

# RF Power Field Effect Transistors

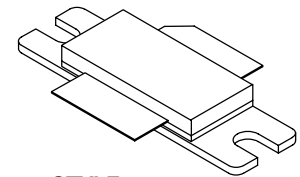
## N-Channel Enhancement-Mode Lateral MOSFETs

Designed for N-CDMA base station applications with frequencies from 2600 to 2700 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN - PCS/cellular radio and WLL applications.

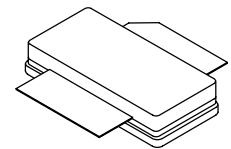
- Typical Single-Carrier N-CDMA Performance:  $V_{DD} = 28$  Volts,  $I_{DQ} = 900$  mA,  $P_{out} = 20$  Watts Avg., Full Frequency Band, IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13) Channel Bandwidth = 1.2288 MHz. Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF.  
Power Gain — 15.5 dB  
Drain Efficiency — 23.5%  
ACPR @ 885 kHz Offset — -48 dBc @ 30 kHz Bandwidth
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 2700 MHz, 85 Watts CW Output Power
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched, Controlled Q, for Ease of Use
- Qualified Up to a Maximum of 32  $V_{DD}$  Operation
- Integrated ESD Protection
- Lower Thermal Resistance Package
- Designed for Lower Memory Effects and Wide Instantaneous Bandwidth Applications
- Low Gold Plating Thickness on Leads, 40 $\mu$ " Nominal.
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

**MRF6S27085HR3**  
**MRF6S27085HSR3**

**2700 MHz, 20 W AVG., 28 V**  
**SINGLE N-CDMA**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFETs**



**CASE 465-06, STYLE 1**  
**NI-780**  
**MRF6S27085HR3**



**CASE 465A-06, STYLE 1**  
**NI-780S**  
**MRF6S27085HSR3**

**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	-0.5, +68	Vdc
Gate-Source Voltage	$V_{GS}$	-0.5, +12	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25 $^\circ\text{C}$	$P_D$	350 2	W W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	- 65 to +150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$
CW Operation	CW	85	W

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value (1,2)	Unit
Thermal Resistance, Junction to Case Case Temperature 80 $^\circ\text{C}$ , 85 W CW Case Temperature 76 $^\circ\text{C}$ , 20 W CW	$R_{\theta JC}$	0.50 0.56	$^\circ\text{C}/\text{W}$

1. MTTF calculator available at <http://www.freescale.com/rf>. Select Tools/Software/Application Software/Calculators to access the MTTF calculators by product.
2. Refer to AN1955/D, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1955.

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

**Table 3. ESD Protection Characteristics**

Test Methodology	Class
Human Body Model (per JESD22-A114)	3A (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	IV (Minimum)

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

Characteristic	Symbol	Min	Typ	Max	Unit
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**Off Characteristics**

Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 68\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{A}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	1	$\mu\text{A}$
Gate-Source Leakage Current ( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{A}$

**On Characteristics**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 250\text{ }\mu\text{A}$ )	$V_{GS(th)}$	1	2	3	Vdc
Gate Quiescent Voltage ( $V_{DS} = 28\text{ Vdc}$ , $I_D = 900\text{ mA}$ )	$V_{GS(Q)}$	2	2.8	4	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 2.2\text{ A}$ )	$V_{DS(on)}$	—	0.21	0.3	Vdc
Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 2\text{ A}$ )	$g_{fs}$	—	5.3	—	S

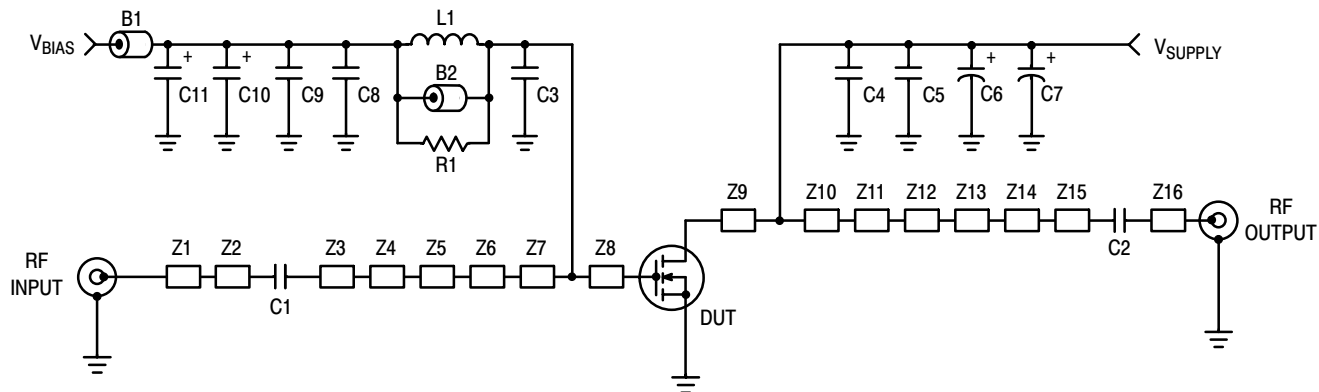
**Dynamic Characteristics** <sup>(1)</sup>

Reverse Transfer Capacitance ( $V_{DS} = 28\text{ Vdc} \pm 30\text{ mV(rms)}$ ac @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )	$C_{rss}$	—	2.8	—	pF
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**Functional Tests** (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ} = 900\text{ mA}$ ,  $P_{out} = 20\text{ W Avg. N-CDMA}$ ,  $f = 2630\text{ MHz}$  and  $2660\text{ MHz}$ , Single-Carrier N-CDMA, 1.2288 MHz Channel Bandwidth Carrier. ACPR measured in 30 kHz Channel Bandwidth @  $\pm 885\text{ kHz}$  Offset. Peak/Avg. Ratio = 9.8 dB @ 0.01% Probability on CCDF

Power Gain	$G_{ps}$	14	15.5	17	dB
Drain Efficiency	$\eta_D$	22	23.5	—	%
Adjacent Channel Power Ratio	ACPR	—	-48	-45	dBc
Input Return Loss	IRL	—	-13	-9	dB

1. Part is internally matched both on input and output.

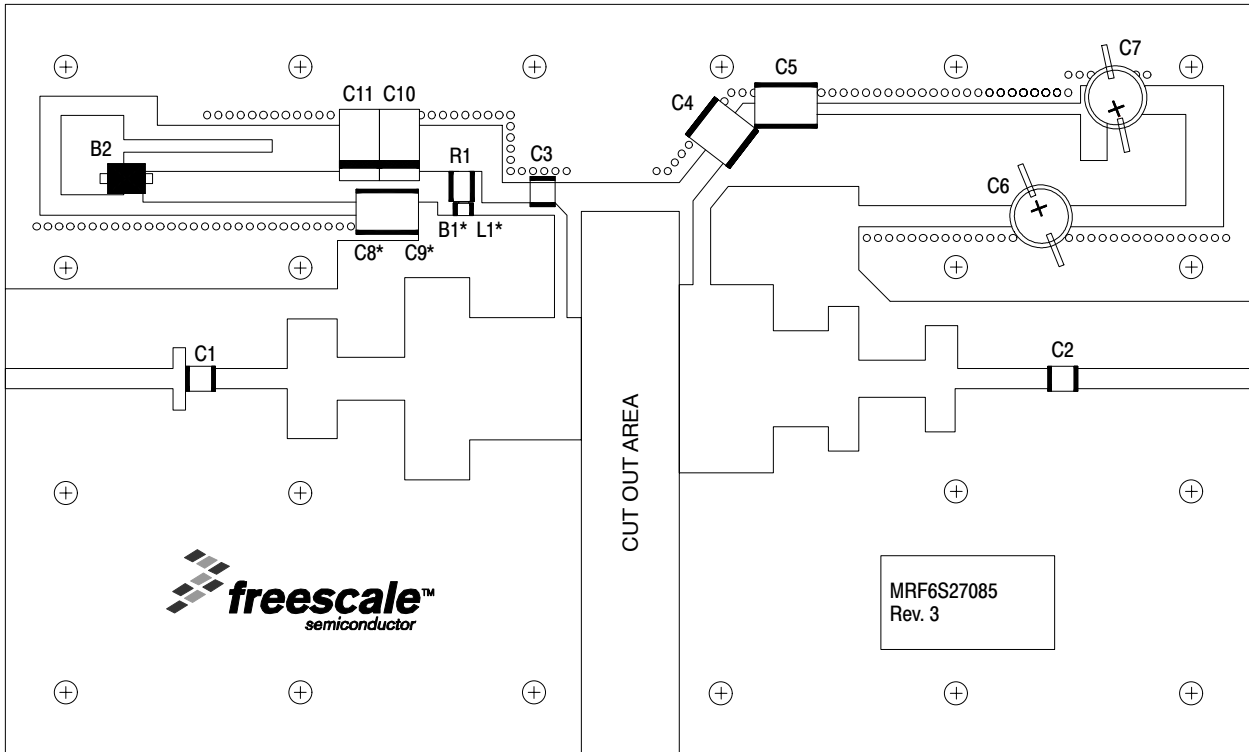


Z1	0.672" x 0.081" Microstrip	Z10	0.287" x 0.753" Microstrip
Z2	0.050" x 0.250" Microstrip	Z11	0.220" x 0.384" Microstrip
Z3	0.288" x 0.081" Microstrip	Z12	0.122" x 0.580" Microstrip
Z4	0.200" x 0.480" Microstrip	Z13	0.266" x 0.148" Microstrip
Z5	0.270" x 0.172" Microstrip	Z14	0.130" x 0.425" Microstrip
Z6	0.260" x 0.810" Microstrip	Z15	0.380" x 0.081" Microstrip
Z7	0.366" x 0.490" Microstrip	Z16	0.703" x 0.081" Microstrip
Z8	0.083" x 0.490" Microstrip	PCB	Arlon GX-0300-5022, 0.030", $\epsilon_r = 2.5$
Z9	0.091" x 0.753" Microstrip		

**Figure 1. MRF6S27085HR3(SR3) Test Circuit Schematic**

**Table 5. MRF6S27085HR3(SR3) Test Circuit Component Designations and Values**

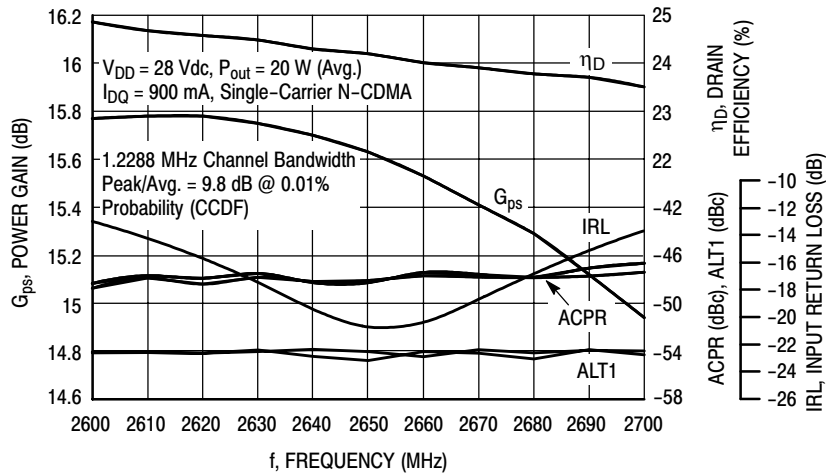
Part	Description	Part Number	Manufacturer
B1	Bead (0805)	2508051107Y0	Fair-Rite
B2	Bead, Surface Mount	2743019447	Fair-Rite
C1, C2	4.7 pF Chip Capacitors, B Case	100B4R7CP500X	ATC
C3	3.6 pF Chip Capacitor, B Case	100B3R6CP500X	ATC
C4	10 $\mu$ F, 50 V Chip Capacitor (2220)	GRM55DR61H106KA88B	Murata
C5, C8	2.2 $\mu$ F, 50 V Chip Capacitors (1825)	C1825C225J5RAC	Kemet
C6	47 $\mu$ F, 50 V Electrolytic Capacitor	MVK50VC47RM8X10TP	Nippon
C7	330 $\mu$ F, 63 V Electrolytic Capacitor	NACZF331M63V	Nippon
C9	0.01 $\mu$ F Chip Capacitor (1825)	C1825C103J1RAC	Kemet
C10	22 $\mu$ F, 25 V Tantalum Capacitor	ECS-T1ED226R	Panasonic TE Series
C11	47 $\mu$ F, 16 V Tantalum Capacitor	T491D476K016AS	Kemet
L1	15 nH, Chip Inductor	L0603150GGW	AVX
R1	3.3 $\Omega$ , 1/4 W Chip Resistor (1210)	ERJ-14YJ3R3U	Dale/Vishay



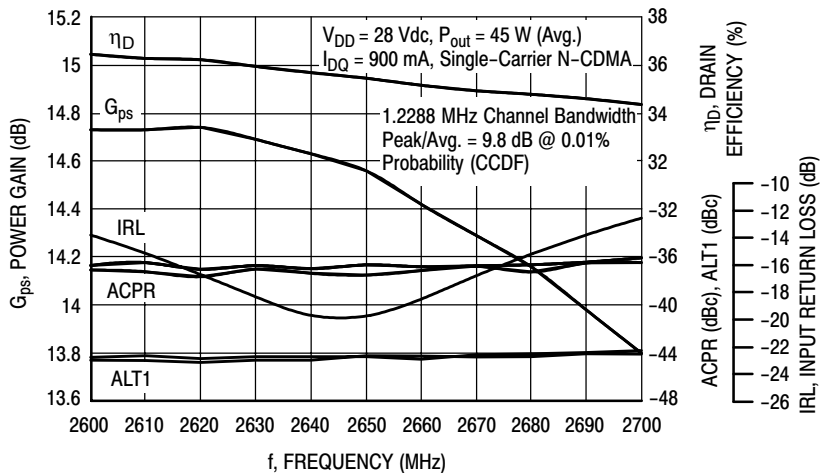
\* Components stacked

Figure 2. MRF6S27085HR3(SR3) Test Circuit Component Layout

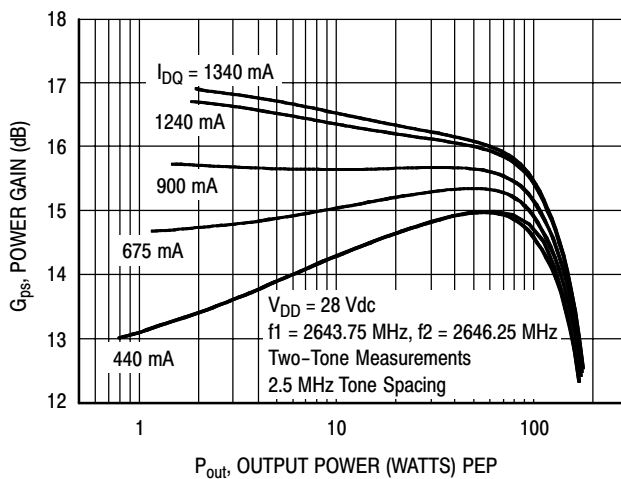
## TYPICAL CHARACTERISTICS



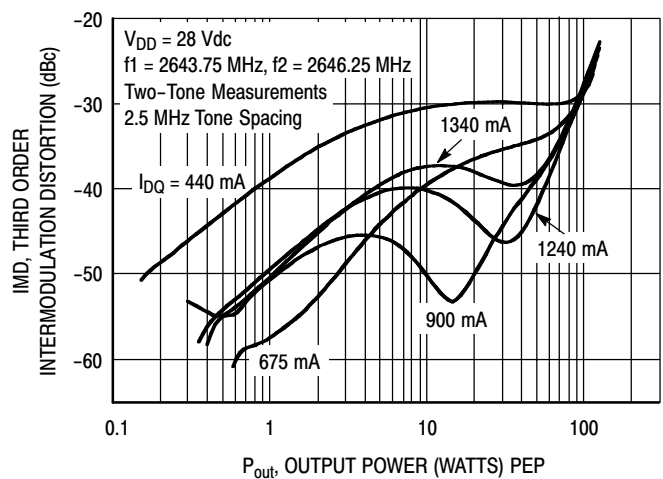
**Figure 3. Single-Carrier N-CDMA Broadband Performance @ 20 Watts Avg.**



**Figure 4. Single-Carrier N-CDMA Broadband Performance @ 45 Watts Avg.**

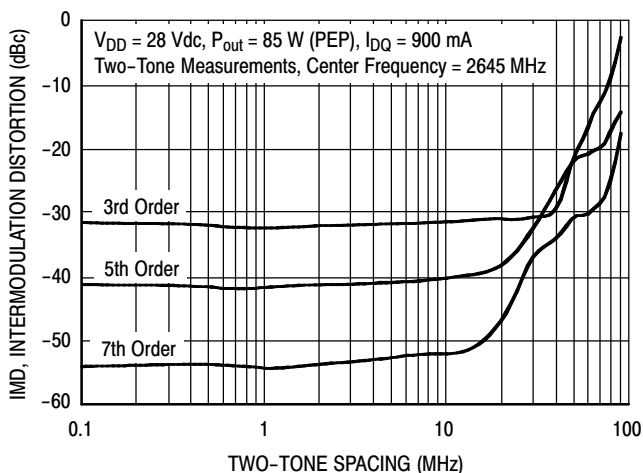


**Figure 5. Two-Tone Power Gain versus Output Power**

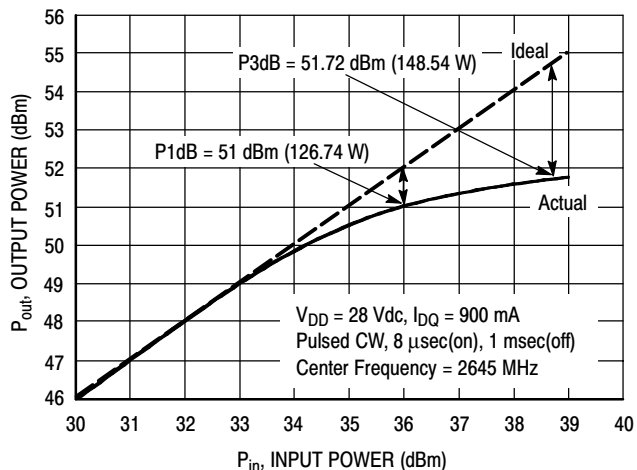


**Figure 6. Third Order Intermodulation Distortion versus Output Power**

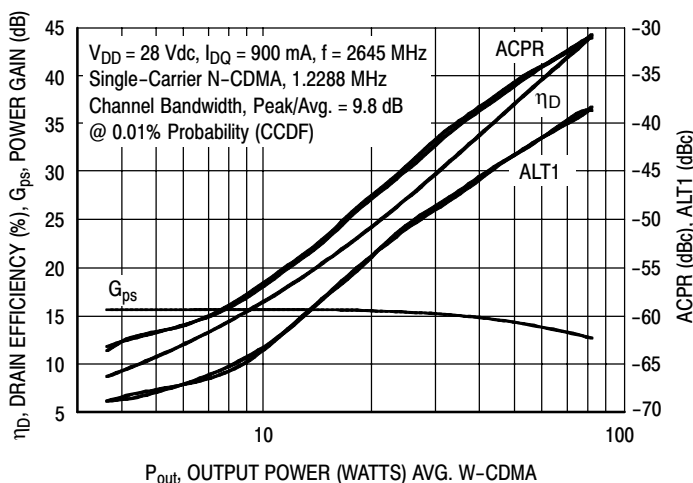
## TYPICAL CHARACTERISTICS



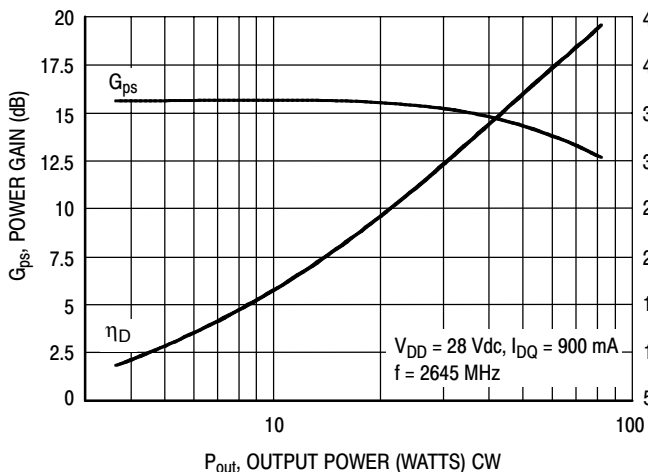
**Figure 7. Intermodulation Distortion Products versus Tone Spacing**



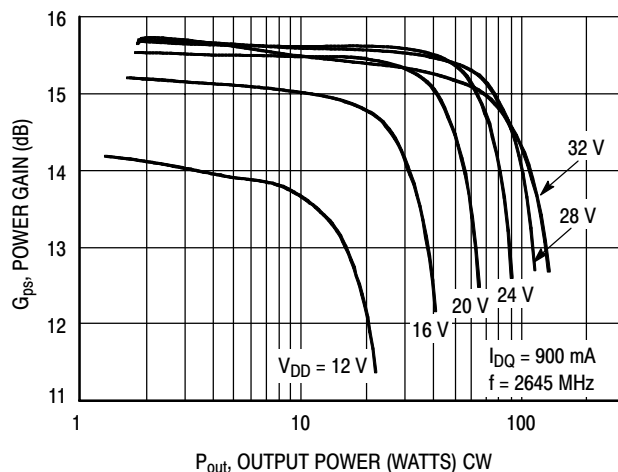
**Figure 8. Pulse CW Output Power versus Input Power**



**Figure 9. Single-Carrier N-CDMA ACPR, ALT1, Power Gain and Drain Efficiency versus Output Power**

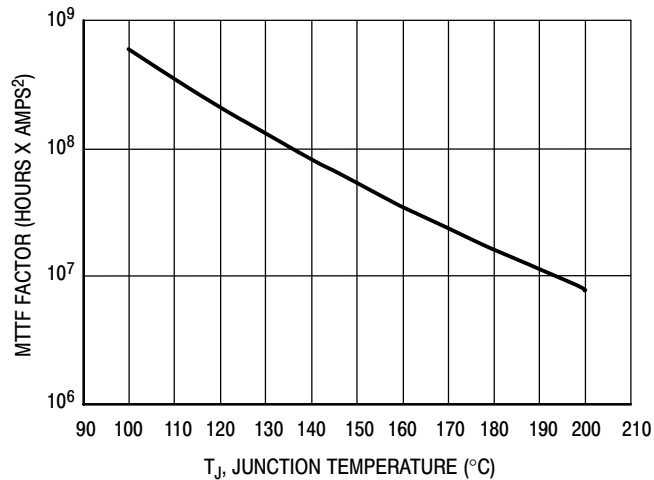


**Figure 10. Power Gain and Drain Efficiency versus CW Output Power**



**Figure 11. Power Gain versus Output Power**

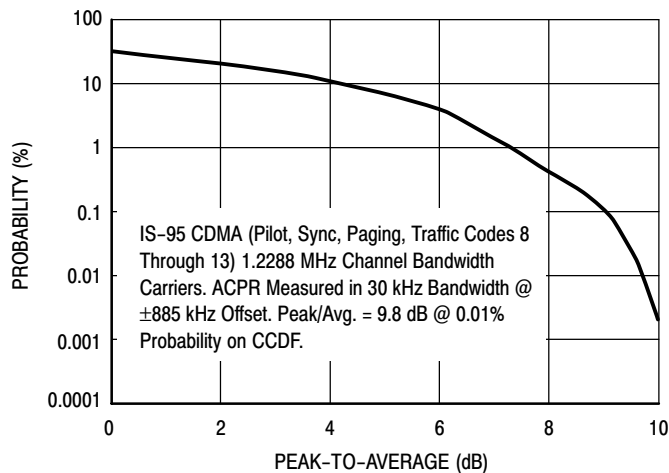
## TYPICAL CHARACTERISTICS



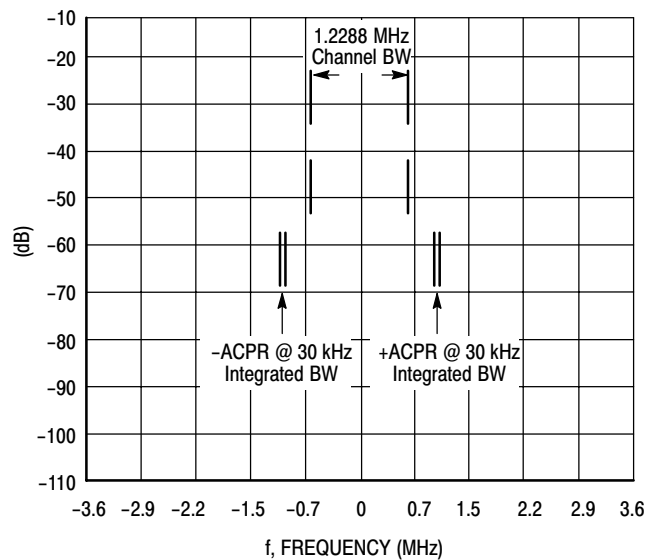
This above graph displays calculated MTTF in hours x ampere<sup>2</sup> drain current. Life tests at elevated temperatures have correlated to better than  $\pm 10\%$  of the theoretical prediction for metal failure. Divide MTTF factor by  $I_D^2$  for MTTF in a particular application.

**Figure 12. MTTF Factor versus Junction Temperature**

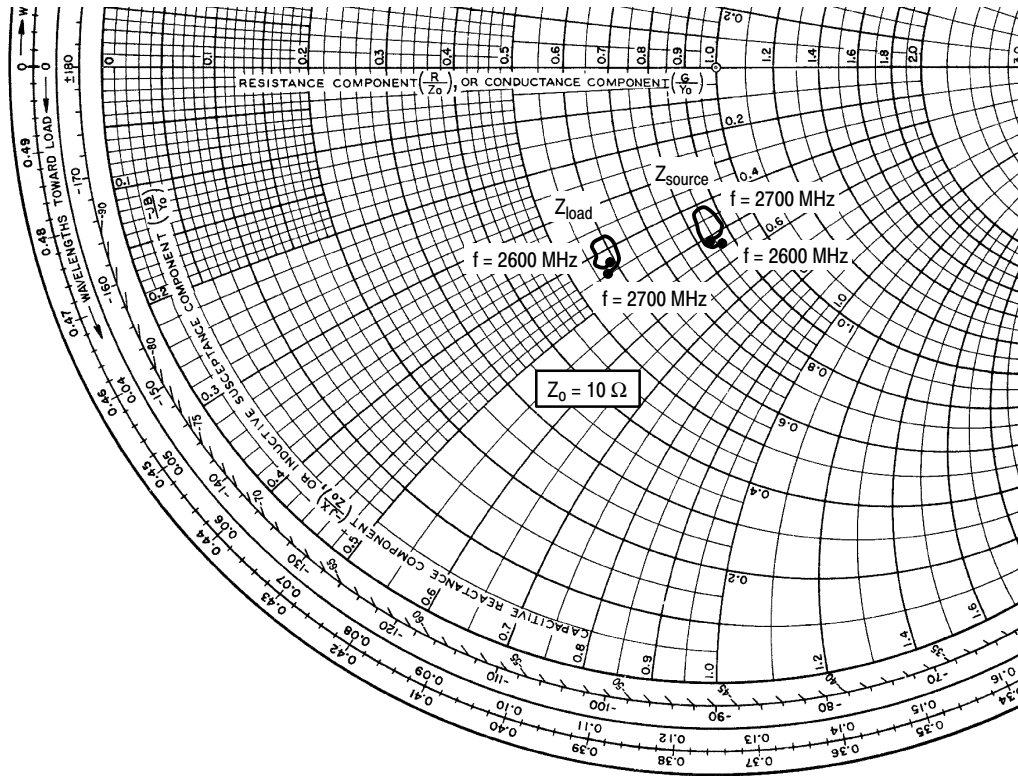
## TYPICAL CHARACTERISTICS N-CDMA TEST SIGNAL



**Figure 13. Single-Carrier CCDF N-CDMA**



**Figure 14. Single-Carrier N-CDMA Spectrum**



$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ} = 900 \text{ mA}$ ,  $P_{out} = 20 \text{ W Avg.}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
2600	8.55 - j5.42	5.86 - j4.34
2610	8.31 - j5.30	5.69 - j4.26
2620	8.21 - j5.10	5.64 - j4.15
2630	8.21 - j4.85	5.67 - j4.00
2640	8.26 - j4.57	5.72 - j3.83
2645	8.40 - j4.43	5.80 - j3.75
2650	8.44 - j4.32	5.86 - j3.70
2660	8.78 - j4.29	6.10 - j3.72
2670	8.94 - j4.59	6.19 - j4.00
2680	8.88 - j5.01	6.07 - j4.36
2690	8.57 - j5.18	5.80 - j4.48
2700	8.36 - j5.10	5.71 - j4.47

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

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

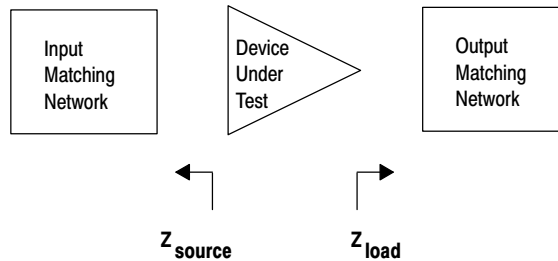


Figure 15. Series Equivalent Source and Load Impedance

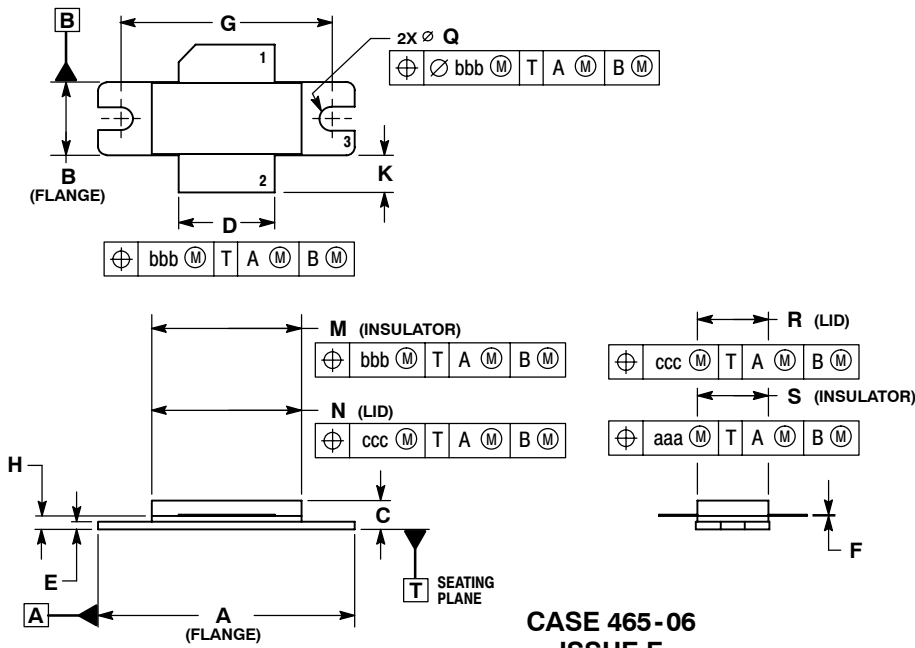


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# NOTES

# NOTES

## PACKAGE DIMENSIONS

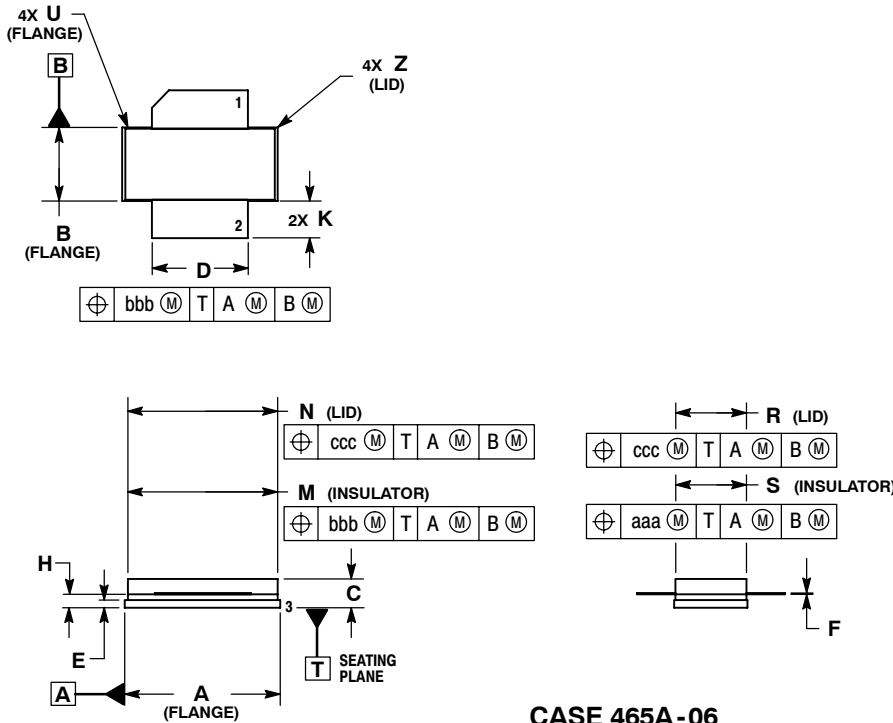


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
  2. CONTROLLING DIMENSION: INCH.
  3. DELETED
  4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

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	0.125	0.170	3.18	4.32
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
G	1.100 BSC		27.94 BSC	
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
M	0.774	0.786	19.66	19.96
N	0.772	0.788	19.60	20.00
Q	Ø.118	Ø.138	Ø.300	Ø.351
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

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

**CASE 465-06  
 ISSUE F  
 NI-780  
 MRF6S27085HR3**



- NOTES:
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  4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.805	0.815	20.45	20.70
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
M	0.774	0.786	19.61	20.02
N	0.772	0.788	19.61	20.02
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
U	---	0.040	---	1.02
Z	---	0.030	---	0.76
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

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

**CASE 465A-06  
 ISSUE F  
 NI-780S  
 MRF6S27085HSR3**

MRF6S27085HR3 MRF6S27085HSR3

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