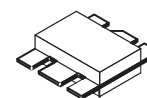


# The RF Line NPN Silicon RF Power Transistor

**MRF858S**

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



CASE 319A-02, STYLE 2

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,  $I_C = 0.5$  Adc Characteristics  
 Output Power = 3.6 Watts CW  
 Minimum Power Gain = 11 dB  
 Minimum ITO = +44.5 dBm  
 Typical Noise Figure = 6 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,  $I_C = 0.5$  Adc and Rated Output Power
- Will Withstand RF Input Overdrive of 0.85 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.

ARCHIVE INFORMATION

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## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CEO}$	30	Vdc
Collector–Base Voltage	$V_{CBO}$	55	Vdc
Emitter–Base Voltage	$V_{EBO}$	4	Vdc
Total Device Dissipation @ $T_C = 50^\circ\text{C}$ Derate above $50^\circ\text{C}$	$P_D$	20 0.138	Watts W/ $^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	–65 to +150	$^\circ\text{C}$

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance ( $T_J = 150^\circ\text{C}$ , $T_C = 50^\circ\text{C}$ )	$R_{\theta JC}$	6.9	$^\circ\text{C}/\text{W}$

## ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
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## OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage ( $I_C = 20$ mA, $I_B = 0$ )	$V_{(BR)CEO}$	28	35	—	Vdc
Collector–Emitter Breakdown Voltage ( $I_C = 20$ mA, $V_{BE} = 0$ )	$V_{(BR)CES}$	55	85	—	Vdc
Collector–Base Breakdown Voltage ( $I_C = 20$ mA, $I_E = 0$ )	$V_{(BR)CBO}$	55	85	—	Vdc
Emitter–Base Breakdown Voltage ( $I_E = 1$ mA, $I_C = 0$ )	$V_{(BR)EBO}$	4	5	—	Vdc
Collector Cutoff Current ( $V_{CB} = 24$ V, $I_E = 0$ )	$I_{CES}$	—	—	1	mA

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**ELECTRICAL CHARACTERISTICS — continued**

Characteristic	Symbol	Min	Typ	Max	Unit
<b>ON CHARACTERISTICS</b>					
DC Current Gain ( $I_C = 0.1\text{ A}$ , $V_{CE} = 5\text{ V}$ )	$h_{FE}$	30	60	120	—
<b>DYNAMIC CHARACTERISTICS</b>					
Output Capacitance ( $V_{CB} = 24\text{ V}$ , $f = 1\text{ MHz}$ )	$C_{ob}$	—	6.5	8	pF
<b>FUNCTIONAL CHARACTERISTICS</b>					
Common-Emitter Power Gain ( $V_{CE} = 24\text{ V}$ , $I_C = 0.5\text{ A}$ , $f = 840\text{--}900\text{ MHz}$ , Power Output = 3.6 W)	$P_g$	11	12	—	dB
Load Mismatch ( $P_o = 3.6\text{ W}$ ) ( $V_{CE} = 24\text{ V}$ , $I_C = 0.5\text{ A}$ , $f = 840\text{ MHz}$ , Load VSWR = 30:1, All Phase Angles)	$\psi$	No Degradation in Output Power			
RF Input Overdrive ( $V_{CE} = 24\text{ V}$ , $I_C = 0.5\text{ A}$ , $f = 840\text{ MHz}$ ) No degradation	$P_{in(over)}$	—	—	0.85	W
Third Order Intercept Point ( $V_{CE} = 24\text{ V}$ , $I_C = 0.5\text{ A}$ ) ( $f_1 = 900\text{ MHz}$ , $f_2 = 900.1\text{ MHz}$ , Meas. @ IMD 3rd Order = -40 dBc)	ITO	+44.5	+45.5	—	dBm
Noise Figure ( $V_{CE} = 24\text{ V}$ , $I_C = 0.5\text{ A}$ , $f = 900\text{ MHz}$ )	NF	—	6	—	dB
Input Return Loss ( $V_{CE} = 24\text{ V}$ , $I_C = 0.5\text{ A}$ , $f = 840\text{--}900\text{ MHz}$ , Power Output = 3.6 W)	IRL	—	-12	-9	dB

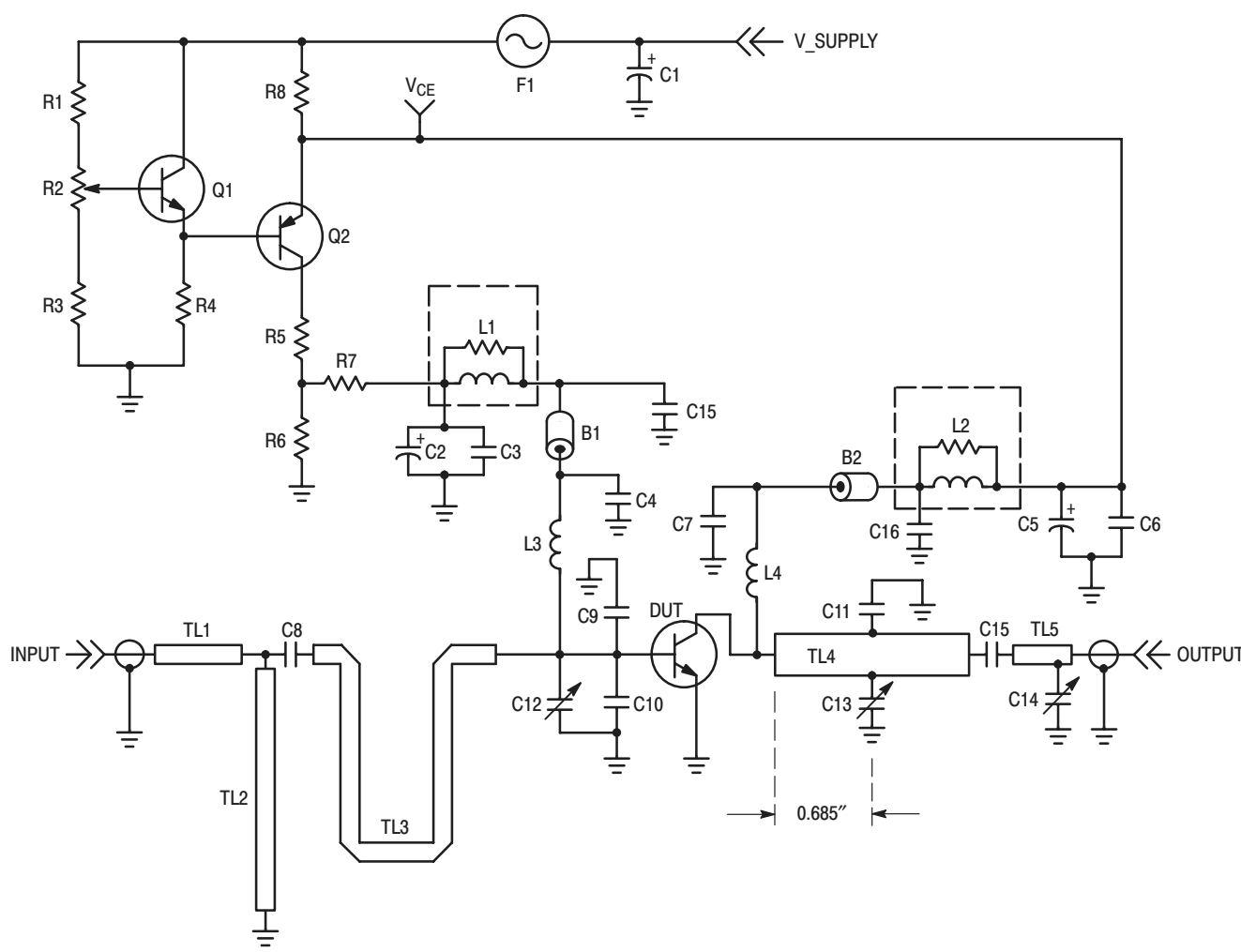
**Table 1. Common Emitter S-Parameters**

$V_{CE}$ (V)	$I_C$ (A)	f (MHz)	$S_{11}$		$S_{21}$		$S_{12}$		$S_{22}$	
			$ S_{11} $	$\angle \phi$	$ S_{21} $	$\angle \phi$	$ S_{12} $	$\angle \phi$	$ S_{22} $	$\angle \phi$
24	0.5	800	0.942	167	1.493	50	0.027	58	0.538	-165
		820	0.942	166	1.453	50	0.027	58	0.541	-164
		840	0.941	166	1.415	49	0.028	59	0.545	-165
		860	0.940	166	1.379	48	0.028	59	0.550	-165
		880	0.941	165	1.351	47	0.029	59	0.553	-165
		900	0.940	165	1.320	46	0.030	59	0.557	-165
		920	0.940	165	1.289	45	0.030	59	0.562	-165
		940	0.940	164	1.252	44	0.031	59	0.566	-165
960	0.940	164	1.222	43	0.031	59	0.570	-165		

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

f (MHz)	$Z_{in}$ (Ohms)		$Z_{OL}^*$ (Ohms)	
840	1.1	2.9	9.9	-14.4
870	1.1	3.5	9.5	-14.6
900	1.2	3.5	9	-14.5

 $V_{CE} = 24\text{ V}$ ,  $I_C = 0.5\text{ A}$ ,  $P_o = 3.6\text{ W}$ 
 $Z_{OL}^*$  = Conjugate of optimum load impedance into which the device operates at a given output power, voltage and frequency.



B1, B2	Short Ferrite Bead, Fair Rite (2743021447)	R1	390 $\Omega$ , 1/4 W
C1	250 $\mu$ F, 50 Vdc Electrolytic Capacitor	R2	500 $\Omega$ Potentiometer, 1/4 W
C2, C5	10 $\mu$ F, 50 Vdc Electrolytic Capacitor	R3	7.5K $\Omega$ , 1/4 W
C3, C6	0.1 $\mu$ F, Chip Capacitor	R4	2 x 4.7K $\Omega$ , 1/4 W
C4, C7	100 pF, Chip Capacitor	R5	56 $\Omega$ , 2 W
C8, C15	43 pF, 100 Mil Chip Capacitor	R6	75 $\Omega$ , 1/4 W
C9, C10	10 pF, Mini-Unelco	R7	4.7 $\Omega$ , 1/4 W
C11	5 pF, Mini-Unelco	R8	4 $\Omega$ , 10 W
C12, C13, C14	0.8–8.0 pF, Johanson Gigatrim	TL1, TL5	50 $\Omega$ , Microstrip Transmission Line
C15, C16	1000 pF, Chip Capacitor	TL2	Microstrip Transmission Line
F1	1 A Micro-Fuse	TL3	Microstrip Transmission Line
L1, L2	10 Turns, 20 AWG, 0.150" ID (10 $\Omega$ 1/2 W Resistor)	TL4	Microstrip Transmission Line
L3	4 Turns, 16 AWG, 0.101" ID	V_Supply	+26 Vdc $\pm$ 0.5 Vdc Due to Resistor Tolerance
L4	0.5" 18 AWG Wire	V <sub>CE</sub>	+24 Vdc @ 0.5 A
Q1	MMBT2222ALT1, NPN Transistor	Board	0.030" Glass-Teflon <sup>®</sup> 2 oz. Cu, $\epsilon_r = 2.55$
Q2	BD136, PNP Transistor		

Figure 1. MRF858S Class A RF Test Fixture Schematic

### TYPICAL CHARACTERISTICS

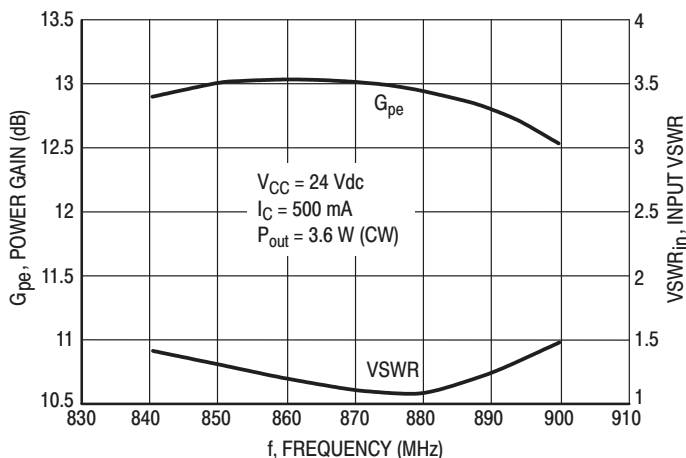


Figure 2. Performance in Broadband Circuit

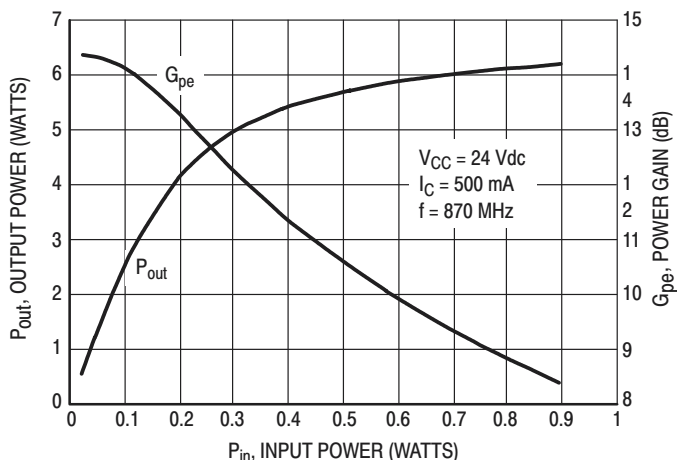


Figure 3. Output Power & Power Gain versus Input Power

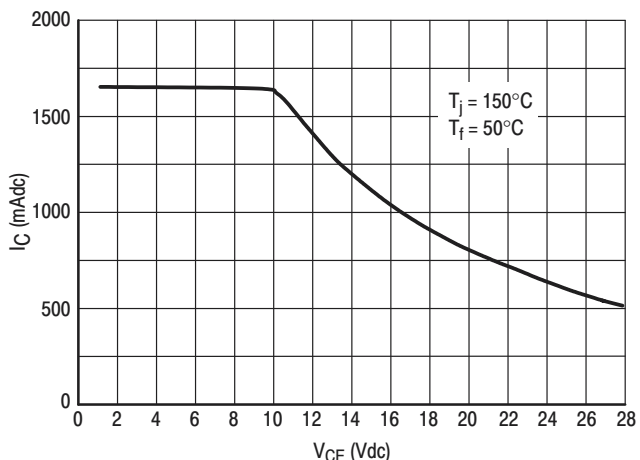


Figure 4. DC SOA

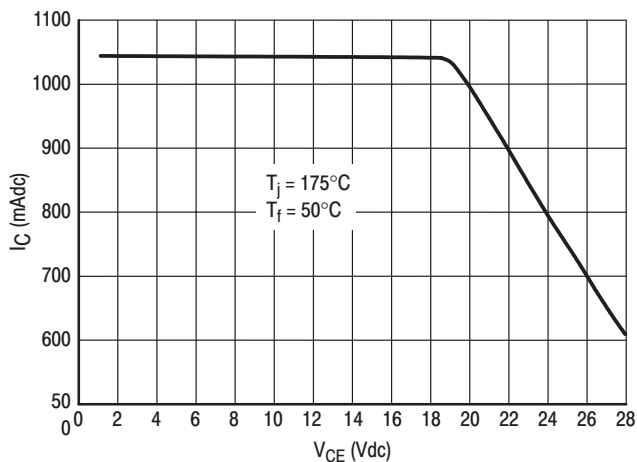


Figure 5. DC SOA  
(This device is MTBF limited for  $V_{CE} < 20$  Vdc.)

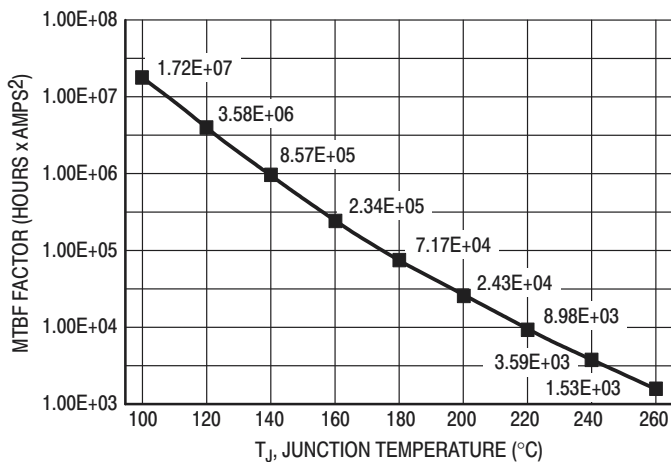


Figure 6. MTBF Factor versus Junction Temperature

ARCHIVE INFORMATION

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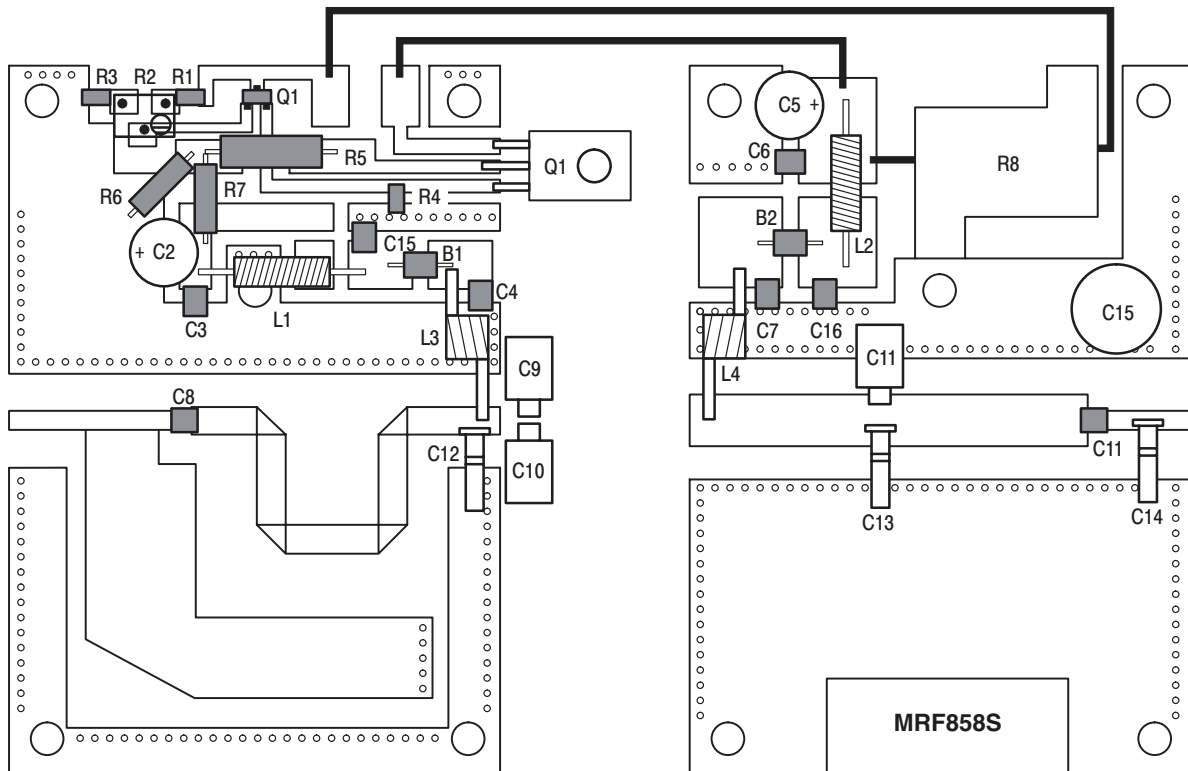
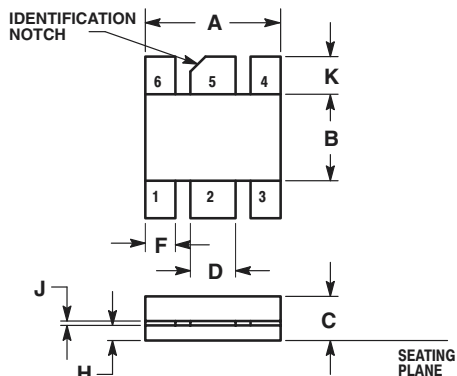


Figure 7. MRF858S Test Fixture Component Layout

## PACKAGE DIMENSIONS



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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.355	0.365	9.02	9.27
B	0.225	0.235	5.72	5.96
C	0.110	0.125	2.80	3.17
D	0.115	0.125	2.93	3.17
F	0.075	0.085	1.91	2.15
H	0.035	0.045	0.89	1.14
J	0.004	0.006	0.11	0.15
K	0.090	0.110	2.29	2.79

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

### CASE 319A-02 ISSUE B

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