A WIDEBAND RF PREAMPLIFIER

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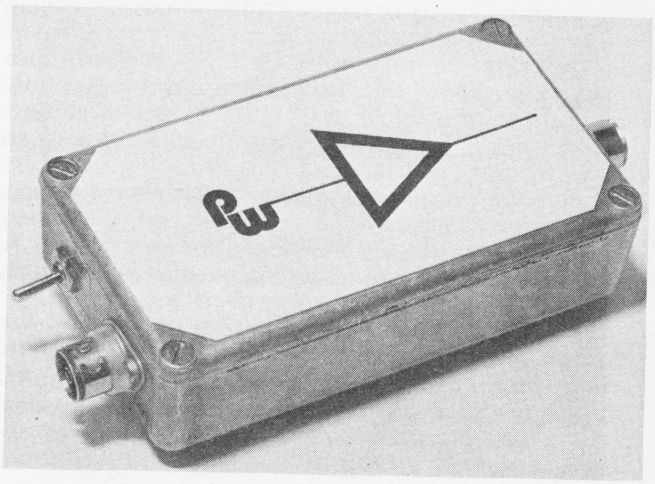
The wideband r.f. pre-amplifier described in this article provides a gain of greater than 20dB over a wide range of frequencies from 200kHz to over 50MHz, making it ideal for use with a large variety of test equipment including oscilloscopes, r.f. voltmeters, digital frequency meters and wavemeters. The unit can enable a considerable increase in sensitivity to be achieved which is particularly useful when measuring very low voltage signals. It can also be used as an untuned pre-amplifier for use with receivers on all bands from l.f. to v.h.f.—it will give a useful boost to the performance of any receiver when an inefficient aerial system is being used, for example.

The pre-amp is powered by an internal 9V battery—this further adds to its versatility when it is used as an r.f. "gain block". In this role, it can be inserted into the signal line whenever the need arises.



Circuit

The complete circuit of the device is shown in Fig. 1. The transistor is operated in the common-emitter mode; its base bias is made adjustable by means of VR1. A relatively low value of collector load resistor is employed and this, together with the very high transition frequency (2GHz at 10mA collector current) of the specified transistor, ensures a flat response over a very wide frequency range. Signals are capacitively coupled into and out of the stage; the values of coupling capacitor were chosen so that low frequency roll-off occurs at approximately 200kHz.

★ specification

Amateur Band Performance

Frequency (MHz)	Gain (dB)
1·8	
3·5	22
7	
14	
21	21·5
28	21
70	19·5
144	17

Input Impedance
250Ω (measured at 10MHz)

Output Impedance
400Ω (measured at 10MHz)

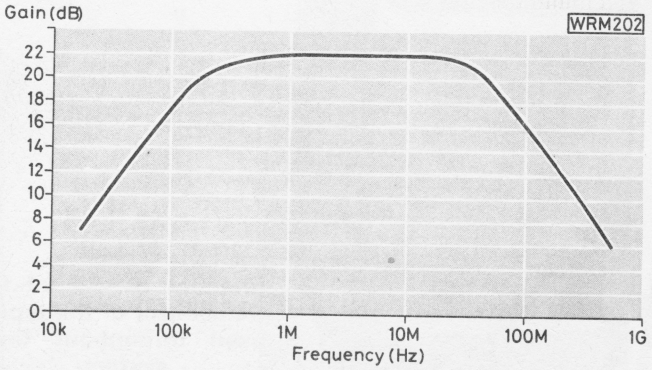
Gain
20dB over the range 200kHz to 50MHz
10dB over the range 30kHz to 200MHz
(measured with 50Ω source and load impedances)

Minimum Source and Load Impedance
50Ω

Power Requirements
9V at 17·5mA (typical)

Construction

With the exception of the coaxial sockets, battery and switch, all the components are mounted on a small printed circuit board; the copper track pattern and component layout are shown in Fig. 2. *Constructors are strongly advised to follow the recommended p.c.b. layout* as the performance at high frequencies (50MHz and upwards) largely depends upon the stray reactances present in the circuit. If the layout is not used then it is most important to



Frequency response

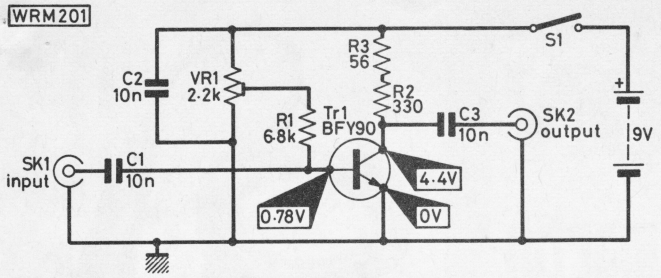


Fig. 1: Circuit diagram. Note that the top end of C2 should go to the junction of R2/R3, not to +9V as shown

keep the wiring as neat and compact as possible, and to ensure that an adequate earth plane (e.g., copper foil or tinplate) is used for all common earth connections. Take care to insert the transistor correctly and to cut the lead-wires as short as possible (about 2·5mm); the object is to mount Tr1 so that its underside is flush with the surface of the p.c.b.

The circuit board is mounted in a diecast or aluminium box using four short threaded spacers—these should be of metal in order to ensure an effective earth connection to the case. The input connection should be taken directly from the input socket (SK1) and a short length of coaxial cable (miniature 50Ω) should be used to link the p.c.b. to the output socket (SK2). The choice of type of socket is left to the individual constructor as it must obviously be compatible with the rest of his equipment. Suitable types are 50Ω BNC, "UHF" (SO239) or standard Belling-Lee sockets.

The PP3 or similar type of battery should be housed inside the box adjacent to the p.c.b. and may be retained by means of a small aluminium bracket. For the electrical connection, use a snap-fit battery connector.

Initial Checks and Use

Having carefully inspected the printed circuit board and its associated wiring, connect the battery, switch on and measure the supply current which should be 10–20mA. If this is not the case, adjust VR1 until 15mA is being drawn from the battery. Now connect the pre-amplifier into the coaxial line between aerial and receiver and then tune to a steady carrier between 5 and 15MHz. Adjust VR1 for maximum indication on the receiver's signal-strength meter and then repeat the procedure at v.h.f. (a receiver for the 144MHz band would be ideal for this purpose), once more adjusting VR1 for maximum "S" meter indication. The wideband r.f. pre-amp. is now ready for use.

It is recommended that the device is used only with screened coaxial input and output leads. It is also worth noting that when the pre-amplifier is used in an unmatched system, it is important to keep the lengths of coaxial cable to a minimum. ●

★ components

Resistors
¼W 5% Carbon film

56Ω	1	R3
330Ω	1	R2
6·8kΩ	1	R1

Capacitors

10nF	3	C1,2,3

Transistor

BFY90	1	Tr1*

Potentiometer
Horizontal mounting, sub-miniature pre-set

2·2kΩ	1	VR1

Miscellaneous
Coaxial sockets (2) to suit individual preference; sub-miniature toggle switch s.p.s.t. or s.p.d.t.; printed circuit board; snap-fit battery connector for PP3 battery; diecast aluminium box; 6BA threaded spacer (4) 6mm long.

* Available from Marshalls, R.S.T., etc.

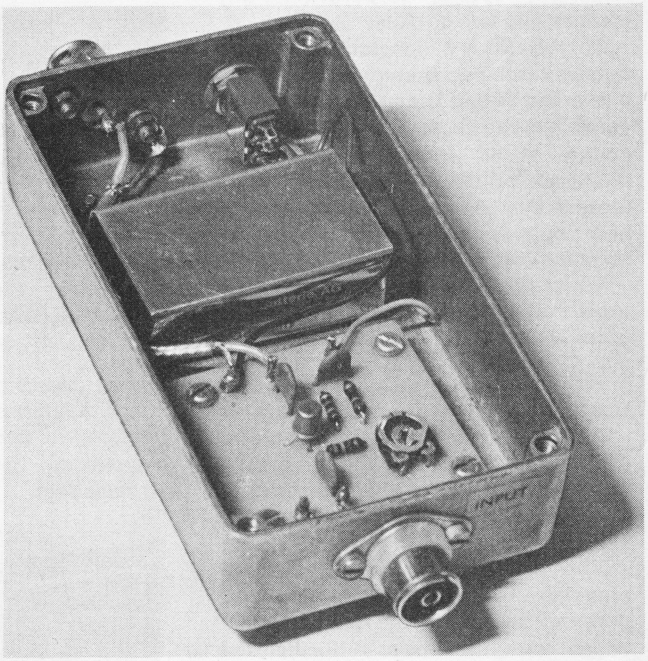


Fig. 2: Copper pattern and component layout, shown full size