

# 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 $50^\circ\text{C}$	$P_D$	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	$^\circ\text{C}/\text{W}$

#### 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

(continued)



**ELECTRICAL CHARACTERISTICS — continued**

Characteristic	Symbol	Min	Typ	Max	Unit
<b>ON CHARACTERISTICS</b>					
DC Current Gain ( $I_C = 0.1$ A, $V_{CE} = 5$ V)	$h_{FE}$	30	60	120	—
<b>DYNAMIC CHARACTERISTICS</b>					
Output Capacitance ( $V_{CB} = 24$ V, $f = 1$ MHz)	$C_{ob}$	2.4	3.3	4.4	pF
<b>FUNCTIONAL CHARACTERISTICS</b>					
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)	$\psi$	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**

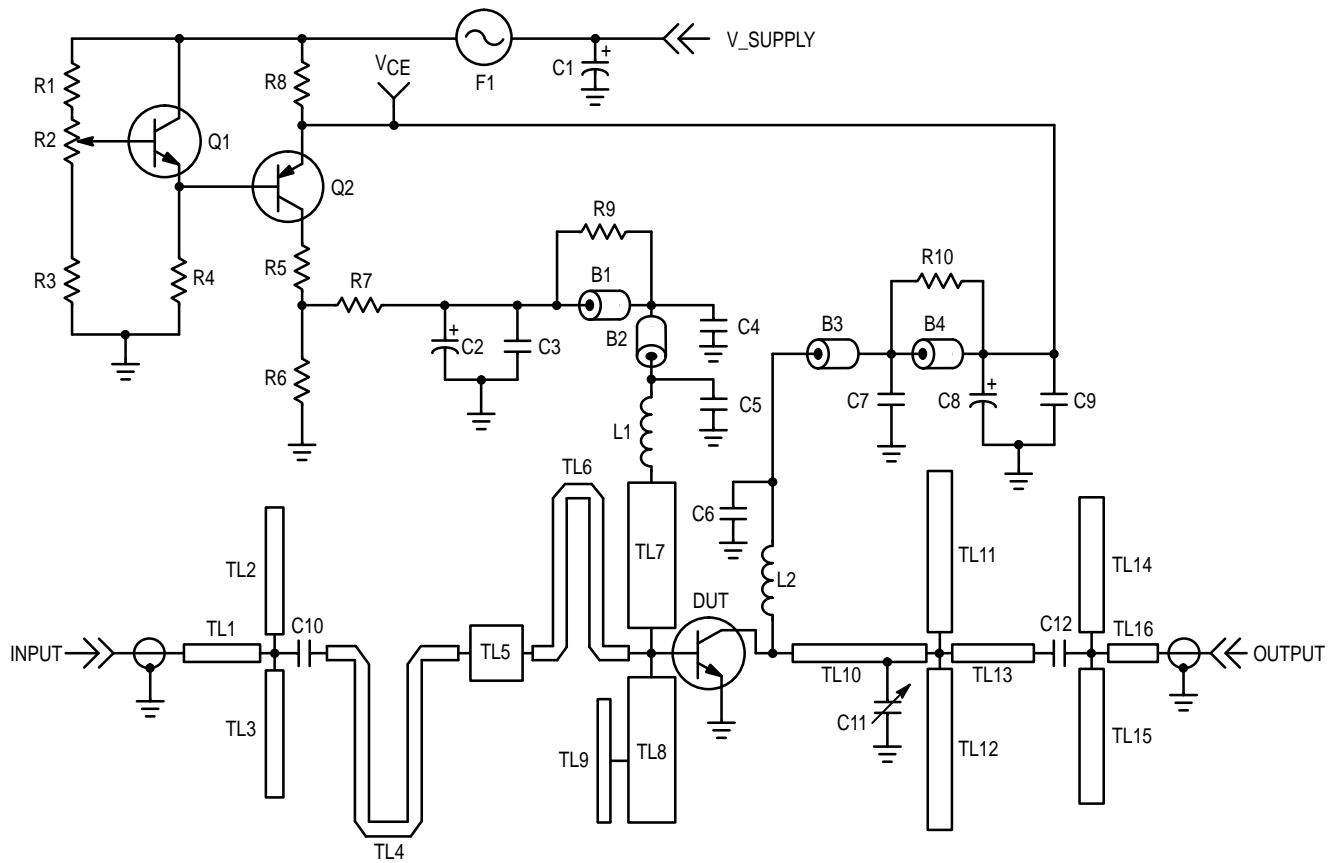
$V_{CE}$ (V)	$I_C$ (A)	f (MHz)	$S_{11}$		$S_{21}$		$S_{12}$		$S_{22}$	
			$ S_{11} $	$\angle \phi$	$ S_{21} $	$\angle \phi$	$ S_{12} $	$\angle \phi$	$ S_{22} $	$\angle \phi$
24	0.3	800	0.915	165	2.098	54	0.037	58	0.343	-157
		820	0.915	165	2.049	53	0.038	58	0.345	-157
		840	0.915	165	1.991	52	0.038	58	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 $\Omega$ , 1/4 W
B2, B3	Short Ferrite Bead, Fair Rite (2743019447)	R2	500 $\Omega$ Potentiometer, 1/4 W
C1	250 $\mu$ F, 50 Vdc Electrolytic Capacitor	R3	4.7K $\Omega$ , 1/4 W
C2, C8	10 $\mu$ F, 50 Vdc Electrolytic Capacitor	R4	2 x 4.7K $\Omega$ , 1/4 W
C3, C9	0.1 $\mu$ F, Chip Capacitor	R5	47 $\Omega$ , 2 W
C4, C7	1000 pF, Chip Capacitor	R6	75 $\Omega$ , 1/4 W
C5, C6	100 pF, Chip Capacitor	R7	4.7 $\Omega$ , 1/4 W
C10, C12	43 pF, 100 Mil Chip Capacitor	R8	10 $\Omega$ , 3 W
C11	0.8–8 pF, Johansen Gigatrim	R9, R10	4 x 39 $\Omega$ , 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 <sup>®</sup> 2 oz. Cu, $\epsilon_r = 2.55$

Figure 1. MRF857S Class A RF Test Fixture Schematic

### TYPICAL CHARACTERISTICS

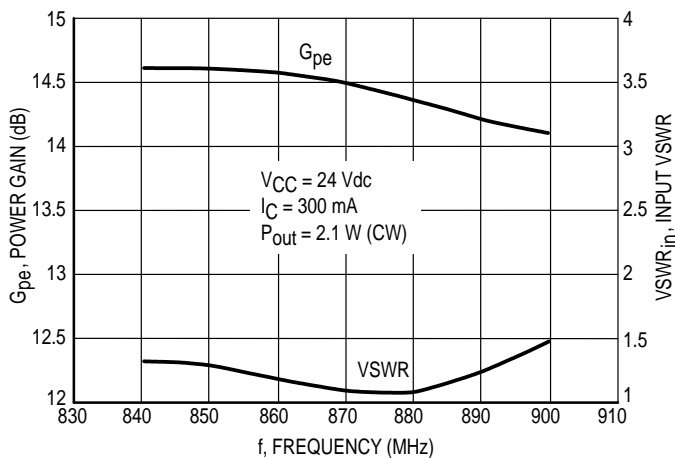


Figure 2. Performance of MRF857S in Broadband Circuit

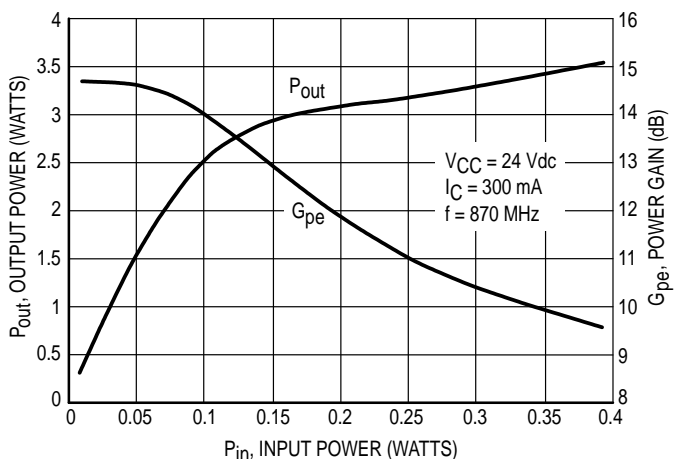


Figure 3. MRF857S Output Power & Power Gain versus Input Power

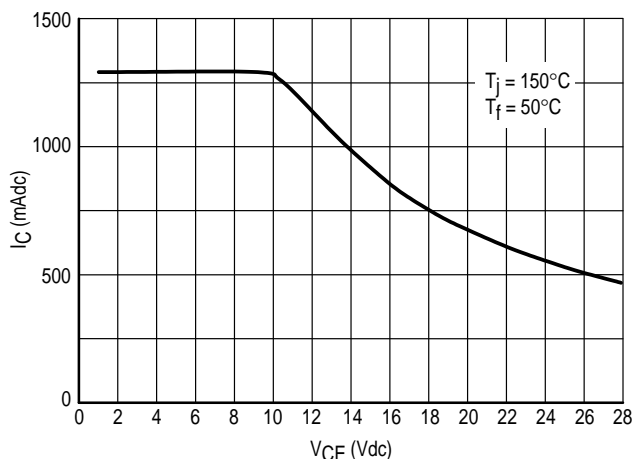


Figure 4. MRF857S DC SOA

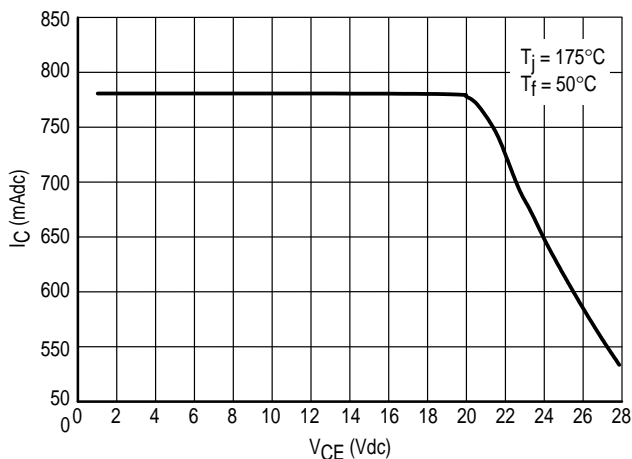


Figure 5. MRF857S DC SOA (This device is MTBF limited for  $V_{CE} < 20$  Vdc.)

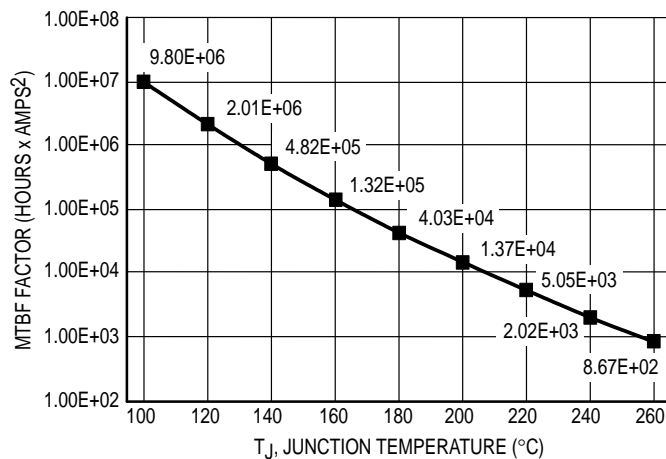


Figure 6. MRF857S MTBF Factor versus Junction Temperature

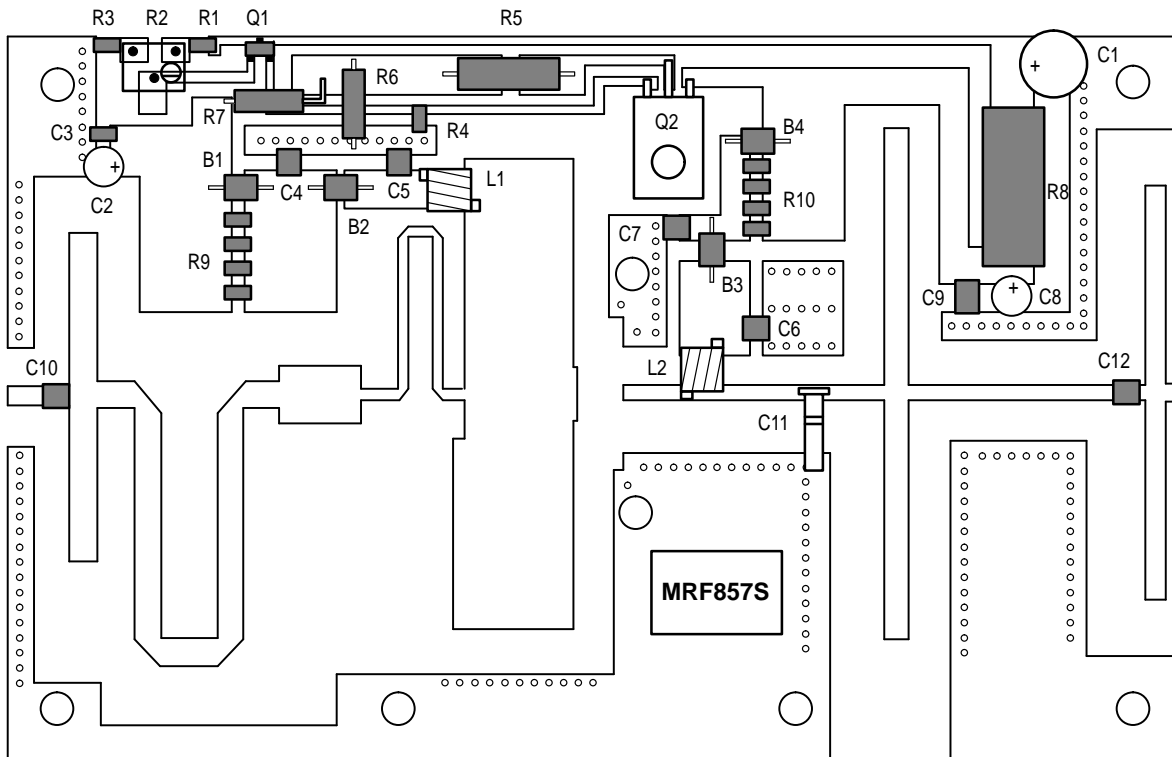
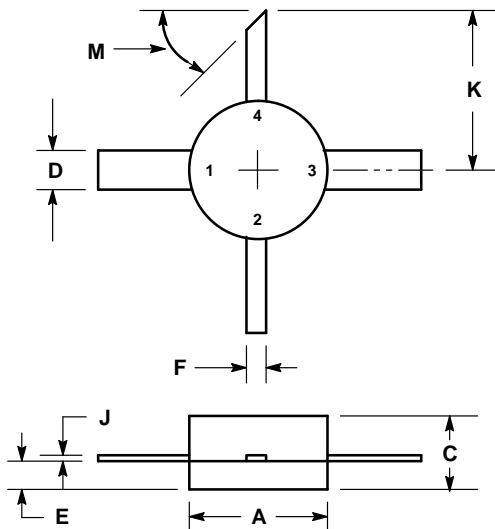


Figure 7. MRF857S Test Fixture Component Layout




- 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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 P.O. Box 5405, Denver, Colorado 80217. 303-675-2140 or 1-800-441-2447

**JAPAN:** Nippon Motorola Ltd.: SPD, Strategic Planning Office, 4-32-1,  
 Nishi-Gotanda, Shinagawa-ku, Tokyo 141, Japan. 81-3-5487-8488

**Mfax™:** RMFAX0@email.sps.mot.com – TOUCHTONE 602-244-6609  
 – US & Canada ONLY 1-800-774-1848

**ASIA/PACIFIC:** Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,  
 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

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