Freescale Semiconductor
Technical Data

MRF9210
Rev. 2, 1/2005

RF Power Field Effect Transistor

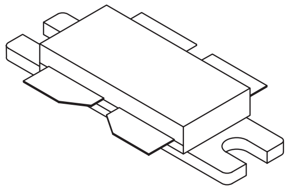
N−Channel Enhancement−Mode Lateral MOSFET

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

- Typical CDMA Performance @ 880 MHz, 26 Volts, I_{DQ} = 2 x 950 mA
  IS−95 CDMA Pilot, Sync, Paging, Traffic Codes 8 Through 13
    Output Power — 40 Watts
    Power Gain — 16.5 dB
    Efficiency — 25.5%
    Adjacent Channel Power —
      750 kHz: −46.2 dBc @ 30 kHz BW
      1.98 MHz: −60 dBc @ 30 kHz BW
- Internally Matched, Controlled Q, for Ease of Use
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 10:1 VSWR, @ 26 Vdc, 880 MHz, 40 Watts Avg. N−CDMA
- Excellent Thermal Stability
- Characterized with Series Equivalent Large−Signal Impedance Parameters
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

MRF9210R3

880 MHz, 200 W, 26 V
LATERAL N−CHANNEL
BROADBAND
RF POWER MOSFET



CASE 375G−04, STYLE 1
NI−860C3

Table 1. 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°C Derate above 25°C	P_D	565 3.2	W W/°C
Storage Temperature Range	T_{stg}	− 65 to +150	°C
Operating Junction Temperature	T_J	200	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (1)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.31	°C/W

Table 3. ESD Protection Characteristics

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M3 (Minimum)
Charge Device Model	C5 (Minimum)

1. MTTF calculator available at http://www.freescale.com/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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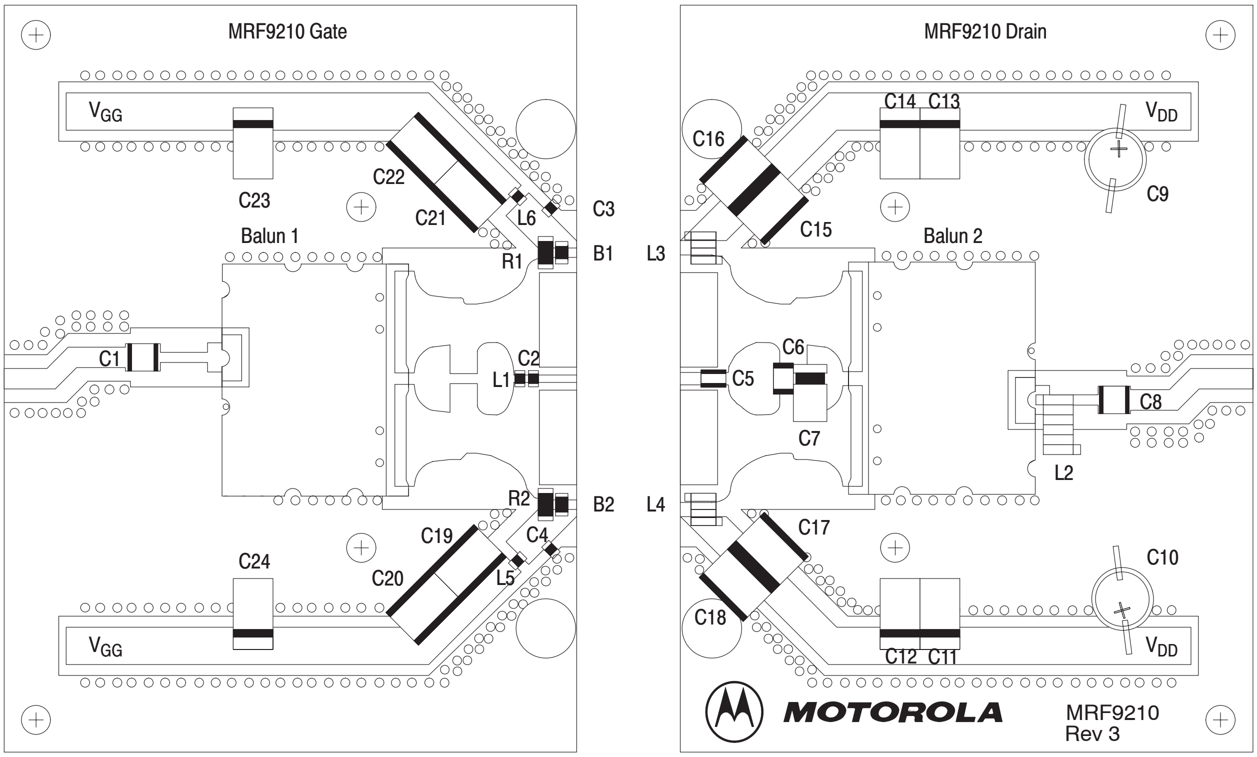
Table 4. Electrical Characteristics (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics [1]					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 65 Vdc, V_{GS} = 0)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 26 Vdc, V_{GS} = 0)	I_{DSS}	—	—	1	μAdc
Gate−Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0)	I_{GSS}	—	—	1	μAdc
On Characteristics [1]					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 330 μAdc)	$V_{GS(th)}$	1.5	2.8	4	Vdc
Gate Quiescent Voltage (V_{DS} = 26 Vdc, I_D = 800 mAdc)	$V_{GS(Q)}$	2.5	3.3	4.5	Vdc
Drain−Source On−Voltage (V_{GS} = 10 Vdc, I_D = 2.2 Adc)	$V_{DS(on)}$	—	0.2	0.4	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 6.7 Adc)	g_{fs}	—	8.8	—	S
Dynamic Characteristics [1]					
Reverse Transfer Capacitance (V_{DS} = 26 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	3.6	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) [2] Single−Carrier N−CDMA, 1.2288 MHz Channel Bandwidth Carrier, Peak/Avg. Ratio = 9.8 dB @ 0.01% Probability on CCDF					
N−CDMA Common−Source Amplifier Power Gain (V_{DD} = 26 Vdc, P_{out} = 40 W Avg. N−CDMA, I_{DQ} = 2 x 950 mA, f = 880 MHz)	G_{ps}	15.8	16.5	—	dB
N−CDMA Drain Efficiency (V_{DD} = 26 Vdc, P_{out} = 40 W Avg. N−CDMA, I_{DQ} = 2 x 950 mA, f = 880 MHz)	η	23	25.5	—	%
Adjacent Channel Power Ratio (V_{DD} = 26 Vdc, P_{out} = 40 W Avg. N−CDMA, I_{DQ} = 2 x 950 mA, f = 880 MHz; ACPR @ 40 W, 1.23 MHz Bandwidth, 750 kHz Channel Spacing)	ACPR	—	−46.2	−45	dBc
Input Return Loss (V_{DD} = 26 Vdc, P_{out} = 40 W Avg. N−CDMA, I_{DQ} = 2 x 950 mA, f = 880 MHz)	IRL	9	17.5	—	dB
N−CDMA Common−Source Amplifier Power Gain (V_{DD} = 26 Vdc, P_{out} = 40 W Avg. N−CDMA, I_{DQ} = 2 x 950 mA, f = 865 MHz and 895 MHz)	G_{ps}	—	16.5	—	dB
N−CDMA Drain Efficiency (V_{DD} = 26 Vdc, P_{out} = 40 W Avg. N−CDMA, I_{DQ} = 2 x 950 mA, f = 865 MHz and 895 MHz)	η	—	25.5	—	%
Adjacent Channel Power Ratio (V_{DD} = 26 Vdc, P_{out} = 40 W Avg. N−CDMA, I_{DQ} = 2 x 950 mA, f = 865 MHz and 895 MHz; ACPR @ 40 W, 1.23 MHz Bandwidth, 750 kHz Channel Spacing)	ACPR	—	−47.5	—	dBc
Input Return Loss (V_{DD} = 26 Vdc, P_{out} = 40 W Avg. N−CDMA, I_{DQ} = 2 x 950 mA, f = 865 MHz and 895 MHz)	IRL	—	15	—	dB
Output Mismatch Stress (V_{DD} = 26 Vdc, P_{out} = 40 W Avg. N−CDMA, I_{DQ} = 2 x 950 mA, f = 880 MHz, VSWR = 10:1, All Phase Angles at Frequency of Tests)	Ψ	No Degradation In Output Power			

1. Each side of device measured separately.
2. Device measured in push−pull configuration.

Table 5. 880 MHz Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
B1, B2	11 Ω RF Beads, Surface Mount (0805)	2508051107Y0	Fair−Rite
Balun 1, Balun 2	0.8−1 GHz Xinger Balun	3A412	Anaren
C1	27 pF Chip Capacitor	100B270JP500X	ATC
C2	12 pF Chip Capacitor (0603)	06035J120GBT	AVX / Kyocera
C3, C4	3.3 pF Chip Capacitors (0603)	06035J3R3BBT	AVX / Kyocera
C5	9.1 pF Chip Capacitor	180R8R2JW500X	ATC
C6	4.3 pF Chip Capacitor	100B4R3CP500X	ATC
C7	0.4−2.5 pF Variable Capacitor	27283PC	Gigatronics
C8	12 pF Chip Capacitor	100B120JP500X	ATC
C9, C10	470 μF, 63 V Electrolytic Capacitors	NACZF471M63V (18x22)	Nippon
C11, C12, C13, C14	22 μF, 35 V Tantalum Chip Capacitors	T491X226K035AS	Kemet
C15, C17, C19, C21	0.01 μF, 100 V Chip Capacitors	C1825C103J1GAC	Kemet
C16, C18	0.56 μF, 50 V Chip Capacitors	C1825C564J5GAC	Kemet
C20, C22	2.2 μF, 50 V Chip Capacitors	C1825C225J5RAC3810	Kemet
C23, C24	47 μF, 16 V Tantalum Chip Capacitors	TPSD476K016R0150	AVX
L1	12 nH Inductor (0603)	0603HC−12NHJBU	Coilcraft
L2	22 nH Inductor	B07T−5	Coilcraft
L3, L4	12.5 nH Inductors	A04T−5	Coilcraft
L5, L6	10 nH Inductors (0603)	0603HC−10NHJBU	Coilcraft
PCB Gate	30 mil, ε_r = 2.56	DS0928	DS Electronics
PCB Drain	30 mil, ε_r = 2.56	DS0978	DS Electronics
R1, R2	24 Ω, 1/8 W Chip Resistors		Dale Vishay



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

Figure 1. 880 MHz Test Circuit Component Layout

TYPICAL CHARACTERISTICS

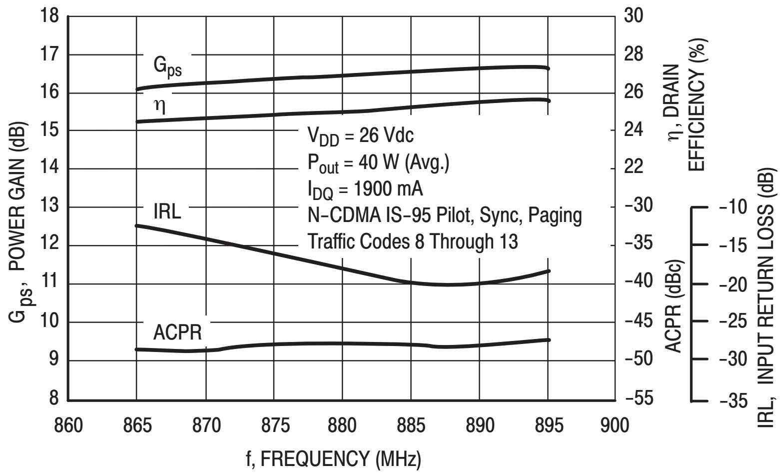


Figure 2. Class AB Broadband Circuit Performance

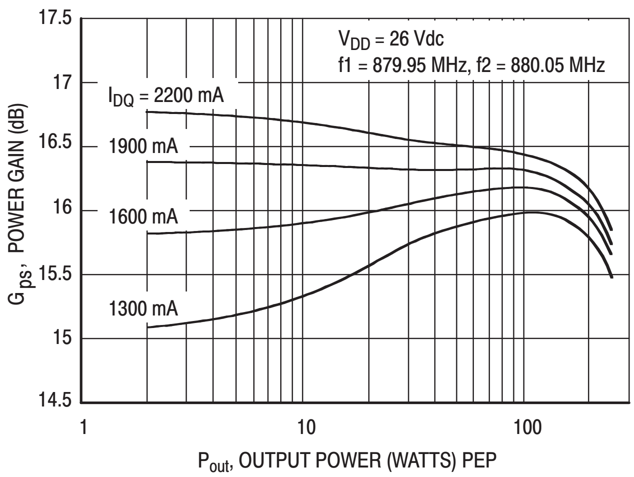


Figure 3. Power Gain versus Output Power

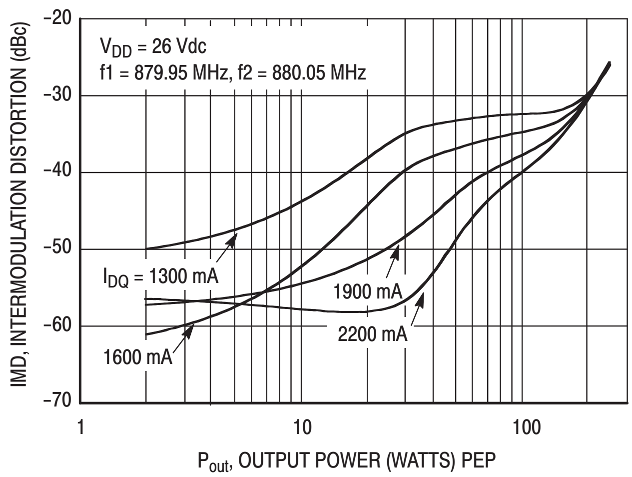


Figure 4. Intermodulation Distortion versus Output Power

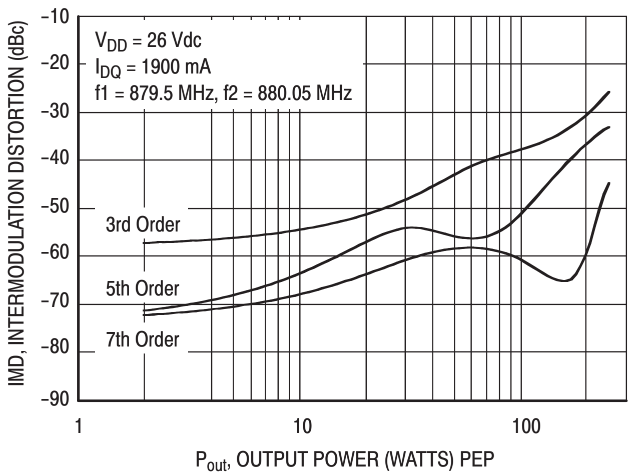


Figure 5. Intermodulation Distortion Products versus Output Power

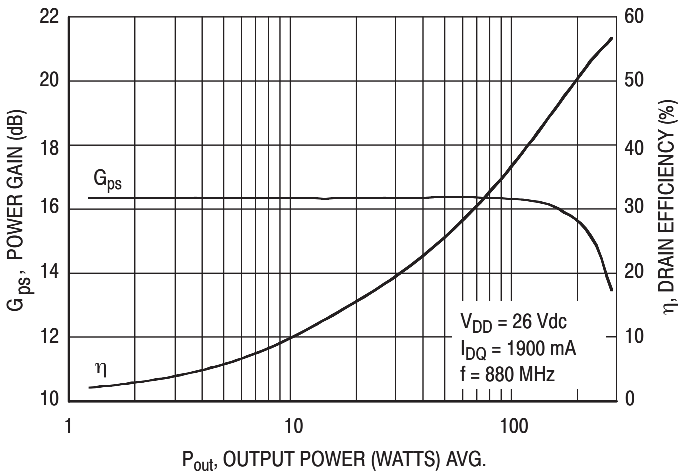


Figure 6. Power Gain and Efficiency versus Output Power

TYPICAL CHARACTERISTICS

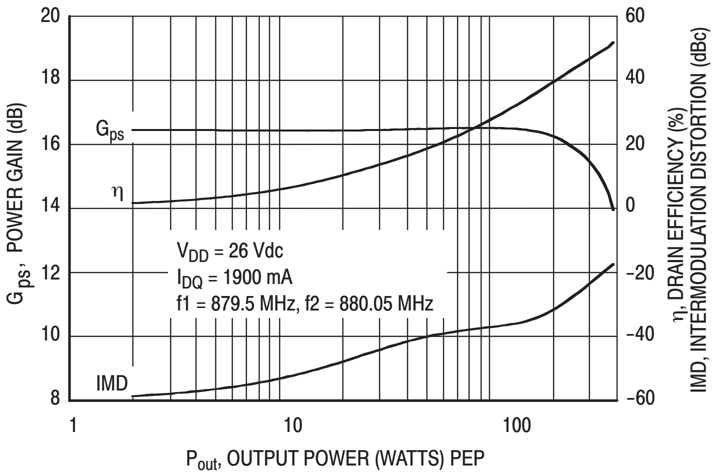


Figure 7. Power Gain, Efficiency and IMD versus Output Power

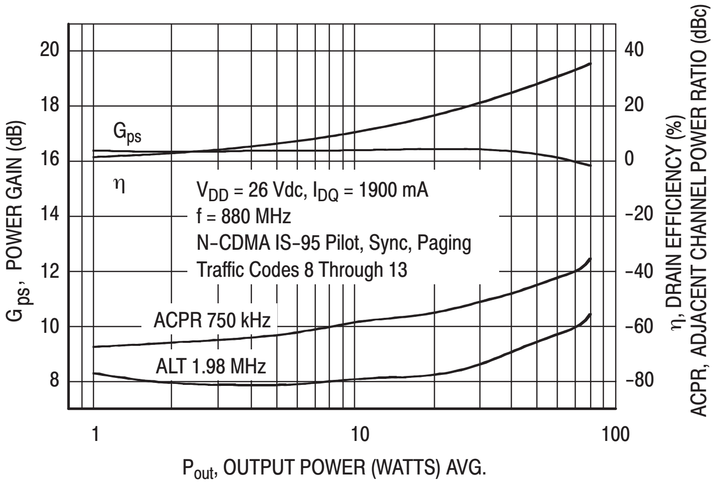


Figure 8. N−CDMA Performance Output Power versus Gain, ACPR, Efficiency

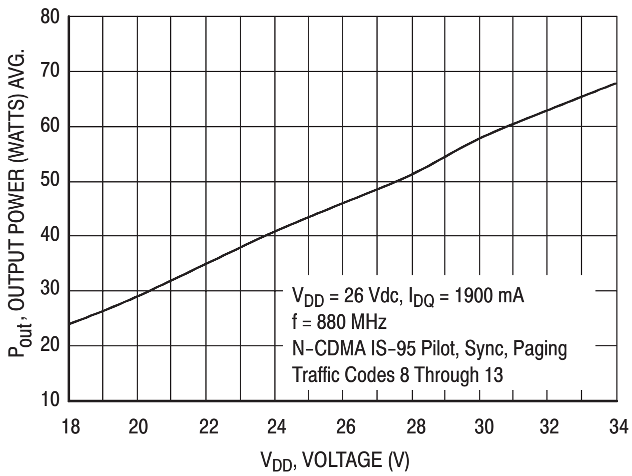


Figure 9. Single−Carrier Maximum N−CDMA Linear Output Power versus Drain Voltage

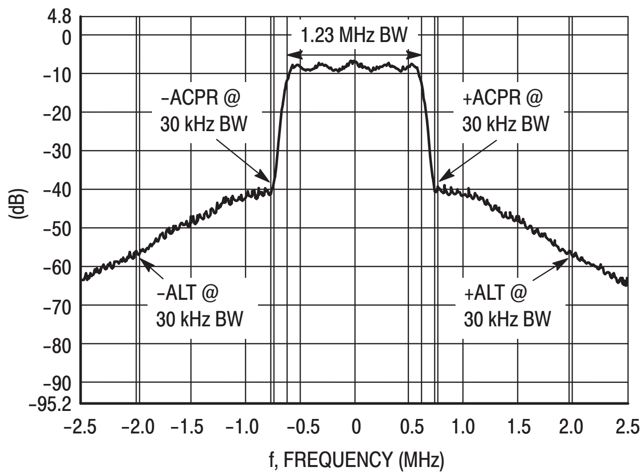
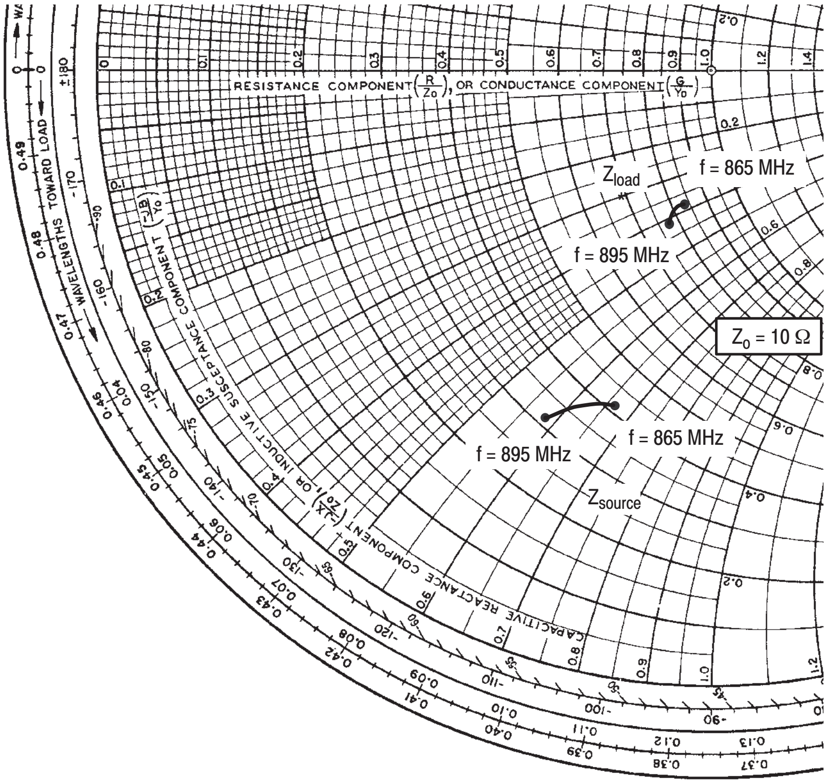


Figure 10. Typical N−CDMA Spectrum



V_{DD} = 26 V, I_{DQ} = 2 x 950 mA, P_{out} = 40 W Avg. N-CDMA

f MHz	Z_{source} Ω	Z_{load} Ω
865	4.19 – j6.71	8.43 – j3.83
880	3.69 – j6.18	8.12 – j3.85
895	3.17 – j5.85	7.84 – j4.08

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.

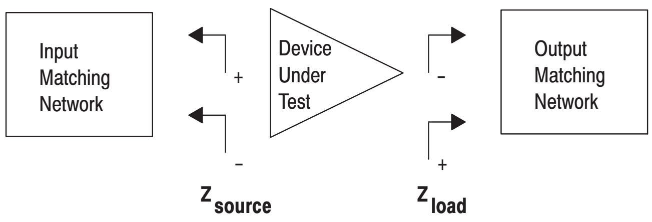
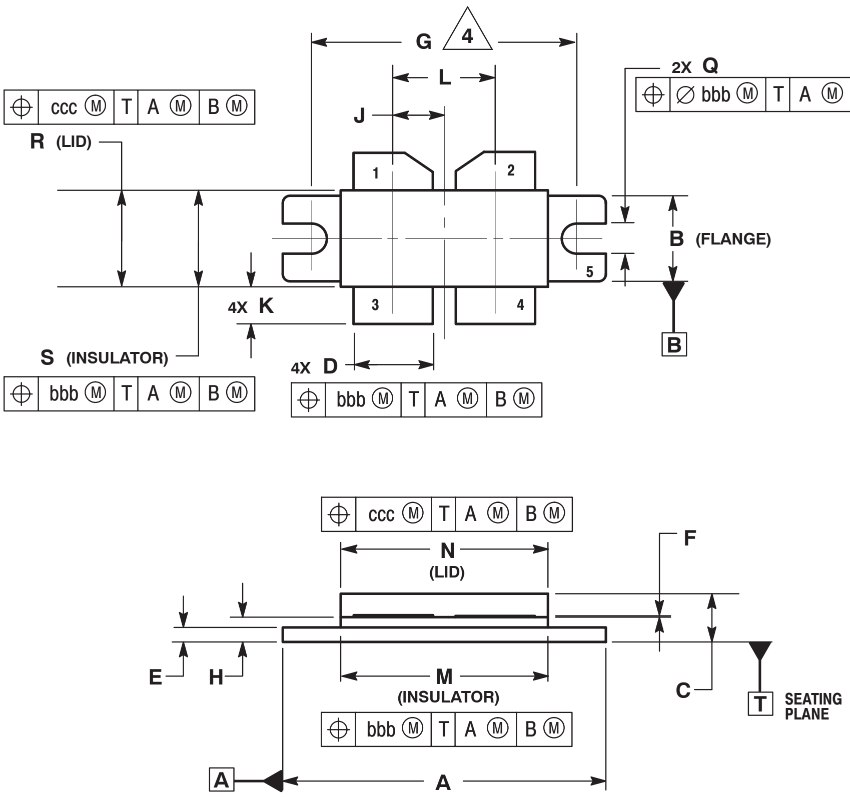


Figure 11. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS



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

	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	0.180	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
J	0.2125 BSC		5.397 BSC	
K	0.135	0.165	3.43	4.19
L	0.425 BSC		10.8 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	3.30
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 375G−04
ISSUE E
NI−860C3

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