

SIMPLE HOME PROJECTS

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THESE projects are similar to those appearing in the first Supplement (Oct 75) and they should not present any particular problems, even for the comparative newcomer to the construction of electronic equipment.

Although a printed circuit board is used in the Tone Control Unit this can be substituted by a piece of veroboard with pins at the appropriate points, as shown in the drawings. The wire ends on components here may be sufficiently long to even do away with the pins, taking the wires through holes in the board.

The Electronic Metronome was built into a wooden case resembling the style of a conventional metronome but this is purely a matter of personal taste. However, a simple wooden case would also give that desirable dead beat of the ordinary metronome, preferable to the metallic note that would probably result from the use of a metal box, which might also rattle or vibrate.

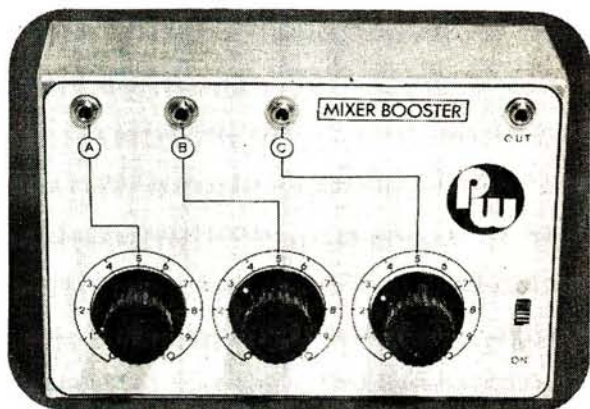
The Mixer-Booster described here has facilities for mixing three separate input signals but there is no reason why the input circuit should not be copied for as many input channels as are required over three. Remember to use plugs and sockets which are compatible with existing equipment. The use here of a metal box is essential to avoid hum problems.

The Enlarging Exposure Meter will prove invaluable to the DIY photographic enthusiast who also likes to make his own enlargements. This business is often a matter of trial-and-error, involving time and materials unnecessarily, in order to determine correct exposure times. The heart of the unit is a photoconductive cell costing only 50p at present, and, if a multimeter is already available, the cost of the remaining few components is almost negligible.

Again, a reminder that if any transistor is replaced by another of a different type the lead-out connections must be checked before wiring the device into the board.

A change of polarity can be made to any of these projects provided that the appropriate transistors are used and that any polarised component, such as an electrolytic capacitor, is reversed.

multi-channel MIXER-BOOSTER

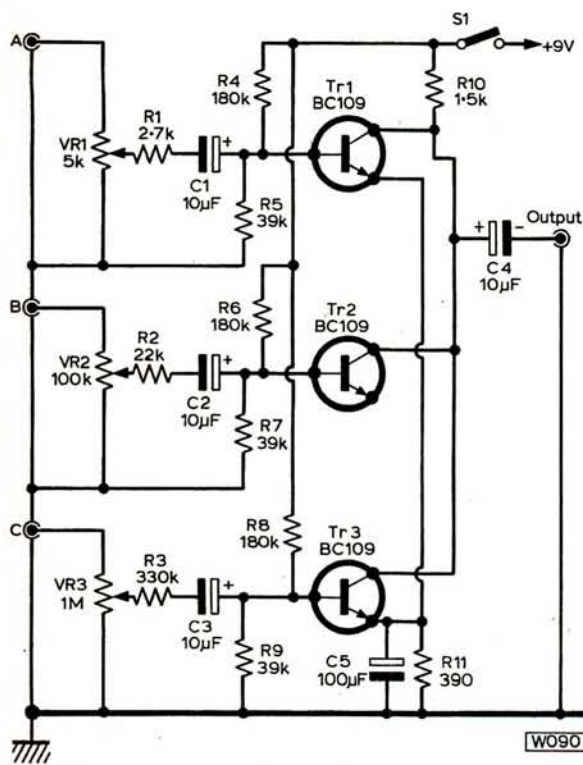


Exterior view of the Mixer-booster, showing jack sockets and control knobs. The finished size of the case is 150 x 100 x 50mm.

A mixer which allows the mixing of signals from two or more sources may be used with a record pick-up, microphone, tape recorder, radio tuner or other equipment. With its help it is easy to produce composite recordings of vocal or instrumental efforts combined with recorded or other accompaniment, or to arrange 'live' performances. It is in order to combine or use commercial records or tapes, radio programmes etc. in this way, provided the purpose is that of home entertainment and

that records etc. are not reproduced for sale or playing to a public audience.

The "mixer-booster" will accept three channels and also enables low-level signals to be amplified, if required, which is not possible with a purely passive resistive mixer.



W090

The circuit diagram above is designed to accept a wide range of input impedances, and will boost low-level signals if necessary.

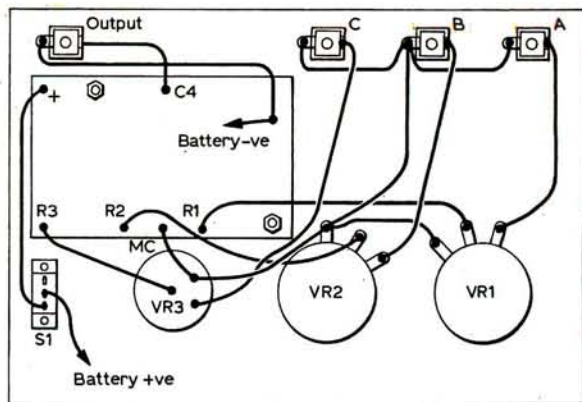
The inputs are A, B and C and they are designed for a wide range of impedances so that almost any likely signal source can be accommodated. Each input has an individual level control and amplifier stage, Tr1, Tr2 and Tr3, outputs of all stages going to the common output socket.

No difficulty is likely to arise when using such a circuit, provided the gain of the amplifier driven from the mixer-booster is set high enough to give the wanted volume from the *smallest* input source. For example, if a radio tuner is operating into A and a crystal microphone into input C, the tuner signal would normally be much the stronger. So the following amplifier would be adjusted for adequate volume with VR3 near maximum, and VR1 would be turned well down to keep the tuner signal at the wanted level.

If a high impedance unit, such as a crystal pick-up, is taken to a relatively low impedance input circuit, frequency response can be expected to deteriorate. So the high impedance input is used in such cases. Actual impedances vary with volume control settings. In practice, difficulty from these effects is not very likely.

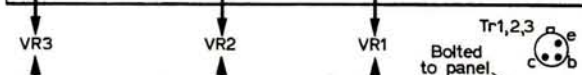
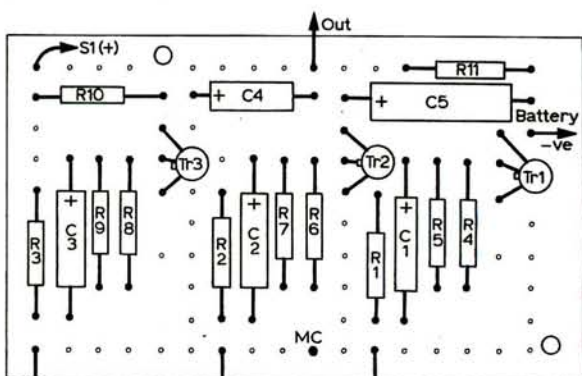
An external resistor pad to couple equipment to the mixer-booster would only generally be needed in exceptional circumstances, such as when using a loudspeaker output circuit as one input. Here the external circuit would be required to load the amplifier and attenuate the signal level.

The drawings show both sides of the circuit board which



W091

Chassis layout drawing, showing flying lead configuration from the various component parts.



W092

0.15in matrix board is used for the main construction. Long leads under the board should be sleeved to prevent shorting.

is plain 0.15in. matrix board. Paxolin sheet, drilled for the wire ends of components, can be used instead. Insulated sleeving is put on leads under the board, where needed to avoid short-circuits. Connecting wire is used where the wire ends of components are not long enough and wires are left for the potentiometers and other external connections. The board is fixed to the panel by countersunk bolts, with extra nuts as spacers so that connections can clear the metal.

The common negative or earth side of the circuit is completed by wire connections, instead of relying upon

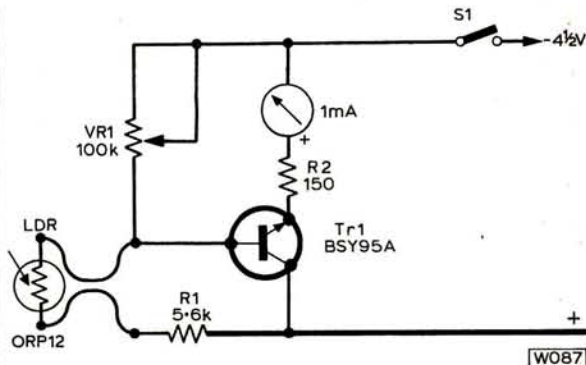
Bits and Pieces

R1 2.7 Ω	R7 39k Ω
R2 22k Ω	R8 180k Ω
R3 330k Ω	R9 39k Ω
R4 180k Ω	R10 1.5k Ω
R5 39k Ω	R11 390 Ω
R6 180k Ω	

All resistors $\frac{1}{4}$ W 10%

VR1 5k Ω log. potentiometer	
VR2 100k Ω log potentiometer	
VR3 1M Ω log potentiometer	
C1/4 10 μ F 10V	
C5 100 μ F 6V	
Tr1 BC109	Tr3 BC109
Tr2 BC109	

3.5mm jack sockets (4). Slide switch. 9V battery and clips. Metal box 150 x 100 x 50mm (6 x 4 x 2in.) Knobs. Board 70 x 40mm (2 $\frac{1}{2}$ x 1 $\frac{1}{8}$ in.) plain 0.15in. matrix.



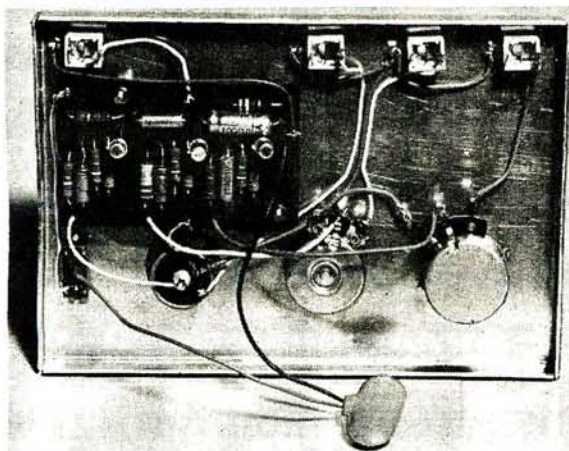
The enlarger exposure meter circuit shown here, makes use of a 1mA meter and a remote light-dependent resistor.

able to give readings directly from the projected image, may be used. The instrument described here is of this type.

When taking photographs, there is a familiar relationship between stops and exposures. For example, if 1/50s at F11 is a correct exposure, so will be 1/100s second at F8 or 1/25s at F16. The change in lens aperture is compensated for by change in the opposite direction in exposure time.

With an enlarger having condensers which bring the light into focus this relationship between aperture and exposure time will, generally, not apply, especially at some degrees of enlargement, because the cone of light may pass primarily through the centre area of the lens. This means that an enlargement having, say, a correct exposure of 5s will not necessarily be correct if the next stop is used and the exposure doubled. If this is not kept in mind, some very confusing results may be obtained.

If a meter is used to find enlarging time, readings can be used in various ways. A whole list of meter readings and corresponding exposure times could be prepared. Alternatively, a short range of times can be listed and

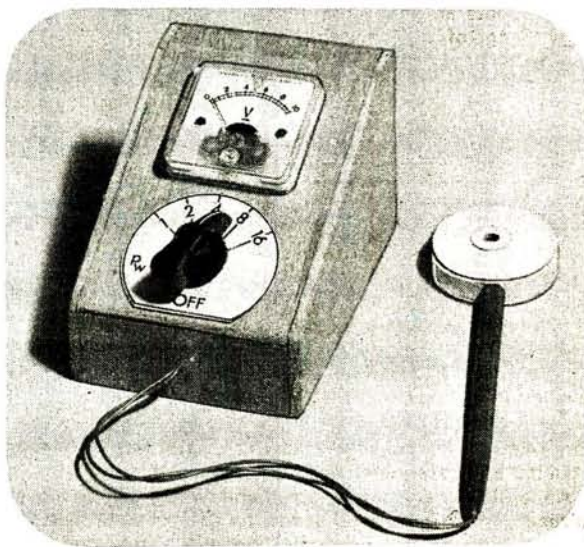


Interior photograph showing general layout of potentiometers, circuit board and jack sockets. The earth connections should be by a common wire, instead of by metal contact.

contact with the metal panel which means that noises or intermittent operation due to bad contact will not arise. Dials should be bought or drawn, or numbered knobs fitted so that controls can be returned to known settings which have been found suitable for a particular recording or other signal. A screened lead with a 3.5mm plug at each end will be useful to connect the unit to popular tape recorders, the microphone lead then being plugged into Input C.

enlarging EXPOSURE METER

The making of a test strip or trial enlargement takes as long as making an enlargement itself because it has to be timed and developed. To avoid this an exposure meter of sufficient sensitivity to place on the enlarger frame, and



The case is made from 5mm plywood, while the remote LDR is housed in circular holder with an old ball-point pen as a handle.

enlarger illumination can be adjusted, by means of the lens stop, to fall on one of these. Different papers also have different sensitivity. The simplest method is, of course, to use one grade of paper, with a set developer, temperature and development time. Otherwise it is necessary to make notes or keep records to cover all materials and processes.

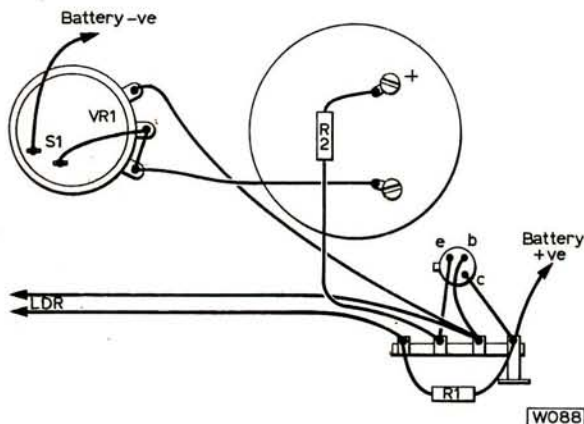
The circuit uses a light-dependent resistor (LDR) as the sensing element. Its resistance falls as light increases causing Tr1 collector current to rise. For one range of

Bits and Pieces

R1 5.6k Ω $\frac{1}{4}$ W 10%
 R2 150k Ω $\frac{1}{4}$ W 10%
 VR1 100k Ω log. potentiometer with switch S1
 Tr1 BSY95A
 LDR ORP12
 Meter, 1mA miniature type
 Tagstrip. Wood for case. Knob. 4.5V battery.

illumination, the meter is adjusted to a calibration point provided on it, by rotating VR1. Exposure time is then read from the scale of VR1. R1 and R2 are to limit current and R2 is also used to reduce sensitivity.

The control scale and meter are sloped so that the meter can be seen by light passing through the enlarger. During adjustment, the LDR has to be screened from the dark-room light or the latter has to be switched off, if it is noticed that this light increases meter readings. (This may even happen with an approved safelight correctly used.) Once



The few components in this project means that a board is unnecessary and components can be mounted on a tagstrip.

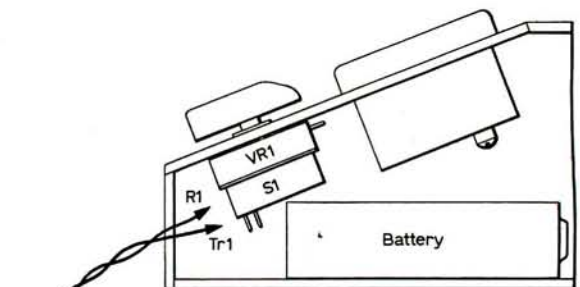
the meter adjustment is made, the light may be put on again, to proceed and read VR1, if needed.

The LDR is a separate, small unit, which can be moved about on the enlarger baseboard or frame, to find the brilliance of various parts of the image. All connections can be completed before fixing the meter or other components in the case. Use flexible leads to VR1 and the switch. Operation can be checked by putting VR1 at minimum resistance and then turning it until the meter reads half

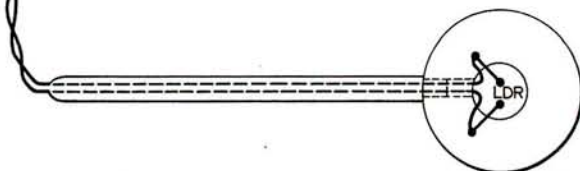
scale with the LDR exposed. Shading the LDR should then cause the meter reading to fall back.

Assembly in the case is quite easy if VR1 is fitted first, then the meter placed in position and its leads finally connected, followed by the tag strip, a bolt or screw fixing the strip to the side of the case. The parts of the case are cut from plywood but a plastic, strong card or metal box could be used instead.

The LDR holder is a piece of wood about 10mm thick and 40mm in diameter, with an old ball-point pen for a handle so that it can be moved without obscuring light from the lens. This device rests flat on the easel so that the LDR is as nearly as possible in the same plane as the paper. A 3-cell 4.5V battery is held in the bottom of the



Case about 75mm wide, 100mm deep, 70mm high at the back and 30mm at the front.



Side view details of case and plan view details of LDR holder.

case and the leads may be soldered to it or attached with small clips.

Note that when the instrument is switched on it is at its least sensitive setting and the control knob is not turned so far as to take the pointer off the meter scale, which will happen if lighting is not subdued.

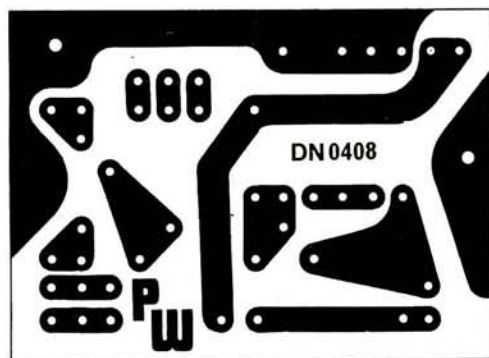
Calibration is done by using small pieces of enlarging paper for test strips, which may be exposed in sections, for varying times. For example, if an opaque card is moved along the strip, exposures of different time can be given to various sections of it. After development, the best time is then seen. Degrees of enlargement, apertures or areas of density can be chosen so that times from 1s to 16s exposure produce full black.

To assist in measuring small areas, a card with a hole 4mm in diameter is fitted centrally over the LDR. With VR1 adjusted to allow a central reading on the meter, maximum sensitivity was then 16s. Once the exposure times have been marked on the scale of VR1 it is only necessary to place the LDR on that part of the image where full black is required and to rotate VR1 to read the exposure.

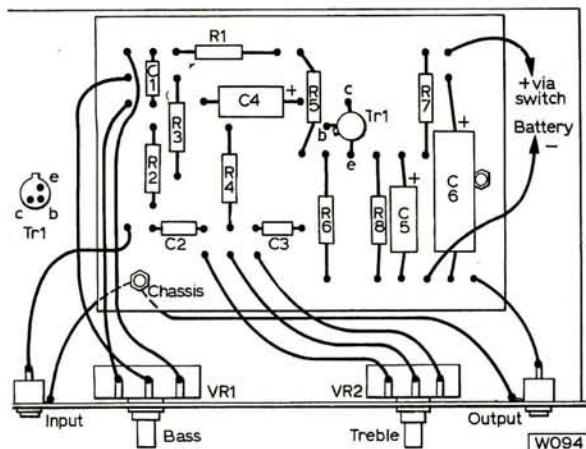
TONE CONTROL UNIT

Some tone control circuits employ purely passive elements, generally resistor-capacitor networks, which attenuate selected frequencies so as to modify bass or treble response. When such circuits are followed by increased amplification, the overall equipment is able to provide a boost of treble or bass frequencies. Though such circuits are simple the circuit used here has the advantage that actual boost of treble or bass can be obtained, as well as treble or bass cut.

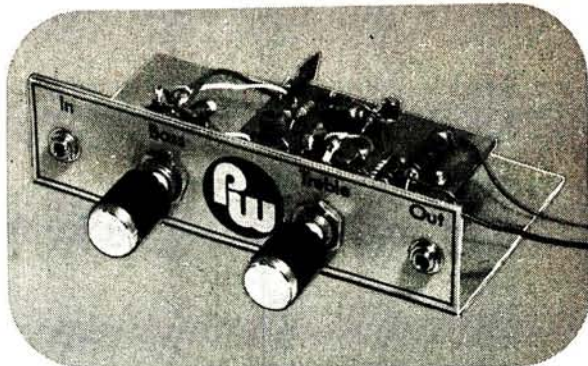
The extreme settings of VR1 or VR2 provide approximately 20dB of bass or treble boost, or bass or treble cut, while middle positions give a flat response. When the input does not exceed 250mV distortion introduced should not exceed 0.1%. The control thus has a wide application



The circuit board should be etched and cut to the size shown above. Holes should be drilled with a No.60 drill.



Topside component layout of the tone control unit. Flying leads are used to connect the board to the potentiometers, jack sockets and battery.

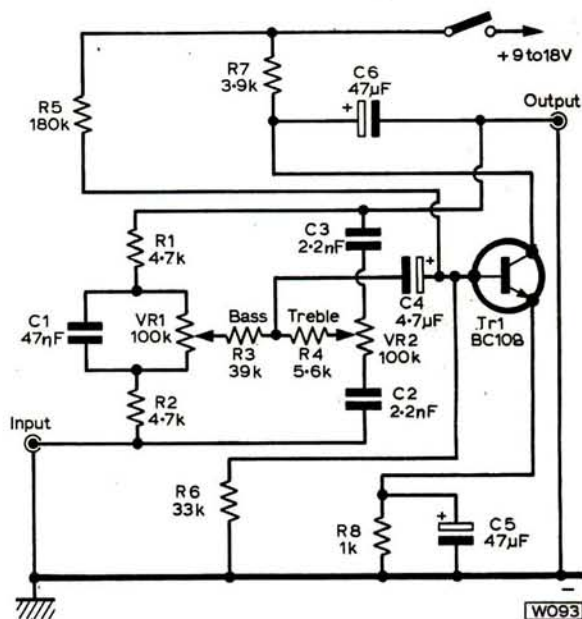


The chassis is of a very simple design, being a piece of 2mm aluminium bent at right angles, and drilled for the components as shown above.

in getting the most satisfactory reproduction from various types of recordings, radio tuner or microphone circuits.

Negative feedback to the bass control VR1 is obtained via R1 while C3 provides negative feedback for the treble control VR2. VR1 and VR2 thus allow adjustment of the base input, or negative feedback from the collector circuit, by either frequency-sensitive circuit.

The printed circuit board used is 65 x 45mm (2½ x 1¾in.) and after drilling, the components are inserted as shown. Note the correct polarity for the electrolytic capacitors. Leads can be spread to prevent components falling out



Distortion from this circuit is approximately 0.1% as long as the input amplitude doesn't exceed 250mV.

after which the board is turned over for soldering, then snipping off excess leads. Flying leads of thin flex, or single strand insulated wire, are left for the potentiometer connections. Flexible leads are provided for the battery supply.

The board and other items are mounted on a 125 x 100mm (5 x 4in.) metal plate, bent to form a 40mm (1½in.) high front for the potentiometers and sockets. The circuit board

is mounted by two 6BA bolts, with extra nuts as spacers. Run the input and output circuits to the inner or tip contact tag of the sockets. The outers are connected to a tag secured by one of the bolts holding the circuit board. Sockets can be changed to suit existing equipment.

A metal box is preferred if the unit is built as a separate

Bits and Pieces

R1 4.7k Ω	R5 180k Ω
R2 4.7k Ω	R6 33k Ω
R3 39k Ω	R7 3.9k Ω
R4 5.6k Ω	R8 1k Ω

All resistors $\frac{1}{2}$ W 10%

VR1 100k Ω linear potentiometer

VR2 100k Ω linear potentiometer

C1 47nF

C4 4.7 μ F 10V

C2 2.2nF

C5 47 μ F 6V

C3 2.2nF

C6 47 μ F 25V

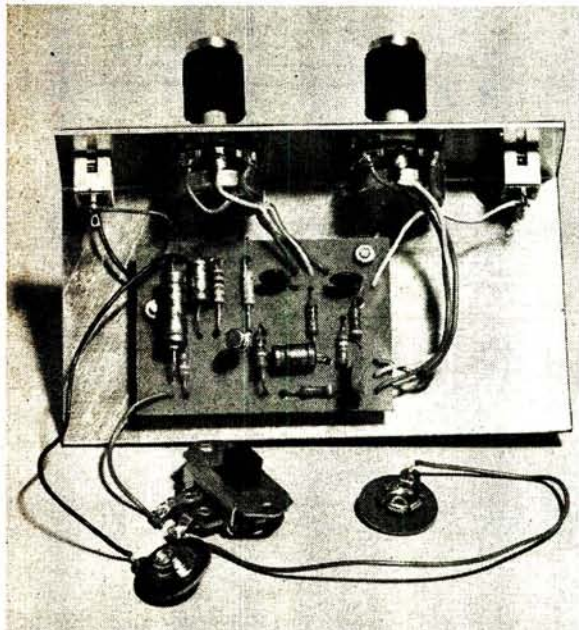
Tr1 BC108

3.5mm jack sockets (2). Knobs. Circuit board.

On-off switch. Battery, see text, and clips. Case, if required, minimum size about 115 x 90 x 40mm (4 $\frac{1}{2}$ x 3 $\frac{1}{2}$ x 1 $\frac{1}{2}$ in.)

unit as this avoids chances of pick-up of interference from adjacent circuits, or similar troubles, while the unit described here can be mounted in existing equipment.

The circuit is designed for 18V operation which may be obtained by connecting two PP4 batteries in series. However, where it is found that performance is adequate with a 9V supply, this can be used instead. The tone control is inserted in a low-level circuit, one where the signal voltage does not exceed about 1V. It is **NOT**



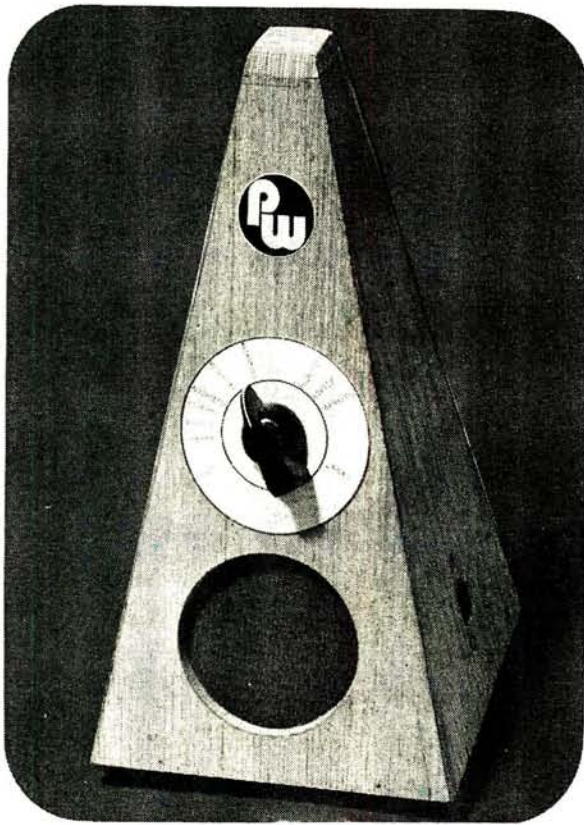
General plan view showing the neat layout of the board in relation to the potentiometers and jack sockets.

intended to take the output of an amplifier used to operate a loudspeaker.

Gain is approximately unity, the input impedance is

around 40k Ω and the output impedance about 180 Ω . The unit is effective over a considerable range of input and output impedances. When "off", signals are still fed through, but without the frequency-selective control provided by VR1 and VR2 but it is not intended that the circuit should be operated in this way.

electronic METRONOME



This Metronome is constructed in an authentic-looking wood case, although any shape would do equally well.

This instrument costs much less than a conventional clockwork metronome, after which it is styled. A metronome provides a click or tick which is adjustable in speed, and it is used either as a guide to the speed at which a piece of music should be played, by setting it to the time marked on the score, or to maintain tempo throughout a piece. The range of adjustment is approximately that required from *Grave* (42 beats per minute) to *Prestissi* (184 per minute).

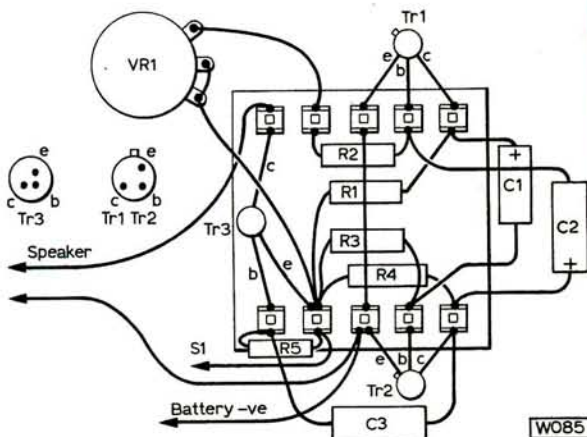
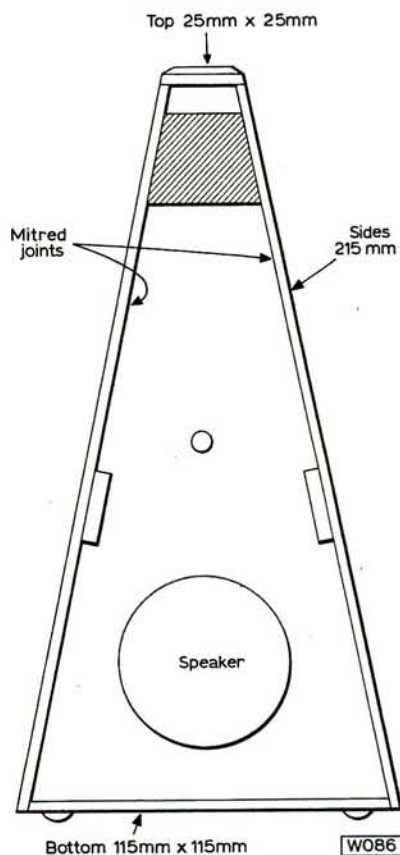
In the circuit periodicity is controlled by potentiometer VR1, which has a pointer knob on the front of the instrument. Current is obtained from a 9V battery and is only about 10mA. Transistors other than those shown can be

used, but it might be necessary to change the values of C1 and C2 or the resistors in this part of the circuit, to obtain a suitable time scale. A single-stage amplifier, Tr3, increases the output level which is greater than that of a musician's clockwork metronome.

Components are assembled directly on a board having two rows of tags. The transistors can be soldered on last

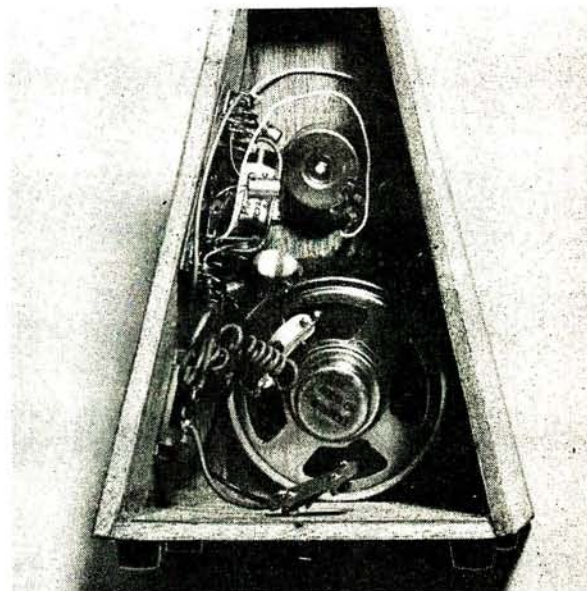
and their leads left long so that there is no chance of damage from overheating. A separate on-off slide switch S1 is used so that VR1 can be left at some pre-arranged setting; which would not be possible if a potentiometer with switch were used.

Dimensions for the case are given as it was decided to copy a conventional metronome. The four sides are similar. The front has an aperture for the speaker and a hole for VR1. Cut a slot for S1 in one side. The best means of



The component layout board is made from paxolin sheet with five tags either side for the fixing of components. The board is approximately 35 x 35mm.

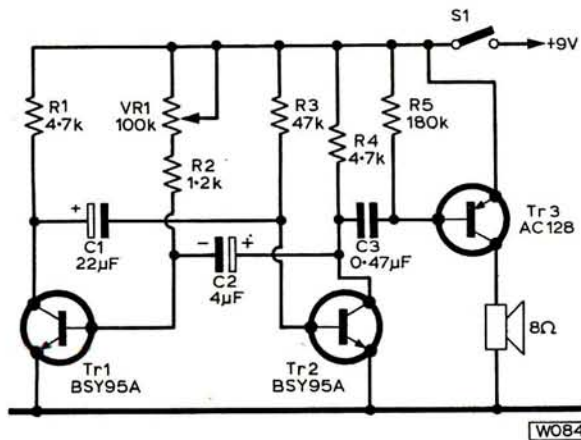
Constructional details of the case which is made from 5mm plywood.



Internal photograph taken from the rear showing the speaker and 'beat' control potentiometer. The tagstrip and on/off switch are mounted on the side.

assembly is to bevel the edges at 45°, then using adhesive to fix the front and sides to a small shaped block, as shown, and to the bottom. Fillets inside will help to strengthen the work. Small screws fix the back so that it can be taken off to replace the battery. For good appearance, the case should be thoroughly glasspapered and varnished (before fitting any electronic items). Four rubber feet are necessary to protect polished surfaces on which the metronome may be placed.

The speaker opening is covered with silk, and the



Utilising a basic multivibrator circuit, this Metronome has the advantage of an audio output stage.

speaker is fixed behind this with adhesive. Screws hold the tag-board on one side of the case. Fit a knob and scale on the front. The table gives speeds and markings. The settings for VR1 will depend on the actual transistors used so the scale must be individually calibrated. The

Bits and Pieces

R1 4.7k Ω $\frac{1}{2}$ W 10%
 R2 1.2k Ω $\frac{1}{2}$ W 10%
 R3 47k Ω $\frac{1}{2}$ W 10%
 R4 4.7k Ω $\frac{1}{2}$ W 10%
 R5 180k Ω $\frac{1}{2}$ W 10%

VR1 100k Ω linear potentiometer

C1 22 μ F 12V

C2 4 μ F 12V

C3 0.47 μ F (0.5 μ F suitable)

Tr1/2 BSY95A Tr3 AC128

On-off switch. Speaker: 8 Ω 2 $\frac{1}{2}$ in. Tagboard. 9V battery and clips. Knob.

beats per minute for the lower rates can be counted using a clock or watch with seconds hand. For example, 80 per minute is *Moderato*. The faster beats, such as *Presto*, may be counted by beating time and counting each second beat.

Metronome Markings

Prestissimo	184	Andantino	66
Presto	144	Andante	60
Vivace	126	Adagio	54
Allegro	116	Large	50
Allegretto	100	Largo	46
Moderato	80	Grave	42

HINTS and TIPS

IN LOOKING through our series of supplements we hope that everyone will find at least one project which catches their eye. It may be, however, that you have never built a project before in your life, so we are taking this opportunity to give you a few hints to help you on your way.

COMPONENTS

After looking through the advertisements in P.W. you will undoubtedly find a retailer who will fulfil your needs so after receiving your components you have the task of identifying them and fitting them together.

The capacitors you receive will almost certainly differ slightly from the appearance in our photographs. Don't worry about this: as long as the value is the same that is all that matters. Electrolytic capacitors have maximum voltage ratings printed on them and here again you may find that yours differ from those stated in the magazine. The only thing to look for is that the voltage rating on the

capacitor that you have is greater than that given in the Bits and Pieces list.

It is important to correctly identify the polarity of electrolytics. Usually the positive end is marked with a '+' sign or a ring or it may be that the negative end is marked with a '-' sign.

In the case of semiconductors (diodes, transistors, and IC's) make sure that the leadouts are correctly identified; these are probably the most expensive components and mistakes can be costly.

CONSTRUCTION

Most of our projects are built on Veroboard which is perforated paxolin board with rows of copper strips on one side. We give you diagrams showing just where to make the breaks in the board, this being done with either a special tool designed for the job called a "spot face cutter" or a hand held drill bit. Cut all the breaks before mounting the components.

Insert the components and bend their leads slightly to hold them firmly—they must not move during soldering. Do not bend the leads too near the component body. Cut off excess leads and solder in place.

Projects not on Veroboard or printed circuit board are on ordinary perforated board. Here, do not cut the leads of the components as they may be used for interconnections.

SOLDERING

For soldering you will need a small (15 to 20 watt) iron with a bit of about 3mm, and some resin cored solder of about 22 s.w.g. A bad joint is most often caused by the parts moving during soldering so make sure components are firm, giving a lead a slight bend if necessary. Heat both parts to be joined with the soldering iron and then apply solder letting it run freely, then removing solder then iron. Don't use too much heat or the flux will not do its job producing what is known as a dry joint. A good joint should look clean and shiny.

NEXT MONTH another 8-PAGE SUPPLEMENT SIMPLEHOME PROJECTS - 3