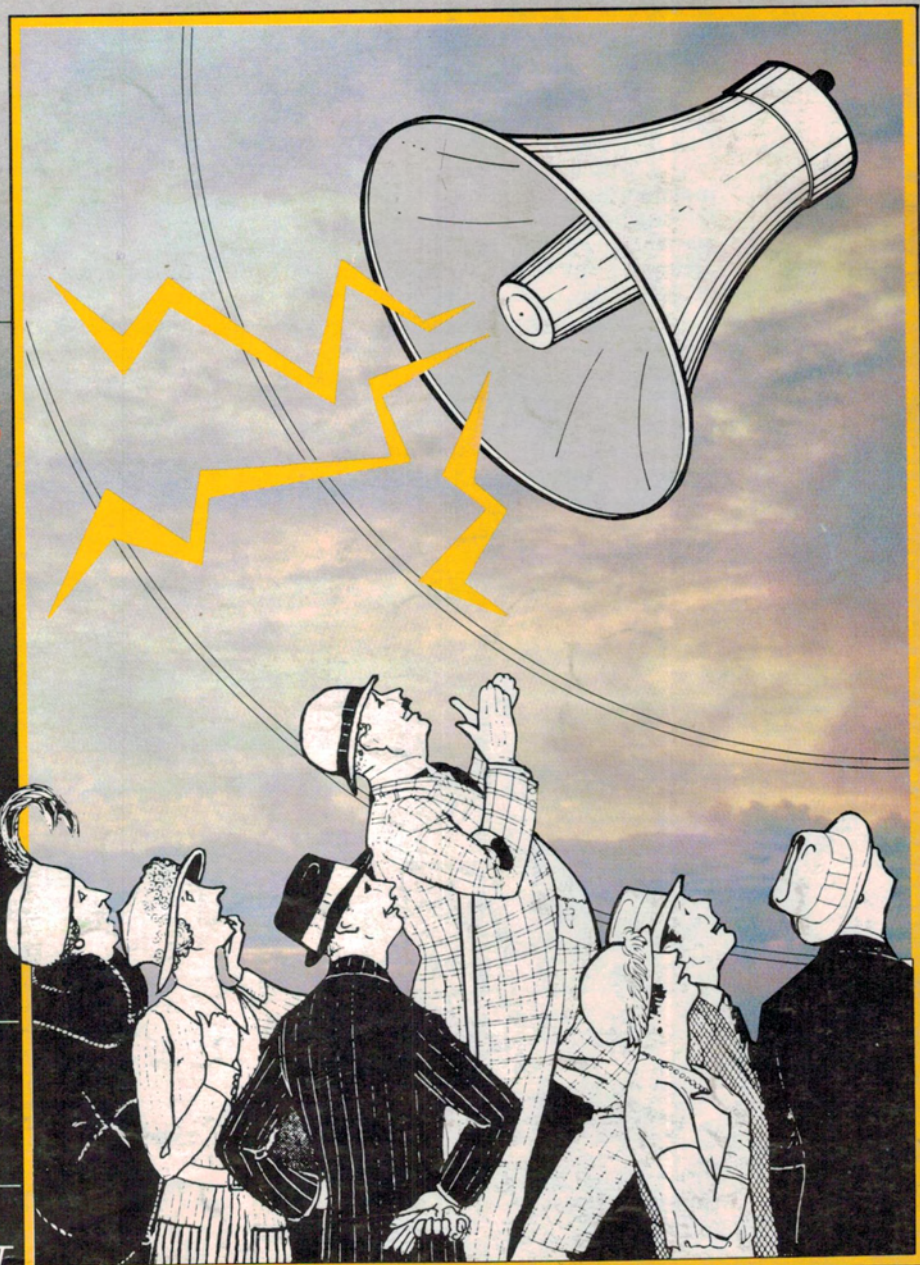


# LOUDHAILER

TO BUILD



# Ta ra, ta ra . . . the ETI loudhailer!

Build this loudhailer and make yourself heard at rallies, picnics or sporting events. Using the ETI-464 General Purpose Amp. Module mounted in the back of a locally available horn speaker, it's simple to build and quite effective.

PROJECTING your voice outdoors is quite a difficult task without some means of 'directing' your voice and amplifying it. Generally, you'll want to address a group of people located some distance away, or a group of people spread out in front of you for some distance. If you can direct your voice over a narrow 'beam', then less of the sound you make is wasted.

The old-fashioned megaphone did that job before 'electronics' entered the picture. Outdoor public address systems came into being with the advent of valves. For many years PA systems were cumbersome, hardly portable beasts until minaturisation came along post World War II. The first 'loudhailer' PA systems portable by one person used miniature valves, a small horn speaker and a set of cumbersome, heavy batteries that didn't last all that long.

When power transistors came along, loudhailers proliferated. They could be held in one hand, used a small number of 'torch' batteries and did the job better than before.

## The horn speaker

The horn loudspeaker is by far the best type for outdoor use. Horns can be made weatherproof and have an efficiency of better than 20% compared to a few per cent for ordinary speakers. This allows an amplifier of lower power to be used, with consequent savings in power consumption, physical size and weight.

Horns are intrinsically limited in their frequency response, and their efficiency is inversely proportional to their bandwidth. PA horns are designed to operate over the voice band at maximum efficiency. The

horn itself is essentially an impedance transforming device which increases the acoustic loading on the driving diaphragm to allow better 'matching' to the air. The throat area of the horn increases exponentially as you move away from the driver.

The horn may be straight, as shown in Figure 1, or folded, as shown in Figure 2. The folded horn is physically smaller and is the most common type in low cost PA systems. Folding the horn reduces the efficiency slightly but increases the coverage or dispersion, which is usually an advantage.

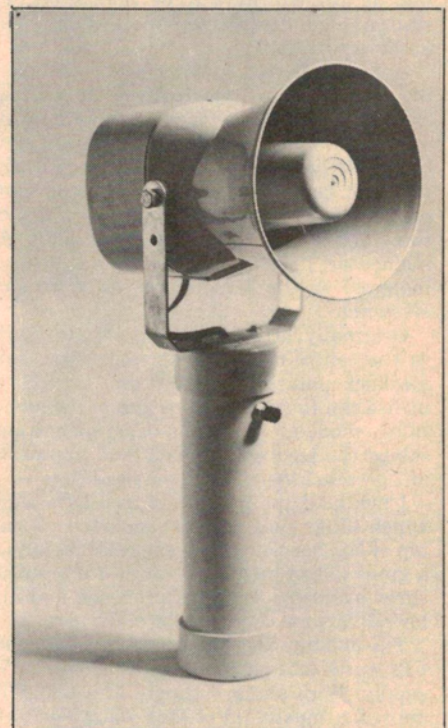
The straight horn has a long 'throw' and is useful for narrow sound coverage at greater distances, but is more cumbersome, especially for handheld applications!

## The project

For our loudhailer, we had to search around for a suitable small folded horn. There is a variety available and prices vary widely. Probably the most common are 130 mm diameter (5") low power folded (or 'reflex') horns generally sold for boat or CB PA use. Rectangular folded horns are also available, having an opening of 200 mm wide by 120 mm or so high.

Efficiencies vary widely and are best judged by the weight! Drivers with larger, heavier magnets are more efficient than those with smaller, lighter magnets. Most have a 'dispersion angle' — the angle over which the majority of sound is dispersed from the horn — of between 60° and 90°. The narrower the dispersion angle, the greater sound level you get at a given distance from the speaker.

Geoff Nicholls



Your shout! Not beautiful, but effective.

The horn we chose for our prototype is imported and marketed by Benelec Pty Ltd, model no. 8-224. It is a 130 mm diameter folded horn, measuring 170 mm long overall. There is a cover on the rear of the horn with plenty of room inside to mount the power amp. module. It has a mounting ▶

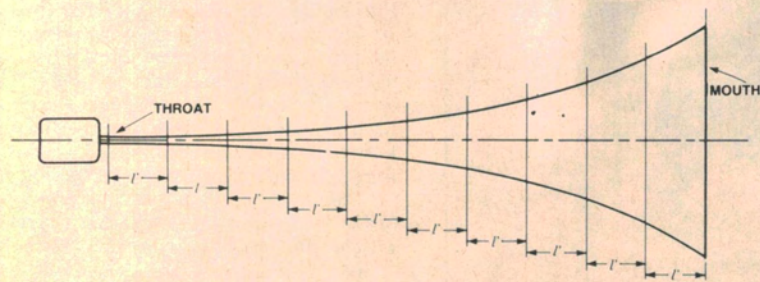


Figure 1. A straight horn has the width of the throat growing exponentially larger with increasing distance from the driver.

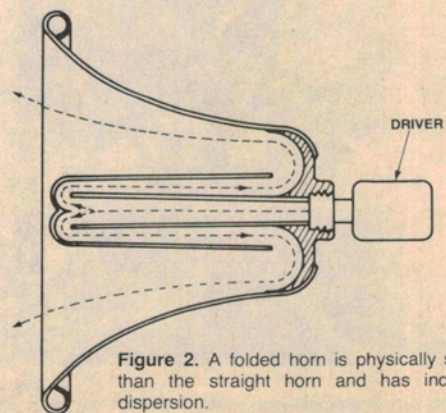


Figure 2. A folded horn is physically smaller than the straight horn and has increased dispersion.

# Project 465

bracket that allows the horn to be swivelled over a wide range of angles. It is available with driver impedances of 4 ohms or 8 ohms, though the latter is best in this application. The dispersion angle is quoted as 60°, which we saw as desirable, and the output is quoted as being 122 dB (presumably with 1 W drive at one metre). It weighs 1.15 kg, which is not too heavy, yet ensures the sort of driver efficiency desirable for maximum effectiveness.

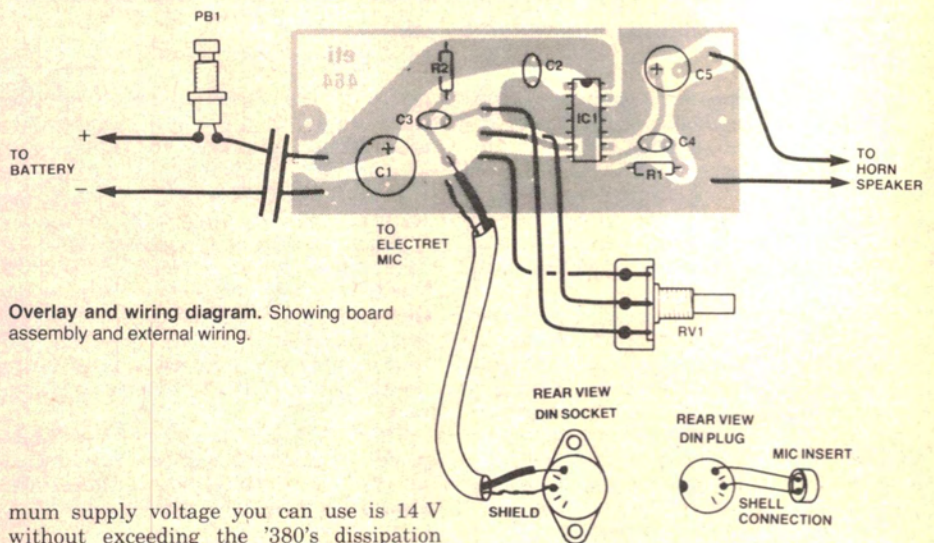
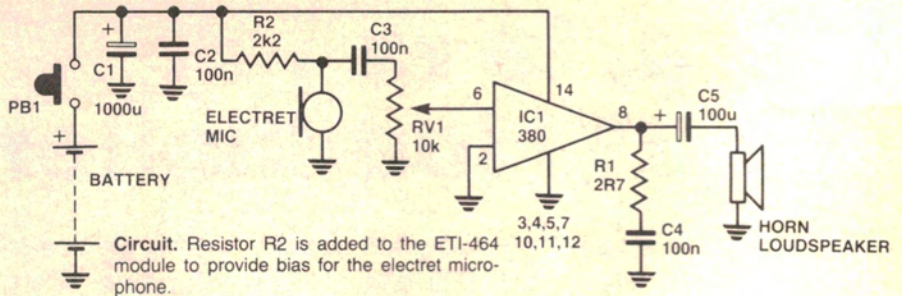
Using this horn, and constructing the loudhailer as described here, you can make yourself heard at 100 metres. If you don't need that much throw, then a lower cost, less efficient horn will suffice, but construction details will have to be worked out to suit yourself. See Shoparound in this issue for horn suppliers.

An electret microphone insert was employed to make a microphone. It proved cheap and effective. To provide a handle and battery case, a short length of 50 mm (i.d.) PVC water pipe was used, along with two end caps. This mounts, via one end cap, on the horn's mounting bracket and the batteries are slipped inside. A momentary action pushbutton switch, mounted on the 'handle', serves as an on/off switch.

Originally, I tried mounting the mic insert in the centre of the horn's rear cover, but feedback proved a problem and I couldn't utilise the full gain and output of the amplifier module. A little experimentation solved the feedback problem and improved an operator's visibility at the same time.

I mounted the mic insert in a DIN plug which plugs into a socket mounted at the top of the horn's rear cover. I also mounted a gain control pot on the cover. These measures overcame feedback problems and allowed you to see over the top of the horn.

The maximum output a '380 will deliver is five watts into an 8 ohm load using a 20 V supply. With an 18 V supply, the '380 will deliver a maximum of four watts (@ 10% distortion — which is tolerable) into an 8 ohm load. With a 4 ohm load the maxi-



mum supply voltage you can use is 14 V without exceeding the '380's dissipation rating, and you only get three watts' output. In a loudhailer, every watt counts.

Hence, I opted to use an 18 V supply. There are two ways you can arrange this with batteries. Two no. 2362 9 V batteries can be 'snapped' in series. These are 75 mm long with a male snap clip at the positive end and a female snap clip at the negative end. Alternatively, you can use 12 AA cells mounted in three four-cell battery holders. There are two advantages to the latter: the batteries last longer and the whole assembly is considerably cheaper.

## PARTS LIST — ETI-465

This requires construction of the ETI-464 amp. module with the addition of the following components:

- R2 ..... 2k2, ¼ W/5%
- RV1 ..... 10k/C panel mount pot.
- Electret mic. insert (e.g. D.S.E. no. C-1160); 5-pin DIN plug and socket; knob; horn loudspeaker — Benelec no. 8-224 8 ohm (see text); three 4-cell AA battery holders and clips plus 12 x AA batteries or 2 x 2362 9 V batteries and snap clips; DPDT momentary action pushbutton (e.g. D.S.E. no. C-1220); length cr 50 mm PVC pipe and two end caps; wire, etc.

**Price estimate \$45-\$50**

## Construction

Putting the loudhailer together is quite straightforward. The ETI-464 pc board has mounting holes which match the mounting posts on the inside of the 8-224 horn speaker's rear cover. Self-tapping screws are used to mount the board and the mounting holes should be drilled to size before assembling the components to the pc board.

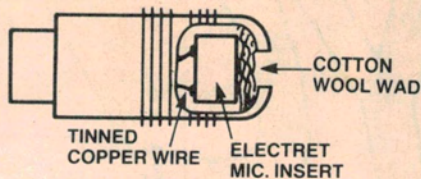
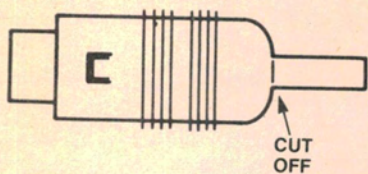
Assemble the power amp module according to the instructions given in the previous article on the ETI-464. Note that R2 has to be added, as shown on the overlay diagram. Don't attach any wires yet until the mechanical assembly has been completed.

Drill the mounting holes for the volume pot and the DIN socket in the speaker's rear

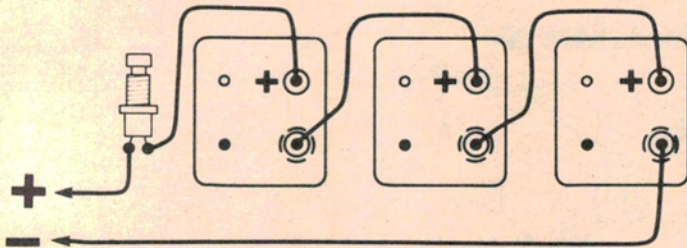


**Insides out.** The amplifier board mounts inside the rear cover of the Benelec 8-224 horn.

# Loudhailer



**Making the microphone.** A DIN plug is modified as shown to house the electret mic insert.



**Battery holder wiring.** If you use a dozen AA cells, as I did, this is how the battery holders are wired up to provide 18 volts.

cover. The DIN socket goes at the top, the volume pot at the bottom. Also drill a hole in the bottom lip of the cover so that the leads from the battery may be passed through.

Now tackle the handle/battery compartment. Cut a 200 mm length of 50 mm i.d. PVC pipe. File the ends smooth and square and slip the end caps on. Holding them in place with masking tape, drill holes on either side, right through the cap and pipe, so that self-tapping ('PK') screws can be used to secure the end caps in place. Drill these holes to the root diameter of the PK screws.

Remove the end caps and enlarge the holes to the appropriate clearance diameter for the PK screws. Drill holes in one end cap to suit the speaker mounting bracket and to pass the battery leads. Bolt it in place.

Now take the tube and mark a hole position at the 'top' end for the on/off pushbutton switch. It should be located such that it clears the upper end cap, yet is not too far down the tube so that access to the switch connections is restricted.

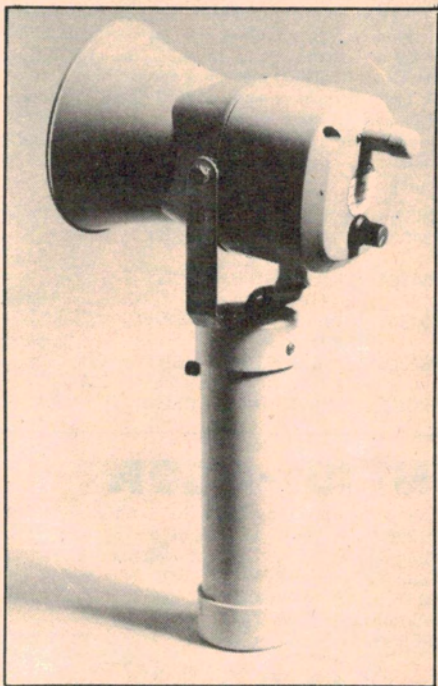
Now wire up all the battery connectors, the pushbutton switch, the DIN socket, the volume pot, the speaker and the pc board. Check it all carefully when finished, then screw it all together. A little wad of sponge rubber in the upper end of the handle secures the batteries.

Now you can make the microphone. The basic assembly is shown in the accompanying diagram. We found that angling the mic insert *down* (when the unit is plugged in) helped reduce feedback problems and a tendency to 'breathiness'.

The accompanying photographs show the internal and overall assembly, when completed.

## Using it

For an initial try-out, set the volume pot about halfway advanced, plug in the microphone, position your mouth about 10 mm or so from the mic, press the button



**Rear view.** The mic plugs into the DIN socket at the top. The volume control is below it. The 'handle' houses the batteries.

and say a few words. No 'howl round' feedback or 'ringing' should be experienced, except perhaps if you're in a small room. Best try the unit outdoors.

Adjust the setting of the volume control for maximum output without feedback or ringing being evident. Always speak very close to the microphone.

If you wish, it may be convenient in some applications to have a 'remote' microphone. An electret insert can be readily installed in a CB-type handheld mic case, with the push-to-talk switch wired in parallel with the loudhailer's on/off pushbutton via the DIN plug and socket.

Happy hailing!