

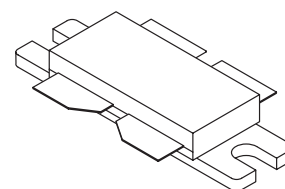
## RF Power Field Effect Transistor N-Channel Enhancement-Mode Lateral MOSFET

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,  $I_{DQ} = 2 \times 950$  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 @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	565 3.2	W W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	- 65 to +150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$

**Table 2. Thermal Characteristics**

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

**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.

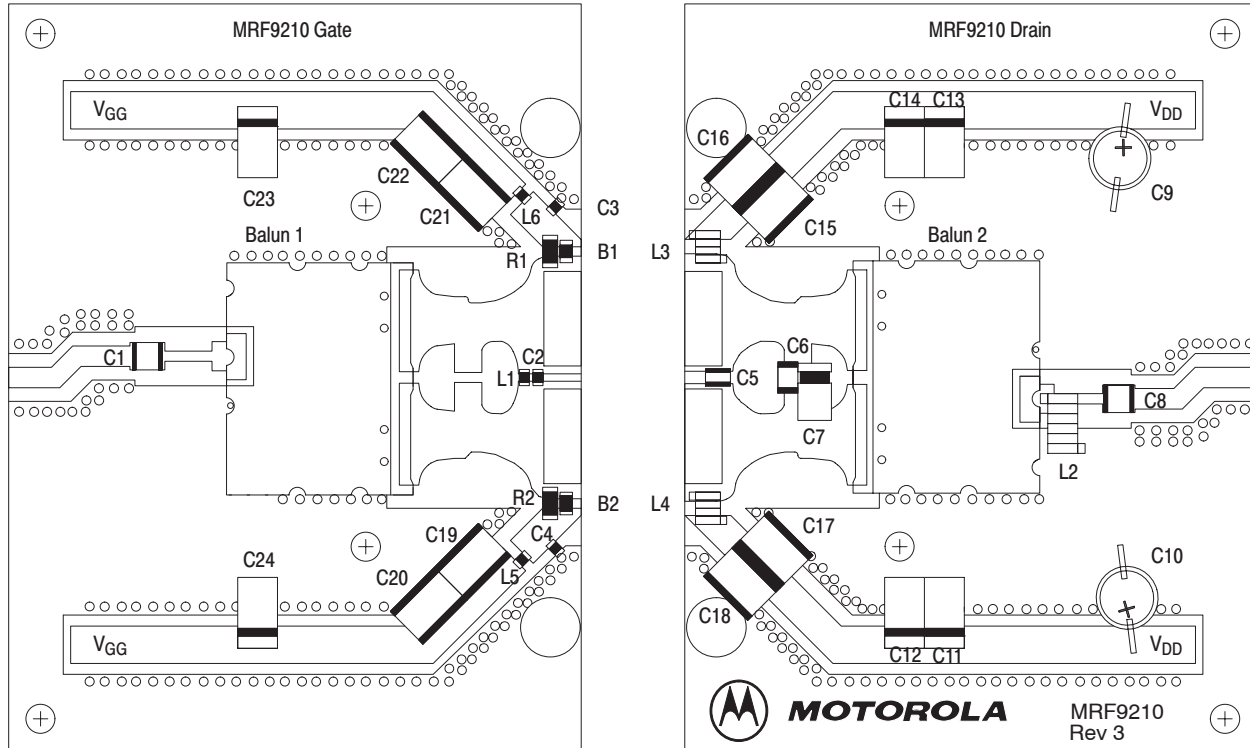
**Table 4. Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b> (1)					
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 65\text{ Vdc}$ , $V_{GS} = 0$ )	$I_{DSS}$	—	—	10	$\mu\text{A dc}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 26\text{ Vdc}$ , $V_{GS} = 0$ )	$I_{DSS}$	—	—	1	$\mu\text{A dc}$
Gate-Source Leakage Current ( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0$ )	$I_{GSS}$	—	—	1	$\mu\text{A dc}$
<b>On Characteristics</b> (1)					
Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 330\ \mu\text{A dc}$ )	$V_{GS(th)}$	1.5	2.8	4	Vdc
Gate Quiescent Voltage ( $V_{DS} = 26\text{ Vdc}$ , $I_D = 800\text{ mA dc}$ )	$V_{GS(Q)}$	2.5	3.3	4.5	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 2.2\text{ A dc}$ )	$V_{DS(on)}$	—	0.2	0.4	Vdc
Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 6.7\text{ A dc}$ )	$g_{fs}$	—	8.8	—	S
<b>Dynamic Characteristics</b> (1)					
Reverse Transfer Capacitance ( $V_{DS} = 26\text{ Vdc} \pm 30\text{ mV(rms)}$ ac @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )	$C_{rss}$	—	3.6	—	pF
<b>Functional Tests</b> (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 ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 40\text{ W Avg. N-CDMA}$ , $I_{DQ} = 2 \times 950\text{ mA}$ , $f = 880\text{ MHz}$ )	$G_{ps}$	15.8	16.5	—	dB
N-CDMA Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 40\text{ W Avg. N-CDMA}$ , $I_{DQ} = 2 \times 950\text{ mA}$ , $f = 880\text{ MHz}$ )	$\eta$	23	25.5	—	%
Adjacent Channel Power Ratio ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 40\text{ W Avg. N-CDMA}$ , $I_{DQ} = 2 \times 950\text{ mA}$ , $f = 880\text{ MHz}$ ; ACPR @ 40 W, 1.23 MHz Bandwidth, 750 kHz Channel Spacing)	ACPR	—	-46.2	-45	dBc
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 40\text{ W Avg. N-CDMA}$ , $I_{DQ} = 2 \times 950\text{ mA}$ , $f = 880\text{ MHz}$ )	IRL	9	17.5	—	dB
N-CDMA Common-Source Amplifier Power Gain ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 40\text{ W Avg. N-CDMA}$ , $I_{DQ} = 2 \times 950\text{ mA}$ , $f = 865\text{ MHz}$ and $895\text{ MHz}$ )	$G_{ps}$	—	16.5	—	dB
N-CDMA Drain Efficiency ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 40\text{ W Avg. N-CDMA}$ , $I_{DQ} = 2 \times 950\text{ mA}$ , $f = 865\text{ MHz}$ and $895\text{ MHz}$ )	$\eta$	—	25.5	—	%
Adjacent Channel Power Ratio ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 40\text{ W Avg. N-CDMA}$ , $I_{DQ} = 2 \times 950\text{ mA}$ , $f = 865\text{ MHz}$ and $895\text{ MHz}$ ; ACPR @ 40 W, 1.23 MHz Bandwidth, 750 kHz Channel Spacing)	ACPR	—	-47.5	—	dBc
Input Return Loss ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 40\text{ W Avg. N-CDMA}$ , $I_{DQ} = 2 \times 950\text{ mA}$ , $f = 865\text{ MHz}$ and $895\text{ MHz}$ )	IRL	—	15	—	dB
Output Mismatch Stress ( $V_{DD} = 26\text{ Vdc}$ , $P_{out} = 40\text{ W Avg. N-CDMA}$ , $I_{DQ} = 2 \times 950\text{ mA}$ , $f = 880\text{ MHz}$ , VSWR = 10:1, All Phase Angles at Frequency of Tests)	$\Psi$	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**

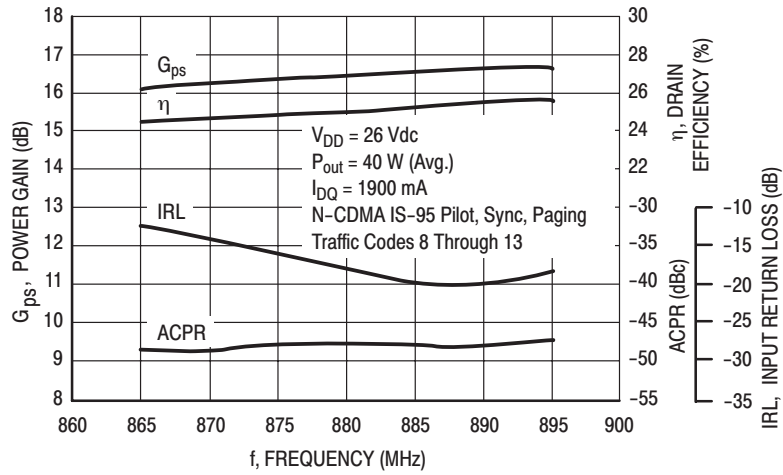
Part	Description	Part Number	Manufacturer
B1, B2	11 $\Omega$ RF Beads, Surface Mount (0805)	2508051107Y0	Fair-Rite
Balun 1, Balun 2	0.8–1 GHz Xinger Balun	3A412	Anaren
C1	27 pF Chip Capacitor	100B270JP500X	ATC
C2	12 pF Chip Capacitor (0603)	06035J120GBT	AVX / Kyocera
C3, C4	3.3 pF Chip Capacitors (0603)	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 $\mu$ F, 63 V Electrolytic Capacitors	NACZF471M63V (18x22)	Nippon
C11, C12, C13, C14	22 $\mu$ F, 35 V Tantalum Chip Capacitors	T491X226K035AS	Kemet
C15, C17, C19, C21	0.01 $\mu$ F, 100 V Chip Capacitors	C1825C103J1GAC	Kemet
C16, C18	0.56 $\mu$ F, 50 V Chip Capacitors	C1825C564J5GAC	Kemet
C20, C22	2.2 $\mu$ F, 50 V Chip Capacitors	C1825C225J5RAC3810	Kemet
C23, C24	47 $\mu$ F, 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, $\epsilon_r = 2.56$	DS0928	DS Electronics
PCB Drain	30 mil, $\epsilon_r = 2.56$	DS0978	DS Electronics
R1, R2	24 $\Omega$ , 1/8 W Chip Resistors		Dale Vishay



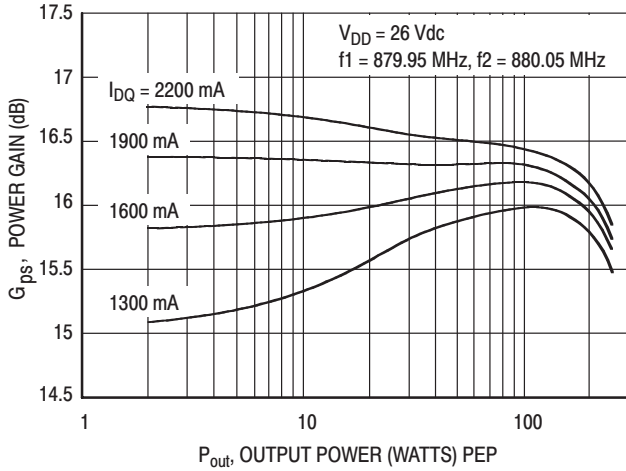
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**Figure 1. 880 MHz Test Circuit Component Layout**

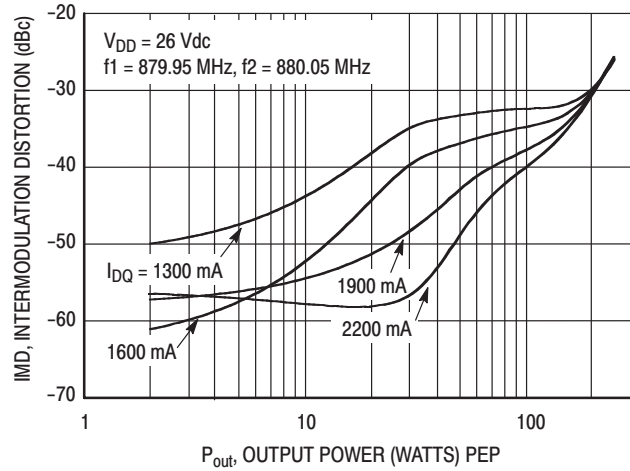
## TYPICAL CHARACTERISTICS



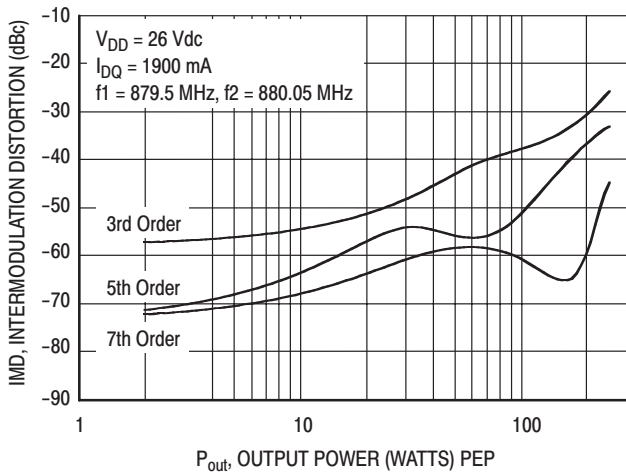
**Figure 2. Class AB Broadband Circuit Performance**



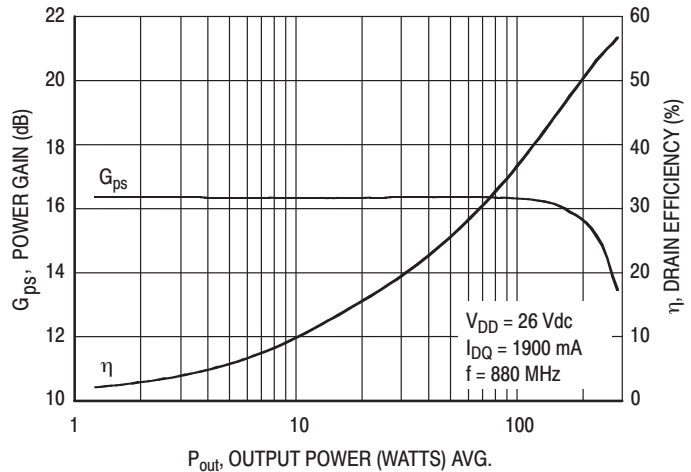
**Figure 3. Power Gain versus Output Power**



**Figure 4. Intermodulation Distortion versus Output Power**

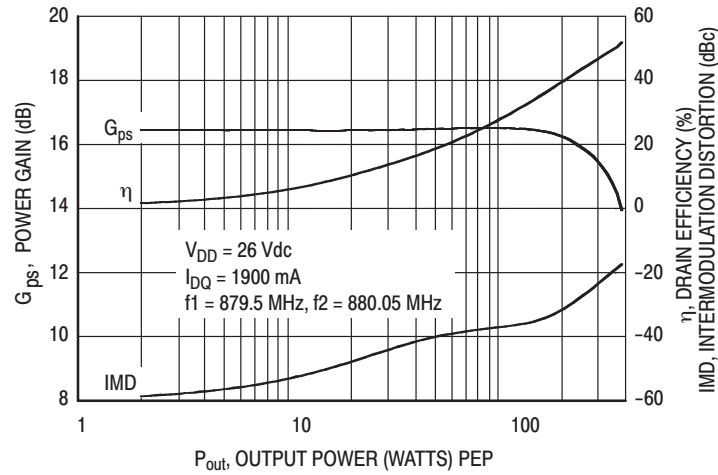


**Figure 5. Intermodulation Distortion Products versus Output Power**

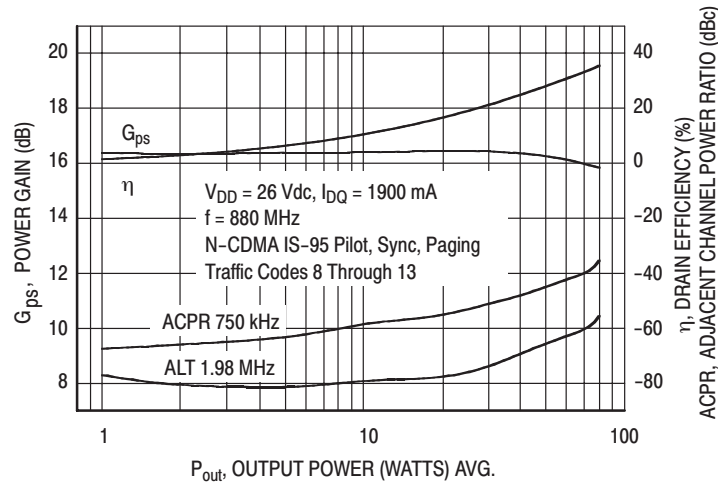


**Figure 6. Power Gain and Efficiency versus Output Power**

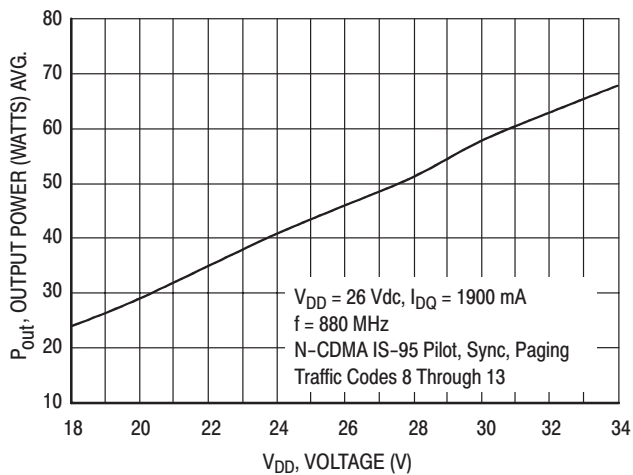
## TYPICAL CHARACTERISTICS



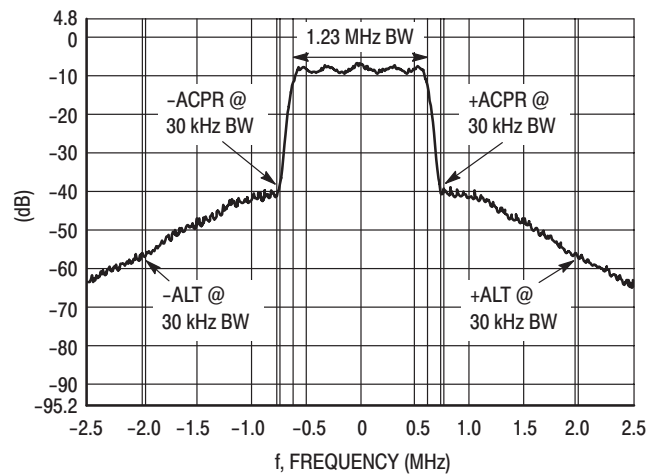
**Figure 7. Power Gain, Efficiency and IMD versus Output Power**



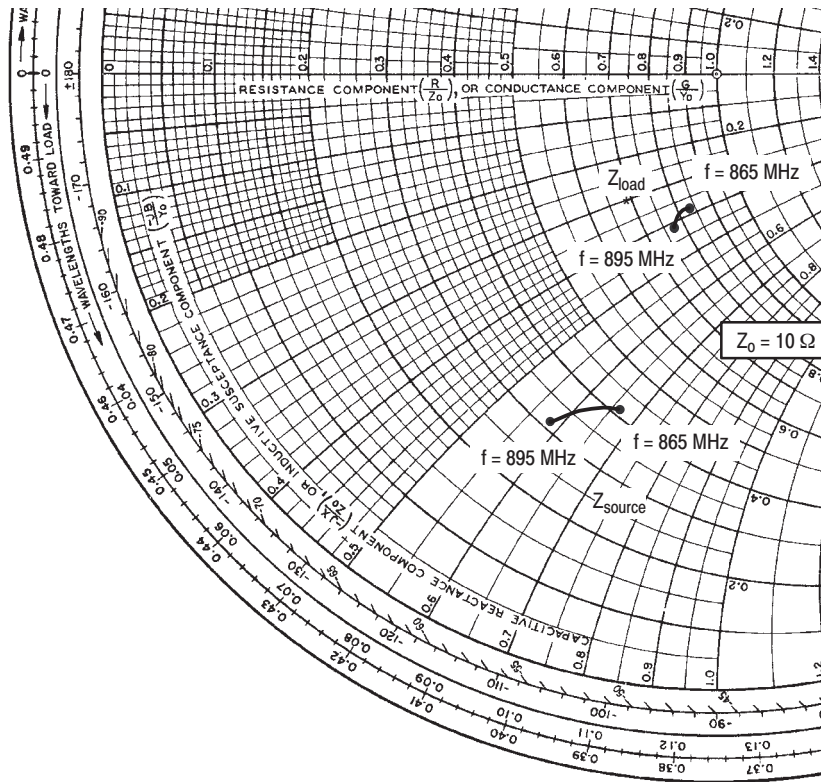
**Figure 8. N-CDMA Performance Output Power versus Gain, ACPR, Efficiency**



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



**Figure 10. Typical N-CDMA Spectrum**



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

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
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.

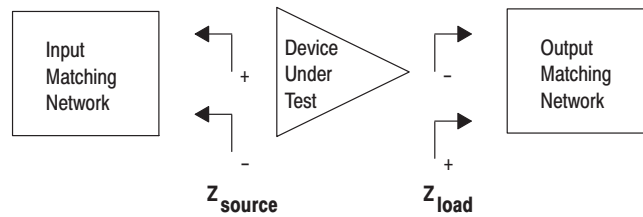
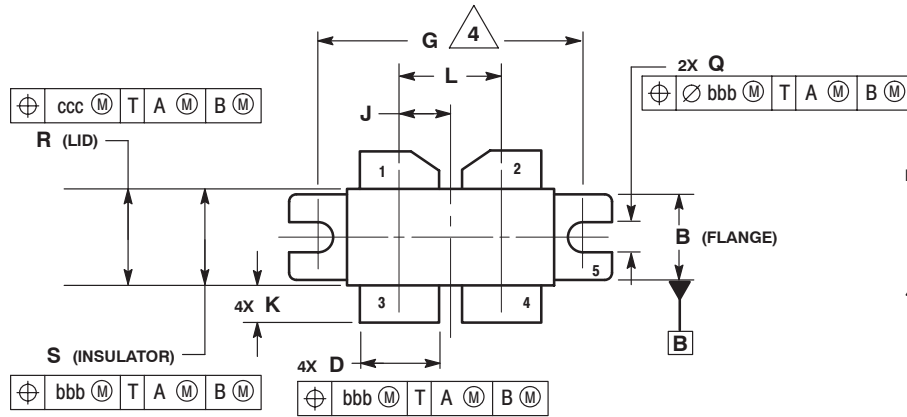


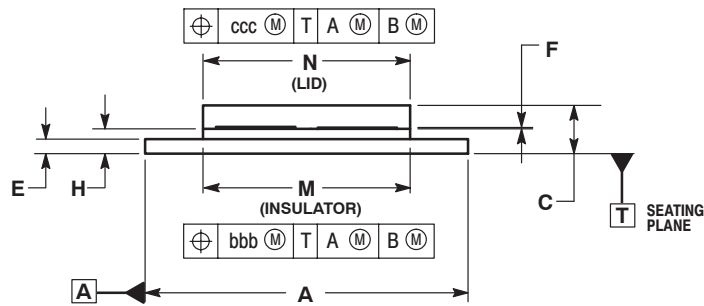
Figure 11. Series Equivalent Source and Load Impedance

## 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.

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
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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