

# 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 32 volt transmitter equipment.

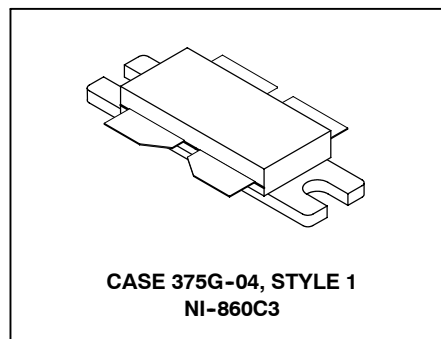
- Typical Narrowband Two-Tone Performance @ f1 = 857 MHz, f2 = 863 MHz, 32 Volts  
Output Power — 180 Watts PEP  
Power Gain — 17 dB  
Efficiency — 36%  
IMD — -35 dBc
- Typical Broadband Two-Tone Performance @ f1 = 857 MHz, f2 = 863 MHz, 32 Volts  
Output Power — 180 Watts PEP  
Power Gain — 14.5 dB  
Efficiency — 37%  
IMD — -31 dBc
- Capable of Handling 3:1 VSWR @ 32 Vdc, 857 MHz, 90 Watts CW Output Power

### Features

- Internally Matched for Ease of Use
- Integrated ESD Protection
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.  
R5 Suffix = 50 Units per 56 mm, 13 inch Reel.

**MRF372R3**  
**MRF372R5**

**470-860 MHz, 180 W, 32 V**  
**LATERAL N-CHANNEL**  
**RF POWER MOSFET**



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**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	V <sub>DSS</sub>	-0.5, +68	Vdc
Gate-Source Voltage	V <sub>GS</sub>	-0.5, +15	Vdc
Drain Current - Continuous	I <sub>D</sub>	17	Adc
Total Device Dissipation @ T <sub>C</sub> = 25°C Derate above 25°C	P <sub>D</sub>	350 2.0	W W/°C
Storage Temperature Range	T <sub>stg</sub>	-65 to +150	°C
Case Operating Temperature	T <sub>C</sub>	150	°C
Operating Junction Temperature	T <sub>J</sub>	200	°C

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	R <sub>θJC</sub>	0.5	°C/W

**Table 3. ESD Protection Characteristics**

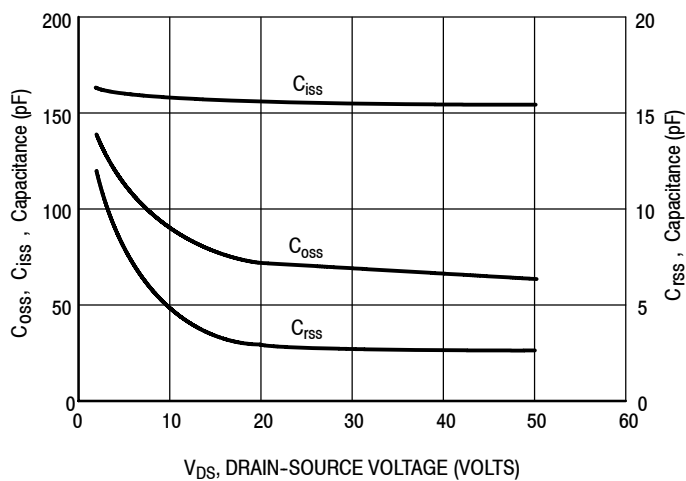
Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M3 (Minimum)

**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 ( $V_{GS} = 0\text{ Vdc}$ , $I_D = 10\ \mu\text{A}$ )	$V_{(BR)DSS}$	68	—	—	Vdc
Zero Gate Voltage Drain Current ( $V_{DS} = 32\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
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	3	4	Vdc
Gate Quiescent Voltage <sup>(2)</sup> ( $V_{DS} = 32\text{ V}$ , $I_D = 100\text{ mA}$ )	$V_{GS(Q)}$	2.5	3.5	4.5	Vdc
Drain-Source On-Voltage <sup>(1)</sup> ( $V_{GS} = 10\text{ V}$ , $I_D = 3\text{ A}$ )	$V_{DS(on)}$	—	0.28	0.45	Vdc
Forward Transconductance ( $V_{DS} = 10\text{ V}$ , $I_D = 3\text{ A}$ )	$g_{fs}$	—	2.6	—	S
<b>Dynamic Characteristics</b> <sup>(1)</sup>					
Input Capacitance (Includes Input Matching Capacitance) ( $V_{DS} = 32\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ )	$C_{iss}$	—	260	—	pF
Output Capacitance ( $V_{DS} = 32\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ )	$C_{oss}$	—	69	—	pF
Reverse Transfer Capacitance ( $V_{DS} = 32\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$ )	$C_{rss}$	—	2.5	—	pF
<b>Functional Characteristics, Narrowband Operation</b> <sup>(2)</sup> (In Freescale MRF372 Narrowband Circuit, 50 ohm system)					
Common Source Power Gain ( $V_{DD} = 32\text{ V}$ , $P_{out} = 180\text{ W PEP}$ , $I_{DQ} = 800\text{ mA}$ , $f_1 = 857\text{ MHz}$ , $f_2 = 863\text{ MHz}$ )	$G_{ps}$	16	17	—	dB
Drain Efficiency ( $V_{DD} = 32\text{ V}$ , $P_{out} = 180\text{ W PEP}$ , $I_{DQ} = 800\text{ mA}$ , $f_1 = 857\text{ MHz}$ , $f_2 = 863\text{ MHz}$ )	$\eta$	33	36	—	%
Intermodulation Distortion ( $V_{DD} = 32\text{ Vdc}$ , $P_{out} = 180\text{ W PEP}$ , $I_{DQ} = 800\text{ mA}$ , $f_1 = 857\text{ MHz}$ , $f_2 = 863\text{ MHz}$ )	IMD	—	-35	-31	dBc
<b>Typical Characteristics, Broadband Operation</b> <sup>(2)</sup> (In Freescale MRF372 Broadband Circuit, 50 ohm system)					
Common Source Power Gain ( $V_{DD} = 32\text{ Vdc}$ , $P_{out} = 180\text{ W PEP}$ , $I_{DQ} = 1000\text{ mA}$ , $f_1 = 857\text{ MHz}$ , $f_2 = 863\text{ MHz}$ )	$G_{ps}$	—	14.5	—	dB
Drain Efficiency ( $V_{DD} = 32\text{ Vdc}$ , $P_{out} = 180\text{ W PEP}$ , $I_{DQ} = 1000\text{ mA}$ , $f_1 = 857\text{ MHz}$ , $f_2 = 863\text{ MHz}$ )	$\eta$	—	37	—	%
Intermodulation Distortion ( $V_{DD} = 32\text{ Vdc}$ , $P_{out} = 180\text{ W PEP}$ , $I_{DQ} = 1000\text{ mA}$ , $f_1 = 857\text{ MHz}$ , $f_2 = 863\text{ MHz}$ )	IMD	—	-31	—	dBc

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

### TYPICAL CHARACTERISTICS



Note:  $C_{iss}$  does not include input matching capacitance.

**Figure 1. Capacitance versus Voltage**

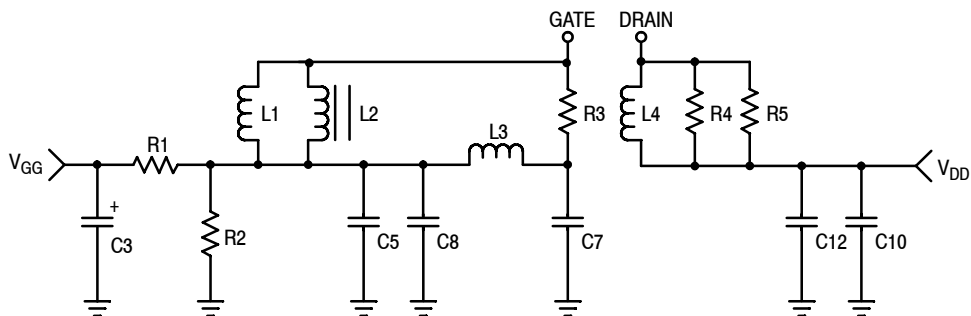


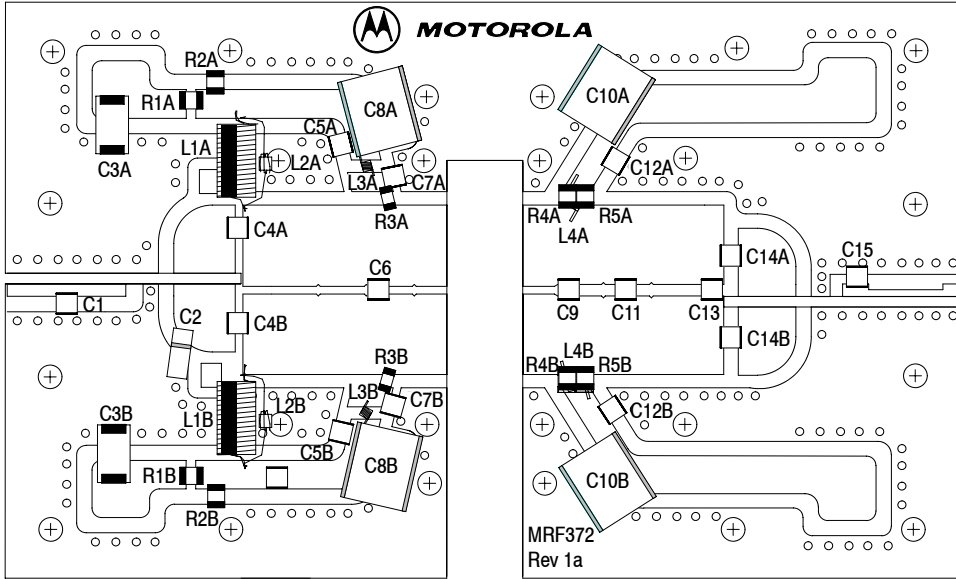
Figure 2. 860 MHz Narrowband DC Bias Networks

Table 5. 860 MHz Narrowband DC Bias Networks Component Designations and Values

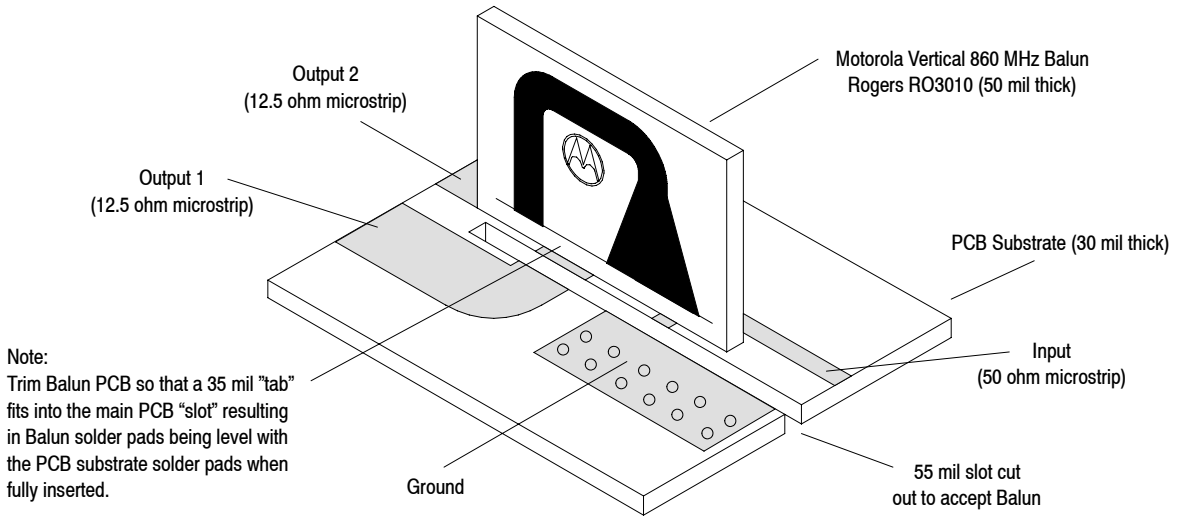
Designation	Description
C1	2.2 pF Chip Capacitor, ATC
C2	0.5 — 5.0 pF Variable Capacitor, Johansen Gigatrim
C3A, B	22 $\mu$ F, 22 V Tantalum Chip Capacitors, Kemet #T491D226K22AS
C4A, B, C14A, B	47.0 pF Chip Capacitors, ATC
C5A, B	100 pF Chip Capacitors, ATC
C6	10.0 pF Chip Capacitor, ATC
C7A, B	2.7 pF Chip Capacitors, ATC
C8A, B	1.0 $\mu$ F, 100 V Chip Capacitors, Vitramon #VJ3640Y105KXBAT
C9	10.0 pF Chip Capacitor, ATC
C10A, B	2.2 $\mu$ F, 100 V Chip Capacitors, Vitramon #VJ3640Y225KXBAT
C11	5.1 pF Chip Capacitor, ATC
C12A, B	0.01 $\mu$ F, 100 V Chip Capacitors, Kemet #VJ1210Y103KXBAT
C13	3.9 pF Chip Capacitor, ATC
C15	1.2 pF Chip Capacitor, ATC
L1A, B	130 nH, Coilcraft #132-11SM
L2A, B	#24 AWG, 3 Turns Loose, Fair Rite #2643706001
L3A, B	3.85 nH, Coilcraft #0906-4
L4A, B	5.0 nH, Coilcraft #A02T
R1A, B, R2A, B R4A, B, R5A, B	180 $\Omega$ , 1/4 W Chip Resistors, Vishay Dale (1210)
R3A, B	12 $\Omega$ , 1/8 W Chip Resistors, Vishay Dale (1206)
PCB	MRF372 Printed Circuit Board Rev 1a, Rogers RO4350, Height 30 mils, $\epsilon_r = 3.48$
Balun A, B	Vertical 860 MHz Broadband Balun, Printed Circuit Board Rev 01, Rogers RO3010, Height 50 mils, $\epsilon_r = 10.2$

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**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 3. 860 MHz Narrowband Component Layout**

## TYPICAL TWO-TONE NARROWBAND CHARACTERISTICS

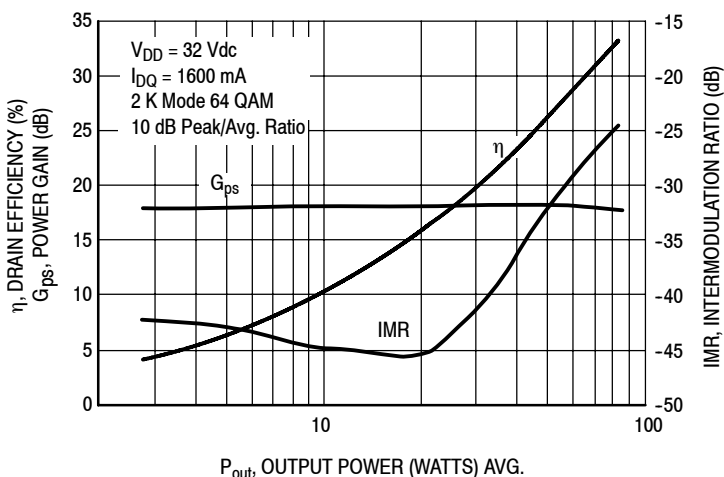


Figure 4. COFDM Performance (860 MHz)

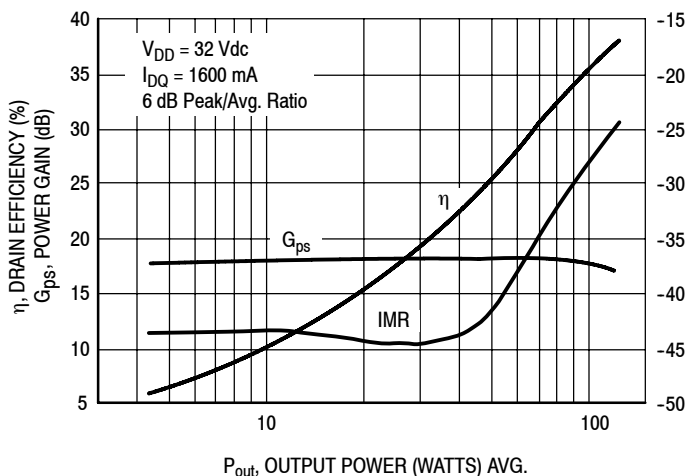


Figure 5. 8-VSB Performance (860 MHz)

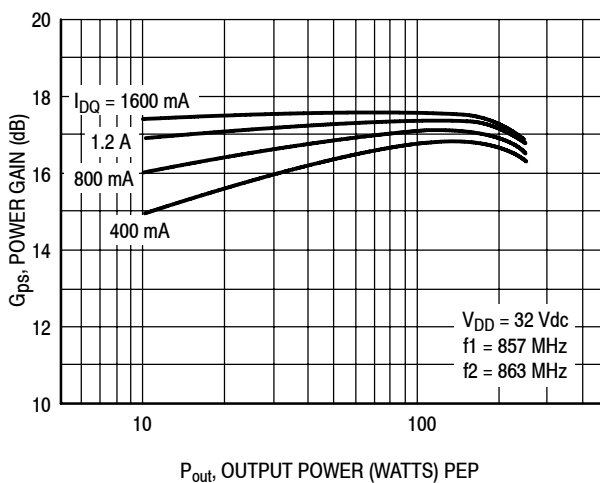


Figure 6. Power Gain versus Output Power

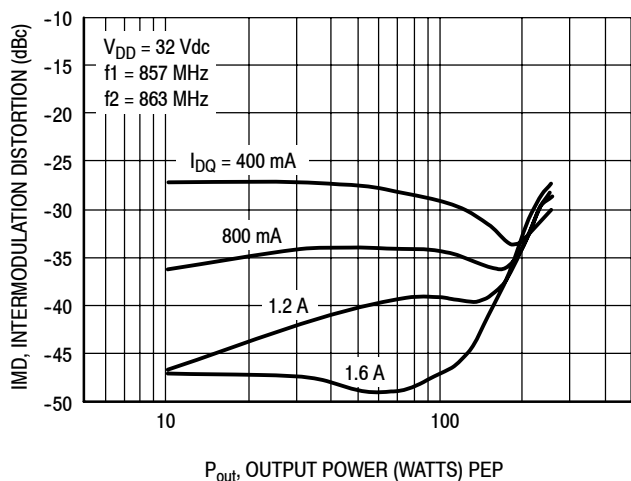


Figure 7. Intermodulation Distortion versus Output Power

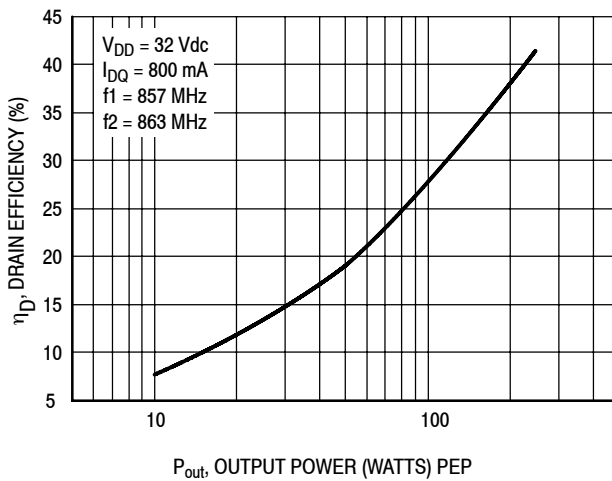
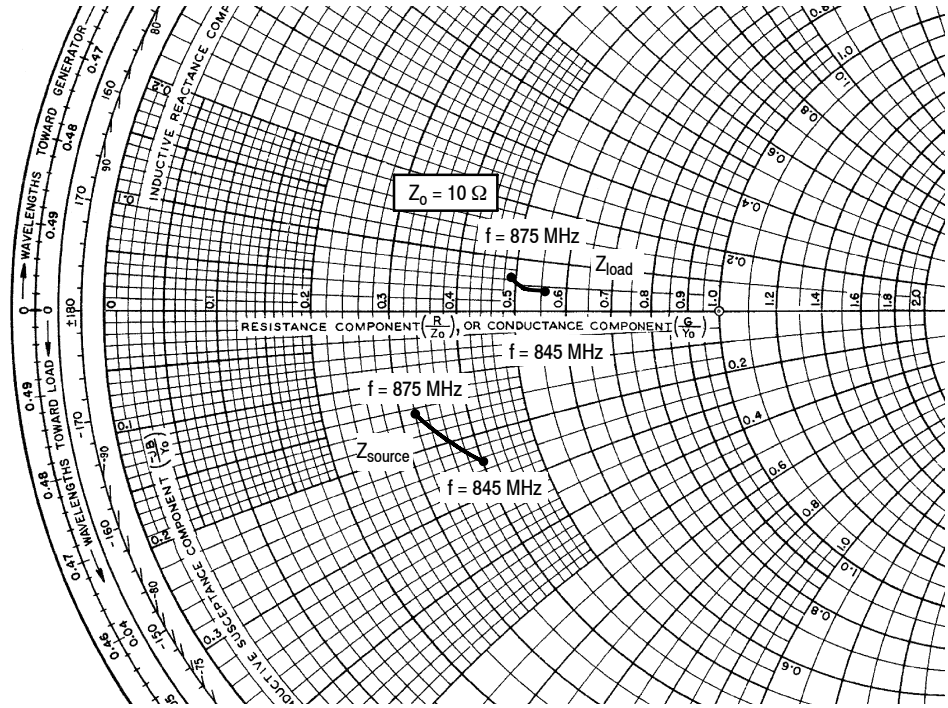


Figure 8. Drain Efficiency versus Output Power



$V_{DD} = 32\text{ V}$ ,  $I_{DQ} = 800\text{ mA}$ ,  $P_{out} = 180\text{ W PEP}$

f MHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
845	$3.99 - j2.50$	$5.63 + j0.38$
860	$3.56 - j1.98$	$5.28 + j0.43$
875	$3.18 - j1.46$	$4.94 + j0.56$
Harmonics		
f GHz	$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
1.69	$2.85 + j14.30$	$1.23 + j9.37$
1.72	$3.27 + j14.32$	$1.54 + j9.60$
1.75	$3.35 + j14.36$	$1.73 + j9.62$

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

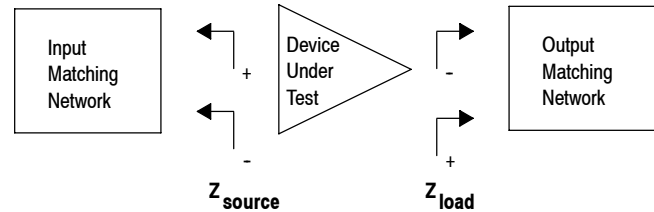


Figure 9. Narrowband Series Equivalent Source and Load Impedance

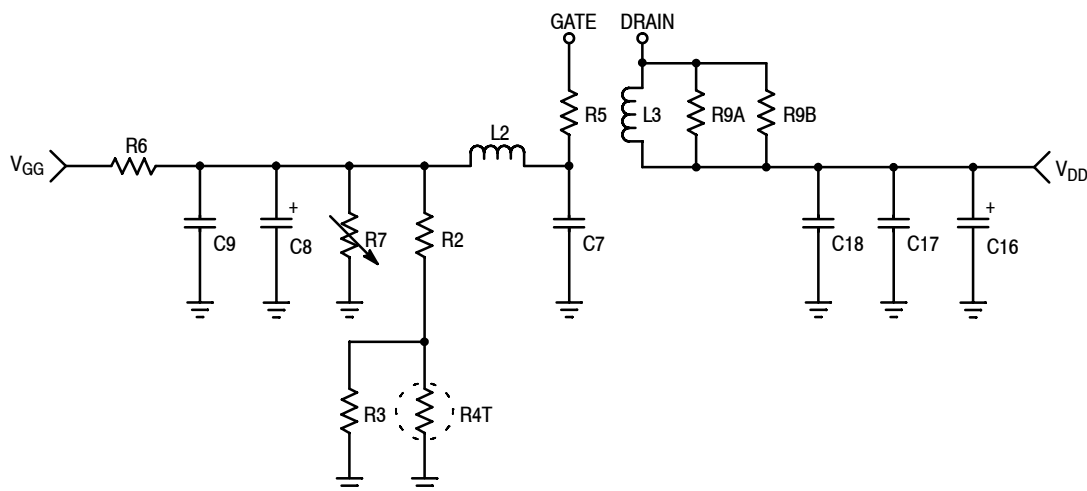
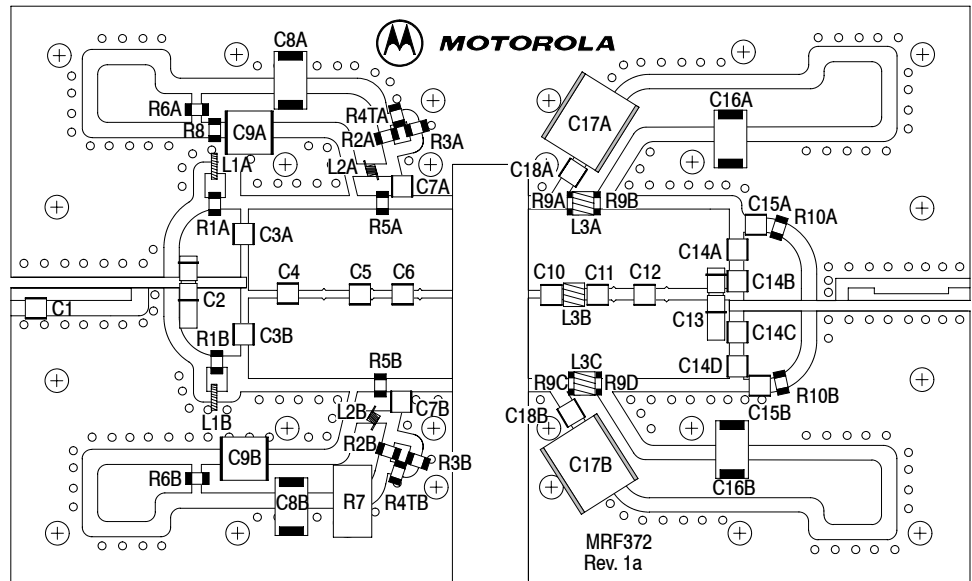


Figure 10. 470-860 MHz Broadband DC Bias Networks

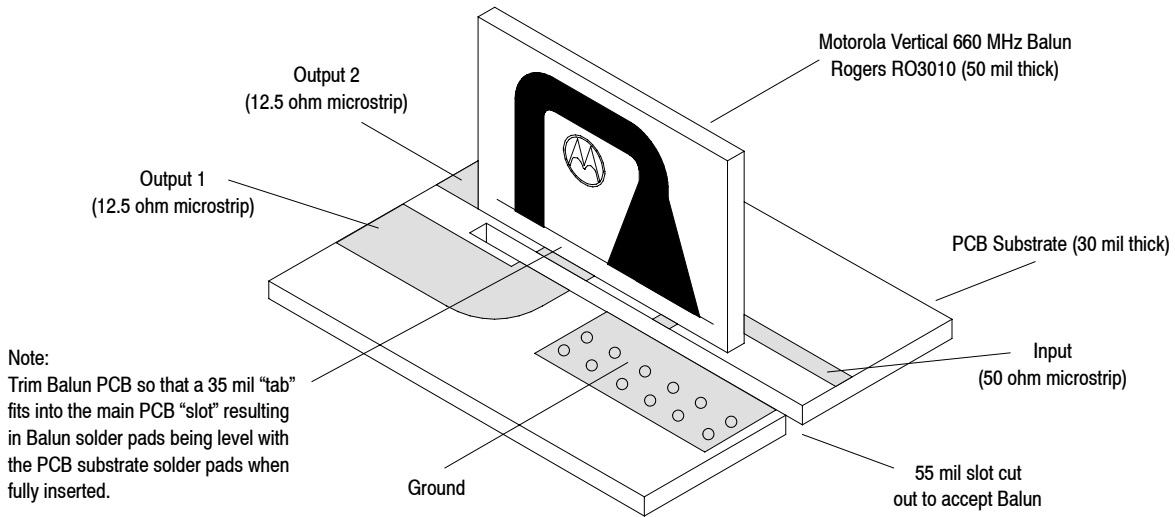
Table 6. 470-860 MHz Broadband DC Bias Networks Component Designations and Values

Designation	Description
C1	0.7 pF Chip Capacitor, ATC
C2, C13	0.8 — 8.0 pF Variable Capacitors, Johansen Gigatrim
C3A, B, C14A, B, C, D	100 pF Chip Capacitors, ATC
C4	4.7 pF, Chip Capacitor, ATC
C5	7.5 pF Chip Capacitor, ATC
C6	10.0 pF Chip Capacitor, ATC
C7A, B	6.2 pF Chip Capacitors, ATC
C8A, B	22 $\mu$ F, 22 V Tantalum Chip Capacitors, Kemet #T491D226K22AS
C9A, B	0.1 $\mu$ F, 100 V Chip Capacitors, Vitramon #VJ3640Y104KXBAT
C10	13 pF Chip Capacitor, ATC
C11	6.8 pF Chip Capacitor, ATC
C12	3.9 pF Chip Capacitor, ATC
C15A, B	3.3 pF Chip Capacitors, ATC
C16A, B	10 $\mu$ F, 35 V Tantalum Chip Capacitors, Kemet #T491D106K35AS
C17A, B	3.3 $\mu$ F, 100 V Chip Capacitors, Vitramon #VJ3640Y335KXBAT
C18A, B	0.01 $\mu$ F Chip Capacitors, ATC
L1A, B	12.55 nH, Coilcraft #1606-10
L2A, B	5.45 nH, Coilcraft #0906-5
L3A, B, C	12.5 nH, Coilcraft #A04T
R1A, B	10 $\Omega$ , 1/4 W Chip Resistors, Vishay Dale (1210)
R2A, B	2.2 k $\Omega$ , 1/4 W Chip Resistors, Vishay Dale (1210)
R3A, B, R10A, B	390 $\Omega$ , 1/8 W Chip Resistors, Vishay Dale (1206)
R4TA, B	520 $\Omega$ , Thermistor, Vishay #NTHS—1206J14520R5%
R5A, B	6.2 $\Omega$ , 1/4 W Chip Resistors, Vishay Dale (1210)
R6A, B	6.8 k $\Omega$ , 1/4 W Chip Resistors, Vishay Dale (1210)
R7	100 k $\Omega$ Potentiometer, Bourns
R8	47.3 k $\Omega$ , 1/8 W Chip Resistor, Vishay Dale (1206)
R9A, B, C, D	180 $\Omega$ , 1/4 W Chip Resistors, Vishay Dale (1210)
PCB	MRF372 Printed Circuit Board Rev 1a, Rogers RO4350, Height 30 mils, $\epsilon_r = 3.48$
Balun A, B	Vertical 660 MHz Broadband Balun, Printed Circuit Board Rev 01, Rogers RO3010, Height 50 mils, $\epsilon_r = 10.2$





### Vertical Balun Mounting Detail



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

**Figure 11. 470-860 MHz Broadband Component Layout**

## TYPICAL TWO-TONE BROADBAND CHARACTERISTICS

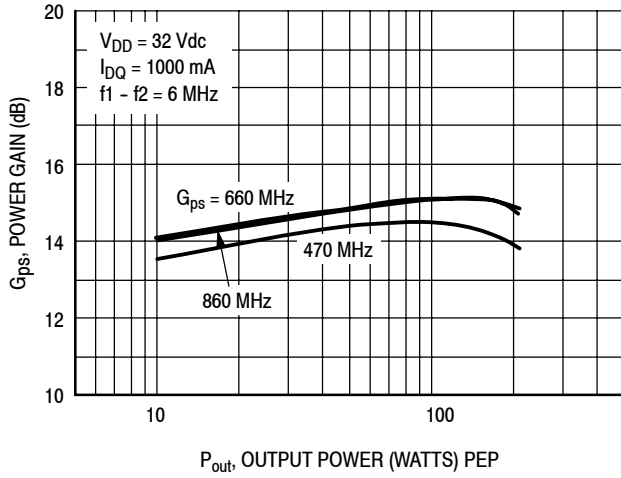


Figure 12. Power Gain versus Output Power

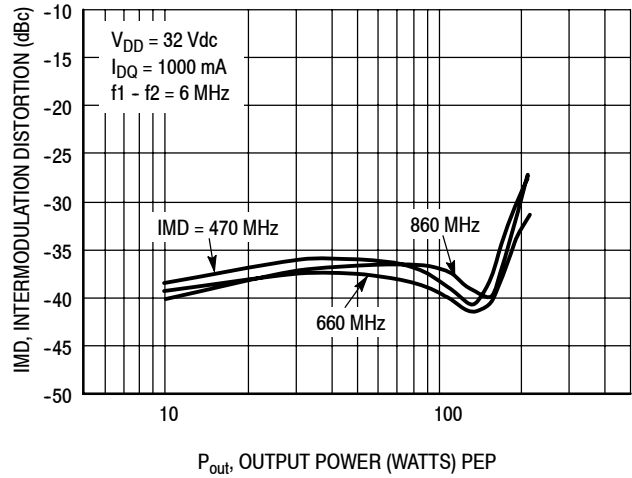


Figure 13. Intermodulation Distortion versus Output Power

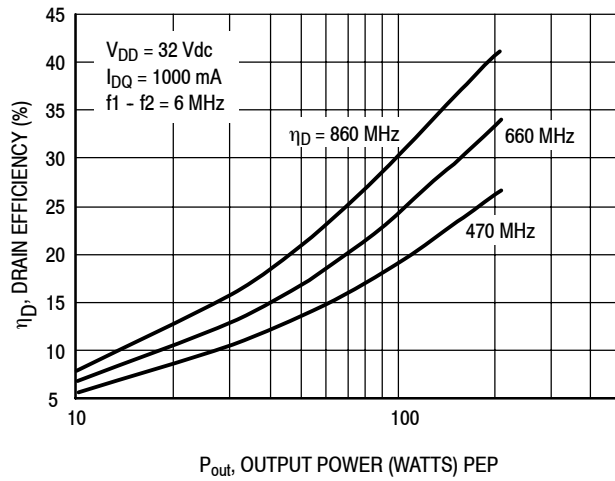
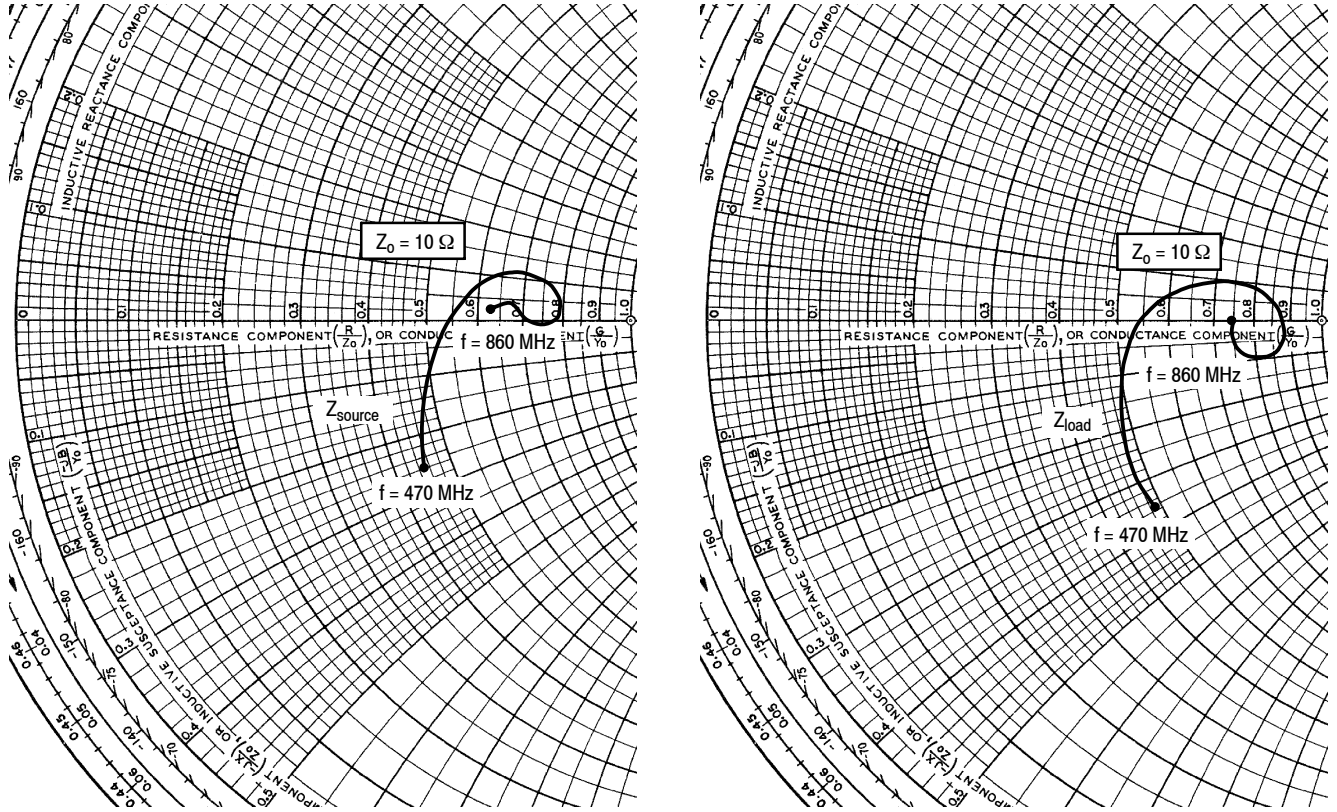


Figure 14. Drain Efficiency versus Output Power

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$V_{DD} = 32\text{ V}$ ,  $I_{DQ} = 1000\text{ mA}$ ,  $P_{out} = 180\text{ W PEP}$

f MHz	$Z_{source}$ Ω	$Z_{load}$ Ω
470	$4.46 - j2.57$	$4.88 - j3.50$
560	$6.40 + j1.06$	$5.45 - j0.07$
660	$7.84 + j0.14$	$8.13 + j0.73$
760	$6.67 + j0.46$	$8.27 - j1.00$
860	$6.25 + j0.31$	$7.52 + j0.02$

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

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

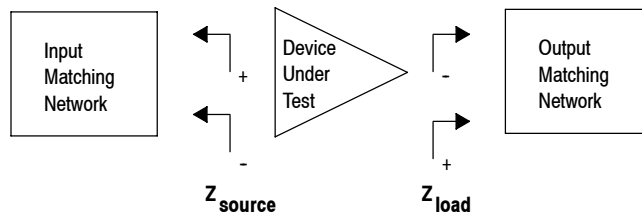


Figure 15. Broadband Series Equivalent Source and Load Impedance

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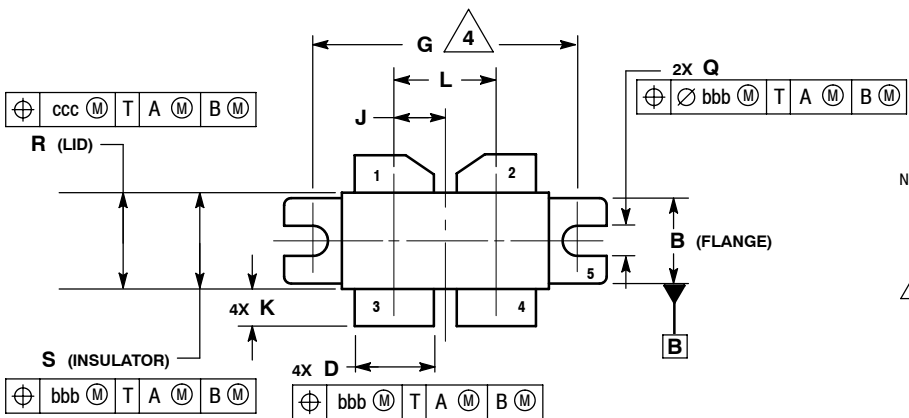
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# NOTES

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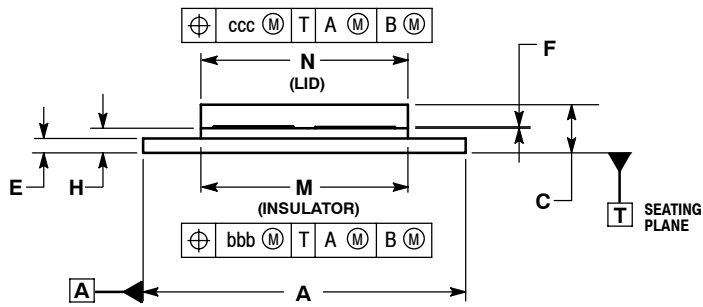
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### PACKAGE DIMENSIONS



- 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
  - DRAIN
  - GATE
  - GATE
  - SOURCE

**CASE 375G-04  
ISSUE G  
NI-860C3**

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