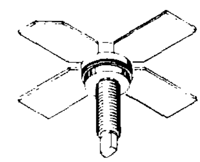
MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

2N5944
2N5945
2N5946

The RF Line

2

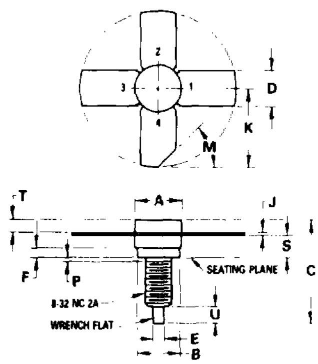
2.0, 4.0, 10 W - 470 MHz
RF POWER
TRANSISTORS
NPN SILICON



NPN SILICON RF POWER TRANSISTORS

. . . designed for 7.0 to 15 Volts, UHF large signal amplifier applications required in industrial and commercial FM equipment operating in the 400 to 960 MHz range.

- Specified 12.5 Volt, 470 MHz Characteristics -
  Power Output = 2.0 W 2N5944
  4.0 W - 2N5945
  10 W - 2N5946
  Minimum Gain = 9.0 dB - 2N5944
  8.0 dB 2N5945
  6.0 dB 2N5946
  Efficiency = 60% Minimum
- Characterized with series equivalent large-signal impedance parameters



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

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

CASE 244-04

MAXIMUM RATINGS

Rating	Symbol	2N5944	2N5945	2N5946	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	0.4	0.8	2.0	Adc
*Total Device Dissipation @ $T_C = 25^{\circ}C$ (1) Derate above 25°C	P_D	5.0 28.5	15 85.5	37.5 214	Watts mW/°C
*Storage Temperature Range	T_{stg}	← -65 to +200 →			°C
Stud Torque (2)		← 6.5 →			in-lbs

*Indicates JEDEC Registered Data
(1) These devices are designed for RF operation. The total device dissipation rating applies only when the devices are operated as RF amplifiers.
(2) For repeated assembly use 5 in lbs.

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage		$V_{(BR)CEO}$				Vdc
(I_C = 50 mAdc, I_B = 0)	2N5944		16	–		
(I_C = 100 mAdc, I_B = 0)	2N5945		16		–	
(I_C = 200 mAdc, I_B = 0)	2N5946		16	–	–	
Collector-Emitter Breakdown Voltage		$V_{(BR)CES}$				Vdc
(I_C = 50 mAdc, V_{BE} = 0)	2N5944		36	–	–	
(I_C = 100 mAdc, V_{BE} = 0)	2N5945		36	–		
(I_C = 200 mAdc, V_{BE} = 0)	2N5946		36	–	–	
Emitter-Base Breakdown Voltage		$V_{(BR)EBO}$				Vdc
(I_E = 1.0 mAdc, I_C = 0)	2N5944		4.0	–	–	
(I_E = 2.0 mAdc, I_C = 0)	2N5945		4.0	–	–	
(I_E = 4.0 mAdc, I_C = 0)	2N5946		4.0	–	–	
Collector Cutoff Current		I_{CES}				mAdc
(V_{CE} = 15 Vdc, V_{BE} = 0, T_C = 55°C)	2N5944		–	0.2	10	
	2N5945,2N5946		–	0.5	20	
Collector Cutoff Current		I_{CBO}				mAdc
(V_{CB} = 15 Vdc, I_E = 0)	2N5944,2N5945				1.0	
	2N5946		–		2.0	
ON CHARACTERISTICS						
DC Current Gain		h_{FE}				–
(I_C = 100 mAdc, V_{CE} = 5.0 Vdc)	2N5944		20	80	–	
(I_C = 200 mAdc, V_{CE} = 5.0 Vdc)	2N5945		20	80	–	
(I_C = 500 mAdc, V_{CE} = 5.0 Vdc)	2N5946		20	80	–	
DYNAMIC CHARACTERISTICS						
Output Capacitance		C_{ob}				pF
(V_{CB} = 12.5 Vdc, I_E = 0, f = 1.0 MHz)	2N5944			11	15	
	2N5945			18	25	
	2N5946			38	45	
FUNCTIONAL TEST (Figures 20 and 21).						
Common-Emitter Amplifier Power Gain		G_{PE}				dB
(V_{CC} = 12.5 Vdc, P_{out} = 2.0 W, I_C(max) = 267 mAdc, f = 470 MHz)	2N5944		9.0	10		
(V_{CC} = 12.5 Vdc, P_{out} = 4.0 W, I_C(max) = 533 mAdc, f = 470 MHz)	2N5945		8.0	9.0	–	
(V_{CC} = 12.5 Vdc, P_{out} = 10 W, I_C(max) = 1.33 Adc, f = 470 MHz)	2N5946		6.0	7.0		
Collector Efficiency		η				%
(V_{CC} = 12.5 Vdc, P_{out} = 2.0 W, I_C(max) = 240 mAdc, f = 470 MHz)	2N5944		60			
(V_{CC} = 12.5 Vdc, P_{out} = 4.0 W, I_C(max) = 500 mAdc, f = 470 MHz)	2N5945		60	–	–	
(V_{CC} = 12.5 Vdc, P_{out} = 10 W, I_C(max) = 1.3 Adc, f = 470 MHz)	2N5946		60		–	

*Indicates JEDEC Registered Data

These devices are available in various packages, such as a studless stripline package, TO-205AD (TO-39) and also in chip form on beryllium oxide carriers for hybrid assemblies.

For further information, contact your nearest Motorola representative or the factory representative.

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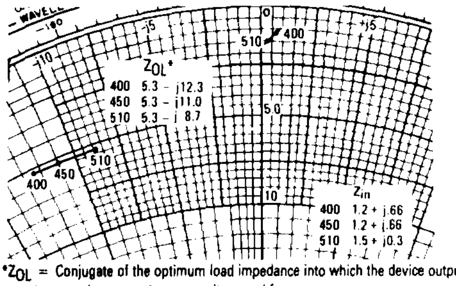
2N5944
TYPICAL PERFORMANCE DATA

FIGURE 1 – SERIES EQUIVALENT IMPEDANCE



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

V_{CC} = 12.5 Vdc, P_{out} = 2.0 W

FIGURE 2 – OUTPUT POWER versus SUPPLY VOLTAGE

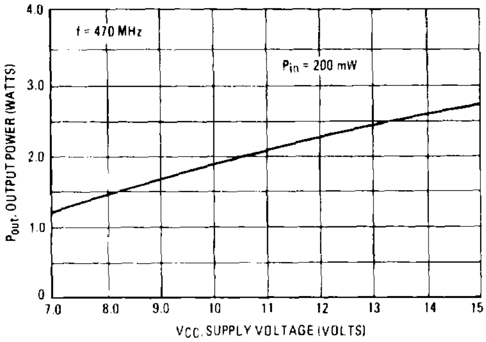


FIGURE 3 – OUTPUT POWER versus INPUT POWER

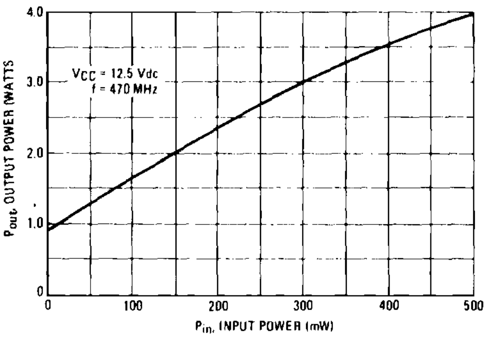


FIGURE 4 – OUTPUT POWER versus FREQUENCY

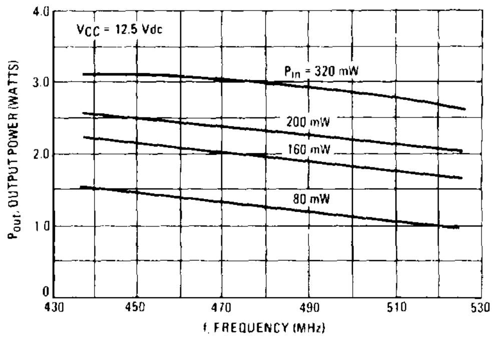


FIGURE 5 – OUTPUT POWER versus INPUT POWER

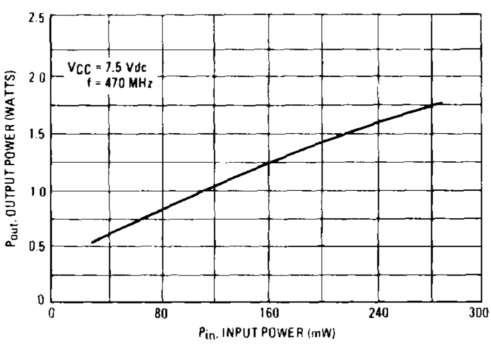
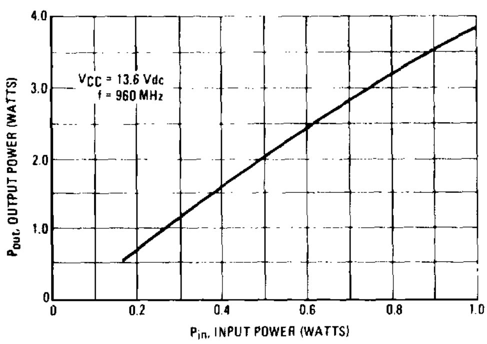
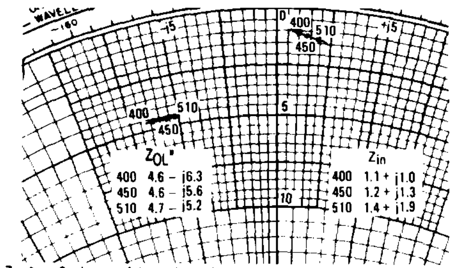


FIGURE 6 – OUTPUT POWER versus INPUT POWER



2N5945
TYPICAL PERFORMANCE DATA

FIGURE 7 – SERIES EQUIVALENT IMPEDANCE



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

V_{CC} = 12.5 Vdc, P_{out} = 4.0 W

FIGURE 8 – OUTPUT POWER versus SUPPLY VOLTAGE

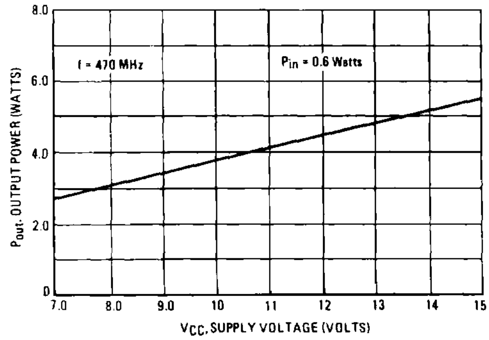


FIGURE 9 – OUTPUT POWER versus INPUT POWER

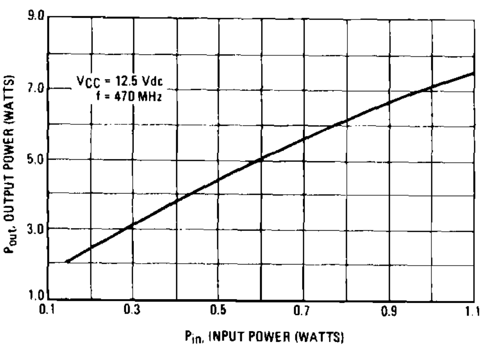


FIGURE 10 – OUTPUT POWER versus FREQUENCY

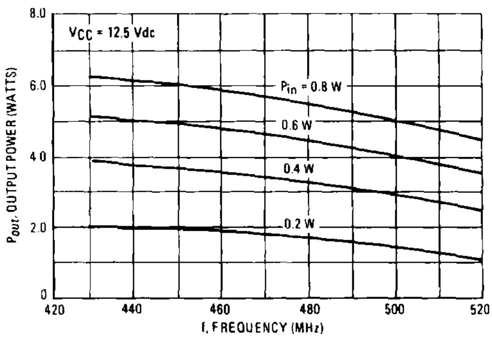


FIGURE 11 – OUTPUT POWER versus INPUT POWER

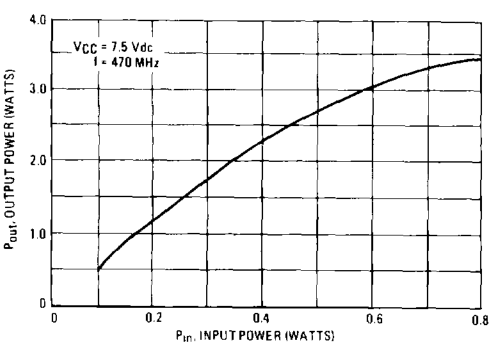
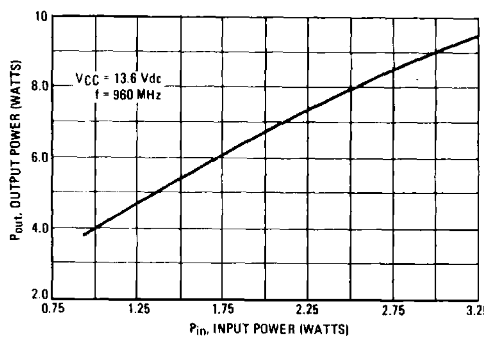


FIGURE 12 – OUTPUT POWER versus INPUT POWER



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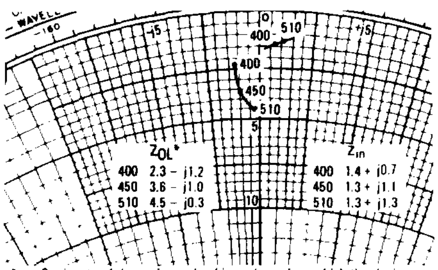
2N5946
TYPICAL PERFORMANCE DATA

FIGURE 13 – SERIES EQUIVALENT IMPEDANCE



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

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

FIGURE 14 – OUTPUT POWER versus SUPPLY VOLTAGE

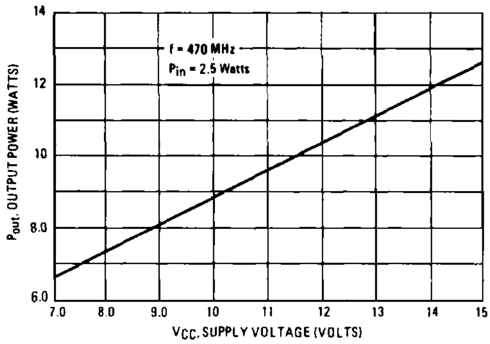


FIGURE 15 – OUTPUT POWER versus INPUT POWER

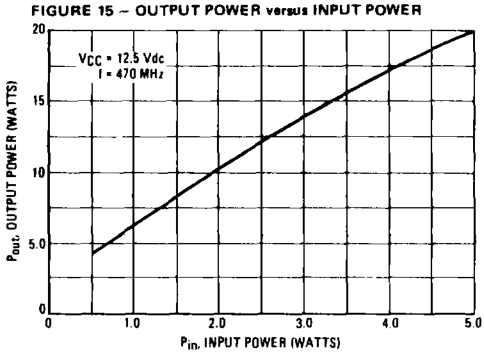


FIGURE 16 – OUTPUT POWER versus FREQUENCY

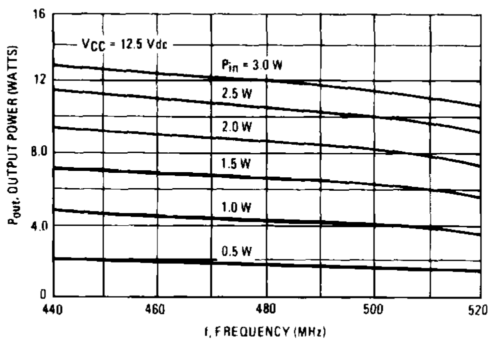


FIGURE 17 – OUTPUT POWER versus INPUT POWER

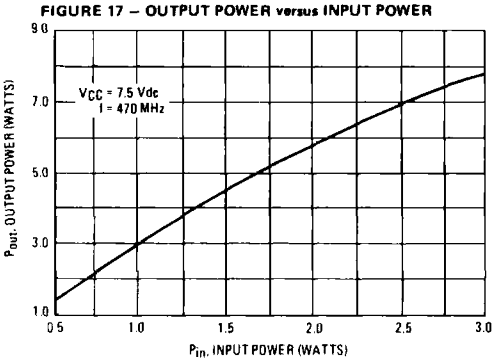
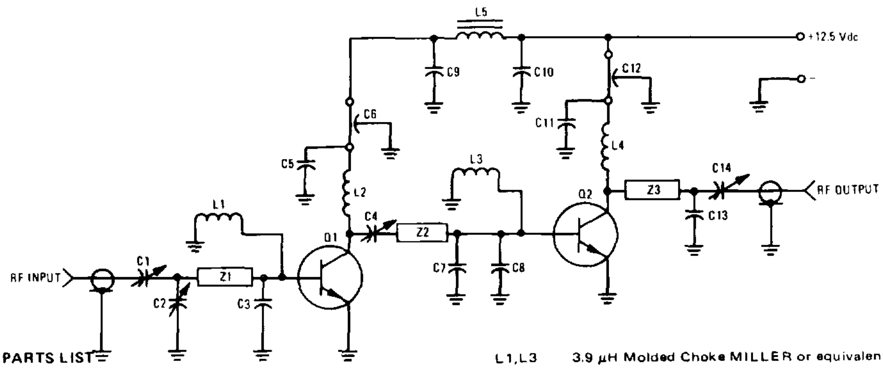


FIGURE 18 — 10-WATT BROADBAND UHF AMPLIFIER



PARTS LIST

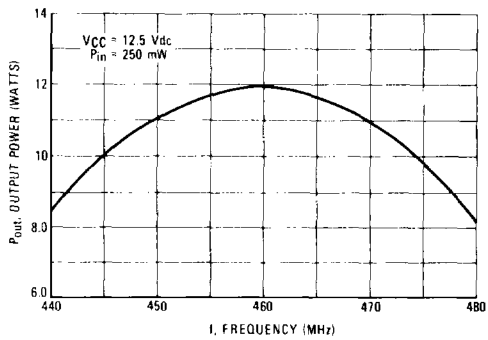
C1,C2,C4,C13,C14	0.9-7.0 pF ARCO 400 or equivalent
C3,C7,C8	25 pF UNELCO or equivalent
C5,C11	0.1 μF Ceramic 35 V
C6,C12	680 pF ALLEN BRADLEY Feedthru
C9,C10	1.0 μF, 35 V Tantalum
L1,L3	3.9 μH Molded Choke MILLER or equivalent
L2,L4	5 Turns #18 AWG Enameled 0.2" I.D.
L5	FERROXCUBE Ferrite Choke VK200 20/4B
Z1,Z2,Z3	Microstrip Lines (See Template Below)
Q1	2N5944
Q2	2N5946

10 W AMPLIFIER PERFORMANCE

V_{CC} = 12.5 Vdc

Frequency MHz	P_{in} mW	P_{out} W	I_C Amp
440	250	8.5	1.5
450	250	11	1.6
460	250	12	1.6
470	250	10.9	1.5
480	250	8.2	1.2

FIGURE 19 – OUTPUT POWER versus FREQUENCY



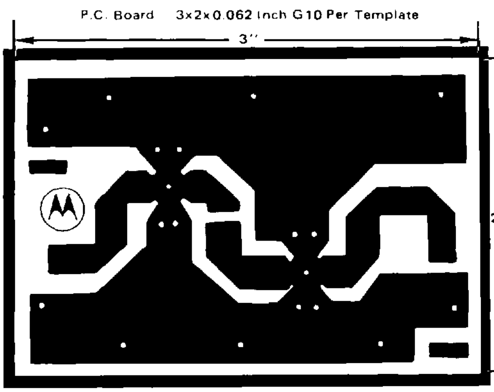


FIGURE 20 — PC BOARD PHOTOMASTER — 10 WATT BROADBAND AMPLIFIER

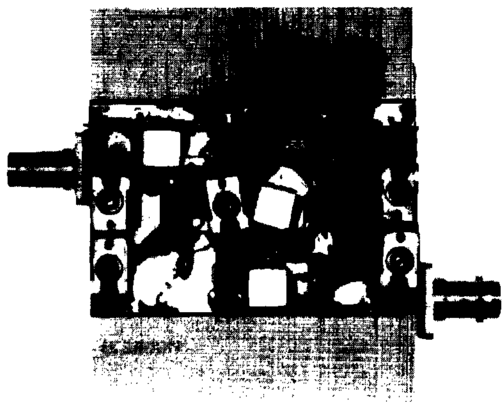


FIGURE 21 — PHOTO OF 10 WATT BROADBAND AMPLIFIER

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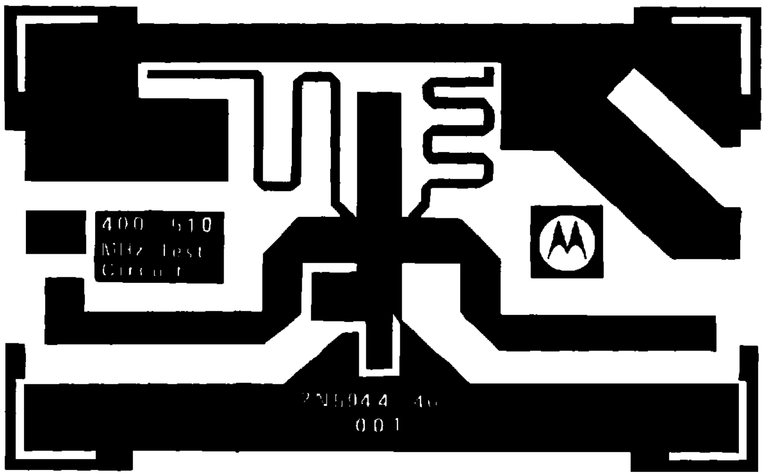
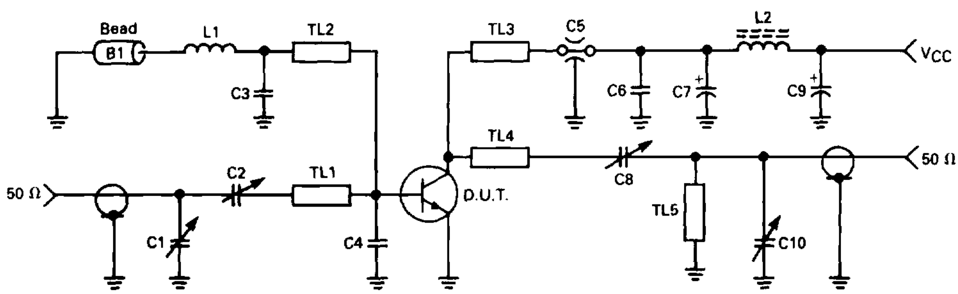


NOTE: The Printed Circuit Board shown is 75% of the original.

FIGURE 22 — 470 MHz TEST CIRCUIT



C1, C2, C8, C10 — Johanson Trimmer, JMC #5501
C3 — 100 pF Unelco 350 Vdc J101
C4 — 15 pF Unelco
C5 — 680 pF Allen Bradley Feed-Thru
C6 — 0.1 μF Monolithic
C7 — 1 μF Tantalum Sprague ±10% 35 Vdc
C9 — 5 μF Electrolytic 5–25 Vdc

TL1 — Micro Strip 0.26" x 2.9"
TL2 — Micro Strip 0.055" x 3.9"
TL3 — Micro Strip 0.055" x 2.9"
TL4 — Micro Strip 0.26" x 2.9"
TL5 — Micro Strip 0.50" x 1.2"
L1 — #18 AWG Wire 0.750" Long
L2 — VK200 20/4B
B1 — Ferroxcube Bead, 56-590-65-3B

Board — 0.062" Glass Teflon
2 oz. Cu CLAD
ϵ_r = 2.56

FIGURE 23 — 470 MHz TEST CIRCUIT SCHEMATIC