

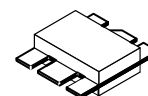
The RF Line

NPN Silicon

RF Power Transistor

MRF859S

CLASS A
800–960 MHz
6.5 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 to 960 MHz.

- Specified for $V_{CE} = 24$ Vdc, $I_C = 0.9$ Adc Characteristics
 - Output Power = 6.5 Watts CW
 - Minimum Power Gain = 11.5 dB
 - Minimum ITO = +47 dBm
 - Typical Noise Figure = 6 dB
- Characterized with Small-Signal S-Parameters and Series Equivalent Large-Signal Parameters from 800 to 960 MHz
- Silicon Nitride Passivated
- 100% Tested for Load Mismatch Stress at All Phase Angles with 30:1 VSWR @ 24 Vdc, $I_C = 0.9$ Adc and Rated Output Power
- Will Withstand RF Input Overdrive of 2 W CW
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration

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 @ $T_C = 60^\circ\text{C}$ Derate above 60°C	P_D	34 0.24	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 ($T_J = 150^\circ\text{C}$, $T_C = 60^\circ\text{C}$)	$R_{\theta JC}$	3.9	$^\circ\text{C}/\text{W}$

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Collector-Emitter Breakdown Voltage ($I_C = 25$ mA, $I_B = 0$)	$V_{(BR)CEO}$	28	32	—	Vdc
Collector-Emitter Breakdown Voltage ($I_C = 25$ mA, $V_{BE} = 0$)	$V_{(BR)CES}$	55	75	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 25$ mA, $I_E = 0$)	$V_{(BR)CBO}$	55	75	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 5$ mA, $I_C = 0$)	$V_{(BR)EBO}$	4	5	—	Vdc
Collector Cutoff Current ($V_{CB} = 15$ V, $I_E = 0$)	I_{CES}	—	—	2	mA

(continued)

ELECTRICAL CHARACTERISTICS — continued

Characteristic	Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS					
DC Current Gain ($I_C = 1\text{ A}$, $V_{CE} = 5\text{ V}$)	h_{FE}	20	60	120	—
DYNAMIC CHARACTERISTICS					
Output Capacitance ($V_{CB} = 24\text{ V}$, $f = 1\text{ MHz}$)	C_{ob}	13	—	26	pF
FUNCTIONAL CHARACTERISTICS					
Common-Emitter Power Gain ($V_{CE} = 24\text{ V}$, $I_C = 0.9\text{ A}$, $f = 840\text{--}900\text{ MHz}$, $P_{out} = 6.5\text{ W}$)	P_g	11.5	13	—	dB
Load Mismatch ($V_{CE} = 24\text{ V}$, $I_C = 0.9\text{ A}$, $f = 840\text{ MHz}$, $P_{out} = 6.5\text{ W}$, Load VSWR = 30:1, All Phase Angles)	ψ	No Degradation in Output Power			
RF Input Overdrive ($V_{CE} = 24\text{ V}$, $I_C = 0.9\text{ A}$, $f = 840\text{ MHz}$) No degradation	$P_{in(over)}$	—	—	2	W
Third Order Intercept Point ($V_{CE} = 24\text{ V}$, $I_C = 0.9\text{ A}$, $f_1 = 900\text{ MHz}$, $f_2 = 900.1\text{ MHz}$, Meas. @ IMD 3rd Order = -40 dBc)	ITO	+47	+48	—	dBm
Noise Figure ($V_{CE} = 24\text{ V}$, $I_C = 0.9\text{ A}$, $f = 900\text{ MHz}$)	NF	—	6	—	dB
Input Return Loss ($V_{CE} = 24\text{ V}$, $I_C = 0.9\text{ A}$, $f = 840\text{--}900\text{ MHz}$, $P_{out} = 6.5\text{ W}$)	IRL	—	—	-9	dB

Table 1. Common Emitter S-Parameters

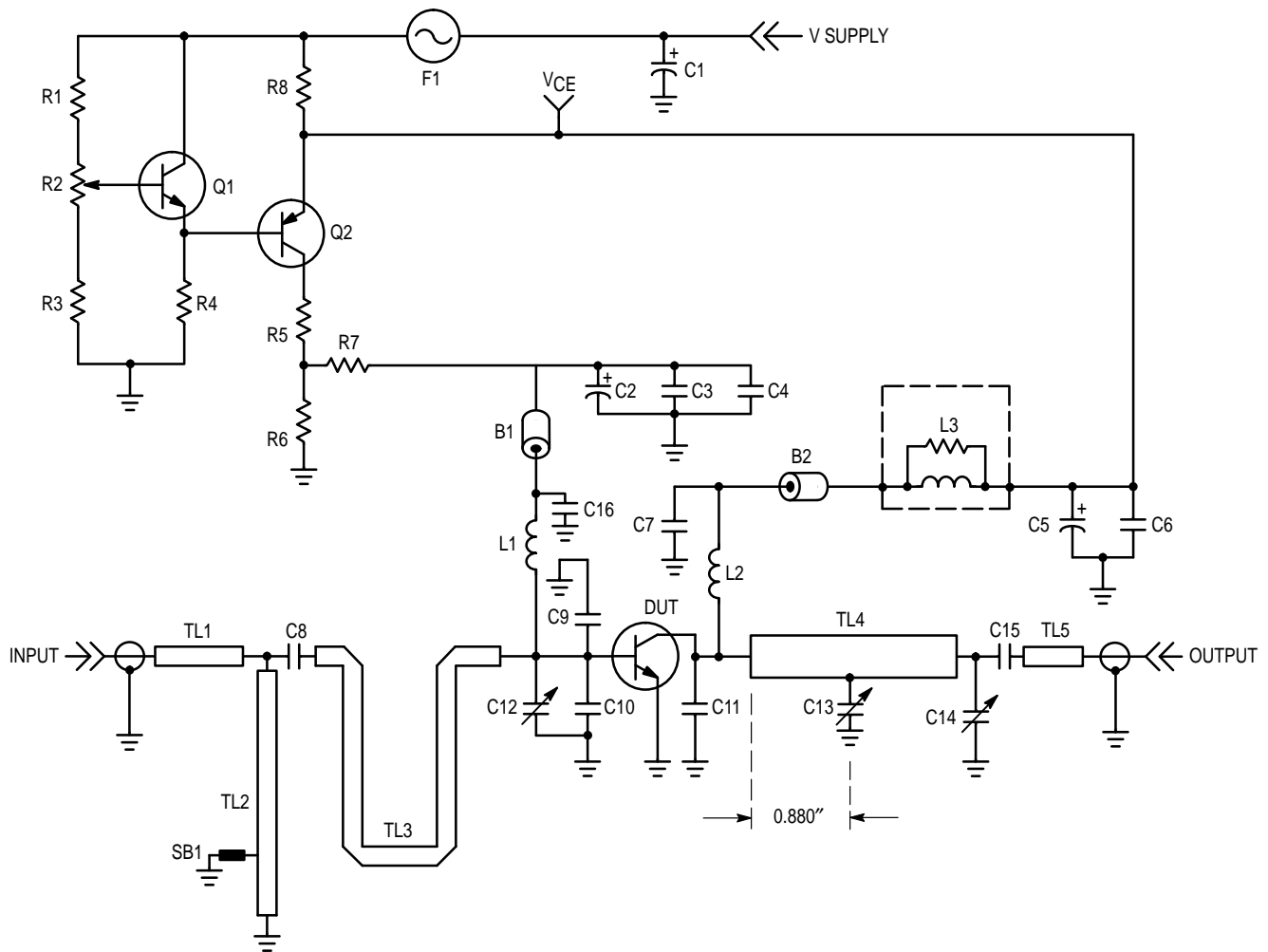
V_{CE} (V)	I_C (A)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$ S_{11} $	$\angle \phi$	$ S_{21} $	$\angle \phi$	$ S_{12} $	$\angle \phi$	$ S_{22} $	$\angle \phi$
24	0.9	800	0.906	170	1.022	12	0.016	11	0.804	-168
		820	0.902	170	1.022	7	0.015	8	0.823	-167
		840	0.897	171	1.018	3	0.013	6	0.845	-167
		860	0.894	171	1.012	-3	0.011	4	0.870	-167
		880	0.893	171	1.005	-8	0.009	3	0.895	-168
		900	0.893	171	0.988	-14	0.007	5	0.920	-168
		920	0.894	172	0.962	-20	0.005	14	0.946	-169
		940	0.897	172	0.924	-26	0.008	47	0.969	-170
		960	0.903	172	0.884	-32	0.004	102	0.987	-172

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

f (MHz)	Z_{in} (Ohms)		Z_{OL}^* (Ohms)	
840	1.6	3.3	2	-4.1
870	1.5	3.6	1.6	-3.3
900	2.2	3.5	1.7	-2.7

$$V_{CE} = 24\text{ V}, I_C = 0.9\text{ A}, P_o = 6.5\text{ W}$$

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



B1, B2	Ferrite Bead, Ferroxcube (56-390-65/3B)	R1	470 Ω , 1/4 W
C1	250 μ F, 50 Vdc, Electrolytic Capacitor	R2	500 Ω Potentiometer, 1/4 W
C2, C5	10 μ F, 50 Vdc, Electrolytic Capacitor	R3	4.7K Ω , 1/4 W
C3, C6	0.1 μ F, Chip Capacitor	R4	2 x 4.7K Ω , 1/4 W
C4	1000 pF, Chip Capacitor	R5	50 Ω , 2 W
C7, C16	100 pF, Chip Capacitor	R6	75 Ω , 1/4 W
C8, C15	43 pF, 100 Mil Chip Capacitor	R7	4.7 Ω , 1/4 W
C9, C10	6.8 pF, Mini-Unelco	R8	4 Ω , 10 W
C11	18 pF, Mini-Unelco	SB1	Copper Block 0.550" x 0.180" x 0.050"
C12, C13, C14	0.8-8.0 pF, Johanson Gigatrim	TL1, TL5	50 Ω , Microstrip Transmission Line
F1	3 Amp Micro-Fuse	TL2	Microstrip Transmission Line
L1, L2	3 Turns, 18 AWG, 0.170" ID	TL3	Microstrip Transmission Line
L3	12 Turns, 22 AWG, 0.150" ID (10 Ω 1/2 W Resistor)	TL4	Microstrip Transmission Line
Q1	MMBT2222ALT1, NPN Transistor	Board	0.030" Glass-Teflon [®] 2 oz. Cu, $\epsilon_r = 2.55$
Q2	BD136, PNP Transistor	V Supply	+27.6 Vdc \pm 0.5 Vdc Due to Resistor Tolerance
		VCE	+24 Vdc @ 0.9 A

Figure 1. MRF859S Class A RF Test Fixture Schematic

TYPICAL CHARACTERISTICS

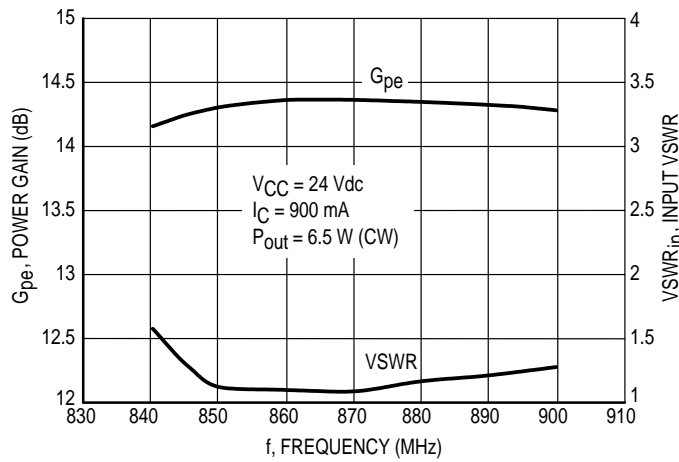


Figure 2. Performance in Broadband Circuit

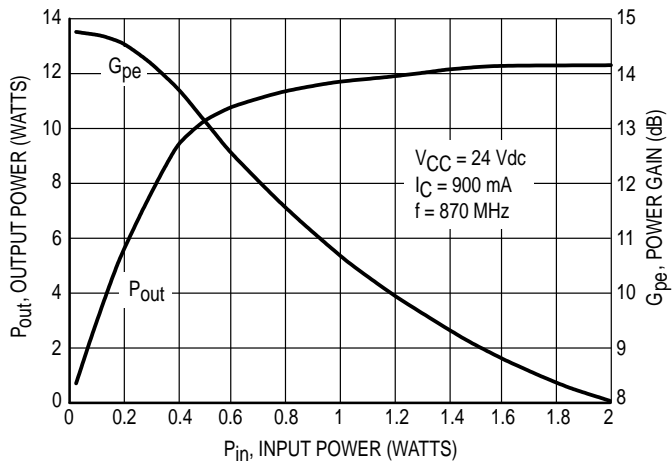


Figure 3. Output Power & Power Gain versus Input Power

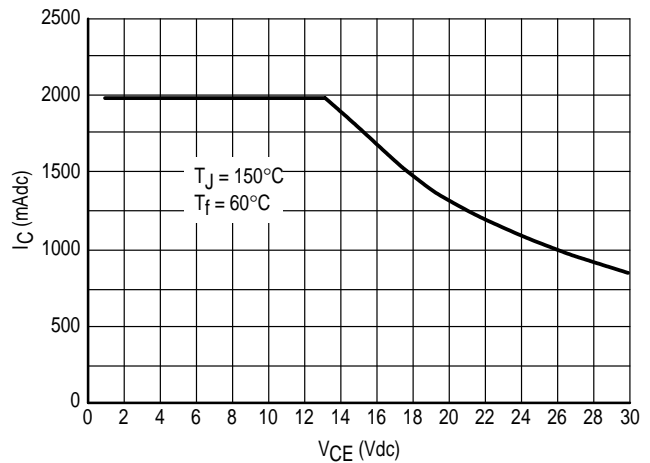


Figure 4. DC SOA

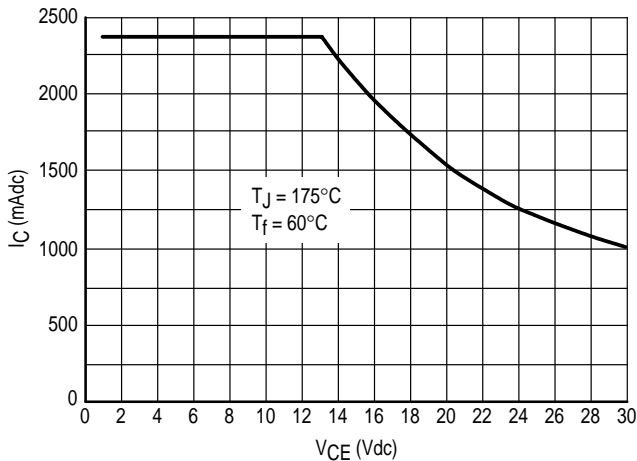


Figure 5. DC SOA

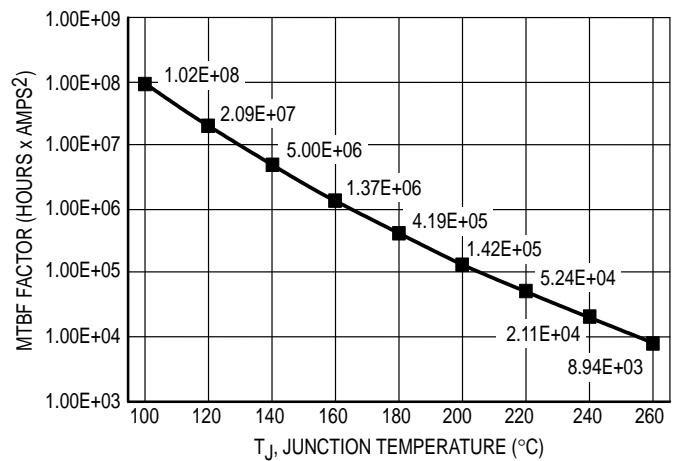


Figure 6. MTBF Factor versus Junction Temperature

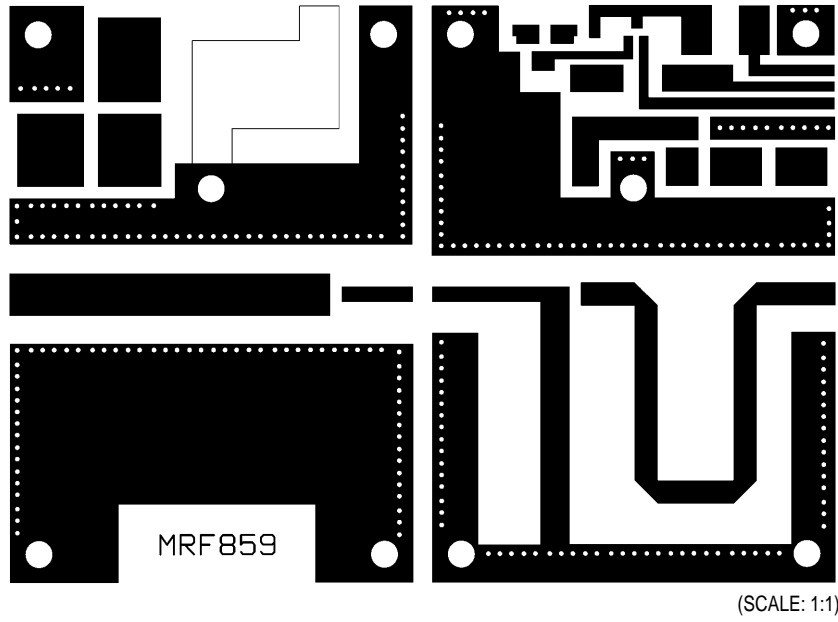


Figure 7. MRF859S Photomaster

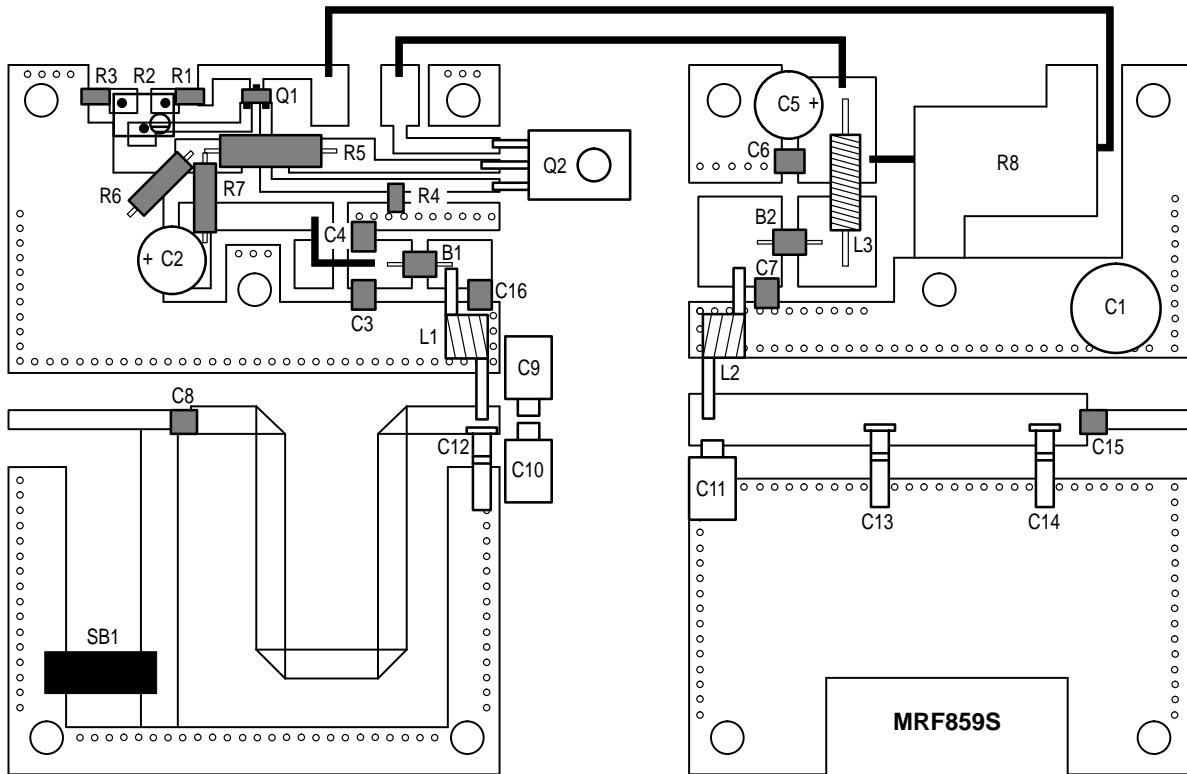
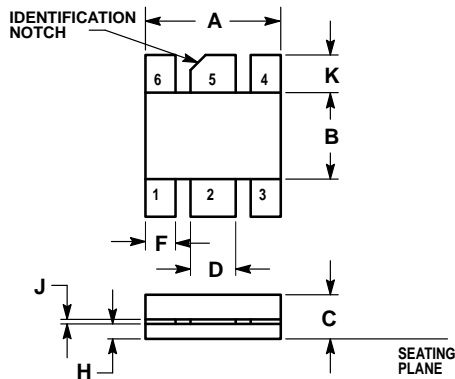


Figure 8. MRF859S Test Fixture Component Layout

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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