$2.95

$3.90NZ

FM BUGS

By
Colin Mitchell
&
Staff

A TALKING ELECTRONICS PTY LTD PUBLICATION

BUILD A BUG KIT

Get into the exciting world of snooping and surveillance. Build an FM bug!

Select from the MICRO BUG, PORTABLE BUG (the 'ANT'), PHONE BUG or GUITAR BUG. All the details for thse and more are included in this issue and with the simple step-by-step guide, you can't go wrong.

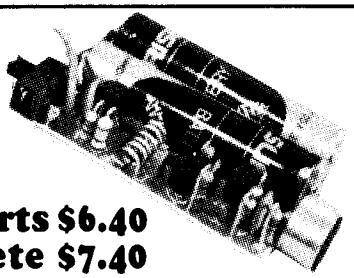
There are so many uses for a wire-less mode of communication that's it's amazing transmitters like these haven't been presented before.

The range and clarity of FM transmission is unbelievable. A tiny 5mW transmitter can be detected over 200 metres away and that's plenty for even the largest home or factory.

You can use it for security, safety, monitoring, or as a simple communication medium in large halls or for sporting events.

Imagine what you could find out about yourself by leaving it in a lunch room or in the childrens room! The PC board on the cover should spur you into building something today. So, don't waste time. Read the articles and work out which model best suits your need.

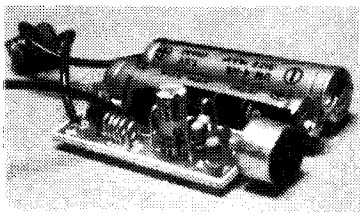
THE ANT



The ANT is our cover project and is possibly the pick of the bunch. It is stable, compact, powerful and sensitive. You have a head-start as the PC board has been taped to this book.

PC board $1.00 **Parts $6.40**
Complete $7.40

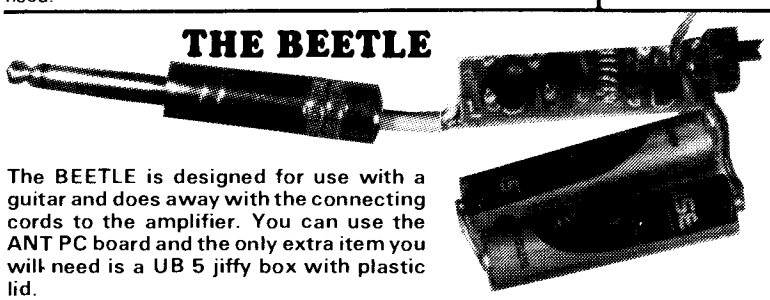
THE GNAT



The GNAT. This is the smallest bug in the range and is a MICRO version of the **FM BUG.**

PC board $1.50 **Parts $6.00**
Complete $7.50

THE BEETLE



The BEETLE is designed for use with a guitar and does away with the connecting cords to the amplifier. You can use the ANT PC board and the only extra item you will need is a UB 5 jiffy box with plastic lid.

PC board $1.00 **Parts $5.40**
Complete $6.40

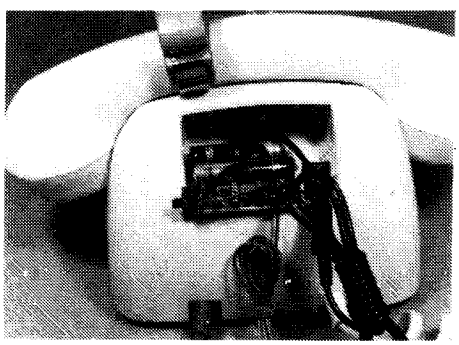
FM BUG

FM BUG is the original BUG and is designed to be set and left in place. Will pick up conversations within a room and is equal to the human ear.

PC board $2.15 **Parts $6.00**
Complete $8.15

THE TELEMITE

The TELEMITE attaches to the phone and you can pick up a two-way telephone conversation.

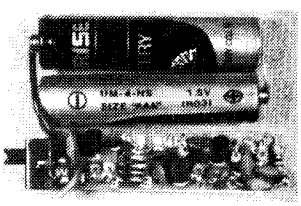


PC board $1.00 **Parts $7.40**
Complete $8.40

THE CRICKET

The CRICKET is a 1kHz tone bug and will transmit this tone a distance of about 200 metres. Ideal for tracking.

PC board $1.80
Parts $4.80
Complete $6.60



BIG EAR

BIG EAR is the FM BUG with a low value load resistor for the microphone, and a large parabolic collecting dish to enable the bug to pick up extremely faint sounds.

PC board $2.15 **Parts $6.00**
Complete $8.15

TALKING ELECTRONICS Pty Ltd

35 Rosewarne Ave., Cheltenham 3192 (03) 584 2386

MasterCard bankcard VISA

Pack and post: $1.80 per kit.
Maximum pack and post: $6.00

Extra 'ANT' PC boards $1.00 each. see P.4.

FM BUGS

By
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&
Staff

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★Recommended and maximum price only.

Designed by Colin Mitchell, 35 Rosewarne Ave., Cheltenham, Victoria, 3192. (03) 584 2386

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A TALKING ELECTRONICS PTY LTD PUBLICATION

Printed by Standard Printers, Cheltenham, 3192.

FROM THE AUTHOR

This book represents a collection of FM transmitters from the design laboratories of TE and once again we have included a printed circuit board on the cover.

I hope you like it and are tempted to build one or more the projects. That's the idea of the board. It isn't very large as we are promoting a miniature FM wireless microphone suitable for wearing on the lapel or hidden in the top pocket and obviously it must be as small as possible.

We go to a lot of work to produce the material for these books and it is heartening to hear from many of the readers about the success of the projects.

The circuits described in this book represent only a small area of electronics and show what can be done with a handful of components and a well-designed circuit.

The idea of being able to transmit over a short distance is even more amazing when you hear the clarity of the reception. FM is a distortion-free mode and is ideal for speech and music.

Even since I was 14, I have had a miniature transmitter capable of transmitting on the broadcast band and I want to exend to you, the excitement I had.

I hope this book does just that, and you put aside digital electronics for a moment and try some of the circuits.

ABOUT THE PC BOARD

The PC board taped to this book is for the FM WIRELESS MICROPHONE.

This project requires a degree of skill in construction and it is suggested that you have some prior experience with soldering before attempting it.

This is because the parts are close together and the solder lands fairly small. Try a few of the simpler TE kits beforehand.

The reason for the 5 projects on the same theme should be obvious. Each performs a slightly different function and depending on your requirement, one of the circuits will be ideal.

All designs have been tried and tested and they all work better than you think.

We have tried commercially available units and apart from their neat finish, most did not perform beyond 20 metres or so.

This makes them unsuitable for halls, sporting events, or between house and workshop when a number of walls restrict the path of the signal.

Many of the units selling for $50.00 or more do not perform nearly as well as our miniature model.

As you read through the articles you will discover the advantages of each design and the reason for the different models.

If this is your first introduction to TALKING ELECTRONICS, we have included a complete list of projects in the centre of the book as well as a whole range of individual components.

Talking Electronics is an educational-based publishing firm intent on bringing electronics to the hobbyist and beginner. Projects range from a simple diode tester to a 9-chip Z-80 based computer.

By following through these kits in a logical way, you will advance quite quickly to a point where you will understand some of the 'ins' and 'outs' of digital circuits.

Most of the projects are based on digital principles as this gets you into the rapidly expanding computer field.

FM transmission has been presented as a diversion and yet it does have its place as a means of remote linking say a robot with a computer.

Applications such as remote control require digital links (or audio links) and thus transmission and reception principles need to be understood.

I hope this book gets you started and/or keeps you going and I would like to see your name in the mail-bag with a request for a kit.

If you have any queries, feel free to ring the author on (03) 584 2386 for assistance on any of the projects in this book or any other TE kits.

All the best,

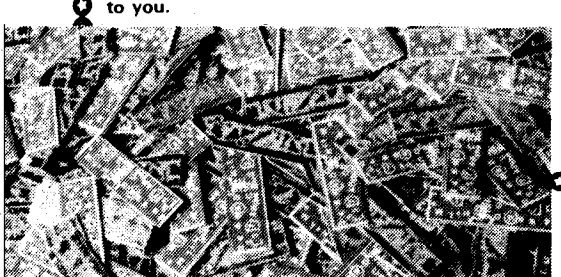
Running off the price list for the next issue of TE.

MORE ON THE PC BOARD

Since having the PC boards made, there is an interesting story to tell.

You will notice the board is made of very thin material. This was especially chosen to match the delicate nature of the project and also to make it as light and compact as possible.

There is only one drawback to this. With possible rough handling during distribution, a few of the boards may get broken and we have kept some to replace those that are damaged. If your board is broken or damaged, just send it in and it will be replaced. We would like you to send for the kit at the same time, but that's up to you.



Now for the amazing PC board story.

I went to the PC board manufacturer (MICRO-ETCH) on Wednesday afternoon at 3pm, with the artwork, primarily to ask for a unit price for the 20,000 cover project boards.

Within 20 minutes they had worked out a price and said if it was acceptable, the boards would be ready Friday morning.

"Friday next week," I said. "No, Friday this week." said George.
"But that's only two days off," "Doesn't matter," said Geroge "with our new NC drill we can have your boards finished in 2 days."

If you've ever wanted to see the efficiency of private enterprise at work, this was it.

Micro-Etch runs two shifts and that afternoon they cut up the panels and stacked them 7 high for the NC drill. All that was required was to program the top left hand board and call a step and repeat program to produce 7 boards in one direction and 10 in the other.

The .9mm drill hits the stack 4 times per second and the whole job used only 2 high-speed drills! Each round took approx 50 minutes and the 1,100,000 holes were completed in about 8 hours.

Next the track-work was stepped and repeated to match up with a drilled panel and the overlay stepped to match the top side. The tracks were printed over the copper laminate with acid resistant ink and the boards etched.

The next day the overlay was screened onto the panels and finally the boards were cut up.

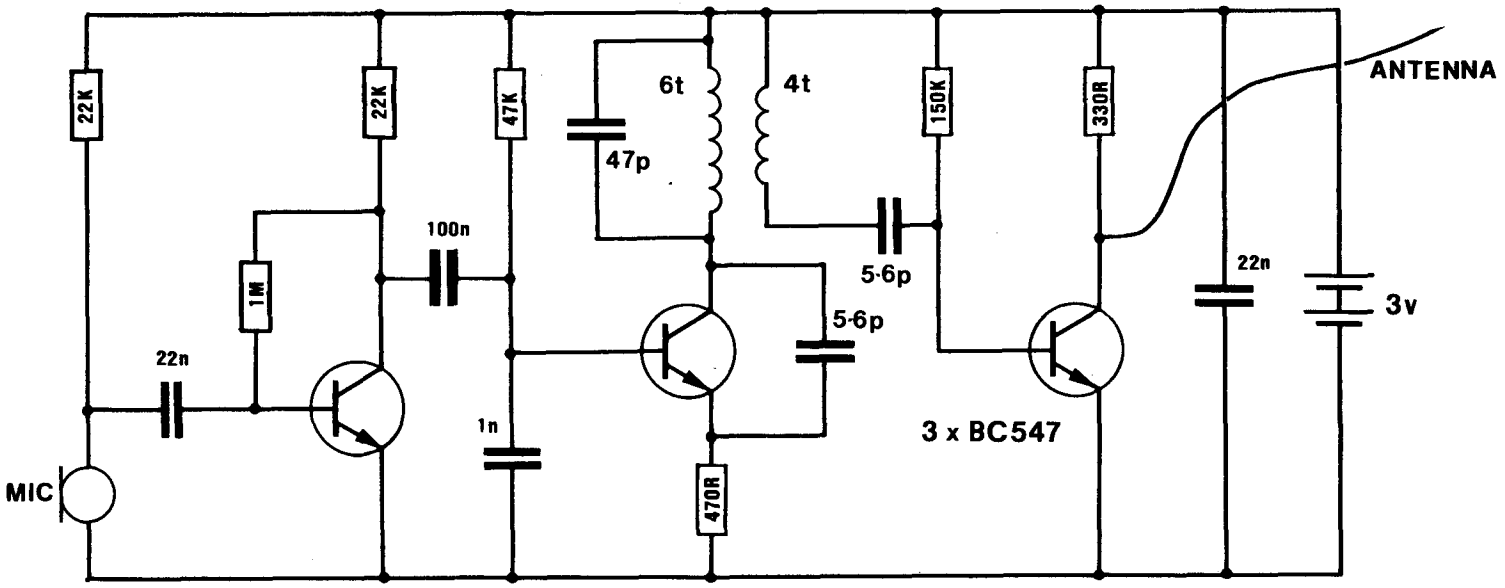
At 10 o'clock Friday morning the job was delivered - including some extras for those damaged in distribution.

You can see why we don't go past Micro Etch and if you want a production run like this, or an exotic plate-through-hole prototype made, they can be contacted on (03) 555 2760.

THE 'ANT'

PC board $1.00
Parts $6.40
Complete $7.40

SELECTED AS THE COVER PROJECT, THIS IS THE PICK OF THE BUNCH



THE 'ANT' FM TRANSMITTER CIRCUIT

All the projects in this book have been given a name. An insect name. During their design, we called them all 'bugs' and it was difficult to differentiate one from another.

Then Ross suggested we give them names corresponding to their size or function. Thus we call this one the ANT.

It's small (but not as small as the mini bug described later in this book) and the name ANT fits perfectly.

Before settling on a particular project, you should read the notes on all the projects as each has something different to offer. The theory behind a simple FM transmitter is enormous and we have tried to present as many facts as possible, but split between each of the projects.

One of the first decisions we had to make was to select a project for the cover and naturally we decided on the ANT. It is very compact, provides a good range and most important of all, it is stable when touched or worn on the body and doesn't drift off frequency.

It has been primarily designed for this and can be made even more compact by using button cells for the supply. We have opted for AAA cells for their size and ease of connection by soldering, but you could just as easily use two button cells if you are careful with a soldering iron. But is not advisable to solder them and you should bend up some clips to hold them in place.

Some of the commercial lapel FM microphones are beautifully designed and we have included a photo of one of these later in this article to show you what to aim for.

Since these cases are not available separately, it is not possible to put them in a kit. But if you are good at fabricating, you may be able to create something similar by combining a sphere with a tube and place the PC board, mic and battery inside.

For the rest of us a simple plastic case, such as a TIC TAC box or large pen barrel will have to do.

A brief outline of the capability of the 'ANT' will help you compare its performance with other designs.

The ANT will transmit a distance of about 200 metres under non-favourable conditions and you can get some idea of the test conditions in the TESTING section.

It transmits on the 88 - 108MHz FM band and must be tuned to an unused portion of the band so that it does not interfere with local radio stations.

Frequency range and fidelity is superb on FM and the transmitted sounds are crystal clear.

You can use this project for animal tracking, remote listening for security, as an early warning alarm or for transferring TV sound from one room to another.

Its uses are limitless and it is especially useful for situations where it is required to be moved or carried. We will leave the ideas up to you.

Kits for the ANT (and also all the other projects) are available by mail-order from TE and with the step-by-step notes on the following pages, you can't go wrong.

Without any more talk, let's start.

PARTS LIST

1 - 330R (orange - orange - brown)
1 - 470R (yellow - purple - brown)
1 - 10k (brown - black - orange)
2 - 22k (red - red - orange)
1 - 47k (yellow - purple - orange)
1 - 150k (brown - green - yellow)
1 - 1M (brown - black - green)

2 - 5p6 ceramic
1 - 47p ceramic
1 - 1n ceramic
2 - 22n ceramic
1 - 100n monoblock

3 - BC 547 transistors

10cm tinned copper wire .71mm diam
10cm enamelled wire .61mm diam
2 - AAA cells
1 - electret mic insert

1 - SPDT slide switch
2metres hook up flex for antenna

1 PC board 'ANT'

HOW THE CIRCUIT WORKS:

There is a lot more to the circuit than first meets the eye.

Some components perform one task, others perform more than one task and everything is fairly critical.

The value of some of the parts is more critical than others and also the placing and spacing of the components is important. This is because the circuit is operating at a high frequency and we want it to operate at peak performance.

Starting at the left hand end of the circuit, we have an electret microphone. As we have mentioned before, this microphone houses an FET (Field Effect Transistor) in which the lead equivalent to the base of a normal transistor, the GATE. The gate is connected to a small metallised diaphragm that is charged with a high potential during manufacture and it holds this charge for the life of the unit.

The diaphragm forms a miniature capacitor or condenser (and this gives rise to its name 'condenser microphone'). When sound waves touch the diaphragm, the charge on the gate of the FET alters. The FET amplifies this and the result appears on the output lead.

These microphones are very sensitive and produce a very good output swing with normal levels of speech.

The 22k resistor is the load resistor and supplies the microphone with a potential. When the microphone picks up signals, the varying voltage across the field effect transistor is passed to the first BC 547 via a 22n capacitor. This value is not critical and has been chosen as it is the largest value ceramic having a small size.

The BC 547 is a self-biasing audio amplifier and is used as a pre-amplifier to boost the output of the microphone to a level suitable for injecting into the oscillator stage.

The transitor is biased via the 1M base resistor and provides a gain of about 100.

The main purpose of the stage is to provide microphone gain so that the circuit will pick up faint sounds (it can be made more sensitive by lowering the value of the load resistor to the electret to 10k or 4k7) and the result is the wireless microphone is nearly as sensitive as the human ear. If this stage is removed, it will be necessary to talk directly into the microphone and the unit will only pick up direct speech.

The output 100n can be any type of capacitor and we have used a mono block mainly for its small size.

The second BC 547 is wired as an oscillator operating at about 100MHz. The frequency has been set by the value of the components in the collector and emitter circuits and also those in the base and coupling circuits.

In other words, the frequency is set by nearly everything in the circuit, including the battery voltage and 22n battery-decoupler. The only components that do not affect the frequency are the pre-amp parts and microphone.

The oscillator stage is turned on via the 47k and this causes a current to flow in the collector-emitter circuit. Connected to the collector of the transistor is a parallel tuned circuit made up of a capacitor and coil.

When a pulse of energy is passed through an arrangement such as this, the capacitor initially stores a charge and this energy is then passed to the coil. The energy is converted to magnetic flux and a very short time later, the magnetic flux cuts adjacent turns and this produces electrical energy that flows back into the capacitor. This phenomenon is called RESONANCE.

In theory this action will go back and forth indefinitely however in practice there are a number of losses in the capacitor and coil and gradually the packet of energy will decrease.

This is where the transistor comes in. It is designed to supply a small amount of energy at each cycle to keep the oscillations at a maximum.

This is done by picking off a small amount of voltage from the collector and feeding it to the emitter. This is done via the 5p6 and the low value of this capacitor has been chosen so that it does not dampen the oscillations too much.

The third transistor is inductively coupled to the oscillator by interleaving 4 turns (called the secondary) with the main coil. The 'pick-off' 5p6 capacitor is a low value and means only a very small sample is picked off. This prevents any loading effect on the oscillator.

The output transistor is turned on slightly by the 150k base resistor and the waveform picked off by the secondary of the air-cored transformer is passed to the base.

The function of the 5p6 is two-fold. Firstly it allows a turn-on voltage to be applied to the base via the 150k and secondly it transforms the package of energy from the secondary of the transformer into a form suitable for the transistor.

The energy output of the transformer comes in a form that is high voltage and low current. The transistor requires low voltage and high current. The capacitor converts the package of energy into this form.

The transistor amplifies this waveform and the current through the collector-emitter is modified to produce a carrier wave.

The carrier is picked up by an FM receiver and when the 'ANT' is tuned in, the background noise reduces to almost zero. When speech is picked up by the microphone, the output frequency is modulated and the receiver converts this back into speech.

This frequency modulation is performed in the oscillator stage. Signals picked up by the electret micrpohone are amplified by the first transistor and appear on the base of the oscillator stage. The 1n capacitor plays an important part in the process. This is how it works:

The base of the transistor is trying to move up and down in sympathy with the emitter. But at 90MHz, the 1n provides a restraint and the result is the base is held firm (at a voltage level of about 1.3v) and this permits the oscillator to function.

Along comes the audio waveform and because it is a much lower frequency, the 1n does not have any hold on the voltage and the base is allowed to rise and fall.

This alters the gain of the transistor and alters its internal capacitance. Thus the frequency of the oscillator changes an amount equal to the waveform entering it. This is called FREQUENCY MODULATION and produces a very clean transmitting signal that is distortion-free.

The circuit is tuned by adjusting the spacing of the oscillator coil. A common alternate approach is to include a variable capacitor across the coil so that it can be adjusted. These trimmers are difficult to obtain and are quite expensive. They also take up more space.

Ours is the better approach as once the frequency is set, it does not require any further adjustment.

Moving the coils apart or together alters the frequency quite appreciably and this must be done carefully so as not to shift the frequency off the band.

The main coil has 6 turns and secondary 4 turns. This means a turns ratio applies between the windings and because the secondary feeds into a 5p6 only a fraction of the energy of the tuned circuit is picked off.

The purpose of the linear amplifier output stage is to reduce the effect of external capacitance on the circuit. This is important if you want to move the unit around or wear it as a lapel mic.

The output stage reduces the loading effect of the aerial and also 'tightens up' the whole circuit so that it is not sensitive to outside capacitive effects.

The final component is the 22n across the battery. This is necessary to reduce the internal impedance of the power supply. The capacitor stabilises the supply rails and allows peak amounts of current to be drawn without affecting the rest of the circuit. This capacitor is also called a 'supply decoupler' and at 90MHz it is very effective.

CONSTRUCTING THE 'ANT'

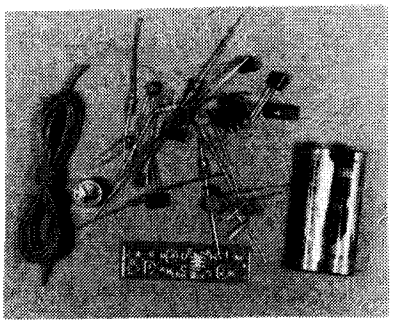
The following step-by-step construction notes show how and when each component is added to the board. And by following this, you are almost guaranteed success.

Lay out all the parts on a clear portion of the work-bench and identify everything.

You should be able to read the value of each component and know that some of them must be inserted around a certain way.

The soldering iron should be clean and you should have a pair of side cutters for clipping the leads after each component has been soldered.

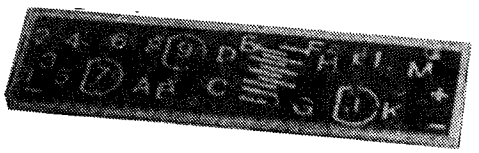
Here we go:



Lay out all the parts similar to this photo. Make sure everything is present by comparing with the parts list. If a component is not marked as stated in the list, it may be the nearest value or a slightly better value. Don't worry too much at this stage unless you are sure it is wrong.

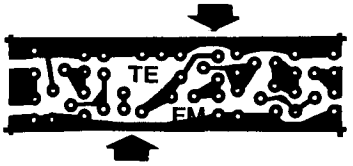
There is one extra resistor in the kit. It is a 10k and should be used as the mic load resistor if you want the ANT to have super-sensitive pick-up.

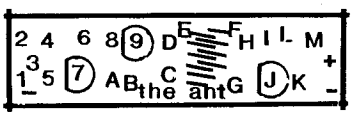
Inspect the board. It has numbers and letters on it in place of component values. This was necessary as the board was too small to write each component value.



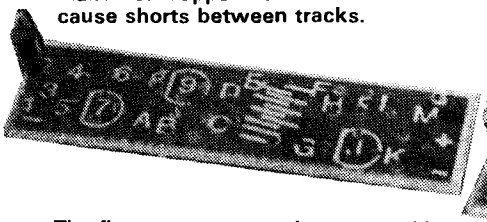
Construction does not follow the numbering but goes across the board in a linear mode so that you have plenty of room when fitting each component.

Check the underside of the board for damaged tracks, especially here and here:

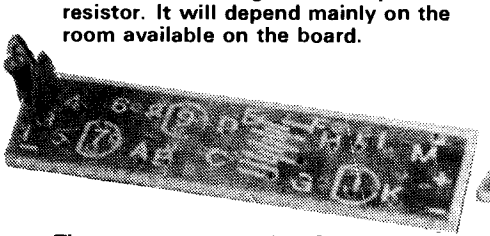




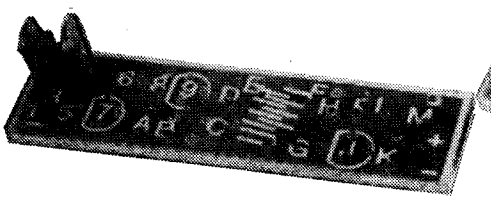
Make sure the legend is readable and that all holes have been drilled. Check the underside of the board for correct track-work and see that all tracks are etched correctly and that no fine 'hairs' of copper have been left to cause shorts between tracks.



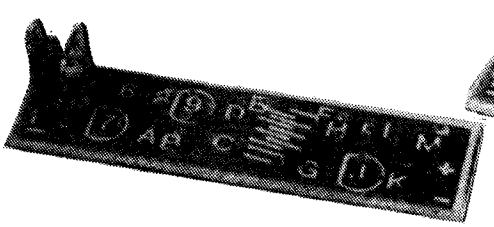
The first component to be mounted is a 22k resistor (red red orange). Bend one lead over close to the body of the resistor and fit the two leads down the holes marked '2', so that the resistor touches the board. Solder it in position and cut the two leads close to the board. This applies to all the resistors in this project and they can be placed either way around as it does not matter which hole gets the body of the resistor. It will depend mainly on the room available on the board.



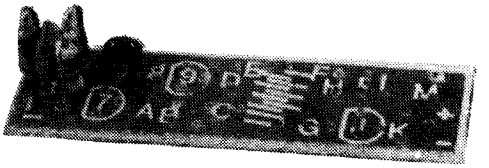
The next component is a 22n ceramic capacitor (marked 223 on the body). It fits down the holes marked '3' and touches the board. It can be placed either way around and soldered quickly so that it doesn't get too hot. Cut the leads close to the board to make a neat job.



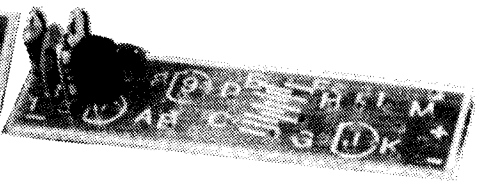
The third component to be added to the board is a 22k (red red orange) resistor. It is fitted over the '4' on the PC board and like the first resistor, the leads are cut off close to the board, after it has been soldered.



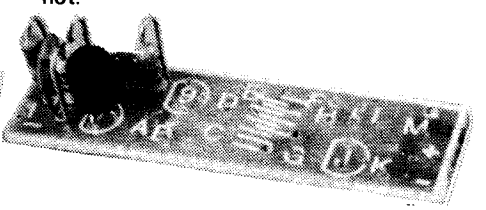
Next fit a 1M (brown black green) resistor over the holes identified by the number '5'. Solder it and cut the leads as before.



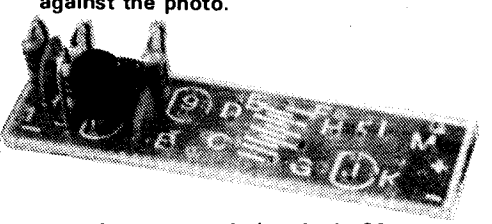
Next is a 100n monoblock. It is identified by 104 on the body and these numbers will be very small and hard to see. It can be placed either way around on the board and goes down holes marked '6'. It is soldered quickly to prevent it overheating. Clip the leads close to the board.



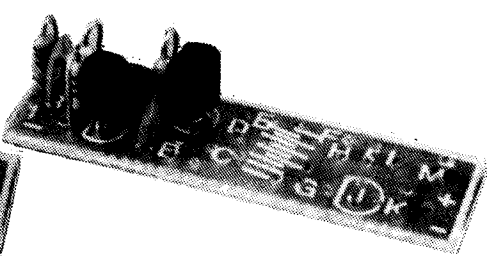
Next fit a BC 547 transistor so that it is level with the top of the 1M resistor. It goes down the three holes marked '7' and the flat on the side of the transistor matches up with the flat on the overlay. Solder the leads quickly as the transistor does not like to be overheated. You can hold the transistor in place with a finger and this will act as heatsink to let you know if the transistor is getting too hot.



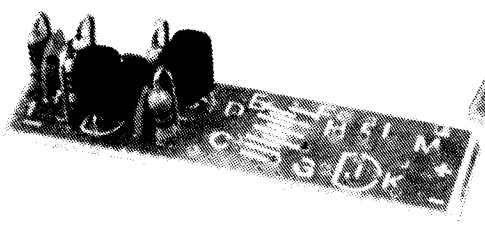
Next fit the 47k (yellow purple orange) resistor down the holes marked '8' and keep it nicely upright with one hand while soldering with the other. Clip the leads and check your board against the photo.



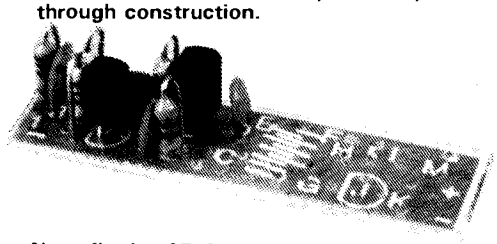
Next the 1n ceramic (marked 102 on the body). This goes down the holes marked 'A' and touches the board both before and after soldering so that the project looks as compact as possible.



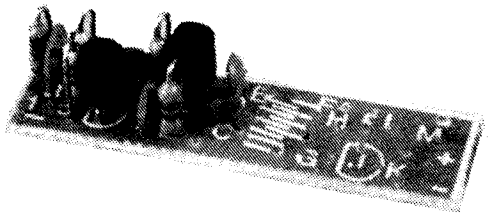
The second BC 547 transistor is now added to the board. This fits down the holes marked '9' and as before, solder it quickly to prevent it getting too hot.



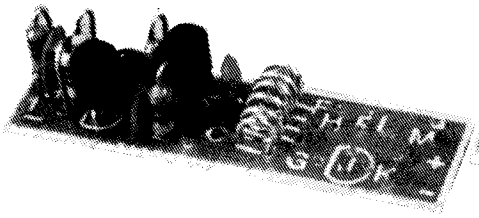
The 470R (yellow purple brown) resistor is fitted down the holes marked 'B' and soldered like the other resistors. Clip the leads close to the board and we are nearly halfway through construction.



Next fit the 47pf ceramic down the holes marked 'D', as shown in the photo. This capacitor will be marked 47 on the body and should be soldered quickly like all the capacitors.

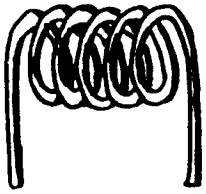


The next component is a 5p6 ceramic and fits down holes marked 'C' on the board. It can be marked 5.6 or 5p6 and can be fitted either way around.

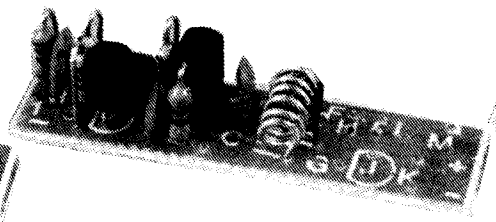


Now comes the most critical part. The main oscillator coil determines the frequency of operation and its size and shape is very important. It must look exactly like that shown in the photo to get the ANT to transmit on the 88 - 108MHz band. The kit contains a pre-wound coil but if it has been squashed or damaged, it must be rewound.

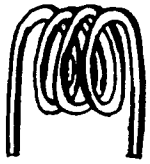
The coil consists of 6 turns of .71mm tinned copper wire wound on a 3mm Philips screwdriver shaft.



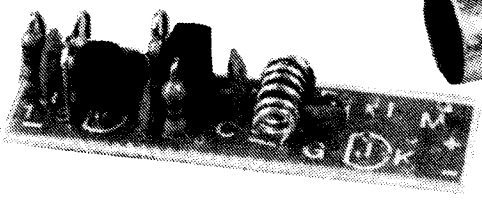
Fit the ends of the coil down the holes as show in the photo and this will create the corect spacing between turns. Solder the ends and cut the excess off close to the board.



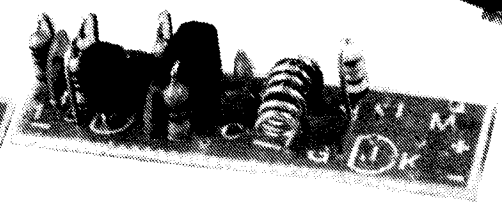
The secondary winding consists of 4 turns of .61mm enamelled wire wound on a 3mm shaft. Bare the ends by scraping them with a nail file or sand paper so that the enamel is completely removed and fit the ends down the holes on the PC board as shown.



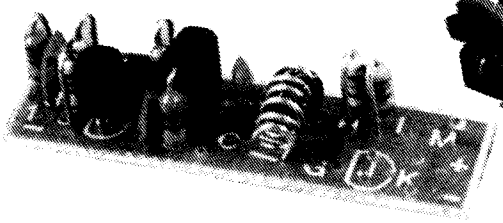
Interleave the turns with those of the tinned copper wire coil. Start at the top and you will find the other end will fit down the appropriate hole on the board. Solder the ends and clip the surplus close to the board.



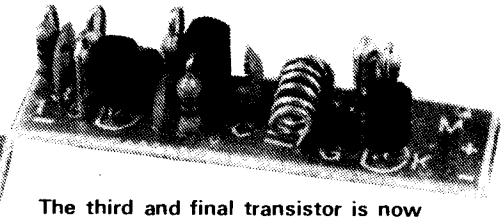
Next fit a 5p6 ceramic down holes marked 'G' on the board. Solder the leads and clip them the same as the other parts. Check your model with the photo to make sure everything is identical.



The next item is a 150k (brown green yellow) resistor and this goes down holes marked 'H'.

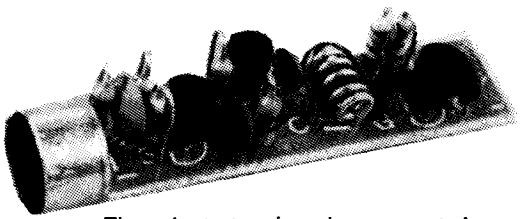


The 330R (orange orange brown) resistor fits down holes marked 'I' and solder it as neatly as the other resistors.

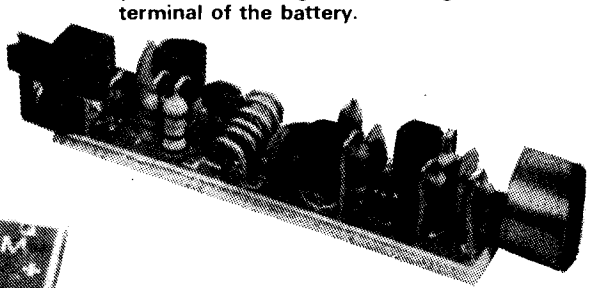


The third and final transistor is now fitted and this BC 547 fits down the three holes marked 'J'. Don't let the transistor project higher than the top of the resistors.

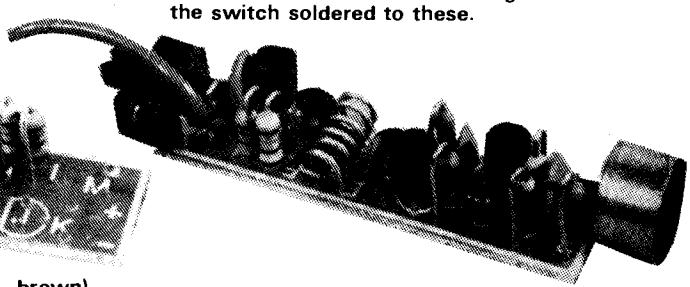
The last capacitor to add is a 22n (marked 223 on the body) and it fits down holes marked 'K'.



The electret microphone must be fitted so that the lead going to the outside of the case goes down the hole marked negative '-' on the board. By checking the copper side of the board, you will notice it goes to the negative terminal of the battery.



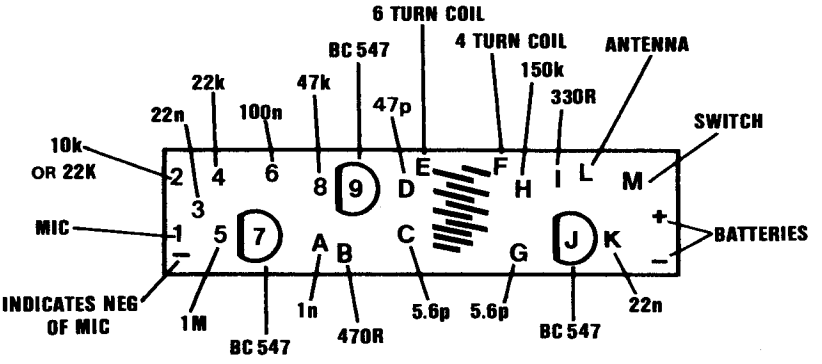
The photo shows how the switch is added to the top of the board. Short lengths of tinned copper wire are soldered to the board and the tags of the switch soldered to these.



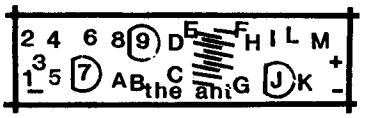
The aerial wire is taken to the hole shown and soldered in place.
It should be cut to 156cm for ½wave or 83cm for ¼wave. Try a half wave antenna first and if the range is not required, go to ¼ wave.

The two AAA cells are connected together by soldering a short length of tinned copper wire between the positive of one end and the negative of the other.

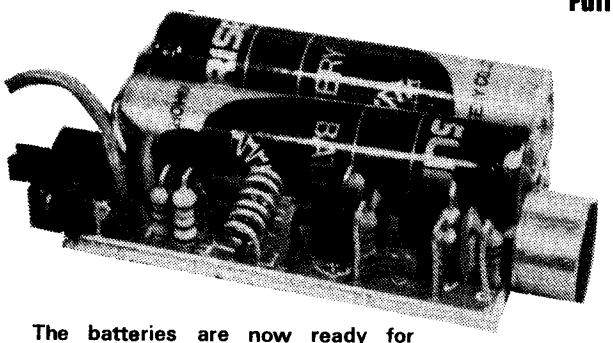
At the other end, a short length of tinned copper wire is soldered to the negative and insulated hook-up wire or flex to the positive.

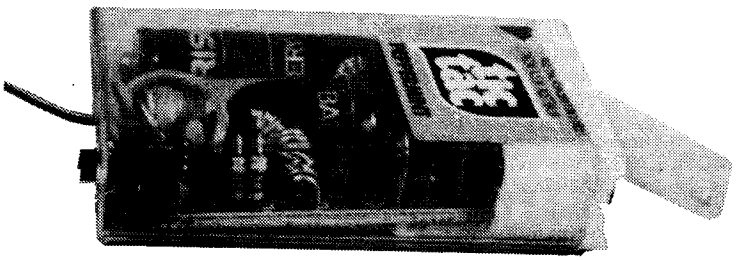


Enlarged overlay showing the relative position of each of the components.



Full size artwork of overlay.

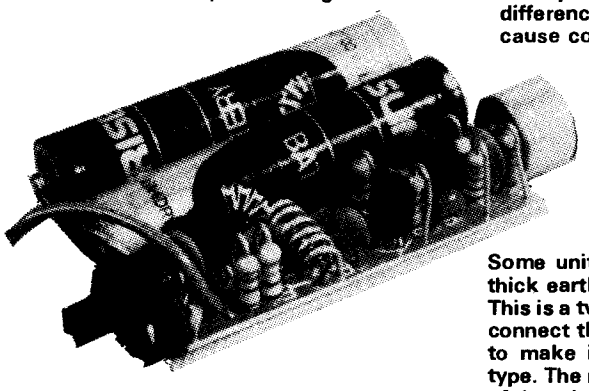




The completed 'ANT' in a TIC TAC box.

The batteries are now ready for attaching to the board and they are laid alongside so that the negative lead goes down the negative hole and the positive lead down the positive '+' hole on the board. Solder them in place and the project is complete.

Check your model against the photo and it is now ready for testing.



SENSITIVITY

The sensitivity of the 'ANT' depends to a large extent on the value of the load resistor used for the electret microphone. We suggest starting with a 22k as this will give an all-purpose pick up capability. If you wish to increase the sensitivity to 'super-bug' performance, the resistor can be decreased to 10k or even 4k7. With this you will be able to pick up sounds that are barely audible. See the BIG EAR project for modifications along these lines.

NOTES ON THE ELECTRET MICROPHONE:

There are a number of electret microphones on the market and the differences between them sometimes cause confusion.

All our circuits call for a two-leaded type and this is when the problem arises.

Some units have two short leads and a thick earth tag next to one of the leads. This is a two-leaded type and you have to connect the closest lead to the earth tag to make it into an obvious two-leaded type. The manufacturer has kept the case of the microphone separate so that it can be earthed or shielded via the rest of the circuit but you must connect the two together otherwise the project will not work and only a buzz will be transmitted.

Other two-leaded microphones are obvious and you can see one of the leads connects to the case while the other is the 'active' lead.

Three-leaded microphones are a bit different. They have a low-value resistor (about 220R to 1k) built into them so that they can be used directly on a 1.5v or 3v circuit without any additional resistor.

But if you want to operate them on more than 3v, an external load resistor must be added. The resistance of this should be between 10k and 47k.

Three-leaded microphones can be used in our circuits by connecting the earth lead to the negative rail and the centre lead to the load resistor on the PC board. This means the resistor inside the microphone is not used.

Don't try to open up the microphone as it contains a FET transistor and a metallised plastic diaphragm and it may not work satisfactorily on re-assembly.

Some electret microphones are larger than others. Both work the same and have the same output waveform when supplied with a voltage. They do NOT produce an output voltage or current but rather they modify a voltage across a load resistor.

They are an active device (due to the presence of a transistor) and must be inserted into a circuit around the correct way. You must not put a voltage directly across them as this may damage the transistor. They must be placed in series with a resistor.

Some microphones come with long leads and can be soldered directly to the board. Others will need longer leads fitted and when doing this, do not overheat the microphone as it can easily be damaged.

TESTING

At first you may think the method of testing a transmitter is around the wrong way. This is because we start at the output stage and work towards the front end.

But when you look at it more closely, you will see the reason for this.

Once you have the output stage working, you have a starting point and from there the procedure is fairly straight-forward.

Once you have read the 'How it works section', you will realise the output waveform of the transmitter consists of two parts. The base part is called the 'carrier' and this is a constant frequency. If we are transmitting at 100MHz, it is a 100MHz frequency. Added to this is the audio component and this causes the 100MHz to increase an amount equal to the audio frequency being picked up by the microphone.

The audio tone FREQUENCY MODULATES the carrier and this gives us the term FM transmission.

We use this knowledge to fault-find the project. Our first concern is to be able to detect the carrier. This is picked up on an FM radio as a 'dead spot' and by turning the transmitter off, the background noise will appear.

The carrier is produced by the oscillator stage and if a linear amplifier is present, it will pass the carrier to the aerial. When we detect a carrier, we prove that both stages are working.

If a dead spot is not heard, we can firstly assume that the frequency of transmission is off the FM band.

To adjust the transmitter, all you need do is close up the turns of the oscillator coil (making sure the turns do not touch each other if bare tinned copper wire is used).

Sweep the entire FM band on the radio, looking for a silent spot. The bandwidth of the transmitter will be quite narrow and it will be necessary to sweep the band fairly slowly.

If nothing is heard, go over some of the simple faults such as making sure the project is turned on, the radio is on the correct band (88MHz to 108MHz), the radio has an antenna connected and no metal objects are near the transmitter etc.

You must detect a carrier before progressing any further. This is the starting point and no other sections can be tested until this is successful.

Unless you have a 100MHz CRO, there is no other way to see if the project is transmitting. This is not entirely true as another solution is to make a second model.

If the second model works successfully (and I see no reason why it shouldn't), you can use it to physically check the spacing of the coil, placement of parts and the position on the FM band, to see why things are not coming through on the first.

When a dip is heard, you are half-way home. In fact you are 90% home. The rest is down-hill.

The next step is the testing of the audio stage or stages. Even though the project contains one audio stage, we can consider the microphone to be a stage since it is an active device containing an FET transistor.

If either the microphone or pre-amplifier stage does not work, you will not get any more than a carrier output.

The testing of these two stages is covered in the section 'More Tips on Fixing The Projects' and you should read this and follow it through.

Testing is done a little differently than you expect.

You don't need any elaborate test gear - just an FM radio.

If this fails to locate the fault, you can use almost any CRO to pick up the waveform at any one of a number of points on the board. It is important to note that you will not be able to transmit when making these tests but this is not necessary as we have already proven the oscillator is producing a carrier.

By whistling into the microphone and picking up the waveform at the output of the mic, (at the point where the load resistor connects to the microphone), you will be able to see the peak-to-peak performance of the microphone.

Next, pick up the waveform at the other end of the coupling capacitor and note that some of the amplitude has been lost.

This point is also the base lead of the audio transistor and it is handy to make a calculation of the gain of this stage.

This is done by whistling at a set distance from the microphone to get say a 5mV p-p waveform. By going to the collector of this stage, (and adjusting the vertical amplifier of the CRO), you will be able to read the peak-to-peak value after amplification.

It should be at least 500mV, giving a gain of 100.

This waveform is injected into the base of the oscillator stage via a DC blocking capacitor and causes it to change frequency as mentioned before. Finally you will be able to detect the audio waveform at the emitter of the oscillator stage and this will prove the audio component is flowing through the circuit.

If the gain of the audio amp stage is less than 100, the transistor should be replaced as it may be leaky or faulty in some way. The only other cause of low gain is the two biasing components being incorrect.

Once the circuit is working successfully, the final stage is peaking the transmitter so that it achieves the range we have stated. If you require only a short range, the project need not be peaked at all. The aerial can be almost any length and providing you have picked a spot on the band that is away from any other radio station, the job is done.

If you want more than a few metres range, you will have to trim the aerial to ½ or ¼ wave and set the frequency to approx mid band. Adjust the position of the two cells and and set everything exactly as it will be placed in the final rest position. Move the transmitter to the next room. Fine tune the radio and listen for such things as a ticking clock.

If the background snow level comes up, you may have to provide an antenna for the FM radio. They are usually a folded dipole, looking very much like the letter 'T' and when this is added to the radio, its range increases enormously. Also the transmitter gives the best range when the aerial is allowed to fall vertically.

Our prototype had a range in excess of 200 metres when carried about in a built-up area.

This is how we tested it: Paul went down to the fish and chip shop with the transmitter placed in his top pocket and the antenna dangling inside his jumper. We could hear him cross the main road some 150 metres away, enter the shop, place the order and hear the ding of the cash register.

Between the shop and our receiver was two layers of glass, two houses and a span of back yards. This is the range to be expected when the unit is peaked and a 9v battery fitted. The 9v supply did not achieve a greatly increased distance, and may be not worth the extra cost. With 3v, the transmitter started to fade out just before entering the shop. Nine volts allowed us to pick up conversation inside the shop and this represents only about 20% improvement.

When peaking up the 'ANT', the air cored transformer plays a very important role. It can be peaked by moving the secondary winding into the main coil or detuned by withdrawing it. This way you can create the range you require.

SETTING UP THE 'ANT'.

This is how it is done: Place the 'ANT' about 1 metre from an FM radio and switch them both ON.

Tune the radio from one end of the band to the other and listen for a feedback whistle. When this is heard, switch the transmitter off and tune the receiver to the closest radio station, either side of the transmitter frequency.

The transmitter must be operated on an unused portion of the band and must not interfere with any other radio station.

If a station is very close, the transmitter will have to be moved along the band. This is done by pushing the turns of the main coil together slightly and repeating the above to see how far the frequency has shifted. These turns can also be spread out to shift the frequency in the other direction.

Once a clear channel has been found in the middle of the band, the coil is not touched again.

If the background hiss dies down from the receiver but no feedback whistle is heard, it indicates the carrier section is working but not the pre-amp or microphone stages.

To fix this, you will have to read the next section on fault finding.

The fine tuning between the transmitter and receiver is done at the receiver end. Move the transmitter away about 10 metres or so (preferably into another room) and fine-tune the receiver slightly to pick up the transmitter as strongly as possible.

Once you are satisfied that the circuit is working equally as good as our description, you can fit it into a TIC TAC container.

If you prefer to use another case remember it is preferable to use a plastic case so that it doesn't have any effect on the performance. A metal case may shift the frequency or deaden the oscillator and reduce the range.

After fitting, the only part you will have to hide is the aerial and at the cost of reducing the range, it can be cut down to 5 or 10cm.

In our field tests, the range was 200 metres in a built-up area and 250 metres in a line-of-sight operation. All these tests were done with an 83cm ¼wave antenna.

This range makes the ANT ideal for large halls or for sporting events where a 100 metre range is required.

On 3v, the circuit comsumes about 5mA and the life of the battery will be about 100 hours.

The transmitter can also be operated on 9v and our tests showed the range to be about 250metres in a built-up area and 300metres in a line-of-sight operation.

In other words, 9v did not increase the range very much and we consider 3v is the best choice.

By now I hope everything is working perfectly and you are off to test the range. But if you think something is not as it should be, read the next section.

FITTING THE 'ANT' INTO A CASE

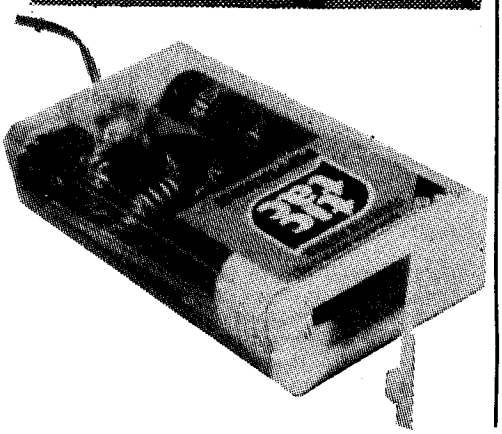
The 'ANT' is designed to be fitted into a TIC TAC box and the photo shows how this is done.

A cut-out is made in the bottom of the box for the slide switch with a hot soldering iron and a small file.

The flip-top lid hides the microphone and it can either be left open, removed or a hole drilled to allow the sound to enter. A small hole will not produce as much clarity as an exposed microphone and you will have to accept a balance between appearance and performance.

Once the case arrangements have been made it will be necessary to 'SET UP' the transmitter and make sure it is working correctly.

This commercial FM mic looks beautiful but it doesn't perform very well. We got only about 5metres out of it. It's only a single transistor model and the microphone is not very sensitive.



MORE TIPS ON FIXING THE PROJECTS:

These notes apply to all the circuits in this book and only slight differences apply to each design.

If any circuit does not work exactly as described, don't despair. It's now that you will pick up a lot of servicing tips.

The equipment you will need is a multi-meter, soldering iron and tools, an uncluttered bench and an FM radio.

All the circuits have been tested and are guaranteed to work. But if one doesn't, there could be one of a thousand reasons. Most of the time it will be due to a simple mistake such as two resistors or capacitors swapped over or a connection that has not been properly soldered.

These are very hard to locate and quite often someone as remote from electronics as your sister, mother or wife can spot a simple mistake as they will see the project with new eyes.

Don't over estimate yourself. It's the simple mistakes that can be so easily made - and so hard to fix!

Talking Electronics provides a repair service but, as you can imagine, the cost of repairing a low-priced project can be more than the inital cost of the kit!

That's why we don't expect these kits to be sent in. We want them to be fixed by you and that's why so much of the book is devoted to getting them going.

There are two ways of going about this. One is to fiddle around making a few voltage checks along the way and somehow, eventually, the thing gets fixed. The other is to make up a second kit and using this as a foundation, repair the first.

This may be an expensive way of going about it as you could finish up with two non-working models. But look on the bright side, you should finish up with two working models and have learned a lot in the meantime.

The idea is to use the second kit to fix the first by swapping one part at a time. You must remember which model is which!

When the second fails to work and the first springs into life, you know the fault has been located.

If, on the other hand, both models become non-operational, you may have located one of the faults and at this point you should swap the components back again to get unit two working. Put a new component in model one and keep going.

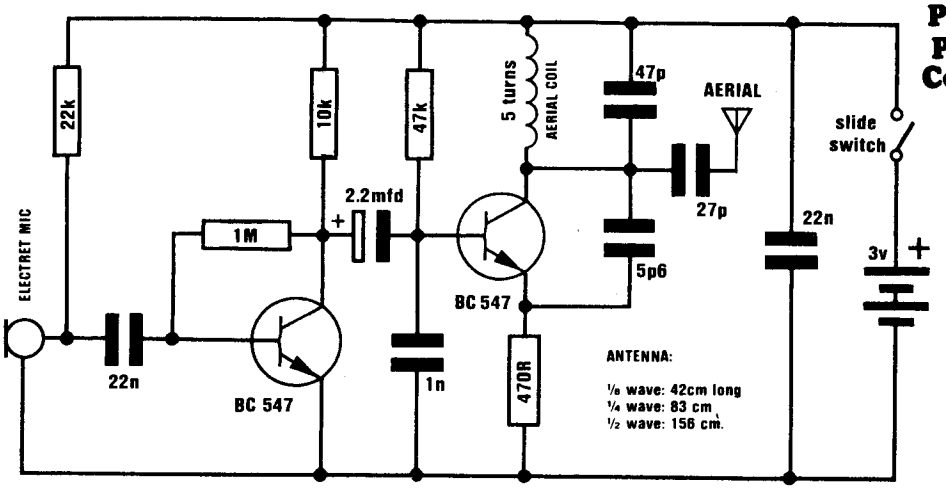
Eventually every component will be transferred and both projects must fire-up. This might be slow and expensive but how else would you be able to locate an open 5p6 capacitor or a dry 2.2mfd electrolytic? (These could have been damaged during assembly or soldering).

cont. P. 48 . . .

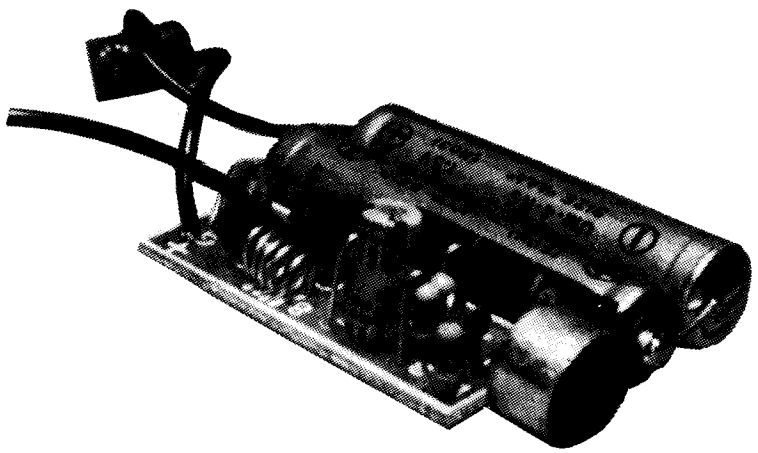
THE 'GNAT'

A MICRO VERSION OF THE FM BUG see P.41.

PC board $1.50
Parts $6.00
Complete $7.50



GNAT FM TRANSMITTER



This is the smallest bug in the series and is designed to be placed in an inconspicuous place and left there. We have called it the **GNAT.** It is small enough to be hidden in a desk ornament, hollow book or clipped to the underside of a table and the most difficult component to conceal will be the battery.

Any battery of worthwhile capacity will be considerably larger than the electronics and this is where most of the concealment difficulties will arise.

You can use a pair of button cells but you will find they are very expensive and do not have a very high capacity. They are also difficult to connect to. The cell we recommend is an 'AA' or 'AAA' cell and they can be soldered to directly and will last from 50 to 150 hours of operation.

One other suitable source of power is a Polar Pulse battery from a spent Polaroid film cartridge. These batteries are flat in shape and ideal for our use.

They can be hidden in a narrow space or fitted between the pages of a folder, alongside the electronics.

They produce 6v and although they have been specially designed for driving a motor in the instant camera, they will supply power for about 100 hours.

Their flat shape has been engineered to produce a very high current for a short period of time (as required by the drive motor) but will be quite suitable for us.

The circuit and characteristics of the GNAT are identical to that of our larger version, THE FM BUG and this means it is not a model that can be carried around. It is designed to be set and left, with the final tuning-in being done on an FM receiver.

The circuit is extremely sensitive and will pick up sounds slightly better than the human ear. If you want to make it super-sensitive, the microphone load resistor should be reduced to 10k or 4k7.

The range of the GNAT will depend mainly on the length of the antenna and since being able to hide it will be one of the critical factors, some facts should be mentioned.

If you want the range to be only about 5-6 metres, the antenna can be as short as 2cm. At this length it will be a very poor match to the circuit and will not be very effective. So, if you want the range, and at the same time hide the wire, you will have to compromise.

PARTS LIST

1 - 470R ¼watt
1 - 10k
1 - 22k
1 - 47k
1 - 1M

1 - 5p6 ceramic
1 - 27p ceramic
1 - 47p ceramic
1 - 1n ceramic
2 - 22n ceramic
1 - 2.2u 16v electrolytic

2 - BC 547 transistors
1 - mini slide switch SPDT.
1 - electret mic insert.
2 - AAA cells
10cm tinned copper wire
2metres aerial wire
1 - 'GNAT' PC BOARD

Another suggestion is to connect the antenna directly to the take-off point on the circuit and omit the 27pf coupling capacitor. You can use tinned copper wire or covered wire for this and by taking it up ½cm and then bending it at right angles, half a dipole can be formed.

A full dipole can be created by connecting another short length to the emitter of the oscillator transistor and bending it to match the first.

This will provide a directional radiator and the range will be improved in the direction of transmission.

You will have to check on the size and shape of the antenna before positioning the unit and check on such things as metal objects near the transmitter and the thickness of the room walls, if you hope to get more than a few metres range.

The main advantage of the GNAT is its small size. You can take advantage of this by separating the microphone and battery from the electronics and concealing them individually.

The connecting leads can be up to 30cm long and this may help with placing the electronics in a position so that it can be given an effective antenna.

Remember that height is all important on transmitting range and a unit placed on the floor will not produce nearly the same range as an elevated version.

Other items to upset the performance are metal filing shelves and hidden wiring or metal beams in the wall. The effect will be minimal but will cause a slight frequency shift and reduce the range in some directions.

To simplify the problems of finding a good location and disguise, mount the project in an unimposing container such as a ball 'room deodoriser' or empty money-box and plant it in the open!

BEFORE CONSTRUCTION

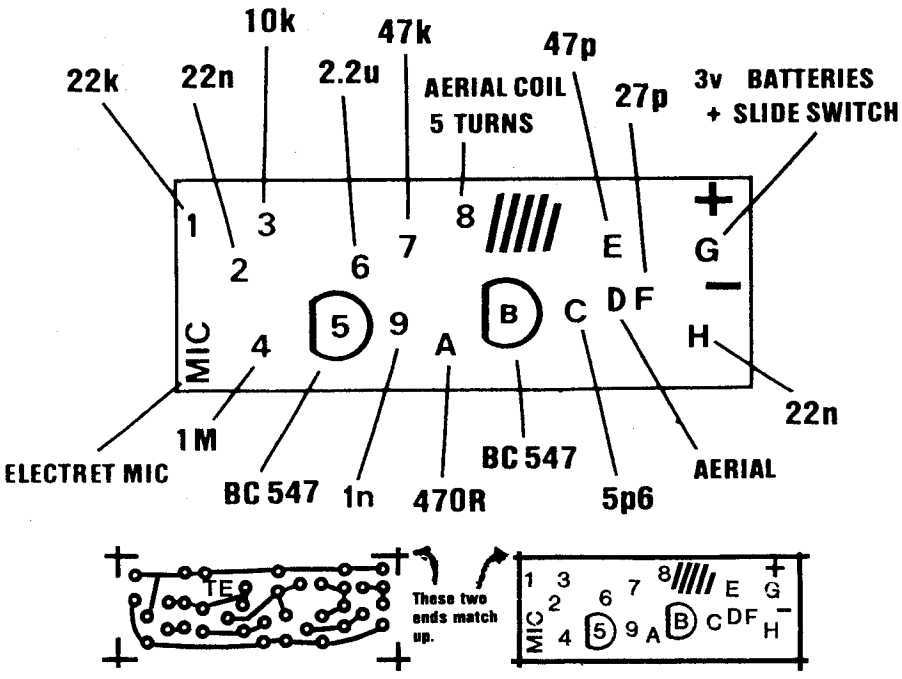
If you are convinced that the GNAT is the transmitter for you, here are two points you must be aware of.

The GANT, being the smallest project in the book, means it is the most compact and most difficult to assemble. You must be good at soldering and you must read the notes on the other projects as some important facts are contained in them.

CONSTRUCTION

Now for construction. We suggest that a kit of parts be obtained rather than buying the parts individually. This is because the kit contains a pre-wound coil of the right number of turns and using the correct diameter wire.

Although it is easy enough to wind the coil yourself, the diameter and wire size is a critical factor in the resulting frequency. In addition, the kit contains parts that are not only the correct value but also the



PC and overlay artwork for the GNAT

correct size and when you are making something as small as this, size is important.

Resistors and capacitor come in at least two different sizes, with the same rating, depending on the manufacturer and the general compactness of the board does not allow the larger version to be fitted.

We do not want to scare you but these are some of the facts we can't include in a fault-finding section and we want the project to work perfectly as soon as it is turned on.

Once you have read the notes on the other projects, you will see how construction is carried out.

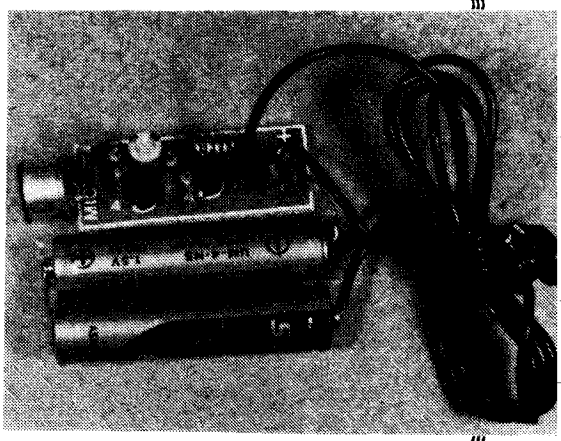
Start at one end of the board and add one component at a time, making sure it corresponds to the code number or letter on the board. The code letters for the other projects are different to this project so don't get them confused.

We have had to use code letters because the board is physically not large enough to write the full component value.

Before starting construction you should lay out all the components in the same order as they appear on the PC. This will prevent parts being swapped over or other mistakes occurring during construction.

Another handy hint is to hold the PC in the jaws of a peg and screw the peg to the workbench to make soldering easier.

The board should be held up-side-down, with the copper side up and when a component is to be added, remove the board and add the part.



The on/off switch for the GNAT is off-board.

Bend the leads slightly apart so that the resistor etc stays in position and hold the board with the peg. This will leave both hands free for the soldering.

We won't be covering construction in detail as we don't have the space. Anyhow most of it can be can be got from the other articles and the **FM BUG** project.

Use the diagram above to identify the position of each component.

Finally, let me mention that Paul designed the board to be fitted into a match-box and this includes the two batteries!

Think of all the fun you will have, using an innocent-looking match-box to bug your friends! It'll be great at a party.

CAUGHT OUT!

- Fiction by Ross Thornton.

It was two o'clock on Friday afternoon. I had just got off the phone; both Ray and Tony, our first year apprentices were at school.

"Another customer complaining about his kits not arriving," I said to Paul. "That's the third one this week, isn't it?" he replied. "We're going to have to do something about this but what can we do?"

Paul and I sat down to think about it for a while. Soon we had a plan. We had to find out where the parcels were going astray. We had been working on a series of FM bug designs for a new book and decided to use the 1kHz transmitter to set a trap. We would plant the transmitter in a packet and hand it over the counter at the parcel depot in the normal way.

To add value to the packet I registered it and made a few comments about 'handling it very carefully.' I then went back to the car where Paul was wailting. He already had the FM radio tuned to pick up the frequency. We picked it up fairly well, considering the conditions.

Now, all we had to do was wait for the delivery van. It was due in about half and hour, so we prepared ourselves for the wait.

The half hour came and went and still no van. We could still pick up the tone and knew it hadn't moved. The parcel was still in the building and the bug was doing its job.

Eventually the delivery van arrived and the workers started to load it. It wasn't entirely in view but we could see large and small parcels being moved from the truck to loading bay and others being loaded for the outward journey.

The tone didn't alter. Paul and I didn't know what to expect, so we waited for the truck to leave. If the tone decreased it would prove the packet had left the building. A few minutes later the truck moved off and as it went down the road, the tone didn't alter! We were surprised. Pleasantly surprised. The possibilities had narrowed. Was the thief one of the staff?

It was more than an hour to knock-off time. About 15 staff occupied the building. Fortunately everyone would emerge from one exit at finishing time and since no overtime was being worked this week, we would see all workers depart in a 20 minute span.

After sitting and waiting for a while, Paul asked me what would happen if two or more emerged at the same time.

Neither of us knew how to handle that situation and hoped it wouldn't happen as the aim was to remain out of sight and conduct the tracking procedure undetected.

It was now knock-off time and the 'quickest' started to filter out. Up to this time the tone remained constant, a little bit weak but as good as could be expected with a short-range antenna and the poorest of transmitting conditions.

Suddenly the tone dropped out; maybe the parcel had been moved! This is what we wanted. If it was being handled at knock-off time . . . . . My thoughts raced to the consequences.

One by one the workers emerged; we kept listening. The signal had picked up now, the background static had died and we knew the transmitter was coming closer. However, our surveillance was more awkward than we thought.

Ken came out first, then Alan. Neither were carrying bags and they moved off around the corner. The tone remained. They were ruled out. Then came Peter Chris and George. They all got into a nearby car and we had little time to check anything.

Fortunately, the tone still came through clearly so we knew the bug was not with them. Then Alice and a friend came through the door. Alice had a large carry-all. Could it be her? The tone died for a second and the snow level came up. This is it; it must be Alice. But as she got into a car, the tone reappeared and we went back to the waiting game.

Five minutes passed and four workers emerged. We became quite tense but our fears were allayed as they walked down the street and the tone remained constant and clear.

How many were left in the building we dodn't know. But we knew they would have to come out soon or our whole exercise would be a flop.

I was becoming despondent and thinking how we had wasted our time when a new face arrived on the scene. It was Tony, our first year apprentice. I don't think he recognised us as we were in Paul's car. Tony walked up to the exit door and stood outside. This changed our thoughts completely. Could Tony have something to do with the disappearances? He was standing there for a couple of minutes when Sue emerged. She had a handbag. She stopped and spoke to Tony for a minute. The tone became crystal clear. I looked at Paul and he looked at me.

Sue looked uneasy. She glanced about and surveyed the street in a single sweep. I partly froze. We both slid further down the seat and below window level. When it came to the crunch, we couldn't look. We felt deceived as the pair walked past. Paul turned the radio down and I hoped they didn't spot us.

We waited and waited. What was a minute seemed like an eternity in our state of disbelief. Then, cautiously, we rose up and looked over the bonnet. About 30 paces up the road the two were getting into a 'P-plate' heap and the snow level rose. For all our trouble we had got our result and wished we hadn't.

How could we handle the next stage? What should we do? What could we say? Calling the Police would involve a lot of hassles and imagine if we were wrong! We didn't really have any hard evidence. Although the bug made us fairly sure, we didn't have direction finding facilities and we would not prove the parcel travelled as we had thought. We finally decided that if we went past Tony's place and picked up the tone, we would have our culprits red-handed.

We drove to Tony's place and pulled up outside. His car was there and the tone was clear. "What do we do now?" Paul said. (He always turns to jelly in a situation like this). It was then that I realised that when the parcel was opened he would know what had happened, so I decided to wait for him to come to work on Monday and bring it up then.

Monday morning came, but Tony didn't. I range his place to find out what had happened. His Mum answered and simply said he won't be coming to work any more and hung up. I then went to the parcel office and asked for Sue. They informed me that she had not come to work today. It was obvious they knew they had been caught out. As I drove back to work I decided not to press it any further.

When Paul arrived I explained to him the morning's happenings. He couldn't suggest any other better plan and so we let it rest.

A week later a mysterious parcel arrived addressed to me personally. On opening it I found a note which read: 'Please find enclosed all the missing items.'

It's a pity to lose a career over a few paltry parts. But, as the saying goes: No matter how smart you are, there's always someone smarter!'

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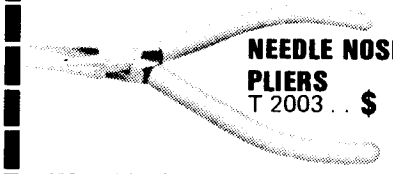

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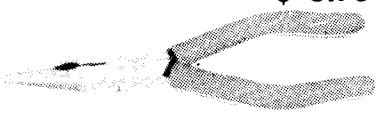

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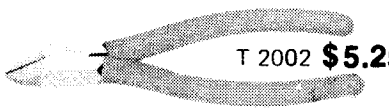

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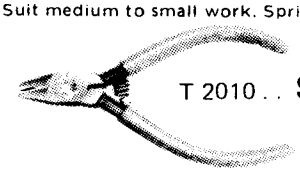

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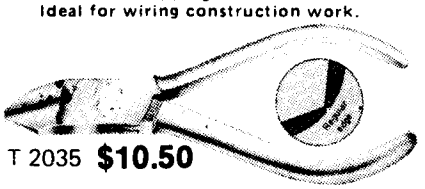

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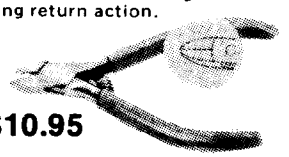

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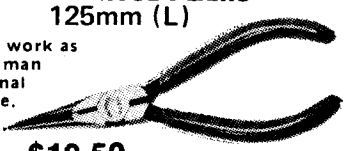

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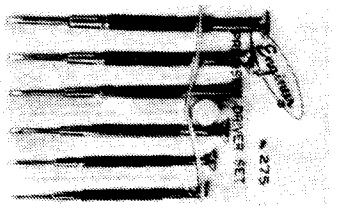

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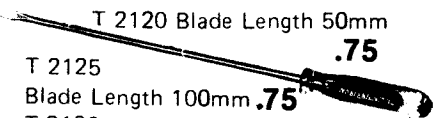

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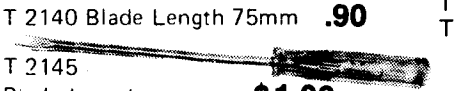

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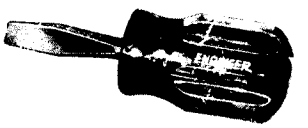

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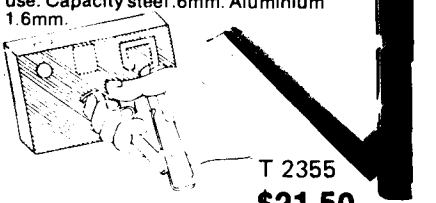

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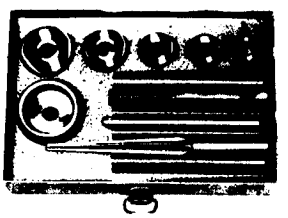

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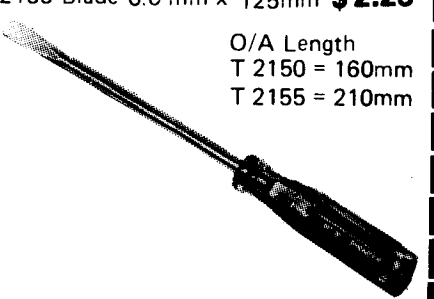

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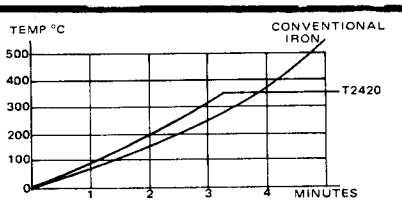

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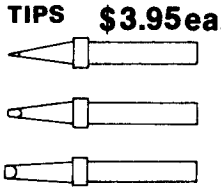

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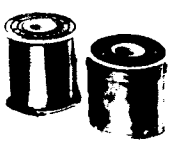

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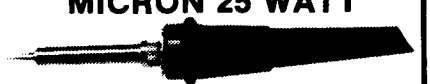

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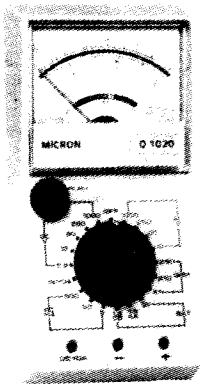

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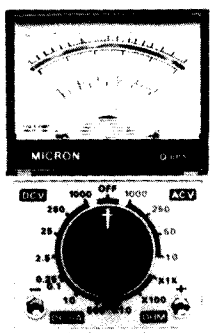
Q 1015 **$22.50**
Sturdy Movement

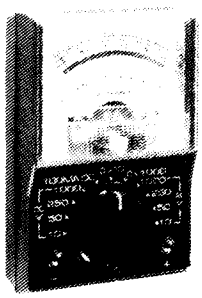


Economy Pocket Tester

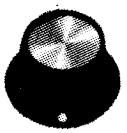
High 2000 Ohms/Volt sensitivity • Overload protected • Dimensions 90x60x30mm • Mirror back scale helps prevent parallex error • complete with test leads and instructions • Uses 1 x AA Battery (supplied) **Ranges**—DC and AC 0-10 50,250,1000V— **Decibels** 10 to + 22dB **Current** 0-100mA **Ohms** 0.1 Meg in two ranges

Q 1013 **$15.95**

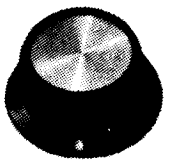
Carry Case
Q 1014 **$2.50**



BLACK PVC 23MM
H 0005 **.65**
10up **.55**

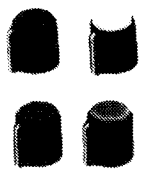


BLACK PVC 24MM
H 0010 **.90**
10up **.85**



BLACK PVC 32MM
H 0011 **.95**
10up **.90**

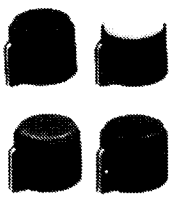
BLACK PVC 20MM
H 0015 **.80**
10up **.70**



COLOUR CAP STYLE 15MM

H 0001	Red
H 0002	Green
H 0003	Blue
H 0004	Yellow

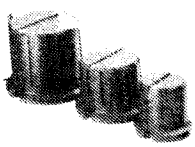
All **.69ea** 10 Up **.65ea**



COLOUR CAP STYLE 20MM

H 0006	Red
H 0007	Blue
H 0008	Green
H 0009	Yellow

All **.90ea** 10 Up **.85**

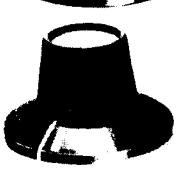


BLACK PVC FLUTED

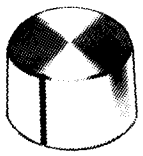
15MM	H 0016	**.70**
	10 Up	**.65**
20MM	H 0017	**.80**
	10 Up	**.75**

METRIC 18 TOOTH TYPE
H 0025 **.85**
10up **.75**

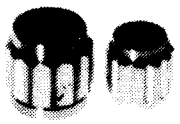
CALIBRATED 1—10
H 0020 **1.10**
10up **.99**



CALIBRATED LINE
H 0021 **1.10**
10up **.99**



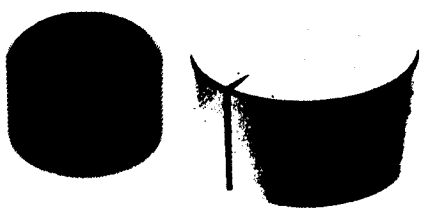
POLISHED ALUM.18MM
H 0040 **.99**
10up **.95**



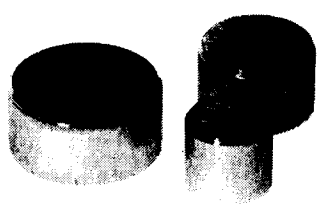
NATURAL ALUM.
15MM H 0045 **.99**
10up **.95**
20MM H 0047 **1.40**
10up **1.30**

ANODISED BLACK
15MM H 00301.10
10up **.99**
20MM H 0031 **1.65**
10up **1.50**

BRUSHED BLACK
16MM H 0032 **1.65** 10up **1.50**
22MM H 0036 **1.85** 10up **1.65**
40MM H 0038 **3.25** 10up **2.95**



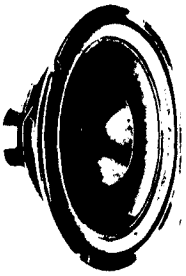
BRUSHED SILVER
16MM H 0050 **1.15** 10up **1.05**
22MM H 0051 **1.40** 10up **1.30**
28MM H 0052 **1.75** 10up **1.60**



WHITE METRIC SHAFT
22MM H 0026 **..90**
10 Up **.85**

All knobs excepting H 0026 are for 1/4", 6.4mm shafts and include grubscrew.

DUAL CONE WIDE RANGE



200mm (8 in.) 10 Watts Max. power input. Public Address, Background Music. Ideal Hi Fi Extension speaker. Includes transformer holes at 51mm.

Over 60,000 sold in Australia!

Mounting holes 140 x 140mm

C 2000 ..... **$10.95**

10up **$10.00**

100mm (4 in.)

Dual Z 4/8 Ohm. 3 Watt RMS. Mounting hole centres at 82mm.

C 0616 ..... **$5.95**

10up **$5.50**

MINI 57MM

200 MW 8 Ohm

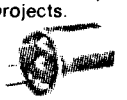
Large Ferrite Magnet. Ideal replacement speaker. Great for hobby projets.

C 0610 ..... **$2.30**

10up **$1.75**

Mic Insert Electret

Great little replacement for tape recorders, etc. Handy for hobby projects.



C 0170 ..... **$1.95**

10 Up **$1.50**

Mini Buzzer 5-15V DC

S 5162

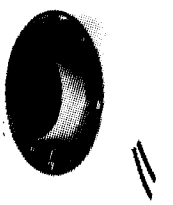
$2.30

Handy little solid state low current buzzer is ideal for use with signaling panels, alarm systems, in the car etc.

Polarity conscious

Piezo Alarm

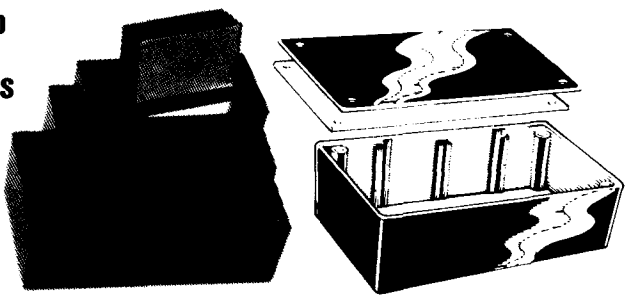
Similar to "Sonalert" type. Absolutely ear piercing sound. Recommended voltage 5 - 15V DC Ideal for almost all audio signalling applications. i.e. Fire, water and gas signalling, computer alarms etc.



S 5166 ..... **$6.95**

10 Up **$6.40**

JIFFY BOXES AS USED IN MOST OF TALKING ELECTRONICS PROJECTS

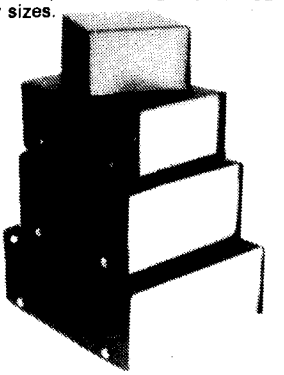


BOX	LID	DIMENSIONS	PCB WIDTH VERTICAL	PCB WIDTH HORIZONTAL	PRICE	10Up
H 0101	Alum.	150 x 90 x 50	90	87	$ 3.25	$ 2.75
H 0102	Alum.	195 x 113 x 60	106	103	4.50	3.75
H 0103	Alum.	130 x 68 x 41	60	60	2.75	2.25
H 0105	Alum.	83 x 54 x 28	47	47	1.85	1.65

Deluxe Cabinets

Natural finish aluminium chassis with black steel ventilated cover. Very attractive appearance. Fitted with 4 rubber feet.

Perfect for power supplies, amplifiers, custom modules etc. Four nifty sizes.



83 x 53 x 102

H 0441 **$4.50** **$4.00**

150 x 61 x 103

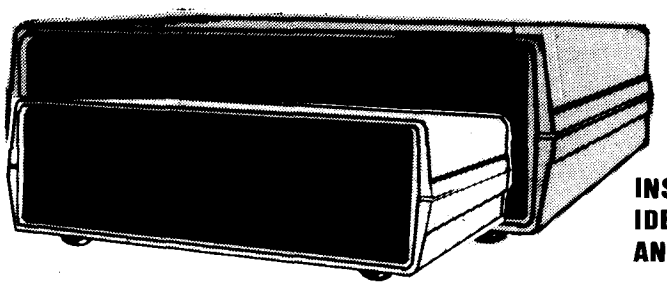
H 0442 **$5.50** **$5.00**

150 x 76 x 134

H 0443 **$6.50** **$6.00**

184 x 70 x 160

H 0444 **$7.50** **$7.00**



INSTRUMENT CASES IDEAL FOR POWER SUPPLY AND AMPLIFIER PROJECTS

H 0480/H 0481 Overall Size: 200 W x 160 D x 70 H

H 0482/H 0483 Overall Size: 260 W x 190 D x 80 H (Vented Case)

- Internal mounting posts enable a wide combination of PCB's. Transformers, etc. to be accommodated (screws supplied).
- PCB guide rails provided internally allow vertical PCB positioning to several locations.
- Removable front and rear panels. Attractive textured finish one side andplain the reverse side. (Enables direct engraving, silk screen printing etc. to plain side.
- Top and bottom split apart for ease of construction or service. Integral feet included.
- Great for test instrument and other high grade projects.

	ea.	10+	100+
H 0480 Light Grey with Black Panels	**$14.85**	**$12.65**	**$10.50**
H 0481 Black Case with Black Panels	**$14.85**	**$12.65**	**$10.50**
H 0482 Light Grey with Black Panels	**$19.95**	**$17.98**	**$13.95**
H 0483 Black Case with Black Panels	**$19.95**	**$17.98**	**$13.95**

Crocodile Clips

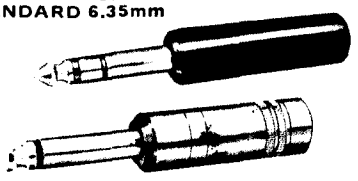
	ea.	10 +
MINI		
P 0100 Red	.49	.35
P 0101 Black	.49	.35
MEDIUM		
P 0110 Red	.45	.40
P 0111 Black	.45	.40

Jack Plugs and Sockets

MINIATURE

	ea.	10 +
P 0112 2.5mm Jack Mono	.40	.35
P 0113 3.5mm Jack Red Mono	.45	.40
P 0114 3.5mm Jack Black Mono	.45	.40
P 0116 3.5mm Stereo Jack	.65	.60

STANDARD 6.35mm



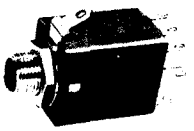
P 0120 Plug 6.35mm Mono Plastic	.80	.70
P 0121 Plug 6.35mm Stereo Plastic	1.10	.95
P 0123 Plug 6.35mm Mono Metal	1.20	1.05
P 0125 Plug 6.35mm Mono Metal	1.25	1.10

Miniature Jack Sockets

QUALITY ENCLOSED TYPE

	ea.	10+
P 0212 2.5mm Mono	.35	.30
P 0213 3.5mm Mono	.40	.35
P 0214 3.5mm Stereo	.85	.75

STD 6.35mm JACK SOCKETS

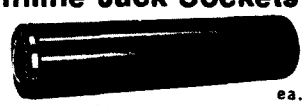


QUALITY ENCLOSED TYPE

	ea.	10 +
P 0127 Mono Switched	1.10	.95
P 0128 Stereo	1.10	.95
P 0129 Stereo SW/DPDT	1.40	1.25
P 0130 Stereo DPDT Sw	1.95	1.65

Insulated Mounting

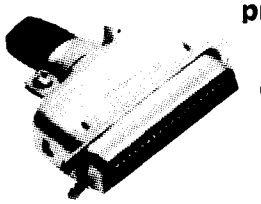
Inline Jack Sockets



	ea.	10 +
P 0202 6.35mm Mono	.85	.75
P 0204 6.35mm Stereo	.90	.80
P 0206 3.5mm Mono	.85	.75
P 0208 3.5mm Stereo	.90	.80

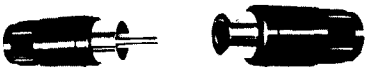
CENTRONICS PLUG 36 Way

Used universally with computer printers etc. Two types available (both male)



	ea	10 up
P 0770 Solder Type	**13.75**	**12.10**
P 0772 IDC cable type	**14.25**	**13.20**

RCA Connectors Line Type

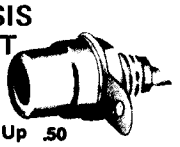


	ea.	10 +
P 0140 Plug Red	.45	.40
P 0141 Plug Black	.45	.40
P 0215 Socket Red	.50	.45
P 0216 Socket Black	.65	.60

Insulated RCA Sockets

	ea.	10 +
P 0232 2 Way	.65	.60
P 0234 4 Way	1.10	.99

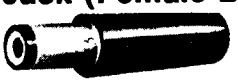
CHASSIS MOUNT RCA



P 0231

.55 10 Up .50

DC Jack (Female Line)

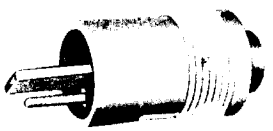


	ea.	10 +
P 0134 2.1mm	.45	.40
P 0135 2.5mm	.50	.45

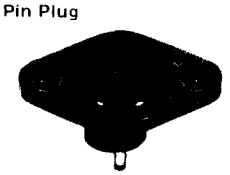
DC Jacks (Chassis Male)

	ea.	10 +
P 0223 2.1mm Pin	.65	.60
P 0224 2.5mm Pin	.65	.60

2 Pin Din Connectors



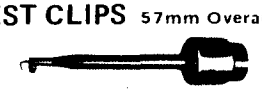
	ea.	10 +
P 0145 2 Pin Plug	.50	.45



P 0222 2 Pin Socket **.45 .40**

Chassis Mount

IC TEST CLIPS 57mm Overall Length



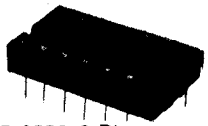
	ea.	10 +
P 0180 Red	.95	.85
P 0181 Black	.95	.85

MOLEX PIN SOCKETS

For use with single pins up to .5mm diam.

Make your own sockets for IC's, displays, LSI's etc.

P 0680 Pack of 100	**2.20**	**1.75**
P 0681 Pack of 1000	**17.90**	**16.50**



IC SOCKETS DIL

LOW PROFILE

	ea.	10 +
P 0550 8 Pin	.30	.27
P 0560 14 Pin	.40	.35
P 0565 16 Pin	.45	.40
P 0567 18 Pin	.45	.40
P 0568 20 Pin	.50	.45
P 0570 24 Pin	.65	.57
P 0572 28 Pin	.75	.70
P 0575 40 Pin	.95	.80
WIRE WRAP		
P 0595 24 Pin	**2.95**	**2.65**
P 0598 40 Pin	**4.95**	**4.50**

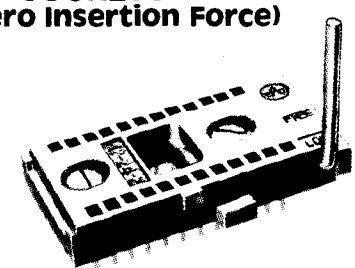
DIL Header Plugs

Plug into standard IC socket (Solder tail type)

	ea	10 up
P 0616 16 Pin	**1.80**	**1.70**
P 0624 24 Pin	**3.50**	**3.30**

ZIF SOCKETS

(Zero Insertion Force)



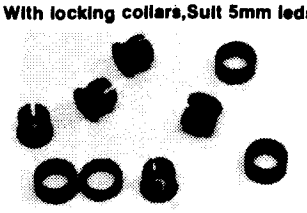
	ea	10 up
P 0650 24 Pin	**14.90**	**13.70**

CAPTIVE HEAD BINDING POSTS with 4mm CROSSHOLE

	.a.	10 +
P 0250 Green	.75	.70
P 0252 Red	.75	.70
P 0254 Black	.75	.70
P 0256 White	.75	.70

Led Mounts

With locking collars, Suit 5mm leds



H 1550 Pack of 20	**$ 1.65**
H 1551 Pack of 1000	**$49.95**

SELF TAPPING SCREWS

Nickel Plated Steel

From less than 1c each

		Pack	Price
H 1100	No. 4 x 6mm	25	.85
H 1102	No. 4 x 6mm	500	5.95
H 1110	No. 4 x 12mm	25	1.05
H 1112	No. 4 x 12mm	500	5.95
H 1116	No. 6 x 9mm	25	1.05
H 1117	No. 6 x 9mm	500	6.50
H 1120	No. 8 x 12mm	25	1.05
H 1122	No. 8 x 12mm	500	7.95

1/8th inch WHITWORTH

STEEL NUTS AND BOLTS ROUND HEAD ZINC PLATED

	Length	Pack Qty.	Price
H 1000	9mm	25	.95
H 1002	9mm	500	4.95
H 1005	12mm	25	.95
H 1007	12mm	500	5.50
H 1009	25mm	25	1.05
H 1011	25mm	500	7.50
H 1020	Hex Nut	30	.85
H 1022	Hex Nut	500	6.50
H 1030	S/Proof Washer	50	1.05
H 1032	S/Proof Washer	500	7.50
H 1040	Flat Washer	50	1.05
H 1042	Flat Washer	500	7.95

Huge Savings with Trade Packs (Contents: 500)

BA NUTS AND BOLTS

Bolts Cheesehead Steel, Nuts Brass

		Pack	Price
H 1045	4BA x 6mm	25	$ 1.05
H 1047	4BA x 6mm	500	6.50
H 1050	4BA x 12mm	25	1.05
H 1052	4BA x 12mm	500	7.95
H 1060	6BA x 12mm	25	1.05
H 1062	6BA x 12mm	500	8.50
H 1070	Nut Hex 4 BA	25	1.10
H 1072	Nut Hex 4 BA	500	16.50
H 1080	Nut Hex 6 BA	25	1.10
H 1082	Nut Hex 6 BA	500	13.75
H 1090	4 BA S/Proof Washer	50	1.10
H 1092	4 BA S/Proof Washer	500	6.60
H 1095	4 BA Flat Washer	50	1.10
H 1097	4 BA Flat Washer	500	7.95

RUBBER GROMMETS

For chassis to 16 gauge

	Chassis Hole	Cable Hole	Pack Qty.	Price
H 1450	9.5mm	6 mm	8	$ .95
H 1452	9.5mm	6 mm	100	6.95
H 1456	12.7mm	9.5mm	8	1.05
H 1458	12.7mm	9.5mm	100	9.90

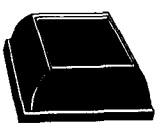
Save 40% with "100" Packs

RUBBER FEET

With 3mm Mounting Hole

Standard

Stickon Type



	Size (diam.)	Pack Qty.	Price
H 0914	13mm	8	$ 1.10
H 0913	13mm	100	8.75
H 0917	16mm	8	1.10
H 0916	16mm	100	9.95
H 0940	12mm Stickon	4	.90
H 0942	12mm Stickon	100	10.60
H 0950	20mm Stickon	4	1.05
H 0952	20mm Stickon	100	12.65

CORDGRIP CLAMPS

H 1470	**Cables to 6.3mm**	**Pack 6**	**.90**
H 1471	**Cables to 6.3mm**	**Pack 100**	**10.95**
H 1475	**Cables to 9mm**	**Pack 6**	**.95**
H 1476	**Cables to 9mm**	**Pack 100**	**11.95**

NEW NYLON CABLE CLAMPS

Available in two handy sizes.

Cat. No.	Pack	Size	Price
H 1480	6	6mm	.65
H 1481	100	6mm	5.50
H 1485	6	9mm	.70
H 1486	100	9mm	8.95

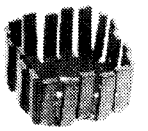
SPACERS (STANDOFFS) SUPERB NICKEL PLATED BRASS

UNTAPPED 4 BA or 1/8" CLEARANCE

Cat.	Length	Pack Qty.	Price
H 1305	6mm	8	1.05
H 1359	6mm	100	9.80
H 1362	9mm	8	1.05
H 1365	9mm	100	10.50
H 1372	12mm	6	1.05
H 1373	12mm	100	12.00
H 1375	25mm	4	1.05
H 1376	25mm	100	16.50

TAPPED 4 BA

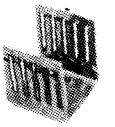
Cat.	Length	Pack Qty.	Price
H 1379	9mm	8	1.10
H 1380	9mm	100	10.50
H 1383	12mm	8	1.35
H 1384	12mm	100	13.75
H 1387	25mm	4	1.10
H 1388	25mm	100	19.25



T03 Minifin

50mm x 50mm x 25mm H
5 deg C/watt. Prepared for T03.

H 0500 ..... $2.25
10 Up $2.10



Mini U

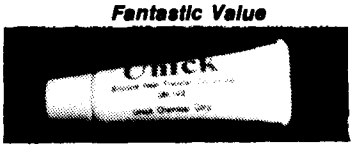
Low Cost — Suits Flat Pack semis.

H 0502 ..... .90
10 Up ..... .89

Heatsink Compound

Heat conducting paste facilitates heat transfer from semi to Heatsink. One tube good for up to 30 T03 package semiconductors.

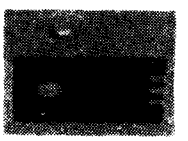
Fantastic Value



H 1600	7.5m PK	$ 2.50
H 1610	150m PK	$11.50

Buy the trade pack (H 1610) Twenty times the compound for just 5 times the price!

TO220 INSULATING KIT



Mica washers and bushes for TO220 or other flat Pack Semis

	Mounts	
H 1585	4 devices	.95
H 1587	100 devices	9.80

TO3 INSULATING KIT

Mica washers and bushes for TO3 semi conductors

	Mounts	
H 1580	4 devices	.85
H 1582	100 devices	13.75

NYLON NUTS & BOLTS

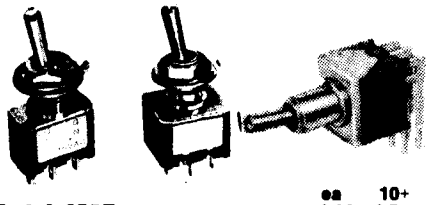
Super Handy for Mounting Semis, PCB's or anywhere an insulated mounting is required

4BA	Cheesehead	Pack	Price
H 1200	4BA x 12mm Bolt	10	$ .95
H 1202	4BA x 25mm Bolt	10	1.05
H 1210	4BA Nuts	10	1.85
H 1215	4BA Washer	10	.75
6BA	**Cheesehead**		
H 1220	6BA x 12mm Bolt	10	.85
H 1222	6BA x 25mm Bolt	10	.98
H 1226	6BA Nuts	10	1.60
H 1228	6BA Washer	10	.75

MINI TOGGLE SWITCHES

OEM QUALITY 250V 2 AMP RATED

6mm mounting hole
12mm x 12.7mm x 20mm (D)



	ea	10+
S 1010 SPDT	1.90	1.70
S 1015 SPDT PCB	2.00	2.35
S 1020 DPDT	2.25	1.95
S 1025 SPDT centre off	2.25	1.95
S 1027 SPDT centre off PCB	2.74	2.50
S 1030 DPDT centre off	2.75	2.50
S 1035 DPDT PCB	2.75	2.50
S 1037 DPDT centre off PCB	2.95	2.75

SLIDE SWITCHES

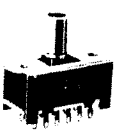
SUB-MINIATURE DPDT
Plastic Handle

S 2010 **.45**
10 up **.40**

SUB-MINIATURE DPDT
Aluminium Handle

S 2020 **.60**
10 up **.55**

MINIATURE
3 POS. 2 POL.
Aluminium Handle



S 2030 **.90**
10 up **.80**

MERCURY SWITCH

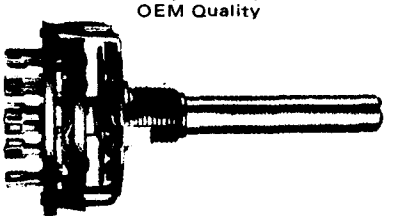
Glass encapsulated
125V/3 AMP AC

Incredible Value!

S 3070 **$1.70**
10 up **$1.50**

ROTARY WAFER SWITCHES

6.3mm (¼") by 32mm plain shafts.
OEM Quality



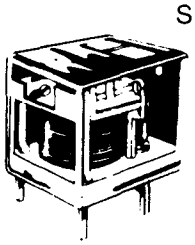
Cat. No.	Pos.	Poles	ea.	10 +
S 3002	2	6	**$1.70**	**$1.50**
S 3003	3	4	**1.70**	**1.50**
S 3004	4	3	**1.70**	**1.50**
S 3005	5	2	**1.70**	**1.50**
S 3006	6	2	**1.70**	**1.50**
S 3012	12	1	**1.70**	**1.50**

		ea.	10 Up
S 3050	4 Way	**1.15**	**1.05**
S 3060	8 Way	**1.75**	**1.65**

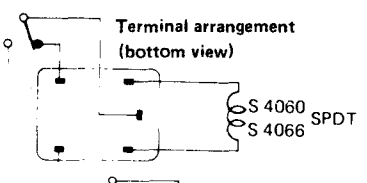
MINI PCB RELAYS

Low Profile 14H x 20W x 12D

12V DC Bobbin
1 AMP Contact Rating



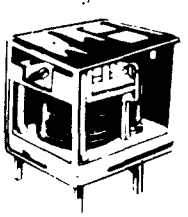
S 4060 SPDT **2.50**
10 Up **2.25**
S 4061 DPDT **3.50**
10 Up **3.15**



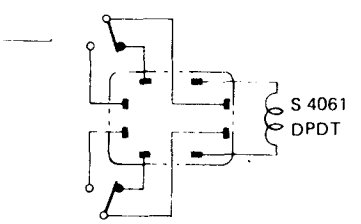
MINI PCB RELAY H/D

Low Profile 15mm (H)

12V DC Bobbin 3 AMP
Contact Rating



S 4066 SPDT **$3.15**
10 Up **$2.70**



MINIATURE PUSH BUTTON

6mm mounting hole
125V/3A Rating

S 1060 Push to make contacts **.55**
10 up **.48**
S 1070 Push to break contacts **.65**
10 up **.60**

SNAP ACTION KEY BOARD SWITCHES

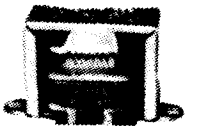
• PCB Mount • Super handy for custom keyboards, security switches etc.

ULTRA LONG LIFE DESIGN
Choose from 5 colours

S 1095 Red S 1098 Green
S 1096 Black S 1099 White
S 1097 Yellow

ALL .80¢ ea 10 up .75¢ ea.

Mini Mains



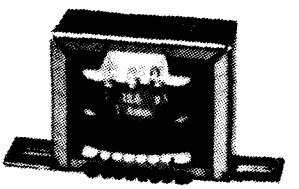
M 2851

Primary: 240V
Secondary: 12.6V ct 150mA;
$4.50 ea 10Up **$3.70** ea

M 2852

Primary: 240V
Secondary: 16V ct at 250mA
$4.95 ea 10 Up **$4.50** ea

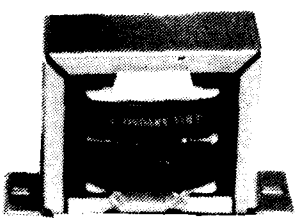
Medium Mains



M 2155

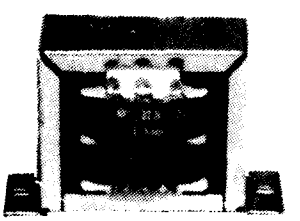
Primary: 240V
Secondary: 6V3, 7V5, 8V5, 9V5, 12V6, 15V at 1 Amp.
$6.90 ea 10Up **$6.30** ea

Standard Mains



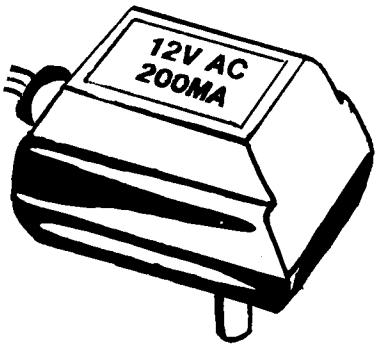
M 2156

Primary: 240V
Secondary: 6, 9, 12, 15V at 2 Amps
$10.50 ea 10Up **$9.50** ea

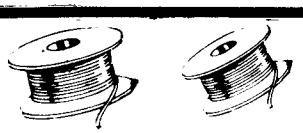


M 6672

Primary: 240V
Secondary: 15, 17V5, 20, 24, 27V5, 30 at 1 Amp.
$10.50 ea 10Up **$9.50** ea



Cat No:	Vout		Imax	Each	5 up:
M 9000	3, 4.5, 6, 7.5, 9, 12v	DC	300mA	$14.50	$12.65
M 9005	6, 9, 12v	DC	500mA	$16.95	$15.50
AC plug pack	12v	AC	200mA	$9.20	



Pro Grade Hook Up Wire
All on 100M Reels

Light Duty
Tinned
13/.012

Buy Eight Reels For Only $30

.10 per Metre
$5 per 100M Reel

W 0250 **Red** W 0254 **Yel**
W 0251 **Blk** W 0255 **Brn**
W 0252 **Brn** W 0256 **Blu**
W 0253 **Orn** W 0257 **Wht**

Medium Duty
Tinned
14/.20

Buy Four Reels For Only $28

.15 per Metre
$9 per 100M Reel

W 0260 **Red** W 0261 **Black**
W 0268 **White** W 0265 **Blue**

Heavy Duty
24/.20

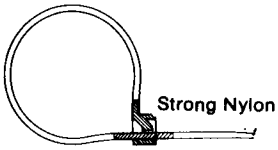
Buy Four Reels For Only $30

.20 per Metre
$14 per 100M Reel

W 0270 **Red** W 0272 **Black**
W 0274 **Green** W 0276 **Brown**
W 0278 **Blue**

FIGURE "8" CABLES (On Reels NOT Hanks)
For speaker wiring, security systems, PA systems, low voltage wiring etc.
All include polarity trace stripe.

	Conductor	Colour	Trace Colour	Per M	Per 100M
W 0200	2x14/.14	Grey	Black	.25	12.00



Cable Ties
Strong Nylon 100mm Long

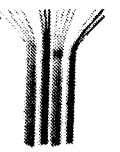
H 1400 Pack 25 **$1.65**
H 1405 Pack 1000 **$29.50**

Lugs

	Max bolt Size	Max Cable Size
Small	3.5mm	1.7mm
Med.	4.5mm	2.2mm
Large	5mm	3.2mm

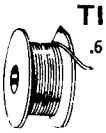
H 1500	Solderlugs Pack 50	**1.10**
H 1501	Solderlugs Pack 100	**12.50**
H 1510	Crimplug Small Pack 25	**1.80**
H 1511	Crimplug Small Pack 500	**22.50**
H 1512	Spadelug Small Pack 25	**1.80**
H 1513	Spadelug Small Pack 500	**22.50**
H 1520	Crimplug Med.pack 20	**1.95**
H 1521	Crimplug Med.pack 500	**25.50**
H 1522	Spadelug Med. pack 20	**1.80**
H 1523	Spadelug Med. pack 500	**24.75**
H 1528	Crimplug Large pack 20	**2.60**
H 1529	Crimplug Large pack 500	**35.75**

RAINBOW CABLE



1.27mm Pitch		Price Per M	Price Per M 10 +
W 0510	10 Core	**1.15**	**1.00**
W 0516	16 Core	**1.80**	**1.60**
W 0524	24 Core	**2.70**	**2.25**

TINNED WIRE PACK
.63mm/22g B&S 100g Pack



W 0420 **$3.75**
10 up each **$3.45**

SINGLE ROTARY POTS $1.40
6.35mm (¼") x 32mm (10 + $1.10)
Plain Shafts

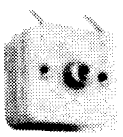
LINEAR		LOGARITHMIC	
R 2001	500 R	R 2020	1K
R 2003	1K	R 2022	5K
R 2005	5K	R 2024	10K
R 2007	10K	R 2026	20K
R 2010	20K	R 2028	50K
R 2012	50K	R 2030	100K
R 2014	100K	R 2031	500K
R 2015	500K	R 2032	1M
R 2016	1M	R 2034	2M
R 2018	2M		

CROC CLIP
To Croc Clip
10 Lead Set
P 0413 $3.85

BLANK PC BOARD
Single sided copper clad.

H 0750 75 x 150 **1.50**
H 0751 150 x 150 **2.95**

VARIABLE TUNING CAPACITOR 60-160 PF



R 2601 **$1.75**
10 Up **$1.40**

FERRIC CHLORIDE BEADS 200 gram pack
makes 1 litre of solution.
H 0800 **$ 2.25**

640 + 200 HOLES
P 1009 ..... **$15.95**

Mains Lead
1.8M
A 2400 **$1.95**

R 3501 .25W RESISTOR PACK
Average contents: 300 $12.00 value
Only: $5.95 10 up $5.50

R 3505 .25W RESISTOR PACK METAL FILM
Average contents: 150
Only: $5.95 10 up $5.50

R 3510 GREENCAP PACK 100V
Average contents: 50 $12.00 value
Only: $5.95 10up **$5.50**

R 3515 CERAMIC PACK 50V
Average Contents: 100 $14.00 value
Only: **$5.95** 10up **$5.50**

R 3520 ELECTROLYTIC PACK PCB TYPE
Average Contents: 40 $14.00 value
Only: **$5.95** 10up **$5.50**

9V BATTERY SNAP

P 0455 .20
10 up **.17**

BIG EAR see FM BUG.

BLACK JACK

Issue 11

2 - 47R ¼ watt
7 - 330R
1 - 470R
1 - 1k
1 - 5k6
1 - 22k
2 - 100k
1 - 220k
1 - 330k
1 - 680k

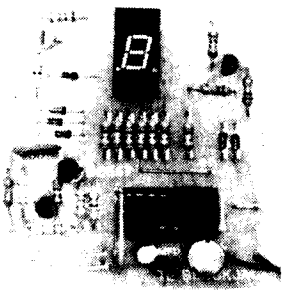
1 - 100n 50v greencap
1 - 22mfd 16v PC electro
1 - 47mfd 16v PC electro

6 - 1N 4148 diodes

3 - BC 547 transistors
1 - BC 557 transistor

1 - TIL 313 display
1 - CD 4026 driver IC

1 - 16 pin IC socket
1 - battery snap



PC board $3.00

Parts $9.10
Complete $12.10

CAPACITANCE METER

Issue 6 P 54
Issue 7 P 61

This project combines with the Mini Frequency Counter to produce a capacitance meter capable of measuring from 100pf to 10 mfd. It is construced on Matrix board type 24 x 25.

See also Mini Frequency Counter project for display section.

1 - 33R
1 - 3k3
1 - 10k
1 - 100k
1 - 1M
1 - 100pf styro
1 - 1n 100v
1 - 2n2
1 - 10n
1 - 22n
1 - 100mfd 16v
1 - 2k mini trim pot
1 - 10k mini trim pot
2 - 100k mini trim pot
2 - 555 timer ICs
1 - CD 4011 IC
Hook-up wire
2 - 8 pin IC sockets
1 - 14 pin IC socket

PC board $2.50

Parts $5.00
Complete $7.50

CLOCK

Issue 8

1 - 220R
7 - 470R
1 - 2k7
7 - 10k
10 - 100k
1 - 330k
1 - 470k
2 - 1M

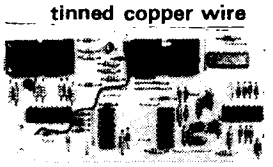
2 - 10n
1 - 1000u 25v
4 - FND 560 displays
2 - CD 4026 IC
1 - CD 4040 IC
1 - CD 4511 IC
1 - CD 4518 IC

5 16 pin IC sockets

1 - 1N 4001 diode
22 - 1N 4148 diodes

4 - BC 547 transistors
2 - BC 557 transistors

1 - Clock Mod PC board
tinned copper wire



PC board $3.95

Parts $23.40
Complete $27.35

LARGE DISPLAY FOR CLOCK

1 - 4-digit display LT-656-12
30 cm 30-way ribbon cable

Parts $6.50

COMBINATION LOCK

Issue 5 P 33

Uses a CD 4017 to unlock a relay

2 - 2k2
1 - 10k
2 - 22k
2 - 10n
1 - 22mfd 16v
1 - CD 4017 IC
2 - BC 547
6 - 1N 4148
1 - 1N 4002
1 - 6v relay
1 - push-to-make switch
1 - battery snap
1 - 16 pin IC socket

PC board $2.50

Parts $6.50
Complete $9.00

CO-ORDINATOR

3 - 470R ¼watt
1 - 3k3
1 - 4k7
1 - 10k
1 - 22k
1 - 47k
1 - 100k

1 - 22uF 16v electro
1 - 47uF 16v electro
1 - 220uF 16v electro

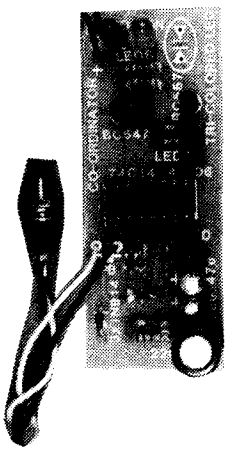
3 - 1N 4148 diode
2 - BC 547 transistors
1 - BC 557 transistor
2 - 3mm red LEDs
1 - 5mm red LED
1 - 5mm green LED

1 - 74C14 or 40106 IC

1 - Push button
1 - Battery snap

1 - 14 pin IC socket

20cm Hook-up flex



PC board $2.50

Parts $5.75
Complete $8.25

CONTINUITY TESTER

1 - 100R ¼watt
1 - 120R (for mod.)
1 - 220R
1 - 1k
1 - 100k

2 - 1uF electro

3 - 1N 4148 diode
2 - BC 547 transistors
1 - BC 557 transistor
1 - 5mm red LED
1 - Mini speaker

1 - DPDT slide switch (or SPDT)
2 - AAA cells

1 - paper clip
10cm tinned copper wire
50cm Hook-up flex

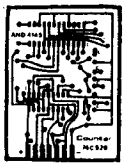
PC board $2.10

Parts $5.60
Complete $7.70

Replacement AAA cells 45¢ each

COUNTER MODULE

Issue 2 P 4



7 - 220R
7 - 270R
7 - 330R

4 - 3k3
4 - 1M

4 - BC 547 transistors
1 - 74c926 IC

1 - 18 pin IC socket
4 - TIL 313 displays
1 - "DISPLAY" PC board
1 - "COUNTER" PC board

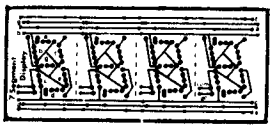
PC board $4.55

Parts $21.50
Complete $26.05

7-SEGMENT DISPLAY

Issue 3 P 23
Issue 4 P 27

In place of the small 4 digit display you can make a large LED display which can be read from across the room.



60 - 5mm red LEDs

PC board $5.40

Parts $8.30
Complete $13.70

CRYSTAL OSCILLATOR

1 - 330R
2 - 1k

1 - 100pf ceramic
1 - 100n monoblock

1 - 3.5795MHz crystal

1 - 74LS04 IC

1 - 7473 IC

2 - 14 pin IC sockets
1 - 16 pin dip header

PC board $2.10

Parts $9.85
Complete $11.95

CUBE PUZZLE

Issue 8

Based on that puzzle you have possibly smashed by now, this is an electronics version to test your patience.

2 - 180R
7 - 220R
10 - 470R
3 - 1k
1 - 22k
2 - 100k
1 - 470k

1 - 100n 100v greencap
1 - 1mfd 16v electro
1 - 10mfd 16v electro
1 - 22mfd 16v electro

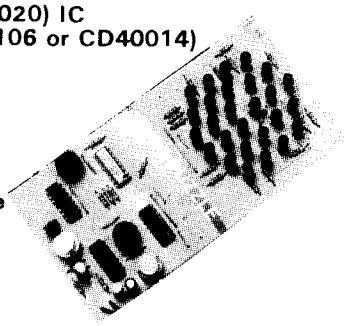
4 - push buttons

2 - 14 pin IC sockets
2 - 16 pin IC sockets

1 - CD 4001 IC
1 - CD 4015 IC
1 - CD 4040 (or CD 4020) IC
1 - 74c14 IC (CD 40106 or CD40014)

9 - 5mm Red LEDs
9 - 5mm orange LEDs
9 - 5mm Green LEDs

tinned copper wire
1 - battery snap



PC board $5.15

Parts $16.30
Complete $21.45

DESIGNER BOARD

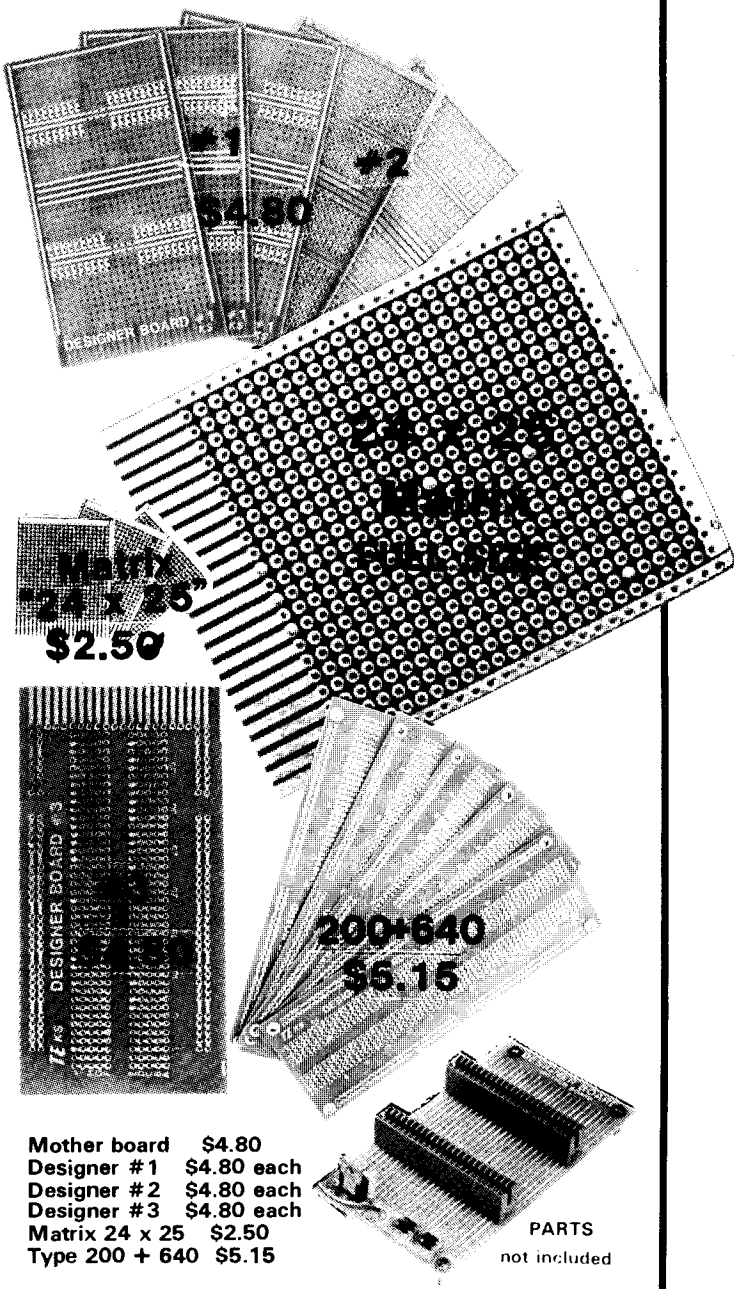
Issue 5 P66
book 2 P 55

This is a mother boarding system in which up to 5 boards are designed to fit onto a mother board via 24 pin edge connectors.

3 different Designer Boards are available @ $4.00

Designer #1 $4.80 each
Designer #2 $4.80 each
Designer #3 $4.80 each

Matrix board 24 x 25 has an edge connector and individual lands for the 600 holes. It is an ideal board for bread-boarding our projects. cost: **$2.10 ea.**



Mother board $4.80
Designer #1 $4.80 each
Designer #2 $4.80 each
Designer #3 $4.80 each
Matrix 24 x 25 $2.50
Type 200 + 640 $5.15

PARTS not included

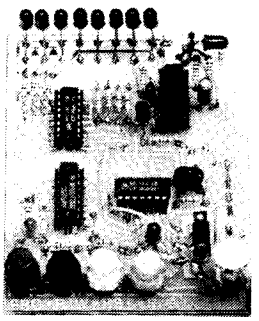
Starter Kit: 1 off each board $22.10

After you buy the **STARTER KIT** you can see which board suits your needs best and buy the bulk pack of 5 boards for **$21.00**

DIGI CHASER

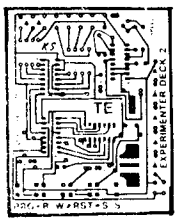
Issue 8

This is an introduction to computers. All the parts are re-useable as they mount on the top side of the PC board and make an ideal demonstration project.



10 - 470R
2 - 1k
2 - 10k
3 - 100k
1 - 220k
1 - 10k mini trim pot
1 - 10n 100v greencap
1 - 100n 100v
1 - 22mfd electro PC mount
1 - 470mfd electro PC mount

10 - 5mm Red LEDs
1 - 5mm coloured LED
6 - 1N 914 diodes
3 - 16 pin IC sockets
1 - 14 pin IC socket
1 - SPDT mini slide switch
4 - push buttons



1 - CD 4015BE IC shift register
1 - CD 4024 IC binary counter
1 - CD 4049 IC hex buffer
1 - 2102 IC 1k x 1 bit memory

1 - battery snap
hook-up wire

PC board $3.60 **Parts $17.30**
Complete $20.90

DIODE TESTER

(and black box puzzle)

2 - 1k
1 - 3k9
1 - 47k
1 - 10n 100v
1 - 555 timer IC
2 - 3mm red LEDs

1 - 8 pin IC socket

PC board $2.15 **Parts $1.80**
Complete $3.95

DOOR CHIME

Issue 5 P5.

"Ding Ding Dong" Door Chime
Uses SAB 0600 chip

1 - 33k
1 3n9 100v
1 - 100n 100v
2 - 100mfd 16v
1 - SAB 0600 IC
1 - 8 pin IC socket
1 - spkr 8 ohm
1 - battery snap
1 - push button

PC board $2.40 **Parts $15.60**
Complete $18.00

★SAB 0600 $8.00

DUAL PSU (Ken's)

Issue 11

2 - 1k ¼watt
2 - 100n ceramic or greencap

6 - 1N 4002 diodes

2 - 10mfd 16v electrolytics
2 - 1000mfd 25v electrolytics

1 - 7815 regulator (positive)
1 - 7915 regulator (negative)

2 - 3mm red LEDs

2 sets nuts and bolts
small amount of thermal grease
15cm hook-up wire, 6 colours

Positive 15v and negative 15v regulators are supplied in the kit. You can request *+5v, +12v, −5v, −12v* regulators in place.

You will also need a 2155 transformer (or maybe two) at $6.90 each or a 6672 transformer, at $10.50 to complete the supply.

PC board $4.55 **Parts $9.60**
Complete $14.15

DUAL TRACKING POWER SUPPLY

Project book 3

1 - 220R ¼ watt
2 - 680R
2 - 1k
1 - 1k5
1 - 4k7
4 - 10k

1 - 5mm Red LED
1 - 5mm Green LED

1 - 100pf ceramic
2 - 100n ceramic
2 - 10mfd electrolytic 25v PC mount
3 - 470mfd electrolytic 25v PC mount
2 - 2200mfd electrolytic 25v PC mount

1 - 500R linear pot.
1 - 10k mini trim pot (can be 1k, 2k or 5k)

10 - 1N4002 diodes
1 - 7805 regulator
1 - 7905 regulator
1 - BC 547 transistor
2 - BC 557 transistors

2 - heat fins for regulators
2 - sets of nuts and bolts for heat fins
2 - sets of nuts and bolts for heat-sink
coloured hook up flex. 10 colours @ 20cm.
length of fine solder
small amount of thermal compound

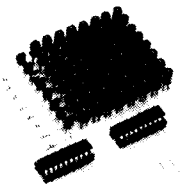
PC board $3.95 **Parts $18.70**
Complete $22.65

8x8 DISPLAY

Issue 11

8 - 22R ¼watt
8 - 1k

8 - BC 547 transistors
8 - BC 338 transistors
2 - 74LS 273 or
2 - 74LS 374 or
2 - 74LS377 IC's.



64 - 5mm red LEDs

2 - Matrix pins
2 - Matrix connectors
5cm heatshrink tubing

30cm hook-up wire, 12 colours
30cm tinned copper wire

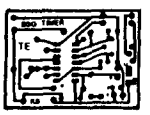
2 - 20 pin IC sockets
1 - 24 pin DIP HEADER

PC board $7.20 **Parts $20.15**
Complete $27.35 ✓

EGG TIMER

Issue 6 P 34

times a 3 min egg



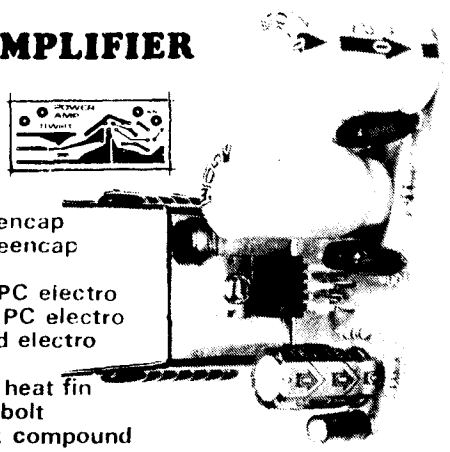
1 - 15R
2 - 3k3
1 - 10k
1 - 47k
2 - 100k
1 - 470k
1 - 4M7
2 - 10n 100v
1 - 10mfd 16v
1 - 22mfd 16v

1 - 14 pin IC socket
7 - 1N 914 diodes
1 - 74C14 IC
1 - BC 547
1 - speaker 8R
1 - battery snap
1 - mercury switch

PC board $2.50 **Parts $7.45**
Complete $9.95

Issue 9 P.13.

8-watt AMPLIFIER



1 - 1R
1 - 2R2
1 - 39R
1 - 220R

1 - 39n greencap
2 - 100n greencap

1 - 4.7mfd PC electro
1 - 470mfd PC electro
2 - 1000mfd electro

1 - mini 'U' heat fin
1 - nut and bolt
heat sink compound

1 - LM 383 or TDA 2002 IC

PC board $3.00 **Parts $8.65**
Complete $11.65

EPROM BURNER

2 - 10k
3 - 100k
1 - 1M
1 - 1M5

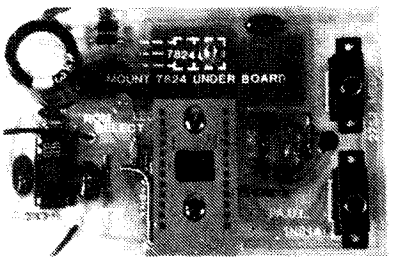
1 - 10n greencap
3 - 100n
1 - 220uf 35v electro

2 - 1N 4148 signal diodes
4 - 1N 4002 power diodes
1 - red LED

2 - BC 547 transistors
1 - 4011 IC
1 - 7824 regulator

1 - 14 pin IC socket
1 - 24 pin wire-wrap socket
1 - 24 pin DIP header
1 - 24 pin ZIF socket **$14.90 extra**

2 - 10cm hook-up flex
2 - matrix pins (for TEC)
2 - matrix pin connectors
4cm heat-shrink tubing
1 - 6BA nut and bolt
3 - DPDT slide switches

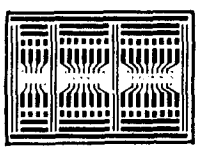


PC board $4.20 **Parts $16.45**
Complete $20.65

EXPERIMENTER BOARD

This is a set of 8 experiments mounted on a re-useable PC board. Each experiment requires the previous components to advance in complexity.

Issue 1 P16
Issue 2 P20
Issue 3 P28
Issue 5 P 60



1 - 470R
7 - 680R
1 - 1k
1 - 2k2
1 - 3k9
1 - 10k
1 - 22k
1 - 100k
2 - 10M
1 - 10n 100v
1 - 100n 100v
1 - 1mfd 16v
1 - 2.2 mfd 16v
1 - 10mfd 16v
1 - BC 557
1 - 555 IC
1 - CD 4017 IC
1 - CD 4024 IC
1 - 74C85 IC
1 - PE cell

1 - 8 pin IC socket
1 - 14 pin IC socket
2 - 16 pin IC sockets
7 - 5mm red LEDs
6 - Molex pins
1 - push switch
30cm hook-up wire
1 - battery snap

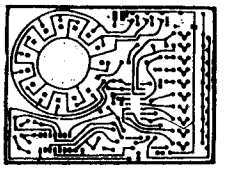
PC board $2.50 **Parts $14.65**
Complete $17.15

EXPERIMENTER DECK

A set of 10 experiments built on the one PC board,culminating in an advertising sign using a circle of LEDs.

Issue 1 P 31
Issue 2 P 46
Issue 3 P 55
Issue 4 P 63

Projects 1 - 10:
1 - CD 4001 IC
1 - CD 4017 IC
1 - 15R
1 - 22R
1 - 120R
1 - 3k3
2 - 4k7
5 - 10k
1 - 47k
1 - 100k
1 - 1n 100v
1 - 3n3 100v
1 - 3n9 100v
3 - 6n8 100v
2 - 22n 100v
1 - 4.7 mfd 16v
1 - 22mfd 16v
6 - 1N4148 diodes
1 - 100k mini trim
1 - 500k mini trim
1 - 14 pin IC socket
1 - 16 pin IC socket



24 - 5mm red LEDs
1 - 5mm green LED
1 - BC 557
3 - BC 547
1 - spkr 8 ohm
30cm hook-up wire
1 - roll of fine solder
30cm tinned copper wire

PC board $5.15 **Parts $15.90**
Complete $21.05

EXPERIMENTER DECK 2 - See DIGI CHASER

FM BUG

Issue 11

Transmits on 88MHz to 108MHz. Up to 200m has been achieved under ideal conditions.

1 - 470R ¼watt
1 - 10k
1 - 22k
1 - 47k
1 - 1M

1 - 5.6pf ceramic = 5p6
1 - 22pf or 27pf or 33pf ceramic
1 - 47pf ceramic
1 - 1n ceramic = 1000pf or 102
2 - 22n ceramic =.022 or 223
1 - 2.2mfd 16v or 25v PC electro.
2 - BC 547 transistors (NOT SGS type).
1 - Mini slide switch (spdt)
1 - electret microphone (insert)

2 - AAA cells

10cm tinned copper wire

2 - metres aerial wire

The 2 batteries are supplied in the kit but NOT the case.

PC board $2.15 **Parts $6.00**
Complete $8.15

Replacement AAA cells 45¢ each

GUITAR PRACTICE AMPLIFIER

1 - 1R ¼watt
1 - 2R2
1 - 39R
1 - 220R
1 - 470R
2 - 1k
1 - 6k8
1 - 10k
1 - 15k
1 - 56k
1 - 68k
1 - 680k
1 - 4M7

1 - 10k mini trim pot
1 - 50k mini trim pot

1 - 1n greencap
1 - 39n
4 - 100n

1 - 4u7 25v PC mount electro
1 - 100uF 25v PC mount
1 - 470uF 25v PC mount
3 - 1000uF 25v PC mount

2 - BC 547 transistors
4 - 1N 4002 diodes
1 - 5mm red LED
1 - LM 383 (TDA 2002) IC

1 - DPDT slide switch
1 - Mini U heatsink
1 - 6BA nut and bolt

PC board $3.40 **Parts $12.30**
Complete $15.70

GUITAR AMP EXTRAS

Kit: $26.40

1 - 10k lin pot
1 - 50k lin pot
2 - knobs to suit
1 - 6.4mm mono socket
1 - 2way RCA socket
1 - SPDT toggle switch
1 - DPDT toggle switch
10cm heatshrink tubing 2.6mm diam
20 lengths of hook-up wire 15cm long
2 lengths of heavy duty hook-up wire
20cm shielded microphone cable
1 - 2155 transformer
1 - mains cord and plug
1 - H 444 case
1 - rubber grommet
2 - 4BA nuts and bolts
3 - 6BA nuts and bolts
4 - 1/8" whitworth nuts & 25mm bolts
4 - 9mm spacers
1 - earth tag
1 - cable clamp

Extras: $26.40
Complete including extras $42.10

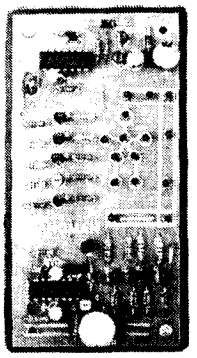
HANGMAN

Issue 6 P 5

"Hang the Butcher" game.
PC board is presented with issue 6.

3 - 150R
3 - 270R
2 - 330R
1 - 680R
1 - 3k3
3 - 4k7
2 - 10k
1 - 22k

2 - 33k
5 - 47k
1 - 150k
1 - 330k
2 - 390k
2 - 2M2
1 - 10M



1 - 100k mini trim
1 - 1n 100v cap
1 - 10n 100v cap

3 - 2.2mfd 16v
1 - 22mfd 16v
1 - 100mfd 16v
1 - 470mfd 10v or 16v
12 - BC 547
1 - BC 557
2 - CD 4011 IC
1 - 1N 914 diode
2 - 1N 4002 diode
20 - 3mm or 5mm red LEDs
1 - battery snap
2 - 14 pin IC sockets

PC board $3.95 **Parts $11.05**
Complete $15.00

HEADLIGHT REMINDER

1 - 15R ¼watt
1 - 150R
2 - 470R
1 - 2k2
3 - 4k7

2 - 10k
6 - 100k
2 - 470k
1 - 1M

1 - 50k mini trim pot

1 - 10n greencap

2 - 1mfd 25v PC electrolytics
2 - 4.7mfd 16v PC electrolytics
1 - 100mfd 16v PC electrolytic

11 - 1N 914 or 1N 4148 diodes
1 - 1N 4002 diode

1 - 5mm red LED
1 - 5mm orange LED

2 - BC 547 transistors
1 - BC 557 transistor

1 - CD 4001 IC
1 - 74c14 or 40106 IC
1 - MEL-12 photo transistor

2 - 14 pin IC sockets
3 'Quick Connect' pins and connectors
1 - 8R speaker
Lengths of hook-up flex

PC board $3.95 **Parts $11.50**
Complete $15.45

INPUT/OUTPUT MODULE

16 - 220R ¼watt

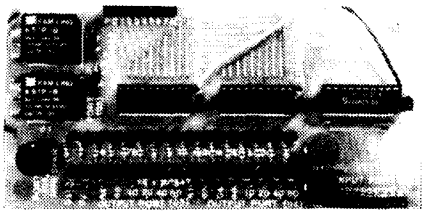
3 - 1n greencap
2 - 100n

2 - 1N 4002 diodes
16 - 3mm red LEDs
16 - BC 338 transistors

2 - 74LS273 IC
1 - 74LS373 IC
1 - 24 pin DIP header
3 - 20 pin IC sockets
2 - PC mount push buttons
1 - Mini Speaker 80R
2 - SPDT relays

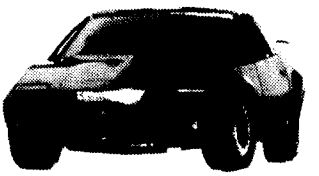
50cm tinned copper wire
5 - PC matrix pins
5 - Matrix connectors
10cm - Heatshrink tubing
15 - 20cm lengths of hook-up flex

20cm - 10 core ribbon cable
1 - 12 key telephone pad



PC board $5.00 **Parts $33.80**
Complete $38.80

KITT SCANNER



1 - 330R ¼ watt
2 - 22k
1 - 39k
2 - 47k

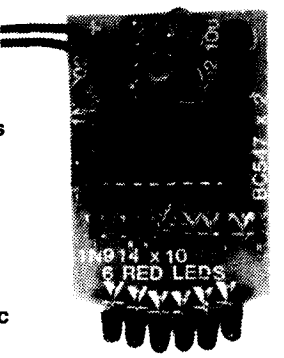
1 - 2.2mfd electrolytic PC mount
1 - 10 mfd PC mount
1 - 22mfd PC mount

11 - 1N 4148 diodes
1 - 1N 4002 diode

2 - BC 547 transistors
1 - CD 4017 IC

1 - 16 pin IC socket

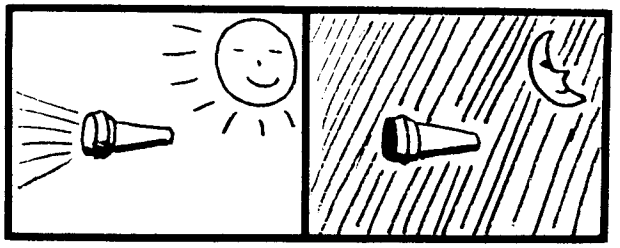
4 - 'AAA' cells
6 - 3mm red LEDs
1 - miniature switch
1 - piece of red plastic



PC board $2.15 **Parts $6.70**
Complete $8.85

Replacement AAA cells 45¢ each

SOLAR POWERED TORCH

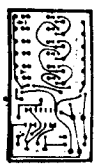


$50.00 ea
10 up . . **$75.00 ea**

LED ZEPPELIN

Issue 1 P 4

A game of skill using a single switch to turn on a row of LEDs



1 - 270R
1 - 330R
1 - 390R
3 - 470R
1 - 560R
3 - 1k
2 - 2k2
1 - 3k3
1 - 4k7
1 - 10k
1 - 22k
1 - 56k
1 - 470k
1 - 4.7mfd 16v
1 - 470mfd 10v or 16v

1 - 14 pin IC socket
7 - BC 547
1 - BC 557
1 - CD 4001 IC
6 - 5mm red LEDs
1 - 3mm red LED
2 - 1N 4148 diodes
1 - push switch
1 - battery snap

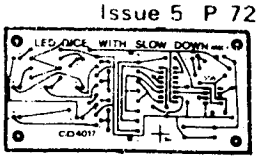
PC board $2.50

Parts $6.90
Complete $9.40

LED DICE WITH SLOW DOWN Mk II

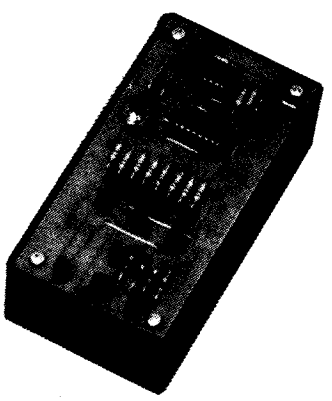
Realistic dice readout with slow-down action

Issue 5 P 72



3 - 330R
1 - 1k
9 - 10k
1 - 3M3
1 - 2M7 or 4M7
1 - 10M

1 - 100n 100v
1 - 1mfd 16v
3 - BC 547
2 - BC 557
1 - CD 4017 IC
1 - 555 timer IC
7 - 5mm LEDs
1 - push switch
1 - battery snap
1 - 8 pin IC socket
1 - 16 pin IC socket



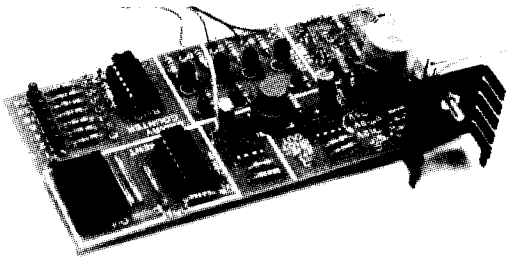
PC board $3.95

Parts $6.90
Complete $10.85

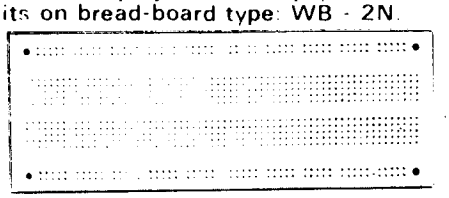
LOGIC DESIGNER

This is the main feature in PROJECT BOOK No. 2.

Project book 2
with PC board $3.95

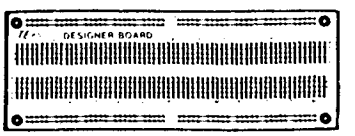


It has 7 building blocks on one PC board. POWER SUPPLY, ONE-SHOT, 10Hz CLOCK, 7-SEGMENT READOUT, 4 BUFFERS and a TRANSISTOR TESTER. This project will help you build and test circuits on bread-board type: WB - 2N.



BREAD-BOARD TYPE WB - 2N $15.95

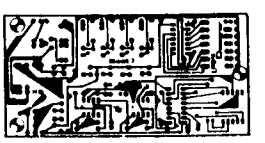
If you want to make a project permanent, use PC board type: 200 + 640



BOARD TYPE 200 + 640 $5.15
Plug Pack $9.20
Jiffy box $2.75

LOGIC DESIGNER

1 - 150R
3 - 220R
1 - 270R
5 - 330R
1 - 390R
7 - 470R
2 - 1k
2 - 3k9
8 - 10k
1 - 22k
2 - 47k
4 - 100k
2 - 555 timer ICs
1 - CD 4024 IC
1 - 4026 IC
4 - BC 547
1 - 7805 regulator
1 - FND 500 display
12 - 3mm red LEDs
1 - 3mm green LED
4 - 1N 914 diodes
4 - 1N 4001 diodes



1 - 100n 100v cap
2 - 1mfd 16v
1 - 1000mfd 16v

2 - 8 pin IC sockets
1 - 14 pin IC socket
1 - 16 pin IC socket
1 - push button
1 - heat fin for 7805
40 - Molex pins
10cm tinned copper wire
length of fine solder
20 - lengths of hook-up wire
4 - 6BA bolts 12mm long
4 - 6BA nuts

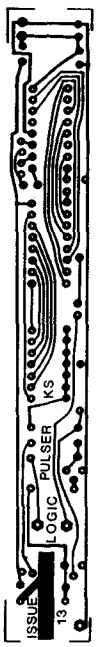
PC board $3.95

Parts $21.10
Complete $25.05

LOGIC PULSER

1 - 100R
1 - 330R
1 - 1k
1 - 2k2
2 - 10k
1 - 100k
1 - 220k
1 - 2M2

1 - 100pf
1 - 10n greencap
1 - 1mfd electro
1 - 10mfd electro
7 - 1N 4148 diodes
1 - 3mm red LED
2 - BC 547 transistors
1 - CD 4060 IC
1 - mini speaker
1 - 8-way DIP switch
1 - 16 pin IC socket
5cm tinned copper wire
1 - paper clip for probe tip
1 - 50cm red hook-up flex
1 - 50cm black hook-up flex
1 - red EZY-CLIP
1 - black EZY-CLIP



PC board $2.50 **Parts $12.25**
Complete $14.75

LOGIC PROBE

Detects HIGH's LOW's and PULSES.
Has audible and LED readout.

1 - 100R
3 - 680R
1 - 10k
1 - 100k
1 - 470k
1 - 560k
3 - 1M
1 - 2M2

2 - 100pf
1 - 2n2 100v
1 - 4n7
1 - 10n

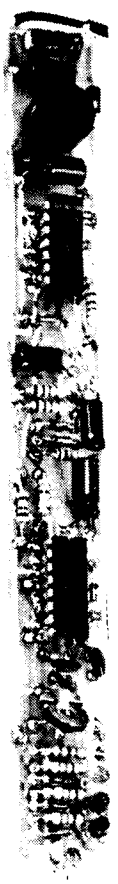
3 - 1mfd 16v

1 - 3mm red LED
1 - 3mm green LED
1 - 3mm orange LED

7 - 1N 4148 signal diodes
1 - 1N 4002 power diode

1 - CD 4049 Hex Inverter
1 - 74c14 Hex Schmitt Trigger

1 - 1M mini trim pot
1 - 8R MINI speaker
tinned copper wire
1 - 30cm red flex for power
1 - 30cm black flex for power
1 - red E-Z hook or alligator clip
1 - black E-Z hook or alligator clip
Case not supplied.



PC board $3.35 **Parts $10.50**
Complete $13.85

LOTTO SELECTOR

Issue 9. P5.

3 - 10k
1 - 1M
1 - 3M3
1 - 4M7
1 - 10M

1 - 10n 100v greencap
1 - 100n 100v greencap

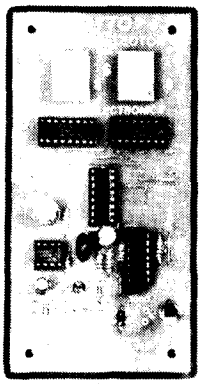
1 - 1mfd 16v electro
1 - 22mfd 16v electro
1 - 100mfd 16v electro

1 - BC 557 transistor

4 - 1N 914 diodes
1 - 1N 4002 diode

1 - 555 timer IC
1 - 74c14 (40014) IC
1 - 4518 dual BCD counter IC
2 - 4511 display driver IC's
2 - FND 500 displays
1 - 8 pin IC socket
1 - 14 pin IC socket
3 - 16 pin IC sockets

1 - ON-OFF-ON switch
1 - battery snap
tinned copper wire

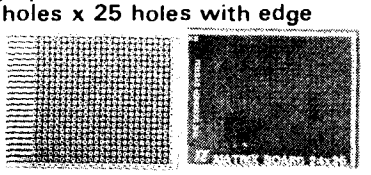


PC board $3.95 **Parts $15.85**
Complete $19.80

MATRIX BOARD

A small bread-boarding system with individual solder lands. Size: 24 holes x 25 holes with edge connector.

PC board $2.50 ea
Set of 3: $6.90

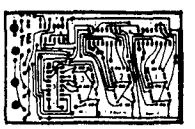


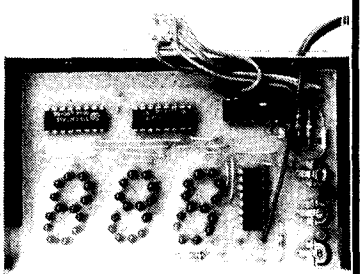
MINI FREQUENCY COUNTER

100Hz to 5MHz in 3 ranges. With 3 digit readout.

Project book No 1
with PC board $3.95

3 - CD 4026 IC
1 - CD 4047 IC
45 - 3mm red LEDs
1 - 10n 100v
1 - 220pf cap
1 - 1N 4148 diode
1 - 1k mini trim pot
1 - 10k mini trim pot
1 - 100k mini trim pot
1 - 3k9
1 - 10k
1 - 39k
1 - 390k
6 - Molex pins
1 - battery snap
1 - red plastic screen
25cm tinned copper wire
1 - roll of fine solder
3 - 16 pin IC sockets
1 - 14 pin IC socket





PC board $3.95 **Parts $18.70**
Complete $22.65

MINI FREQUENCY COUNTER ...cont.

CALIBRATION SERVICE: $3.00
REPAIR SERVICE: $6.00

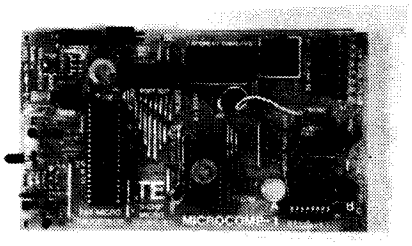
Cascading kit to make 5 digits.

2 - CD 4026 IC
30 - 3mm red LEDs
10cm tinnd copper wire
1 - red plastic screen

PC board $3.95
Parts $11.75
Complete $15.70

A green LED version of the Mini Frequency Counter is available in 3 digits only. **Parts $21.70**

MICROCOMP-1



1 - 10R
8 - 100R
1 - 330R
1 - 470R
1 - 3k3
1 - 4k7
8 - 5k6
6 - 10k
3 - 22k
2 - 39k
4 - 100k

1 - 100k mini trim pot

2 - 1n green cap
1 - 100n
1 - 1mfd 63v electro
1 - 1,000mfd 25v electro

9 - 1N 4148
4 - 1N 4002

1 - 5mm red LED (SPEED)
1 - 5mm green LED
24 - 3mm red LEDs
8 - BC 547 transistors
1 - BC 557 transistor
2 - FND 560

1 - 74LS273 IC
1 - Z-80 CPU
1 - 2732 EPROM (PROGRAMMED)
1 - 7805 regulator

1 - 20 pin IC socket
1 - 24 pin IC socket
1 - 40 pin IC socket
1 - 8 way DIP switch
1 - DPDT slide switch
3 - PC mount push switches

1 - 3.5mm mono socket
1 - mini speaker

1 - 6BA nut and bolt
4 - rubber feet
13 - matrix pins
1 - hollow pin
20cm hook-up flex
1 metre tinned copper wire
1 - female matrix pin connector
2cm heatshrink tubing.

PC board $10.20 **Parts $50.70**
Complete $59.95

✓

MINI MIXER

Issue 6 P 64

and fuzz unit

1 - 150R
1 - 1k
1 - 2k2
1 - 5k6
6 - 10k
1 - 220k
2 - 10mfd 16v
1 - 100mfd 16v
2 - BC 547

2 - 1N 914
1 - 5mm red LED
1 - battery snap

PC board $2.05 **Parts $2.65**
Complete $4.70

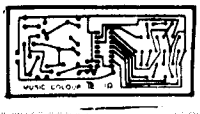
MUSIC COLOUR

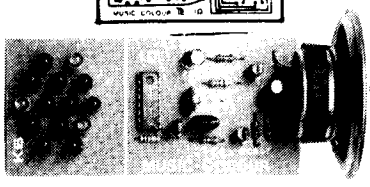
Issue 7 P72

A set of 14 LEDs displays a random pattern according to the sound it picks up. Really effective

1 - 1k
1 - 2k2
1 - 4k7
2 - 10k
1 - 1M
1 - 10k mini trim
1 - 100n 100v
2 - 22mfd 16v
1 - CD 4026 IC
3 - BC 547
8 - 5mm red LEDS
3 - 5mm green LEDs
3 - 5mm yellow LEDs

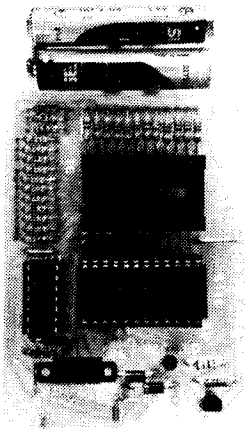
1 - speaker 8 ohm
1 - battery snap
1 - 16 pin IC socket





PC board $2.50 **Parts $9.30**
Complete $11.80 ✓

NON-VOLATILE RAM



1 - 56R ¼watt
1 - 150R
1 - 2k2 (Rx)
3 - 10k
25 - 47k

1 - 100n greencap

2 - 1N 4002 diodes
1 - 3mm LED

1 - BC 547 transistor
1 - CD 4071 IC
1 - 6116 RAM

1 - 14 pin IC socket
1 - 24 IC socket
1 - 24 pin wire-wrap socket
1 - 24 pin DIP header

1 - SPDT switch

2 - AAA cells

20cm tinned copper wire

PC board $4.30 **Parts $23.50**
Complete $27.80

Replacement AAA cells 45¢ each

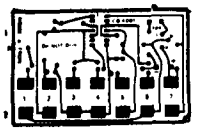
✓

NOISE-A-TRON

Issue 4 P 28

Star wars type noises - very effective when amplified.

1 - 15R
1 - 2k2
1 - 4k7
2 - 10k
1 - 33k
1 - 220k
2 - 2M2
1 - CD 4001 IC
1 - BC 557
1 - 1n 100v
1 - 3n9 100v
1 - 10n 100v



1 - 22n 100v
2 - 47n 100v
1 - 100mfd 16v
1 - speaker 8 ohm
1 - battery snap
1 - 14 pin IC socket

PC board $2.40

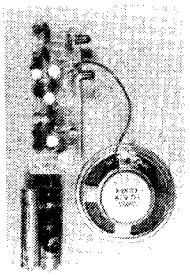
Parts $3.95
Complete $6.35

PHASER GUN

Issue 7 P 63

A transistor project constructed on Matrix 24 x 25 board. Gives very impressive sound

1 - 220R
1 - 470R
1 - 1k
1 - 1k2
1 - 2k2
1 - 6k8
1 - 15k
2 - 18k
1 - 22k
1 - 39k
1 - 50k mini trim pot
1 - mini trim as switch
2 - 22n 100v
1 - 1mfd 16v
2 - 22mfd 16v
1 - 100mfd 16v
1 - 220mfd 16v
4 - BC 547
2 - BC 557
2 - 5mm red LEDs
1 - speaker 8 ohm
1 - battery snap
1 - push button



PC board $2.50

Parts $6.10
Complete $8.60

PILL TIMER

Issue 7 P 63

A long-duration timer to remind you to take your medicine!

1 - 15R
1 - 3k3
1 - 10k
5 - 100k
1 - 220k
1 - 470k
1 - 100k mini trim
1 - 10n 100v
1 - 22n 100v
1 - 1mfd 16v
2 - 22mfd 16v
1 - 220mfd 16v
6 - 1N 914 diode
1 - BC 557
1 - 74C14 IC
1 - 4020B IC
1 - push switch
1 - battery snap
10 - Molex pins
1 - speaker 8 ohm
1 - 14 pin IC socket
1 - 16 pin IC socket

PC board $2.50

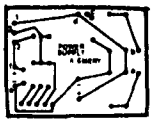
Parts $6.95
Complete $9.45

POWER SUPPLY

Issue 3 P 4

A 1-amp regulated power supply using a 7805 regulator. The components in this kit fit on the PC board. You will need a transformer and power lead.

1 - 39R
1 - 150R
1 - 270R
1 - 470R
1 - 500R mini trim
1 - 100n 100v
1 - 2500mfd 25v



4 - 1N 4002 diodes
1 - 7805 regulator

PC board $2.50

Parts $5.30
Complete $7.80

PRINTER INTERFACE

1 - 100n mono block

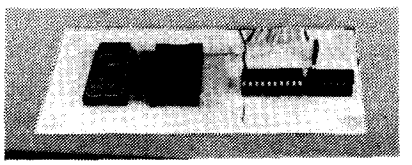
1 - 4069 IC
1 - 74LS273 IC
1 - 2716 (programmed)

Make sure you have a 4-pen Printer/Plotter before ordering the kit.

1 - 14 pin IC socket
1 - 20 pin IC socket
1 - 24 pin IC socket
1 - 24 pin wire-wrap socket
1 - 24 pin DIP HEADER

1 - 36 pin Centronics-type plug

tinned copper wire
hook-up flex
3 - 'quick-connect' pins and sockets



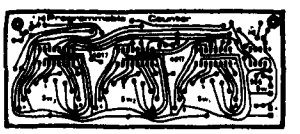
PC board $4.55

Parts $29.80
Complete $35.35

PROGRAMMABLE COUNTER with AUTO RESET

A counter which automatically resets after a given count and gives an audible tone.

1 - 330R
1 - 470R
1 - 10k
3 - 22k
1 - 100k
2 - 330k
2 - 1n 100v
1 - 100mfd 16v
1 - 555 timer IC
3 - CD 4017 IC
1 - BC 547
3 - 1N 914 diode



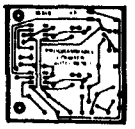
1 - 8 pin IC socket
3 - 16 pin IC sockets
2 - 5mm red LEDs
1 - push switch
30 - Molex pins
1 - battery snap

PC board $4.30

Parts $9.85
Complete $14.15

PROGRAMMABLE COUNTER cont.

PROGRAMMABLE COUNTER
AUTO RESET



1 - 220R
1 - 330R
1 - 3k9
2 - 4k7
1 - 10k
1 - 22k
2 - 10n 100v
1 - 22mfd 16v
1 - 220mfd 16v
1 - 1000mfd 25v
2 - 8 pin IC sockets

2 - 100k mini trim pot
1 - 1N 914 diode
4 - 1N 4002
2 - 555 timer IC
1 - 7805 regulator
1 - 8 ohm speaker

PC board $3.00 **Parts $8.65**
Complete $11.65

QUICK DRAW

Reaction timer for two players

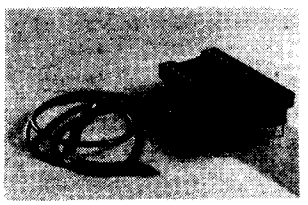
3 - 1k
4 - 2M2
1 - 2.2mfd 16v
1 - CD 4001 IC
2 - 5mm red LEDs
1 - 5mm green LED
1 - battery snap

1 - 14 pin IC socket

PC board $2.50 **Parts $2.15**
Complete $4.65

RAM STACK

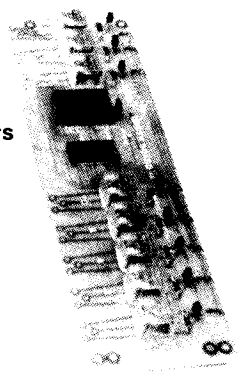
$9.65 per 2k



1 - 6116 IC
1 - 24 pin IC socket
15cm hook-up wire
1 - PC pin
1 - PC pin connector

✓

RELAY DRIVER BOARD



8 - 1k ¼ watt
1 - 100n greencap
8 - BC 547 or BC 338 transistors
8 - 1N 4002 diodes
4 - relays SPDT type S4060
1 - 74LS273 Latch IC
1 - wire-wrap socket 24 pin
1 - dip-header 24 pin
1 - 20 pin IC socket

Note: This kit contains ONLY 4 relays. Additional relays can be bought at $2.50 each as required.

PC board $10.80 **Parts $23.30**
Complete $34.10

ROULED WITH SOUND

1 - 470R
1 - 1k
1 - 220k
1 - 330k
1 - 470k

1 - 100n greencap
1 - 22u 16v

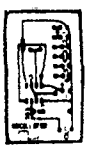
10 - 3mm or 5mm red LEDs

1 - BC 547
1 - BC 557
1 - CD 4017 IC
1 - 80R mini speaker
2 - PC push switches
1 - 16 pin IC socket
1 - Battery snap

PC board $4.30 **Parts $5.90**
Complete $10.20

SQUARE WAVE OSCILLATOR

A very handy square wave output in 6 ranges



issue 3

1 - 1k
1 - 3k9
1 - 68k
1 - 100pf
1 - 1n 100v
2 - 10n 100v
1 - 100n 100v
1 - 1mfd 16v
1 - 10mfd 16v
1 - 5mm red LED

1 - 555 timer IC
1 - battery snap
6 - Molex pins
2 - 20cm hook-up wire
1 - 8 pin IC socket

PC board $2.50 **Parts $3.10**
Complete $5.60

STEREO MINI MIXER

4 CHANNEL VERSION:

Note: Photo shows 6 channels.

2 - 150R
2 - 2k2
20 - 4k7
2 - 5k6
4 - 10k
2 - 220k

4 - 10mfd 16 PC
2 - 100mfd 16v electro

4 - BC 547

6 - 10k LOG sliders
(specify if you prefer rotary)
4 - 5k lin pots

4 - 6.5mm mono jacks
1 - 8-way RCA socket
1 - toggle switch SPST
1 - battery snap
tinned copper wire

PC board $4.10 **Parts $23.50**
Complete $27.60

STEREO MINI MIXER . . . .cont.

EXPANDER (TO 6 CHANNEL)

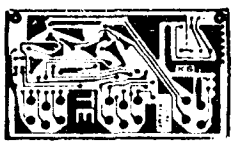
4 - 4k7
2 - 10k LOG sliders
2 - 5k lin rotary
2 - 6.5mm mono jacks

Additional channel $6.95

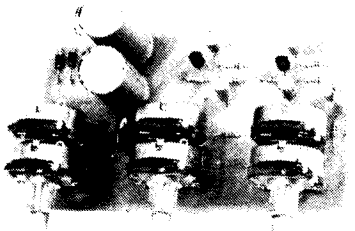
STEREO SIMPLICITY AMP

3 separate modules combine to make an 8 watt stereo amplifier.

STEREO PRE-AMP



8 - 2k2
2 - 10k
2 - 15k
2 - 68k
2 - 220k
2 - 2n2 100v
2 - 47n 100v
6 - 1mfd 16v
2 - 1000mfd 25v
4 - 1N 4004 diode
2 - BC 547
3 - 20k DUAL pots



PC board $4.10 **Parts $11.75**
Complete $15.85

Issue 5 P 10
Issue 7 P 17

FOR EACH CHANNEL:

1 - 2R7 note: 2 point 7 ohms
1 - 22k
1 - 50k mini trim pot
1 - 330 pf
1 - 10n 100v
2 - 100n 100v

1 - 4.7mfd 16v
1 - 10mfd 16v
1 - 470mfd 16v
2 - 1N 914 diode

1 - LM 380 IC

Left or right channel:

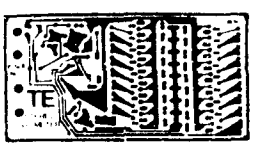
PC board $2.90 **Parts $5.30**
Complete $8.20

Complete 2nd channel: $8.20

STEREO VU METER

Can also be converted to a LED voltmeter, see issue 7 page 9. VU METER board presented with issue 7.

18 - 330R
2 - 470R
1 - 1k
1 - 2k2
5 - 4k7
5 - 10k
2 - 22k
2 - 33k
4 - 39k
4 - 47k
2 - 100k mini trim
4 - 4.7mfd 16v
2 - 22mfd 16v



18 - 1N 914 diode
20 - BC 547 transistors
2 - BC 557 transistors
14 - 5mm red LEDs
4 - 5mm green LEDs
1 - speaker 8 ohm
1 - battery snap.

PC board $3.95 **Parts $12.85**
Complete $16.80

Stage -1 Kit $74.75

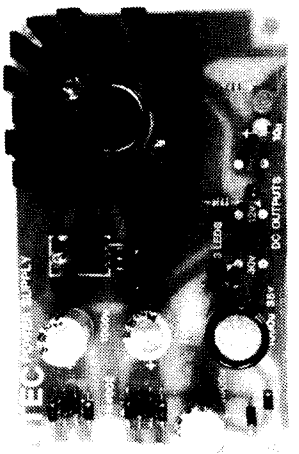
See issue 12. P. 46 for details. . .

TEC POWER SUPPLY

1 - 470R ¼watt
1 - 1k
1 - 2k2

2 - 100n greencap
1 - 10mfd electro
3 - 1000mfd 16v or 25v
1 - 1000mfd 35v or 63v

11 - 1N 4002 diodes



1 - 5mm red LED
1 - 5mm green LED
1 - 5mm yellow LED

1 - 7805 regulator
1 - 2N 3055 transistor

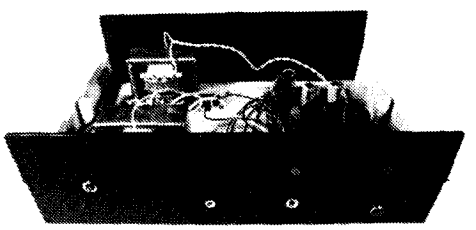
1 - TO-3 heatsink

2 - 4BA nuts and bolts
3 - 6BA nuts and bolts

10 x 20cm hook-up flex
1 - 2 pin DIN socket
1 - 3.5mm socket
1 - RCA socket

1 - 2155 transformer
4cm heat-shrink tubing
1 - cord clamp
1 - power cord and plug-top
1 - solder tag for earth lead
1 - H 0482 case
1 - SPDT switch for mains
heatsink compound

PC board $6.60 **Parts $16.70**
Complete $23.30



EXTRAS:

1 - TEC PSU kit
1 - TEC PSU PC board
1 - large case
1 - 2155 transformer
1 - cord and plug
1 - cord clamp
1 - earth tag

Complete including extras $53.10

Extra parts: 1 - 2 pin DIN plug,
1 - 3.5mm plug & 1 - RCA plug: $1.30

TEC 1B

issues: 10, 11, 12, 13, 14 etc.

1 - 100R
1 - 330R
8 - 1k
1 - 2k2
5 - 10k
1 - 47k
1 - 20k cermet pot

1 - 100pf
6 - 100n 100v
1 - 1mfd 16v
1 - 1000mfd 25v

4 - 1N 4002 diodes
1 - 1N 4148 diode
7 - BC 547 transistors

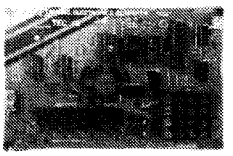
1 - 5mm red LED
1 - green LED
6 - FND 500 or 560 displays
1 - 7805 regulator

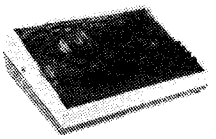
2 - 74LS273 or 374 or 377 IC's
1 - 2732 MON 1B/2 MONitor
1 - 6116 or 58725 RAM
1 - 74C923 IC
2 - 74LS138 IC's
1 - Z-80 or Z-80A CPU
1 - 4049 (NOT Fairchild)

3 - 16 pin IC sockets
3 - 20 pin IC sockets
2 - 24 pin IC sockets
1 - 40 pin IC socket

22 - PC Push switches

1 - 8R speaker
1 - nut and bolt
4 - rubber feet
2m tinned copper wire
2m fine solder
10cm desolder wick
Letraset for keys





PC board $24.30 **Parts $90.60**
Complete $114.90
Case $25.80 **Plug Pack $16.95**

✓

THROTTLE

SPECIAL: Throttle Mk I PC boards 50¢ each.)

THROTTLE Mk II
4 - 2R2
2 - 1k mini trim
1 - 1N 914 diode

Issue 7 P 60
1 - 1N 4002
2 - BC 547
1 - 2N 3055

PC board $2.15 **Parts $3.00**
Complete $5.15

TRAIN SIGNALS

Issue 9. P. 33.

1 - 1k
1 - 2k2
14 - 10k
1 - 68k
1 - 100k

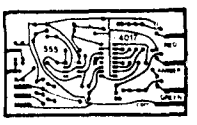
1 - 10mfd 16v PC electro
2 - 100mfd 25v PC electros

4 - 1N 4001 or 4002 diodes
5 - BC 547 transistors

1 - 555 timer IC
1 - CD 4017 decade counter IC

tinned copper wire

1 - 8 pin IC socket
1 - 16 pin IC socket



PC board $3.10 **Parts $6.10**
Complete $9.20

TOUCH PUZZLE

2 - 1M
1 - 4M7
2 - 10M

1 - 10n greencap
2 - 47n for experimenting

1 - 4024 IC
1 - 14 pin IC socket

2 - BC 547 transistors

1 - 3mm red LED
1 - 3mm orange LED
1 - 3mm green LED

1 - slide switch

3 - AAA cells

PC board $2.50 **Parts $5.00**
Complete $7.50

TREMOLO

Povides an effect for guitar or organ. Can be used with FUZZ UNIT.

1 - 560R
1 - 1k5
1 - 3k9
1 - 5k6
1 - 22k
1 - 47k

1 - 8 pin IC socket
4 - 100n 100v
1 - 10mfd 16v
1 - 22mfd 16v
1 - 555 timer
1 - BC 547
1 - battery snap

PC board $2.15 **Parts $2.40**
Complete $4.55

TTL TRAINER DECK

see: Starting in TTL

1 - 100R ¼ watt
7 - 470R
1 - 1k
2 - 2k2
2 - 47k

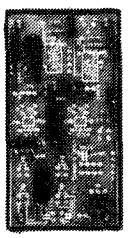
2 - 10n greencap
2 - 220uf 16v electros
1 - 470uf 16v electro

1 - 1N 4002 diode
7 - 5mm red LEDs
3 - BC 547 transistors

3 - 14 pin IC sockets
1 - 16 pin IC socket

1 - 7400 IC
2 - 7473 IC's
1 - 7476 IC

3 - SPDT mini slide switch
1 - mini speaker

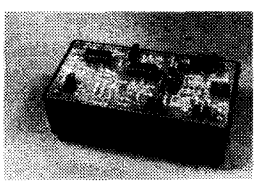


86 - Matrix pins
40 - Matrix pin connectors
60cm Heatshrink tubing

4 - rubber feet
4 - penlight cells

1 - jiffy box size UB3

hook-up wire to create:
10 - 10cm long
10 - 7cm long



PC board $3.95 **Parts $23.55**
Complete $27.50

AIR HORN

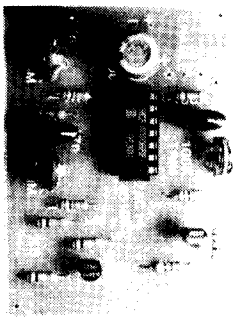
1 - 15R
3 - 1k
4 - 10k
1 - 100k

3 - 100K Mini-trim pots

3 - 47n
1 - 100 mfd electro

1 - 1N4002 diode
2 - BC547
1 - 74C14 or CD40106

1 - 8R speaker
1 - push button
1 - 14 pin ic socket



PC board $3.25

Parts $7.90
Complete $11.15

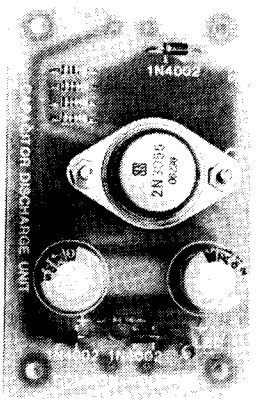
CAPACITOR DISCHARGE UNIT

1 - 1K
4 - 2K2

2 - 1000 mfd 25v-35v. See text.

3 - 1N4002 diodes
1 - 3mm red LED
1 - 2N3055

2 - Nuts & bolts



PC board $3.35
Parts $5.50
Complete $8.85

CROSSING BOOM CONTROL

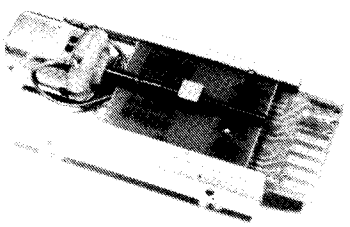
2 - 39R
1 - 1K
2 - 2K2
1 - 10K
1 - 220K

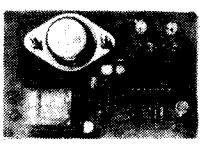
3 - 10K trim pot

1 - 100n
1 - 1 mfd electro
1 - 10 mfd electro
1 - 100 mfd electro

5 - 1N914 diodes
2 - 1N4002 diodes
2 - BC547 transistors
1 - 2N3055 power transistor
2 - MEL-12 phototransistors
1 - 74C14 chip

1 - 14 pin IC socket
2 - nuts & bolts
1 - DPDT 12v Mini relay





PC board $3.25

Parts $12.60
Complete $15.85

CROSSING EXPANSION

6 - 2K2
6 - 10K Mini trim pots

1 - 100 mfd electro

6 - 1N914 diodes
6 - MEL-12 photo-transistors.
1 - 74C14 or 40106

1 - 14 pin IC socket

PC board $3.10

Parts $12.35
Complete $15.45

CROSSING SOUND

1 - 270R
1 - 470R
1 - 1K5
2 - 2K7
7 - 10K
2 - 15K
1 - 33K
1 - 56K
3 - 68K
3 - 100K

3 - 10n
2 - 22n
1 - 1 mfd electro
1 - 2.2 mfd electro
4 - 10 mfd electro
1 - 100 mfd electro

7 - BC547 transistors
2 - BC557 transistors
1 - 74C14 hex schmitt inverter

1 - 14 pin IC socket
1 - 8R speaker

PC board $3.00

Parts $9.90
Complete $12.90

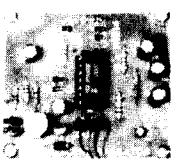
FLUORESCENT SIMULATOR

1 - 1k
1 - 4k7
1 - 47k
1 - 68k
3 - 100k
1 - 150k
1 - 1M

4 - 2.2mfd electro's
1 - 4.7 mfd electro
1 - 100 mfd electro

1 - 1N4002 diode
6 - 1N914 diode

1 - 3mm LED
1 - BC 547 transistor
1 - 74c14 or CD 40106 IC
1 - 14 pin IC socket



PC board $3.10

Parts $5.40
Complete $8.50

HEX TRAIN SENSORS

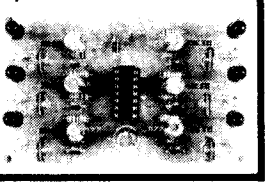
6 - 330R
6 - 2K2
6 - 100K

6 - 10K minitrim

6 - 22mfd electro's
1 - 100mfd electro

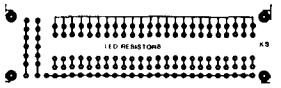
6 - 1N914 diodes
1 - 1N4002 diode
6 - 5mm LEDs
6 - MEL-12 photo-trans.
1 - 74C14 chip

1 - 14 pin IC socket



PC board $3.35
Parts $16.20
Complete $19.55

LED RESISTORS



24 - 470R ¼watt resistors
1 - LED resistors PC board

$3.60

LEVEL CROSSING

2 - 1K
2 - 2K2
1 - 10K
1 - 100K
1 - 150K
1 - 1M

2 - 10K Mini-trim pots

1 - 2.2 mfd electro
1 - 10 mfd electro
1 - 100 mfd electro

4 - 1N914 diodes
2 - BD140 transistors
2 - MEL12 Darlington phototransistors
1 - CD40106 or 74C14
1 - CD4013

2 - 14 pin IC sockets

PC board $3.10

Parts $11.40
Complete $14.50

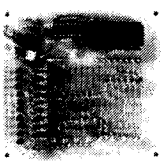
LIGHT SEQUENCER

12 - 4K7
1 - 10K
10 - 100K
1 - 100K Mini trim pot

1 - 10n greencap
1 - 22 mfd electro
1 - 100 mfd electro

10 - BC547 transistors
1 - 555 timer
1 - 4024 counter
1 - 4514 decoder
40 - 1N914 diodes or more as needed

1 - 8 pin IC socket
1 - 14 pin IC socket
1 - 24 pin IC socket



PC board $6.60

Parts $16.20
Complete $20.80

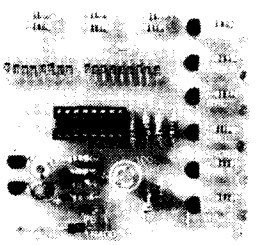
PEDESTRIAN CROSSING

12 - 1K
2 - 22K
1 - 39K
6 - 100K
2 - 220K

1 - 2.2 mfd
1 - 10 mfd
1 - 100 mfd

2 - 3mm Red LEDs
2 - 3mm Green LEDs
2 - 3mm Yellow LEDs
1 - 1N4002 diode
18 - 1N914 diodes
8 - BC547 transistors
1 - CD4017 IC

1 - 16 pin IC socket
1 - Push button



PC board $3.95

Parts $11.40
Complete $15.35

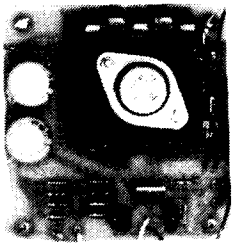
POWER SUPPLY

1 - 330R
3 - 1K
1 - 1K Mini-trim pot

2 - 100n greencap
1 - 10 mfd 25v pc electro
2 - 1000 mfd 25v pc electro

8 - 1N4002
3 - 5mm LEDs
1 - 7805 regulator
1 - 2N3055

2 - Nuts & bolts
1 - T03 Heatsink



PC board $3.60

Parts $10.35
Complete $13.95

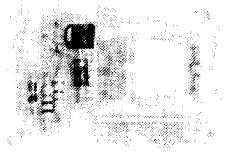
Extras
Fuse & fuse holder
transformer. 15v@2A
1K lin pot

REMOTE RELAY UNIT

1 - 4K7
1 - 10K

1 - 1N914 diode
1 - 1N4002 diode
1 - BC547 transistor

1 - 12v Mini DPDT relay



PC board $1.80

Parts $3.70
Complete $5.50

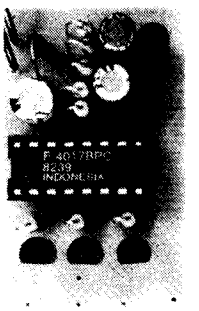
ROTATING LIGHT

3 - 1K
2 - 22K
1 - 39K
2 - 47K

1 - 1 mfd electro
1 - 10 mfd electro
1 - 100 mfd electro

1 - 1N4002 diode
1 - 1N914 diode
5 - BC547 transistors
1 - 4017 chip

1 - 16 pin IC socket



PC board $1.90

Parts $5.15
Complete $7.05

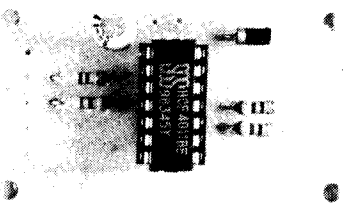
SEARCHLIGHT ADAPTOR

4 - 470R
6 - 100K

1 - 100 mfd electro

1 - 1N4002 diode
1 - 4011 quad NAND

1 - 14 pin IC socket



PC board $1.80

Parts $2.05
Complete $3.85

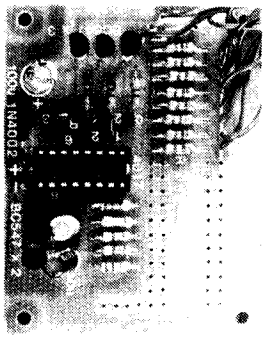
SHOP DISPLAY DRIVER

19 - 470R
3 - 4K7
2 - 22K
1 - 39K
2 - 47K

1 - 2.2mfd electro
1 - 10 mfd electro
1 - 100 mfd electro

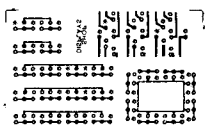
1 - 1N914 diode
3 - 1N4002 diodes
5 - BC547 transistors
1 - CD4017

1 - 16 pin IC socket



PC board $3.50 **Parts $6.70**
Complete $10.20

SHOP DISPLAYS



PC board $5.15

3mm RED LED ..... 16¢
3mm Green LED ..... 23¢
3mm Orange LED .... 28¢
3mm Yellow LED .... 28¢

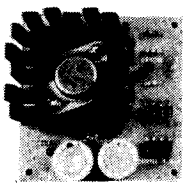
THROTTLE

2 - 39R
2 - 1K
1 - 1K pot

2 - 1000 mfd electro's

8 - 1N4002 diodes
1 - red LED
1 - BC547
1 - 2N3055

1 - T03 Minifin heatsink
2 - nuts & bolts
1 - DPDT Switch



PC board $3.15 **Parts $10.55**
Complete $13.70

TRAIN DETECTOR

5 - 330R
5 - 2K2
5 - 10K

5 - 10K minitrim

1 - 1N4002 diode
5 - 1N914 diode

5 - 5mm LEDs
5 - BC547 transistors
5 - MEL-12 photo-tran.

1 - 100 mfd electro

PC board $3.75 **Parts $11.40**
Complete $15.15

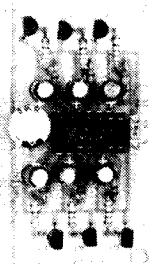
WARNING LAMP FLASHING UNIT

6 - 4k7
6 - 22k
6 - 100k
6 - 220k

6 - 10mfd 16v PC electros
1 - 100mfd 16v PC electro.

6 - 1N 914 (1N 4148) diodes
6 - BC 547 transistors
1 - 74c14 Hex Schmitt Trigger IC

1 - 14 pin IC socket



PC board $3.00 **Parts $6.80**
Complete $9.80

DEDICATED MICROCOMPUTER SYSTEM

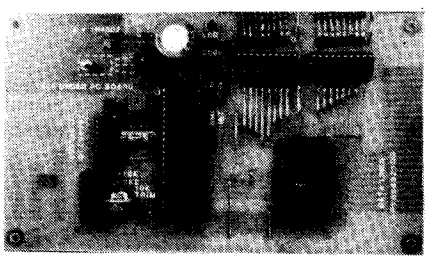
1 - 1K
1 - 2K2
6 - 10K

1 - 10K - 20K trimpot

1 - 100pf ceramic cap
5 - 100n monoblock caps
1 - 1 mfd electro
1 - 1000 mfd electro

4 - 1N4002 diodes
1 - red LED
1 - 7805
1 - CD4049†
1 - 74LS138
2 - 74LS273
1 - Z80 Microprocessor
1 - 2716 EPROM (programmed)

2 - 16 pin IC sockets
2 - 20 pin IC sockets
1 - 24 pin IC socket
1 - 40 pin IC socket
1 - length of tinned copper wire
1 - nut & bolt for regulator.
1 - push button

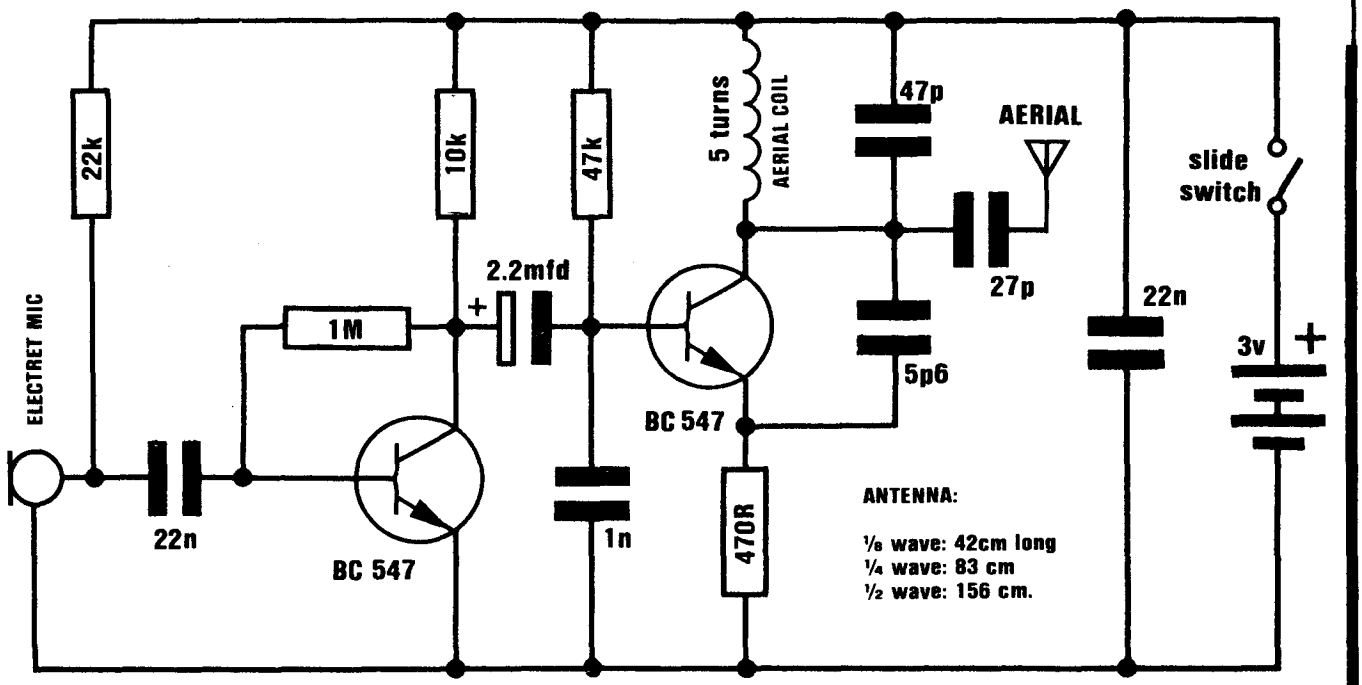


PC board $9.60 **Parts $35.35**
Complete $44.95

FM BUG

PC board $2.15
Parts $6.00
Complete $8.15

No Bugs with this BUG. A guaranteed performer using readily available parts.



COMPLETE FM BUG CIRCUIT

To be honest, this project was the first of our FM designs and although it worked extremely well (when compared to other units on the market) we have improved it out of sight, with the 'ANT' design.

FM BUG originally appeared in issue 11 of Talking Electronics Magazine and we have included it here because of the information it contains. All the features mentioned can be transferred directly to the cover project.

Corporate espionage is reaching new heights in sophistication. The latest information to be released shows the depths firms will go to pry into a rival firm's operations.

By using the latest in electronic bugging, they have stolen information, secrets and even formulas known only to the inventors themselves.

Take the example of one firm:

Leaks from top management level remained a mystery until, one day, a bug was discovered inside the Managing Director's office. Sitting prominently on his desk was a gift box of imported cigars!

Cleverly concealed in the lower part of the box was a miniature FM transmitter . . . all a gift from a phoney sales rep.

This is just one of the many bugging devices available on the eaves-dropping market. The range includes pen and pencil holders, trophies, framed pictures and office furniture with false bottom drawers.

These products are readily sold to fledgling companies, eager to nestle in on big brother's market.

And for a while these bugging devices worked. Few firms knew of their existence, and even less on how to sniff them out.

But that has all changed now. If a corporation suspects a leak at any level, they first thing they order is an investigation into security. Not only personnel, but information and electronic security.

Debugging has grown into big business. Most large security organisations have a section concentrating on electronic surveillance including bugging and debugging.

Everyone has been absolutely amazed at the performance of this bug.

They use scanners to detect hidden devices and can locate absolutely anything, anywhere, and on any frequency.

It was only after the firm above had commissioned a scan of the entire floor, that the cigar box was discovered. Its innocence had deceived everyone. And cost them a small fortune!

Bugging of this kind is completely illegal and we don't subscribe to this type of application at all.

PARTS

1 - 470R ¼watt
1 - 10k
1 - 22k
1 - 47k
1 - 1M

1 - 5.6pf ceramic = 5p6
1 - 22pf ceramic or 27pf or 33pf
1 - 47pf ceramic
1 - 1n ceramic = *1000pf or 102*
2 - 22n ceramic = .022 or 223

1 - 2.2mfd 16v or 25v PC electro

2 - BC 547 transistors (Not SGS type)

1 - mini slide switch spdt.

1 - electret microphone (insert)

2 - AAA cells

10cm tinned copper wire
2 - metres aerial wire

1 - FM BUG PC board

1 - Toothbrush case.

But the uses for our SUPER-SNOOP FM WIRELESS MICROPHONE can be harmless, helpful and a lot of fun.

Our unit is both compact and very sensitive and can be used to pick up even the faintest of conversations or noises and transmit them 20 or so metres to any FM receiver.

When you build the FM BUG you will see why we consider the design to be very clever. We have used only low priced components and they are all easy to obtain.

No air trimmer capacitor is required as the coil is squeezed slightly to obtain the desired frequency. This has allowed us to fit the bug into a tooth-brush case so that it can be carried around or placed on a shelf.

If it is set between two books it will be hidden from view or as a super-vision accessory it can be placed on a small child, etc. The transmitted signal will over-ride the background noise and the the output will be clean. If the child wanders beyond the range of the transmitter, the background noise will come up and signal that the tot is out of range.

As an added bonus, you can listen to the chatterings and squabbles as the children amuse themselves in the back yard.

It is also great for picking up the first signs of a child awakening from his afternoon sleep or it can be used as a HELP-WANTED indicator for a bed-ridden patient.

The great advantage of the bug is the absence of wires. And since it draws only about 5 - 10 milliamps, the pair of AAA cells will last for many months.
The success of this FM BUG is the use of TWO transistors in the circuit. To create a good design, like this, each transistor should be required to perform only one task. In any type of transmitter, there is a minimum of two tasks.

One is to amplify the signal from the microphone and the other is to provide a high frequency oscillator.

The amplified microphone signal is injected into the oscillator to modify its frequency and thus produce a FREQUENCY MODULATED oscillator. If an aerial is connected to the output of the oscillator, some of the energy will be radiated into the atmosphere.

To increase the output of our design, an RF amplifier would be needed but this gets into legal technicalities with maximum transmitting power.

It may be of interest to know that a record distance of 310 miles was achieved with a 350 micro-watt transmitter in the USA, some 15 years ago. This equates to an astounding ONE MILLION miles per watt!

In simple terms, an RF amplifier becomes a LINEAR amplifier. This can be seen as per the second transistor in the Polykit design as presented in issue 4.

We have opted for sensitivity and the first transistor is employed as a pre-amplifier. This will enable you to pick up very low-level sounds and transmit them about 20 to 50 metres.

MAKING THE OSCILLATOR COIL

The only critical component in the FM BUG is the oscillator coil. When I say critical, I am referring to its effect on the frequency. Its critical nature only means it must not be touched when the transmitter is in operation as this will detune the circuit completely.

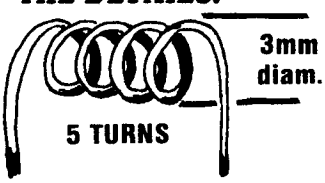
It is the only component which needs to be adjusted or aligned and we will cover its winding and formation in detail.

The oscillator coil is made out of tinned copper wire and does not need any insulation. This is not normal practice but since the coil is small and rigid, the turns are unable to touch each other and short-out.

The coil is made by winding the tinned copper wire over a medium-size phillips screw-driver. The gauge of wire, the diameter of the coil and the spacing between turns is not extremely important and it will be adjusted in the alignment stage. However when the project is fully aligned, it must not be touched at all.

Don't be over-worried at this stage. Just follow the size and shape as shown in the diagram and everything will come out right in the end.

THE DETAILS:



The coil has 5 turns. To be more specific, it has 5 loops of wire at the top and each end terminates at the PC board. The coil must be wound in a clock-wise direction to fit onto the board and if you make a mistake, rewind the coil in the opposite direction.

A pre-wound coil comes with the kits supplied by the magazine however you can make you own very easily in a few minutes.

Collect all the necessary components and lay them on the work bench ready for the next stage:

CONSTRUCTION

Construction is quite straight-forward as everything is mounted on the printed circuit board. The only point to watch is the height of some of the components. The capacitors and electrolytic must be folded over so that the board will fit into the case.

Positioning of the parts is not as critical as you think as the final frequency is adjusted by squeezing the coil together or stretching it apart.

However it is important to keep the component leads as short as possible and the soldering neat due to the high frequencies involved. The components must be soldered firmly to the board so that they do not move when the transmitter is being carried.

Even the poorest of soldering will work but who wants to see poor soldering on a project? Especially when it is housed in a clear perspex case.

The soldering may not affect the resulting frequency but poor layout of the components certainly will.

All the resistors must be pressed firmly against the PC board before soldering and the two transistors must be pushed so that they are shorter than the opening in the case.

Some BC 547 transistors will not work in the circuit. Maybe the frequency is too high. SGS BC 547 transitors did not work at all. The other two types: fBC 547 and Philips BC 547 worked perfectly.

All the small-value capacitors are ceramic as they are not critical in value and do not need to be high stability. But you must be careful when identifying them. It would be a very simple mistake to buy a 56pf instead of 5p6 because there is no difference in the size. 22n may be identified with 223 or 22n or .022. A capacitor marked 22k will be a 22pF cap and will not be suitable. The 1n capacitor may be marked 1n or .001 or 102. These are all the same value. The value 101 or 103 is NOT 1n so be careful, the caps may be about the same size. The rule is: don't use a capacitor unless its markings are clear and you are sure of the value.

The switch is mounted on the PC board with its three terminals fitted into the large holes.

Later, a square cut-out will be made in one half of the plastic case so that the slide of the switch protrudes through.

The final items to add to the board are the two AAA cells. These are available at Tandy stores and we have chosen them for slenderness so that they can be fitted side-by-side in the case. A small piece of tape will keep them together ready for connecting into circuit.

It is very difficult to solder to the zinc case but if you roughen the surface with a file and use a large, HOT, soldering iron, the job can be done very quickly. Use a piece of tinned copper wire to join the positive of one to the negative of the other. At the other end, solder longer lengths of wire so that they can be connected directly to the PC board. Make sure the positive terminal connects to the plus on the PC board.

AAA cells are also obtainable at photographic shops. The only alternative is an 'N' cell which is nearly as thin as an AAA cell but only half the length. If all this fails, you can use 2 AA cells in a long tooth-brush tube by connecting them end-to-end.

The terminal marked A on the board is the antenna output. For a frequency of 90MHz, the antenna should be 165cm long. This is classified as a half-wave antenna and provides one of the most effective radiators. If you find the antenna gets in the way you can opt for a quarter-wave antenna and this will be 83cm long. If you only require to transmit 10 to 20 metres the antenna can be as short as 42cm or even as low as 5 or 10 cm.

The most suitable length will depend on the sensitivity of the FM radio used to pick up the signal and the obstructions between the transmitter and receiver. It will be a good experiment for you to 'cut' your own antenna and determine which is the most suitable for your application.

HOW THE CIRCUIT WORKS

The circuit consists of two separate stages. The first is an audio pre-amplifier and the second is a 90MHz oscillator.

The first stage is very simple to explain. It is a self-biasing common-emitter amplifier capable of amplifying minute signals picked up by the electret microphone. It delivers these to the oscillator stage. The amplification of the first stage is about 100 and it only operates at audio frequencies. The 22n capacitor isolates the microphone from the base voltage of the transistor and allows only AC signals to pass through. The transistor is automatically biased via the 1M resistor which is fed from the voltage appearing at the collector. This is a simple yet very effective circuit. The output from the transistor passes through a 2.2mfd electrolytic. This value is not critical as its sole purpose is to couple the two stages.

The 47k, 1n, 470R and 22n components are not critical either. So, what are the critical components in this circuit?

The critical components are the coil and 47pF capacitor. These determine the frequency at which the bug will transmit. In addition, the effective capacitance of the transistor plays a deciding factor in the resulting frequency.

This stage is basically a free-running 90MHz oscillator in which the feedback path is the 5p6 capacitor.

When the circuit is turned on, a pulse of electricity passes through the collector-emitter circuit and this also includes the parallel tuned circuit made up of the oscillator coil and the 47pf capacitor. This pulse of electricity is due to the transistor being turned on via the 47k resistor in the base circuit.

When ever energy is injected into a tuned circuit, the energy is firstly absorbed by the capacitor. The electricity will then flow out to the coil where it is converted to magnetic flux. The magnetic flux will cut the turns of wire in the coil and produce current and voltage which will be passed to the capacitor.

In theory, this current will flow back and forth indefinitely, however in practice, there are a number of losses which will cause the oscillations to die down fairly quickly.

If a feedback circuit is provided for the stage, the natural RESONANT frequency of the coil/capacitor combination will be maintained. The 5p6 provides this feedback path and keeps the transistor oscillating.

The 5p6 feeds a small sample of the voltage appearing at the collector, to the emitter and modifies the emitter voltage. The transistor sees its base-to-emitter voltage altering in harmony with the resonant frequency of the tuned circuit and turns the collector on and off at the same frequency.

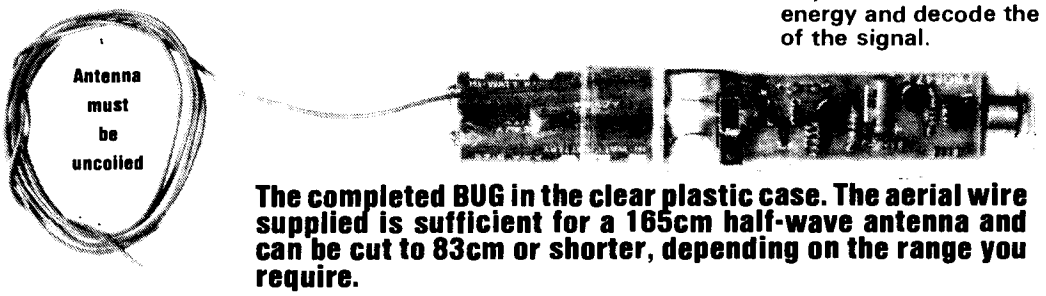
Thus there is a degree of stability in the oscillator frequency.

The actual frequency of the stage is dependent upon the total capacitance of the circuit and this includes all the other components to a minor extent.

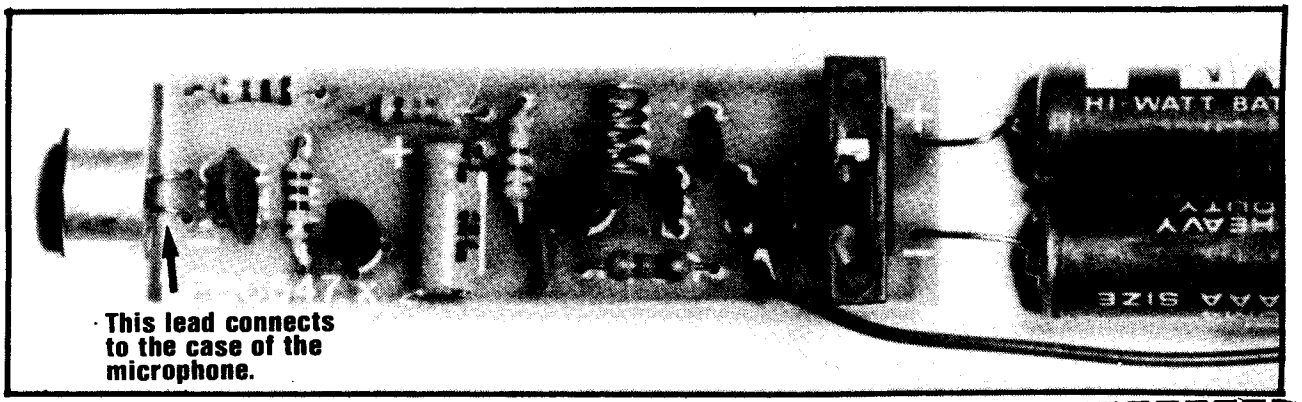
Once the basic frequency of 90MHz is set,the variations in frequency are produced by the changes in effective capacitance of the transistor. This occurs when its base voltage is increased and reduced. The electret microphone picks up the sound waves which are amplified by the first transistor and the resulting frequency is passed to the base of Q2 via the 2.2mfd electrolytic.

This alters the gain of the transistor and changes its internal capacitance. This junction capacitance modifies the oscillator with a frequency equal to the sound entering the microphone thus FREQUENCY MODULATING the circuit. A short length of antenna wire is connected to the collector of the oscillator via a coupling capacitor and some of the energy of the circuit will be radiated to the surroundings.

Any FM receiver will pick up this energy and decode the audio portion of the signal.



The completed BUG in the clear plastic case. The aerial wire supplied is sufficient for a 165cm half-wave antenna and can be cut to 83cm or shorter, depending on the range you require.



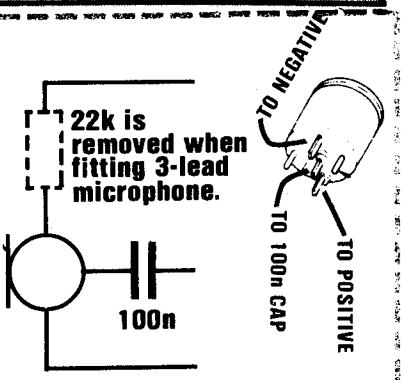
This lead connects to the case of the microphone.

3-LEADED ELECTRET MIC:

If you have a 3-leaded electret microphone, it can be used in the circuit provided a simple modification is made. Three-leaded mics have internal dropping resistors and thus the 22k resistor in our circuit is not needed.

All microphones are polarity sensitive and must be inserted into the circuit around the correct way. See the accompanying diagram.

The 2 holes in the PC take the negative pin and the output pin. A jumper wire is taken from the positive pin on the mic to the positive line on the PC, at a point where the 22k meets the positive rail.



SETTING UP THE TRANSMITTER

When the FM BUG is complete, checked and ready for insertion into its case, there is one slight adjustment which must be made to align it to the correct frequency.

As we have said, the only critical component is the oscillator coil. It is the only item which is adjustable.

Since we are working with a very high freqency, the proximity of your hand or even a metal screw-driver will tend to de-tune the oscillator appreciably.

For this reason you must use a plastic aligning stick to make the adjustment. Any piece of plastic will do. A knitting needle, pen barrel or plastic stirring stick can be used.

Place the bug about a metre from the FM radio and switch both units on. Tune the radio to an unused portion of the band and use the alignment stick to push the turns of the coil together. Make sure none of the turns touch each other as this will short out the operation of the oscillator.

All of a sudden you will hear the background noise diminish and you may even get feed back. This amount of adjustment is sufficient. Place the BUG in its case and tape up the two halves.

The fine tuning between radio and transmitter is done on the radio. Peak the reception and move the BUG further away. Peak the fine tune again and move the BUG into another part of the house and see how far it will transmit.

IF THE BUG FAILS

If the bug fails to operate, you have a problem. Simple digital tests will not fix it nor will ordinary audio procedures. The frequency at which the BUG operates is too high.

You have to use a new method called comparison.

This involves the comparing of a unit which works, with the faulty unit.

This means it is ideal for a group of constructors to build a number of units and compare one against the other.

This will not be possible with individual constructors and they will have to adapt this fault-finding section.

The first fact you have to establish is the correct operation of the FM receiver.

If you have another BUG and it is capable of transmitting through the radio you know the radio is tuned to the correct frequency. Otherwise you will have to double-check the tuning of the dial and make sure the radio is switched to the correct setting.

The next stage is to determine if the BUG is functioning AT ALL. The only voltage measurements you can make are across the collector-emitter terminals of the first transistor (1v to 1.5v) and across the collector-emitter terminals of the second transistor (1.3v to 1.5v) These values won't tell you much, except that the battery voltage is reaching the component.

Tune the radio to about 90MHz and lay the radio antenna very close to the antenna of the BUG. Switch the BUG on and off via the slide switch. You should hear a click in the radio if the BUG is on a frequency NEAR 90MHz. Move the turns of the aerial coil together or apart with a plastic stick as you switch the unit ON and OFF.

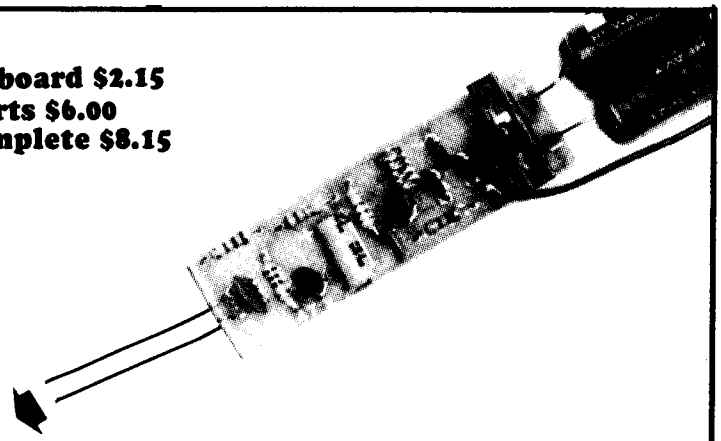
If a click is heard but no feed-back, the oscillator will be operating but not the pre-amp stage. This could be due to the electret microphone being around the wrong way, the transistor around the wrong way, a missing component or an open 2.2mfd electro.

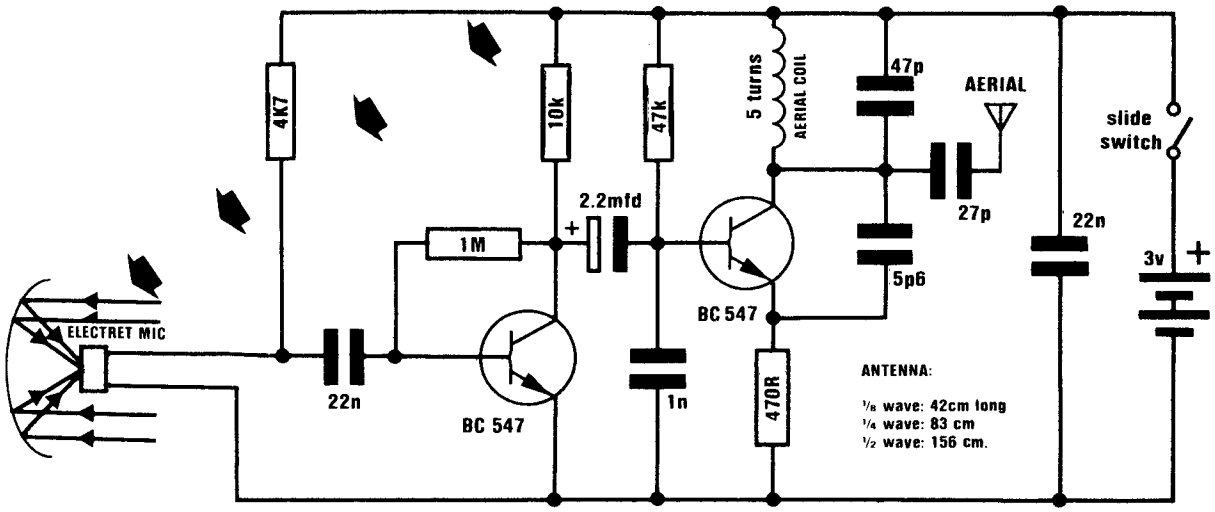
If the fault cannot be located, compare your unit with a friend's. You may have made a solder bridge, connected the batteries around the wrong way, made the coil too big or used the wrong value capacitor for one of the values.

If all this fails, put the unit aside and start again. This time buy a complete kit and see how much more success you have.

BIG EAR

PC board $2.15
Parts $6.00
Complete $8.15





The BIG EAR project is made on the FM BUG PC board. But it could just as easily be made on the ANT board. The only alterations are the 4k7 load resistor for the microphone and the mounting of the microphone at the focus of a parabolic dish so that the sound-gathering capability is increased considerably.

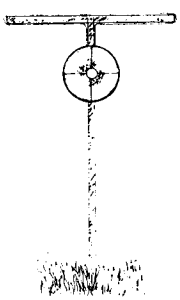
The FM bug in the previous article was originally presented in issue 11 of Talking Electronics and was one of the magazines successes. Not only did it out-perform all the other kit-models on the market, but operated better than one fully built model costing as much as $49.95!

The only trouble that was experienced with some of the kits was due to the poor quality of a batch of SGS transistors. One batch failed to work in the RF stage and it was possibly due to the requirement to work at 100MHz.

It seems incredible that a transistor of this type would fail but we had 3 reports that this was the case.

If you are using transistors from the junk-box, and not getting the performance as stated in the articles, you should try replacing the RF transistor. You will be amazed at the difference it makes.

We have sold the BUG in bulk lots to schools as a first-year project. If you are not lucky enough to be in one of these schools, we suggest you look into building our super-sensitive version. It is called BIG EAR.



The BIG EAR mounted on a 3M pole with the sound-collecting reflecting dish.

PARTS LIST

1 - 470R ¼ watt
1 - 4k7
1 - 10k
1 - 47k
1 - 1M

1 - 5.6pf ceramic
1 - 22pf or 27pf or 33pf ceramic
1 - 47pf ceramic
1 - 1n ceramic
2 - 22n ceramic
1 - 2,2u 16v electrolytic

2 - BC 547 transistors
1 - mini slide switch
1 - electret microphone

2 - AAA cells
2 metres aerial wire

FM BUG PC BOARD

Basically our BIG EAR is the FM BUG circuit as presented in issue 11 with one change to the circuit and one improvement to the layout.

Both these two improve the audio pick-up to a level where it is better than the human ear!

Everyone knows the effect of cupping your hands behind your ears to improve the reflector and thus increase the sound pick-up. The BIG EAR works in the same way.

A parabolic dish behind the microphone serves to reflect microscopic sounds to the focal point or FOCUS of the dish and this is where the electret microphone is situated.

Thus the capture area for the microphone is increased many times, making those elusive, minute sounds come into range.

We have received four requests along these same lines and I think it has wide possibilities.

One reader has a very large property and the front gate is about 250 metres from the house.

It seems a number of cars turn and/or park in front of the gate during the evening hours and it was needed to know if any of the passengers entered the property.

The FM BUG was mounted atop a 3 metre pole and arranged with a dipole antenna directed towards the house.

Two nicads and a set of solar cells were fitted to the top of the pole to power the unit and also charge the batteries. This provided power for continuous day/night operation.

This proved to be a great idea as the FM radio could be turned on whenever a threatening set of headlights was seen at the front gates.

The performance was as good as a land-line system and at only a fraction of the cost.

A small dish reflector concentrated the sounds so that the slightest whispers could be detected. This type of arrangement is trouble-free and requires no maintenance. It could be used in paddocks, out–buildings or even your neighbours house to detect any prowlers etc.

The same set-up would be a good idea for a security organisation. They could place a number of these units around a building and by tuning in an FM receiver, monitor each and every part of the building without having to go the high cost of wiring each unit.

Idea number two came from a reader requiring to tape bird calls and the general sounds in his garden.

He did not explain his reason for this but was very pleased with the clarity and range of the bug when transmitting back to his lounge room. From there he could monitor the sounds and tape them directly from the receiver.

Idea number three came from a piano player who wanted to tape his practicing. The piano was remote from his recorder and the BUG proved to be an ideal transmitting medium.

Again the clarity and performance was stated to be be well beyond a similar low-priced kit and even better than a $49.95 unit which was purchased in built-up form.

He was so impressed with the BUG that he bought another.

● ○ ● ○ ● ○ ● ○ ● ○

Picks up sounds you never thought existed!

● ○ ● ○ ● ○ ● ○ ● ○

The story from reader number four we cannot print. He used his bug to tape his friends!

So, you can see, the ideas are endless for such a compact unit and if you want to listen to something beyond ear-shot, this improved design is the answer.

Gino thought of it first. He added a reflector to the microphone on his BUG and reduced the load resistor to the electret microphone so that it would have increased sensitivity.

The idea actually came from a toy he bought a few years ago. It consisted of a long trumpet or cone containing a microphone. This fed into a two-transistor amplifier and powered a pair of headphones.

With the toy long since defunct, he used the tumpet to house the electret microphone and placed the BUG circuitry in the cavity left by the transistor amplifier.

The idea worked so well that he thought it would be a good extension for the FM BUG. So here it is.

The parabolic reflector in our design can be made from an aluminium pie dish. These can be purchased in packs of three from the super market or removed from your mum's hot pie!

The parabolic shape is created by pressing the dish into a bowl and rubbing with a wooden spoon. The formation needed is a fairly shallow parabola and without being too technical or critical, almost any curved shape will be acceptable.

Solder two long tinned copper wire leads to the microphone and attach the ends to the PC board. This will enable the mocrophone to be positioned at the focus of the dish to achieve maximum sensitivity.

The other improvement to the circuit is to reduce the load resistor to the electret microphone.

This will produce a slightly higher voltage across the microphone and increase the current through it. Inside the microphone is a field effect transistor with the gate lead connected to one plate of a capacitor. That's why only two leads emerge from the microphone.

The other plate of the capacitor is made of a very thin membrane which is a conducting plastic material.

When the sound waves enter the microphone they vibrate the thin membrane and the charge sitting on the two plates interact with each other. This modifies the charge on the gate lead of the FET. This is amplified by the FET and fed to the first BC 547 in the circuit.

By increasing the voltage across the microphone, the output swing will increase for the same sound level and thus fainter sounds will be able to be detected.

Obviously there is a limit to this and using a 4k7 resistor with a 3v supply will be about optimum.

The only other way to increase the sensitivity and range is to increase the supply voltage. By increasing this to 9v, an increased transmitting distance will be achieved with a corresponding increase in sensitivity.

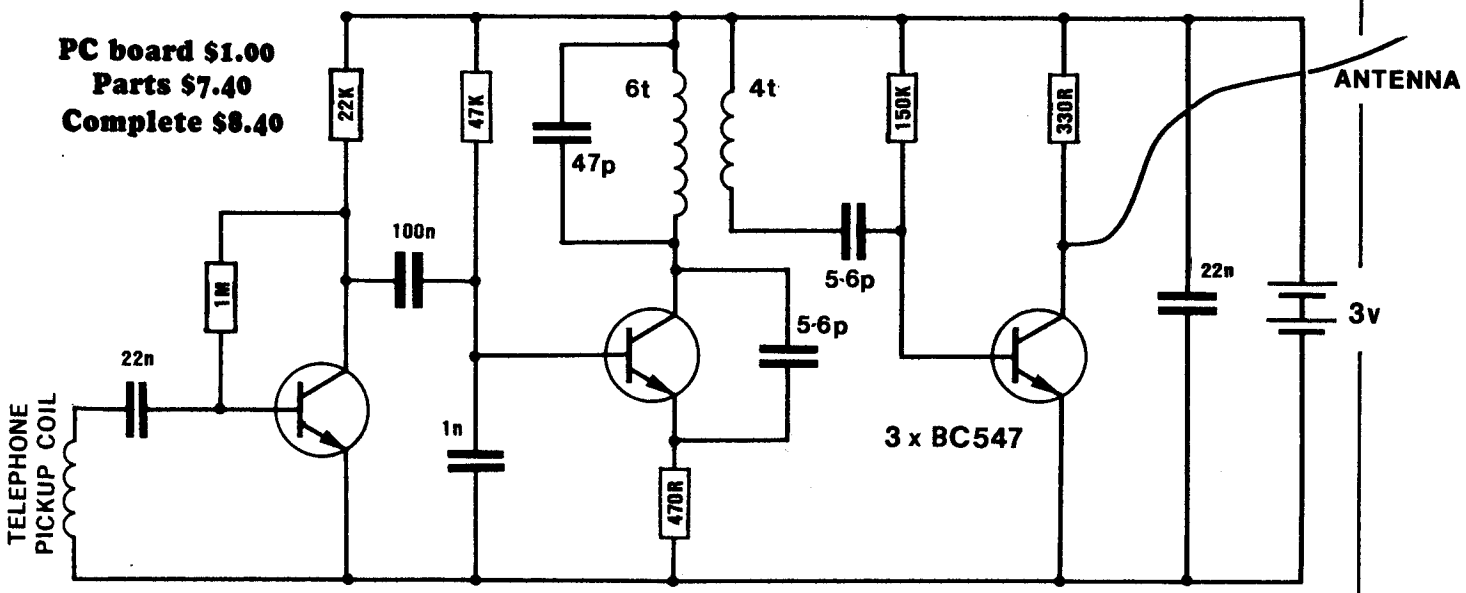
Try experimenting with various values for each of the components in the circuit to determine the effect of each component on the overall performance.

High Frequency transmission is a very interesting field and one which could see a lot more use of the band.

A TELEPHONE BUG . . .

THE TELEMITE

PC board $1.00
Parts $7.40
Complete $8.40



TELEMITE FM TRANSMITTER

This bug is basically our cover project with the front end modified to take a pick-up coil.

It is a very simple modification and is indispensable for extending the telephone system.

Suppose you are working in a part of the house or workshop that is away from the phone and awaiting an important call.

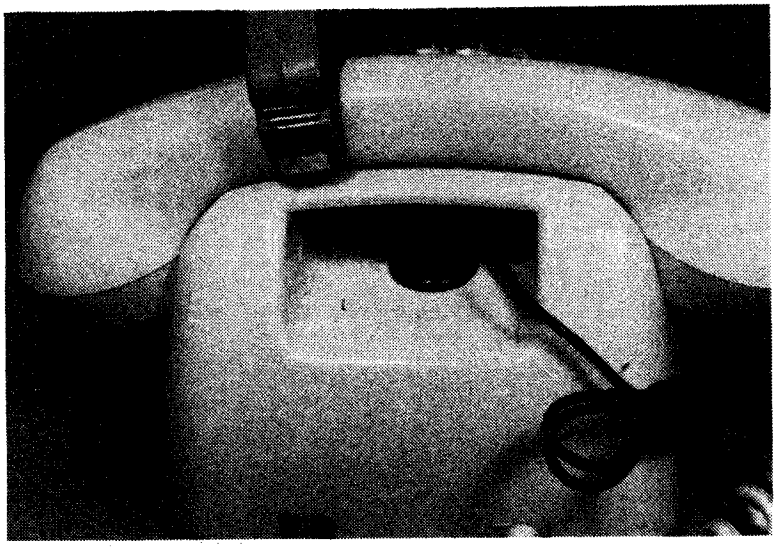
All you have to do is place the Telemite near the phone, with the pick-up coil in place and you will be able to pick up the frequency of the 'ring-tone.' The pulses you will detect will be equivalent to the bell frequency but you will not be able to pick up the tone as this is generated in the gongs.

An advantage of pick-up coil means that a two-way conversation can be picked up with equal volume from each party.

When the phone is answered, the inductive coil picks up the stray flux from the microphone transformer and this is amplified by the pre-amp and injected into the oscillator stage with a level approx equal to that of the electret microphone.

This will allow a second party to listen in on the conversation without crowding around the handset.

Unfortunately some phones, such as hand-held models, do not have a mechanical bell or microphone transformer and cannot be used in this set up.



The Pick-up coil positioned on the rear of the phone.

When using an inductive pick-up coil, the bug does not transmit audible sounds while it is waiting for the phone to ring and this means the output is clean until the ring signal is detected. In this way you do not have to put up with any annoying background noise.

The positioning of the pick-up coil is fairly critical on the back of the phone and a small amount of experimenting will be needed to obtain peak performance.

The best way of doing this is to take the phone off the hook and listen for dial tone. Next tune in an FM radio and pick up the

PARTS LIST

1 - 330R
1 - 470R
1 - 10k
1 - 22k
2 - 5p6 ceramic
1 - 47p ceramic
1 - 1n ceramic
2 - 22n ceramic
1 - 100n monoblock
3 - BC 547 transistors
10cm tinned copper wire .71mm diam
10cm enamelled wire .61mm diam
2 - AAA cells
1 - SPDT slide switch
2metres hook-up flex for antenna
1 - telephone pick-up coil
1 - 47k
1 - 150k
1 - 1M

1 - PC board 'ANT'

dial tone on the speaker. Don't place the radio too near or feedback will be created via the mouthpiece of the phone.

We found the best place for the coil was in the finger-grip of the case, at the back of the phone, as shown in the photos.

This is a good place as the coil can be lightly glued in position and the lead run down the back of the phone so that it is not too obvious. We found the suction cup could fall of the phone if not glued in position.

If possible, the screened lead should be kept as short as possible and if you want to provide a permanent connection, it can be soldered directly to the input line of the PC board.

The principle of operation is identical to the 'ANT', except for the front end.

The pick-up coil consists of thousands of turns of fine wire and when a magnetic flux passes through the coil, a small voltage is produced.

This voltage is about 1mV to 5mV in our case and when amplified by the pre-amplifier, the transmitter will broadcast to a nearby FM radio.

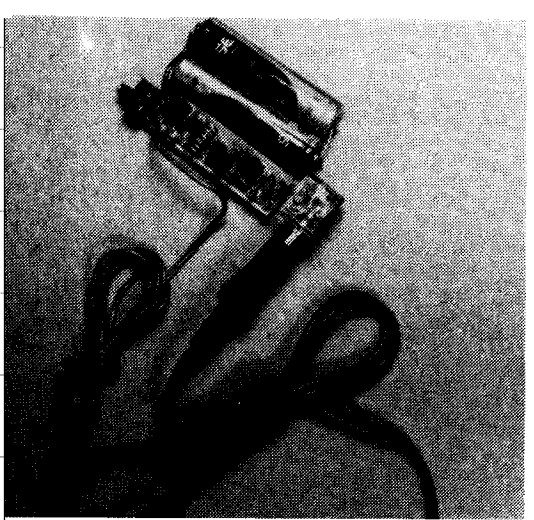
The pick up coil is termed a medium to low impedance device and because of the high gain of the pre-amp stage, the leads to the coil must be screened.

The outside or earth lead connects to the negative rail and the inner 'live' lead connects to the input capacitor. This arrangement prevents any hum being picked up and makes the front end silent.

There is nothing special about the pick-up coil and we have tried different coils with varying results.

Providing the coil has a sufficient number of turns, and a centre iron core to concentrate the flux, it will work. There is no way of knowing how many turns are present on a particular coil but a simple approach is to measure the resistance and if it is in the range 250R to 400R, chances are it will work.

All the rest of the details on construction etc have been covered in the other articles and if you want to add a bug to your phone, this circuit will be for you.



....cont. from P. 11.

MORE TIPS ON FIXING THE PROJECTS:

Before we go any further, let's point out that these notes apply only to those kits built on PC boards and with parts as supplied by Talking Electronics. The quality and size of all items has been pre-checked and a sample kit has been built and tested. It is highly unlikely to get a faulty part but if you use old parts from the junk-box, you run a high risk!

The frequency of operation of these FM circuits is such that Matrix board or hand-wired models using a different layout may not work as you could introduce a layout fault that could not be located via our simple procedure and no amount of fault-finding will locate it.

It will fall into a design-fault category and will require the assistance of an experienced electronics person.

In addition, the use of large components such as ½watt resistors may be sufficient to change the transmitting frequency and shift it off the band; or the capacitance of the large components may kill the oscillator completely and it will fail to transmit.

Other factors, such as using two cells (as shown in the photos) are also important as the circuit as a whole determines the frequency of oscillation.

Only after testing, can various parts of the circuit be modified and if the performance stays the same, the mods can remain.

The fault finding section and How the Circuit Works section in each article is very comprehensive and should be read in conjunction with these notes.

We cannot stress too strongly, the need to go over the board again and again, looking for poor soldering joints and how each part has been placed.

Most of the time it will be a very simple mistake and you shouldn't get too deeply involved before exploring the simple possibilities.

It's very important to know which parts of a circuit are most critical. This way you will know where to concentrate your efforts. In our case it's the oscillator stage.

It is so critical that moving the turns of the oscillator coil a distance equal to the thickness of a few sheets of paper will shift the frequency off the present wavelength, and you will have to re-tune the radio.

In fact the frequency can be shifted across the entire band by expanding the turns a relatively small amount.

There is also a second factor to bear in mind. If you spread the turns too much the oscillator will drop out completely. This is due to the energy from the coil not being sufficient to keep the tuned circuit oscillating.

So there are limits of operation and you must keep within them for the circuits to perform as brilliantly as our prototypes.

Not only is the oscillator stage critical as far as frequency is concerned, but also critical to **LOADING.**

Loading is the term given to the amount of signal that can be 'picked off' or taken from a stage. If you load an oscillator too much it will die. And this is to be avoided at all costs.

In any oscillator circuit part of the signal is fed back to the input to keep it operating. This is called FEEDBACK. Generally it is only about 5% to 10% and is not taken into account in our discussion.

If we tap into the oscillator circuit and pick off a sample of the waveform, the circuit becomes loaded and the amplitude of the wave is reduced. If we pick off more of the signal, the waveform reduces to a point where the amplitude of the feedback signal is not enough to keep the circuit operating. At this point the circuit dies.

When a circuit is operating at 100MHz or so, the mere presence of a metal object near the oscillating components will be enough to load the circuit.

This is due to the air surrounding the circuit being excited by the high frequency and as you move closer to the coil, it will impart some of its energy to the screwdriver or finger or other conducting object and the frequency will either drift or the amplitude will reduce sufficiently to kill the stage.

That's why it is impossible to be working on the transmitter and be transmitting at the same time.

Things like jumper leads and probes will act as an antenna and if they are connected to active parts of the circuit, they will draw off a lot of energy and kill the circuit. They must be removed if you expect to get transmission.

When parts are being tested or replaced, they must be soldered in position exactly as per the original design as the frequency is so high that they will act as radiators if left with long leads!

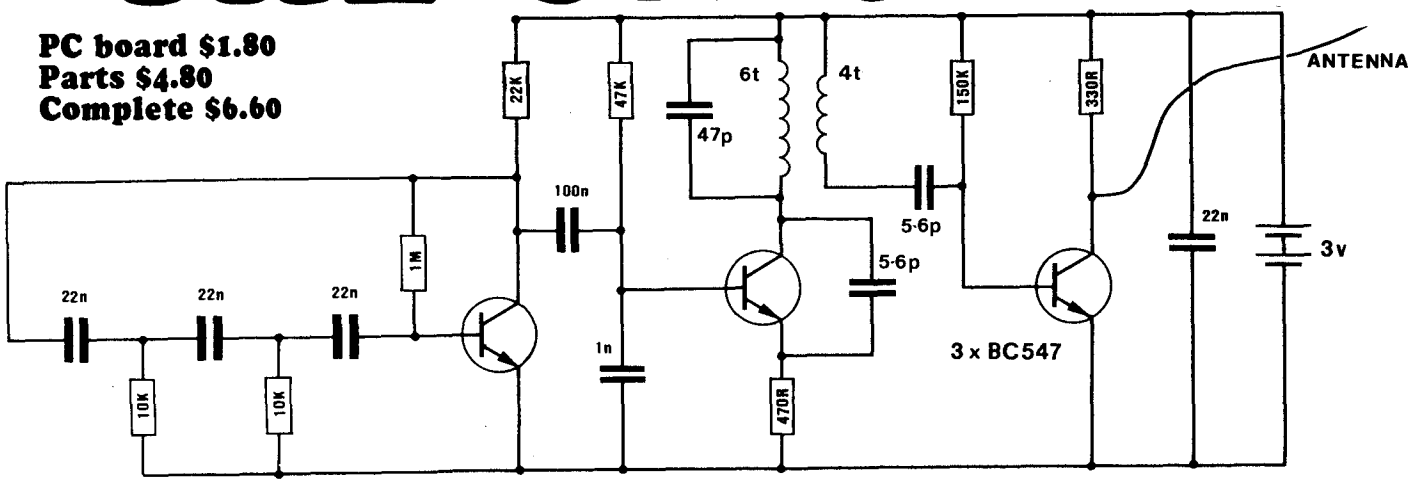
Similarly we don't recommend the use of any other types of components such as mica capacitors, half-watt resistors, unbranded transistors or different layouts as you may introduce new faults that cannot be easily rectified.

Actually we could go on for a whole book, describing the 'ins' and 'outs' of servicing. But space has forced me to stop. Don't worry, I'll have more to say in the next book and also in the pages of Talking Electronics magazine.

FOX HUNT . . .

THE CRICKET

PC board $1.80
Parts $4.80
Complete $6.60



CRICKET CIRCUIT DIAGRAM

This project is used in conjunction with a portable FM radio to create a hunting game called HUNT THE TRANSMITTER or FOX HUNT.

The object of the game is to hide the Cricket and for your partner to attempt to locate it with the aid of an FM receiver.

This means you are using the FM radio as a direction finder and if the range of the Cricket is short, you will be able to encircle it with the radio and eventually pinpoint its location.

We have called the project CRICKET on account of the tone it produces and although it may not have the same sound as a real cricket, it's the closest comparison we could think of.

The circuit is identical to the cover project except the electret microphone is not used. But 2 extra resistors and 2 capacitors are added to create a phase-shift oscillator front end.

We have found this circuit to be extremely reliable and it produces a very pleasing sine wave.

The operation of the phase-shift section is fairly difficult to explain and the simplest approach is to note that the 1M base bias resistor turns the transistor ON and this action injects a pulse into the 22n capacitor connected to the collector of the transistor.

The length of time taken for the pulse to reach the base is such that it is exactly 180° out-of-phase with the collector waveform and this is how the circuit determines the frequency.

The remainder of the circuit is identical to the 'ANT' and you should refer to the construction notes for assembly.

You can build the Cricket on either the 'ANT' board or the CRICKET board. The Cricket PC is specially designed for the job and will take all the components including the 4 extra items at the front end. These are identified on the board as 10k, 10k 22n and 22n as shown on the artwork below.

But you can also build the circuit on the 'ANT' board by adding the extra parts as shown in the photos. They are mounted partly on the board and partly off the board and by cutting the leads very short, they will occupy little more space than the electret mic and load resistor.

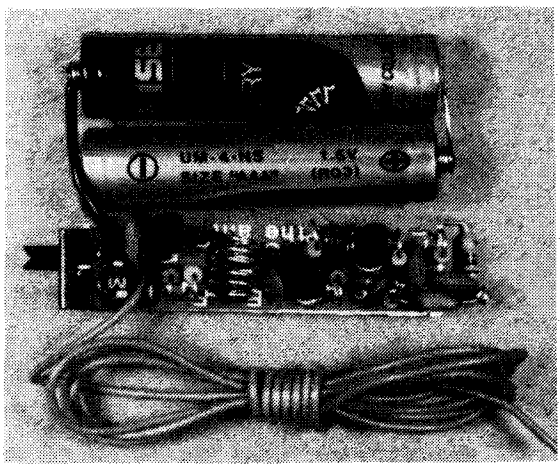
Using the ANT board is cheaper because of the huge quantity we ordered and we are passing this saving on to you. The 4 extra parts are quite easy to add and it'll be good experience working out how to fit them.

The only thing left is to build it and try its range. The antenna can be coiled or cut short to reduce the range and I hope you have fun tracking it down!

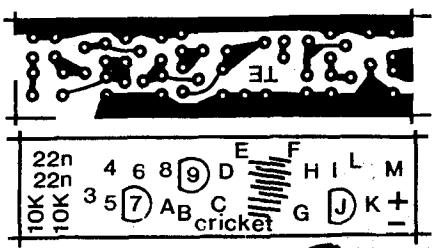
PARTS LIST

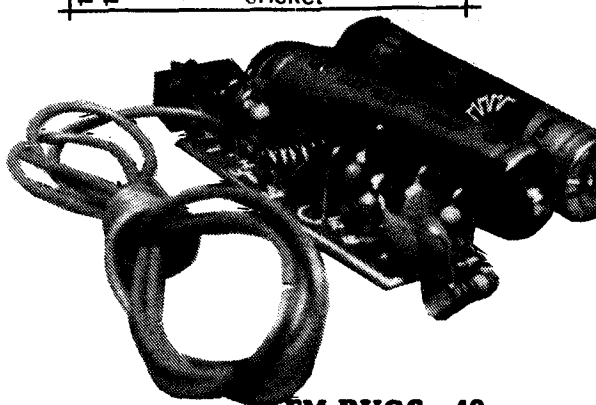
1 - 330R
1 - 470R
2 - 10k
2 - 22k
1 - 47k
1 - 150k
1 - 1M
2 - 5p6 ceramic
1 - 47p ceramic
1 - 1n ceramic
4 - 22n ceramic
1 - 100n monoblock
3 - BC 547 transistors
10cm tinned copper wire .71mm diam
10cm enamelled wire .61mm diam
2 - AAA cells
1 - SPDT slide switch
2metres hook-up flex for antenna

1 PC board 'CRICKET'



Our prototype was constructed on an 'ANT' PC board but the kit comes with a CRICKET PC board on which all the parts will fit.



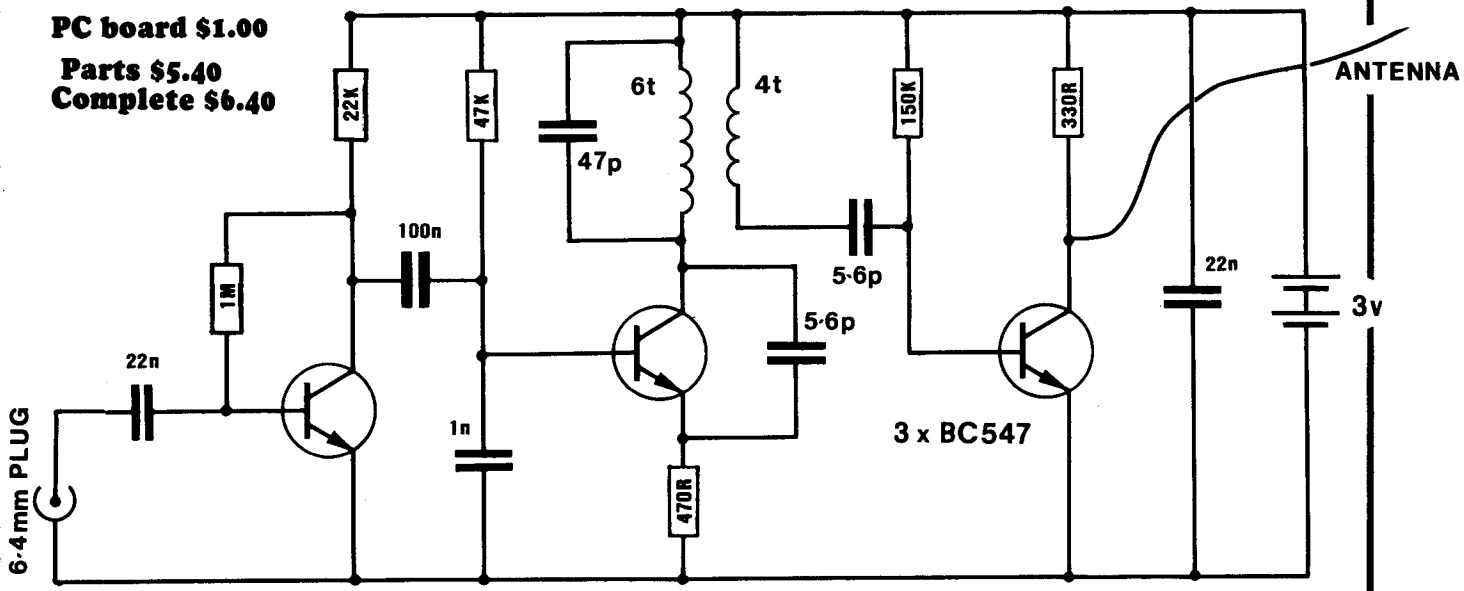


GUITAR BUG. . .

THE 'BEETLE'

PC board $1.00

Parts $5.40
Complete $6.40



BEETLE CIRCUIT

I can't see the connection between the function of this project and its name. But Ross suggested the name and everyone else thought it appropriate.

If you're into music, and especially guitars, this project is for you.

It is designed to replace the coily-cords between guitar and amplifier so that you have complete freedom when performing.

The photo shows a 6.4mm plug connected to the 'ANT' board via a short length of screened lead and this was a quick arrangement for the photographic session.

But this is not the ideal arrangement. Ideally I suggest mounting the board and batteries in a small jiffy box, type UB 5, making sure you get one with a plastic lid to avoid the earthing effects anything metal.

Into the side of the jiffy box a hole is drilled and it is enlarged with a tapered reamer so that a 6.4mm plug can be screwed into the hole.

Next make a slot for the slide switch and add a short length of tinned copper wire to act as an antenna. The completed project can then be plugged into the output socket of a guitar.

Obviously you are not limited to a guitar and the output of a cassette or mini organ could be coupled to the transmitter, providing you use the correct size connector.

The transmitter requires only about 2mV to 10mV at the input to give full output and if overloading is experienced, a series input resistor can be added to the live line.

It is fairly obvious to see that the guitar project is identical to the phone bug and both use the 'ANT' project for the electronics.

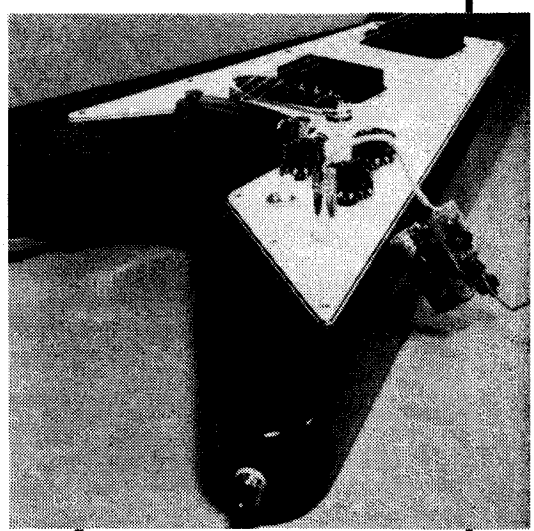
When it comes to construction, the notes on the ANT will give you a step-by-step guide and the only items to be left off the board are the electret mic and its load resistor.

The antenna can be as short as 5 or 10cm and if you require only a short distance for transmission, it can be placed along the inside edge of the box.

The only other thing to remember is to turn the unit off when not in use. Bob's suggestion is to use a stereo plug and jack, and switch the negative line via the jack. This way the transmitter automatically turns off when the plug is removed. Before doing this you will have to make sure the socket can be replaced with a stereo version on the guitar.

The negative terminal of the battery is connected to the middle section of the plug and the earth rail on the PC board is taken to the main shank of the plug. Finally the tip connects to the 'live' line.

The main and middle tabs of the socket are connected together and then the socket is wired exactly the same as the one it replaces.



The 'BEETLE' connected to Ken's guitar. Use a UB 5 jiffy box with plastic lid to house it.

See the parts list for the 'ANT', minus the electret mic and 22k.
PLUS:
1 - 6.4mm phone plug

ALL RESISTORS 4¢

☐ 1R	☐ 2k2	☐ 680k
☐ 2R2	☐ 2k7	☐ 820k
☐ 10R	☐ 3k3	☐ 1M
☐ 12R	☐ 3k9	☐ 1M2
☐ 15R	☐ 4k7	☐ 1M5
☐ 18R	☐ 5k6	☐ 2M2
☐ 22R	☐ 6k8	☐ 2M7
☐ 27R	☐ 8k2	☐ 3M3
☐ 33R	☐ 10k	☐ 3M9
☐ 39R	☐ 12k	☐ 4M7
☐ 47R	☐ 15k	☐ 10M
☐ 56R	☐ 18k	
☐ 68R	☐ 22k	
☐ 82R	☐ 27k	
☐ 100R	☐ 33k	
☐ 120R	☐ 39k	
☐ 150R	☐ 47k	
☐ 180R	☐ 56k	
☐ 220R	☐ 68k	
☐ 270R	☐ 82k	
☐ 330R	☐ 100k	
☐ 390R	☐ 120k	
☐ 470R	☐ 150k	
☐ 560R	☐ 180k	
☐ 680R	☐ 220k	
☐ 820R	☐ 270k	
☐ 1k	☐ 330k	
☐ 1k2	☐ 390k	
☐ 1k5	☐ 470k	
☐ 1k8	☐ 560k	

MINI TRIMPOTS 45¢

CAPACITORS

5p6	14c
27p	14c
47p	14c
100p	14c
220p	14c
330p	14c
1n	25c
2n2	25c
3n3	25c
3n9	25c
4n7	25c
6n8	25c
10n	25c
22n	25c
39n	25c
47n	28c
100n	28c

ELECTROLYTICS

1u 63v	27c
2u2 16v	27c
3u3 16v	27c
4u7 16v	27c
10u 16v	27c
22u 16v	27c
47u 16v	30c
100u 16v	45c
220u 25v	60c
220u 63v	75c
470u 25v	70c
1000u 25v	85c
1000u 63v	1.70
2200u 25v	2.00

IC'c TTL:

7400	70c
74LS04	70c
74LS11	70c
7420	95c
7473	1.10
7476	1.10
74LS93	1.20
74123	1.30
74LS138	1.50
74LS273	2.25
74LS367	1.25
74LS373	2.25

CMOS

4001	70c
4011	70c
4013	99c
4015	1.30
4017	1.50
4020	1.80
4024	1.10
4026	2.60
4040	1.80
4046	2.10
4047	2.10
4049	1.50
4051	1.98
4060	1.70
4069	80c
4071	75c
5410	2.10
4511	2.10
4514	5.60
4518	1.98
40085 or 74C85	2.95
74C14 or 40106	1.25
74C922	9.50
74C923	10.50
74C926	8.75

LINEAR

LM 380	2.80
LM 383 or TDA 2002	3.00
741	99c
555	60c

MICRO IC's

8255	7.50
2102	2.75
6116 (58725)	7.00
2732	7.90
Z-80A	6.50
TEC MONitor ROM	12.00
Microcomp-1 MONitor ROM	12.00
PRINT-2 ROM	10.00
Dedicated MICRO ROM	10.00

VOLTAGE REGULATORS

7805	1.10
7905	1.20
7812	1.10
7815	1.10
7915	1.20
7824	1.10

IC SOCKETS

8 pin	30c
14 pin	40c
16 pin	45c
18 pin	45c
20 pin	50c
24 pin	65c
28 pin	75c
40 pin	95c

DIP HEADERS + WIRE WRAP

16 pin dip header	1.80
24 pin dip header	3.50
24 pin wire wrap	2.95
40 pin wire wrap	4.95

SEMICONDUCTORS

1N 914	8c
1N 4002	9c
BC 547	20c
BC 557	20c
BC 338	32c
BD 139	80c
BD 140	80c
2N 3055	1.30

OPTO DEVICES

3mm RED LED	16c
3mm Green LED	23c
3mm Orange LED	28c
3mm Yellow LED	28c
5mm Red LED	18c
5mm Green LED	23c
5mm Orange LED	28c
5mm Yellow LED	28c
LDR	75c
MEL Photo transistor	1.20
Flashing LED	60c
TIL 313 com cath display	2.50
FND 560	2.90

MISC COMPONENTS:

FERRIC CHLORIDE	2.25
No 60 drill	1.95
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Mini speaker 80R (yes 80R)	2.50
SPDT mini slide switch	45c
DPDT mini slide switch	60c
8 way Dip switch	2.40
SPDT relays 1 amp rating	2.50
SPDT relay 3 amp rating	3.15
DPDT relay 1 amp rating	3.50
Mini U heatsink	90c
TO-3 Heatsink	2.25
Battery snaps (9v)	25c
Push Switch	55c
PC-mount push switch	80c
Solder 200gm spool	6.50
De-solder braid	2.45
Tinner copper wire 100gm spool	3.75
20 Transistors 10 BC 547, 10 BC 557	3.40
100 transistors 50 BC 547, 50 BC 557	14.00
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Resistor pack. 300 resistors	5.95
Greencap pack 50 greencaps	5.95
Ceramic pack 100 ceramics	5.95
Electrolytic pack 40 electro's	5.95

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We are pleased to say a new lesson has now been included.

It is a TTL lesson based on the book **STARTING IN TTL** and includes the Trainer Deck, text book, answer sheets for the questions in the text and a separate test that is sent in to the school for correction. This is lesson number 6 in the course and can be purchased separately for $30.00 incl postage.

As we have mentioned previously, the price of the course has been set to rise for some time and it is now $120.00 for the first 5 lessons or $25.00 per lesson. Lesson 6 is $30.00 incl postage, making the six lesson course $150.00 incl postage.

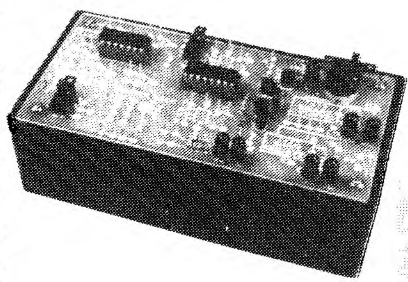
This course is still far cheaper and the most informative course available on the market and hundreds of successful students can attest to this.

The course starts with a preliminary parts identification and soldering ability test. From there you will be guided through 3 interesting projects of which two are sent into the school for marking. These will be returned and remain your property.

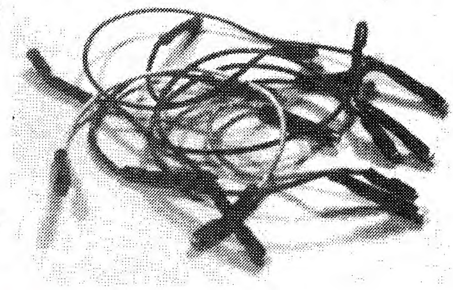
A test accompanies each lesson and these are also sent to the school to be corrected by your instructor.

Individual attention will be given to each student and you progress at your own rate. This is the most important aspect of the course. You can repeat any section untill it is fully understood and you can ask for any additional help relevant to the topic.

Don't delay. This may be the turning point for you. You may think you know electronics, but until it is put to the test and you receive an assessment, you may have some incorrect concepts.



The TTL Trainer Deck is lesson 6.



20 jumpers for use on the DECK.

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