

Masthead amp for UHF TV

If your UHF TV signal is not quite up to scratch and you don't want to add more aerial hardware, this project is for you.

Phil Wait

WHEN INSTALLING a UHF TV antenna system it is often difficult to predict *up front* just how good a picture you're going to get, whether you'll have noise (snow) problems, etc. Undoubtedly, situations will arise where, having installed the antenna and feedline, the picture is found to be acceptable, but contains some snow. Alternatively, having erected a large expensive antenna array and installed expensive, top-quality coax, the picture is 'out of the mud' but not acceptable on anything but a short-term basis. Either way, erecting more hardware may not be as good a solution as attempting to boost the signal at or near the antenna with a suitable booster amplifier. That's where this project comes in.

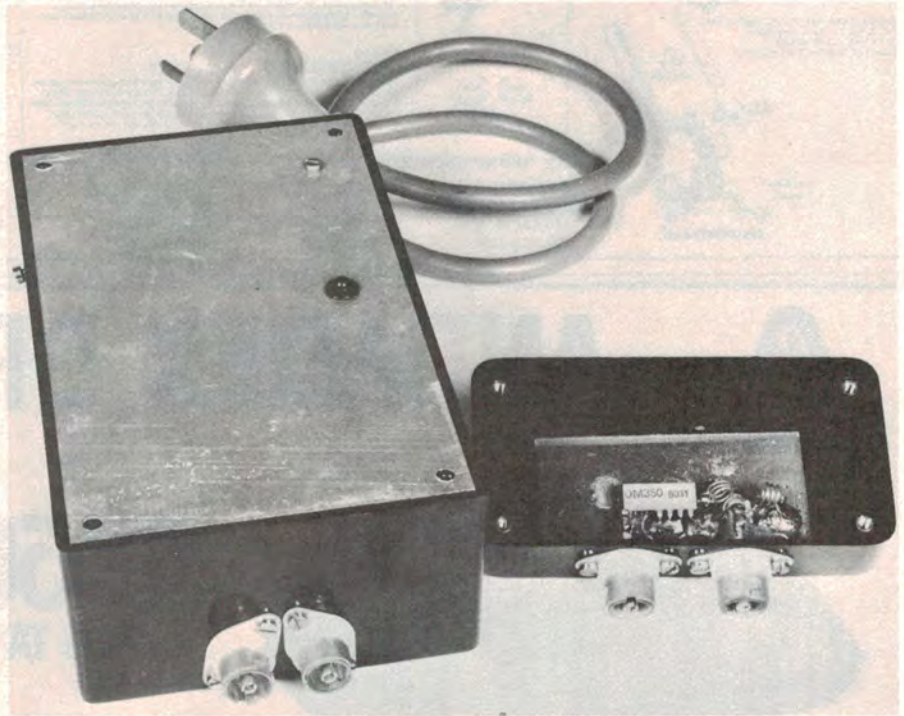
In other situations, long runs of feeder cable may be necessary. Traditionally, 300 ohm open-wire feedline is regarded as 'low loss'. It's not so at UHF. Coax performs better 'upstairs' and suffers less from the effects of weather and picks up less unwanted interference. However, a very long run may have as much as 5 to 7 dB loss, sometimes more. This not only attenuates the signal before it reaches the TV front end, but seriously degrades the tuner's noise figure — and you lose both ways. Again, that's where this project comes in.

The ETI-729 UHF TV Masthead Amplifier covers the UHF TV bands IV and V, extending from 526 MHz to 814 MHz. It provides nearly 18 dB of gain and has a noise figure typically around 6 dB.

Heart of the amplifier is a recently-released Philips wideband hybrid amplifier, the OM350. It is a two-stage amplifier built on a thin-film substrate and encapsulated in a 5-pin, in-line package having a resin-coated body. It is part of a range of five VHF/UHF wideband amplifiers made by Philips, which include the OM345, OM360, OM361 and OM370. We have published a short-form data sheet on the OM350 elsewhere in this article.

Construction

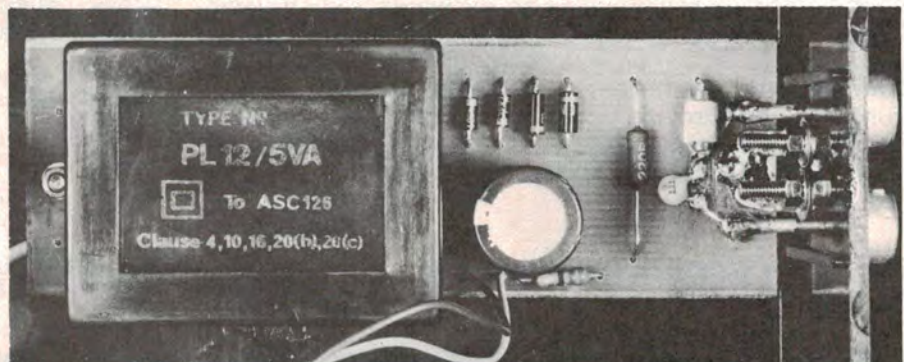
The amplifier is housed inside a small plastic box which is contained within a larger plastic box for weather proofing, the latter being attached to the antenna mast.



Unlike most of our projects, the amplifier does not use a pc board, but rather the components are wired to each other directly and mounted above a flat copper earth plane. This construction is quite easy and gives good results up to quite high frequencies, avoiding the cost of Teflon pc board and specialised components. In fact, our first attempt at making this amplifier used printed inductors for the high pass network and microstrip terminations. Probably owing to the pc board characteristics and the Q of the printed inductors, this was not successful, as the gain dropped off dramatically above 600 MHz.

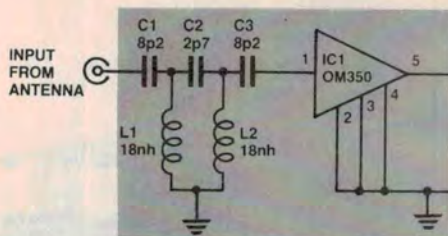
Follow the drawing and photograph of the amplifier very carefully. All earth connections from the coax sockets, the IC and the filter inductors are made directly to the copper ground plane. All the components have absolutely *minimum* or no lead length and you will find a pair of tweezers may help to hold the components while soldering.

Start by mounting the coax sockets about 30 mm apart on the side of the box, with their bolt holes in line with each other. Place two solder lugs under the two innermost mounting bolts for the coax sockets, and to these solder a piece of pc board, copper side up as the



Internal view of the power supply. Note the pc board is double-sided.

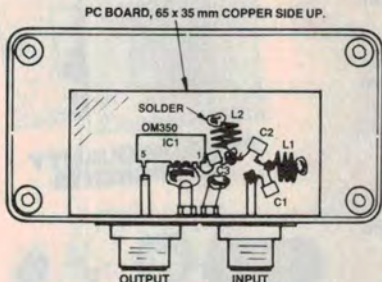
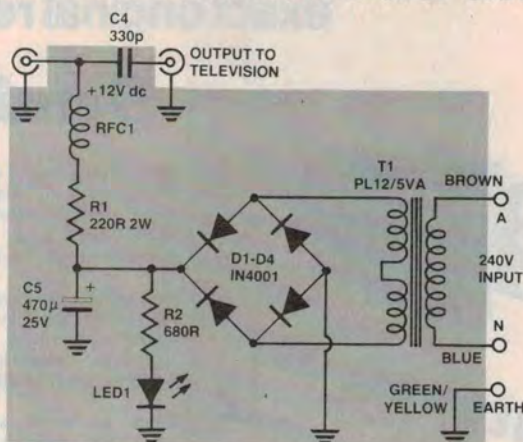
uhf masthead amp



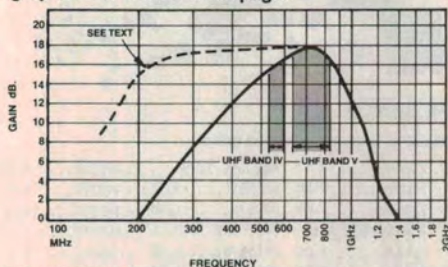
COIL DATA

L1, L2 . . . 3 turns, 4 mm inside diameter by 4 mm long, leads 4 mm long, using 22 swg tinned copper wire

Circuit diagram of the masthead amplifier and power supply.



Construction drawing. Compare this to the photograph at the bottom of the page.



Measured bandpass and gain characteristics of the amplifier. You can alter the response to that shown by the dotted line by adding one turn to L1 and L2.

earth plane. Its exact size is relatively unimportant, so long as it fits in the box. Wire all the components as shown. The three earthed leads on the IC are bent down slightly and soldered onto the earth plane while the output lead is bent up to the output socket, and the input lead solders to the high pass filter.

Be careful not to overheat the coax sockets as the Belling and Lee types used are easily melted.

Drill a small hole (about 3 mm) near the coax sockets to allow ventilation in the box to avoid condensation build-up. Fix the lid in place with Silastic rubber.

Weatherproofing

The amplifier box is contained in a larger box, which is attached to the antenna mast with a U-bolt. Drill clearance holes for the coax plugs so they can be passed through the bottom of the larger box to the amplifier. After mounting the box on the mast and connecting the coax cables, seal the lid with Silastic rubber.

The power supply

The power supply is located near the TV set and housed in its own plastic box. Commence construction by mounting all the components on the pc board, noting that C4 and RFC1 are soldered on the top side of the board. Again, use

HOW IT WORKS — ETI 729

The masthead amplifier is based on one of the Philips range of wideband hybrid integrated circuits. The OM350 features 18 dB gain from 40 MHz to 860 MHz with a noise figure of around 6 dB. Input and output impedances are 75 ohm, allowing the IC to be directly connected in line without impedance matching.

As the output of the chip is open collector the dc power is fed along the output signal path (in our case, the centre of the coax), making the IC ideal for masthead operation.

The signal from the antenna is applied to the input of IC1 via a high pass filter network with a cutoff frequency of about 400 MHz. As this amplifier will be used on antennas designed only to receive UHF transmissions it is desirable to prevent strong HF or VHF stations from being amplified and fed to the TV set. If so, some receivers may be prone to inter-modulation, causing interference patterns on the screen.

The high pass filter comprises C1, C2, C3, L1 and L2.

The amplified signal is fed down the coaxial cable to the power unit mounted close to the television receiver. The signal passes through a blocking capacitor, C4, and is fed to the receiver's antenna input. The dc power is applied to the line on the amplifier side of C4 through an RF choke to prevent the signal being shunted by the power supply circuitry.

The power supply consists of a full-wave rectifier producing about 16 V filtered dc which is dropped to about 12 volts by R1. A LED indicates when the unit is switched on.

ETI-729 UHF TV MASTHEAD AMP

Resistors

- R1 220R, 2W
- R2 680R, ½W

Capacitors

- C1, C3 8p2 ceramic (NPO)
- C2 2p7 ceramic (NPO)
- C4 330p ceramic (NPO)
- C5 470µ/25 V electro.

Semiconductors

- D1 to D4 1N4001 or similar
- LED1 TIL220R red LED
- IC1 OM350 Philips wideband RF amp

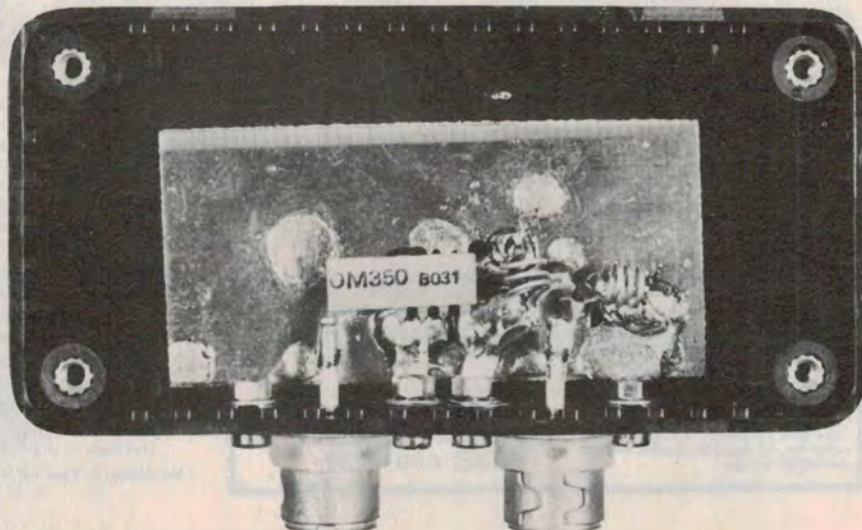
Miscellaneous

ETI-729 pc board; four Belling-Lee coax sockets; four solder lugs; RF choke (see text); Ferguson PL12/5 VA transformer or similar; 240 Vac power cable and plug; plastic box — 100 x 50 x 25 mm (for amp); plastic box — 195 x 110 x 60 mm (weather protector housing); plastic box — 160 x 95 x 50 mm (power supply); 22 swg tinned copper wire, etc.

Price estimate

\$28 - \$34

Note that this is an estimate only and not a recommended price. A variety of factors may affect the price of a project such as — quality of components purchased, type of pc board (fibreglass or phenolic base), type of front panel (if used) supplied etc — whether bought as separate components or made up as a kit.



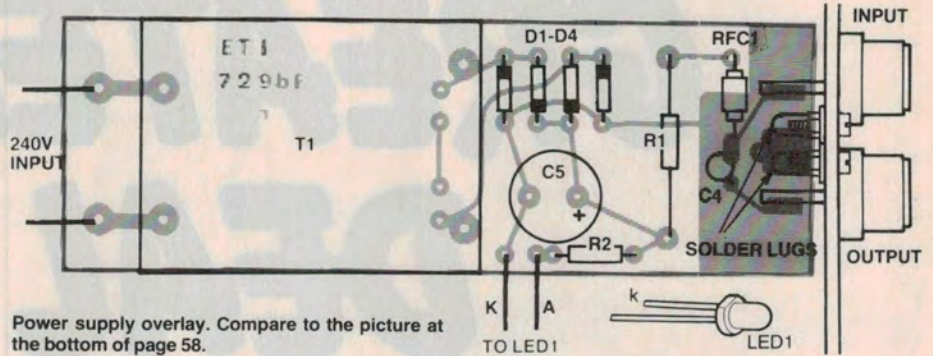
Internal view of the amplifier. A piece of pc board serves as an earth plane.

uhf masthead amp

as short leads as possible. The value of the RF choke is not critical though you should use one which is physically small. We used a commonly available 10 uH choke, though any value above 500 nH should be OK. Mount the two coax sockets at one end of the box exactly 18 mm apart, as shown, again using two solder lugs on the two inside bolts as we did on the amplifier box.

The pc board is supported with one standoff near the transformer and by the connections to the coax sockets at the opposite end. Again, be careful not to melt the coax sockets with too much heat. The 240 Vac power cable terminates directly onto the pc board as we have used a pc mounting transformer. The earth lead (green/yellow) should be firmly soldered onto the two earth lugs at the coax sockets. Leave plenty of slack in this lead so if the cable is pulled from the unit the earth is the last to break off.

Finally, you will have to assemble a patch cord with a coax plug on either end to run from the power supply to the TV set. Use a good-quality coax for this as, although it is short, performance can be seriously degraded if you use a lossy cable ahead of the amplifier.



Power supply overlay. Compare to the picture at the bottom of page 58.

OM 350

HYBRID INTEGRATED CIRCUIT VHF/UHF WIDEBAND AMPLIFIER

Two-stage wide-band amplifier in hybrid integrated circuit technique on a thin-film substrate, intended for RATV and MATV applications.

dc supply voltage
 Frequency range
 Source and load (characteristic) impedance
 Transducer gain
 Flatness of frequency response
 Output voltage

at -60 dB intermodulation distortion (DIN 45004, 3-tone)
 Noise figure
 Operating ambient temperature

ENCAPSULATION 5-pin, in-line, resin-coated body

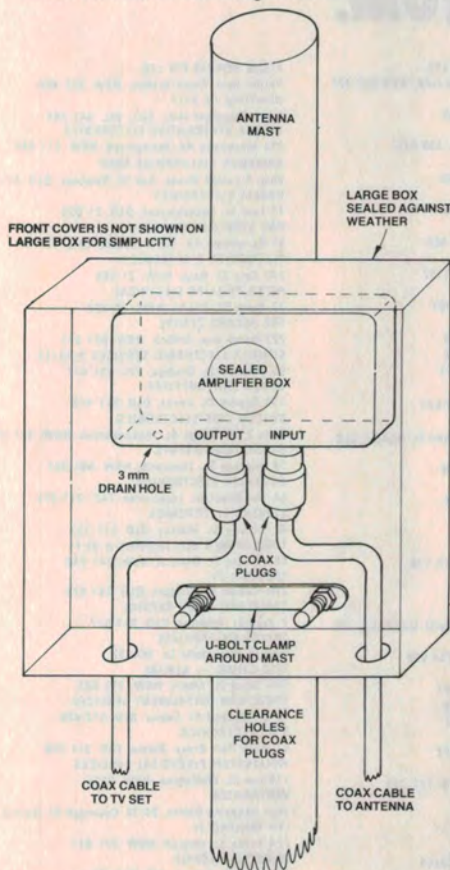
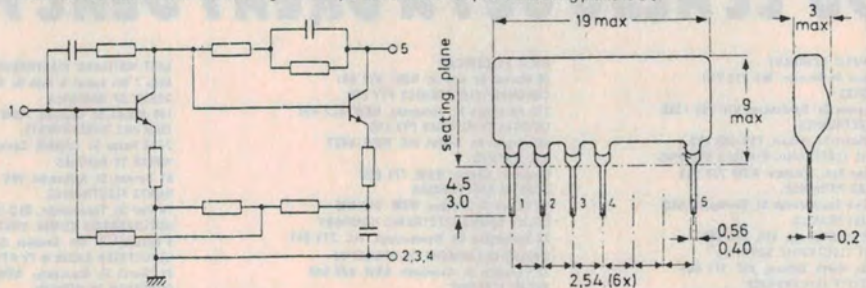
Terminal connections

1 = input
 Hand soldering

2,3,4 = common

5 = output/supply(+)

Maximum contact time for a soldering-iron temperature of 260°C up to the seating plane is 5 s.



ABOVE: Suggestion for mounting the amplifier in a weatherproof housing.

RIGHT: Printed circuit artwork, full size.

