Freescale Semiconductor
Technical Data

Document Number: MRF6S18100N
Rev. 1, 5/2006

RoHS

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

MRF6S18100NR1
MRF6S18100NBR1

Designed for GSM and GSM EDGE base station applications with frequencies from 1800 to 2000 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications.

GSM Application

- Typical GSM Performance: V_{DD} = 28 Volts, I_{DQ} = 900 mA, P_{out} = 100 Watts, Full Frequency Band (1805-1880 MHz or 1930-1990 MHz)
  Power Gain — 14.5 dB
  Drain Efficiency — 49%

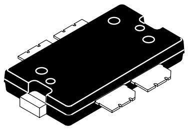
GSM EDGE Application

- Typical GSM EDGE Performance: V_{DD} = 28 Volts, I_{DQ} = 700 mA, P_{out} = 40 Watts Avg., Full Frequency Band (1805-1880 MHz or 1930-1990 MHz)
  Power Gain — 15 dB
  Drain Efficiency — 35%
  Spectral Regrowth @ 400 kHz Offset = -63 dBc
  Spectral Regrowth @ 600 kHz Offset = -76 dBc
  EVM — 2% rms
- Capable of Handling 5:1 VSWR, @ 28 Vdc, 1990 MHz, 100 Watts CW Output Power

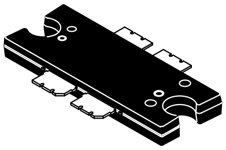
Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Qualified Up to a Maximum of 32 V_{DD} Operation
- Integrated ESD Protection
- Designed for Lower Memory Effects and Wide Instantaneous Bandwidth Applications
- 200°C Capable Plastic Package
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 44 mm, 13 inch Reel.

1805-1990 MHz, 100 W, 28 V
GSM/GSM EDGE
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 1486-03, STYLE 1
TO-270 WB-4
MRF6S18100NR1



CASE 1484-04, STYLE 1
TO-272 WB-4
MRF6S18100NBR1

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°C Derate above 25°C	P_D	343 1.96	W W/°C
Storage Temperature Range	T_{stg}	- 65 to +175	°C
Operating Junction Temperature	T_J	200	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value[1,2]	Unit
Thermal Resistance, Junction to Case Case Temperature 80°C, 100 CW Case Temperature 77°C, 40 CW	$R_{\theta JC}$	 0.51 0.62	°C/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, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

freescale™ semiconductor

Table 3. ESD Protection Characteristics

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

Table 4. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD 22-A113, IPC/JEDEC J-STD-020	3	260	°C

Table 5. Electrical Characteristics (T_C = 25°C unless otherwise noted)

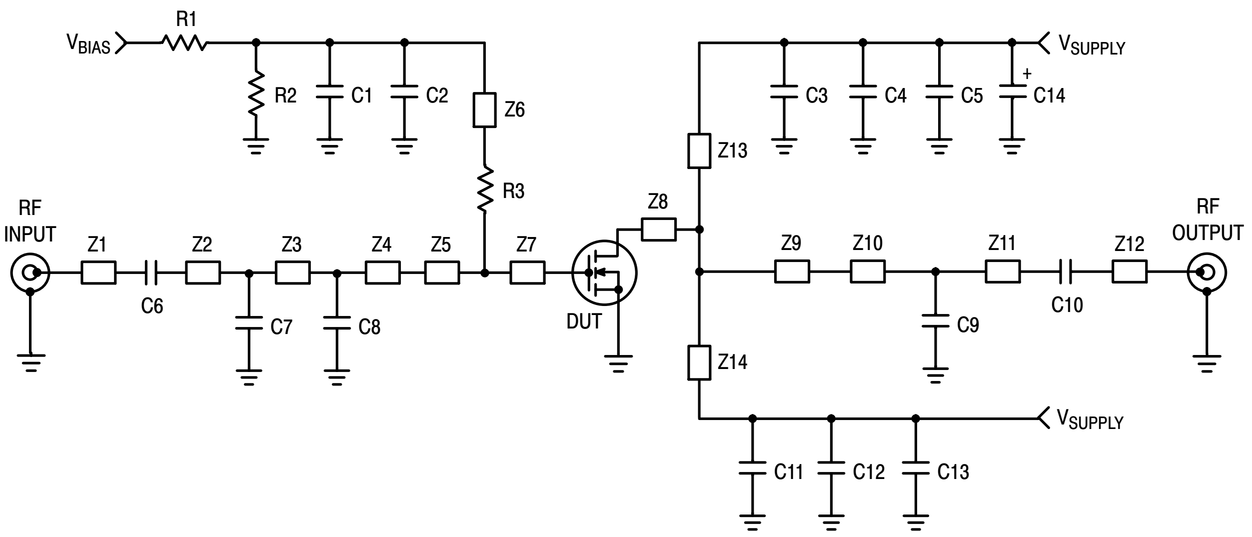
Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Zero Gate Voltage Drain Leakage Current (V_{DS} = 68 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	1	μAdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	500	nAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 330 μAdc)	$V_{GS(th)}$	1.6	2	3	Vdc
Gate Quiescent Voltage (V_{DS} = 28 Vdc, I_D = 900 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	1.5	2.8	3.5	Vdc
Drain-Source On-Voltage (V_{GS} = 10 Vdc, I_D = 3.3 Adc)	$V_{DS(on)}$	—	0.24	—	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 3.3 Adc)	g_{fs}	—	5.3	—	S
Dynamic Characteristics[1]					
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	1.5	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, P_{out} = 100 W, I_{DQ} = 900 mA, f = 1930-1990 MHz					
Power Gain	G_{ps}	13	14.5	16	dB
Drain Efficiency	η_D	47	49	—	%
Input Return Loss	IRL	—	-12	-9	dB
P_{out} @ 1 dB Compression Point	P1dB	100	110	—	W

[1] Part internally matched both on input and output.

(continued)

Table 5. Electrical Characteristics (T_C = 25°C unless otherwise noted **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
Typical GSM EDGE Performances (In Freescale GSM EDGE Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 700 mA, P_{out} = 40 W Avg., 1805-1880 MHz or 1930-1990 MHz EDGE Modulation					
Power Gain	G_{ps}	—	15	—	dB
Drain Efficiency	η_D	—	35	—	%
Error Vector Magnitude	EVM	—	2	—	% rms
Spectral Regrowth at 400 kHz Offset	SR1	—	-63	—	dBc
Spectral Regrowth at 600 kHz Offset	SR2	—	-76	—	dBc
Typical CW Performances (In Freescale GSM Test Fixture, 50 ohm system) V_{DD} = 28 Vdc, I_{DQ} = 900 mA, P_{out} = 100 W, 1805-1880 MHz					
Power Gain	G_{ps}	—	14.5	—	dB
Drain Efficiency	η_D	—	49	—	%
Input Return Loss	IRL	—	-12	—	dB
P_{out} @ 1 dB Compression Point	P1dB	—	110	—	W



Z1, Z12	0.250″ x 0.083″ Microstrip
Z2*	0.450″ x 0.083″ Microstrip
Z3*	0.535″ x 0.083″ Microstrip
Z4*	0.540″ x 0.083″ Microstrip
Z5	0.365″ x 1.000″ Microstrip
Z6	1.190″ x 0.080″ Microstrip
Z7, Z8	0.115″ x 1.000″ Microstrip
Z9	0.485″ x 1.000″ Microstrip
Z10*	0.590″ x 0.083″ Microstrip
Z11*	0.805″ x 0.083″ Microstrip
Z13, Z14	0.870″ x 0.080″ Microstrip
PCB	Taconic TLX8-0300, 0.030″, ε_r = 2.55

*Variable for tuning.

Figure 1. MRF6S18100NR1(NBR1) Test Circuit Schematic — 1930-1990 MHz

Table 6. MRF6S18100NR1(NBR1) Test Circuit Component Designations and Values — 1930-1990 MHz

Part	Description	Part Number	Manufacturer
C1	100 nF Chip Capacitor (1206)	1206C104KAT	AVX
C2, C3, C6, C10, C11	6.8 pF 600B Chip Capacitors	600B6R8BW	ATC
C4, C5, C12, C13	4.7 μF Chip Capacitors (1812)	C4532X5R1H475MT	TDK
C7	0.3 pF 700B Chip Capacitor	700B0R3BW	ATC
C8	1.3 pF 600B Chip Capacitor	600B1R3BW	ATC
C9	0.5 pF 600B Chip Capacitor	600B0R5BW	ATC
C14	470 μF, 63 V Electrolytic Capacitor, Radial	13661471	Philips
R1, R2	10 kΩ, 1/4 W Chip Resistors (1206)		
R3	10 Ω, 1/4 W Chip Resistor (1206)		

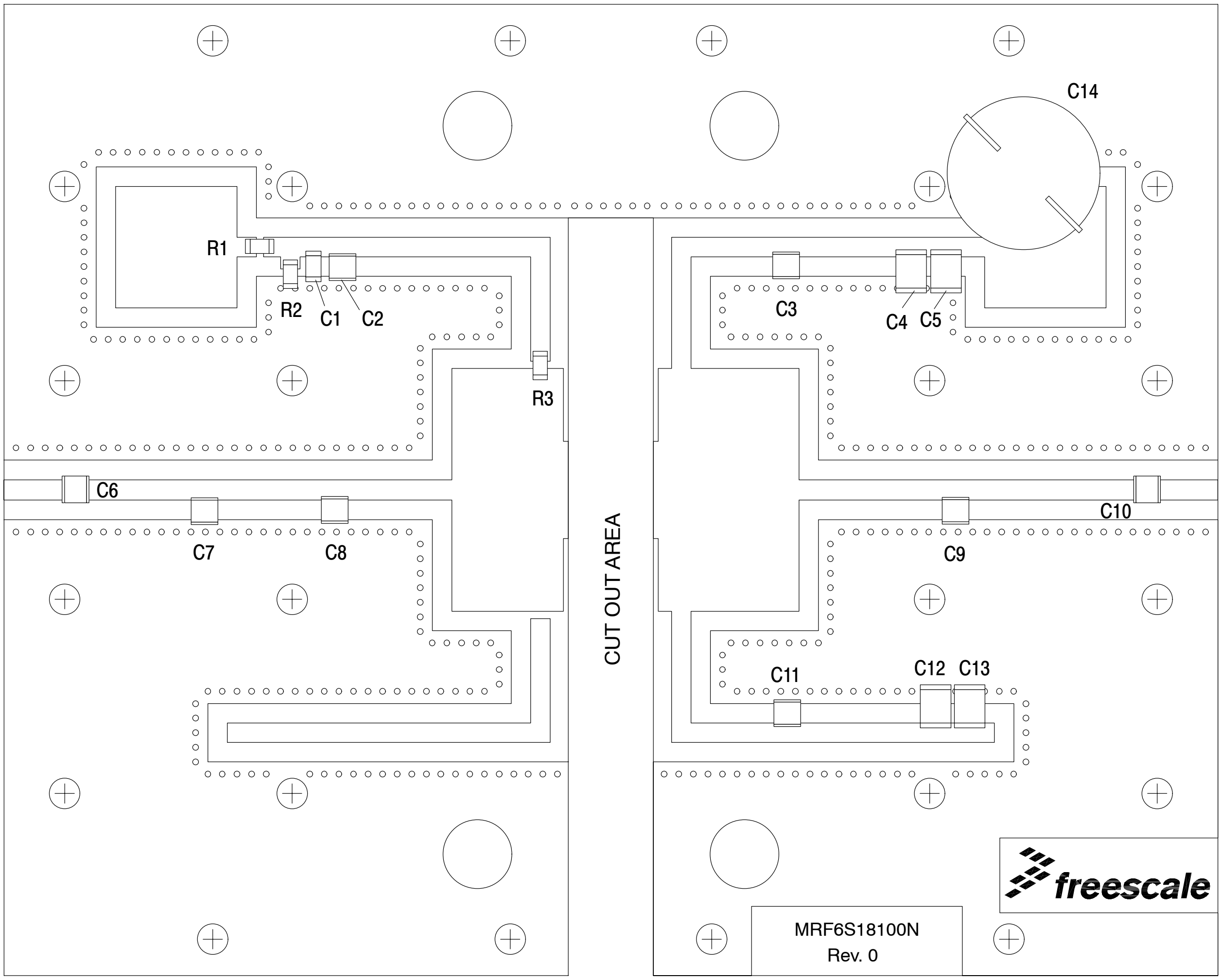


Figure 2. MRF6S18100NR1(NBR1) Test Circuit Component Layout — 1930 - 1990 MHz

TYPICAL CHARACTERISTICS — 1930-1990 MHz

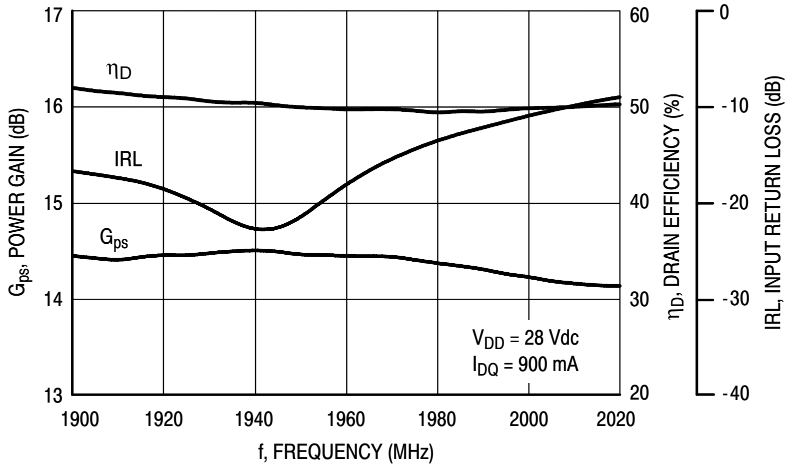


Figure 3. Power Gain, Input Return Loss and Drain Efficiency versus Frequency @ P_{out} = 100 Watts

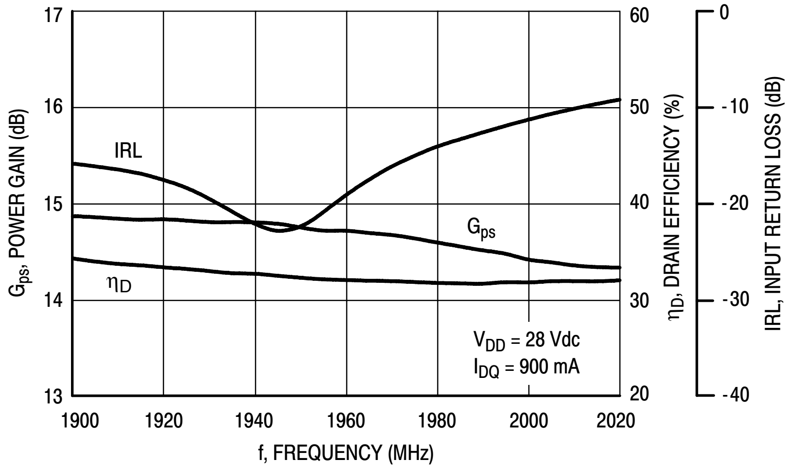


Figure 4. Power Gain, Input Return Loss and Drain Efficiency versus Frequency @ P_{out} = 40 Watts

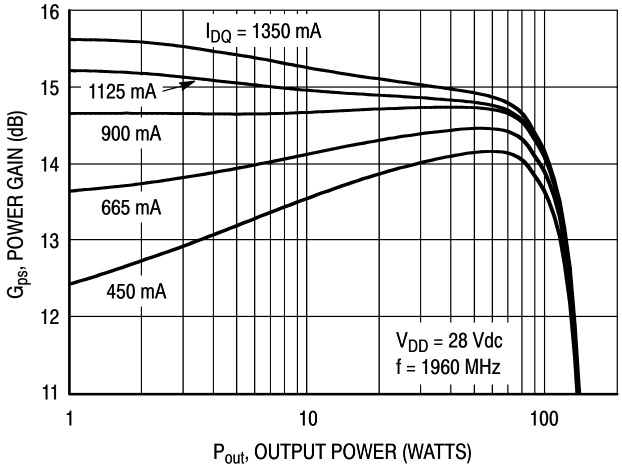


Figure 5. Power Gain versus Output Power

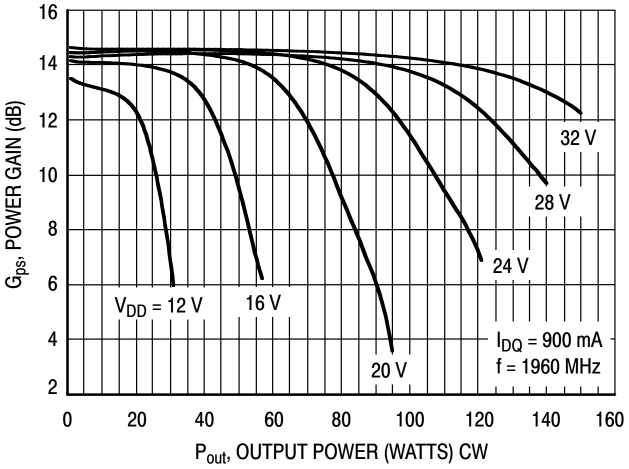


Figure 6. Power Gain versus Output Power

TYPICAL CHARACTERISTICS — 1930-1990 MHz

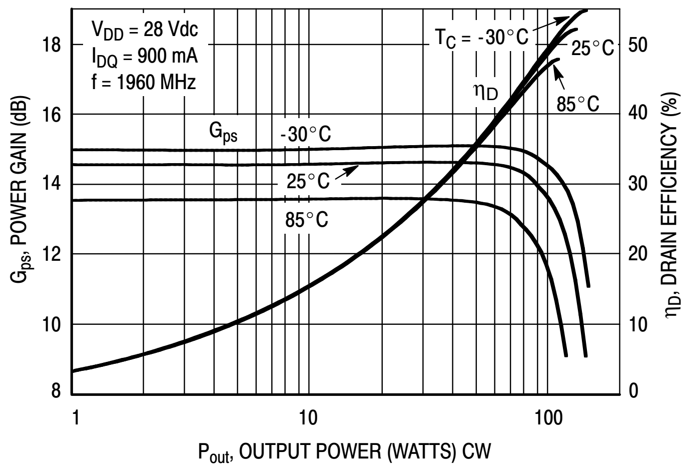


Figure 7. Power Gain and Drain Efficiency versus CW Output Power

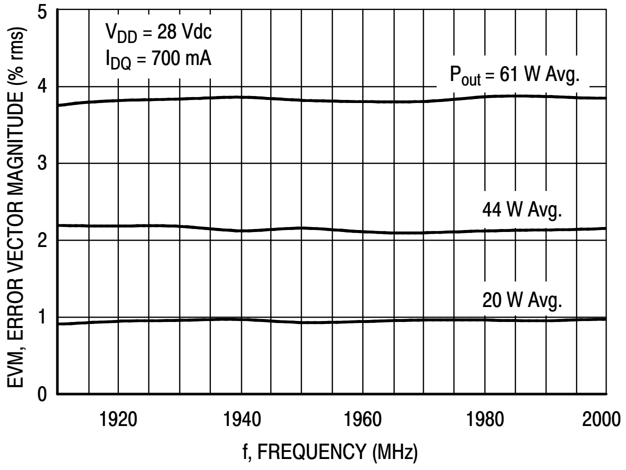


Figure 8. EVM versus Frequency

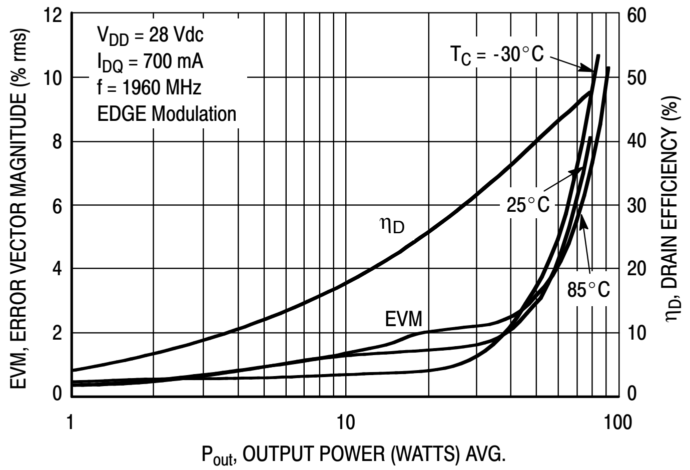


Figure 9. EVM and Drain Efficiency versus Output Power

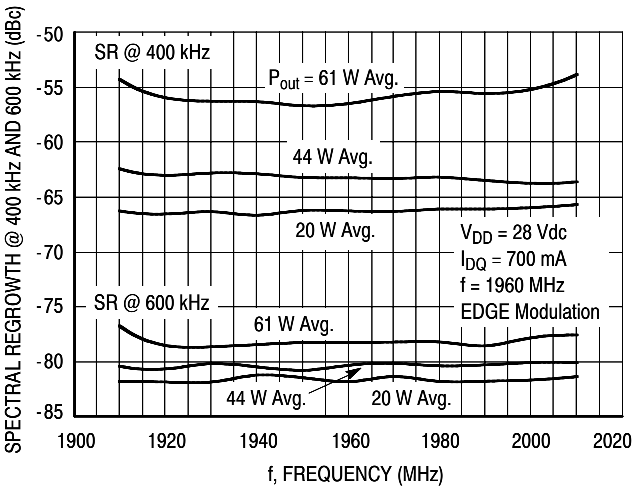


Figure 10. Spectral Regrowth at 400 kHz and 600 kHz versus Frequency

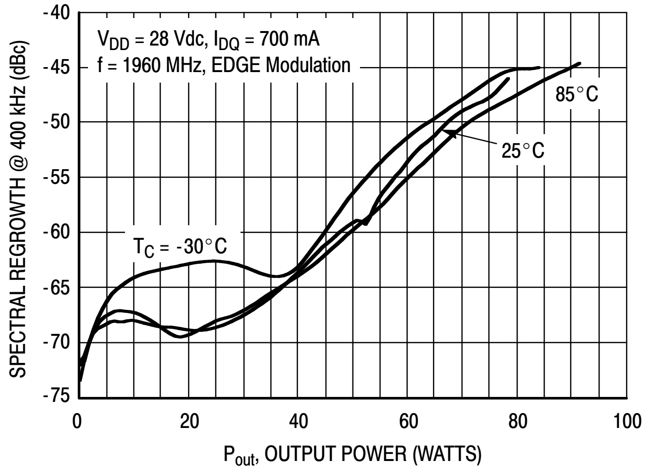


Figure 11. Spectral Regrowth at 400 kHz versus Output Power

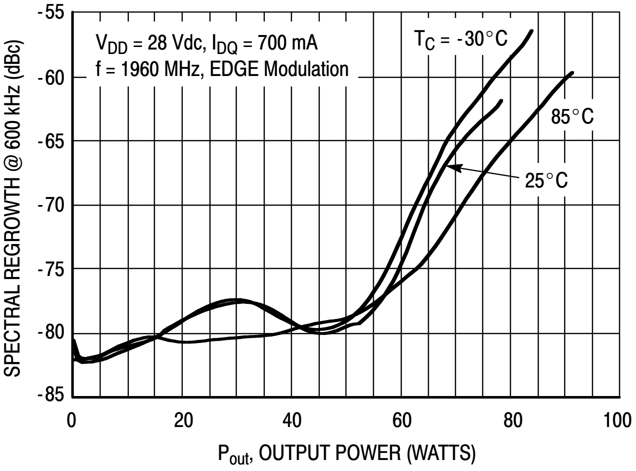
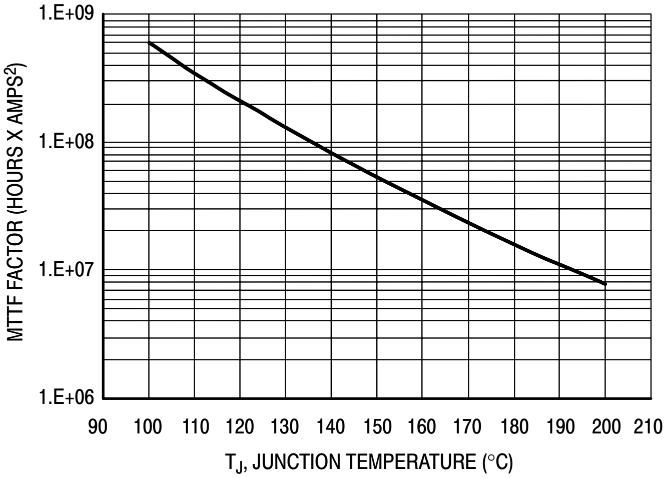


Figure 12. Spectral Regrowth at 600 kHz versus Output Power

TYPICAL CHARACTERISTICS



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

Figure 13. MTTF Factor versus Junction Temperature

GSM TEST SIGNAL

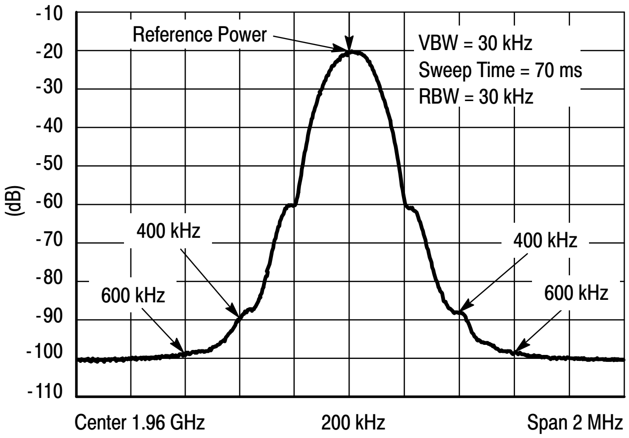
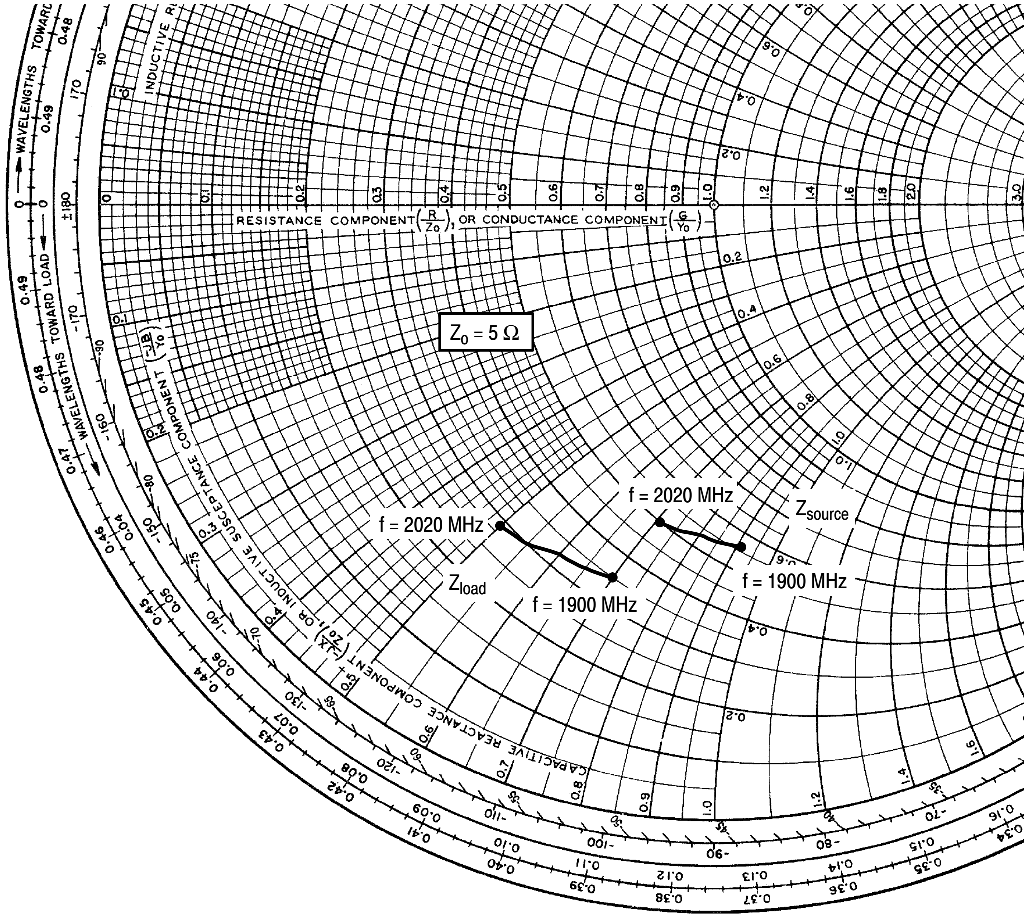


Figure 14. EDGE Spectrum



V_{DD} = 28 Vdc, I_{DQ} = 900 mA, P_{out} = 100 W

f MHz	Z_{source} Ω	Z_{load} Ω
1900	2.80 - j4.53	1.75 - j3.52
1930	2.71 - j4.27	1.67 - j3.25
1960	2.63 - j4.03	1.59 - j2.99
1990	2.56 - j3.79	1.52 - j2.74
2020	2.51 - j3.57	1.47 - j2.51

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

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

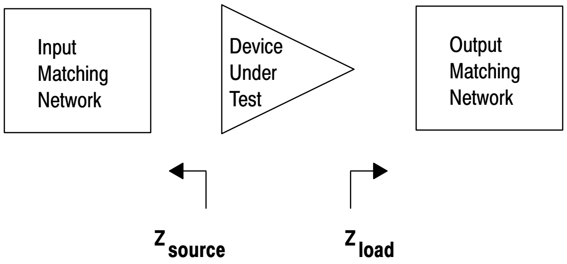
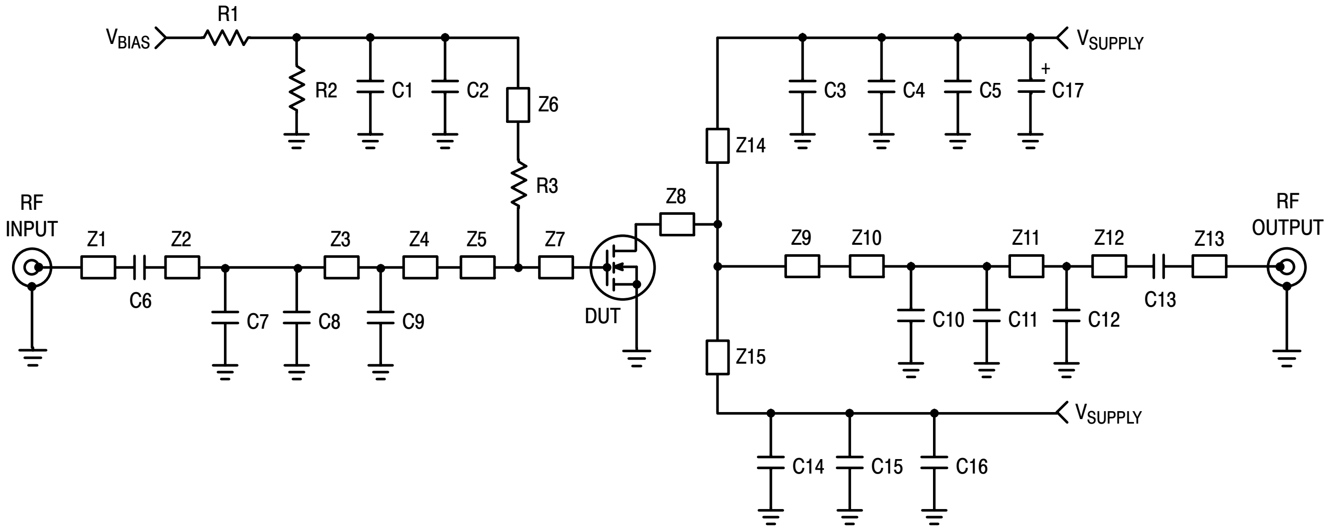


Figure 15. Series Equivalent Source and Load Impedance — 1930-1990 MHz



Z1, Z13	0.250″ x 0.083″ Microstrip
Z2*	0.620″ x 0.083″ Microstrip
Z3*	0.715″ x 0.083″ Microstrip
Z4*	0.190″ x 0.083″ Microstrip
Z5	0.365″ x 1.000″ Microstrip
Z6	1.190″ x 0.080″ Microstrip
Z7, Z8	0.115″ x 1.000″ Microstrip
Z9	0.485″ x 1.000″ Microstrip
Z10*	0.080″ x 0.083″ Microstrip
Z11*	0.340″ x 0.083″ Microstrip
Z12*	0.975″ x 0.083″ Microstrip
Z14, Z15	0.960″ x 0.080″ Microstrip
PCB	Taconic TLX8-0300, 0.030″, ε_r = 2.55

*Variable for tuning.

Figure 16. MRF6S18100NR1(NBR1) Test Circuit Schematic — 1805-1880 MHz

Table 7. MRF6S18100NR1(NBR1) Test Circuit Component Designations and Values — 1805-1880 MHz

Part	Description	Part Number	Manufacturer
C1	100 nF Chip Capacitor (1206)	1206C104KAT	AVX
C2, C3, C6, C13, C14	8.2 pF 600B Chip Capacitors	600B8R2BW	ATC
C4, C5, C15, C16	4.7 μF Chip Capacitors (1812)	C4532X5R1H475MT	TDK
C7, C8, C11, C12	0.2 pF 700B Chip Capacitors	700B0R2BW	ATC
C9	1 pF 600B Chip Capacitor	600B1R0BW	ATC
C10	0.5 pF 600B Chip Capacitor	600B0R5BW	ATC
C17	470 μF, 63 V Electrolytic Capacitor, Radial	13661471	Philips
R1, R2	10 kΩ, 1/4 W Chip Resistor (1206)		
R3	10 Ω, 1/4 W Chip Resistor (1206)		

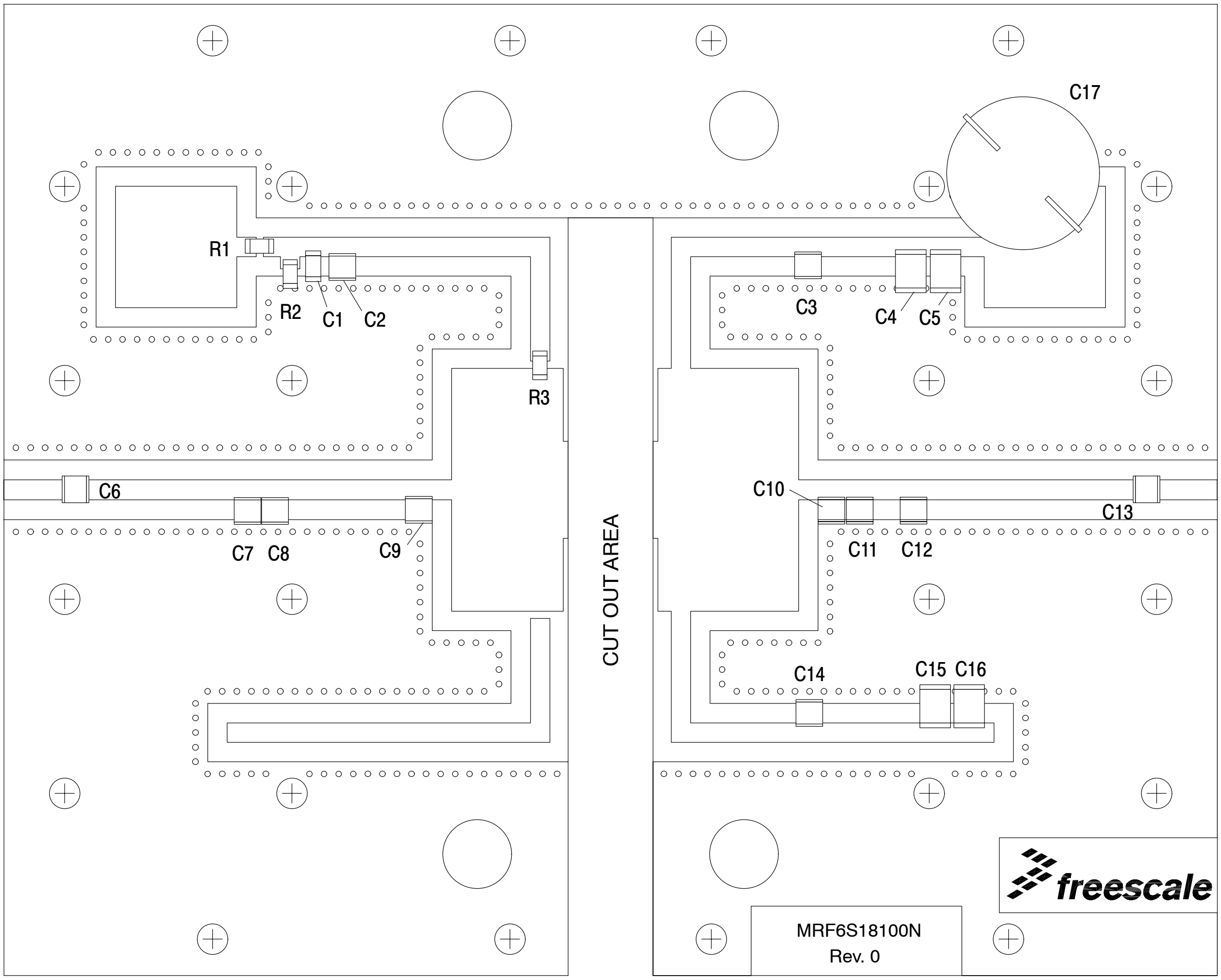


Figure 17. MRF6S18100NR1(NBR1) Test Circuit Component Layout — 1805-1880 MHz

TYPICAL CHARACTERISTICS — 1805-1880 MHz

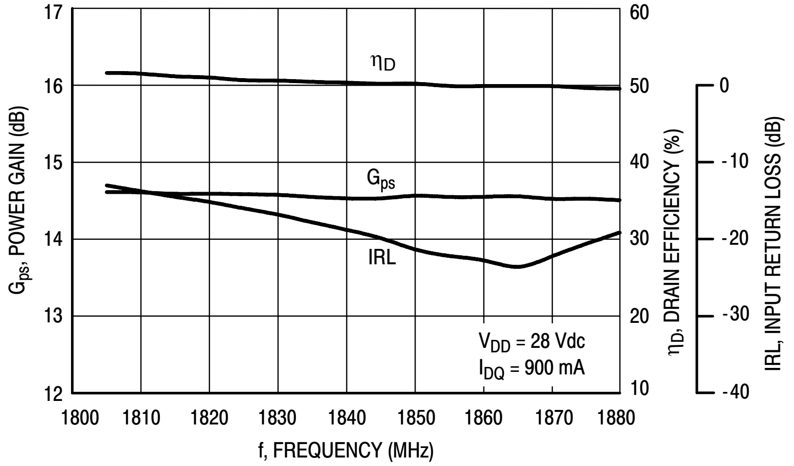


Figure 18. Power Gain, Input Return Loss and Drain Efficiency versus Frequency @ P_{out} = 100 Watts

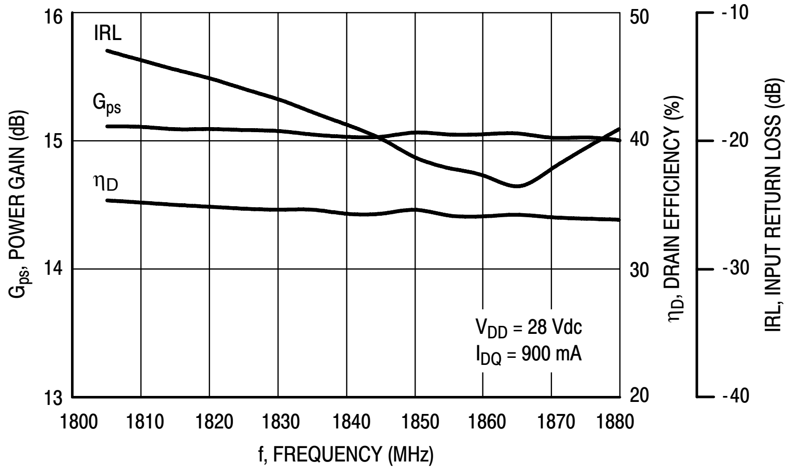


Figure 19. Power Gain, Input Return Loss and Drain Efficiency versus Frequency @ P_{out} = 40 Watts

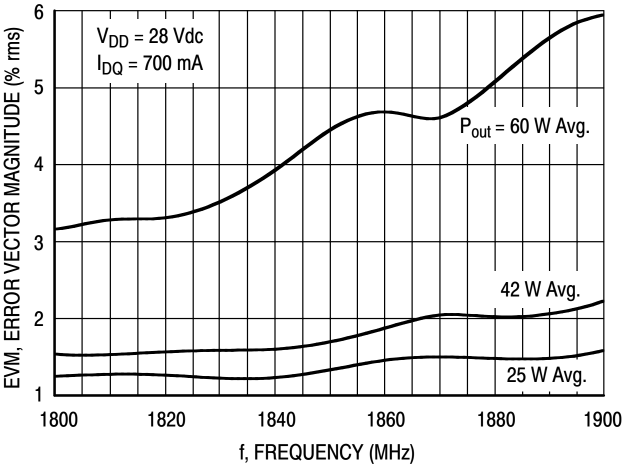


Figure 20. EVM versus Frequency

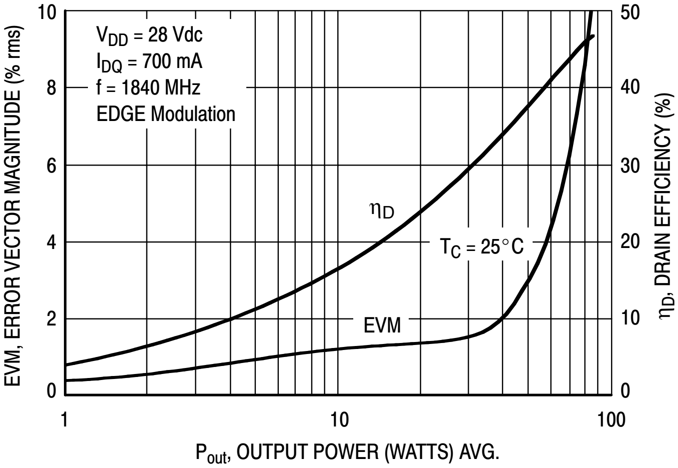


Figure 21. EVM and Drain Efficiency versus Output Power

TYPICAL CHARACTERISTICS — 1805-1880 MHZ

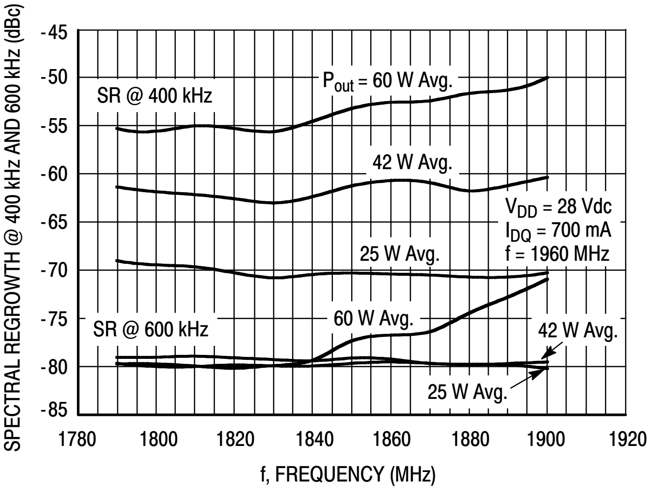


Figure 22. Spectral Regrowth at 400 kHz and 600 kHz versus Frequency

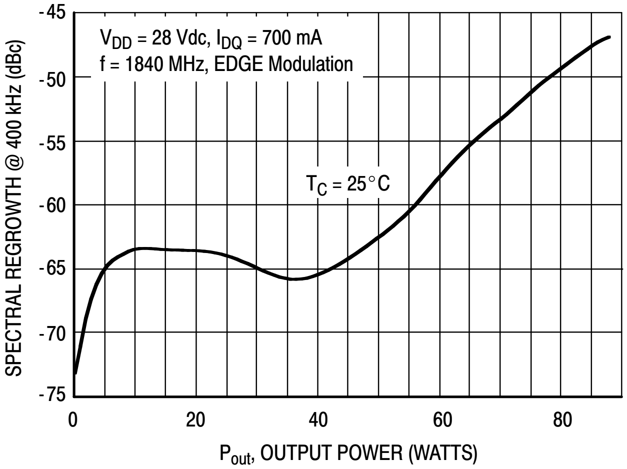


Figure 23. Spectral Regrowth at 400 kHz versus Output Power

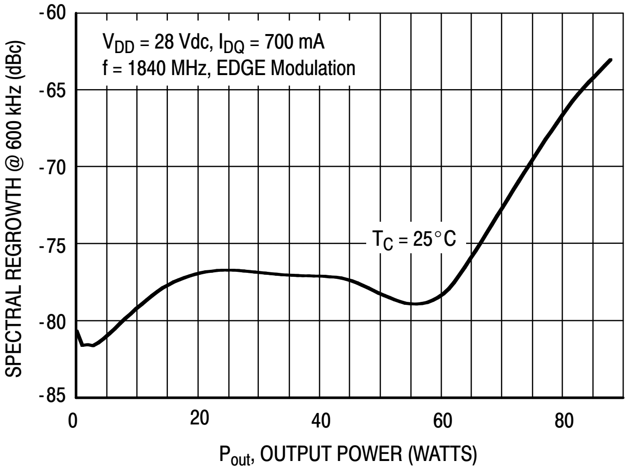
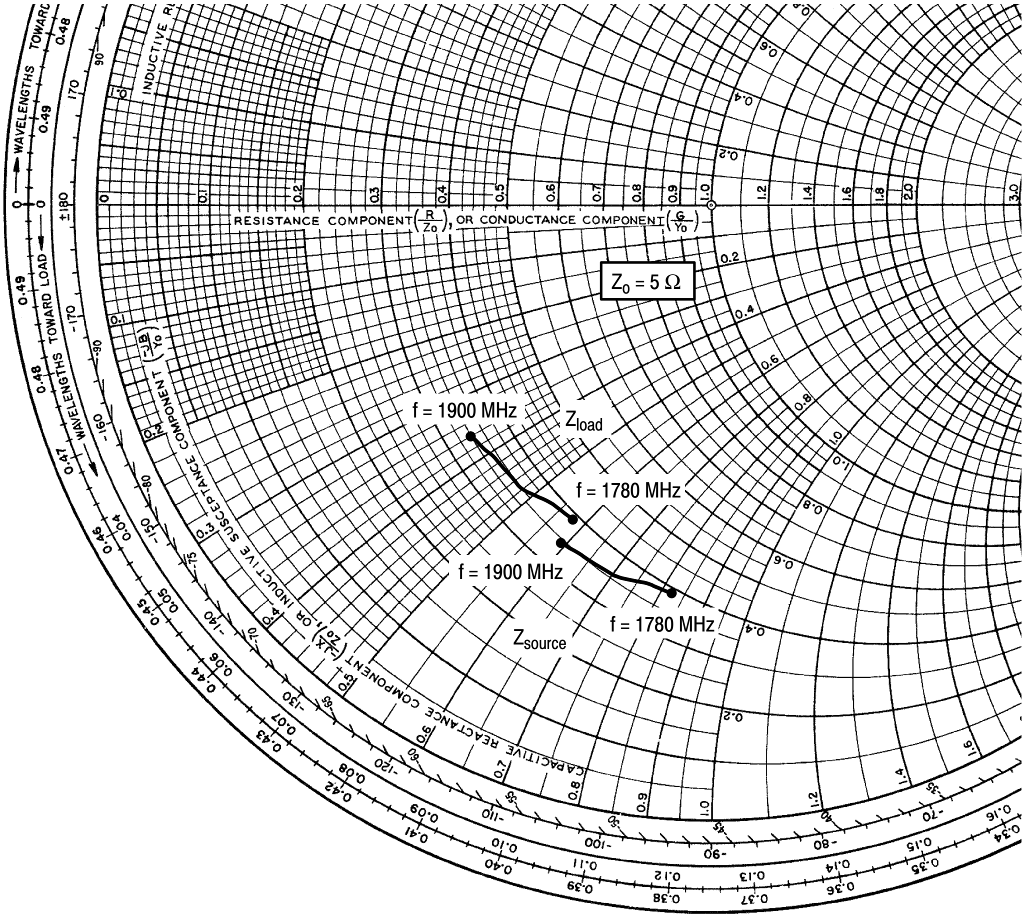


Figure 24. Spectral Regrowth at 600 kHz versus Output Power



V_{DD} = 28 Vdc, I_{DQ} = 900 mA, P_{out} = 100 W

f MHz	Z_{source} Ω	Z_{load} Ω
1780	1.96 - j4.09	1.94 - j2.90
1804	1.90 - j3.86	1.88 - j2.67
1840	1.82 - j3.53	1.80 - j2.42
1880	1.76 - j3.16	1.73 - j1.99
1900	1.72 - j2.97	1.70 - j1.82

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

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

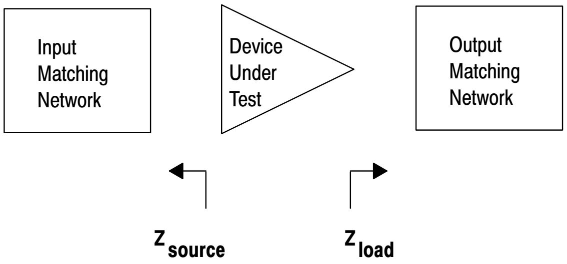
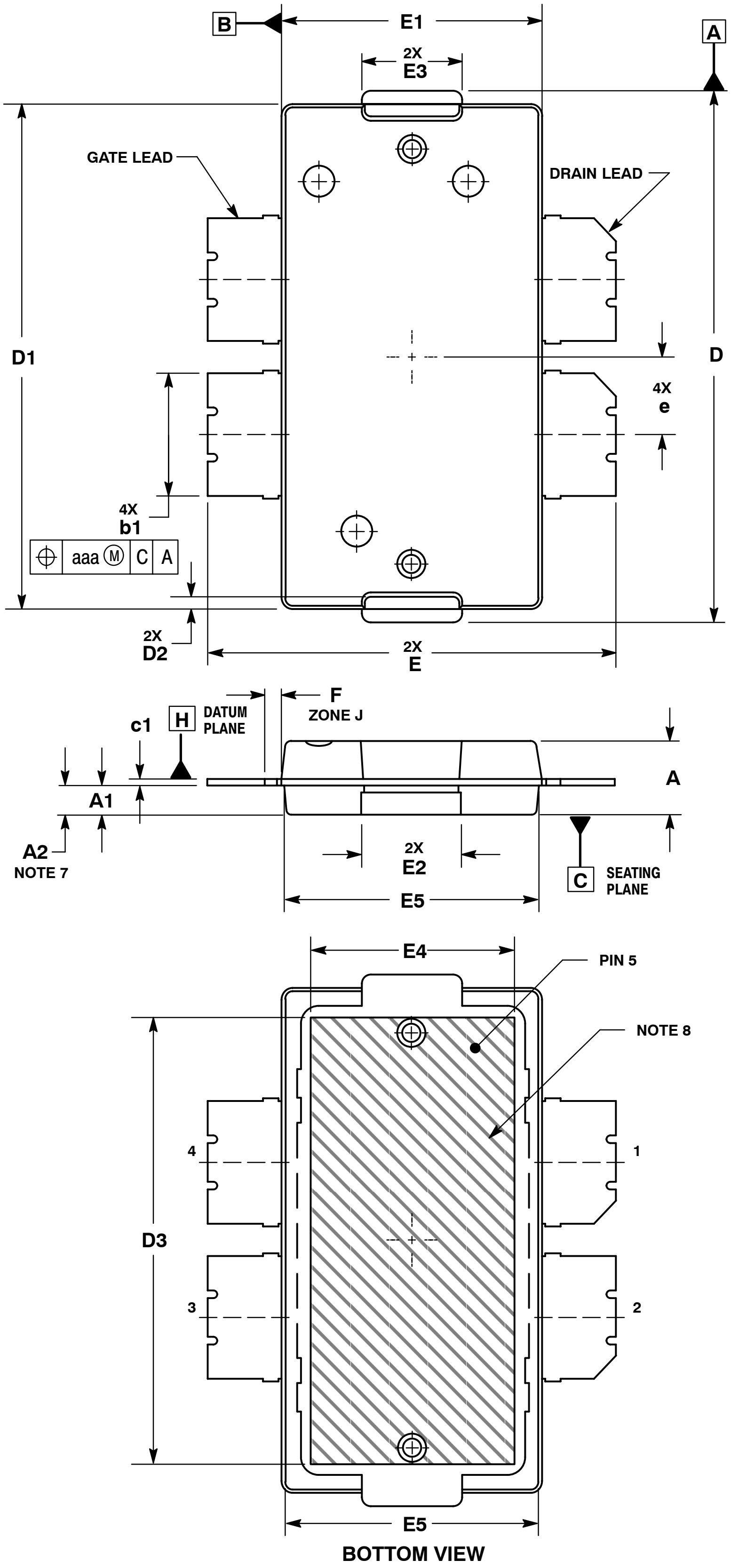


Figure 25. Series Equivalent Source and Load Impedance — 1805-1880 MHz

NOTES

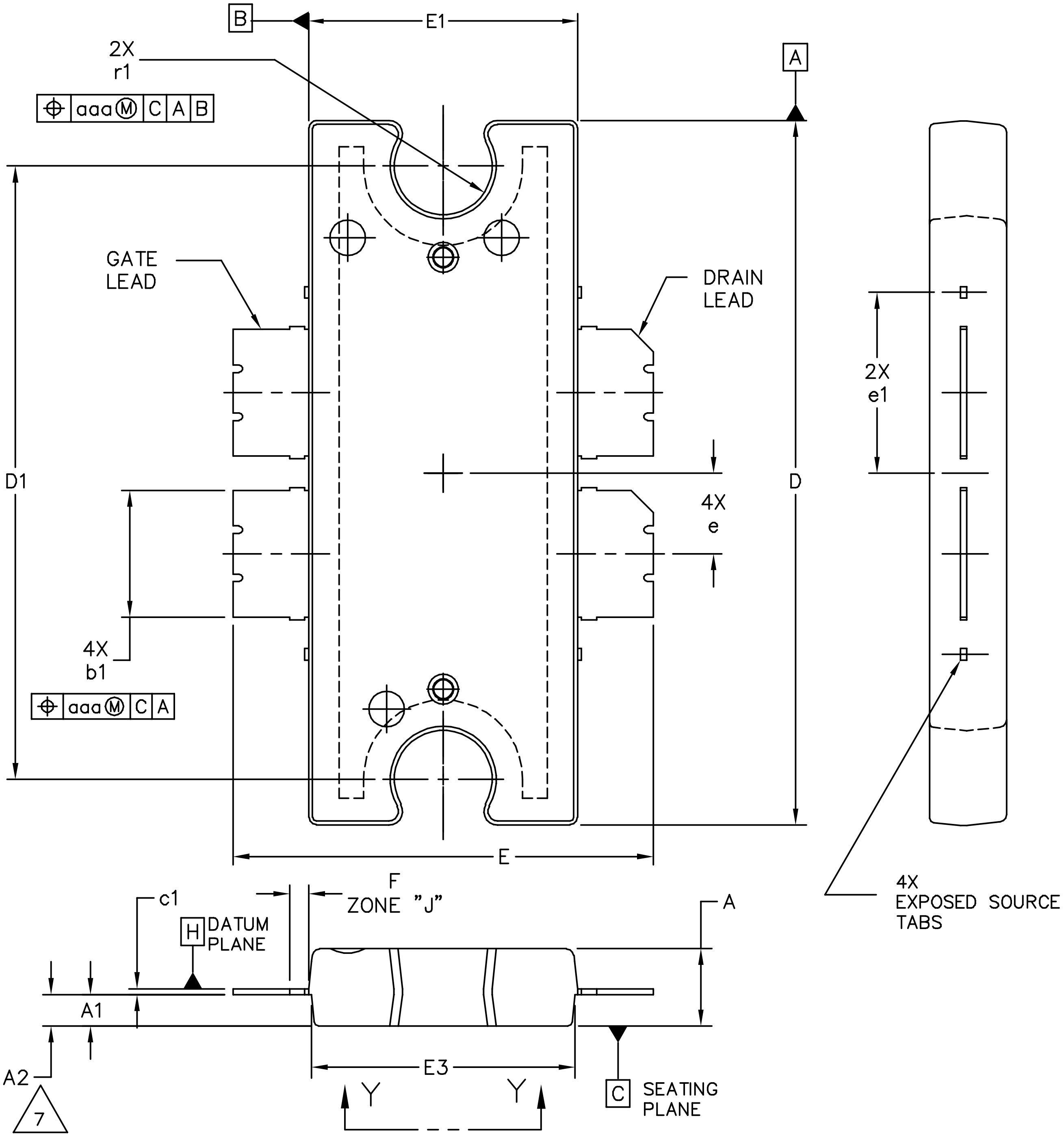


NOTES:
1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DATUM PLANE -H- IS LOCATED AT THE TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
5. DIMENSION "b1" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE "b1" DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-.
7. DIMENSION A2 APPLIES WITHIN ZONE "J" ONLY.
8. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.100	.104	2.54	2.64
A1	.039	.043	0.99	1.09
A2	.040	.042	1.02	1.07
D	.712	.720	18.08	18.29
D1	.688	.692	17.48	17.58
D2	.011	.019	0.28	0.48
D3	.600	---	15.24	---
E	.551	.559	14	14.2
E1	.353	.357	8.97	9.07
E2	.132	.140	3.35	3.56
E3	.124	.132	3.15	3.35
E4	.270	---	6.86	---
E5	.346	.350	8.79	8.89
F	.025 BSC		0.64 BSC	
b1	.164	.170	4.17	4.32
c1	.007	.011	0.18	0.28
e	.106 BSC		2.69 BSC	
aaa	.004		0.10	

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

CASE 1486-03
ISSUE C
TO-270 WB-4
MRF6S18100NR1



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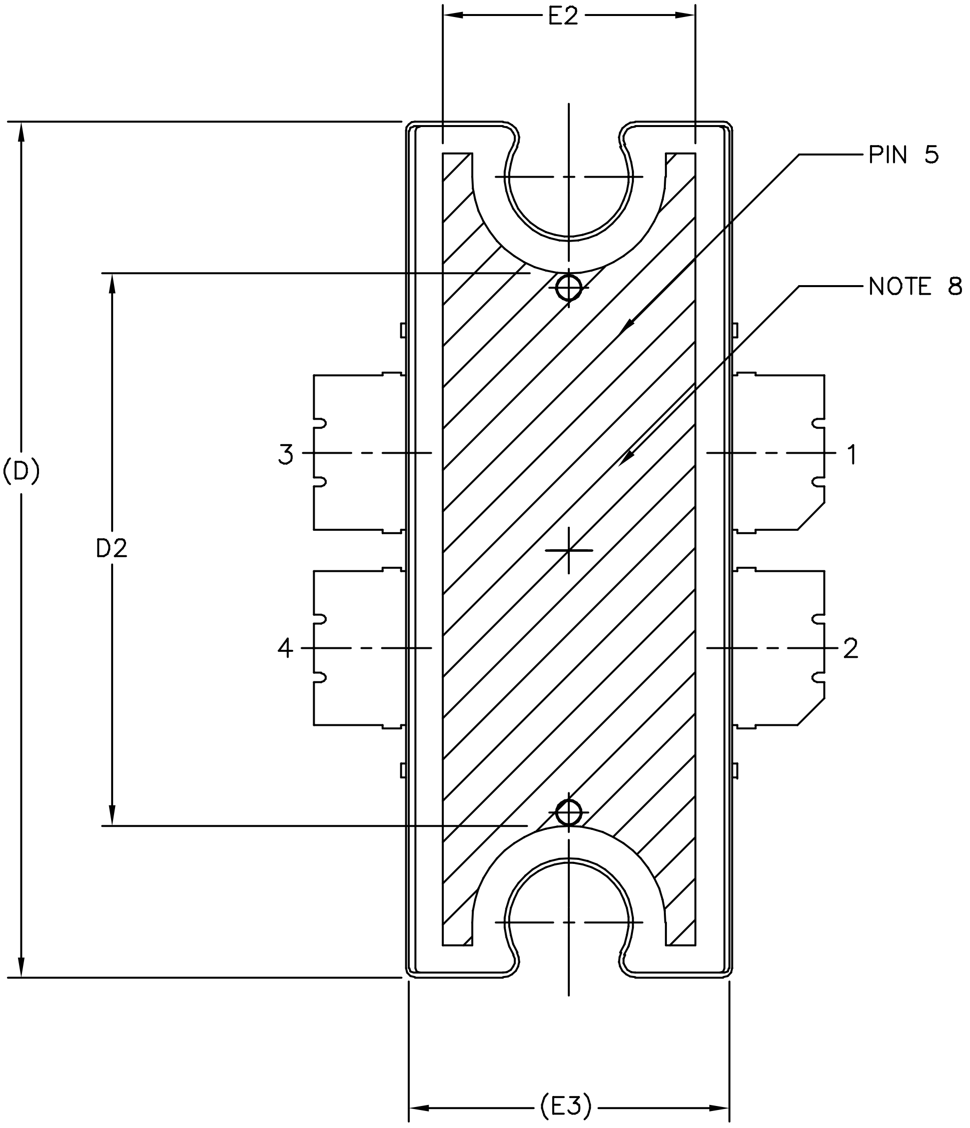
TITLE: TO-272 4 LEAD, WIDE BODY	DOCUMENT NO: 98ASA10575D	REV: D	
	CASE NUMBER: 1484-04	05 APR 2006	
	STANDARD: NON-JEDEC		



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TITLE: TO-272 4 LEAD, WIDE BODY		DOCUMENT NO: 98ASA10575D	REV: D
		CASE NUMBER: 1484-04	05 APR 2006
		STANDARD: NON-JEDEC	

NOTES:

1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DATUM PLANE H IS LOCATED AT THE TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
5. DIMENSIONS "b1" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE "b1" DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUM A AND B TO BE DETERMINED AT DATUM PLANE H.
7. DIMENSION A2 APPLIES WITHIN ZONE "J" ONLY.
8. HATCHING REPRESENTS EXPOSED AREA OF THE HEAT SLUG. HATCHED AREA SHOWN IS ON THE SAME PLANE.

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

	INCH		MILLIMETER			INCH		MILLIMETER	
DIM	MIN	MAX	MIN	MAX	DIM	MIN	MAX	MIN	MAX
A	.100	.104	2.54	2.64	b1	.164	.170	4.17	4.32
A1	.039	.043	0.99	1.09	c1	.007	.011	.18	.28
A2	.040	.042	1.02	1.07	r1	.063	.068	1.60	1.73
D	.928	.932	23.57	23.67	e	.106 BSC		2.69 BSC	
D1	.810 BSC		20.57 BSC		e1	.239 INFO ONLY		6.07 INFO ONLY	
D2	.600	---	15.24	---	aaa	.004		.10	
E	.551	.559	14	14.2					
E1	.353	.357	8.97	9.07					
E2	.270	---	6.86	---					
E3	.346	.350	8.79	8.89					
F	.025 BSC		0.64 BSC						

MECHANICAL OUTLINE

PRINT VERSION NOT TO SCALE

TITLE:
TO–272
4 LEAD WIDE BODY

DOCUMENT NO: 98ASA10575D
REV: D
CASE NUMBER: 1484–04
05 APR 2006
STANDARD: NON–JEDEC

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