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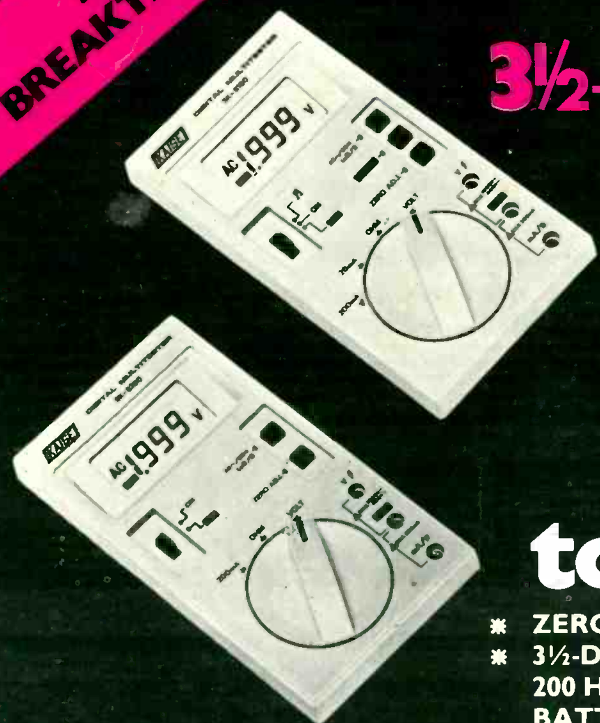

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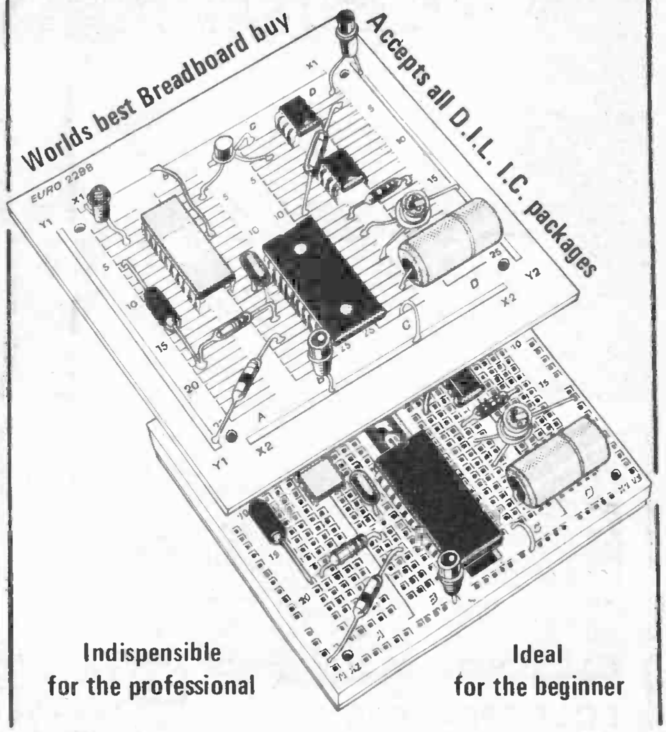

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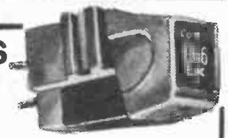

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The unique and valuable components of the Sinclair ZX80.

The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter offers remarkable programming advantages:

- **Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability–takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input–to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up to 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions. USR causes jump to a user's machine language sub-routine.
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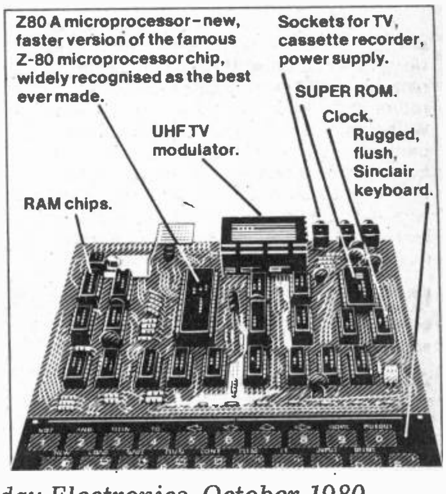
The display shows 32 characters by 24 lines.

And Benchmark tests show that the ZX80 is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.



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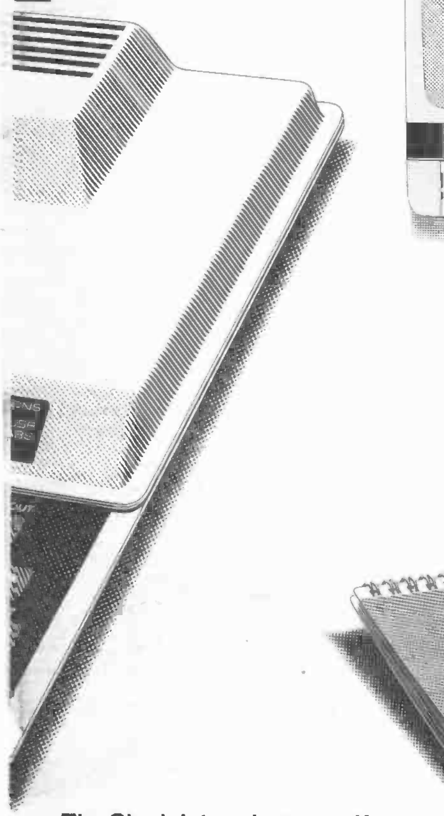

The Sinclair teach-yourself BASIC manual.

If the specifications of the Sinclair ZX80 mean little to you – don't worry. They're all explained in the specially-written 128-page book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. (Available separately – purchase price refunded if you buy a ZX80 later.)
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Demand for the ZX80 is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.

sinclair ZX80

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EE/10/80

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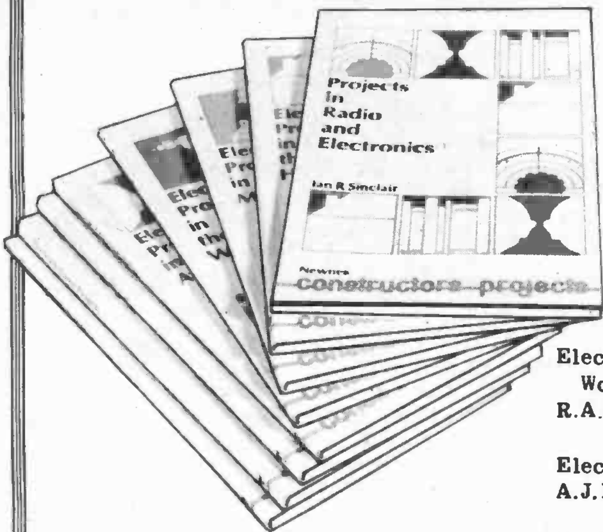

Each book presents a collection of constructional projects, giving details of how the circuit works, how it is assembled and how setting up and troubleshooting problems may be solved. There are eight titles in the series:

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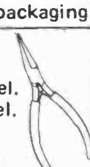
Side Cutter without Bezel.
End Cutter without Bezel.



Vero Metal Shears.
Other items as catalogue.

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Send S.A.E. for details & types
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Vero Board: Superstrips:
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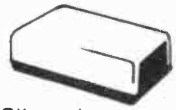

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Also Resistors; Presets; Pots;
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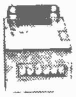
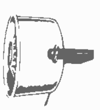


One pulse moves one digit—Type 1 for 230v AC not resettable. Price 80p—Type 2 for 48v DC or 115v AC and resettable £1·35.

DOOR MOVING MOTOR

Franco reversible single phase 240v AC motor with gear box giving final speed 56 rpm very powerful motor, weight approx. 13lb. Price £15 carriage £3 mainland only.

SIREN OR BLEEPER



American Delta mechanical type, works on 6 to 12v to DC or 12 to 24v AC. Price 75p or £60 per 100. Electronic Bleeper TH3S emits high pitched wailing note of varying pitch. In red plastic case with fixing bracket. £5·00.

CASSETTE PLAYER/RECORDERS

With record and playback heads, all electronics, switches and speaker. Price £9·95 (surely this must be the bargain of the year). Music centre replacement stereo with heads but not electronics. £14·95.

FRUIT MACHINE HEART

4 wheels with all fruits, motorised and with solenoids for stopping the wheels, with a little ingenuity you can defy your friends getting the "jackpot". £9·95 + £4 carriage.

DESOLDERING PUMP

Ideal for removing components from computer boards as well as for service work generally. Price £6·35.

4 CORE FLEX CABLE

White pvc for telephone extensions, disco lights etc. 10 metres £2, 100 metres £15. Other multicore cable in stock.

HEADPHONE AMPLIFIER (STEREO)

With volume, tone and balance control 9v operation. All made up ready to go. Price £4·50.

MUGGER DETERRENT

A high note bleeper, push latching switch, plastic case and battery connector. Will scare away any villain and bring help. £2·50 complete kit.

RELAYS

Open type with 2, 10 amp c/o contacts—single screw fixing £1·25 each, please state the coil voltage you require.

HUMIDITY SWITCH

American made by Honeywell. The action of this device depends upon the dampness causing a membrane to stretch and trigger a sensitive micro-switch, very sensitive—breathing on it for instance will switch it on. Micro 3 amp. at 250V a.c. Only £1·15.

SAFE BLOCK

Mains quick connector will save you valuable time. Features include quick spring connectors, heavy plastic case and auto on and off switch. Complete kit £1·95.

VERSA DRILL

A 12 volt battery operated power drill, not just suitable for printed circuit boards but will do all the jobs and is powerful enough to perform all the functions and operations normally expected of Black & Decker and other mains drills. Its chuck accepts up to ¼" drills. Size approx. 150mm × 50mm. Price £16·75.

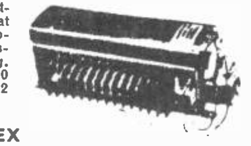
TWIST DRILLS

Precision Swiss made—normal price 50p each 10 diff. sizes covering $\frac{1}{16}$"-¼". £1·99 the lot—don't miss this super bargain.

MAINS SOLENOIDS

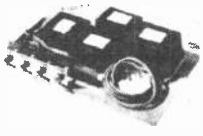
All have powerful pull.
TT2 size 1½" × 2¼" × 2". Price £2·95.
TT6 size 2¼" × ¾" × 2". Price £3·50.
TT10 size 3" × 2¼" × 2". Price £4·86.

MOTORISED DISCO SWITCH



With 10 amp changeover switches. Multi adjustable switches are rated at 10 amps. This would provide, a magnificent display. For mains operating. 8 switch model £6·25. 10 switch model £6·75. 12 switch model £7·25.

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 anyone. In easy-to-assemble modular form 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 £16 including VAT and postage.
FREE GIFT—Buy this month and you will receive a pair of Goodman's elliptical 8"×5" speakers to match this amplifier.

NEW KITS

5 WAVE BAND SHORT WAVE KIT Bandspread covering 13·5 to 52 metres. Complete kit includes case, materials, six transistors and diodes, condensers, resistors, inductors, switches etc. Nothing else to buy, if you have an amplifier to connect it to or a pair of high resistance headphones. Special price is £11·95 inc.

SUB-MIN MICROPHONE
Size only ¾" × ¾" × 3/16" so small enough for a bugging device, ex-hearing aids but guaranteed. Price £1·50.

TRANSMITTER SURVEILLANCE
Tiny, easily hidden but which will enable conversation to be picked up with FM radio. Can be made in a matchbox—all electronic parts and circuit. £2·30.

RADIO MIKE
Ideal for discos and garden parties, allows complete freedom of movement. Play through FM radio or tuner amp. £6·90.

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
Made up model £1·00 extra

VENNER TIME SWITCH mains operated with 20 amp switch, one on and one off per 24 hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2·95. These are new but without case, but we can supply plastic cases (base and cover) £1·75 or metal case with window £2·95. Also available is adaptor kit to convert this into a normal 24 hr. time switch but with the added advantage of up to 12 on/offs per 24 hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2·30.

THIS MONTH'S SNIP

Includes a Free Gift, a desoldering PUMP, the one we are currently selling at £6·35. The snip is perhaps the most useful breakdown parcel we have ever offered, 50 nearly all different computer panels, on these panels you will find over 300 ICs, over 300 diodes, over 200 transistors and several thousand other parts, resistors, condensers, multi-turn pots, rectifiers, etc., etc. You can have the parcel for only £8·50 which when you deduct value of the desoldering PUMP, work out just a LITTLE OVER 4p per panel. Surely this is a bargain you should not miss so send your ORDER today. Add £3·26 for Post and VAT.

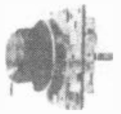
SOUND AND LIGHT UNITS

3 CHANNEL SOUND TO LIGHT KIT Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for Disco work.
The unit is housed in an attractive two-tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special snip price is £13·50 in kit form or £16·50 assembled and tested.

REMOTE CONTROL for Sound to Light (ours or any other circuit) saves connecting to speaker or amp—kit consists of 1 watt amplifier, crystal mike, case, sundries and diagram. Price £3·95.

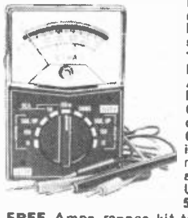
LIGHT EXPANDER AND LATCH for Sound to Light, enables 3000 watts of lighting to be controlled by single channel or each channel and enables lights to be latched on. Kit consists of latching relay, control switch, case, sundries and diagram. Price £4·25.
SINGLE CHANNEL KIT still available. Price £5·18

DELAY SWITCH



Mains operated—delay can be accurately set with pointers knob for periods of up to 2¼ hrs. 2 contacts suitable to switch 10 amps—second contact opens a few minutes after 1st contact. £1·50.

MINI-MULTI TESTER



Deluxe pocket size precision moving coil instrument, jewelled bearings—2000 o.p.v. mirrored scale.
11 instant ranges measure:—
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Continuity and resistance 0-1 meg ohms in two ranges.
Complete with Test Prods and instruction book showing how to measure capacity and inductance as well.
Unbelievable value only £6·75 + 50p post and insurance.

FREE Amps ranges kit to enable you to read DC current from 0-10 amps, directly on the 0-10 scale. It's free if you purchase quickly but if you already own a mini tester and would like one, send £2·50.

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BURGLAR ALARM CONTROL PANEL
Contains labelled connection block, latching relay, test switch and removable key control switch. Simplifies the whole installation, all you have to do is to take wires to pressure pads and to alarm bell. Price £6·00 + 90p. With complete diagram.

PRECISION MAINS OPERATED CLOCK
For only £1·50 + 22p. Sounds unbelievable but that's what you can have if you send your order right away. The clocks which have large clear dials were made by the famous Smiths Company for use with their domestic cooker switch and are brand new and guaranteed.

15-0-15v @ 2 AMP MAINS TRANSFORMER
Mains transformer, upright mounting primary and secondary wound on separate bobbins with fixing lugs. Price £3 + 45p. Post 60p.

25-0-25v @ 750 mA MAINS TRANSFORMER
Mains transformer C core construction, heavily varnished for dead quiet operation. Upright mounting with fixing lugs. Price £2·75 + 41p. Post 50p.

25 WATT MID-RANGE SPEAKER 5¼"
Made by Goodmans so there's none better. 4 ohm coil. Price £3·50 + 45p. Post £1·00.

8 OHM TWEETER
Made by Goodmans. 3½" square, 4" across fixings. Price £1·50 + 22p. Post 30p.

NEW KITS

PRECISION PARKING PAD KIT as specified. £2·50.
LIGHT FAILURE MONITOR KIT as specified. £7·50.

WATERPROOF HEATING WIRE
As used for electric blankets, etc. This has dozens of other applications—in gloves or socks for people with poor circulation are obvious uses. One unusual use suggested by a customer is a 'grow' bag heater. The wire which consists of an element wound on glass fibre then PVC covered has a resistance of 60 ohms per yard. The price is 20p + 3p per yard.

TELEPHONE PICK-UP coil attaches by suction to phone body, enabling conversation to be recorded, put through amp or headphones. Price £1 + 15p.

TRANSDUCERS
As used remote control T.V. receivers. Price £1·50 + 22p.

LIGHT CHASER
Gives a brilliant display—a psychedelic light show for discos, parties and pop groupds. These have three modes of flashing, two chase-patterns and a strobe effect. Total output power 750 watts per channel. Complete kit. Price £14 + £2·10. Ready made up for £4 extra.

PRINTED CIRCUIT KIT
4 copper plated boards and the chemical for etching the printed circuits, also 50 interesting designs of all sorts of electronic gadgets which can be made on these boards. Price £1·70+30p.

MAINS TRANSISTOR POWER PACK to operate transistor radio, cassettes, amplifiers, etc., take the place of any of the following batteries, PP1, PP3, PP4, PP6, PP9 and others. You can make voltage output anything from 3v to 16v at up to 300 mA. Complete kit but no case £1·75 + 26p. Case 75p + 13p.

TELESCOPIC AERIAL
5 sections, 21" when extended. Nickel plated superior make, one nut fixing, folds over for FM. Price 95p + 15p.

FISH BITE INDICATOR enables anglers to set up several lines then sit down and read a book. As soon as one has a bite the loudspeaker emits a shrill note. Kit. Price £4 50+68p.

6 WAVEBAND SHORT WAVE RADIO KIT
Brandspread covering 13·5 to 52 metres. Based on circuit which appeared in a recent issue of Radio Constructor. Complete kit, includes case materials, six transistors and diodes, condensers, resistors, inductors, switches, etc. Nothing else to buy, if you have an amplifier to connect it to on a pair of high resistance headphones. Special price to get this kit off the ground. Is £11·95 inc VAT and postage.

3" EDGEWISE PANEL METER
0·25 MA moving coil made for the G.P.O. A very useful instrument especially when panel space is limited. £2·50 + 38p.

PANEL METER 0·1mA
Japanese made full vision perspex front, flush mounting. Price £3 + 45p.

12v SUBMERSIBLE PUMP
Our drill pump is useful, but this new one is even more so. Just join it to your car battery, drop it into the liquid to be moved and up it comes, no messing about, no priming, etc. and you get a very good head. Suitable for water, paraffin and any non-explosive, non-corrosive liquid. One use if you are a camper, make yourself a shower. Price £6 + 90p. A free gift, first 100 purchasers will get tap with built in switch and length of plastic tubing.

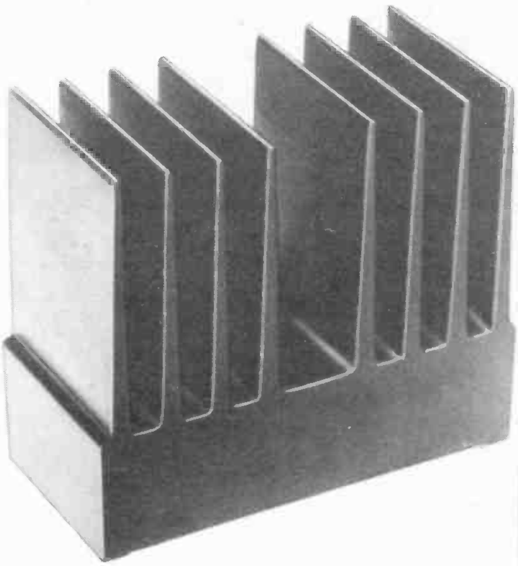
E.H.T. MAINS TRANSFORMER with inductance control, normal primary, secondary output by our equipment, 3·5 kv 3 mA. E.H.T. voltage can be varied by applying a DC voltage to the lower normally unused bobbin. We are not sure how much the voltage may be increased or decreased but using a 9 volt battery we seem to get a rise or fall of about 50 volts. Ex unused P.S.U.'s. Price £2 + 30p. Post 40p.

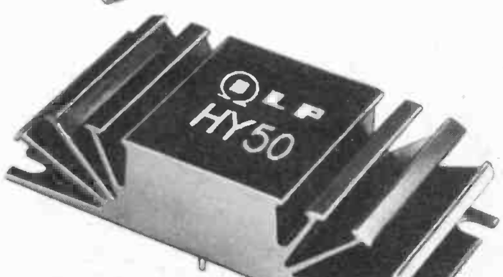
SHORT WAVE CRYSTAL RADIO
All the parts to make up the beginners model. Price £2 + 30p. Crystal earpiece 57p + 8p. High resistance headphones (give best results) £3·25 + 50p. Kit includes chassis and front but not case.

RADIO STETHOSCOPE
Easy way to fault find—start at the aerial and work towards the speaker—when signal stops you have found the fault. Complete kit £4·25 + 65p.

INTERRUPTED BEAM KIT
This kit enables you to make a switch that will trigger when a steady beam of infra-red or ordinary light is broken. Main components—relay, photo transistor, resistors and caps, etc. Circuit diagram but no case. Price £2 + 30p.

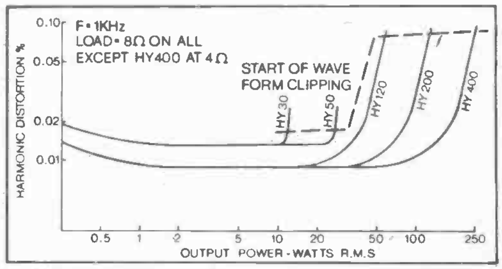
Simply ahead...





POWER AMPLIFIERS

ILP Power Amplifiers are encapsulated within heatsinks designed to meet total heat dissipation needs. They are rugged and made to last a lifetime. Advanced circuitry ensures their suitability for use with the finest loudspeakers, pick-ups, tuners, etc. using digital or analogue sound sources.



Model	Output Power R.M.S.	Distortion Typical at 1KHz	Minimum Signal/ Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	100 dB	-20 -0- +20	105x50x25	155	£6.34 + 95p
HY50	30 W into 8 Ω	0.02%	100 dB	-25 -0- +25	105x50x25	155	£7.24 + £1.09
HY120	60 W into 8 Ω	0.01%	100 dB	-35 -0- +35	114x50x85	575	£15.20 + £2.28
HY200	120 W into 8 Ω	0.01%	100 dB	-45 -0- +45	114x50x85	575	£18.44 + £2.77
HY400	240 W into 4 Ω	0.01%	100 dB	-45 -0- +45	114x100x85	1.15Kg	£27.68 + £4.15

Load impedance - all models 4 Ω - ∞
Input sensitivity - all models 500 mV
Input impedance - all models 100K Ω
Frequency response - all models 10Hz – 45KHz – 3dB

ILP PRE-AMPS ARE COMPATIBLE WITH ALL ILP POWER AMPS AND PSUs

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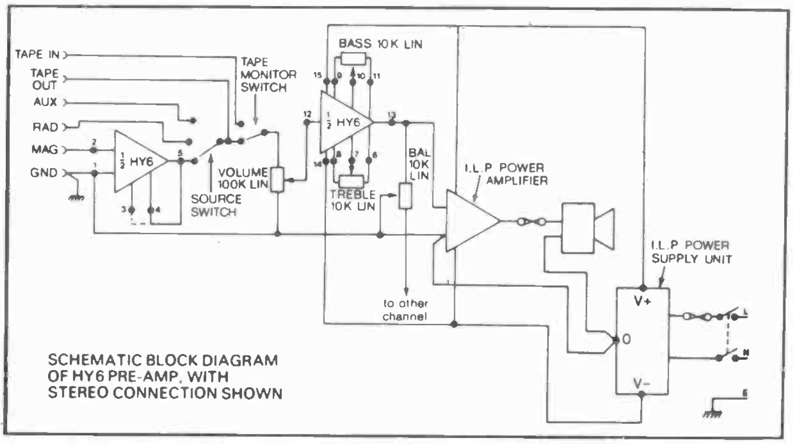
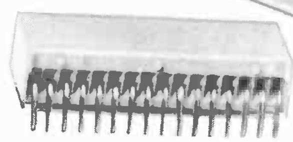
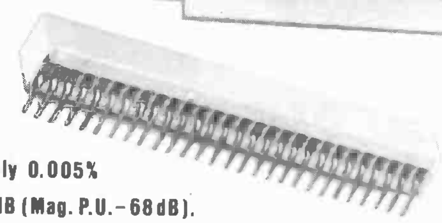




HY6 *mono* HY66 *stereo*



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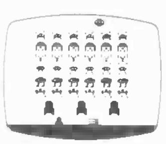

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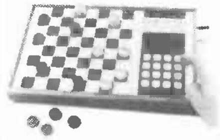

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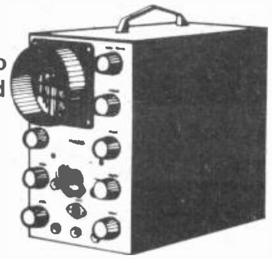

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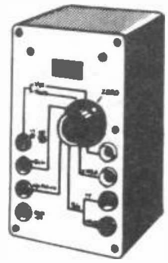

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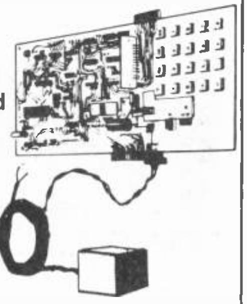

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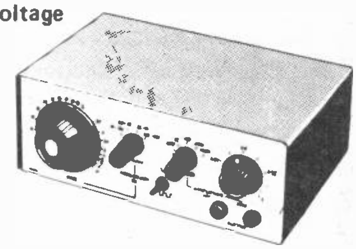

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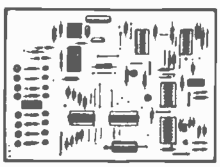

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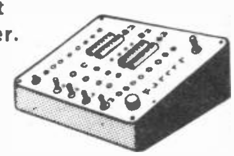

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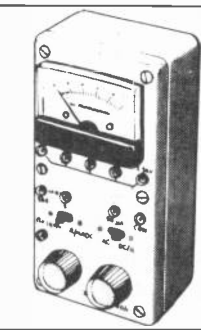

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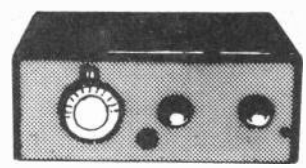

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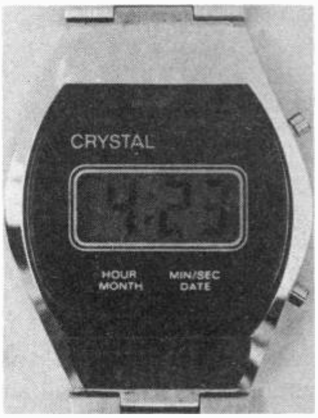

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£4.95p

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Along with the usual time and date displays, this multi-functional timepiece has a 24 hour alarm and a $\frac{1}{10}$ second stopwatch. The time may be set to operate in 12 or 24 hour mode and the date can be in English or American format. The day of the week is continuously indicated and the stopwatch display may, on command, be frozen to show split/laptime while the stopwatch continues to run. Stopwatch operation does not effect normal' time keeping. £12.95 only for this model. Also available with solar energy panel to conserve energy during daylight hours for £14.95

FROM **£12.95p**

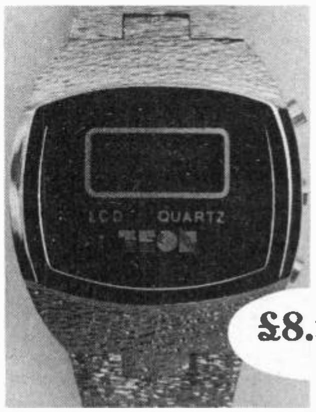
ILLUSTRATED BELOW IS THE LADIES 5 FUNCTION LCD. This watch has the same time and auto calendar functions as the basic gents model described above, together with backlight and adjustable strap to suit the daintiest of wrists. It's compact, pleasing appearance makes it a very practical day watch and it is also often used for boys and girls. Available in black or white face.

From Watches to Clocks, from Calculators to Radios, from Binoculars to Tool Kits – KEELMOOR is the name for the right quality at the right price. Your personal catalogue will tell you more – free with every order.

These are just a few of our fantastic offers remember. A free colour catalogue is posted with every order.

£5.95p

LADIES QUARTZ LCD DRESS WATCH



This attractive ladies model with the standard 5 functions of hours, minutes, seconds, month and date has literally sold in tens of thousands. Available in gold or silver colours with 'sugar coated' finish. Please state first and second choice of square, round or oval design.

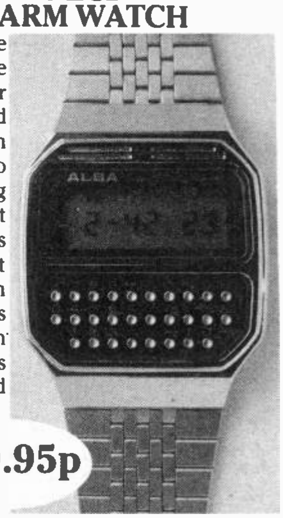
£8.95p

GENTS LCD ALARM WATCH

This model represents fantastic, incredible value for money. The 6 digit display continuously shows hours, minutes and seconds, or may be changed at will to hours, minutes and date. Its effective alarm is extremely useful and may be set to any time within a 24 hr. period. In addition, there is an alarm indicator, 4 year calendar and snooze repeater.

£8.95p

THE ULTIMATE GENTS LCD CALCULATOR/ALARM WATCH



If you want a watch from the top end of the market this is the one for you. Full calculator functions plus memory and percentage are combined with time and alarm functions to make this item an outstanding buy. Manufactured in Japan at the same factory that produces models for probably the most famous name in the watch business, this device represents sheer quality at an unbelievable price. Comes complete with backlight and button operating tool carried in the strap clasp. We advise you to order quickly whilst stocks last.

£39.95p

FULLY GUARANTEED
We must emphasize all these items are fully guaranteed for one year. All electronic goods come complete with demonstration batteries which cannot be guaranteed. New batteries are available for only 60p.

BARCLAYCARD AND ACCESS CARD WELCOME. SEE COUPON.

at Keener Prices

FREE
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Big colourful **Keelmoor** catalogue featuring hundreds of products at bargain prices.

We don't think you'll find items of this quality anywhere else at the price we offer. Order now, Christmas is round the corner and this is the way to make gift buying easier – and cheaper too.

WE ARE PROUD TO INTRODUCE THE AMAZING MELODY ALARM CHRONOGRAPH

ACTUALLY PLAYS

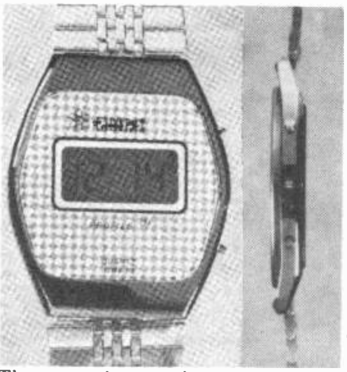
THE YELLOW ROSE OF TEXAS

BUT AS YOU CAN SEE FROM THE DETAILS BELOW THIS CHRONOGRAPH IS NO MERE NOVELTY

Today's technology has produced this fine watch which incorporates a musical alarm which plays a complete verse of 'The Yellow Rose of Texas.' Other functions included are as for model number 1.

£14.95p

NEW TO OUR RANGE, WE COMBINE PRECISION AND STYLE IN THIS – THE SUPER SLIM GENTS 5 FUNCTION CHRONOGRAPH



JUST TO GIVE YOU AN IDEA OF THE ULTRA SLIMNESS OF THESE WATCHES WE HAVE ILLUSTRATED A SIDE VIEW OF THE SUPERSLIM DIGITAL. BELOW, WE HAVE ELABORATED ON SOME OF THE TECHNICALITIES:—

These watches need no special functions to make them stand out in a crowd – their slimness serves that purpose. If you've been put off digital quartz watches in the past because you require an ultra-slim design, now is the time to change. Is equipped with standard 5 functions and backlight.

£9.95p

MAINS DIGITAL ALARM CLOCK

A very practically sized mains operated digital alarm clock – this item is extremely well finished and looks equally at home by the bedside or in the living room. With snooze/repeater alarm you could not even buy the components to build your own for this price. Available at the amazingly low price of only

£8.95p

AND FINALLY, WHAT MUST BE THE ULTIMATE IN SQUEEZING A QUART INTO A HALF PINT POT! THE INCREDIBLE MINIATURE LCD TRAVEL/ALARM CLOCK

As you can see from the photograph above this device is tiny and yet it continuously displays hours and minutes with auto calendar and night light. Invaluable for the busy traveller or simply for use in the modern home, it comes complete with its own travelling case and can easily be carried in top pocket or the smallest of handbags. It has even got a stand for upright position on table, shelf or sleeping compartment. An unusual gift to yourself or others at only £10.95.

Keelmoor Ltd, 78 Castle St, Melbourne, Derby DE7 1DY

Every order dispatched by return, and is sent by recorded delivery. That is **Keelmoor's Promise** To You.

THE KEELMOOR PROMISE

Keelmoor have a tremendous reputation to uphold, both in the retail and wholesale trades and so, with every product sold, we automatically give the Keelmoor Promise. This includes:—

- **NO RISK GUARANTEE.** Try any of these items for 15 days and if you are not completely satisfied with the quality and value simply return it for a complete refund.
- **ONE YEAR'S FULL GUARANTEE** on all products
- **BACK UP SERVICE** second to none

15 DAY TRIAL COUPON.

To Keelmoor Ltd, 78 Castle Street, Melbourne, Derby DE7 1DY

Please send me the items indicated in the boxes below. I understand that if I am not completely satisfied, I may return the goods undamaged within 15 days and my money will be refunded in full.

A	B	C	D	E	F	G	H	I	J	Just indicate with a ✓ tick, item required, if more than one required tick plus number – i.e ✓3
										TOTAL AMOUNT = £

NAME Mrs, Miss, Ms, Mr ______

ADDRESS ______

______ POSTCODE ______

I enclose a cheque/PO to KEELMOOR LTD

Or charge my Access ☐ or BARCLAYCARD ☐ (tick as applicable)

No ______

TOTAL – £

The advertisements to watch for quality precision at the right price. All goods dispatched by return.

EE 5

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- FREEPOST ON ORDERS
- VAT INCLUSIVE PRICES
- ADD 30p P&P
- 24 HR PHONE ANSWERING SERVICE

● ACCESS ● VISA ● CASH ● CHEQUE

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

C·MOS (BUFFERED)

HEF4000	22	HEF4044	105	HEF4512	138
HEF4001	22	HEF4046	133	HEF4516	127
HEF4002	22	HEF4047	109	HEF4517	478
HEF4006	119	HEF4049	57	HEF4518	118
HEF4007	22	HEF4050	57	HEF4519	69
HEF4008	100	HEF4051	87	HEF4520	118
HEF4011	22	HEF4052	90	HEF4521	235
HEF4012	22	HEF4053	90	HEF4528	124
HEF4013	57	HEF4066	62	HEF4532	150
HEF4014	105	HEF4067	475	HEF4534	638
HEF4015	100	HEF4068	22	HEF4539	138
HEF4016	57	HEF4069	22	HEF4585	122
HEF4017	100	HEF4070	22	HEF4724	214
HEF4018	100	HEF4071	23	HEF40097	113
HEF4019	58	HEF4072	23	HEF40098	92
HEF4020	112	HEF4073	23	HEF40106	78
HEF4021	107	HEF4075	23	HEF40160	149
HEF4022	103	HEF4076	130	HEF40192	149
HEF4023	22	HEF4077	22		
HEF4024	78	HEF4078	23	**Voltage Regulators**	
HEF4025	22	HEF4081	23		
HEF4026	244	HEF4082	23	LM309DA(K)	119
HEF4027	57	HEF4085	80	UA723CN	42
HEF4028	89	HEF4086	80	UA7805CU	78
HEF4029	113	HEF4093	63	UA7812CU	78
HEF4030	58	HEF4094	219	UA7815CU	78
HEF4031	250	HEF4104	208	UA7912CU	97
HEF4035	138	HEF4502	114	UA7915CU	97
HEF4040	107	HEF4505	714	UA78L05CS	38
HEF4041	94	HEF4508	230	UA78L12CS	38
HEF4042	83	HEF4510	135	UA78L15CS	38
HEF4043	100	HEF4511	157		

LINEAR

CA3046	84
CA3080E	77
CA3130E	99
CA3140E	48
CA3189E	293
LM301AN	34
LM339N	78
LM380N	104
LM381AN	198
LM3900N	75
MC3403P	156
NE531	131
NE536T	259
NE555N	28
NE556N	66
NE566N	171
NE570N	485
NE571N	505
RC4136	146
TBA120S	88
TDA1022	713
TDA1034B	239
TL081CP	84
TL084CN	156
UA741CN	20
UA741CT	47
Zener Diodes	
400mW C4V7-C33 BZY88/BZX79 + Voltage	9

SEMICONDUCTORS

IN914	5	BC182L	12
IN4001	5	BC184	11
IN4002	5	BC184L	12
IN4004	7	BC212	11
IN4007	9	BC212L	12
IN4148	4	BC214	11
IN5402	15	BC214L	12
2N2369	21	BC547	13
2N2646	46	BC548	11
2N2926G	13	BC549	12
2N3053	19	BC557	15
2N3054	55	BC558	15
2N3055	55	BCY70	15
2N3702	9	BCY71	15
2N3704	9	BD131	39
2N3705	10	BD132	39
2N3773	297	BD139	39
2N3819	22	BD140	39
2N3820	39	BFR90	333
2N3904	9	BFX85	29
2N5457	39	BFY50	17
2N5459	35	BFY51	17
40673	88	BRY39	50
BC107	14	BSX20	21
BC108	14	CL8960	2850
BC108C	18	TIP31	48
BC109	14	TIP32	54
BC109B	19	TIP41C	76
BC109C	20	TIP42C	76
BC148	10	TIP2955	75
BC158	10	TIP3055	60
BC177	17	TI543	36

GMT SELL P.A. EQPT.

PLEASE SEND AN SAE FOR DETAILS

CAPACITORS

Electrolytic Axial — Order Code Cap 018 + µF
−10% to +50% Tol.

µF \ V	16	25	40	63
1.0				9
1.5				9
2.2				9
3.3				9
4.7				9
6.8			9	10
10		8		10
15	8		9	11
22		8		13
33	8		9	
47		8	11	13
68	9			
100		9	13	
150	9	10		31
220	13		26	36
330			30	40
470		23	32	47
680	21	30	39	54
1000	26	30	59	
1500	35	39		
2200	42			

Polyester Radial Leads — Order Code Cap 352, Cap 380 + Value
Dipped Type, C280/352 Style
Moulded Type, 10.2mm Pitch

µF	352	380	µF	352	380
.001		7	.1	7	9
.0015		7	.15	8	10
.0022	6	7	.22	9	11
.0033	6	7	.33	11	
.0047	6	7	.47	14	
.0068	6	7	.68	17	
.01	6	8	1.0	21	
.015	6	8	1.5	30	
.022	6	8	2.2	35	
.033	6	8			
.047	6	8			
.068	7	8			

Electrolytic Radial Leads — Order Code Cap 034 + µF
−10% to +50% Tol.

µF \ V	10	16	25	35	40	50	63
.47							7
.68							7
1.0							7
1.5							7
2.2							7
3.3							7
4.7					7		8
6.8			7			8	9
10		7			8		9
15		7	8			9	11
22	7	8			9	11	
33		8	9		11		
47	8	9		11			
68		9	11				
100	9						
150	11						

D.I.L. Sockets

8 Pin Low Profile Socket Tin	12	DIL SKT 8
14 Pin Low Profile Socket Tin	14	DIL SKT 14
16 Pin Low Profile Socket Tin	16	DIL SKT 16

P.C.B. Components

Dalo Pen, Blue Ink, Slow Drying — 69

RESISTORS — Order Code

Carbon Film, Fixed

0.25W, E24 Values 1R0-10M, 5% Tol. 100/100 (Mult 10/Value)	2 each	Res RD¼
0.5W, E12 Values 1R0-4M7, 10% Tol.	3 each	Res RD½ + Value

Metal Film, Fixed

0.5W, E24 Values, 5R1-1M, 2% Tol.	8 each	Res MR30
2.5W, E12 Values, 10R-27K, 5% Tol	16 each	Res PR52 + Value

Metal Glaze, Fixed

0.5W, E24 Values, 1M-33M, 5% Tol.	16 each	Res VR37 + Value

Skeleton Presets, Miniature — Order Code

0.1W, E3 Values, 100R-1M, Lin. Vertical Mounting	8	Min. Preset V
0.1W, E3 Values, 100R-1M, Lin. Horizontal Mount	8	Min. Preset H + Value

Skeleton Presets, Standard

0.3W, E3 Values, 100R-4M7, Lin. Vertical Mounting	11	Std. Preset V
0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mount	11	Std. Preset H + Value

Potentiometer, Rotary

0.5W, E3 Values, 1K-2M2 Lin	39	Ro Pot Lin
0.25W, E3 Values, 4K7-2M2 Log.	39	Ro Pot Log + Value

Potentiometer, Slider

0.5W, E3 Values, 2K2-470 . Lin.	45	Sl Pot Lin
0.25W, E3 Values, 1K0 · 1M0 Log.	45	Sl Pot Log + Value

SEND A LARGE S.A.E. FOR OUR 'FLOG LIST' & OTHER INFO.

MAINS TRANSFORMERS — Order Code

Secondaries may be connected in series or parallel to give wide voltage range
Primaries 0-220, 240V

6VA – Clamp Type Construction — 235 each
Approx 18% Regulation F C 54, H36, W35

0-4.5V, 0-4.5V Secondaries — Trans 6VA
0-5V, 0-6V
0-12V, 0-12V
0-15V, 0-15V
0-20V, 0-20V

20VA – Clamp Type Construction — 360 each
Approx 16% Regulation F C 70, H48, W46

0-4.5V, 0-4.5V Secondaries — Trans 20VA
0-6V, 0-6V
0-12V, 0-12V
0-15V, 0-15V
0-17.5V, 0-17.5V
0-20V, 0-20V

Plastic Boxes – Boss Industrial Mouldings
Moulded Box and Close Fitting Flanged Lid
ABS Box, C/W Brass Bushes, and Lid In Orange

		Order Code
L112 W62 D31	99	Case BIM2003 OR
L150 W80 D50	131	Case BIM2005 OR
L190 W110 D60	223	Case BIM2006 OR

Plastic Boxes with Metal Lids
Recessed Top Box
ABS Base, C/W Brass Bushes, In Orange
1mm Aluminium Top Panel Finished Grey

		Order Code
L85 W56 D29	112	Case BIM4003 OR
L111 W71 D42	150	Case BIM4004 OR
L161 W96 D53	208	Case BIM4005 OR

Diecast Boxes
Diecast Box and Flanged Lid
Aluminium Box and Lid in Natural Finish

		Order Code
L113 W63 D31	124	Case BIM5003 NA
L152 W82 D50	216	Case BIM5005 NA
L192 W113 D61	334	Case BIM5006 NA

VERO ELECTRONICS PRODUCTS

2.5" x 5" .1" pitch Veroboard	71	200-21069J
3.75" x 5" .1" pitch Veroboard	79	200-21072D
2.5" x 1" .1" pitch Veroboard (5)	85/Pack	200-21076C
3.75" x 5" .1" pitch Plain Board	68	200-21078H
5.62" x 2.9" .1" pitch V-Q DIP Board	135	200-21084E
Spot Face Cutter	107	203-21013A
Pin Insertion Tool for .040 type pin	147	203-21015F
DS Pins .040 (100)	44/Pack	200-21087G
SS Pins .040 (100)	44/Pack	200-21017B
Verowire Kit (1-pen, 2-wire, 25-comb)	454/Kit	200-21341D
Verowire Combs (25)	109/Pack	200-21339F
Verowire Wire (2)	109/Pack	200-21340G

SWITCHES — Order Code

Miniature Toggle – Honeywell

SPDT		67	SW 8A1011
SPDT	C/Off	81	SW 8A1021
SPDT	Double Bias To Centre	90	SW 8A1041
DPDT		99	SW 8A2011
DPDT	C/Off	111	SW 8A2021

Miniature Push – C & K

SP	Push To Make, Momentary	62	SW 8531
SP	Push To Break, Momentary	62	SW 8533

G.M.T. ELECTRONICS KITS

FULL TELETEXT KIT (Free-standing unit- no internal connection to T.V.)	£199-90
TELETEXT DECODER + REMOTE CONTROL KIT (For wiring into existing television)	£135-90
PAL ENCODER/MODULATOR KIT	£ 22-90
DOPPLER RADAR ALARM KIT	£ 44-90
F.E.1. POWER AMPLIFIER OUTPUT MODULE KIT	£ 27-50
ONE AMP POWER SUPPLY MODULE KIT - FIVE VOLTS	£ 6-00
ONE AMP POWER SUPPLY MODULE KIT - TWELVE VOLTS	£ 7-50
MODEL INERTIA CONTROLLER MK I - SLOT RACER	£ 30-00
MODEL INERTIA CONTROLLER MK II - TRAIN (HAND UNIT)	£ 25-00
MODEL INERTIA CONTROLLER MK III - TRAIN (CONSOLE UNIT)	£ 25-00

KITS FOR E.E. PROJECTS

AUTOFADE	(ZB66)	May 80	£10·25
VARICAP RADIO	(ZB1)	Sept 79	£8·50
TRANSISTOR TESTER	(ZB2)	Sept 79	£5·00
4-STATION RADIO (No Case)	(ZB62)	May 80	£14·00
MORSE PRACTICE OSCILLATOR	(ZB43)	Feb 80	£6·00
WARBLING TIMER	(ZB5)	Aug 79	£5·80
MODULATED TONE GENERATOR	(ZB50)	Dec 79	£3·50
ELECTRONIC TUNING FORK	(ZB7)	Aug 79	£8·90
MICRO MUSIC BOX	(ZB45)	Feb 80	£17·00
STEREO HEADPHONE AMP	(ZB57)	March 80	£15·25
UNIBORAD BURGLAR ALARM	(ZB51)	Dec 79	£5·00
KITCHEN TIMER	(ZB55)	March 80	£12·75
UNIBORAD 9V POWER SUPPLY	(ZB47)	Jan 80	£4·50
LIGHTS WARNING SYSTEM	(ZB63)	May 80	£3·60
BATTERY VOLTAGE MONITOR	(ZB64)	May 80	£4·25
SIMPLE S.W. RECEIVER	(ZB44)	Feb 80	£18·00
INTRUDER ALARM	(ZB23)	May 79	£23·00
AUDIO TONE GENERATOR	(ZB67)	May 80	£3·50
DUAL LINE GAME (No Case)	(ZB65)	May 80	£25·00
GAS SENTINEL	(ZB61)	April 80	£27·00
5 RANGE CURRENT LIMITER	(ZB53)	March 80	£4·50
CHASER LIGHT	(ZB4)	Sept 79	£17·50
SHORT WAVE CONVERTER	(ZB25)	May 79	£13·75
UNIBOARD TOUCH SWITCH	(ZB56)	March 80	£9·00
FUNCTION GENERATOR	(ZB52)	Nov 79	£25·00
OPTO ALARM	(ZB41)	Nov 79	£5·00
AUTO-LEVEL CONTROL	(ZB60)	April 80	£8·00
CABLE & PIPE LOCATOR	(ZB54)	March 80	£3·75
CYCLE DIRECTION FINDER	(ZB59)	April 80	£14·50

All above kits include parts as described in articles i.e. veroboard, i.c. sockets connecting wire and cases where applicable.

TEACH-IN '80

New to electronics? Then start at the beginning. All electronic components for construction of Tutor Deck and Teach-In experiments during the first six parts of the series.
Lists A and B £20·00
List C £2·50

ALL PRICES INCLUDE V.A.T.
BARCLAY/VISA/ACCESS CARDS ACCEPTED.
MINIMUM TELEPHONE ORDER £5·00.

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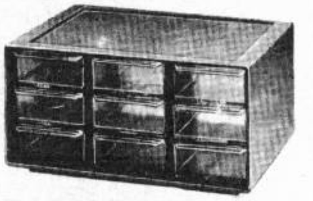

COMPONENT CABINET IDEAL FOR THE NEWCOMER TO ELECTRONICS

Contains hundreds of brand new resistors, capacitors, transistors, diodes and I.C.'s. All useful values, carefully chosen to help the new constructor pursue his hobby without finding himself short of some vital parts.

All parts contained in clearly marked bags in a plastic storage cabinet 232 × 121 × 165mm with 9 drawers into which all parts can be neatly located.

If brought individually parts plus case would cost over £50 but we are offering this for ONLY £33·95 + £1 p & p.

Simply send a cheque or P/O for £34·95 for immediate despatch.

CONTENTS:
200 ¼ watt resistors
20 Wire wound resistors
70 Ceramic Capacitors
70 Mylar Capacitors
70 Polyester Capacitors
56 Electrolytic Capacitors
61 Transistors
12 I.C.'s
20 L.E.D.'s
55 Diodes and rectifiers
Altogether 614 components.
Plus FREE surprise gift.

BARGAIN LIST NO. 10/11
This 10 page A4 size list is FREE—just send a SAE for your copy containing hundreds and hundreds of surplus bargains, many of them illustrated. Also included is a Catalogue News Sheet, featuring new lines and price changes.

1981 CATALOGUE
Now in the course of preparation, available Nov.—send 75p to reserve your copy, which will be sent as soon as printed.

EX-COMPUTER PANELS
Z528 Pack of boards containing 100's R's, C's diodes, including at least 50 transistors. Only £1·30.
Z529 TTL pack—Panels with 74 series on, together with code sheet. From simple gates to complex counters. 20 IC's £1; 100 IC's £4.

COMPONENT TRAY
Attractive yellow tray 285 × 165 × 42mm with clear hinged lid and movable compartments. Up to 15 can be made from dividers supplied. As an added bonus, a selection of new surplus components are included, all for the special low price of £4·35.

BUZZERS & MOTORS & RELAYS
Z401 Powerful 6V DC Buzzer all metal construction 50mm dia × 20mm 70p.
Z402 Miniature type Buzzer 6, 9 or 12V, only 22 × 15 × 16mm. Very neat 53p.
Z450 Miniature 6V DC motor, high quality type 32mm dia × 25mm high, with 12mm spindle. Only £1.
Z459 115/230V ac high torque motor with geared reduction down to 80 rpm. Sturdy construction, 70mm dia × 20mm. Spindle 6mm dia × 20mm long. Only £2.
W892 Heavy duty 12V relay, ideal for car use—single 15A make contact. Coil 25R. 85p.
W890 DIL reed relay—SPCO 2·4V-10V 200R coil. Only £2·20.
W847 Low profile PC mntg 10 × 33 × 20 mm 6V coil, SPCO 3A contacts. 93p.

VEROBLOC BREADBOARD
New from Vero, this versatile aid for building and testing circuits can accommodate any size of IC. Blocs and be joined together. Bus strips on X & Y axis—total 360 connexion points for just £4·15.

WATFORD ELECTRONICS

35 CARDIFF ROAD, WATFORD, HERTS., ENGLAND
MAIL ORDER, CALLERS WELCOME. Tel. Watford 40588/9

ALL DEVICES BRAND NEW, FULL SPEC. AND FULLY GUARANTEED ORDERS DESPATCHED BY RETURN OF POST. TERMS OF BUSINESS: CASH/CHEQUE/P.O.s OR BANKERS DRAFT WITH ORDER. GOVERNMENT AND EDUCATIONAL INSTITUTIONS' OFFICIAL ORDERS ACCEPTED. TRADE AND EXPORT INQUIRY WELCOME. P&P ADD 30p TO ALL ORDERS UNDER £10·00. OVERSEAS ORDERS POSTAGE AT COST. AIR/SURFACE. (ACCESS orders by telephone welcome).

VAT Export orders no V.A.T. Applicable to U.K. Customers only. Unless stated otherwise all prices are exclusive of V.A.T. Please add 15% to total cost including P & P.

We stock many more items. It pays to visit us. We are situated behind Watford Football Ground. Nearest Underground/BR Station: Watford High Street. Open Monday to Saturday 9.00 am–6.00 pm. Ample Free Car Parking space available.

POLYESTER CAPACITORS: Axial lead type (Values are in µF)
400V: 1nF, 1n5, 2n2, 3n3, 4n7, 6n8, 10m, 15n 9p; 18n 10p; 22n, 33n 11p; 47n, 68n 14p; 100n 17p; 150n, 220n, 24p; 330n, 470n 41p; 680n 52p; 1µF 64p; 2µ 82p.
160V: 39µF, 100n, 150n, 220n 11p; 330n, 470n 19p; 680n, 1µF 22p; 1µ5, 2µ2 32p; 4µ7 36p.
1000V: 10nF, 15n, 20p; 22n 22p; 47n 26p; 100n 42p; 470n 80p; 1µF 175p.

POLYESTER RADIAL LEAD CAPACITORS (250V)
10nF, 15n, 22n, 27n, 5p; 33n, 47n, 68n, 100n 7p; 150n 10p; 220n, 330n 13p; 470n 17p; 680n 19p; 1µF 22p; 1µ5 30p; 2µ2 34p.

RECTANGULAR LEDs Red, Green or Yellow with Clips 30p only

ELECTROLYTIC CAPACITORS: (Values are in µF) 500V: 10 50p; 47 78p; 250V: 100 65p; 63V 0·47, 1·0, 1·5, 2·2, 2·5, 3·3, 4·7, 6·8, 9p; 10, 15, 22, 11p; 47, 32, 50 14p; 63, 100 27p; 50V 100, 220, 25p; 470 32p; 1000 80p; 40V: 22, 33, 9p; 100 12p; 2200, 3300 85p; 4700 115p; 35V: 10, 33 8p; 330, 470 32p; 25V: 10, 22, 47, 100 8p; 160, 220, 250, 15p; 470 25p; 640, 1000 35p; 1500 40p; 2200 54p; 3300 77p; 4700 92p; 16V: 10, 40, 47 7p; 100, 125 8p; 220, 330 16p; 470 20p; 1000, 1500 30p; 2200 38p; 10V: 100 7p;
TAG-END TYPE: 450V: 100µF 180p; 70V: 4700 165p; 64V: 3300 150p; 2500 110p; 50V: 3300 135p; 2200 99p; 40V: 4700 130p; 4000 92p; 3300 98p; 2500, 2200 90p; 2000 + 2000 120p; 30V: 4700 110p; 25V: 15000 195p; 6400 120p; 4700 100p; 3000 85p; 2200 60p.

TANTALUM Bead Capacitors
35V: 0·1µF, 0·22, 0·33, 0·47, 0·68, 1·0, 2µ2, 3·3µ, 4·7, 25V: 10, 20V: 6µ8, 16V: 2µ2, 4µ7, 10. 20p.
16V; 22µ 32p; 47, 100 58p; 220 70p.
10V: 15µ, 22, 33, 30p. 3V: 100 32p.

MYLAR FILM CAPACITORS
100V: 0·001, 0·002, 0·005, 0·01µF 6p
0·015, 0·02, 0·04, 0·05, 0·056µF 7p
0·1µF 8p 50V: 0·47 12p

MINIATURE TYPE TRIMMERS
2-5·6pF, 3-10pF, 10-40pF 22p
5-25pF, 5-45pF, 60pF, 88pF 30p

COMPRESSION TRIMMERS
3-40pF, 10-80pF 30p; 25-190pF 33p
100 500pF 45p 1250pF 58p.

POLYSTYRENE CAPACITORS
10pF to 1nF 8p; 1·5nF to 10nF 10p.

SILVER MICA (Values in pF) 3-3, 4-7, 6-8, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 180 11p each
220, 250, 270, 300, 330, 360, 390, 470, 600, 800, 820 16p each
1000, 1200, 1800, 2000, 3300 26p each

CERAMIC CAPACITORS: 50V 0·5pF to 10nF 4p; 22n to 100n 7p.

EURO BREADBOARD £5·20.

POTENTIOMETERS: (ROTARY)
Carbon Track. 0·25W Log & 0·5W Linear Value.
500 Ω, 1 K & 2K (Lin. only) Single 29p
5K-2 MΩ single gang 29p
5K-2 MΩ single with DP switch 69p
5K-2 MΩ double gang 88p

SLIDER POTENTIOMETER
0·25W log and linear values 60mm
5K Ω-500K Ω single gang 60p
10K Ω-500K Ω dual gang 80p
Self Stick Graduated Bezels 36p

PRESET POTENTIOMETERS
Vertical & Horizontal
0-1W 50 Ω—5MΩ Miniature 7p
0-25W 100 Ω—3·3M Ω Horiz 10p
0-25W 200 Ω—4·7MΩ Vert 10p

RESISTORS: Carbon Film, High Stability, Low Noise, Miniature Tolerance 5%.

Range	Val.	1–99	100+
¼W 2Ω2–4M7	E24	2p	1p
½W 2Ω2–4M7	E12	2p	1p
1W 2Ω2–10M	E12	5p	4p
2% Metal Film 10Ω–1M		8p	4p
1% Metal Film 51Ω–1M		8p	8p

100+ price applies to Resistors of each value not mixed.

TGS 812 or 813 gas and smoke detector 415p. Socket for above 30p.

OPTO ELECTRONICS
LEDs plus clips
TIL209 Red 13
TIL211 Grn 18
TIL212 Yellow 18
·2" Red 14
2" Yellow Green 18
Square LED 30
OCP71 120
ORP12 63
ORP61 85
2N5777 45
7 Seg Displays
TIL312 C An 3" 105
TIL313 C Cth 3" 105
TIL321 C An 5" 115
TIL322 C Cth 5" 115
DL704 C Cth 3" 99
DL707 C.A. ·3" 99
DL747 C.A. ·6" 180
FND357 or 500 120
MAN3640 175
·3" Green C.A. 180
·6" Green C.A. 225
LCD 3½ Digit 875
TIL32 Inf. Red 58
TIL78 detector 70
Opto Isolators
IL74 48
TIL111, 112, 75p.
TIL116, 117 100p.
Bargraph Red.
Ten segment 225p

VOLTAGE REGULATORS*

1A	TO3	+ve		—ve	
5V	7805	145p	7905	220p	
12V	7812	145p	7912	220p	
15V	7815	145p		—	
18V	7818	145p		—	
1A	TO220 Plastic Casing				
5V	7805	60p	7905	65p	
12V	7812	60p	7912	65p	
15V	7815	60p	7915	65p	
18V	7818	60p	7918	65p	
24V	7824	60p	7924	65p	
100mA	TO92 Plastic Casing				
5V	78L05	30p	79L05	65p	
6V	78L62	30p		—	
8V	78L82	30p		—	
12V	78L12	30p	79L12	65p	
15V	78L15	30p	79L15	65p	

CA3085	95	LM325N	240	TDA1412	150
LM300H	170	LM326N	240	78H05	595
LM305H	140	LM327N	270	78H05+5V/5A	
LM309K	135	LM723	39		595
LM317K	350	TAA550	50	78HG 5V to 25V	
LM323K	625	TBA625B	95		650

SLIDE 250V:
1A DPDT 14p
1A DP c/off. 15p
½A DPDT 13p
4 pole c/over 24p
PUSH BUTTON
Spring Loaded
SPST on/off 65p
SPDT c/over 70p
DPDT 6 Tag 95p

SWITCHES
TOGGLE 2A 250V
SPST 32p
DPDT 44p
SUB-MIN TOGGLE
SP changeover 59p
SPST on/off 54p
DPDT 6 tags 70p
DPDT c/off 79p
DPDT Biased 115p

SWITCHES Miniature Non-Locking
Push to Make 15p Push to Break 25p
ROCKER: SPST on/off 100A 250V 30p
ROCKER: illuminated DPST
Lights when on: 3A 240V 85p
ROTARY: (ADJUSTABLE STOP) 1 pole/2-12 way 2p/2-6W, 3p/2-4W, 4p/2-3W. 43p
ROTARY: Mains 250V AC, 4 Amp 82p

DIL SOCKETS (Low Profile – Texas)
8 pin 10p; 14 pin 12p; 16 pin 13p; 18 pin 43p; 20 pin 22p; 24 pin 30p; 28 pin 35p; 40 pin 40p.

JACKSONS VARIABLE CAPACITORS
Dilicon 100/300pF 205p
500pF 250p
6 1 Ball Drive 4511/DAF 145p
Dial Drive 4103 6 1/36 1 775p
Drum 54mm 59p
0-1·365pF 325p
00 2 365pF 395p
0 2 365pF with slow motion Drive 450p
00 208/176 395p
" " with slow motion drive 410p
C804-5pF 10 15 25 50 pF 250p
100, 150pF 335p
'L' 3 x 310pF 725p
00·3 x 25pF 550p

DENCO COILS
'DP' VALVE TYPE
Range 1 to 5 Bl., Rd., Yl. Wht. 106p
6–7 B.Y.R. 95p
1·5 Green 130p
'T' 1 to 5 Bl., Yl., Rd., Wht. 130p
B9A Valve Holder 35p
RDT2 120p
RFC 5 120p
RFC 7(19mH) 133p
IFT 13; 14; 15; 16; 17 110p
IFT 18/1·6 116p
IFT 18/465 132p
TOC 1 110p
MW5FR 112p
MW/LW 5FR 134p

VEROBOARD

	0·1 (copper clad)	0·15 (copper clad)	0·15 (plain)
2½ × 3¾	66p	59p	34p
2½ × 5	75p	69p	—
3¾ × 3¾	75p	—	—
3¾ × 5	86p	92p	65p
2½ × 17	240p	—	—
3¾ × 17	296p	260p	178p
4¾ × 17	387p	—	280p
Pkt of 35 pins			20p
Spot face cutter			107p
Pin insertion tool			147p

DIODES
AA129 25
BA100 25
BY126 12
BY127 12
CRO33 158
OA9 45
OA47 18
OA70 12
OA79 12
OA81 15
OA85 15
OA90 8
OA91 8
OA95 8
OA200 8
OA202 9
IN914 4
IN916 5
IN4001/2 5
IN4003 5
IN4004/5 6
IN4006/7 7
IN4148 4
IS44 20
3A/100V 18
3A/400V 20
3A/600V 27
3A/1000V 30

We stock a wide selection of Electronic Books and Magazines

ZENERS
Range 2V7 to 39V 400mW 8p each
Range 3V3 to 33V. 1·3W 15p each

NOISE
Z5J 180

BRIDGE RECTIFIERS (plastic case)
1A/50V 20
1A/100V 22
1A/200V 25
1A/400V 29
1A/600V 34
2A/50V 35
2A/100V 44
2A/200V 44
2A/400V 53
2A/600V 65
4A/800V 120
6A/100V 73
6A/200V 78
6A/400V 85
BY164 56
VM18 DIL 55

DIAC
ST2 25

SCRs
Thyristors
1A/100V 42p
1A/400V 60p
1A600V 70
5A300V 35
5A600V 43
8A300V 48
8A500V 58
8A600V 85
12A300V 60
12A500V 92
15A/700V 195p
2N4444 140p
2N5062 28
2N5064 35
BT106 150
C106D 38
TIC44 25
TIC45 45

TRIACS
3A100V 48
3A200V 49
3A400V 50
8A100V 54
8A400V 64
8A800V 108
12A100V 60
12A400V 70
12A800V 130
16A100V 85
16A500V 150
25A800V 295
25A1000V 480
T28000D 120

TTL 74		74126	55	LS54	30	LS673	750	4095	105	ICM7217A	790
7400	11	74128	74	LS55	70	LS674	850	4096	105	ICM7555	89
7401	12	74132	70	LS63	150			4097	350	LD130	452
7402	12	74136	85	LS73	40	**CMOS**		4098	115	LF356	98
7403	14	74141	85	LS74	48	4000	18	4099	190	LM10	395
7404	14	74142	195	LS75	48	4001	18	4160	125	LM300H	170
7405	18	74143	350	LS76	45	4002	24	4161	125	LM301A	23
7406	48	74144	350	LS78	45	4006	92	4162	125	LM308	70
7407	48	74145	90	LS83	105	4007	22	4163	125	LM318	105
7408	22	74147	180	LS85	105	4008	82	4174	130	LM324	48
7409	22	74148	145	LS86	45	4009	40	4175	120	LM339	70
7410	18	74150	150	LS90	50	4010	48	4194	125	LM348	90
7411	25	74151	75	LS91	125	4011	24	4408	790	LM380	80
7412	20	74153	75	LS92	75	4012	24	4409	790	LM381	145
7413	33	74154	140	LS93	75	4013	45	4410	790	LM382	125
7414	62	74155	75	LS95	118	4014	85	4411	1020	LM1458	40
7416	31	74156	80	LS96	180	4015	85	4412F	1520	LM3900	60
7417	31	74157	75	LS107	45	4016	42	4412V	1520	LM3909N	70
7420	18	74159	185	LS109	75	4017	82	4415F	850	LM3911	125
7421	38	74160	99	LS112	80	4018	88	4415V	850	LM3914	240
7422	26	74161	99	LS113	85	4019	40	4419	320	LM3915	240
7423	32	74162	99	LS114	49	4020	98	4422	570	M253AA	705
7425	30	74163	99	LS123	95	4021	105	4432	1050	MC1310	140
7426	44	74164	120	LS124	180	4022	95	4435	1050	MC1312P	195
7427	32	74165	120	LS125	60	4023	25	4440	899	MC1488	85
7428	35	74166	155	LS126	60	4024	75	4450	350	MC1489	90
7430	20	74167	240	LS132	95	4025	25	4451	350	MC1494	595
7432	28	74170	230	LS133	30	4026	180	4452		MC1495	350
7433	38	74172	420	LS136	65	4027	48	4490F	750	MC1496	92
7437	35	74173	120	LS138	70	4028	82	4490V	750	MC1710	70
7438	30	74174	105	LS139	90	4029	105	4501	28	MC3340P	120
7440	20	74175	82	LS151	96	4030	60	4502	125	MC3360P	120
7441	74	74176	90	LS153	85	4031	225	4503	75	MC3401	52
7442	71	74177	90	LS155	96	4032	125	4506	75	MC3403	135
7443	120	74178	140	LS157	70	4033	175	4507	60	MFC6040	97
7444	116	74180	90	LS158	85	4034	210	4508	325	MK50398	835
7445	118	74181	290	LS160	120	4035	125	4510	99	MM5307	1278
7446	132	74182	88	LS161	94	4036	365	4511	150	MM57160	620
7447	90	74184	143	LS162	110	4037	115	4512	98	NE518	210
7448	99	74185	145	LS163	100	4038	118	4520	115	NE543	210
7450	20	74188	299	LS164	115	4039	360			NE544	185
7451	20	74190	135	LS165	155	4040	105			NE555	22
7453	20	74191	135	LS170	288	4041	80	**LINEAR IC's**		NE556	55
7454	20	74192	135	LS173	105	4042	80	702	75	NE560	325
7460	20	74193	135	LS174	147	4043	85	709C 14 pin	35	NE561	395
7470	41	74194	105	LS175	110	4044	95	710	97	NE562	410
7472	31	74195	198	LS181	295	4045	175	741C 8 pin	17	NE564	435
7473	40	74196	130	LS183	298	4046	130	747C	78	NE565	120
7474	34	74197	90	LS189	120	4047	98	748C	36	NE566	180
7475	56	74198	195	LS190	120	4048	65	753	185	NE567	170
7476	41			LS191	120	4049	45	810	158	NE570	450
7480	55	**74LS**		LS192	125	4050	48	2112	110	NE571	420
7481	129	LS00	13	LS193	125	4051	80	2114	250	S556B	275
7482	75	LS01	13			4052	80	81LS97	140	SAB3209	425
7483	94	LS02	16	LS196	129	4053	80	AY-1-0212	680	SAB3210	275
7484	113	LS03	15	LS197	120	4054	130	AY-1-1313A	660	SN76003	240
7485	121	LS04	20	LS200	345	4055	135	AY-1-1320	315	SN76013	170
7486	33	LS05	23	LS202	345	4056	135	AY-1-5050	190	SN76023	170
7489	215	LS06	23	LS221	120	4057	2050	AY-1-5051	160	SN76033	240
7490	57	LS09	23	LS240	225	4059	575	AY-1-6721/6	210	SN76477	175
7491	85	LS10	20	LS241	225	4060	130	AY-3-8500	390	TBA120S	70
7492	59	LS11	32	LS242	232	4061	1225	AY-5-1224A	235	TBA641	250
7493	59	LS12	32	LS244	225	4062	995	AY-5-1230	450	TBA800	90
7494	95	LS13	40	LS245	450	4063	120	CA3018	68	TBA810	96
7495	75	LS14	75	LS247	135	4066	54	CA3023	170	TCA965	120
7496	95	LS15	40	LS251	130	4067	430	CA3028A	80	TDA1008	310
7497	180	LS20	21	LS253	130	4068	28	CA3035	235	TDA1022	575
74100	130	LS21	32	LS257	115	4069	28	CA3043	278	TDA1024	105
74104	62	LS22	40	LS258	120	4070	30	CA3046	70	TDA2020	320
74105	62	LS26	48	LS259	160	4071	25	CA3048	214	TLO61	54
74107	35	LS27	45	LS261	450	4072	25	CA3080E	65	TLO71	45
74109	60	LS28	48	LS266	75	4073	25	CA3081	190	TLO74	140
74110	54	LS30	24	LS273	180	4075	25	CA3085	85	TLO81	42
74111	68	LS32	30	LS279	88	4076	99	CA3089E	215	TLO83	65
74112	150	LS33	30	LS280	250	4077	48	CA3090AQ	375	TLO84	120
74116	198	LS37	30	LS299	420	4078	30	CA3123E	150	UAA170	175
74118	99	LS38	30	LS324	200	4081	20	CA3130	85	UAA180	175
74119	125	LS40	28	LS365	90	4082	28	CA3140	48	Z80CPU	990
74120	105	LS42	80	LS366	90	4085	90	ICL7106E	705	ZN414	95
74121	42	LS47	85	LS367	90	4086	90	ICL7107	975	ZN424E	130
74122	55	LS48	120	LS368	90	4089	150	ICL8038	340	ZN425E	415
74123	95	LS49	120	LS373	180	4093	89	ICM7205	1150	ZN1034	200
74125	45	LS81	25	LS670	270	4094	240	ICM7218	1950	ZN1040E	685

TRANSISTORS				BDY17	195	MJ2955	99	TIP36A	170	2N2905A	26
AC125	35	BC172	11	BDY56	170	MJE340	54	TIP36C	199	2N2906	22
AC126	25	BC173	11	BDY60	110	MJE370	70	TIP41A	55	2N2926	10
AC127	22	BC177	15	BDY61	165	MJE371	70	TIP41B	60	2N3053	24
AC128	20	BC178	14	BF115	26	MJE2955	99	TIP42A	72	2N3054	65
AC141	27	BC179	15	BF154	25	MJE3055	70	TIP42B	82	2N3055	40
AC142	28	BC181	10	BF156	20	MPF102	66	TIP2955	60	2N3133	43
AC176	25	BC182	10	BF167	28	MPF103	38	TIP3055	60	2N3135	33
AC188	24	BC182L	10	BF173	25	MPF104	36	TIS43	30	2N3250	30
ACY17	60	BC183	10	BF177	24	MPF105	36	TIS44	45	2N3442	140
ACY18	60	BC183L	10	BF178	25	MPF106	40	TIS88A	50	2N3663	17
ACY19	60	BC184	10	BF179	38	MPSA05	22	TIS90	30	2N3702	10
ACY20	53	BC184L	10	BF180	38	MPSA06	24	TIS91	32	2N3703	10
ACY21	60	BC187	25	BF194	11	MPSA12	29	ZTX107	11	2N3704	10
ACY22	60	BC212	8	BF195	12	MPSA55	29	ZTX108	11	2N3705	10
ACY28	60	BC212L	9	BF196	12	MPSA56	29	ZTX109	11	2N3706	12
ACY39	80	BC213	8	BF197	12	MPSU05	50	ZTX300	13	2N3707	12
AD140	70	BC213L	8	BF198	18	MPSU06	50	ZTX301	15	2N3708	11
AD149	75	BC214	10	BF199	21	MPSU56	60	ZTX302	20	2N3709	11
AD161	42	BC214L	10	BF200	29	OC28	120	ZTX303	25	2N3710	12
AD162	42	BC307	14	BF224A	28	OC35	125	ZTX304	17	2N3711	12
AF114	75	BC308	16	BF244B	29	OC36	130	ZTX314	24	2N3713	215
AF118	85	BC327	12	BF245	30	OC41	125	ZTX326	45	2N3771	179
AF139	40	BC328	15	BF256B	50	OC42	48	ZTX341	28	2N3772	195
AF178	75	BC338	12	BF257	35	OC43	55	ZTX500	15	2N3773	283
AF180	70	BC441	30	BF258	35	OC44	55	ZTX501	15	2N3819	20
AF186	50	BC461	30	BF259	35	OC45	40	ZTX502	17	2N3820	45
AF239	42	BC447	35	BF274	42	OC46	40	ZTX503	15	2N3882	130
BC107	10	BC477	35	BF594	40	OC70	40	ZTX504	25	2N3823	70
BC107B	12	BC547	10	BF595	40	OC71	35	ZTX531	25	2N3866	90
BC108	10	BC548	10	BFR39	25	OC72	40	ZTX550	25	2N3903	18
BC108B	12	BC549C	15	BFR40	25	OC74	50	2N696	36	2N3904	18
BC108C	12	BC557	15	BFR41	24	OC76	45	2N697	25	2N3905	18
BC109	10	BC558	15	BFR79	24	OC77	78	2N698	40	2N3906	17
BC109B	12	BC559C	15	BFR80	24	OC81	36	2N699	35	2N4037	58
BC109C	12	BCY70	14	BFR81	24	OC82	50	2N706	19	2N4058	15
BC117	20	BCY71	18	BFX29	28	OC83	48	2N708	22	2N4061	17
BC119	23	BCY72	20	BFX81	45	OC84	45	2N918	33	2N4859	65
BC137	20	BD131	42	BFX84	26	OC140	110	2N961	61	2N5135	42
BC140	26	BD132	42	BFX85	28	OC170	85	2N1131	26	2N5136	42
BC142	26	BD133	50	BFX86	28	OC171	45	2N1132	28	2N5138	20
BC143	26	BD135	40	BFX87	28	OC202	95	2N1302	35	2N5179	60
BC147	8	BD136	40	BFX88	28	TIP29A	36	2N1303	50	2N5180	80
BC148	8	BD137	40	BFY50	21	TIP29C	60	2N1304	50	2N5191	75
BC149	9	BD138	40	BFY51	21	TIP30A	48	2N1305	35	2N5305	40
BC153	20	BD139	40	BFY52	21	TIP30C	58	2N1671B	215	2N5457	35
BC154	13	BD140	40	BFY56	32	TIP31A	45	2N2160	350	2N5458	35
BC157	10	BD142	68	BFY71	20	TIP31C	55	2N2219A	22	2N5459	35
BC158	10	BD145	175	BRY39	30	TIP32A	48	2N2220A	26	2N5485	40
BC159	11	BD205	110	BSX20	20	TIP32C	60	2N2222	20	2N5777	45
BC160	28	BD222	75	BSY65	30	TIP33A	65	2N2369	17	2N6027	44
BC167A	11	BD378	70	BSY95A	18	TIP33C	78	2N2476	125	3N128	112
BC168	10	BD434	32	BU105	170	TIP34A	74	2N2484	25	3N140	112
BC169	10	BD517	70	BU205	170	TIP34C	88	2N2646	48	40360	43
BC170	15	BD659A	85	BU208	215	TIP35A	160	2N2894	30	40361	50
BC171	11	BD695	85	MJ491	175	TIP35C	185	2N2904	26	40362	50
		BD696A	85							40673	95

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The busiest season for constructors is now upon us and we open this new season with an eight-part series *I.C.s Explained*. The first four parts will be devoted to linear devices, the remaining four to digital i.c.s.

That's not all. As back-up, we are giving every reader a specially prepared chart *Guide To Popular Linear I.C.s*—free with this issue.

In general, electronics is becoming more and more to mean *micro*electronics. This is as evident in the constructor's field as elsewhere. The integrated circuit upon which microelectronics is based has risen to a position of paramount importance in designs for the home constructor. In quantity used, the i.c. already tends to be on parity with the transistor, which used to be the key active component in the average circuit.

Anyone who was building electronic circuits before the i.c. came on the scene will appreciate the tremendous changes this device has brought about during the course of the last decade. Electronic circuit design has been transformed—and greatly to the advantage of the constructor. An i.c. takes little more time and effort to solder in position than a transistor yet it introduces an increase in actual operational circuitry of 10 to 10,000 times, or even more, compared to that built around a single discrete transistor.

Integrated circuits are produced in great variety. They can be broadly divided into two classes: linear and digital. They range from comparatively simple devices incorporating, for example, a single operational amplifier or a set of logic gates, right up to those large-scale integration devices such as microprocessors which form the heart of complete computing systems—and which have recently been caught in the glare of large-scale publicity as harbingers of a new technological and social revolution.

Many of the available integrated devices are of immediate interest and usefulness to the constructor. Our new series will identify some of the most important i.c.s and explain their functions and provide suggestions for their use in practical circuits.

Those who are unfamiliar with the integrated circuit (or microchip—to use one of the popular names for this device) are recommended to read first the scene-setting article *Introducing Microcircuits*. This will prepare the ground for our series *I.C.s Explained*.

We hope a large number of new recruits will "join-up" this autumn and so swell the ranks of electronics constructors. It's a grand hobby, and it keeps you up with the technological times!

Fred Bennett

Our November issue will be published on Friday, October 17. See page 645 for details.

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ELECTRONICS

VOL. 9 NO. 9 OCTOBER 1980

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

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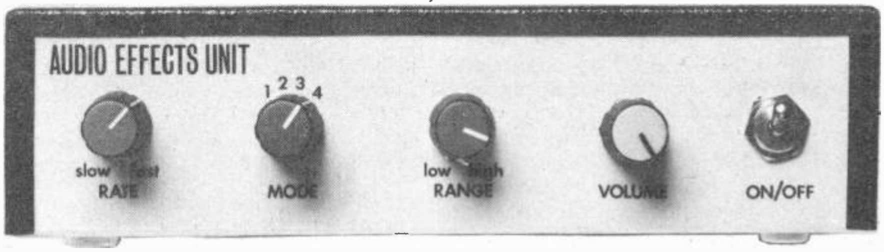
AUDIO EFFECTS UNIT

BY P. BAILEY



FOR WEIRD SOUNDS

With the ever increasing cost of commercially produced electronic sound effects units, it is becoming increasingly economical for the electronics hobbyist to construct his own.

The unit to be described basically reproduces siren tones, but with careful manipulation of the controls, it can produce a whole variety of sounds. It can be built for a fraction of the cost of a ready made unit, and could be of use in home movie-making, tape recording, plays and discos.

OSCILLATOR PRINCIPLE

The circuit is based on the NE556 i.c. This is a "dual timer" i.c. and contains two NE555 timers in one 14 pin d.i.l. package. In this application both of these timers have been connected as astable multivibrators using basically the conventional circuit shown in Fig. 1, which shows the circuit for just one half of the 556.

When the power is first applied, capacitor C_T starts to charge up towards V_{CC} via R_A and R_B. This continues until the voltage on C_T reaches $\frac{2}{3}V_{CC}$ at which point the threshold or, pin 2 senses this and switches on the discharge path, pin 1, which was formerly in a high state, to ground potential thus effectively grounding the junction between R_A and R_B. This allows C_T to discharge to ground via R_B. But when the voltage on C_T falls to $\frac{1}{3}V_{CC}$ the trigger input, pin 6 senses this and drives pin 1 high again, thus allowing C_T to charge up again towards $\frac{2}{3}V_{CC}$ at which point the whole discharging process repeats itself. This charging/discharging of C_T will repeat *ad infinitum* with the C_T voltage varying between $\frac{1}{3}$ and $\frac{2}{3}V_{CC}$.

Each time C_T is charged the output, pin 5, is driven high thus providing a pulse waveform. Thus by making R_B a variable resistor, and giving R_A and C_T set values, we have a variable frequency oscillator.

MODULATING VOLTAGE

An additional feature of the NE556 is that the oscillation frequency can be varied using a control voltage. This is shown in Fig. 1 as a modulating voltage V_M being fed into the control voltage pin, pin 3. This varies the width of the output pulses, while leaving the spaces between them constant so effectively varying the frequency. The higher the voltage fed to pin 3 the lower the frequency.

So if we have an audio frequency oscillator and we use low frequency waveforms to modulate its pitch via its control voltage input, then we can produce a variety of siren type sounds; the particular siren type dependent on the modulating waveform's shape. This is the principle of the unit described below.

CIRCUIT DESCRIPTION

The complete circuit diagram of the Audio Effects Unit is shown in Fig. 2. The low frequency oscillator is built around IC1a, half of the 556 i.c. C1 is the timing capacitor and is charged via R2 and R3+VR1. It is discharged via R3+VR1. The frequency range at the high end is limited by R3, but the frequency range can still be varied from about 0·72Hz to about 12Hz.

The mode of operation is selected by S1 and this determines the shape and type of modulation signal sent to the audio oscillator. The switch positions are summarised as follows.

Position 1: S1a is not connected to anything; S1b is connected to the

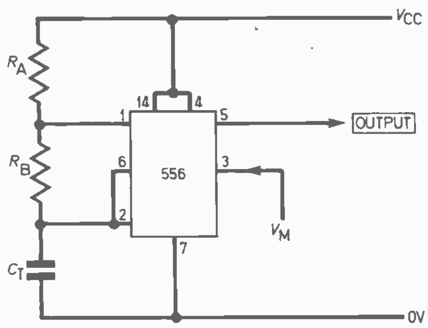


Fig. 1. Circuit diagram of basic astable multivibrator using one half of a 556 timer i.c.

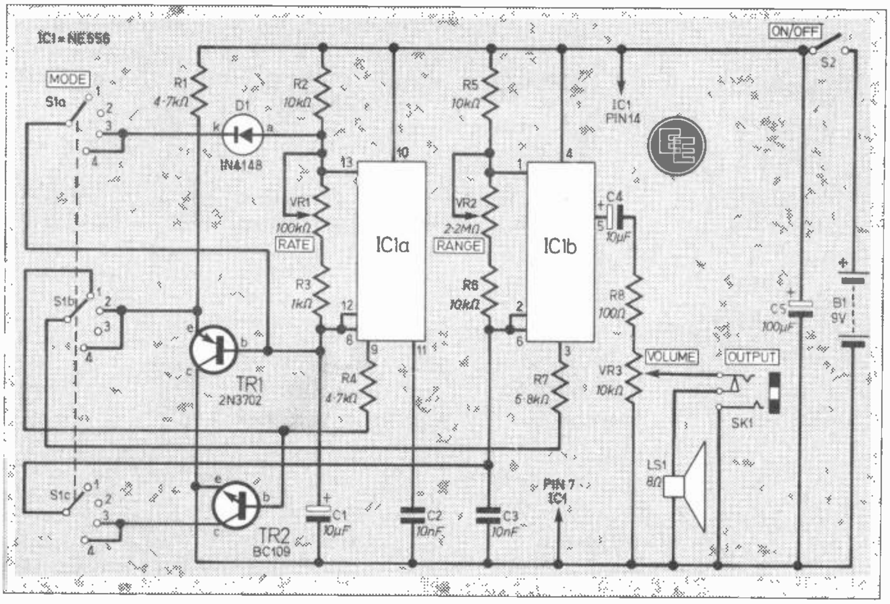


Fig. 2. Complete circuit diagram for the Audio Effects Unit.

low frequency oscillator output; S1c is not connected to anything. Thus a square wave is fed to the audio oscillator causing it to alternate between two tones.

Position 2: S1a is not connected to anything; S1b is connected to the emitter of TR1 which has been set up as an emitter follower (buffer) for the voltage on C1 so producing a ramp waveform that is the charge/discharge curve of C1; S1c is unconnected. Thus a roughly triangular wave is fed to the audio oscillator causing it to glide between two tones.

Position 3: S1a is connected to D1 which is thus connected across R3 and VR1. This has the effect of causing C1 to charge quickly via R2 and VR1; S1b is unconnected; S1c is connected to the collector of TR2. This is switched on and off by the low frequency oscillator output and so, since the output is a series of short pulses, TR2 switches the audio oscillator on and off by shorting out its timing capacitor for short intervals. Thus the audio oscillator produces a pulsed, steady tone.

Position 4: S1a is connected to D1 as before; S1b is connected to TR1 which in this case is producing a reverse sawtooth wave due to the action of D1 on the charging times; S1c is connected to TR2 as before so as to switch the audio oscillator off during the charging of C1. Thus the audio oscillator produces a tone which rises steadily, stops and then rises again starting from its original pitch.

AUDIO OSCILLATOR

The audio oscillator is built around IC1b section of the 556 and its frequency is variable via VR2 with R6 setting an upper limit.

This oscillator works in exactly the same way as the low frequency section described above, but has only one waveform, a square wave taken from its output at pin 5, and it can be manually adjusted over a frequency range of approximately 32Hz to 4kHz.

The purpose of R8 is to limit the current drawn from the output which although it can source or sink well over 100mA, can easily be damaged by a short across the output when VR3 is at full volume.

This resistor also allows the output to directly drive a miniature loudspeaker of virtually any impedance without damage. In the prototype an eight ohm miniature speaker was used but other values should work equally well.

The output is via a switched jack socket and it has been arranged such that the internal speaker is normally on but is disconnected by the entry of a plug in the output socket. Either the socket or the speaker could be omitted if not required.

CONSTRUCTION starts here

CASE

The prototype unit was housed in a two-part metal case size 200×125×50mm which had a removable vinyl covered top which was held in place by two screws. This gave a pleasant, smart, compact appearance, but any other metal or plastic case would do just as well providing it had room for the battery and the speaker, if one is being used.

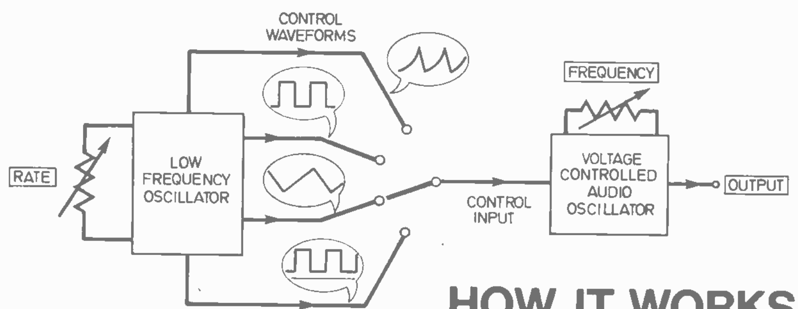
Four small self-adhesive feet or similar should be fixed to the underside of the case to stop it sliding about during use.

The case, once drilled, can be lettered using Letraset or similar rub-down lettering and then given a protective coat or two of clear varnish. The type sold in aerosols is ideal for this.

If a loudspeaker is fitted inside then it is advisable to drill holes in the case to allow the sound to escape.

CIRCUIT BOARD

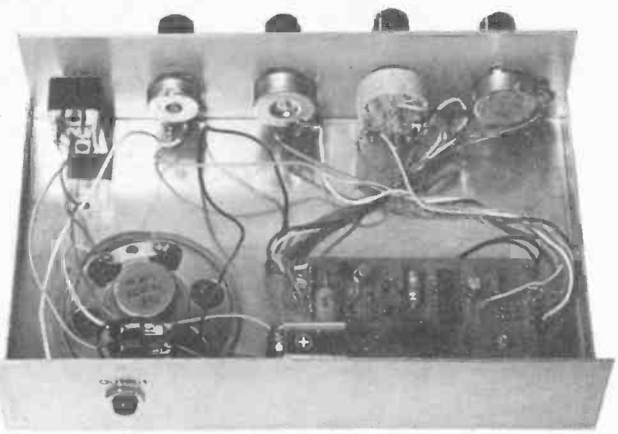
The majority of the components are mounted on a piece of 0·1 inch



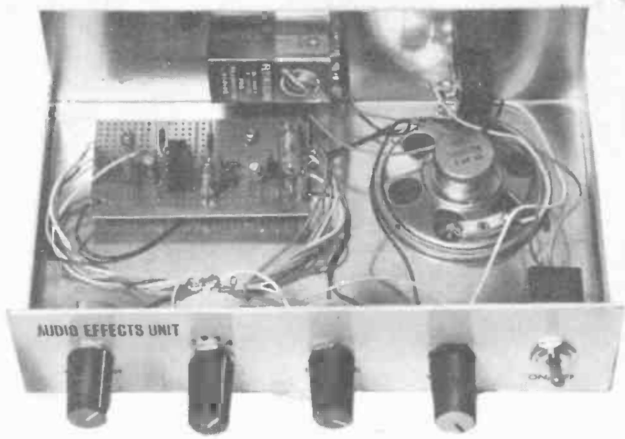
HOW IT WORKS

A low frequency oscillator based round a simple timer i.c. produces square waves at frequencies between about 1Hz and 12Hz. These are processed to produce different control waveforms.

A second timer i.c. is wired to provide a voltage controlled audio oscillator and the waveforms derived from the first oscillator are fed to its control input to provide a wide range of special sound effects.



Completed Audio Effects Unit showing wiring to front panel controls.



Finished unit with top cover removed showing suggested positioning of the battery, circuit board and loudspeaker.

Audio EFFECTS Unit

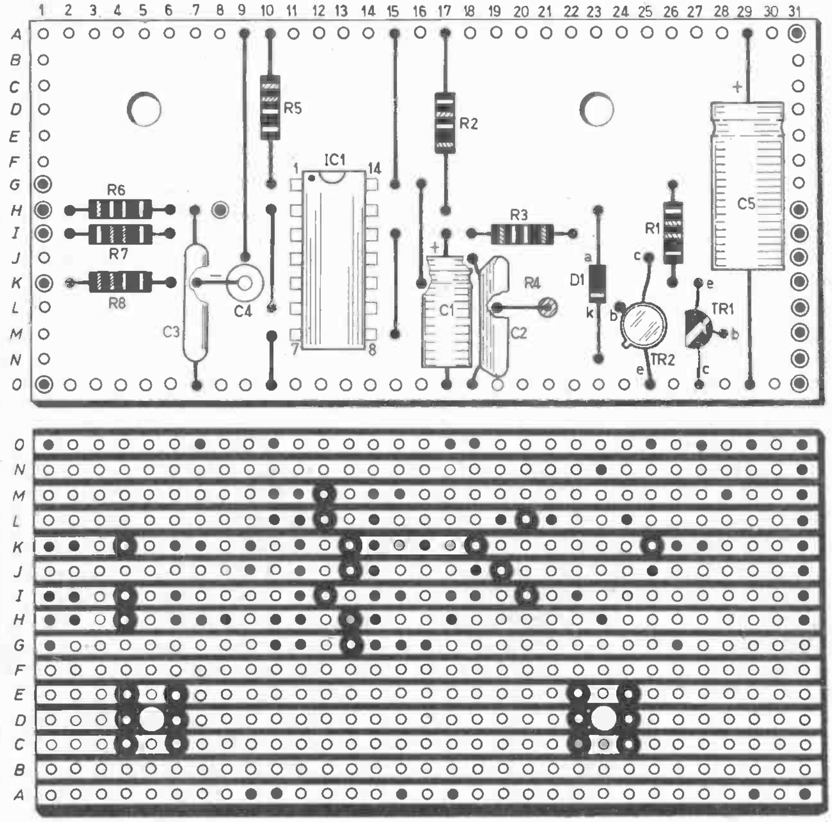


Fig. 3. Component layout on the stripboard together with details of breaks to be made along the copper strips on the underside of the board.

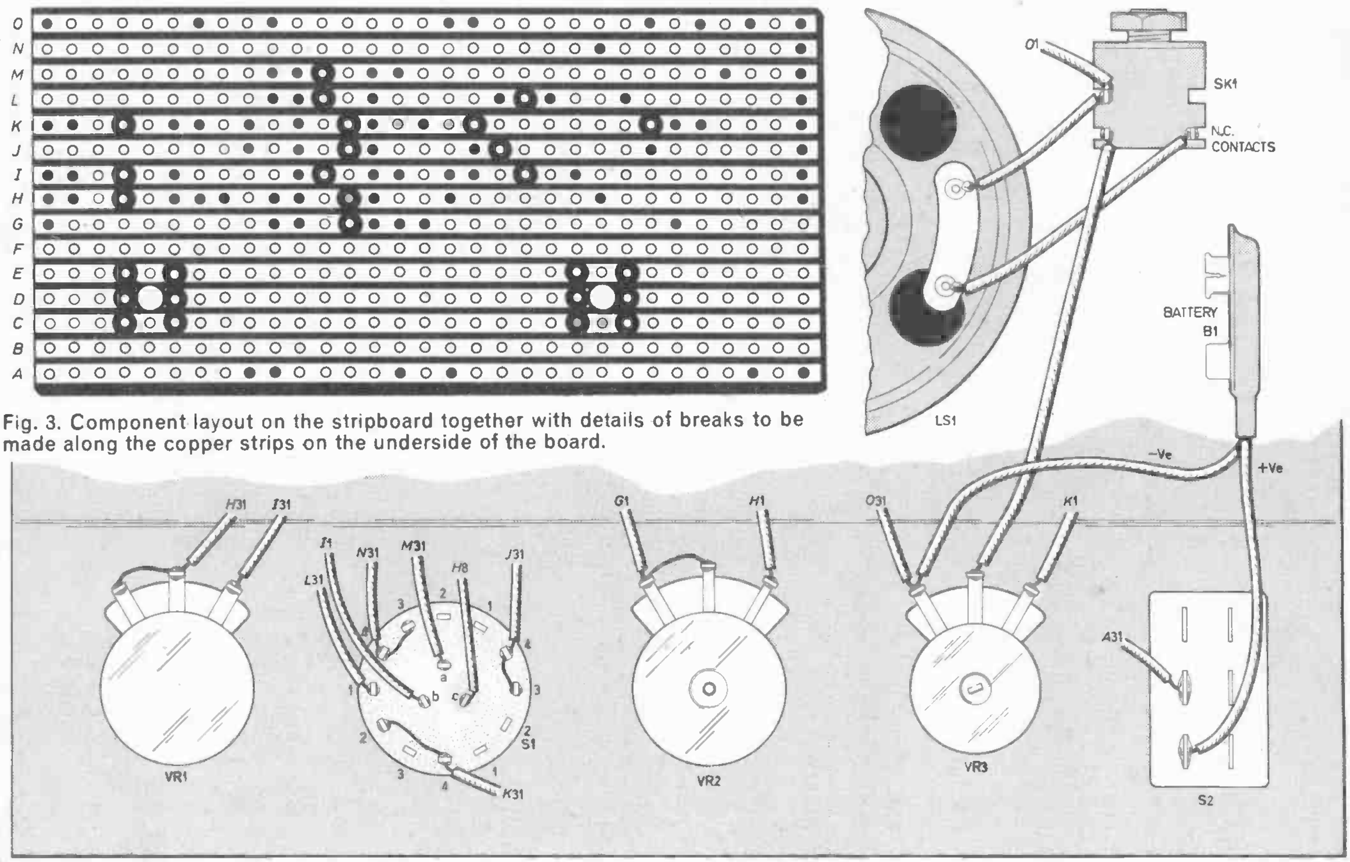


Fig. 4. Interwiring for the offboard components and wiring details to the circuit board.

matrix stripboard size 15 strips by 31 holes. There should be no constructional problems with the circuit board but be careful not to leave out any of the breaks in the copper strips.

The component layout and interwiring are shown in Figs. 3 and 4. First of all mount the resistors and capacitors then the diode and the two transistors. Although the i.c. is not of the delicate CMOS type a socket would be an advantage in easing replacement of the i.c. should this become necessary, and also it avoids the possibility of overheating during soldering.

Soldercon pins were used in the prototype but a 14 pin d.i.l. socket would do just as well. When soldering the diode and the transistors, care should be taken not to overheat them and it is recommended that a heat-shunt should be used.

WIRING UP

To ease the job of connecting flying leads to the circuit board, single ended Veropins could be used and in this case the pin should be pushed through from the copper side so that its head comes up against the strip it is to be soldered to. After soldering the pin, the wire should be wrapped around it and then soldered in place.

The circuit board in the prototype was mounted on the base of the box using 6BA bolts with nuts to suit, and 10mm plastic spacers.

Be careful when wiring up the rotary switch and follow the layout diagram in Fig. 4 to avoid confusion.

The speaker, if used, can be fitted in place using Araldite or a similar adhesive and applying it around the metal edge of the speaker, being careful not to get any on the cone.

The battery in the prototype was secured using a double-sided self-adhesive pad, but double-sided tape or a suitably bent metal strip could be used instead.

TABLE 1

CONTROL SETTING			SOUND PRODUCED
Rate	Mode	Range	
Half-way	1	Half-way	British police siren
Minimum	2	Three-quarter-way	U.S.A. police siren
Maximum	2	Maximum	Canary
Quarter-way	3	Three-quarter-way	Heart beat monitor
Half-way	4	Three-quarter-way	"Star Trek" red alert

TESTING AND USING

Check that all the components have been inserted the right way round especially the i.c. If all seems well, then with the RANGE and RATE controls at around mid-position, the MODE switch in position 1 and the VOLUME control at maximum, switch on.

A two-tone sound should be clearly heard from the loudspeaker or amplifier (whichever is being used). If nothing can be heard switch off immediately and recheck all the wiring particularly the wiring to the VOLUME control because this may have been reversed. Check also to see if the battery is flat.

Assuming that the unit is working now turn the MODE switch to position 2. The sound should now waver about a steady pitch. If this is functioning correctly, modes 3 and 4 can be similarly checked; position 3 should give a beeping sound, and position 4 should give a whooping sound.

IN USE

If these tests are successful then the unit is operating correctly and is ready for use. The unit has a wide range of applications as a sound-effects source since it can produce many different sounds.

Some control settings have been given in Table 1 for producing a small variety of effects and these can obviously be modified by experimentation with the controls. Note that to produce the canary effect the RANGE control should be moved quickly back and forward about a position near the maximum setting.

Finally, if a louder sound is desired than is obtained using the given component values then the value of R8 may be reduced providing that the total value of R8 plus the speaker impedance (with VR3 at maximum volume position) is kept above about 80 ohms.

This is to avoid drawing too much current from the output of IC1, since if this is done then permanent damage may occur.

Also, if any alteration to R8 is to be made, bear in mind that the louder the sound from the speaker, the more current there is being drawn from IC1, and consequently the more current is being drawn from the battery, and a larger battery may be required to give reasonable life.

With the component values shown, a PP3 battery and an 8 ohm speaker, the prototype provided a good volume and the battery lasted for many long periods of use. ◻

COMPONENTS

See Shop Talk page 635

Resistors
- R1 4·7kΩ
- R2 10kΩ
- R3 1kΩ
- R4 4·7kΩ
- R5 10kΩ
- R6 10kΩ
- R7 6·8kΩ
- R8 100Ω

All ¼W carbon ± 5%

Potentiometers
- VR1 100kΩ carbon log.
- VR2 2·2MΩ carbon lin.
- VR3 10kΩ carbon log.

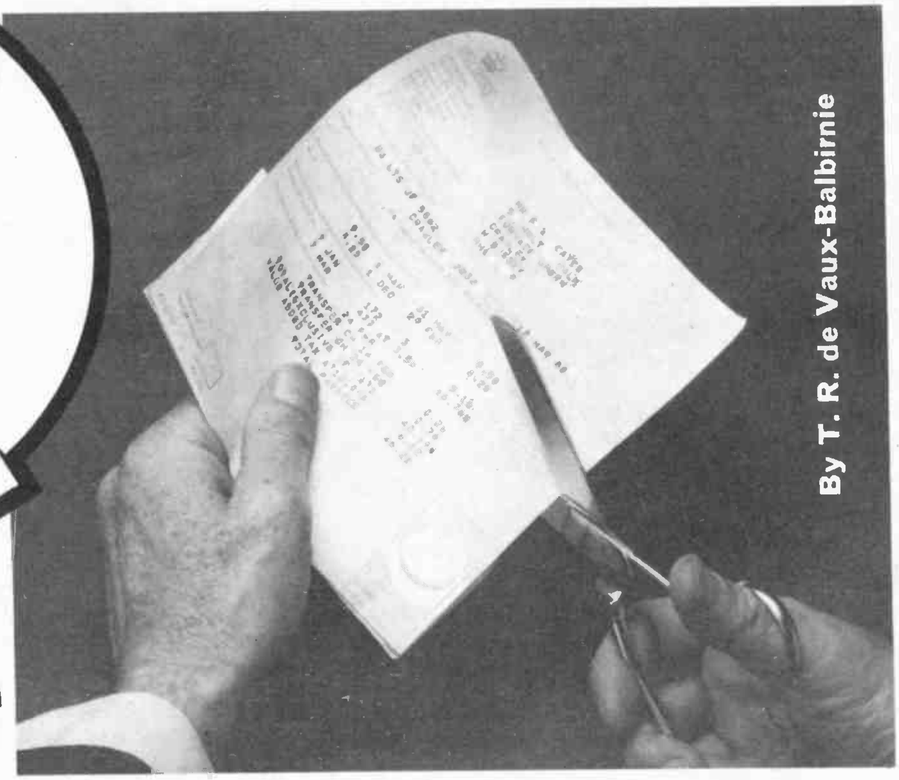
Capacitors
- C1 10µF 25V elect.
- C2 10nF polyester C280
- C3 10nF polyester C280
- C4 10µF 25V elect.
- C5 100µF 16V elect.

Semiconductors
- IC1 NE556 dual timer i.c.
- TR1 2N3702 *pnp* silicon
- TR2 BC109 *npn* silicon
- D1 1N4148 small signal silicon diode

Miscellaneous
- S1 3-pole, 4-way rotary switch
- S2 s.p.s.t. toggle
- SK1 standard mono switched jack socket
- LS1 8 ohms, miniature moving coil loudspeaker
- B1 9V type PP3

Stripboard, 0·1 inch matrix 15 strips by 31 holes; metal case 200 × 125 × 50 mm; 14 pin d.i.l. socket for IC1; four knobs; stranded wire for interconnections; battery connector; 6BA nuts bolts and spacers (2 off each).

COMPONENTS approximate cost £9



By T. R. de Vaux-Balbirnie

cut costs by building our PHONE CALL CHARGE JOGGER

WITH telephone bills flowing freely again, many readers must be examining ways of saving money. Rather than to cut down on the number of calls, choosing the best time of day and eliminating gossip can do a great deal to reduce telephone bills. The circuit described here is a very simple and cheap affair which gives an indication when a fixed sum, presently 3·5p when the call is dialled on your own phone, has been spent.

It has a built-in "nuisance factor" in the form of a button which is pressed to reset the circuit and to initiate a further timing period. Of course, direct connections to the telephone system are prohibited so savings will only be made with the goodwill and co-operation of the user who may choose not to switch the unit on in the first place!

It is probable, however, that members of the family will not be setting out to waste money—they just need a simple jog to remind them of the mounting cost.

There are commercial instruments which "clock up" the cost digitally. There have also been published designs for similar sophisticated circuits which use advanced techniques to give an accurate account of the cumulative cost. These are excellent but tend to be expensive. A cynic might suggest that it would take years to recover their cost in terms of the savings achieved.

By contrast, the present design is cheap and very simple to construct. It does not boast accuracy and uses a simple lamp to indicate when the time is up.

USING THE JOGGER

The device is used in the following way. Before the call is made the correct time period is selected according to the distance and the time of day. At the present time there are four distance factors—Local (L), Medium Distance (a), and Long Distance (b). The fourth is a Channel Islands charge and, with apologies for those making calls to these parts, this is not included.

The charge system allows for three rates according to the time of day—Peak, Standard and Cheap. With three distance factors and three time factors there should be nine possible call times available for the 3·5p unit. In fact, there are only eight as two of them coincide. Nine positions have been included for convenience and the possibility of later non-coincidences. The various periods are set out in Table 1 below but further details may be obtained from the Telephone Dialling Codes booklet supplied to subscribers by the Post Office.

TABLE 1: Time in seconds obtained for 3·5p as a function of call distance and time of day. This applies to calls dialled on your own phone. V.A.T. is to be added to the total cost.

Distance Time	(L) Local	(a) Up to 56km	(b) Over 56km
PEAK Mon–Fri 9am–1pm	120	30	10
STANDARD Mon–Fri 8am–9am 1pm–6pm	180	45	15
CHEAP All other times	480	180	60

The selection of these times could be made by using nine separate switches or by a 9-position rotary switch. The author, however, used the cheap alternative of nine miniature sockets and a plug on a wandering lead which could be placed in the appropriate position. The plug will normally be left in the most frequently used socket.

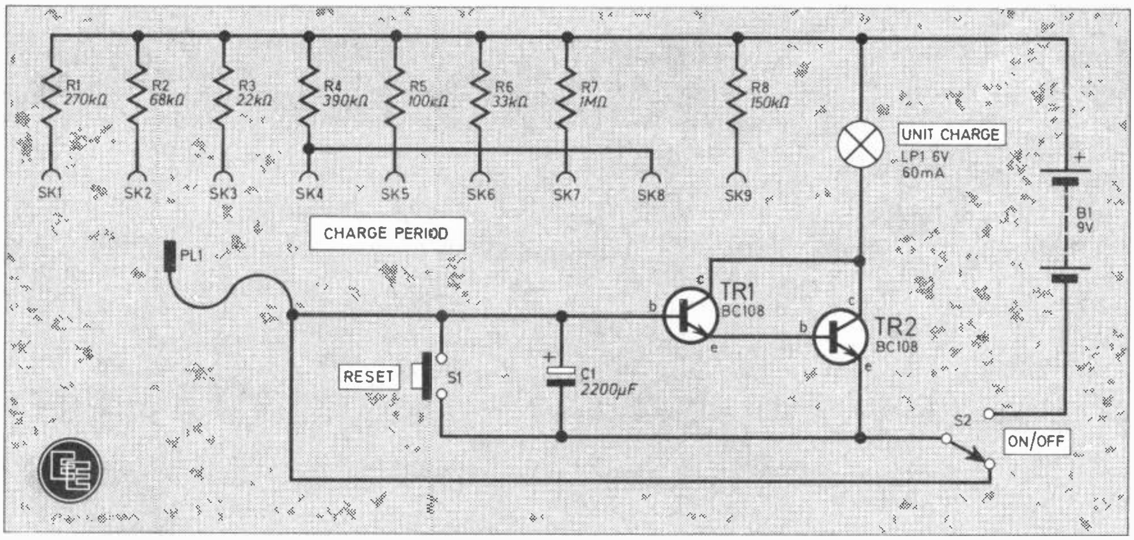


Fig. 1. The complete circuit diagram for the Phone Call Charge Jogger.

With the correct selection made, the unit is switched on. When the call is established, the reset button is pressed momentarily. When the first 3·5p has been used the panel light will come on. To monitor further 3·5 pence worth the reset button is pressed as required. For local cheap rate calls there will be little nuisance value as the intervals will be 8 minutes or so but for the more expensive calls the nuisance factor will be much greater and the mounting cost demonstrated in quite a frightening way!

CIRCUIT DESCRIPTION

The circuit (Fig. 1) consists of two high-gain transistors TR1 and TR2 connected as a "Darlington pair" which produces a very high gain transistor equal to the product of the individual gains. When the circuit is switched on, C1 charges up through one of eight resistors selected by the control panel. The rate of charge will depend on the value of the resistor—the higher the value the more slowly will the capacitor charge. At a certain point the voltage across C1 will be sufficient to turn on TR1. This turns on TR2 which causes the panel lamp to illuminate. The push-button switch S2 is used to discharge C1 and initiate another timing cycle. It will be noted that the on-off switch is placed in the negative battery line. This is necessary because this switch is also used to discharge C1 whilst the unit is "off."

COMPONENTS

Electrolytic capacitors like C1 are a necessary evil in this type of circuit. Any particular component is unlikely to have its nominal value and the manufacturer's tolerance is typically −25 per cent to +100 per cent. In fact it is likely to be well within these limits. All the same, some capacitors could lead to quite significant differences in the timing periods.

On testing, if this is found to be the case, then the easiest course of action is to re-specify the unit cost i.e. the time bought for, perhaps, 2p or 4p instead of 3·5p. The latter unit was originally chosen because the Post Office base their calculations on this at present!

One point to watch is that a newly purchased capacitor or one which has been stored for a long period is likely to be deformed to some extent. It should be found that the time intervals settle down to steady values after a few operations. It is normal for the lamp to come on slowly, especially for the long time intervals.

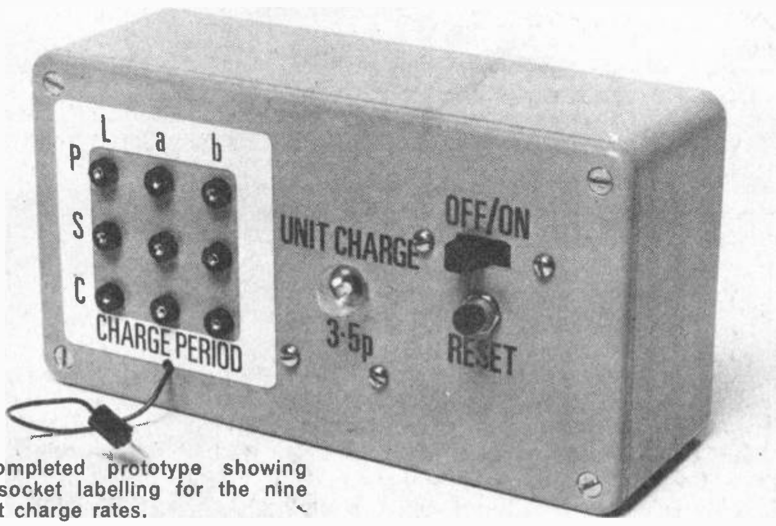
The timing resistors R1-R9 in the circuit diagram can be cheap carbon components with 10 per cent tolerance. In theory, better results would be obtained, especially in the long term, by using more expensive resistors with 5 per cent or better tolerance.

In terms of cost the benefit would not be worthwhile and in practice the cheap type worked satisfactorily with reasonable accuracy.

As well as buying a good quality component for C1, it is necessary to buy good transistors. Cheap "out of spec" transistors may have insufficient gain to work properly in the circuit.

The panel light for the prototype was just a lamp pushed through a rather tight hole with direct soldered connections. This saves cost but some constructors will wish to improve the appearance of the panel by using a proper lampholder.

A cheap plastic box was bought for the prototype but there are generally boxes lying around the house which could be used. The size of this box



The completed prototype showing matrix socket labelling for the nine different charge rates.

COMPONENTS

Resistors
R1 270kΩ
R2 68kΩ
R3 22kΩ
R4 390kΩ
R5 100kΩ
R6 33kΩ
R7 1MΩ
R8 150kΩ
All ¼W carbon ± 5%

See Shop Talk page 635

Capacitor
C1 2200μF 15V elect.

Transistors
TR1, 2 BC108 silicon *npn* (2 off)

Miscellaneous
S1 push-to-make, release-to-break button switch
S2 s.p.d.t. slide switch
LP1 6V 60mA m.e.s. bulb
SK1-9 1mm panel mounting sockets (9 off)
PL1 1mm plug
B1 9V type PP9—see text
Tagpanel 10-way miniature; case, plastic size 150 × 75 × 50mm, Bimbox type BIM 2005/15 or similar

Guidance only Approx. cost £2·75 excluding case

PHONE CALL CHARGE JOGGER

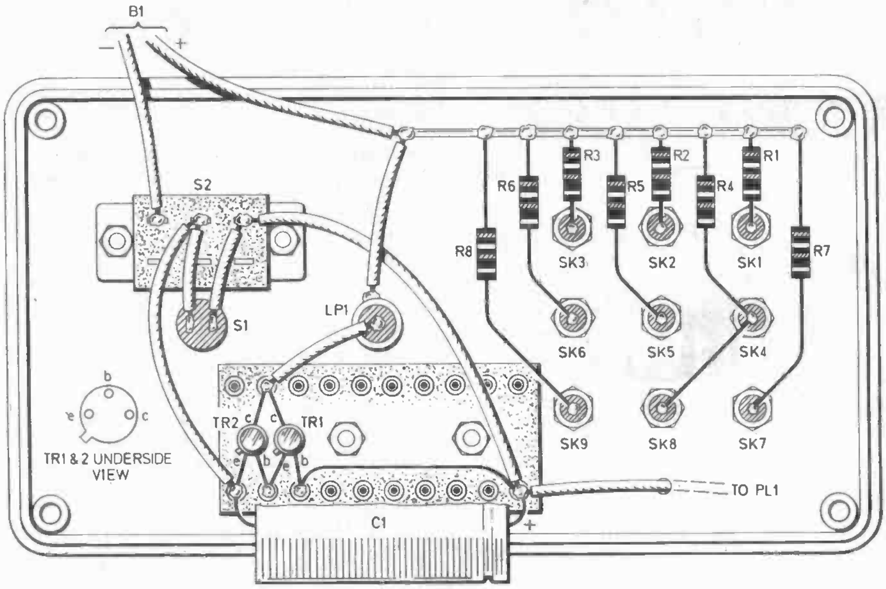


Fig. 2. Shows the method of assembly and interwiring where the case lid is used for mounting all components. Note the link wire on the tag-board. This method is not critical and may be readily changed to suit other case dimensions. The lamp can be mounted in a holder to improve the appearance.

will determine the kind of battery which will be used. It would not be wise to use a small battery like a PP3. This would not give good service. If a larger 9 volt battery like a PP9 could be fitted into the box then this would be a good choice. An alternative would be two 4·5 volt "flat" cycle lamp batteries connected in series. These can be placed separately in the box and manoeuvred into position. It should be noted that the panel lamp is a 60mA (0·06A) type. A higher current rating like 200 or 300mA is not advised.

WIRING UP

The components in the prototype were all secured to the lid of the case as seen in Fig. 2. Begin by drilling the holes to suit these components and their fixings and fit these to the lid with the exception of the tag-panel, and wire up as shown.

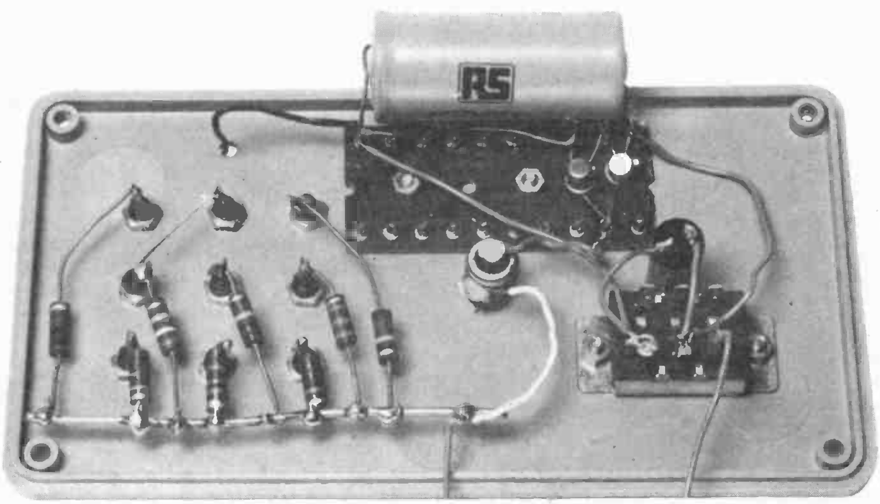
The resistors are connected to the correct socket (see Fig. 2) at one end and the other ends are hooked around a common busbar and securely soldered. The ends leading to the sockets must not touch one another —if they cannot be routed in such a way that this will not happen then the wire ends should be protected by means of sleeving. Insulation stripped from wire of suitable diameter makes excellent sleeving.

The rest of the circuit was built on a small piece of tag-panel to the layout shown in Fig. 2. It is in no way critical, however, and constructors may use tagboard or other boards which may be available. Secure the completed tag panel to the lid and complete the interwiring.

Attach suitably terminated leads to form the battery supply leads and connect to the battery of your choice (see above). With PL1 connected and plugged into SK3 (long distance peak call) the lamp should light after 10 seconds from turning on at S2. Pressing S1 should cause the lamp to extinguish to come on again after a further 10 seconds.

Repeat and check times for all the other positions to see that they agree with Table 1. If so, the unit can be fitted in the case and the top panel labelled as shown in the photograph, and protected from the effects of fingermarks.

After initiating the family in its use it just remains to wait for reduced bills! ⌘



The completed prototype ready for connecting to the batteries and installation in the case base.

By Dave Barrington

Soldering Iron

With the new season upon us many of our readers must be taking stock of their workshop tools and components and making a shopping list of requirements for the months ahead.

Top priority must be the soldering iron. Is the bit still serviceable? Does it handle well? Is the iron rated correctly? Most important, should the selection of bit sizes be changed or added to?

There are many irons to choose from at widely differing prices. Choice will obviously be dictated by the amount of money you can afford but we recommend you purchase the best possible. A little extra outlay now will more than pay for itself over the years. Most of our advertisers carry fairly large ranges and stocks of irons and will be only too pleased to offer advice.

For most work encountered in *Everyday Electronics* an iron rated between 15 and 25 watts should be adequate. For bit sizes we would suggest a selection of 2, 3 and 4mm preferably of the latest iron plated type, for long life. A good choice is the Litesold range manufactured by Light Soldering Developments Ltd., and the Midget range from S. & R. Brewster Ltd.

Try to choose an iron that is lightweight, well balanced, easy to handle and has an adequate length of mains cable. Some irons are fitted with lightweight flexi-cable that will not "pull" on the iron when in use.

Some irons come complete with a protective stand. If this is not included we strongly recommend the purchase of this item as it will save many a burnt cable and other disasters through careless or forgetful use.

If you decide to purchase and use an iron without a stand we suggest you choose one with a built-in hook or "anti-roll collar" so that when placed on the work surface the iron bit stands proud of the worktop.

At the top end of the market there are what is commonly known as "solder stations". These are usually made up of a low voltage temperature controlled iron, ideal for delicate work, an integral stand, with a wiping sponge for cleaning the iron tip and a mains derived low voltage, via a transformer, supply.

The use of the transformer isolates the iron bit from the mains which can be essential in some MOS work.

Solder Station

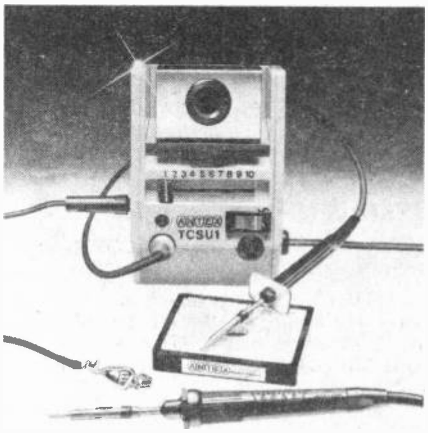
One such thermostatically controlled station is the new version of the Antex TCSU1.

The soldering station is provided with either the miniature CTC 40 watt iron or the XTC 50 watt model. Both irons are fitted with burn free cable terminated with 5 pin DIN plugs for connection to the 24 volt supply from the station.

Thermocouples sense the bit temperatures which is kept at a preset level (between 65 and 420°C) by a slide control on the front facia of the stand. A range of three iron coated bits are included which are a slide fit on the stainless steel shafts of the irons. A removable sponge tray is also included.

A particular feature of the TCSU1 is the inclusion of an anti-static earth socket to help protect MOS devices from damage. Also, by employing zero switching such evils as magnetic fields and spikes are claimed to be eliminated.

Further details, price and stockists can be obtained from Antex Electronics Ltd., Dept EE, Mayflower House, Plymouth, Devon.



The Antex TCSU1 soldering station.

Catalogue

It is claimed that over 400 new product lines have been added to existing ranges in the new Verospeed Autumn '80 components catalogue, which just by glancing through we can well believe. Printed circuit board mounting rotary switches, batteries and chargers, test leads, cases and integrated circuit sockets are just some of the ranges that have been extended.

Two features of this excellent 114-page catalogue which appeal are the inclusion of two pages of "Bargain Basement" items and, more important, the inclusion of all prices against each entry (less VAT). It is hoped that all prices will be held for the period of the catalogue, until January 1981.

Copies of the Verospeed Autumn '80 Catalogue can be obtained from Verospeed Ltd., Dept EE, Stansted Road, Boyatt Wood Industrial Estate, Eastleigh, Hants S05 4ZY.

CONSTRUCTIONAL PROJECTS

Call Charge Jogger

A double-pole double-throw slide switch should be used for the Off/On switch in the *Call Charge Jogger* as this is the more commonly stocked item. The rest of the components for this project are readily available.

Midget Radio

The compression trimmer capacitor C2 called for in the *Midget Radio* is stocked by Home Radio (Components) Ltd. The spindle for this trimmer is made specially for Home Radio.

The aerial coil used in the prototype model was MW 5FR from Denco (Clacton) Ltd., This aerial coil, and the transformer, can also be purchased from Home Radio, Maplin and Watford Electronics.

The t.r.f. radio i.c. ZN414 is available from most component stockists as are the rest of the components for the radio.

Darkroom Timer

The only item likely to cause any concern in the *Darkroom Timer* is the small biased toggle switch. This is available from Watford Electronics and is listed in their "miniature" toggle switch range.

The relay used is the common miniature "continental" type carried by most advertisers. This may be supplied with more than one set of contacts but only one set need be wired in circuit.

Bicycle Alarm

Although the prototype *Bicycle Alarm* used a reed switch and coil it was felt that a relay would be more suitable. Any relay with a coil resistance of 150 ohm or greater and capable of operating at 9V will suffice. The miniature continental relay with an 185 ohm coil is capable of operating down to approximately 5·5V and would seem useable here.

The Delta bleeper alarm from J. Bull (Electrical) Ltd., gives off a most piercing sound and at 75p each seem to be most reasonable. However, any 6 to 12V d.c. buzzer can be used.

Audio Effects Unit

We cannot forsee any buying problems for the *Audio Effects Unit*. Note when ordering components that two log. (logarithmic) potentiometers are specified as you may find you are supplied with all linear types.

Dusk—Dawn Relay

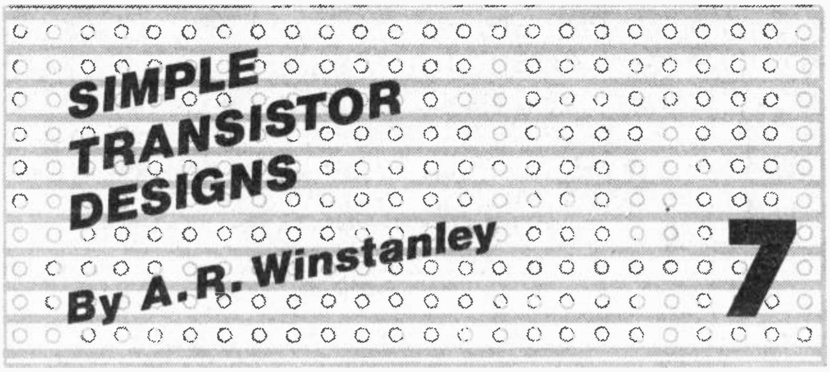
Readers should have no difficulty in locating components for the *Uniboard: Dusk—Dawn Relay*. The relay used is the common miniature continental type rated at 12V 185 ohm coil with 2-pole changeover contacts rated as required.

Iron Heat Control

We do not expect any purchasing problems for the *Iron Heat Control*. The triac for this circuit is available from Home Radio for the sum of 75p, including postage and packing.

We have been informed that Home Radio are also able to supply all parts, including the case.

UNIBOARDS



DUSK–DAWN RELAY

THIS article describes the construction of a device which illuminates a lamp automatically as the night approaches. This three-transistor design operates a changeover relay when the amount of light falling onto a photocell has reached a defined level.

The circuit is powered from a 9 volt rail and whilst this could be derived from dry batteries, the unit described here has been designed to operate from the *9 Volt Power Supply* which appeared in Part 3 of this series.

CIRCUIT DESCRIPTION

The circuit diagram of the Dusk-to-Dawn Relay is shown in Fig. 1. Light-dependent resistor PCC1 is remotely-located and detects the ambient light level. Together with R1 and VR1 (the SENSITIVITY control), the l.d.r. forms a potential divider, so that the voltage at the base of TR1 is dependent upon the amount of light falling onto PCC1.

During the daytime the resistance of the l.d.r. is low—in the order of 20 ohms—and so the voltage at TR1 base is high; conversely as night-time approaches, the resistance of the ORP12 increases, so lowering the voltage at TR1 base.

TR1 and TR2, together with associated resistors, form a circuit configuration called a Schmitt Trigger. This circuit is designed to suddenly switch over at a predetermined setting even though the input signal (i.e. the voltage at the base of TR1) may change over only very slowly.

This snap-over action makes the circuit ideal for operating a lamp when the ambient light level is slowly reducing. The Schmitt Trigger functions as follows.

Consider a night-time situation where the resistance of PCC1 is high—say 500 kilohms or so (although it could be considerably higher). Assuming that VR1 is set to midway, the voltage at the base of TR1 works out at only 150mV. This means that TR1 must be off since the base needs to be 650mV more positive than its emitter for the device to switch on. TR2 is therefore permitted to switch on as base current is able to flow through R2. A voltage then develops across R3 (and also R4); this effectively reverse-biases the base-emitter junction of TR1 and this component remains firmly biased off.

INCREASING LIGHT LEVEL

As the resistance of PCC1 falls (the ambient light level increasing) the voltage at TR1 base will rise until TR1 starts to switch on.

At this point, the collector of TR1 falls, taking TR2 base with it. The effect of this is that TR2 starts to turn off. In so doing, the emitter of TR2 is sent to 0V, as is TR1 emitter. This increases the forward bias on the base-emitter junction of TR1, so enabling TR1 to switch on harder.

As it does this TR2 is forced to switch off even further, thereby causing TR1 to conduct more. This regenerative action, once started, causes TR1 to switch on hard very rapidly, with a consequent switching out of circuit of TR2.

This is the action of the Schmitt Trigger: a very gradual change in the resistance of the l.d.r. results in the circuit "snapping over" very quickly.

As night-time approaches once more, a reverse avalanche takes place resulting in TR1 switching off and TR2 conducting.

TR3 is a *pnp* transistor coupled to the collector of TR2 by R5. When TR2 is on, TR3 is also conducting. This operates RLA, the contacts of which complete the mains circuit to the lamp. Diode D1 also illuminates, signifying that the relay is operating. TR3 serves as a power output stage which prevents loading of the basic Schmitt circuit.

The ratings of the relay contacts must be carefully observed: the specified relay will switch mains loads of up to 3A (750 watts), and this should satisfy most domestic applications.

CONSTRUCTION starts here

CIRCUIT BOARD

The circuit is built onto a standard-sized piece of 0·1in matrix stripboard measuring 10 strips by 24 holes. The l.d.r. and power supply are connected by means of two 3·5mm jack sockets. The Dusk-to-Dawn Relay unit itself was housed in a plastic box which measured 150 × 80 × 50mm.

If desired, there is no reason why the power supply cannot be housed in the same case. A larger case than specified may then be required.

Component layout on the circuit board and complete wiring details are shown in Fig. 2. Two 6BA clearance holes are drilled to take the supporting hardware, and then the circuit board is assembled in the normal manner. Take care regarding the orientation of the transistor leads: do not overheat them and ensure that D2 is soldered in the right way round.

Complete the low-voltage wiring using stranded connecting wire as shown. The l.e.d. is mounted on the front panel using the special mounting clip normally provided with it; the relay can be secured in place with a piece of double-sided adhesive foam.

Basic interwiring is also shown for the mains circuitry. In this respect it is important that the soldering to the relay tags is of a high quality. Also mains connecting wire of the appropriate specification (3 amps at 250V) must be employed.

The photocell was soldered to a small piece of tagstrip and twin core flex terminated in a 3·5mm jack plug was used to connect this to the main unit, see Fig. 2.

Setting up comprises simply adjusting the preset, VR1 to about midway and then repositioning it if necessary until the desired switching point is achieved with the l.d.r. sited in its operating position. ⌘

COMPONENTS

See **Shop Talk** page 635

Resistors
R1 5·6kΩ
R2 15kΩ
R3 68Ω
R4 680Ω
R5 3·3kΩ
R6 680Ω
All ¼W 5% carbon

Semiconductors
TR1, 2 BC108 *npn* silicon (2 off)
TR3 BFX88, BFX30 or 2N2905A *pnp* silicon
D1 TIL220 light emitting diode
D2 1N4148 silicon
PCC1 ORP12 light dependent resistor

Miscellaneous
VR1 22 kilohm miniature horizontal preset
RLA 12V relay, coil resistance 185 ohm Continental with 3A 250V c.o. contacts
SK1, 2 3·5mm jack sockets, (2 off)
PL1 3·5mm jack plug
0·1 inch stripboard, 10 strips × 24 holes; case—BIM2005/15; l.e.d. clip; twin-core flex; tagstrip; mains wire; stranded hook-up wire; 6BA hardware.

Approx cost **Guidance only**
£4.00 **excluding case**

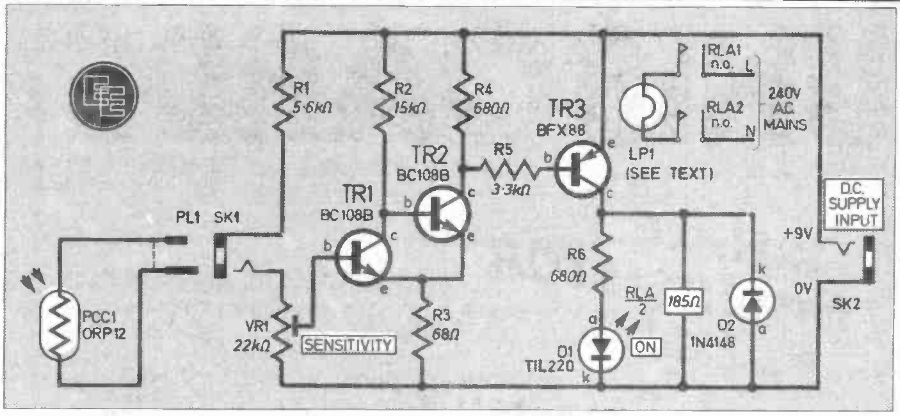
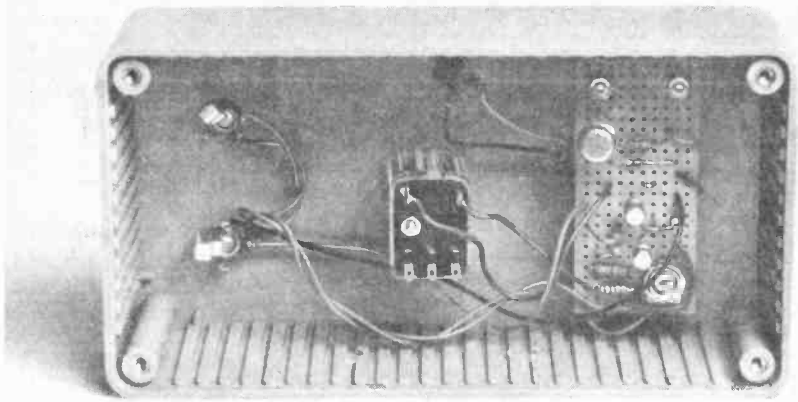


Fig. 1. The circuit diagram of the Dusk-Dawn Relay unit. The power supply may be from battery or the 9V Power Supply Unit featured earlier in this series.



The partially assembled prototype requiring connections from the relay contacts to the lamp and 240V a.c. mains.

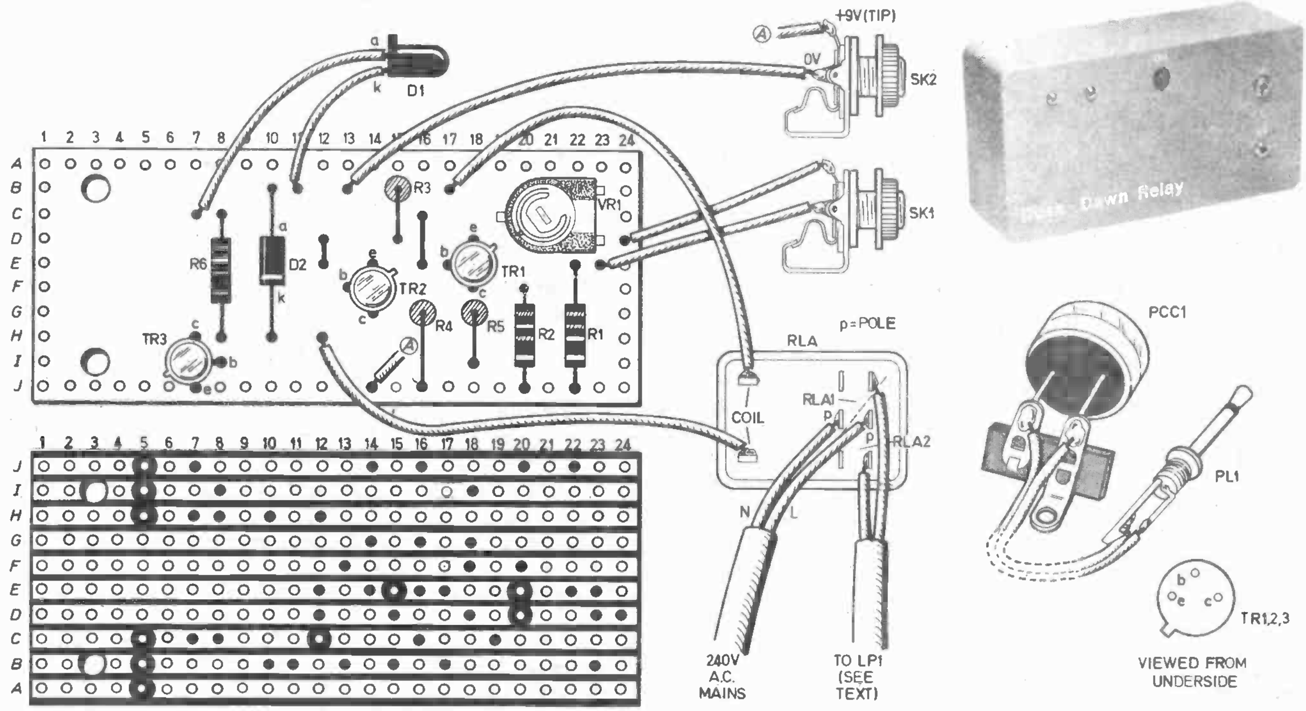


Fig. 2. The layout of the components on the topside of the stripboard, breaks to be made along the copper strips on the underside and wiring up to the off-board components. Also shows 240V a.c. mains connections to the controlled lamp via the relay contacts. The contact arrangement will vary between relay types and should be verified before connection. Seen right is the method used for mounting the light dependent resistor.

in My Class

by
T.R. de Vaux-Balbirnie

RICHARD was choosing a switch for his new project. Looking through the pages of the catalogues, he thought that it would be easy. Unfortunately, he just became increasingly confused. The easy part was the cosmetic one—deciding on a rocker switch rather than the toggle variety. It was the contact current ratings which really confused him so he came along for advice.

"I could understand it if there was just *one* figure given for the current rating", he said in dismay—"but there are *two;* one for a.c. use and one for d.c. Apart from that, there is a different figure given for *switching* current and *carrying* current. To top it all, there is a warning to de-rate in the case of inductive loads—I feel like giving up!"

Though confusing I told him that these ratings must not be taken lightly. To exceed one could seriously reduce the life of the switch. Some manufacturers do give only one current rating and although this seems easier it can lead to misuse.

I explained that at the instant of the contacts "breaking" a spark is produced. This tends to burn the contacts. If a.c. is used the spark tends to go out as the current falls to zero on each half cycle. With d.c. the spark will only go out when the contacts move too far apart to support it. This usually takes longer. For this reason, switches usually have a higher a.c. rating than for d.c. Some switches are not recommended for d.c. use at all because the contacts do not move fast enough.

I went on to say that where *coils* form part of the load—chokes, transformers, motors, and so on, then larger sparks could be expected. It would then be wise to halve the rating at least.

His point about current *carried* and current *switched* was interesting. With the contacts "made" the current could be allowed to rise significantly above the "switched" value.

I rounded off our talk by telling him that switches are better mechanically than they are electrically. With no load, a switch will give far more operations before it fails than on full load. Here, burnt contacts will limit its life.

Although it may cost more, a switch should be generously rated. Good quality switches have an inbuilt "safety margin" which cheap ones might not and I warned Richard not to buy a dubious component.

COMPUTERS AUDIO RADIO MUSIC LOGIC TESTGEAR CB GAMES KITS

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27th Nov — THURSDAY — 10am-8pm
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29th Nov — SATURDAY — 10am-6pm
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SQUARE one FOR BEGINNERS

STRIPBOARD

LOOKING at the constructional articles in EVERYDAY ELECTRONICS, the newcomer will discover that most projects are built on pieces of stripboard. This is a plastics board with copper strips on one side, and perforated with holes, at 0·1 inch intervals. This is a popular method of construction, and is recommended to the beginner.

The size of board used for a particular project is expressed in terms of number of strips and number of holes. For example, "Stripboard: 0·1 inch matrix 25 strips x 18 holes." Refer to Components Lists for further examples.

This board, also known under the proprietary name *Veroboard*, is available from most component stockists in a variety of sizes. The board can be cut to any required size with a small hacksaw or jewel saw. The smallest size supplied is 10 strips x 24 holes. This is adequate for many smaller circuits, as is demonstrated by our *Uniboards Series*.

In all our constructional articles we provide (1) a circuit diagram (2) a diagram showing the layout of all components on the top side of the stripboard and—usually—(3) an underside view showing any breaks that have to be made in the copper strips. Though where the number of breaks involved is small, they may be indicated in (2) by an "X" enclosed in a circle. Breaks are easily made, using a drill bit and rotating by hand, or there is a special tool for this purpose which can be obtained from retailers (Fig. 1a).

In these diagrams, the strips are given a letter reference and the holes are numbered. This facilitates location and co-relation of connection points at both sides of the board.

It is usual to mount all components on the board, except those that happen to be too large physically, and certain items such as controls and switches which need to be mounted on a front panel or on the top of the enclosing case.

Flexible wiring is used to connect such components to the appropriate points on the board. All such interwiring is usually illustrated in the diagram.

PRINTED CIRCUIT BOARD

Other methods are also used for mounting circuit components. Printed circuit boards are commonly used for mass produced commercial equipment, and this same technique has been in wide use amongst private constructors for many years. One does of course have to get familiar with the technique and then practise, to achieve good results.

A wiring pattern, unique to a particular circuit, is produced as a copper image on a plastics board by an etching or masking process. This operation can be undertaken by the individual and special kits for making printed circuit boards (p.c.b.s) can be purchased from certain advertisers.

(A detailed article describing the procedure will appear in a future issue of EVERYDAY ELECTRONICS.)

PLAIN PERFORATED BOARD

Another quite simple and popular method is the use of plain perforated plastics board—this is like stripboard minus the strips.

Special terminal pins (Veropins), tapered to give good fit, are pushed into the appropriate holes in the board to provide anchoring points for components. The snag is that connecting wires have to be soldered between pins to make all the necessary link-ups, in the absence of copper strips (Fig. 2).

All the above mentioned methods of assembling circuit components will be found amongst EE Projects, from time to time. The newcomer should study these constructional articles, noting particularly the layout diagrams.

Since every component and every connection is clearly shown, the "non-electronic" person can go ahead with confidence and build up one of the simpler projects according to these diagrams. Knowledge of exactly how the circuit functions is not essential, for this purpose.

Once a small project has been tackled and successful results obtained, the newcomer will be additionally inspired to learn more about circuit theory and there will always be articles and features in EE to help explain the basics of electronics, both theoretical and practical.

Good luck, all you new constructors.

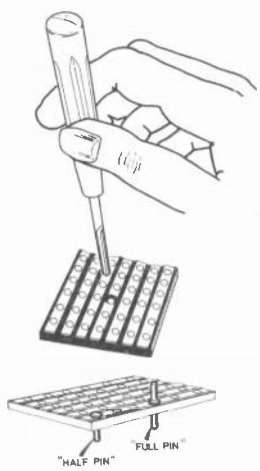
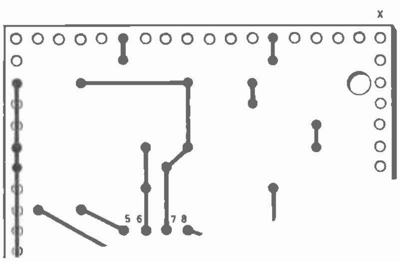
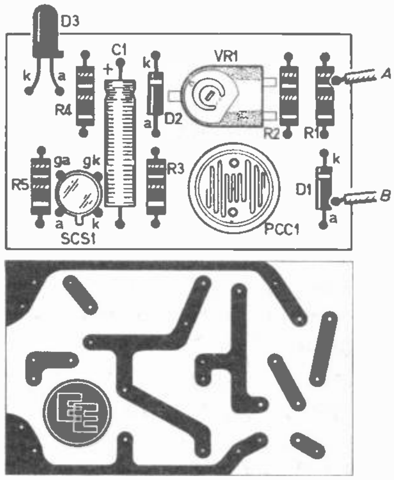


Fig. 1(a). Using the special tool to make breaks in copper strip. (b) Terminal pins shown in stripboard; these are more commonly used with plain perforated board however.

Fig. 2. (below) Underside of plain perforated board showing connecting wires between pins.

Fig. 3. (right) Printed circuit board (actual size), top and underside views.





By M. P. Horsey

BICYCLE ALARM

Bicycles are becoming increasingly expensive, and the ease with which they can be stolen is a major problem for every cyclist. A simple, inexpensive yet effective device was therefore needed to protect a bicycle against the thief, or "joy rider".

As with all alarm systems, care must be taken to ensure the alarm cannot be triggered accidently (if the bicycle fell over for instance), and it was decided to use a fairly conventional wire link system to disable the cycle.

More unusual is the owner's method of de-activating the alarm. Instead of the usual key and lock switch, a less expensive and more novel method was devised using a miniature jack plug "coded" with a suitable resistor. The alarm is then "tuned" to recognise this resistor, the jack plug replacing the key.

The alarm cannot be de-activated using a metal object instead of the jack plug, as the resistance is clearly incorrect. Of course, the alarm could be defeated by a dishonest person, with a knowledge of electronics, armed with the correct equipment, who happens to want to steal a bicycle protected by this particular device.

This combination is thought to be unlikely!

OPERATION

The alarm is operated as follows. When not in use, the wire link, actually screened cable, is connected via the 3·5mm jack plug. To set the alarm, the 2·5mm "key jack" is plugged in, the 3·5mm plug removed, looped through a wheel (or better still, a nearby fixed object), and replaced in its socket. The key jack may now be removed and the alarm is set.

If the wire link is removed or cut, the alarm will sound and cannot be silenced by replacing the link. The only way the alarm can be silenced is by using the key jack.

To de-activate the alarm, the key jack is inserted, the link removed from around the wheel and plugged in again. The key jack is now removed to avoid unnecessary current drain.

CIRCUIT DESCRIPTION

Since the alarm will be set continuously, current consumption is a major consideration. The circuit is therefore based on a CMOS integrated circuit, the CD4011. This consists of four NAND gates, each with two inputs.

With the component values indicated, current consumption is less than one microamp with the link plugged in, and rises to about 1·5mA during the short periods when the key jack, PL1/R1, is used. The current will of course be much higher if the alarm is triggered, but this should not happen often.

The circuit is in two sections (see Fig. 1). Gates a and b of IC1 are wired through presets VR2 and VR1 respectively. If the key jack is missing, the inputs at gate a will be low, and its output logic 1.

The inputs into gate b will be logic 0 at pin 5, and logic 1 at pin 6, and its output logic 1. Assuming the presets are set correctly, as described later, if the key jack socket is shorted, the inputs to gate a will be logic 1, and its output 0.

The inputs to gate b will now be logic 1 at pin 6, and logic 0 at pin 5 resulting in its output being at logic 1.

KEY JACK

Thus the output from gate b will be high whether the key jack socket SK1 is open, or shorted. If, however, a resistance of say 1 kilohm is connected via the key jack, the presets can be arranged so that the potential from preset VR2 maintains the input to gate a low, but the potential from preset VR1 is sufficient to cause an input to pin 5 at logic 1. Since pin 6 is now high as well, the output of gate b falls to zero.

To summarise, if the key jack is unplugged or shorted the output from gate b is at logic 1. If a key jack plug containing the correct resistance is used, the output from gate b is at logic 0.

This output is fed to gate c, such that a zero output from gate b will ensure that the output of gate c is at logic 1, regardless of the state of its other input. This in turn will ensure that the output from gate d is zero, and the alarm cannot sound.

If the key jack is removed, or shorted, the output from gate c is now dependant upon its other input. This is arranged with R2 and R3 as a potential divider, such that the input to pin 9 is logic 1, if the loop connected via SK2/PL2 is removed, and logic 0, with the loop connected.

Thus if the loop is connected pin 9 will be low and the alarm cannot sound. Removing the loop will cause pin 9 to rise to logic 1, and with both inputs to gate c high, its output will be zero, and the output of gate d will be high.

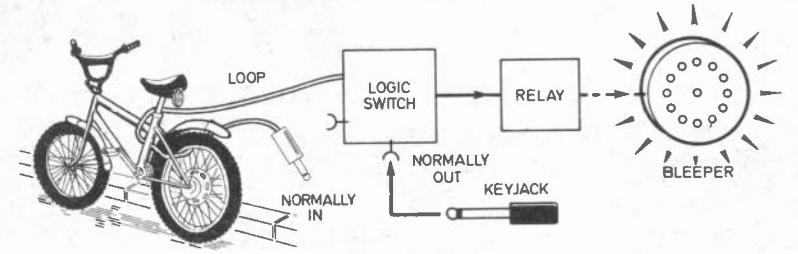
Diode D1 will maintain pin 9 at logic 1 even if the loop is replaced, and therefore the alarm can only be silenced by using the key jack.

WARNING DEVICE

The output from gate d is fed to TR1 via R4 and this in turn operates a relay with diode D2 to protect the transistor. The relay will allow virtually any type of warning device to be used, providing its power requirements are within the limits of the relay contacts and battery.

The prototype used a reed relay, driving a "solid state buzzer", a small device, with a very loud sound! However virtually any small relay will do. Its resistance should be higher than 150 ohms, and it should be able to operate on nine volts.

HOW IT WORKS



A solid state bleeper is connected via a relay to a logic switch. To maintain this switch in the "off" position a loop must be maintained or a special key inserted in the appropriate socket.

The latter consists of a specific resistance which keeps a potential divider balanced such that the logic gating system keeps the switch off.

If the loop is removed or an incorrect resistance inserted the switch will move to the "on" position and the alarm will sound.

CONSTRUCTION starts here

CIRCUIT BOARD

The circuit is arranged on 0·1 inch matrix stripboard, measuring 20 strips by 25 holes (see Fig. 2). Begin by making breaks in the copper track where shown, ensuring that all traces of lose copper are removed. An i.c. socket is essential, and this should be soldered into place, followed by the wire links, ensuring enough space is left for the presets.

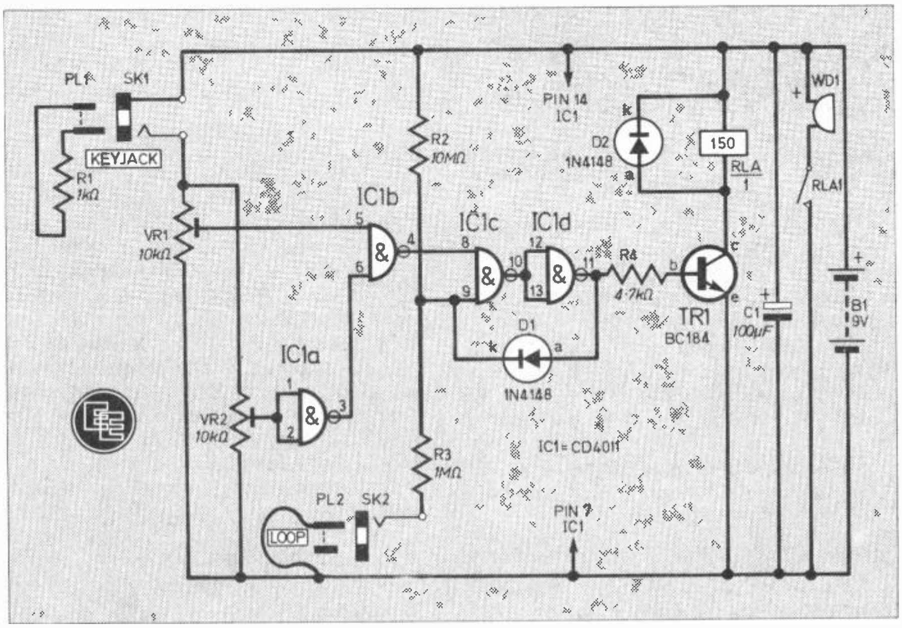
The other components should now be soldered into place, finishing with the transistor which together with the diodes and electrolytic capacitor, should be the correct way round.

Next the battery leads, relay connections and jack sockets can be connected. The wire link is connected as shown in Fig. 2. Good quality screened cable is suggested, since although the outer screen is not used, it is the most difficult to cut and rejoin.

A potential thief would not know that only the inner core was in use, and whilst it would be possible to devise a cunning system to enable both inner and outer cores to be used, using extra i.c. gates, the extra circuitry would not seem justified.

The inner core is joined to location B4 on the stripboard, and terminates at the 3·5mm jack plug. At this stage the board should be carefully inspected for bridged tracks, dry joints and faulty component positions.

Fig. 1. The complete circuit diagram for the Bicycle Alarm.



CMOS I.C.

If all is well, the i.c. may be removed from its protective packaging and, without touching its pins placed into its socket. Make sure it is inserted correctly. This may well be the most difficult operation of the project! Static electricity on your body, especially if wearing man-made fibres, or if standing on a nylon carpet, may possibly damage the i.c. if the pins are touched.

Finally the key jack is constructed, using a 2·5mm jack plug, fitted with a suitable resistor. A 1 kilohm type is suggested, although alternative values in the same region could be tried. Careful setting of the presets can make the circuit fairly selective.

BICYCLE ALARM

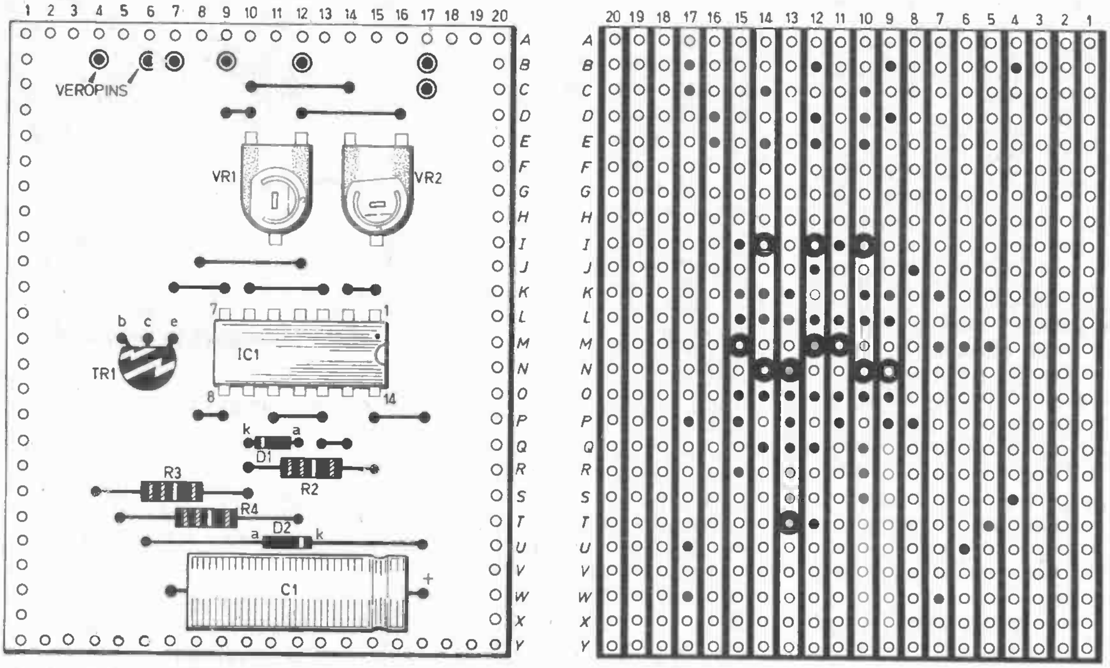


Fig. 2. The layout of the components on the top side of the board and on the right, the breaks to be made along the copper strips on the underside. Note the use of single-sided Veropins for connecting board to other components.

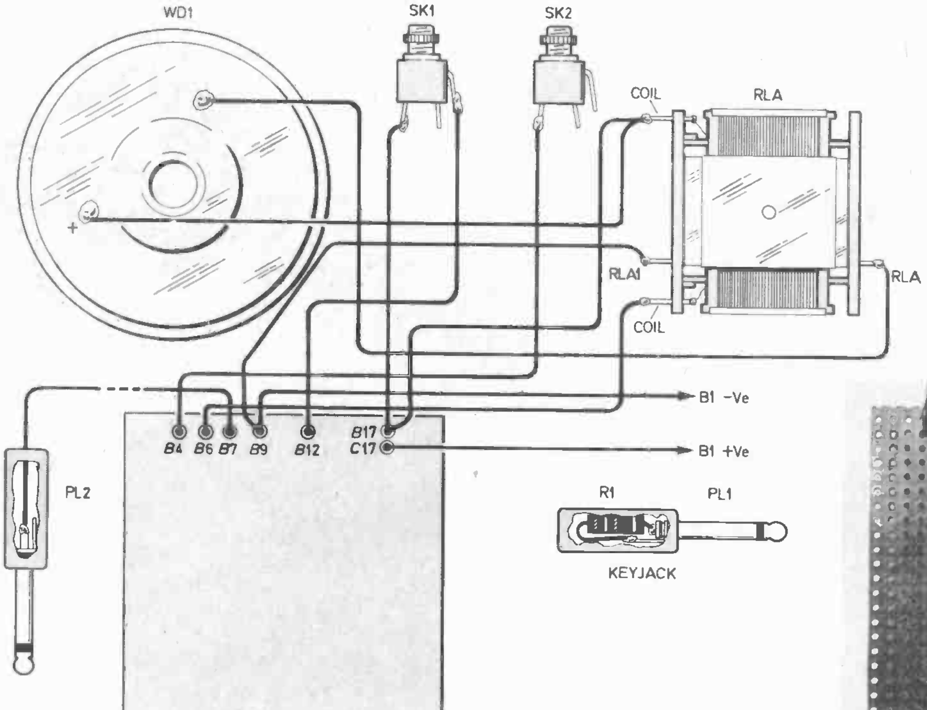
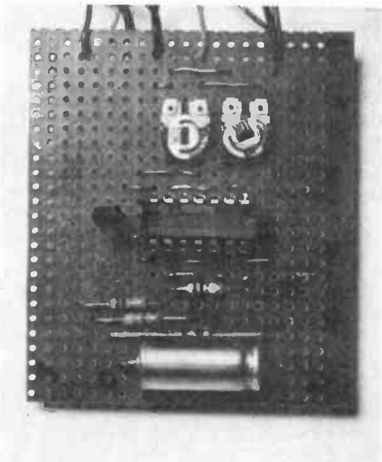


Fig. 3. *(Left)* Full wiring details between circuit board and the remainder of the components. This shows the coil/reed switch assembly used in the prototype which may be replaced by a standard relay as specified in the components list.



(Right) The completed component board from the prototype unit.

THE CASE

Some thought must be given to the case as several factors must be taken into account that are not normally considered. The case must be large enough to house the battery, circuit board and bleeper. It must be strong enough not to invite tampering, be watertight, and not easily opened, except by the owner to very occasionally change the battery.

The prototype was fixed under the saddle, in such a way that it would be very difficult to remove. Although a metal case was used originally, one with rounded corners is far more appropriate.

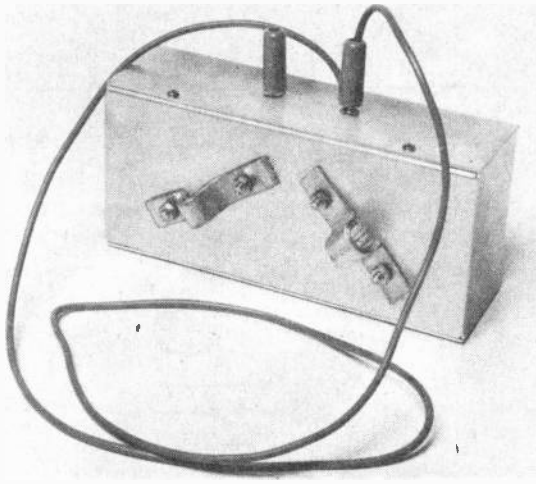
The container used in the prototype was not weather-proof and had sharp protruding corners. Obviously this would be a great disadvantage and we would recommend a plastic or die-cast box with rounded corners instead. Suitable types would be the Bimbox type BIM 2005/15 or a Verobox type 202-21030K.

This can be sited in any convenient place on the cycle using U-clamps or alternatively fixed securely in the saddle bag with the wire loop protruding from the side.

Having decided which way it will fit to the cycle, the case should be drilled *underneath* to allow the sound from the bleeper to penetrate. Care must be taken not to allow rain to enter the case, and the hole for the wire link should also be drilled at the base. The jack sockets are mounted at the rear.

ASSEMBLY

The parts are then assembled inside using any convenient method. In the prototype "superglue" was used to mount the bleeper and relay, and small self-adhesive rubber feet (cut in half) were used to mount the circuit board and create a battery compartment.



The completed alarm showing the fixing brackets and the "key and wire loop jack plugs in position.

Finally the case is fitted to the cycle as securely as possible. Extra security may be obtained by means of a microswitch wired in series with the wire link, and arranged so that any attempt made to undo the case, opens the switch, and triggers the alarm.

As a final precaution against rain entering via the 2·5mm socket (which is left for long periods without a jack plug in place), a small piece of acetate sheet or similar material may be glued just above the socket, so that it hinges over the opening.

A final word of warning: ensure that when riding the cycle, the wire link is safely stowed away so that it cannot foul the wheel.

SETTING UP

Turn preset VR2 fully clockwise. Remove the link, and plug in the key jack. Connect the battery and observe the relay (or bleeper if connected). Adjust preset VR2 until the relay is

COMPONENTS

See Shop Talk page 635

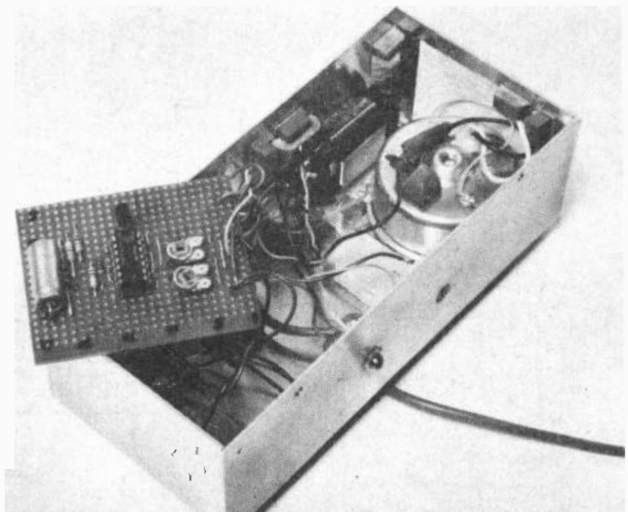
Resistors
R1 1kΩ
R2 10MΩ
R3 1MΩ
R4 4·7kΩ
All ¼W carbon ± 5%

Potentiometers
VR1 10kΩ miniature horizontal preset
VR2 10kΩ miniature horizontal preset

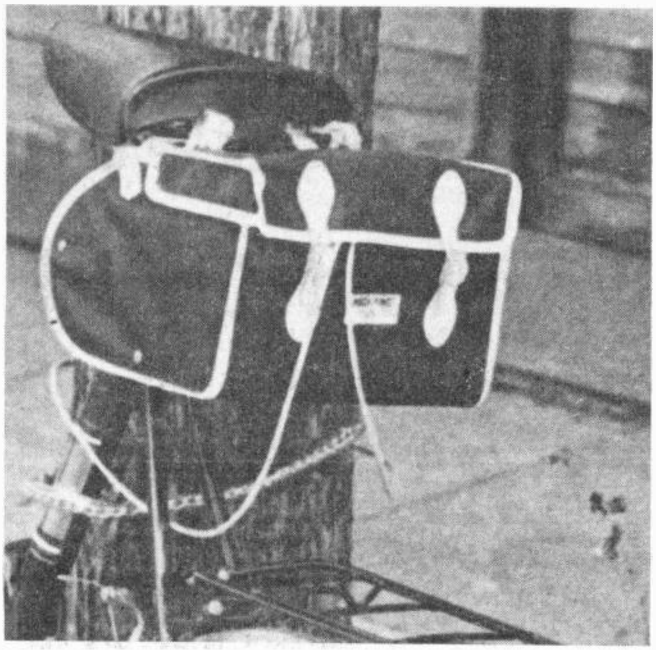
Capacitor
C1 100μF 16V elect.

Semiconductors
IC1 CD4011 CMOS quad 2-input NAND gate
TR1 BC184 *npn* silicon
D1, 2 1N4148 small signal silicon diode (2 off)

Miscellaneous
SK1 2·5mm jack socket
SK2 3·5mm jack socket
PL1 2·5mm jack plug
PL2 3·5mm jack plug
RLA miniature 9V relay, coil resistance 150 ohms, one set of normally open contacts
WD1 9V solid state buzzer ("Delta Bleeper" from J. Bull Ltd or similar)
B1 9V battery, PP7 type
Plastic case, 150 × 80 × 50mm, Bimbox type BIM 2005/15, die-cast box, or similar; 0·1 inch matrix stripboard 20 strips by 25 holes; battery connectors; interconnecting wire; screened cable for loop; mounting hardware to fix unit to bicycle; rubber feet or other fixings to secure circuit board and battery inside case.



COMPONENTS approximate cost £8 Including case



The loop shown in position, securing the bicycle to the tree together with a conventional chain security system. The Bicycle Alarm is mounted securely to the saddle bag.

just off, that is bleeper not sounding. Remove the key jack. The relay should now switch on.

Next short circuit the key jack socket, and turn preset VR2 anticlockwise slowly until the relay just switches on again. If the short circuit is removed, that is the key jack socket is left open circuit, the relay should remain on. The relay should only switch off when the key jack is inserted.

Having become familiar with this procedure, more accurate and selective settings can be achieved by using a higher resistance than one kilohm instead of an open circuit, and a resistance lower than one kilohm instead of the short circuit.

Now that the presets are set, plug in the key jack and connect the wire link. Remove the key jack. The relay should remain off. Removing the link should activate the relay. If the link is replaced, the relay should remain on due to the action of diode D1. The only way it can be deactivated is by replacing the key jack.

TROUBLE SHOOTING

If the circuit does not perform correctly, check again for bridges, dry joints, and incorrect breaks in the tracks. Check the positions of all the components and if all is well use a voltmeter to check the voltage actually reaching the i.c. (positive pin 14, negative pin 7).

With both presets turned fully clockwise, and neither jack inserted, pin 3 should be high (nearly 9V), pin 4 high, pin 10 low (about zero), and pin 11 high. If the key jack is inserted and the presets turned fully anti-clockwise, pin 3 should be low, pin 4 high, pin 10 low and pin 11 high.

Next turn preset VR2 fully clockwise, and VR1 fully anti-clockwise. Insert the key jack only. Pin 3 should be high, pin 4 low, pin 10 high and pin 11 low. Finally connect the loop wire. This should have no effect on the previous readings. However if the key jack is withdrawn, pin 3 should still be high, pin 4 high, and pin 11 low. (The voltage at pin 10 should not be measured, as in so doing, its state may well be changed.)

These tests should locate the faulty section of the circuit. If all the readings were satisfactory, the fault must lie in R3, TR1, or the relay circuit. Having found the problem, and cured it, do not forget to reset the presets as described earlier.

Mail Order

Continuing my remarks on the subject of the purchase of components by Mail Order, I would like to make some further suggestions. I will assume that you have equipped yourself with four or five reputable catalogues, and you are ready to start.

If you have studied them carefully you will have noted particularly what each one does not stock, or in what areas choice is limited. You will now be in a position to say that you will order transistors from dealer A, variable capacitors from dealer B and so on. Now, you can commence sending out your orders.

At the risk of repeating myself I will make the following points.

(1) Always print your name and address clearly in block capitals.
(2) If the items in the catalogue have catalogue numbers, be certain to quote them.
(3) If the firm sends you their order form, make sure you use it.
(4) Make sure you send the correct money and its not a bad idea to allow a little extra for inflation.

Many firms work on a fixed rate of postage, and the way to make this work in your favour, is to send one large order, instead of several small ones

Remember that in to-day's economic climate most of us are operating with the minimum of staff, and the sort of thing that depresses us, is the customer who writes in and says, "In 1975 in Everymans Electronics, there was a circuit for a *Super Burper,* please quote me for all the parts". The poor old dealer knows it will give him at least forty minutes work, and he will also probably discover during his investigations that there is at least one vital part that is no longer available.

It is, therefore, quite obvious he is wasting his time. Even if this is not the case, the chances are, that the customer will probably decide that it is too dear and change his mind.

Delivery Time

How quickly can you expect your goods once you have posted your order? If we assume you write your order on Sunday afternoon, it will be collected Monday and your supplier might have it by Tuesday. If he is really efficient, and has everything in stock, he might get it out the same day, but he probably cannot afford first class post, so it will probably arrive at your home Thursday or Friday.

I have, of course, assumed a set of ideal conditions, which do not always apply. If you are a real enthusiast, and I am sure you are, if only in the making, none of this will worry you, because you will plan ahead all the time.

First of all you will get together all the parts for project number one, and then while you are building this, you will select project number two, and begin ordering the parts for this. Unless you are very unlucky, you will have assembled all you require for project two, before you have finished project one.

I think it is worth while mentioning here that many firms will grant credit facilities which means you can order your requirements by telephone, a time saver.

I would like at this juncture to tell our many friends in Southern Ireland, that since they detached their currency from ours, we have to pay 70p on each cheque or postal order, they send us, to have it cleared by the English Banks. If therefore I receive £1·35 made up of two Irish Postal Orders, and if I try and cash them, I wind up minus five pence!

NEXT MONTH

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SOUND-TO-LIGHT UNIT

A three-channel, simple but effective version of this popular disco lighting effect. The filters consist of passive RC networks and each channel can handle up to 500 watts. Has independent channel level control and is fed from amplifier loudspeaker outlet.

PRECISION TIMER

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Indicates the individual's response time to randomly triggered l.e.d.s. Makes an excellent game for two or more players.

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Everyday ELECTRONICS

NOVEMBER 1980
ISSUE ON SALE FRIDAY, OCTOBER 17

Everyday News

OPEN TO COMMENT

The latest chapter in the fiery debate on the need for a UK Citizens Band radio service (CB) was given added fuel with the publication recently of the Government's Green Paper *Open Channel—a discussion document.*

The message from the document is clear, the Government is in favour in principle of the introduction of a personal short range radio system in this country provided certain conditions can be met.

The Home Office is recommending a frequency allocation somewhere above 928MHz to achieve minimum interference problems.

Frequency Allocation

Why 928MHz? After careful studies the document says "that the 27MHz band used for CB abroad and for illegal transmissions in the UK is inappropriate for this country. This is because the band is already allocated to legitimate uses, such as hospital paging systems and model control. Moreover, other services such as broadcasting, emergency services communications, old people's alarms and aircraft landing system outside the band can also be affected by illicit 27MHz use."

The paper went on to state that in addition to the rising demand for use of the spectrum, there are other constraints on frequency policy grounds. "We must take into account our international obligations when choosing a frequency, and it would be useful if we could choose one with at least some prospect of international standardisation".

Great importance is stressed in the timescale that a suitable frequency can be allocated to the Open Channel. Although it has been suggested that the redundant 405-line television service, bands 41-68MHz and 174-216MHz, could be used it points out that it will be some years, probably 1986, before any other services can be located here.

Equipment used should have a range of 15km (10 miles) in open countryside, but obviously in built-up city areas the range would be considerably less—probably down to "line-of-sight" (3 to 5km). For social services such as car to car in traffic jams, ship to shore from small pleasure boats and between groups of climbers and walkers this should prove adequate. Hand portable equipment should be capable of communications over 1 to 2km in large cities.

The document concludes that the only suitable frequency band is in the new mobile radio allocation around 900MHz. The United States and Canada are giving serious considerations to setting up an up-market range to its existing service, and authorities in Western Europe are also strongly interested. This would give British manufacturers a chance to export.

If a frequency above 928MHz were selected, interference could be kept to a minimum, since there would be no direct frequency relationship between the Open Channel service and the television services, although this frequency may still cause interference to some users of TV and hi fi equipment.

The Government are going to look further into the problems of frequencies before making a final decision.

Controls

The document proposes that there should be close technical control of manufacturers of Open Channel transceivers to ensure high standards of manufacture.

It also proposes that users should pay an annual licence fee to operate certified sets. As the system would have to be self financing the cost of the licence would probably be related to the present amateur radio licence fee, presently £6·40.

Summary

The Government is, in principle, in favour of the introduction in the UK of a freely available personal two-way radio communication to be known as Open Channel. This would be of limited range and rather different from what is thought of as "citizens band" radio in other countries.

The discussion paper is intended to help people to understand what Open Channel would involve and to balance its benefits and drawbacks and would like to receive readers comments.

Copies of *Open Channel—a discussion document*, can be obtained from the Officer in Charge, Home Office Supply and Transport Branch, Royston Road, Caxton, Cambs CB2 8PN.

All comments should be sent by 30 November 1980 to the Radio Regulatory Dept, Home Office, Waterloo Bridge House, Waterloo Road, London SE1 8UA.

All aspects of CB Radio, so popular in Germany, were discussed during this years *Hobby Electronics Show '80* held in Stuttgart, West Germany. (To date we have not received their final findings.)

This years exhibition for practical electronics and microcomputers had a special "Action Centre" where visitors were able to see displays of amateur radio, CB radio, tape/slide synchronisation and special model railway exhibits. During the past year radio controlled cars and model ships controlled by microprocessors have come to the fore and these were strongly represented.

HOME COMPUTERS

The purchase by Lasky's of Micro-digital of Liverpool has brought Lasky's into the home computer market. Apple computers, distributed by Micro-digital, will be retailed through Lasky's 40 UK stores and backed up by Micro-digital's programming experience.

INMOS LIVES

Inmos is to get its second £25 million tranche for the establishment of a UK microelectronics plant for high-volume memory products.

The Inmos preference for the plant to be sited in Bristol near their technology centre has been overruled, and the new factory is expected to be built in South Wales and to provide 2,000 new jobs over the next three or four years.

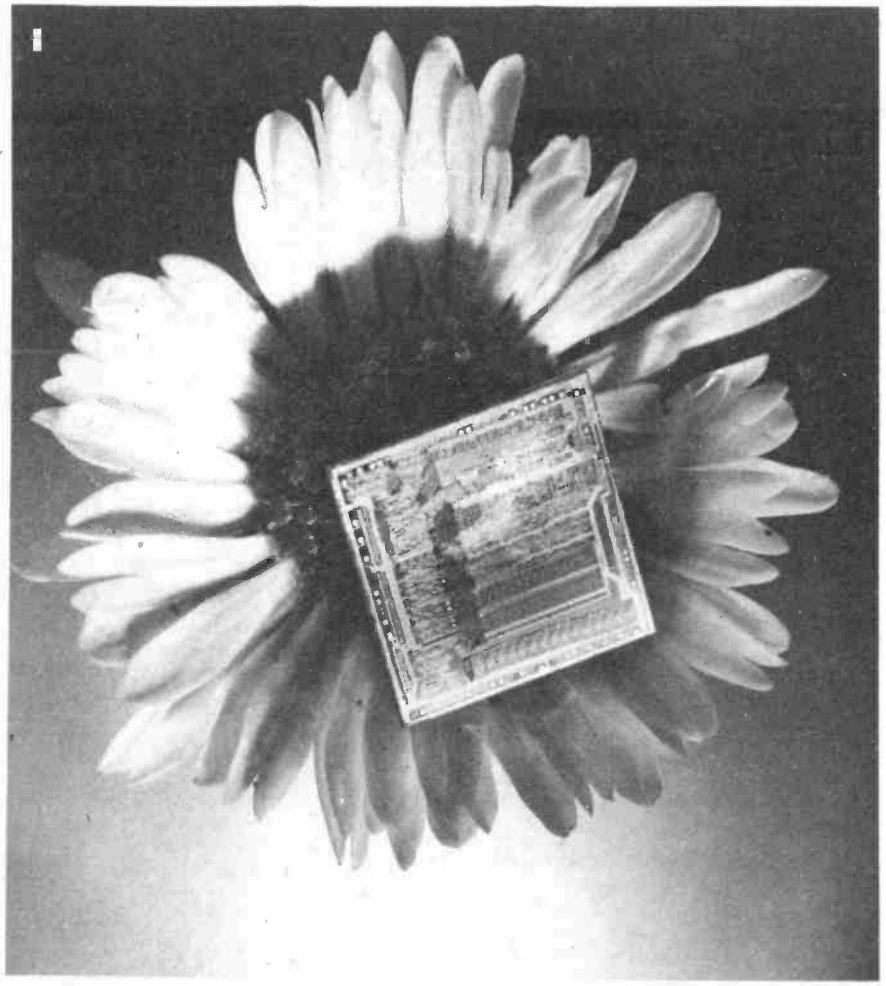
AWARD FOR FLOWERS

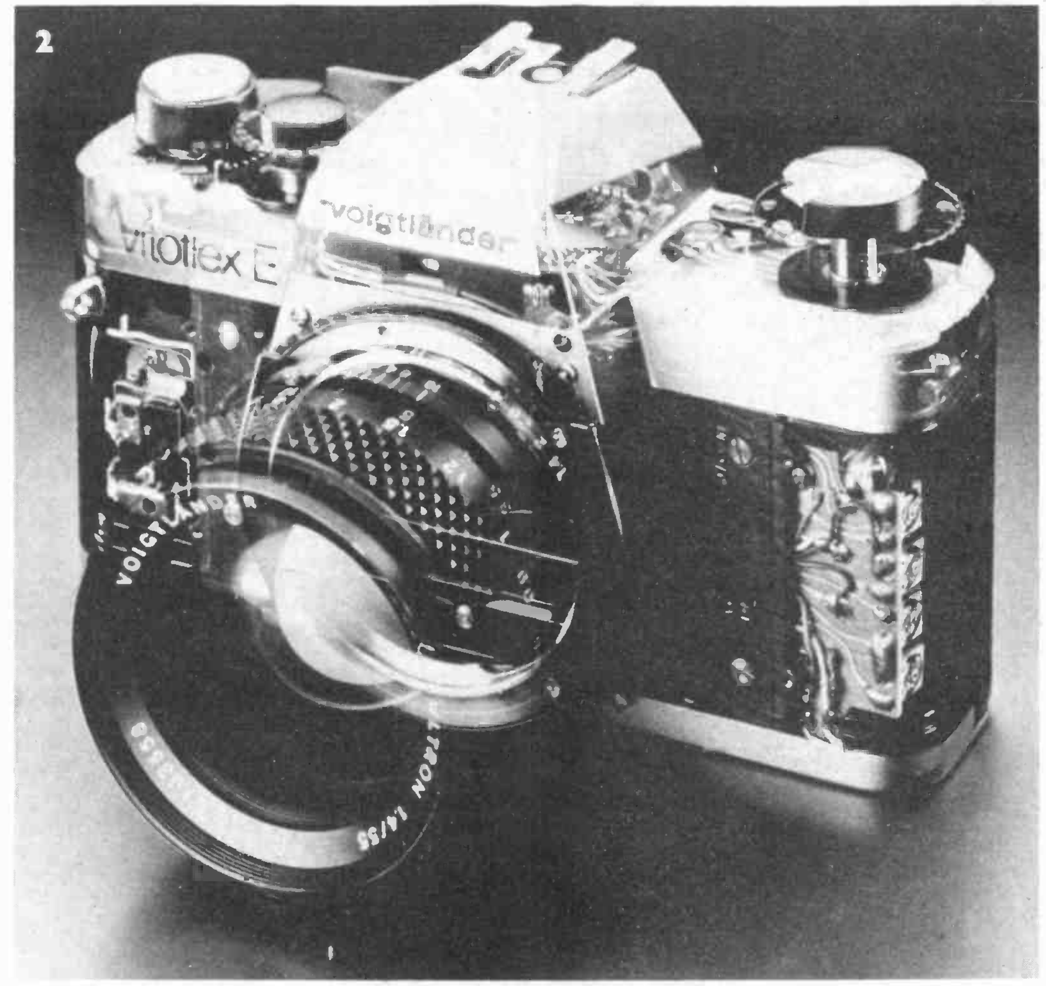
An award that will annually mark the contribution of one engineer to telecommunications science and engineering was launched by British Telecom recently.

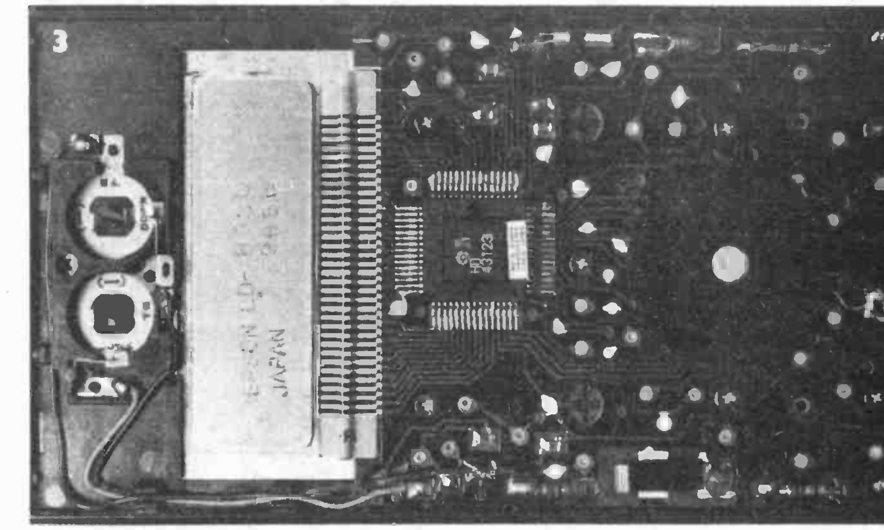
Called the Martlesham Medal, its first recipient was Dr. Tommy Flowers, the man who invented Britain's and possibly the world's first computer and the acknowledged father of electronic switching.

The award, to mark outstanding achievement in telecommunications, will be presented annually to former or present members of British Telecom.

The much heralded 64K RAM is finally available to the general market. Crellon Electronics Ltd, a leading electronic component distributor, hold an advance stock of the Motorola MCM6665L25.







introducing MICROCIRCUITS

BY J.B.DANCE M.Sc.

INTEGRATED circuits are widely used in all types of modern electronic equipment. They are employed in large numbers in computers, in modern electronic telephone exchanges and in almost all professional electronic equipment, as well as in military and space vehicle equipment.

Extensive use is also made of integrated circuits in the consumer equipment we meet in everyday life, such as electronic calculators, washing machines, watches, electronic camera shutters, record player circuitry, radio and television receivers and in ancillary television equipment such as teletext, Prestel, television games and computer displays.

It is certain that new designs of car will contain more integrated circuits. The more expensive vehicles will include microprocessor control of many functions; indeed, the microprocessor will even be able to provide a verbal warning by synthesised speech of an impending fault and will be able to keep a record of the servicing. (The microprocessor is an i.c., albeit a rather complex and larger device than the more commonplace i.c.)

The great advantage of the use of integrated circuits is that they enable complex circuits to be made in a small volume at much lower cost than would be possible using separate transistors, diodes, resistors and capacitors. Integrated circuits have already had a great effect upon our lives, but the impact will be still greater in future years.

INSIDE THE I.C.

Inside its protective package an integrated circuit contains a miniature silicon chip on which a large number of individual electronic components (transistors, diodes, resistors and capacitors) have been fabricated by automated photographic masking techniques. Thus a single monolithic integrated circuit can contain most of the components required for a circuit to perform a certain purpose.

Unfortunately it is not possible to fabricate certain components on a

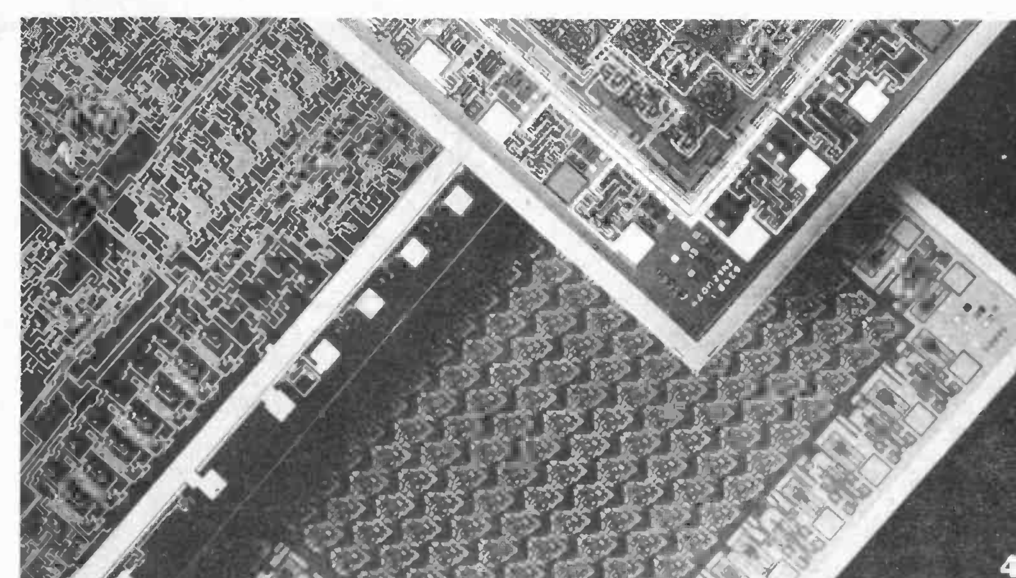
WHAT'S IN A WORD

The uninitiated may well be confused by the jargon surrounding electronics. A striking example is the term *Silicon Chip,* and its aliases, as employed by the media.

So let us clarify the terminology before anything else.

During the past twelve months or so, much publicity has been given to one of the chief marvels of electronic technology. This is an electronic component manufactured on a tiny piece of silicon and incorporating a complete circuit. It is popularly referred to as a *Silicon Chip, Microchip* or *Microcircuit,* or sometimes more simply as just "the chip". All these terms are apt, but in technical circles these devices are commonly known as *Integrated Circuits.*

Integrated circuit is generally abbreviated to "I.C." In text this appears as i.c., while in circuit diagrams and component lists such devices are identified with a reference number preceded by IC (capitals), for example: IC1, IC9.



1. A silicon chip containing the complete circuit for a 16-bit microprocessor, on a wild daisy. *(Ferranti)*

2. Microcircuits allow automatic selection of shutter speed and aperture size. *(Ferranti)*

3. A single i.c. with few external components found in a modern calculator.

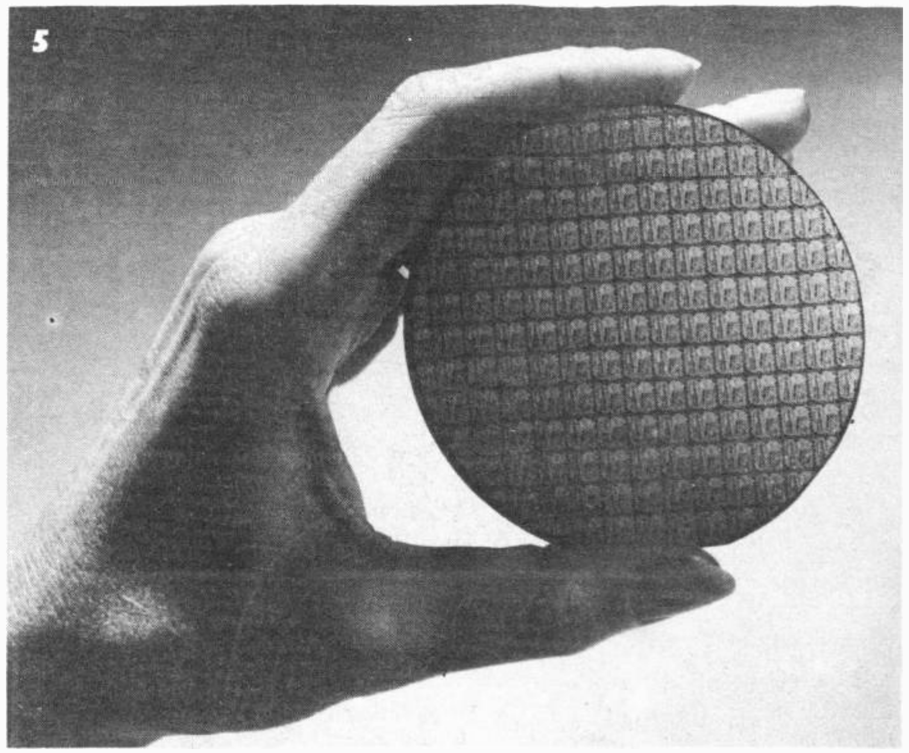
4. Final stages of the Ferranti ULA process: (left) uncommitted state, (top) interconnect mask, (right) committed ship. *(Ferranti)*

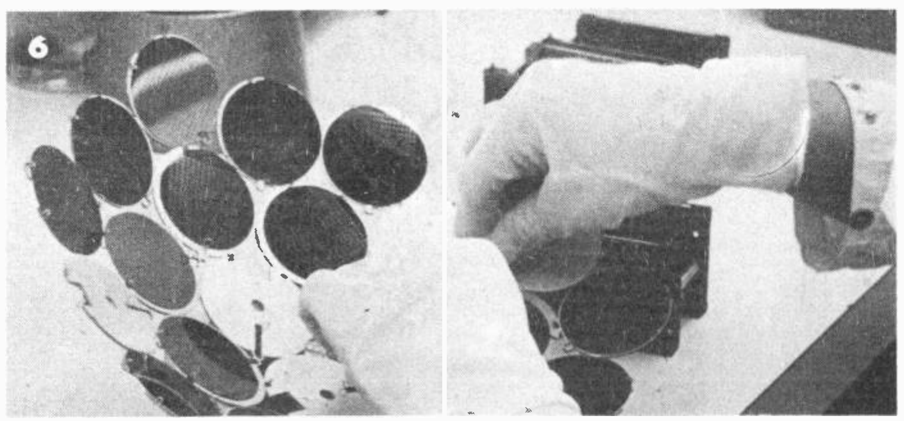
silicon chip. For example, it is not possible to make capacitors of even a moderately large value on the chip, so when such a capacitor is required, a connection is brought out from the chip to a suitable external capacitor. Similarly inductors are not made on a chip, so external inductors must be employed in radio tuning circuits, and the like.

In addition, user-interactive components such as loudspeakers, light emitting diode displays, variable capacitors and variable resistors must be external to the chip.

Strangely enough the microscopically small circuit on a silicon chip is usually considerably more complex than a similar circuit designed for the same application using separate or discrete individual components. This is because the cost of incorporating a few extra components on a silicon chip is negligible when averaged out over the large number of integrated circuits of that type which the manufacturer expects to sell. It makes sound economic sense to add extra "on-chip" components if this will avoid the necessity for an external component which cannot be fabricated on the chip.

Although we have been talking about silicon chips (from which all current production devices are fabricated), it is interesting to note that integrated circuit manufacturers have great hopes for the future of devices employing gallium arsenide chips.





MAIN ADVANTAGES

One of the main advantages of integrated circuit technology is that all of the connections within the chip are made quite automatically by photographic masking techniques during production. This is a vital consideration in these days of high labour costs when the expense of wiring up an electronic circuit using discrete components is very high.

In addition, the connections made automatically inside an integrated circuit are very reliable over the lifetime of the device—far more reliable than the connections made by a person using a soldering iron.

Although it is true that external connections have to be made to an integrated circuit with solder in the normal way, the numbers of these connections is very small compared with the number of connections made automatically inside the device. Thus the failure rate in equipment due to the failure of an external soldered connection is very low.

The constructors of electronic equipment can save a great deal of space through the use of integrated circuits, since the numerous components in each of these devices are included on a single chip. This is a vital consideration in such varied applications as space vehicles and electronic watches.

COST

It is very expensive to set up the masks and equipment required to produce a new type of integrated circuit, but once the production line is in operation the cost of producing each additional device of that type is extremely small. Thus the cost of a device depends mainly on the estimated sales volume.

In practice one finds that many of the simpler integrated circuits retail at prices only about two or three times that of a cheap transistor in spite of the fact that they contain perhaps a hundred components. Complex devices containing thousands or even tens of thousands of devices on a single chip are naturally more expensive, but are very cheap for the job they can do.

PACKAGING

Each silicon chip must be enclosed in a suitable package to prevent damage by contamination with moisture or dust and to facilitate external connections. Some of the cheapest integrated circuits are supplied in dual-in-line packages which consist of a black plastic body with connecting pins on each side of the body bent downwards at right angles to the body. The two lines of pins on each side of the body give rise to the name dual-in-line (d.i.l.).

Circular metal can packages with wire connections coming from the base are also common. The wires of this transistor-type package are arranged in a circle and in some cases these are preformed to be d.i.l.

Various other type of package are also employed, for example, when a device must be able to dissipate a high power level, a package which

Police/Fire Change

One of the effects of new frequency allocations following last year's World Administrative Radio Conference is that broadcasting on v.h.f. is to be expanded up to 180MHz.

Britain's police and fire service radio will now have to be re-equipped for new wavebands at an estimated cost of £50 million at today's prices. The programme, however, will not start until near the end of the decade as the new frequency allocations are not effective until 1990.

Due to expansion of business and increase of personnel Transam, the computer specialists, have moved to new premises opposite the Ministry of Defence at 59/61 Theobalds Road, London WC1.

Production of the Triton and Tuscan computers will be increased with TCL software, a subsidiary of Transam, expanding its own activity to include more emphasis on applications software.

Home Cameras

Japanese manufacturers are working on all-solid-state lightweight TV cameras using charge-coupled devices (CCD) for use in the home.

A market of 2 million cameras is forecast as a follow-on to the expected boom in VTRs. CCD cameras at reasonable cost could be available by 1983 according to some industry pundits.

Mullard Ltd, have supplied a Signetics "Super-Twin" video games development system to Century Electronics Ltd, Oldham. It forms part of a major games development facility which has been set up by Century Electronics, representing an initial investment of around £60,000 over the next six months.

Infrared Security

A new type of coded identity card is used on the latest Plessey time-control and security-access equipment. It uses a coded filter layer embedded in the card which responds to an infra-red beam of light.

It is claimed that the card is far more tamper-proof and difficult to duplicate than the magnetically coded cards now in common use.

Telematics

Telematics is a new word for the 1980s and beyond. It has been coined to describe the convergence of telecommunications, computers and related equipment as in the electronic office, electronic mail and electronic information systems.

The telematics market has the biggest and fastest growth potential for the future.

GLOBAL RADIO

Global radio cover, which will enable ships anywhere in the world to contact the mainland, is now possible through a new arrangement made by British Telecom with the Japanese telephone authority.

The arrangement just reached expands the Marisat system which provides communications with ships through satellites. It means that telephone and telex users in the UK will now be able to reach ships in the Indian Ocean via the Japanese satellite earth station at Yamaguchi, south west of Hiroshima.

Over 300 ships are now equipped with Marisat global satellite communications equipment. Any of these ships can be telephoned ship-shore without the annoying fading and distortion common to conventional radio transmission.

Licences Cancelled

Radio-controlled model and metal detector hobbyists will no longer need official licences to operate their equipment when regulations exempting users are introduced by the Government within the next few months. Neither will licences be required by users of pipe locators.

This does not absolve in any way the 150,000 users of metal locators/cable finders from the need to obtain permission to enter, search and dig land and to keep off protected archaeological and other sites when treasure hunting.

ANALYSIS

THE SPOKEN WORD

It must be nearly 50 years ago that the Girl with the Golden Voice emerged from a competition among the many thousands of telephone operators then employed. She had the distinction of recording the time at intervals for the whole 24 hours for the GPO Talking Clock, a sensation at that period. People used to dial TIM (there were letters as well as figures in those days) just for the delight of hearing a beautifully modulated voice with precise diction.

At London's Heathrow Airport this old-established principle is being revived in a new application called Automatic Volmet, a continuous weather-reporting service transmitted by radio for the benefit of pilots and navigators. Existing Volmet services at all major airports throughout the world use live announcers, all speaking English which is the international language for air traffic.

As may be imagined, there are many and varied accents which frequently lead to difficulty in comprehension. How sensible, then, to introduce a "standard" Volmet voice world-wide, which would soon become familiar to aircrew of all nationalities.

The voice of Automatic Volmet is that of Colonel John West, lately of Her Majesty's Royal Signals. There was no competition to discover this new Golden Voice. He just happened to be on the spot as marketing manager of the Military Communications Division of Marconi Space and Defence Systems who designed Automatic Volmet.

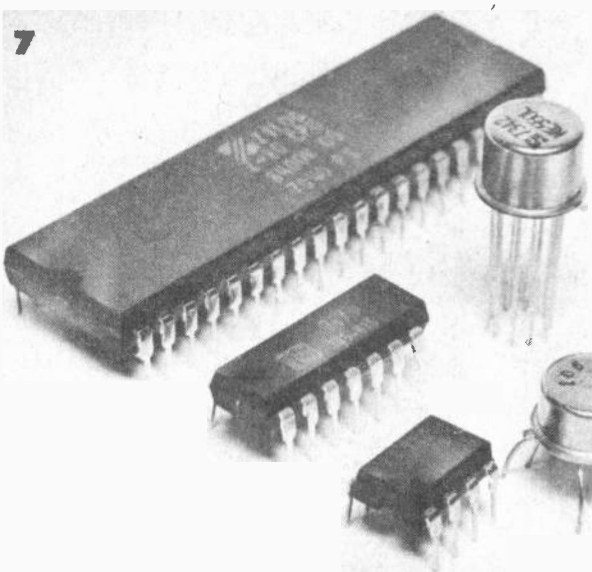
Nonetheless, all agree that his voice is well matched to the application. He has recorded all the standard meteorological phrases, words and figures which have been digitized and stored in a computer memory so that any combination can be selected at will for transmission.

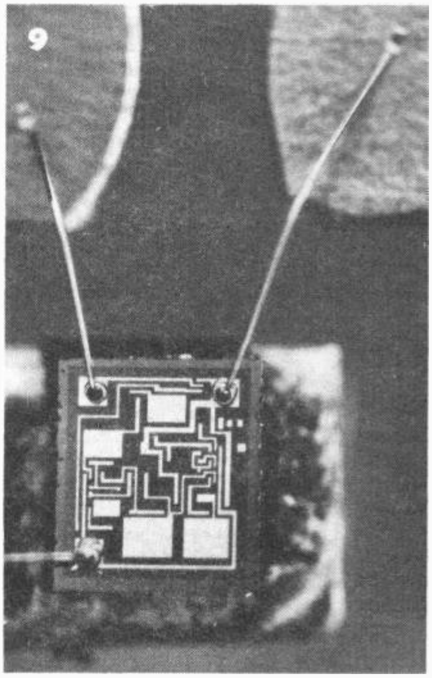
The Heathrow system allows weather reports from selected groups of airports to be transmitted simultaneously over four radio channels. The weather data arrives by telex and is automatically converted by the equipment to a number code which controls the voice output from the computer memory, thus providing automatic and instant up-date of the Volmet transmissions without human intervention.

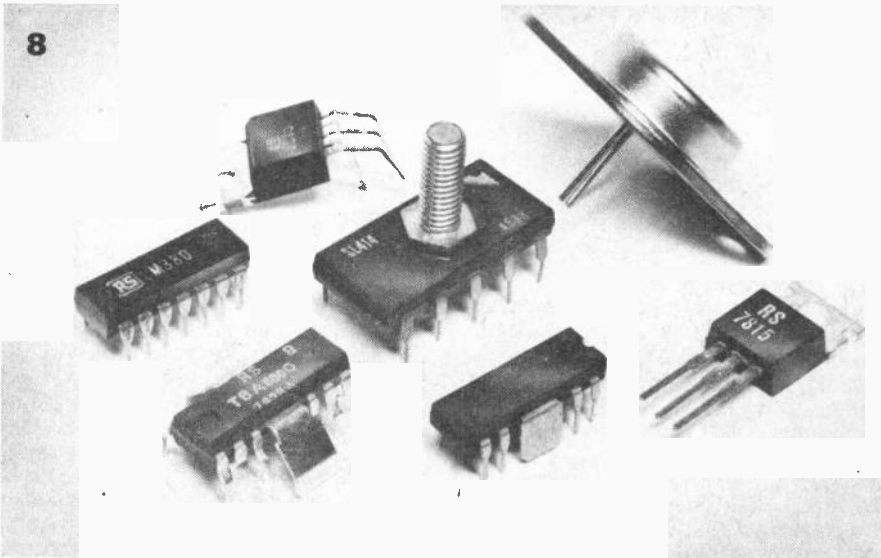
Note that Automatic Volmet uses a real voice, that of John West. It could be argued that a really slick up-to-date system should dispense with an old-fashioned human voice and use artificially generated synthesized speech. This may yet come when clarity and vocabulary are adequate. But for the time being the John West voice is the best solution and far superior to the "Donald Duck" sound so common in present synthesized systems.

I note, however, that Texas Instruments who pioneered low-cost speech synthesis in their Speak & Spell teaching aid four years ago are now releasing chips to other manufacturers and have embarked on a massive development programme for exploitation of solid-state speech technology. So we may reasonably expect that before long we hobbyists will be using the technique in construction projects.

Brian G. Peck







5. A "slice" of silicon containing many identical i.c.s.—the chips. *(Plessey)*

6. One of the many stages in the i.c. manufacturing process. Protective clothing is worn in a clean room. *(Plessey)*

7. Some of the more common packages for encapsulating low power i.c.s.

8. Audio power amplifier and voltage regulator power packages, most with means for easy connection to heatsinks.

9. The common ZN414 radio i.c. showing connection between chip and the device leadouts. *(Ferranti)*

can be bolted to a heat sink is employed. In many cases the same basic integrated circuit is made available in various types of package.

SOCKETS

Sockets are readily available for dual-in-line devices and somewhat less readily available for circular metal can type devices. Although the cost of using a socket is comparable with the cost of the cheaper integrated circuits, the constructor will find that it is much easier to change devices when a socket is employed than when a dual-in-line device has been soldered directly into a circuit board.

However, great care should be taken when inserting or removing devices from sockets or damage can occur. Insertion and extraction tools are available for this. Devices can be easily removed from a socket by inserting a thin screwdriver blade under each end of the body of the device in turn so as to lift it gently out of the socket. If any pins of the device are bent, they should be carefully straightened with forceps and pliers.

LINEAR AND DIGITAL

Most integrated circuits can be conveniently classified as either linear or digital types.

Digital devices usually employ binary logic in which the voltage or current at each point in the circuit can have only one of two possible values at an instant. Calculators and electronic watches are examples of products using digital circuits.

Linear integrated circuits operate with voltage and current levels of any value between certain limits. For example, the output of a power amplifier driving a loudspeaker can have any voltage or current level up to a certain maximum value. This output voltage is proportional to the voltage at the input of the amplifier, so if the output voltage is plotted against the input voltage, a straight line or *linear* graph is obtained. This is the reason why circuits such as power amplifiers are known as linear devices.

The circuit designer has a vast array of linear devices from which he can select the type most suitable for his needs. Some manufacturers offer thousands of linear products. Linear devices are used for voltage regulation, in timing circuits and in many types of consumer circuits for radio and television.

However, the operational amplifier or "op-amp" is probably the best known of all linear devices. Audio amplifiers are a type of op-amp designed for a specific purpose. ⌑

I.C.s EXPLAINED PART 1

OPERATIONAL AMPLIFIERS

NEW SERIES

by J. B. DANCE M.Sc.

OPERATIONAL amplifiers were originally high gain amplifiers operating down to zero frequency which were used in analogue computers to perform mathematical operations, such as addition, integration, etc. Discrete components were used in the early operational amplifiers, but nowadays it is far easier and cheaper to employ an integrated circuit.

Modern operational amplifiers are used for a very wide variety of purposes, although the name operational amplifier is still retained. They are best regarded as gain blocks. The cheapest operational amplifiers are readily available at some tens of pence, but some high performance "instrumentation amplifier" types are priced at tens of pounds.

The purchaser of an operational amplifier can use it in circuits without knowing about the details of its internal design; this is the type of approach we shall adopt.

EARLY DEVELOPMENT

The first linear monolithic device was marketed about 1962, but the first device with a reasonably high performance was the Fairchild μA709 which was introduced in 1965. This device is still a fairly well-known operational amplifier which is available from most of the large semiconductor manufacturers.

Linear devices are therefore little more than fifteen years old—but what an impact they have made in recent years! Initially linear devices were expensive and strange to circuit designers, but they are now very common.

BASIC CIRCUITS

Operational amplifiers have a very high voltage gain, typically of the order of 50,000 (94dB); this *open loop voltage gain* (A_{VOL}) is measured with no feedback applied. In practical circuits the gain is reduced by employing a negative feedback loop, this reduced gain being called the *closed loop voltage gain*.

The advantage of using a high gain amplifier with the gain reduced by negative feedback is that the properties of the circuit, including the gain, depend only on the values of the external components and not on the performance of the amplifier itself which will vary from device to device.

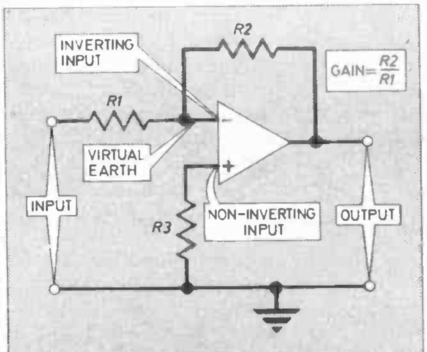


Fig. 1.1. The basic inverting operational amplifier circuit. Power supply lines have been omitted for clarity.

INVERTING AMPLIFIER

A basic inverting operational amplifier circuit is shown in Fig. 1.1, the operational amplifier itself being represented as a triangle on its side with the output at one of the points. The word "inverting" means that the output is in opposite or anti-phase with the input; in other words, as the input becomes more positive, the output becomes more negative and vice-versa. For simplicity, the power supply connections to the amplifier are not shown in Fig. 1.1.

There are two inputs to the operational amplifier itself, the one marked "+" being the non-inverting input and the one marked "−" being the inverting input. As the signal input is fed to the inverting input in Fig. 1.1, the output is out of phase with the input.

If the input voltage to *R1* rises by a very small amount say V_i, this will tend to raise the voltage at the inverting input and the output voltage therefore falls. This fall in voltage is fed back through $R2$ and tends to cancel the increase in the input voltage which produced it.

The gain of the amplifier itself is extremely high and therefore the fall in the output voltage, V_o, will be large enough to almost cancel the rise in voltage at the input of the amplifier. Thus the input of the amplifier remains virtually at earth potential and is known as a "virtual earth" point.

GAIN

The impedance at the two inputs is so high that they take hardly any current. A current therefore flows from the input through $R1$ and $R2$ to the output. As the potential of the input is nearly zero, the current passing through $R1$ is $(V_i/R1)$ and the current through $R2$ is $(V_o/R2)$. These two currents are approximately equal, since the amplifier input takes little current.

Hence

$$\frac{V_i}{R1} = \frac{V_o}{R2}$$

and

$$\text{Gain} = \frac{V_o}{V_i} = \frac{R2}{R1}$$

Thus the gain of the whole circuit is determined by the ratio of these two resistor values. Indeed, one of the advantages of this type of amplifier is that the low frequency gain remains constant and can easily be adjusted by choosing suitable values of $R1$ and $R2$.

The gain of the amplifier itself should be much greater than the closed loop gain of the circuit or the inverting input will not remain very close to earth potential and the above reasoning will then be invalid.

Ideally $R3$ should be approximately equal to the value of $R1$ in parallel with $R2$ so as to minimise the effect of the small amplifier input currents flowing in the resistors. The input resistance of the circuit is almost exactly equal to the value of $R1$, since the right hand side of this resistor remains at about ground potential.

THE 741

The type 741 operational amplifier device is suitable for use in this type of circuit, typical component values for various voltage gains being shown in Table 1.1. It should be noted that the *bandwidth* (the frequency at which the gain reduces to one half of its low frequency value, a measure of the maximum useable frequency) decreases with increasing gain. This type of circuit may be employed as an audio amplifier or for other purposes within its frequency limitations.

Both positive and negative power supply lines are required when the 741 is used in this type of circuit. Normally ± 15V supplies are used, but if lower supply voltages are employed, the maximum swing of the output voltage is more limited.

Table 1.1 Gain and Bandwidth for the circuit of Fig. 1.1.

Gain Factor	Gain (dB)	R1 (kΩ)	R2 (kΩ)	Bandwidth (kHz)
1	0	10	10	1000
10	20	1	10	100
100	40	1	100	10
1000	60	0·1	100	1

Table 1.2 Gain and bandwidth for the circuit in Fig. 1.2.

Gain Factor	Gain (dB)	R1 (kΩ)	R2 (kΩ)	Bandwidth (kHz)
10	20	9	1000	100
101	40	10	100	10
1001	60	100	100	1

NON-INVERTING AMPLIFIER

In the operational amplifier circuit shown in Fig. 1.2, the input voltage is applied to the non-inverting input of the 741 device. The output is therefore in phase with the input. Initially we will ignore VR1.

If the input voltage rises by a very small avount V_i, this will cause the output voltage to rise by a small amount which we will call V_o. Part of this latter rise is fed back to the inverting input. The inverting and non-inverting input voltages must rise by almost equal amounts or the difference between them will be multiplied by the very high gain of the 741 device and cause a large change in the output voltage.

The voltage fed back to the inverting input is equal to V_o multiplied by $R2/(R1+R2)$, since $R1$ and $R2$ form a normal voltage divider. Equating the two input voltages gives

$$V_i = V_o \frac{R2}{R1+R2}$$

Hence,

$$\text{Gain} = \frac{V_o}{V_i} = \frac{R1+R2}{R2} = 1 + \frac{R2}{R1}$$

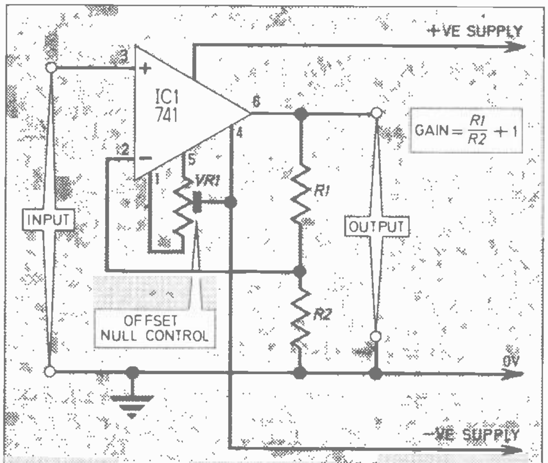


Fig. 1.2. A non-inverting amplifier circuit using the common 741 type op-amp. The preset VR1 allows the quiescent output voltage level to be adjusted.

If $R1$ is much larger than $R2$, the gain is approximately equal to $R1/R2$.

This type of circuit has a much higher input impedance than that of Fig. 1.1. Ideally the impedance of the input source should equal $R1$ in parallel with $R2$ in order to minimise gain errors due to the amplifier input currents.

PINNING

The pin connections for the 741 shown in Fig. 1.2 are for the 8-pin dual-in-line package or for the circular metal (TO-99) package. This device is also available in a 14-pin dual-in-line package with a different pin numbering.

The potentiometer VR1 connected between pins 1 and 5 allows the quiescent voltage at the output to be adjusted to zero. Typical component values are shown in Table 1.2 for various gain values.

THE 709

The 741 device contains a 30pF capacitor formed on the silicon chip which reduces the gain at high frequencies and ensures stability. However, the earlier 709 device does not have this internal capacitor and external capacitors must be used to provide "frequency compensation" and stability.

A typical inverting amplifier using the 709 is shown in Fig. 1.3; it may be compared with the basic 741 circuit of Fig. 1.1. The pin numbers shown are for the 14-pin dual-in-line encapsulation, but the 709 is also available in a circular metal can (TO-99) and an 8-pin d.i.l. package with different connections.

FREQUENCY COMPENSATION

The components *C3* and *R4* provide input frequency compensation, whilst *C4* provides compensation in the output section of the device. The component values may be selected as in Table 1.3 for various values of the circuit gain. It should be noted that the bandwidth obtainable at high gain is considerably greater than with the 741 circuits.

The 741 device includes protection against short circuiting of the output by a circuit which limits the output current to about 25mA. The resistor R5 is included in the output of the Fig. 1.3 circuit to limit the 709 output current, since there is no short circuit protection in this device. There are no provisions for the adjustment of the offset voltage in the 709 in the way VR1 is used in Fig. 1.2.

Small capacitors C1 and C2 are included in the power supply lines in Fig. 1.3 to provide high frequency decoupling. They should be used in all operational amplifier circuits in addition to the electrolytics in the power supply unit. Although the electrolytics provide a high capacitance for low frequency decoupling, they have a high inductance and do not provide satisfactory decoupling at high frequencies. C1 and C2 should be mounted close to the integrated circuit.

The power supply for the Fig. 1.3 circuit may be ±15V, in which case outputs of up to about ±14V may be obtained. Smaller supply voltages may also be used when smaller output voltage swings are satisfactory.

Table 1.3 Gain and bandwidth for the circuit in Fig. 1.3.

Gain Factor	Gain (dB)	R1 (kΩ)	R2 (kΩ)	R3 (kΩ)	R4 (kΩ)	C3 (pF)	C4 (pF)	Bandwidth (kHz)
1	0	10	5	10	1·5	5000	200	450
10	20	10	9·1	10	1·5	500	20	700
100	40	10	10	1000	1·5	100	3	600
1000	60	1	10	1000	0	10	3	300

The input voltage swings should be limited to ±5V at the device inputs. A high or low input voltage to the 709 can cause the output to "latch up" and not return to its normal value when the input voltage is removed, but this cannot occur with the 741.

COMMON MODE

If an input signal is applied to both the inverting and non-inverting inputs, it will have a relatively small effect on the output voltage; this type of signal is known as a *common mode input*, as opposed to the normal *differential input* which is applied only to one of the inputs.

It should be noted that the voltage difference between the two inputs can be only a fraction of a millivolt or the output will approach one of the supply line voltages. Even if the two inputs are joined to ground, the output voltage of a practical amplifier is not zero. The difference between the input voltages required to make the output voltage zero is known as the *input voltage offset*; it is typically a few millivolts.

SENSITIVE MICROAMMETER

A simple and instructive use of the 741 device involves its use as a sensitive microammeter. The circuit of Fig. 1.4 provides a full scale deflection for an input current of 1µA. The potentiometer VR1 sets the zero of the scale when the input current is zero.

When a current of 1µA flows into the input of the circuit and passes through R1, it will develop 1mV across this resistor. This 1mV is amplified by the gain of the circuit, namely, by R2/R1=200 to produce an output voltage of 200mV. If the combined resistance of the meter and VR2 is 2 kilohm, the current passing through the meter will be 100µA and a full scale deflection will be obtained.

INVERTING MODE

The amplifier is used in the inverting mode and therefore if pin 2 be-

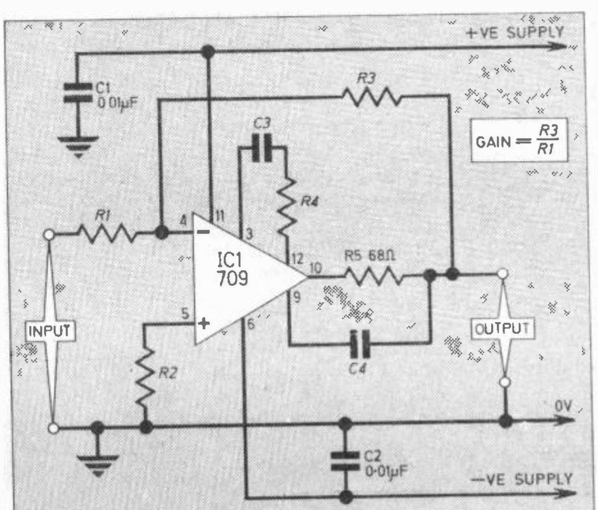


Fig. 1.3. Using the 709 op-amp as an inverting amplifier. External "compensation" components are required for stability. These are not required on the 741 since compensation is built-in.

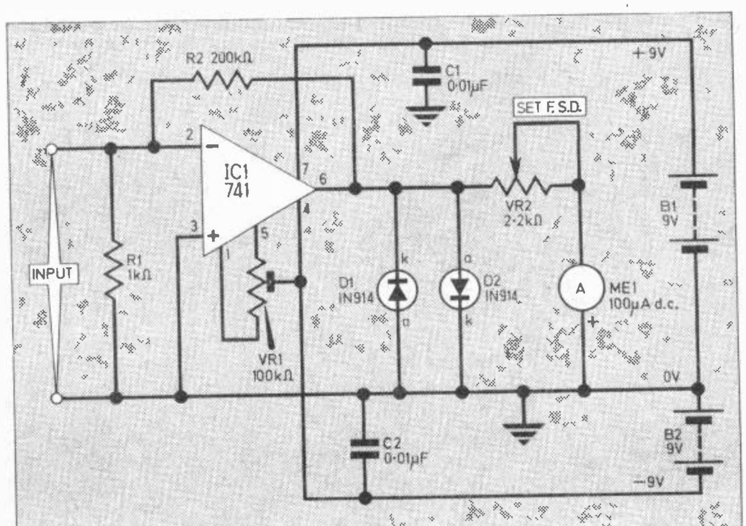


Fig. 1.4. A practical microammeter circuit based on the 741 op-amp. Provides full scale deflection on the meter when 1µA flows through R1.

comes more positive, the output becomes more negative, which explains why the meter is connected with its negative side to pin 6. If desired, however, a centre reading 100-0-100μA meter may be used for measuring input currents which flow in either direction.

The two diodes D1 and D2 protect the meter against overloads. Similarly diodes may be placed across the resistor R1 to protect the 741 input circuit.

This circuit can be calibrated by feeding a current of 1μA into it and adjusting VR2 for a full scale deflection. Such a current can be obtained by using a supply of exactly 10V and connecting it through an accurate 10 megohm resistor to the input.

This same circuit can be used as a meter having a full-scale deflection of 1mV.

POWER SUPPLIES

The circuits described require balanced power supplies. Ideally these should be stabilised at +15V and at −15V, but two 9V batteries may be used. It is always wise to connect 0·01μF capacitors from each of the power supply lines to ground to reduce the chance of instability; these capacitors should be wired directly across the operational amplifier connections using wire which are as short as possible.

Next month. *Part 2 of this series will continue with a discussion of other amplifier devices, including those used for practical audio circuits.*

TWO FOR YOU TO TRY

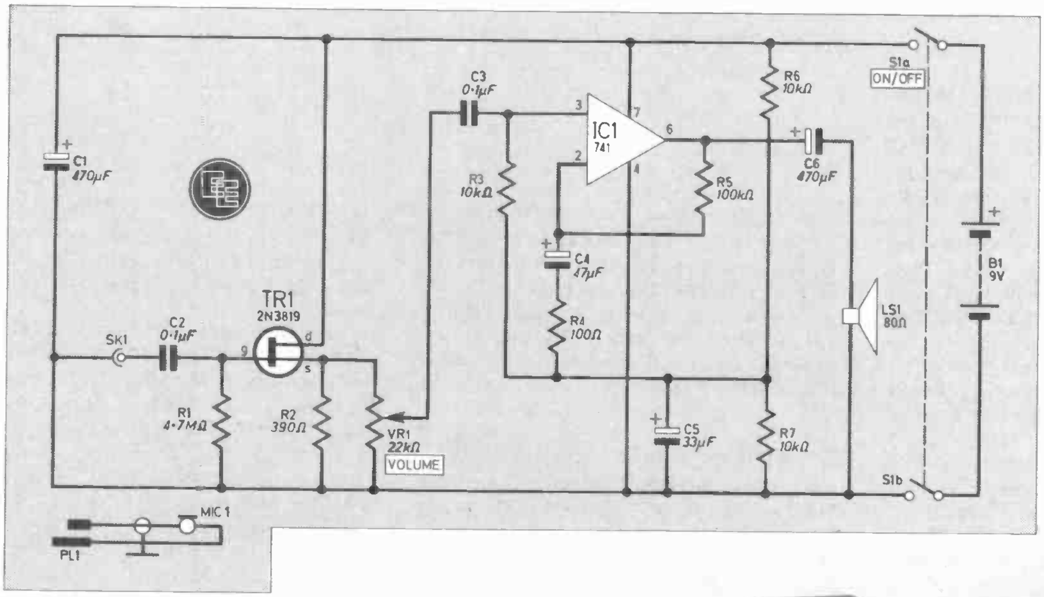
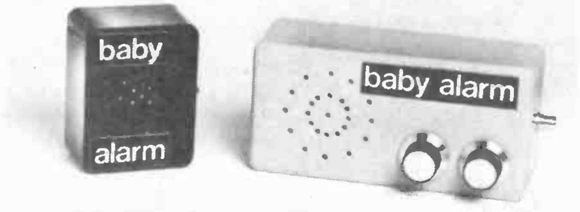


Fig. 1.5. The circuit diagram for a simple Baby Alarm using a 741 op-amp. The microphone needs to be a crystal type. This circuit can also be used as a high impedance sensitive amplifier. (*Previously published in EE November, 1979*).



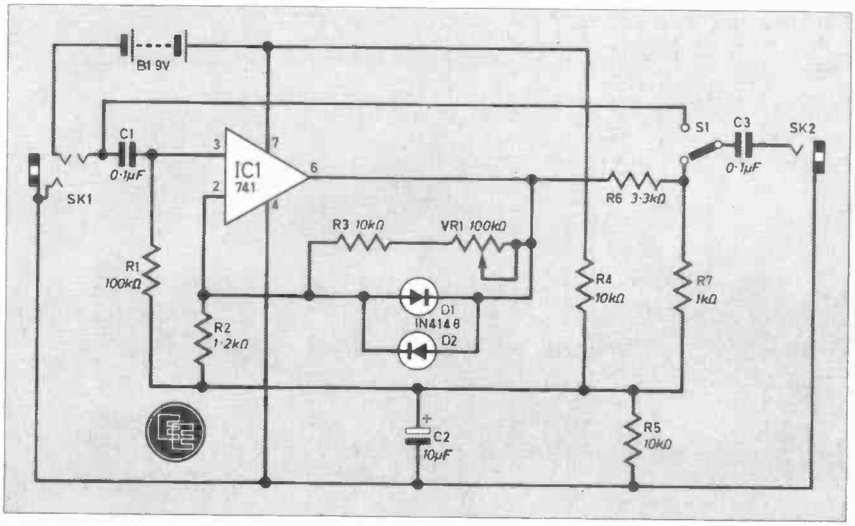


Fig. 1.6. The circuit diagram for a Fuzz Box sound effects unit for guitar based on a single 741 type op-amp. (*Previously published in EE December 1978*).

LETTERS

Patterns On Film

Will you please advise me on a problem I have concerning the making of printed circuit boards. I am unsure of the exact way to go about it. I know I can get the patterns (transfers), the board with an all-over coating of resist and the ferric chloride. I am also aware of ink resist pens to be applied direct to the board. The problem is that I had the idea that one could transfer the pattern to the board by some sort of photographic process, but I do not know how to go about this.

I dare say that I have missed an article on this topic in E.E.

F. A. Craig
Maidstone, KENT

Photographic means for producing p.c.b.s is just one of the many options available to the home constructor and detailed descriptions of the various methods are published from time to time in the pages of E.E. Such a feature is likely to appear in the near future.

What is required here is an actual-size master of the p.c.b. pattern on film or transparent paper, for example tracing paper. This can be realised with the aid of rub-down transfers on the film (or paper) which is laid over the actual-size pattern appearing in the article, and copied. Long or intricate interconnections are best produced with p.c.b. tape or Indian ink.

The finished pattern is placed on top of the photo-resist coated board and held flat to this by use of a piece of plate glass for example, and then exposed to ultraviolet light for between 5 and 10 minutes. The action of the u.v. light on the resist is to soften the exposed areas and make them soluble in a developer (sodium hydroxide solution) leaving exposed the regions of copper to be etched in the normal way.

Photography can also be used to reproduce the pattern on film by "taking a picture" of the pattern and having the negative enlarged and reversed (black on white) to the required size.

Spurious Alarm

I have recently completed the construction and installation of the *Intruder Alarm* published in the May 1979 issue of EVERYDAY ELECTRONICS. Having made this circuit for elderly relatives, I now find myself in the embarrassing position of being told by them that the alarm is being triggered on after it has been set at night when the bedroom light is switched off prior to their retiring for the night. At all other times the alarm functions perfectly.

Can you offer an explanation for this and possibly a remedy?

J. R. H. Hunter
Eastwood, NOTTS

A number of constructors of this project have experienced similar false triggering, but not, we hear, as a result of lights being turned off (or on) but have traced the triggering time to co-incide with the turning on or off of refrigerators, deep-freezers and washing machines. This could be due to the voltage spikes that are produced when inductive loads, such as the electric motors in these appliances, are turned on or off.

If the Intruder Alarm is on the same "loop" as one or more of these household items, then these voltage spikes can find their way along the supply line into the Alarm and to the gate of the thyristor in this circuit causing it to turn on.

These spikes can be induced in other loops in the building if the loops run parallel for any appreciable distance. If possible the Alarm should be plugged into a loop not containing any of the above appliances—although this may not be possible in modern houses. You will need to experiment, trying different sockets around the home. In Mr. Hunter's case, it could be that his lighting wiring runs parallel with that to the socket powering the unit.

It was a constructor who found a remedy for this and informed us. Two additional capacitors are required: a 0·1µF mounted across the terminal block, positions 5 and 6, and a 2·2µF connected across pins 1 and 2 of SK1, positive to pin 2 completely eliminated false triggering of this nature.

Contact Please

I am a fifteen year old electronics fan looking for pen friends all over the world.

I correspond in German and English and these are some of my hobbies: Programming TI calculators, I possess a TI58C, and I am active in short wave listening (SWL).

If any readers would like to contact me my address is:

Christian Munker,
V. Ketteler-Strasse 50,
5060 Bergisch Gladbach 2,
West Germany.

Christian Munker
West Germany

Electronics Club

I recently visited GB on an invitation of an English town band. We even had the great honour to play exclusively for Queen Elizabeth II in Buckingham Palace.

I am interested in musical engineering and bought the June/July 1980 issue of EVERYDAY ELECTRONICS for the *Autowaa* and *Autophase* effect units.

I just want to correct one mistake in the abbreviations list (p.437) concerning the use of "DIN".

DIN does not mean Deutsche Industrie Nummer (German industry number).

DIN is equivalent to ASA (have a look on cameras!) and means Deutsche Industrie Norm(en) (German standard(s) of industry) generally used with a following number, for example DIN45 500 (Hi-Fi Equipment).

I have founded a constructors club for electronic instruments, including musical and synthesiser projects. We also exchange cassette recordings with our ideas on (in German). There is now a section concerning personal computers.

We would be grateful to hear from any similar clubs in Great Britain. Please write to Manfred Bertuch, Werneweg 58, D-4400 Munster, West Germany.

W. Habermehl
West Germany

JACK PLUG & FAMILY... BY DOUG BAKER

RADIO WORLD

By Pat Hawker, G3VA

Companionship

Back in 1976, after looking at CB in the United States and just when the lobby for it was beginning to build up in the UK, I wrote: "The Home Office Radio Regulatory Division should surely be encouraged to explore how modern two-way radio systems could be extended to the public domain for such purposes as traffic information and "companionship" and for the original concept of assisting the private citizen in the conduct of his personal affairs or business activities.

On the other hand there is a strong argument for firmly channelling the hobbyist into amateur radio, where he belongs, with its self-training and technical investigations, possibly by provision of temporary "novice" or "beginner" licences, but with a built-in incentive to progress to the standard licences. Short-range radio has reached the stage where the public at large can benefit by the facilities it provides—is it not time that the UK licensing authorities recognise this?"

Since then, CB in the States has passed its peak (and the industry is now losing rather than making money); the British amateur radio examination has become "multiple-choice" with a much higher pass-rate; illegal 27MHz operation is widespread (though not so much as some claim) and this indeed forms part of its appeal to some enthusiasts; and the CB lobby has grown vocal and respectable.

Open Channel

On August 5, the Home Office finally published its 14-page "Open Channel—a discussion document" (available free of charge from: Officer-in-Charge, Home Office, Supply and Transport Branch, Royston Road, Caxton, Cambridge CB2 8PN—is it a coincidence that the Post Code should be CB?). Comments are invited by November 30.

There is however little reason to suppose that Open Channel (the name the Government prefers) will be with us legally for many months to come. Not the least because of the considerable problem presented to industry by the need to develop equipment for the proposed, unexpectedly high, frequency band of around 928MHz.

It is this ultra high frequency that has caused the proposals to be coolly received by many enthusiasts. Yet, in many respects, the Home Office document (and the additional information revealed at the press conference by Mr Timothy Raison, Minister of State for Home Affairs) are worthy of careful consideration, and are by no means as illiberal or as restrictive as some commentators would have us believe.

Indeed, frequency apart, the proposals come near to meeting those 1976 suggestions of mine. The aim clearly has been to produce a system that would cause minimal interference to the public's reception of radio and television broadcasts; minimal interference to other users of the radio spectrum (including public and private communications systems, radio amateurs, etc); yet not ruling out any of the "fun" or socially-useful elements of CB.

What is proposed is a band about 1MHz wide, representing a nominal forty 25kHz-wide channels or twenty 50kHz-wide channels and a licence requirement (hopefully under £10 per annum) but without any official call-signs. Equipment will not need to be formally "type approved" (a process that adds considerably to the cost of normal business radio) but makers would certify that it was in accordance with a Home Office technical specification (not yet formulated); otherwise there would be minimum restriction on, or supervision of, the use made of the facilities.

On the other hand, if Parliamentary time permits, the Wireless Telegraphy Acts may be modified to make it illegal to sell (or advertise for sale) equipment for the 27MHz band, and the Home Office intend to continue to endeavour to enforce the existing regulations against 27MHz operation (and the import of 27MHz equipment).

Range

The document acknowledges that lower frequencies have been advocated, including not only 27MHz but also around 225MHz and 450MHz. It does not consider the recent suggestion that a channel in Television's Band I (41 to 68MHz) should be used when the 405-line service finally closes, but in any case this is not due to happen until about 1986.

The document argues strongly that the lower frequencies could and would give rise to interference problems, either with existing 27MHz service (radio paging and radio control of models) or with services, including television on nearby or harmonic frequencies. This is indisputable, although some would argue that the assessment of the risks involved for 225 or 450MHz is rather over-stated.

It admits that 928MHz would normally provide only "line-of-sight" range and that in city streets hand-portable or vehicle-to-vehicle range would often be restricted to under a mile. Reference is made to various tests which indicate that this high frequency is capable of providing an effective mobile radio service. Indeed it could be argued that amateur results on a considerably higher frequency (1300MHz) show that under some circumstances (temperature inversions, etc) Open Channel contacts over hundreds of miles should be possible, while hill-top to hill-top ranges should be considerable even under normal conditions.

Cost of Service

The most telling argument *against* 928MHz is the economic one. Current u.h.f. power transistors (or alternatively varactor frequency multiplier chains) capable of providing say 5 watts output at this frequency, with crystal-controlled stability, are not far short of being "state of the art" and cost prohibitive—and all such devices can easily be destroyed.

If the Home Office is prepared to accept (at least for an initial period) self-excited "super-regenerative" type equipment, cost could be kept to reasonable proportions. Another possibility might be the development of mass-produced low cost SAW (surface-acoustic-wave) oscillators although that still leaves the problem of power amplification.

For the Australian CB allocation at 250MHz, Philips developed a 5-watt mobile transceiver with frequency synthesiser. This design (modified for the UK amateur band at 432MHz) is sold in the UK by Catronics for about £250 (including VAT). It would be difficult (some would say "impossible") to produce an equivalent 928MHz unit even for a larger market without significant extra cost. In other words it might be realistic to expect an Open Channel mobile unit at a cost of say £300 to £400, with extra care also being needed in such matters as coaxial plugs, sockets and cables.

Would this price Open Channel out of the market? There is some evidence that some illegal 27MHz units, selling at say £100 to £150 overseas, have been changing hands in the UK at prices not unlike that indicated for Open Channel.

Not a Shamateur band

The Home Office make it clear that they want to avoid creating a shamateur-type band: the document states categorically: "If an individual wishes to use sophisticated equipment to communicate over long ranges and make international contacts, he should become a licensed radio amateur by taking the appropriate examination."

The frequency of 928MHz is being considered for auxiliary CB purposes in the USA, Canada and some other countries. The flaw in this argument is that any narrow-band equipment for 928MHz is almost bound to be "sophisticated". In 1947 the USA initiated CB in the band 460 to 470MHz but little use was made of CB until 27MHz was authorised in 1958.

Using 928MHz would be a challenge—but it is to be hoped that the Home Office proposals will be given serious consideration and not just dismissed as unrealistic. It is very unlikely that the Government will ever be persuaded to legalise 27MHz CB in the UK.

mini i.c. RADIO

By F. G. Rayer

THE radio described here is pocket-sized with internal ferrite aerial and speaker. There is space available in the case to fit a socket to suit an 8 ohm earpiece if this is required. This was not included on prototype.

In order to accommodate the 38mm diameter speaker, standard 9V battery, and other items in the small case, the number and size of components must be kept small. Building then presents no particular difficulty.

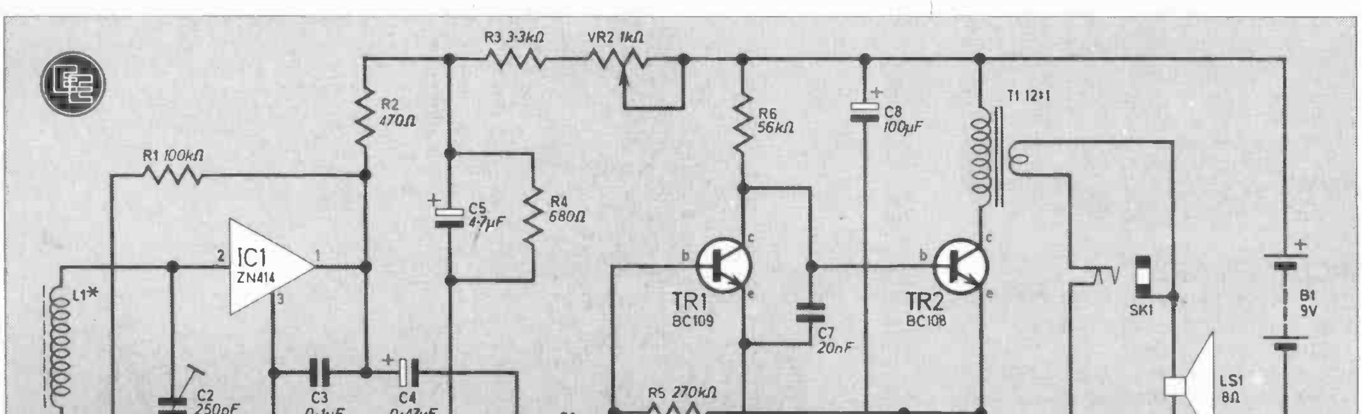
CIRCUIT DESCRIPTION

The circuit diagram appears in Fig. 1. The well-known ZN414 i.c. is used which has a series of r.f. amplifiers, detector, and a.g.c. and needs few additional components. The ferrite rod winding L1 is tuned by the compression trimmer C2.

RF input to IC1 is at 2, with audio output at 1, and feedback via R1. The output load resistor R2 receives its supply from the potential divider R3, and R4 with VR2. The latter allows setting for optimum results.

The supply should be between 1·2V and 1·6V but it is found that an unnecessarily low voltage reduces sensi-

Fig. 1. The complete circuit diagram for the Mini I.C. Radio. The optional earpiece socket SK1 is not included on the prototype.



tivity, while if the voltage is too high instability tends to develop. Should VR2 be omitted, R3 should be 3·9 kilohm, but there is then no means of adjusting operating conditions in this way

Audio signals are routed via C4 to the volume control VR1. This control is necessary as otherwise it is possible to overload the following amplifier section with strong signals. Transistors TR1 and TR2 form a simple but high gain amplifier, d.c. stabilised by feedback via R5. TR2 drives the speaker through the midget transformer T1.

COMPONENTS

Resistors

- R1 100kΩ
- R2 470Ω
- R3 3·3kΩ
- R4 680Ω
- R5 270kΩ
- R6 56kΩ
- R7 39Ω

All ¼W carbon ± 5%

See Shop Talk page 635

Potentiometers

- VR1 5kΩ miniature enclosed pre-set—knob operation type
- VR2 1kΩ miniature horizontal skeleton pre-set

Capacitors

- C1 10nF disc ceramic
- C2 250pF compression trimmer with spindle (Home Radio)
- C3 0·1μF polyester or ceramic
- C4 0·47μF tantalum bead
- C5 4·7μF 6V elect.
- C6 0·47μF tantalum bead
- C7 20nF disc ceramic
- C8 100μF 10V elect.
- C9 100μF 6V elect.

Semiconductors

- IC1 ZN414 t.r.f. radio i.c.
- TR1 BC109 *npn* silicon
- TR2 BC108 *npn* silicon

Miscellaneous

- S1 miniature s.p.s.t. toggle
- L1 m. w. aerial coil type MW5FR including a ferrite rod (Denco)
- T1 miniature push-pull output transformer type LT700
- LS1 8 ohm miniature moving coil loudspeaker about 38mm diameter

Stripboard: 0·1 inch matrix 27 holes × 18 strips, 18 holes by 7 strips; case Vero type 202-21025K General Purpose Plastic Box (2 off—see text); control knob; PP3 battery clips.

COMPONENTS approximate cost £7

NOTE ON COMPONENTS

All components should be readily available. The case is in fact made from two Vero cases from the General Purpose Plastic Box range with the lids not being used. The remaining two halves were held securely together by means of "oval" nails pushed into the lid fixing holes. This allows easy access to the inside of the radio for battery replacement.

Due to limited space within the case small-sized components are required, in particular the capacitors. C4 and C6 are required to be tantalum types, and the remaining electrolytics should be as small as possible. The transformer is the type usually used in push-pull circuits and has a ratio 6+6:1, the centre-tap being unused.

L1 is a ready-wound medium-wave winding provided also with a base coupling coil, and as the latter is not required here the few turns of this coil are unwound and removed. The MW5FR as supplied has a 5 inch long ferrite rod. This must be cut to be 2 inches long. C2 is a compression trimmer fitted with a ¼in. dia spindle to allow tuning via a knob.

CONSTRUCTION starts here

CIRCUIT BOARDS

Two circuit boards are used in this design, and each have components mounted on both sides. The smaller board accommodates the external controls and is secured to the larger by a small right-angled bracket.

The larger board sits between the two halves of the case and held in position by these and the "oval" nails.

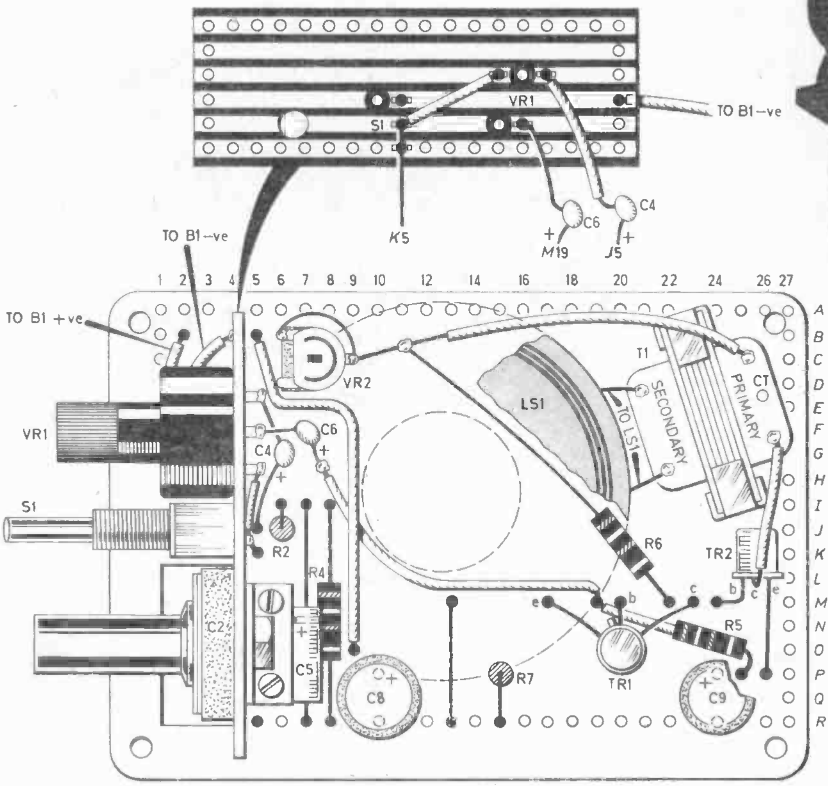
Prepare the larger board, 18 strips × 27 holes. The corners needs to be rounded exactly following the shape of the case and holes drilled to align with the fixings. Also make the cut-outs to allow VR1 and C2 to project through the larger board, the bracket fixing holes and the breaks along the copper strips on the underside.

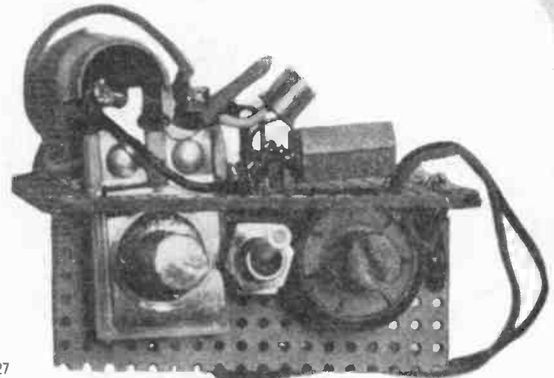
Begin construction with the smaller board making the necessary breaks along the copper strips (as shown in Fig. 2a). The stripboard positions holding S1 and VR1 tags will need to be enlarged. Fit these and C2 to the board and cut C2 tags short. Remember to attach a small bracket to the board via C2 fixing stud/nut. Bolt the two boards together.

CASE PREPARATION

Take one half of the case and drill holes so that C2 spindle, S1 and VR1 can pass through. The large board

The completed prototype with lid removed showing the nails that hold the two sections together.





End elevation of the circuit board showing components mounted on both sides, with the smaller board fixed in place.

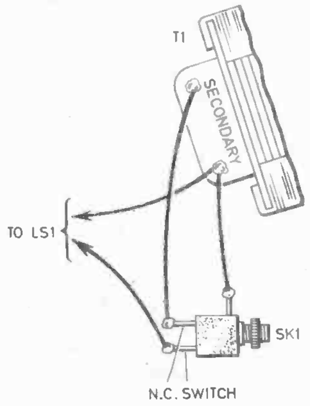


Fig. 2a. The layout of the components on the topside of the stripboard. Only a small section of the loudspeaker has been drawn for clarity. The cone of course faces out of the page. Note the small bracket holding the controls fitted to the second smaller piece of stripboard, details of the latter shown at the top of diagram.

Fig. 3. Modification to be made to Fig. 2b to include an earpiece socket.

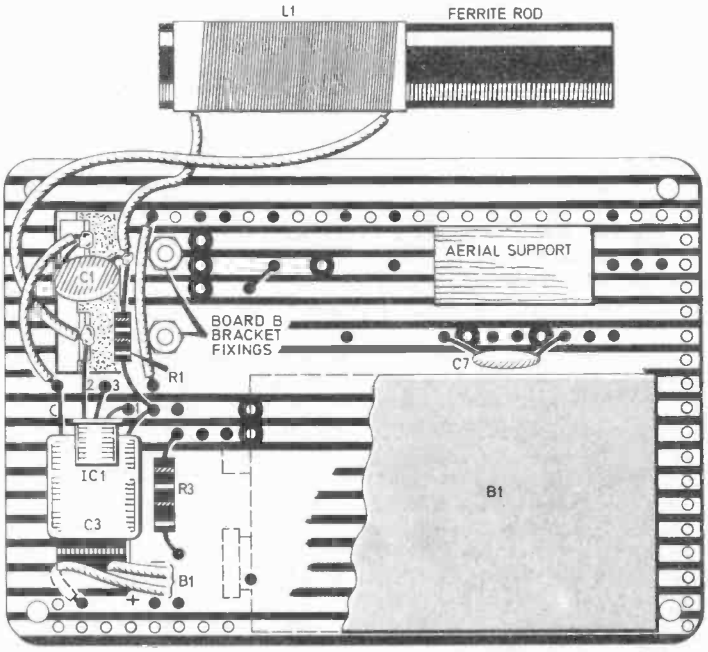
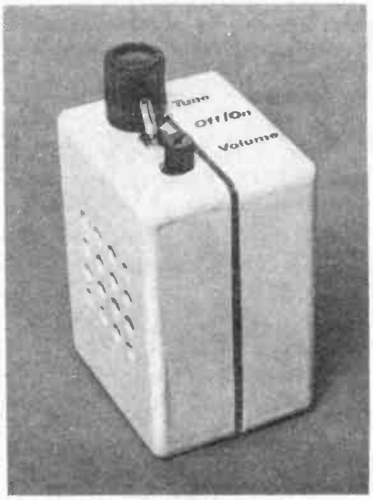
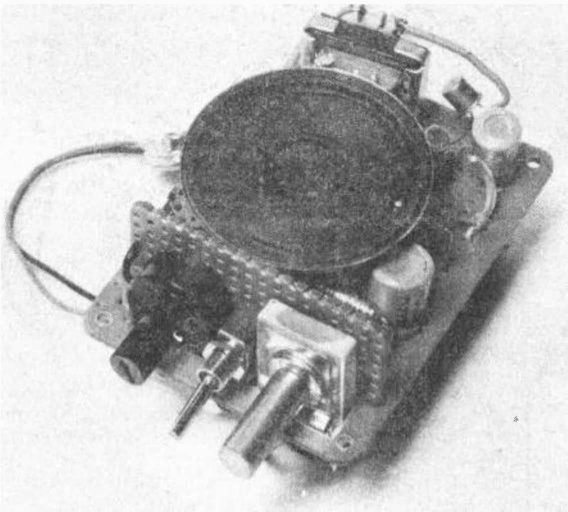


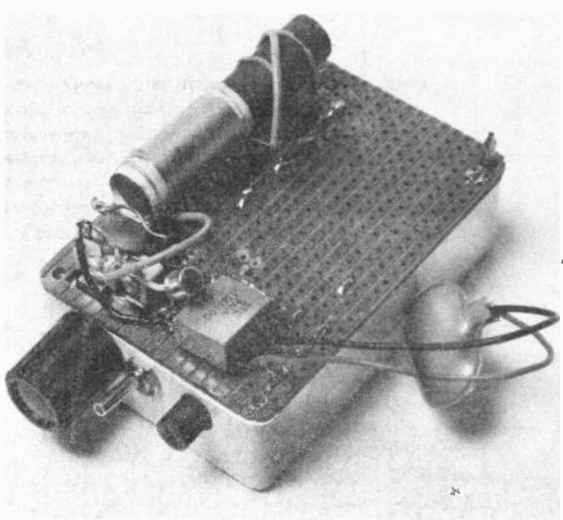
Fig. 2b. The underside of the stripboard showing breaks to be made and position of the components mounted directly to the copper strips. The aerial support is held in place by an elastic band or cord which also secures the ferrite rod in place.

mini i.c. RADIO





The completed prototype circuit board prior to installation in the lower half of the case. The fixing for the trimmer capacitor holds the L-shaped bracket to the smaller board.



Final stage of assembly. The battery sits on the copper side of the stripboard and held in place by double-sided adhesive foam. This also insulates the battery case from the board.

should lie flat on this section of the case.

Accurate positioning of the holes can be simplified by drilling them a little smaller, then enlarging with a round file, adjusting the position meanwhile if necessary. C2 and VR1 spindles should clear the holes. S1 hole should be a close fit. Later, one nut is put inside the case on S1, and one on outside, to help hold this part of the receiver secure.

Drill a grid of small holes in the case where the speaker will finally sit, about 3mm in diameter.

When the finished receiver is assembled, the components in Fig. 2a, with speaker, fit permanently in one half of the case. A small piece of card is glued between the speaker and the board. This will press the speaker against the front of the case. The speaker is fitted to the circuit board, so that this can be checked or tested easily as a unit.

The reverse side of the board (Fig. 2b) carries the ferrite aerial, and leaves space for the battery. So only the case back need be removed to replace the latter.

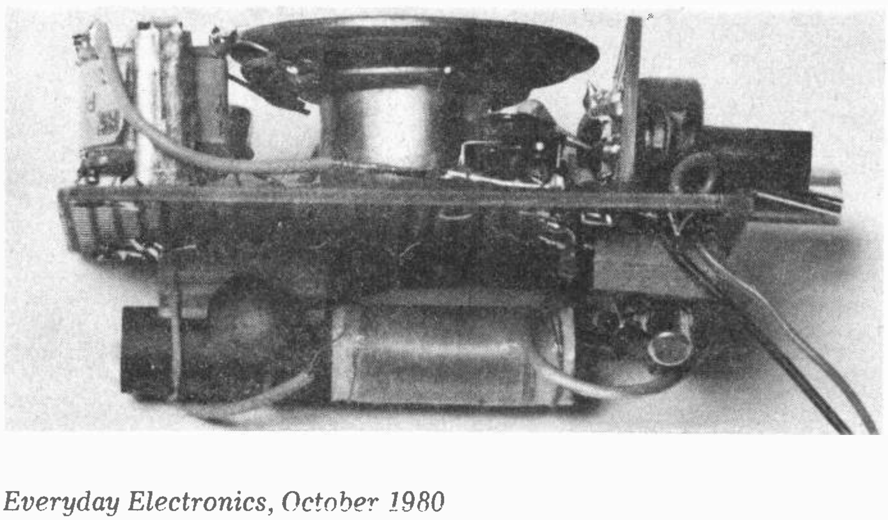
COMPONENT ASSEMBLY

Component layout on the top side of the board and inter-board wiring is seen in Fig. 2a. Carry out assembly and check that components and connections will be clear of the speaker. The latter should not be fitted until all the wiring is finished. It is then cemented to the folded card (see above), which is, in turn, cemented to the circuit board, with cone upwards to be beneath the holes in this half of the case.

If there is any free space between the speaker and case, when fitted in this way, cut a piece of card to go between the two, with a hole to match the speaker cone, and fit (glue) this inside the case. If wished, there is space for an earphone jack socket on the end of the case.

The remainder of the components are mounted on the underside of the circuit board as shown in Fig. 2b.

Side view of the completed circuit board showing in detail the method used for mounting the aerial and its support.



A small block of wood with groove is cut to raise the ferrite rod about 6mm above the board. With the ferrite rod/coil assembly in place (elastic or cotton round the rod and through holes of the board will secure the rod) connect the wire ends of L1 to C2/IC1 pin 2 and R1/C1.

Finally attach PP3 battery leads, feeding through the slot as shown. The shaft of C2 may need to be shortened to allow the small tuning knob to be close to the case end.

ADJUSTMENT

Band coverage can be modified to some extent by moving L1 on the ferrite rod. A suitable position should be found with L1 level with the end of the rod.

Initially have VR2 set at about midway. Later, VR2 can be adjusted so that a high resistance meter shows about 1·3V across C5, or so that instability does not arise at any tuning position of C2. VR2 may be reached by drilling a clearance hole in the board, beneath VR2 for a narrow-blade screwdriver, or it can be set before fitting either part of the case.

Note that the case should be present for proper loudspeaker reproduction, and that it is necessary to turn VR1 back, with strong signals, to avoid overloading and distortion.

The case sections, with board, fit together with the four metal pins (nails) in the corner holes. To change the battery, the back section only is removed, and this is best done by inserting a knife or similar tool so that the back can be lifted away. Foam adhesive tape can be used to hold the battery in place or a thin piece of foam sponge between battery/board, and battery/case will achieve the same result. ⌑

IRON HEAT CONTROL

by A. Sproxton

A SOLDERING iron will become unnecessarily hot when there is some delay in making joints, and these are usually small so that not much heat is carried away. This causes damage to the bit, and also increases the danger of harm to circuit boards or components. The controller described here is particularly intended to avoid these difficulties.

In use, the heat controller is placed in series with the iron, and is adjusted for the temperature required.

CIRCUIT DESCRIPTION

The circuit diagram for the Iron Heat Control unit is seen in Fig. 1. Control is obtained by use of a triac, CSR1. Current at mains voltage is fed to the iron element through the triac. This device is normally in the off state, where it exhibits an open circuit. When it receives a trigger on its gate terminal, the triac turns on (short circuit) for the remainder of the half-cycle in which it was triggered.

Thus by choosing the point at which triggering occurs one is able to select the power delivered to the iron and hence the temperature of its bit. In the circuit of Fig. 1, the triggering point is controlled by the charging time of C1 via R1 and VR1. When the voltage level across C1 reaches the striking voltage of the neon LP1, the neon lights and passes current into the gate of CSR1 turning it on. Thus, the iron bit temperature is controlled by the setting of VR1.

For maximum heat, the triac conducts for virtually the whole of the a.c. cycle. To reduce heat, the triggering angle is reduced, and the triac is then conducting for only a part of each half cycle, so that average power to the iron falls.

With this circuit, the neon was found preferable to a diac, and it also acts as a panel indicator showing that power is on for the iron. When the neon is not lit, no power is available.

Current is drawn from a mains plug receiving power from the usual outlet, and the iron is in turn connected to the controller. Note that the earth conductor *E*, and neutral *N*, run without interruption from the mains plug and cord to the iron circuit. The triac control is placed in the Live (*L*) conductor.

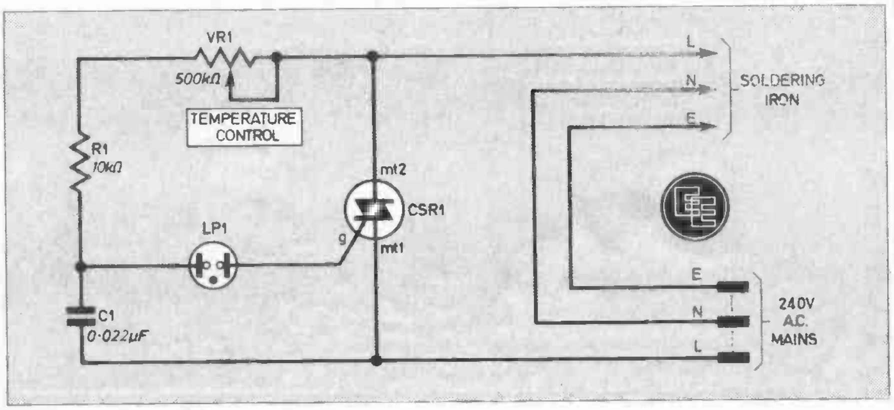
ASSEMBLY

No circuit board is required in the construction. Some of the components are mounted on the metal front panel of the case and point-to-point wiring employed. The prototype used a standard panel neon with integral limiting resistor. This must be removed. Pull off the neon cover, unsolder and take away the resistor, and solder the free neon lead to the holder tag.

The arrangement of the components on the case lid is shown in Fig. 2. The triac used in the prototype and shown in Fig. 2 has an isolated body which is bolted directly to the metal panel. This also acts as a heat-sink for CSR1. If other non-isolated body types are used, a mica washer with insulating bush(es) should be used.

Stud, TO-3 and TO-66 types are not suitable because at least one terminal would be exposed, but the flat plastic packages are, such as the TIC206D and the TIC226D. These have their metal tabs connected to one terminal and should thus be fitted with mica

Fig. 1. The complete circuit diagram of the Iron Heat Controller.



COMPONENTS

R1	10kΩ 1W carbon ± 10%
VR1	500kΩ lin. carbon
CRS1	ECC704 or other mains/3A triac (see text.)
C1	0·022μF plastic or ceramic
LP1	panel neon without limiting resistor (see text)

Tag-type terminal strip, 3-way with extended mounting tag; case, plastic with metal lid or all metal (see text), size approx. 115 × 75 × 50mm used in prototype; control knob; mains cable; rubber grommets (2 off); 6BA fixings.

Approx cost **Guidance only**
£2·50 (see page 635)

washer/bush. Precautions should also be taken to keep its terminals clear of the case.

Note that the panel is earthed via one of the tags on the terminal strip by the earth conductor of the mains cable. This is essential.

The mains cable runs from a 3-pin plug fitted with a 2A or 3A fuse. If a non-fused plug is to be used, a panel fuseholder should be added and fitted to the case. It passes through a grommet in the back of the case. Earth and Neutral leads are soldered directly to the *E* and *N* tags of the tag strip. Live runs directly to mt1 of the triac.

Take the plug off the soldering iron cable, and pass the flex through the front grommet; *E* and *N* conductors connect to *E* and *N* at the terminal tag strip, and *L* to mt2 of the triac. Take care to follow the correct *E*, *N* and *L* connections.

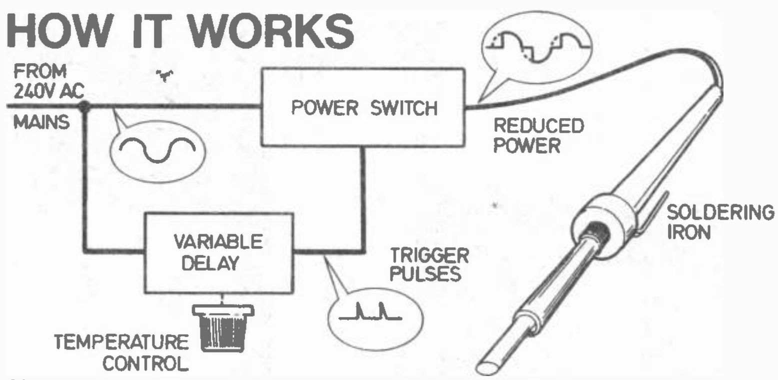
The assembly was fitted into a plastic case. A metal case can be used and earthed with the panel.

IN USE

To test the unit an a.c. voltmeter may be clipped to the *N* and *L* tags of the tag strip. Rotation of VR1 should give a smooth control of voltage, from about 50V minimum up to nearly the full mains voltage.

For average small intermittent work with a 15W to 25W iron, a setting of about 150V should prove to be satisfactory, but this can of course be adjusted as found best in practice.

HOW IT WORKS



Mains voltage is applied to the power switch which is either a short or open circuit. The mains is also used to derive a pulse from the variable delay network in order to trigger the power switch on, i.e. from open to a short circuit.

The position of the trigger pulse with respect to the mains zero crossing point determines the amount of power delivered to the soldering iron. Thus, very early triggering in the half cycle yields maximum power whereas very late triggering gives minimum power to the iron.

The shaded regions in the "switched" main cycle are proportional to the power delivered.

MODIFICATIONS

Due to the way in which the circuit operates, maximum power setting of VR1 provides a little under the full mains voltage. This slight reduction was not found of any importance. It is easy to fit a small mains type toggle switch to the panel for maximum or full power, if wished. This switch should be connected from *L* of the mains cord to *L* of the iron circuit, thereby eliminating (short circuiting) the triac when it is closed.

In use, no troublesome interference was noticed, this being in part due to the low power. Various forms of interference suppression are available such as a 22nF 550V capacitor with a 22 ohm ½W resistor in series, from mt2 to mt1 of the triac. A similar capacitor from *L* to *E* may also be used. ⌑

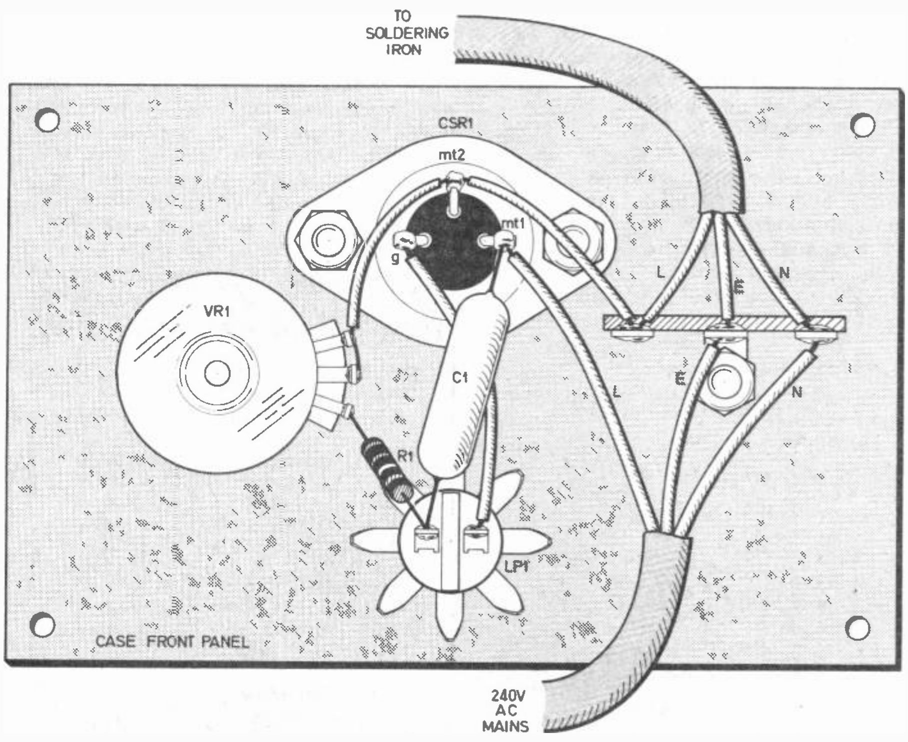
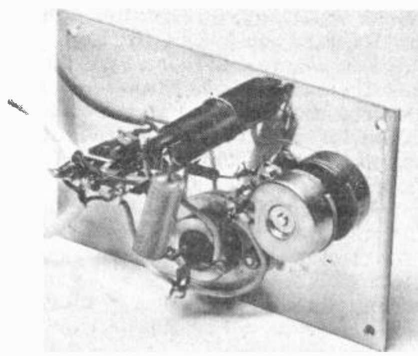
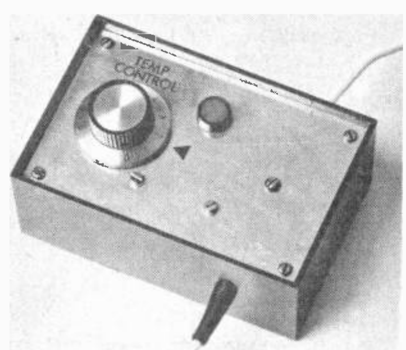


Fig.2. Layout of the components on the case lid and complete interwiring details.



Above shows completed panel of the prototype; (below) finished unit.



DARKROOM CONTROLLER

BY S. IBBS

BY FAR the most useful piece of equipment in a photographic darkroom is a timer for the enlarger. Using this, a high standard of accuracy can be guaranteed, and good quality photographs depend on high standards.

The large majority of photographers prefer to use a test strip technique to establish the right exposure, rather than using an enlarging meter. This is because a meter is dependent on standard light values, which are almost impossible with different negatives, of different subjects, on different films, taken at different times.

The project here described provides a versatile, accurate enlarging timer that not only controls the safelight as well as the enlarger (to make initial focussing and framing easier) but includes a red l.e.d. that produces a very short pulse of light every second.

This makes standardisation of test print exposures very simple. The circuit is relatively easy to construct, very reliable, and has eased life considerably for the author.

THE CIRCUIT

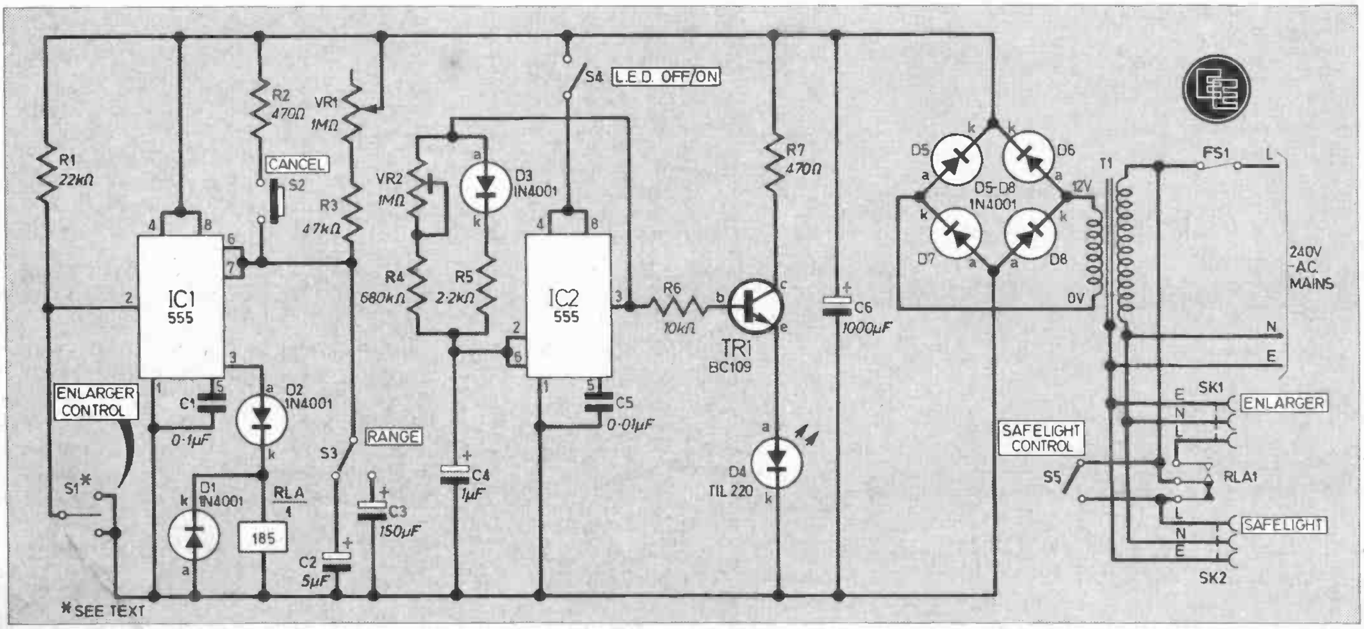
The full circuit of the Darkroom Controller is shown in Fig. 1. It can be seen that this consists of two NE555 timer i.c.s. The first one, IC1, is wired as a monostable and timing is initiated by grounding pin 2.

This causes capacitor C2 or C3 to start charging up and pin 3 to produce a high output thus activating the relay.

When the charge on the capacitor has reached two thirds of the supply voltage, the i.c. rapidly grounds pin 7 thus discharging the capacitor and taking pin 3 "low" again.

The time taken for all this to happen depends on the value of the capacitor and the setting of VR1. The particular values chosen for this pro-

Fig. 1. Complete circuit diagram for the Darkroom Timer.



ject give a timing range from zero to about fourteen minutes.

If we wish to keep pin 3 high all the time then pin 2 should be kept at ground potential. The switch S1 is provided for this purpose.

RELAY

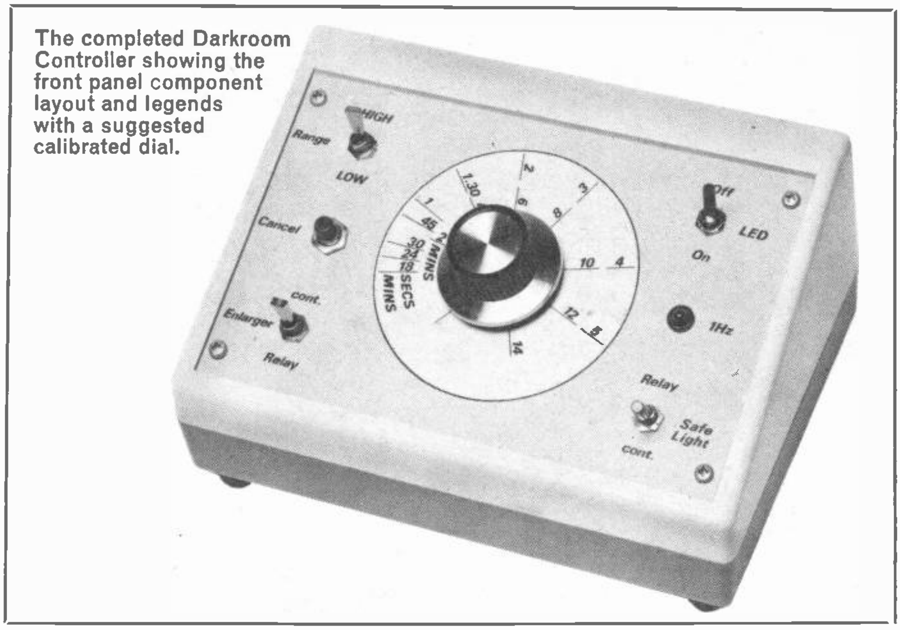
The relay connected to pin 3 of IC1, has one set of change-over contacts and these are wired into the live lead of the enlarger and safelight.

In normal conditions the enlarger is off and the safelight is on, but when the relay coil is activated the contacts change over and the enlarger comes on and the safelight goes off.

There is also a further switch, S5, to override the relay contacts connected to the safelight.

TIMING SIGNAL

The second timer IC2 is provided to give an accurate timing signal. Here we have a 555 i.c. connected in the astable mode. The time period is set by C4 and the VR2, R4, R5, D3 combination and should be adjusted so that D4 flashes on and off at the rate of one short pulse every second. This must be a red l.e.d. as this is the colour that most photographic papers are least sensitive to.



The completed Darkroom Controller showing the front panel component layout and legends with a suggested calibrated dial.

Transistor TR1 is used as a buffer to prevent the l.e.d. from drawing too much current through the i.c.

The power supply to the control circuitry is very basic and consists simply of full wave rectified d.c. derived from the mains via step-down transformer T1 and diode bridge D5-D8, with just one smoothing capacitor, C6.

COMPONENTS

Resistors
R1 22kΩ
R2 470Ω
R3 47kΩ
R4 680kΩ
R5 2·2kΩ
R6 10kΩ
R7 470Ω
All ¼W carbon ± 5%

See **Shop Talk** page 635

Potentiometers
VR1 1MΩ carbon linear
VR2 1MΩ miniature vertical preset

Capacitors
C1 0·1μF polyester type C280
C2 5μF 16V elect.
C3 150μF 16V elect.
C4 1μF 16V elect.
C5 0·01μF polyester type C280
C6 1000μF 16V elect.

COMPONENTS approximate cost £11 excluding case

Semiconductors
IC1, 2 NE555 timer i.c. (2 off)
TR1 BC109 *npn* silicon
D1-D3 1N4001 or other low power silicon diodes (3 off)
D4 TIL220 red l.e.d.
D5-D8 1N4001 50V 1A silicon diodes (4 off)

Switches
S1 s.p.d.t. toggle, centre off with one pole biased off
S2 push-to-make, release-to-break switch
S3 s.p.d.t. miniature toggle
S4, 5 s.p.s.t. miniature mains rated toggle (2 off)

Miscellaneous
T1 mains primary with 12V 100mA secondary
RLA miniature 12V relay, 185 ohms coil resistance with one set of single-pole changeover contacts.
SK1, 2 three pin Bulgin mains socket type P650 (2 off)
FS1 5A cartridge fuse and panel mounting holder
Stripboard, 0·1 inch matrix, 24 strips by 48 holes; sloping front case 171 × 121 × 37mm, Verocase 202-21033A or similar; knob; five amp mains cable; interconnecting wire; 6BA nuts and bolts for fixing transformer and circuit board.

CONSTRUCTION starts here

CIRCUIT BOARD

The prototype is built on 0·1 inch stripboard, 24 strips by 48 holes. This requires several link wires, so follow the layout diagram in Fig. 2 carefully, and construction should cause no problem.

The two i.c.s can be mounted in Soldercon pins, although low profile sockets can be used if preferred. The board is then bolted to the bottom of the box, as is the miniature transformer. The relay can be glued directly to the circuit board or fixed using double-sided adhesive tape.

When doing the interwiring, check at each stage of construction to make sure that you have made no mistakes. The relay used has changeover contacts so a live mains lead is taken to the centre contact, and a wire is taken from the terminal normally connected to the safelight.

A switch is also wired across these two terminals so that mains can be fed direct to the safelight, bypassing the relay.

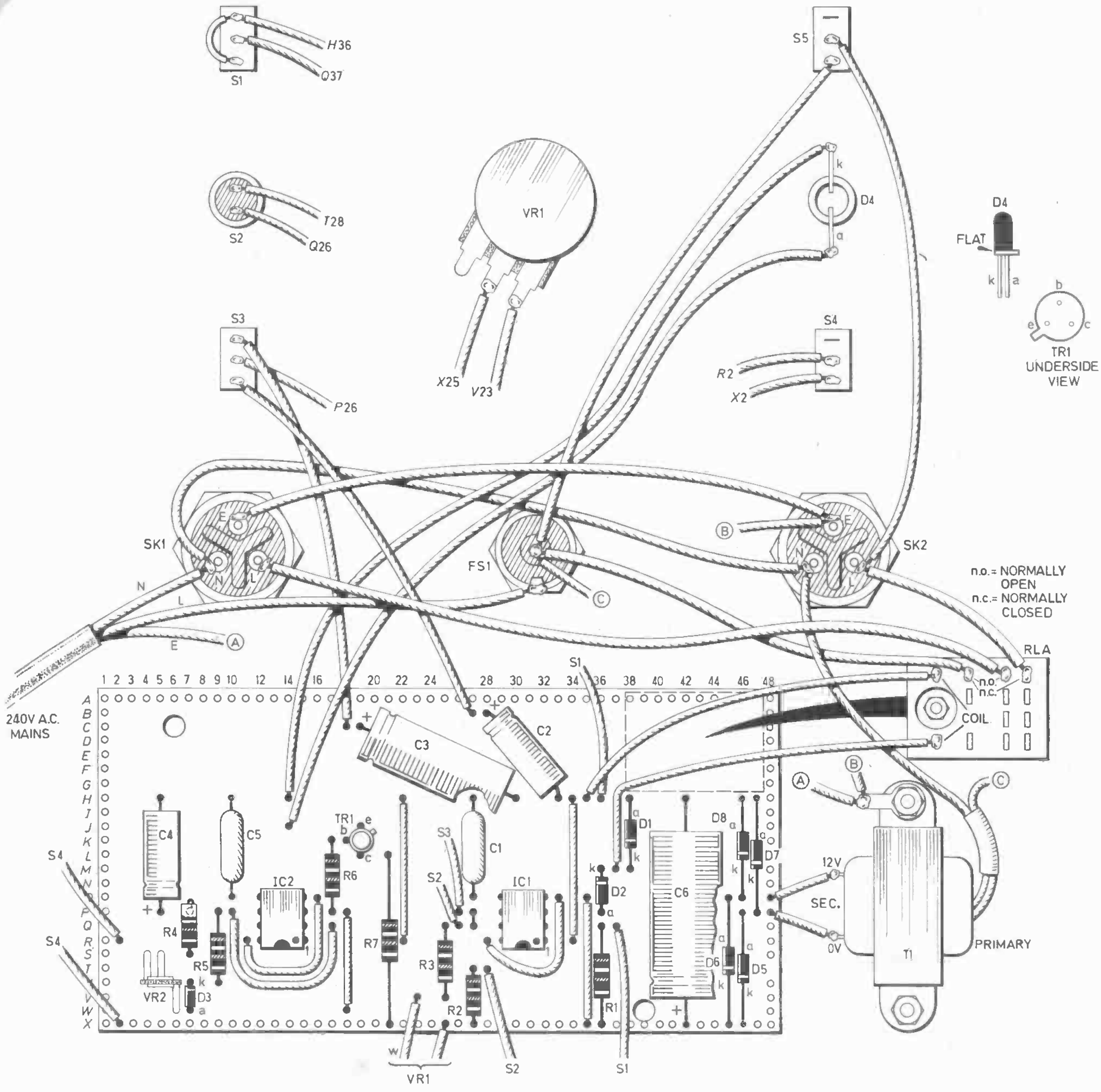
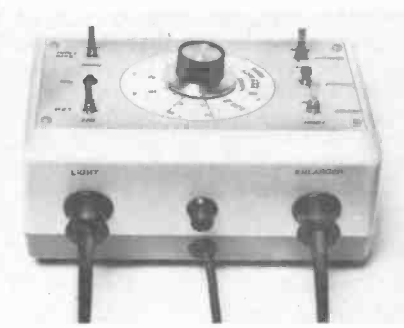
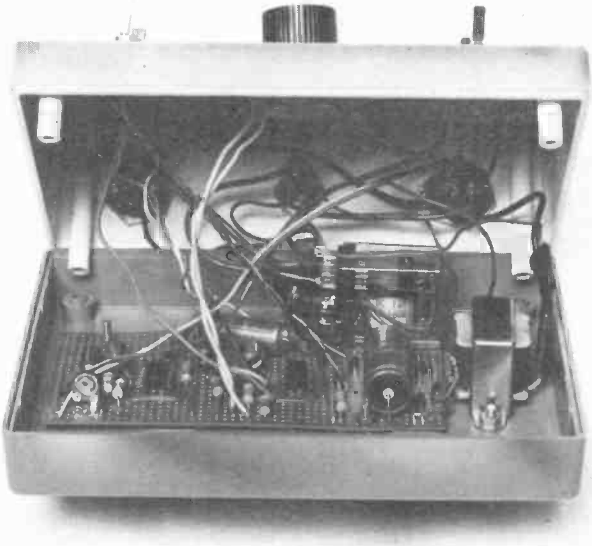


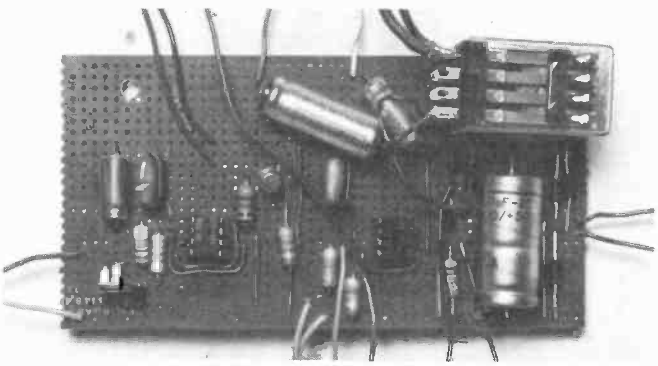
Fig. 2. Circuit board component layout on the topside, details of breaks to be made in the copper strips on the underside and all interwiring to off board components.



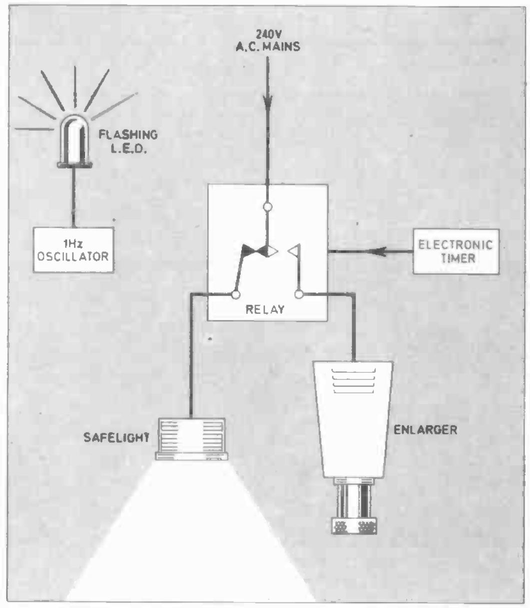
Arrangement at the rear of the case showing positioning of the lights and enlarger plugs and sockets.



The sloping front cover half of the case lifted clear to show positioning of the circuit board, transformer and relay. When completing the final wiring to front panel controls and rear sockets make sure that all leads are long enough to facilitate the removal of front section of the case.



The finished prototype circuit board for the Darkroom Timer. The relay wiring may differ according to type finally selected. Low profile integrated circuit sockets may be used in place of the Soldercon pins if preferred.



HOW IT WORKS

A single timer i.c. is wired as a monostable and its output controls a relay.

In normal conditions the safelight is on and the enlarger off. When the timer is activated the relay changes over and the enlarger comes on and the safelight goes off.

A second timer i.c. is wired so as to switch a l.e.d. on and off at a frequency of 1Hz. This can be used to time exposures reliably and consistently.

The switch S1 deserves some comment. It is a single-pole, double-throw type and is biased to the centre "off" position on one of the poles. This means that it can be left in the "on" position if pushed say up, but cannot be left in the "on" position if pushed down but reverts to the centre "off" position as soon as finger pressure is released.

CASE

The prototype was housed in a sloping front box, size 171 x 121 x 37mm. The Verocase number 202-21033A would be ideal although any similar case would suffice. Drill the front panel and mount all the switches. The rest of the components can then be mounted in position as in Fig. 2 and when interwiring is complete, calibration and checking should be carried out.

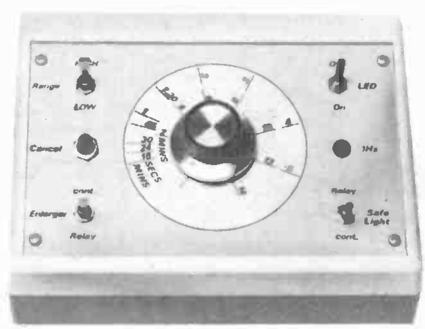
CALIBRATION

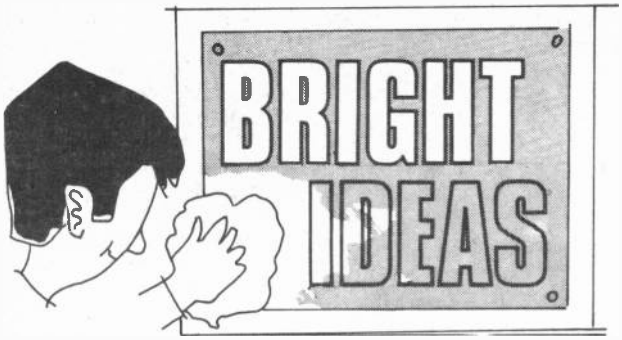
The preset VR2 should first be adjusted until D4 flashes at a rate of precisely 1Hz. Having done this we can then proceed to calibration of the main timing circuit.

Accuracy of calibration for the main timing control VR1 will determine the final accuracy of the timer, so it is best to take care to set the two ranges properly (using pencil marks). Check that all the controls are working.

With the SAFELIGHT switch set on RELAY, and the relay activate switch (S1) used in the push-to-make mode, the light should go out, and the enlarger come on for the timed period.

This period can be terminated at any time by the CANCEL button. Moving the relay activate switch to the unbiased position (CONTINUOUS) should make the enlarger turn on continuously, and the SAFELIGHT switch S5 should turn the safelight on continuously independent of the relay. ☒

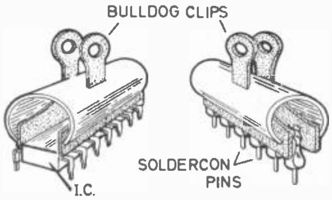




Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

SOLDERING AID

During construction of the *TTL Test Bed* (October 1978) I found that the Soldercon pins were inclined to break away from their frame when every second one was bent up in order to fit alternate pins on the stripboard. You were then left with a lot of loose pins.



I found that by using a "Bulldog" paper clip it made an excellent holder while you soldered the pins in position. A small size "Bulldog" clip will hold six pins while you solder them in position, see diagram.

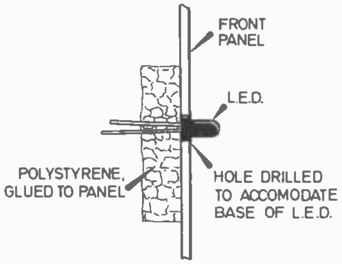
I also use these paper clips while soldering 14 pin and 16 pin i.c.s in position. I find they make an excellent heat shunt as the tension of the clip ensures good contact with each of the pins.

Jerry Murphy, Eire

POLYSTYRENE L.E.D. MOUNTING

I have on occasions been confronted with the problem of mounting single l.e.d.s onto the facia panels of projects. Bearing in mind the cost of specialised holders I have come up with the idea of mounting a small piece of polystyrene (e.g. ceiling tile) behind the panel and using the gripping action of the polystyrene to hold the components.

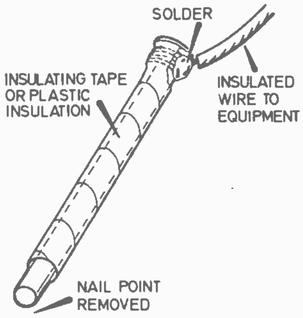
D. E. Kingston,
Lowestoft,
Suffolk.



SIMPLE PROBE

I have made the *Continuity Tester,* which was published in the January issue of EVERYDAY ELECTRONICS. I have found that commercially made probes are not cheap, so I have devised a simple substitute. This can easily be made from the contents of a "spares box".

A nail with the point filed away is the basis of the probe, see diagram. A length of suitable wire is then taken with about 25mm of copper exposed. The area that is to be soldered is cleaned, then "tin" the clean area of the nail with a hot soldering iron. The solder should remain if the surface is clean enough.

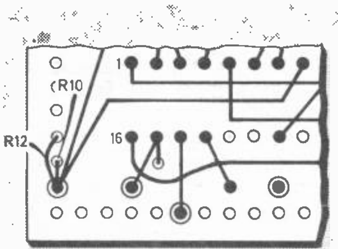


The exposed end of the wire is wrapped around the tinned area of the nail and then soldered. When the joint is cool, it is covered with an appropriate colour of insulating tape or plastic insulation sleeving. The remaining end of the wire should then be taken to a plug or equipment.

This is *only a low voltage probe,* it should *not* be used for mains voltages.

J. Moulder (Age 13), Dumgoyne, Scotland.

PLEASE TAKE NOTE



Cricket Game *(August 1980)*

The underside wiring of Board B is incomplete, the common connections to ground of resistors R10 and R12 being omitted. The completed wiring is shown above.

There are some unused sections (gates and flip-flop) in i.c.s IC4, IC6 and IC9. As these are CMOS devices, the unused inputs should be strapped to the appropriate power supply rail. If this is not done, the i.c. may become very hot and possibly overheat and be damaged. As a result excessive current will be drawn from the supply making battery powered systems uneconomical.

The unconnected pins should be connected as follows: IC4 pins 8, 9, 10 and 11, IC6 and IC9 pins 8, 9, 12 and 13 to the 0V supply rail.

Autophase *(June/July 1980)*

An additional break on the underside of the strip-board is required at location C16.

George Hylton brings it

DOWN TO EARTH

Keeping Things In Proportion

ODD LOOKING numbers abound in electronics. Why do resistors and capacitors have values like 27 ohms and 560pF? Why not have a nice round numbers like 30 and 600? Why do so many test meters these days have scales of 0 to 31·6? In this article the odd numbers are found to be rather less odd than they first appear but still not quite without mystery.

Let's take those multimeter scales first. When I was a lad meters had scales 0 to 10, 0 to 100, and so on. Some had intermediate scales as well but these were always simple multiples of the basic 0 to 10, etc. My old Avometer, for instance, has scales of 0 to 100 and 0 to 400 and the same scale divisions serve for both. But 0 to 31·6? Never!

The choice of this odd-looking intermediate range, 0 to 31·6, is quite sensible. It springs from a commendable anxiety to minimise one kind of error. This is the "reading error" which stems from the fact that the human eye cannot make very fine discriminations of the position of a pointer. Practical meter scales seldom have more than a hundred small divisions because it is difficult to read markings if they are spaced too closely. Experience shows that at normal viewing distances and with average eyesight a hundred small divisions is the practical limit.

Limits

This has a direct bearing on the accuracy obtainable from a pointer type of indication. I'm not thinking of the accuracy of the meter itself, but of the eye's ability to make use of it. Let's assume that the meter itself is absolutely accurate. Even so, the eye can only read off what it says to within certain limits. This is what then fixes the achievable accuracy.

Let's assume that a meter can be read to the nearest small scale division A meter scaled 0 to 100V can then be read to the nearest volt. If the true voltage is 99·5V but you read this as 99V or 100V the reading error is 0·5V which is an error of one half of one per cent and for most purposes is perfectly tolerable.

But if the voltage were 10·5V and you read it as 10V or 11V the error, still only half a scale division, now amounts to 5 per cent, which may be serious.

Best Compromise

The answer, of course, is to switch to a lower voltage range. If the meter has a 0 to 20V range then each small division is now worth 0·2V, and if you read 10·6V instead of the true 10·5V the error is under 1 per cent. However, with scales of 0 to 20V and 0 to 100V you are still in trouble with a voltage like 21V, which is of scale for the 20V range but still quite low down on the 100V range. An error of 0·5V at 21V is about 2·4 per cent. Given that a meter can have one intermediate range between its 0 to 10 and 0 to 100 ranges, what is the best compromise for accuracy? That is what range value gives, on average, the smallest reading errors?

Thirty-one Point Six

The answer is 0 to 31·6. This figure is arrived at because it bears the same proportionate relation to both the other ranges. Actually 31·6 is only an approximation. My pocket calculator says the true figure is 31·6227766. Let's call it 31·6 for short! If you multiply 10 by 3·16 you get 31·6. It's less obvious that if you then multiply the 31·6 by 3·16 you get 100. And if you start with a lowest range of 0 to 1 and go on multiplying by 3·16 you end with ranges which go: 1, 3·16, 10, 31·6, 100, 316, 1000 . . . etc. By turning to the next lowest range when the pointer lies too low on the scale for accuracy you can now always reduce your reading error to less than a third of what it was.

The meter manufacturer must now print two basic scales, 0 to 31·6 and 0 to 100, since the same markings can't be used for both. But all the voltage and current ranges can share these two scales. If the meter also has an ohms scale and a decibels scale the total is still only four scales so the dial is still relatively uncluttered and easy to read. Moreover the only mental arithmetic required is simple multiplication or division of the scale numbers by 10, 100, or 1000. With scales like 0 to 10, 0 to 20, and 0 to 50 you get into difficulties with mental arithmetic when faced with the problem of deciding what the true voltage is when the pointer is at say 33 on the 0 to 100 scale but the meter is actually set to its 0 to 50V range. I do, anyway.

Constant Proportion

Mind you, there are cases when this principle of forming a set of ranges by multiplying by a constant factor like 3·16 (which is the square root of 10, by the way) can't be applied. A common example is the measuring oscilloscope. This has a ruled graticule over its screen and only one set of rulings can be used since two lots, superimposed, would be confusing to the eye. You are stuck with a single scale and have to use intermediate ranges which fit it. This leads to sets of ranges like 0 to 10, 0 to 20, 0 to 50, 0 to 100...... etc., where each range is roughly twice the previous one. In other words you apply the constant proportion principle as nearly as you can but compromise by sacrificing true constancy to convenience in reading.

Component Values

The same basic principle gives rise to those odd-looking component values, like:

10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82, 100, 120...etc.

It may seem more reasonable to use a range like 10, 20, 30, 40, but this gives a very poor selection of values at the low end. If you needed 15pF but all you could buy was 10 or 20pF you'd have to settle for an error of 5pF, which is 33 percent. The 10, 12, 15, 18 series is designed so that this "selection error" is never more than about 10 per cent anywhere in the range. To ensure this, each successive value is greater than the last by the same percentage, about 20 per cent in this case.

This series is called E12 because there are 12 standard values before the same basic numbers start repeating, or in other words there are 12 values per decade. (In the series printed above, the 10 marks the start of one decade and the 100 the start of the next.) For greater choice there is also an E24 series with 24 values per decade and an E48 with 48, but E12 is by far the commonest with component stockists.

Actually the traditional E12 values given above are not quite right. My pocket calculator tells me that each value should be 1·211527659 times the previous one. Using this figure and rounding off the answers gives the series:

10, 12·1, 14·7, 17·8, 21·5, 26·1, 31·6, 46·4, 56·2, 68·8, 82·5......

While most of these correspond with traditional E12 when taken to two significant figures there are a few in the middle which don't. Thus the traditional 33 should really be 32 which is nearer to 31·6. (Yes, it's the magic number 31·6 again!) Similarly the traditional 27 should be 26 and 39 should be 38. I don't know why the traditional values are wrong. Perhaps some knowledgeable reader will tell me. But the errors are too small to have much effect on the usefulness of the series. The maximum selection error is still only a shade over 11 per cent (and occurs when what you need is 24·5 and what you have to settle for is 22 or 27).

WORKSHOP MATTERS

By Harry T. Kitchen

Receiver Sensitivity

Last month we looked, rather briefly, at dummy aerials and the necessity of using cables of the correct impedance. I mentioned the importance of e.m.f. and p.d. and it is important to have a good understanding of all these factors if one is going to be involved in precision measurement as opposed to simply connecting an oscillator or signal generator (sig-gen) to the receiver and hoping for the best.

For measuring the sensitivity of receivers it is essential that the sig-gen—forget the simple oscillators—shall deliver an accurately calibrated output voltage, the source impedance of which should match the source impedance of the aerial with which the receiver is normally used, though this is normally the same as the imput impedance of the receiver.

At the frequencies that most of us are likely to be involved in, receivers are regarded as voltage sensitive, and their sensitivities are generally specified in appropriate terms; for a given a.f. output (in milliwatts) the receiver sensitivity in microvolts is quoted. But Europe, including the UK, differs from the USA.

European practice is to state the sensitivity in terms of source e.m.f. available via the specified source impedance. The receiver impedance, and hence the p.d. developed across it, is generally unknown. In the USA it is customary for the p.d. to be developed across a matched load to be quoted. In essence the two methods are the same provided they are suitably qualified: 15μV e.m.f. or 7·5μV p.d.

EMF and PD

We can now look at e.m.f. and p.d. in some detail. Bear in mind that there is little difference apart from terminology, and that either can be used provided it is made clear which, and that the two are not mixed in any way.

The generator is usually represented as a source voltage in series with its own internal resistance; the pictorial method is to show the source as a circle containing a sine wave symbol, in series with a resistance, the whole being contained within a rectangle. Two leads, sometimes with arrows to show direction of current, connect to the receiver's input impedance, represented by a resistance, sometimes labelled as R_i.

If the attenuator is calibrated in terms of e.m.f., as most are, it means that the source resistance appears in series with the e.m.f. and must be allowed for whilst measurements are made. If a matched receiver input resistance is involved, what happens? We have, in effect, two series resistances with the output taken from their junction, and therefore only half the e.m.f. will appear across R_i, giving us the example quoted earlier, i.e. 15μV e.m.f. or 7·5μV p.d.

If R_i is very much higher, say is infinite, then no voltage will be "lost" across the source resistance, and e.m.f. will equal p.d. If R_i is very low, most of the voltage will be "lost" across the source resistance and e.m.f. will greatly exceed p.d. Hence, the necessity of keeping the two units separate.

Source Impedance

The source impedance of generators is specified, and with the required accessories is typically 50 or 75 ohms, and is single ended, with one side connected to earth. If a floating output is required, with neither end connected to earth, but with a centre tap that is, then the output impedance is commonly 300 ohms. Load resistances, or impedances to be precise, of 50 ohms, 75 ohms and 300 ohms will result in the p.d. being half the e.m.f.

However, the input impedance of a receiver is not precise, nor is it fixed, but varies with frequency. When measuring receiver sensitivity at widely differing frequencies it is quite possible to obtain erroneous results if the input impedance is not compensated for. This is commonly achieved by a "dummy" aerial interposed between the generator and the receiver and is fairly effective from 150kHz to around 30MHz.

Another common source of error is to use connecting cables of varying impedance to connect generator to receiver. What happens is that voltage standing waves are set up and, in very simple terms, we get sum and difference effects, so that at times the standing wave aids the signal and at others it tends to cancel it.

In short, you disregard generator source impedance, receiver input impedance, and cable impedance at your perill

Generator Efficiency

The generator efficiency is not constant but decreases with increasing frequency. Some method is essential for feeding the attenuator with a constant signal. This is frequently achieved by varying the oscillator supply voltage; increasing it causes the oscillator to oscillate more vigourously and so compensate for the increase in frequency.

This setting up of output voltage is most commonly effected by monitoring it with a thermocouple type meter. A thermocouple is substantially unaffected by frequency being a heat operated device, and the meter carries little more than a pre-set mark to which the pointer is adjusted by the "Set R.F." control.

Essentially very simple and reliable, the system has just one drawback: if the output terminals are short-circuited together, at maximum output on the attenuator, the thermocouple can be destroyed by the excess current that is caused to flow. Most high quality generators are inhibited such that maximum output can only be selected after a special catch has been disengaged.

Variable Modulation

Variable depth of modulation is essential for checking detector distortion in receivers. The oscillator can be directly modulated, but it is preferable for an intermediate, or buffer, stage to be modulated, as this reduces the amount of f.m. in the signal. The a.f. oscillator will work at 400Hz or 1kHz, but should be capable of being disconnected from the circuit so that a plain unmodulated, or c.w. (continuous wave) signal is possible.

External modulation should be possible as this extends greatly the usefulness of the instrument. The depth of modulation can be only properly checked on an oscilloscope and is outside our terms of reference; we must, perforce rely on the manufacturer if we lack a 'scope.

Conclusions

There is rather more to sig-gens than meets the casual enquirer, and it has been possible to do no more than arouse the potential user's interest, and caution, in the belief that this will encourage him to carry out further, more detailed, research.

Returning, briefly, to e.m.f. and p.d., it should have been mentioned earlier that some very high quality a.f. generators are also so calibrated, and therefore the loads applied should be considered very carefully before relying on in-built attenuators and output meters.

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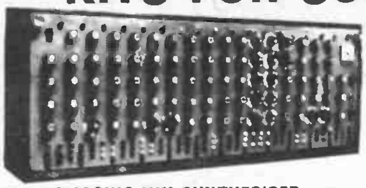

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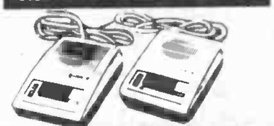

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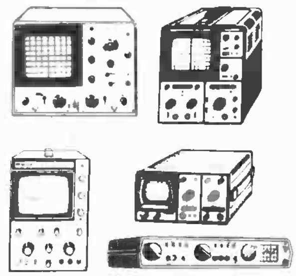

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Hm 307-3 10mHZ, 5mV, 6 × 7cm display plus component Test	£170·00
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CS1572 30mHZ, 5mV, 5" display plus Video Delay	£472·65
CS1830 30mHZ, 2mV, 5" display plus Sweep Delay	£507·15
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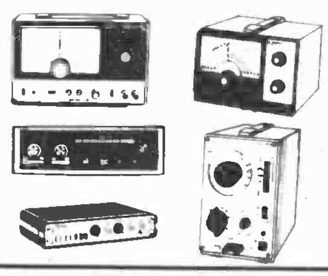

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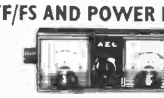

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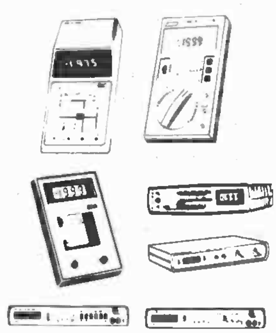

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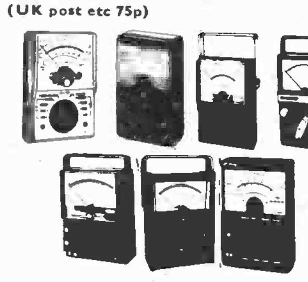

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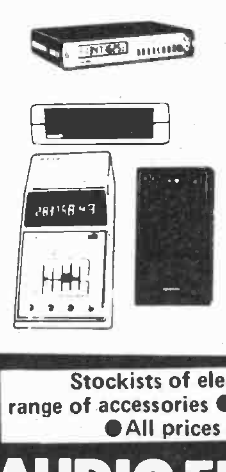

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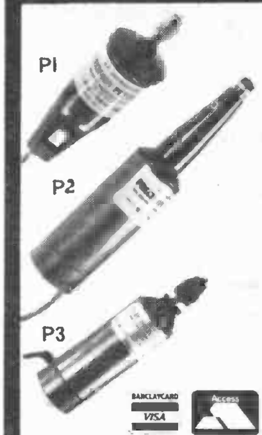

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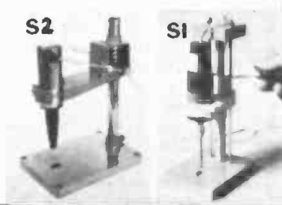

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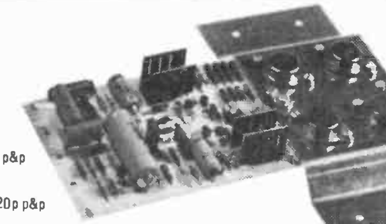
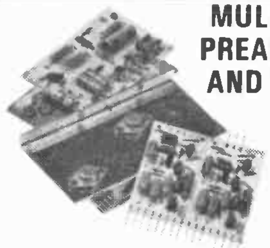


AS FEATURED IN PRACTICAL ELECTRONICS OCTOBER ISSUE

DIY STEREO BARGAIN PACKS FEATURING FAMOUS BUILT MULLARD PREAMP MODULES



MULLARD STEREO PREAMP MODULES AND TWO 12 WATT POWER AMP KITS.

In easy to build form P.C.B.s backprinted, etched and drilled ready to use.

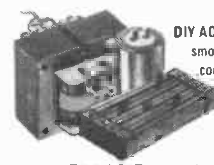
BUILD A 12 WATTS PER CHANNEL STEREO AMPLIFIER £6.00

ACCESSORIES AND L.S. KIT EXTRA *(not available separately)*

DIY PACK 1 2 x power amp kits LP1182/ preamp module, suitable for ceramic and auxiliary inputs. **£6.00** plus £1.10 p&p

DIY PACK 2 2 x power amp kits LP1184 preamp module suitable for magnetic ceramic and auxiliary inputs. **£8.50** plus £1.15 p&p

DIY SPEAKER KIT Two 8" x 5" approx. 4 ohm bass. **£3.50** plus £1.70 p&p



DIY ACCESSORIES Mains transformer smoothing capacitor rectifier 4 x slider controls, for base, treble and volume. **£3.00** plus £1.60 p&p

ACCESSORIES: Available only at time of purchase of Bargain Packs

12 + 12 WATT AMPLIFIER KIT

NOTE: for use with 4 to 8 ohms speakers.

With up-to-the-minute features. To complete you just supply screws, connecting wire and solder. Features include din input sockets for ceramic cartridge, microphone, tape or tuner. Outputs—tape, speakers and headphones. By the press of a button it transforms into a 24 watt mono disco amplifier with twin deck mixing. The kit incorporates a Mullard LP1183 pre-amp module, plus 2 power amplifier assembly kits and mains power supply. Also featured 4 slider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascia panel with matching knobs. Easy to assemble teak simulate cabinet and ready made metal work. For further information instructions are available price 50p. Free with kit.
Size 9¼" x 8¾" x 4" approx.

NOTE: for use with 4 to 8 ohms speakers.

£13.95 plus £2.55 p&p

BSR chassis record player deck with manual set down and return, complete with stereo ceramic cartridge. **£8.50** plus £2.75 p&p when purchased with amplifier available separately **£10.50** plus £2.75 p&p.

TWO WAY SPEAKER KIT. 2 Phillips 8" approx speakers **£4.75** per stereo pair plus £1.50 p&p when purchased with amplifier available separately **£6.75** plus £1.50 p&p.

ALSO AVAILABLE Stereo magnetic pre-amp conversion kit all components including P.C.B. to convert your ceramic input on the 12 + 12 amp to magnetic. **£2.00** when purchased with kit featured above. **£4.00** separately inc. p&p.

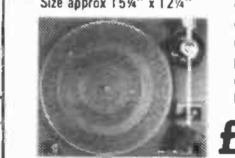
BSR Manual single play record deck with auto return and cueing lever. Fitted with stereo ceramic cartridge 2 speeds with 45 rpm spindle adaptor ideally suited for home or disco use.

£12.25 OUR PRICE plus £2.75 p&p

Size approx 13" x 11"

PHILLIPS RECORD PLAYER DECK GC037

Size approx 15¼" x 12¼"



Hi Fi record player deck, 2 speed, damped cueing, auto shut-off, belt drive with floating sub chassis to minimise acoustic feedback. Complete with GP401 stereo magnetic cartridge—*LIMITED STOCK.* **UNBEATABLE OFFER AT**

£27.50 complete plus £2.75 p&p

OFFER! SAVE MONEY by purchasing 12 + 12 amp kit, BSR record deck and speaker kit together for only **£25.50** p&p £4.50.

PRACTICAL ELECTRONICS CAR RADIO KIT £10.50

(Constructors pack 7) plus £1.75 p&p

- Easy to build • 5 push button tuning
- Modern styling design • All new unused components
- 6 watt output • Ready etched & punched P.C.B.
- Incorporates suppression circuits • Now with tape input socket

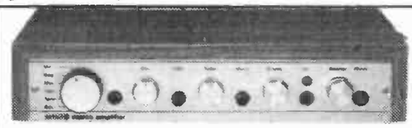
All the electronic components to build the radio, you supply only the wire and solder as featured in the Practical Electronics March issue. Features: Pre-set tuning with five push button options, black illuminated tuning scale, with matching rotary control knobs, one, combining on/off volume and tone-control, the other for manual tuning, each set on wood simulated fascia.
The P.E. Traveller has a 6 watts output, neg ground and incorporates an integrated circuit output stage, a Mullard IF module LP1181 ceramic filter type, pre-aligned and assembled and a Bird pre-aligned push button tuning unit. The radio fits easily in or under dashboards.
Complete with instructions.

CONSTRUCTORS PACK 7A

Suitable stainless steel fully retractable locking aerial and speaker (approx. 6" x 4") is available as a kit complete **£1.95** per pack. p&p £1.00
Pack 7A may only be purchased at the same time as Pack 7.

NOTE: Constructor's pack 7A sold complete with radio kit **£15.20** including p&p.

FEATURED PROJECT IN PRACTICAL ELECTRONICS.



30 + 30 WATT STEREO AMPLIFIER BUILT AND TESTED

Viscount IV unit in teak simulate cabinet silver finished rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mic magnetic and crystal pickups, tape and auxiliary. Rear panel features fuse holder. DIN speaker and input socket 30 + 30 watts. RMS 60 + 60 watts peak for use with 4 to 8 ohm speakers. Size 14¾" x 10" approx.

READY TO PLAY £32.90 plus £3.30 p&p

RTVC

323 EDGWARE ROAD, LONDON W2
21A HIGH STREET, ACTON W3 6NG

ACTON: Mail Order only, No callers
ALL PRICES INCLUDE VAT AT 15%
All items subject to availability. Price correct at 14/8/80 and subject to change without notice.
For further information send for our instruction booklet 20p plus stamped addressed envelope.

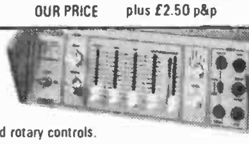
NOTE: Persons under 16 years not served without parent's authorisation.

BARGAIN OFFER!!

ARISTON PICK UP

Ariston pick-up arm manufactured in Japan. Complete with headshell. Listed price over £30.00 OUR PRICE **£11.95** plus £2.50 p&p

100 WATT MONO DISCO AMPLIFIER

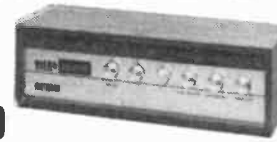


Brushed aluminiou fascia and rotary controls. Size approx 14" x 4" x 10¼. Five vertical slide controls, master volume, tape leverl, mic level, deck level. PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level controls (PRL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.

£76.00 plus £4.00 p&p

50 WATT MONO DISCO AMPLIFIER

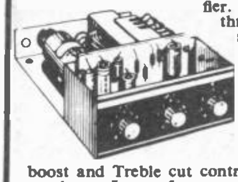
Size appox 13⅜" x 5¼" x 6¾". 50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.



£30.60 plus £3.20 p&p

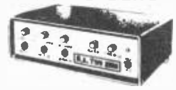
Personal Shoppers EDGWARE ROAD LONDON W2 Tel: 01-723 8432. 9.30am–5.30pm. Closed all day Thursday ACTON: Mail Order only. No callers GOODS DESPATCHED TO MAINLAND AND N. IRELAND ONLY

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz-30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £18·40, P. & P. £1·60.

HARVERSONIC MODEL P.A. TWO ZERO



An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram, etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp). Input 1, 15mV into 47k. Input 2, 15mV into 47k (suitable for use with mic. or guitar etc.). Input 3, 200mV into 1 meg. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 30 watts music power. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200-240 volts. Size approx. 12½in wide × 5in high × 7½in deep.
Special price £29·00 + £3·00 carriage and packing.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER

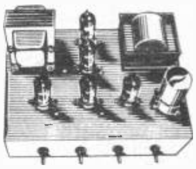
Size 11¾" × 14¼" × 1$\frac{3}{16}$" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz-20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details.
Only £8·80 each + p. & p. (one £1·20, two £1·50).

STEREO MAGNETIC PRE-AMP. Sens. 3mV in for 100mV out. 15 to 35V neg. earth. Equ. ± 1dB from 20Hz to 20KHz. Input impedance 47K. Size 1¾" × 2¾" × ¾" H. £3·20 + 22p P. & P.

MAINS OPERATED SOLID STATE AM/FM STEREO TUNER

200/240V Mains operated Solid State FM/AM Stereo Tuner. Covering M.W. A.M. 540-1605 KHz VHF/FM 88-108 MHz. Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600m/v RMS into 20K. Simulated Teak finish cabinet. Will match almost any amplifier. Size 8¼"w × 4"h × 9½"d approx.
LIMITED NUMBER ONLY at £29·00+£2·00 P. & P.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monoaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet. 50p + SAE (Free with parts). All parts sold separately. ONLY £18·40, P. & P. £2·00. Also available ready built and tested £22·50, P. & P. £2·00.

STEREO DECODER MK.II
SIZE 1½" × 2$\frac{7}{16}$" × ½" ready built. Pre-aligned and tested for 10-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions supplied. £7·00 plus 25p. P. & P. Stereo beacon light if required 40p extra.

Mullard LP1159 RF-IF module 470kHz £2·50 + P. & P. 40p. Full specification and connection details supplied.

Pye VHF FM Tuner Head covering 88-108MHz, 10·7 MHz I.F. output. 7·8V + earth. Supplied pre-aligned, with full circuit diagram with precision geared F.M. gang and 323PF + 323PF A.M. Tuning gang only £3·40 + P. & P. 60p.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £2·30 yd. length. P. & P. 70p per yd. (min. 1 yd.). S.A.E. for samples.

HARVERSONIC SUPERSOUND 10 + 10 STEREO AMPLIFIER KIT

A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integral pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modity to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response: ±3dB 12-30,000Hz Sensitivity: better than 80mV into 1M Ω: Full power bandwidth: ±3dB 12-15,000Hz. Bass boost approx. to ±12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2¾"h.
Fully detailed 8 page construction manual and parts list free with kit or send 50p plus large S.A.E.

AMPLIFIER KIT .. .. £14·95 P. & P. £1·20
(Magnetic input components 33p extra)
POWER PACK KIT .. £6·20 P. & P. £1·50
CABINET .. .. £6·20 P. & P. £1·50
SPECIAL OFFER—only £25·80 if all 3 items ordered at one time plus £2·80p p. & p.
Full after sales service
Also avail. ready built and tested £32·20, P. & P. £2·80.

HARVERSONIC STEREO 44

A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets & 5 pin din tape rec./play socket are mounted on the printed circuit panel, size approx. 9¼" × 2¾" × 1" max. depth. Supplied brand new & tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically) at only £10·40 plus 90p P. & P. Mains transformer with an output of 17v a/c at 500m/a can be supplied at £2·15 + 70p P. & P. if required. Full connection details supplied.

All prices and specifications correct at time of press and subject to alteration without notice.

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. SEND SAE WITH ALL ENQUIRIES.

HARVERSON SURPLUS CO. LTD. (Dept. E.E.) 170 MERTON HIGH ST., LONDON, S.W.19. Tel.: 01-540 3985
A few minutes from South Wimbledon Tube Station. Open 9.30-5.30 Mon. to Fri. 9.30-5 Sat. Closed Wed.

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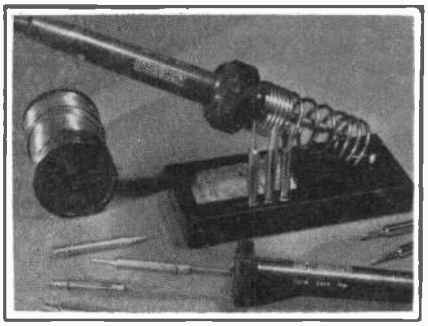
New 'L' series irons, designed to latest safety standards. Outstanding performance, lightweight and easy maintenance. New non-roll GRP safety handles. Ceramic and mica insulated elements enclosed in stainless steel shafts.

Fully earthed with screw connected 3-core leads. Interchangeable, non-seize copper bits.

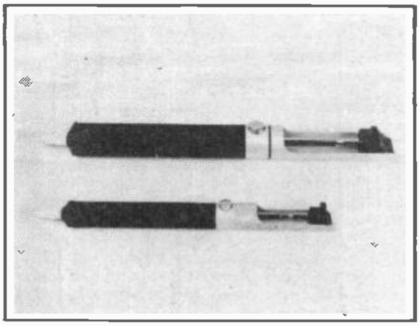


MODEL LC18 18 watts
Lightweight, high-performance iron for all soldering from calculators to T.V. sets. Fitted with 3.2 mm copper bit and complete with spare bits 1.6 , 2.4 and 4.7 mm. £6.31 including p&p and VAT. 240 volts standard but also available 12 and 14 volts. Iron only £4.66 including P&P and VAT.

MODEL LA12 12 watts
Similar to LC18 but with extra slim shaft and bits for fine work. Fitted with 2.4mm copper bit and complete with spare bits 1.2 mm and 3.2mm. £5.58 including p&p and VAT. 240 volts standard also available 6, 12 and 24 volts. Iron only £4.61 including P&P and VAT.

No. 3 SAFETY SPRING STAND for LC18 & LA12
Complete with sponge and location for spare bits £4.41 including P&P and VAT.

LOLA DE-SOLDERING PUMPS
Removes solder from pcb joints quickly, with no fuss. Simple one-handed operation leaves other hand free to hold soldering iron heat source. Needs no external power. Has replaceable PTFE nozzle. Thousands in daily use in major manufacturing companies. Two sizes to choose from.



Lola A 215 mm long x 20 mm dia. £6.89 (including VAT, P&P)
Lola D 165 mm long x 14 mm dia. £5.03 (including VAT, P&P)

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Also our micro chips are at micro prices. Don't be fooled by low prices. We do not offer for sale sub-spec or rebranded devices. All our parts are guaranteed new, first quality, factory prime, full spec devices. It is also our policy to offer you the best of new devices that become available and these are featured regularly. Prices are exclusive of p&p and VAT – please refer to "Ordering Information" before ordering. Official orders from Schools, Colleges, Universities and Gov. Authorities accepted.

DTL

930	55p
935	65p
937	55p
944	65p
946	55p
947	55p
962	55p
9099	90p

7400

7400	11p
7401	12p
7402	12p
7403	13p
7404	17p
7409	18p
7410	16p
7412	18p
7513	28p
7420	16p
7430	18p
7432	25p
7440	16p
7442	68p
7448	75p
7473	32p
7474	32p
7475	40p
7476	40p
7490	35p
7492	50p
7493	50p
7496	45p
74121	35p
74123	45p
74154	90p
74157	55p
74122	45p
74125	50p
74195	100p
74196	100p
74283	140p
74290	120p
74365	90p
74365	90p

74LS

74LS00	18p
74LS01	12p
74LS04	15p
74LS08	20p
74LS10	19p
74LS11	30p
74LS12	30p
74LS14	60p
74LS15	38p
74LS20	19p
74LS30	19p
74LS32	25p
74LS40	26p
74LS42	56p
74LS47	78p
74LS48	85p
74LS49	99p
74LS73	30p
74LS74	30p
74LS75	39p
74LS86	39p
74LS90	40p
74LS107	40p
74LS123	69p
74LS125	50p
74LS132	79p
74LS138	69p
74LS151	75p
74LS153	75p
74LS155	65p
74LS161	78p
74LS163	90p
74LS164	90p
74LS168	190p
74LS174	99p
74LS175	99p
74LS195	87p
74LS221	110p
74LS244	175p
74LS245	325p
74LS251	120p
74LS257	110p
74LS290	95p
74LS293	120p
74LS366	57p
74LS373	170p
74LS374	170p
74LS375	140p
74LS377	188p
74LS393	135p
74LS490	140p
74LS670	260p

CMOS

4001	19p
4002	19p
4006	75p
4007	19p
4008	80p
4009	35p
4010	45p
4011	24p
4012	24p
4013	38p
4014	70p
4015	75p
4016	35p
4017	75p
4018	76p
4019	42p
4020	88p
4021	100p
4022	88p
4023	22p
4024	50p
4025	20p
4026	130p
4027	45p
4028	75p
4029	80p
4030	50p
4031	195p
4033	145p
4035	104p
4036	290p
4037	105p
4038	110p
4039	290p
4040	99p
4041	75p
4042	73p
4043	86p
4044	88p
4045	160p
4047	99p
4048	56p
4049	38p
4050	40p
4051	69p
4052	75p
4053	73p
4054	111p
4055	121p
4056	121p
4059	560p
4060	112p
4063	112p
4066	56p
4067	422p
4068	19p
4069	19p
4070	28p
4071	25p
4072	25p
4075	20p
4076	88p
4077	23p
4078	29p
4081	23p
4082	25p
4085	86p
4086	68p
4089	130p
4093	68p
4094	225p
4095	99p
4096	325p
4098	110p
4099	180p
4501	25p
4502	112p
4503	68p
4507	52p
4508	288p
4510	76p
4511	125p
4512	75p
4514	250p
4515	290p
4516	109p
4518	99p
4520	99p
4521	230p
4526	105p
4527	130p
4528	99p
4529	140p
4531	150p
4532	125p
4538	150p
4543	160p
4556	70p
4560	225p
4569	240p
4572	46p
4584	79p
4585	125p

MEMORIES

2114 300 NS	275p
4116 200 NS	300p
4116 150 NS	395p
4315 (4k x 1) CMOS RAM 450 NS	995p
6514 (1k x 4) CMOS RAM 450 NS	795p

EPROMS

1702A	450p
2708 450 NS	425p
2716 5V 450 NS	995p
2532 32K 450 NS	2995p

UARTS

AY-5-1013A	325p
AY-3-1015D	398p
IM6402 IPL	425p

CHARACTER GENERATOR

RO-3-2513 UC	450p

KEYBOARD ENCODER

AY-5-2376	795p

FLOPPY DISK CONTROLLERS

FD1771 B-01 S/D Inverted Bus	2995p
FD1791 B-01 D/D Inverted Bus	4995p
FD1792 B-01 S/D Inverted Bus	3495p
FD1793 B-01 D/D True Bus	5495p
FD1794 B-01 S/D True Bus	3495p
FD1795 B D/D Inverted Bus, side select	5995p
FD1797 B D/D True Bus, side select	5995p

SUPPORT DEVICES

6520	495p
6522	795p
6532	895p
6551	1095p
6810	375p
6820	425p
6821	425p
6850	425p
6852	425p
8212	395p
8214	450p
8216	395p
8224	395p
8228	395p
8251	495p
8253	1125p
8255	495p
8257	1050p
8259	1325p
MC 144 12VL	797p
Z80 P10	595p
Z80 CTC	595p
Z80A P10	695p
Z80A CTC	695p
Z80 DMA	1995p
Z80A DMA	2495p
Z80 S10/1	2995p
Z80A S10/0	3495p
Z80 S10/1	2995p
Z80A S10/1	3495p
Z80 S10/2	2995p
Z80A S10/2	3495p

CPU'S

6502	795p
6504	795p
6505	795p
6800	695p
6802	995p
8080A	525p
8085A	1095p
Z80	795p
Z80A	995p
Z8001	12500p
Z8002	9500p
WD90008	19900p

VOLTAGE REGULATORS

7805/7812	55p
7905/7912	65p
78H05SC	575p
78HGKC	625p

BIPOLAR PROMS

93448 512 x 8 40 NS	p.o.a.
93453 1k x 4 40 NS	p.o.a.
93451 1k x 8 40 NS	p.o.a.
93511 2k x 8 50 NS	p.o.a.

LINEAR IC's

AY-3-1350	795p
AY-3-8910	825p
709	30p
723	33p
741	18p
ICL7106	595p
ICL7107	695p
ICL8038	295p
ICM7216A	1875p
ICM72168	1675p
ICM7555	80p
LM301AM	30p
LM311	50p
LM318	75p
LM324	45p
LM339	45p
LM380	65p
LM1496	65p
LM1871	550p
LM1872	550p
LM3900	50p
LM3914	225p
LM3915	225p
LM13600	125p
NE555	18p
NE556	50p
RC4136	85p
SN76477N	175p
TBA810DAS	85p
TL071	55p
TL074	130p
TL082	75p
TL084	110p
TL490	175p
XR2206	325p
XR2207	375p

INTERFACE LINEAR

MC1488	90p
MC1489	90p
DM8123	125p
75150	125p
75154	125p
75182	195p
75322	250p
75324	325p
75325	325p
75361	350p
75365	295p
75451	50p
75491/2	75p
8T26	175p
8T28	175p
8T95	175p
8T97	175p

LEDs

TIL209	9p
TIL211	13p
TIL212	15p
TIL220	12p
TIL222	15p
TIL224	18p

DISPLAYS

FND500	80p
FND510	80p
FND567	125p
DL704	85p
DL707	85p
MV57164	225p

DIL SWITCHES

4 pole	99p
6 pole	115p
8 pole	140p
10 pole	175p

ISOLATORS

ILD74	120p
ILQ74	325p
MCT6	90p
TIL111	75p

LOW PROFILE SOCKETS BY TEXAS SALE

8 pin	7p	18 pin	15p	24 pin	22p
14 pin	9p	20 pin	18p	28 pin	25p
16 pin	10p	22 pin	22p	40 pin	28p

NEW

SPECIAL OFFER!

4K CMOS RAM (1K x 4) 450 NS
ONLY £7.95! (8 for £50)

The TC 5514P from Toshiba, CMOS equivalent of the 2114!

- Low Power Dissipation
  - 10pW/BIT (TYP.) @ 3·0V (STANDBY)
  - 10uW/BIT (TYP.) @ 5·0V (OPERATING)
- Data Retention Voltage 2V to 5·5V
- Single 5V Power Supply
- 18 PIN Plastic Package
- Full Static Operation
- Three State Output
- Input/Output TTL Compatible
- Fast Access Time 450NS.

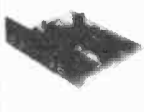
Toshiba's TC5514P (industry type 6514) is a full static read write memory organised as 1024 words by 4 bits using CMOS technology. Ultra low power dissipation means it can be used as battery-operated portable memory system and also as a non-volatile memory with battery back-up. Operates from a single 5V power supply with static operation, hence no refresh periods and a much simplified power supply circuit design. Three state outputs simplify memory expansion for minimum data retention voltage is 2V, the battery back-up system needs only simple circuit. Toshiba's original C^2MOS technology also means wide operating and noise margins. The TC 5514P is moulded in a dual-in-line 18 pin plastic package 0·3 inch in width.

NEW

X-RATED CLOCK!

ZULU II CLOCK KIT
WITH CALENDAR AND NOXtm CIRCUIT

ONLY **£19.99**
Custom high impact moulded case with ruby lens £4.99
P&P 82p + VAT



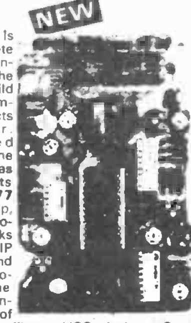
X-TRA VALUE: All the components and high quality plated G-10 PC Boards are provided.
X-TRA CARE IN DESIGN: No wires between readout board and clock board. Large open layout.
X-CELLENCE IN IDEAS: 5 years of designed products for the amateur radio market.
X-CELLENCE IN INSTRUCTIONS: Clear step-by-step instructions with quality illustrations. The assembly manual is not a read-between-the-lines afterthought!
X-TRA FEATURES: There has never been a clock kit with so many features – at any price!

- Unit operates on either 12VAC or 12VDC.
- On board QUARTZ XTAL TIMEBASE.
- Automatic BATTERY BACKUP. Never worry about power failures again!
- Reads true 24 HOUR TIME and 31 DAY CALENDAR.
- Unique NOXtm CIRCUIT activates readouts with a handclap or they can be turned on constantly.
- When used mobile readouts blank ignition is off.
- Special NOISE SUPPRESSION and battery reversal circuits.
- Bright ½" LEDs show hours, minutes and seconds.

Just clap your hands and the time appears for 5 seconds followed by the date for 4 seconds. A low cost 9V transistor battery provides stand-by power in the event of power failures up to 4 hours. With the addition of a low cost 12V 300MA transformer, the unit will work on AC.

SE 01 Sound Effects Kit

NEW



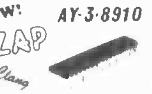
The SE-01 is a complete kit that contains all the parts to build a programmable effects generator. Designed around the new **Texas Instruments SN 76477** Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noices, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator and Multiplex Oscillator for even more versatility. The 3½" x 3" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate **Explosion, Phaser Guns, Steam Trains,** or almost an infinite number of other sounds. The unit has a multiple of applications. The low price includes all arts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100MV amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included.)

COMPLETE KIT ONLY £14.99
P&P 67p + VAT

UNIVERSAL SCR

C106D 400V/5A Sale	30p

NEW! AY-3-8910 ZAP Clang Bang Tweet



THE NEW GI COMPUTER SOUND CHIP

The amazing AY-3-8910 is a fantastically powerful sound and music generator, perfect for use with any 8-bit micro processor. Contains 3 tone channels, noise generator, 3 channels of amplitude controls, 16-bit envelope period control, 2 parallel I/O, 3D/A converters plus much more. All in 40 pin DIP. Super easy to interface to the S-100 or other Busses.

ONLY £8.50 + VAT, including FREE reprint of BYTE '79 article! Also, add £2.25 for 60-page data manual.

"Perhaps the next famous composer will not direct a 150-piece orchestra but, rather, a trio of microcomputers controlling a bank of AY-3-8910s." BYTE July '79.

ULTRASONIC SENDER RECEIVER KIT

TOTAL SECURITY! **Completely invisible** ultrasonic (23KHZ). Sound beam works like a photo-electric beam but is unaffected by light, heat or noise. Separate Transmitter and Receiver can be used from 6 inches to 25 feet! A solid object breaking the beam causes an output to go low that will sink up to 150MA to Drive a Relay, TRIAC etc. Complete electronics are provided. Works on 12VDC (unregulated) and draws less than 100MA. Use it for **burglar alarms, object counters, automatic door openers, automatic door bells, electronic rat trap (?) and more.**

ONLY £19.93 P&P 67p + VAT.

NEW

WARBLE ALARM KIT

A fun EASY kit to assemble that emits an ear piercing 10 watt dual tone scream. Resembles European siren sound. Great for alarms or toys. Operates from 5-12VDC and up to 1 amp (using 12VDC 8 ohm speaker). Over five thousand have been sold. All parts including PC board, less speaker.

ONLY **£4.99** P&P 67p + VAT.

PROGRAMMABLE DUAL OP TRANSCONDUCTANCE AMPLIFIER

NEW

New from National Semiconductor, the LM 13600 is programmable dual operation transconductance amplifier designed to be used as a fundamental building block in current controlled amplifiers, filters and oscillators. It can also be used in multiplexers, timers and even sample and hold circuits. It is well suited for use in electronic organs and music synthesizers, because it can modulate waveshapes with ease. The 16 pin LM 13600 is programmable over six decades, allowing it to function as a basic building block in a broad range of electronically programmable resistors and filters. A truly remarkable circuit.

ONLY **£1.25** + VAT. Data **25p.**

LM1871 RC ENCODER/TRANSMITTER
LM 1872 RC RECEIVER/DECODER

New from National. The LM 1871 is a complete sixchannel digital proportional encoder and RF transmitter intended for use as a low power, non-voice unlicenced communication device at carrier frequencies of 27MHz with a field strength of 10,000 uV/meter at 3 meters. In addition to radio controlled hobby toy and industrial applications, the encoder section can provide a serial input of six words for hard wired, infra-red or fibre optic communications links. Channel add logic is provided to control the number of encoded channels from three to six, allowing increased design flexibility. When used with the LM 1872 RC receiver/decoder, a low cost RF linked encoder and decoder system provides two analog and two ON/OFF decoded channels. Super versatile chip. Just out. Just look at the features – low current 9V battery operation – on-chip RF oscillator/transmitter – one timing capacitor for six proportional channels – programmable number of channels – regulated RF output power – external modulator bandwidth control – on-chip 4·6V regulator – up to 80MHz carrier frequency operation.

LM 1871 **£5.50** LM **1872 £5.50** Pair **£10.50**
Data sheets **25p each.**

3½-DIGIT LIQUID CRYSTAL DISPLAY with 'low bat' indicator.

- High Contrast Ratio
- Wide Viewing Angle
- 0·5in Digit Height
- ULTRA low Power Consumption LCD 106

1.8:8.8 **£6.45**

LED BAR GRAPH AND ANALOG METER DRIVER

New from National LM3914. Drives 10 LED directly for making bar graphs, audio power meters, analog meters, LED Oscillators, etc. Units can be stacked for more LEDs. A super versatile and truly remarkable IC.

Special price.	**Only £2.25**
12 page data	**25p**
Matching red bar display MV57164	**£2.25**
Data	**25p**

THE NEW ULN-2232A INTEGRATED MOTION DETECTOR
The most SOPHISTICATED MOTION DETECTOR available!

- Long Range Operation
- 100mW Audio Output
- Visible or Infra-red Response
- 14-pin Dual In-line Clear Plastic Package
- Automatic Timed Reset
- 120Hz Rejection
- Two Sound Patterns.

Combining I^2L and Bipolar circuitry, the ULN-2232 A Motion Detector is a complex optolinear IC which includes an on-chip photodiode, high-gain logarithmic and linear amps, extensive digital circuitry for sound generation and timing, and high current output drivers. Add on five small capacitors, a speaker and power source and you turn this state-of-the-art device into a complete Motion Detector sensitive to small changes in light level as a function of time. DETAILED DEVICE DESCRIPTION AND APPLICATIONS INFORMATION INCLUDED WITH EVERY ULN-2232A. ONLY £7.60!!

THE INCREDIBLE NEW MUSIC MACHINE KIT!

ONLY £9.95 plus 65p p&p, and VAT As featured in BYTE, July '79

Based on the new GI Tunes Synthesiser chip AY-3-1350, with 25 different popular and classical tunes PLUS 3 different chimes! Use it for musical door bell (up to 4 doors!), mobile horn, boy or music box. Super easy to build, tunes include STAR WARS, BEETHOVEN'S 5TH and 9TH, JINGLE BELLS, YANKEE DOODLE, CLEMENTINE, GOD SAVE THE QUEEN, WESTMINSTER CHIME and DESCENDING OCTAVE CHIMES – plus MANY, MANY MORE! Envelope control gives piano or organ quality AND you can play all the tunes in Sequence! Works from 12V AC or DC or from Mains via 240V transformer (not supplied).

Ordering information. Unless otherwise stated, for orders under £50 add 50p p&p. Add 15% VAT to total. All devices are brand new, factory prime and full spec and subject to prior sale and availability. Prices subject to change without notice. Minimum telephone order using ACCESS is £10. If ordering by post with ACCESS, include name, address and card no. written clearly.

The XR2266 Decoder/Sense & Drive Chip for toys cars that DRIVE LIKE REAL!
ONLY **£5.45!**

NEW!

This versatile 18-pin dual in-line IC combines both the decoder and the sense and drive functions to cut remote control circuitry by at least a factor of two! Steering, lights, indicators, speed control – all from the new XR2266 at only **£5.45!**

MC Micro Circuits

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North Devon EX39 1RY.
Tel: Bideford (02372) 79507
Telex: 8953084

MUSICAL MICRO 24 TUNE DOOR BELL

BUILD THE WORLD FAMOUS

CHROMA-CHIME

Give your friends a warm welcome. Yes, think how delighted and amazed they will be to hear the musical Chroma-Chime play when they press your button!

The Chroma-Chime uses a microcomputer to play 24 well-known tunes. The kit is simplicity itself for ease of construction. Absolutely everything needed is supplied, including:

★ Resistors, Capacitors, Diodes, Transistors, I.C. Socket and all hardware

★ Texas Instruments TMS 1000 microcomputer

★ Comprehensive kit manual with full circuit details

★ Ready drilled and legended PCB included

ONLY £11.95 + 75p p&p UK ONLY

Plays 24 well-known tunes including:

Star Spangled Banner, William Tell Overture, Greensleeves, Rule Britannia, Colonel Bogey, Oh come all ye faithful, plus many other popular tunes.

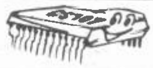
★ No previous microcomputer experience necessary

★ All programming retained is on chip ROM

★ Fully guaranteed

★ **Ideal present any time**

TMS 1000N



–MP0027A Micro-computer chip available separately if required. Full 24 tune spec device fully guaranteed.

This unique chip can be used not only for electronic door chimes but for other projects requiring musical output

Car Horns Musical Boxes Alarms
Amusement Machines Public Address etc

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Z4 100 mixed electrolytics £2·20
Z5 100 mixed polystyrene caps £2·20
Z6 300 mixed printed circuit components £1·50
Z7 300 mixed printed circuit resistors £1
Z8 100 mixed high wattage resistors, wire-wound etc. £2·20
Z9 100 mixed miniature ceramic and plate caps £1·20
Z10 25 assorted pots. £1·50
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Z16 20 1N4148 £1
Z17 20 1N4003/10D2 £1
Z18 20 assorted zeners, 1 watt and 400mw £1·50
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ULTRASONIC TRANSDUCERS. transmitter and receiver. 40KHz. 14mm diam, £3·95 pair

TBA 800 Audio I.C. £1 ea. 3 for £2·50.

BD181 (78W, 15A, TO3) 3 to £1.

12V 1·3W ZENERS 10 for £1

Plastic **BC108's,** 12 for £1

BC154 12 for £1, **BC183L** 12 for £1

200μA Miniature level/batt. meters, as fitted to many cassette recorders. 90p

Deluxe FIBREGLASS printed circuit etching kits.

Includes 100 sq ins. of copperclad F/G board. 1lb ferric chloride, (made for U.S. army to MIL, SPEC.), 1 dalo etch resist pen, abrasive cleaner, etch resist dish and instructions. **OUR PRICE £4·95**

1lb of FeCl. £1·25. 5lb. £5.
150 sq. ins. single sided board. £2·20
150 sq. ins. double sided board. £3·30
Dalo pen. £1

UHF, Transistors T.V. TUNER with slow motion drive, AE.skt. and leads £1·95

100 Miniature reed switches. £3·30

P/B SWITCH BANKS

These cost a fortune! Were made for various music centres. Includes independent and interdependent latching types multi pole c/o etc. Can be modified. Can't be repeated. **3 Banks for £1.**

KNOBS for Switch Banks 10 for £1. Chrome or spun aluminium finish.

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Top quality. Split bobbin construction will give 4·5V-0-4·5V at 250MA. 1¾" × 1½" × 1½", all sorts of uses. **ONLY 90p** 3 for £2·20.

1000 μf, 100V, Radial, 1½" × 2". **ONLY** 70p. 3 for £1·50. 2,200μf 40v. 60p, 3 for £1·50. 4,700μf 40v. 80p. 3 for £2.

Don't Let Your Environment Dehydrate You!

Buy our Honeywell **Humidity Controller.** Membrane actuated, very sensitive, ¼" shaft, 250V, 3·75A Contacts. Ideal for greenhouses, centrally heated homes. offices etc. Build your own humidifiers or alarms. Fraction of original cost 90p ea. 3 for £2.

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Make lovely 60 amp bridges. Ideal for **High Power Battery Chargers.** Type 4AFI. **Set of 4** (2 neg. case + 2 pos. case) £2.

Special Purchase enables us to offer **Mullard C280 Polyester Capacitors** (Liquorice Allsorts) at the unbeatable price of **£2 for 100 mixed. £15 for 1000.** These consist of factory clearance lots i.e. spillages, floor sweepings, cosmetic rejects etc. Also **Mullard miniature electrolytics 100 mixed £1·50. 1000 for £10. Pack of each £3. 1000 of each £30.**

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AC176	£0·21	BC171	£0·10	BD132	£0·40	MPSA06	£0·23	2N2147	£0·86
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AD142	£0·98	BC208	£0·13	BD203	£0·92	OC71	£0·17	2N2905A	£0·23
AD143	£0·86	BC209	£0·14	BD204	£0·92	TIC44	£0·33	2N2906	£0·19
AD149	£0·69	BC212	£0·10	BDY20	£0·92	TIC45	£0·40	2N2906A	£0·21
AD161	£0·40	BC212L	£0·10	BF457	£0·43	TIP29A	£0·46	2N2907	£0·23
AD162	£0·40	BC213	£0·10	BF458	£0·43	TIP29B	£0·48	2N2907A	£0·25
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AF186	£0·58	BC301	£0·32	BFX29	£0·25	TIP32A	£0·46	2N3055	£0·46
AF239	£0·44	BC302	£0·33	BFX30	£0·35	TIP32B	£0·48	2N3614	£1·15
AL102	£1·38	BC303	£0·32	BFX84	£0·25	TIP32C	£0·51	2N3615	£1·21
AL103	£1·36	BC304	£0·44	BFX85	£0·28	TIP41A	£0·51	2N3616	£1·21
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AU110	£1·61	BC328	£0·17	BFX87	£0·25	TIP41C	£0·55	2N3702	£0·09
AU113	£1·61	BC337	£0·17	BFX88	£0·25	TIP42A	£0·51	2N3703	£0·09
BC107	£0·09	BC338	£0·17	BFY50	£0·20	TIP42B	£0·53	2N3704	£0·08
BC107B	£0·10	BC440	£0·35	BFY51	£0·20	TIP42C	£0·55	2N3705	£0·08
BC107C	£0·12	BC441	£0·35	BFY52	£0·20	TIP2955	£0·69	2N3706	£0·09
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BC108B	£0·10	BC477	£0·23	BIP19		UT46	£0·23	2N3709	£0·08
BC108C	£0·12	BC478	£0·23	20MP	£0·92			2N3710	£0·08
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BC109B	£0·10	BC547	£0·12	BU103	£1·84			2N3819	£0·21
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7402	£0·13	7430	£0·13	7475	£0·33	74118	£0·92	74174	£0·75
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7404	£0·13	7433	£0·35	7480	£0·51	74121	£0·28	74176	£0·67
7405	£0·13	7437	£0·24	7481	£0·98	74122	£0·45	74177	£0·67
7406	£0·25	7438	£0·24	7482	£0·78	74123	£0·46	74180	£1·73
7407	£0·25	7440	£0·14	7483	£0·67	74136	£0·60	74181	£0·67
7408	£0·15	7441	£0·53	7484	£1·01	74141	£0·63	74182	£0·81
7409	£0·15	7442	£0·46	7485	£0·78	74145	£0·63	74184	£0·81
7410	£0·13	7443	£0·81	7486	£0·25	74150	£0·78	74190	£0·78
7411	£0·20	7444	£0·81	7489	£1·96	74151	£0·55	74191	£0·71
7412	£0·17	7445	£0·75	7490	£0·37	74153	£0·55	74192	£0·69
7413	£0·28	7446	£0·69	7491	£0·74	74154	£0·94	74193	£0·67
7414	£0·58	7447	£0·55	7492	£0·40	74155	£0·58	74194	£0·71
7416	£0·26	7448	£0·64	7493	£0·35	74156	£0·58	74195	£0·69
7417	£0·26	7450	£0·13	7494	£0·86	74157	£0·58	74196	£1·21
7420	£0·13	7451	£0·13	7495	£0·58	74160	£0·67	74197	£1·21
7421	£0·23	7453	£0·13	7496	£0·58	74161	£0·71	74198	£2·13
7422	£0·18	7454	£0·13	74100	£0·98	74162	£0·71	74199	£2·13
7423	£0·24	7460	£0·13	74104	£0·45	74163	£0·71		
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CD4002	£0·18	CD4015	£0·94	CD4024	£0·75	CD4037	£1·09	CD4049	£0·55
CD4006	£1·06	CD4016	£0·49	CD4025	£0·22	CD4040	£1·01	CD4050	£0·55
CD4007	£0·20	CD1017	£0·94	CD4026	£1·55	CD4041	£0·87	CD4054	£1·27
CD4008	£1·06	CD4018	£0·98	CD4027	£0·58	CD4042	£0·83	CD4014	£0·92
CD4009	£0·52	CD4019	£0·48	CD4028	£0·78	CD4043	£1·01	CD4055	£1·15
CD4010	£0·55	CD4020	£1·04	CD4029	£0·98	CD4044	£0·94	CD4056	£1·55
CD4011	£0·22	CD4021	£0·94	CD4030	£0·55	CD4045	£1·61	CD4069	£0·20

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Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
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CA3014	£1·55	CA3140	£0·81	NE556	£0·69	UA747C	£0·69	TAD100	£1·50
CA3018	£0·75	LM301	£0·33	NE565	£1·38	72747	£0·69	TBA540	£2·42
CA3020	£1·96	LM304	£1·84	NE556	£1·73	UA748	£0·40	TBA810S	£0·86
CA3028	£0·92	LM308	£1·15	NE567	£1·96	748P	£0·40	TBA810	£1·13
CA3035	£1·61	LM309	£1·73	UA702C	£0·53	SN76013N	£2·01	TBA820	£0·81
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200	THY1A/200	£0·37
400	THY1A/400	£0·44
600	THY1A/600	£0·52
800	THY1A/800	£0·67
50	THY3A/50	£0·32
100	THY3A/100	£0·35
200	THY3A/400	£0·37
400	THY3A/400	£0·48
600	THY3A/800	£0·58
800	THY3A/800	£0·75
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100	THY7A/100	£0·58
200	THY7A/200	£0·65
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600	THY7A/600	£0·89
800	THY7A/800	£0·05
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100	THY10A/100	£0·65
200	THY10A/200	£0·71
400	THY10A/400	£0·80
600	THY10A/600	£1·13
800	THY10A/800	£1·40
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100	THY16A/100	£0·66
200	THY16A/200	£0·71
400	THY16A/400	£0·88
600	THY16A/600	£1·03
800	THY16A/800	£1·59
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IS924 300v	£0·11	IS10/600 600v	£0·48
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IN4003 200v	£0·07	**30 Amp**	
IN4004 400v	£0·08	IS30/50 50v	£0·64
IN4005 600v	£0·09	IS30/100 100v	£0·79
IN4006 800v	£0·10	IS30/200 200v	£1·06
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1·5 Amp		IS30/600 600v	£2·02
IS015 50v	£0·10	IS30/800 800v	£2·23
IS020 100v	£0·11	IS30/1000 1000v	£2·65
IS021 200v	£0·12	IS30/1200 1200v	£3·31
IS023 400v	£0·14	**60 Amp**	
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IS027 800v	£0·18	IS70/100 100v	£0·96
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6 amp Volts		**10 amp Plastic** Volts	
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400v RMS	BR1/400	£0·41	400v RMS	BR2/400	£0·67
SILICON 10 amp Type	No.	Price	**SILICON 25 amp** Type	No.	Price
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200v RMS	BR10/200	£1·96	200v RMS	BR25/200	£2·53

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Type	Price	Type	Price	Type	Price	Type	Price
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AA120	£0·09	BY101	£0·25	BYZ12	£0·46	OA95	£0·12
AA129	£0·09	BY105	£0·25	BYZ13	£0·46	OA182	£0·15
AAY30	£0·10	BY114	£0·25	BYZ16	£0·47	OA200	£0·09
AAZ13	£0·17	BY124	£0·25	BYZ17	£0·41	OA202	£0·09
BA100	£0·12	BY126	£0·17	BYZ18	£0·41	SD10	£0·07
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EA148	£0·17	BY128	£0·18	OA5	£0·69	IN34	£0·08
EA154	£0·14	BY130	£0·20	OA10	£0·40	IN34A	£0·08
EA155	£0·16	BY138	£0·24	PA47	£0·09	IN914	£0·07
EA173	£0·17	BY164	£0·58	OA70	£0·09	IN916	£0·07
BB104	£0·46	BY176	£0·86	OA79	£0·12	IN4148	£0·07
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BAX16	£0·09	BYZ10	£0·52	OA85	£0·12	IS920	£0·07
				OA90	£0·12		

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1502	125	GREEN	£0·16
1503	125	YELLOW	£0·16
1504	2	RED	£0·10
1505	2	GREEN	£0·16
1506	2	YELLOW	£0·16
1509	2	CLEAR (Ill Red)	£0·12
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1522	2	RED	£0·11
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1520	OCP71 Photo transistor		£0·40

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μA7824	TO220	£0·75	μA7918	TO220	£0·85
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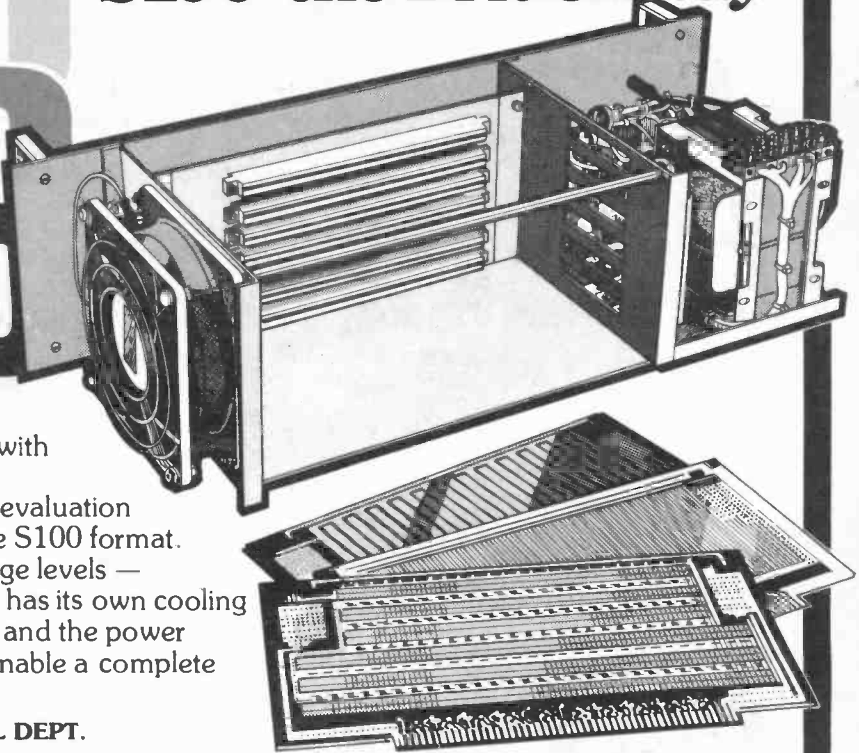

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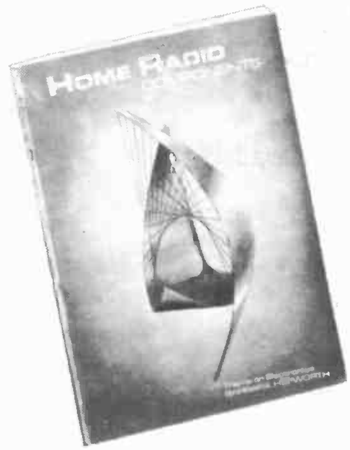

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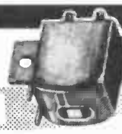

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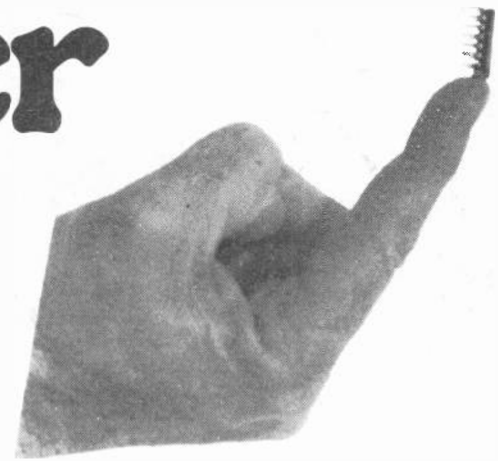

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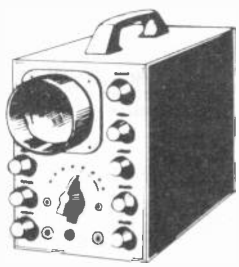

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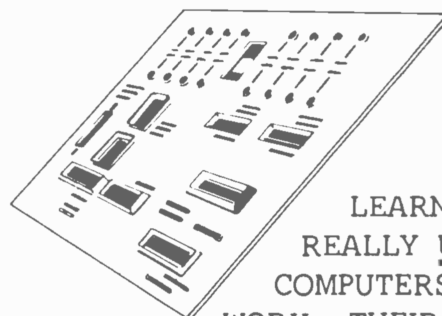

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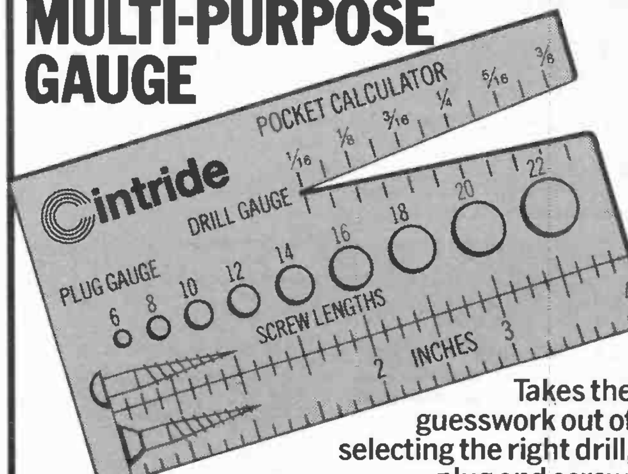

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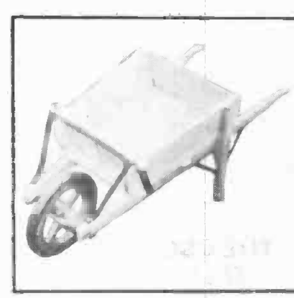

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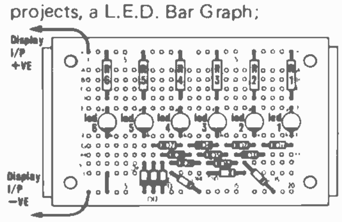

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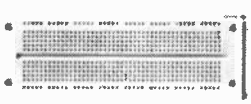

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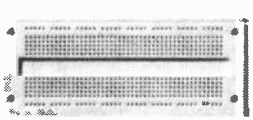

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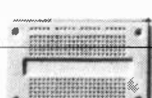

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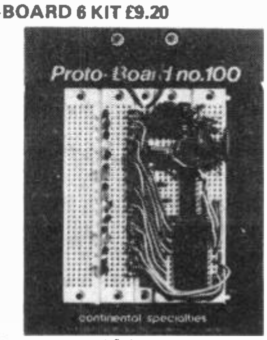

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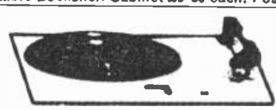

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Technical Specification:
Ranges: D.C. Voltages: 0-0·25-2·5-10-50-250-1000V. A.C. Voltages: 0-5-10-50-250-1000V. D.C. Currents: 0-10μA-2·5mA-25mA-500mA-10 Amps. A.C. Currents: 0-10 Amps. Resistances: ×1×10×1000×10,000 Ohms. Decibels:—10dB + 16dB + 62dB. Special measurements using two torch batteries of 1·5 Volts for Transistors. HFE 0-1000/ICO 0-50μA. Capacities: 5pf-30pf, 30pf-0·01UF, 0·01-50UF.
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Ranges: D.C. Voltages: 0-125-250 mV, 0-1·25-2·5-5-10-25-50-125-250-500-1000V. A.C. Voltages: 0-5-10-25-50-125-250-500-1000V, 0-100 Volts. D.C. Currents: 0·25-50μa 0-2·5-5-25-50-250-500 mA, 0-5-10 Amps. Resistances: 0-2K-20K-200K Ohms, 0-2M-20 Megohms. Centre of scale 10 Ohms. Decibels: —20+62dB in 8 ranges.
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Accuracy: D.C. Voltage ± 3% of reading. A.C. Voltage: ± 4% of reading. D.C. Current: ± 3% of reading. Resistance: ± 3% of scale length.
Db Accuracy & A.C. Accuracy: ± 4% of reading.
Sensitivity: D.C. Voltages: 20 K Ohms/Volt. A.C. Voltages: 10 K Ohms/Volt.
Decibel Scale Sensitivity: 10 K Ohms/Volt.
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Accuracy: D.C. Voltages: ± 4% of reading. A.C. Voltages: ± 5% of reading. D.C. Currents: ± 4% of reading. Resistances: ± 4% of scale length.
Sensitivity: D.C. Voltages: 1 K Ohm/Volt. A.C. Voltages: 1 K Ohm/Volt.
Internal Power Supply: 1·5 Volt battery (Pentorch).
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Technical Specification:
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Accuracy: D.C. Voltages & Currents: ± 3% of reading. A.C. Voltages: ± 4% of reading. Resistances: ± 3% of scale length.
Sensitivity: D.C. Voltages: 20 K Ohms/Volt, 10 K Ohms/Volt. A.C. Voltages: 10 K Ohms/Volt, 5 K Ohms/Volt.
Internal Power Supply: 1·5 Volt battery.
Dimensions: 108 × 79 × 25 mm.
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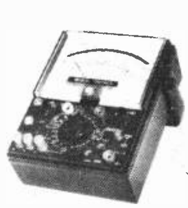
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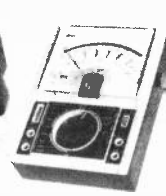
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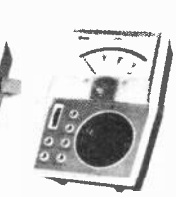
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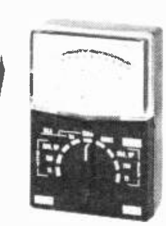
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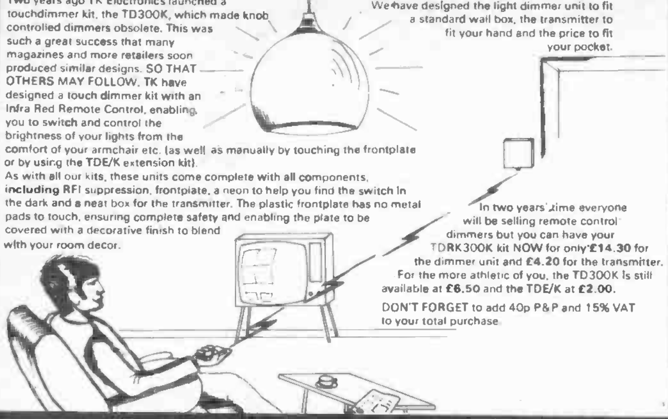
AND NOW A DIMMER THAT MAKES TOUCH DIMMERS OBSOLETE



Two years ago TK Electronics launched a touchdimmer kit, the TD300K, which made knob controlled dimmers obsolete. This was such a great success that many magazines and more retailers soon produced similar designs. SO THAT OTHERS MAY FOLLOW. TK have designed a touch dimmer kit with an Infra Red Remote Control, enabling you to switch and control the brightness of your lights from the comfort of your armchair etc. (as well as manually by touching the frontplate or by using the TDE/K extension kit).

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These ICs can be used with infra red, ultrasonic or radio links, depending on range, cost and speed of operation.

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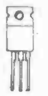
TRIACS



400V Plastic Case (Texas)

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8A	58p	25A	190p		
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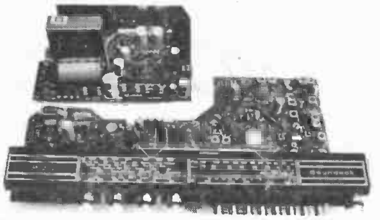
Size Tuner—2¾" × 15" × 7½" approx. Power amp.—2" × 7½" × 4½" approx.
Price £22·00 + £2·50 Postage and Packing.



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★ 'S' shaped tone arm. ★ Belt driven. ★ Full size 12" platter. ★ Precision calibrated counter balance weight 0—3 grms). ★ Damped cueing lever. ★ Anti-skate (bias) device. Nylon thread weight. ★ Cut out template supplied. Size—12¾" × 15¾" (approx).
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★ All items packed (where applicable) in special energy absorbing PU foam.

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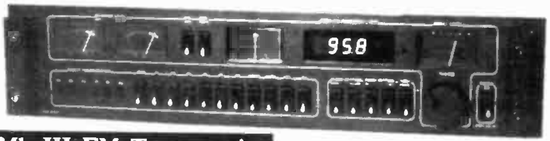
Complete Audio/Tuner Kits



Mk III FM Tuner series

Carriage for Mk III tuner £3 inc

The Mark III series FM tuner has been updated, and now includes a centre zero tuning meter as standard. The instruction manual has been meticulously revised, enabling easy assembly by constructors of various levels of experience - a preview copy may be purchased for £1.00.

Mark III A series 'Reference series' tuner modules ....£171.35 inc.
Mark III B series 'Hyperfi' modules, with switched IF BW, pilot cancel decoder ....£198.95 inc.

A matching synthesiser unit will be made available later this year, and can be retrofitted to either version. All versions include digital frequency readout/clock, VU deviation meters, 6 preset stations, 10 turn pot manual tuning, toroidal PSU, output level adjustment, 110/240v AC input. Full alignment service available.

Power Amplifier

Style and performance - with a real 'belt and braces' PSU design.

After a couple of preview comments, it seems that many of you are waiting to hear about the matching HMOSFET power amplifier for the Mk III tuner. Well, it's out at last - complete with twin toroidal PSUs for comfortable 80W RMS per channel, over 100W peak, but limited by thermal shutdown of the HMOS. 10W-100W log LED output peak indicator, DC offset protection and switch-on pause relay. AC or DC input coupling, direct or relay protected output terminals. The works.
Only one version of this item: Complete kit ....£178.25 inc. Carr. £5.

Preamplifier

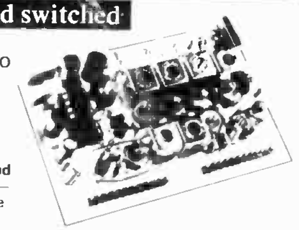
More features and facilities, thanks to DC switching and control design

Previewing the most comprehensive audio preamplifier yet...... DC switching of 7 inputs, plus two tape in/outs. 2 low pass, 2 high pass active filters, genuine volume related loudness, 1dB channel matching, with DC volume, balance, bass and treble controls. Suitable for bus/remote control, tape dubbing, switched monitor etc. 80dB S/N+, THD -75dB or better. Pluggable PU equalization boards, tone control override. Price for complete unit about £149 ex VAT.

Radio/Audio/Communications Modules

LW-MW-SW-SW DC tuned and switched

91072 - All switching of bands by a single pin to gnd. Varicap tuned, with LO output for synth. MW/LW version or MW/LW plus 1 or 2 SW bands MW/LW: £15.58 +1SW £16.73

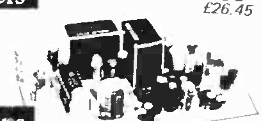


VHF Tunerheads

Europes largest stock range for broadcast and communications. Probably also the world's - details in the catalogues and PL. Specials are also supplied in the region 30-220MHz.

Pilot Cancel PLL Stereo decoders

Again, Europe's widest range of stereo decoders including pilot cancel PLL types. The pic shows the 944378 - pilot cancel including post decoder 26/38kHz filtering and muting preamp output



944378-2 £26.45

Switched bandwidth FM IF strips

Broadcast FM IF strips for all occasions, including the new 911225 - with diode switched narrow filter option, ultra linear phase ceramic filters, 84dB S/N, and 0.04% THD (40kHz deviation). Plus usual things like AGC, AFC, dev. mute, level meter drive. £23.95 (supplied in screen can with 0.1 edge connection system) Also the 7230 hyperfi series - as the 911225, but with slope controlled AFC that operates in conjunction with signal level - and an extra IF amp stage for DXing.

Various digital frequency displays

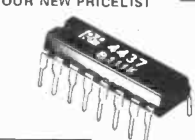
The World's largest range of receiver DFMs is now joined by the DFM7 (shown) - and L shaped version of the DFM3 with remote display mount connector possibility. 1kHz SW resolution with 455kHz or 10.7MHz offsets, 100Hz res up to 3.9999MHz, and VHF to 299.99 MHz in 10kHz steps : £41.75

Semiconductors

Radio/Communications ICs

FOR COMPLETE LISTINGS - SEE OUR NEW PRICELIST

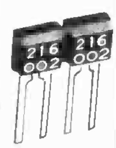
CA3089E	2.11	HA1197	1.61	SD6000	4.31
CA3189E	2.53	CA3123E	1.61	TDA4420	2.59
HA1137W	1.95	TDA1072	3.09	MC1330P	1.38
HA11225	2.47	TBA651	2.53	MC1350P	1.38
HA12412	2.81	TDA1090	3.51	KB4412	2.24
KB4420	1.95	TDA1220	1.61	KB4413	2.24
TBA120S	1.15	TDA1083	2.24	KB4417	2.53
KB4406	0.80	TDA1062	2.24	MC3357P	3.16



SL1610	1.84	SL1626	2.80
SL1611	1.84	SL1630	1.86
SL1612	1.84	SL1640	2.17
SL1613	2.17	SL1641	2.17
SL1620	2.50	SL6600	4.31
SL1623	2.80	SL6640	3.16
SL1624	3.77	SL6690	3.68
SL1625	2.50	MC1496	1.44

VARICAP DIODES........
A section from our PL:

BA102	0.35	16:1 ratio AM tuning	
BB204	0.41	KV1215 9v triple	2.93
BB105	0.41	KV1211 9v dual	2.01
BB109	0.31	KV1225 25v triple	3.16
MVAM2	1.93	BB212 9v dual	2.25



POWER MOSFETS

100W PA's made simple

Since pioneering the 100W complementary MOSFET technique - Hitachi have developed a range of output devices and drivers that ought to revolutionise opinions and attitudes towards the design of all LF amplification systems. We have a new 48 page application note (£1.50 inc) and complete sets of parts, modules and now the new complete PA system (see above).

2SK133	120v N-ch 100W MOSFET	£6.33	2SJ48 Pch complement	£6.33
2SK135	160v N-ch 100W MOSFET	£7.29	2SJ50 Pch complement	£7.39

PA101B Kit for 100W MOSFET PA less Heatsink £16.10. (£23 inc heatsink/bkt)

ULTRA LOW NOISE PU PREAMPLIFIER

The HA12017 is the last word in PU preamps, and general low noise audio design. It is an SIL IC, with 86dB S/N in RIAA configuration, 10v RMS output capability, 0.002% typ THD at 10v RMS output (imagine the overload margin !!). It comfortably supercedes discrete circuit designs in terms of price/performance, and takes the art beyond the TDA1042's capabilities. (Replaces HA1457) £1.80 each - or an RIAA applications PCB with two ICs for £5.75. Complete with Rs&Cs £9.95.

Radio Control ICs

We have various RC ICs, including NE544 NE5044, and two new ones from OKI

KB4445 - 4 channel dig.prop. FM TX IC. 30mW out (amplifyable) -£2.30 inc
KB4446 - 4/5 ch. dig. prop FM RX IC. Suits KB4445 or RCME syst. £2.65.
KB4445/6 pair: £4.75. New 8 page data sheet 35p + SAE. More RC ICs in list

CMOS, LPSNTTL, TTL, MPU: Listings in the new pricelist.

Most CMOS is available in low volume - also LPSN. Standard linears and TTL OK.

Things like ICM7216B, ICL8038, 8080A, 6800P, 2708, NE555,NE556, etc

Coming Soon...........

Contain yourselves, RF fans ! Not yet ready for a full launch until autumn, but previewed here:-

SSB transceiver system : 10kHz to 1000MHz !!

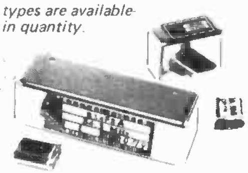
A modular VLF to UHF SSB TX/RX system at last. With the correct first mixer, the basic PCB covers 10kHz to 1000MHz - using LO fed from ext. source (Our 2 IC Mullard synth for instance) and RF PA for TX OP. 0.2uV basic sensitivity in HF, Typ cost for HF synth SSB RX will be less than £200. Add an RF PA for full TRX for another £50. See one in our foyer, and marvel.

Components

Crystal Filters

Most popular types are available ex-stock, and in quantity

10.7MHz	25kHz Channel spacing 8pole	£16.67
	12½kHz ..	£17.82
	2.4kHz SSB	£19.78
	Monolithic dual roofing filter	£2.30
34.5MHz	1.3dB loss, 80dB stopband HF first filter in synth. RX	£36.80
RC XTALS	FM pairs (no spilts)	£3.74
	AM pairs ..	£3.57
USB/LSB	Xtals for 10.7SSB filter	£2.88 ea



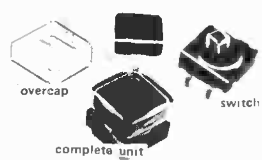
Piezo Sounders

The most efficient warning sounders yet

The latest thing in electro-acoustic efficiency. 1mA of drive from CMOS will give an SPL of 83dB - 10v RMS drive from CMOS uses 3mA for 100dB SPL at 4.8kHz (88dB at 1.65kHz)
The data sheets shows various drive circuits, and give full specifications with regard to broadband responses and power consumption etc. 1 off 44p inc. 100 off 28.75p (25p ex vat)

Keyboard switches and caps

From the world's most widely used switch manufacturers - ALPS - come the biggest and best range of keyswitches, and data entry keyboard switches. The SCM81101 is shown here, with the KT5 2-part cap (with clear top, to enable easy fitting of your chosen legend. Other types are available with built in LED, 90° mounting etc.
SCM81101 : 17p, KT5 : 16p - or 29p/pair



LCD CLOCKS
LCD DVM

Clocks use 1.5v at 15uA only DVM 9v/1mA

CM161: 7mm LCD 12/24hr, alarms etc £11.44 each
CM172: 13mm, 12hr, alarms,timer etc £14.32 each
CM174: 13mm, 12hr, min/sec stopwatch £14.32 ea
DVM 176: ICM7106 based LCD 3½digit £22.36 each

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£1.50 each - or free with pairs of HMOS and the PA101B.

Everything you should know about HMOSFET devices theory and applications.

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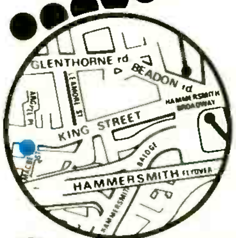

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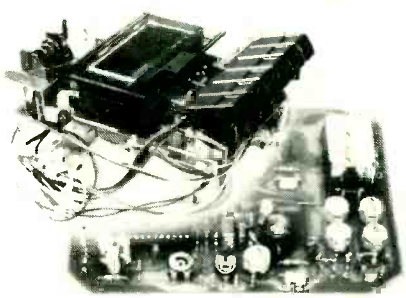
Stereo Cassette Tape Deck



Utilising the superb JVC deck made for Tandberg and a ready-made pre-aligned, tested and guaranteed module, this cassette deck has a superb sound and a high quality specification. We've got everything you need (except cabinet) including full instruction leaflet for only £39.95. Order as XY36P (Cassette Recorder Kit)

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Fight the space invaders, be a polaris captain or a spaceship commander. Full colour action on your own TV set and over 450 games to play.

Basic console with Combat cartridge (ACOOA) £99.50 + £2.50 carriage

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