The RF Line

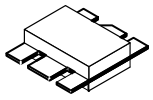
NPN Silicon RF Power Transistor

MRF859S

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

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



CASE 319A–02, STYLE 2

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°C Derate above 60°C	P_D	34 0.24	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 = 60°C)	$R_{\theta JC}$	3.9	°C/W

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
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 A, V_{CE} = 5 V)	h_{FE}	20	60	120	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 24 V, f = 1 MHz)	C_{ob}	13	—	26	pF
FUNCTIONAL CHARACTERISTICS					
Common–Emitter Power Gain (V_{CE} = 24 V, I_C = 0.9 A, f = 840–900 MHz, P_{out} = 6.5 W)	P_g	11.5	13	—	dB
Load Mismatch (V_{CE} = 24 V, I_C = 0.9 A, f = 840 MHz, P_{out} = 6.5 W, Load VSWR = 30:1, All Phase Angles)	ψ	No Degradation in Output Power			
RF Input Overdrive (V_{CE} = 24 V, I_C = 0.9 A, f = 840 MHz) No degradation	$P_{in(over)}$	—	—	2	W
Third Order Intercept Point (V_{CE} = 24 V, I_C = 0.9 A, f1 = 900 MHz, f2 = 900.1 MHz, Meas. @ IMD 3rd Order = –40 dBc)	ITO	+47	+48	—	dBm
Noise Figure (V_{CE} = 24 V, I_C = 0.9 A, f = 900 MHz)	NF	—	6	—	dB
Input Return Loss (V_{CE} = 24 V, I_C = 0.9 A, f = 840–900 MHz, P_{out} = 6.5 W)	IRL	—	—	–9	dB

Table 1. Common Emitter S–Parameters

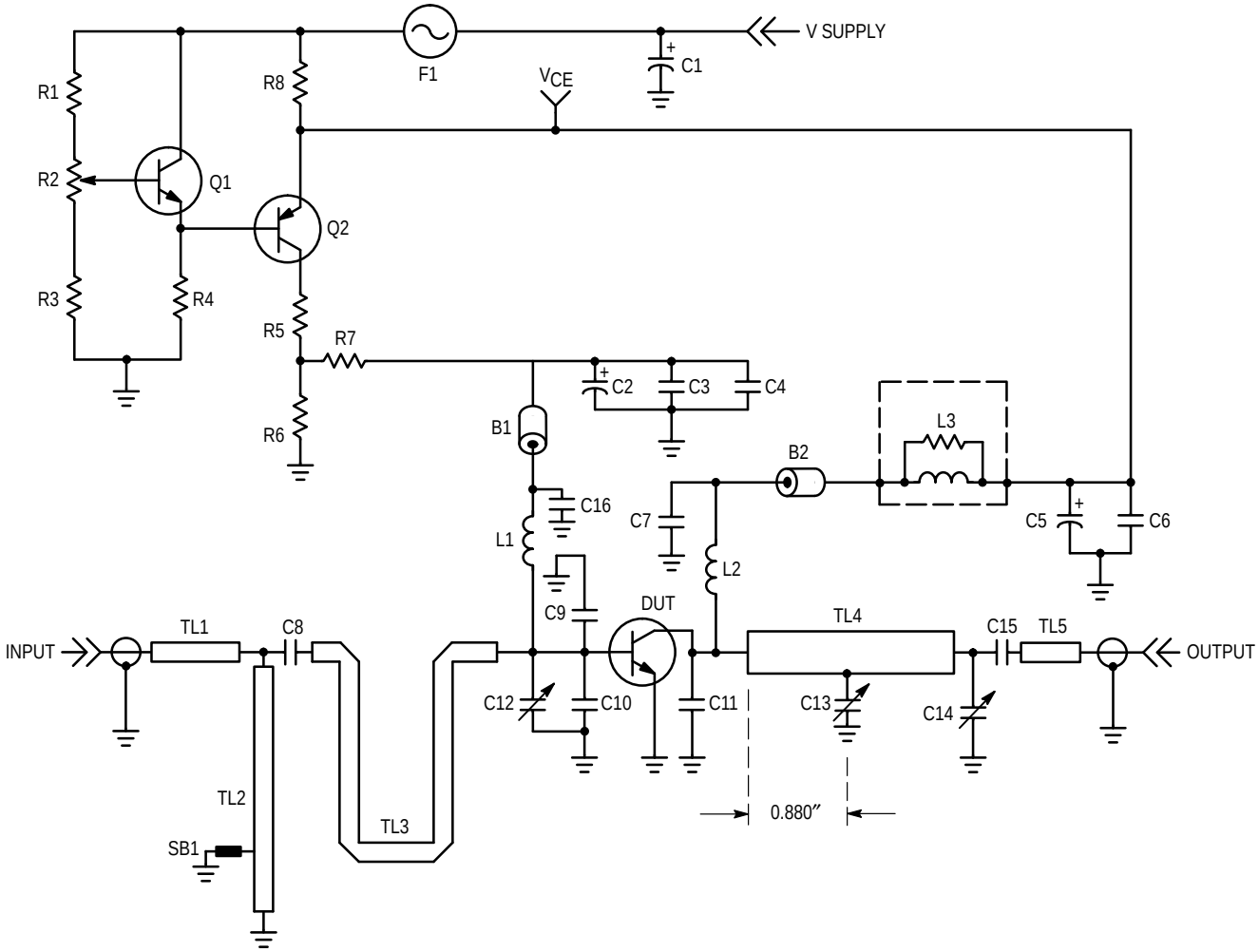
V_{CE} (V)	I_C (A)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	∠ϕ	$\|S_{21}\|$	∠ϕ	$\|S_{12}\|$	∠ϕ	$\|S_{22}\|$	∠ϕ
24	0.9	800	0.906	170	1.022	12	0.016	11	0.804	–168
		820	0.902	170	1.022	7	0.015	8	0.823	–167
		840	0.897	171	1.018	3	0.013	6	0.845	–167
		860	0.894	171	1.012	–3	0.011	4	0.870	–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 V, I_C = 0.9 A, P_o = 6.5 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)
C1	250 μF, 50 Vdc, Electrolytic Capacitor
C2, C5	10 μF, 50 Vdc, Electrolytic Capacitor
C3, C6	0.1 μF, Chip Capacitor
C4	1000 pF, Chip Capacitor
C7, C16	100 pF, Chip Capacitor
C8, C15	43 pF, 100 Mil Chip Capacitor
C9, C10	6.8 pF, Mini–Unelco
C11	18 pF, Mini–Unelco
C12, C13, C14	0.8–8.0 pF, Johanson Gigatrim
F1	3 Amp Micro–Fuse
L1, L2	3 Turns, 18 AWG, 0.170″ ID
L3	12 Turns, 22 AWG, 0.150″ ID (10 Ω 1/2 W Resistor)
Q1	MMBT2222ALT1, NPN Transistor
Q2	BD136, PNP Transistor

R1	470 Ω, 1/4 W
R2	500 Ω Potentiometer, 1/4 W
R3	4.7K Ω, 1/4 W
R4	2 x 4.7K Ω, 1/4 W
R5	50 Ω, 2 W
R6	75 Ω, 1/4 W
R7	4.7 Ω, 1/4 W
R8	4 Ω, 10 W
SB1	Copper Block 0.550″ x 0.180″ x 0.050″
TL1, TL5	50 Ω, Microstrip Transmission Line
TL2	Microstrip Transmission Line
TL3	Microstrip Transmission Line
TL4	Microstrip Transmission Line
Board	0.030″ Glass–Teflon® 2 oz. Cu, ε_r = 2.55
V Supply	+27.6 Vdc ±0.5 Vdc Due to Resistor Tolerance
V_{CE}	+24 Vdc @ 0.9 A

Figure 1. MRF859S Class A RF Test Fixture Schematic

TYPICAL CHARACTERISTICS

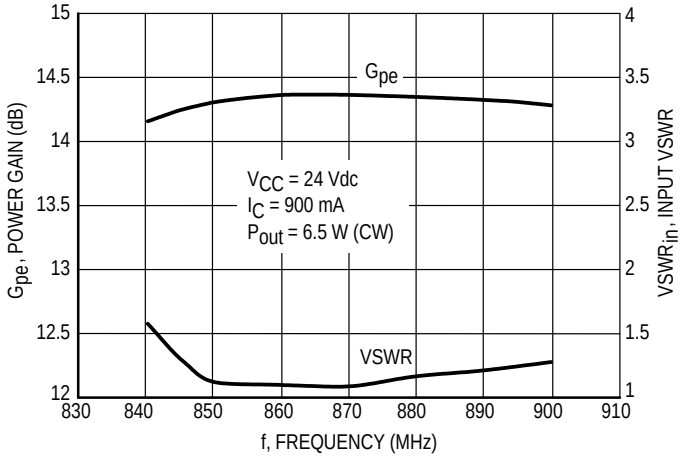


Figure 2. Performance in Broadband Circuit

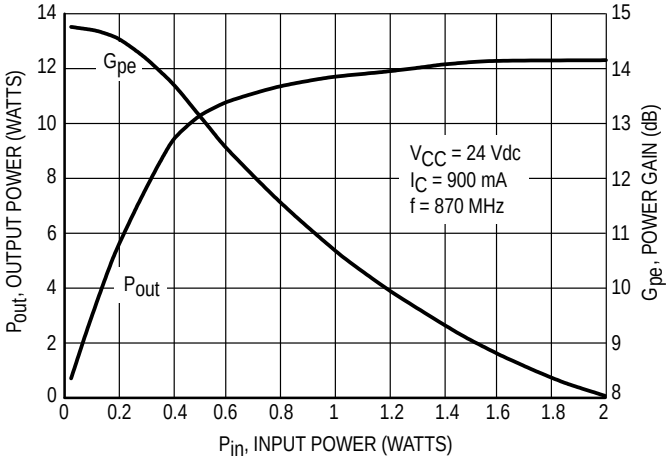


Figure 3. Output Power & Power Gain versus Input Power

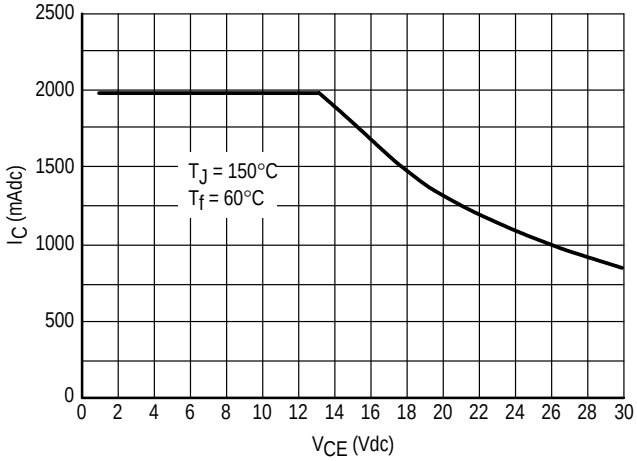


Figure 4. DC SOA

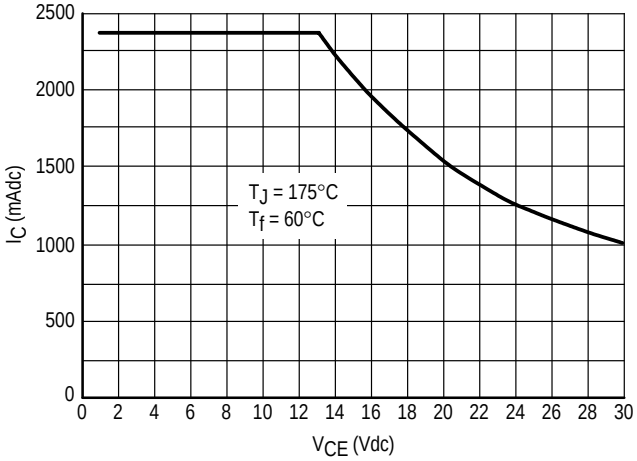


Figure 5. DC SOA

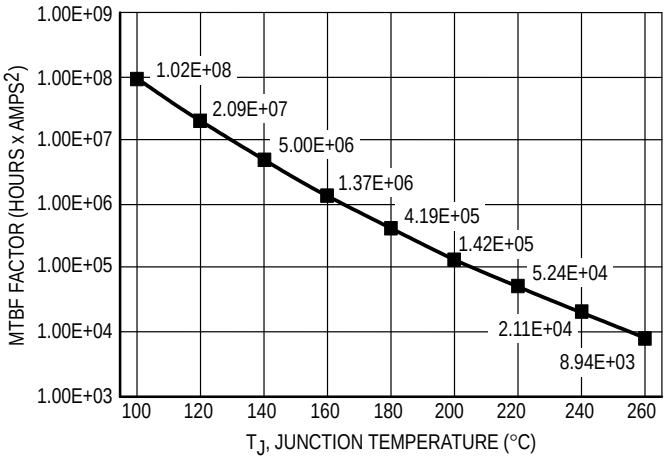


Figure 6. MTBF Factor versus Junction Temperature

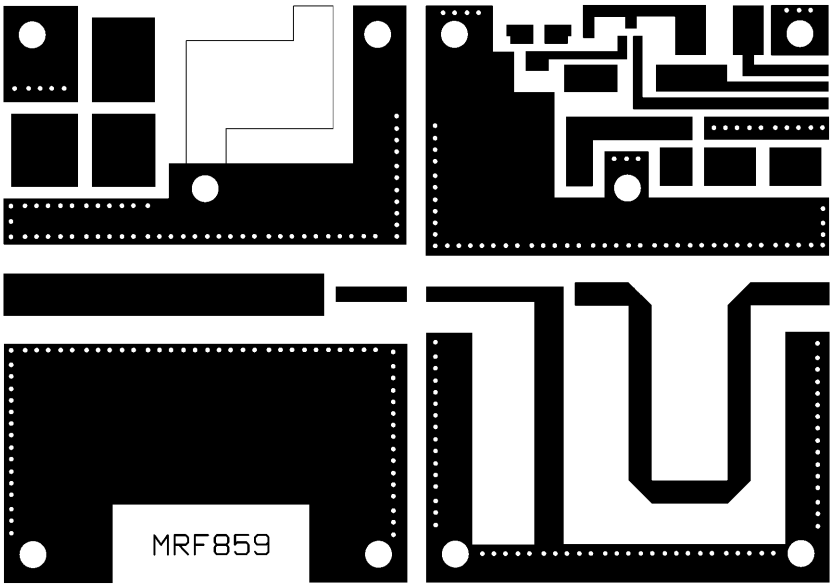


Figure 7. MRF859S Photomaster

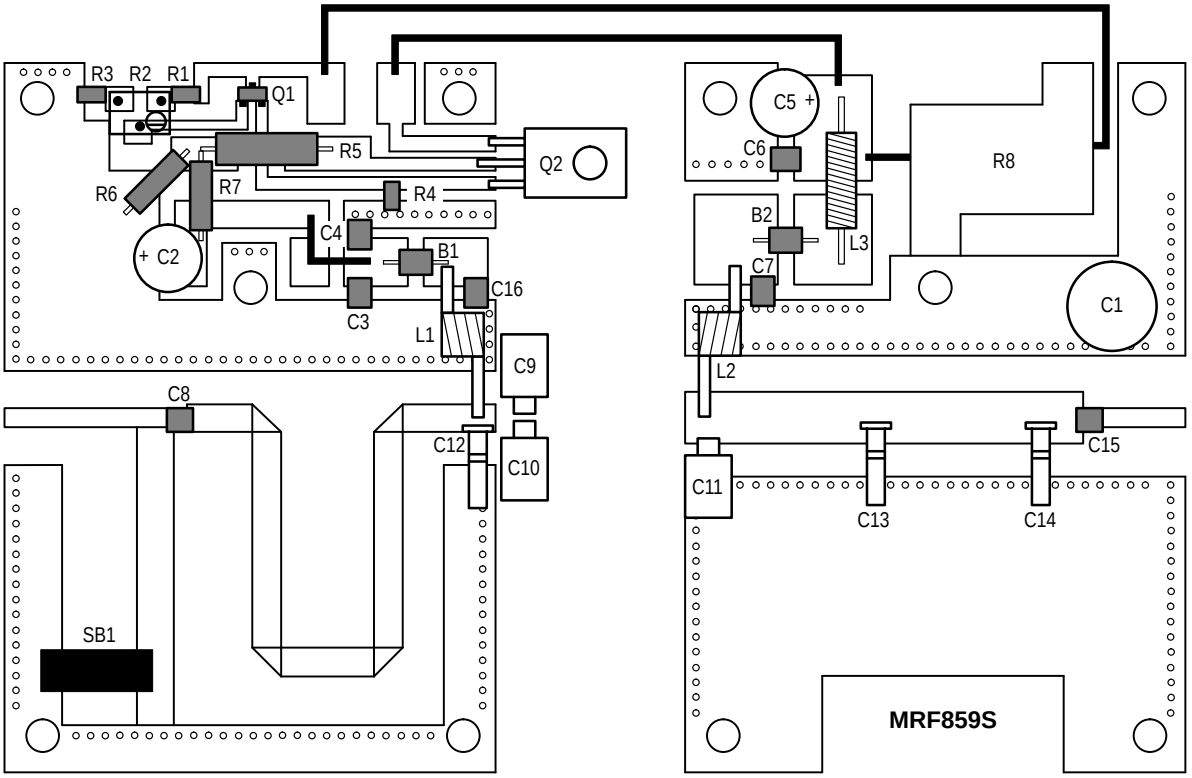
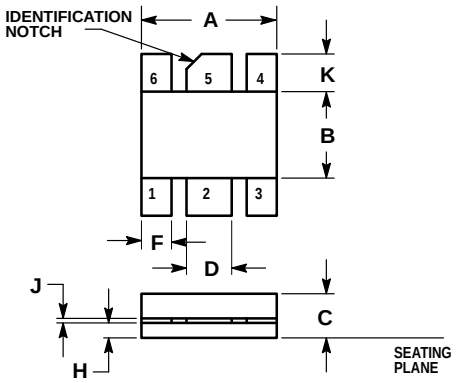


Figure 8. MRF859S Test Fixture Component Layout

PACKAGE DIMENSIONS



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

	INCHES		MILLIMETERS	
DIM	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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