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VOL. 52 NO. 10
ISSUE 840
FEBRUARY 1977

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

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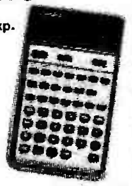

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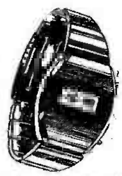

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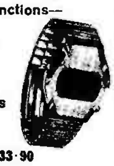

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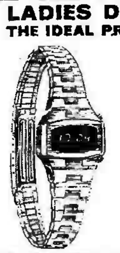

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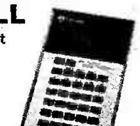

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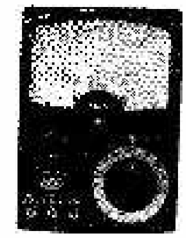

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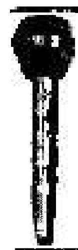
Model ITI-2 20,000 ohm/volt, **£10·05.** P.&P. 24p.



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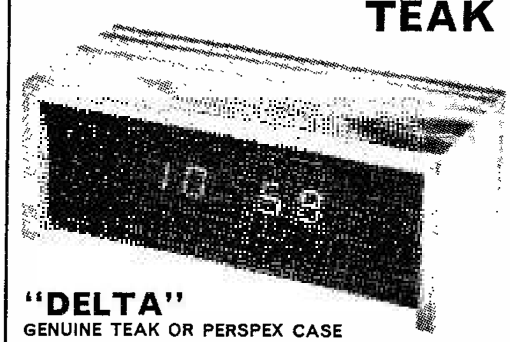

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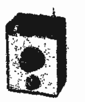

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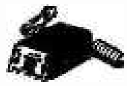

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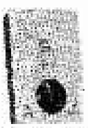

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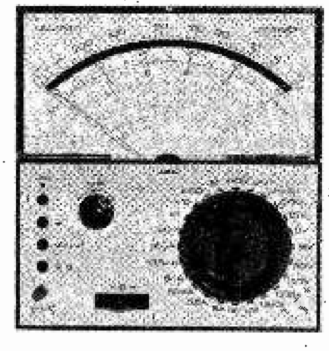

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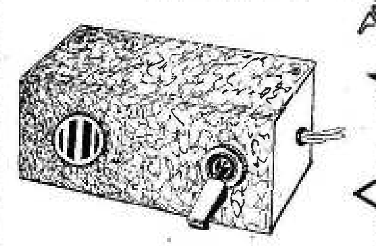

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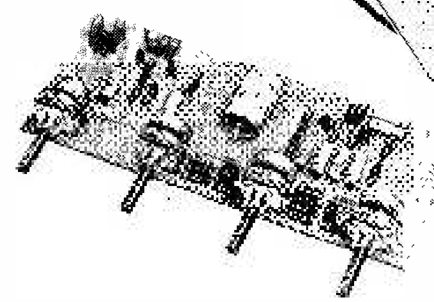

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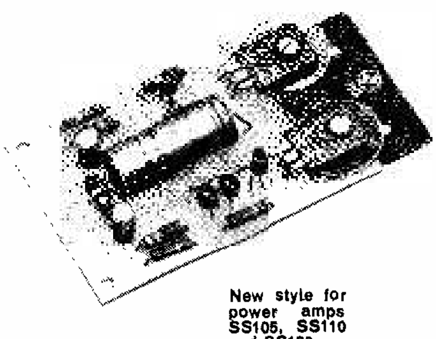

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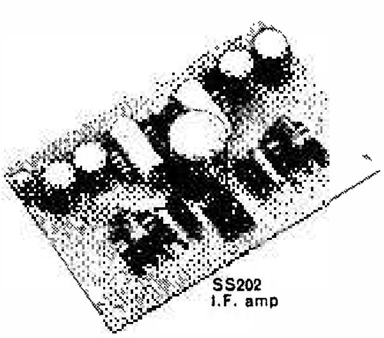

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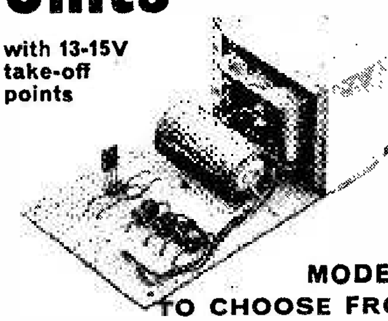

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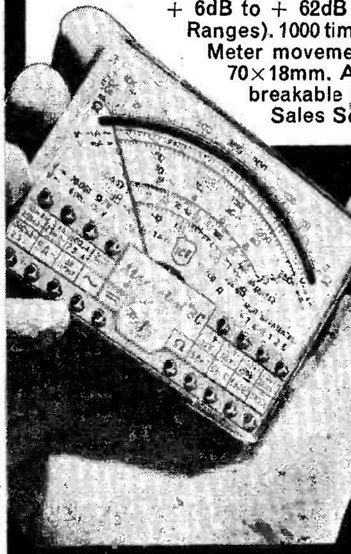

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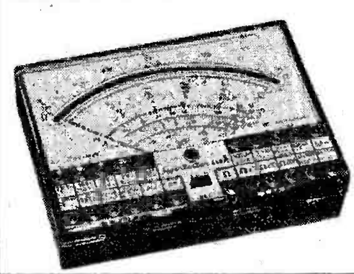

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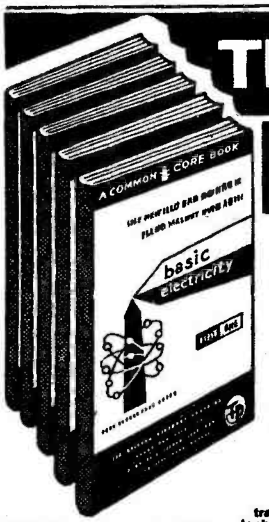

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7404	0·11	0·10	7454	0·12	0·10	74150	1·10	1·05
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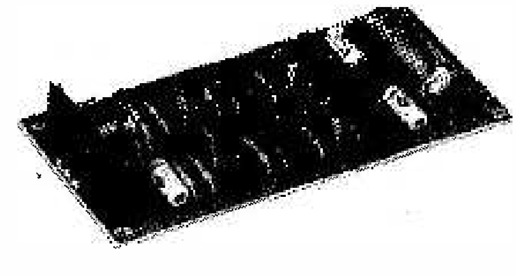
MPA 30



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Damping factor, 8 ohms: 65
Semiconductor complement: 13 transistors 5 diodes
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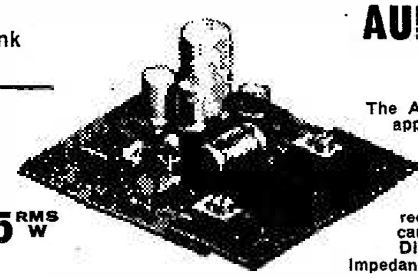

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Constructor, he say.....

WELCOME to 1977. Here's to all Practical Wireless readers and constructors; a very happy and successful New Year to you all.

But will it be? Can such a toast be justified when history and fate have repeatedly combined to ensure just the reverse? Consider the enormous odds against constructors in the coming year.

First, there is the absolute law to which all must bow; if anything can go wrong, it will. Have you never noticed that toast *always* lands butter-side down? Now you don't think that's just chance, surely?

When you've soldered your last joint, tightened the last nut and bolt and switched on—that's when you start building your project!

You must also be resigned to the cantankerous nature of soldering irons. As in 1976 (and all previous years) they will spit hot solder on the carpet when you're not looking, and if you drop one and try to catch it you are absolutely guaranteed to grab the hot end. Some claim they're made that way at the factory, others say they actually turn in mid air.

If you're made of sterner stuff (well done) then you are doubtless going to press on.

But then you'll face the resistor scarcity syndrome; Egad! In simple terms, the number of resistors of any particular value you have is inversely porportional to how badly you need them. If you really, urgently want a particular value then you will, by this law, have zero stocks of it.

The only exception to this rule is when you need two resistors of the same value. In such cases you will always find one.

Another twist to the resistor scarcity syndrome is that when you want, say, a 1kΩ resistor, you will find virtually dozens of 10Ω, 100Ω, 10kΩ, 100kΩ and 1MΩ items. While the 910Ω which is "near enough" will always turnout to be either 91Ω or 9·1kΩ after you've spent five long minutes trying to claw it out from the bottom of the heap.

The charge on a battery is dependent upon how much you need it. Simple rule here: not needed—fully charged, urgently required —flat as a pancake.

No use avoiding batteries, either. The 13A fuse spell has already been cast. This is a magical power given only to fuses enabling them to disappear all on their own, and then to reappear later when not needed. And in a different place from where you distinctly remember putting them, too. This trick is only performed when conditions are just right. Like when you blow a fuse.

Please do remember in the coming year that if you actually build something and get it working, the surest guarantee of instant failure is to demonstrate it to someone else. So try to content yourself with a quiet, solitary gloat.

You should also heed observations that all those vital components (or whatever) you need now will be in every advertisement and shop window in eight months time. And at bargain prices, too. But not now.

So here's a toast for 1977: to all P.W. constructors—you are the salt of the earth. Despite impossible odds you still build things, and get them to work.

How about a combined assault in 1977—a New Years Resolution from both of us?

We at P.W. will try our very hardest to give you the best magazine we can, packed with interesting news and projects etc. And you keep defying the odds, just like you did so magnificently in 1976.

Who knows, between us we just might make that damn toast land butter-side up.

Now there's a thought for 1977.

LIONEL E. HOWES—*Editor*

NEWS...

Why they go up

THE following is a letter from one of *PW's* main component suppliers and explains the position that firms, such as Marshall's, find themselves, having soon to increase their charges by a staggering amount. It further explains the problems of supply, and the return of unsatisfactory components.

"It might be of interest to your readers to note that speaking from a professional point of view, the amateur in the UK has had an advantage over those in all other countries in that he has been able to obtain his 'bits and pieces' at about two-thirds of the normal cost.

This happy state of affairs has now unfortunately come to an end, and unless you are a good shopper you will have to pay 20% to 50% more for your components. This is a regrettable effect of the erosion of the £, the command of product (i.e., the availability from stock for a premium, or delivery of 10/16 weeks), and also the shortage of manufacturing facilities. Readers will recall that in the 1973 era manufacturers opened up plants to meet the demand of shortages, creating an abundance of stock which they were then left with. Thereafter, no sane manufacturer is prepared to do the same again. This of course makes the position of replacements highly problematical.

There are component stockists who still have old stocks at the right price—hence the remark at the start of this letter that a careful shopper will still get value for money, but this will cease as soon as present stocks are exhausted.

Now a word about 'faulty' components. People should realise that when they return products with which they are dissatisfied, manufacturers will only entertain *unsoldered* items for assessment. In 99% of cases these are replaced without comment, although the individual may have unwittingly ruined the component. Therefore the amateur does get the best from

NEWS... NEWS... NEWS...

manufacturers, who are after all there to serve the customer's best interests, and it is important that the consumer end of the market should be serviced."

Sound '77

WE expect that many of you were disappointed to learn that the annual HiFi exhibition held at Olympia was cancelled. Well, if you're really keen and fancy a trip to Manchester, all you HiFi fanatics will be well catered for. It appears that a firm by the name of Hardman Radio has got together some 50 leading manufacturers and is staging a 'breakaway show' called Sound '77.

Apart from the usual equipment paraphernalia, we're reliably informed that there will be day-long demonstrations, film shows, audio shows and lectures and live broadcasts by Radio Piccadilly. One of the main points that the organisers are stressing is the 'air of informality' which they have tried to create, whereby enthusiasts will be encouraged to chat with manufacturers to sort out any worries that they might have concerning their equipment. The venue has also been carefully chosen with this in mind, which is why a hotel was considered more suitable than a large hall.

Sound '77 will start on the 20th January and continue until the 23rd, and will be held in the Excelsior Hotel, Manchester Airport. Finally for all those who think that they couldn't afford it—entrance is FREE.

Latest Catalogue

LOOKING much the same as last year's catalogue, the latest product from Home Radio lists many new components, together of course with a new price list. At £1·00 plus 40p p&p this catalogue represents excellent value for money, considering the saving of time on "shopping around", keen prices for 5,000 components listed and knowing that any components bought from Home Radio are of first class quality and are covered by a full manufacturers guarantee. To those readers purchasing a copy of this catalogue now, will be given free, a supplementary "Bargain Lines" list, which will be updated at regular intervals.

Home Radio (Components) Ltd, Dept. PW, 234-240 London Road, Mitcham CR4 3HD. Tel: 01-648 8422.

Home Office repents

FOLLOWING a letter sent to the Home Office by the RSGB, concerning Double Sideband Suppressed Carrier transmissions (see Leader article —December 1976), the Home Office say that they are now in a position to permit amateurs to use this mode of emission.

This new ruling is effective as from the 1st January, 1977, and will be included in the new Amateur Licence.

So sorry . . .

WE published on the News page in the December issue, the new address of Aiwa Sales and Service (UK) Ltd. Unfortunately this has now changed, and the new address is shown below:—

30-32 Concord Road, Westwood Park Trading Estate, Western Avenue, Acton, London, W3.

Cheaper chips

ANYONE in the market for a few of those "not quite so revolutionary now" ZN414's? Yes, do we hear someone say? Well Ferranti have recently announced a price reduction on this radio chip which is ideally suited for such things as "behind the ear radios"; "local traffic radios", "novelty radios", and IF strips.

The new price structure favours volume buyers, with prices ranging from 70p each for 1,000 off to around 15p each for quantities approaching one million. At prices like these it would be almost worthwhile buying a couple of million and using them as hard core for your garage drive!

2nd time lucky?

ALTHOUGH the first club that Mr Bales, a TV Engineer, formed, sadly had to close through lack of support, he has decided to give it one more go, and will be opening up a brand new Radio and Electronics club. This new venture will start at 7.30pm on Wednesday the 5th January at the Social Institute Hall, Hill Street, Wisbech, Cambridgeshire. So go on all you enthusiasts, nip along there on any Wednesday evening, and make this club a success.

A testing time

THE RSGB will be running an Examination Centre for the Radio Amateur Examination on 19th May 1977, 6.30 to 9.30 p.m. at University College, London. Entries to Headquarters not later than 25th of February 1977.

Moved . . .

FORMALLY of Bishop Taunton, Devon, Xeroza Radio has now been transferred to 306 St. Pauls Road, Highbury Corner, London N1, and it is hoped that these new premises will be open for business during the first week of January. Full control of this new London venture will be held by Mr. Tom Powell who has had extensive experience in the component field over the last 20 years.

The firm carries a complete range of components for the DIY radio/electronic constructor, although special emphasis will be given to providing a wide choice in the capacitor field.

Digital IC TESTER

W. ENGLISH

LIFE is made much easier by using digital ICs to build up electronic circuitry, but it can be awkward if their condition is below specification. This simple, effective and very versatile instrument ensures that "good" ICs are in fact serviceable (the odd one can prove to be partly faulty) and can also sort out bargains from "Untested Packs". Even "Unmarked Packs" can be a source of useful cheap components, and a technique to deal with these is described at the end of the article.

The instrument was developed after a study of manufacturers' parameters, the requirements then being worked up in a practical form covering all anticipated objectives, retaining the original idea of simplicity.

Circuit details

Supply voltage, logic "0" and logic "1" levels are basic. Switchable levels are needed, and are taken from a Square-wave Multivibrator Clock circuit, Fig. 1, which is a preferred means of testing Decade counters. Indication of outputs is done by using LEDs and all functions readily routed to any of the 14 or 16 pins of the IC. This routing is simply achieved with flying leads from a 16-pin DIL socket, terminated by pins which plug into sockets providing the required reference levels.

For simplicity, the logic "0" is commoned to the Ground (negative supply). Logic "1" comes from one gate, both inputs grounded, of an SN7400. Two gates cross-coupled form a Clock multivibrator, frequency 90Hz, with a good squarewave, timing being monitored by a LED driven by the alternate half-cycle to that used for the Clock output. The fourth gate is used to produce trigger pulses needed when testing monostables. Both inputs are normally unconnected making the output logic "0", and a quick press and release of switch S2 momentarily connects the inputs to ground, providing a short logic "1" pulse. This is now fed to a sharply differentiating circuit producing very short +ve and −ve pulses at sockets marked "J".

LEDs 1, 2, 3 and 4 are driven by logic "1" outputs. LED 5 is for a logic "0" output, and its uses are described later. The limiting resistors R1-R4 are 470Ω, which provide sufficient light with economy, although LEDs can vary and another value could be substituted.

The supply switch S1 is also spring-loaded, with the practical advantage that when inserting and extracting ICs both hands are needed, and the set is therefore "dead" during these operations.

The leads from the front panel are arranged in the same pattern as the DIL connections, which helps in setting up. They are numbered in two colours, to cover use of 14- or 16-pin ICs. As an additional aid, the leads 15 and 16 are in **red** and the leads for 1-7 are **yellow**. Leads for 8-14 (10-16) and **green**.

It is necessary to measure the current drawn, and provision is made to clip leads from a multimeter, set to 100mA, to sockets L and K.

Operation

The *Table of Connections*, Fig. 2, covers a sample range of ICs and for convenience *Special Notes* are appended. After a few trial runs, operation of the unit will become easier, and it can be left to the user to explore the infinite possibilities using ICs not on this necessarily short list.

Taking the 7400 as an example, the connections to the sockets are made, then checked, after which the IC is fitted. S1 should now be pressed and LEDs 1, 2, 3 and 4 should come ON and OFF in phase with the Monitor LED 6. If a lamp does not light the particular gate is faulty, and may be presumed open circuit. The current drawn for a good 7400 should be 8-10mA, although if a lamp fails to light and the current taken is 40-60mA or more, that gate is short circuit and the IC should be discarded. If one of the lamps is less bright than the others, that gate has a lower output, but may still be used, perhaps in a selected position.

Special Notes

7400—LEDs 1, 2, 3, 4 in phase with Monitor LED 6.

7403—Set up as 7400, but open circuit collectors. Gates function when taken to socket E (logic "0").

7404—Test 4 gates, then remove (3 and 4) and set up (5 and 6).

7401—NAND open circuit collectors—use socket E (LED 5).

7402—NOR gates—LEDs out of phase with Monitor LED 6.

7470—As set up, LED 1, (Q) ON, LED 2 ($\overline{Q}$) OFF. Then change J and k connections as second row, when Q will be OFF and $\overline{Q}$ will be ON.

7474—As set up, LEDs 2, 4 ($\overline{Q}$) ON. Pull out pins 2, 12—LEDs 1, 3 (Q) ON.

7490—(a) LED 1 (D output) ON once after 10 cycles of Monitor. This is decade configuration.
(b) After Monitor cycles 5 times, LED 1 is ON for 5 cycles. This is BI-QUINARY configuration. (The outputs of extraneous gates may be observed, and the different configurations fully analysed.)

74107 Dual J-K Master/Slave Flip-Flop. As set up LEDs 2, 4 are ON, then change over—LEDs 1, 3 now ON. Change J/K connections as in second row, when LEDs 2, 4 are ON, and stay on.

74121 Monostable. With S1 pressed, LED 2 ($\overline{Q}$) is ON. Press and release S2, LED 2 goes OUT and LED 1 comes ON for about 2 seconds, then goes OFF, when LED 2 will again be ON. This tests the internal resistor (2k), but if a longer output pulse is required, interpose a further resistor between pin 9 and socket (P).

74L42 BCD to Decimal Decoder. The Decimal outputs are logic "0" but it was found preferable to test in reverse, when the output LEDs do NOT come on. Each input *in turn* is set up, pins 1, 2, 3, 4 put in sockets (N), (K) (J), (J), S1 pressed and LED operation noted. (Here for example LED 1 is OFF, but LEDs 2, 3, 4 are ON.) Next use pins 5, 6, 7 and lastly 9, 10,

✶ components list

Resistors

R1 470Ω	R6 4·7kΩ
R2 470Ω	R7 470Ω
R3 470Ω	R8 470Ω
R4 470Ω	R9 1kΩ
R5 4·7kΩ	All 10% ¼W except R9 1/10W

Capacitors

C1 100μF 6·4V	C3 100pF ceramic
C2 100μF 6·4V	C4 1000μF 4V

Semiconductors

IC1 SN7400
LED's 1 to 6 0·2in Red.

Miscellaneous

S1, S2, miniature SP biased push-to-make. 26, 1mm sockets (Doram no. 444 056). 16, 1mm plugs (Doram no. 444 034). 16pin DIL socket. Plywood for console. Veroboard, 0·15in plain 89 x 57mm, 0·1in clad 6 x 8 holes, 0·1in clad 7 x 7 holes. Wire, 18 and 22SWG tinned copper.

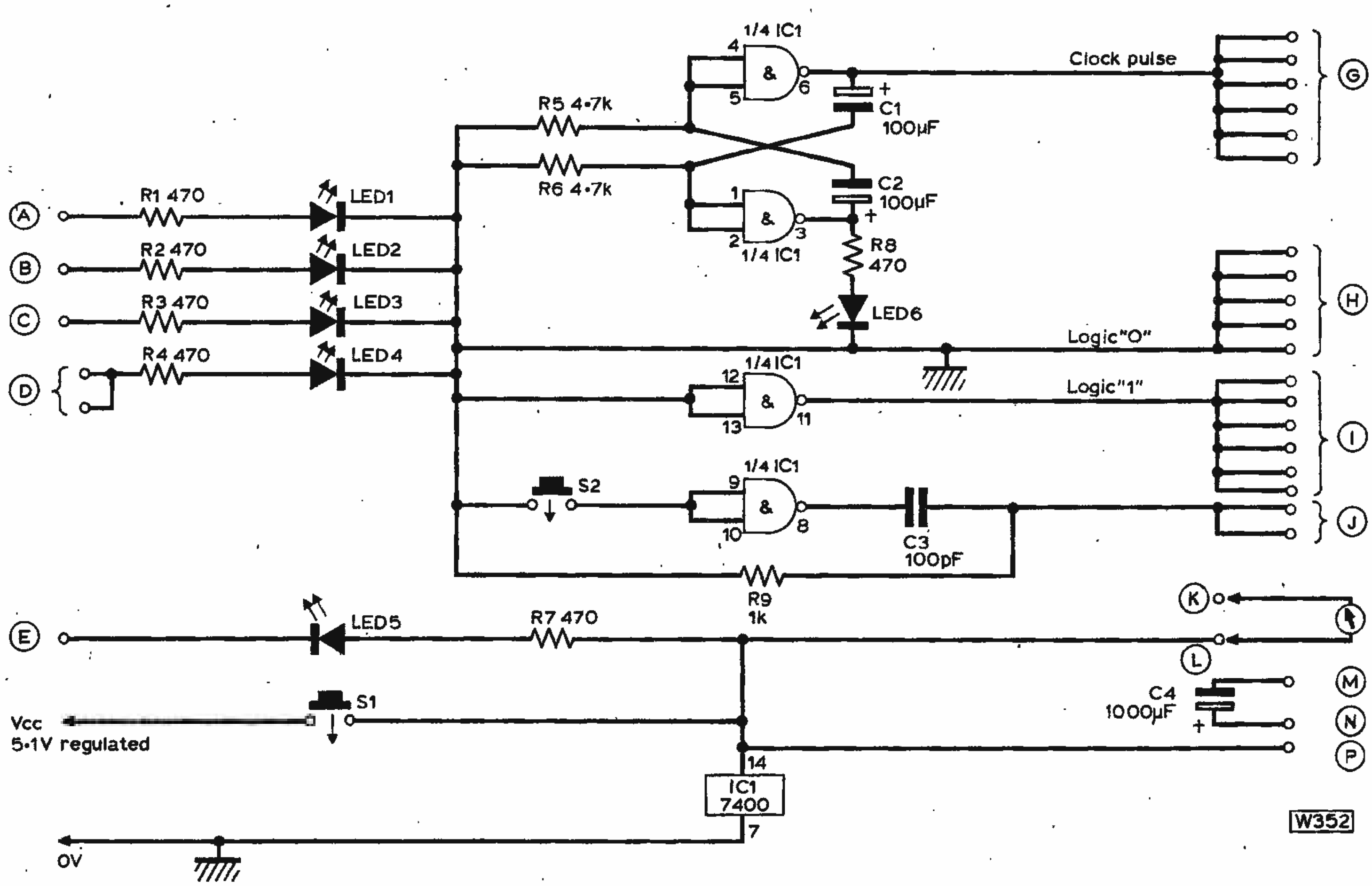


Fig. 1 : Full circuit diagram of the tester, showing the various facilities available from the one internal IC. LED's 1 to 4 indicate logic '1', LED 5 indicates logic 'O', while LED 6 is the Monitor indicator.

Table of Connections (Fig. 2)

Type to be Tested	Pin numbers 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
7400	G	I	A	G	I	B	H	C	G	I	D	G	I	K		
7403	G	I	E	G	I	E	H	E	G	I	E	G	I	K		
7401	E	G	I	E	G	I	H	G	I	E	G	I	E	K		
7402	A	G	H	B	G	H	H	G	H	C	G	H	D	K		
7404	G	A	G	B	G	C	H	D	G	D	G	C	G	K		
7410	G	G	I	I	G	A	H	B	I*	I	G	C	I	K		
7413	I	I	..	G	G	A	H	B	I	I	..	G	G	K		
7420	I	I	..	G	G	A	H	B	I	I	..	G	G	K		
7430	G	G	G	G	I	I	H	A	..	..	I	I	..	K		
7442	SEE SPECIAL NOTES							H								K
7470 (a) (b)	.. ..	I I	I H	I H	H H	B B	H H	A A	H H	H I	H I	G G	I I	K K		
7474 (a) (b)	I I	I H	G G	I I	A A	B B	H H	D D	C C	I I	G G	I H	I I	K K		
7490 (a) (b)	D G	H H	H H	.. ..	K K	H H	H H	C C	B B	H H	A D	D A	.. ..	G D		
74107 (a) (b)	I H	B B	A A	H I	C C	D D	H H	I H	G G	I I	H H	G G	I I	K K		
74121	B	..	J	J	L	A	H	..	P	M	N	..	..	K		

* Touch pin to socket I while testing.
Where socket E is used more than once in a test, take outputs in turn to this socket (logic 'O' LED)

11. The *Truth Table* gives the successive input connections and the Decimal Output LED 5 which should be OFF in each case. Faults show up as additional LEDs OFF. It is possible for the correct output to show *as well as faulty ones* in which case the Decoder will give spurious outputs, and should be rejected.

Construction

The console is made up using 6mm and 2·5mm ply, see Fig. 3. Evostik Woodworking Adhesive is recommended, joints being held until set by a few small pins while the back cover is retained by small woodscrews. A clearance hole is cut in the top to accept the DIL holder and is soldered into a piece of 0·1 matrix Veroboard 6 x 10 holes.

16 pieces of thin insulated *stranded* wire, each 145mm long, coloured as described, are soldered in at right angles. The spreader bar (Fig. 4) made from softwood has shallow saw-cuts on each side as shown. These are given a generous coat of *Dunlop Thixofix,* and with the bar close to the Veroboard, see Fig. 3, the leads are pressed into the saw-cuts and a further coat of adhesive given. When set, the leads are captive, and the assembly is offered up and Araldited in place.

Seven pieces of stiff board are now cut and cemented to the back of the panel and the base between each pair of leads to keep them from getting tangled when they are pulled out and pushed back. Holes for the leads are drilled in the panel as shown in Fig. 5. The size of hole is chosen so that the leads are lightly nipped, in order that they remain neatly in place when stowed away.

In the prototype, pins and sockets taken from surplus 25-way connectors were used but these may not be readily available, so 1mm sockets by Doram Electronics are a good alternative. The mating plugs are rather bulky for this design, and suitable pins can be easily made from 18SWG copper wire with the nominal diameter of 1·2mm reduced by judicious stretching with the aid of a vice and pliers.

Decimal Output	0	1	2	3	4	5	6	7	8	9
Decimal output at pins	1	2	3	4	5	6	7	9	10	11
Pin 12 (input D)	H	H	H	H	H	H	H	H	I	I
Pin 13 (input C)	H	H	H	H	I	I	I	I	H	H
Pin 14 (input B)	H	H	I	I	H	H	I	I	H	H
Pin 15 (input A)	H	I	H	I	H	I	H	I	H	I
LED which is not illuminated corresponds to the IC pin numbers										

Truth table for the BCD to Decimal Decoder 74L42 integrated circuit.

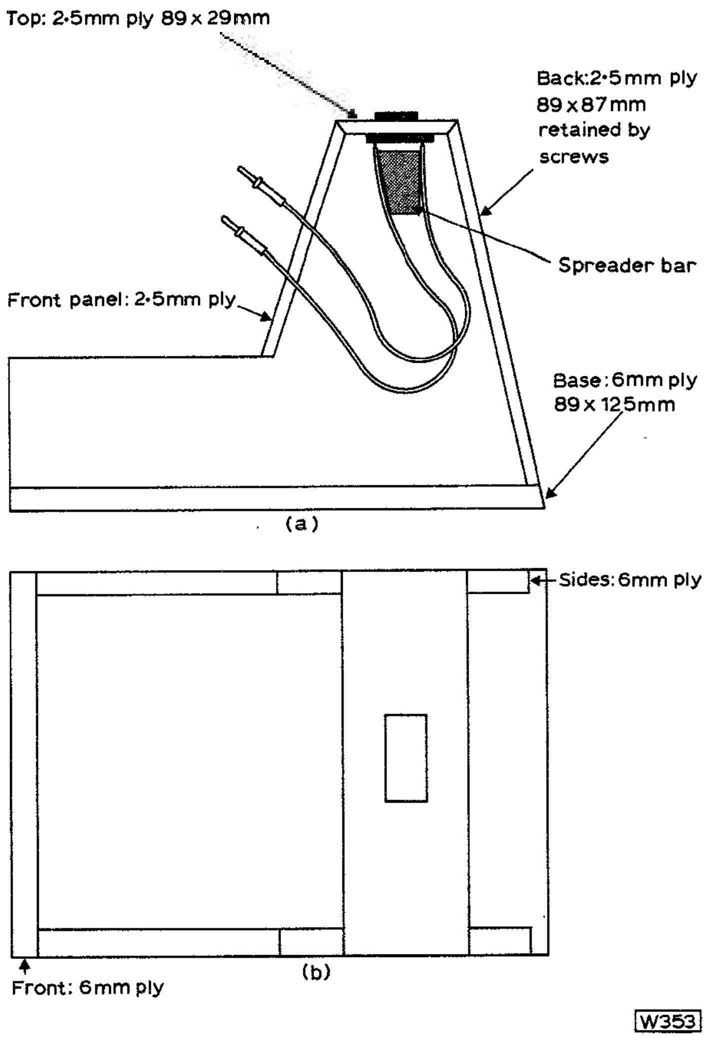


Fig. 3: End and plan view of the console. The wood used in the prototype was ply, although hardboard could be used.

Pieces 15mm long soldered to the leads by 5mm butt joints covered by short sleeves make a neat and satisfactory job. Numbering of the leads is done on the panel in two colours as in Fig. 5.

Control Board

The control board, Fig. 6, is made from 0·15in matrix *plain* Veroboard, 89 x 57mm. Very few extra holes had to be made, two ¼in holes for the switches and six with a No. 55 drill for the LEDs. Before fitting the LEDs test them for uniform brightness. Sockets are spaced every other hole, except for sockets J, P, N and M which are in a compact group away from the others.

The SN7400 is soldered into a piece of Vero 0·1in matrix 7 x 7 holes. A wire from S1 passes through

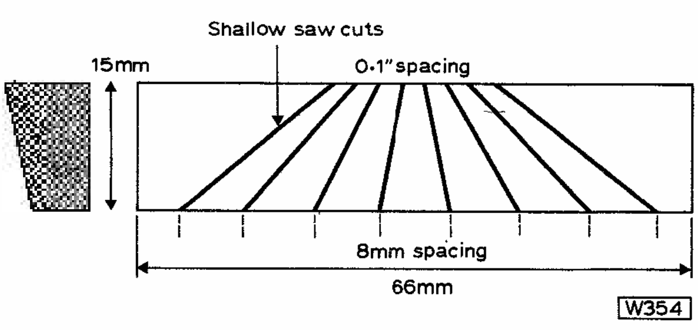


Fig. 4: Spacer bar which ensures that the leads from the IC to be tested don't get tangled and strained through continual use.

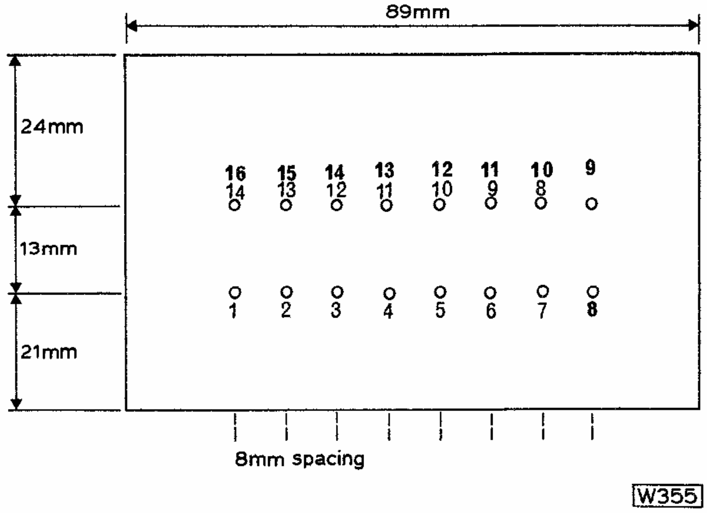
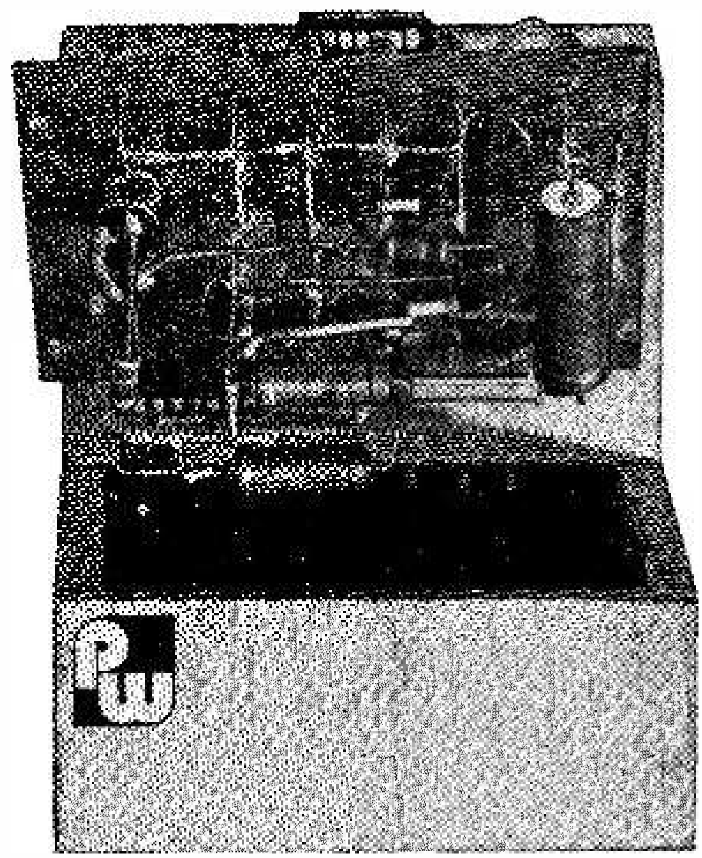


Fig. 5: Dimensioned drawing of the front panel, giving the position of the holes required to enable the leads to pass from the IC under test to the sockets.

the "14" hole to socket L, and then stiff wires taken to logic "0" (H) and "1" (I) sockets. Other components are wired in following a "right angle" pattern, so that sleeving is not necessary. Flexible leads for the power supply are led out of the bottom corner at the back, to an external bench mains unit, 5·1V stabilised or a 4·5V battery pack.



Photograph of the underside of the Prototype control board, showing how the components are soldered directly to the sockets, LEDs and switches.

Testing

When construction is complete, the reference levels may be checked. With S1 pressed, the Monitor LED should come ON and OFF with a 1:1 mark/space ratio. The logic "1" level is checked by patching the H sockets to sockets A, B, C, D when lamps 1, 2, 3, 4 should light. Voltage level should be 3-4V. The current drawn is minimal.

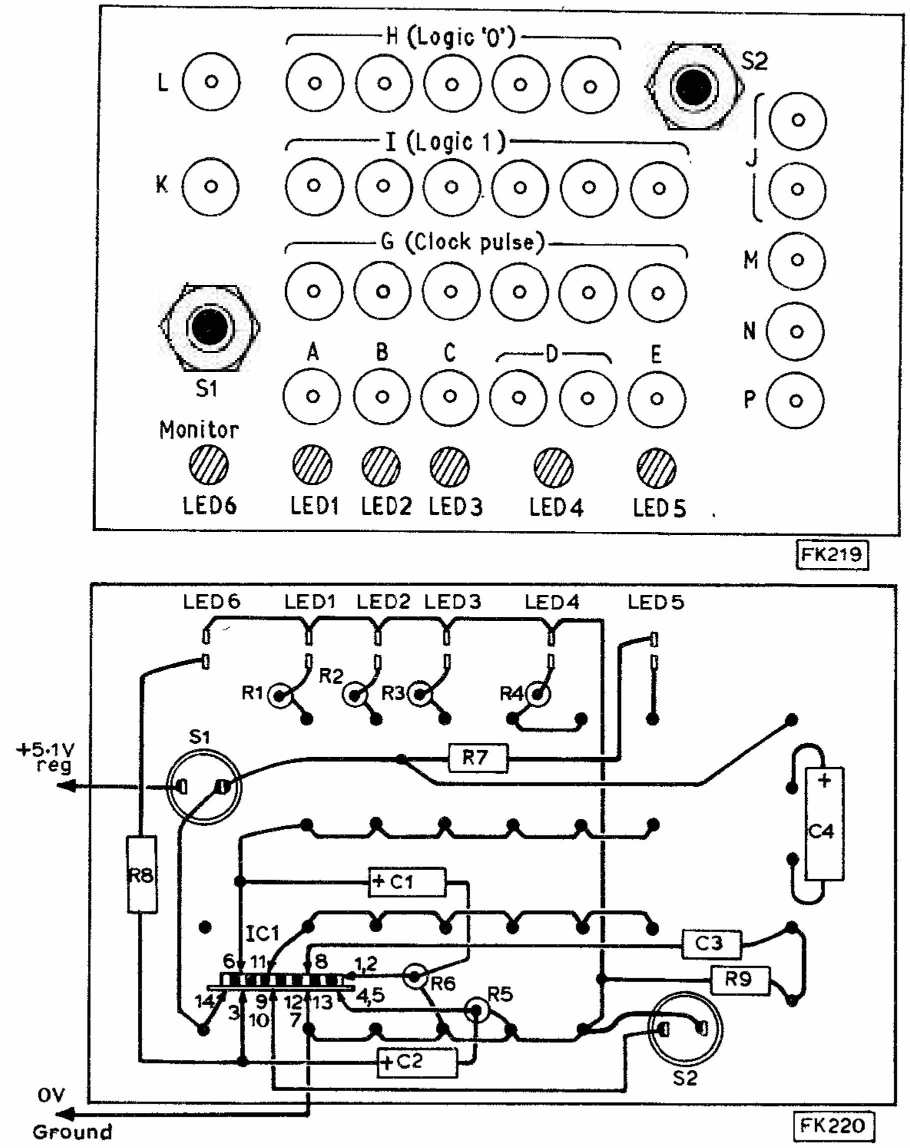


Fig. 6: Full size drawing of both sides of the control board. The sockets used are obtainable from Doram Electronics, and differ from those used in the prototype. See below for details of the IC connections.

Unmarked IC's

The procedure for unmarked ICs requires some patience, but no harm can be done unless the supply is connected the wrong way round. Analysis of TTLs reveals a pattern for these:

	14 Pin			16 Pin		
Vcc —	14	4	5	5	5	16
Ground —	7	11	10	12	13	8

As a starter example, plug in a 14-pin IC, connect pin 14 to socket K, pin 7 to socket H and connect a milliameter to sockets L and K. *Make no other connections.* Press S1, and if a "normal" current is drawn, the supply connections are correct. If no current is drawn, try the next pair, and so on. When supply-ground connections are correct, try:

(1) Pin 3 in socket E (LED 5 responds to a logic "0" output.) The lamp will light for a NAND/NOR gate. If not try...

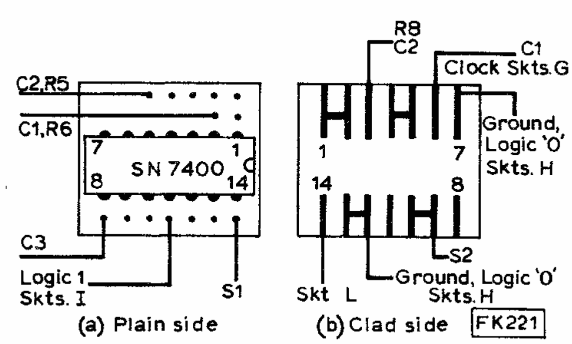
(2) Pin 3 in socket D in case it is an OR/AND gate giving a logic "1" out with floating inputs. Again if not...

(3) Repeat (1) and (2) using pin 6. The first gate could be faulty, or the IC is a 7404, 7410 or 7413.

(4) Pin 8 in socket E, with the first checks unavailing, would indicate a 7430 (8 input NAND).

(5) Finally try pin 1 in socket E—it could be a 7401 NAND gate with open circuit collector, which works with LED 5. Pin 1 in socket D would indicate a 7402 NOR.

These five tests should reveal the *gated* ICs in the batch, and by making the appropriate input connections the type can be identified. The **table of connections** will help, but a full list covering all types is a necessity if all types are likely to be used.

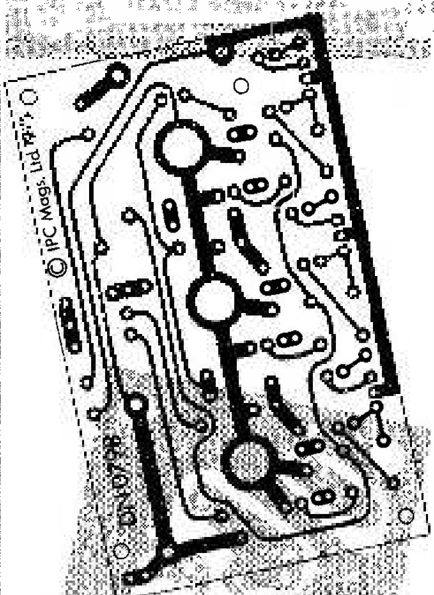


Detailed drawing of the 7400, its mounting, and connections to the board.

Experience is an advantage in identifying the more complicated ICs, but with some practice, following the examples given, it should be possible to do many of them.

PCB SERVICE FOR READERS

All boards, except SRBP, are glassfibre, drilled and roller-tinned



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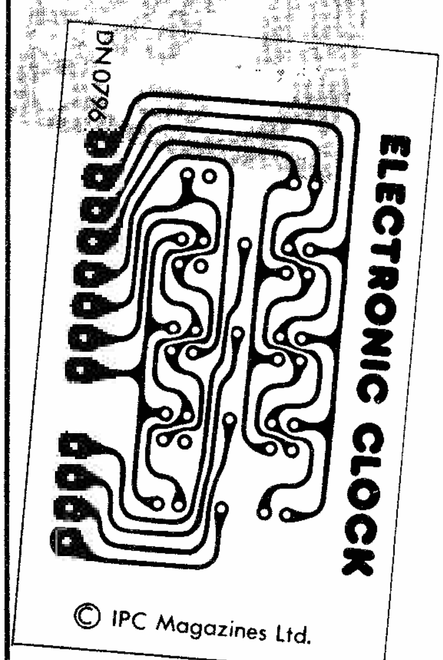

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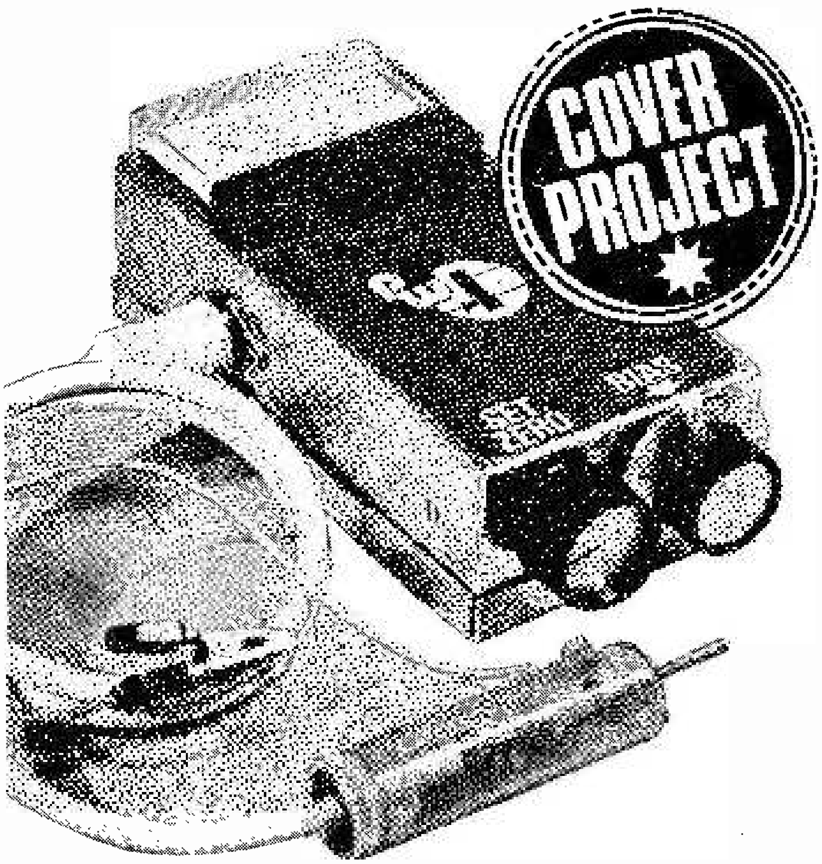
F.E.T. VOLTMETER

N.D.N. BELHAM G8FCH



SOME people, once they become the proud possessors of a digital frequency meter, wonder how on earth they managed without one for so long! The writer feels like that about his slide-back FET voltmeter and wonders why he did not make one years ago!

The meter measures the peak voltage of audio and radio signals over the range 50mV to 2·5V and consists of a control box to which may be connected one or more probes. The box houses two potentiometers, 8 x HP7 batteries and a microammeter, while the probe houses an FET, a resistor and two capacitors.

Operation

The slide-back principle is simply that of providing a variable voltage so connected as to oppose the input voltage to be measured. When no current is drawn from the input then the two voltages are equal and opposite. At balance such a voltmeter therefore presents an infinite input impedance. The scale is linear and this may be provided, as shown in Fig. 1, by a voltmeter across the variable internal supply or by calibrating the potentiometer dial.

Since a microammeter is needed to detect the balance point such a meter must be protected against a large unbalance current with a series resistance and a diode shunt, Fig. 2. To achieve a balance one must be able to detect a movement of the meter pointer for a very small current. Meters with fine pointers and fine graduations may be better than more "sensitive" meters with thicker pointers and graduations. The length of the pointer also plays a part for the end of a longer pointer may move more, for the same current, than the shorter pointer of a more "sensitive" meter. The writer settled for a 50μA meter whose overall dimensions were 60 x 45mm.

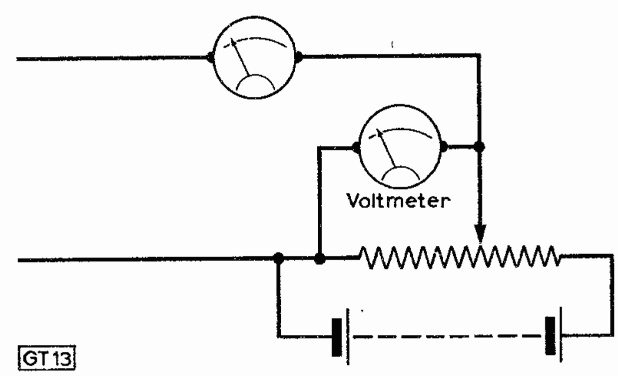
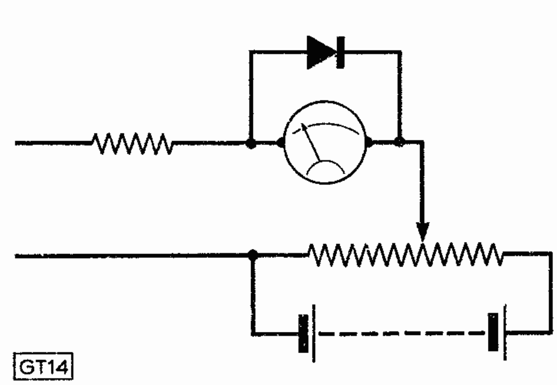


Fig. 1: above, method of providing a known variable voltage when using the slide-back method of voltage measurement.

Fig. 2: below, use of a diode to prevent damage to meter by large out-of-balance currents.



To measure alternating voltage one or more diodes must be included in the circuit. The single diode method, Fig. 3a, suffers from the need to provide a complete DC path before any out of balance current can flow. The methods shown in Fig. 3b and 3c do not need this. In each case a capacitor is included to prevent any DC in the input being measured. The trouble with any diode method is that diodes do not start to conduct until the input reaches about 0·5V

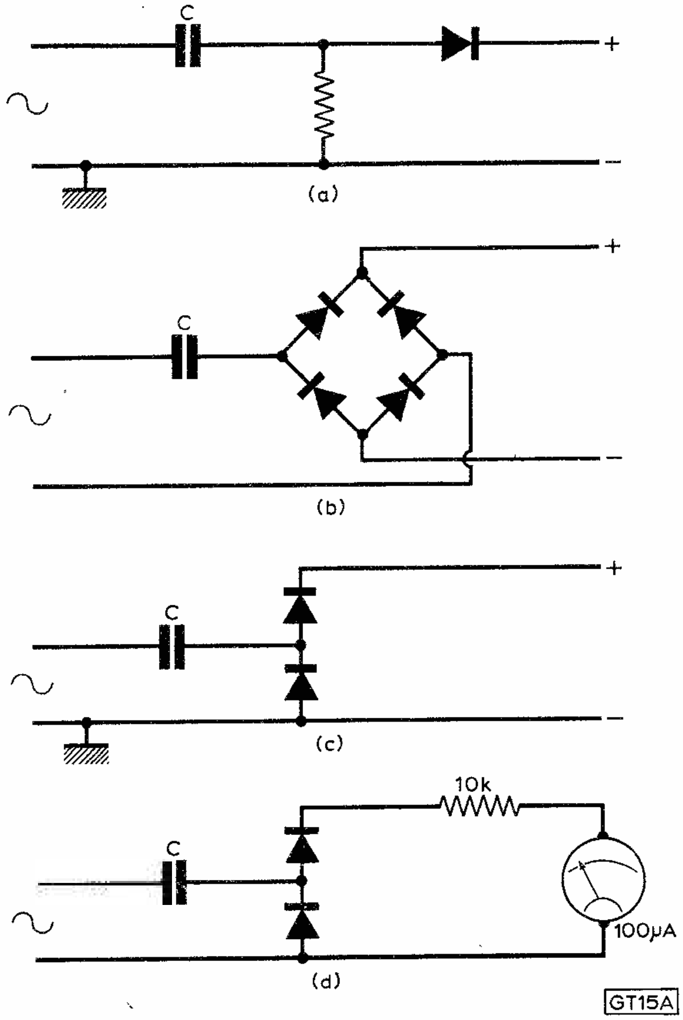


Fig. 3: Methods of rectifying the alternating voltage input. (d) is the circuit used to provide curve A in Fig. 4.

and the scale is not really linear until some 10V are reached. Fig. 4 curve A shows the response curve for a simple diode meter using the circuit shown in Fig. 3d while curve B shows the response of the slide-back FET voltmeter.

The gate-to-source junction of an FET has the characteristics of a silicon diode, but it is used in the reverse bias condition so that its operating current is only a few nanoamps and the input resistance many megohms. The drain-to-source junction acts as a resistor whose value depends on the gate-to-source voltage.

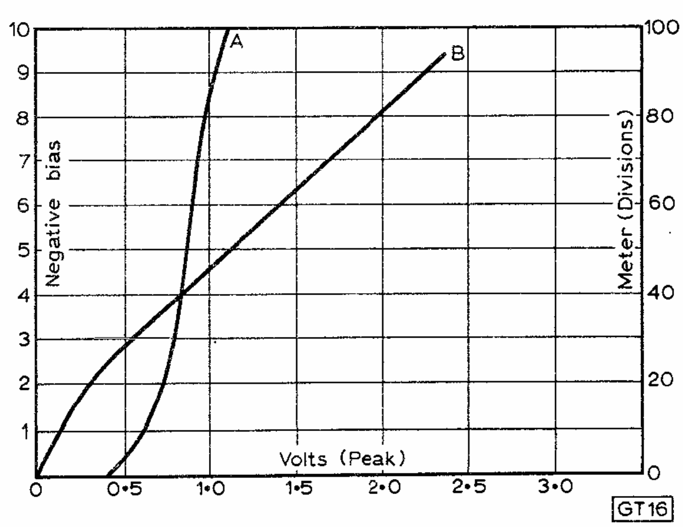


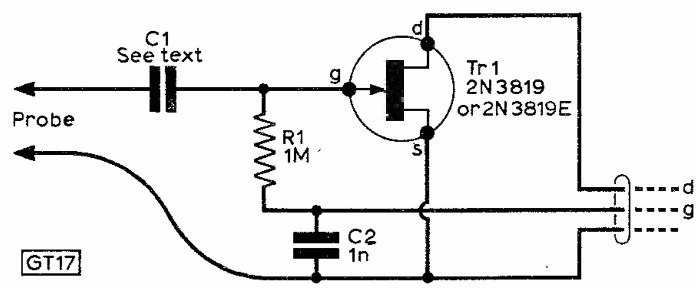
Fig. 4: Curve A is obtained using the circuit of Fig. 3(d) above. Curve B is the response curve of the FET voltmeter described in the article.

★ components list

Resistor R1, 1MΩ1/20W. Rx, see text, about 3·9kΩ. Capacitor C1, see text. C2, 1nF, ceramic. Diodes D1 and D2, 1N914 or similar. Transistor Tr1, 2N3819 or 2N3819E. Meter M1, 50μA FSD, 60 x 45mm (Watford Electronics). Batteries, 8 x HP7, with two holders. Aluminium box 5¼ x 2¾ x 1½in. or similar. Potentiometers VR1, VR2, 5kΩ lin. with knobs. 3-pin plug and socket. Probe cable and material, see text. Switch S1, double pole on-off.

Circuit

Fig. 5 shows the circuit of the probe and Fig. 6 that of the control box. It will be seen that the drain current is measured by the meter which is protected, as already described, but with two diode shunts D1/2, placed back to back. Negative bias is applied to the gate via R1. The bias needed to reduce the drain current to zero varies between samples and it was found, in the case of the 2N3819E used, that about −3·65V were required. The resistance Rx, in series with the zero set potentiometer VR1, is chosen so that the cutoff point is within the range of that control when the negative bias potentiometer VR2 is set at zero. In the case of the prototype the value required turned out to be 3·9kΩ. Thus the operation of the negative bias control could add another 2·25V.



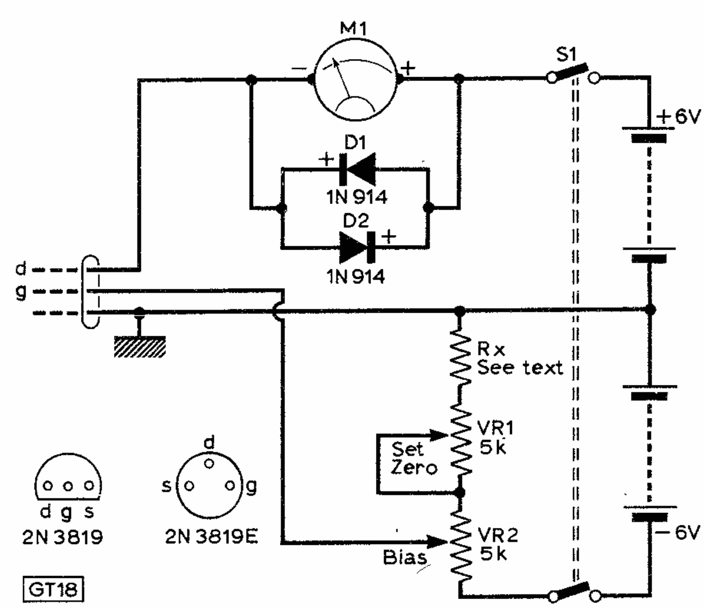


Fig. 5: above, is the circuit of the probe used with the control box, Fig. 6, below. Two probes will cover most AF and RF requirements.

Two 6V batteries are needed, one to provide +6V for the drain circuit and the other to provide up to −6V bias but since the current drawn is less than 1mA small batteries can be used. Since the writer finds a substantial 12V supply useful for other purposes eight HP7's were used, in two boxes each holding four batteries and fitted with press studs.

Construction

The parts of the probe are assembled on a strip of Veroboard 3 holes wide and 24 holes long, Fig. 7a. The FET and resistor R1 are soldered to terminal pins while the stiff earth wire is soldered to two such pins. The capacitor C1 is soldered in and three other terminal pins serve as connections to the three-core cable which is anchored to the board by wire loops. The aluminium box is used upsidedown, with the lid underneath. Fig. 7b shows the wiring. The use of a three-pin socket allows more than one type of probe to be used with the control box. The coupling capacitor C1 is chosen to suit the frequency range i.e. its reactance needs to be small compared with the voltmeter input impedance. For the audio range C1 should not be less than 0·5μF and for radio frequencies not less than 100pF. This capacitor needs to have a very low leakage if the zero point is not to be altered when the load is connected to the input.

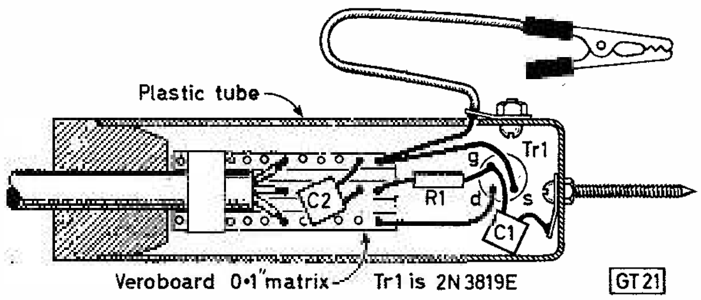
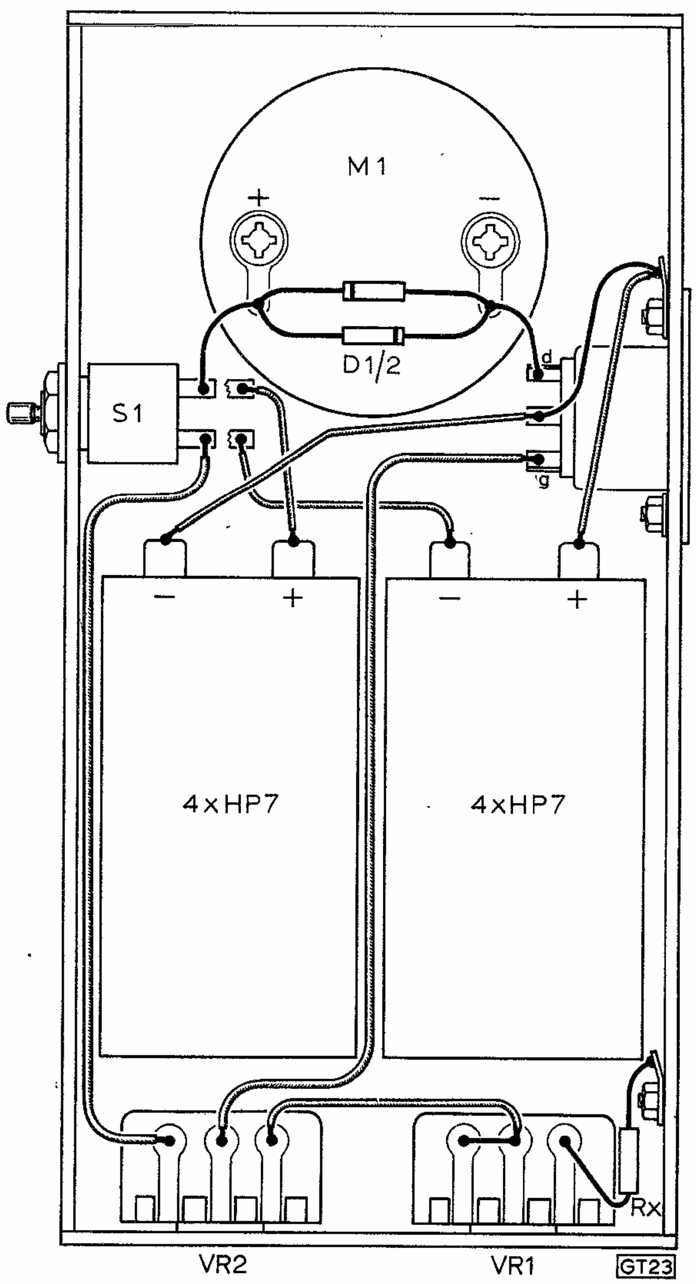
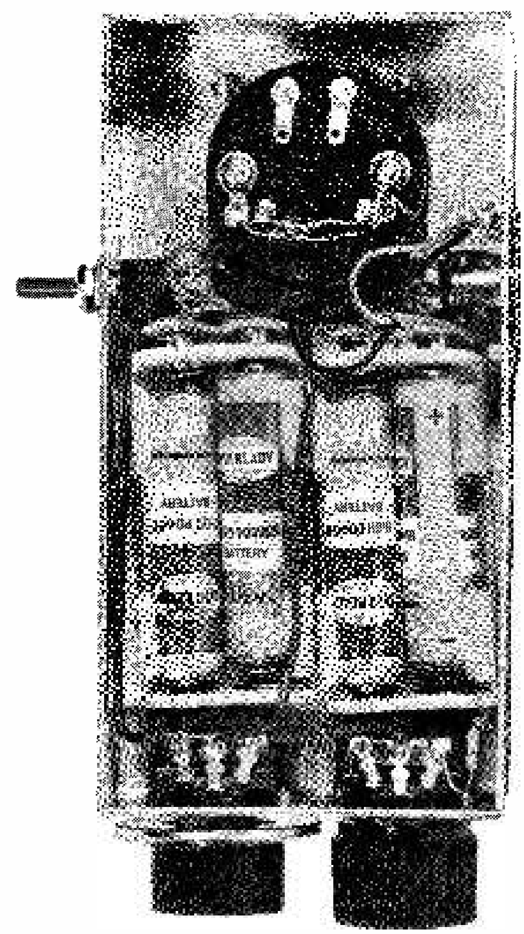


Fig. 7(a) above, shows the method of constructing the simple probe while (b) below, illustrates the location of the few components in the control box and the wiring.





Operation

The operation of the voltmeter is as follows:—

1. Set the bias potentiometer to zero, i.e. towards the end connected to the set zero potentiometer.

2. With no input voltage, set the set zero potentiometer to give a zero meter reading. This is best approached by reducing the meter reading very slowly to zero and then giving a slight movement in reverse. A movement of the pointer should then be just detectable. Care should be taken to see that the pointer is not pressing on any mechanical stop.

3. The input is then connected and this time the negative bias potentiometer used to reduce the meter reading to zero. The final position of this potentiometer is then read off.

If the meter is to be used only as a detector then the bias need only be set to give a convenient reading.

Transistor CHECKER

COVER PROJECT

P. D. MADDISON

THIS device indicates the polarity, *npn* or *pnp* of transistors and of diodes, and can give an indication of "open" or "short" defects. Fig. 1 shows a standard Astable oscillator running at several kHz, Tr1 and Tr2, with buffer transistors Tr3 and Tr4, and drivers Tr5 and Tr6 for the two LED displays. The buffer transistors isolate the oscillator and provide an AC signal to the component under test. The buffers are essential, as a short across the oscillator would stop it functioning. The 10kΩ load resistors limit currents, during normal short conditions, to a safe value.

The collector of Tr3 provides drive to the emitter of the transistor under test. The collector of Tr4 drives the collector and the base, via a current limiting resistor R7, of the transistor under test, ensuring that they are of the same polarity and opposite to that of the emitter.

Operation

Assume an *npn* transistor is connected to EBC so when E is high and C is low the transistor is reverse biased and cut off. The high state is amplified by Tr6 and the LED, D4, lights up. When, on the opposite half cycle, E is low and C goes high the transistor is forward biased and switches on. This forces C to go low also and hence neither LED is lit.

The high speed of the oscillator makes it appear as if a single LED is on, thus giving indication of *npn*. The converse happens for a *pnp* transistor and the other LED stays on. A diode can also be tested by connecting between E and B or C. The *npn* LED then indicates that the cathode is at E.

It can be seen that in the open circuit, no component connected, both LEDs are alternatively switched and appear on. For a short circuit condition the high state is pulled to low and hence both LEDs go out. See summary table.

The diodes, D1 and D2, provide an extra 0·6V voltage drop to ensure that a low condition (approx 1V)

Summary of operation

Both LEDs ON: normal state, open circuit condition.
One LED ON: indicates the required polarity.
Both LEDs OFF: Short circuit condition.
One or both LEDs partly on: partial short circuit, high leakage component, LED drivers not fully off (see text). **Note:** some transistors readily display this fault, especially germanium and 'self-oscillating' HF types. They may not necessarily be faulty so it is wise to check further, in the normal way, with a meter.

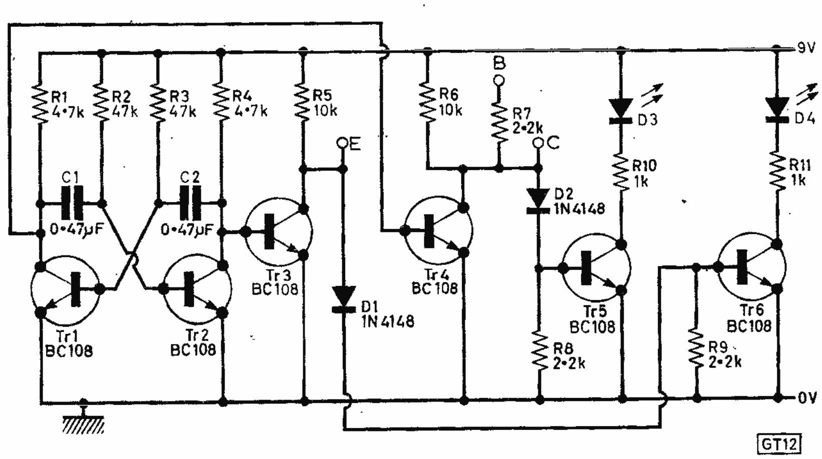


Fig. 1: Circuit of the Transistor Checker. The LED D4 corresponds to an 'NPN' indication and D3 to 'PNP'. A 9V PP3 battery can be located inside the box or two terminals fitted to the box for an external supply.

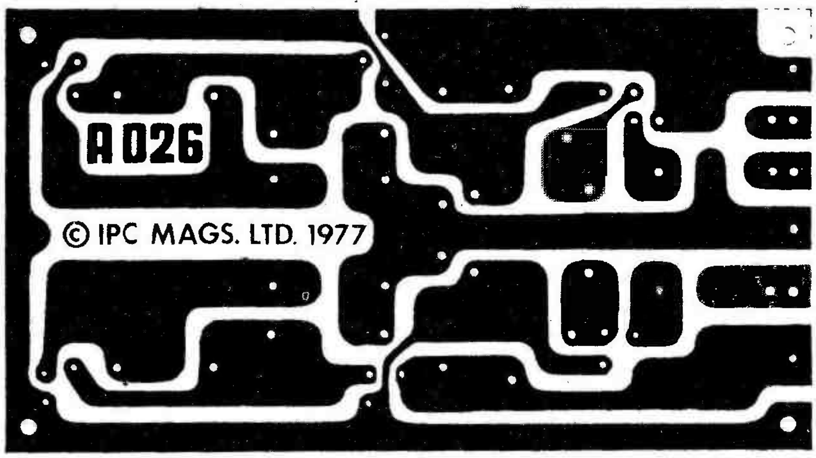
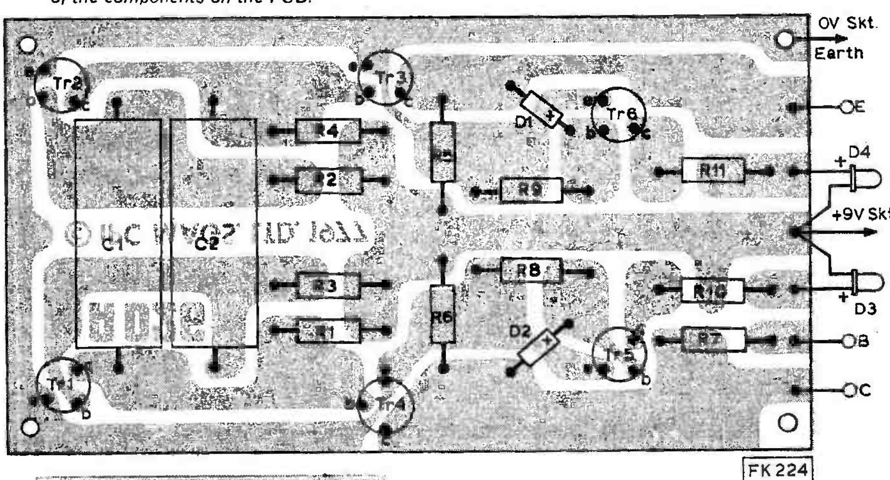
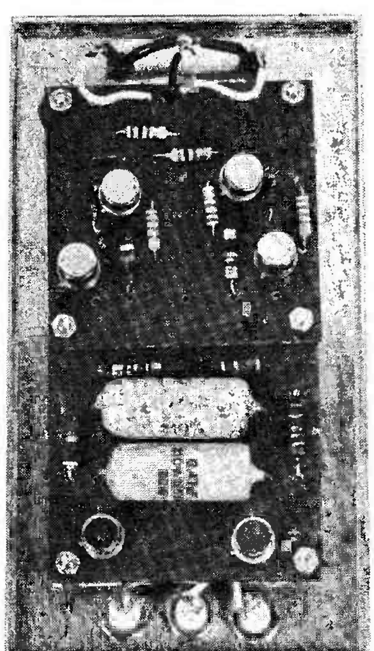


Fig. 2: above, is the printed circuit board, copper side, shown full size. Fig. 3: below, is the layout of the components on the PCB.





View of the first model of the Transistor Checker in which two boards were bolted together. The test sockets are at the bottom and the LED's at the top.

★ components list

Resistors

R1	4·7kΩ	R5	10kΩ	R9	2·2kΩ
R2	47kΩ	R6	10kΩ	R10	1kΩ
R3	47kΩ	R7	2·2kΩ	R11	1kΩ
R4	4·7kΩ	R8	2·2kΩ		

Capacitors
C1 470nF C2 470nF

Semiconductors
Tr1 to Tr6 inc BC108 D1 and D2 1N4148 or similar
D3 and D4 LED general purpose

Miscellaneous
Aluminium box 5¼ x 2¾ x 1½in. or similar
Sockets 5 off. PCB from PW Readers PCB Service, see ad.

turns the LEDs fully off, in conjunction with R8 and R9. If necessary, further resistance may be added in series with the diodes. In the prototype it was found that with a "good" transistor one LED remained partly lit due to this fault, normally indicative of a leaky transistor, especially germanium.

continued on page 848

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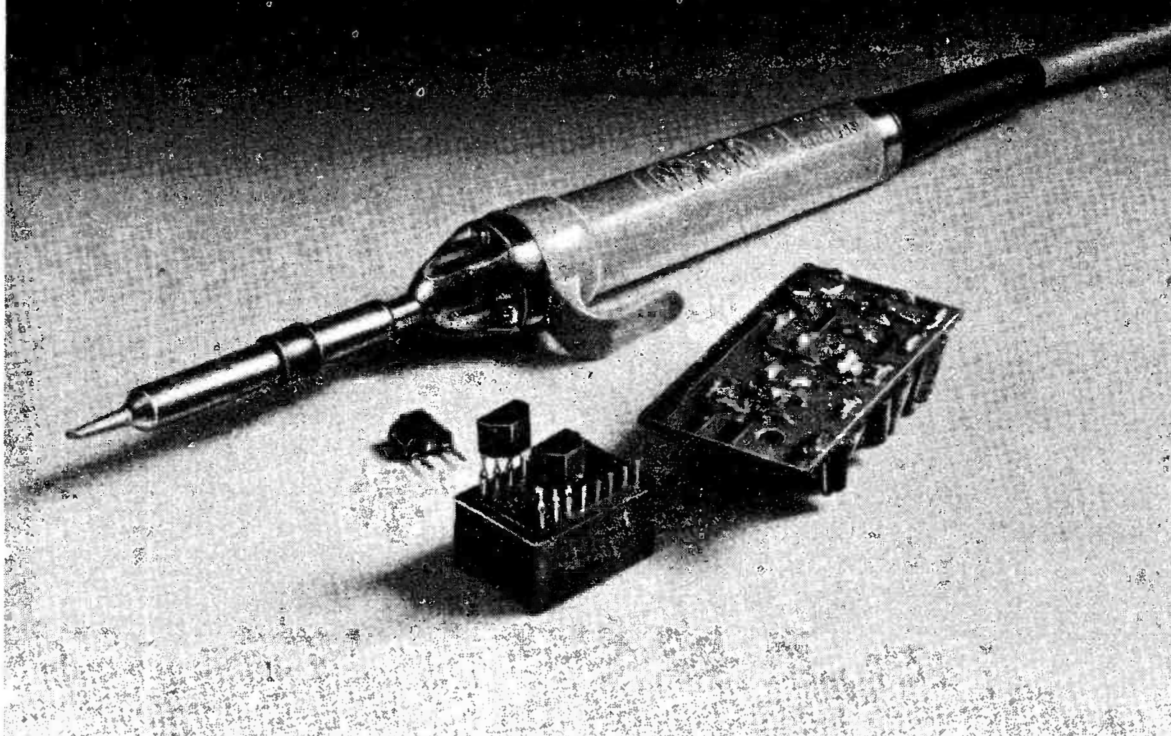
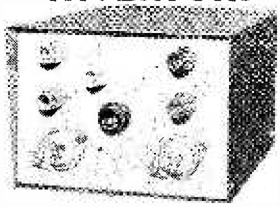


INVERTORS



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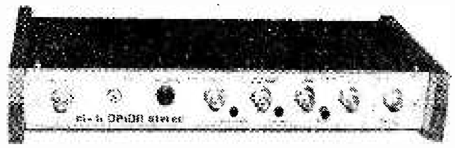

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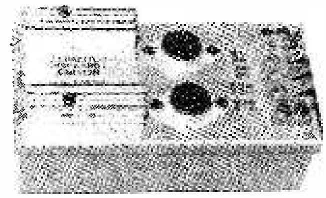

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IAN HICKMAN

COVER PROJECT

MANY electronic systems, in communications, in industrial control systems, computers, aircraft etc., make use of wiring looms and cable forms. Checking these out can be a time consuming chore and various aids have been devised. Where a sufficient number of similar wiring harnesses are involved, the checking time can be cut to seconds by employing Automatic Test Equipment. Such equipment typically tests all possible combinations of terminals, thus picking up shorts between wires as well as open circuits, and displaying or printing out the locations of any faults.

The tedium of programming the ATE is avoided by offering up a known good cable assembly and the ATE checks it out in a "LEARN" mode, storing the locations of all connections found. The ATE can then check out other assemblies in the "TEST" mode by comparing the results with the stored information. Needless to say, a continuity tester is needed to check out the original "known good cable assembly"!

A continuity tester is also used where only one or two cable forms are to be tested or where ATE is not available. In one form or another, continuity testers have been around since long before ATE came on the scene and the circuit of a typical tester is shown in Fig. 1. It is designed to give out an audible tone when the test prods are connected together via a good circuit. Thus the operator does not need to look at the tester but can concentrate on his check-list and the cable-form or multi-way connector lead etc. under test.

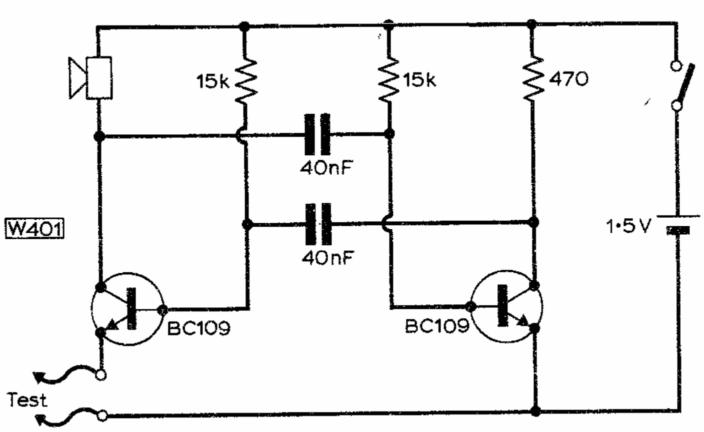
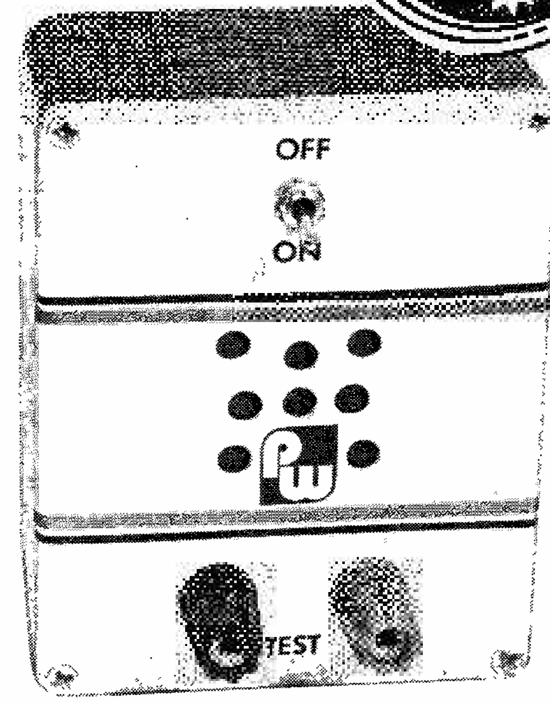


Fig. 1: Circuit of a simple continuity tester with an earpiece or small speaker as indicator.

As can be seen, the circuit is simply a multivibrator with a telephone earpiece as the collector load of one of the transistors and with the OV lead open circuit between the two transistors. When the test probes are connected together, the multivibrator causes a tone to be emitted by the earpiece, loud enough for use in all but the noisiest surroundings,



even when the circuit is powered by a single 1·5V cell. Its main disadvantage is that it does not have good discrimination against marginal circuits and will pass them as good even up to several ohms. Even 20Ω between the test prods will cause a tone to be emitted, though only an inattentive (or tone deaf!) operator would fail to notice that it was higher and weaker than usual.

An improved tester

Various continuity testers have been developed which will only pass a circuit as good when its resistance is less than 1Ω. Whilst this is a big improvement on the performance offered by a tester of the type shown in Fig. 1, the resistance of a "good" connection in most cable-forms, multi-way leads and p.c. board tracks etc. would typically be less than a tenth of this value, unless there is a dry joint or other fault. Fig. 2 shows the circuit of a continuity tester developed by the author which uses very few components and which indicates when a connection has a resistance exceeding 125 milliohms (125mΩ).

Circuit description

Resistor R1 supplies a test current of 10mA to the circuit under test and the potential difference developed across it is applied to the non-inverting input

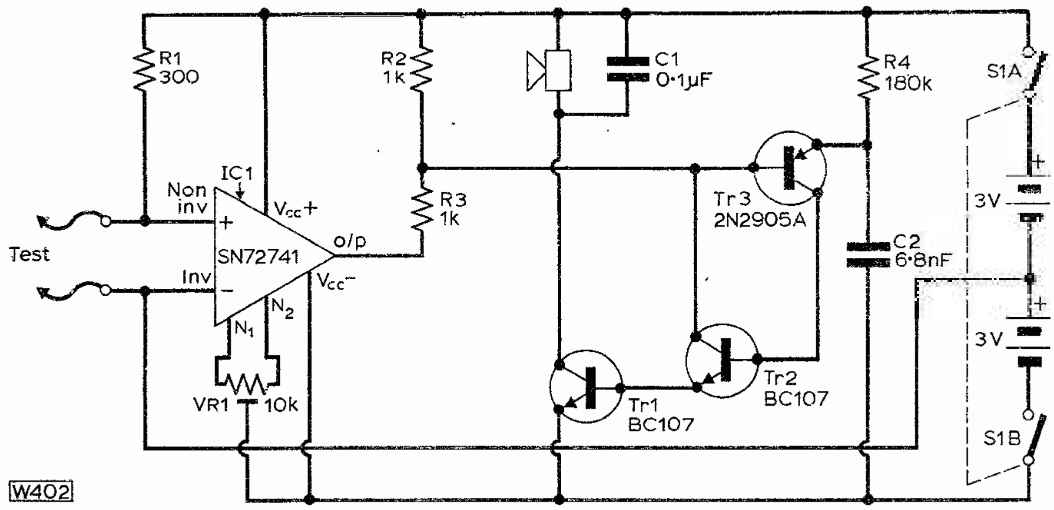
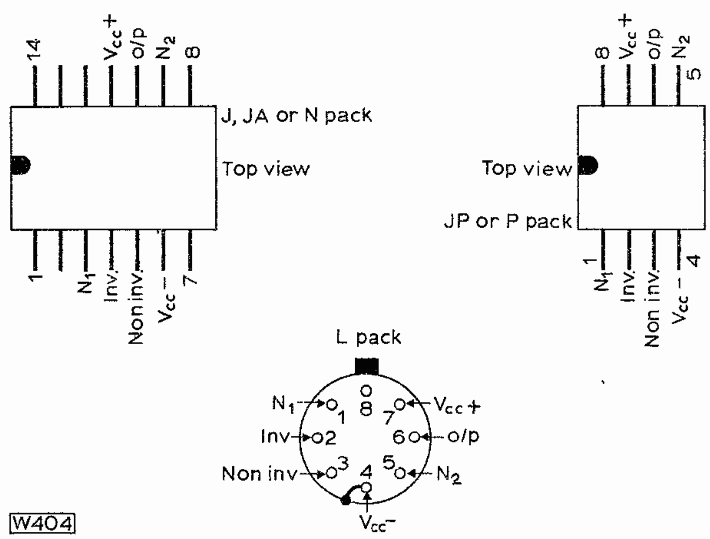


Fig. 2: Circuit of the unit developed by the author, which is much more precise in its indications.

Note: Tr2, collector should go to Tr1 base and emitter to Tr3 base.



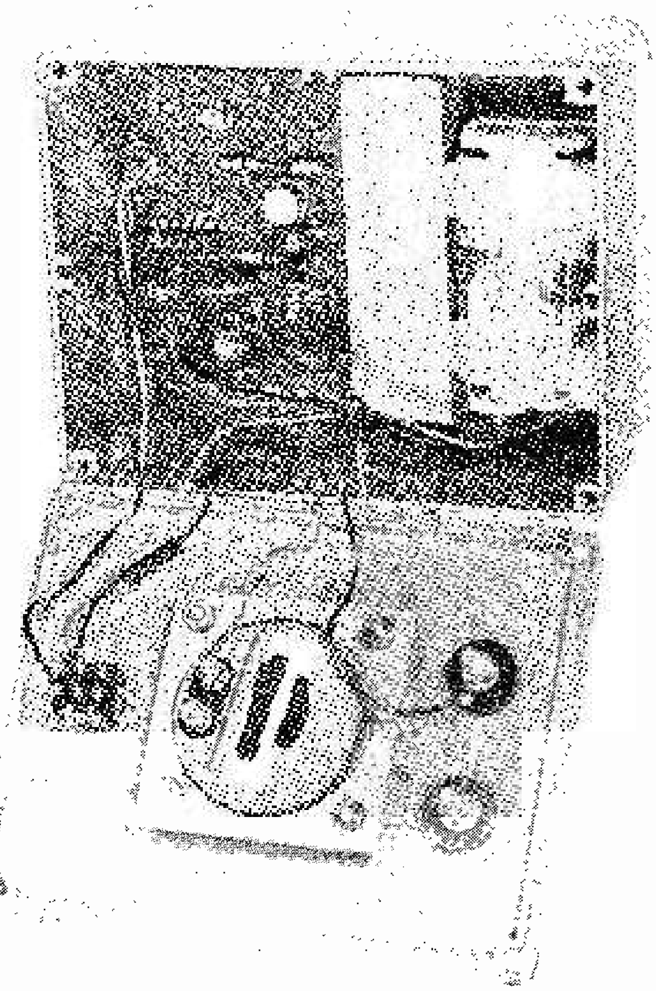
Lead-out diagrams for the various types of package in which the 741 op-amp is available.

of a 741 operational amplifier. VR1 is connected between the offset null terminals, with its slider connected to the negative supply rail. Whilst the normal use for VR1 is to reduce the input offset voltage of the operational amplifier to zero, so that when its input terminals are at the same potential its output terminal is at 0V, in this instance it is used deliberately to introduce an offset of 1·25mV at the non-invert input terminal.

When the input terminals are shorted together, the output terminal of the op. amp. is at nearly −3V, but when the input terminals are open circuit, the output terminal is at nearly +3V. In this condition the junction of R2 and R3, and hence the base of Tr3, is very nearly at +3V, and hence Tr3 cannot conduct. However, when the input terminals are shorted, since the amplifier output is at almost −3V, the junction of R2 and R3 is a little above 0V. Consequently when C2 charges via R4 to a voltage more positive than the base of Tr3, both Tr3 and Tr2 turn on and conduct hard. They thus discharge C2 back down towards the negative rail, via the base emitter junction of Tr1, which also therefore saturates, applying 6V across the earpiece.

During this regenerative action, the junction of R2 and R3 is taken down towards the negative rail by the bottoming action of Tr2, but when C2 is completely discharged, the current via R4 is insufficient to keep Tr2 and Tr3 bottomed due to the fall in current gain of transistors at low current. So the junction of R2 and R3 returns to its former voltage leaving Tr3 cut off, and Tr1 and Tr2 likewise. C2 then commences to recharge via R4, resulting in a sawtooth waveform across it.

When the resistance between the input terminals is 125mΩ, the 10mA test current causes a 1·25mV drop, and as this equals the offset voltage, the amplifier output voltage is 0V. Thus the base of Tr3 is nearer +3V, C2 takes longer to charge to a voltage sufficient to turn on Tr3, and the pitch of the tone emitted by the earpiece falls. Further, owing to the high gain of the 741 op. amp. and the fact that it is used open loop, the noise at its output is appreciable. Hence the tone emitted by the earpiece is not only lower but has a characteristically unsteady nature which contrasts unmistakably with the clear tone which indicates a good connection.



The small component board is mounted in the bottom of the box which can be aluminium or plastic. The earpiece or miniature speaker is attached to the lid and holes drilled or cut in the lid, as shown in the heading photograph.

★ components list

Resistors
R1 300Ω R4 100kΩ *R7 47Ω
R2 1kΩ *R5 2·2kΩ VR1 10kΩ preset
R3 1kΩ *R6 10kΩ miniature vertical
*if required

Capacitors
C1 0·1μF C2 6·8nF

Semiconductors
IC1 SN72741 or alternative
Tr1 BC107 Tr2 BC107 Tr3 2N2905A

Miscellaneous
Diecast box, or similar, approx 4½ x 3½ x 2in. deep. HP7 batteries, 4 off, with holder. Terminals, 2 off. Telephone earpiece 50Ω or equivalent speaker 2½in. dia. probably 80Ω. Two-pole on-off switch. Single pole on-off switch, if required. Piece of veroboard.

Owing to the rapid discharge of C2 when Tr3 conducts, Tr1 is only bottomed for a small fraction of the repetition period. This inductance of the earpiece (which is a 50Ω telephone type) would prevent much current flowing and thus result in an inadequate sound level being emitted, were it not for C1. This is charged by Tr1 during its narrow "on" pulse, thus effectively stretching the pulse resulting in more power being fed into the earpiece.

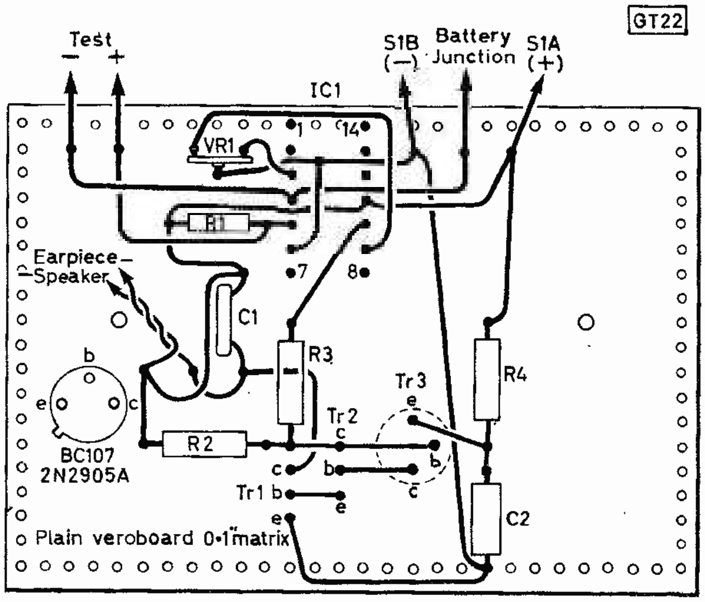
Other factors

The open loop gain of a 741 op. amp. at ±3V supplies is typically 4 x 10^4. So for full output voltage swing from saturated in the positive direction to saturated in the negative direction, an input variation of about 150μV is required. This is about an eighth of the 1·25mV input to the op. amp. provided by the 10mA test current in 125mΩ, giving good discrimination with a fairly narrow "marginal" range of resistance between the value indicated as continuity and that indicated as high resistance/open circuit. There will be some drift of the marginal resistance value with ambient temperature. For the 741 this turns out to be around ±20μV/°C, worst case, when the supply rails are ±15V. It is not thought that this figure will be exceeded at ±3V rails, so the worst drift over ±10°C relative to "room ambient" of 20°C is ±200μV. This corresponds to a worst case variation of ±16% in the 125mΩ marginal resistance point over the range 10°C to 30°C, though of course most op. amps. will exhibit a much lower temperature sensitivity than this.

Variation of supply voltage can in practice be ignored, since the current drain of the tester when the test prods are not shorted is only 250μA. This rises to 10mA whilst the earpiece is sounding, but in normal use, the four penlight cells will show little change in voltage over an extended period. (They should in any case be changed once a year.) Note that with an open circuit voltage at the test probes of 3V and a short circuit test current of 10mA, the maximum power that the tester can deliver to the circuit under test is 1·5V x 5mA = 7·5mW. This is insufficient to damage any common small-signal semiconductor, whilst on the other hand the tester will not indicate a metallic connection via even the largest power diode.

Construction

The prototype was built in a diecast box which has ample room for the circuit board and a plastic battery holder for the four penlight cells. The circuit should be entirely isolated from it. The circuit was built by passing component leads through the holes in a piece of 0·1in. grid SRBP pin board and wiring up on the other side with tinned copper wire suitably sleeved. All the wiring to the input of the op. amp. including the leads from the circuit board to the test terminals and the test prod leads themselves should be of a generous gauge. As the op. amp. is run open loop from low voltage supplies, oscillation is not likely to be a problem, but if experienced, 0·1μF disc capacitors decoupling the rails to 0V, adjacent to the op. amp., will cure the problem. It is probably wise to include them in any case.



Layout of the components on top of the Veroboard. The wiring, shown with heavy lines, is carried out ***on the back of the board*** *with thin insulated wire or the component leads themselves.*

Calibration

The circuit can be calibrated adequately with only a multi-meter and some resistance wire from the junk-box. Using wire of around 10Ω/yard cut a length giving 8·2Ω. As most multi-meters are not too accurate at such low resistance values, cross check against an 8·2Ω 5% resistor. Now cut the wire in half and connect the pieces in parallel keeping the soldered ends to ⅛in. long. The result is a 2Ω resistor, and repeating the process twice more gives a 125mΩ resistor, made up of eight wires in parallel. Connect this securely between the test prods and adjust VR1 until a steady high tone is emitted from the earpiece. Now set VR1 back until the pitch just begins to fall, it will also sound unsteady. The tester is now calibrated.

Variations

By choosing different test currents or offset voltages, other go/no-go resistance values can be obtained. Thus if a 2·2kΩ resistor R6, wired across a switch S2, is placed in series with R1 a choice of 125mΩ or 1Ω is available as the pass resistance, Fig. 3a.

If a pass resistance of 0·5Ω is required, the temperature sensitivity of the tester can be reduced by using the circuit of Fig. 3b. Here, as the necessary

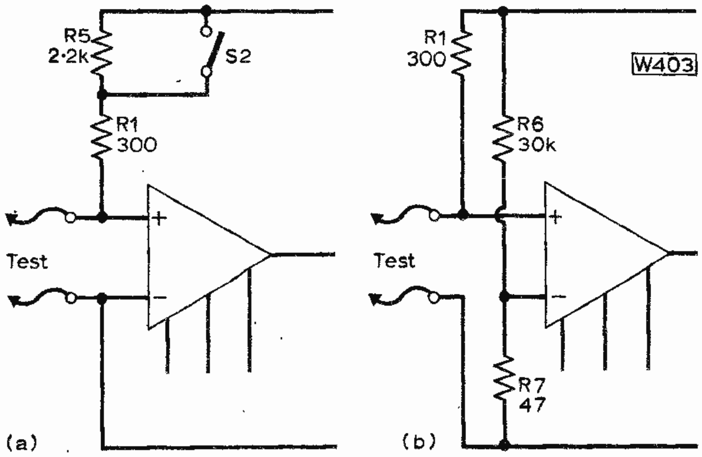


Fig. 3: Modifications to the circuit to allow variations in the value of the pass resistance.

5mV offset at the op. amp. input may be near the limit of VR1, it has been applied directly to the inverting input.

The tester can be set to pass only circuits of 50mΩ or less, but the temperature error becomes troublesome. This can be obviated by making VR1 a front panel control, and mounting a 50mΩ calibrating resistor inside the tester, mounted on pins projecting through the front panel. The tester can thus be set up immediately prior to use at the prevailing temperature.

Obviously, many other variants are possible e.g. by using a variable resistance in place of the 2·2kΩ resistor in Fig. 3a, the sensitivity can be set to any desired value, but it is best to avoid front panel adjustments whenever possible. This is especially so if the continuity tester is to be used by anyone non-technical, and the basic circuit of Fig. 2 probably represents the best general purpose compromise. PW

TRANSISTOR CHECKER—*continued from page 842*

Construction

Construction should present no problems due to the simplicity of the circuit. A home-made printed circuit board was used, Figs. 2 and 3, but veroboard could easily be substituted. Small sockets were used for external battery and transistor connections. This saved on the expense of a transistor socket and battery holder. Most constructors have an S-dec or T-dec breadboard which provides an ideal holder for components under test. Crocodile clips are also useful, especially for TO3 power transistors which cannot easily be plugged into some holders. The LEDs were panel mounting types fitted to the front of the box.

Notes

The unit will work over a wide range of voltages limited at the low end by the oscillator functioning and the dimming of the LEDs. It is not recommended for use over 15V since some components can be damaged by the reverse voltage, (current limited) that may result.

The oscillator outputs are available, buffered, at E, B and C, if required, for example as a signal generator.

Finally, note that when testing transistors the collector should be firmly connected. The unit will give an indication across the base-emitter junction, and, if the collector is unconnected, will fail to reveal a collector-base/collector-emitter short circuit. PW

Theoretically calibration can be made using DC with the input capacitor short circuited, but the source would need to have an output impedance of many megohms. If a DC meter is available which has a resistance many times that of the bias potentiometer, then that potentiometer can be calibrated directly while in the circuit. An alternative is to use a high grade instrument, whose resistance is known, and, after the calibration, to replace it by an equivalent resistor. A low resistance meter is useless for calibration since it must reduce the effective range of the bias potentiometer when replaced by its equivalent resistance.

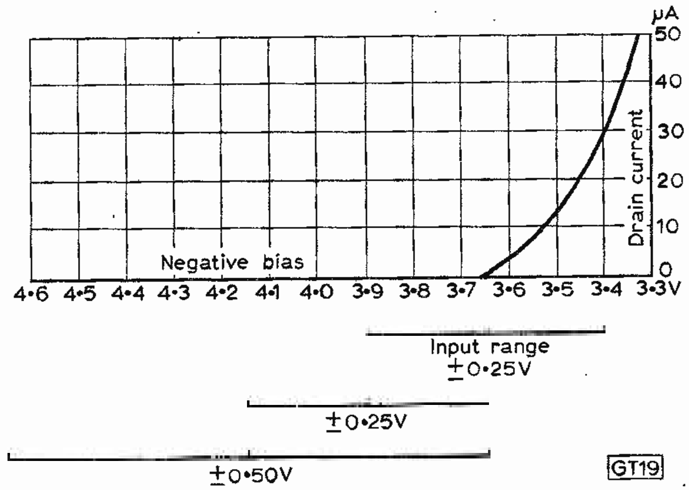


Fig. 8: Graph to illustrate the operation of the FET voltmeter.

The operation of the slide-back FET voltmeter is illustrated by the curve shown in Fig. 8. Assume that the negative bias control is set at minimum and the set zero control is adjusted to give zero drain current. The bias on the gate will then be −3·65V. If a signal having a peak range from +0·25V to −0·25V is then applied the meter will read 30µA on peaks. If the negative bias control is then adjusted to reduce the drain current to zero the total negative bias on the gate will have to be 3·9V. The extra bias needed is equal to the peak-to-zero voltage of the applied signal. If a signal is applied having a peak-to-peak value of 1V then the bias will have to be increased from 3·65V to 4·15V and so 0·5V is the peak-to-zero reading.

FETs are notorious for the range of variation from one sample to another but if more negative bias is needed the 6V battery supplying it can be replaced by a 9V one.

Dear Sir, letters

brr . . . brr . . . click . . .

In my article on Satellite Communications, I stated (p. 398, September issue) that the short audio charging pulses could be heard in the telephone. You published a note (p. 518, October issue) stating that the Post Office have pointed out that these pulses cannot be heard.

My article was submitted to a Post Office official for approval and it so happened that I discussed this very point about the audibility of charging pulses with him. Although the pulses are fairly quiet, they can be heard quite clearly during breaks in the conversation and are especially noticeable on inter-continental calls owing to their greater repetition frequency. Whilst they may be heard on inland calls, especially on long distance calls made at peak times, they are usually indistinguishable from noise on the line unless one times them with a watch and notices their regular timing.

Unfortunately my phrase "short audio pulses" was misleading; it would have been better if I had used the words "short charging pulses" or "meter pulses".—**Brian Dance** (Warwickshire).

Commenting on Mr. Dance's letter, a Post Office spokesman said: "We apologise to Practical Wireless *readers for misleading them by our categorical assertion that metering pulses cannot be heard on telephone calls. We misunderstood Mr. Dance's original reference to audio pulses, which we took to imply bursts of audio-frequency tone.*

"Under certain circumstances metering pulses—square waves of 250 ms duration—can be heard as clicks in the background of a 'phone call. Normally, the level of the pulses is so much less than that of speech (−35 dBO compared to −13 dBO) that they should not be heard on a call. However, we think that, on some connections, out-of-balance conditions, occurring somewhere in the circuit result in higher pulse levels."

Input listening

Having read the September edition of *Practical Wireless* I am writing to say that I am in full agreement with Mr. E. Watt in his comments against the whole system of repeaters on 2m, and now, apparently, on 70cm also.

May I draw the attention of all users of "black boxes" to Section 7 of the Amateur licence which states: "The station shall be equipped for the reception of messages sent on the frequency or frequencies, and by means of the class or classes of emission, which are in current use at the station for the purpose of sending".

I cannot recall the number of times I have listened to stations using a repeater, who are "unable to listen on the input". How many commercial transceivers automatically operate on the 600kHz shift when switched to "Repeater"? So the user cannot listen on the input frequency even if he or she wishes to. It isn't often that one hears a station on 2m or 10m via an Oscar satellite say he is "listening 10/2m downlink *and* this frequency"!

How many stations use an FM transmitter and then slope detect the stations that they work? They do not realise that this is not receiving in the class of emission in which they are transmitting. Such amateurs would soon be in trouble if they failed to fill in their log books or transmitted "gramophone or tape recordings of the type intended for entertainment purposes". So why do so many get away with disregarding Section 7 of the amateur licence conditions?—**Paul Heath** (Wolverhampton).

Simple—isn't it?

In reply to the letter of Mr. Padmore, I, being the laziest so-and-so ever to lay hand to a soldering iron, have had to find the answer to his problem and other such annoying foibles of electronics.

To strip enamelled copper wire I use a pair of long nosed pliers with well ground intermeshing jaws. If the wire is pulled sideways through the jaw it will remove the varnish inside two seconds without damaging the copper in the slightest.

Alas and alack not so for litz. The only way with this awkward animal seems to be to throw it on its back and attack with a new, sharp, Stanley knife blade, angling the blade backward, and rubbing the frayed threads off with the tips of the fingers—at least hopefully!

For another annoyance—that of component fallout—(when turning a PCB over to solder) instead of bending the wires over and ending with an unsightly joint, I use a blob of Blu-Tack (available from all stationers) to hold it in place against the board. This same stuff also does an admirable job as a third hand for holding a heatsink such as the Antex model to the tranny lead for soldering, holding the sink to the board with two blobs.

I have also used this versatile gumph as a sealant for a die cast box, a vibration absorber on heavy components and a temporary flex connector, aside from its obvious use for stopping small nuts and bolts from creeping away while your back is turned.

I make accurate PCB's by positioning a photocopy of a board design over the copper, marking through the holes and then "joining the dots" with a "dalo" pen. The board is then marked completely and with accurate positioning.

I hope that these ideas will be of use to readers, and many thanks for an excellent magazine. —**H. Pruim** (London).

Fish-eye lens?

Re your photo on p. 477 of the October PW; could it be that some ham-fisted engineer has drawn the connecting cables too tight (or they've shrunk!), and, due to the deep foundations of the masts, this has resulted in a concave curvature of the earth between them?

No, I don't think so, either. It's probably the angle at which the photo was taken, or a 'duff' lens.

Incidentally, the last time I wrote to PW was in the mid-'30s, when I sent a "Reader's Wrinkle", suggesting the use of a cycle mileometer for counting the turns when winding transformers by hand. I believe I received half-a-guinea for it. Happy days!—**I. Hutchings** (London).

Democratic, it is . . .

I have read with interest the letter from G4ECB which appeared in December PW, and as I have at the present time the honour of being President of that organisation which he accused of being a toothless dog I feel that a reply is called for.

First of all—let me make it clear that although membership of the national radio society is mandatory in order to obtain a licence in some countries we would not wish for this state of affairs to prevail in Britain.

Mr Leaver accuses the Society of not being democratic. Each and every Council member, Regional Representative, and Area Representative is nominated by and voted into office by the membership. I would have thought that this was democratic? I would be interested to see the figures from which he deduces that the Society represents a minority of amateurs—ours indicate otherwise.

Who wants repeaters on the two metre band? Well Mr Leaver, some amateurs do—and therefore, acting democratically by taking into account the wishes of minorities we now have them. There are many minority interests in amateur radio which have a right to exist.

I am surprised that it is suggested that the Society should use members' money to circularise non-members to find out what they want. If they do not wish to join they can hardly expect those who do to pay the cost of finding out about their interests! Government by referendum is unusual in any democratic nation and there is no indication that the majority of RSGB members desire it, or are prepared to face the enormous additional costs involved.

Does Mr Leaver really know what he is saying when he suggests that RSGB doesn't fight for the amateur bands? As he is a non-member he may not yet have heard of WARC 1979 and the immense amount of work being done by national societies all over the world in preparation for it. All this is being financed by funds derived from members of national societies. If therefore, the Amateur Radio Service emerges unscathed from the conference, Mr Leaver and his fellow free-loaders will benefit just as much as those who are actively working for its preservation. Surely this is democracy! It may be of course that he and others who share his beliefs in other countries are preparing their own case for the conference, and that they are briefing their own administrations and sending their own delegations to Geneva when the time comes. Although I fear that this may not be the case!

Mr Leaver believes that questions should be asked. I invite him to go ahead and ask them. **Dr. John Allaway, G3FKM,** (President, RSGB).

1/4 wave condemned

In his letter published in *Practical Wireless* November, 1976, your reader Mr. J. Bradbury (G3AVR) expressed surprise at my advocating the use of plastics such as PVC and Paxolin and sealing compound, namely Sealastic, in VHF aerial applications. (My article "Vertical Aerials for 144MHz" *Practical Wireless* July '76). If Mr. Bradbury took the trouble to examine VHF and indeed UHF transmitting aerials by any well known manufacturer he would find PVC and similar plastics commonly used in construction.

Obviously one does not use such materials at RF voltage maxima points but at low impedance junctions and connecting points, paxolin, PVC and the like produce no measurable loss. Sealastic also exhibits no loss either when used to seal the "weather" end of low impedance co-axial cables and neither does polyurathane paint or varnish applied to radiating elements. Tests on aerials using the above materials have been carried out with test equipment capable of measurement to within less than 0·5dB at 145MHz and higher.

I must also question the statement by Mr. Bradbury that the "unipole" or common quarter-wave radiator, as he calls it, is used as a standard reference aerial when measuring directivity gain of other VHF aerials by comparison. I suggest he reads the McGraw-Hill book "Antennas", by Professor John Kraus, once more and particularly page 454 in the chapter "Antenna Measurements" from which I quote *"Gain is always measured with respect to some reference antenna. Since an isotropic source is a hypothetical standard it is common practice to make actual gain measurements with respect to a half-wavelength reference antenna".*

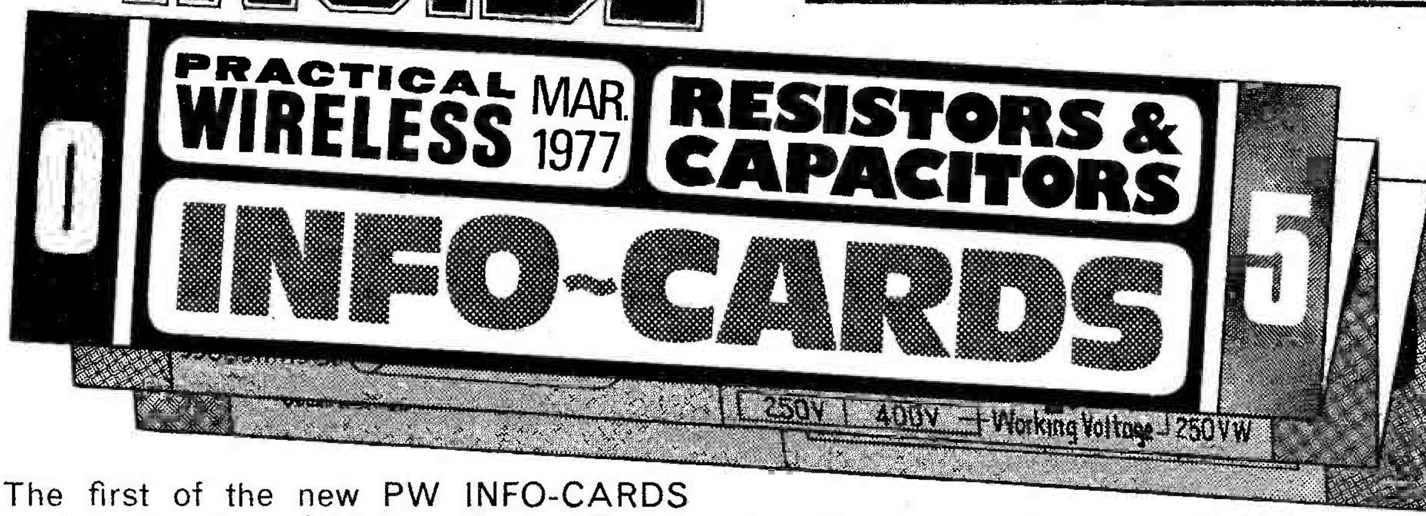
The quarter-wave aerial is frequently used as a reference at medium and very low frequencies (medium and long wavelengths) and then only in conjunction with a large area buried radial earth system to obviate the generally poor conductivity of earth itself. Such a system is generally only used when measuring the directivity gain of other grounded vertical aerials. At VHF a quarter-wave aerial would be impossible to use except with an infinite artificial ground plane of high conductivity, which is not practicable, because VHF and UHF aerials must be in "free space" i.e., well clear of other conducting structures when making gain and radiation pattern measurements.

A small ground plane, such as commonly used with VHF vertical aerials, is not practicable either as power losses and high angle radiation are caused by "edge" effect (standing wave and phase shift due to fractional wavelength radials) which means that such an aerial will have less than its theoretically possible gain. It is for this reason that the USA FCC have condemned the quarter-wave as a reference aerial as its use can make the gain figures for other aerials appear higher than they really are. Some manufacturers even resort to quoting an isotropic radiator (which does not exist as it is hypothetical) as a reference, as this can make gain claims look even better.

Incidentally, it is high time some action be taken in this country in connection with misleading claims for VHF and UHF aerial gain, frequently made without any reference whatsoever, or to an isotropic but without this fact being revealed, or to a quarter-wave ground plane (for reasons I have already mentioned). The most classic case of questionable specification I have come across so far and quite recently, is a claim of 3dB gain for a half-wave (mobile) 145MHz aerial with reference to a half-wave dipole. Perhaps some one has at last discovered how to make a piece of wire produce gain!—**F. C. Judd, FISTC M.INST.A A.INST.E** (London).

*FREE INSIDE

IN NEXT MONTH'S PRACTICAL WIRELESS



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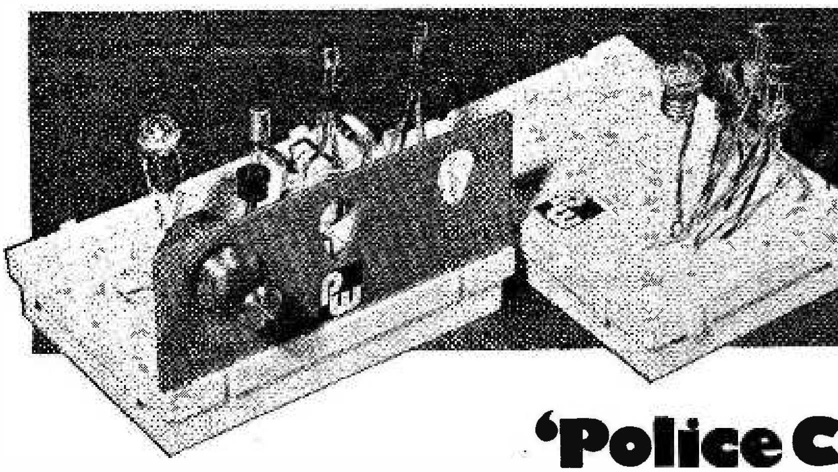


DAVID GIBSON

THIS MONTH

'Police Car Wailer'

THE circuit this month was built mainly for novelty. However, it does lend itself to other applications and experimentation. In its basic form it is a police car wailer; the noise so often heard in current television "cops and robbers" programmes. It is an uncritical circuit and works well from quite low battery voltages. There should be no problems at all in getting it to work.

To generate the noise (the WOW-WOW sound) it is necessary to physically move one component by hand. To generate the sound entirely electronically would demand far more complex circuity which would in turn defeat the object of this series.

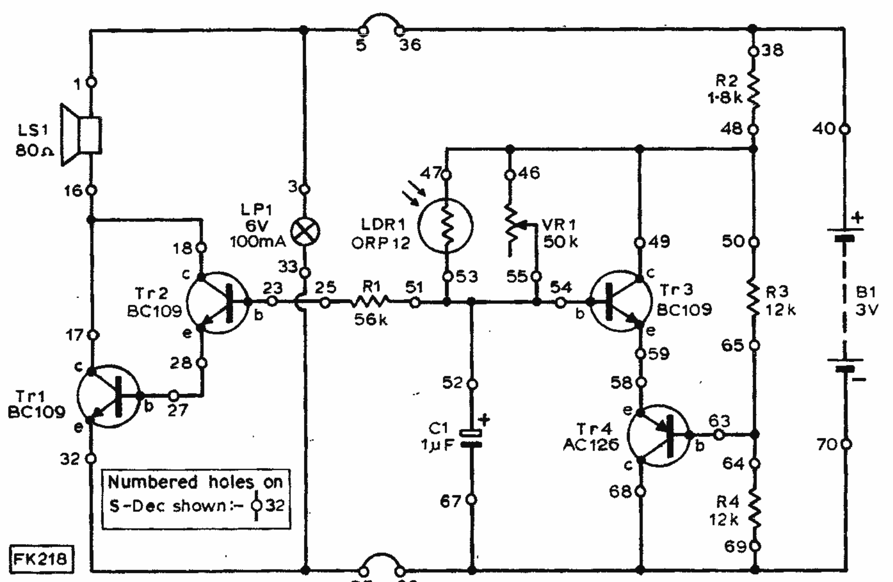
Circuit details

The NPN/PNP pair of transistors (Tr3 and Tr4) in the circuit diagram are connected up as a form of unijunction device. The first two transistors (Tr1 and Tr2) are connected in a Darlington configuration or perhaps more correctly a Darlington current pair amplifier.

These high sounding names merely mean that we have two little circuits, each being composed of two transistors. In essence, we have an oscillator (Tr3/Tr4) and a high gain amplifier (Tr1/Tr2). The capacitor C1 together with resistors LDR1 and VR1 determines the rate at which the oscillator voltage rises.

In this circuit we are using a light dependent resistor (LDR). This is a device which offers a varying resistance depending upon the amount of light falling upon it. The more (brighter) the light the lower its resistance.

Because the bulb LP1 and LDR1 are fairly close



Complete circuit diagram of the 'Car Wailer' S-DeC project. The capacitor C1 can be varied in value—anything from about 1μF up to 4.7μF.

you will need . . . . .

R1	56kΩ	Tr1	BC109
R2	1·8kΩ	Tr2	BC109
R3	12kΩ	Tr3	BC109
R4	12kΩ	Tr4	AC126
VR1	50kΩ pot	LDR1	ORP12
C1	1μF 6V	LP1	6V 100mA bulb
B1	3V battery	LS1	75 – 80 ohms
One S-Dec			

together the light from LP1 will fall on LDR1 lowering its resistance. By altering the resistance of LDR1 in this manner, we can control the oscillator by affecting the rate at which C1 charges and discharges.

To generate the "WOW-WOW" sound, simply switch on the circuit (i.e. connect a suitable battery) and an audible note will be heard immediately. Make sure that the bulb and LDR1 are close together—about one inch to start with. The actual pitch of the note may now be varied by moving the bulb first towards LDR1 and then away from it. The bulb may remain stationary and LDR1 "rocked" if desired.

The basic idea is thus quite simple: an oscillator feeds an amplifier which in turn feeds a small loudspeaker. But there are many ideas which lend themselves to experiment and these are mentioned later.

Plug them in

Constructing the police car wailer is extremely simple. If you constructed the two previous circuits in this series then you will find that many of the components can be used again.

Simply plug the relevant components into the S-DeC holes. The correct holes are shown in the circuit diagram. For example, resistor R4 is plugged (by its own wires) into S-DeC holes 64 and 69. The bulb LP1 is plugged into S-DeC holes 3 and 33. By plugging in the components into the correct numbered holes, the circuit will automatically be connected up properly by the tiny socket connections underneath the S-DeC surface.

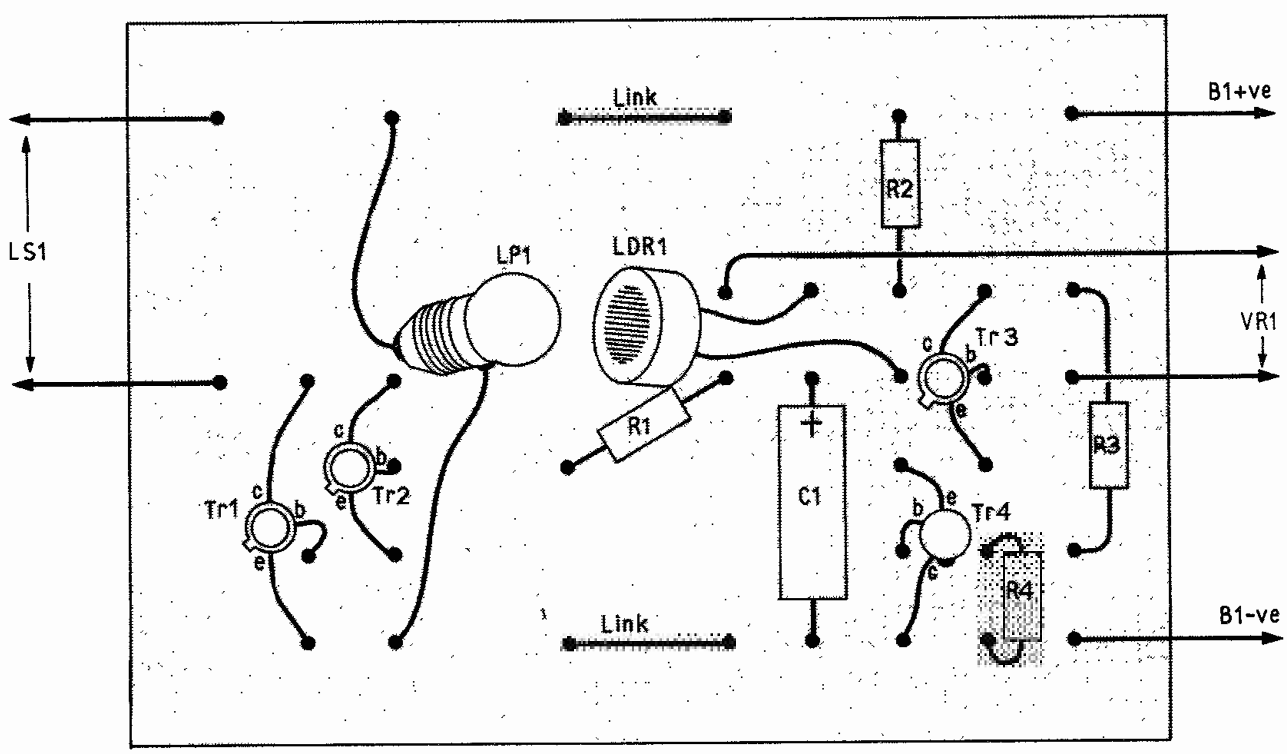
If you don't want to use a soldering iron at all, then try using small crocodile clips to connect the loudspeaker and pot etc. In the prototype, transistor holders are used because the leads of most silicon transistors are not long enough. It may help when identifying leads to put a small spot of crayon or pencil mark at the emitter lead end of the transistor holder—makes it simpler when you plug the transistors in. The capacitor C1 used was not an electrolytic. It was a 2·2μF polycarbonate component which just happened to be at hand. If your capacitor doesn't exactly look like this one, don't worry—almost any type will do although electrolytic types must be plugged in with correct polarity. (The same remarks apply if a tantalum device is employed).

Varying pitch

The basic idea is thus quite simple: an oscillator feeds a two-transistor amplifier which in turn feeds a small loudspeaker. But there are a number of ideas which lend themselves to experiment.

For example, the pitch of the note can also be varied by the potentiometer and it would be possible to actually play a tune by varying the angle of the potentiometer shaft. (Waggle the pot shaft for vibrato!).

Again, the cell (LDR) is sensitive to light. Its resistance is dependent upon the amount of light reaching it and thus the pitch of the oscillator is affected by the light level falling on the cell. By using the cell pointing towards ordinary room lighting and interposing ones hand between light and cell, the note pitch can be varied and the circuit then becomes a light-controlled Theremin. You can play



Full size drawing of the S-DeC showing the numbered holes into which the components are plugged. The LDR is soldered to long leads, to enable it to be 'waggled' in front of the bulb.

simple tunes by merely "waving" your hand over the cell. (Deceptively simple—in reality the playing of a tune by this method requires a fair bit of practice). For parties it's a real winner. Each person is asked to "play" a tune while the others guess what the tune is!

Further experiment is possible by simply altering the value of the capacitor C1. This is simple with the S-DeC because one merely unplugs one value of capacitor and plugs another into exactly the same holes on the DeC.

Altering the capacitor affects the pitch/range of the note. The voltage also affects this too. Using 4·5V and a 4·7μF electrolytic capacitor for C1 gave a low "laughing" sound when the cell was waggled

Photograph of the unit, showing the method of connecting the speaker and potentiometer. Transistor holders are used as some transistors have very short leads making their use on S-DeC's difficult.

near to the bulb. With the 1μF value shown, the circuit will still oscillate right down to 2V. With 3V and a 1μF capacitor, the best police car wailer effect was produced.

For those with a sense of humour—try a 0·1μF capacitor and a 3V battery. This gives a superb electronic canary! Dare I suggest that it's a cheap way to make the sound?

Sound effect

Placing a capacitor across the loudspeaker terminals also has some effect. This is quite simply done on your S-DeC by plugging this second capacitor into holes 4 and 19. Start with about 0·22μF to hear a noticeable difference in the tone which will now appear to be mellowed. A 2·2μF capacitor made quite a big difference while a 10μF capacitor reduced the volume right down to about a quarter. (A 330μF component reduced the volume to zero because it bypassed all the audio signal which should have gone through the loudspeaker—not one of my most successful tricks!). If you do try electrolytic capacitors here, make sure you insert them the right way round i.e. observe polarity: positive lead pushed into S-DeC hole 4, negative lead into hole 19.

The bulb should not be rated at more than 100mA. The 6V 100mA recommended is available at most large cycle stores. The best battery voltage for the circuit was found to be 3V which is also conveniently obtained from cycle shops.

Simple Windmill

Further applications of the circuit are a matter of imagination. One example would be to build the circuit permanently on a Super Solder Board (its copper conducting pattern exactly matches the S-DeC pattern and the holes are numbered exactly the same, too). The bulb and LDR could then be mounted a short distance apart to allow the blades of a small windmill to pass between them. Thus, as the wind blew, so the note would rise; a sort of audio wind speed indicator. Perhaps even better, a simple windmill could be constructed for indoor use. The person being "tested" is asked to blow the sails of the windmill and produce the highest warble possible—a sort of "Puff-ometer". Perhaps even sneezing championships would be possible?

The sensitivity of LDR to light is quite high. It will give a noticeable warble when cigarette smoke is blown between it and the bulb. This was tried in a darkened room and it must be noted that ambient light can effect the circuit if it is too bright.

Used again

If you do decide to build this months S-DeC circuit you'll be pleased to know that most of the components can be used again in a later circuit in the series. Your S-DeC can, of course be used to build all of the circuits.

Next month is the time for lovers—St. Valentine's Day. What better than an electronic St. Valentine's aid? Not convinced. Well, next issue we will show you how to make a passion meter with just 3 (three) components, one S-DeC and a small battery. If you're still not convinced, why not make one anyway—think of all the fun you'll have trying to prove me wrong!

PW TECHNICROSS PUZZLE

Solution to No. 17 presented last month

1 B	■	2 S	■	■	3 C	A	4 P	A	5 C	I	6 T	Y
7 R	O	L	E	■	L	■	O	■	U	■	A	■
A	■	O	■	8 R	E	S	I	S	T	O	R	9 S
10 C	O	W	L	■	F	■	L	■	I	■	■	A
E	■	T	■	11 J	■	12 T	U	13 R	N	14 O	F	F
15 A	I	R	B	A	T	H	■	O	■	N	■	E
N	■	A	■	C	■	R	■	V	■	S	■	T
D	■	I	■	K	■	16 O	V	E	R	L	A	Y
17 B	A	N	18 D	S	19 A	W	■	R	■	A	■	V
I	■	■	I	■	P	■	20 S	■	21 T	U	N	A
22 T	23 U	R	N	T	A	B	L	E	■	G	■	L
■	D	■	E	■	R	■	U	■	24 C	H	E	V
25 V	I	B	R	A	T	O	R	■	■	T	■	E

Part 2

The PW electronic POLYPHON

M. J. HUGHES M.A., C.Eng. MIERE

Circuit operation

The full circuit diagram for the unit is given as Figs. 10, 11, 12 and 13. We refer first to Fig. 10.

The master oscillator utilises the NE555 timer integrated circuit operating in astable mode. Its frequency is set by VR1 which gives a wide variation (about two octaves) in basic pitch of the instrument. IC2 is an MOS organ tone generator and great care should be exercised in handling it. It is imperative to use a DIL socket and before removing it from its protective foam you should take all necessary precautions to avoid static electricity. The output levels of this device are not compatible with TTL and we need transistors Tr1 to Tr12 and their associated resistors (36 in all) to shift the levels prior to branching the 12 individual notes to feed the data inputs of the two data selectors (ICs 3 and 4). IC5a and b provides the divide by two circuits for the two respective notes and the logic of IC6 selects which octave is to pass for Note 1 (similarly IC7 selects the octave for Note 2).

The wires from the pick-up contacts for Note 1 are returned to the +5V rail via resistors R40 to

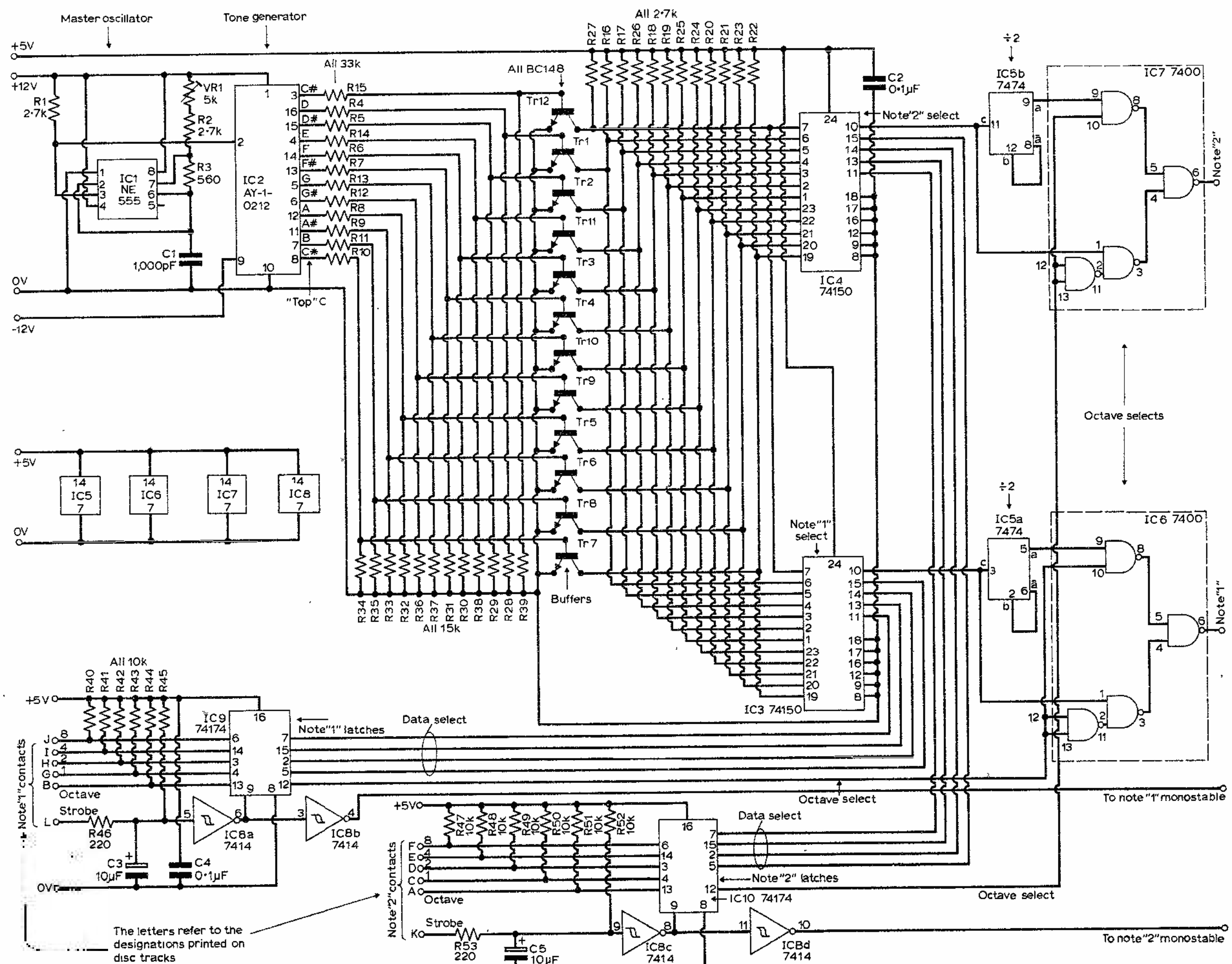
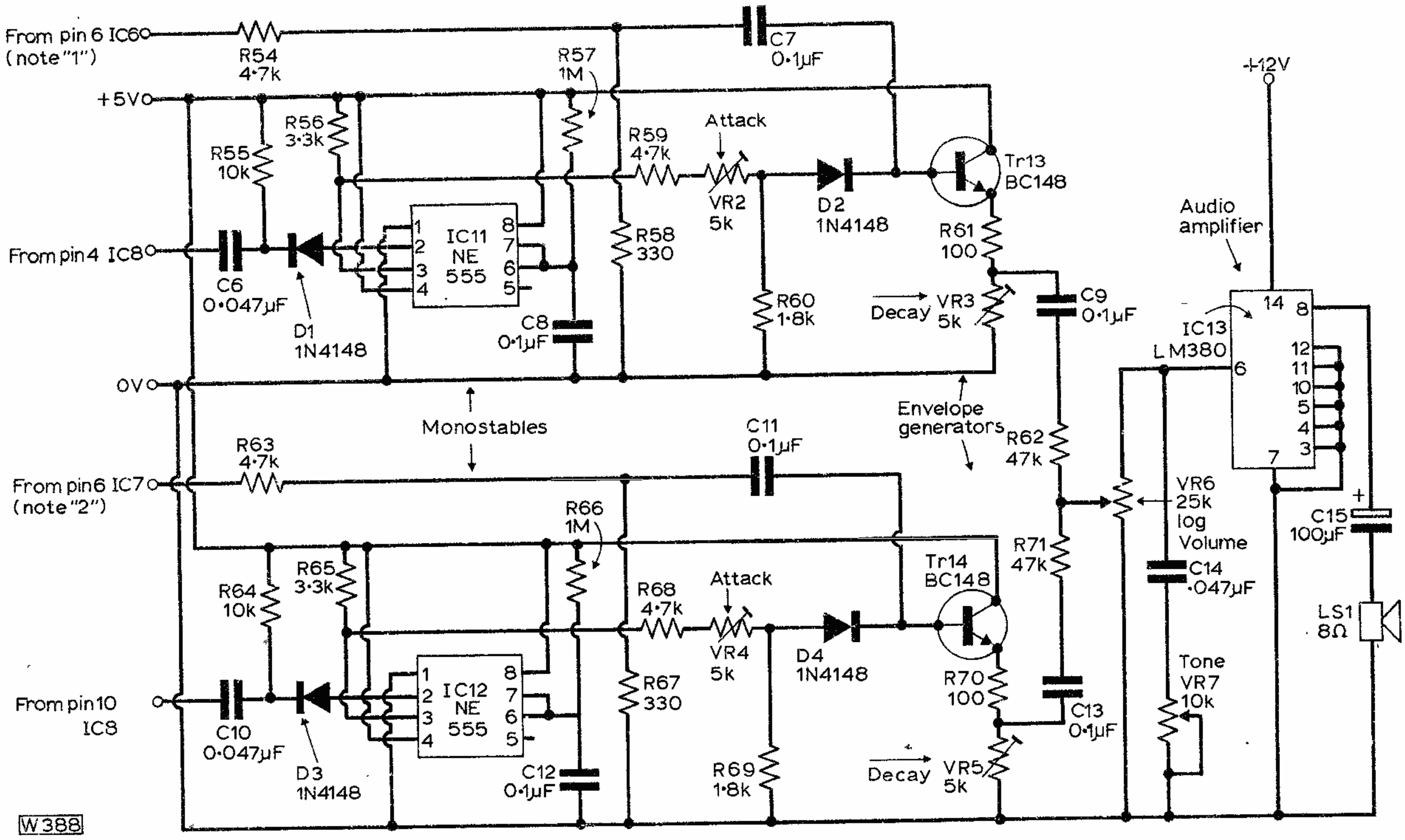


Fig. 10. The circuit diagram of the note generation and selection section of the unit



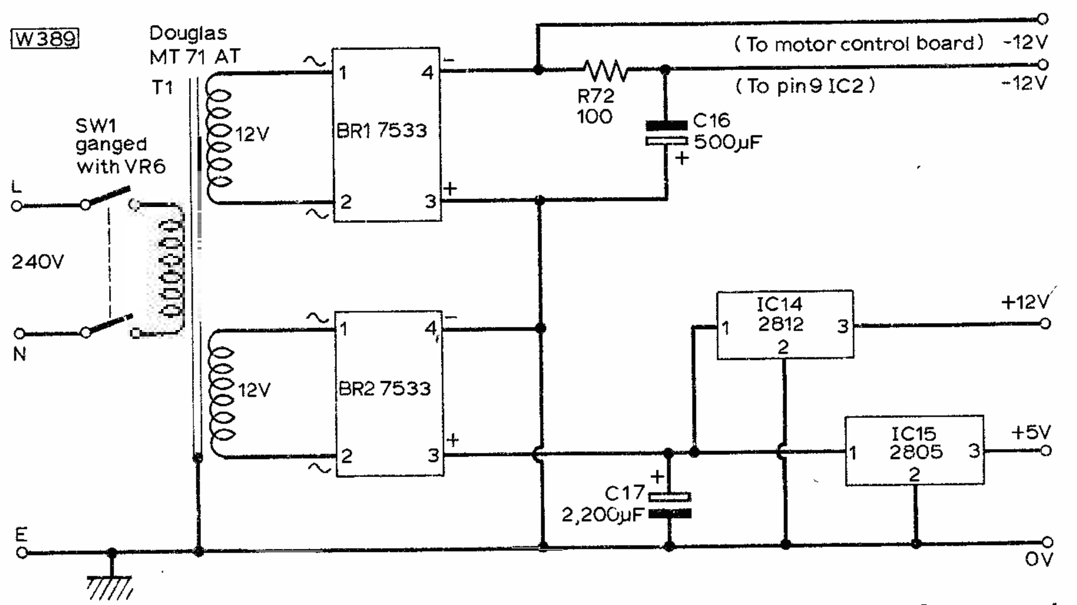


Fig. 11. The circuit for the remainder of the audio section which provides the envelope shape for each note and sufficient amplification to drive a loud speaker.

Fig. 12. The arrangement of the power supply components. Note that BR1 and BR2 are dual-in-line packages, each capable of supplying 1A.
All the components of Figs. 10, 11 and 12 (except the transformer, switch, loud speaker and volume controls) are on the main PCB.

R45 before entering the latches of IC9. Note that the strobe line for this note is coupled through R46 to C3. This circuit, in conjunction with the Schmitt Trigger (IC8a) protects the strobe from contact bounce (otherwise notes might sound twice) whilst IC8b serves to invert the strobe so that it will trigger the monostable which feeds the envelope generator. Similar circuitry conditions the signals for Note 2 through the latches of IC10.

Note the presence of capacitors C2 and C4 across the power rails—these are present to prevent high frequency noise and spurious switching transients affecting the logic.

Consider now the components of Fig. 11. IC11 is the monostable for Note 1. Only the leading edge of the strobe has any effect on it and the output pulse duration from pin 3 has its duration set by R57 and C8. This period is critical to obtain the right rate of attack and decay. The pulse is used to control the operating point of emitter follower Tr13 which has an attenuated level of the note (from IC6) capacitively coupled to its base. The level of this a.c. signal is less than the 600mV required for it to appear at the emitter but when the trigger pulse from the monostable is applied the DC working point is shifted upwards but at a speed set by the time constant of R59, VR2 and C7. This permits the AC signal to appear at the emitter. Although the monostable pulse falls back to zero very quickly D2 prevents a rapid discharge of the DC level on C7. This will gradually leak away as base current into Tr13 and this in turn will be controlled by the emitter load. Thus large values of VR3 will extend the time this takes—giving rise to the decay control period. Provided VR3 is not reduced to below 1,000 ohms there will be no significant effect on the signal amplitude. It should be remembered, however, that if VR3 is reduced to zero it effectively shorts the signal path to ground therefore it is important that when you start testing the instrument you should set VR3 (and VR5—for Note 2) to mid positions.

The two notes are mixed by C9, C13 and R62 and R71 before being applied to the audio stage (IC13).

The power supply stage is shown in Fig. 12. In order to keep it as small as possible on the main board sub-miniature DIL bridge rectifiers are used and IC voltage regulators for the +12 and +5V supplies. An unregulated −12V supply is used for the tone generator and as the current required for that is very small there is ample supply available from BR1 to drive the motor control board. Because we are running the +5V rail from an unregulated source in excess of 12V there will be a considerable amount of power dissipation from IC15 hence the heatsink.

Motor control

We had great difficulty in locating a suitable low-priced motor for this unit and eventually had to settle on a rather expensive model maker's motor which is manufactured in Germany but available in this country at some of the better model shops. It is the Ripmax "Mini-Pile" type EM 136P and its advantage is that it has a four-stage epicyclic reduction drive and an exceedingly high torque at low speeds. Unfortunately even with the four-stage reduction gearing it still does not run at a low enough speed for our application. We need a shaft rotation ranging from 15 seconds to 1 minute per revolution (depending on the type of tune); we also need to have a variable speed. By adding a bit of extra circuitry it is possible to get this speed reduction and make it variable at the same time. The technique adopted is that of pulsing the motor at a rate of about 10 pulses per second. By making the pulses long or short we can obtain a wide range of speed control and we do not suffer unduly from lack of torque because of the high mechanical gear ratio.

The motor will be subject to speed variation depending whether it is on or off load and rotation will be in short, jerky steps. Neither of these has proved to be a problem in this application.

The pulsing circuitry is shown in Fig. 13. Note that the −12V rail is common because we are using the available rectified output from B1; because of this it is important that you do not ground this common rail to chassis. A simple series stabiliser (Tr15) provides a nominal 6V rail and IC16 generates short pulses having a frequency of about 10Hz. These drive IC17 connected as a monostable and VR8 is used to control the width of the output pulse. These pulses are then applied to the motor via the cascaded emitter followers Tr16 and Tr17.

This circuit has been specially designed to match the specified motor and there is no guarantee that it will work with other types.

Cabinet details

Fig. 14 shows that the prototype cabinet is basically four sides (each with a ledge onto which the base plate is screwed), a removable bottom (for easy servicing) and a split lid.

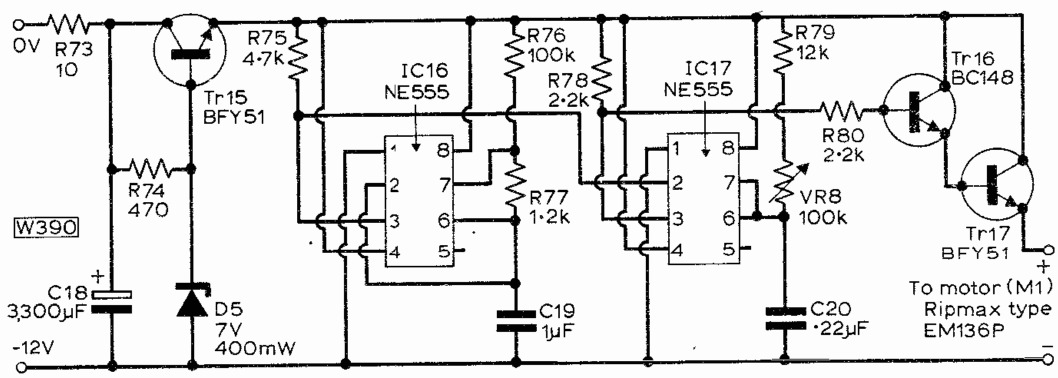
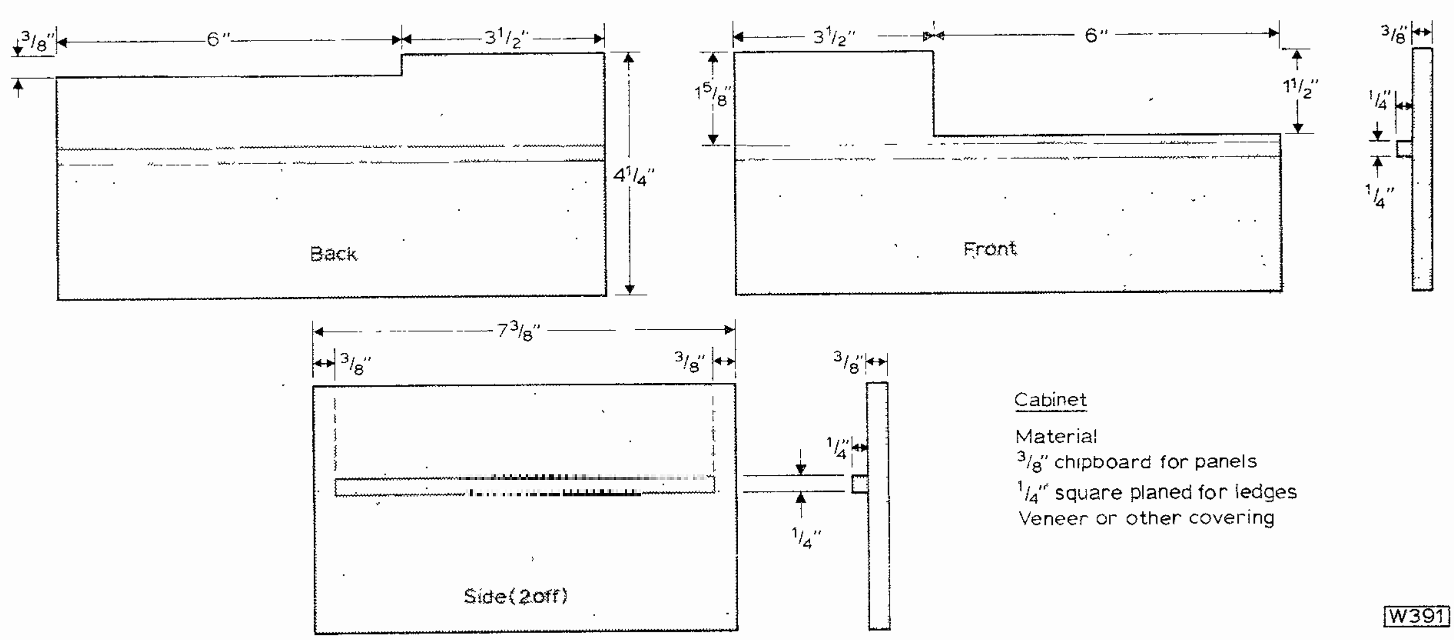
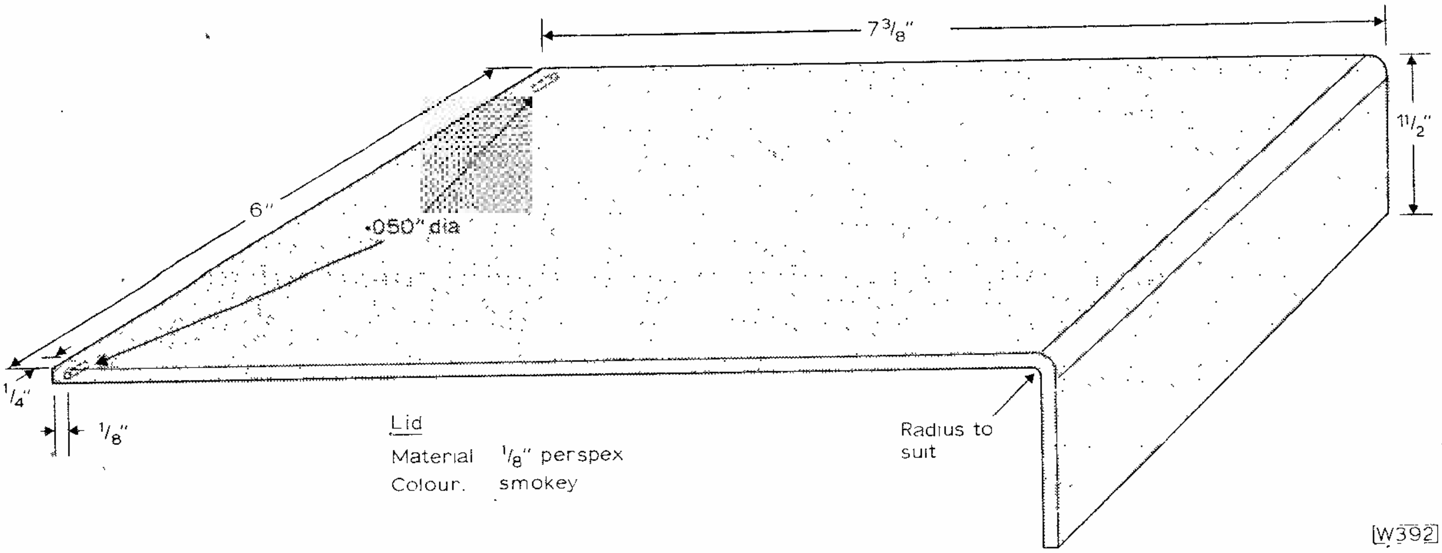


Fig. 13. The circuit of the motor speed control board. Note that this design is for the motor specified. The use of other motors may require considerable changes or even a different system.

Fig. 14. The basic dimensions of the cabinet used by the author. Three holes are required in the front panel to suit the positioning of the variable controls.





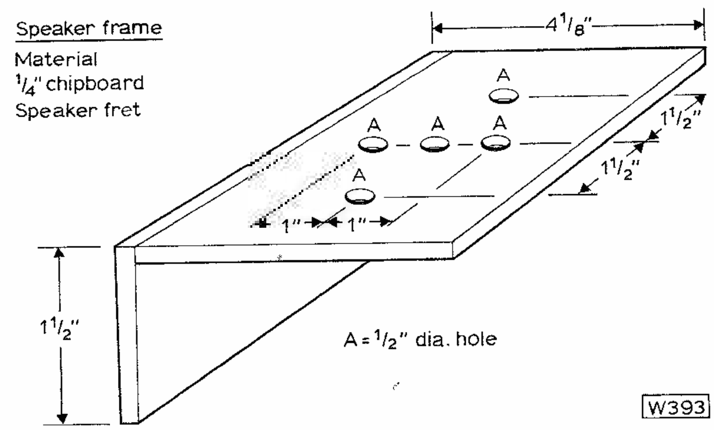


Fig. 15. The shape and dimensions of the lid used on the prototype. If a home-made lid is fabricated care must be taken in making the bend and in drilling the holes. Errors in either will be difficult to correct. Ensure that the pivot pins are loose in the holes.

Fig. 16. A simple support for a 5in eliptical speaker. A large cut-out could be used instead of the 5 small holes.

One section of the lid is made from smokey perspex which has been bent to form a right angle and then has had two holes drilled near the rear of the longer section to take the pivot pins. These pins, although free to rotate in the perspex, are stuck with epoxy resin into small slots cut into the back of the cabinet. Panel pins with the head removed make very good pivots. The lid from Visijar will be ready bent and drilled. Details are given as Fig. 15.

The other section is made by the speaker and its enclosure. The speaker is fixed to a right angle wooden support (see Fig. 16) and the face is covered by speaker grill material. The type of material will depend on the use to which the player will be put. For example, if a young child will be allowed to use it then stout plastic would be used whereas if it is a present to a discerning adult then a more exotic covering would be called for. The frame can either be a tight fit in the cabinet or small chrome wood screws can be used. The drawing doesn't show a ledge for the screws.

Unless your woodworking is exceptionally good it is worthwhile trying the base plate in the cabinet before the additional items are assembled onto it. Any adjustments required are easier to make at this stage. Similarly, try the speaker frame before the speaker is fixed to it.

Assembling into the cabinet

At this stage all the major items should be assembled to the base plate except for the controls bracket. Feed the cableform from the contact comb through the grommett, cut the free ends to length and solder to the correct board pins. If the individual wires have been identified earlier make certain the identification is transfered before the wires are cut to size. If the leads aren't identified they will need some form of "buzzing out" to ensure correct connection, don't rely on following the lead through the cableform by eye.

The leads for the speaker are fed through the small hole and connected. No grommett is used here since the leads will not be subjected to movement and should not suffer wear.

The mains lead is connected via the switch on VR6. The earth wire is connected to the metalwork by a solder tag under one of the transformer fixing screws. Some form of cable retainer should be used inside the cabinet to prevent strain on the soldered joints.

The inter-unit wiring connections are made and the base plate put into the cabinet from the top and screwed down.

The unit is now ready for a trial.

Cutting a disc

Before a tune can be played a disc has to be programmed and before attempting to cut a disc the following features of the coding system used should be read carefully.

When an uncut disc rotates under the pick-up wires strobe signals for both notes 1 and 2 are generated every time a note position goes past the pick-up comb. Even though we get a strobe we will not, however, get a note because the code will be all zeros (none of the contacts have been cut). This is very convenient because if a long blank period is needed it is not necessary to cut any contacts at all.

If a note is programmed and it needs to be extended over two or more strobes (such as a minim or a long decaying sustain at the end of a piece of music) the necessary number of strobes after the one which initiated the note must be cut—it is not

		Notes Req. 1	Notes Req. 2		Strobe 1	Strobe 2	Notes 1				Notes 2				Octave 1	Octave 2
							8	4	2	1	8	4	2	1		
				Track →	L	K	J	I	H	G	F	E	D	C	B	A
				Contact ↓												
Note 1	Lower Octave	C♯		0						×					×	
		D		1					×						×	
		D♯		2					×	×					×	
		E		3				×							×	
		F		4				×		×					×	
		F♯		5				×	×						×	
		G		6				×	×	×					×	
		G♯		7			×								×	
		A		8			×			×					×	
		A♯		9			×		×						×	
		B		10			×		×	×					×	
		C		11			×	×							×	
	Upper Octove	C♯		12						×						
		D		13					×							
		D♯		14					×	×						
		E		15				×								
		F		16				×		×						
		F♯		17				×	×							
		G		18				×	×	×						
		G♯		19			×									
		A		20			×			×						
		A♯		21			×		×							
		B		22			×		×	×						
		C		23			×	×								
Note 2	Lower Octave		C♯	24										×		×
			D	25									×			×
			D♯	26									×	×		×
			E	27								×				×
			F	28								×		×		×
			F♯	29								×	×			×
			G	30								×	×	×		×
			G♯	31							×					×
			A	32							×			×		×
			A♯	33							×		×			×
			B	34							×		×	×		×
			C	35							×	×				×
	Upper Octave		C♯	36										×		
			D	37									×			
			D♯	38									×	×		
			E	39								×				
			F	40								×		×		
			F♯	41								×	×			
			G	42								×	×	×		
			G♯	43							×					
			A	44							×			×		
			A♯	45							×		×			
			B	46							×		×	×		
			C	47							×	×				

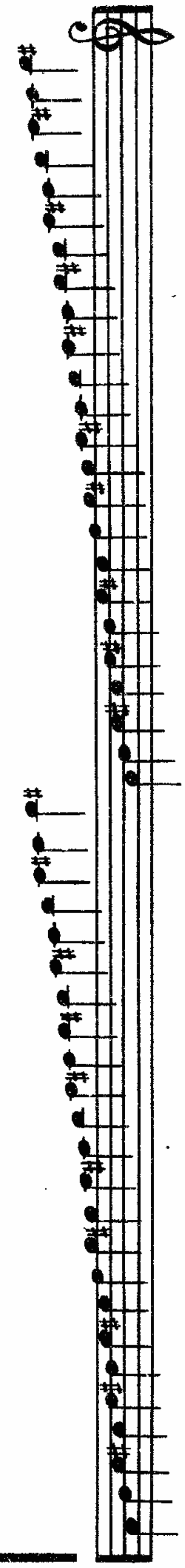


Fig. 17. The cutting pattern required to produce each note available. An "X" in a column denotes a cut is needed.

necessary to repeat the coding of the note because its data will be held in the input latches until a new strobe signal comes along. If you wish to sound the same note twice you must, of course, leave the strobe uncut and insert the correct code for the note every time you want it to sound.

If you programme a note in a position where you do not need a note, all you need do is cut the strobe contact and the wrongly programmed note will not sound—the preceding note will, however, continue to decay during this period. To truncate the previous note in this period leave the strobe uncut but cut the binary coding contacts so that the code exceeds

Notes Req.			Strobe		Notes								Octave	
1	2		1	2	1				2				1	2
					8	4	2	1	8	4	2	1		
		Track → Contact ↓	L	K	J	I	H	G	F	E	D	C	B	A
C	F	0			×	×				×		×	×	×
tD	,,	1		×			×							
C	A	2			×	×			×			×	×	×
A	F	3			×			×		×		×	×	×
,,	,,	·4	×	×										
,,	,,	5	×	×										
C	F	6			×	×				×		×	×	×
tD	,,	7		×			×							
C	A	8			×	×			×			×	×	×
A	F	9			×			×		×		×	×	×
,,	,,	10	×	×										
,,	,,	11	×	×										
tG	E	12				×	×	×		×				×
,,	G	13	×							×	×	×		×
tG	C	14				×	×	×	×	×				×
tE	E	15				×				×				×
,,	G	16	×							×	×	×		×
,,	C	17	×						×	×				×
tF	A	18				×		×	×			×		×
,,	C	19	×						×	×				×
tF	A	20				×		×	×			×		×
C	F	21			×	×				×		×	×	×
,,	A	22	×						×			×		×
,,	F	23	×							×		×		×
tD	F	24					×			×		×		×
,,	A♯	25	×						×		×			×
tD	F	26					×			×		×		×
tF	D	27				×		×			×			×
tE	A♯	28				×			×		×			×
tD	F	29					×			×		×		×
C	F	30			×	×				×		×	×	×
tD	,,	31		×			×							
C	A	32			×	×			×			×	×	×
A	F	33			×			×		×		×	×	×
,,	,,	34	×	×										
,,	,,	35	×	×										
tD	F	36					×			×		×		×

Notes Req.			Strobe		Notes								Octave	
1	2		1	2	1				2				1	2
					8	4	2	1	8	4	2	1		
		Track → Contact ↓	L	K	J	I	H	G	F	E	D	C	B	A
,,	A♯	37	×						×		×			×
tD	F	38					×			×		×		×
tF	D	39				×		×			×			×
tE	A♯	40				×			×		×			×
tD	F	41					×			×		×		×
C	F	42			×	×				×		×	×	×
tD	,,	43		×			×							
C	A	44			×	×			×			×	×	×
A	F	45			×			×		×		×	×	×
,,	,,	46	×	×										
,,	,,	47	×	×										
tG	E	48				×	×	×		×				×
,,	G	49	×							×	×	×		×
tG	A♯	50				×	×	×	×		×			×
tA♯	E	51			×		×			×				×
tG	A♯	52				×	×	×	×		×			×
tE	G	53				×				×	×	×		×
tF	A	54				×		×	×			×		×
,,	C	55	×						×	×				×
,,	A	56	×						×			×		×
tA	F	57			×			×		×		×		×
,,	C	58	×						×	×				×
,,	A	59	×						×			×		×
tF	A	60				×		×	×			×		×
C	F	61			×	×				×		×	×	×
A	F	62			×			×		×		×	×	×
C	E	63			×	×				×			×	×
A♯	G	64			×		×			×	×	×	×	×
G	E	65				×	×	×		×			×	×
F	F	66				×		×		×		×	×	×
A	,,	67		×	×			×					×	
C	A	68			×	×			×			×	×	×
tF	A	69				×		×	×			×		×
,,	,,	70	×	×										
,,	,,	71	×	×										
,,	,,	72	×	×										
,,	,,	73	×	×										

Fig. 18. The cutting pattern for the carol "Silent Night".

1100 (reference to the table of binary codes for each note will show that codes 1101, 1110 and 1111 do not play notes).

If a mistake is made in cutting a contact it is possible to repair the mistake with a thin wire and a very small solder connection. However, this method of correction should be avoided whenever possible since the solder could deflect the contact wire when the disc is rotating.

For those who want to put their own tunes on discs Fig. 17 gives the full cutting details for chromatic scales, for each note in turn, running over the complete two octave range. For those wishing to make a second disc before designing tunes we include the full cutting details for a christmas carol "Silent Night" as Fig. 18.

Adjustment

Having cut a disc the electronics can be tested and the variable controls set.

Before the player can produce a note the pick-up comb must be set. The fixing screws holding the comb to the arm should be slackened off but don't have them too loose or the comb will probably move before they can be tightened again. The slots in the comb assembly and the arm should allow the wire contacts to be positioned exactly in the centre of each pad and also allow the line of contact points to be exactly on a radius. The correct position will be obvious both to the eye and by the fact that the correct sequence of notes is generated.

Having set the contacts, switch on the unit and play the tune. Adjust the present controls for attack and decay for each note until they sound similar.

Finally, by using VR1, adjust the pitch of the instrument to suit your particular requirement. PW

HOTLINES

ON RECENT DEVELOPMENTS

LIGHT LOCK

Electronics in motor cars has long been a favourite subject. The usual problem is that motor manufacturers have to produce to a price and so are not keen to pay very much for electronic 'extras'. One of the newest applications involves light emitting diodes (LEDs). The plan is to include LEDs which will be moulded into a plastic lens. This is mounted in such a fashion as to throw a circle of light around the key locks on the doors whenever the car door handles are raised. The electronics which backs up the LEDs will turn out the light automatically after a lapse of about half a minute or if the ignition is switched on.

HOME GAME

With the increase in popularity of TV games it just had to come. A German television receiver manufacturer is currently building sets with built-in games. These 26-inch colour receivers will offer half a dozen 'ball' type games such as tennis, soccer, hockey etc. but in addition there is an external electronic rifle which goes with the set! This allows additional games like "pigeon shooting", "combat" and "foxhunt" etc to be played. It is interesting that the manufacturers are quoted as saying that the models with games cost only the sterling equivalent of £50 more than their ordinary 26-inch colour receiver. Gunner get one?

SPEEDY LASER

One of your scribes most impressive memories was to stand at a Physics Exhibition at Alexandra Palace, and to watch a great screed of paper stream out from an electronic printer. It was really something and the sight of it caused quite a stir at the time.

I wonder what the new printer I've just heard about would be like to watch. This one uses a moving laser beam. The beam generates all the characters to be printed and these are made visible on plain paper by the use of electrographic means. The machine is claimed to be up to ten times faster than conventional so called "high-speed" printers—it can produce some 70,000 (seventy thousand) characters every second. Put the other way; to generate one character takes only one seventy thousandth of a second. Wonder what it could do if it were taught shorthand?

SMILE PLEASE!

I was intrigued to hear from an American colleague that the police have found yet another task for the ubiquitous computer. This time its task is that of an electronic "mug shot" book. A leading American university has been given a large sum of money to develop the system. Basically the wanted person's description is fed into a computer to enable it to visualize that person. Once its got a picture firmly into its electronic brain, it will run through all the other electronic "photographs" it has in its memory, and will match any which correspond closely to the wanted image. Just think, you could be exactly the same as Bridget Bardot except for a couple of points.

THE END OF MORSE?

Not long ago I commented on the U.S. military, firing television cameras in artillery shells. Apparently this still isn't enough to give them the picture. Electronics is ever increasing on the mock battlefield. The latest is a tiny hand-held terminal which gives alpha-numeric (letters and figures) on a small screen. And what an ingenious device it is, too. It measures barely $8\frac{1}{2} \times 6$ inches and it has no buttons to press as does a calculator. At the bottom are some "select mode" areas. By just touching the surface of these a pattern is generated on the $4\frac{1}{2} \times 3$ inch display. If it is desired to send a message, then the alphabet plus digits 0–9 are called up. Directly beneath these images are some special thin switches. To the user, there is no real switch action. To enter/transmit data, one merely touches the area directly over the character required and it's done. The entry device is called a membrane switch and consists of a tiny sandwich of three layers. Attached to the outer layers are copper wires barely five thousandths of an inch thick. These make contact through minute holes in the plastic insulating layer. Three LED modules are employed to make up the display area each containing some 4,698 diodes. Diagrams and maps can easily be displayed so a map of the battle area could be sent to commanders in the field and this could be updated as things changed. Perhaps it might be an idea for the January sales; shoppers could be updated with urgent information on the bargains battlefield.

I hear that a system of visually activated switches is being tested out in an avionics application. A pilot with an infra red source mounted in his helmet can activate switches by directing the beam at them. No more news to date since this is a military application, but the mind boggles. Imagine; if the pilot looks round the cockpit to make sure that everything's alright he could whip the landing wheels down, switch off all the lights and eject himself all in one go. Nasty!

MICRO CHARGER

Batteries in digital watches run down, as all batteries do eventually. But a Swiss company is doing something about it: no, not light cells! They have cunningly taken a step back to go forward. In ordinary self-winding watches, the self-winding mechanism performs its task as the wearer moves his wrist. The Swiss have incorporated a self winding movement into a digital watch. They've wound a small alternator coil onto the self-winder so that every time it moves it generates a voltage—which charges up the battery. If your watch batteries do happen to get low, just turn the bathroom taps on and off a few times in quick succession.

Ginsberg

PRODUCTION LINES

bill tull

Encapsulated power

Although a good power supply is a 'Must' in a well designed piece of electronic equipment, it is often skimped and relegated in preference to more glamourous circuitry. To overcome this problem, a new range of high quality fully stabilised encapsulated power supplies have been introduced by Cliffpalm Ltd.

The range comprises the Delpack D12-250, the D15-200 and D5-1C. The former provides ±12V output at 250mA per channel, has an RMS ripple and noise figure of 500μV and short circuit current of 150mA. The D15-200 gives ±15V at 200mA with S/C current of 120mA and 1mV RMS ripple and Noise. Both of these units are overload protected and have line/load regulation in the order of 0·01%.

The third model in the range is the D5-1C which provides a 5V logic supply at up to 1A. The line/load regulation is claimed to be 0·02% and 0·05% respectively, with short circuit current of 800mA.

All three models are packaged into 64 x 89 x 32mm with five pins projecting for mains input and DC output suitable for PCB mounting. Priced at £23·60 + VAT each or £16·85 plus VAT for 100 off, they can be obtained from *Cliffpalm Ltd., (Dept. PW) 13 Hazelbury Crescent, Luton, Beds. LU1 1DF.*

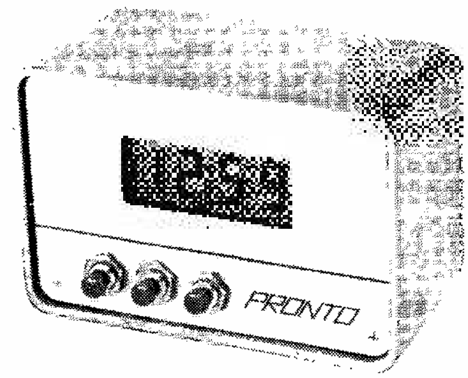
Liquid time

One of the drawbacks to Electronic Digital Clocks and watches is the cost of the continual replacement of batteries—which today are far from cheap. One way that life can be extended is by using a Liquid Crystal Display (LCD) instead of LED's. Power consumed by a large 12mm LCD is in the order of a few micro-watts, and it is this type of display featured in a new digital clock kit by Pronto Electronic Systems.

Designated the 301, accuracy is claimed to be better than 2 minutes per year, and has the facility to display hours and minutes (12 hr. mode), seconds only, or the date. Either one of these three modes can be selected by one of three push buttons mounted on the front panel.

The kit contains detailed assembly instructions, all components including a 32kHz crystal and CMOS chip, and a black moulded case with brushed aluminium facia. Size is approximately 100×65×50mm. Cost for this kit is £29·95 inc. VAT & p&p or ready built for £32·95.

Readers may also be interested to know that Pronto have recently gained



a distribution franchise from Mostek UK Ltd. Although a full range of MOS devices can now be obtained from Pronto, they say that they will probably concentrate on the F8 microprocessor and the third generation Z80 microprocessor system.

Further information from Pronto Electronic Systems, Ltd., 645/647 High Road, Seven Kings, Essex, 1G3 8RA.

Wake up to stereo

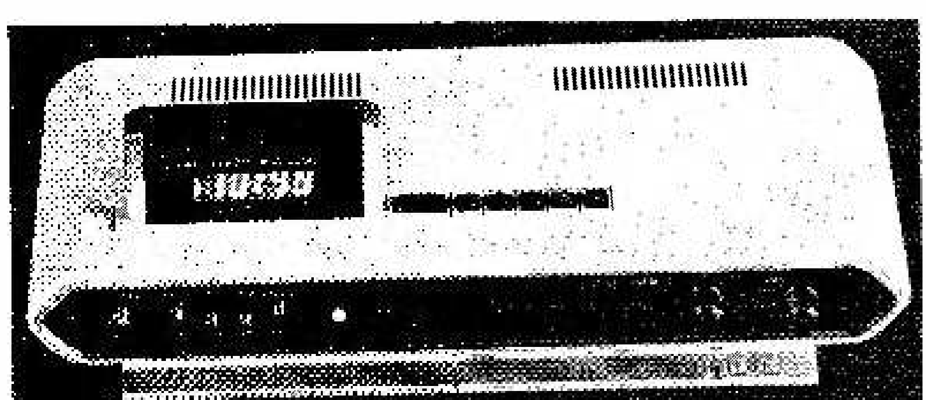
Ever gone to sleep with the radio on, and woken to a flat battery? Well if this is the case, your troubles are over. Kramer and Co. have recently announced a mains clock radio with automatic alarm facility—the Realtone E4.

This unusual looking newcomer is equipped with an AM/FM stereo radio and can be set to turn itself off after a set period of up to 59 minutes.

An alarm is also incorporated which can be used just by itself, or together with the radio to provide that added incentive to 'Rise and Shine'.

Clock display is a large green digital readout which can be used to show minutes and seconds or hours and minutes, while the intensity can be adjusted from very bright down to a dim glow.

Priced at £39·95 plus £1·00 p&p the E4 can be obtained from *Kramer and Co. (Dept. PW), 9 October Place, Holders Hill Road, London, NW4.*



THE LEICESTER SHOW

THE fifth National Amateur Radio Exhibition took place at Granby Halls, Leicester, in October last. This three-day event is really a series of trade stands at which visitors can buy the goods of their choice so 'exhibition' therefore always seems to be rather a misnomer. The show is put on by the Amateur Radio Retailers' Association and organised by Tom Darn G3FGY and Les Hellier G3TED, a retailer from Loughborough.

In this report, there isn't space to mention all the stands, or all the items which took our eye, but a few brief details may whet your appetite for next year's show, which is to take place at the same venue on 27th, 28th and 29th October.

Stephens-James Ltd showed a new range of equipment including their MkII ATU for SWL's. This covers 500kHz to 30MHz and should be available now. **Waters and Stanton Electronics** had the Fukuyama 'Multi-U 11' and 'Multi-11' FM mobile transceivers for 70cm and 2m respectively. They were also showing the FDK 'Multi-2700' 2m transceiver, retailing at about £450.

QM70 Electronics exhibited their 'Cobra' unit which is designed to be used in conjunction with a 2m FM transceiver to access the 70cm band repeaters as well as in the simplex mode. This is priced at £86.

The **RSGB** was taking orders for Volume 1 of their new handbook and Volume 2 will be available shortly. **Doram Electronics** showed a kit for a CMOS morse key, a design which appeared in the RSGB magazine Radio Communication. They also had a kit for a TV cross-hatch generator which included an 8-step grey-scale facility.

Moving on now to one of the big names in the business, **SMC (South Midlands Communications)**, showed a fair proportion of their extensive range from lowly 5-core cable to an impressive, new, complete 2m station designated the FT221R. It combines USB, LSB, AM, FM and CW and offers the user a choice of phase-locked VFO or 44 crystal channels, simplex or repeater, and either mains or battery operation. The firm further claim that the FT221R is the only model which gives full 4MHz coverage (UK and US) and optional auxiliary shift for repeaters.

Other models on show by SMC included the new FT301 range, which are fully solid state transceivers working in the range 10 to 160m in 500kHz segments. Audio output is 3W to the internal speaker, while power can be from either mains or 12V battery. The FRG7 general coverage receiver was also on show, as was the FT301D and FT301S transceivers. Output from these two models is 200W and 10W respectively.

Moving on a little further now we find the Digital 11 which gives 5kHz step coverage across 2m and has a selectable 10 or 1W output for simplex or duplex operation. Readout is digital, and takes the form of six 7-segment LED's. Finally, completing the SMC display, was a new range of Ampere and KLM solid state linears with outputs in the range 10W to 160W, and the Multi-U11 transceiver which is claimed by SMC to "add a new dimension" to 70cm FM.

Lowe Electronics attracted interest with items such as the Trio TS-820 transceiver, a unit crammed with electronics and which can be supplied with digital read-out. Bargain items at the show included a 0-24V 500mA power supply unit from **Bamber Electronics** at £7 and another PSU, giving 13V and 4·5V from **M and B Radio** at £1·50. **Eley Electronics** had computer keyboards, at £6·50, which could be altered to suit many projects by changing just four connections. **Western Electronics** had a 10m to 2m transverter at about £140 and a 10m to 70cm transverter at around £160. These units match Yaesu equipment in appearance but are made in the UK. Also exhibited was the 'Penetrator DX33' beam aerial for 10m, 15m and 20m operation. Another interesting item on this stand was the Westover tilt-over aerial tower which is available to a number of specifications. The PM-2000 peak reading wattmeter was also shown; this covers 3·5MHz to 30MHz and has four ranges, 200W, 500W, 1kW and 2kW. PW

PW 'Easybuild' VIDEO-WRITER

PART 7

M. J. HUGHES M.A., C.Eng. MIERE

ALTERNATIVE KEYBOARD

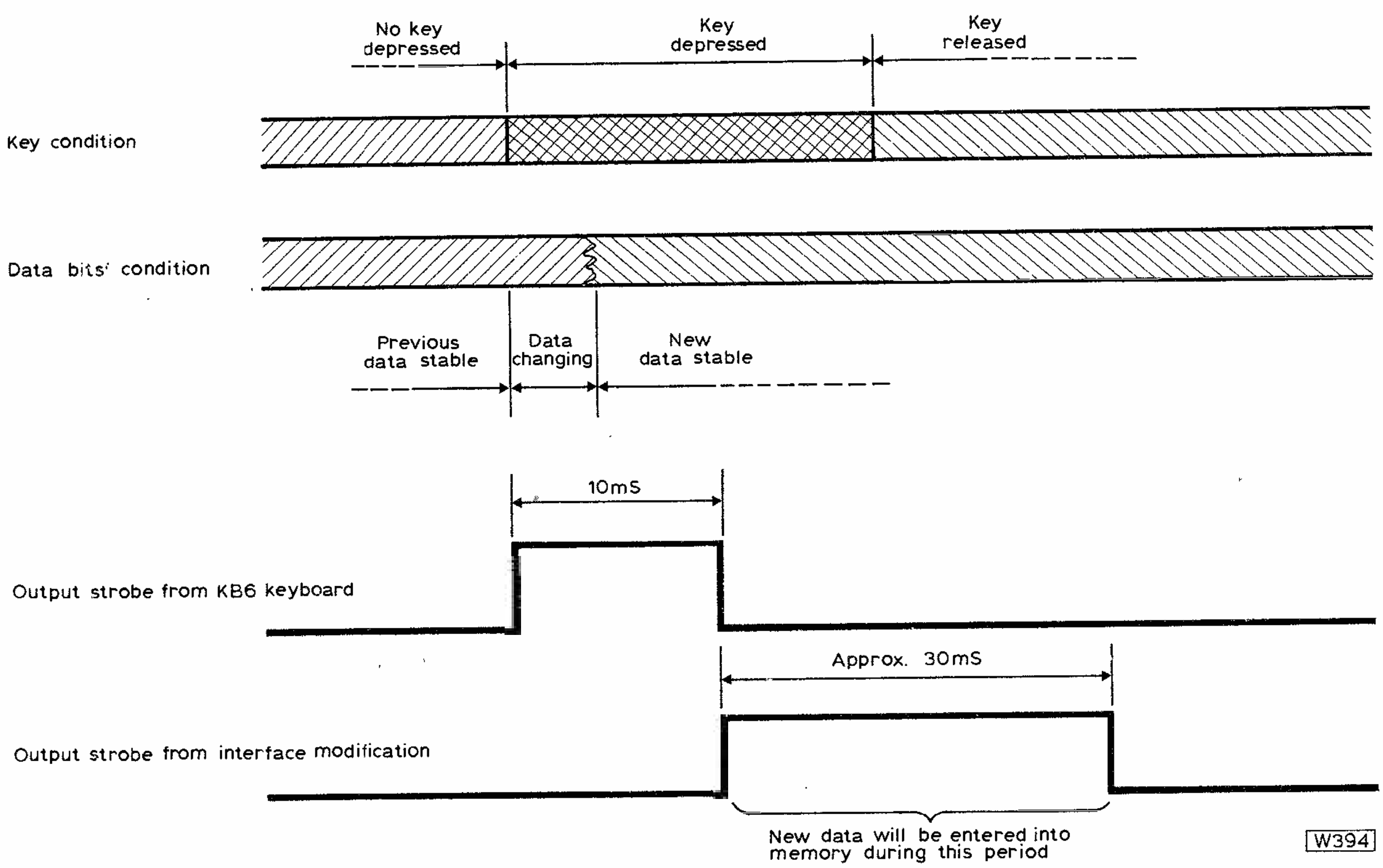
Since the initial design of the Video-Writer there has been a change in the availability of keyboards. The one most easily obtainable at the present time is the 56-station unit available from Electronic Brokers under the type number KB6. This unit has slightly different electronic output signals which need modifying before being applied to the Video-Writer. The differences are that the Strobe output occurs at the wrong time period, there is no parity bit and the drive capability is only sufficient for one TTL load.

SIGNAL CONVERTION

Although the strobe would appear to present a problem the solution is relatively simple. The KB6 strobe goes high (to the logic level "1") as soon as the key is depressed and then falls to "0" of its own accord approximately 10mS after the key depression (irrespective of whether the key is released or held continuously). The Video-Writer needs a strobe which rises to logic level "1" a few milliseconds AFTER the key is depressed and the strobe must stay at this level for at least 20mS before reverting to "0". Fig. 31 shows the output available from the KB6 compared with the signal we actually need.

To get our required signal we use the falling edge of the KB6's strobe to trigger a 555 timer integrated circuit set to give a 30mS positive going pulse which matches the input requirements of the Video-Writer perfectly. The circuit is shown in Fig. 32.

Fig. 31. Time relationship between the key action, the data stabilisation, the keyboard strobe and the strobe after the interface board delay.



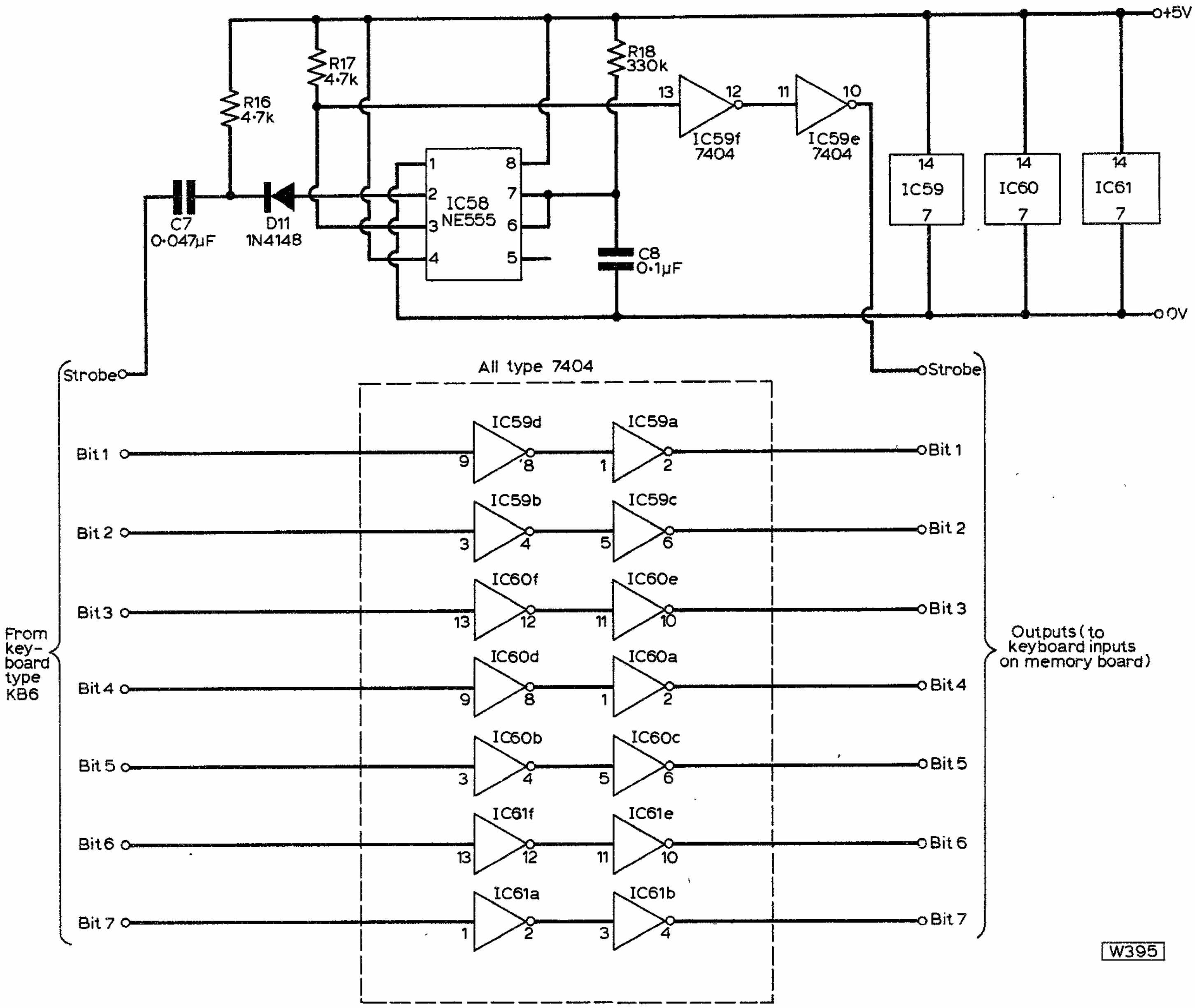


Fig. 32. The schematic diagram of the interface board to match the KB6 keyboard to the Video-Writer.

The absence of a parity bit is of no consequence since the Video-Writer circuit doesn't need it.

Output buffers are used in each line to overcome the low output capability of the keyboard. ICs 59, 60 and 61 perform these functions, including re-invertion to maintain the correct logic levels. This circuit is shown on Fig. 32.

The layout of a simple PCB for these signal conversions is given as Fig. 33. The component positions are shown on Fig. 34. This extra board can be accommodated anywhere within the existing cabinet and can draw its power from the existing 5V supply.

★ components list

56 station keyboard Type KB6 (From Electronic Brokers)

R16	4·7kΩ 10% ¼W
R17	4·7kΩ 10% ¼W
R18	330kΩ 10% ¼W
C7	0·047μF (Polyester)
C8	0·1μF (Polyester)
D11	1N4148
IC58	NE555
IC59	7404
IC60	7404
IC61	7404

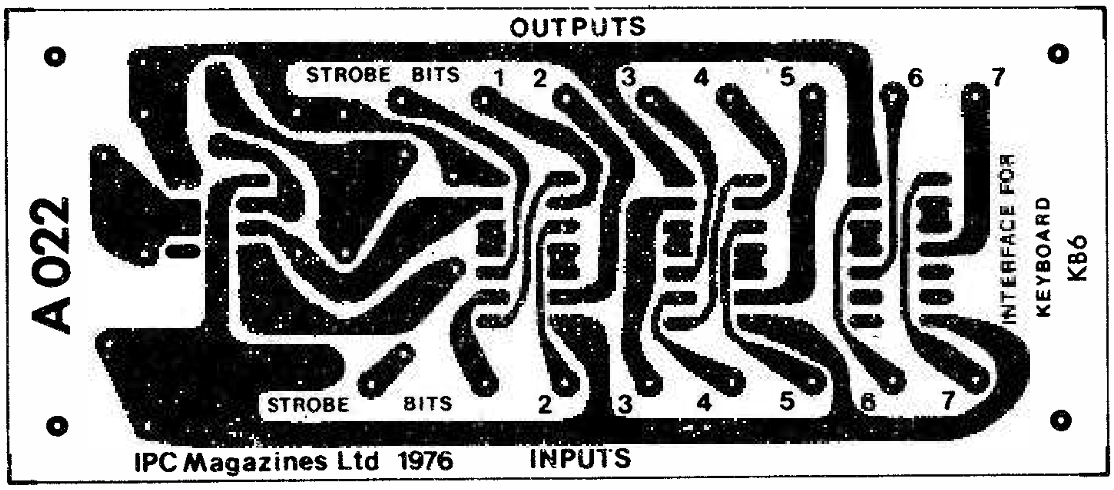
Printed circuit board, Circuit board pins.

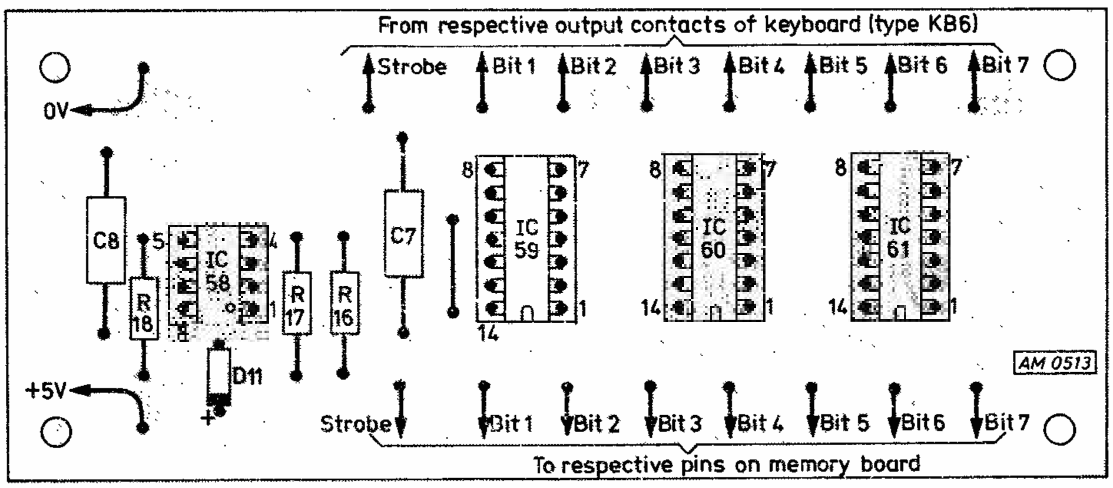
KEY ACTION DIFFERENCES

There are a few other minor differences in the key actions and, although they are of no real significance, they are given for completeness.

For example it is not necessary to press the character shift key to get the upper case letters (this is soon sorted out when using the final equipment). The "TAB" control key is shared with the key for upper case "I" and, since we need the TAB signal for our "Forward/Reverse" control, it is necessary to press "Shift" and "I" to change direction of typing for correction purposes. There is no "Backspace" key and it will be recalled that this signal is used as a non-writing "Cursor Step". Although there is no key marked as such the necessary code is obtained by pressing "Control" and "H". Provided that the Control key is held down repeated pressing of "H" will step the cursor over existing characters without erasing them.

The only other difference which might take one by surprise is that the KB6 outputs are "latched". This means that when you have pressed a key the data is held on the output even when the key is released and only changes when a new key is pressed.

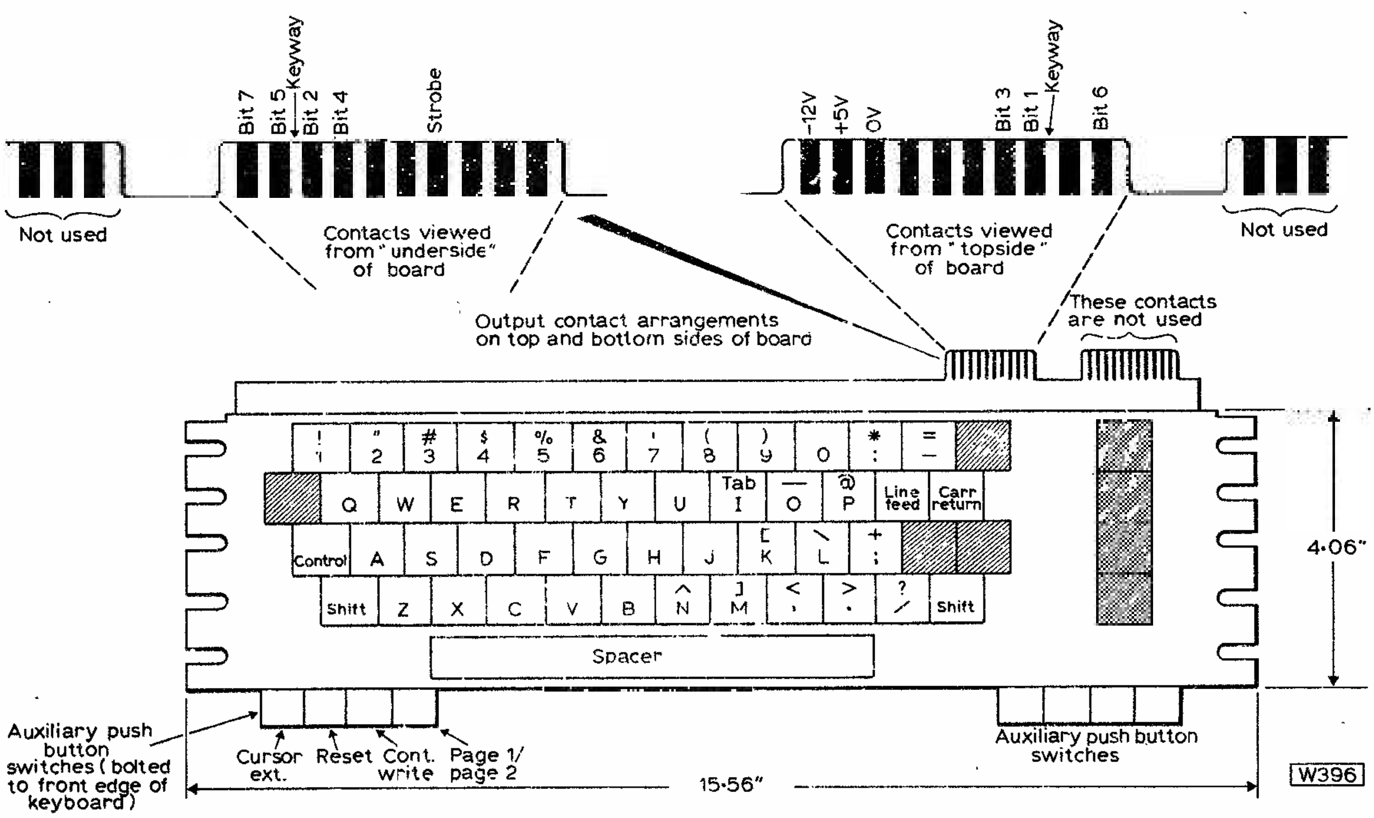




This does not affect the normal use of the machine and is only noticeable if "Continuous Write" is depressed. In many respects this is a useful difference because when it is necessary to erase the screen the spacer bar has to be depressed to set up the "Space" code which is then latched on the output and the Continuous Write button can then be depressed irrespective of whether the spacer bar is held down or not.

Figs. 33 and 34. The wiring pattern of the interface board, drawn full size, and the component overlay showing component positions and orientations.

Fig. 35. The layout of the KB6 keyboard. The shaded keys are not used. To obtain the "upper character" on a shared key the "shift" control must be depressed. To obtain "Cursor Step" the "Control" key must be depressed with "H".



There are a number of "Direct Function" keys on the KB6 which do not occur on the original. Most of these are separated from the main part of the keyboard and could be used for extra functions by those who wish to modify the Video-Writer for special purposes.

CONNECTIONS TO KEYBOARD

There are two sets of output contacts from the KB6 keyboard. We only make use of the left hand set (when viewing the keyboard from the top front). Note that there are contacts on BOTH sides of the keyboard pcb and ideally you should use a double-sided edge connector to make contact with them. It might be difficult to get such a connector and we suggest that you make soldered connections with flying leads. This, however, must be done with great care because there is an MOS integrated circuit in the keyboard and you must ensure that your soldering iron is well earthed and take all other necessary steps to prevent static electricity. Ideally the conductive foam pad should be left over the connections of the IC until after this operation. Fig. 35 shows the connections that have to be made to the keyboard pcb.

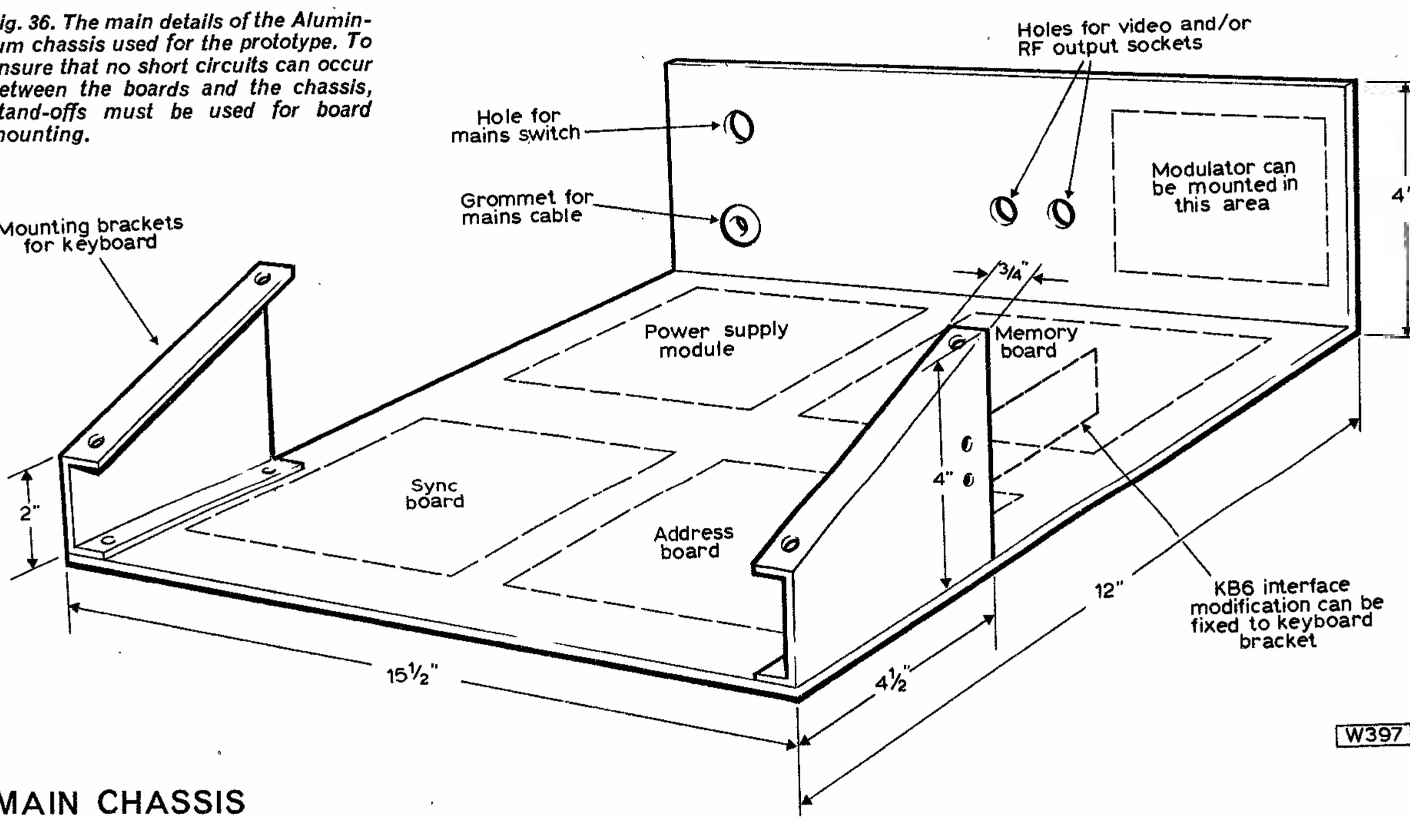
the keyboard is left off until most of the wiring has been completed.

The boards should all be "stood off" the chassis with spacers and care should be taken to make sure that no part of the pcb wiring is allowed to short to ground through the screws. The only connections to the chassis are the mains earth, common ground (0V rail) at the power supply, and the video output screen or the modulator chassis (if you are using one of the recommended modulators).

Three flying leads are taken from the Address Register board to connect, eventually, with the Forward/Reverse LEDs which should be mounted on the keyboard panel. Likewise make sure that you do not forget flying leads to the auxiliary push buttons; these are "Reset", "Cursor Extinguish", "Continuous Write" and "Page 1/Page 2". A common ground has to be taken to each of these switches and this can be picked off any of the 0V pins on any of the boards.

To share the load of the 5V rail we suggest that you run the Sync Generator and Address Register board in parallel from one of the regulators and the Memory, Keyboard, and interface modification from the other. If you are using the Crofton Modu-

Fig. 36. The main details of the Aluminium chassis used for the prototype. To ensure that no short circuits can occur between the boards and the chassis, stand-offs must be used for board mounting.



MAIN CHASSIS

It only remains to make the final chassis and to assemble the Power Supply module, the three major boards, the keyboard interface board just described and the keyboard itself on it. Fig. 36 shows the chassis details as used for the prototype.

The case of the prototype was made from plywood so that it dropped over the metal chassis and was held in place by four screws. Some care is needed in setting the angle of the sloping front and in cutting the aperture for the keyboard to ensure that none of the keys catch on the wooden surround.

The interboard wiring is shown in Fig. 37 and although most of the wiring could be connected with the boards off the chassis a neater end result will be obtained if the separate parts are assembled on to the chassis first. However it will be easier if

later you can make use of the −12V rail as a power source but if you intend to use the *Practical Wireless* modulator, to be published in March, this has its own internal power supply and only needs a mains input. If you use the latter you must remember to common its ground to the rest of the circuitry.

SETTING-UP

If the Video-Writer is being used with a video monitor the output can be connected to the input of the monitor, provided the internal 75 ohm termination is switched in. If the Heathkit portable TV (modified to accept a video input as described in Part 1), is being used for the display the reference to the 75 ohm resistor doesn't apply, just connect

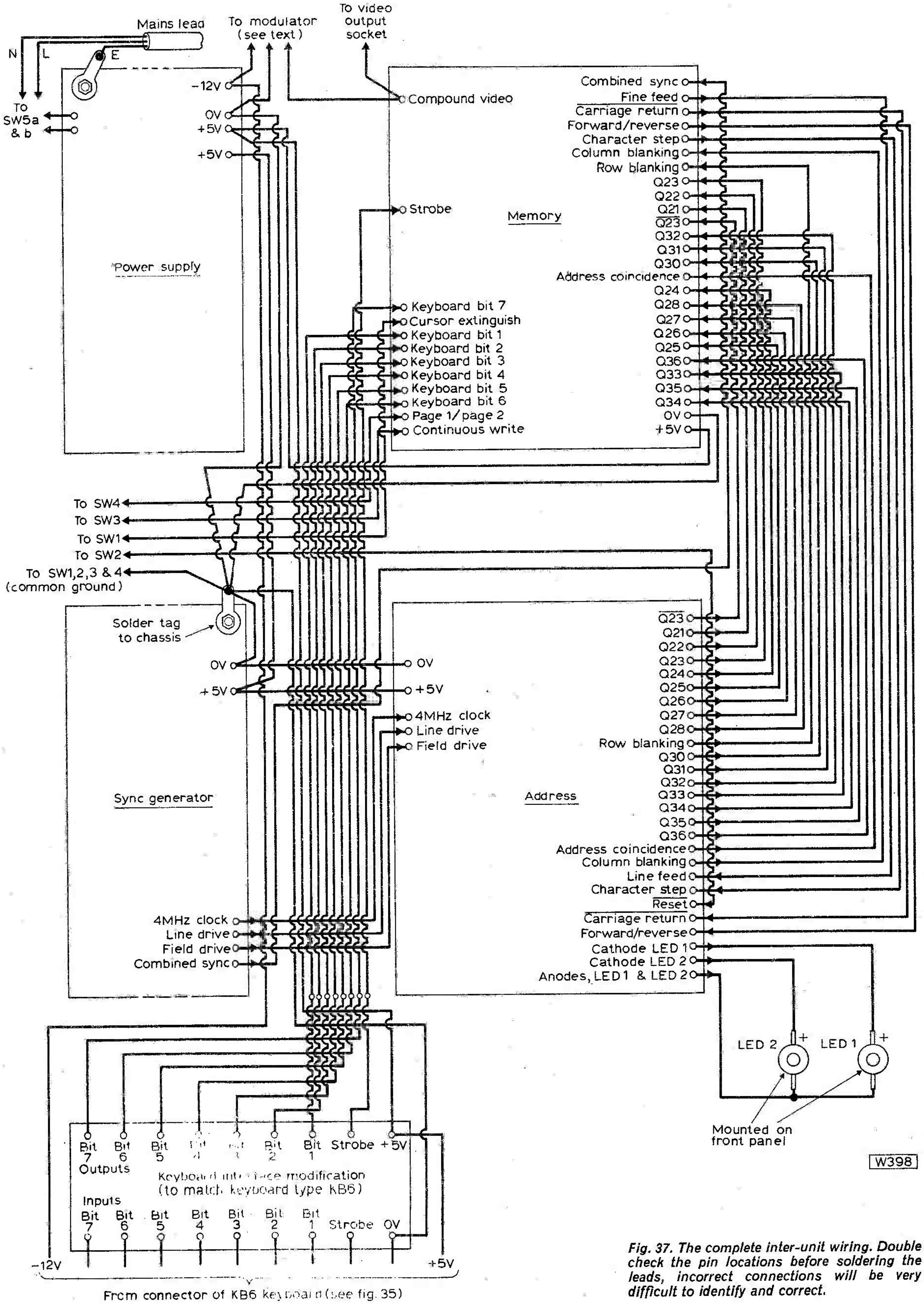


Fig. 37. The complete inter-unit wiring. Double check the pin locations before soldering the leads, incorrect connections will be very difficult to identify and correct.

the Video-Writer output to the modification point. If a domestic television set is being used a modulator must be used with its output connected to the aerial socket of the receiver.

Apply power to the Video-Writer and, if you are operating at video level, you should immediately see patterning on the monitor. If using a modulator you will have to tune the television set until you see the patterning. It is unlikely that you will see any recognisable characters at first unless you are very lucky, because the internal clock frequency of the Video-Writer will probably need adjustment.

At switch on the Random Access Memory will have taken up an arbitrary state and will be giving a random selection of output codes for each of the character cell locations on the screen (i.e. a random selection of letters, figures and punctuation). You should set the slug of L1/L2 in a central position and then adjust C2 with a screwdriver until the moving pattern stabilises and locks into a steady picture which should be the random collection of characters referred to. You will note that the picture locks over quite a large range of adjustment of C2 but changes size.

You should aim to set C2 so that the line sync frequency is exactly 15·625kHz but you do not need test instruments to do this. You can either adjust C2 until you can see 31 complete characters along a row with the 32nd character just disappearing off the screen or turn the brightness of the television set up and look carefully for a faint "Hum Bar" moving up the screen. If you adjust the Video-Writer's clock until this hum bar is stationary you will know that you have a sufficiently accurate sync.

If it is difficult to obtain a fine enough adjustment with C2 you can revert to the core of L1 and L2.

The next test is to check that you have memory for two pages. Actuate the Page 1/Page 2 switch and the random characters should change to another set. Select page 1 and erase the memory by depressing the spacer bar (hold it down if you are using the original keyboard) and momentarily depress "Continuous Write". The screen should clear apart from the chequered cursor. Next check that "Cursor Extinguish" works. Carry out the erase test on page 2. The rest of the tests can be carried out on either page 1 or page 2.

Press "Carriage Return" on the keyboard and the cursor should jump from wherever it is to the extreme left hand end of the row. Next press "Reset" and the cursor should jump to the top left hand corner of the screen. Depress the Forward/Reverse button several times (this is the control labelled "TAB" on the keyboard) and watch the two LEDs, they should be illuminated alternately. End up with LED 1 illuminated as this means you are operating in the FORWARD mode. Now type all the characters in turn, using carriage return and line feed commands whenever necessary, and fill the screen with text to check all memory locations for that page. Remember that you must only expect to see the 63 characters and the space which were shown in the ROM format (see Fig. 4, Part 1), so if you depress a key which is marked as something outside this limitation you may get a character or control function you don't expect! When you are happy that you have the instrument under control in a forwards direction try it in reverse and make use of the Cursor Step button (marked "Backspace" on the original keyboard) to position the cursor for a correction. When in position you depress the correct key and whatever was on the screen in that position will be replaced with the new character.

Repeat the above tests on the second page.

If you get the wrong characters for the keys in question it is worth checking that the RAMs and the ROM are correctly inserted, e.g. no pins bent under. If these are correct then the most likely cause is mixed up data lines from the keyboard.

If a character comes up at two or more places at the same time the probable causes are short circuits between address lines or one or more dry joints on the board pins associated with the address lines. It is assumed that the boards were checked for solder bridges and dry joints when they were assembled.

If you get the random display on switch on but nothing else happens the chances are that you either have something wrong with the keyboard (make sure you have removed the conductive foam pad from under the MOS device on it) or you are not getting data and a strobe from it. First check that you have +5V, −12V and a good 0V connection to the keyboard and then check the data lines with a voltmeter. You should be able to read the binary code for any character if you make a measurement on each of the seven lines while the key is depressed. You can check the strobe signal with a sensitive voltmeter at the output point of the modification board. A depression of any key should give a minute flicker on the meter's needle.

Several working units have been built using the published printed circuits so if there are any problems they are almost certainly due to wrongly inserted or wrong value components, dry joints, missed connections (particularly stake throughs!), short circuits caused by solder bridging across adjacent connections, or small blobs of solder which may have fallen from the soldering iron, or board interconnections wrongly positioned.

It has been noticed that the character generator read only memory is very susceptible to electrostatic fields and this is demonstrated by bringing a finger close to it while the circuit is functioning. Some of the characters might change momentarily and, in the worst case, all the screen will "White Out" until the finger is removed. A demonstration model of the Video-Writer suffered very bady from this because a perspex cover was used. Fortunately the effect of stray fields does not leave any lasting damage but the fact ought to be mentioned so that the problem can be avoided. A metal cabinet should completely remove the problem but in practice the plywood cabinet of the prototype presented no problems.

This article will be concluded next month.

KINDLY NOTE!

VIDEO-WRITER, PART 5

Resistor R13 was omitted from the parts list although it appears on the board lay-out. Its value is [illegible], 10%, ¼W.

CHROMACHASE, PART 1

The components list gives R13 as 100kΩ. The correct value should be 100Ω as shown on the circuit diagram.

ON THE AIR

AMATEUR BANDS

by Eric Dowdeswell G4AR

THIS month we start off with a rousing salute to **Julie Rose** of Warley, West Midlands, who proudly announces the passing of the RAE and the acquisition of callsign G8MKD! Although Julie has contributed to this column I had not realised that she is a sixth-former and still hard at her studies so she has been pretty busy! I suppose that I had better mention the fact that her Dad did likewise and is now G8MKE! She hopes to get on to 2m very soon if Dad will let her get her hands on the gear!

So, all you likely lads, working for your RAE, you have a challenge here so don't let the side down. The December RAE is now history so I hope that I shall hear that some of you have made the grade. Incidentally, Julie is very sensibly swotting up the code and hopes to get her 'A' ticket before long.

I know the point has been raised in the past but it does seem a pity that the G8 + 3 can't retain the suffix part of the call when getting the 'A' licence. It might be a matter of years before say, G8ZZZ is promoted to G4XXX thus losing the identity that will have built up on the VHF bands. I know that G7 is kept for special purposes but it could have so easily have been issued so that G8ZZZ became G7ZZZ thus pleasing all concerned.

Paul Barker BRS34898 of Sunderland has still not got around to erecting a proper aerial since he moved QTH and persists with a telescopic whip job. However it can't be too bad as he 'copied' SSTV stuff from the US and reports S8 ZL's on 20m SSB. He uses a Trio JR310 and a Sommerkamp FRDX500 (very nice!). Hastings reader **B. Harrison** has built himself an ATU now and hopes to have a 300ft wire on the end of it if he can get permission from those concerned. He comments on a W station having a 9 element beam on 15m on a 70ft boom and 60ft up in the air! "What's he turn it with?" asks B. Harrison in amazement! The Armstrong method is definitely out in this case! For those not acquainted with this method it involves turning the mast by hand! Armstrong? oh, well!

You'll never believe it but **Neil Braeman,** near Horsham, now has three old valve sets in action! The normal one plus one as a BFO and the other as an additional audio amplifier! He gives a short list of stuff heard on 20m CW just to prove the set-up works. Neil also has a two transistor job for 80m but it is proving a bit unselective being 'jammed solid' after dark. On the conglomeration of prefixes now bedevilling the amateur bands, particularly the US ones, Neil says they ought to "be clamped down on. With messing around like this you hardly know what you are listening to". Neil is one of those who hopes to get some happy news on the December RAE. He is definitely going straight for his G4 + 3.

Michael Walker in Leeds is taking up our hobby but got off to a rather discouraging start when he tried to contact the Star Radio Club at the advertised times. If anyone has up-to-date info on the club please let Michael know at 100 Langdale Road, Woolesford, Leeds. **J. R. Beer** is another newcomer and resides in Barnstaple, Devon. He is getting his hand in on 20m as he finds 40 and 80m full of Europeans. Unfortunately he does not mention the gear he is using.

BRS 37621 is **David Peck** of Cambridge and he is restarting in the short wave lark and managed to find a few good ones among the pages of stations logged so far. David wants to get on to a countries heard list but as I have told him, we do not run one because of the difficulty of checking claims made and it would not have any standing unless claims were verified. David has an FRG7 receiver and the present interest is RTTY for which he has now got a Creed 7B and a demodulator. He should be ready to copy on all bands very soon.

Martin Sole A9065 now has a HyGrain 18V vertical adorning (?) his QTH in Peterborough complete with radials. He still keeps a multiband long wire going as well which is always a good idea. Propagation can do funny things to the polarisation of DX signals and a bit of wire can sometimes outperform a beam on certain signals. Martin has been consorting with friend G4FIS while he worked the DX with his FT200 which ought to act as a strong incentive for Martin to get his own ticket! Martin comments on VP8HZ heard on 10m with a linear feeding a rhombic pointing at G land! He was 58 most of the time but faded out at dusk.

M. J. Mathews G3JFF, Hon. Sec. of the Royal Naval ARS has supplied some interesting information concerning member ZC4IO who is now active on 80 and 160m with 75W to a trap dipole on 80m the feeders being strapped together on 160m. Operation is on 3501kHz between 1945 and 2000GMT and between 2000 and 2030GMT on 1825kHz. Several British stations and OH have been worked already on 160m.

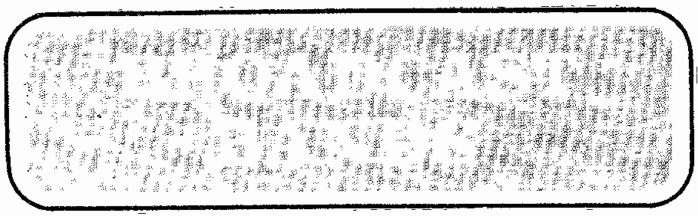
Log Extracts

P. Barker:—20m EP2NC LU5DE TA1ZB VE7DEW ZL2APM ZL2ASJ **20m SSTV** HA6VK HB9ADD I1MSV IS0XRI OH5RM OK1DWZ ON4MK SP3PJ VE3PT W3LSG W4LZZ WB4OVX

B. Harrison:—40m VK5BP VK7BC **20m** FP8HL FY2BHI **15m** VK5AAA ZP6BF 3A2FY

D. Peck:—15m CT3AF EA8JE FG0CXV/FS7 ZD8RD 9J12WR

M. Sole:—20m HC1BU KH6GMT TA1AZ **10m** CX8CN 5U7AG 7X2EPM



MEDIUM WAVE DX

by Charles Molloy

NORTH American medium wave stations have been very conspicuous this winter, the result no doubt of the low level of solar activity at the minimum of the current sunspot cycle. **Roy Patrick** confirms this when he says "reception of trans-Atlantic stations has been excellent. The best one is CJON, just like a local at 2300. The next best is WINS!" Roy's log comes from Mackworth, Derby where he used a Trio 9R59DS to pull-in CJON St John's, Newfoundland on 930kHz; CHER Sydney, Nova Scotia on 950; WINS New York City on 1010 and CBA Moncton, New Brunswick on 1070.

The writer heard CJON recently at 2230 using a VEF 204 transistor portable with internal ferrite rod aerial. Transatlantic signals usually suffer from slow cyclic fading, even the strongest signals are affected. Newcomers to the band may miss quite strong stations if they happen to tune to the channel during a fade, so tune carefully and stay on a frequency for a minute or two. Even CJON can be S9+ one moment and inaudible the next.

More North American DX from **Derek Taylor** who uses a Realistic DX160 and loop from his QTH at Preston in Lancashire. Seventeen stations were heard, the highlights being CHCM in Marystown, Newfoundland on 560kHz; WOR New York on 710; WHDH Boston on 850; WTIC Hartford, Connecticut on 1080; WOKO Albany N.Y. on 1460; WTOP Washington DC on 1500; WKBW Buffalo NY on 1520; WQXR New York on 1560 and Radio St Pierre on 1375kHz. Radio St Pierre is in the French islands of St Pierre et Miquelon which are located to the south of Newfoundland. Programming is in French and the station can be heard once Lille on 1376 has signed off, usually at 2230. Derek refers to a weak signal on 1390kHz which he suspects might be WVON, since Chicago was mentioned a few times. WVON has been logged in the UK but it is better to wait for a definite identification as it is unwise to list-log on the medium waves. Derek's final logging is of ZDK on 1100kHz, which is on the island of Antigua in the Eastern Caribbean and transmits with a power of 10kW.

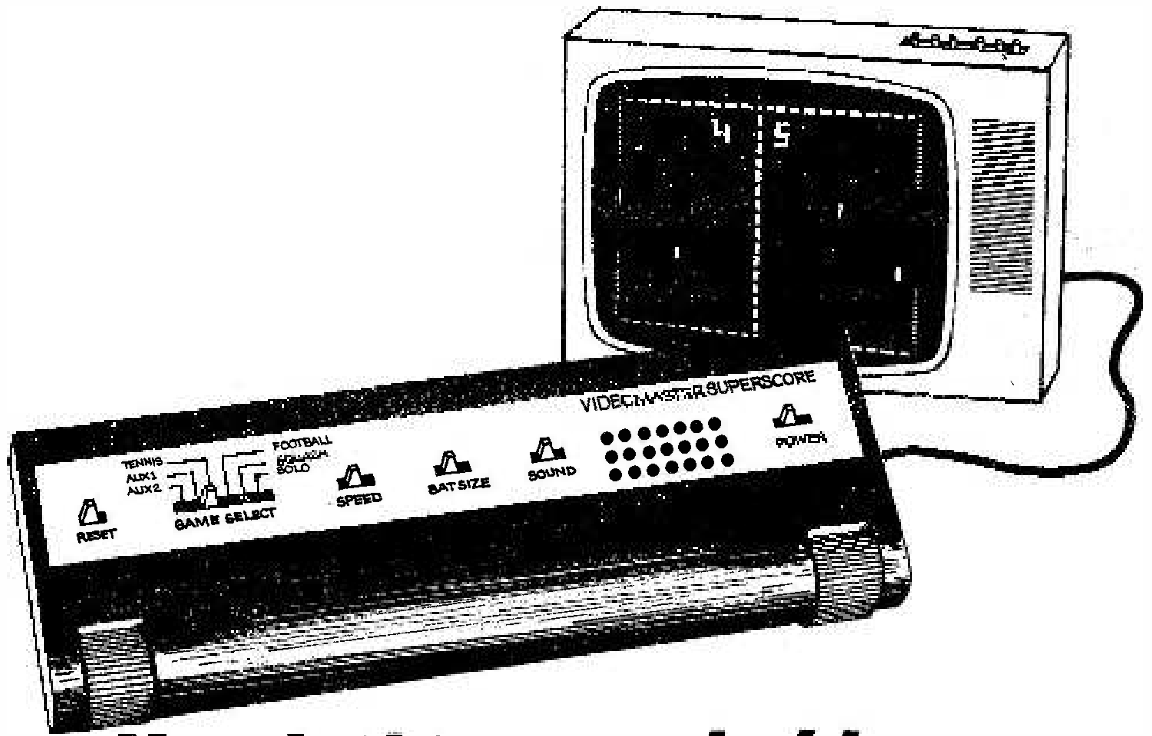
D. R. Mayhew, Littlehampton has pulled-in a fine log of Latin American DX using a loop and a Philips receiver. He was highly delighted to hear Uruguay so clearly. Four stations were heard—Radio Oriental on 770kHz, Radio Montecarlo on 930, Radio El Tiempo on 1010 and Radio Sodre on 1050. From Brazil comes Radio Mundial 860, Radio Jornal 940, Radio Nacional 980, Radio Maua 1130, Radio Globo 1180, Radio Eldorado 1220 and Radio Tupi 1280, all in Rio de Janeiro, Radio Record in Sao Paulo on 1000, Radio Brasil Central in Goiania on 1270 and Radio Recife on 1370. A really excellent log which ends with "I listened many nights to get a positive identity of Uganda on 638kHz. The announcer said "thank you for listening to this broadcast of Uganda." Kampala, Uganda is on 638 with a power of 100kW until 2110.

Ralph Newman (Reading) uses a homebrew receiver, which has FETs and Toko mechanical filters, connected to a medium wave loop. Ralph describes recent North American reception as 'fantastic between 0010 and 0050' and he reports hearing WNBC New York on 660, WCBS also in NY on 880, KDKA (which claims to be the world's first broadcasting station) in Pittsburg on 1020, WHN New York on 1050, CJMS Montreal on 1280 and WQXR New York on 1560. Ralph gives further details on how to connect a loop and differential amplifier to a portable receiver (PW November 1976) 'Two methods are possible. If the radio just uses a few turns on the ferrite rod to couple up, use at least 6ft of co-ax, to space the loop aerial away from the radio, otherwise feedback from the ferrite rod to the loop causes the system to take off." Ralph's receiver did not have a coupling winding so he used a 1000pF capacitor going to the transistor mixer base.

'Is world-wide reception possible on the medium waves' is a question often put to the writer and although the answer is YES it must be qualified with "but unlikely from the UK".' North and South America, Africa and Asia are heard regularly but difficulties arise with Alaska, Hawaii and the Pacific Islands as the radio waves cross polar regions where absorption is high. Australia and New Zealand present another problem. High power Europeans at the HF end are occasionally heard in NZ but reception in the opposite direction is difficult as there are few high power outlets in Australia and there is a high level of interference on the band in the UK.

One possibility is 4QD located at Emerald, Queensland, Australia which transmits on 1550kHz with a power of 50kW. A positive logging of 4QD in October 1976 comes from Norway, which is on the great circle path between Australia and the UK. **Harold Emblem** in Mirfield and the writer in Southport have been monitoring this frequency but the only results to date have been a weak unidentified carrier heard between 1800 and 1900 GMT. A path of darkness is required and this only occurs for a short period each day.

Nothing is new on the medium waves—the oldest DX band. Has any reader a recollection of medium



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ON THE AIR

wave reception of Australia in the early days of radio when interference was much lighter than it is today? It is only a question of time until 4QD is heard in the UK and when this happens it would be interesting to know if it is a "first time ever".

BROADCAST BANDS

SHORT WAVE BROADCASTS

by Derek Bell

A VERY mixed bag this month with something for everyone's taste, starting with a curious situation out in the Pacific Ocean. It seems that in the Gilbert Islands November 1st was the date of the start of internal self-government. **P. Kiddle** who lives in Tarawa, in that sunblessed part of the globe, writes to say that Radio Tarawa, normally a medium wave service, went off the air due to faults in the transmitter. These faults could not be put right due to lack of spares thus it was that, with the self-government date looming up, the authorities were faced with a quandary. They solved this by "borrowing" a frequency from the Posts and Telecommunications department namely 5890kHz and put out the internal service during the run up to self-government. Now that we are in the time of year that favours medium wave signals it could be that the MW fans have missed this service, thus it is with our compliments they now know where to listen! PK writes that the repairs should take three weeks and that by the middle of November things should have been back to normal. However if anyone has pulled in the signal on 5890kHz a note to Radio Tarawa, Bairiki, Tarawa, Gilbert Islands, Western Pacific may produce a QSL.

While dealing with QSLs **Ken Smith**, of Ross-on-Wye, our resident VOA expert, complains bitterly regarding the service to listeners that this station is giving. Ken sends a fine postcard of San Francisco cable cars sent by the VOA in lieu of a QSL and says that with the card was sent the schedule for May to October, posted in mid-November! Come on, VOA, shape up! **Jonnathan Hershbaum** from somewhere in South Africa has nothing but praise however for the QSLs from Radio Australia. Unfortunately he did not describe them. If they are still the same as those of two years ago they are jumbo size with coloured photographs of the Parkes radio telescope and the Capitol building. Jonnathan also logs a couple of rarely reported stations namely Swazi Music Radio on 6500 at 1200 and Voice of Greece on 17830 at 1800. It would seem that in South Africa, as in other parts of the world, DXers have problems with the supply of sets and literature. As regards the literature the WRTVH is dealt with by Technical Books Ltd., PO Box 2866, Cape Town 8000.

A new step back now into the "memory lane" department, via **Norman Gillkerson** of Southampton, who, in an interesting letter recalls the 1920s and the days of the Manchester Wireless Society call sign 2FZ. Norman, using such nostalgic phrases as "bright emitter" says that "with interference absent in the early hours" he and his friends listened to KDKA and WGY from the US. Nowadays Norman is trying for Radio New Zealand on 11960 but so far without success though he has pulled in Radio Australia on 9590 and 9600. Australia's nearest frequencies to these is 9580 and 9625. Norman goes on to say that a Windom external aerial was hooked on to his Challenge SRJ802FL receiver and so it would seem that this has thrown the calibration out a little.

Proceeding further with matters technical, **Niels Montanana** of Camberley reports that a Russian transmitter has been causing quite a few problems in the 25m and 31m bands with "a machine gun chatter". This signal comes from the Ukrainian Byelorussia region of the Soviet Union and was first detected several months ago by an "intruder watch" service on the short wave spectrum. It seems to use a rotatable aerial since the first skip lands in different areas. Uninformed opinion hazards the guess that it is an attempt to create an artificial "hot bubble" in the ionosphere so that the short wave signals can be steered by the reflective properties of the heated atmospheric layer!

Despite all these problems we can still enjoy signals from many miles away and to close this month **Robin Bayley** of Wolverhampton has sent a log of several unusual stations heard on his Marconi R1475 with a long wire.

Radio Bolivia on 4760 at 1000
Radio Zanzibar on 4919 at 1800
Radio Lebanon on 5980 at 1800
TWR Swaziland on 6070 at 0715
Radio Uganda on 9515 at 1615
Radio Mozambique on 11820 at 1730

So with these few for you to try for in the long cold nights and short cold days I will bid you best 73s and close down for this month.

VHF

by Ron Ham

EARLY in November the writer heard from **Nick Taylor** (Sunbury-on-Thames) a keen VHF listener who uses a Pioneer SX737 Tuner/Amp fed by a Jaybeam FM9S which is sitting on a Stolle rotator. Over the past two years Nick has heard about 150 stations in Band II, many of them from Belgium, Germany, Italy and Spain. On August 20/21 he logged broadcast stations from Germany and Luxembourg which is consistent with the prevailing tropospheric opening, details of which were reported in December PW.

ON THE AIR

The interesting tropo-opening which occurred between November 19 and 21 can be associated with the large weather system which crossed the UK from the north. The roots of this event can be traced back to midday on the 12th when the atmospheric pressure, which had been below 30·0″ for the previous month, suddenly took off from 29·75″ to reach 30·4″ by noon on the 15th, where, apart from slight variations, it remained until noon on the 18th when it began to rise reaching it's peak of 30·65″ during the afternoon of the 19th. The fall began around midnight on the 19th and continued down until midnight on the 22nd.

This falling pressure opened up the 70cm band because the writer, at his home in Sussex, received a consistent signal from GB3SC (432·89MHz) between midday 19th and the late evening on the 21st. At 0830 on the 20th and 0120 on the 21st this beacon signal reached 599. The signal from the Emley Moor beacon GB3EM (432·91MHz) was only heard once by the writer, at 0120 on the 21st.

On the 19th a delighted **Angus McKenzie,** G3OSS (London) using his 88 element multibeam at 70′ AGL, and 50W PEP on 70cms worked GI8HXY and GI8KAI and on the 20th he added GM8DMZ/P, SK6AB and GD2HDZ.

BROADCAST BANDS
Short Wave Reports by the 15th of the month to Derek Bell, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD. **Medium Wave** Logs to **Charles Molloy**, 132 Segars Lane, Southport, PR8 3JG.
AMATEUR BANDS
Logs covering any amateur band/s in band/alphabetical order by the 25th of the month to **Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey, KT21 2TW.**

For most of the opening the writer received a good picture, subject at times to some fading, from the Midlands IBA transmitter at Lichfield on Chan. 8 (189MHz), with a vertical dipole feeding the receiver. During the event some DX was being worked in the 2-metre band. At 0155 on the 21st the writer heard GW4CQT call CQ DX and then work OZ1AED and 15 minutes earlier he heard G8JQE report he had worked GM and GI during the evening of the 20th, and had just then been working GC.

At no time during this event did the writer find any DX between 88 and 102MHz because the good signal path was coming from the north while most of the broadcast DX comes from the south and east. Furthermore, **Eric Clarke** (Chichester) reports that before the main event began on the 19th, there was an opening towards his north affecting the ATC radio frequency in "middle" band during the evening of the 17th.

An interesting report came from **Alan Baker,** G8LGQ (Newhaven) who feels sure that he heard a "fuzzy" signal from a UA station during the 2m CW contest at 0030 on the 7th. Can any reader provide any more information about activity at that time please? Alan's "home brew" pre-amp uses a 3N204 and the 2m signals are collected by a crossed 8 element yagi so his gear may have been just sensitive enough to have detected that rare signal without "atmospheric" aid, because at that time there was no known disturbance to account for it. Reports like this one are always welcome.

Cmdr. Henry Hatfield, Gen. Sec. B.A.A. (Sevenoaks) observed a small group of active sunspots with his spectrohelioscope between the 17th and 20th. The writer recorded the radio noise associated with these sunspots at both 95 and 136MHz between the 18th and 21st. The most intense solar noise was recorded at 95MHz on the 19th.

Signals averaging 549 were received from 5B4CY (28·18MHz) between 0900 and 1100hrs on Nov. 1, 9, and 15 and at 1300hrs on the 14th.

A 599 signal from the German beacon DL0IGI (28·195MHz) was heard for a short period at 0950 on the 15th indicating that the E-region of the ionosphere was disturbed. At the same time strong and frequent bursts of signals were being received from the R1 television system (49·75MHz) in the 6m band. R1 vision pulses were also heard during the early mornings on days 6, 9, 11, the afternoon of the 19th, and for most of the day on the 16th.

Having heard very strong "pings" of speech or music which frequently occur in the 4m amateur band, many readers would like to know the cause. Briefly, you are hearing a tiny part of the signal from a broadcast transmitter in Poland bouncing off the trail of ionised gas left by a meteor particle as it burns up within the earth's atmosphere, about 60 miles above us. The earth is continually being bombarded by these tiny particles but periodically, on it's orbit around the sun, the earth encounters large swarms of these particles and the result is known as a meteor shower.

The writer uses a crystal controlled receiver tuned to the working frequency of the Polish broadcast station at Gdansk (70·31MHz) to detect these "pings." The signal is collected on a three-element beam directed toward the north-east and an electronic counter is connected to the output of the receiver to record the number of "pings" received.

Between November 15 and 19 the earth passed through the Leonid meteor shower and 4m operators should have noticed more frequent bursts of broadcast signals during that period. The actual peak of the shower occurred at 0700 on the 17th, and between 0800 and 0900 the writer's "detector" recorded 621 "pings" and between 0900 and 1000 more than 1100 "pings" were counted. This meteor "ping" receiver also acts as a very good detector for extensive sporadic-E disturbances and aurora-borealis. Meteor showers to watch out for in 1977:—

Quadrantids, Jan. 1 to 6, peak Jan. 3, 1600hrs.
April Lyrids, Apr. 19 to 24, peak Apr. 22, —
Perseids, Aug. 1 to 18, peak Aug. 12, 1200hrs.
Leonids, Nov. 15 to 19, peak Nov. 17, 1300hrs.
Geminids, Dec. 7 to 15, peak Dec. 14, 1000hrs.

Reports to Ron Ham, Faraday, Greyfriars, Storrington, Sx, RH20 4HE.

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CD 4009AE	0.52
CD 4010AE	0.52
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[illegible]	2.02
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CD 4033AE	1.28
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CD 4040AE	0.98
CD 4041AE	0.77
CD 4042AE	0.77
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CD 4044AE	0.86
CD 4045AE	1.28
CD 4046AE	1.22
CD 4047AE	0.84
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AUDIO I.C's	
[illegible]3028A	0.83
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D.I.L. Sockets	
[illegible] pin	[illegible]
[illegible]4 pin	[illegible]
[illegible]6 pin	[illegible]
[illegible]4 pin	[illegible]
[illegible]8 pin	[illegible]
I.C's	
LM 55[illegible]	[illegible]
70[illegible]	[illegible]
709CN	[illegible]
7[illegible]	[illegible]
7[illegible]	0.61
8 pin 741CN	0.2[illegible]
747CN	1.0[illegible]
748CN	0.4[illegible]
3900CN	0.7[illegible]
301AN	0.5[illegible]
DIODES	
[illegible]4001	0.0[illegible]
[illegible]4002	0.04
[illegible]4003	0.04
[illegible]4004	0.05
[illegible]4005	0.05
[illegible]4006	0.05
[illegible]4007	0.05
[illegible]4148	0.02
[illegible]914	0.03
BZY 38c 2.7v.	
33v	0.06
[illegible]47	0.05
[illegible]200	0.07
[illegible]202	0.07
I.C's	
[illegible]7400N	0.[illegible]2
[illegible]7401	0.[illegible]3
[illegible]7403	0.[illegible]3
[illegible]7404	0.[illegible]5
[illegible]7408	0.26
[illegible]7409	0.[illegible]6
[illegible]7410	0.[illegible]3

SN 7413	0.52
SN 7417	0.37
SN 7420	0.23
SN 7427	0.31
SN 7430	0.23
SN 7432	0.30
SN 7437	0.35
SN 7441	0.90
SN 7442	0.90
SN 7445	1.51
SN 7447	1.65
SN 7447A	1.41
SN 7448	1.51
SN 7470	0.46
SN 7472	0.31
SN 7473	0.46
SN 7474	0.39
SN 7475	0.60
SN 7476	0.49
SN 7482	0.90
SN 7485	1.31
SN 7489	2.91
SN 7490	0.71
SN 7491	1.01
SN 7492	0.71
SN 7493	0.71
SN 7495	0.81
SN 74107	0.42
SN 74121	0.46
SN 74122	0.66
SN 74141	0.91
SN 74145	1.01
SN 74154	1.62
SN 74174	1.26
SN 74180	1.01
SN 74181	3.64
SN 74192	1.61
SN 74193	1.61
SN 74196	1.11
TRANSISTORS	
2N69[illegible]	[illegible]19
2N7[illegible]	[illegible]13
2N[illegible]	[illegible]39
2N2102	[illegible]70
2N2369	[illegible]23
2N[illegible]	[illegible]32
2N3[illegible]	[illegible]18
2N3[illegible]	[illegible]58
2N3[illegible]	[illegible]62

2N3440	0.57
2N3442	1.54
2N3702	0.17
2N3703	0.17
2N3704	0.18
2N3706	0.17
2N3708	0.16
2N4036	0.59
2N4037	0.48
2N5296	0.42
3N128	0.71
3N140	0.89
3N141	0.79
40360	0.24
40361	0.25
40362	0.26
40406	0.42
40407	0.33
40408	0.48
[illegible]09	0.49
[illegible]10	0.49
[illegible]11	2.44
[illegible]95	0.80
[illegible]94	0.69
[illegible]36	1.06
[illegible]73	0.49
BC107	[illegible]14
BC108	[illegible]13
BC109	[illegible]16
BC[illegible]	[illegible]12
BCY7[illegible]	[illegible]18
BCY71	[illegible]20
BCY72	[illegible]
BF[illegible]29	[illegible]37
BF[illegible]30	[illegible]40
BF[illegible]84	[illegible]27
BF[illegible]85	[illegible]33
BF[illegible]	[illegible]28
BF[illegible]50	[illegible]28
BF[illegible]51	[illegible]27
BF[illegible]52	[illegible]27

Terms – cwo, add 8% VAT on Cos/Mos and 12½% VAT on Transistors, Diodes etc. plus 15p postage and packing.

Rosebank Parade, Plough Road, Yateley, Camberley, Surrey. Tel: 0252 871388.

ROWNSGEM LTD.

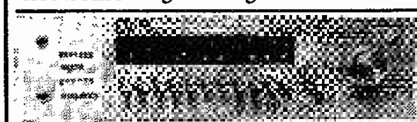
AMBIT international (dept 85)

The Dynamic Twosome: Signalmaster/Audiomaster

After long and thorough deliberation, we are proud to announce a new unit from Larsholt - the Audiomaster. As ever, the instructions are designed to lead the unwary- and the inexperienced- through point-to-point steps that culminate in a professionally styled and finished amplifier to complement the Signalmaster FM tuner. Price £79.00

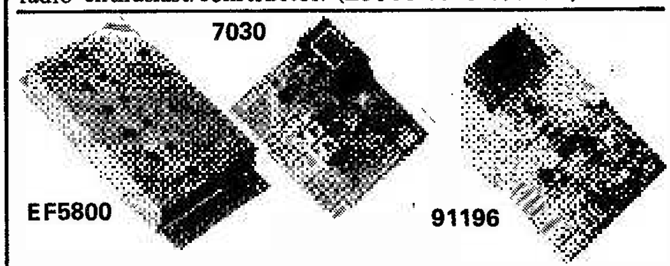
Power: 25+25W RMS
THD: Less than 0.3%
Dynamic range: an exceptional 80dB
(Signalmaster shown on top of the Audiomaster)

The Signalmaster Mk.8 is equally simple to assemble, and results reflect the superb Scandinavian styling and careful electronic engineering. £85.00.



International Mk.2: A choice of tuners for the more experienced constructors.

A chassis, cabinet and front panel designed to be used with a variety of electronics inside. The standard set, with the Larsholt 7253 varicap FM tunerset, plus all necessary parts to complete costs £65.00. Alternative modules for the signal processing stages are available for the more advanced F.M. radio enthusiast/constructor. (EF5800/7030/91196)



From left to right, the EF5800 6 circuit varicap FM tunerhead. Two MOS RF stages, both with AGC control, and an ultra stable oscillator. Next the 7030 Linear Phase 10.7MHz IF. Distortion 0.08%, muting, AGC, meter, auto stereo switch outputs. Finally the new 91196 mpx decoder and combined birdy filter. Mono THD 0.05%, stereo sep. 55dB at 1kHz, 42dB at 10kHz - the best decoder module yet.
EF5800.....£14.50 7030.....£10.95 91196.....£12.99 (Built).
Overall performance of the three modules when correctly assembled:- 30dB S/N at 0.85uV input. 60dB at 5uV. THD 0.09%. AFC holds THD below 0.2% over 400kHz if required. AGC effective over a 90dB range. Image rejection -90dB. Noise floor -73dB.

Components: Coils, ICs Filters, etc.

Radio ICs: (and modules)		Coils and filters:-	
CA3089E/HA1137W FM	1.94	AM IFTs TOKO	
CA3090AQ mpx	3.75	YRCS/YHCS types(10mm)	0.30
MC1310/KB4400 mpx	2.20	7MCS types (7mm)	0.30
HA1196 mpx	4.20	FM IFTs:-	
HA1197 AM radio	1.40	KACS/KALS types(10mm)	0.33
TBA120AS FM IF	1.00	94A types (10mm)	0.30
TBA651 AM radio	1.81	AM filters:-	
uA720/CA3123E AM rad	1.40	CFT types ceramic (455)	0.55
LM380N 2W Audio	1.00	CFU type ceramic (470)	0.60
TBA810AS 7W Audio	1.09	SFD470 types (470)	0.75
TCA940 10W Audio	1.80	FM filters:-	
TDA2020 20W Audio	2.99	CFS/SFE ceramic (10.7)	0.50
LM381N stereo preamp	1.81	SFE6MA (TV sound)	0.80
LM3900 Quad amp	0.68	3132 linear phase	2.25
78M12-20-24 volt reg	ea:1.20*	MPX 19&38kHz notch	
NE550A variable reg	0.80*	BLR3107 (4k7 imp)	1.75
TAA550B varicap reg 32v	0.50*	BLR2007 (3k3 imp)	1.75
NE560/2B PLL IC	ea:2.50	23 or 36mH chokes	0.33
NE561B PLL IC	3.50	Tunerheads: (& tunersets)	
NE565A/567V PLL	ea:2.50	EF5600 5 gang varicap	12.80
810k kit for TBA810 amp	2.75	EC3302 3 gang varicap	5.50
2020k kit for 2020 amp	9.35	8319 (Larsholt)	12.00
92310 kit for mpx decoder	5.35	7252 tunerset complete	26.00
7020 kit for 3089 FM IF	6.65	7253 stereo tunerset	26.00
971197 kit for varicap AM radio tuner	9.65	Standard transistors also kept in stock - see lists for further detail and price information.	
7700 built TV sound tuner	27.00		

Terms: Vat extra, 12.5% unless marked *, which is 8%, all complete tuners require £3.00 for packing and carriage. The standard P&P rate remains at 22p per order. Catalogue 40p.
Phone (0277) 216029 (After 3pm please). SAE for free price lists.

Write to: 37a High Street Brentwood, Essex: CM14 4RH

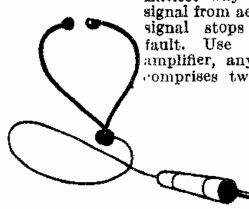
DRILL CONTROLLER

Electronically changes speed from approximately 10 revs to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions **£3·45** including post & VAT. Made up model **£1·00** extra.

MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only **£1·50** VAT & Postage 50p.

RADIO STETHOSCOPE



Easiest way to fault find, traces signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV, amplifier, anything. Complete kit comprises two special transistors and all parts including probe tube and crystal ear-piece, **£2·95**, twin stetho-set instead of earpiece. £1·00 VAT and postage incl.

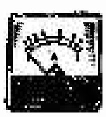
MICRO SWITCH BARGAINS

Rated at 5 amps 250 volts, ideal to make a switch panel for a calculator and for dozens of other applications. Parcel of 10 for **£1·00**, VAT and post paid.

MOTORISED DISCO SWITCHES

With six 10 amp changeover switches. Multi adjustable switches are rated at 10 amp each so a total of 2000w's can be controlled and this would provide a magnificent display. For mains operating **£4·25** post & VAT Paid. Ditto 9 switch **£4·95** Post & VAT Paid. **DITTO BUT 12 SWITCH £5·75** POST & VAT PAID.

AMMETERS



Ideal for chargers etc. 2" sq. full vision 8 amp **95p**. 1½" *round* 2 amp **55p**, 3 amp **65p**. Post & VAT 25p each.

MAINS OPERATED SOLENOIDS

Model 772—small but powerful 1in. pull—approx. size 1½ × 1⅛ × 1¼in., **£1·00**
Model 4001/—⅜in. pull. Size 2¾ × 2 × 14in. **£1·50**
Model TT1—1¼in. pull. Size 3 × 2¼ × 2in. **£2·50**
Prices include VAT & postage.

SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. **£7·95** plus **95p** VAT & Postage

RELAY BARGAIN

Type 600 relay with twin 500 ohm coils which may be joined in series or parallel thus relay will operate off voltages between 5 and 30 volts DC. Price **44p** each, 10 for **£4** post and VAT paid.

BATTERY CONDITION TESTER

Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad —silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 3⅞" × 6¼" × 2" with leads and prod. **£4·50** post & VAT paid.

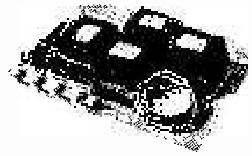
BATTERY CHARGER

Famous Atlas in metal cas with meter, output lead terminated by crocodile clips. For 6 or 12V charging simply by changing plug on front panel. Ready built new and still **£2·95** plus £1 Post & VAT

HONEYWELL PUSH BUTTON PANEL MOUNTING MICRO SWITCH

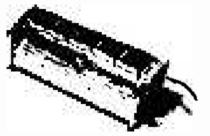
1-2-3 Bank, each Bank consisting of the changeover micro switch rated at 10 amps 250 volts. Through panel fixing by 2 lock nuts complete with black 1" diameter knob. Prices:— 1 bank **40p**—2 bank **55p**— 3 bank **70p**.

MULLARD UNILEX



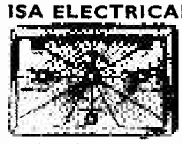
A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Celestion speakers normally £8. This should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only **£17** including VAT and postage.

TANGENTIAL HEATER UNIT



This heater unit is most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch. **£5·83** plus VAT & post £1. 2kW Model as above **£4·25** plus VAT & post 75p. Don't miss this. Control Switch **44p**. P. & P. 40p.

ISA ELECTRICAL PROGRAMMER



Learn in your sleep; Have radio playing and kettle boiling as you wake—switch on lights to ward off intruders—have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price **£2·95**, VAT & Postage 60p, or with glass front, chrome bezel, **£1·50** extra.

ROOM THERMOSTAT

Famous Satchwell, elegant design, intended for wall mounting. Will switch up to 20 amps at mains voltage, covers the range 0-30°C Special snip this month **£2·50**, post and VAT paid.

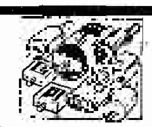
SMITHS CENTRAL HEATING CONTROLLER

Price **£7·50** including VAT and postage.

RANDALL CENTRAL HEATING CONTROLLER

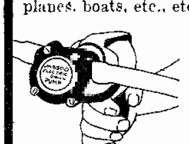
Price **£6·50** including VAT and postage.

8 POWERFUL BATTERY MOTORS



For models, Meccano's, drills, remote control, planes, boats, etc., etc. **£2·00**.

ROTARY PUMP

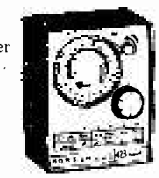


Self priming, portable fits drill or electric motor, pumps up to 200 gallons per hour depending upon revs. Virtually uncorrodable, use to suck water, oil, petrol, fertilizer, chemicals, anything liquid. Hose connectors each end. **£2·00** Post Paid.

MAINS RELAYS

With triple 10 amp changeover contacts—operating coil wound for 230 volts AC, chassis mounting, one screw fixing, ex unused equipment **60p** each. 10 for **£5** post and VAT paid.

HORSTMANN 24-HOUR TIME SWITCH



With 6 position programmer. When fitted to hot water systems this could programme as follows:

Programme	Hot Water	Central Heating
0	Off	Off
1	Twice Daily	Off
2	All Day	Off
3	Twice Daily	Twice Daily
4	All Day	All Day
5	Continuously	Continuously

Suitable, of course, to programme other than central heating and hot water, for instance, programme upstairs and downstairs electric heating or heating and cooling or taped music and radio. In fact, there is no limit to the versatility of this Programmer. Mains operated. Size 3in × 3in × 2in deep. Price **£5·50**. 80p Post and VAT. as illustrated but less case

SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 31, 29 metre bands. Kit contains chassis front panel and all the parts **£1·90**—crystal earphone **55p** including VAT and postage.

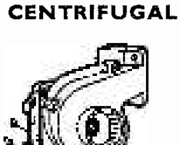
PAPST MOTOR

West German make, these fine motors are noted for their performance and reliability. Special features are the rotating heavy outer which acts as a flywheel to eliminate wow and flutter and switchable reversing.

We have four types in stock, all 1350 revs., including starting capacitor.

(1) Reference No. KLZ 20.50-4, 230 volts 50HZ, price **£5·50**
(2) Reference No. KLZ 32.50-4, 230 volts 50HZ, price **£6·50**
(3) Reference same as above, 115 volts 50HZ, price **£2·50**
(4) Reference same as above, 110 volts 60Hz, price **£2·50**
Post and VAT 80p each extra.

CENTRIFUGAL BLOWER



Miniature mains driven blower centrifugal type blower unit by Woods. Powerful but specially built for quick running—driven by cushioned induction motor with specially built low noise bearings. Overall size 4½" × 4½" × 4". When mounted by flange, air is blown into the equipment, but to suck it out, mount from centre using clamp. Ideal for cooling electrical equipment or fitting into a cooker hood, film drying, cabinet or for removing flux smoke when soldering, etc. etc. A real bargain at **£3·30**. 60p post & VAT.

TERMS: Where order is under £6 please add 50p surcharge to offset packing expenses

J. BULL (ELECTRICAL) LTD.

(Dept. P.W.), 103 TAMWORTH ROAD, CROYDON CR9 1SG.

ITS FREE!

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—its an interesting list and its free—just send S.A.E. Below are a few of the Bargains still available from previous lists.

ARE WE GOING TO HAVE A HARD WINTER? We have already had some cold spells and by the law of averages a cold winter is due, so we take this opportunity to give you brief details of the heater and elements which we have available.

Tubular Heaters, 12ft. 720 watts nominal loading made by G.E.C., ideal for greenhouses, store sheds and other places where a low level of heating spread over a long distance is required. These are green enamelled tubes 3" dia. approx. The element runs right through them and the loading is 60w per ft. They keep just hot enough not to burn you if you touch them, similarly they will not scorch paper or rag so are not a fire risk even though curtains, etc., may touch. They are supplied complete with mounting brackets. Price **£5·50** + 44p each. Carriage £2·50 + 20p each.

Heating Rods, contour following, mineral filled, metal clad, very pliable. 2000w approx. at 240v. Total element length 6ft., supplied in the form of a double U, but this is completely mouldable and may be straightened or bent to fit almost any shape. Ideal to fit into box to make a convector, to replace the element in an old convector, or to wrap around a pipe or cylinder or hang over the side into a tank, and generally to fit into places where straight elements will not go. Bend it as you put it in. Price **£1·65** + 13p. Post 75p + 6p.

Ditto, but 1KW, 4ft. long. Price **£1·65** + 13p. Post 50p + 4p.

Metal Clad Element, 1250w, 4ft. long but bent into 'U' shape. Ideal for convector or back heat radiator. **£1·50** + 12p. Post 75p + 6p.

80w Tubular Elements, brass-encased with beaded flex ends. Standard replacement in most absorption type refrigerators, but also dozens of other uses. Price **85p** + 7p. Post 20p + 2p.

1000w heat and light tube (Mullard) with special holder and terry clips for securing tube. Internally mirrored. Suitable for spit cooking or for general use or also useful under benches to prevent cold feet and legs. Price **£3·30** + 26p. Post £1 + 8p.

1000w Fire Spiral, replacement in many fires. Also useful for dozens of other applications where Nichrome resistance wire is required. **35p** + 3p. Post 10p + 1p.

750w Flat Element, made for Hotpoint Safety Kettle, this measures 5" long, 2½" wide and is about ⅛" thick—very useful for contact heating. Price **50p** + 4p. Post 10p + 1p.

4 × 1KW Element Bank, a versatile bank of heaters. Relatively simple switching gives 8 heat outputs ranging from 250w to 4000w. The 4 × 1KW elements are welded through a 3" square iron plate. The heat part is a mineral filled nickel alloy clad loop which extends 17" from the plate. Contact is made by standard push on tag. Price **£2·20** + 18p. Post £1 + 8p.

Replacement Elements, this is the old type 1KW spiral wire in clay refractory, bowed and size approx. 11" long and 3" wide. Standard replacement in many old type radiant heat fires. Price **£1·25** + 16p. Post 40p + 3p.

400w Wire spirals in clay refractories, held in metal jacket, overall size 18" × k¾". Probably a replacement for some old type Jackson cookers. Price **£1·25** + 16p. Post 40p + 3p.

Flexible heat; you have probably from time to time wanted to warm something by actually winding the heater around it. You can do this now for we have in stock flexible elements comprising glassfibre tape approx. ½" wide, approx. 1/16" thick, 15ft. long. The element is embedded into this, and fully insulated from the outside. The ends can be taken directly into a 13 amp plug or plastic junction box which we can supply at **30p** + 2p extra. These are rated at 100 watts but you can reduce this if you wish by joining two in series. Price of element is **£1·30** + 10p. Post 35p + 3p.

Cooker Elements, believe originally for the Baby Belling cooker—size approx. 10" × 8" 'M' shaped. 1350w. 230-240v. Price **90p** + 7p. Post 40p + 3p.

Cooker Rings, radiant type as fitted to Tricity and similar cookers. 2000w. Ring size 6¼". Price **£1·85** + 15p. Post 40p + 3p.

Waterproof heating element. This is blanket wire but other uses include, winding round water pipes to prevent freezing, under seed boxes to assist germination, in gloves or boots to help keep warm—13 yd. length gives approx. 30 watts at 230v., has self-regulating temperature control. Price **75p** + 6p. Post 10p + 1p.

AM/FM Tuner with scale slow motion drive and pointer, Japanese made, six transistor, AM frequency 530-1600 KHZ, size approximately 5" × 3" for 12 volt operation. Price **£10·25** + £1·25. Post 40p.

FM Tuner with nice clear scale and pointer, SM drive six transistor 12 volt operation. Price **£8** + £1. Post 40p.

Decoder designed for use with FM tuner but also effective with most other tuners, six transistor 12 volts, price **£8·50** + £1. Post 40p unless ordered with the above tuner.

Equaliser for amplifying the output of magnetic cartridges tape heads, low output microphones, etc. gives 2·5v output with 30 mv input. Price **£2** + 25p.

Stereo Equaliser similar to the above but with two separate inputs and outputs. Price **£4·50** + 56p.

GREENWELD

443 Millbrook Road Southampton
S01 OHX Tel:(0703) 772501

All mail order and callers (OPEN 9–6 MON.–SAT.) to this address please —callers only to 21 Deptford Broadway, SE8 (Tel. 01-692 2009), and 38 Lower Addiscombe Road, Croydon (Tel. 01-688 2950).

TRANSMITTER/RECEIVERS

Redifon G410 Tx/Rx 2-16MHz, 4 Xtal channels (no xtals) or ext. VFO. USB/LSB/CW/AM. Brand new chassis containing PA & Driver sections (no valves—needs Z759 & 2 6146, **£10** extra). Complete front end, but 3 PC boards missing. Supplied with separate PSU, 12 or 24V input (state which). Tx O/P 100W. **£40·00**. Tx/Rx only, **£32**; PSU only, **£16**. Circuit diagrams supplied.

Redifon G450 Low Power Transmitter (Exciter). SSB/AM/CW 100mW output. Fully tunable 1·5–30MHz (Needs ext VFO). 10 switched channels xtal controlled (no xtals). All transistor construction. Standard mains supply voltage 240V 50Hz. Brand new units. Needs SSB filter. **£40·00**.

BUMPER BARGAIN PARCEL

25 kilos—yes, ½cwt. Clearing several stores to make room for more goodies, mountains of miscellaneous items too time consuming to list, so we're disposing of it in this manner. You'll get a great variety of components and made-up units, contents too varied to describe, but excellent value at only **£8·00**.

7lb BARGAIN PARCEL

Hundreds of new components—pots, switches, resistors, capacitors, PC Boards with semiconductors, loads of odds and ends. Amazing value at only **£2·90**.

FREQUENCY SOURCE

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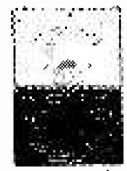

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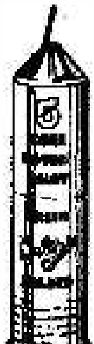

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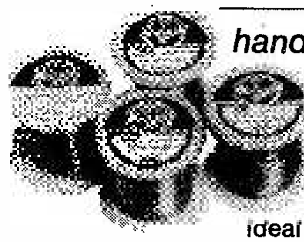

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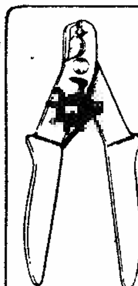

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ELECTROLYTIC CAPACITORS: Axial lead type (Values are in μF).
250V: 100μF, 40p; **100V:** 20, 6p; **63V:** 0·47, 1·0, 1·5, 2·2, 2·5, 3·3, 4·7, 6·8 7p; 8, 10, 15, 22, 8p; 47, 32, 50, 10p; 63, 100, 12p; 1000, 50p; **50V:** 1·0, 6p; 50, 10p; 220, 10p; 470, 30p; **40V:** 33, 8p; 100, 10p; 3300 52p; **35V:** 1000, 38p: **25V:** 10, 22, 6p; 80, 100, 160, 8p; 220, 13p; 470, 640, 25p; 1000, 27p; 2000, 34p; 3300, 39p; 4700, 47p; **16V:** 10, 40, 47, 68, 100, 125, 220, 6p; 1000, 1500, 18p; 2200, 25p; 4700, 46p; **10V:** 4, 100, 6p; 540, 10p; 1000, 14p;
TAG-END TYPE: **70V:** 2500, 98p; 4700, 111p; **64V:** 3300, 94p; **40V:** 10000 145p; 4000 70p; 2500, 65p; **25V:** 4700, 48p; **16V:** 4500 38p; **40V:** 2000+2000 95p.

TANTALUM BEAD CAPACITORS
35V: 0·1μF, 0·22, 0·33, 0·47, 0·68, 1·0, 2·2μF, 3·3, 4·7, 6·8. **25V:** 1·5, 10. **20V:** 1·5. **16V:** 10μF, 22, 47. **10V:** 4·7, 15, 25, 33. **6V:** 47μF. **3V:** 100μF. 12p each.

MYLAR FILM CAPACITORS
100V: 0·001, 0·002, 0·005, 0·01μF 5p
0·015, 0·02, 0·04, 0·05, 0·056μF 6p
0·1μF, 0·15, 0·2 **50V:** 0·47μF 7p

CERAMIC CAPACITORS 50V.
Range: 0·5pF to 10,000pF 3p
0·015μf, 0·022μf, 0·033μf, 0·047μf 4p

TETFER Trimmer (Jackson) 10pF, 58p.

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Carbon Track, 0·25W Log & 0·5W Linear values
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5KΩ–2MΩ single gang 24p
5KΩ–2MΩ single gang D/P switch 45p
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0·25W 200Ω–4·7MΩ Vert. } larger 8p

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DILEMIN
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Drum 54mm 30p
6:1 Ball Drive 4511/DAF 107p

Dial Drive 4103
6:1/36:1 468p
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00 2 365pF 265p
00 208/176 270p
,, ,, with slow motion drive 290p
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0·5W	2·2Ω-4·7M	E12	2p	1·5p
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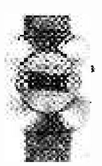

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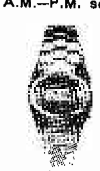

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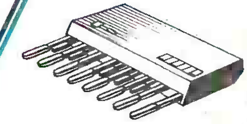

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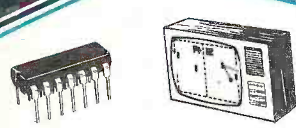

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