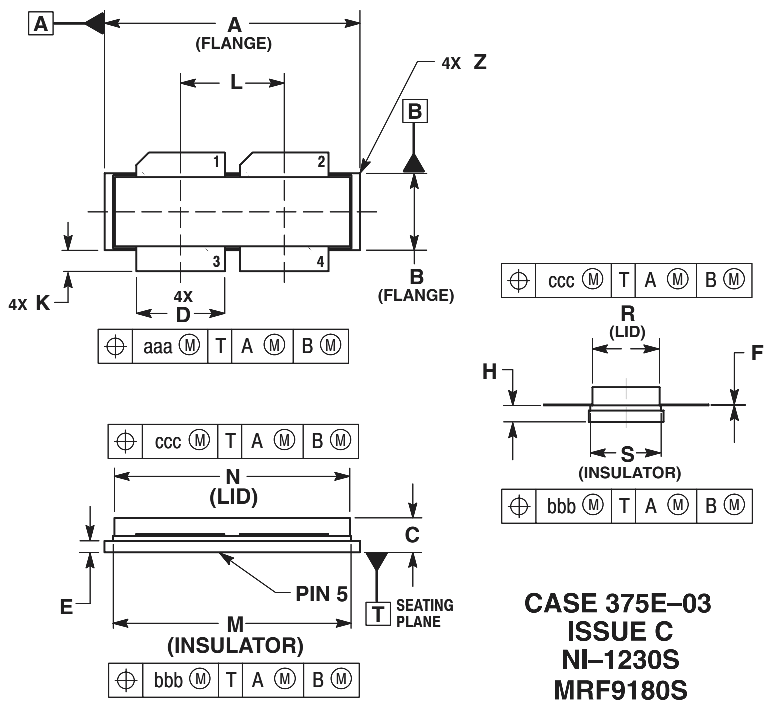


CASE 375D–04
ISSUE C
NI–1230
MRF9180

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 1.52 (38.61) BASED ON M3 SCREW.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.615	1.625	41.02	41.28
B	0.395	0.405	10.03	10.29
C	0.150	0.200	3.81	5.08
D	0.455	0.465	11.56	11.81
E	0.062	0.066	1.57	1.68
F	0.004	0.007	0.10	0.18
G	1.400 BSC		35.56 BSC	
H	0.079	0.089	2.01	2.26
K	0.117	0.137	2.97	3.48
L	0.540 BSC		13.72 BSC	
M	1.219	1.241	30.96	31.52
N	1.218	1.242	30.94	31.55
Q	0.120	0.130	3.05	3.30
R	0.355	0.365	9.01	9.27
S	0.365	0.375	9.27	9.53
aaa	0.013 REF		0.33 REF	
bbb	0.010 REF		0.25 REF	
ccc	0.020 REF		0.51 REF	

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



CASE 375E–03
ISSUE C
NI–1230S
MRF9180S

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.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.325	1.335	33.66	33.91
B	0.395	0.405	10.03	10.29
C	0.150	0.200	3.81	5.08
D	0.455	0.465	11.56	11.81
E	0.062	0.066	1.57	1.68
F	0.004	0.007	0.10	0.18
H	0.079	0.089	2.01	2.26
K	0.117	0.137	2.97	3.48
L	0.540 BSC		13.72 BSC	
M	1.219	1.241	30.96	31.52
N	1.218	1.242	30.94	31.55
R	0.355	0.365	9.01	9.27
S	0.365	0.375	9.27	9.53
Z	0	0.040	0	1.02
aaa	0.013 REF		0.33 REF	
bbb	0.010 REF		0.25 REF	
ccc	0.020 REF		0.51 REF	

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

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