The RF Line

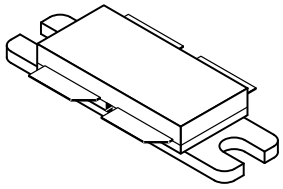
NPN Silicon RF Power Transistor

MRF861

Designed for 24 Volt UHF large–signal, common emitter, class A linear amplifier applications in industrial and commercial equipment operating in the range of 800–960 MHz.

- Specified for V_{CE} = 24 Vdc, I_C = 3.75 Adc Characteristics
  Output Power = 27 Watts CW
  Minimum Power Gain = 9.5 dB
  Minimum ITO = +53.5 dBm
  Typical Noise Figure = 6.5 dB
- Characterized with Small–Signal S–Parameters and Series Equivalent Large–Signal Parameters from 800–960 MHz
- Silicon Nitride Passivated
- 100% Tested for Load Mismatch Stress at All Phase Angles with 30:1 VSWR @ 24 Vdc, I_C = 3.75 Adc and Rated Output Power
- Will Withstand RF Input Overdrive of 8 W CW
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Circuit board photomaster available upon request by contacting RF Tactical Marketing in Phoenix, AZ.

CLASS A
800–960 MHz
27 W (CW), 24 V
NPN SILICON
RF POWER TRANSISTOR



CASE 375A–01, STYLE 1

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	28	Vdc
Collector–Base Voltage	V_{CBO}	60	Vdc
Emitter–Base Voltage	V_{EBO}	4	Vdc
Total Device Dissipation @ T_C = 70°C Derate above 70°C	P_D	130 1	Watts W/°C
Operating Junction Temperature	T_J	200	°C
Storage Temperature Range	T_{stg}	–65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance (T_J = 150°C, T_C = 70°C)	$R_{\theta JC}$	0.92	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (1)					
Collector–Emitter Breakdown Voltage (I_C = 50 mA, I_B = 0)	$V_{(BR)CEO}$	28	33	—	Vdc
Collector–Emitter Breakdown Voltage (I_C = 50 mA, V_{BE} = 0)	$V_{(BR)CES}$	60	75	—	Vdc
Collector–Base Breakdown Voltage (I_C = 50 mA, I_E = 0)	$V_{(BR)CBO}$	60	75	—	Vdc
Emitter–Base Breakdown Voltage (I_E = 5 mA, I_C = 0)	$V_{(BR)EBO}$	4	4.5	—	Vdc
Collector Cutoff Current (V_{CB} = 24 V, I_E = 0)	I_{CES}	—	—	10	mA

(1) All DC tests are per side.

(continued)

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ELECTRICAL CHARACTERISTICS — continued

Characteristic	Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS (1)					
DC Current Gain (I_C = 1 A, V_{CE} = 5 V)	h_{FE}	30	60	120	—
DYNAMIC CHARACTERISTICS (1)					
Output Capacitance (V_{CB} = 24 V, f = 1 MHz) (3)	C_{ob}	—	45	—	pF
FUNCTIONAL CHARACTERISTICS (2)					
Common–Emitter Power Gain (V_{CE} = 24 V, I_C = 3.75 A, f = 840–900 MHz, Power Output = 27 W)	P_g	9.5	11	—	dB
Load Mismatch (V_{CE} = 24 V, I_C = 3.75 A, f = 840 MHz, Power Output = 27 W, Load VSWR = 30:1, All Phase Angles)	ψ	No Degradation in Output Power			
RF Input Overdrive (V_{CE} = 24 V, I_C = 3.75 A, f = 840 MHz) No degradation	$P_{in(over)}$	—	—	8	W
Third Order Intercept Point (V_{CE} = 24 V, I_C = 3.75 A, f1 = 900 MHz, f2 = 900.1 MHz, Meas. @ IMD 3rd Order = –40 dBc)	ITO	+53.5	+54.5	—	dBm
Noise Figure (V_{CE} = 24 V, I_C = 3.75 A, f = 900 MHz)	NF	—	6.5	—	dB
Input Return Loss (V_{CE} = 24 V, I_C = 3.75 A, f = 840–900 MHz, Power Output = 27 W)	IRL	—	—	–8	dB

(1) All DC tests are per side.
(2) Operating bias point I_C is the total for both halves.
(3) C_{ob} measurement is for reference only. This device is collector matched.

Table 1. MRF861 Common Emitter S–Parameters (Per Side)

V_{CE} (V)	I_C (A)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	∠ϕ	$\|S_{21}\|$	∠ϕ	$\|S_{12}\|$	∠ϕ	$\|S_{22}\|$	∠ϕ
24	1.875	800	0.980	163	0.532	81	0.023	62	0.904	164
		820	0.976	162	0.577	77	0.023	58	0.896	164
		840	0.968	161	0.632	73	0.024	55	0.884	164
		860	0.958	160	0.708	67	0.025	51	0.871	164
		880	0.940	159	0.792	60	0.027	45	0.856	164
		900	0.919	158	0.884	52	0.027	38	0.838	164
		920	0.887	158	0.991	41	0.027	28	0.822	166
		940	0.848	158	1.087	29	0.025	16	0.814	168
		960	0.812	159	1.148	14	0.023	3	0.824	170

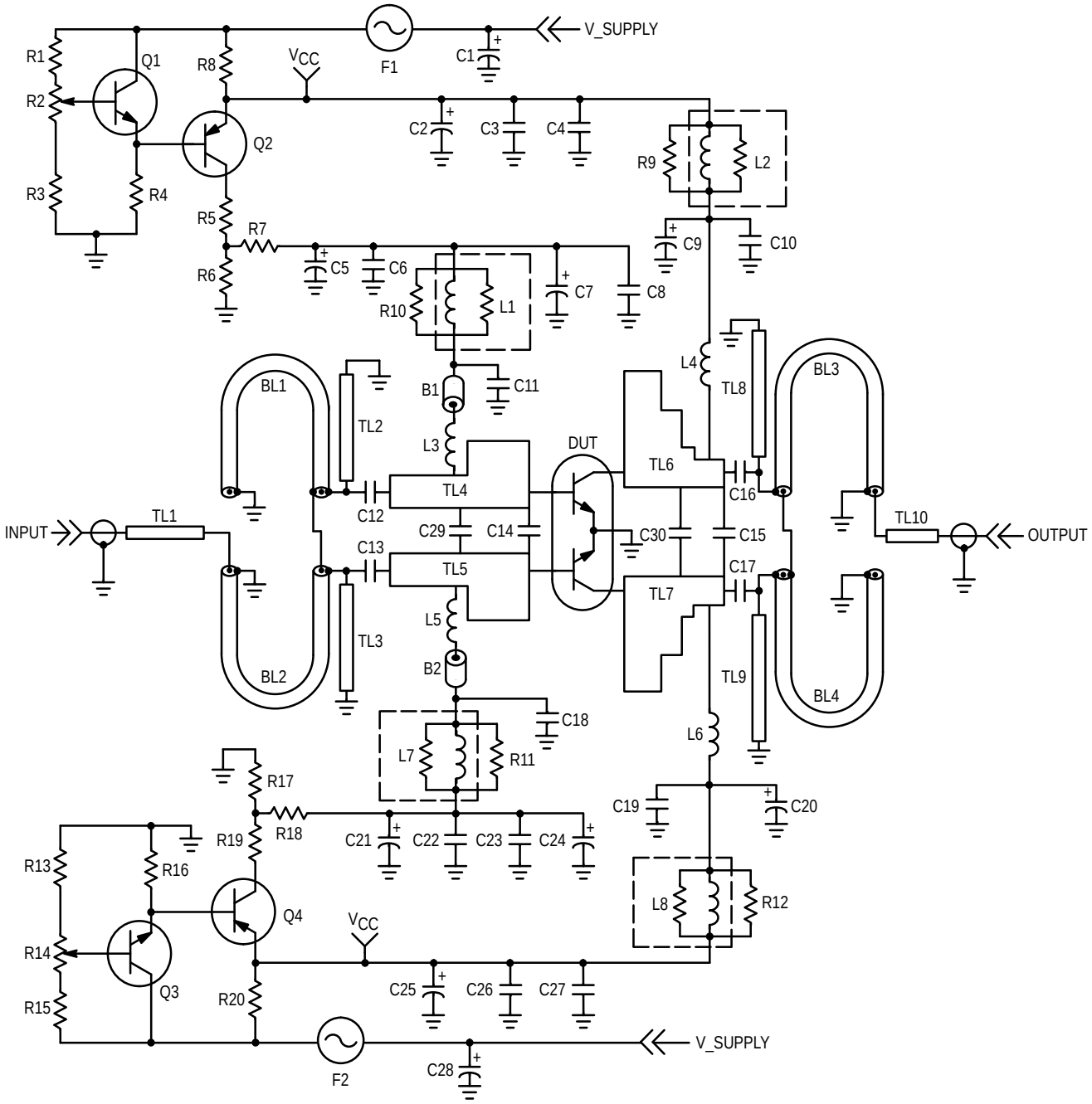
Table 2. Z_{in} and Z_{OL}* versus Frequency

f (MHz)	Z_{in} (Ohms)		Z_{OL}* (Ohms)	
840	2.6	11.4	12	1.8
870	3.2	12.3	12	0.5
900	3.9	12.4	9.4	–0.8

V_{CE} = 24 V, I_C = 3.75 A, P_o = 27 W

Z_{in} is a balanced base–to–base measurement.

Z_{OL}* = Conjugate of optimum load impedance, collector to collector, into which the device operates at a given output power, bias current, voltage and frequency.



B1, B2	Short Ferrite Bead	Q1, Q3	MMBT2222ALT1, NPN Transistor
BL1 – BL4	2.20″ 50 Ω 0.085″ OD Semi–Rigid Coax	Q2, Q4	BD136, PNP Transistor
C1, C5, C21, C28	470 μF, 50 Vdc Electrolytic Capacitor	R1, R15	470 Ω, 1/4 W
C2, C7, C9, C20, C24, C25	10 μF, 50 Vdc Electrolytic Capacitor	R2, R14	500 Ω Potentiometer, 1/4 W
C3, C8, C23, C26	0.1 μF, Chip Capacitor	R3, R13	4.7K Ω, 1/4 W
C4, C6, C22, C27	1000 pF, Chip Capacitor	R4, R16	2 x 4.7K Ω, 1/4 W
C10, C11, C18, C19	100 pF, 100 Mil Chip Capacitor	R5, R19	47 Ω, 2 W
C12, C13, C16, C17	43 pF, 100 Mil Chip Capacitor	R6, R17	82 Ω, 1 W
C14	7.5 pF, 50 Mil Chip Capacitor	R7, R18	4.7 Ω, 1/4 W
C15	1.7 pF, 100 Mil Chip Capacitor	R8, R20	2 Ω, 10 W
C29	2.7 pF, 100 Mil Chip Capacitor	R9, R10, R11, R12	4 x 39 Ω 1/8 W Chip Resistors in Parallel
C30	0.3 pF, 100 Mil Chip Capacitor	TL1, TL10	50 Ω, Microstrip Transmission Line
F1, F2	3 A Micro–Fuse	TL2 – TL9	Microstrip Transmission Line
L1, L2, L7, L8	12 Turns, 22 AWG, 0.150″ ID (Wrapped around 10 Ω, 1/2 W Resistor)	V_Supply	+27.75 Vdc ±0.5 Vdc Due to Resistor Tolerance
		V_{CC}	+24 Vdc @ 1.875 A
L3, L4, L5, L6	4 Turns, 20 AWG, 0.163″ ID	Board	0.030″ Glass–Teflon® 2 oz. Cu, ε_r = 2.55

Figure 1. Class A RF Test Fixture Schematic

TYPICAL CHARACTERISTICS

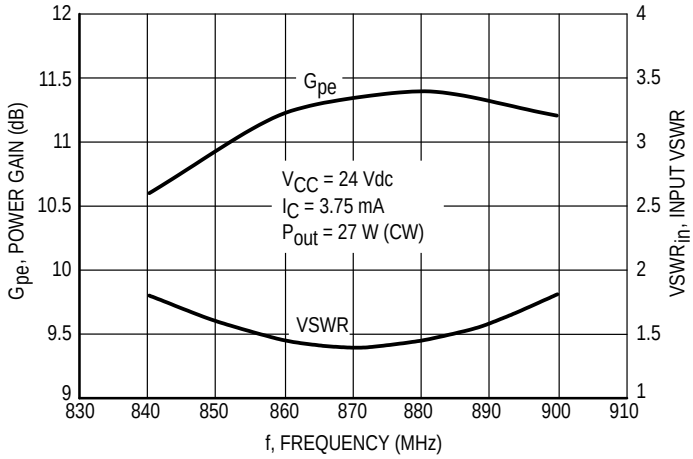


Figure 2. Performance in Broadband Circuit

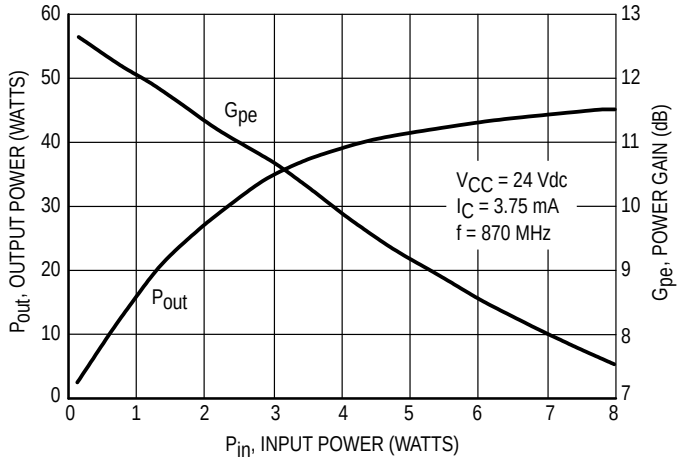


Figure 3. Output Power & Power Gain versus Input Power

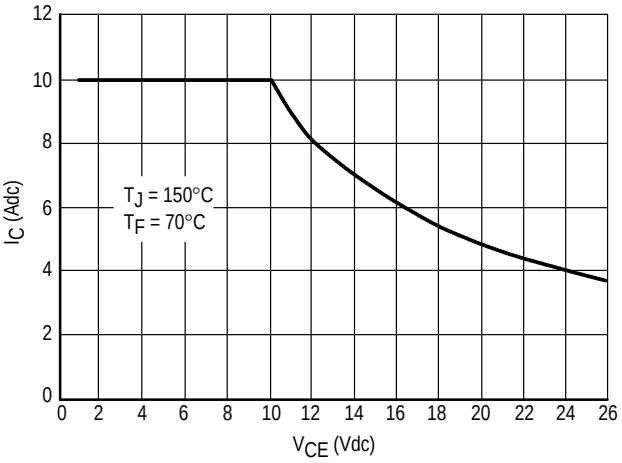


Figure 4. DC SOA (Total I_C for both halves operating.)

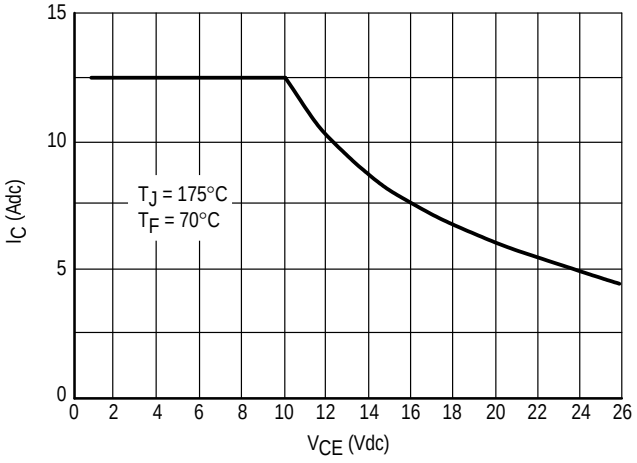


Figure 5. DC SOA (Total I_C for both halves operating.)

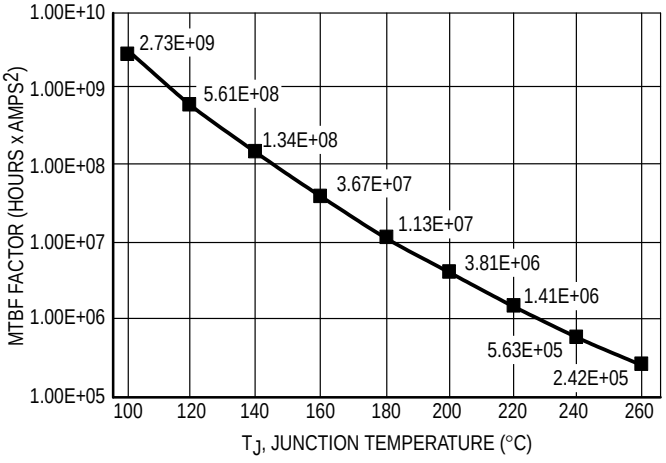


Figure 6. MTBF Factor versus Junction Temperature

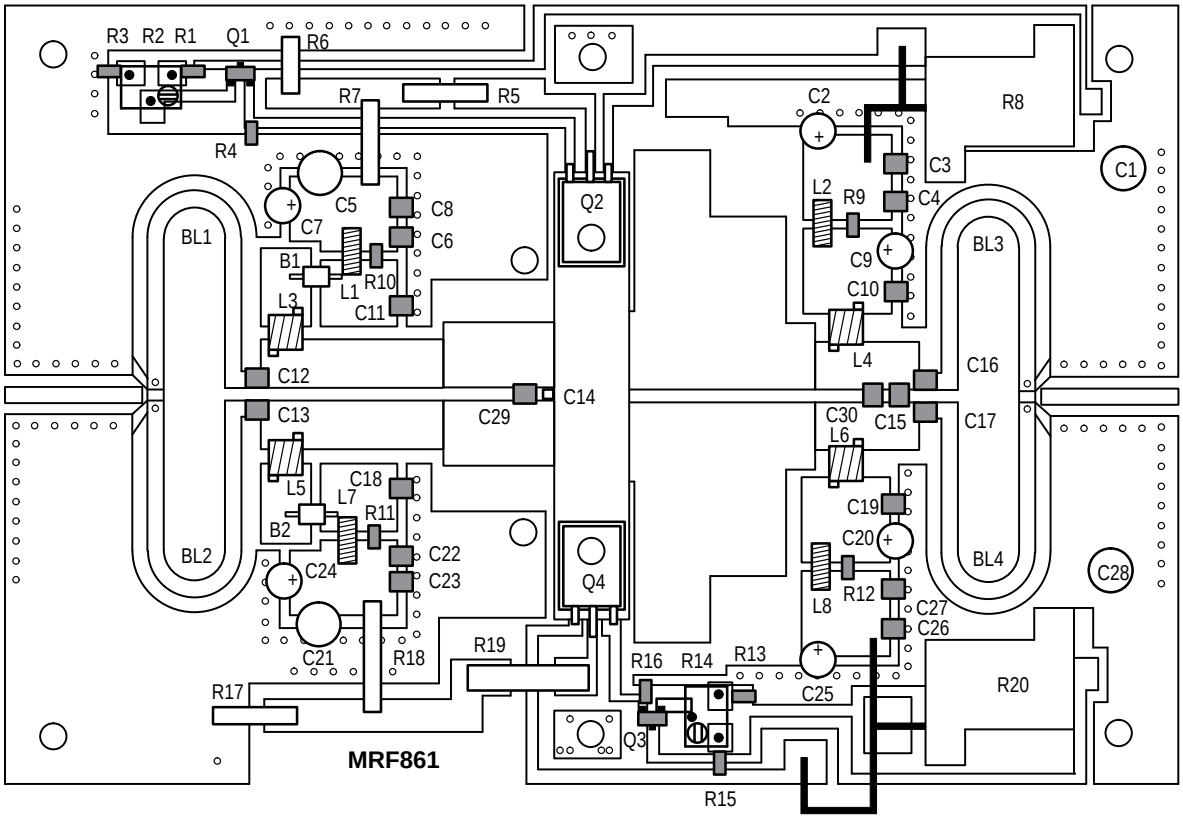
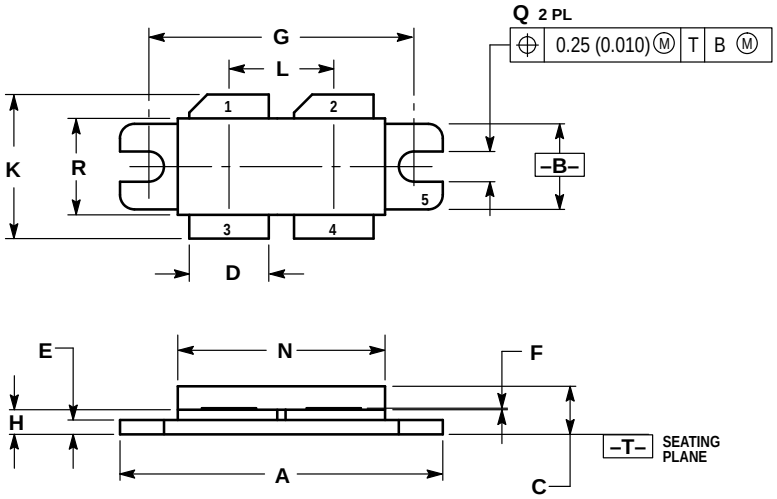


Figure 7. MRF861 Test Fixture Component Layout

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.330	1.350	33.79	34.29
B	0.375	0.395	9.52	10.03
C	0.180	0.205	4.57	5.21
D	0.320	0.340	8.13	8.64
E	0.060	0.070	1.52	1.77
F	0.004	0.006	0.11	0.15
G	1.100 BSC		27.94 BSC	
H	0.082	0.097	2.08	2.46
K	0.580	0.620	14.73	15.75
L	0.435 BSC		11.05 BSC	
N	0.845	0.875	21.46	22.23
Q	0.118	0.130	3.00	3.30
R	0.390	0.410	9.91	10.41

STYLE 1:
PIN 1. COLLECTOR
2. COLLECTOR
3. BASE
4. BASE
5. EMITTER

CASE 375A–01
ISSUE O

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