For best results, the masthead amplifier should be mounted high on the mast, near the antenna terminals. The plastic conduit case makes a neat weatherproof assembly which is easily attached to the mast using an automotive-type hose-clamp.

MASTHEAD AMPLIFIER FOR TV AND FM

This unit can be used as a masthead amplifier or as a distribution amplifier. It's simply added to your existing antenna feeder system and can greatly improve your television or FM radio reception.

By BRANCO JUSTIC

You can put this masthead amplifier together for less than $30.00. It's easy to install and is suitable for amplifying both VHF and UHF TV signals, and FM signals.

Quite often, a signal which is otherwise quite acceptable at the antenna terminals produces poor results when fed to a TV or FM receiver. This occurs because of signal losses in the signal distribution system; in the feeder cable, in matching transformers or baluns and in splitters. Such losses can severely degrade picture quality.

The best way around this problem is to amplify the incoming signal at the antenna terminals (ie, right at the masthead) to make up for signal losses occurring later in the distribution system. Alternatively, the amplifier can be installed ahead of a splitter system to ensure adequate signal level at each outlet. A splitter is used when you want to connect two or more TV sets to the same antenna.

The circuit of the masthead amplifier is based on an OM350 thick film hybrid IC which gives around 18dB of gain from 40MHz to 1GHz. This means that there is plenty of gain right across both the VHF and UHF TV bands, as well as across the FM band (88-108MHz).

To make the unit easy to build, all the parts are installed on a small printed circuit board. Apart from the IC itself, the circuit uses just three diodes, five capacitors and a small RF choke. The completed assembly slides into a 150mm x 32mm O.D. piece of plastic conduit which is fitted with end caps for weatherproofing.

The plastic conduit certainly makes for a very neat and effective

assembly. And it's easily mounted on the mast using a large automotive type hose clip (see photo on facing page).

Transmission losses

Before moving on to the circuit description, let's take a closer look at the losses that occur in the signal distribution system. By understanding what these losses are, you'll know when and where to employ the masthead amplifier.

- Feeder cable loss: this is simply the loss that occurs in the cable that connects the TV set to the antenna. It depends on the length and quality of the connecting cable being used and, for good quality coaxial cable, is typically about 1dB per 10 metres at VHF.

Unfortunately, losses are much higher at UHF so a masthead amplifier can make a big difference to your UHF TV reception. Note that you should always use good quality coaxial cable for TV signal distribution, particularly at UHF, to minimise signal losses. Coaxial cable is also less prone to ghosting and noise pickup than 300-ohm ribbon cable.

- Balun loss: a matching transformer or balun is normally used to match the feeder cable impedance (75 ohms) to the antenna impedance (300 ohms). Good quality baluns exhibit losses of less than 1dB at VHF but have slightly higher losses at UHF.

Don't use a cheap balun if you want to watch UHF channels. It may be OK at VHF but could introduce unacceptable losses if used at UHF, particularly if followed by a long cable run or in marginal signal areas.

- Splitter loss: this is the loss that occurs between the splitter's input and any one of its outputs. Of course, the more outputs the splitter has, the greater will be the signal loss.

Typical 2-way and 4-way splitters have losses of 3.5dB and 6.5dB respectively at VHF, but again losses at UHF are somewhat higher.

So should you use a masthead amplifier to solve your TV reception problems or not? The answer is yes, depending on the circumstances.

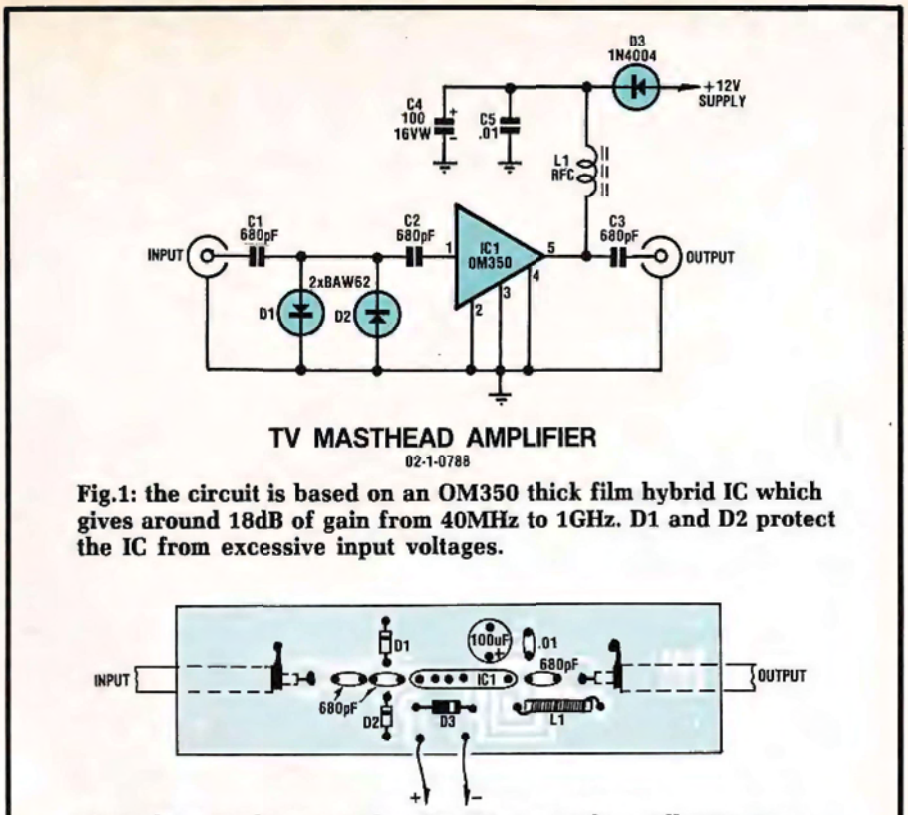
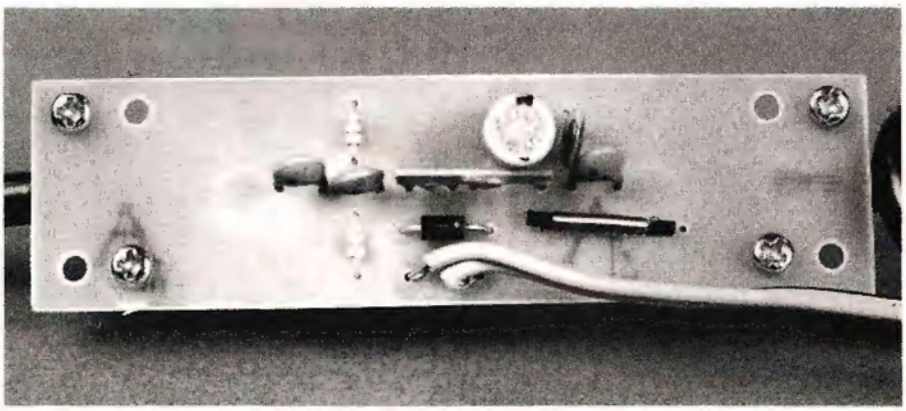


Fig.1: the circuit is based on an OM350 thick film hybrid IC which gives around 18dB of gain from 40MHz to 1GHz. D1 and D2 protect the IC from excessive input voltages.

Fig.2: the parts layout on the PCB. Be sure to keep all component leads as short as possible and take care when installing polarised components.



This view shows the fully assembled PCB. The board is powered from separate supply leads which are run up the mast adjacent to the coaxial cable.

Your installation will benefit from a masthead amplifier if:

- reception is poor on one or more stations and you are using a fairly simple antenna system;
- reception is poor due to signal losses in the cable or in splitters; and
- one or more channels is borderline in quality and you intend adding splitters for additional TV sets to the system.

How it works

Fig.1 shows the circuit details. All the required gain is produced in IC1 (OM350). The input signal is coupled to IC1 via capacitors C1 and C2, while diodes D1 and D2 protect the IC from excessive input voltages (eg, from close RF transmitters, nearby lightning strikes, static build-up, etc).

Note that BAW62 diodes are specified here because they are a

The PCB has been specially designed to slide into a 32 x 150mm length of plastic conduit which is then fitted with end caps for weatherproofing. The input, output and power supply leads are fed through holes drilled in the bottom end cap and secured to the mast using cable ties.

Where to buy the parts

Parts for this project are available from Oatley Electronics, 5 Lansdowne Pde (PO Box 89), Oatley, NSW 2223. Telephone (02) 579 4985. Prices are as follows (mail orders add $3.00 p&p):

Complete kit (includes PCB, on-board parts, cable clamps, screws and nuts, conduit and end caps)	$27.95
9V plugpack supply to suit	$10.50
4-way splitter	$8.50
Power supply/signal combiner	$4.50

Note: copyright for the PCB artwork associated with this project is retained by Oatley Electronics.

PARTS LIST

1 PCB, code OE12 (from Oatley Electronics)
1 150mm length of 32mm O.D. plastic conduit
2 32mm I.D. end caps
1 prewound RF choke

Semiconductors

1 OM350 wideband amplifier IC
2 BAW62 silicon diodes
1 1N4004 silicon diode

Capacitors

1 100μF 16VW PC electrolytic
1 .01μF ceramic
3 680pF ceramic

Miscellaneous

Cable clamps, screws, nuts, washers, coaxial cable.

high-speed switching type with very low capacitance. This means that they offer good protection to the OM350 without significant signal loss.

The amplified output signal from IC1 appears at pin 5, which is also the supply pin for the OM350. From there, the signal is coupled to the feeder cable via capacitor C3. Inductor L1 presents a high impedance at signal frequencies and thus ensures that IC1's output is not loaded by the supply rail.

Power for the circuit is derived from an external plugpack supply and is applied to pin 5 of IC1 via D3 and L1. D3 is there to protect the IC against reversed supply connections while C4 and C5 provide supply decoupling.

Construction

A kit of parts for this project is available from Oatley Electronics (see panel). The kit is supplied complete and includes the printed circuit board, all on-board components, cable clamps, screws and nuts, and the plastic conduit case.

Fig.2 shows the parts layout on the PCB. Be sure to mount the ceramic capacitors and the IC as close to the board as possible, and note that D1 and D2 are the BAW62s. The inductor is supplied prewound on a ferrite core and can be installed either way around.

The coaxial cable leads are secured to the copper side of the PCB using the clamps, screws and

How to Combine the Signal and Power Supply

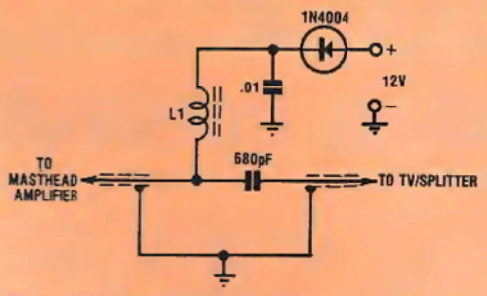


Fig.3: this simple circuit allows the DC supply to be fed to the masthead amplifier via the coaxial cable.

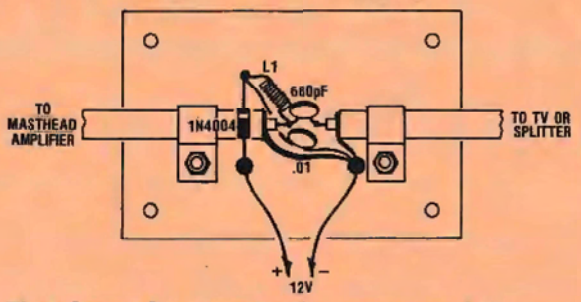


Fig.4: here's how to wire the power supply/ signal combiner circuit. Keep all leads as short as possible.

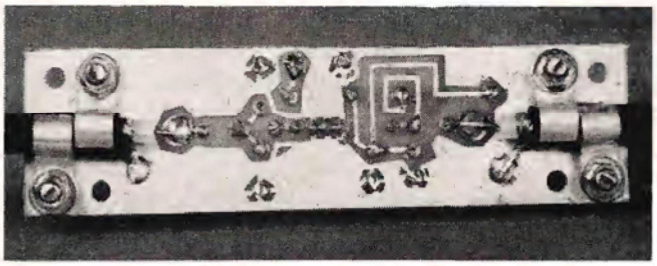
It is easy to eliminate the need for a separate supply cable between the masthead amplifier and the plugpack supply. This simply involves modifying the physical construction of the unit so that the DC supply is fed to the amplifier via the coaxial cable.

Fig.3 shows the relevant circuit of the power supply/signal combiner while Fig.4 shows how the circuit can be built onto the lid of a small plastic case. Most of the parts used here are simply transferred from the main PCB.

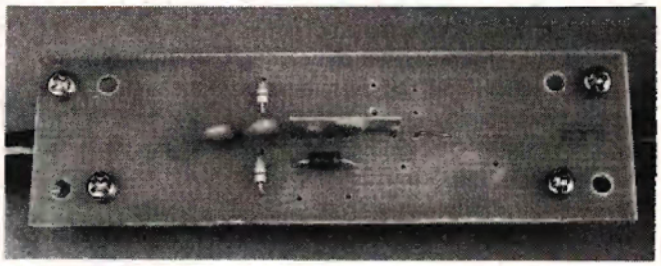
To modify the PCB, delete C3, C4, C5, D3 and L1, and connect a wire link in place of C3. The left-over parts can then be used to wire up the combiner circuit as shown in Fig.4. Be sure to keep all leads as short as possible and note that the 100μF capacitor (C4 in Fig.1) is no longer required.

The only additional items required are the plastic case, a 2-way terminal strip, two cable clamps, and screws and nuts.

Installation of the combiner is quite straightforward. It is simply positioned next to the plugpack supply and inserted into the coaxial cable between the masthead amplifier and the TV set or splitter. Power will now be fed to the amplifier via the coaxial cable which means that you no longer have to run DC supply leads up the mast.



The coaxial cable leads are secured to the rear of the PCB using small clamps and machine screws and nuts. Use good-quality coaxial cable.



This alternative version of the board is used with the power supply/signal combiner circuit shown in Figs.3 & 4. D3 appears in this photograph but can also be deleted.

nuts provided (see photograph). Solder the inner and outer (shield) conductors to the PCB as shown in Fig.2 and note that these leads should be kept as short as possible.

Installation

If you intend using the unit as a masthead amplifier, it should be installed on the mast adjacent to the antenna terminals as shown in one of the photographs. This arrangement will provide the best signal to noise ratio although a short length of high-quality coaxial cable between the antenna terminals and the masthead amplifier shouldn't make too much difference.

To install the unit, the completed board assembly is simply pushed into the plastic conduit and the end caps fitted to provide a weather-proof assembly. Note that both the input and output leads, along with the power supply leads, emerge through holes drilled in the bottom cap. These holes can all be sealed with silicone sealant after the assembly has been installed and tested.

If used as a distribution amplifier, the unit should be placed as close as practicable to the point where the coaxial cable enters the building. The only proviso here is that you must have a noise-free signal to feed into the amplifier. The output of the amplifier is connected to the splitter input and the splitter outputs then run to the TV receivers.

For best performance, the amplifier should be powered from a 10-14V DC supply. Before connecting the supply, check the output voltage with your multimeter. The OM350 has a maximum supply voltage of 15V DC so take care not to exceed this figure.

The prototype was powered from a 9V plugpack supply which actually gave an output voltage of 11.5V with the low current drawn by the amplifier (approx. 30mA).