MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF837

The RF Line

NPN SILICON RF LOW POWER TRANSISTOR

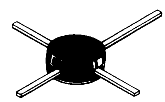
. . . designed primarily for wideband large signal predriver stages in 800 MHz and UHF frequency ranges.

- Specified @ 12.5 V, 870 MHz Characteristics
  Output Power = 750 mW
  Minimum Gain = 8.0 dB
  Efficiency 60% (Typ)
- Low Cost Macro-X Plastic Package
- State-of-the-Art Technology
  Fine Line Geometry
  Gold Top Metal and Wires
  Silicon Nitride Passivated
  Ion Implanted Arsenic Emitters

750 mW 870 MHz

RF LOW POWER TRANSISTOR

NPN SILICON



Macro-X

3

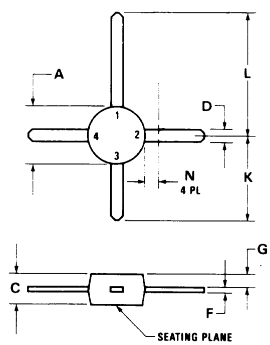
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector-Current — Continuous	I_C	200	mAdc
Total Device Dissipation @ T_C = 50°C Derate above 50°C (1)	P_D	2.5 25	Watts mW/°C
Storage Temperature Range	T_J, T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	40	°C/W

(1) Case temperature measured on collector lead immediately adjacent to body of package.



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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	4.44	5.21	0.175	0.205
C	1.90	2.54	0.075	0.100
D	0.84	0.99	0.033	0.039
F	0.20	0.30	0.008	0.012
G	0.76	1.14	0.030	0.045
K	7.24	8.13	0.285	0.320
L	10.54	11.43	0.415	0.450
N	–	1.65	–	0.065

NOTE:
DIMENSION D NOT APPLICABLE IN ZONE N.

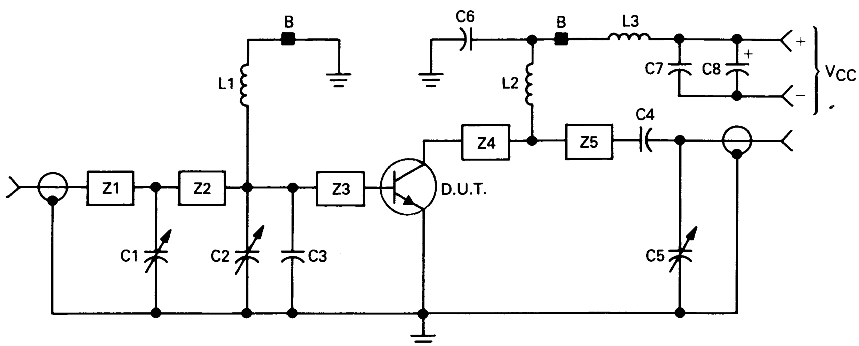
CASE 317-01

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 5.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 5.0 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	—	—	0.1	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 50 mAdc, V_{CE} = 10 Vdc)	h_{FE}	30	90	200	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 15 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	1.8	2.5	pF
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 0.75 W, f = 870 MHz)	G_{pe}	8.0	10	—	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 0.75 W, f = 870 MHz)	η	55	60	—	%

3

FIGURE 1 — 800–880 MHz BROADBAND CIRCUIT



C1, C2, C5	— 0.8–8.0 pF Johanson Gigatrim	L1, L2	— 4 Turns, #21 AWG, 5/32″ ID
C3	— 5.0 pF Clamped Mica, Mini-Underwood	L3	— 7 Turns, #21 AWG, 5/32″ ID
C6	— 91 pF Clamped Mica, Mini-Underwood	Z1	— 0.80″ x 0.163″ Microstrip, Z_o = 50 Ω
C4	— 470 pF Ceramic Chip Capacitor	Z2	— 1.375″ x 0.163″ Microstrip, Z_o = 50 Ω
C7	— 68 pF Clamped Mica, Mini-Underwood	Z3, Z4	— 0.375″ x 0.163″ Microstrip, Z_o = 50 Ω
C8	— 1.0 μF 25 V Tantalum	Z5	— 1.35″ x 0.163″ Microstrip, Z_o = 50 Ω
B	— Bead, Ferroxcube 56-590-65/3B	PCB	— 1/16″ Glass Teflon, ϵ_r = 2.56

FIGURE 2 — 800–880 BROADBAND CIRCUIT

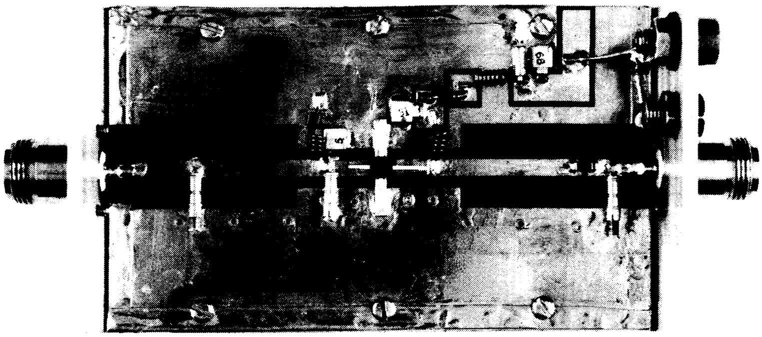
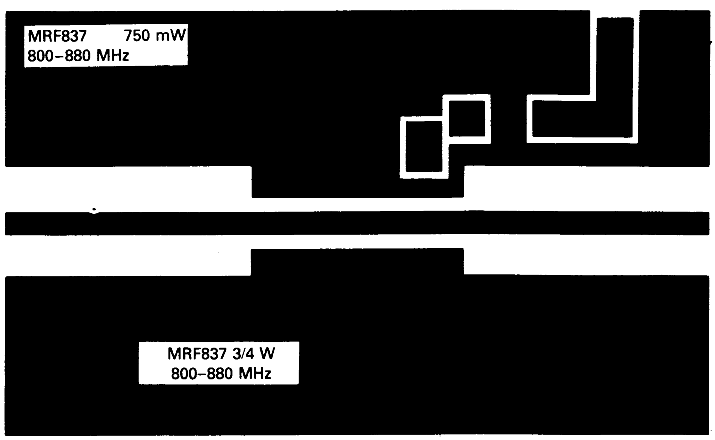


FIGURE 3 — 800–880 MHz BROADBAND CIRCUIT PHOTOMASTER



NOTE: The Printed Circuit Board shown is 75% of the original.

800/900 MHz BAND DATA

FIGURE 4 — BROADBAND PERFORMANCE

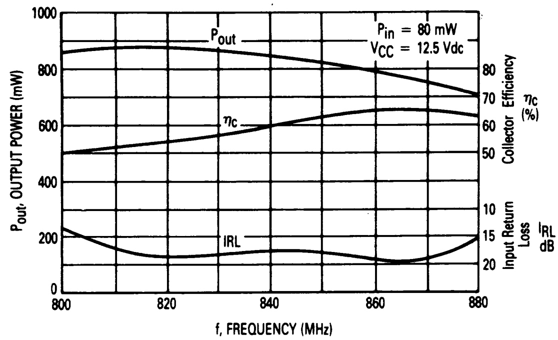


FIGURE 5 — Z_{in} AND Z_{OL} versus COLLECTOR VOLTAGE, INPUT POWER AND OUTPUT POWER

f Frequency MHz	Z_{in} Ohms		Z_{OL}* Ohms	
	V_{CC} = 7.5 V	V_{CC} = 12.5 V	V_{CC} = 7.5 V	V_{CC} = 12.5 V
	P_{in} = 150 mW	P_{in} = 100 mW	P_{out} 806 MHz = 870 mW P_{out} 870 MHz = 820 mW P_{out} 960 MHz = 700 mW	P_{out} 806 MHz ≐ 1.05 W P_{out} 870 MHz = 950 mW P_{out} 960 MHz = 725 mW
806	6.1 + j3.6	4.3 + j0.6	38.3 − j16.4	23.2 − j31.6
870	5.6 + j5.2	6.5 + j3.6	40.8 − j18.9	41.3 − j18.4
960	6.1 + j6.8	6.4 + j4.5	43.8 − j14.7	41.4 − j19.0

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

800/900 MHz BAND DATA (continued)

FIGURE 6 — OUTPUT POWER versus INPUT POWER
f = 870 MHz

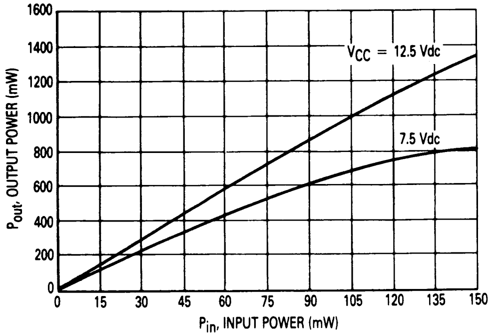


FIGURE 7 — OUTPUT POWER versus FREQUENCY
V_{CC} = 7.5 Vdc

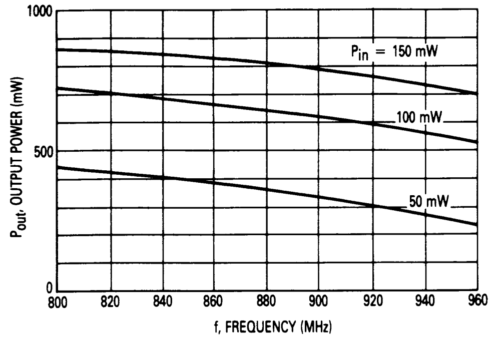


FIGURE 8 — OUTPUT POWER versus COLLECTOR VOLTAGE
f = 870 MHz

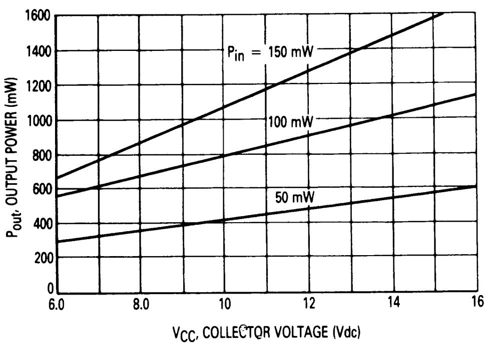
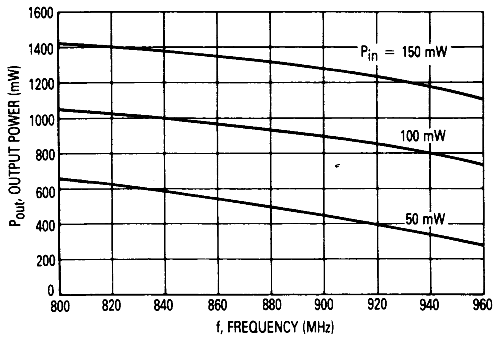


FIGURE 9 — OUTPUT POWER versus FREQUENCY
V_{CC} = 12.5 Vdc



3

UHF BAND DATA

FIGURE 10 — Z_{in} AND Z_{OL} versus COLLECTOR VOLTAGE, INPUT POWER, AND OUTPUT POWER

f Frequency MHz	Z_{in} Ohms		Z_{OL}* Ohms	
	V_{CC} = 7.5 V	V_{CC} = 12.5 V	V_{CC} = 7.5 V	V_{CC} = 12.5 V
	P_{in} = 75 mW	P_{in} = 50 mW	P_{out} 400 MHz = 875 mW P_{out} 450 MHz = 790 mW P_{out} 512 MHz = 675 mW	P_{out} 400 MHz = 1.25 W P_{out} 450 MHz = 1.1 W P_{out} 512 MHz = 775 mW
400	9.6 − j7.5	8.2 − j11.5	37.8 + j12.3	51.8 − j7.2
450	11.3 − j7.5	9.7 − j11	35.8 + j8.6	52.2 − j16.7
512	11.5 − j6.8	12 − j9.2	42.4 + j0.24	43.7 − j5.7

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

FIGURE 11 — OUTPUT POWER versus INPUT POWER
f = 512 MHz

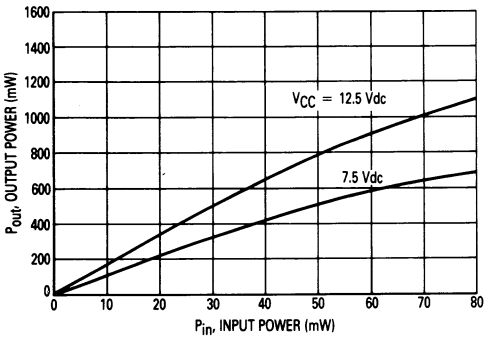


FIGURE 12 — OUTPUT POWER versus FREQUENCY
V_{CC} = 7.5 Vdc

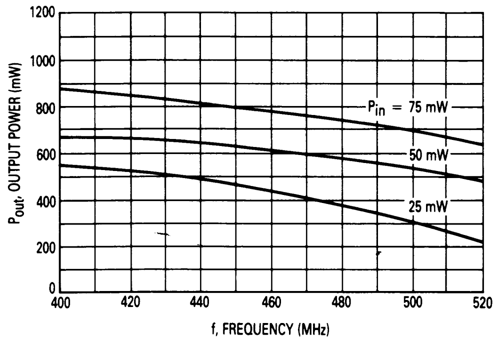


FIGURE 13 — OUTPUT POWER versus COLLECTOR VOLTAGE
f = 512 MHz

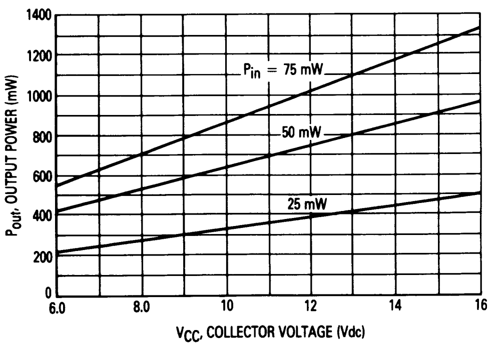
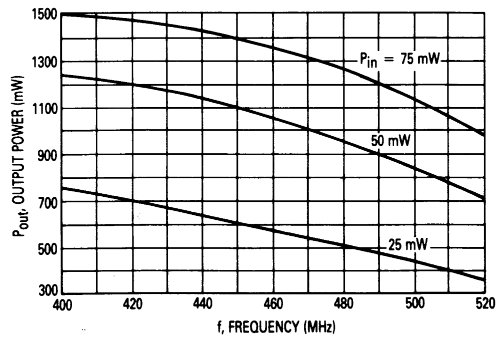


FIGURE 14 — OUTPUT POWER versus FREQUENCY
V_{CC} = 12.5 Vdc



MRF838
MRF838A

The RF Line

NPN SILICON RF POWER TRANSISTOR

. . . designed for 12.5 volt UHF large-signal, common-emitter amplifier applications in industrial and commercial FM equipment operating in the range of 806–960 MHz.

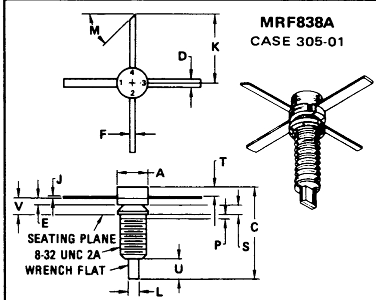
- Specified 12.5 Volt, 870 MHz Characteristics:
  Output Power = 1.0 Watt
  Minimum Gain = 6.5 dB
  Efficiency = 60% Typ
- Series Equivalent Large-Signal Characterization

1 W–870 MHz

RF POWER
TRANSISTOR

NPN SILICON

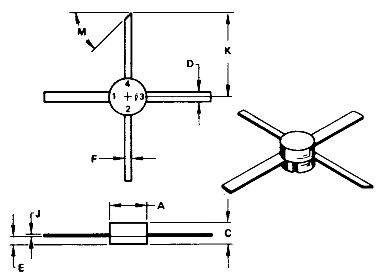
MRF838A
CASE 305-01



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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.08	5.59	0.200	0.220
C	13.97	16.26	0.550	0.640
D	1.40	1.65	0.055	0.065
E	1.02	1.27	0.040	0.050
F	0.64	0.89	0.025	0.035
J	0.08	0.18	0.003	0.007
K	11.05	–	0.435	–
L	1.40	1.65	0.055	0.065
M	45° NOM		45° NOM	
P	–	1.27	–	0.050
S	1.40	1.65	0.055	0.065
T	1.40	1.78	0.055	0.070
U	2.79	3.81	0.110	0.150
V	2.41	2.92	0.095	0.115

MRF838
CASE 305A-01



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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.08	5.59	0.200	0.220
C	2.41	3.30	0.095	0.130
D	1.40	1.65	0.055	0.065
E	1.02	1.27	0.040	0.050
F	0.64	0.89	0.025	0.035
J	0.08	0.18	0.003	0.007
K	11.05	–	0.435	–
M	45° NOM		45° NOM	

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	0.3	Adc
Total Device Dissipation @ $T_C = 25°C$ (1) Derate Above 25°C	P_D	2.5 0.014	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	70	°C/W

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

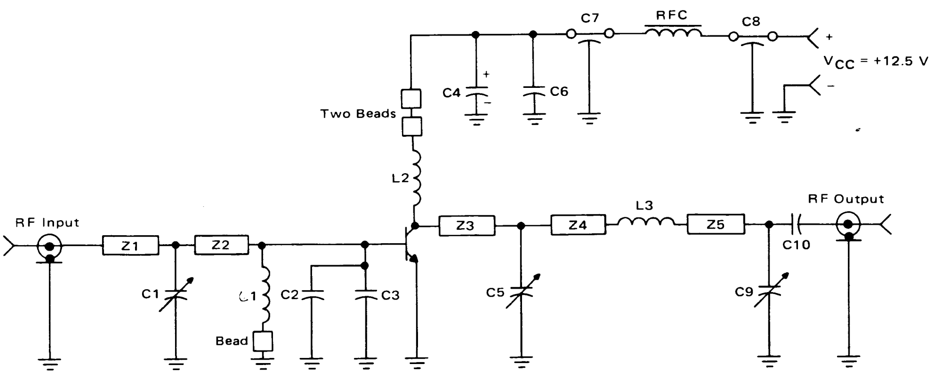
(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 10 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	–	–	1.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 100 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	10	80	150	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	5.0	7.0	pF
FUNCTIONAL TEST					
Common-Emitter Amplifier Power Gain (P_{out} = 1.0 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	G_{PE}	6.5	7.5	–	dB
Collector Efficiency (P_{out} = 1.0 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	η	50	60	–	%

3

FIGURE 1 – 870 MHz TEST CIRCUIT



C1, C5, C9 – 0.8-8.0 pF Johanson Gigatrim #7291
C2, C3 – 10 pF ATC Chip Capacitor (Case A)
C4 – 1.0 µF 30 V Tantalum Capacitor
C6 – 0.1 µF Erie Redcap 100 V
C7, C8 – 680 pF Feedthru
C10 – 100 pF Chip Capacitor (100 mil)
L1, L2 – 1 Turn #18 AWG 1/8" Diameter
L3 – #14 AWG 1/2 Turn 0.250" Diameter

RFC – Ferroxcube VK200 20/4B
Bead – Ferroxcube #56-590-65/3B
Z1, Z2 – 1.2" X 0.155" Microstrip
Z3 – 1.05" X 0.155" Microstrip
Z4 – 0.5" X 0.155" Microstrip
Z5 – 1.5" X 0.155" Microstrip
Board Material – 0.0625" Thick Glass-Teflon, ϵ_r = 2.5

FIGURE 2 — OUTPUT POWER versus INPUT POWER

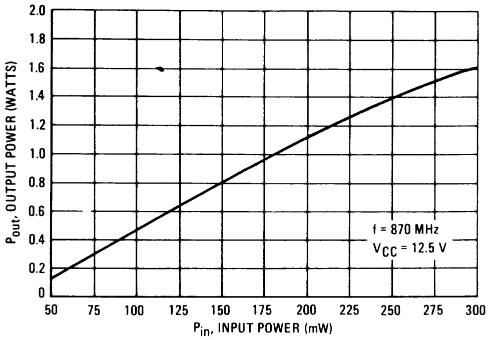


FIGURE 3 — OUTPUT POWER versus FREQUENCY

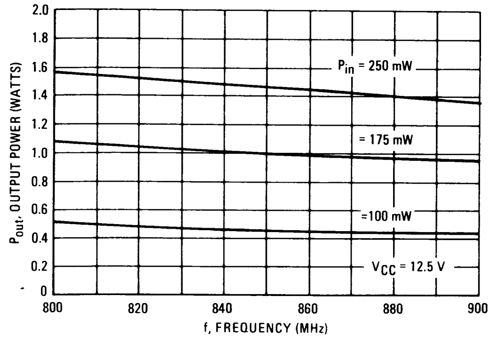


FIGURE 4 — OUTPUT POWER versus SUPPLY VOLTAGE

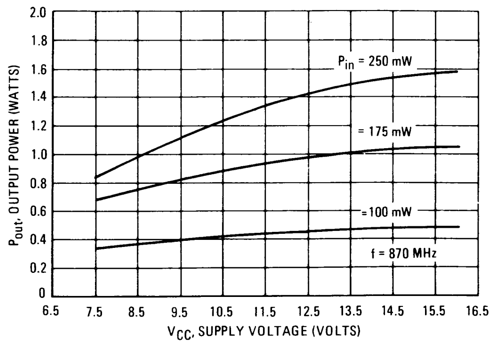
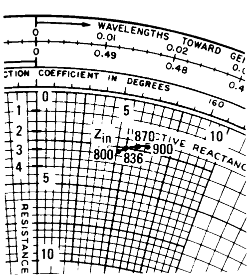


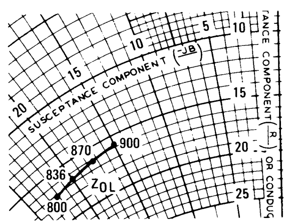
FIGURE 5 — SERIES EQUIVALENT INPUT IMPEDANCE



P_{out} = 1.0 W, V_{CC} = 12.5 Vdc

f MHz	Z_{in} Ohms
800	2.8 + j4.6
836	2.6 + j5.0
870	2.4 + j5.6
900	2.3 + j6.2

FIGURE 6 — SERIES EQUIVALENT OUTPUT IMPEDANCE

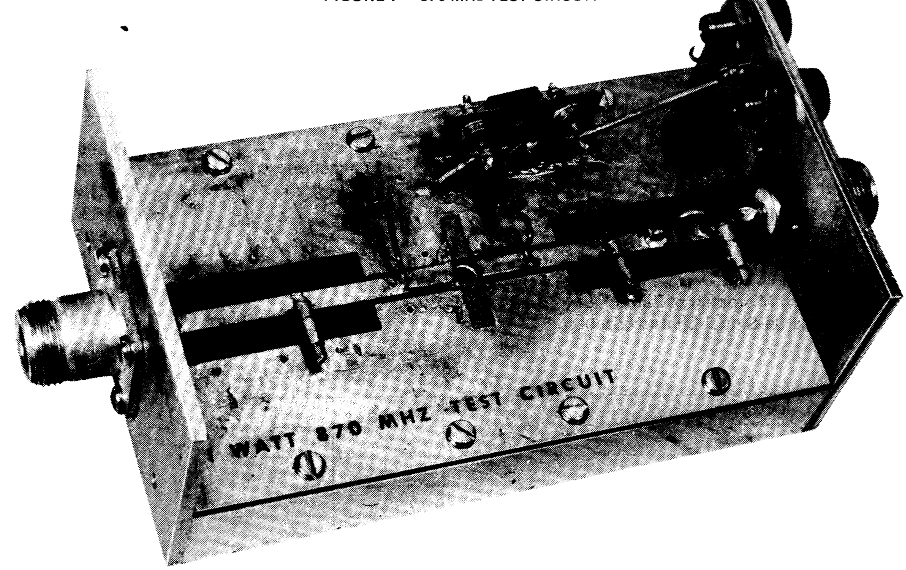


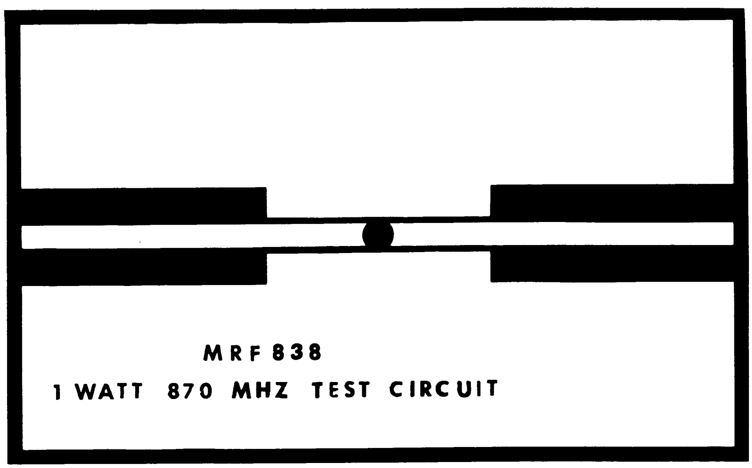
P_{out} = 1.0 W, V_{CC} = 12.5 Vdc

f MHz	Z_{OL}* Ohms
800	17.1 - j22.2
836	16.6 - j20.0
870	16.1 - j17.4
900	15.9 - j15.0

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

FIGURE 7 – 870 MHz TEST CIRCUIT





NOTE: The Printed Circuit Board shown is 75% of the criginal.

MRF839
MRF839F

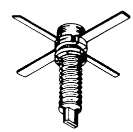
The RF Line

NPN Silicon RF Power Transistors

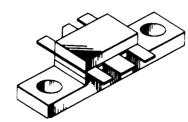
. . . designed for 12.5 Volt UHF large-signal, **common-emitter** amplifier applications in industrial and commercial FM equipment operating in the range of 806–960 MHz.

- Specified 12.5 V 870 MHz Characteristics
  Output Power = 3 Watts
  Minimum Gain = 8 dB
  Minimum Efficiency = 55%
- 100% Tested for Load Mismatch at Rated Input Power and 15.5 V
- Series Equivalent Large-Signal Characterization

**3 W 806–960 MHz
RF POWER
TRANSISTORS
COMMON-EMITTER
NPN SILICON**



**CASE 305-01
MRF839**



**CASE 319-04
MRF839F**

MAXIMUM RATINGS

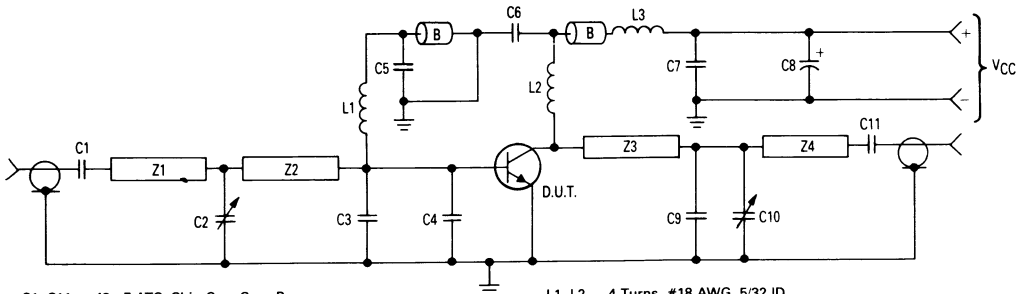
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4	Vdc
Collector-Current — Continuous	I_C	0.6	Adc
Operating Junction Temperature	T_J	200	°C
Total Device Dissipation @ T_C = 110°C Derate above 110°C	P_D	10 111	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	9	°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 5 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 5 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	4	—	—	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	—	—	1	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 100 mAdc, V_{CE} = 5 Vdc)	h_{FE}	10	90	150	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 15 Vdc, I_E = 0, f = 1 MHz)	C_{ob}	—	6.5	10	pF
FUNCTIONAL TESTS (FIGURE 1)					
Common-Emitter Amplifier Power Gain (P_{out} = 3 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	G_{PE}	8	10	—	dB
Collector Efficiency (P_{out} = 3 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	η_c	55	63	—	%
Load Mismatch Stress (V_{CC} = 15.5 Vdc, P_{in} = 0.5 W, f = 870 MHz, VSWR = 20:1, all phase angles)	—	No Degradation in Output Power			



C1, C11 — 43 pF ATC, Chip Cap, Case B
C2, C10 — 0.8–8 Johanson Gigatrim
C3, C4 — 10 pF Clamped Mica, Mini-Underwood
C5, C6, C7 — 68 pF Clamped Mica, Mini-Underwood
C8 — 10 μF, 25 V Tantalum
C9 — 5 pF Clamped Mica, Mini-Underwood
B — Bead, Ferroxcube #56-590-65/3B

L1, L2 — 4 Turns, #18 AWG, 5/32 ID
L3 — 7 Turns, #18 AWG, 5/32 ID
Z1 — 0.850″ x 0.077″ Microstrip, Z_o = 50 Ω
Z2 — 1.100″ x 0.077″ Microstrip, Z_o = 50 Ω
Z3 — 0.920″ x 0.077″ Microstrip, Z_o = 50 Ω
Z4 — 1.150″ x 0.077″ Microstrip, Z_o = 50 Ω
Board Material — 0.032″ Glass Teflon, 2 oz. Copper Clad, ϵ_r = 2.55

Figure 1. MRF839 800–880 MHz Broadband Test Circuit

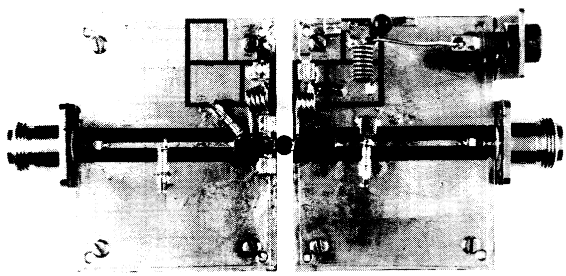


Figure 2. MRF839 Broadband Test Circuit

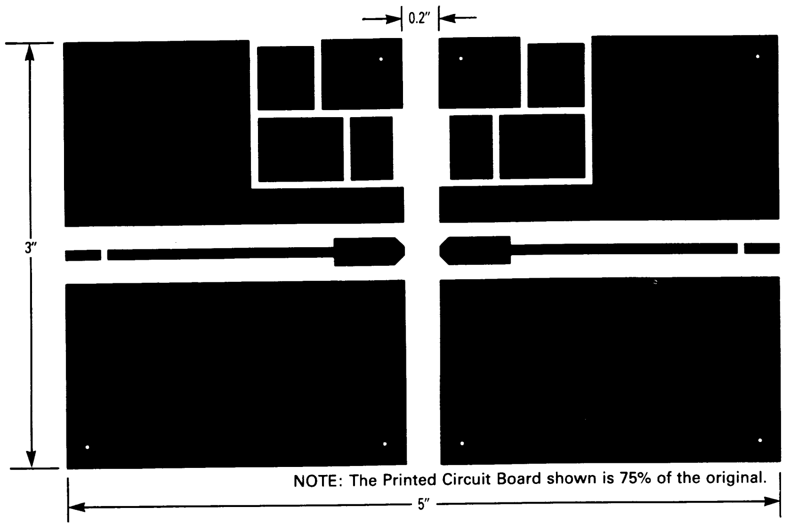


Figure 3. MRF839 Photomaster

3

MRF839

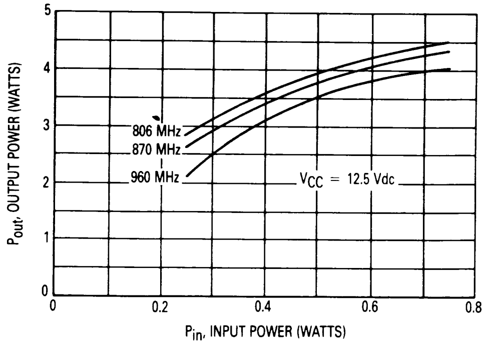


Figure 4. Output Power versus Input Power

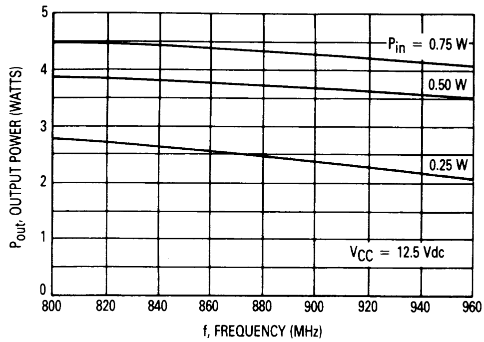


Figure 5. Output Power versus Frequency

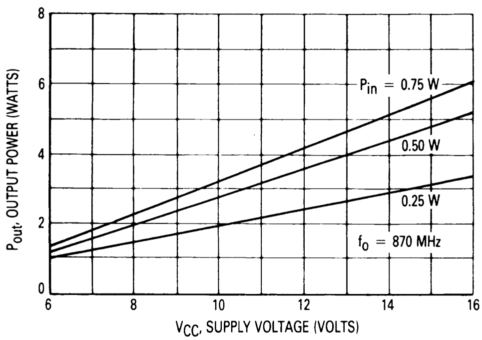


Figure 6. Output Power versus Supply Voltage

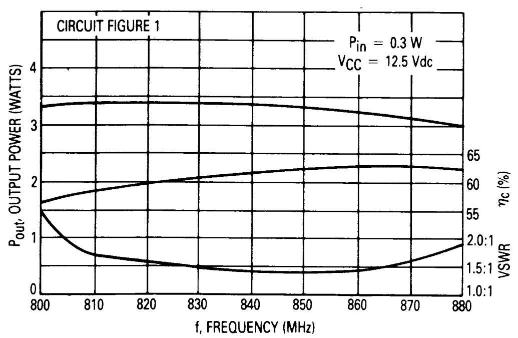
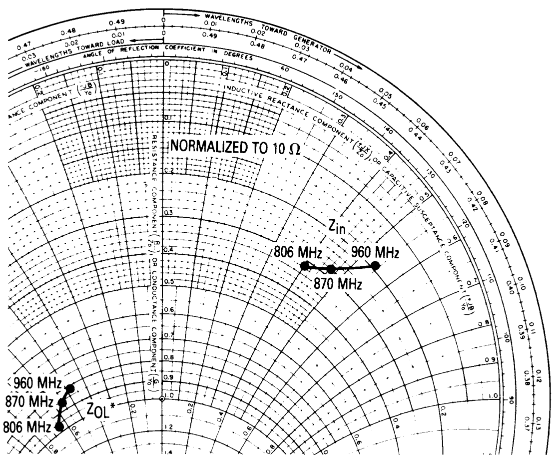


Figure 7. Broadband Performance



P_{out} = 3 Watts, V_{CC} = 12.5 Vdc

f MHz	Z_{in} Ohms	Z_{OL}* Ohms
806	3.1 + j4.0	9.6 − j6.5
870	2.8 + j4.6	8.5 − j5.6
960	1.9 + j5.4	8.1 − j4.8

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

Figure 8. Series Equivalent Input/Output Impedances

3

MRF839F

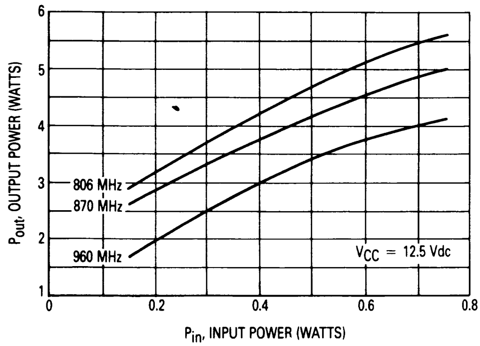


Figure 9. Output Power versus Input Power

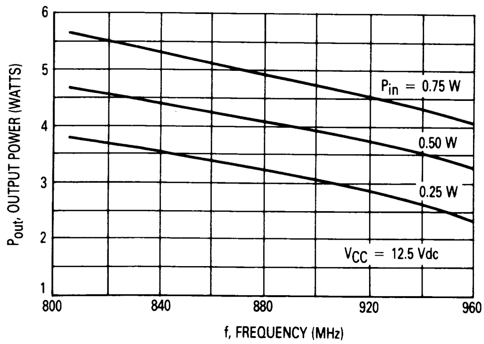


Figure 10. Output Power versus Frequency

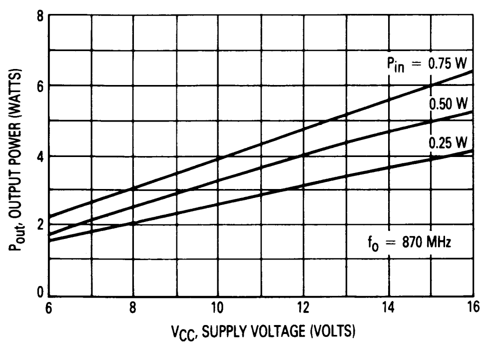


Figure 11. Output Power versus Supply Voltage

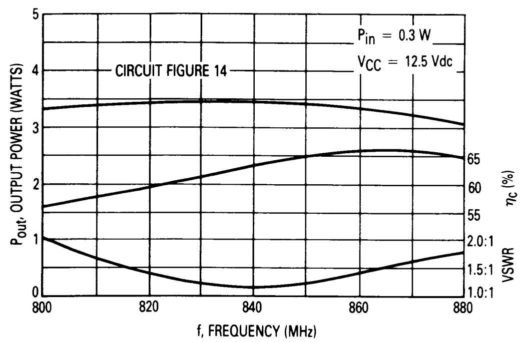
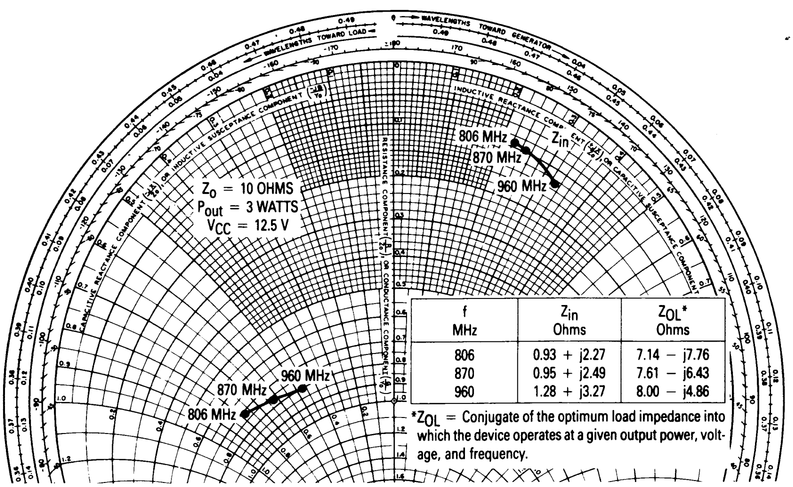


Figure 12. Broadband Performance

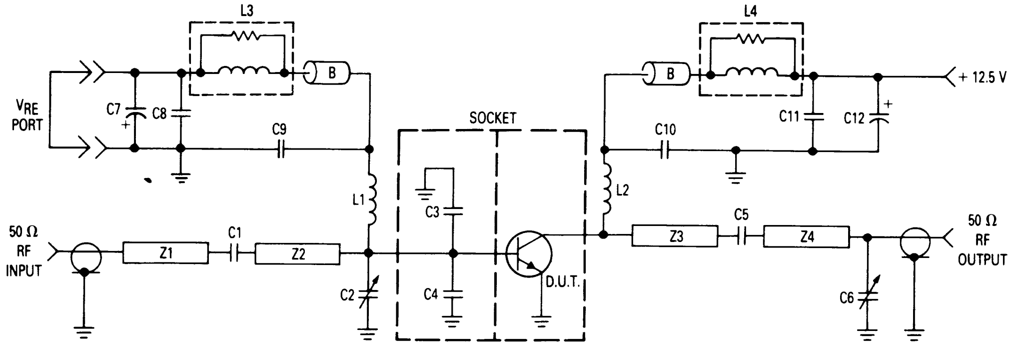


f MHz	Z_{in} Ohms	Z_{OL}* Ohms
806	0.93 + j2.27	7.14 − j7.76
870	0.95 + j2.49	7.61 − j6.43
960	1.28 + j3.27	8.00 − j4.86

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

Figure 13. Series Equivalent Input/Output Impedances

3



C1 — 47 pF Chip Cap (Murata Erie MA20470B)
C3, C4 — 13 pF Mini-Underwood
C5 — 51 pF Chip Cap (ATC 100B510JC500)
C2, C6 — 0.8–8 pF Johanson #7291
C7, C12 — 10 μF, 35 V Electrolytic Capacitor
C8, C11 — 1000 pF Unelco, J101
C9, C10 — 91 pF Mini-Underwood
B — Bead, Ferroxcube #56-590-65/3B

L1, L2 — 4 Turns, #18 Enameled, 5/32″ ID
L3, L4 — 12 Turns, #22 Enameled over 10 Ohm, 1/2 W Carbon Resistor
Z1, Z4 — 50 Ohm Stripline
Z2 — 32 Ohm Stripline (1/4 λ @ 838 MHz)
Z3 — 16 Ohm Stripline (1/4 λ @ 838 MHz)
Board Material — 0.032″ Glass Teflon, 2 oz. Copper Clad, ϵ_r = 2.55

Figure 14. MRF839F 800–880 MHz Broadband Test Circuit

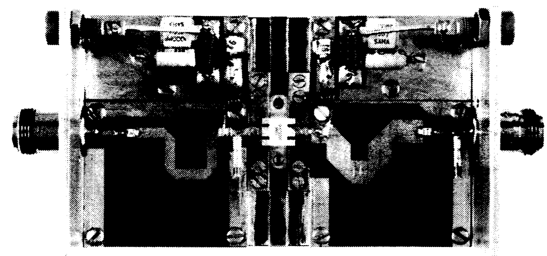


Figure 15. MRF839F Broadband Test Circuit

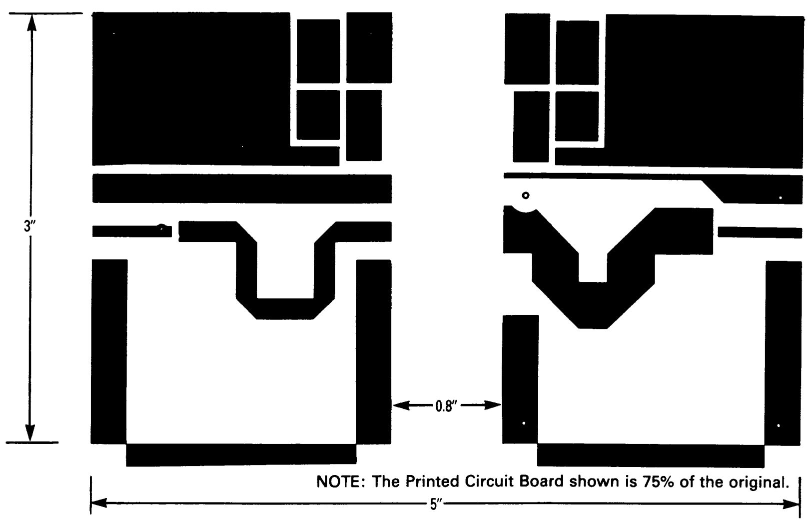
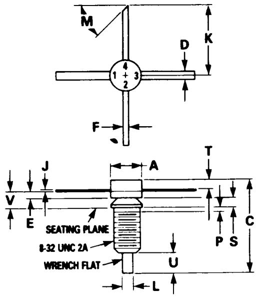


Figure 16. MRF839F Photomaster

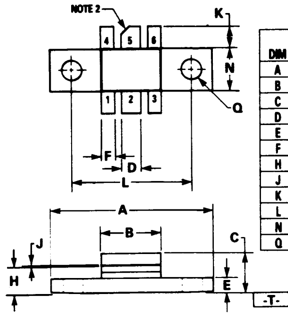
OUTLINE DIMENSIONS



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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.08	5.59	0.200	0.220
C	13.97	16.26	0.550	0.640
D	1.40	1.65	0.055	0.065
E	1.02	1.27	0.040	0.050
F	0.64	0.89	0.025	0.035
J	0.08	0.18	0.003	0.007
K	11.05	—	0.435	—
L	1.40	1.65	0.055	0.065
M	45° NOM		45° NOM	
P	—	1.27	—	0.050
S	1.40	1.65	0.055	0.065
T	1.40	1.78	0.055	0.070
U	2.79	3.81	0.110	0.150
V	2.41	2.92	0.095	0.115

CASE 305-01



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	24.51	25.02	0.965	0.985
B	9.02	9.52	0.355	0.375
C	5.84	6.60	0.230	0.260
D	2.92	3.18	0.115	0.125
E	2.69	2.95	0.106	0.116
F	1.91	2.16	0.075	0.085
H	4.06	4.31	0.160	0.170
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42 BSC		0.725 BSC	
N	5.72	6.12	0.225	0.241
Q	3.18	3.43	0.125	0.135

NOTES:
1. POSITIONAL TOLERANCE FOR Q HOLES:
   ⌖ | ϕ 0.15 (0.006) Ⓜ | T | A Ⓜ | N Ⓜ
2. IDENTIFICATION NOTCH 1.0mm (0.04) MIN X 45°.
3. DIM D APPLIES 2 PLACES,
   DIM K APPLIES 2 PLACES,
   DIM Q APPLIES 2 PLACES,
   DIM F APPLIES 4 PLACES.
4. DIMENSIONS A AND N ARE DATUMS AND -T- IS DATUM SURFACE.
5. DIMENSION B APPLIES TO LEAD FRAME AND Beo.
6. POSITIONAL TOLERANCE FOR D TERMINAL AND DIMENSION B:
   ⌖ | 0.38 (0.15) Ⓜ | T | A Ⓜ | N Ⓜ

STYLE 2:
PIN 1. EMITTER (COMMON)
2. BASE (INPUT)
3. EMITTER (COMMON)
4. EMITTER (COMMON)
5. COLLECTOR (OUTPUT)
6. EMITTER (COMMON)

CASE 319-04

3

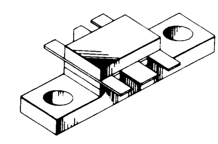
MRF840

The RF Line

10 W – 870 MHz

RF POWER
TRANSISTOR

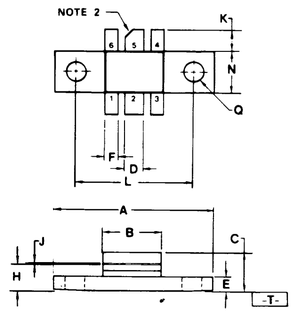
NPN SILICON



NPN SILICON RF POWER TRANSISTOR

. . . designed for 12.5 volt UHF large-signal, common-base amplifier applications in industrial and commercial FM equipment operating in the range of 806–960 MHz.

- Specified 12.5 Volt, 870 MHz Characteristics
  Output Power = 10 Watts
  Minimum Gain = 6.0 dB
  Efficiency = 50%
- Series Equivalent Large-Signal Characterization
- Internally Matched Input for Broadband Operation
- Tested for Load Mismatch Stress at All Phase Angles with 20:1 VSWR @ 15.5 Volt Supply and 50% RF Overdrive
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated



STYLE 1:
PIN 1. BASE (COMMON)
2. EMITTER (INPUT)
3. BASE (COMMON)
4. BASE (COMMON)
5. COLLECTOR (OUTPUT)
6. BASE (COMMON)

NOTES
1. POSITIONAL TOLERANCE FOR Q HOLES:
⌖ | ϕ 0.15 (0.006) Ⓜ | T | A Ⓜ | N Ⓜ
2. IDENTIFICATION NOTCH 1.0mm (0.04) MIN X 45°
3. DIM D APPLIES 2 PLACES,
DIM K APPLIES 2 PLACES,
DIM Q APPLIES 2 PLACES,
DIM F APPLIES 4 PLACES.
4. DIMENSIONS A AND N ARE DATUMS AND -T- IS A DATUM SURFACE.
5. DIMENSION B APPLIES TO LEAD FRAME AND Beo.
6. POSITIONAL TOLERANCE FOR D TERMINAL AND DIMENSION B
⌖ | 0.38 (0.15) Ⓜ | T | A Ⓜ | N Ⓜ

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	24.51	25.02	0.965	0.985
B	9.02	9.52	0.355	0.375
C	5.84	6.60	0.230	0.260
D	2.92	3.18	0.115	0.125
E	2.69	2.95	0.106	0.116
F	1.91	2.16	0.075	0.085
H	4.06	4.31	0.160	0.170
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42 BSC		0.725 BSC	
N	5.72	6.12	0.225	0.241
Q	3.18	3.43	0.125	0.135

CASE 319-04

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	3.8	Adc
Total Device Dissipation @ $T_C = 25°C$ (1) Derate Above 25°C	P_D	40 0.32	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	3.1	°C/W

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

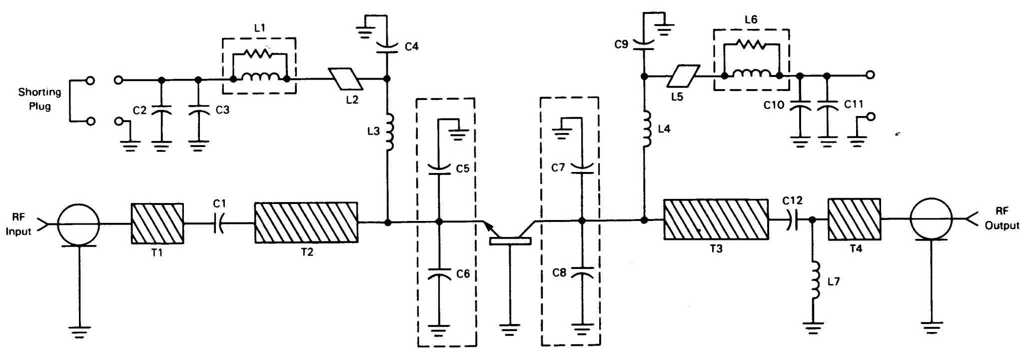
3

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 5.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	I_{CBO}	–	–	2.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 1.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	–	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	24	35	pF
FUNCTIONAL TEST					
Common-Base Amplifier Power Gain (P_{out} = 10 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	G_{PB}	6.0	7.0	–	dB
Collector Efficiency (P_{out} = 10 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	η	50	55	–	%
Load Mismatch Stress (V_{CC} = 15.5 Vdc, P_{in} = 3.0 W,* f = 870 MHz, VSWR = 20:1, all phase angles)	–	No Degradation in Output Power			

*P_{in} = 150% of the typical input power requirement for 10 W output power @ 12.5 Vdc.

FIGURE 1 — 870 MHz TEST CIRCUIT



C1, C12 — 50 pF, 100 Mil Chip Capacitor
C2, C11 — 15 μF, 20 V Tantalum
C3, C10 — 1000 pF, 350 V UNELCO
C4, C9 — 91 pF Mini-Underwood
C5 — 15 pF
C6 — 15 pF
C7 — 15 pF
C8 — 15 pF

L1, L6 — 11 Turns 20 AWG Around 10 Ω 1/2 W Resistor
L2, L5 — Ferrite Bead
L3, L4 — 4 Turn 20 AWG 0.2" I.D.
T1, T4 — Z_0 = 50 Ω
T2 — Z_0 = 30 Ω $\ell = \lambda/4$ @ 838 MHz
T3 — Z_0 = 13.5 Ω $\ell = \lambda/4$ @ 838 MHz
L7 — 18 AWG Wire Loop (0.25" × 0.5")

FIGURE 2 — OUTPUT POWER versus INPUT POWER

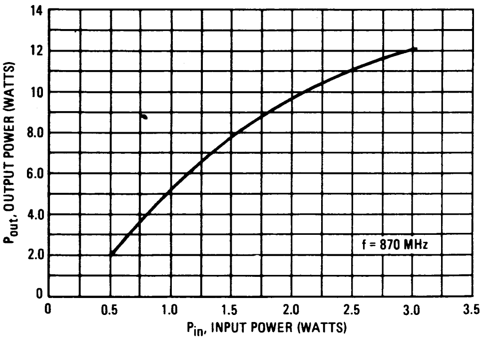


FIGURE 3 — OUTPUT POWER versus FREQUENCY

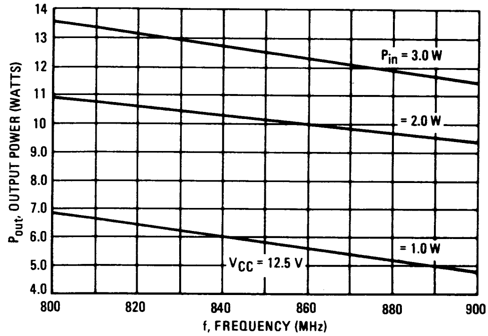


FIGURE 4 — OUTPUT POWER versus SUPPLY VOLTAGE

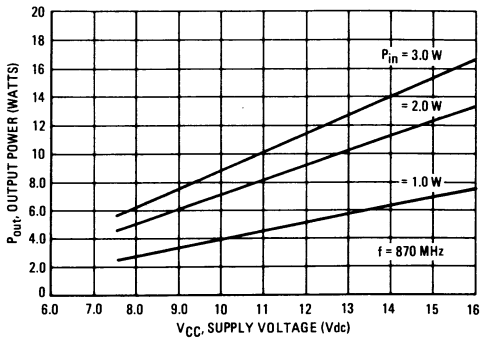
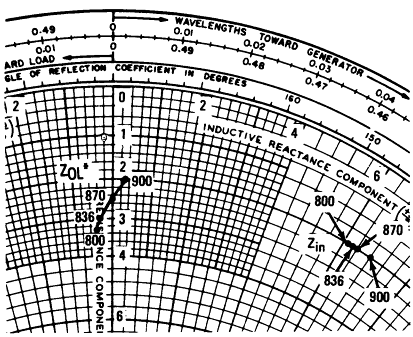


FIGURE 5 — SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCE



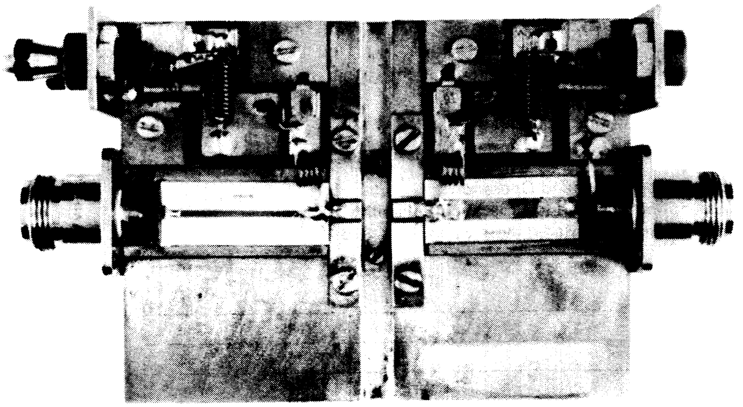
P_{out} = 10 W, V_{CC} = 12.5 Vdc

f MHz	Z_{in} Ohms	Z_{OL}* Ohms
800	2.0 + j6.1	3.3 − j0.4
836	2.0 + j6.2	3.0 − j0.3
870	2.0 + j6.4	2.5 + j0.0
900	2.0 + j6.8	2.0 + j0.3

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

3

FIGURE 6 — 870 MHz TEST CIRCUIT



MRF841
MRF841F

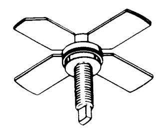
The RF Line

NPN Silicon RF Power Transistors

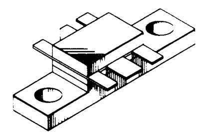
5 W 870 MHz
RF POWER TRANSISTORS
NPN SILICON

... designed primarily for wideband large-signal output and driver stages in the 806–960 MHz frequency range.

- Specified 12.5 Volt, 870 MHz Characteristics @ P_{out} = 5 W
  Common Base Gain = 10 dB (Typ)
  Efficiency = 65% (Typ)
- Internally Matched Input for Broadband Operation
- Gold Metallized and Emitter Ballasted for Improved Reliability
- 100% Tested for Load Mismatch at Rated Input Power and 15.5 V



MRF841
CASE 244-04



MRF841F
CASE 319-04

MAXIMUM RATINGS

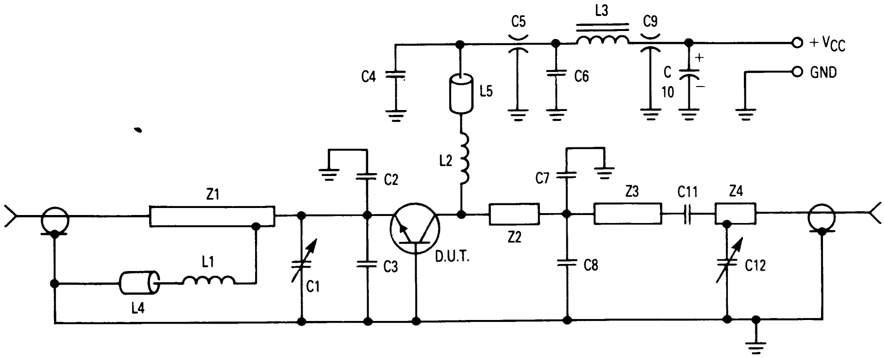
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4	Vdc
Collector Current — Continuous	I_C	2	Adc
Total Device Dissipation @ T_C = 25°C Derate Above 25°C	P_D	25 143	Watts mW/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C
Operating Junction Temperature	T_J	200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	7	°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 5 mAdc, I_C = 0)	$V_{(BR)EBO}$	4	—	—	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, V_{BE} = 0)	I_{CES}	—	—	1	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 200 mAdc, V_{CE} = 5 Vdc)	h_{FE}	10	—	150	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 15 Vdc, I_E = 0, f = 1 MHz)	C_{ob}	6	9.5	15	pF
FUNCTIONAL TESTS (f = 870 MHz)					
Common-Base Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 5 W)	G_{PB}	8.5	10	—	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 5 W)	η_c	—	65	—	%
Load Mismatch (V_{CC} = 15.5 Vdc, P_{in} = 710 mW, VSWR = 20:1, all Phase Angles)	ψ	No Degradation in Output Power			



C1, C12 — 0.8–8 pF Johanson 7290 Variable
C2 — 5 pF Mini-Underwood Mica
C3 — 8.2 pF Mini-Underwood Mica
C4 — 91 pF Mini-Underwood Mica
C5, C9 — 680 pF Feedthru
C6 — 0.1 μF Ceramic
C7, C8 — 10 pF Mini-Underwood Mica
C10 — 1 μF Electrolytic
C11 — 43 pF Mini-Underwood

L1, L2 — 4 Turns, #22 AWG Wire, 0.2-inch ID
L3 — VK200 Ferroxcube
L4, L5 — Ferrite Bead, Ferroxcube #56-590-65-3B
Z1 — 2.36″ x 0.145″ Microstrip 33 Ohm Line
Z2 — 0.5″ x 0.175″ Microstrip 28 Ohm Line
Z3 — 1.40″ x 0.175″ Microstrip 28 Ohm Line
Z4 — 0.40″ x 0.175″ Microstrip 28 Ohm Line
Board = 0.032″ Glass Teflon 2 oz. cu clad ϵ_r = 2.55

MRF841
Figure 1. 800–960 MHz Broadband Power Gain Test Circuit

3

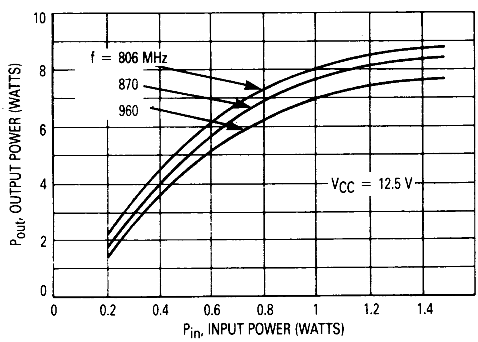


Figure 2. Output Power versus Input Power

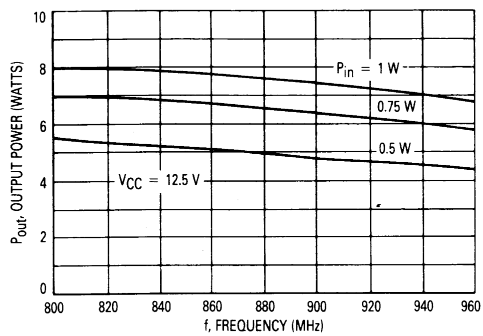


Figure 3. Output Power versus Frequency

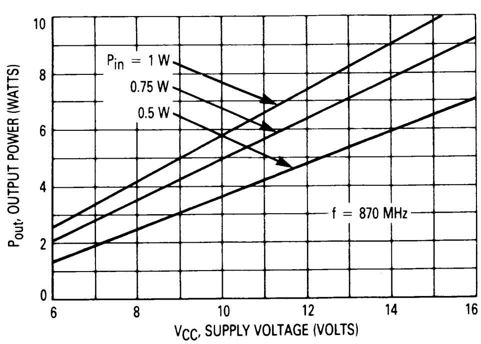


Figure 4. Power Out versus Supply Voltage

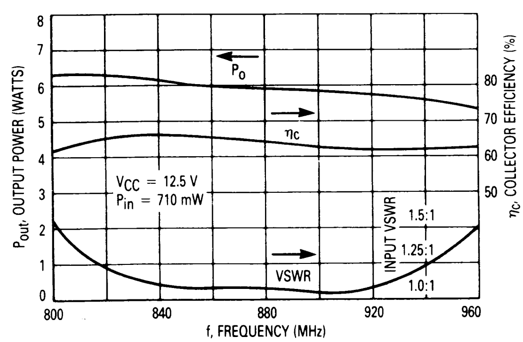


Figure 5. Typical Performance in Broadband Circuit

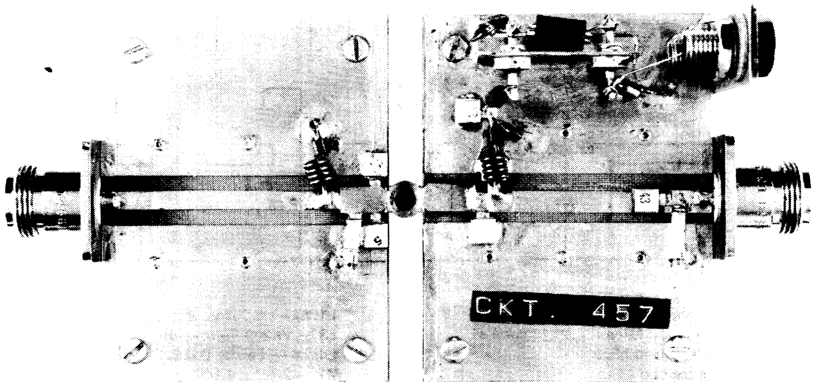


Figure 6. MRF841 Broadband Power Gain Test Circuit

3

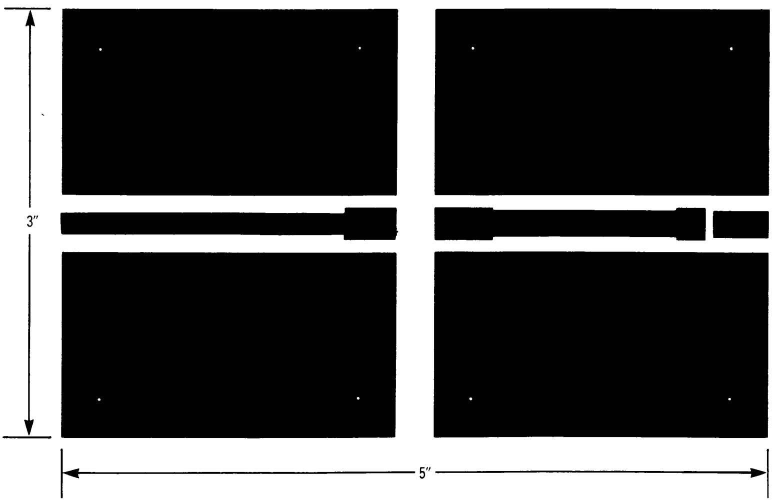


Figure 7. MRF841 Test Circuit Photomaster
NOTE: The Printed Circuit Board shown is 75% of the original.

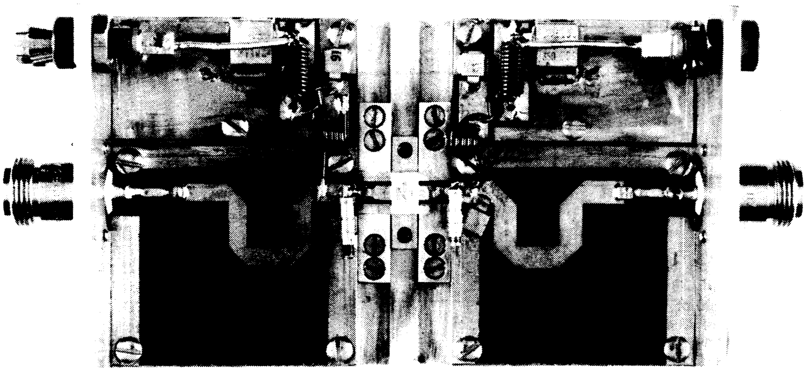


Figure 8. MRF841F Broadband Power Gain Test Circuit

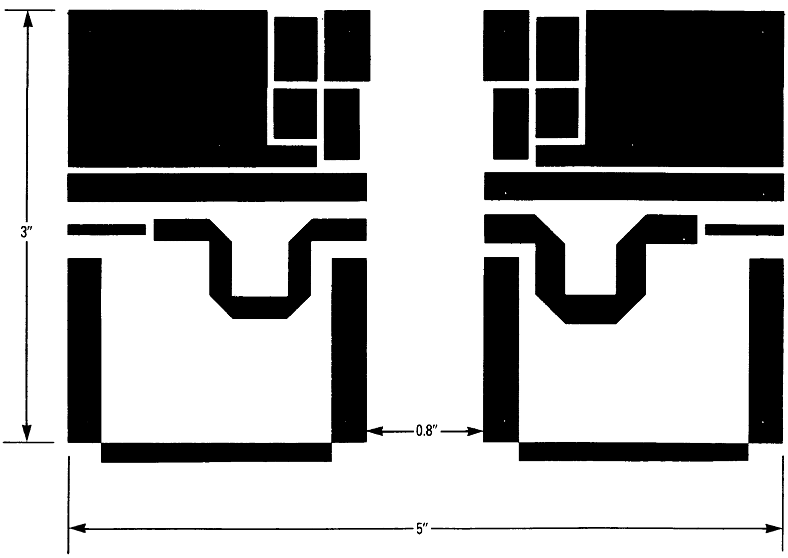
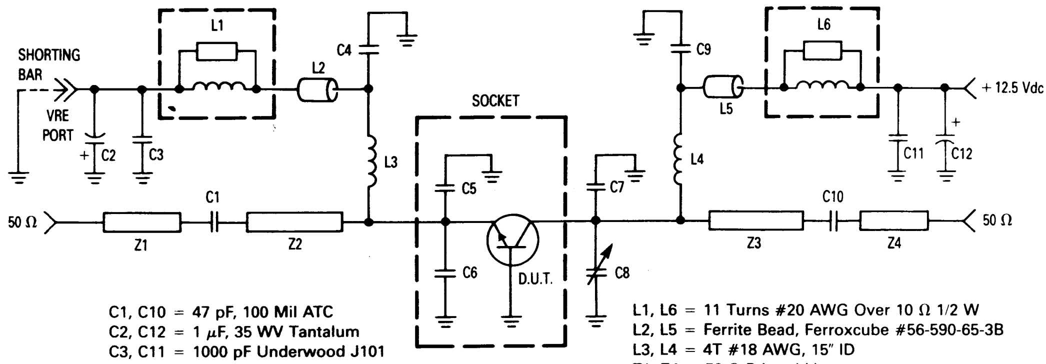


Figure 9. MRF841F Test Circuit Photomaster

NOTE: The Printed Circuit Board shown is 75% of the original.

3



C1, C10 = 47 pF, 100 Mil ATC
C2, C12 = 1 μF, 35 WV Tantalum
C3, C11 = 1000 pF Underwood J101
C4, C9 = 91 pF Mini Underwood
C5 = 12 pF Mini-Underwood
C6 = 10 pF Mini-Underwood
C7 = 10 pF Mini-Underwood
C8 = Johansen Giga Trim
0.8–8 pF 7290 Variable

L1, L6 = 11 Turns #20 AWG Over 10 Ω 1/2 W
L2, L5 = Ferrite Bead, Ferroxcube #56-590-65-3B
L3, L4 = 4T #18 AWG, 15″ ID
Z1, Z4 = 50 Ω Printed Line
Z2 = 30 Ω Printed Line, λ/4 @ 838 MHz
Z3 = 24 Ω Printed Line, λ/4 @ 838 MHz
Board = 0.032″ Glass Teflon 2 oz. cu clad ϵ_r = 2.55

NOTES: C7 and C8 mounted ≈ 250 mils
down Z3 from collector edge of board

MRF841F
Figure 10. 800–960 MHz Broadband Power Gain Test Circuit

3

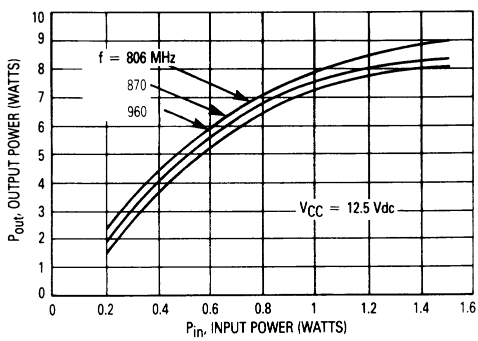


Figure 11. Output Power versus Input Power

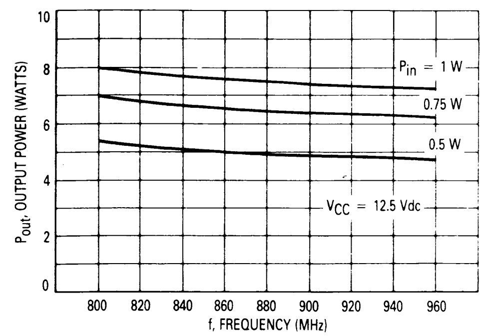


Figure 12. Output Power versus Frequency

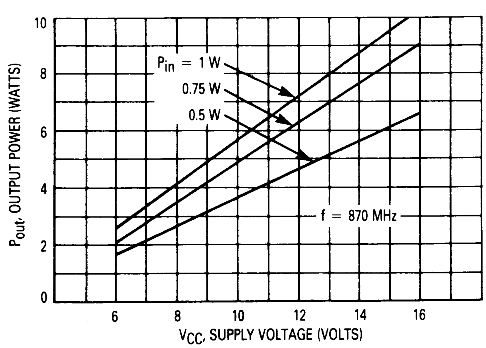


Figure 13. Output Power versus Supply Voltage

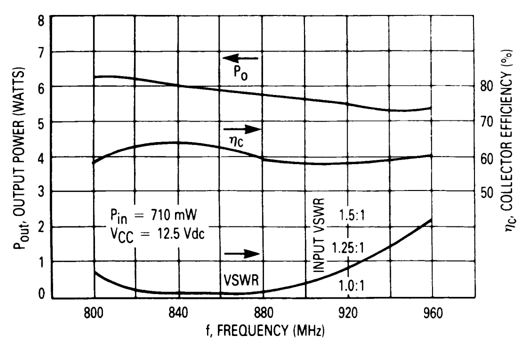
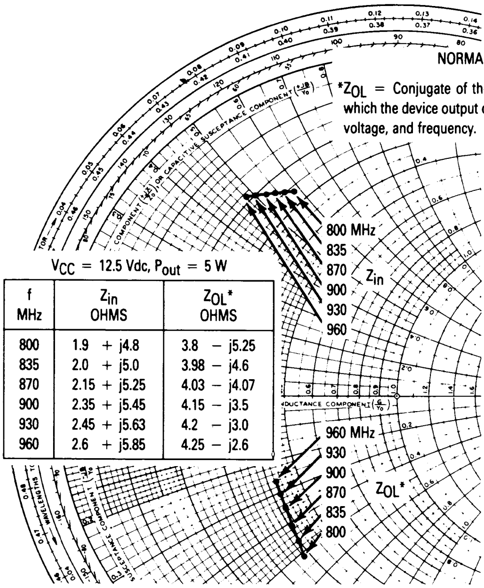


Figure 14. Typical Performance in Broadband Circuit

MRF841



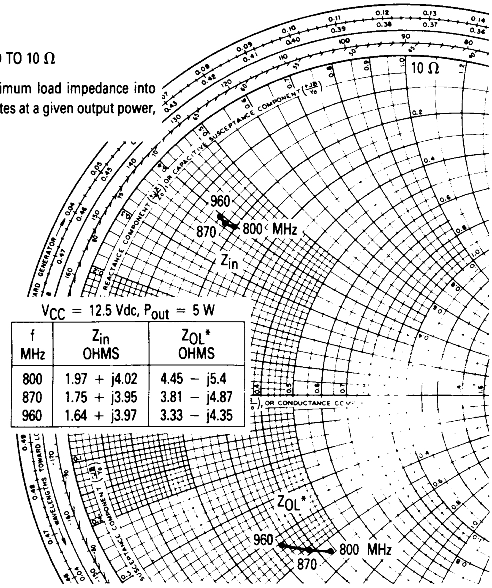
V_{CC} = 12.5 Vdc, P_{out} = 5 W

f MHz	Z_{in} OHMS	Z_{OL}* OHMS
800	1.9 + j4.8	3.8 − j5.25
835	2.0 + j5.0	3.98 − j4.6
870	2.15 + j5.25	4.03 − j4.07
900	2.35 + j5.45	4.15 − j3.5
930	2.45 + j5.63	4.2 − j3.0
960	2.6 + j5.85	4.25 − j2.6

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

Figure 15. Series Equivalent Input/Output Impedances

MRF841F



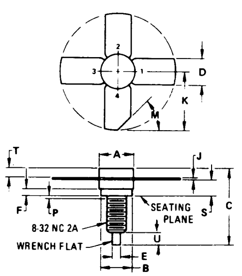
V_{CC} = 12.5 Vdc, P_{out} = 5 W

f MHz	Z_{in} OHMS	Z_{OL}* OHMS
800	1.97 + j4.02	4.45 − j5.4
870	1.75 + j3.95	3.81 − j4.87
960	1.64 + j3.97	3.33 − j4.35

Figure 16. Series Equivalent Input/Output Impedances

OUTLINE DIMENSIONS

MRF841
CASE 244-04

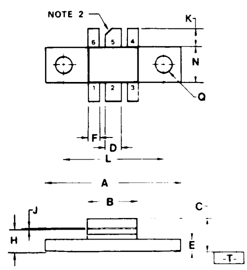


STYLE 4:
PIN 1. BASE
2. EMITTER
3. BASE
4. COLLECTOR

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	7.06	7.26	0.278	0.286
B	6.20	6.50	0.244	0.256
C	14.99	16.51	0.590	0.650
D	5.46	5.96	0.215	0.235
E	1.40	1.65	0.055	0.065
F	1.52	–	0.060	–
J	0.08	0.17	0.003	0.007
K	11.05	–	0.435	–
M	45° NOM		45° NOM	
P	–	1.27	–	0.050
S	3.00	3.25	0.118	0.128
T	1.40	1.77	0.055	0.070
U	2.92	3.68	0.115	0.145

MRF841F
CASE 319-04

STYLE 1
PIN 1 BASE (COMMON)
2 EMITTER (INPUT)
3 BASE (COMMON)
4 BASE (COMMON)
5 COLLECTOR (OUTPUT)
6 BASE (COMMON)



NOTES
1 POSITIONAL TOLERANCE FOR Q HOLES
| ⌖ | ⌀ 0.15 (0.006) Ⓜ | T | A Ⓜ | N Ⓢ |
2 IDENTIFICATION NOTCH 1.0mm (0.04) MIN X 45°
3 DIM D APPLIES 2 PLACES.
DIM K APPLIES 2 PLACES.
DIM Q APPLIES 2 PLACES.
DIM F APPLIES 4 PLACES
4 DIMENSIONS A AND N ARE DATUMS AND -T- IS A DATUM SURFACE
5 DIMENSION B APPLIES TO LEAD FRAME AND Beo
6 POSITIONAL TOLERANCE FOR D TERMINAL AND DIMENSION B
| ⌖ | 0.38 (0.15) Ⓜ | T | A Ⓜ | N Ⓢ |

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	24.51	25.02	0.965	0.985
B	9.02	9.52	0.355	0.375
C	5.84	6.60	0.230	0.260
D	2.92	3.18	0.115	0.125
E	2.69	2.95	0.106	0.116
F	1.91	2.16	0.075	0.085
H	4.06	4.31	0.160	0.170
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42 BSC		0.725 BSC	
N	5.72	6.12	0.225	0.241
Q	3.18	3.43	0.125	0.135

3

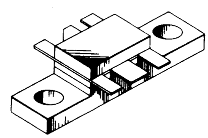
MRF842

The RF Line

20 W – 870 MHz

RF POWER TRANSISTOR

NPN SILICON



NPN SILICON RF POWER TRANSISTOR

. . . designed for 12.5 volt UHF large-signal, common-base amplifier applications in industrial and commercial FM equipment operating in the range of 806–960 MHz.

- Specified 12.5 Volt, 870 MHz Characteristics
  Output Power = 20 Watts
  Minimum Gain = 6.0 dB
  Efficiency = 50%
- Series Equivalent Large-Signal Characterization
- Internally Matched Input for Broadband Operation
- 100% Tested for Load Mismatch Stress at All Phase Angles with 20:1 VSWR @ 15.5 Volt Supply and 50% RF Overdrive
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated

3

MAXIMUM RATINGS

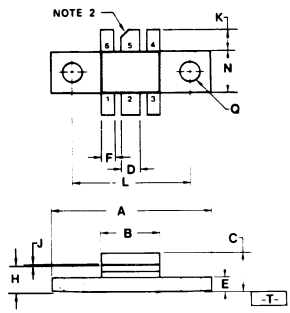
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	7.6	Adc
Total Device Dissipation @ $T_C = 25°C$ (1) Derate Above 25°C	P_D	80 0.64	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	1.5	°C/W

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.



STYLE 1:
PIN 1. BASE (COMMON)
2. EMITTER (INPUT)
3. BASE (COMMON)
4. BASE (COMMON)
5. COLLECTOR (OUTPUT)
6. BASE (COMMON)

NOTES:
1. POSITIONAL TOLERANCE FOR Q HOLES: | ⌖ | ⌀ 0.15 (0.006) Ⓜ | T | A Ⓜ | N Ⓜ |
2. IDENTIFICATION NOTCH 1.0mm (0.04) MIN X 45°.
3. DIM D APPLIES 2 PLACES, DIM K APPLIES 2 PLACES, DIM Q APPLIES 2 PLACES, DIM F APPLIES 4 PLACES.
4. DIMENSIONS A AND N ARE DATUMS AND [-T-] IS A DATUM SURFACE.
5. DIMENSION B APPLIES TO LEAD FRAME AND Beo.
6. POSITIONAL TOLERANCE FOR D TERMINAL AND DIMENSION B: | ⌖ | 0.38 (0.15) Ⓜ | T | A Ⓜ | N Ⓜ |

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	24.51	25.02	0.965	0.985
B	9.02	9.52	0.355	0.375
C	5.84	6.60	0.230	0.260
D	2.92	3.18	0.115	0.125
E	2.69	2.95	0.106	0.116
F	1.91	2.16	0.075	0.085
H	4.06	4.31	0.160	0.170
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42 BSC		0.725 BSC	
N	5.72	6.12	0.225	0.241
Q	3.18	3.43	0.125	0.135

CASE 319-04

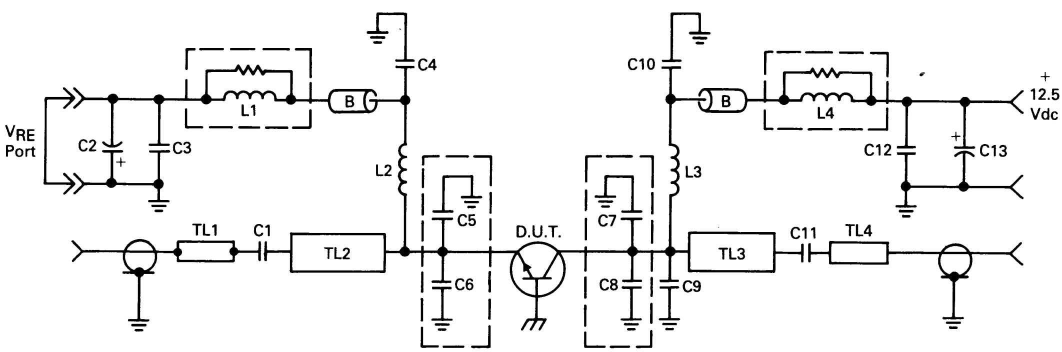
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	I_{CBO}	–	–	5.0	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	–	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	45	65	pF
FUNCTIONAL TEST					
Common-Base Amplifier Power Gain (P_{out} = 20 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	G_{PB}	6.0	7.0	–	dB
Collector Efficiency (P_{out} = 20 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	η	50	55	–	%
Load Mismatch Stress (V_{CC} = 15.5 Vdc, P_{in}* = 6.0 W, f = 870 MHz, VSWR = 20:1, all phase angles)	–	No Degradation in Output Power			

*P_{in} = 150% of the typical input power requirement for 20 W output power @ 12.5 Vdc.

3

FIGURE 1 — 870 MHz TEST CIRCUIT SCHEMATIC



C1, C11 — 51 pF, 100 Mil Chip Capacitor
C2, C13 — 15 μF, 20 WV Tantalum
C3, C12 — 1000 pF Unelco J101
C4, C10 — 91 pF Mini-Underwood
C5 — 15 pF Mini-Underwood
C6 — 12 pF Mini-Underwood
C7, C8 — 21 pF Mini-Underwood
C9 — 11 pF Mini-Underwood

L1, L4 — 11 Turns #20 AWG Over 10 ohm 1/2 W Carbon
L2, L3 — 4 Turns #20 AWG, 200 Mil ID
B — Ferrite Bead, Ferroxcube 56-590-65-3B
TL1, TL4 — Micro Strip, Z_o = 50 Ω
TL2 — Micro Strip, Z_o = 38 Ω, λ/4 @ 838 MHz
TL3 — Micro Strip, Z_o = 24 Ω, λ/4 @ 838 MHz
Board — 0.032″ Glass Teflon
2 oz. Cu CLAD, ϵ_r = 2.55

FIGURE 2 – OUTPUT POWER versus INPUT POWER

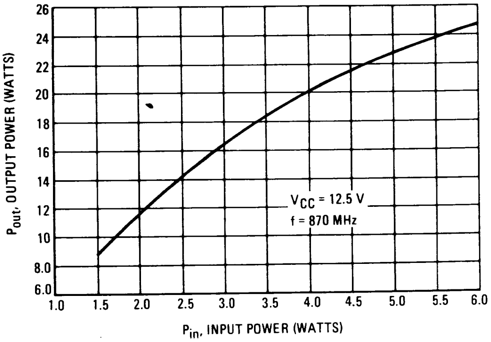


FIGURE 3 – OUTPUT POWER versus FREQUENCY

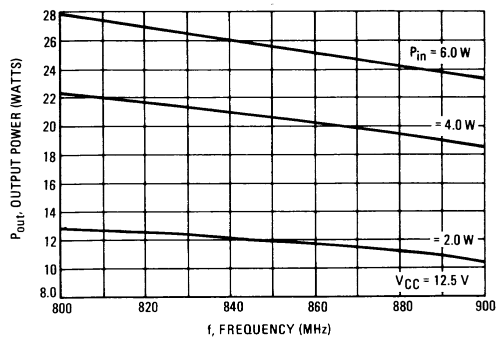


FIGURE 4 – OUTPUT POWER versus SUPPLY VOLTAGE

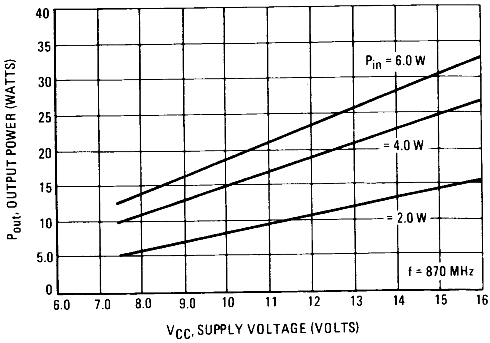
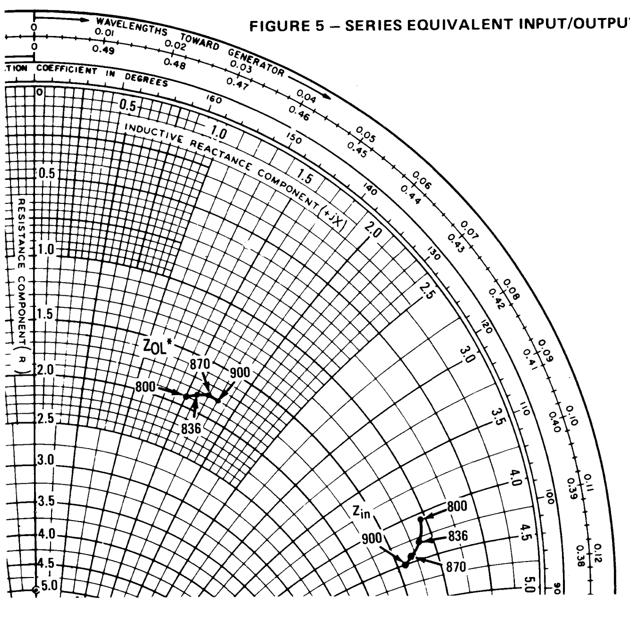


FIGURE 5 – SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCE

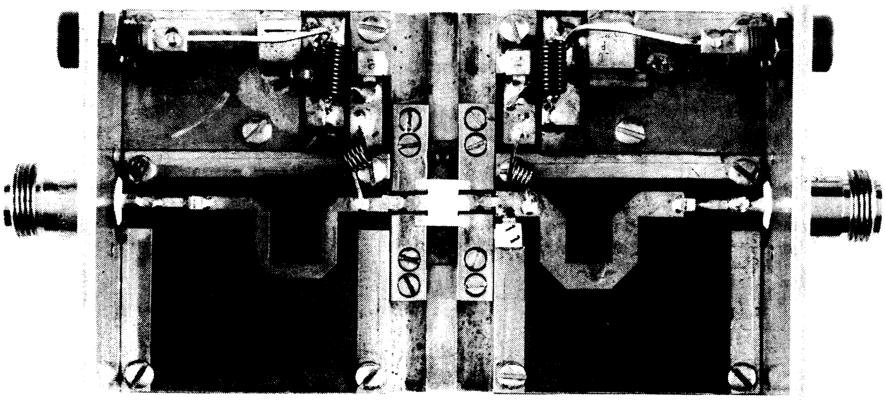


P_{out} = 20 W, V_{CC} = 12.5 Vdc

f MHz	Z_{in} Ohms	Z_{OL}* Ohms
800	1.1 + j4.1	1.9 + j1.5
836	1.2 + j4.3	1.85 + j1.6
870	1.4 + j4.4	1.8 + j1.7
900	1.6 + j4.5	1.8 + j1.8

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

FIGURE 6 — 870 MHz TEST CIRCUIT



MRF843
MRF843F

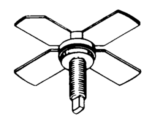
The RF Line

NPN Silicon
RF Power Transistors

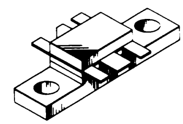
**15 W 806–960 MHz
RF POWER
TRANSISTORS
COMMON BASE
NPN SILICON**

... designed for 12.5 Volt UHF large-signal, **common-base** applications in industrial and commercial FM equipment operating in the range of 806–960 MHz.

- Specified 12.5 Volt, 870 MHz Characteristics
  Output Power = 15 Watts
  Minimum Gain = 7 dB
  Efficiency = 55%
- Internally Matched Input for Broadband Operation
- Gold Metallized and Emitter Ballasted for Long Life
- 100% Tested for Load Mismatch at 2 dB Overdrive and 15.5 V



**CASE 244-04
MRF843**



**CASE 319-04
MRF843F**

3

MAXIMUM RATINGS

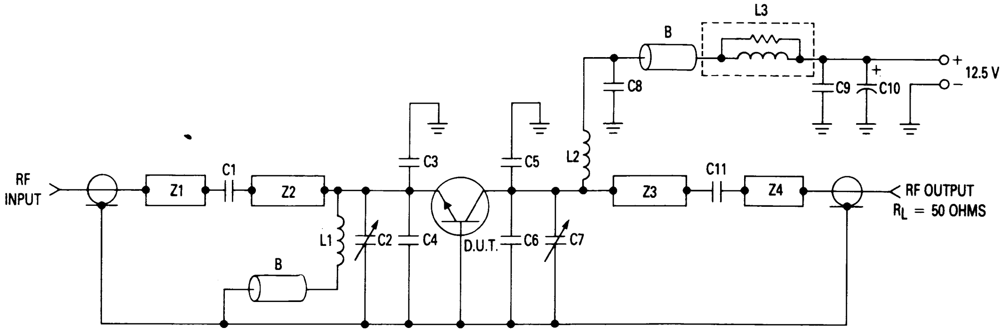
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4	Vdc
Collector-Current — Continuous	I_C	4	Adc
Operating Junction Temperature	T_J	200	°C
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	44 0.25	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	4	°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 25 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 5 mAdc, I_C = 0)	$V_{(BR)EBO}$	4	—	—	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	—	—	5	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 1 Adc, V_{CE} = 5 Vdc)	h_{FE}	10	—	120	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 15 Vdc, I_E = 0, f = 1 MHz)	C_{ob}	—	30	45	pF
FUNCTIONAL TESTS					
Common Base Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 15 W, f = 870 MHz)	G_{pb}	7	7.9	—	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 15 W, f = 870 MHz)	η	55	60	—	%
Load Mismatch Stress (P_{in} = 2 dB Overdrive, V_{CC} = 15.5 V, f = 870 MHz, VSWR = 20:1 @ All Phase Angles)	ψ	No Degradation in Output Power			



C1 — 39 pF ATC 100 Mil Ceramic Chip
C2, C7 — 0.8–8 pF Johanson Gigatrim (7290)
C3, C4 — 8 pF Mini Underwood Mica
C5, C6 — 10 pF Mini Underwood Mica
C8 — 68 pF Mini Underwood Mica
C9 — 1000 pF Unelco
C10 — 10 μF Electrolytic
C11 — 33 pF Mini Underwood Mica
L1 — 4 Turns 0.10″ ID #24 AWG
L2 — 4 Turns 0.20″ ID #24 AWG
L3 — 10 Turns on 10 Ohm ½ W Resistor
Z1 — 0.100″ x 0.525″ Microstrip TX Line
Z2 — 0.100″ x 1.80 36 Ohm Microstrip TX Line
Z3 — 0.200″ x 1.90″ 30 Ohm Microstrip TX Line
Z4 — 0.150″ x 0.450″ Microstrip TX Line
B — Bead, Ferroxcube #56-590-65/3B
Board Material — 0.032″ Glass Teflon 2 oz. Copper Clad ϵ_r = 2.55

Figure 1. MRF843 800–900 MHz Broadband Test Fixture

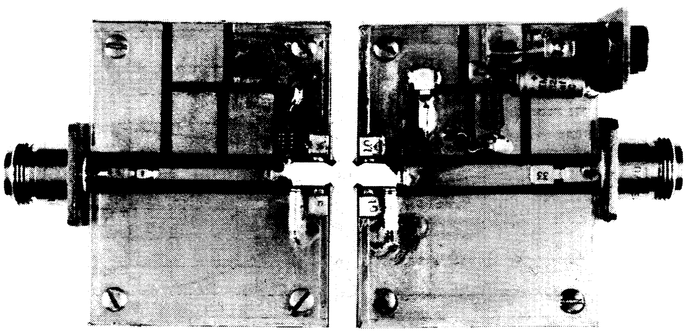


Figure 2. MRF843 800–900 MHz Test Circuit

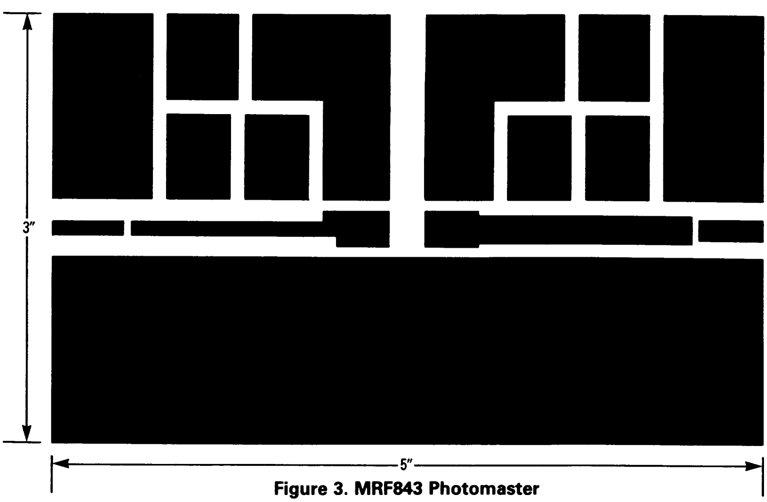


Figure 3. MRF843 Photomaster

NOTE: The Printed Circuit Board shown is 75% of the original.

MRF843

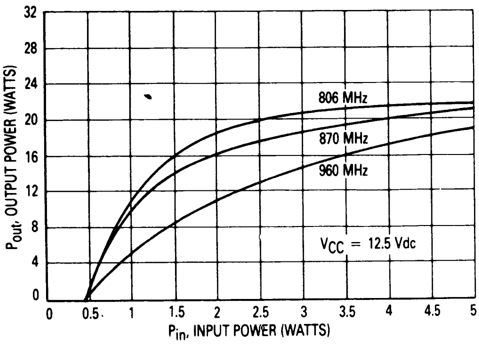


Figure 4. Output Power versus Input Power

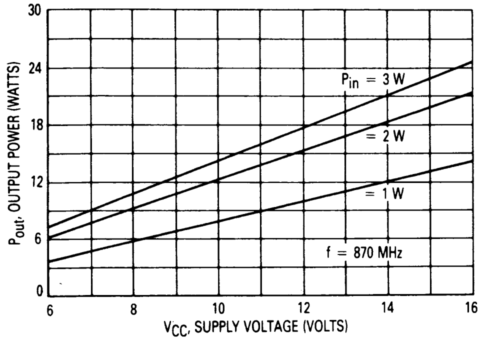


Figure 5. Output Power versus Supply Voltage

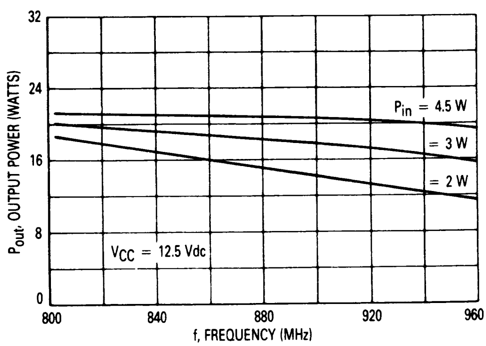


Figure 6. Output Power versus Frequency

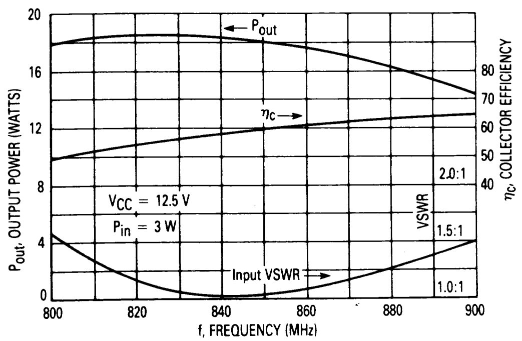
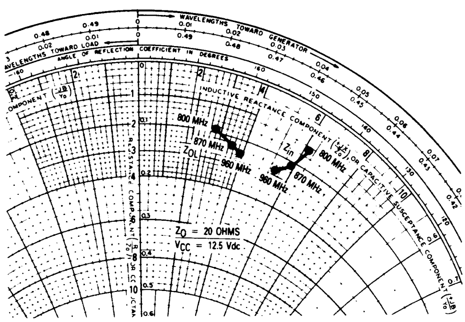


Figure 7. Typical Performance in Broadband Test Fixture



f MHz	Z_{in} Ohms	Z_{OL}* Ohms
800	1.23 +j 6.13	1.98 +j 2.62
870	2.09 +j 5.91	2.24 +j 3.49
960	2.58 +j 5.46	2.51 +j 3.92
NOTE: Circuit tuning and input power adjusted to maintain output power of 15 W and 65% efficiency.		

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

Figure 8. Series Equivalent Input and Output Impedance

MRF843F

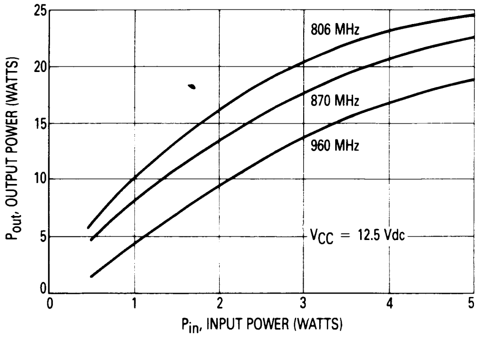


Figure 9. Output Power versus Input Power

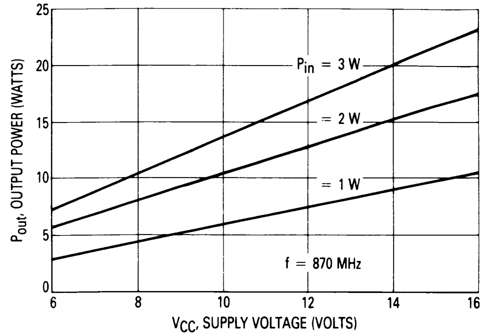


Figure 10. Output Power versus Supply Voltage

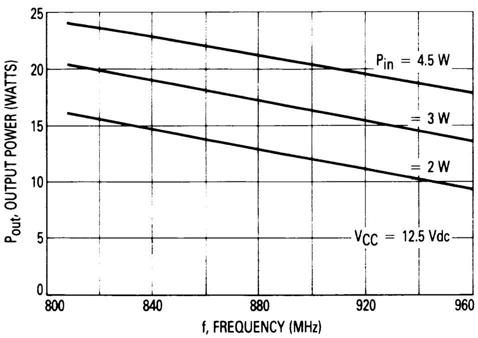


Figure 11. Output Power versus Frequency

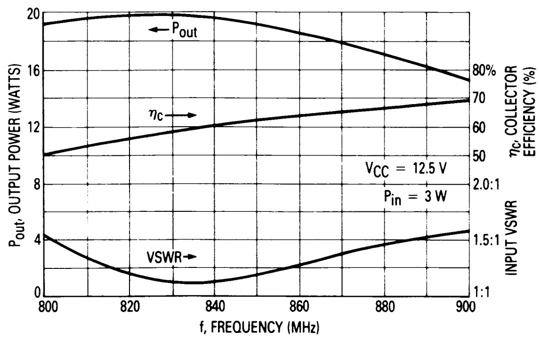
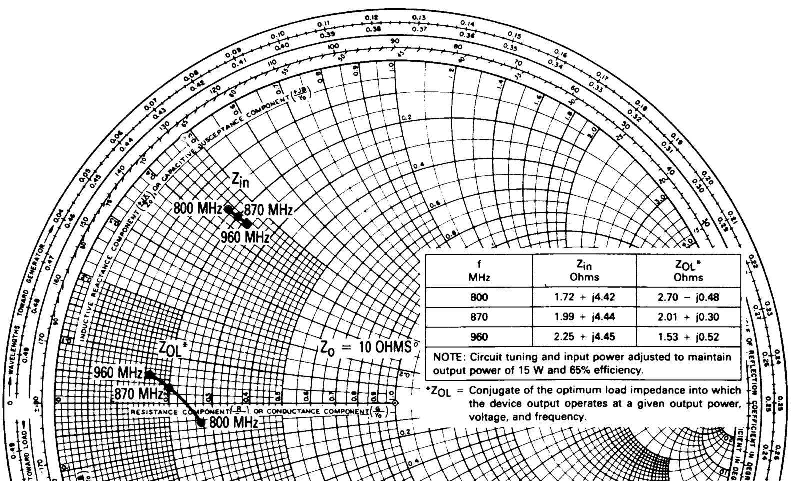


Figure 12. Typical Performance in Broadband Test Fixture

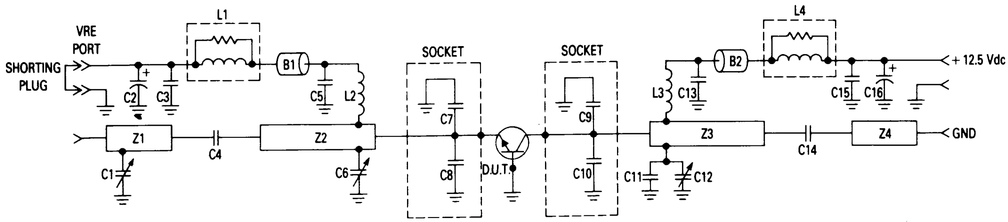


f MHz	Zin Ohms	ZOL* Ohms
800	1.72 + j4.42	2.70 − j0.48
870	1.99 + j4.44	2.01 + j0.30
960	2.25 + j4.45	1.53 + j0.52

NOTE: Circuit tuning and input power adjusted to maintain output power of 15 W and 65% efficiency.

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

Figure 13. Series Equivalent Input and Output Impedance



C1 — 0.6–4.5 pF Johansen Gigatrim (7270)
C2, C16 — 1 μF, 35 WV Tantalum
C3, C15 — 1000 pF Underwood Mica J101
C4, C14 — 47 pF 100 Mil ATC
C5, C13 — 91 pF Mini-Underwood Mica
C6, C12 — 0.8–8 pF Johansen Gigatrim (7290)
C7, C8 — 8 pF Mini-Underwood Mica
C9, C10 — 15 pF Mini-Underwood Mica
C11 — 10 pF Mini-Underwood Mica
L1, L4 — 11 Turns #20 AWG over 100 HM ½ W Resistor
L2, L3 — 4 Turns #18 AWG, 0.15″ ID
B1, B2 — Ferrite Bead, Ferroxcube 56-590-65-3B
Z1, Z4 — 50 Ohm Microstrip
Z2 — 36 Ohm Microstrip λ/4 @ 838 MHz
Z3 — 32 Ohm Microstrip λ/4 @ 838 MHz
Board Material — 0.032″ Glass Teflon, 2 oz. Copper Clad, ϵ_r = 2.55

Figure 14. MRF843F 800–900 MHz Broadband Test Circuit

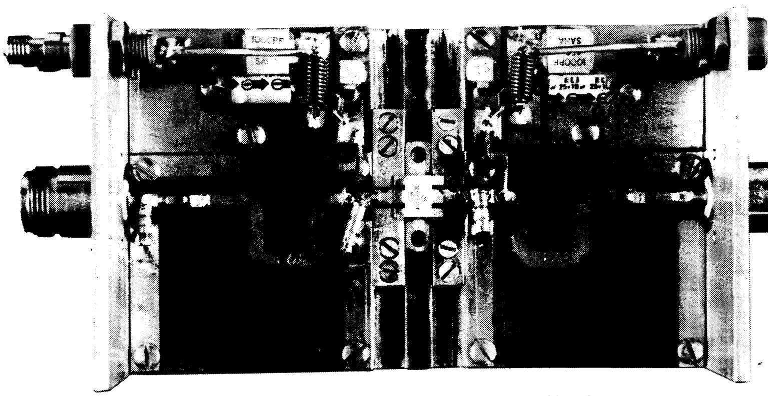


Figure 15. MRF843F Broadband Test Circuit

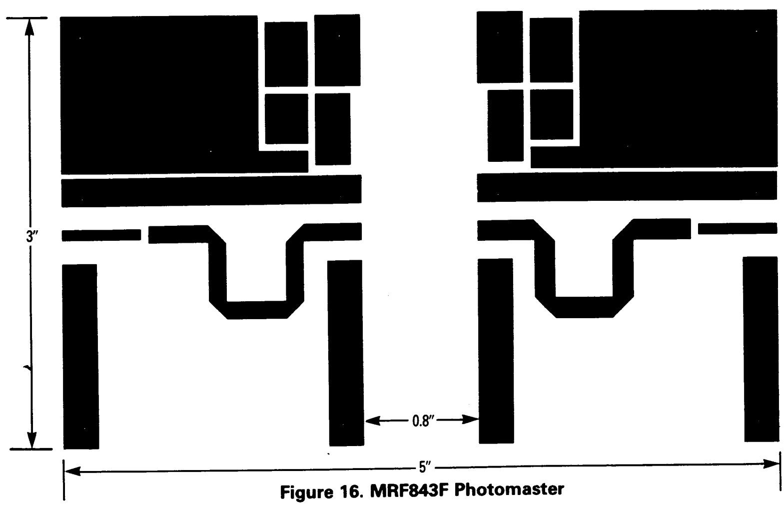
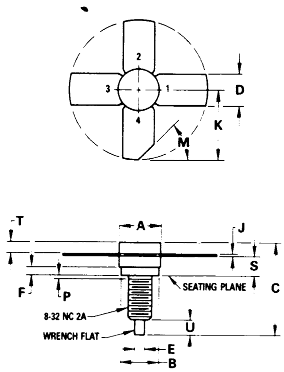


Figure 16. MRF843F Photomaster

NOTE: The Printed Circuit Board shown is 75% of the original.

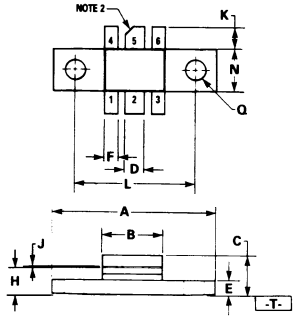
OUTLINE DIMENSIONS



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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	7.06	7.26	0.278	0.286
B	6.20	6.50	0.244	0.256
C	14.99	16.51	0.590	0.650
D	5.46	5.96	0.215	0.235
E	1.40	1.65	0.055	0.065
F	1.52	—	0.060	—
J	0.08	0.17	0.003	0.007
K	11.05	—	0.435	—
M	45° NOM		45° NOM	
P	—	1.27	—	0.050
S	3.00	3.25	0.118	0.128
T	1.40	1.77	0.055	0.070
U	2.92	3.68	0.115	0.145

CASE 244-04



NOTES:
1. POSITIONAL TOLERANCE FOR Q HOLES:
   ⌖ | ϕ 0.15 (0.006) Ⓜ | T | A Ⓜ | N Ⓜ
2. IDENTIFICATION NOTCH 1.0mm (0.04) MIN X 45°.
3. DIM D APPLIES 2 PLACES,
   DIM K APPLIES 2 PLACES,
   DIM Q APPLIES 2 PLACES,
   DIM F APPLIES 4 PLACES.
4. DIMENSIONS A AND N ARE DATUMS AND -T- IS DATUM SURFACE.
5. DIMENSION B APPLIES TO LEAD FRAME AND Beo.
6. POSITIONAL TOLERANCE FOR D TERMINAL AND DIMENSION B:
   ⌖ | 0.38 (0.15) Ⓜ | T | A Ⓜ | N Ⓜ

STYLE 1:
PIN 1. BASE (COMMON)
2. EMITTER (INPUT)
3. BASE (COMMON)
4. BASE (COMMON)
5. COLLECTOR (OUTPUT)
6. BASE (COMMON)

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	24.51	25.02	0.965	0.985
B	9.02	9.52	0.355	0.375
C	5.84	6.60	0.230	0.260
D	2.92	3.18	0.115	0.125
E	2.69	2.95	0.106	0.116
F	1.91	2.16	0.075	C.085
H	4.06	4.31	0.160	0.170
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42 BSC		0.725 BSC	
N	5.72	6.12	0.225	0.241
Q	3.18	3.43	0.125	0.135

CASE 319-04

3

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

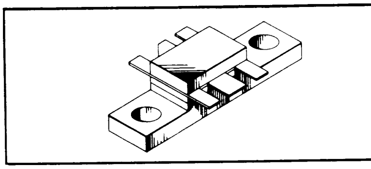
MRF844

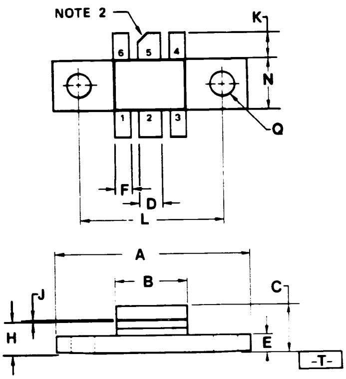
The RF Line

30 W–870 MHz

RF POWER TRANSISTOR

NPN SILICON





STYLE 1:
PIN 1. BASE (COMMON) 4. BASE (COMMON)
2. EMITTER (INPUT) 5. COLLECTOR (OUTPUT)
3. BASE (COMMON) 6. BASE (COMMON)

NOTES:
1. POSITIONAL TOLERANCE FOR Q HOLES:
| ⌖ | φ 0.15 (0.006) Ⓜ | T | A Ⓜ | N Ⓜ |
2. IDENTIFICATION NOTCH 1.0mm (0.04) MIN X 45°.
3. DIM D APPLIES 2 PLACES, DIM K APPLIES 2 PLACES, DIM Q APPLIES 2 PLACES, DIM F APPLIES 4 PLACES.
4. DIMENSIONS A AND N ARE DATUMS AND -T- IS A DATUM SURFACE.
5. DIMENSION B APPLIES TO LEAD FRAME AND Beo.
6. POSITIONAL TOLERANCE FOR D TERMINAL AND DIMENSION B:
| ⌖ | 0.38 (0.15) Ⓜ | T | A Ⓜ | N Ⓜ |

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	24.51	25.02	0.965	0.985
B	9.02	9.52	0.355	0.375
C	5.84	6.60	0.230	0.260
D	2.92	3.18	0.115	0.125
E	2.69	2.95	0.106	0.116
F	1.91	2.16	0.075	0.085
H	4.06	4.31	0.160	0.170
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42 BSC		0.725 BSC	
N	5.72	6.12	0.225	0.241
Q	3.18	3.43	0.125	0.135

CASE 319-04

NPN SILICON RF POWER TRANSISTOR

. . . designed for 12.5 volt UHF large-signal, common-base amplifier applications in industrial and commercial FM equipment operating in the range of 806–960 MHz.

- Specified 12.5 Volt, 870 MHz Characteristics
  - Output Power = 30 Watts
  - Minimum Gain = 5.2 dB
  - Efficiency = 50%
- Series Equivalent Large-Signal Characterization
- Internally Matched Input for Broadband Operation
- Tested for Load Mismatch Stress at All Phase Angles with 20:1 VSWR @ High Line and RF Overdrive
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current – Continuous	I_C	10.9	Adc
Total Device Dissipation @ $T_C = 25°C$ (1) Derate Above 25°C	P_D	115 0.66	Watts W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	1.5	°C/W

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

3

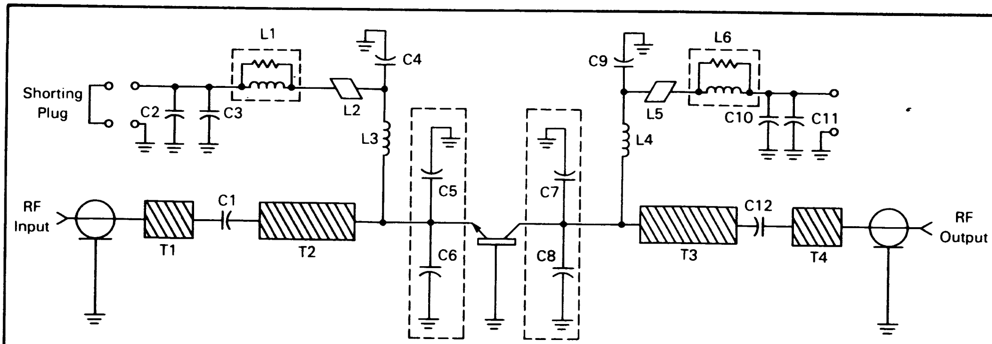
ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	I_{CBO}	–	–	10	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	40	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	60	90	pF
FUNCTIONAL TEST					
Common-Base Amplifier Power Gain (P_{out} = 30 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	G_{PB}	5.2	6.0	–	dB
Collector Efficiency (P_{out} = 30 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	η	50	55	–	%
Load Mismatch Stress (V_{CC} = 15.5 Vdc, P_{in} = 12 W*, f = 870 MHz, VSWR = 20:1, all phase angles)	–	No Degradation in Output Power			

*P_{in} = 150% of the typical input power requirement for 30 W output power @ 12.5 Vdc.

3

FIGURE 1 — 870 MHz TEST CIRCUIT



C1, C12 — 50 pF, 100 Mil Chip Capacitor
C2, C11 — 15 μF, 20 V Tantalum
C3, C10 — 1000 pF, 350 V UNELCO
C4, C9 — 91 pF Mini-Underwood
C5 — 15 pF Mini-Underwood
C6 — 15 pF Mini-Underwood
C7 — 18 pF Mini-Underwood
C8 — 24 pF Mini-Underwood

L1, L6 — 11 Turns 20 AWG Around 10 Ω 1/2 W Resistor
L2, L5 — Ferrite Bead
L3, L4 — 4 Turn 20 AWG 0.2" I.D.
T1, T4 — Z_0 = 50 Ω
T2 — Z_0 = 38 Ω $\ell = \lambda/4$ @ 838 MHz
T3 — Z_0 = 26 Ω $\ell = \lambda/4$ @ 838 MHz

3

FIGURE 2 — OUTPUT POWER versus INPUT POWER

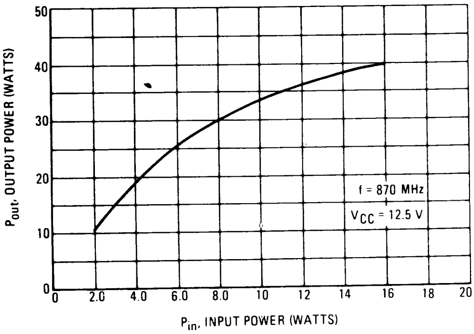


FIGURE 3 — OUTPUT POWER versus FREQUENCY

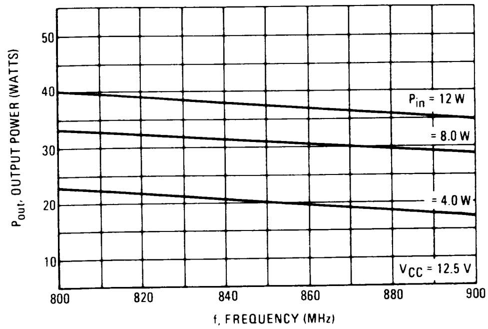


FIGURE 5 — SERIES EQUIVALENT INPUT/OUTPUT IMPEDANCE

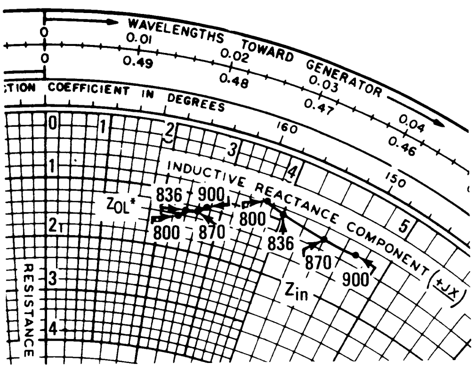
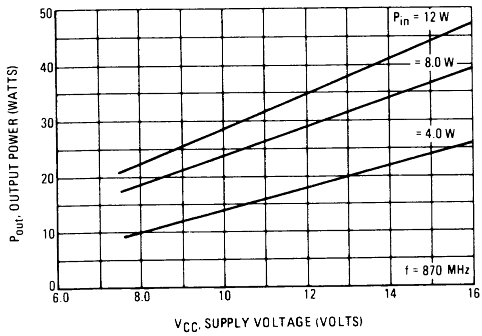


FIGURE 4 — OUTPUT POWER versus SUPPLY VOLTAGE

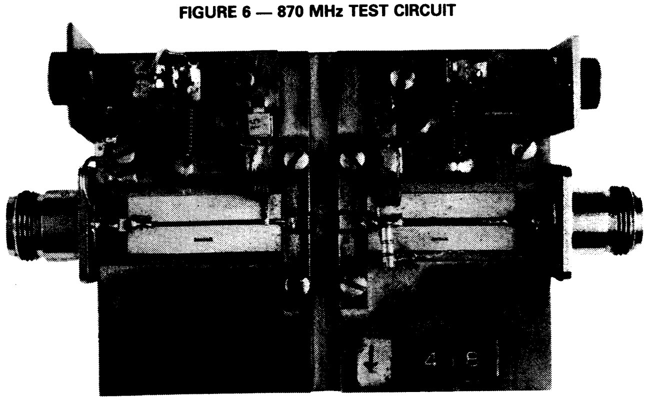


P_{in} = 7.5 W, P_{out} = 30 W, V_{CC} = 12.5 Vdc

f MHz	Z_{in} Ohms	Z_{OL}* Ohms
800	0.8 + j3.7	1.4 + j2.3
836	0.9 + j4.0	1.3 + j2.4
870	1.0 + j4.4	1.25 + j2.6
900	1.0 + j4.7	1.2 + j2.7

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

FIGURE 6 — 870 MHz TEST CIRCUIT



MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

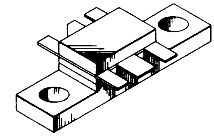
MRF846

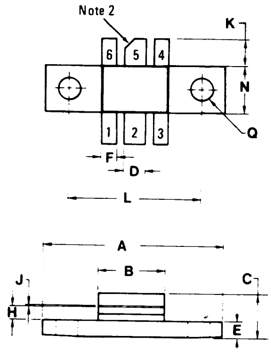
The RF Line

40 W-870 MHz

RF POWER TRANSISTOR

NPN SILICON





STYLE 1:
PIN 1. BASE (COMMON)
2. EMITTER (INPUT)
3. BASE (COMMON)
4. BASE (COMMON)
5. COLLECTOR (OUTPUT)
6. BASE (COMMON)

NOTES:
1. HOLES WITHIN 0.15 mm (0.006) TRUE POSITION TO EACH OTHER AT MAXIMUM MATERIAL CONDITION.
2. IDENTIFICATION NOTCH 1.0 mm (0.04) MIN × 45°.
3. DIM D APPLIES 2 PLACES, DIM K APPLIES 2 PLACES, DIM Q APPLIES 2 PLACES, DIM F APPLIES 4 PLACES.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	24.51	25.02	0.965	0.985
B	8.76	9.02	0.345	0.355
C	5.72	6.48	0.225	0.255
D	2.92	3.18	0.115	0.125
E	2.29	2.54	0.090	0.100
F	1.78	2.03	0.070	0.080
H	1.65	1.90	0.065	0.075
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42	BSC	0.725	BSC
N	5.72	5.97	0.225	0.235
Q	3.05	3.30	0.120	0.130

CASE 319-04

NPN SILICON RF POWER TRANSISTOR

. . . designed for 12.5 volt UHF large-signal, common-base amplifier applications in industrial and commercial FM equipment operating in the range of 806–960 MHz.

- Specified 12.5 Volt, 870 MHz Characteristics
  Output Power = 40 Watts
  Minimum Gain = 4.3 dB
  Efficiency = 50%
- Series Equivalent Large-Signal Characterization
- Internally Matched Input for Broadband Operation
- Tested for Load Mismatch Stress at All Phase Angles with 10:1 VSWR @ High Line and RF Overdrive
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector Current — Continuous	I_C	14.0	Adc
Total Device Dissipation @ $T_C = 25°C$ (1) Derate Above 25°C	P_D	150 0.86	Watts W/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (2)	$R_{\theta JC}$	1.17	°C/W

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.

(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

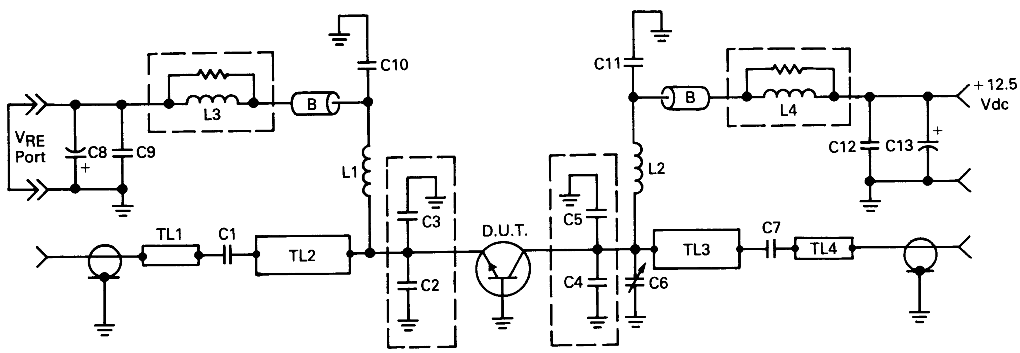
ELECTRICAL CHARACTERISTICS ($T_C = 25^oC$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	–	–	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	I_{CBO}	–	–	10	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	10	50	–	–
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	85	120	pF
FUNCTIONAL TEST					
Common-Base Amplifier Power Gain (P_{out} = 40 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	G_{PB}	4.3	5.2	–	dB
Collector Efficiency (P_{out} = 40 W, V_{CC} = 12.5 Vdc, f = 870 MHz)	η	50	55	–	%
Load Mismatch Stress (V_{CC} = 15.5 Vdc, P_{in} = 15 W, f = 870 MHz, VSWR = 10:1, all phase angles)	–	No Degradation in Output Power			

*P_{in} = 125% of the typical input power requirement for 40 W output power @ 12.5 Vdc.

3

FIGURE 1 — 870 MHz TEST CIRCUIT SCHEMATIC



C1 — 43 pF, 100 Mil Chip Capacitor
C2 — 12 pF Mini-Unelco
C3 — 15 pF Mini-Unelco
C4 — 21 pF Mini-Unelco
C5 — 18 pF Mini-Unelco
C6 — 0.8–8.0 pF Johanson Gigatrim
C7 — 47 pF, 100 Mil Chip Capacitor
C8 — 10 μF, 25 WV
C9, C12 — 1000 pF Unelco J101
C10, C11 — 91 pF Mini-Unelco
C13 — 25 μF, 25 WV

L1, L2 — 4 Turns #18 Enameled; 200 Mil ID
L3, L4 — 15 Turns #24 Enameled Over 12 ohm Carbon Resistor
B — Ferrite Bead; Ferroxcube 56-590-65-3B
TL1, TL4 — Micro Strip; 50 Ω
TL2 — Micro Strip; Z_o = 34 Ω, λ/4 @ 838 MHz
TL3 — Micro Strip; Z_o = 30 Ω, λ/4 @ 838 MHz
Board — 0.032″ Glass Teflon
2 oz. Cu CLAD, ϵ_r = 2.55

FIGURE 2 — OUTPUT POWER versus INPUT POWER

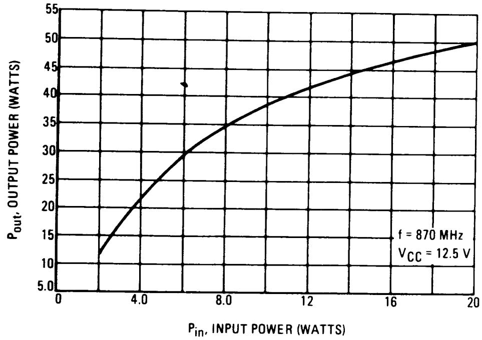


FIGURE 3 — OUTPUT POWER versus FREQUENCY

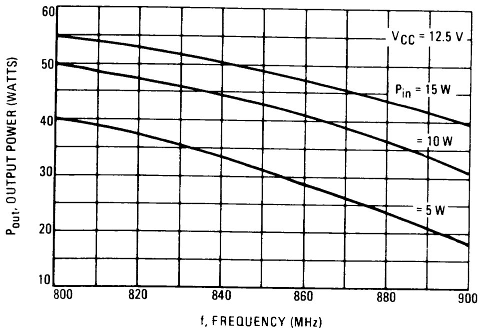


FIGURE 4 — OUTPUT POWER versus SUPPLY VOLTAGE

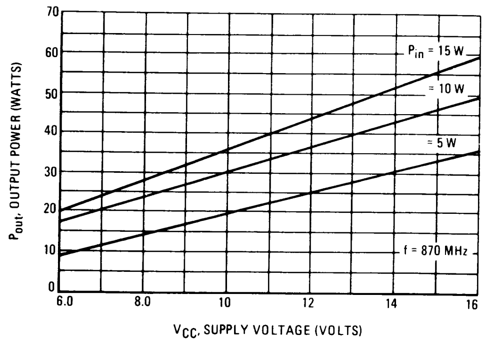
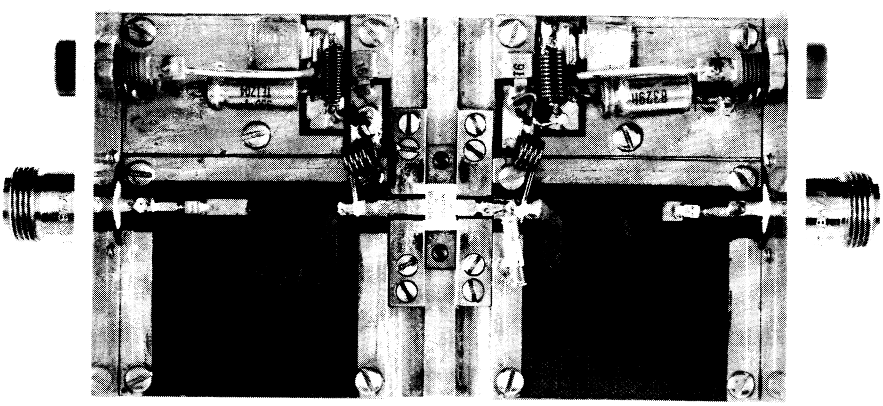
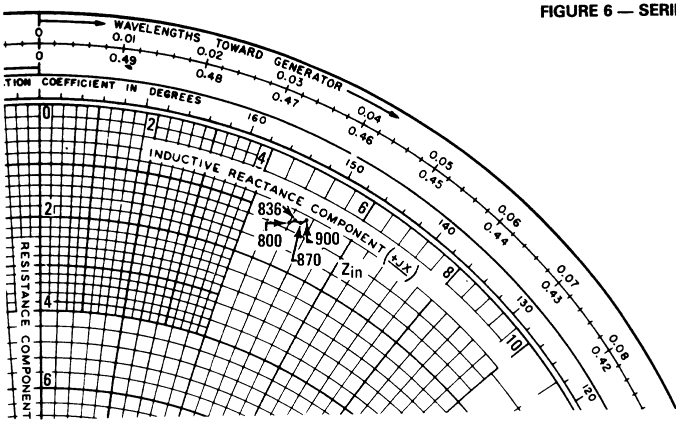


FIGURE 5 — 870 MHz TEST CIRCUIT



3

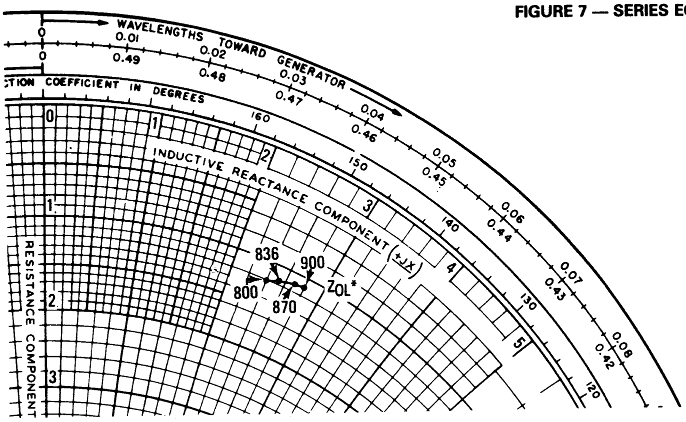
FIGURE 6 — SERIES EQUIVALENT INPUT IMPEDANCES



V_{CC} = 12.5 Vdc, P_{in} = 12 W

f MHz	Z_{in} Ohms
800	1.1 + j4.8
836	1.0 + j4.9
870	1.0 + j5.0
900	0.9 + j5.1

FIGURE 7 — SERIES EQUIVALENT OUTPUT IMPEDANCES



V_{CC} = 12.5 Vdc, P_{out} = 40 W

f MHz	Z_{OL}* Ohms
800	1.2 + j2.4
836	1.15 + j2.5
870	1.1 + j2.7
900	1.1 + j2.8

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

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MRF848

Advance Information

The RF Line

NPN SILICON RF POWER TRANSISTOR

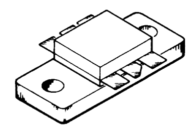
. . . designed for 12.5 Volt UHF large-signal, common base amplifier applications in industrial and commercial FM equipment operating in the range of 804–960 MHz.

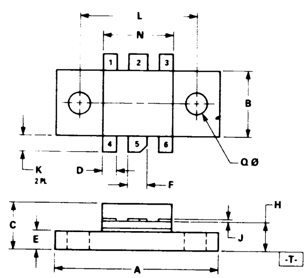
- Motorola Advanced Amplifier Concept Package
- Specified 12.5 Volt, 870 MHz Characteristics
  Output Power = 60 Watts
  Minimum Gain = 4.0 dB
  Efficiency = 60%
- Double Input/Output Matched for Wideband Performance and Simplified External Matching
- Series Equivalent Large-Signal Characterization
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated

60 W 800–960 MHz

RF POWER TRANSISTOR

NPN SILICON





NOTES:
1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM PLANE.
2. POSITIONAL TOLERANCE FOR Q HOLES: ⌖ | ϕ .13 (0.005) Ⓜ | A Ⓜ | B Ⓜ
3. DIMENSION -D- FOUR PLACES. DIMENSION -F- TWO PLACES.
4. DIMENSIONING AND TOLERANCING PER Y14.5M, 1982.
5. CONTROLLING DIMENSION: INCH.

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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	24.51	25.02	0.965	0.985
B	9.91	10.41	0.390	0.410
C	6.86	7.36	0.270	0.290
D	1.91	2.28	0.075	0.090
E	2.42	2.92	0.095	0.115
F	5.47	5.96	0.110	0.130
H	3.94	4.44	0.155	0.175
J	0.10	0.15	0.004	0.006
K	2.29	2.94	0.090	0.116
L	18.41 BSC		0.725 BSC	
N	10.54	11.04	0.415	0.435
Q	3.18	3.42	0.125	0.135

CASE 333A

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16	Vdc
Collector-Base Voltage	V_{CBO}	36	Vdc
Emitter-Base Voltage	V_{EBO}	4.0	Vdc
Collector-Current — Continuous	I_C	14	Adc
Total Device Dissipation @ $T_A = 25°C$ Derate above 25°C	P_D	175 1.0	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.00	°C/W

This document contains information on a new product. Specifications and information herein are subject to change without notice.

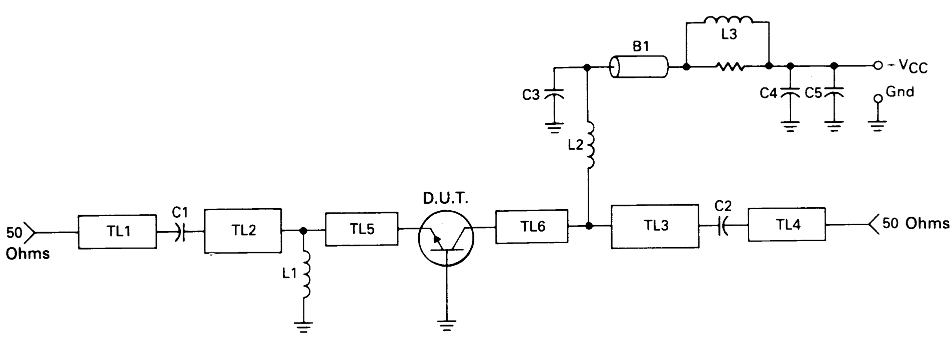
3

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, I_B = 0)	$V_{(BR)CEO}$	16	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 50 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 5.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	—	—	10	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 Adc, V_{CE} = 5.0 Vdc)	h_{FE}	20	50	150	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	—	88	110	pF
FUNCTIONAL TESTS					
Common-Base Amplifier Power Gain (V_{CC} = 12.5 Vdc, P_{out} = 60 W, f = 870 MHz)	G_{pb}	4.0	4.8	—	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 60 W, f = 870 MHz)	η	60	68	—	%
Output Mismatch Stress (V_{CC} = 15.5 Vdc, P_{in} = 24 W, f = 870 MHz, VSWR = 10:1, all phase angles)	ψ	No degradation in output power			

3

FIGURE 1 — 800–870 MHz BROADBAND TEST CIRCUIT



C1, C2 — 39 pF, 100 Mil Chip Capacitor
C3 — 91 pF, Mini Underwood
C4 — 1000 pF, 350 V Unelco
C5 — 10 μF, 35 V Tantulum
L1, L2 — 4 Turns #26 AWG Choke
L3 — 11 Turns #20 AWG Choke on 10 Ohm Resistor
B1 — Bead, Ferroxcube 56-390-65/3B

TL1, TL4 — 50 Ohm Microstrip
TL2 — 17.4 Ohm, θ=85° Microstrip @ 870 MHz
TL3 — 15.9 Ohm, θ=70° Microstrip @ 870 MHz
TL5, TL6 — 140 x 200 Mils
Board Material Epsilam-10 50 Mil

FIGURE 2 — OUTPUT POWER versus INPUT POWER

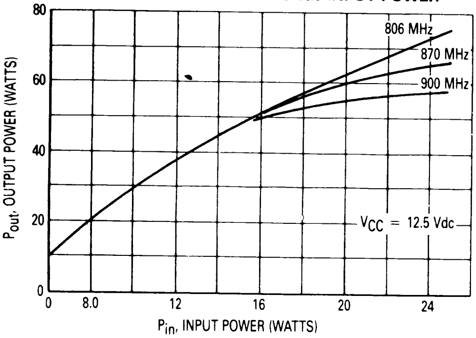


FIGURE 3 — OUTPUT POWER versus SUPPLY VOLTAGE

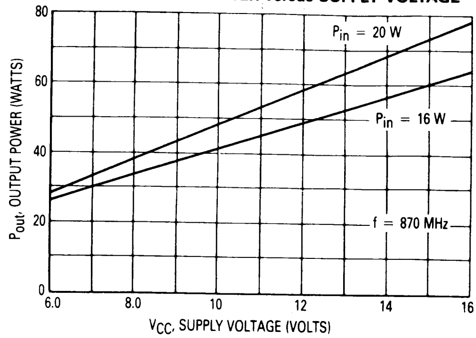


FIGURE 4 — OUTPUT POWER versus FREQUENCY

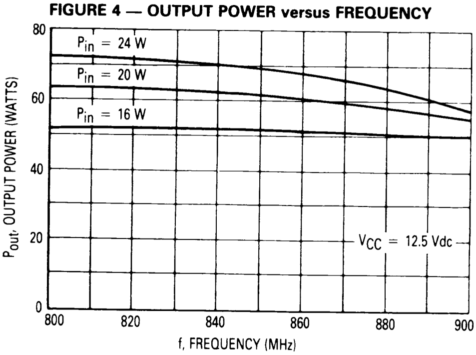


FIGURE 5 — TYPICAL BROADBAND CIRCUIT PERFORMANCE

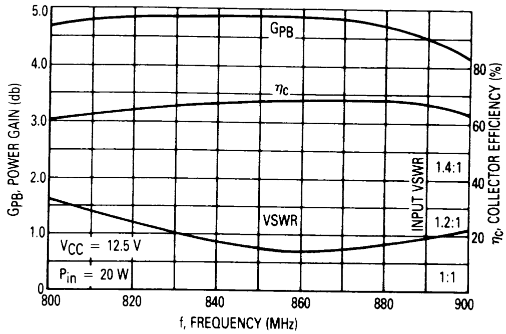
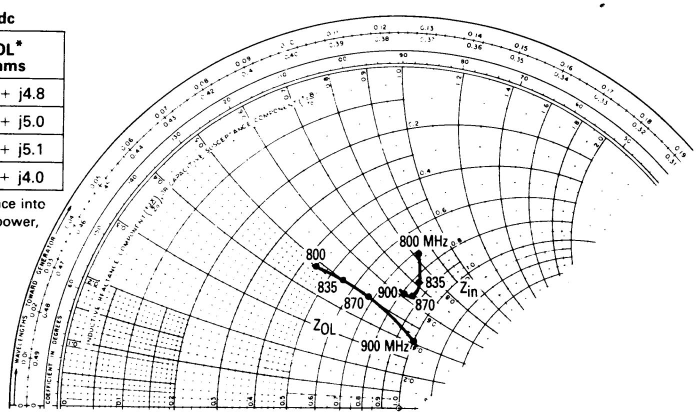


FIGURE 6 — INPUT/OUTPUT IMPEDANCE

P_{out} = 60 Watts, V_{CC} = 12.5 Vdc

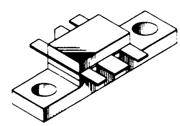
f MHz	Z_{in} Ohms	Z_{OL}* Ohms
800	7.16 + j8.2	4.5 + j4.8
835	8.7 + j6.9	5.45 + j5.0
870	8.76 + j6.17	6.75 + j5.1
900	8.25 + j6.06	10.2 + j4.0

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



MRF873

15 W 806-960 MHz
RF POWER TRANSISTOR
COMMON-EMITTER
NPN SILICON



CASE 319-04

The RF Line

NPN Silicon RF Power Transistor

. . . designed for 12.5 Volt UHF large-signal, **common-emitter** applications in industrial and commercial FM equipment operating in the range of 806–960 MHz.

- Specified 12.5 Volt, 870 MHz Characteristics
  Output Power = 15 Watts
  Minimum Gain = 7 dB
  Efficiency = 60%
- Internally Matched Input for Broadband Operation
- Series Equivalent Large-Signal Characterization
- Capable of withstanding 20:1 VSWR Load Mismatch at Rated Input Power and 15.5 Vdc
- Gold Metallized, Emitter Ballasted for Long Life and Resistance to Metal Migration
- Silicon Nitride Passivated

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	16.5	Vdc
Collector-Emitter Voltage	V_{CES}	38	Vdc
Emitter-Base Voltage	V_{EBO}	4	Vdc
Collector-Current — Continuous	I_C	2.4	Adc
Operating Junction Temperature	T_J	200	°C
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	44 0.25	Watts W/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	4	°C/W

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

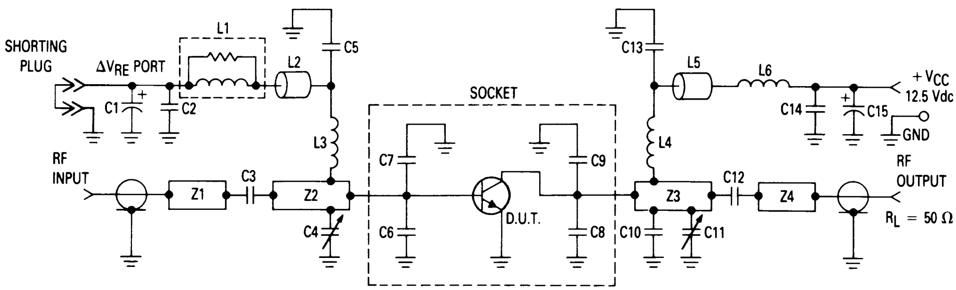
Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 20 mAdc, I_B = 0)	$V_{(BR)CEO}$	16.5	—	—	Vdc
Collector-Emitter Breakdown Voltage (I_C = 20 mAdc, V_{BE} = 0)	$V_{(BR)CES}$	38	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 5 mAdc, I_C = 0)	$V_{(BR)EBO}$	4	—	—	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, V_{BE} = 0, T_C = 25°C)	I_{CES}	—	—	5	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 1 Adc, V_{CE} = 5 Vdc)	h_{FE}	40	—	200	—
DYNAMIC CHARACTERISTICS					
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 1 MHz)	C_{ob}	—	19.5	25	pF

(continued)

(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.
(2) Thermal Resistance is determined under specified RF operating conditions by infrared measurement techniques.

ELECTRICAL CHARACTERISTICS — continued (T_C = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (Broadband) (V_{CC} = 12.5 Vdc, P_{out} = 15 W, f = 870 MHz)	G_{pe}	7	8	—	dB
Collector Efficiency (V_{CC} = 12.5 Vdc, P_{out} = 15 W, f = 870 MHz)	η	60	69	—	%
Load Mismatch Stress (V_{CC} = 15.5 Vdc, f = 870 MHz, P_{in} = 3 W, VSWR = 20:1, all phase angles)	ψ	No degradation in output power			



C1, C15 — 10 μF, 25 V Tantalum
C2, C14 — 1000 pF, 350 V Unelco
C3, C12 — 43 pF, 100 Mil ATC Chip Capacitor
C5, C13 — 91 pF, Mini-Unelco
C4, C11 — 0.8-8 pF Johansen Gigatrim 7290 Variable
C6 — 16 pF Mini-Underwood
C7, C8, C9 — 12 pF Mini-Underwood
C10 — 10 pF Mini-Underwood

NOTE: C11 ≈ 0.4″ down Z3 from socket edge.

L1 — 13 Turn #20 AWG Around 10 Ω 1/2 W Resistor
L2, L5 — Ferroxcube Bead #56-590-65-3B
L3, L4 — 4 Turns #20 AWG Choke ID 0.2″
L6 — 6 Turns #20 AWG Choke ID 0.2″
Z1, Z4 — 50 Ohm Microstrip
Z2 — 36 Ohm Microstrip λ/4 @ 838 MHz
Z3 — 26 Ohm Microstrip λ/4 @ 838 MHz
Board Material — 0.032″ Glass Teflon 2 oz. Copper Clad ϵ_r = 2.55

Figure 1. 806–900 MHz Broadband Test Fixture

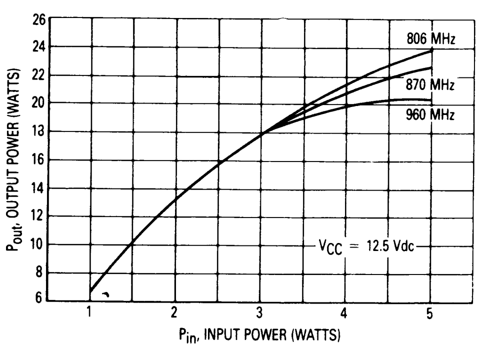


Figure 2. Output Power versus Input Power

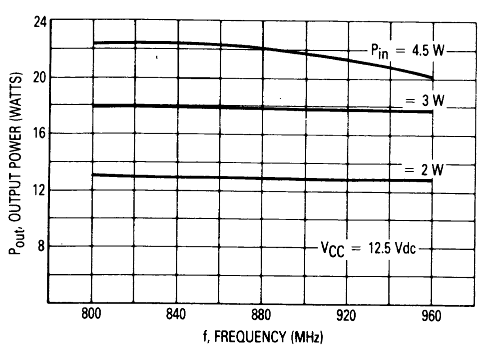


Figure 3. Output Power versus Frequency

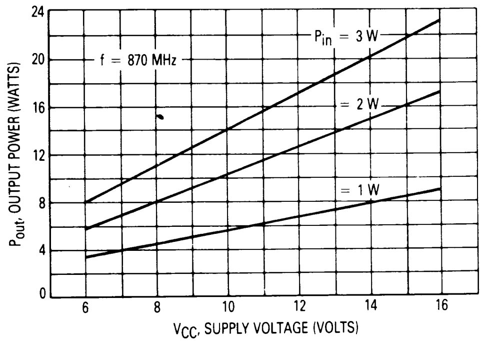


Figure 4. Output Power versus Supply Voltage

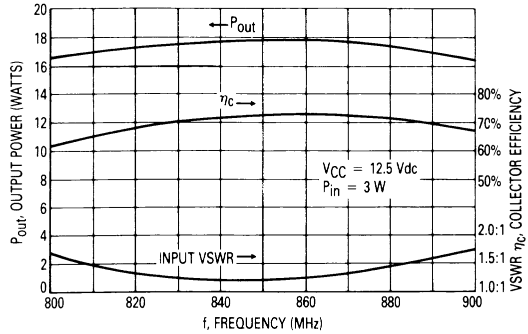


Figure 5. Typical Performance in Broadband Test Fixture

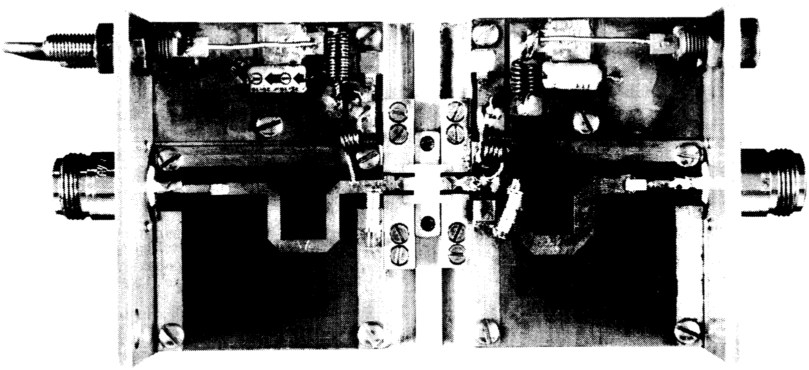


Figure 6. Photo Test Circuit

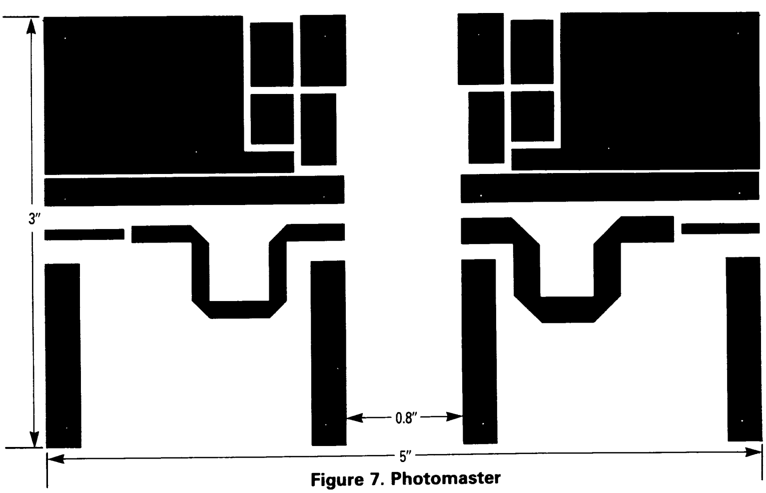
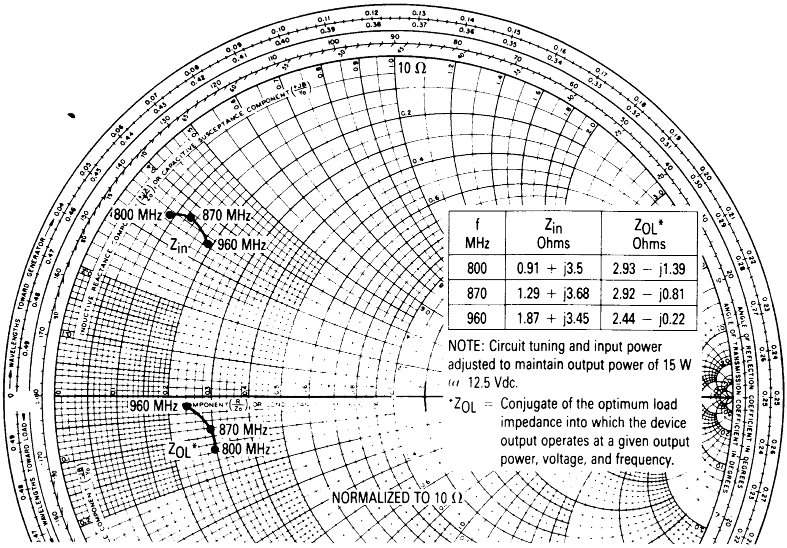


Figure 7. Photomaster

NOTE: The Printed Circuit Board shown is 75% of the original.

3



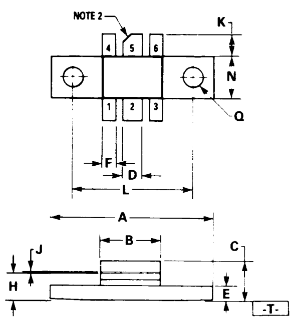
f MHz	Z_{in} Ohms	Z_{OL}* Ohms
800	0.91 + j3.5	2.93 − j1.39
870	1.29 + j3.68	2.92 − j0.81
960	1.87 + j3.45	2.44 − j0.22

NOTE: Circuit tuning and input power adjusted to maintain output power of 15 W @ 12.5 Vdc.

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

Figure 8. Series Equivalent Input/Output Impedances

OUTLINE DIMENSIONS



NOTES:
1. POSITIONAL TOLERANCE FOR Q HOLES: | ⌖ | ⌀ 0.15 (0.006) Ⓜ | T | A Ⓜ | N Ⓜ |
2. IDENTIFICATION NOTCH 1.0mm (0.04) MIN X 45°.
3. DIM D APPLIES 2 PLACES, DIM K APPLIES 2 PLACES, DIM Q APPLIES 2 PLACES, DIM F APPLIES 4 PLACES.
4. DIMENSIONS A AND N ARE DATUMS AND [-T-] IS DATUM SURFACE.
5. DIMENSION B APPLIES TO LEAD FRAME AND Beo.
6. POSITIONAL TOLERANCE FOR D TERMINAL AND DIMENSION B: | ⌖ | 0.38 (0.15) Ⓜ | T | A Ⓜ | N Ⓜ |

CASE 319-04

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	24.51	25.02	0.965	0.985
B	9.02	9.52	0.355	0.375
C	5.84	6.60	0.230	0.260
D	2.92	3.18	0.115	0.125
E	2.69	2.95	0.106	0.116
F	1.91	2.16	0.075	0.085
H	4.06	4.31	0.160	0.170
J	0.10	0.15	0.004	0.006
K	2.29	2.79	0.090	0.110
L	18.42 BSC		0.725 BSC	
N	5.72	6.12	0.225	0.241
Q	3.18	3.43	0.125	0.135

STYLE 2:
PIN 1. EMITTER (COMMON)
2. BASE (INPUT)
3. EMITTER (COMMON)
4. EMITTER (COMMON)
5. COLLECTOR (OUTPUT)
6. EMITTER (COMMON)