MOTOROLA

MHW613

The RF Line

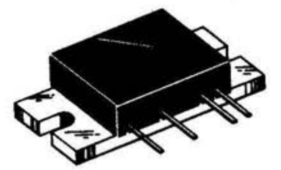
VHF POWER AMPLIFIER MODULE

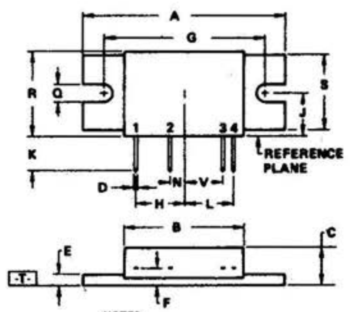
. . . designed for 12.5 volt VHF power amplifier applications in industrial and commercial FM equipment operating to 174 MHz.

- Frequency Range — 150 to 174 MHz
- Specified 12.5 Volt, VHF Characteristics
  - Output Power = 30 Watts
  - Minimum Gain = 20 dB
  - Harmonics = −30 dB
- 50 Ω Input/Output Impedances
- Guaranteed Stability and Ruggedness
- Gain Control Pin for Manual or Automatic Output Level Control
- Thin Film Hybrid Construction Gives Consistent Performance and Reliability

30 W — 150-174 MHz

RF POWER AMPLIFIER MODULE





NOTES:
1. DIMENSIONS A AND S ARE DATUMS.
2. [-T-] IS DATUM AND SEATING PLANE.
3. POSITIONAL TOLERANCE FOR SLOTS:
   ◆ | 0.25 (0.010) Ⓜ | T | S Ⓜ | A Ⓜ
   LEADS: (MEASURED AT REF PLANE)
   ◆ | 0.25 (0.010) Ⓜ | T | A Ⓜ | S Ⓜ
4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1973.

STYLE 1:
PIN 1. RF OUTPUT
2. + DC
3. + DC/GAIN
4. RF INPUT
Mounting Flange is Ground.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	44.60	45.36	1.756	1.786
B	26.54	26.80	1.045	1.055
C	8.38	8.89	0.330	0.350
D	0.46	0.56	0.018	0.022
E	2.54	2.92	0.100	0.115
F	3.18	3.94	0.125	0.155
G	35.41 BSC		1.410 BSC	
H	10.80 BSC		0.425 BSC	
J	9.40	9.65	0.370	0.380
K	7.62	–	0.300	–
L	11.30 BSC		0.445 BSC	
N	3.18 BSC		0.125 BSC	
Q	3.81	4.06	0.150	0.160
R	18.80	19.30	0.740	0.760
S	16.51	16.76	0.650	0.660
V	8.76 BSC		0.345 BSC	

CASE 301A-03

MAXIMUM RATINGS (Flange Temperature = 25°C)

Rating	Symbol	Value	Unit
DC Supply Voltages	V_s, V_{sc}	16	Vdc
RF Input Power	P_{in}	500	mW
RF Output Power ($V_s = V_{sc} = 12.5$ V)	P_{out}	40	W
Storage Temperature Range	T_{stg}	−65 to +125	°C
Operating Case Temperature Range	T_C	−30 to +100	°C

ELECTRICAL CHARACTERISTICS (Flange Temperature = 25°C, 50 Ω system, and $V_s = V_{sc}$ = 12.5 V unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Frequency Range	BW	150	—	174	MHz
Input Power (P_{out} = 30 W)	P_{in}	—	—	300	mW
Power Gain (P_{out} = 30 W)	G_p	20	—	—	dB
Efficiency (P_{out} = 30 W)	η	40	—	—	%
Harmonic Output (P_{out} = 30 W Reference)	—	—	—	-30	dB
Input Impedance (P_{in} = 300 mW, 50 Ω Reference, V_{sc} set for P_{out} = 30 W)	Z_{in}	—	—	2:1	VSWR
Power Degradation (-30 to +80°C) (P_{in} = 300 mW, V_{sc} set for P_{out} = 30 W @ T_C = 25°C)	—	—	—	0.7	dB
Load Mismatch Stress ($V_s = V_{sc}$ = 15.5 Vdc, P_{out} = 40 W, VSWR = 30:1, all phase angles)	—	No degradation in Power Output			
Stability 1. (P_{in} = 100 to 400 mW, $V_s = V_{sc}$ = 9.5 to 15.5 V, $P_{out} \leq$ 40 W, Load VSWR = 3:1) 2. (V_s = 12.5 V, V_{sc} = 0 to 12.5 V, P_{in} = 300 mW, Load VSWR = 3:1)	All spurious outputs ≥70 dB below the desired output signal level				

FIGURE 1 — TEST CIRCUIT

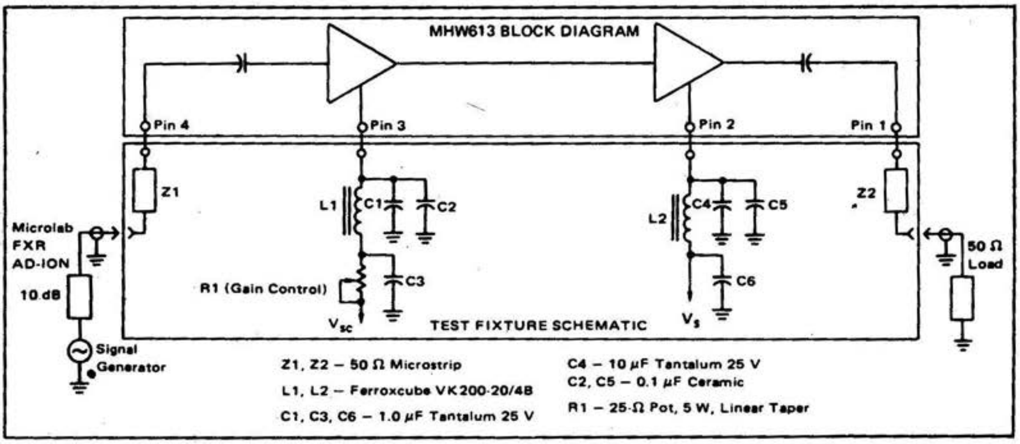


FIGURE 2 — INPUT POWER, EFFICIENCY AND VSWR versus FREQUENCY

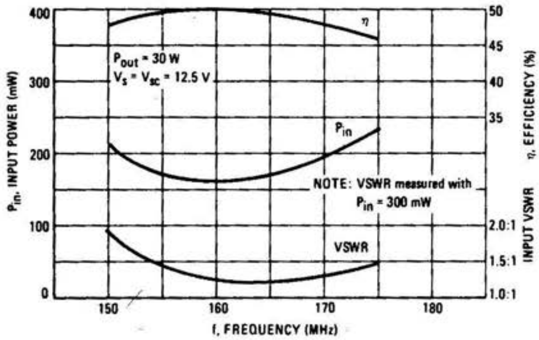


FIGURE 3 — OUTPUT POWER versus INPUT POWER

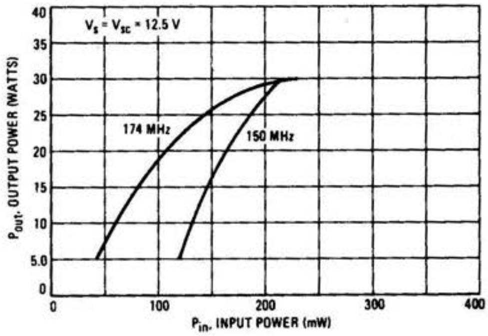


FIGURE 4 — OUTPUT POWER versus VOLTAGE

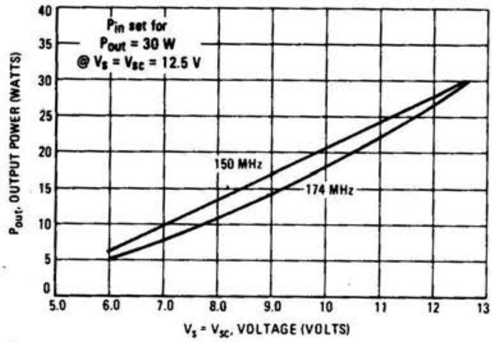


FIGURE 5 — GAIN CONTROL CURRENT versus CONTROL VOLTAGE

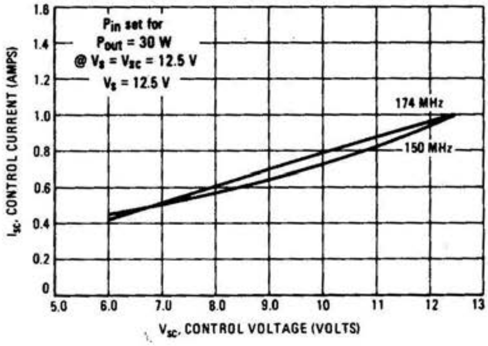


FIGURE 6 — OUTPUT POWER versus GAIN CONTROL VOLTAGE

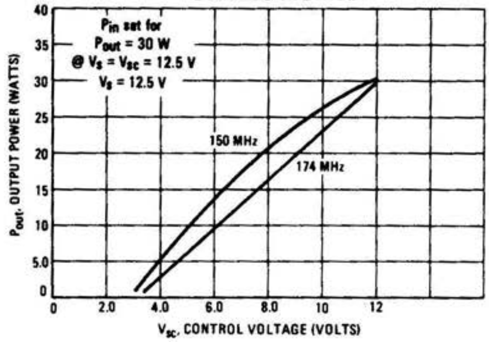
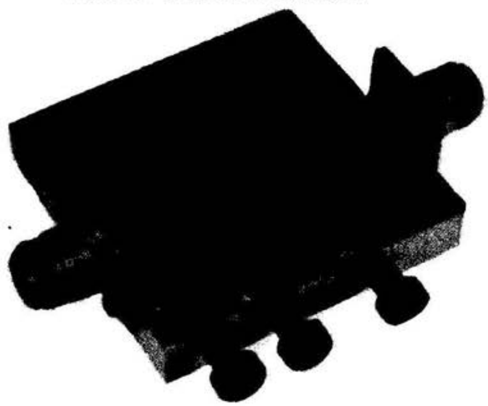


FIGURE 8 — TEST CIRCUIT ASSEMBLY



APPLICATIONS INFORMATION

Nominal Operation

All electrical specifications are based on the following nominal conditions: (P_{in} = 300 mW, V_S = 12.5 V, V_{SC} adjusted for 30 W P_{out}). These modules are designed to have excess gain margin with ruggedness, but operation outside the limits of published specifications is not recommended unless prior communications regarding intended use has been made with a factory representative.

Gain Control

In general, the module output power should be limited to 35 watts. The preferred method of power output control is to fix both V_{SC} and V_S at 12.5 volts and to vary the input RF drive level at Pin 4. The next method is to control V_{SC} through a stiff voltage source.

A third method of power output control is to control V_{SC} through a current source or a voltage source with series resistance. This mode of control creates a region of negative slope on the power gain profile curve and aggravates output power slump with temperature.

Operation at $P_{out} \leq 1.0$ Watt

Marine VHF radio applications usually require the transmitter RF output power be reduced to less than one watt during in-harbor operation. This may be achieved with the MHW613 by removing the dc voltage from the module output stage, i.e., V_S (Pin 2) = 0, and leaving Pin 2 open circuit. With V_S = 0, V_{SC} (Pin 3) = 12.5 V and the RF power input = 300 mW, the module RF output power P_{out} is typically in the range $0.3\ W < P_{out} < 1.0\ W$.

The above technique of operating the module at low RF output power is preferred over methods utilizing low RF input power and/or low supply voltage which tends to have gain stability problems and potential generation of spurious outputs.

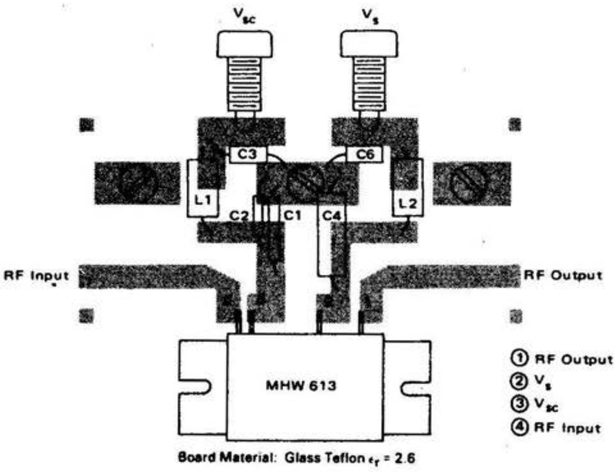
Decoupling

Due to the high gain of each of the two stages and the module size limitation, external decoupling networks require careful consideration. Both Pins 2 and 3 are internally bypassed with a 0.018 μF chip capacitor effective for frequencies of 5 MHz through 174 MHz. For bypassing frequencies below 5 MHz, networks equivalent to that shown in the test figure schematic are recommended. Inadequate decoupling will result in spurious outputs at specific operating frequencies and phase angles of input and output VSWR less than 4:1.

Load Pull

During final test, each module is "load pull" tested in a fixture having the identical decoupling network described in Figure 1. Electrical conditions are V_S and V_{SC} equal to 15.5 volts output, VSWR 30:1 and output power equal to 40 watts.

FIGURE 7 – VHF POWER MODULE TEST FIXTURE PRINTED CIRCUIT BOARD



Board Material: Glass Teflon ϵ_r = 2.6

See Figure 1 for component values.