

The RF Line NPN Silicon RF Power Transistor

MRF857S

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, $I_C = 0.3$ Adc Characteristics
 - Output Power = 2.1 Watts CW
 - Minimum Power Gain = 12.5 dB
 - Minimum ITO = +43 dBm
 - Typical Noise Figure = 5.25 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, $I_C = 0.3$ Adc and Rated Output Power
- Will Withstand RF Input Overdrive of 0.4 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
 2.1 W (CW), 24 V
 NPN SILICON
 RF POWER TRANSISTOR



CASE 305D-01, STYLE 1

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°C	P_D	17 0.114	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 ($T_J = 150^\circ\text{C}$, $T_C = 50^\circ\text{C}$)	$R_{\theta JC}$	8.4	$^\circ\text{C/W}$

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

(continued)

ELECTRICAL CHARACTERISTICS — continued

Characteristic	Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS					
DC Current Gain ($I_C = 0.1$ A, $V_{CE} = 5$ V)	h_{FE}	30	60	120	—
DYNAMIC CHARACTERISTICS					
Output Capacitance ($V_{CB} = 24$ V, $f = 1$ MHz)	C_{ob}	2.4	3.3	4.4	pF
FUNCTIONAL CHARACTERISTICS					
Common-Emitter Power Gain ($V_{CE} = 24$ V, $I_C = 0.3$ A, $f = 840$ – 900 MHz, Power Output = 2.1 W)	P_g	12.5	13.5	—	dB
Load Mismatch ($P_o = 2.1$ W) ($V_{CE} = 24$ V, $I_C = 0.3$ A, $f = 840$ MHz, Load VSWR = 30:1, All Phase Angles)	ψ	No Degradation in Output Power			
RF Input Overdrive ($V_{CE} = 24$ V, $I_C = 0.3$ A, $f = 840$ MHz) No degradation	$P_{in(over)}$	—	—	0.4	W
Third Order Intercept Point ($V_{CE} = 24$ V, $I_C = 0.3$ A) ($f_1 = 900$ MHz, $f_2 = 900.1$ MHz, Meas. @ IMD 3rd Order = -40 dBc)	ITO	+43	+44.5	—	dBm
Noise Figure ($V_{CE} = 24$ V, $I_C = 0.3$ A, $f = 900$ MHz)	NF	—	5.25	—	dB
Input Return Loss ($V_{CE} = 24$ V, $I_C = 0.3$ A, $f = 840$ – 900 MHz, Power Output = 2.1 W)	IRL	—	-15	-10	dB

Table 1. MRF857S Common Emitter S-Parameters

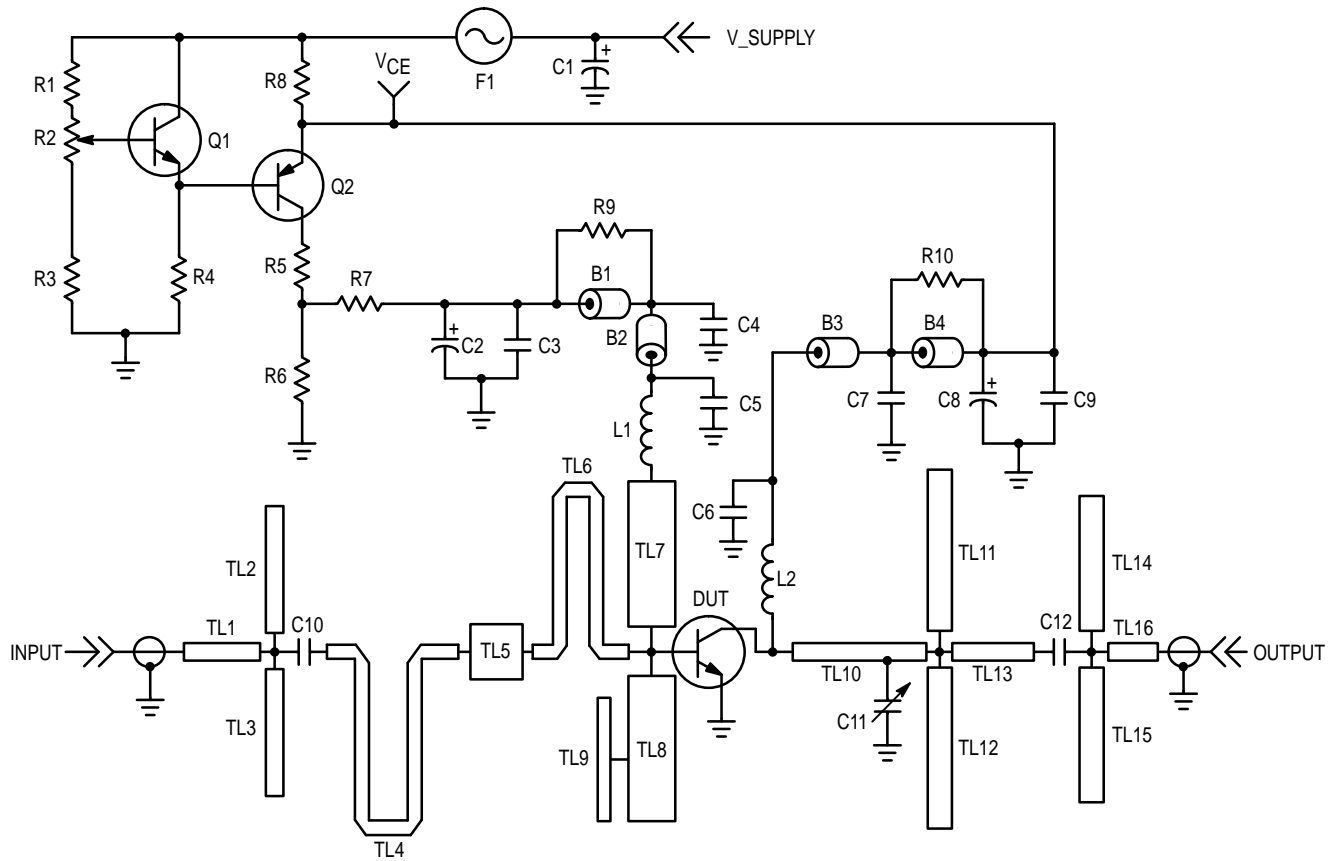
V_{CE} (V)	I_C (A)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$ S_{11} $	$\angle \phi$	$ S_{21} $	$\angle \phi$	$ S_{12} $	$\angle \phi$	$ S_{22} $	$\angle \phi$
24	0.3	800	0.915	165	2.098	54	0.037	58	0.343	-157
		820	0.915	165	2.049	53	0.038	58	0.345	-157
		840	0.915	165	1.991	52	0.038	58	0.349	-157
		860	0.913	164	1.951	51	0.039	59	0.352	-158
		880	0.914	164	1.912	50	0.040	59	0.355	-158
		900	0.914	163	1.865	49	0.041	59	0.359	-158
		920	0.913	163	1.832	48	0.042	59	0.362	-158
		940	0.915	162	1.783	47	0.043	59	0.366	-159
		960	0.916	162	1.748	46	0.043	59	0.369	-159

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

f (MHz)	Z_{in} (Ohms)		Z_{OL}^* (Ohms)	
840	1.5	4.4	18.4	-26.3
870	1.7	4.7	18.0	-26.1
900	1.5	4.8	14.9	-26.2

$$V_{CE} = 24 \text{ V, } I_C = 0.3 \text{ A, } P_o = 2.1 \text{ W}$$

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



B1, B4	Long Ferrite Bead, Fair Rite (2743021447)	R1	330 Ω , 1/4 W
B2, B3	Short Ferrite Bead, Fair Rite (2743019447)	R2	500 Ω Potentiometer, 1/4 W
C1	250 μ F, 50 Vdc Electrolytic Capacitor	R3	4.7K Ω , 1/4 W
C2, C8	10 μ F, 50 Vdc Electrolytic Capacitor	R4	2 x 4.7K Ω , 1/4 W
C3, C9	0.1 μ F, Chip Capacitor	R5	47 Ω , 2 W
C4, C7	1000 pF, Chip Capacitor	R6	75 Ω , 1/4 W
C5, C6	100 pF, Chip Capacitor	R7	4.7 Ω , 1/4 W
C10, C12	43 pF, 100 Mil Chip Capacitor	R8	10 Ω , 3 W
C11	0.8–8 pF, Johansen Gigatrim	R9, R10	4 x 39 Ω , 1/8 W Chip Resistors in Parallel
F1	1 A Micro-Fuse	TL1–TL16	Microstrip Transmission Line
L1, L2	5 Turns, 20 AWG, 0.126" ID, 46.2 nH	V_Supply	+27 Vdc \pm 0.5 V Due to Resistor Tolerance
Q1	MMBT2222ALT1, NPN Transistor	V_CE	+24 Vdc @ 0.3 A
Q2	BD136, PNP Transistor	Board	0.030" Glass-Teflon [®] 2 oz. Cu, $\epsilon_r = 2.55$

Figure 1. MRF857S Class A RF Test Fixture Schematic

TYPICAL CHARACTERISTICS

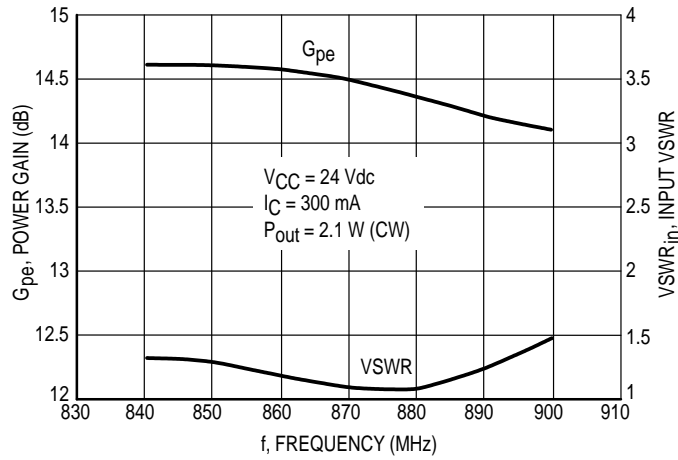


Figure 2. Performance of MRF857S in Broadband Circuit

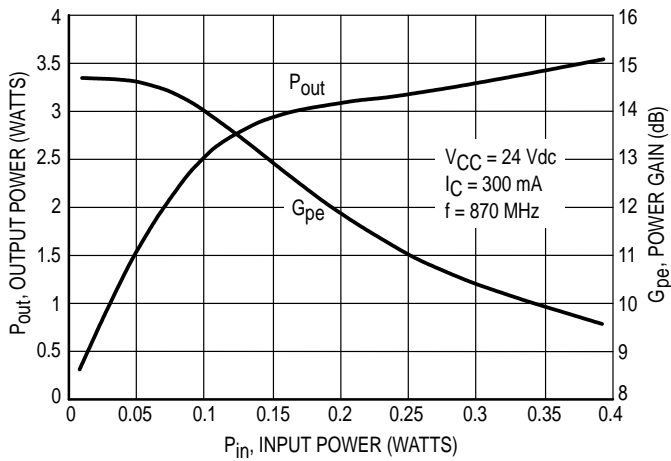


Figure 3. MRF857S Output Power & Power Gain versus Input Power

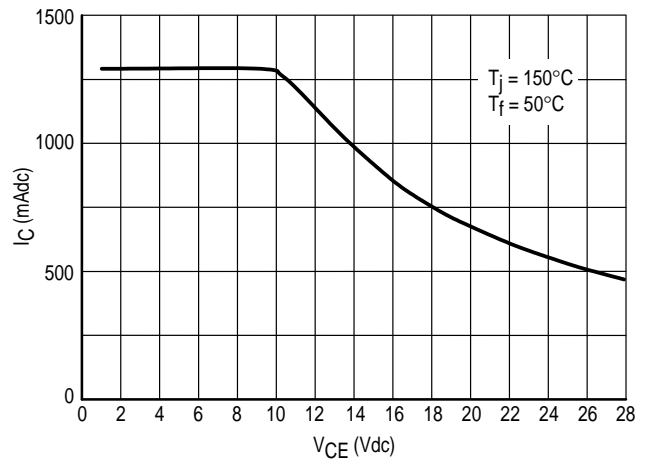
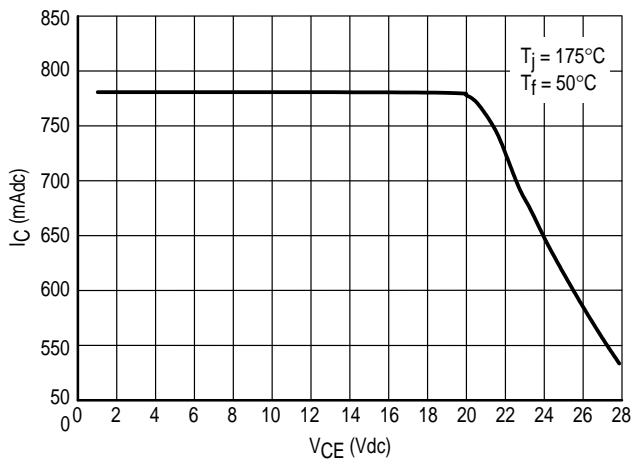


Figure 4. MRF857S DC SOA



**Figure 5. MRF857S DC SOA
(This device is MTBF limited for $V_{CE} < 20$ Vdc.)**

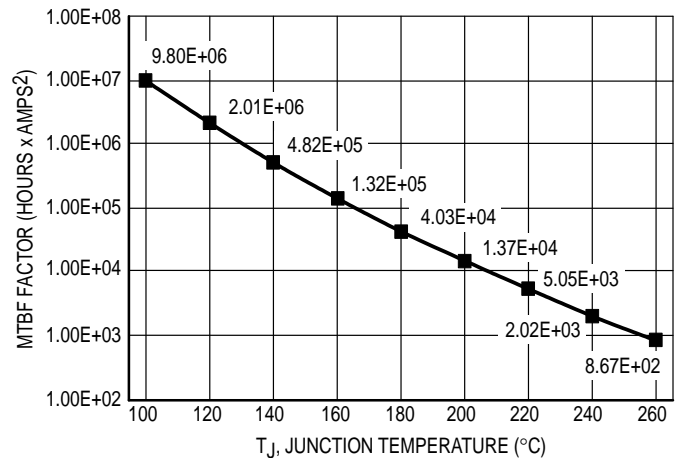


Figure 6. MRF857S MTBF Factor versus Junction Temperature

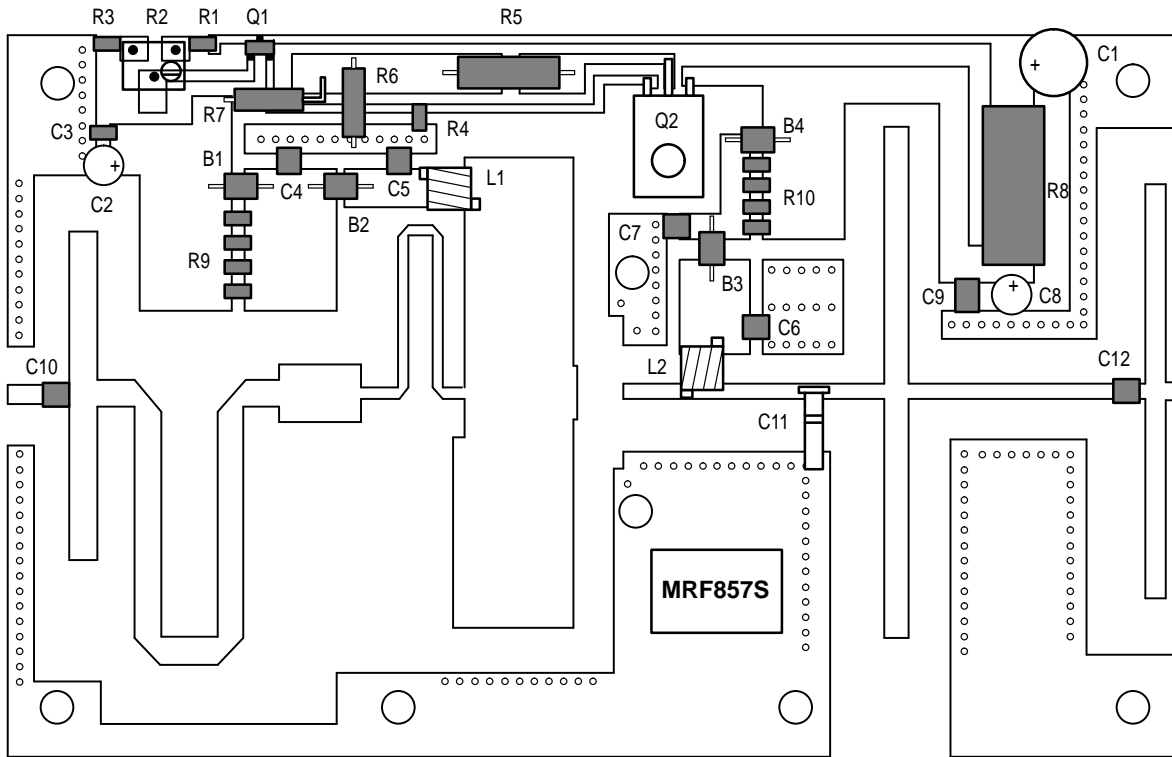
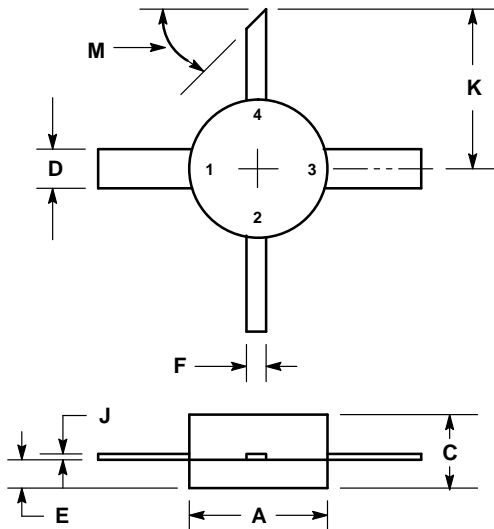


Figure 7. MRF857S Test Fixture Component Layout




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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.200	0.220	5.08	5.59
C	0.095	0.130	2.41	3.30
D	0.055	0.065	1.40	1.65
E	0.040	0.050	1.02	1.27
F	0.025	0.035	0.64	0.89
J	0.003	0.007	0.08	0.18
K	0.235	0.265	5.97	6.73
M	45° NOM		45° NOM	

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

**CASE 305D-01
 ISSUE O**

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