

**Table 3. ESD Protection Characteristics**

Test Methodology	Class
Human Body Model (per JESD22-A114)	1C (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	IV (Minimum)

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b>					
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 65\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	1	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$
<b>On Characteristics</b>					
Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 174\ \mu\text{Adc}$ )	$V_{GS(th)}$	1.2	2	2.7	Vdc
Gate Quiescent Voltage ( $V_{DD} = 28\text{ Vdc}$ , $I_D = 750\text{ mAdc}$ , Measured in Functional Test)	$V_{GS(Q)}$	2	2.7	3.5	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1.74\text{ Adc}$ )	$V_{DS(on)}$	0.1	0.21	0.3	Vdc
<b>Dynamic Characteristics</b> <sup>(1)</sup>					
Reverse Transfer Capacitance ( $V_{DS} = 28\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )	$C_{rss}$	—	0.64	—	pF
Output Capacitance ( $V_{DS} = 28\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )	$C_{oss}$	—	297	—	pF

**Functional Tests** (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ} = 750\text{ mA}$ ,  $P_{out} = 24\text{ W Avg.}$ ,  $f = 1987.5\text{ MHz}$ , Single-Carrier W-CDMA, IQ Magnitude Clipping, PAR = 7.5 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm 5\text{ MHz}$  Offset.

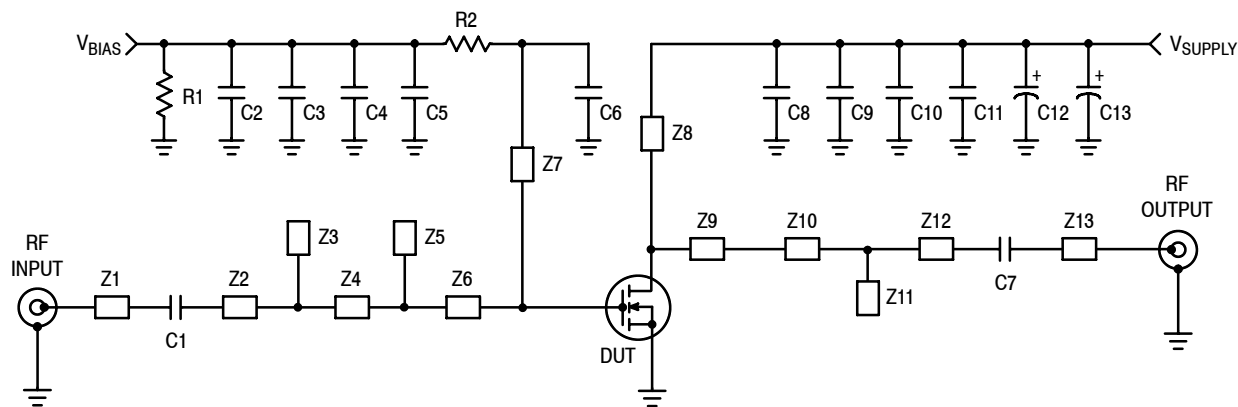
Power Gain	$G_{ps}$	17	18	20	dB
Drain Efficiency	$\eta_D$	30	32	—	%
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF	PAR	5.7	6.2	—	dB
Adjacent Channel Power Ratio	ACPR	—	-38	-35	dBc
Input Return Loss	IRL	—	-20	-9	dB

1. Part internally matched both on input and output.

(continued)

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Typical Performances</b> (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$ , $I_{DQ} = 750\text{ mA}$ , 1930-1990 MHz Bandwidth					
Video Bandwidth @ 80 W PEP $P_{out}$ where $IM3 = -30\text{ dBc}$ (Tone Spacing from 100 kHz to VBW) $\Delta IMD3 = IMD3 @ \text{VBW frequency} - IMD3 @ 100\text{ kHz} < 1\text{ dBc}$ (both sidebands)	VBW	—	90	—	MHz
Gain Flatness in 60 MHz Bandwidth @ $P_{out} = 24\text{ W Avg.}$	$G_F$	—	0.165	—	dB
Average Deviation from Linear Phase in 60 MHz Bandwidth @ $P_{out} = 80\text{ W CW}$	$\Phi$	—	1.14	—	$^\circ$
Average Group Delay @ $P_{out} = 80\text{ W CW}$ , $f = 1960\text{ MHz}$	Delay	—	2.25	—	ns
Part-to-Part Insertion Phase Variation @ $P_{out} = 80\text{ W CW}$ , $f = 1960\text{ MHz}$ , Six Sigma Window	$\Delta\Phi$	—	22.3	—	$^\circ$
Gain Variation over Temperature ( $-30^\circ\text{C}$ to $+85^\circ\text{C}$ )	$\Delta G$	—	0.009	—	dB/ $^\circ\text{C}$
Output Power Variation over Temperature ( $-30^\circ\text{C}$ to $+85^\circ\text{C}$ )	$\Delta P_{1dB}$	—	0.017	—	dB/ $^\circ\text{C}$



Z1	0.530" x 0.084" Microstrip	Z8	0.306" x 0.388" x 0.090" Taper
Z2	0.336" x 0.084" Microstrip	Z9	0.880" x 0.201" x 0.795" Taper
Z3	0.211" x 0.180" x 0.084" Taper	Z10	0.415" x 0.084" Microstrip
Z4	0.704" x 0.216" Microstrip	Z11	0.191" x 0.243" x 0.084" Taper
Z5	0.220" x 0.216" x 0.084" Taper	Z12	0.510" x 0.084" Microstrip
Z6	0.504" x 0.800" x 0.084" Taper	Z13	0.525" x 0.084" Microstrip
Z7	0.265" x 0.313" x 0.332" x 0.040" Taper	PCB	Arlon CuClad 250GX-0300-55-22, 0.030", $\epsilon_r = 2.55$

**Figure 1. MRF7S19080HR3(HSR3) Test Circuit Schematic**

**Table 5. MRF7S19080HR3(HSR3) Test Circuit Component Designations and Values**

Part	Description	Part Number	Manufacturer
C1, C7	15 pF Chip Capacitors	ATC100B150JT500XT	ATC
C2, C11	13 pF Chip Capacitors	ATC100B130JT500XT	ATC
C3	10 $\mu$ F Chip Capacitor	GRM31MF51A106ZA01B	TDK
C4	1000 pF Chip Capacitor	ATC100B102JT50XT	ATC
C5, C10	0.1 $\mu$ F Chip Capacitors	C1206C104K5RAC	Kemet
C6	5.1 pF Chip Capacitor	ATC100B5R1CT500XT	ATC
C8	6.8 pF Chip Capacitor	ATC100B6R8CT500XT	ATC
C9	2.2 $\mu$ F Chip Capacitor	C1825C225J5RAC	Kemet
C12	470 $\mu$ F, 63 V Electrolytic Capacitor	EKME630ELL471MK25S	United Chemi-Con
C13	100 $\mu$ F, 50 V Electrolytic Capacitor	MCHT101M1HB-1017-RH	Multicomp
R1	330 $\Omega$ , 1/4 W Chip Resistor	CRCW12063300FKEA	Vishay
R2	10 $\Omega$ , 1/4 W Chip Resistor	CRCW120610R0FKEA	Vishay

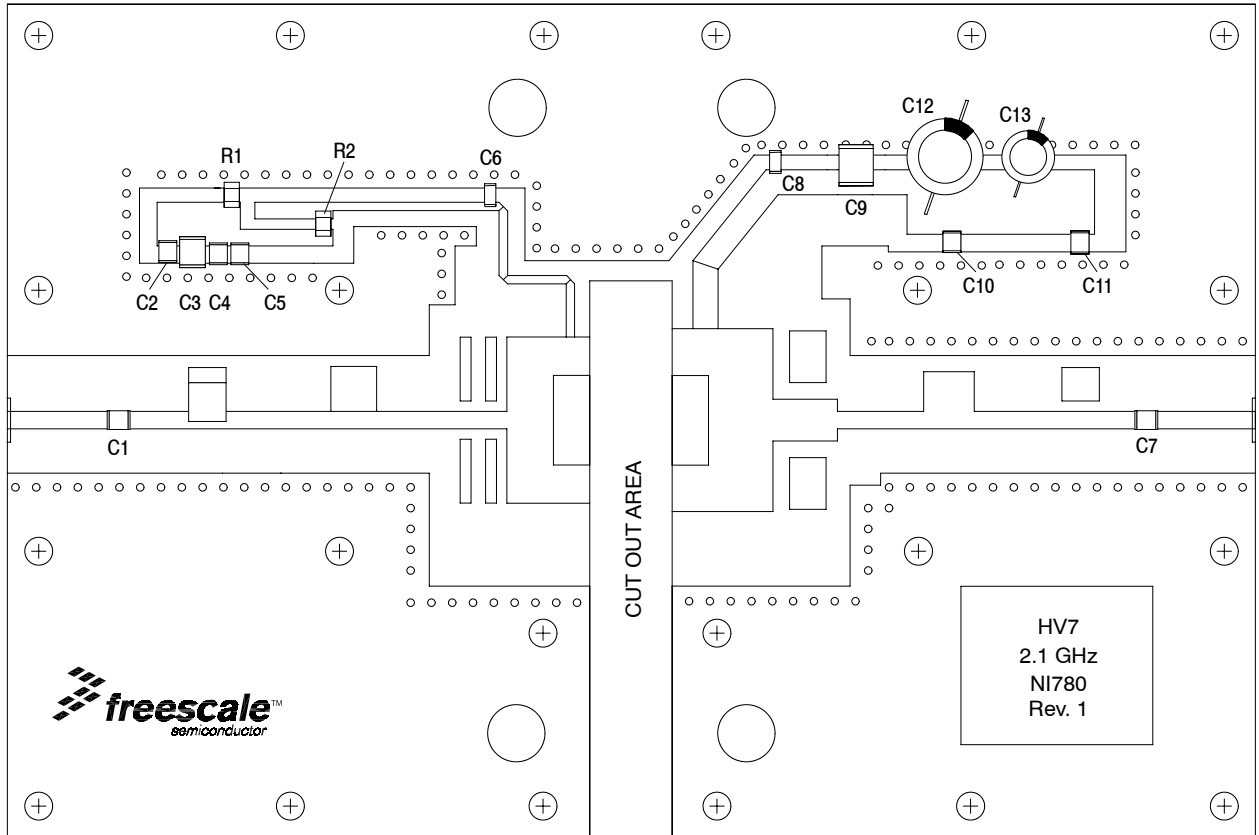


Figure 2. MRF7S19080HR3(HSR3) Test Circuit Component Layout

## TYPICAL CHARACTERISTICS

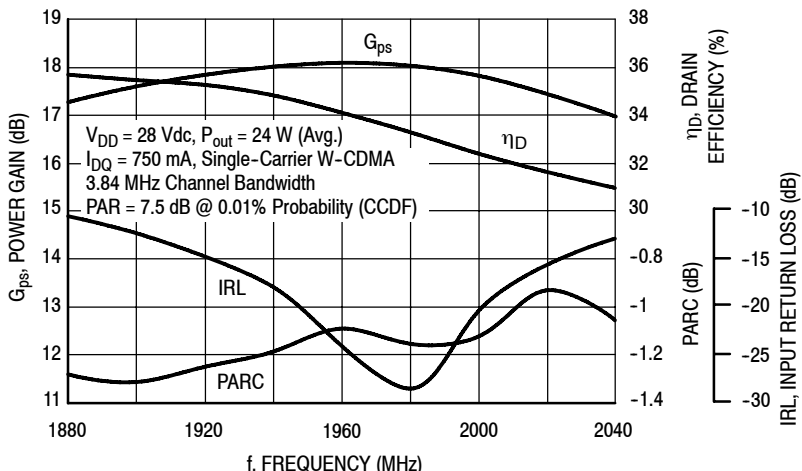


Figure 3. Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @  $P_{out} = 24$  Watts Avg.

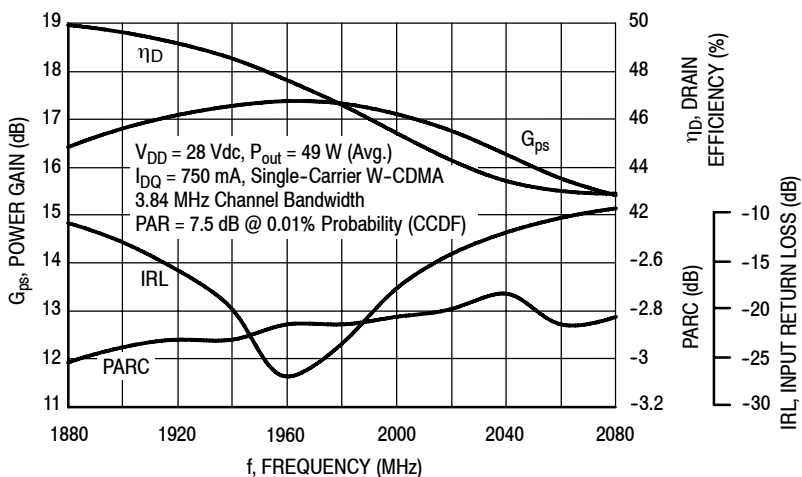


Figure 4. Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @  $P_{out} = 49$  Watts Avg.

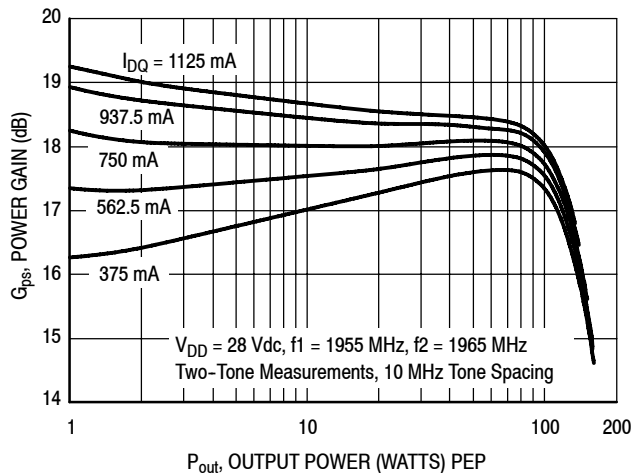


Figure 5. Two-Tone Power Gain versus Output Power

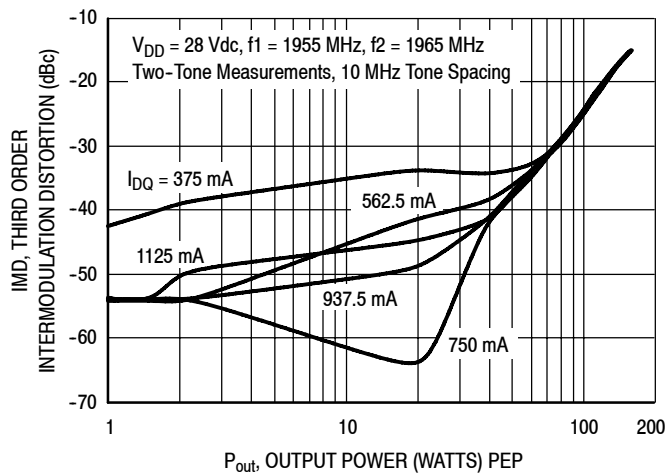
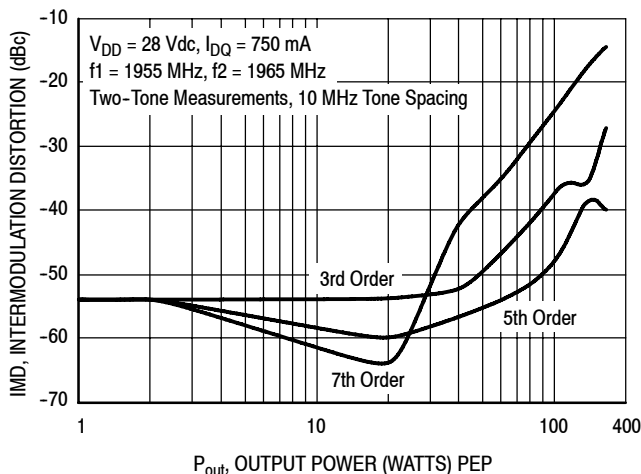
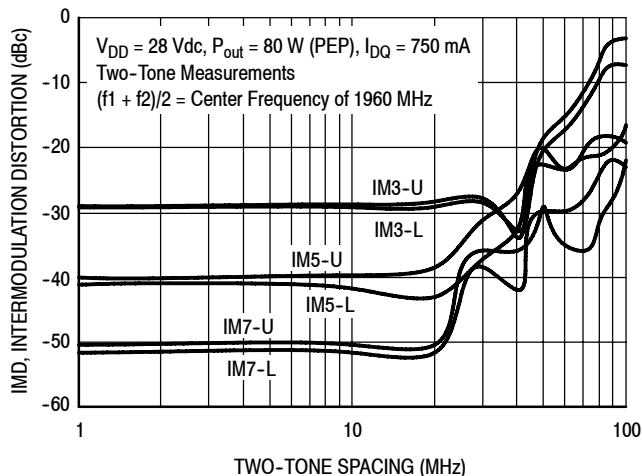


Figure 6. Third Order Intermodulation Distortion versus Output Power

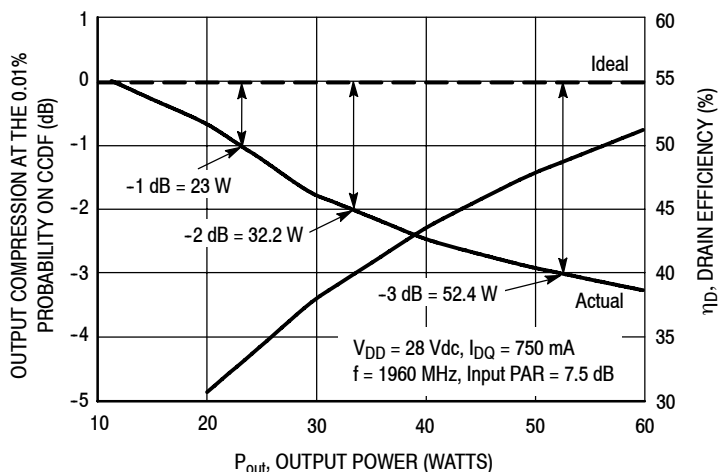
## TYPICAL CHARACTERISTICS



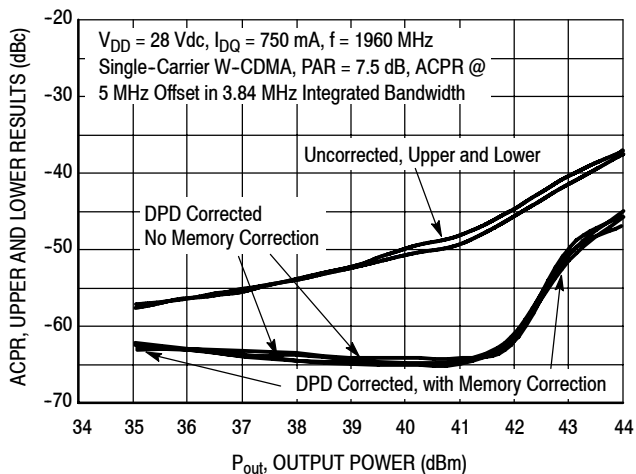
**Figure 7. Intermodulation Distortion Products versus Output Power**



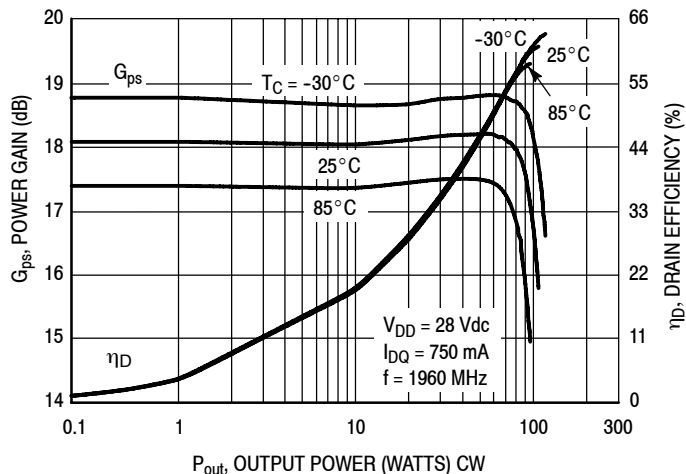
**Figure 8. Intermodulation Distortion Products versus Tone Spacing**



**Figure 9. Output Peak-to-Average Ratio Compression (PARC) versus Output Power**



**Figure 10. Digital Predistortion Correction versus ACPR and Output Power**



**Figure 11. Power Gain and Drain Efficiency versus CW Output Power**

MRF7S19080HR3 MRF7S19080HSR3

## TYPICAL CHARACTERISTICS

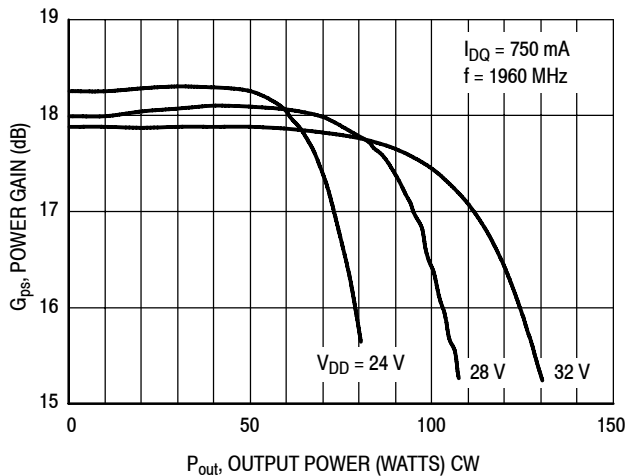


Figure 12. Power Gain versus Output Power

## W-CDMA TEST SIGNAL

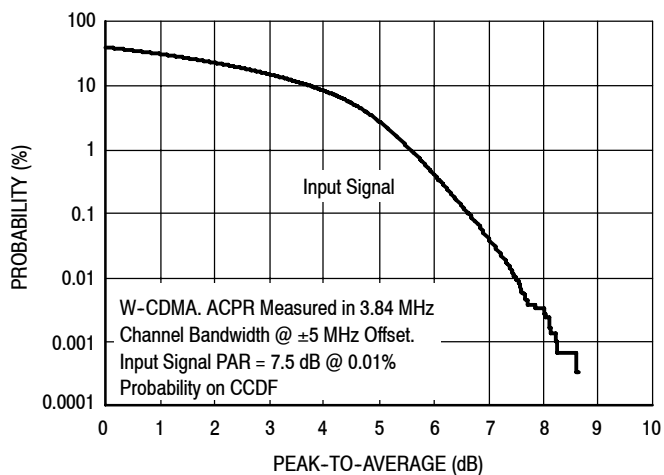


Figure 13. CCDF W-CDMA IQ Magnitude Clipping, Single-Carrier Test Signal

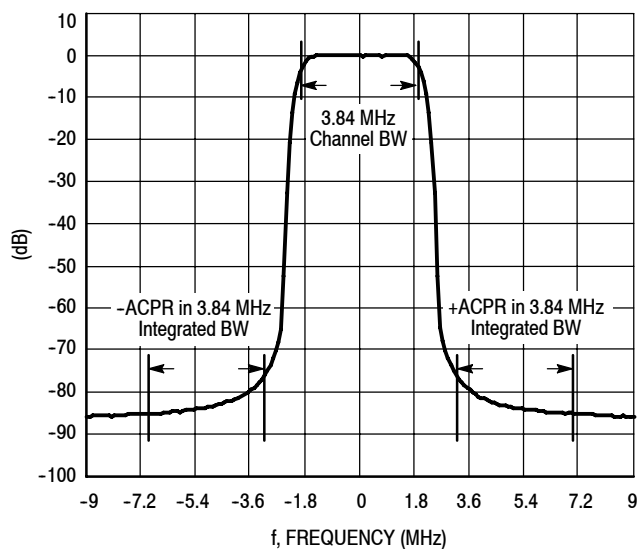
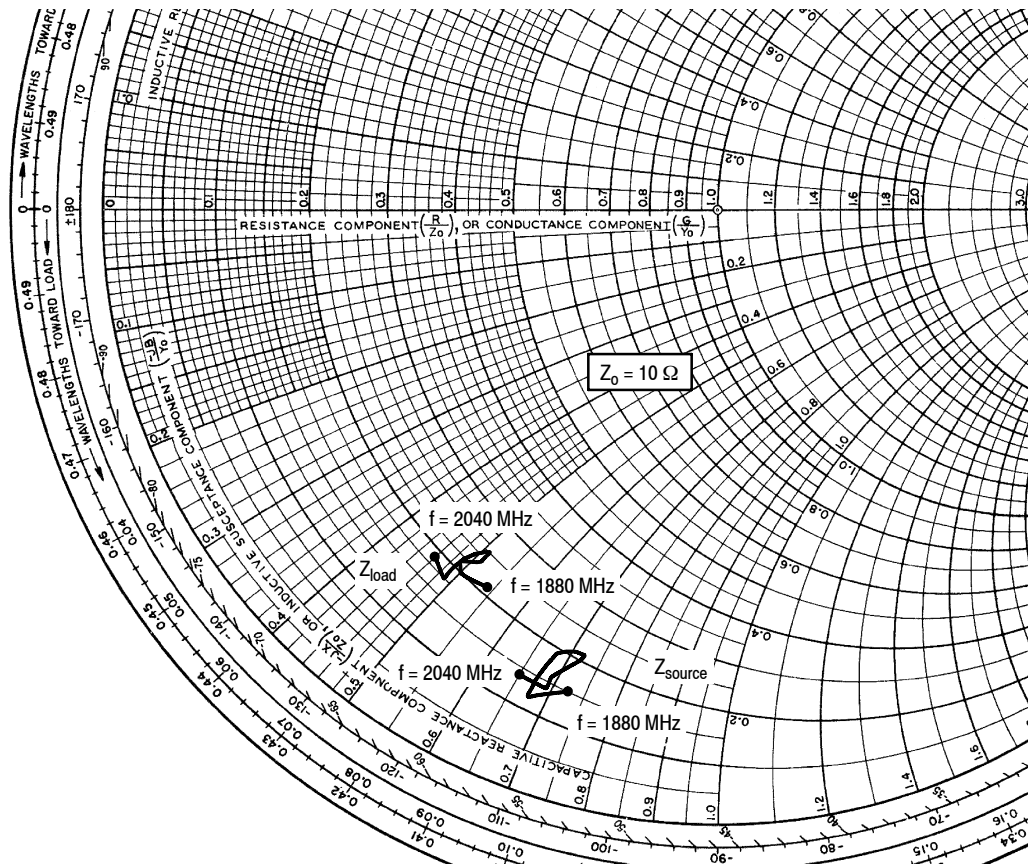


Figure 14. Single-Carrier W-CDMA Spectrum



$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ} = 750 \text{ mA}$ ,  $P_{out} = 24 \text{ W Avg.}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
1880	$1.47 - j7.3$	$2.10 - j5.4$
1900	$1.22 - j6.7$	$1.96 - j5.0$
1920	$1.43 - j6.7$	$2.06 - j4.9$
1940	$1.89 - j6.8$	$2.27 - j5.1$
1960	$2.10 - j7.1$	$2.45 - j5.1$
1980	$2.11 - j7.2$	$2.38 - j5.0$
2000	$1.60 - j6.9$	$2.08 - j4.9$
2020	$1.41 - j6.9$	$1.84 - j4.9$
2040	$1.43 - j6.5$	$1.89 - j4.6$

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

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

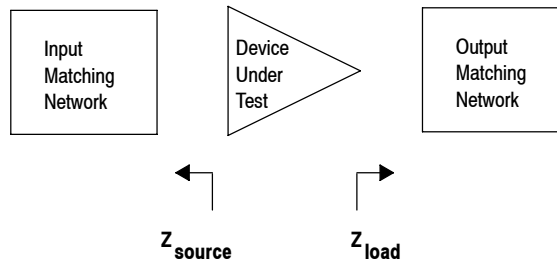
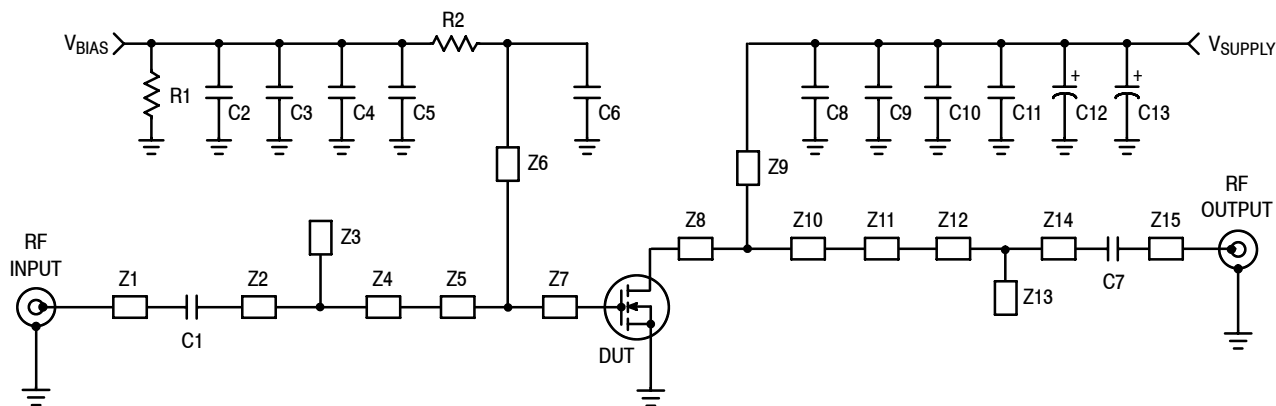


Figure 15. Series Equivalent Source and Load Impedance



## TD-SCDMA CHARACTERIZATION



Z1	0.490" x 0.084" Microstrip	Z9	0.432" x 0.121" Microstrip
Z2	1.082" x 0.084" Microstrip	Z10	0.327" x 0.974" Microstrip
Z3	0.131" x 0.220" Microstrip	Z11	0.505" x 0.201" Microstrip
Z4	0.734" x 0.084" Microstrip	Z12	0.220" x 0.084" Microstrip
Z5	0.308" x 0.800" Microstrip	Z13	0.191" x 0.243" Microstrip
Z6	0.889" x 0.040" Microstrip	Z14	0.781" x 0.084" Microstrip
Z7	0.092" x 0.800" Microstrip	Z15	0.500" x 0.084" Microstrip
Z8	0.160" x 0.880" Microstrip	PCB	Arlon CuClad 250GX-0300-55-22, 0.030", $\epsilon_r = 2.55$

**Figure 16. MRF7S19080HR3(HSR3) Test Circuit Schematic — TD-SCDMA**

**Table 6. MRF7S19080HR3(HSR3) Test Circuit Component Designations and Values — TD-SCDMA**

Part	Description	Part Number	Manufacturer
C1, C7	15 pF Chip Capacitors	ATC100B150JT500XT	ATC
C2, C11	13 pF Chip Capacitors	ATC100B130JT500XT	ATC
C3	10 $\mu$ F Chip Capacitor	GRM31MF51A106ZA01B	TDK
C4	1000 pF Chip Capacitor	ATC100B102JT50XT	ATC
C5, C10	0.1 $\mu$ F Chip Capacitors	C1206C104K5RAC	Kemet
C6	5.1 pF Chip Capacitor	ATC100B5R1CT500XT	ATC
C8	6.8 pF Chip Capacitor	ATC100B6R8CT500XT	ATC
C9	2.2 $\mu$ F Chip Capacitor	C1825C225J5RAC	Kemet
C12	470 $\mu$ F, 63 V Electrolytic Capacitor	EKME630ELL471MK25S	United Chemi-Con
C13	100 $\mu$ F, 50 V Electrolytic Capacitor	MCHT101M1HB-1017-RH	Multicomp
R1	330 $\Omega$ , 1/4 W Chip Resistor	CRCW12063300FKEA	Vishay
R2	10 $\Omega$ , 1/4 W Chip Resistor	CRCW120610R0FKEA	Vishay

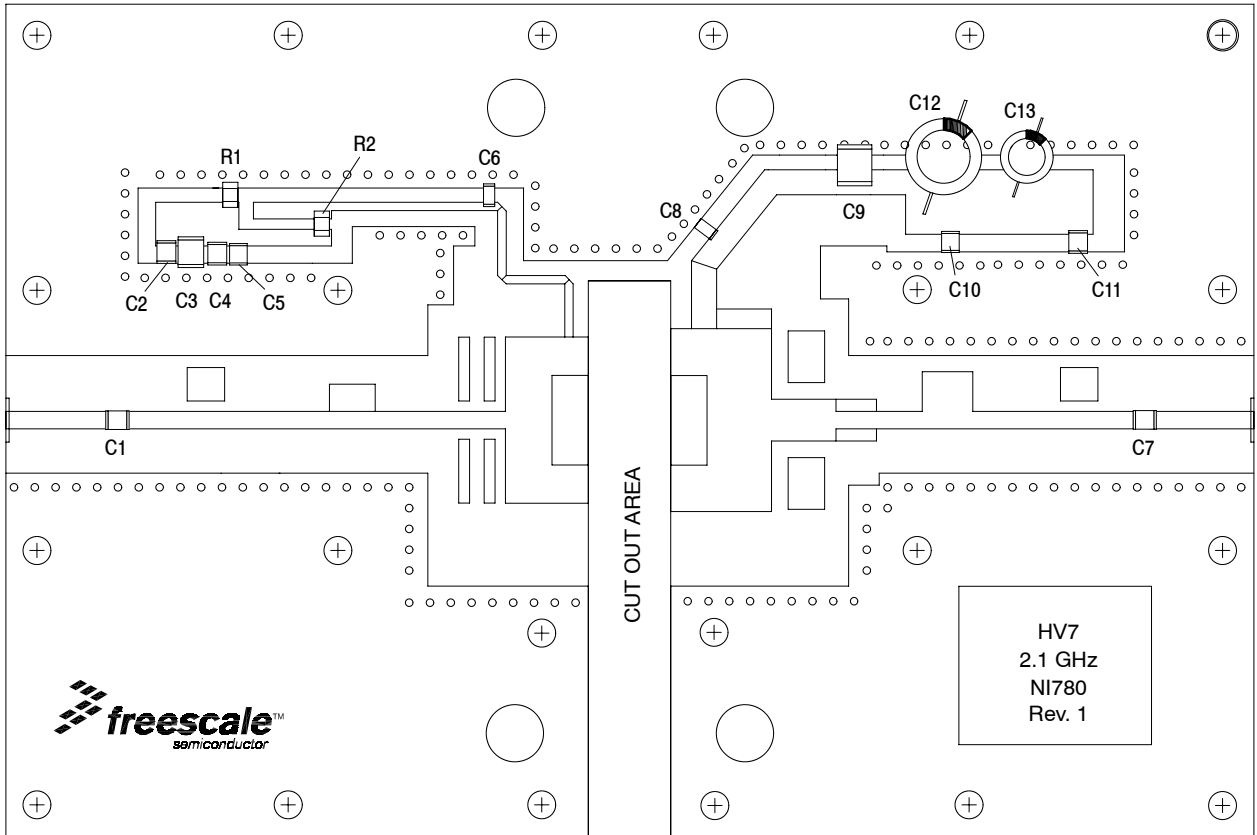
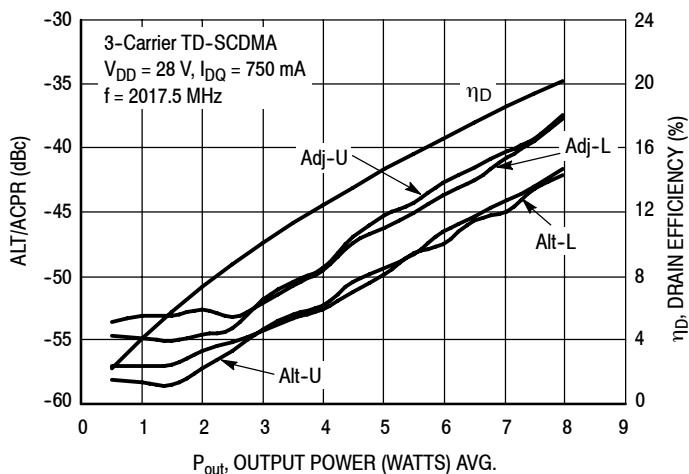
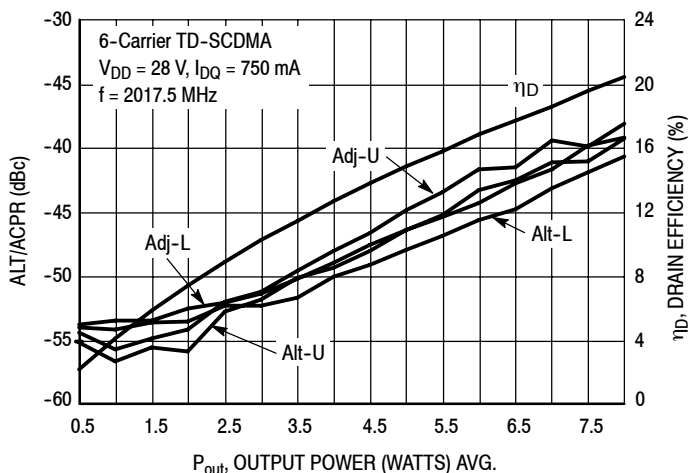


Figure 17. MRF7S19080HR3(HSR3) Test Circuit Component Layout — TD-SCDMA

## TYPICAL CHARACTERISTICS

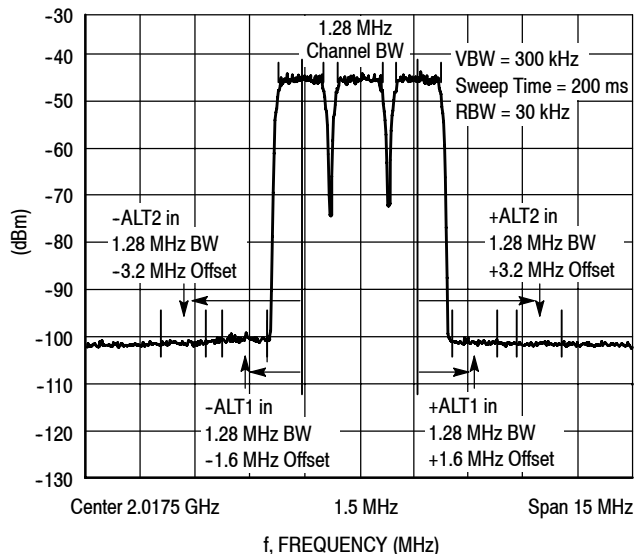


**Figure 18. 3-Carrier TD-SCDMA ACPR, ALT and Drain Efficiency versus Output Power**

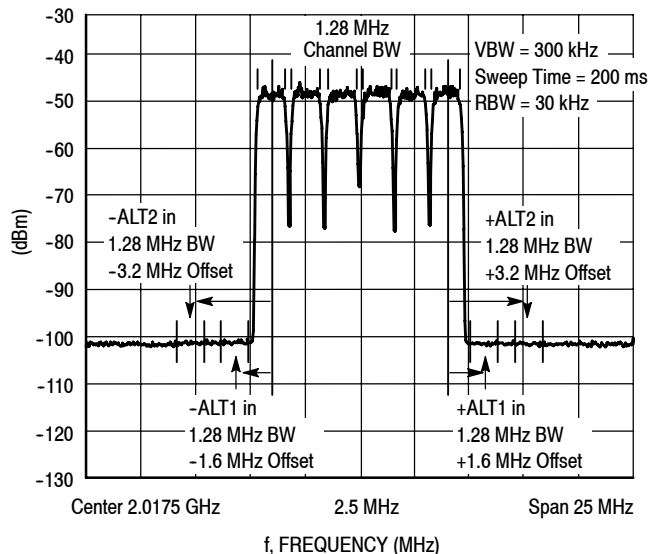


**Figure 19. 6-Carrier TD-SCDMA ACPR, ALT and Drain Efficiency versus Output Power**

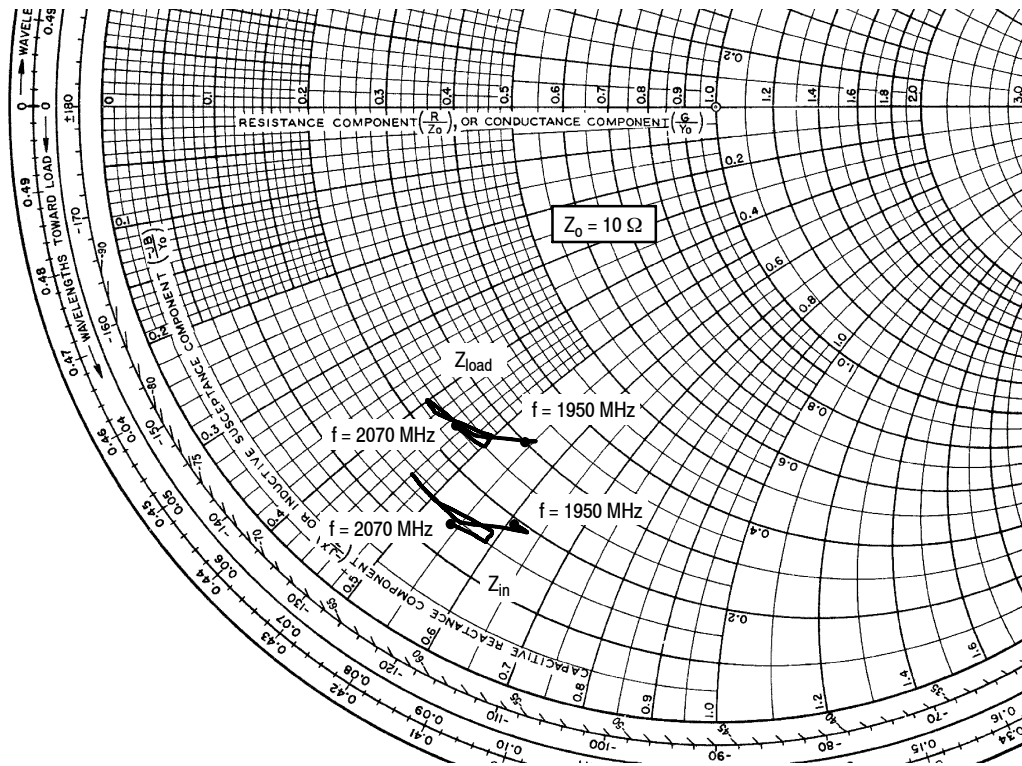
## TD-SCDMA TEST SIGNAL



**Figure 20. 3-Carrier TD-SCDMA Spectrum**



**Figure 21. 6-Carrier TD-SCDMA Spectrum**



$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ} = 750 \text{ mA}$

f MHz	$Z_{in}$ $\Omega$	$Z_{load}$ $\Omega$
1950	$1.87 - j6.10$	$2.98 - j5.42$
1960	$1.94 - j6.25$	$3.07 - j5.47$
1970	$1.77 - j6.04$	$2.87 - j5.26$
1980	$1.52 - j5.47$	$2.53 - j4.77$
1990	$1.46 - j4.92$	$2.35 - j4.26$
2000	$1.49 - j4.62$	$2.30 - j3.99$
2010	$1.53 - j4.64$	$2.34 - j3.98$
2020	$1.50 - j4.85$	$2.34 - j4.20$
2030	$1.50 - j5.15$	$2.40 - j4.44$
2040	$1.62 - j5.56$	$2.59 - j4.75$
2050	$1.63 - j5.90$	$2.68 - j5.03$
2060	$1.47 - j5.86$	$2.52 - j4.98$
2070	$1.38 - j5.40$	$2.35 - j4.54$

$Z_{in}$  = Device input impedance as measured from gate to ground.

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

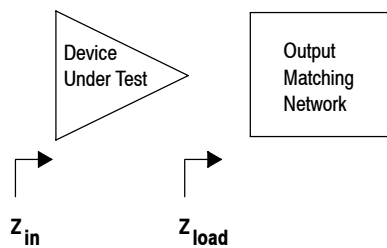
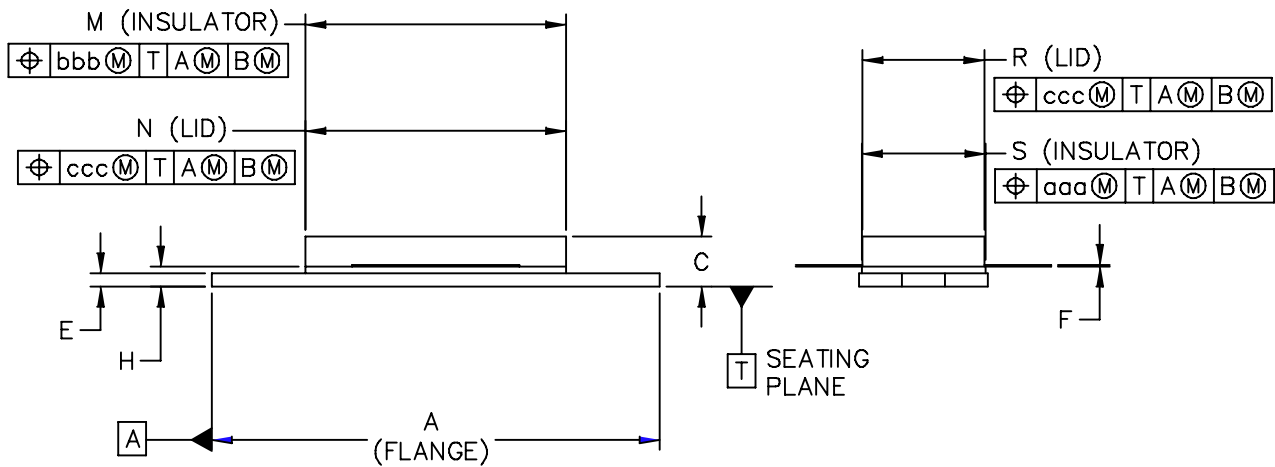
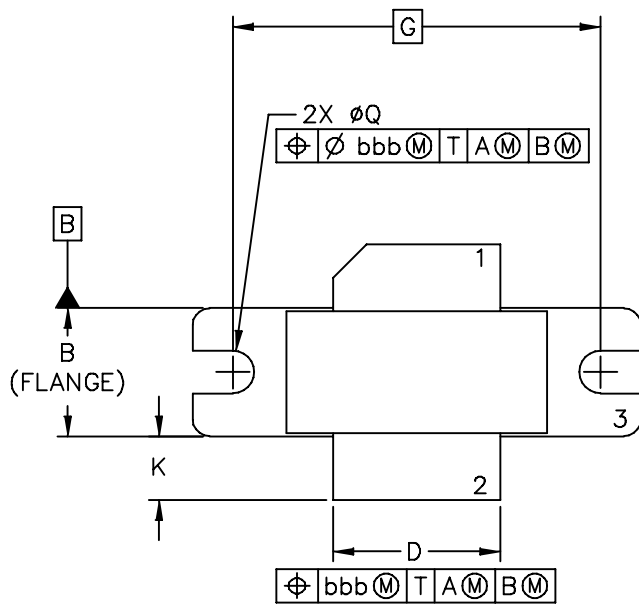


Figure 22. Series Equivalent Input and Load Impedance — TD-SCDMA

### PACKAGE DIMENSIONS



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TITLE:  <div style="text-align: center; font-size: 1.2em;">NI-780</div>	DOCUMENT NO: 98ASB15607C	REV: G
	CASE NUMBER: 465-06	31 MAR 2005
	STANDARD: NON-JEDEC	

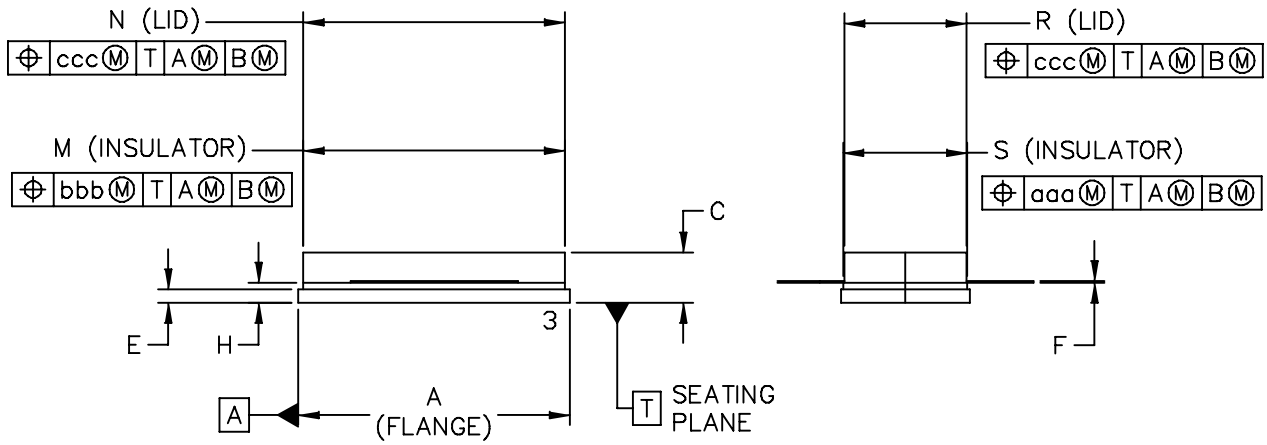
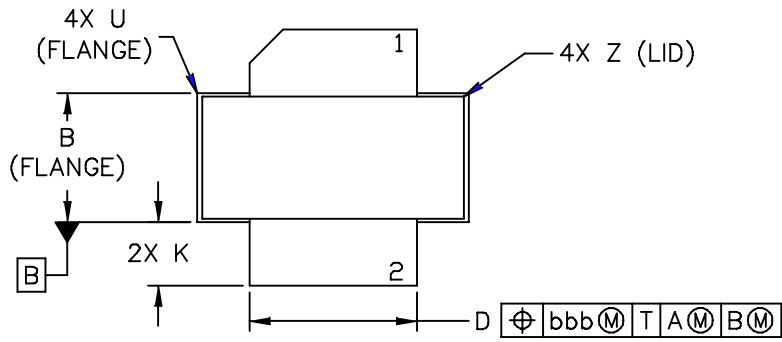
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED .030 (.762) AWAY FROM PACKAGE BODY.

STYLE 1:

- PIN 1. DRAIN  
 2. GATE  
 3. SOURCE

DIM	INCH		MILLIMETER		DIM	INCH		MILLIMETER	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16	R	.365	.375	9.27	9.53
B	.380	.390	9.65	9.91	S	.365	.375	9.27	9.52
C	.125	.170	3.18	4.32	aaa	—	.005	—	0.127
D	.495	.505	12.57	12.83	bbb	—	.010	—	0.254
E	.035	.045	0.89	1.14	ccc	—	.015	—	0.381
F	.003	.006	0.08	0.15	—	—	—	—	—
G	1.100 BSC		27.94 BSC		—	—	—	—	—
H	.057	.067	1.45	1.7	—	—	—	—	—
K	.170	.210	4.32	5.33	—	—	—	—	—
M	.774	.786	19.66	19.96	—	—	—	—	—
N	.772	.788	19.6	20	—	—	—	—	—
Q	∅.118	∅.138	∅3	∅3.51	—	—	—	—	—
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	CASE NUMBER: 465A-06	31 MAR 2005
	STANDARD: NON-JEDEC	

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH.
3. DELETED
4. DIMENSION H IS MEASURED .030 (0.762) AWAY FROM PACKAGE BODY.

STYLE 1:

- PIN 1. DRAIN
2. GATE
3. SOURCE

DIM	INCH		MILLIMETER		DIM	INCH		MILLIMETER	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
A	.805	-.815	20.45	20.7	U	-.040			1.02
B	.380	-.390	9.65	9.91	Z	-.030			0.76
C	.125	-.170	3.18	4.32	aaa	-.005		0.127	
D	.495	-.505	12.57	12.83	bbb	-.010		0.254	
E	.035	-.045	0.89	1.14	ccc	-.015		0.381	
F	.003	-.006	0.08	0.15	-				
H	.057	-.067	1.45	1.7	-				
K	.170	-.210	4.32	5.33	-				
M	.774	-.786	19.61	20.02	-				
N	.772	-.788	19.61	20.02	-				
R	.365	-.375	9.27	9.53	-				
S	.365	-.375	9.27	9.52	-				
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TITLE:  NI-780S					DOCUMENT NO: 98ASB16718C			REV: H	
					CASE NUMBER: 465A-06			31 MAR 2005	
					STANDARD: NON-JEDEC				



## PRODUCT DOCUMENTATION AND SOFTWARE

Refer to the following documents and software to aid your design process.

### Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

### Software

- Electromigration MTTF Calculator
- RF High Power Model

For Software, do a Part Number search at <http://www.freescale.com>, and select the "Part Number" link. Go to the Software & Tools tab on the part's Product Summary page to download the respective tool.

## REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Jan. 2007	<ul style="list-style-type: none"><li>• Initial Release of Data Sheet</li></ul>
1	Dec. 2008	<ul style="list-style-type: none"><li>• Table 4, On Characteristics, corrected <math>V_{DS}</math> to <math>V_{DD}</math> in the RF test condition voltage callout for <math>V_{GS(Q)}</math>, p. 2</li><li>• Table 4, On Characteristics, tightened <math>V_{GS(Q)}</math> max value from 3.8 to 3.5 to match production test value, p. 2</li><li>• Updated PCB information to show more specific material details, Figs. 1 and 17, Test Circuit Schematic, p. 4, 10</li><li>• Updated Part Numbers in Tables 5 and 6, Component Designations and Values, to latest RoHS compliant part numbers, p. 4, 10</li><li>• Updated Fig. 14, CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 50% Clipping, Single-Carrier Test Signal, to better represent production test signal, p. 8</li></ul>
2	Mar. 2011	<ul style="list-style-type: none"><li>• Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN13628, p. 1, 2</li><li>• Fig. 13, MTTF versus Junction Temperature removed, p. 8. Refer to the device's MTTF Calculator available at <a href="http://freescale.com/RFpower">freescale.com/RFpower</a>. Go to Design Resources &gt; Software and Tools.</li><li>• Fig. 14, CCDF W-CDMA IQ Magnitude Clipping, Single-Carrier Test Signal and Fig. 15, Single-Carrier W-CDMA Spectrum updated to show the undistorted input test signal, p. 8 (renumbered as Figs. 13 and 14 respectively after Fig. 13 removed)</li><li>• Added Electromigration MTTF Calculator and RF High Power Model availability to Product Software, p. 18</li></ul>

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