

# RF Power Field-Effect Transistor

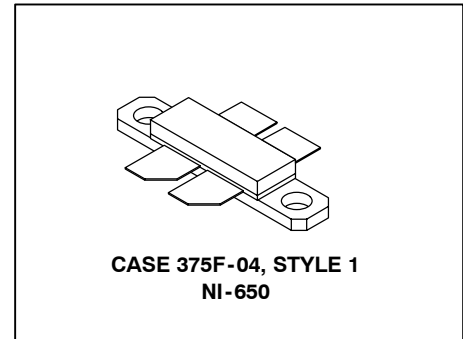
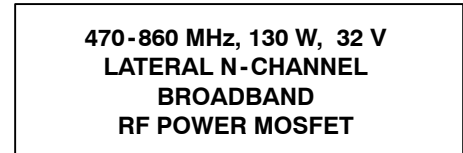
## N-Channel Enhancement-Mode Lateral MOSFET

Designed for broadband commercial and industrial applications with frequencies from 470 to 860 MHz. The high gain and broadband performance of this device make it ideal for large-signal, common source amplifier applications in 28/32 volt transmitter equipment.

- Typical Two-Tone Performance @ 860 MHz, 32 Volts, Narrowband Fixture  
 Output Power — 130 Watts PEP  
 Power Gain — 17.3 dB  
 Efficiency — 41%  
 IMD — -32.5 dBc
- Capable of Handling 10:1 VSWR @ 32 Vdc, 857 MHz, 130 Watts CW Output Power

### Features

- Integrated ESD Protection
- Excellent Thermal Stability
- Characterized with Differential Large-Signal Impedance Parameters
- RoHS Compliant



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**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	-0.5, +70	Vdc
Gate-Source Voltage	$V_{GS}$	-0.5, +15	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	302 1.72	W W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-65 to +150	$^\circ\text{C}$
Case Operating Temperature	$T_C$	150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.58	$^\circ\text{C}/\text{W}$

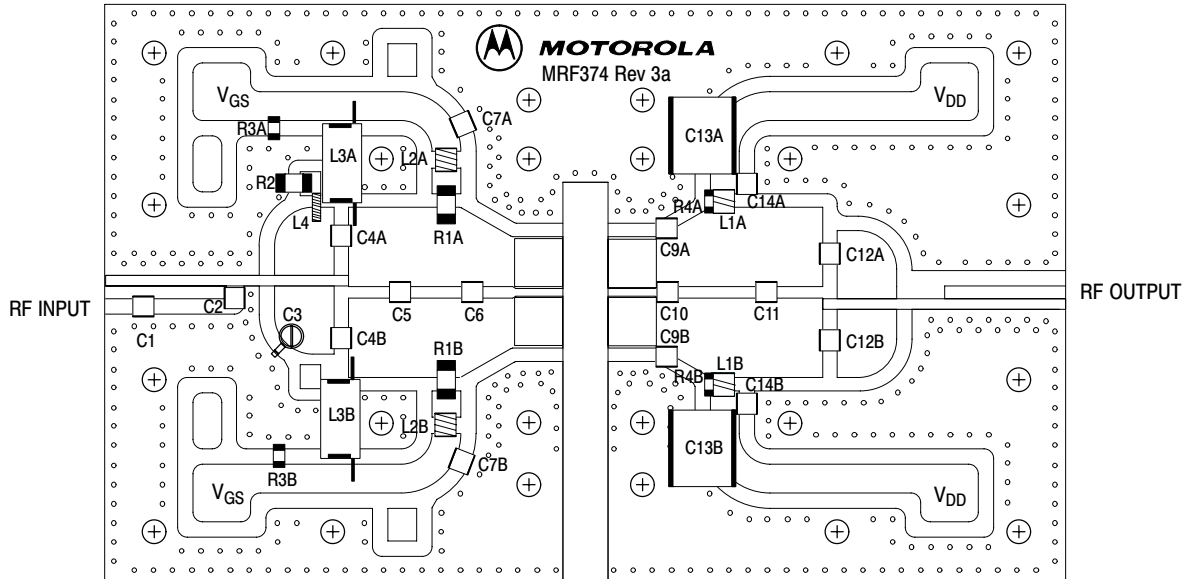
**Table 3. ESD Protection Characteristics**

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M2 (Minimum)

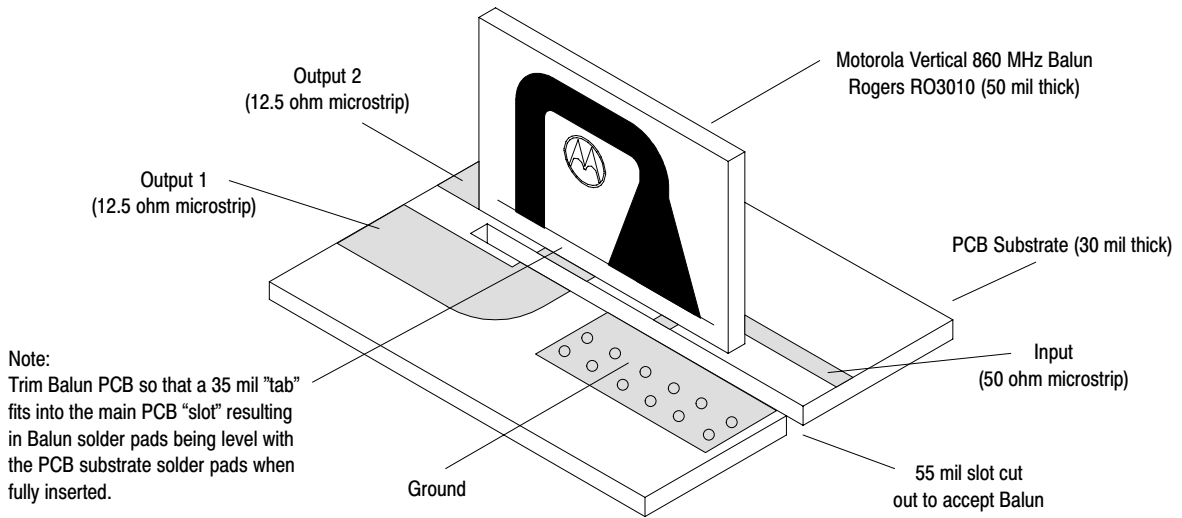
**Table 4. Electrical Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Off Characteristics</b> <sup>(1)</sup>					
Drain-Source Breakdown Voltage ( $V_{GS} = 0\text{ Vdc}$ , $I_D = 10\ \mu\text{A}$ )	$V_{(BR)DSS}$	70	—	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 32\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	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 <sup>(1)</sup> ( $V_{DS} = 10\text{ V}$ , $I_D = 200\ \mu\text{A}$ )	$V_{GS(th)}$	2	2.9	4	Vdc
Gate Quiescent Voltage <sup>(2)</sup> ( $V_{DS} = 32\text{ V}$ , $I_D = 100\text{ mA}$ )	$V_{GS(Q)}$	2.5	3.3	4.5	Vdc
Drain-Source On-Voltage <sup>(1)</sup> ( $V_{GS} = 10\text{ V}$ , $I_D = 3\text{ A}$ )	$V_{DS(on)}$	—	0.41	0.45	Vdc
<b>Dynamic Characteristics</b> <sup>(1)</sup>					
Input Capacitance ( $V_{DS} = 32\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ )	$C_{iss}$	—	97.3	—	pF
Output Capacitance ( $V_{DS} = 32\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ )	$C_{oss}$	—	49	—	pF
Reverse Transfer Capacitance ( $V_{DS} = 32\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ )	$C_{rss}$	—	1.91	—	pF
<b>Functional Characteristics, Narrowband Operation</b> <sup>(2)</sup> (In Freescale MRF374A Narrowband Circuit, 50 ohm system)					
Common Source Power Gain ( $V_{DD} = 32\text{ Vdc}$ , $P_{out} = 130\text{ W PEP}$ , $I_{DQ} = 400\text{ mA}$ , $f_1 = 857\text{ MHz}$ , $f_2 = 863\text{ MHz}$ )	$G_{ps}$	16	17.3	—	dB
Drain Efficiency ( $V_{DD} = 32\text{ Vdc}$ , $P_{out} = 130\text{ W PEP}$ , $I_{DQ} = 400\text{ mA}$ , $f_1 = 857\text{ MHz}$ , $f_2 = 863\text{ MHz}$ )	$\eta$	36	41.2	—	%
Intermodulation Distortion ( $V_{DD} = 32\text{ Vdc}$ , $P_{out} = 130\text{ W PEP}$ , $I_{DQ} = 400\text{ mA}$ , $f_1 = 857\text{ MHz}$ , $f_2 = 863\text{ MHz}$ )	IMD	—	-32.5	-28	dB

- Each side of device measured separately.
- Measurement made with device in push-pull configuration.



Vertical Balun Mounting Detail



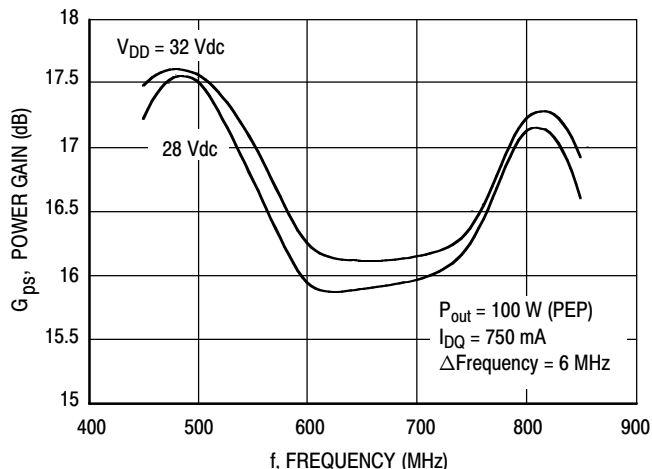
Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 1. MRF374A Narrowband Test Circuit Component Layout

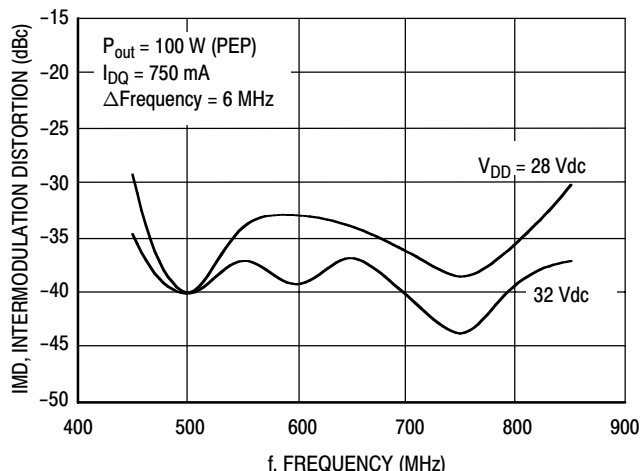
**Table 5. MRF374A Narrowband Test Circuit Component Layout Designations and Values**

Designation	Description
C1	0.8 pF Chip Capacitor, ATC
C2	2.2 pF Chip Capacitor, ATC
C3	0.5 - 5.0 pF Variable Capacitor, Johanson Gigatrim
C4A, B, C12A, B	47 pF Chip Capacitors, ATC
C5	1.0 pF Chip Capacitor, ATC
C6	10 pF Chip Capacitor, ATC
C7A, B, C14A, B	100,000 pF Chip Capacitors, ATC
C9A, B	15 pF Chip Capacitors, ATC
C10	3.9 pF Chip Capacitor, ATC
C11	5.1 pF Chip Capacitor, ATC
C13A, B	2.2 $\mu$ F, 100 V Chip Capacitors, Vishay #VJ3640Y225KXBAT
L1A, B	5.0 nH, Coilcraft #A02T
L2A, B	8.0 nH, Coilcraft #A03T
L3A, B	130.0 nH, Coilcraft #132-11SMJ
L4	8.8 nH, Coilcraft #1606-8
R1A, B	51 $\Omega$ , 1/4 W Chip Resistors, Vishay Dale (1210)
R2	10 $\Omega$ , 1/2 W Chip Resistor, Vishay Dale (2010)
R3A, B	3.3 k $\Omega$ , 1/8 W Chip Resistors, Vishay Dale (1206)
R4A, B	180 $\Omega$ , 1/4 W Chip Resistors, Vishay Dale (1210)
PCB	MRF374 Printed Circuit Board Rev 03, Rogers RO4350, Height 30 mils, $\epsilon_r = 3.48$
Balun B1A, B	Vertical 860 MHz Narrowband Balun, Printed Circuit Board Rev 01, Rogers RO3010, Height 50 mils, $\epsilon_r = 10.2$

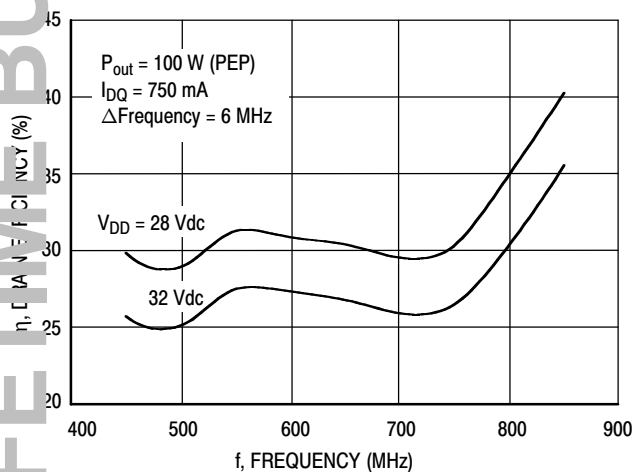
## TYPICAL CHARACTERISTICS



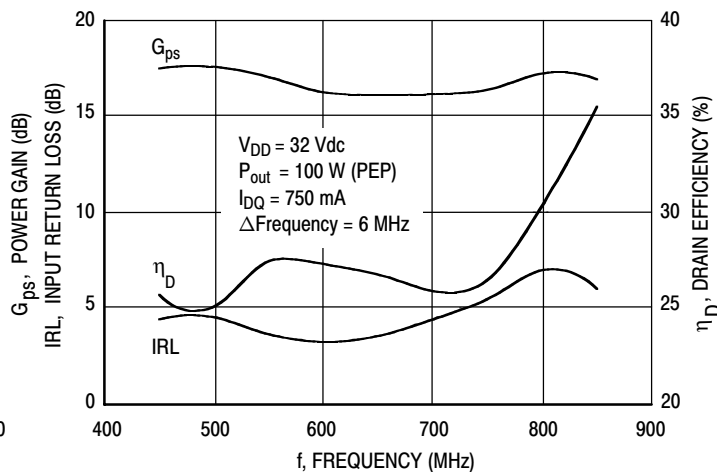
**Figure 2. Gain versus Frequency in Broadband Circuit**



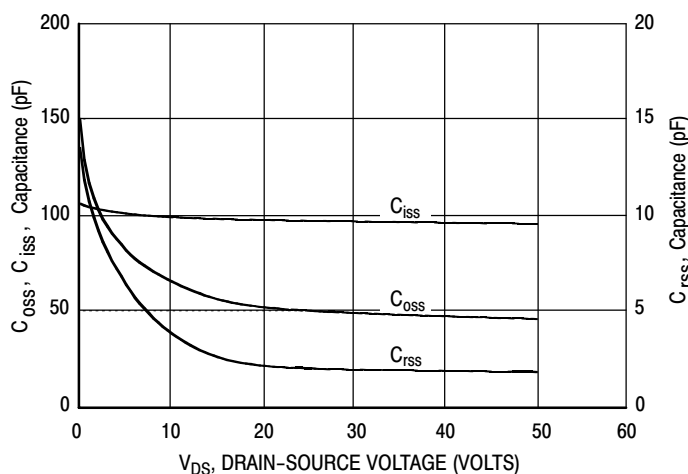
**Figure 3. Intermodulation Distortion versus Frequency in Broadband Circuit**



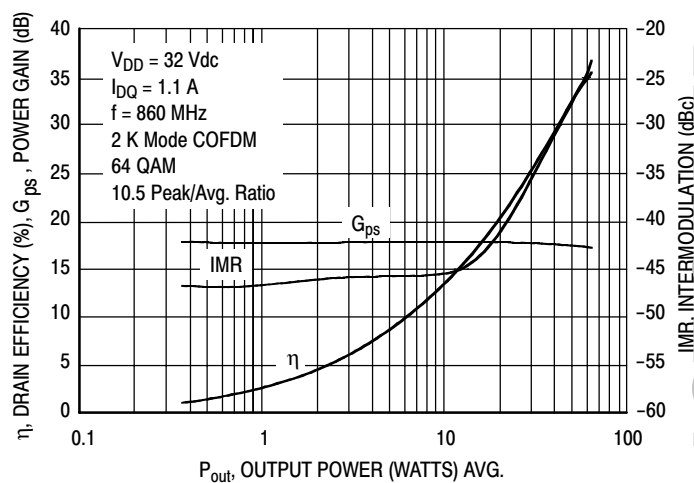
**Figure 4. Drain Efficiency versus Frequency in Broadband Circuit**



**Figure 5. Performance in Broadband Circuit**



**Figure 6. Capacitance versus Voltage**



**Figure 7. COFDM Intermodulation, Gain and Efficiency versus Output Power in Broadband Circuit**

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TYPICAL CHARACTERISTICS

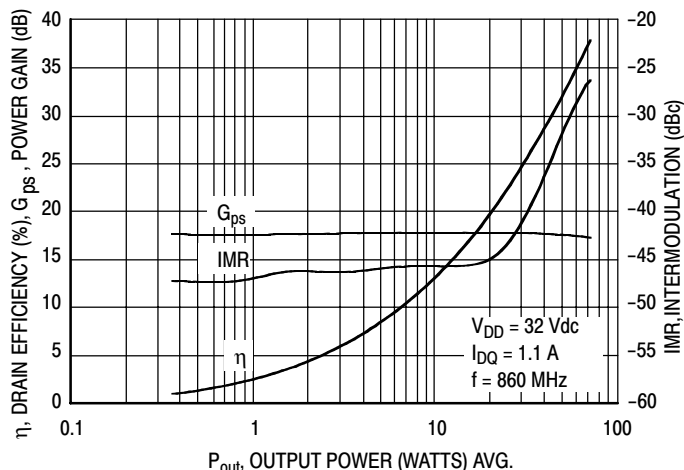


Figure 8. 8-VSB Intermodulation, Gain and Efficiency versus Output Power in Broadband Circuit

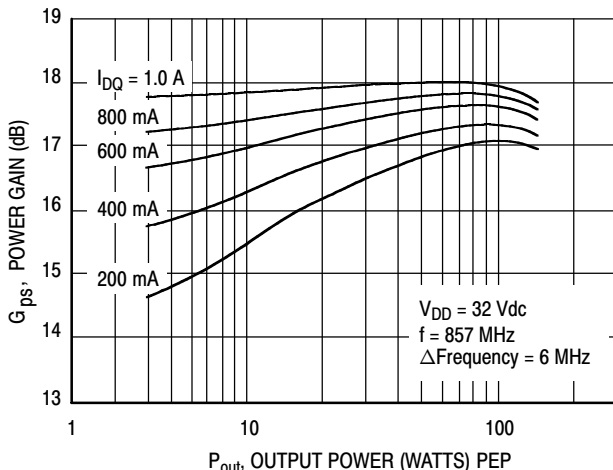


Figure 9. Power Gain versus Peak Output Power in Narrowband Circuit

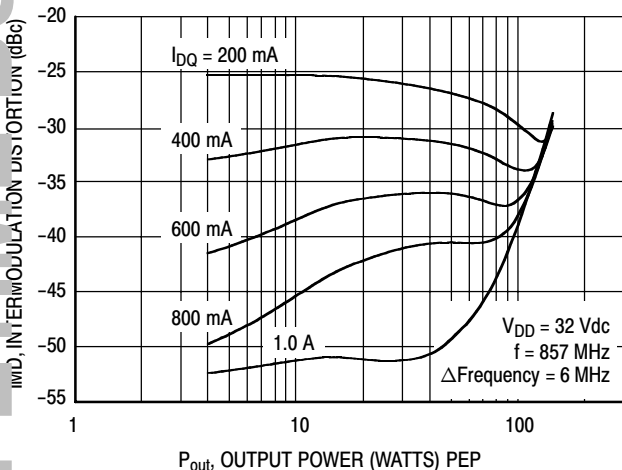


Figure 10. Intermodulation Distortion versus Peak Output Power in Narrowband Circuit

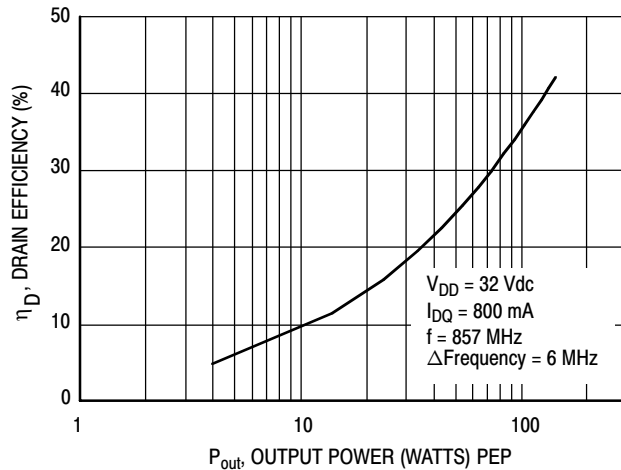


Figure 11. Drain Efficiency versus Peak Output Power in Narrowband Circuit

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## TYPICAL CHARACTERISTICS

$V_{DD} = 28 \text{ Vdc}$

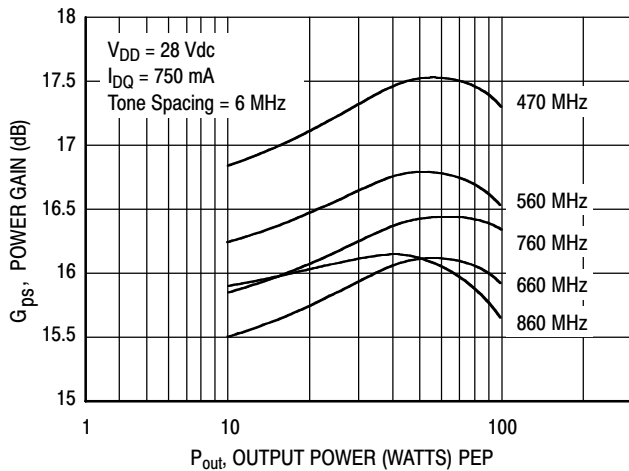


Figure 12. Power Gain versus Peak Output Power in Broadband Circuit

$V_{DD} = 32 \text{ Vdc}$

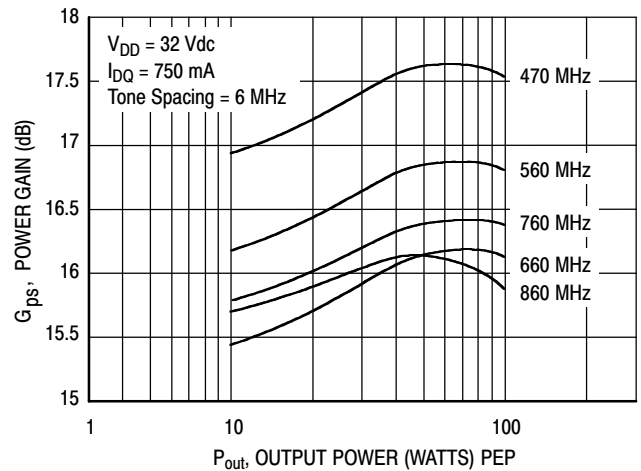


Figure 13. Power Gain versus Peak Output Power in Broadband Circuit

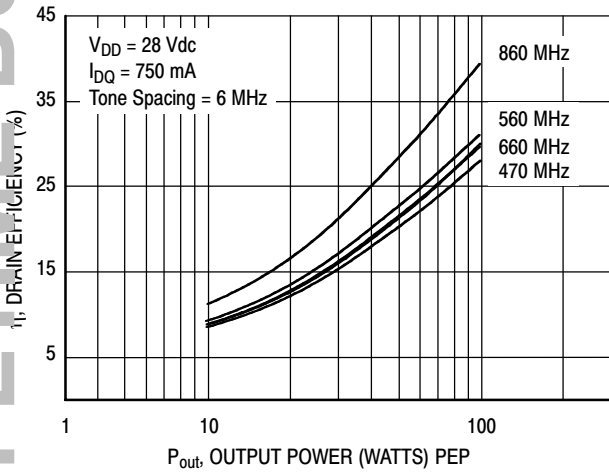


Figure 14. Drain Efficiency versus Peak Output Power in Broadband Circuit

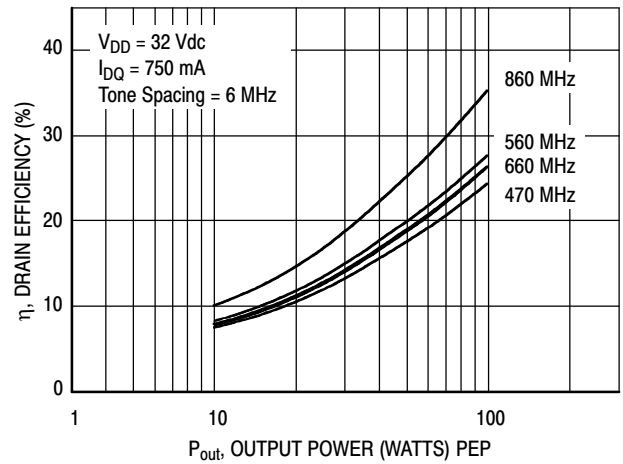


Figure 15. Drain Efficiency versus Peak Output Power in Broadband Circuit

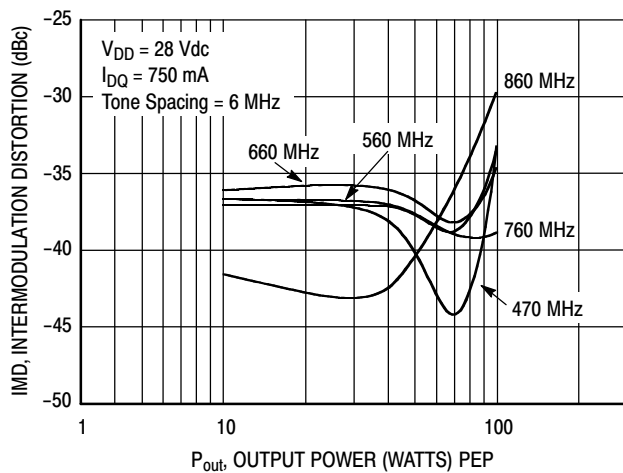


Figure 16. Intermodulation Distortion versus Peak Output Power in Broadband Circuit

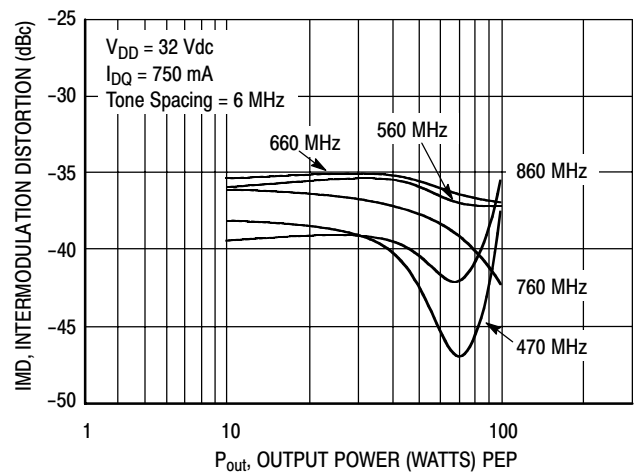
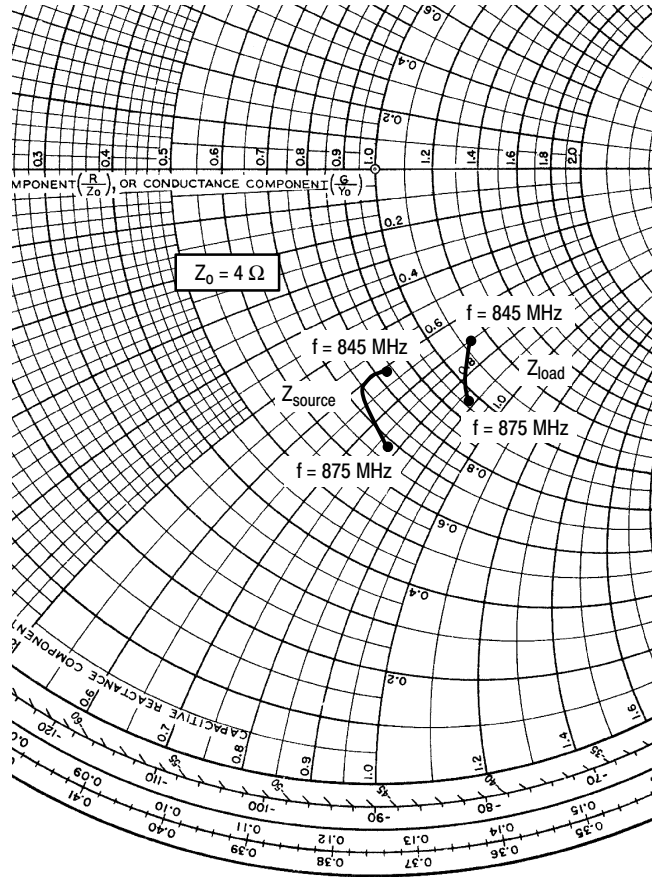


Figure 17. Intermodulation Distortion versus Peak Output Power in Broadband Circuit

MRF374A



$V_{DD} = 32\text{ V}$ ,  $I_{DQ} = 400\text{ mA}$ ,  $P_{out} = 130\text{ W PEP}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
845	$3.33 - j2.42$	$4.56 - j2.86$
860	$3.03 - j2.39$	$4.22 - j3.16$
875	$2.73 - j3.10$	$3.87 - j3.52$

$Z_{source}$  = Test circuit impedance as measured from gate to gate, balanced configuration.

$Z_{load}$  = Test circuit impedance as measured from drain to drain, balanced configuration.

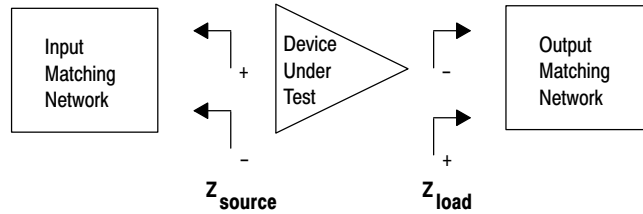


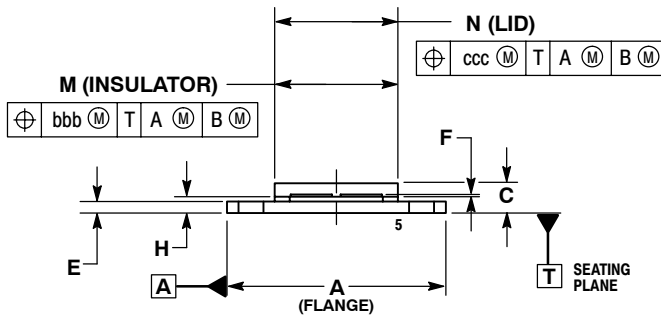
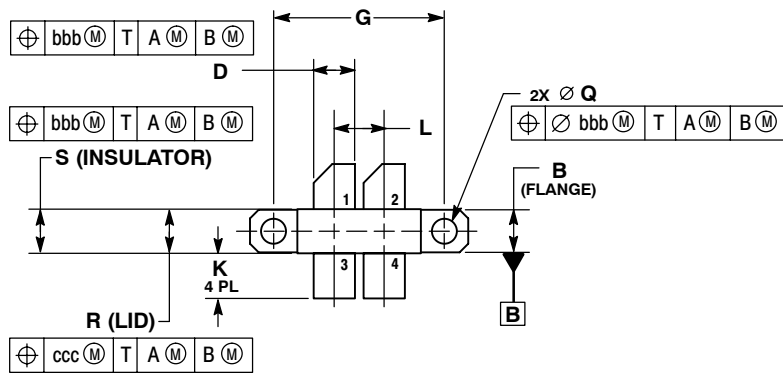
Figure 18. Series Equivalent Source and Load Impedance



# NOTES

# NOTES

## PACKAGE DIMENSIONS



**NOTES:**

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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.135	1.145	28.80	29.10
B	0.225	0.235	5.72	5.97
C	0.135	0.178	3.43	4.52
D	0.210	0.220	5.33	5.59
E	0.055	0.065	1.40	1.65
F	0.004	0.006	0.11	0.15
G	0.900	BSC	22.86	BSC
H	0.077	0.087	1.96	2.21
K	0.220	0.250	5.59	6.35
L	0.260	BSC	6.60	BSC
M	0.643	0.657	16.33	16.69
N	0.638	0.650	16.20	16.50
Q	∅ .125	∅ .135	∅ 3.175	∅ 3.43
R	0.227	0.233	5.77	5.92
S	0.225	0.235	5.715	5.97
bbb	0.010	BSC	0.254	BSC
ccc	0.015	BSC	0.381	BSC

**STYLE 1:**

- PIN 1. DRAIN
2. DRAIN
3. GATE
4. GATE
5. SOURCE

**CASE 375F-04  
ISSUE E  
NI-650**

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